



**City of Phoenix**

**STANDARD SPECIFICATIONS  
and  
DETAILS  
for  
PUBLIC WORKS  
CONSTRUCTION**

**2015 Edition**

**An integrated document of the 2015 Edition Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction, the 2015 City of Phoenix Supplement and the 2015 City of Phoenix Supplemental Details**





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Binder Spine Insert, trim as necessary.





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## FORWARD

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) provides an integrated document that utilizes a specific City adopted edition of the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction, and the corresponding adopted edition of the City of Phoenix Supplement, to provide a clear compilation of the information within a single document. In the interest of maintaining consistency of established procedures, standards, specifications, and other documents used, the City has elected to adopt a complete, specific, edition of the Specifications periodically. In the interest of promoting county-wide standardization to the greatest extent possible, the City has established a standing Specifications Committee to periodically develop each edition of the Specifications utilizing that year's Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction and Standard Details as its basis. The Delegates to the Committee represent interested City departments, the consulting engineering community, the engineering contracting community, the home building community and the Design Advisory Board.

A complete, integrated Specifications, in continual review, with periodically issued editions, will enhance this document's usability by engineers, architects, contractors, inspectors and others. The integrated format will reduce misinterpretations, conflicting language, and provide improved clarity of the construction documents.

These Specifications are developed for public works construction within the City of Phoenix and include construction of improvements that will be owned and/or maintained by the City of Phoenix. These improvements may be located on City owned property, public right-of-way, public right-of-way easements, or any other type of easement dedicated to the City of Phoenix. These Specifications are not intended to supersede the City of Phoenix Construction Code, or any other applicable law, or ordinance.

The Specifications should be thoroughly reviewed by the professional engineers and architects in responsible charge prior to incorporating them into project plans and specifications. The Specifications are not a substitute for good engineering judgment. Unique conditions will arise that are outside of the scope of this document. Professional engineers and architects are required to use their judgment to develop special provisions to properly adjust the Specifications to best meet site-specific needs. Professional engineers and architects are required to provide professional services in accordance with the statutes of the State of Arizona and the rules of the Arizona State Board of Technical Registration. Not all specifications contained herein will apply to all projects.

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) are revised periodically to allow for current trends in the construction industry and to promote county-wide standardization to the greatest extent possible. For more information on the standing Specifications Committee, or the process for submitting a *Request for Change of the Specifications*, please contact:

City of Phoenix, Street Transportation Department  
City Engineer  
200 West Washington Street, 5th Floor  
Phoenix, Arizona, 85003  
(602) 262-6136

A copy of the currently adopted City of Phoenix Standard Specifications and Details for Public Works Construction is available for review and download on the City of Phoenix Website at the following address:

<https://www.phoenix.gov/streets/reference-material/2015maguniformstd>

Kini L.E. Knudson, P.E.  
City Engineer

**2015 CITY OF PHOENIX SUPPLEMENT AND THE 2015 CITY OF PHOENIX SUPPLEMENTAL STANDARD  
DETAILS TO THE 2015 MAG UNIFORM STANDARD, SPECIFICATIONS AND DETAILS FOR PUBLIC  
WORKS CONSTRUCTION**

The **2015 editions** of the City of Phoenix Supplement and the City of Phoenix Supplemental Standard Details to the 2015 Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction are effective **July 1, 2015**. The **2015 editions** supersede all previous editions.

All public works construction contracts advertised and all permits issued on or after **July 1, 2015** shall be governed by the **2015 editions**.

A copy of the **2015 editions** are available for review and download on the City of Phoenix Website at the following address:

<https://www.phoenix.gov/streets/reference-material/2015maguniformstd>

For more information, or a copy of this publication in an alternate format, contact Street Transportation Department at 602-262-6284 (Voice) and 602-256-4286 (TTY).

## **MARGIN BAR MARKINGS**

Solid vertical lines in the margins adjacent to the text (margin bars) indicate the location where a 2015 City of Phoenix (COP) Supplement has been integrated into the base 2015 Edition Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction document.

Margin bars that extend into the section number header and page number footer indicate the addition of a complete section by a COP Supplement.

Complete 2015 MAG sections that have been deleted by a COP Supplement do not appear in the body of this document. The Table of Contents indicates this deletion by placing a margin bar adjacent to a blank line where the deleted section title would have appeared.

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## SECTION 101

### ABBREVIATIONS AND DEFINITIONS

#### 101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, standard details or on the plans, they are to be constructed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials	BTU	British Thermal Units
AAN	American Association of Nurserymen	BVC	Beginning of vertical curve
AB	Aggregate base	C	Centigrade or Curb
Aban	Abandon	CB	Catch Basin
ABC	Aggregate base course	CBF&C	Catch basin frame & cover
AC	Asphalt cement or concrete	CC or C/C	Center to Center
ACB	Asphalt concrete base	CE	City or County Engineer
ACI	American Concrete Institute	Cem	Cement
ACP	Asbestos cement pipe	CF	Curb face
ACPA	American Concrete Pipe Association	cfs	Cubic Feet per second
ACWS	Asphalt concrete wearing surface	CIP	Cast Iron pipe
AFRB	Arizona Fire Rating Bureau	CIPP	Cast-in-place concrete pipe
AGC	Associated General Contractors of America, Inc.	CL or C	Centerline
Agg	Aggregate	CLR	Clear
ADOT	Arizona Department of Transportation	Cm	Centimeter
ADA	Americans With Disabilities Act of 1990	CMP	Corrugated metal pipe
ADEQ	Arizona Department of Environmental Quality	CO	Clean out
Ahd	Ahead	Col	Column
AIA	American Institute of Architects	COP	City of Phoenix
AIEE	American Institute of Electrical Engineers	Conc	Concrete
AISC	American Institute of Steel Construction	Const	Construct
ANSI	American National Standards Institute	CP	Concrete pipe (non-reinforced)
APA	American Plywood Association	CTB	Cement Treated Base
Approx	Approximate	Cu	Cubic
APWA	American Public Works Association	Deg	Degree
AR	Aged residue	DF	Douglas Fir
ARAC	Asphalt-Rubber Asphalt Concrete	DG	Decomposed granite
ARIZ	Arizona Department of Transportation Test Method	Dia	Diameter
ARS	Arizona Revised Statutes	Dim	Dimension
ASCE	American Society of Civil Engineers	DIP	Ductile Iron Pipe
ASME	American Society of Mechanical Engineers	Div	Division
ASTM	American Society for Testing Materials	Dr	Drive
Ave	Avenue	Drwg	Drawing
AWPA	American Wood Preservers Association	Dwy	Driveway
AWSC	American Welding Society Code	Ea	Each
AWWA	American Water Works Association	Ease	Easement
Bbl	Barrel	E	East
BC	Beginning of curve	EC	End of curve
BCR	Beginning of curb return	ECR	End of curb return
Beg	Beginning	El or Elv	Elevation
Bk	Book or Back	Equa or Eq	Equation
Bld	Boulevard	EVC	End of vertical curve
BM	Bench Mark or Board Measure	Ex or Exist	Existing
Brg	Bearing	F	Fahrenheit
BST	Bituminous Surface Treatment	FB	Field book
BTB	Bituminous Treated Base	F & C	Frame & cover
		FH	Fire hydrant
		FL or F	Floor line or flow line

## SECTION 101

Fl El	Floor Elevation	NCPI	National Clay Pipe Institute
Fnd	Found	NE	Northeast
fps	Feet per second	NEC	National Electric Code
FS	Finished surface	NEMA	National Electrical Manufacturer's Association
FSS	Federal Specifications and Standards	NFPA	National Fire Protection Association
Ft	Foot or feet	NP	Non-plastic
G	Gutter	NPI	Non pay item
Ga	Gage	NSC	National Safety Council
Galv	Galvanized	NSF	National Sanitation Foundation
GL	Ground line	NTS	Not to Scale
Gpm	Gallons per minute	NW	Northwest
		No	Number
Gr	Grade		
H	High or height		
HC	House connection		
HH	Hand hole	OC	On center
Hdwl	Headwall	OD	Outside diameter
Horiz	Horizontal	Oz	Ounces
Hwy	Highway	P.C	Point of curvature
ICA	Industrial Commission of Arizona	PCC	Point of compound curve or Portland Cement Concrete
ID	Improvement District or inside diameter		
IE	Invert Elevation	PI	Point of intersection or plastic index
IEEE	Institute of Electrical and Electronic Engineers	PL	Property line
		POC	Point of Curve
In	Inch	POS	Point of Spiral
Inv	Invert	PP	Power pole
IP	Iron Pipe	ppm	Parts per million
IPS	Iron Pipe Size	PRC	Point of reverse curve
Irrig	Irrigation	Prod	Produced
Jt	Joint	Prop	Proposed or property
JC	Junction Chamber	psi	Pounds per square inch
Jct	Junction	psf	Pounds per square foot
JS	Junction Structure	PT or POT	Point of Tangent
L	Length	P&TP	Power and telephone pole
Lb	Pound	Pvmt	Pavement
L&T	Lead and tack	Q	Rate of flow
LD	Local depression	R	Radius
LF	Linear Feet	RC	Reinforced concrete
LH	Lamp hole	RCP	Reinforced concrete pipe
Lin	Linear	Rd	Road
Long	Longitudinal	Rdwy	Roadway
Lt	Left	Reinf	Reinforced, Reinforcing
M	Map or maps	Ret Wall	Retaining Wall
MAG	Maricopa Association of Governments	RGRCP	Rubber Gasket Reinforced Concrete Pipe
Max	Maximum	rpm	Revolutions Per Minute
MCR	Maricopa County Records	Rt	Right
Meas	Measured	R/W	Right-of-way
MH	Manhole	S	South or slope
MHF&C	Manhole frame and cover	SAE	Society of Automotive Engineers
Min	Minutes or minimum	San	Sanitary
Misc	Miscellaneous	SC	Spiral to Curve
ML or M	Monument line	SCCP	Steel cylinder concrete pipe
mm	Millimeter	SD	Storm drain or Sewer District
Mon	Monolithic or monument	Sdl	Saddle
MTD	Multiple tile duct	Sec	Seconds
N	North	Sect	Section
NBS	National Bureau of Standards	SE	Southeast

## SECTION 101

Sht	Sheet
Spec	Specifications
SPR	Simplified Practice Recommendation
Sp MH	Special manhole
Sq Ft Yd	Square Foot, Yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
Str gr	Structural grade
Struct	Structure or structural
SW	Southwest
SWPPP	Storm Water Pollution Prevention Plan
T	Tangent Distance
Tel	Telephone
Temp	Temporary
TH	Test hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UL	Underwriters' Laboratories Inc.
USC & GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
°	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

**SECTION 101**

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## SECTION 101

### 101.2 DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

**Addendum:** A supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

**Advertisement:** The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

**Agency:** The governmental agency for which the construction is being done, either by permit or contract.

**Architect:** The individual or firm who has accomplished the architectural services for the project, including his representatives.

**Arizona Test Method:** Arizona Department of Transportation Materials Testing Manual test method.

**Award:** The formal action of the governing body is accepting a proposal.

**Backfill:** Material placed in an excavated space to fill such space. For trenches, see definition for Initial Backfill and Final Backfill.

**Base Course:** The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

**Bedding:** A material layer placed on top of the trench foundation to the bottom of the pipe, typically 4 – 6 inches in height. The bedding establishes the line and grade for a conduit and provides support that is firm, but not hard.

**Bidder:** Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

**Board of Supervisors:** The Maricopa County Board of Supervisors acting under the authority of the laws of the State of Arizona.

**Bond Issue Project:** A project financed from bonds issued by the City or County pledging credit or a revenue resource.

**Bridge:** A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom or curbs or guard timbers or in the case of multiple heights of curbs, between the bottoms of the lower risers.

**Budget Project:** A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the Council or Board of Supervisors.

**Building:** Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

**Building Code:** A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specification of materials and methods.

## SECTION 101

**Calendar Day:** Every day shown on the calendar.

**Call for Bids:** The standard forms inviting proposals or bids.

**“Careful and prudent manner”:** means conducting excavation in such a way that when it approaches within twenty-four inches of the underground facility located and marked by the owner or operator, by stakes, paint or in some customary manner, the exact location is manually determined, and the uncovered facility is supported and protected.

**Change Order:** A written order issued by the Engineer to the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

**City:** A municipal corporation, organized and existing under and by virtue of the laws of the State of Arizona.

**City/County Clerk:** The duly authorized person who performs the duties of clerk for the Contracting Agency.

**Completion Time:** The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

**Conflicting Utility:** An existing utility, shown or not shown on the plans is conflicting when any part of the utility falls within the dimensions of the new installation, such that it would be in physical contact with the new installation.

**Construction Project:** The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

**Contingent Bid Item:** This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

**Contract:** The written instrument executed by the Contractor and the Contracting Agency by which the Contractor is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the Contractor therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

**Contract Documents:** All the integral documents of the contract, including but not limited to, Call for Bids, Plans, Standard Specifications and Details, Special Provisions, Proposal, Addenda, Performance Bond, Payment Bond, Certificates of Insurance, Ordinance, Contract, and Change Orders.

**Contracting Agency:** The legal entity that has contracted for the performance of the work or for whom the work is being performed.

**Contractor:** The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

**Council:** The City Council which by law constitutes the Legislative Department of the City.

**County:** Maricopa County, organized and existing under and by virtue of the laws of the State of Arizona.

**Culvert:** Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

**Days:** Unless otherwise designated, days will be understood to mean calendar days.

**Emergency:** Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the Contract Documents, or which endanger life or property and call for immediate action or

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remedy.

**Engineer:** The person, appointed as City or County Engineer by the Council or the Board of Supervisors, acting directly or through his duly authorized representative.

**Equipment:** (Construction) — All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) — All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

**Extra Work:** An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

**Final Backfill:** The material placed in a trench above the initial backfill to the top of the trench or to the bottom of the road base material.

**Flooding:** Flooding will consist of the inundation of the entire lift with water, puddle with poles or bars to insure saturation of the entire lift.

**Force Account Work:** Work done by personnel of the Contracting Agency as in-house work.

**Foundation:** For buildings or structures, this will be the substructure. For a trench the foundation is the bottom of the required trench excavation. The foundation surface is either native material or replacement material when unsuitable material occurs and is removed and replaced at the bottom of the required trench excavation.

**Full Depth Pavement:** An asphalt concrete pavement structure in which the granular base and subbase are replaced by proportionate thicknesses of asphalt concrete.

**Haunching:** The material placed in a trench from the bottom of the pipe or conduit to the springline of the pipe or conduit.

**Improvement District Project:** A project financed by assessments against the property included in a special assessment district authorized under, or implemented by an act of the legislature of the State and/or a procedural ordinance of the City or County.

**Initial Backfill:** The material placed in a trench above the springline of the pipe or conduit and the bottom of the Final Backfill. The height above the crown of the pipe or conduit is dependent on the pipe material and the type of facility.

**Inspector:** The Engineer's authorized representative assigned to make detailed inspections of contract performance.

**Jetting:** Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

**Laboratory:** The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to and/or authorized by the Engineer to test materials and work involved in the Contract.

**Major Item:** A major item shall be the total of any item of work and/or materials specified in the bid schedule that exceeds the amount established in Table [109-1](#).

**Materials:** Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

**Median:** The portion of a divided highway separating the roadways used by traffic going in opposite directions.

**Non Pay Item:** An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

**Notice of Award:** A letter from the City or County Clerk advising the Contractor that he is the successful bidder and the

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Council or Board of Supervisors has accepted his proposal.

**Notice to Proceed:** A directive issued by the Engineer, authorizing the Contractor to start the work or improvements required in the Contract.

**Obligee:** One to whom another is obligated.

**Open Trench:** The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

**Owner:** The City or County, acting through its legally constituted officials, officers or employees.

**Pavement:** Any surfacing of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, portland cement or asphalt cement.

**Pavement Structure:** The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

**Pay Item:** A detail of work for which separate payments are to be made under the Contract, as specified in the proposal.

**Payment Bond:** The security provided by the Contractor solely for the protection of claimants, supplying labor and materials to the Contractor or his Subcontractors.

**Performance Bond:** The security provided by the Contractor solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

**Permit:** The license to do construction in public rights-of-way and/or easements; issued by an Agency to a Contractor working for another party.

**Pipe Embedment Zone:** The area of the trench consisting of the Bedding, Haunching and Initial Backfill areas.

**Plans:** All approved drawings or reproductions thereof pertaining to the work and details therefore, which are made a part of the Contract Documents.

**Plant:** The Contractor's and/or subcontractor's facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for preparation of materials and prosecution of work for the project.

**Principal:** The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

**Professional Engineer:** A person who has a current engineering registration granted by the Arizona State Board of Technical Registration in one or more branches of engineering recognized by the board.

**Profile Grade:** The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

**Project:** A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

**Proposal:** The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

**Proposal Form:** The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

**Proposal Guarantee:** The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

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**Proposal Pamphlet:** The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

**Referred Documents:** On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e., Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

**Right-of-way:** A general term denoting land, property, or interest therein, usually in a strip acquired for or devoted to a street, highway, or other public improvement.

**Road:** A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

**Roadside:** A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

**Roadside Development:** Those items necessary to the complete roadway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

**Roadway:** The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

**Sewers:** Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

**Shop Drawings:** Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data, which the Contractor is required to submit for approval.

**Shoulder:** The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

**Sidewalk:** That portion of the roadway primarily constructed for the use of pedestrians.

**Special Provisions:** The special conditions, requirements, additions, and/or revisions to the Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration.

**Specifications:** The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

**Springline:** The vertical location having a maximum horizontal dimension or in box sections, the mid-height of the vertical wall.

**Standard Details:** Uniform detail drawings of structures or devices adopted as Standard Details by the Engineer.

**Standard Specifications:** Uniform general specifications adopted as Standard Specifications by the Engineer.

**Storm Drain:** Any conduit and appurtenance intended for the reception and transfer of storm water.

**Street:** Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

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**Structures:** Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, end walls, sewers, service pipes underdrains foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

**Subbase:** The lower course of the base of a roadway, immediately above the subgrade.

**Subcontractors:** Those having direct contracts with the Contractor and those who furnish material worked into a special design according to the Plans and Specifications for the work, but not those who merely furnish material not so worked.

**Subgrade:** The supporting structures on which the pavement and its special undercourses rest.

**Substructure:** All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

**Superintendent:** The Contractor's authorized representative in responsible charge of the work.

**Superintendent of Streets:** The person duly appointed by the Council of the Contracting Agency, as provided by the Arizona Revised Statutes.

**Superstructure:** The entire structure or building except the substructure.

**Supplemental Specifications:** Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book.

**Supplementary General Conditions:** Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration.

**Surety:** The individual, firm or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

**Surface Course:** The finished or wearing course of an asphalt concrete pavement structure.

**Title or Headings:** The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

**Township, City, Town or District:** A subdivision of the County used to designate or identify the location of the proposed work.

**Traveled Way:** The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

**“Underground Facility”:** means any item which shall be buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground.

**Utility:** Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting, traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

**Waterworks (Water Supply System):** The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

**Work:** Any or all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

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**Working Day:** A calendar day, exclusive of Saturdays, Sundays, and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

**101.3** In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned, it shall be understood as if the expression were followed by the words by the Engineer or to the Engineer.

*- End of Section -*

## SECTION 102

### BIDDING REQUIREMENTS AND CONDITIONS

#### 102.1 ELIGIBILITY AND PREFERENCE:

The employment of Contractors and Subcontractors on Public Works shall be governed by the provisions of Section 34-241 of the Arizona Revised Statutes.

#### 102.2 CONTENTS OF PROPOSAL PAMPHLET:

The prospective bidder may examine and/or purchase plans, special provisions, and proposal pamphlets at the Engineering Office of the Contracting Agency advertising for bids.

The proposal pamphlet will state the location of the contemplated construction; give the description of the various quantities of work to be performed or materials to be furnished, and have a bid schedule of pay items for which unit bid prices are invited. In addition, it will state the form and amount of the proposal guarantee, the time in which the work shall be completed and include additional instructions not included in these specifications.

The plans, the standard specifications, the standard details, the special provisions, the Contracting Agency's supplements and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In a case of a discrepancy or conflict, the order in which the various documents shall govern is as follows from highest to lowest: addenda, special provisions, plans, agency's supplements to the standard specifications, agency's supplements to the standard details, standard specifications and standard details.

Each and every provision of law and clause required by law to be inserted in the contract shall be deemed to be inserted herein, and the contract shall be read and enforced as though it were included herein.

#### 102.3 INTERPRETATION OF QUANTITIES IN PROPOSAL:

The quantities appearing in the proposal are approximate only and are to be used for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract at the unit bid price in the proposal.

After the contract is awarded the quantities of work listed by any pay item, or all pay items, may be increased or decreased a reasonable amount at the discretion of the Contracting Agency, without in any way invalidating the unit bid price.

#### 102.4 EXAMINATION OF PLANS, SPECIAL PROVISIONS AND SITE OF WORK:

The Contracting Agency will prepare plans and special provisions in accordance with acceptable engineering standards, giving such direction as will enable any competent Contractor to carry them out.

The bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of the test holes, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty expressed or implied that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

#### 102.5 PREPARATION OF PROPOSAL:

The bidder shall submit his proposal on the forms obtained from the Contracting Agency. The bidder shall specify a unit bid

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price and extension in words, figures or both, whichever is required, for each pay item where units and approximate quantities are given.

The proposal total will be obtained by adding the extension amount or lump sum indicated for the individual pay items. If there is a conflict between words and figures, the words shall apply. If there is a conflict between the unit bid price and the extension for a particular pay item, the unit bid price shall govern. In either case, the Contracting Agency shall correct the discrepancy in accordance with the above procedure and the corrected proposal total will apply.

In addition, the following shall be completed by the bidder on the proposal:

- (A) Acknowledge receipt of and agree that the proposal is based on the listed Addenda received with and/or after receipt of the proposal pamphlet.
- (B) Note the bidders Arizona State Contractor's License number and classification.
- (C) Signatures in ink and attested or witnessed as applicable.

### **102.6 SUBCONTRACTORS LIST:**

When required, the List of Subcontractors form will be attached to the proposal pamphlet. The bidder shall submit this form with his proposal, in a separate sealed envelope, listing the firm name and business address of each specialty subcontractor to whom he proposes to subcontract any portion of the work. Only one name shall be listed for each category.

The bidder may list himself to perform one or more of the listed categories of work for which he has any requisite State licenses when required.

### **102.7 IRREGULAR PROPOSALS:**

Proposals will be considered irregular and may be rejected for the following reasons:

- (A) If the proposal is on a form other than that furnished by the Contracting Agency; or if the form is altered or any part thereof is detached.
- (B) If there are unauthorized additions, statements, conditional or alternate bids, or irregularities of any kind.
- (C) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.
- (D) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.
- (E) If, when required, the bidder fails to accomplish and submit the List of Subcontractors form.

### **102.8 PROPOSAL GUARANTEES**

No proposal will be read unless accompanied by a proposal guarantee in the proper amount and in the form provided in the proposal pamphlet. The guarantee shall be made payable and acceptable to the Contracting Agency as a guarantee that the bidder, if awarded the contract, will execute the contract documents and furnish the required bonds and certificates of insurance to be forfeited if the Contractor fails or refuses to enter into a contract as required by the bid documents.

The proposal guarantee shall be in the form of a certified check, cashier's check, or surety bond for ten percent of the amount of the bid. The surety bond shall be executed solely by a surety company or companies holding a certificate of authority to Transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The surety bond shall not be executed by an individual surety or sureties. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Guide, published by the A.M. Best Company.

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**102.9 SUBMISSION OF PROPOSAL:**

The proposal and proposal guarantee shall be submitted in a sealed envelope. The outside, lower right-hand corner of which shall be marked as follows:

Bid of \_\_\_\_\_, Contractor  
For \_\_\_\_\_  
\_\_\_\_\_ Project No. \_\_\_\_\_ Contracting Agency

Envelopes shall be mailed or delivered to the office of the Contracting Agency, and must be received before the time and date specified in the Call for Bids or any Addenda.

Proposals received after the time and date specified will be returned, unopened, to the bidder.

**102.10 WITHDRAWAL OR REVISION OF PROPOSAL:**

Any bidder may withdraw or revise a proposal after it has been deposited with the Contracting Agency, provided his request is received by the Contracting Agency, in writing or by telegram, before the time specified for opening proposals or as stipulated herein.

Pursuant to the provisions of Section 2-188 of the City Code, the low bidder may file a request to withdraw his or her bid with the City Clerk.

**102.11 PUBLIC OPENING OF PROPOSALS:**

Proposals will be opened and read publicly at the time and place specified in the Call for Bids or any Addenda. Bidders, their authorized agents and other interested parties are invited to be present.

When proposals for more than one project are to be opened at the same time, any bidder may, after the time set for the opening proposals, request to withdraw his second or succeeding proposal prior to the opening of proposals for that project. Should this occur, there will be a brief delay in the opening of proposals to permit the bidder to submit his request. Upon receipt of the bidder's written request, by the Contracting Agency, his proposal will be returned unopened.

**102.12 DISQUALIFICATION OF BIDDERS:**

Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal:

- (A) Receipt of more than one proposal for the same work from an individual, partnership or corporation under the same or different names.
- (B) Evidence of collusion among bidders or assistance from any officer of the Contracting Agency, or of any Department thereof.

**102.13 SUCCESSFUL BIDDERS:**

Unless otherwise specified in the proposal pamphlet, the successful bidder may obtain 7 sets of plans and special provisions, for the project from the Contracting Agency, at no cost.

*- End of Section -*

## SECTION 103

### AWARD AND EXECUTION OF CONTRACT

#### 103.1 CONSIDERATION OF PROPOSALS:

After the proposals, for the contemplated work, have been opened and read as provided in these specifications, the respective totals will be checked and compared by the Contracting Agency. The basis of comparison will be to verify the accuracy of the total proposal by checking the extensions and additions. In the event of a discrepancy, in the amount bid for a pay item, the unit bid price will govern unless obviously in error. The results of such comparison will be considered public information.

The right is reserved to award the contract to the lowest and/or best responsible bidder, or to reject all proposals and to re-advertise for any reason the Contracting Agency determines.

In case all proposals are rejected, any subsequent changes, additions, addenda, or new sets of plans and special provisions will be provided to all purchasers of the first issue of the plans and special provisions at no additional charge, except that out-of-town bidders will pay shipping charges.

#### 103.2 RETURN OF PROPOSAL GUARANTEE:

All proposal guarantees, except those of: the two lowest responsible bidders on Bond Issue and Budget Projects; the lowest responsible bidder or the lowest responsible bidders of alternative plans and specifications on Improvement District Projects, will be returned immediately following the opening and checking of proposals. The retained proposal guarantee or guarantees will be returned immediately after the contract documents have been executed by all parties.

#### 103.3 AWARD OF CONTRACT:

The Contracting Agency, through its duly authorized body or agent will award the contract to the lowest and/or best responsible bidder, or all proposals will be rejected, as soon as practicable after the date of opening proposals.

No proposal shall be withdrawn for a period of 50 days after opening without consent of the Contracting Agency through the body or agent duly authorized to accept or reject the proposal except that in the case of Federally-assisted projects, or other projects award of which is conditioned on the approval of an agency not under the control of the Contracting Agency, withdrawal shall be made within a period of 50 days after opening without such consent.

If written notice of the acceptance of a proposal is delivered to the successful bidder within the times noted above, or at any time thereafter before such proposal has been withdrawn, the bidder shall execute and deliver a contract in the prescribed form, within 10 days after receipt of such notice or his proposal guarantee shall be forfeited as provided elsewhere herein. Concurrently with the contract, the Contractor shall submit all documentation required to enable the agency to execute the contract.

The successful bidder will be furnished a Notice of Award on:

(A) Bond Issue or Budget Projects by letter, to the address shown on the proposal.

(B) Improvement District Projects by publication in accordance with the requirements of Arizona Revised Statutes, Section 9-681.

#### 103.4 CANCELLATION OF AWARD:

The Contracting Agency reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties, without any liability against the Contracting Agency.

#### 103.5 REQUIREMENT OF CONTRACT BONDS:

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following bonds, which shall become binding upon the award of the contract to the Contractor.

(A) A Performance Bond in an amount equal to the full contract amount conditioned upon the faithful performance of the contract in accordance with plans, specifications and conditions thereof. Such bond shall be solely for the protection of the

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Contracting Agency awarding the contract.

(B) A Payment Bond in an amount equal to the full contract amount solely for the protection of claimants supplying labor or materials to the Contractor or his Subcontractors in the prosecution of the work provided for in such contract.

Each such bond shall include a provision allowing the prevailing party in a suit on such bond to recover as a part of his judgment such reasonable attorney's fees as may be fixed by a judge of the court.

Each such bond shall be executed by a surety company or companies holding a certificate of authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The bonds shall not be executed by an individual surety or sureties. The bonds shall be made payable and acceptable to the Contracting Agency. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, as by law required, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Rating Guide, published by the A.M. Best Company.

**103.6 CONTRACTOR'S INSURANCE:**

**103.6.1 General:** The Contractor shall agree to carry all insurance which may be required by Federal and State Laws, County and City Ordinances, Regulations and Codes. Neither the Contractor nor any subcontractor shall commence work under a contract until the Contracting Agency has approved the insurance. The entire project covered by the contract will be at the Contractor's risk until final acceptance by the Contracting Agency.

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following:

(A) Public Liability and Property Damage Insurance: The Contractor shall provide and maintain, during the life of the contract, General Liability, Automobile Liability, and Worker's Compensation Insurance as follows:

**INSURANCE**

**MINIMUM LIMITS OF LIABILITY**

GENERAL LIABILITY	\$1,000,000 Combined Single Limit —
Comprehensive Form	
Premises/Operations	
Underground Explosion	
and Collapse Hazard	
Exclusions Deleted	
(where applicable)	
Products/Completed	
Operations	
Contractual	
Independent Contractors	
(OCP)	
Broad Form Property Damage	
Personal Injury with Exclusion	
“C” Deleted	
AUTOMOBILE LIABILITY	\$1,000,000 Combined Single Limit
Owned	
Hired	
Non-Owned	
EXCESS LIABILITY	As required
Umbrella Form	
WORKER'S COMPENSATION & EMPLOYERS' LIABILITY	Statutory Limits

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### BUILDER RISK/COURSE OF CONSTRUCTION

As required

The Contracting Agency shall have no responsibility or liability for such insurance coverage.

The Contractor shall furnish a Certificate of Insurance on a form approved by the Contracting Agency. The Certificate shall be issued by an insurance company authorized to transact business in the State of Arizona, or be named on the list of Unauthorized Insurers maintained by the Arizona Department of Insurance. Insurance coverage shall not expire until all the work has been completed and the project has been accepted by the Contracting Agency. If an insurance policy does expire during the life of the contract, the Contractor shall provide a renewal certificate of the required insurance coverage to the Contracting Agency not less than thirty (30) days prior to the expiration date.

(B) Worker's Compensation and Employer's Liability: A Letter of Certification, from the Industrial Commission of Arizona, that the Contractor is insured by the State Compensation Fund or is an authorized self-insurer or a Certificate of Insurance issued by an insurance company authorized by the Arizona Department of Insurance to provide Workmen's Compensation and Employer's Liability Insurance in the State of Arizona.

(C) Builders Risk/Course of Construction: When the project includes construction of a new building or addition to an existing building, the Contractor shall also obtain insurance coverage for at least, as a minimum, the perils of fire, extended coverage, vandalism and malicious mischief for the full amount of the contract. The Contractor shall be responsible for any deductibles, mutual waiver of subrogation and any co-insurance for the construction that is the subject of this contract.

(D) Additional Insured: The Contracting Agency, its officers, agents and employees shall be named as insurers on policies listed in (A) and (C) and this shall also be indicated on the Certificates of Insurance issued to the Contracting Agency. The Contractor's coverage shall be primary for any and all losses arising out of the performance of this contract.

(E) Owner Protective Policy: In addition to other insurance the Contractor is required herein to provide and maintain in its own name, the Contractor shall also provide and maintain a separate policy of insurance, at its sole cost and expense, naming the Contracting Agency as the insured and providing primary coverage for the Contracting Agency in an amount not less than One Million Dollars, or other minimum amount determined by the Agency, for personal injury or death, per person and per occurrence, and not less than \$500,000 for property damage for any damage or injury suffered as a result of any work performed by Contractor or its employees, representatives, contractors or subcontractors in connection with the Project or Permit. Such policy shall also provide the Contracting Agency coverage, in the amounts specified above, for any and all damages or injury suffered as a result of alleged acts or omissions of the Contracting Agency in connection with, directly or indirectly, the Project or Permit. Such policy shall be primary and not contributory to any insurance maintained by the Contracting Agency. The insurance company writing such policy must have a BEST rating of not less than "A-" and be licensed by the Arizona Department of Insurance to do business in the State of Arizona. The form of the policy must be approved by the Contracting Agency before the notice to proceed will be issued.

**103.6.2 Indemnification of the Contracting Agency Against Liability:** To the fullest extent permitted by law, the Contractor, its successors, assigns and guarantors, shall pay, defend, indemnify and hold harmless the Agency, its agents, representatives, officers, directors, officials and employees from and against all allegations, demands, proceedings, suits, actions, claims, damages, losses, expenses, including but not limited to, attorney fees, court costs, and the cost of appellate proceedings, all claim adjusting and handling expense, related to, arising from or out of or resulting from any actions, acts, errors, mistakes or omissions caused in whole or part by the Contractor relating to work or services in the performance of the Contract, including but not limited to, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable and any injury or damages claimed by any of the Contractor's and Subcontractor's employees.

### **103.7 EXECUTION AND APPROVAL OF CONTRACT:**

The Contractor shall execute the contract with the Contracting Agency as follows:

(A) Bond Issue or Budget Projects within 10 calendar days after the date of Notice of Award of contract from the Contracting Agency.

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(B) Improvement District Projects, not less than 15 or more than 20 calendar days after the date of the first publication of Notice of Award, if no objections have been filed.

The Contracting Agency will approve and execute the contract within 10 calendar days following receipt of signed contract and acceptable bonds and certificates of insurance.

No contract shall be considered in effect until it has been fully executed by all parties concerned.

Information relative to the execution of contract documents may be obtained from the Engineering Office of the Contracting Agency advertising for bids.

#### **103.8 FORFEITURE OF PROPOSAL GUARANTEES:**

If the Contractor fails or refuses to enter into the contract, within the time stated, then the Contracting Agency may declare a forfeiture of his proposal guarantee as liquidated damages for failure to enter into the contract.

*- End of Section -*

## SECTION 104

### SCOPE OF WORK

#### 104.1 WORK TO BE DONE:

**104.1.1 General:** The Contractor shall perform all work as may be necessary to complete the contract in a satisfactory and acceptable manner in full compliance with the plans, specifications and terms of the contract.

In the event a conflict exists between Contract Documents the order of precedence listed in descending order shall be as follows:

- Change Orders
- Addenda
- Special Provisions
- Project Plans
- Contracting Agency's supplements to the MAG Uniform Standard Specifications and Details
- MAG Uniform Standard Specifications
- MAG Standard Details

Unless otherwise specified in the special provisions, The Contractor shall furnish all labor, materials, equipment, transportation, utilities, services and facilities required to perform all work for the construction of the project within the time specified.

**104.1.2 Maintenance of Traffic:** The Contractor's operations shall be in accordance with the traffic manual and/or policies of the appropriate public agency having jurisdiction over the project and Section [401](#). These operations shall cause no unnecessary inconvenience to the public and public access rights shall be considered at all times. Unless otherwise authorized in the specifications or on a temporary basis by the Engineer, traffic shall be permitted to pass through the work area. The Contractor shall coordinate with the various agencies both commercial and public, involved in the collection and removal of trash and garbage, so that adequate services are maintained.

Safe and adequate pedestrian and vehicular access shall be provided and maintained to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, motel, hospitals, fire stations, police stations, and establishments of a similar nature. Access to residential properties shall be in accordance with Section [107](#).

Grading operations, roadway excavation and fill construction shall be conducted and maintained in such a manner as to provide a reasonably satisfactory and safe surface for vehicular and pedestrian traffic. When rough grading is completed, the roadbed shall be brought to and maintained in a reasonably smooth condition, satisfactory and safe for vehicular traffic at the posted speed limit. Pedestrian walkways shall be provided and maintained in a like manner. The Contractor shall accomplish any additional grading operations and/or repairs, including barricade replacement or repairs during working and nonworking periods which, in the opinion of the Engineer, are required.

In the event of abnormal weather conditions, such as windstorms, rainstorms, etc., the Contractor shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained.

The Contractor shall provide the Engineer with the emergency address of his representatives as required by Section [105](#).

#### 104.1.3 Water Supply:

Water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

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The Contractor shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use.

The tank truck and/or trailer shall meet all safety and licensing regulations and the water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus.

No measurement will be made of water, unless otherwise provided for in the special provisions or proposal.

The cost of watering will be included in the proposal price for the construction operation to which such watering is incidental or appurtenant.

**104.1.4 Cleanup and Dust Control:** Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work area clean and free from rubbish, excess materials and debris generated by Construction Activities.

At disposal sites and storage sites, other than agency landfills, the Contractor shall be responsible for all required dust control measures. This includes temporary yard or staging areas.

The Contractor shall take whatever steps, procedures or means required preventing any dust nuisance due to his construction operations. The dust control measures shall be maintained at all times to the satisfaction of the Engineer and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.

Failure of the Contractor to comply with the Engineer's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension and the Engineer has the authority to take such other measures as may be necessary to remedy the situation. Section [104.2.5](#) applies.

**104.1.5 Final Cleaning Up:** Before final acceptance, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work area shall be left in an acceptable condition.

### 104.2 ALTERATION OF WORK:

**\*104.2.1 By the Contracting Agency:** The Contracting Agency reserves the right to make, at any time during the progress of the work, such alterations in the details of construction and such increases or decreases in quantities as may be found necessary or desirable. Such alterations and changes shall not invalidate the contract nor release the surety and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract. The Engineer will issue Change Orders to cover unforeseen circumstances which make it impossible to carry out the work in accordance with the original contract plans and specifications.

If the alterations or changes made by the Contracting Agency increases or decreases the total cost of the contract or the total cost of any major item by more than 20 percent, either party may request an adjustment in payment in accordance with Section [109](#).

#### 104.2.2 Due to Physical Conditions:

\*(A) Should the Contractor encounter or discover during the process of the work, subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the Engineer shall be promptly notified in writing of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease in the cost of or the time required for performance of the contract, an equitable adjustment will be made and the contract modified in writing accordingly.

## SECTION 104

\*(B) If at the time of opening up any portion of the work, material from which the subgrade, backfill or bedding is to be constructed contains an excess of moisture so that the required compaction cannot be obtained without additional manipulation, the Engineer will determine the cause of such condition. If the cause of such condition is determined to have been unforeseeable and beyond the control of and without fault or negligence of the Contractor, the Engineer will determine whether the material shall be aerated or removed and replaced. Such work shall be done as directed and will be paid for as provided in Section [109](#).

\*(C) Failure to notify the Engineer of the conditions described in A and B above prior to doing any work may be just cause to reject any claims for additional monies and/or time.

\*(D) Material in ditches and ditch banks that contains moisture in an amount considered excessive by the Engineer shall be removed and shall be aerated to the extent required by the Engineer before compaction is affected. No measurement or direct payment for the removal and aeration of such material will be made.

\*(E) After any portion of the work has been opened up, saturation of material caused by irrigation water, storm drainage, weather or such similar causes will be considered as within the responsibility of the Contractor.

**\*104.2.3 Due to Extra Work:** The Contractor shall perform unforeseen work, for which there is no unit bid price in the proposal, whenever it is deemed necessary or desirable by the Engineer in order to fully complete the work as contemplated. Such work shall be governed by all applicable provisions of the contract documents and payment will be made in accordance with the provisions set forth in Section [109](#).

Should the Contractor claim that any instructions received involve extra work under the contract, he shall give the Engineer written notice within two work days after receipt of such instructions, and in any event before proceeding to execute the work, except in emergencies endangering life or property. No claim shall be valid unless written notice is given.

If this extra work is performed by others, the Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

**104.2.4 At the Contractor's Request:** Changes in the plans or specifications, which do not materially affect and are not detrimental to the work or to the interests of the Contracting Agency, may be granted to facilitate the work. Requests shall be in writing and submitted to the Engineer for approval. These changes, if approved and when resulting in a saving to the Contractor, will be made at an equitable reduction in cost or in no case at any additional cost to the Contracting Agency.

### **104.2.5 Due to the Failure of the Contractor to Properly Maintain the Project:**

(A) If the Contractor fails to provide adequate Maintenance of Traffic or Cleanup and Dust Control or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to suspend the work wholly or in part until this condition has been corrected.

(B) If the Contractor fails to comply with the Engineer's written order to provide adequate maintenance of traffic, cleanup, dust control, or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to have this work accomplished by other sources.

(C) The Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

*- End of Section -*

## SECTION 105

### CONTROL OF WORK

#### 105.1 AUTHORITY OF THE ENGINEER:

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer's estimates and decisions shall be final and conclusive. In case any question should arise, relative to the Contract Documents, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive final approval of the work being questioned under the contract.

In giving instructions, the Engineer may make minor changes in the work, not involving extra work and not inconsistent with the purpose of the work, except in emergencies endangering life or property.

The Engineer will suspend the work wholly or in part due to the failure of the Contractor; to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

#### 105.2 PLANS AND SHOP DRAWINGS:

The Contractor shall submit, for review, a proposed schedule of shop drawings and product data submittals. This schedule will include concrete and asphalt concrete mix designs unless they are previously approved supplier's mix design. The schedule will show the needed response date for each submittal and will indicate the relationship of the submittal to the project construction schedule.

Shop drawings for major temporary support structures such as falsework, shoring, soldier piles, and other major temporary structures that facilitate construction shall be prepared by and bear the seal and signature of a Professional Engineer. Temporary support structures for Minor Structures as defined in Section [505.1.1](#) are exempt from this requirement.

The Contractor shall submit five (5) copies of each shop drawing, product data or mix design to the Engineer for review. Each submittal shall be numbered sequentially and shall be submitted in accordance with the schedule established in conjunction with the Contracting Agency so as to cause no delay in the work schedule. The Contractor shall certify, by stamp or letter, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents. If this certification is not included, the submittal will be returned without action.

At the time of each submittal, the Contractor shall define and delineate in writing, separate from the certification, any deviations from the contract documents. If the Engineer accepts this deviation, he will authorize the deviation by issuing a change order or if the deviation is minor by endorsement to the letter.

The Engineer will review and return the submittals in accordance with the previously established response date. The review will be only for conformance with the design concept of the work and for compliance with the information contained in the contract documents. The review of a specified item, as such, will not indicate review of the assembly in which the item functions. Review by the Engineer will not relieve the Contractor from responsibility for any errors or omissions in the submittals nor from his responsibility for complying with the contract documents. The only exception is deviations accepted in accordance with the preceding paragraph.

If the submittal is acceptable, one (1) copy with each page stamped "Furnish as Submitted" will be returned to the Contractor. The Contractor shall submit additional copies (as required) to the Engineer.

If the Engineer determines that the submittal requires corrections or is to be rejected, one (1) copy stamped "Furnish as Noted" or "Revise and Resubmit" will be returned to the Contractor. The Contractor will submit five (5) corrected or new copies.

The copy stamped "Furnish as Submitted," returned to the Contractor, will become a part of the contract documents and will be kept at the job site. Any work done prior to the receipt of this review will be at the Contractor's risk and expense.

## SECTION 105

### 105.3 CONFORMITY WITH PLANS AND SPECIFICATIONS:

All work performed and all materials furnished shall be in conformity with the lines, elevations, grades, cross-sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications, but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no additional cost to the Contracting Agency.

In all instances wherein the items and/or specifications require installation or construction in accordance with either manufacturers' or suppliers' recommendations and/or instructions, said recommendations and/or instructions shall be submitted with the applicable portion clearly marked for approval prior to the commencement of work on that item or portions of the contract.

### 105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

### 105.5 COOPERATION OF CONTRACTOR:

The Contractor will be supplied with a minimum of seven sets of approved plans and special provisions, one set of which the Contractor shall keep available on the work site at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other Contractors in every way possible.

The Contractor shall at all times be present at the work in person or represented by a competent superintendent. The superintendent shall be authorized to receive and fulfill instructions from the Engineer and who shall supervise and direct the work. No less than fourteen days prior to the scheduled/planned Notice to Proceed, the Contractor shall submit to the Engineer for review and approval, the name and qualifications of the proposed superintendent. When the superintendent is approved, he shall not be changed by the Contractor without written approval of the Engineer. Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

(A) All phases of the project such as concrete work, pipe work, etc., shall be under the direct supervision of a foreman or his designated representative on the site who shall have authority to accept instructions, with respect to that particular phase of the project, and take action required to properly carry out the work.

(B) In the event of noncompliance with the above, the Engineer may require the Contractor to stop work on that part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses, and telephone numbers of representatives who can be contacted, at any time, in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice. Emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared in case of such emergencies from whatever cause, to do all necessary work promptly.

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### 105.6 COOPERATION WITH UTILITIES:

The Contracting Agency will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of Arizona Revised Statutes-40-360.21 through 40-360.29 (one call system, Blue Stake) in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water user's association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint himself with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense except as otherwise provided for in the special provisions or as noted on the plans. In the event an existing service is found to be in a materially different location than shown on the plans and requires additional or more costly work on the part of the Contractor, the procedures in Section [104](#), will apply.

It is understood and agreed that the Contractor has considered in his proposal all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenance or the operation of moving them. If delays are encountered because utility owners have not relocated or adjusted their facilities, the contract time will be adjusted in accordance with Section [108](#).

It shall be the responsibility of the Contractor to ascertain the need for bracing or shoring of utility poles during the construction of the project and no additional compensation will be allowed for such bracing or shoring.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others by the Contractor. Any work performed by the Contractor for any utility company, separate from the contract shall be paid for by the utility company and will not be a part of the agency contract.

**105.6.1 Notifications Requirement in the Event of Any Damage to or Dislocation of Underground Facilities:** In the event of any damage to or dislocation of any underground facility, the Contractor responsible for the excavation operation shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

**105.6.2 Work Within a Railroad Right of Way:** When a railroad right of way is included in the work, the Contractor shall:

(A) Comply with the rules and regulations of the railroad company relative to the required manner of constructing said portion of the work; and shall perform the work so as not to endanger or interfere with the safe operation of the track(s) and property of the railroad company and of the traffic moving on such track(s).

(B) Carry the kinds and amounts of insurance and bonds required by the railroad company for the period of time in which work is performed on or adjacent to the railroad company's property, and until such work has been satisfactorily completed and all tools, equipment and materials have been removed from the railroad company's property and such property is left in a clean and presentable condition.

(C) Contact the railroad company at least 48 hours in advance of performing any construction within the right of way of any track(s).

### 105.7 COOPERATION BETWEEN CONTRACTORS:

The Contracting Agency reserves the right at any time to contract for and perform other or additional work on or near the

## SECTION 105

work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Contracting Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contracting Agency will not honor any claim for extra compensation due to delays, extra work, or extension of time caused by any other Contractors working within the limits of the same project.

### **105.8 CONSTRUCTION STAKES, LINES AND GRADES:**

The Engineer will set construction stakes establishing lines and grades for road work, curbs, gutters, sidewalks, structures and centerlines for utilities and necessary appurtenances as he may deem necessary, he will furnish the Contractor with all necessary information relating to the lines and grades. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work.

The Contractor shall perform the work in accordance with the Engineer's stakes and marks, and shall be charged with full responsibility for conformity and agreement of the work with such stakes and marks.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost for replacing them will be charged against him and will be deducted from the payment for the work.

The Contractor shall give notice to the Engineer not less than two working days in advance of when he will require survey services in connection with any portion of the work.

The Contractor shall set the construction stakes for buildings establishing lines, grades, and elevations to include necessary utilities and appurtenances and shall be responsible for their conformance with plans and specifications. The Engineer will establish or designate a control line or bench mark of known location and elevation for use as a reference.

### **105.9 DUTIES OF INSPECTOR:**

The Engineer may provide the Inspector, assistants, and other field staff to assist the Engineer in observing performance of the work of the Contractor. Through onsite observations of the work in progress and field checks of materials and equipment, the Inspector shall endeavor to provide further protection for the Contracting Agency against defects and deficiencies in the work of the Contractor; but, the furnishing of such services will not make the Inspector responsible for or give the Inspector control over construction means, methods, techniques, sequences, or procedures or for safety precautions or programs, or responsibility for the Contractor's failure to perform the work in accordance with the contract documents.

Inspectors employed by the Contracting Agency will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

The inspector will, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

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### **105.10 INSPECTION OF WORK:**

Inspection of the work by the Engineer or his authorized representative shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

Any work done or materials used without supervision and inspection by an authorized Contracting Agency representative may be ordered removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision is to pay a portion of the cost of the work covered by the contract, its representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

### **105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK:**

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at no additional cost to the Contracting Agency.

### **105.12 MAINTENANCE DURING CONSTRUCTION:**

The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end so that the roadway or structures are kept in satisfactory conditions at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations. All cost of maintenance work during construction and before the project is accepted shall be included in the unit bid price on the various pay items.

### **105.13 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE:**

If the Contractor, at any time, fails to perform maintenance during construction, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

### **105.14 PARTIAL USE OR OCCUPANCY:**

Should an urgent or unforeseen need occur, the Contractor agrees to let the Contracting Agency use or occupy a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, prior to final acceptance.

Prior to such use or occupancy the Contracting Agency will prepare a written agreement with the Contractor and accomplish a partial acceptance inspection. The written agreement will include a revised construction schedule, responsibilities for maintenance of the partial acceptance and continued construction of the original project to final acceptance, payments, insurance and bond requirements.

## SECTION 105

### 105.15 ACCEPTANCE:

(A) Partial Acceptance: If at any time during the prosecution of the project the Contractor substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the Engineer to make final inspection of that work. If the Engineer finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and the Contractor may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(B) Final Acceptance: Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, the inspection shall constitute the final inspection and the Engineer will make the final acceptance. The Contractor will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

*- End of Section -*

## SECTION 106

### CONTROL OF MATERIALS

#### 106.1 SOURCE OF MATERIALS AND QUALITY:

All construction materials to be used on the work or incorporated into the work, equipment, plant, tools, appliances or methods to be used on the work shall be subject to the inspection and approval or rejection of the Engineer.

The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed source of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the Contractor shall furnish materials from other sources.

Unless otherwise noted, all materials used in the project shall be new and unused. Additionally, any new materials used in this project that are damaged during the construction of the project and prior to final acceptance, as determined by the Engineer, shall be replaced by the Contractor with new material at no additional cost to the Contracting Agency.

#### 106.2 SAMPLES AND TESTS OF MATERIALS:

All materials to be incorporated in the work may be subject to sampling, testing and approval, and samples furnished shall be representative of the materials to be used. The Engineer may select samples, or may require that samples be delivered by the Contractor to a laboratory designated by the Engineer.

The Contracting Agency will pay for the initial or normal test required by the Engineer to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by the Contractor. The Engineer will designate the laboratory which will accomplish the additional test(s).

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with the following: The City of Phoenix Minimum Sampling Frequency Guide, The City of Phoenix Materials Testing Manual, and the standard methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least one copy of the test results to the Contracting Agency or his designated representative, to the Contractor, and to the appropriate material supplier.

With respect to certain manufactured materials, the Engineer may permit the use of some materials prior to sampling and testing provided they are delivered with either a certificate of compliance or analysis or both, stating that the materials comply in all respects with the requirements of the specifications. These certificates shall be furnished in triplicate and clearly identify each delivery of materials to the work area. The certificates shall be signed by a person having legal authority to bind the supplier or manufacturer.

#### 106.3 PLANT INSPECTION:

The Engineer may undertake the inspection of materials at the source. In this event, the following conditions shall be met:

(A) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

(B) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

It is understood that the Contracting Agency reserves the right to retest all materials, prior to their use in the work, upon delivery.

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### 106.4 TRADE NAMES AND SUBSTITUTIONS:

Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Unless the name is followed by words indicating that no substitution is permitted, such references shall be regarded as establishing a standard of quality, finish, appearance, performance or, as indicated, a selection based upon compatibility with existing equipment or materials.

The use of an alternate or substitute item or source may be permitted, subject to the following:

- (A) No consideration will be given to a substitution prior to the award of the contract.
- (B) Only substitutions submitted by the Contractor will be accepted for review. The substitution shall be submitted in writing to the Engineer.
- (C) The submittal shall certify that the substitution will perform the functions and achieve the results called for by the general design, be similar and of equal substance, and be suited to the same use as that specified.
- (D) The submittal shall state any required changes in the contract documents to adapt the design to the proposed substitution. This will include all changes required of other contractors/subcontractors affected by the resulting changes.
- (E) The submittal shall contain an itemized estimate of all costs and credits that will result directly or indirectly from the acceptance of such substitution, including costs of design, license fees, royalties, testing, Engineer's evaluation, claims of other contractors/subcontractors, etc. Also, the submittal shall include any adjustment in the contract time created by the substitution.
- (F) The Contractor, on request of the Engineer, shall submit samples or any additional information the Engineer may deem necessary to evaluate the acceptability of the substitution. The Engineer will evaluate the information provided, perform tests when necessary and make comparisons. The Engineer will then make the final decision as to the acceptability of the proposed substitution. The Contractor will be notified in writing by the Engineer as to whether his substitution has been accepted or rejected.
- (G) The submittal, for purposes of review, number of copies, etc., shall follow the procedures as outlined in Subsection [105.2](#), except in the case of response time. If the Engineer does not respond in a timely manner, which in turn, impacts the substitution, the Contractor shall continue to perform the work in accordance with the contract and the substitution will be considered rejected. Also, no adjustment in the contract time will be granted for nonacceptance of the substitution.
- (H) There will be no additional costs to the Contracting Agency for the substitution. If the substitution yields a net savings in the contract price, the amount of savings shall be divided between the Contracting Agency and the Contractor in a percentage established by the Contracting Agency.
- (I) If the substitution is accepted and an adjustment in the contract cost and/or contract time is in order, a change order will be issued to the Contractor for the changes.

### 106.5 STORAGE OF MATERIALS:

The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment to be used in the work. Stored materials and/or equipment, even though approved before storage, may again be inspected prior to their use in the work. Stored items shall be located so as to facilitate their prompt inspection. That portion of the right-of-way and easements not required for public travel may be used for storage purposes, when approved by the Engineer. Any additional storage area as required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested, by the Engineer, copies of such written permission shall be made available.

No placement or storage of construction materials or storage bins, trash bins or trash receptacles on final surface pavement of Arterial and Collector streets.

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### **106.6 HANDLING MATERIALS:**

All materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work.

### **106.7 UNACCEPTABLE MATERIALS:**

All materials and/or equipment not conforming to the requirements of the specifications, whether in place or not, may be rejected. Rejected materials and/or equipment shall be removed immediately from the site of work unless otherwise permitted by the Engineer. No rejected material and/or equipment, the defects of which have been subsequently corrected, shall be used until approved in writing by the Engineer.

Materials containing asbestos and/or lead in any form are unacceptable to incorporate into the project unless formally accepted in writing by the City of Phoenix. This written approval shall take place prior to the material being incorporated into the project and/or brought to the site.

Repair kits or touch-up materials, materials that include asbestos and/or lead introduced into the product at the factory or applied at the assembly plant are all unacceptable. Any and all field-applied products that are comprised of asbestos and/or lead containing materials are also unacceptable.

If asbestos and/or lead are installed without written approval by the City of Phoenix, the contractor will remove these materials at his expense and dispose of these materials in accordance with all state and federal laws and pay for the supervision and reporting costs in addition to the cost to properly remove them.

### **106.8 FURNISHED MATERIALS:**

Materials and/or equipment, furnished by the Contracting Agency, will be delivered or made available to the Contractor as indicated in the special provisions. The cost of handling and placing shall be considered as included in the contract price for the pay item with which they are used.

The Contractor will be held responsible for all materials and/or equipment accepted by him and will make good any shortages, deficiencies and damages which may occur after such acceptance.

*- End of Section -*

## SECTION 107

### LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

#### 107.1 COMPLIANCE WITH LAWS:

The Contractor shall keep fully informed of, observe and comply with all Federal and State laws, County and City ordinances, regulations, codes and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any way affect the conduct of the work. The Contractor warrants that all items supplied and work performed under the contract have been sold, produced, delivered and furnished in strict compliance with all such laws, ordinances, regulations, codes, orders and decrees to which the items, work and Contractor are subject. Upon request, Contractor shall execute and deliver to the Agency such documents as may be required by the Agency to evidence compliance with such laws, ordinances, regulations, codes, orders and decrees. The Contractor shall protect and indemnify the Contracting Agency and its representatives against any claim or liability arising from or based on the violation of such, whether by the Contractor or the Contractor's employees.

#### 107.2 PERMITS:

Permits, bonding and insurance requirements shall be as required by statutes, codes, ordinances or regulations.

The Public Agency, when acting as the Contracting Agency, may obtain some of the required permits. It is the duty of the Contractor to determine that all necessary permits have been obtained. The Contractor shall, at the Contractor's own expense, obtain all the required permits which have not been furnished. The Contractor shall comply with all permit requirements until the Contract is completed or the permit is closed-out or transferred. The Contractor shall be responsible to close out all permits except those authorized by special provision to be transferred.

In all cases, the Contractor or the person supervising the authorized work shall notify the appropriate permit agency so as to insure proper inspection by the agency concerned.

#### 107.3 PATENTED DEVICES, MATERIALS AND PROCESSES:

If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the Contracting Agency, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Contracting Agency for any costs, expenses, and damages which it may be obligated to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

#### 107.4 ARCHAEOLOGICAL REPORTS:

Attention is directed to Sections 41-844 and 41-865 Arizona Revised Statutes. In view of the above, it shall be a provision of every contract that when archaeological features are encountered or unearthed in the excavation of material pits or of the roadway prism, or other excavation, the Contractor shall report promptly to the Director of the Arizona State Museum and the Contracting Agency. The Contractor will be allowed extra time as appropriate in accordance with the provisions of Section [108](#).

#### 107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health or as specified by the Maricopa County Health Department, Sanitary Code.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Engineer may determine, reasonably necessary to protect the life and the health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and

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State occupational safety and health acts, and standards and regulations promulgated there under.

**107.5.1 Asbestos Materials:** If asbestos materials are encountered during any building remodeling/demolition work, the Contractor shall comply fully with the Arizona Administrative Code, A.A.C. R18-2-901 and notify the Engineer. An extension of contract time will be granted for any delay resulting from the asbestos material in accordance with Section [108](#).

**107.5.2 Lead-Containing Paint:** Paint and similar surface coating materials that contain lead compounds and in which the lead content exceeds 0.06 percent of the total weight of the non-volatile content of the paint or the weight of the dried paint film is declared a banned hazardous product and will not be used (Consumer Product Safety Act Part 1303 dated 9-1-77).

**107.5.3 Hoist Certification:** Prior to the final acceptance (Section [105](#)), the Contractor shall schedule a hoist, crane acceptance inspection through the Engineer. This inspection and load test will be performed by an agency approved by the Engineer. This inspection and acceptance will not relieve the Contractor from his contractual responsibility nor from his warranty for this installation.

### 107.6 PUBLIC CONVENIENCE AND SAFETY:

The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons and property, of the general public and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

**107.6.1 Contractor's Marshaling Yard:** Contractors shall obtain approval of the City Engineer when using vacant property to park and service equipment and store material for use on City construction contracts.

- (A) The Contractor shall notify adjacent property owners/residents of this proposed use.
- (B) Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing of material will require the Contractor to obtain written approval from the property owner. This approval shall contain any requirements which are a condition of this approval.
- (C) A copy of the property owner's approval shall be submitted along with the Contractor's request to the City Engineer for approval for the use of the marshaling yard in connection with the project. An appropriate distance from adjacent property will be set by the City Engineer on a case by case basis on the size and type of equipment to be used on the project.
- (D) The yard shall be fenced and adequately dust-proofed in a manner such as to preclude tracking of mud onto paved City streets.
- (E) Work in the yard shall be scheduled so as to comply with the City Noise Ordinance.
- (F) Equipment, materials, etc., shall be located so as to minimize impact on adjacent properties. A sound barrier may be required if deemed necessary by the City Engineer.
- (G) The Contractor shall clean up property promptly upon completion of use.

**107.6.2 Contractor's Marshaling Yard when the Agency is not the Contracting Party (private development, utility work, subdivision construction, etc):** All conditions will apply as in Subsection [107.6.1](#) except that the permit holder will be responsible for obtaining all documents. The permit holder will retain the documents and make them available to the Agency upon request.

**107.6.3 City Code Section 23-14 (h):** The Contractor shall comply with the City Code concerning work hours and noise level during construction.

### 107.7 BARRICADES AND WARNING SIGNS:

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the

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public. Roads, partially or fully closed to traffic, shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department which is hereby made a part of these specifications.

### **107.8 USE OF EXPLOSIVES:**

The use of explosives or blasting agents is controlled by the Uniform Fire Code, which is generally administered by the Fire Department of the Agency. The Contractor shall obtain a special permit from the Agency's Fire Department for the use of explosives. A copy of this permit shall be delivered to the Engineer prior to the use of explosives. If the Agency does not use the Uniform Fire Code or have a department for enforcement of this Code, the Contractor shall use explosives only when authorized in writing by the Engineer. The approval by the Engineer for the use of explosives shall not relieve the Contractor from his responsibilities for proper use and handling of the explosives or for any and all damages resulting from their use.

Explosives shall be transported, stored, handled and used in accordance with the provisions and requirements of all applicable laws, ordinances and regulations. Work shall be done in accordance with recommendations of the AGC Manual of Accident Prevention in Construction, the Institute of Makers of Explosives, and the Occupational Safety and Health Administration Regulations (29 CFR 1926.1(U)). In addition to the applicable regulations, the Contractor shall:

- (A) Exercise the utmost care not to endanger life or damage property.
- (B) Furnish and erect special signs to warn the public of his blasting operations. They shall be located and maintained so as to be clearly evident to the public during all critical periods of blasting operations.
- (C) Notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.
- (D) Make a survey of adjacent properties, before commencing blasting operations, locating on drawings and by photographs all existing cracks and damages to structures. A copy shall be filed with the Engineer, including a report.
- (E) Blasting shall be accomplished in such a manner that nearby buildings, structures, railways, highways, etc. will be safe from rocks and other projectiles. Adequate blasting mats or other means of protection shall be employed when blasting in congested area or close proximity to any of the above improvements. Steel mats shall not be allowed within 2,000 feet of power lines.
- (F) At the time of firing, the Contractor shall station men along the road at sufficient distance from the blasting operation to flag down any vehicles.

The Contracting Agency reserves the right to order the discontinuance of blasting operations at any time.

### **107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE:**

The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed. The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at no cost to the Contracting Agency, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he

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shall make good such damage or injury in an acceptable manner. Such damage will include but not be limited to landscaped areas. The contractor shall regrade the disturbed area as directed and restore the surface material to match existing in type and quality.

When construction is within temporary construction easements, the Contractor shall restore all disturbed areas to a condition equal to or better than the existing improvements. Such restoration will include but not be limited to asphalt, walkways, fences, lights, sprinklers, landscaping, etc. In the case of landscaping, the Contractor may remove and store sod and plant material. If, in the determination of the Engineer, the sod and/or plant material did not survive the transplanting in good condition, the Contractor shall replace the sod and/or plant material to match in type and quality. Also, the Contractor may salvage any sprinkler system materials, lighting materials, etc. In the event that it is not feasible to reinstall the salvaged material, new material shall be installed.

The Contractor shall not dump spoil or waste material on private property without first obtaining from the owner written permission for such dumping. All such dumping shall be in strict conformance with the Grading and Drainage Ordinance of the Contracting Agency.

Access to private property shall be maintained to keep inconvenience to the property owner to a minimum. Prior to any construction in front of driveways the Contractor shall notify the property owner 24 hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability as soon as possible. If it is necessary to leave open excavation for a long period of time, the Contractor shall provide structurally adequate steel plates to bridge the excavation.

### **107.10 CONTRACTOR'S RESPONSIBILITY FOR WORK:**

The Contractor shall properly guard, protect, and take every precaution necessary against injury or damage to all finished or partially finished work, by the action of the elements or from any other cause until the entire project is completed and accepted by the Engineer. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance at no cost to the Contracting Agency. Partial payment for completed portions of the work shall not release the Contractor from such responsibility.

In case of suspension of the work for any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project and shall erect any necessary temporary structures, signs, or other facilities at no cost to the Contracting Agency.

### **107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES:**

At points where the Contractor's operations are adjacent to properties of utility firms or other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

The Contractor shall cooperate with the owners of any underground or overhead utilities in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

If any utility service is interrupted as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

The Contractor shall expose all underground utilities and structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The Contractor shall assume full responsibility for damages to any underground facility/utility as a result of failing to obtain information as to its location, failing to excavate in a careful and prudent manner or failing to take measures for protection of the facilities/utilities. The Contractor is liable to the owner of the underground facility/utility for the total cost of the repair.

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### **107.12 FURNISHING RIGHT-OF-WAY:**

The Contracting Agency will provide right-of-way and easements for all work in advance of construction. Any exceptions will be indicated in the special provisions.

### **107.13 PERSONAL LIABILITY OF PUBLIC OFFICIALS:**

In carrying out any provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Contracting Agency, Engineer, or their authorized representatives, either personally or as officials of the Contracting Agency, it being understood that in all such matters they act solely as agents and representatives of the Contracting Agency.

### **107.14 NO WAIVER OF LEGAL RIGHTS:**

Upon completion of the work, the Contracting Agency will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Contracting Agency from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Contracting Agency be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Contracting Agency of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract and in addition to any specific remedy provided the Contracting Agency in the contract documents, shall be liable to the Contracting Agency for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Contracting Agency's rights under any warranty or guaranty or remedy required by law.

*- End of Section -*

## **SECTION 108**

### **COMMENCEMENT, PROSECUTION AND PROGRESS**

#### **108.1 NOTICE TO PROCEED:**

(A) On Bond Issue and Budget Projects, neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall commence work as soon as practicable after the starting date specified in the Notice to Proceed. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus extensions, beginning with the day following the starting date specified in the Notice to Proceed.

(B) On Improvement District Projects, the Contractor shall commence work within 10 days from the date of execution of the contract with the Contracting Agency. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus any days extended on the contract, beginning with the day following the date of execution of the contract. The time set for completion of the project will be established by the Contracting Agency, in accordance with Arizona Revised Statutes Section 9-683.

The Contractor shall notify the Field Engineering Inspection Section 24 hours in advance of the time and place where work will begin and the Survey Section two working days in advance for staking.

#### **108.2 SUBLETTING OF CONTRACT:**

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed there under shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for pipeline construction, roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than 50 percent of the total contract cost.

On other types of contracts the individual agency shall determine the percentage or waive this requirement.

#### **108.3 CORRESPONDENCE TO THE CONTRACTOR:**

A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail, to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

#### **108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:**

The Contractor, when required, shall furnish the Engineer a construction schedule for his review. The Engineer's review of the Contractor's schedule is for purposes of: (1) the Contracting Agency's staffing the project as may be required; (2) to insure general compliance with the contract documents as it relates to the completion of all work; and (3) to monitor and evaluate the construction status for purposes of approving progress payments. In the event the schedule does not contain sufficient information to meet the above purpose, as determined by the Engineer, the Contractor shall resubmit a new schedule with the additional information requested by the Engineer. The right to determine the sequence of the work is a function vested solely in the Engineer and the construction schedule, when established, shall not be changed without the

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written consent of the Engineer. The orderly procedure of all work to be performed shall be the full responsibility of the Contractor.

Review of a submitted schedule by the Engineer shall in no way be construed as an affirmation or admission that the schedule is reasonable or workable which responsibilities remain the obligations of the Contractor. When the schedule shows a completion prior to the contract completion date, this extra time between the contract completion date and the scheduled completion date (float), may be used by the Contracting Agency without additional compensation to the Contractor. The Contracting Agency shall not be liable to the Contractor for any damages for delay if the Contractor completes the work prior to expiration of the original Contract completion date or as modified by approved change orders, if any.

### **108.5 LIMITATION OF OPERATIONS:**

The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

### **108.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT:**

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the specifications.

All workmen shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this Section.

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with. All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the work in conformity with the requirements of the specifications.

When the specifications state the construction shall be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified, he may request authority from the Engineer to do so. The request shall be in writing

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and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with the specifications. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet the specifications, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

### **108.7 DETERMINATION AND EXTENSION OF CONTRACT TIME:**

The number of calendar days allowed for the completion of the work included in the contract will be as stated in the proposal and will be known as the contract time.

When the contract time is on a calendar day basis it shall consist of the number of calendar days specified, including all weekends and legal holidays. All calendar days elapsing between the effective dates of any written notice from the Engineer to suspend work and to resume work following suspensions, not the fault of the Contractor, shall be excluded.

When the contract completion time is a fixed calendar date it shall be the date on which all work on the project shall be completed and meet final inspection.

If the Contractor finds it impossible for reasons beyond his control to complete the work within contract time as specified or as extended, he shall immediately submit a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer\* finds that the work was delayed because of conditions beyond the control and through no fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

### **108.8 GUARANTEE AND WARRANTY PROVISIONS:**

The Contractor shall guarantee the work against defective workmanship and materials for a period of one year from the date of its final acceptance under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of the Engineer to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or materials at any time before final acceptance and within one year thereafter.

Should any defects develop within one year from the date of final acceptance due to faults in workmanship or materials the Contractor shall, within 14 calendar days of receipt of written notice from the Contracting Agency begin making the necessary repairs to the satisfaction of the Engineer. Such work shall include the repair or replacement of other work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

If defects develop which are determined by the Engineer to be an emergency, the Engineer shall notify the Contractor, via the most expeditious means, regarding the nature and condition of the defects. In turn, the Contractor shall immediately dispatch necessary forces to correct the defect or the emergency condition. If the Contractor, in his initial action, resolves the emergency condition but not the defect, a letter as discussed above will follow and normal procedures for corrections will be employed. If immediate or appropriate action, satisfactory to the Engineer, is not taken by the Contractor, or if the Contractor cannot be contacted, the Engineer will deploy necessary forces to correct and/or secure the deficiency. Costs of the Engineer's action shall be paid by the Contractor and/or his bonding agency. Should it later be determined that the defects requiring such emergency action are not the responsibility of the Contractor, the Contractor will be paid for all costs incurred as a result of these demands in accordance with Subsection [109.5](#). Such action by the Engineer will not relieve the Contractor of the guarantees required by this Section or elsewhere in the Contract Documents.

In case of work, materials, or equipment for which written warranties are required by the special provisions, the Contractor shall provide or secure from the appropriate Subcontractor or supplier such warranties addressed to and in favor of the

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Contracting Agency and deliver same to the Engineer prior to final acceptance of the work. Delivery of such warranties shall not relieve the Contractor from any obligation assumed under any other provisions of the contract.

The warranties and guarantees provided in this Subsection of the contract documents shall be in addition to and not in limitation of any other warranties, guarantees or remedies required by law.

**108.9 FAILURE TO COMPLETE ON TIME:**

For each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer, the sum per calendar day shown in Table [108-1](#), unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the Contractor, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract.

<b>TABLE 108-1</b>		
<b>LIQUIDATED DAMAGES</b>		
<b>Original Contract Amount</b>		<b>Daily Charges</b>
<b>From More Than</b>	<b>To and Including</b>	<b>Calendar Day or Fixed Date</b>
\$ 0	\$ 25,000	\$ 210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	—	1,780

**108.10 FORFEITURE AND DEFAULT OF CONTRACT:**

It is further agreed to by the Contractor that if he:

- (A) Fails to begin the work under the contract within a reasonable time, or
- (B) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or
- (C) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
- (D) Discontinues the prosecution of the work, or
- (E) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
- (F) At any time colluded with any party or parties, or
- (G) Allows any final judgment to stand against him unsatisfied for a period of 14 calendar days, or
- (H) For any cause whatsoever, fails to carry on the work in an acceptable manner, the Engineer will give notice in writing to the Contractor and his surety of such delay, neglect, or default, and advise them that the work must be resumed immediately.

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If the Contractor or surety, within a period of 14 calendar days after such notice, has not proceeded in accordance therewith, then the Contracting Agency will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The Contracting Agency may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Contracting Agency, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Contracting Agency the amount of such excess.

### **\*108.11 TERMINATION OF CONTRACT**

The Contracting Agency may terminate the contract or a portion thereof if conditions encountered during the progress of the work make it impossible or impracticable to proceed with the work or a local or national emergency exists.

When contracts, or any portion thereof, are terminated before completion of all work in the contract, adjustments in the amount bid for the pay items will be made on the actual quantity of work performed and accepted, or as mutually agreed for pay items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the contract or any portion thereof shall not relieve the Contractor of his responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the work performed.

*- End of Section -*

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### MEASUREMENTS AND PAYMENTS

#### 109.1 MEASUREMENT OF QUANTITIES:

All work completed under the contract will be measured by the Engineer according to United States standard measures. The methods of measurement and computation to be used in determination of quantities of materials furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice. A station, when used as a definition or term of measurement, will be 100 linear feet.

Unless otherwise specified, longitudinal measurements will be made along the grade line.

Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

In computing volumes of excavations or fill, the average end area method or other acceptable methods as determined by the Engineer will be used.

Volumes will be computed at 60 F, using ASTM D1250 for asphalt or ASTM D633 for tars.

Lumber will be measured by the thousand board foot measure actually used in the work. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as a pay item, will mean complete payment for the work described.

Sundry items which have a basis for measurement and payment herein and which are incidental to or required in the construction of the work but are not included as items in the fee schedule shall be considered an integral part of the contract, and all labor, materials, etc. required for such items shall be furnished by the Contractor and the cost of same included in the unit price.

Where the units of measurement shown on the proposal form or the methods of measurement specified in the project special provisions differ from the measurement and payment provisions of the Uniform Standard Specifications, the project documents shall have precedence.

#### 109.2 SCOPE OF PAYMENT:

Measurement and payment for pay items in the proposal will be as indicated in the applicable standard specification or in the special provisions.

When payment is specified to be made on the basis of weight, the weighing shall be done by a licensed public weighmaster or the weighmaster's deputy on a device licensed or certified as defined by Arizona Revised Statutes Section 41-2091 and 41-2093. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates showing the actual net weights together with the information required by the rules adopted by the Department of Weights and Measures as authorized by Arizona Revised Statutes Section 41-2065. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates at the time of delivery unless the Engineer designates a different submittal time. The Contracting Agency will accept the certificates as evidence of the weight delivered.

Payment for the various items in the proposal will be made at the unit price in the proposal, and shall be compensation in full for furnishing all labor, materials, equipment and appurtenances necessary to complete the work in a satisfactory manner as shown on the plans and as required in the specifications, with all connections, testing, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurtenances, for the satisfactory use and operation of said item. No additional payment will be made for work related to any item unless

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specifically called for in the proposal. This compensation shall also cover all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Section [107](#).

The unit prices shall include all costs for salaries and wages, all payroll additives to cover employee benefits, allowances for vacation and sick leave, company portion of employee insurance, social and retirement benefits, all payroll taxes, contributions and benefits imposed by any applicable law or regulation and any other direct or indirect payroll-related costs. The unit prices shall also include all costs for indirect charges, overhead, mileage, travel time, subsistence, materials, freight charges for materials to Contractor's facility or project site, equipment rental, consumables, tools, insurance costs, all applicable taxes and fees, as well as Contractor's fee and profit. The unit prices shall further include all site clean-up costs, hauling of construction debris, and proper disposal in accordance with all laws and regulations and the project plans and specifications.

Payment will be made for only those items listed in the proposal. All materials and work necessary for completion of the project are included in proposal items. Work or materials not specifically identified by a proposal item are considered as included in the unit price of related proposal items.

Unless otherwise specified, payment will not be made for unused materials.

**109.2.1 Taxes and Fees:** Taxes are deemed to include all sales, use, consumer and other taxes that are legally enacted at the time of submittal of the project fee proposal, whether or not they are yet effective or merely scheduled to go into effect. Any such taxes shall be paid by Contractor and shall be included in the unit prices.

The Contractor shall also be responsible to contact all municipalities and other governmental agencies having jurisdictional authority over the project or the project area to determine if they will charge the Contractor other fees (e.g., permit fees) for the project work. Unless otherwise specified in the project documents or on the proposal form, the Contractor shall include the cost of such fees in the unit prices on the proposal form.

### **109.3 ASSIGNMENT OF PAYMENTS:**

The Contractor shall not assign payments of a contract or any portion thereof without approval of surety and written consent of the Contracting Agency.

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Any assignment of money shall be subject to all proper setoffs and withholdings in favor of the Contracting Agency and to all deductions provided for in these specifications.

### **109.4 COMPENSATION FOR ALTERATION OF WORK:**

All compensation due the Contractor for alteration of work shall be documented by a Change Order. Except in emergency situations or as otherwise directed by the Engineer, the Contractor shall not proceed with Change Order work until said Change Order has been approved by the Agency.

#### **\*109.4.1 By The Contracting Agency:**

(A) For a decrease greater than 20 percent in either the total cost of the contract or the total cost of a major item and when a reasonable cost analysis supports an increase in the pro rata share of fixed cost chargeable to this item in total, an increase adjustment in the monies due the Contractor may be made. This adjusted compensation will not exceed 80 percent of the original lump sum contract amount or, if for a unit price item, the adjustment will not exceed 80 percent of the original extended unit price. This does not apply to items labeled as contingent items in the proposal.

(B) For an increase greater than 20 percent in either the total cost of the contract or the total cost of a major item, any adjustment made will only apply to that cost in excess of 120 percent of the original total cost of the contract or, in the case of a major item, in excess of 120 percent of the original proposed extended unit price. If either party presents a reasonable cost analysis that shows a change in the pro rata share of fixed costs chargeable to this item in total, an increase or decrease

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adjustment will be made. This increase or decrease adjustment will be made on such basis as is necessary to cover a reasonable estimate of cost, plus an allowance, not to exceed 15 percent, for overhead and profit. If the parties are unable to reach an agreement, the Engineer has the authority to order the excess work done on an actual cost basis as specified in Subsection [109.5](#).

(C) For either an increase or decrease in cost, no claim shall be made by the Contractor for any loss of anticipated profits.

### **\*109.4.2 Due to Physical Conditions:**

(A) If the Engineer, after his investigation of the site conditions, agrees that they materially differ from those indicated in the contract and would cause an increase in the Contractor's cost of accomplishing the work, new unit prices or a lump sum cost (for the additional work only) may be negotiated. If the parties are unable to reach an agreement on price, the Engineer has the authority to order this additional work accomplished on an actual cost basis as specified in Subsection [109.5](#).

(B) If the Engineer, after his investigation of the site conditions, finds that these conditions do not materially differ from those indicated in the contract, he has the authority to order the work to be accomplished at the original price(s).

**\*109.4.3 Due to Extra Work:** If the Contractor can present valid, factual evidence, satisfactory to the Engineer, that the work in question is an item not provided for in the contract as awarded then a unit price or lump sum cost, for this item only, may be negotiated. If the parties are unable to reach an agreement on price or cost, the Engineer has the authority to order the extra work accomplished on an actual cost basis as specified in Subsection [109.5](#).

**109.4.4 Made at the Contractor's Request:** Any alterations, if approved, will be a reduction in cost or at no additional cost to the Contracting Agency.

### **109.4.5 Due to Failure of Contractor to Properly Maintain the Project:**

(A) For any suspension of work during normal working hours due to failure of the Contractor to properly maintain the project, there will be no additional compensation or time allowed.

(B) If the Engineer provides the Contractor with a written order to provide adequate maintenance of traffic, adequate cleanup, and adequate dust control or to correct deficiencies resulting from abnormal weather conditions and the Contractor fails to comply in the time frame specified, the Contracting Agency may have the work accomplished by other sources. The Contracting Agency will deduct the cost of accomplishing the work from monies due or to become due to the Contractor. Computation of the cost will be in accordance with Subsection [109.5.4.2](#).

**109.4.6 Allowable Mark-Ups:** Only the allowable mark-ups as defined in Subsection [109.5](#) shall be allowed. Additional compensation for other items, including extended overhead and conditions, shall not be considered or allowed.

### **\*109.5 ACTUAL COST WORK:**

The compensation for actual cost work performed by the Contractor (Subcontractor) shall be determined by the Engineer in the following manner.

**109.5.1 Equipment:** For all equipment, the use of which has been authorized by the Engineer, except for small tools and manual equipment, the Contractor will be paid in accordance with the latest Schedule of Equipment Rates used by the Arizona Department of Transportation. Payment for equipment will be made following the calculations in Section [109](#) of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction. The value of 0.933 shall be used for the adjustment factor F used in the rental rate formulas ( $F = 0.933$ ).

**109.5.2 Material:** For all material, accepted by the Engineer and used in the work, the Contractor will be paid the actual cost of such material including transportation cost, to which total cost will be added a sum equal to 15 percent thereof.

**109.5.3 Labor:** For all labor and for the foreman, when he is in direct charge of the operation, the Contractor will be paid:

(A) The actual wages paid plus the current percentage thereof as determined by the Arizona Department of Transportation

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which is deemed to cover the Contractor's cost incurred as a result of payment imposed by State or Federal Law and payments that are made to, or on behalf of, the workman other than the actual wage. Actual wage is defined as the required current hourly rate paid to the labor classification concerned and does not include any fringe benefits or dislocation allowances. If the Contractor is not required to pay fringe benefits equivalent to the Current rates published in the Federal Register, an equitable deduction will be made from the current percentage established by the Arizona Department of Transportation.

(B) For the first \$50,000 of labor cost computed under paragraph (A) above, the Contractor will be paid an amount equal to (15) fifteen percent for overhead and profit.

(C) For all labor cost computed under paragraph (A) above, in excess of \$50,000 but not exceeding \$100,000, the Contractor will be paid an amount equal to (12) twelve percent for overhead and profit.

(D) For any labor cost computed under paragraph (A) above in excess of \$100,000 the Contractor will be paid an amount equal to (10) ten percent for overhead and profit.

### **109.5.4 Work Performed by Subcontractors or Other Sources:**

**109.5.4.1 Work Performed by Subcontractors:** If it is determined by the Engineer that portions of the Actual Cost Work to be performed requires specialized labor or equipment not normally used by the Contractor and such work is then authorized to be performed by a subcontractor(s), the subcontractor(s) will be paid by the Contractor in accordance with the actual cost work procedures outlined herein. The Contractor will be paid by the Contracting Agency the full amount of the subcontract plus the following percentages for administration and supervision.

(A) For the first \$10,000 accumulated total of all change order work performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contractor will be paid \$300 for administration and supervision.

(B) For all change order work in excess of \$10,000 accumulated total performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to five percent of the accumulated total for administration and supervision.

**109.5.4.2 Work Performed by Other Sources:** If the Contracting Agency has work performed by other sources, in accordance with Subsection [109.4.5](#) (B), the Contracting Agency will deduct, from monies due or to become due to the Contractor, the full amount of the cost of accomplishing the work by other sources plus the following percentages for administration and supervision:

(A) For the first \$10,000 accumulated total of work performed by other sources, the Contracting Agency will deduct an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contracting Agency will deduct \$300 for administration and supervision.

(B) For all work in excess of \$10,000 accumulated total performed by other sources, the Contracting Agency will deduct an amount equal to 5 percent of the accumulated total for administration and supervision.

### **109.5.5 Documentation:**

(A) Except in emergency situations, the Contracting Agency will not be liable for any Actual Cost Work performed by the Contractor prior to written authorization by the Engineer or prior to full execution of a written agreement by all parties concerned.

(B) Payment for work performed on an actual cost basis will not be made until the Contractor has furnished the Engineer, on forms agreed to by the Contracting Agency, duplicate itemized statements of such work, including subcontractor(s) costs, detailed as follows:

- (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

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(2) Designation, dates, daily hours, total hours, rental rates and extension for each unit of equipment, and machinery.

(3) Quantities of material, prices, extension and transportation cost on a daily basis. These charges shall be substantiated by vendor invoices.

(C) The Engineer will compare his records with the statement furnished by the Contractor, resolving any differences and making the required adjustments. This statement when agreed upon and signed by both parties, shall be the basis of payment for the work performed.

**109.5.6 Bonds and Insurance:** The Contractor shall be paid for the actual cost plus (10%) ten percent for Administrative cost when the Contractor can provide evidence of payment for premiums on required payment and performance bonds, premiums on railroad and/or airport extended liability insurance, and premiums for property damage and/or public liability insurance. No duplication of payment for Contractor's costs included under Subsection [109.5.3](#) (A) will be allowed.

**109.5.7 Authority of Engineer:** The Engineer is in charge of Actual Cost Work and has the authority to direct which labor and equipment will be used, to suspend operations, and to refuse to pay for any labor or equipment which he feels is not doing productive work.

### **109.6 PAYMENT FOR IMPROVEMENT DISTRICT PROJECTS:**

Payment to the Contractor shall be made in accordance with ARS Sections 48-523 to 48-613, both inclusive.

As soon as the Contractor has fulfilled his contract, the Superintendent of Streets shall estimate the benefits arising from the work and make assessments to cover the work performed and specified in the contract, including incidental expenses in accordance with ARS Section 48-589.

The Contractor agrees to accept payment in the form of Assessments with attached Warrants and/or Improvement Bonds at the rate of interest declared in the resolution of intention prepared by the Contracting Agency.

### **\*109.7 PAYMENT FOR BOND ISSUE AND BUDGET PROJECTS:**

(A) Partial Payments: The Contracting Agency will make a partial payment to the Contractor on the basis of an estimate prepared by the Contractor or Engineer for work completed through the last day of the preceding calendar month. Payment will be within 14 calendar days after the estimate has been certified and approved by the Engineer and received by the owner.

The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the contract in accordance with Arizona Revised Statutes Section 34-221 or 34-607, unless the Contractor elects to deposit securities in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5.

When the Contractor is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided he is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent completed, no more than five percent of the amount of any subsequent progress payments made under the contract will be retained providing the Contractor is making satisfactory progress on the project. Except that, if at any time the owner determines satisfactory progress is not being made, ten percent retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

Any material or equipment which will become an integral part of the completed project will be considered for partial payment in the Contractor's monthly progress payments. The intent of making partial payments is to provide the Contractor payment for direct material or equipment purchased. The purpose is to minimize the effect of escalating costs by procuring key materials. It is not the intent to pay for all materials but only those meeting the following conditions.

(1) A total value of all items requested for payment must be greater than \$20,000. No payment will be processed until the material or equipment has been observed, reviewed or verified by the Contracting Agent representative. Only the material or equipment meeting the requirements of the plans and specifications will be paid. Payment for material or equipment does not constitute final acceptance.

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(2) Materials or equipment must be stored or stockpiled either on site, in a warehouse, or secured storage area. The Contractor assumes all responsibility for protection of these materials or equipment and shall insure them to cover loss or damage to same without additional liability or added costs to the Agency for providing this security, insurance, and storage.

(3) The Contractor will provide access to the storage area or warehouse upon request of the Contracting Agent's representative for the purpose of verifying the inventory of items paid for under this Section. None of the materials or equipment paid for under this Section will be removed from the storage site until incorporated into the work of the project. The storage site shall be within the general geographical area of the project.

(4) The Contractor shall provide a paid invoice and/or lien waiver for items paid for under this Section. The Agency will not pay more than the invoice price for the item or items, less retention.

(5) The Engineer may exclude individual payment requests which in the Engineer's judgment do not warrant storage and prepayment under the intent of this Section.

(B) Final Payment: When the project has been accepted as provided in Section [105](#), and within 30 calendar days after final inspection of the work completed under the contract, the Engineer will render to the Contracting Agency and the Contractor, a final estimate which will show the amount of work performed and accepted under the contract. All prior estimates and partial payments will be subject to correction in the final estimate for payment.

Within sixty (60) calendar days after final acceptance, the Contracting Agency will pay the Contractor all amounts due him under the contract, except that before final payment will be made, the Contractor shall satisfy the Contracting Agency by affidavit that all bills for labor and materials incorporated in the work have been paid. The Contractor's Affidavit may be obtained from the Engineering Office of the Contracting Agency.

If payment will be longer than 60 days after final completion and acceptance, the owner will provide the Contractor specific written findings for reasons justifying the delay in payment.

The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

### **109.8 PAYMENT FOR DELAY:**

The procedures contained in this Section shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

**109.8.1 Failure to Locate or Incorrect Location of Utilities:** Arizona Revised Statutes 40-360.28 indicates that if a person (owner, operator, or agent) fails to locate or incorrectly marks the location of the underground facility in a timely manner, the person (owner, operator, or agent) becomes liable for resulting damages, costs and expense to the injured party." The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

**109.8.2 Contracting Agency Delays:** Arizona Revised Statutes 34-221 states "A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract." In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

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(B) The Compensation paid to the Contractor shall be in accordance with Section [109](#).

**109.8.3 Extension of Contract Time:** For any such delays, the contract time will be adjusted in accordance with Subsection [108.7](#).

**109.9 DOLLAR VALUE OF MAJOR ITEM:**

<b>TABLE 109-1</b>	
<b>DOLLAR VALUE OF MAJOR ITEM</b>	
Original Contract Amount	Dollar Value of Major Item
\$0.00 to \$1,000,000.00	\$50,000 or 10% of original contract amount, whichever is less
\$1,000,000.00 to \$5,000,000.00	5.0% of original contract amount
\$5,000,000.00 or greater	\$250,000.00 or 2.5% of original contract amount, whichever is greater

**109.10 PAYMENT FOR MOBILIZATION/DEMOBILIZATION:**

The Agency will compensate Contractor for a single round trip mobilization/demobilization of Contractor's personnel, equipment, supplies and incidentals, including establishment of offices, buildings and other facilities required for the performance of the work on the project, as well as preparatory work and operations prior to the commencement of the work on the project site.

Mobilization/demobilization will be measured for payment by the lump sum as a single complete unit of work. Payment for mobilization/demobilization will be made at the contract lump sum price. Payment shall be made in equal one-third portions. The first payment will be paid with the Contractor's initial billing. The second payment will be made when the total payments to the Contractor for the pay items, exclusive of payments for mobilization/demobilization, equal greater than one-half of the initial contracted amount, exclusive of mobilization/demobilization. The remaining one-third will be paid as part of the final payment due to the Contractor.

When other contract items are adjusted as provided in Section [109](#), and if the costs applicable to such items of work include mobilization costs, such mobilization costs will be considered as recovered by Contractor in the lump sum price paid for mobilization, and will be excluded from consideration in determining compensation under Section [109](#).

If the Contractor performs a second or additional mobilization/demobilization of personnel, material and/or equipment at the Engineer's express written request, the Agency will compensate the Contractor for such expenses at the Contractor's actual costs. The Contractor shall provide all documentation for these costs at the request of the Engineer.

For projects that do not list mobilization/demobilization as a pay item, a single round trip mobilization/demobilization shall be considered a non-pay item for said projects, the cost of which shall be spread across other appropriate items. Should a second or additional mobilization/demobilization be required at the Engineer's express written request, compensation for such shall be handled as detailed in the foregoing paragraph.

*- End of Section -*

## SECTION 110

### NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

#### 110.1 GENERAL:

When changes are initiated by the Contracting Agency, or as a result of decisions rendered by the Agency, inaction of the Agency or changed conditions unknown to all parties at the time of bid, the Contractor may request an adjustment to the contract amount and/or contract time. This Section does not preclude the use of legal remedies in the event of claims or litigation brought by third parties. The procedure for this adjustment is a two step process, (1) Initial Notification and Dispute Resolution and (2) Administrative Process for Dispute Resolution, as discussed below:

#### 110.2 INITIAL NOTIFICATION AND DISPUTE RESOLUTION:

**110.2.1 Notification:** As required by these Specifications or any time the Contractor believes that the action or decision of the Contracting Agency, lack of action by the Contracting Agency, or for some other reason will result in or necessitate the revision of the contract, the Engineer must be notified immediately. If within two working days the identified issue has not been resolved between the Contracting Agency and the Contractor, the Contractor shall provide a written notice. At a minimum, the written notice shall provide a description of the nature of the issue, the time and date the problem was discovered, and if appropriate, the location of the issue. After initial written notice has been provided, the Engineer will proceed in accordance with Subsection [104.2](#). In addition to proceeding in accordance with Subsection [104.2](#), the Contracting Agency and the Contractor must make every effort to resolve the issue identified in the initial notice. Only if the issue cannot be quickly resolved will it be necessary to proceed to the next step in this Subsection.

**110.2.2 Dispute Resolution:** Once the above process has been exhausted or within seven calendar days of the date of the initial written notice, whichever is sooner, the following steps will be taken:

(A) The Contractor shall provide in writing the following information to the Engineer. If known, a cost analysis may be included with the information.

- (1) The date of occurrence and the nature and circumstances of the issue for which initial notice was given.
- (2) Name, title, and activity of each Contracting Agency or all other persons knowledgeable of the issue.
- (3) Identity of any documents and the substance of any oral communication related to the issue.
- (4) Basis for an assertion that the work required is a change from the original contract work or schedule.
- (5) Identity of particular elements of contract performance for which a change in compensation and/or time may be sought, including:
  - (a) Pay item(s) that have been or may be affected by the issue and any adjustments to unit price(s) that are required;
  - (b) Labor and/or materials that will be added deleted or wasted by the problem and what equipment will be idled or required;
  - (c) Delay and disruption in the manner and sequence of performance that has been or will be caused;
  - (d) Adjustments to delivery schedule(s), staging, and contract time due to the dispute and
  - (e) Estimate of the time within which the Contracting Agency must respond to the notice to minimize cost, delay, or disruption of issue.
- (6) Any other items or information germane to the dispute.
- (7) The Contractor's written certification, under oath, attesting to the following:
  - (a) The request is made in good faith.
  - (b) Supportive data is accurate and complete to the Contractor's best knowledge and belief.
  - (c) When provided, the amount requested accurately reflects the Contractor's actual cost incurred.

In complying with this request, the Contractor shall use the Contracting Agency's certification form.

(B) Within ten calendar days after the Contractor's submission in accordance with the above paragraph, the Engineer will respond in writing to the Contractor to:

- (1) Confirm that a supplemental agreement is necessary and, when necessary, give appropriate direction for further performance, or
- (2) Deny that the contract has been revised and, when necessary, direct the Contractor to proceed with the contract work, or

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(3) Advise the Contractor that adequate information has not been submitted to decide whether (1) or (2) applies, and indicate the needed information and date it is to be received by the Engineer for further review. The Contracting Agency will respond to such additional information within ten calendar days of receipt from the Contractor.

**110.2.3 Conditions:** The failure of the Contractor to comply with the requirements of this Subsection constitutes a waiver of entitlement to additional compensation or a time extension.

### 110.3 ADMINISTRATIVE PROCESS FOR DISPUTE RESOLUTION:

**110.3.1 General:** If the Contractor rejects the decision of the Engineer in Subsection [110.2.2](#) (B) above, the Contractor may begin the Administration Process to resolve the dispute.

The notice provision set forth in Subsection [110.2](#) is a contractual obligation assumed by the Contractor in executing the contract. It is understood that the Contractor will be forever barred from recovering against the Contracting Agency if the Contractor fails to give notice of any act or failure to act, by the Engineer, or the happening of any event, thing, or occurrence, in accordance with Subsection [104.2](#) Alteration of Work.

The administrative process for the resolution of disputes is sequential in nature and is composed of the following levels:

- Level I. (Representative reviewed by: *e.g. Construction Engineer*)
- Level II. (Representative reviewed by: *e.g. Assistant County/City Engineer*)
- Level III. (Representative reviewed by: *e.g. County/City Engineer*)

Note: The above stated titles may vary depending on the Contracting Agency's organization.

These three levels of review; the specific titles; the financial authority of each; and the names of people assigned to each level shall be provided at the preconstruction conference. The equivalent information regarding the Contractor's organization shall also be provided at the preconstruction conference.

Except as provided elsewhere herein, no dispute will be accorded a particular level of review unless the dispute has been reviewed at the preceding level and the Contractor rejects the decision in writing within the time period specified, or both parties agree that the decision for compensation is above that levels authority.

Unless specifically requested otherwise by the Contracting Agency, submission of additional information by the Contractor or Engineer, at any level of the review process shall cause the process to revert to Level I.

**110.3.2 Required Information:** At a minimum, the information described in Subsection [110.2](#) must accompany each dispute. If the following applies, it shall also be provided in addition to the information required by Subsection [110.2](#).

(A) If additional compensation is sought, the Contractor shall submit the exact amount sought as required by Subsection [110.2.2](#) (A) (5) broken down into the following categories:

- (1) Direct Labor
- (2) Direct Materials
- (3) Equipment
- (4) Job Overhead
- (5) General and Administrative Overhead
- (6) Subcontractor's Work (broken down as 1, 2, 3 and 4 above)
- (7) Other categories as specified by the Contractor.

(B) If additional time is sought, the Contractor shall provide a comprehensive time impact analysis showing the delay(s) and how they affect the critical path. The time impact analysis must include both the original and as-built critical path schedules and must be supported by documentation such as delivery schedules, invoices, correspondence, memoranda of telephone calls, payroll data, daily work schedules, etc. NOTE: The path of the longest duration of continuous and dependent work activities through the schedule network is identified as the Critical Path and is the minimum amount of time required to build the project as depicted by the schedule.

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(C) The Contractor shall also notify the Contracting Agency's Level I Representative in writing that all documentation in support of the dispute has been provided and that the administrative review process should begin. No formal action will be taken by the Level I Representative until this written notification is received. The documentation provided to the Level I Representative shall serve as the basis for evaluating the Contractor's position regarding the dispute throughout the administrative process.

**110.3.3 Process:** The Contracting Agency's Level I Representative will render a written decision regarding the matter in dispute within two working days of receipt of the Contractor's notification that the dispute resolution process should begin.

The Contractor shall, upon receipt of the decision by the Level I Representative, either accept or reject the decision in writing. If the Contractor does not reject the Level I Representative's decision within two working days of its receipt, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level I Representative, the dispute will be forwarded by the Level I Representative to the Level II Representative. The Level II Representative will, within seven working days of receipt of the dispute information from the Level I Representative, schedule and hold a meeting to review the dispute with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level II Representative will, within seven working days of the meeting, issue a written decision, with justification, regarding the dispute.

The Contractor shall, within seven working days of receipt of the decision, either accept or reject it in writing. If the Contractor does not reject the Level II decision within seven working days, the Contractor will be deemed to have accepted the decision and the dispute will be considered withdrawn from the administrative process and there will be no further remedy.

If the Contractor rejects the decision of the Level II Representative, the Level II Representative will forward the dispute to the Level III Representative. The Level III Representative will, within fourteen working days of receipt of the dispute information from the Level II Representative, schedule and hold a meeting with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level III Representative will, issue a written decision within fourteen working days of the meeting, with justification, regarding the dispute.

The Contractor shall, within fourteen working days of the receipt of the decision of the Level III Representative, either accept or reject it in writing. If the Contractor does not reject the Level III Representative's decision within fourteen working days, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level III Representative, there will be no further administrative review of the dispute. The resolution will then proceed as follows:

(A) Mediation: Prior to filing for arbitration or litigation, the Contractor may request non-binding mediation by filing a request for mediation in writing with the Engineer. If agreeable, the Engineer will then arrange for a mutually agreeable mediator. Such request for mediation shall be made within thirty calendar days from the date of the Level III Representative's decision as provided for in this Subsection.

In connection with the mediation, each party shall bear its own costs, attorney's fees, and expert fees. Any fees and expenses assessed by the mediator shall be borne equally by the parties.

(B) Dispute Review Board: The decision of the Level III Representative in relation to the claim shall be final. The Contractor reserves the right to initiate litigation pursuant to Section 12-821 et. seg. of the Arizona Revised Statutes, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing the Dispute Review Board as prescribed in Subsection [110.4](#).

### **110.4 DISPUTE REVIEW BOARD:**

If the Dispute Review Board is utilized as prescribed in Subsection [110.3.3\(B\)](#), the Engineer shall be notified within thirty

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days after the Level III Representative decision. The Dispute Review Board is a three member board independent of the parties involved in the issue. The Agency and Contractor shall each select a member for this board. The third member shall be mutually agreed upon independent member. This Review Board must be selected within fourteen calendar days after notice to the Level III Representative. Each member shall agree to impartially serve the Agency and the Contractor. The Dispute Review Board shall meet within thirty days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns responsibilities and allocates adjustments in the contract time, if applicable, within seven calendar days after the meeting.

### **110.5 FINAL DOCUMENTATION AND PAYMENT:**

If at any step in the process a dispute is resolved, the Contractor must sign a supplemental agreement setting forth the resolution of the dispute and including an unconditional release as to any and all matters arising from the dispute. In addition, when the agreement results in a change in contract amount and/or time, a change order shall be prepared by the Contracting Agency for said changes and signed by both parties within 30 days from the date of the agreement. Payment of the change order will be made to the appropriate party(s) in accordance with Section [109](#).

*- End of Section -*

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**PART 200**  
**EARTHWORK**

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## SECTION 201

### CLEARING AND GRUBBING

#### 201.1 DESCRIPTION:

This work shall consist of removing objectionable material from the right-of-way, easements and such other areas as may be specified in the special provisions. Clearing and grubbing shall be performed in advance of grading operations.

#### 201.2 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations, see Section [107](#).

#### 201.3 CONSTRUCTION METHODS:

The construction site and areas on each side of the roadway from centerline to the toe of an embankment, the top of a cut slope, the slope rounding limit or to a line 10 feet outside the edge of the surfaced area, whichever is greater, but not beyond the limits of the right-of-way, shall be cleared of all trees, stumps, brush, roots, rubbish, debris and other objectionable matter, except as follows.

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. In any event, the Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall, insofar as practicable, be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

For the full width of all water courses within the right-of-way lines, no stump, root or other obstruction shall be left higher than the natural stream bed.

From excavated areas, all stumps, roots and other obstructions 3 inches or over in diameter shall be grubbed to a depth of not less than 18 inches below finish grade.

In embankment areas or other areas to be cleared outside the road prism slope lines, all stumps, roots and other obstructions shall not be left higher than specified in Table [201-1](#).

<b>Height of Embankment Over Stump</b>	<b>Height of Clearing and Grubbing</b>
0 Feet to 2 Feet	All stumps or roots 6 inches or over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
2 Feet to 3 Feet	All stumps 1 foot and over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
Over 3 Feet	No stumps shall be left higher than the stump top diameter, and in no case more than 18 inches.

Cavities left below subgrade elevation by removal of stumps or roots shall be carefully backfilled and compacted.

Tree branches extending over the roadway, which hang within 12 feet of the profile grade or that restrict sight distance shall be cut off close to the trunk or stem of the tree in a neat and workmanlike manner. The Contractor shall remove additional tree branches under the direction of the Engineer, in such a manner that the tree will present a balanced appearance. Scars resulting from the removal of branches shall be treated with a heavy coat of an approved tree sealant.

All tree trunks, stumps, brush, limbs, roots, vegetation and other debris removed in clearing and grubbing shall be removed to locations outside of and out of sight of the right-of-way, or otherwise disposed of so as to leave the construction site and adjacent areas in a neat and finished condition, free from unsightly debris.

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### **201.4 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS:**

Items and materials of salvage value as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

### **201.5 PAYMENT, CLEARING AND GRUBBING:**

Unless otherwise provided in the special provisions or bid proposal, no payment will be made for clearing and grubbing as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which said clearing and grubbing are incidental or appurtenant.

### **201.6 MEASUREMENT, REMOVAL AND DISPOSAL OF TREES:**

If the proposal includes separate estimates of quantities for the removal of trees, the tree will be classified by size as follows:

(A) Trees 12 inches or less in diameter at 1-foot above the original ground surface will be included in the bid price for clearing and grubbing or excavation and no additional compensation will be allowed therefore.

(B) Trees more than 12 inches in diameter at 1-foot above the original ground will be included as separate bid item and payment will be made at the unit bid price quoted in the proposal.

### **201.7 PAYMENT, REMOVAL AND DISPOSAL OF TREES:**

Payment for removal of trees will be on a unit price for each tree measured and removed, in accordance with the above classifications, at the unit price stipulated in the proposal.

*- End of Section -*

## SECTION 205

### ROADWAY EXCAVATION

#### 205.1 DESCRIPTION:

Roadway excavation shall consist of excavation involved in the grading and construction of roadways, except structure excavation, trench excavation and any other excavation separately designated.

#### 205.2 UNSUITABLE MATERIAL:

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use shall be excavated and removed from the site or otherwise disposed of as directed by the Engineer.

The removal and disposal of such unsuitable material will be paid for as roadway excavation.

#### 205.3 OVERSHOOTING:

Material outside the authorized cross-section which may be shattered or loosened because of blasting shall be removed by the Contractor at no additional cost to the Contracting Agency. The Contractor shall discontinue any method of blasting which in the opinion of the Engineer leads to excessive overshooting or is dangerous to the public or destructive to property or to natural features.

#### 205.4 SLIDES AND SLIPOUTS:

Material outside the planned roadway or ditch slopes which in the opinion of the Engineer is unstable and constitutes potential slides, material which has come into the roadway or ditch, and material which has slipped out of new or old embankments shall be excavated to designated lines or slopes either by benching or in such manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer.

The removal and disposal of slide and slipout material as specified above, not resulting from overshooting as specified above, will be paid for at the contract prices for roadway excavation; however, if due to the character of the work, the removal and disposal of such material is not properly compensable at the contract prices for roadway excavation, the work may be paid for as extra work provided the Contractor requests in writing such payment prior to performing any such work.

Only those quantities of slide or slipout material which are actually removed as ordered by the Engineer will be paid for.

#### 205.5 SLOPES:

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope, except where excavation is in rock no point shall vary more than 2 feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed the average plane of slopes shall conform to slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope.

## SECTION 205

### **205.6 SURPLUS MATERIAL:**

Unless otherwise shown on the plans, specified in the special provisions, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the Engineer, and shall upon request file with the Engineer the written consent of the owner of the property upon which he intends to dispose of such material.

If the quantity of surplus material is shown on the plans or specified in the special provisions, the quantity shown or specified is approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material inside or outside the right-of-way. Any shortage of material caused by premature disposal of surplus material by the Contractor, shall be replaced by him and no compensation will be allowed the Contractor for such replacement.

### **205.7 MEASUREMENT:**

The following earthwork operations will be measured as roadway excavation for the quantities of material involved.

Excavating the roadway prism including public and private road approaches, connections and driveways; excavating unsuitable material when shown on the plans or specified in the special provisions; excavating slides and slipouts not resulting from overshooting; excavating surplus material; excavating selected material and topsoil from within the limits of project and removing such materials from stockpiles when stockpiling is ordered; excavating ditches and excavating borrow.

The Engineer will compute the quantities of material excavated by a method which in his opinion is best suited to obtain an accurate determination.

Excavation in excess of the planned or authorized cross-section will not be paid for, except as provided above. The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation of authorized section at no additional cost to the Contracting Agency.

Material resulting from excavating ditches or channels may be used to construct roadway embankments, dikes, or for other purposes, or disposed of, as directed by the Engineer.

Care shall be exercised to prevent excavating below the grade for the bottom of the ditch and areas excavated below grade shall be filled with suitable material and compacted by the Contractor at no additional cost to the Contracting Agency.

### **205.8 PAYMENT:**

Quantities of roadway excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping, rounding tops and ends of excavations, loading, depositing, conditioning, spreading, and compacting the material complete in place and disposal of surplus material.

When the proposal does not include a pay item for roadway excavation the cost thereof shall be considered as being included in the price bid for the construction or installation of the items to which such roadway excavation is incidental or appurtenant.

*- End of Section -*

## SECTION 206

### STRUCTURE EXCAVATION AND BACKFILL

#### 206.1 DESCRIPTION:

Structure excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls, box culverts, head walls for culverts, and other structures, and other excavation designated on the plans or in these specifications or in the special provisions as structure excavation.

Structure backfill shall consist of furnishing material, if necessary, and placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment and the providing of other facilities which may be necessary to perform the excavations and place and compact the backfill, and the subsequent removal of these facilities, except where they are required or permitted by the plans, special provisions or Engineer to remain in place.

#### 206.2 FOUNDATION MATERIAL TREATMENT:

When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost thereof will be paid for as extra work.

When no piles are used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Excavation below grade shall be replaced with the same class of concrete specified for the structure or with 1 ½ sack controlled low strength material as specified in Section 728. When the replacement material is structural concrete, the material shall be placed at the same time as the structure material. Placement of controlled low strength material shall be per Section 604 which will require a time lag between placement of the material and the structural concrete. The placement of the additional material shall be at no cost to the Agency except when over-excavation is directed by the Engineer.

The excavation for structures shall be completed to the bottom of the footings before any piles are driven therein, and excess material remaining in the excavation after pile driving shall be removed to the elevation of the bottom of the footings.

When piles are used and ground displacement results from pile driving operations, the Contractor shall at his expense excavate or backfill the footing area to the grade of the bottom of the footing as shown on the plans with structure backfill material.

#### 206.3 INSPECTION:

When any structure excavation is completed, the Contractor shall notify the Engineer who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the Engineer.

#### 206.4 STRUCTURE BACKFILL:

**206.4.1 Preparation for Structure Backfill:** Prior to the placement of structure backfill, the Contractor shall remove all loose, unstable materials from the sides of the structure excavation that may constitute a safety concern or impact proposed backfill operations. The Contractor shall then compact the bottom of the remaining open structure excavation to a uniform density of not less than 95 percent maximum dry density. With the approval of the compaction of the bottom of the open structure excavation by the Engineer, the Contractor may start the placement of the Structure Backfill.

**206.4.2 Structure Backfill for Earth Retaining Structures:** Structure Backfill to be placed against structures designed to retain earth loads, such as bridge abutment backwalls and wingwalls, box culvert outside walls and wingwalls, and retaining walls:

## SECTION 206

(A) Shall conform to the material and the gradation requirements for Select Material, Type A, Type B, or Aggregate Base Course in Table [702-1](#) unless otherwise approved by the Engineer.

(B) Shall not be placed until the concrete has reached its full design strength.

(C) Shall be placed in layers not more than 8 inches in depth before compaction, when compacted by pneumatic or mechanical tamping devices.

(D) Shall be uniformly compacted to at least 95 percent of maximum density.

**206.4.3 Structure Backfill for Structures Other than Earth Retaining:** Structure Backfill placed against concrete structures not designed to retain earth loads:

(A) Shall not be placed until the concrete has attained a minimum compressive strength of 2500 psi in compression as specified in Section [725](#) and in no case less than 72 hours after casting.

(B) Shall be uniformly compacted to at least 95 percent of maximum density.

**206.4.4 Structure Backfill for Structures within Paved Areas:** Where a structure is located within an existing street, proposed street, or paved area:

(A) Backfill within 2 feet of the surface shall be compacted to the minimum density specified in Section [601](#), for Type I compaction or shall be filled with controlled low strength material as specified in Sections [604](#) and [728](#).

(B) All other structure backfill shall be compacted to the minimum density specified in Section [601](#), for Type III compaction or shall be filled with controlled low strength material as specified in Sections [604](#) and [728](#).

**206.4.5 Structure Backfill for Precast Minor Structures:** Minor structures, as defined in Subsection [505.1.1](#), when furnished as precast structures, shall be placed on a compacted layer of Structure Backfill at least 6 inches in depth that conforms to the material requirements of Subsection [206.4.2](#). The layer shall be shaped to fit the bottom surface of the precast unit and compacted to not less than 100 percent maximum density. The Structure Backfill shall be at or near optimum moisture content, as approved by the Engineer. After the unit has been initially set in place and checked for line and grade, it shall be removed, and any defects in its bearing area or line and grade shall be corrected by trimming and by placing and compacting similarly moistened Structure Backfill and the unit reset in place. If in the opinion of the Engineer the bearing area or line or grade of a set precast unit is defective, the Contractor shall remove the unit, correct the bearing area and reset the unit at no additional cost to the Agency. Precast units shall be installed on compacted, shape-conformed Structure Backfill in reasonable conformity with the lines and grades shown on the project plans.

**206.4.6 Relative Compaction:** Unless otherwise provided in the plans and/or special provisions the maximum density shall be determined using procedures defined in Section [301](#).

### 206.5 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for structure excavation and backfill as such; the cost thereof shall be included in the contract price for the construction or installation of the items to which such excavation and backfill are incidental or appurtenant.

When the Special Provisions identify Structure Excavation and/or Structure Backfill as pay items, the following methods of measurement and payment shall be used:

#### 206.5.1 Measurement

(A) **Structure Excavation:** Structure Excavation will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Excavation shall be in accordance with the applicable details shown on the current Arizona Department of Transportation (ADOT) Standard Drawings B-19.30 and/or B-19.50.

## SECTION 206

No reduction in measurement for payment will be made when the Contractor elects to not excavate all material between the limits of the actual structure, and the pay limits shown on the Project Plans and/or the above referenced ADOT Standard Drawings.

No additional measurement for payment will be made for excavation resulting from lack of side support for structure excavations, nor due to carelessness of the Contractor.

(B) **Structure Backfill:** Structure Backfill will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Backfill shall be in accordance with the applicable details shown on the current ADOT Standard Drawings B-19.40 and/or B-19.50.

### **206.5.2 Payment**

**Structure Excavation and Structure Backfill:** The accepted quantities of Structure Excavation and the accepted quantities of Structure Backfill will be paid for at their respective contract unit prices.

Hauling, placing, and compacting surplus Structure Excavation in embankments, or otherwise disposing of the material, shall be included in the contract price paid for Structure Excavation.

*- End of Section -*

## SECTION 210

### BORROW EXCAVATION

#### 210.1 LOCAL BORROW:

Local borrow shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be obtained by widening cuts or by excavating from other sources outside the planned or authorized cross-section within the right-of-way and within the limits of the project. Local borrow shall be excavated to the lines and grades established by the Engineer.

#### 210.2 IMPORTED BORROW:

Imported borrow shall consist of material required for construction and unless otherwise designated in the special provisions, the Contractor shall make arrangements for obtaining imported borrow and shall pay all costs involved. When designated sources for imported borrow are indicated on the plans, in the special provisions, the material shall be assumed approved by the Engineer.

Borrow material for fill within the roadway prism shall meet the following requirements:

The Plasticity Index (PI) (AASHTO T-90) and the percent passing the number 200 sieve (Minus 200) (ASTM C136) when used in the equation below, shall give a value of X that does not exceed 62.

$$X = (\text{Minus 200}) + 2.83 (\text{PI})$$

When the percentage of the Minus 200 material is greater than 30, the PI for the soil shall be at least 5 and at the same time in compliance with the X value requirement.

The material shall be free from wood, vegetation, or other deleterious matter. The maximum size of this material shall not be greater than 2/3 the compacted thickness of the course placed in the subgrade.

The Contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross-section elevations and measurements of the ground surface after stripping may be taken and sufficient time for testing and material will be allowed.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the area of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition.

#### 210.3 PLACING AND COMPACTING:

Local borrow and imported borrow shall be placed and compacted as specified in Section [211](#).

The Contractor shall satisfy himself that there is sufficient space available in fill locations for placing any excavated material, before placing borrow. Any excess excavation which develops as a result of placing borrow in advance of completing excavations shall be disposed of by the Contractor at no additional cost to the Contracting Agency in accordance with the provisions in Section [205](#) and a corresponding reduction in the quantity of borrow to be paid for will be made, for which the Contractor will have no claim for compensation.

#### 210.4 MEASUREMENT:

Quantities of borrow will be measured as specified for roadway excavation in Section [205](#).

Material excavated at the borrow site and not used on the work will be deducted from the computed quantities and will not be paid for.

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### **210.5 PAYMENT:**

Quantities of borrow excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping and cleaning of borrow area, hauling, depositing, spreading and compacting the material complete in place, and disposal of surplus material, unless an alternate basis of payment is stipulated in the proposal.

*- End of Section -*

## SECTION 211

### FILL CONSTRUCTION

#### 211.1 DESCRIPTION:

Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of material in holes, pits, and other depressions.

#### 211.2 PLACING:

Rocks, broken concrete, or other solid material, which are larger than 4 inches in greatest dimension, shall not be placed in fill areas where piles are to be placed or driven.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built  $\frac{1}{2}$  width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started where ever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Contracting Agency, unless the width of the bench required exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph:

When the fill material includes large rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within 2 feet of the finished grade of the fill.

#### 211.3 COMPACTING :

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception.

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable materials in a uniformly distributed layer of thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

Unless specified herein, or in the special provisions, the construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of 6 inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95 percent.

The loose thickness of each layer of fill material before compacting shall not exceed 8 inches, except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than 90 percent, except that where a new or widened roadway and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95 percent.

When fill material contains by volume over 25 percent of rock larger than 6 inches in greatest dimension, the fill below a plane 3 feet below finished grade may be constructed in layers of a loose thickness before compaction not exceeding the

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maximum size of rock in the material but not exceeding 3 feet in thickness.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the fill with the following limitation:

- (A) The maximum dimension of any piece used shall be 6 inches.
- (B) Pieces larger than 4 inches shall not be placed within 12 inches of any structure.
- (C) Pieces larger than 2 ½ inches shall not be placed within 12 inches of the subgrade for paving.
- (D) Nesting of pieces will not be permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent but no more than 5 percent.

### **211.4 TESTS:**

Unless otherwise provided in the plans or special provisions the fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T-99, Method A, and T-191 or ASTM D6938 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No. 4 sieve.

### **211.5 MEASUREMENT:**

The quantities of fill construction used to construct embankments or dikes will be those of the complete bid item, in place, within the limits of dimensions shown on the plans.

The Engineer will compute the quantities of fill by a method which in his opinion is best suited to obtain an accurate determination.

### **211.6 PAYMENT:**

Quantities of fill construction will be paid for at the contract unit price per cubic yard of fill as stipulated in the proposal. Such price shall include placing and compaction and all related work as specified above, unless an alternate basis of payment is stipulated in the proposal.

Unless otherwise provided in the special provisions, no payment will be made for fill construction to replace unsuitable material or for fill for holes, pits, and other depressions. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

*- End of Section -*

## SECTION 215

### EARTHWORK FOR OPEN CHANNELS

#### 215.1 DESCRIPTION:

Earthwork for open channels shall consist of clearing, stripping, excavation, fill, backfill, grading and disposal of excavated and removed material.

Open channels for the purpose of this Section shall mean open rectangular concrete channels and lined or unlined trapezoidal channels.

#### 215.2 STRIPPING:

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer.

The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

Soil loosened below the stripping depth specified or designated by the Engineer, shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the Contractor at no additional cost to the Contracting Agency.

#### 215.3 EXCAVATION:

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation are firm and unyielding; are such as will stand or can be made to stand without sloughing and are, at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or subdrainage material, shall be to the lines indicated on the plans; and, excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90 percent or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over-excavation or material used for such backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer.

(A) When the void is below the subgrade for reinforced concrete channel, it shall be filled with suitable material, as approved by the Engineer, and compacted to a uniform density of not less than 90 percent. With the approval of the Engineer, concrete of the same mix as used in the concrete channel, may be used.

(B) When the void is in the side of the excavation, it shall be filled with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the Contracting Agency. The cost of such work shall be included in the prices bid for the various items of work.

If during the progress of excavation, material is encountered, which, in the opinion of the Engineer, is unsuitable for subgrade for the channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the pay lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load of the proposed channel and not upon the capacity to withstand the loads which may be placed upon it by the Contractor's equipment. Should the Contractor be directed to excavate beyond the pay lines shown on the plans, said pay

## SECTION 215

lines will be extended to include such ordered excavation; and the pay lines for subdrainage material, if used, will be adjusted accordingly.

Materials used or work performed by the Contractor, to stabilize the subgrade so it will withstand loads which may be placed upon it by his equipment shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

### **215.4 FILL AND BACKFILL:**

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material is first removed. However, stone, broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill or fill with the limitations as specified in Section [211](#).

Unless otherwise specified in the special provisions, the density of fills and backfills shall be at least 90 percent.

### **215.5 GRADING:**

Grading of unlined channels, levees and access roads shall conform to the following tolerances:

(A) A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

- (1) Channel bottom
- (2) Channel side slopes in both cut and fill
- (3) Levee and access road side slopes in cut

(B) A vertical tolerance of none below and 3 inches above the specified grade will be allowed on:

- (1) Top surface of levee and access road in both cut and fill
- (2) Levee and access road side slopes in fill

Regardless of the construction tolerances specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface.

Construction tolerances specified above for grading are solely for purposes of field control.

### **215.6 TESTS:**

Density tests shall be made in accordance with Section [211](#).

### **215.7 MEASUREMENT:**

If compensation for stripping is included in the price paid for other items of work the Contractor shall notify the Engineer sufficiently in advance of excavation or other work so that cross-section elevations and measurements of the ground surface may be taken upon completion of stripping.

The Engineer will compute the quantity of excavation by a method which in his opinion is best suited to obtain an accurate determination.

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### **215.8 PAYMENT:**

Earthwork for open channels will be paid for on a lump sum basis or at the contract unit price per cubic yard of excavation as stipulated in the proposal. Such price shall include clearing, stripping, excavation, fill, backfill, compaction, grading, hauling, removal and disposal of excess excavated material and debris unless an alternate method of payment is stipulated in the proposal.

*- End of Section -*

## SECTION 220

### RIPRAP CONSTRUCTION

#### 220.1 DESCRIPTION:

Riprap construction shall consist of furnishing and placing stone, with or without grout, and underlain with filter material of granular filter blankets or erosion control geosynthetic fabric. The depth and type of riprap shall be as shown on the plans or in the special provisions.

#### 220.2 MATERIALS

Riprap shall conform to the requirements of Section [703](#).

Erosion control geosynthetic fabric shall conform to the requirements of Table [796-3](#) in Section [796](#).

Waste or sacked concrete shall not be permitted for use as riprap.

The Contractor, at no additional cost, shall provide mechanical equipment, a sorting site, and labor needed to assist in checking riprap gradation.

Granular filter blankets shall consist of processed natural material conforming to the requirements of Section [701](#), with the gradation and thicknesses as specified on the plans or in the special provisions.

#### 220.3 PREPARATION OF GROUND SURFACES

The bed for placement of riprap shall be shaped and trimmed to provide even surfaces.

#### 220.4 PLACEMENT OF EROSION CONTROL GEOSYNTHETIC FABRIC:

Fabric shall be placed at the locations shown on the project plans. The Contractor shall provide a surface free of obstructions, depressions, debris, and soft yielding surfaces prior to the placement of fabric. The fabric shall be loosely laid (not in a stretched condition), aligned and placed with no fold over wrinkles.

The fabric shall be placed to provide a minimum 24-inch of overlap for each joint. On horizontal joints, the uphill fabric shall overlap the downhill fabric. On vertical joints, the upstream fabric shall overlap the downstream fabric.

Bedding material shall be placed uniformly on the fabric to the depth specified on the plans and shall be free of mounds, dips, and windrows. Bedding material shall not be compacted.

#### 220.5 RIPRAP PLACEMENT:

Riprap shall be carefully placed on filter material consisting of a granular filter blanket or the bedding material on erosion control geosynthetic fabric. Placement shall not damage the underlying filter blanket or geosynthetic fabric. If the Engineer determines that the placement of stone has damaged or displaced the filter material to the extent that it cannot function as intended, the Contractor, at his expense, shall remove the placed riprap stone and properly correct the damage to, and/or the displacement of, the filter material. Such correction may include the removal of the filter material, re-grading the affected area, and subsequent replacement of the filter material and riprap stone as required by the Engineer.

Riprap shall be placed in a manner which will produce a dense, reasonably well-graded mass without segregation and with a minimum amount of voids. The larger stone shall be evenly distributed through the riprap mass. The individual placement of larger riprap stones may be required to obtain a uniform distribution of stone size. The riprap placement shall be supplemented by such hand methods as are required to obtain a uniform finished surface. Allowable tolerance from the slope lines and grades shown for the finished riprap surfaces shall not exceed a distance equal to 1/3 of the nominal  $D_{50}$  size above or below the design surfaces. The final surface elevations shall be lower than any adjacent apron or pipe invert elevations and shall not obstruct the operation of adjacent structures. The flow line within riprap shall provide positive drainage with minimal ponding. Individual stones shall depress below the finished grades no lower than a distance equal to 1/2 of the nominal  $D_{50}$  size. Special care shall be exercised in placing riprap within 3 feet of structures to avoid damage to such

## SECTION 220

structures.

### 220.6 GROUTED RIPRAP:

Place riprap as specified in Subsection [220.5](#), excluding the use of filter material and secure in place with portland cement grout meeting the requirements of Table [220-1](#). Place grout to the depth as shown on the plan but in no case less than 70 percent of the depth of riprap. Consolidate grout into place with suitable spades, trowels or other approved means to provide a dense stone and mortar layer with all voids and interstices filled. After grout has been placed, the rocks shall be thoroughly brushed so that their top surfaces are exposed. If required, use water pressure to clean stone faces after the mortar has achieved sufficient strength. The outer rocks shall project 1/3 to 1/4 their diameter above the grouted surface.

TABLE 220-1			
Grout for Riprap			
Minimum Cementitious Material (lbs)	Maximum W/CM Ratio	Slump (in)	Air Content (%)
850	0.60	9 +/- 2	0 % - 8 %

The cementitious materials shall meet the requirements of Subsection [725.2](#). Up to 25 percent by weight of the Table [220-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. The aggregates shall meet the applicable requirements of ASTM C33, #8 (3/8") coarse aggregate grading and fine aggregate (sand) grading. All Ready Mixed Grout volume calculations shall be based on "absolute volume" with the total volume per cubic yard equal to 27 cubic feet. Coarse aggregate volume shall be a maximum of 35% of the total aggregates volume. All mixing shall be in accordance with the applicable requirements of Subsection [725.7](#).

The amount of slump shall be the minimum amount needed to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer.

### 220.7 MEASUREMENT:

The completed, in place riprap construction within the limits of the dimensions shown on the plans shall be measured. Measurement will be in cubic yards rounded to the nearest cubic yard.

No separate measurement will be made for erosion control geosynthetic fabric, bedding material, or grout.

### 220.8 PAYMENT:

Payment for riprap will be made for the accepted complete in-place riprap construction at the contract unit price. Riprap construction shall include excavation, ground surface preparation, erosion control geosynthetic fabric (if used for the project), bedding material, riprap stone, grout (if used for the project) and backfilling.

Payment for riprap shall be full compensation for furnishing all material, labor and equipment for riprap construction.

- End of Section -

## SECTION 230

### DUST PALLIATIVE APPLICATION

#### 230.1 DESCRIPTION:

This Section shall govern the application of dust control palliatives (agents) on unpaved roads, traffic surfaces, vacant lots, construction sites and road shoulders. Dust palliatives may also be used to protect erosion of slopes, embankments, sediment control and re-vegetated areas.

Dust palliatives may be applied as topical treatments to penetrate an undisturbed surface, or may be applied to larger areas using mixing methods that blend the product with surface material and then compact the mixture to provide a stabilized, dust resistant, surface course.

#### 230.2 MATERIALS:

Materials to be used as dust palliatives shall conform to the requirements of Section [792](#). The specific dust palliative to be used shall be as shown on the plans or as directed by the Engineer.

Water used for diluting dust palliatives and for pre-wetting of treated subgrade shall be either potable or from a source compatible with dust palliative ingredients.

**230.2.1 Product Verification:** The Contractor, in the presence of the Engineer or his designee, shall obtain samples of the bulk, undiluted liquid dust palliative/stabilizer product as it is delivered to the job site. Samples shall be taken from each bulk tanker that delivers the liquid dust palliative/stabilizer for product verification testing purposes. If the bulk undiluted liquid dust palliative/stabilizer is delivered in containers, a sample must be taken from each container delivered to the job site. The Engineer will select the exact locations and times of sampling. The obtained liquid dust palliative/stabilizer samples will be split in three equal portions (minimum 2 ounce each), whereby the Contractor may retain one sealed portion for verification testing, and the Engineer will retain two sealed portions. One portion of the Engineer's samples will be provided to an AASHTO accredited test lab chosen by the Contractor. The other sample will be held for backup until the testing is completed. Sample containers will be labeled and sealed under the supervision of the Engineer.

The accredited lab will test the product in accordance with ASTM D2834 to confirm that the liquid dust palliative/stabilizer meets the requirements of Subsection [792.2](#) for active solids. Contractor is responsible for the cost of product verification testing.

If the test reports indicate that the minimum acceptable active solids content value as specified in Subsection [792.2](#) is not met, the quality of the liquid dust palliative/stabilizer product shall be deemed deficient by the Engineer. The delivery and application of a deficient product shall be stopped. Work shall not resume until all product verification testing is complete or the Contractor replaces the product and initial tests on the new material show compliance.

The Contractor may perform additional verification testing on the split samples. In case of dispute where the verification tests produce different results by the Contractor than the Engineer, the Engineer will hire a different independent AASHTO accredited testing laboratory to perform a third round of testing. Such testing and the results of the testing shall be considered final by both the Engineer and Contractor for verification.

#### 230.3 COMPLIANCE:

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the following Applicator qualifications: (a) Information showing that the Applicator has at least three years of experience within the last five years serving as either a primary contractor or subcontractor in delivering and applying dust palliative/stabilizer product services, (b) A minimum 3 local references (including company/organization name, contact person and telephone number) to demonstrate that the Applicator is familiar with local environmental and permitting requirements associated with soil stabilization and dust palliative, and (c) Copy of the Applicator's State of Arizona Registrar of Contractors License.

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the proposed application methods and equipment for the project. The information provided shall include: (a) curing time for each application method required for the project, (b) application and dilution rates proposed for the project, and (c) equipment to be used during all phases of application that are in conformance with Subsection [230.4](#).

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Prior to the commencement of any work, the Contractor shall provide copies of all required environmental/dust control permits, any required notices of intent, and the current Material Safety Data Sheet (MSDS) for the dust palliative/stabilizer product. The MSDS must include all chemical compounds present in concentrations greater than 1% for dust palliative/stabilizer product.

### **230.4 EQUIPMENT:**

The Contractor shall provide all equipment necessary to complete the work. The equipment may include but not be limited to motorized graders, distribution trucks, mixing and pulverizing equipment, pneumatic-tired rollers, sprinkler systems, etc. All equipment used for this work is subject to approval by the Engineer. Equipment which fails to provide an acceptable application of properly diluted dust palliative/stabilizer product or does not perform satisfactorily shall be removed from the job and replaced with acceptable equipment meeting the requirement of this specification.

Distributor trucks shall be designed, equipped, maintained and operated so that dust palliative/stabilizer product may be applied uniformly on variable widths of surface up to 16 feet at readily determined and controlled rates from 0.03 to 1.0 gallons per square yard, with uniform pressure, and with an allowable transverse variation from any specified rate not to exceed 10% or 0.02 gallon per square yard, whichever is less. The maintenance and calibration of this vehicle shall be checked periodically. The record of maintenance and calibration shall be submitted to the Engineer for review upon request.

Distributor trucks proposed for use shall have been tested within 6 months from the date of spreading to determine the rate of the transverse spread. If requested, the Contractor shall furnish the Engineer with evidence that the transverse spread of the distributor truck, when the trucks were approved for use, was as uniform as practicable and under no condition was there a variance on any of the test pads greater than the allowable transverse variation; however, the Engineer may require that each distributor truck be tested to determine the rate of the transverse spread. The rate of the transverse spread shall be determined in accordance with the requirements of Arizona Test Method 411.

### **230.5 PREPARATION OF SURFACE:**

All surface preparation shall be in conformance with Maricopa County Rule 310 and 310.01 as applicable.

**230.5.1 Topical Preparation:** Prior to the application of the dust palliative, the surface shall be graded to provide drainage.

Dust palliatives shall not be applied when the surface is excessively wet or saturated. Surfaces shall be pre-moistened only if required by the product manufacturer.

**230.5.2 Surface Course Preparation:** Areas to receive dust palliative shall be graded and scarified to at least the minimum depth and width shown on the plans. The soil shall be scarified/loosened by tilling, disking, ripping, or by other soil preparation methods, which achieves uniform results to the minimum depth shown on the plans. The material shall be damp at time of scarification to reduce dust and aid in pulverization. Soil clods shall be pulverized until all material, exclusive of gravel or stone, will pass a 2-inch sieve.

All debris, weeds, organic material, stone larger than 4 inches, etc., shall be removed from the site. Surface gravel or stones shall be removed or thoroughly mixed with the surrounding soils to obtain a homogeneous mixture.

If pre-wetting is required, ample amount of water shall be added and mixed with the in-place material to obtain a moisture content near optimum. This moisture content shall be established prior to and maintained until the application of the dust palliative. The methods to establish and maintain the moisture shall be done in accordance with manufacturer's recommendations. The moisture must be uniformly distributed throughout the surface course and over the underlying undisturbed soil. Dust palliatives shall not be applied when the soil is excessively wet or saturated. Moisture content shall be determined in accordance with either ASTM D6938 or ASTM D4944.

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### 230.6 APPLICATION:

**230.6.1 General:** The dust palliative shall be applied by a pressure type distributor vehicle equipped with a power unit for the pump, full circulation spray bars adjustable laterally and vertically, and computer controls. The distribution vehicle shall be calibrated to ensure a controlled application method. Spray bars and extensions shall be of the full circulating type. Valves which control the flow from nozzles shall be of a positive active design so as to provide a uniform, unbroken spread of dust palliative on the surface.

Corners or surface that cannot be accessed by the distributor truck shall be hand sprayed by means of hoses or bars pressurized by a gear pump or air tanks.

Distributor equipment shall be equipped with a tachometer and pressure gauge. To provide for accurate, rapid determination and control of the amount of dust palliative being applied, distributor equipment shall include one or more of the following: accurate volume measuring devices, a calibrated tank, and/or a certified meter or weight tickets and calibration charts relating to the specific gravity of the concentrate and/or dilution.

The dust palliative shall be applied at the dilution ratio and application rate specified in accordance with Section [792](#), unless otherwise directed by the Engineer. The Contractor shall dilute the dust palliative product as needed, with the dilution ratio adjusted within the ranges specified in Section [792](#), to bring the mixture to the desired moisture content. Products may be applied in multiple passes at reduced application rates to meet the total application rate specified and/or assure uniform coverage.

The Contractor shall notify the Engineer a minimum of 5 working days prior to any application of dust palliative.

**230.6.2 Topical Application:** Topical applications shall be rolled only when recommended by the manufacturer. Complete penetration of palliative will be required prior to the surface rolling. Complete penetration occurs when the compaction equipment will not track or pick up the dust palliative and/or the top layer of the surface material.

**230.6.3 Surface Course Application:** The stabilization product shall be applied, incorporated and thoroughly blended into the soil until the homogeneous mixture is obtained to the full depth of treatment. Mixing shall be done in-place using mixing equipment or by motorized grader (blade mixing). The blending methods utilized shall result in a uniformly treated mixture of soil and dust palliative at or near optimum moisture content (minus any post-compaction dust palliative top coat application quantity). The dilution ratio may be adjusted to bring the mixture to the desired moisture content. The amount of area treated each day shall be limited to that which the Contractor can thoroughly mix and compact within that work day.

Complete penetration of palliative will be required prior to compaction. Complete penetration occurs when the compaction equipment will not track or pick up the blended material.

The blended material shall be shaped to the required grade line and cross-section shown on the plans and be compacted at least 95% of maximum density in accordance with ASTM D698, unless otherwise directed by the Engineer. The final surface shall be rolled to a smooth and even grade. Sufficient grading shall be done to provide reasonable drainage within the limits of existing drainage patterns. Immediately after the compaction, a top coat of dust palliative shall be applied.

### 230.7 CURING:

No equipment or traffic will be permitted on the treated surface for 24 hours unless otherwise approved by the Engineer. Once cured, the dust palliative final coat shall form a skin at the surface or a crusted surface. For purpose of this work, a "skin" on the surface will be a formation of any palliative on the surface of the soil that cannot be dislodged from the soil by winds. Any formation of the palliative on the soil surface must adhere to the underlying soil to a depth of 1/8th inch when applied topically.

### 230.8 WEATHER CONDITIONS:

Dust palliative/stabilizer product shall be applied only when the ambient temperature is above 50°F. Application should be avoided during high wind or when there is the chance of rain within the next 8 hours. The Contractor shall be responsible to retreat at no additional cost if the application is degraded by weather within the first 24-hours of placement.

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### 230.9 QUALITY CONTROL

The Contractor must provide manufacture-trained personnel for on-site technical assistance during initial delivery and application. This technical assistance is to assure that the dust palliative/stabilizer product is applied at proper dilution ratios and application rates on various soil, and subgrade types for optimum results.

At the start of each work day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product brought to the job site. At the end of the day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product remaining at the job site. The distributor truck shall be inspected to insure it is empty at the end of the day. The total gallons of liquid dust palliative/stabilizer product used for the day will be established by the start and end of day measurements of the bulk tanker.

A daily "Gallon Use Report" will be filled out by the distributor truck driver. The report will also identify the size of area treated for the day. It will be verified and signed by the Engineer or his designee. This report will be used to verify application rate and total product used. If the report indicates that the minimum application rate was not achieved, the work shall be deemed deficient by the Engineer.

### 230.10 DEFICIENCIES AND WARRANTY

If applied product active solids content is found deficient per Subsection [230.2.1](#), the Engineer may allow the Contractor to apply to any surfaces already treated by the deficient product additional topical coats of the dust palliative/stabilizer product to remedy the deficiency. Otherwise, the Contractor shall be required to repeat all work as directed by the Engineer with a different approved liquid dust palliative/stabilizer product that is compatible with the original product and will not result in adverse effects. The Contractor shall bear the cost of all remediation work for deficient product.

If the application rate as determined by the methods described in Subsection [230.9](#) or as agreed to in the contract documents is found to be deficient, the Contractor shall apply additional product within 24-hours of the original application to bring the total application rate to at least the minimum specified amount. If liquid dust palliative/stabilizer product was used as a soil stabilizer per Subsection [230.6.3](#), as directed by the Engineer, the Contractor shall re-scarify the stabilized section to its full depth and re-apply product at the original application rate. The Contractor shall bear the cost of all remediation work for deficient application rate.

For non-traffic areas (less than 150 vehicle trips per day), application of the dust palliative/stabilizer product placed in accordance with this Section shall provide a surface meeting the stabilization requirements of Maricopa County Rule 310 Section 302 and Maricopa County Rule 310.01 Section 302 for a minimum of 12 months from acceptance by the Engineer.

During the warranty period, the Contractor shall provide and install the product free of charge if the finished product fails to meet the performance requirement and specification/criteria outlined under this technical specification. The Contractor shall provide additional applications when within five working days of notification from the Engineer of performance failure.

### 230.11 MEASUREMENT:

Dust palliative surface course application shall be measured by the square yard, in place, treated, compacted, to the proper depth and accepted.

Dust palliative materials will be measured by the ton of undiluted material. Any conversion from volumetric quantities shall be done with Contractor-supplied calibration charts relating to the specific gravity of the concentrate and/or dilution.

### 230.12 PAYMENT:

Payment will be made for the applicable items at the Contract unit price and shall constitute full compensation for the item complete in place.

*- End of Section -*

**PART 300**

**STREETS AND RELATED WORK**

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## SECTION 301

### SUBGRADE PREPARATION

#### 301.1 DESCRIPTION:

This Section shall govern the preparation of natural or excavated areas prior to the placement of sub-base material, pavement, curbs and gutters, driveways, sidewalks or other structures. It shall include stripping and disposal of all unsuitable material including existing pavement and obstructions such as stumps, roots, rocks, etc., from the area to be paved.

#### 301.2 PREPARATION OF SUBGRADE:

With the exception of areas where compacted fills have been constructed as specified in Section [211](#), in the areas where new construction is required, the moisture content shall be brought to that required for compaction by the addition of water, by the addition and blending of dry, suitable material or by the drying of existing material. The material shall then be compacted to the specified relative density. If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

The Contractor's grading operations will proceed in an orderly sequence and shall be followed directly with the placement of base course. At no time shall the Contractor's total grading operations precede the placement of base course by more than 1200 feet without specific written approval of the Engineer. At the end of each day's operation, the first lift of base course shall have been placed to within a maximum distance of 300 feet behind the finished subgrade area. Drop-offs on opposite sides of the pavement at the same time will not be allowed.

Existing pavement under proposed median islands shall be removed. Payment for this work shall be considered incidental to the project.

When excavating for concrete work, such as curb and gutter and sidewalk, the Contractor shall place the excavated material in uniform windrows. The windrows shall not interfere with property access or traffic flow on the streets.

Subgrade preparation shall also include preparing the subgrade to the required line and grade for paved or unpaved shoulders, tapers, turnouts, and driveways, and at all other project locations where aggregate base and/or select material courses are used in accordance with the Project Plans.

**301.2.1** The Contractor may use removed existing asphalt concrete and other existing bituminous roadway surfacing materials originating on the project site, as embankment fill. All materials used shall be thoroughly crushed to sizes not exceeding four inches, or as approved by the Engineer. These asphalt/bituminous materials shall be placed not less than two feet below finished subgrade elevation.

Project earthwork quantities when included as separate contract pay items will include removed asphalt/bituminous material volumes, unless otherwise specified in the Special Provisions.

All unsuitable material and all excess material shall be disposed of in accordance with the requirements of Subsections [205.2](#) and [205.6](#), respectively. When additional material is required for fill, it shall conform to Section [210](#).

#### 301.3 RELATIVE COMPACTION:

The subgrade shall be scarified and loosened to a depth of 6 inches. Rock 6-inches or greater in size that becomes exposed due to scarification shall be removed from the scarified subgrade. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having the following minimum compaction, measured as a percentage of maximum dry density when tested in accordance with AASHTO T-99, and T191 or ASTM D6938 with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, ARIZ-227c to compensate for the rock content larger than that which will pass a ¾ inch sieve or a No. 4 sieve. Unless otherwise noted in the project plans or project specifications, compaction shall be performed within 2 percentage points of the optimum moisture content.

<sup>(1)</sup>Arizona Department of Transportation test method.

## SECTION 301

### (A) Street Pavement Section

(1) Top 6" Subgrade (under ABC)	100% for Arterial Streets/Major Streets
(2) Top 6" Subgrade (under ABC)	95% for Collector/Local Streets
(3) Top 6" Subgrade (under Asphalt / Concrete)	100%

### (B) Sidewalks not subject to vehicular traffic

(1) Refer to Subsection <a href="#">340.3.1</a> for marginally expansive or expansive soils.	95%
	90%

### (C) Curbs, Gutters, Curb Ramps, ADA ramps, Driveways, Driveway Entrances, Sidewalks subject to vehicular traffic

95%

### 301.4 SUBGRADE TOLERANCES:

Subgrade upon which pavement, sidewalk, curb and gutter, driveways, or other structures are to be directly placed shall not vary more than 1/4 inch from the specified grade and cross-section. Subgrade upon which sub-base or base material is to be placed shall not vary more than 3/4 inch from the specified grade and cross-section. Variations within the above specified tolerances shall be compensating so that the average grade and cross-section specified are met.

### 301.5 GRADING OF AREAS NOT TO BE PAVED:

Areas where grade only is called for on the plan shall be graded to meet the tolerances for the subgrade where subbase or base material is to be placed. The surface shall be constructed to a straight grade from the finished pavement elevations shown on the plans to the elevation of the existing ground at the extremities of the area to be graded.

### 301.6 PROTECTION OF EXISTING FACILITIES:

The Contractor shall exercise extreme caution to prevent debris from falling into manholes or other structures. In the event that debris should fall into a structure it shall immediately be removed.

### 301.7 MEASUREMENT:

Measurement for Subgrade Preparation will be by the square yard. The area to be measured will be the total accepted area of new asphalt concrete pavement and new portland cement concrete pavement (PCCP), including paved shoulders, tapers, turnouts, and unpaved roadway shoulders. Subgrade Preparation area measured will also include the accepted surface area of driveways that are surfaced with aggregate base, or select materials and non-surfaced areas designated for vehicle traffic.

Except for PCCP, the area under portland cement concrete surfaces such as concrete curb and gutter, sidewalk, concrete driveways and driveway entrances, and concrete alley entrances will not be included in the Subgrade Preparation measurement.

Project earthwork quantities for Roadway Excavation, Borrow Excavation, and Fill Construction shall not be separately measured when they are not listed as separate line items on the fee proposal form. In such case, unless otherwise specified, payment for said earthwork items shall be included in the unit price for Subgrade Preparation.

### 301.8 PAYMENT:

Payment for Subgrade Preparation will be made only when it is performed for street or roadway paving projects.

Payment shall be compensation in full for stripping, scarifying, grading, excavating, hauling, filling, compacting, and disposing of excess or unsuitable materials, together with all costs incidental thereto.

- End of Section -

<sup>(1)</sup>Arizona Department of Transportation test method.

## SECTION 306

### MECHANICALLY STABILIZED SUBGRADE - GEOGRID REINFORCEMENT

#### 306.1 DESCRIPTION:

Mechanically stabilized subgrade shall consist of furnishing and placing a geogrid material within or below untreated base to provide a stabilized platform on which paving materials are placed. Geogrid type, fill thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.

#### 306.2 MATERIALS:

The geogrid material shall be supplied in accordance with and conform to the material requirements of Section [796](#) and Table [796-4](#).

#### 306.3 SUBGRADE PREPARATION:

The geogrid shall not be placed when weather or surface conditions do not meet the manufacturer's recommendations for installation.

**306.3.1 Placing Geogrid on Soft Subgrade:** Prior to placement of geogrid material, soft subgrade shall be lightly proof rolled to provide a firm surface, brought to grade and shaped to conform to the typical sections, lines and grades as shown on the plans. The surface on which the geogrid will be placed shall be free of rock and other material that could damage the geogrid. The placement of the geogrid shall be approved by the Engineer before placement of overlaying materials.

Subgrade tolerances shall be in accordance with Subsection [301.4](#).

**306.3.2 Placing Geogrid Within Untreated Base:** Subgrade shall be prepared in accordance with Section [301](#).

#### 306.4 EQUIPMENT:

Mechanical or manual laydown equipment shall be capable of laying the geogrid properly and smoothly, in compliance with the manufacturer's recommendations.

#### 306.5 GEOGRID PLACEMENT:

The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.

The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or acceptable fill material as required by fill placement procedures, weather conditions, or as directed by the Engineer. A 12-inch minimum secured overlap is required at all joints (both transverse and longitudinal). At transverse joints, the preceding roll shall overlap the following roll in the direction that the aggregate base will be placed. The geogrid shall be rolled out along the alignment in the direction of advancing construction. All wrinkles and folds shall be removed.

The geogrid shall be tensioned by hand and anchored to the ground at the edges, including overlaps, and in the center of the roll at 30-foot intervals along the roll length, at the corners if applicable, or as directed by the Engineer. Securing locations may be reduced or eliminated if it can be shown to the satisfaction of the Engineer that an alternative installation process will provide satisfactory results.

Geogrid shall be placed to obtain full coverage of the indicated area. Placement of geogrid on irregular shaped areas and radii may require cutting of the geogrid material and the use of diagonal overlapping joints. Buckling of geogrid material will not be allowed.

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### **306.6 PLACING AND COMPACTING AGGREGATE FILL:**

The aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. The aggregate material shall be bladed on the geogrid in such a manner that the aggregate rolls forward onto the grid ahead.

When underlying substrate is trafficable with minimal rutting, rubber-tired equipment may pass over geogrid reinforcement at slow speeds (less than 10 mph). Sudden stops and turning by trucks shall be avoided on the geogrid. Traffic shall not be allowed onto coated geogrid materials. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles shall be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

Any ruts which develop during spreading or compacting aggregate fill shall have additional aggregate added rather than bladed from surrounding areas. Placing additional aggregate into the rutted areas limits disturbance to the underlying geogrid keeping it intact.

Untreated base shall be compacted as specified in Section [310](#). Untreated base material shall not be mixed or processed on the geogrid. Base materials will be uniformly blended and sampled for acceptance prior to placement on the geogrid material. Contamination and segregation of base materials during placement shall be minimized.

### **306.7 REPAIR:**

Any geogrid material damaged before, during or after installation shall be replaced by the Contractor at no additional cost to the Agency.

Replacement of geogrid reinforcement shall consist of removal and replacement of the geogrid and aggregate fill from the defective area. The aggregate fill shall be removed at least 3 feet beyond the limits of the defective area. The replacement geogrid shall be installed with proper overlaps. Aggregate fill replacement shall not commence until placement of the geogrid material has been inspected and approved.

### **306.8 PAYMENT:**

The surface area of accepted in-place geogrid reinforcement will be measured to the nearest square yard.

Payment for geogrid reinforcement at the contract unit price shall be full compensation for furnishing all labor, material, equipment, and installing complete in place the geogrid as shown on the project plans.

*- End of Section -*

## SECTION 309

### LIME STABILIZATION OR MODIFICATION OF SUBGRADE

#### 309.1 DESCRIPTION:

This Section shall consist of constructing a mixture of soil, lime and water for the stabilization or modification of subgrade soils. The work shall be performed in conformity with the lines, grades thickness, and typical cross sections shown on the plans.

According to the National Lime Association, "Stabilization: When adequate quantities of lime and water are added, the pH of the soil quickly increases to above 10.5, which enables the clay particles to break down. Determining the amount of lime necessary is part of the design process and is approximated by tests such as the Eades and Grim test (ASTM D3276). Silica and alumina are released to react with calcium from the lime to form calcium-silicate-hydrates (CSH) and calcium-aluminate-hydrates (CAH). CSH and CAH are cementitious products similar to those formed in portland cement. They form the matrix that contributes to strength of lime-stabilized soil layers. As this matrix forms, the soil is transformed from a sandy, granular material to a hard, relatively impermeable layer with significant load bearing capacity. The process begins within hours and can continue for years in a properly designed system. The matrix formed is permanent, durable, and significantly impermeable, producing a structural layer that is both strong and flexible."

Lime modification may be used to "Dry-up of wet soil at a construction sites" or "include treating fine-grained soils or granular base materials to construct temporary haul roads or construction platforms."

#### 309.2 MATERIALS:

**309.2.1 Soil or Subgrade:** For lime stabilization applications, the soil or subgrade material used for this work shall consist of materials on the site or imported, and shall be free of roots, sod, weeds and stones larger than 3 inches and have a plasticity index (PI) greater than 10, when tested in accordance with AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90. For lime modification applications, the allowable soil or subgrade properties will be determined by the Engineer.

**309.2.2 Quicklime and Hydrated Lime:** Lime used shall be either quicklime or hydrated lime and shall conform to the requirements of ASTM C977. All lime shall come from a single source. If a source change is requested, a new mix design shall be submitted using lime from the proposed new source. The new design must be approved by the Engineer prior to use.

**309.2.3 Lime Slurry:** Lime slurry shall be a pumpable suspension of solids in water. The solids portion of the mixture, when considered on the basis of solids content, shall consist principally of hydrated lime of a quality and fineness sufficient to meet Subsection [309.2.2](#) requirements. A certificate of compliance shall be provided to the Engineer for each load of lime applied at the project.

**309.2.4 Water:** Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test.

#### 309.3 COMPOSITION:

**309.3.1 Lime Stabilization Mix Design:** Before commencing lime treatment work, the Contractor shall submit for approval by the Engineer, a proposed mix design. The proposed mix design shall be prepared by a testing laboratory under the direction and control of a registered professional engineer. The mix design shall be determined using the soils or subgrade material to be stabilized and lime from the proposed supplier, and shall determine the following:

For soil stabilization applications, the mix design shall report and comply with the following requirements:

##### Untreated Soil:

- (a) Sulfates: Tested per ARIZ 733, AASHTO T-290, or ASTM C1580.
- (b) Moisture-Density Relationship (Proctor): Tested per ASTM D698A.
- (c) Plasticity Index: Test method AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (d) Sieve Analysis and Minus No. 200 Wash: Test methods ASTM C136 and ASTM D1140.

## SECTION 309

### **Lime Treated Soil:**

- (a) pH: Lime saturation content per ASTM C977 APPENDIX or ASTM D6276.
- (b) Plasticity Index: Less than 3, per AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (c) Swell Potential: Maximum expansive potential of 1.0 per ARIZ 249 using passing No. 4 sieve material. The maximum expansive potential shall be determined on a sample compacted to approximately 95 percent of the ASTM D698A maximum dry density at approximately 2% below optimum moisture content. The sample should be confined under a 100 psf surcharge and inundated.
- (d) Unconfined Compressive Strength: Minimum 160 psi per ASTM D5102 Procedure A, after five days curing at 100°F, sealed in air-tight condition.
- (e) Mellowing time and mellowing moisture content for treated soil sections b and c to be determined by design engineer. Mellowing time and mellowing moisture content for treated soil section d determined by ASTM D5102.
- (f) Hydrated Lime Content: The design engineer shall designate the minimum percentage of lime by dry weight of the dry soil to satisfy the criteria for Subsection [309.3.2](#) requirements. The percentage of lime specified shall be sufficient to allow for expected variations during the mixing process. A minimum of 5.0% hydrated lime by dry weight of the dry soil is required for all mix designs.

**309.3.2 Lime Modification:** For soil modification purposes only, the Engineer shall specify the minimum amount of hydrated lime or lime slurry required to meet the desired improved soil properties.

### **309.4 CONSTRUCTION:**

**309.4.1 General:** It is the primary requirement of this specification to secure a completed subgrade containing a uniform lime mixture free from loose segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses.

Prior to beginning any lime stabilization or modification, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines and grades as shown on the plans.

Lime shall be applied at the mix design rate for the depth of subgrade stabilization or modification shown on the plans or requested by the Engineer.

When the design requires treatment to a depth greater than 12 inches, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 12 inch thick compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 12 inch thick compacted lifts.

**309.4.2 Weather Limitation:** Lime treated subgrade shall not be constructed if the ambient temperature is below 40° F or when conditions indicate that temperatures may fall below 40° F within 24 hours.

**309.4.3 Equipment:** Contractor shall provide all equipment necessary to complete the work including grading and scarifying equipment, a spreader of the lime, mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment and trucks. Gravity feed or tailgate spreading, defined as not having automatic controls, will not be permitted. The spreader shall demonstrate the ability to maintain a consistent spread rate over variable travel speeds. All equipment used for this work is subject to approval by the Engineer.

**309.4.4 Application:** Lime shall be spread only on that area where the mixing operation can be completed during the same working day. The lime application rate shall be at the design content to +0.5%, based on weight of dry soil. The Engineer reserves the right to vary the rate of application of lime from the mix design during the progress of construction as necessary to maintain a pH of the lime/soil mixture above 12.0 and the desired characteristics of the treated subgrade.

For all lime applications, the Contractor shall provide the Engineer with daily application quantities.

**309.4.4.1 Quicklime Application:** Quicklime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of quicklime. Contractor shall exercise safety measures when mixing quicklime with water.

## SECTION 309

**309.4.4.2 Dry Hydrated Lime Application:** Hydrated lime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of dry lime.

**309.4.4.3 Lime Slurry Application:** Lime slurry shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system. Lime slurry shall be applied at a rate that will yield the required lime percentage determined by the mix design.

**309.4.5 Mixing:** The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are strictly prohibited except in areas specified by the Engineer. To insure a complete chemical reaction of the lime and soil or subgrade, water shall be used as required to maintain moisture content at optimum to +4% above the optimum of the lime treated mix design proctor, prior to beginning compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted. No traffic other than the mixing equipment will be allowed to pass over the spread of lime until after completion of mixing.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	<u>Percent</u>
Minimum of clay lumps passing 1-1/2 inch sieve	100
Minimum of clay lumps passing No. 4 sieve	60

**309.4.6 Compaction:** Compaction of the mixture shall begin after final mixing and shall be accomplished in accordance with the design specifications. Areas inaccessible to conventional rolling equipment shall be compacted to the required density by methods approved by the Engineer. Mellowing time and mellowing moisture content shall be specified by the mix design and performed prior to final compaction.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. A composite of treated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum dry density and optimum moisture content in accordance with ASTM D698. The field density of the compacted mixture shall be at least 95 percent of the maximum dry density of the field sampled proctor. The in-place compacted field density shall be determined in accordance with ASTM D1556, sand cone, or ASTM D6938, nuclear gauge. In the event of disputed results, the nuclear gauge density shall be correlated to the referee sand cone density while the nuclear water content shall be correlated to the referee ASTM D2216 water content. The adjustment for rock larger than the no. 4 sieve shall be performed in accordance with ASTM D4718.

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements and finished requirements, it shall be reworked to meet requirements at no additional cost to the Contracting Agency.

**309.4.7 Thickness:** The thickness of the lime treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 1000 square yards per layer. If more than one layer, the method used to remove material to determine the depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 1 inch, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Contracting Agency, the material where depth tests are taken.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereupon or the work is accepted. Compaction and finishing shall be done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the Agency.

**309.4.8 Finishing and Curing:** After the final layer or course of lime treated subgrade has been compacted, it shall be

## SECTION 309

brought to the required lines and grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

Each layer of lime treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing, in compliance with Section [333](#), shall be furnished and applied to the surface of the final layer of the lime stabilized material as soon as possible after the completion of final rolling and before the temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate will be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the lime stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the Contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course should be kept moist during the curing process.

**309.4.9 Maintenance:** The Contractor shall maintain, at his/her own expense, the entire lime treated subgrade in good condition from the start of work until all the work has been completed, cured and accepted by the Engineer.

### **309.5 MEASUREMENT:**

The quantity of lime slurry treated soils shall be measured by the square yard, measured in place, treated, compacted, to the proper depth, and accepted.

The quantity of curing seal shall be measured by the ton.

### **309.6 PAYMENT:**

The lime treated soils measured as provided above, will be paid for at the contract price per square yard, which price shall be full compensation for the item complete, as herein described and specified.

The Owner or Engineer reserves the option to pay for the lime separately. Should this option be chosen, the lime treated soils measured as provided above will be paid for at the contract price per square yard which shall include full compensation for the item less lime, as herein described and specified. The lime materials will be paid for by the contract price per ton based on hydrated lime. If quicklime in slurry form is used there will be an additional pay factor of 1.3 applied to determine the actual amount of hydrated lime placed.

Payment for curing seal will be by the ton, based on the rate of application as requested by the Engineer.

*- End of Section -*

## SECTION 310

### PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

#### 310.1 DESCRIPTION:

Aggregate base course shall comply with Section [702](#) unless the use of a different type of material is specifically authorized in the special provisions.

#### 310.2 PLACEMENT AND CONSTRUCTION:

The compacted lift thickness shall not exceed 6 inches, unless approved by the Engineer. Based on the type of material, type of equipment and compaction methods used, the Contractor may propose a greater lift thickness to the Engineer for approval.

After distributing, the aggregate base course material shall first be uniformly watered and then graded to a uniform layer that will net, after compacting, the required thickness. The grading operation shall be continued to such extent as may be necessary to minimize segregation. The quantity of water applied shall be that amount which will assure proper compaction resulting in the density required by Subsection [310.3](#).

After placement, the aggregate base course surface shall be true, even and uniform conforming to the grade and cross-section specified. In no case shall the aggregate base course vary by more than ½ inch above or below required grade.

#### 310.3 COMPACTION

The Contractor is responsible for providing appropriate equipment and techniques to achieve the compaction results required by this specification. The aggregate base course shall be compacted in lift thicknesses as allowed by Subsection [310.2](#).

The laboratory maximum dry density and optimum moisture content for the aggregate base course material shall be determined in accordance with Arizona Test Method 225, method "A". Field 'one-point' maximum dry density and optimum moisture procedures shall only be allowed as a measure of quality control until a laboratory maximum dry density and optimum moisture content is provided.

The in-place density shall be determined in the field by nuclear density testing in accordance with AASHTO T-310 or sand cone density testing in accordance with AASHTO T-191. In the event nuclear density testing is selected, and density results are in question, a sand cone correlation will be performed by the accepting agency at the Contractor's request, not to exceed one sand cone for each ten nuclear density tests.

A rock correction, to compensate for rock content larger than the #4 sieve, shall be performed in accordance with Arizona Test Method 227. Care should be taken to account for the specific gravity of the oversize particles particularly if recycled materials are utilized for aggregate base course. The specific gravity shall be determined in accordance with AASHTO T-85, as applicable.

For roadway construction, a minimum of one field density test shall be performed per lift per 660 feet per lane. For other aggregate base course applications, a minimum of one field density test shall be performed for each 800 square yards.

Unless otherwise noted in the project plans or project specifications, the moisture content of the aggregate base course at the time of compaction shall be the optimum moisture content +/- 2%.

The following percent compaction is required:

- |                                                                                                         |      |
|---------------------------------------------------------------------------------------------------------|------|
| (A) Below asphalt concrete pavement                                                                     | 100% |
| (B) Below portland cement concrete pavement, driveways, curb & gutter, sidewalks, and roadway shoulders | 95%  |
| (C) All other areas not subject to vehicular traffic                                                    | 95%  |

**SECTION 310**

**310.4 THICKNESS AND/OR PLASTICITY INDEX DEFICIENCY:**

When in the opinion of the Engineer there is reason to believe that a deficiency in thickness, or an excess of plasticity exists, measurements or samples will be taken in the same pattern as that defined in Section 321. If the base has been covered or it is otherwise impractical to correct the deficiency, the corrective measures in Table 310-1 shall be taken by the Contractor at no additional cost to the Contracting Agency.

<b>TABLE 310-1</b>		
<b>THICKNESS AND PLASTICITY DEFICIENCY</b>		
<b>Type</b>	<b>Deficiency</b>	<b>Corrective Measure</b>
I	Less than 1/2 inch of the required thickness	No corrective measure required.
II	1/2 inch or more but less than 1 inch of the required thickness	(1) The Contractor may choose to add additional material and rework the grade to meet the specification requirements. (2) The Contractor may choose to increase the thickness of asphalt concrete by the amount of the aggregate base course thickness deficiency at no additional cost to the Owner. Required grade shall be met.
III	Thickness deficiency by greater than 1 inch	(1) The Contractor will remove the aggregate base course and regrade the subgrade to allow the required aggregate base course layer thickness to be constructed. (2) If grades allow, the Contractor may propose that the thickness of asphalt concrete be increased by the amount of the aggregate base course deficiency at no additional cost to the Owner.
IV	A plasticity index of 6 to 7 inclusive or gradation deficiency	(1) The Contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications. (2) If grades allow, the Contractor may increase the thickness of asphalt concrete by 1/2-inch minimum at no additional cost to the Owner. The thickness must be approved by the Engineer prior to the placement of asphalt concrete.
V	A plasticity index of over 7	(1) The Contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications.

**310.5 PAYMENT:**

Payment for aggregate base course will be made on the basis of the contract unit price per ton unless an alternate basis of payment is provided in the proposal.

*- End of Section -*

## SECTION 311

### PLACEMENT AND CONSTRUCTION OF CEMENT TREATED SUBGRADE

#### 311.1 DESCRIPTION:

This item shall consist of a cement treated subgrade composed of a mixture of local soil, portland cement, and water compacted at optimum moisture content.

#### 311.2 MATERIALS:

Portland cement and water shall comply with Section [725](#). The soil for the mixture shall consist of the material in the area to be paved. The material shall not contain more than 5 percent gravel or stone retained on a 3 inches sieve. It shall be demonstrated by laboratory tests that the plasticity and strength characteristics as defined in Subsection [311.4.5](#) of the soil will be adequately modified by the specified cement content.

#### 311.3 EQUIPMENT:

An ample number of machines, combination of machines and equipment shall be provided and used to produce the complete soil cement treated layer meeting the requirements for soil pulverization, cement distribution, water application, incorporation of materials, compaction, finishing, and for application of the curing material as provided in these specifications.

Mixing shall be accomplished by means of multiple-pass soil-cement mixer, single-pass soil-cement mixer or central plant mixer.

Water may be applied through the mixer or with the water trucks equipped with pressure sprays. Water trucks providing fine fog-type sprays shall be furnished for finishing and curing. Properly adjusted garden type nozzles on a pressure bar may be used to produce fog spray if approved by the Engineer.

Cement spreader shall be a specially constructed device to distribute bulk cement at the specified rate. The spreader shall have the ability to maintain a consistent spread rate over variable travel speeds.

#### 311.4 CONSTRUCTION METHODS:

Prior to construction, the Contractor shall remove all deleterious material, organic material, and particles retained on the 3 inch sieve from the area to be treated. The soil shall be brought to a compacted condition, true to line and grade as directed by the Engineer or as shown on the plans. The compacted soil and surface shall be approved by the Engineer prior to proceeding with mixing.

The material shall be scarified, pulverized, mixed with water and cement, compacted, finished and cured in lengths permitting the full roadway width to be complete in not more than 4 hours from the time that cement is exposed to water. Such lengths will generally be not less than 600 feet or the length of one City block and preferably more. Where a gutter section exists the material shall be pulled back from the gutter face for the full depth of the course before processing.

**311.4.1 Pulverizing:** Prior to application of cement, soil to be processed shall be scarified to depth of base. The material shall be damp at time of scarifying to reduce the dust generation and to aid in pulverization. Soil shall be pulverized until not less than 80 percent, exclusive of gravel or stone, will pass a No. 4 sieve.

**311.4.2 Application of Cement:** The quantity of cement shall be by weight as a percentage of the dry weight of the soil as determined by the laboratory and/or as directed by the Engineer and shall be applied uniformly on the soil in a manner satisfactory to the Engineer. The allowable deviation in uniformity shall not exceed 10 percent. The entire operation of spreading and mixing shall be conducted in such a manner as will result in a uniform soil cement and water mixture for the full design width and depth.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of the soil and cement during mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

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**311.4.3 Mixing:** Mixing with addition of water as required shall be continued until the product is uniform in color and at optimum moisture content to +4% of optimum moisture content as determined in accordance with ASTM D558. Any mixture of soil and cement which has not been compacted and finished shall not remain undisturbed for more than 30 minutes but shall be agitated by remixing.

**311.4.4 Optimum Moisture:** Optimum moisture requirements and field tests of moisture density shall be determined in accordance with ASTM D558, and D6938, with moisture content periodically corrected in accordance with AASHTO T-217 on representative samples of soil cement mixture obtained from the area being processed. At the time of compaction, the moisture content shall not be below optimum moisture, and shall be less than that quantity which will cause the base course to become unstable during the compaction and finishing process. Any area which becomes so unstable shall be removed and replaced with new cement stabilized material.

**311.4.5 Compressive Strength:** Laboratory compressive strength testing of the cement treated subgrade is required to evaluate the proposed amount of cement and/or verify the compressive strength achieved during construction. Laboratory compressive strength testing shall be done in accordance with ARIZ-241.

**311.4.6 Compaction:** After mixing is complete, the mixture shall be carefully placed in a uniform loose depth which will provide a surface true to grade and section when compacted. Unless otherwise directed by the Engineer, initial compaction shall be by means of a tamping, grid, or pneumatic roller. After the tamping roller has partially walked out, pneumatic rollers shall be used. Density of final product shall be not less than 95 percent as determined by ASTM D6938 as specified above.

**311.4.7 Finishing:** As compaction nears completion, the surface of the base course shall be shaped to required lines, grades and cross-section. When required, the surface shall be lightly scarified with spike tooth harrows or other approved equipment to remove imprints left by equipment or to prevent slippage planes. During the finishing process the surface shall be kept moist by means of fog-type sprays. Surface finish and final compaction shall be completed in not more than 2 hours from the time the cement is exposed to water. The completed base course shall be true to line, grade, cross-section and shall not vary more than ½ inch in thickness and not more than 1 inch in surface tolerance when tested with a 10 foot straight edge. It shall be free of surface cleavage planes, cracks, or loose material. As a final operation, the surface shall be very lightly scalped with a motor grader, wet with a fog spray and rolled with a pneumatic roller as directed by the Engineer.

**311.4.8 Thickness Deficiency:** The Engineer may choose to have cores obtained to evaluate the thickness of the treated cement stabilized subgrade layer. Should the thickness of the treated layer not meet the project specifications, the Engineer may require the Contractor to submit an Engineering Analysis (EA) to address the pavement section. The EA will provide an opinion as to the anticipated performance of the pavement section as a result of the reduced cement treated layer thickness and make recommendations on possible corrective actions. The Engineer shall determine what corrective actions, if any, are required.

**311.4.9 Curing:** Each layer of cement treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing in compliance with Section [333](#), shall be furnished and applied to the surface of the final layer of the cement stabilized material as soon as possible after completion of final rolling and before the ambient temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate shall be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the cement stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the Contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course shall be kept moist during the curing process.

**311.4.10 Construction Joints:** At the end of each day's work, a construction joint shall be made transverse to the centerline of the road by cutting back into the work to provide a full depth vertical joint. Except where specifically authorized by the Engineer, no other construction joints will be permitted. Where authorized, such joints shall be full depth vertical joints.

**311.4.11 Maintenance:** The Contractor shall maintain the surface until it has been covered with the designated bituminous wearing course. In case it is necessary to replace any soil cement, it shall be for the full depth. No skin patches or soil cement will be permitted. Minor surface pits may be filled with compacted bituminous surfacing, if authorized by the Engineer. Immediately prior to the placing of the bituminous wearing course, the surface shall be broomed to remove all loosened

## SECTION 311

material from the surface.

### **311.5 MEASUREMENT:**

Measurement of soil cement will be the number of square yards constructed to the required depth, completed and accepted.

Measurement of portland cement will be the number of tons of cement mixed with local soil.

### **311.6 PAYMENT:**

Payment will be made for the applicable items at the contract unit prices bid in the proposal, and shall constitute full payment for furnishing all material, equipment, tools, labor and incidentals necessary to complete the work and for carrying out the maintenance provisions.

No measurement or payment will be made for any imported earth materials.

*- End of Section -*

## SECTION 312

### CEMENT TREATED BASE

#### 312.1 DESCRIPTION:

Cement treated base shall consist of a combination of base material and portland cement as specified in Section [705](#).

#### 312.2 GENERAL:

When the mixing of cement treated base in a stationary mixer is required, it will be so specified. Otherwise, cement treated base may be mixed in either a traveling plant or in a stationary plant, at the option of the Contractor.

If the cement treated aggregate is mixed in a central plant, it shall not contain moisture in excess of 1 percent above or below optimum at the time of delivery on the grade. Certain types of transit mixers will not discharge such material unless it is greatly in excess of optimum moisture. Use of such mixers will not be permitted.

If the material is mixed in place, the machine or combination of machines used shall be capable of thoroughly mixing the cement and aggregate, when using the granular material specified, in a single pass. No lift thickness shall exceed 8 inches. If the thickness required is in excess of 8 inches, it shall be mixed in 2 separate lifts of equal thickness.

#### 312.3 CONSTRUCTION METHODS:

Mixing of materials, regardless of the type of mixer used or method employed shall be continued until the cement and water are evenly distributed throughout the aggregate, and a mixture of uniform appearance is obtained.

The amount of cement used shall conform to requirements of Section [705](#). Cement delivered in standard sacks from commercial producers will be assumed to weigh 94 pounds per sack and need not be weighed. Bulk cement or fractional sacks of cement shall be weighed.

The amount of water used shall be that required to give optimum moisture content. A portion of the required water may be added to the aggregate prior to the addition of the cement, if approved. Moisture content of the material delivered to the grade shall be checked for moisture content a minimum of four times per shift using AASHTO T-217. Batch adjustments shall be made as necessary to correct for deficiencies.

After spreading, the cement treated base shall be compacted to a density of at least 95 percent of the maximum density as determined by the mix design. Density testing shall be performed using ASTM D6938, with moisture content periodically corrected in accordance with AASHTO T-217.

Compressive strength of the cement treated base material shall be tested a minimum of twice per shift using Arizona ARIZ-241. Strength specimens shall be compacted on site and protected from moisture loss or disturbance by any practical means. Specimens shall be kept in this manner on site for 18-24 hours inside a hard outer shelled container that will protect the specimens from external environmental elements. The specimens shall be carefully transported to the laboratory for moist curing after this initial 18-24 hour cure.

After compaction, the surface of the cement treated base course shall not deviate at any point more than 3/8 inch from the lower edge of a 10-foot straightedge laid parallel to the centerline of the roadway.

A construction joint shall be made at the end of each day's construction by trimming the end of the compacted mixture to a straight vertical plane, normal to the centerline of the roadway and with the vertical edge in thoroughly compacted material.

Cement shall not be added to more material than will be mixed, compacted and sealed the same day. Cement treated base shall not be mixed or placed when either the aggregate or subgrade is frozen. The air temperature shall be at least 40°F. in the shade and rising at the time of mixing.

In areas which are inaccessible to the mixing, spreading or compacting equipment designated herein, other methods and equipment acceptable to the Engineer may be utilized.

The mixed material shall not remain undisturbed on the subgrade for more than 30 minutes and not more than 3 hours shall elapse between the time water is added to the mixture and final compaction is accomplished.

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The mixed materials shall be spread for the full width of the base under construction, either by one spreader or by several spreaders operating in a staggered position across the subgrade, unless permission is granted to do part-width construction. Should permission be granted for part-width construction, not more than 30 minutes shall elapse between the times of placing the material in adjacent lanes at any location, and the longitudinal joint against which additional mixed material is to be placed shall be trimmed to a straight vertical plane parallel to the centerline of the roadway. Trimming shall be done in such a manner as to cause the least possible loosening of the compacted base material and to leave no loose material on the subgrade. The material cut away in trimming may be used in the construction of the shoulders or the adjacent lanes if approved, or shall be disposed of in a satisfactory manner.

During mixing, spreading and compacting and until the application of the curing seal, any moisture lost by evaporation shall be replaced by the addition of water by means of a light fog or fine spray.

The mixed base materials shall be covered as soon as possible after final compaction and shall be cured in accordance with this specification.

### 312.4 TRAVELING PLANT MIXING:

**312.4.1 Placing Aggregate:** The aggregate to be treated shall be placed on the roadway either as a uniform layer which, when compacted, will produce a base of the depth and width shown on the plans or as one or more windrows which, when spread, will yield a uniform layer which will compact to the prescribed dimensions. If the aggregate is placed in one or more windrows, a windrow sizer will be required. The number and size of the windrows may vary, depending on the width and depth of treatment and on the capacity of the machine, but regardless of size, the windrow shall be uniform in cross-section and shall not be larger than can be handled by the plant.

Care shall be exercised during the placement of the aggregate to prevent segregation of the fine and coarse portion of the aggregate.

**312.4.2 Placing Cement:** Cement shall be added to the uniform layer or windrow of aggregate by means of mechanized equipment which will spread the cement in correct and uniform quantities. For any section of roadway, the quantity of cement placed by mechanical spreaders shall not deviate more than 10 percent from the computed quantity for the section. When cement is applied to a windrow, the top of the windrow shall be slightly trenched to retain the spread of cement.

If storm winds cause a loss of spread cement, spreading operations shall be halted until such winds subside and, at the first indication of losses, prompt action shall be taken to avoid further losses. If cement losses are deemed excessive, the deficient quantity shall be furnished and added in the proper amount by the Contractor at no additional cost to the Contracting Agency.

**312.4.3 Mixing:** Mixing shall be accomplished by means of an approved single pass traveling continuous mixing machine, or combination of machines, of the pug or auger type. The machine shall be so constructed that the device for picking up or mixing the aggregate can be controlled and during the mixing operations it shall be set to mix the aggregate, cement and water to the design depth without cutting into or disturbing the subgrade or picking up any material other than that material to be processed. The machine shall be equipped so that water may be introduced at the time of mixing through a metering device which will accurately and uniformly control and measure the amount of water being used.

The cement and aggregate shall be mixed in the machine simultaneously with the adding, through the machine, of the additional amount of water required.

The material shall be spread immediately after mixing, in reasonably close conformity to the lines, grades and dimensions established or shown on the plans.

**312.4.4 Stationary Plant Mixing:** If the stationary plant method of mixing is employed, the aggregate, cement and water shall be mixed at a central plant using either a batch pug mill type or a continuous type mixer. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected, either by a reduction in the weight of materials or by other adjustments.

**312.4.5 Batch Mixing:** If a batch pug mill type mixer is used, the aggregate and cement shall be proportioned by batch weights. Cement shall be weighed on separate scales from the aggregate batching scales.

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The weight of the charge in a batch mixer shall not exceed that which will permit complete mixing of all materials. The period of mixing shall not be less than 30 seconds from the time all materials are in the mixer. Water may be proportioned by volume or by weight.

**312.4.6 Continuous Mixing:** If a continuous type mixer is used, the materials shall be proportioned by volume.

The continuous type mixer shall be equipped with metering devices and feeders which will introduce the cement, aggregate and water into the mixer in the specified proportions. The water pump shall be equipped with a means of varying the rate of delivery. The metering devices and feeders shall be interlocked and so synchronized as to maintain a constant ratio of cement and water to the aggregate.

The rate of feed to a continuous type mixer shall not exceed that which will permit complete mixing of all the material.

**312.4.7 Spreading:** The treated material shall be transported from the plant to the prepared subgrade in approved equipment.

The surface on which the material is to be placed shall be thoroughly moistened and kept moist, but not excessively wet, until covered by the material.

Plant mixed cement treated base shall be spread by approved spreader boxes or finishing machines. The machines shall be constructed and operated so as to produce a layer of uniform density and cross-section in sufficient quantity to provide a compacted base reasonably conforming to the lines, grades and cross-sections established or shown on the plans.

**312.4.8 Compacting:** Initial compaction shall begin immediately after mixing and spreading. Successive passes of compacting equipment shall overlap the previous adjacent pass by at least 25 percent of its width. Following initial compaction and before final compaction, the treated material shall be bladed with a motor grader or a Planning machine to obtain a surface reasonably true to the lines, grades and cross-sections established or shown on the plans. During and immediately following the shaping operations, if required, the Contractor shall lightly scarify the surface with a nail drag or other approved equipment to prevent the formation of surface compaction planes.

Extreme care shall be exercised by the Contractor during the blading operation so that no more material than is necessary is disturbed and so that this operation can be completed as quickly as possible. Material thus cut shall be wasted if so directed. Compaction shall proceed without interruption, except as stated above, until the required degree of compaction is obtained.

### 312.5 INVERTED SECTION:

Where the cement treated base is to be covered with an aggregate base material, the minimum thickness of the aggregate base shall be 5 inches, unless otherwise specified in the special provision. In order to provide for free internal drainage of the aggregate base course overlaying the cement treated material, it shall be ABC per Section 725. The cement treatment shall be held back approximately 1 foot from each curb line.

### 312.6 CURING:

Keep the surface of the compacted cement treated base course continuously moist until overlaid with the aggregate base course. The aggregate base or the surfacing may be placed as soon as the cement treated base has been compacted. The spray equipment on the water truck shall be approved by the Engineer prior to the use of this equipment to spray the soil cement base course. The spray equipment must produce a fine, even spray to prevent washing of the surface of the base course. A cement treated section may be opened to all traffic immediately after placement and compaction of the surfacing.

### 312.7 DEFICIENCY:

When, in the opinion of the Engineer, there is reason to believe that a deficiency in thickness exists in the cement treated base, cores will be taken in the same pattern as that defined in Section 321. If the base has been covered or it is otherwise impractical to correct the deficiency of ½ inch or more in thickness, the corrective measure listed in Table 310-1 for Type II deficiency shall be taken by the Contractor at no additional cost to the Contracting Agency.

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### **312.8 PAYMENT:**

Payment for the portland cement will be made by the tons of cement complete in place.

Payment for base material will be made by the tons of aggregate complete in place including mixing, spreading, and compacting.

No separate payment will be made for curing.

*- End of Section -*

## SECTION 315

### BITUMINOUS PRIME COAT

#### 315.1 DESCRIPTION:

Bituminous prime coat shall consist of furnishing bituminous material and applying this bituminous material to a prepared base course, in accordance with these specifications.

#### 315.2 MATERIALS:

Bituminous material shall conform to the requirements of Section [712](#) for the type and grade specified.

#### 315.3 CONSTRUCTION METHODS:

**315.3.1 Preparation of Surface:** The surface on which the bituminous prime coat is to be placed shall be uniformly smooth and firm and reasonably true to grades and cross-sections as shown on the plans, and shall be so maintained throughout the period of placing the prime coat. In no event shall a prime coat be placed on a soft, uneven base. Any holes, depressions or irregularities shall be repaired by the removal of all loose and unsuitable material and replacement by suitable material, which shall be compacted to produce a dense surface conforming to the adjacent area. Uniformity of surface texture is of the utmost importance.

When required, the surface on which the prime coat is to be placed shall be lightly bladed and rolled immediately prior to the application of bituminous material.

**315.3.2 Application of Bituminous Material:** Bituminous material shall be applied only when the surface is either slightly damp or dry. For extremely dry areas, a light application of water may be required prior to the application of bituminous material.

The approximate quantity of bituminous material to be used will be specified; however, the exact amount used will be determined by the Engineer at the time of application. The bituminous material shall be uniformly applied to the prepared surface at the rate so designated and in one application.

The application of bituminous material and distributing equipment shall conform to the requirements of Section [330](#).

When it is deemed necessary, areas having excess bituminous material shall be blotted with material as directed.

When so directed, the surface of the complete prime coat shall be rolled with a pneumatic-tired roller.

**315.3.3 Maintenance of Surface:** Traffic shall be kept off the bituminous material until it has penetrated the base or subgrade and cured sufficiently.

The integrity of the prime coat shall be maintained at all times until the next course is placed or until the final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks shall be satisfactorily repaired by the Contractor.

#### 315.4 MEASUREMENT:

The accepted quantities of bituminous material for bituminous prime coat will be measured by the ton undiluted for the bituminous material used.

No measurement or direct payment will be made for rolling.

Materials necessary for repair of holes or breaks in the surface after the prime coat has been accepted, when such holes or breaks are caused by traffic other than that of the Contractor, will be measured for payment under the respective contract item for the materials used.

## SECTION 315

### **315.5 PAYMENT:**

Payment for the bituminous material will be on the basis of the price bid per ton, undiluted, complete in place. Payment for furnishing, applying and removing blotter material will be paid for as an extra work item.

*- End of Section -*

## SECTION 317

### ASPHALT MILLING

#### 317.1 DESCRIPTION:

The work under this Section shall consist of milling existing asphalt concrete pavement where shown on the Plans or requested by the Engineer.

#### 317.2 CONSTRUCTION REQUIREMENTS

Contractor is responsible for locating all milling hazards on and below the surface within the areas to be milled including areas requiring special milling. Special milling is not a separate pay item and shall be paid for as Asphalt Milling.

The milling cut depth shall be the depth indicated on the Plans plus or minus 1/8 inch. The milling machine shall have electronic grade controls. Contractor shall remove the milled material and sweep the roadway clean with a power pick-up broom to the satisfaction of the Engineer.

Asphalt pavement adjacent to manholes, valve boxes, small radius curbs and other fixed objects that produce confined area shall be removed with milling equipment specifically designed to operate in constricted areas. The equipment shall be capable of removing asphalt concrete of the specified thickness without damage to, or displacement of, the adjacent object(s).

The Contractor shall be responsible for continually checking the milling operation to determine that the proper depth of milling has been achieved, that the proper profile and cross slope are achieved, and that the surface texture is (a) free from longitudinal ridges, and (b) has a uniform pattern.

The Contractor shall immediately notify the Engineer when:

- The existing pavement thickness is found to be less than anticipated and breaking of the underlying material occurs.
- Delamination of underlying material occurs.

The work shall result in a clean milled surface to the specified depth for the area indicated by the construction documents including the areas immediately around and next to any individual hazard within the area to be milled. The edge of milled area shall form a straight clean cut line.

For milled surfaces on major streets (arterial and collector streets) that will be subject to traffic prior to overlay, a tack coat per Section [329](#) may, when authorized by the Engineer, be applied to the milled surface as a dust control measure. The tack coat shall be applied after sweeping and prior to allowing traffic on the milled surface. The tack coat application rate shall be half of the prescribed tack rate or contract amount or an alternate rate as prescribed by the Engineer. The Contractor shall be responsible for clean-up of any tack coat tracking that occurs.

#### 317.3 MEASUREMENT AND PAYMENT:

Measurement for Asphalt Milling will be by the square yard and shall only include area milled to the required depth and cross-section.

Payment for Asphalt Milling at the contract unit price shall be full compensation for the work, complete-in-place, including all asphalt milling, milling around structures, removal and disposal of milled materials, and sweeping.

Engineer approved tack coat applied for dust control will be paid at the contract rate for tack coat. No additional payment for the application of dust control tack coat shall be made.

*- End of Section -*

## SECTION 320

### ROAD-MIXED SURFACING

#### 320.1 DESCRIPTION:

Road-mixed surfacing shall consist of a mixture of mineral aggregate and bituminous binder mixed on the roadbed or other area, spread and compacted on a prepared subgrade or base course in conformity with the lines, grades, and dimensions shown on the plans or typical cross-section, or as specified in the special provisions.

#### 320.2 MATERIALS:

Materials shall conform to the requirements of Sections [710](#) and [712](#) for the type and grade specified on the special provisions.

#### 320.3 PRIME COAT:

When a prime coat is required, it shall be applied as specified in Section [315](#).

#### 320.4 SPREADING AGGREGATE:

The mineral aggregate shall be deposited in a windrow along one side of the roadbed by means of approved spreader box equipped with a readily adjustable strike off device or other suitable equipment. The maximum lift for blade mixing and laying shall not exceed 1 cubic yard per running foot. If the mineral aggregate is delivered to the roadbed in separate sizes, each size of aggregate shall be spread in a windrow of the required quantity for that size of material, after which the windrows of various sizes shall be blended into one windrow alongside of the roadbed.

The aggregate shall be so spread that the windrows will be uniform and equal in size and will contain the proper quantity of material to provide surfacing of the required width and thickness. Care shall be exercised to prevent the aggregate from becoming mixed with earth or shoulder material. Preparatory to applying the liquid asphalt, a portion of the material from the windrow shall be spread uniformly over one-half the width of the roadbed.

Unless permitted by the Engineer, no more aggregate shall be spread on any one day than can be mixed with liquid asphalt within 72 hours. If traffic conditions require, the Engineer may require spread or flattened windrows.

#### 320.5 APPLICATION OF LIQUID ASPHALT:

The temperature of the liquid asphalt, when applied, shall be in accordance with Section [712](#), and 16 to 22 gallons shall be applied for each cubic yard of road-mix material, in not less than 2 approximately equal applications.

Unless otherwise approved by the Engineer, no liquid asphalt shall be spread when weather conditions are unsuitable, or when the moisture content of the mineral aggregate exceeds 3 percent by weight of the dry aggregate. When the aggregate is unusually porous, the permissible moisture content may be increased and liquid asphalt spread at the discretion of the Engineer, when laboratory tests indicate that such increased moisture content will not produce an unstable mixture.

Liquid asphalt shall be prevented from spraying upon adjacent pavements, structure, guard rails, guide posts, culvert markers, trees and shrubbery, adjacent property and improvements, and other highway improvements or facilities not specifically mentioned herein, or that portion of the traveled way being used by traffic.

#### 320.6 MIXING:

Immediately following each successive application of liquid asphalt, the surfacing material shall be thoroughly mixed by means of a blade. After the final application, the material shall be bladed into a windrow and the windrow bladed back and forth between the center and the edge of the area to be surfaced with a heavy blade grader having a wheel base not less than 16 feet long, until a satisfactory mixture of uniform appearance is obtained.

Should the mixture show an excess or deficiency of liquid asphalt, or uneven distribution thereof, prior to spreading and compacting, the condition shall be corrected by adding mineral aggregate or liquid asphalt, as the need may be, and remixing the material to produce a satisfactory mixture. If necessary, all compressed masses of material shall be broken up.

## SECTION 320

After mixing, the material shall be placed in a windrow prior to spreading.

After the material has been mixed as above specified all of the mixed material shall be bladed into a single windrow in the center of the roadbed and the entire mass of treated material turned not less than 4 complete times by blading first to one side of the road and then to the other.

In lieu of mixing the material as above specified, a road-mixing machine or any equipment other than that required above may be employed which will produce a completed mixture equal to that which would be produced by means above specified. The Engineer reserves the right to order the use of any equipment discontinued which, in his opinion, fails to produce a satisfactory mixture.

Road-mixing machines shall be of the pug mill or auger type or other suitable equipment capable of picking up the loosened material completely from the roadbed, leaving practically no loose material on the ground, and which will introduce the liquid asphalt through a metering device at the time of mixing. The machine shall be equipped with the positive control of the amount of liquid asphalt introduced into the mix which can be readily adjusted to changes in grading of the road material.

The rate of movement of the machine along the roadway, the amount of material mixed and the amount of mixing shall be so regulated that a uniform mixture of unchanging appearance is obtained and all particles of aggregate are thoroughly coated with liquid asphalt. Before mixing on the roadbed the loosened material shall be placed in windrows or in a blanket of uniform cross-section and of such size that all the material in the windrow or blanket can be passed through the mixing machine at each mixing operation. Sufficient material, as determined by the Engineer, shall be placed in windrows or in a blanket in advance of mixing.

No mixed material shall be spread and compacted until the mixture has been approved by the Engineer.

The amount of material mixed on any one day shall not be more than can be spread and compacted on the following day, except that when directed by the Engineer mixed material shall remain in the windrow for a longer period.

Mixing the liquid asphalt with the mineral aggregate prior to delivery on the roadbed will be permitted, provided that the complete mixture is uniform in character and the same consistency with respect to grading, asphalt content and moisture as that specified for road-mixing.

Liquid asphalt added to mineral aggregate at a central mixing plant shall be accurately weighed by means of dial scales or other approved weighing devices. Liquid asphalt added to mineral aggregate in a traveling mixing plant shall be accurately measured by means of meters or other approved measuring device. Weighing or measuring liquid asphalt being added to mineral aggregate at mixing plants in accordance with the above specified methods shall be for the purpose of properly proportioning the material and not for determining the pay quantities of liquid asphalt.

### **320.7 SPREADING AND COMPACTION:**

Spreading shall be in increments not exceeding 1 inch in thickness.

Rolling shall be continuous throughout the spreading operations until all the loose material has been laid and consolidated.

Segregation of coarse or fine particles shall be avoided and the surfacing as spread shall be free from lumps or pockets of coarse or fine material. Segregated materials or lumps shall be remixed by blading.

After spreading on the roadbed, should the moisture content of the mixture exceed 3 percent it shall be reduced by blading and reblading the mixture and allowing it to dry before the final spreading. Should blading and reblading of the mixture fail to reduce the moisture content below that above specified, the mixture shall be scarified, turned and respread until the moisture content does not exceed 3 percent by weight of the dry aggregate, with the exception, however, that in certain special cases, when the mineral aggregate is unusually porous the permissible moisture content may be increased at the discretion of the Engineer, when laboratory tests indicate that such increase will not result in an unstable mixture.

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During blading and rolling, all lumps or compressed masses of the mixture shall be remixed and again rolled. On completion of the blading operations all loose stones shall be swept to the outside of the surfaced area and incorporated with the shoulder material or picked up and disposed of.

The edges of the completed surfacing shall be trimmed uniformly to the required cross-section and width before the shoulders are finally rolled and shaped.

The completed surface, when ready for acceptance, shall be thoroughly compacted, smooth and even, true to grade and cross-section, and free from ruts, humps, depressions, or irregularities. When a 10 foot straightedge is laid on the finished surface and parallel with the center line of the road, the surface shall vary in no place more than 1/8 inch from the lower edge of the straightedge.

Should pneumatic-tired roller be used, the final finishing shall be done with a tandem roller. Sufficient blading and rolling equipment shall be furnished.

Where shown on the plans or specified in the special provisions, road-mixed material shall be placed and compacted around spillway assemblies, drop inlets and manholes outside the area to be surfaced, upon road approaches and connections, over gutter, ditch and dike areas, and over other areas, to the thickness shown on the plans or ordered by the Engineer.

At locations where the surfacing is to be placed over areas inaccessible to the required spreading and compacting equipment or over areas where the use of required spreading and compacting equipment would be impractical, the mixed material may be spread and compacted by other methods when approved or so ordered by the Engineer. Road-mixed surfacing placed on road approaches and connections shall be placed to the thickness and as specified for surfacing to be placed on the roadbed.

After final rolling the finished surface course shall have a density of at least 92 percent of the theoretical maximum density possible to obtain with the same materials in like proportions when computed without voids by specific gravity tests.

### **320.8 MEASUREMENT:**

Measurements for determining the area to be paid for will be made horizontally unless otherwise specified.

### **320.9 PAYMENT:**

Payment for road-mixed surfacing will be made on the basis of the price bid per square yard unless an alternate basis of payment is provided in the proposal. The price bid per square yard shall include the furnishing of all labor, materials, tools, compaction, asphalt and the dressing of the subgrade, or base course necessary to complete the work. Prime coat, when required, will be paid for by the ton, undiluted, complete in place.

*- End of Section -*

## SECTION 321

### PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

#### 321.1 DESCRIPTION:

This Section is to provide specifications for furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture and asphalt binder to form a pavement course for placement upon a previously prepared base or sub base.

#### 321.2 MATERIALS AND MANUFACTURE:

The materials shall conform to Section [710](#) for the type specified. Warm Mix Asphalt (WMA) technologies may be used within the mixture provided all requirements of the specifications are met, and the technology is on the ADOT Approved Products List. The specified required mix type shall be called out in the contract documents or as directed by the Engineer.

#### 321.3 WEATHER AND MOISTURE CONDITIONS:

Asphalt concrete shall be placed only when the surface is dry. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub base on which the material is to be placed is unstable. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.

For any pavement courses two inches thick or greater the atmospheric temperature shall be a minimum of 40 degrees Fahrenheit and rising.

For all pavement surface courses less than two inches thick, the surface temperature on which the course is to be placed shall be a minimum of 50 degrees Fahrenheit and rising.

#### 321.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of asphalt concrete prior to the placing of a succeeding lift of asphalt concrete. The tack coat may be deleted when a succeeding layer of asphalt concrete is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1-h or CSS-1-h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

#### 321.5 MIX DESIGN

Should the Contractor wish to utilize a project specific mix design or a mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab 15 working days prior to the start of the asphalt placement. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through annual asphalt concrete supplier calibrations. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all of the required information as outlined in Subsection [710](#). If WMA technologies are used within the mix design, the type of WMA technology used shall be indicated on the mix design. The target values for gradations, binder contents, and air voids will be established as the accepted Job Mix Formula (JMF) based upon the mix design. Mix designs not containing all of the information will be returned within five working days of receipt of all mix design information, for action and resubmission by the Contractor.

Once the mix design has been approved by the agency and the mixing plant selected, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer.

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If the Contractor elects to change its source of material, the Contractor shall furnish the Engineer with a new mix design, which meets the requirements of Section [710](#), as amended by the Project Specifications.

The Contractor may make self-directed target changes to the approved mix design within the limits shown below. Requests for self-directed target changes shall be made in writing and acknowledged by the Engineer prior to the start of production of a lot and will remain in effect until such time as any additional changes are implemented. The self-directed target changes must meet the contract requirements for mix design criteria and gradation limits.

<b>TABLE 321-1</b>	
<b>ALLOWABLE SELF-DIRECTED TARGET CHANGES</b>	
<b>MEASURED CHARACTERISTICS</b>	<b>ALLOWABLE SELF-DIRECTED TARGET CHANGES</b>
Gradation (Sieve Size)	
3/8 inch	± 4% from mix design target value
No 8	± 4% from mix design target value
No 40	± 2% from mix design target value
No 200	+0.5% from mix design target value
Binder Content	± 0.2% from mix design target value
Effective Air Voids	None

The Contractor may propose target changes, other than self-directed changes, to the approved mix design for the approval of the Engineer. The Engineer will determine if the proposed target change will result in mix production that meets the contract requirements for mix design criteria and gradation limits. The target changes will not be retroactive for the purpose of acceptance.

### **321.6 MIX PRODUCTION:**

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein. If WMA technology is being used, any equipment associated with the production of the hot mix asphalt shall be calibrated and in proper working order according to the WMA equipment specifications. If there are any deviations in the production or compacting temperatures of the hot mix asphalt with WMA technology, the mix design shall state the differences.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weight belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the asphalt concrete production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

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The introduction of bituminous material shall be controlled by an automated system fully integrated with the controls or the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the mineral admixture from becoming coated with un-spent fuel. The completed asphalt concrete may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the asphalt concrete, upon discharge from the mixer shall be per Table [321-1.1](#). The discharge temperature may be increased on the recommendation of the binder supplier, when approved by the Engineer. If the asphalt concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the asphalt concrete will be minimized.

Type of Asphalt Mix	Minimum Temperature °F	Maximum Temperature °F
<b>Conventional Asphalt Mix</b> (1/2", 3/4" & 1½")	<b>285</b>	<b>325</b>
<b>Rubberized Asphalt Mix</b>	<b>290</b>	<b>350</b>

### 321.7 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

### 321.8 PLACEMENT:

Placement of asphalt concrete pavement shall not commence until authorized by the Engineer. The Engineer's authorization to allow commencement of asphalt concrete paving will generally require all newly constructed valley gutters, curbing, and curb and gutters which new pavement is to be placed against to be in-place and in an acceptable condition. While it is preferred to have all newly constructed concrete items against which new pavement is to be placed be in an acceptable condition, the Engineer may allow paving to commence based on weather, the amount of defective concrete, or other considerations.

**321.8.1 Placing:** All courses of asphalt concrete shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (a) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (b) Taut stringline or wire set to grade
- (c) Short ski or sonar sensing units from curb control
- (d) Joint matching shoe

"Ski-type device or string line as described in (a) or (b) above shall be used as directed by the Engineer."

In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-

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type device or string line as described in C above to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

If the asphalt concrete is dumped from the hauling vehicles directly into the paving machine, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

If asphalt concrete is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphalt concrete shall be picked up and loaded into the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown indicated on the Project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings must be minimized and the paving machine will not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

**321.8.2 Joints:** Transverse joints, before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tack coated prior to placement of the new asphalt concrete. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline.

Longitudinal joints of each asphalt course shall be staggered a minimum of 6 inches with relation to the longitudinal joint of the immediate underlying course's cold longitudinal construction joint.

Longitudinal joints with existing or cold (more than 32 hours old) asphalt concrete shall require the existing pavement to be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tacked prior to placement of the adjacent course. Longitudinal joints with an existing asphalt pavement that is less than 32 hours old that has had its edge protected from damage may have adjacent new asphalt concrete placed after apply the required tack coat. After placement and finishing of longitudinal joints, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge when tested with the straightedge placed across the joint in any direction.

**321.8.3 Asphalt Leveling Course:** A leveling course shall be used when specified, or as directed in writing by the Engineer, to bring existing pavement to a uniform grade prior to placing an overlay or other course. If a leveling course is being applied on an Asphalt surface, a tack coat shall be applied. The compaction requirements contained in Subsection [321.10](#) do not apply to leveling courses.

**321.8.4 Compaction; Asphalt Base Course and Surface Course:** It is the Contractor's responsibility to perform Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the asphalt concrete immediately behind the laydown machine shall meet the minimum requirements of Table [321-2](#), unless WMA technology is being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. A probe type electronic thermometer with a current calibration sticker

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attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. The minimum temperatures in Table 321-2 do not guarantee that the asphalt mix will be compacted to the required density. The Contractor is responsible to achieve the required compaction.

<b>TABLE 321-2</b>						
<b>MINIMUM ASPHALT CONCRETE PLACEMENT TEMPERATURE</b>						
Base <sup>(1)</sup> Temp (°F)	Mat Thickness (inches)					
	1/2	3/4	1	1 1/2	2	3 and greater
40 – 50	---	---	310	300	285	275
50 – 60	---	310	300	295	280	270
60 – 70	310	300	290	285	275	265
70 – 80	300	290	285	280	270	265
80 – 90	290	280	270	270	265	260
+90	280	275	265	265	260	255

(1) Base on which mix is to be placed

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer’s recommendations and the project requirements. During the rolling operation, the speed of the roller shall not exceed 3 miles per hour, unless otherwise approved by the Engineer.

Pneumatic tired compactors shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the compaction process.

The Engineer will determine the acceptability of the pavement compaction in accordance with Subsection [321.10](#).

**321.8.5 Smoothness:** The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than one-fourth (¼) inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway.

**321.8.6 Asphalt Concrete Overlay:** Asphalt concrete overlay consists of the placing and compacting plant mix asphalt concrete over existing pavement. The mix design and thickness of the overlay shall be as shown on the plans or as specified in the special provisions. Asphalt concrete mix aggregate gradation and percentage of asphalt binder shall be in accordance with Table [321-3](#) using a D1/2” Marshall High or Low Volume mix designation for overlays.

Except when the existing asphalt surface is to be preheated and remixed, pavement surfaces shall be prepared as follows:

- (a) Areas designated for pavement repair by the contract documents (which may include severely raveled areas, severely cracked areas, over-asphalted areas, and other defects) shall be cut out and replaced. Pavement repairs shall be completed and approved before placing asphalt concrete overlay.
- (b) Before placing asphalt concrete overlay, milling shall be done as shown on the plans or specified in the special provisions and shall be in accordance with Section [317](#).
- (c) After pavement repairs and milling have been completed the entire surface shall be cleaned with a power broom.
- (d) After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat per Subsection [321.4](#). Traffic will not be permitted to travel over surfaces which have received a tack coat, except when tack coat is applied to milled surfaces in compliance with Subsection [317.2](#) for dust control purposes. When the overlay is to extend onto a concrete gutter, the gutter shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

Asphalt concrete overlay shall be placed as specified in Subsection [321.8.1](#) and compacted as specified in Subsection [321.8.4](#). The surface smoothness shall meet the tolerances specified in Subsection [321.8.5](#).

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Frames and covers of manholes, survey monuments, valve boxes, clean-outs and other existing structures shall be adjusted in accordance with Section [345](#) to set flush with the finished surface of the new pavement. During adjustment if pavement or base materials are removed or disturbed, they shall be replaced with approved materials installed in a manner acceptable to the Engineer.

On roads without curb and gutter, the existing unpaved shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of the new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Subsection [301.3](#). Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of shoulder adjustment shall be included in the price paid for the asphalt concrete overlay or other related pay items. When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional material. Acceptable material for shoulders includes the existing shoulder material, millings, untreated base materials, or a granular material approved by the Engineer. Engineer requested imported material for shoulder adjustment is not included in the price paid for the asphalt concrete overlay.

**321.8.7 Pavement Fabric Interlayer:** Pavement fabric interlayer shall be used only when specified on the plans or in the specifications.

Pavement fabric interlayer shall be in accordance with Table [796-1](#) and be the class designated on the plans or in the specifications.

Asphalt binder coat used to bond the fabric to the pavement shall be paving asphalt PG 70-10 asphalt cement conforming to the requirements of Section [711](#). The application and distributing equipment for the asphalt binder shall conform to the requirements of Section [330](#). The asphalt binder coat shall be uniformly spray applied to the prepared pavement surface at the rate of 0.20 gallons per square yard for Class B fabric or at the rate of 0.25 gallons per square yard for Class A fabric. Some underlying surfaces may require a higher or lower application rate. A test strip may be necessary to determine the proper application rate. The width of liquid asphalt cement application shall be the fabric width, plus six inches.

Neither the asphalt binder coat or fabric interlayer shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. The asphalt binder and fabric interlayer shall only be placed when the pavement is dry, the ambient air temperature is 50 degrees F and rising, and pavement temperature is 40 degrees F and rising.

Equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment shall be able to lay the fabric smoothly to maximize pavement contact and remove air bubbles. Stiff bristle brooms shall be used to smooth the fabric. The equipment used to place the fabric shall be in good working order and is subject to approval by the Engineer.

Pavement fabric interlayer shall not be placed if the in-place binder is hotter than 325 degrees F or has cooled to 180 degrees F or below (as determined by non-contact thermometer).

Pavement fabric interlayer shall be placed onto the asphaltic binder with the heat bonded side up with a minimum amount of wrinkling or folding. Remaining wrinkles or folds 1-inch and larger shall be removed or slit and shingle-lapped in the direction of paving. Burning or torching of wrinkles is not allowed. Fabric shall overlap three to six inches to insure full closure of the joint. Transverse joints shall be shingle-lapped in the direction of paving to prevent edge pickup by the paver. A second application of hand-placed asphalt binder may be required at laps and repairs as determined by the Engineer to ensure proper binding of the narrow double fabric layer.

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All areas where fabric has been placed shall be paved with asphaltic concrete during the same workshift. Placement of the asphaltic concrete shall closely follow fabric lay down. The temperature of the asphaltic concrete immediately behind the laydown machine shall not exceed 325 degrees F, unless modified by the WMA technology being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. In the event that the asphalt binder coat bleeds through the fabric causing construction problems before the overlay is placed, the affected areas shall be sanded with a sand blotter in compliance with Section [333](#). Excess sand shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphaltic concrete, the fabric shall be allowed to dry before the asphalt concrete is placed.

Turning of the paving machine or of other vehicles on the fabric shall be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. Decrease of binder rate in order to minimize pick-up on tires is not allowed.

**321.8.8 Thickened Edge:** When the depth of the thickened edge extends four inches or more below the bottom of the asphalt pavement, the portion of the thickened edge extending below the asphalt pavement shall be placed and compacted prior to placement of the asphalt pavement. Placement of tack coat on the surface of the compacted thickened edge asphalt may be omitted when additional asphalt pavement is placed on the same day and the Engineer agrees that the surface of the thickened edge asphalt has remained clean.

When the depth of the thickened edge extends less than four inches below the bottom of the asphalt pavement, the portion below the asphalt pavement may be placed and compacted with the asphalt pavement in a single operation.

**321.8.9 Safety Edge:** The finished safety edge slope shall be planar forming a  $30^{\circ} \pm 5^{\circ}$  angle with the adjacent roadway surface and extend a minimum of five inches (5") below the roadway pavement's finished surface.

The safety edge shall be constructed with the top or final paving lift of a new pavement or overlay using a device that is mounted to or is a part of the screed portion of the laydown machine. The safety edge device shall be capable of constraining the asphalt concrete material to increase density of the extruded profile by reducing the volume. A conventional single strike-off plate is not acceptable. Compaction obtained from the extruded safety edge shall be acceptable when the extruded shape conforms to the specified shape.

During laydown operations if the extruded safety edge does not conform to the specified shape, the Contractor shall take immediate actions to correct the deficiency and to repair all non-compliant sections of safety edge. The Contractor shall stop paving operations until corrections to the laydown operation have been made and resumption of paving is approved by the Engineer or his designated representative.

**321.8.10 Protection for Asphalt Base Course:** Arterial roadway traffic shall not be allowed on a new asphalt base course that is less than five inches (5") in thickness without written consent of the Engineer.

### **321.9 QUALITY CONTROL:**

It is the Contractor's responsibility to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required compaction and to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order the use of any drying, proportioning and mixing equipment or the handling of any material discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

The asphalt concrete produced shall conform to the requirements of the production tolerances established in Section [321.10](#). When the asphalt concrete does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency.

Requests for Referee Testing as described in [321.11](#) will only be considered based on quality control test results performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories for the set of tests in question. The laboratory shall use

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properly certified technicians to accordance with ASTM D3666, Section 7 (Personnel Qualifications).

### 321.10 ACCEPTANCE:

**321.10.1 Acceptance Criteria:** A City of Phoenix representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the asphalt concrete. The sampling frequency for hot asphalt concrete at the asphalt plant shall be 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix representative at the plant, asphalt concrete may be sampled at the same frequency taken from the project by a City of Phoenix designated representative or from the list of approved materials testing labs. The approved list is available through the City of Phoenix Materials Lab. The samples will be transported to the City of Phoenix Materials Lab or other designated laboratory for acceptance testing. All samples will be obtained according to the procedures of Arizona Test Method 104 or AASHTO T-168.

Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing. Each sample obtained for that day's production shall be tested for oil content utilizing a calibrated Nuclear Oil Content Gauge, according to AASHTO T287. If all the samples are within oil content tolerances, a random sample will be taken and further testing will be performed, this includes oil content with a calibrated ignition oven, gradation, marshall, rice, and air voids. However, if there is a sample outside of the tolerances for oil content, each specific failing Nuclear Oil Content sample will be tested. The selected sample(s) will be tested for oil content, utilizing an ignition oven, and gradation. Testing for marshall, rice, and air voids will be performed on each sample tested utilizing an ignition oven.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 95.0% of the Marshall density, from the specimens composed of the same mixture, and compacted in the laboratory by the 75-blow method of AASHTO T-245.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

**321.10.2 Gradation, Binder Content and Air Voids:** The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168. The minimum weight of the sample shall be of sufficient amount to provide enough material to meet all the testing requirements as determined by the engineer. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209. Effective voids of the laboratory compacted specimens will be determined at a minimum of once per day in accordance with the requirements of AASHTO T-269. Acceptance testing results will be furnished to those who request test results within five working days of receipt of samples by the acceptance laboratory.

During production, deviation of the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

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<b>TABLE 321-3</b>						
<b>ACCEPTANCE LIMITS FOR STANDARD COP MARSHALL MIX DESIGNS</b>						
<b>LOW AND HIGH VOLUME</b>						
	<b>A 1-1/2"</b>		<b>C3/4"</b>		<b>D 1/2"</b>	
<b>Sieve Size</b>	<b>Target</b>	<b>Tolerance</b>	<b>Target</b>	<b>Tolerance</b>	<b>Target</b>	<b>Tolerance</b>
<b>1 1/2"</b>	100	---	100	---	100	---
<b>1"</b>	93	+/-7%	100	---	100	---
<b>3/4"</b>	90	+/-7%	95	88-100	97-100	---
<b>1/2"</b>	---	---	85	+/-7%	88	+/-7%
<b>3/8"</b>	63	+/-7%	75	+/-7%	78	+/-7%
<b>No. 4</b>	45	+/-7%	58	+/-7%	58	+/-7%
<b>No. 8</b>	35	+/-5%	44	+/-5%	45	+/-5%
<b>No. 30</b>	20	+/-5%	24	+/-5%	25	+/-5%
<b>No. 200</b>	5	+/-2%	4	+/-2%	5	+/-2%
	<b>High Volume</b>	<b>Low Volume</b>	<b>High Volume</b>	<b>Low Volume</b>	<b>High Volume</b>	<b>Low Volume</b>
<b>Oil Content %</b>	4.3 +/- .4	---	5.0 +/- .4	5.5 +/- .4	5.1 +/- .4	5.6 +/- .4
<b>Air Voids % (Recommended)</b>	5.0 +/- 1.0	---	4.5 +/- 1.0	4.0 +/- 1.0	4.5 +/- 1.0	4.0 +/- 1.0
<b>Density (On Grade)</b>	95% Minimum of 75-Blow Marshall Density (For All COP Mix Designs)					

If the results from a single acceptance sample fall outside of the acceptance limits in Table 321-3, a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table 321-3.

If the asphalt binder content is within  $\pm 0.40\%$  of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than  $\pm 0.40\%$  from the mix design target value, the deficient area will be evaluated by coring at maximum intervals of 100 feet of either side from the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than  $\pm 0.40\%$  from the mix design target value, then Table 321-4 shall apply to the deficiency. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

<b>TABLE 321-4</b>		
<b>ASPHALT BINDER CONTENT PAYMENT REDUCTION (AC)</b>		
<b>Deviation from that permitted (Acceptance to the tenth of a percent)</b>	<b>When Contracting Agency is Owner: Payment Reduction (Percent dollar per ton asphalt concrete)</b>	<b>When Contracting Agency is Not Owner (Permit Work): Payment Reduction (Percent dollar per ton asphalt concrete)</b>
Over/Under 0.0 to 0.1%	10%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
Over/Under 0.1 to 0.2%	25%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

\*Additional permit and fee required for extended warranty.

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If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section [321.10](#), and specifically Tables [321-3](#) as applicable, and Table [321-4](#) from Section [321.10](#), when determining the acceptance of the asphalt concrete with the material supplier.

**321.10.3 Surface Testing:** If directed by the Engineer surface drainage test shall be performed. The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the Contractor and shall be acceptable to the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

**321.10.4 Asphalt Pavement Thickness:** The method of acceptance for pavement thickness will be determined by the engineer at any time. Coring may be required at the request of the engineer by accepted methods based on inspection practices and at the request of the engineer. If the thickness is determined to deviate from the specified thickness, four inch cores will be obtained for verification of the deficiency. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found at in Section [321.14](#). Each core location will be patched by the party responsible for the coring.

Acceptance or assessment of penalties for asphalt pavement thickness will be based on the combined total thickness of all asphalt concrete layers omitting all layers of asphalt-rubber asphalt concrete. If the final total pavement thickness exclusive of all ARAC layers is deficient from the target thickness by 0.25 inches or less, it will be paid for at the contract unit price.

If the pavement thickness deficiency is greater than 0.25 inches and the contracting agency is not the owner (i.e. permits) the following steps will apply:

- (1) If the thickness deficiency of the pavement exceeds 0.25 inch, the limits of the deficient area will be evaluated by coring at maximum intervals of 100 feet from the deficient core. The thicknesses of the original deficient core will be averaged with the thicknesses of the cores taken from 100 feet on each side of it to determine compliance with the acceptance requirements. If the resulting average thickness deficiency is greater than 0.25 inch, additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.
- (2) If the pavement thickness from step one above deviates from the target thickness by more than 0.25 inch but not more than 0.50 inch, corrective action will be required. This corrective action will consist of application of a Type II Slurry Seal or Micro Seal coat, as determined by the Engineer. The Contractor may present proposed remedial measures in writing for the consideration of the Engineer. The Engineer will review and decide within 30 working days whether to accept the proposed remedial measures.
- (3) If the pavement thickness from step one above deviates from the target thickness by more than 0.50 inch, corrective action will be required. The deficient area shall be overlaid with no less than a 1 inch thick lift, for the full width of the pavement to meet or exceed the designed thickness, with appropriate end and edge milling, with a mixture approved by the Engineer. The Contractor may present other proposed remedial measures for the Engineer's consideration. The Engineer will review and decide within 30 working days whether to accept the proposed remedial measures. If the Engineer chooses to reject the proposed remedial measures, the indicated overlay will be constructed by the Contractor at no additional cost to the Owner.

If the pavement thickness deficiency is greater than 0.25 inches, but less the 0.50 inches, Table [321-6](#) will apply.

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<b>TABLE 321-6</b>		
<b>ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION</b>		
<b>For Thickness Deficiency of More Than 0.25 inches and less than 0.50 inches</b>		
<b>Specified Pavement Thickness</b>	<b>When Contracting Agency is Owner: Reduction in Payment</b>	<b>When Contracting Agency is Not Owner (Permitted Work): Reduction in Payment</b>
		<b>*See note below</b>
2.00 inches to 2.49 inches	25%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
2.50 inches to 2.99 inches	33%	Extended Warranty for three years with posted bond for the value of the taper mill and overlay
3.00 inches and over	50%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay

\*Additional permit and fee required for extended warranty.

**321.10.5 Density:**

**321.10.5.1 Pavement 1-1/2 Inches or Less in Nominal Thickness:** Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor’s responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

**321.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness:** Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor’s responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

The Contractor will provide the traffic control to facilitate any coring operations necessary for compaction acceptance.

The Contractor shall repair all of the core holes high strength, no shrink grout. Sample cores shall follow Section [321.14](#). The frequency of testing will be determined by the City of Phoenix Materials Lab current minimum testing schedule, maintained by the City of Phoenix Materials Lab.

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<b>Table 321-8</b>		
<b>PAVEMENT DENSITY PAYMENT REDUCTION</b>		
<b>Deviation Below Specification</b>	<b>When Contracting Agency Owner: Reduction in Payment (Percent dollar per ton of asphalt concrete)</b>	<b>When Contracting Agency Not Owner (Permitted Work):</b>
94.0% to 94.9%	15%	<b>*See note below</b> Extended Warranty for three years with posted bond for the value of the taper mill and overlay
93.0% to 93.9%	20%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Below 93.0%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

\*Additional permit and fee required for extended warranty.

**321.11 REFEREE:**

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Engineer will select an independent and accredited materials lab from the City of Phoenix Contract Lab and Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

These tests may include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, maximum theoretical unit weight, laboratory air voids and density (compaction). Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Subsection [321.10](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the Contractor. The independent laboratory shall include a report sealed and signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

**321.12 MEASUREMENT:**

Asphalt concrete pavement will be measured by the ton, or by the square yard, for the mixture actually used as allowed above, which shall include the required quantities of mineral aggregates, asphalt binder, and mineral admixture. Measurement shall include any tonnage used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

**321.13 PAYMENT:**

The asphalt concrete measured as provided above will be paid for at the contract price per ton or square yard, as adjusted per Subsection [321.10](#), which price shall be full compensation for the item complete, as herein described and specified.

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

No payment will be made for any overrun in quantity of asphalt concrete in excess of 10 percent based on actual field measurement of area covered, design thickness, and the mix design unit weight. The calculations and payment for overrun

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will be by individual pay item. To compensate or adjust for a thickness deficiency in an underlying asphalt concrete course, the Engineer may authorize a quantity increase in excess of 10 percent for a subsequent asphalt concrete course. In such cases, the quantity in excess of 10 percent will be paid for at the lowest unit price.

Agency required repairs of existing pavement prior to roadway overlay operations will be paid for as a separate pay item.

Except as otherwise specified, no separate payment will be made for work necessary to construct miscellaneous items or surfaces of asphalt concrete.

### **321.14 ASPHALT CORE METHOD: Core Drilling of Hot Mix Asphalt (HMA) for Specimens of 4” or 6” diameter**

**321.14.1 Scope:** This method is to establish a consistent method of the use of a diamond bit core to recover specimens of 4 or 6 inch diameter for laboratory analysis and testing. The method will require the use of: water, ice (bagged or other suitable type), dry ice, and a water-soap solution to be utilized when coring asphalt rubber concrete. Individuals doing the specimen recovery should be observing all safety regulations from the equipment manufacturer as well as the required job site safety requirements for actions, and required personal protective equipment.

**321.14.2 Core Drilling Device:** The core drilling device will be powered by an electrical motor, or by an acceptable gasoline engine. Either device used shall be capable of applying enough effective rotational velocity to secure a drilled specimen. The specimen shall be cored perpendicularly to the surface of pavement, and that the sides of the core are cut in a manner to minimize sample distortion or damage. The machinery utilized for the procedure shall be on a mounted base, have a geared column and carriage that will permit the application of variable pressure to the core head and carriage throughout the entire drilling operation. The carriage and column apparatus shall be securely attached to the base of the apparatus; and the base will be secured with a mechanical fastener or held in place by the body weight of the operator. The core drilling apparatus shall be equipped with a water spindle to allow water to be introduced inside of the drill stem while operating. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with embedded diamond chips in the cutting surface. The core barrel shall be of sufficient diameter to secure a specimen that is a minimum of four or six inches or whichever is prescribed for necessary testing. The core barrel shall not be missing more than one of the teeth used for cutting; if so it shall be discarded and another barrel shall be used. The core barrel shall also be a minimum of two inches longer than the anticipated depth of pavement in accordance with project paving plans.

**321.14.3 Accessory Equipment:** A sufficient supply of ice and dry ice shall be provided to sufficiently cool the pavement prior to securing the samples from the designated areas in the pavement. The ice should also be used to adjust the temperature of the water used to cool the core bit. A water supply (usually a plastic 35 – 55 gal drum) with sufficient hose to introduce the water into and through the spindle of the coring device by gravity feed. The drum should be white or light in color to minimize excessive thermal heating of the water (*see Note 1 for coring of asphalt rubber*). At no time shall the water utilized in the coring operation exceed 65° F during the coring operation. Ice shall be utilized to ensure the temperature control of the water being introduced during the cutting operation. An ice chest or other suitably insulated container that can maintain a temperature of less than 70° F shall be used to secure the specimens during transport. The container will be equipped with flat shelving that will support the drilled cores throughout the entire specimen dimension during transport back to the testing facility.

Miscellaneous hand tools to remove the drilled specimen from the drill hole or the core barrel taking great care in not disturbing the specimen more than necessary (refer to fig. 1 in ASTM D5361-05).

**321.14.4 Process:** The pavement surface at the time of coring shall not exceed a temperature of 90° F; the pavement shall be conditioned with ice or dry ice to ensure that this requirement is met. Immediately after it has been ensured that the pavement has dropped to the required temperature, core drilling shall begin. The operator will then apply an even and continuous pressure (*see Note 2*) to penetrate through the full depth of the pavement. The operator will concurrently ensure that enough water is moving over the core surface as to adequately remove any and all cuttings that could damage the drilled core. After the pavement thickness has been penetrated the core shall be carefully removed from either the drill hole or the core barrel and be immediately transferred to an ice chest or other suitable container. Each individual core shall be placed on a shelf in the cooler with the exposed side of the specimen facing down, or the “top side” down. If the specimen is a two lift core, the only acceptable means of separating lifts is with a power or other acceptable wet saw type of equipment (conforming to ASTM D5361); however, at no time shall cores be split using a mallet and screwdriver or metal straight edge when being tested for bulk density. Perpendicularity of the specimen shall be checked in the field after the specimen has been extracted from the surface. The core operator shall hold the core up to eye level and place the core top side down in a “speed

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square” or small carpenters square. The specimen placed in the square shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). If the specimen is outside of this distance from square it shall be discarded in the field and another sample cored that falls within tolerance. The cores upon arriving at the laboratory for testing shall be carefully cleaned and measured for thickness in accordance with ASTM D3549. A speed square shall be utilized to measure perpendicularity as compared to a 90° degree angle and shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). All remaining testing shall be done within the parameters of the current project and / or agency required specification.

*- End of Section -*

Note 1 – It should be noted that when the material to be cored is a rubberized asphalt mixture a wetting agent such as liquid dish soap shall be added to the water barrel to hinder the material from sticking or allowing the binder to spread during coring.

Note 2 – This refers to pressure exerted on the core barrel and machine during the coring process. Too much pressure can cause damage to the core barrel and the motor; and too little pressure can cause a glazing of the diamonds, reducing cutting efficiency and premature wear of the barrel.

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### PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

#### 324.1 DESCRIPTION:

This item shall consist of construction of a pavement composed of plain jointed portland cement concrete on a prepared subgrade. The Contractor shall furnish all labor, materials and equipment necessary for the construction of the pavement in accordance with these specifications and in reasonably close conformity to the lines, grades, thicknesses and details indicated by the plans or as established by the Engineer. All tests shall be performed by a laboratory approved by the Engineer.

#### 324.2 MATERIALS:

**324.2.1 Portland Cement Concrete:** Portland cement concrete shall conform to the applicable requirements of Section [725](#) and the additional requirements of this Section.

Concrete shall conform to the applicable requirements of Section [725](#) and the additional requirements of this Section.

Concrete shall comply with Table [725-1](#) for Class AA, 4000 psi unless otherwise specified by the Engineer.

The maximum concrete slump shall be as determined by the approved mix design in accordance with Subsection [725.9\(A\)\(1\)](#).

**324.2.2 Reinforcement:** Tie bars shall be deformed billet steel reinforcing bars conforming to the requirements of ASTM A615, Grade 40.

Dowel or load transfer bars shall conform to the requirements of ASTM A615, Grade 40.

An approved support system shall be used to hold bars in position.

**324.2.3 Curing Materials:** Materials for curing concrete shall conform to the requirements of Section [726](#).

**324.2.4 Joint Materials:** Joint sealant shall be poured type, conforming to the requirements of Subsection [729.2](#) or as approved by the Engineer.

Preformed expansion joint filler shall conform to the requirements of Subsection [729.1](#) or as approved by the Engineer.

#### 324.3 CONSTRUCTION METHODS:

**324.3.1 General:** Pavement shall be constructed with mechanical equipment utilizing stationary side forms or by the use of slipform paving equipment without stationary side forms. Manual methods of placing and finishing concrete with stationary side forms may be permitted by the Engineer for areas inaccessible for mechanical equipment.

All curbs and gutters shall have the same Class of concrete as the adjacent PCCP. Gutter sections shall have the same thickness as the PCCP section. All curbs or combined curb and gutter joints shall align with roadway joints.

**324.3.2 Equipment:** Design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer. Equipment shall be at the jobsite sufficiently ahead of the start of concrete paving operations to permit thorough examination and approval by the Engineer prior to start of concrete paving.

Equipment used to place concrete may consist of one or more machines, shall be capable of uniformly distributing and consolidating the concrete as it is placed without segregation and shall be capable of producing concrete pavement which will conform to the required cross-section with a minimum of hand work. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to the concrete delivery rate.

Vibrators shall be used to consolidate concrete; the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and not less than 8,000 cycles per minute for internal vibrators. Power to vibrators mounted on mechanical

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equipment shall be so connected that vibration ceases when forward or backward motion of the machine is stopped. Contractor shall furnish a tachometer or other suitable device for measuring and indicating the frequency of vibration.

Slipform pavers shall be equipped with high frequency internal vibrators mounted with axes either parallel or normal to pavement alignment for the full paving width. Vibrators mounted with axes parallel with pavement alignment shall be spaced at intervals not to exceed 24 inches, measured center-to-center. Vibrators mounted with axes normal to pavement alignment shall be spaced so that lateral clearance between individual vibrating units does not exceed 6 inches.

Slipform paving equipment which will be wholly or partially supported on subgrade shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete at free edges laterally for a sufficient length of time during placement to produce pavement of the required cross-section, and shall be equipped and operate with automatic sensing and control devices such that the machine automatically senses deviations from the established guideline and performs the necessary corrective maneuvers to overcome variations from correct grade and alignment.

When concrete will be placed adjacent to existing pavement or curb and gutter, that part of the equipment supported on the existing pavement or curb and gutter shall be equipped with protective pads on crawler tracks or rubber-tired wheels with bearing surfaces offset a sufficient distance from the edge of the pavement or curb and gutter to avoid edge damage, or the surface of the existing pavement or curb and gutter shall be otherwise protected against such damage in a manner approved by the Engineer.

**324.3.3 Subgrade and Base Preparation:** Subgrade and base shall conform to the applicable compaction requirements and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and deleterious material when concrete is placed.

The surface of the subgrade shall be uniformly moist when concrete is placed. The surface of the subgrade shall be moistened immediately prior to placement of concrete if necessary to produce a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

**324.3.4 Stationary Side Forms and Setting of Forms:** Side form sections shall be straight, free from warps, bends, indentations or other defects. Side forms shall be of metal, have a base width of at least four inches and a minimum depth equal to the thickness of the pavement. No section shall show a variation from a true plane greater than 1/8 inch in ten feet on the top of the form or more than 1/4 inch in ten feet on the inside face. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Suitable materials other than metal may be used to form end closures or at other locations where use of metal forms is not practical. Forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be of such cross-section and strength and so secured and supported on the subgrade as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they are to support without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

Subgrade under forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be so supported and secured during the entire operation of placing and finishing that they will not deviate vertically at any point more than 1/8 inch from the proper elevation. Forms shall be set to the required lines and grades well in advance and for a distance sufficient to prevent delay in placing concrete, and shall be approved by the Engineer prior to placing concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

Side forms shall remain in place until the day after placing concrete, and in all cases until the edge of the pavement no longer requires the protection of the forms. Forms shall be carefully removed in such a manner as to avoid damage to the pavement. Use of pry bars between the pavement and the forms will not be permitted.

**324.3.5 Placing, Spreading and Compacting:** Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompact. Except when otherwise approved by the Engineer, concrete shall be deposited on the subgrade and spread full width using mechanical methods that result in minimal handling and segregation.

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Necessary hand spreading shall be done with shovels, not rakes. Placement shall be continuous between transverse joints without the use of intermediate bulkheads.

The Contractor shall make adequate advance arrangements for preventing delay in delivery and placing of concrete. An interval of more than 15 minutes between placing of any two consecutive batches shall constitute cause for stopping operations, and Contractor shall remove all concrete placed beyond the last scheduled joint or install a joint of the type and at the location as directed by the Engineer.

Concrete shall be deposited as near to expansion and construction joints as possible without disturbing them but shall not be dumped onto a joint assembly. Concrete shall be thoroughly consolidated against and along the faces of all forms, adjacent pavement or curb and gutter, and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with joint assemblies, the grade, or side forms, and shall not be operated longer than 15 seconds in any one location.

Manual methods of placing, spreading, and compacting may be used in the construction of pavement lanes of irregular width or widths less than 10 feet, and sections of intersections or other locations with complex variable surface configurations when permitted by the Engineer. Workmen shall not be allowed to walk in the freshly placed concrete.

**324.3.6 Shaping and Initial Finishing:** Concrete shall be struck off, consolidated, and float-finished with a slipform paver, mechanical finishing machine, vibrating screed, or by hand finishing methods when approved by the Engineer so that the complete pavement will conform to the thickness and cross section requirements of the plans and specifications. When the pavement being constructed is contiguous to existing parallel concrete pavement or curb and gutter, the elevation of the new pavement surface shall conform as closely as possible to the elevation of the existing pavement or gutter surface in a manner which will prevent ponding. The difference in elevation shall not exceed 1/4 inch.

Water shall not be applied to the pavement surface during screeding and finishing operations in excess of the amount lost by evaporation. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted. When applications of water to the surface are required to prevent rapid evaporation of water from the surface during finishing operations, it shall be applied as a fog spray and with approved spray equipment.

**324.3.6.1 Slipform Supported on Subgrade Method:** When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and the slipform paver track area shall be brought to proper grade and cross section by means of a properly designed and operated machine. The equipment shall spread, consolidate, screed and float-finish the concrete in one complete pass of the machine. The machine shall be operated with as nearly a continuous forward movement as possible and all paving operations shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. Sliding side forms shall be rigidly held together to prevent spreading. Any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch shall be corrected.

No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed 1 inch from the alignment established by the Engineer.

While concrete is being spread, compacted and shaped, vibrating units shall be operated within fresh concrete so that the longitudinal axis, at the center of each unit, is not more than 6 inches above the top of the subgrade. Amplitude of vibration shall be sufficient to be perceptible on the surface of concrete along the entire length of vibrating units and for a distance of at least one foot.

**324.3.6.2 Mechanical Equipment Supported on Fixed Form Method:** When concrete is spread without the use of internal vibration, the finishing machine shall be equipped with vibrating equipment that will internally vibrate the concrete for the full paving width and with not less than two oscillating or reciprocating screeds. Concrete shall be struck off and consolidated so that the surface will conform to the finished grade and cross section shown on the project plans and with sufficient material on the surface for floating operations.

After the concrete has been struck off and consolidated, it shall be floated with a longitudinal float of a type approved by the Engineer.

A slipform paver or a single machine which will effectively spread, consolidate, screed, and float in one operation may be used in lieu of separate finishing and floating equipment.

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**324.3.6.3 Manual Methods with Fixed Forms:** Concrete shall be deposited, spread and struck off to such an elevation that, when properly consolidated, the surface will conform to the required lines and grades. Concrete shall be consolidated by internal vibration as it is struck off with a screed. A slight excess of concrete shall be kept in front of the screed at all times during the strike-off operation.

After consolidation and screeding, concrete shall be tamped to the proper surface elevation and cross-section using either a heavy plank with a length in excess of the width of pavement being placed by one foot or more, or with a mechanical vibrating unit spanning the full width between forms. The tamping plank, if used, shall be stiffened as necessary to prevent sag and shall have the lower tamping edge shod with metal. The tamping plank shall be moved forward with a combined vertical tamping and longitudinal screeding motion so that the concrete will be thoroughly consolidated and the surface screeded to the required elevation. A small surplus of concrete shall be kept in front of the tamper or vibrating unit. Tamping or vibrating shall continue until the specified cross-section is obtained and the mortar flushed slightly to the surface. On grades in excess of 5 percent a second strike board shall follow from 25 to 50 feet behind the tamper or vibrating unit and shall be used in the same manner to remove waves caused by the flow of concrete behind the first strike board.

Methods other than the tamping plank may be utilized for screeding when approved by the Engineer.

Pavement shall be finished smooth and true to grade with suitable manually operated floats or powered finishing equipment.

**324.3.7 Final Finishing:** After the pavement has been float finished, it shall be scraped with a 10-foot long straightedge equipped with a handle to permit operations from the edge of the pavement, and excess water and laitance shall be removed from the surface. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half length after each pass. Irregularities shall be corrected by adding or removing concrete, and disturbed places shall be again straight-edged.

Long-handled floats shall be used only in areas not accessible to finishing equipment and in emergencies, and use of such floats shall be confined to a minimum.

The addition of water to the surface of the concrete to assist in finishing operations shall not be permitted unless approved by the Engineer. When the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted when applied as a fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the manufacturer's recommendations. When either of these methods is approved and used it does not take the place of proper curing methods per Subsection [324.3.8](#).

Pavement edges and joints shall be edged in accordance with details shown on the project plans or as directed by the Engineer.

In advance of curing operations, pavement shall be textured. Texturing shall be performed with an artificial turf drag with a board added to assure the weight needed to obtain an approved surface. Artificial turf shall be a molded composite structure with polyethylene face, nylon and polyester backing, a pile height of 0.85 inches, and total weight of 75 oz. /sq. yd. The surface obtained during initial surface texturing shall be subject to approval by the Engineer. The texturing approval on the initial construction shall not be changed without the Engineer's approval. Each time the construction is stopped or cause the texturing to stop, the artificial turf must be shaken clean before continuing.

**324.3.8 Curing:** Curing shall begin immediately following surface texturing and edging. Before concrete placement begins, the Contractor shall have at hand and ready to install the materials and equipment needed for adequate curing.

After finishing operations have been completed, the newly placed concrete shall be cured by moist curing methods, by application of a white pigmented liquid membrane compound conforming to the requirements of Section [726](#), or by a combination of these methods. All surfaces not covered by reasonably waterproof forms shall be kept damp by applying water with a nozzle that so atomizes the flow of water that a fog mist and not a spray is formed until the surface is covered with liquid membrane compound, the surface has hardened sufficiently to permit sprinkling of the surface, or moist curing by covering with wet burlap or other approved materials can be initiated. Moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a

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flow and erode the surface. Moist curing shall be continued until liquid membrane curing compound or other type of curing membrane is applied.

Membrane curing compound shall be applied to all pavement by automatic mechanical method from a construction bridge.

The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these exposed surfaces with continuous curing treatment equal to the method selected for curing the pavement surface.

The membrane method of curing may be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the rate of one gallon per 100 square feet, or as otherwise recommended by the manufacturer, shall be required. Compound shall be kept agitated to prevent pigment from settling.

### **324.3.9 Joints:**

**324.3.9.1 General:** Joints shall be provided in the pavement of the type, dimensions and at the locations as indicated in the plans or as specified herein.

Joints in concrete pavement will be designated as transverse expansion joints, longitudinal or transverse construction joints, longitudinal or transverse weakened plane joints, or isolation joints. The faces of all joints shall be perpendicular to the pavement surface. Joints shall be constructed in accordance with the details shown or referenced in the plans and in accordance with the following provisions.

At all times prior to acceptance of the construction, joints shall be maintained clean and free of soil, gravel, and other foreign material except approved types of joint filler materials.

**324.3.9.2 Longitudinal Joints:** Longitudinal joints shall be weakened plane or construction joints. Longitudinal weakened plane joints shall be constructed by sawing or by insertion of a parting strip in the plastic concrete to be left in place. Longitudinal construction joints shall be constructed with tie bars or keyways as indicated in the plans.

**324.3.9.3 Transverse Joints:** Transverse joints shall be weakened plane, construction or expansion joints. All transverse weakened plane joints will be constructed by sawing and in accordance with the details shown in the project plans. Transverse construction joints shall be constructed in accordance with the details shown or referenced in the project plans. Transverse expansion joints shall be constructed in accordance with the details shown or referenced in the project plans.

Dowel bars, when required, shall be supported with an approved support system.

**324.3.9.4 Joint Location:** Longitudinal and transverse joints shall be constructed at locations as indicated in the project plans.

Isolation joints shall be provided around manholes, catch basins, or other elements which extend into or project through the pavement and act as point of restraint to horizontal or vertical movement of the pavement. Isolation joints shall be located in accordance with MAG Standard Detail 224 or as directed by the Engineer.

### **324.3.9.5 Construction of Joints:**

**324.3.9.5.1 Sawed Joints:** Sawed joints shall be constructed by cutting a groove in the pavement using a single or multiple-blade power saw. The groove shall be cut to the dimensions shown on the project plans. Suitable guidelines or devices shall be used to ensure joints are cut true to the lines as shown on the project plans.

If joints are sawed in stages, the initial saw cut shall be of the minimum width specified and sawed to the required depth. The depth of the initial saw cut in the construction of weakened plane joints shall be a minimum of 1/4 of slab thickness.

Sawing of weakened plane joints shall be done before uncontrolled cracking takes place, and after the concrete has hardened to the extent that tearing or raveling of the edges of the saw cut is not excessive. The exact time for all sawing shall be determined by the Contractor when not otherwise specified.

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Any procedure for sawing joints that result in premature, uncontrolled cracking shall be revised immediately. The Contractor shall be responsible for replacing or repairing areas containing uncontrolled cracking and for repairing spalled or chipped concrete along the edges of sawed joints to the satisfaction of the Engineer.

After saw cutting of the joint and just prior to sealing the joint, the internal joint surfaces shall be cleaned of all dirt, curing compound residue, laitance and other foreign materials. The internal joint surface shall be defined as the sawed portion of the joint and the resultant crack for the full depth of the pavement.

Sealing of sawed joints, where required, shall be completed prior to the opening of the pavement to traffic unless otherwise approved by the Engineer. When delayed sealing of sawed joints is permitted, saw cuts and formed recess to be filled with sealant shall be protected to ensure thorough curing of the concrete along the edges of the joint recesses and to prevent entry of foreign materials into the joint. At the Contractor's option, inert compressible joint filler material such as plastic backer rod or upholstery cord may be inserted into joints immediately after sawing or forming of the joint recess to provide curing protection and prevent entry of foreign material. If absorptive filler material is used, it shall be thoroughly moistened either before or immediately after installation in the sawed groove. When filler material is rope, or similar material which does not fill the entire depth of sawed groove, it shall be depressed not less than ½ inch below the pavement surface before the pavement is opened to traffic.

**324.3.9.5.2 Expansion and Construction Joints:** Longitudinal and transverse expansion and construction joints shall be as required by the project plans.

**324.3.9.5.3 Isolation Joints:** Isolation joints, unless otherwise detailed in the construction documents, shall be 1/2 inch wide expansion joints in accordance with MAG Standard Detail 224 or as directed by the Engineer.

**324.3.9.5.4 Sealing of Joints:** Sealant shall be applied in accordance with the sealant manufacturer's recommendations. A primer shall be furnished and applied after the joint has been cleaned and prepared to receive sealant when indicated in the manufacturer's recommendations.

Prior to the application of the sealant, an approved type of inert, compressible joint filler material such as plastic backer rod or upholstery cord, or an approved type of bond breaker, shall be inserted along the joint in accordance with the details shown on the project plans. The joint shall then be filled with sealant to a level not less than 1/8 inch or more than 1/4 inch below the elevation of the pavement surface adjacent to the joint edge.

The equipment used to apply sealant shall be as recommended by the sealant manufacturer. Sealant shall not be spilled on the surface of the concrete pavement, and Contractor shall remove any sealant inadvertently spilled on the pavement surface.

**324.3.9.5.5 Repair of Cracks, Spalls, Raveling and Tearing:** Contractor shall be responsible for replacing or repairing all areas of pavement containing uncontrolled cracking, surface spalls, or other types of surface defects. Repairs, when authorized, shall be made and completed by methods acceptable to the Engineer.

### 324.4 TESTS OF FINISHED PAVEMENT:

**324.4.1 Smoothness:** The pavement surface, including pavement in intersections, will be tested with a ten-foot straight-edge placed parallel to the centerline of the pavement in each lane. Ordinates measured from the face of the straight-edge to pavement surface shall at no place exceed one-quarter inch. Areas that do not meet the required surface accuracy as determined by straight-edge testing shall be marked, and Contractor shall at his own expense and as required by the Engineer either:

- (1) Grind down areas higher than 1/4 inch but not more than 1/2 inch above the correct surface.
- (2) Correct areas lower than 1/4 inch but not lower than 1/2 inch below the correct surface by grinding down the adjacent areas.
- (3) Remove and replace pavement when the deviation exceeds 1/2 inch from the correct surface. Area replaced shall be of a length, width and depth as required to allow formation of a new slab of the required quality. The area replaced shall be compatible with the joint layout shown on the project plans as determined by the Engineer.

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After grinding, the finished surface of the ground area shall be provided with a uniform texture acceptable to the Engineer. The method of texturing shall be approved by the Engineer.

**324.4.2 Pavement Thickness:** Concrete pavement shall be constructed in accordance with the thickness requirements of the plans and specifications. Tolerances for base and subgrade construction and other provisions of these specifications which may affect thickness shall not be construed to modify such thickness requirements.

Pavement thickness testing shall begin after achieving pavement smoothness compliance. For the purpose of determining acceptability for thickness, cores shall be drilled by the Contractor at the locations specified by the Engineer. Cores shall have a minimum diameter of four inches. Length of cores will be determined in accordance with the requirements of AASHTO T 148.

In calculating average length, cores which have a length in excess of the thickness specified by more than 0.25 of an inch will be deemed to have a length of the specified thickness plus 0.25 of an inch. Field length measurements will be acceptable in lieu of average length measurement in accordance with the requirements of AASHTO T 148, provided the original core in any secondary unit meets or exceeds the specified thickness. Measurements in accordance with the requirements of AASHTO T 148 will be required on any questionable thickness measurements and on the three cores used to determine the average length for payment, regardless of length.

A primary unit of pavement shall be the area of pavement placed in each day's paving operation. Each intersection or special section shall be considered as a primary unit.

A secondary unit of pavement shall consist of 1,000 linear feet, or fraction thereof, of each traffic lane. Each 1,300 square yards of pavement in intersections, etc., shall be considered a secondary unit regardless of when the concrete was placed.

One core shall be drilled in each secondary unit. If the length of that core is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the length of that core is deficient by more than 0.25 of an inch but less than 1.0 inch, two additional cores shall be drilled within that secondary unit and the length of the three cores averaged. If the average length is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the average length of the three cores is deficient by more than 0.25 of an inch, that secondary unit will be measured for payment in accordance with the requirements of Table [324-1](#).

If the core in the secondary unit is deficient by more than 1.00 inch, that core will not be used in determining the average thickness of that secondary unit. Additional cores shall be drilled at intervals not to exceed ten feet in each direction from the deficient core, parallel to the main-line centerline, until one core is obtained in each direction which is not deficient by more than 1.00 inch. The pavement between these two cores will be evaluated separately from the balance of the pavement in that secondary unit. The limits for evaluation shall be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, it shall be removed and replaced with pavement of the specified thickness and no payment will be made for the removal pavement.

If the pavement in the deficient area is removed, either by the order of the Engineer or at the option of the Contractor, it shall be removed between the limits of the evaluation. After the pavement has been replaced, one core shall be drilled at random in that secondary unit after deducting the area of the replaced pavement and one core shall be drilled in the new pavement. Pavement represented by the core drilled in the secondary unit, less the replaced pavement, will be measured for payment as hereinbefore specified. The core drilled in the replaced pavement shall be not less than the specified thickness; otherwise that pavement will not be measured or paid for.

At all locations where cores have been drilled, the resulting holes shall be filled with concrete in a manner satisfactory to the Engineer.

### **324.5 PROTECTION OF PAVEMENT:**

The Contractor shall be responsible for taking adequate steps to protect concrete placed during rain, hot or cold weather as defined in ACI Standards. Any concrete damaged by rain or extreme temperatures shall be removed and replaced at the Contractor's expense.

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When ordered by the Engineer, pavement crossings shall be constructed for the convenience of public traffic. Where motor vehicles are encountered, a temporary bridge to span the newly placed concrete will be provided.

No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement until the concrete has developed a compressive strength of 3500 psi.

Equipment for sawing joints will be permitted on the pavement when, in the Contractor's judgment, the concrete has developed sufficient strength to support the equipment without damage to the concrete. In case of visible cracking or other damage to the pavement, operation of the equipment on the pavement shall be immediately discontinued.

Any damage to the pavement resulting from early use of pavement by the Contractor's equipment shall be repaired by the Contractor at his expense.

### 324.6 METHOD OF MEASUREMENT:

Portland cement concrete pavement will be measured by the square yard. Any opening in excess of one square yard will not be measured for payment.

### 324.7 BASIS OF PAYMENT:

The accepted quantities of portland cement concrete pavement, measured as provided for herein, will be paid for at the contract unit price complete in place, except that where the average length of cores indicates pavement deficient in thickness by more than 0.25 of an inch but not more than 1.00 inch, payment will be made as specified in Table [324-1](#). Payment will be made to the nearest cent.

No additional payment will be allowed for pavement constructed in excess of the thickness specified on the project plans.

<b>TABLE 324-1</b>	
<b>PAVEMENT THICKNESS PAYMENT REDUCTION (PCCP)</b>	
<b>Core Thickness, Less Than Specified Thickness, Inches</b>	<b>Percent of Contract Unit Price Allowed</b>
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	63
0.76 to 1.00	50

*- End of Section -*

## SECTION 325

### PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

#### 325.1 DESCRIPTION:

Asphalt-rubber asphalt concrete (ARAC) consists of supplying, placing and compaction of plant-mixed, gap-graded ARAC over asphalt surfaces. The thickness of the finished ARAC overlay shall be within the range of one to two inches as shown on the plans or as specified in the special provisions.

#### 325.2 MATERIALS:

ARAC shall consist of a mixture of aggregate, mineral admixture and asphalt-rubber binder (ARB) as specified in Section [717](#).

**325.2.1 Mixing of Asphalt-Rubber Binder:** Mixing of asphalt-rubber binder (ARB) may take place in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility. In either case, the temperature of the asphalt cement shall be between 375° F and 425° F prior to the addition of crumb rubber. No agglomerations of crumb rubber particles in excess of 2 inches in the least dimension shall be allowed in the mixing chamber. The crumb rubber and asphalt cement shall be accurately proportioned in accordance with the ARB design, as identified in Section [717](#) and thoroughly mixed prior to the beginning of the one hour reaction period. Reaction time may be decreased to 45-minutes if documentation is provided that the physical properties of the mix design requirements are consistently met using a 45-minute reaction period. The Contractor or supplier shall document that the proportions are accurate and that the crumb rubber has been uniformly incorporated into the mixture. Additionally, the Contractor or supplier shall demonstrate that the crumb rubber particles have been thoroughly mixed into the base asphalt cement. The occurrence of crumb rubber floating on the surface or agglomerations of crumb rubber particles shall be evidence of insufficient mixing. The temperature of the ARB immediately after mixing shall be between 350° F and 400° F. Reaction time shall start after all of the material for the batch has been mixed and the minimum reaction temperature of 350° F has been achieved.

Prior to use, the viscosity of the ARB shall be tested by the use of a rotational viscometer, which is to be furnished by the Contractor or supplier. The Contractor or supplier shall provide a qualified person to perform the testing.

**325.2.2 Handling of ARB:** Once the ARB has been mixed, it shall be kept thoroughly agitated during periods of transport and use to prevent settling of the crumb rubber particles. During the production of ARAC the temperature of the ARB shall be maintained between 325° F (163°C) and 400° F (204°C). However, in no case shall the ARB be held for more than 10 hours at these temperatures. It may be allowed to cool to a temperature of 250° F (121°C) or lower and held at that temperature for not more than four days. The process of cooling and reheating shall not be allowed more than one time for a batch of ARB.

For each load or batch of ARB, the Contractor or supplier shall provide the Engineer with the following documentation:

- (A) The source, grade, amount and temperature of the asphalt cement prior to the addition of crumb rubber.
- (B) The source, type and amount of crumb rubber and the rubber content expressed as percent by the weight of total ARB.
- (C) Times and dates of the crumb rubber additions, resultant viscosity test, and the elapsed reaction time at which the viscosity test was taken.
- (D) A record of the temperature, with time and date reference for each load or batch. The record shall begin at the time of the addition of crumb rubber and continue until the load or batch is completely used. Readings and recordings shall be made at every temperature change in excess of 20° F, and as needed to document other events which are significant to batch use and quality.

#### 325.3 WEATHER AND MOISTURE CONDITIONS:

ARAC shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 55° F or higher. No ARAC shall be placed when the weather is foggy or rainy. ARAC shall be placed only when the Engineer determines that weather conditions are suitable.

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### 325.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of ARAC prior to the placing of a succeeding lift of ARAC. The tack coat may be deleted when a succeeding layer of ARAC is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1h or CSS-1h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

### 325.5 MIX PRODUCTION:

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weigh belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the ARAC production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The introduction of ARB shall be controlled by an automated system fully integrated with the controls for the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the aggregate or mineral admixture from becoming coated with un-spent fuel. The completed ARAC may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the ARAC, with unmodified binders, upon discharge from the mixer shall not exceed 350° F. The discharge temperature may be increased, when approved by the Engineer. If the ARAC is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the ARAC will be minimized.

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### 325.6 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

### 325.7 PLACEMENT:

#### 325.7.1 Surface Preparation:

Before placing ARAC on existing pavements, severely raveled areas or cracked areas that are depressed more than 3/4" from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted (bleeding or flushing) areas or rough high spots shall be removed by burning or blading. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the Engineer. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above surface cleaning requirements are included as part of the ARAC paving operations, and the cost thereof shall be included in the ARAC pay item. Pavement repairs and crack sealing when required are to be compensated for by other appropriate contract pay items.

Prior to placing the ARAC on milled surfaces, pot-holes left by the milling operation shall be repaired by the Contractor, as a related non-pay item and as required by the Engineer. The milled area shall be swept.

After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat as specified in Subsection [325.4](#).

Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto a concrete surface, the concrete surface shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

#### 325.7.2 Placing and Construction Methods:

All courses of ARAC shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (A) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (B) Taut stringline or wire set to grade
- (C) Short ski or sonar sensing units from curb control
- (D) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

The ARAC shall be dumped from the hauling vehicles directly into the paving machine unless otherwise approved by the Engineer.

Care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving

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machine by the truck.

If ARAC is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the ARAC shall be picked up and loaded into the paving machine. If ARAC is placed in a windrow during paving, the windrow shall not exceed a distance greater than 150 feet in front of the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown as indicated on the project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings shall be minimized and the paving machine shall not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

**325.7.3 Compaction:** It is the Contractor's responsibility to perform any desired Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the ARAC immediately behind the laydown machine shall be at least 275° F. A probe type electronic thermometer with a current calibration sticker attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. When the pavement lift is less than 1.5-inches, the temperature of the material shall be measured in the truck by inserting a calibrated probe type electronic thermometer, or other approved measuring device, to a point at least 6" below the surface of material.

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. Pneumatic tired compactors shall not be used.

The Engineer will determine the acceptability of the pavement compaction in accordance with Subsection [325.9](#). At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

**325.7.4 Lime Water:** An application of lime water shall be applied by the Contractor to the compacted ARAC surface after final compaction, prior to opening the roadway to traffic, or when requested by the Engineer to cool the pavement to prevent tracking and pick-up. The lime water solution shall be applied at the rate of approximately ½ gallon/square yard. The lime shall be mixed using a minimum of one (1) 50-pound bag per 3,000 gallons of water.

**325.7.5 Adjustments:** After installation of an overlay course all necessary frame and cover adjustments for manholes, valve boxes, survey monuments, sewer clean-outs, etc., shall be completed by the Contractor within the given segments being surfaced.

On roads without curb and gutter, the existing shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material includes the existing shoulder, millings, untreated base materials, or a granular material approved by the Engineer. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Subsection [301.3](#).

### **325.8 QUALITY CONTROL:**

It is the Contractor's responsibility to perform Quality Control monitoring and/or testing during ARAC production to achieve the required compaction and the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order that the use of any drying, proportioning or mixing equipment or the handling of any material be discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

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During production of the ARAC, the Contractor shall sample and test the mineral aggregate every 500 tons, with a minimum of one sample per day and shall test a calibration cold feed sample prior to the start-up on the first day of production. A calibrated nuclear oil content gauge will be furnished by the Contractor and 1 sample will be tested for each 350 tons produced, with a minimum of once per day. If at any time the oil content falls outside of the specified range, further testing will be performed until satisfactory results are obtained. An asphalt content test using an ignition furnace will be required once per each 500 tons of ARAC produced. A Marshall, maximum theoretical density and effective voids of the laboratory compacted specimens will be determined once per shift.

Viscosities will be performed on the asphalt rubber blend, either at the asphalt production plant or rubber-blend plant, by plant quality control personnel for each blend prior to delivery or introduction to the final product. All viscosities shall be performed with a City Of Phoenix representative present.

The ARAC produced shall conform to the requirements of the production tolerances established in Subsection [325.9](#). When the ARAC does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency or Engineer.

### 325.9 ACCEPTANCE:

**325.9.1 Acceptance Criteria:** During production, deviation from the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

<b>TABLE 325-1</b>		
<b>ACCEPTANCE LIMITS FOR CITY OF PHOENIX ARAC</b>		
<b>MARSHALL MIX DESIGNS</b>		
<b>LOW AND HIGH VOLUME</b>		
<b>Modified D 1/2" ARAC</b>		
<b>Sieve Size</b>	<b>Target</b>	<b>Tolerance</b>
<b>3/4"</b>	100	+/-0%
<b>1/2"</b>	97-100	+/-0%
<b>3/8"</b>	85	+/-7%
<b>No. 4</b>	35	+/-7%
<b>No. 8</b>	18	+/-5%
<b>No. 30</b>	8	+/-5%
<b>No. 200</b>	4	+/-2%
	<b>High Volume</b>	<b>Low Volume</b>
<b>Oil Content %</b>	8.0+/- .4	8.5+/- .4
<b>Air Voids %</b> (Recommended)	5.0+/-1.0	3.5+/-1.0
<b>Density (On Grade)</b>	95% Minimum (For All COP Mix Designs)	

**325.9.2 Sampling and Testing:** A City of Phoenix Materials Lab representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the ARAC. Sampling for hot ARAC at the asphalt plant shall be 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix Materials Lab representative at the plant, ARAC shall be sampled on grade at a frequency of 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. Tests used to determine acceptance will be performed by the City of Phoenix Materials Lab or other lab designated by the Engineer. In either case the laboratory shall be accredited by the AASHTO Accreditation Program (AAP), for the tests being performed. Acceptance testing results will be furnished, by the City of Phoenix Materials Lab, to those who request test results within five working days of receipt of samples by the acceptance laboratory.

Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing. Each sample obtained for that day's production shall be tested for oil content utilizing a calibrated Nuclear Oil Content Gauge, according to AASHTO T287. If all the samples are within oil content tolerances, a random sample will be

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taken and further testing will be performed, this includes oil content with a calibrated ignition oven, gradation, Marshall, maximum theoretical density, and air voids. However, if there is a sample outside of the tolerances for oil content, each specific failing Nuclear Oil Content sample will be tested. The selected sample(s) will be tested for oil content, utilizing an ignition oven, and gradation. Testing for Marshall, maximum theoretical density, and air voids will be performed on each sample tested utilizing an ignition oven.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently calibrated with actual densities of asphalt cores. This calibration will be accomplished on the first days of paving. A four inch core will be obtained at one of the locations tested by nuclear method. The obtained core will be tested for density by the laboratory performing the testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Calibration of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. The density of the compacted mixture shall not be less than 95% of the laboratory unit weight composed of the same mixture compacted by the 75 blow method of AASHTO T-245. If the desired density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One 4 inch core in the deficient area and two additional four inch cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

**325.9.2.1 Mineral Aggregate Gradation:** For each shift of ARAC production, at least one sample of mineral aggregate will be taken. For batch plants, the sample shall be taken from the hot bins. For plants other than batch plants, the sample shall be taken from the cold feed belt. Samples will be taken by means of a sampling device which is capable of obtaining representative samples. The device, which shall be approved by the Engineer, shall be furnished by the Contractor.

Samples will be tested for conformance with the mix design gradation, with or without mineral admixture as appropriate, in accordance with the requirements of Arizona Test Method 201. If the results from a single acceptance sample fall outside of the acceptance limits in Table [325-1](#) a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table [325-1](#) the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [325-1](#).

**325.9.2.2 Binder Content:** During production of ARAC, the Contractor shall maintain at the plant site a nuclear asphalt content gauge calibrated and operated in accordance with Arizona Test Method 421. The Contractor will utilize the same calibration samples that are provided to the City of Phoenix Materials Lab prior to the start of production. The City of Phoenix Materials Lab will store the nuclear oil content gauge calibration samples until the completion of the project. These samples may be utilized for recalibration if needed. Under the observation of the City of Phoenix Materials Lab or designated representatives, the Contractor shall determine the ARB content by means of the nuclear asphalt content gauge for each 350 tons, sampled randomly. The City of Phoenix Materials Lab or designated representative shall determine the time that the samples are taken. The Contractor's technicians performing the testing, including the calibration of the nuclear gauge, shall meet the technician requirements given in the Arizona Department of Transportation (ADOT) System for the Evaluation of Testing Laboratories. The requirements may be obtained from ADOT Materials Group, 1221 North 21st Avenue, Phoenix, AZ 85009.

Production of ARAC shall cease immediately and the plant and/or the nuclear asphalt content gauges re-calibrated if any single test result varies by an amount greater than  $\pm 0.40\%$ , or the average of three consecutive test results varies by an amount greater than  $\pm 0.40\%$ , from the mix design target. Material that has already been produced may be used on the project if the single test value representative of that material varies by an amount from  $\pm 0.40\%$  to  $\pm 0.60\%$ , inclusive, from the mix design target. Material that has already been produced may not be used on the project if the single test value representative of that material varies by an amount greater than  $\pm 0.61\%$  from the mix design target unless, by retesting, the material is found to be acceptable.

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**TABLE 325-2**

<b>ASPHALT RUBBER BINDER CONTENT PAYMENT REDUCTION (ARAC)</b>		
<b>Deviation from that permitted (Acceptance to the tenth of a percent)</b>	<b>When Contracting Agency is Owner: Payment Reduction (Percent dollar per ton asphalt concrete)</b>	<b>When Contracting Agency is Not Owner (Permit Work): Payment Reduction (Percent dollar per ton asphalt concrete)</b>
		<b>*See note below</b>
Over/Under 0.0 to 0.1%	10%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
Over/Under 0.1 to 0.2%	25%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

\*Additional permit and fee required for extended warranty

**325.9.3 Density:** The temperature of ARAC just prior to compaction shall be at least 275° F. The Engineer may change the rolling procedure if in the Engineer's judgment the change is necessary to prevent picking up of the ARAC.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 95.0% of the Marshall density, from the specimens composed of the same mixture, and compacted in the laboratory by the 75-blow method of AASHTO T-245.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

**325.9.3.1 Equipment:** Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. The compactors shall be self-propelled and shall be operated with the drive wheel in the forward position. The compactors shall weigh not less than eight tons. Compactors shall not be used in the vibratory mode for courses of one inch or less in nominal thickness. The wheels of compactors shall be wetted with water, or if necessary soapy water, or a product approved by the Engineer to prevent the ARAC from sticking to the steel wheels during rolling.

**325.9.3.2 Compaction Procedures**

**325.9.3.2.1 Pavement Lift Thickness 1 ½ Inches or Less:** Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures.

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Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

**325.9.3.2.2 Pavement Lift Thickness Greater than 1 ½ Inches:** Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor’s responsibility and shall be sufficient to meet these requirements. Initial breakdown rollers shall follow as closely behind the paving machine as practical. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

<b>Table 325-3</b>		
<b>PAVEMENT DENSITY PAYMENT REDUCTION</b>		
<b>Deviation Below Specification</b>	<b>When Contracting Agency Owner: Reduction in Payment (Percent dollar per ton of asphalt concrete)</b>	<b>When Contracting Agency Not Owner (Permitted Work):</b>
94.0% to 94.9%	15%	*See note below Extended Warranty for three years with posted bond for the value of the taper mill and overlay
93.0% to 93.9%	20%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Below 93.0%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

\*Additional permit and fee required for extended warranty.

**325.9.3.3 Compacting Miscellaneous Items and Surfaces:** ARAC used in the construction of miscellaneous items and surfaces shall be compacted using compactors, hot-hand tampers, smoothing irons, mechanical vibrating hand tampers, or with other devices to the extent considered necessary by the Engineer.

**325.10 REFEREE:**

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The engineer will select an independent and accredited materials lab from the City of Phoenix Contract Lab and Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

These tests will include Marshall unit weight, maximum theoretical unit weight, and laboratory air voids. Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

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The number of samples taken will be the same as specified in Subsection [325.9.3](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the Contractor. The independent laboratory shall include a report signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated either does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

### **325.11 MEASUREMENT:**

ARAC shall be measured by the ton, for the mixture actually used, which shall include the required quantities of mineral aggregates, filler material, asphalt-rubber binder and admixture.

Application of Lime Water shall be measured by the square yard. The measured area shall be the area of ARAC pavement to which the lime water is applied. The measured area shall only be counted one time regardless of the number of applications applied to the ARAC pavement section.

Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of this work shall be included in the price paid for ARAC or other related pay items.

### **325.12 PAYMENT:**

Payment for Asphalt Milling will be as specified in Section [317](#).

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

Payment for ARAC will be at the contract unit price, complete in place.

Application of Lime Water as approved by the Engineer will be paid at the contract unit price.

Payment for frame and cover adjustments will be at the contract unit prices specified in the proposal.

*- End of Section -*

## SECTION 327

### HOT IN-PLACE RECYCLING

#### 327.1 DESCRIPTION

This work shall consist of rehabilitating the surface layer of existing asphalt concrete pavement. Rehabilitation shall be accomplished with specially designed equipment in a simultaneous multistep process of heating, scarifying, applying an asphalt recycling agent and thoroughly remixing and reshaping the old asphalt concrete surface to an average depth of 1", and then placing an overlay of new hot mix asphalt concrete in compliance with the lines, grades, thickness and typical cross-sections shown on the plans (typically 1" to 2"). NOTE: This work shall be performed with a single machine that heats, scarifies, recycles and spreads new asphalt concrete hot mix, all in one continuous pass. Additional preheaters may be utilized to achieve specified depth and temperature.

#### 327.2 MATERIALS:

Asphalt Recycling Agent used to restore the existing pavement shall be approved by the Engineer prior to use. A manufacturer's certification shall be submitted for each load of recycling agent delivered to the project.

Hot Mix Asphalt Concrete (HMAC) shall meet the requirements of Section [710](#) or Section [717](#).

#### 327.3 EQUIPMENT

The Contractor shall specify, in the bid proposal, the type of equipment intended for use. The equipment shall be on the project in operating condition a minimum of 2 days before beginning operations to allow evaluation by the Engineer. The Engineer reserves the right to reject equipment deemed not suitable for the intended purpose, at no additional cost to the Agency.

The recycling equipment shall meet the following minimum requirements:

Repaver: The equipment for this work shall be a self-contained, self-propelled, automated unit capable of heating, scarifying (or milling), mixing, redistributing and leveling the existing asphalt concrete pavement to the specified depth, all in a single pass.

It shall have a means of automatically applying an asphalt recycling agent at a uniform rate as shown on the plans, special provisions, or as requested by the Engineer. It shall be capable of applying a new HMAC layer over the hot, partially compacted recycled mixture.

Heating Unit: This unit shall be hooded to prevent damage to adjacent property, including trees and shrubs. It shall be capable of heating the pavement surface to a temperature high enough (375° - 400° F.) to allow scarification to the required depth without breaking aggregate particles or charring the pavement surface.

Scarifying or Milling Units: The scarifiers or rotary millers shall be able to penetrate the pavement surface to a depth shown, up to a maximum of one inch in one pass. Scarifiers or millers shall be equipped with separate, automatic height adjustments which allow clearance over manholes and other obstructions.

Recycling Agent Applicator: This system shall automatically add recycling agent to the scarified material at a uniform rate as shown on the plans, special provisions or as requested by the Engineer. The application rate shall be synchronized with the machine's forward speed to maintain a tolerance, within 5% of the specified rate.

Conveying System: Shall consist of a receiving hopper and conveying system to collect and transport new hot mix asphalt concrete material to the finishing unit.

Recycling Unit: A system that mixes, distributes and levels the scarified material over the width processed to produce a uniform cross-section of recycled material.

Finishing Unit: This unit shall have automatic screed controls to produce a surface conforming to that shown on the plans. The unit shall be capable of producing a uniform slope, grade and texture.

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### **327.4 CONSTRUCTION METHODS:**

The Contractor shall be responsible to clean the pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

The heating shall be sufficient to soften the pavement to the extent that it can be scarified or milled to the depth specified. Due to the varying properties of the existing asphalt pavement, depth of the scarification material may be varied, if requested by the Engineer. Heating shall be done in a manner that will assure uniform softening and will not char the asphalt.

The Contractor shall be responsible for protecting the area adjacent to the work from heat damage. If damage occurs, the Contractor shall replace all damaged areas, landscape, curb, parked vehicles, etc. at no cost to the Agency.

To provide a welded longitudinal joint, the standing edge of the adjoining asphalt pavement shall be fully heated to a width at least 2 inches beyond the width to be scarified and recycled.

Immediately following heating, the pavement surface shall be scarified (or milled) to the specified depth. The scarified material shall have a temperature between 225° F. and 265° F. unless otherwise requested by the Engineer. The material shall be leveled, mixed and treated with a recycling agent. The application rate shall be as shown on the plans, special provisions or as requested by the Engineer. Application rate for the recycling agent may be adjusted as necessary to maintain a uniform mixture.

The reclaimed material shall be gathered by a leveling device and spread to a uniform depth over the width being processed. After it is placed and while it still has a residual temperature of at least 190° F., a layer of new HMA conforming to the job mix formula shall be placed over it. The application rate of new material shall be sufficient to provide the required pavement thickness.

Construction, compaction and smoothness of the surface shall be in accordance with Section [321](#) except as modified in this Section.

### **327.5 WEATHER CONDITIONS:**

This work shall not be done when it is raining or if there is a threat of rain. The ambient temperature shall be at least 50° F. and rising and the application shall cease when the temperature reaches 55° F. and falling.

### **327.6 AIR QUALITY:**

The equipment and process shall meet all Arizona Department of Environmental Quality (ADEQ) and County air quality regulations and the Contractor shall have the appropriate ADEQ air quality control permit prior to the issuance of the notice to proceed.

### **327.7 MEASUREMENT:**

Pavement Recycling will be measured by the square yard completed and accepted. Recycling Agent will measure by the gallon of actual material used in place. Hot Mix Asphalt Concrete (HMAC) will be measured by the ton in place.

### **327.8 PAYMENT:**

The accepted quantities of pavement recycling will be paid at the contract unit price per square yard. Payment shall include cleaning the existing pavement surface and heating, scarifying, redistributing, leveling and compacting HMA pavement. Asphalt Recycling Agent will be paid for by the gallon used in place. Hot Mix Asphalt concrete (HMAC) will be paid for by the ton in place.

*- End of Section -*

## SECTION 329

### TACK COAT

#### 329.1 DESCRIPTION:

Tack coat for bituminous paved surfaces shall consist of the application of emulsified asphalt as specified in Section [713](#).

Tack coat shall be Type SS-1h per Section [713](#).

#### 329.2 PREPARATION OF SURFACE:

Surfaces to be treated shall be cleaned of all loose material as specified in Section [330](#).

#### 329.3 APPLICATION:

Tack coat shall be diluted in the proportion of 50 percent water and 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard. Application shall be made in advance of subsequent construction as ordered by the Engineer.

#### 329.4 EQUIPMENT:

Tack coat shall be applied by distributor trucks designed, equipped, maintained and operated in accordance with Section [330](#). Hand spray by means of hose or bar through a gear pump or air tank shall be acceptable for resurface work, corners or tacking of vertical edges. Care shall be taken to provide uniform coverage. Equipment that performs unsatisfactory shall be removed from the job.

#### 329.5 PROTECTION FOR ADJACENT PROPERTY:

According to Section [333](#).

#### 329.6 MEASUREMENT:

Bituminous emulsion that is diluted prior to application will be measured by the ton of diluted material. Any conversion from volumetric quantities shall be in accordance with Section [713](#).

#### 329.7 PAYMENT:

Payment for the emulsified bituminous tack coat will be by the ton, diluted.

*- End of Section -*

## SECTION 330

### ASPHALT CHIP SEAL

#### 330.1 DESCRIPTION:

This work shall consist of the application of a bituminous material followed by the application of a cover material.

#### 330.2 MATERIALS:

**330.2.1 Asphalt:** The type of grade of the bituminous material will be specified in the contract documents.

Paving grade asphalt shall meet the requirements to Section [711](#).

Liquid Grade asphalt shall meet the requirements of Section [712](#).

Emulsified asphalt shall meet the requirements of Section [713](#).

**330.2.2 Aggregate:** The cover material (chips) shall meet the requirements of Section [716](#). Gradation of the chips shall be as specified in Table [716-1](#) or Table [716-2](#).

#### 330.3 TIME OF APPLICATION AND WEATHER CONDITIONS:

Chip seal shall not be applied for at least 7 days after completion of new bituminous paving.

The chip seal shall be placed only when the roadway surface is dry and there is no imminent threat of rain. The ambient temperature must be at least 60°F. and rising.

Caution should be exercised in the placement of asphalt chip seal between the dates of Oct. 1 and April 1.

#### 330.4 CONSTRUCTION METHODS:

**330.4.1 Preparation of surfaces:** Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pickup sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms.

The bituminous material shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

For chip seals using paving grade asphalt as the binder, a bituminous tack coat shall be applied prior to sealing. The tack coat shall comply with Section [329](#). The exact rate shall be determined by the Engineer.

**330.4.2 Application of Bituminous Material:** The bituminous material shall be applied as soon as possible after preparation of surfaces. At the time of application, temperatures of the asphalt shall be within the ranges specified in Table [330-1](#) and Table [330-2](#) or in Sections [711](#), [712](#) and [713](#) for each specified asphalt type. The Engineer may require a specific temperature within the ranges.

The quantity of liquid or emulsified asphalts will be between the range of 0.20 and 0.40 gals. /sq. yd. The quantity of paving grade asphalt will be between the range of 0.17 and 0.31 gals. /sq. yd. The exact rate of application will be determined by the Engineer.

The bituminous material shall be placed using a distributor as specified in Section [330](#). Application methods shall insure that a uniform distribution is obtained over the area to be sealed.

The chips shall be spread before the bituminous material sets. The maximum distance that the bituminous material is applied in advance of the chips will be determined by the Engineer.

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<b>TABLE 330-1</b>		
<b>APPLICATION TEMPERATURES OF LIQUID ASPHALTS</b>		
All types of Liquid Asphalt	Distributor Application Temperature, Degree F.	
	Min.	Max.
70	105	175
250	140	225
800	175	255
3000	215	290

<b>TABLE 330-2</b>		
<b>APPLICATION TEMPERATURE OF EMULSIFIED ASPHALTS</b>		
Grade of Emulsified Asphalts	Distributor Application Temperature, Degree F.	
	Min.	Max.
RS-1, CRS-1, CRS-1h	75	140
RS-2, CRS-2, CRS-2h	125	185
SS-1, CSS-1	75	130
SS-1h, CSS-1h	75	130

The surfaces of structures, trees and shrubbery adjacent to the areas being seal coated shall be protected in such manner as to prevent their being spattered with bituminous material or marred. The Contractor shall be responsible for all damage to such structures or landscaping.

**330.4.3 Application of Cover Material:** Immediately following the application of the bituminous material, the chips shall be spread with a self-propelled mechanical spreader. The chip spreading equipment shall be capable of applying a uniform application of cover material. The self-propelled requirement may be waived for projects under 10,000 sq. yds.

At the time of application, precoated aggregate shall be within the temperature range of 250 degrees F. and 350 degrees F. measured at a point 6 to 12 inches below the top of the load.

At the time of application, uncoated chips shall not contain moisture in excess of a saturated, surface dry condition when liquid or paving grade asphalt are used as the seal coat binder.

At the time of application, chips shall be surface wet but free from running water when emulsified asphalt is used as the seal coat binder.

The precise application rate for cover material will be determined by the Engineer within the ranges of 15 to 25 pounds per square yard for the 1/4 in. size and 20 to 30 pounds per square yard for the 3/8 in. size.

When so directed by the Engineer and within 48 hours after application of the precoated chips, all chipped surfaces on major streets shall receive a flush coat in accordance to Section 333. The exact rate of application shall be as directed by the Engineer.

**330.4.4 Rolling:** Immediately following the application of the cover material, the surface shall be rolled with self-propelled pneumatic-tired rollers. Three coverages shall be made with a pneumatic roller. Each roller shall carry a minimum of 2,000 pounds on each wheel and a minimum of 60 psi in each tire. The roller shall not travel in excess of 12 miles per hour. A minimum of 3 self-propelled pneumatic rollers shall be required for projects over 10,000 sq. yds. On projects under 10,000 sq. yds. one roller may be used provided it performs the same number of coverages.

**330.4.5 Joints:** All joints shall be constructed as approved by the Engineer such that there will be a uniform application of cover material and bituminous material.



## SECTION 331

### MICROSURFACING SPECIFICATIONS

#### 331.1 GENERAL:

The work covered by this specification consists of furnishing all labor, equipment, and materials for the application of a "quick traffic solid/polymer microsurface."

This specification covers the equipment and construction procedures for rut filling and/or resurfacing of existing paved surfaces. The microsurface shall be a mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water and other additives properly proportioned, mixed and spread on the pavement surface.

#### 331.2 MATERIALS:

The Contractor shall supply all materials necessary for the performance of the work in accordance with the specifications. The asphalt emulsion, aggregate, and mineral filler shall be as specified in Section [714](#). Materials shall be approved by the Engineer prior to the start of construction. Certificates of Compliance shall accompany each delivery of emulsion.

The Contractor shall be responsible for the safety of all materials of which he has taken delivery until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or theft, or damage by water, and shall bear the cost of replacing any such material that is lost, spilt, destroyed or damaged after delivery.

#### 331.3 PROPORTIONING:

The microsurface shall be proportioned in accordance with the mix design. Calibrated sign flowmeters shall be provided to measure both the addition of water and additives to the pugmill. Emulsion and cement flow shall be tied directly to aggregate flow. All additive flows shall be calibrated.

**331.3.1 Performance:** The microsurface mixture shall be proportioned per the mix design to ensure:

(A) Trafficability - the material will permit controlled traffic without damage to the surface within thirty (30) minutes and uncontrolled traffic without damage within sixty (60) minutes, per Subsection [331.4.2.2](#).

(B) Prevent development of bleeding, raveling, separation or other distress for seven (7) days after placing the microsurface.

#### 331.4 MIX DESIGN:

##### 331.4.1 General:

**331.4.1.1:** The Contractor shall provide a job mix formula from an approved laboratory and present certified test results for the Engineer's approval. Compatibility of the aggregate and polymer modified emulsion shall be certified by the emulsion manufacturer. All the materials used in the job mix formula shall be representative of the materials proposed by the Contractor for use in the project.

**331.4.1.2:** All the products used in the construction shall have certifications from the suppliers and they shall be given to the Engineer upon delivery to the project.

**331.4.1.3:** Mix design and proportioning will be approved by the Engineer prior to the start of the project.

##### 331.4.2: Specifications:

**331.4.2.1:** The Engineer shall approve the mix design prior to use. The specification limits are as follows:

Residual Asphalt	(ASTM D244)	6% - 11.5% by dry weight of aggregate
Mineral Filler	(ASTM C136)	0.1% - 1% by dry weight of aggregate

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Polymer Content/Type Additive	4% min. (see Subsection <a href="#">714.4</a> ) As required for mix properties
Water	As required for mix properties
Aggregate Grading	Meets Subsection <a href="#">331.4.2.4</a>
Consistency (ISSA T-106)	2.5 to 3.0 cm
Traffic Time	See Subsection <a href="#">331.4.2.2</a>
Abrasion Loss (ISSA TB-100)	75 g/ft <sup>2</sup> maximum
Adhesion (ISSA TB-114)	90% minimum
Loaded Wheel Sand Adhesion	See Subsection <a href="#">331.4.2.3</a>

**331.4.2.2 Modified Cohesion Test (ISSA TB-139):** Furnish laboratory test data showing the mix design to be trafficable thirty (30) minutes after application at 77 F conforming to the following criteria in accordance with test methods described in the applicable specifications.

Set Time Test: 30 minutes 12 kg-cm minimum.

Early Rolling Traffic Time: 60 minutes 20 kg-cm minimum.

**331.4.2.3 Loaded Wheel Sand Adhesion Test (ISSA TB-109):** Furnish laboratory test data showing the mix design conforming to the following criteria in accordance with test methods described in the appropriate specifications.

<u>Vehicles/day</u>	<u>Minimum Sand Adhesion</u>
0-30	70 g/ft <sup>2</sup>
250-1500	60 g/ft <sup>2</sup>
1500-3000	55 g/ft <sup>2</sup>
greater than 3000	50 g/ft <sup>2</sup>

**331.4.2.4** The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect). The report must clearly show the theoretical recommended proportion of aggregate, mineral filler (Min. & Max.), water (Min. & Max.), additive(s), and asphalt, and how the proportions are based (dry aggregate weight, total mix, etc.).

**331.5 TESTING:** Samples for quality assurance will be taken throughout the project per ISSA TB101 for testing by an approved laboratory as required by the Engineer. Materials with test results not meeting these specifications shall be corrected immediately. Testing shall be at the expense of the Agency for the following:

- (A) Asphalt content
- (B) Aggregate gradation
- (C) Percent polymer content and type-certified by supplier

### **331.6 EQUIPMENT:**

**331.6.1 General:** All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working condition at all times to ensure a high quality product.

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**331.6.2 Mixing Equipment:** The mixing machine shall be a self-propelled or truck mounted mixing machine which shall be able to accurately deliver and proportion the aggregate, mineral filler, water, additive, and polymer-modified asphalt emulsion to a revolving multi-blade mixer capable of minimum speeds of 200 RPM and discharge the product on a continual flow basis. The machine shall have sufficient storage capacity for aggregate, polymer modified asphalt emulsion, mineral filler, water, and additive to maintain an adequate supply to the proportioning controls.

### **331.6.3 Material Control:**

**331.6.3.1 Calibration:** Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration data, if done within the calendar year, using the same material, may be used, providing a verification of the aggregate feed agrees.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided, and shall be accessible to the Engineer. Each material control device shall be calibrated prior to work and documented for inspection by the Engineer.

**331.6.3.2 Aggregate Feed:** The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

**331.6.3.3 Emulsion Pump:** The emulsion pump shall be the positive displacement type with a jacketed housing for uniform heating. A revolution counter or similar device shall be fitted so that the amount of emulsion used may be determined at any time.

**331.6.3.4 Fines Feeder:** An approved fines feeder is required that will provide a uniform, positive, accurately metered range of 0 to 1 percent by dry aggregate weight. The fines feeder shall have a counter so the amount of mineral filler can be determined at any time.

**331.6.3.5 Liquid Additive:** The mixing machine shall be equipped with a liquid additive system that provides a pre-determined amount of additive to the mixing chamber. This additive system must be equipped with a counter that can determine the amount used at any time.

**331.6.3.6 Water System:** The mixing machine shall be equipped with a water system that provides a pre-determined amount of water to the mixing chamber. This water system must be equipped with a counter that can determine the amount used at any time.

**331.6.4 Operator Controls:** Controls will allow the operator to sequence and proportion the material per the mix design.

**331.6.5 Spray Bars:** The mixing machine shall be equipped with a water pressure system that provides a water spray immediately ahead of and outside the spreader box.

### **331.6.6 Spreading Equipment:**

**331.6.6.1:** The paving mixture shall be spread uniformly by means of mechanical type laydown box attached to the mixer, equipped with agitation, to spread the materials throughout the box without any dead zones. The paddles shall be designed and operated so all the fresh mix will be agitated. Flexible seals, front and rear, shall be in contact with the road surface to prevent loss of mixture from the box. The spreader box shall be equipped with hydraulic cylinders for controlling the thickness of the spread mixture.

**331.6.6.2:** The rut filling spreader box shall have 6 to 8 skids to provide for leveling and filling uneven depressed areas. Two adjustable steel strike-off plates are required. The rear flexible seal shall act a final strike-off and shall be adjustable. The steel strike-offs shall be controlled by hydraulic cylinders placed at the rear of the spreader box.

**331.6.6.3** The spreading equipment shall be maintained free from build-up of the mixture on the paddles or side walls. Skips, lumps, or tears will not be allowed in the finished product.

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### 331.7 APPLICATION:

**331.7.1 General:** The microsurface shall be of the desired consistency when deposited in the spreader box and nothing more shall be added to it. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the mixture shall be chuted into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

**331.7.2 Weather:** Microsurfacing shall not be placed if either the pavement or air temperature is below 50 degrees F and falling, but may be applied if both the air and pavement temperature are at least 45 degrees F and rising, and it is not raining.

**331.7.3 Protection of Existing Surfaces:** The Contractor shall take all necessary precautions to prevent microsurface or other material used from entering or adhering to gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks, and other road fixtures. Immediately after resurfacing, the Contractor shall clean off any such material and leave any grating, manholes, etc. in a satisfactory condition.

**331.7.4 Fogging Pavement:** The surface shall be pre-wetted by Fogging ahead of the spreader box. The rate should be adjusted as dictated by the pavement temperature, surface texture, humidity, and dryness of existing pavement.

**331.7.5 Mix Stability:** The mix shall possess sufficient stability so that premature breaking of material in the spreader box does not occur. The mixture shall be homogeneous during mixing and spreading; it shall be free of excess water or emulsion, and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

**331.7.6 Application Rate:** The application rates, pounds per square yard of mix specified, are average rates; the surface texture variation throughout the work will dictate the actual spreading rates. The strike-off squeegee shall be adjusted to provide a microsurface thickness which will completely fill the surface voids and provide an additional thickness not exceeding one and one-half times the largest top-size stone. The requirement of 1-1/2 stone depth does not apply to rut filling operations as these depths vary greatly according to the surface irregularities.

**331.7.7 Joints:** No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. A maximum of 4.0" overlap will be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the work. Half passes and odd width passes will be used in minimal amounts. If half passes are used, they cannot be the last pass on any area. Care shall be taken to ensure straight lines along curbs and shoulders. No runoff will be permitted on these areas. Construction joints shall be neat in appearance and shall be tapered or feathered to conform to the existing surface. All excess material shall be removed from the surface upon completion of each run.

**331.7.8 Handwork:** Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and in other areas where hand spreading may be required.

**331.7.9 Protection of the Microsurface:** Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

**331.7.10 Damage to the Microsurface:** The Contractor's responsibility to replace microsurface damaged by unexpected rain after spreading shall be limited to the period within four (4) hours of placement of the microsurface.

### 331.8 PAYMENT:

The micro-surfacing shall be paid for by the weight of the aggregate and weight of emulsified asphalt, as shown on certified weight tickets from the supplies delivered to the project, less weigh backs. The price shall be full compensation for furnishing, mixing and applying all materials; and for all labor, equipment, tools, design tests, and incidentals necessary to complete the job as specified herein.

*- End of Section -*

## SECTION 332

### PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION SLURRY SEAL COAT

#### 332.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, and materials necessary to perform all operations required for the application of an asphalt emulsion slurry surface.

NOTE: THESE SPECIFICATIONS DO NOT COVER THE APPLICATION OF COAL TAR SLURRY SEALS.

#### 332.2 MATERIALS:

The asphalt emulsion material, mineral aggregate and mineral filler shall be as specified in Section [715](#).

#### 332.3 EQUIPMENT:

**332.3.1 General:** When requested by the Engineer, descriptive information on the slurry seal mixing and applications equipment to be used will be submitted for approval no less than 7 days before the work starts.

**332.3.2 Self Contained Slurry Machine:** The mixing machine will be a continuous flow type. It will be capable of accurately delivering a predetermined proportion of pre-wetted aggregate, mineral filler, water and asphalt emulsion to the mixing chamber and discharging the thoroughly blended mixture on a continuous basis. The mixing machine will be equipped with a mineral filler feeder. The feeder will have an accurate metering device or method to introduce a predetermined proportion into the mixer. The filler will be introduced into the mixing chamber at the same time and location as the aggregate.

The mixing machine will be equipped with a water pressure system and fog-type spray bar, adequate for complete water fogging of the surface to be sealed.

The mixing machine will be mounted on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout the operation to ensure the slurry is spread evenly and all cracks are filled.

**332.3.3 Slurry Spreading Equipment:** Attached to the mixer machine shall be a mechanical type squeegee spreader equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean. Build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

**332.3.4 Rollers:** Rollers shall be approved by the Engineer.

**332.3.5 Cleaning Equipment:** Power brooms, pick-up brooms, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

**332.3.6 Auxiliary Equipment:** Hand squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

#### 332.4 PREPARATION OF THE SURFACE:

**332.4.1** Immediately before applying the slurry, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing will not be permitted in areas where cracks are present in the pavement surface.

The slurry shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

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**332.4.2 Tack Coat:** When specified, a tack coat shall be applied in accordance with Section [329](#) using the same type and grade of asphalt emulsion as specified for the slurry seal.

**332.4.3 Water Fogging:** When required by local conditions, the surface, directly ahead of the slurry box, shall be pre-wetted by fogging. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

### **332.5 WEATHER LIMITATIONS:**

The slurry seal shall not be applied unless the pavement temperature is at least 45°F. and rising. The mixture shall not be applied during unsuitable weather.

### **332.6 PROTECTION OF UNCURED SURFACE:**

Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

### **332.7 MIXING AND APPLICATION:**

The mixing time shall not exceed four minutes. Excessive mixing will not be allowed. The resulting mixture shall have the desired consistency, when placed on the surface. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded.

A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained.

No streaks caused by oversized aggregate shall be left in the finished surface. Build-up on longitudinal and transverse joints will be kept to a minimum. Approved squeegees shall be used to spread slurry in areas nonaccessible to the slurry mixer.

### **332.8 ROLLING:**

As soon as the asphalt slurry has been set sufficiently to prevent any material from being picked up, it shall be rolled until all ridges have been ironed out and a uniform surface is obtained.

### **332.9 MEASUREMENT:**

Quantities and materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

(A) Bituminous tack coat if specified	Ton (Diluted)
(B) Emulsified asphalt for slurry	Ton (Undiluted)
(C) Aggregate for slurry	Ton (Surface Dry)

*- End of Section -*

## SECTION 333

### FOG SEAL COATS

#### 333.1 DESCRIPTION:

Fog seal coats on bituminous paved surfaces shall consist of the application of emulsified asphalt and a sand blotter when necessary.

#### 333.2 TIME OF APPLICATION AND WEATHER CONDITIONS:

Fog seal coats on new pavements shall be applied within 24 hours. This time restriction may be extended by the Engineer.

Emulsified asphalt shall not be applied when the surface is wet or when there is a threat of rain. The ambient temperature shall be at least 50 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling.

#### 333.3 MATERIALS:

**333.3.1 Emulsified Asphalt:** Unless otherwise specified in the special provisions, emulsified asphalt may be a grade SS-1h, CSS-1h, or CQSH, as specified in Section [713](#). The emulsified asphalt shall be diluted in proportions of 50% water and 50% emulsified asphalt.

**333.3.2 Sand Blotter:** The sand shall be as specified in Subsection [701.3](#) and shall be graded in accordance with Table [333-1](#).

TABLE 333-1	
SAND BLOTTER GRADATION	
Sieve Size	Percentage Passing (by weight)
3/8 inch	100%
No. 4	90-100%
No. 200	0-12%

#### 333.4 TESTS, TEST REPORTS AND CERTIFICATIONS:

Asphalt emulsion shall meet requirements of Section [713](#).

Test reports and certifications shall be as specified in Section [711](#).

#### 333.5 PREPARATION OF SURFACES:

Immediately before applying the emulsion, the area to be surfaced shall be cleaned of dirt and loose material by means of power brooms, or pick-up brooms supplemented by hand brooms if necessary. The fog seal shall not be applied until an inspection of the surfaces has been made by the Engineer and he has determined that the surfaces are suitable.

#### 333.6 APPLICATION OF ASPHALT EMULSION:

The diluted material shall be well mixed before application. It shall be applied by a distributor truck equipped with fog nozzles at the approximate rate of 0.10 gallon per square yard. The exact rate shall be as directed by the Engineer. The distributor truck shall be as specified in Section [330](#).

#### 333.7 SAND BLOTTER:

A sand blotter shall be applied as directed by the Engineer where there is an excess of asphalt emulsion. After the treated area has been opened to traffic, any excess asphalt emulsion that comes to the surface shall be immediately covered with additional sand.

#### 333.8 PROTECTION FOR ADJACENT PROPERTY:

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Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pavements, including that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs, and property of all kinds.

### **333.9 PROTECTION OF TREATED SURFACE:**

The treated surface shall be protected by barricades until the asphalt emulsion will not be picked up by traffic.

### **333.10 PAYMENT:**

Payment for asphalt emulsion in place will be by the ton, diluted.

Payment for furnishing and applying sand blotter in place will be paid for by the ton.

*- End of Section -*

## SECTION 334

### PRESERVATIVE SEAL FOR ASPHALT CONCRETE

#### 334.1 DESCRIPTION:

The asphalt concrete preservative seal shall be composed of an emulsified asphalt or asphalt rejuvenate, or an asphalt sealant to preserve the asphalt concrete pavement.

Preservative seals are applicable for asphalt pavements as directed on the plans, special provisions, or the Engineer.

#### 334.2 MATERIALS:

The preservative seal shall be one of the following materials as specified by the Engineer:

<u>Type</u>	<u>Description</u>	<u>Material Conformance</u>
A	Rejuvenating emulsion	Section <a href="#">718</a>
B	Petroleum hydrocarbon emulsion	Section <a href="#">718</a>
C	“Filled” asphalt sealer such as TRMSS or equal	Section <a href="#">718</a>
D	Acrylic polymer emulsion	Section <a href="#">718</a>
Other	Diluted asphalt emulsion, CSS-1 or SS-1h	Section <a href="#">713</a>

#### 334.3 CONSTRUCTION METHOD:

The material shall be approved by the Engineer in accordance to this specification. The application rates, dilution and curing shall be directed by the Engineer in accordance with this specification.

The Contractor shall be responsible to clean the pavement to be treated free of trash, debris, earth or other deleterious substances present in sufficient quality to not interfere with the work to be performed.

The application rate will be based upon a typical surface condition test site with application rate trials to determine the needed rate. All application rates specified in Section [712](#) shall be a diluted 50-50 emulsified asphalt and water, except as recommended by the manufacturer for Type B and C. Any over applied seal will be sanded as directed by the Engineer. Application equipment shall be in accordance with Section [330](#).

Before opening a treated area to traffic, the surface shall be checked for slipperiness and/or tackiness. If the treated portion of the roadway must be opened to traffic prior to the disappearance of slipperiness and/or tackiness, the surface shall be sanded with a minimum of 1 ½ pounds per square yard or as directed by the Engineer. Sand Blotter shall comply with Section [333](#).

#### 334.4 MEASUREMENT:

Preservative seal for asphalt concrete will be measured by the gallon or ton applied.

#### 334.5 PAYMENT:

Payment will be made on the basis of the unit price bid in the proposal. Payment shall be full compensation for preservative seal complete and in place.

- End of Section -

## SECTION 335

### PLACEMENT AND CONSTRUCTION OF HOT ASPHALT-RUBBER SEAL

#### 335.1 DESCRIPTION:

This work shall consist of applying an application of asphalt-rubber binder, a combined mixture of hot paving grade asphalt and crumb rubber modifier. It shall be immediately covered with a cover material.

The work involves furnishing and placing all materials on existing pavement surfaces in accordance with this specification.

#### 335.2 MATERIALS:

The asphalt-rubber binder shall comply with Section [717](#). Sand Blotter shall comply with Section [333](#). Cover material shall be precoated and comply with Section [716](#). Fog seal coats shall comply with Section [333](#).

**335.2.1 Certification and Quality Assurance:** Prior to application, the Contractor shall submit certification of compliance to the Engineer at least 7 days prior to application for all materials to be used in the work. For example: Asphalt-rubber binder designs (Section [717](#)), cover material test results (Section [716](#)), sand blotter material (Section [333](#)), fog seal coats (Section [333](#)), and any additional materials used on the project.

#### 335.3 EQUIPMENT:

**335.3.1 General:** The method and equipment for combining the crumb rubber modifier and hot paving grade asphalt shall be so designed and accessible that the Engineer can readily determine the percentage by weight of each of two materials being incorporated into the mixture.

All equipment shall meet requirements of Section [330](#) with the following modifications:

(A) Pneumatic-tired rollers: At least three pneumatic-tired rollers shall be used. Each roller shall carry a minimum of 5,000 pounds on each wheel and a minimum of 90 psi in each tire. Rollers shall not travel in excess of 12 mph.

(B) Distributor: The distributor must be equipped with a mechanical mixing device.

**335.3.2 Mechanical Pre-Blender:** Crumb rubber modifier and the hot paving grade asphalt for the asphalt-rubber binder may be pre-blended prior to introduction of the blend into the distributor.

The mechanical pre-blender shall be equipped with an asphalt totalizing meter in gallons and a flow rate meter in gallons per minute.

#### 335.4 MIXING:

Mixing shall be done in accordance with Section [717](#). Application shall proceed immediately upon the asphalt-rubber binder requirements being met.

#### 335.5 CONSTRUCTION:

Prior to placing the hot asphalt-rubber binder, soil and other objectionable materials shall be removed from the pavement surface.

The application rate of the hot asphalt-rubber binder shall be 0.55 to 0.70 gallons per square yard or as directed by the Engineer based on field conditions. Material shall be applied at temperatures of 350 degrees F. to 400 degrees F. The application of the cover material shall follow as close as possible behind the distributor truck.

The cover material shall be preheated immediately prior to application and precoated as specified in Section [716](#) – COVER MATERIALS. The temperature of the precoated chips shall be in accordance with Section [330](#).

Hot asphalt-rubber binder with hot precoated cover aggregate shall be placed only when the ambient temperature is at least

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60 degrees F. and rising, on a dry surface and there is no imminent threat of rain.

The rate of application of the cover material shall be from 18 to 25 pounds per square yard for the Low Volume Chip or 28 to 35 pounds per square yard for the High Volume Chip, or as directed by the Engineer.

The rolling of the cover material shall proceed immediately after application in order to insure maximum embedment of the aggregate. Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the aggregate spreader. If the spreading is stopped for an extended period, the spreader shall be moved ahead or off to the side so that all cover material may be immediately rolled. Three (3) complete passes with rollers shall be made with all rolling completed within one (1) hour after the application of the cover material.

The Contractor shall sweep all joint edges clean of overlapping cover material prior to the adjacent application of asphalt-rubber binder. Transverse joints shall be made by placing building paper over the ends of the previous applications. The joining application shall start on the building paper. Once the application process has progressed beyond the paper, the paper shall be removed and disposed of to the satisfaction of the Engineer. All reasonable precautions shall be taken to avoid skips and overlaps at joints and to protect the surfaces of adjacent structures, trees and shrubs, etc., from being spattered or marred. Correction of any such defects will be required at no additional cost to the Contracting Agency.

Traffic will not be permitted on the surface until after sweeping operations have finished and the cover aggregate has set. Traffic control shall be in accordance with Section [401](#) as supplemented by the Contracting Agency.

At signalized intersections, an application of 2 to 5 pounds of sand blotter per square yard shall be applied through the intersection and for a distance of 200 feet each way from the near curb returns after rolling and before opening a lane to traffic. Sand Blotter shall meet requirements of Section [333](#).

After sweeping and prior to striping, a fog seal coat shall be applied to the asphalt-rubber seal consisting of 0.05 to 0.10 gallons per square yard according to Section [333](#). The application of the fog seal coat may be delayed to facilitate curing or to avoid placement under unfavorable high temperature conditions.

Note: The fog seal coat shall not be applied to the area 200 feet either side of and through signalized intersections.

### 335.6 MEASUREMENT:

Certified weight slips of all materials shall be delivered to the Engineer before the materials are applied.

Certified weight slips of any bituminous material being weighed back in for credit shall be delivered to the Engineer for the next day.

Quantities of materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items actually used on the project.

(A) Cover Material (Precoated)	Ton
(B) Asphalt Rubber Binder	Ton
(C) Emulsified Asphalt (Fog Seal)	Ton (diluted)
(D) Sand Blotter	Ton (surface dry)

### 335.7 PAYMENT:

Payment will be full compensation for furnishing and placing all materials specified and used, with no allowance for waste, and shall include labor, equipment, tools, and incidentals necessary to complete the work as prescribed in the specifications and as directed by the Engineer.

Asphalt cement for precoating chips will be included in the price per ton for hot precoated chips.

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No payment will be made for materials rejected due to improper placing, improper proportions of materials, or materials found to be defective.

*- End of Section -*

## SECTION 336

### PAVEMENT MATCHING AND SURFACING REPLACEMENT

#### 336.1 DESCRIPTION:

Street and alley pavement and surfacing within the Contracting Agency's rights-of-way, removed by construction activities or to be widened or matched in connection with the improvement of Public Works, shall be placed as shown on the plans and applicable standard details, in accordance with this specification and/or the special provisions.

Asphalt concrete roadway pavement replacement shall be constructed in accordance with Type A, B, or T-Top of Standard Detail 200-1 and as indicated on the plans or in the special provisions.

Portland cement concrete pavement replacement shall be in accordance with Type C of the Standard Detail 200-1 and as required by Section [324](#).

All other surface replacement in the right-of-way but not in paved roadways shall be constructed in accordance with Type D of Standard Detail 200-1 and as indicated on the plans.

Temporary pavement replacement shall be constructed as required herein.

Pavements to be matched by construction of new pavements adjacent to or at the ends of a project shall be milled or saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within ADOT rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

#### 336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and surfacing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

**336.2.1 Pavement Widening or Extensions:** Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a device specifically designed for this purpose. The minimum depth of cut shall be 1 ½ inches or D/4, whichever is greater.

The existing pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphalt concrete for pavement widening or extension, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphalt concrete pavements. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the widening or pavement extension.

The exact point of matching, termination, and overlay may be adjusted in the field, if necessary, by the Engineer or designated representative.

**336.2.2 Pavement to be Removed:** Existing asphalt pavement to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability of the cutting device and manner of operation shall be final.

In lieu of cutting trenches across driveways, curbs and gutters, sidewalks, alley entrances, and other types of pavements, the Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

When installations are within the street pavement and essentially parallel to the center line of the street, the Contractor, with approval of the Engineer, may elect to bore or tunnel all or a portion of the installation. In such installations, the seal coat requirements, as discussed in Subsection [336.2.4](#), will be modified as follows:

(A) If the pavement cuts (bore pits, recovery pits, etc.) are 300 feet or more apart, the bore or tunneled distance will not be

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considered as part of the open trench and the seal coat may not be required.

(B) If the pavement cuts (bore pits, recovery pits, etc.) are less than 300 feet apart, the distance between the cuts will be considered the same as a trench cut and the distance will be added to any trench cut distances.

**336.2.3 Temporary Pavement Replacement:** Temporary pavement replacement as required in Section 601 may be made using cold mix asphalt concrete. The cold mix shall be MC-70 or MC-250 liquid asphalt (6.0 +/- 0.4 percent) combined with the aggregate gradation shown below. Paving asphalt AC 2.5 (5.5 percent) may be substituted for the liquid asphalt. AC 2.5 must be heated for mixing.

**TABLE 336-1**

SIEVE SIZE	% PASSING	TOLERANCE
3/4"	97-100	+/- 7%
1/2"	88	+/- 7%
3/8"	78	+/- 7%
#4	60	+/- 7%
#8	47	+/- 5%
#30	25	+/- 5%
#200	.5	+/- 2%

Temporary pavement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

The cold mix shall be placed in two inch increments and compacted with a roller that has not less than 60 psi. contact pressure. Each layer shall be compacted to 96 percent of the laboratory compacted density for like materials. On small areas where the use of the equipment specified above is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained. The surface of the temporary pavement shall be flush with the adjacent pavement.

### **336.2.4 Permanent Pavement Replacement and Adjustments:**

**336.2.4.1 Permanent Pavement Replacement:** All pavement replacement shall match gradation and thickness of the existing pavement. Pavement replacement shall be compacted to the same density specified for asphalt concrete pavements in Section [321](#). The compacted thickness of all courses shall conform to the requirements of Table [710-1](#).

Unless otherwise noted, pavement replacement shall comply with the following:

- (A) Single course pavement replacement shall consist of a 1/2" or 3/4" mix in accordance with Section [710](#).
- (B) The base course(s) of a multi-course pavement replacement shall consist of a 3/4" mix in accordance with Section [710](#).
- (C) The surface course of a multi-course pavement replacement shall consist of a 3/8" or 1/2" mix in accordance with Section [710](#) to match the existing surface.
- (D) Where the base course is to be placed with non-compactive equipment, it shall be immediately rolled with a pneumatic-tired roller.
- (E) Where the trench is 6 feet or more in width, all courses shall be placed with self-propelled spreading and compacting equipment. When the trench is from 6 to 8 feet in width, self-propelled spreading and compacting equipment shall not be wider than 8 feet.
- (F) Placement of the surface course is to be by means which will result in a surface flush with the existing pavement.

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The pavement replacement surface shall not vary more than 1/4 inch from the lower edge of a straightedge placed across the replacement pavement surface between edges of the existing matched surfaces. When the pavement replacement includes replacement of the roadway crown, the surface smoothness shall comply with requirements of Section [321](#).

Laying a single course or the base course(s) of the asphalt concrete pavement replacement shall never be more than 600 feet behind the ABC placement for the pavement replacement.

The trench must be compacted to its required density, and required ABC must be in place and compacted prior to the placement of the asphalt concrete. For cuts greater than 300 feet in length the entire area shall then be slurry seal coated in accordance with Section [332](#) or as otherwise specified. This seal coat shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb or where the pavement patch straddles the centerline, the entire width of street shall be seal coated.

In lieu of placing the seal coat as required previously, and with approval of the Contracting Agency, the Contractor may deposit with the Contracting Agency for credit to the Street Maintenance Department, a negotiated agreed upon amount. The Street Maintenance Department will incorporate this work into their street maintenance program.

**336.2.4.2 Adjustments:** The Contractor shall be responsible for adjusting to grade all new and existing manholes, valves, survey monuments, clean outs, etc., as directed by the Engineer. The Contractor shall remove all asphalt material and aggregate from this or prior work from all metal lids and covers encountered using a method approved by the Engineer. Debris will not be allowed to enter sanitary or storm drains. All loose material shall be removed from the excavation site and the interiors of structures prior to resetting the frames.

The Contractor shall coordinate with the various utility companies regarding the adjustment and inspection of their facilities. Each utility company's specifications shall be adhered to during the adjustment. The Contractor shall be responsible for meeting any additional requirements of the utility companies.

Manhole frames shall be adjusted according to the MAG Standard Detail 422, except that the concrete collar shall extend up to the finished grade. Water valve, survey monument, and sewer clean out frames shall be adjusted in accordance with the COP Standard Details P1270 and P1391.

The work will be done in compliance with OSHA standards and regulations regarding confined space entry. The Contractor shall remove all material attached to the lids and/or covers including that of prior work. The method of removal shall be approved by the Engineer and/or the Utility Representative.

### **336.3 TYPES AND LOCATION OF BACKFILL AND SURFACING REPLACEMENT:**

Normally, the type of pavement replacement and backfill required for the trench excavation will be noted on the plans or specified in the special provisions and construction will be in accordance with COP Standard Detail P-1200.

- (A) Unless otherwise specified, the "T" top as shown in COP Standard Detail P-1200 will not be required within the City of Phoenix. If the project extends into another municipality/county the "T" top may be required for that portion of the project.
- (B) When the trench excavation is not being accomplished in conjunction with a paving project, the following backfill and pavement replacement requirements apply:
  - (1) When the trench is transverse (45 to 90 degrees to street centerline) the backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.
  - (2) When the trench is parallel or less than 45 degrees to the street centerline, the backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is required.
  - (3) When the trench crosses a major street, collector street, or any other signalized intersection, the backfill materials required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.

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- (C) When the trench excavation is being accomplished in conjunction with a paving project the following backfill and pavement replacement requirements apply:
- (1) When the trench is transverse (45 to 90 degrees to street centerline) the backfill material required by COP Standard Detail P-1200 for Type B will be used. Permanent pavement replacement is not required.
  - (2) When the trench is parallel or less than 45 degrees to the street centerline, the backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is not required.
  - (3) When the trench crosses a major street, collector street, or any other signalized intersection, the backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is not required.
  - (4) Temporary pavement replacement (Subsection [336.2.3](#)) will be required at intersections for traffic control and at existing partial paved areas when the total pavement is not scheduled for immediate removal and replacement. In addition to the above, the Engineer may require temporary pavement at any area where public safety and welfare warrants. This will be a non-pay item considered incidental to the project.
  - (5) If the excavation extends beyond the limits of the paving project, the Contractor shall provide permanent trench pavement replacement in accordance with paragraph (B) for this extension.
- (D) When the trench excavation is made in portland cement concrete pavement, COP Standard Detail P-1200 Type C backfill and pavement replacement applies.
- (E) When the condition of the existing pavement does not justify the use of COP Standard Detail P-1200, Type A or Type B backfill, Type D backfill and pavement replacement shall apply. Written approval from the Engineer shall be required.
- (F) When the trench excavation is made in ABC or decomposed granite pavement, COP Standard Detail P-1200 Type E backfill and pavement replacement shall apply.
- (G) When the trench excavation is made in asphalt concrete pavement which has a soil cement base course, concrete treated base course or bituminous treated base course, the Contractor has the option of matching the existing pavement structure, including all courses, or replacing the pavement structure with equivalent full depth asphalt concrete pavement. For computing the equivalent asphalt concrete pavement required, 1 inch of asphalt concrete is equivalent to 3.25 inches of ABC or 1.4 inches of soil cement, cement treated base or bituminous treated base. After computations are completed, the equivalent depth will be rounded off to the next higher 1/2 inch, i.e., 6.15 inches computed would be rounded to 6.5 inches.

### 336.4 MEASUREMENT:

Measurement and payment for permanent pavement replacement will be by the square yard, for the thickness specified. In computing the pay quantity, the field measurement along the centerline of the trench and the trench pay width as listed in Section [601](#) shall be used. When the longitudinal trench is only partially in the pavement, adjustments in the pay width will be made by the Engineer.

There will be no separate measurement for pipe bedding, haunching, initial backfill, final backfill and compaction. The cost of the pipe, bedding, haunching, initial backfill, final backfill and compaction shall be considered incidental to the cost of the pipe.

Unless otherwise included in a separate pay item in the proposal, removal of obstructions shown on the plans shall be considered incidental to the cost of the pipe.

There will be no separate measurement for subgrade preparation or asphalt pavement removal. Subgrade preparation and

## SECTION 336

asphalt pavement removal shall be considered incidental to the cost of the permanent pavement and surface replacement.

(A) In computing pay quantities for replacement Types A, B, C and E, pay widths will be based on the actual field measured width; however the boundaries of the measurement will not extend further than  $\frac{1}{2}$  the distance, either side, from the centerline of the pipe as specified in Table 601-1, Maximum Width At Top of Pipe Greater Than O.D. of Barrel.

(B) In computing pay quantities for replacement Types B-“T” Top, and D, pay widths will be based on the actual field measured width, however the boundaries of the measurement will not extend further than  $\frac{1}{2}$  the distance plus 12 inches, either side, from the centerline of the pipe as specified in Table 601-1, Maximum Width At Top of Pipe Greater Than O.D. of Barrel. In all cases, the minimum pay width for replacement Types B-“T” Top and D shall be 48 inches.

(C) Where a longitudinal trench is partly in pavement, computations of pay quantities shall be based on the limitations specified above.

(D) The length of pavement and surfacing replacement shall be measured through any manhole, valve box, or other structure constructed in the pipe line, and any pavement or surface replacement and/or seal treatment in excess of the above pay widths shall be considered and included in the bid item for such structure.

(E) Any pavement replacement in excess of the specified pay widths necessitated by the installation of valves, tapping sleeves and valves, valve by-passes, and concrete thrust blocks shall be included in the bid price for these items.

(F) When special provisions allow deviations from the trench widths specified in Section 601, the above allowed pay widths for pavement replacement may be altered where so specified.

(G) Measurement of pavement and surfacing replacement shall be made along the finished surface of the ground to the nearest foot, and shall be computed to the nearest square yard.

### **336.5 PAYMENT:**

Direct payment for pavement or surfacing replacement will be made for replacement over all pipe trench cuts except as otherwise allowed in the special provisions. Payment for replacements over other work shall be included in the cost of constructing that work, in accordance with the applicable standard details and specifications.

Payment for pipe bedding, haunching, initial backfill, final backfill and compaction shall be included in the cost of the pipe.

Payment for removal of obstructions shown on the plans, and not otherwise included in a separate pay item in the proposal, shall be included in the cost of the pipe.

Payment for subgrade preparation and asphalt pavement removal shall be included in the cost of the permanent pavement and surface replacement.

Payment for temporary pavement replacement shall be included in the cost of the pipe.

Payment for pavement replacement shall include the replacement cost of any existing pavement markings that have been obscured, obliterated or removed by underground trench construction or repairs.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavement, curb and gutter, sidewalk, driveway, and alley entrances, as allowed for open cut construction.

*End of Section -*

## SECTION 337

### CRACK SEALING

#### 337.1 DESCRIPTION:

This work consists of furnishing and placing sealant material in Contractor prepared cracks and joints of asphalt concrete or portland cement concrete pavements. All cracks and joints, including the space between asphalt concrete pavement and the curb and gutter, which have a clear opening of one-quarter inch ( $\frac{1}{4}$ " ) or greater, shall be sealed for the length of the crack that equals or exceeds one-eighth inch ( $\frac{1}{8}$ " ) in width. The Contractor shall notify the Engineer when cracks are encountered that have an opening greater than one inch ( $>1$ " ). The Engineer shall specify the treatment requirements for cracks having an average clear opening greater than one inch ( $>1$ " ).

#### 337.2 MATERIALS:

Sealant materials shall be a premixed, single component mixture of asphalt cement, aromatic extender oils, polymers, and granulated rubber in a closely controlled manufacturing process. Materials shall conform to the following specifications when heated in accordance with ASTM D5078 and the manufacturer's maximum safe heating temperature.

TEST	REQUIREMENT
Cone Penetration (ASTM D5329)	20-40
Resilience (ASTM D5329)	30% Minimum
Softening Point (ASTM D113)	210°F (99°C) Minimum
Ductility, 77°F (25°C) (ASTM D113)	30 cm Minimum
Flexibility (ASTM D3111 *Modified)	Pass at 30°F (-1°C)
Flow 140°F (60°C) (ASTM D5329)	3 mm Maximum
Brookfield Viscosity 400° (204°C) (ASTM D2669)	100 Poise Maximum
Asphalt Compatibility (ASTM D5329)	Pass
Bitumen Content (ASTM D4)	60% Minimum
Tensile Adhesion (ASTM D5329)	400% Minimum
Maximum Heating Temperature	400°F (204°C)
Minimum Heating Temperature	380°F (193°C)
Flash Point (ASTM D92)	450°F Minimum

\*Specimen bent 90° over a 1-inch mandrel within 10 seconds.

**337.2.1 Certification and Quality Assurance:** Prior to application, the Contractor shall submit certification of compliance to the Engineer for all materials to be used in the work.

#### 337.3 EQUIPMENT:

The melter applicator unit shall be a self-contained double boiler device with the transmittal of heat through heat transfer oil. It must be equipped with an on board automatic heat controlling device to permit the attainment of a predetermined temperature, and then maintain that temperature as long as required. The unit shall also have a means to vigorously and continuously agitate the sealant to meet the requirements of Appendix X1.1 of ATSM D6690. The sealant shall be applied to the pavement under pressure supplied by a gear pump with a hose and wand and direct connecting applicator tip. The pump shall have sufficient pressure to apply designated sealant at a rate of at least three (3) gallons (11.4 L) per minute. Melter applicators shall be approved for use by the sealant manufacturer.

#### 337.4 CLEANING AND PREPARING CRACKS OR JOINTS:

Immediately prior to application of sealant, all cracks and joints shall be cleaned of debris and dust. Cracks and joints shall be vacuumed during final cleaning.

**337.4.1 Routing:** Routing, when specified, shall create a sealant reservoir. Cutting should remove at least  $\frac{1}{8}$ " from each side and produce vertical, intact surfaces with no loosely bonded aggregate. Routing of joints and cracks shall produce a reservoir having a nominal size of  $\frac{3}{4}$ " wide x  $\frac{3}{4}$ " deep. Variations from the nominal size are subject to acceptance or rejection at the engineer's discretion.

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**337.4.2 Vacuuming:** Final cleaning shall thoroughly clean cracks and joints to a minimum depth of 1". The vacuum unit shall use high pressure 90 psi minimum, dry oil free compressed air to remove remaining dust. The high pressure tool shall be integral with a vacuum unit to collect the dust and residue. Both sides of the crack or joint shall be cleaned. Surfaces will be inspected to assure adequate cleanliness and dryness.

### 337.5 APPLICATION:

**337.5.1 Weather:** In no case shall sealant be placed during damp roadway conditions such as wet roadway surfaces or damp material inside the cracks. Operations stopped by the Engineer, due to weather, shall be at no additional cost to the contracting Agency. If installing at night, ensure that dew is not forming on the pavement surface.

Sealant material shall only be applied when pavement temperature exceeds 40°F (4°C). If pavement temperature is lower than 40°F (4°C), it may be warmed using a heat lance that puts no direct flame on the pavement.

**337.5.2 Temperature:** Sealant temperatures should be maintained at the maximum heating temperature recommended by the manufacture.

**337.5.3 Placement of Sealant:** The sealant shall be applied in cracks, joints, and sealant reservoirs uniformly from bottom to top and shall be filled without formation of entrapped air or voids.

Cracks and joints shall be slightly overfilled then leveled with a 3" sealing disk or v-shaped squeegee to create a neat band extending approximately 1" on each side of the crack or joint for surface waterproofing. The band shall be as thin as possible and shall not extend more than 1/8 inch above the pavement surface.

If the pavement is to be overlaid with Hot Mix Asphalt within six months of sealant application, cracks shall be routed, and sealant placement shall be recessed 1/4" in the crack or joint reservoir with no over band. If routing is not used, the sealant over band thickness and width should be kept as narrow and thin as possible.

During and after placement of the sealant, the Contractor shall protect against harm to persons or animals that may be exposed to the hot material.

**337.5.4 Unacceptable Work:** The Contractor, at no additional cost to the contracting Agency, shall correct unacceptable work. Unacceptable work shall include, but not be limited to, unsealed cracks, material wastage on the sides of the roadway, and excess quantities of material on the roadway that adversely affects driving.

Correction of unacceptable work shall be accomplished within five working days after notification from the Engineer of the unacceptable work. The Contractor shall not progress to a new area until the unacceptable work is corrected to the satisfaction of the Engineer.

**337.5.5 Reporting Requirements:** The Contractor shall meet with the Engineer or the Engineer's designated representative on a daily basis and supply a signed daily report indicating the amount of crack sealant material applied for the day in total pounds and total square yards of pavement sealed. In addition, the Contractor shall supply the Engineer with the dates of completion of each road segment.

### 337.6 OPENING TO TRAFFIC:

Sealant material shall not be exposed to traffic until fully cured. If the sealed area must be open to traffic, blotter material shall be applied to the surface of all uncured sealant material.

All sealed cracks that have an average clear opening of 1½ inches or greater shall have blotter material applied prior to opening to traffic.

**337.6.1 Blotter:** On two lane roads or where traffic may come in contact with the hot sealant before it cures, a blotter or specialized bond breaking material shall be used to prevent asphalt bleeding and/or pickup of sealant by vehicular traffic. Blotter material shall be compatible with the crack sealant and any surface treatment being used.

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### **337.7 MEASUREMENT:**

Accepted pavement crack sealing shall be measured as indicated in the fee proposal by one of the following methods: square yards of pavement surface area sealed, pounds of sealant placed, or linear feet of cracks sealed.

### **337.8 PAYMENT:**

Payment for pavement crack sealing at the contract unit price shall be full compensation for all labor, materials, equipment, tools, and incidentals used for surface preparation, placement of crack sealant and blotter materials, and cleanup.

*- End of Section -*

## SECTION 340

### CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE

#### 340.1 DESCRIPTION:

The various types of concrete curb, gutter, sidewalk, curb ramps, driveways and alley entrances shall be constructed to the dimensions indicated on the plans and standard detail drawings.

#### 340.2 MATERIALS:

Concrete class shall be as specified on the plans, special provisions, and standard details. Concrete shall conform to the requirements of Section [725](#).

Expansion joint filler shall be ½-inch thick preformed bituminous material in compliance with Section [729](#), unless otherwise noted.

**340.2.1 Detectable Warnings:** Truncated dome dimensions and spacing for detectable warnings are defined by the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) and, upon its adoption, the Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) for optimal detect-ability and public safety.

Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the ADAAG and, upon its adoption, the PROWAG. Detectable warning edges shall be sized and installed so that dome spacing is maintained across adjoining edges. Each dome shall have a minimum static friction of coefficient of 0.8 as tested per ASTM C1028.

**340.2.1.1 Color and Contrast:** Detectable warnings shall contrast visually with adjoining surfaces, either light-on-dark or dark-on-light. Specific colors to be used shall be approved by the local jurisdictional agency prior to installation. Detectable warnings shall have integral color throughout.

**340.2.1.2 Materials:** Detectable warning materials shall be durable with a non-slip surface not subject to spalling, chipping, delamination, or separation. All detectable warnings shall be approved by the local jurisdictional agency prior to installation.

**340.2.1.3 Attachment System:** Detectable warning tiles shall be back buttered with an approved, commercial-source, 5000 psi non-metallic non-shrink grout, and wet-set in freshly placed concrete to assure complete and continuous contact of the detectable warning tile bottom surface with the concrete as it cures, thus rendering the ramp a single monolithic structure.

Repair and replacement of existing detectable warning tiles shall conform to a method recommended by the manufacturer and approved by the Engineer.

#### 340.3 CONSTRUCTION METHODS:

Existing concrete shall have a clean vertical edge where it is to be joined by new construction. Saw cutting is required when the existing matching edge is not a straight vertical edge.

**340.3.1 Subgrade Preparation:** The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section [301](#). All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer. Removal and replacement of soft or unsuitable materials will be paid for as extra work.

Subgrade classified as marginally expansive or expansive as defined in Table [340-1](#) shall be treated as follows unless the construction documents require alternative measures for mitigation of expansive soils. The upper 6 inches of marginally expansive soils shall be compacted per Subsection [301.3](#) at a moisture content between 0% to 3% above optimum moisture per ASTM D698. Expansive soils shall be considered unsuitable and shall be treated or removed and replaced with material as directed by the Engineer. Alternate corrective measures contained in an existing geotechnical report or new site analysis can be submitted to the Engineer for approval. The submittal of alternative corrective measures must be a recommendation of an Arizona registered engineer and have the professional seal affixed.

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<b>Table 340-1</b>			
Description	Percent Fines (- #200 sieve) <sup>(1)</sup>	Plasticity Index <sup>(2)</sup>	Additional Testing
Non-expansive	> 20%	≤ 15	None
Potentially expansive		> 15	Perform Swell Test <sup>(3)</sup>
Description	% Swell <sup>(3)</sup>		
Non-expansive	< 1		
Marginally expansive	1 – 3		
Expansive	> 3		

(1) Tested in accordance with ASTM C117

(2) Tested in accordance with AASHTO T-90 (wet prep per AASHTO T-146)

(3) Swell Test: Samples for swell tests shall be re-molded in accordance with ARIZ 249 (ADOT Materials Testing Manual) to 95% of maximum dry density at optimum moisture as determined by ASTM D698 and tested for one-dimensional expansion in accordance with the applicable portions of ASTM D4546 applying a surcharge of 144 psf.

Material removed for construction shall not be placed on the base and/or surfacing material already in place on the roadway nor shall the excavated material be placed in such a manner as to interfere with access to property or traffic flow in the street.

**340.3.2 Formwork:** Concrete curbs, gutters and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of an appropriate machine when approved by the Engineer.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machine shall be discontinued and the Contractor shall make necessary repairs at his own expense. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, curb ramps, driveway, and alley entrance shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete.

Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the concrete.

**340.3.3 Concrete Placement:** The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate is below the concrete surface. The surface shall then be struck off and worked to grade and cross section with a float.

If machine placement is used, the machine shall place, consolidate and finish the concrete in one complete pass, requiring a minimum of hand finishing producing a dense and homogeneous section. A form shall trail behind the machine for such a distance that no appreciable concrete slumping will occur. Final finishing shall be as specified in Subsection [340.3.7](#), Form Removal and Finishing.

**340.3.4 Joints:** Shall be constructed in a straight line, vertical plane and perpendicular to the longitudinal line of the sidewalk, curb and gutter, single curb, etc., except in cases of curved alignment, where they shall be constructed along the radial lines of the curve.

Curb and gutter joints shall match the location of concrete pavement joints when abutting concrete pavement.

The space between joints in curbs and gutters (space between contraction joints or between contraction and expansion joints) shall not exceed ten feet.

Sidewalk that abuts curb or gutter shall have joints that match the curb or gutter joints.

**340.3.4.1 Expansion Joints:** Expansion joints shall be constructed to the full depth and width of the concrete. The expansion joint material shall extend fully through the concrete and one inch into the subgrade with the top of the expansion joint

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material one-quarter inch below the top surface. Expansion joint material shall be secured in place prior to placement of concrete.

Expansion joints shall be installed along all abutting structures to provide complete separation from the structure.

Sidewalk, curb, and gutter expansion joints shall be installed at all radius points, at both sides of each driveway, at both sides of each alley entrance, between intersecting sidewalks and at adjacent portland cement concrete slabs and driveways. The maximum distance between expansion joints shall be 50 feet.

**340.3.4.2 Contraction Joints:** Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the minimum finished depth of contraction joints shall be 3/4 inch.

Unless an expansion joint is required, a contraction joint shall coincide with each form joint.

Sidewalk score marks shall not exceed 1/2 inch width, be at least 1/2 inch deep and shall be placed midway between contraction joints.

**340.3.5 Edges:** All exposed edges shall be shaped with a suitable tool to form edges having the shape as indicated on the referenced detail.

**340.3.6 Detectable Warnings:** Detectable warnings shall be installed perpendicular to the direction of pedestrian/wheelchair travel and have a minimum width of 24 inches measured perpendicular to the edge of the roadway or rail crossing. The base surface of detectable warnings shall be installed flush with the adjacent walkway surface; the truncated domes shall extend above the walkway surface. The boundary between detectable warnings and the adjacent walkway shall provide a flush uniform surface that will not cause ponding of water nor present a tripping hazard. Partial domes at the edge of the detectable warning shall be made flush to match the base surface of the detectable warning. Detectable warnings installed on curb ramps shall extend the full width of the ramp depression.

Detectable warnings installed on curb ramps shall modify the sidewalk concrete thickness at the detectable warning to provide a minimum concrete thickness of four-inches (4"). When detectable warnings are modules inset into the curb ramp, the bottom surface of the sidewalk shall be lowered a distance equal to or greater than the module thickness to maintain the minimum sidewalk thickness. The sidewalk bottom surface shall have a minimum transition taper length of 12" between the thickened and normal depth sections of sidewalk. The detectable warning surface shall be located so that the edge nearest the curb line is 6 inches minimum and 8 inches maximum back from the face of curb.

Detectable warning surfaces for pedestrian at-grade rail crossings not located within a street or highway shall be installed on each side of the rail crossing, located as shown on plans. Detectable warnings shall extend the full width of the pedestrian walkway.

**340.3.7 Form Removal and Finishing:** The front face form shall not be removed before the concrete has taken initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Any portion of concrete damaged while stripping forms shall be repaired or replaced at no additional cost to the Contracting Agency.

After the forms are removed, the joints shall be tooled and the surface finished with a float to remove all imperfections. As needed, retool joints after finishing to prevent groove bonding. In all cases, the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed. No plastering of the concrete will be allowed. The concrete work shall have a true surface; shall be free from sags, twists, or warps; have a uniform appearance; and be true to the lines, grades, and configurations indicated on the drawings.

Surfaces shall be light broom finished; flow lines shall be troweled for a smooth finish.

If the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete due to weather conditions, materials used, or for any other reason, and there is any likelihood of the fresh concrete checking or cracking before the curing operation, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted as an indirect fog spray

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with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the manufacturer's recommendations. At no time will free water/evaporation reducer be worked into the concrete surface. Approved measures shall continue until curing operations per Subsection [340.3.8](#), Curing, are started in the particular area affected.

The Contractor shall stamp the company name and year on each end of the sidewalk or curb ramp constructed. The letters shall not be less than 3/4 inch in height and the depth of the stamped impression shall be between 1/8-inch and 1/4-inch.

**340.3.8 Curing:** As soon after the completion of the finishing operation as the condition of the concrete will permit, all exposed surfaces shall either be sprayed with a pigmented curing compound or sealed with a material conforming to Section [726](#). Curing compound shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely seal all exposed concrete surfaces with a uniform film. The membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. Concrete surfaces shall be kept damp until the curing compound is applied. Should the curing compound seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional curing compound over the damaged area.

The need for adequate curing is greatest during the first few hours after placement of the concrete.

**340.3.9 Tolerances:** The face, top, back, and flow line of the curb and gutter shall not deviate in excess of 1/4-inch over 10 feet, as tested with a 10-foot straightedge or curve template, longitudinally along the surface.

The surface of concrete sidewalk or curb ramp shall not deviate in excess of 1/8-inch over 5 feet as tested with a 5-foot straightedge except for the 1/4-inch recess of the preformed material in expansion joints.

All finished concrete elevations shall not deviate from the elevations shown on the plans, or indicated by typical sections or standard details referenced within the construction documents, by more than 1/2 inch.

When required by the Engineer, gutters shall be water tested. The Contractor shall establish flow in the length of gutter to be tested by supplying and distributing water from a hydrant, tank truck or other source. After the supply of water is shut off and water has stopped flowing, the gutter shall be inspected for evidence of ponding or improper shape. The work shall be deemed deficient if water is found ponded in the gutter to a depth greater than 1/2 inch or ponding extends onto the adjacent asphalt pavement.

Areas between elevations shown on the plans shall be straight graded or smoothly transitioned through a vertical curve in a manner approved by the Engineer or as otherwise indicated on the construction documents.

**340.3.10 Deficiencies:** Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency. Replacement or reconstruction shall be from joint to joint.

Concrete work that does not comply with tolerance requirements of Subsection [340.3.9](#), Tolerances, shall be removed and replaced. Remove and replace gutters that exceed the ponding tolerance. Grinding shall only be allowed if approved by the Engineer.

### **340.4 BACKFILLING:**

Unless otherwise specified the Contractor shall backfill behind the curbs, sidewalk or curb ramps with soil native to the area to the lines and grades shown on the plans.

### **340.5 MEASUREMENT:**

Concrete curbs and gutters of the various types shown on the plans and in the proposal will be measured along gutter flow line through inlets, catch basins, driveways, curb ramps, etc., by the lineal foot to the nearest foot for each type, complete in place. Measurement for curb terminations and transitions shall be included with the linear measurement of the various types of curb or curb and gutter as shown on the plans and in the proposal.

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Curb and gutter type shall be based on the configuration of the final exposed surfaces. The increased curb and gutter depth required at valley gutter aprons or driveways shall not be measured as a separate pay item; any additional Contractor cost shall be included in the unit cost associated with the valley gutter, driveway or other associated item.

Concrete sidewalks, driveways, alley intersections, valley gutters and aprons will be measured to the nearest square foot complete in place.

Detectable warnings shall be measured by the square foot.

Curb ramp installations shall be measured as complete installed units and shall include the ramp curb and the walking surfaces between the ramp curb and back of curb and gutter or single curb. Single curb or curb and gutter located at the edge of roadway shall be measured and paid for separately. The surface area of the curb ramps shall be included in the measured quantity for sidewalk.

### **340.6 PAYMENT:**

Payment for the above named items will be made at the unit price bid in the proposal. Such payment shall include full compensation for the necessary removal of asphalt pavement, subgrade preparation and for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

Payment for detectable warnings will be made at the unit price bid in the proposal for detectable warning strip. Such payment shall include full compensation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

*- End of Section -*

**SECTION 342**

**DECORATIVE PAVEMENT  
CONCRETE PAVING STONE**

**342.1 GENERAL:**

The Contractor shall furnish all necessary labor, material, tools and equipment to complete the proper installation of decorative concrete pavers used in medians, crosswalks, intersections or as otherwise noted in the Contract Documents. This includes furnishing a 10-foot straightedge to accomplish the level test when required by this specification.

The decorative pavement shall be true in line and grade and installed to coincide and align with the adjacent work elevation. All edges shall be retained to secure the pavers and sand laying course.

The Contractor shall construct a sample panel 10-feet by 10-feet for inspection and approval by the Engineer, prior to the actual installation for the project. Once approved, the panel shall be used as a standard for the remainder of the work. The panel shall remain undisturbed throughout the construction of the pavers and final approval by the Engineer.

**342.2 MATERIALS:**

**342.2.1 Aggregate Base Course:** Aggregate Base Course shall be per Table [702-1](#).

**342.2.2 Portland Cement Concrete:** When the pavers are subject to vehicular traffic, portland cement concrete shall be Class A per Section [725](#). All other locations, the portland cement concrete shall be a minimum of Class B per Section [725](#).

**342.2.3 Sand:** Sand used for laying course shall conform to ASTM C33 except for the gradation. The gradation shall comply with Table [342-1](#).

<b>TABLE 342-1</b>								
<b>SAND GRADATION</b>								
Sieve Size	3/8 inch	No. 4	No. 8	No. 16	No.30	No. 50	No. 100	No. 200
Percent Passing	100	95-100	85-100	15-85	25-60	10-30	2-10	0-1

**342.2.4 Concrete Pavers:** Pavers shall have a minimum of thickness of 80 mm (3.15) when installed in traffic bearing areas and 60 mm (2.36 in.) When installed in non-traffic bearing areas. Pavers shall be of an interlocking design conforming to ASTM C936-82. Pavers shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. The Contractor shall submit two samples of each type of pavers used on the project for review and approval by the Engineer prior to any work. The pavers and materials used in their manufacture shall conform to the following:

- (A) Compressive Strength: Pavers shall have a minimum compressive strength of 8,000 psi in accordance with ASTM C140.
- (B) Absorption: The average absorption shall not be greater than 5 percent, with no individual unit absorption greater than 7 percent.
- (C) Portland Cement: Cement shall comply with Subsection [725.2](#), Type II.
- (D) Aggregates: Aggregates shall conform to ASTM C33 (washed, graded sand and rock, no expanded shale or lightweight aggregates).
- (E) Other Constituents: Coloring pigments shall be applied integrally to the concrete. Air entraining admixtures, coloring pigments, integral water repellents, and finely ground silica shall be previously established as suitable for use in concrete and either shall conform to ASTM standards where applicable, or shall be shown by test or experience not to be detrimental to the concrete.
- (F) Physical Properties: The size, shape, design and color of the pavers shall be as noted in the Contract Documents.

**342.2.5 Expansion Joint:** Expansion joint filler material shall be 1/2-inch premolded and comply with Section [729](#) and ASTM D1751.

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### 342.3 CONSTRUCTION PROCEDURES:

**342.3.1 Subgrade:** The subgrade shall be constructed true to grades and lines shown on the plans and compacted to a minimum dry density of 95% as specified in Section [301](#).

**342.3.2 Aggregate Base Course:** The base course for decorative pavement shall consist of CLSM of a thickness specified in the plans or special provisions. 1-Sack CLSM shall be installed over subgrade soil compacted to a minimum of 95% density. The surface elevation of the CLSM shall be set to bring the 1-inch sand laying course, plus the thickness of the paving stones or bricks to the desired finished elevation of decorative pavement. The surface of the 1-Sack CLSM shall not vary more than +1/8 inch in 10 feet.

**342.3.3 Concrete Header and Base Slab:** Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the portland cement concrete.

The portland cement concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. Compacted by mechanical vibrators may be used when approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate has been tamped below the surface.

All edges shall be shaped with a suitable tool to form a rounded edge of radius as directed in MAG Standard Detail 225.

The portland cement concrete header face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. The concrete header outer form shall not be removed until the concrete has hardened sufficiently to prevent any damage to the concrete. Any porting of concrete damaged while stripping forms shall be repaired or if the damage is severe, replaced at no additional cost to the Contracting Agency. The face and top of the concrete header shall be tested with a 10-foot straightedge or curve template, longitudinally along the surface. Any deviation in excess of 1/4-inch in 10-feet shall be corrected at no additional cost to the Contracting Agency.

Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency.

Finishing and curing of the concrete shall be done in the manner specified in Section [340](#).

**342.3.4 Expansion Joints:** Expansion joints shall be constructed to the full depth and width of the concrete with the top of the material one-half inch below the top surface as depicted in MAG Standard Detail 225 unless otherwise specified. After the concrete is cured, the top one-half inch shall be filled to the surface of the concrete with a premium-grade, high-performance, moisture-cured, single-component, polyurethane-based, non-sag elastomeric sealant, ASTM C920, Type S, Grade NS, Class 25, Sikaflex-1A or equal.

Joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they will be constructed along the radial lines of the header. In the case of base slabs, pavers shall be placed continuously over the expansion joints.

**342.3.5 Contraction Joints:** Contraction joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they will be constructed along the radial lines of the header. They shall be constructed to a depth of one inch with rounded edges and placed at 10-foot intervals. Contraction Joints shall be filled to the surface of the surrounding concrete with elastomeric sealant specified in [342.3.3](#).

**342.3.6 Sand Laying Course:** The maximum thickness of the sand course shall be one-inch. Screeding boards shall be used to ensure a uniform thickness. The sand shall not be compacted, walked on or wet down.

**342.3.7 Concrete Paving Stones:** The concrete pavers shall be clean and free of foreign materials before installation. Paving work shall be plumb, level and true to line and grade and shall be installed to properly coincide and align with adjacent work and elevations. All edges must be retained to secure the perimeter pavers and the sand laying course. The pavers shall be laid in such a manner that the desired pattern is maintained and joints between the pavers are as tight as possible.

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The Contractor shall lay the pavers starting from the longest straight line and from a true 90-degree corner. The pavers shall be installed hand-tight and level on the undisturbed sand course in a manner that eliminates gaps between the stones and the edge retention header. String lines shall be used to hold all pattern lines true. The gaps at the edge of the paver surface shall be filled with pavers cut to fit. Cutting shall be accomplished to leave a clean edge to the traffic (vehicular or pedestrian) surface using a masonry saw cut.

After the pavers are in place, they shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force. This will require two passes at 90 degrees to each other. After vibration, approximately 1/4-inch of clean masonry sand containing at least 30 percent of 1/8-inch particles shall be placed over the paver surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill joints. Excess sand shall be swept from the surface.

The finished paver surface shall be tested longitudinally and transverse to the concrete header or curb with a 10-foot straightedge along the surface. Any deviation in excess of 1/8-inch shall be corrected at no additional cost to the Contracting Agency.

Any broken or damaged pavers shall be removed and replaced. Replacement pavers shall be tamped into place and the joints filled with masonry sand as specified herein. The completed installation shall be cleaned of all debris, surplus material and equipment.

### **342.4 MEASUREMENT AND PAYMENT:**

Measurement for deco pavement shall be by the square foot. Payment for deco pavement shall be made at the unit bid price per square foot including subgrade preparation, 1-Sack CLSM, and sand base. This payment shall be full compensation for all labor, materials, tools and equipment required to complete the work.

*- End of Section -*

## SECTION 343

### EXPOSED AGGREGATE PAVING

#### 343.1 DESCRIPTION:

Exposed aggregate paving consists of placing a concrete slab with exposed aggregate in the surface of the finished concrete. This exposed aggregate paving is designed for decorative or pedestrian use only. It should not be used in areas subject to vehicular traffic.

#### 343.2 MATERIAL:

**343.2.1 Concrete:** Concrete shall be Class A per Section [725](#) with a maximum slump of 3 inches.

**343.2.2 Exposed Aggregate:** The exposed aggregate shall be uncrushed riverrun rocks. The Contractor shall provide at least a 10-pound sample for approval by the Engineer prior to any aggregate paving.

(A) When the paving is for decorative use only, no pedestrian traffic, the aggregate shall not be larger than 3 inches or smaller than 1 ½ inches.

(B) When the paving is to be used for pedestrian traffic, the aggregate shall be not larger than 2 inches or smaller than 1 inch.

#### 343.3 CONSTRUCTION PROCEDURE:

The Contractor shall construct a sample panel 3 feet by 3 feet for inspection and approval by the Engineer, prior to actual construction. When approved, this panel shall be used as a standard for the remainder of the work.

Unless specified otherwise, the exposed aggregate may be seeded onto the surface of the finished slab and worked into the slab, or the exposed aggregate may be integral with the concrete mix.

If the exposed aggregate is to be seeded, the slab surface shall be screeded and darried; the aggregate placed onto the surface to the desired pattern; and the surface reworked to embed the aggregate into the slab and bring the cement paste over the aggregate. Cement paste shall completely surround the aggregate, leaving no holes or voids

A non-staining surface retarder shall be applied per the manufacturer's recommendations to provide an aggregate exposure of approximately 1/8". The surface will be covered with a protective material for the period of time recommended by the retarder manufacturer. After this time has elapsed, the upper, retarded layer of concrete will be removed using a water jet stream and a brush. The protective cover will be replaced and the concrete allowed to cure. After curing, the surface shall be cleaned and a silicone seal applied.

The Contractor shall utilize a method that will collect and contain the waste water, and shall properly dispose the waste water and concrete by products generated by exposing the aggregate. The Contractor shall submit the proposed method in writing to the Engineer for review prior to start of the exposed aggregate paving.

#### 343.4 MEASUREMENT AND PAYMENT:

Measurement will be by the square foot. Payment will be made at the unit bid price in the proposal. This price shall include subgrade preparation, construction and disposal of the sample panel, waste water collection and disposal, concrete by-product collection and disposal and be full compensation for all labor, material, tools, and equipment required to complete the work

- End of Section -

## SECTION 345

### ADJUSTING MANHOLE FRAMES AND UTILITY BOXES

#### 345.1 GENERAL:

This specification covers the work required to adjust manhole frames and utility boxes to established grades including new and existing sewer manholes, storm drain manholes, other utility manholes, valve boxes, survey monument boxes, cleanout boxes, meter boxes and other utility boxes.

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frames and boxes as indicated on the plans or as designated by the Engineer.

The Contractor may elect to remove old frames, covers, and boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the Contracting Agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Missing or defective frames, covers and boxes shall be reported to the Engineer in writing during the initial locating process to allow for timely replacement. The Engineer shall furnish replacements for missing or defective items, reported by the Contractor, at no cost. Replacements for missing or defective items not reported to the Engineer during the initial locating process shall be furnished by the Contractor at no additional cost to the Contracting Agency.

The Contractor shall submit a written adjustment plan and schedule to the Engineer for approval prior to commencing the work. The adjustment plan will specify the locations of the adjustments to be completed each day and specify the expected timeframes for the work.

The Contractor shall submit a written method for cleaning manhole covers and box lids to the Engineer for approval prior to commencing the work. Cleaning shall be completed prior to starting the adjustment work.

Adjustment of existing manhole frames and existing utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course.

Adjustment of new manhole frames and new utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course, slurry seal materials and/or microsurfacing materials.

The Contractor shall attempt to locate all unexposed water valve boxes within the project's limits shown on the quarter section maps and shall excavate to a maximum depth of 18 inches in the attempt. Unexposed water valve boxes found, shall be adjusted to grade. Excavations for water valve boxes not found shall be backfilled and compacted with base material conforming to Section 702.

**345.1.1 Quarter Section Maps for Water and Sewer Lines:** For City projects, the Contractor may obtain up to three sets of water line and sewer line quarter section maps for the project area, at no cost, after the contract is awarded and issued. The Contractor shall bring proof of contact award and a signed Service Request Form (SERF). For permit projects, the Contractor may purchase sets of water line and sewer line quarter section maps for the project area. Maps can be obtained from the Water Services Department Infrastructure Record Services counter on the 8<sup>th</sup> floor of City Hall, 200 West Washington Street.

**345.1.2 Water Valve As-Built Drawings:** Upon completion of the water valve box adjustments, the Contractor shall provide one complete, accurate and clearly legible set of marked-up as-built waterline quarter section maps to the Engineer. The Contractor shall mark the set with symbols consistent to those that appear on the quarter section maps. The Contractor shall color code all water valves on the maps as follows:

- Blue - All valves shown on the Q.S. map found and adjusted.
- Yellow - All valves shown on the Q.S. map but not found in the field.

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Red - All valves not shown on the Q.S. maps but discovered in the field and adjusted. (Draw the valve symbol at the appropriate location on the map and provide the offset and location dimensions for these valves.)

### 345.2 LOWERING PROCEDURE:

If required, manholes and boxes located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging these facilities. Care shall be taken to prevent entrance of any debris into these facilities.

All manhole frames, boxes and related items removed by the Contractor during the lowering process shall be maintained in a secure area, and the Contractor shall bear full responsibility for the material. Sewer manhole frames and covers shall be matched, kept together, and replaced onto their original manholes. Any hardware items lost or damaged by the Contractor shall be replaced in kind, at no additional cost to the Contracting Agency.

**Preparation for Milling:** Compacted asphalt concrete shall be temporarily placed over the steel plate, filling the excavated area. Excavated areas that will be subjected to traffic prior to placement of the portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

### 345.3 ADJUSTING MANHOLE FRAMES:

Manhole frames shall be adjusted to the elevations indicated on the plans, or established by the Engineer.

The Contractor shall loosen manhole frames in such a manner that existing facilities will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary sewers or storm drains. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system the Contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked and mortared in place with masonry or metal supports per MAG Standard Detail 422. Spaces between the frame and the facility shall be sealed to prevent any concrete from entering the manhole. A portland cement concrete collar shall be placed around the frame at the required elevation and slope.

Adjustments of 24 inches or more shall require a top-of-manhole rebuild. For existing precast concrete manholes, the cone shall be removed, the manhole shaft extended with the necessary precast concrete manhole sections and the existing precast concrete cone re-installed. The Engineer shall review the condition of each exposed precast concrete cone and approve its reuse. Existing brick manholes shall be reconstructed with brick as necessary.

Existing sanitary sewer manholes adjusted to grade shall have corrosion coating or liner applied to the new portion to match the existing corrosion system in the manhole. No separate measurement or payment shall be made for the corrosion coating or liner and the cost shall be incidental to the adjustment.

Existing sanitary sewer manholes adjusted to grade shall be painted with insecticide, on the new portion, when applicable per Section 627. No separate measurement or payment shall be made for painting with insecticide and the cost shall be incidental to the adjustment.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

### 345.4 ADJUSTING BOXES:

Boxes shall be adjusted to the elevations indicated on the plans, or established by the Engineer.

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Boxes shall be adjusted per COP Standard Detail P 1270. The top of the valve riser pipe shall be extended or shortened to conform to the dimension in COP Standard Detail P1270.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

A debris cap with locating coil shall be installed in water valve boxes adjusted to grade in conformance with COP Standard Detail P1165. Prior to installation of the debris cap, valve risers shall be thoroughly cleaned to fully expose the operating nut. Undamaged existing debris caps with locating coils may be reinstalled. For permit projects, the Contractor shall furnish and install debris caps with locating coils. For City projects, the Contractor shall install City furnished debris caps with locating coils.

### **345.5 PORTLAND CEMENT CONCRETE COLLARS:**

The portland cement concrete collar around the frame or box shall be circular, and shall be a minimum of eight (8) inches thick, placed flush with the adjacent new pavement surface per COP Standard Detail P1270 and MAG Standard Detail 422. Concrete shall be a minimum of Class AA. All concrete shall be obtained from plants approved by the Engineer.

A single No. 4 rebar hoop shall be placed in each concrete collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box, and the outer edge of the concrete collar, the depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be ¼ -inch wide by ½ - inch deep. The concrete collar surface shall be medium broom finished.

Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500 psi on residential and 3000 psi on collector and major streets. On major streets the Contractor shall use "high-early" in the concrete mix, approved by the Engineer, to minimize delay in reopening the street(s) to traffic.

### **345.6 MEASUREMENT:**

The quantities measured will be the actual number of existing frames adjusted and accepted.

The quantities measured will be the actual number of existing boxes of each type adjusted and accepted.

The quantities measured will be the actual number of attempts made to locate water valve boxes that are ultimately not found.

The quantities measured for rebuilding manhole tops will be the actual number of existing manhole tops rebuilt regardless of the utility served or the type of manhole construction.

No separate measurement will be made for adjusting frames of new manholes, adjusting new boxes or for adjusting frames of manholes requiring the rebuilding of the manhole top.

### **345.7 PAYMENT:**

Payment for adjusting existing frames will be made at the contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for adjusting existing boxes will be made at the contract unit price for each type. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for attempts to locate water valve boxes that are ultimately not found shall be made at the contingent contract unit price. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including excavation, backfill, compaction and permanent surface replacement.

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Payment for top-of-manhole rebuilds will be made at the contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including adjusting the frame to grade.

No separate payment will be made for adjusting frames of new manholes, or adjusting new boxes. The cost shall be considered incidental to the respective new manhole or box and shall be included in the contract unit price for the new manhole or box.

*- End of Section -*

## SECTION 350

### REMOVAL OF EXISTING IMPROVEMENTS

#### 350.1 DESCRIPTION:

This work shall consist of removal and disposal of various existing improvements, such as pavements, structures, pipes, conduits, curbs and gutters, and other items necessary for the accomplishment of the improvement.

#### 350.2 REMOVALS:

**350.2.1 General:** The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

Plans shall specify existing sidewalk removals for a distance that would provide a 5% (1:20) maximum running slope for the replaced portion of sidewalk unless the site's grade at that location makes it impractical to provide. All driveways shall be removed to a distance designated on the plans or as required by standard details.

Portland cement concrete pavements, driveways, driveway entrances, curbs and gutters and sidewalks designated on the plans for removal, or as necessary for other work, shall be saw-cut at specified match lines or the nearest existing construction joint, and removed.

Portland cement concrete pavements, curbs and gutters and sidewalks designated on the plans for removal shall be saw-cut at match lines

Removal of trees, stumps, roots, rubbish, and other objectionable materials in the right-of-way shall be done in accordance with Section 201 or as a miscellaneous removal item when not included otherwise in the proposal.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

#### 350.2.2 Disposal of Surplus Materials:

**350.2.2.1 Inert Materials:** Surplus and/or waste material not containing asbestos or lead may be incorporated into the project when permitted by the construction documents and the Engineer.

The location for off-site disposal shall be at the Contractor's option, subject to the following conditions:

1. When the City landfills are used, the Contractor shall pay the normal fee.
2. When private property within the City of Phoenix City Limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and storm water requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the City of Phoenix Grading and Drainage Ordinance and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The Contracting Agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.
3. When private property outside the City of Phoenix City Limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and storm water requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the jurisdiction's laws and ordinances and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The Contracting Agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.

No separate measurement or payment will be made for hauling and disposal. The cost shall be incidental to the work in the proposal.

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**350.2.2.2 Non-Inert Materials:** Surplus and/or waste material containing asbestos and/or lead in any form shall not be incorporated into the project unless formally accepted in writing by the Engineer prior to its incorporation.

Disposal of materials containing asbestos and/or lead shall be in conformance with all regulations, laws and ordinances.

No separate measurement or payment will be made for hauling and disposal of material containing asbestos and/or lead. The cost shall be incidental to the work in the proposal.

**350.2.3 Removal of Pipe:** Pipe designated on the plans for removal shall include excavation; removal and disposal of paving, obstructions and encasement; removal, preparation and proper disposal of pipe and debris; and backfill and compaction per Section [336](#) and Section [601](#). Measurement and payment shall be by the linear foot.

### **350.2.4 Removal of Structures:**

Structures designated on the plans for removal shall include the removal of irrigation structures and any other structures noted on the plans and not included otherwise in the proposal. Removal of structures shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structure and debris; and backfill and compaction per Section [336](#) and Section [601](#). Measurement and payment shall be by the lump sum.

### **350.2.5 Removal of Structural Concrete:**

Structural concrete designated on the plans for removal shall include the removal of sidewalk scuppers and any other reinforced concrete and masonry noted on the plans and not included otherwise in the proposal. Removal of structural concrete shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structural concrete and debris; and backfill and compaction per Section [336](#) and Section [601](#).

Measurement and payment shall be by the cubic yard of structural concrete removed.

### **350.2.6 Removal of Asphalt Outside of the Roadway Prism:**

Roadway prism is defined as the area within a roadway between the lip-of-gutter and the opposing lip-of-gutter or edge of pavement where gutters are not present.

Asphalt removal, in areas to be covered by new sidewalk, driveway, driveway entrance, curb and gutter and other improvements that include subgrade preparation, shall be incidental to those improvements. Other asphalt areas shall be included as miscellaneous removal, except where otherwise specified as incidental to an item by its specifications.

### **350.2.7 Removal, Salvage and Disposal of Street Lights:**

Street lights designated on the plans for removal shall include the removal of the light pole, arm and luminaire; removal and disposal of the junction box and conduit; removal and proper disposal of landscaping, paving, obstructions, concrete or other foundation fill material; necessary excavation; removal and proper disposal of concrete, or other foundation material, attached to the street light; proper disposal of other debris; backfill and compaction; and any restoration necessary and not included otherwise in the proposal with other work.

Payment shall be made for each light pole removed.

### **350.2.8 Abandonment and Removal of Utilities:**

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

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A utility may be abandoned in place below a new major structure that is part of the work only if approved by the City and solidly filled with approved grout using methods approved by the City. All abandoned utilities to remain, and the approved abandonment method, shall be noted on the record drawings.

Utilities to be removed by the Contractor shall be disconnected and taken out in accordance with the requirements of the utility owner to the limits shown on the plans. Utility removal shall not be performed until a release has been obtained from the utility stating that their respective service connection and appurtenant equipment have been disconnected, removed or sealed and plugged in a safe manner.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

### **350.3 MISCELLANEOUS REMOVAL AND OTHER WORK:**

Miscellaneous removal and other work shall include, but not limited to, the following and as designated on the plans and not otherwise included in the proposal with other work. Existing improvements shown on the plans that may need removal, but are not specifically designated on the plans for removal, and are not included otherwise in the proposal with other work, shall be removed and restored as miscellaneous removal. Payment shall be by the lump sum.

- (A) Relocate existing fence and gate.
- (B) Remove and reset mail boxes.
- (C) Remove signs and bases in right-of-way.
- (D) Remove planter boxes, block walls, concrete walls, footings, headwalls, irrigation structures, and storm water inlets.
- (E) Install plugs for pipes and remove existing plugs as necessary for new construction.
- (F) Remove wooden and concrete bridges.
- (G) Remove median island slabs.
- (H) Remove pavements and aggregate base where called for outside the roadway prism.
- (I) Landscape Irrigation System Removal and Restoration: The Contractor shall remove the conflicting portion of all underground landscape irrigation systems that are within the right of way and/or easements that conflict with new work or any portion which may remain under proposed curb, gutter or sidewalk regardless of whether shown or not shown on the plans.

The Contractor shall restore all affected landscape irrigation systems to an operational condition at least as good as existed prior to removal. Bubbler and/or sprinkler heads shall be installed behind the new sidewalk in areas where watering was accomplished by landscape irrigation heads which were removed. Specifically, all areas behind the new sidewalk which were watered by the existing irrigation system before relocation shall be watered after relocation without any accumulation of water on the sidewalk or pavement.

The Contractor shall have the option of either providing all new materials or salvaging and reusing existing materials. Either new or salvaged irrigation heads shall be installed in a new location, as close as practical to the existing location. Either new or salvaged pipe shall be installed and all the necessary connections made to put the system back into operation.

In the event it is not feasible to reinstall removed irrigation heads, the Contractor shall then make all the necessary connections to make the remaining portion of the system operational. Irrigation heads and pipe not reinstalled shall be given to the owner.

The Contractor shall furnish all new irrigation heads, new pipe and fittings, and pipe compound necessary to supplement salvaged materials.

The Contractor shall notify the affected property owners, at least fourteen days prior to removing and replacing

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underground landscape irrigation systems because some of the owners may desire to do this work themselves.

- (J) Lawn Restoration: When any construction by the Contractor encroaches into an improved yard, in or outside the right-of-way, the Contractor shall level any disturbed ground, re-sod all grass covered areas, and restore rock-covered areas with material to match existing in type and quality.
- (K) Precast Safety Curbs Inside Right-of-Way: Existing precast concrete safety curbs inside the right-of-way and approximately parallel to the new curb line shall be reset by the Contractor directly opposite their existing location, with the back edge on the right-of-way line.

All other precast concrete safety cubs inside the right-of-way shall be salvaged and stockpiled by the Contractor at a location on the adjacent property agreeable to the property owner.

- (L) Encroachments Inside the Right-of-Way: The Contractor shall notify property owners, who have encroaching walls, fences, planters, plants, bushes, small diameter trees, and other improvements in the right-of-way that interfere with construction, at least fourteen days before clearing is necessary.

Any encroaching items, not timely removed by the owner, shall be removed and disposed of by the Contractor in accordance with the Contract Documents.

- (M) Restoration of Temporary Construction Easements: The Contractor shall leave the easements in as good a condition or better after work is completed. Special care must be taken to replace any asphalt, trees, sprinklers, lights, walls, fences, etc., which were disturbed as a result of construction. Where grass is located within the easement such as a lawn, the Contractor shall remove the sod which would be in the path of any construction, store it, keep it moist, and replace it immediately after construction is complete.

- (N) Any removals called for on the Traffic Signal Plans and not otherwise included in a separate pay item.

- (O) Any and all items not specifically set forth as a separate pay item

### **350.4 PAYMENT:**

Payment for removals will be made at the unit proposal price which price shall be full compensation for the item complete, as described herein or on the plans to the satisfaction of the Engineer.

*- End of Section -*

## SECTION 355

### UTILITY POTHOLES-KEYHOLE METHOD

#### 355.1 DESCRIPTION:

This specification covers the requirements for coring, vacuum excavation, backfilling, and reinstatement of the asphalt core into asphalt pavement.

#### 355.2 EXCAVATION

Excavation requires coring a circular hole through asphalt pavement using drilling/coring equipment and removal of the intact asphalt pavement core. The vertical alignment of the coring operation shall be perpendicular to the horizon and cutting shall be extended the full depth of the existing pavement section.

Pavement cores shall not be greater than 24 inches in diameter, shall not be spaced closer than 3 feet between cores (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8-inch wide, and shall only be obtained from pavements where the asphalt concrete section is at least 4 inches thick.

Contractor shall place a temporary mark (paint or chalk) on the pavement core and adjacent pavement prior to cutting to insure that the pavement core when replaced will have the same orientation as found in the original pavement.

Pavement cores shall be either removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for reinstatement into the pavement.

Soil shall be removed by air/vacuum extraction methods to expose utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the core hole.

The Contractor shall dispose of all excess materials.

#### 355.3 BACKFILL AND COMPACTION

**355.3.1 Backfill Using Mechanical Compaction:** Backfill shall be aggregate base per Section [702](#) or native backfill material per Section [601](#), placed in maximum 6 to 8-inch loose lifts.

Backfill compaction shall be determined by use of a compression wave amplitude monitoring device manufactured specifically for the purpose of measuring soil compaction. This device shall measure the compression wave amplitude as compaction progresses using below grade piezoelectric transducer wave sensors and an above-grade electronic monitor. The device shall signal the operator of successful compaction (the compaction wave amplitude becomes asymptotic for continued compaction effort) for each lift.

At time of compaction backfill material shall have sufficient available moisture to be compacted based on the physical appearance (soil ball) method as specified in USDA Soil Conservation Service Agricultural Information Bulletin 199, described as follows:

Firmly squeeze a palm-size sample of soil into a ball by hand. Granular soils with sufficient available moisture will tend to ball under pressure, but seldom holds together for long. Cohesive soils with sufficient available moisture will form a ball that can be rolled into approximate 1/4" wide ribbons between the palms of the hands without breaking apart, leaving no free water on the hand.

A compaction sensor shall be placed at the bottom of the first loose lift. A new sensor shall be placed for every 48 inches of compacted fill depth.

Pneumatic compaction equipment (pneumatic rammers or equivalent) shall be used for compaction of the backfill material. The size of the compactor shall not exceed one-half the diameter of the hole.

## SECTION 355

Mechanical compaction on each lift shall be continued until the electronic monitor signals that compaction is complete. A new lift shall not be placed until a positive signal has been received. Remove backfill soil and sensor if the monitor does not give a positive compaction signal after repeated compaction efforts. Repeat backfilling and compaction with a new sensor.

Contractor shall provide compaction documentation to the Agency upon request.

**355.3.2 Slurry Backfill:** If mechanical compaction is not used, the Contractor shall use ½-sack CLSM as backfill in accordance with Section [728](#).

**355.3.3 Leveling Course:** A 1-1/2-inch to 2-inch thick leveling course of compacted crushed gravel meeting the requirements of ASTM C33, No. 8 coarse aggregate shall be placed above the backfill and directly below the asphalt concrete pavement section.

### 355.4 PAVEMENT RESTORATION

The pavement surface shall be restored to its original condition by setting the reinstated pavement core flush with and in its original orientation.

Bonding agent meeting the requirements of Section [708](#) shall be used for pavement core reinstatement. Excess bonding material shall be removed from the restored pavement surface. A "patched" appearance shall be avoided in surface restoration wherever possible.

The Contractor shall reinstate the pavement core within 24 hours of cutting the pavement. Holes left open longer than 24 hours after cutting shall be covered with an approved steel road plate capable of supporting traffic loads. The steel plate must be rounded with a fitted collar that, when inserted into the hole, will prevent the steel plate from tipping, tilting, bouncing or spinning out of the hole under traffic conditions. An asphalt mix shall be used to ramp pavement up to the steel plate along all edges.

### 355.5 SURFACE TOLERANCES

The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16-inch between the bottom of a minimum 3-foot long straightedge and the surface of the pavement in any direction on the surface of the keyhole core, except across the pavement crown or drainage gutters.

### 355.6 DEFICIENCIES

Where the pavement core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstating, the defective or damaged core shall not be used to reinstate the pavement. Pavement repair shall be performed in accordance with MAG Standard Detail 212, Type A Pavement Repair.

A pavement core is considered unacceptable when one of the following conditions exist:

- (a) The core contains any vertical cracks wider than 1/8-inch extending full depth or partial depth through the core;
- or
- (b) Any deteriorated piece of the core is larger than 10 percent of the overall area of the core.
- (c) Two or more successive layers of asphalt concrete in the core become horizontally delaminated and cannot be rebounded to each other with the bonding compound.

All unacceptable pavement cores shall be removed from the job site.

### 355.7 MEASUREMENT

Each acceptable utility pothole repair shall be counted. No distinction shall be made based on size of the utility pothole or method of repair.

## SECTION 355

### 355.8 PAYMENT

Payment at the contract price for utility pothole repair complete in place shall be full compensation for all labor, equipment and material required for a complete in place installation. Payment includes traffic control and disposal of all excess materials.

*- End of Section -*

## SECTION 360

### TELECOMMUNICATIONS INSTALLATION

#### 360.1 DESCRIPTION:

This work shall consist of the installation of underground telecommunications facilities within the public right-of-way.

#### 360.2 TRENCHING, BACKFILL AND RESTORATION:

All work shall be done in accordance with Section [601](#).

#### 360.3 CABLE INSTALLATION:

(A) "Trunk Lines" Cable providing telecommunications service by connecting regions or states or by connecting central offices within a metropolitan area. Such cable shall be installed as described below:

(1) If the cable is to be installed within an open trench, the cable shall be placed within schedule 40 PVC conduit or equal with a minimum inside diameter of 4 inches. The conduit shall be buried at a minimum depth of 48 inches below finished grade measured to the top of the conduit. A color coded plastic warning tape with a minimum thickness of 5 mil and a minimum width of 3 inches shall be installed in the trench and centered over the PVC conduit at a depth of from 18 to 30 inches below finish grade.

(2) Cable crossings under existing paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency. The cable shall be placed within a schedule 40 PVC conduit or better at a minimum depth of 48 inches.

(B) Telecommunications cables other than "trunk lines" shall be installed as described below.

(1) If a cable is to be installed within the right-of-way of an arterial or collector street, it shall be placed at a minimum depth of 36 inches below finished grade. A color coded plastic warning tape as described in "A" shall be placed 18 inches below the surface.

(2) If a cable is to be installed within the right-of-way of a local/residential street it shall be placed at a minimum depth of 24 inches below finished grade.

(3) Cable crossings under existing, paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency.

#### 360.4 CABLE LOCATING (FIBER OPTIC):

If a cable which is to be installed is fiber optic a tracing or locating wire shall be installed with the cable.

#### 360.5 PAYMENT:

Payment will be made at the contract unit price bid per lineal foot.

- *End of Section* -

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**PART 400**

**RIGHT-OF-WAY AND TRAFFIC CONTROL**

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## SECTION 401

### TEMPORARY TRAFFIC CONTROL

#### 401.1 DESCRIPTION:

Temporary traffic control shall consist of traffic control devices and flagger or pilot cars deployed to protect and guide all modes of traffic (motor vehicle, bicycle, and pedestrian) within the construction work zone areas.

The Manual on Uniform Traffic Control Devices 2009 (MUTCD) with Arizona Supplements, and the City of Phoenix 2007 Traffic Barricade Manual (TBM), or the most recent adopted editions, take precedence over Section [401](#).

#### 401.2 TRAFFIC CONTROL DEVICES:

The Contractor may be required to submit a temporary traffic control plan to the Engineer to obtain a Temporary Restriction and Closure System permit (TRACS) as specified in Chapter 2 of the TBM.

The Contractor shall furnish, erect and maintain all temporary traffic control in conformance with the TRACS permit and as approved by the Engineer.

Traffic control devices shall consist of providing, erecting, and maintaining the necessary and adequate devices for the protection of the work, the workers and the public.

- (A) Temporary traffic control devices shall be used to guide all traffic modes through the construction area. They include, but are not limited to, traffic cones to channelize traffic, portable barricades for warning, water-filled barriers for pedestrian separation, vertical panel channelizing devices to divert traffic, concrete barriers to protect traffic from hazards, and lighting devices between the hours of sunset and sunrise.
- (B) Advance warning devices shall be used to alert all modes of traffic to the construction area. They include diamond-shaped signs, flags, and flasher-type high level warning devices mounted 8 feet above the roadway.

#### 401.3 FLAGGERS AND PILOT CARS:

Flagging of traffic or pilot cars shall consist of providing a sufficient number of properly trained flaggers (with proper signing), uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic. Off-duty law enforcement officers shall be used at signalized intersections when one through lane is maintained in any direction.

#### 401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected in compliance with the TRACS permit. The Engineer reserves the right to require additional traffic control measures in any specific instance. These devices shall be immediately removed when no longer needed.

#### 401.5 GENERAL TRAFFIC REGULATION:

Requests for a TRACS permit shall be submitted to the Right of Way Management Agent (RMP Agent) through the Engineer or the Permit Inspector on permit work. Unless directed otherwise by the Engineer or RMP office, an advance notice of 72 hours for complete closures on major and collector streets 48 hours for partial closures on major and collector streets; and 24 hours for complete or partial closures on local streets and alleys is required.

A minimum 11 foot clear traffic lane shall be required for a safe motor vehicle operating speed of 35 miles per hour.

For the purpose of temporary traffic control, an intersection is defined as all of the area within the right-of-way of the intersecting streets plus 300 feet beyond the prolongation of the intersecting right-of-way line on each street.

Except during emergency conditions, or otherwise provided for in the special provisions or permit, or approved by the RMP Agent, the following are minimum traffic control requirements for all traffic restrictions:

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- (A) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 8:30 a.m., and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on Major or Collector streets.
- (B) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 9:00 a.m., and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on streets with reversible lanes.
- (C) During WEEKDAY OFF PEAK TRAFFIC HOURS, when one traffic lane is restricted at a multiple lane signalized intersection with left-turn lanes, the left-turn lanes may be used to provide a minimum of four through traffic lanes (two lanes for each direction).
- (D) Except as provided for in items A and C above, a minimum of two traffic lanes (one for each direction) shall be maintained on all Major and Collector streets through the week nights and through the weekends.
- (E) A minimum of two traffic lanes in the same direction shall be maintained on "one way" streets at all times.
- (F) A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt.
- (G) The Contractor, utility or other agency shall provide a City of Phoenix approved uniformed off-duty police officer during OFF PEAK traffic hours to assist with traffic control at multiple lane signalized intersections whenever traffic is reduced to one through lane in any one direction. This requirement may be waived by the Engineer when conditions, in his opinion, do not require it.
- (H) Local streets may be closed except for local access, when construction or maintenance requires.
- (I) Local access shall be maintained to all properties on all streets (Major, Collector and Local) at all possible times. When local access cannot be maintained, the Contractor, utility or other agency shall notify the affected property owner, resident, or tenant, a minimum of 72 hours in advance and restore access as soon as possible. Unless specifically authorized by the Engineer, access to businesses will not be closed during business hours.
- (J) All Contractors doing work in the right-of-way shall promptly remove all traffic control devices when the closure or lane restrictions are no longer in effect. When no construction work is being done, all advance warning signs shall be turned so that they are not readable by drivers. All traffic control devices may be temporarily stored in cluster method behind the sidewalk for short periods of time. All temporary traffic control devices shall be collected and removed from the right of way within 24 hours of the expiration of the TRACS permit.
- (K) Special Events: If there are special events scheduled to take place during the construction of any project, the Contractor shall coordinate the construction schedule with these events.

### 401.6 EXISTING TRAFFIC CONTROL DEVICES:

During construction and maintenance operations it is important that all existing traffic control devices be kept compatible with the traffic restrictions imposed. This includes existing signs, parking meters, traffic signals and pavement markings. Some devices will remain applicable to traffic and must be maintained. Other devices must be covered, relocated or removed. Requirements for each group of devices are detailed in this section.

#### (A) Traffic Signs:

The Contractor, utility or other agency shall maintain all existing STOP, YIELD and street name signs, verifying they are erect, clean and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor, utility or other agency shall temporarily relocate the signs to permit construction, but the devices must be kept in full view of the intended traffic. Portable signs shall be used to supplement the relocated permanent signs.

Other signs still applicable shall also be maintained erect, clean and in full view of the intended traffic by the

## SECTION 401

Contractor, utility or other agency at all times. Existing signs, not applicable, shall be removed by the Contractor, utility or other agency without damage, and salvaged on the adjacent property lines. The Streets Transportation Department shall be notified of all removals.

### (B) Traffic Signals:

The Contractor, utility or other agency shall maintain all existing traffic signal equipment except in-pavement vehicle detector sensing devices, fully operational in the existing locations and in full view of the intended traffic at all times unless otherwise specified in the City of Phoenix Traffic Barricade Manual or in the Project or Permit Plans or specifications. All traffic signal work performed by a Contractor shall be in accordance with Section [404](#).

The Contractor, utility or other agency shall notify the Traffic Signal Shop (602-262-6021) 48 hours prior to the start of construction in the vicinity of signalized intersections. The Traffic Signal Shop will, in accordance with the Arizona Blue Stake regulations, provide the approximate locations of all underground traffic signal equipment (conduits, junction boxes, vehicle detector sensing devices, etc.). The exact location of this underground equipment shall be determined by the Contractor, utility or other agency prior to any excavating operations.

The Contractor, utility or other agency shall exercise care to prevent damage to all existing traffic signal equipment. Should damage occur, The Traffic Signal Shop will make the necessary temporary repairs to immediately restore traffic signal operation.

Responsibility for permanent repair or replacement of damaged equipment shall be as follows:

The cost for the permanent repair or replacement shall be at the Contractor's, utilities', or other agency's expense, when the approximate location of the damaged equipment has been made known to them. They will also be charged by the Traffic Signal Shop for any temporary or permanent repairs made by City of Phoenix forces. Permanent repairs or replacements made by a Contractor shall be approved in advance by the Traffic Signal Shop Supervisor or his or her designee and constructed in accordance with Section [404](#).

All permanent repairs or replacement shall be at the City's expense, when the approximate location of the damaged equipment has not been made known to the Contractor, utility or other agency; provided they have complied with the notification requirements of this section and requested underground locations.

When the existing traffic signal equipment cannot be maintained as provided for in the Arizona Supplemented MUTCD or in the Project or Permit Plans or specifications, the Contractor, utility or other agency shall, at their expense, have the Traffic Signal Shop or a qualified Contractor (as specified in Section [404](#)) relocate said equipment to a temporary location and/or provide additional temporary equipment, such that all functions and indications of the existing signal equipment, except in-pavement vehicle detector sensing devices, are operational and in full view of the intended traffic at all times. The location and type of all temporary signal equipment shall be approved by the Streets Transportation Dept. All signal equipment relocations and/or installations of temporary signal equipment shall be coordinated by the Contractor, utility or other agency with the approval of the Traffic Signal Engineer. 72 hours advance notice is required.

When temporary equipment or new equipment is installed to replace existing equipment, the temporary or new equipment shall be fully operational before the existing equipment is removed.

The Contractor, utility or other agency shall restore all traffic signal control equipment to the original locations or new locations, if so specified, as soon as possible after all work in the immediate area is completed.

### (C) Signalized Intersection Requirements:

The Contractor shall notify the Engineer and the Traffic Signal Shop (262-6021) at least 72 hours prior to the start of any construction in the vicinity of a signalized intersection where traffic signals may be affected.

The Contractor shall provide the Engineer and the Traffic Signal Shop a written schedule indicating days, times and specific locations where traffic signals will be interrupted or modified. **When work has been completed, the Contractor shall immediately notify the Traffic Signal Shop.**

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The Contractor shall maintain the “cone of vision” for traffic signal heads in accordance with the Arizona Supplemented 2009 MUTCD Part 4 Section 4D.13 (see figure 4D-4 on page 463) or most current version at all signalized intersections for full view of intended traffic and signal indication. Motorists driving through signalized intersections in a construction zone must always be able to see at least two (2) traffic signal heads within the “cone of vision”. If the traffic control setup cannot provide the required “cone of vision”, the Contractor shall contact the Engineer and the Traffic Signal Shop at (602) 262-6021 for instructions.

### (D) Pavement Markings:

Existing pavement markings that conflict with the vehicle path indicated by barricades and channelization and cause driver confusion shall be removed or obliterated by the Contractor, utility or other agency as directed by the Streets Transportation Dept.

Generally, pavement marking removal or obliteration is only required on long term construction projects such as detours for bridge construction or similar fixed location projects. However, removal or obliteration of existing pavement markings may be required at any location when visual inspection and/or accident history shows driver confusion caused by existing pavement markings.

Proper pavement marking removal or obliteration leaves a minimum of pavement scars and completely removes existing markings. Painting over existing markings with black paint or asphalt material is not satisfactory except in emergency conditions awaiting more permanent removal to follow immediately.

Final Signing and Striping of Roadway: The Contractor, through the City project inspector, shall notify the Street Transportation Department, Traffic Operations Division (602) 262-6456, at least thirty (30) days prior to desired completion of final roadway signing and lane striping.

### (E) Parking Meters:

The Contractor, utility or other agency shall maintain all metered parking spaces open for parking at all possible times. When parking meters must be hooded or removed, the Contractor, utility or other agency shall notify the Streets Transportation Dept. two business days in advance.

All parking meter post removals, relocations or installations shall be done by the Contractor, utility or other agency as provided for in the plans, or as directed by the Parking Meter Supervisor. The Street Transportation Department will provide the parking meter posts.

### (F) Coordination with Other Agency Projects:

The Contractor shall coordinate and schedule work to minimize disruption or conflicts with any other Agency projects.

Any work that may affect the project shall be coordinated with the appropriate Agency contact at least fourteen (14) days in advance.

### (G) Pedestrian Access Requirements:

The Contractor shall ensure that all sidewalks on this project remain in compliance with the Americans with Disabilities Accessibilities Guidelines (ADAAG) and, upon its adoption, the Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG). All open pedestrian walkway areas, paved or unpaved, shall be maintained and safely usable at all times. Such measures as backfilling or ramping to existing sidewalks or providing alternate sidewalk areas adjacent to existing sidewalks may be used. In high pedestrian use areas, the Engineer may request temporary hard-surface walkways, such as compacted stabilized decomposed granite, compacted cold-mix asphalt, CSLM or hot-mix asphalt.

In addition, diversions shall conform to Figure [401-1](#).

## SECTION 401



**City of Phoenix**  
STREET TRANSPORTATION DEPARTMENT

June 25, 2013

Dear City of Phoenix **Traffic Barricade Manual (TBM)** User:

**RE: POLICY PERTAINING TO SIDEWALK BYPASS DESIGN AND IMPLEMENTATION OF 2009 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) RULES**

Effective July 1, 2013, updated regulations specific to pedestrian diversions in Part 6 of the 2009 MUTCD will be phased into general use by the City of Phoenix, Street Transportation Department. These regulations change the required devices utilized for pedestrian diversions as well as how diversions are installed and maintained.

This addendum specifically addresses two portions of the existing TBM in Chapter 3 pertaining to pedestrian safety and Chapter 6 pertaining to traffic control devices.

In Chapter 3, "Pedestrian Safety and Service Considerations" on page 22 (Figure 1) of the existing TBM, both "In-Street" and "Out of Street" diagrams, shall be modified as follows:

**IN-STREET DIVERSIONS**

- 1) A continuous barrier shall be installed on the outside portion of the temporary pathway nearest traffic. Vertical panels with caution tape, pedestrian fencing, cones, and any other devices will no longer be accepted, except in cases where a designated spotter is utilized (SEE EXCEPTION BELOW). "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
- 2) The inner barrier of the constructed pathway may consist of any channelizing device accepted by the City of Phoenix.
- 3) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03, 2009 MUTCD)
- 4) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
- 5) When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility. (Refer to 6H.28.01, 2009 MUTCD)

**OUT-OF-STREET DIVERSIONS**

- 1) A continuous detectable barrier shall be provided throughout the length of the affected facility. "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
- 2) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03, 2009 MUTCD)

FIGURE 401-1 ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL

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- 3) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
- 4) The detectable barrier should be placed nearest to the work zone.

WHAT THIS MEANS TO CONTRACTORS, CITY CREWS, BARRICADE COMPANIES AND OTHER RIGHT-OF-WAY USERS

Contractors will have the option of selecting from a number of new products that will fulfill the specifications for the creation of detectable pathways. **When a spotter is not utilized, the outer barrier closest to traffic must have detectable edging.** The inner barrier of an on-street pathway does not have to comply with this rule at this time. There are no current changes to ramps, ramp elevation ratios, or signage.

When selecting an out-of-street pathway, the barrier nearest the work area should have the detectable edge, while the other side of the pathway can be constructed of acceptable devices.

Thank you again for your partnership with the City in maintaining mobility safety for all work activities in Phoenix right-of-way. If you have any questions, please contact John Morgan at 602-262-4483 or Luiz Moreno at 602-262-6565.

Sincerely,



Thomas L. Godbee, P.E.  
Deputy Street Transportation Director

P: RMP Working Documents\TBM Addendums\Sidewalk Bypass Addendum 6-25-2013

C: Luiz Moreno  
John Morgan  
Lorena Hall  
Rick Florian

FIGURE 401-1 ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL, CONT

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### 401.7 HOLIDAY SEASON TRAFFIC:

During the holiday season from Thanksgiving Day through the 1st of January, it is imperative that traffic restrictions be minimized or eliminated to the greatest extent possible.

On all major streets, adjacent to, or serving as primary access to large regional shopping centers, work that restricts traffic should be minimized. In addition, work within the entire Central Phoenix area should be.

Careful planning of work schedules to avoid operations that restrict traffic flow can do much to benefit the traveling public and decrease traffic accidents.

### 401.8 FAILURE TO PROVIDE ADEQUATE MAINTENANCE OF TRAFFIC:

If the Contractor fails to provide adequate temporary traffic control, the Engineer will have the work performed by other sources. The cost of having this work performed by other sources will be computed in accordance with Subsection [401.11](#). The total cost will be deducted from monies due to the Contractor.

### 401.9 TRAFFIC BARRICADE MANUAL - VIOLATIONS; CIVIL SANCTIONS:

**401.9.1 Authority and administration:** The City Manager and the Director of the Police Department are authorized to issue notices for violating the Traffic Barricade Manual and may take those measures necessary to promote, preserve and protect public health, safety and welfare within the public right-of-way.

**401.9.2 Violations of Traffic Barricade Manual, Civil Sanctions:** The following violations of the Traffic Barricade Manual may result in a Civil Sanction. The amount of the Civil Sanction listed is the minimum amount per day for a violation prior to the commencement of a Civil Action.”

**SUMMARY OF VIOLATIONS AND PENALTIES:**

VIOLATION	DESCRIPTION	CIVIL SANCTION
#1	Creates imminent risk of injury to the public within ROW.	\$1,500
#2	Restricting ROW without proper certification or TRACS Permit.	\$1,000
#3	Restricting traffic during peak hours as described in the TBM without authorization.	\$1,000
#4	Failing to correct a violation, as listed, within the time period stated on the warning notice.	\$1,000
#5	Restricting traffic at signal with no work occurring.	\$1,000
#6	Closing sidewalk improperly, or without proper certification, or TRACS permit.	\$500
#7	Violating the restrictions, limits, times, and locations of the TRACS permit.	\$500
#8	Missing or improper use of advance warning signs.	\$500
#9	Missing or improper use barricades/channelizing devices.	\$500

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#10	Leaving advance warning signs facing traffic after restriction has been removed – per one traffic direction.	\$250
#11	Leaving TTC devices in the ROW 24-hours after TRACS permit expires, unless a request for a permit extension is received prior to the expiration of permit.	\$250
#12	Use of “unacceptable” quality traffic control devices as described in the TBM.	\$250
#13	Rendering a bus stop inaccessible without relocating it or making other accommodations.	\$250

**401.10 MEASUREMENT:**

Off-duty law enforcement officers will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. Minimum payment shall be three hours on any separate call out.

**401.11 PAYMENT:**

Payment for complete temporary traffic control will be made at the unit bid price in the proposal item TRAFFIC CONTROL DEVICES.

Payment for uniformed off-duty law enforcement officer will be made at the unit bid price in the proposal item ALLOWANCE FOR UNIFORMED, OFF-DUTY LAW ENFORCEMENT OFFICER. If the officer is utilized in excess of 8 hours in any calendar day or in excess of 40 hours in any calendar work week, payment shall be at the rate of 1-1/2 times the proposal price for all hours worked in excess in either of the above time periods.

*- End of Section*

## SECTION 404

### TRAFFIC SIGNALS

#### 404.1 GENERAL:

The following specifications will outline the obligations of the private developer and /or private contractor constructing or relocating City of Phoenix traffic signal equipment. This includes private contractors working for ADOT, other agencies, or other departments within the City of Phoenix. **Any deviations to these work responsibilities will need to be discussed with the City of Phoenix Traffic Engineering Supervisor (602) 262-4690 or authorized designee.** The term Engineer for this section shall mean Traffic Engineering Supervisor or any of his or her authorized designees.

These specifications and approved, signed traffic signal plans are in addition to other applicable specifications and policies of the City of Phoenix, Maricopa Association of Governments and the Arizona Department of Transportation.

The Contractor shall notify the City of Phoenix, Traffic Signal Shop (602) 262-6021 a minimum of fourteen (14) calendar days prior to beginning any traffic signal work.

#### 404.2 PREPARATION:

Before starting any traffic signal work under the project, **read and review** all project documents and general notes to make certain understanding and agreement is clear with all conditions stated.

**Be sure that the traffic signal plans are the final approved plans.** Final approved plans shall have the signatures of City of Phoenix, Street Transportation Department officials. An approved set of plan documents shall be present on the job site during construction.

Work to be done shall mean all labor, materials, equipment and other incidentals necessary to complete the work in accordance with the project plans. In the event an error or omission is discovered, it should be brought to the attention of the Engineer immediately. The Engineer shall make such corrections and interpretations as may be deemed necessary.

The Engineer also has the authority to suspend traffic signal work to correct conditions unsafe for the workers or the general public, for failure to carry out provisions of the contract and/or to carry out orders.

The Contractor shall note that approval from the Engineer is required before ordering or installing any material that is to be used on the project. A list of materials and equipment shall be submitted that contains all items to be supplied on the project by the Contractor. The City of Phoenix reserves the right to reject an incomplete or unclear submittal. Contractor supplied materials will be listed on the signal plans. The Engineer reserves the right to accept a partial list prior to full submission. This approval also includes the paint color for traffic signal equipment. The Engineer shall answer all questions that may arise as to quality and acceptability of materials furnished and work performed, interpretation of plans and specifications, and all questions related to acceptable completion of work. It is recommended that the Contractor invite the Engineer to a pre-construction meeting to discuss any traffic signal related questions and/or concerns. This meeting can be held in conjunction with other disciplines.

#### 404.3 MAINTENANCE OF TRAFFIC:

Traffic shall be protected in accordance with The City of Phoenix, Traffic Barricade Manual, the Manual on Uniform Traffic Control Devices and Section [401](#).

#### 404.4 MATERIALS AND WORKMANSHIP:

Materials and construction details shall conform to the latest City of Phoenix Standard Traffic Signal Drawings, the Arizona Department of Transportation, Highways Division, Supplemental Specifications to Standard Specifications for Road and Bridge Construction, latest edition, the latest edition of the Arizona Highway Department Traffic Signal and Highway Lighting Systems Standard Drawings and the current National Electrical Code Standards unless otherwise specified herein or on the plans.

All electrical materials and workmanship shall conform to the requirements of the current National Electric Code (NEC).

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Contractor shall be responsible for all work and materials as shown on the signal plans, the project specific specifications and/or general provisions.

The Contractor shall call the Blue Stake Center at least 48 hours prior to excavation for information relative to the location of buried utilities. The Contractor shall also contact the City of Phoenix Traffic Signals Department at (602) 262-6204 for traffic signal locates.

All underground conduits shall be schedule 40 rigid polyvinyl chloride (PVC) installed 24 inches to 30 inches below finished grade with the exception of loop lead-in conduits which shall be schedule 40 rigid PVC installed in accordance with the latest City of Phoenix Standards. All conduits shall be installed in straight lines (unless otherwise shown on the plans) junction box to junction box or junction box to signal equipment foundation with one 90 degree sweep on each end as specified in the plans. All conduits entering junction boxes shall be vertical, with the top of the conduit six inches below the bottom of the cover.

Foundations shall conform in size, type, and location as shown on the plans. The foundation anchor bolts shall be supplied by the Contractor unless otherwise noted on the plans and installed square with the intersection. The top of the pole foundation shall be set at the finished grade and at the back of sidewalk for each location unless otherwise shown of the plans. Concrete for foundations shall be Class A, 3000 psi concrete with a 6" slump per Section [725](#). Minimum pole foundation curing times are: A-Poles five (5) days, M-poles seven (7) days, Special M-poles (SM) and Special R-poles (SR) ten (10) days, NO EXCEPTIONS. With approval of the Engineer, high-early strength concrete may be used at no additional cost to the City. Testing is required to verify high-early strength concrete has attained a 3000 psi compressive strength per ASTM C39 and shall be performed at the Contractor's sole expense.

The Contractor shall have a Level II IMSA certified Technician/ Electrician on site at all times during construction/maintenance of traffic signal equipment. Conductor splices and terminations shall be made by a qualified Journeyman Electrician, who has successfully completed a recognized four (4) year apprenticeship program or equivalent training, or by a person enrolled in a recognized four (4) year apprenticeship program under the direct supervision of a Journeyman Electrician.

A separate loop lead-in circuit shall be supplied for each inductive loop. Inductive loop lead-in cable shall be continuous without splices from the loop stub-out junction box to the controller cabinet. A minimum of five (5) feet of slack shall be provided in the controller cabinet and a minimum of three (3) feet of slack shall be provided in each junction box.

Detector loops shall be installed and tested ONLY in the presence of an authorized representative of the City of Phoenix Traffic Signal Shop. Detectors installed without said representative in attendance, for any reason, shall be removed from the pavement and new conductors installed, all at the Contractors expense. Each detector shall be installed according to the latest Traffic Signal Standard Drawing. Installations shall be made permanent with approved sealant after successful testing. The loop conductor shall be temporarily spliced to the lead-in cables, as directed by the Inspector, and tested at the controller cabinet. Loop sealant shall be injected into all cuts and, before setting, surplus sealant shall be struck off flush with and removed from the roadway surface.

All traffic signal heads shall be covered until activation except for 12" mast arm heads, which will not be installed until the day of the activation. These coverings must be maintained in good repair.

The Contractor shall maintain work and work site in an acceptable manner during the course of the project. Upon completion of the work all surplus earth, construction debris including abandoned foundations, and/or remnant equipment shall be removed and properly discarded by the Contractor and the work area shall be restored to a neat, orderly condition.

### **404.5 INSPECTION:**

The City of Phoenix Traffic Signal Foreman or his designee shall inspect all work performed including these critical components: all trenches and conduit runs including splices before being covered, wiring, junction box installations, loop layout, saw cuts, loop installation, and traffic signal pole foundations before being poured. The Contractor shall contact the appropriate Traffic Signal Foreman forty-eight (48) hours in advance to request inspection or call (602) 262-6733.

Inspections are typically at no cost to the Contractor. However, if the Contractor's performance results in the need for additional inspections or excessive inspection time for the Traffic Signal Foreman or his designee the Contractor will be put

## SECTION 404

on notice and subsequent inspection costs shall become the Contractor's responsibility.

The Traffic Signal Foreman, or his designee, are authorized to inspect and reject work and materials; and shall refer rejected work not resolved in the field to the Traffic Signal Engineer for resolution.

In the event the Traffic Signal Engineer determines that the materials furnished, work performed, or the finished product not in conformance with the plans and specifications, the non-conforming improvements shall be removed and replaced or otherwise brought into conformity at the sole expense of the Contractor.

The Traffic Signal Engineer has the authority to reject defective material and to suspend any work that is improperly performed.

### **404.6 ACTIVATION OF TRAFFIC SIGNAL WORK:**

Notify the traffic signal shop prior to pulling conductors and activating the traffic signal system. Activation of new traffic signal intersections shall be scheduled through the Traffic Signal Engineer. An off duty Police Officer supplied by the Contractor is required to be present for the activation to provide traffic control.

### **404.7 SALVAGED MATERIALS:**

Any existing equipment identified by the Traffic Signal Shop Foreman or his designee as salvageable shall be removed without damage, and delivered to 2141 E. Jefferson Street and unloaded where designated. Contact the Traffic Signal Shop at (602) 495-2083, 24 hours in advance for an appointment to return salvaged equipment.

Remnants of obsolete traffic signal equipment shall be delivered to the Traffic Signal scrap yard by the Contractor. Contact the Traffic Signal project inspector 24 hours in advance for an appointment to deliver obsolete equipment to the scrap yard.

### **404.8 WARRANTY:**

The warranty period will begin the day the work is accepted by the City.

There will be a two (2) year warranty on all Contractor supplied equipment and detector loops following final acceptance of the work except as noted herein. The Contractor will warranty workmanship supplied in association with the installation of City supplied equipment for a two (2) year period following acceptance of the work. All LED indication modules furnished by the Contractor will be warranted for five (5) years following acceptance of the project.

### **404.9 MEASUREMENT:**

Measurement for foundations, junction boxes, and loops shall be of the number of units of each satisfactorily constructed.

Measurement for conduit shall be the linear feet of conduit satisfactorily installed as measured along the centerline of the conduit through fittings from end of conduit to end of conduit. Measurement shall be made to the nearest 0.5 feet.

Measurement for the temporary signal cable and the lead-in cable shall be the linear feet of cable satisfactorily installed as measured along the centerline of the cable from end to end. Measurement shall be to the nearest 0.5 feet. The temporary signal cable is a contingency item and may be eliminated without compensation by the Engineer.

### **404.10 PAYMENT:**

Payment for traffic signal work will be made at the unit prices in the applicable proposal items, the combination of which shall be full compensation for all material and labor required to complete the work, including incidentals not specified, but required, to complete the work including temporary traffic signals as described and specified herein, on the plans and permits.

*-End of Section-*

## SECTION 405

### SURVEY MONUMENTS

#### 405.1 DESCRIPTION:

This work shall consist of furnishing and installing survey monuments at the locations shown on the plans or directed by the Engineer. The work also includes the preparation and recording of a corner record or result of survey in accordance with the Arizona State Board of Technical Registration requirements.

Monuments shall conform to the standard details or details shown on the plan.

#### 405.2 MATERIALS:

The concrete portion of monuments shall be constructed in accordance with the provisions in Sections [725](#) and [505](#).

Concrete shall be Class B.

Brass caps for survey monuments shall be furnished by the Contractor unless otherwise specified in the special provisions.

#### 405.3 CONSTRUCTION:

Monuments may be cast in drilled holes without the use of forms.

Survey monuments shall be set vertically in the ground.

The brass caps assembly shall be firmly embedded in the concrete cylinder before the concrete has acquired its initial set. The concrete cylinder shall be so located that, the reference point will fall within a 1 inch circle in the center of the brass cap.

The tops of survey monument covers shall be set flush with the pavement surface.

#### 405.4 MEASUREMENT:

Survey monuments will be measured by the number of units of each type of monument constructed and accepted.

#### 405.5 PAYMENT:

Payment for monuments will be at the contract unit price and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the monuments, complete in place, as shown on the plans or as directed by the Engineer including preparing and recording a corner record or results of survey.

*- End of Section -*

## SECTION 410

### PRECAST SAFETY CURBS

#### 410.1 DESCRIPTION:

This work shall consist of furnishing and installing precast safety curbs as shown on standard details or as detailed on the plans, or as directed by the Engineer.

#### 410.2 MATERIALS:

Portland cement concrete shall be Class A, conforming to the applicable requirements of Section [725](#).

Steel reinforcing shall conform to the requirements of Section [727](#). The dimensions of the precast curb shall be as indicated on the plans and standard details.

Dowels shall conform to ASTM A615 plain, intermediate grade, 1/2 inch round by 24 inches.

Mastic may be either a fiberized mastic cement or an epoxy cement. The Contractor shall submit to the Engineer, the type of mastic and manufacturer's recommended procedures for use, within 10 days after the date of award of contact which will enable the Engineer to determine that the proposed material is acceptable.

#### 410.3 CONSTRUCTION METHOD:

Back of safety curbs shall be set at the property line unless otherwise shown on the plans. Curbs shall be kept a minimum distance of 5 feet from driveways.

Precast safety curb installed on natural earth or gravel surfaces shall be secured in place with a minimum of 2 steel dowels through each curb. A minimum 12 inches diameter by 12 inches deep Class B concrete cylinder or approved equal shall be poured in place around each dowel.

Precast safety curb installed on portland cement concrete or asphalt concrete surfaces shall be bedded in a continuous layer of mastic cement under its complete base area and secured with a minimum of 2 steel dowels driven through the safety curb.

Dowels shall extend into the sub-surface and/or concrete cylinder a minimum of 18 inches. When installed, the top of each dowel shall be flush with the top of the safety curb.

The Engineer will verify locations of all safety curbs in the field at time of construction.

#### 410.4 MEASUREMENT:

Measurement will be the number of safety curbs furnished and installed, complete in place.

#### 410.5 PAYMENT:

Payment will be made at the unit price bid each in the proposal for the following:

- (A) Safety curbs installed on natural earth or gravel.
- (B) Safety curbs installed on portland cement concrete.
- (C) Safety curbs installed on asphalt concrete.

*- End of Section -*

## SECTION 415

### FLEXIBLE METAL GUARDRAIL

#### 415.1 DESCRIPTION:

The work under this Section shall consist of furnishing all materials, constructing new guardrail, and delineating guardrail sections at the locations shown on the plans.

Guard rail end treatments shall be as specified on the plans or special provisions.

#### 415.2 MATERIALS:

The rail elements, bolts, nuts and other fittings shall conform to the specifications of AASHTO M 180, except as modified in this Section. The rail metal shall conform to AASHTO M 180, Type I, Class A and in addition to the requirements of AASHTO M 180, shall withstand a cold bend, without cracking of 180 degrees around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

Three certified copies of mill test reports of each heat from which the rail element is formed shall be furnished to the Engineer.

All materials shall be new, except as otherwise noted on the plans or special provisions.

Railing Parts furnished under these specifications shall be interchangeable with similar parts regardless of source. All surfaces of guardrail elements that are exposed to traffic shall present a uniform, pleasing appearance and shall be free of scars, stains or corrosion.

Nails shall be 16 penny common galvanized.

Bolts shall have shoulders shaped to prevent the bolts from turning.

Unless otherwise specified the rail elements, terminal sections, bolts, nuts, and other fittings shall be galvanized in accordance with Section [771](#). Where galvanizing has been damaged, the coating shall be repaired in accordance with Section [771](#).

Guardrail reflector tabs shall be either 3003-H14 Aluminum strip  $0.063 \pm 0.004$  inches thick, or steel strip  $0.078 \pm 0.008$  inches thick galvanized in accordance with ASTM A 653 coating designation G 90. The reflector material shall be high-reflectivity sheeting, either silver-white or yellow and shall conform to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction. Adhesive for sheeting attachment to the metal tab shall be of the type and quality recommended by the sheeting manufacturer. Reflector tabs shall conform to the Reflector Tab Detail of Maricopa County Department of Transportation Standard Detail 3002.

Timber for posts and blocks shall be rough sawn (unplanned) or S4S with the nominal dimensions indicated. Any species or group of woods graded in accordance with the requirements for Timber and Posts of the Western Wood Products Association may be used. Timber shall be No. 1 or better, and the stress grade shall be as follows:

6" by 8" Post and Block	1200 psi
8" by 8" Post and Block	900 psi
10" by 10" Post and Block	900 psi

When the plans show guardrail systems using 8" by 8" timber posts and blocks, the Contractor may use 8 1/4" nominal size posts and blocks with a stress grade of 825 pounds per square inch.

At the time of installation, the dimensions of timber posts and blocks shall vary no more than plus or minus 1/2" from the nominal dimensions as specified on the project plans. The size tolerance of rough sawn block in the direction of the bolt holes shall vary no more than plus or minus 3/8".

All timber shall have a preservative treatment as per the requirements of AASHTO M 133.

## SECTION 415

Structural steel shapes shall conform to the requirements of ASTM A36 and be galvanized in conformance with the appropriate requirements of AASHTO M 111. Dimensions shall meet the dimensional requirements of the American Institute of Steel Construction.

Steel tubes shall conform to the material requirements of ASTM A500 or A501 and be galvanized in conformance with the requirements of AASHTO M 180, Type 1.

### 415.3 CONSTRUCTION REQUIREMENTS:

**415.3.1 General:** The construction of the various types of guardrail shall include the assembly and erection of all component parts complete at the locations shown on the project plans or as directed by the Engineer.

Posts shall be as indicated by plans, standard details, or special provisions. Only one type and size of post and block shall be used for any one continuous length of guardrail.

Terminal sections shall be installed in accordance with the manufacturer's recommendations.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

The various types of guardrail shall be constructed with wood posts and wood blocks, except as otherwise noted on the plans.

The bolted connection of the rail element to the post shall withstand a 5,000 pound pull at right angles to the line of the railing. All metal work shall be fabricated in the shop. No punching, cutting or welding shall be done in the field, except as provided for by the project plans. All metal cut in the field shall be cleaned and the galvanizing repaired in accordance with Section [771](#).

Where field cutting or boring of wood posts and blocks is permitted, the affected areas shall be thoroughly swabbed with at least two passes of the same type of wood preservative as initially used.

Where wood posts with rectangular sections are used, the posts shall be set so that the longest dimension is perpendicular to the rail.

All bolts shall extend beyond the nuts a minimum of two threads, except that all bolts adjacent to pedestrian traffic shall be cut off flush to the nut.

Bolts extending more than 2" beyond the nut shall be cut off to less than 1/2" beyond the nut.

Unless otherwise shown on the plans, bolts shall be torqued as follows:

Diameter of Bolt	Torque, Foot/Pounds
5/8"	45-50
3/4"	70-75
7/8" and larger	120-125

All bolts, other than those specified to be torqued, shall be securely tightened.

When guardrail is being constructed under traffic, the work shall be conducted so as to constitute the least hazard to the public. Guardrail work shall be performed in the direction of traffic flow when feasible.

Any section of guardrail that is removed for modification shall be replaced within five calendar days of the date the guardrail is removed, unless otherwise directed by the Engineer. At the end of each day, incomplete guardrail sections having an exposed end toward oncoming traffic shall have an appropriate temporary protective end treatment acceptable to the Engineer set securely in place together with approved overnight traffic control devices set in place.

**415.3.2 Delineation:** The maximum spacing between reflector tabs shall not exceed six posts. The slotted part of the tab shall

## SECTION 415

be installed under the mounting bolt head so that the Reflectorized surface of the tab faces oncoming traffic. The exposed ends of the slotted part of the tab shall be bent up against and then over the top of the bolt head. The color of the reflective portion of the barrier markers shall conform to the color of the adjacent edge line. Silver-faced reflector tabs shall be installed on the right hand side of all roadways, and yellow-faced tabs shall be installed on the left-hand side of one-way, or median divided roadways.

**415.3.3 Roadway Guardrail:** Wood posts shall be used for new guard rail installations unless otherwise indicated by plans or special provisions. Wood posts shall either be driven or placed in manually or mechanically dug holes; however, driven posts will not be permitted at locations where damage to the curb, gutter, sidewalk, buried items, shoulders or pavement might occur. The Engineer will be the sole judge as to whether driving of posts will be allowed. Driving of posts shall be accomplished in a manner that will prevent battering, burring, or distortion of the post. Any post which is damaged to the extent it is unfit for use in the finished work, as determined by the Engineer, shall be removed and replaced at no additional cost to the Agency.

The posts shall be firmly placed in the ground. The space around posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding material.

Where pavement is disturbed in the construction of guardrail, the damaged surfacing shall be repaired as approved by the Engineer.

Where a culvert or other obstacle is at an elevation which would interfere with full depth post placement, guardrail installation shall comply with requirements of Subsection [415.3.4 Bolted Guardrail Anchors](#) or Subsection [415.3.5 Nested Guardrail](#).

Wood blocks shall be toe nailed to the wood post with one 16 penny galvanized nail on each side of the top of the block. Wood blocks shall be set so that the top of the block is no more than ½" above or below the top of the post, unless otherwise shown on the project plans.

Rail elements shall be spliced at 25 foot intervals or less. Rail elements shall be spliced at posts unless otherwise shown on the project plans and shall be spliced by lapping in the direction of traffic in the nearest adjacent lane. Rail elements at joints shall have full bearing. When the radius of curvature is 150 feet or less, the rail elements shall be shop curved.

The Contractor shall dispose of surplus excavated material remaining after the guard railing has been constructed.

**415.3.4 Bolted Guardrail Anchors:** Where the elevation of the top surface of a concrete box culvert or other similar installation prevents the placement of a post of the specified length, the posts shall be shortened and anchored in accordance with Maricopa County Department of Transportation Standard Detail 3010.

**415.3.5 Nested Guardrail:** This work shall consist of furnishing and constructing nested guardrail, Type 1, 2, or 3, as shown in Maricopa County Department of Transportation Standard Details 3008-1 through 3008-3.

**415.3.6 Guardrail to Structure Transitions:** Guardrail transitions shall be constructed in accordance with requirements shown on the plans and special provisions.

### 415.4 MEASUREMENT:

The limits of measurement for roadway guardrail shall be as detailed in Maricopa County Department of Transportation Standard Detail 3016, except as otherwise noted on the plans or special provisions. Guardrail, of the type shown on the project plans, will be measured by the linear foot along the face of the rail element from center to center of posts, exclusive of guardrail terminals, guardrail end terminal assemblies, nested guardrail (Types 1, 2 and 3) and guardrail transitions.

Delineation is considered a part of installation of guardrail and hence will not be measured as a separate item.

The accepted quantities of guardrail posts secured with bolted guardrail anchors will be measured by the unit each.

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Nested guardrail, Types 1, 2, or 3, and guardrail transitions will be measured by the unit each, complete in place and accepted as shown on the plans.

### **415.5 PAYMENT:**

Payment for accepted quantities of each type of guardrail will be made at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrails, complete in place including excavation, backfill, and disposal of surplus material.

Payment for Bolted Guardrail Anchors will be at the contract unit price, and shall be full compensation for the work, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts, and box culverts, and disposal of surplus materials.

Payment for guardrail transitions will be at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrail transitions, complete in place including excavation, backfill, and disposal of surplus material.

*- End of Section -*

## SECTION 420

### CHAIN LINK FENCES

#### 420.1 DESCRIPTION:

This work shall consist of constructing chain link fences at the locations and in accordance with the details shown on the plans, and as provided in these specifications and the special provisions. When installation procedures are not covered within these specifications, standard details, special provisions, plans or other documents, installation will comply with ASTM F567.

#### 420.2 MATERIALS:

Chain link fence material shall conform to the requirements of Section [772](#). Portland cement concrete shall conform to the requirements of Section [725](#).

#### 420.3 CONSTRUCTION METHODS:

**420.3.1 Fence Construction:** Before any fence is installed, the Contractor shall submit to the Engineer for approval, shop drawings showing the details of all fittings and gates proposed to be furnished.

Posts shall be spaced at not more than 10 foot intervals, measured from center to center of posts, and shall be placed in a vertical position.

Changes in line or grade where the angle of deflection is 30 degrees or more shall be considered as corner and slope points, respectively, and corner or slope posts shall be installed at these points.

All posts shall be set in Class C concrete footings, which footings shall be crowned at the top to shed water. Footings for line posts for 72 inch fabric or less shall not be less than 30 inches deep and 8 inches in diameter, and footings for line posts for fabric more than 72 inches shall be shown on plans. All other footings, unless otherwise indicated on the plans or in the special provisions, shall be not less than 36 inches deep and 12 inches in diameter.

End, corner, slope and gate posts shall be braced to the midpoint of the nearest line post or posts with horizontal braces used as compression members and the said line posts trussed from the brace back to the bottom of the end, corner, slope or gate post with 3/8 inch steel truss rods with turnbuckles used as tension members.

Unless otherwise specified all fence shall be installed with a top rail and a bottom tension wire and the post tops shall be secured to the post by bolts or rivets. When top rail is omitted, a top and bottom tension wire shall be used.

The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects above the top rail of the fence to form a knuckled or barbed projection. The fabric shall be stretched taut and securely fastened to the posts, the top rail, and the bottom tension wire. The tension wire shall be installed on a straight grade between posts by excavating the high points of ground and in no case will filling of depression be permitted. Unless otherwise specified the bottom of the fence shall be on a line approximately 2 inches above the ground surface.

The fabric shall be fastened to end, corner, slope and gate posts with 3/16 inch  $\times$  3/8 inch high carbon steel tension bars and not less than 12 gage  $\times$  1 inch steel tension bar bands spaced at 16 inch intervals; and to line posts, top rail and tension wire with 11 gage or heavier tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16 inches, and on top rail and tension wire at intervals of approximately 18 inches.

Barbed wire shall be installed on the fence only when specifically required by the plans or special provisions. When required, it shall be installed on extension arms of a type specified under Section [772](#).

**420.3.2 Construction of Gates:** The widths of any gates to be installed will be indicated on the plans or in the special provisions. Gates in which the width of the leaf is greater than 6 feet shall be constructed with an internal horizontal or vertical stiffener of the same diameter as the frame; the frame shall be trussed with a 3/8 inch adjustable tension rod. Gates in which the width of the leaf is 6 feet or less will not require a stiffener and will require only 1 truss rod.

## SECTION 420

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16 inch intervals.

The swing gates shall be hung by at least 2 steel or malleable iron hinges, so designed as to securely clamp to the gate post and permit the gate to be swung back against the fence.

Semi-cantilever gates shall be provided with a combination steel or malleable iron catch and locking attachment of approved design, and shall be subject to approval of the Contracting Agency. Stops to hold gates open and a center rest with catch shall be provided on all double drive gates and on all other gates where required.

**420.3.3 Repair of Damaged Coating:** Welds made after galvanizing shall be ground smooth, then wire brushed to remove loose or burned zinc coating, after which the cleaned areas shall be repaired to the satisfaction of the Engineer in accordance with Section [771](#). Repairs to abraded or otherwise damaged zinc coating shall be made in a similar manner.

### **420.4 MEASUREMENT:**

Chain link fence shall be measured on the fence line along the bottom strain wire from center to center of end posts, deducting the widths of gates and openings.

### **420.5 PAYMENTS:**

The price bid and paid per linear foot for chain link fence shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the fence complete in place as specified on the plans, and in the special provisions, except for furnishing and installing gates.

Gates will be paid for at the unit price bid for each size of gate required by the plans or special provisions, which price shall include full compensation for furnishing the gates, together with all necessary gate posts, fittings and hardware, and doing all the work involved in installing the gates complete in place as specified. If double gates are required, each double gate will be paid for at the unit price bid and such unit price shall include furnishing and installing both leaves.

Full compensation for clearing the line of the fence and disposing of the resulting material, excavating high points in the existing ground between posts, excavating and furnishing and placing concrete footings, connecting new fences to structures and existing fences, and any other related work shall be considered as included in the price bid per linear foot of fence and no additional allowance will be made therefore.

*- End of Section -*

## SECTION 424

### PARKWAY GRADING

#### 424.1 DESCRIPTION:

This grading shall include all work necessary to bring the surface of the parkway, between the back of curbs and sidewalks and/or the parkway between sidewalks and the right-of-way line, to the grade and cross-section shown on the plans or as directed by the Engineer. It shall also include median islands between divided roadways.

#### 424.2 ROUGH GRADING:

- (A) Fill material shall contain no rocks over 3 inches in diameter, broken concrete, or debris of any nature.
- (B) Backfill behind curbs and along the edges of the sidewalk shall be made immediately upon the completion of those items.
- (C) The parkway area shall be graded at a variable slope from 1 inch below the back of sidewalk to meet the existing surface at the right-of-way line in accordance with the typical section shown on the plans. Material displaced in the grading of parkways shall not be allowed to be placed on base and surfacing material already in place on the roadway. No measurement or direct payment will be made for this work.

#### 424.3 FINE GRADING:

- (A) The finished surface shall be free from stone and all debris and be true to grade and cross-sections after compaction to not less than 80% of maximum density, as determined by test methods specified in Section [301](#).
- (B) Where existing parkways are planted in grass, flowers or shrubs, and the level is somewhat above the top of the curb or sidewalk, the parkway shall be graded as per City of Phoenix Landscape Standards and Guideline Detail "Water Retention on Turf Installation" with the least possible damage to the planted area.

#### 424.4 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for parkway grading as such; the cost thereof shall be included in the price bid for construction or installation of the items to which such grading is incidental or appurtenant.

*- End of Section -*

## SECTION 425

### TOPSOILS

#### 425.1 DESCRIPTION:

This work shall consist of furnishing and hauling topsoil from an approved source and placing the topsoil as shown on the plans, in accordance with this specification and special provisions.

#### 425.2 MATERIALS:

Topsoil shall conform to the requirements of Section [795](#).

#### 425.3 CONSTRUCTION METHODS:

Prior to the excavation of topsoil, all grass, weeds, brush, stumps, loose rocks and other objectionable material shall be removed from the surface of the area from which the topsoil is to be removed.

The topsoil source shall be excavated in such a manner that all material excavated will be of the same composition and structure throughout.

Topsoil shall be spread over the areas and to the depths as specified, and shall be water settled.

After the topsoil has been spread, stumps, roots and other objectionable matter shall be removed from the surface of the area and disposed of in a manner satisfactory to the Engineer.

#### 425.4 MEASUREMENT:

Unless otherwise specified, topsoil shall be measured by the cubic yard in place and loose after watering and settling.

#### 425.5 PAYMENT:

The quantities measured as provided above, will be paid for at the contract price per cubic yard for furnishing and placing topsoil, which price shall be full compensation for the item complete, as described and specified.

*- End of Section -*

## SECTION 429

### TRAILS

#### 429.1 DEFINITION OF TERMS

- (A) Multi-Use Trail (MUT): The MUT shall be a 10' wide compacted decomposed granite (DG) surface stabilized to its full 3" depth and shall also have 2' DG shoulders, allowing pedestrian, bicycle, equestrian and maintenance vehicle use. Switchbacks and clearances for obstacles, vegetation, and plants will be measured from the edge of the MUT excluding the 2' shoulders where installed. All MUTs shall meet or exceed the Americans with Disabilities Act (ADA) requirements and shall be Barrier Free Trails.
- (B) Multi-Use Trail Easement (MUTE): The MUT shall be constructed within a dedicated 30' public MUTE.
- (C) Shared-Use Path: The Shared-Use Path (SUP) is a non-equestrian 10' wide concrete pathway providing recreation and educational experiences. All SUPs shall meet or exceed the ADA requirements.
- (D) Private Trails: The Trails Master Plan does not regulate the locations of Private Trails (PT). Construction and maintenance of PT is the responsibility of the private development. Construction of PT should follow the MUT or SUP guidelines set forth in these specifications.

#### 429.2 SPECIFICATIONS

##### (A) MULTI-USE TRAIL

###### (1) Users:

- (a) Hikers, joggers, bicyclist, equestrians and the disabled.

###### (2) Multi-Use Trail Easements (MUTE):

- (a) Multi-Use Trails shall be located within an exclusive 30 foot minimum public trail easement.
- (b) This easement is exclusive for the trail, landscaping, and PUE unless modified by Development Services.
- (c) Trail easements along an open space or wash corridor will be a minimum 25' wide.

###### (3) Sub Grade:

- (a) The sub-grade shall be 90% compacted prior to the installation of the MUT.

###### (4) Grade:

- (a) Maximum sustained longitudinal grade 5% (20:1).
- (b) The cross slope shall not exceed 2%.

###### (5) Tread Surface:

- (a) The tread surface shall be a minimum of 10' wide with a 2' shoulder on each side. No shoulder will be required for the MUT in turf area.
- (b) Trail shall allow for side-by-side travel and ease of passing by horses and bicycles. Tread conditions must provide an adequate walking or riding surface free of obstacles or hazards.
- (c) The MUT surface shall be ¼" minus decomposed granite (DG) of a color contrasting with the surrounding DG and shall be stabilized to its full 3" depth.
- (d) When located in turf, the MUT shall have a 6"x8" concrete header that meets or exceeds MAG Standards on each side. Shoulders shall not be required in turf.

###### (6) Path Locations:

- (a) Public Multi-use Trails shall not be placed in retention basins, drainage ways, channels or naturally occurring or man made washes, unless otherwise approved by the Parks & Recreation Department.

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- (b) There shall be a minimum 5-foot horizontal clearance between trails and other obstacles i.e., fences, walls, utility boxes and other fixed objects. Safety rails or ADA railing are the exception to this requirement.
- (c) Where the trail surface ties into another hardscape surface material i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface.
- (d) Trails shall feed directly into ADA ramps at all roads and driveway crossings.

### (7) Switchbacks:

- (a) The inside radius of a trail switchback shall be a minimum of 5'.

### (8) Vegetation Clearance and Removal:

- (a) Plant material shall not be planted or allowed to grow in the 2' shoulders.
- (b) Plant material shall be cleared to a height of 10' measured from the trail surface.
- (c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5' of the trail.

### (9) Plants with Thorns and Poisonous Plants:

- (a) Plants with thorns such as cacti, *Acacia greggi*, *Dasyllirion* species etc., shall not be planted or allowed to grow within 10' of the MUT.
- (b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora*, *Euphorbia rigida* etc., shall not be planted or allowed to grow within 10' of the MUT.

## (B) SHARED-USE PATHWAY

### (1) Users:

- (a) Hikers, joggers, bicyclist and the disabled.

### (2) Easements:

- (a) Trails shall be located within 20' public trail/sidewalk pedestrian easements.

### (3) Sub Grade:

- (a) The sub grade shall be 90% compacted.

### (4) Grade:

- (a) Maximum sustained longitudinal grade 5% (20:1).
- (b) The cross slope shall be 2% maximum.

### (5) Surface:

- (a) The tread surface shall be 10' wide, standard. No SUP shall be less than 8' wide unless approved by the Parks & Recreation Department.
- (b) The tread conditions shall provide an adequate walking surface free of obstacles or hazards and shall allow for side-by-side travel and ease of passing by pedestrians and bicycles.
- (c) Concrete shall meet or exceed Section 725 requirements.
- (d) Where the pathway surface ties into another hardscape surface material i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface

### (6) Path Locations:

- (a) SUP shall not be placed in retention basins, drainage ways, and channels or in naturally occurring or manmade washes, unless otherwise approved.

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- (b) There shall be a minimum 5-foot horizontal clearance between sidewalks and trails and other obstacles i.e., fences, walls, utility boxes and other fixed objects.

### (7) Switchbacks:

- (a) The inside radius of a pathway switchback shall be a minimum of 5 feet.

### (8) Vegetation Clearance and Removal:

- (a) Plant material shall not be planted or allowed to grow in the 2' shoulders.
- (b) Plant material shall be cleared to a height of 10' measured from the trail surface.
- (c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5' of the trail surface.

### (9) Plants with Thorns and Poisonous Plants:

- (a) Plants with thorns such as cacti, *Acacia greggi*, *Dasyliirion* species etc., shall not be planted or allowed to grow within 10' of SUP.
- (b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora*, *Euphorbia rigida* etc., shall not be planted or allowed to grow within 10' of the SUP.

## (C) GRADE SEPARATED CROSSING (UNDERPASS FOR PEDESTRIAN/EQUESTRIAN USAGE)

- (1) When major trails intersect streets or roads, a pedestrian and/or equestrian cell (a barrel within a culvert) or bridge shall be provided for user safety.
- (2) The underpass/bridge shall have a minimum 12-foot vertical and 10-foot horizontal clearance and unobstructed sight lines shall be maintained.
- (3) Underpasses and bridges more than 50-foot in length shall be artificially lit to an average of 2 foot-candles minimum on the trail surface
- (4) The underpass shall be connected to the MUT/SUP with a concrete tread surface, rough broom finished. The MUT shall receive a heavy broom finish to improve equestrian footing.

***-End of Section-***

## SECTION 430

### LANDSCAPING AND PLANTING

#### 430.1 DESCRIPTION:

This Section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials shall be in accordance with Section [795](#).

Existing utilities and improvements not designated for removal shall be protected in place. The Contractor, at no additional cost to the Contracting Agency, will repair any damages.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

#### 430.2 GENERAL:

Furnish all labor, materials, equipment, and incidental needs to install the landscape to the drawings, details and specifications shown in the plans.

Applicable publications listed below form a part of this specification to the extent referenced:

Arizona Nursery Association Growers Committee Recommended Tree Specification (latest edition)

American Society for Testing and Materials

(ASTM) C136, Standard method for sieve analysis of fine and coarse grained aggregates;

(ASTM) F1632, Test methods for particle size analysis and sand grading of golf course greens and sports field root zone mixes;

(ASTM) D2974 Method B, Test moisture, ash, and organic matter of peat and other organic soils;

(ASTM) F1647, Test methods for organic matter content of golf course greens and sports turf root zone mixes.

All landscaping and irrigation work shall be installed by a contractor licensed to perform this specialty work.

Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State and local authorities in furnishing, transporting and installing materials as shown or for completing the work identified herein.

**430.2.1 Source Quality Control:** Ship materials with Certificate of Inspection required by governing authorities.

Do not make substitutions: If specified material is not obtainable, submit proof of non-availability, together with proposal for use of equivalent material, similar in appearance, ultimate height, shape, habit of growth and general soil requirements. The Contractor may make substitution of a larger size of the same species with approval by the Engineer. However, any additional cost for these substitutions will be borne by the Contractor.

Before delivery of the following materials, a letter of compliance shall be submitted, certifying that materials meet the requirements for legal transportation of State and Local government agricultural laws, and are true to analysis as specified. Certify the following:

Nursery propagated plants

Cacti, succulents, and native plants

Soil Amendments, and conditioners

Lawn seeds, stolons, and sod

Native seed mixes

**430.2.2 Samples and Tests:** The Engineer reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected materials shall be immediately removed

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from the site at the Contractor's expense. The Contractor shall pay cost of testing materials not meeting specifications.

**430.2.3 Herbicide / Pesticide Applicators:** All herbicide / pesticide applicators shall be properly licensed for application of non-restricted use chemicals with an A-20 license or an A-21 license with Pesticide Endorsement from the State Registrar of Contractors and Structural Pest Control Commission. All Landscape contractors are required to furnish a copy of their application from the Registrar of Contractors, which shall list the names of those employees approved as applicators by the Registrar of Contractors. Application of non-restricted use pesticides shall not take place until the Engineer receives a copy of the application.

### **430.3 PLANT ESTABLISHMENT GUARANTEE AND MAINTENANCE:**

Unless otherwise authorized, the Contractor shall maintain all landscape areas on a continuous basis as they are completed during the course of work and until final Plant Establishment Guarantee and Maintenance Acceptance. The Contractor shall provide adequate personnel to accomplish maintenance. Maintenance shall include keeping the landscape areas free of debris on a weekly basis, chemical control of weeds and fertilization as needed, cultivating the planting areas, and mowing of turf where lawns are part of the project.

Plants shall be kept in a healthy, growing condition by watering, pruning, spraying, weeding and any other necessary operation of maintenance. Plant saucers and beds shall be kept free of weeds, grass and other undesirable vegetation. Plants shall be inspected at least once per week and appropriate maintenance performed. Pruning and re-staking is to include removal of any growth conflicting with vehicular or pedestrian movement.

Turf from seed or stolons shall be considered established when it is ready for use, and turf exceeds 95 percent coverage of an 18 inch diameter ring when placed on the ground by the Engineer. The turf shall be vigorously growing, uniform in color, and cut to a uniform height designated by the Engineer. Roots shall have penetrated the soil to a depth of not less than 4 inches.

The Contractor shall maintain the irrigation system and make any necessary repairs regardless of cause to assure a complete and operational system as originally designed and constructed. Repairs shall be made within 48 hours of detection.

Chemical mixing for weed control shall be done in the presence of the Engineers representative. The method of application shall be approved by the Engineer.

The Contractor shall request an initial inspection by the Engineer when all planting and related landscape work is accomplished. After this initial inspection, and subject to approval of work by the Engineer, written field notification to the Contractor, setting the effective date for beginning of the Plant Establishment Guarantee and Maintenance Period will be issued. This Period shall last for 90 days or as specified, unless extended by the Engineer. If the landscape areas are improperly maintained; if appreciable plant replacement is required (for whatever reason); if corrective work is required for the operation of the irrigation system; or if other corrective work is necessary; the Plant Establishment Guarantee and Maintenance Period shall be extended and the Contractor shall continue to maintain the entire site until accepted at no increased cost to the Owner.

At the end of the Plant Establishment, Guarantee and Maintenance Period a final inspection will be performed. If, after inspection, the Engineer is of the opinion that all planting areas are weed free, plant materials are in satisfactory growing condition, the Engineer will give the Contractor written Notice of Acceptance of the landscape installation. Any plants which need to be replaced, regardless of the cause, shall be replaced prior to final acceptance.

### **430.4 JOB CONDITIONS:**

Site Examination: The prospective Contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

Water costs are the Contractors responsibility, until Final Acceptance or end of Plant Establishment, Guarantee, and Maintenance Period whichever is longer and the water meters are transferred to the City.

Before the beginning of landscape work, all planting areas shall be left free of construction debris and/or toxic material and subgraded to a level to permit landscape and irrigation construction. Trenches, foundation backfill or other filled excavations

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shall be compacted prior to the beginning of any landscape work. No soil preparation or planting shall begin before the site has been cleared and cleaned of debris. Commencement of work indicates acceptance of job site conditions.

Cooperate and coordinate with other contractors and trades working in and adjacent to landscape areas.

**430.4.1 Utilities:** Determine location of underground utilities and perform work in a manner, which will avoid possible damages. The Contractor, at no additional costs to the Contracting Agency, will repair any damages. Hand excavate, as required. Maintain stakes by others until removal is mutually agreed upon by parties concerned.

**430.4.2 Obstructions:** If rock or other obstructions are encountered in excavation for planting, notify the owner's representative. Proceed with work only as directed.

**430.4.3 Existing Surface Soils (Borrow Excavation):** Shall be used for plating non-pave (non-turf) areas, and as part of the backfill mix for planting Nursery Stock.

**430.4.4 Imported clean fill:** Shall be used for turf areas and amended per Subsection [430.11](#) Preparation for Lawn. Unless otherwise specified the minimum clean fill depth in lawn areas shall be 6 inches.

### **430.5 DELIVERY, STORAGE, AND HANDLING:**

**Packaged Materials:** Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored on site.

**Sod:** Time delivery so that sod will be placed within 24 hours after stripping at the sod farm. Protect against drying, cracking, and breaking of soil on the rolled strips.

**Trees and Shrubs:** Do not prune prior to delivery unless otherwise approved by owners representative. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide adequate protection for root systems. Protect root balls from drying wind and sun.

Deliver trees/shrubs just prior to planting. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage. Keep roots moist. Water as often as necessary.

**Plant Inspection Prior to Delivery to the Project Site:** Before delivery of any species to the project site, the Contractor shall make the necessary arrangements with the Engineer for an inspection of the plant material and tagging of representative plant stock. The Contractor will pay for travel to non-local Nurseries, out of the metropolitan Phoenix area, when plants are not available locally.

The Contractor shall notify the Engineer, at least 7 days in advance for inspection of the plant material. Prior to notification of the Engineer for inspection, the Contractor shall physically verify that the plant material meet the size specified.

After delivery, any plants found to be unsuitable in growth or condition, or plants, which are not true to the specification, or equal to the tagged plant stock, shall be removed, and replaced with acceptable plants at the Contractor expense.

### **430.6 MATERIALS AND PRODUCTS:**

Materials and products shall conform to the requirements of Section [795](#).

### **430.7 SEQUENCING AND SCHEDULING:**

Proceed with and complete landscape work as rapidly as portions of the site become available, working with reasonable limitations for each kind of work required.

Plant or install lawns during normal planting seasons or as directed by the Engineer.

For Bermuda, seed from April 15 to the end of September, provided nighttime temperatures are averaging above 60 degrees Fahrenheit.

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For Perennial Rye Grass, when directed by the Engineer.

Coordination: Plant trees and shrubs after final grades are established and prior to planting lawns, unless otherwise accepted in the construction schedule by the Engineer. If tree and shrub planting occurs after lawn work, protect lawn areas and properly repair damage to lawns resulting from tree or shrub planting operations.

### **430.8 PREPARING THE SITE FOR LANDSCAPING:**

All non-paved areas, as directed by the Engineer, shall be treated with a chemical control, such as Round-up or equal, to control and kill weeds. All applications of the chemical control agent shall contain a blue or green dye so that treated areas can be identified. These areas shall be cleared and grubbed, no sooner than two weeks after the last application of chemical weed control, or when week kill has been established to the satisfaction of the Engineer. Any area to receive seed mix or which is to remain undisturbed shall be excluded from treatment.

Clear and grub landscape areas in accordance with Section [201](#).

Remove or relocate trees, shrubs, grass, improvements or obstructions that interfere with the installation of new work. Removal includes digging out stumps and roots to a depth of 12 inches below existing or proposed grade whichever is lower.

Fill depressions caused by clearing and grubbing operations with satisfactory soil material. Place fill in 6" loose depths and compact to adjacent ground densities.

Soil Preparation in non-turf areas including planters: After clearing and grubbing is complete, rough grade and remove all deleterious materials. Fine grade the areas. Rocks and debris, including miscellaneous concrete spillage clumps, over 1 inch in any dimension, shall be removed and disposed of offsite.

The finish grade for landscape areas shall not vary more than 1 inch from specified grade and cross section and shall be a smooth, uniform surface, free of abrupt grade changes or depressions. Surface drainage shall flow as designated on the plans.

Finished soil grades, adjacent to paving, curbs or headers will consider the depth of applied toppings materials such as granite or river run. Unless otherwise specified the soil grade for granite areas shall be 3 inches below adjacent pavements, for application of 2 inches of granite. Apply a pre-emergent weed suppressant to the finish soil surface; include dye as specified with the application.

### **430.9 HEADER INSTALLATION:**

Headers shall be installed at the locations and elevations shown on the plans.

Concrete forms, shall be approved by the Engineer prior to pouring concrete. Concrete shall be Class B.

### **430.10 EXECUTION OF PLANTING:**

Clearing and grading areas shall be free of construction debris and/or toxic materials and graded to permit landscape construction.

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods. Prior to excavating plant pits, layout individual trees and shrubs for owner's representative to approve the locations. Make minor adjustments as might be requested.

Protect existing vegetation from damage during planting operations. The Contractor is responsible to replace any damaged vegetation in kind as directed by the Engineer.

#### **430.10.1 Deciduous and Evergreen Plantings:**

Excavation: Plant pits shall be dug to produce vertical sides and flat, non-compacted but firm bottoms. If pits are dug with an auger and sides of pits are glazed, scarify the glazed surface. The size of the pits shall be twice the diameter of plant root

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ball or container size, and only as deep as the root ball.

Drainage: Test drainage of plant pits by filling with water twice in succession. Plant pits retaining water for more than 24 hours shall be brought to the attention of the owner’s representative. Submit in writing a proposal for correction, for approval by Engineer, before proceeding.

Plant Backfill Mix: Shall consist of 1 part organic mulch, two parts excavated soil and 4 pounds gypsum and 1 pound of sulfur per cubic yard. The backfill shall be produced by thoroughly blending these components into a homogeneous mixture. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. When requested submit a letter and test analysis results from a certified horticultural testing laboratory.

Setting and Backfill for Plants: Set plant material on non-compacted firm soil, plumb and in center of pit or trench. The crown (juncture of the root and shoot) shall be at grade when planting is complete. Remove pallets or containers before placing backfill. Do not handle container plants by foliage, branches or trunks. After removing plant from container, scarify side of root ball. Do not plant stock if root ball is cracked, broken, or root bound. When set at the proper elevation and orientation, place additional backfill mix, brace plant, and place fertilizer tablets. Work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water the plant thoroughly; before placing remainder of backfill. Repeat watering again after placing final layer of backfill mix until soil is completely saturated.

Place fertilizer tablets approximately 6" below grade and evenly spaced around the plant.

- For one-gallon container ..... 1 tablet
- For five-gallon container..... 2 tablets
- For fifteen-gallon container.. 4 tablets
- For twenty-four inch box ..... 6 tablets

Plant Saucers: Prepare an example plant saucer for the Engineer’s review and approval. Schedule this review with the Engineer before starting planting operations.

Stake All Trees Per Plans: Set stakes vertically and spaced to avoid penetrating balls or root masses. Place tree ties for maximum support with top tie above scaffold branches and second tie midway to the ground level. Avoid "rigid" restraint of tree and allow for some trunk movement. Stakes are to be set into native soil.

**430.10.2 Agave, Aloe, Cactus, Ocotillo and Yucca Plantings:**

Excavation and Drainage: Shall be completed per Subsection [430.10.1](#), except plant pit shall be 6” deeper than root ball.

Backfill Mix: Shall be a mixture of 3 shovel’s full of sand, or very coarse dirt (not clay or silt), one shovel of gypsum, one shovel of organic matter (avoid cow manure), 1/2 cup of sulfur, and 1/2 cup of phosphate (0-45-0). As you need more backfill mix, increase in these proportions.

Setting and Backfill: Do not set plant deeper than the plant grew naturally. Prior to placement, lay the plant down just over the hole. Trim off old dead roots to no longer than 2 inches and clean out any rocks stuck in the plant. All new plant root growth will come from the center of the root ball, not from the old roots or from the side of the stem or trunk. Sprinkle a tablespoon full of phosphate (0-45-0) in the hole. Place plant in the hole and orient to match the previous heliotropic growing condition. Set plant elevation to the visible dirt line mark of the plant and backfill the plant using the specified backfill mix. Plant shall be planted to maintain positive drainage away from the root collar of the plant. Tamp the soil to stabilize the plant. Now drench and wash off the plant.

Monitor watering closely. Normal watering for Agave, Aloe, Cactus, Ocotillo and Yuccas are once per week. During the heat of the summer, briefly spray or mist these plants from a hose, to cool the plants surface temperature. During cooler temperatures, adjust the watering schedule for the time of day and frequency.

**430.11 PREPARATION FOR LAWN:**

**430.11.1 Soil preparation and Fine Grading New Turf areas:** Excavate as necessary to accommodate depth of clean fill, topsoil and soil amendments. Prior to placing fills and amendments till to a depth of not less than 4 inches, making alternate

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passes at right angles. Remove rocks and debris greater than 1 inch, in any dimension. Remove high areas and fill depressions. Apply soil amendments (refer to the Section [795](#)) as follows:

Organic matter 2 inches deep

Sulfur 10 lbs/1,000 SF

Iron Chelate 1 oz/1,000 SF

Roto-till soil and amendments to homogenous fine mixture, free of lumps clots, stones, roots and other extraneous matter. Till the mixture until it is uniform in color and appearance to the satisfaction of the Engineer.

Forty-eight (48) hours prior to seeding operations fine grade lawn areas to a smooth, even surface with a loose uniformly fine texture. Finish drag or rake lawn areas removing all deleterious material  $\frac{1}{2}$ " or larger from the surface and to a depth of 2 inches below the surface. Roll the lawn surface to obtain the desired compaction and remove ridges. Finish grade shall be as shown on the plans. Finish grade shall be set 1-1/2" inches below adjacent paving, curb and headers. The Engineer shall be able to push a hand probe to a depth of 4 inches at any location where turf is to be established.

Apply fertilizer (refer to Section [795](#)) fertilizer percentages (N-P-K) and the rate of application per soil fertility test results. For bidding purposes, the fertilizer shall be (15-15-15), applied at 5 LBS/ 1000 SF. Apply additional fertilizer at the end of the turf establishment or date agreed upon with the City. Establishing turf is the Contractor's responsibility.

**430.11.2 Recondition Existing Lawn Areas:** Areas damaged by Contractor's operations, including damage caused by movement of vehicles, or from the storage of materials or equipment shall be reconditioned prior to seeding or sodding.

Remove ridges, ruts, and aerate compacted soils. Fill depressions with topsoil soil. Rake surfaces to remove clumps and debris and other deleterious material  $\frac{1}{2}$ " or larger from the surface. Apply fertilizer (refer to Section [795](#)) at the rate recommended by the manufacturer (stated on bag) before initial seeding operations.

### 430.12 LAWNS

The Contractor shall not begin planting until the irrigation system is completely installed and is adjusted for full coverage and is completely operational.

**430.12.1 Sod:** Allow for sod thickness in areas to be sodded. Apply commercial fertilizer at rates specified by the manufacturer and thoroughly mix into upper 2 inches of soil. Delay applications of fertilizer if planting will not follow within a few days.

Lay sod within 24 hours of initial cutting. Form a solid mass of sod with tightly fitted joints. Butt ends and sides of sod. Do not overlap joints. Stagger sod strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Sod edges and joints shall be leveled with approved soil mix.

**430.12.2 Seeding Lawns:** Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

Sow seed using a spreader or seeding machine at a rate of 3 1/2 pounds Bermuda per 1,000 square feet. Do not seed when wind velocity exceeds 5 MPH. Distribute seed evenly over the entire area by sowing equal quantities in two (2) directions at right angles to each other.

Bermuda seed shall be planted only at times when daytime atmospheric temperatures are consistently above 90 degrees F. and the nighttime atmospheric temperatures are consistently above 60 degrees F. If turf establishment from seed cannot be completed during the contract period, then Perennial Rye grass seed will be planted when required by the Engineer, at no additional cost to the City. Apply Rye grass at the rate of 15 pounds per 1,000 square feet. Distribute Rye seed evenly over the entire area by sowing equal quantities in two (2) directions at right angles to each other.

Rake lightly into top 1/8 inch of soil, roll and water with a fine spray.

**430.12.3 Hydroseeding Lawn Areas:** Contractor shall follow a two-step process of hydroseeding followed immediately by hydromulching. Equipment used shall be manufactured for the purpose of hydroseeding. It shall be equipped with a tank capable of continuous agitation, suspension, and blending of the slurry components. It shall be equipped with a pumping system capable of maintaining a continuous spray. It shall be equipped with nozzles and hoses to obtain a uniform

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application on designated areas. The tank and accessories shall be cleaned and be free of contaminants. The storage tanks shall have a means of estimating the volume used or remaining in the tank.

For hydroseeding and mulching materials refer to Section 795. All materials shall be labeled or supplied with test information concerning analysis of the various components. All work shall be performed in a professional manner to the best industry standards. Care shall be taken to avoid drift and displacement of material or any damage to structures and landscape. Protective covering shall be used where material would be objectionable. Clean up shall be done daily. Seeded areas shall be protected from traffic and construction activities.

Water, fertilizer, mulch and seed shall be combined in proportion in the first application to cover the areas at the specified rates. The ingredients shall be allowed to mix thoroughly. Allow the ingredients to mix for a minimum of 5 minutes before application of the slurry, but do not allow seed to be in the tank longer than 60 minutes, inclusive of the time to agitate.

Hydroseed an even first application of the following components:

- Bermuda Seed ..... 200 LBS / Acre
- Fertilizer ..... 200 LBS / Acre
- Mulch (100% Wood Cellulose Fiber) .....400 LBS / Acre

Hydromulch an even second application immediately after hydroseeding with the following components:

- Mulch (100% Wood Cellulose Fiber) .....1400 LBS / Acre
- Tackifier ..... 100 LBS / Acre

Hydroseeding or mulching deposited on adjacent trees and shrubs, on roadways, structures or other area surfaces where they are not specified shall be removed.

Water the hydroseed to germinate the seed and continue watering until established. Monitor watering every day. DO NOT over water or under water. It may be necessary to water several times a day. Newly germinated areas must be kept moist.

**430.13 DECOMPOSED GRANITE AND RIVER RUN AREAS:**

The areas on which the granite mulch or river run rock is to be placed shall be graded according to the drawings, prior to the placement of any granite or river run rock. The ground shall be reasonably smooth and rocks larger than 1" in diameter, within the top 1" of soil shall be removed and disposed of off-site.

The Contractor shall stake out all areas to receive granite mulch or river run rock. These areas shall be treated with a pre-emergent control, such as Surflan or equal, prior to and after placement of the cover material.

Decomposed granite shall be evenly distributed on the designated areas to a depth as indicated on the plans and details. If a depth is not indicated the minimum depth shall be two inches.

After placing and grading the granite mulch, the Contractor shall water granite with a light spray to settle the to granite and remove fine materials from the surface. Immediately after watering, the Contractor shall roll the granite mulch with an appropriate device to an extent satisfactory to the owner’s representative.

River run rock used shall be as specified on the plans. The rock shall be evenly distributed on the designated areas to depth 1-1/2 to 2 times the maximum gradation size.

**430.14 CLEANUP AND PROTECTION:**

During Landscape Work, keep pavements clean and work areas in an orderly conditions. Sweep, scrub or hose affected areas as directed by the owner’s representative to maintain a clean and neat work area.

Protect Landscape Work and Materials from damage due to landscape installation, operations by other contractors and trades, trespassers and animals. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed by the owner’s representative. Remove all debris, trash and excess materials generated by the landscape

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installation.

### **430.15 MEASUREMENT AND PAYMENT:**

The lump sum or unit prices established on the schedule of values shall be full compensation for furnishing all labor, material, tools and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs and ground cover.

The quantities of lawn seeding will not be measured but shall be the quantities designated in the contract documents, except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity designated in the Contract. The quantity of lawn shall include soil preparation, fertilizer, seed, and water, established and accepted.

The quantity of sod to be measured will be the actual number of square feet, including soil preparation, water, fertilizer and sod, established and accepted.

When line item bids or schedule of values do not initially include a cost for the Plant Establishment and Maintenance Period the cost shall be assumed in the schedule of values for landscape items (i.e., plant materials, irrigation, and inert materials, such as decomposed granite, river run and boulders). Ten percent of the sum total of landscape items in addition to retention will be held for distribution during the maintenance period. Equal monthly payments for maintenance will be authorized, based on inspection and subject to extensions, where the Contractor fails to comply with previously stated requirements in Subsection 430.3. Payment may or may not be supplemental to final project payment.

*- End of Section -*

## SECTION 431

### PALM TREE TRANSPLANTING

#### 431.1 DESCRIPTION:

This Section shall govern the relocation (transplanting) and planting of palm trees required by the plans or specifications. The Contractor shall furnish all labor, materials and equipment required to complete the excavation, lifting, transporting and transplanting of palm trees.

#### 431.2 GENERAL:

Unless otherwise provided by this Section the work shall conform to Section 430 and the following.

#### 431.3 PALM ESTABLISHMENT GUARANTEE AND MAINTENANCE:

Palm establishment, guarantee and maintenance shall be per Section 430 with the following modifications or additions:

The palm establishment, guarantee and maintenance period shall be for 90 days, unless otherwise extended.

Guarantee palms against the vascular disease Penicillium (Gliocladium) vermeseni, the fungus Fusarium oxysporum, and the root disease Phytophthora and similar vascular infections for a period of five (5) years.

Replace without additional cost to the City all dead palms and all palms not in a vigorous condition as determined by the Engineer. Replacement shall be when directed by the Engineer.

#### 431.4 JOB CONDITIONS:

Prospective contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

It may be necessary to supplement the irrigation system and provide additional water to establish newly planted palm trees. Water from the existing irrigation system will be paid for by the City. The Contractor is responsible for delivery and payment of water from other sources.

Remove all debris, trash and excess materials found on site or generated by the Contractor's operations.

Prior to digging and transplanting of palm trees the Contractor shall notify the Engineer at least two (2) working days before starting any work.

#### 431.5 DELIVERY, STORAGE AND HANDLING:

Palms shall be free of dead or dying fronds with all fronds of a normal size and color.

The Landscape Architect will be available to review and tag palms at place of growth and will again review palms upon delivery for conformity to the specifications. Travel to non-local Nurseries, out of the metropolitan Phoenix area, when requested by the Contractor, will be paid for by the Contractor. In lieu of non-local nursery review, the Contractor may elect to provide photographs with a person adjacent to each palm for preliminary review. Such review shall not impair the right of review and rejection during progress of the work should the palms not meet the specifications. The selected palms shall not exceed the specified height by more than 1 foot. It is unacceptable to plant the root ball deeper than 1 foot above the soil line of the palm.

The Contractor must certify that the palms are free of disease prior to shipment.

After tagging of the palms, remove all thatch from older leaves and cut back all resulting stems to within 2 inches of the base of the trunk. The crown of the palm shall be reduced per standard nursery practice prior to shipping. Use soft rope (organic twine) to tie remaining fronds to protect crown bud. Do not permit fronds to become damaged by means of restraint.

Exercise extreme caution while pruning palms, to prevent spread of vascular diseases. Dip pruning tools in a sterilizing agent

## SECTION 431

before beginning pruning and before moving from one palm to another. Do not use any chain type saws for pruning operations.

Lifting, Off-loading, and Transporting: A lattice type crane, a telescoping type crane or a specially designed tree crane is acceptable for lifting and off-loading palm trees. For transporting, the trailer used shall be long enough to avoid damage to the heart of the palm. Loading and unloading of palms must be accomplished with the aid of nylon or fabric sling/straps with a minimum width of 4 inches. Excessive scarring or trunk damage will not be permitted and will be cause for rejection of the palms at the project site.

If the palms are not planted the day they arrive at the project site, the crowns and root ball should be protected from the sun and from reflected heat from the ground. Avoid storing on an asphalt surface.

Covering material must allow air movement so that heat does not build up under the covering. Do not use plastic or rubberized tarpaulins. Trees may not be stored for more than 48 hours. Do not stack palms, but lay them in a single layer on a flat surface. Covered root balls must be watered lightly every couple of hours.

### **431.6 MATERIALS AND PRODUCTS:**

All palms shall have been grown in accordance with good horticultural practices under climatic conditions similar to those for the project for at least two (2) years prior to shipment to the site.

All palms shall be well-grown, symmetrical, without curvature or leaning trunk from the perpendicular and so trained or favored in development and appearance as to be superior in form, compactness and symmetry of crown. All palms shall be within one foot above or below the height specified, measured from the bottom of the crown bud to finish grade after installation.

All palms shall be sound, healthy and vigorous, well foliated prior to pruning and showing no signs of disease. They shall be free of disease, insect pests, eggs or larvae. They shall also have well developed root systems. All palms shall be free from physical damage or adverse conditions which would prevent thriving growth.

Verify that all field dug palms contain an adequate root ball to guarantee transplantation. Do not wrap root ball in plastic. Do not install palms that have damaged root balls.

#### Accessories:

Clean washed river sand.

Frond Tie: Minimum 1/2 inch diameter soft sisal rope capable of maintaining frond in tied condition for 1 year.

Fungicides: Soil Drench: "Subdue" by CIBA-GIEGY

### **431.7 SEQUENCING AND SCHEDULING:**

Coordinate delivery of palms with planting operations to avoid on site storage longer than 48 hours. Planting delays may result in rejection of the palm.

### **431.8 PREPARING THE SITE FOR LANDSCAPING:**

Remove palms designated for replacement. Removal includes digging out stumps and roots to make room for replacement material. Remove all debris, trash and excess materials generated, and dispose of this material off-site.

Protect existing plant material, walls, pavements and other site amenities from damage.

### **431.9 PALM TREE SALVAGING:**

Prior to excavation, the palm tree shall be thoroughly watered.

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Excavation: A trenching machine, a backhoe with a narrow bucket or a properly sized tree spade is acceptable as the excavation equipment. The exact equipment used must be approved by the Engineer.

Reduce the crown of palm trees per standard nursery practice. Use soft sisal rope to tie remaining fronds to protect crown bud.

The size of the root ball taken shall be a minimum of 18" to 24" deep and have a 2" to 3" wider radius than the base of the palm, unless otherwise directed by the Engineer. Certify that all field dug palms contain adequate root ball to guarantee successful transplanting.

Carefully lift and transport palm tree to the new location so as not to cause damage to the tree or site.

### **431.10 EXECUTION OF PLANTING:**

Layout palms at locations shown on the plans. Use 3 foot lath, color coded for each palm. The Engineer will check location of palms in the field to exact position before planting begins.

Where palms are to be preplanted to permit site improvements to be installed around them, be responsible for the accurate layout of those palms, measured to their centerlines. Be responsible for the protection of those palms while work is taking place. Provide regular irrigation as necessary until final acceptance.

The palm tree excavation shall be a minimum of 1.5 times (x) larger than the root ball depth and 1 foot larger on all sides. It is acceptable for the final site grade around the palm to be 6 to 12 inches higher than the original soil line of the root ball. The depth of the pit shall be approved by the Engineer prior to planting the tree.

Water test each tree pit for drainage by filling the holes twice in succession with water. If when filled with water the second time the pit fails to drain within 24 hours, then additional excavation is necessary to break through the impermeable layer or provide a thick under layer of sand below the root ball. The cost for over excavation and for the installation of a drainage chimney will be considered should the tree pit not drain.

Clean moist washed river sand should be added to the bottom of the hole and tamped or water jetted, prior to insertion of the tree.

Install drainage and viewing pipe(s) in each tree pit to assure wetting of the whole root ball and to enable monitoring and viewing of the tree pit chamber. The vents shall be 4" diameter perforated PVC, with sufficient length to extend to the bottom of the tree pit. Do not backfill drainage or viewing pipes.

Backfill should be clean washed river or concrete sand amended with 25% native soil. In areas where soils are heavy in caliche, 100% sand shall be used. After placement of the palm, moistened sand shall be thoroughly tamped as backfill is being added to assure stability of the tree.

A 6" deep swale shall be made around each palm tree to provide water holding capability.

Mulch: Apply a 2" layer of decomposed granite in all palm tree watering basins.

After planting, the crown buds of all the palms shall be within 1 foot of the designated palm height above finish grade.

After planting, drench the soil with the fungicide, "Subdue" per manufacturer's recommendations by flooding the planting basin. Reapply as often as label permits throughout the maintenance period.

Irrigation: It is essential that irrigation be deep enough to assure wetting of the whole root ball. The Contractor shall maintain the irrigation system to the existing trees and supplement additional water to newly planted trees as necessary for establishment. Use a tensiometer weekly during the maintenance period to verify correct watering at the surface and at the bottom of the root ball, report moisture levels to the Engineer.

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### 431.11 MEASURE AND PAYMENT:

Measurement will be made on the number of trees that survive the planting operations. Unless otherwise specified by the Engineer, the Contractor shall be responsible for the cost of replacement and planting of any palm tree, in kind, that does not survive. Palms that do not survive become the property of the Contractor for disposal. Payment will be made at the unit bid price for each surviving tree which will be full compensation for all labor, materials, tools and equipment required for excavating, transporting, transplanting, and watering of the tree(s).

*-End of Section-*

## SECTION 440

### LANDSCAPE IRRIGATION SYSTEM INSTALLATION

#### 440.1 GENERAL:

The Contractor shall furnish all labor; materials, tools, equipment, and services necessary for the execution and completion of the irrigation system work as indicated on the drawings and as described in these specifications and the General Conditions.

Due to the scale of the drawings, it is not possible to indicate all offsets, fittings and sleeves, which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such offsets, fittings and sleeves as may be required to meet such conditions. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

The work of this Section generally includes provisions of an automatic underground irrigation system including the following:

Trenching, stockpiling excavation material, and refilling trenches.

Complete system including but not limited to piping, backflow preventer assemblies, valves, fittings, emitters, controllers and wiring, and final adjustments to insure complete coverage.

Replacement of unsatisfactory materials.

Clean-up, inspection, and approval.

Tests: The system shall efficiently and uniformly irrigate all areas and perform, as required, by the plans and specifications.

No irrigation work is to be performed until all areas are finished to proper grade and until soil preparation is completed, and has been approved by the Engineer.

**440.1.1 Work By The Water Services Department:** The Contractor will coordinate with the Engineer at the Preconstruction Meeting to schedule water service dates well in advance of need. The Engineer will contact the Water Services Department to authorize work required to be performed by Water Services Department crews. At least six weeks prior to need the Contractor will make application with the Water Services Department. At the time of application, the Contractor will contact the Water Services Department to schedule installation of a water tap and meter, and to provide them with his billing address.

The Contractor shall pay for all water used until the project is accepted, or until completion of the Landscape Maintenance period, whichever is later, and the water meter accounts are transferred back to the City. At the close of the project, the Contractor shall submit water meter account numbers to the Engineer and request transfer of the meter to the City. The Contractor will remain responsible for water used and payment thereof, until transfer.

**440.1.2 Work By The Power Company:** The Contractor will be responsible for coordinating with the power company to locate power drops for the irrigation controller(s), when power is not serviced by a Service Entrance Section.

Unless otherwise specified or directed by the Engineer, the Contractor will obtain an account with the utility company and will pay for all electrical power used until the project is accepted, or until completion of the Landscape Maintenance period, whichever is later, and the utility accounts are transferred. At Final Acceptance, Contractor will submit electrical meter account numbers to the Engineer and request transfer of the meter to the City, or the Contractor will remain responsible for electrical use and payment thereof, until transfer.

#### 440.2 REFERENCES:

Conform to the requirements of reference information listed below except where more stringent requirements are shown or specified in the Contract Documents.

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American Society of Testing Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.

Underwriters Laboratories (UL) - UL Wires and Cables.

### 440.3 QUALITY ASSURANCES:

Work involving plumbing for installation of copper piping, backflow preventer(s), and related work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.

**440.3.1 Tolerances:** Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, re-compaction, and repair of finish grade treatment.

**440.3.2 Coordinate Work with Other Trades:** For a period of one year from Final Acceptance, guarantee/warranty irrigation materials, equipment, and workmanship against defects. The Contractor shall replace any pavement damage resulting from the installation of the irrigation system and repair damage to grading, soil preparation, seeding, sodding, or planting at no additional cost to the owner. Make repairs within 3 days following notification by the Engineer.

**440.3.3 Delivery Storage and Handling:** During storage protect pipe from heat and sunlight. Provide shade protective cover and allow air to circulate between pipe. Transport pipe so as not to subject pipe to bending or concentrated external loads. Pipe, which is sun tanned, dented, or damaged will be rejected.

### 440.4 SUBMITTALS:

**440.4.1 Shop drawings and product information:** Prepare and make submittals in accordance with conditions of the Contract, and as follows: A minimum of ten days prior to beginning work on the irrigation system the Contractor shall submit six (6) copies of manufacturers literature. Highlight product specifics including name, and model numbers of materials listed below and any other items requested by the Engineer. Do not order materials until the Engineer approves products.

Items to be submitted:

Sprinklers (turf heads, shrub bubblers, emitters)	Backflow Preventers	Flowmeters
Pipe & Fittings	Automatic Valves	Flushcaps
Swing Joint Assemblies	Controllers	Micro-tubing & Stakes
Quick Coupling Valves	Solvents	Wire & Connectors
Gate Valves	Wye Strainers	Valve Boxes, Pull Boxes, etc.
Pressure Regulating Valves		

All items shall be those specified and approved by the Engineer. Substitutions will not be allowed without approval.

**440.4.2 Record Drawings:** The Contractor shall maintain an accurate set of as-built plans on site. At the end of each day work accomplished shall be updated on the as-built plans. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following:

- Connection to existing water lines
- Connection to existing electrical power
- Gate valves
- Routing of Sprinkler pressure lines (dimension at a minimum of 100 feet along routing)
- Emitter control valves
- Routing of control wiring
- Quick-coupling valves
- Other related equipment as directed by the Engineer

The Contractor shall indicate any non-pressure pipe routing changes on the as-built drawings.

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Before the final inspection, the Contractor shall deliver to the Engineer one copy of the as-built plans to review. Delivery of this set of plans does not relieve the Contractor of the responsibility of furnishing required information that may be requested by the Engineer. The Contractor shall make corrections noted and submit final as-built plans to the Engineer for approval and acceptance. The Engineer will not certify payment requests or make final payment if as-built plans are not current or complete.

**440.4.3 Controller Charts:** As-Built drawings shall be approved by the Engineer before controller charts are prepared. The chart shall show the area controlled by the automatic controller and shall be 24" x 36" sheet size, unless a reduced size is approved by the Engineer. Identify the area of coverage of each remote control valve, using a distinctively different color, drawing over the entire area of coverage. Following review of the charts by the Engineer, they shall be hermetically sealed between two layers of 20 mm thick plastic sheets. These charts shall be completed and approved prior to final inspection of the irrigation system. When approved by the Engineer a separate card listing stations and areas covered may be substituted for the 24" x 36" hermetically sealed plan sheet(s).

**440.4.4 Operation and Maintenance Manuals:** Submit four (4) operation and maintenance manuals to the Engineer for review prior to final acceptance. The manuals should include the complete technical description of materials and products used; guarantee statement, complete operating and maintenance instructions on all major equipment. Contractor to provide a demonstration to maintenance personnel, with the Owner's Representative present, of how to adjust and maintain all sprinkler head types, controller functions, and recommended controller programs, as established by the Contractor. Contractor is also to review recommended watering rates for new plant materials.

**440.4.5 Equipment to be Furnished:** All materials to be new and bear the appropriate National Association seal of approval for example, NSF, UL. etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source replacement will be furnished to the Engineer.

Equipment to be furnished:

- a. Two sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied to the project.
- b. Two quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
- c. One five foot valve key for operation of gate valves

Extra Stock to be furnished:

- a. 2 sprinklers of each type and 5 nozzles of each precipitation rate.
- b. 2 bubblers of each flow rate used.
- c. 5 Single Port Emitters of each flow rate used.
- d. 2 Multi-port Emitters of each flow rate used.

The above mentioned equipment and stock shall be turned over to the Owner at the conclusion of the project. Before final inspection, evidence that the Owner has received this material must be provided to the Engineer.

### 440.5 PERMITS:

All permits for installation or construction of the work included under this Section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

### 440.6 EXECUTION:

Examine areas and conditions under which work of this Section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

**440.6.1 Staking:** Mark the routing of the pressure supply line with powdered lime, and stake the locations of various components. Coordinate locations with other trades. Coordinate sleeving with other trades. Preliminary adjustments to conform to actual site conditions shall be accomplished during staking. Should changes be required, the Contractor shall

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obtain approval of the Engineer prior to actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned.

**440.6.2 Trench Excavation:** Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

- a. Electrical conduit - 18 inches cover
- b. Waterlines continuously pressurized - 18 inches cover
- c. Lateral sprinkler lines - 12 inches cover
- d. Plastic lines under pavement - 24 inches cover

The bottom of the trenches shall be true to grade and free of protruding stones, roots or other matter, which would prevent proper bedding of pipe or other facilities. Where ledge rock, hard pan, or boulders are encountered, the trench bottom shall be undercut and filled with sand or fine grained material approved by the Engineer.

Clearances:

- a. Piping 3" and larger - minimum trench width of 12 inches.
- b. Piping smaller than 3" - minimum trench width of 7 inches.
- c. Provide not less than 4 inches of clearance between each line, and not less than 12 inches of clearance between lines of other trades, to permit service or replacement without disturbing the other line.

Grading and Stockpiling of trenched materials shall comply with Section [601](#).

**440.6.3 Sleeving:** Piping located under asphalt, concrete, or other pavements shall be sleeved, size and schedule as noted on the plan. If not noted, sleeves shall be Schedule 40, sized to easily accommodate piping. Use separate sleeve for wiring.

Boring will be permitted only where pipe must pass under obstructions, which cannot be removed, or when approved by the Engineer. When any cutting or removal of asphalt and or concrete work is necessary, it shall be saw cut in accordance with Section 601. Permission to cut asphalt or concrete shall be obtained from the Engineer. When piping on the drawings is shown in paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

**440.6.4 Piping:** Provide pipe, schedule and size as shown on the drawings and per these specifications.

PVC Pipe: Snake pipe in trench as much as possible to allow for expansion and contraction. Provide a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. Installation of pipe shall be installed in accordance with ASAE Standard: ASAE 376. Pipe shall be clean prior to installation and shall be maintained in that condition during installation. When pipe lying is not in progress, the open ends of the pipe shall be closed by approved means.

If reclaimed water is used, all piping and associated appurtenances shall meet the applicable requirements of the Arizona Administrative Code R18-9-602(G). Signage will be placed to indicate the use of non-potable water.

Sand bedding or fine-grained material shall be provided where ledge rock, hard pan, or boulders are encountered. Compact bedding material is to provide a minimum depth of bed between pipe and rock of 4 inches.

Solvent welded joints shall be made in accordance with ASTM D-2855, and the type of solvent and primer recommended by the pipe manufacturer shall be used. Primer and solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly. The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

Schedule 80 pipe shall be used for threaded joints. Field threading shall be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Solvent will not be used on threaded pipe. Threaded joints shall be hand tightened with final tightening as necessary to prevent leaks with a strap wrench.

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The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches will be used. Any plastic pipe, which has been nicked, scarred, or otherwise damaged, shall be removed and replaced. Care shall be exercised so that stress on a previously made joint is avoided.

When PVC to metal pipe connectors are required, these connections shall be accomplished first. A plastic adapter with external pipe threads should be used, screwing it into the metal internal pipe threads. Use a non-hardening pipe dope, such as Permatex #2, or equal, on all plastic to metal threaded joints. The joint shall be hand-tightened. Utilize a light wrench, as necessary, to prevent leaks.

When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

Use 45 degree fittings at all changes in depth of pipe. Couplings to be schedule 80 unless otherwise noted. Minimum length of PVC nipple shall be 3 inches.

**440.6.5 Wiring:** Service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified. A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum Service wire shall be No. 12 AWG copper 600 volt type, TWH or larger, as required by the contract documents or controller manufacturer. Wire splices for Service wiring shall be located in pull boxes where required to facilitate installation of wiring. Pull Boxes shall be plastic, except where subject to vehicular traffic, concrete rated boxes shall be required. Service wiring shall be per current Local, State, National NEC requirements.

Low Voltage Control Wiring issuing from the controller shall be direct burial, type UF, No.12 AWG copper, unless otherwise required and installed in main or lateral waterline trenches wherever practical. Install common ground wire (type UF No. 12 AWG Copper) and one pilot or hot wire (type UF No. 14 AWG Copper) for each remote control valve (These are minimum wire sizes allowed when not noted otherwise on plans.). Multiple valves on a single control wire are not permitted.

Install two (2) control wires along the entire length of the mainline. Locate wire adjacent to main line piping. Never place wire on top of pipe. Bundle wires at 10 foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring to provide for expansion and contraction. Provide 12" loop (2 feet) at all changes in direction or at a minimum of 250 feet. When control wiring cannot be installed in the pipe trench it shall be installed a minimum of 18 inches below finish grade. Attach wire markers to the ends of the control wires and label valve stations at controller locations.

All pilot or "hot" wires are to be of a different color and all common wires are to be of another (common) color. If multiple controllers are being utilized, and wire paths of different controllers cross both common and control wires, from each controller, shall be of different colors.

Splices in control wire shall be made only in Junction Boxes with approval from the Engineer. Splices shall be made with waterproof connector, approved for underground use. Sufficient slack shall be left to allow splices brought to the surface without disconnecting the wire. No splices shall be permitted under pavements.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment. All controllers shall be grounded independent of any other controller as recommended by the controller manufacturer, and all valves shall be connected to the common ground wire of their respective controller. A single separate pilot or hot wire (different color) shall be extended from the valve to the specified controller. Low voltage wire splices outside of the valve box are not permitted, unless approved by the Engineer, at which case they must be made in a PVC Pull Box.

One spare #12 AGW wire "Pilot" (orange) and one #12 "Common" wire, (total 2 - #12 wires) shall be installed from the controller along the entire length of pressure lines to last (farthest) electric control valve on each and every leg of the mainline. The color of the spare control wire is to be of an alternate color. Provide 3 foot length of all spare wires in each remote control valve box along wire routing.

**440.6.6 Valves, Valve Boxes, and Special Equipment:** Backflow Preventer Assembly: The Backflow Prevention assembly shall be installed per the details shown on the drawings and associated governing code requirements. Provide pipe supports and the accessories to properly secure the assembly. The irrigation system shall not be operated until the assembly has been tested and certified to meet the requirements of the Water Services Department.

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After the backflow assemblies have been properly installed by the Contractor and approved by Planning and Development Department the Contractor shall pay for testing and be responsible for having the assembly(ies) tested by a certified backflow prevention assembly tester, approved by the City. The tester shall prepare test report(s), showing the condition of the assemblies and confirming that the assemblies are properly functioning. It is the Contractors responsibility to submit the forms to the Engineer. Final acceptance will not be given until the reports are approved by the Engineer.

Valves, Pressure Regulators, and Related Accessories shall be installed as shown on the plans, or as specified. They shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. The equipment shall be set at a sufficient depth to provide clearance between the valve box cover and the valve handle, cap, or key for operation of the system.

Gate Valves and Isolation Valves shall be installed below ground and shall be housed in a concrete or plastic pipe, with bolt down locking cover that will permit access for servicing. The pipe shall be centered on the valve stem. Isolation valves shall not be located within range of the sprinklers they control without approval of the Engineer.

Drain Valves shall be installed at all low points in pressure supply line as detailed. Provide drainage sump for each drain valve based on the table below:

**TABLE 440-1  
CUBIC FEET OF GRAVEL PER DRAIN VALVE  
DISTANCE OF PIPING TO BE DRAINED**

<b>Pipe Size</b>	<b>0-250 LF</b>	<b>251-500 LF</b>	<b>501-750 LF</b>	<b>751-1000 LF</b>
1"	0.75	1.50	2.25	3.00
1-1/4"	0.75	1.50	2.25	3.00
1-1/2"	1.50	3.00	4.50	6.00
2"	2.50	5.00	7.50	10.00
2-1/2"	4.00	8.00	12.00	16.00
3"	6.00	12.00	18.00	24.00
4"	11.00	22.00	33.00	44.00
6"	25.00	50.00	50.00	50.00

Quick Couplers and Hose Bibcocks shall be installed as shown on the plans, or as specified. Their location shall be a minimum of 3 feet from curbs, pavements and walks, unless approved otherwise by the Engineer. Hose bibcocks shall be set 12 inches above finish grade and installed on a galvanized riser or as detailed.

Quick Coupler Assemblies: shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly as manufactured by Lasco Inc., or approved equal is specified. All quick couplers shall be set perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer.

Valve Boxes: Install one valve box for each valve installed as shown on the plans, or specified unless directed otherwise by the Engineer. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted. Set valve boxes 1/2 inch above finish grade.

The valve boxes shall be branded with the controller letter and station number of the contained valve. The letter and number size shall be no smaller than 1 inch and no greater in size than 1-1/2 inches. Depth of branding shall not be more than 1/8 inch into the valve box lid. All labeling shall be neat and legible.

**440.6.7 Sprinklers, Bubblers, and Emitters:** Sprinklers, Bubblers, and Emitters: Install where indicated on the drawings, staked and approved. Set to finish grade as detailed; spacing of Sprinklers shall not exceed maximum recommended by the manufacturer without approval of the Engineer. Assemblies shall be installed as detailed, provide at least 4 inches clearance from vertical elements projecting above grade such as walls, planter boxes, curbs, and fences.

Turf Heads Assemblies shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly such as that manufactured by Lasco Inc., or approved equal is specified. All sprinkler heads shall be

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perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer. Install for head to head coverage and uniform distribution throughout the turf area.

Plant Bubbler Assemblies shall consist of a horizontal connection to the lateral line with 1/2" S.D.R. 13.5 PVC lateral extension, schedule 40 fittings, and 1/2" flex hose riser (sch 40) with male adaptor (slip x thread) to receive the bubbler. Install bubbler assemblies as detailed on the plans. Locate the top of bubbler:

- a. 1" above finish grade in shrub beds.
- b. In turf areas - provide 4" diameter (times 12" long) PVC class 200 vertical sleeve filled with pea gravel. Install bubbler 3" below top of sleeve. Set top of pipe flush with finish grade of turf.

Emitter Assemblies provide a horizontal connection to the lateral line using schedule 40 PVC fittings and PVC to flex adapters (slip x slip), 1/2" schedule 40 flex tubing (max. length, 20') and slip x threaded male adaptor to receive the emitter. Emitter outlets shall be installed to the high side of the plant. Provide a minimum of 1 outlet per shrub, and 3 outlets per tree, equally space around the plant, unless otherwise noted in the plans. Single port emitters shall be located 1 inch above grade as detailed. Multi-port emitters shall be located below finish grade, as detailed, and the distribution tubing staked in place then covered with 2 inches of mulch. The distribution tube outlet end shall be exposed above the soil/mulch surface to water the root ball of the plant.

**440.6.8 Controller System:** The controller and accessories shall be installed at the locations designated and per the details shown on the contract documents. Submit shop drawings of components.

Controllers located outdoors shall be installed in cabinets specifically design to house the controller, or as detailed on the plans. The concrete pad for controller enclosures shall be Class B, size shall be as shown, or if not shown, as recommended by the manufacturer. All copper pipes in contact with concrete shall be type k copper and sleeved or wrapped with "Scotchwrap #50" or equal minimum thickness 40 mils.

Controllers located in building: Prepare an elevation plan detailing placement of equipment, conduit, sleeves and wire gutter runs to the Engineer, for approval. Stub out all conduit 2 feet beyond concrete foundations or walls and provide bushings for all conduit. All RGS conduit in contact with earth shall be wrapped with "Scotchwrap #50, or equal, minimum thickness 40 mils.

**440.6.9 Pipe Bedding, Backfill, and Compaction:** Bedding: Pipe shall be bedded in at least 4 inches of finely graded native soil or sand to provide a firm uniform bearing. After laying the pipe shall be surrounded with additional finely grained native soil, or sand, then covered with not less than 4 inches of the same material. Bedding sand shall be required when site conditions dictate and clean finely grained native soil is not available. Contractor shall verify site conditions and satisfy his concern prior to bidding; no separate payment shall be made for bedding sand.

Backfill trenches and excavations with clean material. Remove organic material, as well as rocks larger than 1 inch in diameter. Place acceptable backfill material in lifts, the height of which shall not exceed that which can be effectively compacted, pending on the type of equipment and methods used. Trenches and excavations shall be backfilled to match engineered earthwork sections.

Partially backfill the irrigation trenches and pressure test the system, prior to completing backfill operations. Center load the pipe with sufficient backfill to hold the line in place, keeping the joints exposed for observation until completion of testing.

Compaction shall be in accordance with Section [601](#). Water settling of the trenches is not permitted unless approved by the Engineer.

**440.6.10 Cleaning:** Maintain continuous cleaning operations throughout the duration of the work. Dispose of, off-site at no additional cost to the Owner, all trash or debris generated by installation of the irrigation system.

### **440.7 FLUSHING AND TESTING:**

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials, and labor necessary to perform the tests shall be furnished by the Contractor, and all tests shall be

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conducted in the presence of the Engineer.

**Pipeline Pressure Test:** A water test shall be performed on all pressure mains. Pressure mains shall be tested with all control valves installed and in the closed position. The constant test pressure and duration of the test shall be for 6 hours at 125 psi. Any leaks, which occur during the test period, will be repaired immediately following the test. The pressure mains will then be re-tested until accepted by the Engineer.

**Sprinkler Coverage Test:** The coverage test shall be performed after the sprinkler heads have been installed and shall demonstrate that each section or zone in the irrigation system is balanced to provide uniform and adequate coverage of the areas served. The Contractor shall correct any deficiencies in the system.

**Operational Test:** The Contractor shall perform an operational test of the system to ensure proper and even distribution of water to all plants. Adjust or replace any type of irrigation equipment not operating correctly prior to the walk-through inspection.

### **440.8 PRELIMINARY, SUBSTANTIAL AND FINAL WALK-THROUGH INSPECTIONS:**

Arrange for a preliminary walk-through with the General Contractor's Superintendent, when the entire system is operational. Operate each zone in its entirety, additionally, open all valve boxes and expose items covered, if directed. Generate a list of items to be corrected and make adjustments, "fine tuning" the entire system by regulating valves, adjusting patterns and break-up devices, and setting pressure regulators at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all outlet devices for optimum performance and to prevent run-off or spray on to walks, roadways, and buildings.

Arrange for a Substantial Completion walk-through with the Engineer when all items generated from the preliminary walk-through have been corrected. Items deemed not acceptable by the Engineer shall be reworked to complete satisfaction. The Landscape Maintenance Period will not begin unless the irrigation system is operating correctly and until authorization by the Engineer. All accessories, charts, record drawings and equipment, as required, will be provided before scheduling the Final walk-through.

Following the Landscape Maintenance Period a Final walk-through inspection will be scheduled to review the system and make adjustments to the watering schedules.

### **440.9 MEASUREMENT AND PAYMENTS:**

Measurement and payment shall be in accordance with the General Conditions. The lump sum established in the schedule of values shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary for completion of the irrigation system described or specified in the contract documents.

When unit bid items are included in the proposal sheets, the unit prices quoted shall include the following items of work and material.

- (A) **Water Service Tap and Meter:** The work under this item will be performed by the City of Phoenix Water Services Department and consists of furnishing and installing a curb stop, concrete meter box with cover, tap to main and pipeline to the curb stop at the locations and in accordance with the details shown on the plans. The curb stop and water meter box will be paid for under this item. Payment will be made at the current price for this service as charged by the City of Phoenix. With some projects an allowance may be shown in the bid proposal for this item (refer to Subsection [440.1.1](#)).
- (B) **Backflow Prevention Unit:** The unit price for this item shall include the backflow prevention unit, locking cage assembly, risers and concrete thrust blocks, complete and in place.
- (C) **Electrical Remote Control Valve and Assembly:** The unit price for this item shall include the valve, the valve box with stainless steel hex bolt secured cover, pea gravel and specified pipe to the meter or backflow prevention unit.
- (D) **Sprinkler Controller:** The unit price for this item shall include:

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Cost of sprinkler controller (automatic);

All wiring for a complete underground control system, including trenching, wire, conduit, boring or jacking;

Steel security cabinet with concrete base, grounding system, metal hasp and padlocks, and all wiring within the cabinet unless controller is placed on a building or within a walled enclosure.

The junction box and any work and materials required from the stub out provided by the power company in order to complete the installation of the controller.

- (E) Irrigation Pipe: The contract price for this item shall include the pipe and fittings, trenching, backfilling and any necessary boring or jacking to install the pipe. Sleeves shall be Schedule 40.
- (F) Pull Box: The contract price for this item shall include the pull box (plastic irrigation valve box with stainless steel hex bolt secured cover).
- (G) Sprinkler Head: The contract price for this item shall include the head and all fittings, nipples and risers from lateral to the head.

*- End of Section -*

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**PART 500**

**STRUCTURES**

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### CONCRETE STRUCTURES

#### 505.1 DESCRIPTION:

Concrete bridges, culverts, catch basins, manholes, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformity with the plans and specifications. Concrete for use in work constructed under this specification and testing thereof shall conform to the requirements of Section [725](#). Reinforcing shall conform to the requirements of Section [727](#).

Permanent ladders, embedded ladder rungs, and permanently embedded tie-off points are not permitted and shall not be installed.

**505.1.1 Minor Structures:** Concrete structures such as cattle guards, catch basins, median barriers, headwalls, and other miscellaneous structures as defined by the Engineer are hereby defined as Minor Structures. Such Minor Structures, at the option of the Contractor, may be either constructed of cast-in-place concrete, or furnished as precast units. Precast units shall be fabricated in accordance with shop drawings submitted by the Contractor and approved by the Engineer, in accordance with the requirements of Section [105.2](#). All structures not defined as Minor Structures shall be classified as Major Structures.

#### 505.2 SUBGRADE FOR CONCRETE STRUCTURES:

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and placement of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. No payment will be made for the work required to keep such materials dewatered, other than such costs as may be included in the prices bid for various items of work or amount bid for dewatering when the schedule provides an item for same.

When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer and the base for structures shall be slush grouted or otherwise treated as the Engineer may direct.

Precast Concrete Minor Structures shall be founded in accordance with the requirements of Subsection [206.4.5](#).

#### 505.3 FORMS:

Forming plans for cast-in-place bridge decks and cast-in-place bridge superstructures shall be prepared in accordance with the requirements of Subsection [105.2](#).

Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Engineer. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material which will provide a surface at least equally satisfactory. Any lumber or material which

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becomes badly checked or warped prior to placing concrete may be rejected.

Forms for all exposed surfaces of bridges, viaducts, overcrossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be exterior type, of the grade Concrete-Form Exterior, conforming to the specifications of the NBS, Commercial Standards latest edition. Plywood shall be furnished and placed in 48 inches widths and in uniform lengths of not less than 96 inches, except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span. Where plywood is attached directly to the studding or joints, the panels shall be not less than 5/8 inch thick, and the studdings or joints shall be spaced not more than 12 inches, center to center. Plywood less than 5/8 inch thick, otherwise conforming to the requirements specified, may be used with a continuous backing of 5/8 inch sheathing. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous.

Wood forms for copings and curbs shall have a thickness of not less than 15/8 inches and a width of not less than the full depth of coping or curb.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4 inch triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve.

Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portion of forms to remain.

Forms for girders and slabs shall be cambered as may be required by the Engineer.

Forms shall, as far as practicable, be so constructed that the form marks will conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales, all based on the rate of concrete placement.

The Contractor may at his own option, place such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(A) If concrete is placed directly against the sides of the excavation, the faces of the excavation must be firm and compact, and be able to stand without sloughing off and be at all points outside the concrete lines shown on the plans.

(B) If concrete is placed against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is to be placed shall be faced with building paper. Except as otherwise specified all sheathing shall be removed, but not until either at least 7 days after placing concrete or until the concrete has attained a strength in compression of not less than 2,000 psi. Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated by jetting as directed by the Engineer. When, in the opinion of the Engineer, field conditions or the type of sheathing or methods of construction used by the Contractor are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been placed may be left in place.

Regardless of the method used in the placement of concrete without outside forms the following stipulations shall hold:

(A) The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the Engineer.

(B) No direct payment will be made for building paper, sheeting, gunite or concrete placed outside of concrete lines shown on the plans. The cost thereof shall be absorbed in the prices bid for the various items of work.

(C) The Contractor shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

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**505.3.1 Removal of Forms:** The falsework supporting any span of a continuous or rigid frame structure subject to bending stress shall not be released until after the last concrete placed in the span and in the adjoining spans, excluding concrete above the deck slab, has attained a compressive strength of not less than twice the design unit stress, or 21 days after the concrete is placed, whichever occurs first.

Stairway riser forms shall be removed and the finish of the steps completed on the day the concrete is placed. Metal stairway treads, if required by the plans, shall be installed immediately after the steps have been placed.

Side forms for beams, girders, columns, railings, or other members wherein the forms do not resist dead load bending shall be removed not more than 24 hours after placing concrete, where finishing is required, unless otherwise directed by the Engineer, provided that satisfactory arrangements are made to cure and protect the concrete thus exposed.

Side forms for arch rings, columns, and piers shall be removed before the members of the structure which they support are placed so that the quality of the concrete may be inspected. Such forms shall be so constructed that they may be removed without disturbing other forms which resist direct load or bending stress.

Forms and shoring for box and arch sections of sewers and storm drains may be removed as follows:

- (A) Forms for open channel walls — 16 hours.
- (B) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms — 16 hours.
- (C) Arch sections in open cut — 12 hours.
- (D) Slab forms for box sections:
  - (1) Type II Cement — 48 hours or 6 hours per foot of span between supports, whichever is greater.
  - (2) Type III Cement — 24 hours or 3 hours per foot of span between supports, whichever is greater.
  - (3) Type V Cement — 56 hours or 7 hours per foot of span between supports, whichever is greater.

The periods of time at which the Contractor may remove forms, as set forth above, are permissive only and subject to the Contractor's assuming all risks that may be involved in such removals. At his option, except for surfaces to be finished, the Contractor may leave the forms in place for such longer periods as are, in his opinion, required.

### **505.4 FALSEWORK:**

Falsework construction and erection shall not commence until the Contractor has received written approval of the sealed final falsework shop drawings.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure concrete were placed at one time.

All falsework, staging, walkways, forms, ladders, cofferdams, and similar accessories shall equal or exceed the minimum applicable safety requirements of Section [107](#). Compliance with such requirements shall not relieve the Contractor from full responsibility for the adequacy and safety of said items.

Falsework shall be founded upon a solid footing safe against undermining and protected from softening. When the falsework is supported on timber piles, the piles shall be driven to a bearing value as determined by the Contractor's Engineer.

Falsework and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the falsework to set the forms to grade or camber shown on the plans, or to take up any settlement in the form work either before or during the placement of concrete. Single wedges for this purpose will not be permitted; it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joints will be compensated for by varying depths of the joists or by using varying depth nailing strips.

Arch centering shall be removed uniformly and gradually, beginning at the crown and working toward the springing, to permit the arch to take its load slowly and evenly. Centering for adjacent arch spans shall be struck simultaneously.

Falsework under any continuous unit or rigid frame shall be struck simultaneously; the supporting supports being released

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gradually and uniformly, starting at the center and working both ways towards the supports.

**505.4.1 Falsework Design:** Falsework design shall be in accordance with the requirements of Subsection [105.2](#).

Falsework shall be designed by the Contractor to carry all loads and pressures which may be applied to it. The construction loads to be applied are as follows:

Tunnel centering – 100 percent of the concrete load where concrete is placed by pumping. Forms shall be so constructed to provide adequate relief for excessive pump pressure.

All other structures – a live load of 30 pounds per square foot of horizontal area.

Transverse and longitudinal bracing – a horizontal force equal to 2 percent of the vertical load.

The unit stresses for wood falsework shall be those recommended in the West Coast Lumbermen's Association's standard grading and dressing rules increased 25 percent for short time loading.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacings and connection values of bolts and spikes shall be in accordance with the national design specifications for stress-grade lumber and its fastenings as recommended by National Lumber Manufacturers Association except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both direction by girts.

Unit stresses for steel falsework shall be in accordance with the requirements of the specifications for design, fabrication and erection of structural steel for buildings of the AISC.

### **505.5 PLACING REINFORCEMENT:**

Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections with wire not smaller than No. 16 gage and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Wooden supports shall not be used.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

Bundle bars shall be tied together at not more than 6 foot centers.

The Contractor will be allowed the following tolerances when placing, tying and supporting reinforcing steel:

- (1) In slabs and beams, horizontal bars shall be within ¼ inch measured vertically, of the position indicated on the plans.
- (2) In vertical walls, columns, wings, and similar members, clearance from the forms shall be within ¼ inch of the clearance shown on the plans.
- (3) In slabs or walls, long runs of bars may vary up to 2 inches in spacing; however, the specified number of bars shall be placed.

**505.5.1 Splicing:** Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

**505.5.2 Bending Reinforcement:** Bending of reinforcing steel shall conform to the requirements of the AASHTO LRFD Bridge Construction Specifications Section 9.4.

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Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

**505.5.3 Welded Wire Fabric:** Welded wire fabric shall be held firmly in place and spliced not less than 2 meshes.

### **505.5.4 Dowels:**

**505.5.4.1 Dowel Placement:** Dowel placement shall consist of drilling or coring dowel holes in concrete, furnishing and placing anchoring materials, and placing reinforcing steel dowels in accordance with the details shown on the Project Plans, and the requirements of the project Special provisions and these Specifications.

Dowel holes shall be cored where dowels are to be placed:

(A) in bridge decks and other thin concrete sections, and the depth of the dowel hole shown on the project plans projects to 3 inches or less from the opposite face of the concrete section, or

(B) within 4 inches from an existing concrete edge.

Cored holes shall be intentionally roughened after coring.

All holes shall be blown clean with compressed air, prior to applying the anchoring material.

The diameter of the holes for the dowels shall be 1/8" larger than the diameter of the dowels to be placed. The depth of the holes for the dowels shall be as shown on the Project Plans.

The anchoring materials for the dowels shall be an epoxy adhesive conforming to the requirements of Subsection [505.5.4.2](#), unless otherwise specified on the Project Plans and/or the project Special Provisions, or as approved by the Engineer.

**505.5.4.2 Anchoring Materials:** Epoxy materials shall be used for anchoring dowels. The Contractor shall submit Certificates of Compliance or Analysis, complete with supporting documentation, to the Engineer for all epoxy materials to be used for anchoring dowels on a specific project, in accordance with the requirements of Subsection [106.2](#). The epoxy materials shall be provided by the Contractor in general conformance with the requirements of Section 1015 – General Requirements of Section 1015 – EPOXY MATERIALS of the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, amended to date.

Epoxy resin base anchoring adhesive shall be used for anchoring dowels in concrete. High viscosity, or non-sag epoxies in the form of a gel, shall be used for horizontal or near-horizontal applications, where flow out of the anchoring hole is a problem. Low and medium viscosity epoxies may be used in vertical anchoring holes that open upward. The anchoring product shall specifically be designed for the designated application, according to the manufacturer's product literature.

Epoxy resin base anchoring adhesive shall provide the specified minimum tensile pullout resistance, when tested in accordance with Arizona Test Method 725, as modified in accordance with Subsection [505.5.4.3](#) of these specifications. The pot life of the anchoring material shall be determined in accordance with AASHTO T-237, Part I. The determined pot life shall be within 25 percent or 10 minutes of the pot life specified by the manufacturer, whichever is greater.

**505.5.4.3 Dowel Strength Requirements:** The epoxy resin base anchoring adhesive shall provide the following minimum pullout resistances:

#4 dowels:	12.0 Kips
#5 dowels:	18.6 Kips
#6 dowels:	26.4 Kips
#7 dowels:	36.0 Kips

Arizona Test Method (ATM) 725 is a Tensile Proof Dowel Test, developed by ADOT to specifically test #6 reinforcing steel dowels anchored in portland cement concrete with an epoxy adhesive. When testing reinforcing steel dowel sizes, the anchoring hole (ATM 725: PREPARATION – 4. (a)) shall be modified as follows; the rotary hammer drill bit size (ATM 725: APPARATUS – 2. (a)) shall be modified accordingly:

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#4 dowels:	5/8" diameter x 8" long
#5 dowels:	3/4" diameter x 10" long
#6 dowels	7/8" diameter x 12" long
#7 dowels	1" diameter x 14" long

The Contractor may opt to conduct pullout tests with hole lengths other than those required above, based on the adhesive manufacturer's product literature and recommendations; however, test results shall demonstrate that the tested system provides the required pullout resistances.

### 505.6 PLACING CONCRETE:

No concrete shall be placed in any forms supported by falsework until the Contractor's Professional Engineer has inspected the completed falsework, and has issued a properly sealed and signed certificate that the falsework has been constructed according to the approved falsework drawings.

Where a schedule for placing concrete is shown on the plans, no deviation will be permitted therefrom unless approved in writing by the Engineer.

The placing of concrete for a given pour shall start at the low point and shall proceed up grade, unless otherwise permitted by the Engineer.

With the exception of concrete placed in slope paving and aprons, and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Concrete for columns shall be placed using pipes of adjustable length and not less than 6 inches in diameter.

Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been

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consolidated and a minimum 2 hour period has elapsed to permit shrinkage to occur.

Walkways shall be provided along each side and for the full length of bridge structures outside the deck area. These walkways shall be of sufficient width, and so constructed as to provide for the support of the bridges from which the longitudinal floats specified are to be operated. Inspection walkways and access thereto shall be provided under the deck forms between each pair of girders and outside of each outside girder for the full length of the bridge structure. The walkways shall be not more than 8 feet below the concrete to be inspected.

**505.6.1 Construction Joints in Major Structures:** The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the Engineer. The Contractor shall complete, by continuous depositing of concrete, section for the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed.

All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting prior to placing the adjacent concrete. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of waste water employed in washing the concrete surfaces shall be such that the waste water will not stain, discolor, or affect exposed surfaces of the structures. The method of disposal will be subject to the approval of the Engineer.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section [776](#).

Expansion and contraction joints in the concrete structures shall be formed where shown on the plans and as directed. In general, such joints shall have smooth abutting surfaces, painted or separated and sealed as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans. Concrete or mortar shall not be permitted to lap these joints in such a manner as to effect a tie or bond that would later promote spalling.

Asphalt paint or premolded asphalt filler used in joints shall be as specified in Section [729](#).

No direct payment will be made for furnishing and placing asphaltic paint, premolded asphaltic filler or other types of joint separators; their costs shall be included in the price bid for the item of work of which they are a part.

### **505.6.2 Adverse Weather Concreting:**

(A) Hot Weather Concreting: Hot weather is defined as any combination of high ambient temperature, low relative humidity, and wind velocity which would tend to impair the quality of fresh concrete. These effects become more pronounced as wind velocity increases. Since last minute improvisations are rarely successful, preplanning and coordination of all phases of the work are required to minimize these adverse effects.

As an absolute minimum, the Contractor shall insure that the following measures are taken:

(1) An ample supply of water, hoses, and fog nozzles are available at the site. (2) Spare vibrators are on hand in the ratio of one spare vibrator for each three in use. (3) Preplanning has been accomplished to insure prompt placement, consolidation, finishing, and curing of the concrete. (4) Concrete temperature on arrival should be approximately 60°F. and in any event shall not exceed 90°F. The use of cold water and ice is recommended. (5) The subgrade is moist, but free of standing water. (6) Fog spray is utilized to cool the forms and steel. Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity, and wind, even strict adherence to these measures may not produce the quality desired and it may be necessary to restrict concrete placement to early morning only. If this decision is made, then particular attention must be directed to the curing process since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

(B) Cold Weather Concreting: Concrete shall not be placed on frozen ground, nor shall it be placed when the ambient temperature is below 40°F. unless adequate means are used to heat the aggregate and/or water and satisfactory means have

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been taken for protecting and heating the concrete during the curing period.

(C) Wet Weather Concreting: Placing of concrete shall be discontinued when the quantity of rainfall is such as to cause a flow or wash to the surface. Any concrete already placed and partially cured shall be covered to prevent dimpling. A construction joint will be installed prior to shut down.

(D) Replacement of Damaged or Defective Concrete: Upon written notice from the Engineer, all concrete which has been damaged or is defective, shall be replaced by the Contractor at no cost to the Contracting Agency.

(E) Recommended Reference:

- (1) ACI-305 Hot Weather Concreting
- (2) ACI-306 Cold Weather Concreting
- (3) ACI-308 Recommended Practices for Curing Concrete

### 505.6.3 Bridge Deck Joint Assemblies:

**505.6.3.1 Description:** This work shall consist of furnishing and installing expansion devices including the seals, anchorage system, and hardware in accordance with the project plans and these specifications.

**505.6.3.2 Materials:** Elastomer Seals shall be of the Compression Seal or Strip Seal type, and shall conform to the requirements of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction Section 1011-5.

Steel shapes and plates shall conform to the requirements of ASTM A36, or ASTM A588.

### 505.6.3.3 Construction Requirements:

(1) General: Deck joint assemblies shall consist of elastomer and steel assemblies which are anchored to the concrete at the deck joint. The seal armor shall be cast in the concrete. The completed assembly shall be properly installed in the planned position, shall satisfactorily resist the intrusion of foreign material and water, and shall provide bump-free passage of traffic. For each size of seal on a project, one piece of the seal material supplied shall be at least 18 inches longer than required by the project Plans. The additional length will be removed in the presence of the Engineer and used for materials testing. Certificates of Compliance conforming to the requirements of Subsection [106.2](#) shall also be submitted by the Contractor.

(2) Shop Drawings: Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for approval, in accordance with the requirements of Subsection [105.2](#). The shop drawings shall show complete details of the method of installation to be followed, including a temperature correction chart for adjusting the dimensions of the joint according to the ambient temperature, and any additions or rearrangements of the reinforcing steel from that shown on the project plans.

(3) Elastomer Seals: Seals shall conform to the requirements specified.

(4) "Armor: All steel for cast-in-place deck joint assemblies shall conform to the requirements specified."

(5) Galvanizing: All steel parts of strip seal assemblies shall be galvanized after fabrication, in accordance with the requirements of ASTM A123 and A153, unless ASTM A588 steel is used. Bolts shall be high strength, conforming to the requirements of ASTM A325M, with a protective coating of zinc, followed by a chromate and baked organic coating conforming to the requirements of ASTM F1135, Grade 3, 5, 6, 7, or 8 and Color Code A.

Steel parts of compression seal assemblies do not require galvanizing, plating, or painting.

(6) Joint Preparation and Installation: At all joint locations, the Contractor shall cast the bridge decks and abutment backwalls with a formed blockout, sized to accommodate the pre-assembled joint assembly. The joint assembly will be anchored in the concrete to be placed with the secondary pour in the blockout. Prior to the secondary pour, the surface of the existing concrete in the blockout shall be coated with an approved adhesive specifically formulated for bonding new concrete to old concrete.

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(7) Welding: All welding and inspection of welding for structural steel shall be performed in accordance with the requirements of the latest revision of the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code. The use of electro-slag welding process on structural steel will not be permitted.

Installed armor assemblies shall be covered or otherwise protected at all times prior to installing the elastomer portion of the joint assembly. The elastomer shall be installed at such time and in such manner that it will not be damaged by construction operations.

Immediately prior to the installation of the seal element, the steel contact surfaces of the joint armor shall be clean, dry, and free of oil, rust, paint, or foreign material. Any perforation or tearing of the seal element due to installation procedures or construction activities will be cause for rejection of the installed seal element.

During the installation of all proprietary deck joint assemblies, the manufacturer's representative shall be present. As a minimum, the representative shall be present during the placement of the joint assembly in the deck blockout, prior to the secondary concrete pour, and shall also be present during the installation of the seal element.

**505.6.4 Water Stops:** Water stops of rubber or plastic, shall be placed in accordance with the details shown on the project plans. Where movement at the joint is provided for, the water stops shall be of the type permitting such movement without damage. Water stops shall be mechanically spliced, vulcanized, or heat-sealed to form continuous watertight joints, in accordance with the manufacturer's recommendations, and as approved by the Engineer.

**505.6.5 Longitudinal Joints between Precast Bridge Deck Units:** After erection of the units and at the time requested by the Engineer, the longitudinal shear key joints between units shall be thoroughly packed with a pre-packaged non-shrink grout or a sand-cement grout with an expansion agent approved by the Engineer. The Contractor shall then transversely connect the deck units with the connection rods, stressing and anchoring them as shown on the project plans.

### **505.7 CONCRETE DEPOSITED UNDER WATER:**

When conditions render it impossible or inadvisable in the opinion of the Engineer to dewater excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or underwater bottom dump bucket, a layer of concrete of sufficient thickness to thoroughly seal the cofferdam. To prevent segregation the concrete shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Water shall be maintained in a still condition at the point of deposit.

A tremie shall consist of a water tight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when concrete is being placed. The tremie tube shall be kept full of concrete. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

The underwater bucket shall have an open top and the bottom doors shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid back wash and shall not be dumped until it rests on the surface upon which the concrete is to be deposited. After discharge, the bucket shall be raised slowly until well above the concrete.

Concrete deposited in water shall have 10 percent extra cement added.

### **505.8 CURING:**

As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with earth, sand or burlap; sprayed with a curing compound or sealed with a material conforming with Section [726](#). All concrete for bridge structures shall be water cured unless otherwise permitted by the Engineer. The Contractor shall use the wet burlap method for the water cure of all concrete in bridge decks and approach slabs, unless otherwise authorized by the Engineer.

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Concrete that is water cured must be kept continuously wet for at least 10 days after being placed; preferably being covered, if possible, with at least 2 layers of not lighter than 7 ounce burlap, except that handrail, baserail, railing posts, tops of walls, and similar parts of the structure, if water cured, must be covered with burlap as above prescribed, immediately following the finishing treatment specified therefore, and such covering shall not be removed in less than 4 days. Roadway areas, floors, slabs, curbs, walks, and the like, that are water cured may be covered with sand to a depth of at least 2 inches, in lieu of the burlap as specified above, as soon as the condition of the concrete will properly permit, and such covering must remain wet and in place until the concrete so covered is at least 10 days old unless otherwise directed by the Engineer or provided by special provisions.

When a sprayed impervious membrane is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. To insure complete coverage, membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. The membrane, however, shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joints, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the sealing medium in order to prevent any of the membrane from being deposited thereon; and any such surface with which the seal may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to avoid and prevent any damage to the membrane seal during the curing period. Should the seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the membrane seal, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When tops of walls are cured by the membrane sealing method the side forms, except metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

If due to weather conditions, materials used, or for any other reason, there is any likelihood of the fresh concrete checking or cracking prior to the commencement of the curing operations, it shall be kept damp, but not wet, by means of an indirect fine spray of water until all danger of such checking or cracking is past, or until the curing operations are started in the particular area affected.

Since hot weather leads to more rapid drying of concrete, protection and curing are far more critical than in cool weather. Water curing shall be used wherever it is practical and shall be continuous to avoid volume changes due to alternation of wetting and drying. The need for adequate continuous curing is greatest during the first few hours after placement of concrete in hot weather.

### **505.9 FINISHING CONCRETE:**

Immediately after the removal of forms as provided above, all concrete surfaces shall be finished in accordance with the requirements specified below.

All surfaces scheduled to be covered with backfill shall be finished so as to be free of open and rough spaces.

All surfaces that will remain exposed in the completed work shall be finished so as to be free of open and rough spaces, depressions or projections. All angles and fillets shall be sharp and true and the finished surface shall present a pleasing appearance of uniform color.

All top surfaces of walls, abutments, piers, etc., shall be finished to a smooth surface and shall be cured by an approved method.

If rock pockets or honeycomb are of such an extent and character as to affect materially the strength of the structure and to endanger the steel reinforcement the Engineer may declare the concrete defective and require the removal and replacement of that portion of the structure affected by the Contractor at no additional cost to the Contracting Agency.

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If finishing operations are not carried out as set forth below, all placing of concrete shall stop until satisfactory arrangements are made by the Contractor to promptly correct defective finishing work and to carry out finishing operations as specified.

One of the classes of finish as specified shall be applied to the various surfaces as set forth under applicability of finishes.

No finishing or patching shall be permitted until the surface has been inspected by the Engineer.

**505.9.1 Finishing Fresh Concrete in Bridge Decks:** Upon placing the deck to a uniform and true surface, screed supports shall promptly be removed from the surface and any necessary hand finishing shall be promptly accomplished in the areas where the screed supports have been removed.

After final floating of the plastic concrete, bridge decks subject to vehicular traffic shall be textured transversely. Apparatus producing textured grooved shall be mechanically operated from an independent self-propelled bridge. Grooves shall be 1/16 to 1/8 inch in width and 3/32 to 6/32 in depth. Center to center spacing of the grooves shall be as follows: 7/8 inch, 3/4 inch, 1 inch, 3/4 inch, 1-1/8 inch and then repeated or other measurements as approved by the Engineer. Texturing shall be completed before surface of concrete is torn or unduly roughened by texturing operation. Grooves that close following texturing will not be permitted and will have to be retextured. Hand tine brooms shall be available on the job site, at all times during texturing operation, to repair faulty texturing grooves.

The finished surface will be tested with a 10 foot straightedge furnished by the Contractor. The testing will be accomplished by holding the straightedge in contact with the deck surface and parallel to the centerline. The surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch shall be corrected by cutting or planning. The cutting or planning machine shall be a rotary type, equipped with an adjustable cutter and having a minimum wheel base of 10 feet. Areas showing low spots of more than 1/8 inch shall be filled with an approved mixture of sand, cement and epoxy. The mixture shall firmly adhere to the surface and shall match the surrounding concrete. All areas corrected shall not show deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

**505.9.2 Finishing Fresh Concrete in Sidewalks and Bridge Sidewalks:** After the concrete has been placed and spread between the forms, it shall be thoroughly worked until all the coarse aggregate is below the surface and the mortar comes to the top. Concrete may be consolidated by means of mechanical vibrators approved by the Engineer.

The surface shall then be struck off and worked to grade and cross-section with a wood float.

A mechanical finishing machine that will consolidate the concrete and strike off and finish the surface may be used if permitted by the Engineer, provided that the machine produces a sidewalk equal to or better in all respects than that produced by the methods specified herein.

The surface shall be sweat finished by means of a steel trowel followed by a light broom finish.

The sidewalks shall be marked and edged with the proper tools to form the joints, marking and edges shown on the plans.

**505.9.3 Finishing Green Concrete:** Class I Finish — All bolts, wires and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part of cement and 2 parts of fine sand. A portion of the required cement for mortar shall be white as required to match the color of the surrounding concrete.

Class II Finish — The surface shall be patched and pointed as specified above for Class I Finish and then promptly covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive or other suitable means. Only white polyethylene film for covering will be acceptable.

When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part of fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for grout shall be white as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface

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shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

**Class III Finish** — The surface shall be treated as specified above under Class II Finish except that after brushing, the surface shall again be securely covered with polyethylene film, wet burlap or wet cotton mats. In not less than 1 day nor more than 4 days, the surface shall be uncovered and rubbed with a carborundum stone. This rubbing shall continue until the entire surface is of a smooth texture and uniform color. During the process, the use of a thin mixture of equal parts of sand and cement with water will be permitted. At the time a light dust appears, the surface shall be brushed or sacked, care being taken to carry this brushing in one direction so as to produce a uniform texture.

**505.9.4 Finish Hardened Concrete:** If for reasons either beyond the control of the Contractor or with the approval of the Engineer, more than 6 days have elapsed between the time of placing concrete and the time of the removal of forms, the concrete shall be considered as hardened. Prior to finishing hardened concrete, the surface shall be covered with burlap or cotton mats and kept thoroughly wet for a period of at least 1 hour. Finishing shall be identical to the respective requirements for Class I, Class II and Class III Finish for green concrete, except that the use of a mechanically operated carborundum stone will be required for Class II and Class III Finishes.

**505.9.5 Applicability of Finishes:** Surfaces requiring Class I Finish — All formed structures that are to be covered by backfill and those surfaces that are normally not in view of either vehicular or pedestrian traffic such as the surfaces on the inside of barrels of culverts, the under surfaces of decks, surfaces of concrete girders, piers and abutment walls.

Surfaces requiring Class II Finish — All exposed surfaces of headwalls, wingwalls, deck edges on culverts, end of piers on bridges and culverts, retaining walls and those vertical surfaces under highway grade separation structures that are exposed to view of the traveling public, including piers and pier caps, the outside face of outside girders, and other similar surfaces.

When surfaces of uniform texture and pleasing appearance are obtained through the use of first class metal forms, paper tubing or the use of special form coatings and the use of special care, such surfaces may, upon approval of the Engineer, be excluded from the surfaces requiring Class II Finish.

Surfaces requiring Class III Finish for bridge structures — All formed or finished surfaces above the surface of the deck on the roadway side of the handrail and the outside vertical surfaces from the top of handrail and dado to the lower edge of the chamfer at the bottom of the deck.

### 505.10 DIMENSIONAL TOLERANCES:

The maximum allowable tolerances or deviations from dimensions shown on the project plans or the approved shop drawings shall be as follows:

#### 505.10.1 Cast-in-Place Concrete:

- (A) Variation from plumb in the lines and surfaces of columns, piers, abutment and girder walls:
  - In any 10 foot or less length: 0.4 inches
  - Maximum for the entire length: 1 inch
- (B) Variation in cross-sectional dimensions of columns, piers, girders, and in the thickness of slabs and walls:
  - + 1/4 inch
  - 1/8 inch
- (C) Girders alignment (deviation from straight line parallel to center line of girder measured between diaphragms):
  - 1/8 inch per every 10 feet in length
- (D) Variation in footing cross-sectional dimensions in project plans:
  - + 2 inches
  - 1/2 inch
- (E) Variation in footing thickness:
  - Greater than specified - No Limit
  - Less than specified - 5 percent of specified thickness up to a maximum of 1 inch

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(F) Subgrade Tolerances:

Slab poured on subgrade excepting footing thickness:

+ 1/4 inch

- 3/4 inch

(G) Girder Bearing Seats:

Deviation from plane surface (flatness):  $\pm 1/8$  inch in 10 feet.

Deviation from required elevation:

+ 1/4 inch

- 1/8 inch

(H) Cast-in-Place concrete box girder superstructures:

Deviation in overall depth:

+ 1/4 inch

- 1/8 inch

Deviation in slab and wall thickness:

+ 1/4 inch

- 1/8 inch

Deviation of post-tensioning ducts:

$\pm 1/4$  inch

**505.10.2 Minor Precast Concrete Structures:** Precast units that do not comply with the dimensional tolerances specified herein will be rejected. Precast units that show evidence of cracks, pop outs, voids or other evidence of structural inadequacy, or imperfections that will reduce the aesthetics of the unit after final placement will be rejected. The maximum allowable tolerances or deviations from the dimensions shown on the drawings shall be as follows:

(A) Over-all dimensions of member:  $\pm 1/4$  inch per 10 feet, maximum of  $\pm 3/4$  inch.

(B) Cross-sectional dimensions: sections 6 inches or less  $\pm 1/8$  inch

Sections 18 inches or less and over 6 inches  $\pm 1/4$  inch

Sections 39 inches or less and over 18 inches  $\pm 1/4$  inch

(C) Deviations from straight line:

Not more than 1/4 inch per 10 feet

All exposed, sharp corners of the concrete shall be filleted  $3/4$  inches with a maximum allowable deviation of  $\pm 1/8$  inch.

### 505.11 MEASUREMENT:

**505.11.1 Reinforcing Steel:** When reinforcing steel is scheduled for payment as a specific item, it will be measured in pounds, based on the total computed weight for the size and length of bars, or for the area of welded wire fabric, as shown on the Project Plans or as approved by the Engineer.

Unit bar weights for deformed and plain billet-steel bars will be the nominal unit weights specified in AASHTO M-31 (ASTM A615).

Area unit weights for steel welded wire fabric will be calculated based on specified wire spacing's and unit weights for specified wire types and sizes. Unit weights for plain wire shall be based on the nominal areas specified for Wire Size Numbers in AASHTO M-32 (ASTM A82). Unit weights for deformed wire shall be the nominal unit weights specified for Deformed Wire Size Numbers in AASHTO M-225 (ASTM A496).

If the area unit weights for steel welded wire fabric are specified on the Project Plans or in the Special Provisions, both the Contractor and the Engineer shall independently calculate the area unit weight, using specified wire spacing's, types and sizes, and the criteria in the preceding paragraph. Any apparent discrepancy between the specified and calculated area unit weights shall be resolved by the Engineer prior to the Contractor placing the order for the steel welded wire fabric.

Lap splices made for the convenience of the Contractor will not be included in the measurement for payment.

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Reinforcing steel for Minor Structures, as defined in Subsection [505.1.1](#), will not be measured, but will be included in the items unit price or specified method of payment, unless otherwise called out on the Project Plans or in the Special Provisions.

Dowel Placement will be measured by the unit each.

**505.11.2 Concrete:** When concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans. The quantity will be based on the concrete having the specified plan lengths, widths/depths, and thicknesses. However, all concrete shall be placed to line and grade within the tolerances specified in Subsection [505.10](#), or as approved by the Engineer as being reasonable and acceptable for the type of work involved. No volumetric deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 0.5 square yard or less in area.

The quantity of concrete will be calculated considering any mortar used to cover construction joints as being concrete. The cost of cement used in any mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the cost of the item of work of which said mortar is a part.

**505.11.3 Deck Joint Assemblies:** Deck joint assemblies will be measured to the nearest tenth of a foot. Measurement will be made along the centerline of the joint, at the surface of the roadway, from face-to-face of curb or barrier. No measurement will be made for that portion of the deck joint assembly required by plan details to extend through the barrier face or curb; that portion of the joint assembly will be considered incidental to the sealing of the joint.

### **505.11.4 Bridge Railing, Curbs, Barriers, and Approach Slabs:**

Bridge Pedestrian Fence and Curb, Bridge Pedestrian Fence and Parapet, and Bridge Fence and Parapet will be measured to the nearest tenth of a foot, from end post to end post.

Bridge Traffic and Pedestrian Rail will be measured to the nearest foot, determined from the outside dimensions of the rail.

Bridge Concrete Barrier will be measured to the nearest tenth of a foot.

Barrier Concrete Barrier Transition will be measured as a unit for each constructed.

Reinforced Concrete Approach Slab will be measured to the nearest square yard.

### **505.12 PAYMENT:**

Payment for portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete and doing all work required to construct the structures in conformity with the plans and specifications.

**505.12.1 Reinforcing Steel:** The accepted quantities of reinforcing steel, of the type indicated on the Project Plans or specified in the Special Provisions, and measured in conformance with Subsection [505.11.1](#) will be paid for at the contract unit price per pound, complete in place.

The accepted quantity of dowels placed will be paid for at the contract unit price for Dowel Placement, which shall be full compensation for the work, complete in place. Steel reinforcement furnished for the dowels will be measured and paid for under the pay item Reinforcing Steel.

No measurement or direct payment will be made for dowels which are required to replace existing reinforcing steel that is damaged as a result of the Contractor's operations; the Contractor shall furnish and place such dowels at his own expense.

**505.12.2 Concrete:** Payment for portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete, and

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doing all work required to construct the structures in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

An adjustment in the contract unit price, to the nearest cent, will be made for the quantity of concrete represented by the results of cylinder strength tests that are less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Subsection [725.8](#). The adjustment in contract unit price, if the concrete is accepted, will be based on Table [725-2](#) in Subsection [725.9](#).

The contract unit price for structural concrete shall include full compensation for all items incidental to providing a concrete structure complete in place, including waterstops, roadway drains, scuppers, metal inserts, and bearing pads.

**505.12.3 Minor Concrete Structures and Accessories:**

The accepted quantities of:

Minor Structures .....	Each
Deck Joint Assemblies .....	0.1 Foot
Bridge Pedestrian Fence and Curb .....	0.1 Foot
Bridge Pedestrian Fence and Parapet .....	0.1 Foot
Bridge Fence and Parapet .....	0.1 Foot
Bridge Traffic and Pedestrian Rail .....	Foot
Bridge Concrete Barrier .....	0.1 Foot
Bridge Concrete Barrier Transition .....	Each
Reinforced Concrete Approach Slab .....	Square Yard

will be paid for at the unit price and/or lump sums as set forth in the proposal. The contract unit price shall include full compensation for all labor, materials, tools and equipment necessary to provide the concrete structure or accessory complete in place, including all concrete, reinforcing steel, and items embedded in the concrete, such as anchor bolts, grates and frames, metal inserts, etc.

*- End of Section -*

## SECTION 506

### PRECAST PRESTRESSED CONCRETE MEMBERS

#### 506.1 DESCRIPTION:

This work shall consist of furnishing and placing precast prestressed concrete members in accordance with the details shown on the plans, and as provided in these specifications and special provisions.

This work shall include the manufacture, transportation and storage of girders, slabs, and other structural members of precast prestressed concrete and shall also include the placing of all precast prestressed concrete members.

The members shall be furnished complete including all concrete, prestressing steel, bar reinforcing steel, and incidental materials in connection therewith.

Prestressing may be performed by either pretensioning or posttensioning methods. The method of prestressing to be used shall be optional with the Contractor, subject to the requirements provided in these specifications.

Prior to casting any members to be prestressed, the Contractor shall submit to the Engineer for review complete details of the method, materials and equipment he proposes to use in the prestressing operations, including any additions or rearrangement of reinforcing steel from that shown on the plans. Such details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, anchoring stresses, type of enclosures, and all other data of the prestressing steel in the members, pressure grouting materials and equipment. For any rearrangement of prestressing tendons the stress calculations shall be submitted for approval by the Engineer.

#### 506.2 CONCRETE:

Concrete construction shall conform to the provisions in Section [505](#).

The Contractor shall be responsible for furnishing concrete for prestressed members which contains not less than 611 nor more than 752 lbs., of cement per cubic yard of concrete, which is workable and which conforms to the strength requirements specified. Batch proportions shall be determined by the Contractor.

The compressive strength of the concrete will be determined from concrete test cylinders cured under conditions similar to those affecting the member.

The use of admixtures for the purpose of producing high strength at an early date shall be subject to the approval of the Engineer. In no case shall calcium chloride or any additive containing calcium chloride be used in concrete for prestressed construction.

Concrete shall not be deposited in the forms until the Engineer has inspected the placing of the reinforcement, enclosures, anchorages, and prestressing steel.

The concrete shall be vibrated internally or externally, or both, as required to consolidate the concrete. The vibrating shall be done with care and in such a manner that displacement of reinforcement, enclosures, and prestressing steel will be avoided.

Holes for anchor bars, and for diaphragm dowels which pass through the member, openings for connection rods, recesses for grout and holes for railing bolts shall be provided in the members in accordance with the details shown on the plans. Where diaphragm dowels do not pass through the member, the dowels may be anchored in the member by embedment in the concrete or by means of an approved threaded insert.

Forms for interior cells or voids in the members shall be constructed of a material that will resist breakage or deformation during the placing of concrete and will not materially increase the weight of the member.

Forms may be removed when permitted by the Engineer provided that the concrete is not damaged in so doing and that adequate curing is provided. The members shall be properly supported to prevent dead load bending at all times prior to initial tensioning. After prestressing, the members shall be handled or supported at or near the final bearing points for storage.

The members shall be supported in transporting in a manner that will allow reasonable conformity to the proper bearing

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points with consideration for limitations of adequate hauling equipment. At all times members shall be handled or supported securely in an upright position, avoiding tipping or racking.

Lifting devices shall not project above the surface of the member after erection unless they will be imbedded in a subsequent concrete pour, have a minimum concrete cover of 2 inches and do not interfere with the placement of reinforcing steel or concrete.

The steam curing method or other approved methods may be used for curing precast prestressed concrete members in lieu of water curing. Steam curing, if elected by the Contractor, shall conform to the following provisions:

(A) After placement of the concrete, members shall be held for a minimum 2-hour presteaming period. The initial application of the steam shall be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place.

(B) All exposed surfaces of the members shall be kept wet continuously during the holding and curing period.

(C) The steam shall be saturated below pressure and shall be distributed uniformly over all exposed surfaces of the member and shall not impinge on the exposed concrete surfaces.

(D) The steam hood shall be equipped with temperature recording devices that will furnish an accurate continuous permanent record of the temperatures under the hood during the curing period. The position of the temperature devices shall be approved by the Engineer.

(E) During application of the steam the ambient air temperature shall increase at a rate not to exceed 40°F. per hour until a maximum temperature of from 140°F. to 160°F. is reached. The maximum temperature shall be held until the concrete has reached the desired strength.

**506.3 PRESTRESSING STEEL:**

Prestressing steel shall be high-tensile wire conforming to ASTM A421, high-tensile wire strand conforming to ASTM A416, or high-tensile strength alloy bars conforming to the following requirements:

High-tensile strength alloy bars shall be thermal stress relieved to produce suitable metallurgical structure and shall be individually proof-tested during the process of manufacturing to a minimum of 90 percent of the manufacturer's minimum guaranteed ultimate strength. The mechanical properties of the completed bars shall be as follows:

	Regular Grade	Special Grade
Ultimate tensile strength psi. min. ....	145,000	160,000
Yield strength, measured by the 0.7 percent extension under load method, psi. min. ....	130,000	140,000
Elongation in 20 bar diameters after rupture, percent, minimum.....	4.0	4.0
Reduction of area, percent, min. ....	25.0	20.0
Modulus of elasticity at 70 percent of the manufacturer's minimum guaranteed ultimate strength psi.min.....	25×10 <sup>6</sup>	25×10 <sup>6</sup>

Diameter tolerances shall conform to ASTM A29

Bars of different ultimate strength shall not be used interchangeably in the same member, unless otherwise permitted by the Engineer.

In handling and shipping bars, every care shall be taken to avoid bending, injury from deflection, scraping or overstressing of the bars. All damaged bars will be rejected.

All wire and strand to be post-tensioned shall be:

(A) Protected from corrosion during shipping by a factory treatment or processing.

## SECTION 506

(B) Protected against abrasion during shipment and handling.

Wires shall be arranged to produce equal stress in all wire of wire groups or parallel lay cables that are to be stressed simultaneously or when necessary to insure proper positioning in the enclosures.

Where wires are to be button-headed, the buttons shall be cold formed symmetrically about the axes of the wires, and shall develop the full strength of the wire. No cold forming process shall be used that causes indentations in the wire.

When the button-headed wire assembly is tested as a unit in tension at least 90 percent of the failures at or above the minimum guaranteed ultimate strength of the wire shall occur in the wire and not in the buttons.

All prestressing steel shall be protected against rust and other corrosion and damage and shall be free of all dirt, scale and pits due to rust, oil, grease and other deleterious substances when finally encased in concrete or grouted in the member.

### **506.4 ANCHORAGES AND DISTRIBUTION:**

All post tensioned prestressing steel shall be secured at the ends by means of approved anchoring devices. The anchors shall be of such nature that they will not kink, neckdown or otherwise damage the prestressing steel.

The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete.

Anchoring devices for all post-tensioned prestressing steel shall be of the permanent type.

Where the end of a post-tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the prestressing steel and all parts except tendons of the anchoring devices will be at least 2 inches inside of the end surface of the members, unless a greater embedment is shown on the plans. Following post-tensioning, the recesses shall be filled with grout, and finished flush.

When headed wires are used, the outside edge of any hold for prestressing wire through a stressing washer or through an unthreaded bearing ring or plate shall not be less than 1/4 inch from the root of the thread of the washer or from the edge of the ring or plate.

Distribution plates or assemblies shall conform to the following requirements:

(A) The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 psi, and a suitable grillage of reinforcing steel shall be used in the stressed area.

(B) Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed design working stress, as determined by the Engineer, in the anchorage plate when 100 percent of the ultimate load is applied.

(C) Materials and workmanship shall conform to the requirements in Section [515](#).

Should the Contractor elect to furnish anchoring devices of a type which are sufficiently large and which are used in conjunction with a steel grillage imbedded in the concrete that effectively distributes the compressive stresses to the concrete and steel distribution plates or assemblies may be omitted.

### **506.5 ENCLOSURES:**

Enclosures for prestressing steel shall be metallic and mortar-tight and shall be accurately placed at the locations shown on the plans or approved by the Engineer.

In lieu of metallic enclosures, openings for prestressing steel may be formed by means of cores or ducts composed of rubber or other suitable materials that can be removed prior to installing prestressing steel.

All enclosures or openings or anchorage assemblies shall be provided with pipes or other suitable connections for the injection of grout after prestressing.

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### 506.6 PRESTRESSING:

All prestressing tendons shall be tensioned by the use of equipment allowing actual elongation to be measured directly and using a hydraulic ram equipped with an accurate method of determining the tensioning force applied using one of the following methods; a gauge measuring the internal hydraulic pressure of the ram, or force exerted by the ram; a spring-type dynamometer used with the tensioning force applied directly; an electronic load cell used with the tensioning force applied directly. Readings taken from any one of these gauges shall be converted to actual tensioning forces through the use of calibrated values taken from a certified chart from a recent calibration. All gauges shall be of sufficient size and adequately made to allow accurate readings to be made of load increments of one percent of the total capacity of the ram used, not to exceed two percent of the tensioning force used.

The force in each tendon as obtained from the calibrated value shall be compared with the tensioning force obtained from calculation using the modulus of elasticity, cross-sectional area and length of tendon for the actual net elongation measured directly. When there is a difference between the values in excess of 5 percent final anchorage of the tendon shall be delayed until the reason for the discrepancy is found and appropriate correction is made to reduce the difference to five percent or less. Within the allowable difference, final anchorage shall be made when the required tensioning force is obtained according to the elongation used in pretensioning and according to the corrected gauge reading in post-tensioning.

The tensioning of prestressing steel in any post-tensioned member and the cutting or releasing of prestressing steel in any pretensioned member shall not be performed until tests on concrete cylinders indicate that the concrete in the member has attained a compressive strength of not less than the value shown on the plans for transfer strength.

Subject to prior approval by the Engineer, a portion of the total prestressing force may be applied to a member when the strength of the concrete in the member is less than the value shown on the plans and the member may then be moved. Approval by the Engineer of such partial prestressing and moving shall in no way relieve the Contractor of full responsibility for successfully constructing the members.

The cutting and releasing of prestressed steel in pretensioned members shall be performed in such an order that lateral eccentricity of prestress will be a minimum. The prestressing steel shall be cut off flush with the end of the member and the exposed ends of the prestressing steel shall be heavily coated with roofing asphalt or coal tar.

Post-tensioning will not be permitted until it is demonstrated to the satisfaction of the Engineer that the prestressing steel is free and unbonded in the enclosure.

The tensioning process as applied to post-tensioned members shall be so conducted that tension being applied and the elongation of the prestressing steel may be measured at all times. A record shall be kept of gauge pressures and elongations at all times and shall be submitted to the Engineer for approval.

Draped prestressing steel in post-tensioned members shall be tensioned by simultaneous jacking at each end of the assembly, except where low frictional forces permit tensioning from one and as determined by the Engineer.

Determination of the jacking stresses shall be supported by calculations, or both calculations and field tests when specified, prepared by the Contractor. The Contractor shall submit his calculations to the Engineer for approval, and prior to making field tests shall submit details of his proposed gauges and load devices for determining the jacking load at each end of the test prestressing unit to the Engineer for approval. The stress at the center will be calculated from the average of the end test loads, when tests are required. Jacking stresses within 2 percent of the specified values will be considered satisfactory.

The following friction coefficients shall be used in calculating friction losses. K represents the wobble of the ducts, and U represents the curvature in draped cables:

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Type of Steel	Type of Duct	K	U
Bright metal wire or strand	Bright metal	0.002	0.30
	Galvanized	0.0015	0.25
Bright metal bars	Bright metal	0.0003	0.20
	Galvanized	0.0002	0.15

The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 75 percent of the ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the plans but in no case shall the initial stress exceed 70 percent of the ultimate tensile strength of the prestressing steel.

### 506.7 BONDING AND GROUTING:

Post-tensioned prestressing steel shall be bonded to the concrete by pressure grouting the enclosures or openings.

All prestressing steel to be bonded to the concrete shall be free of scale and pits due to rust, dirt, oil, grease and other deleterious substances.

Grouting equipment shall be capable of grouting to a pressure of at least 100 psi. The grouting shall consist of neat cement and water conforming to the provisions in Section [725](#). The grout shall completely fill the enclosure or opening.

All enclosures or openings shall be clean and free of all foreign materials that would impair bonding of the grout. Each enclosure or opening shall be thoroughly flushed out with water and blown out with air or cleaned by other approved methods immediately prior to grouting.

After post-tensioned prestressing steel has been pressure grouted, the member shall not be moved or otherwise disturbed until at least 24 hours have elapsed.

### 506.8 SAMPLES FOR TESTING:

Sampling and testing shall conform to the specifications or ASTM A416 and A421 as provided in this specification.

Samples from each size and each lot of prestressing steel wires and bars, from each manufactured reel of prestressing steel strand, and from each lot of anchorage assemblies and bar couplers to be used shall be furnished for testing.

All wire or bars of each size from each mill lot and all strands from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. Each lot of anchorage assemblies and bar couplers to be installed at the site shall be likewise identified. All unidentified prestressing steel, anchorage assemblies or bar couplers received at the site will be rejected.

The following samples of material and tendons, selected by the Engineer from the prestressing steel at the plant or job site, shall be furnished by the Contractor to the Engineer well in advance of anticipated use:

(A) For wire or strand one 7 foot long sample shall be furnished for each heat or reel and for bars one 6 foot long sample shall be furnished for each heat.

(B) If the prestressing tendon is to be prefabricated, one completely fabricated prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies. If the prestressing tendon is to be assembled at the job site, sufficient wire or strand and end fittings to make up one complete prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies.

(C) If the prestressing tendon is a bar, one 6 foot length complete with one end anchorage shall be furnished and in addition if couplers are to be used with the bars two 3 foot lengths of bar equipped with one coupler and fabricated to fit the coupler

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shall be furnished. Prestressing systems previously tested and approved need not be furnished as complete tendon samples, provided there is no change whatsoever in the material, design or details previously approved. Shop drawings shall contain an identification of the project on which approval was obtained, otherwise sampling will be necessary.

For prefabricated tendons, the Contractor shall give the Engineer at least 10 days' notice before commencing the installation of end fittings or the heading of wires. The Engineer will inspect all end fitting installations and wire headings while such fabrication is in progress at the plant and will arrange for all required testing of the material to be shipped to the site.

No prefabrication tendon shall be shipped to the site without first having been released by the Engineer, and each tendon shall be tagged before shipment for identification purposes at the site. All unidentified tendons received at the site will be rejected.

Job site or site as referred to herein shall be considered to mean the location where the members are to be manufactured whether at the project site or a removed casting yard.

The release of any material by the engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

### **506.9 HANDLING:**

Extreme care shall be exercised in handling, storing, moving and erecting precast prestressed concrete members to avoid twisting, racking or other distortion that would result in cracking or damage to the members. Precast prestressed members shall be handled, transported and erected in an upright position and the points of support and directions of the reactions with respect to the members shall be approximately the same during transportation and storage as when the member is in its final position.

Precast prestressed concrete members shall be placed in the structure in the conformity with the plans and special provisions for the structure to be constructed.

### **506.10 PAYMENT:**

Precast prestressed concrete members, will be paid for at the contract price or prices for furnishing and erecting precast prestressed concrete members of the various types and lengths set forth in the proposal.

The contract price paid for furnishing the member shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing and furnishing the member at the site of the work complete in place as shown on the plans, and as specified.

Partial payment will be allowed for members which are in the stockpile at the manufacturer's plant.

*- End of Section -*

## SECTION 510

### CONCRETE BLOCK MASONRY

#### 510.1 DESCRIPTION:

All materials for concrete block masonry shall conform to the requirements of Sections [775](#) and [776](#).

#### 510.2 CONSTRUCTION:

Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, etc. with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular and edges exposed in the finished work shall be cut with a power driven abrasive saw.

Where no bond pattern is shown, the wall shall be laid up in straight uniform course with regular running bond with alternate header joints in vertical alignment.

Intersecting masonry walls and partitions shall be bonded by staggering the joints to form a masonry bond and the use of 1/4 inch minimum diameter ties at 24 inches o.c. maximum.

Where stack bond is indicated on the plans, approved metal ties shall be provided horizontally at 24 inches o.c. maximum.

Where masonry facing is a part of wall construction metal, ties shall be furnished and installed as directed by the Engineer.

Mortar joints shall be straight, clean and uniform in thickness. Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be approximately 3/8 inch thick with full mortar coverage on the face shells; shall have vertical joints buttered well for a thickness equal to the face shell of the block and these joints shall be shoved tightly, so that the mortar bonds to both blocks. No slushing or grouting of a joint will be permitted, nor shall a joint be made by working in mortar after the units have been laid.

Exposed walls shall have joints tooled with a round bar or V-shaped bar to produce a dense, slightly concave surface well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.

If it is necessary to move a block so as to open a joint the block shall be removed from the wall, cleaned and set in fresh mortar.

#### 510.3 PLACING REINFORCING STEEL:

Reinforcing steel shall be placed as indicated on the plans. Splices shall be lapped a minimum of 40 diameters, except that dowels other than column dowels need to be lapped only 30 diameters. Column dowels shall lap 50 diameters.

Outside horizontal steel shall lap around corners 40 diameters, and be carried through columns unless otherwise shown on the plans. Inside horizontal steel shall extend as far as possible and bend into corner core. A dowel shall be provided in the foundation for each vertical bar. Bending of dowels to fit openings will not be permitted and, where required, new dowels shall be installed by drilling and grouting. All lap joints shall be wired.

Vertical cores containing steel shall be filled solid with grout, and thoroughly rodded.

Where knockout blocks are used, steel shall be erected and wired in place before 3 courses have been laid. Vertical cores at steel locations shall be filled as construction progresses.

Where knockout blocks are not used, vertical cores at steel locations shall be filled in lifts of not more than 4 feet. The maximum height of pour shall be 8 feet. Cores shall be cleaned of debris and mortar and shall have reinforcing steel held straight in place. If ordered by the Engineer, inspection and cleanout holes shall be provided at the bottom of each core to be filled.

Reinforcing steel shall be inspected prior to placing grout.

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### **510.4 CURING:**

Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient only to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

### **510.5 MORTAR AND GROUT:**

Mortar and grout used for concrete block masonry shall conform to Section [776](#).

### **510.6 PAYMENT:**

Payment for concrete block masonry will be included in the lump sum price for the structure of which the masonry is a part, unless another basis for payment is included in the proposal.

*- End of Section -*

## SECTION 511

### BRICK MASONRY

#### 511.1 MATERIALS:

Unless otherwise specified, brick masonry shall be constructed of brick conforming to Section [775](#) and cement mortar as described in Section [776](#).

#### 511.2 BRICKLAYING:

The amount of wetting will depend on the rate of absorption of the brick at the time of laying. When being laid, the brick shall have suction sufficient to hold the mortar and to delete the excess water from grout, and shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed after being laid without breaking the mortar bond.

Brick work shall be plumb, level, straight and true to dimensions shown on the plans. Such work shall start, where feasible, at a least important corner of wall and the Contractor shall request an early inspection of the work by the Engineer. All pattern work, bonds or special details indicated on the plans shall be accurately and uniformly executed. Face bonding shall be as shown on the plans, but if not shown, shall be running bond for standard size brick and approximately  $\frac{1}{3}$  bond for oversize brick and approximately  $\frac{1}{4}$  bond for modular brick unless otherwise designated by the Engineer. All bed and head joints shall be solidly filled with mortar at the time of laying.

Unless otherwise shown or detailed on the plans the thickness of mortar joints shall be uniformly  $\frac{1}{2}$  inch.

Face bricks shown to be laid in stack bond shall have the center lines of vertical joints plumb and the brick laid equidistant from the center line with not more than  $\frac{1}{8}$  inch variation in the width of these joints. The brick in each separate stack shall not vary more than  $\frac{1}{8}$  inch in length, but the separate stacks may vary in width of stacks.

When mortar has slightly stiffened, solidly fill with mortar all interstices between bricks and between bricks and other materials and also fill all line pin holes. Jointing and tooling shall be done before mortar has stiffened.

Masonry to be plastered shall have all mortar joints trowel cut flush.

Masonry to be painted and not shown to be tooled or raked, shall have all joints carefully and evenly struck with a trowel.

Masonry to be left exposed without paint or plaster, shall have all mortar joints carefully and evenly tooled with a metal jointing tool of a type as approved by the Engineer. Masonry shown or indicated to have raked joints shall have the joints raked out  $\frac{3}{8}$  inch deep, then tooled with a flat jointing tool, then brushed with a stiff non-metallic brush. Sack-rubbing or wiping finished masonry with rags will not be permitted.

#### 511.3 PROTECTION:

Protect all sills, ledges, offsets, other materials, etc., from droppings of mortar during construction. Protect the tops of all unfinished masonry from rain by using water-repellant covering such as roofing felt or tar paper.

Protect the surfaces of wall, piers, etc., from mortar droppings, or splashes at scaffold heights.

#### 511.4 CURING:

Finished masonry shall not be wetted, except when exposed to extreme hot weather or hot wind, and then only by using a nozzle regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

#### 511.5 REINFORCED GROUTED BRICK MASONRY:

Mortar in all bed joints shall be held back  $\frac{1}{4}$  inch from edges of brick adjacent to grout space, or shall be beveled back and upward from grout space. The thickness of head and bed joints shall be as hereinbefore specified or shown. Head joints specified or shown to be less than  $\frac{5}{8}$  inch thick shall be solidly filled with mortar as brick are laid. Head joints  $\frac{5}{8}$  inch or

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more in thickness may have mortar sufficient only to form dams to retain the grout. Bed joints shall not be deeply furrowed with the trowel. All brick shall be shoved at least ½ inch into place. One outer tier shall be not more than 12 inches before grouting, but the other tier shall be not more than 4 inches high before placing the grout. Grout shall be thoroughly agitated and mixed to eliminate segregation before being placed. All interior grout spaces shall be filled with grout and immediately puddled or swished with a stick or rod (not a trowel) sufficiently to cause the grout to flow into all interstices between the bricks and to fully encase the reinforcing steel. Wherever possible, grouting shall be done from the inside face of exterior masonry. If any grout contacts the finished masonry, it shall be immediately removed, and the surface cleaned.

In masonry which is more than 2 tiers in thickness, including pilasters and columns, the interior shall be of whole or half bricks placed into grout with not less than ¾ inch of grout surrounding each brick or half brick. Except at the finish course, all grout shall be stopped 1 ½ inches below the top of both outer tiers. Where necessary to stop off a longitudinal run of masonry, it shall be done only by racking back ½ brick length in each course and stopping grout 2 inches back of the rack. Tothing will not be permitted unless special approval is given by the Engineer.

Reinforcing steel shall be accurately placed in strict accordance with the plans and notes thereon. Vertical steel shall be held firmly in proper position. Where necessary this shall be done by means of frames or other suitable devices. Horizontal steel may be placed as the work progresses.

### **511.6 PAYMENT:**

Payment for brick masonry will be included in the lump sum price for the structure of which the masonry is a part unless another basis for payment is included in the proposal.

*- End of Section -*

## SECTION 515

### STEEL STRUCTURES

#### 515.1 DESCRIPTION:

This Section shall govern the construction of steel structures within the public right-of-way and public right-of-way easements.

**515.1.1 Shop Drawings:** The Contractor shall prepare and submit to the Engineer for approval, complete shop drawings which shall show details, dimensions, sizes of materials, and all information and data necessary for the metal work, including full details of the match markings. Any materials fabricated by the Contractor prior to the approval of the drawings will be at his risk. The Contractor shall be responsible for the correctness of the drawings and for shop fits and field corrections, even though the drawings may have been approved by the Engineer.

**515.1.2 False work:** The Contractor shall be fully responsible for designing and providing false work capable of supporting all loads which are applied.

**515.1.3 As Built Plans:** Before formal acceptance of the work, the Contractor shall submit detailed As-Built plans of the structure to the Engineer. Scans of the As-Built plans will be retained by the City as permanent records. As-Built plans shall be submitted on bond paper and shall be of a quality satisfactory to the Engineer. Mylar or Vellum plans may be submitted at the Contractor's option at no additional cost to the City.

**515.1.4 Methods and Equipment:** Special provisions shall specify special inspection requirements for the fabrication, erection and assembly of structural members and connections.

When requested by the Engineer, before starting erection of any structural members, the Contractor shall inform the Engineer fully as to the methods he proposes to follow and the amount and character of equipment he proposes to use. The use of such methods and equipment shall be subject to the approval of the Engineer. Approval by the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his methods or equipment or for carrying out the work in full accordance with the plans and specifications.

An inspector or other authorized representative of the Engineer may examine the metals and metal items to be fabricated before they are worked in the shop and may exercise constant surveillance over the work during its progress, with full power to reject materials or workmanship not conforming to the plans and specifications.

The Contractor shall give the Engineer sufficient advance notice to permit ample time for the inspection of materials before commencement of the fabricating operations.

The Engineer shall be furnished complete copies in triplicate of all mill reports. The Contractor shall furnish ample means and assistance for sampling all materials. Arrangements shall be made for the Engineer to have free access at all times to any portion of the shops where work is being done.

No fabricating, machining, cutting, welding, assembling, or painting shall be done except with the knowledge of the Engineer. Any work done otherwise will be subject to rejection.

The acceptance of any material or finished member by the Engineer shall not be a bar to subsequent rejection if it is later found to be defective. Rejected material and workmanship shall be promptly replaced.

Samples of materials, except castings, shall be cut from stock designated by the Engineer or will be selected from items furnished. Gray iron, steel, and bronze castings shall be cast with test coupons.

#### 515.2 STEEL BUILDING AND MISCELLANEOUS STEEL STRUCTURES:

Details of design, fabrication and erection of such buildings and structures shall conform to the City of Phoenix Construction Code.

The design, fabrication and erection of structural steel and all similar work incidental or appurtenant to steel construction for highway bridges shall be performed in accordance with the latest standard specifications for highway bridges adopted by

## SECTION 515

AASHTO. The plans or special provisions will designate the members to be galvanized.

**515.2.1 Miscellaneous Metal Fabrication:** The provisions of this Subsection shall apply to items not intended primarily for structural purposes and which are fabricated from metals.

If straightening of any materials is necessary, the straightening shall be done by methods which will restore the material to its original shape or surface without residual blemish. Sharp kinks or bends will be considered a cause for rejection of the materials.

The finish of miscellaneous metal items shall not be less in quality and workmanship than that standard considered to be the commercial standard for the kind of member being furnished. Punched and drilled holes shall be burred and, unless otherwise specified, sheared and machined edges shall be finished by grinding to an appropriate radius. Riser, sprue, or vent marks on castings shall be ground flush with the adjacent surface. Blow holes in castings shall not be repaired by any method except as authorized in advance by the Engineer. Exposed edges of sheet metal shall be dressed with a stone or file to remove the sharp edges or corners. Drilled or punched holes which are improperly located or misaligned shall be cause for rejection and may not be corrected without the prior approval of the Engineer. All parts of assemblies shall be fabricated so that they may be assembled without forcing or drifting.

Welders proposed to be used on miscellaneous metal fabrication will be subject to qualifications.

### **515.3 WORKMANSHIP:**

Workmanship and finish shall be equal to the best general practice in modern bridge shops.

Rolled material before being laid off or worked shall be straight. If straightening is necessary, it shall be done by methods approved by the Engineer. Kinks and bends may be cause for rejection of the material.

If straightening is necessary in the field only methods approved by the Engineer shall be used.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately. Undercut gusset plates will not be accepted. All sharp corners and edges, and edges that are marred, cut or roughened in handling or erection, shall be slightly rounded by grinding or other suitable means.

### **515.4 COMPUTED WEIGHT:**

The computed weight shall be obtained by the use of the following rules and assumptions:

(A) The weight of structural and cast steel shall be assumed at 0.2833 pound per cubic inch. The weight of cast iron shall be assumed at 0.2604 pound per cubic inch. The weight of wrought iron shall be assumed at 0.2776 pound per cubic inch.

(B) The weights of rolled shapes and of structural plates, shall be computed on the basis of their nominal weights and dimensions, as shown on the shop drawings, deducting for copes, cuts, and open holes, exclusive of rivet or bolt holes.

(C) Rivets, bolts, and welds shall be considered as incidentals and their price shall be included in the price of steel shapes and plates.

(D) The weight of castings and fillets shall be computed from the dimensions shown on the shop drawings, deducting for all openings or cuts in the finished casting.

(E) The weight of pins and rollers shall be computed from the dimensions shown on the shop drawings, deducting for all holes, openings, pockets, and metal removed by machine finishing.

Pilot nuts and driving nuts for each size of pin shall be furnished for erection work and the weights of such nuts will not be included in the weight of structural steel to be paid for.

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(F) If computed weights are used to determine the pay quantities of galvanized metal, the weight to be added to the calculated weight of base metal for the galvanizing shall be determined from the table of weights of zinc coatings specified by the ASTM A153.

### 515.5 PAINTING:

With the exception of items which are to be galvanized, structural steel members and miscellaneous metal items shall have a shop prime coat of approved rust-inhibitive paint. Application shall be as specified in Section [530](#). The thickness of the prime coat shall be not less than one mill.

After erection of structural steel uncoated surfaces at connections, surfaces where the shop coat has been abraded or otherwise damaged shall be touched up. Match marks and identification marks shall be properly cleaned off and painted over. The paint shall be identical to that used for the shop prime coat.

### 515.6 MEASUREMENT:

Steel structures will be paid for at a lump sum price or at a price per pound for structural steel, and at prices per pound for cast steel and cast iron. The pay quantities will be determined by computed weights or, by scale weights obtained as provided in this specification. Only material actually used in the completed structure will be paid for.

The pay quantities will be determined by computed weights for rolled sections and scaled weights for castings except as otherwise specified.

Computed weights will be used to determine pay quantities of alloy and carbon steel when members contain both alloy and carbon steel.

The weight of erection bolts, paint, boxes, crates, and other containers used for packing and the materials used for supporting members during transportation will not be included in the weights of material to be paid for.

The weight of structural steel to be paid for will not exceed the computed weight by more than 1 ½ percent. The weight of cast steel or cast iron to be paid for will not exceed the computed weights by more than 7 ½ percent. If the scale weight of any member is less than 99 ½ percent of the computed weight of that member, the member will be rejected and will not be paid for.

If computed weights are used, the weight to be paid for will be the calculated weight as established by the Engineer and no allowance will be made for weight in excess thereof.

### 515.7 PAYMENT:

Unless otherwise provided in the proposal, the basis of payment for steel structures shall be as follows:

The price paid per pound for structural steel including full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating, delivering, erecting and prime coating the steel work, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The prices paid per pound for cast steel, cast bronze and cast iron shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing the materials, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for furnishing and placing sheet piling, performed fabric pads, elastomeric or elastic bearing pads, and red lead paste, and for grouting masonry or bearing plates as shown on the plans shall be considered as included in the price paid for structural steel and no separate payment will be made therefore. Where the specifications or plans require metal to be galvanized, the price paid per pound for the metal, including the weight of zinc coating, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in

## **SECTION 515**

furnishing the galvanized metal complete in place, as shown on the plans, and as specified in the specifications and the special provisions, and as directed by the Engineer.

*- End of Section -*

## SECTION 520

### STEEL AND ALUMINUM HANDRAILS

#### 520.1 DESCRIPTION:

Metal handrail shall consist of furnishing all materials and constructing handrail of steel or aluminum, including railing, posts, fittings and anchorages. Metal handrail shall be fabricated, installed and painted, when required, in accordance with the details shown on the plans and these specifications.

#### 520.2 FABRICATION:

Prior to beginning any work on the fabrication of the railing, the Contractor shall submit shop drawings for approval, showing complete railing details.

Materials furnished for metal handrail shall conform to the requirements specified on the plans.

The Engineer shall be furnished complete, copies in triplicate of all mill reports on steel and aluminum materials furnished.

Railings shall be fabricated from welded or seamless members of the size and thickness shown on the plans. Steel members shall conform to the requirements of ASTM A53, Grade B structural steel conforming to ASTM A36, or tubular sections of hot rolled mild steel, as shown. Aluminum handrails shall conform to the requirements of either ASTM B429 for round extruded tube or ASTM B221 for semi-hollow extruded tube with rounded corners.

Aluminum railings or members shall be Aluminum Alloy 6063-T6 as per the Aluminum Alloy Association Standards for Handrails.

Aluminum railings shall be approved for use by the City Engineer or City Materials Lab Supervisor prior to being installed in concrete. This will insure that the Aluminum items shall have an approved, continuous, protective coating on all surfaces that will be in contact with a portland cement concrete product.

Welding shall be performed by the electric arc process and shall be done in conformance with AASHTO/AWS D1.5, Bridge Welding Code. All butt welds on exposed surfaces shall be ground flush with adjacent surfaces.

Railing panels shall be straight and true to dimensions.

For structures on curves, either horizontal or vertical, the railing shall conform closely to the curvature of the structure.

The completed steel railing units shall be galvanized in accordance with the requirements of Section [771](#) unless otherwise specified.

Provide Series 300 stainless steel fasteners for aluminum alloy handrails.

#### 520.3 ERECTION:

The railing shall be carefully erected, true to line and grade. Posts and balusters shall be vertical and parallel with the deviation from the vertical for the full height of the panel not exceeding 5/8 inch. After erecting the railing, any abrasions or exposed steel shall be repaired in accordance with Section [771](#) or Section [530](#).

#### 520.4 MEASUREMENT:

The various types of railing will be measured by the linear foot from end to end along the face of the railing including terminal sections.

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### **520.5 PAYMENT:**

The price paid for handrailing shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in constructing the railing complete in place as shown on the plans and specified herein.

*- End of Section -*

## SECTION 525

### PNEUMATICALLY PLACED MORTAR

#### 525.1 DESCRIPTION:

The work under this Section shall consist of furnishing all material and pneumatically placing, by means of suitable equipment and competent operators, either premixed portland cement and fine aggregate (dry mix process) or premixed concrete (wet mix process).

#### 525.2 DRY MIX PROCESS:

The dry mix process shall consist of thoroughly mixing a proportional combination of fine aggregate and portland cement and conveying this mixture through a delivery hose to a special nozzle where water is added and combined with the dry ingredients prior to discharge. The nozzle water ring shall be cleaned daily.

The fine aggregate shall be material sand, conforming to ASTM C33, with Gradation No. 1 as shown in Table [525-1](#) and with not less than 3 percent or more than 7 percent moisture by weight.

Portland cement and mixing water shall conform to the requirements of Section [725](#).

The dry mix shall consist of 1 part portland cement and 4.5 parts of fine aggregate by weight. Machine mixing will be required. This operation of proportioning and mixing shall be subject to the approval of the Engineer.

#### 525.3 WET PROCESS:

The wet process shall consist of premixing by mechanical methods a proportional combination of portland cement, aggregate and water required to produce mortar or concrete and conveying this mortar or concrete through the delivery hose to the special nozzle where additional compressed air is added prior to discharge. The air ports in the nozzle shall be cleaned daily.

The portland cement concrete used for the Wet Mix Process shall conform to Section [725](#) and shall be Class A (3000 psi) unless otherwise specified. In no event shall a slump greater than 4 inches be used. As the work approaches the vertical, the maximum slump shall not exceed 1 inch.

The fine and coarse aggregate shall conform to ASTM C33 using one of the three gradations shown in Table [525-1](#). Unless otherwise specified, Gradation No. 1 will be used.

TABLE 525-1			
PNEUMATICALLY PLACED MORTAR GRADATION (A.C.I. TABLE 2.2.1)			
Sieve size	Percent by weight passing individual sieves		
	Gradation No. 1	Gradation No. 2	Gradation No. 3*
3/4 in.	—	—	100
1/2 in.	—	100	80-95
3/8 in.	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

\*Batch fine and coarse aggregates separately to avoid segregation.

#### 525.4 REINFORCING STEEL:

Reinforcing steel bars or welded-wire fabric shall conform to Section [727](#) and shall be 6 x 6 - W 1.4 x 1.4 welded wire fabric unless otherwise specified. Reinforcement shall be placed as closely as possible to the center of the mortar.

## SECTION 525

### **525.5 EQUIPMENT:**

Prior to the start of construction, the Contractor shall demonstrate that his equipment, materials and operators are capable of providing a finished structure in accordance with the specifications. For this demonstration, the Contractor shall provide test panels, 30 inches by 30 inches, with a depth the same as the structure, but not less than 4 inches. A separate panel shall be provided for each shooting position to be used (overhead, slope and/or slab) and one half of each panel shall contain reinforcement as used in the structure. Cores will be taken for visual inspection and compressive strength tests. The Engineer has the authority to accept or reject equipment, materials and/or operators based on his evaluation and his decision will be final.

If the Contractor can present valid, factual documentation to the satisfaction of the Engineer that his equipment, materials and operators have produced satisfactory results on similar work within the past six months, the Engineer may eliminate the test panel procedure.

### **525.6 SURFACE PREPARATION:**

The surface on which the mortar is to be placed shall be compacted and true to line and grade as required by the plans and specifications. The surface shall be uniformly moistened so that water will not be drawn from the freshly-placed mortar. Placement of the mix shall not start until the temperature is 35° F and rising and shall stop when the temperature is 40°F and falling.

### **525.7 FORMS AND GROUND WIRES:**

Forms shall be plywood or some other suitable material, true to line and grade, sufficiently rigid to resist deflection during mortar placement.

Ground or gauging wires shall be installed where necessary to establish the thickness and finish lines of the structure.

### **525.8 JOINTS:**

Construction joints shall be tapered to a shallow edge from not more than one inch thick over a width of approximately one foot except where the joint will be subjected to compressive stress. In this case, square joints shall be constructed. Joints shall be thoroughly cleaned and wetted prior to any additional application.

Install control joints in accordance with the plans. Reinforcement will not extend across control joints.

### **525.9 FINISHING:**

Unless otherwise specified, the natural gun finish will be provided.

### **525.10 CURING:**

Curing shall be accomplished using Type 2 compound as specified in Section [726](#). Application rate shall be not less than one tenth of a gallon per square yard. Subsection [505.6.2](#) Adverse Weather Concreting is applicable.

### **525.11 TESTING:**

Tests to determine the quality of the mortar will be performed by the Engineer periodically during the course of work. Test panels shall be prepared by the Contractor.

Test panels shall be at least 12 inches square and as deep as the structure, but not less than 4 inches. Cores shall be taken from the panel for visual and compressive strength tests. The minimum compressive strength at the end of 28 days shall be 3000 psi.

The Engineer may allow the use of 6 inches by 12 inches hardware cloth cylinders for testing in lieu of the test panels. These cylinders will be furnished by the Contractor.

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All rebound pockets and any mortar, defective in the compressive strength test, shall be cut out and replaced

### **525.12 PAYMENT:**

Payment for pneumatically-placed mortar will be made at the unit price per square yard or the lump sum as set forth in the proposal. Such payment shall be full compensation for furnishing all labor, tools, equipment and accomplishing all work in conformity with the plans and specifications.

*- End of Section -*

## SECTION 530

### PAINTING

#### 530.1 DESCRIPTION:

This work shall consist of furnishing paint and other necessary materials and painting metal, wood or other surfaces in accordance with the details shown on the plans and these specifications.

#### 530.2 MATERIALS:

Materials used in paint for painting shall conform to the requirements of Section [790](#).

#### 530.3 WEATHER CONDITIONS:

Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided below, painting will not be permitted when weather conditions during application are such that the atmospheric temperature will drop below 35°F. during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the Contractor at no additional cost to the Contracting Agency.

Subject to the approval of the Engineer, the Contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to control atmospheric conditions artificially inside the enclosures within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

#### 530.4 APPLICATION:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used, they shall be of a type that does not leave a stippled texture in the paint file.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use, to thoroughly mix the pigment and vehicle together. Paint shall be kept thoroughly mixed while being applied.

#### 530.5 THINNING PAINT:

Paints specified are formulated ready for application and no thinning will be allowed. If the paint becomes thick in cool weather, it shall be heated in the container immersed in hot water.

#### 530.6 PROTECTION OF WORK:

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes, and smirches of paint or of paint materials. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property, and shall provide protective means to guard against such damage at his expense.

## SECTION 530

Paint stains which might result in an unsightly appearance shall be removed or obliterated by the Contractor.

When ordered by the Engineer, if traffic causes an objectionable amount of dust, the Contractor shall sprinkle the adjacent roadbed and shoulders with water for a distance on each side of the location where painting is being done sufficient to abate the dust nuisance. The Contractor shall furnish and post at his own expense DRIVE SLOWLY signs and take other necessary precautions to prevent dust and dirt from accumulating on freshly painting surfaces.

### 530.7 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law in Section [107](#).

The applicable sections of NACE, A Manual for Painter Safety.

### 530.8 SURFACE PREPARATION FOR PAINTING:

**530.8.1 Steel:** Surface preparation for painting of the steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified, the commercial blast method shall be used.

After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial painting is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

#### 530.8.2 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed in Section [530.8.1](#) above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand and solvent cleaning, the cleaned areas shall then be painted by brushing on at least 1 full coat of paint No. 1. Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

**530.8.3 Wood Surface:** Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding, or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

### 530.9 PAINTING:

#### 530.9.1 Structural Steel:

(A) Paint: Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section [515](#), a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 3 mills. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coats shall be as specified for general use on structural steel in Section [790](#). Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section [790](#) to produce a perceptible color difference between the paint coat being applied and the preceding coat.

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Any damage to sound paint on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired as directed by the Engineer.

Application of Paint: Painting of structural steel, except for shop applied prime coats and sections which will be inaccessible after erection as described below, shall be done after erection unless otherwise specified in the special provisions. Requests to do any additional painting prior to erection shall be submitted by the Contractor and approved by the Engineer in writing before such work is started. Painting prior to erection will be limited to a prime coat of paint, except that surfaces exposed to the atmosphere which would be inaccessible for painting after erection shall be painted the full number of coats prior to erection. Any deficiencies in the prime coat of paint, or any second coat shall be corrected to the satisfaction of the Engineer prior to the application of the finish coat of paint.

The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material which would prevent the bond of the succeeding coat. In spot painting, any old paint which lifts after application of the touch-up coat, shall be removed by scraping and the area repainted before application of the next coat.

The finish coat shall not be applied until the required total film thickness of the undercoats of paint, as described above is obtained.

Open seams at contact surfaces of built-up members which would retain moisture shall be caulked with red lead paste before applying the second coat of paint.

Except for anchor bolt assemblies, steel embedded in concrete need not be painted. Anchor bolt assemblies shall be painted or dipped with 1 coat of paint prior to installation.

With the exception of abutting chord and column splices and column and truss shoe bases, machine finished surfaces shall be coated with a rust inhibitor which can be easily removed. Surfaces of iron and steel castings which have been machine finished shall be painted with a coat of shop paint.

**530.9.2 Machinery:** Prior to installation, all surfaces of machinery exposed to the atmosphere which are subject to corrosion and are normally painted, shall be painted with 2 coats of paint. Unless otherwise specified, after installation of the machinery, such surfaces shall be painted with a finish coat. All coats shall be as specified for structural steel.

**530.9.3 Galvanized Surfaces:** Unless otherwise provided on the plans or in the special provisions, galvanized surfaces shall be left unpainted. Areas of galvanized coating damaged due to welding after fabrication or handling shall be prepared as specified above and then painted with 1 full coat of paint No. 15.

**530.9.4 Metal Guard Rails:** Metal guard rails when required to be painted shall be painted with 2 coats of paint No. 11.

### **530.9.5 Wood Surfaces:**

(A) Paint: The surface shall be prepared as specified above and painted with paint No. 6 or 7. The number of coats of paint will be specified in the special provisions.

(B) Application of Paint: When permitted in writing by the Engineer, the prime coat of paint may be applied prior to erection. After the prime coat has dried and the timber is in place, all cracks, checks, nail holes, etc., shall be puttied flush with the surface and allowed to dry before the second coat is applied.

Skips, holidays, and thin areas or other deficiencies in any 1 coat of paint shall be corrected to the satisfaction of the Engineer before the succeeding coat is applied.

The surface of the paint coat being covered shall be free of any deleterious material before any additional paint is applied.

### **530.10 TESTING::**

Paint and paint materials shall be sampled and tested prior to use. Tests shall be conducted in accordance with methods specified by ASTM or by methods set forth in Federal Standard 141. In the absence of any such methods, other suitable methods may be designed and utilized by the Engineer. Lots or batches of paint of proprietary brand, as defined in Section

## SECTION 530

[790](#), which have been previously sampled and tested by the Contracting Agency, and approved, may be used without further testing, if permitted by the Engineer.

### **530.11 PAYMENT:**

Payment for the preparation of surfaces, shop prime coat and field touch-up coats on structural steel and miscellaneous metal items shall be considered as included in the prices for the structural steel and miscellaneous metal items. Payment for second and finish coats on structural steel or miscellaneous metal items shall be considered as included in payments for the structures, except that payment for cleaning all painting on miscellaneous metal items shall be considered as included in the price for the item when a separate price therefore is included in the proposal.

Full compensation for preparing surfaces and for painting machinery, galvanized metal, guard rails and wood shall be considered as included in the various prices paid for the contract items or work and no separate payment for such work will be made.

*- End of Section -*

**PART 600**

**WATER, SEWER, STORM DRAIN AND IRRIGATION**

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## SECTION 601

### TRENCH EXCAVATION, BACKFILLING AND COMPACTION

#### 601.1 DESCRIPTION:

The work covered by this specification consists of furnishing all plant, labor, equipment, appliances and materials, and performing all operations in connection with the excavation and backfilling of trenches in accordance with the plans and special provisions.

Excavation for appurtenant structures, such as manholes, inlets, transition structures, junctions, structures, vaults, valve boxes, catch basins, etc., shall be deemed to be in the category of trench excavation.

#### 601.2 EXCAVATION:

**601.2.1 General:** No extra monetary compensation or additional time will be authorized for claims that soil conditions differ from those anticipated or those indicated by soil logs and/or reports. It is the Contractor's responsibility to make his own determination as to actual existing conditions.

**601.2.2 Trench Widths:** Trenches for other than cast-in-place concrete pipe shall conform to the following dimensions, unless otherwise specified in the special provisions, indicated on the plans, and/or approved by the Engineer.

Table 601-1

Size of Pipe (I.D.)	Max. Width at Top of Pipe Greater Than O.D. of Barrel	Min. Width at Springline Each Side of Pipe
Less than 18"	16"	6"
18" to 24" inclusive	19"	7-1/2"
27" to 39" inclusive	28"	12"
42" to 60" inclusive	1/2 O.D.	12"
Over 60"	36"	12"

The width of the trench shall not be greater than the maximum indicated above, at and below the level of the top of the pipe. If the maximum trench width as specified above is exceeded at the top of the pipe, the Contractor shall provide, at no additional cost to the Contracting Agency, the necessary additional load bearing capacity by means of bedding, having a higher bedding factor than that specified, higher strength pipe, a concrete cradle, cap or encasement, or by other means approved in writing by the Engineer.

The width of the trench above the top of the pipe may be made as wide as necessary for shoring, sheeting or other wall support measures necessary for a safe and proper installation. The Contractor may elect to slope the trench walls in lieu of shoring, sheeting or other wall support measures. In all cases the Contractor shall be responsible for any and all problems encountered and costs incurred as a result of increased trench width.

No increases in contract time will be allowed as a result of sloping trench walls. Table 601-1 shall be used for computing trench pay width.

**601.2.3 Trench Grade:** Alignment and elevation stakes shall be furnished as requested by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Engineer will also furnish the Contractor with cut sheets.

For all pipe 8 inches or greater in diameter, the Contractor shall excavate for and provide a granular bedding at least four inches thick or 1/12 the O.D. of the pipe whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and accurately fine graded to provide uniform bearing and support along the bottom of the pipe except where necessary to excavate for bells and pipe joint couplings.

**601.2.4 Overexcavation:** Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth indicated.

## SECTION 601

Whenever rock is encountered in the trench bottom, rock shall be overexcavated no less than 6 inches below the exterior bottom of the pipe. The overexcavation shall be backfilled with ABC material compacted to a uniform density of not less than 95 percent.

If the Engineer determines that overexcavation and backfilling, below the bedding material is required as a result of unsuitable material, it will be considered extra work. Payment and construction time extension will be negotiated with the Contractor. As a condition of the Contractor receiving payment for the extra work, agreement on method of payment and construction time extensions shall be reached prior to start of work.

Unauthorized excavation below the specified grade line shall be backfilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent.

**601.2.5 Excavation for Manholes, Valves Inlets, Catch Basins and Other Accessories:** When placing concrete for a poured-in-place structure, the Contractor may place the poured concrete directly against the excavated surface, provided that the faces of the excavation are firm and unyielding and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall overexcavate to place the structure.

When the structure is within the maximum trench limit, backfilling shall be in accordance with the requirements specified for the adjoining pipe. If the item is being constructed outside of the maximum trench limits, the overexcavation shall be backfilled with ABC compacted to 100%.

Any excavation below the elevation indicated for the foundation of any structure shall be filled with ABC per Section [702](#) and compacted to at least 95% at the expense of the Contractor.

**601.2.6 Grading and Stockpiling:** All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water, either surface or ground, accumulated in the trench shall be removed by pumping or by other approved methods. There shall be no additional payment for this work.

Excavated material, with excessive or inadequate moisture content, shall be considered unsuitable for proper compaction. The Contractor shall, at his own expense, remove or add moisture to the excavated material to bring it within the range of +2 to -2 percent of the optimum moisture content in order that proper compaction, as per Table [601.3](#), can be obtained.

In lieu of the above, the Contractor may, at no cost to the Contracting Agency, haul-off and dispose of excessively wet or dry material and replace it with material conforming to the backfill specifications. Disposal shall be in accordance with the project specifications.

In either event, the proper compaction and stability shall be obtained.

There will be no additional payment or time extension for this work.

**601.2.7 Shoring and Sheet piling:** All shoring and sheet piling necessary to protect the excavation, and provide a stable trench condition to safeguard vehicular and pedestrian traffic, the Engineer's representatives during inspection and testing procedures, and any other permitted public uses shall be installed and maintained. See Section [107](#).

**601.2.8 Open Trench:** Where a trenching operation crosses under existing 12 inch or smaller ACP waterlines (excluding service lines) and four feet or more of the existing ACP pipe is exposed, the Water Services Department - Water Distribution Division will isolate the exposed waterline by either cutting in any necessary valves or by the use of existing valves. After the exposed waterline has been isolated, the Contractor shall remove that part of the exposed waterline to the limits shown in MAG Standard Detail 403-3. The waterline shall then be replaced by the Contractor (during the trench backfilling operation) with the same size, Class 350, ductile iron pipe as shown in MAG Standard Detail 403-3. The removal and replacement section shall extend at least five feet beyond the trenching operation's trench wall and into undisturbed ground. The Contractor shall request a shut-down, at least one week in advance, from Water Distribution (262-4711 or 4712). City forces will perform the shutdown and/or valve cut-in. There will be no charges to the Contractor for this work. On permit work, the Contractor shall pay for any and all work required.

The Contractor will be paid for the ductile iron pipe at the unit price bid per each crossing under the bid schedule item

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**WATERLINE REPLACEMENT.** If there is an unanticipated conflict at the crossing which can be resolved with "offset pipe joints", the Water Services Department will supply the offset joints to the Contractor at no cost. Offset pipe joints will be picked up by the Contractor at the City's Water Stores Warehouse at 2640 South 22nd Avenue. Requests to pick up such material must be conveyed to the Water Services Department at least 24 hours in advance by the City Inspector. The Contractor shall install the offset joints at no additional cost. The WATERLINE REPLACEMENT item shall include costs for trench excavation, backfill, compaction, and surface restoration.

### **601.3 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:**

**601.3.1 Bedding:** Bedding is ABC material (unless otherwise specified in Subsection [601.3.10](#)) placed below the bottom of the pipe at a uniform density with minimum compaction to provide uniform bearing and support along the bottom of the pipe except where necessary to excavate for bells and other pipe joint couplings. Lime-treated bedding material shall be prohibited.

Bell and joint coupling holes shall be dug after the trench grade has been fine graded. Such holes shall be of sufficient width to provide room for caulking, banding or bolting. Holes shall be excavated only as necessary to permit accurate work in making of the joints and to ensure that the pipe will rest upon the prepared foundation material, and not be supported by any portion of the joint.

Depression of joints, other than bell and spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

**601.3.2 Haunching and Initial Backfill:** Haunching is the material placed from the bottom of the pipe to the pipe springline. Initial backfill is the material placed from the pipe springline to one foot above the top of the pipe or conduit (1-inch above the top of pipe for SRPE pipe). Haunching and initial backfill material type is dependent upon the type of pipe and on the type of utility. Haunching and initial backfill shall be Aggregate Base (ABC) or Controlled Low Strength Material (CLSM), unless otherwise specified in Subsection [601.3.10](#). Lime-treated haunching and initial backfill material shall be prohibited. Open graded rock will not be used without the written approval of the Engineer.

Where water consolidation is used, haunching and initial backfill for pipes, 24 inches or less in I.D., may be placed in one lift. For larger pipes, the first lift shall not exceed the springline of the pipe. Where mechanical compaction is used, the moisture content shall be within a range of +2 to -2 percent of the optimum moisture content prior to placing the material in the trench. The first lift shall be eight inches or 2/3 of the distance to the springline whichever is greater. Succeeding lifts shall not exceed one foot loose and extreme care will be taken to prevent damage to or movement of the conduit by the compaction equipment.

The Contractor shall employ the necessary means and methods to maintain roundness of CMP, HDPE and SRPE type pipe during haunching, initial backfilling and final backfilling. The Contractor shall adequately anchor the pipe against buoyant forces to maintain grade and alignment during the placement of the CLSM haunching and initial backfill.

**601.3.3 Haunching and Initial Backfill for Storm Drains Maintained by the City of Phoenix:** Haunching and initial backfill for public storm drain pipe lines maintained by the City of Phoenix shall conform to this Subsection.

The Contractor shall employ the necessary means and methods to maintain roundness of CMP, HDPE and SRPE type pipe during haunching, initial backfilling and final backfilling. The Contractor shall adequately anchor the pipe against buoyant forces to maintain grade and alignment during the placement of the CLSM haunching and initial backfill.

**601.3.3.1 Haunching and Initial Backfill for Storm Drain Mainline Pipe:** Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types, except cast-in-place pipe that is cast against the trench walls.

ABC initial backfill shall be utilized from the springline to 1 foot above reinforced concrete pipe (RGRCP), and cast-in-place concrete pipe storm drains.

The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

High density polyethylene (HDPE) pipe shall have CLSM initial backfill from the springline to one 1 foot over the outside

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top of pipe.

Steel reinforced polyethylene pipe (SRPE) shall have CLSM initial backfill from the springline to one 1 inch over the outside top of pipe. No additional initial backfill will be required over the CLSM initial backfill.

**601.3.3.2 Haunching and Initial Backfill for Storm Drain Catch Basin Connector Pipe:** Aggregate Base Course (ABC) haunching or Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types. ABC initial backfill shall be utilized from the springline to 1 foot above the pipe for all approved storm drain pipe types.

The Contractor, at his option, may substitute CLSM for other haunching and initial backfill materials specified at no additional cost.

**601.3.3.3 Haunching and Initial Backfill for Storm Drain Culverts:** Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain culvert types, except cast-in-place pipe that is cast against the trench walls. ABC initial backfill shall be utilized from the springline to one (1) foot above the top of culvert.

The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

Corrugated Metal Pipe (CMP) culvert shall have CLSM haunching and initial backfill from the outside bottom of pipe to one (1) foot over the outside top of pipe.

**601.3.4 Final Backfill:** Final backfill is the material placed above the initial backfill. The type of final backfill required shall conform to Subsection [336.3](#). Final backfill shall be sound material free from broken concrete, broken pavement, wood or other deleterious material. Unless otherwise specified, this may be native material or borrow material with no piece larger than eight inches, select material or aggregate base course. Under pavement, parking lots, sidewalks, etc., pieces larger than three inches will not be used in the final 12 inches below the pavement subgrade.

Where water consolidation is used, final backfill will be placed in lifts as required in the following table prior to settlement.

**TABLE 601-2**

TRENCH WIDTH	FINAL BACKFILL LIFTS (FOR WATER CONSOLIDATION)
18" TO 24"	NOT TO EXCEED 4'
25" TO 36"	NOT TO EXCEED 6'
OVER 36"	NOT TO EXCEED 8'

The above final backfill lift limitations are not applicable when water consolidation is accomplished by the jetting method.

When mechanical compaction is to be used, the Contractor will provide a test section demonstrating his proposed method and equipment to be used. Upon agreement with the Engineer as to the acceptability of the Contractor's proposed method and equipment, they shall not be changed without the prior approval of the Engineer. Mechanical compacted lifts in excess of one foot will not be allowed without the written consent of the Engineer.

Final backfill material shall be within the range of +2% to -2% of the optimum moisture content, prior to placing the material in the trench. The moisture content shall be uniform throughout the final backfill material. If clayey material is encountered within the trench excavation, the optimum moisture deviation range shall be determined by the Engineer. Clayey material will not be utilized as trench backfill without the approval of the Engineer.

Material not meeting these requirements may be required to be removed from the trench and moisture added or removed to correct the deficiencies prior to replacement, all at no increase in cost to the Contracting Agency.

It shall be the Contractor's responsibility to blend excavated material, removing or adding moisture as may be necessary to meet the requirements of the specifications, all at no increase in cost to the Contracting Agency.

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Excavated material, when used for final backfill, shall meet the requirements of Subsection 601.2.6.

The moisture content requirements contained herein are waived when granular final backfill material is used and water consolidated.

The Engineer may require all or any part of the trench to be load tested for stability with Contractor's equipment prior to placement of asphalt or portland cement concrete pavement. Unstable pumping areas as determined by the Engineer shall be corrected by the Contractor at no increase in cost to the Contracting Agency.

<b>TABLE 601-3</b>				
<b>MINIMUM TRENCH COMPACTION DENSITIES</b>				
<b>Backfill Type</b>	<b>Location</b>	<b>From Surface To 2 feet Below Surface</b>	<b>From 2 feet Below Surface To Top of Initial Backfill</b>	<b>Haunching and Initial Backfill</b>
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract, or when any part of the trench excavation is within 2-feet of the above.	100% for granular and non-granular	95%	95%
II	On any utility easement street, road or alley right-of-way outside limits of (I).	95%	95%	95%
III	Around any structures or exposed utilities.	95% in all cases		

Note: The compaction type required will generally be shown on the plans and the plans will govern. Where no compaction type is shown on the plans the compaction type shall comply with the above.

A consideration in determining the compaction types as shown on the plans is based on the trench widths as shown in the Contract Documents. If these trench widths are increased beyond those widths referred to above and fall within the 2-foot limit of paved surfaces and other improvements due to construction means and method or site conditions, the compaction designation for that portion within the 2-foot limit of such improvements shall be Type I even though Type II may be shown on the plans.

**601.3.5 Compaction Methods:** Water consolidation by jetting shall be accomplished with a 1-1/2" pipe of sufficient length to reach the bottom of the lift being consolidated with adequate hose attached and a water pressure of not less than 30 psi.

All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from top to the bottom.

Jetting shall be used as the consolidation method for all conduit haunching and initial bedding. The Contractor shall be entirely responsible for establishing each lift depth so as to avoid floating the conduit being placed and shall make any repair or replacement at no cost to the Contracting Agency. However, for conduit larger than 24 inches I.D. the first lift shall not exceed the springline of the conduit.

Flooding is not acceptable as a water consolidation method unless authorized in the specification or by a written change order. It will consist of the inundation of the entire lift with water and then puddled with poles and bars to ensure saturation of the entire lift.

Where jetting or flooding is utilized and the surrounding material is such that it does not permit proper drainage, the Contractor shall provide, at his expense, a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that

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such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

Where water consolidation is not permitted or does not result in adequate compaction, the haunching, initial backfill and final backfill material shall be compacted with hand and/or mechanical work methods using equipment such as rollers, pneumatic tamps, hydro-hammers or other approved devices which secure uniform and required density without injury to the pipe or related structures.

Water consolidation will not be permitted for non-granular material.

**601.3.6 New Residential Development Area:** In a new development area, prior to paving and prior to opening the area to public traffic, the following deviation to water consolidation, haunching, initial backfill, and compaction shall only apply to new local streets:

- (A) Water consolidation by jetting of non-granular material will be permitted only at the Engineer's discretion and approval. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.
- (B) Water consolidation by flooding shall be allowed ONLY where backfill material meets the specification for granular backfill material (Subsection 601.3.7) OR the bottom of the lift is less than 4 feet from top of subgrade. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.
- (C) The minimum density required for haunching and initial backfill shall be 95%. Manholes shall be compacted to 95% within 24" of the structure. Outside these limits, 95% shall be required. Native material is acceptable.
- (D) The minimum density required for backfill from 2 feet below the surface to the top of initial backfill shall be 95%. The minimum density from the surface to 2 feet below the surface shall be as prescribed in Table [601-3](#).
- (E) Sewer services shall require compaction tests on 30% of the total sewer services in new subdivision.

**601.3.7 Specifications for Granular Backfill Material:** Granular Backfill Material shall not be used in the pipe embedment zone. For purposes of this specification, Granular Backfill Material shall be defined as material for which the sum of the plasticity index and the percent of the material passing No.200 sieve shall not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-90.

**601.3.8 Rights of Way Belonging To Others:** Bedding, initial backfill, final backfill and compaction for irrigation lines of the Salt River Valley Water User's Association and Roosevelt Irrigation Districts and for trenches on State of Arizona and Maricopa County rights-of-way, outside the limits of the City of Phoenix, shall be accomplished in accordance with their permit and/or their specification.

**601.3.9 Test Holes:** Boring logs shown on the plans or included in the specifications do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the soils moisture content and the amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

**601.3.10 Bedding, Haunching and Initial Backfill for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines:** Bedding, haunching and initial backfill for these underground facilities shall be native material or sand which conform the grading requirement of ASTM C-33 for fine aggregate. Lime-treated bedding, haunching and initial backfill shall be prohibited. When final backfill material consists of aggregate base course, crushed stone or other material containing stones, only sand will be used for bedding, haunching and initial backfill. The bedding depth shall be six inches and initial backfill depth shall be one foot above the top of the facility. Compaction will be in accordance with Section [601](#).

### **601.4 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:**

**601.4.1 Grading:** The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be

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necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

**601.4.2 Restoring Surface:** All streets, alleys, driveways, sidewalks, curbs, or other surfaces in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section [336](#).

**601.4.3 Clean-Up:** The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

**601.4.4 Temporary Pavement:** The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section [336](#) immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section [336](#), this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

### **601.5 PAYMENT:**

The cost for work covered in this Section, which may include the removal of asphalt pavement, removal of obstructions, trench excavation, overexcavation, bedding, haunching and initial backfilling (including CLSM), final backfilling, compaction, testing and placement of temporary pavement shall be considered incidental to the respective structure, pipe and conduit work and shall be included in the unit price bid in the proposal for the structure, pipe and conduit work.

*- End of Section -*

## SECTION 602

### TRENCHLESS INSTALLATION OF STEEL CASING

#### 602.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation to install steel casing using horizontal earth auger boring, hand tunneling or pipe ramming.

#### 602.2 MATERIALS:

The steel casing shall consist of steel plates rolled and welded into a cylinder. Plate material shall meet the minimum requirements of ASTM A283. Shop and field joints shall be butt welded in accordance with the minimum requirements of American Welding Society (AWS) D1.1/D1.1M. Welding shall be performed by AWS D1.1 certified personnel.

The steel casing for pressurized carrier pipes shall be a minimum of 12-inches larger than the largest OD of the carrier line including pipe bells and flanges or the size indicated on the plans, whichever is greater.

The steel casing for gravity carrier pipes shall be a minimum of 18-inches larger than the largest OD of the carrier line including pipe bells and flanges or the size indicated on the plans, whichever is greater.

#### 602.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Subsection [105.2](#), detailed shop drawings of the bore pit and receiving pit shoring, the casing, bulkheads, carrier pipe installation method, and welder certifications.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements and to protect against ground movement.

On steel casing 37-inches (ID) or larger, grout connections shall be provided at a maximum spacing of every 20-feet located at 12 o'clock in the steel casing. Upon completion of the boring operation, the Contractor shall inspect each grout hole to determine if grouting is required. Any void greater than 2 inches outside the casing will require the boring Contractor to grout fill the void. After grouting, the grout holes shall be closed with a threaded plug.

Steel casing smaller than 36-inches (OD) installed by horizontal earth auger boring, hand tunneling or pipe ramming will not require outside grouting unless caving or earth movement occurs.

#### 602.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

#### 602.5 CARRIER PIPE PLACEMENT:

The tolerances allowed for the alignment and grade of carrier pipe shall comply with requirements of Section [610](#), [615](#) or [618](#) as applicable. The Contractor shall be responsible to obtain the required line and grade for the carrier pipe. The carrier pipe shall not contact or rest on the casing.

Pressurized carrier pipes, (i.e. water, gas, force main) shall be placed using casing spacers, wood skids or steel pipes for rails. Casing spacers shall be installed 3 per joint minimum with 8-foot maximum spacing. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

Gravity carrier pipes, (i.e. sewer, storm drain, irrigation) shall be placed using wood skids or steel pipes for rails. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

Bulkheads consisting of brick and mortar or concrete shall be constructed on the ends of the casing; bulkheads shall be a

## SECTION 602

minimum of 8-inches thick. Alternative casing end closures may be substituted for brick and mortar or concrete bulkheads if approved by the engineer.

PVC conduits for dry utilities, (i.e. communications, fiber, electric) shall be placed using non-metallic PVC casing spacers. The annular space between the casing and carrier line shall be filled as indicated in the contract documents.

After completing the carrier pipe installation, the Contractor shall remove all loose and disturbed material in the bore pits and backfill the pits in accordance with Sections [601](#) and [336](#).

### **602.6 MEASUREMENT AND PAYMENT:**

Measurement for steel casing shall be the number of horizontal linear feet from the end of casing in the bore pit to the end of casing in the reception pit. Payment for steel casing shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of steel casing, complete in place including but not limited to carrier pipe and bulkhead placement and the excavation and backfilling of pits.

*- End of Section -*

## SECTION 604

### PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

#### 604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

CLSM may be specified as fill in areas where post-construction consolidation would be detrimental and in areas not accessible for the proper compaction of other fill material types.

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

The following is a brief description of the types of CLSM:

**1/2 SACK:** A non-compressible, self-consolidating, fill material that allows future excavation with conventional hand tools and can be used as a general backfill, structure backfill, pipe bedding and embankment fill. 1/2 SACK CLSM is the default CLSM type unless otherwise specified.

**1 SACK:** A non-compressible, self-consolidating, fill material used, when specified, for additional compressive strength.

**1-1/2 SACK:** A non-compressible, self-consolidating, fill material used, when specified, under structure foundations, as thermal fill, and as mechanical protection for duct banks and conduits.

#### 604.2 MATERIALS:

CLSM shall conform to the requirements of Section [728](#). Ready-mixed concrete, including timed-out, rejected, and truck wash-out material, shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

#### 604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required. The total elapsed time between the initial addition of water to the CLSM and the completed placement shall not exceed 90 minutes.

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

Where CLSM is used for backfill around pipes or conduits with a depth less than 20 feet, the width of the excavation shown on the plans or in Section [601](#) may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches for pipes or conduits 42 inches and larger, 6 inches for pipes or conduits between 4 inches and 42 inches and 3 inches for pipes or conduits 4 inches and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation of the backfilling.

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CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Subsection [610.6](#). Pipes smaller than 4 inches can be completely wrapped with tape as per Subsection [610.6](#) or approved equal.

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. CLSM mixes must be modified where long term freeze-thaw durability is indicated as a concern. The mix design shall have an air content of no less than six percent by volume, when tested in accordance with ASTM C6023.

### **604.4 PERFORMANCE TESTING:**

CLSM placed within the traveled way or otherwise to be covered by paving or embankment materials, shall not be covered until one of the following performance criteria have been met:

- (A) When a person of average weight and shoe size can walk on the surface of the CLSM without creating greater than 1/8-inch indents in the material, or
- (B) When the in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM D4832, or
- (C) When a ball drop indentation of 3-inches or less is obtained, when tested in accordance with ASTM D6024, or
- (D) When a penetration resistance reading of 650 is achieved, when tested in accordance with ASTM C403.

Additionally, CLSM shall not be covered if proof rolling by pneumatic-tired or steel wheel vibratory roller results in the bringing of free water to the surface or results in surface undulation (pumping).

When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM C403, or allowed to set in place for 24 hours, whichever occurs first.

### **604.5 ACCEPTANCE:**

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer when it does not conform to Section [728](#).

Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

### **604.6 PAYMENT:**

No separate measurement or payment will be made for CLSM. The cost for placing the material shall be included in the unit price for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

*- End of Section -*

## SECTION 605

### SUBDRAINAGE

#### 605.1 DESCRIPTION:

The subdrainage system shall be constructed in accordance with the notes and details shown on the plans and the applicable provisions of these specifications except as modified in the special provisions.

#### 605.2 CONCRETE:

All concrete placed in drainage structures, subdrain outlets, pipe collars, and similar features of the subdrainage system shall conform to the applicable provisions of Section [725](#).

#### 605.3 SUBDRAINAGE PIPE:

Subdrainage pipe, both perforated and non-perforated, shall be either bell and spigot concrete, bell and spigot vitrified clay, or corrugated metal pipe, as shown on the plans or specified in the special provisions. However, if the particular kind of pipe is not shown on the plans nor specified in the special provisions, subdrainage pipe shall be concrete pipe of at least standard strength quality and shall conform to the requirements of Section [735](#). Vitrified clay pipe shall conform to the requirements of Section [743](#). Corrugated metal pipe shall conform to the requirements of Section [760](#).

**605.3.1 Pipe Joints:** Unless the pipe joints are of a self-aligning type, have the bottom half of the bell joint filled with mortar to securely hold the pipe in alignment and to bring the inner surface of abutting pipes flush and even. Where a tight joint for non-perforated pipe is required, the bell joint shall be completely filled with mortar.

#### 605.4 SUBDRAINAGE MANHOLES:

Subdrainage manholes, including inlets, outlets, flap gates, gate boxes, and drop steps, shall comply with the requirements of the plans and the special provisions.

#### 605.5 FILTER MATERIALS:

The filter materials shall be placed within the limits shown on the plans. The compositions of the filter materials shall each conform to one of the grading requirements in Table [605-1](#); the particular requirement to be used will be specified in the special provision.

The materials used shall conform to requirements for concrete aggregates in Subsection [725.3](#); however, the requirements for grading, and reactivity, as stated therein, shall not apply. The minimum bulk specific gravity shall be 2.50, by ASTM C127.

TABLE 605-1			
FILTER MATERIAL GRADING - % PASSING			
Screen or Sieve Size	TYPE		
	F1	F2	F3
3/4"		100	100
3/8"	100	80 - 100	70 - 100
No. 4	90 - 100	60 - 85	45 - 75
No. 8	75 - 90	45 - 70	30 - 60
No. 16	55 - 80	30 - 55	20 - 45
No. 30	30 - 60	15 - 40	10 - 30
No. 50	10 - 40	5 - 20	0 - 15
No. 100	0 - 15	0 - 10	0 - 5
No. 200	0 - 5	0 - 5	

#### 605.6 PLACEMENT:

**605.6.1 General:** The excavated subgrade shall be kept free of surface water. Mudholes, ruts, or soft spots due to the Contractor's operations shall be repaired at no additional cost to the Contracting Agency, as ordered by the Engineer.

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Filter and drain material shall be placed around drainage pipe so as to provide even support throughout the entire length of the pipe and to permit the installed pipe to lie upon true alignment and grade. The minimum thickness of filter material surrounding the pipe shall be 6 inches.

Filter material shall be spread to such depth as to obtain the required thickness after compaction and shall be uniform and true to the line and grades indicated on the plans.

The surface under sloped bank lining or invert shall not show any variation or departure greater than ½ inch from the testing edge of a 10 foot straightedge. Ridges and humps shall be regarded depressions filled and compacted, and tested for straightness until grading is accomplished within the tolerance specified. No relative density will be required.

Pipe damage during placement or compaction shall be replaced by the Contractor at no additional cost to the Contracting Agency. The Contractor shall exercise due care to prevent water from surface drainage or other sources, mud, muck, or debris, from running into the filter material both during and after its placement, until the lining, backfill, or structure placed thereon is completed or set. The Contractor shall provide and operate drainage sumps and pumps, or equivalent means satisfactory to the Engineer, to prevent any such saturations of the filter materials.

**605.6.2 Under Sloped Bank Lining:** Those portions of filter materials which become subgrade for sloped bank lining shall be compacted by 4 passes of a small roller weighing not less than 600 pounds, and 20 pounds per inch of roller width, or by other means approved by the Engineer.

**605.6.3 Under Invert:** Those portions of filter materials which become subgrade for channel invert linings shall be compacted by 2 passes of a smooth-wheeled roller lapping 1 foot each pass, or by use of manually-operated hand tampers, or by other means as approved by the Engineer. The weight of the roller or the size of the tamper shall be approved by the Engineer.

**605.6.4 In Trenches and Along Heels or Walls of Sides of Structures:** The filter materials shall be placed in 1 foot lifts and compacted by hand-held tamping or vibrating equipment to the satisfaction of the Engineer.

### **605.7 TESTS OF THE SUBDRAINAGE SYSTEM:**

Two separate tests shall be made on each subdrain line by the Contractor to assure the proper functioning of the subdrainage system.

Each test shall be conducted in the presence of the Engineer and shall consist of the flushing of the subdrain line with sufficient water to develop a flow of 5 cubic feet per minute out of the end of the line being tested, as measured by approved measuring equipment furnished by the Contractor.

When a channel invert slab is required, the first test of each completed section of the subdrain system shall be performed immediately prior to the placement of reinforcing steel for the channel invert slab and the second test shall be performed after completion of the channel invert work. Manholes shall be cleared of all debris prior to beginning the second test.

Final acceptance of the subdrainage system will be made only if the discharge is of uniform flow and of adequate quantity. Any necessary clearing of drain lines to meet the above requirements shall be performed by the Contractor at no additional cost to the Contracting Agency.

All costs involved in the performance of the tests, including the furnishing of all labor, equipment, and material required therefore, shall be included in the prices bid for the items under which the subdrainage system is to be constructed.

### **605.8 PAYMENT:**

Payment for the work included in this specification will be made on the basis of the lump sum or unit prices stipulated in the proposal, unless the payment for subdrainage work is included in the cost for other improvements. Such payment shall include full compensation for furnishing all labor, tools, and equipment and incidentals for doing the work involved.

- *End of Section* -

## SECTION 607

### TRENCHLESS INSTALLATION OF SMOOTH WALL JACKING PIPE

#### 607.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation for the installation of thirty-inch inside diameter (30" ID) and larger, tongue and groove smooth wall jacking pipe installed by horizontal earth pipe jacking or hand tunneling.

#### 607.2 MATERIALS:

The jacking pipe shall be tongue and groove smooth wall reinforced concrete pipe per ASTM C76 class V unless vitrified clay pipe per ASTM C1208 or centrifugally cast fiberglass reinforced polymer mortar pipe per ASTM D3262 is approved by engineer.

#### 607.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Subsection [105.2](#), detailed shop drawing of the bore pit and receiving pit shoring, the jacking pipe, bulkheads, installation method, and the annular grouting mix design and grouting method. The proposed installation method and equipment shall be at the Contractor's option, no field construction shall commence until the proposed installation method is approved in writing by the Engineer. The Engineer's approval shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements against ground movement.

The leading section of jacking pipe shall be equipped with a tunnel shield. Excavation shall be carried out entirely within the tunnel shield and no excavation in advance thereof will be permitted. Every effort shall be made to avoid any loss of earth outside of the tunnel shield. Excavated material shall be removed from the jacking pipe as excavation progresses.

Upon completion of the jacking operation and if the grade of the jacking pipe is acceptable, all voids around the outside of the pipe shall be filled with grout.

#### 607.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

#### 607.5 MEASUREMENT AND PAYMENT:

Measurement for jacking pipe shall be the number of horizontal linear feet from the end of jacking pipe in the bore pit to the end of jacking pipe in the reception pit.

Payment for jacking pipe shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of the jacking pipe, complete in place including but not limited to shop drawings, dewatering, jacking pipe, bulkhead placement, grouting, and the excavation and backfilling of pits.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavements, curb and gutter, sidewalk, driveway and alley entrances, as allowed for by open cut construction.

- End of Section -

## SECTION 610

### WATER LINE CONSTRUCTION

#### 610.1 DESCRIPTION:

The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

#### 610.2 GENERAL:

All pipes shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where water lines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

#### 610.3 MATERIALS:

All pipes for water lines shall be of the classes shown on the plans or as specified below.

4-inch to 24-inch diameter pipe shall be ductile iron per Section [750](#) unless a specific material is specified. Class shall be designated in the plan or special provisions.

24-inch and larger diameter pipe may be concrete pressure pipe, steel cylinder type, per Section [758](#).

Service material containing brass or bronze must comply with the current NSF 61-8 standards at the time the project begins.

All brass or bronze service material must meet the current AWWA C-800 standards.

Any product used in water line construction containing brass or bronze that comes in contact with potable water shall meet the current NSF standards and federal law.

Only such packing materials as are included in the list of acceptable materials in AWWA C-600 for installation of cast iron water main, shall be used. The packing materials shall be handled in such a manner as to avoid contamination, and shall be dry when placed in the joints. All such materials shall be free of oil, tar, or greasy substances, except that treated paper packing material, jute, cement, or sulfur compound caulking will not be permitted.

#### 610.4 CONSTRUCTION METHODS:

**610.4.1 Trenching / Cover:** All water mains in major streets shall have a minimum cover of 48 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 48 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

Except as otherwise required in this specification, the special provisions, or by the Engineer, the trench excavation, backfilling and compaction shall be in accordance with requirements of Section [601](#). Backfilling may be accomplished as soon as the pipe line has been installed to the satisfaction of the Engineer, subject to the requirements for testing per Section [611](#).

**610.4.2 Laying Pipe:** No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling.

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If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

Curb stops with flushing pipes or fire hydrants shall be installed at the ends of dead end mains according to standard details.

Thrust blocks shall be installed in accordance with this specification.

Valve boxes and covers shall be according to standard details.

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section [750](#).

PVC C-900 pipe shall be installed in accordance with AWWA C900 and Section [601](#).

**610.4.3 Blocking and Restraints:** All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with standard details. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be installed per details shown on the plans. The areas stipulated in the standard details are minimums and shall not be decreased.

If irregular soil or pressure conditions are encountered, a thrust block design revision or an alternate joint restraint system may be required by the Engineer.

When restrained/welded joints are specified to resist thrust forces, blocking is not required.

With the Engineer's approval, restrained/welded joints may be used in lieu of thrust blocks.

Where restrained joints are specified on mains sixteen (16) inches in diameter and smaller, ductile iron pipe shall be used with an approved joint restraint method.

On mains sixteen (16) inches in diameter and larger where plans specify welding joints and where ductile iron pipe is furnished, joints shall be restrained by an approved joint restraint method for the distance specified.

**610.4.4 Maintain Pipe Cleanliness / Pipe Cleaning:** The interior of all pipe and fittings shall be kept as free as possible of all dirt and foreign material at all times, until the pipe is placed in the new line.

Every precaution shall be taken to prevent foreign material from entering the pipe. When on the project site, the ends of the pipe section shall be plugged, wrapped or tarped at all times when pipe laying is not in progress, which includes storage and staging at the site. The pipe shall be stored on a pallet, blocking or other means to prevent foreign materials from entering the pipe. The pipe line shall be protected by a water-tight plug or other means approved by the Engineer when the pipe is in the trench if pipe laying is not in progress.

If in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation, the interior of the pipe shall be cleaned and swabbed, as necessary, with a .005 to .010 percent chlorine solution.

If the Contractor or pip-laying crew cannot install the pipe in the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is to be made to the adjacent pipe.

At the close of each day's work, and at times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of all pipe in the trench shall be completed before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

**610.4.5 Testing:** Hydrostatic testing shall be in accordance with Section [611](#).

After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with Section [611](#).

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All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

### 610.4.6 Construction Work by City Forces:

- (A) City forces shall perform all valve cut-ins, waterline shutdowns, and wet taps that are necessary for construction.

The Contractor shall contact the inspector to make the necessary arrangements to have the City forces perform the required work. With the exception of permit work, there will be no charge for valve cut-ins, waterline shutdowns, and wet taps that are necessary for construction.

For any valve cut-ins, waterline shutdowns, or wet taps requested by the Contractor, which are not necessary and are for the convenience of construction, the Contractor shall make application and pay the required charges to the Contracting Agency.

On permit work, the Contractor shall pay all costs incurred.

- (B) When an existing waterline, other than as noted on the plans, conflicts with any proposed new work in the contract and no provision has been made in the proposal for relocating such lines, the City has the option to make any necessary adjustments or relocations, alter the proposed new work or negotiate with the Contractor for relocating the obstructing line.

**610.4.7 Construction work by Other Utility Owners:** Except as otherwise provided in the plans or project specification, all private utilities in conflict with the new work will be relocated by the owner thereof. Utility companies will adjust their manholes. In the event of an unanticipated conflict between the new work and a utility and the owner thereof disclaims responsibility for relocation, the City will negotiate with the owning utility and the conflict shall be resolved without extra cost to the Contractor. It will be necessary for the Contractor to coordinate his work with the utility companies in the relocation of their facilities during construction.

### 610.4.8 Construction Work by the Contractor:

- (A) The Contractor shall adjust valve and meter boxes to final grade as described in Section [345](#).
- (B) Where the centerline of the new waterline parallels the existing curb and gutter and is approximately two feet from the lip of the gutter, the Contractor shall remove and replace the pavement to the lip of the gutter. The Contractor will be paid for the extra pavement replacement in addition to the normal pavement re-placement over the pipe trench in accordance with Section [336](#).
- (C) The Contractor shall accomplish the cutting and plugging of City water mains, where required on the plans, in accordance with COP Standard Detail P1343.

The cuts and plugs will remain exposed until line pressure is restored and they can be inspected for leakage. The Contractor shall schedule the restoration of line pressure through the Engineer.

Payment shall be at the unit bid price or lump sum bid price for "CUTTING AND PLUGGING EXISTING WATER LINES." This payment shall be full compensation for material, labor, tools and equipment necessary to complete the work.

- (D) Unless other adequate provisions are made for fire protection, a fire hydrant will not be out of service for a period exceeding 24 hours. When relocating water meters which utilize either galvanized or polyethylene service pipe (or any other non-standard service pipe) the entire service piping shall be replaced using the approved service pipe material for that particular meter size. The existing corporation stop can be used provided and approved copper pipe adapter is used. Approved adapters are the Ford C04-43 and C04-54 conversion assembly or equal.
- (E) The Contractor shall submit record drawings and make a record of the locations of all work completed as part of the project. The as-builts shall show the locations of the beginning(s) and end(s) of the construction; all valves, fire hydrants, blow-off hydrants, pipe fittings, service connections, meters, and where pipes change alignment. The as-

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builds shall also show the locations and elevations where pipe changes elevation abruptly. Locations shall be shown by stationing and dimensioning from appropriate monument lines or, in their absence, appropriate lot lines, property lines or easement line references.

**610.4.9 Approved Water Service Components:** Approvals shown are not necessarily exclusive. If approval of a similar device, believed to be comparable and equal, is desired, a request should be submitted supported by appropriate information and data.

If general approval is desired, request should be submitted directly to the Water Services Department.

**TABLE 610-1  
CORPORATION STOPS**

<b>MANUFACTURER</b>	<b>COPPER SERVICES</b>	<b>W/DIELECTRIC INSULATION</b>
FORD	P-1600	F-1000
HAYES		
JONES	J-3401	
McDONALD	4701 T	
MUELLER	H- 15028 B- 25028	

**TABLE 610-2  
ADAPTERS**

<b>MANUFACTURER</b>	<b>IPS COPPER, ELL</b>
FORD	L-84-33 L-84-44
HAYES	
JONES	J-2619
MUELLER	H-15531
McDONALD	4779 MT

**TABLE 610-3  
CURB STOPS AND METERING COUPLINGS**

<b>MANUFACTUREER</b>	<b>CURB STOPS *</b>	<b>METERING COUPLINGS</b>
FORD	B-11-333 B-11-666 B-11-444 B-11-777	SPM-2R
JONES	J-1900	J-130 J-134
McDONALD	6101	4622 or 4624
MUELLER	B-20283	H-10890 H-10891
HAYES	4000	5680 or 5682

\*Heads of all curb stops shall be drilled 1/4" diameter for locks.

**610.4.10 Concrete Pressure Pipe - Steel Cylinder Type:** Where concrete, steel cylinder, pressure pipe is installed the following shall apply:

- (A) The Contractor shall mortar the inside and outside of all pipe joints. The mortar shall be applied in the field on the inside joints such that the mortared surface is flush with the adjacent pipe mortar lining. The outside of the joints shall be mortar coated by the diaper method. The mortar shall be a Type "M" mortar per Section [776](#) using Type II, low alkali cement.
- (B) All non-mortar coated steel, including flanges, shall be covered with a minimum of two (2) inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Mortar shall be the same as applied to the joints. Field-

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applied coal tar coatings will not be accepted in lieu of mortar. Except, coal tar enamel in accordance with AWWA C-203 shall be applied to the non-mortar coated steel and flanges on the 24" side outlets in access manholes.

- (C) Joint restraints shall be provided by means of welded joints. The extent of welded joints shall be as shown on the pipeline and layout drawings, and shall in no case be less than that shown on the plan drawings. Where welded joints are required, the weld shall be continuous about the entire circumference of the pipe joint. Welds shall be made intermittently, in short sections of about six (6) inches, to avoid overheating the gaskets on points where a gasket is used. Welds shall conform to that shown on the approved shop drawings and calculations.

**610.4.11 For Mains Eighteen (18) Inches and Larger, the following shall apply:**

- (A) Backfill and compaction for the full distance encompassed by welded/restrained joints shall be completed prior to testing.
- (B) All mainline valves shall be covered with a minimum of two (2) inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Field applied coal tar coatings will not be accepted in lieu of mortar. Portions of valves within manholes shall not be mortar coated. The mortar shall be a Type "M" mortar per Section [776](#) using Type II, low alkali cement.
- (C) Where plans call for welding joints and ductile iron pipe is furnished, the Contractor shall restrain the joints by an approved joint restraint method.

**610.4.12 Restrained Joints on Mains Less Than Eighteen (18) Inches in Diameter:** Where restrained joints are specified on mains less than eighteen (18) inches in diameter, ductile iron pipe shall be used with an approved joint restrain method.

**610.4.13 Joints in Fire Hydrant "Run-Out" Piping:** Joints in fire hydrant "run-out" piping to conform to Subsection [750.3](#). All joints in the fire hydrant "run-out" from the main through the shut-off valve shall be restrained by an approved joint restraint method, which may include the use of thrust blocks as approved the City of Phoenix Engineer.

**610.4.14 Payment for Water Used During Construction:** The Contractor shall pay for all water used during the course of construction. This cost shall be included in the unit bid price for pipe. The final fill of the pipeline with replacement water shall not be included in the cost. Water rates shall be obtained from the Water Services Department - Accounting Division (602) (262-6687).

Measurement will be through a fire hydrant meter or, if this is not possible, calculated by one of the procedures listed below:

- (A) Unmetered water used for testing, flushing and chlorination shall be calculated on a cubic foot basis, using the volume per foot pipe multiplied by the number of times the pipe is filled and by the total length of pipe installed for each hydrostatic test, flushing and chlorination procedure. If any additional testing, flushing or chlorination is required, because of failure to meet any of the above conditions, the volume of water used for each procedure shall be calculated as on the above basis for first procedure.

**TABLE 610-4  
FOR ONE FOOT LENGTH OF PIPE**

<b>Diameter (Inches)</b>	<b>Cubic Feet</b>	<b>Gallons</b>	<b>Gallons Per Mile</b>
3	.0491	.3673	1,939
4	.0873	.6528	3,447
6	.1963	1.469	7,756
8	.3490	2.611	13,786
10	.5455	4.081	21,547
12	.7854	5.876	31,025
14	1.069	7.977	42,224
16	1.396	10.44	55,123
18	1.767	13.22	69,802
20	2.182	16.32	86,170
24	3.142	23.50	124,080

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Diameter (Inches)	Cubic Feet	Gallons	Gallons Per Mile
30	4.909	36.72	193,882
36	7.069	52.88	279,203
42	9.620	71.96	379,950
45	11.044	82.62	436,233
48	12.566	94.02	496,326
54	15.90	118.97	628,162
60	19.63	146.88	775,526
66	23.76	177.72	938,362
72	28.27	211.44	1,116,403

- (B) Unmetered water used for settling trench backfill for small waterlines 12" and less in diameter shall be estimated at a volume of 2.66 cubic feet of water per linear foot of trench settled.
- (C) Water used for settling trench backfill on waterlines 14" and larger, shall be metered by a fire hydrant meter, or other means approved by the Engineer.

### 610.5 SEPARATION:

**610.5.1 General:** Water lines and sewer lines shall be separated to protect water lines from contamination by sewer lines.

The angle of a water line and sewer line crossing shall be limited to between (45) forty-five degrees and (90) ninety degrees. Intersection angles of less than (45) forty-five degrees shall not be allowed.

Separation distances are measured from the outside diameter of the water or sewer line, or the centerline of a manhole.

When water and sewer lines cannot meet separation requirements, extra protection is required as described in Subsection [610.5.5](#) and shown in MAG Standard Details 404-1, 404-2 and 404-3.

Extra protection requirements for line crossings are measured from the closest outside surfaces of the sewer and water line.

Water line service connections to individual building supply and distribution plumbing shall not be placed below sewer lines, and shall otherwise comply with the separation requirements of the applicable plumbing code as applied by the Agency (Administrative Authority). Methods described for extra protection do not apply to these service lines.

Water and sewer lines shall not be constructed parallel within a common trench.

**610.5.2 Water Line Separation from Gravity Sewer Lines:** Water lines shall not be placed within two (2) feet horizontal and one (1) foot vertical above and two (2) feet vertical below gravity sewer lines.

Extra protection is required where a water line is placed within six (6) feet horizontal and two (2) feet vertical above a gravity sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and any distance below a gravity sewer line.

**610.5.3 Water Line Separation from Pressurized Sewer Lines:** Water lines shall not be placed within six (6) feet horizontal and within two (2) feet vertical below or within two (2) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and within six (6) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within (6) feet horizontal and any distance below a pressurized sewer line.

**610.5.4 Water Line Separation from Manholes:** Water lines shall not pass through or come into contact with any part of a

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sewer manhole and shall be separated six (6) feet horizontal from the center of a sewer manhole.

**610.5.5 Extra Protection:** New water lines that require extra protection from new sewer lines, shall have extra protection provided by using ductile iron pipe for both lines. Lines of standard pipe length shall be centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal.

New water lines that require extra protection from sewer lines, shall have identification wrap and/or tape installed on the water and sewer lines for the length that requires extra protection for each line.

New water lines that require extra protection from existing sewer lines shall be constructed using the extra protection specified for new water lines, and the existing sewer line:

- (1) shall be reconstructed using a standard length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal, or
- (1) shall be encased in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

Existing water lines that require extra protection from new sewer lines shall provide for extra protection by:

- (1) constructing the new sewer line and reconstructing the existing water line using ductile iron pipe for both lines with standard pipe lengths centered at the point of crossing so that no joints exist within six (feet) horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) encasement of both the existing water line and the new sewer line in six (6) inches of concrete for the horizontal distance of the lines that require extra protection but for a distance no less than ten (10) feet horizontal.
- (3) Extra protection for existing ductile iron water lines can be met by the installation of restrained or mechanical joints on the existing water line within ten (10) feet horizontal of the crossing and either
  - (a) construction of new sewer line using a standard pipe length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
  - (b) encasement of the new sewer line in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

## 610.6 POLYETHYLENE CORROSION PROTECTION

**610.6.1 General:** Pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

**610.6.2 Materials:** Materials shall meet requirements of ANSI/AWWA C105/A21.5-10, most current version. The polywrap shall be of virgin polyethylene, not less than 8 *mils* in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ultraviolet light will be less than 48 hours.

Otherwise the material shall be pigmented with 2 to 2 1/2 percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with 2-inch wide pressure sensitive tape not less than 10 mils thick. This flexible tape shall consist of a polyethylene or polyvinyl chloride backing with a synthetic elastomeric adhesive film comprised of butyl rubber. Tape shall remain flexible over a wide range of temperatures, with tensile strength and elongation properties in conformance with ASTM D1000.

The minimum tube size for each pipe diameter shall be per Table [610-5](#).

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**TABLE 610-5 (from AWWA C105-05)  
POLYWRAP FLAT TUBE WIDTHS**

Nominal Pipe Diameter (Inches)	Cast Iron Or Ductile Iron With Push-On Joints (inches)	Cast Iron or Ductile Iron With Mechanical Joints (inches)
4	14	16
6	16	20
8	20	24
10	24	27
12	27	30
14	30	34
16	34	37
18	37	41
20	41	45
24	54	53
30	67	-
36	81	-
42	81	-
48	95	-
54	108	-
60	108	-
64	121	-

**610.6.3 Installation:** The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe, and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

**610.6.4 Payment for Polywrap:** Payment for this item shall be per the provisions of Subsections [109.4](#) and [109.5](#) of the specifications unless this item is specifically called for on the plans or in the supplemental specifications or special provisions as a specific component and pay item for a given project.

**610.7 VALVES:**

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves and corporation stops shall be in accordance with Section [630](#).

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Just before installation in the trench, valves shall be fully opened and closed to check the action, and a record made of the number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 12 inches and smaller in size shall be supported by concrete blocks, in accordance with the standard details.

Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs, and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and manholes, and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans. Buried valves shall be supported on concrete blocks as detailed on the plans.

Valve boxes shall be installed over all buried valves in accordance with standard details.

Standard couplings or matching joints shall be used when more than one length of pipe is required, or when two or more pieces are joined, to form the valve box riser. Install extension stems on all valves where the operating nut is 5 feet or more below grade.

### **610.8 MANHOLES AND VAULTS:**

Construction shall consist of furnishing all materials and constructing manholes or vaults complete in place, as detailed, including foundation walls, cast iron steps, frames, covers, and any incidentals thereto, at location shown on the plans.

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details, except the inside diameter shall be 60 inches.

Vaults shall be constructed of reinforced concrete conforming to Section [725](#) and of concrete pipe conforming to ASTM C76 Wall A or B. Vaults shall be kept moist for 7 days before backfilling.

### **610.9 FIRE HYDRANTS:**

The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete in place at locations shown on the plans in accordance with the standard details and special provisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Section [756](#).

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

All hydrants must be flushed and left in good working condition with the control valve open.

Except where otherwise required on the plans, the City of Phoenix will furnish the Contractor fire hydrants without cost for City of Phoenix projects. To secure the hydrants, the Contractor shall obtain a permit at the Water Distribution Special Operations office at 3045 S. 22nd Avenue, and then pick up the hydrants at the City of Phoenix Water Stores, 2500 South 22nd Avenue.

Whereas a new fire hydrant furnished by the City of Phoenix is found to be defective, the Contractor shall remove the defective hydrant, return it to the **water stores**, pick up a new one and install as indicated on the plans. The second installation will be treated as a new fire hydrant installation and the Contractor will be paid for both installations, each at the unit bid price in the proposal for fire hydrant installations.

All connections from the main to the fire hydrant shall be cast iron or ductile iron pipe as shown on the detail drawings. Fire hydrants shall be the dry-barrel type. If plugs are present in the weep holes, they shall be removed before installation.

Extenders for hydrants or valves are not permitted on new fire hydrant installations unless approved by the Water Services Department.

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### 610.10 COUPLINGS, JOINTS, GASKETS AND FLANGES:

(A) Couplings: The couplings used to join the pipe to flanged valve adapters shall have a minimum working pressure of 150 psi, and shall have a fusion-bonded epoxy finish. The coupling sleeves shall be carbon steel with a minimum yield of 30,000 psi. The flanges shall have a minimum yield of 30,000 psi and be ductile iron or carbon steel for sizes up to 12", or high-strength, low-alloy steel for sizes 14" and larger.

(B) Joints: The joints and fitting shall conform to Sections [750](#).

(C) Bolts and Nuts:

- (1) Bolts, studs, and nuts used in underground field flanged connections or for connecting fittings shall be carbon steel compliant with ASTM A307, Grade A unless Grade B is specified. Bolts, studs, and nuts shall be in accordance with AWWA C111. Bolts and studs shall have Class 2A thread tolerance with the corresponding nuts having Class 2B tolerance. Bolts, studs and nuts shall have a hot-dipped zinc coating in accordance with ASTM F2329. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. If specified, allowable exceptions to zinc coating shall be bolts, studs, and nuts made from 316 stainless steel per ASTM F593 or cadmium plated per ASTM B766. All bolts shall be hexagonal heads.
- (2) The minimum requirement for underground mechanical joint connections using T-head bolts shall meet the requirements of AWWA C111 using a high strength low alloy steel manufactured for atmospheric corrosion resistance per ASTM A242.

These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

(A) Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling. Cement mortar shall be composed of 1 part cement, ASTM C150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gage welded wire fabric, firmly wired in place.

(B) Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

**Pan Method:** The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve, is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection, and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application shall conform to AWWA C-203. No thinning will be allowed.

(C) Cocoon Method: The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line, and the top of the cocoon is opened and laid back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(D) Gaskets: Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one- ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material.

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Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D2000, Class 4AA805A13.

(E) Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type, and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing

### **610.11 CONNECTION TO EXISTING MAINS:**

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

All connections to existing mains shall be constructed according to the plans.

Valves connecting new work to the existing system shall be kept closed at all times.

Only Agency personnel shall operate existing valves. The Contractor shall not operate valves in the existing system.

After disinfected samples have been taken and the new work passes the bacteriological tests, the new line shall then be turned over to the Contracting Agency with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the Contracting Agency. A conference between the Contractor's representative, Engineering Inspection, and Water Distribution personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

The Contracting Agency will close existing valves, but will not guarantee a 100% complete shutdown.

For any tie-ins/connections or required shutdowns to existing transmission mains (16-inch and larger) and systems, the Contractor shall submit a shutdown/tie-in plan to the City Inspector and / or Engineer and shall be approved at least two weeks prior to the start of the event. The plan shall include dates, durations, procedures, staffing, and any other information pertinent to shutting down the system and connecting to a new system.

### **610.12 FIRE LINE SERVICE CONNECTIONS:**

Fire line service connections shall be installed in accordance with standard details.

The fire line from the control valves at the main to the detector check valve shall be constructed of ductile iron pipe per Section [750](#).

### **610.13 METER SERVICE CONNECTIONS:**

All new meters must be installed by the Contracting Agency after the proper application as required by Code with fees paid at prevailing rates.

All water service connections shall be made using Type K copper tubing which conforms to Subsection [754.1](#) and fittings which conform to Subsection [754.2](#). Joints in the copper tubing shall be made by the use of approved compressing fittings such as flared joints or pack joints. Soldered joints are not acceptable.

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- (A) When a meter is specified to be relocated, the Contractor shall replace and/or extend water service lines in accordance with COP Standard Detail P1342. The Engineer will determine when the existing service lines are unsatisfactory and must be replaced. Existing copper services in good condition, with sufficient cover, may be extended. Where the existing service pipe material is other than copper, the entire service shall be replaced from main to meter.
- (B) When the existing main is not abandoned, and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.
- (C) Taps and service connections to the new main shall be made prior to testing and disinfection of the new line.
- (D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer.
- (E) The use of direct taps on water mains for meter service connections will not be allowed. New service taps shall be installed using an all bronze double-strap tapping saddle or a tapped coupling.

When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency. Boxes may be picked up by the Contractor after written authorization is received from the Engineer. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

### 610.14 CLEANUP:

When testing, chlorination, compaction and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

### 610.15 PAVEMENT AND SURFACE REPLACEMENT:

Pavement and surface replacement shall be in accordance with the requirements of Section [336](#).

### 610.16 MEASUREMENT AND PAYMENT:

(A) Pipe:

(1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement of lateral line pipes shall start at the centerline of valve at the connection to the main. Measurement of service lines shall be from the centerline of the new main to the connection at the meter. Measurement shall be to the nearest foot.

(2) Payment will be made at the contract unit price per linear foot of each type and size of. Such payment shall be compensation in full for furnishing and installing the pipe and fittings, specials, adapters, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, testing, disinfecting, connections to existing lines or works, and all work not specifically covered in other pay items.

(B) Service Line Connections: Measurement shall be of the number of unit connections made for water services, if called for in the bid. Each bid item unit shall consist of the connection to the water main and to the meter, as may be required in the plan details. Payment will be made at the contract unit price for each water service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above. If no contract bid item exists for

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connections, then the cost for connections to meters and main lines shall be included in the corresponding pipe bid item unit price.

- (C) Relocation of Existing Meters and Boxes: Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the unit price bid in the proposal for each meter and box relocated and installed.
- (D) Permanent Pipe Supports and Encasement of Existing Pipes: Measurement shall be of each unit included in the bid, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#).
- (E) Concrete Thrust Blocks: Concrete thrust blocks and anchors for all pipe 16 inches and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the contract unit price per cubic yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#). All thrust blocks and anchors for 12 inches and smaller pipe shall be included in the linear foot cost of the pipe.
- (F) Valves: Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section [630](#).
- (G) Fire Hydrants: Measurement shall be the number of fire hydrants installed. Payment will be at the contract unit price for the installation of each fire hydrant complete in place and in operating condition. The 6 inch ductile iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.
- (H) Pavement and/or Surfacing Replacement: Payment for pavement and/or surfacing replacement will be made as stipulated in Section [336](#), except as otherwise established in this specification. The cost of pavement and/or surface replacement required for service line installations shall be included in the contract unit price for service line pipe.

*- End of Section -*

## SECTION 611

### WATER, SEWER AND STORM DRAIN TESTING

#### 611.1 HYDROSTATIC TESTING:

The Contractor shall test waterlines for water tightness, including all fittings and connections to the waterlines. Each pipe shall be tested for leakage and pressure in accordance with applicable provisions of AWWA standards and/or Manuals, except as modified below.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, including measuring device and all other equipment necessary for making the tests.

The pipe shall be tested between the closed ends of the pipe. There shall be no testing against a valve unless otherwise approved. Pipe test section shall be limited to 2,500 linear feet, or less, unless otherwise approved in writing by the Engineer. The new pipeline must be separated from any potable system in such a way to prevent any potential for cross-contamination between the existing potable water system and the new pipeline.

The test shall be made after the backfilling is completed or compacted, regardless of the compaction method.

All connections, blowoffs, hydrants and valves shall be tested with the main, where practical.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as approved by the Superintendent of Water Distribution, with at least 24-hour notice required before filling is scheduled.

- (A) Pressure Tests: Waterlines, including all fitting and connections shall be tested for water tightness by subjecting each test section to pressure test. The test pressure shall be measured at the lowest end of the test section. The test pressure shall be 188 psi unless otherwise specified. The duration of each pressure test shall be at least 2 hours.

The pressure test shall begin after the pipe has been filled with water for at least 24 hours to allow for absorption.

- (B) Leakage Tests: Leakage tests shall be made after pressure test has been completed, pressure test results are satisfactory, and all backfilling and compaction is completed.

The duration of each leakage test shall be at least 2 hours. Leakage test pressure shall be at least 150 psi and the test pressure shall be maintained within 5 psi of the specified leakage test pressure during the test. Water may be continually fed or added when the pressure drops 5 psi.

The maximum allowable leakage from the pipe line shall be determined by the formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

in which:

L = allowable leakage in gallons per hour

N = number of joints in the pipe being tested, with no allowance for joints at branches, blowoff, fittings, and similar appurtenances. "N" is calculated using the standard length of pipe installed divided into the length being tested.

D = nominal inside diameter of pipe in inches.

P = average test pressure, in psi gage, as measured at the lowest point in the test section.

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and correct until the leakage is within the specified allowance for a 2-hour duration. All repairs and retests shall be at the Contractor's expense.

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Leakage is defined as the quantity of make-up water necessary for the test section to maintain the specified leakage test pressure after the pipeline has been filled with water and all air expelled.

All water must be dechlorinated to negligible levels prior to discharge to any location. Connections to existing pipelines or existing valves shall be made after new construction has satisfactorily passed both the pressure and leakage tests and potable water piping has been flushed and disinfected in accordance with this Section.

### **611.2 DISINFECTING WATER MAINS:**

#### **611.2.1 Flushing Completed Pipe Lines:**

(A) Preliminary Flushing: All mains 12 inches and smaller shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. It is difficult to flush mains over 12 inches in diameter, so in such instances the requirements above, must be rigidly adhered to.

Heavy duty, factory bushed, tapped couplings, with corporation stops shall be located at all high points in the lines to allow the air to be removed prior to testing the water lines and at disinfection points as may be required. Field taps will not be permitted.

The couplings, at high points and disinfection points, shall be left exposed during backfilling until the testing is complete. Couplings and corporation stops shall be left on the mains upon completion of water mains.

(B) Valve Damage by Foreign Material: Unless proper care and thorough inspection are practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired. If it is believed that such foreign material(s) may be in the main, all hydrants on the line shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition.

#### **611.2.2 Chlorine Residual:**

Before being placed in service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe.

#### **611.2.3 Methods of Applying Chlorine:**

Any of the following methods of application of chlorine (arranged in order of preference) may be used, subject to the approval of the Engineer.

Liquid chlorine gas-water mixture.  
Direct chlorine feed.  
Calcium or sodium hypochlorite and water mixture.

#### **611.2.4 Application of Liquid Chlorine:**

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device or, if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas or of the gas itself must provide means for preventing the backflow of water into the cylinder.

#### **611.2.5 Chlorine-Bearing Compounds in Water:**

On approval of the Engineer, a mixture of water and a chlorine-bearing compound of known chlorine content may be substituted for liquid chlorine.

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(A) Compounds to be Used: The chlorine-bearing compounds that may be used are: Calcium hypochlorite\*, and sodium hypochlorite\*\*.

(B) Preparation of Mixture: High-test calcium hypochlorite must be prepared as a water mixture for introduction into the water mains. The powder should first be made into a paste and then thinned to approximately a 1 percent chlorine solution (10,000 ppm). The preparation of a 1 percent chlorine solution requires the following proportions of powder to water:

<b>Product</b>	<b>Amount of Compound</b>	<b>Quantity of Water (Gallons)</b>
High-test calcium hypochlorite (65—70% Cl)	1 lb.	7.50
Liquid laundry bleach (5.25% Cl)	1—2 pts.	12.6

### **611.2.6 Point of Application:**

The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension.

### **611.2.7 Rate of Application:**

Water from the existing distribution system or other source of supply shall be controlled so the rate of flow shall not exceed 500 gpm, unless approved by the Superintendent of Water Distribution, through a suitable measuring device into the newly laid pipe line during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more

On lines 12 inches in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 12 inches in diameter, the disinfection operation is generally started with the line empty.

Measurement of the flow of water into and out of all lines shall be made by means of a pitot gage, current type meter, or other approved device.

### **611.2.8 Preventing Reverse Flow:**

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves shall be used to accomplish this.

### **611.2.9 Retention Period:**

Treated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least 24 hours and should produce no less than 10 ppm residual chlorine at the extreme end of the line at the end of the retention period.

NOTE: If the circumstances are such that less than a 24 hour retention period must be used, the chlorine concentration shall be increased to 100 ppm. Under these conditions, special care should be taken to avoid attack on pipes, valves, hydrants and other appurtenances.

### **611.2.10 Chlorinating Valves and Hydrants:**

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled

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with the chlorinating agent. All valves in lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.

### **611.2.11 Final Flushing, Sampling and Testing:**

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon testing, be proved comparable in quality to the water served to the public from the existing water system. Prior to sample collection for laboratory testing, the residual chlorine shall be verified using a color comparator or chlorine meter at each sample point to ensure the chlorine residual is not less than 0.2 ppm or greater than 4.0 ppm. Swimming pool test kits or chlorine test strips are not sensitive enough to provide results within this range and shall not be used. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below. The quality of water in the new main shall be as determined by laboratory examination and analysis of the samples over a period of up to three full days (72 hours).

Water Services Department laboratory technicians will perform sampling for tests of new water mains upon receipt, from the inspector, of a written request by the Contractor. The written request should be made to the Water Services Department no less than 24 hours prior to the time when samples are to be taken, so that the Department can properly schedule laboratory work. Waterlines less than 150 feet in length require one sampling riser installed as near the end as possible; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 feet to 3,000 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards. One sample shall be taken at each sampling riser.

Results of all tests shall be sent by the laboratory to the Water Services Department. Results of laboratory analysis will be interpreted by the Water Services Department, and reported to the Engineer. Under no circumstances shall the Contractor contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Water Services Department.

### **611.2.12 Repetition of Chlorination Procedure:**

Should the initial treatment fail to result in the conditions specified above, the original chlorination procedure shall be repeated until satisfactory results are obtained.

### **611.3 SEWER LINE TESTING:**

Pressure testing of force mains shall be done in accordance with Subsection [611.1](#).

Sewers and pipe lines shall be subject to acceptance testing after backfilling has been completed but prior to the placement of the finished surface material.

The Contracting Agency reserves the right to require testing of the entire installation. Cost of repairs or corrections necessary to conform to the following testing requirements will be borne by the Contractor at no additional cost to the Contracting Agency.

#### **(A) Low Pressure Air Test:**

Testing will be accomplished by the means of "Low Pressure Air Testing." Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Engineer.

#### **Test Procedure:**

- (1) Before testing, the pipe shall be thoroughly cleaned.
- (2) The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.

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- (3) A minimum of two connecting hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.
  - (a) One hose is to induce air through the test plug and into the test chamber.
  - (b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.
- (4) UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.
- (5) Add air slowly into the test section. After an internal pressure of 4.0 psi is obtained, allow internal air temperature to stabilize.
- (6) After stabilization period, adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin timing the test.
- (7) Refer to Table 611-1 to determine the length of time (minutes) the section under test must sustain while not losing in excess of 1 psi as monitored by the test gauge. If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
- (8) Sections so determined to have lost 1 psi or less during the test period will have passed the leakage test. Those sections losing in excess of 1 psi during the test period will have failed the leakage test.
- (9) Appropriate repairs must then be completed and the line retested for acceptance.

<b>TABLE 611-1</b>			
<b>SANITARY SEWER AIR TEST</b>			
Minimum Test Time for Various Pipe Sizes*			
Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time), min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

\* The time has been established using the formulas contained in ASTM C828, Appendix.

**(B) Hydrostatic Test:**

**Exfiltration Testing (water):**

Sanitary sewer testing by means of exfiltration should only be considered when low pressure air testing cannot be used and only with the approval of the Engineer.

**Testing Procedure:**

- (1) The Contractor shall furnish all equipment for testing.
- (2) Seal off the downstream end of the line and fill with water to a minimum head of 4 feet in a stand pipe at the high end.
- (3) A period of at least one hour will be allowed for absorption time before making the test.
- (4) A suitable meter or method of measuring the quantity of water used is necessary.
- (5) The allowable water loss for sanitary sewers shall not exceed 0.158 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

**(C) Closed Circuit T.V. Inspection:**

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Sanitary sewer lines eight inches and larger in diameter shall be subject to closed circuit T.V. inspection.

The Contractor shall notify the Engineer at least 48 hours prior to completion of the backfilling so that the inspection can be scheduled. Closed circuit T.V. inspections will be conducted by the City of Phoenix Water Services Department after backfilling has been completed.

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Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

### 611.4 POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS:

#### (A) Video Inspection:

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline and laterals. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to the Engineer, and reviewed and approved by the Engineer prior to the Contractor being allowed to place the final pavement over the storm drain line.

#### (B) Deflection Test for HDPE and SRPE Pipe:

The Contractor shall perform a deflection test on the system by use of a mandrel or other approved method as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section 738 shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the storm drain. If the Contracting Agency determines that the deflection has exceeded 7 1/2% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

#### (C) Leakage Test for Mainline HDPE, or SRPE Storm Sewer Pipe:

In addition to full CLSM haunching and initial backfill of HDPE and SRPE mainline storm sewer pipe, the Engineer may require the Contractor to also perform random leakage tests on the mainline. Field leakage tests, if required, will be conducted in accordance with the following criteria:

1. After placement of CLSM haunching and initial backfill to 1 foot above HDPE pipe and 1 inch above SRPE pipe, the Engineer will select a minimum of three (3) joints of mainline pipe to be tested in accordance with the following procedure:
  - a. Testing shall be accomplished by plugging the pipe test section and all branch lines and filling the pipe with water. Equipment for the test shall be furnished by the Contractor, and shall include a standpipe, a suitable meter or other acceptable method of measuring the quantity of water used. A period of at least one (1) hour shall be allowed for absorption before making the test.
  - b. The allowable water loss shall not exceed 1.0 gallon per hour per 100 linear feet of pipe per inch of pipe diameter under a minimum test head of 4 feet above the top of the pipe at the upper end of the test section. A minimum test time of one (1) hour shall be required after the initial one (1) hour for absorption.
  - c. The leakage test shall be made by the Contractor in the presence of the Engineer.
2. If the first test exceeds the specified leakage limit, the Contractor shall repair or replace all sections that fail the leakage test at no additional cost to the City of Phoenix. All repaired or replaced pipe sections shall be retested for compliance. The Engineer reserves the right to require additional leakage tests as deemed necessary during the course of construction to ensure that the remainder of the pipeline is leak resistant.

### 611.5 PAYMENT:

No separate pay item shall be contained in the proposal for disinfecting water mains. This operation shall be included in the price bid for the water mains, installed complete in place, as specified in the proposal.

The Contracting Agency will pay for the initial Sewer C.C.T.V. inspection. Any additional inspection(s) required, due to the failure of the initial inspection, shall be paid for by the Contractor.

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There will be no measurement and payment for sewer line testing. The Contractor shall include all associated costs in the unit bid price for the sewer pipe installation.

No separate payment will be made for this Storm Drain Video or Deflection Testing; the cost of the video and deflection testing shall be included in the cost of the pipe.

There will be no separate pay item for the HDPE or SRPE Storm Drain Pipe Leakage Tests. If requested by the Engineer, initial leakage test(s) shall be paid by the City of Phoenix except initial leakage test(s) that fail. Failed initial leakage test(s) and retests shall be paid by the Contractor at no cost to the City of Phoenix.

*- End of Section -*

## SECTION 615

### SEWER LINE CONSTRUCTION

#### 615.1 DESCRIPTION:

The construction or extension of sewer lines shall conform to the applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

Concrete pipe shall conform to Section [735](#). Vitrified clay pipe shall conform to Section [743](#). Ductile iron pipe shall conform to Section [750](#).

#### 615.2 MATERIALS:

Pipe used for sewer line construction, including specials, joints, and gaskets, shall be according to the following Sections, or as modified by the special provisions.

- Reinforced Concrete Pipe (RCP), see Section [735](#)
- High Density Polyethylene (HDPE) Pipe, see Section [738](#)
- Steel Reinforced Polyethylene (SRPE) Pipe, see Section [739](#)
- Vitrified Clay Pipe (VCP), see Section [743](#)
- Ductile Iron Pipe (DIP), see Section [750](#)

#### 615.3 TRENCHING:

Excavation of trenches shall be accomplished in accordance with Section [601](#).

The Engineer shall furnish the Contractor alignment and elevation stakes at agreed-upon intervals and offset together with cut sheets showing the difference in elevation from the top of the stakes to the flow line of the pipe.

The trench shall be dry when the fine grading of the bottom of the trench is accomplished. Before placement of pipe the fine grade shall be carefully checked by use of a string line, laser beam, or other means so that when in final position the pipe will be true to line and grade,  $\pm 0.05$  feet for 12 inch and smaller diameter pipe and  $\pm 0.10$  feet for 15 inches and larger.

#### 615.4 SEPARATION:

To protect water lines from contamination by sewer lines, separation and extra protection shall be in accordance with Section [610](#) and MAG Standard Detail No. 404-1, 404-2, and 404-3.

Sewer lines that are constructed of ductile iron pipe for extra protection shall be internally lined for sewer service.

#### 615.5 PIPE INSTALLATION:

Pipe shall be of the type, class, and size called for on the plans. All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe shall be installed in the work. Pipe shall be kept clean at all times, and as the work progresses, the interior of the pipe shall be cleared of all dirt and superfluous materials of every description.

The laying of the pipe shall be in trenches free from water or debris, and shall commence at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

The alignment and grade of each length of pipe shall be checked after setting by measurement from the string line, laser beam target or other means approved by the Engineer.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

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### 615.6 FITTINGS:

All fittings shall conform to the requirements of the pipe specifications and shall be located as shown on the plans, or as directed by the Engineer, in accordance with the standard details.

### 615.7 JOINTING:

**615.7.1 Gasket Joints:** Prior to joining pipe, all surfaces of the portions of the pipes to be joined shall be cleaned, dried, and prepared in accordance with the manufacturer's recommendations. The joints shall then be carefully centered and completed.

Trenches shall be kept water-free during the installation of joints and couplings.

The joint and coupling materials will be as specified in the appropriate pipe sections and shall be installed in accordance with the manufacturer's recommendations. Cement mortar joints will NOT be permitted in sanitary sewer construction.

### 615.8 SANITARY SEWER SERVICE TAPS:

When the construction of sanitary sewer service taps are called for in the special provisions, they shall be constructed in accordance with standard details for sewer taps.

The locations of the service tap for each property shall be in the downstream  $\frac{1}{3}$  of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2'-4').

When sewer taps are found to be in conflict with the new work and no provision has been made in the proposal for relocating such taps, they shall be relocated by the Contracting Agency or the Contracting Agency will negotiate with the Contractor for their relocation. When a sewer tap or other sewer line is in conflict with the new work and it is impractical or impossible to raise or lower the tap or sewer to clear the new work, the City will negotiate with the Contractor to relocate the sewer on a different alignment or grade to avoid the conflict.

### 615.9 SANITARY SEWER CLEANOUTS:

The cleanouts shall be constructed at locations shown on the plans, in accordance with the standard details.

### 615.10 MANHOLES:

Manholes shall be constructed to conform with the requirements of Sections [625](#) and standard details.

### 615.11 BACKFILLING:

Backfilling and compaction shall be done in accordance with Section [601](#).

### 615.12 TRENCHLESS INSTALLATIONS:

Trenchless installation of pipe shall be in accordance with Section [602](#) or Section [607](#).

### 615.13 INSPECTION AND TESTING:

Testing and inspection shall be in accordance with Section [611](#).

### 615.14 PAVEMENT AND SURFACE REPLACEMENT:

Pavement and surface replacement shall be in accordance with Section [336](#).

## SECTION 615

### 615.15 CLEANUP:

The Engineer has the right to close down forward trenching and pipe laying where testing, backfill, compaction and cleanup does not follow in an orderly manner-

### 615.16 MEASUREMENT AND PAYMENT:

#### (A) Sewer Pipe and Fittings:

Measurement will be made horizontally through manholes and fittings and from centerline to centerline of structures, for the various types and sizes of pipe called for on the plans and in the proposal.

Payment for the various sizes and types of pipe will be made at the contract unit price per linear foot, and shall be compensation in full for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, removal of obstructions, backfilling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

#### (B) Sanitary Sewer Service Lines and Taps:

Measurement of the number of taps installed will only be made when pay items for sanitary sewer taps are contained in the contract.

When pay items for sanitary sewer taps are contained in the contract, payment for sanitary sewer service taps will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe and fittings needed to connect to the main, complete in place, as specified and called for on the plans and standard details, including all cost for furnishing and installing electronic markers, and all cost of excavation, removal of obstructions, shoring and bracing, backfilling, compaction, pavement replacement, maintenance of traffic, and all work incidental thereto.

The length of pipe required for the service lines shall be measured and payment made as Sanitary Sewer Pipe and Fittings. If no pay item is provided for the sanitary sewer taps, the connection cost including all costs for furnishing and installing electronic markers shall be included in the unit cost of the sanitary sewer pipe.

#### (C) Sanitary Sewer Cleanouts:

Measurement will be the number and type of cleanout installed.

Payment will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe, fittings, and frame and cover as called for on the plans and in accordance with the standard details.

#### (D) Concrete Encasement:

Measurement and payment for concrete sewer encasement shall be by the linear foot of sewer concrete encased, which price shall include trenching, backfill, compaction, materials, and any pavement and surface replacement in excess of the applicable pay widths assigned to the adjacent water pipe.

*- End of Section -*

## SECTION 616

### RECLAIMED WATER LINE CONSTRUCTION

#### 616.1 GENERAL:

This specification prescribes standards for utility water mains for the purpose of conveying, under pressure, reclaimed water for permitted reuse. Installation of reclaimed water mains shall be constructed in accordance with these specifications for materials, installation, and identification.

#### 616.2 MATERIALS:

Pipe materials shall be in accordance with Section [610](#).

Valves shall be in accordance with Sections [610](#) and [630](#).

Valve boxes shall be in accordance with Section [345](#), this Section and MAG Standard Detail 391-1 and 391-2. Manholes shall be in accordance with Section [625](#), [787](#) and this Section, and applicable Details.

#### 616.3 INSTALLATION:

Pipe shall be installed in accordance with Sections [601](#), [610](#), and this Section.

Valves and risers shall be installed in accordance with this Section.

Valve box debris caps shall be installed in accordance with this Section and MAG Standard Detail 392.

When a reclaimed water main is adjacent to or crosses a potable water main, the reclaimed water main shall be considered a pressure or force sanitary sewer and comply with MAG Standard Details 404-1, 404-2 and 404-3 for separation and/or protection. When reclaimed water main is adjacent to or crosses a gravity, pressure or force sanitary sewer, the reclaimed water main shall be considered a potable water main and comply to MAG Standard Detail 404-1, 404-2 and 404-3 for separation and/or protection.

#### 616.4 IDENTIFICATION:

The color purple shall be used for identifying all pipes, valves, and other equipment used for conveying reclaimed water.

Reclaimed water identification tape shall be an inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick and no less than 3 inches wide. The tape shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification sleeving (pipe socks) shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The sleeving shall be a minimum of 4.0 mils thick. The sleeving shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification decals shall be made of inert material resistant to cracking, peeling, and fading due to sunlight and heat. Decals shall have an aggressive adhesive to ensure permanent bonding to the surface that is being identified. The decals shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black lettering on a purple background. Lettering shall be a minimum 1 inch high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water pipe identified by stenciling shall use paint or ink resistive to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Stenciled pipe shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black or white lettering on a purple background continuously along the entire length.

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Lettering shall be a minimum of 1 ½ inches high lettering shall be placed on a painted purple band a minimum of 3 inches wide that runs the entire length of the pipe.

Reclaimed water locating tape shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick, 3 inch wide and contain a minimum thickness of 1/3 mil metallic foil or two embedded copper wires. The tape shall be purple and printed with the words, "CAUTION: RECLAIMED WATER LINE BELOW" or similar wordings printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Integral colored reclaimed water pipe shall be purple in color and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering at intervals no greater than 3 feet. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water valve tags shall be inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tags shall be purple and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering. The lettering shall be a minimum of ½ inch high.

### **616.4.1 Below- Ground Pipe:**

(A) All below-ground reclaimed water pipelines shall be marked by identification tape, or sleeving, or integral coloring, or stenciling in conformance with this Section.

Identification tape shall be installed parallel to the centerline and on top of the pipe. The identification tape shall be installed continuously for the entire length of the pipe and shall be securely fastened with plastic adhesive tape banded around both the pipe and identification tape at no more than 4-foot intervals.

Identification sleeving shall be installed so the wording runs along the top of the pipe. Care shall be exercised to avoid displacement of sock and to ensure its integrity.

Stenciled pipe shall be installed so the wording is parallel to the centerline and on top of the pipe.

(B) The Agency will need to maintain adequate records, install locating devices, conduct surveys, etc. to be capable of locating all below-ground reclaimed water mains as required by Arizona Revised Statutes 40-360. The means for locating the mains shall be at the discretion of the Agency. When locating tape is used, the tape shall be installed with the printed side up, directly above the pipe, parallel to the centerline, and buried 24 inches below the finished surface grade. The backfill shall be sufficiently leveled so that the tape is installed on a flat surface. Care shall be exercised to avoid displacement of the tape and to ensure its integrity.

In lieu of locating tape, a locating wire can be fastened by plastic adhesive tape to the top center of the pipe. The adhesive tape shall be banded around both the pipe and wire at no more than 4 foot intervals. The wire shall be continuous for the entire length of the pipe, without gaps, breaks, etc. The wire shall terminate above ground in a valve riser housing.

**616.4.2 Above-Ground Pipe:** All above ground pipe shall be identified by stenciling or decals in conformance to this Section.

Stenciled pipe shall be installed so that the wording runs along both sides of the pipe.

Identification decals shall be placed on both sides of the pipe at intervals no greater than 3 feet. Surfaces shall be prepared to ensure proper adhesion of the decals.

**616.4.3 Valves and Risers:** Valve handles shall be affixed with tags in accordance with this Section. Tags shall be securely fastened in a manner that ensures their visibility.

Riser pipes shall be painted purple both inside and out from the top of the pipe to at least one foot below the finished grade.

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Debris caps shall be required in all valve housings per MAG Standard Detail 392 and shall be colored purple and affixed with tags in accordance with this Section. Tags shall be securely fastened in a manner that ensures their visibility.

**616.4.4 Valve and Manhole Covers:** Valve and manhole covers shall be stamped with the words or shall have raised lettering with the words "RECLAIMED WATER". Reclaimed water valve covers shall be of a shape that is not interchangeable with potable water valve covers.

*- End of Section -*

## SECTION 618

### STORM DRAIN CONSTRUCTION WITH PRE-CAST CONCRETE PIPE, HIGH DENSITY POLYETHYLENE PIPE, OR STEEL REINFORCED POLYETHYLENE PIPE

#### 618.1 DESCRIPTION:

This Section covers rubber-gasketed reinforced (RGRCP) pre-cast concrete pipe line, high density polyethylene (HDPE) pipe line and steel reinforced polyethylene (SRPE) pipe line construction used for the conveyance of storm drainage in public storm drains.

This Section does not include irrigation pipe lines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipe lines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in State Highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

#### 618.2 MATERIALS:

In general, the pipe class or strength specified will be based upon the maximum anticipated design loads and trench conditions to which the pipe will be subjected upon completion of the project.

The structural design of the pipe for any depth of cover shall be in conformance with Section 6 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, and established manufacturer recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section [336](#) unless otherwise noted in the plans and specifications.

Should the Contractor, as a result of his construction means and methods, or for any other reason, subject the pipe to loading or trench conditions that do not conform to the plans and specifications, it shall be the Contractor's responsibility to take whatever steps are necessary to remediate, strengthen or otherwise protect the pipe from damage at the Contractor's expense.

Pipe that is stronger than that specified may be furnished at the Contractor's option and expense.

The RGRCP, HDPE and SRPE pipe, specials, joints, gaskets, and testing shall be according to Sections [735](#), [738](#), and [739](#), except as specified below.

(A) Specials: Pipe specials such as closure pieces, wyes, tees, bends, and manhole shafts shall be provided as indicated on the plans, and such specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing, or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication.

(B) Gasket Joints: The joint shall be sealed with a continuous ring gasket made in such size and cross-section as to fill the annular space provided for it. The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters, porosity, and other imperfections.

(C) Water Stops: Water Stops will be required when connecting HDPE and SRPE pipe to concrete structures, manholes, etc. The water stop shall comply with Section [738](#) or Section [739](#) and will be installed per manufacturer recommendations.

(D) Storm Drain Pipe Size Option: The Contractor may substitute the next larger multiple of 6 inch size storm drain pipe for the intermediate 3 inch size pipes shown on project plans at his discretion. The cost of the increase in size shall be borne by the Contractor. The intermediate 3 inch size pipe will remain in the bid proposal as the required size. If the Contractor elects to use the next larger multiple of 6 inch size pipe he shall be responsible for any utility or any other conflict caused by the increase in the size of the pipe. There shall be no extension of time granted for any delay caused by these conflicts.

#### 618.3 CONSTRUCTION METHODS:

Excavation, bedding, backfilling, compaction or consolidation and testing shall be accomplished in accordance with Section 601 except as specified below.

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The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. Curves, bends and closures shall be made in accordance with Section [735](#), [738](#), and [739](#). Pipe shall be of the type, class and size shown on the plans or in the special provisions.

The minimum and maximum cover for HDPE and SRPE pipe shall be in conformance with Section 6.4 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, established manufacturer recommended design procedures and special provisions.

All pipes installed in railroad rights-of-way shall be reinforced concrete pipe per ASTM C76, Class V and the minimum cover over all pipes shall be as specified in the railroad permit and/or special provisions. Bedding and backfill shall be in accordance with the railroad's standards and details and/or special provisions.

HDPE and SRPE pipe is prohibited as an alternate pipe material for culverts. HDPE and SRPE pipe is also prohibited as an alternate pipe material within a minimum distance of 24ft from an open end condition requiring a headwall, trash rack or access barrier. The pipe transition shall utilize an external, gasketed coupling band with cinching straps or bolts to provide a waterproof connection. The transition shall be fully bedded with CLSM or a concrete pipe collar. No separate payment will be made for the transition and the cost shall be considered incidental to the cost of the pipe.

The Contractor shall employ the necessary means and methods to maintain roundness of the HDPE and SRPE pipe during haunching, initial backfilling and backfilling. The Contractor shall employ all necessary means and methods to adequately anchor the pipe against buoyant forces to maintain grade during the placement of the CLSM haunching and initial backfill. The Contractor shall schedule a meeting with the HDPE and/or SRPE pipe supplier, the installing Contractor and the Engineer to discuss the installation procedures prior to trench excavation.

**618.3.1 Pipe Joints for RGRCP:** Either O-ring gasket joints, or offset spigot-profile gasket joints will be used. Hydrostatic water tests may be required at the discretion of the Engineer. Certification for Hydrostatic tests will be required for all pipe joints. Gasket joints will not require mortaring and grouting.

**618.3.2 Procedure for Connecting Pipes to New Storm Drain and Temporary Pipe Closure:** All inlet connecting pipes and lateral pipes shall remain temporarily plugged until all lines and facilities downstream have been completed to the satisfaction of the Engineer.

Existing storm drains shall be connected to the new storm drain where indicated on the plans. However, existing storm drain systems shall remain intact or a by-pass maintained until mainline downstream has been completed to the satisfaction of the Engineer.

All pipes shall have a temporary closure placed at the open end at the end of each work day.

**618.3.3 Connecting Extensions to Mainline Storm Drains:** Prior to extending any existing mainline storm drain, the Contractor shall verify the depth, size, pipe type, and horizontal location of the existing storm drain in the field. If the new pipe extension is the same type and size as the existing, or if the pipe manufacturer makes a standard watertight adapter fitting made specifically to join with the existing pipe type, a standard manufacturer-recommended connection may be used. Otherwise, a concrete field collar in accordance with COP Standard Detail P1505 shall be used. The cost of connections shall be considered incidental to the cost of the project. No separate measurement or payment will be made for field connecting extensions to existing mainline storm drain pipes except that the removal of an existing pipe plug shall be paid under a separate item.

**618.3.4 Structures:** Inlets, manholes and similar reinforced concrete structures generally built underground as part of the storm drain are shown on the plans and shall conform to Section [505](#). Castings shall conform to Section [787](#). Miscellaneous

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steel shall conform to Sections [727](#) and/or [770](#).

Through manhole, lateral manhole or transition manhole, when specified on the plans, shall denote the construction and installation of a complete manhole including the base, shaft, reinforced concrete rings, frames and covers, concrete caps, frame adjustment to grade, etc., as shown on the plans and Standard Details. Note: Manhole steps shall not be installed. If installed they shall be removed and the holes filled with approved epoxy or approved commercial-source non-shrink, non-metallic, patching grout with an approved bonding agent.

As an option, MAG Standard Detail 522 is hereby modified to allow precast unreinforced manhole shaft pipe and cones which shall have a thickness of 6 inches and be manufactured of an approved portland cement concrete mix per Section 725. All other features of MAG Standard Detail 522 shall remain unchanged.

**618.3.5 Cleaning Pipe:** All pipe shall be swabbed, flushed with water, or subjected to a combination of these or other methods in order to leave the pipeline clean and free from debris, garbage, rubbish, stones, and deposits, and like foreign materials.

**618.3.6 Material and Layout Submittals:** At least 6 weeks prior to the manufacture and delivery of the storm drain pipe, the Contractor shall submit material and layout drawings to the Engineer for review and approval.

Submittals shall show pipe material type, layout, stationing, laying length, pipe class or gauge thickness (as appropriate), detailed fabrication drawings for mainline, curvilinear sections, prefabricated bends, special sections, etc., and any other pertinent data including certification that pipe joints have been independently tested and conform to watertight joints per ASTM D3212.

In addition, a list of catch basin connector pipes shall be submitted. The list shall contain the following information:

1. Inside diameter and type of material to be used, (RGRCP, HDPE, SRPE).
2. If RGRCP is used for connector pipe, the pipe class shall be shown.
3. Station at which connector pipes join mainline.
4. Number of sections of pipe and laying length of sections.

### **618.4 POST INSTALLATION INSPECTION AND TESTING:**

Post installation inspection and testing shall be in accordance with Section [611](#).

### **618.5 MEASUREMENT:**

(A) Main Line Pipe: Shall be the number of linear feet of pipe laid as measured along the pipe axis.

Unless hereinafter modified, measurement shall extend through manholes when no change in pipe size occurs. When a change in pipe size occurs within a manhole, unless hereinafter modified, measurement for each size will be taken to the centerline of the manhole.

(B) Catch Basin Connector Pipe: Shall be the number of linear feet of pipe installed, as measured along the pipe axis from a main line pipe, or a manhole, or a catch basin to a catch basin, or a plugged end, and shall include the portions of the connecting pipe embedded in the above structures.

(C) Prefabricated Tees and Wyes: When separate bid items are provided in the proposal, they shall be measured by the number of such tees and wyes constructed.

(D) Concrete Pipe Collars: There shall be no measurement for construction of pipe collars for pipe less than 24 inches in diameter. For pipe collars on pipe 24 inches or larger, measurement shall be the number of such pipe collars constructed.

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### 618.6 PAYMENT:

(A) Main Line Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot, for each size of pipe and shall be compensation in full for furnishing and installing the pipe as specified and as shown on the plans including removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, testing, temporary pavement, joint materials, joining, and field closures.

(B) Catch Basin Connector Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, temporary pavement, joint materials, joining, collars, field closures, and testing.

(C) Prefabricated Tees and Wyes: The cost of prefabricated tees and wyes shall be included in the unit price bid for main and connector pipes unless separate bid items are included in the proposal.

(D) Concrete Pipe Collars: There shall be no payment for construction of pipe collars for pipe less than 24 inches in diameter. Payment for pipe collars, on pipe 24-inches or larger, shall be made at the unit price bid for each and will be compensation in full for all labor, material, equipment and incidentals required for construction.

*- End of Section -*

## SECTION 620

### STORM DRAIN CONSTRUCTION WITH CAST-IN-PLACE CONCRETE PIPE

#### 620.1 GENERAL:

This specification covers cast-in-place non-reinforced concrete pipe intended for use in storm drain systems. CIPP is conduit made of portland cement concrete cast monolithically in a properly prepared trench, using equipment specifically designed for this purpose. The type of equipment to be used by the Contractor must be approved by the Engineer and the Contractor may be required to furnish evidence of the successful use of this equipment on prior work. CIPP will be placed only:

- (A) By experienced operators. The Engineer will be the sole judge as to experience level.
- (B) In the presence of the Engineer.
- (C) In ground capable of standing unsupported from the bottom of the trench to the top of the pipe without sloughing.
- (D) In systems that will not exceed a 15 ft operating head at any time during the life of the system.
- (E) When designated as an allowable alternate pipe material on the Alternate Pipe Chart Sheet of the Plans. Designation of CIPP as an allowable alternate pipe material shall not be construed to indicate that the site conditions will be suitable for its use. The Contractor shall be responsible for all costs incurred to properly evaluate, prepare and utilize CIPP as part of a complete storm drain pipeline.
- (F) When approved by the Engineer as a result of a formal Value Engineering Process that considered all location, geologic, hydrologic, and maintenance conditions. The Contractor shall be responsible for all costs incurred for developing and presenting the engineering and documentation of the Value Engineering proposal for a thorough evaluation.

CIPP is prohibited from being placed:

- (A) Within the curb lines of arterial and major collector streets.
- (B) Within the curbs of signalized and potentially signalized intersections to the limits of the curb returns.
- (C) Within railroad rights-of-way.
- (D) In fill, unless it can be demonstrated to the satisfaction of the Engineer, that the fill will adequately support the pipe.
- (E) Where expansive or collapsible soils are encountered below the top of pipe.

#### 620.2 MATERIALS:

**620.2.1** Cement shall be ASTM C150, Type II, and low alkali as per Section [725](#).

**620.2.2** Sand aggregate used for concrete and mortar shall conform to Section [701](#). Maximum size of the aggregate shall not be greater than  $\frac{1}{3}$  of the minimum wall thickness up to and including a wall thickness of 4  $\frac{1}{2}$  inches. The maximum aggregate size is 1  $\frac{1}{2}$  inches.

**620.2.3** Water used for concrete and for curing the pipe shall be as per Section [725](#).

**620.2.4** Concrete shall be a minimum Class A per Section [725](#). Concrete shall be of a type, and have a design strength and slump necessary for the site conditions and the Contractor's construction methods. The slump shall not exceed 3 inches (75MM).

**620.2.5** Bonding mortar shall consist of two (2) or more parts of cement to three (3) parts of sand by volume.

#### 620.3 CONSTRUCTION METHODS:

**620.3.1 Excavation:** The trench will be neatly excavated with vertical sides and semi-circular bottom. The trench shall be shaped to form the bottom outside of the pipe on the alignment and to the grades specified in the plans. Departure from and return to established grade shall not exceed 1 inch per 10 linear feet with a maximum allowable departure of 1  $\frac{1}{2}$  inches. Departure from and return to specified alignment shall not exceed 2 inches per 10 linear feet with a maximum allowable alignment departure of 4 inches. The bottom of the trench, hereinafter known as the trench form, will be shaped to provide full, firm, and uniform support by undisturbed earth or compacted fill for at least the bottom 210 degrees of the pipe. Density

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of the fill shall be at least five percent (5%) greater than the natural in-place soil, but in no case less than 85 percent (85%) when tested in accordance with AASHTO T-99, Method A and T-191 or ASTM D6938.

When it is necessary to install the pipe in rocky areas, the rock will be removed and replaced with suitable fill material compacted to proper density. The rock will be over-excavated to leave 6 inches minimum compacted soil cushion between the rock and the pipe. For construction accuracy, areas left void by rock removal will be completely filled with compacted material, then trenched for the pipe as though natural ground. If the rock below the pipe subgrade is fractured or fragmented or if it consists of large cobblestones or boulders, the replacement fill material will be carefully selected to insure that it is of such gradation that it will not be removed downward by fluctuation of the water table. In no case will expansive soils be used for fill. A similar procedure of over-excavation, backfill, compaction, and retrenching will be used where sloughing sand or where soft or spongy soil conditions are encountered.

Excavated trench shall be checked for compliance with requirements for grade and alignment prior to placement of concrete. The Contractor shall submit his proposed method of grade and alignment control and checking of same for conformance with specifications to the Engineer for his approval prior to start of work. The Contractor shall supply manpower, equipment and materials, as are required, to provide and confirm compliance with grade and alignment requirements. This is a non-pay item and all costs incurred shall be included in the bid item(s) for the pipe installation.

Where the pipe is to be constructed through fill materials, such fill shall have stability in the zone of the trench form equal to firm undisturbed earth, in the area adjacent to the fill.

Upon direction of the Engineer, the Contractor shall substitute RCP or an acceptable alternate at locations where the conditions are unsuitable for CIPP. All cost for this substitution shall be borne by the Contractor.

**620.3.2 Placement:** At the time of concrete placement, all soil in the trench will be adequately moistened so that water is not drawn from the freshly placed concrete. However, the trench form will be completely free of water, mud, and debris. All forming devices, including the slipforms and hopper of the placement device, shall be thoroughly moistened.

Concrete shall not be placed when temperature of the concrete exceeds 90 degrees Fahrenheit or is less than 50 degrees Fahrenheit. The soil adjacent to the trench shall be at a temperature above freezing.

The pipe shall be constructed in one placement, the entire cross-section being placed monolithically. Inside forms shall be sufficiently rigid to withstand consolidation of the fresh concrete. Placement shall be such as to produce a thoroughly consolidated homogeneous concrete mixture conforming to the test requirements of this specification. Effective consolidation means shall be applied to the fresh concrete over the entire circumference and from within the pipe shell. Consolidation means shall be capable of effectively placing and consolidating fresh concrete at production speeds. Methods of consolidating shall be capable of building up sufficient pressure to effectively bond the concrete to the surrounding earth and to keep loose sand, mud, and water out of the pipe shell.

Under no circumstances will the Contractor be allowed to continue the pipe installation if the vibrators of the cast-in-place machine are inoperable. Portable vibrators or "stingers" shall only be used to supplement internal vibrators on the machine and not as a sole source to consolidate and distribute the concrete mix.

The Contractor shall make provisions for removing sloughed material, debris and any foreign objects from trench before and during placement of concrete such that build-up of material does not occur ahead of the machine. In addition, small transverse trenches shall be dug across the trench bottom, at distances not to exceed 25 linear feet, to receive soil any build-up that is pushed ahead of the slipform

(A) Construction Joints: When pipe placement stops in excess of ninety (90) minutes, a construction joint shall be formed. The ends of the pipe that are to be butt contact shall be left in rough condition with a slope between 20 and 45 degrees. Number 4 reinforcing bars shall be embedded 12 inches in the previous pour and 12 inches into the next pour and shall be placed 12 inches on center for pipe 42 inches in diameter or less and 18 inches on center for pipe diameters in larger than 42 inches. For pipe diameters 60 inches or less an excavation shall be made along the sides and bottom of the joint before resuming to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1-1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two (2) times the wall thickness. Immediately before resuming concrete placement the surface to be bonded shall be cleaned of all laitance, coatings, foreign materials, and loose or defective concrete thoroughly wetted and coated with a layer of bonding mortar (Subsection [620.2.5](#))

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approximately 1/4 inch (6MM) thick. In lieu of the bonding mortar, neat cement paste may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

For a joint that may be used for connections to another pipe or structure, a joint shall be made by squaring off the end of the pipe. An excavation shall be made along the sides and bottom of the cast-in-place pipe, for any diameter, to permit casting of a concrete collar as described above.

The outside top of all joints shall be capped for the entire width of the pipe that is exposed, that is, between the earth walls of the excavated trench. This cap shall have a minimum thickness equal to the wall thickness of the pipe and shall lap the joint, both upstream and downstream from the joint by at least twice the wall thickness of the pipe. A cap as described is required regardless of pipe size.

(B) Pipe Dimensions and Tolerances:

- (1) The internal diameter of the pipe at any point shall not be less than 95 percent of the nominal diameter, and the average of any four (4) measurements of the internal diameter made at 45 degree intervals shall not be less than the nominal diameter.
- (2) The minimum wall thickness shall be 1/12<sup>th</sup> of the inside diameter plus 1 inch.
- (3) Offsets at form laps and horizontal edges shall not exceed ½ inch for pipe having inside diameter not greater than 42 inches; 3/4 inch for pipe having inside diameter greater than 42 inches, but not greater than 72 inches; and 1 inch for pipe having inside diameter greater than 72 inches.

**620.3.3 Curing and Backfilling:** The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Final backfill and compaction shall not be started sooner than seven days after concrete placement and only after the concrete has attained a compressive strength of at least 3000 psi. The pipe shall be checked for grade, alignment and thickness prior to backfilling. Curing shall be performed in such a manner as to prevent the premature drying of the concrete.

Polyethylene film complying with ASTM C-171, nominal thickness 0.0015 inches (0.038 MM), shall be placed on the exposed top surface of the pipe immediately after the pipe is cast. The film shall be anchored in place with loose soil to assure continuous, adequate curing.

A humid atmosphere within the pipe, as evidenced by condensation on the interior surface, shall be maintained for at least seven (7) days following concrete placement. To prevent air drafts which may dry the pipe and to maintain a humid atmosphere inside the pipe, all openings, ends, manholes, connector pipes shall be kept closed or securely covered, except when actual work is in progress on the inside of the pipe. The pipeline shall be partially filled with water during the curing period when work is not being performed on the inside of the pipe. If necessary, a maximum 24 hour period will be permitted within the seven days following placement for removal of forms and repairs.

**620.3.4 Repair:** Immediately after removal of the forms, the inside of the pipe shall be inspected for required repairs and conformance with all dimensional requirements including alignment and grade.

The Engineer shall be the sole judge as to the repairability of deficiencies. He shall require removal and replacement of those sections of pipeline which he judges to be non-repairable or are not within required dimensional tolerances including alignment and grade.

When concrete placement is done by a method requiring the use of metal inner forms, the Contractor shall schedule his work force, by extended, staggered or multiple shifts, as required, to provide for removal of forms within 4 to 6 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

When concrete placement is done by methods using pneumatically inflated inner liner, the Contractor shall schedule his work force, by extended, staggered or multiple shifts, as required, to provide for removal of the pneumatic inner liner within 12 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

All rock pockets, non-longitudinal cracks or indentations shall be cleaned out, moistened and filled with 1:2 cement grout or approved epoxy material. Except where, in the opinion of the Engineer, the width and/or length of the crack may indicate a structural deficiency, repairs shall be made as required for longitudinal cracks.

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At the discretion of the Engineer, longitudinal cracks exceeding 0.01 inches in width and 12 inches in length may be cause for rejection and removal and replacement of that portion of the pipe. Subject to the approval of the Engineer, cracks may be repaired using a pressure applied epoxy compound capable of providing structural correction to the area in addition to sealing the void. A longitudinal crack shall be defined as one which has the general direction of a 30 degree angle or less with the alignment of the pipe.

Irrespective of concrete placement method, all repairs, patches and finishing shall be completed within 24 hours of concrete placement.

The Contractor, prior to start of concrete placement on project shall submit a written schedule of his proposed work activities and work time schedules for the Engineer's review and approval. No time schedule requiring overtime by the Engineer's staff is authorized without specific written approval of the Engineer.

**620.3.5 Finish:** Except for the form offsets, the interior surface of the pipe shall be equivalent to or better than a wood float finish. Form offsets shall be trimmed so as to provide a reasonably tapered slope from surface to surface. The bottom of the pipe below the metal forms shall be finished in a workmanlike manner and shall conform to the general circular circumference of the pipe without sags, dips and humps. All extraneous concrete shall be removed from the interior surface.

### 620.4 TESTS:

Random tests shall be made of the wall thickness at the top, bottom and sides, approximately every 100 feet, on a daily basis by probes through fresh concrete or small holes drilled through the concrete. Holes shall be properly and permanently closed and sealed, flush with the inside surface of the pipe, after measurements are made, in accordance with the requirements of the fourth paragraph of Subsection [620.3.4](#).

Test cylinders shall be prepared and tested per Section [725](#). If the 28-day strength test does not comply to the specified compressive strength requirements, cores shall be taken from the same section of concrete represented by the non-compliant test under the supervision of the Engineer. The diameter of the core specimens for the determination of compressive strength should be at least three (3) times the maximum nominal size of the coarse aggregate used and must be at least twice the maximum nominal size of coarse aggregate.

The length of the specimen, when capped, should be twice the core diameter. A core having a maximum height of less than 95 percent of its diameter before capping or a height less than its diameter after capping shall not be tested.

If cores are taken, the Contractor shall patch all core holes in a manner that will be permanent, will be watertight to a minimum of 15 ft of internal pressure head, and will have a smooth interior finish flush with the interior surface of the pipe.

Obtaining the core specimens, preparing the specimens, testing the specimens, restoring the pipe, and the Engineer's supervision shall be at the Contractor's expense.

The Engineer will evaluate the test results and his decision as to required corrective action will be final.

### 620.5 MEASUREMENT:

Measurement of cast-in-place concrete pipe will be the number of linear feet of pipe measured horizontally along the pipe axis from end to end of the pipe. At changes in diameter, the measurement shall be to center of manhole or transition.

### 620.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing the cast-in-place concrete pipe complete as specified including removal of paving and obstructions; excavating, backfilling and compacting; testing; repair and all necessary incidental costs not specifically covered in other items in the proposal.

- End of Section -

## SECTION 621

### STORM DRAIN CULVERT AND CATCH BASIN CONNECTOR PIPE CONSTRUCTION WITH CORRUGATED METAL PIPE AND ARCHES

#### 621.1 DESCRIPTION:

This Section covers corrugated metal pipe and arches used as culverts and catch basin connector pipes for the conveyance of storm drainage in public storm drains.

This Section does not include irrigation pipe lines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipe lines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in State Highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

#### 621.2 MATERIALS:

The types of pipe and fabrication shall be in accordance with Section [760](#).

The structural design of pipe and arches shall be in conformance with Section 6 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, and established manufacturer recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section [336](#).

All helical corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

All prefabricated fittings for connector and culvert pipes larger than 24 inches shall be welded fittings.

#### 621.3 INSTALLATION:

Excavation, bedding, initial and final backfill and compaction shall be in accordance with Section [601](#).

No pipe shall be laid except in the presence of an inspector. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipe lines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes and arches shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

Corrugated metal pipe and pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. CMP shall be carefully handled at all times to prevent damage to the coating. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to verify that no damage has been done to the coating that will be concealed when the pipe is placed. Damaged coating shall be repaired in accordance with AASHTO M-36. As determined by the Engineer, pipe and arch that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

Where a curved alignment is indicated, curves shall be formed by straight pipe and fabricated specials. Pipe shall be of such length that no deflection angle of the pipeline exceeds 10 degrees. All deflection angles shall occur between the point of curvature and point of tangent of the curve as shown on the plans.

Transition manhole bases, for pipe larger than 48 inches, may be constructed with a prefabricated transition and a 48 inch stubbed manhole shaft cast as one structure. Dimensions of this structure shall be equivalent to those shown in the Standard Detail. A shop drawing of this option shall be submitted to the Engineer for review. Corrugated steel manhole shafts will not

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be permitted unless a detail of construction is included and reviewed with the shop drawing.

Pipe layout shall be such that for manholes not located at a joint, the outside edge of the manhole shaft shall be a minimum of 1.5 pipe diameters away from the nearest joint, on both sides of the manhole.

If the manhole cannot be so located, then the concrete encasement shall be extended to include the joint or joints, not outside to minimum distance of 1.5 pipe diameters from the outside of the manhole shaft.

**621.3.1 Joints:** Pipe sections shall be joined together with annular corrugated type bands or hugger type bands locking in at least one annular corrugation and shall be designed to form a leak-resistant joint. The hugger type band shall use an O-ring gasket. The annular corrugated type band shall use a 1/4 inch thick rubber sleeve gasket the same width as the connecting band.

One-piece bands may be used on pipe with diameters up to and including 48 inches. O-ring gaskets or one-piece bands shall be a minimum of 3/4 inch diameter. Two or more piece bands shall be used on all pipe diameters exceeding 48 inches. For pipe with diameters exceeding 48 inches, O-ring gaskets shall be a minimum of 7/8 inches in diameter. The minimum connecting band width shall be 7 inches for pipe diameters of 12 inches through 30 inches, 10-1/2 inches for pipe diameters of 33 inches through 60 inches, and 13-1/2 inches for pipe diameters greater than 60 inches through 120 inches. The connecting bands may be two numerical gage thickness lighter than the gage specified for the pipe material, but not less than 0.064 inches (16 gage) nor more than 0.109 inches (12 gage).

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed hugger type band and gaskets or other type band incorporating a locking channel and gaskets.

The band shall be tightened evenly, keeping equal tension on the bolts. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint, the nuts shall be tested for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained.

**621.3.2 Vertically Elongating Catch Basin Connector Pipe:** When connector pipe is not fully bedded with CLSM, pipe may be vertically elongated. Pipe may be elongated  $5 \pm \frac{1}{2}$  percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical dimension of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

### **621.4 TEST SPECIMENS:**

Compliance with these specifications as set forth, shall be the responsibility of the Contractor. Three certified copies of test results indicating compliance shall be furnished for each lot or shipment prior to delivery of the material to the Contractor.

### **621.5 MEASUREMENT:**

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of the pipe through manholes and specials. No separate measurement will be made for specials and other necessary fabrications. At changes in diameter the measurement will be to center of manhole or special.

### **621.6 PAYMENT:**

Payment will be made at the unit price bid for each size of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe, specials and necessary fabrications, including removal of asphalt paving, removal of obstructions, excavation, bedding, haunching, initial and final backfilling, compacting, temporary pavement, joints, joint materials, transitions with other pipe types, testing, and all incidental costs not specifically covered in other items in the proposal.

- End of Section -

## SECTION 625

### MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

#### 625.1 DESCRIPTION:

**625.1.1 Manholes:** Construction shall consist of furnishing all materials and constructing manholes complete in place, as detailed, including foundation walls, manhole frames, covers, and any incidentals thereto, at locations shown on the plans.

**625.1.2 Sanitary Drop Sewer Connections:** Construction shall consist of furnishing all materials and constructing drop sewer connections complete in place as detailed, including foundation materials, pipe, and any incidentals thereto, at locations shown on the plans.

#### 625.2 MATERIALS:

Unless otherwise shown on the plans or specified in the special provisions, materials to be used shall conform with the following:

Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames per Section [345](#). Bricks for manholes per Section [775](#).

Cement mortar for manholes Class D, per Section [776](#).

Concrete for cast in place manholes bases shall be Class A, for drop sewer connection shall be Class C, per Section [725](#).

Pipe used in manholes or drop sewer connections shall comply with pipe requirements of Section [615](#).

Manhole frame, cover per Section [787](#) and cast in accordance with standard details.

Manhole steps shall not be used.

#### 625.3 CONSTRUCTION METHODS:

**625.3.1 Manholes:** Manholes shall be constructed of brick or precast concrete risers, cones, flat tops, or of cast in place concrete, with cast iron frames and covers. Brick or precast manholes shall be constructed in accordance with the standard details. All manholes shall be constructed with cast in place bases. Precast manhole bases shall not be used. Cast in place manholes shall be constructed from details sealed by a licensed structural engineer in the State of Arizona. Manhole steps are prohibited. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a radius as large as the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

Invert channels may be formed of concrete or be half tile laid in concrete, or may be constructed by laying full section of sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The bench of the manhole outside the channels shall be smoothed and shall slope towards the channels.

The excavation shall be in such a manner, access is maintained around the manhole base before, during, and after placement of the manhole.

Cast-in-place manhole bases shall be constructed with Class A concrete in accordance with the standard details and Section [505](#).

Brickwork, precast concrete structures, or cast in place concrete shall not be laid upon a concrete manhole base less than 24 hours after such manhole base has been poured. No brickwork, precast concrete structures, or cast in place concrete shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

Bricks shall be thoroughly moistened prior to placing, and shall be laid in full cement mortar beds. Every course may be a header course, but at least every fourth course shall be a header course. The horizontal cross-section of the manhole shall be

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circular unless otherwise called for on the plans or standard details. An oval or egg-shaped section will not be permitted. The brick manholes shall be mortared outside with ½ inch of cement mortar as shown. Inside of the brick wall shall be neatly pointed. The mortar coat shall be cured with a liquid membrane-forming compound conforming with Section [726](#) immediately after mortar has been placed and finished.

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Manhole covers in pavement shall be standard open pickslot unless otherwise designated by Engineer. When specified, provide concealed pickslot, watertight or bolt-down covers and frames in lieu of open pickslot. Refer to COP Standard Detail P1424. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade. The frame and cover shall be continuously and solidly supported per MAG Standard Detail 422 prior to placing the collar concrete. A concrete collar per MAG Standard Detail 422 shall be constructed around the frame and cover after the frame and cover is adjusted to grade and solidly supported.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section [601](#).

**625.3.2 Sanitary Sewer Drop Connections:** Drop sewer connections shall be constructed in conformance with standard details.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section [601](#).

**625.3.3 Sanitary Sewer Manhole Testing:** All new sanitary sewer manholes installed shall be tested for exfiltration either by a watertightness test or by a negative air pressure (vacuum) test modified for the timeframes listed below. Exfiltration testing shall be performed in accordance with Subsection [611.3\(B\)](#) and Arizona Department of Environmental Quality (ADEQ) Engineering Bulletin No. 11, Chapter 4, Section B.

When using the watertightness test method, exfiltration loss shall not exceed 0.1 gallons per vertical foot of manhole in a 24-hour period.

Negative air pressure (vacuum) testing shall be performed in accordance with ASTM C 1244, modified for the timeframes below. Testing shall be performed at the top of the manhole cone for manholes located in paved areas. Manholes outside paved areas shall be vacuum tested at the ring and cover. A negative air pressure of ten (10) inches of mercury shall be drawn on the manhole. The time shall be measured for the vacuum to drop from ten (10) inches to nine (9) inches of mercury. The manhole shall pass this test if the time to drop in mercury meets or exceeds the following values:

**TABLE 625-1**

MANHOLE DEPTH	MINIMUM TEST DURATION (SECS) 48-INCH DIAMETER MANHOLE	MINIMUM TEST DURATION (SECS) 60-INCH DIAMETER MANHOLE
12 feet or less	60	75
Greater than 12 feet to 15 feet	Not Applicable*	90
Greater than 15 feet	Not Applicable*	105

\*Manholes greater than 12 feet in depth shall be 60-inch diameter

If manhole joint compound is pulled out during the vacuum test, the manhole shall be disassembled and the joint repaired or replaced as necessary. The vacuum testing shall then be repeated until the manhole passes.

Exfiltration testing of sanitary sewer manholes is considered incidental to the cost of furnishing and installing the manhole. There will be no separate measurement or payment for this testing.

### 625.4 MEASUREMENT:

Each type of manhole installed shall be measured as a complete unit. No distinction shall be made based on manhole depth.

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### **625.5 PAYMENT:**

Payment will be made at the contract unit price for each accepted manhole, and shall be compensation in full for furnishing and installing the manhole, complete in place, with formed or pre-cast inverts, concrete foundation, sanitary sewer drop connections, sheeting and bracing, removal of obstructions, cast iron frame and cover, excavation and backfill, paving cut replacement in excess of the applicable pay widths authorized in Section [336](#), and any incidentals thereto, in conformance with the plans and specifications.

*- End of Section -*

## SECTION 626

### CORROSION COATING OF SANITARY SEWER MANHOLES

#### 626.1 GENERAL

##### 626.1.1 Description

- (A) Scope: All new concrete manholes and access structures constructed over 15-inch diameter or larger sanitary sewers shall have an internal corrosion coating as specified herein. When specified, existing sanitary sewer manholes shall be similarly coated.
- (B) Requirements
- (1) Contractors shall furnish all labor, materials, and equipment required to clean and line the manholes.
  - (2) Contractor shall comply with the local authority and all occupation safety and health administration (OSHA) requirements for confined space entry.
  - (3) All materials specified by name brand or manufacturer shall be delivered unopened to the job in original containers.
  - (4) All Safety precautions recommended by the manufacturer in printed instructions or special bulletins shall be obtained and followed.
  - (5) For existing manholes, application of coating shall be carried out after all planned repairs to cone, walls, pipe penetrations, bench and invert are completed.
  - (6) Contractor applicator shall be certified by the coating and underlayment material manufacturers as properly trained for applying the manufacturer's coating and underlayment products. Underlayment products include repair materials, fillers, primers, etc.

##### 626.1.2 Quality Assurance

- (A) Standardization: Materials and supplies provided shall be the standard products of manufacturers. The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the Engineer that they are equal in composition, durability, and usefulness for the purpose intended. Requests for submission shall include directions for the application, descriptive literature, safe storage, handling, and disposal of the product.
- (B) Warranty:
- (1) A written warranty against coating failure shall be provided for the entire coating system, including all repair material, defect fillers, primers, intermediate, and finish coats. The minimum duration of the warranty shall be five (5) years. The product and the installation may be both covered by the manufacturer's warranty, or separate warranties may be issued by the manufacturer and installer.
  - (2) This warranty shall state that the coating will not fail for a minimum period of five years. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate. The warranty shall also apply to any underlayment materials used in the application. If any repair or replacement is necessary within the warranty period, a new 5 year warranty period shall start at the date that the manhole is placed back into service.

##### 626.1.3 Submittals

- (A) Contractor Shall Submit:
- (1) Manufacturer's data:
    - (a) Manufacturer's technical literature on coating material.

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- (b) Description of installation method including:
- (I) Product material safety data sheets (MSDSI).
  - (II) Maximum storage life and storage requirements.
  - (III) Mixing and proportioning requirements (as applicable).
  - (IV) Environmental requirements for application and worker safety, including ventilation, humidity, and temperature ranges.
  - (V) Application film thickness PM coat of primer and finish coat.
  - (VI) Curing time required.
- (2) Sample of finished product showing final color: Coating shall be light in color.
- (3) Contractor (or subcontractor) applying coating shall be an Arizona licensed contractor: Each of the Contractor's employees applying coatings and underlayments shall be certified by manufacturer as having sufficient training and knowledge to properly apply their products. Contractor shall submit certification documents. Such certification shall be no more than two (2) years old for any applicator.

### 626.2 PRODUCTS

#### 626.2.1 Coating Material

- (A) Approved Materials: Coating materials shall be one of the following pre-approved products:
- (1) Sauereisen corrosion-clad polymer lining No. 210, and Sauereisen underlayment. No. F-120, as manufactured by Sauereisen Cements, Pittsburgh, PA 15238. The underlayment shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
  - (2) Sewer shield 100 topcoat as manufactured by Environmental Coating, Mesa, AZ 85207. An underlayment recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
  - (3) Raven 405, as manufactured by Raven Living Systems, 1024 North Lansing Avenue, Tulsa, OK, 74106. An underlayment recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
  - (4) COR+GARD, Polymer and Permacast MS 10,000 underlayment as manufactured by AP/M Permaform P.O. Box 55, 620 NW Beaver Drive, Suite 1 Johnston, IA 50131. The underlayment shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.

NOTE: This product is a trial product with limited applications. A maximum of 50 total manholes in City of Phoenix until February 26, 2019, or five (5) years following first installation, whichever is later. All applications shall be reported to the Water Services Department Wastewater Engineering and Construction Management Section.

- (B) Dry film thickness of epoxy/polymer coatings shall be minimum 1/8-inch (125 Mils) thick.
- (C) Cured underlayment thickness shall equal or exceed minimum thickness recommended by manufacturer, but shall provide uniform finished surface for application of epoxy/polymer.

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### 626.3 EXECUTION

#### 626.3.1 Manhole Cleaning

- (A) Cleaning shall remove all sediment, rocks, debris, roots, grease accumulations, and obstructions from the manholes. Cleaning of the manhole walls, bench, and channel shall remove all grease, scale encrustation, and loose mortar so that no foreign intrusion shall cause imperfections in the coating. Cleaning methods shall include washing with high-pressure water, mechanical removal, or other as approved by the Engineer.
- (B) The Contractor shall use water blasting with a minimum water pressure of 3,000 PSI to clean the manhole prior to applying the coating. Contractor shall also be responsible for any additional surface preparation beyond water blasting as required by the coating system manufacturer. Where additional preparation is required, the Contractor shall provide all labor materials and equipment as necessary at no additional cost to the City.
- (C) Before installation of the coating system, the surface must be clean. Excess water shall be blown from the surface using compressed air equipment with oil-trapping filters. Suitable heaters shall be used as needed to produce a surface-dry condition. The surface shall be vacuumed to make sure that loose particles are not present.
- (D) Any sediment or debris from cleaning operations larger than U.S. #8 sieve shall not be deposited downstream in the sewer. Sedimentation deposited downstream, as determined by the Engineer, shall be removed at no cost to the City.

#### 626.3.2 Coating Installation and Repair

- (A) With Engineer's approval new manholes may have corrosion coating applied at manhole manufacturer's facility but all final acceptance testing shall be performed in field following installation of manhole.
- (B) If new manhole is coated at manufacturer's facility then joints will require sealing and coating in the field after manhole assembly. After the joint is assembled in field the Contractor shall prepare the coated surface above and below the joint to receive the protective coating in accordance with the manufacturer's recommendations. Typically a light abrasion blast to 2-inches above and below the joint will clean the surface and give the coating a good surface to adhere to.
- (C) If new manhole is coated at manufacturer's facility, coating of joints, chimney, bench and invert, and any necessary repairs to barrel or cone shall be performed in the field after successful leakage testing per Section [625](#).
- (D) New manholes that do not have corrosion coating applied at manhole factory shall be fully coated in the field including barrels, cones, joints, chimney, and bench and invert after successful leakage testing per Section [625](#).
- (E) When identified for corrosion coating existing manholes shall be prepared in accordance with these specifications and the manufacturer's recommendations. Weak and deleterious material shall be removed down to sound substrate. Repairs shall be made with coating manufacturer's recommended underlayment. Coating shall be applied to barrels, cones, joints, chimney, and bench and invert. If flows cannot be bypassed or diverted with a flow thru plug, Engineer may waive coating of invert.
- (F) If frame and cover of an existing coated manhole is adjusted in the field, the existing or added chimney adjustment rings shall be coated or have coating repaired as necessary in accordance with the manufacturer's recommendations.

#### 626.3.3 Inspection and Testing

- (A) Contractor shall give Engineer a minimum of three days advance notice ~~on~~ before start of ~~field~~ any surface preparation work, underlayment application work, ~~or~~ coating application work or testing.
- (B) All work and testing shall be performed in presence of Engineer, unless Engineer has granted prior approval to perform portions of the work in his/her absence.

## SECTION 626

- (C) Acceptance for holidays testing and adhesion testing shall be witnessed by an independent Testing Agency or Laboratory approved by the City of Phoenix. Cost of this inspection and testing shall be the responsibility of the Contractor. At owner's option, owner may waive requirement for Contractor provided testing agency or laboratory and have engineer witness this testing.
- (D) Additional illumination, scaffolding, and confined space entry equipment and support shall be provided by Contractor as necessary to facilitate inspection by Engineer and/or Testing Agency when requested.
- (E) Contractor shall furnish appropriate equipment and supplies for holiday testing, dry and wet film thickness testing, and coating adhesion testing. Contractor shall provide trained personnel for performing required acceptance testing including operation of holiday detection devices.
- (F) Holiday testing equipment and procedures shall be performed in strict accordance with latest edition of NACE "Standard Recommended Practice-Discontinuity (Holiday) Testing of Protective Coatings." Areas containing holidays shall be marked repaired or re-coated and re-tested in accordance with coating manufacturer's printed instructions. Holiday detectors shall be:

High voltage pulse-type holiday detectors as manufactured by Tinker & Rasor or D.E. Stearns Co. Unit shall be adjusted to operate at voltage required to cause sparks jump across air gap equal to twice specified coating thickness. Minimum applied voltage for 125 Mil coating shall be 12,500 volts.

- (G) Wet film thickness measurement shall be provided by report submitted by Contractor ~~or~~ to Engineer. The report shall be presented after completion of underlayment, top coating operations, and shall state number of manufacturer's product units used and total square footage of surface area covered. Engineer shall have option of requiring Contractor to document number of units (coating materials) on hand before and after coating operations to verify actual minimum dry film thickness applied.

All film thicknesses not meeting required minimums will be re-coated per manufacturer's recommendations to required minimum 125 mil thickness.

- (H) Contractor shall perform adhesion tests on 15% of the manholes coated on any given project (at least one manhole if 15% is less 1.0). Adhesion tests shall conform to ASTM D7234, minimum pull off strength shall be 200 PSI on concrete and 100 PSI on brick and some portion of substrate shall be adhered to coating and dolly. A minimum pull off strength of 150 PSI on concrete will be acceptable if substrate is adhered to coating and dolly on more than ½ the area of the dolly. 50mm dollies shall be used for adhesion testing. In the event of a failure, Engineer and Contractor shall determine limits of failure through additional investigation, sounding and pull tests. Failed areas shall be removed and repaired in accordance with these specifications and manufacturers recommendations. Repaired area shall be tested.

### 626.3.4 Warranty Period Inspection:

Owner may conduct inspection anytime prior to five (5) years following completion of new coating work and/or repaired coating work. Contractor and representative of coating manufacturer shall be notified of any apparent coating failures. Defective work or coating failures shall be repaired in accordance with specifications and to satisfaction of Owner. If warranty inspections are not held, Contractor is not relieved of responsibilities under Contract Documents.

### 626.4 MEASUREMENT

Measurement shall be per square foot of manhole wall coated.

### 626.5 PAYMENT

Payment shall be made at unit price bid per square foot, and be full compensation for cleaning, surface preparation materials, application, testing, and any incidentals, thereto, in conformance with the plans and specifications.

- End of Section -

## **SECTION 627**

### **PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE**

#### **627.1 GENERAL**

This specification pertains to manholes on sewer, 15-inch in diameter and under.

All new manholes shall be painted with insecticide.

After the new pipe has been tested, inspected, and accepted for service and the manhole has been adjusted to final grade, the top 8 feet or from the manhole bench to the finish grade whichever is less shall be painted. The entire interior circumference shall be covered, including adjusting rings.

The interior of the manhole shall be free from all loose material to provide a clean bonding surface. Refer to manufacturer's specifications for preparation instructions.

Existing manholes, to which corrosion coatings are applied, shall be painted with insecticide.

#### **627.2 INSECTICIDE PAINT**

Product shall meet requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application.

#### **627.3 APPLICATION**

Product shall be applied in accordance with requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application. Paint must be applied to top 8-feet of manhole cone and barrel. Paint must be applied by a State of Arizona Licensed Pest Control Applicator.

Existing manholes to which a tap or main connection is made do not require insecticide paint.

#### **627.4 MEASUREMENT**

Measurement shall be per manhole.

#### **627.5 PAYMENT**

Payment shall be made at unit price bid per manhole, and be full compensation for cleaning, surface preparation, materials, application, and any incidentals, thereto, in conformance with plans and specifications.

*- End of Section -*

## SECTION 630

### TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

#### 630.1 DESCRIPTION:

The installation of all tapping sleeves, valves and valve boxes shall conform to this specification and standard details, except as otherwise required on the plans or as modified in the special provisions.

#### 630.2 GENERAL:

For valves 12 inches and smaller, the Contractor shall furnish the manufacturer's standard data and catalogues for gate valves, tapping valves, tapping sleeves, curb stop valves, butterfly valves and any castings.

For valves larger than 12 inches, the Contractor shall furnish shop drawings and technical data required for evaluating and approval of each type of valve, tapping sleeve and valve and butterfly valve. This information shall include complete details, dimensions, weights, diameter of stems, alloy for all valve parts, and any information that may be required to assemble, install, operate and maintain the valve.

The name of the manufacturer, the year of manufacture, the size of the valve, model number and rated working pressure, shall be cast on the body of each valve.

The Contracting Agency may test 10 percent of each type and size of valve furnished. Failure of any of the valves tested to meet these specifications shall be deemed sufficient cause to reject the entire lot delivered.

The internal working parts of valves of the same make, type, and size, shall be interchangeable.

#### 630.3 GATE VALVES:

**630.3.1 General:** All valves shall conform to the latest revisions of AWWA standards supplemented as follows:

Valves shall be of the non-rising stem type and shall be counter-clockwise opening (left-hand).

The valve may be furnished with valve stems made from 300 or 400 series stainless steel.

Unless otherwise noted, valves shall have a 2 inch square operating nut.

All valves shall be class 150 or higher as necessary to withstand the requirements of the pressure and leakage test.

Bronze for all interior parts of valves shall contain no more than 6 percent zinc if made from cast bronze, or must conform to Copper Development Association #67600 if made from bar stock material.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specifications TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

By-pass valves, valves attached to side outlets and valves in blow-off lines shall be flanged.

Valves in air release and vacuum relief lines shall be flanged or screwed as shown on the plans.

Valves in fire hydrant lines shall have a flanged joint end on the side towards the main and a restraint or mechanical joint end on the side towards the hydrant.

Valves larger than 20 inches shall have flanged ends, unless otherwise noted.

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Valves 20 inches and smaller may be furnished with flanged ends, mechanical joint ends, or push-on joint ends compatible with the type of pipe used, unless otherwise noted.

**630.3.2 Supplements Specifically Relating to Valve Sizes:** Iron body resilient-seated gate valves are allowed up to 30 inches in accordance with AWWA C509-01.

(A) Valves smaller than 3 inches:

Valves shall be threaded, all bronze, standard double disc, non-rising stem with wheel handles or brass ball style.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

(B) Valves 3 inches through 12 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515.

The valve shall be designed to work equally well with pressure on either side of the gate.

The valve shall be equipped with o-ring packing.

(C) Valves. 14 inches through 20 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515, or shall be double-disc gate in accordance with AWWA C-500.

Valves designed in accordance with AWWA C-509 shall be designed to work equally well with pressure on either side of the gate

Valves designed in accordance with AWWA C-500 shall be equipped with bronze tracks, rollers and scrapers. The bolts, nuts, studs, etc., used with the gear case shall conform the requirements for Bonnet Bolting in AWWA C-500.

Valves shall be for operation in a horizontal position. The valve shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. The case shall be filled with grease at the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

(D) Valves 24 inches and larger:

Valves shall be double-disc gate in accordance with AWWA C-500.

Valves shall be for operation in the horizontal position and equipped with bronze tracks, rollers and scrapers. Valves shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. Bolts, nuts, studs, etc., used with the gear case shall conform to the requirements for Bonnet Bolting in AWWA C-500. The case shall be filled with grease to the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

### **630.4 TAPPING SLEEVES AND VALVES:**

**630.4.1 Tapping Valves:** Tapping valves shall be identical in construction with the above specifications for gate valves. Tapping sleeves are considered an integral part of a tapping sleeve and valve assembly, with openings the same as the valve. Tapping valves shall have ends and seat rings of sufficient size to permit the use of full size cutters of either the Mueller or

**SECTION 630**

Smith type tapping machines. Tapping sleeve valves shall be flanged on one end to fit the tapping sleeve and a flange hub-end or mechanical joint on the other.

The tapping valve shall have the discs and seat ring so constructed that the inside diameter of the rings shall be at least 3/16 inch larger than the nominal size of the valve. The seat rings shall be bronze and shall have a minimum seating surface area equal to that of a standard gate valve, and the discs shall be proportionately larger to match.

Once the tap has been completed, the Contractor shall not operate the valve unless under direct supervision of the inspector.

<b>TABLE 630-1</b>	
<b>BY-PASS VALVE SIZES</b>	
<b>Gate Valve Diameter in Inches</b>	<b>By-Pass Valve Diameter in Inches</b>
16 to 20	3
24 to 30	4
36 to 42	6
48	8

**630.4.2 Tapping Sleeves:** All tapping sleeves where the tap size is the same size as the size of the main to be tapped shall conform to Subsection [630.4.2 \(A\) \(1\)](#).

Tapping sleeves shall be of extra heavy construction to provide resistance to line pressures. They shall be built in two halves for assembly around the main to be tapped.

The branch outlet shall have a flanged face for bolting to the tapping valve.

The inside diameter of the outlet branch shall be sufficiently larger than the nominal size to provide clearance for the full size cutters of the tapping machine.

Tapping sleeves shall be of the following types:

(A) Tapping sleeves for pipelines constructed of cast iron, ductile iron or asbestos cement:

Unless otherwise noted, the tapping sleeve assembly shall be pressure tested to 200 psi for a minimum of 30 minutes. The pressure test shall occur prior to tapping the main.

(1) Tapping sleeves in which the water is allowed to circulate between the sleeve and the outside surface shall comply to the following:

Gaskets of approved material shall be provided to form watertight joints along the entire length of the sleeve. The circumferential joints at the ends of the run of these sleeves shall be sealed by mechanical joints. Mechanical joints shall conform to the requirements set forth in AWWA C-111 as to dimensions, clearance, materials, etc. except the gaskets and glands for mechanical joints shall be in two pieces.

The longitudinal gaskets shall be totally confined or compressed between ridges and/or grooves extending continuously for the full length of both halves of the sleeve casting. Bolts shall be located close to the outside of the gaskets and closely spaced so as to exert sufficient pressure to form a watertight joint and to amply take care of any design stresses.

(2) Tapping sleeves in which the water is confined to the immediate area of the tap opening may be either of the following:

(a) Cast Iron - The outlet half of each sleeve shall be fitted with a continuous gasket of approximately circular cross-section permanently cemented into a groove surrounding the outlet opening. The back half of each sleeve shall be fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe. The sleeve shall be similar in construction to the Kennedy Square Seal or Rich-Corey improved sleeve.

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(b) Stainless Steel, Type 304 - All integral metal parts of the sleeve shall be stainless steel, type 304. All welds shall be chemically treated and the residue removed so as to return the welded stainless steel to its original corrosion resistant state. The sleeve shall be capable of withstanding 125 ft.-lbs. of bolting torque without deformation of any sleeve components. Actual bolting torque during installation shall be as specified by the manufacturer.

All gaskets shall be of virgin styrene butadiene rubber (SBR), or equal, compound for water services. The complete circle gasket shall be 0.25 inch  $\pm$ 0.03 thick and permanently attached to the sleeve. A dielectric insulating flange insulation kit shall be installed between the stainless steel flange and the cast iron valve. The kit shall contain full faced gaskets, full length sleeves, and single insulating washers. Insulation gasket material shall be neoprene-faced phenolic, insulation sleeves shall be mylar or minlon and full length, insulation washers shall be phenolic, or approved equal. All insulation material shall be of a type designated by the manufacturer as suitable for service at the operation temperatures and pressure specified.

(B) Tapping sleeves for concrete pressure pipes shall be fabricated tapping sleeves and comply to the following:

The sleeves shall be installed in accordance with AWWA Manual M-9. They shall also meet AWWA C-301, and AWWA C-303 standards pertaining to design, manufacturing, testing and welder qualifications. When tapping AWWA C-301 pipe, additional considerations pertaining to installation, testing and tapping shall be noted in the special provision and/or the plans.

The tapping sleeve assembly shall be designed to meet or exceed the pressure rating of the pipe using the same safety factors.

The tapping sleeve assembly shall be pressure tested to at least 5 percent over the actual working pressure in the pipeline. The main shall be pressurized to full working pressure during the test of the sleeve. The test shall occur prior to tapping of the main.

The sleeve shall be a three part design, back half, front half with draw flange and a gland as shown in MAG Standard Detail 342. The sleeve shall be designed to permit the cutting of the rods or prestressing wires of the pipe after installation of the two sleeve halves. The gland shall have a sealing gasket set in a retaining groove on the pressure plate. The sealing portion of the gasket shall be square or rectangular in shape and have minimum dimensions of 1/2 inch x 1/2 inch. The pressure plate on the gland shall be stabilized to eliminate flexing. The gland shall be equipped with load bearing set screws to protect the pipe cylinder from any excess loading caused by the valve, tapping machine, etc. The annular space between the sleeve and the gland shall be grouted through an opening in the sleeve.

Both halves of the sleeve shall be the same thickness and width. With approval from the Engineer, stainless steel strapped back sleeves will be permitted when the outside pipe diameter is irregular and cannot accommodate a full back sleeve.

The sleeves shall be furnished with grout horns/openings through which the annular space between the outside pipe surface and the sleeve shall be grouted.

All interior and exterior ferrous surfaces shall be epoxy coated to a minimum dry film thickness of 12 mils. Epoxy coating shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550 for use in a potable water system.

All bolts shall be 304 stainless steel.

No weld-on sleeves or nozzles will be permitted.

Tapping sleeves shall be JCM #415 Type 2 ESS or approved equal.

All external surfaces of the tapping sleeve shall be covered with a minimum of two inches of mortar. The mortar shall be Type "M" per Section [776](#) using Type II low alkali cement. The mortar shall be held in place by use of wire mesh.

The Contractor shall obtain the necessary dimensions for ordering the sleeve from direct field measurements. Excavation may be required to obtain the measurements. If an excavation is required, the Engineer may require the Contractor to return the land to its original use until the materials are delivered.

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The Contractor shall provide, for approval of the Engineer, the manufacture, shop drawings, calculations, and any other technical data as required by the Engineer for the tapping sleeve. Also, the contractor shall submit the manufacture history of 6 successful production of the sleeves over the last year. The submittal shall include but not limited to the number, size, location, agency and contact person, etc.

The Contractor shall also provide, for approval by the Engineer, the name of the company/contractor/subcontractor to install the sleeve and perform the tap. The submittal shall include a history of 5 successful sleeve installations and taps per year over the last 3 years. The submittal shall include but not limited to the sizes and locations of the taps, the agencies and contact persons, the addresses and telephone numbers, etc.

**630.4.3 Tapping and Associated Fees:** Except for meter service connections, taps shall be made by the Agency at prevailing rates or by approved Contractors when allowed or requested by the Contracting Agency. After installation of the tapping sleeve and valve, the Contractor shall provide an excavation sufficient in size to accommodate the tapping operation.

The Contractor shall pay the established shutdown charge to the Contracting Agency every time it is necessary to shut off valves and take a section of a water main out of services.

The above charges, as well as charges for tap connections to steel cylinder and reinforced concrete pipe, are subject to change, as established by the Contracting Agency.

### **630.5 BUTTERFLY VALVES:**

(A) 16 inches and larger:

Valves shall be in accordance with AWWA C-504 latest revision as modified herein:

- (1) Valve body shall be of cast iron or ductile iron with connecting ends one of or a combination of Flanged (Short Body), mechanical joint or ACP Hub End.
- (2) Valves shall be Class 150-B unless otherwise specified.
- (3) When requested the manufacturer shall furnish records of tests specified in AWWA C-504.
- (4) Shaft seal may be O-ring seal, V-type packing or pull down packing.
- (5) The valve disc may be either cast iron or ductile iron.
- (6) Valves and operators shall be for direct burial installation.
- (7) Valves to be furnished with manual operators and 2 inch square operating nut. Operator torque rating shall be calculated in accordance with AWWA C-504.
- (8) Valves shall open when turning the operating nut counter-clockwise.
- (9) Valves shall be installed with valve shaft in a horizontal position and the operating shaft vertical.
- (10) All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.
- (11) All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.
- (12) A manufacturer's affidavit of compliance shall be furnished.

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(13) Shop drawings shall be furnished.

(14) The rubber valve seats shall be located in the valve body for valves 16-inches in diameter and larger. Valve seat configurations which rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable. The seating surfaces mating with rubber seats shall be AISI Type 304 or 316 stainless steel, monel or plasma-applied nickel-chrome overlay for all valves.

(15) Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts with a hexagonal cross section is not acceptable. The connection between the shaft and the disc shall be mechanically secured by means of a solid, smooth sided, stainless steel or monel taper pin or dowel pin. Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of bolts, setscrews, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins, or other devices instead of the solid, smooth sided, stainless steel or monel taper pins or dowel pins shall not be acceptable.

(16) Prior to installation of the butterfly valve, Contractor shall provide to the inspector, certification statements from the valve manufacturer indicating the leakage tests in both directions, proof of design tests were performed and successfully met per AWWA C504-06 Section 5.1.2. If certifications are not provided, Contractor can elect to perform tests per AWWA C504-06 Section 5.1.2 and witnessed by the inspector. If the tests are not successful, the contract is required to contact the manufacturer to have the seats adjusted until such a time the tests are successful in both directions.

(B) 3 inches through 12 inches:

This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chalmers Manufacturing Company, or approved equal.

Where material or equipment is designated on the plans or in this specification by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance and performance.

All specific requirements of this specification must be adhered to, and all necessary modifications shall be made in the article specified by the trade name, type or model or manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B, except as modified herein:

(1) Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets, forecast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.

(2) Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.

(3) Valves shall be left-hand opening, counter-clockwise unless shown otherwise on the plans.

(4) Discs shall be Ni-Resist, ASTM A436, Type 1, or cast iron, ASTM A48, Class 40, in accordance with the following variations:

(a) Cast iron disc may be used providing the rubber seat ring is contained on the disc with the rubber ring closing against a Type 304 stainless steel ring or a bronze ring contained in the body of the valve.

(b) Ni-Resist disc may be used where rubber seat is contained in the valve body.

(c) Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, unless the shaft is completely sealed from the

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line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other metal parts in contact with the line fluid to be Type 304 stainless steel.

Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in its final position. Rubber seats which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304, or bronze conforming to ASTM B61 or ASTM B584.

Manual operators shall have AWWA 2 inch square operating nuts and shall require at least 2 turns per inch diameter to rotate the disc 90 degrees. Operators must accept a minimum of 300 ft. lbs. input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils.

Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions.

The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

### **630.6 AIR RELEASE AND VACUUM VALVES**

Valve assemblies shall be furnished and installed where shown and as detailed on the drawings.

(A) Air release on water mains shall be controlled by the use of an air release valve assembly, of size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as designated on the Agency's approved products list or in the special provisions.

(B) Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above. The valves shall be of the same manufacture or may be a combination air and vacuum valve assembly designated on the Agency's approved products list or in the special provisions.

### **630.7 CONSTRUCTION METHODS:**

All valves, their supports, manholes, vaults, and valve boxes shall be installed in accordance with Section [610](#).

Valves 16 inches and larger, before being shipped from the factory, shall have the flanged ends completely covered with plywood. Plywood shall be left on the valve until just before installation in the line.

### **630.8 MEASUREMENT:**

Measurement will be by the unit each of the various kinds and sizes of valves, manholes, vaults, or tapping sleeves and valves, including valve boxes and covers.

### **630.9 PAYMENT:**

Payment will be made at the contract unit price and shall be compensation in full for the complete installation in place including all labor, materials, equipment, and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section [336](#) for pavement replacement over pipe trenches.

*- End of Section*

## SECTION 631

### WATER TAPS AND METER SERVICE CONNECTIONS

#### 631.1 DESCRIPTION:

This specification covers work by Contractors installing water services in new subdivisions by Permit and in projects under Contract. All the materials used shall comply with applicable standard specifications and the work performed in accordance with these specifications and standard details. The service connections shall be complete and all material shall be furnished by the Contractor except for the water meter.

All water service connections shall be constructed of Type K copper tubing or ultra-high molecular weight polyethylene pipe of nominal iron pipe outside diameter.

All new subdivision water lines shall be staked for line and grade at 100 foot intervals by the Developer's Engineer prior to construction. All meter locations shall be staked by setting two stakes for line and marking one of the stakes for grade.

#### 631.2 MATERIALS:

Copper pipe, tubing and fittings shall conform with Section [754](#).

All fittings, pipe and tubing for polyethylene and copper pipe shall be as noted on standard details and as indicated in Section [610.3](#) Materials.

#### 631.3 INSTALLATIONS:

**631.3.1 General:** Installation of copper tubing for meter service connections shall be in accordance with Section [754](#).

Meter service connection with copper tubing shall be in accordance with standard details.

The water service connection shall include the tap on the main, the corporation stop, the saddle if applicable, service pipe, appurtenant fittings, the curb stop, meter box and meter box cover, in accordance with standard details. Water meter boxes shall be installed in accordance with standard details to line and grade set by the Developer's Engineer. Upon acceptance, the Developer shall be responsible for damage to water meter boxes and covers until such time as the meters are installed by the Contracting Agency.

After the installation and acceptance of the water main and meter service pipe connections the water meter will be installed by the Contracting Agency upon proper application and payment of prevailing fees.

**631.3.2 Standards:** Except as otherwise specified all work shall be done in accordance with Sections [601](#) and [610](#).

**631.3.3 Excavation and Backfill:** The backfilling and compaction may be done as soon as the service line is installed, except backfilling and compaction shall not be completed around the corporation stop at the main water line until after inspection and recording of all tap locations. Trench bottom must be smooth and free of sharp objects. The minimum width of trench for water service pipe shall be 3 inches. The minimum depth of service pipe shall be 30 inches below the finished paving grade.

**631.3.4 Polyethylene Pipe:** Polyethylene pipe shall not be kinked, gouged or damaged during installation and backfilling operations. The pipe shall be placed in the trench allowing at least 12 inches per 100 feet for thermal contraction and expansion. Polyethylene pipe has a high thermal expansion and should never be confined under tension. The pipe should not be stored in the sun or left in the trench under abnormal high temperature. The pipe shall be carefully snaked in the trench bottom and covered up with uniform slack throughout its length. In trenches less than 8 inches in width, the expansion shall be obtained by making the tap on the opposite side of the main from the water meter and providing a loop of slack service pipe back over the top of the water main. Before installing, inspect pipe to detect any damage that may be caused by shipping, storage or handling. Damage spots can be cut out and pipe recoupled with Ford C-66-33, C-66-44, or approved equal brass compression fitting to form a continuous length. Damaged pipe shall not be used. Polyethylene pipe shall be cut only with a tubing cutter with rollers properly designated for the size of pipe being cut. When polyethylene pipe is used, the meter box setting must be placed parallel to the back of the sidewalk in accordance with standard details. Polyethylene pipe

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shall be installed with large sweeping bends with radius of not less than 18 inches. Polyethylene pipe has a cold flow characteristic and must not be installed under a stressed condition. Compression fittings only may be used with the plastic being held securely between metal to metal. Stainless steel or brass inserts shall be placed in the proper position in each compression fitting with care taken to assure that the insert remains in place when the fitting is tightened. All meter service lines shall extend at right angles from the main to the curb lines.

**631.3.5 Service Taps:** One inch and 3/4 inch service taps to new meter mains may be made with a saddle, tapped coupling or direct tap in accordance with the following provisions:

The Developer may use heavy tapped couplings for meter service connections on all sizes of pipe including the 3 inch pipe in cul-de-sac streets. Bronze corporation stops must be installed in the tapped couplings prior to pressure testing or disinfection of the water main. Normally in subdivisions no saddles are required for 6 inch pipe and larger. At the Contractor's option, saddles may be used on all 6 inch pipe and larger. All service connections on major and collector streets shall be made with saddles or heavy duty tapped couplings regardless of the water main size or service pipe size. All taps on pipe smaller than 6 inches must be made by either a saddle or heavy tapped coupling with bronze insert. Direct taps must be made by the use of a corporation stop with tapered AWWA machine thread. All wet taps must be made by the Mueller Type B-100 tapping machine or approved equal. A sharp tapping bit must be used in order to obtain clean sharp threads. In general, each tapping tool should be resharpened or discarded after making 6 taps. The minimum distance between taps, saddles, and tapped couplings shall be 3 feet.

### **631.4 TESTING:**

All services, service taps and fittings shall be tested along with the water main in accordance with Subsection [610.14](#).

### **631.5 CLEANUP AND COMPLETION:**

Upon completion and acceptance of all phases of the water main and meter service lines the Developer shall release the new subdivision water system to the Contracting Agency for final operation and maintenance with all interior valves and corporation stops in open position and with all meter curb stops and valves at the connections to existing mains closed.

### **631.6 INSPECTION:**

The Developer's Engineer shall make an as-built plan and make a record of the locations of all water service connections prior to the connections being covered up. This as-built plan shall give the stationing of each service tap. The stationing to be continuous for each street, and shall begin at the street intersection or property line at the end of the block.

### **631.7 SERVICE OVER 2 INCHES:**

All service taps larger than 2 inches shall be made by the Agency after an application and payment of prevailing fees, unless otherwise required by the Agency.

### **631.8 SERVICE ON EXISTING MAINS:**

Where all or part of a new subdivision is served by existing water mains, only authorized personnel of the Contracting Agency shall install the service connections upon proper application and payment of prevailing fees.

*- End of Section -*

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**PART 700**  
**MATERIALS**

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## SECTION 701

### AGGREGATE

#### 701.1 GENERAL:

Coarse and fine aggregates are defined in accordance with ASTM D2487. Material property requirements for specific uses are provided in applicable sections.

Apparent specific gravity shall be at least 2.50, when tested in accordance with ASTM C-127.

#### 701.2 COARSE AGGREGATE:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. Aggregate sources shall include, but not be limited to alluvial deposits, terrace aggregates, quarry stone, or other suitable sources including recycled products that meet all material test requirements as approved by the Engineer. Aggregate classification shall be made by size as noted herein.

**701.2.1 Boulders:** Particles of rock that will not pass a 12-inch square opening.

**701.2.2 Cobbles:** Particles of rock that will pass a 12-inch square opening, but are retained on a 3-inch square opening.

**701.2.3 Coarse Gravel:** Particles of rock that will pass a 3-inch U.S. standard sieve, but are retained on a 3/4-inch U.S. standard sieve.

**701.2.4 Fine Gravel:** Particles of rock that will pass a 3/4-inch U.S. standard sieve, but are retained on a No. 4 U.S. standard sieve

#### 701.3 FINE AGGREGATE (SAND):

Fine aggregate (sand) shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended. Fine aggregates particles shall pass a No. 4 U.S. standard sieve, but are retained on a No. 200 U.S. standard sieve.

#### 701.4 RECLAIMED CONCRETE MATERIAL (RCM)

Reclaimed concrete material (RCM) is defined as an aggregate material that is derived from the crushing, processing and classification of portland cement concrete construction materials recovered, salvaged, or recycled from roadways, sidewalks, buildings, bridges, and other sources.

The use of RCM in any manner shall require prior approval from the Engineer. In accordance with Section 7 of AASHTO M319, RCM shall not contain more than five percent by mass of brick or concrete block and shall be free of wood, metal, plaster, and gypsum board. RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction. With the approval of the Engineer, these respective quantities may be adjusted if the performance of the RCM is not adversely impacted. RCM may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RCM shall not be used in portland cement concrete without the prior approval of the Engineer.

#### 701.5 RECLAIMED ASPHALT PAVEMENT (RAP) AND RECLAIMED ASPHALT SHINGLES (RAS):

Reclaimed asphalt pavement (RAP) is defined as all recovered, salvaged or recycled asphalt road waste, large particles or milled material that has been size-reduced, crushed and or screened appropriately, making it reusable. This material shall be of a consistent and relatively clean manner as to not adversely affect the final material usage. RAP shall not be used in asphalt concrete, portland cement concrete or CLSM. RAP shall not be used in Structure Backfill. The use of RAP in other fill shall require prior approval from the Engineer.

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Reclaimed asphalt shingles (RAS) is defined as all recovered, salvaged or recycled asphalt roof shingles that have been processed to make the material reusable. RAS shall not be used in asphalt concrete, portland cement concrete or CLSM. RAS shall not be used in Structure Backfill. The use of RAS in other fill shall require prior approval from the Engineer.

### **701.6 SAMPLING:**

Sampling of aggregates shall be performed in accordance with ASTM D-75.

*- End of Section -*

**SECTION 702**

**BASE MATERIALS**

**702.1 GENERAL:**

Base material (Select Material Type A, Select Material Type B, Aggregate Base ABC), shall be crushed aggregate, with gradation per Table [702-1](#).

The Contractor shall submit documentation to the Engineer from a City approved testing laboratory showing compliance with Table [702-1](#) ten (10) days prior to placement of base material except where base materials are being obtained from an approved source that is on a list maintained by the City of Phoenix, Street Transportation Department, Design and Construction Management Division, Materials Lab Section.

RCM and RAP will not be utilized as base material without prior approval from the City of Phoenix Materials Lab.

Cement or lime treated base meeting the requirements of Section [705](#) can be utilized as base material, except within the pipe embedment zone around Reinforced Concrete Pipe (RCP) and metal pipe.

**702.2 PHYSICAL PROPERTIES:**

Crushed aggregate shall consist of crushed rock or crushed gravel or a combination thereof as defined in Section [701](#).

<b>TABLE 702-1</b>			
<b>Sieve Analysis</b>			
<b>Test Methods AASHTO T-27, T-11</b>			
<b>Accumulated Percentage Passing Sieve, by Weight</b>			
<b>Sieve Sizes (Square Openings)</b>	<b>Select Material</b>		<b>Aggregate Base</b>
	<b>Type A</b>	<b>Type B</b>	
3"	100	--	--
1 1/2"	--	100	100
1"	--	--	90-100
No. 4	30-75	30-70	38-65
No. 8	20-60	20-60	25-60
No. 30	10-40	10-40	10-40
No. 200	0-12	0-12	3-12
<b>CBR</b>			
<b>Test Method AASHTO T-193</b>			
Minimum at 0.2000 inch penetration at 65 blows, 100% compaction	50		50
<b>Liquid Limit</b>			
<b>Test Method AASHTO T-89 Method A, T-90, T-146 Method A</b>			
Maximum allowable value	25		25
<b>Plasticity Index</b>			
<b>Test Methods AASHTO T-89 Method A, T-90, T-146 Method A</b>			
Maximum allowable value	5		5

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<b>Fractured Face, One Face</b>		
<b>Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve</b>		
Minimum required value	50	50
<b>Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine</b>		
<b>Test Method AASHTO T-96, Percent Loss by Weight</b>		
Maximum allowable value 100 revolutions	10	10
Maximum allowable value at 500 revolutions	40	40
<b>Friable or Deleterious Substances</b>		
<b>Test Method ASTM C-142, Percent by Weight</b>		
Maximum allowable in fine aggregate	3	3
Maximum allowable in coarse aggregate	3	3
<b>Soundness</b>		
<b>Test Method ASTM C-88, Percent Loss by Weight</b>		
Maximum allowable in fine aggregate	10	10
Maximum allowable in coarse aggregate	12	12
<b>Apparent Specific Gravity</b>		
<b>Test Method ASTM C-127</b>		
Minimum (considering other factors)	2.65	2.65
<b>pH and Resistivity</b>		
<b>Test Method ARIZ 236</b>		
pH (For Pipe Embedment Zone Only)	5.0 – 9.0	5.0 -9.0
Minimum resistivity	2,000 ohm-centimeters	2,000 ohm-centimeters

- End of Section -

## SECTION 703

### RIPRAP

#### 703.1 GENERAL:

Aggregate for grouted and ungrouted riprap shall meet the requirements of Sections [701.2](#) and [703.2](#) unless otherwise stated in the project specifications.

Aggregate shall be color-matched with adjacent landscape aggregate if specified on the plans or in the special provisions.

The Contractor shall provide the Engineer, in writing, material information and the source location at least 10 days prior to use of the material unless the material is currently acceptable for use as determined by the Engineer.

#### 703.2 PHYSICAL PROPERTIES:

Riprap shall have the following physical properties:

(A) The maximum aggregate size shall be 150% of the indicated  $D_{50}$  size and the minimum aggregate size shall be 50% of the indicated  $D_{50}$  size.

(B) Aggregate shall be angular and shall not exceed 3:1 ratio for flat and/or elongated pieces when determined by ASTM D4791. Rounded aggregate shall only be allowed when specified or approved by the Engineer.

(C) The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM C535, shall not exceed 40 percent (by weight) after 1000 revolutions.

*- End of Section -*

## SECTION 705

### PORTLAND CEMENT TREATED BASE

#### 705.1 GENERAL:

The cement treated base shall consist of aggregate, cement, and water. Use of other types of materials must be approved by the Engineer. The compressive strength requirement shall be determined by the project specifications. The amount of cement used in the mix design shall be determined by the project specifications.

#### 705.2 AGGREGATE FOR CEMENT TREATED BASE:

The aggregate for cement treated base shall conform to the requirements of Subsection [702.2](#) Aggregate Base Course.

#### 705.3 PORTLAND CEMENT AND WATER:

Portland cement and water shall conform to the requirements of Section [725](#).

#### 705.4 CEMENT TREATED BASE MIX DESIGN:

A cement-treated base mix design incorporating the proposed materials shall be completed prior to the start of work. The mix design shall be performed in accordance with Arizona Department of Transportation test methods ARIZ-220, ARIZ-221, and ARIZ-222. Compressive strength specimens shall be tested in accordance with ARIZ-241.

The final report shall include the following elements:

- (1) The source and supplier of the aggregate including gradation and plasticity index testing.
- (2) The source, supplier, and type of cement.
- (3) The cement content required to meet the project specifications. Cement content shall be calculated by the dry weight of the combined aggregate-cement mixture.
- (4) The optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-221.
- (5) The rock corrected optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-222.
- (6) A summary of design compressive strength testing including a graph plotting cement content as the x-axis and compressive strength as the y-axis.

*- End of Section -*

## SECTION 708

### ASPHALT PAVEMENT CORE BONDING MATERIALS

#### 708.1 GENERAL:

This specification covers the materials required to bond asphalt pavement cores to the asphalt concrete pavement from which it was originally removed.

#### 708.2 MATERIALS:

Bonding material shall be a single component cementitious, rapid hardening, high strength, waterproof bonding agent conforming to the physical properties shown in Table [708-1](#).

TABLE 708-1		
Bond Material Properties		
Property	ASTM Test Method	Requirements
Bond Strength, psi	C882	20 min.
Compressive Strength, psi, (70 degrees F., 30 minute cure)	C109	200 min.

Bonding material shall be impervious to water penetration at the joint after curing.

Bonding material shall, within 30 minutes at minimum ambient temperature of 70 degrees F., allow an 18" diameter core to support a traffic load equivalent to at least three (3) times the AASHTO H-25 standard wheel load.

The bonding material is required to securely bond the asphalt concrete core to asphalt concrete pavement and to fill all voids between the core and pavement and within the core.

#### 708.3 TEST REPORT:

Specifications and test results for the bonding material shall be submitted to the Agency for review and approval before use.

*- End of Section -*

## SECTION 710

### ASPHALT CONCRETE

#### 710.1 GENERAL

Asphalt concrete shall consist of a mixture of paving asphalt and mineral aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed at a central mixing plant in the proportions hereinafter specified to provide a homogeneous and workable mixture.

Asphalt concrete is designated as Type A-1½ Base Course; Type C-¾ Base, Surface or Single Course; Type D-½ Single or Surface Course, and Gyratory (on specified projects).

Each mix shall be designed using Marshall compaction methods, unless Gyratory is specified. Marshall Mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

#### 710.2 MATERIAL

**710.2.1 Asphalt:** The asphalt to be mixed with mineral aggregate shall be paving grade asphalt conforming to Section [711](#), and shall be PG 64-16 or PG 70-10 as directed by the Engineer, unless otherwise specified in the special provisions.

**710.2.2 Aggregate:** Coarse and fine aggregates shall conform to the applicable requirements of Section [701](#) except as modified herein.

Coarse aggregate is material retained on the No. 4 sieve and fine aggregate is material passing the No. 4 sieve.

Blending sand shall be clean, hard and sound material, either naturally occurring sand or crushed fines, which will readily accept asphalt coating. The exact grading requirements shall be such that, when it is mixed with the mineral aggregate, the combined product shall meet the requirements of the designated mix as specified elsewhere in this specification.

#### 710.2.3 Mineral Filler and Anti-Stripping Agent:

(A) Mineral filler shall conform to the requirements of AASHTO M-17. The mineral filler shall be dry hydrated lime conforming to the requirements of ASTM C 1097, or portland cement conforming to Section [725](#) or other approved mineral filler shall be added to the aggregate in accordance with the requirements contained herein. The amount of mineral filler to be used shall be determined by the Engineer. The method of adding the mineral filler shall be such that the aggregate is uniformly coated and the mineral filler is uniformly distributed without loss or waste within the material prior to adding the asphalt to the mixture.

(B) When aggregate is subject to stripping, dry hydrated lime conforming to the requirements of ASTM C 1097, portland cement conforming to Section [725](#) or other approved anti-strip agent shall be added. Hydrated lime and portland cement shall be added in accordance with Subsection [710.2.3\(A\)](#).

Other approved no strip agents shall be added in accordance with the manufacturer's recommendations and approved by the Engineer.

#### 710.2.4 Combined Aggregates:

The combined aggregates sampled after all processing, except the adding of asphalt and mineral filler, shall conform to the following quality requirements.

At least 85 percent by weight of the aggregate retained on the No. 8 sieve shall consist of particles which have at least one

**SECTION 710**

rough, angular surface produced by crushing.

**710.2.5 Mix Design Criteria:** Should the Contractor wish to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab 15 working days prior to the start of the asphalt placement. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the COP Materials Lab. These samples will not include standard COP mix designs approved through annual asphalt concrete supplier calibrations.

The mix design shall be performed by the Marshall Mix Design method and shall conform to the requirements specified herein. After the asphalt mix designs have been approved by the Engineer, the Contractor and/or the asphalt supplier shall not change the mix design or utilize additional mixing plants without prior approval of the Engineer.

<b>TABLE 710-1</b>						
<b>CRITERIA FOR STANDARD COP MARSHALL MIX DESIGNS</b>						
<b>LOW AND HIGH VOLUME</b>						
<b>Sieve Size</b>	<b>A 1-1/2"</b>		<b>C3/4"</b>		<b>D 1/2"</b>	
	<b>Target</b>	<b>Tolerance</b>	<b>Target</b>	<b>Tolerance</b>	<b>Target</b>	<b>Tolerance</b>
<b>1 1/2"</b>	100	---	100	---	100	---
<b>1"</b>	93	+/-7%	100	---	100	---
<b>3/4"</b>	90	+/-7%	95	88-100	97-100	---
<b>1/2"</b>	---	---	85	+/-7%	88	+/-7%
<b>3/8"</b>	63	+/-7%	75	+/-7%	78	+/-7%
<b>No. 4</b>	45	+/-7%	58	+/-7%	58	+/-7%
<b>No. 8</b>	35	+/-5%	44	+/-5%	45	+/-5%
<b>No. 30</b>	20	+/-5%	24	+/-5%	25	+/-5%
<b>No. 200</b>	5	+/-2%	4	+/-2%	5	+/-2%
	<b>High Volume</b>	<b>Low Volume</b>	<b>High Volume</b>	<b>Low Volume</b>	<b>High Volume</b>	<b>Low Volume</b>
<b>Oil Content %</b>	4.3 +/- .4	---	5.0 +/- .4	5.5 +/- .4	5.1 +/- .4	5.6 +/- .4
<b>Air Voids % (Recommended)</b>	5.0 +/- 1.0	---	4.5 +/- 1.0	4.0 +/- 1.0	4.5 +/- 1.0	4.0 +/- 1.0

<b>TABLE 710-2</b>				
<b>MARSHALL MIX DESIGN CRITERIA</b>				
<b>Criteria</b>	<b>Requirements</b>			<b>Designated Test Method</b>
	<b>1/2" Mix</b>	<b>3/4" Mix</b>	<b>1.5" Mix</b>	
Voids in Mineral Aggregate: %, Min.	14.0	13.0	12.0	AI MS-2
Effective Voids: %, Range (Recommended)	4.0 ±0.2 (LV) 4.5 ±0.2 (HV)	4.0 ±0.2 (LV) 4.5 ±0.2 (HV)	5.0 ±0.2	AI MS-2
Absorbed asphalt: %, Range*	0-1.0	0-1.0	0-1.0	AI MS-2
Dust to Eff. Asphalt Ratio, Range **	0.6-1.4	0.6-1.4	0.6-1.4	AI MS-2
Tensile Strength Ratio: % Min.	60	60	60	ASTM D 4867
Dry Tensile Strength: psi, Min.	100	100	100	ASTM D 4867
Stability: pounds, Min.	2,500	2,500	3,000	AASHTO T-245
Flow: 0.01-inch, Range	8-16	8-16	8-16	AASHTO T-245

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**710.2.6 Gyratory Mix Designs:** Gyratory Mix Designs shall be performed in accordance with the requirements of latest edition of the Asphalt Institute's SP-2 manual. Mix design laboratory compacted specimens shall be prepared using a gyratory compactor in accordance with AASHTO T-312.

The mix design shall be formulated in a manner described for volumetric mix designs in the current edition of the Asphalt Institute Manual SP-2, except the number of trial blend gradations necessary will be determined by the mix design laboratory. Duplicate gyratory samples shall be prepared at a minimum of four (4) binder contents to select the recommended binder content. The gyratory specimens shall be compacted to 160 gyrations. Volumetric data for the design number of gyrations,  $N_{des}$ , and the initial number of gyrations,  $N_{ini}$ , are then back calculated based on the bulk specific gravity,  $G_{mb}$ , of the  $N_{max}$  specimens and the height data generated during the compaction process of those same specimens. For Low traffic designs, volumetric data for 115 gyrations,  $N_{max}$  for Low Traffic designs, is also back calculated from the specimens compacted to 160 gyrations.

The corrected density of the specimens shall be less than 89.0 percent of maximum theoretical density at  $N_{ini}$ . The corrected density of the specimens shall be less than 98.0 percent of maximum theoretical density at  $N_{max}$ . The Gyratory mix shall comply with the criteria in Table [710-3](#).

<b>TABLE 710-3</b>				
<b>GYRATORY MIX DESIGN CRITERIA</b>				
<b>Criteria</b>	<b>Requirements</b>			<b>Designated Test Method</b>
	<b>3/8" Mix</b>	<b>1/2" Mix</b>	<b>3/4" Mix</b>	
Voids in Mineral Aggregate: %, Min.	15.0	14.0	13.0	AI SP-2
Effective Voids: %, Range	4.0 - 0.2	4.0 - 0.2	4.0 - 0.2	AI SP-2
Absorbed Asphalt: %, Range *	0 - 1.0	0 - 1.0	0 - 1.0	AI SP-2
Dust to Eff. Asphalt Ratio, Range **	0.6 - 1.4	0.6 - 1.4	0.6 - 1.4	AI SP-2
Tensile Strength Ratio: %, Min.	75	75	75	ASTM D 4867
Dry Tensile Strength: psi, Min.	75	75	75	ASTM D 4867
Mineral Aggregate Grading Limits				AASHTO T-27
	<b>Percent Passing with Admix</b>			
<b>Sieve Size</b>	<b>3/8 inch Mix</b>	<b>1/2 inch Mix</b>	<b>3/4 inch Mix</b>	
1 inch			100	
3/4 inch		100	90 - 100	
1/2 inch	100	90 - 100	43 - 89	
3/8 inch	90 - 100	53 - 89	-	
No. 8	32 - 47	29 - 40	24 - 36	
No. 40	2 - 24	3 - 20	3 - 18	
No. 200	2.0 - 8.0	2.0 - 7.5	2.0 - 6.5	
Number of Gyrations	<b>Low Traffic</b>		<b>High Traffic</b>	
$N_{ini}$	7		8	
$N_{des}$	75		100	
$N_{max}$	115		160	

\* Unless otherwise approved by the Engineer.

\*\* The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

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### 710.3 COMPOSITION AND GRADING:

The grading of the combined aggregates shall be such as to conform to the requirements indicated on the approved list. Contact the City of Phoenix Materials Lab for approved list of all standard COP mixes.

### 710.4 GENERAL REQUIREMENTS:

Mixtures shall be delivered to the site of the work without segregation of the ingredients and within the temperature range specified in Section [321](#).

At the time of delivery to the job site, the Engineer shall be provided with a legible weight master's certificate (delivery ticket) containing the following information:

- (1) Date
- (2) Supplier's name;
- (3) Plant location and/or plant number;
- (4) Ticket number;
- (5) Truck number;
- (6) Contractor's name;
- (7) Project name and/or location;
- (8) Product code/description with percent asphalt;
- (9) Mineral filler/additive and percent;
- (10) Temperature at batching;
- (11) Time of batching, arrival and unloading;
- (12) Material weight or vehicle weight with and without material;
- (13) Weight of accumulative loads.

*- End of Section -*

## SECTION 711

### PAVING ASPHALT

#### 711.1 GENERAL:

The asphalt shall be produced from crude asphalt petroleum or a mixture of refined liquid asphalt and refined solid asphalt. It shall be free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water.

Polymer modified asphalt cement shall be produced from crude asphalt petroleum and a polymer or blend of polymers mixed to produce a homogeneous material free from water.

Asphalt shall not be heated during the process of its manufacture, storage, or during construction so as to cause injury as evidence by the formation of carbonized particles.

#### 711.2 TESTING REQUIREMENTS:

Paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-1 and AASHTO M-320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent.

<b>TABLE 711-1</b>				
<b>PERFORMANCE GRADING SYSTEM</b>				
	<b>PG 58-22</b>	<b>PG 64-16</b>	<b>PG 70-10</b>	<b>PG 76-16</b>
<b>Original Asphalt</b>				
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
<b>Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)</b>				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear AASHTO T-315 G*/Sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
<b>Tests Using Pressure Aging Vessel Residue (AASHTO R-28)</b>				
PAV Aging Temperature, °C (AASHTO R-28)	100	100	110	110
Dynamic Shear AASHTO T-315 G**•Sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	28	34	34
Creep Stiffness, AASHTO T-313 (Note 3) S, Maximum, 300.0 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-12	-6	0	-6
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-12	-6	0	-6

**NOTES:**

(1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of G\*/sin(d) at test temperatures when the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).

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(3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.

Polymer modified paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-2 and AASHTO M320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent. P is for Polymer and TR is for Tire Rubber.

<b>TABLE 711-2</b>				
<b>PERFORMANCE GRADING SYSTEM</b>				
	<b>PG 64-28P</b>	<b>PG-76-22P</b>	<b>PG76-22TR Type 1 (Note 4)</b>	<b>PG76-22TR Type 2 (Note 4)</b>
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear, AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
Elastic recovery, ASTM D6084 Procedure "B" @ 10°C	65	65	65	55
Phase Angle, Max	75	75	75	75
Separation test, Texas 540 % Max	4	4	4	4
Solubility in Trichloroethylene, ASTM 2042 or n-propyl bromide, ASTM D7553 % Minimum	-	-	97.5	-
<b>Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)</b>				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear, AASHTO T-315 G*/sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
<b>Tests Using Pressure Aging Vessel Residue (AASHTO R-28)</b>				
PAV Aging Temperature, °C (AASHTO R-28)	100	110	110	110
Dynamic Shear, AASHTO T-315 G* sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	31	31	31
Mass Loss, AASHTO T-240 Weight % Max	1.0	1.0	1.0	1.0
Creep Stiffness, AASHTO T-313 S, Maximum, 300 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-18	-12	-12	-12
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-18	-12	-12	-12

**NOTES:**

(1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of G\*/Sin δ, at test temperatures when the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).

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(3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.

(4) "TR" binders shall have 9% to 11% reclaimed tire rubber and enough virgin polymer to meet all performance grade criteria specified. The blend percentages shall be listed on the Certificate of Compliance by the manufacturer. Type 1 shall meet solubility limits.

### 711.3 TEST REPORT AND CERTIFICATION:

At the time of delivery of each shipment of asphalt, the supplier supplying the material shall deliver to the purchaser 3 certified copies of the test report which shall indicate the name of the refinery and supplier, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the above specified tests. The test report shall be signed by an authorized representative of the supplier certifying that the product delivered conforms to the specifications for the type and grade indicated.

Until the certified test reports and samples of the material have been checked by the Engineer, that material will be only tentatively accepted by the Contracting Agency. Final acceptance will be dependent upon the determination of the Engineer that the material involved fulfills the requirements prescribed. The certified test reports and the testing required in connection with the reports shall be at no additional cost to the Contracting Agency.

### 711.4 TEMPERATURES:

Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating.

### 711.5 CONVERSION OF QUANTITIES:

When pay quantities of paving asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on Table [711-3](#).

<b>TABLE 711-3</b>		
<b>ASPHALT CEMENT QUANTITY CONVERSION</b>		
<b>Grade of Material</b>	<b>Gals. Per Ton of 60 °F.</b>	<b>Lbs. Per Gal at 60 °F.</b>
PG 58-22	236	8.47
PG 64-16	235	8.51
PG 70-10	235	8.51
PG 64-28P	236	8.47
PG 76-22P,TR	236	8.47
PG 76-16	233	8.58

- End of Section -

**SECTION 712**

**LIQUID ASPHALT**

**712.1 GENERAL:**

Liquid asphalt shall consist essentially of either natural crude or refined asphalt petroleum, or a residual product thereof.

The liquid asphalt shall be medium curing product designed by the letters MC, and shall consist of a paving asphalt conforming to the provisions in Section [711](#), fluxed or blended with a kerosene type solvent.

The asphalt shall not be heated during the process of its manufacture or during construction so as to cause injury as evidence by the formation of carbonized particles.

**712.2 TEST REQUIREMENTS:**

The liquid asphalt shall consist of materials specified above and shall conform to the requirements set forth in Table [712-1](#).

**712.3 TEST REPORTS AND CERTIFICATIONS:**

Test reports and certifications will be furnished in accordance with Section [711](#).

**712.4 CONVERSION OF QUANTITIES:**

When pay quantities of liquid asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on the data contained in Table [712-2](#)

<b>TABLE 712-1</b>										
<b>AASHTO M-82 TABLE 1</b>										
	<b>MC-30</b>		<b>MC-70</b>		<b>MC-250</b>		<b>MC-800</b>		<b>MC-3000</b>	
	<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>
Kinematic Viscosity at 60°C (140°F) centistokes	30	60	70	140	250	500	800	1600	3000	6000
Flash point (Tab. open-cup), degrees C° (F)	38 (100)	...	38 (100)	...	66 (150)	...	66 (150)	...	66 (150)	...
Water percent	...	0.2	...	0.2	...	0.2	...	0.2	...	0.2
Distillation test: Distillate percentage by volume of total distillate to 360°C (680°F)										
to 225°C (437°F)	...	25	0	20	0	10	...	...	...	...
to 260°C (500°F)	40	70	20	60	15	55	0	35	0	15
to 315°C (600°F)	75	93	65	90	60	87	45	80	15	75
Residue from distillation to 360°C (680°F) Volume percentage of sample by difference	50	...	55	...	67	...	75	...	80	...
Tests on residue from distillation:										
Absolute viscosity at 60°C (140°F) poises	300	1200	300	1200	300	1200	300	1200	300	1200
Ductility, 5 cm/min, cm.	100	...	100	...	100	...	100	...	100	...
Solubility in Trichloroethylene, percent	99	...	99	...	99	...	99	...	99	...

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<b>TABLE 712-2</b>		
<b>LIQUID ASPHALT QUANTITY CONVERSION</b>		
<b>Grade of Materials</b>	<b>Gals. Per Ton at 60 Degrees F.</b>	<b>Lbs. Per Gals. at 60 Degrees F.</b>
70	253	7.90
250	249	8.03
800	245	8.16
2000	241	8.30

- End of Section -

**SECTION 713**

**EMULSIFIED ASPHALTS MATERIALS**

**713.1 GENERAL:**

Emulsified asphalts shall be composed of a paving asphalt base uniformly emulsified with water and an emulsifying or stabilizing agent. It shall be homogeneous throughout and if stored, shall show no separation of ingredients within 30 days after delivery. Emulsified asphalt shall be classified as quick setting, rapid setting, medium setting or slow setting type in either anionic or cationic emulsions.

Emulsified asphalt shall be specified as follows:

- (A) Penetration type and high viscosity type emulsion shall be designated by the letters RS-Rapid Setting.
- (B) Mixing type emulsion shall be designated by the letters SS-Slow Setting, MS-Medium Setting and QS-Quick Setting.

**713.2 TESTING REQUIREMENTS:**

The emulsified asphalt shall conform to the requirements set forth in Table [713-1](#).

**713.3 TESTS REPORT AND CERTIFICATION:**

Test reports and certifications shall be made in accordance with Section [711](#).

TABLE 713-1														
REQUIREMENTS FOR ANIONIC EMULSIFIED ASPHALT (Specification Designation)														
Type	Rapid-Setting				Medium-Setting				Slow-Setting					
Grade	RS-1		RS-2h		MS-1		MS-2		MS-2h		SS-1		SS-1h	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tests on emulsions														
Viscosity, Saybolt Furol at 77°F (25°C.), sec	20	100			20	100	100		100		20	100	20	100
Viscosity, Saybolt Furol at 122°F (50°C.), sec			75	400										
Demulsibility, 35 ml. 0.02 N. CaCl <sub>2</sub> , percent	60		60											
Coating ability and water resistance														
Coating, dry and aggregate					good		good		good					
Coating, after spraying					fair		fair		fair					
Coating, wet aggregate					fair		fair		fair					
Coating, after spraying					fair		fair		fair					
Cement mixing test, percent											2		2	
Sieve test, percent		0.1		0.1		0.1		0.1		0.1		0.1		0.1
Residue by distillation, percent	55		63		55		65		65		57		57	
Tests on Residue from Distillation Test:														
Penetration 77°F (25°C), 100g, 5 s	100	200	40	90	100	200	100	200	40	90	100	200	40	90
Ductility, 77°F (25°C), 5 cm/min. cm.	40		40		40		40		40		40		40	
Solubility in trichloroethylene, %	97.5		97.5		97.5		97.5		97.5		97.5		97.5	

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TABLE 713-1 (continued)																				
REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT (Specification Designation)																				
Type	Quick Setting		Rapid Setting		Medium Setting		Slow Setting		Quick Setting											
Grade	QSH		CQSH		CRS-1		CRS-2h		CMS-2		CMS-2h		CSS-1		CSS-1h		PMCQS-1h			
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Tests on emulsions:																				
Visc., Saybolt Furol at 77°F., sec.	20	100	20	100									20	100	20	100	20	100		
Visc., Saybolt Furol at 122°F., sec.					20	100	100	400	50	450	50	450								
Storage Stability Test, 1 day, %	1		1		1		1		1		1		1		1		1		1	
Demulsibility, 35 ml 0.8% sodium dioctyl sulfosuccinate, %					40		40													
Coating ability and water resistance:																				
Dry aggregate after spraying									Good	Good										
wet aggregate after spraying									Fair	Fair										
Particle charge test			Positive		Positive		Positive		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	
Sieve Test, %	0.10		0.10		0.10		0.10		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Cement Mixing test, %													2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Distillation:																				
Oil distillate, by volume of emulsion, %					3		3		12	12	12	12								
Residue, %	57		57		60		65		65	65	65	65	57	57	57	57	57	57	60	
Test on residue from distillation test:																				
Penetration, 25°C (77°F), 100 g. 5 sec.	40	110	40	110	100	250	40	90	100	250	40	90	100	250	40	90	100	250	55	75
Ductility, 25°C (77°F.) 5 cm per min, cm.	40		40		40		40		40	40	40	40	40	40	40	40	40	40	40	
Ring and Ball Softening Point, AASHTO T-53																			130	
Elastic Recovery, % AASTHO T30																			55	
Solubility in trichloroethylene, %	98		98		98		98		98	98	98	98	97.5	97.5	97.5	97.5	97.5	97.5	97.5	

- \* If the Particle Charge Test result is inconclusive for CSS-1 or CSS-1h, material having a maximum ph value of 6.7 will be accepted.
- \* If using PMCQS-1h the Residue from distillation shall be obtained from ARIZ-504.

**713.4 TEMPERATURES:**

Unless otherwise specified, the various grades of emulsified asphalt shall be applied at temperatures within the limits specified in Table [713-2](#) the exact temperature to be determined by the Engineer. Emulsified asphalt shall be reheated if

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necessary. But at no time, after loading into a tank car or truck for transportation to the work site, shall the temperature of the emulsion be raised above the maximum temperature shown in Table [713-2](#). During all reheating operations, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40 degrees F.

<b>TABLE 713-2</b>		
<b>APPLICATION TEMPERATURE OF EMULSIFIED ASPHALT</b>		
<b>Grade of Emulsified Asphalt</b>	<b>Minimum °F.</b>	<b>Maximum °F.</b>
RS-1, MS-1, SS-1, SS-1h, CSS-1, CSS-1h	70°F.	140°F.
RS-2, MS-2, MS-2h, CRS-1, PMCQS-1h CRS-1h, CRS-2h, CMS-2, CMS-2h, QSH, CQSH	125°F.	185°F.

Emulsified asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the emulsified asphalt during heating.

**713.5 CONVERSION OF QUANTITIES:**

When pay quantities of emulsified asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on Table [713-3](#).

<b>TABLE 713-3</b>		
<b>EMULSIFIED ASPHALTS QUANTITY CONVERSION</b>		
<b>Grade of Material</b>	<b>Gals Per Ton at 60°F.</b>	<b>Lbs Per Gal. at 60°F.</b>
All grades	240	8.33

*- End of Section -*

## SECTION 714

### MICROSURFACING MATERIALS

#### 714.1 GENERAL:

Microsurfacing materials shall consist of a properly proportioned mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water, and other additives.

#### 714.2 AGGREGATE:

**714.2.1 Mineral Filler:** Mineral filler, as required by the mix design, shall be any recognized brand of non-air-entrained Type I/II normal portland cement that is free of lumps and clods, with a minimum of 85% passing the #200 sieve, added by weight of aggregate as specified by the mix design.

**714.2.2 Mineral Aggregate:** Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). Aggregates shall be 100% crushed with no rounded particles. No natural sand will be allowed. The mineral aggregate shall conform to Table [715-1](#) for gradation only. Application rates shall be 18-24 pounds of aggregate/square yard for Type II, and 24-35 pounds/square yard for Type III.

The mineral aggregate and mineral filler shall have a sand equivalency value not less than 50 (ASTM D2419) and be non-plastic.

If more than one kind of aggregate is used, the correct amount of each kind of aggregate needed to produce the required gradation shall be proportioned separately in a manner that will result in a uniform and homogeneous blend. The final blended aggregate shall meet the above requirements for grading, sand equivalency, and plasticity.

#### 714.3 BITUMINOUS MATERIAL:

The Polymerized Emulsion is a slow-setting, cationic type emulsion for mixing applications and seal coats. A minimum of 4% saturated polymer shall be high sheared into the asphalt prior to the emulsification process. The Agency may choose to sample the polymerized asphalt for testing. The amount of polymer will be based on weight of polymer and asphalt (total weight) and be certified by the supplier. The polymerized emulsion will meet the following specifications listed in Table [714-1](#).

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<b>Table 714-1</b>		
<b>Polymerized Emulsion</b>		
<b>Test</b>	<b>AASHTO Method</b>	<b>Specification Limits</b>
Tests on Emulsion		
Viscosity, SSF, @ 77°F. sec.	T59	15-100
Sieve Test, %	T59	0.30 Maximum
Particle Charge	T59	Positive
Storage Stability, 24 hr. %	T59	1.0 Maximum
Evaporation Residue, %	Arizona 512	60 Minimum
Tests on Evaporation Residue                      Arizona 504		
Kinematic Viscosity 275°F.cst	T201	650 Minimum
Penetration, 77°F 100g @ 5 sec	T49	40-90
Softening Point, degrees F.	T53	140 Minimum
Ductility, 77%, 5 cm/min.	T51	60 Minimum
Tests on Evaporation Residue after RTFO		
Kinematic Viscosity, 275°F. aging ratio, cst	T201	2.5 Maximum
Softening Point, degrees F.	T53	140 Minimum
The emulsion, upon standing undisturbed for a period of twenty-four (24) hours, shall show no white or milky colored substance on its surface, and shall be a homogeneous brown color throughout.		

**714.4 MODIFIER TYPE AND CONTENT:**

The modifier shall be saturated. The use of latex type modifier will be allowed only if both the test results and field performance are accepted by the Engineer. The asphalt cement shall contain a minimum of 4% solid polymer by weight of asphalt residue, sheared into the asphalt prior to emulsification. Plant verification by the Agency, and certification of the polymer content and type by the supplier, will be required throughout the duration of the contract. Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall be provided to the Agency.

**714.5 WATER:**

Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Agency.

**714.6 ADDITIVES:**

Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.

The use of additives in the mix shall be supplied in quantities predetermined by the laboratory mix design.

**714.7 TEST CERTIFICATES AND REPORTS:**

Test certificates and reports for the bituminous material shall be furnished in accordance with Subsection [711.3](#).

*- End of Section -*

## SECTION 715

### SLURRY SEAL MATERIALS

#### 715.1 GENERAL:

Slurry seal shall consist of a properly proportioned mixture of emulsified asphalt, mineral aggregate, mineral fillers, additives (if necessary), and water.

All material sources must be approved prior to their use. The Contractor will submit a job mix formula and if requested prequalifications for materials at least seven days prior to start of construction. When requested, additional samples will be furnished during the construction period at no cost to the Contracting Agency. This is a non-pay item.

#### 715.2 AGGREGATE:

**715.2.1 Mineral Filler:** Mineral filler shall consist of finely divided matter, such as hydrated lime, portland cement, limestone dust or fly ash, conforming to the requirements of ASTM D4318. Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler will be used and it will be considered as part of the blended aggregate. The expected range shall be between .25% and 2.0% by weight of aggregate.

**715.2.2 Mineral Aggregate:** Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). The mineral filler will be considered as part of the blended aggregate. The material shall be non-plastic (ASTM D4318) with a sand equivalent (ASTM D2419) of at least 50. The abrasion loss (ASTM C131) shall not exceed 35 percent. Historical test data from source aggregate may be used that was run within the past two years. Mineral aggregates used shall be 100% crushed. No natural sand shall be allowed. The gradation of mineral aggregate without mineral filler shall conform to Table [715-1](#).

<b>SLURRY SEAL AGGREGATE</b>			
<b>SIEVE SIZE</b>	<b>Type I % PASSING</b>	<b>Type II % PASSING</b>	<b>Type III % PASSING</b>
3/8	100	100	100
No. 4	100	85/100	70/90
No. 8	90/100	65/90	45/70
No. 16	65/90	45/70	28/50
No. 30	40/60	30/50	19/34
No. 50	25/42	18/30	12/25
No. 100	15/30	10/21	7/18
No. 200	10/20	5/15	5/15
Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D3910 (W.T.A.T. TEST)	18	16	14
Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D3910 (W.T.A.T. TEST)	10-16	7.5-13	6.5-12
Pounds of Aggregate per Square Yard (approx.)	8-10	12-18	18-25

#### 715.3 BITUMINOUS MATERIAL:

The emulsified asphalt used for seal coating shall be quick setting or slow setting as per Section [713](#).

Polymer modified cationic quick setting emulsion (PMCQS-1h) may be used when approved by the Engineer.

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The quick setting emulsified asphalt shall be of the anionic or cationic quick set type such as QSH, CQSH, or PMCQS-1h that will react to chemically active mineral fillers such as portland cement in such a way that the applied slurry mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula and field performance.

Polymer modified cationic quick setting emulsion (PMCQS1-h) shall be homogeneous and the polymer used shall consist of either a solid polymer milled / blended into the asphalt or latex blended into the emulsifier solution prior to the emulsification process. The PMCQS-1h shall contain a minimum of three percent polymer and shall conform to Section [713](#).

Slow setting emulsion may be used when traffic control is not a critical item.

Quick Set Emulsion Mix Properties	
Slurry Seal Mixing, 70-85 degree F., Sec.	120 Sec. Min.
Slurry Seal Setting text, 70-85 degree F., 1 hour cure	No Brown Stain
Slurry Seal Water Resistance Test, 70-85 degree F., 30 minute cure	No More Than Slight Discoloration

Placement of slurry seal is temperature dependent and should be tested under field conditions.

### 715.4 WATER:

Water shall be potable and be compatible with the slurry ingredients used.

### 715.5 DETERMINATION OF JOB MIX FORMULA:

The job mixture shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in a qualified laboratory to determine their suitability for use in the slurry seal. The Wet Track Abrasion Test (W.T.A.T.) will be used for design purposes to establish the mix design to be used in the specified slurry seal.

The test will show a maximum wear loss of 75 grams per square foot. Samples of materials to be used on the job shall be used to run the W.T.A.T. The test will be performed in accordance with ASTM D3910 Design Testing and Construction of Slurry Seal.

**715.5.1 Composition of Slurry Seal Mixtures:** The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three types whose combined aggregates conform to the graduation requirements of Table [715-1](#). The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

**715.5.2 Trial Applications:** The Contractor shall place a test strip of 60 square yards in the area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The slurry mixture placed in a test strip shall conform to the design mix as determined by the W.T.A.T. with minor variations to obtain crack filling, set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of design mix and acceptance following the placing of a test strip.

### 715.6 TEST CERTIFICATES & REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

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### 715.7 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section [713](#).

*- End of Section -*

## SECTION 716

### COVER MATERIAL

#### 716.1 GENERAL:

Cover material “chips” shall consist of precoated or uncoated aggregate spread in conjunction with a bituminous or asphalt-rubber seal coat.

#### 716.2 COVER MATERIAL AGGREGATE:

##### 716.2.1 Properties:

- (1) When tested in accordance with AASHTO T-96, the loss shall not exceed 40 percent at 500 revolutions.
- (2) When tested in accordance with AASHTO T-104 (Sodium Sulfate Soundness), the loss shall not exceed 12 percent.
- (3) When tested in accordance with ARIZ-212, a minimum of 75 percent, by weight, of the material retained on the No. 8 sieve, shall have at least one fractured face.

**716.2.3 Gradation:** When tested in accordance with AASHTO T-27 and T-11, the gradation shall comply with Table [716-1](#) and/or Table [716-2](#).

TABLE 716-1	
COVER MATERIAL (CHIPS) GRADATION For Low Volume Traffic Only	
Sieve Size	Percent Passing
½ inch	100
3/8 inch	97/100
1/4 inch	70/100
#8	0-5
#200	0-2

TABLE 716-2	
COVER MATERIAL (CHIPS) GRADATION For High Volume Traffic	
Sieve Size	Percent Passing
¾ inch	100
½ inch	97/100
3/8 inch	70/100
1/4 inch	0-10
#8	0-5
#200	0-2

#### 716.3 PRECOATED CHIPS:

When specified, the aggregate shall be heated and precoated with asphalt cement as specified in Section [711](#). The quantity of bituminous material used shall not be less than 0.30 percent or greater than 0.70 percent of the combined weight of the bituminous material and the aggregate to achieve a “salt and pepper” appearance.

The final percentage of asphalt used for coating shall be as directed by the Engineer. The precoating shall be done in a drum mix hot plant. With approval of the Engineer a pug mill mixing facility may be used.

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### **716.4 UNCOATED CHIPS:**

When liquid or paving grade asphalt is used as the bituminous binder, the uncoated chips shall not contain moisture in excess of a saturated surface dry condition.

When emulsified asphalt is used as the bituminous binder, the uncoated chips shall be surface wet but free from running water.

*- End of Section -*

## SECTION 717

### ASPHALT-RUBBER ASPHALT CONCRETE

#### 717.1 DESCRIPTION:

The work under this Section shall consist of furnishing, proportioning and mixing all the ingredients necessary to produce an asphalt-rubber Asphalt Concrete (ARAC) material. ARAC mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

#### 717.2 MATERIALS:

##### 717.2.1 Asphalt-Rubber Binder (ARB):

**717.2.1.1 Asphalt Cement:** Asphalt cement shall conform to the requirements of Section [711](#).

**717.2.1.2 Crumb Rubber:** Crumb Rubber shall meet the gradation requirements as shown in Table [717-1](#) below when tested in accordance with Arizona Test Method 714.

TABLE 717-1	
GRADATION REQUIREMENTS OF CRUMB RUBBER	
Sieve	Percent Passing
Size	Type B
2.36 mm (#8)	
2.00 mm (#10)	100
1.18 mm (#16)	65 - 100
600 µm (#30)	20 - 100
300 µm (#50)	0 - 45
75 µm (#200)	0 - 5

The crumb rubber shall have a specific gravity of  $1.15 \pm 0.05$  and shall be free of wire or other contaminating materials, and shall not contain more than 0.5 percent fabric. Calcium carbonate, up to four percent by weight of the crumb rubber, may be added to prevent the particles from sticking together.

Certificates of Compliance conforming to Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted. In addition, the Certificates shall confirm that the rubber is a crumb rubber, derived from processing at ambient temperature, whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced is taken from automobiles, trucks, or other equipment owned and operated in the United States. The Certificates shall also verify that the processing does not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above the ground. The crumb rubber to be used in asphalt-rubber binder shall be the type produced through a process of mechanical grinding at ambient temperature. Use of crumb rubber granules produced from a cryogenic process is prohibited.

**717.2.1.3 Asphalt-Rubber Proportions and Properties:** Ground crumb rubber in ARB shall be a minimum of 18 percent by weight of total binder,

ARB shall be Type 1 unless otherwise specified and conform to the requirements of Table [717-2](#) below:

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<b>TABLE 717-2</b>	
<b>PHYSICAL PROPERTIES OF ASPHALT RUBBER BINDER</b>	
<b>Grade of base asphalt cement</b>	<b>PG 64-16</b>
<b>Property</b>	<b>Requirement</b>
Rotational Viscosity*; 350° F, Pascal seconds	1.5-4.0
Penetration; 39° F (4° C), 200g, 60 sec. (ASTM D5); dmm, min	10
Penetration, 77° F, 100g, 5 sec: 1/10 mm (ASTM D5), min.	20
Softening Point; (ASTM D36); °F, min.	135
Resilience; 77°F (ASTM D3407); %,min	25
Flash Point: °F (ASTM D92), min.	450
* The Viscometer used must be a hand held rotational viscometer, such as a Rion (formerly Haake) Model VT – 04, or an equivalent, using Rotor No. 1. The rotor, while in the off position, shall be completely immersed in the binder at a temperature from 350° to 355° F for a minimum heat equilibrium period of 60 seconds, and an average viscosity determined from three separate constant readings (± 0.5 pascal-seconds) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.	

**717.2.1.4 Asphalt-Rubber Binder Design:** At least two weeks prior to paving, the Contractor shall submit an ARB design prepared by an ADOT approved laboratory. Such design shall meet the requirements specified herein. The design shall show the values obtained from the required tests, along with the following information: percent, grade and source of the asphalt cement used; and percent, gradation and source(s) of the crumb rubber used.

**717.2.2 Aggregate:** Coarse and fine aggregates shall conform to the applicable requirements of Tables [717-3](#) and [717-4](#) below. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate is material retained above the Number 8 sieve and fine aggregate is material passing the Number 8 sieve. Aggregates shall be free of deleterious materials, clay balls, and adhering films or other material that prevent thorough coating with the asphalt cement. Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

<b>TABLE 717-3</b>		
<b>MIX DESIGN GRADATION REQUIREMENTS</b>		
<b>LOW AND HIGH VOLUME</b>		
<b>Modified D 1/2" ARAC</b>		
<b>Sieve Size</b>	<b>Target</b>	<b>Tolerance</b>
3/4"	100	+/-0%
1/2"	97-100	+/-0%
3/8"	85	+/-7%
No. 4	35	+/-7%
No. 8	18	+/-5%
No. 30	8	+/-5%
No. 200	4	+/-2%

The combined aggregate properties shall conform to the requirements of Table [717-4](#) below.

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<b>TABLE 717-4</b>		
<b>COARSE/FINE AGGREGATE REQUIREMENTS</b>		
<b>Characteristics</b>	<b>Test Method</b>	<b>Requirements</b>
Fractured Faces, % (Plus No. 8)	ARIZ-212	85, 1 fracture 80, 2 or more
Uncompacted Voids, %	ARIZ-247	45.0 (High Traffic Volume) 42.0 (Low Traffic Volume)
Sand Equivalent (Minus No. 4)	AASHTO T-176	65 minimum
Plasticity Index	AASHTO T-89 & T-90	Non Plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2	2.35-2.85
Combined Water Absorption, %	AI MS-2	0-2.5

**717.2.3 Mineral Admixture:** Mineral admixture used in ARAC shall be dry hydrated lime conforming to the requirements of ASTM C1097 or portland cement conforming to ASTM C150 for Type II, or ASTM C595 for Type IP. The minimum mineral admixture content will be 1.0percent, by weight of total aggregate.

**717.3 MIX DESIGN REQUIREMENT:**

**717.3.1 General:** The mix design for ARAC shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphalt Concrete Mix Design Engineer” within ADOT’s latest list of approved laboratories. The latest list of approved laboratories is available on ADOT’s web page: [http://www.azdot.gov/highways/materials/quality\\_assurance.asp](http://www.azdot.gov/highways/materials/quality_assurance.asp).

The date of the design shall not be older than one year from the date of submittal, unless supportive documentation is submitted to, and approved by, the Engineer.

The mix design method used shall be in accordance with the Marshall Mix procedure, 75 blows, as described in Arizona Test Method 832 “Marshall Mix Design Method for Asphaltic Concrete (Asphalt Rubber) [AR-AC]”. Mix designs are subject to approval by the Engineer.

**717.3.2 Mix Design Criteria:** The mix shall comply with the criteria in Table [717-5](#) below.

<b>TABLE 717-5</b>		
<b>MARSHALL MIX DESIGN CRITERIA</b>		
<b>Criteria</b>	<b>Low Volume Traffic</b>	<b>High Volume Traffic</b>
Asphalt Rubber Binder Content	8.5% minimum	8.0% minimum
Mixture Air Voids, %	3.5 +/-1	5.0 +/- 1
Voids in Mineral Aggregate, %	19.0 min	19.0 min
Tensile Strength Ratio, AASHTO T-283	60% min	60% min
Marshall Stability, pounds minimum	800	800
Marshall Flow, 0.01 inch minimum	16	16

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.
- (2) The mix plant identification and/or location, as well as the supplier or producer name.
- (3) The traffic condition (low or high traffic) and lift thickness.

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(4) A description of all products that are incorporated in the ARAC along with the sources of all products, including asphalt binder, crumb rubber, mineral aggregate, and admixtures.

(5) The results of all testing, determinations, etc., such as: specific gravity and gradation, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio (AASHTO T-283), Marshall bulk density, stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration's 0.45 Power Gradation Chart and plots of the compaction curves.

(6) The laboratory mixing and compaction temperature ranges for the supplier and grade of asphalt binder used within the mix design.

(7) A specific recommendation for design ARB content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.

(8) The supplier's product code, the laboratory Engineer's seal (signed and dated), and the date the design was completed.

(9) The ARB blend design.

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the asphalt binder, including modifiers in the asphalt binder, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

*- End of Section -*

## SECTION 718

### PRESERVATIVE SEAL FOR ASPHALT CONCRETE

#### 718.1 GENERAL

Asphalt Concrete preservative seal shall be one of the following types or equal, with typical application rates.

**TYPE A** - Asphalt rejuvenating agent shall be an emulsion composed of a petroleum resin oil base uniformly emulsified with water. Each supplier must submit a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the required physical and chemical requirements. They also must provide documentation of tests that determine the acceptable range of application of the product. Typical application rates are .07 to .18 gallons per square yard.

**TYPE B** - Petroleum Hydrocarbon emulsion. Applied at .05 to .20 gallons per square yard, diluted.

**TYPE C** - Tire modified surface sealer (TRMSS) or equal not diluted, and applied at a rate of .10 to .20 gallons per square yard.

**TYPE D** - Acrylic polymer, modified emulsion. Diluted to the manufacture's recommendation and applied at a rate of .08 to .20 gallons per square yard.

#### 718.2 TEST METHODS AND REQUIREMENTS

Preservative seal for asphalt concrete material, shall meet type A, B, or C on Table [718-1](#) by certification from the manufacturer.

All tests shall be performed by AMRL accredited laboratory, accredited in the specified test being performed.

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**TABLE 718-1**

<b>PRESERVATIVE SEAL SPECIFICATIONS</b>					
<b>Properties * (note 2)</b>		Type-A	Type-B	Type -C	Type-D
Saybolt Viscosity @77°F (sfs)	ASTM D7496-09	45-55 (KU)* (note 1)	15-40	15-40	15-40
Residue by evaporation 138°C	ASTM D6934-08	30-40	.10 Max	53 min.	60-65
Sieve test %	ASTM D6933-08	N/A		.10 max.	0.1
5 day settlement test	ASTM D6930-10		2.0% max	N/A	N/A
<b>Test on residue from evaporation ASTM D6934-08</b>					
Flash point °F	ASTM D92	450°F	450°F	450°F	385°F
Softening point	ASTM D36M-09	130°F min	N/A	130°F min.	N/A
Accelerated weathering test	ASTM D4799-03	Report * (note 3)	N/A	Report (note 3)	Plant certification within 6 months
Ductility (@77°F) 100g 5 sec.	ASTM D113-07	N/A	N/A	20 min.	N/A
Storage stability, test 1 day%	ASTM 6930-10	N/A	N/A	N/A	N/A
Viscosity @ 140°F, cSt	D-445	N/A	1,000-9,500	N/A	210-390
Asphaltenes, % w (max)	D-2006-70	N/A	10.0 Max.	N/A	1.00
Maltene Dist. Ratio	D-2006-70	N/A	0.2-1.4	N/A	0.3-0.6
PC/S Ratio <sup>45</sup> (Min) (Note 4)	D-2006-70	N/A	0.5 Min.	N/A	0.5
Saturated Hydrocarbons, S <sup>5</sup> (note 4)	D-2006-70	N/A	28 Max.	N/A	21-28

Notes:

1. Krieb units (ASTM D562)
2. A full set of tests shall be performed by as specified by the special provisions in the undiluted condition. These tests and any other specified will be performed at the Contractor's expense.
3. The Ultraviolet resistance testing results will be provided at no cost to the engineer.
4. Only residue by evaporation shall be run on diluted samples. Specification limits should be diluted rate times minimum residual value of concentrate.
5. PC/S ratio:  $\frac{PC + A_1^5}{S + A_2}$

- End of Section -

## SECTION 725

### PORTLAND CEMENT CONCRETE

#### 725.1 GENERAL:

Portland cement concrete shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives.

TABLE 725-1		
CONCRETE CLASSES - MINIMUM REQUIREMENTS		
Class of Concrete	Minimum Cementitious Materials Content (lbs. per cubic yard)	Minimum Compressive Strength (1) at 28 Days (psi)
AA	600	4000
A	520	3000
B	470	2500
C	420	2000

(1) In accordance with Subsection [725.8](#).

#### 725.2 CEMENTITIOUS MATERIALS:

Cementitious materials to be used or furnished under this specification shall be:

Portland cement, meeting the requirements of ASTM C150

Type II, low alkali, when no other specific type is specified

Type III, low alkali, for high early strength, when applicable or specified

Type V, low alkali, when specified in the special provisions for applications requiring high sulfate resistance

Portland Pozzolan Cement ASTM C595

Type IP (MS), when no other specific type is specified

Supplementary Cementitious Materials (SCM) shall not be used as an additional cementitious materials replacement in concrete in combination with portland pozzolan cement.

Cementitious materials shall be sampled and tested as prescribed in the applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the material manufacturer, identifying the cementitious material and stating that the cementitious material delivered to the batching site complies with the appropriate specifications. When requested by the Engineer, the Contractor shall furnish three copies of the cementitious materials certification. The cost of furnishing tested cementitious materials shall be considered as included in the contract bid price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cementitious materials, such facilities shall be used. Otherwise the cementitious material shall be delivered in original unopened sacks that bear the name or brand of the manufacturer. The type of cementitious material, and the weight contained in each sack shall be plainly marked thereon.

Cementitious materials shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cementitious material be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

**725.2.1 Supplementary Cementitious Materials (Pozzolans):** Supplementary Cementitious Materials to be used in concrete or furnished under this specification shall conform to the appropriate ASTM requirements as follows:

Fly ash or natural pozzolan

ASTM C618 and C311

Silica Fume

ASTM C1240

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Up to 25 percent by weight of the Table [725-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. Additional pozzolanic material in excess of the minimum Table [725-1](#) requirements may be incorporated into a concrete mix design to achieve enhanced performance, upon approval of the Engineer.

The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the pozzolan supplier identifying the pozzolanic material and stating the pozzolan delivered to the batching site complies with the appropriate specifications. The cost of furnishing tested pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolanic materials shall be handled and stored in the same manner as other cementitious materials. When facilities for handling a bulk pozzolan are not available, the pozzolan shall be delivered in original unopened sacks bearing the name and brand of the supplier, the type and source of the pozzolan, and the weight contained in each sack plainly marked thereon.

### **725.3 AGGREGATES:**

Coarse and fine aggregate shall conform to the applicable requirements of ASTM C33. Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate, Table 2. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

The average value of 3 successive sand equivalent samples shall not be less than 70 when tested in accordance with ASTM D2419. No individual sample shall have a sand equivalent less than 65.

The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM C131, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

Prior to the delivery of the aggregates and whenever required during concrete production, the Contractor shall make stockpiles available to the Engineer for testing. All required samples shall be furnished at the expense of the Contractor, and the cost of sampling and testing shall be at the expense of the Contracting Agency.

Reclaimed Concrete Materials (RCM) and Reclaimed Asphalt Pavement (RAP) as defined in Section [701](#) shall not be used in portland cement concrete without the prior approval of the Engineer.

### **725.4 WATER:**

The water used for mixing concrete shall be potable or shall meet the requirements of ASTM C1602, when tested by a qualified independent testing laboratory.

### **725.5 ADMIXTURES AND ADDITIVES:**

Admixtures or additives of any type, except as otherwise specified, shall not be used unless identified in the approved mix design or authorized by the Engineer.

Water reducing admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C494 for the appropriate type.

Air entraining admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C260.

Pigments incorporated into the approved concrete mix design for integrally colored concrete shall meet the requirements of ASTM C979.

Fibers incorporated into the approved concrete mix shall meet the requirements of ASTM C1116.

Any admixtures used shall be included in the price for that item.

### **725.6 MIX DESIGN PROPORTIONING:**

A concrete mix design carrying the producer's designated mix number for each type of concrete being furnished under these

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specifications shall be submitted to the Engineer at least once each year for approval. Each design shall utilize the proper proportioning of ingredients to produce a concrete mix that is homogeneous and sufficiently workable to provide a consistent and durable concrete product that meets the specified compressive strength and other properties as required by the application.

In the event there is a modification to the mix design proportions:

(A) Modifications that do not require a new mix design submittal/approval:

- (1) Modifications which do not result in batch target weights for the fine aggregate or combined coarse aggregates changing by more than 5 percent from the original approved mix design.
- (2) Modifications to the percentage of coarse aggregate fractions that do not change the total coarse aggregate volume.
- (3) Modifications to dosages of chemical or air-entraining admixtures, within the manufacturer's recommendations.
- (4) The incorporation or elimination of chemical admixtures which are listed on the mix design to effect a change in the time-of-set (retarders or accelerators).

(B) Modifications that require a new mix design submittal/approval and may require performance verification:

- (1) Modification to the class of concrete per Table [725-1](#).
- (2) Modification to the type/class/source of cement, fly ash, natural pozzolan, or silica fume.
- (3) Modification to the percentage of fly ash, natural pozzolan, or silica fume.
- (4) Modification to a coarse aggregate size designation.
- (5) Modification of the type of chemical admixture, or the incorporation or elimination, of an air-entraining admixture.
- (6) Modification of coarse or fine aggregate source.

### 725.7 MIXING:

All proportioning/batching/mixing equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or National Ready Mixed Concrete Association. The proportioning shall consist of combining the specified sizes of aggregates with cementitious materials, admixtures/additives, and water as herein provided. No method which may cause the segregation or degradation of materials shall be used.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

Any admixture/additive shall be measured accurately by mechanical means into each batch by equipment or in a method pre-approved by the Engineer.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight. The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

Machine mixing will be required in all cases unless pre-approved by the Engineer. Regardless of the method employed,

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mixing shall be commenced as soon as possible after the cementitious material is placed in contact with the aggregates or water. All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

**725.7.1 Paving and Stationary Mixers:** Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cementitious materials, admixtures/additives and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum.

The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

**725.7.2 Transit Mixers:** Transit mixers shall meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association. Ready mix concrete and shall comply with ASTM C94 except as herein specified.

Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this Section, the amount of materials charged into the mixer shall be reduced.

The rotation speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible delivery ticket which shall contain the following information:

Date and Truck Number.

Name of the Supplier.

Name of the Contractor.

Specific designation of job (name and location).

Number of cubic yards in the batch.

Time the transit mixer is loaded.

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Amount of water added at the job site at request of receiver, and his signature or initials.

Suppliers' mix design code number.

Type and amount of admixture or additive that is not already included in the approved mix design, if any.

Serial number of the ticket.

Additional water may be added on the jobsite in accordance with ASTM C94 Tolerances in Slump section to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications in Subsection [725.9 \(A\) \(1\)](#) and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete shall be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the job site.

**725.7.3 Job Mixed Concrete:** All job mixed materials and procedures shall be pre-approved by the Engineer. A prepackaged commercial product shall be used for job mixed concrete placement in accordance with the manufacturer's recommended procedure.

In lieu of the use of a prepackaged commercial product, individual ingredients for concrete placement shall be prepared in a watertight container of suitable volume in batches not to exceed 1/3 cubic yard each. Proportioning of batches shall be in accordance with the applicable required mix design in Table [725-1](#) and Subsection [725.6](#). All mixing shall be done prior to placement in the forms and in accordance with the following procedure:

- (A) Mixing shall be done in a mechanical batch mixer of approved type.
- (B) The mixer shall be rotated at a speed recommended by the manufacturer.
- (C) Mixing shall continue for at least 1-1/2 minutes after all materials are in the mixer, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of ASTM C94.
- (D) Materials handling, batching, and mixing shall conform to the applicable provisions of ASTM C94.
- (E) Suitable records shall be kept to identify the number of batches, proportions of materials used, and time and date of mixing and placement along with the approximate location in the structure.

**725.7.4 Dry Batched Unmixed Concrete:** All dry batched unmixed concrete materials and procedures shall be pre-approved by the Engineer. An accurate batch weight shall be provided to record the quantities of cementitious materials, aggregate, admixtures/additives, and water batched into the containers. The date of batching, the container number and the batching certificate number shall be recorded at the time of batching. Copies of the batch weight records shall be submitted to the Engineer upon request.

All dry batched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot come in contact with the water and aggregate within the container. Any admixture/additive added in powder form shall be added to the cement; if added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

Any spillage of cementitious materials, aggregate, water or admixtures/additives during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

**725.7.5 Volumetric Batching and Continuous Mixing Concrete and Equipment:** Volumetric-batching and continuous-mixing concrete and equipment may be utilized upon approval of the Engineer for job site concreting applications. Material handling, procedures, and operations shall be in accordance with ACI 304.6R, Guide for the use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment and all concrete produced and all test performed shall be in accordance with ASTM C685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing. All equipment shall meet the requirements of the Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau and shall

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have a suitable copyrighted rating plate furnished by the Bureau and attached to the volumetric mixing equipment.

### 725.8 TESTS AND TEST METHODS:

**725.8.1 Field Sampling and Tests:** Concrete shall be sampled in accordance with ASTM C172 for determination of temperature, slump, unit weight and yield (when required) and air content (when required) as well as for fabrication of test cylinders for compressive strength determination at 28 days. Samples shall be of sufficient size to perform all the required tests and fabricate the necessary test cylinders but in no case less than 1 cubic foot. Concrete shall be sampled during discharge of the middle portion of the batch. At the discretion of the Engineer, a sample may be obtained at the beginning of the discharge if the properties of the concrete do not appear to be within the specification limits for slump or temperature.

All sampling and testing shall be done by a certified technician meeting the requirements of the ACI Concrete Field Testing Technician, Grade I or equivalent.

Temperature of the concrete mixture shall be determined in accordance with ASTM C1064.

Slump of the concrete mixture shall be determined in accordance with ASTM C143.

Air content of the concrete mixture (when required) shall be determined in accordance with ASTM C231 or C173, whichever is applicable.

Unit weight and yield of the concrete mixture (when required) shall be determined in accordance with ASTM C138.

All compressive strength test specimens shall be made, cured, handled, protected, and transported in accordance with the requirements of ASTM C31. The Contractor shall provide and maintain for the sole use of the testing laboratory/technician adequate facilities for safe storage and proper curing of concrete test cylinders on the project site including sufficient access on weekends and holidays to allow the timely pick-up of cylinders specimens. Any and all deviations from the standard procedure of any test method shall be promptly identified and corrected. Any deviations shall be clearly noted by the testing laboratory on all written reports. Testing results obtained from non-standard testing procedures shall be considered invalid and discarded by Engineer.

Sampling and testing for the 7-day cylinder, the 14-day cylinder, the two 28-day concrete acceptance test cylinders and the two HOLD cylinders will be at the expense of the Contracting Agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

**725.8.2 Concrete Cylinder Test:** A cylinder strength test shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least two 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days. An adequate number of cylinder specimens shall be made for each 50 cubic yards or not less than each half-day's placement of each class of concrete. All specimens will be tested in a laboratory approved by the Engineer in accordance with ASTM C39 for concrete acceptance. Should an individual cylinder show evidence of improper sampling, molding, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining cylinder(s). A single 7-day and a single 14-day cylinder shall be made and tested to provide progress information only and neither shall be considered an acceptance test. Two HOLD cylinders shall also be made and shall be acceptance tested at a 56-day when the 28-day test fails to comply. Additional cylinder specimens may be made and tested at other ages to obtain additional compressive strength information and shall not be considered as acceptance tests. Cylinder testing performed for concrete acceptance will be at the expense of the Contracting Agency. Cylinder testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

**725.8.3 Additional Concrete Testing:** If the 28-day strength test does not meet the compressive strength requirements, additional concrete testing may be performed to further evaluate the concrete in question for purposes of acceptability or payment. This may involve testing of additional cylinders at later ages, (for example - hold cylinders at 56 days or more), or core testing to determine in-place concrete strengths. This additional testing and all coring repairs shall be pre-approved by the Engineer and at the expense of the Contractor. If core testing is performed, at least three representative cores shall be obtained, conditioned and tested in accordance with ASTM C42 from each concrete member or area of concrete to be tested at locations designated by the Engineer. Cores damaged subsequent to or during removal shall be rejected and additional core samples taken. Cores shall be obtained and delivered to a laboratory acceptable to the Engineer in time to allow complete strength testing within 48 days of original concrete placement. The Contractor may elect to have a representative present

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during sampling and testing. A core strength test shall be the average of the results of the three cores. Should an individual core show evidence of improper sampling, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining core(s). Results of the core strength testing shall replace the results of the cylinder strength test for that sample.

### 725.9 ACCEPTANCE:

#### (A) Plastic Concrete Properties

(1) The slump of the concrete shall meet the requirements of ASTM C94 Tolerances in Slump section. When the approved mix design or project specification requirements for slump are a “maximum” or “not to exceed”, the following tolerances apply:

Specified slump:	If 3” or less	If more than 3”
Plus tolerance	0 inch	0 inch
Minus tolerance	1 1/2 inch	2 1/2 inch

When the approved mix design or project specification requirements for slump are not written as a “maximum” or “not to exceed”, the following tolerances apply:

For design slump of:	Tolerance
2 inch and less	+/- 1/2 inch
More than 2 through 4 inch	+/- 1 inch
More than 4 inch	+/- 1 1/2 inch

(2) Limit the maximum allowable temperature of the concrete mixture immediately before placement to 90 degrees F unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer. At the discretion of the Engineer, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information and may be used to modify maximum allowable concrete temperature and acceptance.

Per ACI 306, Specification for Cold Weather Concreting, when the atmospheric temperature at the time of placing concrete is above 30°F the temperature of the concrete, as placed, shall not be less than 60°F. When the atmospheric temperature at the time of placing concrete is between 0°F and 30°F the temperature of the concrete, as placed, shall not be less than 65°F.

(3) Air entrained concrete shall meet the requirements of ASTM C94 Air-Entrained Concrete section. The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within the approved mix design tolerance or +/- 1.5 % of the specified value. When a representative sample taken prior to discharge shows an air content below the specified level by more than the allowable tolerance, additional air entraining admixture shall be added to the concrete mix to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

(4) Per ASTM C94 Mixing and Delivery section, discharge of the concrete shall be completed within 1 1/2 hour after the introduction of the mixing water to the cementitious materials or the introduction of the cementitious materials to the aggregates. The Engineer may allow the continuation of concrete placement after the 1 1/2 hour time limit has been reached if the concrete is of such slump or workability that it can be placed without the addition of water to the batch.

Any concrete failing to meet the tolerances for plastic concrete properties in [725.9 \(A\) \(1\)](#) through (4) shall be reviewed by the Engineer and is subject to rejection.

#### (B) Hardened Concrete Properties – Compressive Strength

Compressive strength of concrete shall be determined on the basis of cylinder strength tests obtained in accordance with Subsection [725.8.2](#) and shall be acceptable if the tests meet or exceed the minimum specified strength. When the validity of cylinder strength tests are suspect, the strength of concrete in question shall be determined in accordance with Subsection [725.8.3](#).

When compressive strength test results are less than the specified minimum, an Engineering Analysis to determine the impact

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of the strength reduction may be required by the Engineer prior to the decision to accept or reject the concrete. The Engineering Analysis will be at the Contractor's expense. Any concrete that is rejected by the Engineer shall be removed and replaced by the Contractor at the Contractor's expense.

When concrete is accepted by the Engineer on the basis of test results of less than 100% of the required minimum compressive strength, an adjustment in the concrete unit price may be made for the quantity of concrete represented by such strength tests in accordance with Table [725-2](#).

<b>TABLE 725-2</b>			
<b>Adjustment in Concrete Unit Price Based on Strength Deficiency</b>			
Class AA and Class A		Class B and Class C	
Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed	Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed
100 % or greater	100	100 % or greater	100
98-99	90	95-99	95
96-97	85	90-94	90
95	80	85-89	85

*- End of Section -*

## SECTION 726

### CONCRETE CURING MATERIALS

#### 726.1 GENERAL:

Curing materials shall consist of waterproof paper, polyethylene film or liquid membrane-forming compounds which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period. All curing materials and methods shall be approved by the Engineer prior to use. Wet coverings such as burlap, cotton mats, or other moisture-retaining fabrics also may be used, or may be required by special provisions.

#### 726.2 MATERIALS:

(A) Waterproof paper, or polyethylene film, shall conform with ASTM C171.

(B) Liquid membrane-forming compounds shall conform with ASTM C309. Type 1 compound with either a Class A or Class B vehicle shall be used for concrete structures, except bridge decks, approach slabs, and portland cement pavement. Type 2 white pigmented compound, with either a Class A or Class B vehicle shall be used for portland cement concrete pavement, bridge decks and approach slabs.

(C) Burlap cloth made from jute or kenaf shall conform to AASHTO M-182.

*- End of Section -*

## SECTION 727

### STEEL REINFORCEMENT

#### 727.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating of any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer. When required by the Engineer, the Contractor or supplier shall furnish a spot sample taken on the project and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the Contractor or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the Engineer. The Contractor shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM A615 and the shapes shall conform with ASTM B670.

In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of Subsection [505.5.2](#).

The various grades of steel shall not be used interchangeably in structures.

#### 727.2 WIRE REINFORCEMENT:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A82.

#### 727.3 WIRE MESH REINFORCEMENT:

Mesh reinforcements shall conform to ASTM A185. The gage of the wire and the dimension of the mesh will be specified in the special provisions or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

#### 727.4 WIRE TIES:

Wire for ties shall be black, annealed, not lighter than 16 gage.

*- End of Section -*

**SECTION 728**

**CONTROLLED LOW STRENGTH MATERIAL**

**728.1 GENERAL:**

Unless approved by the Engineer, the Controlled Low Strength Material (CLSM) shall be from an approved commercial-source and is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. Approved CLSM shall be identified by a product code that includes "PHCLSM". CLSM is a self-compacting, flowable, cementitious material primarily used as a backfill, structural fill, or a replacement for compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section 604.

**728.2 MATERIALS:**

Cementitious materials shall conform to Subsection [725.2](#).

Coarse aggregate shall conform to ASTM C-33 grading size No. 57. The size and gradation of fine aggregates (sand) shall conform to ASTM C-33. Alternate materials meeting the applicable requirements of Section [701](#) or [702](#) such as combinations of other aggregates, Aggregate Base Course (ABC) or Reclaimed Concrete Material (RCM) may be used to replace the required coarse and fine aggregate as long as the approved mix design meets the requirements of Table [728-1](#) and is approved by the Engineer.

Water shall conform to Subsection [725.4](#).

**728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:**

Proportioning of the mixture shall comply with Subsection [725.6](#) and Table [728-1](#). The CLSM shall have consistency, workability, plasticity, and flow characteristics such that the material when placed is self-compacting. A minimum of 40% coarse aggregate shall be used. A mix design shall be submitted for the Engineer's approval prior to the excavation for which the material is intended for use. Sampling shall be in accordance with ASTM D5971. The flow consistency shall be tested in accordance with ASTM D6103. Unit weight (when applicable) shall be obtained by ASTM D6023. Compressive strength shall be tested in accordance with ASTM D4832.

<b>TABLE 728-1</b>	
<b>CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS</b>	
Portland Cement Content, Sack/cu yd	Flow, inches
1/2 Sack	9±2
1 Sack	9±2
1 1/2 Sack	9±2

Note for Table [728-1](#):

- (1) CLSM mixes meeting the table requirements will not generally be placeable by means of a concrete pump or may not provide the needed workability for certain conditions. When pumpable mixes or increased workability are required, the addition of fly ash or a natural pozzolan in excess of the required portland cement content may be used.
- (2) Ready-mixed concrete, including timed-out, rejected, and truck wash-out material, shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

**728.4 MIXING:**

CLSM mixing shall comply with Subsection [725.7](#) Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable.

- End of Section -

## **SECTION 729**

### **EXPANSION JOINT FILLER**

#### **729.1 PREMOLDED JOINT FILLER:**

Expansion joint filler materials shall consist of preformed strips of a durable resilient compound and comply with ASTM D1751, D1752, or D2628, as specified by the Contracting Agency or as approved by the Engineer.

#### **729.2 POUR TYPE JOINT FILLERS FOR PORTLAND CEMENT CONCRETE PAVING (PCCP):**

Pour type joint fillers shall comply with ASTM D3406 or as approved by the Engineer. Joint sealant shall not contain any coal tar materials. The following requirement shall be added to paragraphs 7.1 of ASTM D3406:

The minimum ambient temperature during application and ambient temperatures under various storage conditions shall be clearly marked on the container.

#### **729.3 TEST REPORT AND SHIPMENT CERTIFICATE:**

Each shipment shall be accompanied by a certificate from the supplier that the material will comply with the above specifications and such certificate shall be delivered to the Engineer.

*- End of Section -*

## SECTION 735

### REINFORCED CONCRETE PIPE

#### 735.1 GENERAL:

These specifications cover reinforced concrete pipe and related structures intended to be used for conveyance of sewage, industrial waste, and storm and irrigation water.

Except as modified herein reinforced concrete pipe shall be manufactured and tested in conformance with the requirements of ASTM C76 for circular pipe, ASTM C506 for arch pipe, and ASTM C507 for elliptical pipe.

These specifications cover reinforced concrete pipe and related structures intended to be used for conveyance of sewage, industrial waste, storm water and irrigation water and installed by the open cut method.

The size, type, and class of pipe shall be as shown on the plans, or specified under the item of work for the project of which the pipe is a part.

When specified in the special provisions, four sets of pipe line layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. The pipe layouts will be used by the Contracting Agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout. Catch basin connector pipe need not be included in the pipe line layout; however, pipe stubs shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information.

- (A) Size, and class of pipe.
- (B) Station at which pipe joins main line.
- (C) Number of section of pipe, length of section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

All pipe installed in tunnels shall be ASTM C76, Class III. Pipe stronger than that specified may be furnished at the Contractor's option, and at no additional cost to the Contracting Agency, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

Whatever struts or other protective methods proved necessary to furnish and install the pipe to meet the limitation of cracks as specified herein, shall be provided and maintained throughout pipe handling and transportation.

#### 735.2 JOINTS:

**Bell Reinforcement:** All reinforced concrete pipes less than 36 inch inside diameter and the same approximate equivalent size shall include an area of reinforcing steel in the bell not less than the area required for the circumferential reinforcement in the wall of the pipe.

Rubber gaskets shall be in accordance with ASTM C443.

#### 735.3 FABRICATED SPECIALS – WYES, TEES, CURVES, BENDS AND CLOSURES:

Fabricated pipe specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing or steel items.

Horizontal and vertical long-radius curves shall be formed by bevel adapters or by beveling the straight pipe joint. The bevel of the pipe shall not exceed 5 degrees and the total angular deflection, for beveled pipe, shall not exceed 10 degrees. Small angular changes may be made with straight pipe provided that the joint opening does not exceed 3/4 inch. Short radius curves and closures shall be formed with fabricated specials; however, the angular deflection of any segment of the fabricated section shall not exceed 10 degrees.

#### 735.4 MATERIALS:

## SECTION 735

Except when otherwise permitted by the Engineer, no materials other than water, portland cement, pozzolanic materials, mineral aggregates and steel shall be used in the manufacturing of the pipe with the following exceptions:

(A) Portland Cement: Portland cement shall comply with ASTM C150, Type II, and low alkali. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specifications as to yield per cubic yard of concrete poured.

(B) Concrete Admixtures: The pipe manufacturer shall certify in writing that no calcium chloride or admixture containing calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Engineer. The pipe manufacturer shall certify to the brand and chemical content of such admixtures used.

(C) Steel Reinforcement: The pipe manufacturer shall supply three copies of mill certificates showing heat numbers, chemical analysis, and physical tests on reinforcing steel. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of steel used meets this specification. The area of steel used shall be the same as that shown on the shop drawing for that pipe.

### 735.5 MANUFACTURER'S QUALIFICATIONS AND EQUIPMENT REQUIREMENTS:

The manufacturer shall be competent to manufacture the type, size and quality of pipe; in addition, the manufacturer shall have satisfactory curing and storage facilities, and satisfactory financial resources.

Calibration of Cement and Aggregate Scales: The pipe manufacturer shall make whatever alterations are necessary to his equipment to enable the Contracting Agency's Sealer or State Inspector of Weights and Measures to check, calibrate, and seal the aggregate and cement scales used in the pipe production.

### 735.6 CURING OF PIPE:

(A) Steam Curing: The manufacturer shall provide adequate steam plant, piping, enclosures, and other facilities for curing the pipe. The enclosures shall be such that the temperature is maintained continuously between 110 and 150°F.

(B) Curing of the pipe shall not commence until the concrete has attained its initial set, but in any event not sooner than 1 hour and no later than 8 hours after placing of the concrete. Rate of rise of temperature shall not exceed 30°F per hour.

(C) Water Curing: The pipe shall be kept moist during daylight hours. The pipe, including the ends, shall be covered with burlap for the first 3 days, except that, if the pipe is kept constantly and completely wet with fog sprays during the daylight hours, the burlap covering may be omitted. If the manufacturer fails to proceed immediately with the required water curing, the surfaces of the concrete, except joint surfaces that are to be grouted, shall be sealed with an approved, white pigmented sealing compound in accordance with Section [726](#).

### 735.7 TESTS AND ACCEPTANCE:

(A) Basis of Acceptance: The basis of acceptance for the reinforced concrete pipe shall be in accordance with ASTM C76, ASTM C506, or ASTM C507, as applicable, including the method stated in the special provision and as amended herein. However, the purchaser may, at his option, make concrete cylinder tests for the purpose of determining release dates for shipment of the pipe and for his information in regard to general quality of the concrete.

(B) Segregation of Material: The slump of the concrete mix shall not exceed 4 inches so as to preclude excessive segregation of the materials used and shall be proportioned so that the result shall be a homogeneous concrete mixture of such quality that the pipe will conform to the tests and design requirements of these specifications.

(C) A pipe has failed the D-load test when the opening crack exceeds .01 inch for a distance of 1 foot when measured at close intervals. These measurements are taken within the 1 foot measured span only when the crack line is more or less parallel to the axis of the pipe, as it is obvious that where the crack deviates substantially from parallel, and approaches a direction normal to the axis, that the edges of the crack tend to slip past each other, instead of opening up under load. The intent of the test is to measure the crack opening under stress.

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(D) Porous or honeycomb concrete areas 6 inches or less in diameter may be removed and repaired. Pipe having defects or repairs greater than 6 inches in diameter will not be accepted.

(E) Any crack exceeding 1 foot in length that goes completely through the pipe, is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

(F) Any crack that is .01 inch in width for one-sixteenth inch in depth or deeper, for a length of 1 foot or more and continues as a hairline crack down to the reinforcing steel for over 1/2 the length of the pipe is not considered acceptable whether repaired or not.

(G) A single continuous hairline crack which does not extend to the reinforcing steel and not in excess of .01 inch in width for a distance of 1 foot is acceptable without repair. This type of crack, longer than 1 foot shall be repaired.

(H) Repairs shall be made by filling the defect with epoxy under pressure or by chipping out a V-Section to the full depth of the defect and repairing with an approved patching compound. The composition of the patching compound shall be furnished to the Engineer for approval.

(I) The words regarding acceptability and repair ability in the above paragraphs shall also apply when the crack occurs after loading of the pipe in the trench with backfill. Cracks wider than .01 inch shall be assumed to indicate overstress of the steel. In such case, the defective portion of the installation shall be replaced or repaired in a manner acceptable to the Engineer. After structural repairs are completed, the remaining cracks shall be filled as required above. All corrective measures shall be at the expense of the Contractor.

(J) Blisters: All pipe joints having blisters involving less than 1/4 the interior surface area shall be repaired by removing all loose material and exposing all hollow area and replacing with fresh concrete properly bonded, with an acceptable bonding agent, and curing the repair with membrane coating. Blisters with larger areas are not considered to be repairable or acceptable.

(K) Painting of pipe, or portion of pipe, with grout to cover defects, minor or major, will not be permitted until approved by the Engineer.

(L) Where the modified or special design method, under the ASTM Standard elected, acceptance on the basis of material tests and inspection of manufactured pipe for defects and imperfections shall be as stated in the ASTM Standard, and as amended herein. However, one joint of each size and D-load shall be selected by the Engineer for test purposes, and shall be tested for strength by the 3 edge bearing method, ASTM C497, with the results being used for confirmation of the submitted design for this D-load. If the pipe section tested fails in compression or shear before reaching the D-load specified, the test shall be considered a failure. Additional sections of the same diameter size and class shall be tested as specified above until the load requirements are met for the D-load strength. This test procedure shall be accomplished only once per manufacture regardless of the number of contractors he supplies. Placing of reinforcing steel in the test section of pipe to control shear cracks will not be permitted.

Requirements regarding defects shall be the same as stated above for standard pipe.

Concrete test requirements specified under compression tests of the ASTM Standard shall be amended in part to read as follows: "The average of any 5 consecutive strength tests of the laboratory-cured specimens shall be equal to or greater than the specified strength set forth in the design strength requirements table for the type and class of pipe being produced, and not more than 20 percent of the strength tests shall have values less than the specified strength. If more than 20 percent have values less than the specified strength, the lot represented shall be considered to be defective and not acceptable. In no case shall any cylinder tested fall below 80 percent of the specified design strength. If anyone cylinder falls below 80 percent of the specified design strength, then the entire production represented by that cylinder will not be accepted for purchase by the Contracting Agency unless the Contractor can demonstrate by coring to the satisfaction of the Engineer, that the cylinder in question is not representative of the entire production, or is representative of only a portion of the entire production."

During the fabrication of the pipe, concrete cylinders shall be made from a representative sample of the concrete. Concrete cylinders and slump tests shall be made by the Engineer or under his direct supervision. A set of cylinders shall consist of [five](#). A minimum of one set shall be made for each day's production.

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In vibrated and spun pipe, where the slump of the concrete approaches 0, the cylinders shall be made as follows:

Fill the cylinder can in 3 equal layers. Each layer shall be vibrated and assisted by rodding or other mechanical contrivance simultaneously until the moisture comes to the surface. Care shall be taken that the material is not over-vibrated which will cause segregation. When the moisture rises to the surface of the third layer, it is struck off and leveled. The cap is put on the cylinder and it is marked for identification. It shall then be steam cured in the same manner as the pipe, at the conclusion of which, the cylinders shall be brought into the laboratory for standard moist curing until the prescribed time for the compressive test.

The cylinders shall be made according to ASTM C31 where the pipe is manufactured with concrete that has enough slump for the material to be hand rodded. For reinforced concrete pipe made by the centrifugal method, the manufacturer may substitute centrifugally cast test cylinders for standard test cylinders. Centrifugally cast cylinders shall be made in accordance with AWWA C302 and cured in the same manner as normal test cylinders, except that the net area of the hollow cylinder will be used to determine the compressive strength.

### **735.8 SANITARY SEWER PIPE:**

In addition to the above, sewer pipe shall meet the requirements of ASTM C76, reinforced concrete pipe having O-ring Rubber Gasket Joints with an interior lining of plastic liner plate in accordance with Section [741](#).

(A) Pipe Design: The wall thickness and the amount of circumferential reinforcement shall not be less than that required for the D-load indicated on the plans and required by the specifications. The calculations for wall thickness and amount of steel area per foot of pipe, having concrete lining, shall be for a pipe 2 inches larger in internal diameter than that specified on the plans. The additional concrete lining shall not be considered in the calculation for the area of steel required, nor in any of the load calculations.

D-load class of pipe and the date poured shall be plainly marked inside each pipe section. Specific approval must be obtained, prior to submitting a bid; to decrease the cover over the reinforcing steel at the joint should the steel interfere with the rubber gasket in the groove at the spigot end.

(B) Pipe Construction: Tamped or packer head pipe will not be allowed. Pipe having concrete lining shall have the internal diameters indicated on the plans, measured to the inside of the additional 1 inch of covering. The various sizes of pipe shall be centrifugally spun. Pipe having plastic liner plate shall be vibrocast to 1/2 inch tolerance to match the unlined pipe of the D-load indicated on the plans.

(C) Test and Acceptance: In addition to the statements above, any crack that goes completely through the pipe, regardless of length of crack is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

### **735.9 ACCEPTANCE MARK:**

The Engineer may, at the place of manufacturer, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

If the pipe is subsequently rejected, the mark placed thereon by the Engineer shall be defaced.

*- End of Section -*

## SECTION 738

### HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN

#### 738.1 GENERAL:

This specification covers the requirements of open profile high density polyethylene (HDPE) pipe manufactured per ASTM F894 or AASHTO M-294 (corrugated Type S) for gravity flow storm drain. When noted on the plans or in the special provisions, gravity flow storm drain may be constructed using HDPE pipe. The HDPE pipe will be 15 inch diameter through 48 inch diameter only.

All pipe joints shall conform to the controlled pressure test of 10.8 psi of air or 25 feet of water as stipulated in ASTM D3212.

The size and class of the HDPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than RSC-63 for ASTM F894 open profile pipe, or the Pipe Stiffness (PS) for corrugated Type S pipe per the requirements of AASHTO M-294.

#### 738.2 MATERIALS:

**738.2.1 Base Material Composition:** Open profile pipe base material and fittings shall, in accordance with ASTM F894, be made from a PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248 and with established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.4 degrees F° as determined in accordance with Method ASTM D2837. Materials meeting the requirements of cell classification PE 334433 C or higher cell classification, in accordance with ASTM D3350 are also suitable. Corrugated Type S pipe base material shall comply with the requirements of AASHTO M-294 and have a minimum cell classification PE 335420C.

**738.2.2 Other Pipe Materials:** Materials other than those specified under Base Materials shall comply with ASTM F894, or AASHTO M-294.

**738.2.3 Gaskets:** Gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

**738.2.4 Water Stops:** Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

**738.2.5 Thermal Welding Material:** The material used for thermally welding the pipe material shall be compatible with the base material.

**738.2.6 Lubricant:** The lubricant used for assembly shall comply to manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

#### 738.3 JOINING SYSTEMS:

**738.3.1 Gasket Type:** Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe. Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect sealability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

**738.3.2 Thermal Weld Type:** The pipe ends shall consist of an integrally formed bell and spigot, with or without the elastomeric centering gasket, which join together to form an interface between bell and spigot, such that it is suitable to seal

## SECTION 738

by thermal weld using the extrusion welding process, in accordance with the manufacturer's recommended procedure.

Thermal welded joints may be effected by welding from inside the pipe or outside, or both.

The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

Thermal welded joints shall be used only when specified on plans or in specifications.

### **738.4 FITTINGS:**

Fittings for HDPE open profile or corrugated Type S pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [738.3](#).

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of-way easements, and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section [625](#).

### **738.5 CERTIFICATION:**

A manufacturer's certification that the material was manufactured, sampled, tested and inspected in accordance with ASTM F894 and been found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

Pipe and resin producers that manufacture according to AASHTO M-294 shall be certified according to the Plastic Pipe Institute protocol for their Third Party Certification Program.

A manufacturer's certification that the material was manufactured, tested and supplied in accordance with AASHTO M-294 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

### **738.6 DIMENSIONS AND TOLERANCES:**

Open profile HDPE pipe dimensions shall comply with dimensions given in Table 1 of ASTM F894. The "average or nominal inside diameter" of profile wall HDPE pipe shall not deviate from its normal pipe size by more than as specified in Table 1 of ASTM F894. Corrugated Type S HDPE pipe dimensions shall be "nominal inside diameter" dimensions and shall not deviate from its nominal pipe size by more than the minimum and maximum tolerances as described in AASHTO M-294, Section 7.2.3.

Pipe shall have a Ring Stiffness Constant (RSC) or Pipe Stiffness (PS) as shown on the plans. The minimum RSC for open profile HDPE pipe shall be RSC-63. The minimum PS for corrugated Type S pipe shall be as shown in AASHTO M-294 (Section 7.4), and tested per ASTM D2412. In no case shall the minimum PS be less than the equivalent PS value for RSC-63.

### **738.7 CLASSIFICATIONS:**

HDPE open profile pipe products shall be made in four standard Ring Stiffness Constant (RSC) classifications, 40, 63, 100 and 160. These are referred to as RSC-40, RSC-63, RSC-100 and RSC-160. The RSC test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with ASTM F894. HDPE corrugated Type S pipe shall meet the minimum Pipe Stiffness (PS) requirements of AASHTO M-294. The PS test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with AASHTO M-294.

### **738.8 MARKINGS:**

Markings on pipe shall be per ASTM F894 or AASHTO M-294. These markings shall be clearly shown on the pipe at

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intervals of approximately 12 feet and include but not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol. In addition, manufacturers of AASHTO M-294 corrugated Type S pipe shall print on or affix the appropriate Plastic Pipe Institute Program Mark on each length of pipe produced that meets the requirements of the program.

### **738.9 CARE OF PIPE AND MATERIALS:**

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. Pipe that is gouged, marred or scratched forming a clear depression shall not be installed, and it shall be removed if damaged during the installation

Open profile pipe in shipping or storage shall not be stacked higher than three rows for pipes 21 inches in diameter or less, nor higher than two rows for pipes 24 to 36 inches in diameter inclusive. Pipe shall not be stacked, shipped, or stored with weight on the bells of the pipe.

Corrugated Type S pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 5 rows for pipe 24 inches or less in diameter, or 3 rows for pipe greater than 24 inches in diameter.

*- End of Section -*

## SECTION 739

### STEEL REINFORCED POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN

#### 739.1 GENERAL:

This specification covers the requirements of ribbed-pipe profile steel reinforced polyethylene pipe (SRPE) pipe manufactured per ASTM F2562 for gravity flow storm drains. When noted on the plans or in the special provisions, gravity flow storm drains may be constructed using SRPE pipe. The SRPE pipe will be 24 inch diameter through 48 inch diameter only.

All gasketed pipe joints shall conform to the controlled pressure test of 10.8 psi or 25 feet of water as stipulated in ASTM D3212.

All electro fusion pipe joints shall conform to the controlled pressure test of 30.0 psi or 69 feet of water as stipulated in ASTM D3212.

The size and class of the SRPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than Class 1 per the requirements of ASTM F2562.

#### 739.2 MATERIALS:

**739.2.1 Base Steel Materials:** Continuous high strength galvanized ribs shall be cold rolled steel meeting the requirements of either ASTM A1008 or ASTM A1011 with minimum yield strength of 80,000 psi. Steel ribs shall be completely encased within the HDPE profile.

**739.2.2 HDPE Material Composition:** SRPE pipe high density polyethylene material and fittings shall, in accordance with ASTM 2562, be made from a high density polyethylene plastic compound meeting the minimum requirements of cell classification 335464C or higher cell classification, in accordance with ASTM D3350.

**739.2.3 Gaskets:** Rubber gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

**739.2.4 Water Stops:** Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

**739.2.5 Thermal Welding Material:** The material used for thermally welding the pipe material shall be compatible with the base material.

**739.2.6 Lubricant:** The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

**739.2.6 Other Materials:** Materials other than those specified above shall comply with ASTM F2562.

#### 739.3 JOINING SYSTEM:

**739.3.1 Gasketed Type:** Steel reinforced bell and spigot joints for the piping system and fittings shall consist of an integrally formed steel reinforced bell and steel reinforced spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe. Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect seal ability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

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**739.3.2 Thermal Weld Type:** Electro fusion (EF) joints shall utilize plain ended pipe welded together by internal pressure testable couplers. The internal couplers shall have a minimum wall thickness equal to or greater than the pipe wall thickness as defined in pipe specification, ASTM F2562. The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

### **739.4 FITTINGS:**

Fittings for SRPE pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [739.3](#).

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of way easements, and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section [625](#).

### **739.5 CERTIFICATION:**

A manufacturer's certification that the product was manufactured and tested in accordance ASTM F2562 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

### **739.6 DIMENSIONS AND TOLERANCES:**

Profile wall SRPE pipe dimensions shall comply with dimensions given in Table 2 of ASTM F2562. The "inside diameter" of profile wall SRPE pipe shall not deviate from its published inside diameter by more than as specified in Section 6.2.3 of ASTM F2562.

### **739.7 MARKINGS:**

Markings on pipe shall be per ASTM F2562. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include by not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol.

### **739.8 CARE OF PIPE MATERIALS:**

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. Pipe that is gouged, marred or scratched forming a clear depression shall not be installed, and it shall be removed if damaged during the installation. Gaskets shall remain covered at all times by the supplied gasket cover material until the joint is ready for lubrication and assembly.

SRPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 4 rows. Pipe shall not be stacked, shipped or stored with weight on the bells of the pipe.

- End of Section -

## SECTION 741

### LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE

#### 741.1 GENERAL:

The interior area of the reinforced concrete pipe as indicated on the plans shall be protected with lining, as specified below.

The installation and application of the pipe lining shall be accomplished by the supplier of the reinforced concrete pipe.

All work for and in connection with the installation of lining in concrete pipe and the field welding of joints shall be done in strict conformance with all applicable published specifications, instructions and recommendations of the approved lining manufacturer.

#### 741.2 MATERIALS:

**741.2.1 Material Composition:** The material shall be a liner plate which is a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make a permanently flexible sheet.

The liner plate shall be resistant to the following: Oxidizing agents, sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, petroleum oils and greases; vegetable and animal oils, fats, greases and soaps that normally occur in sanitary sewers.

Liner plate shall be impermeable to sewage gasses and liquids and shall be nonconductive to bacterial or fungus growth. All liner plates shall be factory checked electrically to insure freedom from any porosity with a high voltage holiday detector set at a minimum of 20,000 volts.

Joint strips and welding strips shall have the same general composition and corrosion resistance as liner plate, but shall not have locking extensions.

The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to a ¼ inch settling crack which may take place in the pipe or in the joint after installation without damage to the lining.

Once cast into the pipe, the lining shall be permanently and physically attached to the concrete by locking extensions and shall not rely on an adhesive bond.

**741.2.2 Material Details and Dimensions:** The liner plate shall not be less than 0.065 inches in thickness. Locking extension shall be of the same material as the liner and shall be integrally extruded with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be formed by removing the locking extensions as required.

Liner plate shall be supplied either as pipe size sheets or tubes and fabricated by shop welding together using the di-electric welding process. Tensile strength measured across the shop welded joint shall be in accordance with ASTM D412 using Die B and shall be at least 2000 PSI.

Joint strips shall be 4-inches  $\pm$  0.25 inches in width and shall have each edge beveled prior to application.

Welding strips shall be 1-inch  $\pm$  0.125 inch in width and shall have the edges beveled at time of manufacture.

The Contractor shall submit a shop drawing showing liner plate details for approval by the Engineer, prior to fabrication of the pipe.

#### 741.3 INSTALLER QUALIFICATIONS:

The application of joint strips, weld strips and plastic liner to forms and other surfaces is considered to be specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation and shall demonstrate their ability to the Engineer prior to commencing work.

Each welder shall pass an approved qualification welding test before doing any welding. Certification shall be renewed on a

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yearly basis and the list of qualified personnel shall be maintained by the pipe manufacturer. All test welds shall be made in the presence of the Agency's representative and shall consist of the following:

- (A) Two pieces of liner at least 15-inches long and 9-inches wide, shall be lapped 1 ½-inches and held in a vertical position.
- (B) A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2-inches beyond the liner to provide tabs.

The weld sample shall be tested by the Engineer as follows:

- (A) Each welding strip tab, tested separately, shall be subjected to a 10-pound pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner
- (B) Three test specimens shall be cut from the welded sample and the weld shall be tested for tensile strength in accordance with ASTM D412 using Die B. Tensile strength measured across the welded joint shall be at least 2000 PSI.
  - (1) If none of these specimens fails when tested as indicated above, the weld will be considered as satisfactory.
  - (2) If one specimen fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory.
  - (3) If two of three specimens fail, the welder will be considered to be an unqualified welder and shall be disqualified.

A disqualified welder may submit a new welding sample when he has had sufficient off-the-job training or experience to warrant re-examination.

### **741.4 INSTALLATION OF LINER PLATE:**

The installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. Liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer, unless otherwise shown on the plans. All joints between individual sheets or sections of liner plates shall be continuously heat-welded by the use of welding strips of the same general composition and equivalent thickness of material as the liner plates (with the exception of the integral extension ribs).

Liner plate shall be held snugly in place against inner forms by means of light gage steel wire, light steel banding straps or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose or onto flaps created at pipe ends.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod ¼-inch in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate for concrete pipe or some other approved method for holding the lower edge of the liner plate snugly against the form shall be provided. Concrete poured against liner plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete.

In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes, cuts, torn or seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

The Contractor shall take all necessary measures to prevent damage to installed liner plate from equipment and materials used in or taken through the work.

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The applied lining shall be free from bubbles due to poor workmanship, and the Contractor shall cut out said bubbles and weld a similar sheet in place of the bubble, unless otherwise directed by the Engineer.

Application on Concrete Pipe-Special Requirements: Type P-1 joint, Liner plate shall be set to within  $\frac{1}{4}$ " of the inner edge of the bell or groove end of a pipe section and shall extend to within  $\frac{1}{4}$ " of the spigot or tongue end. Type P-2 joint, Liner plate shall be set to within  $\frac{1}{4}$ " of inner edge of the bell or groove end of a pipe section and shall extend a minimum of 3" beyond the spigot or tongue end.

Wherever concrete pipe, which are protected with liner plate, join structures not so lined, such as brick structures, concrete pipe, cast-in-place structures or clay pipe, the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 2-inches.

Where a pipe spur, not of plastic lined concrete, is installed through lined concrete pipe, the liner plate shall be returned not less than 2-inches at the surface of contact. The seal between the liner plate and the spur shall be made using an approved adhesive material and strapped in place. If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this adhesive, the joint space shall be filled with 2-inches of densely caulked lead wool or other approved caulking material.

Lined concrete may be cured by standard curing methods. Care shall be exercised, in handling, transporting and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable forklift lifting the pipe only from the exterior.

No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the Engineer.

### **741.5 FIELD JOINTS:**

The Contractor shall obtain the services of qualified and approved personnel to weld the liner plate field joints. Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry.

No field joint shall be made in liner until the lined pipe or structure has been backfilled and 7 days have elapsed after the flooding, jetting, or other means of compaction has been completed. Where groundwater is encountered, the joint shall not be made until pumping of groundwater has been discontinued for at least 7 days and no visible leakage is evident at the joint. The liner at the joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made. When the pipe liner coverage is 360 degrees, 6 to 8-inches of the downstream side of the joint strip or flap at the pipe invert shall not be welded.

Heated joint compound shall not be brought in contact with liner.

No coating of any kind shall be applied over any joint, corner, or welding strip, except where nonskid coating is applied to liner surfaces.

Field joints in the liner plate at pipe joints may be either of the following described types:

Type P-1 joint shall be made with a separate 4-inch joint strip and two (2) 1-inch welding strips. The 4-inch strip shall be centered over the joint, secured to the liner plate by heat sealing with hot air and welded along each edge to adjacent liner plate with a 1-inch weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2-inches. The 4-inch joint strip shall lap over each liner plate a minimum of 1-inch.

Type P-2 joint shall be made with an integral joint flap with locking extensions removed, extending a minimum of 3-inches beyond the spigot end of the pipe. The flap shall overlap the adjacent lined pipe and shall be heat sealed to this lining and then welded on the edge to the adjacent liner with 1-inch weld strip. Care shall be taken to protect the flap from damage. Excessive tension and distortion while bending the flap back to facilitate laying and joint mortaring shall be avoided. Heat shall be applied to straighten the PVC flaps as needed to prevent cracking of the PVC.

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Any flap which has been bent back and held shall be allowed to return to its original shape and flatness well in advance of making the liner joint.

If joints are to be mortared, field joints on liner at pipe joints shall not be made until the mortar in the pipe joint has been allowed to cure for at least 48 hours and the pipe has successfully passed the leakage tests.

### **741.6 INSTALLATION OF WELDING STRIP:**

Welding strips shall be fusion welded to joint strips and liner by welders approved by the Engineer, and trained by the manufacturer, using only approved methods and techniques.

Adequate ventilation shall be maintained during all welding operations.

Hot air welding tools shall provide clean effluent air at constant pressure to the surfaces to be joined within a temperature range between 260°C and 315°C (500°F and 600°F).

For lap welds, the welding strip shall be positioned so that approximately 1/3 of the width is placed on the high side of the lap and properly fused. The weld strip shall be completely fused across its' entire width, except for a small allowable gap in the center. Incomplete fusion, charred, or blistered welds will be rejected by the Engineer.

### **741.7 JOINT REINFORCEMENT:**

A 12-inch long welding strip shall be applied as reinforcement across each transverse joint, weep channel, or return which extends to the lower terminal edge of liner. These reinforcement strips shall be centered over the joint being reinforced and located as close to the edge of liner as possible.

### **741.8 TESTING AND REPAIRING DAMAGED LINER SURFACES:**

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical holiday detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over repairs to the liner plate wherever damage has occurred shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

The Contractor shall provide adequate ventilation, ladders for access, barricades or other traffic control devices, and shall be responsible for opening and closing entrances and exits. All areas of liner failing to meet the field test shall be properly repaired and retested. The electrical holiday detector shall be supplied by the Contractor and shall be a Tinker & Rasor Holiday Detector (Model AP-W).

The Contractor, at his expense, shall have an independent inspection service perform the visual inspection and the probing of all weld joints. The independent inspection service and the inspection and probing procedures shall be approved by the Engineer. In addition, the independent inspection service shall witness the spark testing and any repairs performed by the Contractor. Inspectors employed by the independent inspection service to test the welds shall have passed the qualification welding test specified in Subsection [741.3](#). Upon completion of all liner testing and inspection, the Contractor shall submit certification by the independent inspection service that all installation and weld joints have been tested and inspected and are in compliance with the Specifications. However, this certification shall not relieve the Contractor of the responsibility to correct defective work.

### **741.9 PAYMENT:**

Payment for plastic liner materials, their installation and testing shall be included in the price bid for the pipe or structure to which they are applied.

*- End of Section -*

## SECTION 742

### PRECAST MANHOLE

#### 742.1 GENERAL:

This specification covers requirements for precast manhole sections except precast manhole bases. All precast manhole manufacturers shall be NPCA (National Precast Association) certified and shall provide all NPCA certifications upon request. Loading criteria for the precast manhole sections shall meet or exceed the AASHTO HS20-44 loading requirements. All precast manhole risers shall be monolithically cast to ensure water tightness and have a certified structural design and the manhole sections shall be cast in a fashion to achieve water tightness.

#### 742.2 MATERIALS:

**742.2.1 Concrete Materials:** Concrete materials shall conform to the requirements of Section [725](#) and Table [725-1](#) for Class AA.

**742.2.2 Precast Sections:** Precast sections shall conform to ASTM C478 (except Sections 15 and 16) and AASHTO M199 (except Sections 15 and 16). The design shall be in accordance with ACI 318 and ASTM C890 using traffic load A-16 (HS20-44).

**742.2.3 Joints and Connections:** Details of proposed joints and connections shall be submitted to the engineer for approval and shall conform to ASTM C990, C993, or C425 as applicable.

#### 742.3 MANHOLE BASES:

Sanitary sewer manhole bases shall be cast-in-place concrete in accordance with MAG Standard Details 420-1 and 420-2.

Storm drain manhole bases shall be cast-in-place concrete in accordance with COP Standard Details P1520 and P1560.

#### 742.4 REINFORCING:

Reinforcing steel shall meet the following specifications:

- Bars ASTM A615 or A706
- Wire and wire fabric A1064

Design of the reinforcing shall be in accordance with ACI 318 and ASTM C890

#### 742.5 GASKETS:

Sanitary sewer manhole joints shall have gaskets and cement mortar in accordance with MAG Standard Details 420-1 and 420-2.

Storm drain manhole joints shall have grouted joints in accordance with MAG Standard Detail 522 and COP Standard Details P1520 and P1560.

#### 742.6 LIFTING POINTS:

Lifting points shall be designed and evaluated by a registered professional engineer and have a minimum safety factor of four. After installation, the lifting holes shall be thoroughly packed with an approved commercial-source, non-shrink, non-metallic patching grout with an approved bonding agent. Bent reinforcing steel bars shall not be used as lifting devices. Through lifting holes will not be allowed.

#### 742.7 IMPERFECTIONS:

Any imperfections which in the opinion of the engineer may adversely affect the performance of the precast section shall be cause for rejection.

– End of Section –

## SECTION 743

### VITRIFIED CLAY PIPE

#### 743.1 GENERAL:

Vitrified clay pipe, 30 inch diameter or less, shall be extra strength in accordance with the requirements set forth in ASTM C700, except as modified herein. Pipe larger than 30 inches shall be of the type specified in the Special Provisions.

#### 743.2 MANUFACTURING REQUIREMENTS:

**743.2.1 Shape:** Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe.

The ends of the pipe shall be so formed that when the pipes are laid together and the joints made, they shall constitute a continuous and uniform line of pipe and shall have a smooth and regular interior surface.

**743.2.2 Stoppers, Branches, Ends:** Stoppers shall be used with all branch pipes that are to be left unconnected. Stoppers for branch pipes having flexible compression joints may be either clay discs with flexible compression joints, factory applied, that will mate with the branch joint; or, a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied; or, of other material approved by the Engineer. Wooden stoppers will not be accepted.

Branches shall be furnished with connections of the sizes specified, securely and completely fastened to the barrel of the pipe in the process of manufacture.

“T” branches shall have their axis perpendicular to the longitudinal axis of the pipe. “Y” branches shall have their axis 45 degrees (unless otherwise specified) from the longitudinal axis of the pipe, measured from the socket end.

All branches shall terminate in sockets. Barrel of the branch shall be of sufficient length to permit making proper joint when the connecting pipe is inserted in the branch socket.

**743.2.3 Imperfections:** The following additional imperfections in a pipe or fittings will be considered injurious and cause for rejection:

(A) Any surface fire crack in the ends of the spigot or bell which exceeds 1 inch in length.

(B) Any piece broken from the bell end of the pipe or fittings when it adversely affects the performance of the joint or connection.

**743.2.4 Certification:** A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of this specification, including test reports for the hydrostatic pressure test and the loading test herein specified.

#### 743.3 TESTS:

In addition to the required tests at the manufacturer's plant, the Engineer's representative may select specimens at random at the point of delivery or at the job site. Tests on these specimens shall be performed at a local testing facility under the supervision of the Engineer's representative. The cost of such supervision will be borne by the Contracting Agency and all other costs shall be borne by the Contractor.

When the pipe is subjected to an internal hydrostatic pressure of 10 psi for the time shown in Table [743-1](#), the accumulated moisture on the exterior surface shall not run down the sides in such quantity that will exceed 10 milliliters.

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TABLE 743-1	
TABLE OF TESTING TIME FOR PIPES	
Thickness of Wall Inches	Test Time Minutes
Up to and including 1	7
Over 1 and including 1 1/2	9
Over 1 1/2 and including 2	12
Over 2 and including 2 1/2	15
Over 2 1/2 and including 3	18
Over 3	21

The loading test shall conform in manner to that specified in ASTM C301 for 3-edge bearing and shall be applied to all specimens selected for testing.

### 743.4 IDENTIFICATION MARKS:

Pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, a code number identifying production control and plant location, and extra strength designation.

### 743.5 JOINTS:

Acceptable joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe.

Compression joints and couplings shall conform to the requirements of ASTM C425.

*- End of Section -*

## SECTION 750

### DUCTILE IRON PIPE AND FITTINGS

#### 750.1 SANITARY SEWER PIPE

All ductile iron pipe for conveying sewerage shall be in accordance with AWWA C-150:

- 14" inside diameter and smaller shall be pressure class 350
- 16" inside diameter through 24" inside diameter shall be pressure class 250
- 30" inside diameter and larger shall be pressure class 150

Ductile iron pipe with a minimum wall thickness of Class 50 may be substituted in lieu of the above.

The lining shall cover, at a minimum, the inner surfaces of the pipe and the fitting from the plain end or beveled spigot end to the rear of the gasket socket. If flanged fittings and pipe are included in the project, the lining must not be used on the face of the flange, however full face gaskets must be used to protect the ends of the pipe. At the ends of the pipe and fittings, the lining thickness shall taper for a distance of four inches to a minimum thickness of ten mils.

All ductile iron sewer pipe shall have a protective lining with a nominal thickness of 40 mils and a minimum thickness of 35 mils of Protecto 401 (ceramic epoxy), Polythane (polyurethane), throughout the barrel area of the pipe. However, the lining in the bell area shall transition to a minimum thickness of ten mils at the edge of the gasket socket. The ten-mil lining shall extend into the gasket socket area to a point where the gasket would overlap the lining when it is compressed due to pipe assembly during construction. The ten-mil lining shall also continue from inside the barrel area, around the spigot end of the pipe and along the outside of the pipe to a point where the center of the gasket of the next pipe section would contact the edge of the lining on the spigot end of the previous pipe section. The thickness of the linings shall be determined by using a dry film thickness magnetic gauge at four quadrants.

Each section of pipe and each fitting shall be tested and shall have an absence of holidays when tested by a suitable holiday detector. In all cases, the barrel area of the pipe shall be tested using a voltage of 2, 500 volts and a dry conductive probe.

Holiday testing shall conform to ASTM G 62-87 and NACE Standards RP0274-74 and RP0188-90 (latest revision).

The pipe manufacturer shall be solely responsible for the quality of the lining and shall supply a certification as to compliance to the specification. The certification shall state specifically the following items:

- (A) All ductile sewer pipe and fittings have a protective lining of 40 mils (35 mils min) in the barrel area, ten mils in the bell area and ten mils minimum on the exterior of the spigot end.
- (B) Each section of pipe and each fitting have been tested for holidays utilizing a test voltage of 2,500 volts with a dry conductive probe in the barrel area and a test voltage of 67.5 volts with a wet sponge in both the bell area and the exterior of the spigot end, and no holidays were found.
- (C) The lining material used meets the current specifications and that the material was applied as required by the specification.

If the Contractor makes a field cut of the lined ductile pipe, the Contractor shall comply with the recommendations of the pipe manufacturer in applying a field coating to the end of the pipe ends. In all cases, as a minimum, a ten mil coating shall be applied to the pipe end and shall overlap the lining by four inches and extend around the pipe end and along the outside of the pipe a minimum of ten inches. The coating shall be allowed to dry before assembly. In addition, the overlapped surface of the lining shall be roughed up to produce a three to five mil profile over the entire surface. The end result of this process is to insure proper adhesion of the field coating.

**750.1.1 Repair:** Repair of the damaged sections of the lining shall be in accordance with the lining manufacturer's recommendation or as specified above so that the repair area is equal to the undamaged lined area in all respects. All damaged lined areas and holidays shall be repaired immediately after discovery.

Holiday testing may be required by the Engineer before pipe assembly when deemed appropriate. The testing and repair

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requirements shall follow the procedures called for in this specification and all cost for such repairs will be the responsibility of the Contractor.

There will be no other provision for repair of the lining of DIP.

**750.1.2 Protective Collar:** In order to protect the exterior spigot end against abrasion and damage during shipping and handling, the manufacturer shall install temporary collars on the exterior of each spigot end of each pipe section. The manufacture shall secure the collars to the pipe to prevent accidental removal during shipping and normal handling by the Contractor. The collars are not to be removed from the pipe until right before the pipe section is to be installed or field cut

**750.2 DUCTILE IRON WATER PIPE:**

All ductile iron water pipe shall be designed in accordance with AWWA C-150 and shall be manufactured in accordance with AWWA C-151. The class shall be as designated in the plans or special provisions.

Manufacturer shall have a minimum of five years of experience producing ductile iron pipe and fittings, and shall be able to show evidence of at least five installations in satisfactory operation of similar diameters, lengths, and pipe class required for the Work.

All ductile iron pressure water pipe shall be furnished by a single manufacturer and fully manufactured in the USA, including casting, testing, and all applicable linings and coatings. The supplier shall be responsible for the provisions of all test requirements specified in AWWA C151 as applicable. In addition, all ductile iron pressure water pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Contracting Agency. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, will be borne by the Contracting Agency.

Ductile iron water pipe shall be of minimum pressure class as follows in accordance with AWWA C-150:

14" and smaller... ..	350
16" through 24" .. ..	250
30" and larger .....	150

The wall thickness of all flanged and grooved end pipe shall be minimum Class 53 except where the specified pressure requires heavier pipe.

All ductile iron water pipe shall be cement-mortar lined and seal coated in accordance with AWWA C-104.

For ductile iron pipe eighteen (18) inches and larger, a manufacturer's pipeline layout shall be submitted showing the line layout with each fitting specified and detailed. Numbering of each standard joint is not required.

All ductile iron pipe shall have polyethylene wrap per Section [610](#).

**750.3 JOINT REQUIREMENTS:**

Push-on joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include synthetic rubber gaskets and lubricant.

Mechanical joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include cast iron glands, synthetic rubber gaskets, and T-head bolts and nuts.

Flanged joints for cast iron or ductile iron water pipe shall be as detailed on the plans or as designated in the special provisions.

Restrained Joints:

When noted on plans or approved by the Engineer, joints for push-on or mechanical jointed ductile pipe may be modified to provide a fully restrained joint. These modifications to push-on and mechanical joints, including but not limited to

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segmented or special glands and split sleeves, shall conform to AWWA C-111. The Engineer shall review and/or approve each manufacturer's modifications to the joint. Upon request of the Engineer, the manufacturer of the modified joint shall provide test data showing compliance with AWWA C-111.

Joints for piping located in vaults shall be flanged unless mechanical clamp-type couplings or flange adapters are shown on the Drawings.

Bolts and nuts for joints shall conform to ANSI B18.2.1 and ANSI B18.2.2, respectively. Exposed and buried bolts and nuts shall be ASTM A 307, Grade B, with buried bolts and nuts coated with a petroleum based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

The following are approved integral restrained joint ductile iron pipes:

Pacific States Pipes.....	Thrust-Lock
U.S. Pipe.....	TR Flex
U.S. Pipe .....	HP Lok
American Ductile Iron Pipe.....	Flex Ring
American Ductile Iron Pipe.....	Lok-Ring
Clow Water Systems .....	Super-Lock
Griffin Pipe.....	Snap-Lok
Griffin Pipe.....	Bolt-Lok

The following are approved restrained joint glands for mechanical joint pipe and fittings:

Star Pipe Products .....	Stargrip Series 3000
Romac Industries .....	Romagrip
Romac Industries .....	GripRing
EBAA Iron .....	Megalug Series 1100
Ford Meter Box .....	Uni-Flange Series 1400
Tyler Union .....	Tuf-grip
Sigma Corporation .....	Sigma One Lok Series

Split restrained joint glands for mechanical joints, or wedge action restrained joint glands for push (non-mechanical) joints, are only allowed for connection or repair to existing installed pipe. The following are approved split restrained joint or wedge glands:

Star Pipe Products .....	Stargrip Series 3000S, 3100P, 3100S
EBAA Iron .....	Megalug Series 1100SD, 1100HD
EBAA Iron .....	Megalug Series 1700
Ford Meter Box .....	Uni-Flange Series 1450
Sigma Corporation .....	Sigma One Lok Series

All pipeline valves and fittings shall have thrust blocks as shown or referenced on the drawings designed for the working pressure in addition to the above restraining systems.

Flanged joints are allowable for above ground piping installations only, except for locations where valves are connected. Buried flanged joints shall be coated with a petroleum based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

Weld-on boss outlets are not acceptable.

### 750.3.1 Welded-On Outlets For Ductile Iron Pipe Larger Than 16 Inches:

**750.3.1.1 Scope:** Welded-on outlets shall be limited to branch outlets having a nominal diameter not greater than 50% of the nominal diameter of the main line pipe or 12-inch whichever is smaller (see Table [750-1](#)). Welded-on outlets may be provided as a radial (tee) outlet, or lateral outlet fabricated at a specific angle to the main line pipe, as indicated on the drawings. Welded outlets for ductile iron pipe are not acceptable for a tangential configuration unless shown on the plans or

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approved by the ENGINEER. No welding shall be permitted within 24-inches from the end of the pipe. Spacing of welded outlets shall not be closer than two times the diameter of the largest outlet. The pipe manufacturer or fabricator shall have a minimum of 5 years' experience in the fabrication and testing of outlets of similar size and configuration.

**Table 750-1**  
**Main Line Nominal Diameter Versus Maximum Nominal Branch Outlet Diameter**

Main Line Nominal Diameter	Maximum Nominal Branch Outlet Diameter
18"	8"
20"	10"
24"	12"
30"	12"
36"	12"
42"	12"
48"	12"
54"	12"
60"	12"
64"	12"

**750.3.1.2 Outlet Joint Types:** The joints on welded-on branch outlets shall meet, where applicable, the requirements of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15.

**750.3.1.3 Design:** Weldment for welded-on outlets shall be based on the method described in Section VIII of the ASME Unfired Pressure Vessel Code. Reinforcing welds shall be placed using Ni-Rod FC 550 cored wire or Ni-Rod 550 electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties). Carbon Steel electrodes are not acceptable.

Parent pipe and branch outlet pipe shall be centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured in accordance with ANSI/AWWA C151/A21.51. Minimum classes shall be: for sizes 4-inch through 54-inch, Special Thickness Class 53; for sizes 60-inch through 64-inch, Pressure Class 350.

Welded outlets require submittal and approval of design calculations, welding procedures, and actual structural testing results for both hydrostatic pressure as well as transverse and axial loading imposed on the outlet itself.

**750.3.1.4 Testing:** All welded-on outlets shall be rated for a working pressure of 250 psi and must have a minimum safety factor of 2.0 based on proof of design hydrostatic test results. The manufacturer shall, at the request of the owner or owner's Engineer, provide representative proof test data confirming hydrostatic test results and safety factors.

Prior to the application of any coating or lining in the outlet area all weldments for branch outlets to be supplied on this project shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any leakage shall be detected by applying an appropriate soapy water solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer's written procedures.

**750.3.1.5 Quality Assurance:** The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the Guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedure specification (WPS), procedure qualification (PQR), and welder performance qualification test (WPQR) records as well as appropriate air test logs documenting air leakage tests. The manufacturer shall have ISO 9001 or 9002 registration.

Prior to the start of manufacturing any proposed manufacturer not meeting ISO 9001 or 9002 registration requirements shall submit to the owner or owner's Engineer the name of an Independent Inspection Agency and the agency's qualifications. Submitted qualifications shall include but are not limited to the following:

- (A) List of project references for projects of similar type and size

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- (B) Resumes for inspection and testing personnel
- (C) Capacities for chemical and mechanical testing of material specimens
- (D) Frequencies for all instrument and testing equipment certifications

The independent inspection agency shall be responsible for all of the following:

- (A) Verify compliance to written welding procedures specification (WPS) and procedure qualification (PQR)
- (B) Verify qualification of all welders (WPQR) per ANSI/AWS D11.2 criteria
- (C) Document use of Ni-Rod FC 55o cored wire or Ni-Rod 55o electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties)
- (D) Witness and document all air testing of outlet welds

**750.3.1.6 Field Welding:** No field welding or field repairs shall be allowed. Should a leak be detected at a welded-on outlet after installation, the piece shall be removed and returned to the pipe manufacturer's facility, where originally produced, for repair.

### 750.4 FITTINGS:

Iron fittings shall be either Gray-Iron or Ductile Iron conforming to AWWA C-110 or AWWA C-153 with a minimum pressure rating of 250 psi. Flanged ends shall conform to AWWA C-110. Push-on and mechanical joints ends shall conform to AWWA C-111.

Mechanical joint fittings shall conform to AWWA C110, and flange fittings shall conform to AWWA C110 and C115. AWWA C153 compact fittings are acceptable for use unless otherwise specified. Long-radius elbows shall be provided where specified.

Fittings for water pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

### 750.5 CATHODIC PROTECTION:

All ductile iron pipe 16-inches and larger shall have cathodic protection. Pipelines less than 16 inches shall have cathodic protection where called for in the plans and specifications or directed by the Engineer.

**750.5.1 Bonded Joints:** Bond wires shall be provided across all non-conductive ductile iron pipe joints to ensure electrical continuity. Joint bonds shall be installed as shown on the drawings. Joint bonds shall be made utilizing #4 AWG type HMWPE stranded conductors. Bond wires shall not exceed 18 inches in length. Joint bond wires shall be installed as shown on the plans. Connections shall be made utilizing the exothermic weld process per Subsection [750.5.2](#).

**750.5.2 Exothermic Welds:** Exothermic welds shall be provided for wire to structure connections in strict accordance with the manufacturer's recommendations. Connections shall be made at locations shown on plans. Exothermic welds shall be "Cadweld", as manufactured by Erico Products, Inc., "Thermoweld" as manufactured by Continental Industries, Inc., "Pin Brazing" by BAC, or approved equal. Duxseal packing as manufactured by Johns-Manville or approved equal shall be used where necessary to prevent leakage of molten weld metal.

The shape and charge of the exothermic weld shall be chosen based on the following parameters:

- Pipe Material
- Pipe Size
- Wire Material
- Number of Strands to be Welded
- Orientation of Weld (Vertical or Horizontal)

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Type of exothermic weld to be used shall be submitted to the Construction Manager for approval. Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends of all stranded wires prior to exothermic welding to improve mechanical strength and thermal capacity.

Exothermic weld connections shall be installed in the manner and at the locations shown on the plans. Coating materials shall be removed from the surface over an area of sufficient size to make the connection. The steel surface shall be cleaned to shiny metal by grinding or filing prior to welding the conductor. The use of resin impregnated grinding wheels will not be allowed. The conductor shall be welded to the pipe by the exothermic welding process with a copper sleeve fitted over the conductor. Only enough insulation shall be removed such that the copper conductor can be placed in the welding mold. After the weld has cooled, all slag shall be removed and the metallurgical bond shall be tested for adherence to the pipe or casing. All defective welds shall be removed and replaced. All exposed surfaces of the copper and steel shall be covered with insulating materials as shown in the detail drawings. No connections to the piping shall be buried prior to inspection and approval of the Engineer. Connections made in violation of this requirement shall be rejected.

Welds shall be primed with an elastomer resin based primer, covered with a weld cap, and then over-coated with bitumastic.

**750.5.3 Weld Caps:** Welds to be buried or submerged shall be primed with an elastomer resin based primer then be covered with a 100% solids mastic filled plastic cap. Use the plastic cap on dielectric coated pipe following the manufacturer's instructions. Primer shall be Roybond Primer 747 as manufactured by Royston Laboratories, or equivalent. Weld caps shall be Royston Handy Cap, as manufactured by Royston Laboratories, Inc. Thermit Weld Cap, as manufactured by Phillips Petroleum Co. or an approved equal.

**750.5.4 Testing:** The Contractor shall be responsible for testing the corrosion monitoring and cathodic protection systems. All testing shall be performed by or under the direct supervision of a Corrosion Engineer. All field tests shall be performed at the expense of the Contractor. This testing shall include all insulators, wires, continuity testing, and cathodic protection system activation. The tests shall be conducted in the presence of the Owner or its representative. The Contractor shall correct, at his expense, all deficiencies in the installation observed by these tests and inspections.

The Contractor shall pay for all retests made necessary by the corrections.

- (A) Services of Corrosion Engineer: Contractor shall obtain the services of a Corrosion Engineer to inspect, activate, adjust, locate electrical discontinuities, and evaluate the effectiveness of the cathodic protection system. The Corrosion Engineer is herein defined as a registered Professional Engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by NACE International at the level of Corrosion Specialist or Cathodic Protection Specialist (i.e. NACE International CP Level 4). Such a person shall have not less than five years' experience inspecting pipeline cathodic protection systems.
- (B) Services of Cathodic Protection Technician: If necessary, obtain the services of a Cathodic Protection Technician to inspect, activate, adjust, and evaluate the effectiveness of the cathodic protection system. The Cathodic Protection Technician is herein defined as a person accredited or certified by NACE International as a Cathodic Protection Level 2 Technician. Such a person shall have not less than five years' experience inspecting pipeline cathodic protection systems and shall be under the direct supervision of the Corrosion Engineer.

Upon completion of installation of all components in accordance with these specifications, testing shall be performed to demonstrate that the installation has been completed and is in working order in conformance with the plans and specifications. In no case shall the testing be less than those outlined herein unless requested in writing by the Contractor and approved by the Construction Manager. The testing described herein shall be in addition to and not a substitution for any required testing of individual items at the manufacturers' plant. The Contractor shall provide testing of the system. The test data shall be submitted to the Engineer for acceptance to demonstrate that the system is in proper working order. The cost of the testing shall be borne by the Contractor, including any additional expenses which result from retesting due to equipment or installation which is not in conformance with these specifications and drawings.

**750.5.4.1 Exothermic Weld Testing:** Exothermic welds shall be tested by the Contractor for adherence to the pipe or casing and for electrical continuity between the pipe or casing and wires. Test completed weld by striking weld with a hammer and pulling on wire. A 22-ounce hammer shall be used for adherence testing by striking a blow to the weld. Care shall be taken to avoid hitting the wires.

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**750.5.4.2 Joint Bond Testing:** After installation, all joint bonds shall be tested for effectiveness. The testing shall be performed prior to backfill of the pipe and shall be verified upon completion of backfilling operations. Prior to backfilling, current shall be circulated through the pipe and the measured resistance shall be compared to the theoretical resistance of the pipe and bond cables. The resistance measured shall not exceed 120 percent of the theoretical resistance. Once backfilling operations have been completed, the testing shall be repeated to ensure continued effective continuity. All data shall be tabulated and submitted upon completion of testing and prior to final acceptance of the contract.

*- End of Section -*

## **SECTION 754**

### **COPPER PIPE, TUBING AND FITTINGS**

#### **754.1 PIPE AND TUBING:**

All copper pipe and tubing shall be new seamless copper pipes and tubes, designed for underground water services, plumbing purposes, etc. They shall conform to all the requirements of ASTM B88, Type K.

All pipe or tubing shall be made of copper free from cuprous oxide, as determined by microscopic examination at a magnification of 75 diameters.

Type K tubing, when furnished in coil, shall be annealed after coiling.

#### **754.2 FITTINGS:**

All fittings used in connection with copper pipe or tubing, shall be copper or bronze fittings as shown on standard details.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

*- End of Section -*

## SECTION 756

### DRY BARREL/FIRE HYDRANTS

#### 756.1 GENERAL:

Fire Hydrants furnished by the Contractor shall be designed, manufactured, and tested in compliance with the latest edition of the American Water Works Association (AWWA) - C. 502 Standard for Dry-Barrel Fire Hydrants, supplemented as follows:

#### 756.2 DRAWINGS:

Detail drawings or blue prints showing all components, principal dimensions, construction details and materials used shall be submitted to the Contracting Agency for approval. The Contracting Agency reserves the right to consider the quality, appearance and past performance of fire hydrants when reviewing drawings for approval.

#### 756.3 HYDRANTS:

Fire hydrant makes and models (and approved alternates) shall be specified by the owner and designated on an approved products list, which will be maintained by the owner. Alternate hydrants by request only to Owner. The diameter of the main valve seat opening shall be not less than 5 inches in diameter. The entire valve assembly shall be effectively sealed against moisture.

Approved fire hydrants allowed for installation in the City of Phoenix include:

- Mueller Super Centurion 250
- Clow Medallion (new model)
- Kennedy K-81 Guardian
- American Darling B-84-B
- East Jordan Iron Works CD-250

All fire hydrants shall be supplied to meet a 42-inch bury depth.

All interior ferrous surfaces of the shoe exposed to fluid flow (including the valve plate and cap nut), shall be epoxy coated to a minimum dry thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C 550-81, NSF 61 approved, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

Style of inlet shoe connections shall be a restrained mechanical joint with accessories, gland, bolts, gaskets and having a 6 inch diameter inlet connection. Solid flange or ring tight "bump in" connections will not be allowed unless through exception by owner. Facing of the main valve against seats shall be rubber or synthetic rubber. The top of the stem or bonnet shall be equipped with the O ring seal. Hydrants shall be constructed so that extension sections in multiples of 6 inches, with rod and coupling, can be added to increase barrel length. The hose and streamer nozzle connections shall match the standard size and threads per inch of the Contracting Agency. Operating and outlet nozzle cap nuts shall be of solid pentagonal shape. The pentagon shall measure fifteen sixteenths to thirty one thirty seconds inch on side, 1 1/2 inch from point to flat. All barrels above ground shall have a prime coat and painted with two coats of fire hydrant yellow paint or as specified by owner. Hydrants shall be constructed so that the standpipe can be rotated 360 degrees to at least 8 different positions.

Hydrants shall be designed for a 250 psi working pressure and factory bench tested to a 500 psi hydrostatic pressure.

Hydrants shall be field tested consistent with the specified pressure ratings for the connecting pipes or as specified by AWWA.

Hydrants shall be of the break flange traffic model type with a replaceable breakable unit immediately above the ground line to minimize repairs necessary due to traffic damage. The breakable stem coupling will be made of a corrosion resistant material such as stainless steel or bronze, or have a permanently applied non corrosive finish such as nickel plating or fusion bonded epoxy coating.

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Hydrants shall be of the compression type; constructed such that the main valve closes with the water pressure to assure no loss of water in the event of damage to the upper portion of the fire hydrant.

Main valve opening shall have a minimum diameter of 5-inches to assure optimum flow. Facing of the main valve against the seats shall be of rubber or synthetic rubber minimum of 1 inch in thickness. Plastic or Neoprene type main valves will not be allowed.

Hydrants shall be of the dry top design with o-ring seals to ensure that the operating threads will be protected from water entry. Dry top design to include factory- lubricated operating mechanism which allows supplemental lubricant to be added in the field without removal of the upper barrel.

Standard lubricant shall be a NSF 61 approved oil or grease suitable for a temperature range of 20 degrees to 150 degrees F.

Hydrants shall have a cast iron weather shield at the operating nut to protect the clearance area between the top casting and the operating nut.

The operating nut shall be a one-piece bronze casting. Both the operating nut and the nozzle cap nuts shall be National Standard Pentagon in shape and measure 1-1/2 inches from point to flat at the base of the nut.

Hydrants shall have two hose nozzles, 2.5 inches in diameter, and one pumper nozzle approved by the Owner. Rubber gasket nozzle caps shall be provided. Screw Threads shall be per owner requirements.

Hydrant nozzle section shall be capable of rotation through 360 degrees to at least 8 points of rotation with respect to the standpipe to allow the positioning of the hose or pumper nozzles

Minimum distance allowable between the centerline of the lowest nozzle and ground / bury line is 18-inches. Bury line shall be visibly marked on lower barrel of hydrant.

Hydrants shall have markings indicating direction of opening right to left (counter-clockwise).

Hydrants shall have permanent markings identifying the manufacturer name, model identification, size of the main valve opening and the year of manufacture.

Hydrants shall have an automatic drain that is operated by the main valve rod. The drain valve is to open as the main valve is closed and close as the main valve is opened. The port and seat of the drain valve shall be bronze. Drain facings shall not be leather.

The outside of the hydrant top section shall be painted a minimum of one coat of non- lead base premium primer and two (2) finished coats of non-lead base premium durable paint. The surface will be properly prepared, smooth, clean, and dry before primer is applied. The primer coat will be applied to a DFT (Dry Film Thickness) of 3-4 mils. The final 2 coats will be applied to achieve a DFT of 6-8 mils on top of the primer coat. Paint will be a semi-gloss, bright chrome safety yellow in color or as specified by owner. Paint will have high color retention. Paint will be fade and UV resistant, rust resistant, resistant to abrasions and chipping and have flexibility qualities.

Hydrants shall have a bronze valve seat and shall be threaded into a bronze drain ring or shoe bushing to prevent electrolysis between these components

Hydrants shall be designed to permit the use of extension sections.

Hydrants shall be designed to allow all working parts to be removed through the bonnet/dome or upper nozzle section of the hydrant without removal of the entire upper barrel section.

Hydrants shall be suitable for installation in 36-inch to 72-inch trench depth or as specified by owner.

All nuts and bolts of the factory hydrant to be buried below ground will be a minimum of 304 stainless steel and coated for gall protection.

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The friction loss must be guaranteed by the manufacturer to match statistics in Table [756-1](#).

### 756.4 MANUFACTURER:

The manufacturer shall guarantee that the hydrant is so constructed that the valve stem will not be bent when hydrant is damaged or broken at or near the grade level. A safety breaking flange or thimble, shall be provided. The friction loss must be guaranteed, by the manufacturer, to satisfy Table [756-1](#).

TABLE 756-1			
MAXIMUM PERMISSIBLE LOSS OF HEAD FOR HYDRANTS			
Number of Outlet Nozzles	Nominal Diameter of Outlet	Total Flow From Outlet Nozzles GPM	Maximum Permissible Head Loss PSI
2	2 1/2 inches	500	2.0
1	4 inches	600	2.5

### 756.5 WARRANTY:

All items shall be warranted by the manufacturer for a minimum period of five (5) years from date of acceptance by the Owner, against defects in material and workmanship. At any time during that period, if a defect should occur in any item, it shall be repaired or replaced by the manufacturer at no obligation to the Owner, except where it would be shown that the defect was caused by misuse and not by fault of manufacturer. The manufacturer shall make necessary repairs within the time frame specified by the owner or reimburse the owner if emergency repairs are required. The manufacturer expressly warrants all items to be new, free from defect in design, materials, and workmanship and to be fit and sufficient for their intended purpose. All warranties shall survive acceptance and payment by the city.

### 756.6 INSPECTION:

All items shall be inspected before acceptance by an authorized representative of the Owner for workmanship, acceptance and proper functioning of components, and conformance to all requirements of this specification.

Should deficiencies be found, it shall be the responsibility of the supplier to pack the item(s) in question, make necessary corrections, and then return to the Owner for re-inspection and acceptance at no additional expense or obligation to the Owner.

*- End of Section -*

## SECTION 757

### LANDSCAPE IRRIGATION SYSTEM

#### 757.1 GENERAL:

All materials and fittings shall be new, of the manufacturer's most current design, and shall bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source of supply for replacement parts will be furnished to the Engineer.

The Manufacturer of component equipment shown on the drawings or specified in the Special Provisions form the basis of the irrigation design as well as the physical and operational standards for which the components were selected. Component equipment from other manufacturers may be submitted, by the Contractor, to the Engineer for approval. No equipment however is to be ordered without approved shop drawings.

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coatings shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, asphalt tape, Pretecto Wrap No. 200, Safe-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50, or approved equal. Tape shall be edge lapped no less than 1/4 inch.

#### 757.2 PIPE AND FITTINGS:

The type of pipe material and fittings shall be as designated on the plans or in the special provisions. The type utilized shall comply with one of the following:

**757.2.1 Steel Pipe:** All steel pipe shall be newly galvanized, welded or seamless steel pipe conforming to the requirements of ASTM A53, standard weight, schedule 40.

**757.2.2 Plastic Pipe:** Rigid Plastic Pipe shall be extruded from 100% virgin normal impact unplasticized polyvinyl chloride (PVC) Type I, Grade I or II resin 2000 psi (PVC 1120 or PVC 1220), design stress ASTM D1784, Department of Commerce PS-21-70, PS-22-70, Standard Dimension Ratio (SDR) 26 or less than 160 psi. Pipe shall conform to ASTM D-2241 and D-2672.

Testing of pipe: Provide written certificate by supplier that polyvinyl chloride pipe has successfully passed the following tests:

Acetone test: Immerse a sample of pipe in 99% pure anhydrous acetone for 15 minutes; at the end of this time there should be no evidence of flaking or delamination on the inner or outer walls of pipe. Evidence of softening or swelling shall not constitute failure.

Flattening: Cut a specimen two inches long from each end of the pipe sample. Flatten each test specimen from parallel plates of a press until the distance between the plates, in inches, is equal to sixty (60) percent of the pipe O.D., and there shall be no evidence of cracking, splitting or breaking.

The pipe shall be homogeneous throughout, free from visible cracks, holes, or foreign materials. The pipe shall be free from blisters, dents, wrinkles or ripples and die and head marks.

Piping up to and including 2-1/2" size shall be SDR solvent welded.

Pressure mainline piping 3" size and larger shall be gasket pocket type, as manufactured by the Swanson Co. or approved equal, and shall conform to ASTM F-477.

Continuously and permanently mark pipe with manufacturer's name or trademark, kind and size (IPS) of pipe, material, manufacturer's lot number, schedule or type and NSF seal of approval.

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### 757.2.3 Pipe Fittings and Couplings:

(A) Steel Pipe Fittings and Couplings: Steel pipe fittings and couplings shall be 150 psi pressure rated, banded, galvanized, malleable iron screwed fittings and couplings.

(B) Plastic Pipe Fittings and Couplings: For pipe fittings up to and including 2-1/2" size, fittings and couplings shall be either threaded type or slip fitting tapered socket solvent weld type. Schedule 80 pipe will only be used for threaded joints. Tapered socket solvent weld fittings may be either Schedule 80 or Schedule 40, but in either case, will be equal to or greater than the schedule and Pressure Rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

PVC fittings shall be marked with manufacturers name or trademark, type PVC, size and NSF seal of approval. Extruded couplings to be produced from NSF rated raw materials and meet ASTM standards.

For pipe 3" and greater, fittings shall be ductile iron, grade 80-55-06, in accordance with ASTM A-536. Fittings shall have mechanical joints with gaskets meeting ASTM F-477. Fittings shall have radii of curvature conforming to AWWA C110.

(C) Copper Pipe Fittings and Couplings - Copper pipe fittings and couplings shall conform with Section [754](#).

**757.2.4 Solvent Cement:** The solvent cement shall be a solution of Type 1, Grade 1, unplasticized, polyvinyl chloride molding or extrusion compound as specified in ASTM D1784, or an equivalent PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic undissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring. Container labeling shall be in accordance with ASTM D2564.

**757.2.5 PVC Primer:** The primer shall be specifically formulated for the pipe and type of connection, as recommended by the pipe manufacturer.

### 757.3 VALVES AND VALVE BOXES:

**757.3.1 General:** Valves shall be of the size, type, and capacity designated on the plans or in the special provisions and shall comply with the requirements specified herein.

All valves except garden valves shall be capable of satisfactory performance at a working pressure of 200 psi. Valves shall be designed to permit disassembly to replace sealing components without removal of the valve body from the pipeline.

Valves on galvanized pipelines shall be all bronze, double disc wedge, non-rising stem with wheel handle on top, such as Jones J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B62.

**757.3.2 Gate Valves:** Gate valves in size two inches and smaller shall be all bronze double disc wedge type with integral taper seats and non-rising stem. Sizes two and one-half inches and larger shall be iron body, brass trimmed, with the other features the same as for the two inch.

**757.3.3 Manual Control Valves:** Manual control valves shall be brass or bronze, and shall be straight or angle pattern glove valves, full opening; key operated with replaceable compression disc and ground joint union on the discharge end.

**757.3.4 Electrical Remote Control Valves:** The electric remote control valve listed on the plans or specifications and described by the manufacturer's most recent literature (catalogue cut sheet), constitute the quality and performance standards for the specified valve.

**757.3.5 Garden Valves:** Garden valves shall be brass or bronze except for the handle. They shall have a replaceable compression disc, and shall be 3/4 inch straight-nosed, key operated and pressure rated for operation at 150 psi.

**757.3.6 Quick-Coupling Valves and Assemblies:** Quick-coupling valves shall be brass or bronze with built-in flow control and self-closing valve and supplied in 3/4-inch size unless otherwise required. When a quick-coupler assembly is specified, it shall consist of the valve, quick-coupler connection and hose swivel. Keys and hose swivel ells shall be furnished as specified on the plans.

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**757.3.7 Valve Boxes:** All valve boxes shall have stainless steel bolts and washers with lock down covers. Valve boxes and covers shall be molded, non-corrosive plastic, ASTM D638, D-356, except when located in paved surfaces. These shall be concrete boxes with lock down steel or concrete cover rated for traffic conditions to which it will be exposed.

### **757.4 BACKFLOW PREVENTER ASSEMBLY:**

The Backflow Preventer Assembly shall consist of Pressure type or Reduced Pressure type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans or specifications. The backflow preventer unit shall be equal in quality and performance to the unit listed in the Contract Documents.

**757.4.1 Backflow Preventer Cage:** Pre-manufactured units shall be approved for use by the Engineer. The Contractor shall submit catalog information. Pipe used to support the units shall be not less than 1-1/4" schedule 40 and shall be ASTM A-53 Grade A electric weld Pipe, expanded metal shall be 1/2" spacing, #13 gauge flattened diamond pattern steel. There shall be no exposed ends of expanded metal on the outside of the enclosure. The expanded metal shall be "die formed" for uniformity. Welds shall be a minimum of 1/4" long weld on a 4" spacing. All units shall withstand a minimum of 200 lbs. per square foot for 24 hours without deflection or distortion. Cage locking mechanism shall be vandal resistant. Cage shall be powder coated by electrostatic application to 1.5 to 2 mil thickness. Color shall be approved by the Engineer.

### **757.5 SPRINKLER EQUIPMENT:**

Sprinkler heads, bubbler heads and spray nozzles shall be of the types and sizes as shown on the plans. All major components shall be brass, bronze, stainless steel, or high impact plastic.

Equipment of one type with similar flow characteristics shall be from the same manufacturer and shall bear the manufacturer's name and identification code in a position where they can be identified after installation.

Spray heads, impact sprinkler heads, rotor pop-up sprinkler heads, bubblers, emitters, etc., as shown on the plans or specifications and as described in the Manufacturer's latest literature (Catalogue cut sheets) constitute the performance and quality standards for this equipment.

### **757.6 ELECTRICAL MATERIAL:**

All equipment and material shall comply with the requirements of the governing code and shall be listed by Underwriters' Laboratories, Inc.

**757.6.1 Conduit:** Conduit shall be as designated on the plans or specifications.

**757.6.2 Conductors:** Service line conductors shall be supplied in the size shown on the plans and shall be THW 600 volts insulation rating conforming to ASTM D2219 or D2220. Low voltage control conductors shall be Type UF No. 14 AWG copper unless otherwise shown on the plan and shall be UL approved for direct burial installation.

**757.6.3 Controller Unit and Assembly:** The Controller unit and assembly listed on the plans or specifications and as described in the Manufacturer's latest literature (Catalogue cut sheets) constitute the quality, performance and operational standards for the specified Controller.

*- End of Section -*

## SECTION 758

### CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE

#### 758.1 GENERAL:

All pipe shall be designed for 150 psi working pressure plus 60 psi surge pressure unless otherwise specified. Test pressure shall be 188 psi.

The pipe shall be designed to support the earth cover over the pipe as shown by the pipeline profiles on the plans. Where the earth cover over the pipe is less than eight (8) feet, the design shall be based on eight (8) feet minimum cover. When the plans show both existing and future surface profiles, the critical cover shall be used for design purposes.

Earth loads on pipe shall be calculated assuming the pipe is installed in a positive projecting embankment condition. The loading for positive projecting embankment condition shall be derived using a product of the projection ratio and the settlement ratio of 0.5. The Ku factor shall be 0.150. The soil unit weight shall be 140 pounds per cubic foot.

Pipe reinforced with ring stiffeners will not be permitted. Dimensions of fittings and specials shall conform to AWWA C-208.

Field joints for specials and fitting shall be as called for on the plans. Flanges shall be Class D steel ring flanges in accordance with AWWA C-207, unless otherwise specified.

These specifications apply to Concrete Pressure Pipe intended for use in water supply pipelines that carry water under pressure. Concrete pressure pipe is specified as follows:

(A) Reinforced concrete pressure pipe-steel cylinder type, pretensioned, shall be designed, manufactured and tested in accordance with AWWA C-303. With agreement by the purchaser and the manufacturer, pipe may be manufactured to larger sizes and for higher pressures than indicated herein.

Reinforced concrete cylinder pipe (CCP) may be furnished in pipe diameters of twenty-four (24) inches through sixty (60) inches.

Pipe and fittings shall be designed by the methods described in AWWA Manual M9 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

The pipe shall be designed for the maximum stress to be encountered in place as indicated on the plans, whether it is internal pressure, external backfill load, H-20 truck load on the backfill, or any combination of loading.

The pipe shall be designed to limit the deflection of the pipe, in inches, under the external loads specified to not more than the square of the diameter of the pipe in inches divided by 4,000. Deflection shall be calculated by "Spangler's" formula using a bedding constant (K) of 0.1 and an appropriate modulus of soil reaction (E'). An E' value of 1,500 psi may be used for pipe bedding material based on 90 percent Standard Proctor or 70 percent relative density for pipe cover depths between 5 feet and 15 feet. For pipe burial depths less than 5 feet or greater than 15 feet or alternative pipe bedding materials, designer may use alternate E' values provided that the rationale for developing the alternate E' value is acceptable to the Owner. E' = 2,500 psi may be used for controlled low-strength material (CLSM).

The pipe shall be designed for external loading based on an H-20 truck loading and impact factors recommended by AASHTO for highway truck loads in "Standard Specifications for Highway Bridges."

Immediately after the cement-mortar coating has been placed, the ends of each section of pipe shall be tightly capped with waterproof covers to prevent the escape of moisture when water curing. When steam curing, waterproof covers may not be necessary until completion of cure, provided prompt application of steam is begun. The waterproof covers shall become a component part of the completed pipe section, to protect the interior of the pipes, and shall remain on the pipe until it is installed in the trench.

The minimum steel plate thickness for fittings and special pipe shall be 0.25 inches.

For fittings and special pipe, the minimum cement mortar or concrete lining thickness shall be 0.75 inches and the 0.75 inches shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any design

## SECTION 758

calculations. External or outside cement mortar coating shall be limited to a maximum of 1.25 inches for the purpose of resisting any external loads.

For standard pipe, the maximum allowable cement mortar coating shall be 1.25 inches, measured from the bar wrap.

(B) Prestressed concrete pressure pipe steel cylinder type, shall be designed, manufactured and tested in accordance with AWWA C-301 and AWWA C-304.

Prestressed concrete pressure pipe may be furnished in pipe diameters forty-two (42) inches and larger.

Pipe shall be designed by the methods described in AWWA C-304 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

Pipe shall be embedded cylinder type. Stress analysis of pipe shall be made using "Olander's" coefficients for a 120 degree bedding angle.

Prestressed concrete cylinder pipe (PCCP) may be furnished in forty-two inch and larger diameters.

Except as otherwise provided in this Section, fabricated steel plate fittings and specials shall be designed for internal pressure only. The internal pressure design shall be based upon a design stress of 15,000 psi. The minimum steel plate thickness shall be 1/4 inch.

Outlets, where specified on the plans, with an internal diameter of less than one-half the diameter of the mainline pipe may be installed on prestressed concrete cylinder pipe. Outlets with an internal diameter greater than one-half the diameter of the mainline pipe or twenty-four (24) inches shall be designed and manufactured as a separate fabricated steel plate fitting.

The exterior of fabricated steel plate fittings and specials shall not be mortar coated, but shall be shop painted as provided in this Section.

All fabricated steel plate fittings and specials shall be encased in reinforced concrete as shown on the details in the plans.

At mainline valves, where a steel plate section is required to comply with plans and/or attach a companion flange for connection to the valve, the following shall apply to such plate sections:

- (a) Design shall limit deflection to the square of the diameter in inches divided by 4,000 for pipe diameters less than sixty (60) inches. For pipe diameter sixty (60) inches and greater, deflection is limited to one and one-half (1-1/2) percent of the diameter.
- (b) Unless otherwise specified, plate sections shall not be longer than one (1) foot.
- (c) Plate sections shall comply with all other applicable provisions, MAG Specifications, Phoenix supplement to MAG and AWWA Standards and AWWA Manual of Water Supply Practices-M9, second edition, with the following exception. For design, the minimum cement mortar or concrete lining thickness shall be 0.75 inches and the 0.75 inches shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any design calculations. External or outside cement mortar coating shall not be considered for the purposes of resisting any external loads.

### 758.2 MANUFACTURE:

The Contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-303 or AWWA C-301.

An approved rust inhibitor shall be applied on the exposed portions of the steel joint rings.

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The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-301 or AWWA C-303.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

An affidavit of compliance as specified in Section 1.11 of AWWA C-301 and Section 1.11 of C-303 shall be furnished to the Engineer.

Cement used in manufacture of pipe shall conform to ASTM C-150, Type II, low alkali.

No concrete admixture shall be used except as approved in writing by the Engineer.

Liquid membrane-forming compounds shall conform to ASTM C-309, Type I, and shall be of such composition that after drying they will not impart taste or odor to water flowing through the pipe, nor will they contain any toxic materials. The use of such compounds shall be subject to the approval of the Engineer.

Rust inhibitors used for preventing rust on steel surfaces at holdbacks of mortar lining and/or coating shall be quick-drying material with good bonding properties to the steel, and shall be tack-free and smooth within four (4) hours after applying.

All joints shall be the Carnegie Bell and Spigot type with rubber gaskets. The joint rings for spigot ends for rubber gasket joints shall be Carnegie Shape M-3516, M-3818 or M-3836.

Openings, connections and outlets shall be cement mortar lined and concrete coated as detailed on the plans.

Prestressing wire shall be wrapped directly over steel shorting straps (Minimum of 4). Steel bars shall be welded between prestress anchor assemblies and joint rings.

Design steel cylinders and welds between cylinders and joint rings for the longitudinal thrust exerted by full test pressure. Minimum cylinder thickness for AWWA C 301 pipe shall be 10 gauge where restrained joints are required.

### **758.3 MATERIAL DRAWINGS:**

The Contractor shall furnish the Engineer with six (6) copies of shop drawings, pipe layout diagrams, manufacturer's catalog data, and detailed information, in sufficient detail to show complete compliance with all specified requirements, covering but not limited to the following items:

Fabricated pipe and specials; design calculations; field closures; reinforcing steel and concrete mix designs.

The manufacturer's complete design calculations shall be submitted to the Engineer for review prior to or with the Joint Detail submittal.

The procedure outlined in American Water Works Association Manual M-9 will be used in determining the length of pipe requiring welded joints. Joint restraints design shall be based on test pressures. Shop drawing submittal shall include calculations showing the length of welded joints, tensile stress to be resisted by, and design of joint welds and pipe longitudinal reinforcement. Minimum design parameters shall be as follows: Soil unit weight is 110 pounds per cubic foot; soil friction coefficient 0.3; height of backfill over pipe - maximum four (4) feet or as shown on plans (if less than four (4) feet). Throat thickness of welds shall be based on an allowable stress of 8,800 pounds per inch per inch of throat thickness using an E60 low-hydrogen electrode. The allowable stress in the steel cylinder shall not exceed 15,000 psi.

Shop Drawings and Line Layout:

- (A) The manufacturer's pipeline layout shall be furnished together with standard details for review. The line layout shall show each standard pipe joint and each special joint or fitting by number. Manufacturer's standard details shall be furnished in sufficient details to assure that the detail design of the pipe and specials will comply with the design

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concept and structural requirements of the project as presented in the Contract Documents. Full details of reinforcement, concrete, cement, mortar, joint dimensions, etc., for the straight pipe, specials and connections shall be furnished. Layout drawings shall show stations and the invert elevations of the pipeline.

- (B) Manufacturer's shop drawings shall be furnished for fabrication, inspection and record purposes in accordance with the "General Conditions". The manufactured pipe and specials shall conform to the approved standard details and shall meet all specified requirements unless otherwise approved in writing.
- (C) Valves and fittings to be incorporated in the pipeline shall be considered when preparing the pipeline layout.

### 758.4 SHOP INSPECTION AND TESTS:

#### (A) Inspection:

- (1) The City and its representatives shall have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection during the manufacturing process.
- (2) Inspection by the City or its representatives, or failure of the City or its representatives to provide inspection, shall not relieve the Contractor of his responsibility to furnish materials and to perform work in accordance with this specification.
- (3) Material, fabricated parts, and pipe which are discovered to be defective or which do not conform to the requirements of this specification, will be subject to rejection at any time prior to final acceptance. Rejected material and pipe shall promptly be removed from the site of the work.

#### (B) Test and Materials:

- (1) In advance of manufacture of the pipe, the Contractor shall furnish to the Engineer three (3) copies of the mill test certificate for all steel products incorporated in the pipe. Three (3) copies shall be furnished of mill test reports on each heat from which the steel is rolled.

- (2) Methods of Tests for Cement, Mortars and Concrete:

- (a) Mortar Lining: The mortar for all mortar lined pipe shall be sampled and molded by the following procedure:

The mortar sample shall be taken directly from the transfer bucket between the mixer and the charging trough which injects the mixed mortar into the spinning pipe. A sufficient amount shall be extracted to make four (4) 4" x 8" cylinders, and shall be placed in a wheelbarrow or other suitable container. The mortar sample material shall then be transported to the location at which the cylinder cans are to remain without moving for the next 24 hours. The mortar shall be thoroughly mixed immediately prior to pouring into the cylinders in order to prevent segregation. After the mortar has been thoroughly mixed, it shall be poured in a continuous stream into the cylinder cans. The cans shall immediately be capped and allowed to remain without disturbing for twenty-four (24) hours.

- (b) Mortar Coating: Mortar for all mortar coated pipe shall be sampled by molding four (4) cylinders for compressive tests of the representative material being used to seat the pipe. The mortar sample shall be molded in 4" diameter cylinders in accordance with applicable provisions of ASTM D-558.

- (c) Curing of Test Cylinders: The curing of concrete, lining and coating cylinders for the first twenty-four (24) hours shall be the same as that for the pipe, except that the mortar for coating cylinders shall be covered with a piece of damp burlap to retard the drying out or the low moisture content of the mortar coating. At the end of twenty-four (24) hours, the cylinders shall be transported to a moist curing cabinet and cured in accordance with ASTM C-192.

- (3) Strength of Cement Mortar Lining, Coating, Concrete and Steel:

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- (a) Mortar Lining: The average compressive strength, as per Section C below, of cylinders for mortar lining for the several types of pipe shall be as follows:
- (i) Semi-Rigid Pipe: Steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 1700 psi at seven days, and 2300 psi at 28 days.
  - (ii) Rigid Pipe: Steel cylinder pipe prestressed, the average compressive strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days. Steel cylinder pipe, double wrapped shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
- (b) Mortar Coating and Concrete for Prestressed Pipe:
- (i) Semi-Rigid Pipe: Steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
  - (ii) Rigid Pipe: Steel cylinder pipe prestressed, and steel cylinder pipe, double wrap pretensioned, the average compressive strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
- (c) To conform to these requirements (a and b above), the average of any five (5) consecutive strength tests of the laboratory cured specimens shall be equal to or greater than the specified strength, and no more than 20% of the strength test shall have values less than the specified strength. If any one cylinder falls below 80% of the specified strength at seven days, an extra cylinder from the same batch shall then be broken, and if the strength of this cylinder also falls below 80% of the specified strength, then the entire production represented by these cylinders will not be accepted for use until the results of the twenty-eight day test is known, and if it also falls below 80% of the specified strength, the above non-acceptance will become final. The expense of the required tests of cylinders and mortar shall be the responsibility of the Contractor.
- (d) Testing of Steel Pipe Cylinders (Hydrostatic Pressure Test): Each steel pipe cylinder, prior to embedment in cement mortar, or concrete, shall be hydrostatically tested under a water pressure which stressed the steel to a unit stress of at least 22,000 psi after the bell and spigot ends have been welded in place, utilizing companion bell and spigot test heads. While under this stress, the welded seams shall be hammered vigorously at one foot intervals with a one pound sledge hammer, and shall be thoroughly inspected.
- All parts of the cylinder showing leakage shall be marked for rewelding. After rewelding, such cylinders shall be subjected to another hydrostatic test as stipulated above. The costs of hydrostatic pressure test shall be at the Contractor's expense.
- (e) Testing of Fittings and Specials: The seams in angle pipe, short-radius bends and special fittings shall be welded in two or more passes, and each weld tested for tightness by the air-soap method or by the dye-penetrant method. However, if the fitting is fabricated from cylinders which have been previously tested hydrostatically, no further test is required for seams so tested. Hydrostatic testing of fittings to 150% of the design operating pressure may replace the tests described above. Any defect revealed under any of the alternate test methods shall be rewelded, and the weld tested again. The cost of these tests shall be at the Contractor's expense.

### 758.5 MARKING, HANDLING AND DELIVERY:

- (A) Marking: Identification markings, for each type of water pipe as specified herein, shall be placed on the pipes. These markings shall show the proper location of the pipe or special in the line by reference to layer drawings. All bends shall be marked on the ends with the angle of deflection and the plane through the axis of the pipe. All beveled pipe shall be marked with the amount of the bevel, and the point of maximum bevel shall be marked at the end of the spigot.

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- (B) Handling and Delivery: All pipe shall be manufactured, handled, loaded, shipped, unloaded and stored at the job site in such a manner as to prevent any damage to the pipe. Any pipe section that becomes damaged shall be repaired as directed by the Engineer if, in his opinion, a satisfactory repair can be made. Otherwise, it shall be replaced with an undamaged section, at the Contractor's expense. Lifting from the inside of the pipe will not be permitted.

### **758.6 CATHODIC PROTECTION:**

- (A) Joint Bonding: Except where otherwise specified, all non-welded joints shall be bonded in accordance with the details shown on the drawings. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The steel bonding clips (1.25-inches wide) shall be welded to the joint rings during installation. The total resistance of the bonds at the joint shall not be more than 150-percent of the linear resistance of a pipe section. A minimum of two bonding clips shall be furnished at each joint and installed at the pipe springline, one on each side of the pipe.
- (B) Cathodic Protection: Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, test lead wires and test stations shall be installed where shown. See *Water Services Department Guide Specifications* Section 13110, Cathodic Protection Systems for additional requirements

- End of Section -

## SECTION 759

### STEEL PIPE

#### 759.1 GENERAL:

These specifications apply to Steel pipe intended for use in water supply pipelines that carry water under pressure. Steel pipe is specified as follows:

Steel pipe shall be designed, manufactured and tested in accordance with AWWA C-200.

Steel pipe and fittings may be furnished in pipe diameters of six (6) inches and larger.

Pipe shall be designed by the methods described in AWWA C-200 and AWWA Manual M11, to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

Trench excavation, backfilling and compaction shall be in accordance with Section [601](#) unless otherwise specified in the plans and specifications. For Steel Pipe with a flexible coating the backfill pipe zone material shall consist of Granular Material, maximum 3/4 inch size.

As an option, the backfill in the pipe zone may be Controlled low strength material (CLSM) in accordance with Section [728](#) and placement per Section [604](#).

#### 759.2 LINING AND COATING OPTIONS:

(A) Cement mortar lining and cement mortar coating shall be in accordance with AWWA C-205.

(B) Polyurethane coatings for interior and exterior of steel pipe shall be in accordance with AWWA C-222. The MDFT shall be 20 mils. on the interior lining and 25 mils. on the exterior coating.

(C) Polyethylene tape coating shall be in accordance with AWWA C-214. The total thickness of the tape coating shall be minimum 50 mils for pipe up to 54 inches diameter and minimum 80 mils for pipe 54 inches diameter and larger.

(D) Liquid-Epoxy coating systems for the interior and exterior of steel water pipelines shall be in accordance with AWWA C-210. Interior lining will be applied in one or two coats MDFT of 16 mils.

All linings for potable waterlines shall be NSF approved.

#### 759.3 MANUFACTURE:

The Contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-200 or AWWA manual M11.

Standard pipe shall be furnished with rolled-groove bell and spigot rubber gasket joints. Restrained joints shall be lap-welded slip joints with the bell formed by cold formed expanded dies.

Unless otherwise specified, fabricated steel pipe shall be manufactured in uniform lengths to fit the pipeline alignment shown on the plans, subject to a maximum length of 40 feet. For Steel Pipe with flexible coatings the pipe length may be 60 foot maximum, subject to the Manufacturer's recommendations. Shorter lengths may be furnished to facilitate special conditions.

The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-200 or AWWA Manual M11.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

*- End of Section -*

## SECTION 760

### CORRUGATED METAL PIPE AND ARCHES

#### 760.1 GENERAL:

Corrugated metal pipe, pipe arches, and connectors to be used or furnished under this specification shall be manufactured and inspected in conformance with the requirements of AASHTO M-36, and as hereinafter specified. The size, type, and wall thickness of the pipe to be furnished shall be as specified on the project plans or specifications.

Corrugated metal pipe and arch utilization in public storm drain facilities is limited to culverts and catch basin connectors.

#### 760.2 MATERIALS:

Corrugated metal products covered by this specification shall be aluminum-coated Type 2 conforming to the requirements of AASHTO M-36 Type I or Type II as modified herein. No other coating is approved for use in the City of Phoenix.

#### 760.3 FABRICATION:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical pipe and arches, when specified, shall be shaped after fabrication and coating have been completed.

**Corrugated Metal Pipe and Arches:** The pipe and arches shall be manufactured per AASHTO M-36, Type 1 or II. Nominal pipe sizes and corrugations furnished shall be in accordance with Table 6 of AASHTO M-36. Arches furnished shall be in accordance with Tables 2, 3, 4 and 5 of AASHTO M-36. Other shapes shall be as shown on the plans. Pipe and arches with helical corrugations shall have a continuous lock or weld seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

#### 760.4 COUPLING BANDS:

Watertight joints shall be fabricated for corrugated metal pipe by the use of couplers or connecting bands per AASHTO M-274, aluminum-coated Type 2, with each band overlapping by at least 2 inches. Corrugated coupling bands shall be constructed and connected as specified in AASHTO M-36, except as otherwise required herein. The couplers or bands shall be manufactured of material 2 gages lighter than the gage specified for the pipe material, shall have corrugations or dimples to match the pipe corrugations or end treatment or may be flat, and shall be fastened with bolts. Dimpled coupling bands shall be 10 1/2 inches wide for diameters 12 through 60 inches, and 17 inches wide for diameters above 60 through 96 inches. The 10 1/2 wide bands shall have 2 rows of dimples of not less than 7 dimples per row, and the 17 inch wide bands shall have 4 rows of dimples of not less than 7 dimples per row. The dimple arrangements shall be such that a maximum spread can be attained.

The shape of the dimple shall be such that it shall, in general conform to the standard pipe corrugation. The connecting angles for dimpled coupling bands may be riveted as for standard corrugated coupling bands, or may have slotted angles. The bands shall be attached by means of 1/2 inch nominal diameter carriage bolts. Two bolts are required for pipe up to 36 inches in diameter, 3 bolts for 36 through 60 inch diameters and 5 bolts for pipes above 60 inches in diameter. Plain flat coupling bands and spiral rib flange bands shall have the same width and number of bolts as specified above. Flat coupling bands having a single circumferential corrugation rolled in each edge to match a similar corrugation in the end of each pipe may be 10 1/2 inches wide regardless of pipe diameter and shall be fastened with 2 bolts.

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed channel band or other band incorporating a locking channel not less than 3/4 inches in width. The depth of the channel shall be not less than 1/2 inch. The channel band shall have a minimum nominal thickness of 0.079 inches.

The rubber O-ring gasket shall conform to the requirements of ASTM C-361. The sleeve gasket shall be a closed cell rubber in accordance with ASTM D-1056, grade SCE 43.

## SECTION 760

### 760.5 PERMISSIBLE VARIATIONS IN DIMENSION:

The internal diameter of 12 through 24 inch pipe shall not vary more than  $\pm 1.5$  percent from the design diameter. The internal diameter of 27 through 108 inch shall not vary more than  $\pm 1$  percent or  $3/8$  inch, whichever is greater from the design diameter.

*- End of Section -*

## SECTION 761

### STRUCTURAL PLATE PIPE, ARCHES, AND PIPE ARCHES

#### 761.1 GENERAL:

Structural plate pipe, arches, and pipe arches shall be of the sizes, gages, and dimensions designated on the plans or in the special provision and as specified herein.

#### 761.2 MATERIALS:

Plates, nuts and bolts shall conform to the specifications of AASHTO M-167.

Galvanized surfaces which are damaged shall be repaired in accordance with the provision in Section [771](#).

Bituminous coating shall conform to the provisions of AASHTO M-190.

Damaged bituminous coatings shall be repaired by the Contractor at his expense by applying bituminous material conforming to AASHTO M-190.

#### 761.3 IDENTIFICATION:

The gages of structural plates will be identified on the plans in accordance with the following:

Each installation will be designated not only by size, but also by symbol indicating the number and gage of plates required. Thus, (412-18) will be used to designate an installation for 1 plate length composed of 4, 12 gage plates and 1, 8 gage plate, the heaviest to be placed in the invert.

#### 761.4 DISTORTION:

In advance of placing backfill material around circular structural plate pipes, the pipe shall be distorted.

Distortion may be performed either at the fabricating shop or in the field.

If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5 percent for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field the method of distortion shall conform to the details shown on the plans. The vertical diameter shall be increased the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates - 1 percent

Pipes using 5 or 7 gage top and side plates - 2 percent

Pipes using 8, 10, or 12 gage top and side plates - 3 percent

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

*- End of Section -*

## SECTION 770

### STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS

#### 770.1 GENERAL:

All steel, unless otherwise designated on the plans or in the special provisions, shall conform to the requirements of ASTM A36.

Report of Tests: Before fabrication, the Contractor shall furnish to the Engineer a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10 tons of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specification, for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in weight and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM A6.

Stock Material: When the Contractor proposes to use material already in stock, he shall notify the Engineer of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

#### 770.2 STRUCTURAL STEEL:

Stock Materials: The Contractor shall select the material he wishes to use from stock. The Contractor shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the Engineer from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the Engineer shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the Engineer. The cost of all tests on stock material shall be borne by the Contractor.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM, A572, A709 or A992, as specified in the special provisions.

General Purpose Structural Steel: Structural steel shall conform to the requirements of ASTM A36 with a minimum of 0.2 percent copper.

#### 770.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the Engineer in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the Engineer.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM A502.

Structural Rivet Steel: The material shall conform to the requirements of ASTM A502, except that the test specimen shall be bent upon itself when performing the bend test.

#### 770.4 BOLTS:

## SECTION 770

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 1/4 inch beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM A307, except that steel manufactured by the acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

### **770.5 ANCHOR BOLTS:**

Anchor bolts shall be manufactured from steel conforming to ASTM A36 or A307.

### **770.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:**

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM A668. They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinnel hardness number of 130, and a maximum of 190, when tested in accordance with ASTM E10.

*- End of Section -*

**SECTION 771**  
**GALVANIZING**

**771.1 GENERAL:**

Materials shall be hot-dip galvanized and the weight and uniformity of coating determined in accordance with the standard specifications given in Table [771-1](#).

<b>TABLE 771-1</b>		
<b>GALVANIZING SPECIFICATIONS</b>		
<b>Material</b>	<b>ASTM Spec.</b>	<b>Wt. of Coating Oz./Sq. Ft. (Min.)</b>
Corrugated Metal Pipe	A929	1.80
Flat Steel or Iron Sheets	A653, A924	1.25
Iron or Steel Wire	A116	.80
Chain Link Fabric	A392	1.20
Barbed Wire	A121	.50
Steel Pipe - Rails and Posts	A53	1.80
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps, and Curb Armor	A123	2.00
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A153	1.25

**771.2 WORKMANSHIP:**

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

**771.3 TEST COUPONS:**

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

**771.4 REPAIR OF GALVANIZED SURFACES:**

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraded, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the Engineer with zinc dust-zinc oxide coating conforming to AASHTO M-36.

*- End of Section -*

## SECTION 772

### CHAIN LINK FENCE

#### 772.1 GENERAL:

All material shall be new and, upon request, the Contractor shall furnish to the Contracting Agency, a certification of inspection stating that the materials have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

#### 772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A, B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this Section will cover fencing up to 12 feet in height with post spacing not to exceed 10 feet. The nominal outside dimensions and minimum weights shall be in accordance with Table [772-1](#). The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the country of manufacture.

**Type A:** Pipe shall be black steel, welded or seamless, hot-dipped zinc coated, manufactured in conformance to ASTM F1083, plain end, standard weight (schedule 40). The hot-dipped zinc coating (galvanized) shall be applied both inside and outside with not less than 1.8 ozs. per square foot  $\pm$  0.1 ozs.

**Type B:** Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM A1011 having a minimum yield strength of 50,000 psi. The pipe will be manufactured by electric welded cold-formed process per ASTM A500. The exterior surface will be triple coated and the interior surface single coated per ASTM F1043. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 ozs. per square foot  $\pm$  0.1 ozs., followed by a chromate conversion coating, having a weight not less than 1.05 micro ounces per square foot  $\pm$  0.353 micro ounces (30 micrograms per square inch  $\pm$  15 micrograms) and an acrylic coating having a thickness of 0.0005 inches  $\pm$  0.0002 inches. The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 0.0005 inches.

**Type C:** Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM A653 Grade D having a minimum yield strength of 50,000 psi. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM A653 and A-924 having the weight of not less than 1.0 oz. per square inch  $\pm$  0.1 oz. The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM A789. After manufacturing, the final two external coatings shall be a chromate conversion having a weight of not less than 1.05 micro ounces per square inch  $\pm$  0.353 micro ounces and an acrylic coating having a thickness of 0.0005 inches  $\pm$  0.0002 inches.

#### 772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A392 (Zinc-Coated) or ASTM A491 (Aluminum-Coated). The coating process must leave the fabric completely free of barbs, icicles, or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh. Fabric less than 60 inches wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. Fabric 60 inches or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

#### 772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire per ASTM A824. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch.

**SECTION 772**

<b>TABLE 772-1</b>					
<b>FENCE MEMBER SIZES &amp; WEIGHTS</b>					
<b>USE</b>	<b>FENCE HEIGHT (Feet)</b>	<b>NPS DESIGNATOR</b>	<b>OUTSIDE DIAMETER (Inches)</b>	<b>WEIGHT (Lb/Lf Minimum)</b>	
				<b>TYPE A Schedule 40</b>	<b>TYPE B and C</b>
<b>FENCE POSTS</b>					
End, corner, slope, pull and strain posts	Less than 6	2	2.375	3.65	3.12
	6 and over but less than 9	2 1/2	2.875	5.79	4.64
	9 and over but not over 12	3 1/2	4.000	9.11	6.56
Line posts	less than 6	1 1/2	1.900	2.72	2.28
	6 and over but less than 9	2	2.375	3.65	3.12
	9 and over but not over 12	2 1/2	2.875	5.79	4.64
<b>GATE POSTS</b>					
Single swing gates 6 feet or less in width or double swing gates 12 feet or less	less than 6	2	2.375	3.65	3.12
	6 and over but not over 12	3 1/2	4.000	9.11	6.56
Single swing gates over 6 feet but not over 13 feet in width or double swing gates over 12 feet but not over 26 feet in width	—	3 1/2	4.000	9.11	6.56
Single swing gates over 13 feet but not over 18 feet in width or double swing gates over 26 feet but not over 36 feet in width	—	6	6.625	18.97	—
Single swing gates over 18 feet in width or double swing gates over 36 feet in width	—	8	8.625	28.55	—
<b>OTHER MEMBERS</b>					
Top rail and braces	—	1 1/4	1.666	2.27	1.84
Frame for gates	—	1 1/2	1.900	2.72	2.28
Stiffeners for gates	—	1 1/4	1.666	2.27	1.84

Notes to Table 772-1:

- All unit weights shall be subject to the standard mill tolerance of ±5 percent.
- Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps.
- Top rail shall be furnished in random lengths of approximately 20 feet where required.

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### **772.5 TRUSS OR TENSION RODS:**

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

### **772.6 FITTINGS:**

Fittings shall conform to ASTM F626.

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

Extension arms for barbed wire on pipe posts shall be of 13 gage steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms shall carry 3 wires at approximately 5 1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

### **772.7 BARBED WIRE:**

Barbed wire shall be 4 point pattern; composed of 2 strands of 12 1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A121.

*- End of Section -*

## SECTION 775

### BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

#### 775.1 BRICK:

Brick shall be whole, sound, and hard burned and shall give a clear ringing sound when struck together. They shall be uniform in quality and shall be culled or sorted before delivery to the work.

**775.1.1 Manhole Brick:** Manhole brick shall conform to the requirements of ASTM C216, Grade SW. Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames.

Manhole brick shall conform to Table [775-1](#).

TABLE 775-1			
MANHOLE BRICK DIMENSIONS			
Brick	Inches Depth	Inches Width	Inches Length
Standard Size	2 1/4	3 1/2	7 1/2
Allowable Variations	±1/8	±1/8	±1/4

The following paragraphs shall be added to the section on visual inspection:

No individual brick shall be rejected unless it shows visual evidence of major cracking. A major crack is defined as one that has at least one complete separation, for a distance of 1 3/4 inches, through the brick in any direction, including any cored area. Such a crack shall be regarded as affecting the serviceability of the brick and shall be rejected and not used in the structure.

Fifty bricks may be sampled at random intervals from any cube for visual inspection. Of the 50 samples, 45 must pass visual inspection for major cracks. Should less than 45 pass, the cube of brick shall be rejected and the brick must not be used in the structure.

**775.1.2 Building Brick:** Building brick shall conform to the requirements of ASTM C62, grade MW.

**775.1.3 Facing Brick:** Facing brick shall conform to the requirements of ASTM C216, Grade MW, Type FBS. The size, color, and texture shall be as specified on the plans or as approved by the Engineer.

#### 775.2 CONCRETE MASONRY UNITS:

Unless otherwise noted on the plans or special provisions, concrete masonry units shall conform to ASTM C90, Normal Weight, Type I with a minimum compressive strength of 1900 psi.

The units shall be fully cured and shall have been made not less than 28 days prior to delivery.

The moisture content at the time of delivery shall not exceed 30 percent of the minimum absorption value of the units. The Contractor shall provide any protection he deems necessary to maintain the units in this condition until time of use.

The linear change from saturated to cool oven dry shall not exceed 0.0054 inches per linear foot or 0.045 of 1 percent conducted in accordance with test method in ASTM C426.

The units shall be made with normal weight aggregate conforming to ASTM C33.

The nominal size of the units shall be as indicated on the plans. The overall dimensions for width, height and length shall differ by not more than ±1/8 inch from the specified standard dimensions. Standard dimensions of units are the manufacturer's designated dimensions. Nominal dimensions of units are equal to the standard dimensions plus the thickness of one mortar joint.

## **SECTION 775**

No less than 5 samples of the units shall be submitted to the Engineer for approval and to show the full variance of texture and full range of color. Units used in the work shall match the approved samples. These samples may be tested for strength.

All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or would significantly impair the strength or permanence of the construction. When units are to be used in an exposed setting, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6 feet under diffused lighting.

Units that are intended to serve as a base for plaster or stucco shall have a sufficiently rough surface to afford a good bond.

*-End of Section -*

**SECTION 776**

**MASONRY MORTAR AND GROUT**

**776.1 GENERAL:**

Masonry mortar and grout shall consist of a mixture of cementitious material and aggregate to which sufficient water has been added to bring the resulting mixture to the desired consistency.

Table [776-1](#) and [776-2](#) indicates the average compressive strength obtained when the cementitious material, aggregate, and water (the required amount to provide a flow of 110±5 percent) are combined in the proportion shown in Table [776-3](#) and Table [776-4](#).

The mortar or grout to be used will be designated by class in the special provisions and the correct proportions of cementitious materials and aggregate will be combined with the minimum amount of water to provide a workable mixture.

Retempering of the mortar or grout will not be a standard practice and the Engineer's approval will be required for any exception.

TABLES 776-1 & 776-2			
MASONRY MORTAR AND GROUT COMPRESSIVE STRENGTH			
Table 776-1 Masonry Mortar		Table 776-2 Grout	
Type	Compressive Strength 28 Days (psi)	Type	Compressive Strength 28 Days (psi)
A	5500	Fine Grout	2500
B	5000	Coarse Grout	2500
C	4000		
D	3000		
M	2500		
S	1800		

TABLE 776-3			
MASONRY MORTAR PROPORTIONS BY VOLUME			
Type	Portland Cement	Hydrated Lime	Aggregate ASTM C144
A	1	0	1
B	1	0	1 1/2
C	1	0	2
D	1	0	2 1/2
M	1	1/4	2 1/4 to 3
S	1	1/2	2 1/4 to 3

\*Masonry cement type S may be substituted for the cementitious material. Prior approval of the Engineer is required.

TABLE 776-4			
GROUT FOR REINFORCED MASONRY PROPORTIONS BY VOLUME FOR FIELD BATCHING			
Type	Portland Cement	Fine Aggregate (ASTM C404)	Coarse Aggregate (ASTM C404)
Fine Grout	1	2 1/4 to 3	0
Coarse Grout	1	2 1/2	1 to 2

**776.2 PORTLAND CEMENT:**

The cement used shall conform with Section [725](#). For volumetric proportioning an unopened sack of cement weighing 94 pounds shall be considered as having a 1 cubic foot volume.

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In proportioning the cement, it shall be measured loose, without shaking or compacting, in measuring devices of known capacity.

### **776.3 AGGREGATE:**

All aggregate shall be approved by the Engineer prior to being utilized on the job.

Fine aggregate (sand) to be used in mortar shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine aggregate shall conform to the applicable requirements of ASTM C144.

Fine or coarse aggregate to be used in masonry grout shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine or coarse aggregate shall conform to the applicable requirements of ASTM C404.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70 when tested in accordance with ASTM D2419. No individual sample shall have a sand equivalent less than 65.

In proportioning the aggregate, it shall be measured damp, loose without shaking or compacting, in measuring devices of known capacity.

### **776.4 MASONRY CEMENT:**

Masonry cement used shall conform to ASTM C91 with the exception that the average compressive strength shall not be less than 2500 psi at 28 days.

### **776.5 HYDRATED LIME:**

Hydrated lime used shall conform to ASTM C207, Type S.

### **776.6 WATER:**

The water used shall conform to Section [725](#).

### **776.7 ADMIXTURES:**

Admixtures, unless prescribed in the special provisions, will not be used without prior approval of the Engineer.

### **776.8 TESTS:**

**776.8.1 Mortar:** If in the opinion of the Engineer there is sufficient cause to question the quality of the mortar being utilized, random field test in accordance with ASTM C780 Annex A-1 and A-6 will be performed. For this area, the penetration of the cone penetrometer correlating to a flow of  $110 \pm 5$  percent is  $40 \pm 3$  mm.

**776.8.2 Grout:** If required, tests shall be performed in accordance with Uniform Building Code Standard No. 24-23 Section 24.2301.

*-End of Section -*

## SECTION 778

### LUMBER

#### 778.1 GENERAL:

Unless otherwise specified or shown on the plans, all lumber shall be Douglas Fir or graded pine and shall be selected as to grade and shall conform in all particulars to the standard grading and dressing rules of the West Coast Lumber Inspection Bureau.

Plywood shall be not less than 3 ply, manufactured and graded in accordance with the standard grading rules of the APA.

Lumber for uses listed shall not be lower than the following grades:

Uses	Grade
(A) Permanent Construction, such as bridges and culverts.	Select Structural, for beams and stringers; Construction, for balance of structure.
(B) Minor permanent construction, such as fences, guard rails and posts, pavement headers, bulkheads, retaining structures, etc.	Construction.
(C) Falsework and studs, and wales for formwork.	Construction, for framing, beams, or timbers.
(D) Form sheeting for nonshowing surfaces of concrete.	Standard, for boards; shiplap; or any grade of plywood.
(E) Form sheeting for showing surfaces of ornamental concrete.	C and Better Industrial clear; concrete form grade of plywood; or overlay plywood.
(F) Form sheeting for curved soffits of bridge & tunnel arches, plastered or unplastered.	Select Merchantable, board; concrete form grade of plywood; or overlay plywood.
(G) Soffits of beams and girders and slabs between beams and girders; for beam and girder sides, except ornamental concrete; and for headwalls or endwalls of culverts or covered conduits.	Concrete form grade of plywood or overlay plywood.
(H) Form sheeting for showing surfaces of channel walls or interior surfaces, except floors; for covered conduit and all other showing surfaces not specified above.	Tongue and groove flooring equal to C and Better flat grain; concrete form grade of plywood; or overlay plywood.
(I) All other lumber.	Construction.

#### 778.2 REDWOOD:

Redwood lumber shall be selected as to grade and shall conform in all particulars to the standard specifications for grades of California Redwood of the California Redwood Association.

Redwood lumber for the uses listed shall not be lower than the following grades:

Uses	Grade
(A) Bridges, culverts, and guardrail posts	Dense Structural
(B) All other Redwood Lumber	Foundation

## SECTION 778

### 778.3 GRADE MARKING:

Lumber: Each piece of lumber shall bear an official grade mark which, unless authorized otherwise, shall be the grade mark adopted by one of the following associations:

(A) For Douglas Fir and Pine -The West Coast Lumber Inspection Bureau or other agency approved by the Engineer.

(B) For Redwood -The California Redwood Association.

Plywood: Each sheet of plywood shall bear the official stamp of the APA stating the grading of the sheet.

*-End of Section -*

## SECTION 779

### WOOD PRESERVATIVES

#### **779.1 GENERAL:**

This work shall consist of treating lumber, timber, and piling. Lumber, timber, and piling to be treated shall conform to the requirements of the specification of the AWPA and as specified herein.

Where practical, lumber to be treated shall be cut to size and framed, prior to treatment. Proper allowance for shrinkage in the sizes of lumber shall be made by the Contractor where it is necessary to meet definite dimensions shown on the plans.

#### **779.2 OIL TYPE PRESERVATIVE TREATMENT:**

Preservatives under this specification shall be creosote, creosote-coal tar solutions, creosote petroleum solutions, or pentachlorophenol in petroleum oils, conforming to AWPA specifications and as specified by the Engineer.

Treatment: The treating operations shall conform to the applicable requirements of the AWPA specifications.

Unless indicated otherwise on the plans or in the special provisions, the amount of preservative to be retained and the treating process to be used for the various types of service shall conform to the appropriate AWPA specification.

Incising: Unless otherwise specified, timber to be treated under this specification that is 3 inches or more in nominal thickness and 4 inches or more in nominal width, shall be incised before treatment as a means of securing penetration of the preservative. If such thickness is less than 4 inches, the material may be incised on the wide faces only; otherwise, all 4 faces shall be incised.

#### **779.3 WATER BORNE SALT PRESERVATIVES TREATMENT:**

Preservatives under this specification shall conform to the requirements of AWPA specifications unless otherwise approved in writing by the Engineer, but restricted to the following preservatives:

Chromated Zinc Chloride (CZC)

Tanalith (Wolman Salts)

Ammoniacal Copper Aresnite (Chemonite)

Chromated Zinc Arsenate (Boliden Salt)

Chromated Copper Arsenate (Erdalith)

#### **779.4 FIELD TREATMENT OF CUT SURFACES:**

When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with 2 coats of the same kind of preservative in conformance with AWPA specification. The maximum protection requirement specified therein shall be met in all instances.

*-End of Section -*

## SECTION 787

### GRAY IRON CASTINGS

#### 787.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, spongings, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted boldly at angles, and the arises shall be sharp and true.

Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates, and risers ground flush.

#### 787.2 TEST SPECIMENS:

Test coupons shall be cast separately of the castings, using a mold as described in ASTM A48. A representative of the Engineer may be present at the time a melt is poured to identify both coupons and castings.

Two test coupons are required for each melt poured. Additional coupons shall be cast for use as replacements or in case a retest is required.

A representative of the Engineer may discard and replace specimens which show obvious lack of continuity of metal or if the machining is defective.

The manufacturer shall machine the tension specimens to the dimension specified for specimen B of ASTM A48, at no additional cost to the Contracting Agency.

When approved by the Engineer transverse tests may be made in lieu of tensile tests, in which case the castings shall meet the requirements of ASTM A48.

#### 787.3 MANHOLE FRAME AND COVER SETS:

Castings shall conform to ASTM A48, Class 30. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly onto the frame without rocking.

Covers shall be the types and shall be imprinted as shown on the plans or standard details.

ASTM A-48 Class 35, gray cast iron manhole frames and covers are approved for use on City projects. The weights of the 30-inch frame and cover castings shall be a minimum of 219 pounds for the frame and 207 pounds for the cover. The weights of the 24-inch frame and cover castings shall be a minimum of 170 pounds for the frame and 180 pounds for the cover. The Contractor shall provide manufacturer's certification that the product meets the required H-20 traffic loading.

The casting shall be tested in accordance with the method and procedure that is outlined in AASHTO M306 Section 7.0, proof load testing. The casting shall be tested on a suitable and calibrated load testing machine and the casting shall hold a 40,000-pound proof load for one minute without experiencing any cracks or detrimental permanent deformation. Any added costs for testing are assumed by the manufacturer.

A foundry certification shall be furnished to the Owner stating that the samples have been tested, inspected, and are in accordance with these specifications.

#### 787.4 RAILINGS, RAILING POSTS, AND WHEEL GUARDS:

Castings shall conform to ASTM A48, Class 40.

#### 787.5 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES:

Castings shall conform to ASTM A48, Class 50.

## **SECTION 787**

Castings shall be machined and finished as specified on the plans provided that tool marks on sliding contact surfaces shall run in the direction of plate movement, or in the case of rocker plate bearings, perpendicular to the rocker movement. Tool marks shall be not more than 1/32 inch apart.

### **787.6 UNCLASSIFIED CASTINGS:**

All castings not specifically classified, shall conform to the requirements of ASTM A48, Class 30.

*-End of Section -*

## SECTION 790

### PAINT

#### 790.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight containers appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture. Paint containing lead shall comply with Subsection [107.5.2](#).

#### 790.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distribution and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or special provision by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the Engineer. Information required by the Engineer as proof of the comparative quality shall be furnished by the Contractor.

#### 790.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

#### 790.4 MATERIALS:

Materials shall conform in all respects to the requirements of references specifications indicated for such material.

Upon request of the Engineer, the Contractor shall furnish a certification from the manufacturer that the material conforms with this specification.

(A) <b>Vehicles:</b>	<b>Specification:</b>
Raw Linseed Oil	ASTM D234
Boiled Linseed Oil	ASTM D260
Water-Resistant Spar Varnish	Navy Department Specification 52V20
Alkyd Resin	TT-R-266C
Driers	ASTM D600, Class A or Class B, as applicable
Thinners:	
Xylene	TT-X-916B, Grade A
Turpentine (shall be used in paints used for timber)	ASTM D13, Gum Spirits
Petroleum Spirits (Mineral Spirits)	ASTM D235
(B) <b>Pigments</b>	<b>Specifications:</b>
Carbonblack	TT-P-343 Form 1, Class B
Lampblack	ASTM D209
Red Lead	ASTM D83
Titanium Dioxide, Non-extended	ASTM D476, Type II, Class II
Titanium Dioxide, Extended (Titanium Calcium, Rutile)	ASTM D476
Titanium Dioxide	TT-P-422B, Type III, Class A

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White Lead Basic Carbonate	ASTM D81
Zinc Yellow (Zinc Chromate)	ASTM D478, Type II
Zinc Oxide	ASTM D79
Iron Blue	TT-P-385
Iron Oxide, Yellow	TT-P-458A
Iron Oxide, Orange	ASTM D3721, D3722, D3724
Hansa Yellow G	MIL-H-10330
Organic Green Gold	Dupont YT 562-D or equal, specific gravity 161 ±0.05
Chromium Oxide, Green Graphite	TT-P-347

Graphite shall be natural amorphous material (American product) which shall contain not less than 35 percent nor more than 45 percent graphite carbon. The remainder shall be insoluble siliceous material containing a total of not more than 5 percent calcium and magnesium carbonate and sulfate. The pigment shall be ground to such a fineness that not less than 97 percent shall pass a No. 325 sieve. The graphite paste shall be made by grinding the pigment in pure raw linseed oil in the following proportions:

Amphorus Graphite .....	68.0 percent
Linseed Oil .....	32.0 percent

<b>(C) Inert Materials:</b>	<b>Specifications:</b>
Diatomaceous Silica	ASTM D604, Type A
Magnesium Silicate	ASTM D605

**790.5 MIXED PAINTS:**

All mixed paints shall, in general, be machine-mixed and shall consist of the pigment of the required fineness and composition, ground to the desired paste consistency in pure raw or boiled linseed oil, to which shall be added the remainder of the vehicle to make paint conforming to the required formula as herein specified.

Paint which has hardened and thickened in the container such that it cannot be readily broken up to a smooth uniform paint of good brushing consistency shall not be used.

All materials used in mixed paints shall conform to the requirements as herein specified. The paint shall be made to satisfactory workable consistency conforming to one of the following formulas for paint as required on the plans or in the special provisions. All percentages shown are by weight.

Any of the following paints which are too thick to have a satisfactory workable consistency shall be thinned with a suitable thinner from the group of thinners herein specified. In no case shall gasoline be used as a thinner.

Fineness of grind for enamel shall conform to Hegman 7 minimum.

The following paints shall conform to the latest ADOT standard specifications for Road and Bridge Construction. All paints, except Paint No. 10 (Aluminum), shall be shipped ready for use.

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When Paint No. 1 is specified, it may be Paint No. 1-A or Paint No. 1-B. Paint No. 1-D shall be used only when specifically designated.

### Paint Number

1-A  
1-B  
1-D  
4  
5  
6  
7  
8  
9  
10  
11  
15

### Type

(Red Lead — Linseed Oil)  
(Red Lead — Alkyd Resin)  
(Zinc Chromate)  
(Dull Black)  
(Jet Black)  
(Black — For Timber Primer Only)  
(White — For Timber Primer Only)  
(White)  
(Light Grey)  
(Aluminum)  
(White Enamel)  
(Zinc)

*-End of Section -*

**SECTION 792**

**DUST PALLIATIVE**

**792.1 GENERAL:**

Dust palliatives shall consist of various chemical dust suppressants which work by binding together lighter soil particles.

All materials must meet the environmental requirements of Subsection [792.3](#) and must be approved by the Engineer prior to their use.

**792.2 TYPE OF MATERIALS AND APPLICATION RATES:**

Emulsions shall be miscible with water in all proportions as noted in Table [792-1](#). The dilution ratio will vary based upon the local soil and weather conditions. The ratios shall be proposed by the Contractor and agreed upon by the Engineer.

The rate of application noted in Table [792-1](#) shall be for the treatment, method and use specified by the Contracting Agency, or as directed by the Engineer. To compensate for local conditions or changes in soil type, the Contractor may adjust the application rate within the ranges specified.

Products specifically formulated as tackifiers which prevent wind-blown erosion shall not be acceptable as dust palliatives for vehicular traffic, but may be used for their intended purposes.

<b>TABLE 792-1</b>				
<b>DUST PALLIATIVE DILUTION RATIOS AND APPLICATION RATES</b>				
<b>Product Type</b>	<b>Use/Treatment <sup>(1)</sup></b>	<b>Dilution Ratio <sup>(2)</sup></b>		<b>Application Rate <sup>(3)</sup> (gal/sy)</b>
		<b>Range</b>	<b>Typical</b>	
Acrylic Copolymer And Polymers	Topical - Road or parking Lot	20:1 to 4:1	9:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 4:1	15:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 4:1	9:1	0.08 to 0.06
Lignin-Based Type (Lignosulfonate)	Topical - Road or parking Lot	1:1	1:1	0.10 to 0.05
	Topical - Road Shoulder	7:1 to 4:1	8:1	0.05 to 0.03
	Surface Course (per inch of depth)	1:1	1:1	0.30 to 0.10
Organic Resin	Topical - All	10:1 to 2:1	5:1	0.25 to 0.15
	Surface Course (per inch of depth)	2:1 to 1:1	1:1	0.15 to 0.10
Petroleum Resin	Topical - Road or parking Lot	4:1	4:1	0.15 to 0.10
	Topical - Road Shoulder	10:1 to 7:1	8:1	0.15 to 0.07
	Surface Course (per inch of depth)	4:1	4:1	0.11 to 0.07
Tall Oil Pitch Emulsion	Topical - Road or parking Lot	20:1 to 5:1	5:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 3:1	3:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 2:1	10:1	0.08 to 0.06
Other	As approved by the Engineer			

(1) Topical application rates shown are to obtain 1/2 to 1 inch penetration. Higher rates should be used if greater penetration is anticipated.

(2) The dilution ratio (water: product) is variable and shall be appropriate for the local soil and weather conditions, as proposed by the Contractor and agreed upon by the Engineer.

(3) Application rate of undiluted concentrate.

Contractor shall submit proof of conformance in the form of test reports to verify that the dust palliative product proposed for use meets the minimum material requirements specified in this Section. Testing must be specific to the proposed product and not

## SECTION 792

generic to similar type palliative products. Testing shall be performed by independent AASHTO accredited laboratories, and signed and sealed by Professional Engineers registered in the State of Arizona. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

### (A) Acrylic Copolymer and Polymer Types:

The material shall be a white or clear emulsion that can penetrate, saturate and bond together treated soils to create a hard, dust-free and water resistant surface. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Composition	--	Acrylics, acrylates & acetates
pH	E70	4.0 – 9.5
Residue (active solids content), %	D2834	40 min.
Flash Point	D92	None
Absolute Viscosity (Brookfield), cP, 77°F	--	1500 max.
Specific Gravity, 60/60°F	D1298	1.00 – 1.15

### (B) Lignin-Based Types:

Lignin-based dust palliative shall be an aqueous lignosulfonates (a residual co-product of wood pulping by the sulfite process in the manufacturer of cellulose products) that dispersed readily in water to yield a stable, brown-colored solution. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	<1000
Residue (total solids content), %	D2834	48 min.
Lignin sulfonate content (% of solids)	D2834	60 min.
pH	E70	5.0 - 7.0
Specific Gravity (liquid), 77/60°F	D1298	1.00 min.

### (C) Organic Resinous Types:

The material shall be a tan emulsion designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that utilize non-petroleum based organic esters and resins combined with other additives to penetrate, bond and coat treated soils. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	50 – 200
pH	E70	3.0 - 9.0
Residue (active solids content), %	D2834	45 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	1.00 min.

### (D) Petroleum Resinous Types:

The materials shall be a light yellow petroleum resinous emulsion suitable for use as agglomerate for soil particles. The material shall have the following properties in its undiluted emulsified state:

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Specification Designation	ASTM Test Method	Requirements
Kinematic Viscosity, SFS at 77°F	D244	188 min.
pH	E70	4.0 – 7.0
Residue, % wt <sup>(1)</sup>	D2834	60 min.
Sieve Test, % wt. Retained <sup>(2)</sup>	D244	0.1 max.
Particle Charge Test	D244	Positive
Flash Point of base product, CO, °F.	D92	400 min.
Specific Gravity, 60/60°F	D1298	1.00 min.

(1) ASTM test modified by heating 50 g of sample to 300 °F until foaming ceases, then cooling immediately and calculation results.

(2) Replace 2% sodium oleate solution with distilled water in test.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at temperatures between 35°F and 200 °F for a minimum of 3 months. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil and not form a skin at the surface or a crusted surface.

### (E) Tall Oil Pitch Emulsion:

The material shall be a light brown tree resinous emulsion produced from distilled tall oil and not associated with the use of chlorine-based chemicals to bleach pulp from the production of paper. The product shall be designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that can penetrate, saturate and bond together soils to create a hard, dust-free and water repellent surface. The product shall be non-water soluble once cured. The emulsion shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
pH	E70	2.5 - 9.0
Residue (active solids content), %	D2834	35 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	0.998 min.

### (F) Other Types:

Other types of dust palliative may be approved for use by the Engineer. Test methods, requirements, dilution ratios and application rates shall be as specified by the manufacturer.

### 792.3 PERFORMANCE STANDARDS AND TEST METHODS:

Product shall be blended at the specified stabilizer content application rate with soil that is either representative of the site soils to be treated or be a local A-7 in accordance with AASHTO M-145 (as determined by the Engineer) and tested in accordance with ASTM D1883. Results of treated soil must show a minimum 25% increase in CBR (California Bearing Ratio) value over the untreated soil for the product to be accepted for either topical dust suppression or soil stabilization.

Testing shall be in accordance with ASTM D1883, as modified herein. Test reporting shall include all the information required by ASTM D1883, Section 10.0 for both treated and untreated CBR samples. In addition, the penetration vs. stress plot for each test shall be included (ASTM D1883, Fig. 2) along with the rate of product application and the percent stabilizer solids. CBR specimens, after molding, shall be left in their mold, on their sides and cured in the laboratory air for 7 days prior to being immersed in water for 96 hours and then tested for CBR. At least three CBR test specimens shall be compacted at the optimum moisture content, both treated and untreated (ASTM D698, method C), with the result reported as the average value. The surcharge weight shall be 10 pounds.

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### 792.4 ENVIRONMENTAL CRITERIA:

Contractor shall submit proof to the Engineer in the form of test reports and certificates to verify that the dust palliative product is in environmental compliance. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

Products shall not contain or emit chlorinated fluorocarbons (CFC's or Freon's) and shall not contain or emit volatile organic compounds (VOC's) that exceed Federal, State or Local air quality limitations.

Products and their degradation products shall not be composed of elements, compounds, mixtures or produce runoffs with the characteristics identified under Arizona Revised Statutes 36-2822 of the Arizona Hazardous Waste Management Act, emit or off-gas during placement, use or degradation of any hazardous air pollutant listed under Section 112 of the Federal Clean Air Act [42 U.S.C. § 7412], be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act [15 U.S.C. § 2606], be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act, be prohibited for use by the Arizona Department of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule or regulation.

Product runoff and their degradation product runoffs shall not contain concentrations that exceed the parameters designated in Section 2.18 'Table 5' of the National Pollution Discharge Elimination System (NPDES) Multi-Sector General Permit for Industrial Activities (*see Note A*). Adequate proof can be shown by providing one of the following:

(A) Complete aquatic toxicity test for lethal concentration at 50% (LC50).

(B) Provide complete and accurate listing of all individual chemical constituents (including proprietary chemical information) and percentage of each in a given volume of pure chemical product.

(C) Surface water runoff test. This test involves running distilled water over a treated soil area, collecting the test water, and submitting to a certified lab for analysis.

Contractor shall obtain from the dust palliative product manufacturer independent verification and certification of performance and environmental claims by a recognized agency of the United States, Canadian Precertification, Environmental Technology Verification, or EcoLogo Certification programs for chemical dust suppressants.

Products or their components and degradation products shall be tested and certified by the manufacturer not to be substances or composed of substances known to be, or reasonably anticipated to be carcinogenic or toxic by the U.S. Department of Health and Human Services.

Products must have hazardous Materials Identification System (HMIS) ratings equal to or less than the following for each category: H=1; F=1; R=1; PPE=X.

- End of Section -

Note A: Parameter benchmark values shall be provided by the Engineer and based on the Contracting Agency's Requirements.

**SECTION 795**

**LANDSCAPE MATERIAL**

**795.1 GENERAL:**

Material used for landscaping purposes shall be in conformance with this Section.

**795.2 TOPSOIL:**

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, weed seed or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer, at no additional cost, with a soil sample from each source for analysis and tests.

Soil tests will be accomplished by an approved independent soil testing laboratory capable of doing the appropriate horticultural soil test. The results of the test will determine the acceptability of the soil. The testing laboratory may suggest ways to amend the soil to make it suitable to grow plants. The Contractor may be directed by the Engineer to provide the amendments at no additional cost.

To be acceptable, the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 10 inclusive, and it shall contain between 1 and 2%, by dry weight, organic matter either natural or added.

Gradation shall be as follows:

**TABLE 795-1**

<b>SIEVE SIZE</b>	<b>PERCENT PASSING</b>
1/2"	100
No. 4	90-100
No. 10	70-100
No. 200	15-70

**795.3 SOIL AMENDMENTS AND CONDITIONERS:**

**795.3.1 Chemical Conditioners:** Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. Fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals, or plants. Material which has become caked or otherwise damaged shall not be used.

Fertilizing material for plants shall be similar to the product "Super Start" or approved equal, with the following additive ingredients (% by weight): 3% Nitrogen, 10% Sulfur, 4% Iron, 1% Zinc, 0.08% Manganese, and 0.13% Viterra. All fertilizing material shall be in 40 pound packages with additive ingredient derived from:

1. Nitrogen from Urea Formaldehyde and M.A.P.
2. Sulfur from Potassium Sulfate
3. Iron from Sequestrene 138 Iron
4. Zinc from Sequestrene Zinc
5. Manganese from Sequestrene Manganese
6. Viterra from a synthetic, superabsorbent co-polymer.

Slow Release Fertilizer Plant Tablets: Shall be Agriform 21 gram tablets or equal with 20-10-5 analysis.

Fertilizing Material for lawn areas or used in revegetation shall be a commercially approved brand or a mixture of standard commercial forms to meet the requirements recommended by horticultural test results.

Slow Release Nitrogen: Shall be Methylene urea (38-0-0) or equivalent. It is use to extend nitrogen availability over time on sites where long term nitrogen availability is a limiting factor.

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795.3.2 Organic Soil Amendments:

General Soil Conditioner: Compost shall be naturally organic, free of weeds and weed seeds, and contain no plant growth inhibiting factors. This material shall be tested and meet the following minimum requirements.

Germination Rate (full strength extract).....	85% minimum
Maturity Index (full strength extract).....	50% minimum
Conductivity EC mmhos/cm .....	less than 8
Exchangeable Sodium Percentage.....	less than 15
Carbon/Nitrogen Ratio .....	less than 20:1
Total Nitrogen (not added).....	0.5% minimum
pH range of extract....	5.5 – 8.0

When cow manure is used as a soil conditioner in turf areas, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be treated with a non-toxic agent so as to be hydrophilic.

Plant Conditioner: Shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a ph not exceeding 7.5% and organic matter not less than 85%. Mulch gradation shall be treated with a non-toxic agent so as to be hydrophilic. Cow Manure shall not be used as organic mulch in plant backfill mixes.

Bone Meal: Commercial grade product uniform in composition.

Sand: Shall be brown washed natural mortar sand passing at least a #7 screen, free of weeds, organic material, stones, deleterious materials, non-toxic to plant and human life and usable for backfill mixtures.

Hydromulch shall be packaged in units containing current labels, with the manufacturer’s name, the net weight, and certification that the material meets the forgoing requirements. The mulch shall be dyed green to aid in the visual metering application. The dye shall be biodegradable and not inhibit plant growth.

(A) 100% Wood Cellulose Fiber Hydromulch: Shall be shall be used as mulch when hydroseeding turf grass.

Moisture content.....	10.0% + 3.0%
Organic Matter (Wood Cellulose Fiber).....	99.3% + 0.2%
Ash content.....	0.7% + 0.5%
pH.....	4.9 + 0.5%
Water Holding Capacity .....	10 : 1

(B) Cellulose Fiber Hydromulch: Shall be used as mulch when hydroseeding native seed. Cellulose fiber mulch shall consist of at least 70% specially prepared virgin wood cellulose fiber which has been thermo-mechanically processed for specific use as hydromulch. It shall contain no growth inhibiting factors. It shall have the following properties:

Wood Cellulose Fiber.....	70% (minimum)
Recycled Cellulose Fiber.....	30% (maximum)
Ash Content.....	0.8% + 0.3% (maximum)
pH.....	4.5 + 1.0
Water Holding Capacity ratio; water: fiber .....	10:1

Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption and percolation and shall cover and hold seed in contact with the soil.

Tackifier: Used in hydroseeding shall consist of a free-flowing, noncorrosive powder produced from the natural plant gum of Plantago insularis (Desert Indianwheat), applied in a slurry with water and wood fiber. The powder shall possess the following properties:

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Protein content.....	1.6 + 0.2 %
Ash content.....	2.7 + 0.2%
Fiber .....	4.0 + 0.4%
pH 1% solution.....	6.5 –8.0 %

The material used for mulch tackifier shall not contain any mineral filler, recycled cellulose fiber, clays, or other substance which may inhibit germination or growth of plants.

Activated Charcoal: Agricultural grade powdered activated charcoal is used in the hydromulching slurry to boost seed germination during cold weather as a soil colorant.

Granular humus based soil conditioner used in hydromulching operations shall be tested and meet the following:

Total humus.....	50% minimum
Total humic acid.....	15% minimum

Liquid humic acid soil based conditioner used in hydromulching operations shall be tested and meet the following:

Total humic acid.....	6% minimum
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**795.4 SEEDS:**

**795.4.1 Native Seeds:** Shall be certified to scientific name, lot number or other identification, origin of the seed, purity of the seeds as a percentage of pure live seed by weight, germination percentage and percentage of firm ungerminated seeds, name and address of person who labeled or offers seed for sale.

Pure Live Seed (PLS) percentage = (% germination + % ungerminated firm seed) x (% purity). The seed rate specified is pounds of Pure Live Seed.

**795.4.2 Turf Seed:** Shall be fresh clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer’s name guaranteed analysis and germination percentage. They shall have a certification or a stamp or a release accomplished by an agricultural commission.

**795.5 PLANTS:**

Plants shall be nursery grown or plantation grown stock conforming to ANSI 260-1 and shall be of the varieties specified in the plant list bearing botanical name listed. Plants shall meet the standards established by the Arizona Nursery Association Grower's Committee recommended specifications.

Planting stock shall be well broached and well formed, sound, vigorous, healthy and free from disease, sun-scald, windburn, abrasion and harmful insects or insect eggs and shall have healthy, normal and unbroken root system which is neither root or pot-bound and are free of kinked or girdling roots. Plants shall have been grown under climate conditions similar to those at the project site.

**795.6 SOD:**

The sod shall be Midiron Bermuda if not specified on the plans and meet State standards to insure high quality and freedom from noxious weeds.

Sod shall be machine cut at a uniform soil thickness of 1/2 inch (plus or minus 1/4 inch), at time of cutting. Measurement excludes top growth and thatch.

Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 30% of the section.

Sod shall be free from disease, nematodes, and soil born insects.

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### **795.7 MISCELLANEOUS MATERIAL:**

**795.7.1 Lumber:** Lumber in contact with the earth shall be redwood heartwood, sized according to the drawing. When unit bid items that include headers or lumber are included in the proposal sheets, the unit prices quoted shall be per linear foot.

**795.7.2 Clean fill:** Clean fill shall be soil free of weeds, boulders, clods, heavy clay, aggregate base, asphalt or concrete or other deleterious material.

**795.7.3 River Run Rock:** Rock shall be clean, hard, durable, uniform in quality, free from seams and coatings, rounded and water-worn. The gradation shall be as specified and approved by the Engineer.

*- End of Section -*

## SECTION 796

### GEOSYNTHETICS

#### 796.1 GENERAL:

This Section defines the requirements for geosynthetic fabrics, grids and membranes typically used as pavement fabric beneath asphalt concrete overlays, filtration/drainage separation between soil/aggregate layers, erosion control filter/separators for riprap protection, and soil or base reinforcement to improve the stability of weak soils or reinforce aggregate bases.

#### 796.2 MATERIALS AND REQUIREMENTS:

Identification, packaging, delivery, storage and handling of geosynthetic materials shall be in accordance with manufacturer's recommendations and ASTM D4873. Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number date of manufacture, and shipping date.

Geosynthetic materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

Geosynthetic materials shall be packaged with material that will protect the geosynthetic (including ends of rolls) from damage due to shipment, water, sunlight and contaminants. During storage, geosynthetic materials shall be elevated off the ground and protected from the following: site construction damage, precipitation, extended ultraviolet radiation, strong acid or strong base chemicals, flames (including welding sparks), temperatures in excess of 160°F, and any other environmental condition that may damage geosynthetic material property values. Protection shall be in accordance with manufacturer's specifications and shall be maintained during periods of shipment and storage.

Materials required for complete and proper installation of geosynthetic materials that are not specifically described herein (such as pins, nails, washers, etc.) shall conform to the manufacturer's recommendations and be as selected and supplied by Contractor subject to final approval by the Engineer.

Requirements represent minimum average roll values in the weaker principal direction. Average of test results from any sampled roll in a lot shall meet or exceed the minimum values noted herein. Lot sampling shall be in accordance with ASTM D4354.

**796.2.1 Pavement:** Pavement fabric geosynthetics are non-woven polyester or polypropylene fabrics that are field saturated with an asphalt binder and placed as an interlayer beneath a pavement overlay or between pavement layers. When placed, the fabric becomes an integral part of the roadway section, forming a barrier to water infiltration and absorbing stresses to reduce reflective and fatigue cracking of the new pavement surface layer.

Pavement fabric shall be constructed of at least 95 percent (by weight) nonwoven synthetic fibers of polyester or polypropylene, thermally bonded on one side. The fabric material shall additionally conform to the physical properties shown in Table [796-1](#).

TABLE 796-1			
PAVEMENT GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Weight: oz/yd <sup>2</sup>	4.1 min.	4.0 min.	ASTM D3776
Grab tensile strength: lbs.	100 min.	90 min.	ASTM D4632
Elongation at break: %	50 min.	50 min.	ASTM D4632
Melting point: degree F	300 min.	300 min.	ASTM D276
Asphalt retention: gal/yd <sup>2</sup>	0.25 min. <sup>(1)</sup>	0.20 min.	ASTM D6140

(1) May be reduced within street intersections, on steep grades or in other zones where vehicle braking is common, but not less than 0.20 gal/yd<sup>2</sup>, when approved by the Engineer.

**796.2.2 Filtration (Drainage) and Separation:** Filtration and separation fabrics are nonwoven or woven polypropylene or polyester fabrics with specified strength characteristics used as permeable separators to restrain soil or other particles

## SECTION 796

subjected to hydrodynamic forces while allowing the passage of fluids into or across a geotextile and to prevent inter-migration of adjacent soil layers of vastly different particle sizes and particle distributions.

Filtration and separation fabrics shall be nonwoven or woven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed or woven into a stable network such that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-2](#).

<b>TABLE 796-2</b>			
<b>FILTRATION &amp; DRAINAGE GEOSYNTHETIC PROPERTIES</b>			
<b>Property</b>	<b>Class A <sup>(1)</sup></b>	<b>Class B <sup>(2)</sup></b>	<b>Test Method</b>
Grab tensile strength: lbs.	180 min.	80 min.	ASTM D4632
Seam strength: lbs.	160 min.	70 min.	ASTM D4632
Puncture strength: lbs.	80 min.	25 min.	ASTM D4833
Trapezoidal tear: lbs	50 min.	25 min.	ASTM D4533
Apparent opening size: US Standard sieve size	>50	>50	ASTM D4751
Ultraviolet Stability: %	50 min.	50 min.	ASTM D4355

- (1) Class A - Use where installation stresses are more severe than for Class B application (i.e. very coarse sharp angular aggregate or high compaction requirements).
- (2) Class B – Use with smooth graded surface having no sharp angular projections and sharp angular aggregate.

**796.2.3 Erosion Control:** Erosion control fabrics are used below areas to receive aggregate or riprap slope protection and act as filter/separators to provide sustained permeability while maintaining structural stability.

Erosion control fabrics shall be a woven monofilament fabric or a nonwoven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed into a stable network that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-3](#).

<b>TABLE 796-3</b>			
<b>EROSION CONTROL GEOSYNTHETIC PROPERTIES</b>			
<b>Property</b>	<b>Class A</b>	<b>Class B</b>	<b>Test Method</b>
Grab tensile strength: lbs.	270 min.	200 min.	ASTM D4632
Elongation at break: %	45min., 115 max.	15 min., 115 max.	ASTM D4632
Puncture strength: lbs.	110 min	75 min.	ASTM D4833
Burst strength: psi	430 min.	320 min.	ASTM D3786
Trapezoidal tear: lbs	75 min.	50 min.	ASTM D4533
Permittivity: second <sup>-1</sup>	0.07 min.	0.07 min.	ARIZ-730 <sup>(1)</sup>
Apparent opening size: US Standard sieve size	30 – 140	30 - 140	ASTM D4751
Ultraviolet Stability: %	70 min.	70 min.	ASTM D4355

- (1) Arizona Department of Transportation test method.

**796.2.4 Soil or Base Reinforcement:** Geogrid geosynthetic materials are used for improving the stability of weak soils or reinforcing aggregate bases. Geogrids are defined as biaxial or triaxial polymeric grids formed by a regular network of integrally connected polymer tensile elements with apertures of sufficient size to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials to function primarily as reinforcement.

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The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall be integrally formed and deployed as a single layer; comprised of 100 percent polypropylene or high-density polyethylene. Geogrids shall additionally conform to the physical properties shown in Table [796-4](#).

<b>TABLE 796-4</b>			
<b>REINFORCEMENT GEOGRID PROPERTIES</b>			
<b>Property</b>	<b>Type 1</b>	<b>Type 2</b>	<b>Test Method</b>
Aperture size: inches	1 min.	1-3/8 min.	ID callipered
Ultimate Tensile Strength: lb/ft	850 min.	1300 min.	ASTM D4945
Flexural Rigidity: Mg-cm	250,000 min.	750,000 min.	ASTM D1388
Tensile Strength @ 2% Strain: lb/ft MD <sup>(1)</sup>	270 min.	410 min.	ASTM D6637
Tensile Strength @ 2% Strain: lb/ft CMD <sup>(2)</sup>	380 min.	620 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft MD <sup>(1)</sup>	550 min.	810 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft CMD <sup>(2)</sup>	720 min.	1340 min.	ASTM D6637
Junction Efficiency: % Ultimate Tensile Strength	75 min.		GRI-GG2 <sup>(3)</sup>
Ultraviolet Stability: % Retained Strength	70 min.		ASTM D4355

(1) MD = Test in the machine direction along roll length

(2) CMD = Test in the cross-machine (transverse) direction across roll width

(3) Geosynthetic Research Institute test method

### 796.3 TEST AND CERTIFICATION REQUIREMENTS:

Certificates of compliance shall be submitted to the engineer upon delivery of material for use on a specified project. Samples of materials shall be submitted for testing. Each geosynthetic material lot or shipment must be approved by the Engineer before the materials may be incorporated in the work.

Testing methods and results shown in the certificate of compliance shall conform to the listed specifications for the proposed geosynthetic use. Manufacturer's supporting documentation including, but not limited to, product information sheets, installation procedures and recommendations, recommended use, and project references shall be submitted to the Engineer for product evaluation and approval.

- End of Section -

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**UNIFORM STANDARD  
DETAILS**

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**100 SERIES: GENERAL INFORMATION**

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110-2	2011	PLAN SYMBOLS (LINE TYPES)
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160	2013	6' CHAIN LINK FENCE AND GATE

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211	1998	STANDARD TRENCH PLATING DETAIL
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303-1	1998	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES (DRAWING)
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\* NEWLY REVISED.

DETAIL NO.

**100-1**STANDARD DETAIL  
ENGLISH**INDEX (PAGE 1 OF 2)**

REVISED

01-01-2015

DETAIL NO.

**100-1**

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552	2015 *	FORD CROSSING WITH CUT-OFF WALLS
555	2010	EROSION PROTECTION/GABIONS

\* NEWLY REVISED.

1. THESE DETAILS HAVE BEEN PREPARED IN AN EFFORT TO STANDARDIZE THE CONSTRUCTION DETAILS USED BY VARIOUS CONTRACTING AGENCIES IN MARICOPA COUNTY. THEY ARE TO BE USED IN CONJUNCTION WITH THE CURRENT EDITION OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" SPONSORED AND DISTRIBUTED BY THE MARICOPA ASSOCIATION OF GOVERNMENTS.
2. MANY NOTES WITHIN THESE DETAILS REFER TO VARIOUS SECTIONS OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION." WHERE THIS REFERENCE IS MADE, ONLY THE ABBREVIATION "SECT." IS USED. AN EXAMPLE OF THIS REFERENCE WOULD BE: "CLASS 'A' CONCRETE PER SECT. 725."
3. MANY NOTES WITHIN THESE DETAILS REFER TO OTHER DETAILS WITHIN THIS BOOK. WHERE THIS REFERENCE IS MADE, THE ABBREVIATION "DETAIL" IS USED. AN EXAMPLE OF THIS WOULD BE: "SEE DETAIL 391 FOR VALVE BOX INSTALLATION."
4. MANY DETAILS COVER MORE THAN ONE SHEET. THESE SHEETS HAVE BEEN GIVEN THE SAME NUMBER WITH A SUFFIX NUMBER, EXAMPLE: 391-1 AND 391-2.
5. AN EFFORT HAS BEEN MADE TO INCLUDE THE MOST COMMONLY USED CONSTRUCTION DETAILS IN THIS BOOK. ITEMS WHICH REQUIRE DESIGN CONSIDERATION BY THE DESIGNING ENGINEER HAVE NOT BEEN INCLUDED.
6. SOME OF THE DETAILS PRINTED HEREIN MAY BE USED BY SOME OF THE AGENCIES BUT NOT OTHERS. THE DESIGNING ENGINEER SHOULD THEREFORE CONTACT THE AGENCY WITHIN WHOSE JURISDICTION HE IS WORKING FOR DIRECTION AS TO WHICH DETAIL OR PORTIONS OF DETAILS SHOULD BE USED.
7. DETAIL DRAWINGS ARE NOT TO SCALE.

DETAIL NO.

101



MARICOPA  
ASSOCIATION of  
GOVERNMENTS

STANDARD DETAIL  
ENGLISH

GENERAL INFORMATION

REVISED

01-01-2011

DETAIL NO.

101

SEWER CLEANOUT



FIRE HYDRANT



WATER METER



UTILITY MANHOLE



IRRIGATION STANDPIPE



UTILITY VALVE



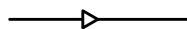
SEWER SERVICE CONNECTION



MONITORING WELL



REDUCER



WOOD UTILITY POLE



STEEL UTILITY POLE



CONCRETE UTILITY POLE



STREET LIGHT ON MAST ARM



POLE MOUNTED LIGHT



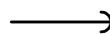
ELECTRIC, GAS METER



TRANSFORMER



DOWN GUY & ANCHOR



SURVEY MONUMENT



SURVEY MONUMENT IN HANDHOLE



MAIL BOX



SIGNAL POLE



SINGLE POST SIGN



DOUBLE POST SIGN



STREET NAME SIGN



VIDEO DETECTION CAMERA



PULL BOX



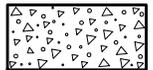
CELLULAR TOWER



BITUMINOUS (SECTION)



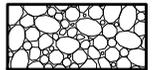
CONCRETE (SECTION)



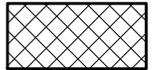
AGGREGATE BASE COURSE (SECTION)



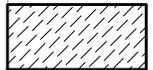
RIPRAP (PLAN & SECTION)



OBLITERATE PAVEMENT



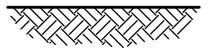
TAPERED MILL



UNIFORM MILL



EARTH (SECTION)



**NOTES:**

1. PLAN SYMBOLS FOR EXISTING FEATURES ARE TO BE DASHED, GRAY SCALED, OR DRAWN USING THIN LINEWORK.

2. ADD LABELS TO PLAN SYMBOLS AS NEEDED FOR CLARITY.

DETAIL NO.

110-1



STANDARD DETAIL  
ENGLISH

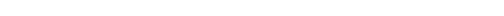
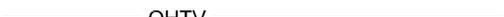
PLAN SYMBOLS

REVISED

01-01-2011

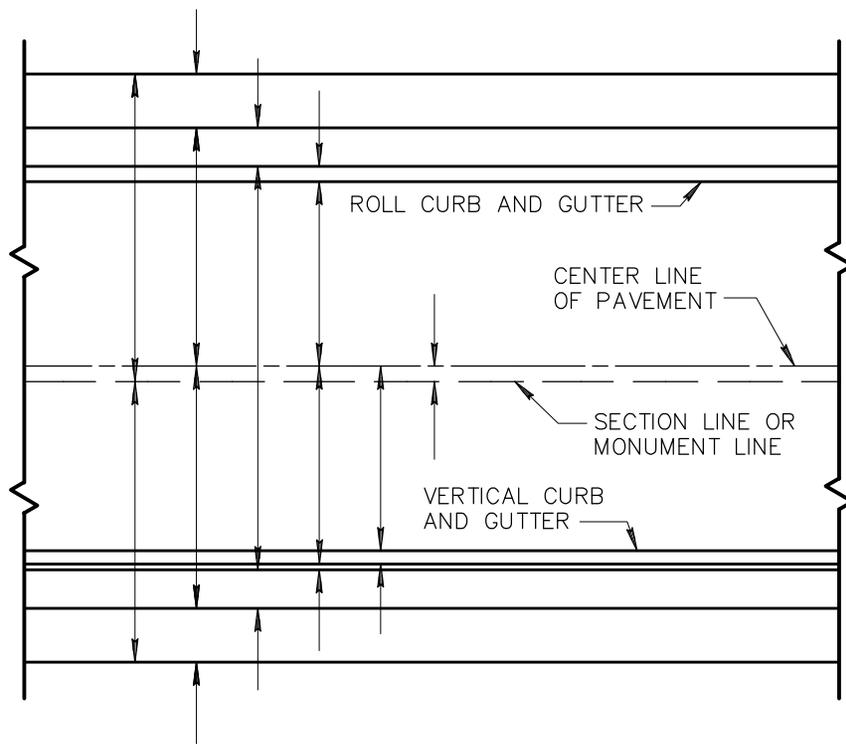
DETAIL NO.

110-1

SECTION LINE	
R/W	
EASEMENT	
PROPERTY LINE (OPTION 1)	
PROPERTY LINE (OPTION 2)	
JURISDICTIONAL BOUNDARY (OPTION 1)	
JURISDICTIONAL BOUNDARY (OPTION 2)	
ROADWAY CENTERLINE	
UNDERGROUND ELECTRIC BURIED CABLE	
UNDERGROUND ELECTRIC CONDUIT	
UNDERGROUND ELECTRIC DUCT BANK	
OVERHEAD ELECTRIC	
UNDERGROUND TELEPHONE LINE	
OVERHEAD TELEPHONE LINE	
FIBER OPTIC	
CABLE TELEVISION	
OVERHEAD CABLE TELEVISION	
TELEPHONE DUCT BANK	

CHAIN LINK FENCE	
BARBED WIRE FENCE	
BLOCK WALL	
WOOD FENCE	
GAS LINE (12" & SMALLER)	
GAS LINE * (GREATER THAN 12")	
SEWER LINE (12" & SMALLER)	
SEWER LINE * (GREATER THAN 12")	
NEW STORM DRAIN PIPE *	
STORM DRAIN * (GREATER THAN 12")	
IRRIGATION LINE (12" & SMALLER)	
IRRIGATION LINE * (GREATER THAN 12")	
NEW IRRIGATION LINE *	
WATER LINE (12" & SMALLER)	
WATER LINE * (GREATER THAN 12")	

\* SCALE TO ACTUAL WIDTH



DIMENSION SHOULD BE GIVEN ONCE ON EACH SHEET AND SHOULD BE PLACED NEAR THE CENTER OF THE SHEET. IF ANY OF THE GIVEN CONDITIONS CHANGE, THEY SHOULD BE REDIMENSIONED AT THE POINT OF CHANGE.

GIVEN DIMENSIONS IN ORDER STARTING WITH THE LONGEST AND ENDING WITH THE SHORTEST, AS SHOWN IN THE SKETCH.

GIVE COMPLETE DIMENSIONS.

IF THE CENTERLINE OF PAVEMENT DOES NOT FALL ON THE SECTION LINE OR MONUMENT LINE OF THE STREET, DIMENSION AS ABOVE AND SHOW THE DIFFERENCE BETWEEN THE SECTION OR MONUMENT LINE AND THE CENTERLINE.

DETAIL NO.

112



MARICOPA  
ASSOCIATION of  
GOVERNMENTS

STANDARD DETAIL  
ENGLISH

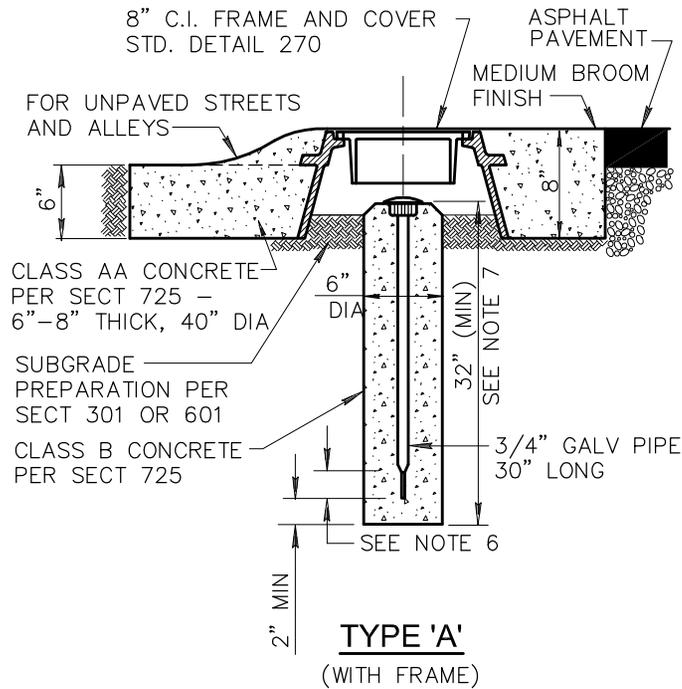
## DIMENSIONING FOR ROAD IMPROVEMENT PLANS

REVISED

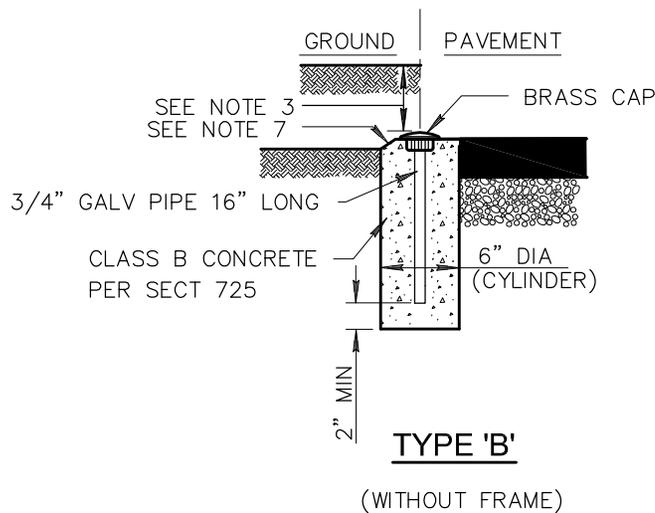
01-01-1998

DETAIL NO.

112



**TYPE 'A'**  
(WITH FRAME)

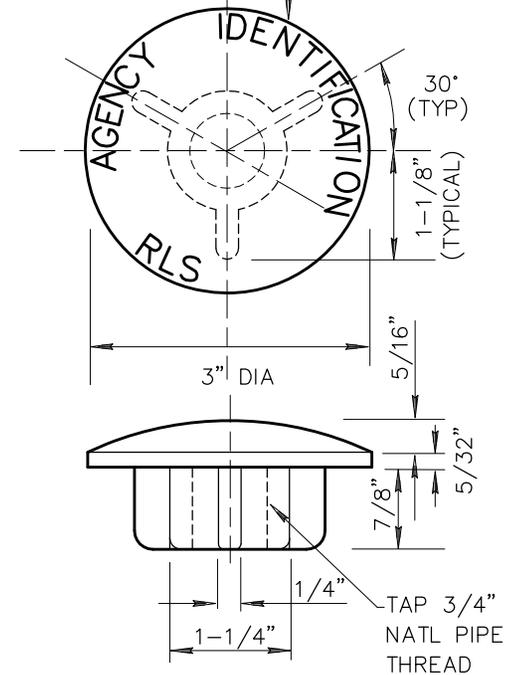


**TYPE 'B'**  
(WITHOUT FRAME)

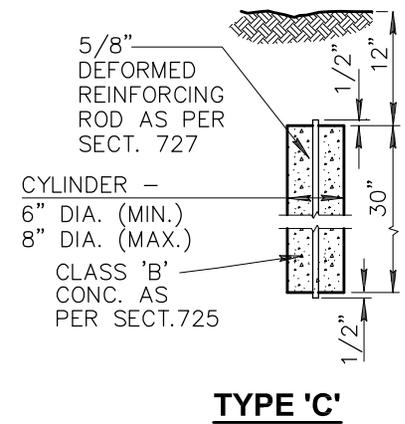
**NOTES:**

1. TYPE 'A' TO BE USED AT INTERSECTIONS OF MAJOR STREETS & COLLECTOR STREETS, SECTION CORNERS, SECTION 1/4 CORNERS, CENTER OF SECTIONS, AND AT OTHER POINTS AS SHOWN ON PLANS.
2. TYPE 'B' TO BE USED (EXCEPT WHERE TYPE 'A' IS SPECIFIED) AT INTERSECTION OF STREET CENTERLINES, PC'S, PT'S AND PI'S OF CURVES, SECTION 1/16 CORNERS, SUBDIVISION CORNERS, CHANGE IN ALIGNMENT OF SUBDIVISION BOUNDARIES, AND AT OTHER POINTS AS SHOWN ON PLANS.
3. FOR UNPAVED STREETS AND ALLEYS SET TOP OF MARKER SIX INCHES BELOW FINISHED GRADE.
4. CAP TO BE CONSTRUCTED OF RED BRASS OR BRONZE.
5. LETTERS TO BE APPROX. 1/32" WIDE & 1/32" DEEP.
6. FLATTENING THE BOTTOM 2" OF THE GALVANIZED PIPE IS OPTIONAL.
7. TOP OF CONCRETE POST IS CHAMFERED 3/4" EXCEPT WHEN SET FLUSH WITH PAVEMENT.
8. THE CAP SHALL SHOW THE POINT SURVEYED BY A PUNCH MARK OR SCRIBED CROSS AND THE CAP SHALL BE STAMPED WITH THE YEAR AND THE REGISTERED LAND SURVEYOR'S (RLS) REGISTRATION NUMBER.
9. WHEN APPLICABLE, THE CAP SHALL BE STAMPED WITH THE APPROPRIATE PUBLIC LAND MARKING PER CURRENT MANUAL OF INSTRUCTIONS FOR THE SURVEY OF PUBLIC LANDS OF THE UNITED STATES, PREPARED BY THE BUREAU OF LAND MANAGEMENT.
10. SUBMIT TO THE ENGINEER A COPY OF THE RECORDED CORNER RECORD OR RESULTS OF SURVEY TO DOCUMENT COMPLIANCE WITH THE ARIZONA BOARD OF TECHNICAL REGISTRATION REQUIREMENTS.

1/16" BORDER FROM EDGE OF CAP TO TOP OF 1/4" LETTERING.



**CAP DETAIL**



**TYPE 'C'**

DETAIL NO.

120



STANDARD DETAIL  
ENGLISH

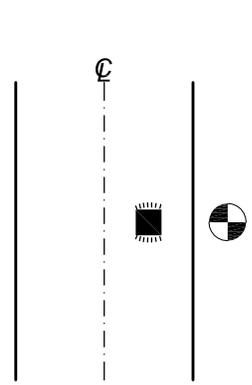
SURVEY MARKER

REVISED

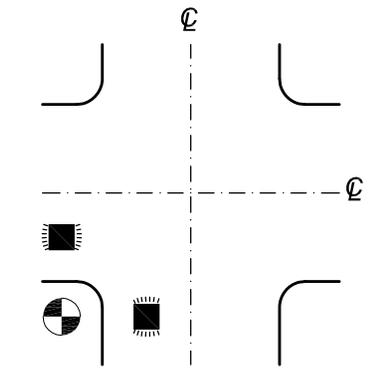
01-01-2015

DETAIL NO.

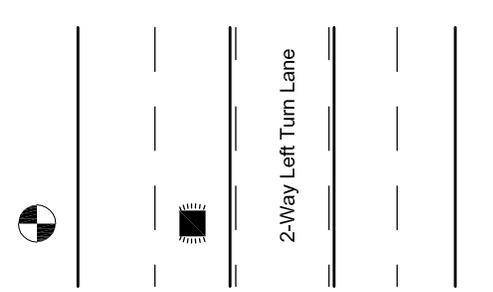
120



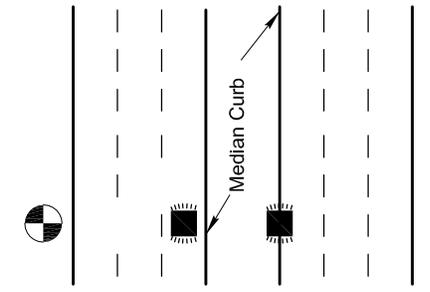
LOCAL STREET



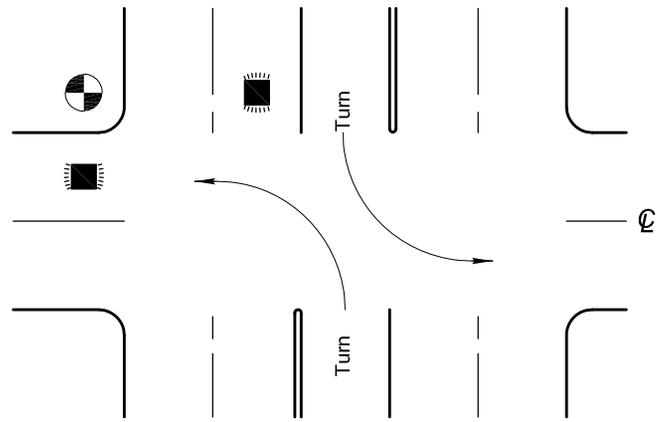
LOCAL CROSS STREET INTERSECTION



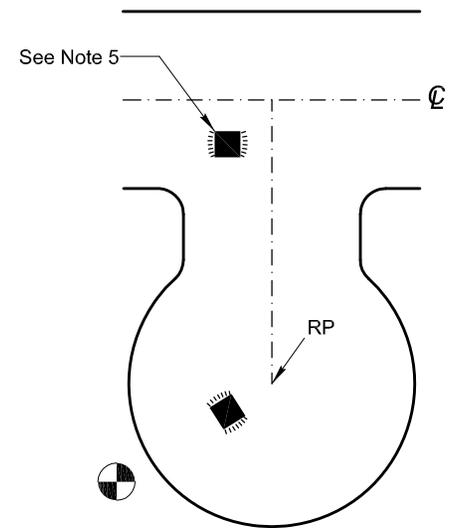
MULTI-LANE STREET W/ TWO WAY LEFT TURN LANE



MULTI-LANE STREET W/ RAISED MEDIAN



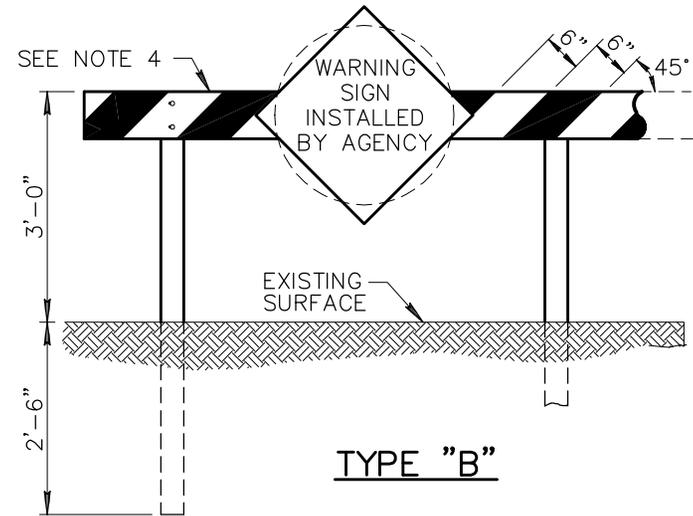
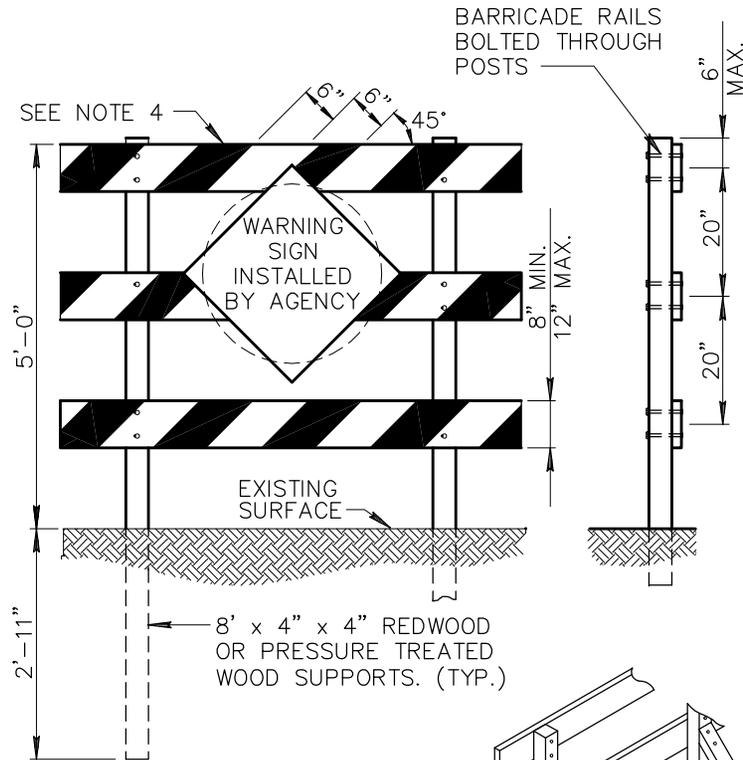
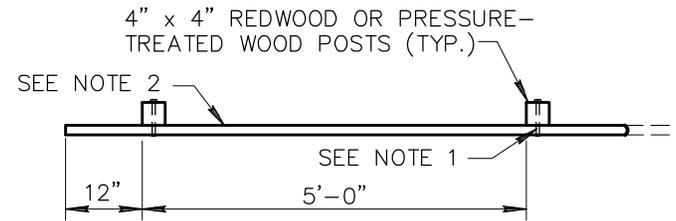
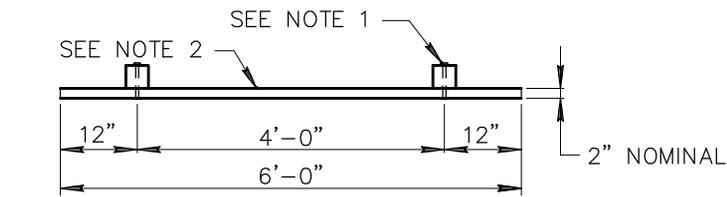
FOUR LANE STREET WITH TURN LANE AT INTERSECTION



CUL-DE-SAC

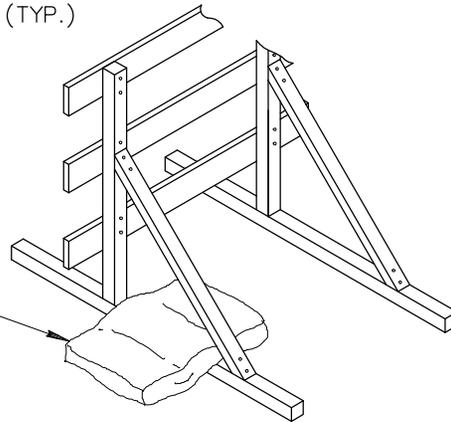
**NOTES:**

1. LOCATE PAVEMENT MARKER IN CENTER OF TRAVEL LANE AND ALIGN WITH HYDRANT.
2. FOR MULTIPLE LANE ROADS LOCATE PAVEMENT MARKER IN LEFT MOST THROUGH TRAFFIC LANE.
3. ADJUST MARKER LOCATION TO BE LOCATED OUTSIDE OF ANY DELINEATED CROSSWALK AREA.
4. FOR HYDRANT LOCATED ON FAR SIDE OF RAISED MEDIAN, LOCATE PAVEMENT MARKER ON TOP OF MEDIAN CURB ALIGNED WITH HYDRANT.
5. OMIT FOR CUL-DE-SAC GREATER THAN 250' IN LENGTH.
6. FIRE HYDRANT PAVEMENT MARKERS SHALL BE 2-WAY RETROREFLECTIVE BLUE: ADOT TYPE BB, 911A-BLUE BY FIRE LITE AMERACE CORPORATION, OR APPROVED EQUAL.



**TYPE "A"**

SEE NOTE 3



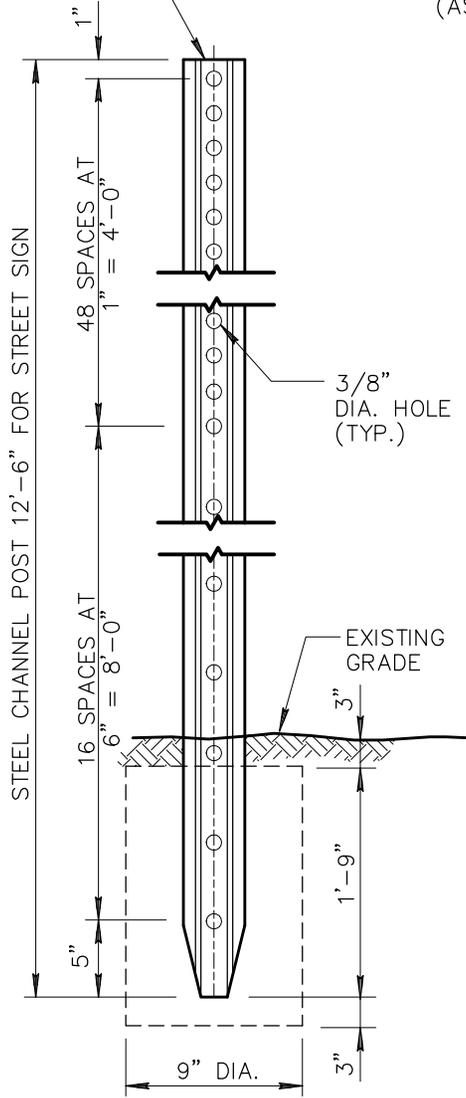
**NOTES:**

1. FASTEN WITH 1/2" x 5" LAG SCREWS WITH 2 FLAT WASHERS OR (2) 5/8" BOLTS, WITH 4 FLAT WASHERS.
2. 2" x 8" DOUGLAS FIR PLANK (LENGTH TO BE DETERMINED ON PLANS.)
3. WHEN BARRICADE (TYPE "A") IS CONSTRUCTED ON BASES INSTEAD OF POSTS SET INTO THE GROUND, IT MAY BE DESIRABLE TO BALLAST THE BASES WITH SAND BAGS OR BY STAKING TO PROVIDE RESISTANCE TO OVERTURNING DURING PERIODS OF HIGH WINDS.
4. TWO COATS OF WHITE PAINT PER SECTION 790 SHALL BE APPLIED TO ALL EXPOSED SURFACES OF THE BARRICADE. AN ADDITIONAL TWO COATS OF ORANGE PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE THE ALTERNATE ORANGE AND WHITE STRIPES FOR TEMPORARY BARRICADES AND TWO COATS OF RED PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE ALTERNATE RED AND WHITE STRIPES FOR PERMANENT BARRICADES. HIGHWAY SAFETY SPHERES (BEADS) PER ADOT 708-2.02 SHALL BE APPLIED BY HAND TO ALL CROSS MEMBERS, FRONT AND BACK AND ON BOTH COLORS, IMMEDIATELY AFTER PAINTING. THE STRIPES SHALL SLOPE DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS.

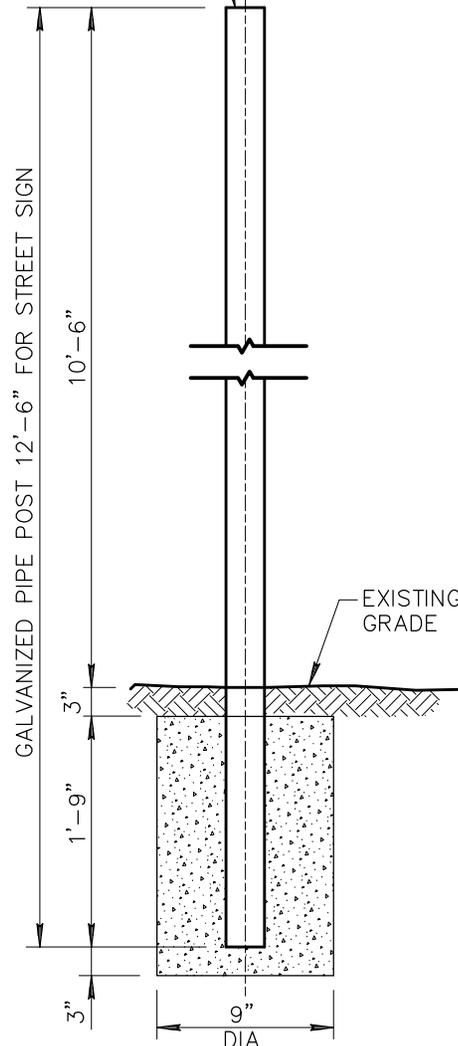
FLANGED STEEL 'U' CHANNEL (2 LBS. OR 3 LBS. PER SQUARE FOOT AS SPECIFIED)

2-1/2" DIA. STANDARD PIPE GALVANIZED OR 2-3/8" O.D. STANDARD PIPE GALVANIZED (AS SPECIFIED)

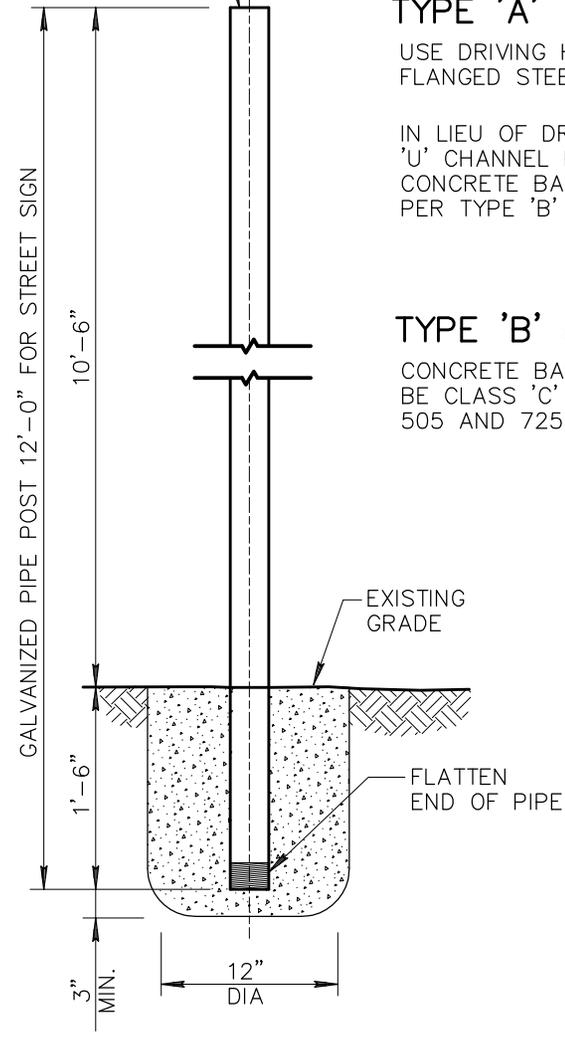
2" DIA. STANDARD PIPE GALVANIZED



TYPE 'A'



TYPE 'B'



TYPE 'C'

**NOTES**

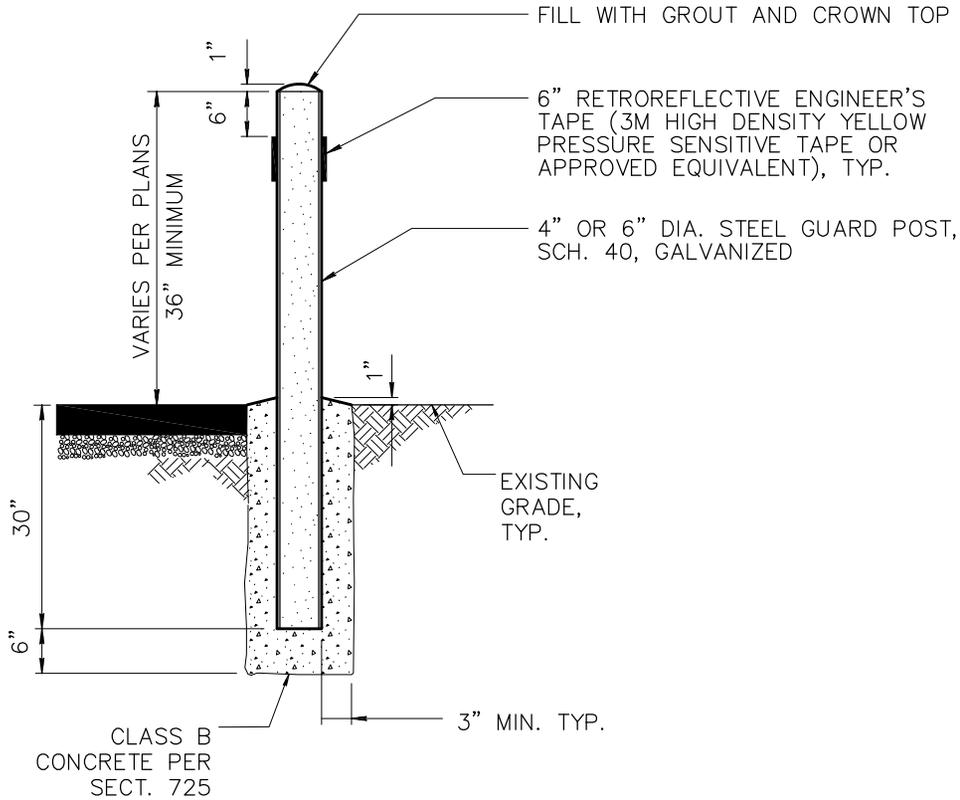
**TYPE 'A'**

USE DRIVING HEAD FOR DRIVING ALL FLANGED STEEL 'U' CHANNEL POSTS.

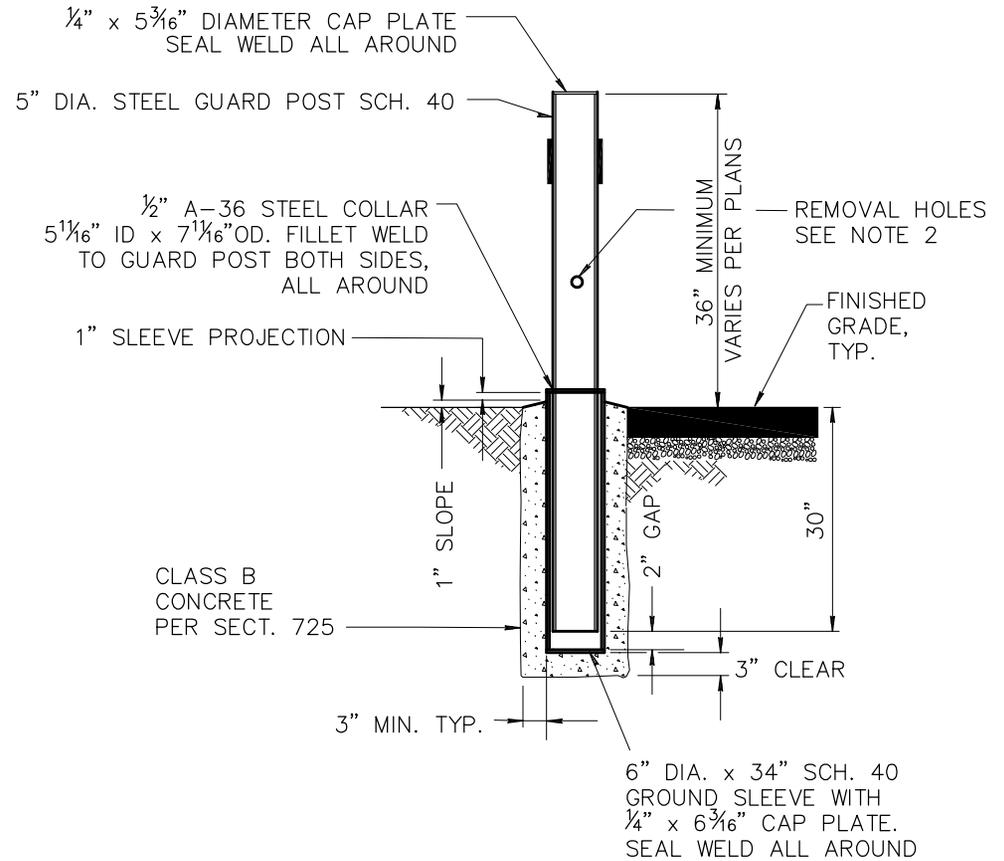
IN LIEU OF DRIVING FLANGED STEEL 'U' CHANNEL POSTS MAY BE SET IN CONCRETE BASE FOUNDATION AS PER TYPE 'B' BASE.

**TYPE 'B' & TYPE 'C'**

CONCRETE BASE FOUNDATIONS SHALL BE CLASS 'C' CONCRETE AS PER SECT. 505 AND 725.



**TYPE 1 PERMANENT**



**TYPE 2 REMOVABLE**

**NOTES**

1. BOLLARDS SHALL HAVE A HEIGHT OF 3 FEET OR BE EQUAL TO THE HEIGHT OF THE BACK SCREEN WALL OF BIN ENCLOSURES. POSTS SHALL BE PLACED A MINIMUM OF 4" FROM THE WALL.
2. REMOVABLE POSTS SHALL HAVE 1" DIA. HOLES DRILLED THROUGH AT A DISTANCE 1/3 THE OVERALL POST LENGTH FROM TOP.
3. REMOVABLE POST - GRIND SMOOTH ALL SHARP EDGES PRIOR TO GALVANIZATION. GALVANIZE PER ASTM A54 AFTER FABRICATION.

DETAIL NO.

140



STANDARD DETAIL  
ENGLISH

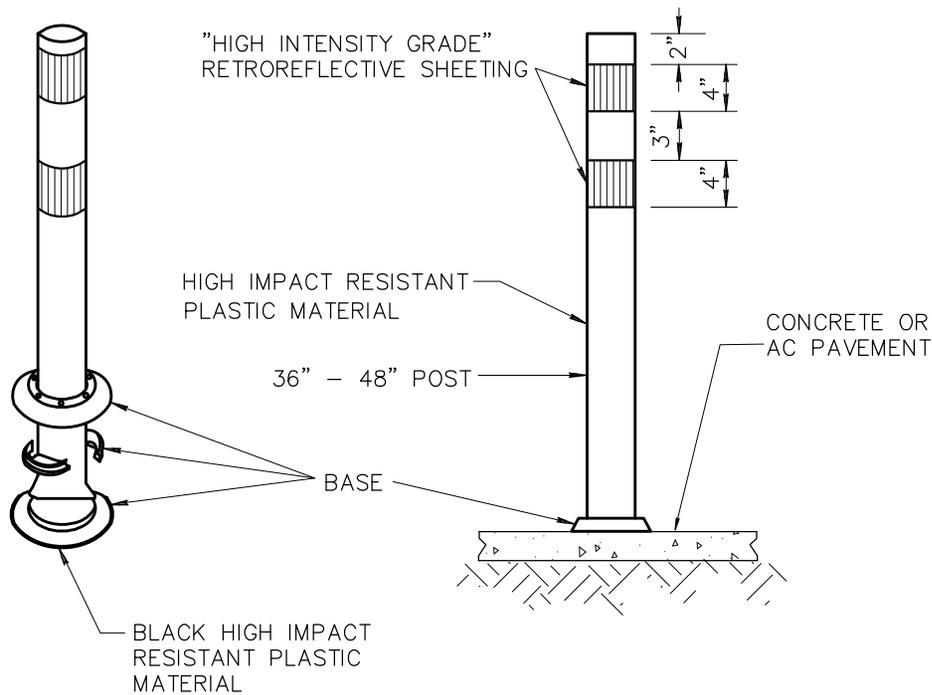
BOLLARD

REVISED

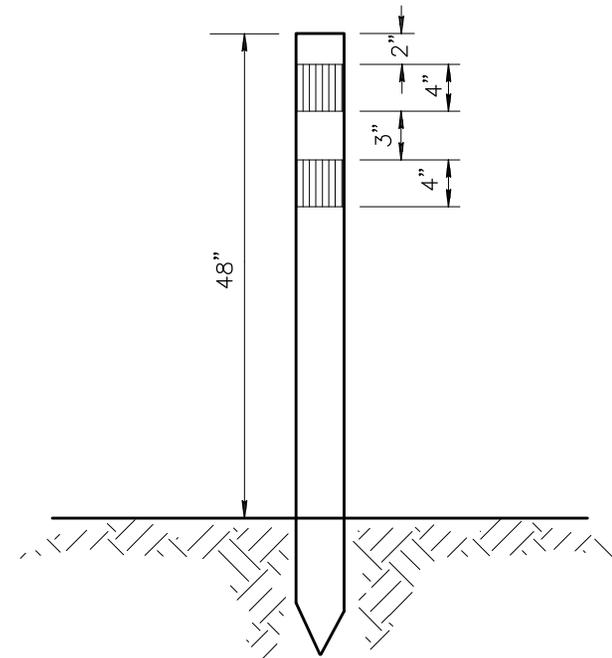
01-01-2009

DETAIL NO.

140



TYPE 1 SURFACE MOUNT



TYPE 2 GROUND MOUNT

NOTES

1. CONTRACTOR SHALL CLEAN ROADWAY SURFACE PRIOR TO PLACEMENT OF FLEXIBLE TUBULAR MARKER.
2. FLEXIBLE TUBULAR MARKERS SHALL BE CEMENTED TO THE PAVEMENT SURFACE WITH AN EPOXY ADHESIVE IN ACCORDANCE WITH THE TUBULAR MARKER MANUFACTURER'S SPECIFICATIONS.
3. YELLOW TUBULAR MARKERS SHALL HAVE A YELLOW POST AND YELLOW "HIGH INTENSITY GRADE" RETROREFLECTIVE SHEETING. ORANGE TUBULAR MARKERS SHALL HAVE AN ORANGE POST AND WHITE HIGH INTENSITY RETROREFLECTIVE SHEETING.
4. POST SHALL BE FLEXIBLE, HIGH IMPACT RESISTANT PLASTIC MATERIAL.

DETAIL NO.

141



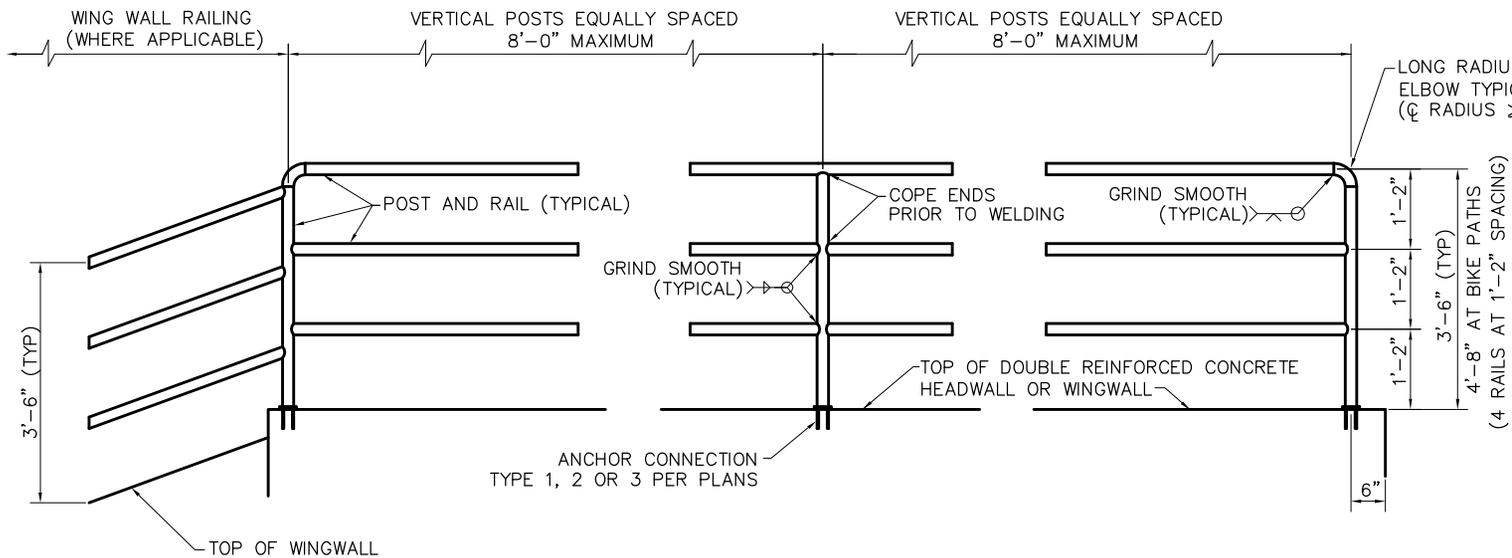
STANDARD DETAIL  
ENGLISH

HAZARD MARKER

REVISED  
01-01-2009

DETAIL NO.

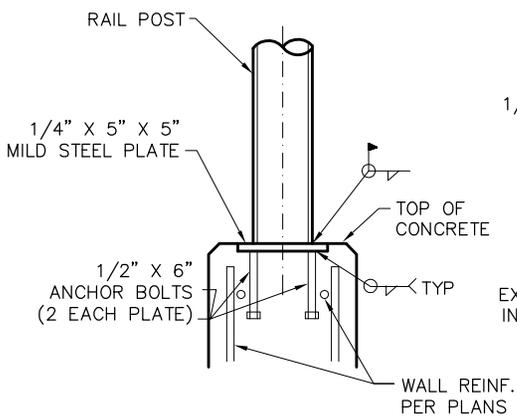
141



### ELEVATION

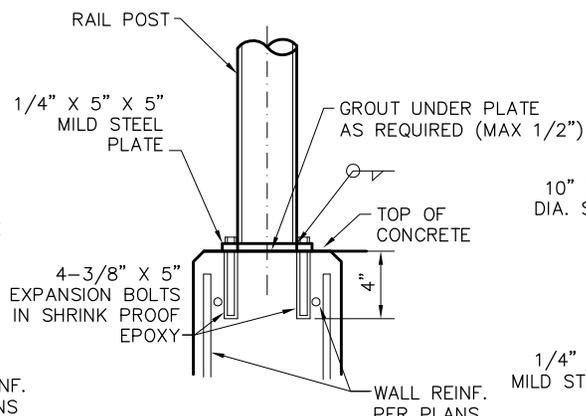
### NOTES:

1. POSTS AND RAILS SHALL BE 1.5" SCHEDULE 40 HOT-DIPPED GALVANIZED STEEL PIPE ASTM A 53, GRADE B (2.72 #/LF, 1.9" O.D.). GALVANIZING SHALL BE IN ACCORDANCE WITH SECTION 771.
2. PAINT RAIL PER MAG SPECIFICATIONS SECTION 530 WHEN REQUIRED BY PLANS. SHOP PRIME WITH RUST INHIBITING PRIMER (FIELD REPAIR PRIMER AS NEEDED). COLOR PER PLANS.
3. VERTICAL POSTS TO BE EVENLY SPACED.
4. REMOVE ALL SHARP EDGES.
5. INSTALL SAFETY RAIL AS REQUIRED BY PLANS OR SPECIFICATIONS.
6. THE EMBEDMENT FOR ANCHOR TYPES 1, 2 AND 3 SHALL BE LOCATED INSIDE THE WALL REINFORCEMENT CAGE.
7. SAFETY RAIL IS NOT TO BE USED AS A PEDESTRIAN BRIDGE RAIL.



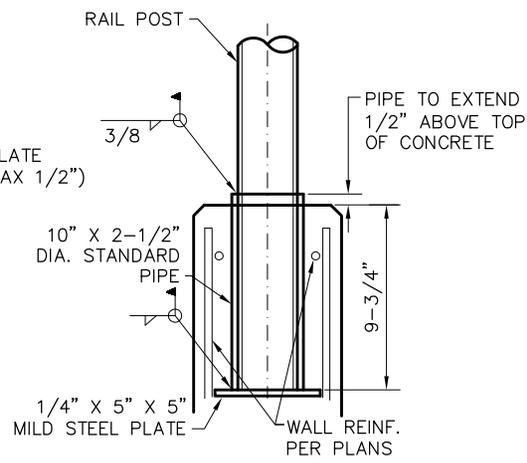
### TYPE 1

ANCHOR PLATE DETAIL



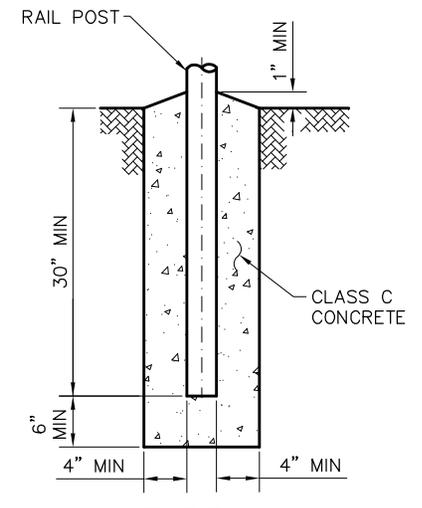
### TYPE 2

EXPANSION BOLT DETAIL



### TYPE 3

PIPE SLEEVE DETAIL



### TYPE 4

GROUND INSTALLATION DETAIL

**NOTE:** SEE PLANS FOR ANCHORAGE DETAILS FOR ATTACHMENT TO SINGULARLY REINFORCED AND NON-REINFORCED WALLS.

DETAIL NO.

145



STANDARD DETAIL  
ENGLISH

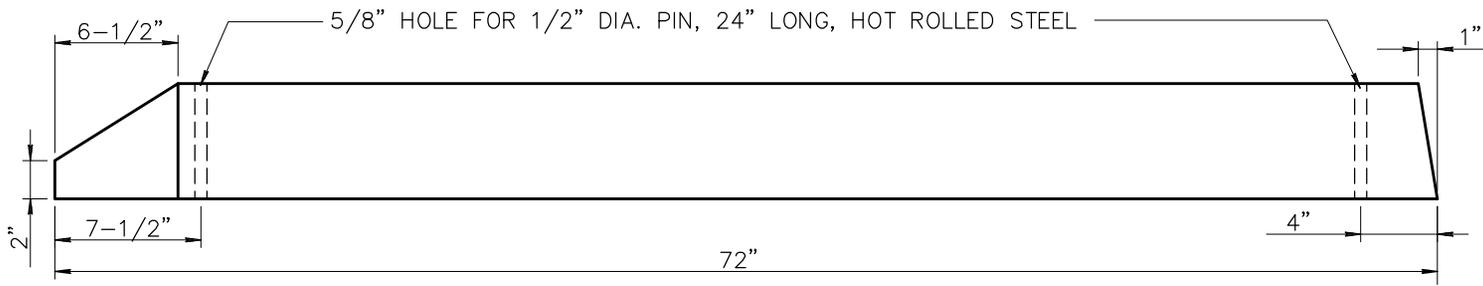
SAFETY RAIL

REVISED

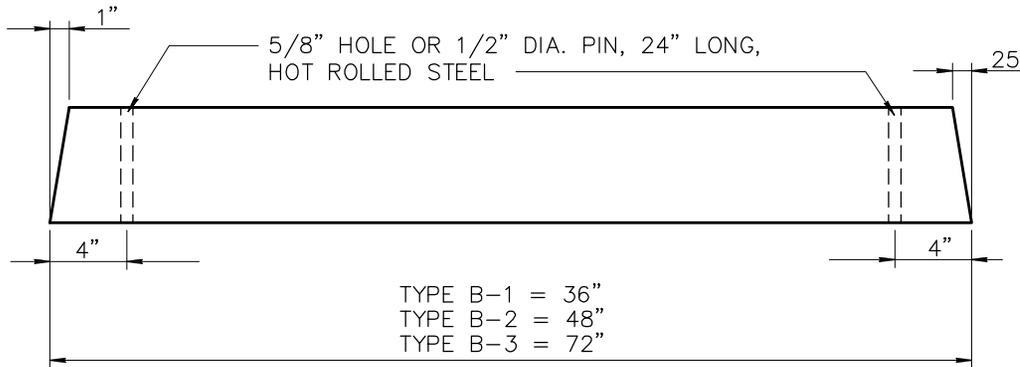
01-01-2011

DETAIL NO.

145



**TYPE A**

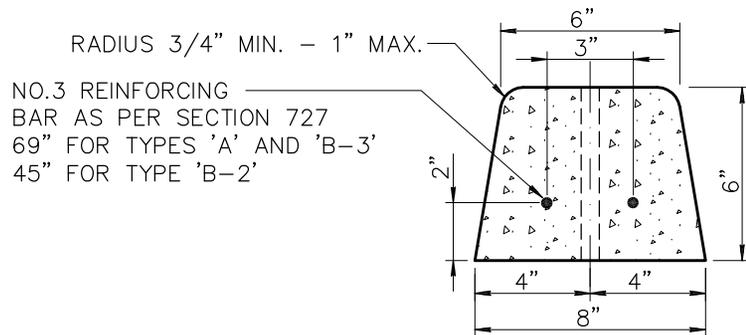


**TYPE B-1, B-2, AND B-3**

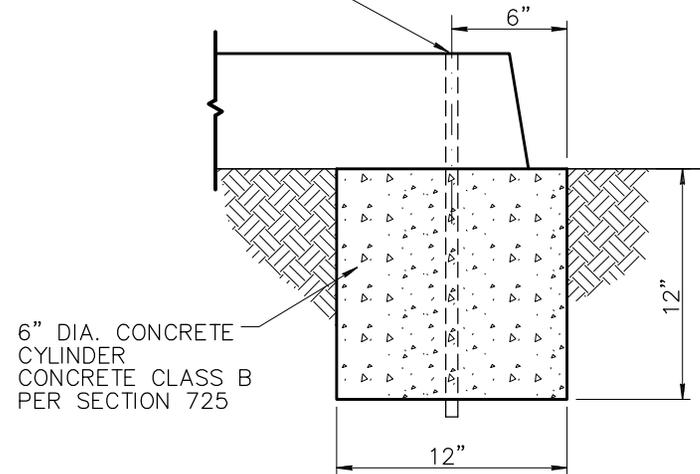
**NOTES:**

1. DIMENSIONAL AND REINFORCEMENT CHANGES WILL BE PERMITTED UPON PRIOR WRITTEN APPROVAL OF THE ENGINEER.
2. UNLESS OTHERWISE NOTED, CONCRETE SHALL BE CLASS 'A' PER SECTION 725.

1/2" DIA. PINS -  
24" LONG, HOT  
ROLLED STEEL



**TYPICAL SECTION**



**SAFETY CURB  
INSTALLATION ON DIRT**

DETAIL NO.

**150**



STANDARD DETAIL  
ENGLISH

**PRECAST SAFETY CURB**

REVISED

01-01-1998

DETAIL NO.

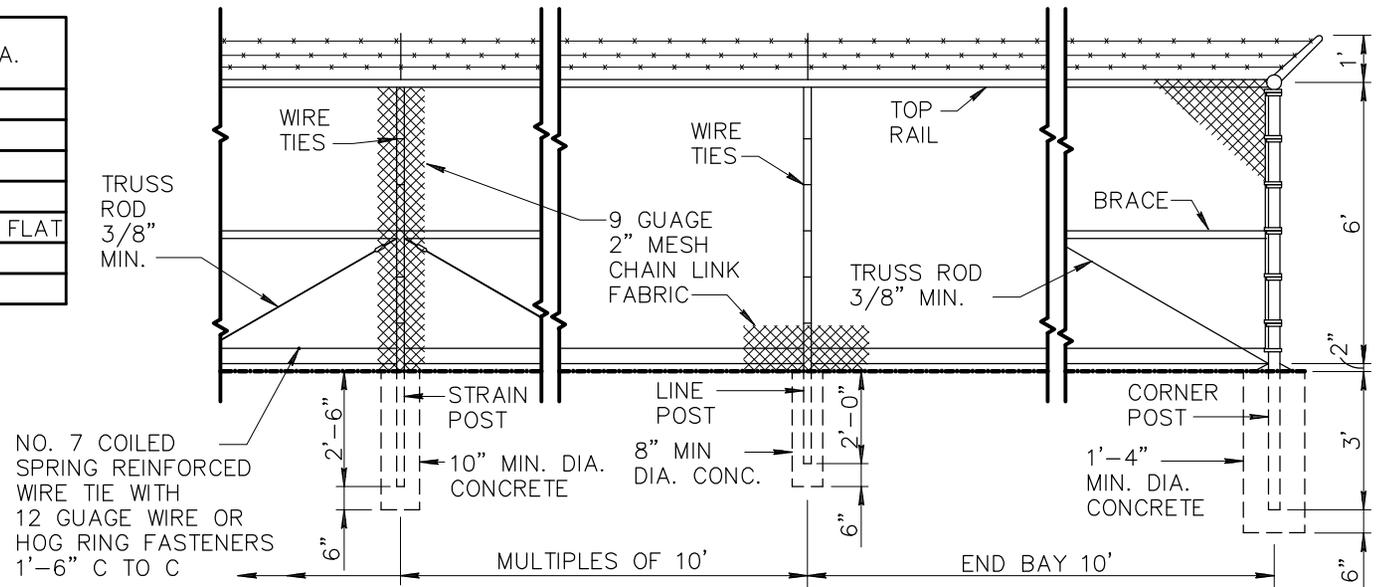
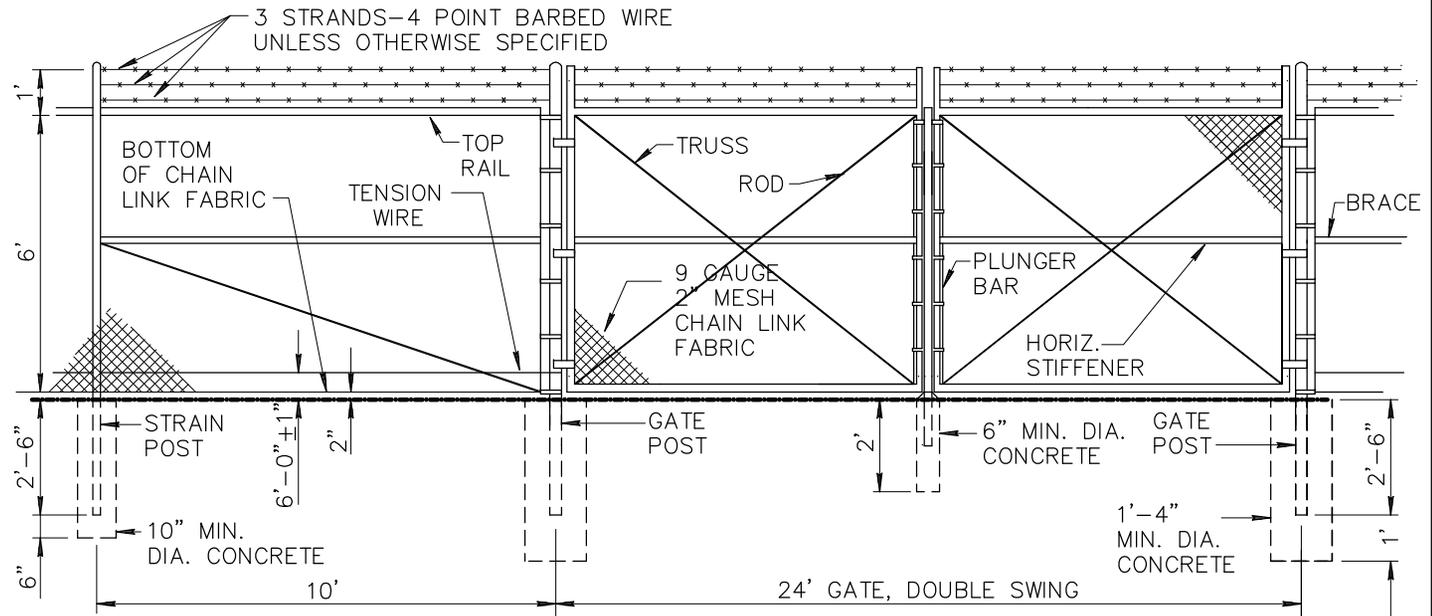
**150**

## NOTES

1. ALL CONCRETE SHALL BE CLASS 'C' PER SECT. 725.
2. FITTINGS NOT SPECIFICALLY DETAILED SHALL BE HEAVY DUTY DESIGN.
3. STRAIN POSTS SHALL BE SPACED AT 500' MAXIMUM SPACING.
4. BOTH CORNER AND STRAIN POSTS SHALL HAVE STRAIN PANELS.
5. ALL POSTS SHALL BE CAPPED.
6. MEMBER SIZES SHALL BE THE FOLLOWING:

MEMBER	AISC SIZE	OUTSIDE DIA.
CORNER POST	2-1/2"	2.875"
LINE POST	1-1/2"	1.900"
STRAIN POST	1-1/2"	1.900"
BRACE	1-1/4"	1.666"
STRETCH BAR	3/16"x3/4" FLAT	3/16"x3/4" FLAT
GATE POST	3-1/2"	4.000"
TOP RAIL	1-1/4"	1.666"

7. CONSTRUCTION AND MATERIALS SHALL CONFORM TO SECT. 420 AND 772, RESPECTIVELY. SEE TABLE 772-1 FOR WEIGHTS OF MEMBERS.



NO. 7 COILED SPRING REINFORCED WIRE TIE WITH 12 GAUGE WIRE OR HOG RING FASTENERS 1'-6" C TO C

DETAIL NO.

160



STANDARD DETAIL  
ENGLISH

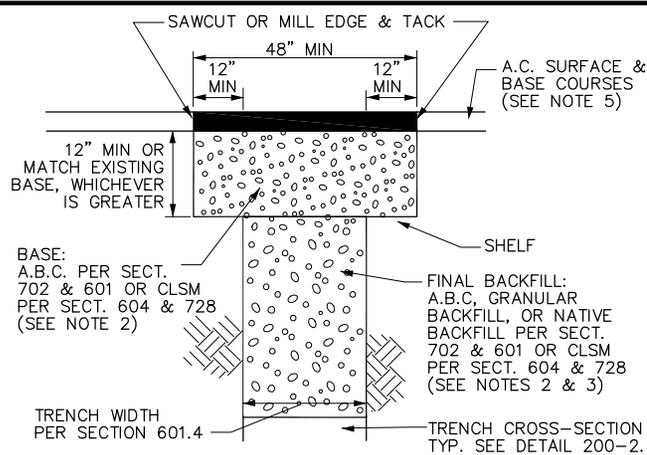
6' CHAIN LINK  
FENCE AND GATE

REVISED

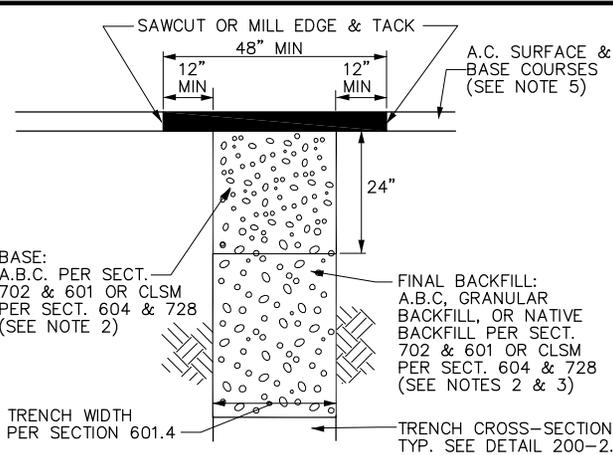
01-01-2013

DETAIL NO.

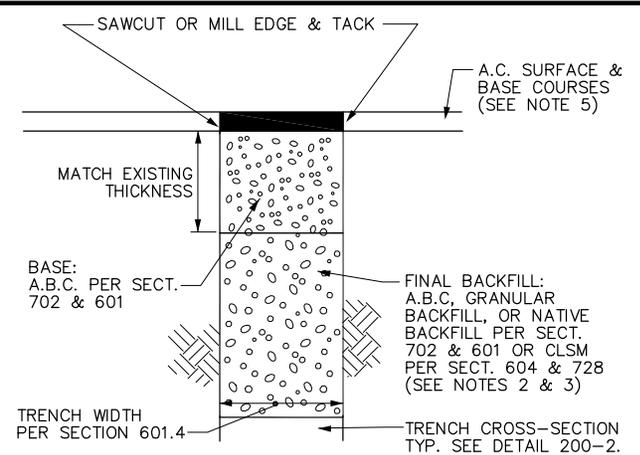
160



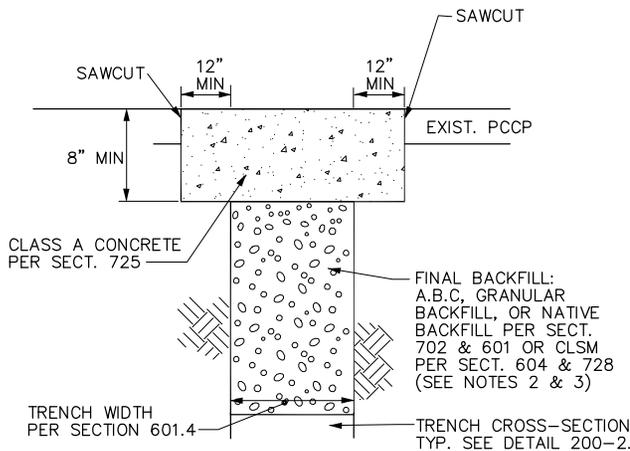
**"T TOP" TRENCH REPAIR**



**TYPE "A" TRENCH REPAIR**

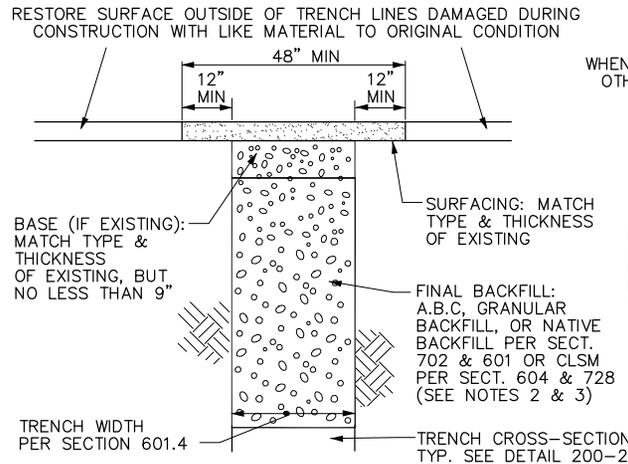


**TYPE "B" TRENCH REPAIR**



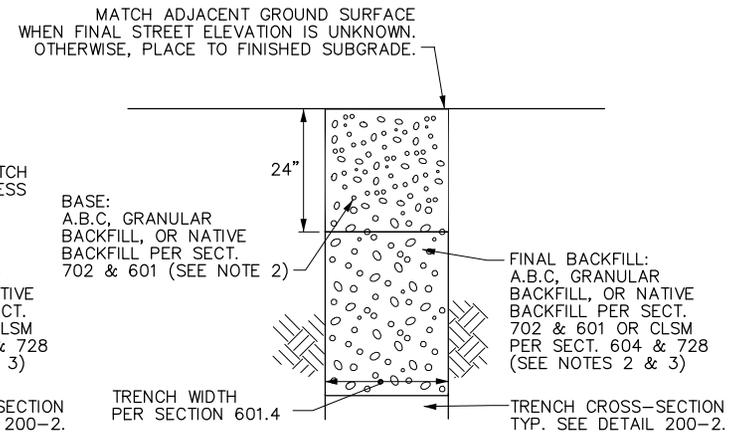
**TYPE "C" TRENCH REPAIR**

(TRENCH IN PORTLAND CEMENT CONCRETE PAVEMENT)



**TYPE "D" TRENCH REPAIR**

(TRENCH NOT UNDER CONCRETE OR ASPHALT PAVEMENT)



**TYPE "E" TRENCH REPAIR**

(TRENCH IN FUTURE ROADWAY PRISM OR ALLEY)

**NOTES:**

1. PAVEMENT MATCHING AND SURFACE REPLACEMENT SHALL BE IN ACCORDANCE WITH SECTION 336.
2. TYPE OF BACKFILL AND BASE (IF APPLICABLE) SHALL BE AS NOTED HEREIN UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. IF NOT SPECIFIED, CLSM SHALL BE 1/2-SACK PER SECTIONS 604 AND 728.
3. TRENCHES LESS THAN 24" WIDE SHALL BE BACKFILLED FROM TOP OF INITIAL BACKFILL TO BOTTOM OF SURFACING MATERIALS WITH 1/2-SACK CLSM PER SECTIONS 604 AND 728.
4. BASE, FINAL BACKFILL, AND PIPE EMBEDMENT ZONE COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH SECTION 601.
5. ASPHALT CONCRETE SURFACE AND BASE COURSES SHALL COMPLY WITH SECTION 336.2.4.1 UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS.
6. USE TYPE "A" FOR LONGITUDINAL TRENCH REPAIR AND USE "T-TOP" FOR TRANSVERSE TRENCH REPAIR (SEE DETAIL 200-2) UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. TYPE "B" TRENCH REPAIR MAY BE USED FOR TRANSVERSE TRENCH REPAIR IF SPECIFIED BY THE AGENCY.
7. PROVIDE MINIMUM 12" WIDE SHELF AS SHOWN IN "T-TOP" TRENCH REPAIR AT ENDS OF TYPE "A" TRENCH REPAIR EXCEPT WHERE EDGE ABUTS EXISTING CONCRETE.
8. USE "T-TOP" PAVEMENT REPLACEMENT WHERE A TRENCH IS NOT PARALLEL TO A STREET OR GOES THROUGH AN INTERSECTION.
9. SEE DETAIL 200-2 FOR REMNANT PAVEMENT REMOVAL REQUIREMENTS.
10. EXPOSED COPPER OR POLYETHYLENE WATER PIPE UP TO 2" IN DIAMETER IN TRENCHES TO BE BACKFILLED WITH CLSM SHALL BE WRAPPED WITH MINIMUM 3/4" THICK PREFORMED PIPE-COVERING FOAM INSULATION BEFORE PLACING CLSM.

DETAIL NO.  
200-1



STANDARD DETAIL  
ENGLISH

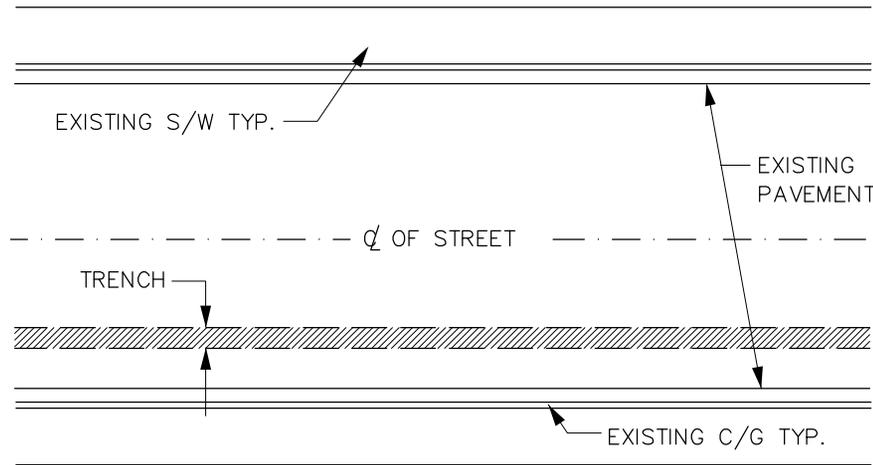
BACKFILL, PAVEMENT  
AND SURFACE REPLACEMENT

PROPOSED  
01-01-2015

DETAIL NO.  
200-1

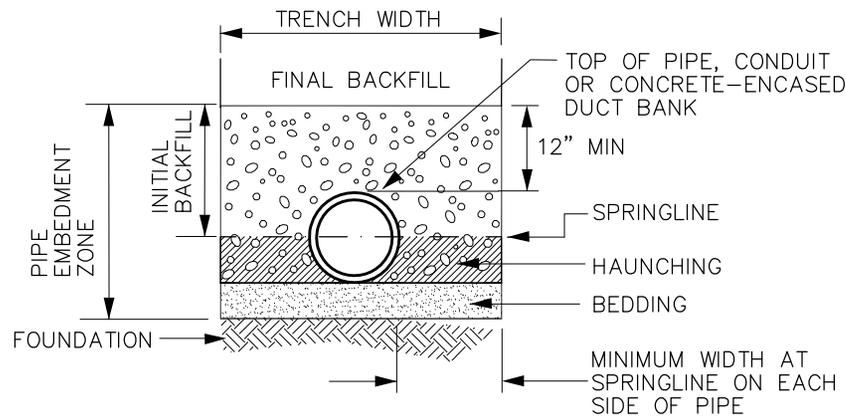
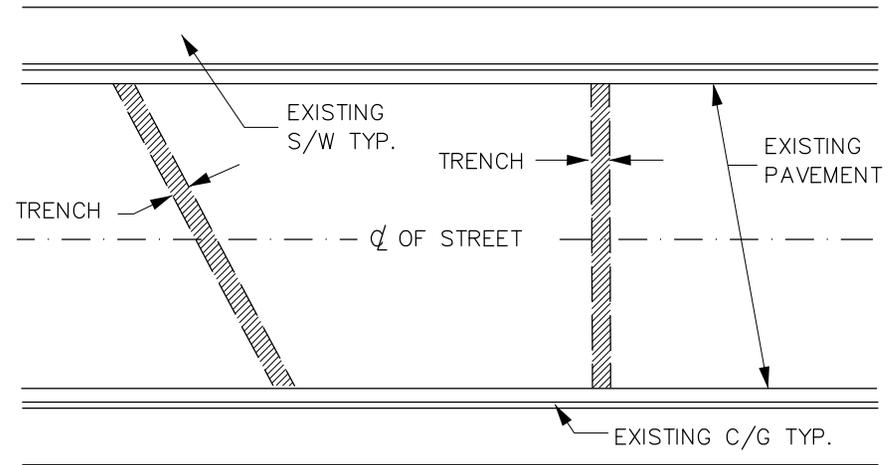
## LONGITUDINAL TRENCH

(TRENCH IN PAVEMENT PARALLEL TO TRAFFIC)

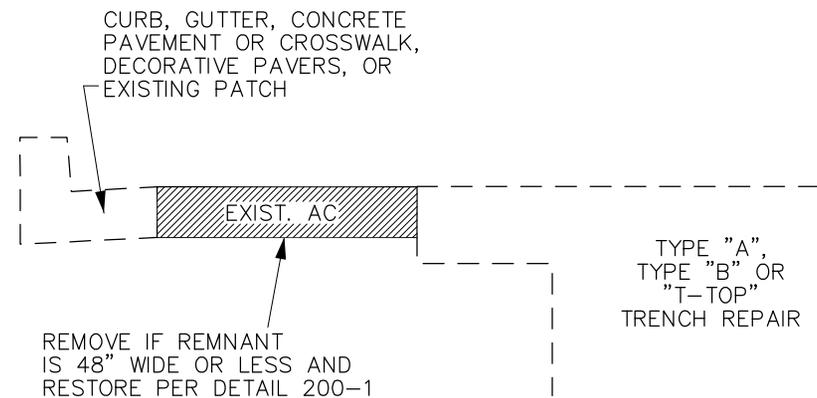


## TRANSVERSE TRENCH

(TRENCH IN PAVEMENT NOT PARALLEL TO TRAFFIC)



**TRENCH CROSS-SECTION DETAIL**



**REMNANT PAVEMENT REMOVAL**

### NOTES:

1. SEE SECTION 601 FOR TRENCH EXCAVATION, BACKFILLING AND COMPACTION REQUIREMENTS.
2. SEE MAG DETAIL 200-1 FOR DETAILED TRENCH REPAIR REQUIREMENTS FOR TRENCH TYPES NOTED HEREIN.
3. SEE MAG DETAIL 211 FOR REQUIREMENTS REGARDING THE USE OF PLATING TRANSVERSE TRENCHES. USE OF STEEL PLATES SHALL NOT EXCEED 72 HOURS AFTER COMPLETION OF BACKFILL AND PRIOR TO FINAL PATCHING.

DETAIL NO.  
200-2

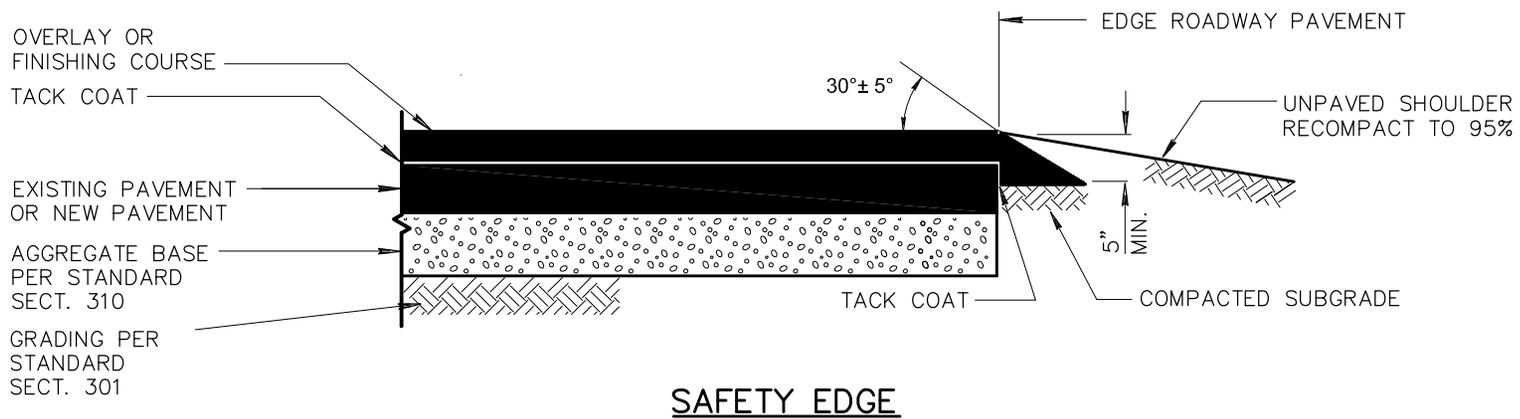
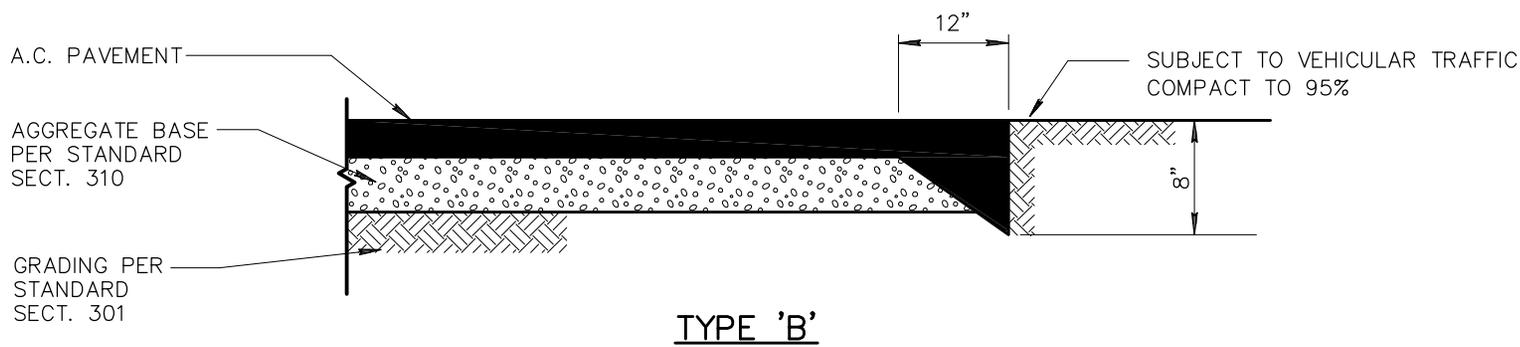
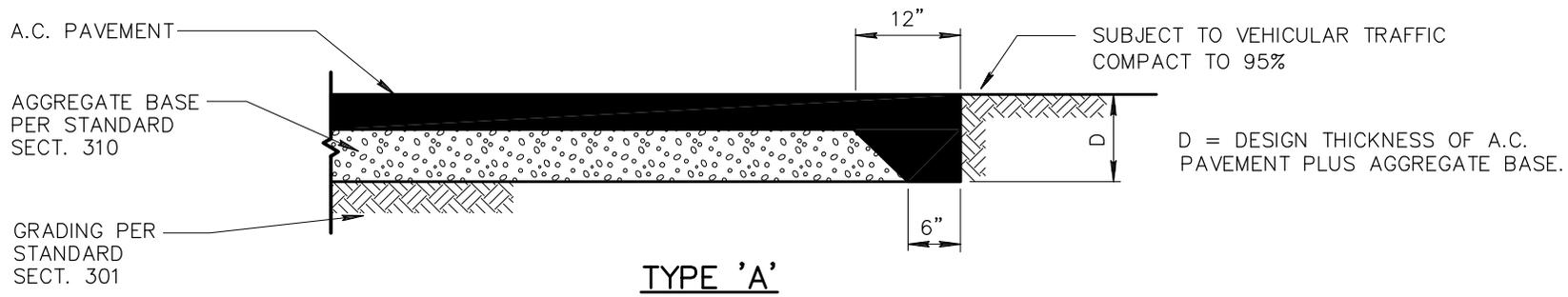


STANDARD DETAIL  
ENGLISH

BACKFILL, PAVEMENT AND  
SURFACE REPLACEMENT

PROPOSED  
01-01-2015

DETAIL NO.  
200-2



DETAIL NO.  
**201**

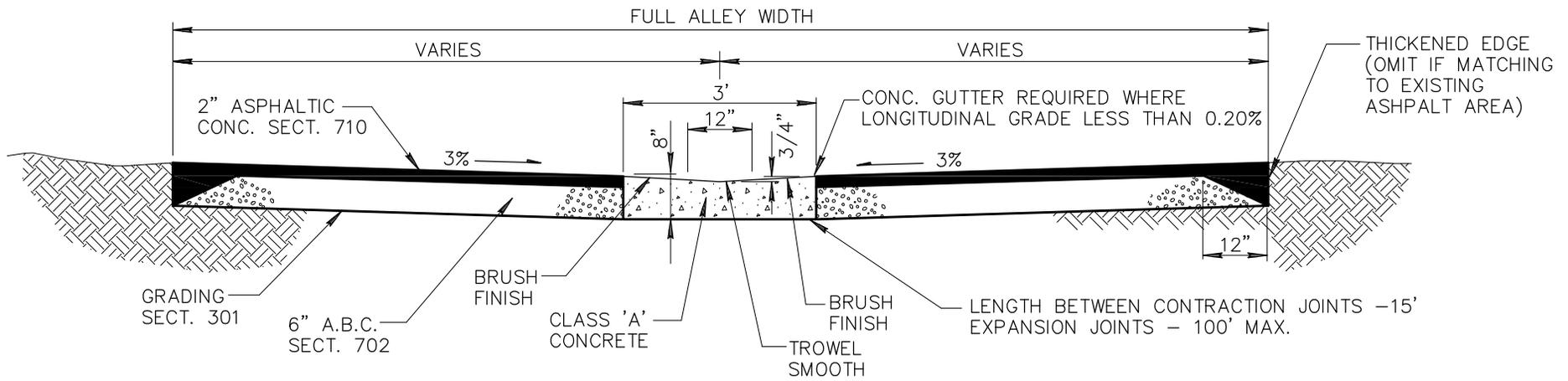


STANDARD DETAIL  
ENGLISH

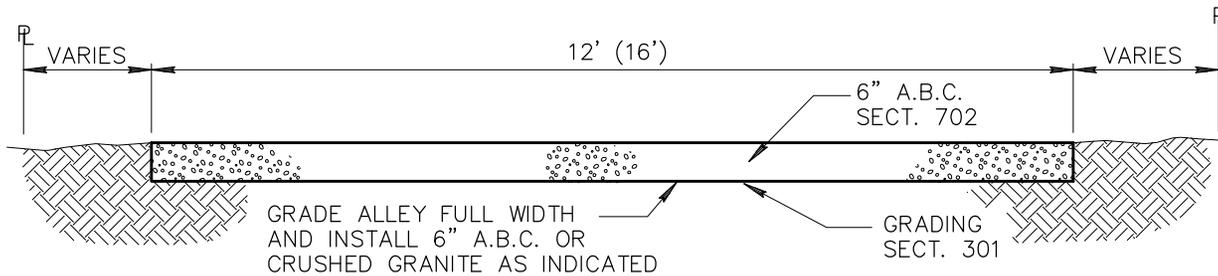
**ASPHALT PAVEMENT EDGE DETAILS**

DATE  
01-01-2014

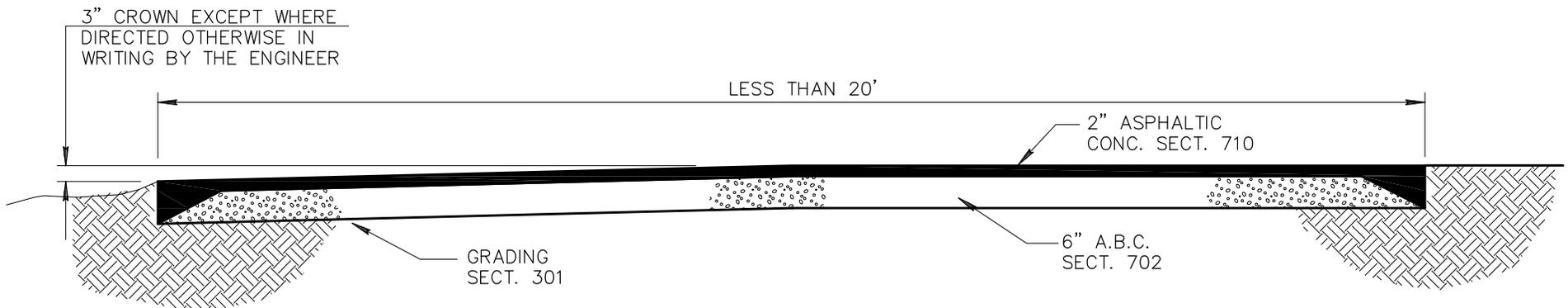
DETAIL NO.  
**201**



**PAVED ALLEY DETAIL**



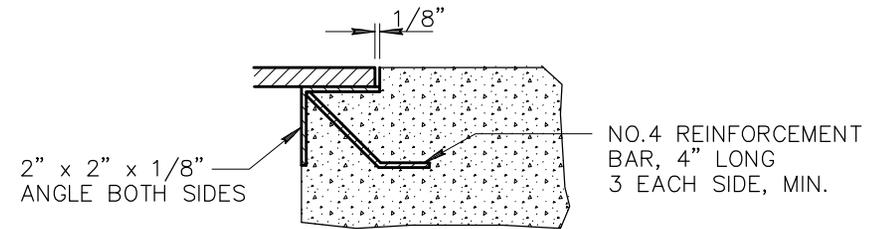
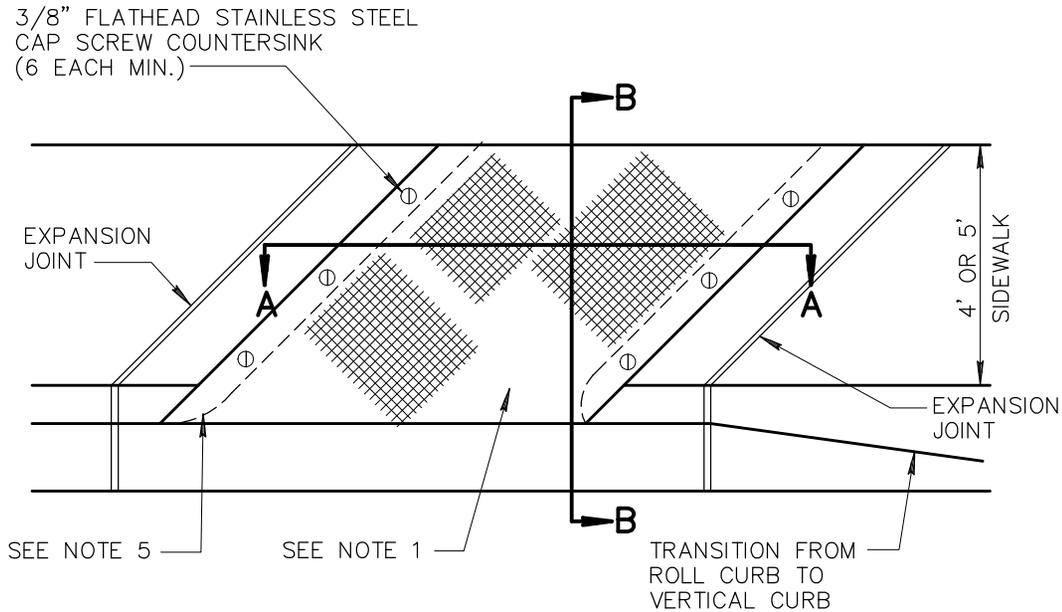
**UNPAVED ALLEY DETAIL**



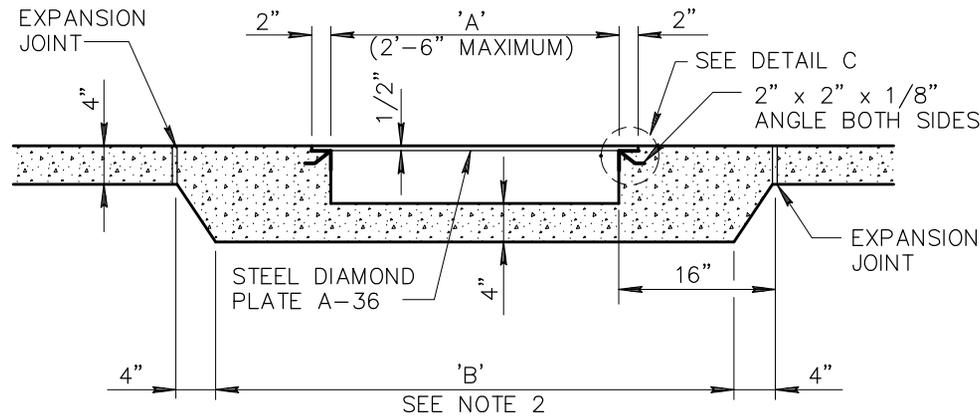
**RESIDENTIAL ALLEY DETAIL**

**NOTES:**

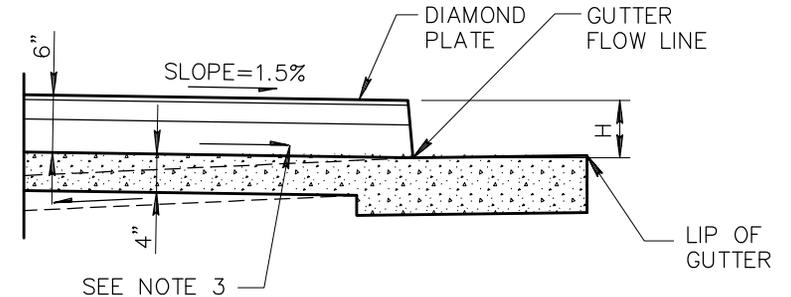
1. ANGLE EQUALS 45° UNLESS SPECIFIED ON PLAN.
2. DIMENSION 'B' EQUALS 'A' + 2'
3. ( ———> ) INDICATES DIRECTION OF FLOW.
4. PAINT STEEL ACCORDING TO SECTION 790. PAINT NUMBER 1-A OR 1-B.
5. R EQUALS 1" UNLESS OTHERWISE DIRECTED.
6. H EQUALS CURB FACE HEIGHT.
7. FOR ROLL CURB AND GUTTER, USE 2' TRANSITIONS TO VERTICAL CURB.
8. CONCRETE SHALL BE CLASS B PER SECT. 725 AND INSTALLED PER SECT. 505.



**DETAIL C**



**SECTION 'A-A'**



**SECTION 'B-B'**

DETAIL NO.

**203**



STANDARD DETAIL  
ENGLISH

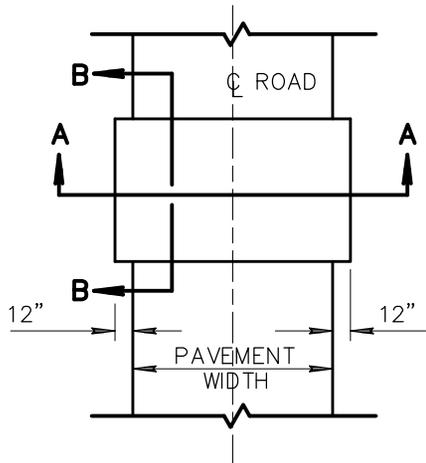
**SCUPPERS**

REVISED

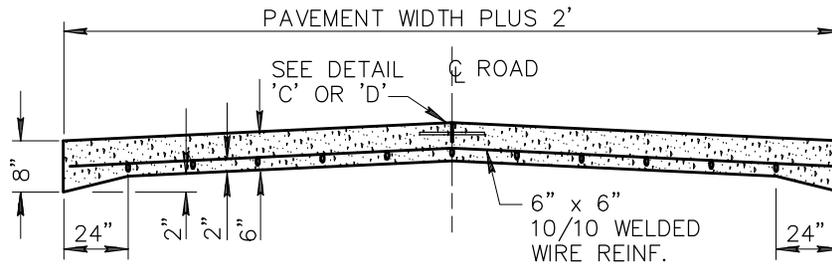
01-01-1998

DETAIL NO.

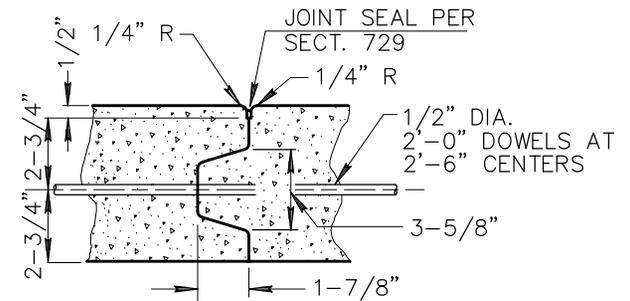
**203**



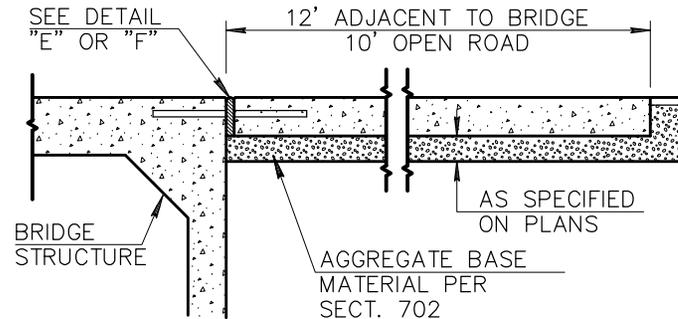
**PLAN OF CONCRETE EQUIPMENT CROSSING**



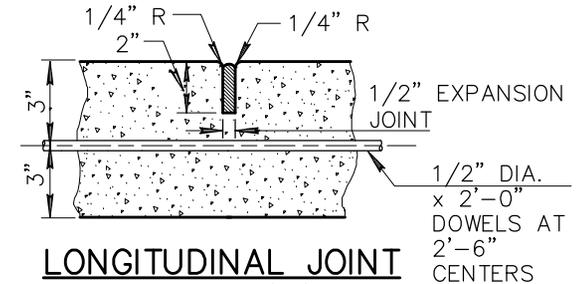
**SECTION A-A**



**LONGITUDINAL JOINT DETAIL 'C'**



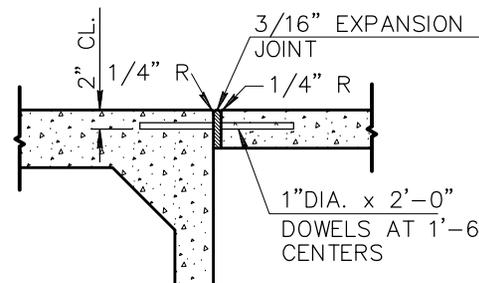
**SECTION B-B**



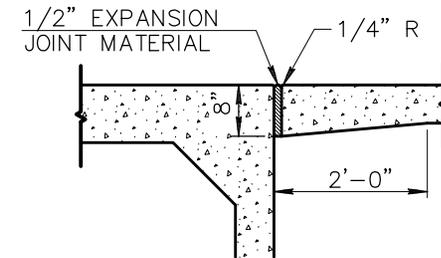
**LONGITUDINAL JOINT DETAIL 'D'**

**NOTES:**

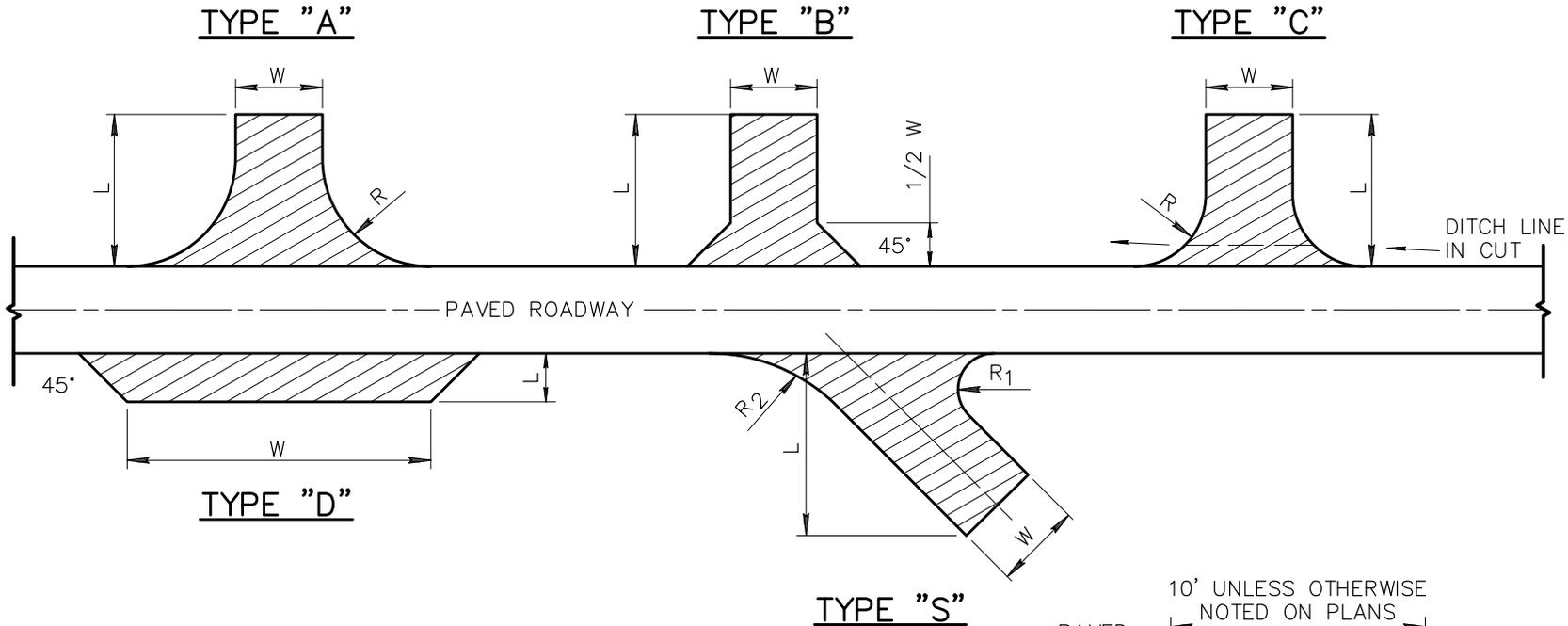
1. WHEN EQUIPMENT CROSSING LIES ADJACENT TO BRIDGE OR BOX CULVERT, CONSTRUCT THE EQUIPMENT CROSSING TO WIDTH OF BRIDGE ROADWAY.
2. ALL DOWELS IN CENTER JOINTS SHALL BE DEFORMED BARS AND SHALL HAVE UNBROKEN BOND. THEY SHALL BE HELD SECURELY IN PLACE, PARALLEL TO THE SUBGRADE AND PERPENDICULAR TO THE CENTER LINE OF THE ROAD.
3. THE EDGING TOOL USED FOR ALL LONGITUDINAL JOINTS SHALL BE SO CONSTRUCTED AS TO PROVIDE A SMOOTH TROWELED SURFACE 3" WIDE ON EACH SIDE OF THE JOINT.
4. IF APPROVED BY THE ENGINEER, OTHER DEFORMATIONS MAY BE USED IN LONGITUDINAL JOINT - DETAIL 'C'.
5. DETAIL 'C' TO BE USED ONLY WHEN FULL WIDTH CAN NOT BE POURED IN ONE POUR. USE DETAIL 'D' IF FULL WIDTH IS POURED IN ONE POUR.



**JOINT AT NEW BRIDGE DETAIL 'F'**

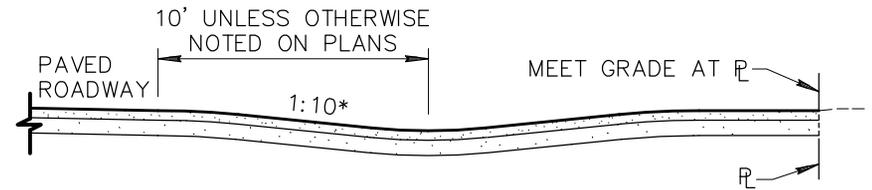


**JOINT AT EXISTING BRIDGE DETAIL 'E'**

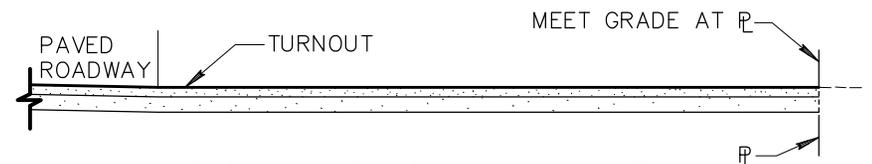


**NOTES:**

1. W - INDICATES WIDTH OF PAVED SURFACE OF TURNOUT.  
L - INDICATES LENGTH OF PAVED SURFACE OF TURNOUT.  
R - RADIUS.
2. SIZE AND TYPE OF TURNOUT SHALL BE NOTED ON PLANS AS FOLLOWS:  
90° - NO RADIUS: WxL-SURFACE-TYPE; (12' x 30'-A.C.-TYPE "B" TURNOUT),  
90° - WITH A RADIUS: WxLxR-SURFACE-TYPE; (12' x 20' x 15'-A.C.-TYPE "C"  
TURNOUT). OTHER THAN 90° WITH 2 RADII-TYPE "S": WxLxR<sub>1</sub> xR<sub>2</sub>-SURFACE-TYPE;  
(12' x 20' x 15'-A.C.-TYPE "S" TURNOUT).  
OR IT MAY BE NOTED ON PLANS IN CONVENTIONAL TERMS.
3. TURNOUTS TO BE STRAIGHT TYPE UNLESS OTHERWISE NOTED ON PLANS.
4. A.C. AND BASE MATERIAL THICKNESS FOR TURNOUTS SHALL BE THE SAME AS SHOWN ON THE ROADWAY SECTION, UNLESS OTHERWISE NOTED.
5. ANY EXCAVATION OR EMBANKMENT FOR TURNOUTS IS INCLUDED IN THE ROADWAY QUANTITIES.
6. TURNOUTS ARE TO BE PLACED WHERE SHOWN ON PLANS, OR AS DIRECTED BY THE ENGINEER.



**TYPICAL VALLEY GUTTER TURNOUT**



**TYPICAL STRAIGHT TURNOUT**

\* UNLESS OTHERWISE NOTED ON PLANS

DETAIL NO.

**205**



STANDARD DETAIL  
ENGLISH

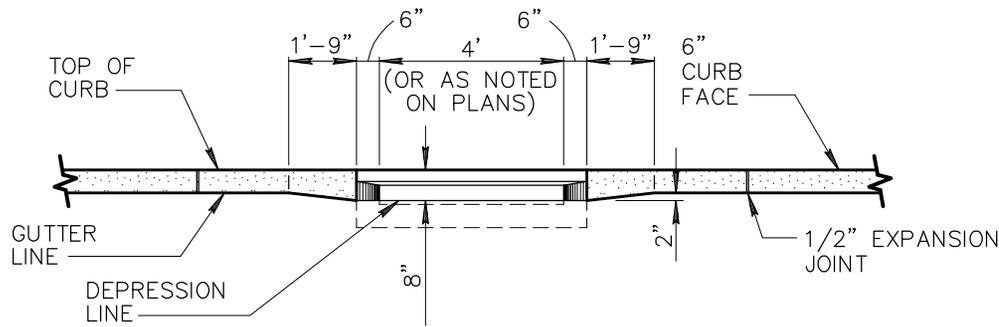
**PAVED TURNOUTS**

REVISED

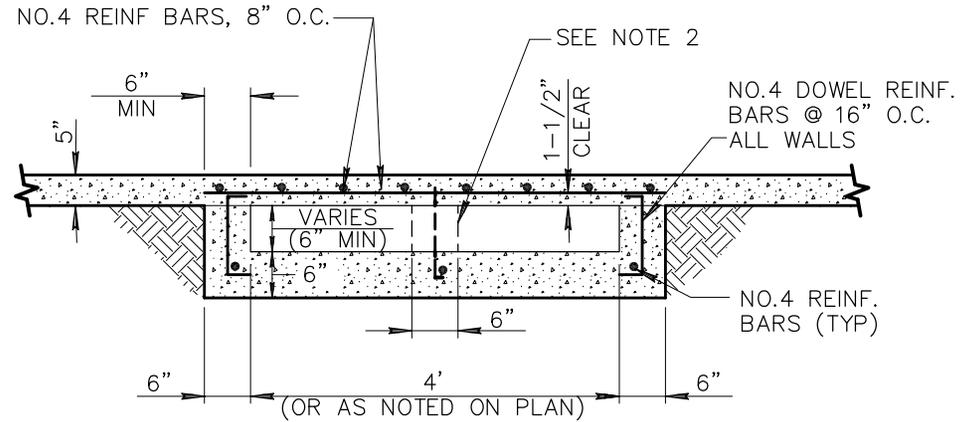
01-01-2006

DETAIL NO.

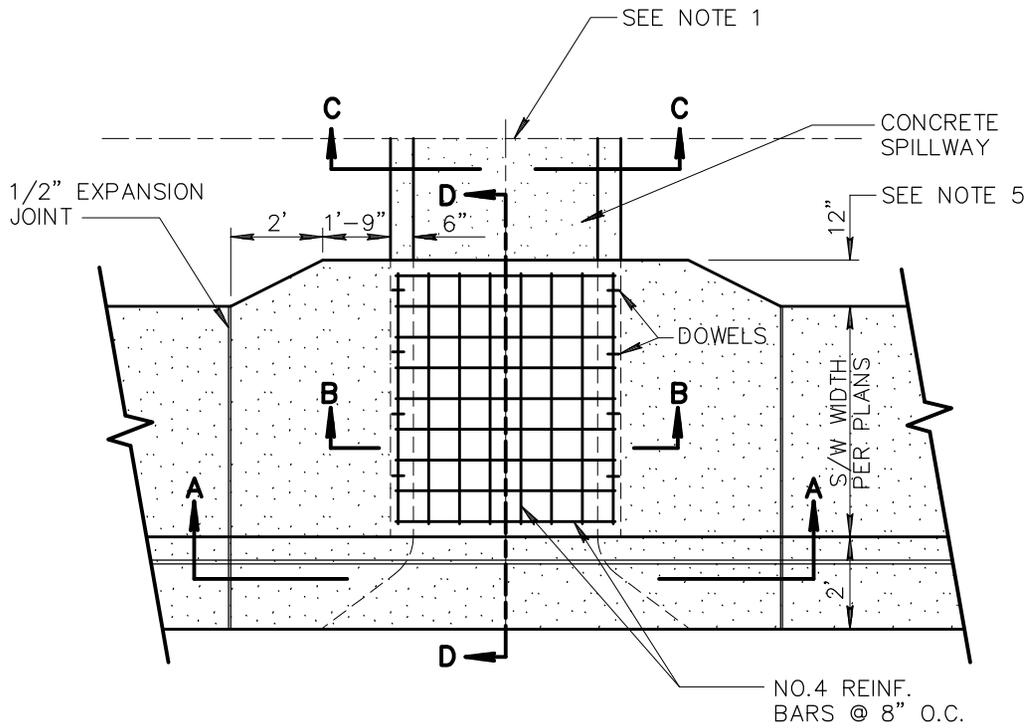
**205**



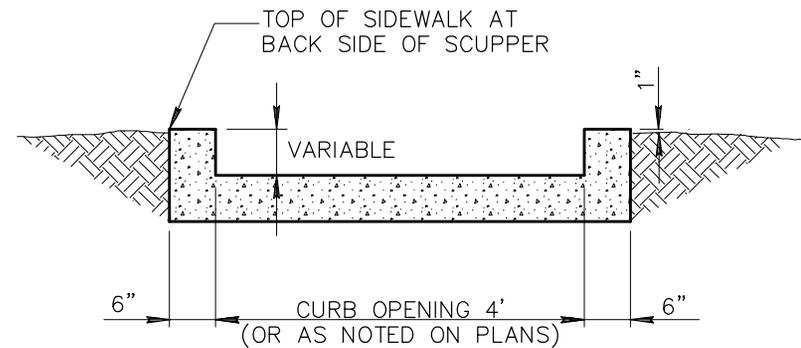
**SECTION A-A**



**SECTION B-B**



**SCUPPER PLAN VIEW**

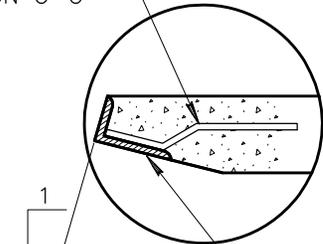


**SECTION C-C SPILLWAY**

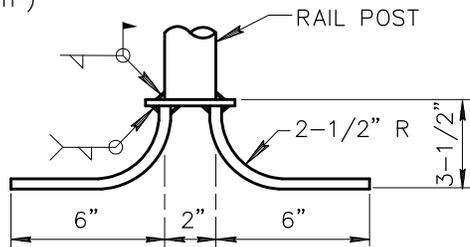
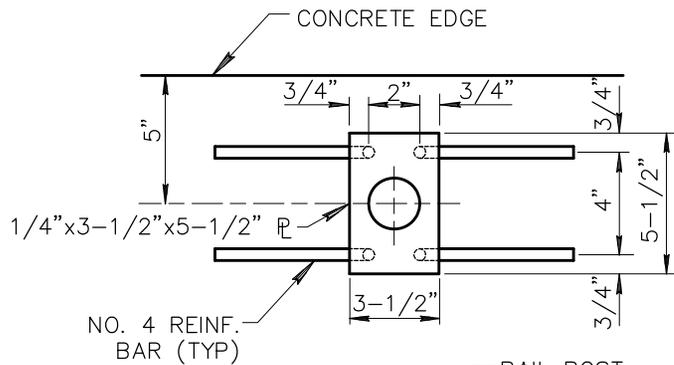
**NOTES:**

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A', PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. 12" OFFSET DISTANCE SHALL BE INCREASED TO 2'-6" FOR DESIGNATED BICYCLE PATHS.

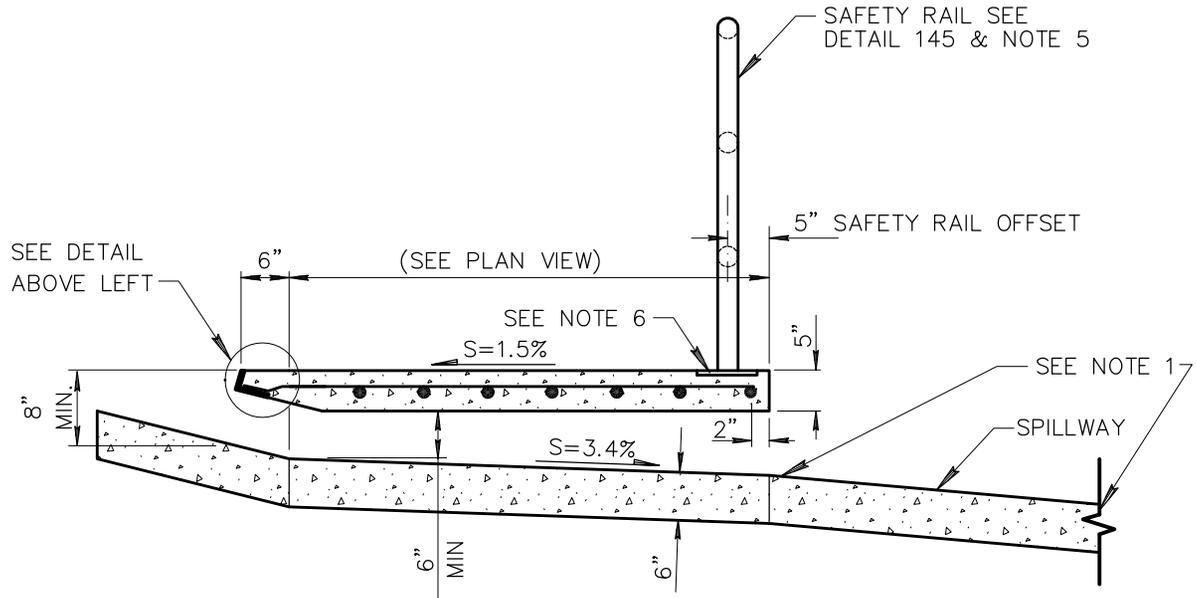
NO. 4 REINFORCEMENT  
WELDED TO ANGLE SEE  
DETAIL 536-1,  
SECTION C-C



1  
6  
NOSE ANGLE  
 $\angle 3" \times 4" \times 1/2"$   
STANDARD CURB BATTER



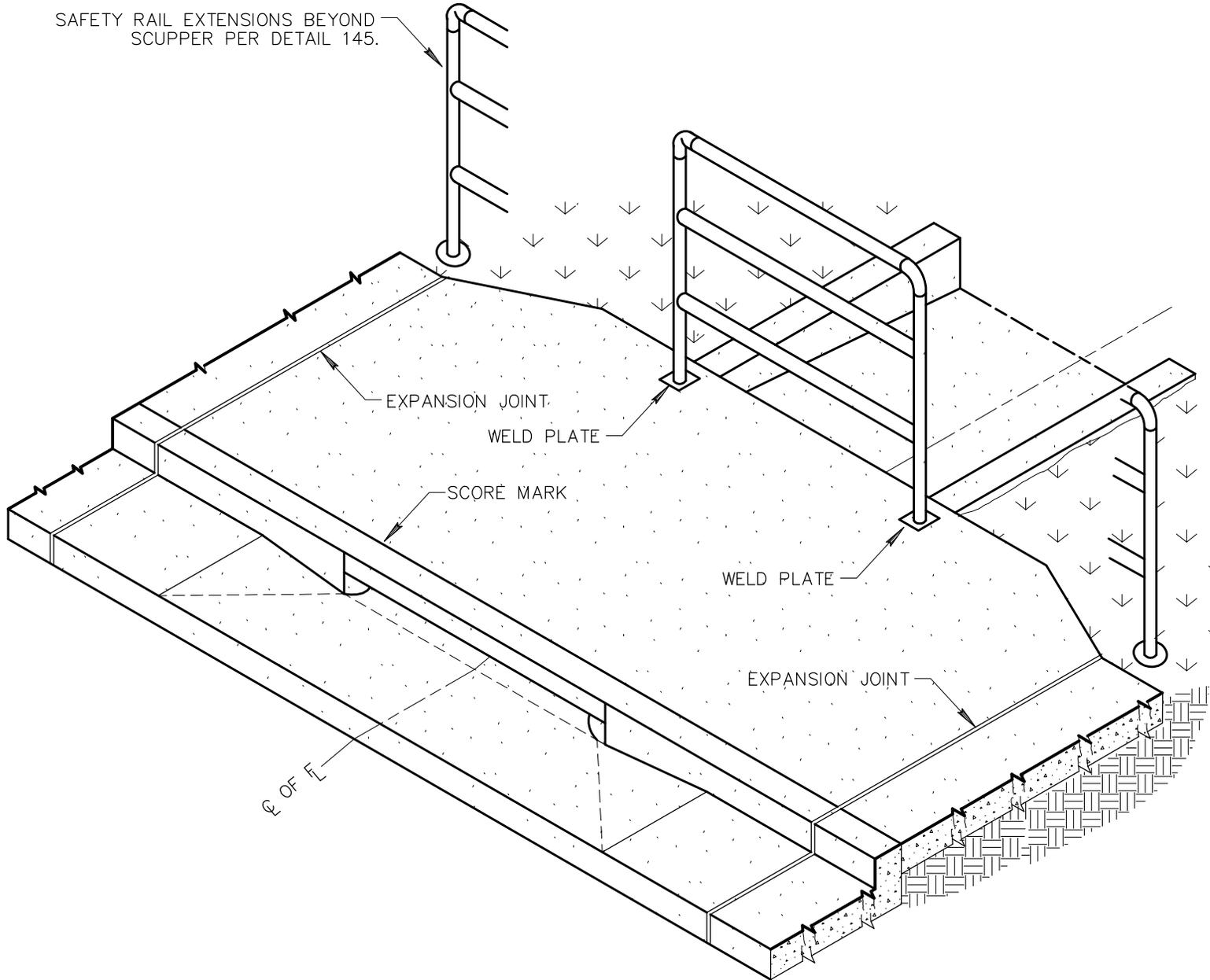
**WELD PLATE**



**SECTION D-D**

**NOTES:**

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A', PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. SAFETY RAIL SHALL BE CONTINUOUS BETWEEN THE SPILLWAY EXTERIOR WALLS.
6. USE WELD PLATES FOR SAFETY RAIL ANCHORS LOCATED IN THE 5" THICK CONCRETE.



SAFETY RAIL EXTENSIONS BEYOND SCUPPER PER DETAIL 145.

EXPANSION JOINT

WELD PLATE

SCORE MARK

WELD PLATE

EXPANSION JOINT

E OF F

DETAIL NO.  
206-3

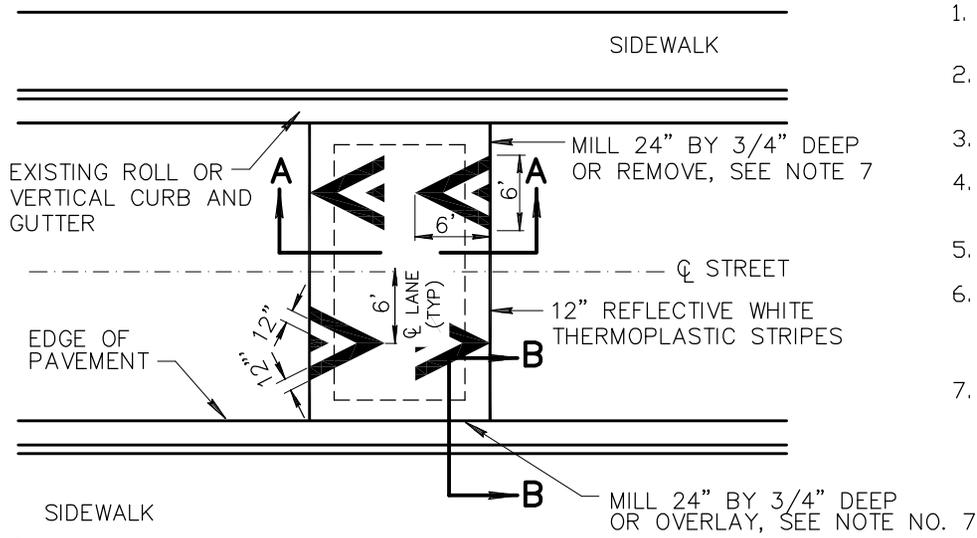


STANDARD DETAIL  
ENGLISH

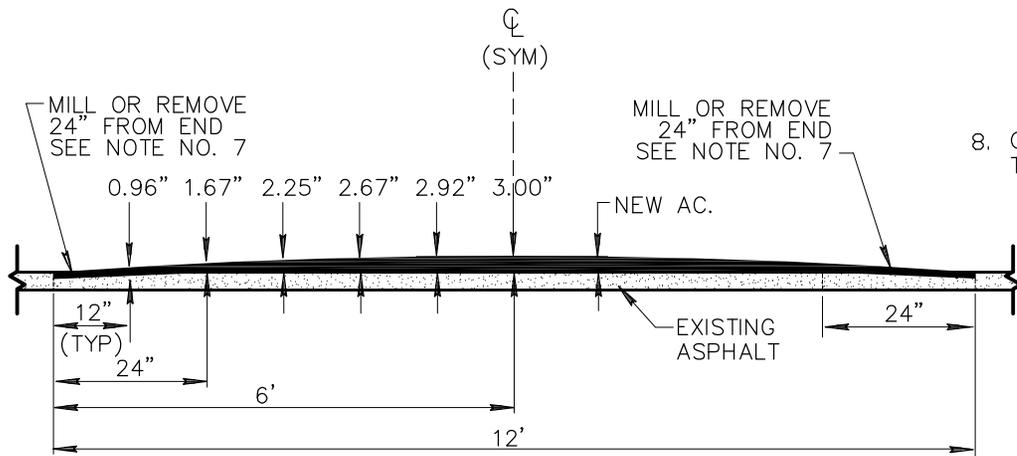
CONCRETE SCUPPER

REVISED  
01-01-2007

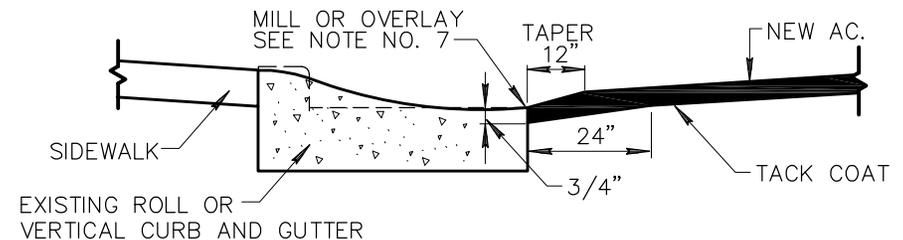
DETAIL NO.  
206-3



**PLAN VIEW**



**SECTION A-A**



**SECTION B-B**

**NOTES:**

1. HUMPS MUST BE THE FULL 3" FOR MAXIMUM EFFECT BUT SHALL NOT EXCEED 3.25".
2. HUMPS CONSTRUCTED OVER 3.25" OR LESS THAN 3.00" SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE.
3. CROSS-SECTION ELEVATIONS SHALL HAVE A MAXIMUM TOLERANCE OF +0.25".
4. SPEED HUMPS SHALL NOT BE PLACED OVER MANHOLES, WATER VALVES, SURVEY MONUMENTS, JUNCTION CHAMBERS, ETC. OR IN CONFLICT WITH DRIVEWAYS.
5. SPEED HUMPS MUST BE PLACED AT LOCATIONS APPROVED BY THE AGENCY.
6. HUMP TO BE CONSTRUCTED WITH ASPHALT MIX APPROVED BY THE AGENCY. ASPHALT COMPACTION SHALL BE PER SECTION 321. A TACK COAT PER SECTION 713 SHALL BE APPLIED PRIOR TO APPLICATION OF PAVEMENT.
7. INSTALLATION JOINTS:
  - A. STANDARD INSTALLATION:  
THE EXISTING ROADWAY SHALL BE MILLED TO A MINIMUM DEPTH OF 3/4" AROUND THE PERIMETER. CROSS SECTION DIMENSIONS DO NOT INCLUDE THE 3/4" MILLING. CONTRACTOR MUST PROVIDE VERIFICATION OF CROSS-SECTION DIMENSIONS.
  - B. ALTERNATIVE INSTALLATION:  
FOR TRANSVERSE JOINTS (CROSS ROADWAY), THE EXISTING ASPHALT SHALL BE SAW CUT AND REMOVED FOR A WIDTH OF 24". THE ASPHALT SHALL BE REPLACED WITH THE SAME ASPHALT AND AT THE SAME TIME AS THE HUMP ASPHALT. FOR LONGITUDINAL JOINTS, THE EXISTING ASPHALT SHALL BE OVERLAID AND TAPERED IN 12". CROSS-SECTION DIMENSIONS REFLECT DISTANCES FROM THE SURFACE OF EXISTING ASPHALT.
8. CONTACT THE AGENCY (OR INSPECTOR) ONE WEEK PRIOR TO INSTALLATION TO COORDINATE PAVEMENT MARKINGS AND SIGNING.

DETAIL NO.

**210**



STANDARD DETAIL  
ENGLISH

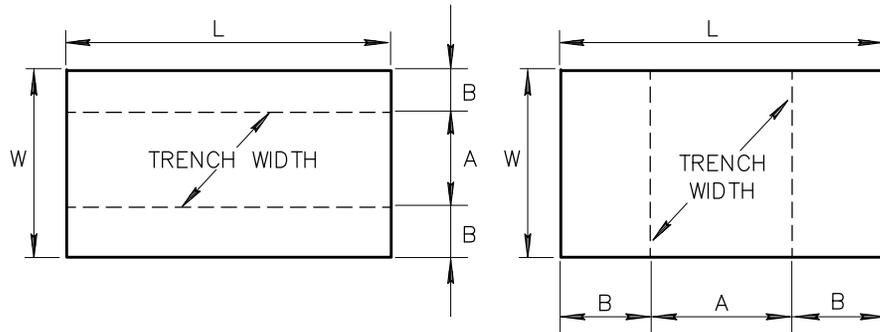
**RESIDENTIAL SPEED HUMP**

REVISED

01-01-2012

DETAIL NO.

**210**



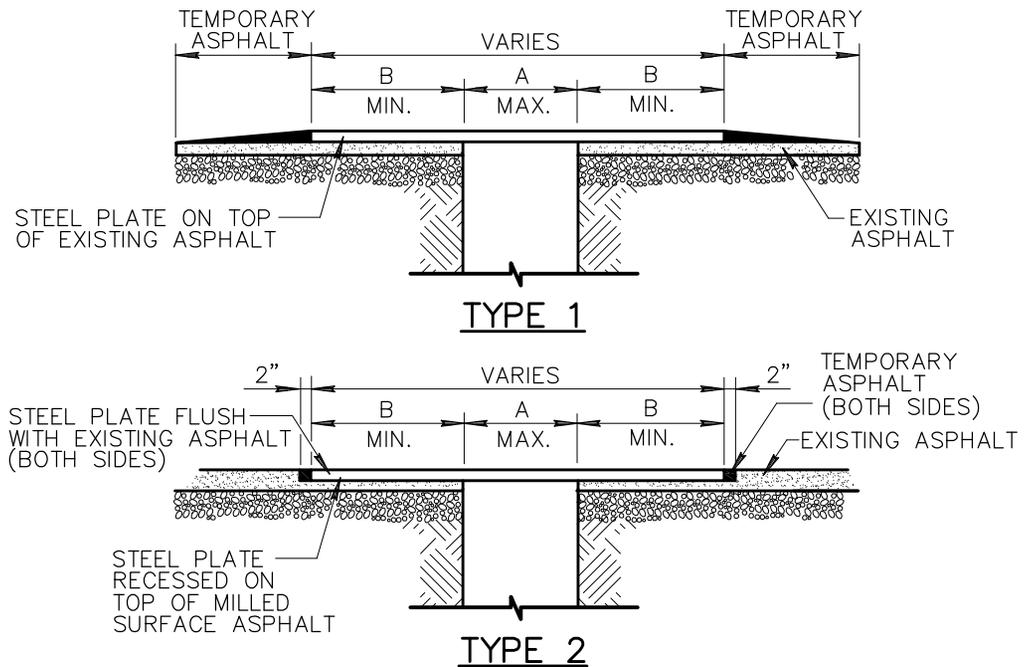
LONGITUDINAL STEEL PLATE

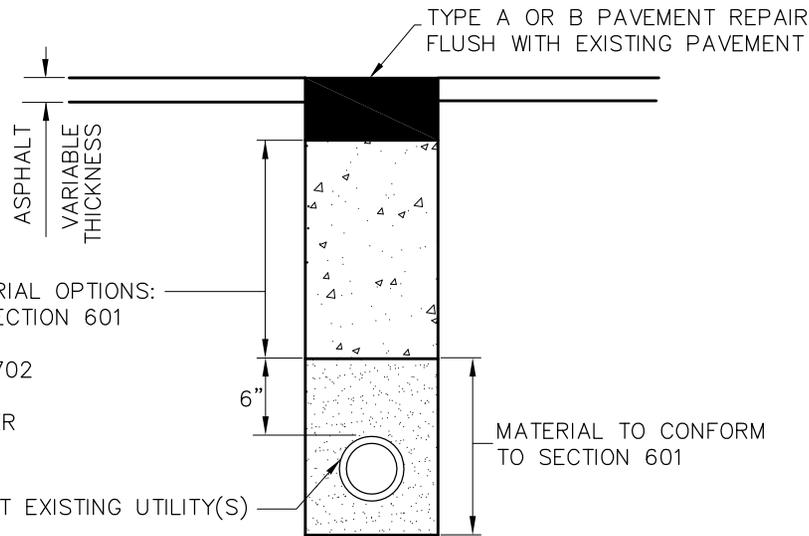
TRANSVERSE STEEL PLATE

PLATE SIZE						
LONGITUDINAL					TRANSVERSE	
(A)	(B)	THICKNESS	(W)	(L)	(A)	(B)
12"	18"	1"	4'	8'	58"	19"
12"	18"	1"	4'	10'	58"	31"
24"	18"	1"	5'	10'	70"	25"
36"	18"	1"	6'	10'	44"	38"
48"	18"	1"	7'	10'	52"	34"
60"	18"	1"	8'	10'	58"	31"
12"	18"	1-1/4"	4'	15'	88"	47"
24"	18"	1-1/4"	5'	12'	104"	20"
36"	18"	1-1/4"	6'	12'	66"	39"
36"	18"	1-1/4"	6'	16'	66"	63"
48"	18"	1-1/4"	7'	12'	76"	33"
48"	18"	1-1/4"	7'	16'	76"	58"
60"	18"	1-1/4"	8'	12'	86"	29"
60"	18"	1-1/4"	8'	15'	86"	47"
60"	18"	1-1/4"	8'	16'	86"	63"
60"	18"	1-1/4"	8'	20'	86"	77"
60"	18"	1-3/8"	8'	20'	102"	69"

**NOTES:**

1. USE TYPE 1 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS LESS THAN 30 MPH. USE TYPE 2 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS 30 MPH OR GREATER.
2. FOR TYPE 2 PLATE INSTALLATION, THE STEEL PLATE SHALL BE RECESSED BY MILLING INTO THE EXISTING ASPHALT TO SET FLUSH WITH THE SURFACE OF THE EXISTING ASPHALT. FULL DEPTH CUTTING OF PAVEMENT SECTION OUTSIDE OF TRENCH IS NOT PERMITTED. MILLING DEPTH SHALL MATCH THICKNESS OF PLATE. THE GAP BETWEEN THE EDGE OF THE PLATE AND THE ADJACENT EXISTING ASPHALT PAVEMENT MUST BE FILLED WITH TEMPORARY ASPHALT.
3. TRENCH WIDTHS ARE BASED ON AN ANALYSIS PER THE 14TH EDITION OF STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES BY AASHTO. AN ASSUMED AXLE LOADING OF 12 TONS WITH A 30% IMPACT FACTOR WAS USED. THE AXLE LENGTH IS 6 FEET; THEREFORE THE NUMBER OF WHEELS CARRIED BY A PLATE DEPENDS ON THE ROADWAY WIDTH.
4. STEEL PLATE MUST BE ABLE TO WITHSTAND H-20 TRAFFIC LOADINGS WITHOUT ANY MOVEMENT.
5. PLATES SHALL BE FABRICATED FROM ASTM A36 STEEL (MIN).
6. PLATES SHALL BE SECURED FROM LATERAL MOVEMENT AND VERTICAL VIBRATION (ASSOCIATED NOISE) WHILE IN USE BY TEMPORARY ASPHALT (COLD MIX.)

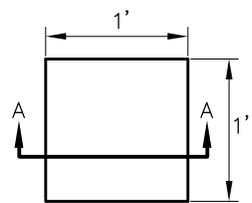




- FINAL BACKFILL MATERIAL OPTIONS:
- NATIVE SOIL PER SECTION 601 (TYPE B ONLY)
  - ABC PER SECTION 702 (TYPE B ONLY)
  - 1/2-SACK CLSM PER SECTION 728

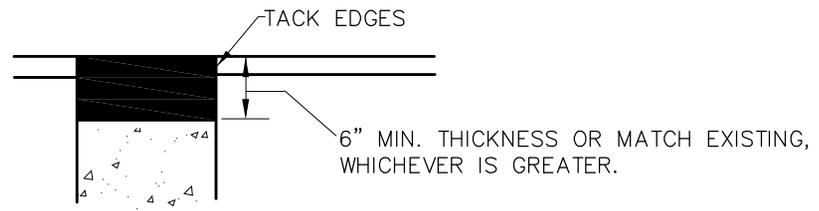
**SECTION VIEW**

**TYPE A PAVEMENT REPAIR**



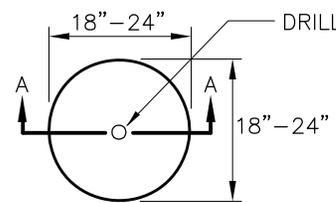
- NOTES:
1. DIMENSIONS ARE NOMINAL.
  2. EDGES SHALL BE CUT TO A NEAT VERTICAL FACE.
  3. PLACE CLSM BACKFILL IN ACCORDANCE WITH SECTION 604.
  4. PLACE AGENCY-APPROVED ASPHALT CONCRETE IN MAXIMUM 2" LIFTS.

**PLAN VIEW**



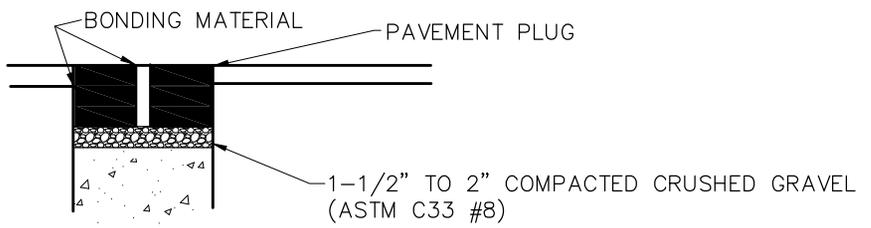
**SECTION A-A**

**TYPE B PAVEMENT REPAIR**

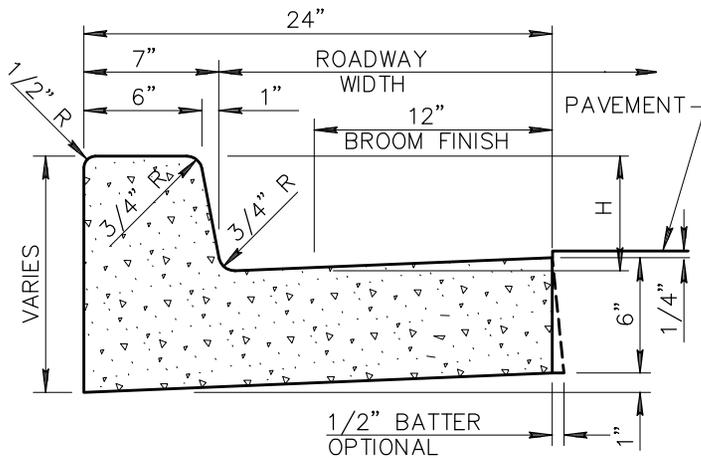


- NOTES:
1. CUT, REMOVE AND REPLACE PAVEMENT. PLUG IN ACCORDANCE WITH SECTION 355.
  2. PLACE BACKFILL IN ACCORDANCE WITH SECTION 355.
  3. BONDING MATERIAL SHALL BE AS SPECIFIED IN SECTION 708.

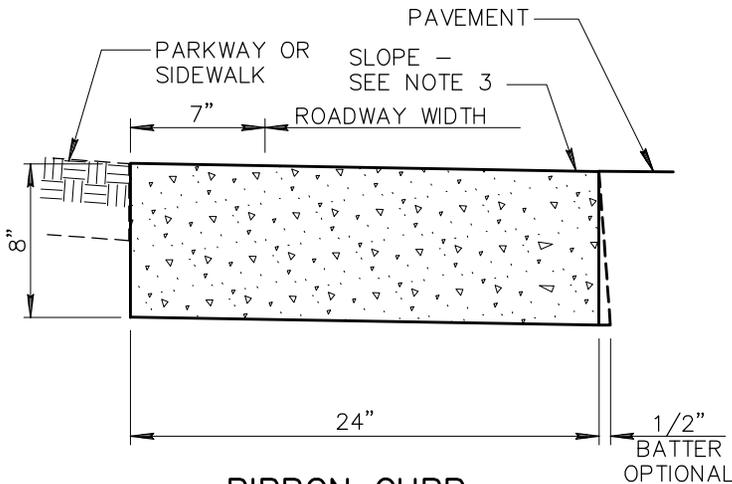
**PLAN VIEW**



**SECTION A-A**



**VERTICAL CURB AND GUTTER  
(TYPE A)**



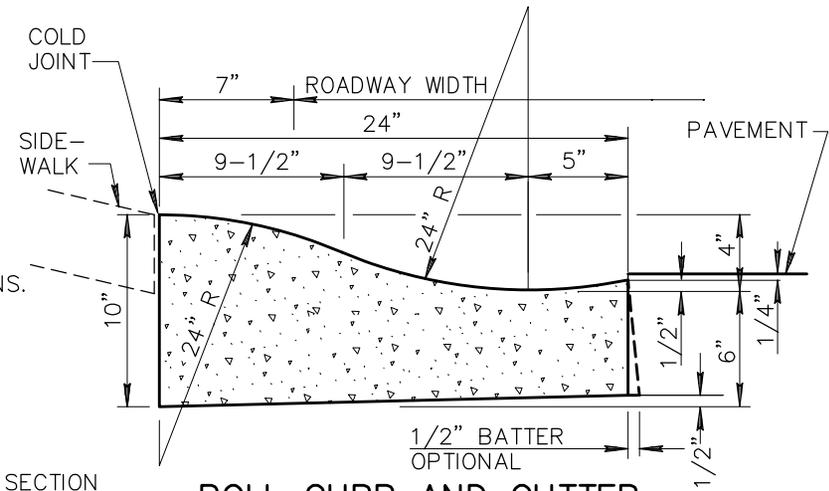
**RIBBON CURB  
(TYPE B)**

**NOTES: (TYPE A)**

1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. H=6" OR AS SPECIFIED ON PLANS.
3. CONTRACTION JOINT SPACING 10' MAXIMUM.
4. EXPANSION JOINTS AS PER SECT. 340.
5. CLASS 'B' CONCRETE PER 725.
6. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH PAVEMENT CROSS SLOPE.

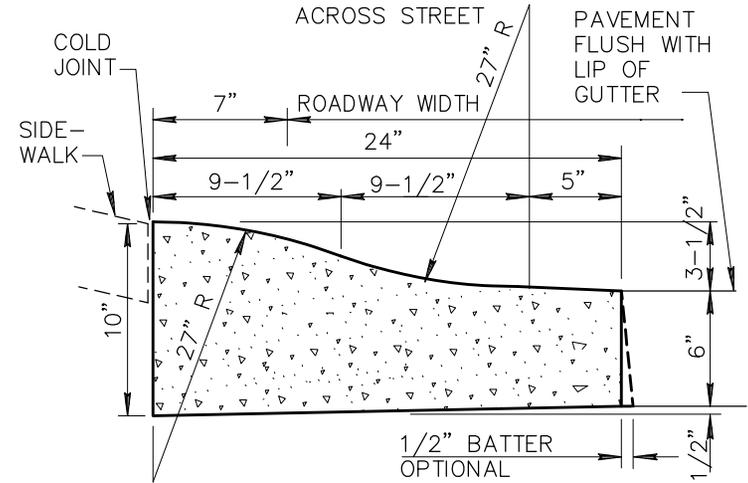
**NOTES: (TYPE B)**

1. CONSTRUCT CURB AND INSTALL 1/2" MASTIC EXPANSION JOINTS, A.S.T.M. D-1751. SECT. 340.
2. BROOM FINISH ALL SURFACES.
3. RIBBON CURB MAY SLOPE TOWARDS PAVEMENT OR PARKWAY AS INDICATED ON PLANS.
4. CONTRACTION JOINT SPACING 10' MAXIMUM.
5. CONCRETE SHALL BE CLASS 'B' PER SECT. 725 AND INSTALLED PER SECT. 505.



**ROLL CURB AND GUTTER  
(TYPE C)**

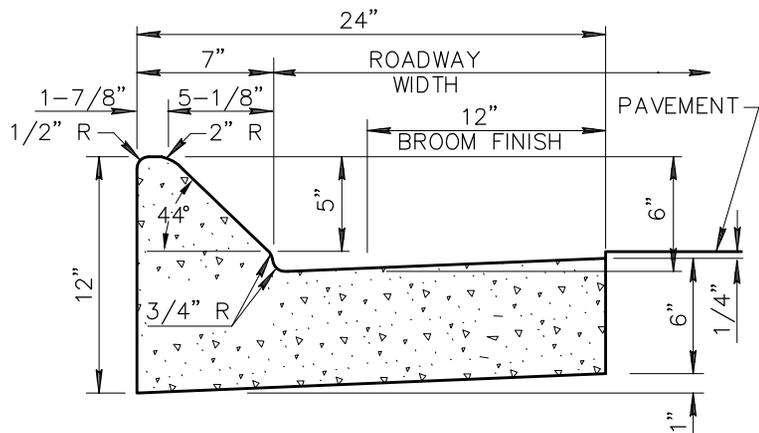
SPECIAL SECT. USE FOR HIGH SIDE CURB WITH SHEET DRAINAGE ACROSS STREET



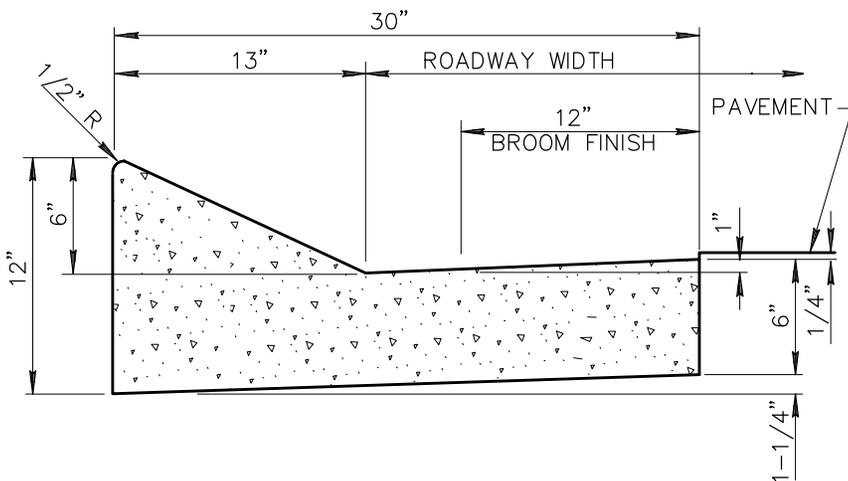
**(TYPE D)**

**NOTES: (C & D)**

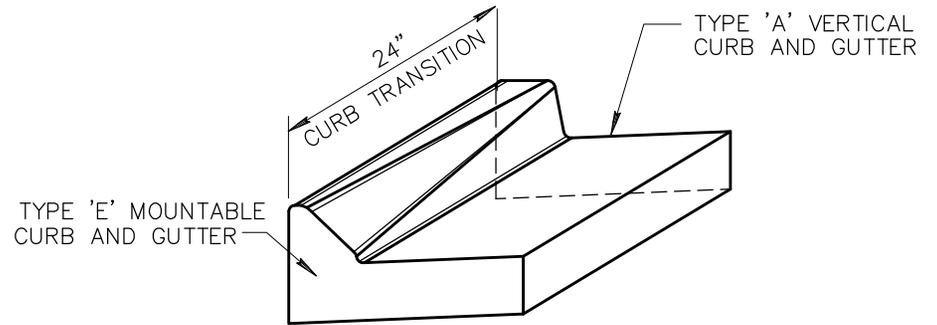
1. ALL WORK AND MATERIALS SHALL CONFORM TO SECT. 304, 505 AND 725. BROOM FINISH TO EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS AS PER SECT. 340.
4. CLASS 'B' CONCRETE PER 725.



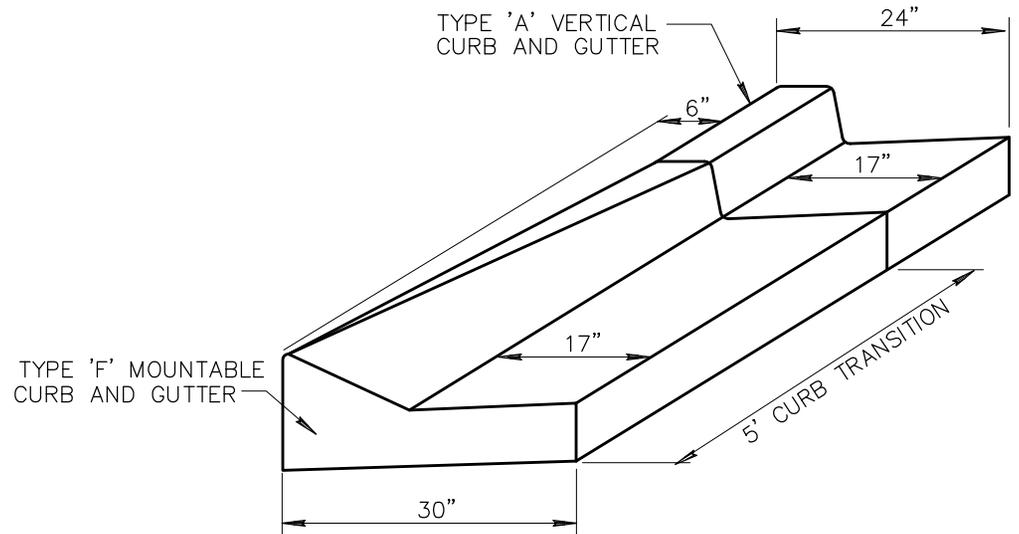
**MOUNTABLE CURB AND GUTTER (TYPE E)**



**MOUNTABLE CURB AND GUTTER (TYPE F)**



**CURB TRANSITION TYPE 'E' TO TYPE 'A'**



**CURB TRANSITION TYPE 'F' TO TYPE 'A'**

**NOTES: (E & F)**

1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS PER SECT. 340.
4. CLASS 'B' CONCRETE PER SECT. 725.
5. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH THE PAVEMENT CROSS SLOPE.

DETAIL NO.

**220-2**



**MARICOPA  
ASSOCIATION of  
GOVERNMENTS**

STANDARD DETAIL  
ENGLISH

**CURB AND GUTTER  
TYPES E AND F**

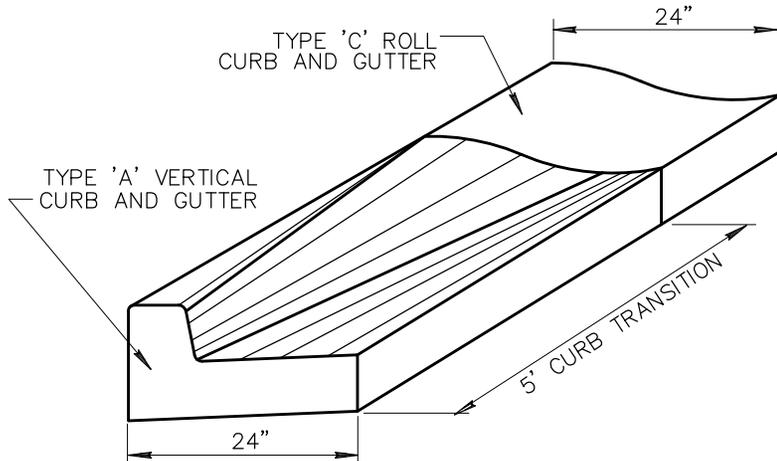
REVISED

01-01-2007

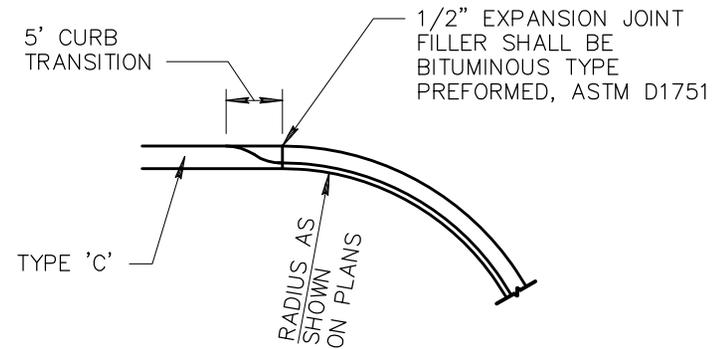
DETAIL NO.

**220-2**

## CURB TRANSITION TYPE 'A' TO TYPE 'C'



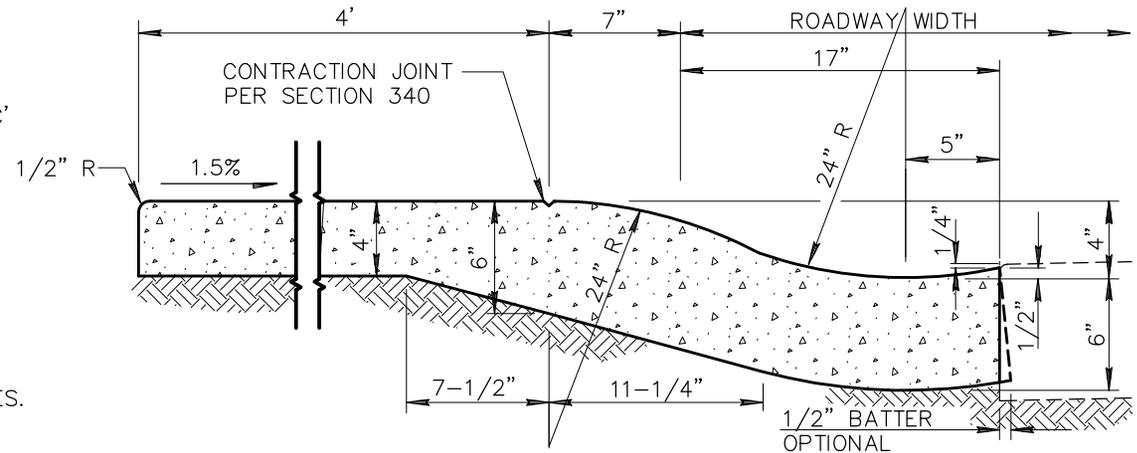
## CURB AND GUTTER TRANSITION



### NOTES: (CURB AND GUTTER TRANSITIONS)

1. TRANSITIONS WILL BE PAID FOR AS THE PREDOMINANT TYPE OF CURB AND GUTTER BEING TRANSITIONED. WHEN TYPE 'A' CURB AND GUTTER ARE USED AT CURB RETURNS AND TYPE 'C' CURB AND GUTTER IS PREDOMINANTLY USED ELSEWHERE, THE TYPE 'A' TO TYPE 'C' TRANSITIONS SHALL BE MEASURED AND PAID FOR AS TYPE 'C' CURB AND GUTTER.
2. WHERE PROPOSED CONSTRUCTION IS TO BE CONNECTED TO EXISTING CURB AND GUTTER, THE TRANSITION SHALL BE INDICATED ON PLANS.
3. CLASS 'B' CONCRETE PER SECTION 725.
4. TRANSITION BETWEEN TYPICAL SECTIONS SHALL BE ACCOMPLISHED BY THE USE OF DIRECT STRAIGHT LINE TRANSITIONS OF THE FLOW LINE AND OTHER SURFACE FEATURES.

## INTEGRAL ROLL CURB, GUTTER AND SIDEWALK



### NOTES: (INTEGRAL ROLL CURB, GUTTER AND SIDEWALK)

1. CONCRETE TO BE MONOLITHIC POUR. EXPOSED SURFACE FINISH AS PER SIDEWALK AND GUTTER DETAIL.
2. CONTRACTION JOINT SPACING 5' MAXIMUM.
3. EXPANSION JOINTS PER SECTION 340.
4. CLASS 'B' CONCRETE PER SECTION 725.

DETAIL NO.

221



STANDARD DETAIL  
ENGLISH

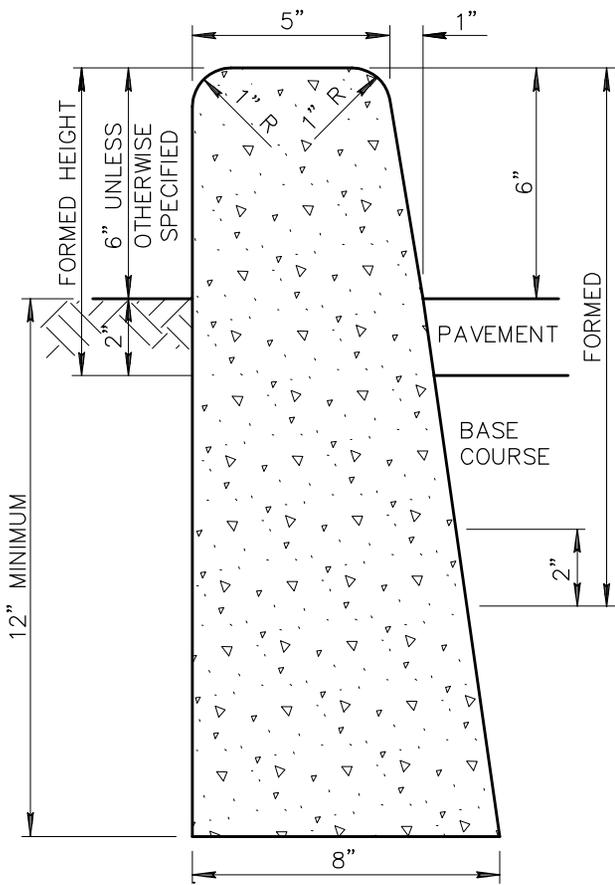
CURB AND GUTTER TRANSITION TYPE A TO TYPE C  
INTEGRAL ROLL CURB, GUTTER AND SIDEWALK

REVISED

01-01-2014

DETAIL NO.

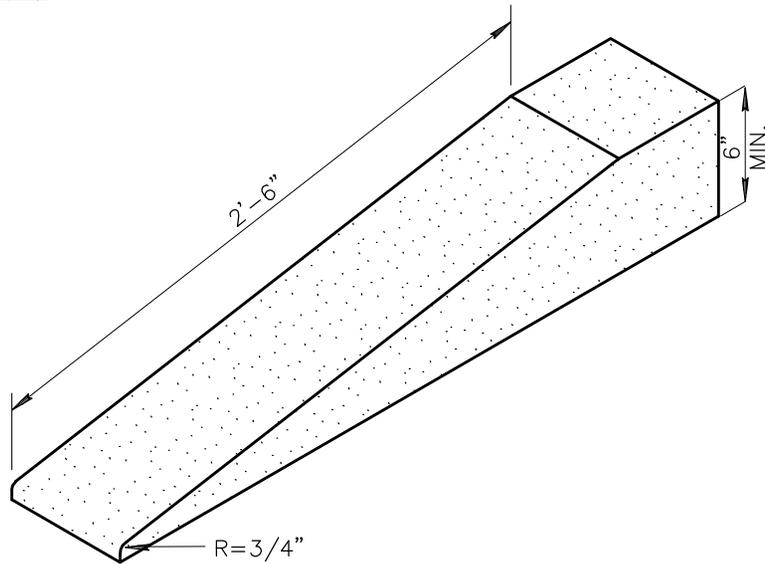
221



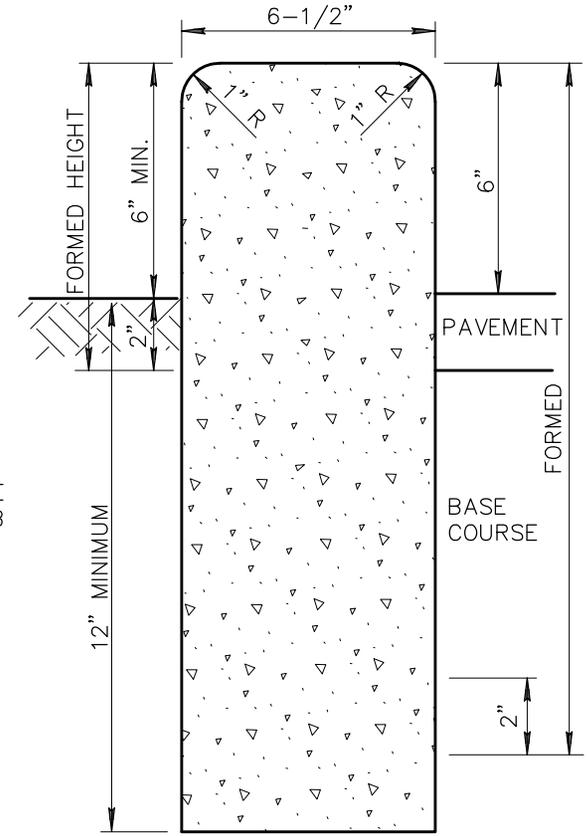
TYPE 'A'

**NOTES:**

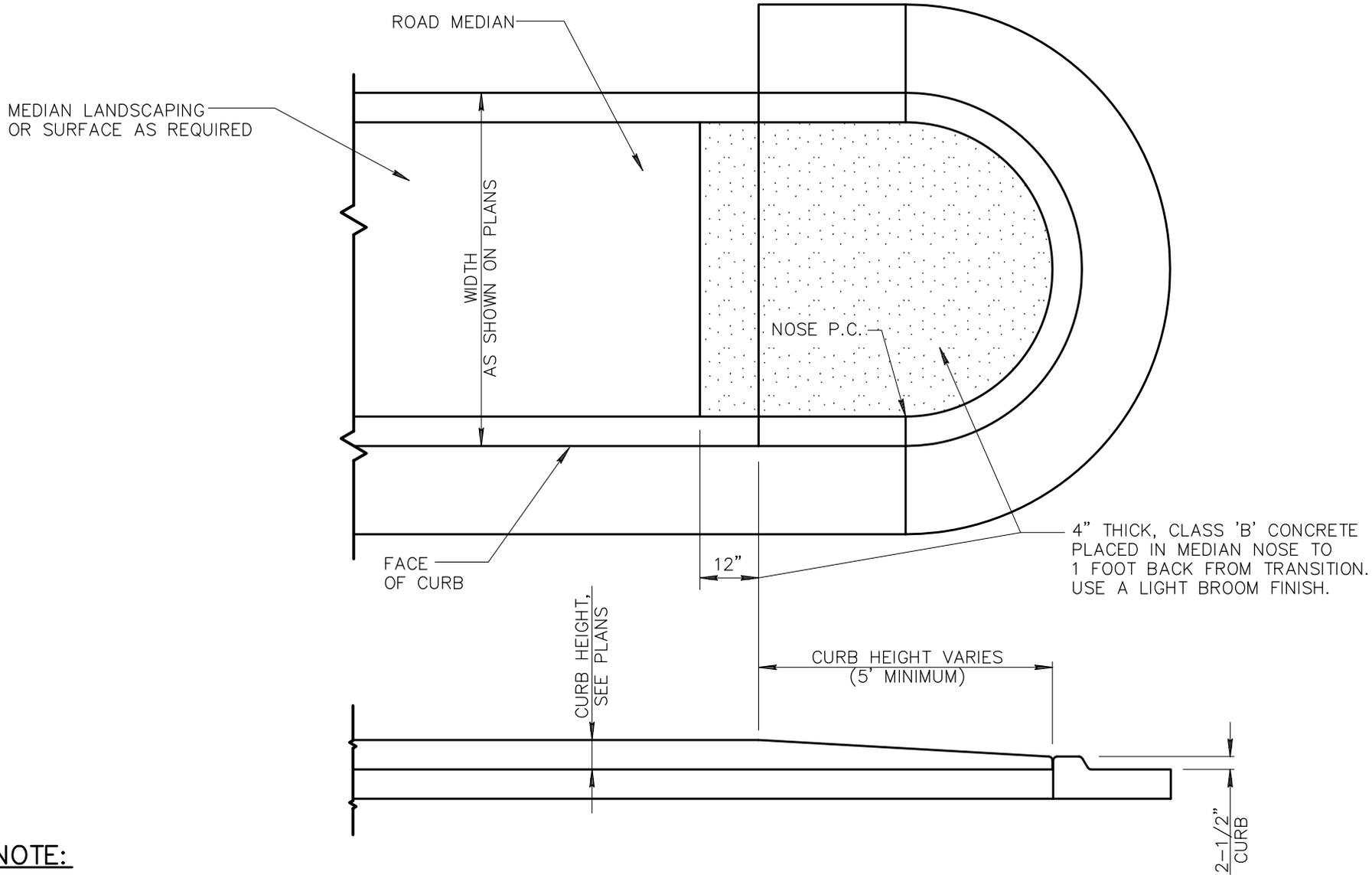
1. ALL VERTICAL SURFACES TO BE FORMED.
2. VERTICAL SURFACES DOWN FROM 2" BELOW UNDISTURBED SOIL MAY BE PLACED AGAINST NEAT CUT IF APPROVED BY THE ENGINEER AND CONCRETE WILL NOT EXTEND MORE THAN 1" BEYOND THEORETICAL FACE.
3. ALL EXPOSED SURFACES TO BE STRIPPED GREEN AND TROWEL FINISHED.
4. CONCRETE CURBS CONFORM TO SECT. 340.
5. MAXIMUM SPACING OF CONTRACTION JOINTS IS 10'
6. CONCRETE TO BE CLASS 'B' PER SECT. 725.
7. WHEN PAVEMENT AND BASE COURSE EQUALS OR EXCEEDS 10" IN DEPTH, THE ENTIRE ROADWAY SIDE OF THE CURB SHALL BE FORMED. THE TOTAL CURB HEIGHT REMAINS 18" UNLESS NOTED OTHERWISE.



TYPICAL CURB TERMINATION



TYPE 'B'



**NOTE:**

LENGTH OF TRANSITION SHALL BE EQUAL TO RADIUS OF MEDIAN NOSE, (5' MINIMUM). FOR LOCATION SEE PLANS.

DETAIL NO.

223



STANDARD DETAIL  
ENGLISH

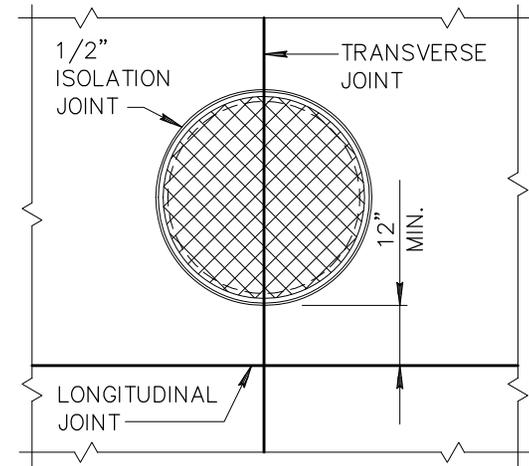
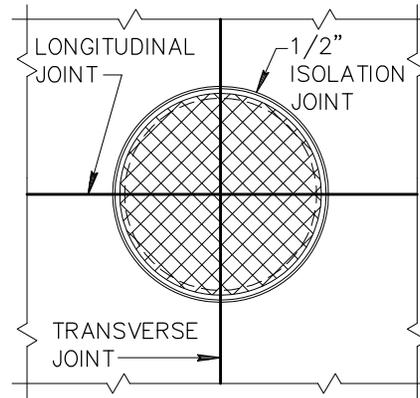
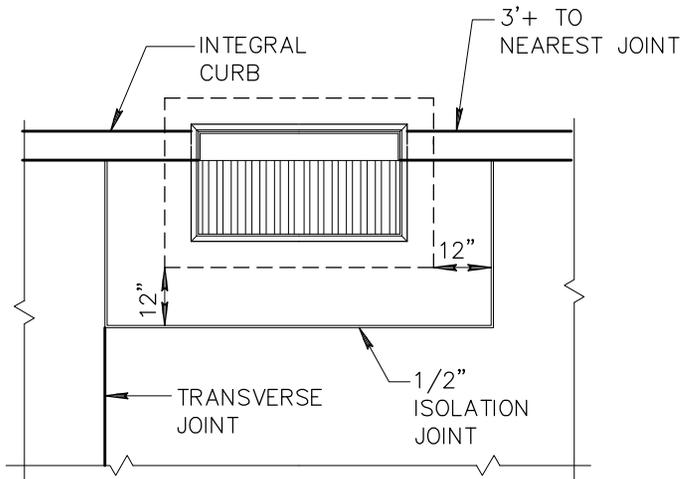
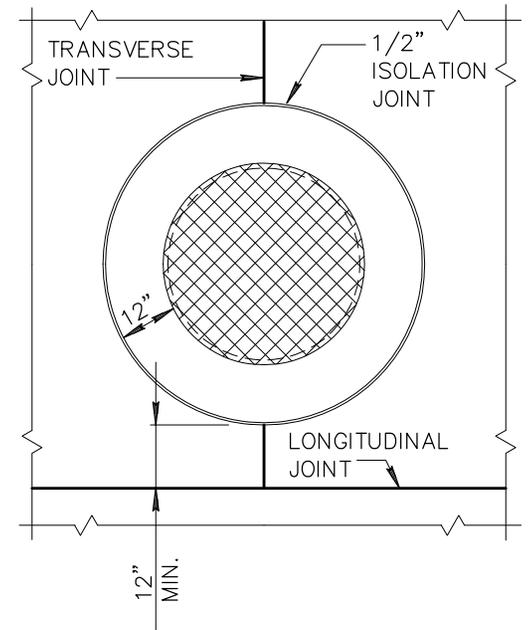
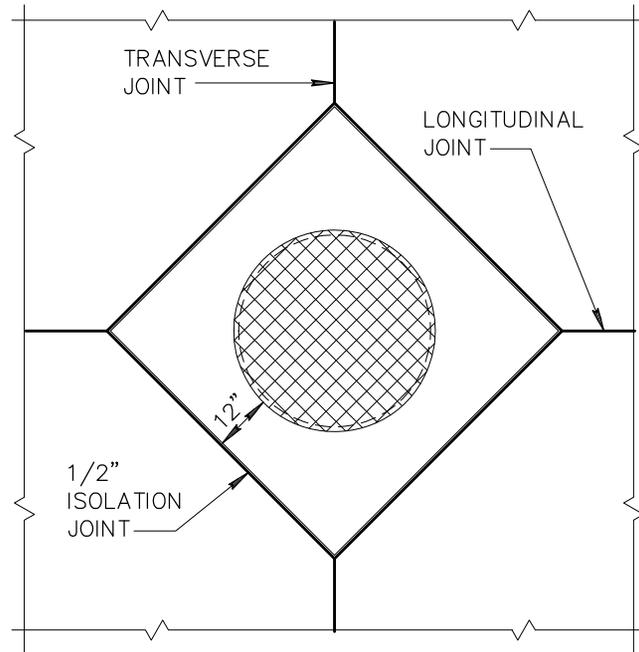
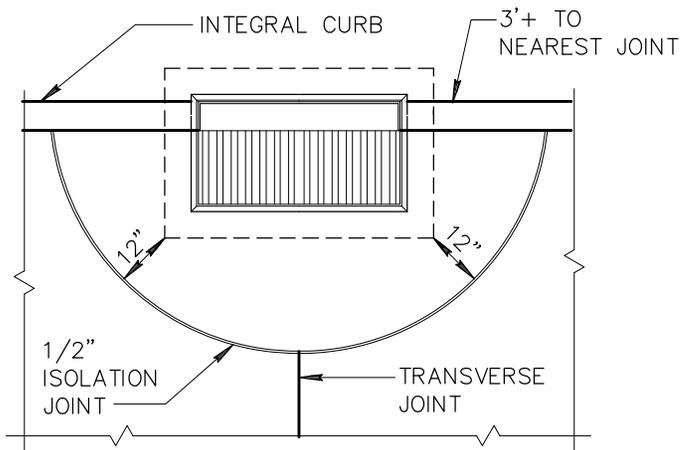
**MEDIAN NOSE TRANSITION**

REVISED

01-01-1998

DETAIL NO.

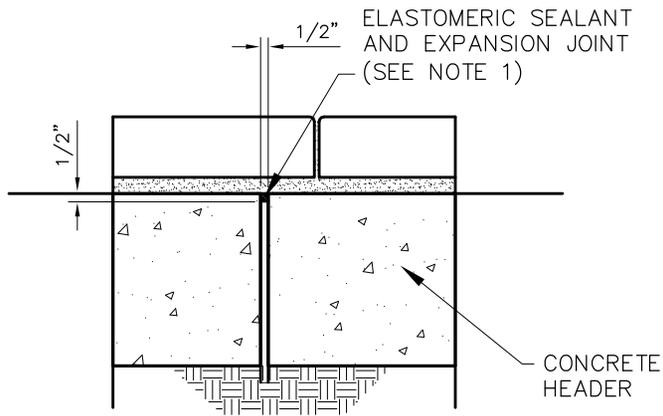
223



**DRAINAGE INLET**

**MANHOLE COVERS**

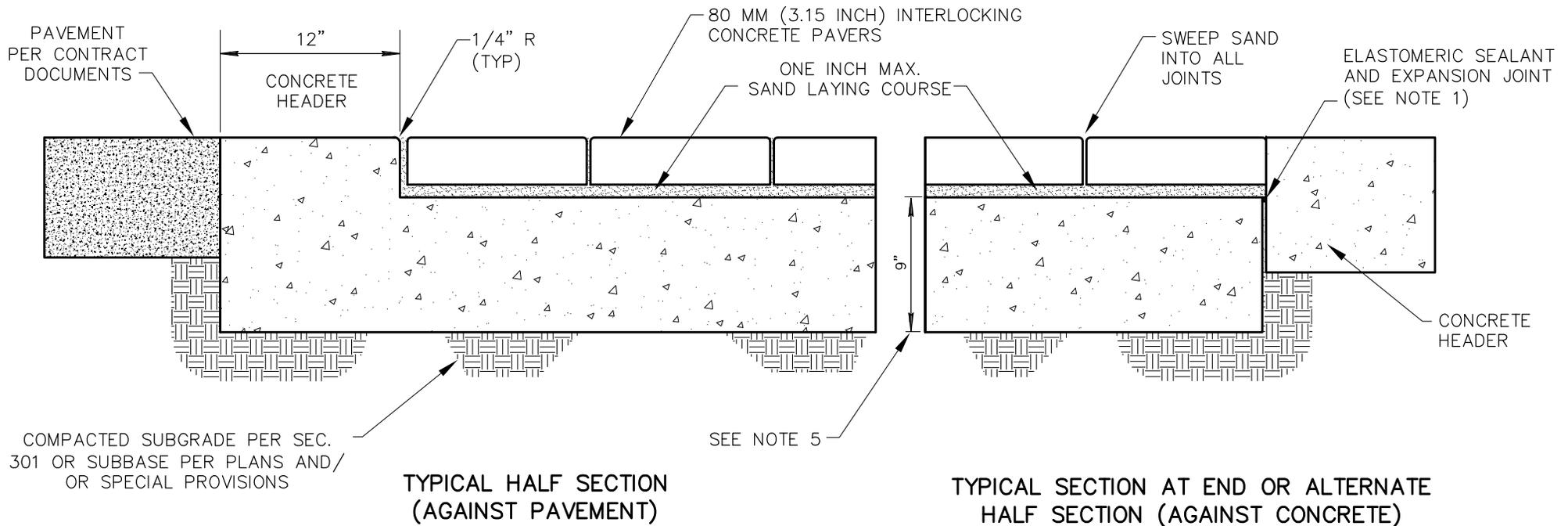
**MANHOLE COVERS**



EXPANSION JOINT DETAIL

NOTES:

1. 1/2 INCH EXPANSION JOINT, ASTM D-1751 PER SEC. 729 AND ELASTOMERIC SEALANT PER SEC. 342
2. CONTRACTION JOINTS PER SEC. 342
3. MATERIALS AND CONSTRUCTION PER SEC. 342
4. PORTLAND CEMENT CONCRETE SHALL BE CLASS A
5. DESIGN PARAMETERS FOR THE THICKNESS IS BASED ON:  
 ASSUMES MODULUS OF SUBGRADE REACTION (K) = 100 pci  
 CONCRETE WORKING STRESS  $f = 300$  psi  
 TERMINAL SERVICABILITY INDEX  $I_p$  OF 2.5 OVER 20 YEARS  
 AND 1 MILLION TOTAL EQUIVALENT 18-KIP SINGLE-AXLE  
 LOAD APPLICATIONS



DETAIL NO.

225



STANDARD DETAIL  
ENGLISH

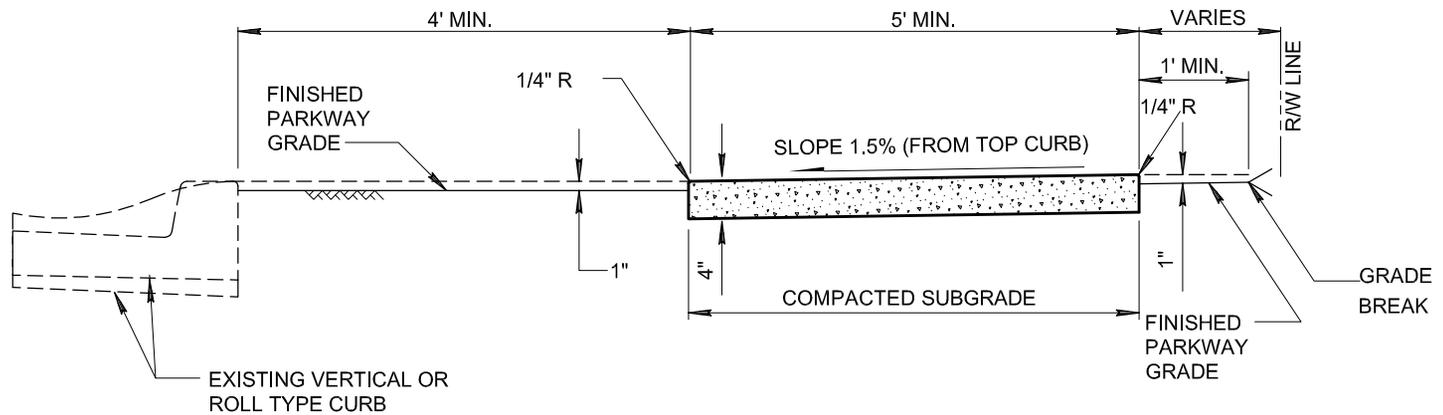
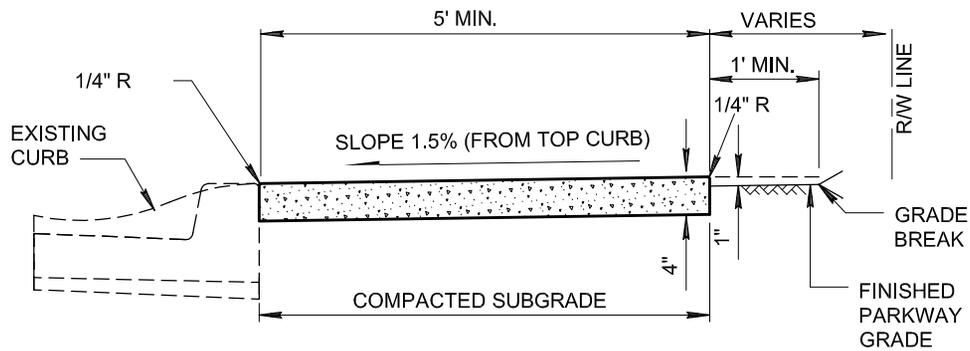
CONCRETE PAVERS

REVISED

01-01-2005

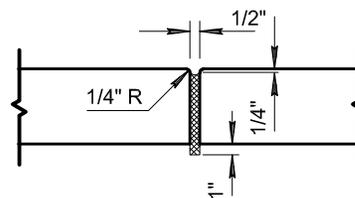
DETAIL NO.

225

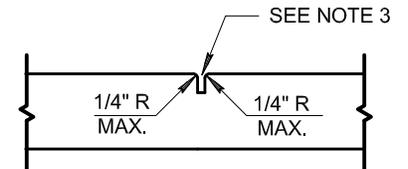


**NOTES:**

1. SIDEWALK CONSTRUCTION SHALL CONFORM TO SECTION 340.
2. EXPANSION JOINTS SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, PER SECTION 729.
3. LARGE AGGREGATE, IN CONTRACTION JOINT SHALL BE SEPARATED TO A DEPTH OF 1", FINISH DEPTH SHALL BE A MINIMUM OF 3/4".
4. EXPANSION JOINTS SHALL CONFORM TO SECTION 340, BE INSTALLED PRIOR TO CONCRETE PLACEMENT, AND AT A MAXIMUM SPACING OF 50'.
5. CONCRETE SHALL BE CLASS 'B' PER SECTION 725.
6. WHEN SIDEWALK AND ADJACENT CURB ARE CONSTRUCTED MONOLITHICALLY, ALL EXPANSION AND CONTRACTION JOINTS SHALL EXTEND ACROSS THE CURB.



**EXPANSION JOINT**



**CONTRACTION JOINT**

DETAIL NO.

230



STANDARD DETAIL  
ENGLISH

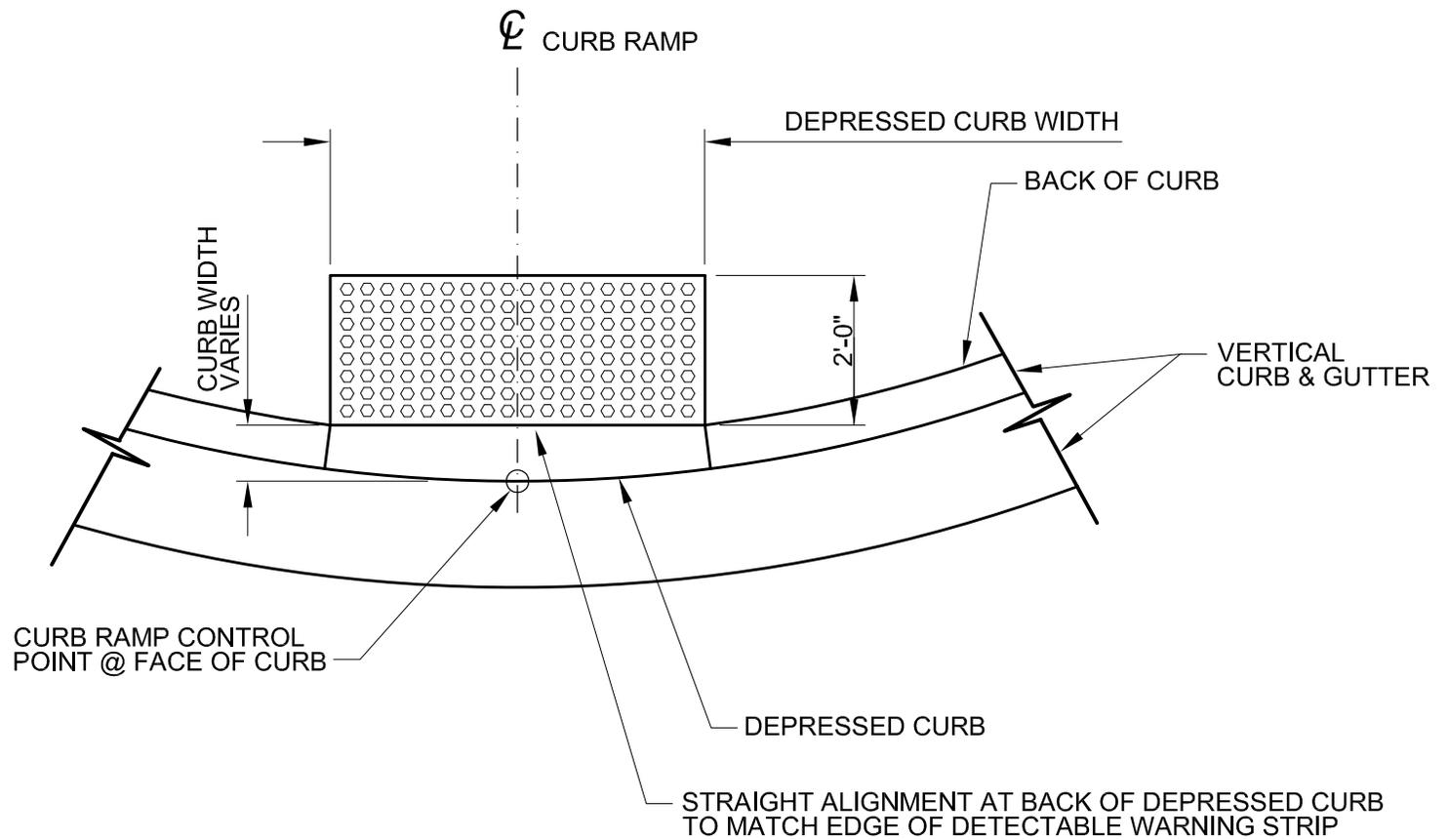
SIDEWALKS

REVISED

01-01-2014

DETAIL NO.

230



PLAN VIEW

DETAIL NO.

**234**



MARICOPA  
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GOVERNMENTS

STANDARD DETAIL  
ENGLISH

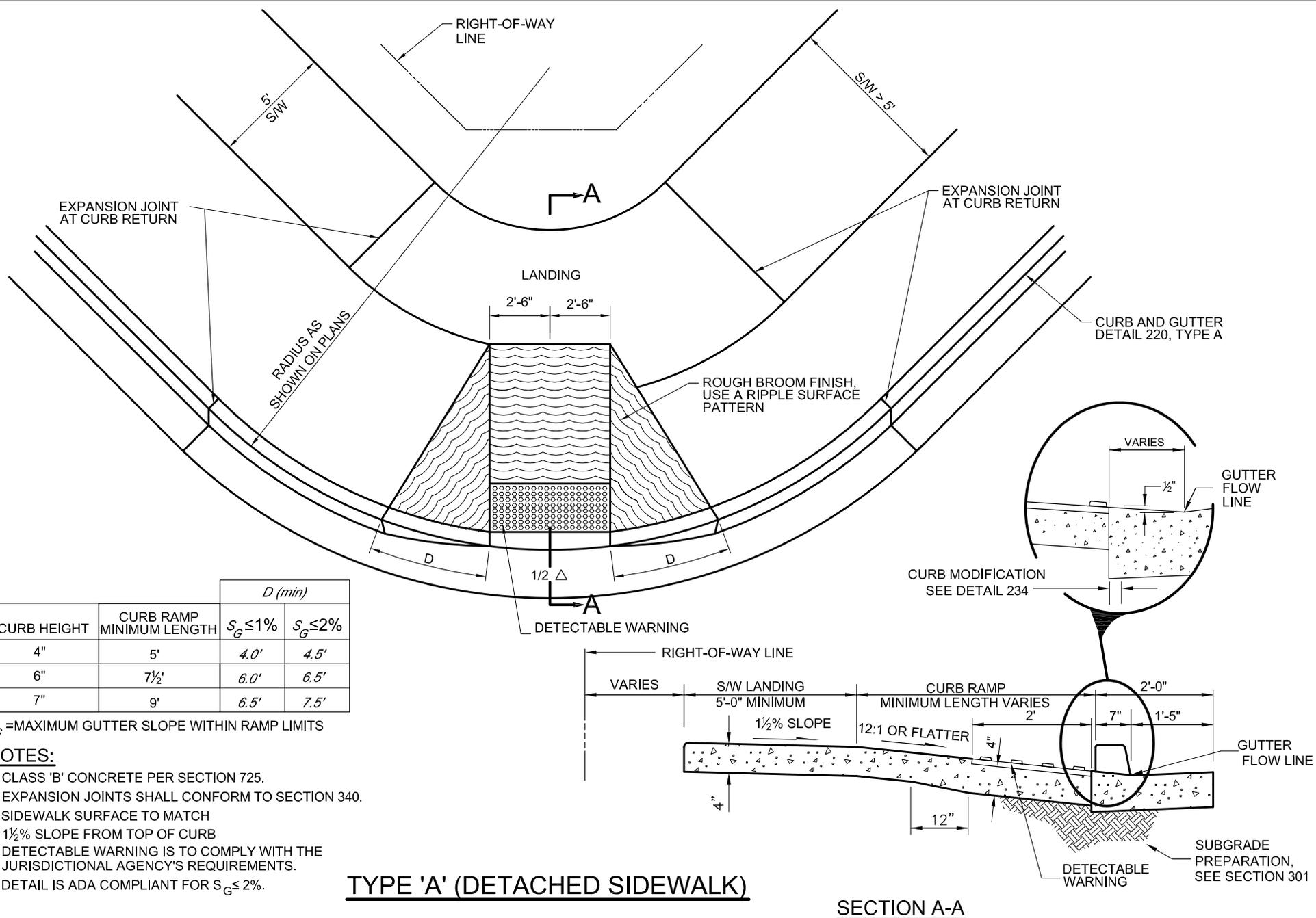
**CURB MODIFICATION  
AT DETECTABLE WARNING**

REVISED

01-01-2012

DETAIL NO.

**234**



CURB HEIGHT	CURB RAMP MINIMUM LENGTH	<i>D (min)</i>	
		$S_G \leq 1\%$	$S_G \leq 2\%$
4"	5'	4.0'	4.5'
6"	7½'	6.0'	6.5'
7"	9'	6.5'	7.5'

$S_G$  = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS

**NOTES:**

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. SIDEWALK SURFACE TO MATCH  
1½% SLOPE FROM TOP OF CURB
4. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
5. DETAIL IS ADA COMPLIANT FOR  $S_G \leq 2\%$ .

**TYPE 'A' (DETACHED SIDEWALK)**

**SECTION A-A**

DETAIL NO.

235-1

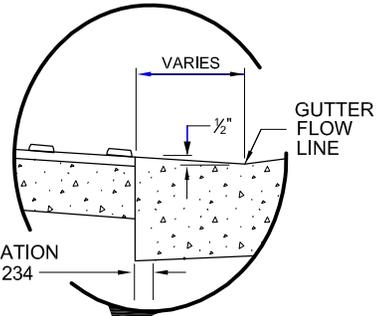
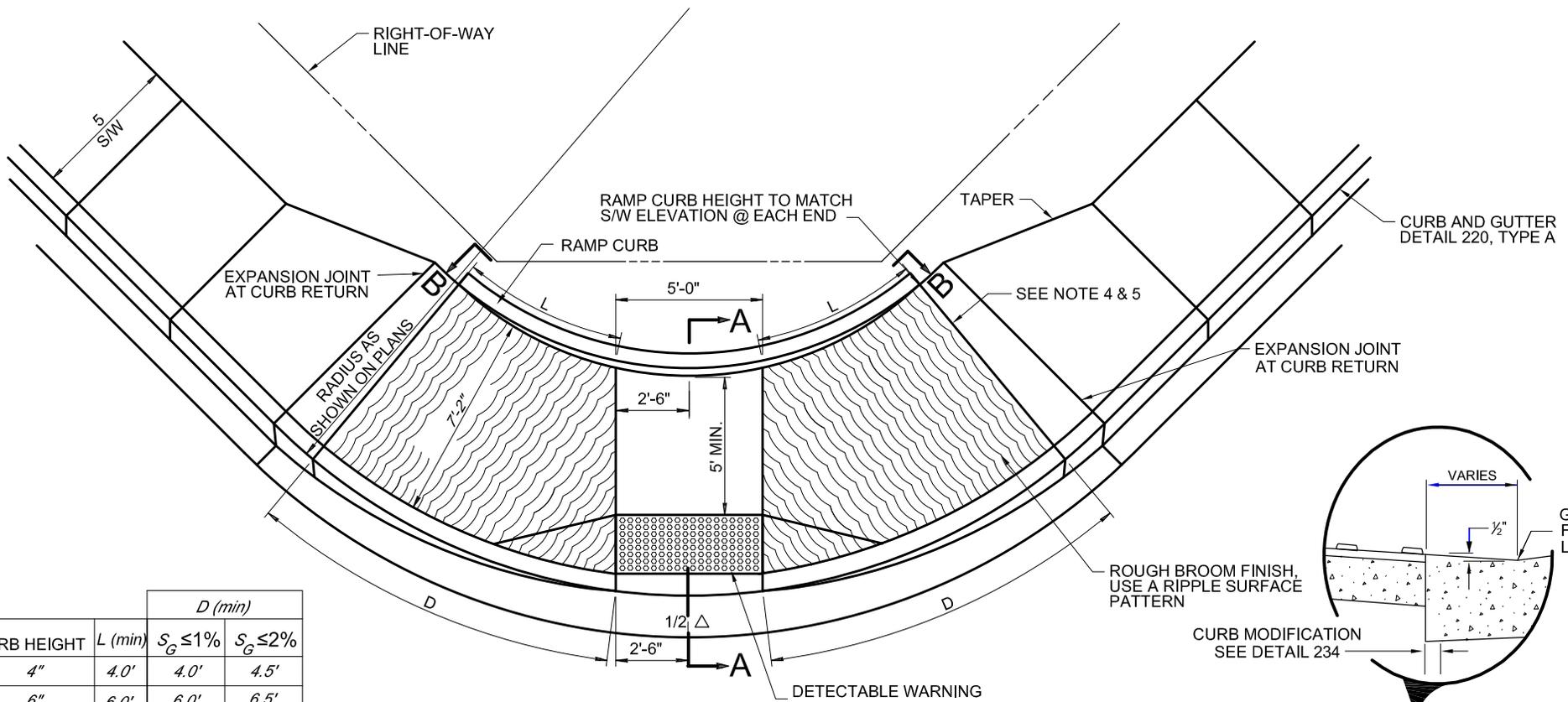


STANDARD DETAIL  
ENGLISH

CURB RAMPS

REVISED  
01-01-2012

DETAIL NO.  
235-1

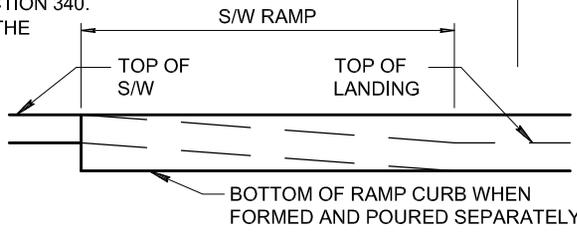


CURB HEIGHT	L (min)	D (min)	
		$S_G \leq 1\%$	$S_G \leq 2\%$
4"	4.0'	4.0'	4.5'
6"	6.0'	6.0'	6.5'
7"	7.0'	6.5'	7.5'

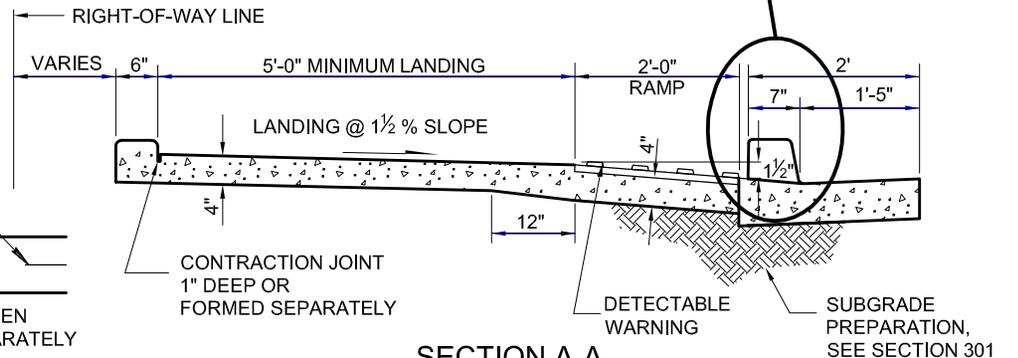
$S_G$  = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS

**NOTES:**

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
4. INCREASE 'L' OR 'D' AS NEEDED TO HAVE THE TOP OF RAMP FORM A RADIAL LINE.
5. WHEN TOP OF RAMP IS LESS THAN 4' FROM CURB RETURN, EXTEND RAMP TO THE CURB RETURN.
6. DETAIL IS ADA COMPLIANT FOR  $S_G \leq 2\%$ .



**SECTION B-B**



**SECTION A-A**

**TYPE 'B'**

DETAIL NO.  
235-2



STANDARD DETAIL  
ENGLISH

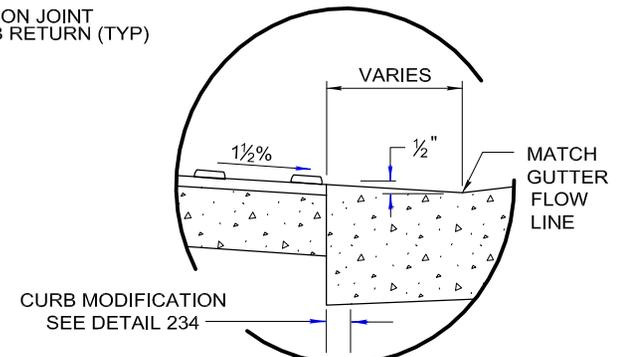
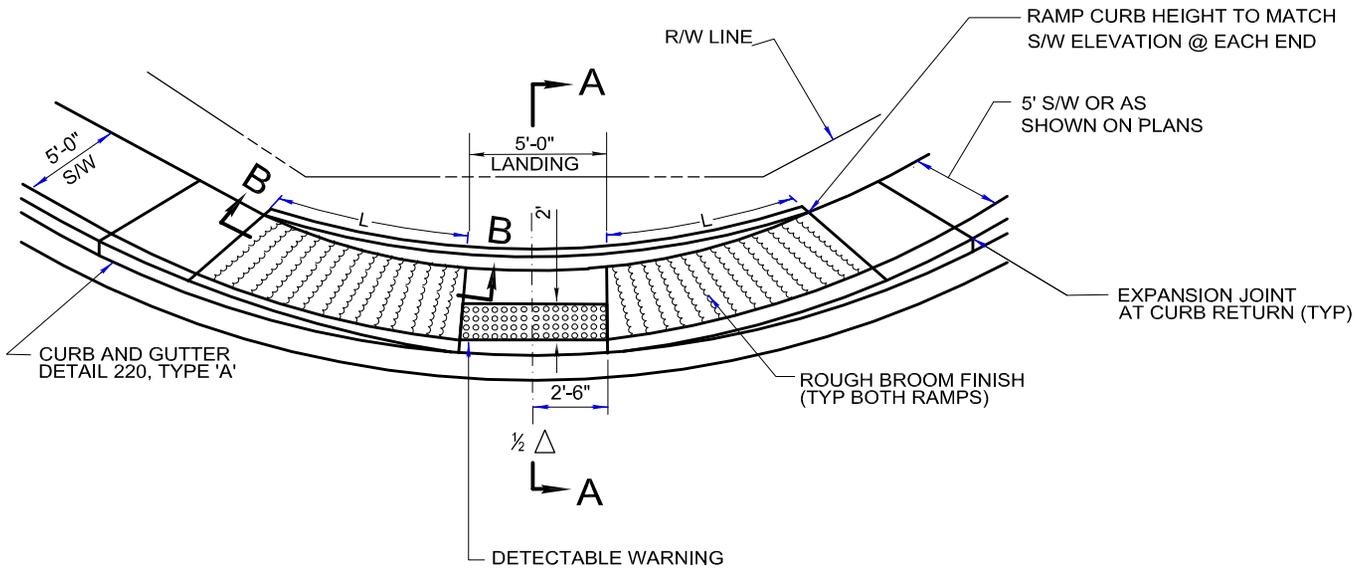
CURB RAMPS

REVISED  
01-01-2012

DETAIL NO.  
235-2

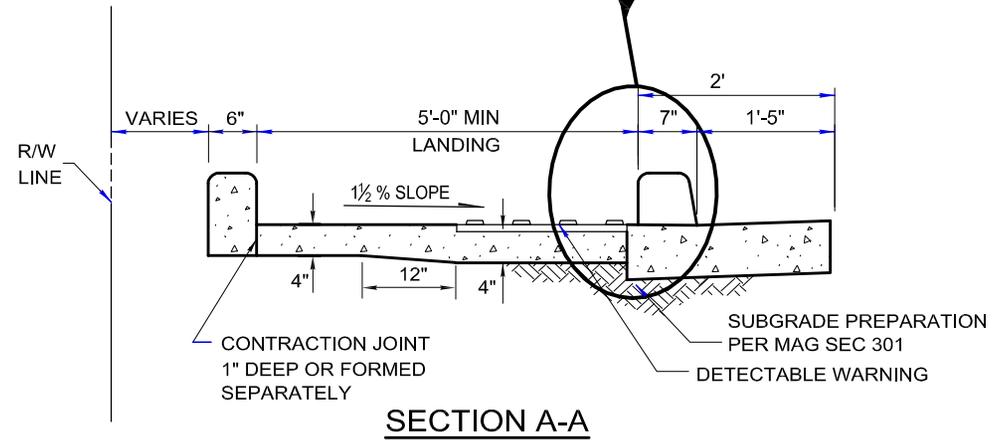
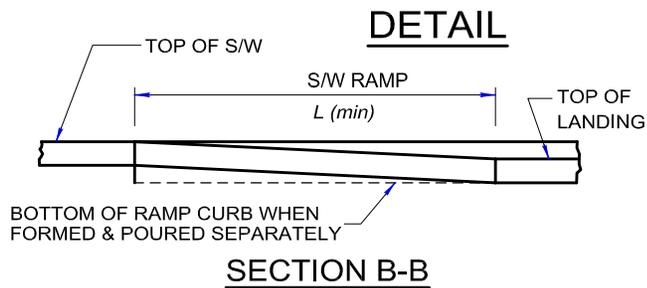
**NOTES:**

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECTION 725.
2. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENT.
3. RAMP LONGITUDINAL SLOPE SHALL BE 12:1 OR FLATTER.
4. RAMP CROSS SLOPE SHALL BE 1½%.
5. DETAIL IS ADA COMPLIANT FOR CURB RADII ≥ 20' AND GUTTER SLOPE ≤ 2.0%.



CURB HEIGHT	L (min)	
	$S_G \leq 1\%$	$S_G \leq 2\%$
4"	5.0'	6.0'
6"	7.0'	8.5'

$S_G$  = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS



**TYPE 'C'**

DETAIL NO.  
235-3

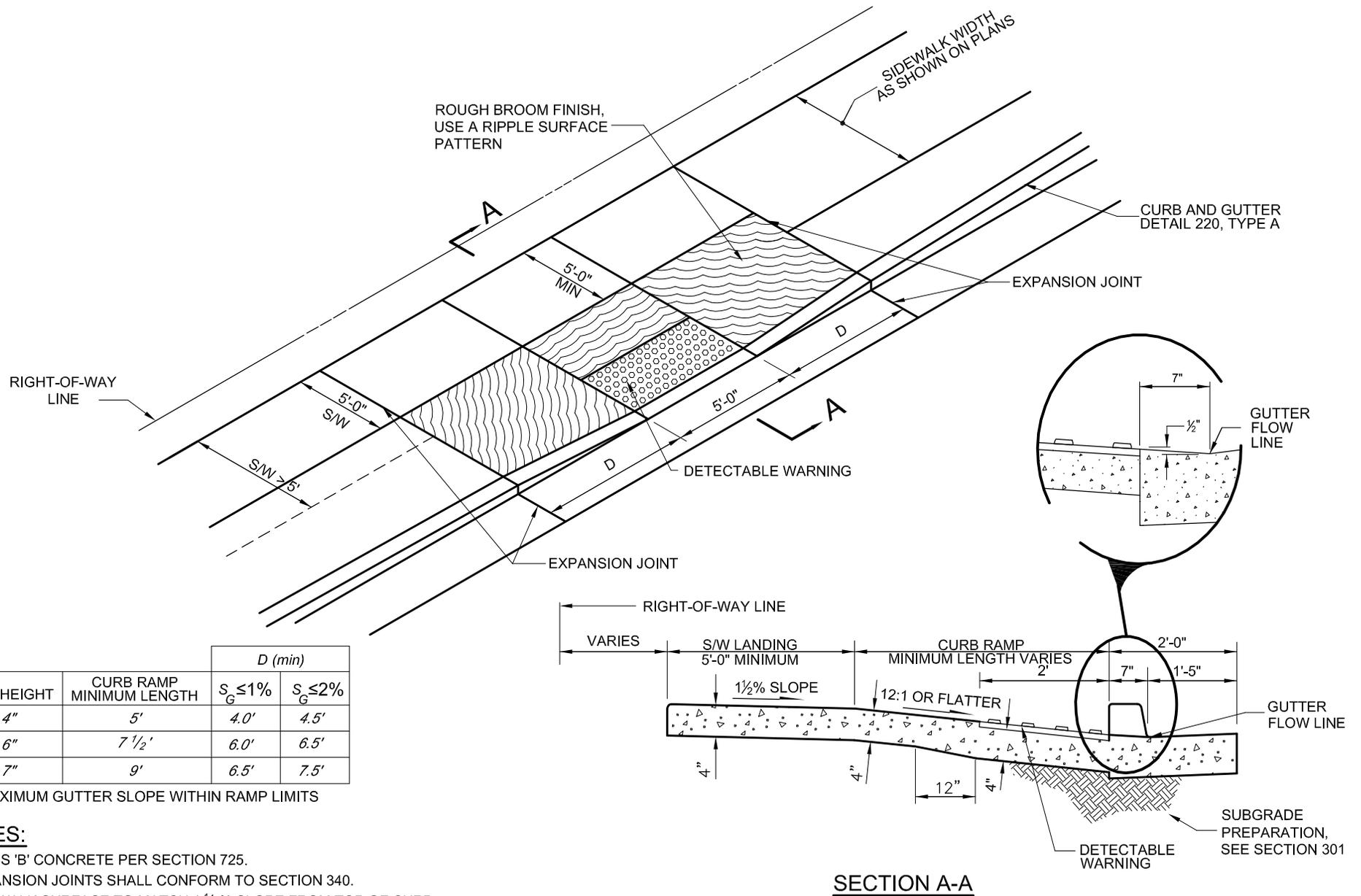


STANDARD DETAIL  
ENGLISH

CURB RAMPS

REVISED  
01-01-2012

DETAIL NO.  
235-3



CURB HEIGHT	CURB RAMP MINIMUM LENGTH	D (min)	
		$S_G \leq 1\%$	$S_G \leq 2\%$
4"	5'	4.0'	4.5'
6"	7 1/2'	6.0'	6.5'
7"	9'	6.5'	7.5'

$S_G$  = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS

**NOTES:**

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. SIDEWALK SURFACE TO MATCH 1 1/2 % SLOPE FROM TOP OF CURB.
4. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
5. DETAIL IS ADA COMPLIANT FOR  $S_G \leq 2\%$ .

**TYPE 'D' DETACHED SIDEWALK**

DETAIL NO.  
235-4

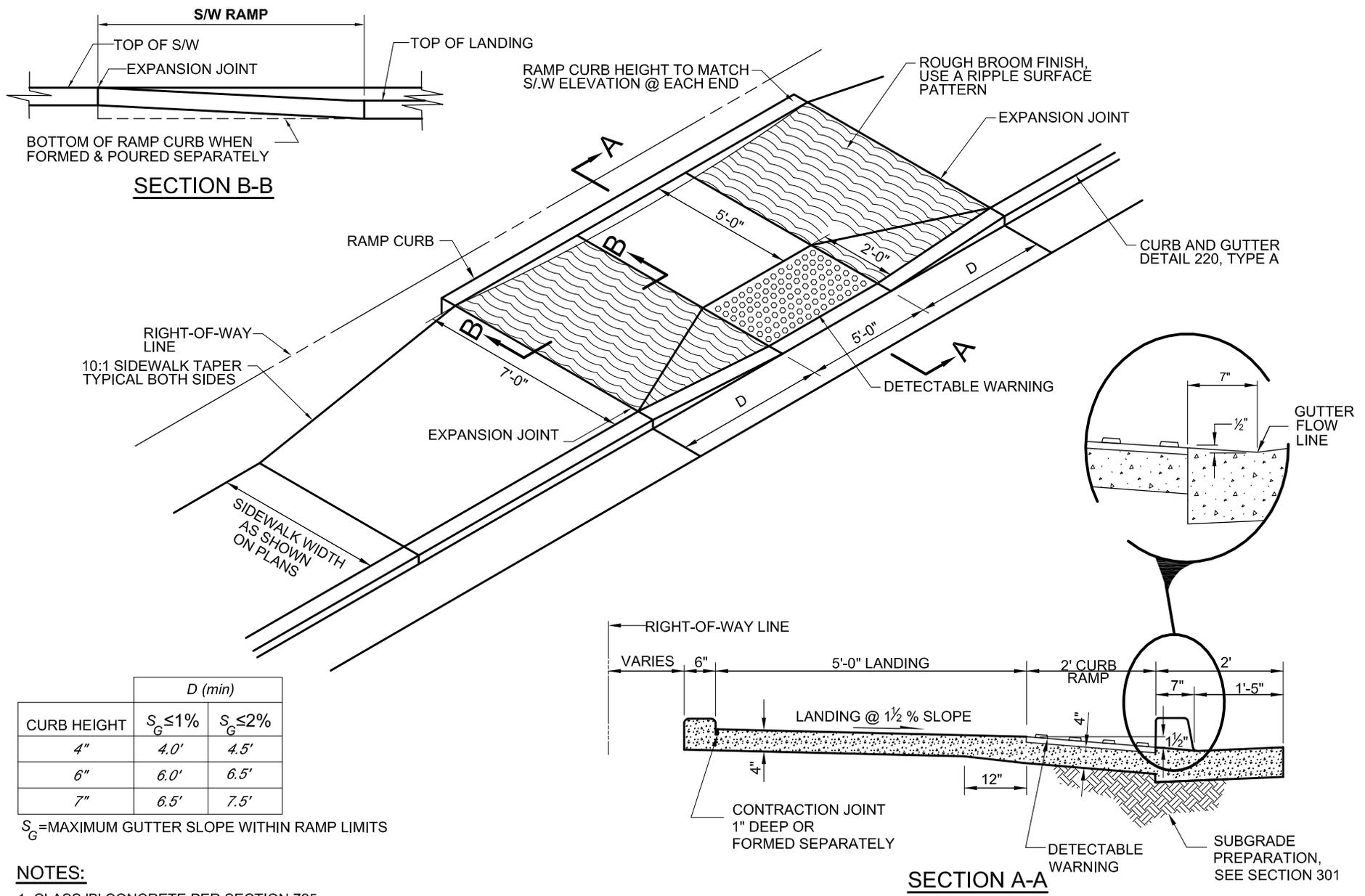


STANDARD DETAIL  
ENGLISH

CURB RAMPS

REVISED  
01-01-2011

DETAIL NO.  
235-4

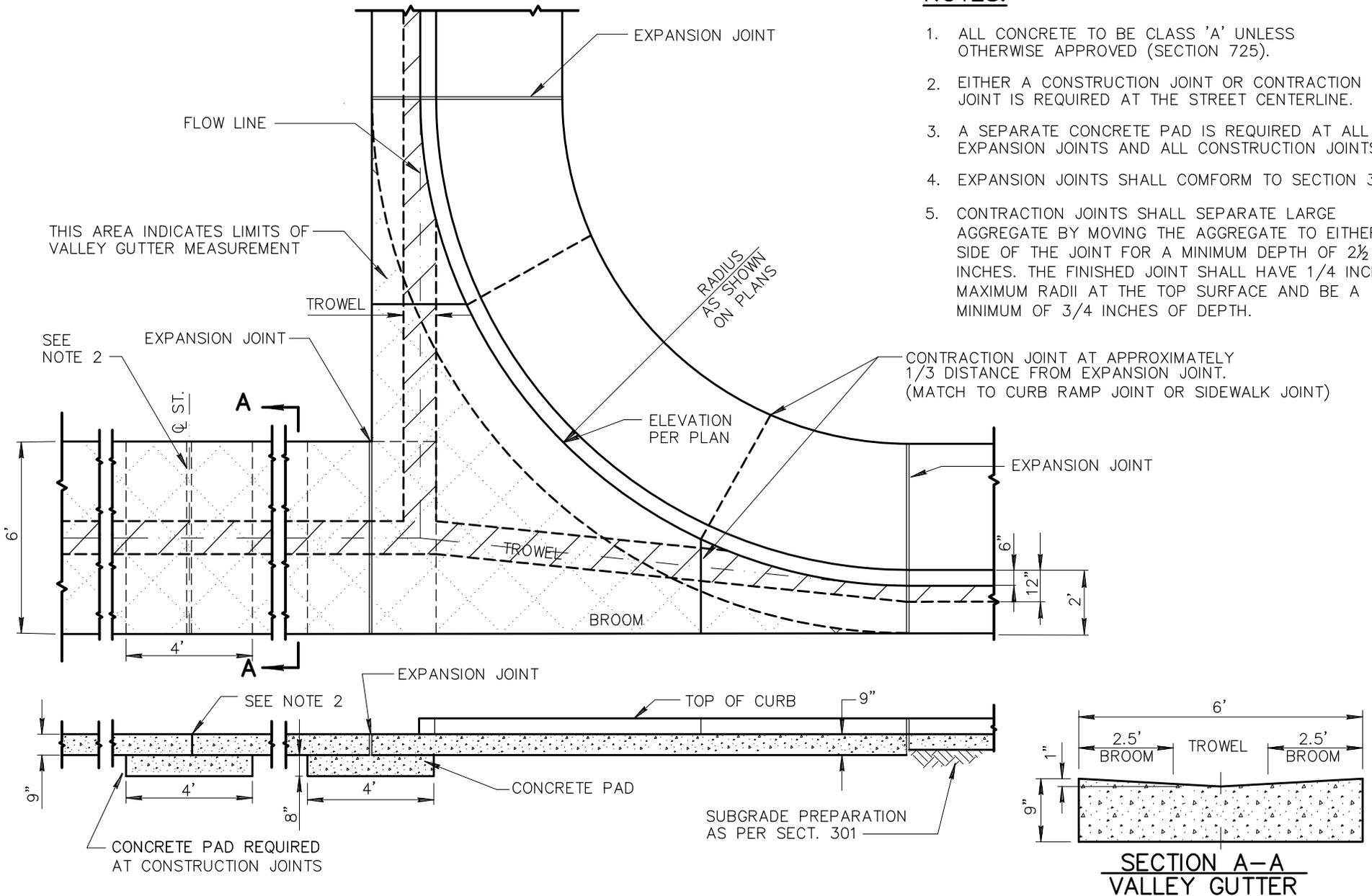


**TYPE 'E'**

- NOTES:**
1. CLASS 'B' CONCRETE PER SECTION 725.
  2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
  3. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
  4. DETAIL IS ADA COMPLIANT FOR  $S_G \leq 2\%$ .

**NOTES:**

1. ALL CONCRETE TO BE CLASS 'A' UNLESS OTHERWISE APPROVED (SECTION 725).
2. EITHER A CONSTRUCTION JOINT OR CONTRACTION JOINT IS REQUIRED AT THE STREET CENTERLINE.
3. A SEPARATE CONCRETE PAD IS REQUIRED AT ALL EXPANSION JOINTS AND ALL CONSTRUCTION JOINTS.
4. EXPANSION JOINTS SHALL COMFORM TO SECTION 340.
5. CONTRACTION JOINTS SHALL SEPARATE LARGE AGGREGATE BY MOVING THE AGGREGATE TO EITHER SIDE OF THE JOINT FOR A MINIMUM DEPTH OF 2½ INCHES. THE FINISHED JOINT SHALL HAVE 1/4 INCH MAXIMUM RADII AT THE TOP SURFACE AND BE A MINIMUM OF 3/4 INCHES OF DEPTH.



DETAIL NO.

**240**



STANDARD DETAIL  
ENGLISH

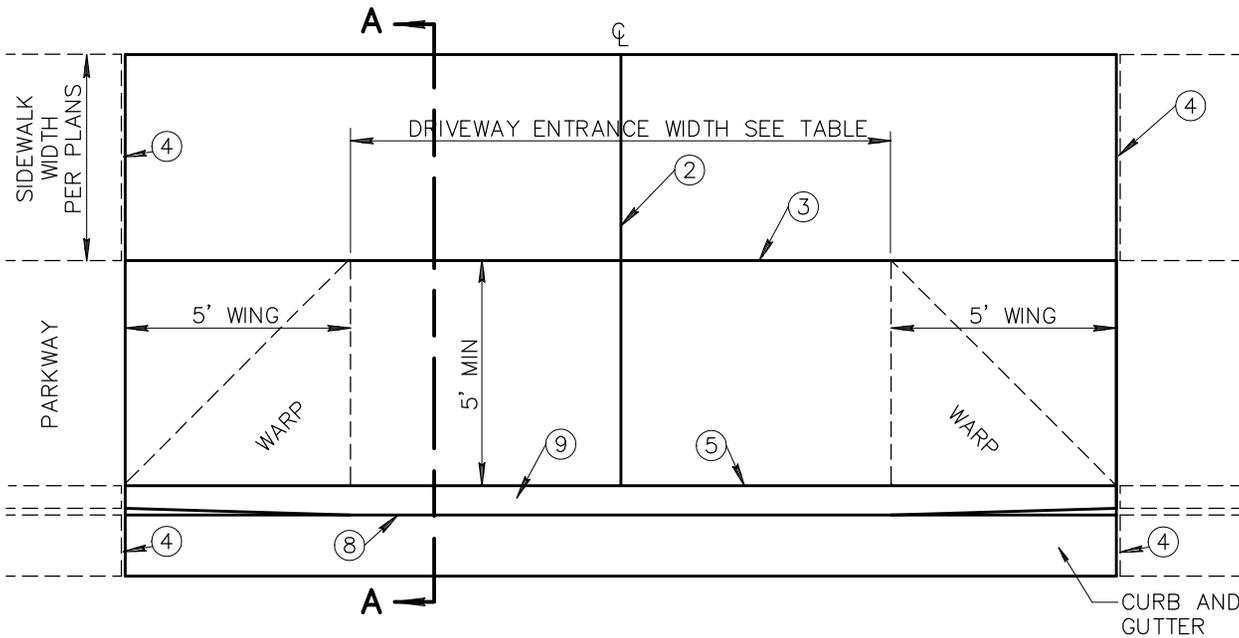
**VALLEY GUTTER**

REVISED

01-01-2010

DETAIL NO.

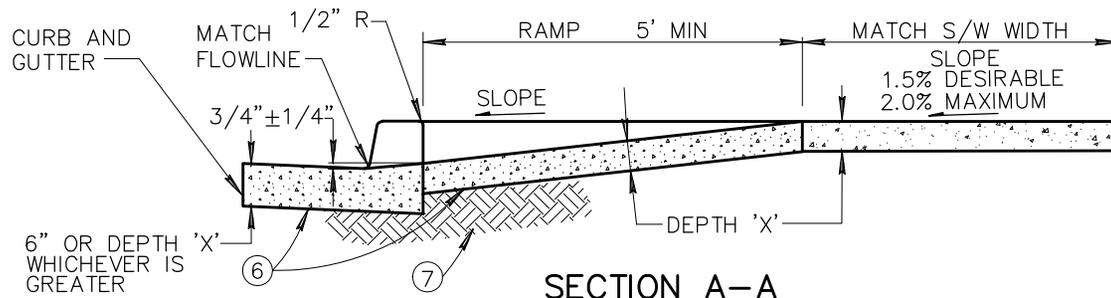
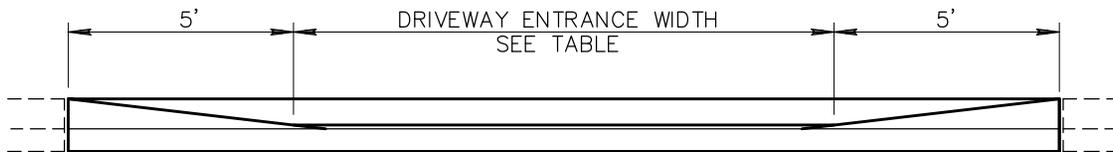
**240**



**DRIVEWAY WITH DETACHED SIDEWALK**

**NOTES:**

1. DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
2. CONTRACTION JOINT ON D/W CENTERLINE.
3. CONTRACTION JOINT.
4. 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
5. BACK OF CURB - CONSTRUCTION JOINT.
6. CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
7. SUBGRADE PREPARATION, SECT. 301.
8. FLOW LINE OF GUTTER.
9. DEPRESSED CURB.
10. SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
11. ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
12. TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
13. 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
14. ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.



**SECTION A-A**

COMMERCIAL AND INDUSTRIAL				
DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"
INDUSTRIAL	* 16'	40'	A	9"
* 24' MIN. FOR TWO WAY TRAFFIC				
RESIDENTIAL				
DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
MAJOR STREET	16'	30'	B	5"
COLLECTOR STREET	* 12'	30'	B	5"
LOCAL STREET	12'	30'	B	5"
* 16' DESIRABLE				

DETAIL NO.

**250-1**



STANDARD DETAIL  
ENGLISH

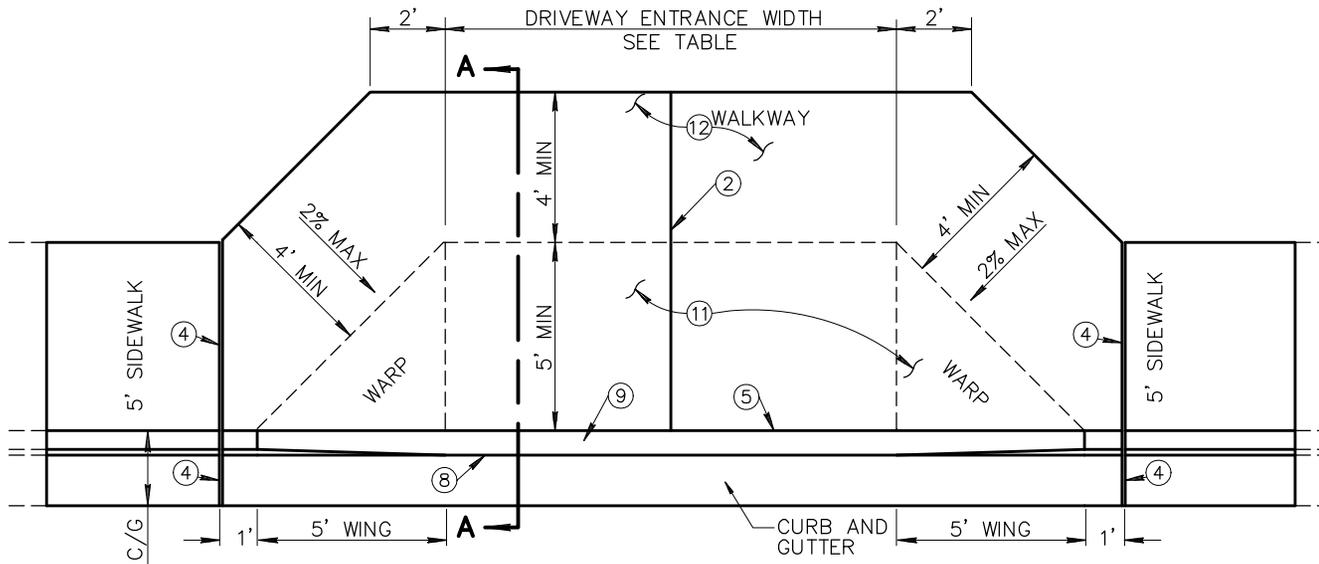
**DRIVEWAY ENTRANCES WITH  
DETACHED SIDEWALK**

REVISED

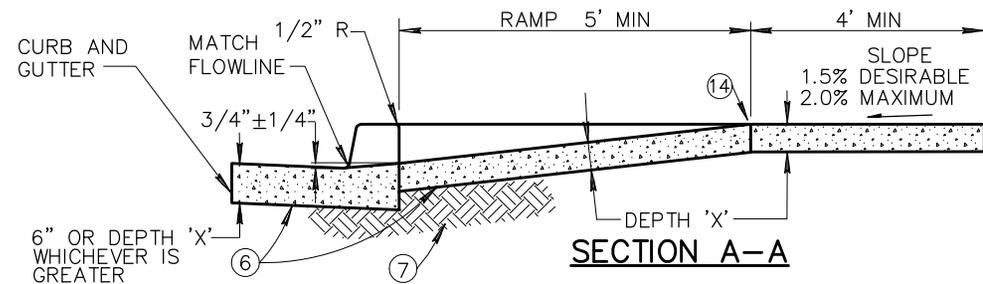
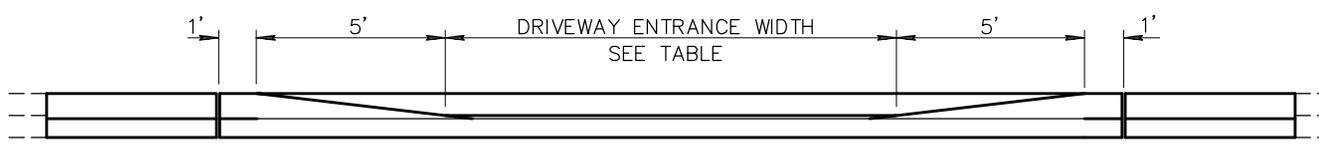
01-01-2014

DETAIL NO.

**250-1**



**DRIVEWAY WITH SIDEWALK ATTACHED TO CURB**



COMMERCIAL AND INDUSTRIAL					RESIDENTIAL				
DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'	DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"	MAJOR STREET	16'	30'	B	5"
INDUSTRIAL	* 16'	40'	A	9"	COLLECTOR STREET	* 12'	30'	B	5"
* 24' MIN. FOR TWO WAY TRAFFIC					LOCAL STREET	12'	30'	B	5"
					* 16' DESIRABLE				

**NOTES:**

- DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- CONTRACTION JOINT(S) FOR DRIVEWAY ENTRANCE: WIDTH LESS THAN 22' NONE REQUIRED; WIDTH GREATER THAN 22' AND LESS THAN 30' LOCATE SINGLE JOINT ON D/W CENTERLINE; WIDTH OF 30' OR GREATER LOCATE TWO JOINTS TO EQUALLY DIVIDE THE DRIVEWAY ENTRANCE WIDTH.
- DETAIL GEOMETRICS ARE BASED ON A CURB HEIGHT OF SIX INCHES (6"), AN ATTACHED SIDEWALK WIDTH OF FIVE FEET (5'), AND A DRIVEWAY RAMP LENGTH NOT EXCEEDING SIX FEET (6'). GEOMETRIC MODIFICATIONS MAY BE REQUIRED WHEN CONDITIONS ARE MODIFIED.
- 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
- BACK OF CURB - CONSTRUCTION JOINT.
- CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
- SUBGRADE PREPARATION, SECT. 301.
- FLOW LINE OF GUTTER.
- DEPRESSED CURB.
- SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
- ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
- TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
- 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
- ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.

DETAIL NO.  
**250-2**

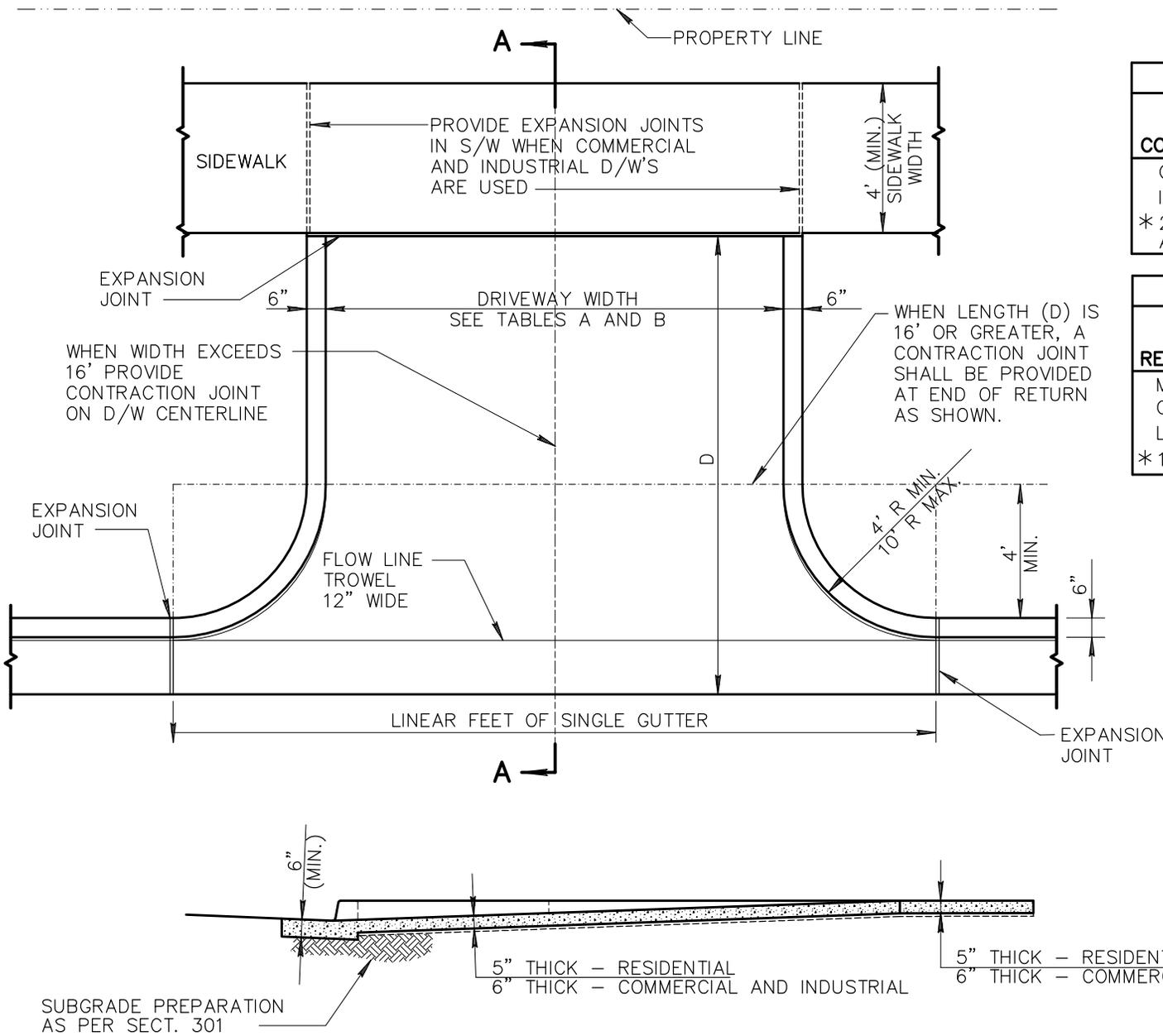


STANDARD DETAIL  
ENGLISH

**DRIVEWAY ENTRANCES WITH  
SIDEWALK ATTACHED TO CURB**

REVISED  
01-01-2013

DETAIL NO.  
**250-2**



**SECTION A-A**

TABLE A		
ZONING	DRIVEWAY WIDTH	
	COMMERCIAL AND INDUSTRIAL	MIN.*
COMMERCIAL	16'	40'
INDUSTRIAL	16'	40'
* 24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

TABLE B		
ZONING	DRIVEWAY WIDTH	
	RESIDENTIAL	MIN.*
MAJOR STREET	16'	30'
COLLECTOR STREET	12'	30'
LOCAL STREET	12'	30'
* 16' WIDTH IS DESIRABLE		

**NOTES:**

1. EXPANSION JOINTS SHALL COMPLY TO SECTION 340.
2. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF ENGINEER.
3. CLASS 'B' CONCRETE CONSTRUCTION AS PER SECT. 725

DETAIL NO.

**251**



STANDARD DETAIL  
ENGLISH

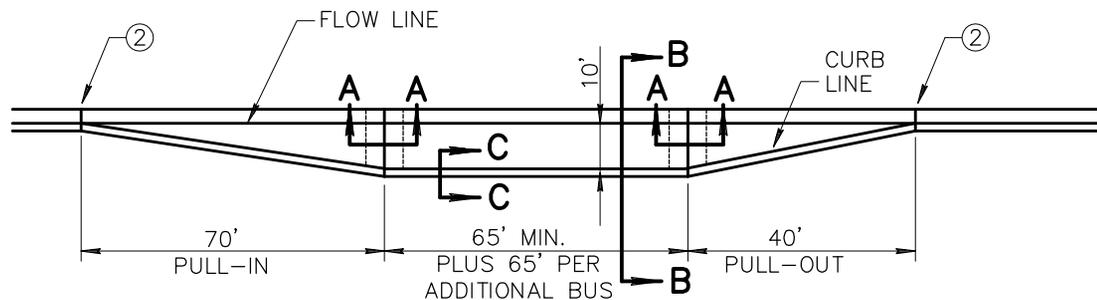
**RETURN TYPE DRIVEWAYS**

REVISED

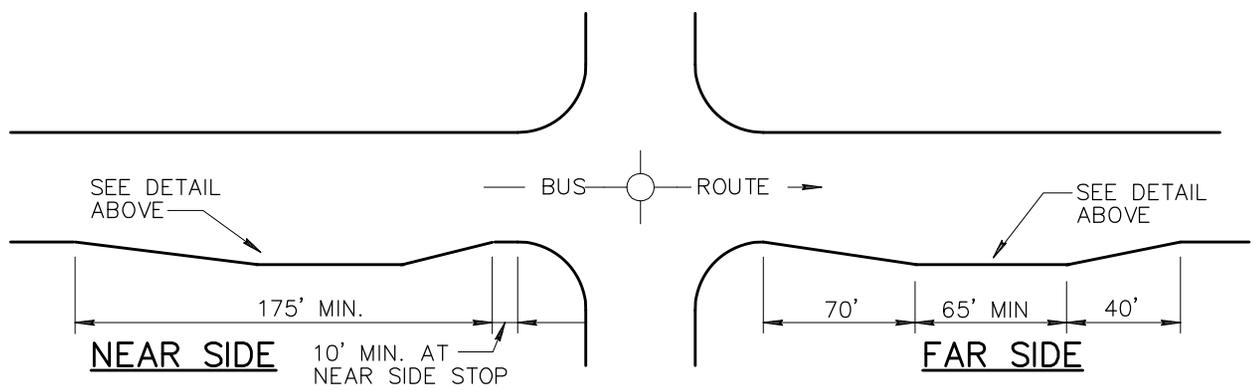
01-01-2003

DETAIL NO.

**251**

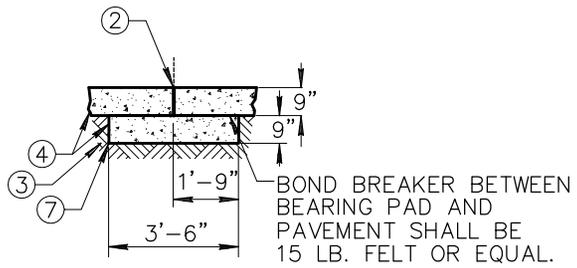


**DETAIL**

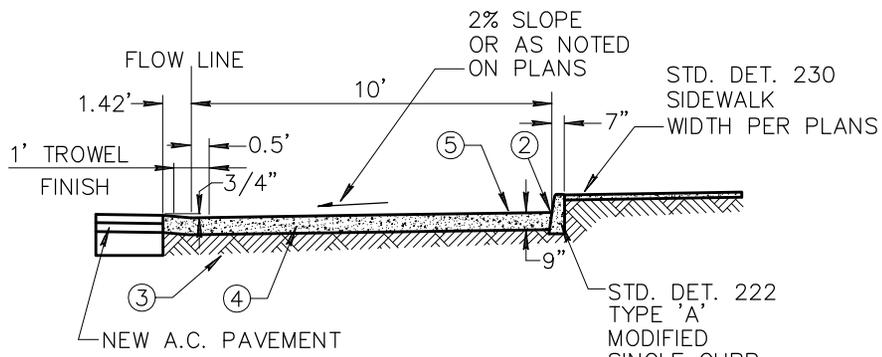


**NEAR SIDE**

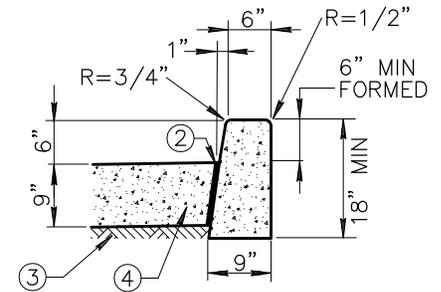
**FAR SIDE**



**SECTION A-A**



**SECTION B-B**



**SECTION C-C**

STD. DET. 222 TYPE 'A' MODIFIED SINGLE CURB

**NOTES:**

1. SUFFICIENT RIGHT-OF-WAY MUST BE AVAILABLE TO CONSTRUCT THE BUS BAY.
2. 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER ASTM D-1751 PER SPECIFICATION SECTION 729.
3. SUBGRADE PREPARATION PER SPECIFICATION SECTION 301 COMPACTED TO 95% MINIMUM DENSITY.
4. CONCRETE SHALL BE CLASS 'A' PER SPECIFICATION SECTION 725.
5. CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED, EXCEPT WHERE OTHERWISE NOTED.
6. CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB, 15 FT. MAXIMUM SPACING.
7. CONCRETE BEARING PAD (SECTION A-A) TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT.

DETAIL NO.

**252**



STANDARD DETAIL  
ENGLISH

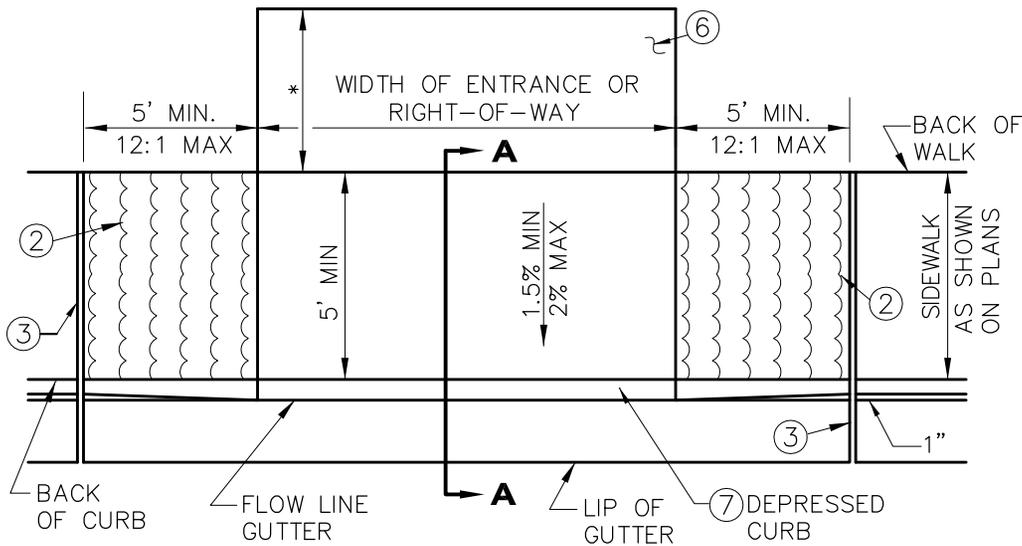
**BUS BAYS**

REVISED

01-01-2005

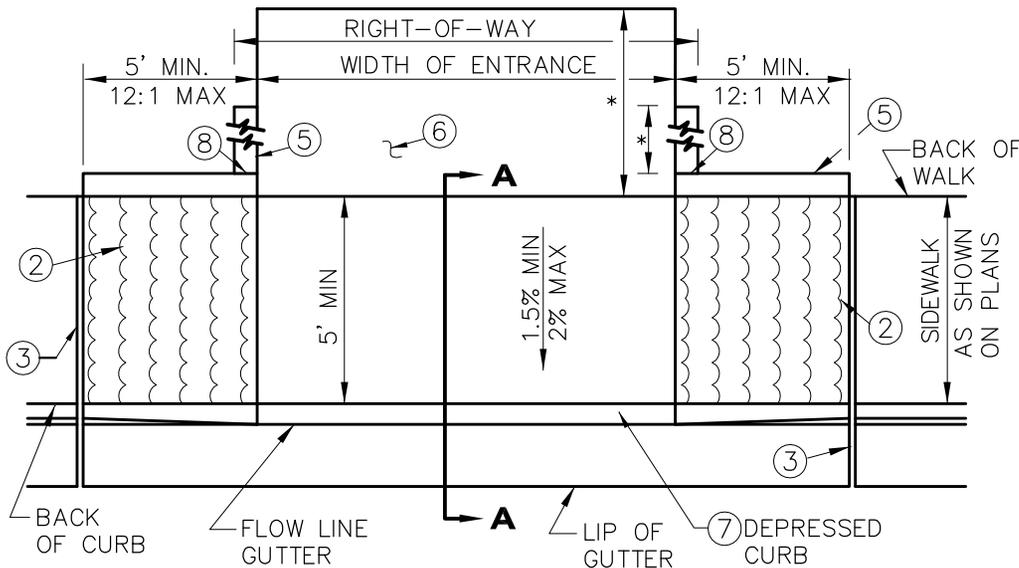
DETAIL NO.

**252**



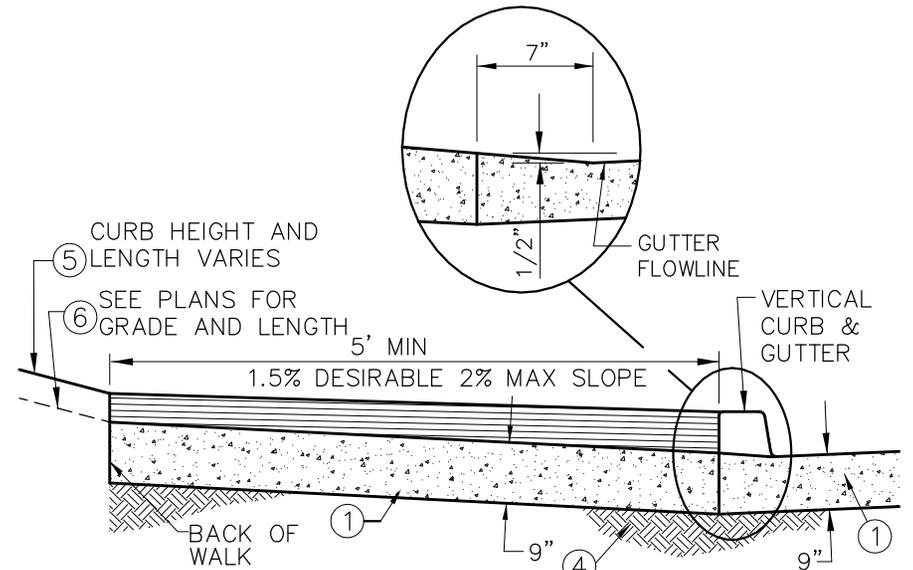
**TYPE A - WITHOUT RETAINING CURB**

\* SEE PLANS FOR ALLEY SURFACING REQUIREMENTS



**TYPE B - WITH RETAINING CURB**

\* SEE PLANS FOR RETAINING CURB LENGTHS, TOP OF CURB ELEVATIONS, AND ALLEY SURFACING REQUIREMENTS



**SECTION A-A**

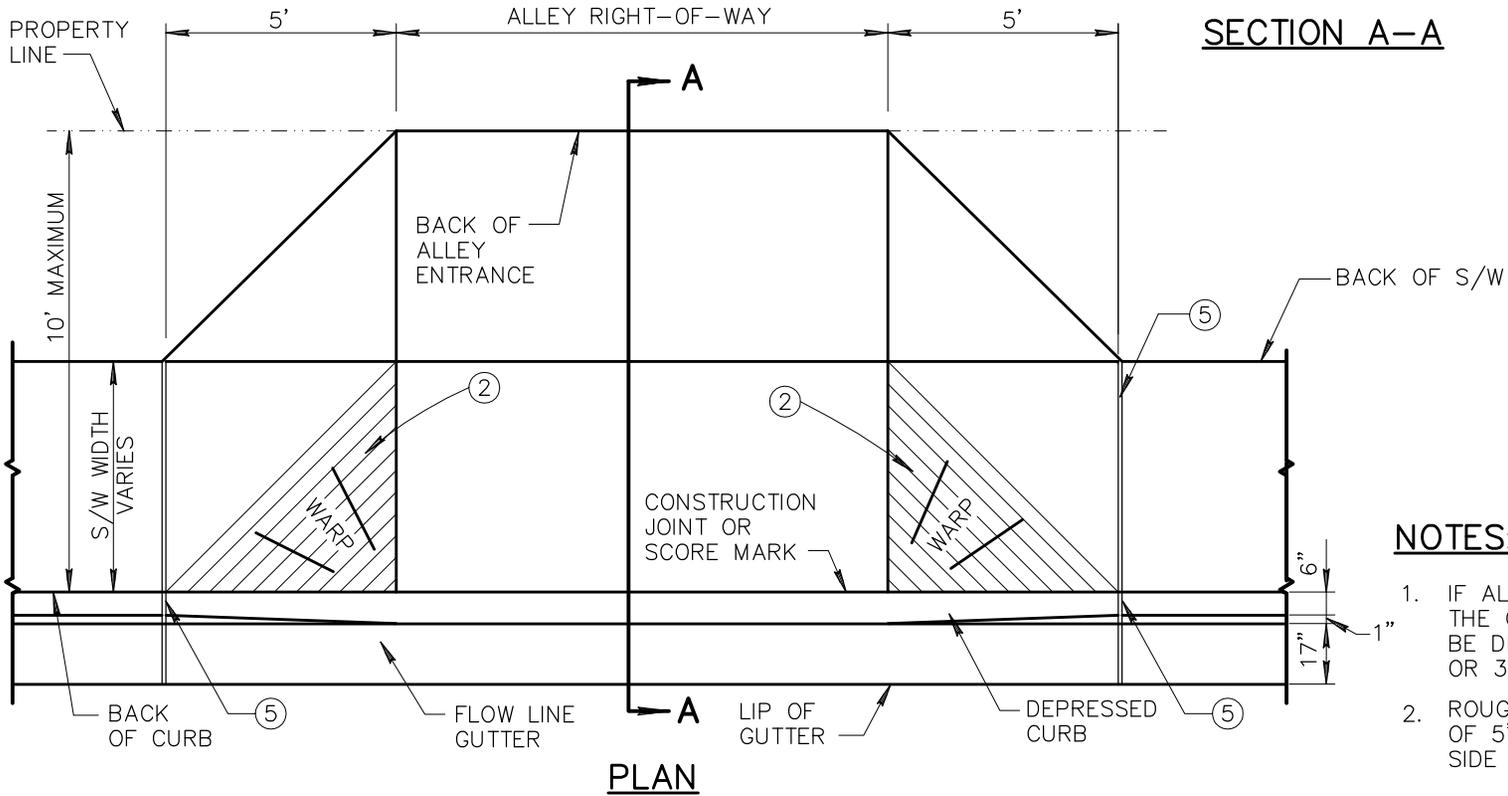
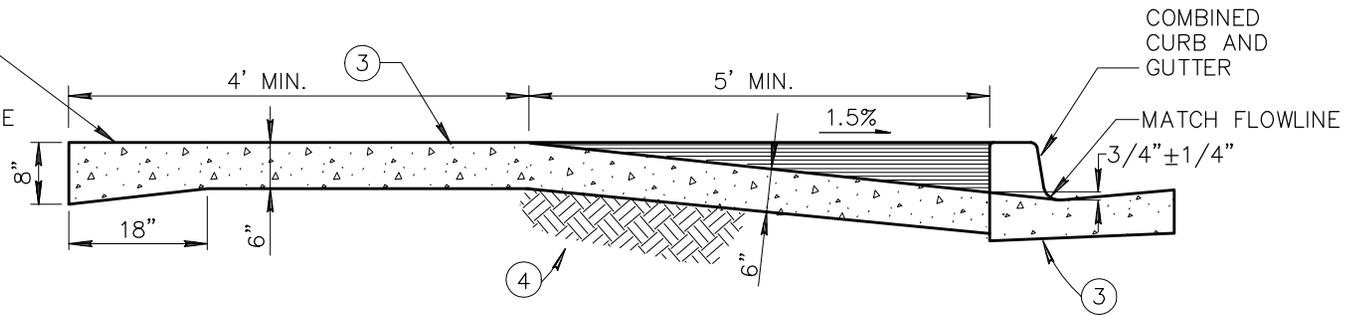


**ELEVATION**

**NOTES:**

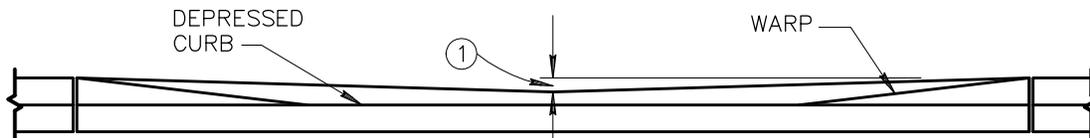
- ①. CLASS "A" CONCRETE PER SECTION 725.
- ②. LIMITS OF HEAVY ROUGH BROOM FINISH.
- ③. EXPANSION JOINTS PER SECTION 340.
- ④. SUBGRADE PREPARATION PER SECTION 301.
- ⑤. SINGLE CURB PER DETAIL 222, TYPE "B".
- ⑥. ALLEY SURFACING PER PLANS.
- ⑦. DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- ⑧. CONTROL JOINT.

THICKEN CONCRETE FROM 6" TO 8" IN 18" AT BACK OF ALLEY ENTRANCE



**NOTES:**

1. IF ALLEY ENTRANCE IS USED FOR DRAINAGE, THE CENTER BACK OF ALLEY ENTRANCE MAY BE DEPRESSED 2" FOR 4" CURB OR 3" FOR 6" CURB.
2. ROUGH BROOM FINISH FULL WIDTH OF 5' WARP SECTION, EACH SIDE OF ALLEY ENTRANCE.
3. CLASS 'B' CONCRETE CONSTRUCTION PER SECT. 725.
4. SUBGRADE PREPARATION, PER SECT. 301.
5. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.



**ELEVATION**

DETAIL NO.

**262**



STANDARD DETAIL  
ENGLISH

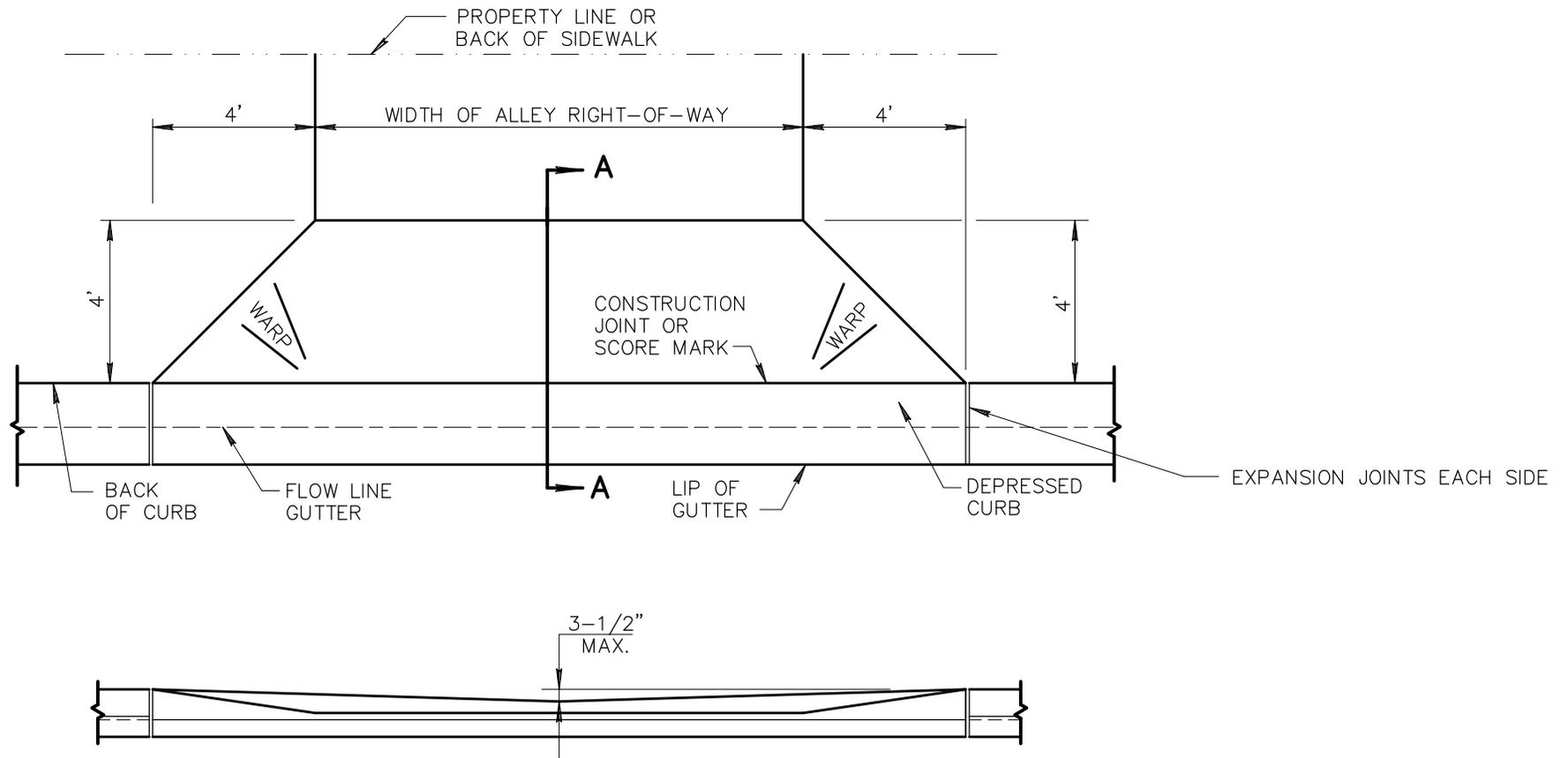
**WING TYPE ALLEY ENTRANCE  
(WITH COMBINED CURB AND GUTTER)**

REVISED

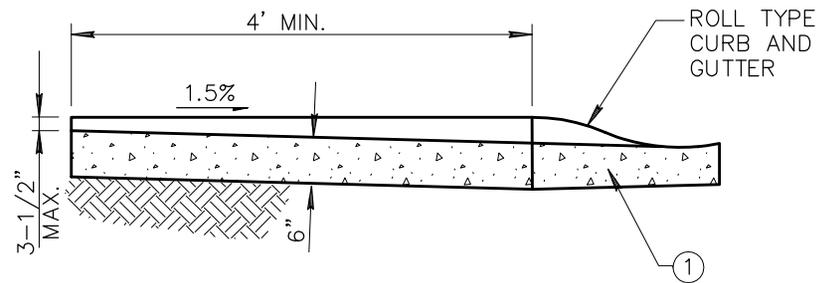
01-01-2012

DETAIL NO.

**262**



ELEVATION



SECTION A-A

**NOTES:**

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECT. 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECT. 340.
3. SUBGRADE PREPARATION PER SECTION 301.

DETAIL NO.

**263**



STANDARD DETAIL  
ENGLISH

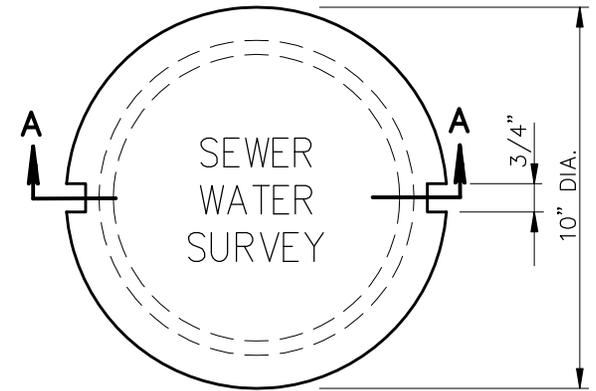
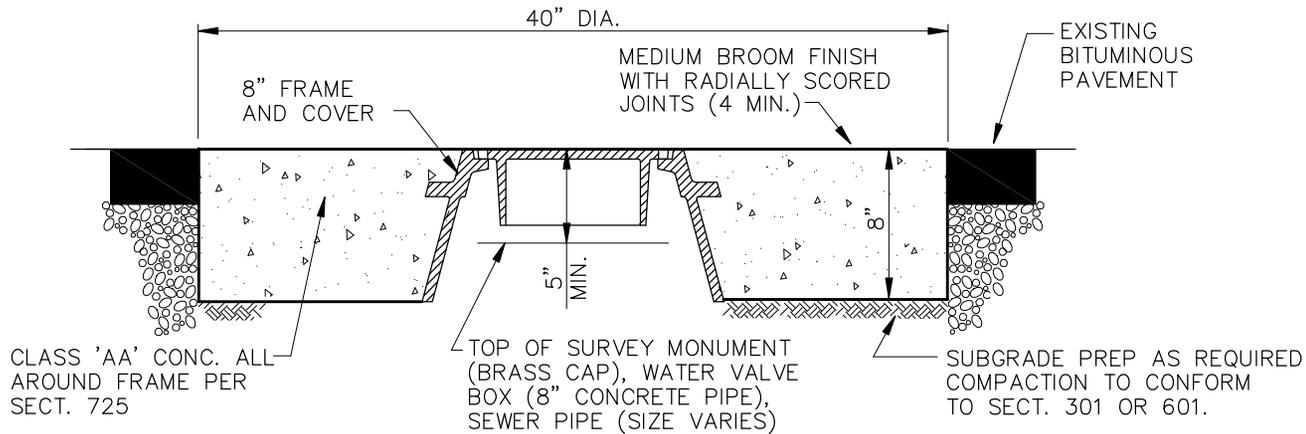
**WING TYPE ALLEY ENTRANCE  
(WITH ROLL TYPE CURB AND GUTTER)**

REVISED

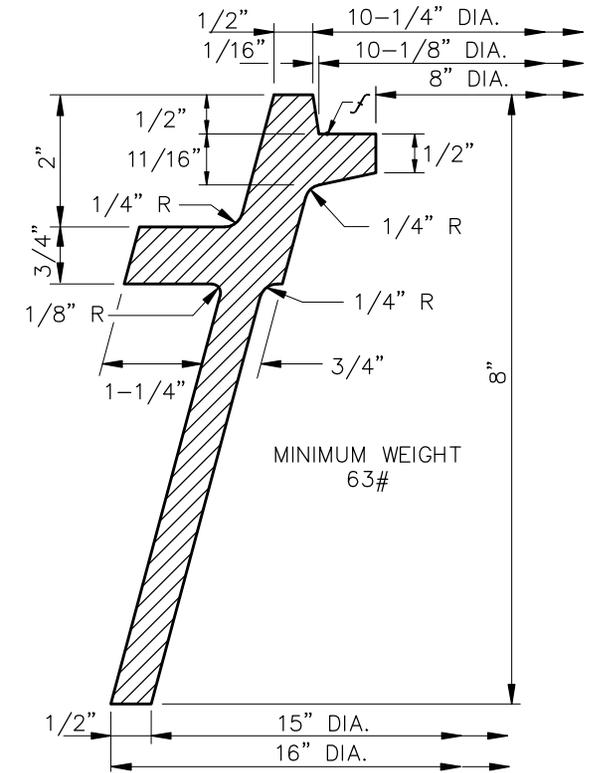
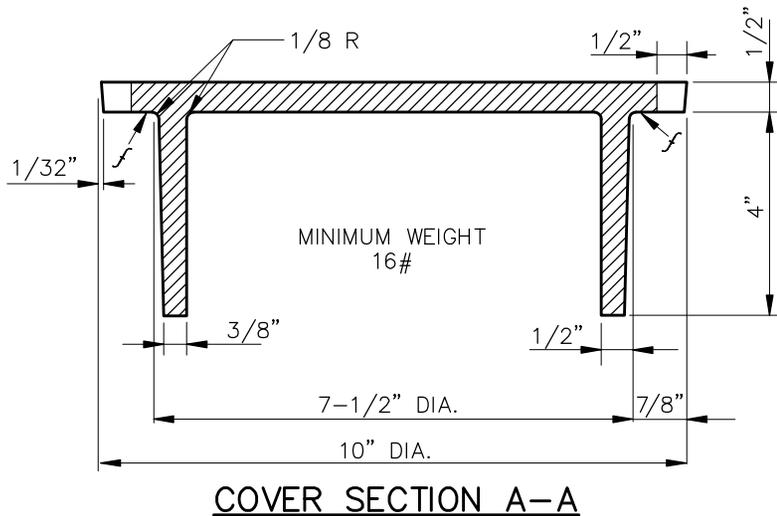
01-01-2002

DETAIL NO.

**263**



**CLEAN OUT FRAME & GRADE ADJUSTMENT  
WATER VALVE, SURVEY MONUMENT, OR SEWER**



**8" C.I. FRAME AND COVER**

**NOTES:**

1. CASTING TO CONFORM TO SECT. 787.
2. LETTERS ON COVER TO BE AS FOLLOWS:  
"SEWER", "WATER", OR "SURVEY" AS DIRECTED TOTAL WIDTH OF WORD "SEWER" OR "WATER" 3-3/4". TOTAL WIDTH OF WORD "SURVEY" 4-1/2". LETTER SIZE 5/8" x 3/4", RAISED 1/16" ABOVE LEVEL OF COVER, TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL.
3.  $\nearrow$  INDICATES MACHINE FINISHED SURFACE.

DETAIL NO.

270



STANDARD DETAIL  
ENGLISH

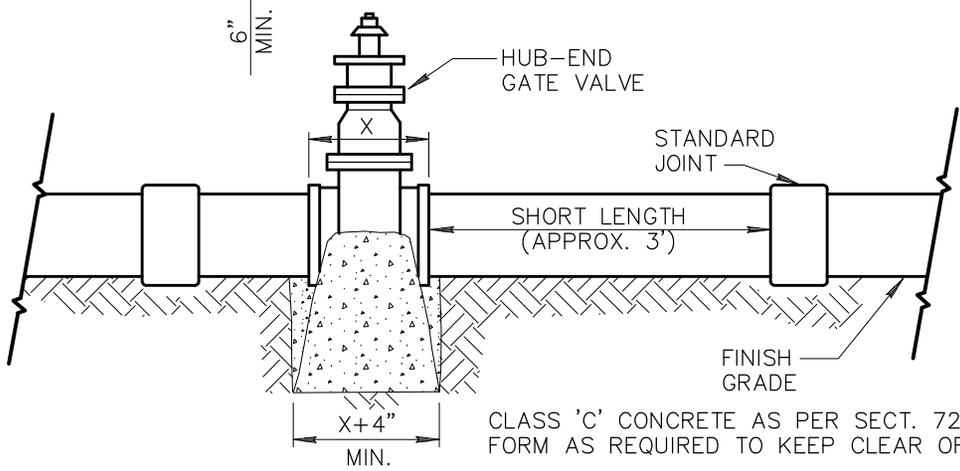
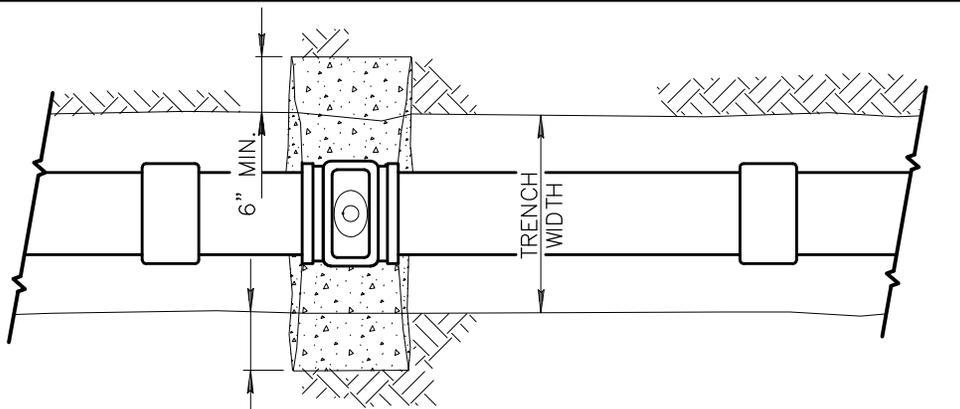
FRAME AND COVER

REVISED

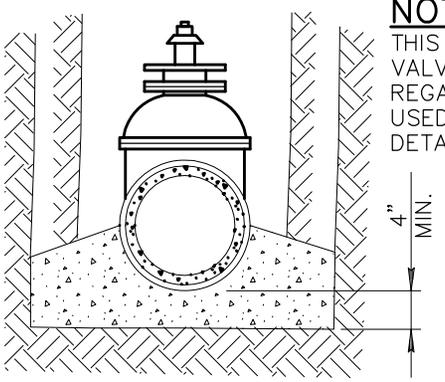
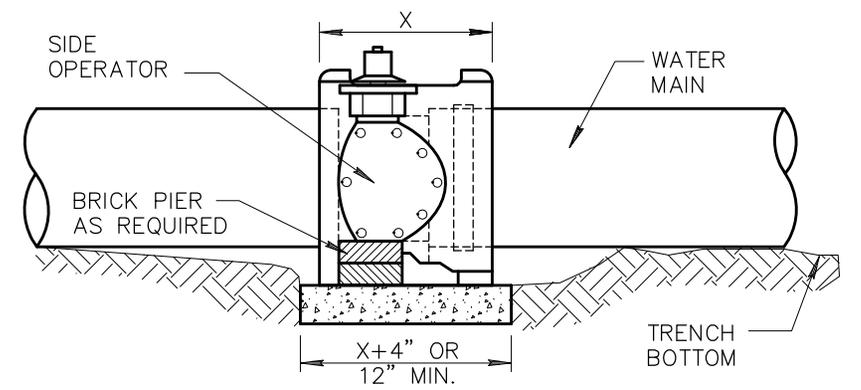
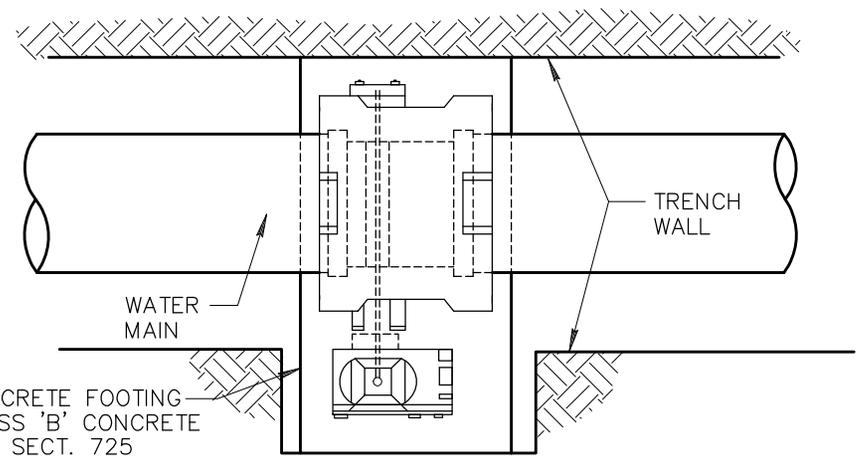
01-01-2014

DETAIL NO.

270

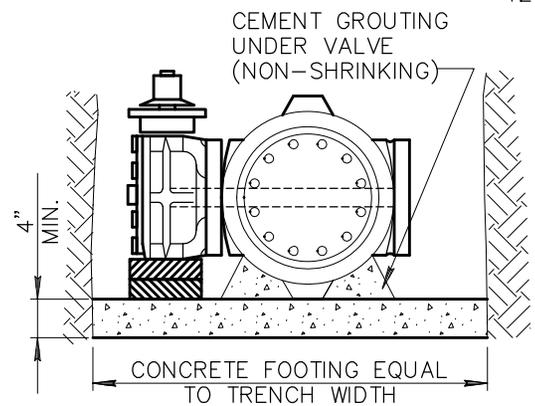


CLASS 'C' CONCRETE AS PER SECT. 725  
FORM AS REQUIRED TO KEEP CLEAR OF JOINTS.



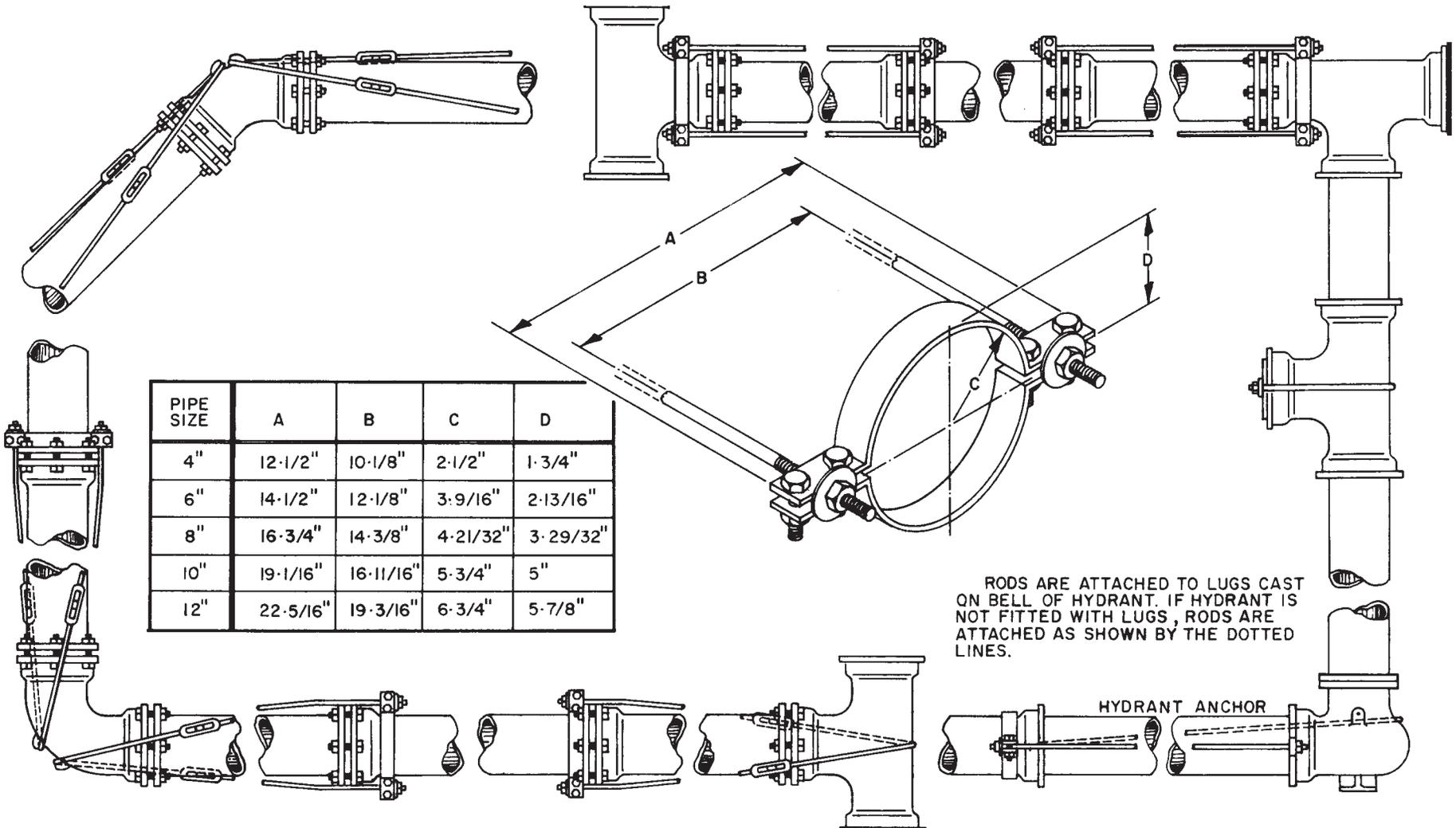
**WATER GATE VALVE**

**NOTE:**  
THIS DETAIL COVERS WATER GATE VALVES, 4" TO 12" INCLUSIVE REGARDLESS OF TYPE OF PIPE USED. LARGER LINES TO BE DETAILED ON PLANS.



**BUTTERFLY VALVE**

- NOTES:**
1. THIS DETAIL COVERS BUTTERFLY VALVE INSTALLATION, 3" TO 12" INCLUSIVE, REGARDLESS OF TYPE OF PIPE OR JOINT USED. LARGER LINES TO BE DETAILED ON PLANS.
  2. VALVE BOX AND COVER REQUIRED PER DETAILS 270 AND 391.



PIPE SIZE	A	B	C	D
4"	12-1/2"	10-1/8"	2-1/2"	1-3/4"
6"	14-1/2"	12-1/8"	3-9/16"	2-13/16"
8"	16-3/4"	14-3/8"	4-21/32"	3-29/32"
10"	19-1/16"	16-11/16"	5-3/4"	5"
12"	22-5/16"	19-3/16"	6-3/4"	5-7/8"

RODS ARE ATTACHED TO LUGS CAST ON BELL OF HYDRANT. IF HYDRANT IS NOT FITTED WITH LUGS, RODS ARE ATTACHED AS SHOWN BY THE DOTTED LINES.

HYDRANT ANCHOR

THIS DETAIL IS FOR USE ONLY ON UNDERGROUND INSTALLATIONS WHERE THE USE OF CONCRETE THRUST BLOCKING PER DETAIL 380 CANNOT BE USED BECAUSE OF OBSTRUCTIONS, OR REQUIREMENTS OF THE SPECIFICATIONS...

- \* CLAMPS SHALL BE 1/2 BY 2 INCHES FOR PIPE 4 AND 6 INCHES IN DIAMETER; 5/8 BY 2-1/2 INCHES FOR PIPE 8 AND 10 INCHES; 5/8 BY 3 INCHES FOR PIPE 12 INCHES. BOLT HOLES SHALL BE 1/16 INCH IN DIAMETER LARGER THAN BOLTS.
- \* RODS SHALL BE 3/4 INCHES IN DIAMETER FOR PIPES 4,6 AND 8 INCHES IN DIAMETER; 7/8 INCHES FOR PIPE 10 INCHES AND 1 INCH IN DIAMETER FOR PIPE 12 INCHES.
- \* BOLTS SHALL BE 5/8 INCHES IN DIAMETER FOR PIPE 4, 6 AND 8 INCHES IN DIAMETER; 3/4 INCHES FOR PIPE 10 INCHES AND 7/8 INCHES IN DIAMETER FOR PIPE 12 INCHES
- \* WASHERS MAY BE CAST IRON OR STEEL, ROUND OR SQUARE, DIMENSIONS FOR CAST IRON WASHERS ARE 5/8 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 3/4 BY 3-1/2 INCHES FOR PIPE 12 INCHES. DIMENSIONS FOR STEEL WASHERS ARE 1/2 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 1/2 BY 3-1/2 INCHES FOR PIPE 12 INCHES IN DIAMETER. HOLES SHALL BE 1/8 INCH LARGER THAN THE RODS.

FOR PIPE LARGER THAN 12 INCHES IN DIAMETER, RESTRAINT DETAILS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO INSTALLATION.

1. ALL TIE RODS, ROD COUPLINGS, TURNBUCKLES, BOLTS AND NUTS FOR THESE JOINTS SHALL BE OF CARBON STEEL EQUIVALENT TO A.S.T.M. A-307, GRADE B, WITH CADMIUM PLATING IN ACCORDANCE WITH A.S.T.M. A-165. EXCEPT THAT THE MIN. THICKNESS OF THE PLATING SHALL BE .0002 OF AN INCH. CADMIUM PLATED BOLTS SHALL HAVE CLASS 2A THREADS AND THE NUTS, ROD COUPLINGS AND TURNBUCKLES SHALL HAVE 2B THREADS.
2. HIGH STRENGTH, HEAT TREATED CAST IRON TEE-HEAD BOLTS WITH HEXAGON NUTS, ALL IN ACCORDANCE WITH THE STRENGTH REQUIREMENTS OF A.W.W.A. C-111, MAY BE USED IN LIEU OF THE CADMIUM PLATED BOLTS AND NUTS.
3. THE SKETCHES IN THIS SERIES OF FIGURES SHOW ACCEPTABLE METHODS OF PROVIDING ANCHORAGE. THERE IS NO PARTICULAR SIGNIFICANCE TO BE ATTACHED TO WHETHER THE SKETCH SHOWS A BELL AND SPIGOT JOINT OR A STANDARD MECHANICAL JOINT. THE ANCHORING PROCEDURE ILLUSTRATED APPLIES IN MOST CASES TO EITHER TYPE OF JOINT. IN SOME CASES, DIMENSIONS OF THE PARTICULAR PIPE OR HUB AND SPACE AVAILABLE FOR WORKING AROUND THE PARTICULAR JOINT WILL INFLUENCE THE CHOICE OF METHODS USED.
4. IN CERTAIN ASSEMBLIES OF RODS AND CLAMPS SHOWN, RODS RUN FROM A LUG ON THE FITTING (OR A CLAMP BEHIND THE HUB OF A BELL) TO A CLAMP AGAINST A FACE OF A BELL. NOTE THAT THIS ARRANGEMENT ANCHORS ONLY ONE JOINT. THE STABILITY OF THE JOINT WHERE THE CLAMP IS AGAINST THE FACE OF THE BELL DEPENDS ON HAVING SOIL ABOVE A RELATIVELY LONG PIECE OF PIPE ON BOTH SIDES OF THE JOINT. CONSEQUENTLY, IF THE DISTANCE BETWEEN THE FIRST AND SECOND JOINTS IS LESS THAN 12 FEET, THE SECOND JOINT SHOWN SHALL BE ANCHORED BY A CLAMP BEHIND THE HUB OF THE BELL AND RODS TO A CLAMP AT THE FACE OF THE NEXT BELL.
5. COATING TYPE: A.H.D. ASPHALTIC PRIMER 719(A). - ALL EXPOSED METAL.

SHEET 2 OF 2

DETAIL NO.  
302-2

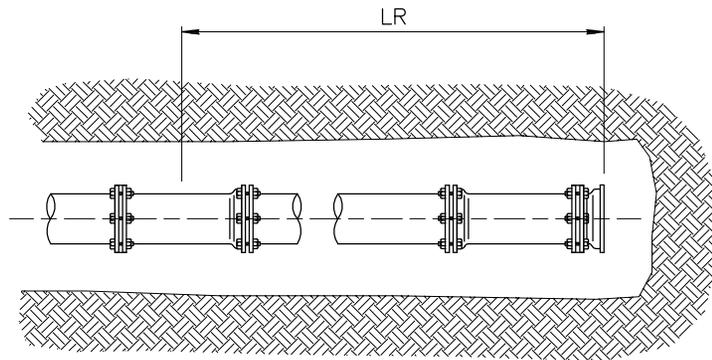


STANDARD DETAIL  
ENGLISH

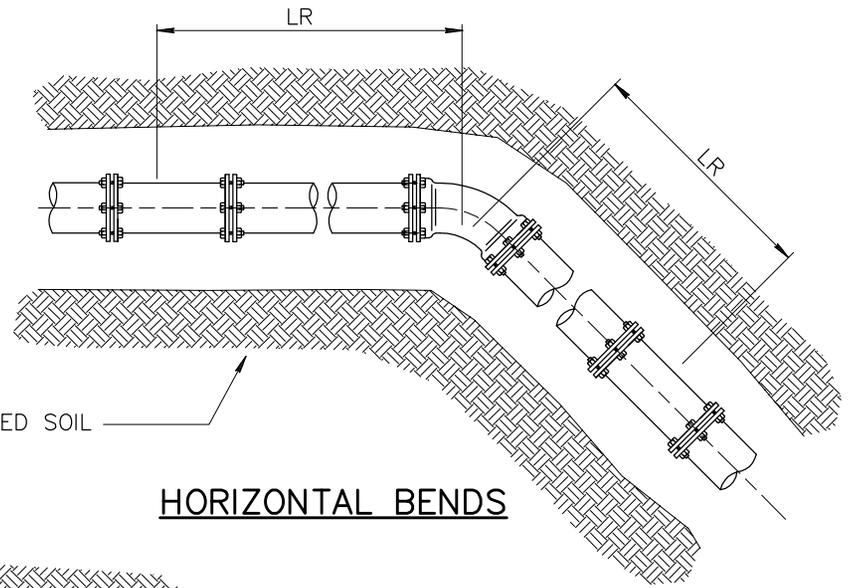
JOINT RESTRAINT WITH TIE RODS

REVISED  
01-01-1998

DETAIL NO.  
302-2

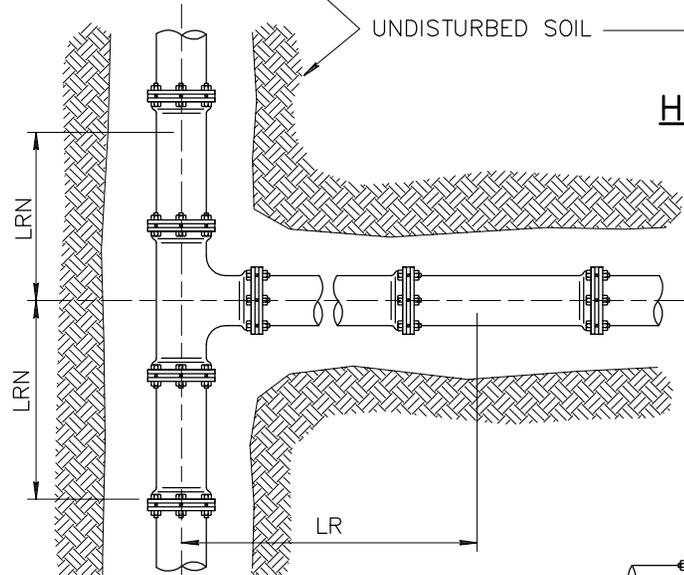


**DEAD ENDS**

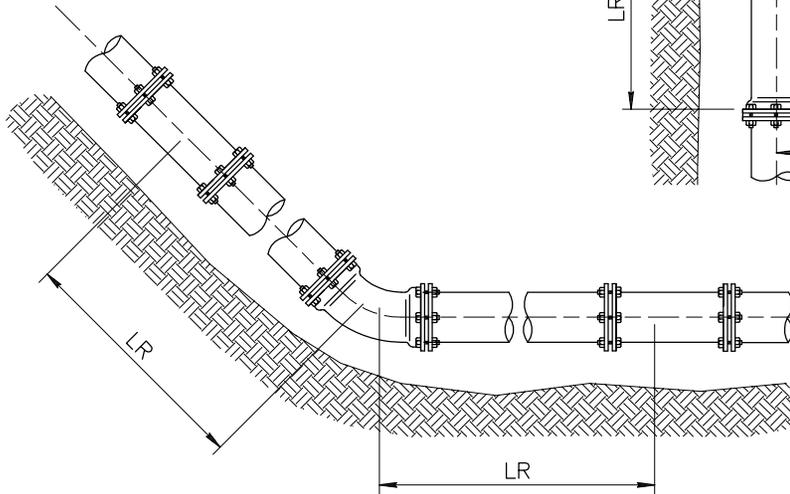


**HORIZONTAL BENDS**

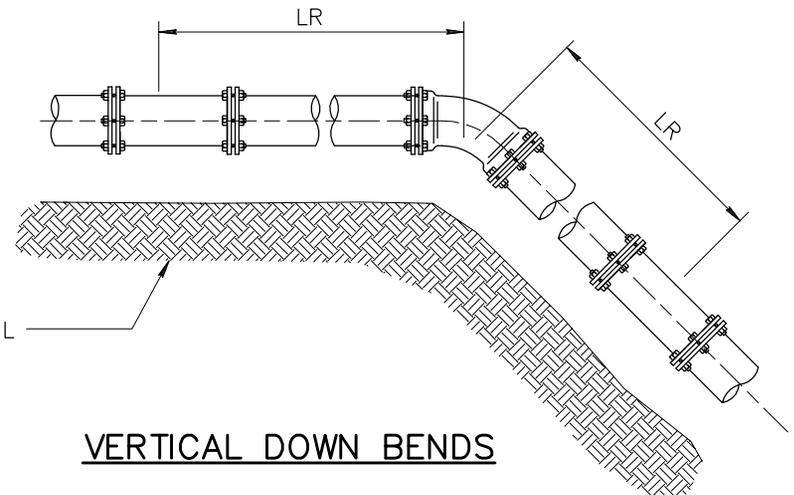
LRN = SHORTEST LENGTH OF PIPE RESTRAINED TO THE RUN OF THE TEE FITTING (BOTH SIDES OF TEE).



**TEES**



**VERTICAL UP BEND**



**VERTICAL DOWN BENDS**

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	18	7	4	30	8	31	18	13	7	6	3	31
6	25	10	5	43	20	44	25	18	10	9	5	44
8	32	13	6	56	34	58	32	24	13	11	6	58
10	38	16	8	68	45	69	38	29	16	14	8	69
12	45	19	9	80	57	81	45	34	19	16	9	81
14	51	21	10	91	68	92	51	38	21	18	10	92
16	57	24	11	103	79	104	57	43	24	21	11	104
18	62	26	12	113	90	115	62	48	26	23	12	115
20	68	28	14	125	100	126	68	52	28	25	14	126
24	79	33	16	145	121	147	79	61	33	29	16	147

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE WITH POLYETHYLENE WRAP												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	26	11	5	69	18	72	26	30	11	14	5	72
6	36	15	7	99	47	102	36	42	15	20	7	102
8	47	19	9	130	78	133	47	55	19	26	9	133
10	56	23	11	157	103	159	56	66	23	32	11	159
12	65	27	13	185	131	187	65	77	27	37	13	187
14	74	31	15	211	156	214	74	89	31	42	15	214
16	82	34	16	238	183	241	82	100	34	48	16	241
18	90	37	18	263	207	266	90	110	38	53	18	266
20	98	41	20	289	233	292	98	121	41	58	20	292
24	113	47	22	337	280	340	113	141	47	68	22	340

**NOTES:**

1. ALL JOINTS WITHIN THE SPECIFIED LENGTH LR MUST BE RESTRAINED.  
ALL LENGTHS ARE GIVEN IN FEET.
2. THE MAXIMUM TEST PRESSURE SHALL NOT EXCEED 200 PSI
3. THE MINIMUM DEPTH OF BURY SHALL BE 3' TO TOP OF PIPE.
4. RESTRAINED LENGTHS MAY BE REDUCED WHEN SUPPORTED BY ENGINEERING CALCULATIONS.

DETAIL NO.

303-2



STANDARD DETAIL  
ENGLISH

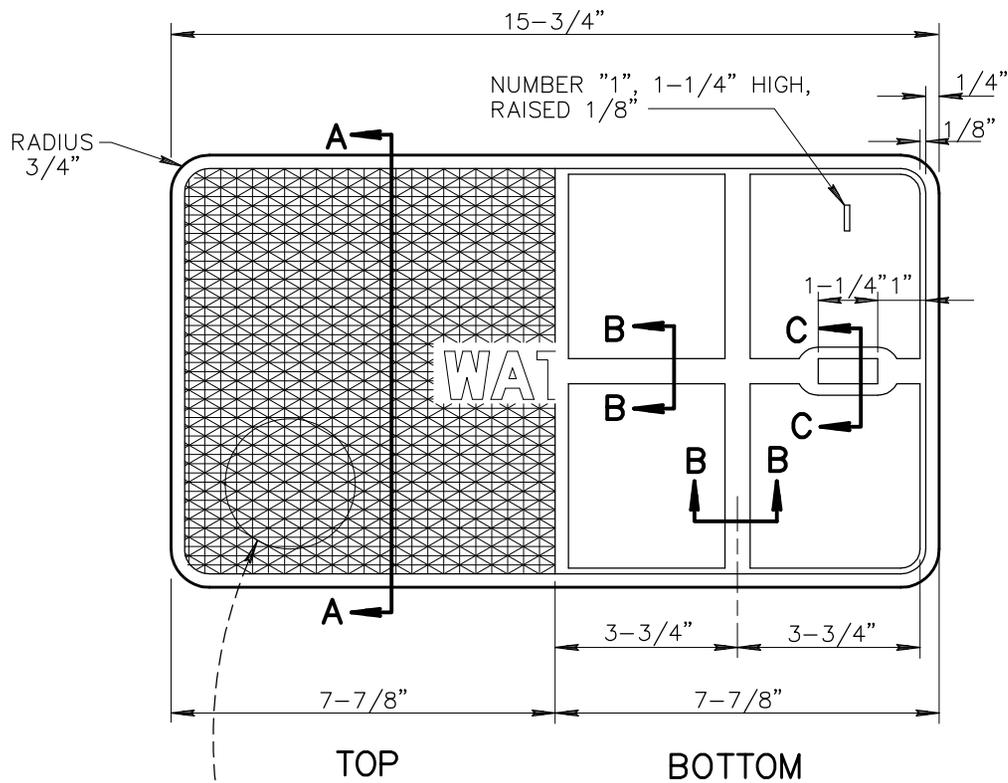
**JOINT RESTRAINT FOR DUCTILE IRON AND  
POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES**

REVISED

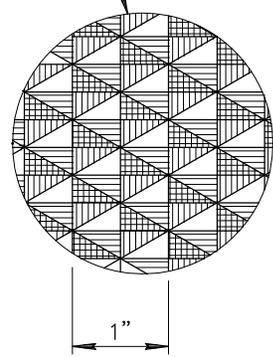
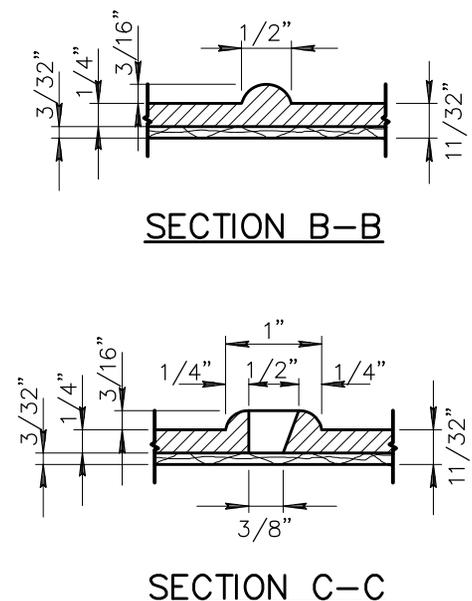
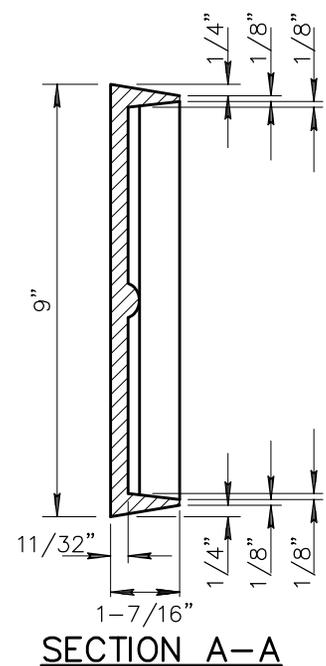
01-01-1998

DETAIL NO.

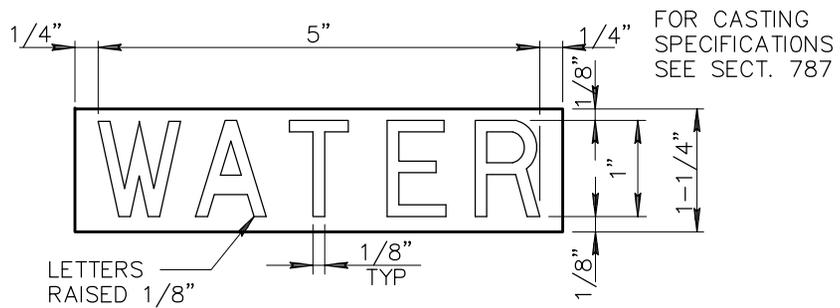
303-2



PLAN



TOP OF COVER



DETAIL NO.  
**310**



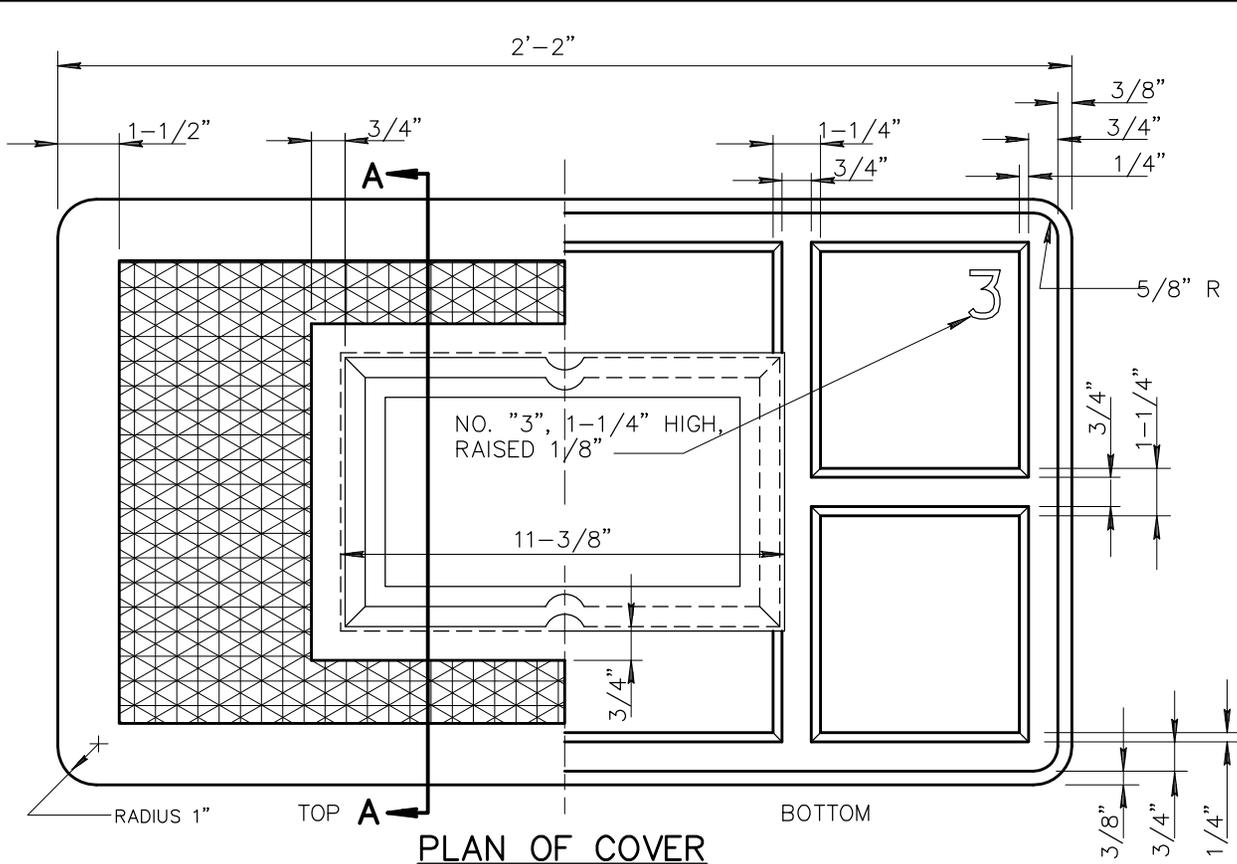
STANDARD DETAIL  
ENGLISH

**CAST IRON WATER METER BOX  
COVER NO. 1**

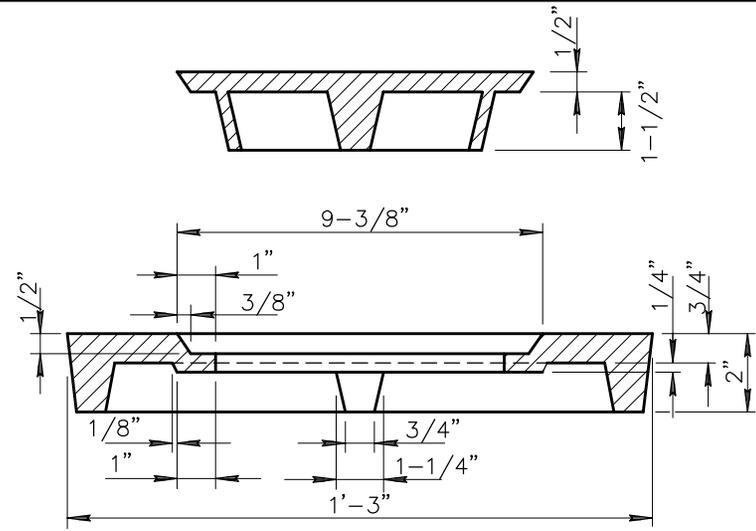
REVISED  
01-01-1998

DETAIL NO.  
**310**





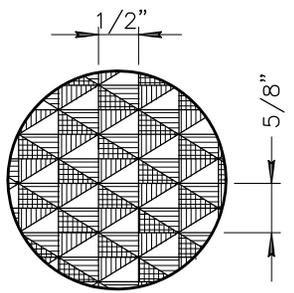
**PLAN OF COVER**



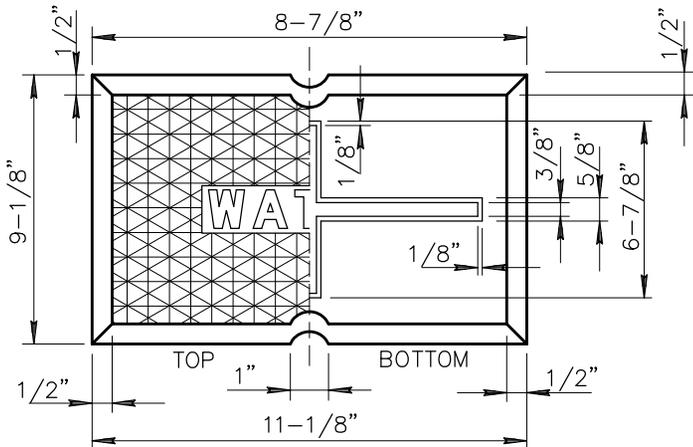
**SECTION A-A**

**NOTES:**

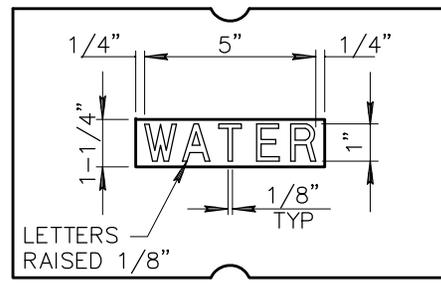
1. INSPECTION PLATE IS SAME AS USED WITH METER BOX COVER NO. 4.
2. FOR CASTING SPECIFICATIONS, SEE SECTION 787.
3. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.



**DETAIL**

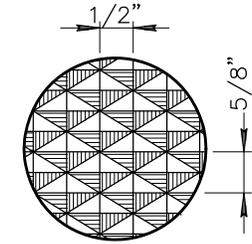
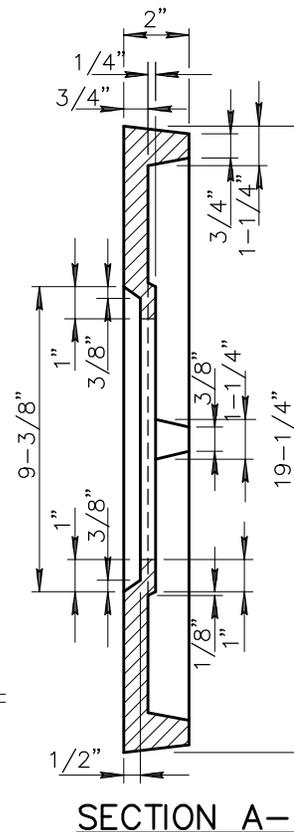
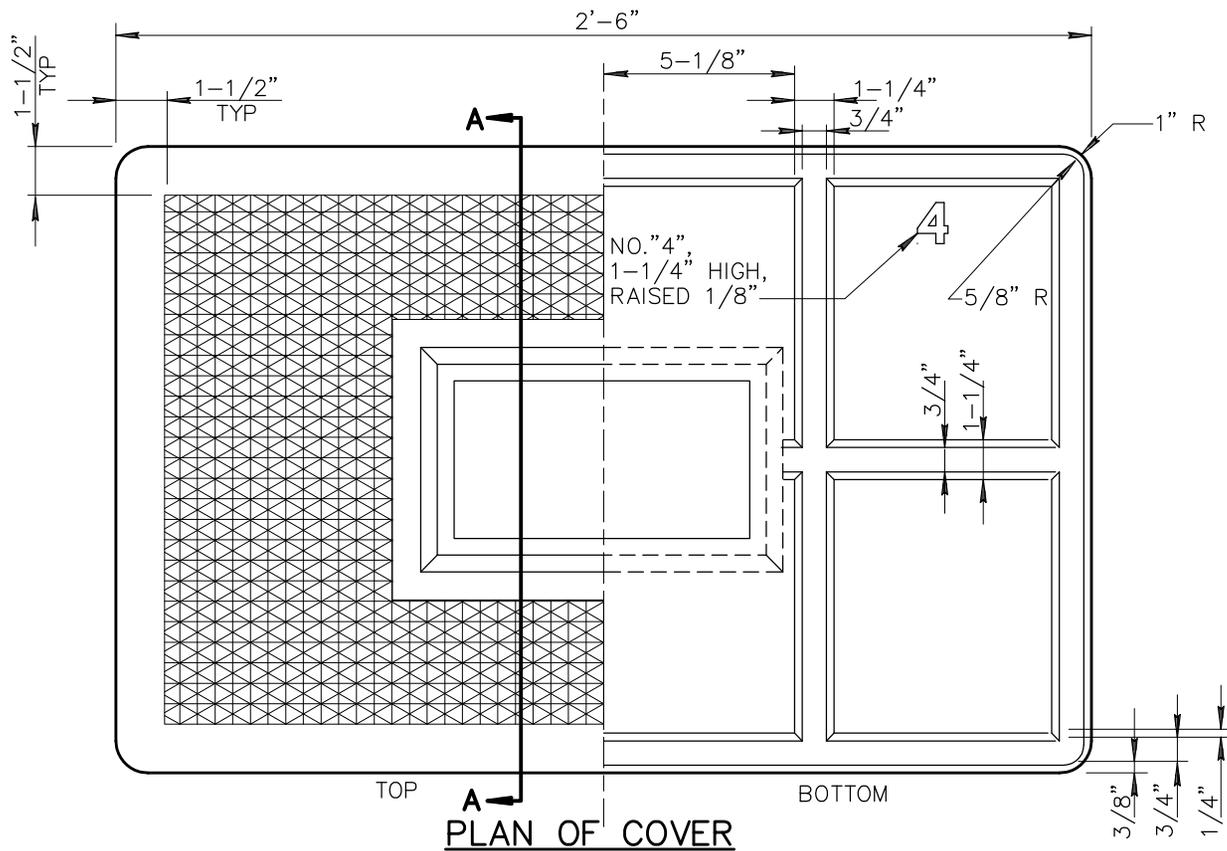


**INSPECTION PLATE**

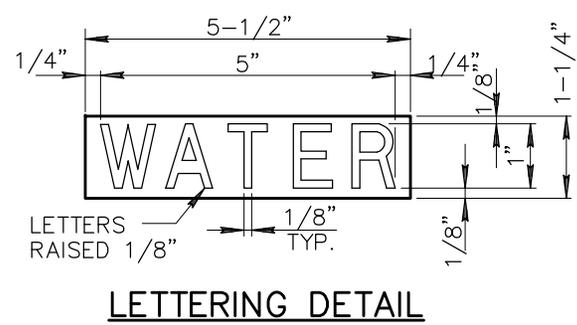
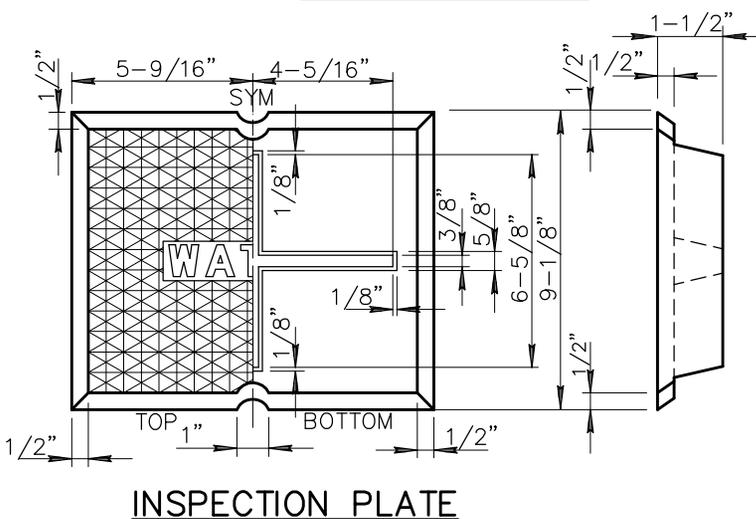


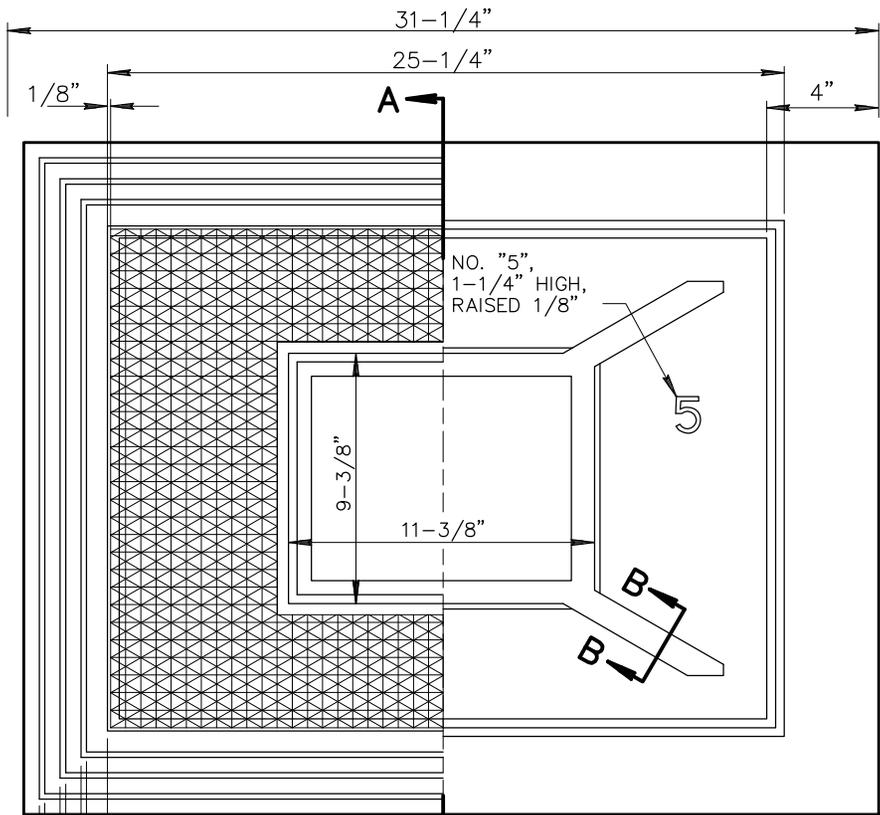
**LETTERING DETAIL**

**TOP OF COVER & PLATE**

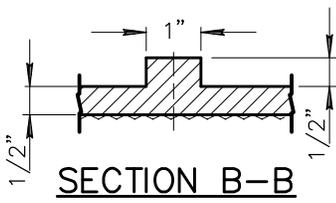
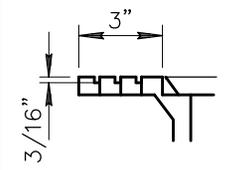
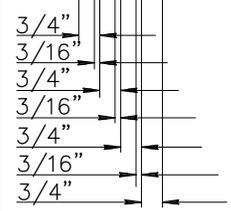


- NOTES:**
1. FOR CASTING SPECIFICATIONS, SEE SECT. 787. THE BEARING
  2. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.

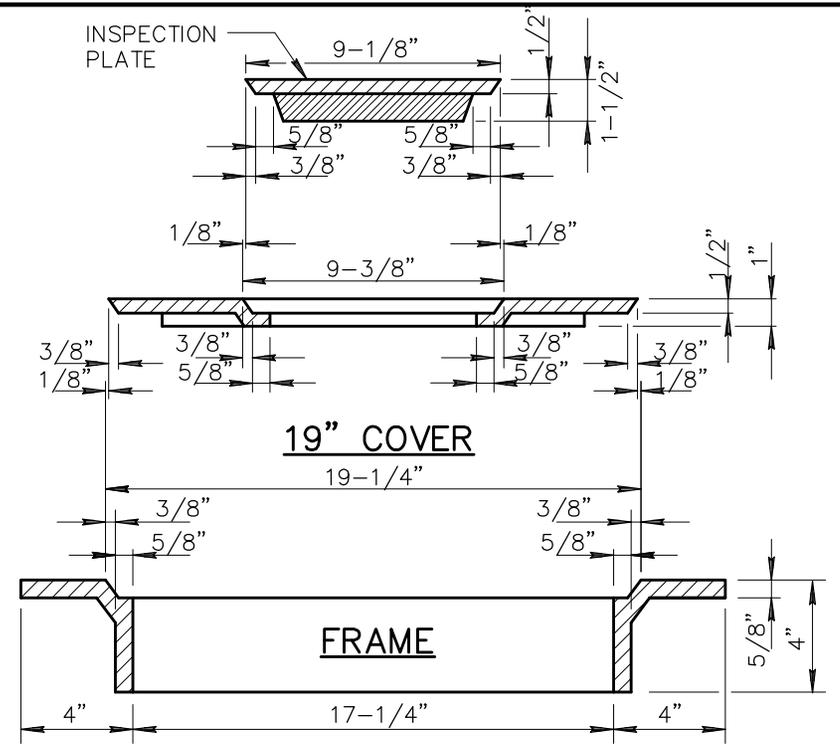




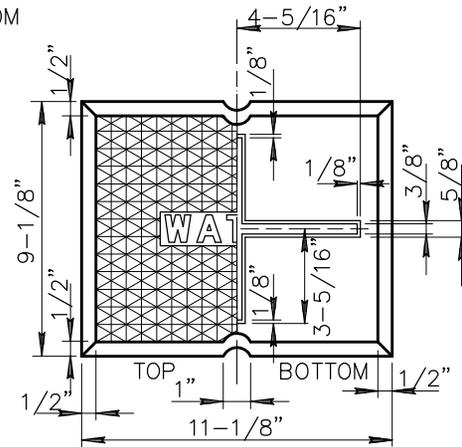
**PLAN OF COVER**



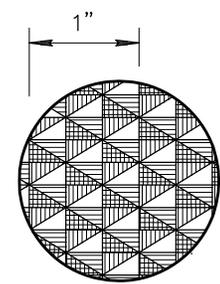
**SECTION B-B**



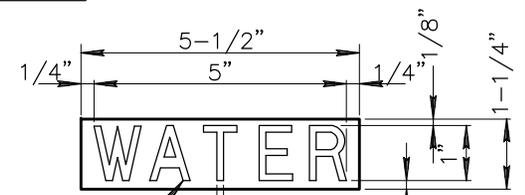
**SECTION A-A**



**INSPECTION PLATE**



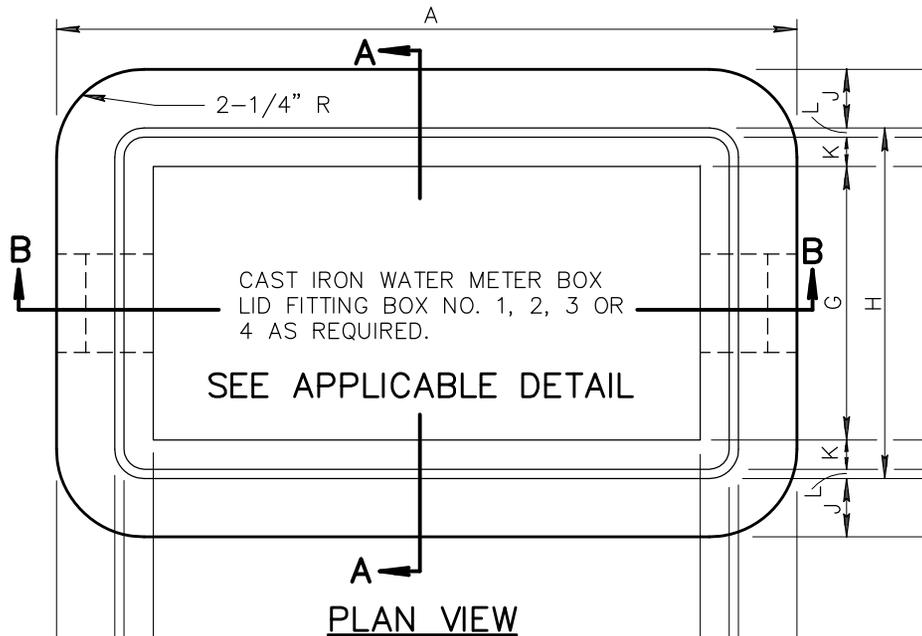
**DETAIL TOP OF COVER**



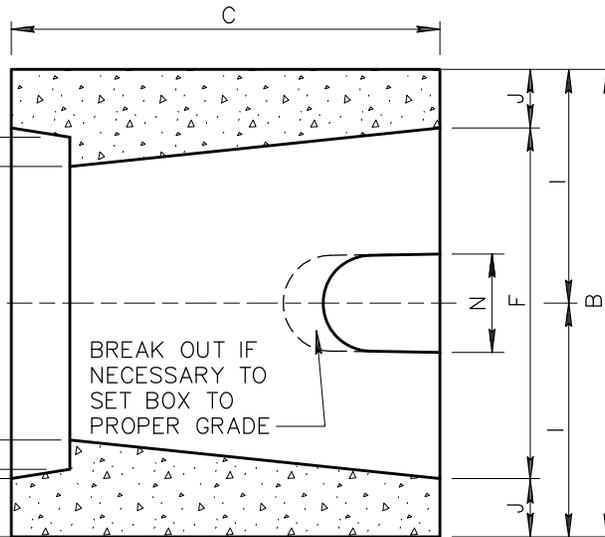
**LETTERING DETAIL**

**NOTES:**

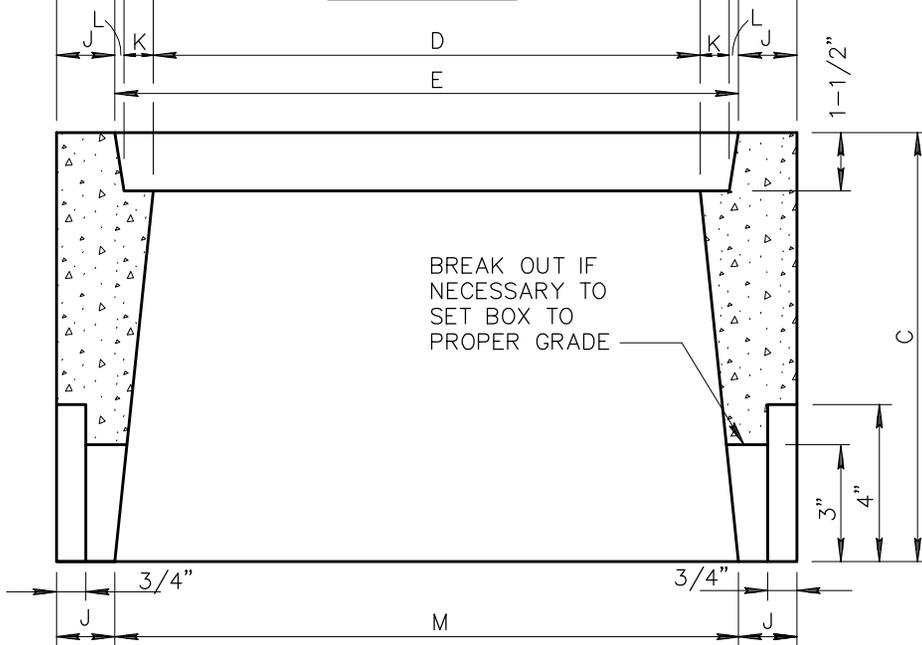
1. FOR CASTING SPECIFICATIONS, SEE SECT. 787.
2. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.



**PLAN VIEW**



**SECTION A-A**



**SECTION B-B**

**NOTES:**

1. THE METER BOXES SHALL CONFORM TO THE DIMENSIONS AS SHOWN AND SHALL BE MADE OF PORTLAND CEMENT CONCRETE POURED AND TAMPED (OR VIBRATED) IN TRUE FORMS.
2. USE CLASS 'AA' CONCRETE PER SECT. 725.

METER BOX DIMENSIONS				
DIMS	BOX NUMBER			
	1	2	3	4
A	19"	24-1/2"	29-1/2"	33-1/2"
B	12"	16-3/4"	18-1/2"	22-3/4"
C	11"	12"	13"	12"
D	14"	19"	23-3/4"	27-3/4"
E	16"	22"	26-1/2"	30-1/2"
F	9"	13-1/4"	15"	19-3/4"
G	7"	11-1/4"	12-3/4"	17"
H	9"	14-1/4"	15-1/2"	19-3/4"
I	6"	8-3/8"	9-1/4"	11-3/8"
J	1-1/2"	1-3/4"	1-3/4"	1-1/2"
K	3/4"	1-1/8"	1"	1"
L	1/4"	3/8"	3/8"	3/8"
M	16"	21"	25-1/2"	30-1/2"
N	2-1/2"	3-1/2"	4"	4"
	5/8" OR 3/4" METER	1" METER	1-1/2" METER	2" METER

DETAIL NO.

**320**



STANDARD DETAIL  
ENGLISH

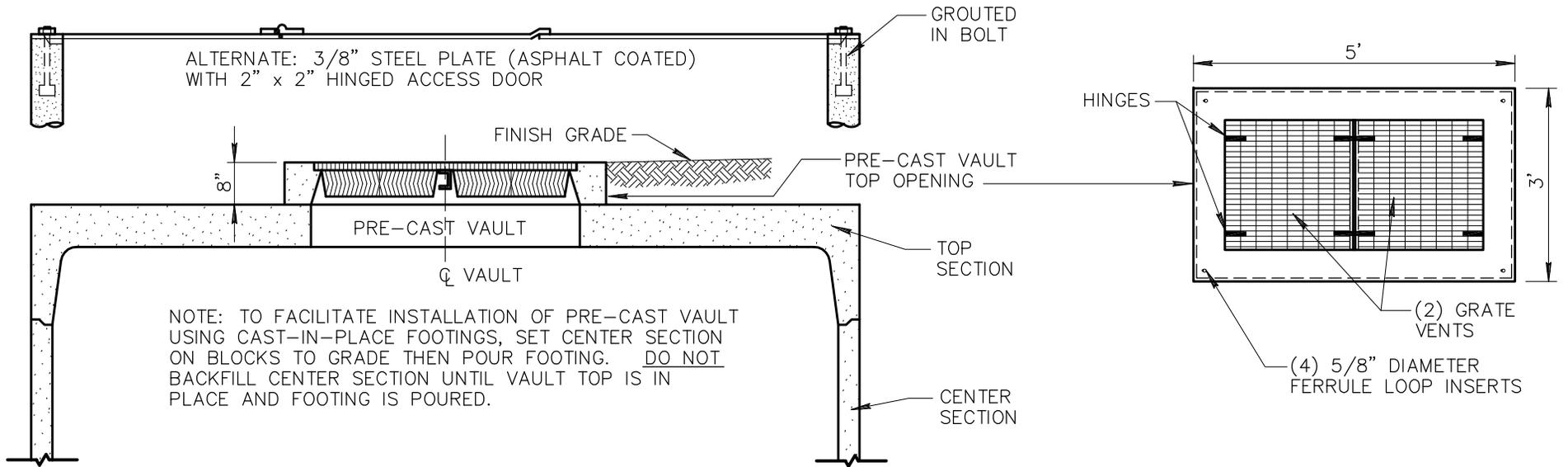
**CONCRETE WATER METER BOXES**

REVISED

01-01-1998

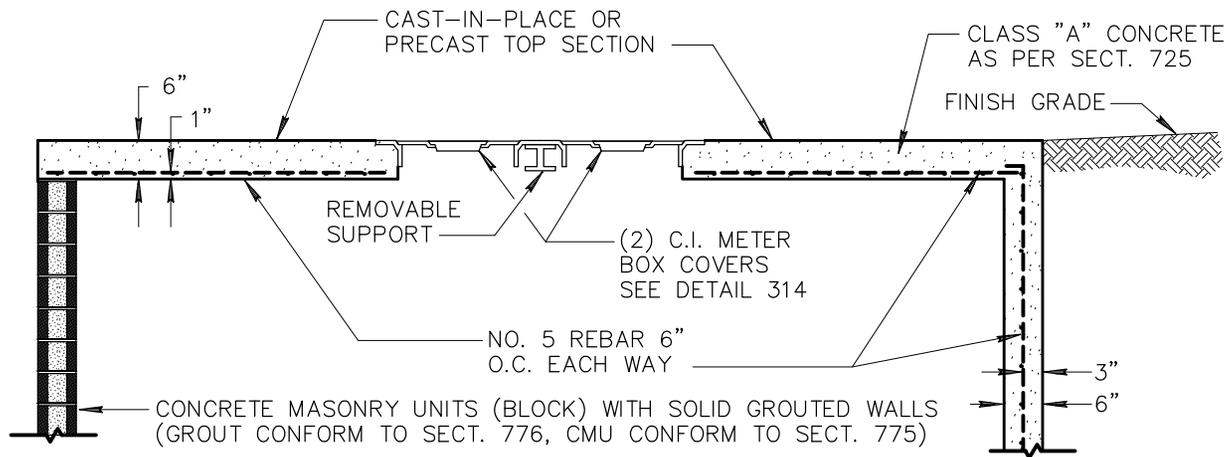
DETAIL NO.

**320**



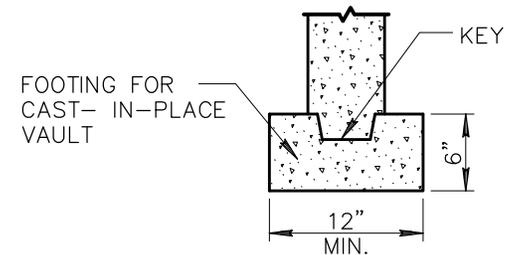
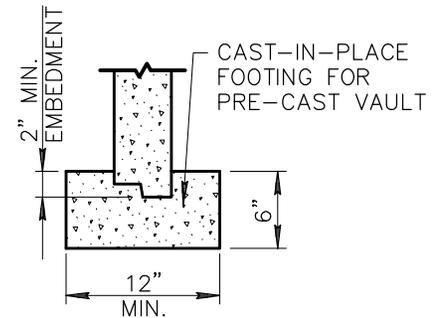
**PRE-CAST VAULT SECTION**

NOTE: PRECAST REINFORCED VAULT SECTIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS AS APPROVED BY ENGINEER.



BLOCK MASONRY MAY BE USED IN LIEU OF CAST-IN-PLACE VAULT WALLS, NO. 4 REBAR IN EVERY OTHER CORE.

**CAST-IN-PLACE VAULT SECTION**



DETAIL NO.

321



STANDARD DETAIL  
ENGLISH

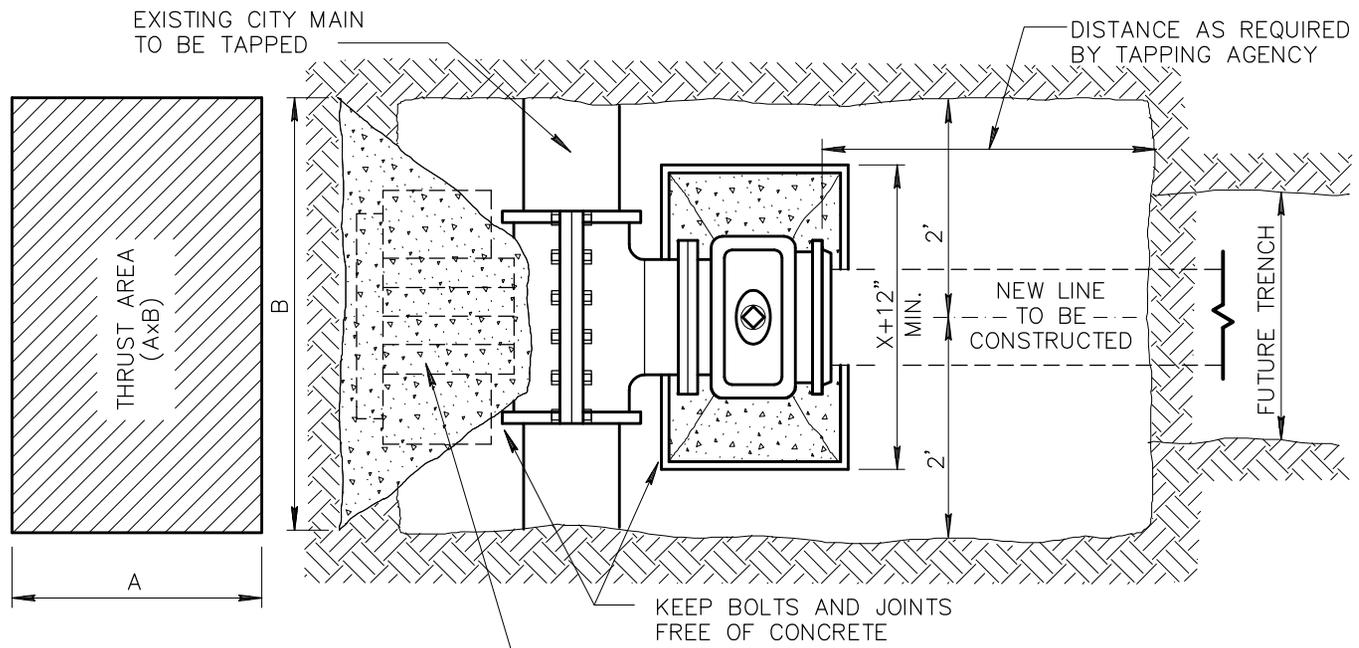
STANDARD WATER METER VAULT

REVISED

01-01-1998

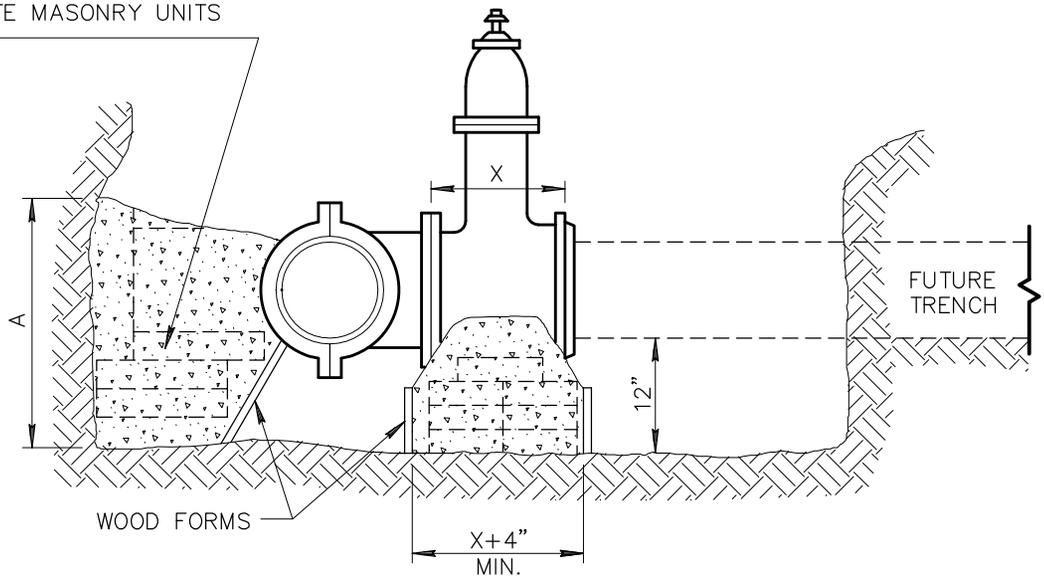
DETAIL NO.

321



**PLAN**

OPTIONAL BLOCKING – 2" x 8" x 12" SOLID CONCRETE MASONRY UNITS AS INDICATED.

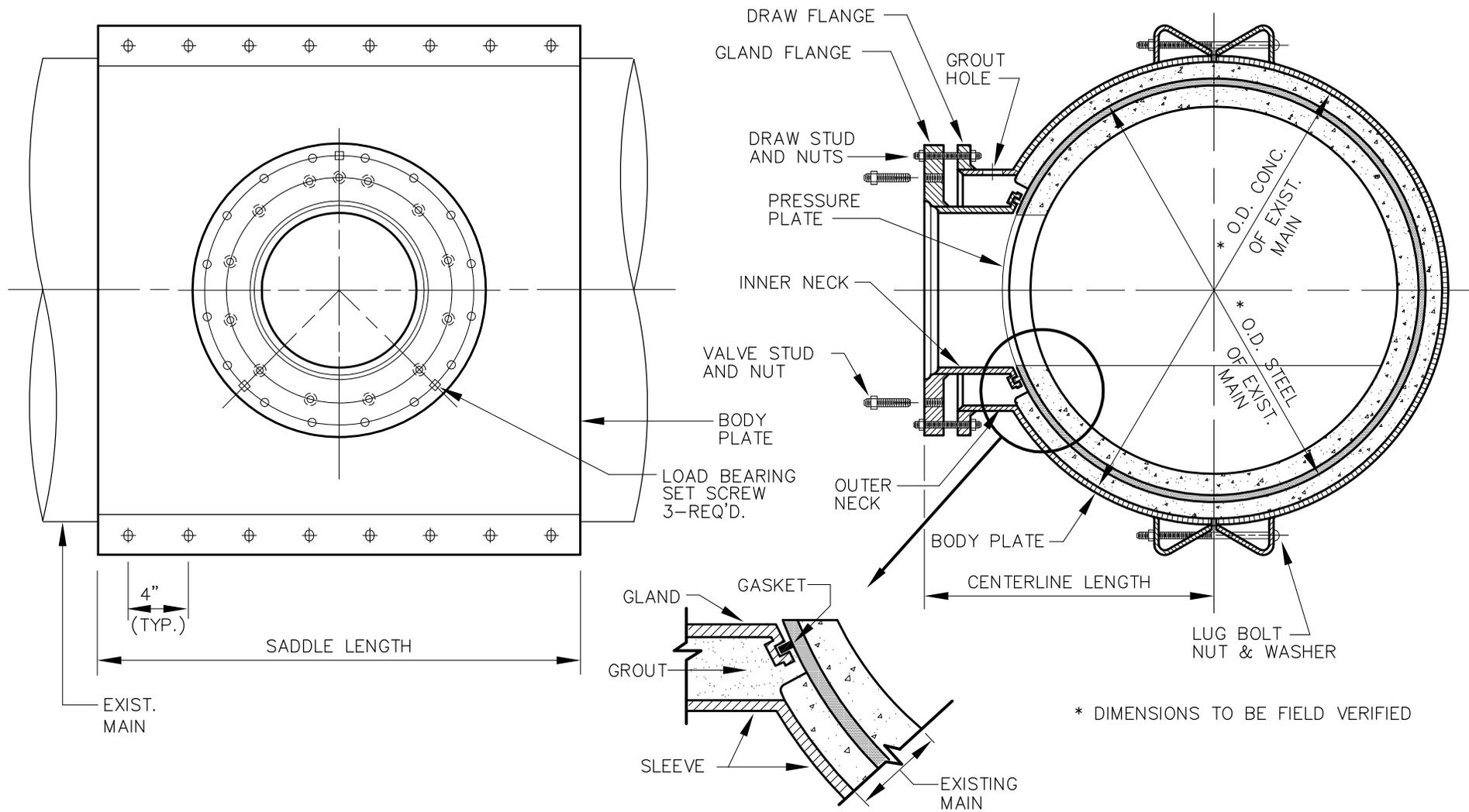


**ELEVATION**

**NOTES:**

1. TAPPING SLEEVE TO BE PLACED A MINIMUM OF 18" FROM ANY BELL COUPLING, VALVE, FITTING OR OTHER OBSTRUCTION
2. CONTRACTOR SHALL EXCAVATE AS SHOWN AND SHALL SET TAPPING SLEEVE AND VALVE AND TIGHTEN ALL BOLTS PRIOR TO THE PRESSURE TEST.
3. ALL TAPPING SLEEVES AND VALVES MUST BE PRESSURE TESTED PRIOR TO BLOCKING OR TAPPING. THE TEST MUST BE WITNESSED AND APPROVED BY THE INSPECTOR.
4. BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND AND BE INSTALLED BEFORE THE TAP IS MADE. ALL FLANGE BOLTS SHALL BE FREE AND CLEAR OF CONCRETE.
5. CONCRETE THRUST BLOCKS SHALL BE CLASS 'B' PER SECT. 725. NORMALLY, CURE TIME FOR CONCRETE IS 24 HOURS BEFORE BACKFILLING.
6. TAPS SHALL BE MADE BY CITY CREWS AT PREVAILING RATES OR BY APPROVED CONTRACTORS WHEN ALLOWED BY AGENCY.
7. THIS DETAIL COVERS TAPPING SLEEVES 4" THROUGH 16" IN SIZE ON DUCTILE IRON, CAST IRON AND ASBESTOS CEMENT PIPE. ANY OTHER SIZE OR TYPE OF PIPE WILL REQUIRE A SEPARATE SUBMITTAL AND APPROVAL BY THE ENGINEER.

SIZE OF PIPE BEING CONNECTED	MINIMUM THRUST AREA REQUIRED EQUALS (AxB) (SQUARE FEET)
4" AND LESS	3
6"	4
8"	6
10"	9
12"	13
16"	23



DETAIL NO.

342



STANDARD DETAIL  
ENGLISH

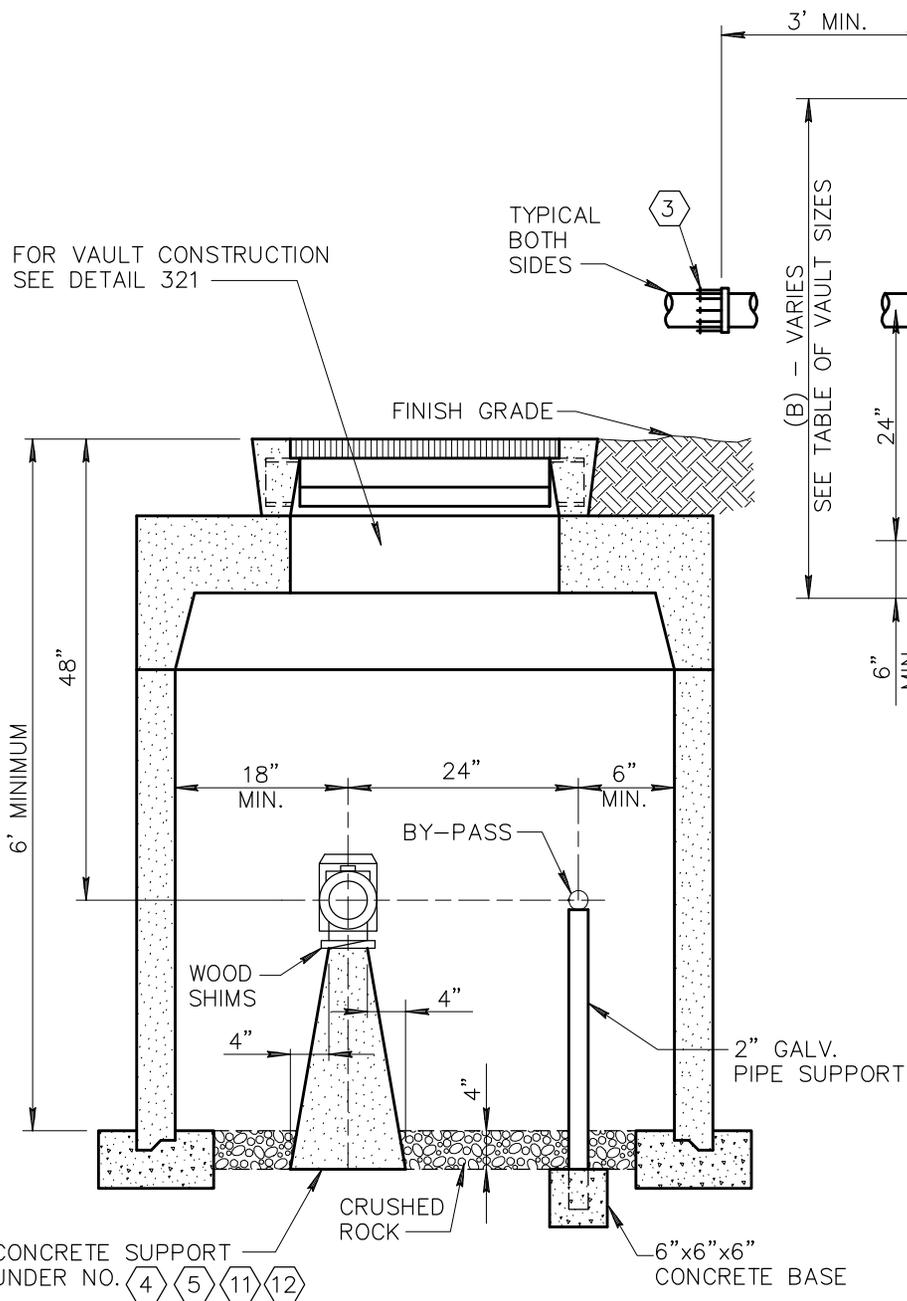
CONCRETE PRESSURE PIPE  
TAPPING SLEEVE

REVISED

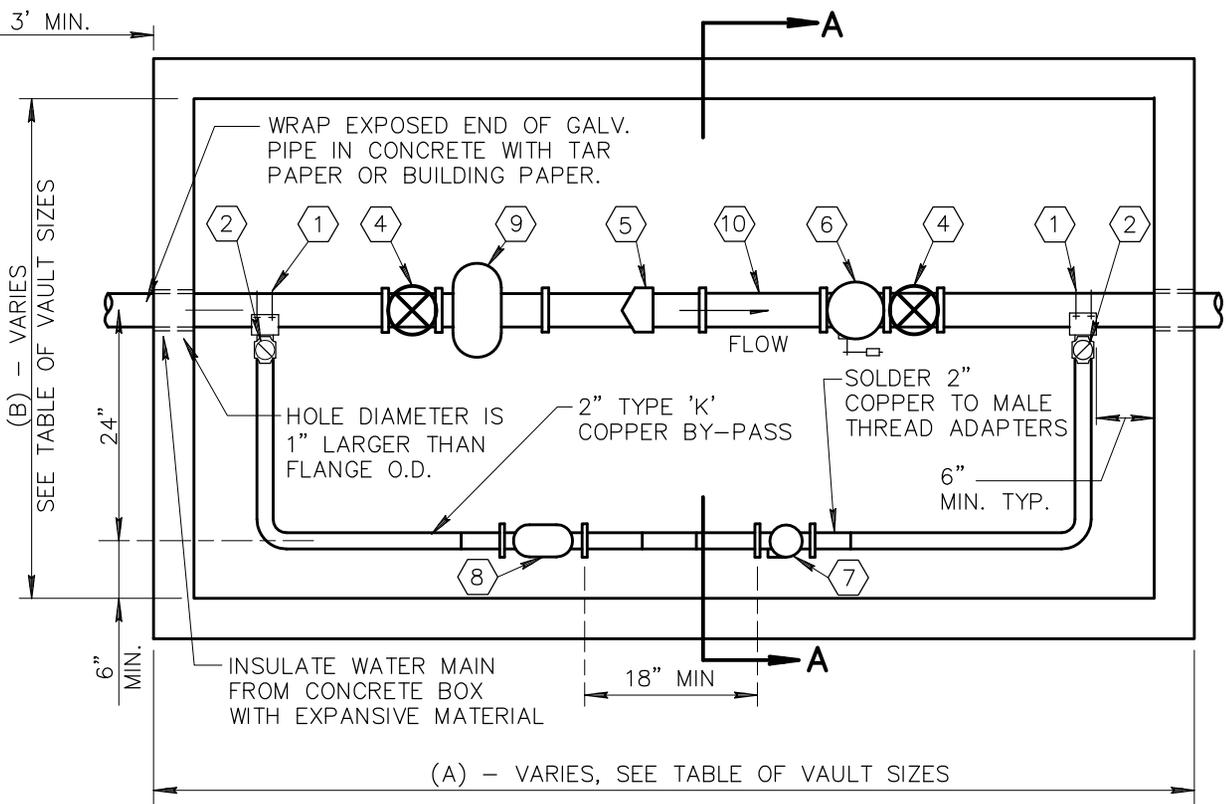
01-01-1998

DETAIL NO.

342



**SECTION A-A**



VAULT DIMENSION DETAILS			
A.C.P. SIZE	3"	4"	6"
(A)	8'-4"	10'-6"	12'-0"
(B)	4'-4"	5'-0"	5'-0"

NOTE: METER VAULTS MAY BE EITHER CONCRETE MASONRY UNITS OR CAST-IN-PLACE OR PRE-CAST CONCRETE, SEE DETAIL 321 FOR VAULT CONSTRUCTION.

DETAIL NO.  
**345-1**



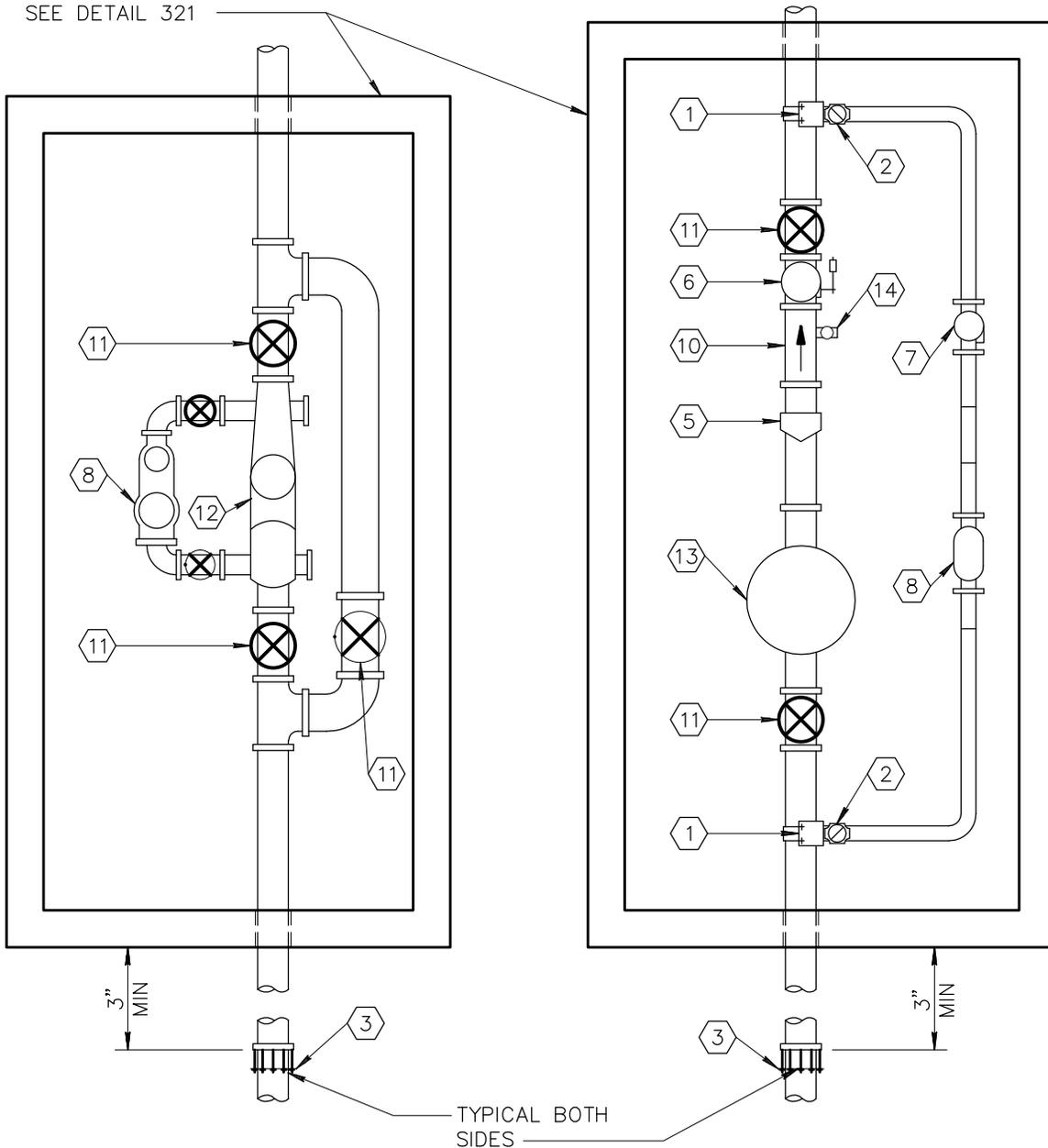
STANDARD DETAIL  
ENGLISH

**3", 4", 6" WATER METER**

REVISED  
01-01-1998

DETAIL NO.  
**345-1**

FOR VAULT CONSTRUCTION  
SEE DETAIL 321



### LEGEND

- ① DOUBLE STRAP ALL BRONZE SERVICE SADDLES.
- ② CORP. STOP, 2" (BALL TYPE).
- ③ ADAPTER, FLANGED, TO MECH. JOINT FOR A.C.P.
- ④ GATE VALVE, FLANGED, WITH HAND WHEEL, OPEN LEFT.
- ⑤ TURBOMETER: ROCKWELL SERIES 'W' OR HERSEY SERIES 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑥ FLANGED SWING CHECK VALVE WITH EXTERNAL LEVER AND WEIGHT.
- ⑦ 2" BRONZE CHECK VALVE.
- ⑧ 2" TURBOMETER: ROCKWELL 'W-160' OR HERSEY 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑨ STRAINER (3", 4", 6") AVAILABLE FROM METER MANUFACTURER, INSTALL ONLY WHEN 'TURBO' IS USED.
- ⑩ FLANGED SPOOL (3 PIPE DIAMETERS IN LENGTH).
- ⑪ O.S.&Y. GATE VALVE, FLANGED WITH HAND WHEEL OPEN LEFT, AND RISING STEM.
- ⑫ TURBOMETER U.L. APPROVED: ROCKWELL W-5000 DR. OR W-2000 DR. OR HERSEY F.M.-C.T. OR NEPTUNE TURBINE-F.S.-U.L.
- ⑬ 6" OR 10" STRAINER, U.L. APPROVED.
- ⑭ 2" THREADED OUTLET AND GATE VALVE.

### NOTES

1. FOR LARGER METERS, SPECIAL VAULT DESIGN IS REQUIRED.
2. USE OF REMOTE READING DEVICE AT OPTION OF UTILITY.
3. CERTAIN AGENCIES AND/OR UTILITIES PREFER TO CONSTRUCT VAULT, CONTACT AGENCY INVOLVED PRIOR TO VAULT CONSTRUCTION.

DETAIL NO.  
**345-2**

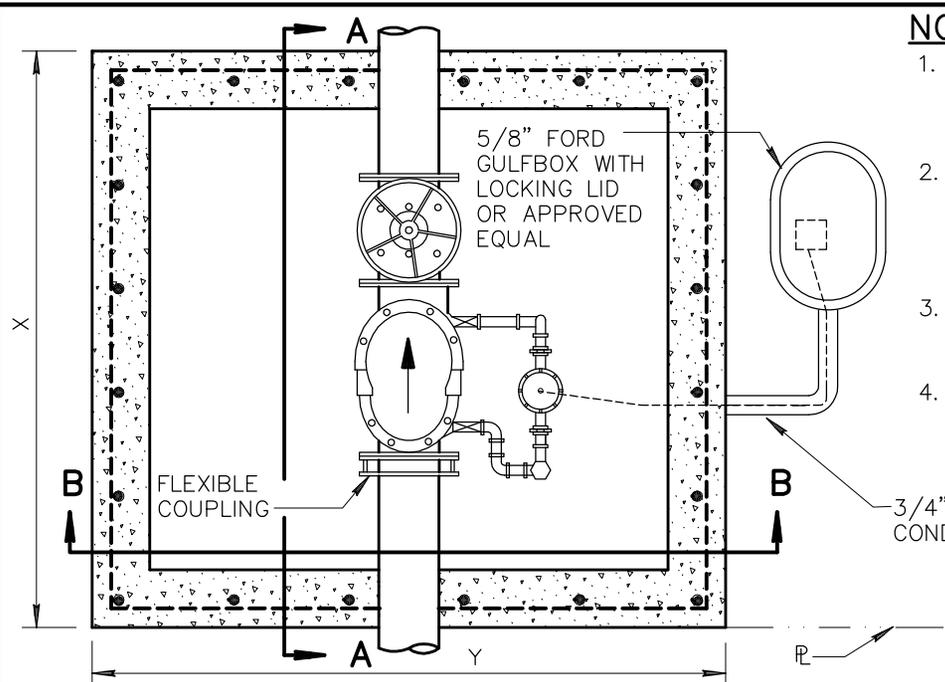


STANDARD DETAIL  
ENGLISH

**4", 6" WATER METER  
WITH ON-SITE FIRE HYDRANTS**

REVISED  
01-01-1998

DETAIL NO.  
**345-2**

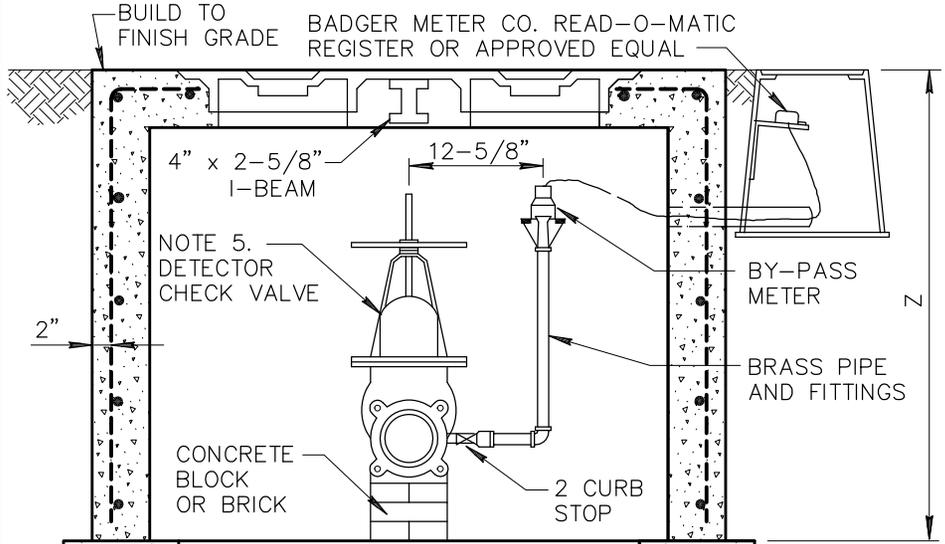


PLAN VIEW-BELOW COVER

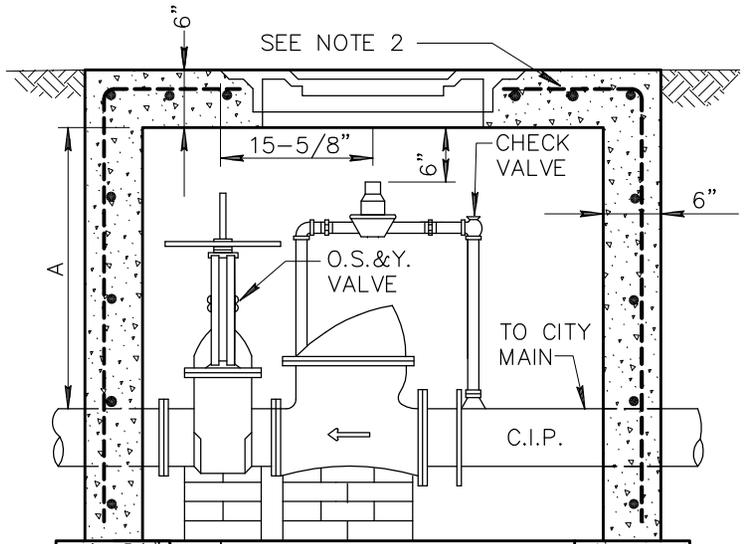
**NOTES:**

1. FIRELINE FROM CITY MAIN TO PROPERTY LINE SHALL BE CONSTRUCTED OF CAST IRON PIPE.
2. REINFORCING TO BE 1/2" DIAMETER REBAR ON 6" CENTERS EACH WAY ON TOP AND 12" CENTERS EACH WAY ON THE SIDES.
3. COVERS TO CONSIST OF TWO METER BOX COVERS DET. 314.
4. BY-PASS METER TO BE ACCORDING TO GOVERNING AGENCY.
5. CHECK VALVE TO BE GLOBE MODEL "A" GRINNEL, HERSEY MODEL D.C., VIKING MODEL "A" OR APPROVED EQUAL.
6. VAULT SHALL BE CONSTRUCTED IN OWNERS PROPERTY AGAINST THE FRONT PROPERTY LINE OR ANOTHER APPROVED LOCATION. WALLS AND FENCES SHALL NOT OBSTRUCT ACCESS.
7. CITY CONTROL VALVE TO BE REQUIRED AT MAIN.
8. PARTS OF PIPE TO BE EMBEDDED IN CONC. SHALL BE WRAPPED WITH 30 LB ASPHALT ROOFING FELT.
9. REMOTE READING DEVICE SHALL BE OF SELF GENERATING ELECTRICAL TYPE. HYDRAULIC OR MECHANICAL DRIVE REGISTERS WILL NOT BE ACCEPTABLE.
10. CONCRETE TO BE CLASS 'B' PER SECT. 725.

DIA. OF PIPE	X	Y	Z	BY-PASS METER SIZE	A
4"	60"	66"	49"	5/8" x 3/4"	30"
6"	66"	72"	49"	5/8" x 3/4"	30"
8"	72"	72"	58"	1"	36"
10"	78"	72"	69"	1-1/2"	36"



SECTION B-B



SECTION A-A

DETAIL NO.

**346**



STANDARD DETAIL  
ENGLISH

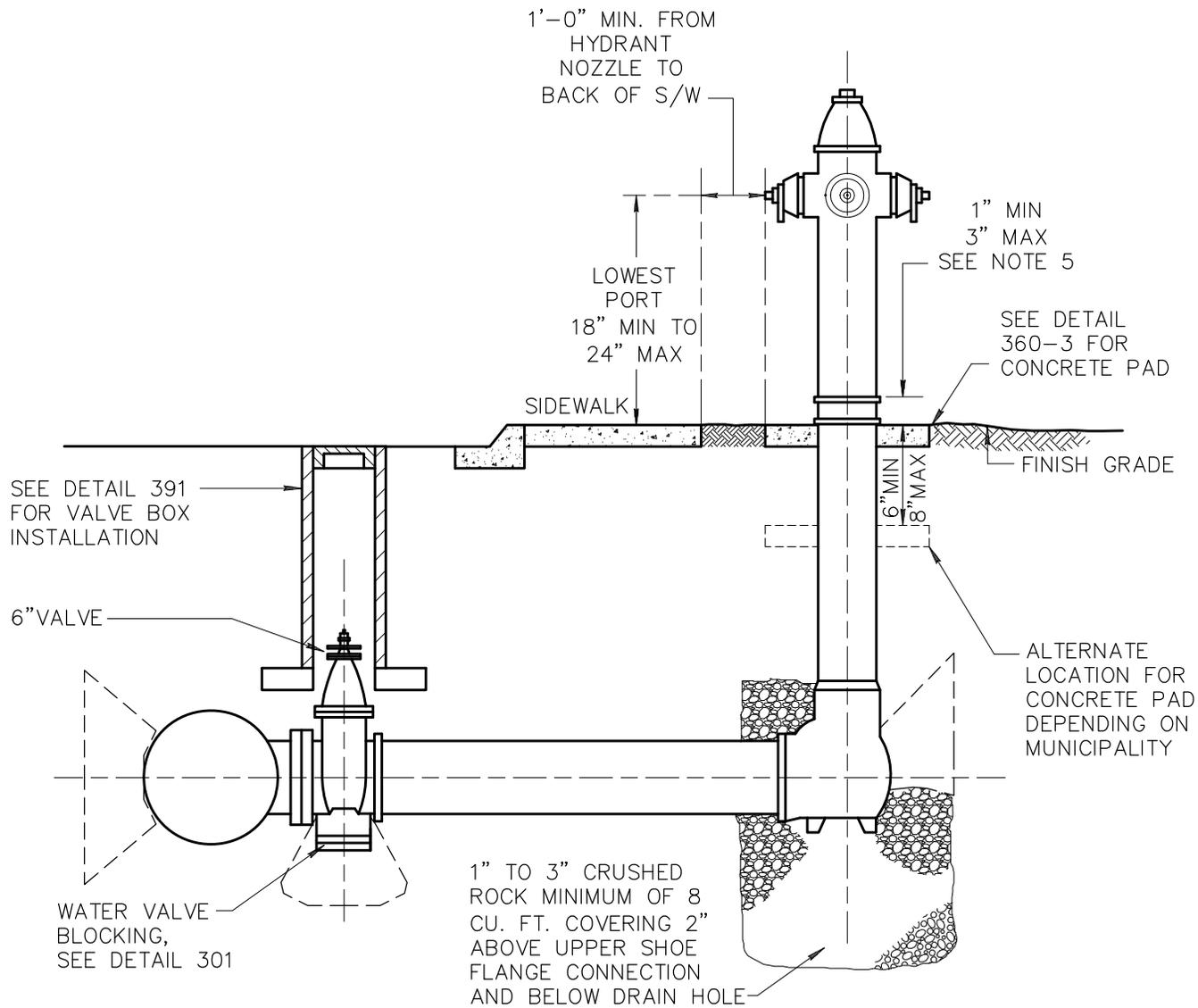
**FIRE LINE DETECTOR CHECK VAULT**

REVISED

01-01-1998

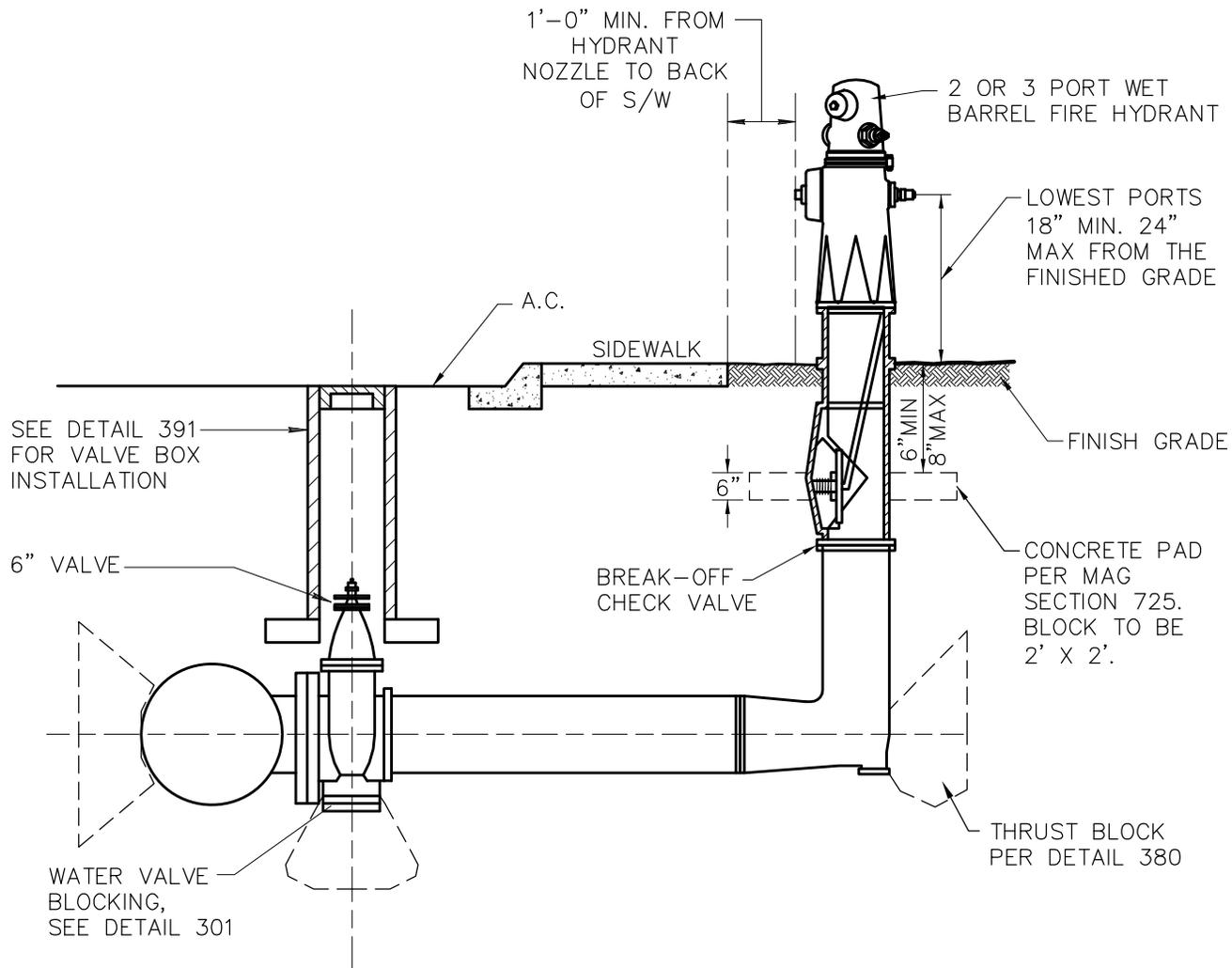
DETAIL NO.

**346**



**NOTES:**

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE RESTRAINT OR MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. SEE SECTION 756 FOR HYDRANT MATERIAL.



## NOTES:

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE MECHANICAL RESTRAINT MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. THE HYDRANT SHALL HAVE 2- 2½" PORT AND 1- 4½" PORT (INDUSTRIAL OR COMMERCIAL).
12. THE HYDRANT SHALL HAVE 1- 2½" PORT AND 1- 4½" PORT (RESIDENTIAL).

DETAIL NO.

360-2



STANDARD DETAIL  
ENGLISH

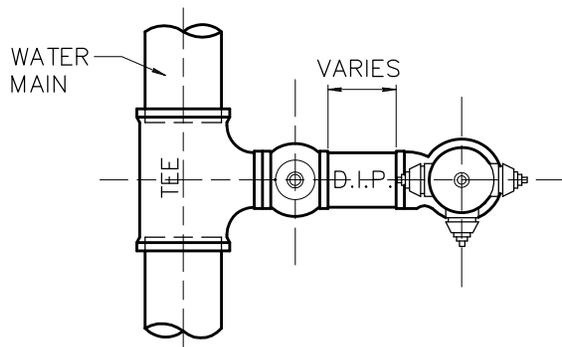
WET BARREL FIRE HYDRANT INSTALLATION

REVISED

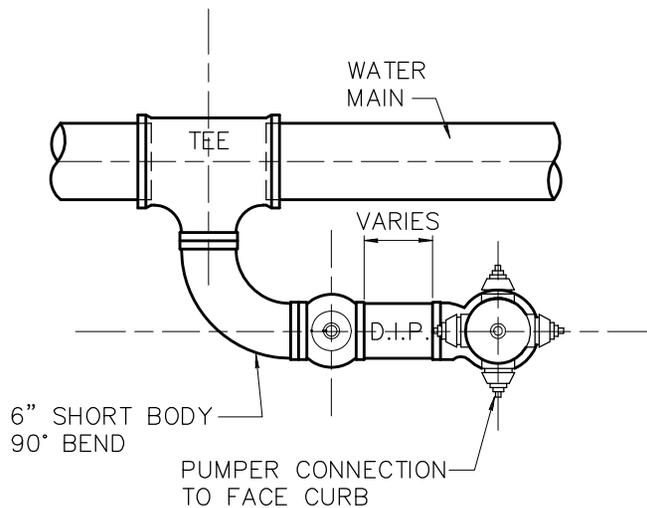
01-01-2013

DETAIL NO.

360-2

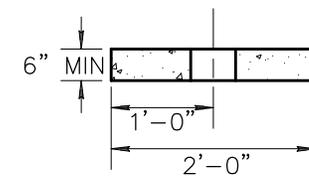
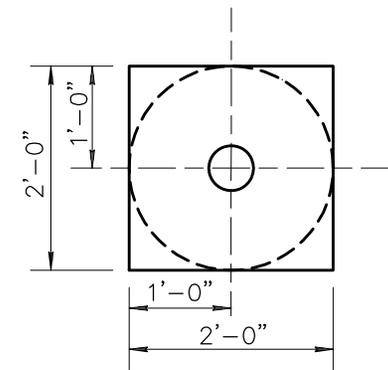


TYP MAIN CONNECTION  
(PREFERRED)

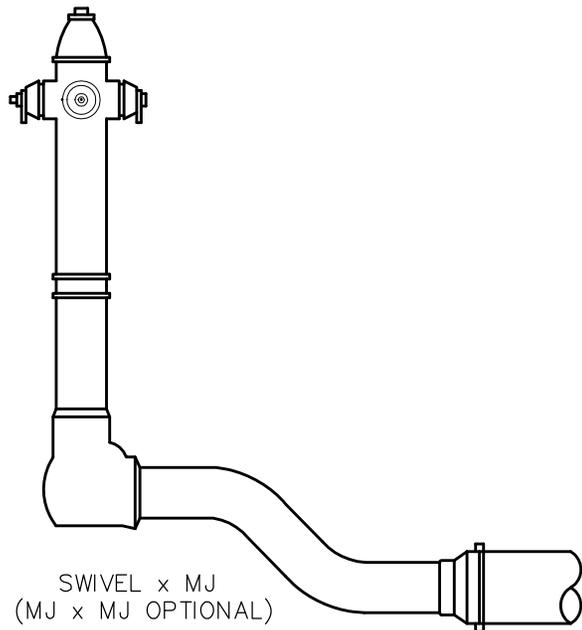


ALT MAIN CONNECTION

SQUARE OR ROUND IS ACCEPTABLE  
IF ROUND: 24" DIAMETER MIN. REQUIRED



CONCRETE PAD  
LOCATION DETAIL



OFFSET FITTINGS

**NOTES:**

1. CONCRETE FOR PAD SHALL BE CLASS "A".
2. SCORE LINE SHALL BISECT CONCRETE PAD AT MID POINT OF ALL SIDES.
3. CONCRETE COLOR SHALL MATCH ADJACENT CONCRETE. THE FINISHED CONCRETE SURFACE SHALL HAVE A ROUGH BROOM FINISH (SURFACE ONLY).
4. MULTIPLE OFFSET FITTINGS SHALL NOT BE ALLOWED.
5. MINIMUM 36" CLEARANCE PER NFPA-24 AROUND FIRE HYDRANT.
6. 1/2" BITUMINOUS EXPANSION SHALL BE PLACED AROUND THE BARREL OF THE FIRE HYDRANT AT THE CONCRETE PAD.

DETAIL NO.

360-3



STANDARD DETAIL  
ENGLISH

FIRE HYDRANT INSTALLATION DETAILS

REVISED

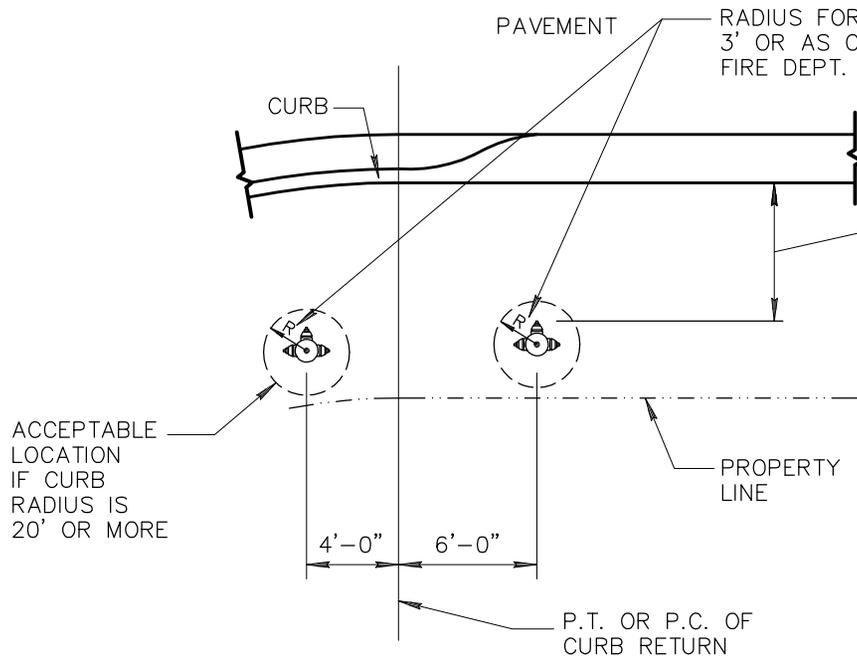
01-01-2013

DETAIL NO.

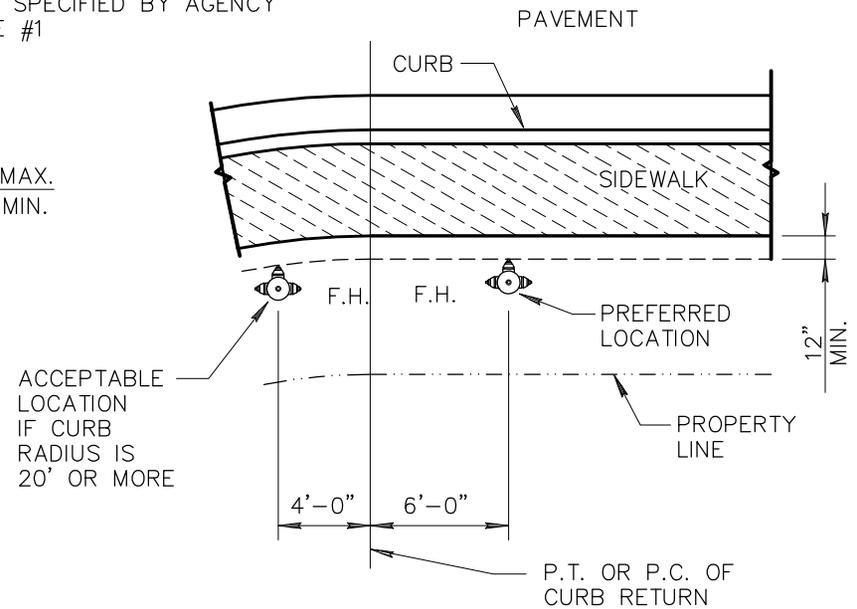
360-3

**NOTES:**

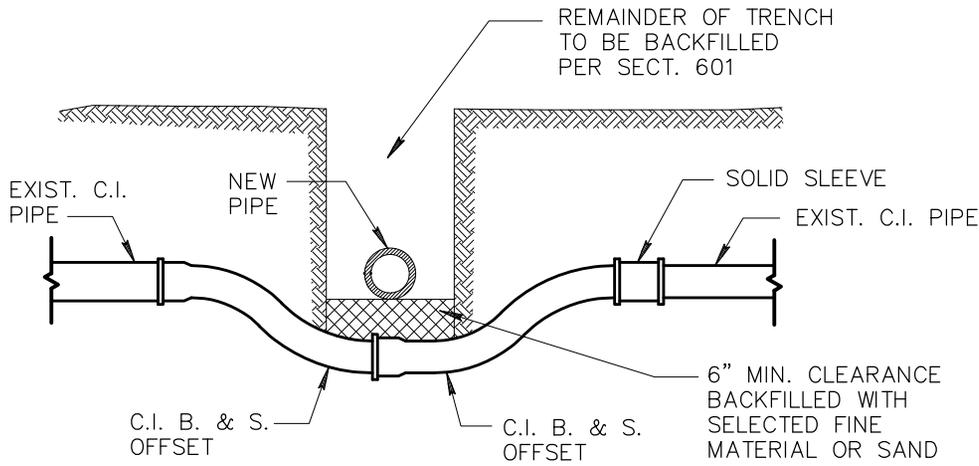
1. OBSTRUCTIONS SUCH AS UTILITY POLES, STREET SIGNS, IRRIGATION BOXES, FENCES, ETC., MUST NOT BE PLACED BETWEEN CURB AND HYDRANT AND WITHIN THE RADIUS FOR FIRE DEPT. ACCESS.
2. DIMENSIONS SHOWN ON CONSTRUCTION DRAWINGS SUPERSEDE LOCATIONS SHOWN HERE.
3. ON LOCATIONS IN MIDBLOCK, THE FIRE HYDRANT WILL BE ALIGNED WITH A PROPERTY LINE.



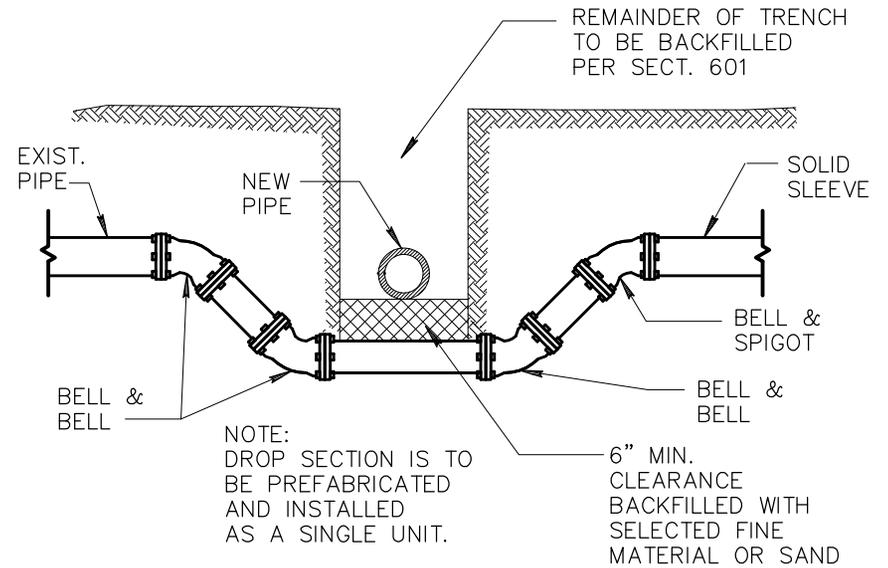
PARKWAY AREA OR NO SIDEWALK



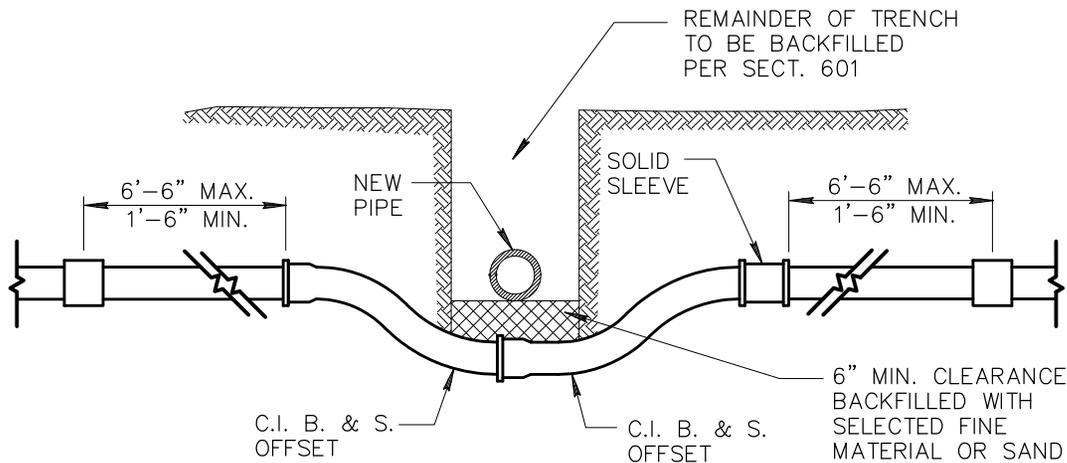
AREA WITH SIDEWALK



**CAST IRON**



**CAST IRON MECHANICAL JOINT**

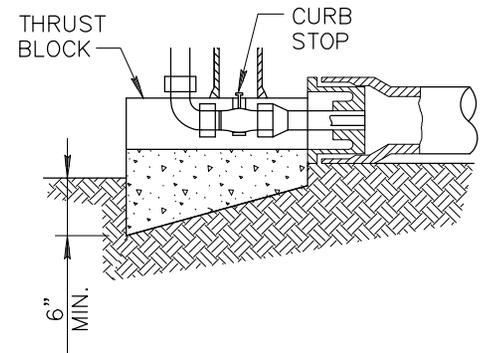
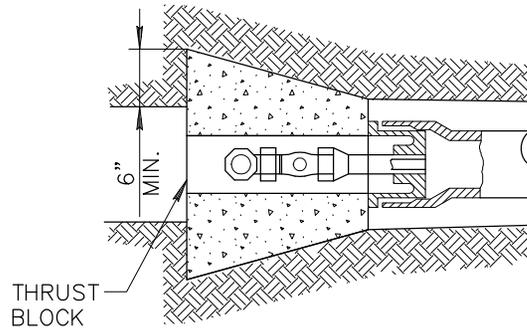
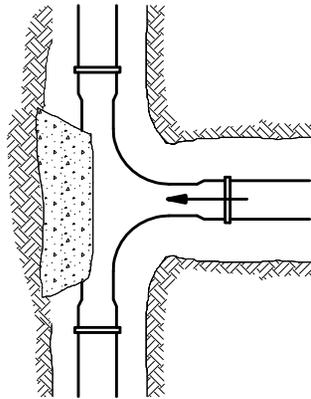
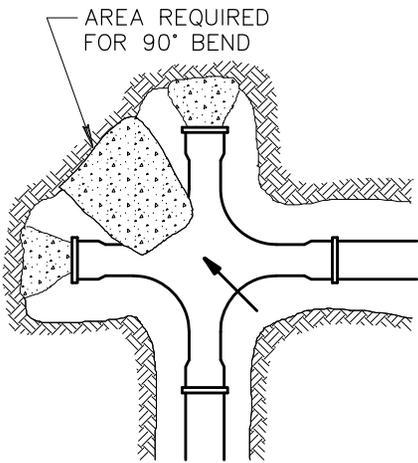


**ASBESTOS CEMENT**

**NOTES:**

1. THIS DETAIL COVERS MOVING OF WATER MAINS 2" TO 12" ONLY.
2. THRUST BLOCKING AS PER DET. 380 & 381.
3. IF OFFSET IS TO GO OVER OBSTRUCTION, JOINT RESTRAINTS MUST BE USED.
4. PIPE IS TO BE CAST IRON OR DUCTILE IRON.

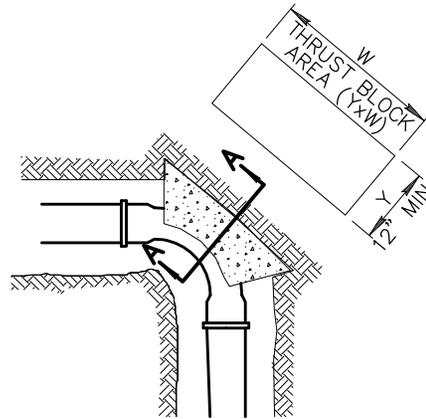
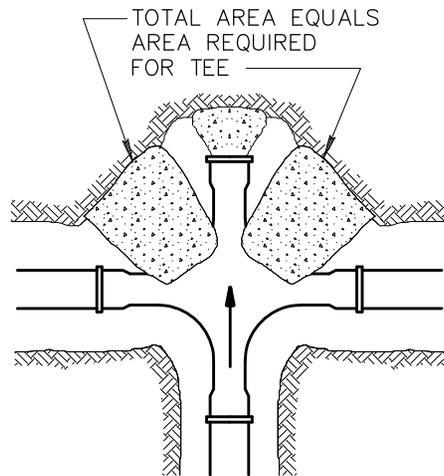
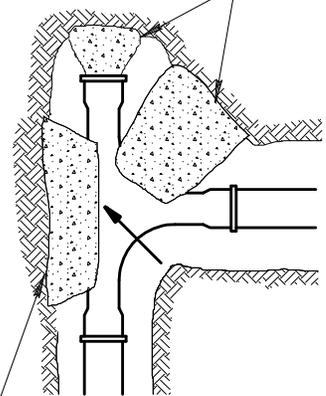
## TYPICAL LOCATIONS OF THRUST BLOCKS



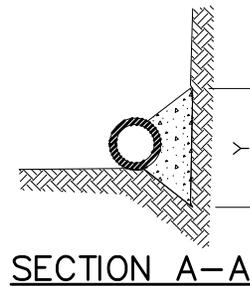
### NOTES:

1. TABLE IS BASED ON 200 P.S.I. TEST PRESSURE AND 3,000 LBS/SQ. FT. SOIL. IF CONDITIONS ARE FOUND TO INDICATE SOIL BEARING IS LESS, THE AREAS SHALL BE INCREASED ACCORDINGLY.
2. AREAS FOR PIPES LARGER THAN 16" SHALL BE CALCULATED FOR EACH PROJECT.
3. FORM ALL NON-BEARING VERTICAL SURFACES.
4. THRUST BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND. CONCRETE TO BE CLASS 'C', SECT. 725.

1/2 AREA REQUIRED FOR 90° BEND



AREA FOR TEE



### MINIMUM THRUST BLOCK AREA REQUIRED (YxW) (SQ. FT.)

PIPE SIZE	WATER PIPE	
	TEE, DEAD END, 90° BEND	45° & 22 1/2° BENDS
4" OR LESS	3	3
6"	4	3
8"	6	3
10"	10	5
12"	14	7
16"	24	12

DETAIL NO.

380



STANDARD DETAIL  
ENGLISH

THRUST BLOCKS FOR WATER LINES

REVISED

01-01-1998

DETAIL NO.

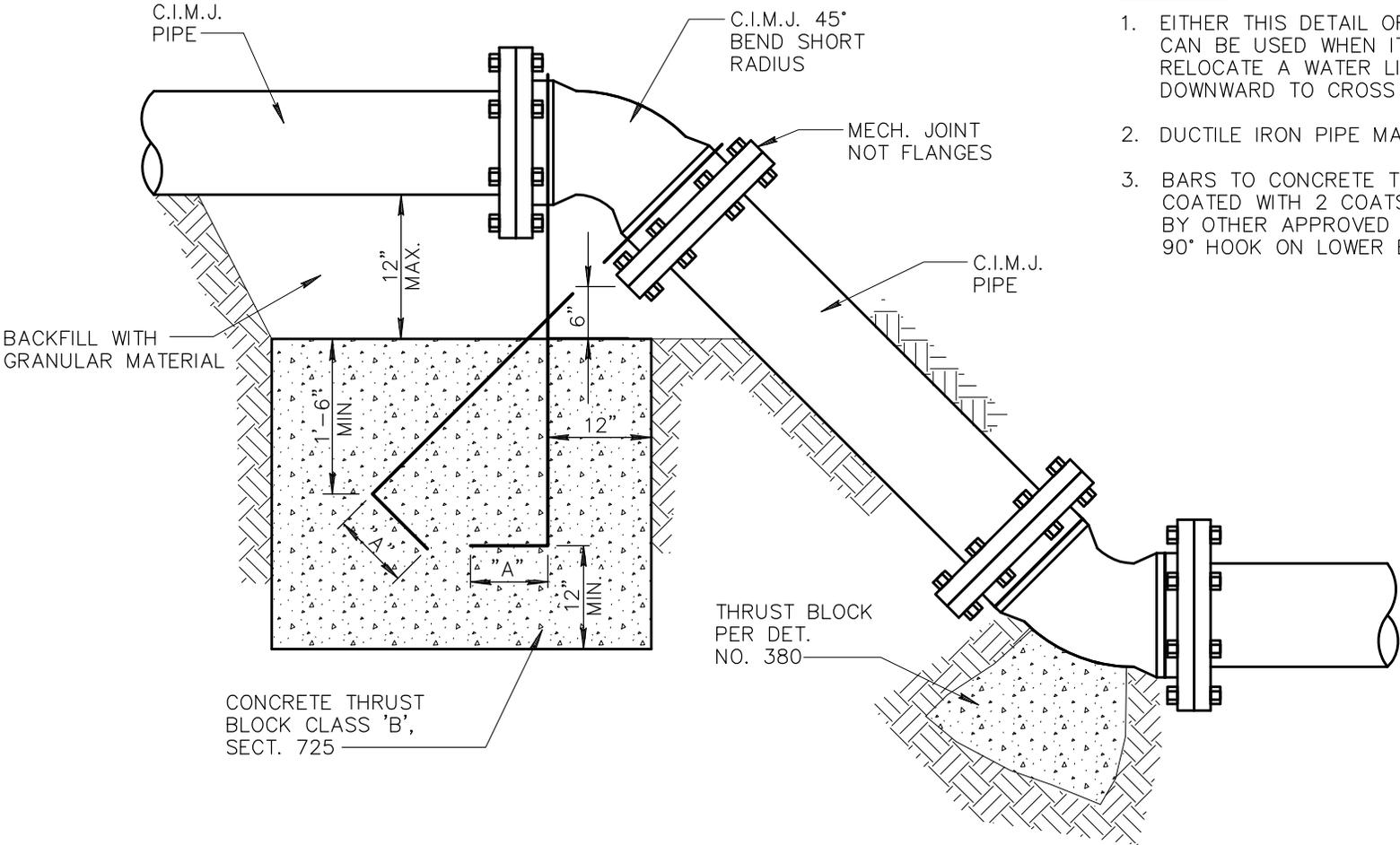
380

PIPE SIZE	MIN BAR SIZE	"A" - DIMENSION HOOK	MIN. * BLOCK DIM.
6"	#6	6"	3' x 3' x 3'
8"	#6	9"	4' x 4' x 2.5'
12"	#8	9"	4' x 4' x 5'

\* FOR 125 P.S.I. WORKING PRESSURE.

**NOTES:**

1. EITHER THIS DETAIL OR RESTRAINT RODS CAN BE USED WHEN IT IS ALLOWED TO RELOCATE A WATER LINE UPWARD OR DOWNWARD TO CROSS A CONFLICT.
2. DUCTILE IRON PIPE MAY BE USED.
3. BARS TO CONCRETE THRUST BLOCK TO BE COATED WITH 2 COATS COAL TAR, EPOXY OR BY OTHER APPROVED METHOD. BARS TO HAVE 90° HOOK ON LOWER END, AS PER TABLE.

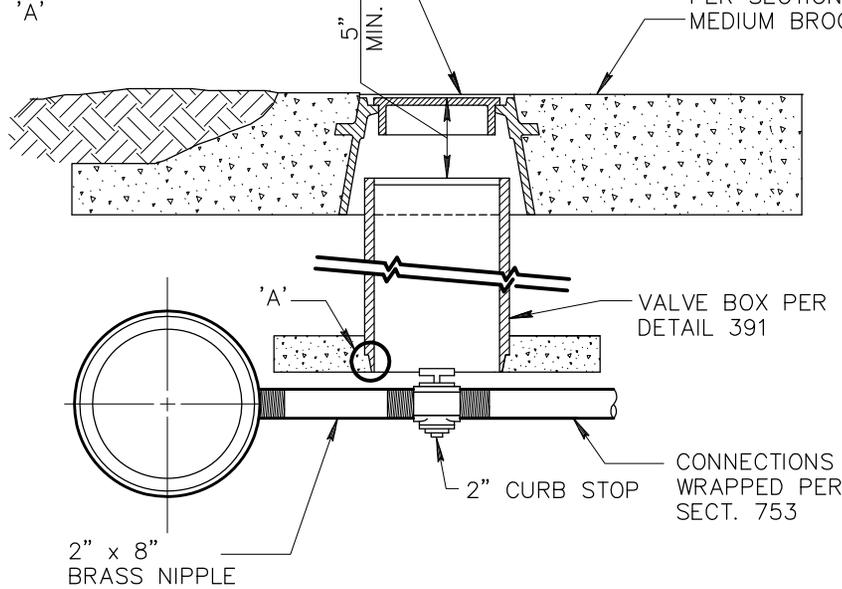




ENLARGED  
'A'

FRAME AND  
COVER PER  
DETAIL 270

POURED CONCRETE COLLAR 8" THICK  
AND 40" SQUARE OR ROUND, VALVE BOX  
CENTER. CLASS 'AA' CONCRETE AS  
PER SECTION 725. RADIALLY SCORE JOINTS (4" MIN)  
MEDIUM BROOM FINISH



TYPE 'A'

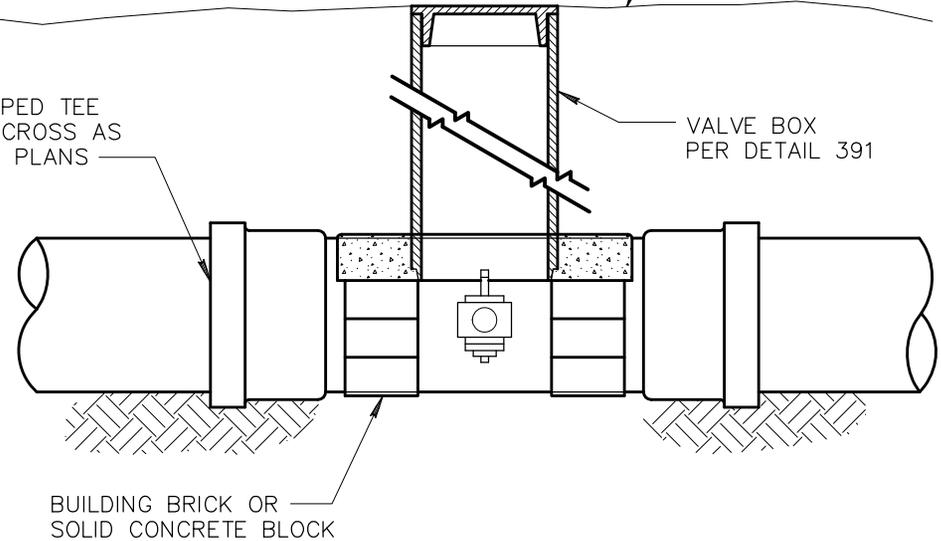
**NOTES:**

1. CURB STOP TO BE MUELLER ORISEAL (H-10283), FORD BALL VALVE B11-777, HAYES BULLETIN 400, J. JONES (J-1900) OR APPROVED EQUAL.
2. REDUCER MAY BE USED WHEN CONNECTING TO SMALLER GALVANIZED PIPE.
3. THIS DETAIL IS TO BE USED WHEN CONNECTING EXISTING GALVANIZED PIPE TO ASBESTOS CEMENT PIPE OR CAST IRON PIPE.

FINISH  
PARKWAY  
GRADE

TAPPED TEE  
OR CROSS AS  
PER PLANS

VALVE BOX  
PER DETAIL 391



TYPE 'B'

**NOTE:**

1. VALVE BOX TO BE SUPPORTED ON BRICKS TO PREVENT VERTICAL LOADS FROM BEING TRANSMITTED TO THE SMALL PIPE.

DETAIL NO.

**389**



STANDARD DETAIL  
ENGLISH

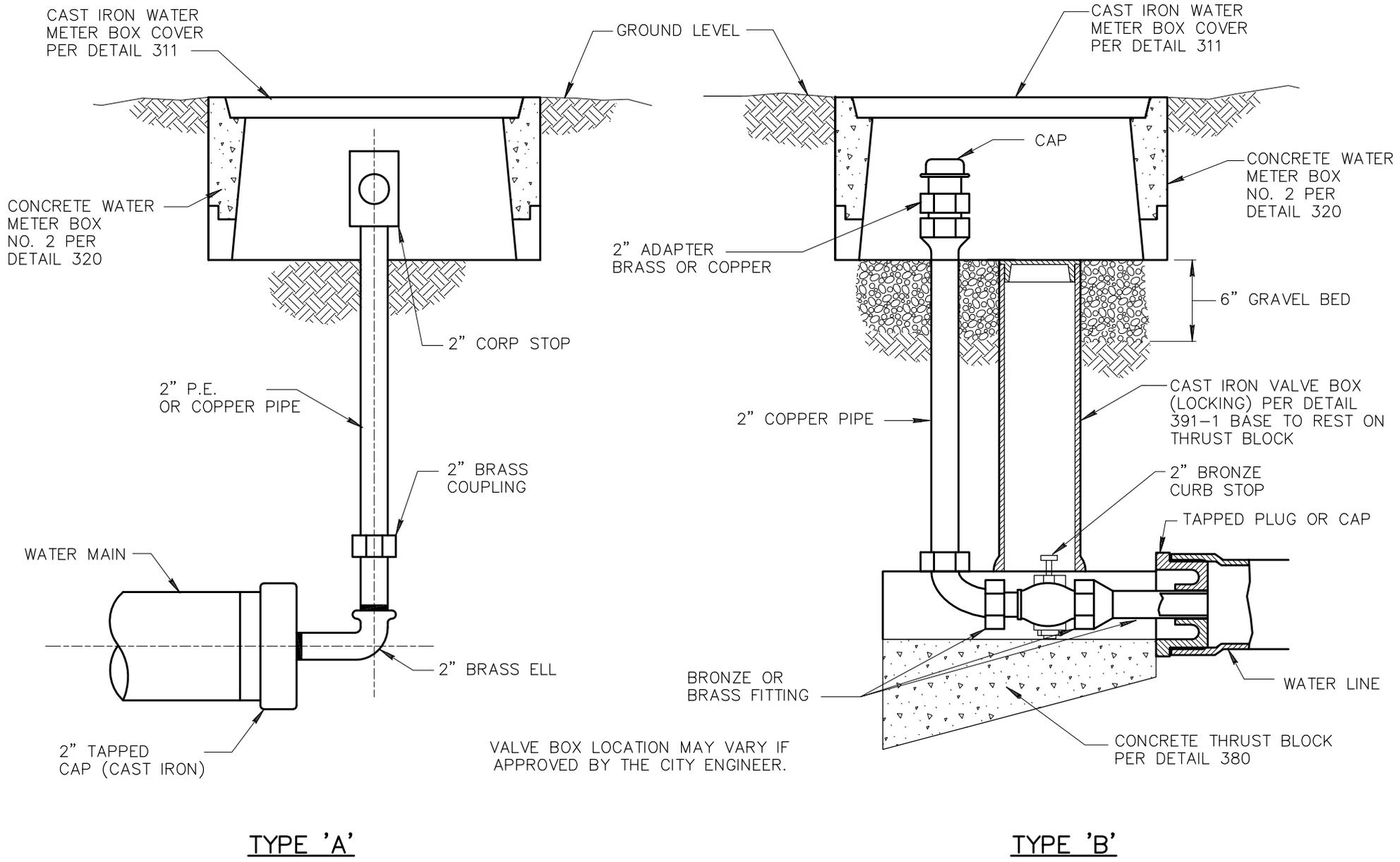
**CURB STOP WITH VALVE BOX  
AND COVER**

REVISED

01-01-2001

DETAIL NO.

**389**



DETAIL NO.  
**390**

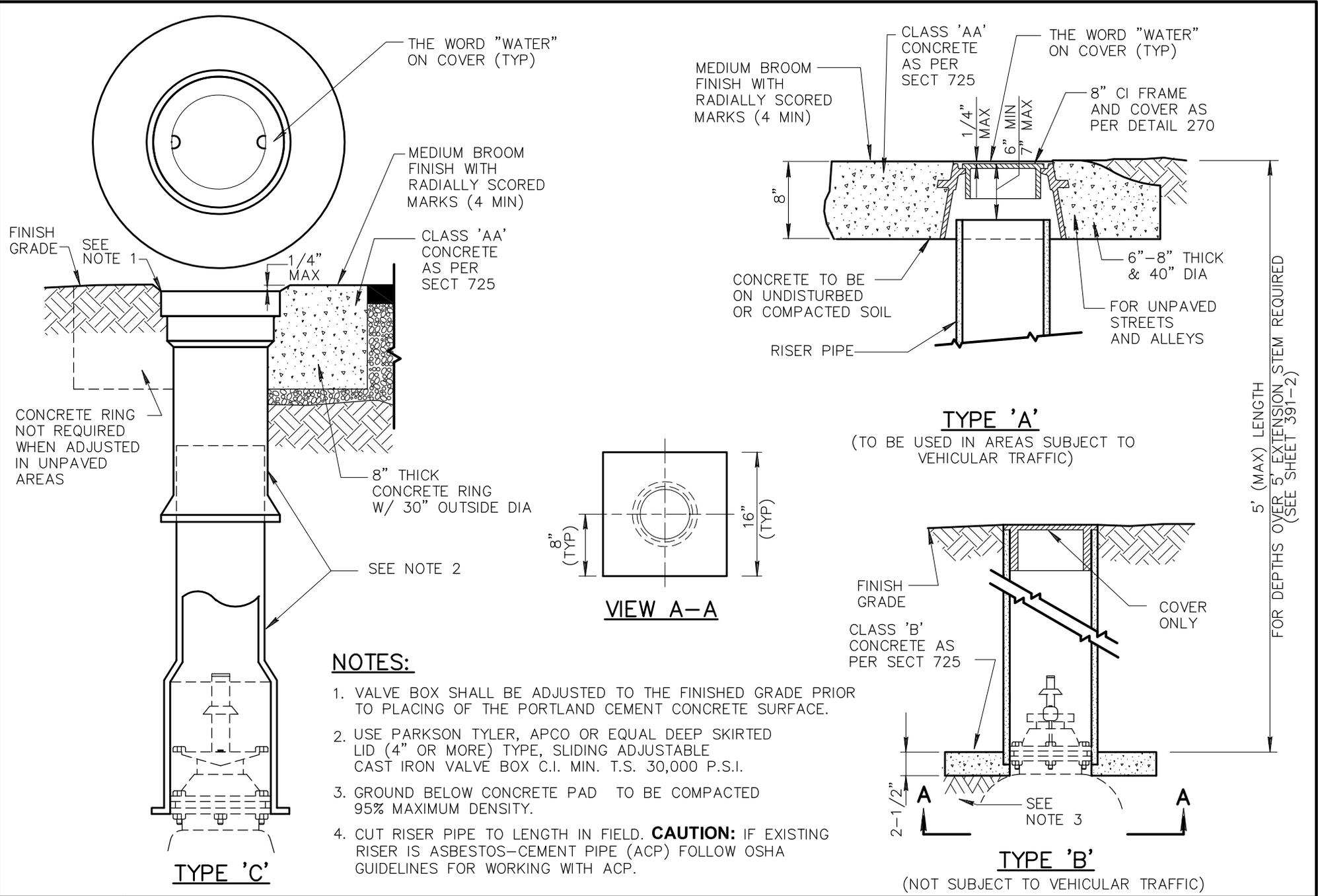


STANDARD DETAIL  
ENGLISH

**CURB STOP WITH FLUSHING PIPE**

REVISED  
01-01-1998

DETAIL NO.  
**390**



DETAIL NO.  
**391-1**



STANDARD DETAIL  
ENGLISH

**VALVE BOX INSTALLATION AND GRADE ADJUSTMENT**

REVISED  
01-01-2015

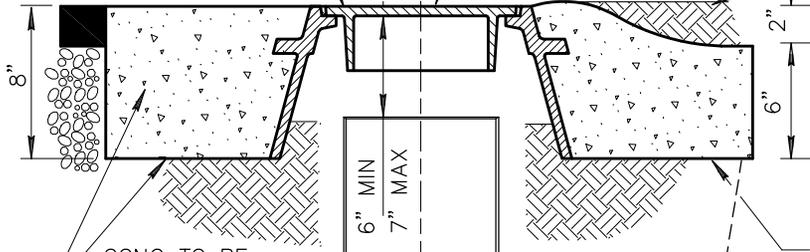
DETAIL NO.  
**391-1**

THE WORD 'WATER'  
ON COVER (TYP)

CENTER LINE OF VALVE BOX TO BE  
PLUMB OVER Q<sub>L</sub> OF OPERATING NUT

8" CI FRAME  
AND COVER AS PER  
DETAIL 270

GROUND



CONC TO BE  
ON UNDISTURBED  
OR COMPACTED  
SOIL

CLASS 'AA' CONC  
AS PER SECT 725  
RADIALLY SCORE  
JOINTS. MEDIUM  
BROOM FINISH

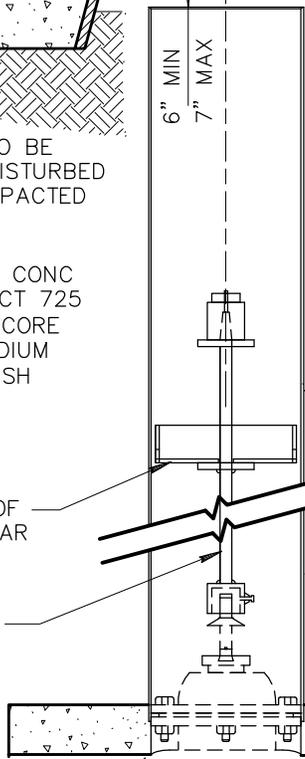
POURED CONC.  
COLLAR 6"-8" THICK AND  
40" SQUARE OR ROUND  
VALVE BOX CENTERED

COMPACTED BACKFILL  
IN LAYERS SO AS  
NOT TO DISTURB THE  
RISER PIPE, DENSITY  
PER TABLE 601-2  
IN SPEC SECT 601

RISER 8" C-900 PVC  
PER AWWA C900 OR  
APPROVED EQUAL  
SEE NOTE 2

SEE DETAIL OF  
DISC & COLLAR  
RIGHT

SEE NOTE 1



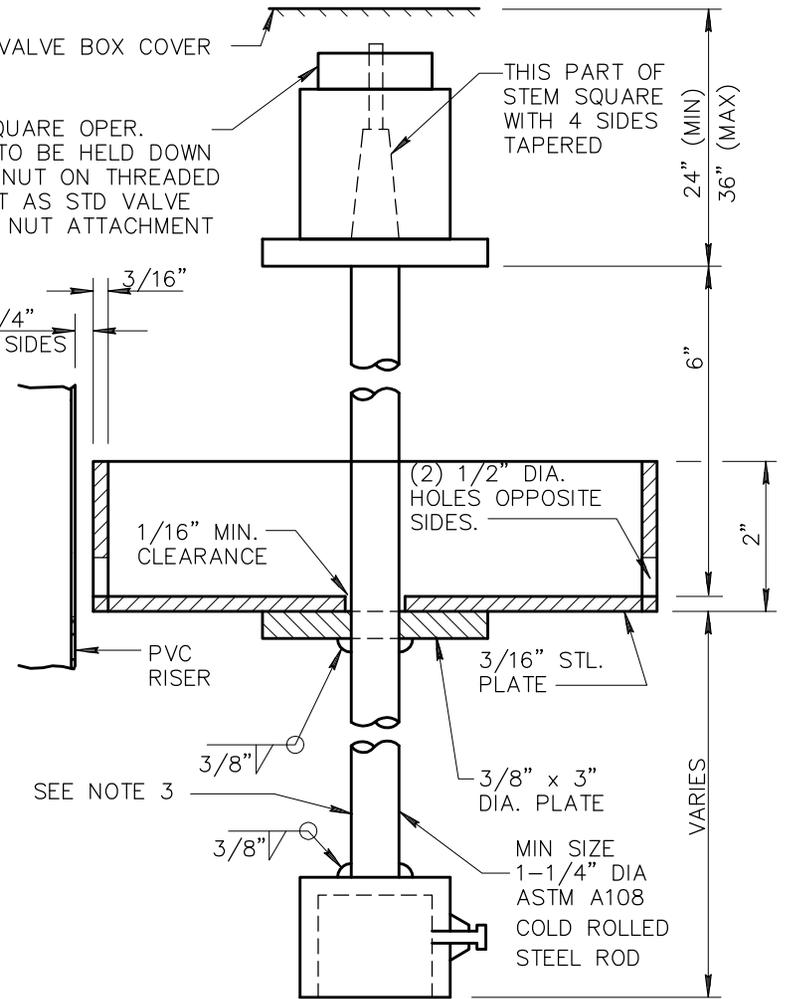
SEE NOTE 3  
SHEET 1

TOP VALVE BOX COVER

2" SQUARE OPER.  
NUT TO BE HELD DOWN  
WITH NUT ON THREADED  
SHAFT AS STD VALVE  
STEM NUT ATTACHMENT

THIS PART OF  
STEM SQUARE  
WITH 4 SIDES  
TAPERED

3/16"  
1/4"  
ALL SIDES



(2) 1/2" DIA.  
HOLES OPPOSITE  
SIDES.

1/16" MIN.  
CLEARANCE

PVC  
RISER

3/16" STL.  
PLATE

3/8" x 3"  
DIA. PLATE

MIN SIZE  
1-1/4" DIA  
ASTM A108  
COLD ROLLED  
STEEL ROD

**NOTES:**

1. EXTENSION STEM: WITH SQUARE SOCKET ON BOTTOM TO FIT 2" SQUARE VALVE NUT. EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES INSTALLED WHERE OPERATING NUT IS OVER 5' BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION. OPERATING NUT TO BE HELD ON TOP OF EXTENSION WITH STOP NUT.
2. IF TWO OR MORE SECTIONS OF PIPE ARE USED TO MAKE THE VALVE BOX RISER, THEY SHALL BE COUPLED OR BONDED TO FORM DEBRIS-TIGHT JOINTS.
3. STEM PAINTING: ALL STEEL TO HAVE PRIME COAT OF PAINT NO. 1-D AND ONE HEAVY APPLICATION (FINISH COAT) OF PAINT NO. 9 AS PER SECT. 790.

DETAIL NO.  
**391-2**

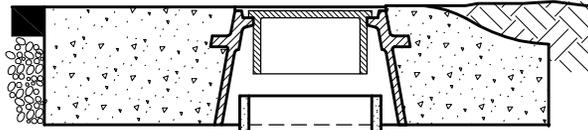


STANDARD DETAIL  
ENGLISH

**VALVE BOX INSTALLATION  
AND GRADE ADJUSTMENT**

REVISED  
01-01-2015

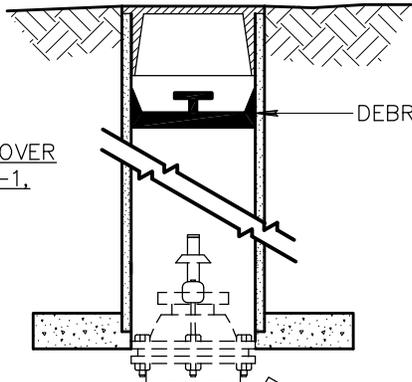
DETAIL NO.  
**391-2**



VALVE BOX AND COVER  
FOR DETAIL 391-1,  
TYPE A

DEBRIS CAP

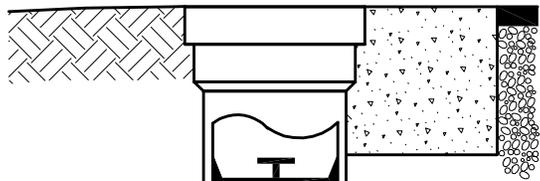
TYPE 'A'



VALVE BOX AND COVER  
FOR DETAIL 391-1,  
TYPE B

DEBRIS CAP

TYPE 'B'



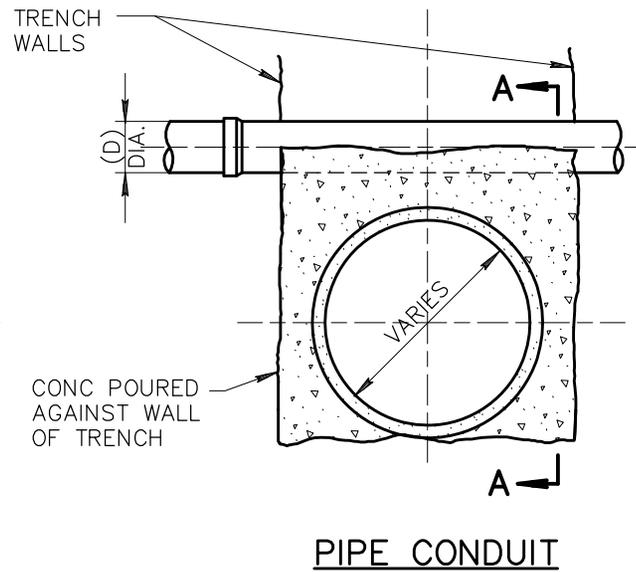
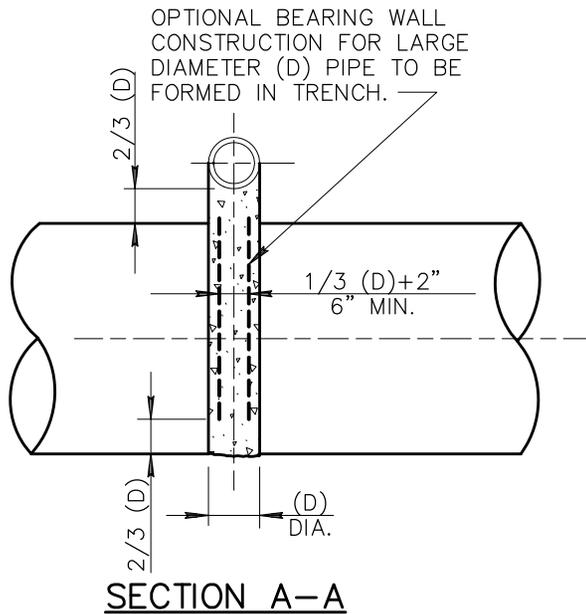
VALVE BOX AND COVER  
FOR DETAIL 391-1,  
TYPE C

DEBRIS CAP

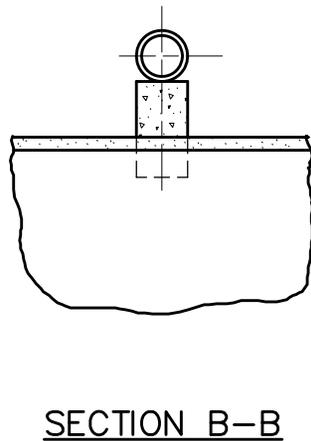
TYPE 'C'

**NOTES:**

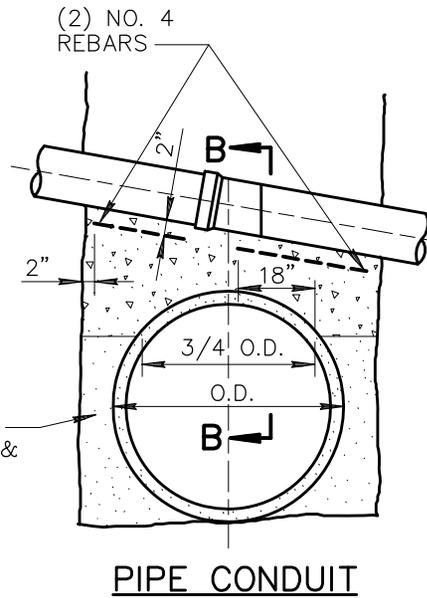
1. THE DEBRIS CAP SHALL BE DESIGNED AND INSTALLED TO PREVENT DEBRIS SUCH AS DIRT, DUST SAND, ETC., FROM PASSING AROUND THE CAP AND DOWN INTO THE VALVE HOUSING. THE CAP SHALL BE HELD IN PLACE BY A MECHANISM WHICH WILL NOT DAMAGE THE VALVE HOUSING.
2. THE CAP SHALL BE MANUFACTURED OF CORROSIVE RESISTANT MATERIALS.
3. DEBRIS CAP SHALL BE INSTALLED AS CLOSE UNDER THE CAST IRON COVER WITHOUT INTERFERING WITH COVER OPERATION.
4. THE CAP SHALL BE CAPABLE OF SECURELY HOLDING A STANDARD LOCATING COIL, "SCOTCH MARK" 4 DISK MARKER BY 3M OR EQUAL.
5. THE CAP SHALL BE CONSTRUCTED TO ALLOW THE DEVICE TO BE SECURED BY A LOCK. THE LOCK (PAD, BARREL, ETC.) SHALL BE SUPPLIED BY THE AGENCY.
6. THE CAP SHALL BE INSTALLED IN ALL VALVE HOUSINGS AS REQUIRED BY THE CONTRACT DOCUMENTS OR BY THE AGENCY'S POLICIES.



TYPE 'A'



SEE SECT. 601 FOR BACKFILL & COMPACTION



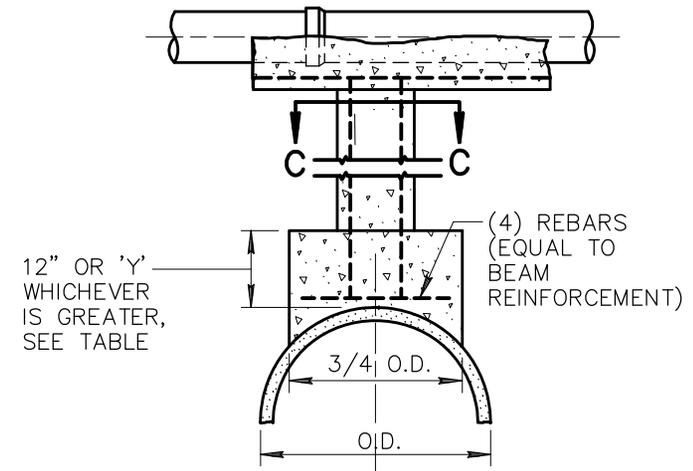
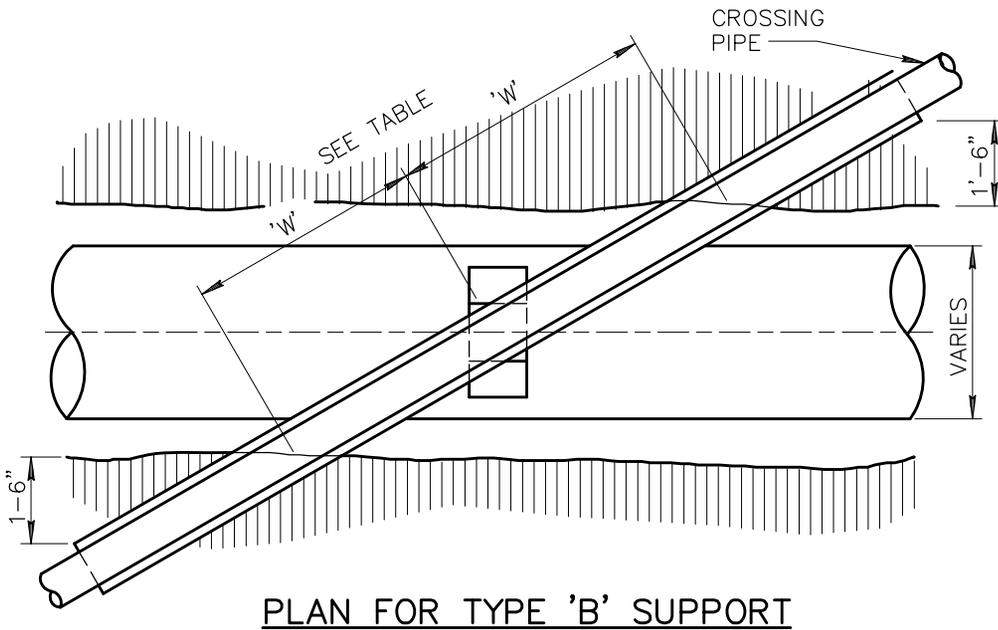
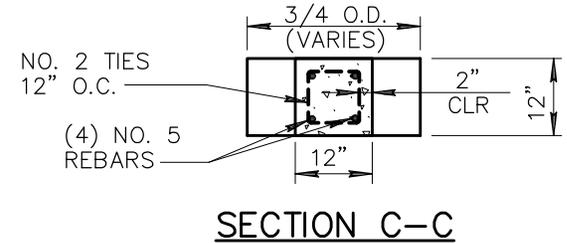
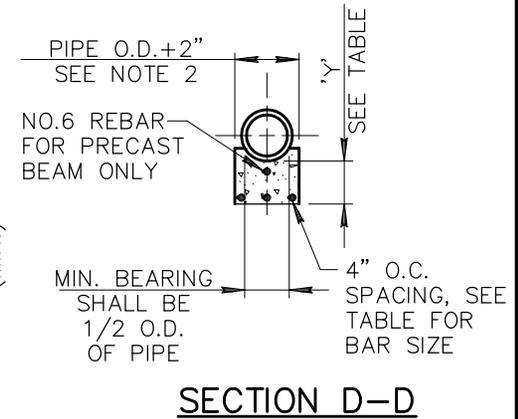
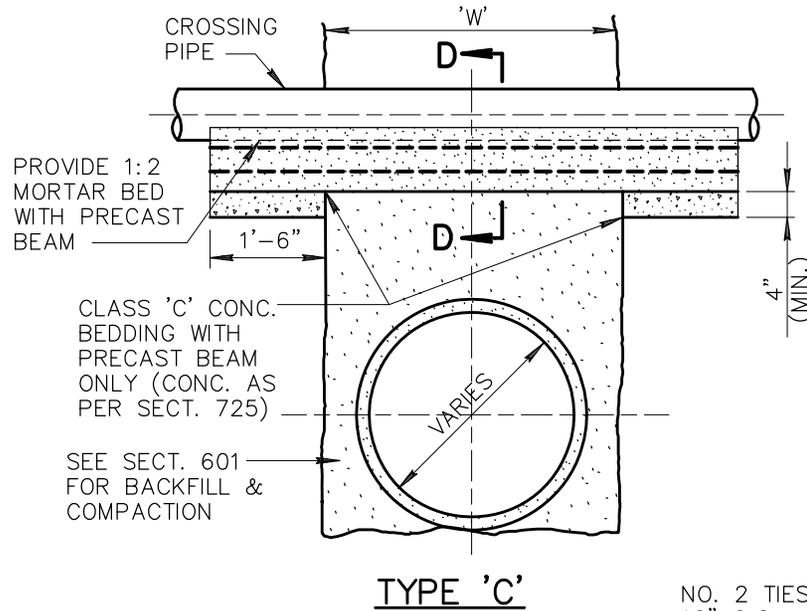
TYPE 'B'

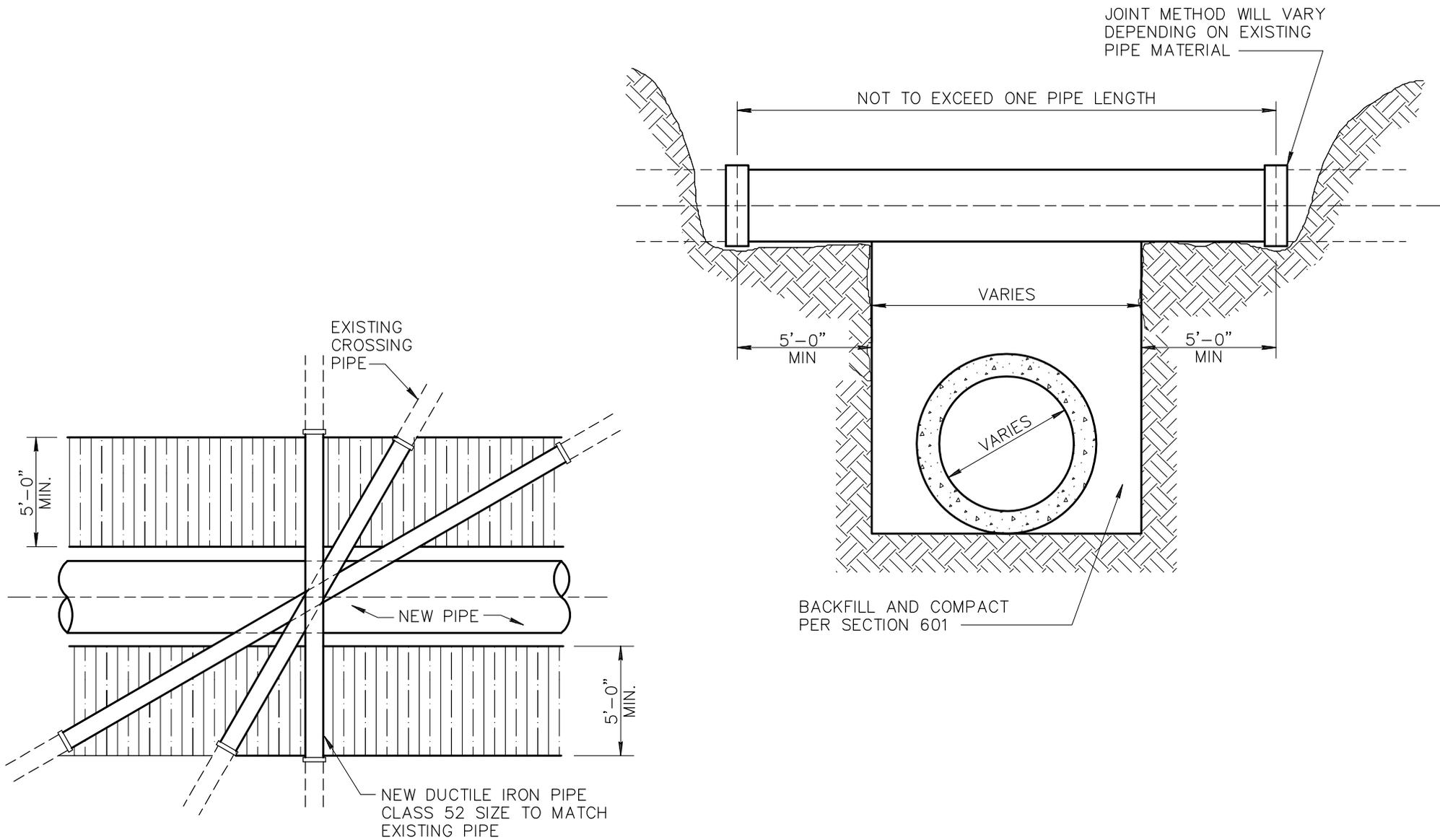
**NOTES:**

1. TYPE 'A' PIPE SUPPORT MAY BE USED FOR ANY TYPE CROSSING CONDITION.
2. TYPE 'C' PIPE SUPPORT MAY BE USED FOR CROSSING PIPES WITH A BELL DIAMETER OF 18" OR LESS IF SUFFICIENT CLEARANCE OVER STORM SEWER IS AVAILABLE AND TOTAL SPAN IS LESS THAN 34'
3. INTERMEDIATE PIPE SUPPORT SHALL BE USED IN CONJUNCTION WITH TYPE 'C' PIPE SUPPORT IF TOTAL SPAN EXCEEDS MAX. 'W' IN TABLE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING ALL SUPPORTS BOTH PERMANENT AND TEMPORARY. TEMPORARY SUPPORTS SHALL NOT BE A SEPARATE PAY ITEM.
5. PERMANENT PIPE SUPPORTS MAY BE DECREASED FROM PLAN QUANTITIES OR EXTENDED TO INCLUDE SOME LISTED BELOW AS TEMPORARY SUPPORTS IF CONDITIONS WARRANT THESE CHANGES AT THE TIME OF CONSTRUCTION. DECISION SHALL BE MADE BY THE ENGINEER.
6. WHEN TYPE 'A' PIPE SUPPORT IS USED AND WHENEVER SO DIRECTED BY THE ENGINEER, THE CONTRACTOR SHALL PIERCE THE WALL WITH SUITABLE OPENINGS TO PREVENT UNEQUAL PRESSURE RESULTING FROM FLOODING OF THE BACKFILL. THE VOLUME OF THE PIERCED OPENING SHALL NOT EXCEED 1/2 THE VOLUME OF THE SUPPORTING WALL.
7. USE TYPE 'B' PIPE SUPPORT INSTEAD OF TYPE 'C' WHEN CLEARANCE IS LESS THAN 'Y' IN TABLE, BETWEEN PIPES.
8. CLASS 'A' CONCRETE AS PER SECT. 725 UNLESS OTHERWISE NOTED.

SCHEDULE OF REQUIRED SUPPORTS	
PERMANENT	TEMPORARY
SEWER LINES	CAST IRON PIPE CONC. IRRIG. PIPE BURIED TELCO. GAS PIPES CONC. STORM DRAIN CONC. BOX CULVERT TRAFFIC CONTROL CONDUIT WATER & SEWER LINES
OTHER UTILITIES AS NOTED ON THE PLANS OR AS REQUIRED BY THE ENGINEER AT TIME OF CONSTRUCTION.	

TABLE				
'W'	DEPTH OF COVER ON SUPPORTS			
	0' TO 8'		8' TO 16'	
	BAR NO.	Y	BAR NO.	Y
TO 6'	5	8"	6	11"
7'	5	9"	6	12"
8'	5	10"	6	13"
9'	6	11"	6	14"
10'	6	12"	7	15"
11'	6	13"	7	16"
12'	6	14"	7	17"
13'	7	15"	7	19"
14'	7	16"	8	20"
15'	7	17"	8	21"
16'	7	18"		
17'	8	19"		





DETAIL NO.  
403-3



STANDARD DETAIL  
ENGLISH

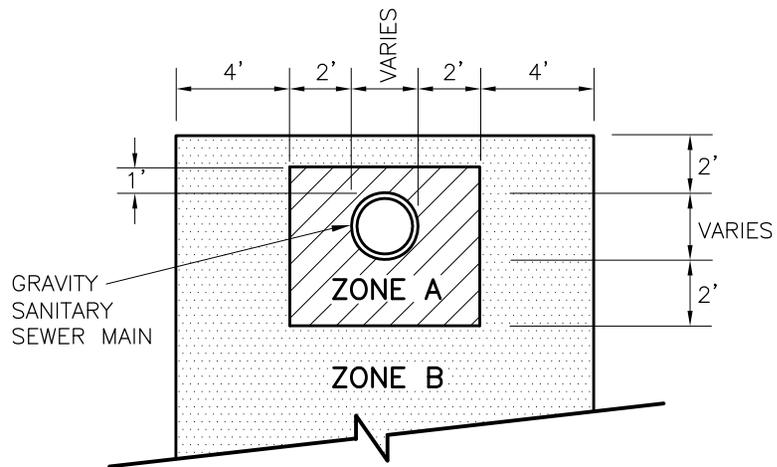
ALTERNATE TO PIPE SUPPORT

REVISED  
01-01-1998

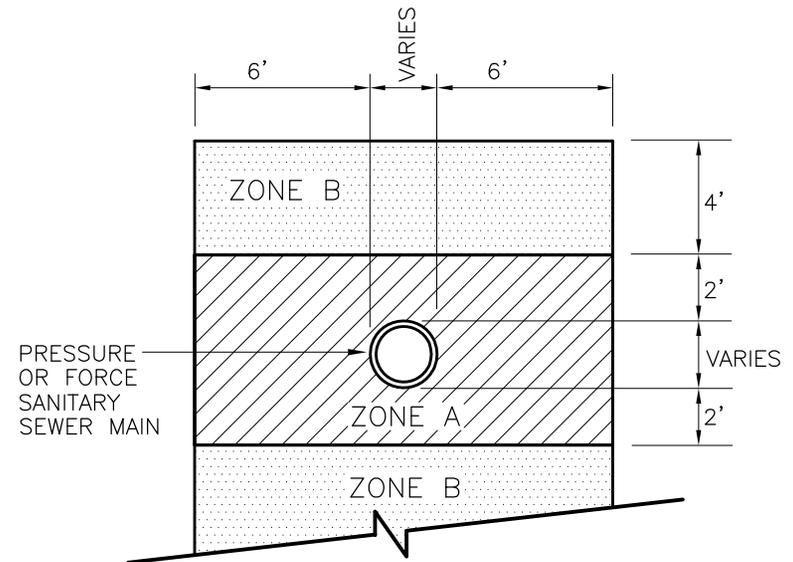
DETAIL NO.  
403-3

WATER LINE EXCLUSION AND EXTRA PROTECTION ZONES\*

GRAVITY SANITARY SEWER



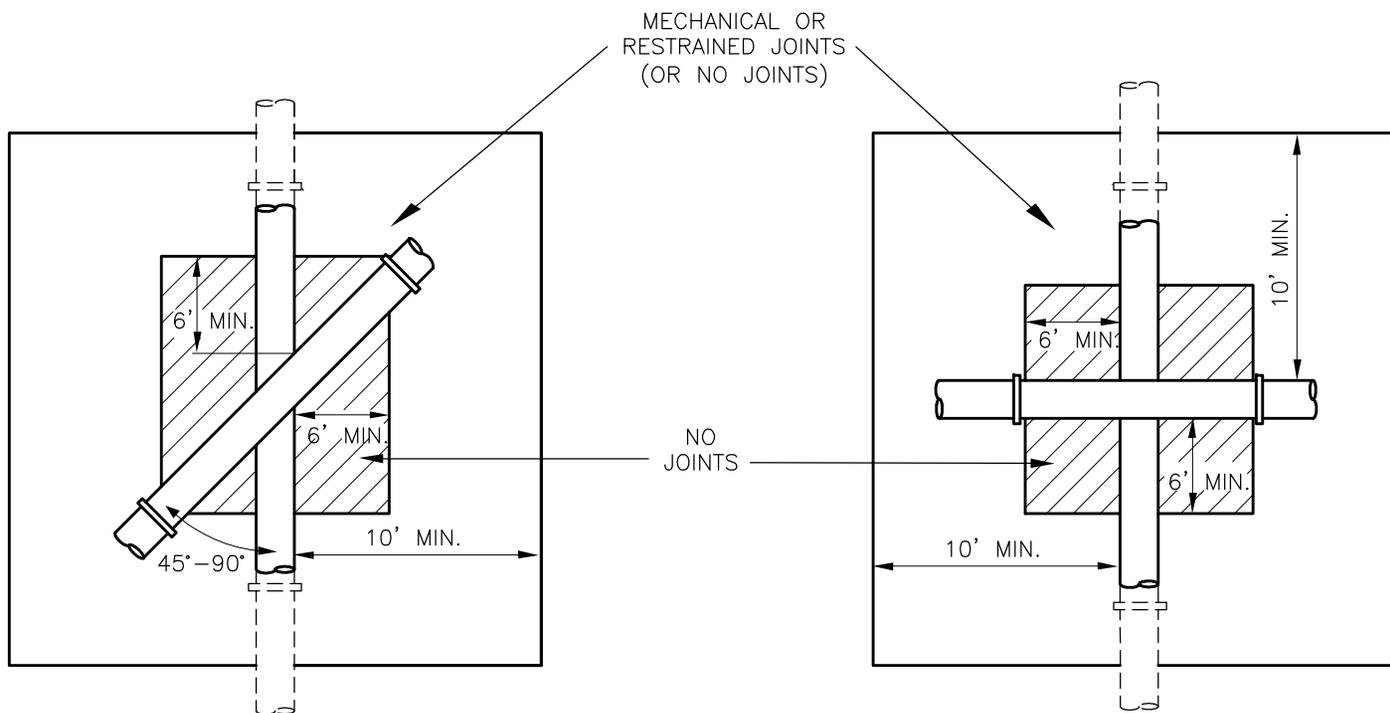
PRESSURIZED SANITARY SEWER



**NOTES:**

- ZONE A: NO WATER LINES ALLOWED/MINIMUM SEPARATION.
- ZONE B: EXTRA PROTECTION REQUIRED FOR WATER LINES.
- \* REFER TO STANDARD 610, WATER LINE CONSTRUCTION.

**WATER LINE EXTRA PROTECTION**  
**DUCTILE IRON PIPE WITH RESTRAINED OR MECHANICAL JOINTS\***



**EXTRA PROTECTION DUCTILE IRON PIPE**  
**(GRAVITY OR PRESSURIZED) SEWER LINE**

**NOTES:**

\* REFER TO MAG STANDARD SPECIFICATION SECTION 610.

DETAIL NO.

**404-2**



STANDARD DETAIL  
 ENGLISH

**WATER AND SANITARY SEWER  
 SEPARATION/PROTECTION**

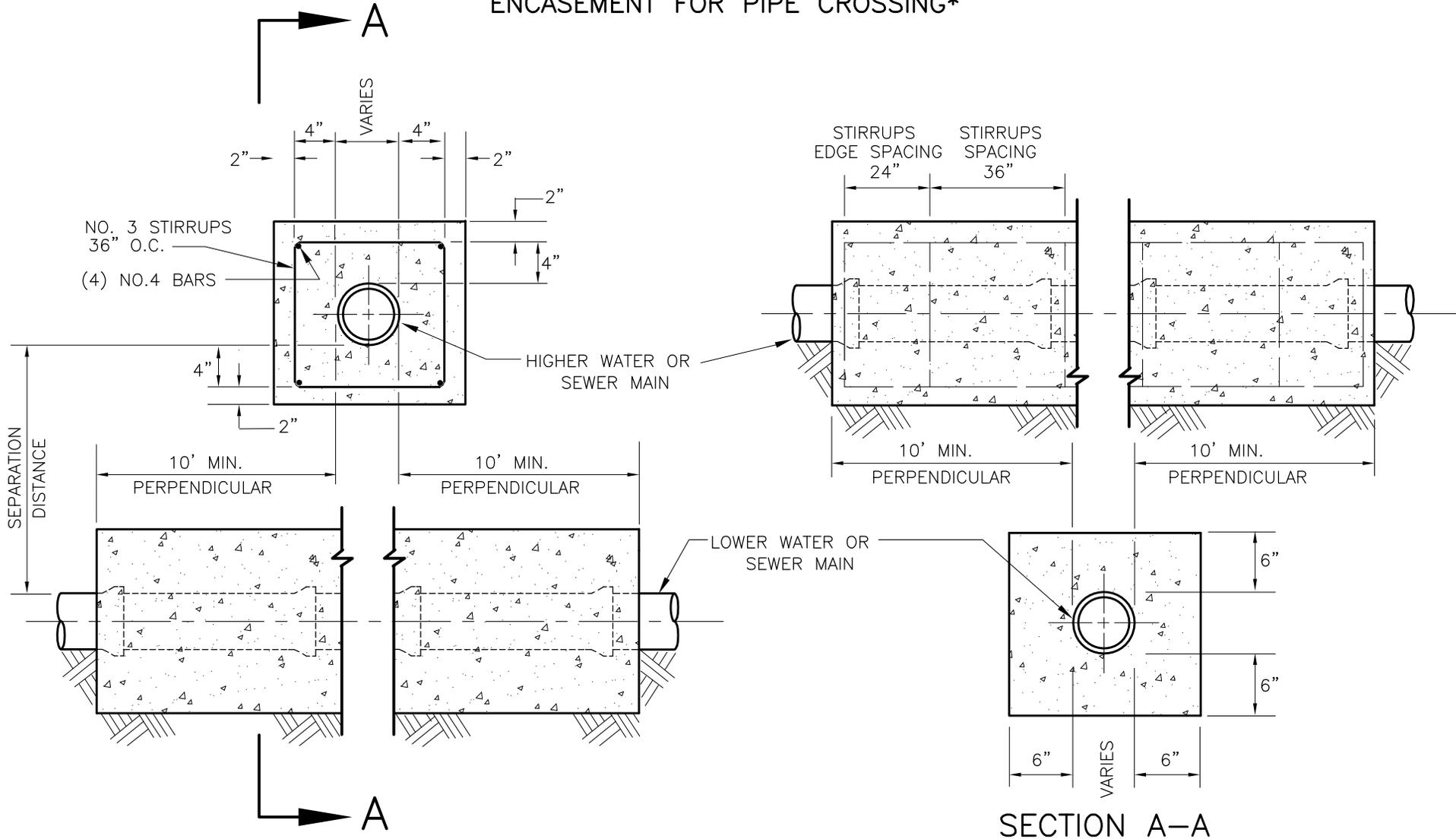
REVISED

01-01-2006

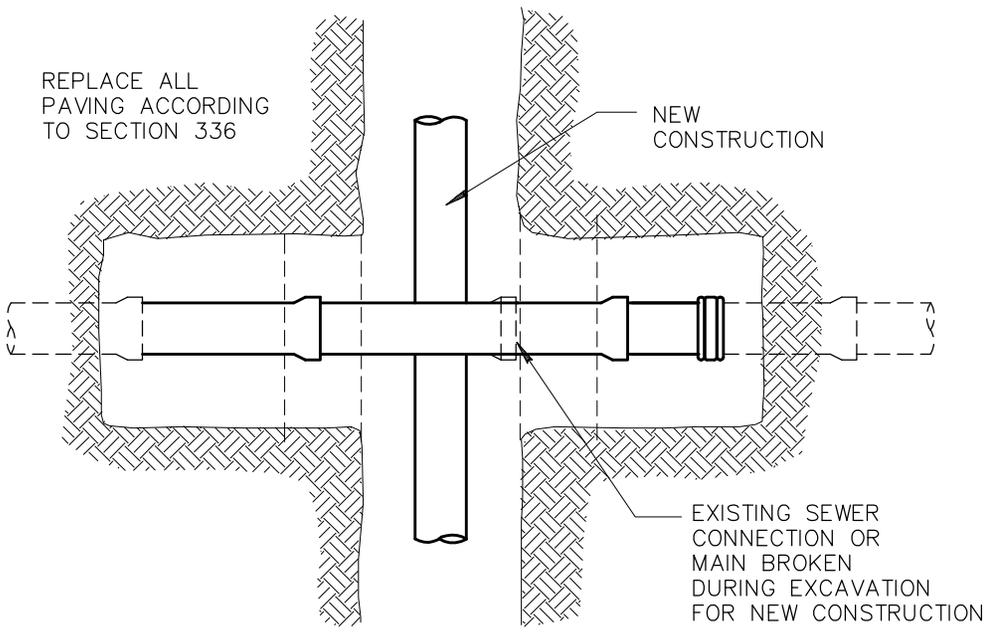
DETAIL NO.

**404-2**

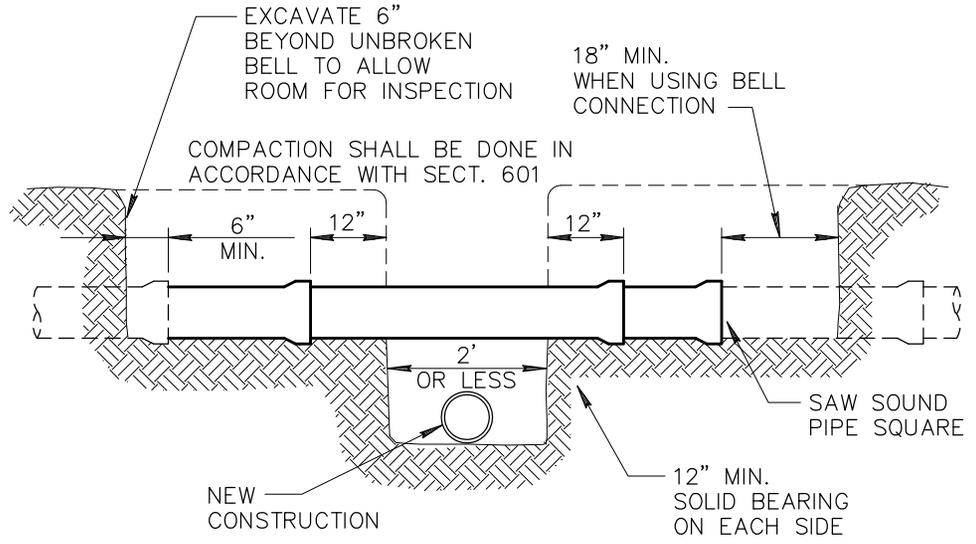
# ENCASEMENT FOR PIPE CROSSING\*



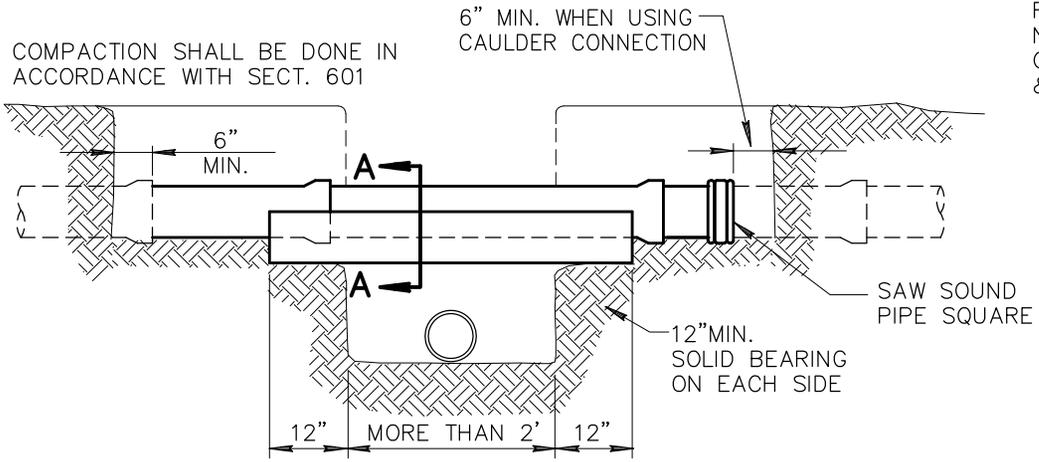
- NOTES:**
1. CLASS 'C' CONCRETE AS PER SECTION 725.
  - \*REFER TO MAG STANDARD SPECIFICATION SECTION 610.



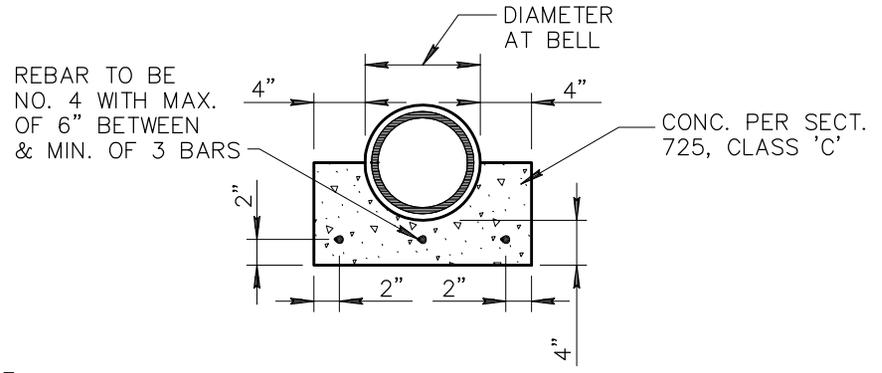
**PLAN VIEW OF REPLACEMENT**



**REPLACEMENT WHEN NEW TRENCH 2' WIDE OR LESS**



**REPLACEMENT WHEN NEW TRENCH MORE THAN 2' WIDE**



**SECTION 'A-A'**

**NOTES:**

1. BROKEN PIPE SHALL BE REPLACED WITH A MINIMUM OF ONE FULL JOINT AND TWO SHORT LENGTHS WITH UNBROKEN BELLS. CONSTRUCTION AND JOINTS TO BE MADE AS PER SECTION 615.

**TYPE 'A' TOP**

(PRECAST ECCENTRIC CONICAL TOP MANHOLE)

24" OR 30" FRAME  
& COVER PER DET.  
423, 424, 425 (TYP)

24" TO 26-3/4" ON  
48" MANHOLE  
30" ON 60" MANHOLE  
(TYP)

OVERALL ADJUSTMENT RING  
HEIGHT SHALL BE 12" MIN  
TO 18" MAX (TYP)

24" MAX ADJUSTING  
RINGS PER DETAIL  
422 (TYP)

30" MIN.  
36" MAX.

USE BUTYL RUBBER  
MASTIC JOINT SEALANT ON  
ALL JOINTS; EXCEPT TOP  
ADJUSTMENT RINGS

PRECAST RISER SECTIONS  
AS REQUIRED

CONCRETE SHELF SHALL BE  
PER DETAIL 420-3 SECTION  
A-A

DIAMETER  
PER PLAN

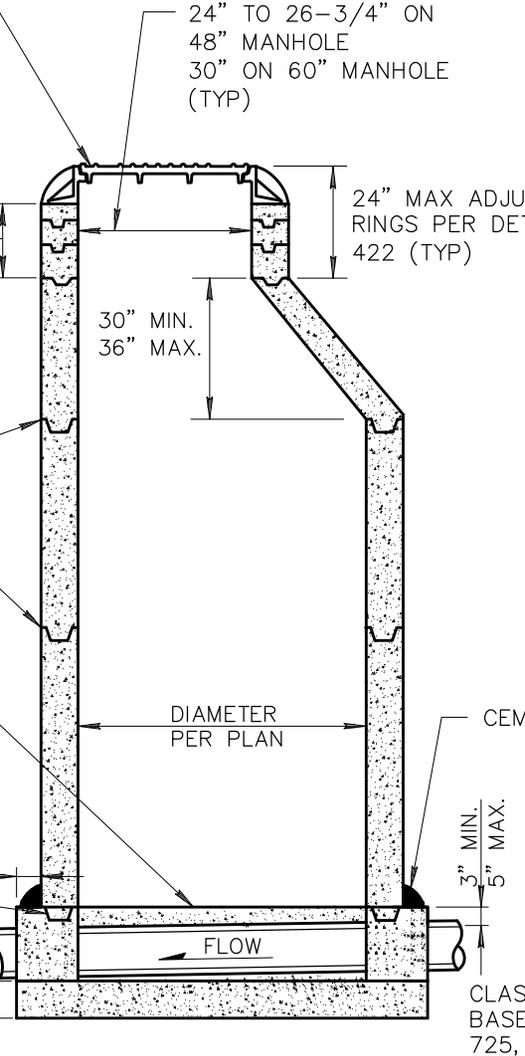
CEMENT MORTAR

4" TYP  
KEYWAY PRESSED INTO BASE  
TO MATCH PRECAST RISER

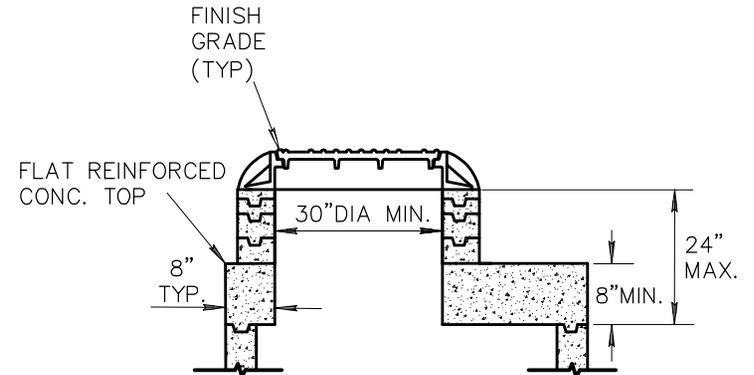
3" MIN.  
5" MAX.

8" IF MANHOLE IS 13' OR LESS  
12" IF MANHOLE IS OVER 13'

CLASS "A" CONCRETE  
BASE PER SECTION  
725, 505



**(PRECAST FLAT TOP M.H.)**



**NOTES:**

1. PRECAST STEEL REINFORCED MANHOLE SECTIONS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C 478 EXCEPT AS MODIFIED HEREIN.
2. CAST-IN-PLACE MANHOLE BASE TO BE CONSTRUCTED IN ONE PLACEMENT.
3. CAST-IN-PLACE MANHOLE BASE SHELF AND CHANNEL TO RECEIVE SMOOTH TROWEL FINISH.
4. MANHOLE COATINGS PER AGENCY.
5. SEE MAG DETAIL 422 FOR FINAL ADJUSTMENT TO GRADE.
6. ANY MANHOLE OVER 20' SHALL REQUIRE ENGINEER (STRUCTURAL) CALCS.
7. THE MANHOLE ACCESS POINT SHALL BE ORIENTED IN SUCH A WAY THAT THE OPENING IS DIRECTLY ABOVE THE LOWEST INVERT, OR AS OTHERWISE DIRECTED BY THE PLANS OR ENG.
8. FOR PRECAST BASE SEE DETAIL 420-2.
9. FLAT TOPS SHALL ONLY BE USED WITH APPROVAL FROM THE ENGINEER.

DETAIL NO.

420-1



STANDARD DETAIL  
ENGLISH

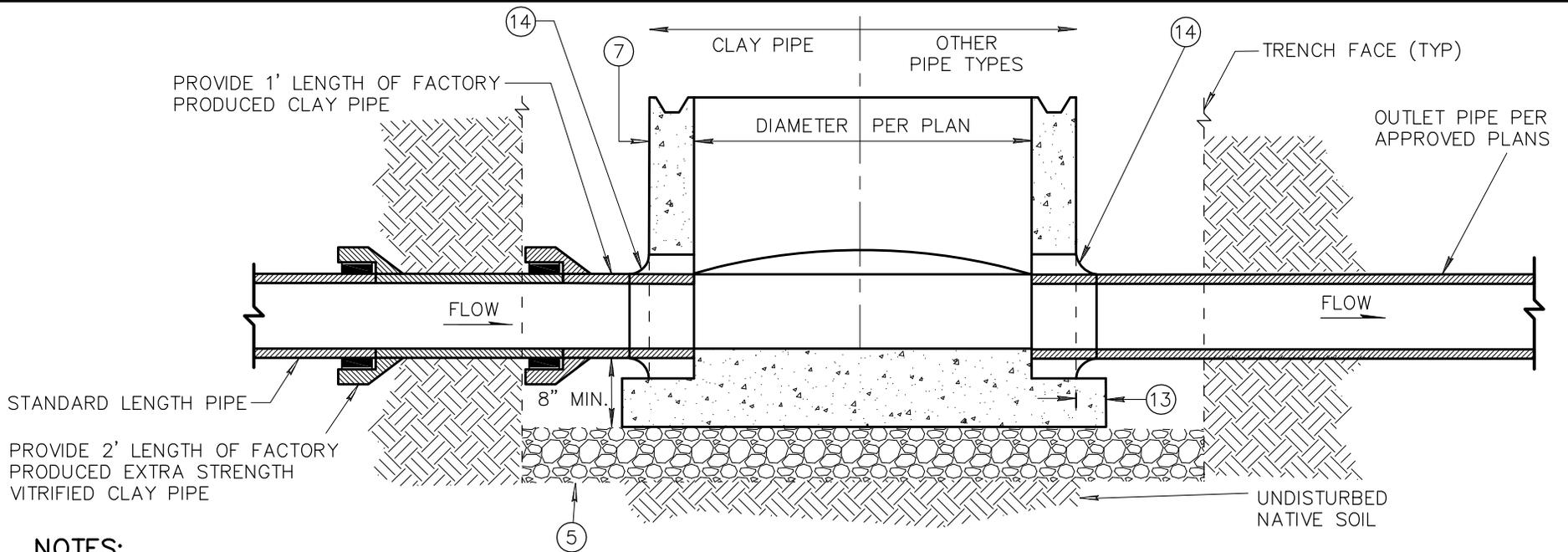
CONCRETE SANITARY SEWER MANHOLE

REVISED

01-01-2015

DETAIL NO.

420-1



**NOTES:**

- ① PRECAST, MANUFACTURER SHALL BE AN NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA) CERTIFIED PLANT. ENTIRE PRECAST BASE SHALL BE MANUFACTURED AT THE PLANT PER ASTM C478.
- ② MAG "AA" 4000 PSI CONCRETE SHALL BE USED FOR PRECAST MANHOLE BASES.
- ③ SPRING LINE OF CAST-IN-PLACE BELL SHALL STOP AT INSIDE FACE OF MANHOLE.
- ④ JOINTS FOR BARREL SECTION SHALL BE TONGUE AND GROOVE TYPE. ALL LIFTING HOLES SHALL BE SEALED WITH GROUT.
- ⑤ ALL PRECAST MANHOLE BASES SHALL BE PLACED ON 8" MINIMUM OF ABC PER SECTION 702 COMPACTED TO 100% MAXIMUM DENSITY.
- ⑥ ALL MODIFICATIONS SHALL BE APPROVED BY THE ENGINEER.
- ⑦ MINIMUM WALL THICKNESS SHALL BE PER ASTM C478 (MIN 5").
- ⑧ REINFORCEMENT SHALL BE DESIGNED BY AN ARIZONA REGISTERED PROFESSIONAL ENGINEER.
- ⑨ CHANNEL TRANSITION SHALL BE CONSTANT FROM INLET TO OUTLET OF MANHOLE TO FACILITATE SMOOTH TRANSITIONS AND ACCOMMODATE CORRESPONDING MANDREL.
- ⑩ THERE SHALL BE NO HARD CONNECTIONS (GROUTED) INTO THE MANHOLE BASE UNLESS APPROVED BY THE ENGINEER.
- ⑪ ALL SEWER SERVICE CONNECTIONS SHALL HAVE THE SAME CONNECTION TYPES IN THE PRECAST MANHOLE BASE.
- ⑫ ALL CORE HOLES INTO THIS STRUCTURAL PRECAST BASE SHALL BE COATED WITH AN APPROVED COATING MATERIAL.
- ⑬ THE MANHOLE BOTTOM SHALL EXTEND OUTSIDE THE MANHOLE WALL A MINIMUM 6" WIDE ON 48" BASES, 7" WIDE ON 60" BASES, AND 8" WIDE ON 72" BASES. EXTENDED BOTTOM SHALL BE A MINIMUM OF 5" THICK.
- ⑭ ALL PIPE CONNECTIONS SHALL BE IN COMPLIANCE WITH ASTM F477 OR ASTM C425. AN EXTRA STRENGTH VCP BELL WITH A POLYURETHANE JOINT THAT MEETS ASTM C425 MAY BE USED WITH VCP.

DETAIL NO.

**420-2**



STANDARD DETAIL  
ENGLISH

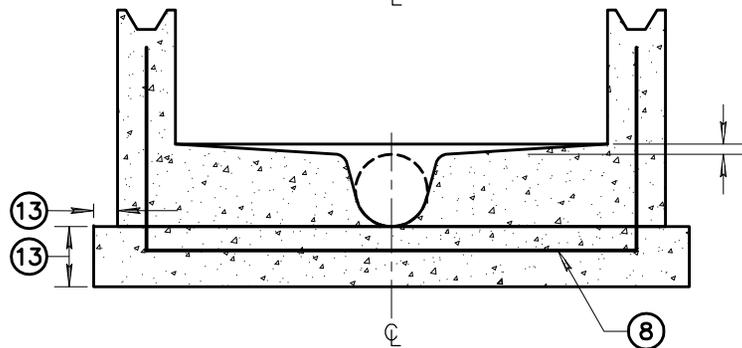
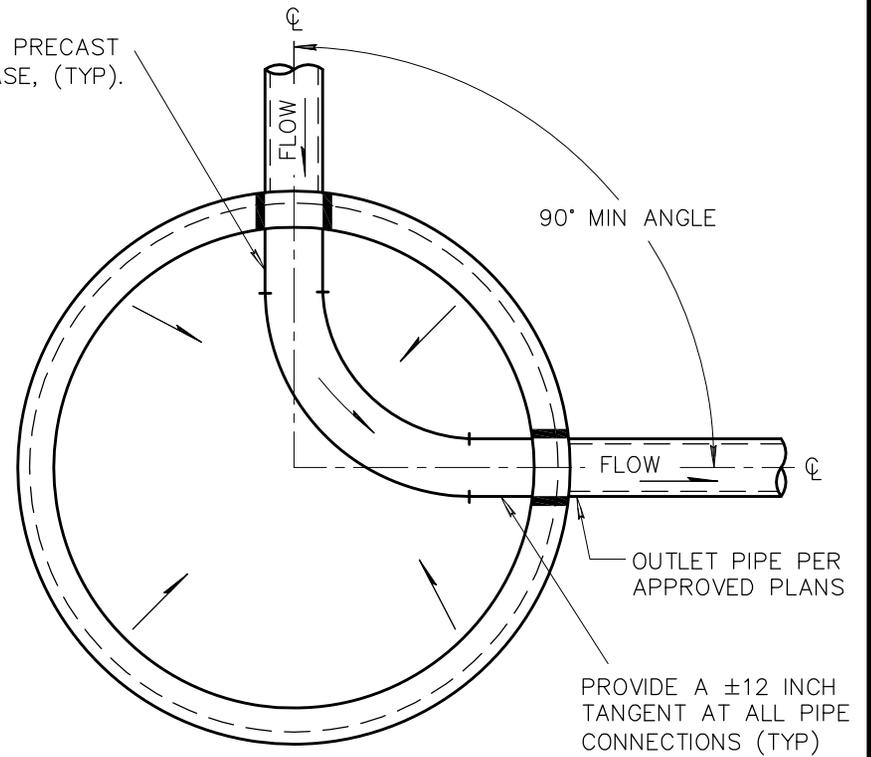
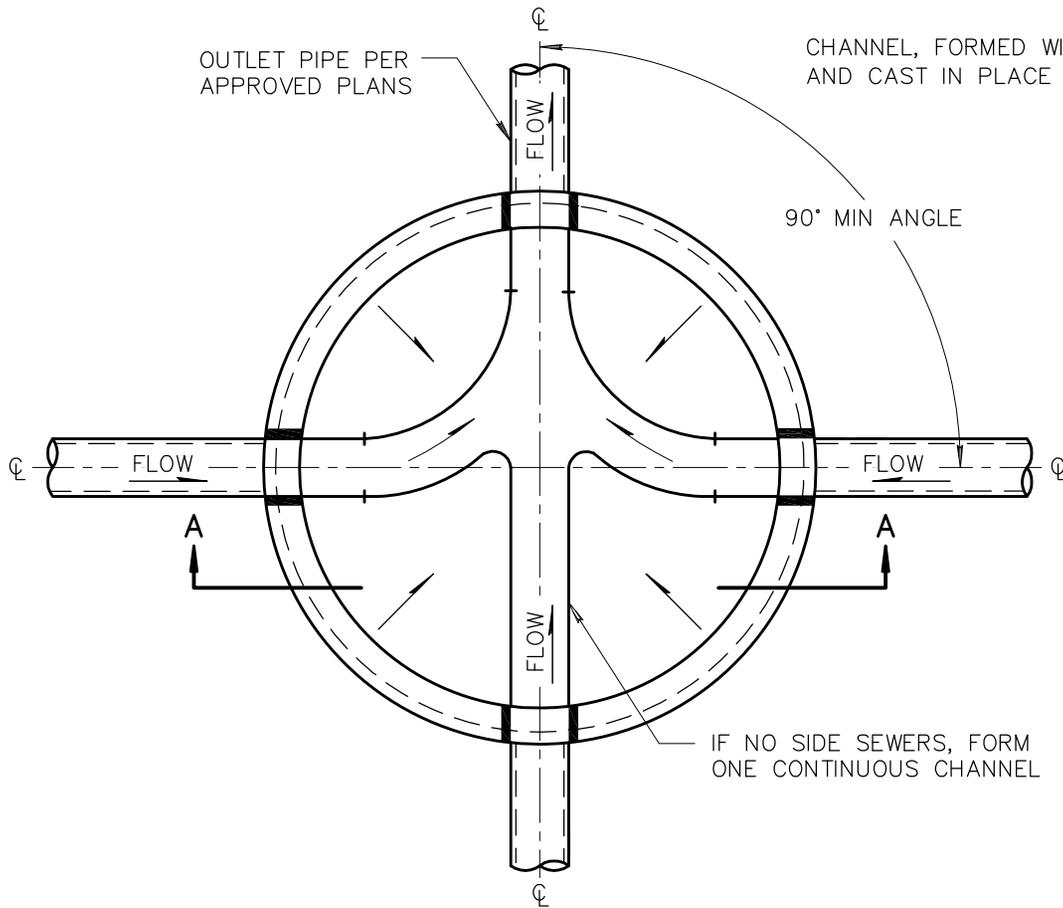
**PRECAST CONCRETE MANHOLE BASE**

REVISED

01-01-2015

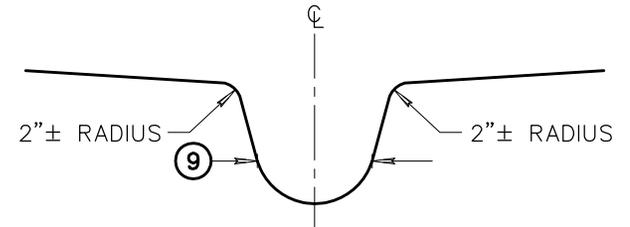
DETAIL NO.

**420-2**



SECTION A-A

TOP OF SHELF TO  
TOP OF PIPE  
(MIN 2% SLOPE)  
NOT  
TO EXCEED 3"



CHANNEL TRANSITION SHALL BE CONSISTENT  
FROM INLET TO OUTLET OF MANHOLE TO  
FACILITATE SMOOTH TRANSITIONS AND  
ACCOMMODATE CORRESPONDING MANDREL.

TYPICAL CHANNEL

SEE DETAIL 420-2 FOR NOTES

DETAIL NO.  
420-3



STANDARD DETAIL  
ENGLISH

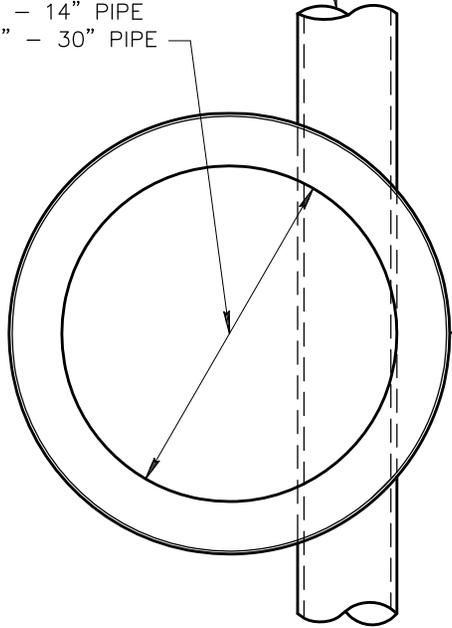
CONCRETE MANHOLE BASE

REVISED  
01-01-2015

DETAIL NO.  
420-3

PIPE SIZE & ELEVATION  
AS SHOWN ON PLANS

48" I.D. FOR 8" - 14" PIPE  
60" I.D. FOR 15" - 30" PIPE



MANHOLE ADJUSTMENT  
PER DETAIL 422

COMBINED CURB  
AND GUTTER

SEE DETAIL  
420-1 FOR  
ADJUSTMENT  
REQUIREMENTS

MANHOLE TO BE  
PRECAST PER  
SECT. 625

PRECAST RISER PER  
ASTM C-478

4"  
TYP

2% MIN NOT TO  
EXCEED 3"

CEMENT  
MORTAR  
(TYP)

30" MIN.  
36" MAX.

CLASS A CONCRETE  
PER SECT. 725, 505

TROWEL  
FINISH  
SMOOTH

8" IF MANHOLE  
IS 13' OR LESS  
12" IF MANHOLE  
IS OVER 13'

DETAIL NO.

421



STANDARD DETAIL  
ENGLISH

OFFSET MANHOLE 8" TO 30" PIPE

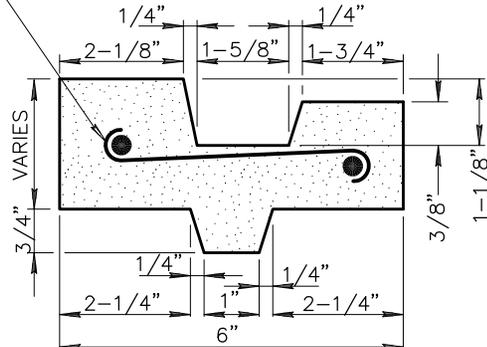
REVISED

01-01-2015

DETAIL NO.

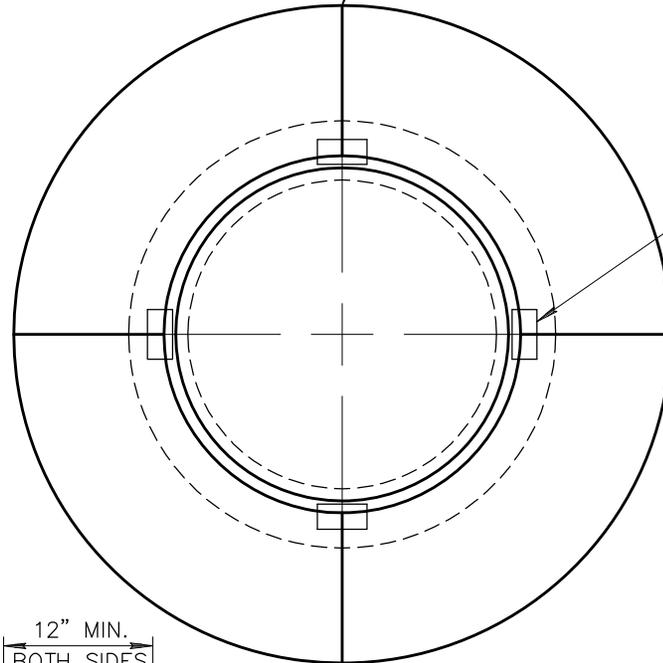
421

(2) NO.2 HOOPS FOR 4" RING TIED WITH NO. 4 A.S.& W. GAUGE WIRE. 6" & 8" RING REQUIRE (4) NO. 2 HOOPS.



**ADJUSTING RING DETAIL**

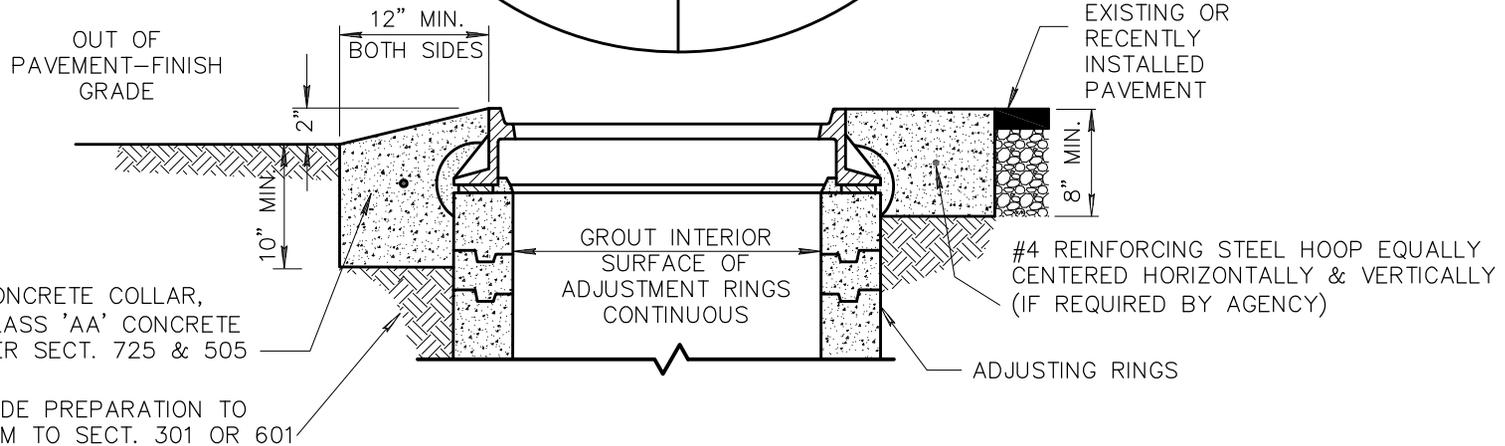
MEDIUM BROOM FINISH WITH RADIALLY SCORED MARKS (4 MIN.)



**NOTES:**

1. CONTRACTORS SHALL ADJUST ALL MANHOLE RINGS AND COVERS, INCLUDING MANHOLES OUTSIDE OF THE PAVEMENT.
2. ADJUSTMENT SHALL BE CONSTRUCTED PER MAG SECTION 345.
3. MANHOLE COATINGS PER AGENCY
4. GROUT SHALL BE USED BETWEEN FRAME AND ADJUSTING RING TO ACHIEVE WATER TIGHTNESS.

SPACER TYPE	REQUIRED THICKNESS
BRICK	GREATER THAN 2"
4"X2" STEEL SPACER	1/2" TO 2"
GROUT	LESS THAN 1/2"



DETAIL NO.

422



STANDARD DETAIL  
ENGLISH

**MANHOLE FRAME  
AND COVER ADJUSTMENT**

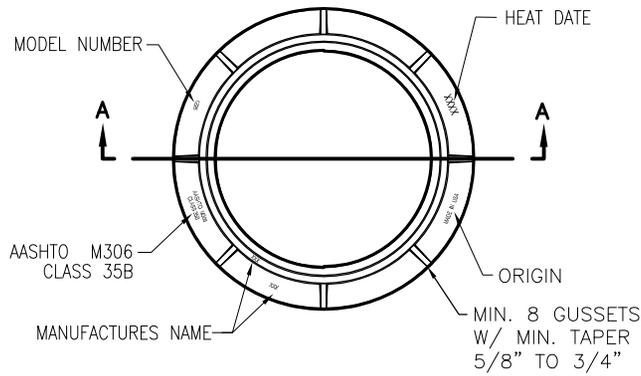
REVISED

01-01-2015

DETAIL NO.

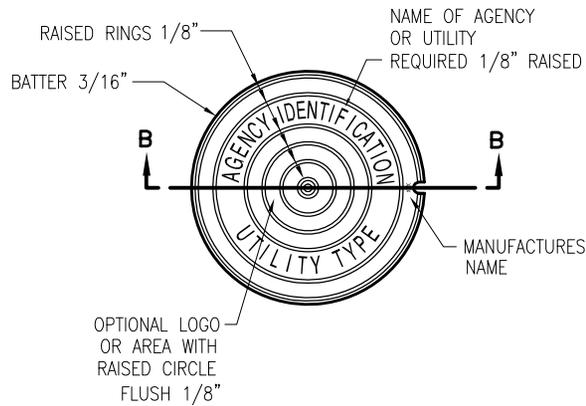
422

**FRAME TOP VIEW**

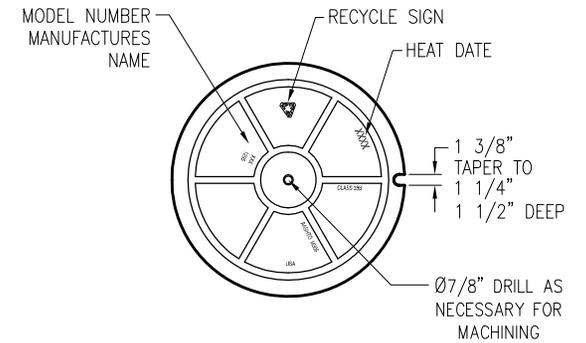


FRAME WT. (CL. 35) – 180 LBS

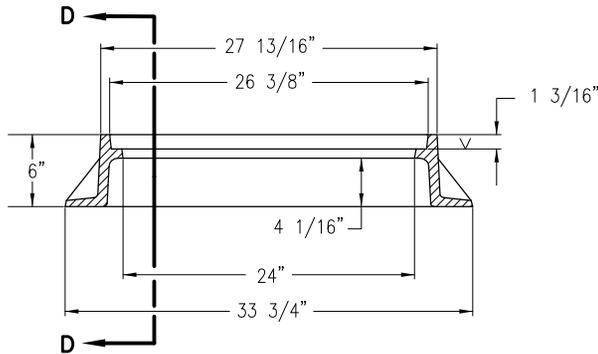
**COVER TOP VIEW**



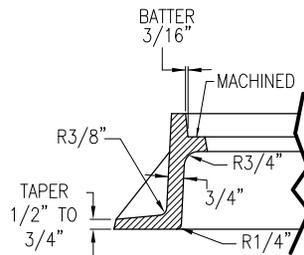
**COVER BOTTOM VIEW**



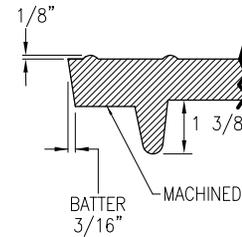
COVER WT. (CL. 35) – 188 LBS



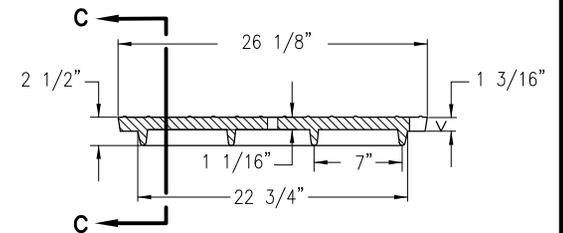
SECTION A



SECTION D



SECTION C



SECTION B

**NOTE:**

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF RINGS. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

423-1



STANDARD DETAIL  
ENGLISH

24" CAST IRON  
MANHOLE FRAME AND COVER

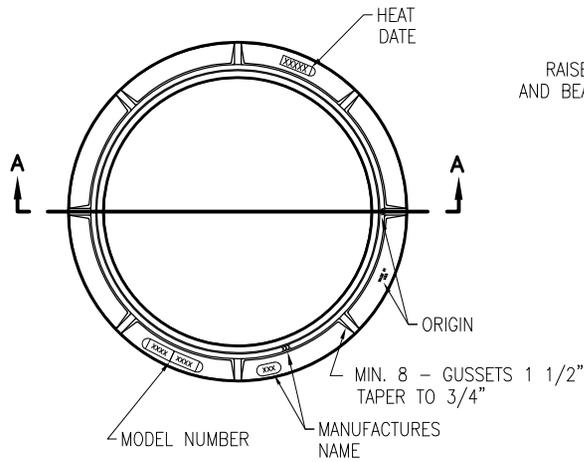
REVISED

01-01-2012

DETAIL NO.

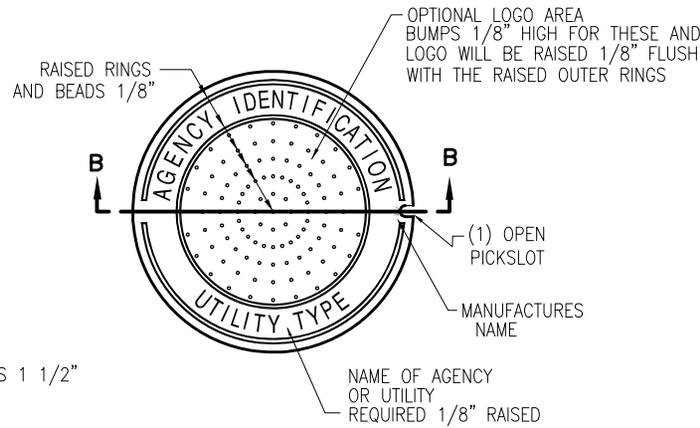
423-1

**FRAME TOP VIEW**

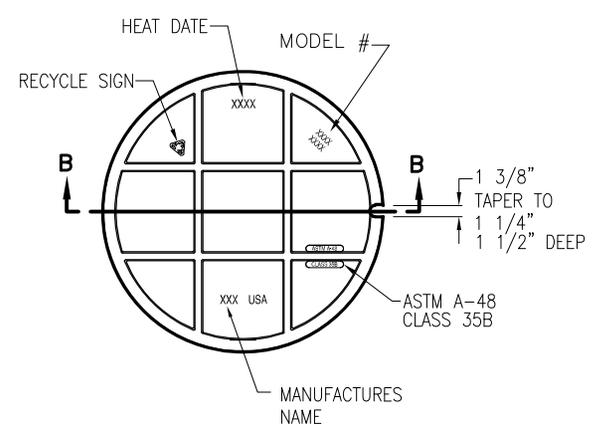


FRAME WT. (CL. 35) - 227 LBS

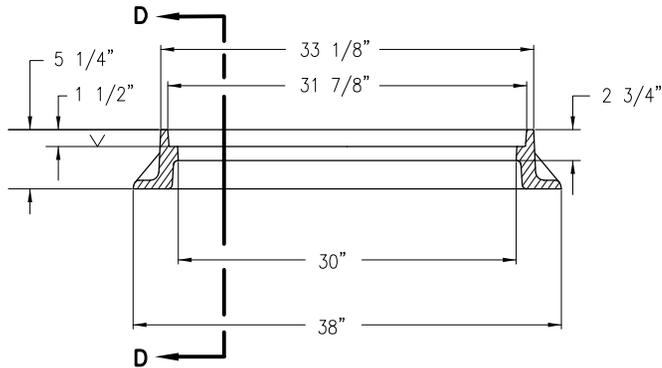
**COVER TOP VIEW**



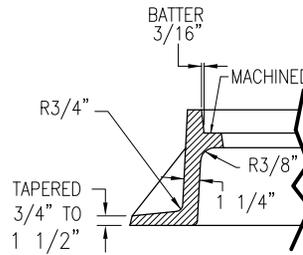
**COVER BOTTOM VIEW**



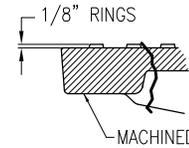
COVER WT. (CL. 35) - 210 LBS



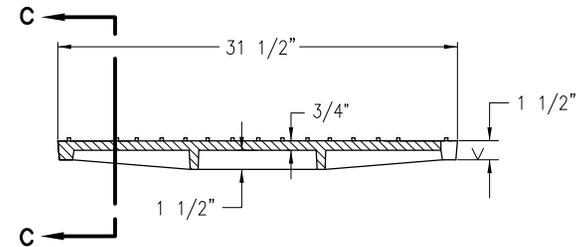
**SECTION A**



**SECTION D**



**SECTION C**



**SECTION B**

**NOTE:**

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.  
**423-2**



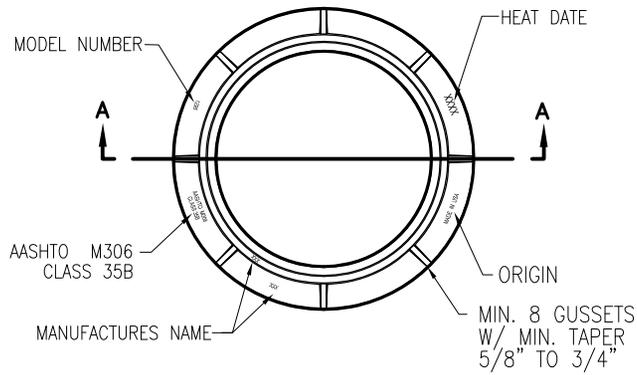
STANDARD DETAIL  
ENGLISH

**30" CAST IRON  
MANHOLE FRAME AND COVER**

REVISED  
01-01-2012

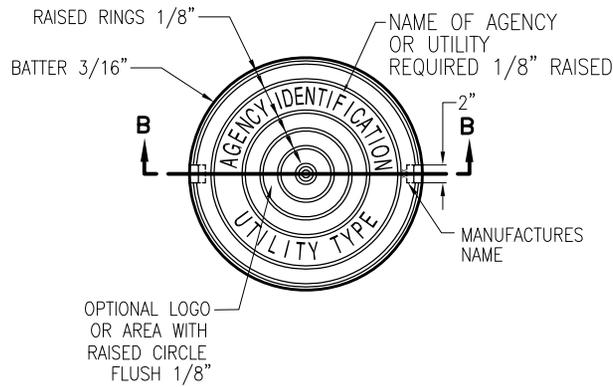
DETAIL NO.  
**423-2**

**FRAME TOP VIEW**

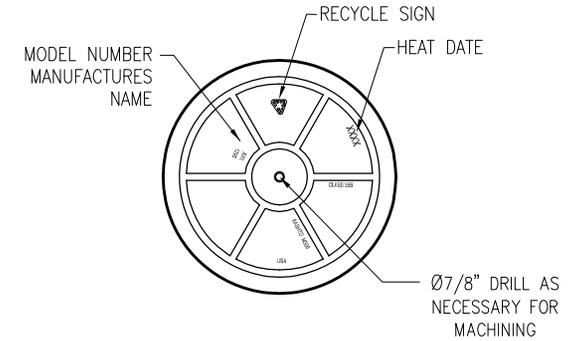


FRAME WT. (CL. 35) – 180 LBS

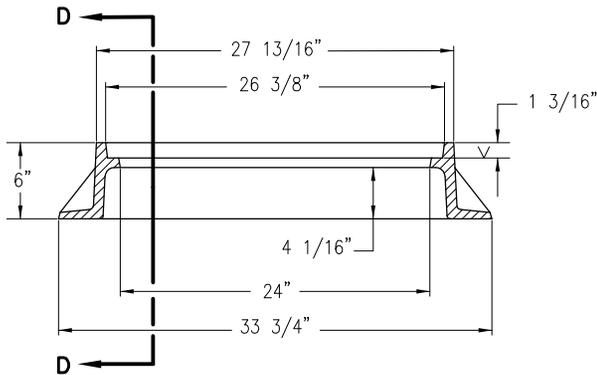
**COVER TOP VIEW**



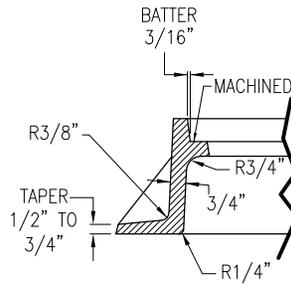
**COVER BOTTOM VIEW**



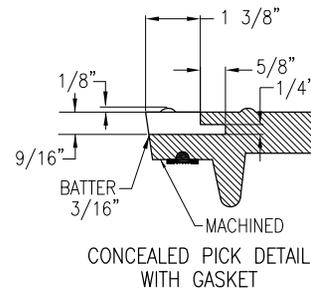
COVER WT. (CL. 35) – 188 LBS



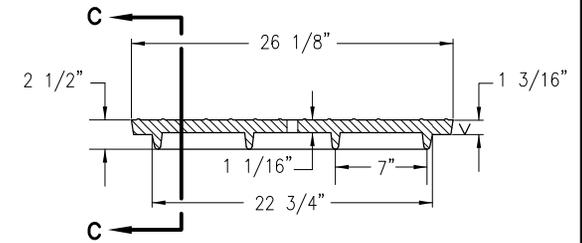
**SECTION A**



**SECTION D**



**SECTION C**



**SECTION B**

**NOTE:**

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

**424-1**



STANDARD DETAIL  
ENGLISH

**24" CAST IRON WATERTIGHT  
MANHOLE FRAME AND COVER**

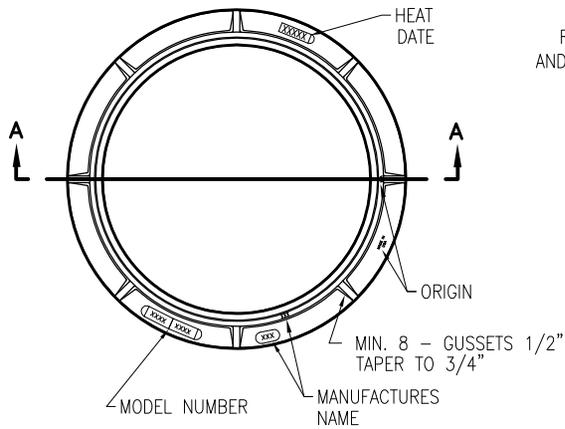
REVISED

01-01-2012

DETAIL NO.

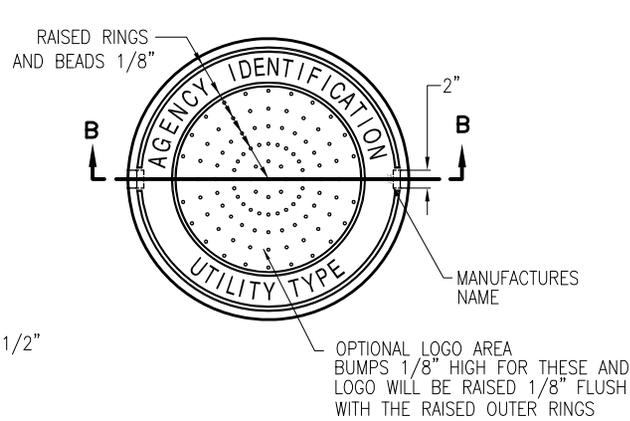
**424-1**

**FRAME TOP VIEW**

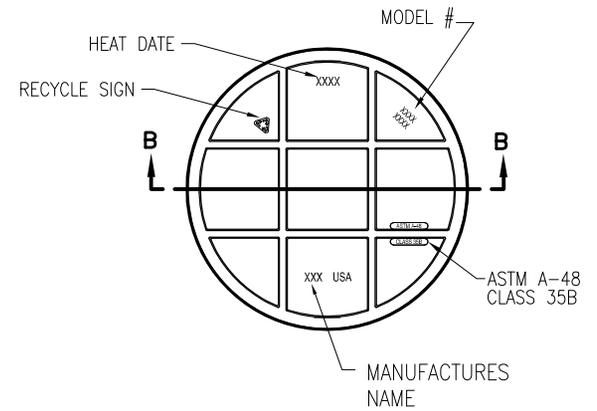


FRAME WT. (CL. 35) - 227 LBS

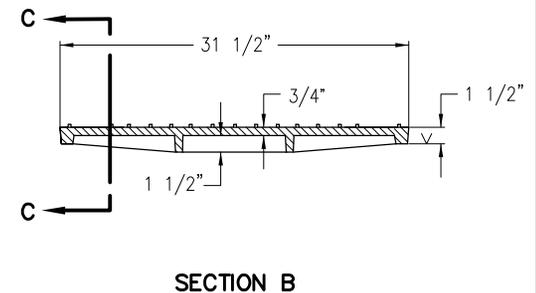
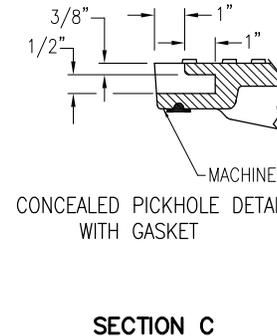
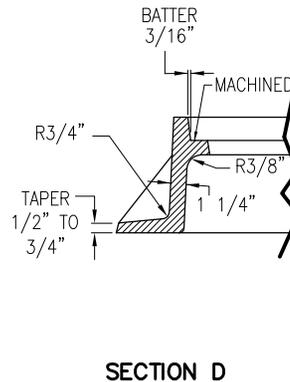
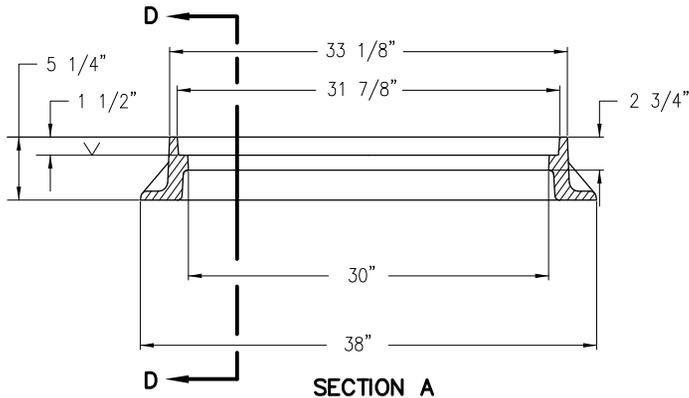
**COVER TOP VIEW**



**COVER BOTTOM VIEW**



COVER WT. (CL. 35) - 210 LBS



**NOTE:**

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.  
**424-2**



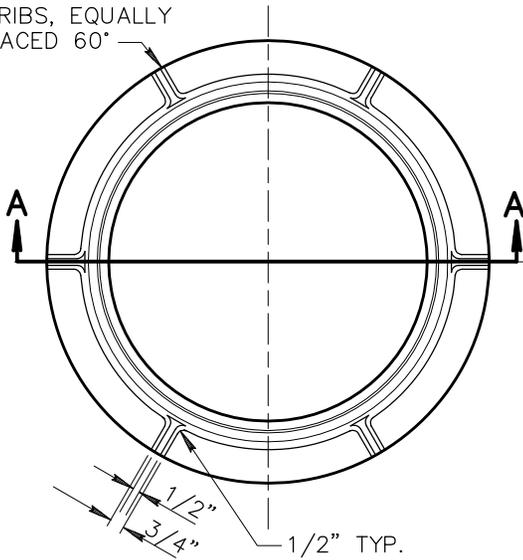
STANDARD DETAIL  
ENGLISH

**30" CAST IRON WATERTIGHT  
MANHOLE FRAME AND COVER**

REVISED  
01-01-2012

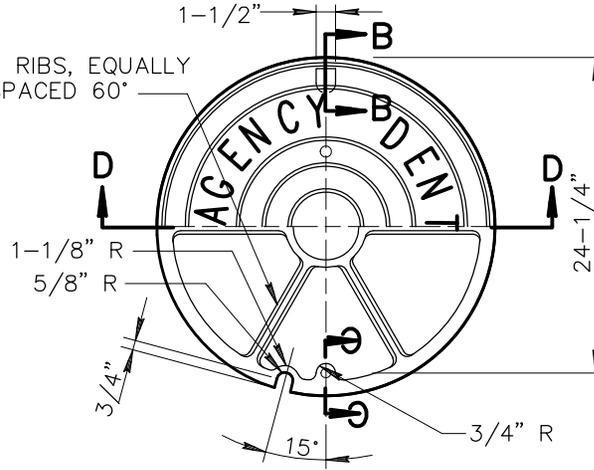
DETAIL NO.  
**424-2**

6 RIBS, EQUALLY SPACED 60°



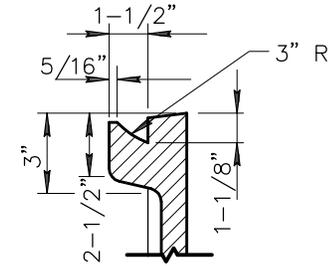
**TOP VIEW**

6 RIBS, EQUALLY SPACED 60°

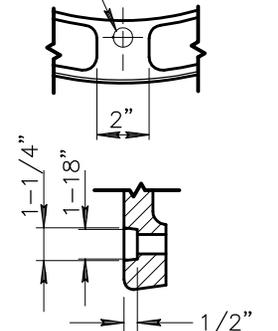


**BOTTOM VIEW**

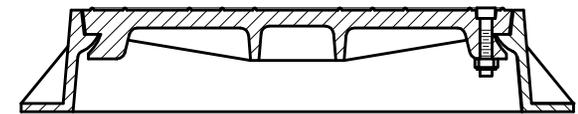
3/4" DRILL



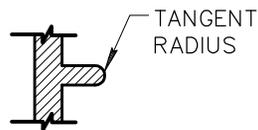
**SECTION 'B-B'**



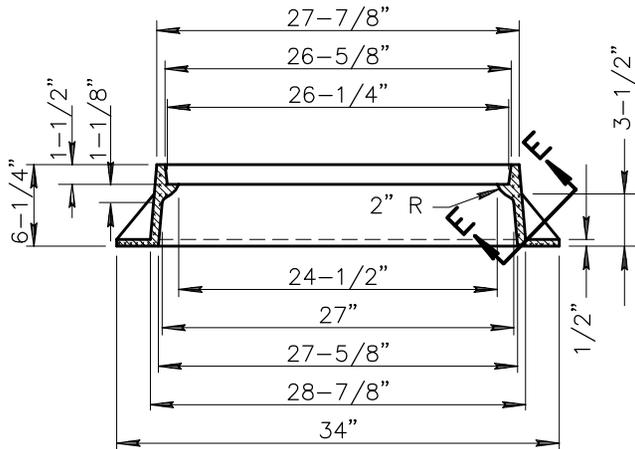
**SECTION 'C-C'**



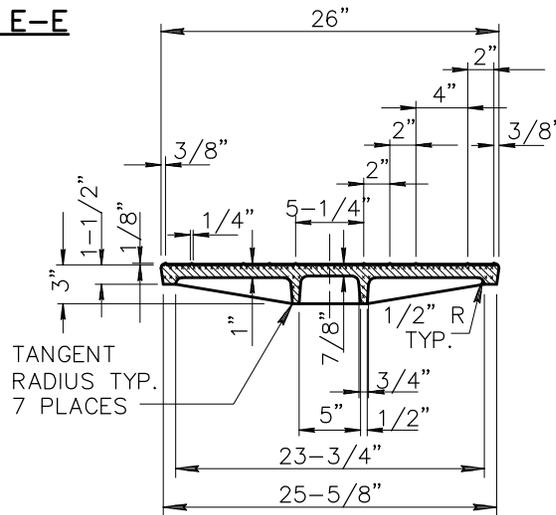
**SECTION VIEW OF FRAME AND COVER WITH CAM LOCKING DEVICE**



**SECTION E-E**



**SECTION 'A-A'**



**SECTION 'D-D'**

**NOTES:**

1. MATERIAL SHALL CONFORM TO A.S.T.M. STANDARDS  
B 179-65 ALLOY SN122A  
B 179-65 ALLOY CN42A  
B 108-65 ALLOY SC103A  
(ALL 3 ACCEPTABLE)
2. LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED. (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" RAISED 1/8" ABOVE LEVEL OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL.
3. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% LESS THAN THE APPROXIMATE WEIGHT SPECIFIED.
4. CASTINGS SHALL CONFORM TO SECT. 787.
5. SHALL CONFORM TO SECT. 625.3.1 - (FRAME AND COVER).

DETAIL NO.

**425**



STANDARD DETAIL  
ENGLISH

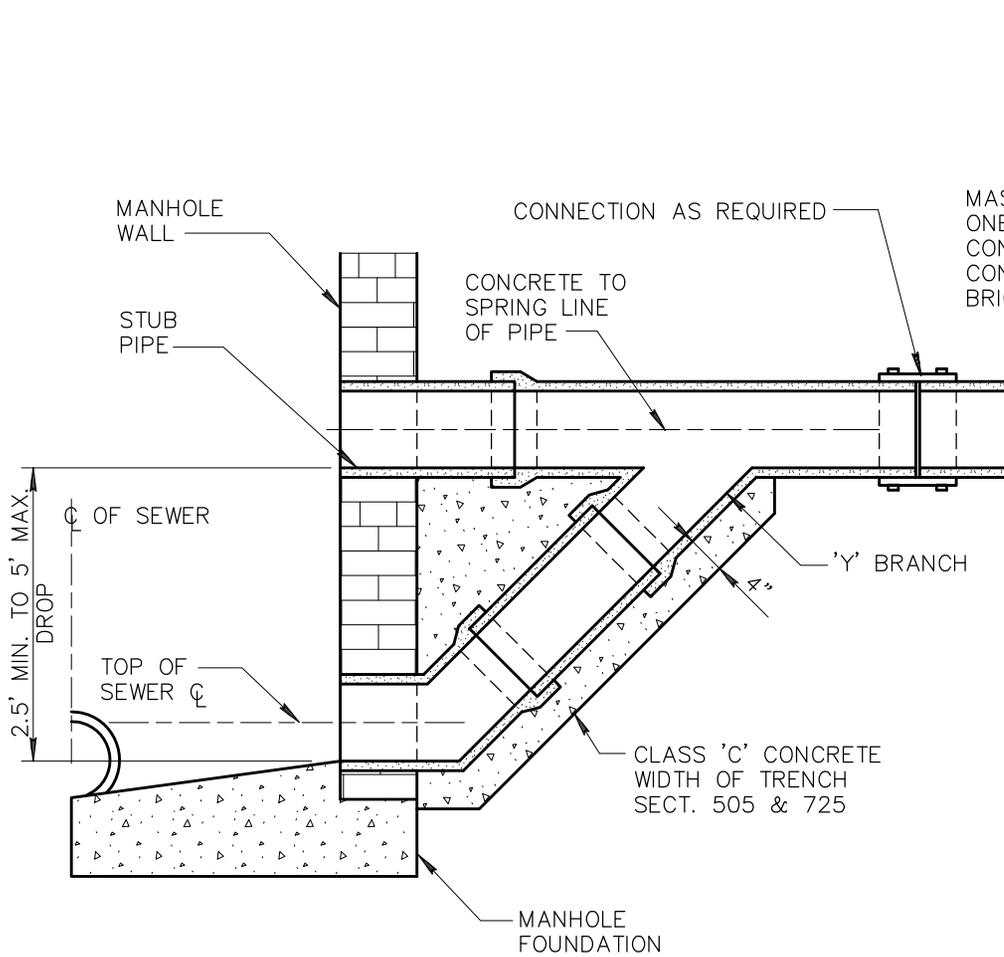
**24" ALUMINUM  
MANHOLE FRAME AND COVER**

REVISED

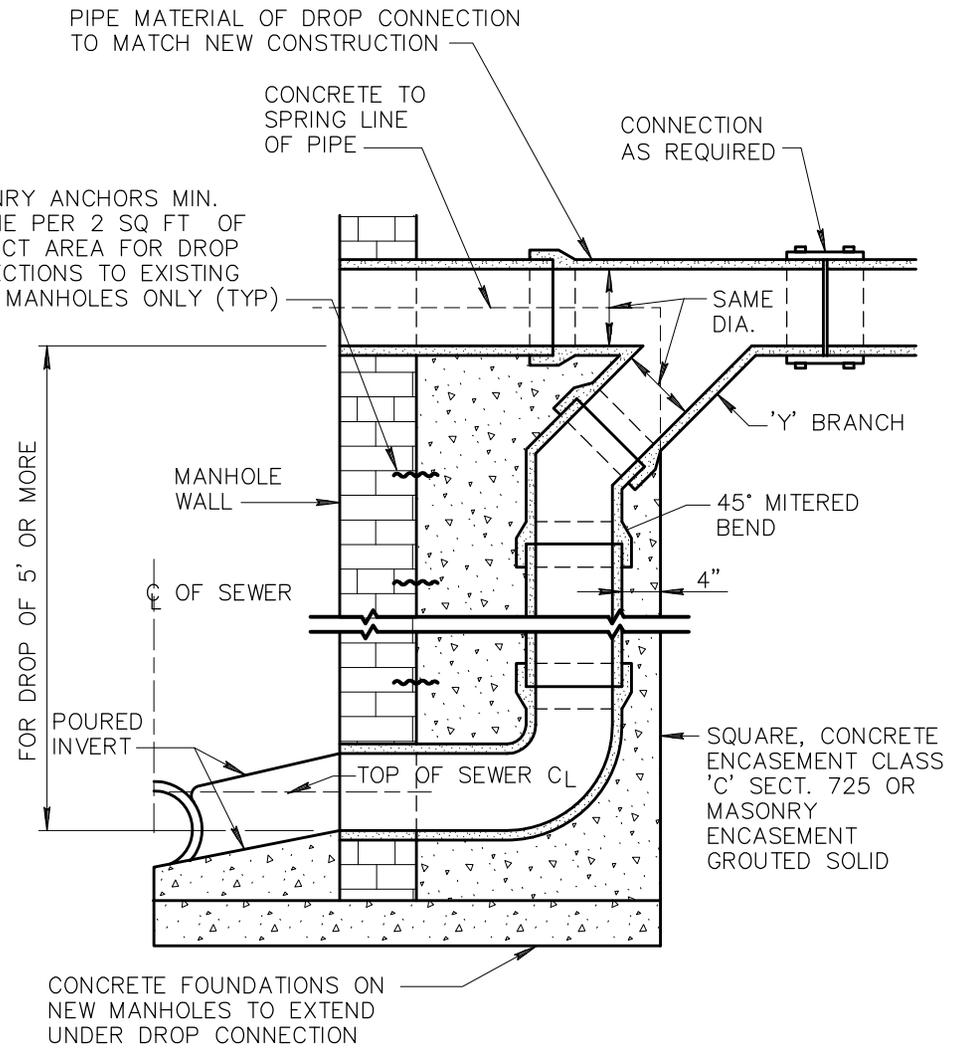
01-01-1998

DETAIL NO.

**425**



**TYPE A**  
2.5' TO 5' DROP



**TYPE B**  
5' OR MORE

DETAIL NO.

426



STANDARD DETAIL  
ENGLISH

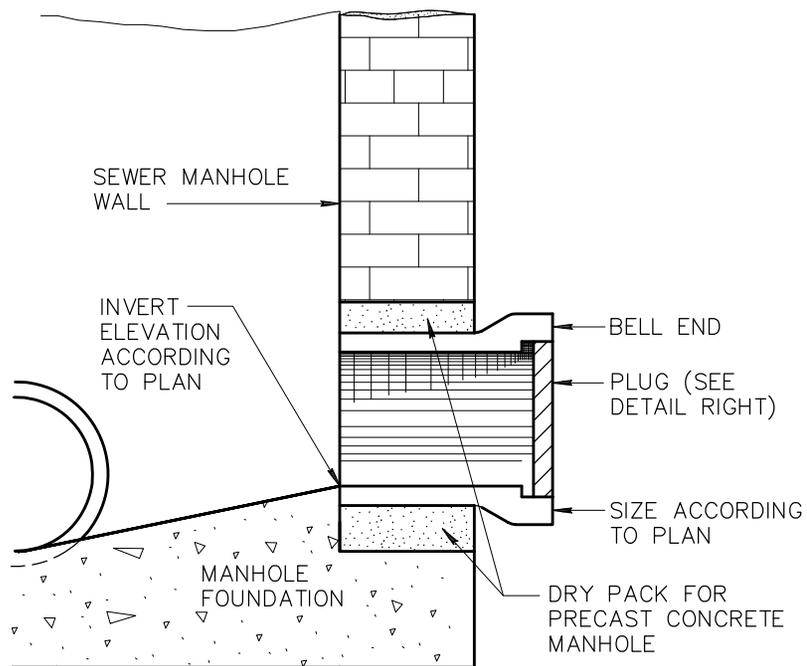
**DROP SEWER CONNECTIONS**

REVISED

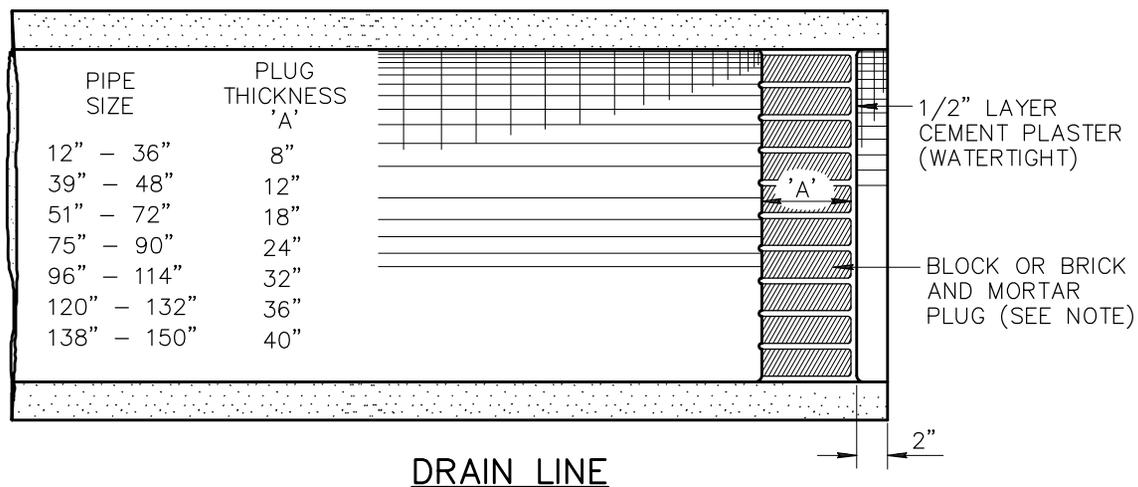
01-01-2007

DETAIL NO.

426

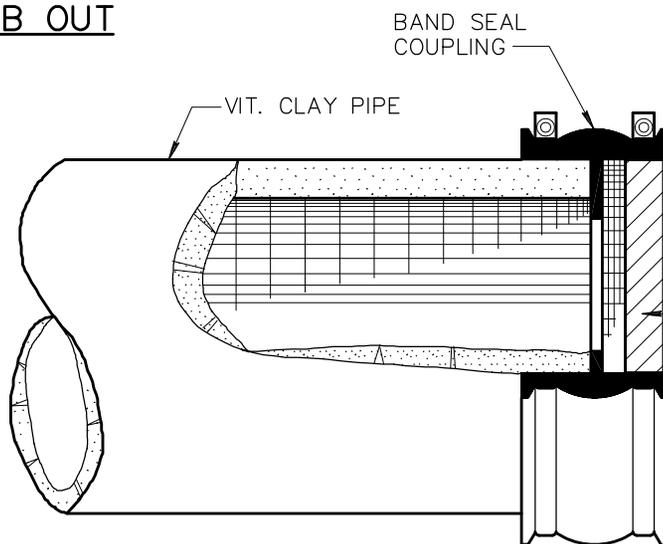


**TYPICAL STUB OUT**

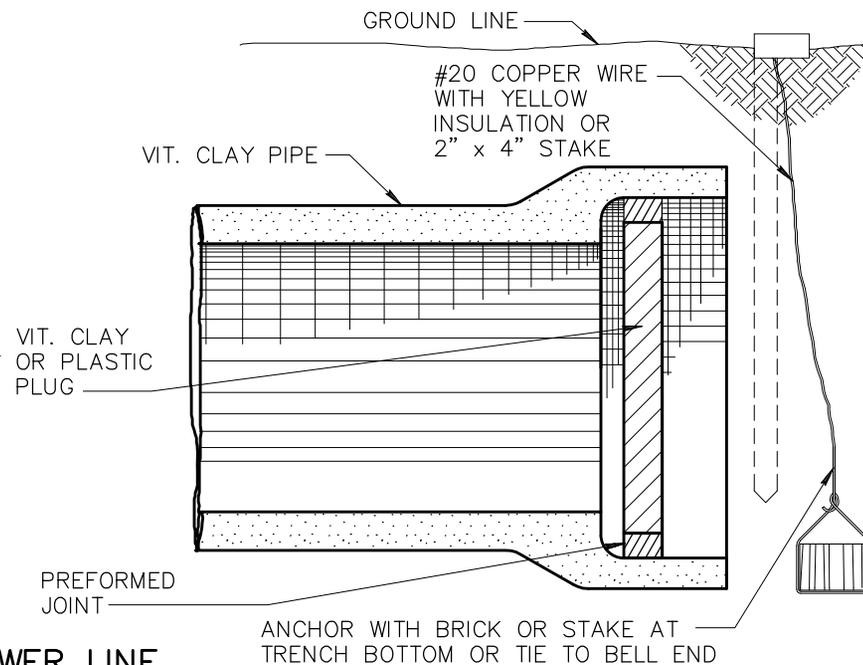


**NOTES:**

- NOTE: COMPACT SOIL AT END OF PIPE TO 95% OF MAXIMUM DENSITY.
- IF DEPTH OF COVER IS LESS THAN 5' OR GREATER THAN 10' INCREASE PLUG THICKNESS A MIN. OF 4".



**SEWER LINE**



DETAIL NO.

427



STANDARD DETAIL  
ENGLISH

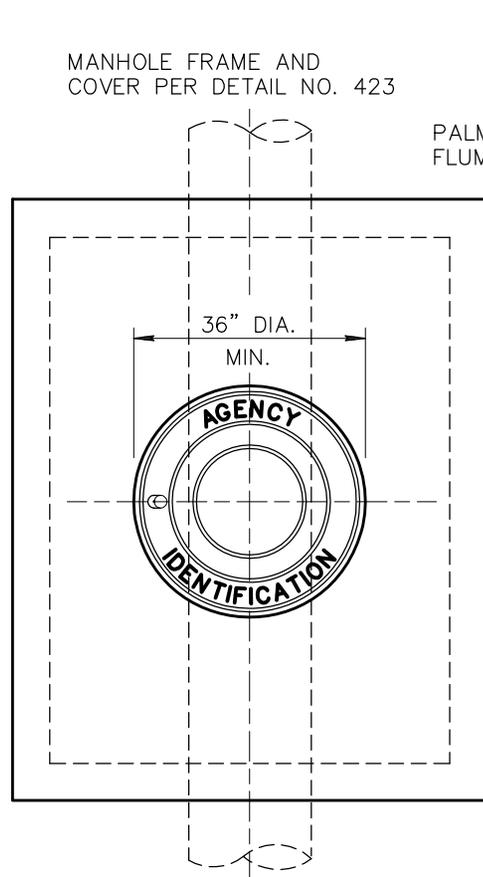
**STUB OUT AND PLUGS**

REVISED

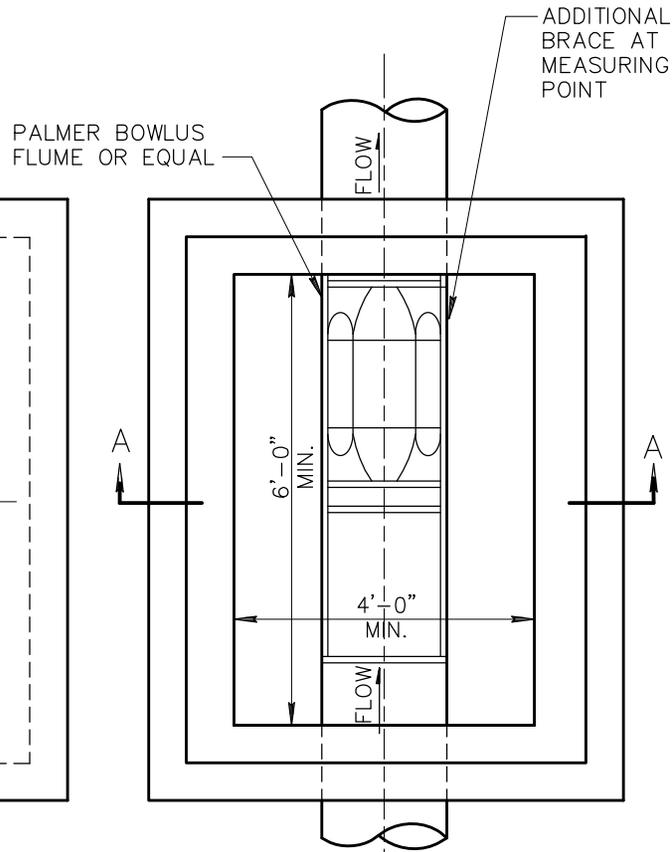
01-01-1998

DETAIL NO.

427

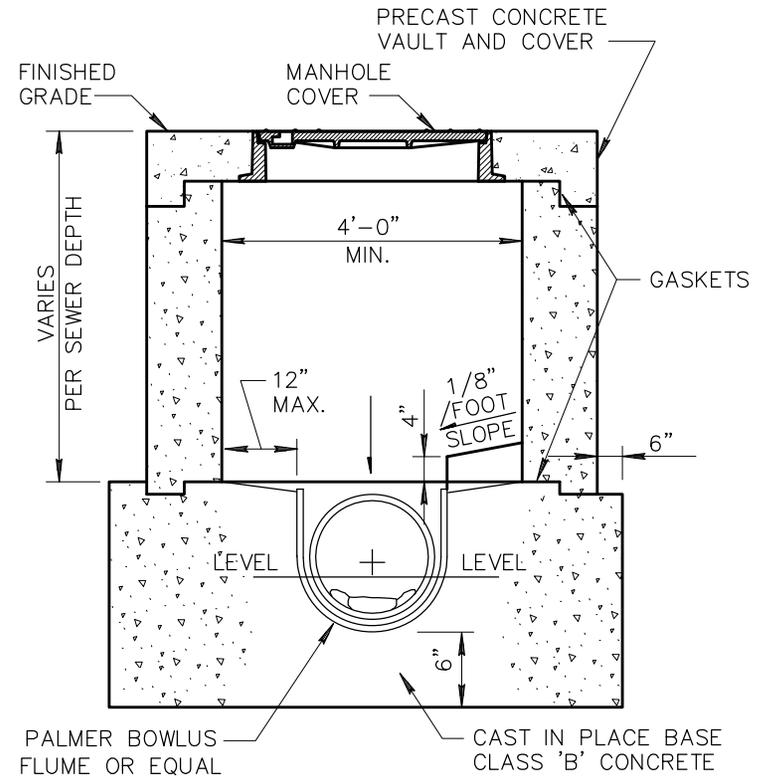


**MANHOLE & COVER SLAB**



**PLAN VIEW**

NOTE: WITH COVER REMOVED.



**SECTION A-A**

NOTE: LADDER NOT SHOWN IN SECTION VIEW. SECTION SHOWN WITH COVER IN PLACE.

**NOTES:**

1. THIS CONTROL VAULT WITH MANHOLE AND COVER SHALL BE USED ON 6" AND 8" DIAMETER SEWER WITH FLOWS IN THE RANGE OF 40 TO 340 GPM.
2. VAULT TO BE CONSTRUCTED ON STRAIGHT RUN OF BUILDING SEWER. ACCESSIBLE AND SAFELY LOCATED ON THE OWNERS PROPERTY ADJACENT TO A PUBLIC RIGHT-OF-WAY.
3. THE PALMER BOWLUS FLUME SHALL BE INSTALLED PER THE MANUFACTURERS RECOMMENDATIONS.
4. THE PRE-CAST CONCRETE VAULT SHALL BE RECTANGULAR WITH MINIMUM INSIDE DIMENSIONS OF 4' WIDE AND 6' LONG AND AT A DEPTH OF THE DESIGN OF THE BUILDING SEWER.
5. A SHOP DRAWING SHALL BE SUBMITTED TO THE CONTRACTING AGENCY FOR APPROVAL BEFORE INSTALLATION OF THE VAULT AND THE PALMER BOWLUS FLUME WILL BE ALLOWED.

DETAIL NO.

**429**



STANDARD DETAIL  
ENGLISH

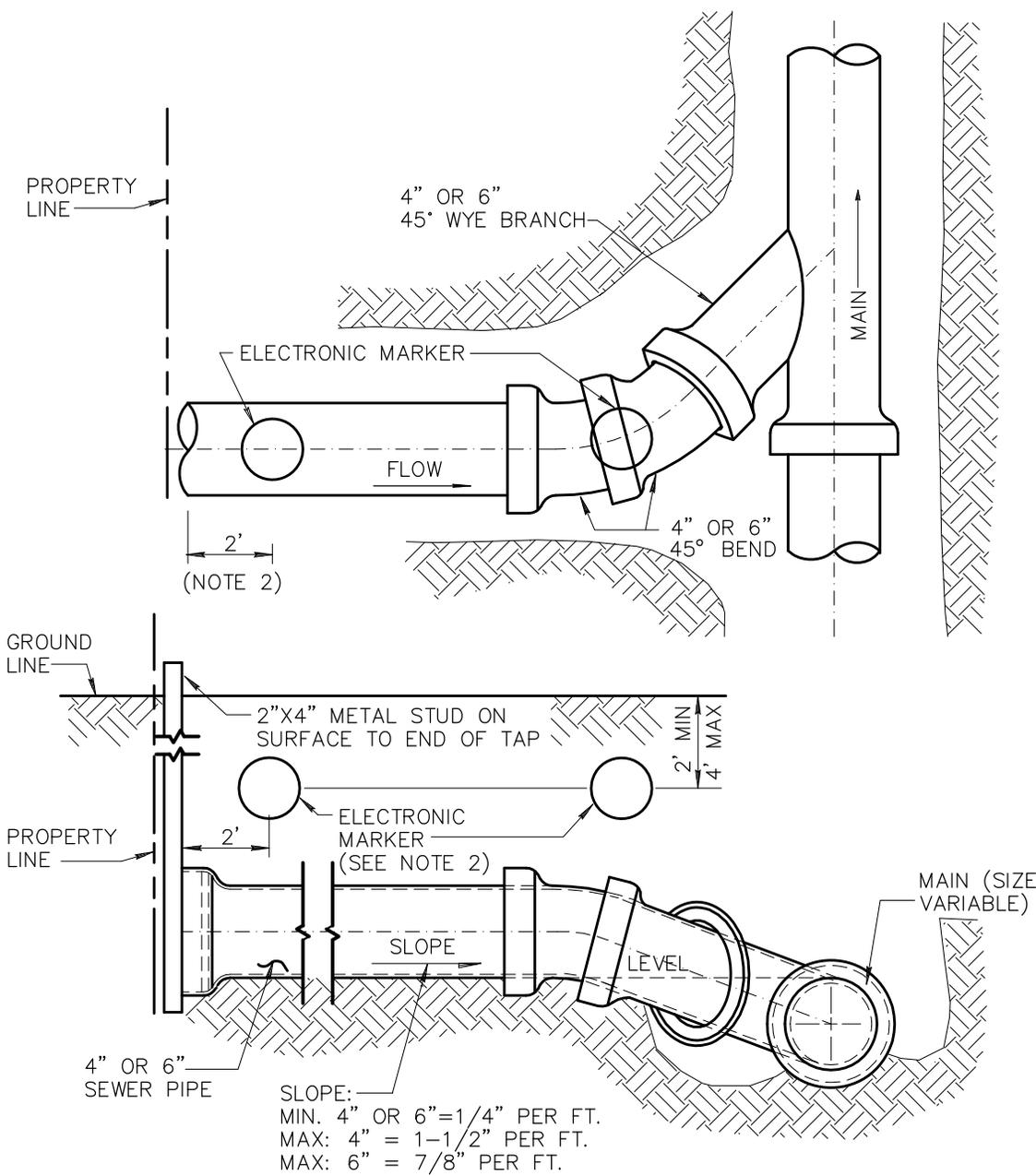
**INDUSTRIAL WASTE CONTROL  
VAULT WITH MANHOLE**

REVISED

01-01-2015

DETAIL NO.

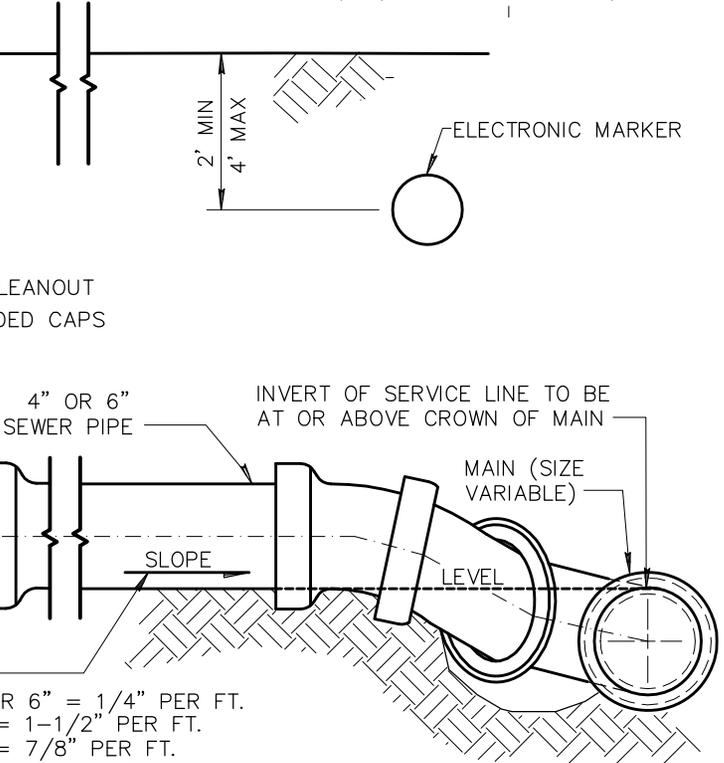
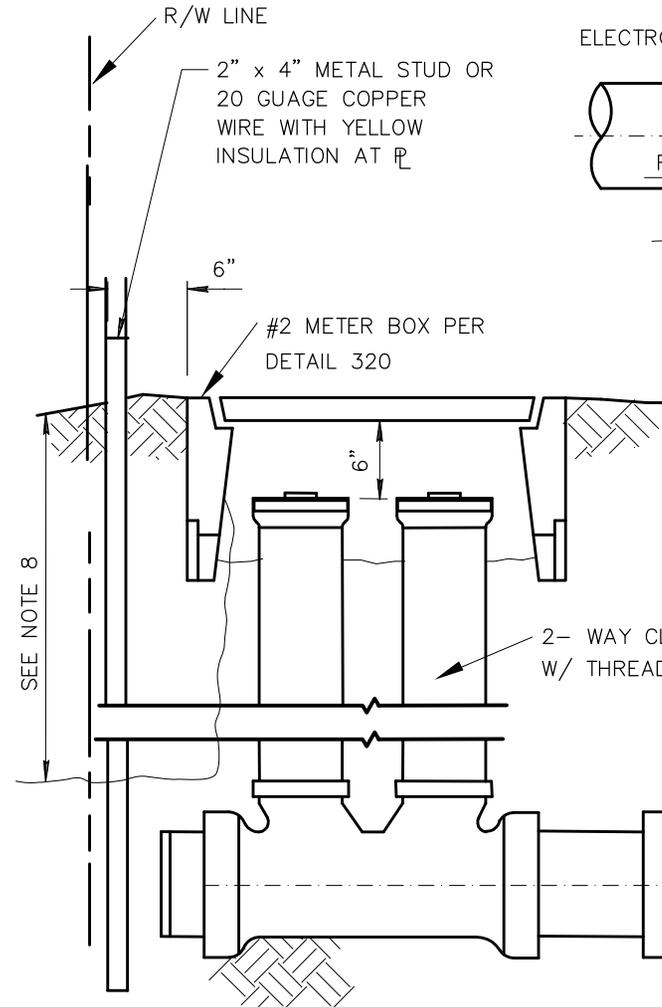
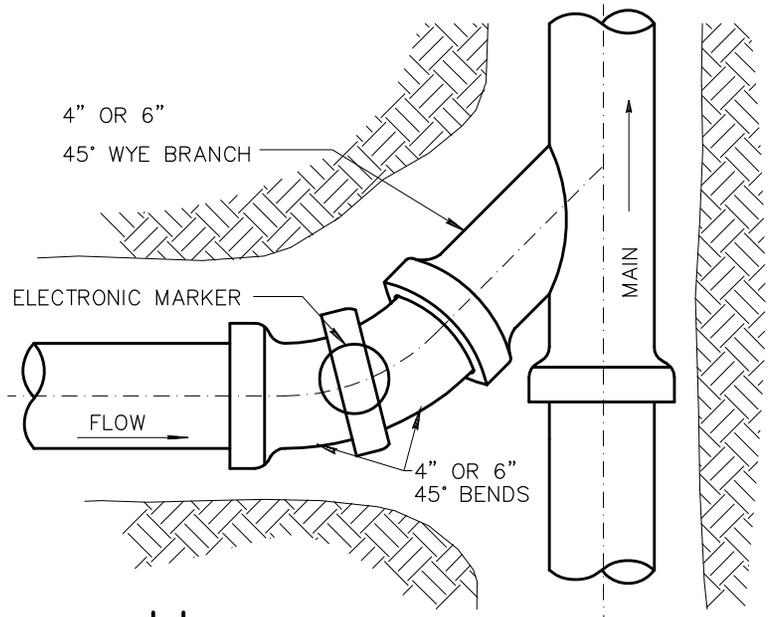
**429**



**NOTES:**

1. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
2. MARKER SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S DIRECTIONS, 2' BACK FROM THE END OF THE SEWER SERVICE STUB AND CINCH TIED TO PIPE OR ABOVE PIPE AS REQUIRED BY LOCAL AGENCY. AN ADDITIONAL MARKER SHALL BE INSTALLED AT EACH SERVICE STUB BEND.
3. ELECTRONIC MARKER SHALL BE RESTORED BY CONTRACTOR IF DISTURBED WHEN PRIVATE SERVICE LINE CONNECTION IS INSTALLED.
4. MARKER SHALL BE USED IN ADDITION TO A 2"x4" METAL STUD.
5. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
6. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
7. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
8. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTINGS JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
9. END OF TAP TO BE SEALED AND MARKED AS NOTED.

ELECTRONIC MARKER PLACEMENT



SLOPE:  
 MIN: 4" OR 6" = 1/4" PER FT.  
 MAX: 4" = 1-1/2" PER FT.  
 MAX: 6" = 7/8" PER FT.

**NOTES:**

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED AS NOTED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. # 14 BARE COPPER LOCATOR WIRE ACCESSIBLE AT R/W AND AT PROPERTY OWNER CLEANOUT BOX NO GREATER THAN 4' DEEP.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

DETAIL NO.  
**440-2**

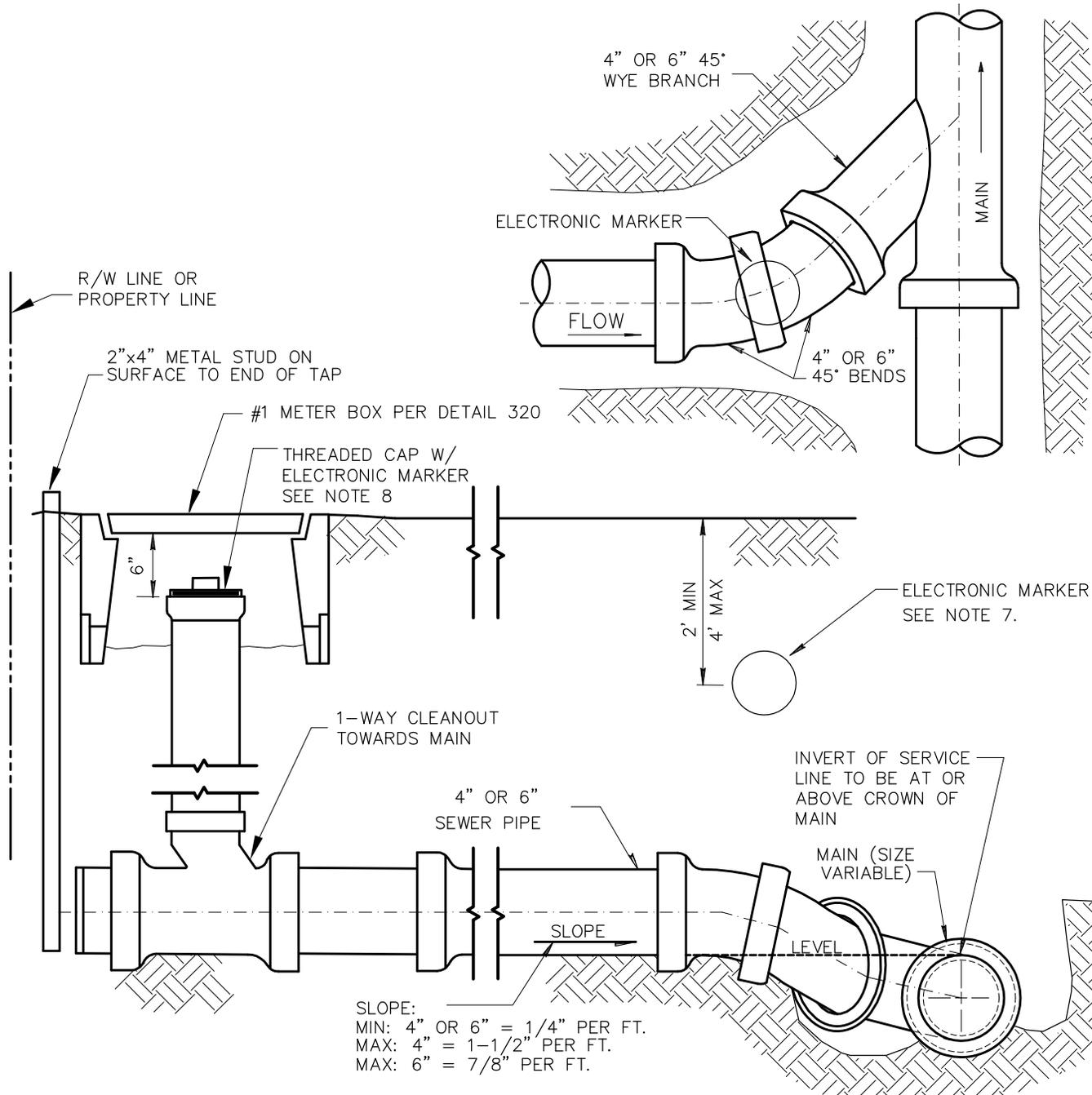


STANDARD DETAIL  
 ENGLISH

**TYPE 'B' - SEWER BUILDING CONNECTION**  
**TWO-WAY CLEANOUT AND METER BOX AT R/W**  
 (WHEN SPECIFIED BY LOCAL AGENCY)

REVISED  
 01-01-2007

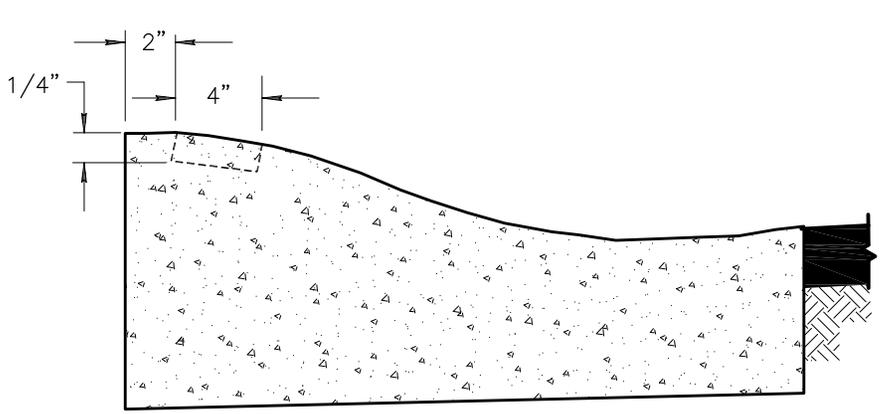
DETAIL NO.  
**440-2**



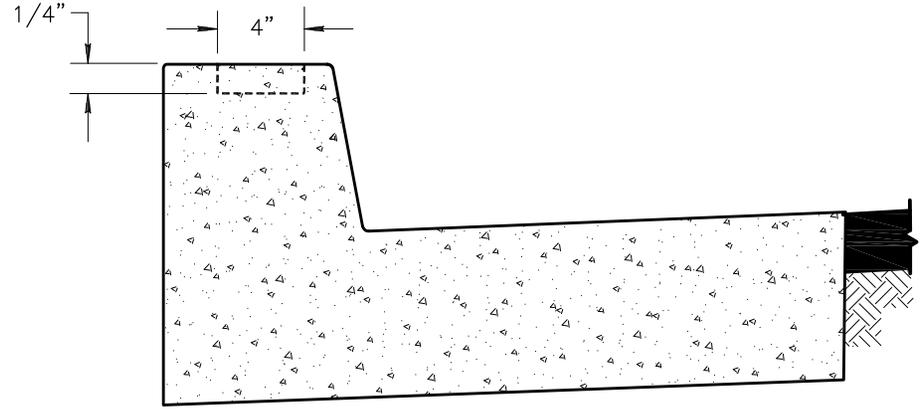
**NOTES:**

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MIN. SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. INSTALL RAISED 4" THREADED PLUG IN CLEANOUT INCORPORATING 3M MODEL 1414 ELECTRONIC DISC MARKER. GREEN IN COLOR. LOCATOR PLUG TO BE GPK PRODUCTS MODEL #228-0004 DM OR APPROVED EQUAL.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

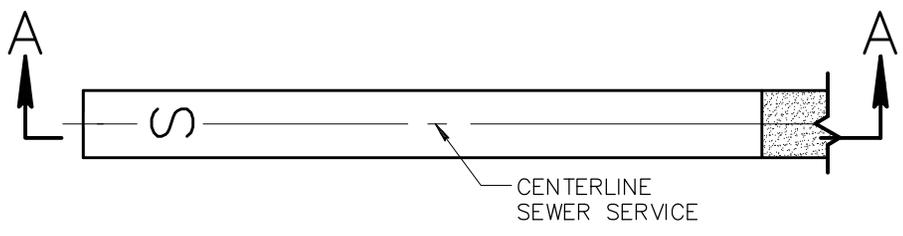
SLOPE:  
 MIN: 4" OR 6" = 1/4" PER FT.  
 MAX: 4" = 1-1/2" PER FT.  
 MAX: 6" = 7/8" PER FT.



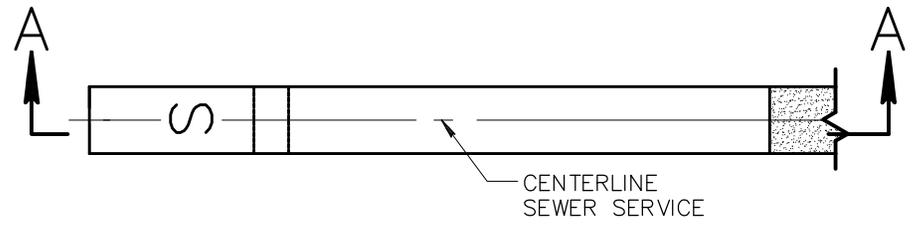
SECTION A-A



SECTION A-A



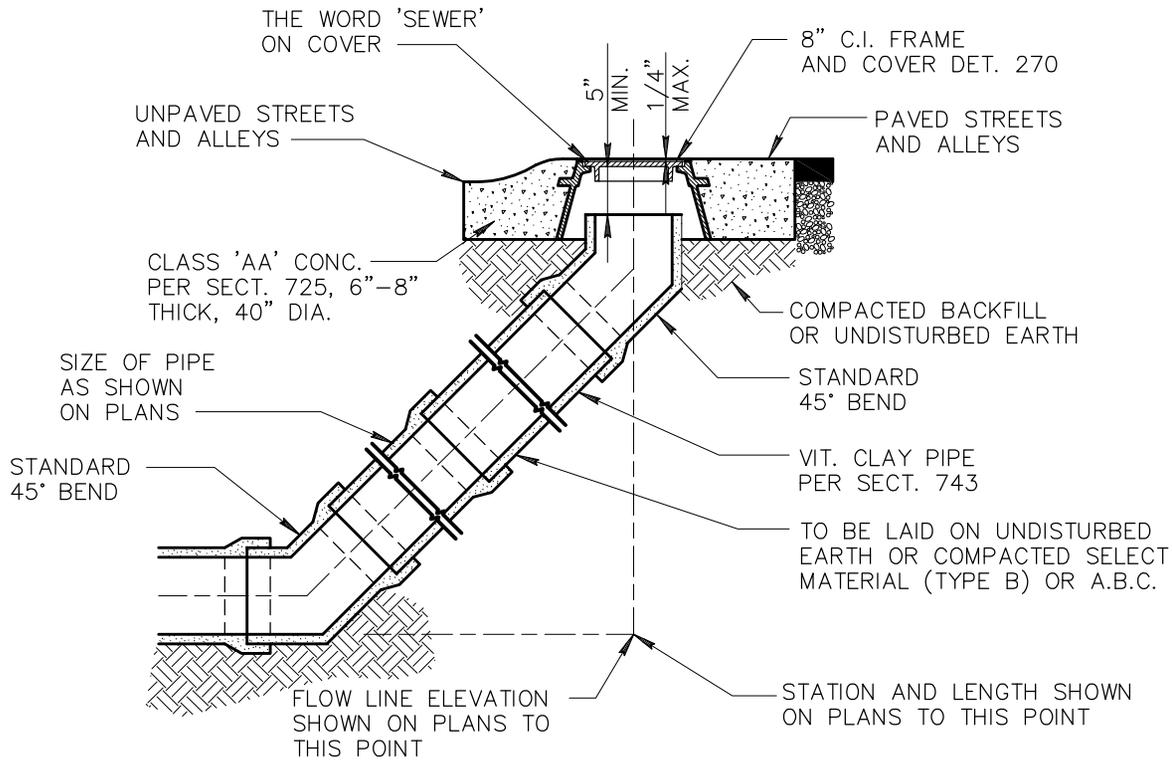
CURB STAMP ROLLED CURB



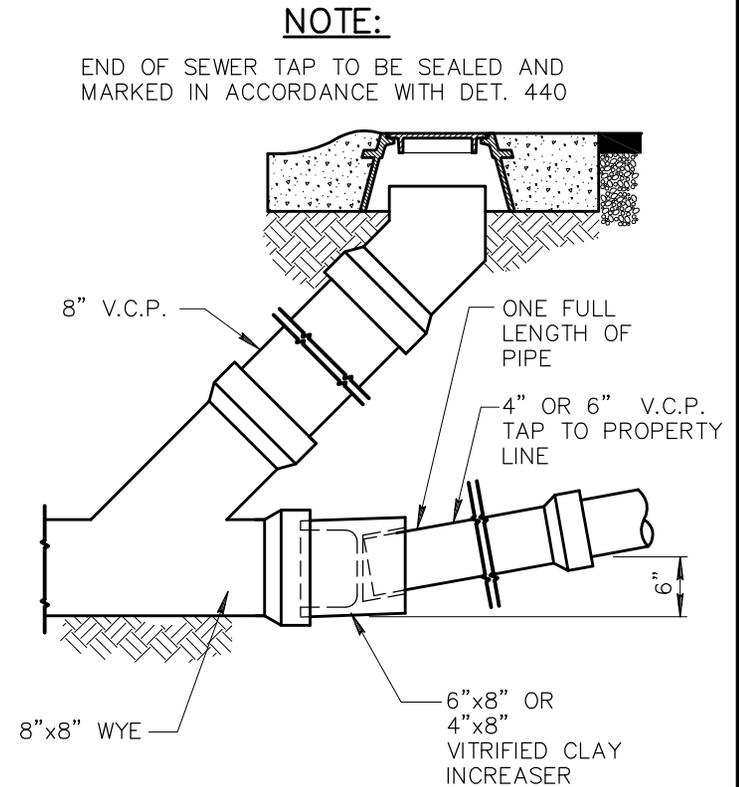
CURB STAMP VERTICAL CURB

NOTES:

1. STAMP TOP OF CURB WITH 4" TALL BY 1/4" DEEP "S" TO DESIGNATE SEWER SERVICE LINE CROSSING.



CLEANOUT INSTALLATION



SEWER TAP AT CLEANOUT

DETAIL NO.

441



MARICOPA  
ASSOCIATION of  
GOVERNMENTS

STANDARD DETAIL  
ENGLISH

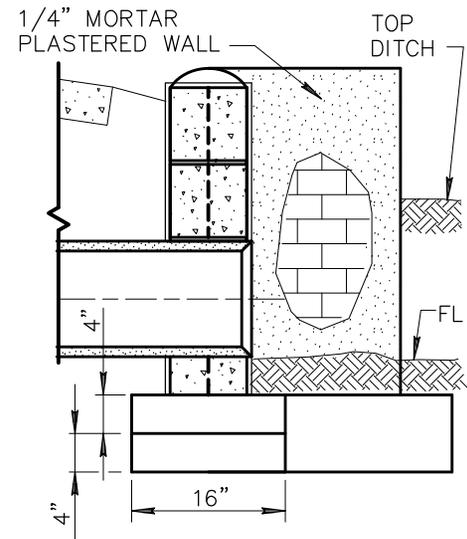
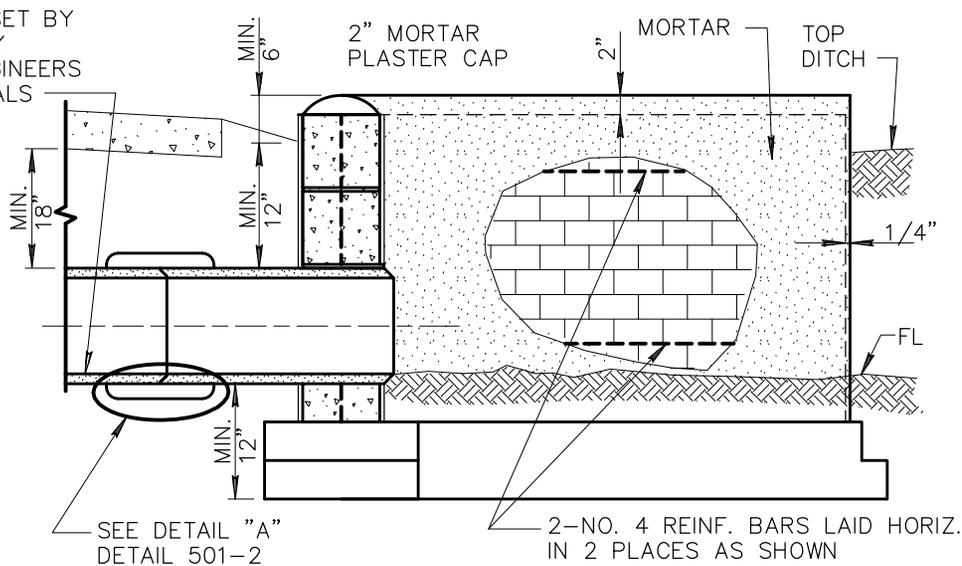
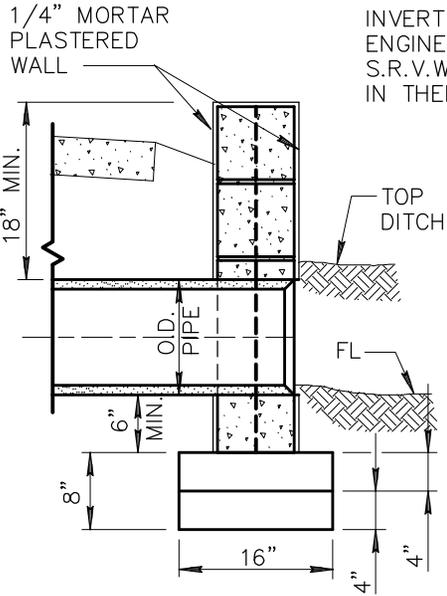
SEWER CLEANOUT

REVISED

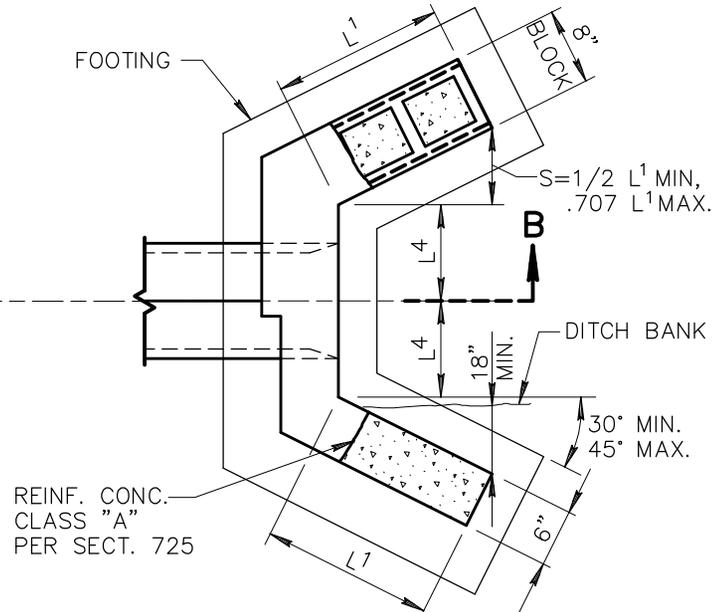
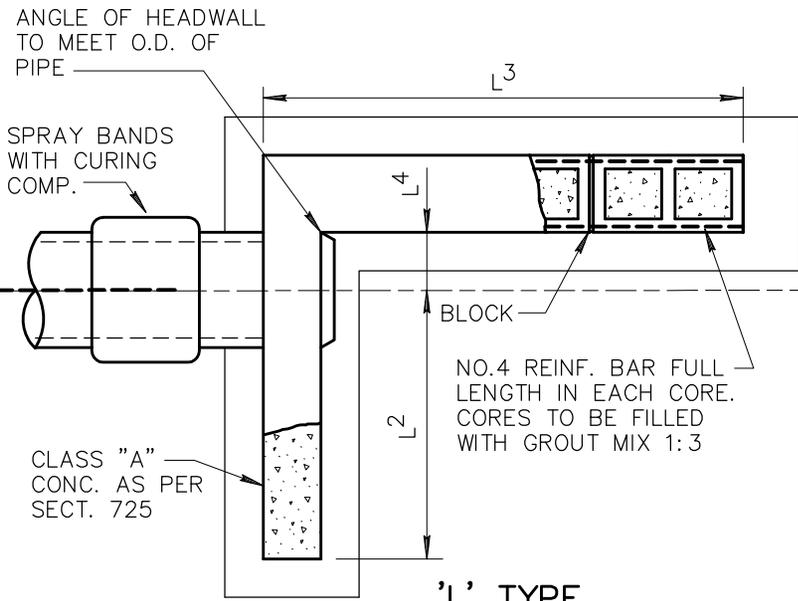
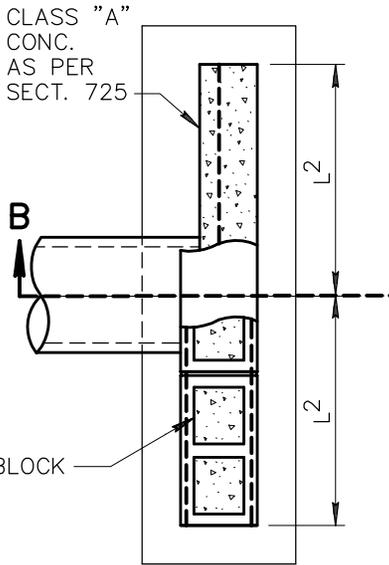
01-01-2001

DETAIL NO.

441



**SECTION B-B**



**STRAIGHT TYPE**

**'L' TYPE PLAN**

**'U' TYPE**

DETAIL NO.  
**501-1**

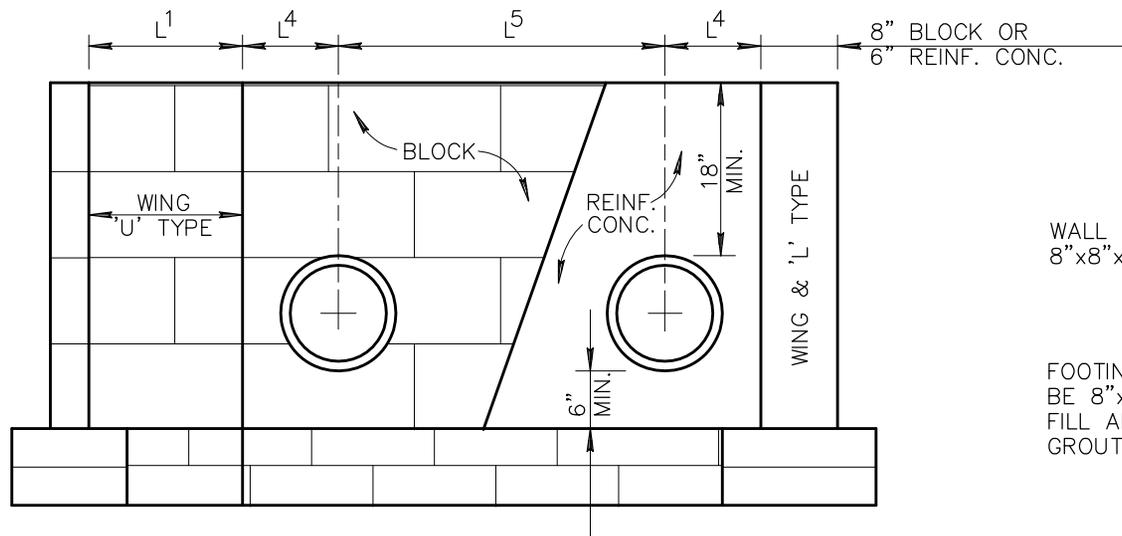


STANDARD DETAIL  
ENGLISH

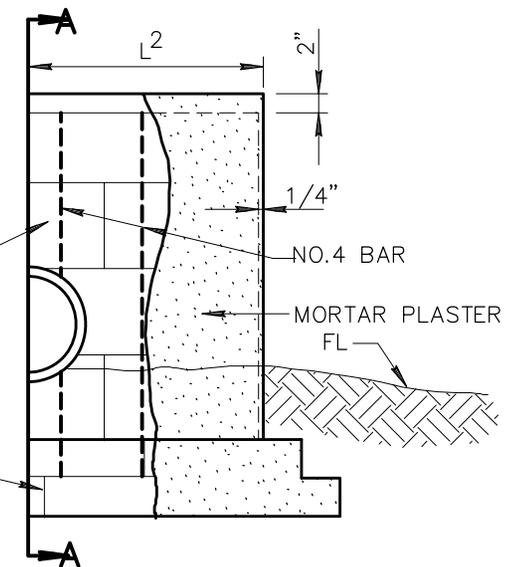
**HEADWALL**

REVISED  
01-01-2012

DETAIL NO.  
**501-1**



**DOUBLE PIPE HEADWALL**



**ELEVATION**

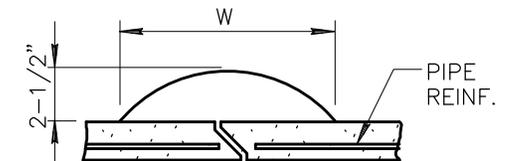
CONCRETE MASONRY UNITS (BLOCK) HEADWALLS JOINED WITH CEMENT MORTAR PLASTERED BOTH SIDES OF WALL FULL HEIGHT AND SHALL BE CURED PER SECT. 726.

**NOTES:**

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 505 & 725.
2. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776.
3. CONCRETE REINF. SHALL BE NO.4 BAR 12" O.C. BOTH WAYS.

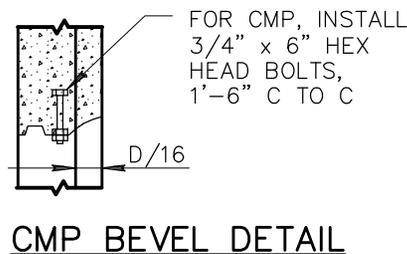
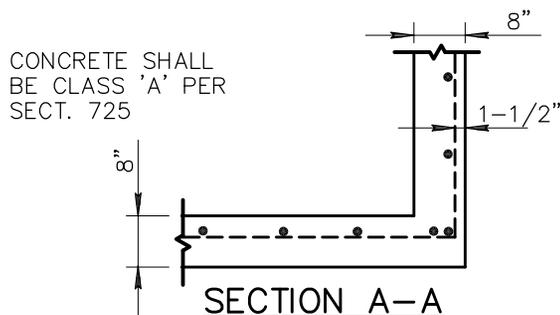
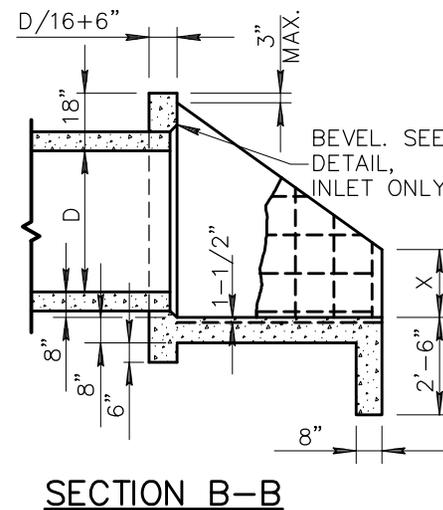
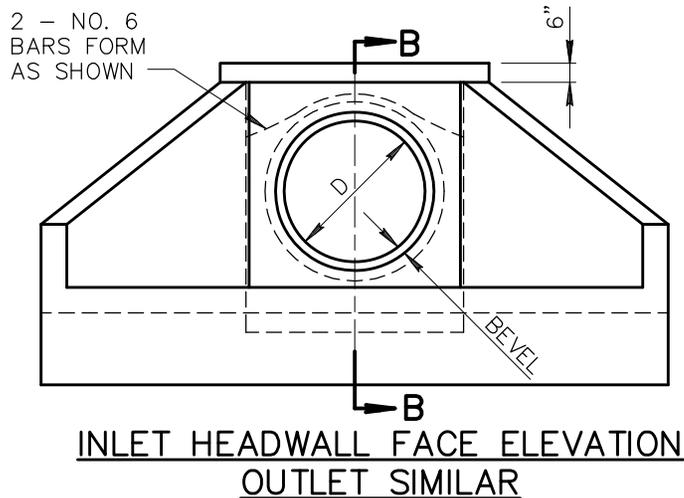
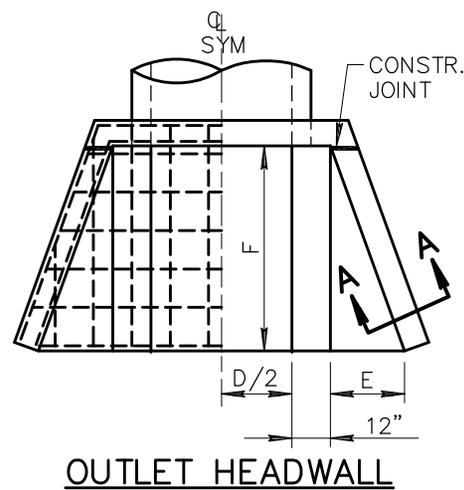
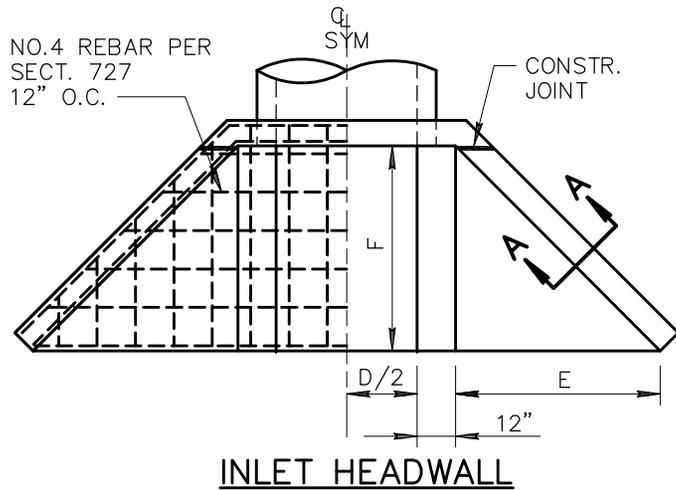
HEADWALL DIMENSIONS					
*NOMINAL PIPE SIZE	L <sup>1</sup>	L <sup>2</sup>	L <sup>3</sup>	L <sup>4</sup>	L <sup>5</sup>
12"	1'-4"	2'-0"	3'-8"	0'-10"	2'-10"
15"	2'-0"	2'-8"	4'-0"	1'-0"	3'-0"
18"	2'-0"	3'-8"	4'-8"	1'-2"	3'-4"
21"	2'-8"	4'-0"	5'-4"	1'-3"	3'-8"
24"	2'-8"	4'-0"	5'-4"	1'-6"	3'-11"
30"	2'-8"	5'-4"	6'-8"	1'-10"	4'-7"
36"	3'-4"	6'-8"	8'-0"	1'-10"	5'-2"
42"	4'-0"	8'-0"	9'-4"	2'-2"	5'-9"

\* NOMINAL PIPE SIZE GIVEN FOR REINFORCED CONC. PIPE.



PIPE SIZE	W
12" - 21" INCL.	11"
24" - 42" INCL.	13"

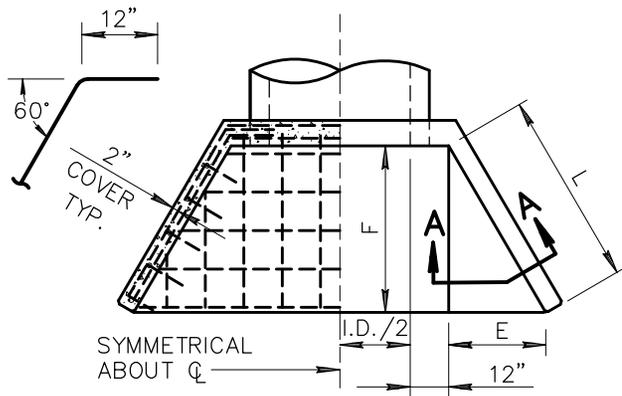
**DETAIL "A"**



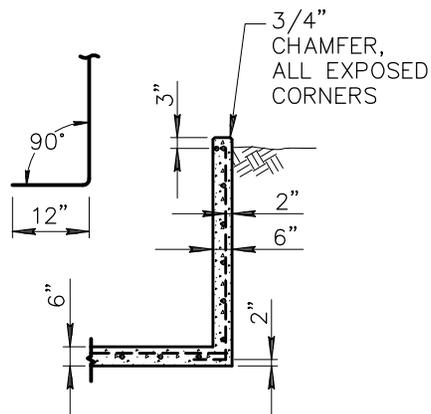
1:1 1/2 EMBANKMENT SLOPE				
D	TYPE *	DIMENSIONS		
		F	E	X
42"	1 (IN)	5'-2"	5'-2"	1'-9"
	2 (OUT)	5'-2"	1'-11"	1'-9"
48"	3 (IN)	5'-8"	5'-8"	1'-11"
	4 (OUT)	5'-8"	2'-1"	1'-11"
54"	5 (IN)	6'-2"	6'-2"	2'-1"
	6 (OUT)	6'-2"	2'-3"	2'-1"
60"	7 (IN)	6'-8"	6'-8"	2'-3"
	8 (OUT)	6'-8"	2'-5"	2'-3"
66"	9 (IN)	7'-2"	7'-2"	2'-5"
	10 (OUT)	7'-2"	2'-7"	2'-5"
72"	11 (IN)	7'-8"	7'-8"	2'-7"
	12 (OUT)	7'-8"	2'-9"	2'-7"
78"	13 (IN)	8'-2"	8'-2"	2'-9"
	14 (OUT)	8'-2"	3'-0"	2'-9"
84"	15 (IN)	8'-8"	8'-8"	2'-11"
	16 (OUT)	8'-8"	3'-2"	2'-11"

1:4 EMBANKMENT SLOPE				
D	TYPE *	DIMENSIONS		
		F	E	X
42"	17 (IN)	8'-8"	8'-8"	3'-0"
	18 (OUT)	8'-8"	3'-2"	3'-0"
48"	19 (IN)	8'-8"	8'-8"	3'-6"
	20 (OUT)	8'-8"	3'-2"	3'-6"
54"	21 (IN)	8'-8"	8'-8"	4'-0"
	22 (OUT)	8'-8"	3'-2"	4'-0"
60"	23 (IN)	9'-4"	9'-4"	4'-4"
	24 (OUT)	9'-4"	3'-5"	4'-4"
66"	25 (IN)	9'-8"	9'-8"	4'-9"
	26 (OUT)	9'-8"	3'-6"	4'-9"
72"	27 (IN)	9'-8"	9'-8"	5'-3"
	28 (OUT)	9'-8"	3'-6"	5'-3"
78"	29 (IN)	10'-0"	10'-0"	5'-8"
	30 (OUT)	10'-0"	3'-8"	5'-8"
84"	31 (IN)	10'-8"	10'-8"	6'-0"
	32 (OUT)	10'-8"	3'-11"	6'-0"

\* (IN) REFERS TO INLET  
(OUT) REFERS TO OUTLET

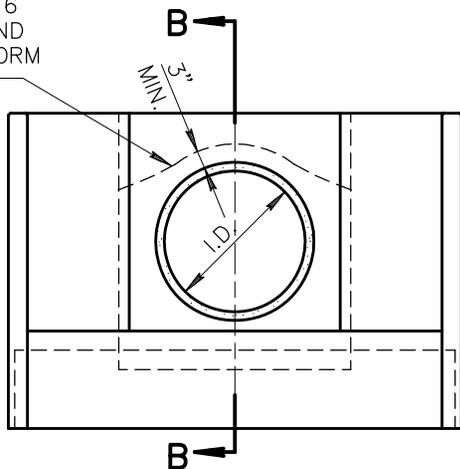


**PLAN**

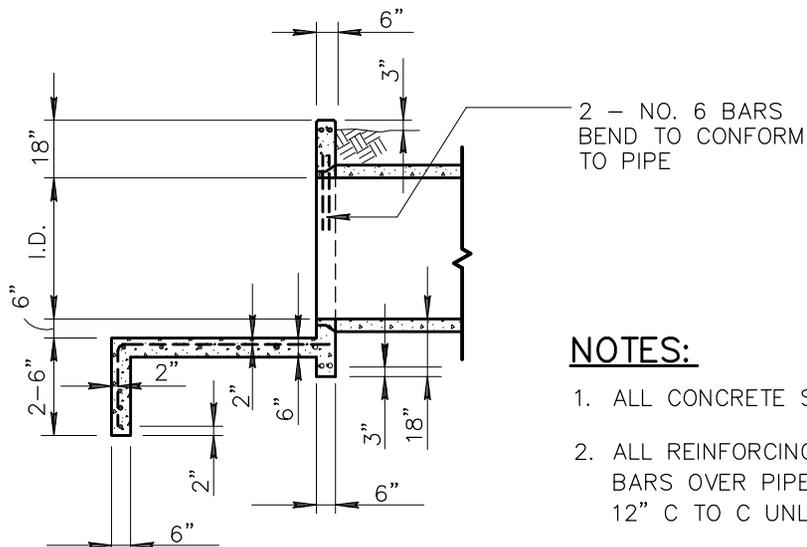


**SECTION A-A**

2 - NO. 6 BARS BEND TO CONFORM TO PIPE



**ELEVATION**



**SECTION B-B**

PIPE I.D.	DIMENSIONS		
	L	E	F (APPROX)
18"	2'-0"	1'-0"	1'-9"
24"	2'-0"	1'-0"	1'-9"
30"	3'-0"	1'-6"	2'-7"
36"	4'-0"	2'-0"	3'-6"
42"	5'-0"	2'-6"	4'-4"
48"	6'-0"	3'-0"	5'-2"
54"	7'-0"	3'-6"	6'-1"
60"	8'-0"	4'-0"	6'-11"

**NOTES:**

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
2. ALL REINFORCING BARS SHALL BE NO. 4 EXCEPT NO. 6 BARS OVER PIPE. BAR SPACING APPROXIMATELY 12" C TO C UNLESS OTHERWISE NOTED.
3. 30° WING WALL FLARE SHOWN; 45° NORMALLY DESIRABLE.

DETAIL NO.

**501-4**



STANDARD DETAIL  
ENGLISH

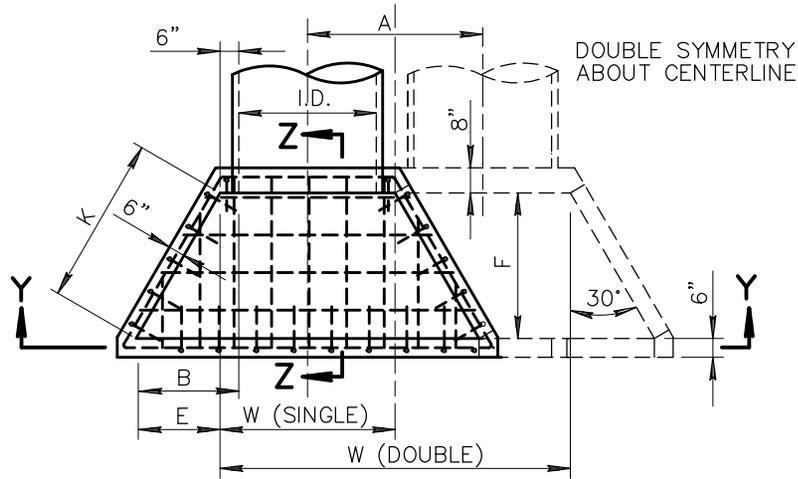
**HEADWALL IRRIGATION  
18" TO 60" PIPE**

REVISED

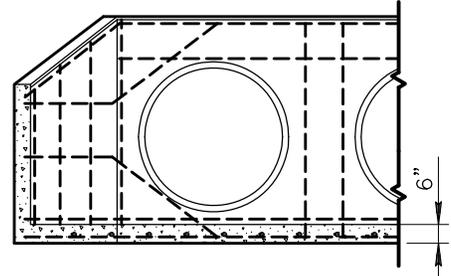
01-01-1998

DETAIL NO.

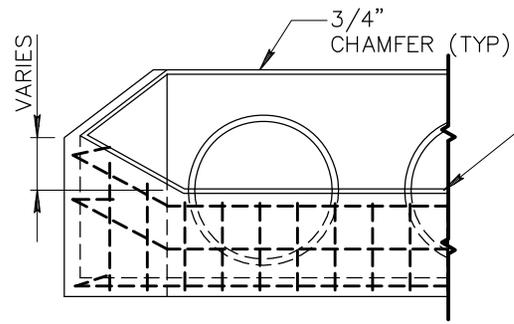
**501-4**



**PLAN**

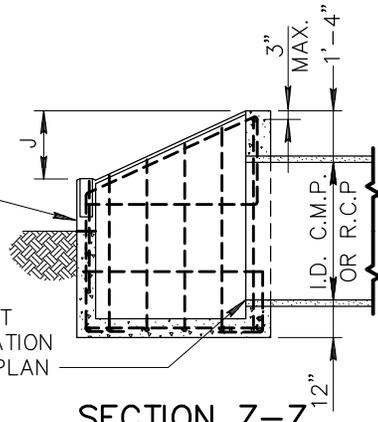


**SECTION Y-Y**



**ELEVATION**

ELEVATION PER PLAN



**SECTION Z-Z**

INVERT ELEVATION PER PLAN

PIPE	DIMENSIONS							
	W		A	B	E	F	J	K
	SINGLE	DOUBLE						
18"	2'-6"	5'-2"	2'-8"	1'-3"	0'-9"	1'-3.5/8"	9"	1'-6"
24"	3'-0"	6'-6"	3'-6"	1'-7.1/2"	1'-1.1/2"	1'-11.3/8"	11"	2'-3"
30"	3'-6"	7'-10"	4'-4"	2'-0"	1'-6"	2'-7.1/4"	1'-1"	3'-0"
36"	4'-0"	9'-2"	5'-2"	2'-4.1/2"	1'-10.1/2"	3'-3"	1'-4"	3'-9"
42"	4'-6"	10'-6"	6'-0"	2'-9"	2'-3"	3'-10.3/4"	1'-6"	4'-6"

**NOTES:**

1. HIGH POINT OF HEADWALL SHALL NOT PROJECT MORE THAN 3" ABOVE SLOPE.
2. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
3. ALL REINFORCING BARS SHALL BE NO. 4, 12" C TO C AND 3" CLEAR TO INSIDE OF FLOOR AND WALLS.

DETAIL NO.  
**501-5**

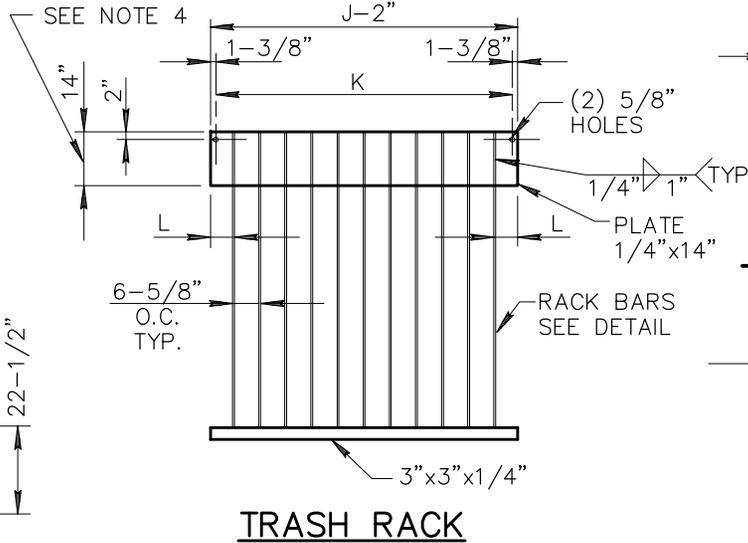
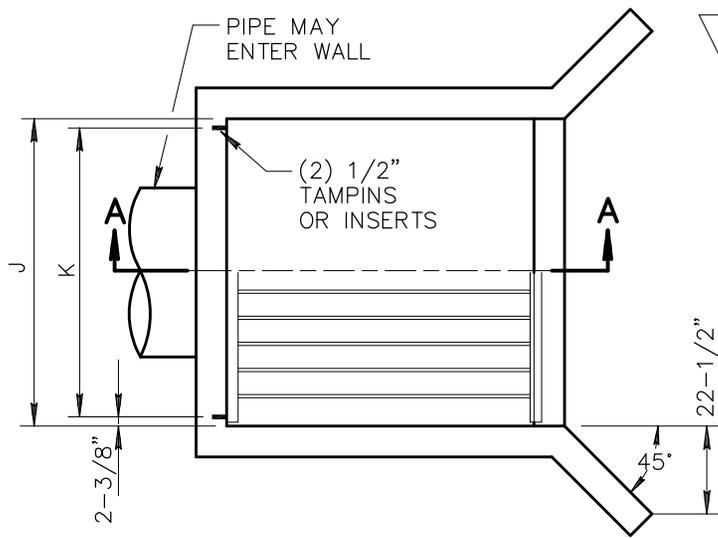


STANDARD DETAIL  
ENGLISH

**HEADWALL DROP INLET**

REVISED  
01-01-2014

DETAIL NO.  
**501-5**



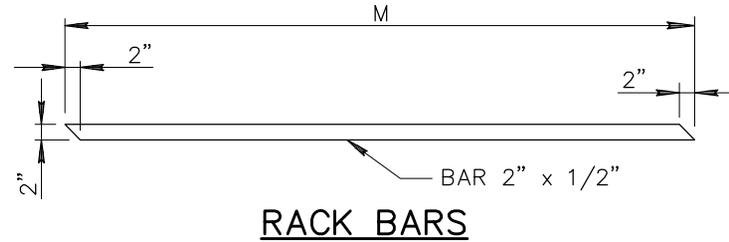
### POURED WALLS

NO. 4 REINFORCED BARS 12" O.C. BOTH WAYS, CLASS 'A' CONC PER SECT. 505, 725 & 727.

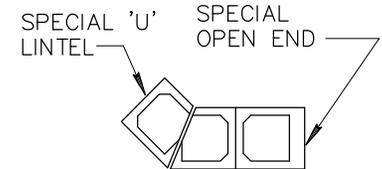
### BLOCK WALLS

BLOCK HEADWALL TO HAVE ONE NO.4 REINF. BAR CENTERED IN EACH CORE FOR FULL HEIGHT AND CORES FILLED WITH CONCRETE OR CEMENT GROUT (3:1 RATIO). ALL BLOCKS TO BE JOINTED WITH MORTAR. PLASTERED ON EXPOSED SURFACES THEN SPRAY WITH WHITE PIGMENTED CURING COMPOUND. SECT. 510, 727 & 776.

### TRASH RACK



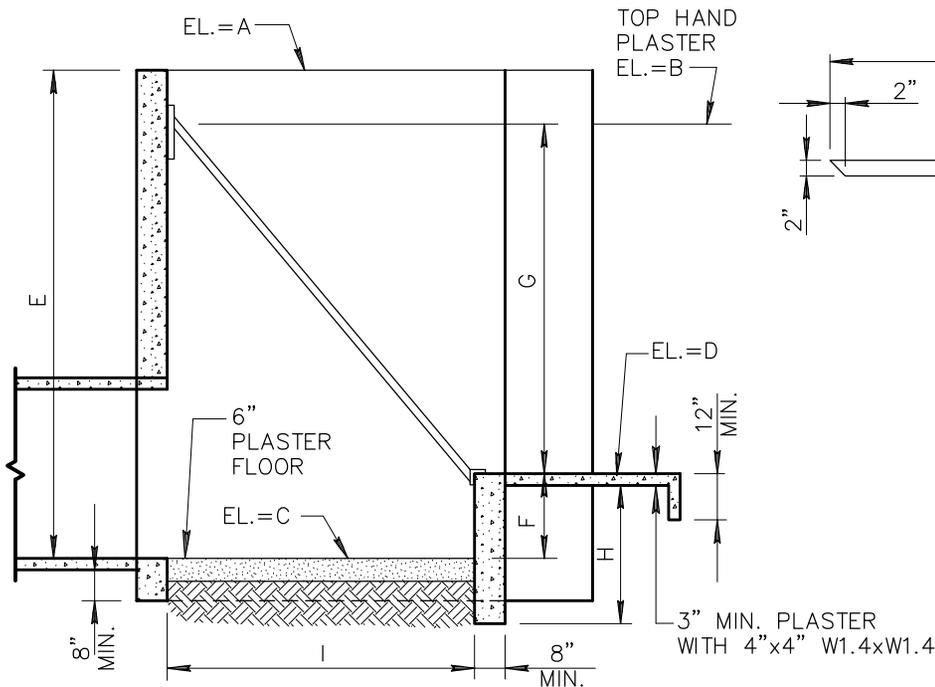
### RACK BARS



### 45° BLOCK CORNER

### NOTES:

1. REMOVE ALL SCALE FROM RACK BARS. METAL SPRAY OR PAINT WITH ONE COAT ZINC CHROMATE OR RED LEAD PRIMER (INDUSTRIAL QUALITY). OVERCOAT WITH GREY INDUSTRIAL ENAMEL SECT. 790.
2. SHAPE, COMPACT AND PLASTER NEW DITCH FROM HEADWALL TO UNDISTURBED EXISTING DITCH. PLASTER TO EXTEND TO MINIMUM ELEVATION NOTED 3 FEET BEYOND CONNECTION TO UNDISTURBED EXISTING DITCH.
3. ELEVATIONS A, B, C & D AND DIMENSIONS E, F, G, H, I, J, K, L & M WILL BE SHOWN ON PLANS. DIMENSIONS SHOULD PROVIDE STANDARD SIZE BLOCK.
4. 14" PLATE SHALL NOT EXTEND BELOW TOP OF PIPE.



### SECTION A-A

DETAIL NO.  
502-1



STANDARD DETAIL  
ENGLISH

TRASH RACK

REVISED  
01-01-1998

DETAIL NO.  
502-1

CONCRETE MANSIONRY UNITS (BLOCK)

REINF. CONC. CLASS 'A' PER SECT. 725

STRAIGHT TYPE

'U' TYPE

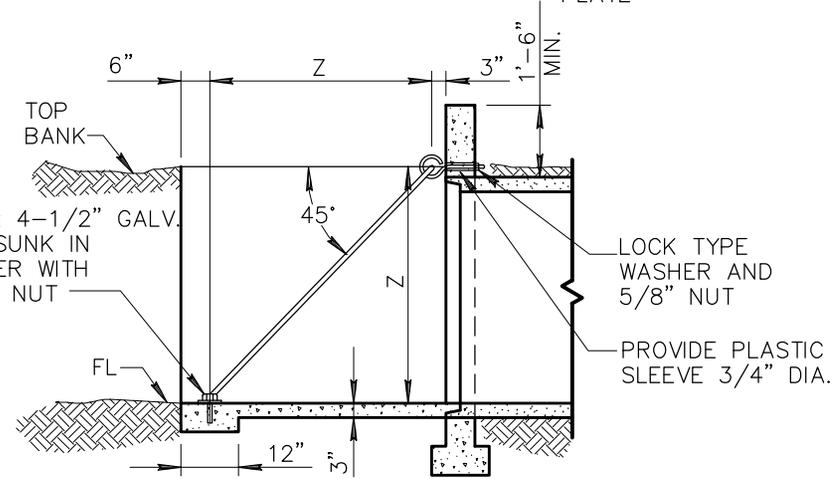
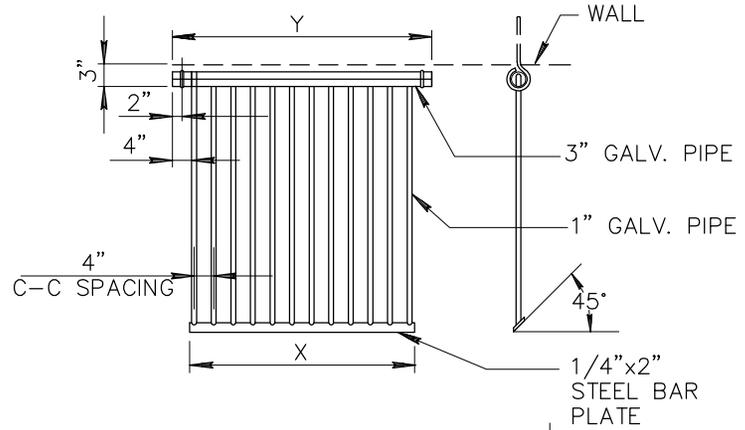
CONC. LINING THICKNESS 1-1/2" MIN., 2" MAX.

A

12" TYP.

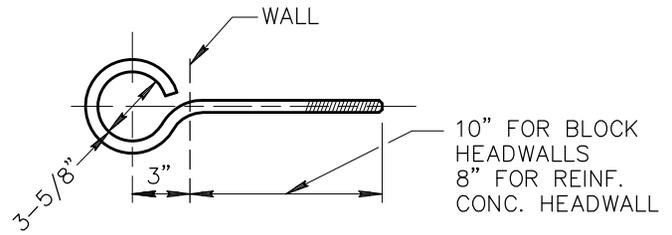
SLOPE 1:1 MIN. 1:1.5 MAX.

A



SECTION A-A

TYPE BASED ON PIPE SIZE						
TYPE	PIPE SIZE	NO. OF BARS	LENGTH OF BARS	DIMENSIONS		
				X	Y	Z
A	18"	6	3'-7"	1'-9"	2'-5"	2'-5"
	24"	8	3'-7"	2'-5"	3'-1"	2'-5"
B	30"	10	4'-4 1/4"	3'-1"	3'-9"	2'-11 1/2"
C	36"	10	5'-1 1/2"	3'-1"	3'-9"	3'-6"
D	42"	12	5'-10 5/8"	3'-9"	4'-5"	4'-0 1/2"
E	48"	14	6'-7 3/4"	4'-5"	5'-1"	4'-7"



EYE BOLT

DETAIL NO.

502-2



STANDARD DETAIL ENGLISH

TRASH RACK

REVISED 01-01-2004

DETAIL NO.

502-2

NOTE:  
 PAINT COVER BOTH SIDES  
 ONE PRIME COAT, TWO  
 FINISH COATS, SECT.  
 790, PAINT NO. 9

10 GAUGE SHEET  
 STEEL COVER

HANDLE EXTENDS  
 6" BELOW  
 TOP WHEN GATE  
 IS OPEN

STANDARD  
 CONCRETE  
 PIPE

CONCRETE AS  
 REQUIRED TO  
 SECURE GATE

FINISH  
 GRADE

VARIABLE

(2) 5/16"  
 HOLES  
 4" O.C.

1/4" ROD  
 HANDLE

2-1/2"

UNLESS OTHERWISE  
 SPECIFIED

30"

TYPE 'A'

**NOTES:**

1. BRACE TO BE INSTALLED EVERY 2' FROM TOP OF HEADGATE FRAME. BOTTOM BRACE TO BE HIGH ENOUGH TO ENABLE FULL OPENING OF HEADGATE.
2. INSTALL 1/2" BOLTS INTO LEAD PLUG DRILLED TO WITHIN 1" OF OUT SIDE OF STANDPIPE. SPACERS TO BE INSTALLED AT EACH BOLT BETWEEN HEADGATE FRAME AND INSIDE OF STAND PIPE.
3. LOCATION OF 2" HOLE FOR GATE STEM TO BE DETERMINED AFTER INSTALLATION OF GATE.
4. CONCRETE SHALL BE CLASS A PER SECT. 725.

PAINT ARROW ON OUTSIDE OF STANDPIPE INDICATING DIRECTION "TO OPEN" HEADGATE.

GATE TYPE,  
 SIZE AND NO.  
 REQUIRED AS  
 GIVEN ON PLANS

SIZE OF PIPE  
 AS SHOWN  
 ON PLANS

6"

4"

TYPE 'B'

SEE NOTE 3

(4) 3/8" BOLTS TO BE GROUTED INTO STANDPIPE EQUI-DISTANT WITH 1-1/2"x3" RECTANGULAR WASHERS AND NUTS

GALVANIZED EXPANDED METAL LID (9 GAUGE)

REINF. CONC. PIPE

VARIABLE

FINISH GRADE

1" C.R.S. LIFT ROD

HEADGATE TO BE SWANSON 800 SERIES OR APPROVED EQUAL

FORM CONC. AROUND END OF PIPE BEHIND HEADGATE FRAME

TYPE 'B'

SEE NOTE 2

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

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TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

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TYPE 'B'

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GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

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18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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TYPE 'B'

SEE NOTE 1

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18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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SEE NOTE 1

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SIZE OF PIPE AS SHOWN ON PLANS

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18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

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TYPE 'B'

SEE NOTE 1

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GROUT JOINTS WATER TIGHT

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SIZE OF PIPE AS SHOWN ON PLANS

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SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

4"

4"

TYPE 'B'

SEE NOTE 1

GROUT JOINTS WATER TIGHT

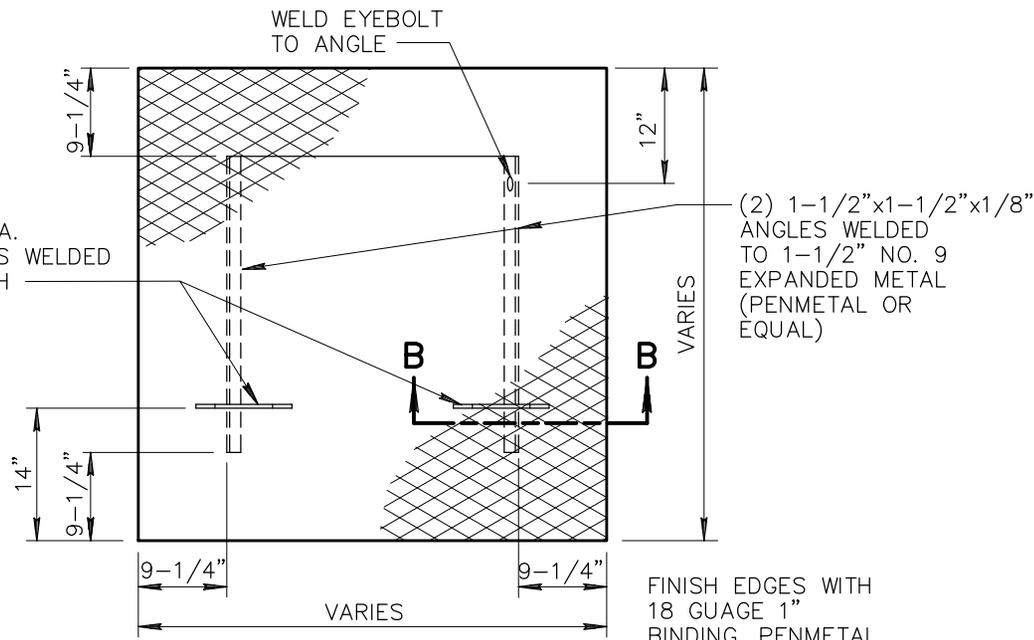
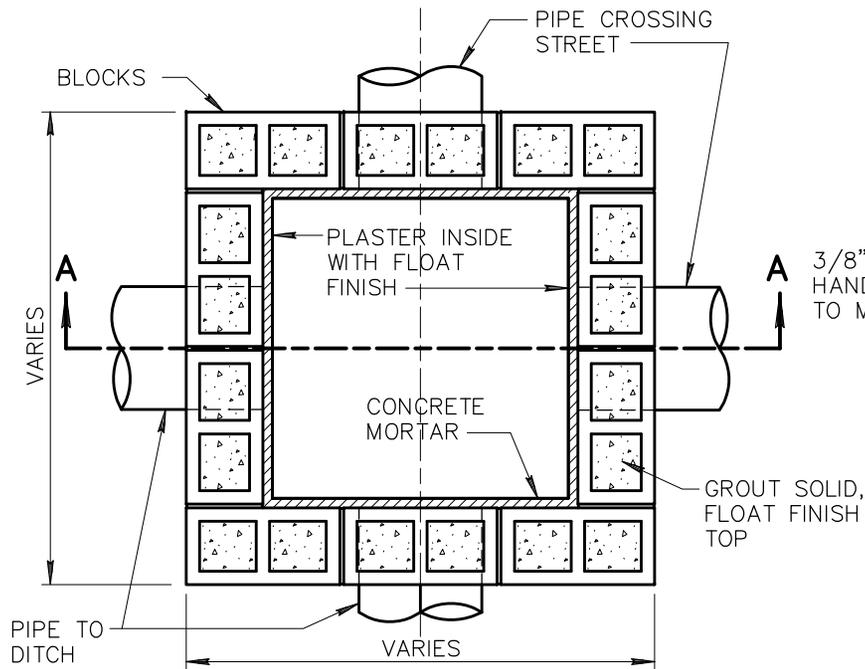
18" MIN.

SIZE OF PIPE AS SHOWN ON PLANS

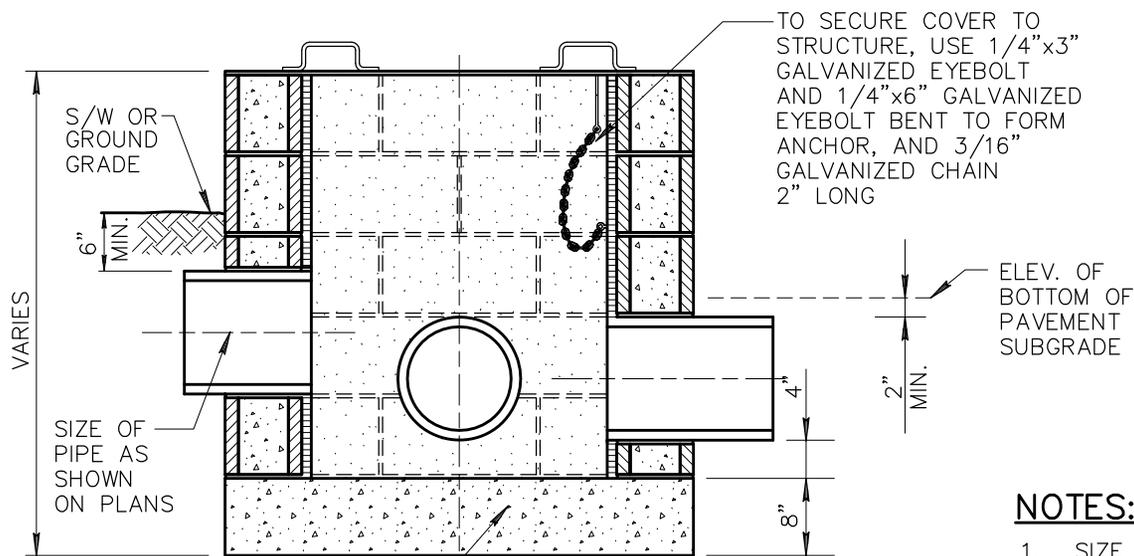
4"

4"

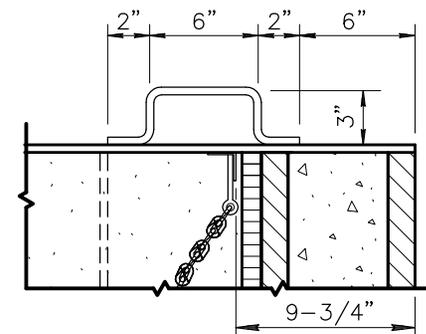
TYPE 'B'



**PLAN OF COVER**



**SECTION A-A**



**SECTION B-B**

**NOTES:**

1. SIZE OF JUNCTION BOX TO BE DETERMINED BY THE ENGINEER.
2. GATE TYPE, SIZE AND NUMBER REQUIRED AS SHOWN ON PLANS OR AS SPECIFIED.
3. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776

DETAIL NO.

**504**



STANDARD DETAIL  
ENGLISH

**CONCRETE BLOCK JUNCTION BOX**

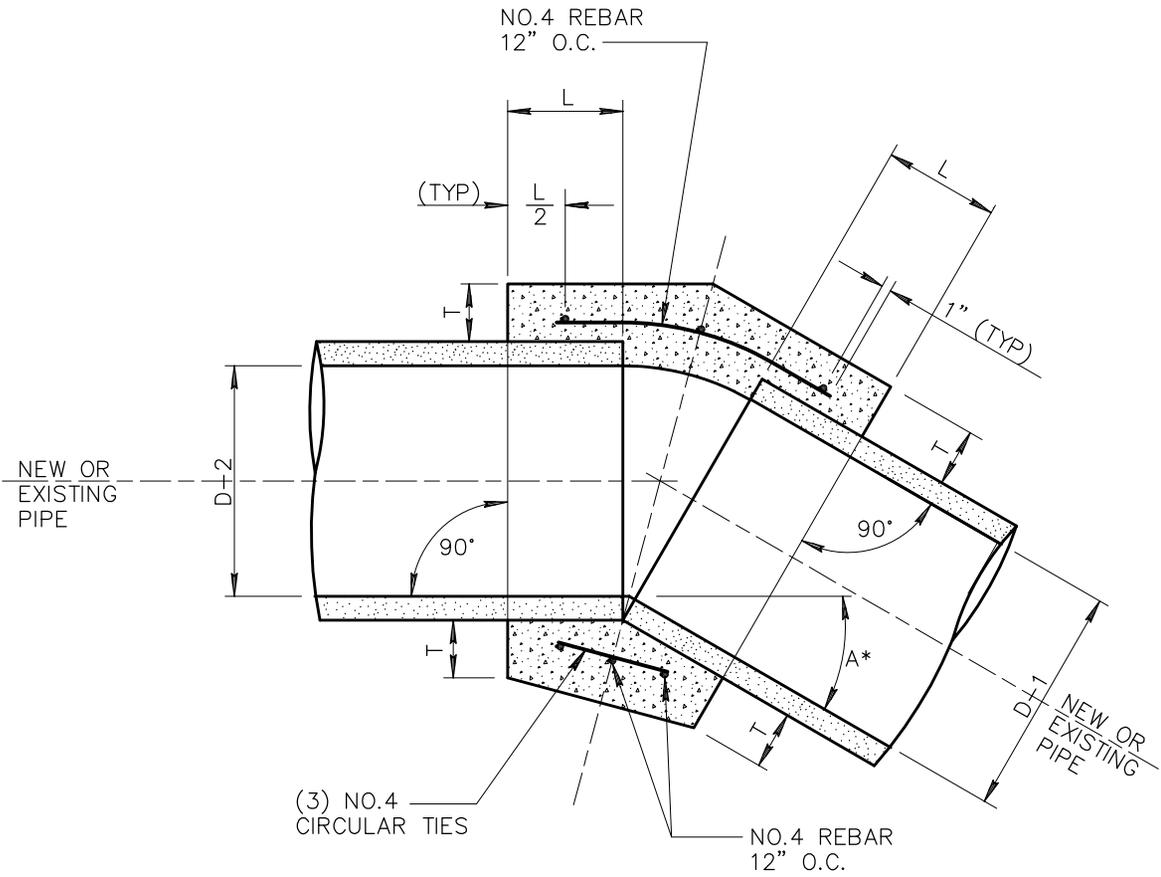
REVISED  
01-01-1998

DETAIL NO.

**504**

**NOTES:**

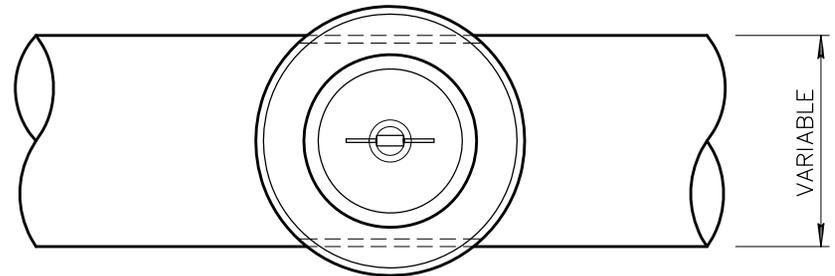
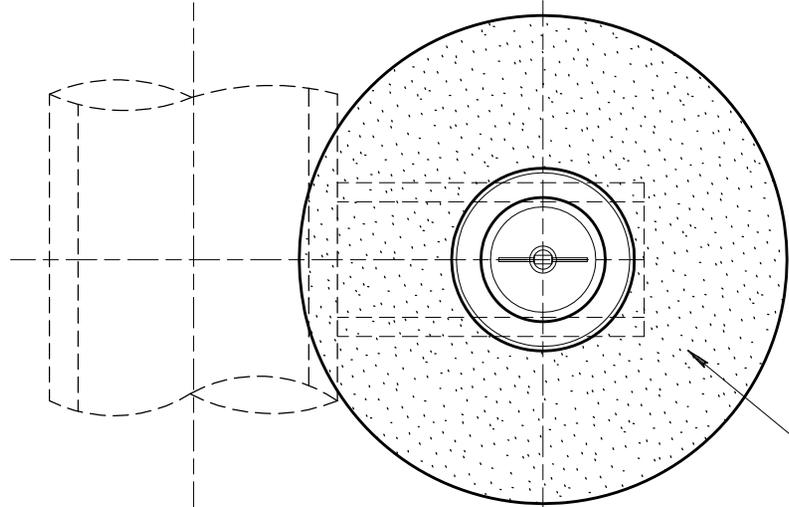
1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE.  $D=D-1$ , OR  $D-2$  WHICHEVER IS GREATER.
3. FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE NEXT SIZE LARGER.
4. OMIT REINFORCING ON PIPE 24" OR LESS IN DIAMETER.
5. WHERE REINFORCING IS REQUIRED, THE DIAMETER OF THE CIRCULAR TIES SHALL BE... OUTSIDE DIAMETER OF PIPE+T.
6. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
7. CONCRETE SHALL BE CLASS B PER SECT. 725.



$A^*$ =ANGLE OF DEFLECTION

TABLE		
D	L	T
12"	1.0'	4"
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
48"	1.5'	10"
57"	1.5'	10"
60"	1.75'	11"
66"	1.75'	11"

NOTE:  
 CONTRACTOR MAY USE PRECUT FITTINGS IF DESIRED.  
 BID ITEM INCLUDES LATERAL PIPE, RISER, PAD, VALVE,  
 LABOR AND INCIDENTAL MATERIAL REQUIRED FOR  
 INSTALLATION.



CONSTRUCT OPTIONAL  
 CONCRETE SCOURING  
 BASIN AROUND VALVE  
 ASSEMBLY WHERE SPECIFIED

VARIABLE

BREAK PIPE  
 AND MAKE  
 WATERTIGHT  
 JOINTS PER  
 DETAIL 524

MAIN

CLASS 'C' CONCRETE  
 PER SECTION 725  
 WITH TROWEL FINISH

SNOW, IDEAL,  
 WATERMAN ALFALFA  
 VALVE OR EQUAL

PIPE DIAMETER  
 TO BE SAME AS  
 VALVE SIZE

PLUG END PER  
 DETAIL 427

GROUT AS PER  
 DETAIL 524

PIPE DIAMETER  
 TO BE SAME AS  
 VALVE SIZE

CONCRETE PIPE  
 SECT. 735 & 736

CONCRETE TEE  
 OR ELBOW

BID ITEM

DETAIL NO.

506



STANDARD DETAIL  
 ENGLISH

IRRIGATION VALVE INSTALLATION

REVISED

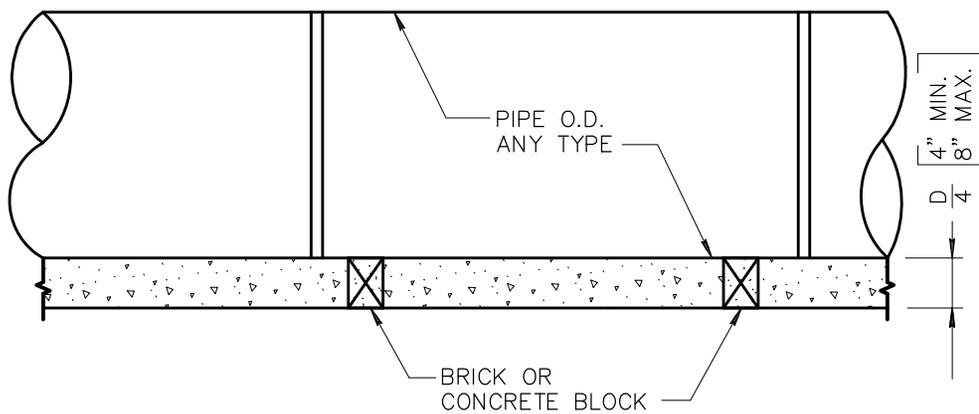
01-01-1998

DETAIL NO.

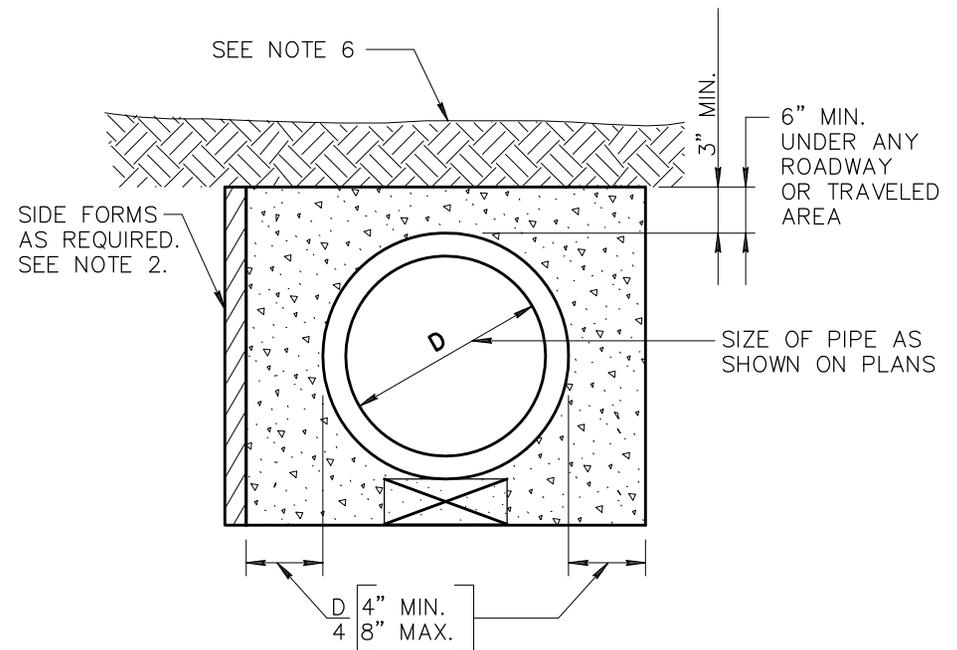
506

**NOTES:**

1. THIS DETAIL SHALL BE REQUIRED WHEN NEW OR EXISTING PIPE INSTALLATIONS WILL BE SUBJECT TO DAMAGE ANYTIME IN THE FUTURE DUE TO LACK OF PROPER COVER, AS DETERMINED BY THE ENGINEER.
2. FOR PIPE OVER 18" I.D. WOOD, METAL OR GYPSUM BOARD FORMS MUST BE USED TO FORM THE SIDES OF THE ENCASEMENT. GYPSUM BOARD FORMS MAY BE LEFT IN THE GROUND BELOW THE TOP OF THE ENCASEMENT. THIS SHALL BE OPTIONAL WITH POURING AGAINST TRENCH WALLS FOR ENCASEMENT OF 18" AND SMALLER PIPE.
3. FOR ALL SITUATIONS WHERE SIDE FORMS ARE USED, TRENCH WALLS SHALL BE OVER-EXCAVATED TO ALLOW SUFFICIENT ROOM TO OPERATE PROPER MECHANICAL COMPACTION EQUIPMENT.
4. CONCRETE WHICH SPILLS BEYOND 12" FROM THE SIDES OF THE PIPE FOR ANY REASON SHALL BE REMOVED BACK TO THE PROPER LINE PRIOR TO BACKFILLING.
5. SEE SECTION 601 FOR TRENCH PREPARATION.
6. CONCRETE TO BE CLASS 'A' PER SECT. 725.
7. COVER TO BE APPROVED BY ENGINEER.



LONGITUDINAL SECTION



END SECTION

DETAIL NO.

507



STANDARD DETAIL  
ENGLISH

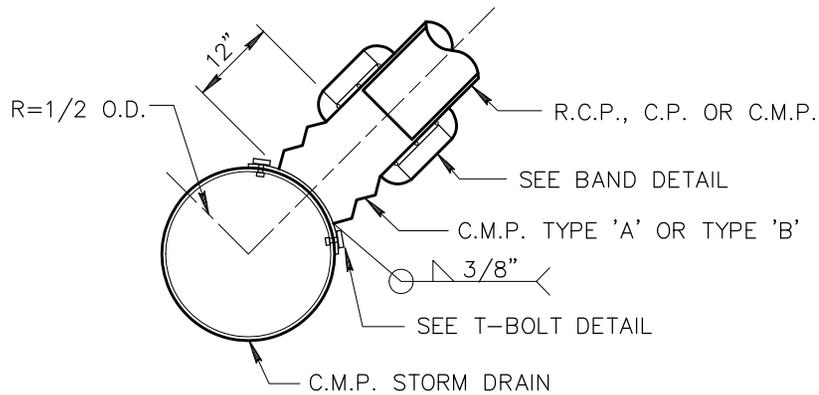
**ENCASED CONCRETE PIPE  
(FOR SHALLOW INSTALLATION)**

REVISED

01-01-1998

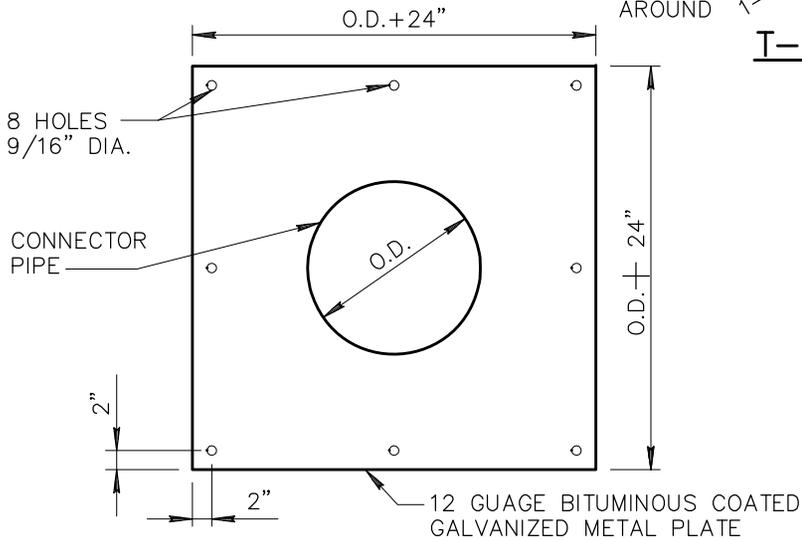
DETAIL NO.

507

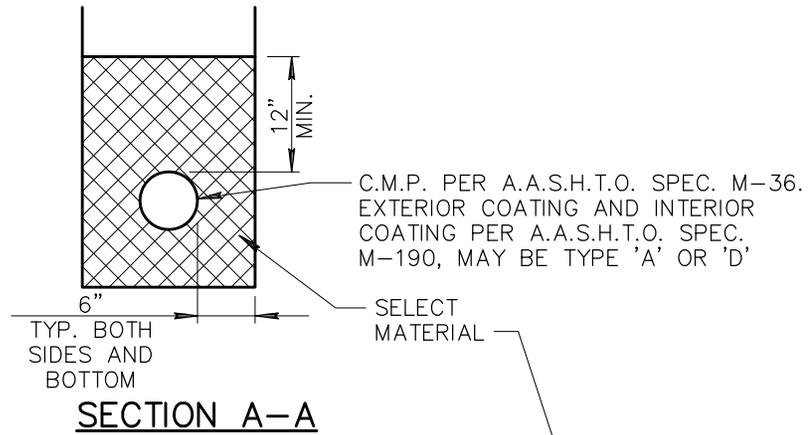


**CONNECTOR CROSS SECTION**

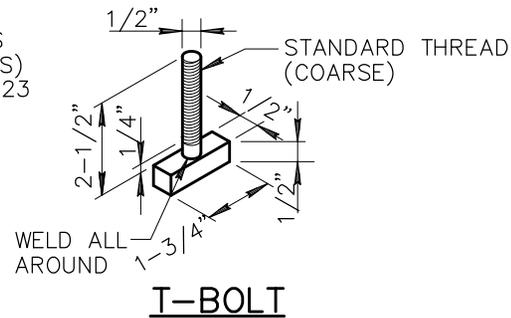
NOTE:  
USE 5/8" WASHER AND NUT, ALL PIECES  
(NUTS, WASHERS, AND FABRICATED BOLTS)  
TO BE GALVANIZED AS PER A.S.T.M. A-123  
LATEST REVISION.



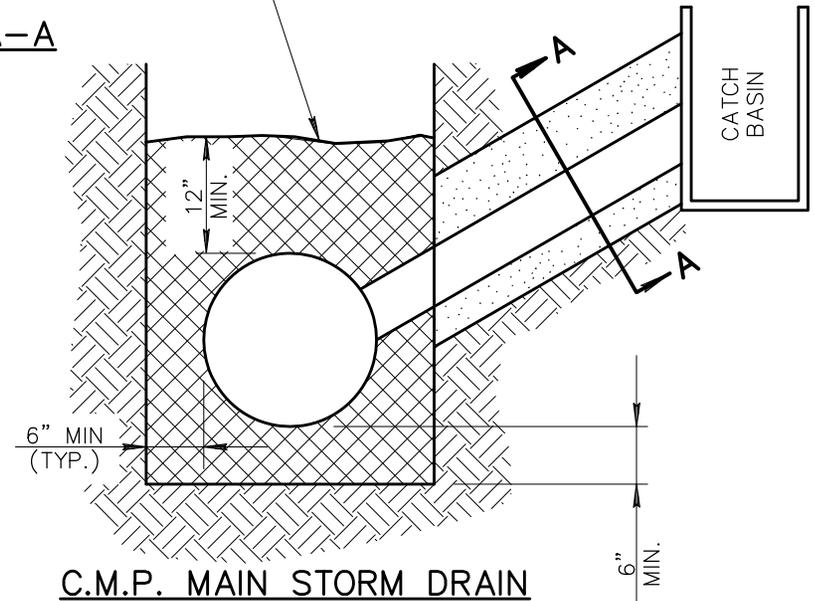
**C.M.P. CONNECTION TO MAIN STORM DRAIN  
24" PIPE AND SMALLER**



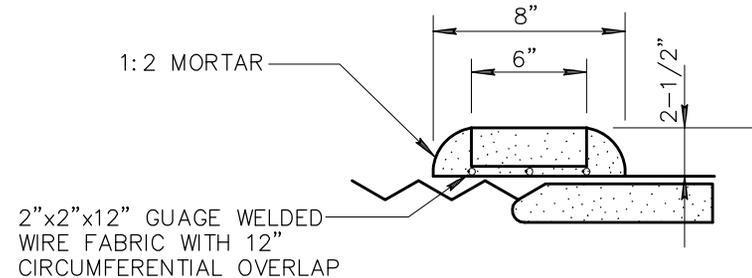
**SECTION A-A**



**T-BOLT**



**C.M.P. MAIN STORM DRAIN**



**BAND DETAIL**

DETAIL NO.

510



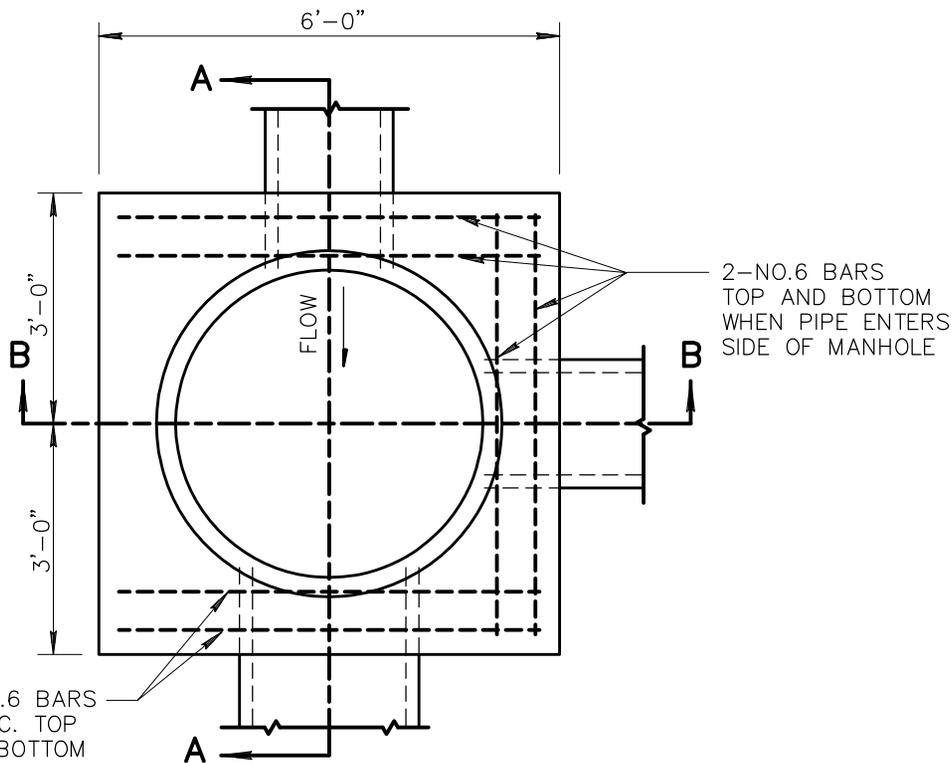
STANDARD DETAIL  
ENGLISH

**CORRUGATED METAL PIPE  
AND INSTALLATION**

REVISED  
01-01-1998

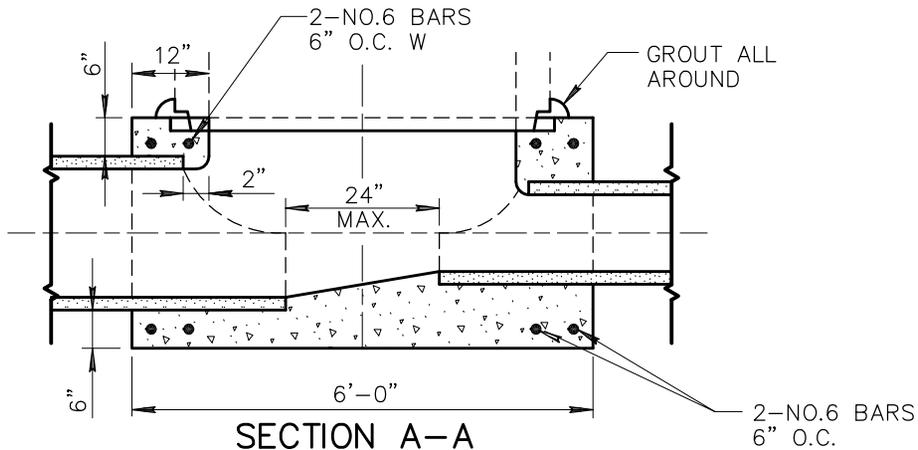
DETAIL NO.

510



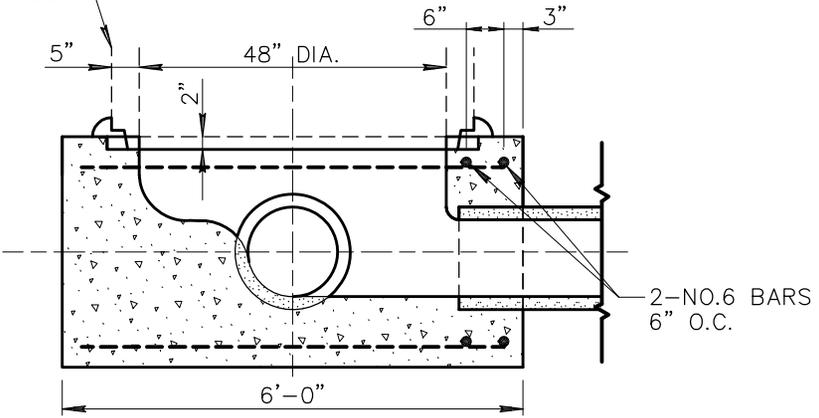
2-NO.6 BARS  
6" O.C. TOP  
AND BOTTOM

**PLAN**



**SECTION A-A**

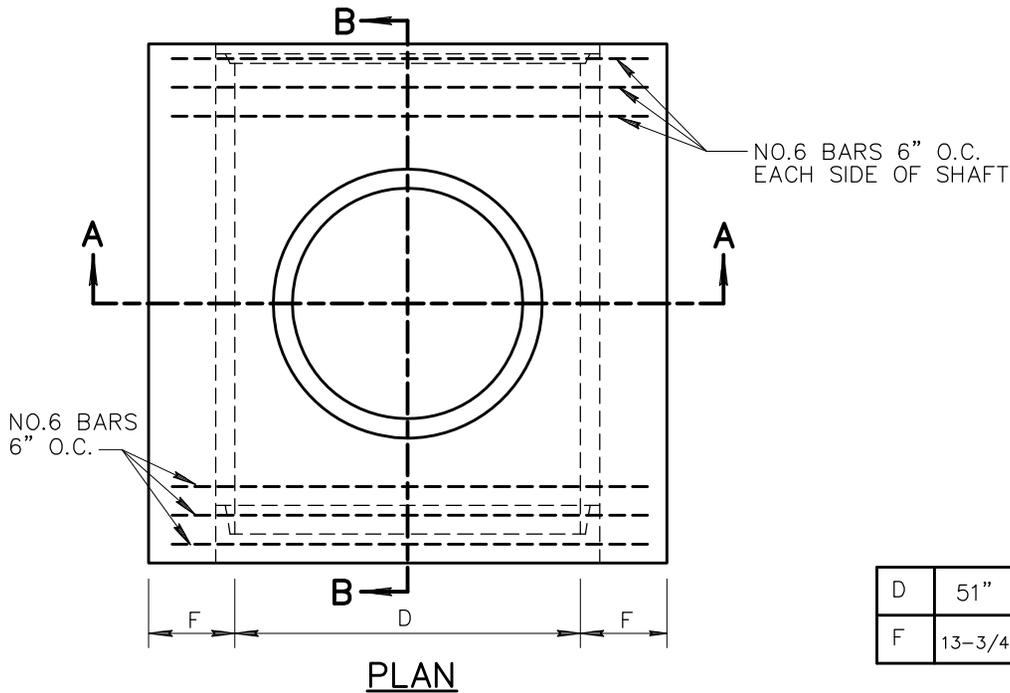
MANHOLE SHAFT  
PER DETAIL 522



**SECTION B-B**

**NOTES**

1. ALL CONCRETE TO BE CLASS 'A' PER SECT. 725, 505.
2. MATCH SPRING LINES OF PIPE ENTERING MANHOLE UNLESS OTHERWISE NOTED.
3. CUT PIPES TO ALLOW SETTING OF 4' DIA. CYLINDRICAL FORM FROM 6" ABOVE MAIN LINE PIPE TO SPRING LINE. CUT PIPE 2" LARGER THAN FORM TO ALLOW 2" CONCRETE OVER ENDS OF ALL CUT PIPE.
4. INVERT AND BASE OF MANHOLE TO BE POURED AND INVERT TO BE SHAPED BY HAND TO MAKE SMOOTH TRANSITION. FINISH WITH RUBBER FLOAT.
5. CENTER MANHOLE ON PIPE JOINT WHERE PIPE CHANGES SIZES, LEAVING A GAP OF 12" MINIMUM, 24" MAXIMUM.

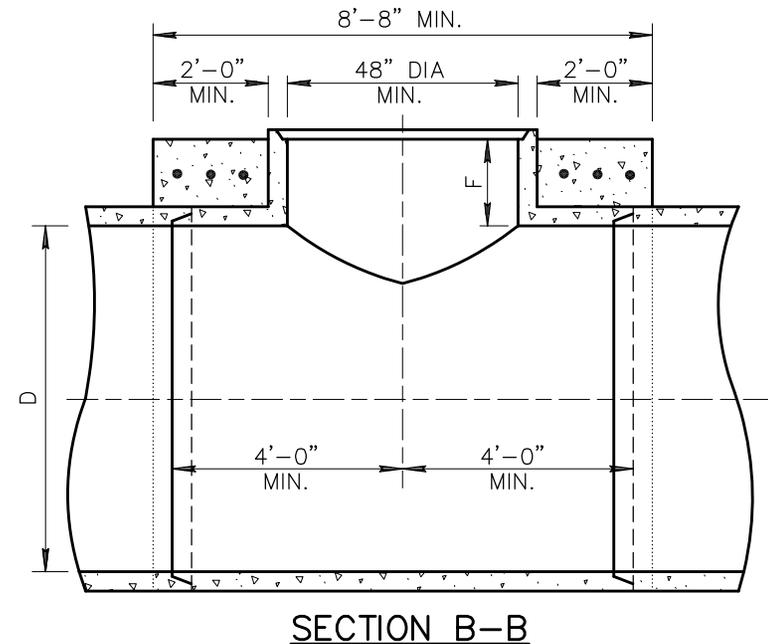
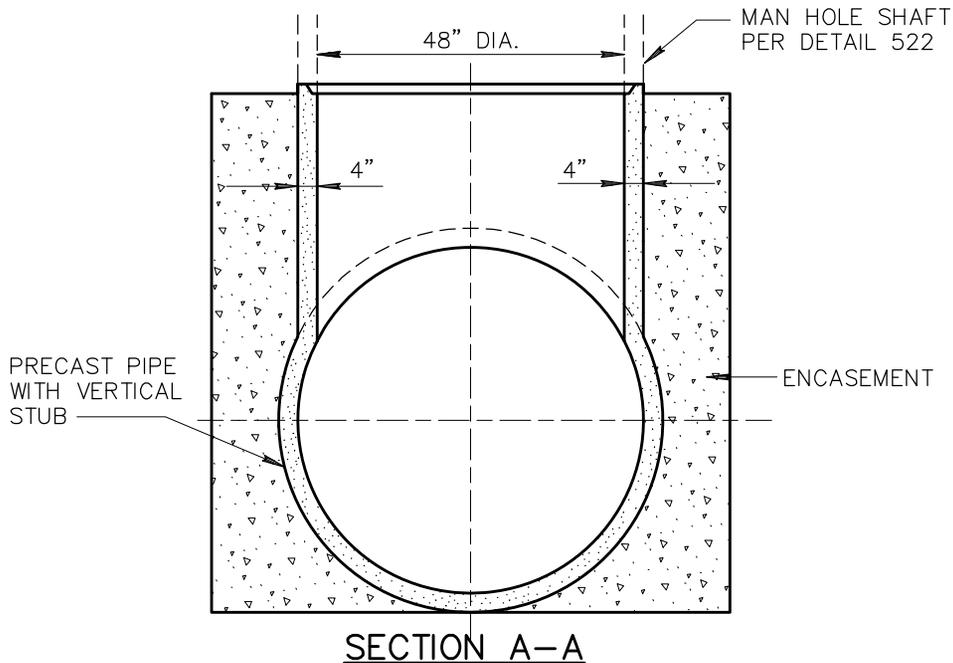


**NOTES:**

1. LINE PIPE AND STUB MAY BE CAST MONOLITHICALLY OR STUB MAY BE CAST ON TO LINE PIPE SECTION PRIOR TO COMPLETE CURING.
2. ALL LINE PIPE REINFORCEMENT SHALL BE TURNED UP INTO STUB.
3. THE VERTICAL STUB TO BE A.S.T.M. C-76 CLASS II WALL 'A' AND THE HORIZONTAL PIPE TO BE EQUAL TO STRENGTH OF PIPE ENTERING MANHOLE.
4. ALL REINFORCING STEEL SHALL CLEAR FACE OF CONCRETE BY 1-1/2" UNLESS SHOWN OTHERWISE.
5. CONCRETE ENCASEMENT SHALL BE CLASS 'A' PER SECT. 725 AND 505.

**TABLE OF VALUES FOR 'F' & 'D'**

D	51"	54"	57"	60"	63"	66"	69"	72"	78"	84"	90"	96"
F	13-3/4"	14-1/2"	15"	15-1/2"	16-1/4"	16-3/4"	17-1/2"	18"	19-1/4"	20-1/2"	21-3/4"	23"



DETAIL NO.

521



STANDARD DETAIL  
ENGLISH

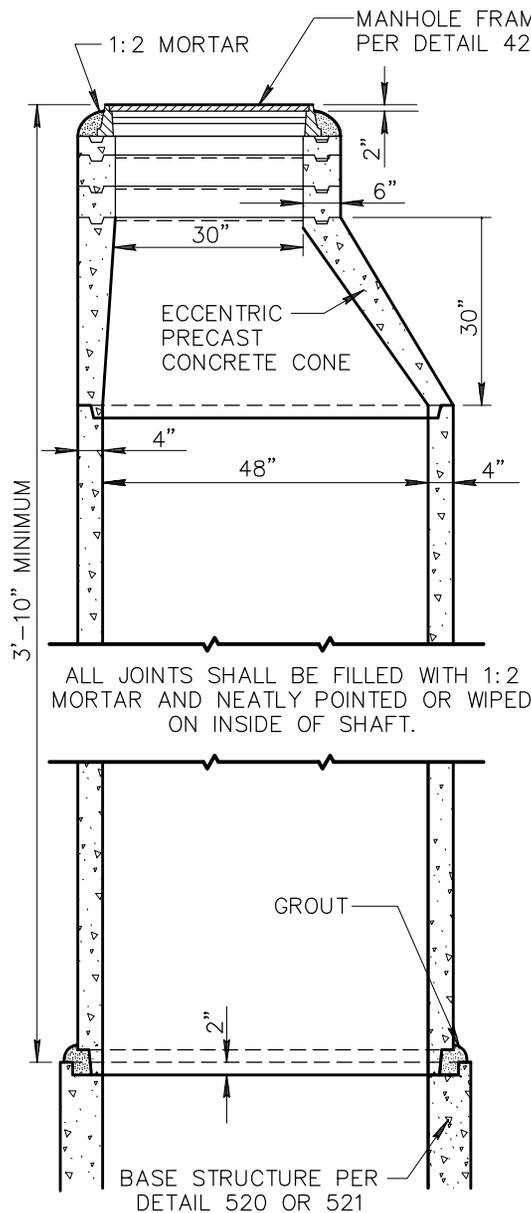
**STORM DRAIN MANHOLE BASE  
(51" OR LARGER)**

REVISED

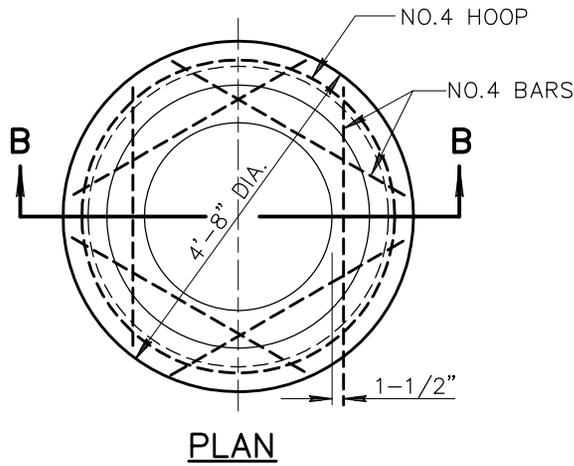
01-01-1998

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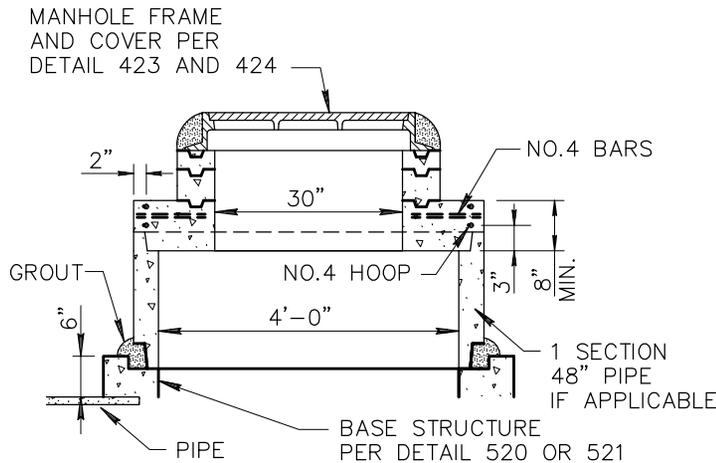
521



**VERTICAL SECTION OF  
ECCENTRIC MANHOLE SHAFT**



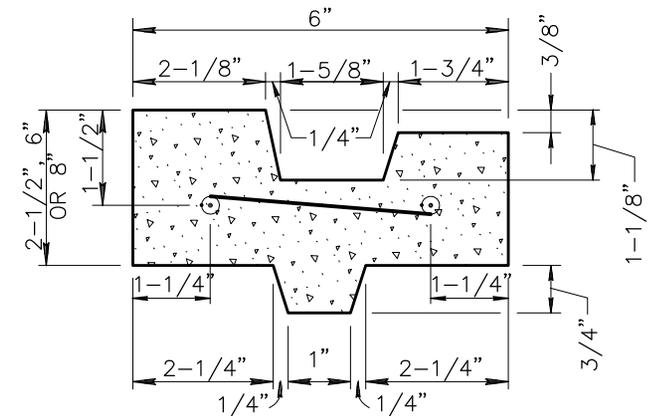
**PLAN**  
USE WHERE THERE IS 3'-10"  
OR LESS COVER OVER PIPE



**SECTION B-B**  
**SHALLOW MANHOLE**

**NOTES:**

1. PRECAST CONCRETE CONES AND SECTIONS TO BE A.S.T.M. C-478.
2. BRICK MAY BE USED IN LIEU OF OR IN COMBINATION WITH CONCRETE ADJUSTING RINGS.
3. PRECAST CONCRETE SECTIONS 48" DIA PIPE MAY BE FURNISHED IN STANDARD LENGTHS.
4. UNLESS OTHERWISE SHOWN ON PLANS, USE (2) 2-1/2" PRECAST CONCRETE ADJUSTING RINGS ON IMPROVED STREETS AND (4) 2-1/2" RINGS ON UNIMPROVED STREETS.
5. CONCRETE SHALL BE CLASS A PER SECTION 725 AND 505.



2-1/2" RINGS SHALL BE REINFORCED WITH TWO 1/4" ROUND STEEL HOOPS; 6" AND 8" RINGS SHALL BE REINFORCED WITH FOUR 1/4" HOOPS, TIED WITH NO. 14 A.S.& W. GAUGE WIRE 8" O.C.

**REINFORCED CONCRETE  
ADJUSTING RING**

DETAIL NO.

**522**



STANDARD DETAIL  
ENGLISH

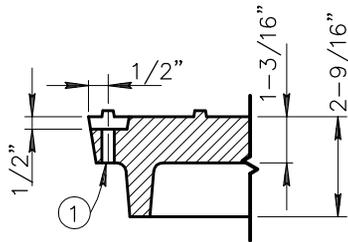
**STORM DRAIN MANHOLE SHAFT**

REVISED

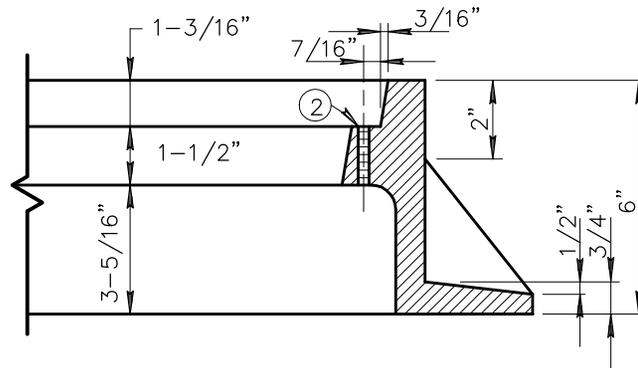
01-01-2015

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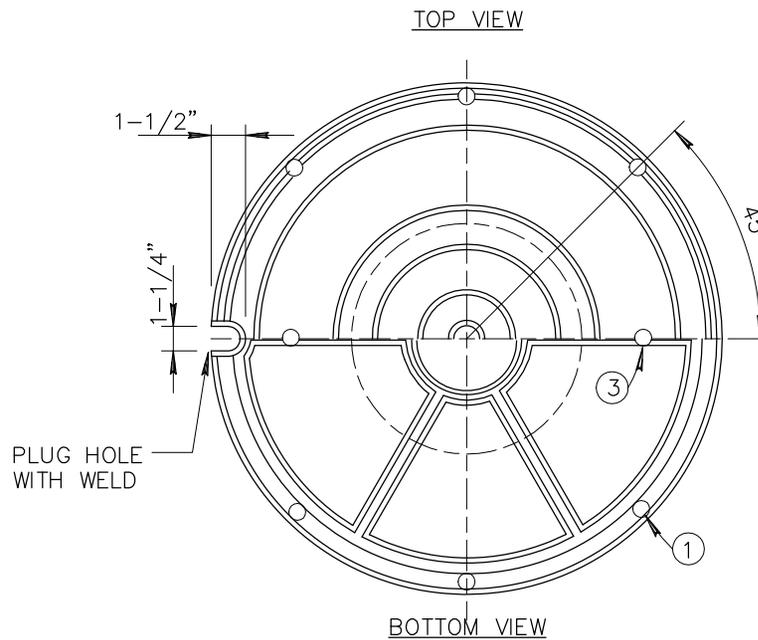
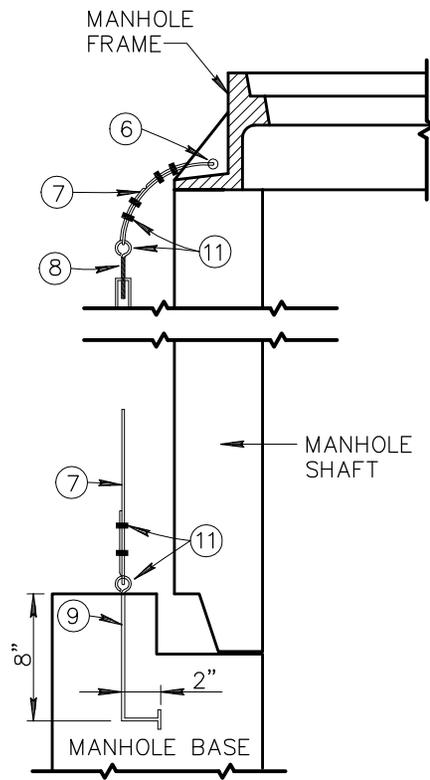
**522**



**COVER SECTION**



**FRAME SECTION**



**STANDARD 24" M.H.  
FRAME AND COVER**

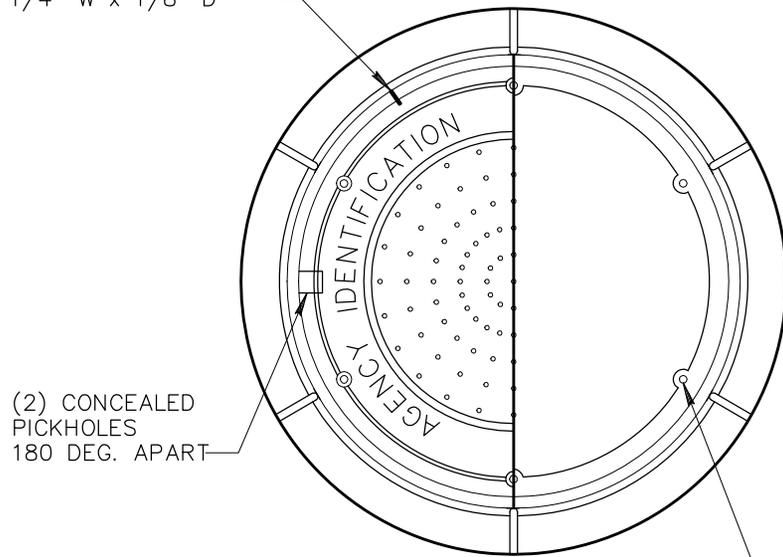
FOR A 30" M.H. OPENING, USE THE STD. WATER TIGHT 30" M.H. FRAME & COVER, AND ANCHOR THE FRAME AS OUTLINED IN THE INSTRUCTIONS NOTED ON THIS SHEET.

FOR A 24" M.H. OPENING, MODIFY THE STD. 24" M.H. FRAME & COVER, FOLLOWING THE NOTED PROCEDURES, ONE THRU FIVE.

**NOTES:**

- ① DRILL (8) HOLES  $17/32$ " IN COVER FOR  $1/2$ " CAPSCREWS, COUNTERBORE  $1/2$ " DEEP BY  $1-1/8$ " DIA. TO ACCOMODATE CAPSCREW AND SOCKET WRENCH. SPACE EQUALLY.
  - ② DRILL (8) HOLES AND TAP FOR  $1/2$ " - 13 THREAD NATIONAL COARSE BOLT.
  - ③ DRILL, TAP AND COUNTERBORE (2) HOLES FOR  $1/2$ " CAPSCREWS TO BE USED FOR LIFTING COVER. PLUG WITH CAPSCREWS.
  - ④ COVER AND FRAME MUST BE MATCHED, DRILLED AND TAPPED IN SETS.
  - ⑤ CASTING DIMENSIONS GIVEN ABOVE ARE FROM DET. 424, 24" MANHOLE FRAME AND COVER.
- BOTH 24" AND 30" FRAMES TO BE ANCHORED AS FOLLOWS:
- ⑥ DRILL  $1/2$ " HOLE IN FILLET. DO NOT USE ADJACENT FILLETS.
  - ⑦  $1/4$ " STAINLESS STEEL CABLE. SECURED WITH CABLE CLAMPS.
  - ⑧  $1/2$ "x9" HOOK AND EYE TURNBUCKLE.
  - ⑨  $1/2$ " EYE BOLT WITH 1" DIA. EYE.
  - ⑩ INSTALL THREE CABLES PER 24" COVER (FOUR CABLES FOR 30" COVERS). EYEBOLTS TO BE SET DIRECTLY BELOW FILLETS USED.
  - ⑪ TRIPLE WRAP TURNBUCKLES AND CABLE CLAMPS WITH 1" WIDE TAPE, SAFE-T-CLAD, F.O.S. 655, OR APPROVED EQUAL.

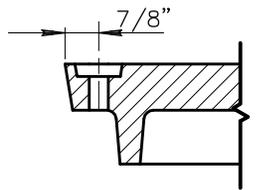
GROUND MATCH MARK  
1/4" W x 1/8" D



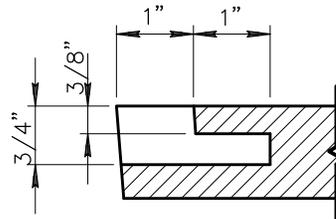
(2) CONCEALED  
PICKHOLES  
180 DEG. APART

**NOTES:**

1. DRILL (6) HOLES IN 30" COVER (4 HOLES IN 24" COVER) 17/32" CORED RECESS FOR 1/2" CAPSCREWS. SPACE EQUALLY (304 S.S.)
2. DRILL (6) HOLES IN 30" FRAME (4 HOLES IN 24" FRAME) AND TAP FOR 1/2" - NATIONAL COARSE BOLT (HEX HEAD).
3. COVER AND FRAME MUST BE MATCH MARKED, DRILLED AND TAPPED IN SETS.
4. DIMENSIONS, LETTERING, WEIGHTS AND MATERIALS SHALL CONFORM TO DET. 424.
5. REFER TO DETAIL 523-1 FOR INSTALLATION PROCEDURES.

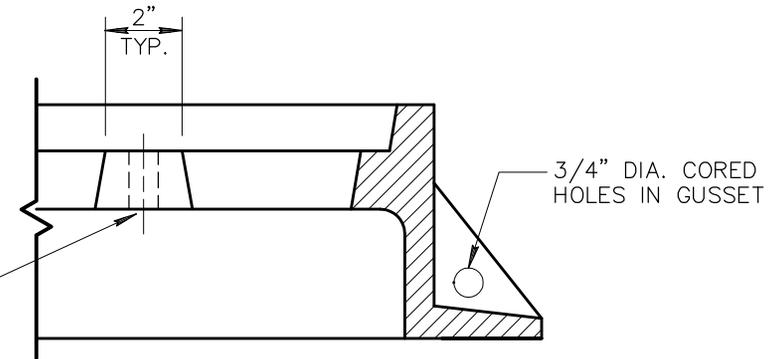


BOLT HOLE DETAIL



PICKHOLE DETAIL

TYP. BOLT PAD



FRAME SECTION

COVER SECTION

DETAIL NO.

523-2



MARICOPA  
ASSOCIATION of  
GOVERNMENTS

STANDARD DETAIL  
ENGLISH

PRESSURE MANHOLE

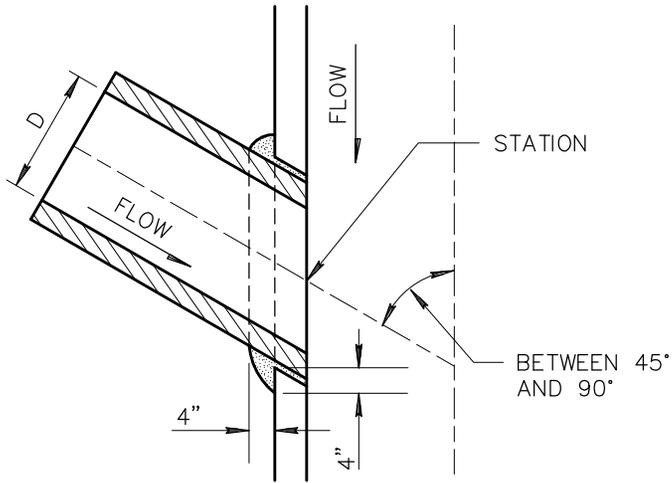
REVISED

01-01-1998

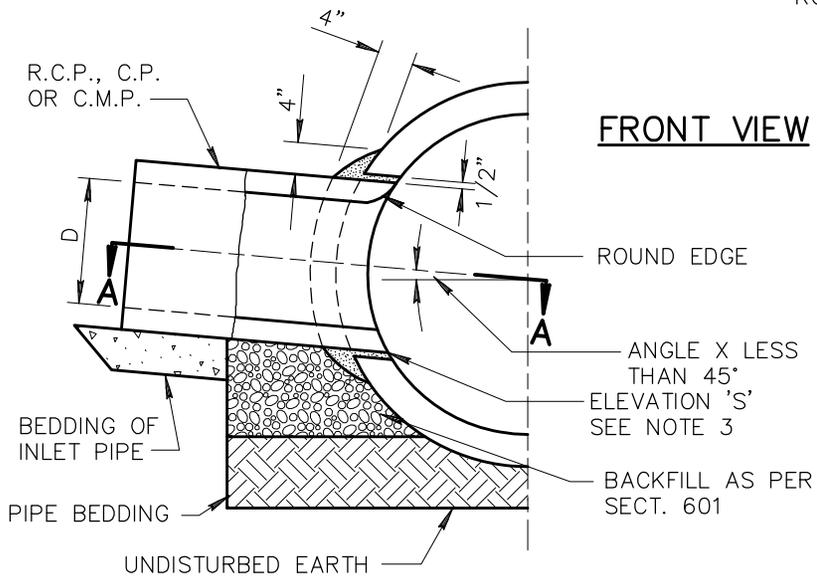
DETAIL NO.

523-2

**TOP VIEW**

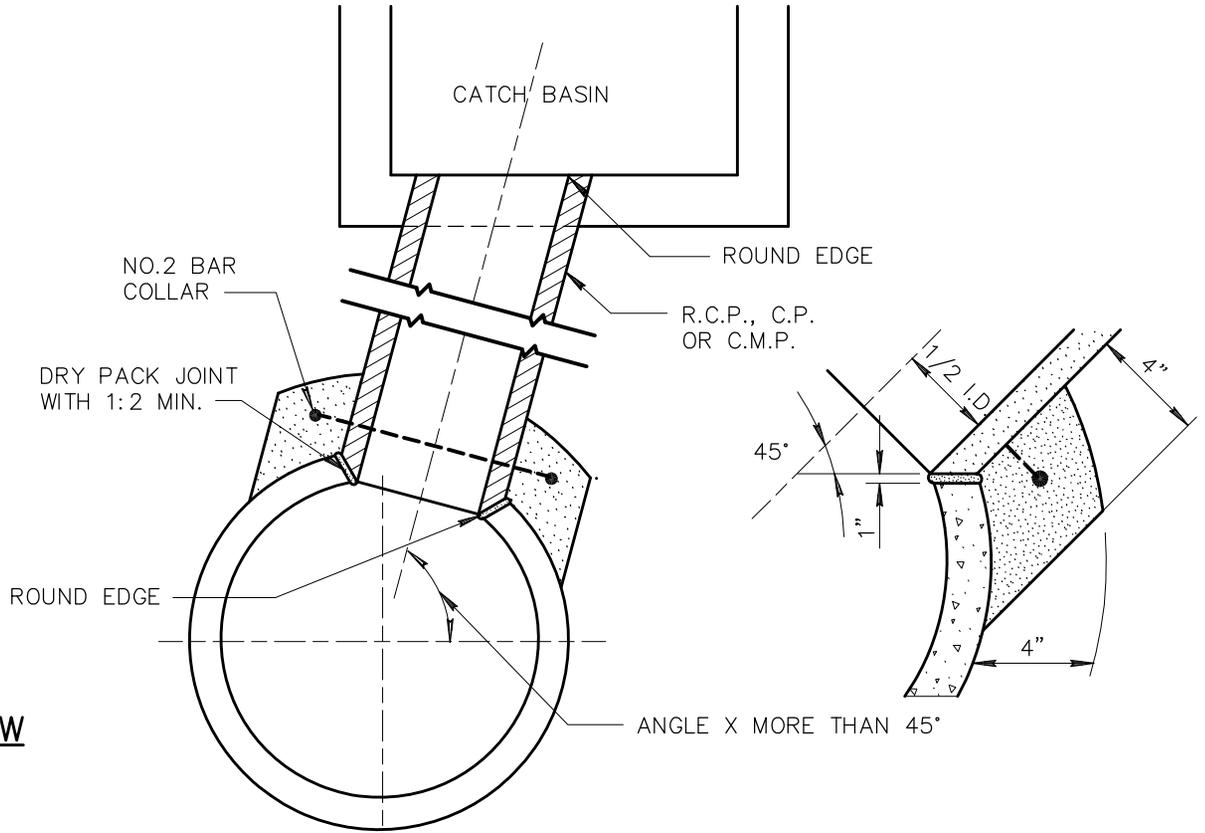


**SECTION A-A**



**SIDE INLET  
TYPE 1**

**FRONT VIEW**



**CATCH BASIN ABOVE STORM DRAIN  
TYPE 2**

**NOTES:**

1. D SHALL BE 24" OR LESS. FOR LARGER VALUE OF D USE MANHOLE OR JUNCTION STRUCTURE.
2. IN NO CASE SHALL THE OUTSIDE DIAMETER OF THE INLET EXCEED ONE HALF THE INSIDE DIAMETER OF THE MAIN STORM DRAIN.
3. CENTERLINE OF INLET SHALL BE ON RADIUS OF MAIN STORM DRAIN EXCEPT WHEN ELEVATION 'S' IS SHOWN ON PLANS.
4. THE MINIMUM OPENING INTO THE STORM DRAIN SHALL BE THE OUTSIDE DIAMETER OF THE CONNECTING PIPE PLUS 1".
5. IF ANGLE X FROM HORIZONTAL IS 45° OR LESS USE TYPE 1.  
IF ANGLE X IS 45° OR OVER USE TYPE 2.

DETAIL NO.

**524**



STANDARD DETAIL  
ENGLISH

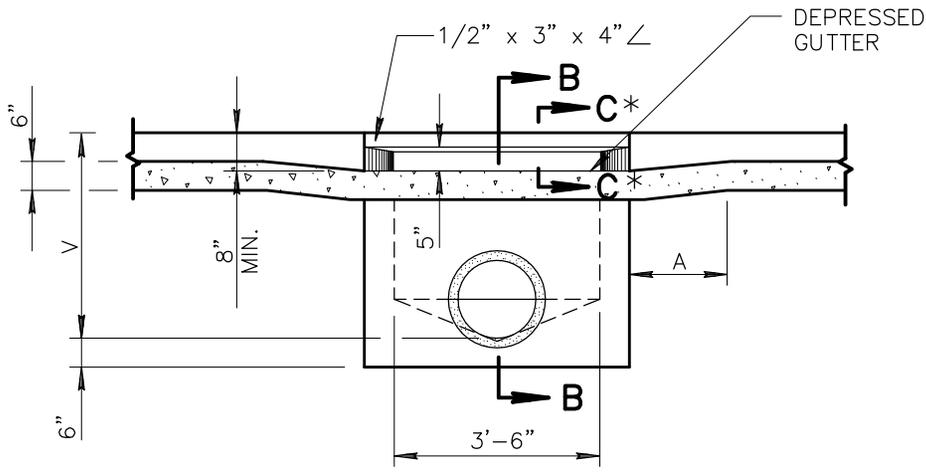
**STORM DRAIN LATERAL  
PIPE CONNECTIONS**

REVISED

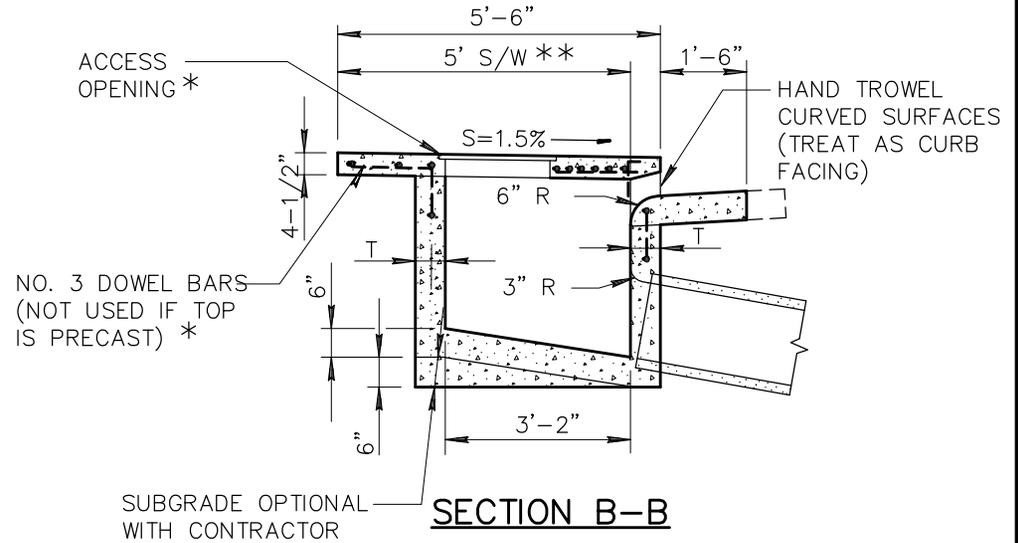
01-01-1998

DETAIL NO.

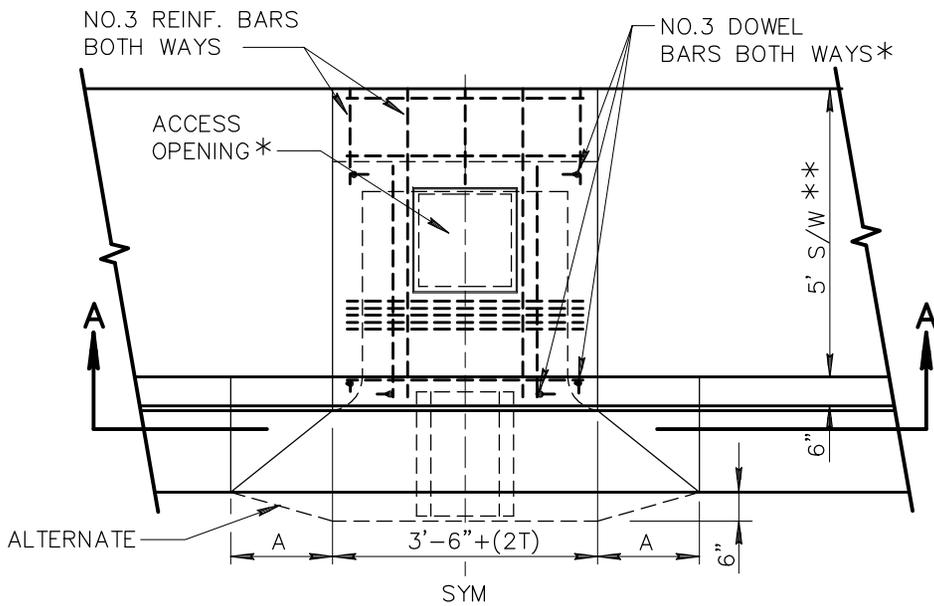
**524**



**SECTION A-A**



**SECTION B-B**



**PLAN VIEW**

**NOTES:**

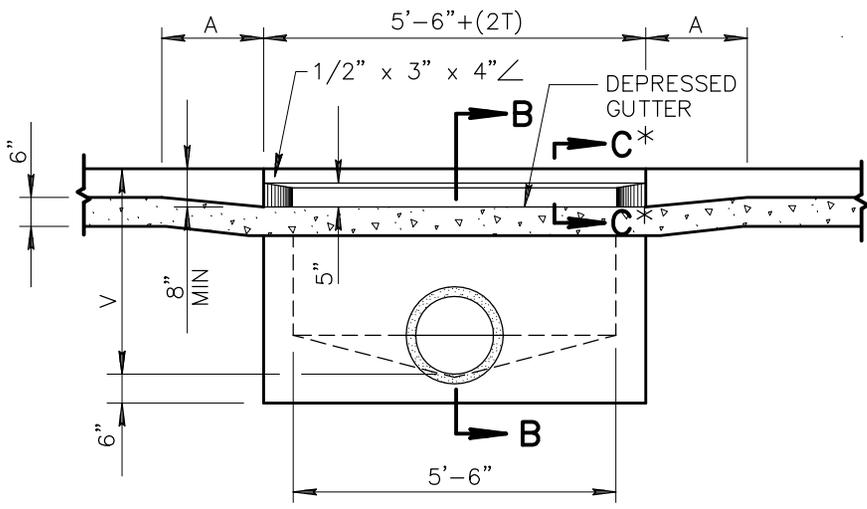
1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

**DIMENSIONS**

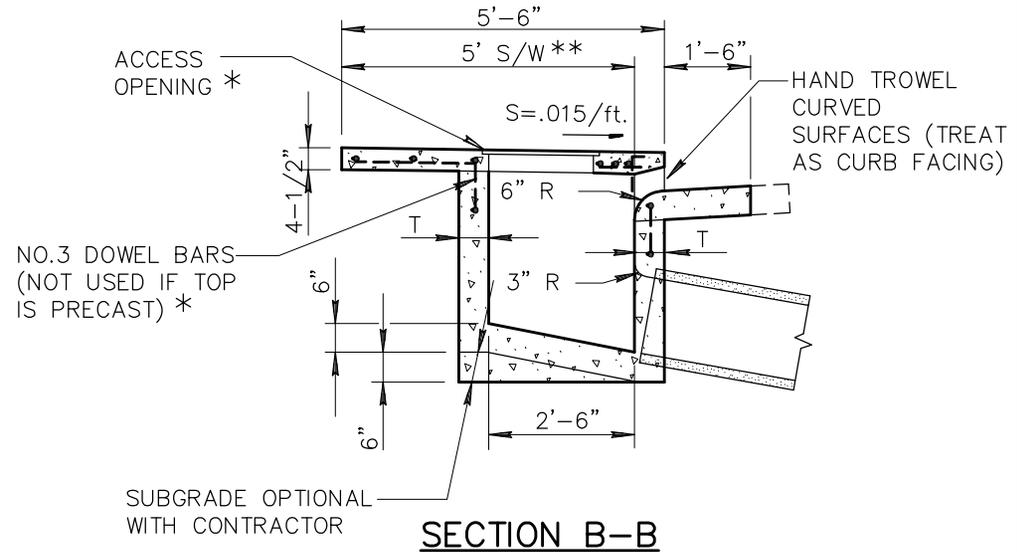
CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

T=6" IF V=4' OR LESS  
 T=8" IF V IS BETWEEN 4' AND 8'  
 T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)  
 V=3'-6" UNLESS OTHERWISE SPECIFIED.

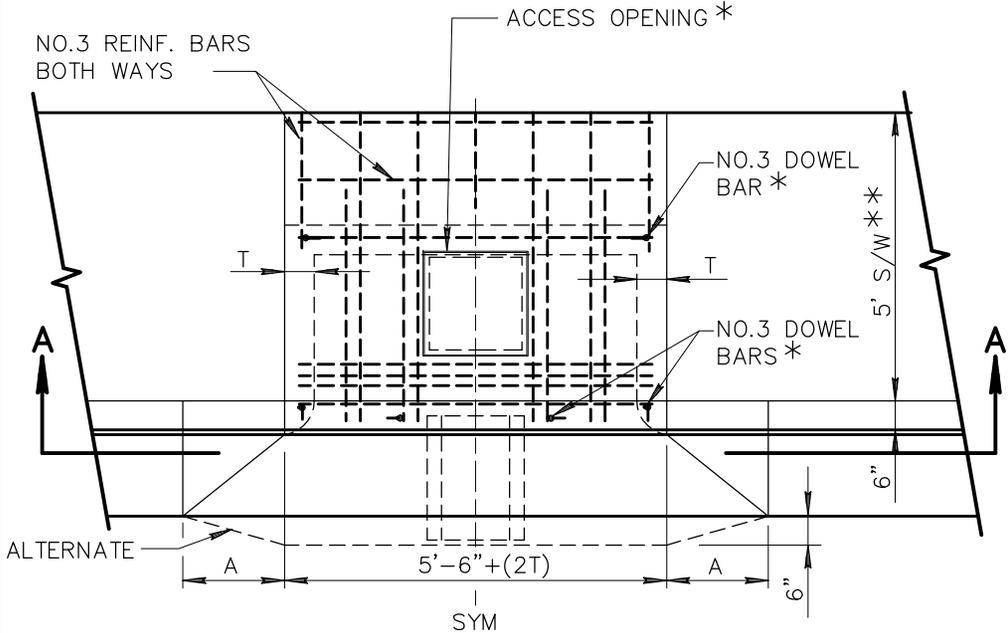
\* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.  
 \*\* 4' LOCATIONS WHERE 4' S/W IS REQUIRED.



**SECTION A-A**



**SECTION B-B**



**PLAN VIEW**

**NOTES:**

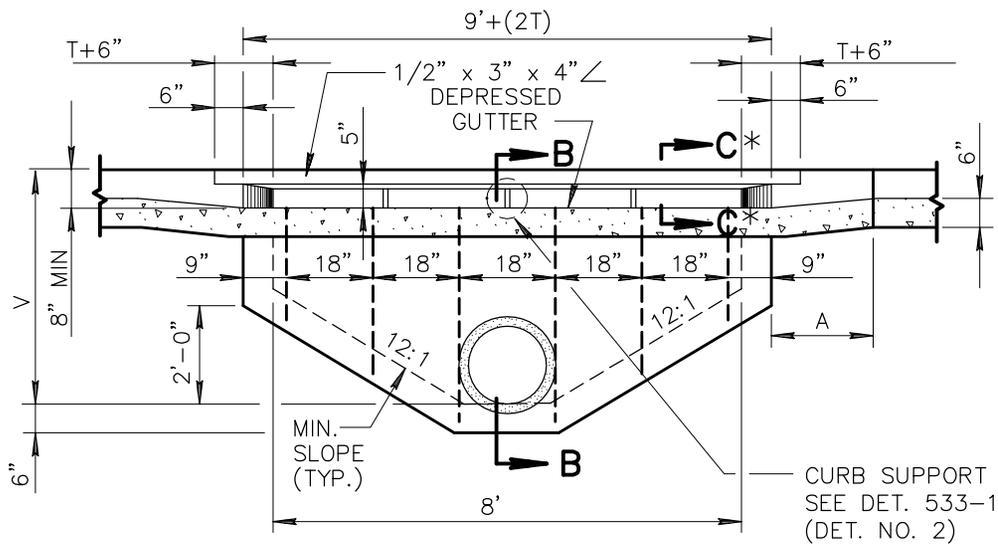
1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

**DIMENSIONS**

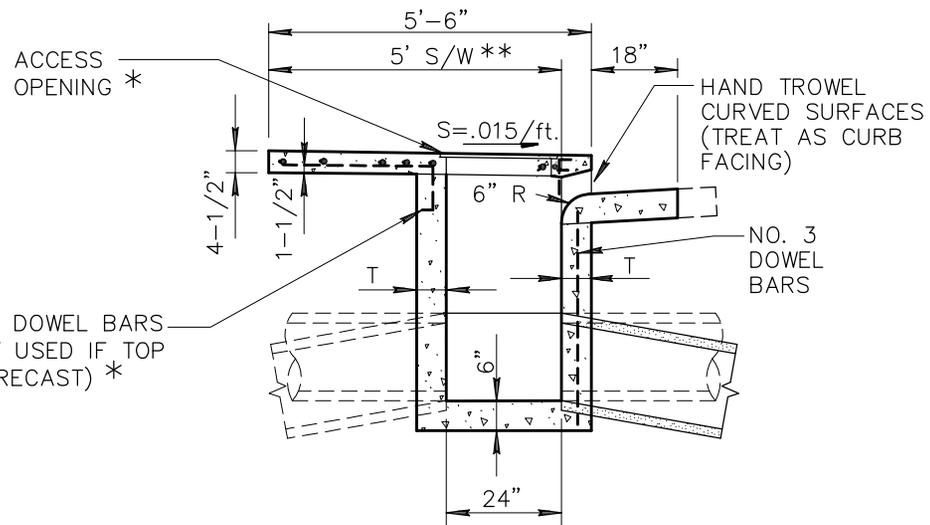
CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

T=6" IF V=4' OR LESS  
 T=8" IF V IS BETWEEN 4' AND 8'  
 T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)  
 V=3'-6" UNLESS OTHERWISE SPECIFIED.

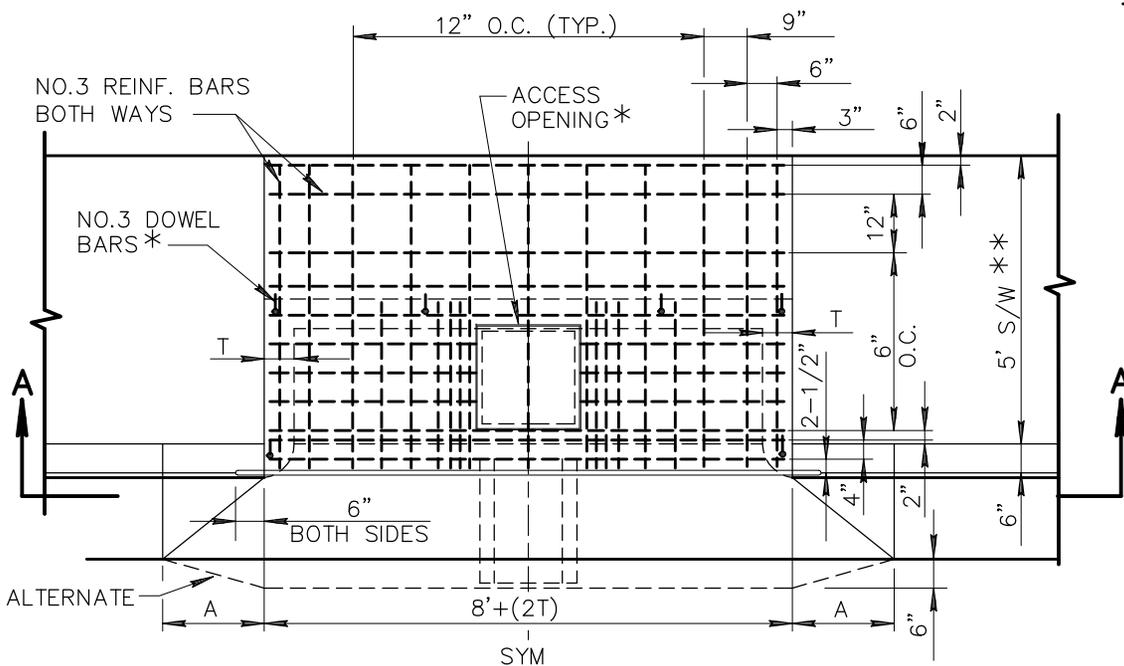
\* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.  
 \*\* 4' LOCATIONS WHERE 4' S/W IS REQUIRED.



**SECTION A-A**



**SECTION B-B**



**PLAN VIEW**

**NOTES:**

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO.1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

**DIMENSIONS**

T=6" IF V=4' OR LESS  
 T=8" IF V IS BETWEEN 4' AND 8'  
 T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)  
 V=4' UNLESS OTHERWISE SPECIFIED.

\* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.  
 \*\* 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

**532**



STANDARD DETAIL  
 ENGLISH

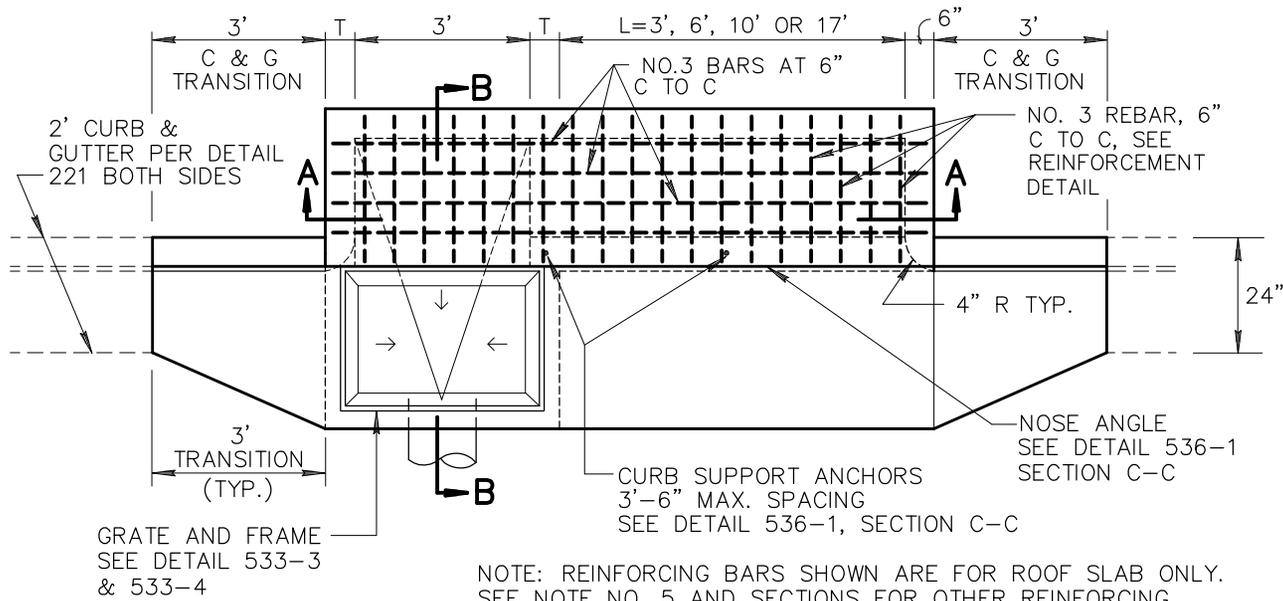
**8'-0" CURB OPENING  
 CATCH BASIN - TYPE 'C'**

REVISED

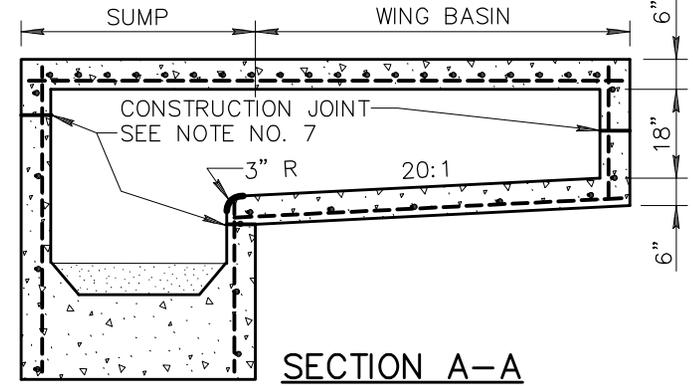
01-01-1998

DETAIL NO.

**532**



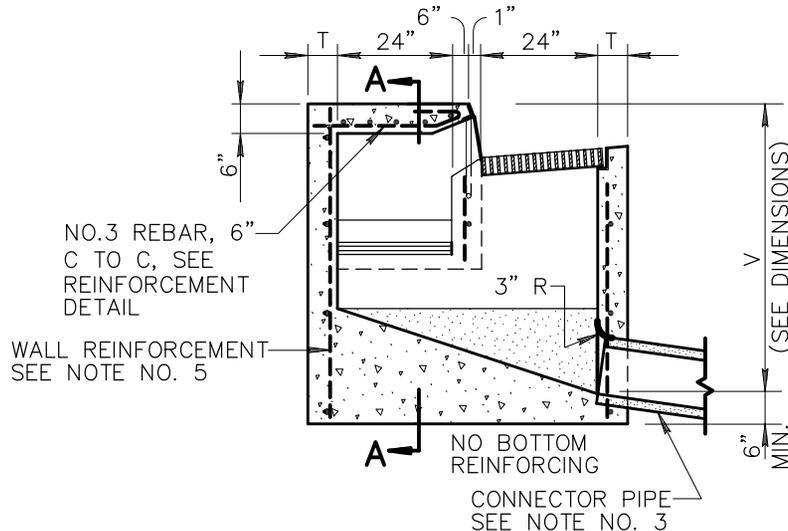
NOTE: REINFORCING BARS SHOWN ARE FOR ROOF SLAB ONLY. SEE NOTE NO. 5 AND SECTIONS FOR OTHER REINFORCING.



**NOTES:**

1. SINGLE C.B. (ILLUSTRATED), SUMP WITH WING BASIN UPSTREAM.
2. DOUBLE C.B. SUMP WITH SYMMETRICAL WING BASINS EACH SIDE.
3. PIPES CAN BE PLACED IN ANY WALL EXCEPT WALL ADJACENT TO A WING BASIN. PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS PLACED.
4. SUMP FLOOR SHALL HAVE A WOOD TROWEL FINISH AND A MIN. SLOPE OF 4:1 IN ALL DIRECTIONS TOWARD OUTLET PIPE.
5. ALL REFORCING BARS SHALL BE NO.4 18" C TO C BOTH WAYS AND 1-1/2" CLEAR TO INSIDE OF WALLS AND OUTSIDE WING BASIN FLOOR EXCEPT AS SHOWN. SEE SECT. 727.
6. ALL CONCRETE SHALL BE CLASS 'A', PER SECT. 725.
7. CONSTRUCTION JOINTS SHALL BE PLACED TO MEET FIELD CONDITIONS.
8. ALL EXPOSED STEEL SHALL BE GALVANIZED OR PAINTED WITH ONE SHOP COAT OF #1 PAINT AND TWO FIELD COATS OF #10 PAINT.

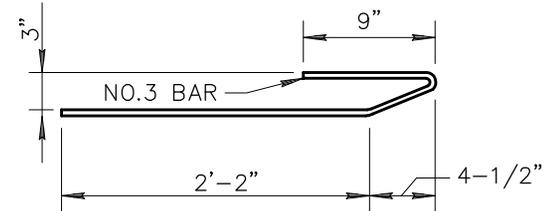
**PLAN VIEW**



**SECTION B-B**

**DIMENSIONS**

- V = 3'-3" MIN. WHEN L = 3'
- V = 3'-5" MIN. WHEN L = 6'
- V = 3'-7" MIN. WHEN L = 10'
- V = 4'-0" MIN. WHEN L = 17'
- T = 6" WHEN V IS LESS THAN 8'
- T = 8" WHEN V IS EQUAL TO OR GREATER THAN 8'
- H = CURB HEIGHT PRIOR TO THE TRANSITION



**REINFORCEMENT DETAIL**

DETAIL NO.

533-1



STANDARD DETAIL  
ENGLISH

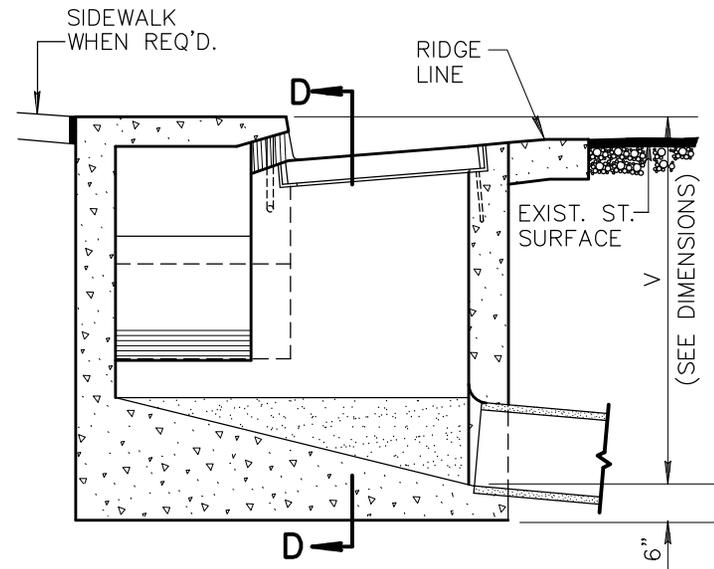
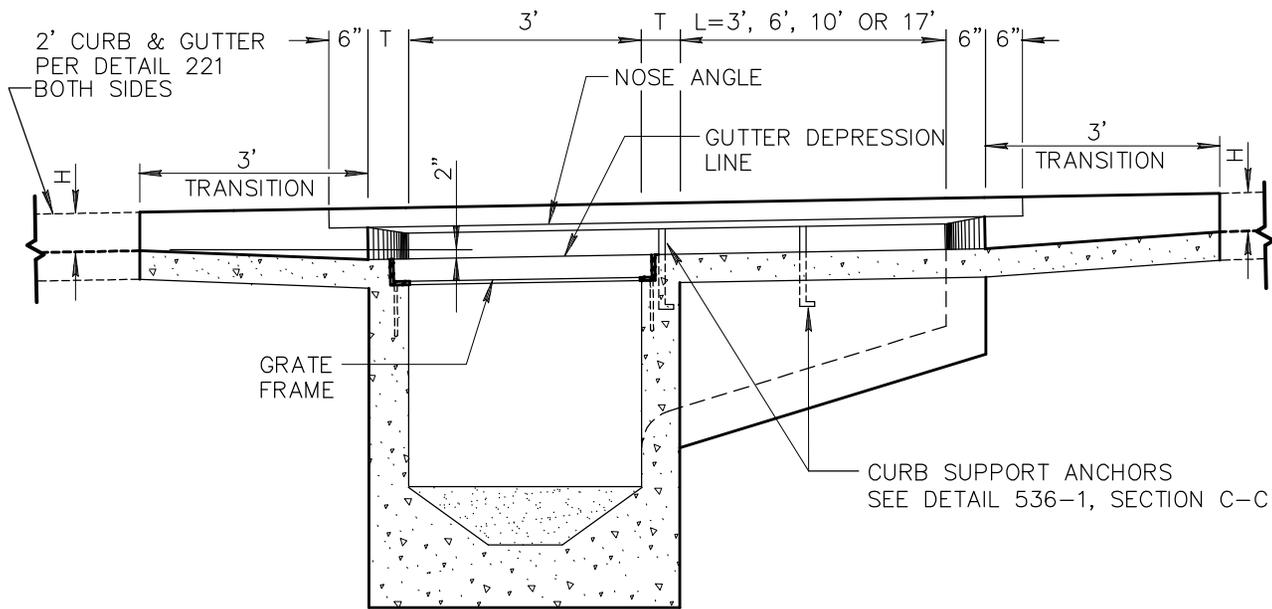
CATCH BASIN TYPE 'D

REVISED

01-01-1998

DETAIL NO.

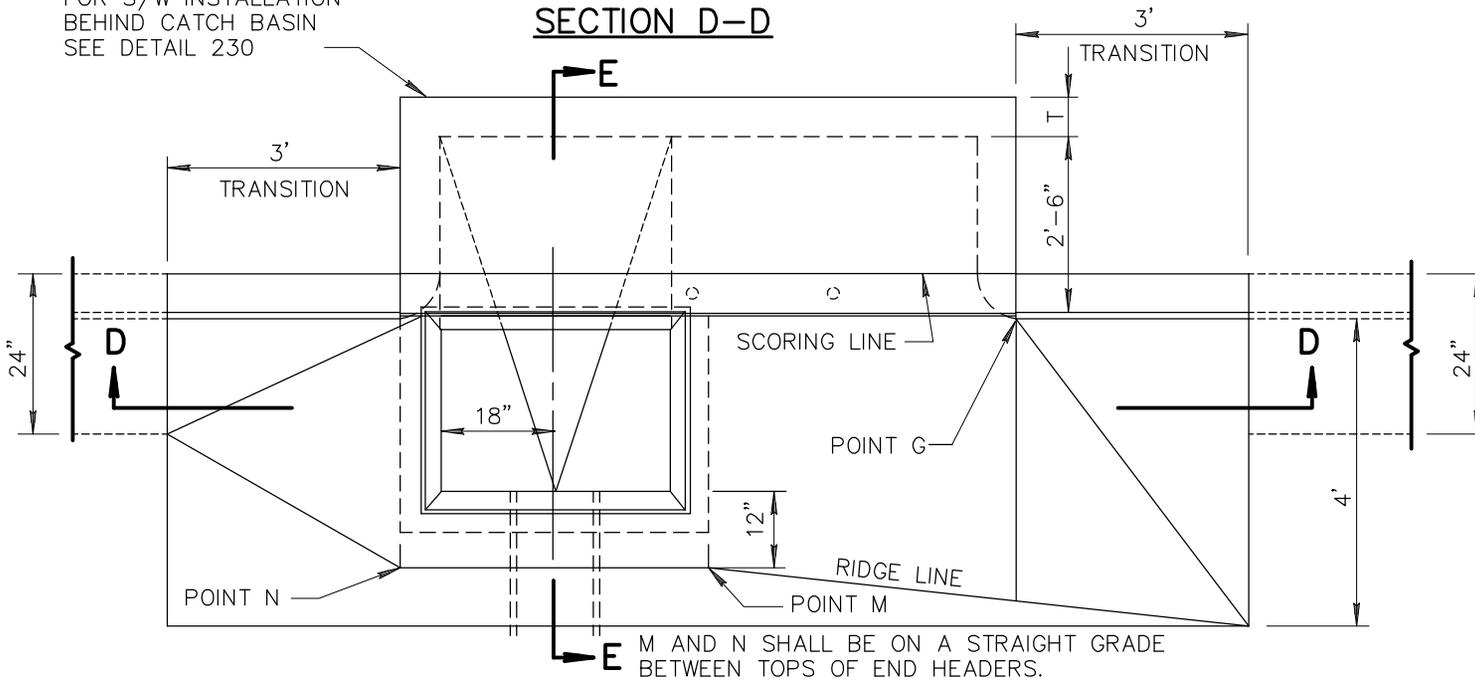
533-1



FOR S/W INSTALLATION  
BEHIND CATCH BASIN  
SEE DETAIL 230

**SECTION D-D**

**SECTION E-E**



**PLAN VIEW**

**APRON NOTES:**

9. APRON IS CONSTRUCTED ONLY WHEN SPECIFIED ON PLANS.
10. CONCRETE IN APRON SHALL BE NOT LESS THAN 8" THICK.
11. CURB FACES AT CATCH BASIN OPENING AND POINT G SHALL BE THAT OF THE EXISTING CURB FACE PLUS 2' OR AS OTHERWISE SHOWN.
12. ELEVATION AT THE OUTER CORNERS OF THE LOCAL DEPRESSION SHOWN ON THE PLANS ARE FOR THE FINISHED SURFACE.
13. SEE DETAIL 533-1 FOR ADDITIONAL DIMENSIONS, REBAR PLACEMENT AND OTHER INFORMATION TO CONSTRUCT CATCH BASIN.

DETAIL NO.  
**533-2**



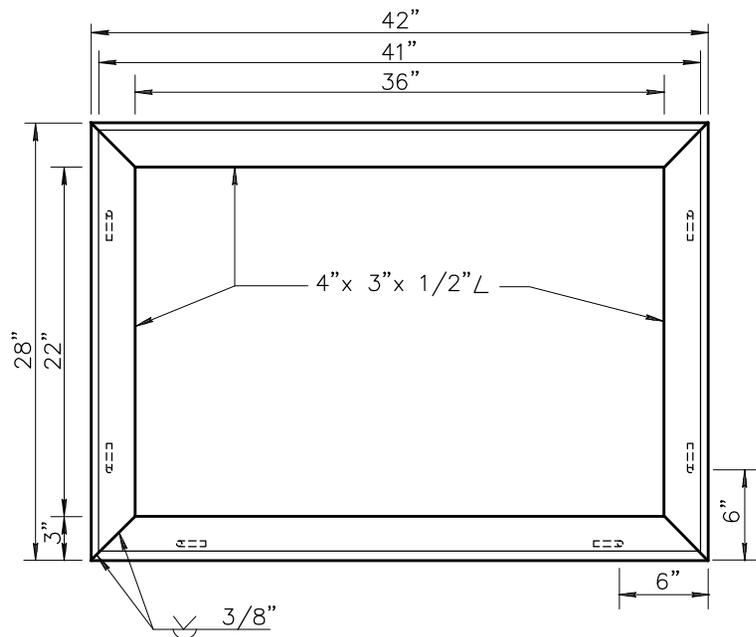
STANDARD DETAIL  
ENGLISH

**APRON FOR TYPE 'D' CATCH BASIN**

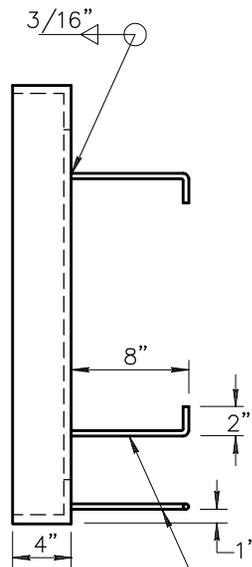
REVISED  
01-01-1999

DETAIL NO.  
**533-2**

M AND N SHALL BE ON A STRAIGHT GRADE  
BETWEEN TOPS OF END HEADERS.

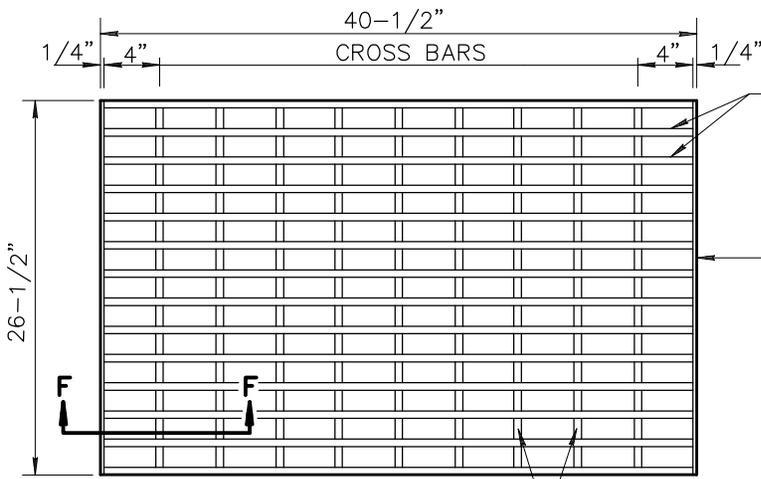


**FRAME DETAIL**



ANCHORS - TOTAL 6  
SEE NOTE NO. 17

- FRAME AND GRATE NOTES**
14. FRAME AND GRATING SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
  15. ALL WELDING SHALL BE IN ACCORDANCE WITH STANDARD WELDING SPECIFICATIONS.
  16. CROSS BARS AND END BARS MAY BE FILLET WELDED, RESISTANCE WELDED OR ELECTOR FORGED TO BEARING BARS.
  17. ANCHORS SHALL BE 3/8" DIA. STEEL ROD, NO. 3 REBAR, 3/8" DIA. x 8" BOLTS OR 8" NELSON STUDS.
  18. ALL PARTS SHALL BE OF STRUCTURAL GRADE STEEL.
  19. ALL EXPOSED STEEL SHALL BE GALVANIZED OR PAINTED WITH ONE COAT #1 PAINT AND TWO FIELD COATS OF #10 PAINT.

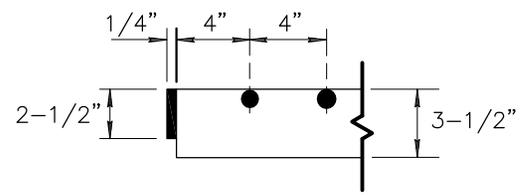


**GRATE DETAIL**

BEARING BARS:  
3-1/2" x 1/2" x 40"  
2" C. TO C., 14 EACH

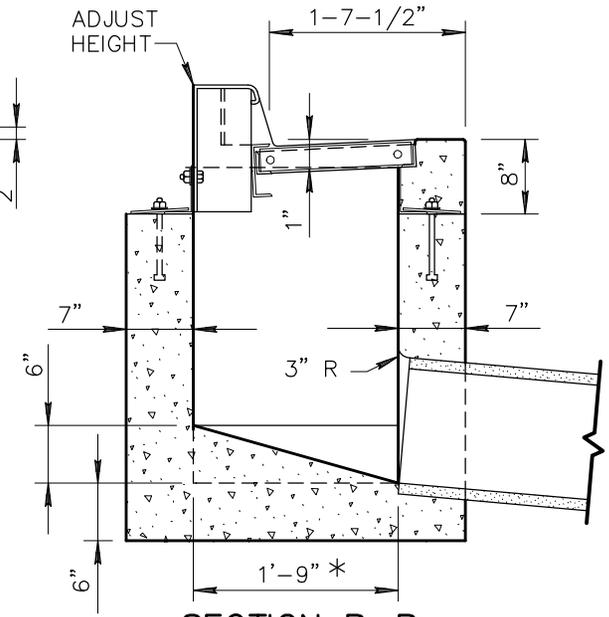
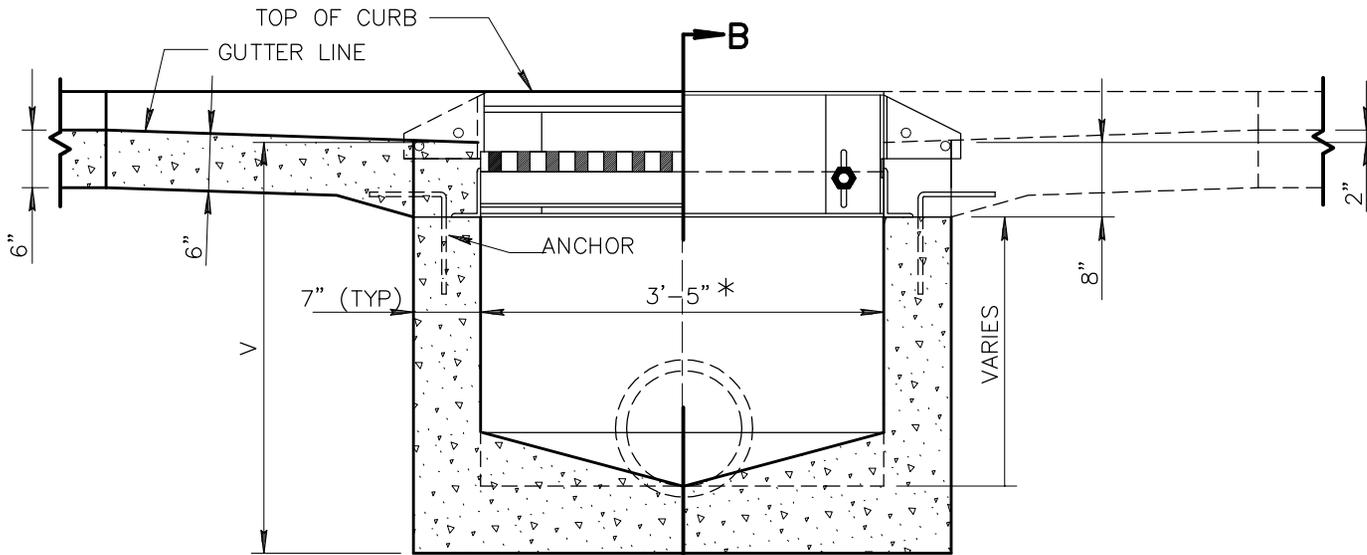
END BARS:  
2-1/2" x 1/4" x 26-1/2"  
2 EACH

CROSS BARS:  
1/2" DIA. x 26-1/2" ROD  
4" C. TO C., 9 EACH



**SECTION F-F**



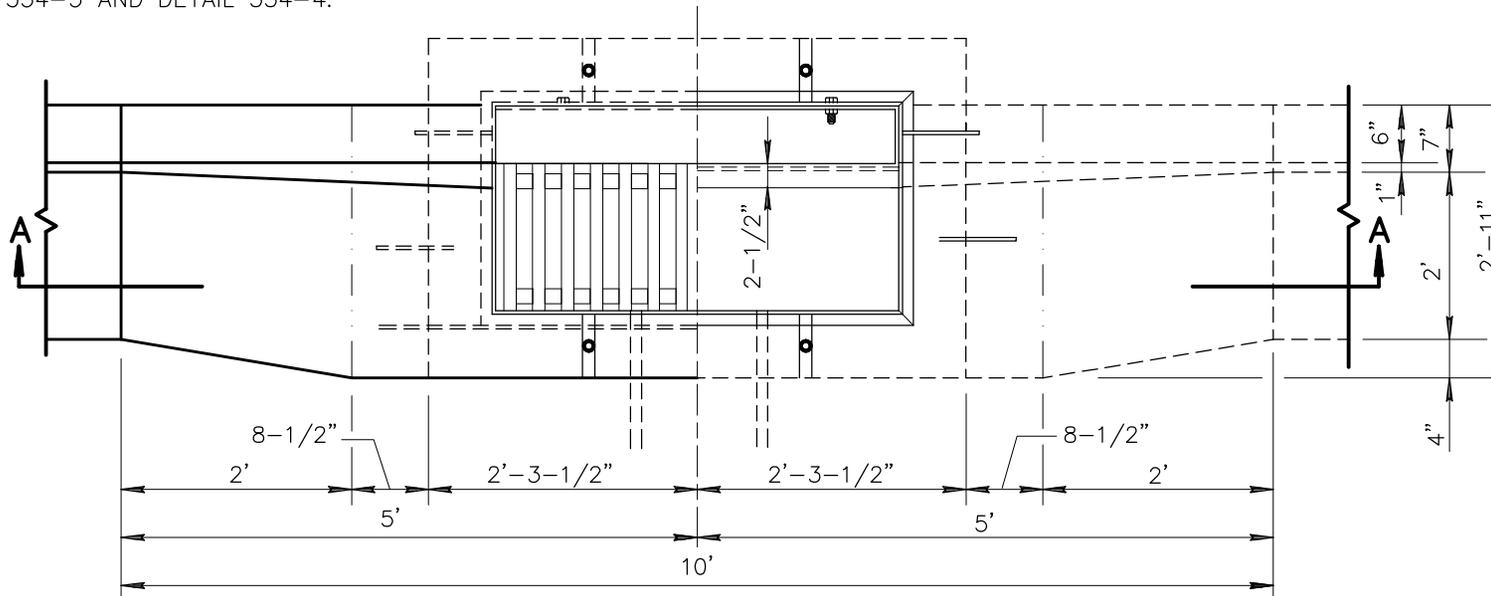


**DIMENSION**

V=3'-0" UNLESS OTHERWISE SPECIFIED.  
 \* DIMENSIONAL CHANGE WITH DETAIL  
 534-3 AND DETAIL 534-4.

**SECTION A-A**

**SECTION B-B**

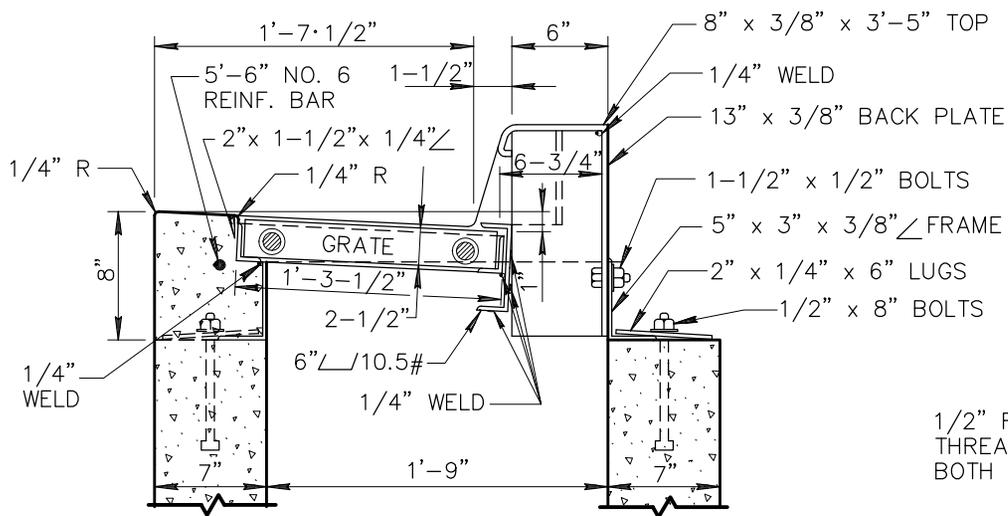


**HALF PLAN GUTTER & GRATE**

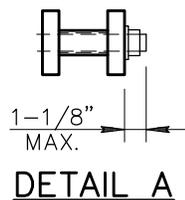
**HALF PLAN FRAME & ANCHORS**

**NOTES:**

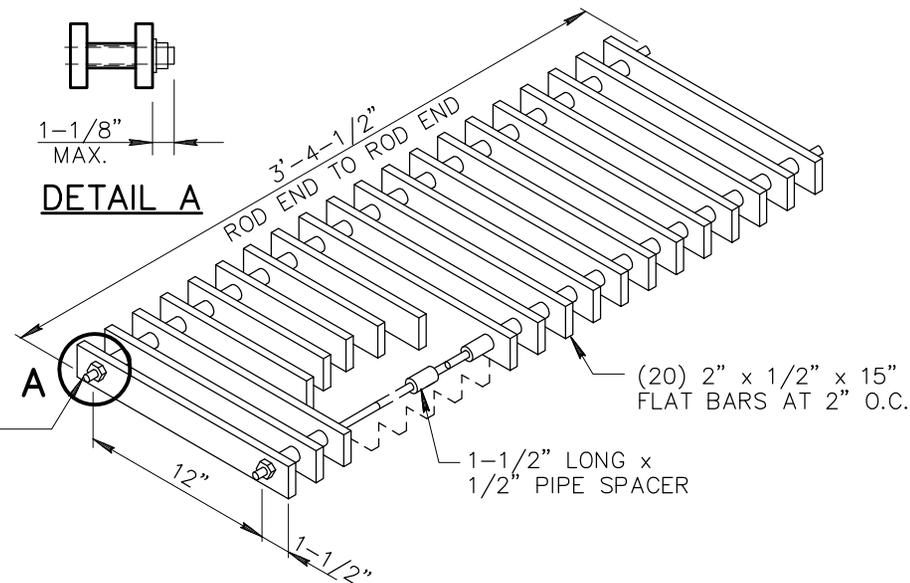
1. ADJUSTABLE CURB, FRAME AND GRATING UNITS SHALL BE STRUCTURAL STEEL OR CAST IRON
2. PIPES MAY ENTER OR LEAVE ANY WALL. BOTTOM OF BOX TO BE SLOPED TO OUTLET PIPE FROM ALL DIRECTIONS AND TROWELLED TO A HARD SMOOTH SURFACE.
3. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
4. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS Poured.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. ALL CONCRETE, CLASS 'A' AS PER SECTION 725.



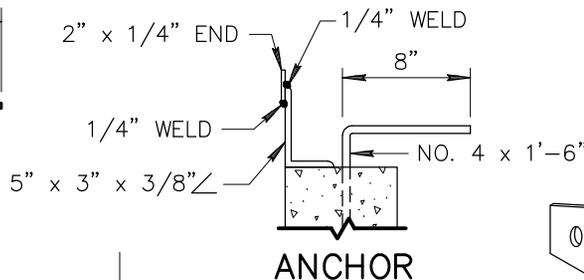
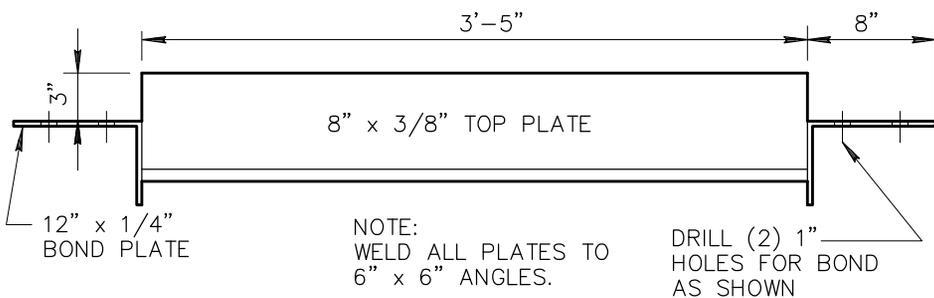
**CROSS SECTION**



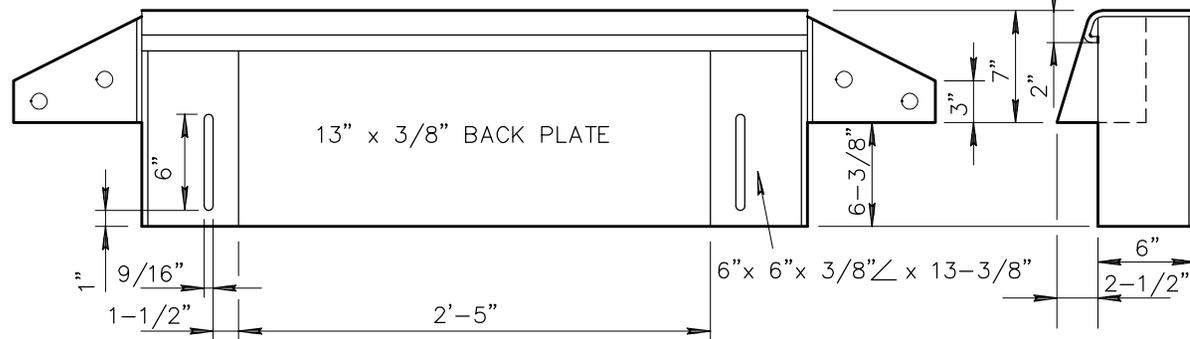
**DETAIL A**



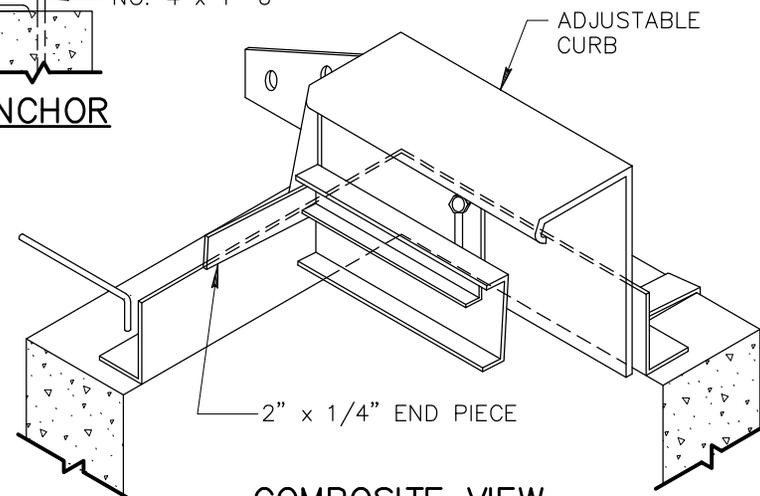
**GRATE**



**ANCHOR**



**ADJUSTABLE CURB**



**COMPOSITE VIEW**

DETAIL NO.

**534-2**



STANDARD DETAIL  
ENGLISH

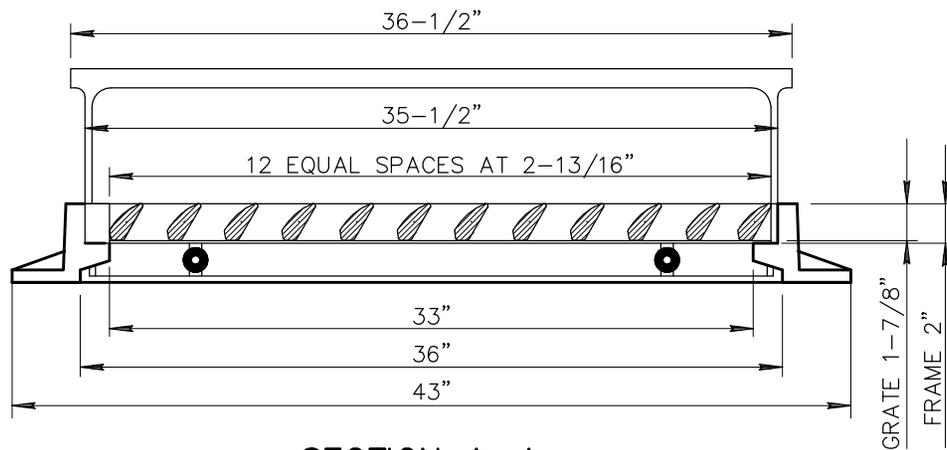
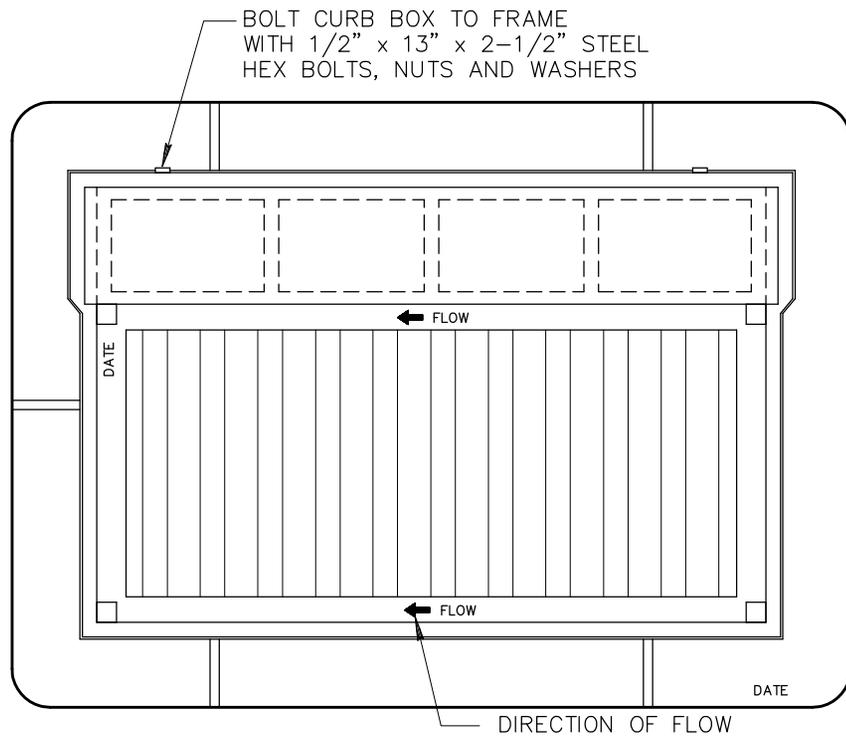
**CATCH BASIN TYPE 'E' (DETAILS)**

REVISED

01-01-1998

DETAIL NO.

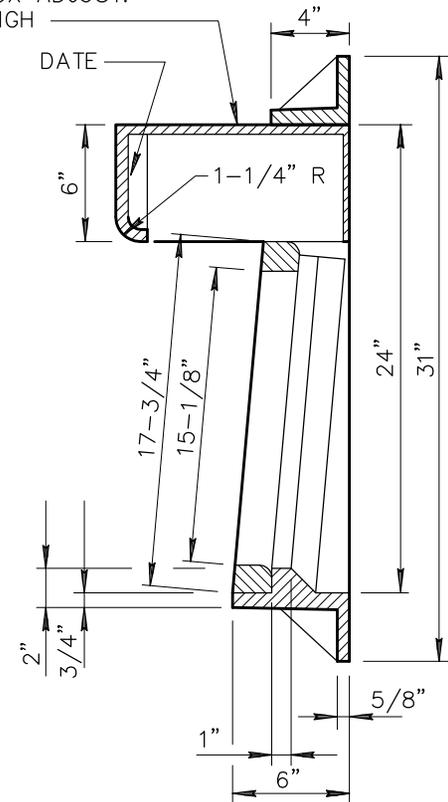
**534-2**



**SECTION A-A**

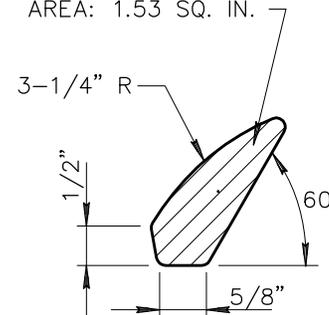
**CAST IRON FRAME - GRATE - CURB BOX**

CURB BOX ADJUST.  
TO 9" HIGH



**SECTION B-B**

CROSS-SECTIONAL  
AREA: 1.53 SQ. IN.

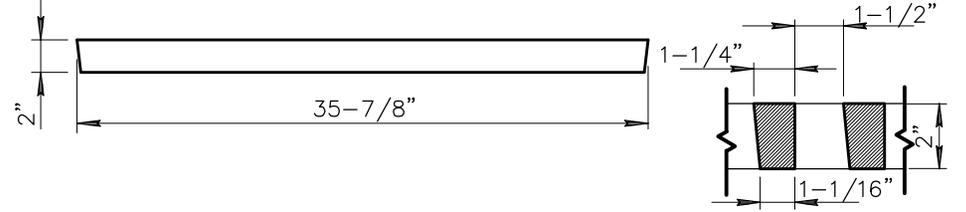
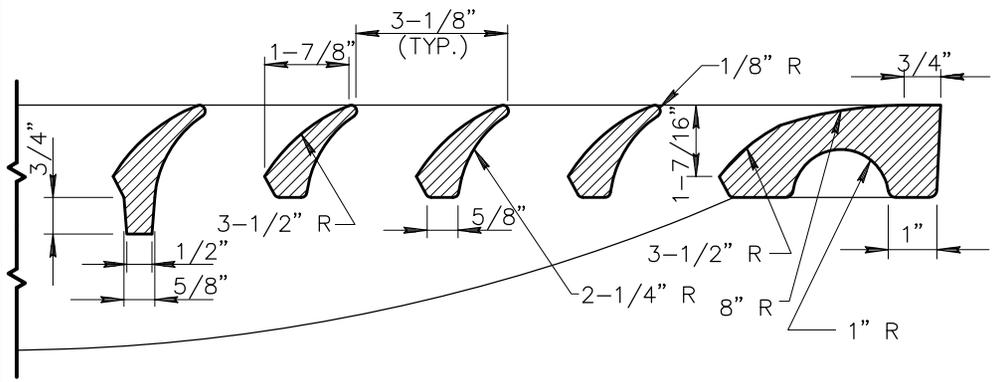
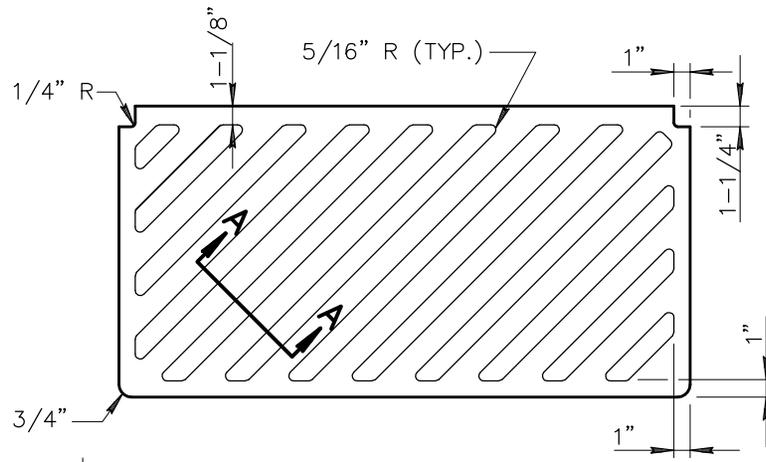
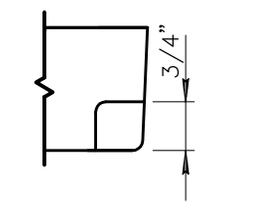
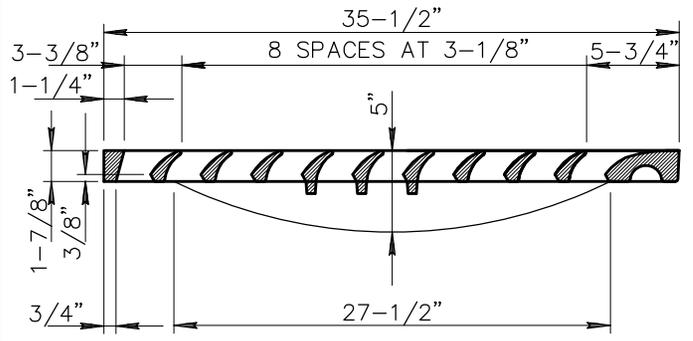
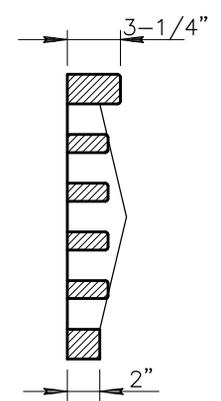
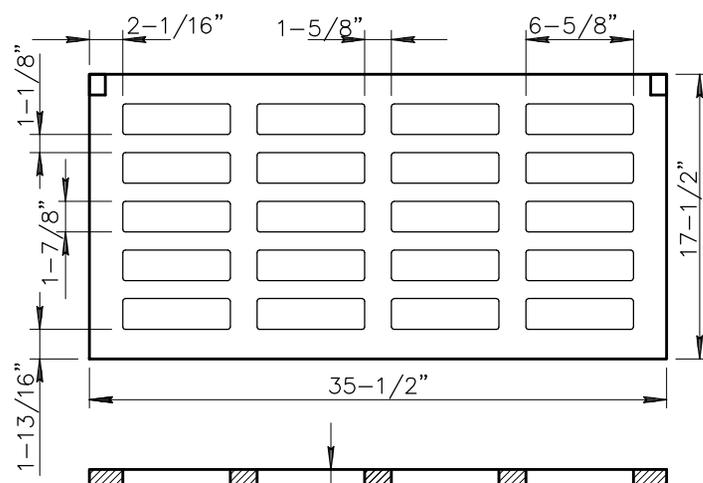
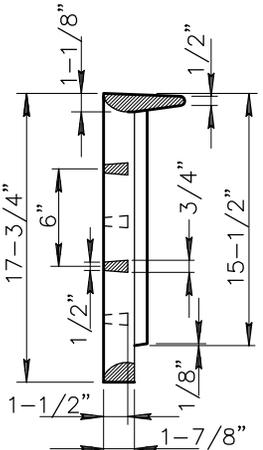
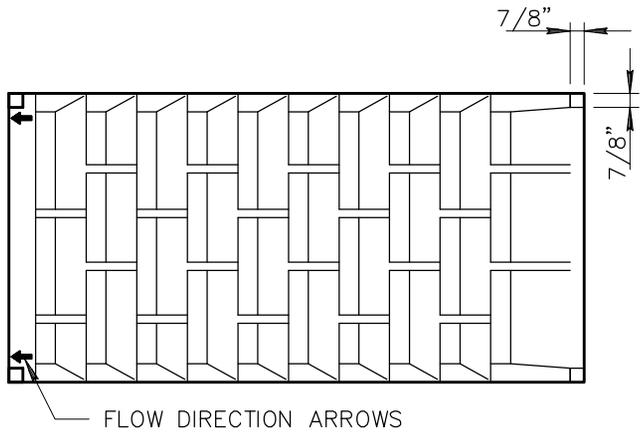


**VANE DETAIL**

**NOTE:**

DIMENSIONAL CHANGE REQUIRED FROM 3'-5"  
WIDTH TO 3'-0" AND 1'-9" DEPTH TO 2'-0"  
MATERIAL CAST GRAY IRON ASTM A-48-83 CLASS 35B.  
FRAME WEIGHT 209 LBS; GRATE 140 LBS; CURB BOX 92 LBS.





DETAIL NO.  
**534-5**

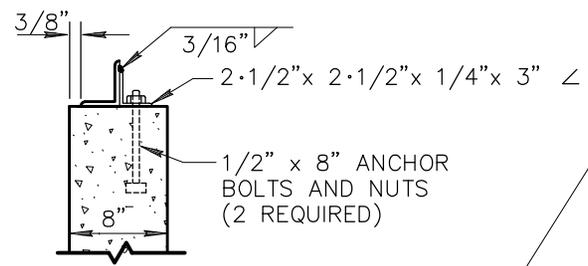
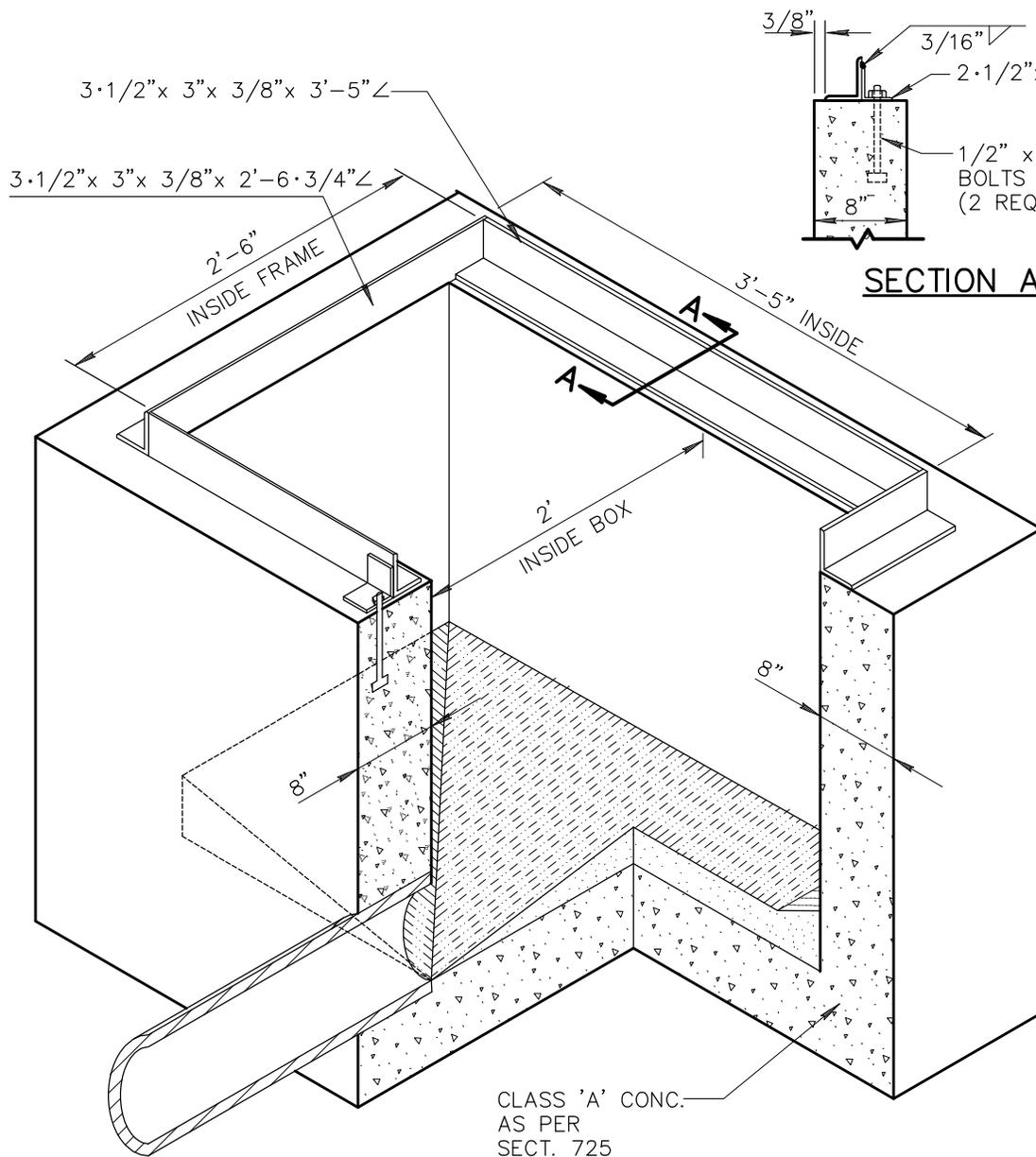


STANDARD DETAIL  
ENGLISH

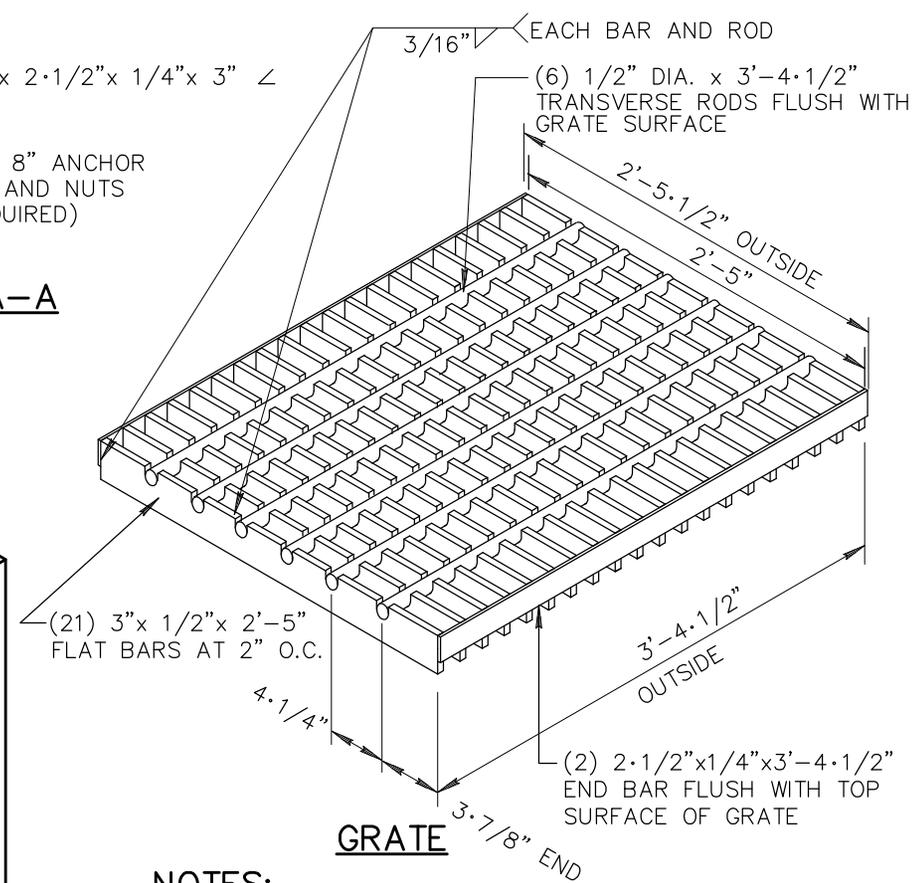
**ALTERNATE GRATE STYLES  
SUMP LOCATION**

REVISED  
01-01-1998

DETAIL NO.  
**534-5**



**SECTION A-A**



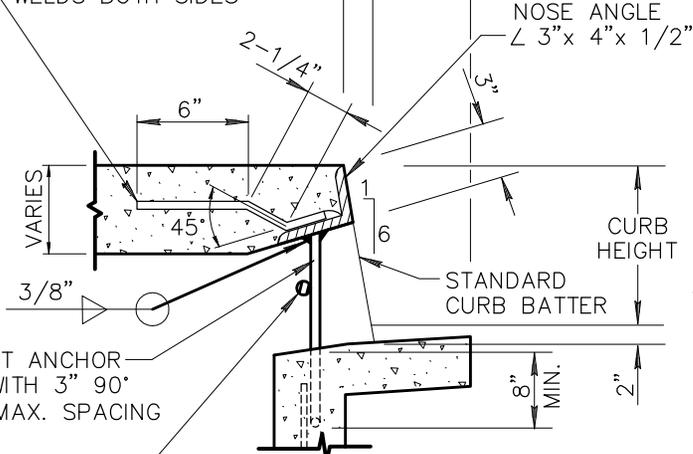
**GRATE**

**NOTES:**

1. PIPES MAY ENTER OR LEAVE ANY WALL. BOTTOM OF BOX TO BE SLOPED TO OUTLET PIPE FROM ALL DIRECTIONS AND TROWELLED TO A HARD SMOOTH SURFACE.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
5. ALL WELDS ON FRAME AND SIDE BARS ON GRATE SHALL BE FULL LENGTH OF JOINT.
6. TOTAL COMBINED CLEARANCE BETWEEN FRAME AND GRATE IS 1/2".

NOTE:  
SEE DETAIL 534-1 FOR THICKNESS AND SLOPE DIMENSIONS OF BOTTOM.

NO. 4 REINFORCEMENT BARS, 12" SPACING, WELDED TO NOSE ANGLE WITH 3/8" WELDS BOTH SIDES

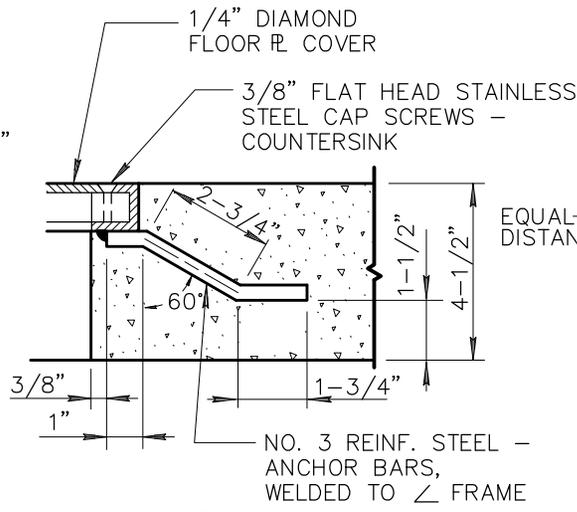


**SECTION C-C**

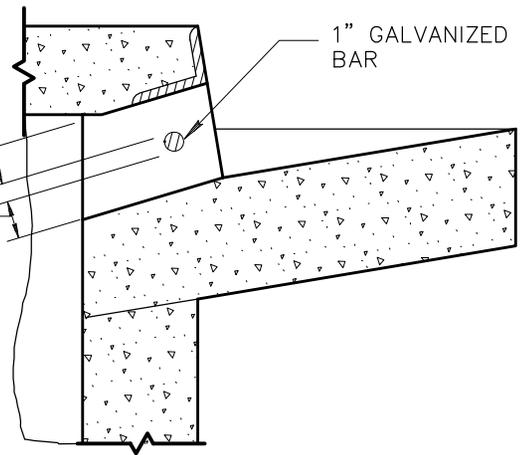
FOR DETAILS 531, 532 AND 533

CURB SUPPORT ANCHOR  
1" DIA. BAR WITH 3" 90°  
BEND, 3'-6" MAX. SPACING

PROTECTION BAR  
SEE THIS DETAIL



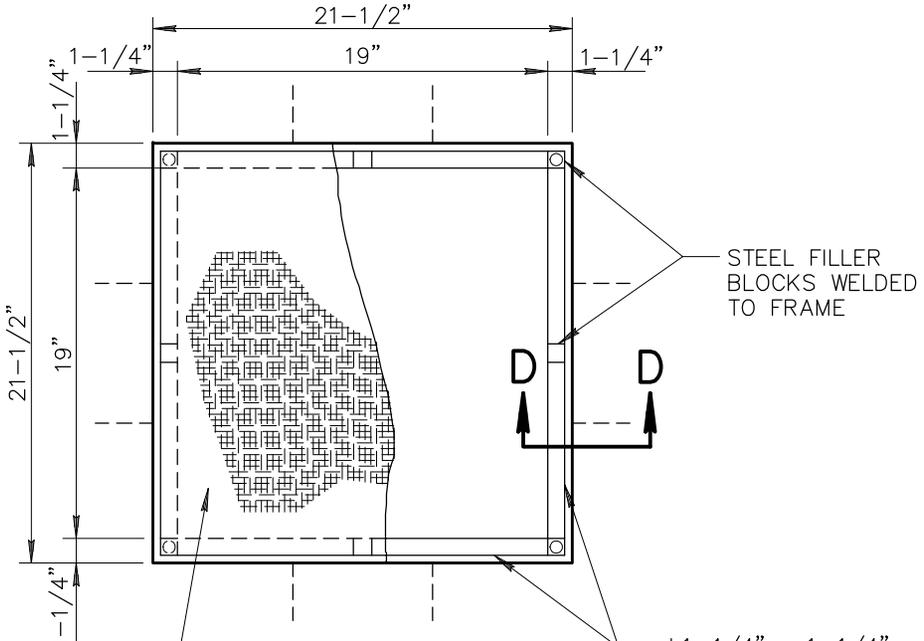
**SECTION D-D**



**PROTECTION BAR**

**NOTES:**

- 1) HORIZONTAL PLAIN ROUND GALVANIZED STEEL PROTECTION BAR SHALL BE USED WHEN CURB FACE IS 9" OR MORE.
- 2) THE BAR SHALL BE EMBEDDED 5" AT EACH END.

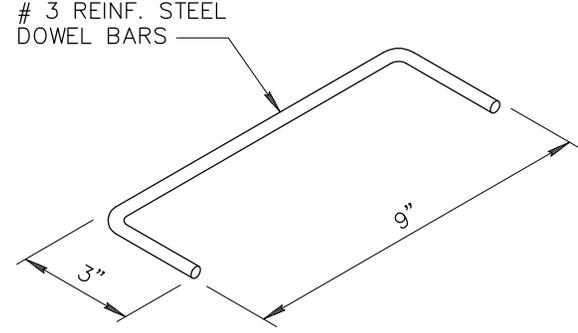


**PLAN VIEW**

STEEL FILLER  
BLOCKS WELDED  
TO FRAME

1/4" DIAMOND  
FLOOR R COVER

L1-1/4" x 1-1/4" x 1/4"  
IRON FRAME



**DOWEL BAR**

DETAIL NO.  
**536-1**

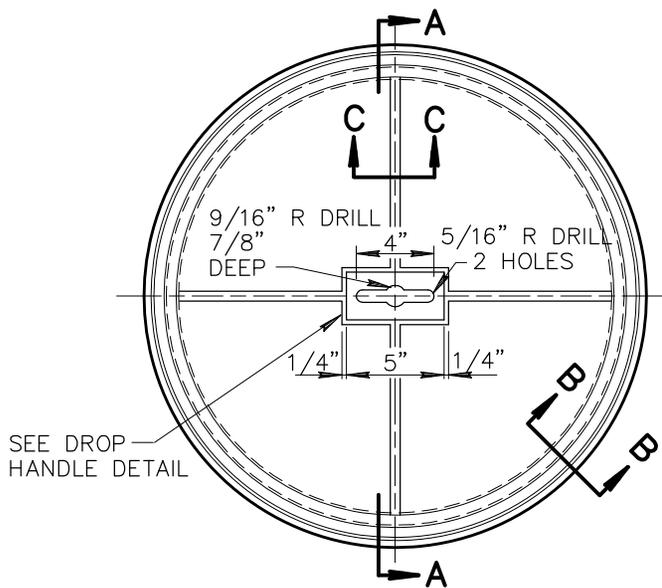


STANDARD DETAIL  
ENGLISH

**COMMON DETAILS AND SECTIONS  
FOR CURB OPENING CATCH BASINS**

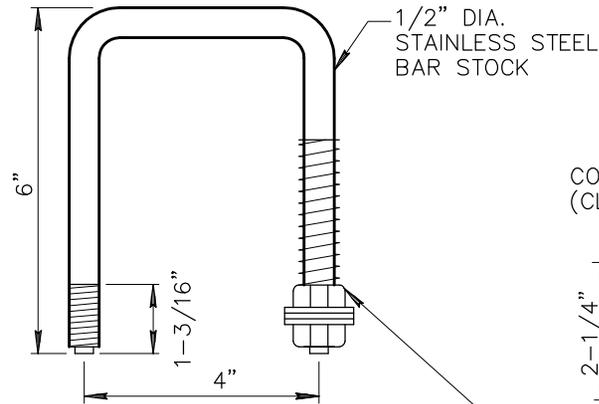
REVISED  
01-01-1999

DETAIL NO.  
**536-1**



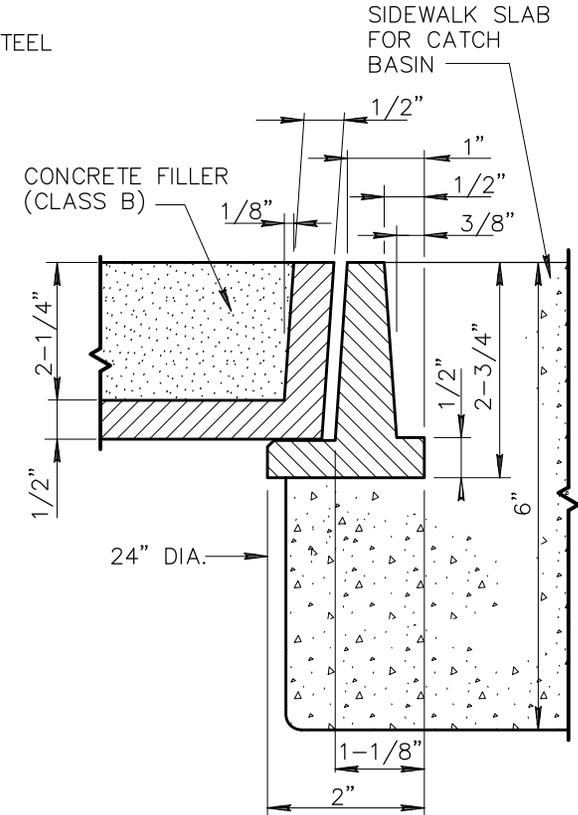
**PLAN VIEW**

SEE DROP HANDLE DETAIL

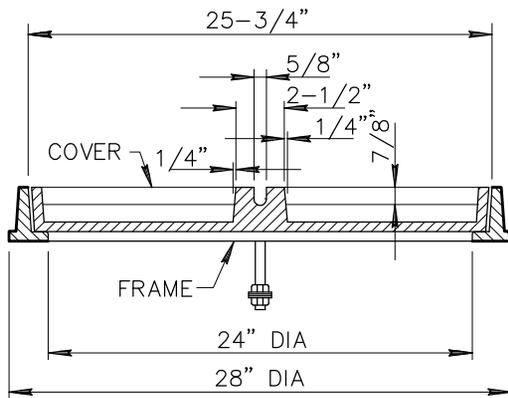


- FURNISH FOR EACH SIDE OF HANDLE
- 1 EACH 304-S.STL. SPRING  
2-1/2" x 17/32" I.C. x 3/32"
  - 2 EACH 1/2" HEX NUT
  - 3 EACH 1/2" FLAT WASHER
  - 1 EACH 1/2" LOCK WASHER

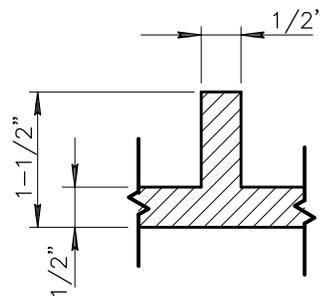
**DROP HANDLE**



**SECTION B-B**



**SECTION A-A**



**SECTION C-C**

**NOTES:**

1. FRAME SHALL BE NON-LOCKING.
2. FRAME AND COVER SHALL BE CAST IRON OR ASTM A-36 STRL. HORIZONTAL SURFACE OF COVER IN CONTACT WITH FRAME SHALL BE MACHINED. ASA B-46 ROUGHNESS SHALL NOT EXCEED 1/32".
3. COVER SHALL BE FILLED WITH CONCRETE AND BROOM FINISHED.
4. SMALL VARIATIONS IN DIMENSIONS OF FEATURES OF A MINOR NATURE THAT ARE PART OF THE FOUNDRY'S CASTING ARE PERMISSIBLE.

DETAIL NO.

**536-2**



STANDARD DETAIL  
ENGLISH

**ALTERNATE COVER FOR  
CURB OPENING CATCH BASINS**

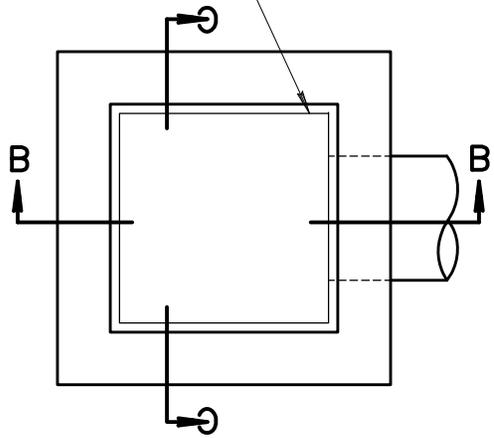
REVISED

01-01-1998

DETAIL NO.

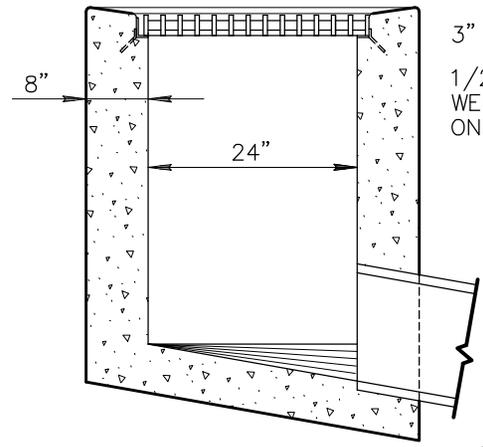
**536-2**

29" x 29" I.D.  
GRATE FRAME

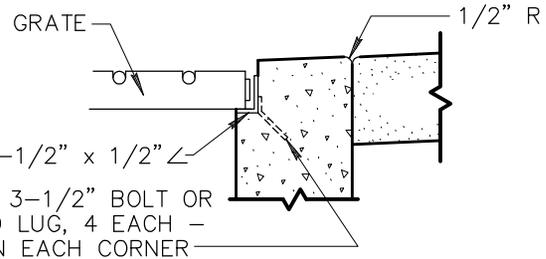


PLAN

SINGLE GRATE

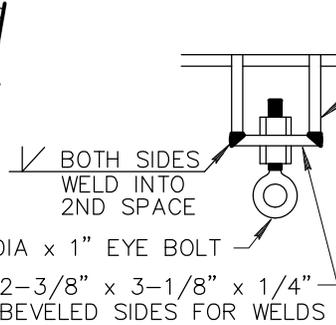


SECTION B-B

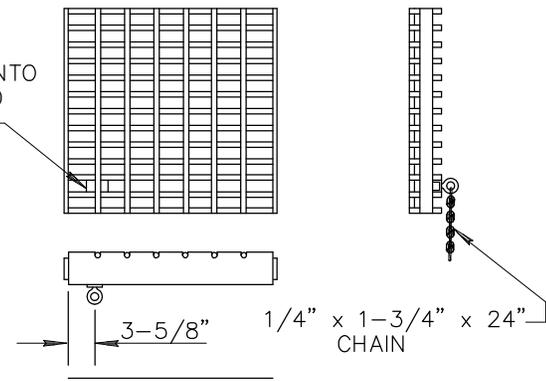


DETAIL OF ANGLE FRAME  
GRATE SUPPORT

ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725. EXPOSED EDGES SHALL BE FINISHED WITH A 1/2" RADIUS.

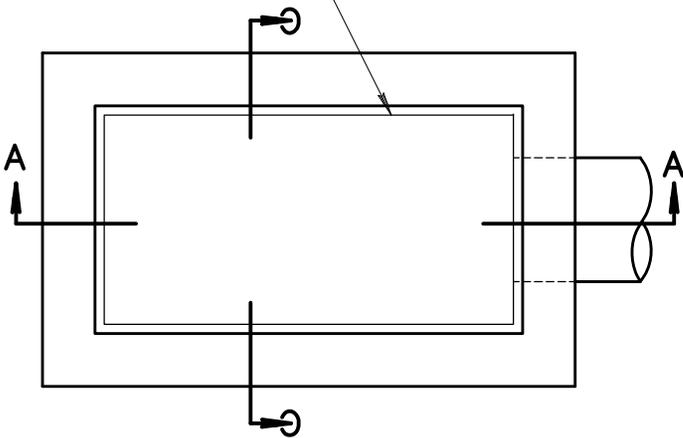


1/2" DIA x 1" EYE BOLT  
2-3/8" x 3-1/8" x 1/4"  
BEVELED SIDES FOR WELDS



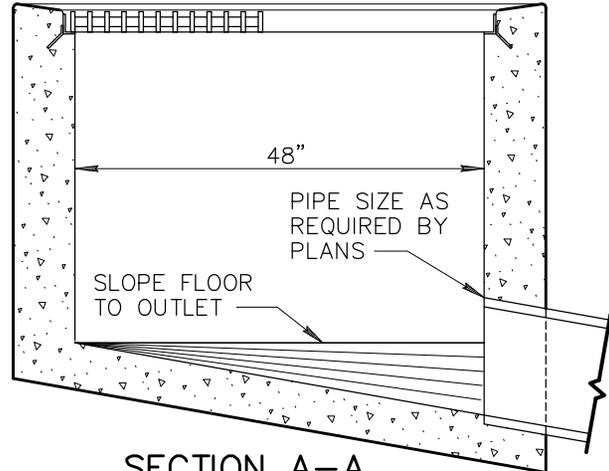
BAR GRATE  
SEE DETAIL 539

29" x 53" I.D.  
GRATE FRAME



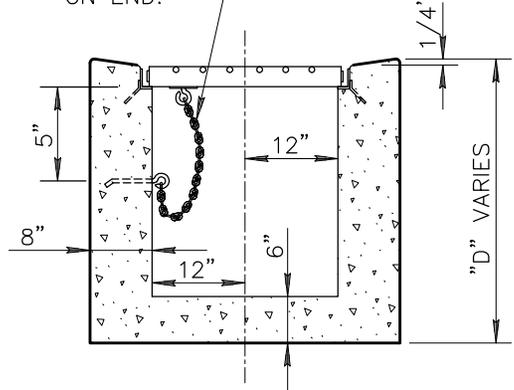
PLAN

DOUBLE GRATE



SECTION A-A

1/4" x 1-3/4" x 24" CHAIN TO 1" x 6" EYE BOLT IN WALL. BEND BOLT 1" ON END.



SECTION C-C

DETAIL NO.

537



STANDARD DETAIL  
ENGLISH

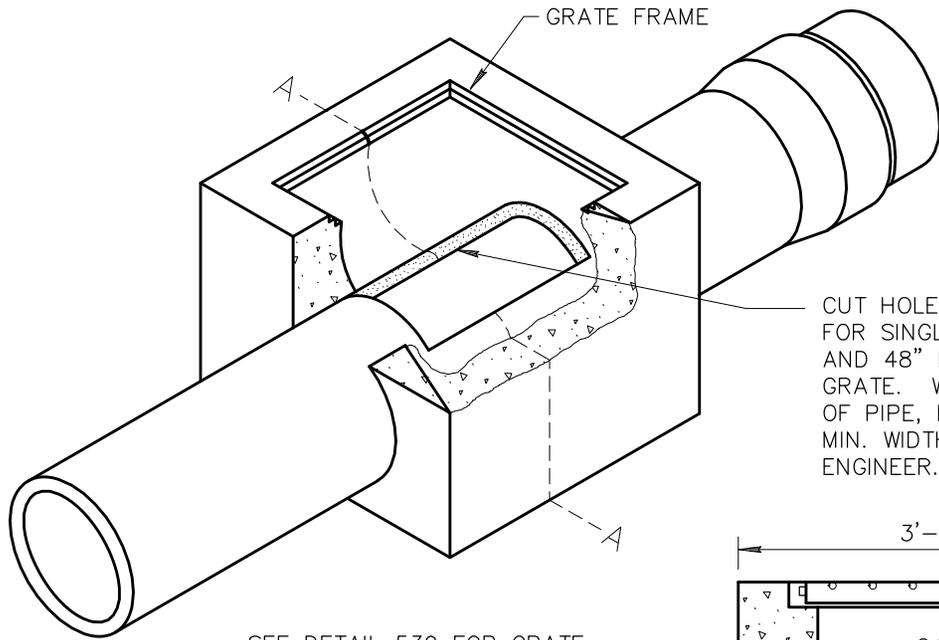
CATCH BASIN - TYPE 'G'

REVISED

01-03-2002

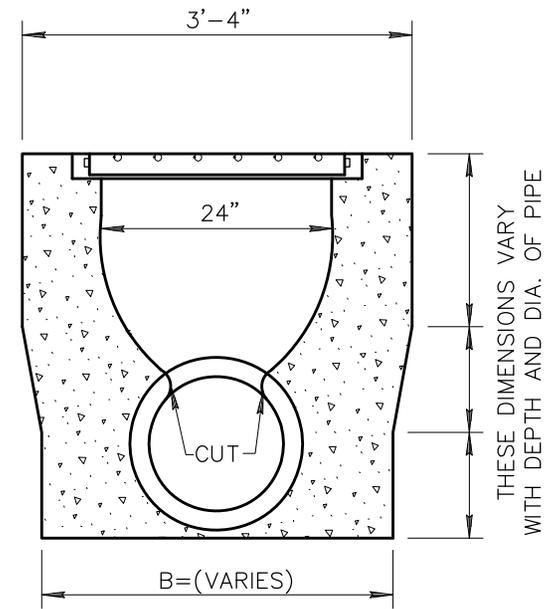
DETAIL NO.

537

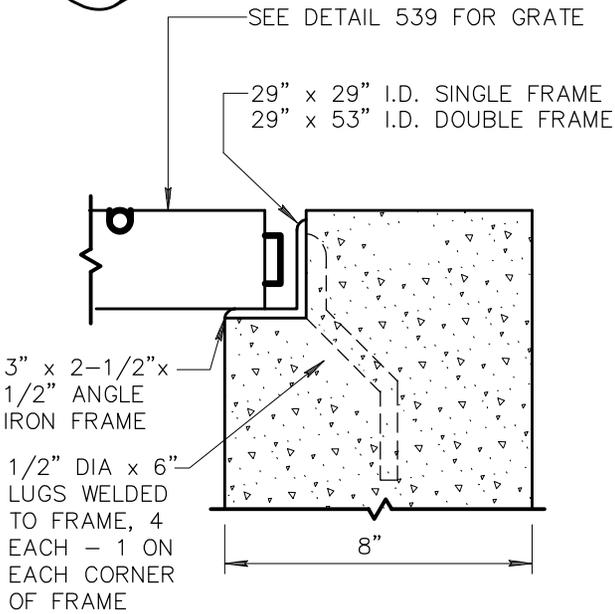


WHEN DOUBLE GRATE IS USED INCREASE THE LENGTH OF THE STRUCTURE ACCORDINGLY.

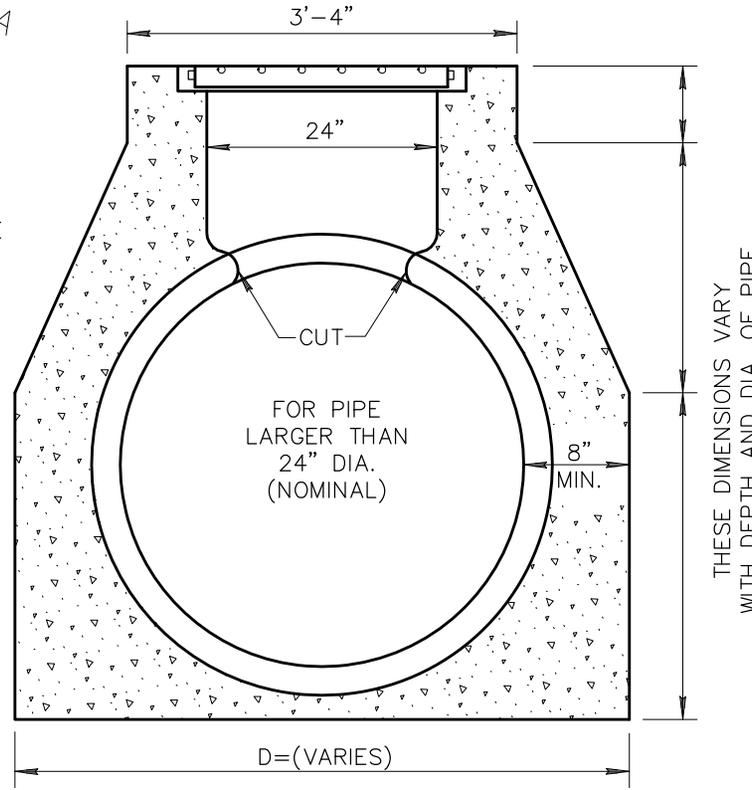
CUT HOLE IN PIPE 24" LONG FOR SINGLE GRATE STRUCTURES AND 48" LONG FOR DOUBLE GRATE. WIDTH DEPENDS ON DIA. OF PIPE, NOT TO EXCEED 22" MIN. WIDTH TO BE SET BY PROJECT ENGINEER.



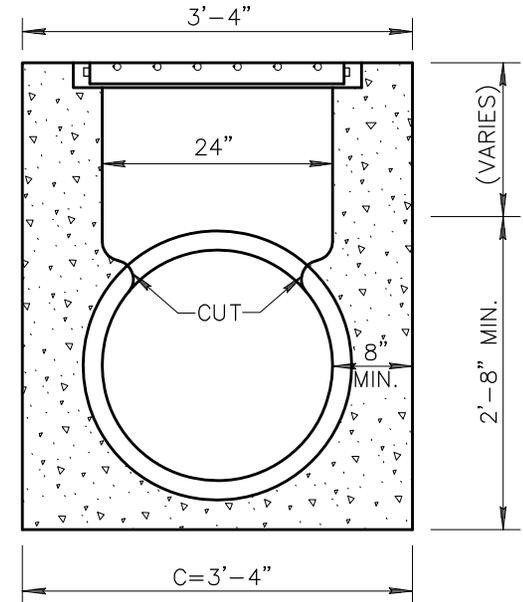
SECTION A-A



DETAIL OF ANGLE FRAME GRATE SUPPORT



SECTION A-A



SECTION A-A  
24" PIPE (NOMINAL)

DETAIL NO.

538



STANDARD DETAIL  
ENGLISH

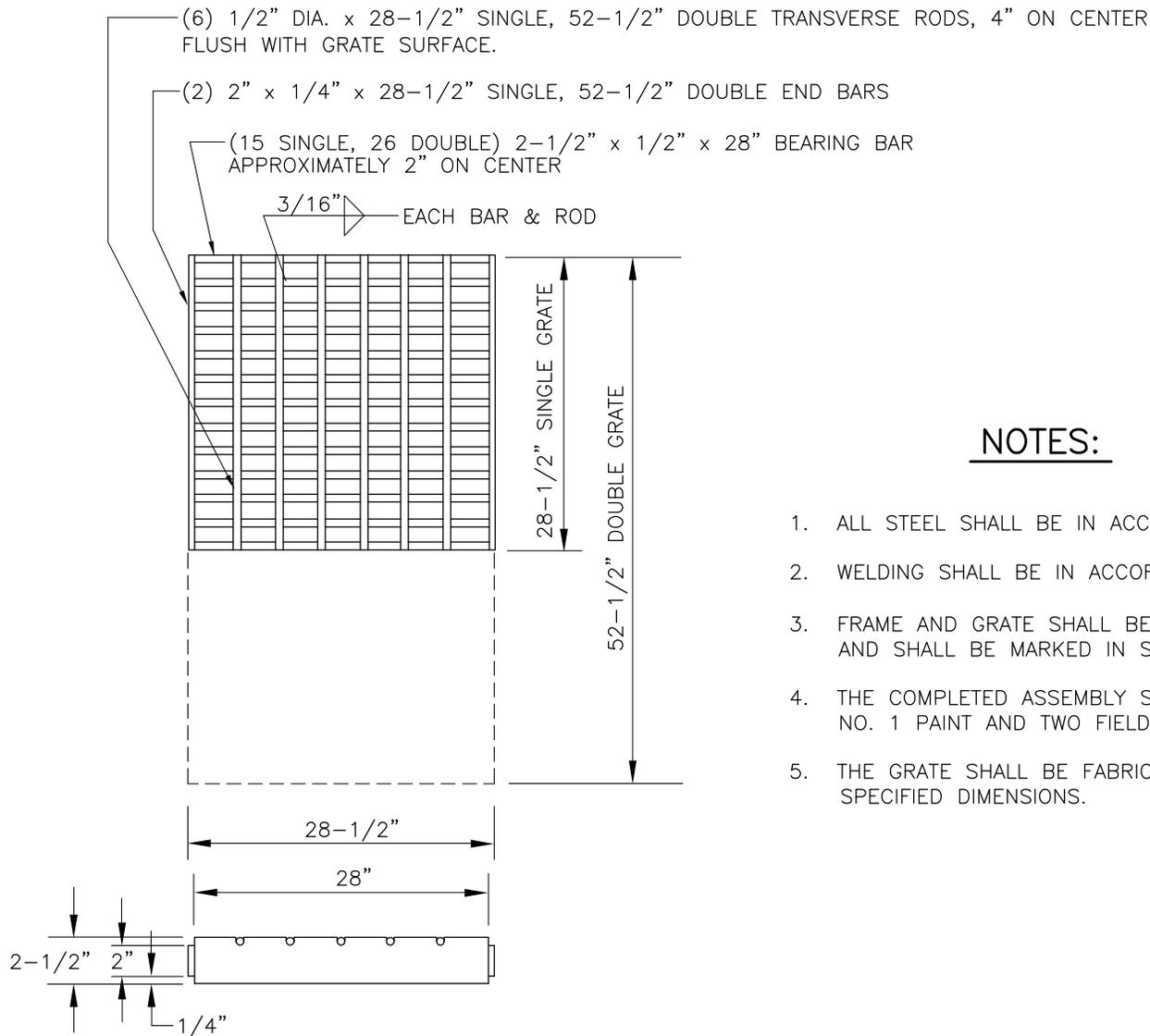
CATCH BASIN - TYPE 'H'

REVISIONS

01-01-1998

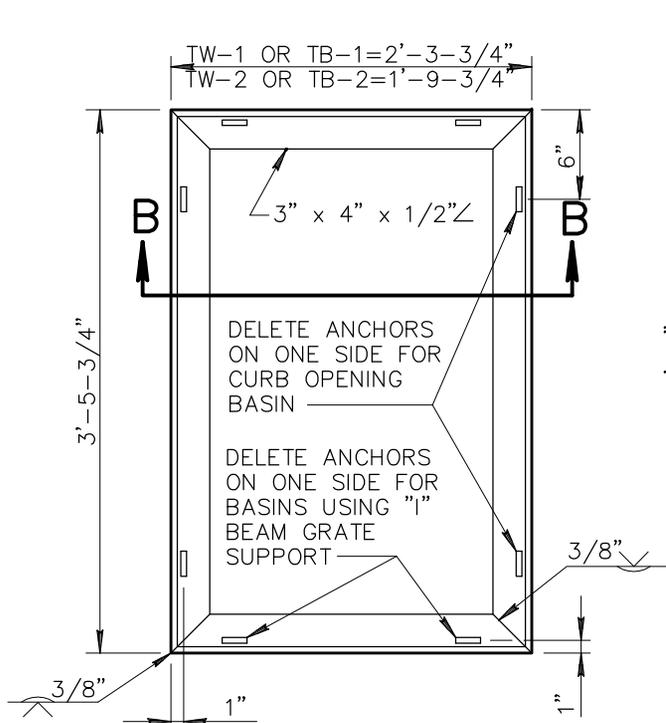
DETAIL NO.

538

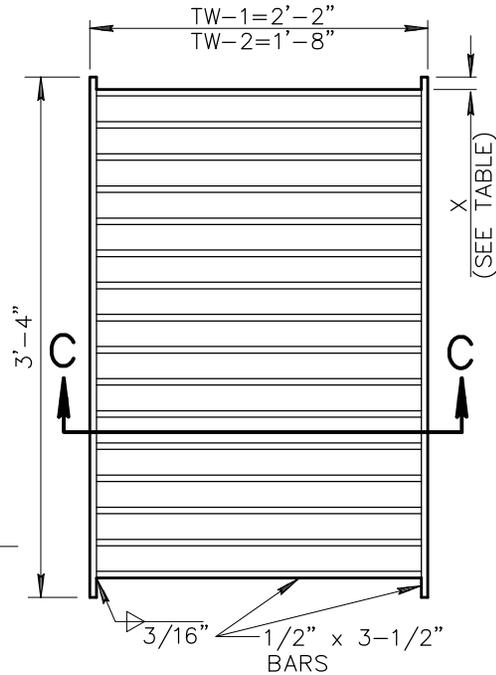


NOTES:

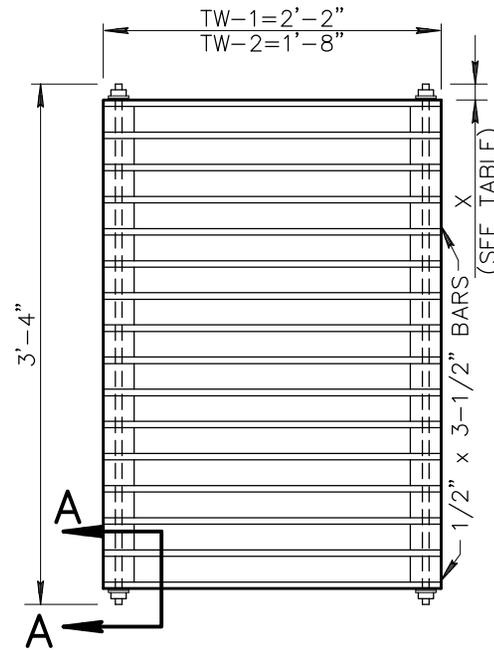
1. ALL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH A.W.S. SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE GRATE SHALL BE FABRICATED TO WITHIN 1/8" SPECIFIED DIMENSIONS.



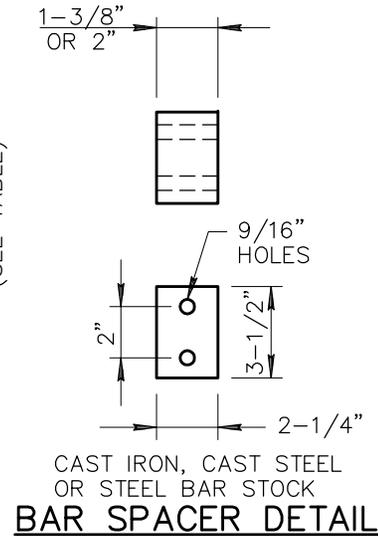
**PLAN I**



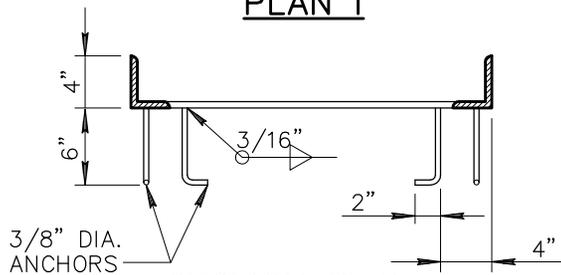
**PLAN IA**



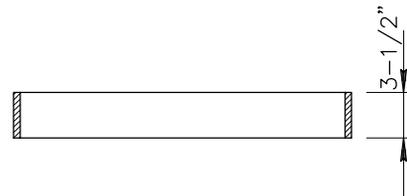
**PLAN IB**



**BAR SPACER DETAIL**

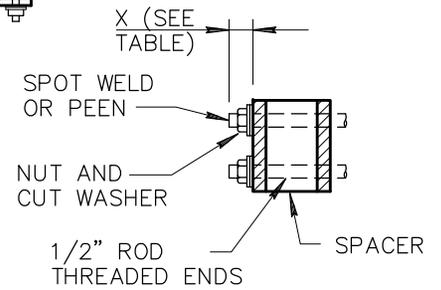


**SECTION B-B**



**SECTION C-C**

GRATE TYPES TW-1 AND TW-2



**SECTION A-A**

GRATE TYPES TB-1 AND TB-2

**NOTES:**

1. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED.
2. WELDING SHALL BE IN ACCORDANCE WITH STD. WELDING SPECS.
3. THE COMPLETED ASSEMBLY SHALL BE GIVEN TWO SHOP COATS OF NO. 1 PAINT AS PER SECT. 790.
4. FRAME AND GRATE SHALL FIT TO A MAX. ROCK OF 0.093" AT ANY POINT.
5. RESTRICT USE TO GRADES OF 3% OR LESS.

BAR TABLE				
TYPE	CLEAR SPACING	NO. BARS	X	GRATE OPENING ft <sup>2</sup>
TW OR TB-1.0	1"	26	1"	3.21
TW OR TB-1.1	1-3/8"	21	1"	3.32
TW OR TB-1.2	2"	16	1"	4.66
TW OR TB-2.0	1"	26	1"	2.32
TW OR TB-2.1	1-3/8"	21	1"	2.41
TW OR TB-2.2	2"	16	1"	2.65

TW INDICATES TRANSVERSE WELDED  
TB INDICATES TRANSVERSE BOLTED

DETAIL NO.

**540-1**



STANDARD DETAIL  
ENGLISH

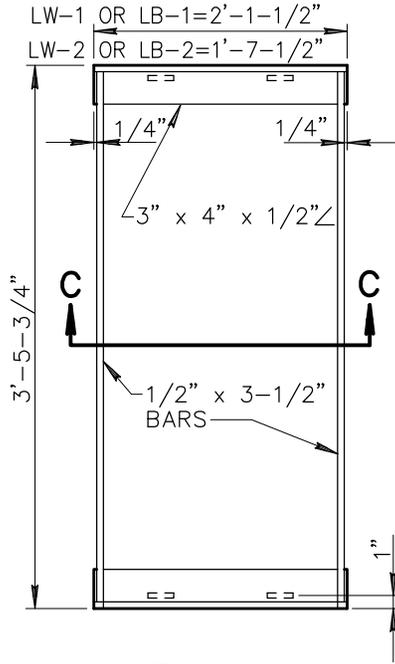
**CATCH BASIN GRATES**

REVISED

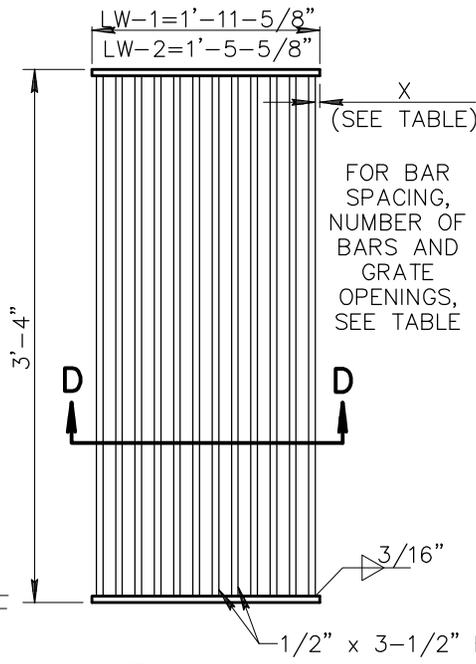
01-01-1998

DETAIL NO.

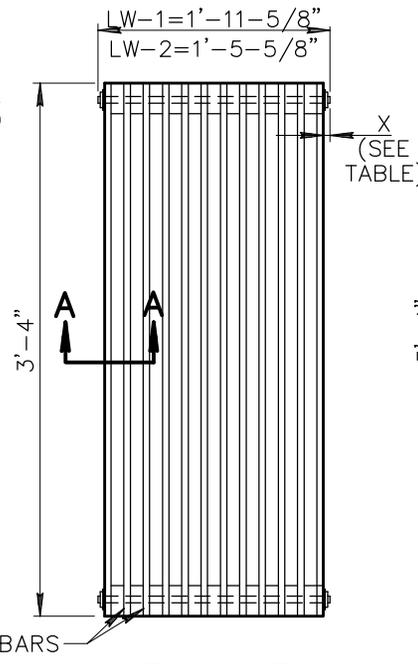
**540-1**



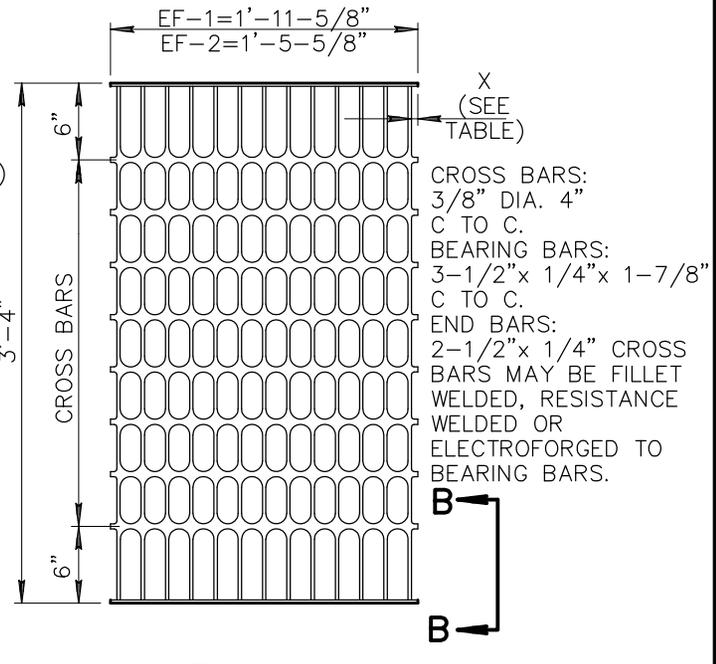
**PLAN II**



**PLAN IIA**

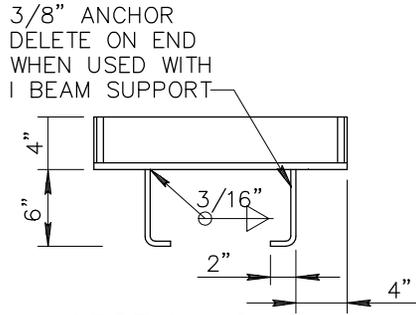


**PLAN IIB**

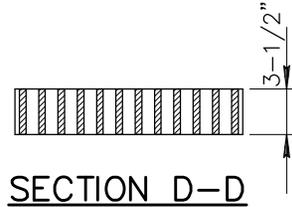


**PLAN II**

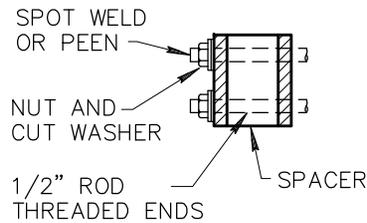
CROSS BARS:  
3/8" DIA. 4"  
C TO C.  
BEARING BARS:  
3-1/2" x 1/4" x 1-7/8"  
C TO C.  
END BARS:  
2-1/2" x 1/4" CROSS  
BARS MAY BE FILLET  
WELDED, RESISTANCE  
WELDED OR  
ELECTROFORGED TO  
BEARING BARS.



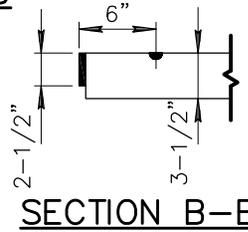
**SECTION C-C**



**SECTION D-D**



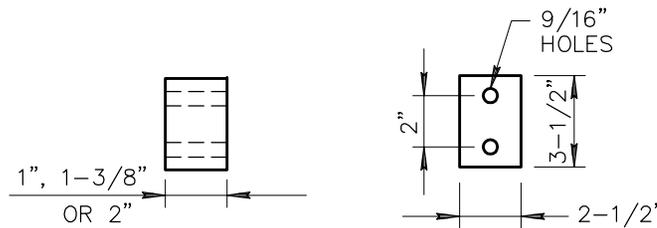
**SECTION A-A**



**SECTION B-B**

**NOTES:**

1. LW INDICATES LONGITUDINAL WELDED.
2. LB INDICATES LONGITUDINAL BOLTED.
3. EF INDICATES ELECTROFORGED.
4. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL 'A-36 EXCEPT AS NOTED.
5. ALL WELDING SHALL BE IN ACCORDANCE WITH STANDARD WELDING SPECIFICATIONS.
6. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT.
7. FRAMES AND GRATES SHALL FIT TO A MAXIMUM ROCK OF 0.093" AT ANY POINT.
8. GRATE TYPE LW AND EF RESTRICTED TO SLOPES OF 3% OR LESS
9. GRATES TYPE LB USE LONGITUDINAL GRADES IN EXCESS OF 3% OR AS AN ALTERNATE TO TYPES LW OR EF ON GRADES OF 3% OR LESS.



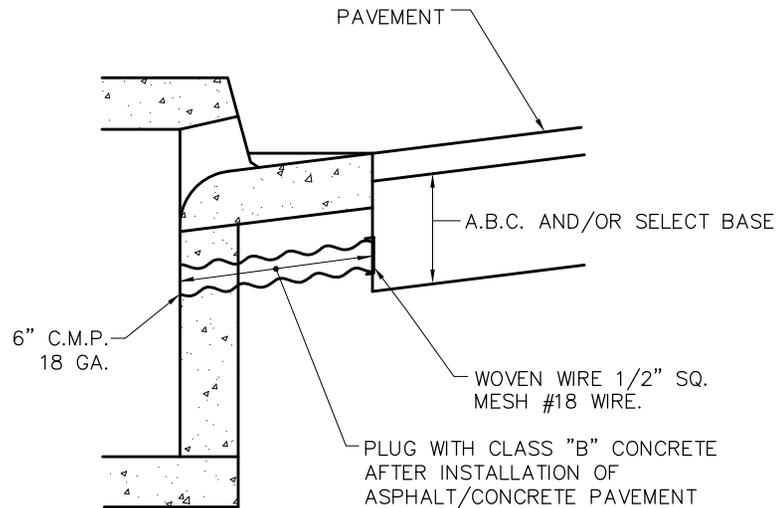
**BAR SPACER DETAIL**

CAST IRON, CAST STEEL  
OR STEEL BAR STOCK

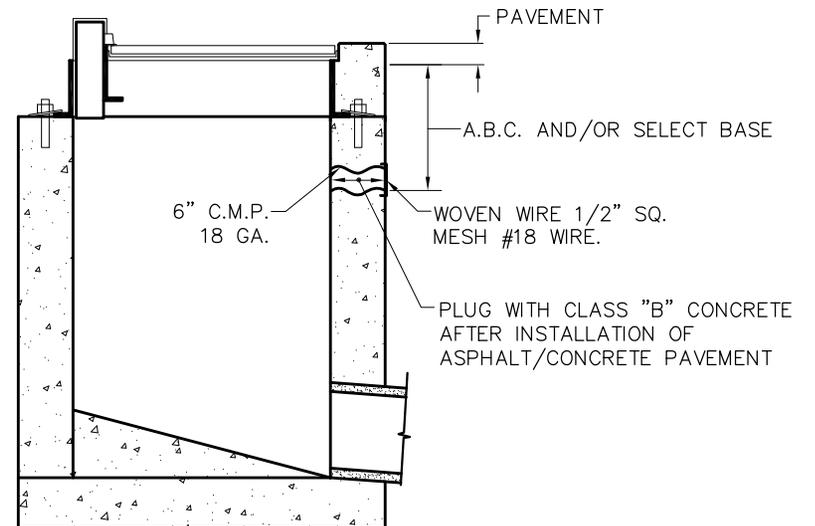
GRATE TYPE	CLEAR BAR SPACING	NO. BARS	X	GRATE OPENING ft <sup>2</sup>
LW OR LB-1.0	1"	16	5/16"	3.97
LW OR LB-1.1	1-3/8"	13	5/16"	4.34
LW OR LB-1.2	2"	9	1-9/16"	4.84
EF-1	1-5/8"	13	7/16"	4.66
LW OR LB-2.0	1"	12	5/16"	2.98
LW OR LB-2.1	1-3/8"	9	1-1/16"	3.35
LW OR LB-2.2	2"	7	1-1/16"	3.60
EF-2	1-5/16"	10	1/4"	3.48

**NOTES:**

1. INSTALL WHEN REQUIRED BY PLANS, SPECIFICATIONS, OR APPROVED BY THE ENGINEER.
2. SEE PROJECT PLANS FOR CATCH BASIN DETAILS AND PAVEMENT STRUCTURAL SECTION.



CURB OPENING INLET



GRATE OPENING INLET

DETAIL NO.

**541**



STANDARD DETAIL  
ENGLISH

**CATCH BASIN SUBGRADE DRAIN**

REVISED

01-01-2005

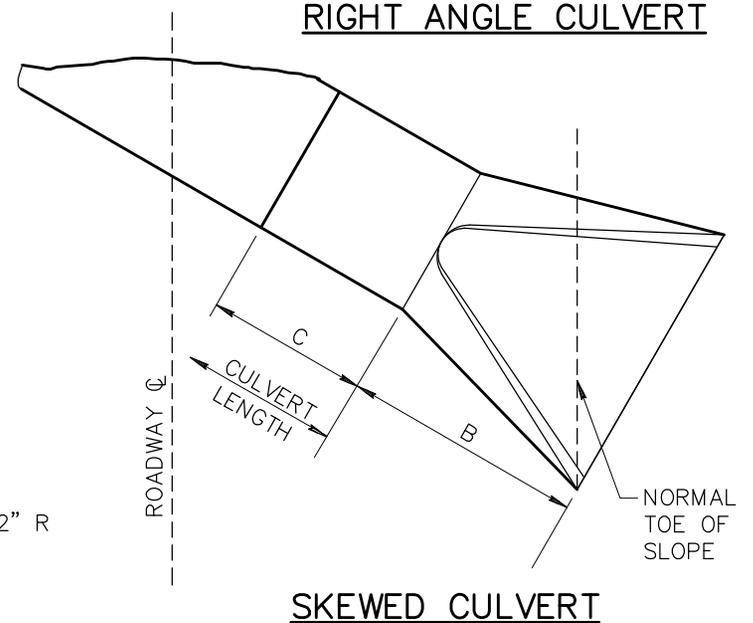
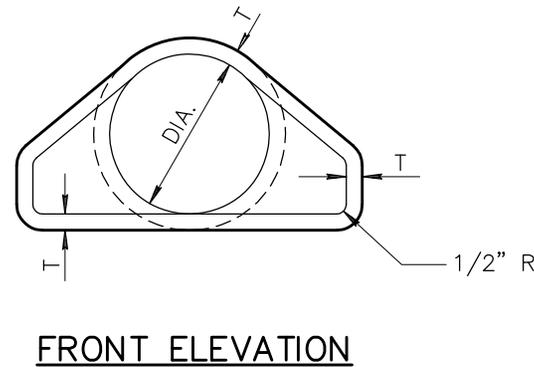
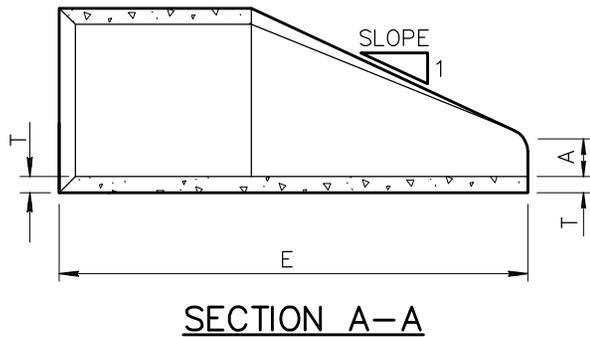
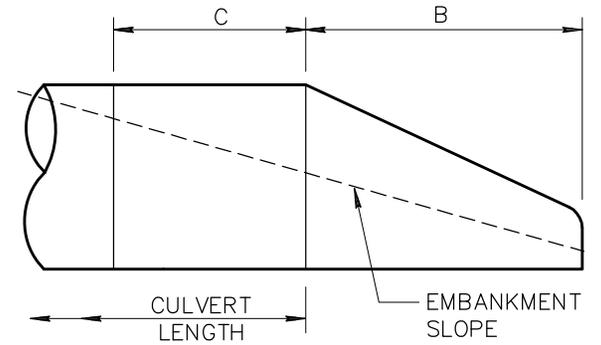
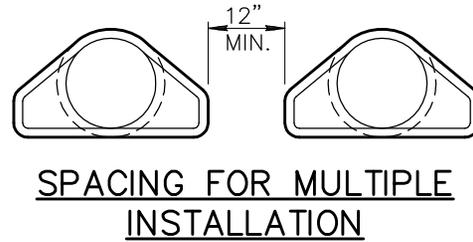
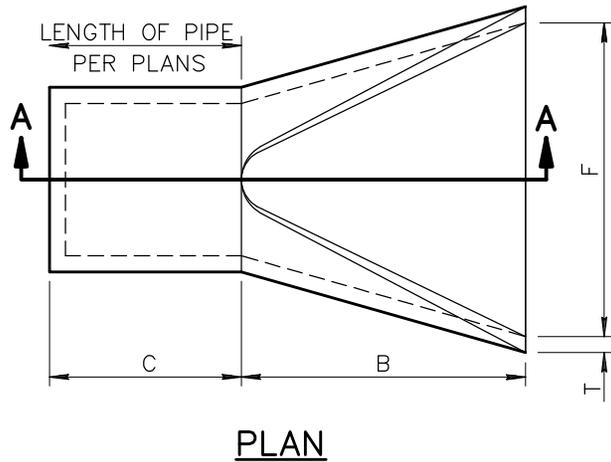
DETAIL NO.

**541**

PIPE DIA.	APPROX. WEIGHT (LBS.)	DIMENSIONS - INCHES						APPROX. SLOPE
		T	A	B	C	E	F	
24"	1520	3	9-1/2	43-1/2	30	73-1/2	48	3
27"	1930	3-1/4	10-1/2	49-1/2	24	73-1/2	54	3
30"	2190	3-1/2	12	54	19-3/4	73-3/4	60	3
36"	4100	4	15	63	34-3/4	97-3/4	72	3
42"	5380	4-1/2	21	63	35	98	78	3
48"	6550	5	24	72	26	98	84	3
54"	8240	5-1/2	27	65	33-1/4	98-1/4"	90	2 1/2

**NOTES**

1. DESIGN OF END SECTION SHALL CONFORM TO STANDARD FOR REINFORCED CONCRETE PIPE.
2. END SECTION JOINT CONFORMATION SHALL MATCH THE PIPE JOINTS.
3. EMBANKMENT SLOPE SHALL BE WARPED TO MATCH SLOPE OF END SECTION.
4. CULVERT LENGTH IS AS SHOWN ON PLANS.



DETAIL NO.

**545**



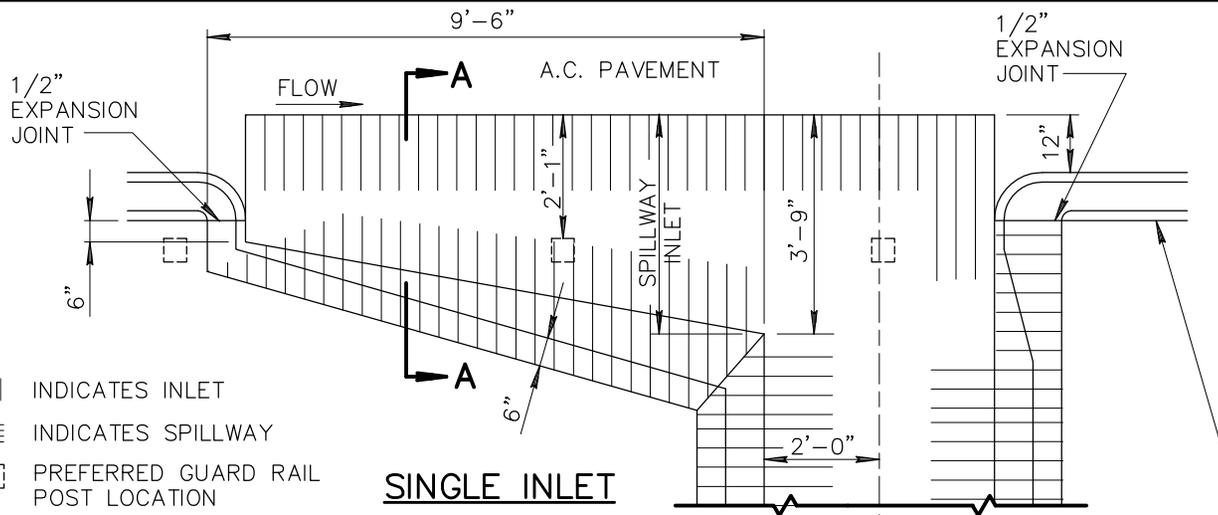
STANDARD DETAIL  
ENGLISH

**END SECTION-REINFORCED CONCRETE PIPE**

REVISED  
01-01-1998

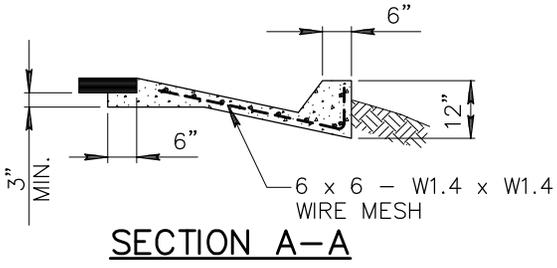
DETAIL NO.

**545**

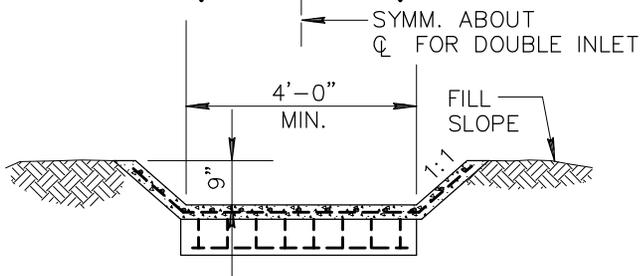


**SINGLE INLET**

|||| INDICATES INLET  
 |||| INDICATES SPILLWAY  
 - - - - PREFERRED GUARD RAIL POST LOCATION



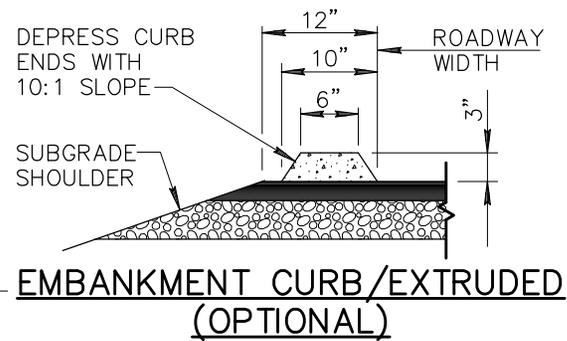
**SECTION A-A**



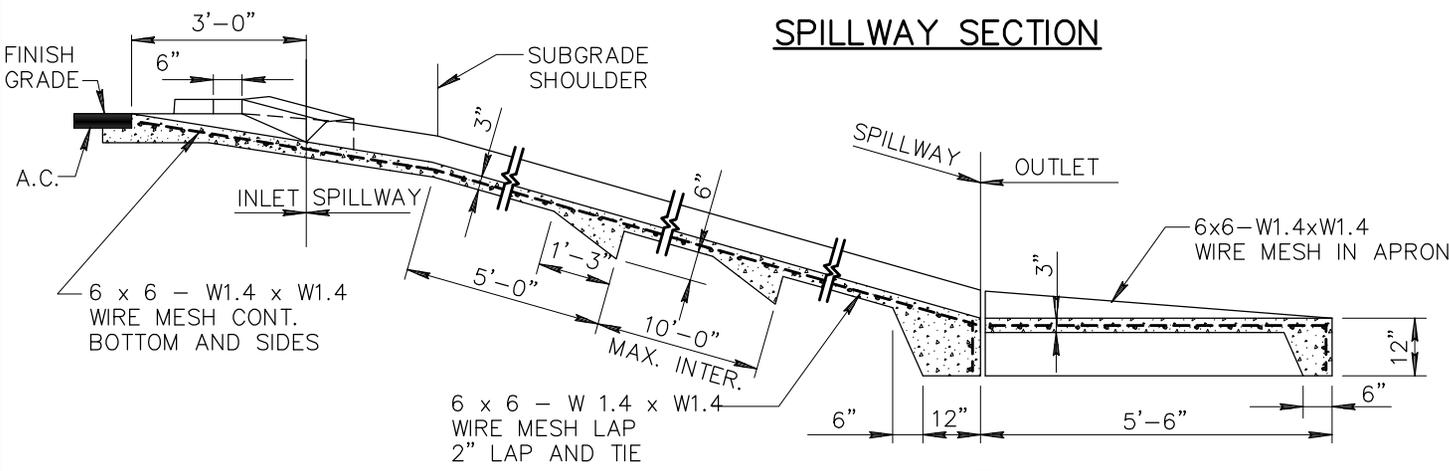
**SPILLWAY SECTION**

**NOTES:**

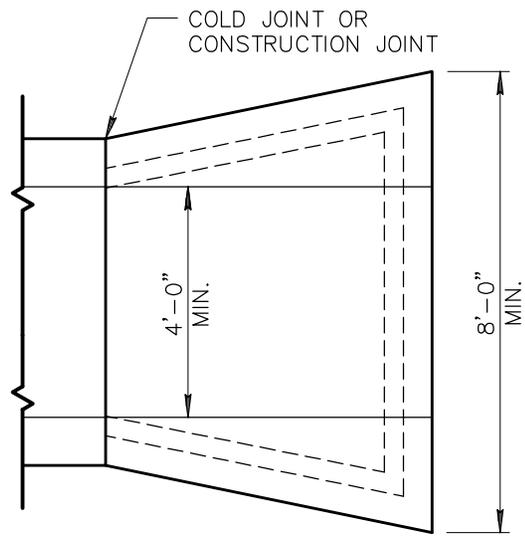
1. WHERE ROCK IS ENCOUNTERED THE OUTLET MAY BE OMITTED.
2. ALL PORTIONS OF SPILLWAY TO BE TROWEL FINISHED.
3. CONCRETE FOR THE SPILLWAY INLET, SPILLWAY AND OUTLET SHALL BE CLASS 'B' PER SECT. 725.
4. WHEN THE OUTLET IS USED, THE WIRE MESH SHALL EXTEND THROUGH THE JOINT INTO THE OUTLET IN LIEU OF BENDING INTO THE KEY.



**EMBAKMENT CURB/EXTRUDED (OPTIONAL)**



**SECTION ON SPILLWAY Q DOUBLE INLET**



DETAIL NO.  
**550**

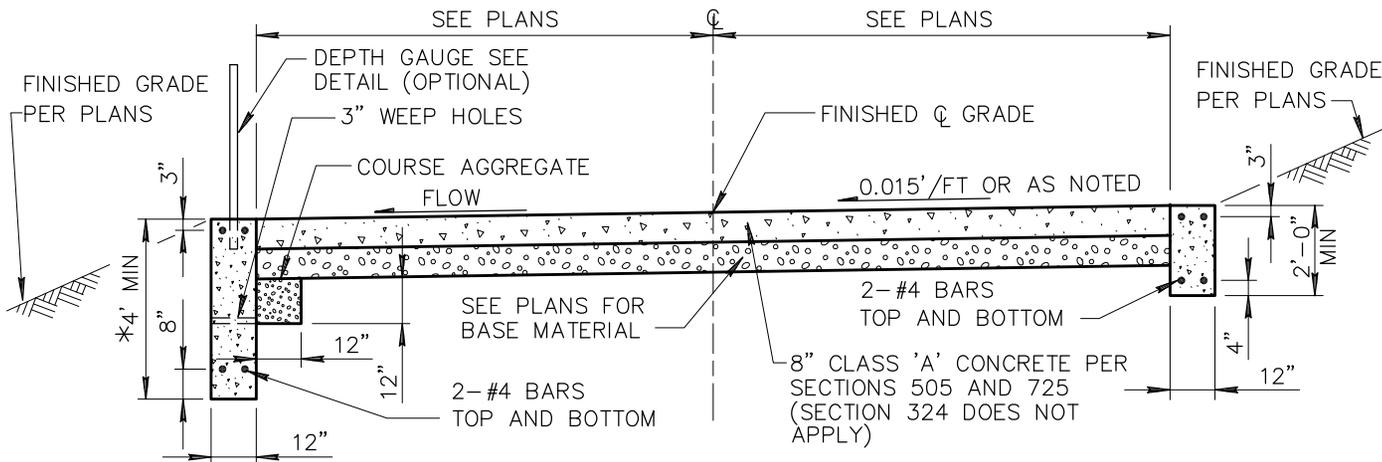


STANDARD DETAIL  
 ENGLISH

**SPILLWAY INLET AND OUTLET**

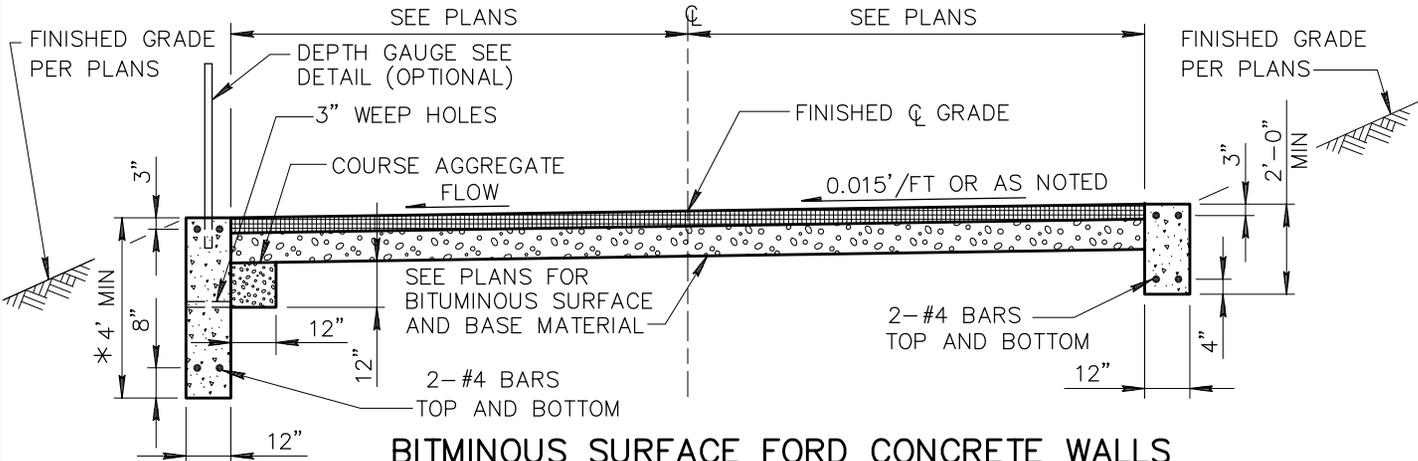
REVISED  
 01-01-1998

DETAIL NO.  
**550**



**CONCRETE SURFACE FORD CONCRETE WALLS**

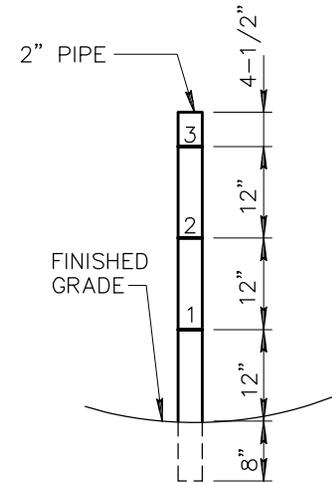
\*MIN. DISTANCE BELOW STREAM BED



**BITMINOUS SURFACE FORD CONCRETE WALLS**

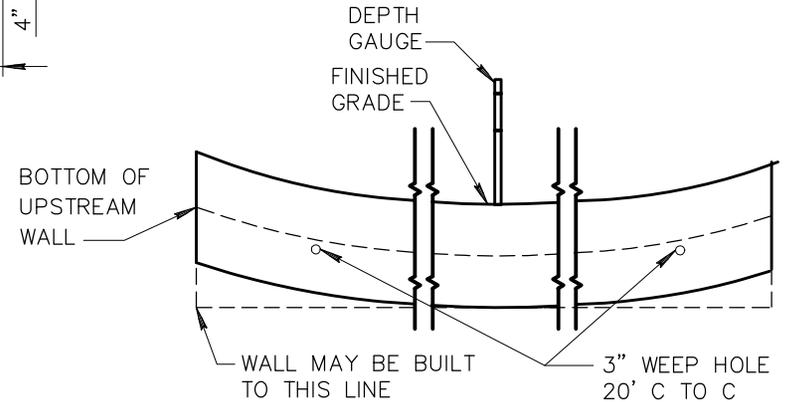
**NOTES:**

1. FORD WALLS SHALL BE CLASS 'A' CONCRETE PER SECT. 725.
2. DEPTH GAUGE SHALL BE PAINTED 2 COATS WHITE ENAMEL. NUMERALS AND MARKERS SHALL BE 1 COAT BLACK ENAMEL.
3. NUMBERS ON DEPTH GAUGE TO BE 2" HIGH.
4. HEIGHT OF DEPTH GAUGE PER PLANS.
5. REINFORCING BARS SHALL BE SET 3" CLEAR FROM SIDES OF CUT-OFF WALLS.
6. COURSE AGGREGATE AT WEEP HOLES SHALL BE ASTM C33 SIZE 57, ENCLOSED IN FILTER FABRIC (SECTION 796, CLASS B), AND EXTENDED Laterally A MINIMUM OF SIX-INCHES (6") ON EACH SIDE OF THE WEEP HOLE.



**DEPTH GAUGE DETAIL**

(OPTION OF THE CONTRACTING AGENCY)



**ELEVATION LOOKING UPSTREAM**

DETAIL NO.

552



STANDARD DETAIL  
ENGLISH

FORD CROSSING AND CUT-OFF WALLS

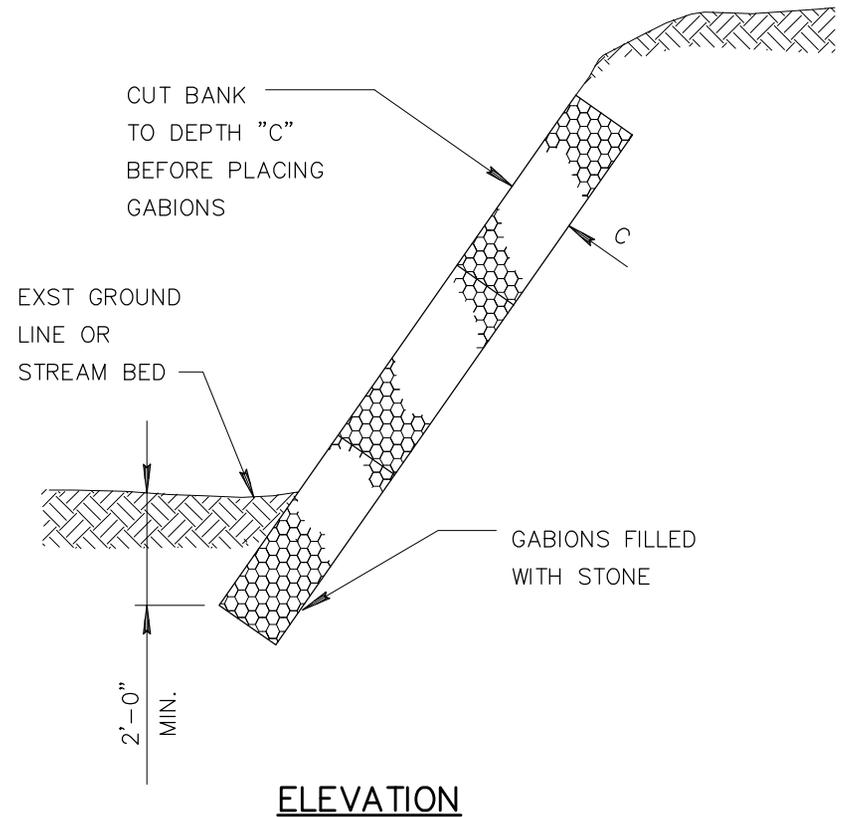
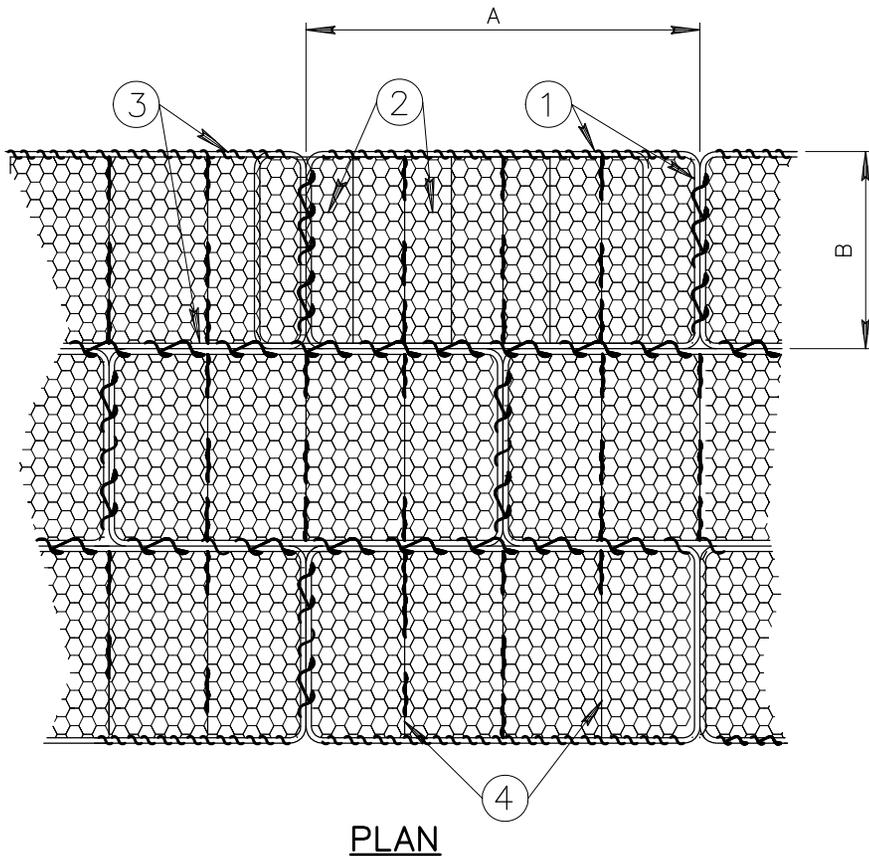
REVISED

01-01-2015

DETAIL NO.

552

## TYPICAL GABIONS



- ① HEAVY GAUGE FRAME WIRE.
- ② HEAVY GAUGE TRIPLE-TWIST HEXAGONAL MESH (OR EQUAL) FASTENED TO FRAME WIRE.
- ③ CONTINUOUS HEAVY GAUGE WRAPPED AROUND FRAMES TO FASTEN GABIONS TO EACH OTHER.
- ④ PARTITIONS TO PREVENT SHIFTING, NORMALLY ONE PER 3' LENGTH. INSTALLED AT FACTORY.

NOMINAL SIZE COMBINATIONS		
LENGTH	WIDTH	DEPTH
A	B	C
6'	3'	1' 1.5' 3'
9'	3'	1' 1.5' 3'
12'	3'	1' 1.5' 3'

**NOTE:**

OTHER SIZES AVAILABLE FROM MANUFACTURER.

**APPENDIX B**

**CITY OF PHOENIX SUPPLEMENTAL STANDARD DETAILS**

1000 SERIES  
TRAFFIC ENGINEERING

NO	TITLE	DATE
P1010	MINIMUM ARTERIAL STREET CROSS SECTIONS	2008
P1013	MINIMUM COLLECTOR STREET CROSS SECTIONS	2008
P1014	MINIMUM LOCAL STREET CROSS SECTIONS	2008
P1017	ACCESS ROAD OPENING	1992
P1018	ACCESS ROAD TERMINATION AT ALLEYS	2000
P1019	ACCESS ROAD TERMINATION AT INTERSECTION	2008
P1020-1	PLANNED AREA DEVELOPMENT	REV. 2015
P1020-2	PRIVATE ACCESSWAY	2008
P1021	PRIVATE DRIVEWAY (STREET) (FOR PLANNED AREAS, SUB-LOTS, SPECIAL PERMITS, ETC.)	1992
P1024	STEEL PIPE BARRICADE	1992

1100 SERIES  
GENERAL INFORMATION

NO	TITLE	DATE
P1102	DEPTH OF BASE COURSE RESIDENTIAL STREET	1992
P1103	DEPTH OF BASE COURSE (LOCAL COMMERCIAL & LIGHT INDUSTRIAL STREETS)	1992
P1104	DEPTH OF BASE COURSE (MAJOR STREETS & HEAVY INDUSTRIAL STREETS)	2002
P1105	STEEL COVER FOR OPEN TRENCHES	1992
P1106	BARRICADE	1992
P1120	V.C.P. TRENCH LOADING	2012
P1121	8" & 10" V.C.P. TRENCH LOADING	1992
P1122	12" & 15" V.C.P. TRENCH LOADING	1992
P1123	18" & 21" V.C.P. TRENCH LOADING	1992
P1124	24" & 27" V.C.P. TRENCH LOADING	1992
P1125	30" & 33" V.C.P. TRENCH LOADING	1992
P1126	36" & 39" V.C.P. TRENCH LOADING	1992
P1127	42" V.C.P. TRENCH LOADING	1992
P1130	MULTI-USE TRAILS AND SHARED-USE PATHS	2008
P1131	VERTICAL CLEARANCE, MULTI-USE, SHARED-USE, AND UNDERPASS/BRIDGE CLEARANCE	2008
P1164	MAXIMUM DRIVEWAYS & ALLEYS SLOPE	1994
P1165	DEBRIS CAP INSTALLATION	2008
P1170	TRENCHING STEEL PLATE	1992
P1173	SAFETY RAILING DETAIL	2012
P1174	CONDITIONS WHERE SAFETY RAILS ARE REQUIRED	2012

1200 SERIES  
STREET INFORMATION

NO	TITLE	DATE
P1200	TRENCH BACKFILL & SURFACE REPLACEMENT	REV. 2015
P1230	SIDEWALKS	REV. 2015
P1231	APRON JOINTS	REV. 2015
P1232	TRUNCATED DOMES DETAIL	REV. 2015
P1233	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' LANDSCAPE PLANTERS, BOTH SIDES	REV. 2015
P1234	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' & 5' LANDSCAPE PLANTERS	REV. 2015
P1235	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' LANDSCAPE PLANTER, ONE SIDE	REV. 2015
P1236	CURB RAMP DETAIL - 25', 30', & 35' RADII NO LANDSCAPE PLANTERS	REV. 2015
P1237	CURB RAMP DETAIL - ALL RADIUS CURB RETURNS, LIMITED RIGHT OF WAY	2008

1200 SERIES  
STREET INFORMATION (CONTINUED)

NO	TITLE	DATE
P1238-1	CURB RAMP DETAIL - 20' RADIUS LANDSCAPE PLANTERS, BOTH/ONE LEG(S)	REV. 2015
P1238-2	CURB RAMP DETAIL - 20' RADIUS NO LANDSCAPE PLANTERS	REV. 2015
P1239	CURB RAMP DETAIL - 20' RADIUS 4" VERTICAL CURB RETURN	REV. 2015
P1240	SINGLE CURB RAMP DETAIL ALL RADIUS CURB RETURNS	REV. 2015
P1240-1	SINGLE CURB RAMP DETAIL WITH LIMITED R/W	2012
P1240-2	CURB RAMP DETAIL WITH ATTACHED S/W (CORNER AT A DIAGONAL)	NEW 2015
P1240-3	CURB RAMP DETAIL WITH DETACHED S/W (CORNER AT A DIAGONAL)	NEW 2015
P1241-1	CURB RAMP DETAIL (MID BLOCK)	2012
P1241-2	CURB RAMP DETAIL (MID BLOCK) WITH DETACHED SIDEWALK	2012
P1241-3	CURB RAMP DETAIL (MID BLOCK) WITH 4" ROLL CURB	2012
P1241-4	CURB RAMP DETAIL (MID BLOCK) MODIFIED (LIMITED RIGHT OF WAY)	2012
P1243	RETURN TYPE DRIVEWAYS WITH ATTACHED SIDEWALK	2004
P1243-1	LIMITED ACCESS DRIVEWAY WITH NO LT-IN AND WITHOUT DECELERATION LANE	NEW 2015
P1243-2	LIMITED ACCESS DRIVEWAY WITH NO LT-IN/OUT AND WITHOUT DECELERATION LANE	NEW 2015
P1243-3	LIMITED ACCESS DRIVEWAY WITH NO LT-IN AND WITH DECELERATION LANE	NEW 2015
P1243-4	LIMITED ACCESS DRIVEWAY WITH NO LT-IN/OUT AND WITH DECELERATION LANE	NEW 2015
P1244	DRIVEWAY - PEDESTRIAN RAMP COMBINATION (FOR USE AT T TYPE INTERSECTIONS)	2008
P1255-1	DRIVEWAY ENTRANCE - TYPE I (SIDEWALK ADJACENT TO CURB)	2008
P1255-2	DRIVEWAY ENTRANCE - TYPE II (DETACHED SIDEWALK)	2008
P1255-3	DRIVEWAY ENTRANCE - ADA RETROFIT	2003
P1255-4	DRIVEWAY WIDTHS POLICY	2008
P1256-1	BUS BAY (TYPE 1)	2008
P1256-2	BUS BAY (TYPE 2)	2008
P1258	BUS SHELTER PAD LOCATION (BUS STOP)	2008
P1260	BUS SHELTER/ACCESSORY PAD BUS STOP	2008
P1261	BUS SHELTER/ACCESSORY PAD BUS BAY	2008
P1262	PARKWAY BUS SHELTER/ACCESSORY PAD	2008
P1263-1	BUS SHELTER/ACCESSORY PAD FRONTAGE ROAD MID-BLOCK	2008
P1263-2	PARKWAY BUS SHELTER/ACCESSORY PAD	2008
P1270	FRAME AND COVER INSTALLATION AND GRADE ADJUSTMENT	2008
P1270-1	SECURE VALVE BOX LID TYPE A	2001

DETAIL NO.

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**City of Phoenix**  
**STANDARD DETAIL**

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DATE

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1300 SERIES  
WATER INFORMATION

NO	TITLE	DATE
P1315	STEEL WATER METER BOX COVER	1992
P1342	WATER SERVICE CONNECTIONS	2008
P1343	WATERLINE - CUT AND PLUG FOR 12" DIA. MAIN AND SMALLER	1994
P1344	WATERLINE CUT OUT (TEES & CROSSES) FOR 12" DIA. MAIN AND SMALLER	1992
P1351	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 3" AND OVER	2001
P1352	DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 3" AND OVER	2001
P1353	DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 2 1/2" AND UNDER	2001
P1354	REDUCED PRINCIPLE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 2 1/2" AND UNDER	2001
P1355	PRESSURE VACUUM BREAKER ASSEMBLY INSTALLATION 2" AND UNDER	2001
P1356	TEMPORARY SUPPORT FOR FIRE HYDRANT BACKFLOW ASSEMBLY	2001
P1359	HYDRANT GUARDS	2001
P1360	FIRE HYDRANT ASSEMBLY	2008
P1361	FIRE HYDRANT THREADS 2 1/2" & 4"	1992
P1362	FIRE HYDRANT LOCATION	2004
P1363	WATER METER LOCATION	2000
P1370	VERTICAL REALIGNMENT OF WATERLINE	2012
P1391	VALVE BOX INSTALLATION	2008
P1391-1	VALVE OPERATING NUT EXTENSION	2001
P1394	PRESSURE REDUCING & SUSTAINING VALVE	1992
P1395	WATER LINE SUSPENSION	1992
P1396	DOUBLE CHECK VALVE ASSEMBLY	1992

1400 SERIES  
SANITARY SEWER INFORMATION

NO	TITLE	DATE
P1422	CONCRETE COLLAR AROUND MANHOLE FRAME	DELETED 2015
P1424	24" & 30" MANHOLE COVERS	2012
P1424-1	STORM DRAIN MANHOLE COVER	REV. 2105
P1431	SEWER TAP DEPTH & MARKING	1999
P1432	SEWER TAP RETROFITTING	1999
P1435	SANITARY SEWER MANHOLE KNOCKOUT	2004
P1440	SEWER BUILDING CONNECTION & ELECTRONIC MARKERS	2012

1500 SERIES  
IRRIGATION & STORM INFORMATION

NO	TITLE	DATE
P1505	CONCRETE PIPE COLLAR	2012
P1520	STORM DRAIN MANHOLE BASE 48" & SMALLER	1992
P1560	STORM DRAIN MANHOLE BASE TRANSITION 51" & LARGER	REV. 2015
P1561	FRAME AND COVER CATCH BASIN ACCESS	2008
P1562	BARRIER SPECIFICATION SCHEDULE	2003
P1563	STORM DRAIN OUTFALL ACCESS BARRIER	REV. 2015
P1564	CATCH BASIN GRATE FRAMES	1992
P1565	CATCH BASIN GRATES	REV. 2015
P1566	CATCH BASIN COMBINATION TYPE "J" WITH CONCRETE APRON	2012
P1567	CATCH BASIN COMBINATION TYPE "K"	2012
P1568	CATCH BASIN - TYPE "L" CURB & PARKWAY OPENING INLET DETAILS	2012
P1569-1	CATCH BASIN TYPE "M"	2012
P1569-2	CATCH BASIN - TYPE "M" TOP MODIFICATION IN LANDSCAPE PARKWAY	2012
P1570	CATCH BASIN TYPE "N"	2012
P1571	CATCH BASIN - TYPE "P" DOUBLE CURB OPENING FOR FRONTAGE ROAD ISLANDS	2012
P1572	CATCH BASIN TYPE "Q"	2012
P1573	CATCH BASIN TYPE "R"	2012
P1574	INLET CURB OPENING & PIPE ENTRY DETAIL	1992
P1575	CONSTRUCTION SUB-GRADE DRAIN	1992
P1576	CAST-IN-PLACE PIPE LATERAL PIPE CONNECTION	1999
P1577	SMALL STORM DRAIN LATERAL OR CATCH BASIN CONNECTOR PIPE CONNECTION TO EXISTING STORM DRAIN MAIN	REV. 2015
P1578	LARGE STORM DRAIN LATERAL OR CATCH BASIN CONNECTOR PIPE TO EXISTING RCP STORM DRAIN MAIN	REV. 2015
P1581	CATCH BASIN - TYPE "M" MODIFIED (OFFSET OPENING)	2000
P1583	CATCH BASIN - TYPE "L-R" MODIFIED (WITH REAR INLET)	2012
P1584	CATCH BASIN - TYPE "R" MODIFIED (WITH WING AND OFFSET OPENING)	2012

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**STANDARD DETAIL**

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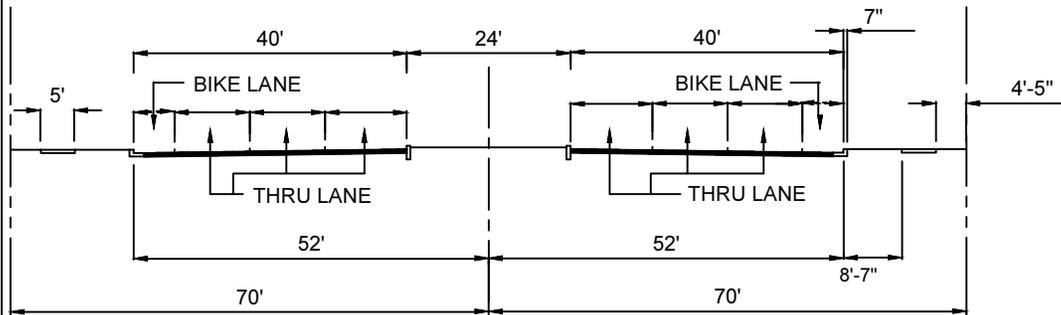
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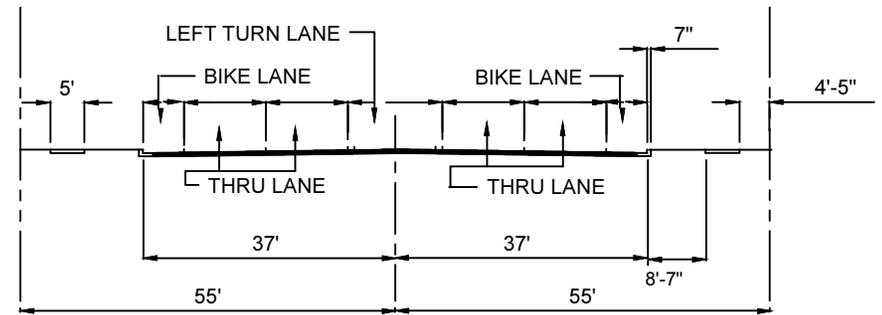
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DATE

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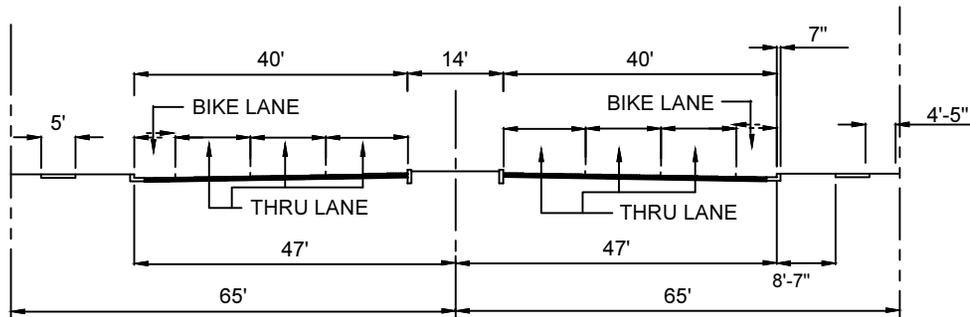
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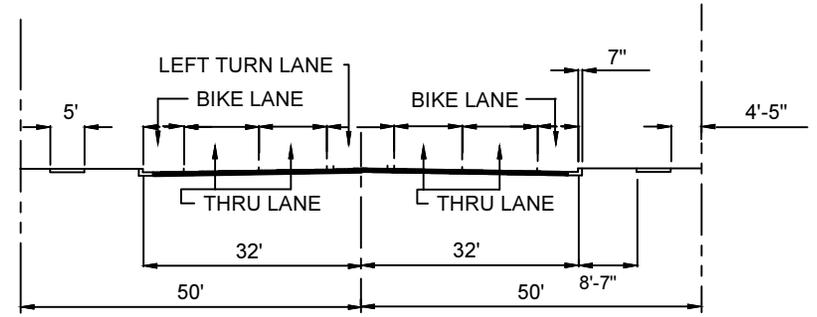
CROSS SECTION A



CROSS SECTION C  
CROSS SECTION C-M. (SEE NOTE 4)

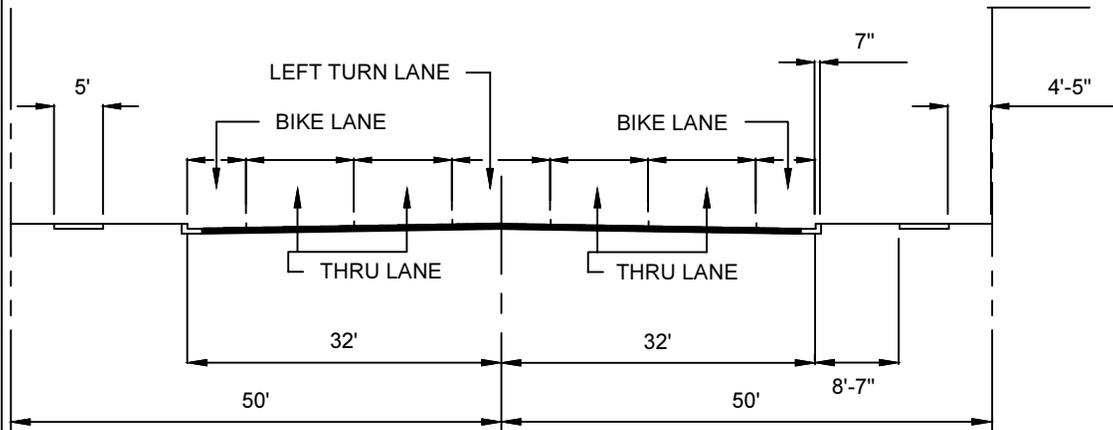


CROSS SECTION B



CROSS SECTION D

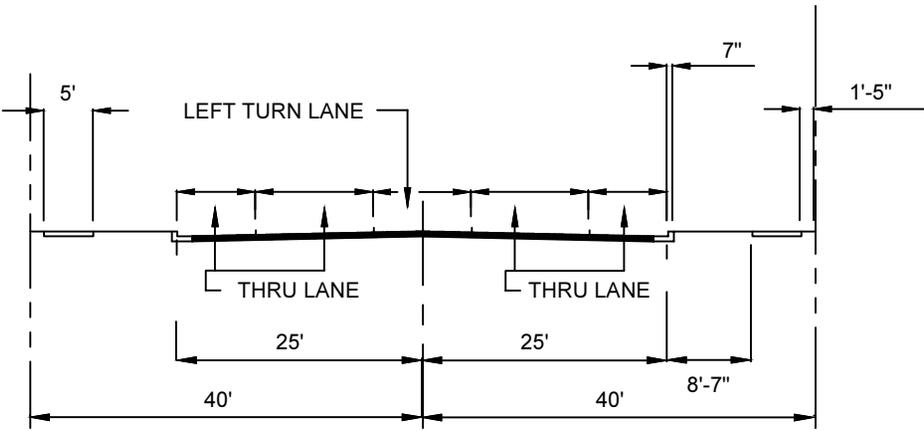
- NOTES:**
- LANE WIDTHS AND CONFIGURATION ARE CONCEPTUAL ONLY. FINAL LANE WIDTHS AND CONFIGURATION TO BE APPROVED BY THE STREET TRANSPORTATION DEPT.
  - ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, TRAFFIC SIGNALS, IRRIGATION FACILITIES OR TRAILS.\*\*
  - CROSS SECTION "C" HAS A 14' TWO WAY LEFT TURN LANE.  
CROSS SECTION "C-M" HAS A 14' RAISED MEDIAN.
  - ALL DIMENSIONS ARE TO THE FACE OF CURB.
- \*\* ACCORDING TO THE TRAILS PLAN, A 10 FOOT SIDEWALK MAY BE REQUIRED ON CROSS SECTIONS A, B, C, D, E, F, & G.



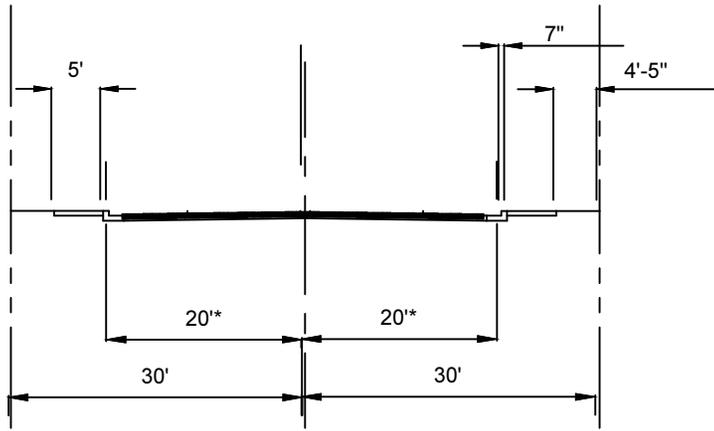
CROSS SECTION D

NOTES:

- 1. LANE WIDTHS AND CONFIGURATION ARE CONCEPTUAL ONLY. FINAL LANE WIDTHS AND CONFIGURATION TO BE APPROVED BY THE STREET TRANSPORTATION DEPT.
- 2. ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, TRAFFIC SIGNALS, IRRIGATION FACILITIES OR TRAILS.
- 3. ALL DIMENSIONS ARE TO THE FACE OF CURB.

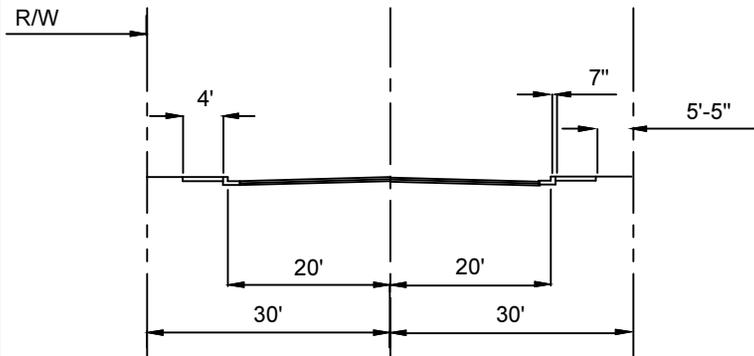


CROSS SECTION E



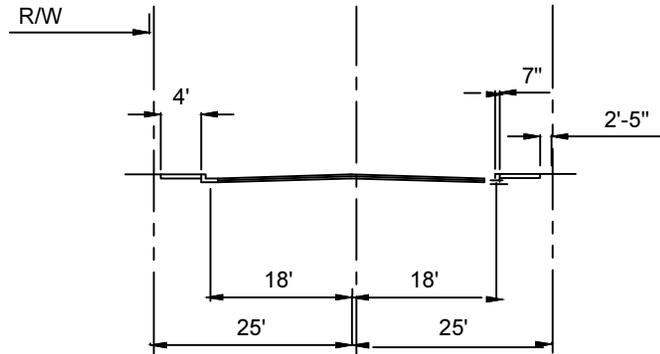
CROSS SECTION F

\* COLLECTORS WITH RESIDENTIAL BACKUP TREATMENT MAY BE 18'.



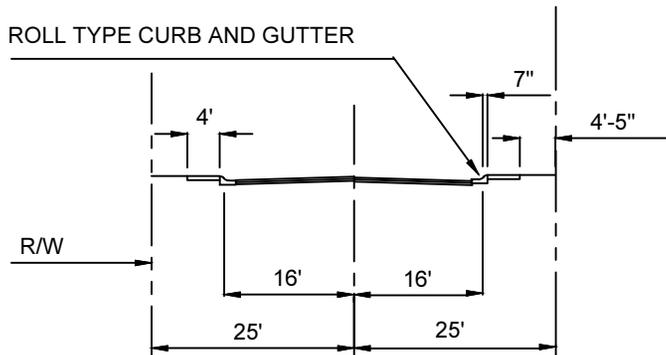
**CROSS SECTION F**

INDUSTRIAL LAND USE  
VERTICAL CURB AND ADJACENT SIDEWALK



**CROSS SECTION G**

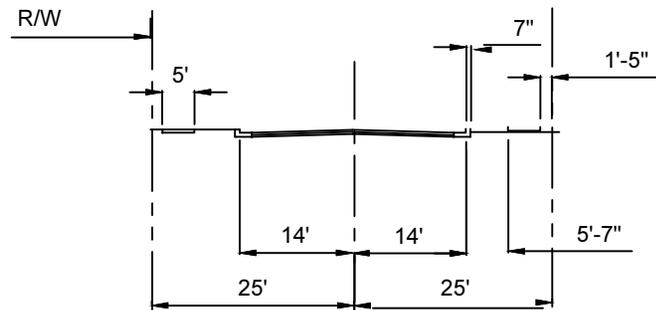
COMMERCIAL & MULTI FAMILY  
RESIDENTIAL LAND USE  
VERTICAL CURB AND ADJACENT SIDEWALK



**CROSS SECTION H**

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION A:  
ROLL CURB AND ADJACENT SIDEWALK



**CROSS SECTION I**

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION B:  
VERTICAL CURB AND SET BACK SIDEWALK

**NOTES:**

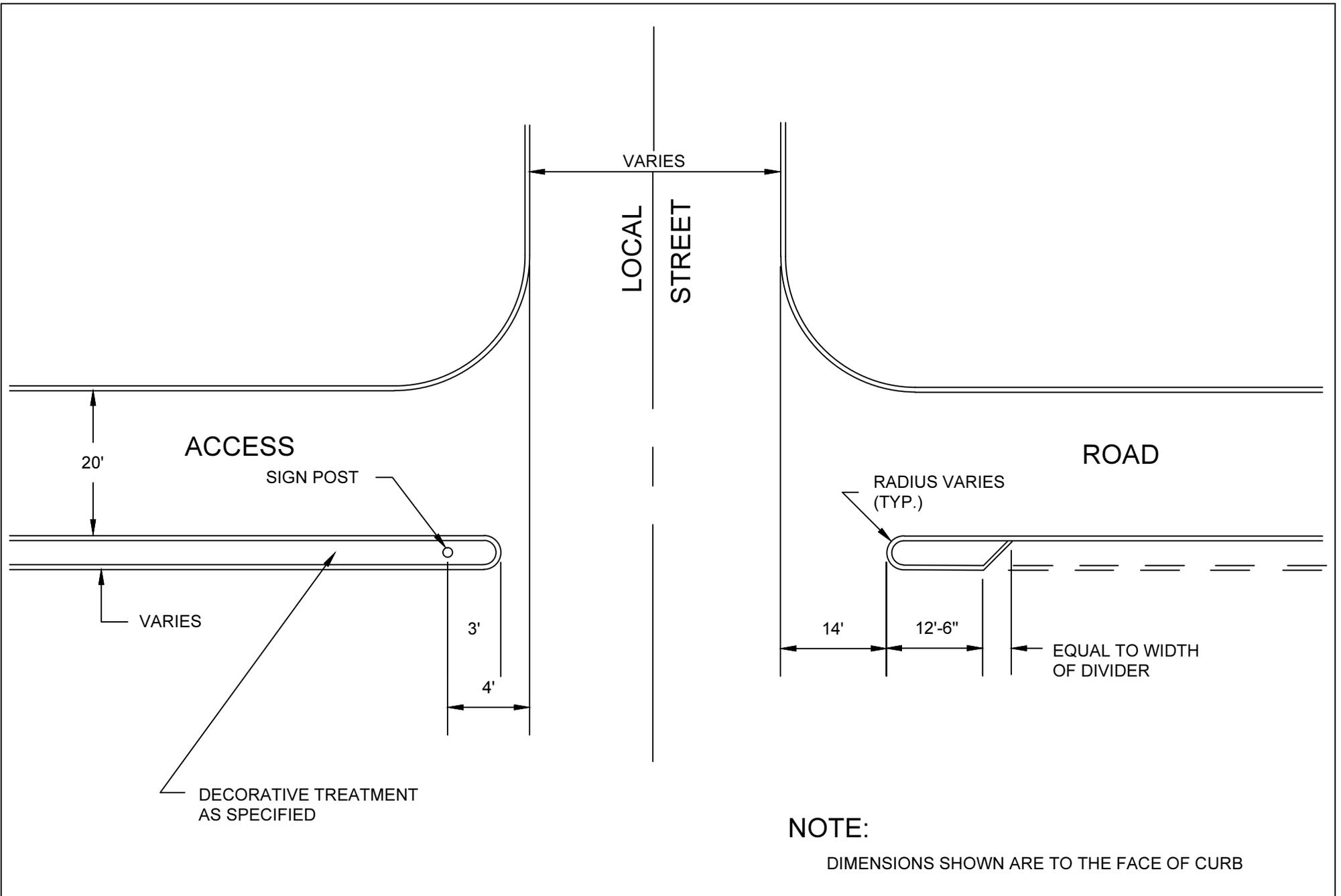
LANE WIDTHS AND CONFIGURATION  
ARE CONCEPTUAL ONLY. FINAL  
LANE WIDTHS AND CONFIGURATION  
TO BE APPROVED BY THE STREET  
TRANSPORTATION DEPT.

ADDITIONAL RIGHT-OF-WAY  
MAY BE REQUIRED FOR DRAINAGE,  
UTILITIES, SLOPE RIGHTS,  
IRRIGATION FACILITIES, OR TRAILS.

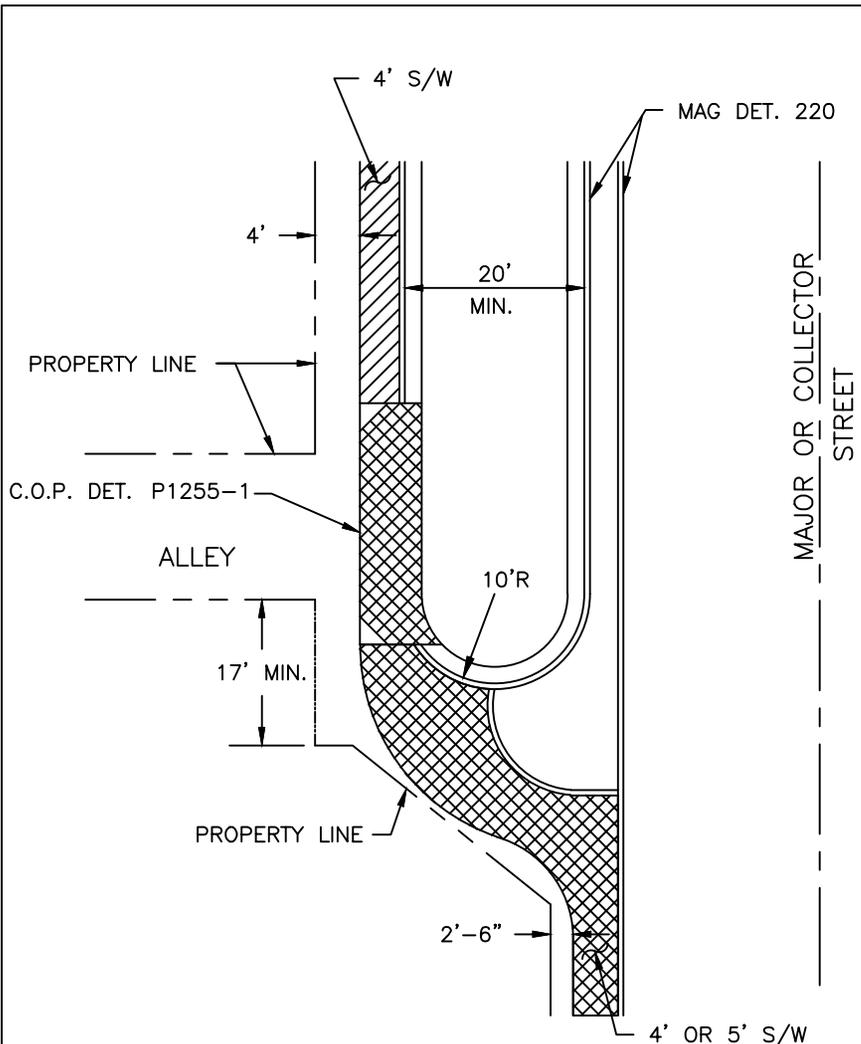
ALL DIMENSIONS ARE TO THE  
FACE OF CURB.

ALL CURBS ARE VERTICAL  
UNLESS NOTED.





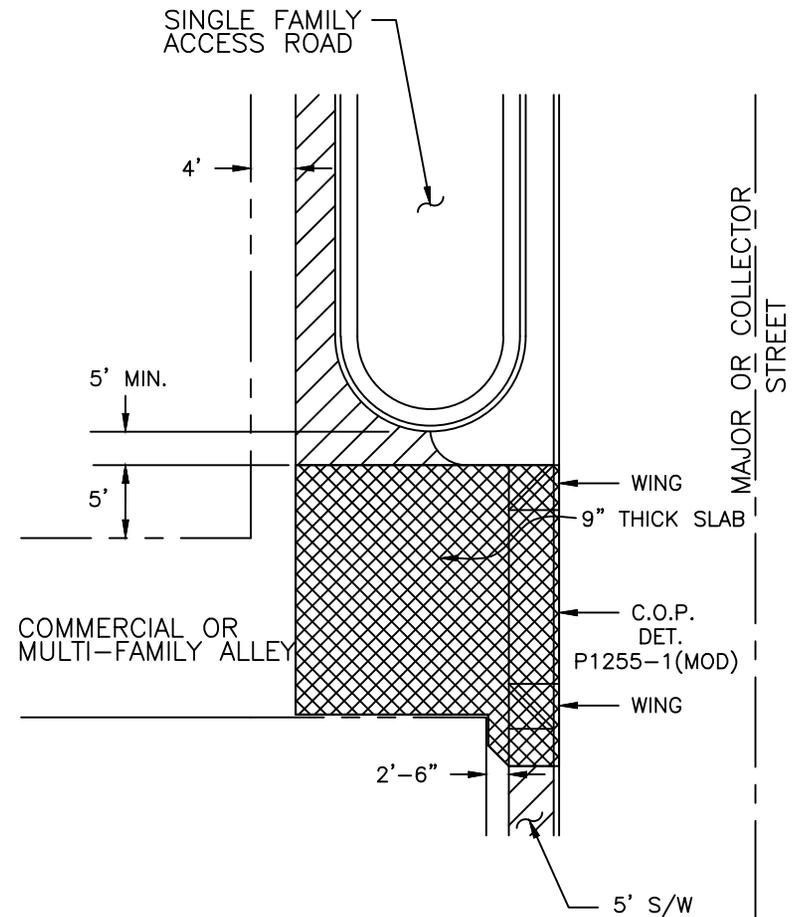
**NOTE:**  
 DIMENSIONS SHOWN ARE TO THE FACE OF CURB



NOTE:

SUFFICIENT RIGHT-OF-WAY MUST BE AVAILABLE TO CONSTRUCT ACCESS ROAD TERMINATION

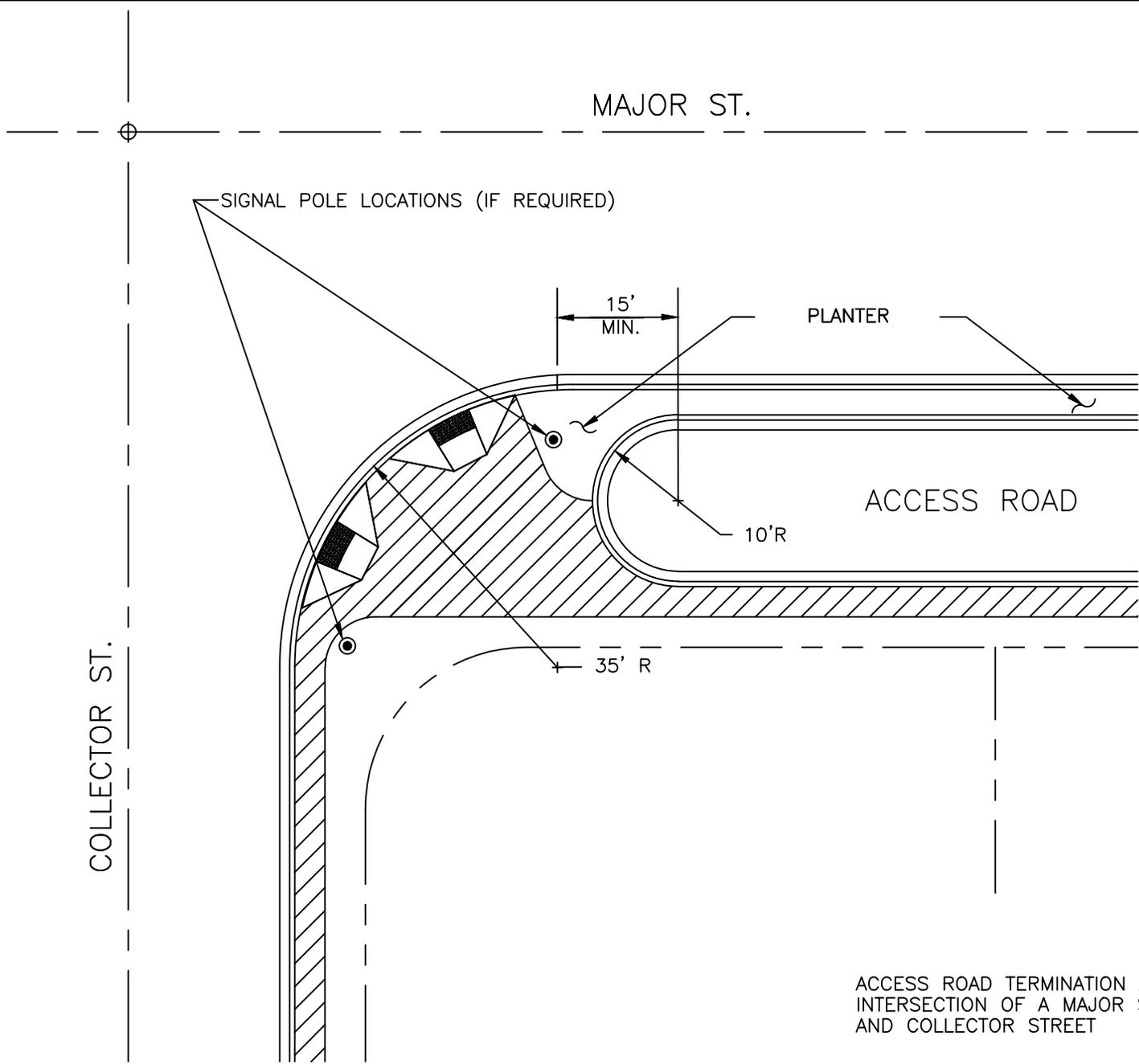
SINGLE FAMILY ALLEY



NOTE:

1. COMMERCIAL AND MULTI-FAMILY ALLEYS MAY NOT PROVIDE ACCESS TO SINGLE FAMILY ACCESS ROADS.
2. ONLY ALLOWED FOR LOCATIONS WHERE REFUSE COLLECTION IS NOT PROVIDED ALONG THE ACCESS ROAD.

COMMERCIAL OR MULTI-FAMILY ALLEY



ACCESS ROAD TERMINATION AT THE INTERSECTION OF A MAJOR STREET AND COLLECTOR STREET

REVISED 4/14/08

A PRIVATE ACCESSWAY IS INTENDED TO APPLY TO PRIVATE STREETS WITHIN DEVELOPMENTS SUCH AS PRD'S PAD'S, MOBILE-HOME PARKS, AND HILL SIDE DEVELOPMENTS WHERE LOT SALES ARE PROPOSED.

1. PRIVATE ACCESS WAYS WILL BE ALLOWED IN NEW DEVELOPMENTS WHERE THEIR USE IS LOGICALLY CONSISTENT WITH A DESIRE FOR NEIGHBORHOOD IDENTIFICATION AND CONTROL OF ACCESS, AND WHERE SPECIAL OVERALL DESIGN CONCEPTS MAY BE INVOLVED.
2. PRIVATE ACCESS WAYS WILL BE PERMITTED ONLY WHERE A SATISFACTORY MEANS OF PROVIDING FOR THEIR MAINTENANCE AND OPERATION IS DEMONSTRATED.
3. THE USE OF PRIVATE ACCESS WAYS AS A DEVICE FOR PERMITTING INADEQUATE DESIGN WILL NOT BE ALLOWED.
4. THE USE OF PRIVATE ACCESS WAYS IS ORDINARILY LIMITED TO CUL-DE-SACS AND TO LOCAL STREETS NOT CARRYING THROUGH TRAFFIC. NORMALLY COLLECTOR STREETS WILL BE PUBLIC. FURTHER, THERE WILL BE AN ADEQUATE INTERNAL CIRCULATION SYSTEM AND NO PROPERTY WILL BE LANDLOCKED BY A PRIVATE ROAD SYSTEM.
5. THE DESIGN OF ALL PRIVATE ACCESS WAYS SHALL BE REVIEWED AND APPROVED BY D.S.D. THE CONSTRUCTION SHALL BE INSPECTED BY D.S.D., WITH A STANDARD INSPECTION FEE TO BE PAID.
6. NOTE TO BE PLACED ON PLAT "PRIVATE ACCESS WAY, NOT DEDICATED FOR PUBLIC USE".
7. THE HOMEOWNER'S ASSOCIATION CONSTITUTION AND BY-LAWS SHALL INCLUDE ACKNOWLEDGEMENT OF THE OWNERSHIP AND MAINTENANCE RESPONSIBILITY OF THESE PRIVATE FACILITIES, INCLUDING RESPONSIBILITY FOR ENFORCEMENT OF TRAFFIC CONTROL.
8. GATED ENTRIES ARE ALLOWED IF TURNAROUND AREAS ARE PROVIDED PER DSD GATED ENTRY DETAILS

I GENERAL

1. PRIVATE ACCESS WAYS, AND/OR REFUSE COLLECTION EASEMENTS MAY BE USED IN PAD'S, MOBILE-HOME DEVELOPMENTS AND PRD'S AND SHALL BE KNOWN AS "PRIVATE ACCESS WAYS". UTILITIES MAY BE PLACED IN A PRIVATE ACCESS WAY IF THEY ARE AT LEAST 28' WIDE.
2. MAJOR DRAINAGE WAYS SHALL BE DEDICATED.
3. SIDEWALKS ARE NORMALLY REQUIRED ADJACENT TO ALL COLLECTOR STREETS AND IN ALL MULTIFAMILY DEVELOPMENTS AND DEVELOPMENTS WITH LOTS LESS THAN 18,000 SQ. FT. OR IN THE SAID EASEMENT RIGHT OF WAY UNLESS OTHER MEANS OF ACCOMMODATING PEDESTRIAN TRAFFIC ARE PROVIDED IN THE DEVELOPMENT.
4. PRIVATE ACCESS WAYS SHALL BE ADEQUATELY DESIGNED TO CITY SPECIFICATIONS TO PROVIDE FOR LANE DELINEATION, STREET SWEEPING, AND DRAINAGE CONTROL. NORMALLY, A CROWN SECTION WITH CONCRETE CURB OR CONCRETE CURB AND GUTTER ON BOTH SIDES WILL BE REQUIRED; HOWEVER, OTHER MEANS OF PROVIDING SIMILAR FUNCTIONAL CHARACTERISTICS MAY BE CONSIDERED IF APPROVED BY THE PLAN REVIEW TEAM.
5. RETURN-TYPE DRIVEWAY ENTRANCE MAY BE USED ON PRIVATE ACCESS WAYS. IF THE STREET IS 28' OR GREATER. DEPRESSED DRIVEWAY APPROACHES SHALL BE USED WHERE THERE IS ONLY DIRECT ACCESS TO A PARKING AREA OR WHERE THE STREET IS LESS THAN 28' WIDE.

II MINIMUM PAVEMENT WIDTHS

THE ENTIRE WIDTH OF THE PRIVATE ACCESS WAY SHALL BE DESIGNATED BY PLAT AS A "PRIVATE ACCESS WAY".

<u>STREET CLASSIFICATION</u>	<u>CURB TO CURB</u>	<u>CURB RETURNS</u>
COLLECTOR	36'-40'	35'
LOCAL STREETS		
WITH PARKING PLANNED ON BOTH SIDES	29'-36'	20'
WITHOUT PLANNED PARKING	24'	25'
ONE-WAY, PLANNED PARKING ONE SIDE	22'-24'	25'

III GRADES

1. DESIRABLE MAXIMUM - 10%
2. MAXIMUM - 15%
3. MINIMUM - 0.30% - GRADES LESS THAN 0.30% SHALL REQUIRE CONCRETE VALLEY GUTTERS, ABSOLUTE MINIMUM GRADE 0.15%.

IV ALIGNMENT

1. STREET SHALL NORMALLY INTERSECT AT RIGHT ANGLES AND NO GREATER DEFLECTION THAN 15' FROM A RIGHT ANGLE WILL BE ALLOWED AND SHALL HAVE AT LEAST 20' TANGENT ADJACENT TO INTERSECTIONS. THE TANGENT LENGTH SHALL BE INCREASED WHERE SHORT RADIUS CURVES ARE USED NEAR THE INTERSECTIONS.
2. CUL-DE-SACS SHALL NOT ORDINARILY EXCEED 400' IN LENGTH. CURB RADIUS TO FACE OF CURB AT THE TURNAROUND SHALL BE 45' RADIUS MINIMUM.
3. IN SPECIAL SITUATIONS WHERE CITY REFUSE COLLECTION AND/OR CITY MAINTENANCE IS NOT REQUIRED, DEAD-ENDED PRIVATE ACCESS WAYS MAY BE USED AND SHOULD NOT EXCEED 300 LINEAL FEET. ADEQUATE TURNAROUND FACILITIES MAY BE REQUIRED AT THE END OF EACH DEAD-ENDED PRIVATE ACCESS WAY FOR EMERGENCY VEHICLE TURNAROUND.
4. CENTERLINE RADIUS SHALL BE 100' MINIMUM FOR LOOP STREETS AND LOCAL STREETS OVER 800' IN LENGTH. WHERE RIGHT-ANGLED BENDS ARE USED IN THE STREET PATTERN IN LIEU OF THE MINIMUM RADII REQUIRED ABOVE, WIDENING SUFFICIENT TO ACCOMMODATE TRUCK-TURNING MOVEMENTS SHALL BE PROVIDED BY USE OF KNUCKLES OR OTHER APPROPRIATE MEANS.

V STRUCTURAL SECTION

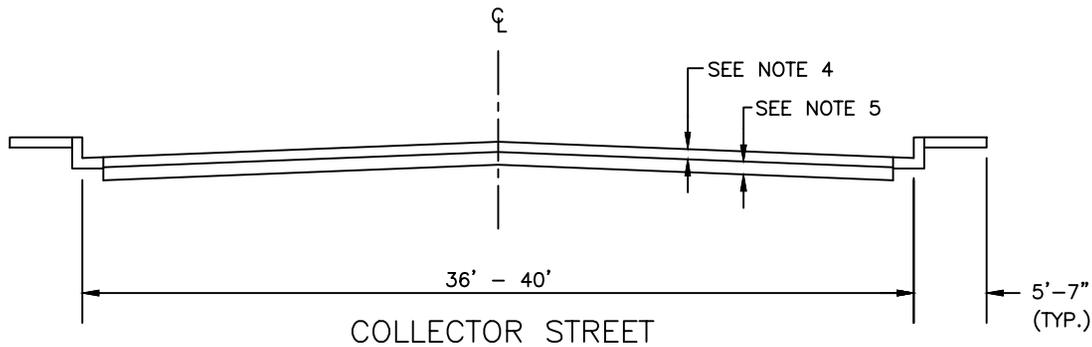
THE MINIMUM STRUCTURAL DESIGN OF PAVING, CURB, GUTTER, AND SIDEWALK SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS.

VI UTILITIES

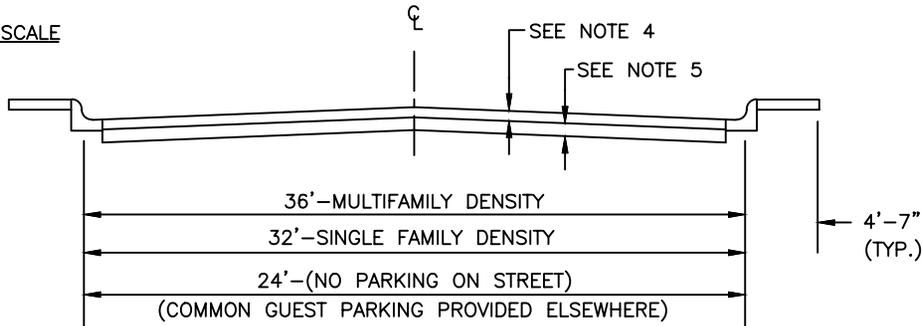
1. ADEQUATE PROVISIONS FOR PUBLIC UTILITIES SHALL BE MADE.
2. FIRE HYDRANTS SHALL BE LOCATED ON THE PUBLIC STREET AT THE ENTRANCE TO THE PRIVATE ACCESS WAYS AND ALONG PRIVATE ACCESS WAYS AS REQUIRED BY THE CITY OF PHOENIX WATER AND WATER SERVICES DEPARTMENT STANDARDS.
3. STANDARDS OF CONSTRUCTION AND INSPECTIONS ON PRIVATE ACCESS WAYS SHALL BE TO CITY OF PHOENIX STANDARDS AND SPECIFICATIONS.
4. COSTS OF MAINTENANCE AND REPAIRS OF PRIVATE ACCESS WAYS, LIGHTS, AND NON-PUBLICLY-OWNED UTILITIES ARE TO BE THE RESPONSIBILITY OF THE HOMEOWNER'S ASSOCIATION.
5. PUBLIC WATER AND SEWER LINES ARE ACCEPTABLE WITHIN 28' WIDE OR GREATER PRIVATE ACCESSWAYS WITH AN EXCLUSIVE EASEMENT FOR PUBLIC WATER & OR SEWER.
6. SOME TYPE OF PRIVATE STREET LIGHTS ARE TO BE PROVIDED.

VII SIGNS

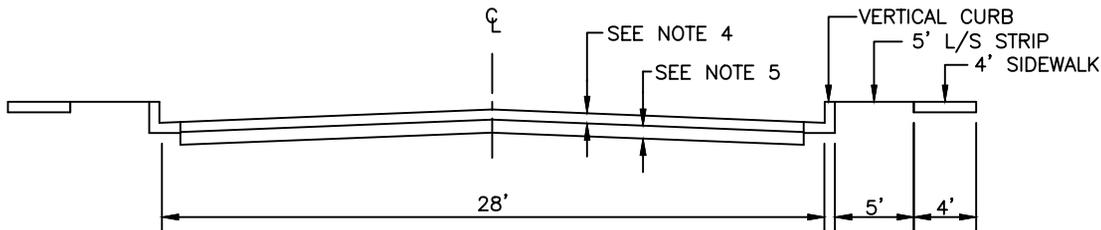
1. ALL NEW CURB SHALL BE IMPRINTED WITH THE WORDS, "PRIVATE STREET - NO CITY MAINTENANCE" IN 2" HIGH LETTERS AT EVERY CURB RETURN AND AT EVERY ENTRANCE INTO A NEW PRIVATE PROPERTY SUBDIVISION.
2. A STOP SIGN SHALL BE POSTED AT ALL INTERSECTIONS OF PRIVATE ACCESS WAYS WITH PUBLIC STREETS. SIGNS SHALL BE IN ACCORDANCE WITH THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES AND SHALL BE MAINTAINED BY THE HOMEOWNER'S ASSOCIATION.



NOT TO SCALE



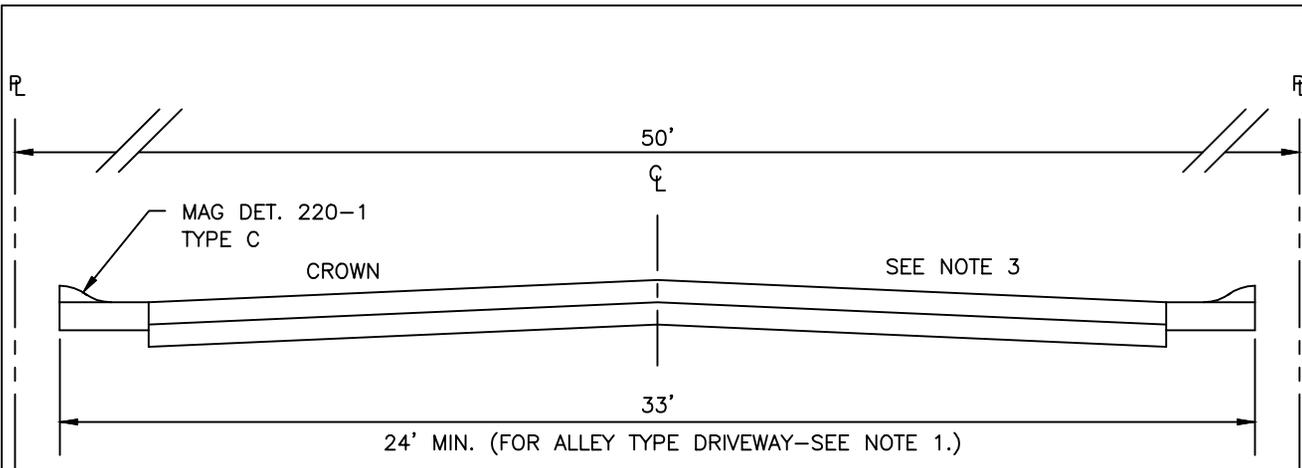
NOT TO SCALE



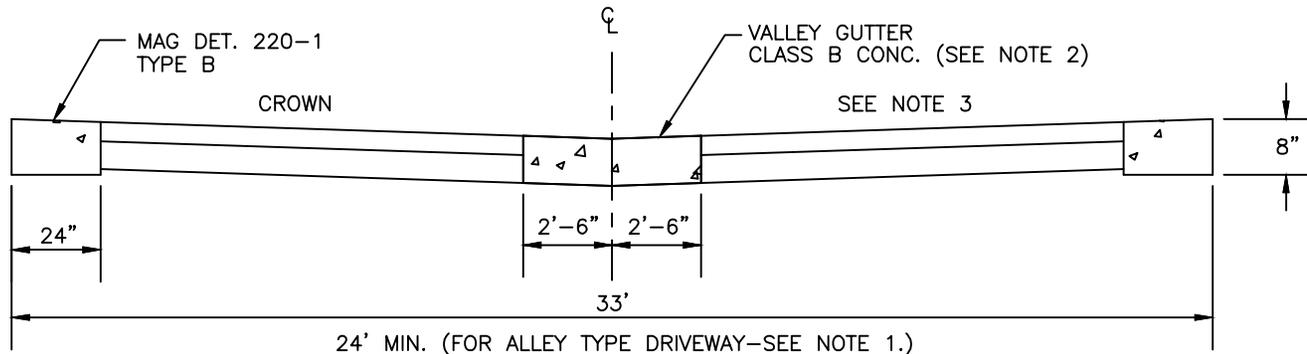
NOT TO SCALE

NOTES:

1. DRIVEWAY ENTRANCE RETURNS - VERTICAL CURB FACE
  - A. COLLECTOR STREET - 35' RADIUS TO FACE OF CURB
  - B. LOCAL STREET (36' OR 32' WIDE) - 20' RADIUS TO FACE OF CURB
  - C. LOCAL STREET (24' OR 28' WIDE) - 25' RADIUS TO FACE OF CURB
2. SIDEWALK-STD. DET. P1230. THE SITE DEVELOPMENT MANAGER MAY WAIVE THE REQUIREMENT FOR SIDEWALKS, IF SIDEWALKS PROVIDED ELSEWHERE IN THE DEVELOPMENT WILL SATISFACTORILY SERVE THE SAME PURPOSE.
3. CURBS
  - A. COLLECTOR STREET & MULTIFAMILY DENSITY - STD. DET. 220-1 TYPE "A" (VERTICAL CURB AND GUTTER)
  - B. LOCAL STREET-STD. DET. 220-1 TYPE "C" (ROLL CURB AND GUTTER) OR STD. DET. 221 WHEN SIDEWALK IS ADJACENT, RIBBON CURBS WILL BE PERMITTED WHERE DRAINAGE WILL BE RETAINED OR ADEQUATE DRAINAGE CHANNELS ARE PROVIDED THROUGH ADJACENT PROPERTY. RIBBON CURB MAY NOT BE USED ADJACENT TO SIDEWALK.
4. ASPHALT CONCRETE-2" THICKNESS, CONFORM TO M.A.G. SECT. 321. OTHER TYPES OF SURFACE TREATMENT MAY BE PERMITTED BY AUTHORITY OF THE PAVING PLAN REVIEW SUPERVISOR AFTER DEMONSTRATION THAT STRUCTURAL STRENGTH IS EQUAL TO OR GREATER THAN THAT OF THE EXISTING CITY STANDARDS.
5. AGGREGATE BASE COURSE-THICKNESS TO CONFORM WITH P1103. INSTALL TO CONFORM WITH M.A.G. SECT. 310.
6. STREET FURNITURE, FIRE HYDRANTS AND MAJOR PLANTINGS SHALL BE SET BACK A MINIMUM OF 5' FROM THE BACK OF CURB AND BUILDINGS SHALL BE SET BACK A MINIMUM OF 10' FROM THE BACK OF CURB.
7. GARAGES ARE TO BE SETBACK 18' FROM BACK OF SIDEWALK.



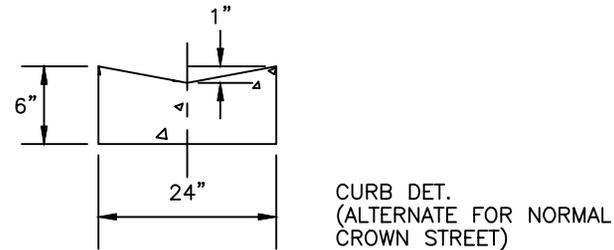
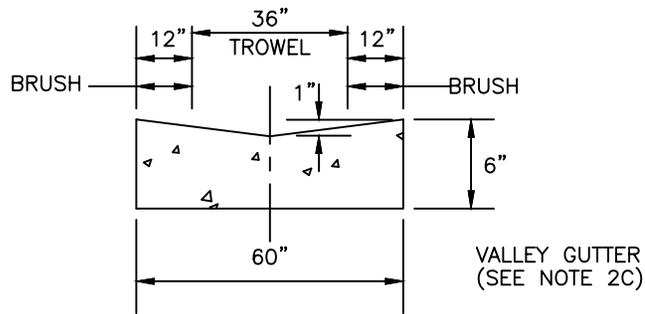
NORMAL CROWN

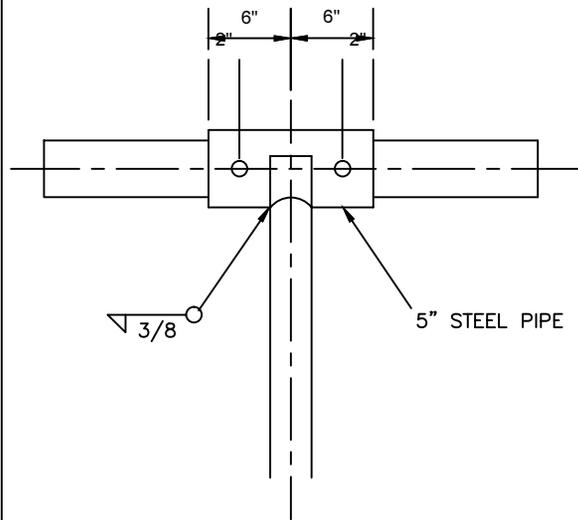


INVERTED CROWN

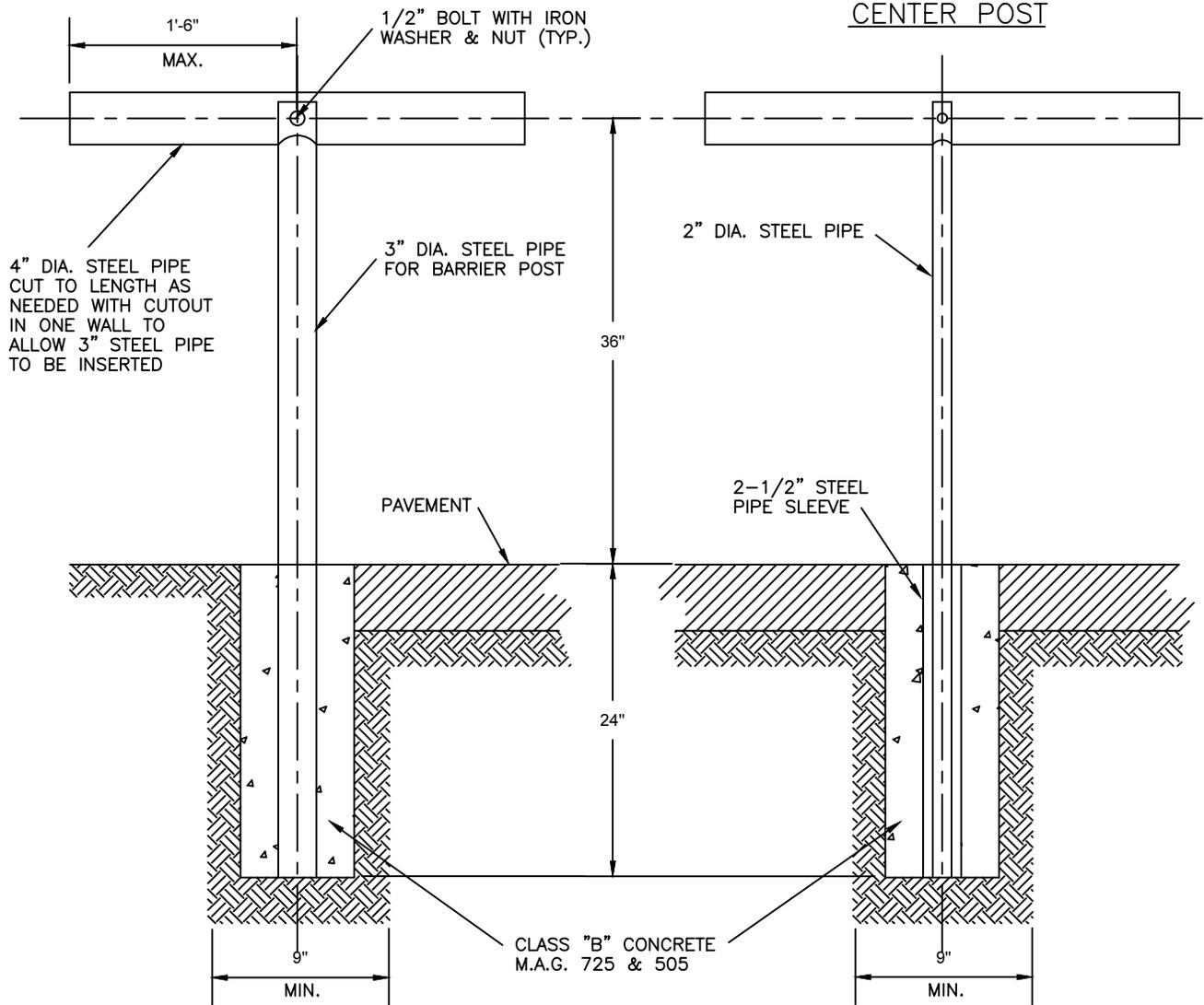
NOTES:

1. 24' MIN. WIDTH MAY BE APPROVED FOR SHORT DEAD-END OR CUL-DE-SAC DRIVEWAYS OR DRIVEWAYS IN APARTMENT TYPE DEVELOPMENT. A 3' UTILITY EASEMENT TO BE DEDICATED ADJACENT.
2. GRADES
  - (A) MAX.-15%. STREET GRADES EXCEEDING 12% SHOULD HAVE MAX. LENGTH OF 600'.
  - (B) DESIRABLE MIN. GRADE-0.25%.
  - (C) WHEN THE LONGITUDINAL GRADE OF INVERTED CROWN IS LESS THAN 0.30%, CONC. VALLEY GUTTER SHALL BE INSTALLED.
3. CROWN
  - (A) 5" TO 6" WHERE STREET GRADE IS LESS THAN 0.25%.
  - (B) 4" TO 5" WHERE STREET GRADE EXCEEDS 0.25%.
  - (C) INVERTED CROWN 4" TO 6", NOTE: FOR 24' WIDTH DRIVEWAYS DEDUCT 1" FROM ABOVE CROWNS.
4. WITH INVERTED CROWN STREETS, ROLL CURB, WITH DEPRESSED LIP, MAY BE SUBSTITUTED FOR RIBBON TYPE CURB.
5. RIBBON TYPE CURB IS NOT TO BE INSTALLED IF S/W ARE PROPOSED.
6. CONCRETE PER MAG SEC. 725 & 505.





"T" SLEEVE OPTION



NOTES:

1. 1'-6" MAX. OVERHANG
2. MAX. OVERALL LENGTH IS 33'
3. CENTER POST REQUIRED IF CLEAR SPAN EXCEEDS 15'.
4. CENTER POST SHALL BE 2" DIA. WITH A 2-1/2" DIA. SLEEVE IN THE FOOTING.
5. ALL PIPE IS SCHEDULE 40, GALVANIZED STEEL. (ASTM A 53)

DETAIL NO.  
P1024



**City of Phoenix**  
**STANDARD DETAIL**

STEEL PIPE BARRICADE

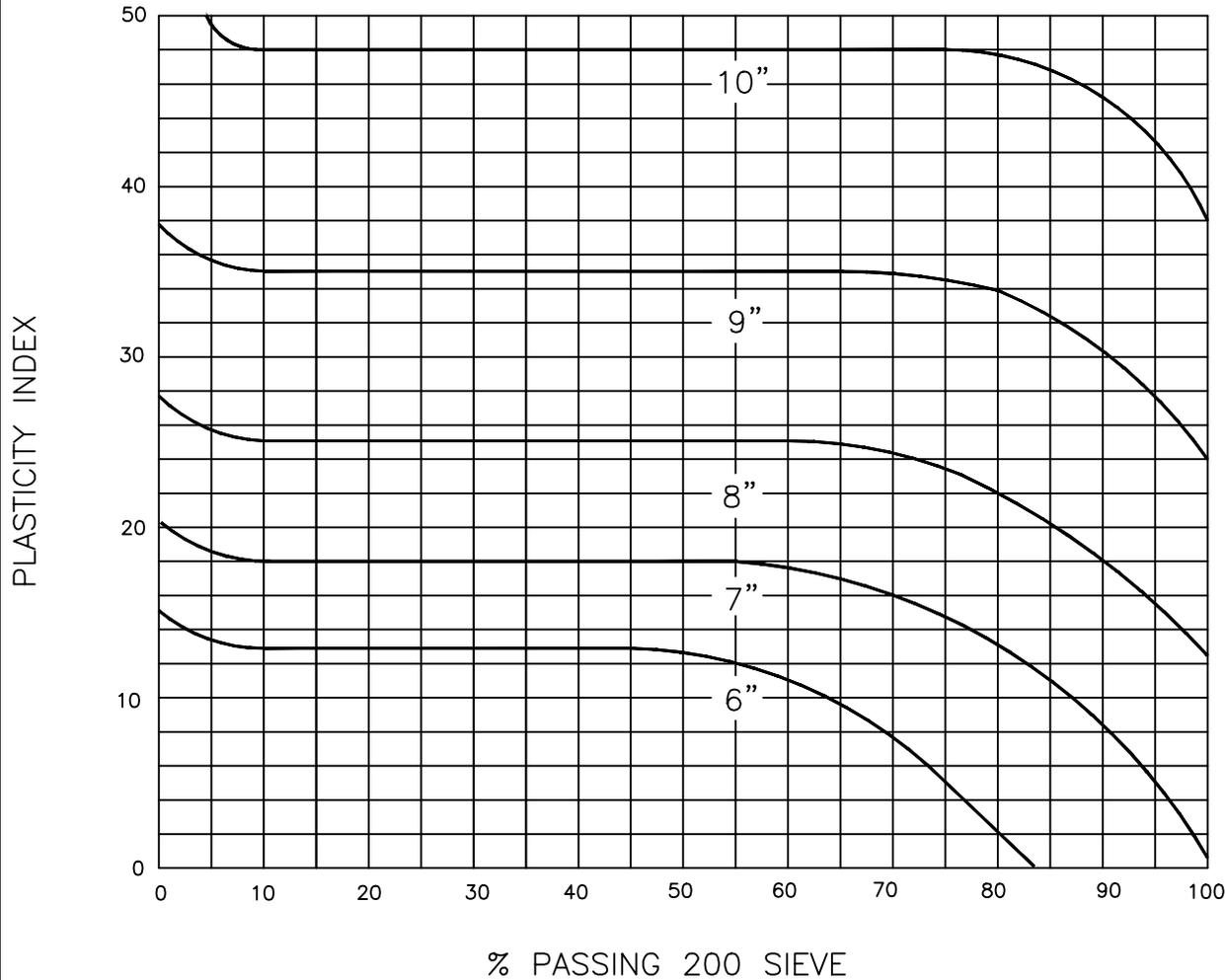
APPROVED

*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1024

### BASE THICKNESS CHART



**NOTES:**

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM-DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 2" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.  
P1102



**City of Phoenix**  
**STANDARD DETAIL**

DEPTH OF BASE COURSE  
RESIDENTIAL STREET

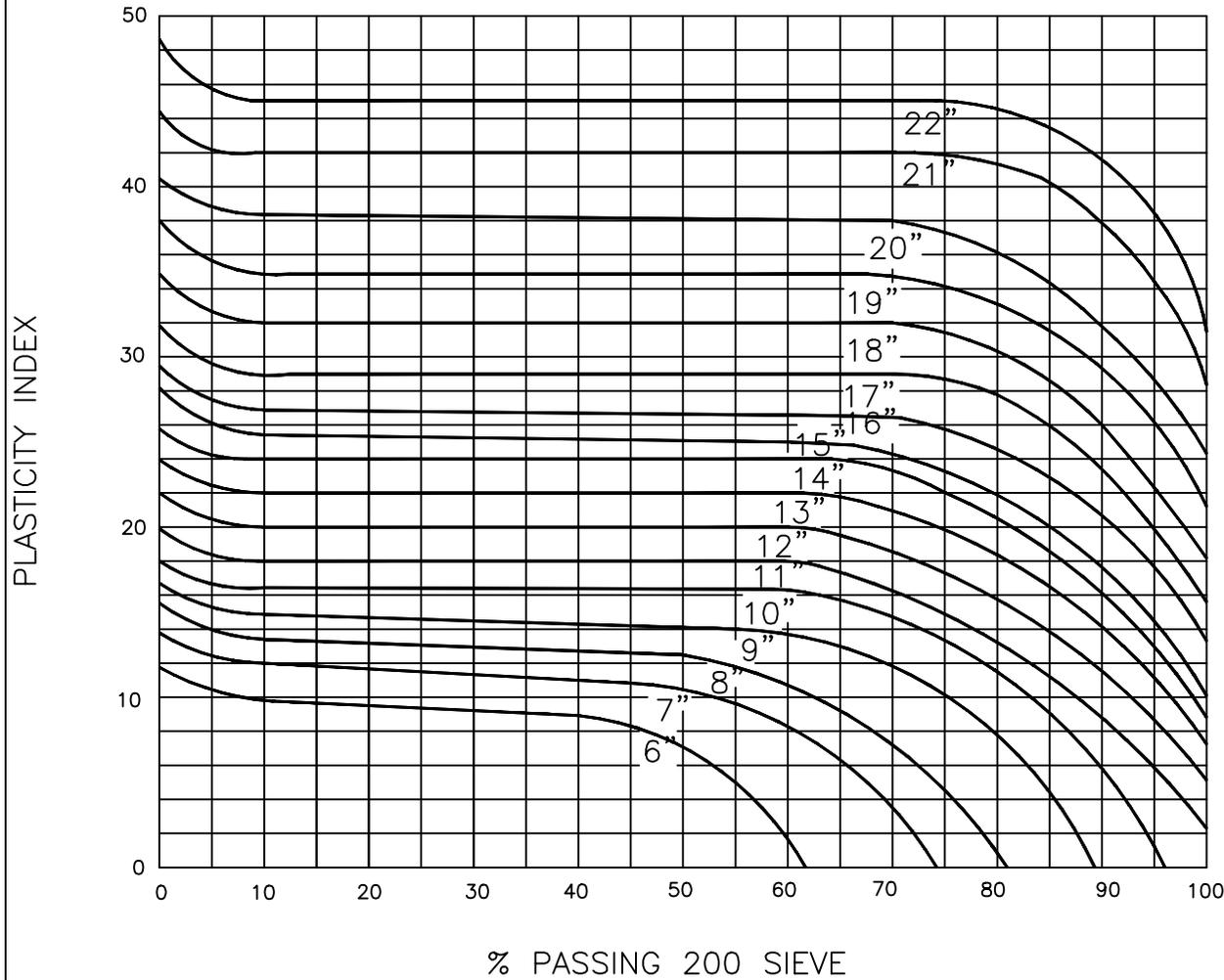
APPROVED

*Kenny W. Harris*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1102

### BASE THICKNESS CHART



**NOTES:**

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM-DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 2" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.  
P1103



**City of Phoenix**  
**STANDARD DETAIL**

DEPTH OF BASE COURSE  
(LOCAL COMMERCIAL & LIGHT INDUSTRIAL STREETS)

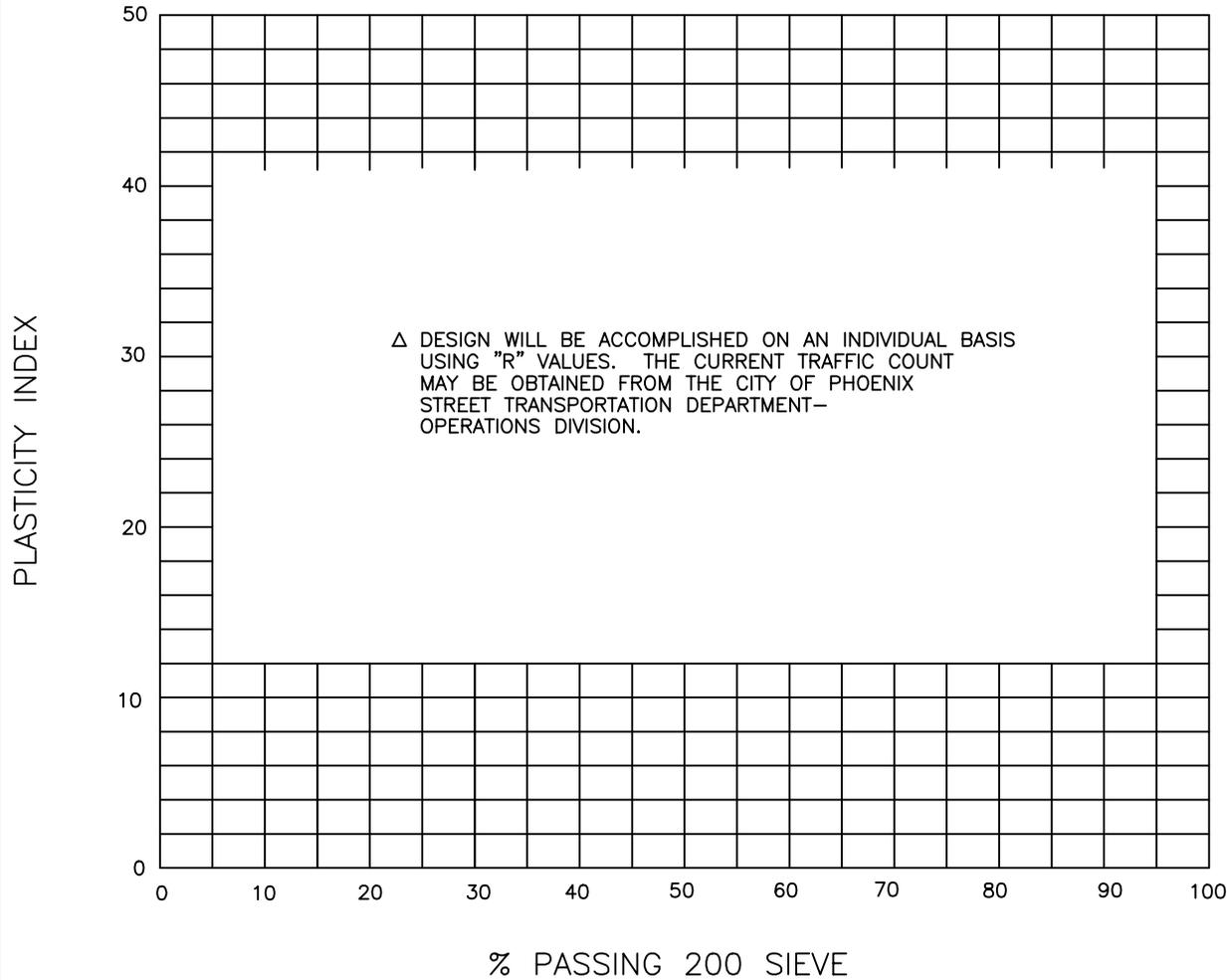
APPROVED

*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1103

### BASE THICKNESS CHART



**NOTES:**

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM-DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 5" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.  
P1104



**City of Phoenix**  
**STANDARD DETAIL**

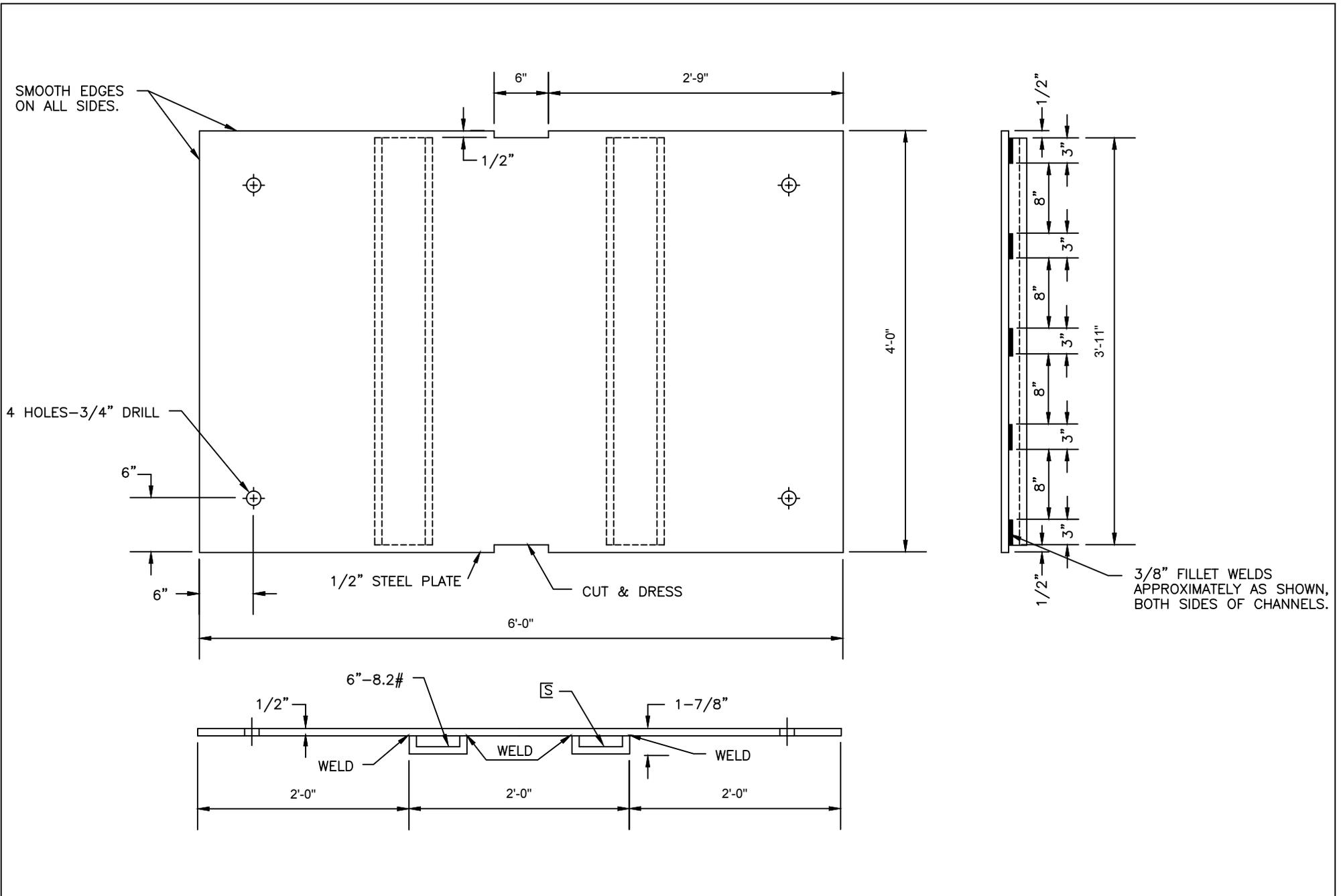
DEPTH OF BASE COURSE  
(MAJOR STREETS & HEAVY INDUSTRIAL STREETS)

APPROVED

*Maria S. Demando*  
CITY ENGINEER

2/11/02  
DATE

DETAIL NO.  
P1104



DETAIL NO.  
P1105



**City of Phoenix**  
**STANDARD DETAIL**

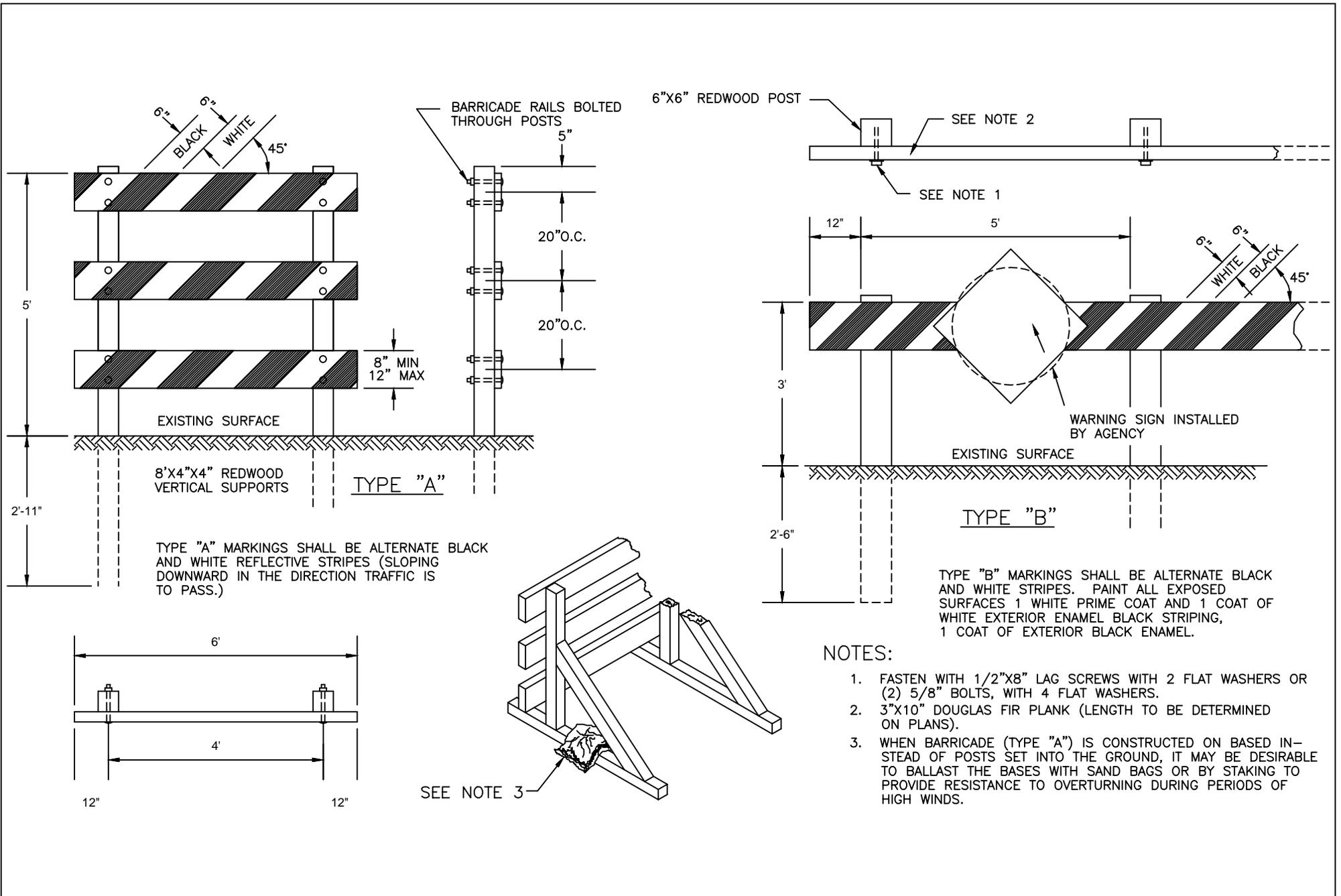
STEEL COVER FOR OPEN TRENCHES

APPROVED

*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1105



TYPE "A"

TYPE "B"

TYPE "A" MARKINGS SHALL BE ALTERNATE BLACK AND WHITE REFLECTIVE STRIPES (SLOPING DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS.)

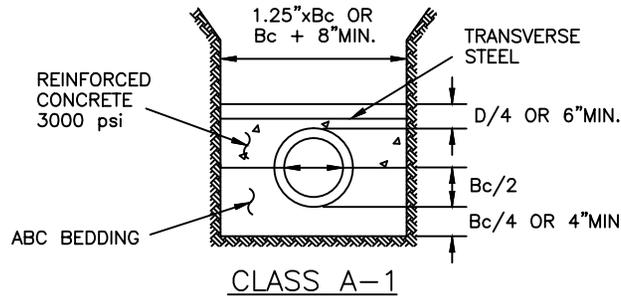
TYPE "B" MARKINGS SHALL BE ALTERNATE BLACK AND WHITE STRIPES. PAINT ALL EXPOSED SURFACES 1 WHITE PRIME COAT AND 1 COAT OF WHITE EXTERIOR ENAMEL BLACK STRIPING, 1 COAT OF EXTERIOR BLACK ENAMEL.

**NOTES:**

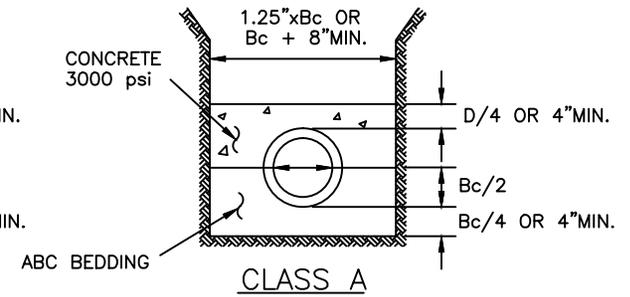
1. FASTEN WITH 1/2"x8" LAG SCREWS WITH 2 FLAT WASHERS OR (2) 5/8" BOLTS, WITH 4 FLAT WASHERS.
2. 3"x10" DOUGLAS FIR PLANK (LENGTH TO BE DETERMINED ON PLANS).
3. WHEN BARRICADE (TYPE "A") IS CONSTRUCTED ON BASED INSTEAD OF POSTS SET INTO THE GROUND, IT MAY BE DESIRABLE TO BALLAST THE BASES WITH SAND BAGS OR BY STAKING TO PROVIDE RESISTANCE TO OVERTURNING DURING PERIODS OF HIGH WINDS.

ALLOWABLE V.C.P. TRENCH LOADING

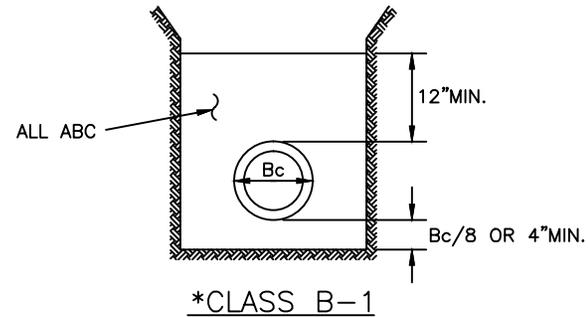
PIPE SIZE (INCHES)	V.C.P. THREE EDGE BEARING STRENGTH MIN.	ALLOWABLE TRENCH LOAD PER CLASS OF BEDDING SOIL WT.=130#/CU.FT. SAFETY FACTOR=1.5		
		CLASS A-1 L.F.=3.4	CLASS A L.F.=2.8	*CLASS B-1 L.F.=2.2
8	2200	4987	4107	3227
10	2400	5440	4480	3520
12	2600	5893	4853	3813
15	2900	6573	5413	4253
18	3300	7480	6160	4840
21	3850	8727	7187	5647
24	4400	9973	8213	6453
27	4700	10653	8773	6893
30	5000	11333	9333	7333
33	5500	12467	10267	8067
36	6000	13600	11200	8800
39	6600	14960	12320	9680



LOAD FACTOR: 3.4 REINFORCED CONCRETE,  $p=0.4\%$



LOAD FACTOR: 2.8 PLAIN CONCRETE



LOAD FACTOR: 2.2 ABC ENCASEMENT

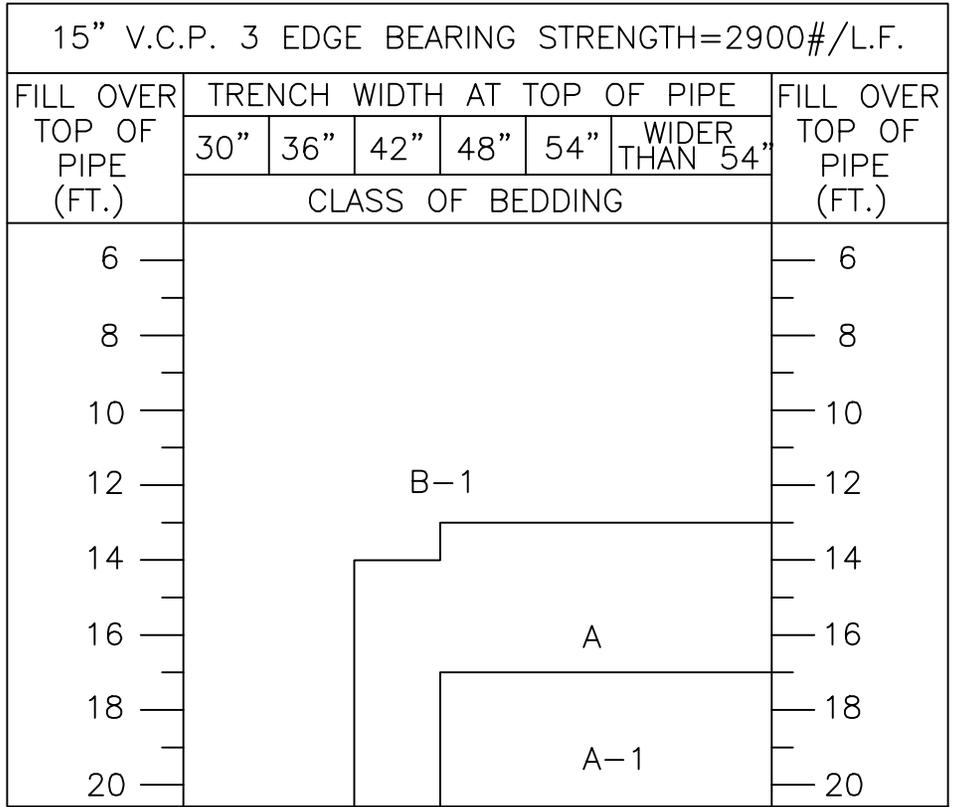
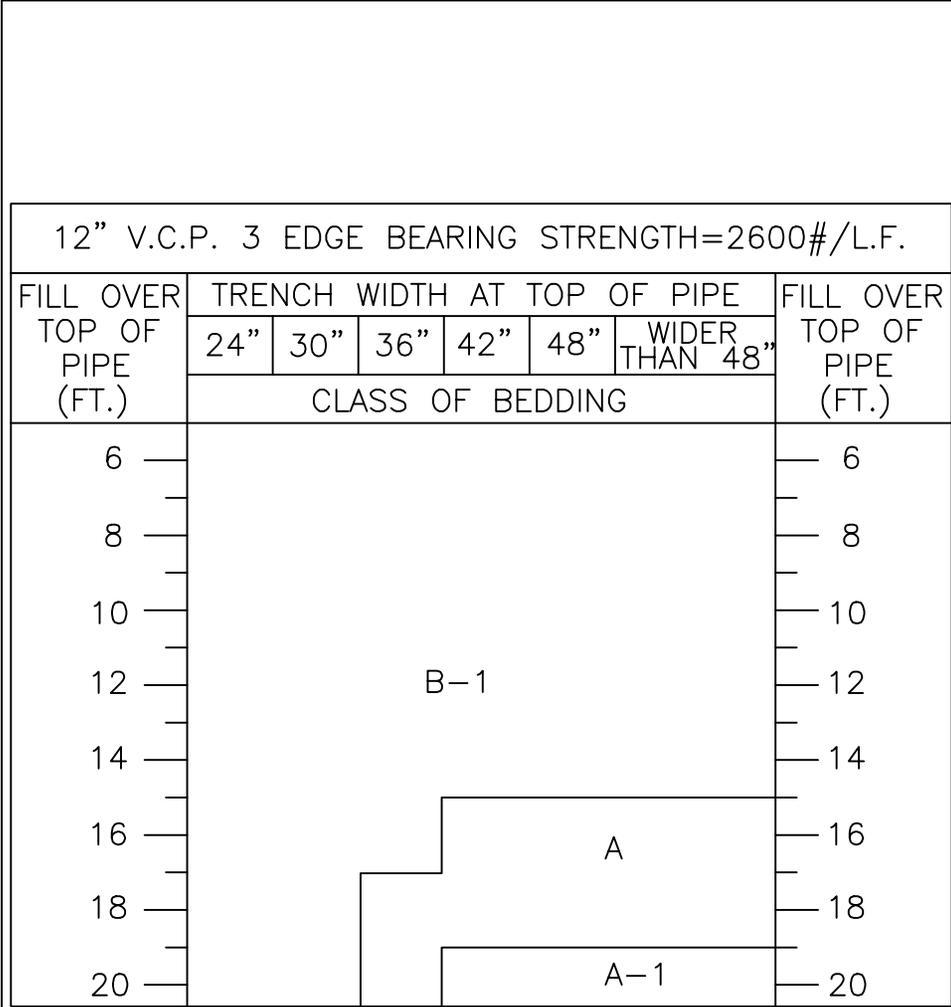
**NOTE:**

SECTION 601 APPLIES FOR FOUNDATION, BEDDING, BACKFILL, MATERIALS AND COMPACTION.

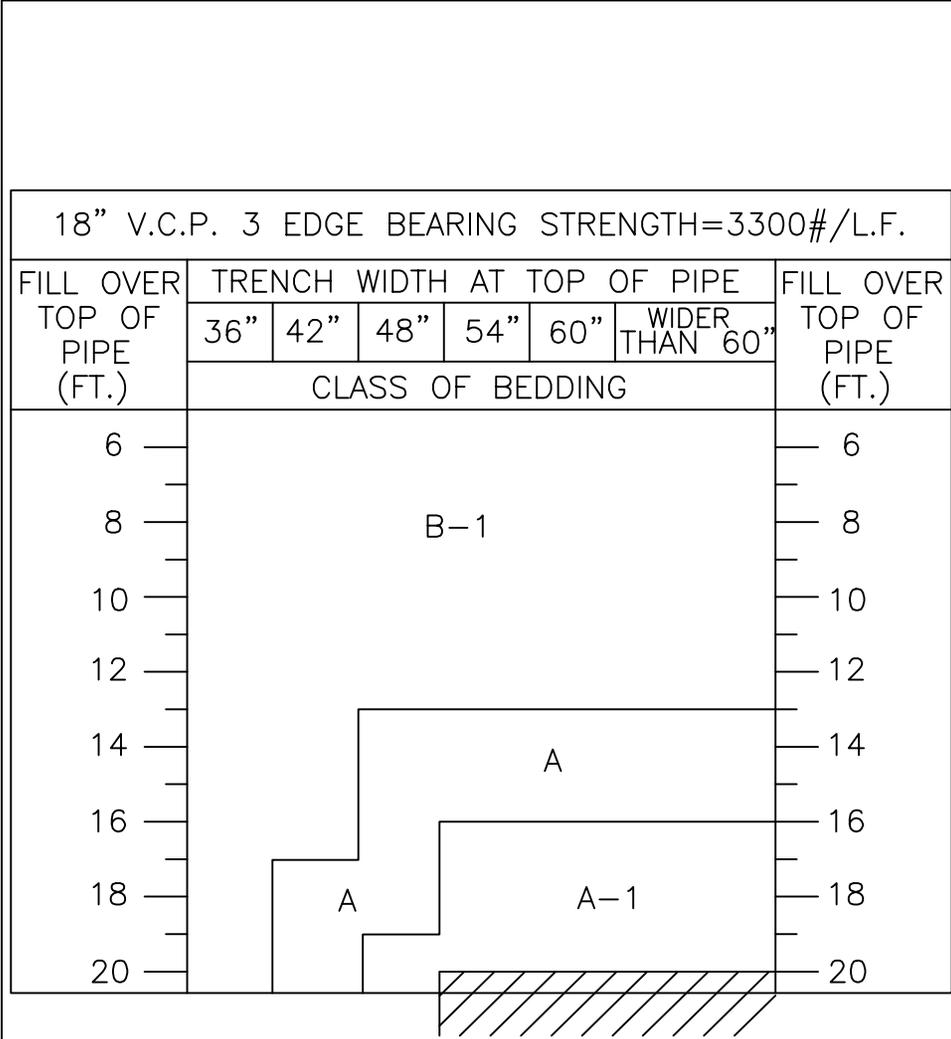
8" V.C.P. 3 EDGE BEARING STRENGTH=2200#/L.F.							
FILL OVER TOP OF PIPE (FT.)	TRENCH WIDTH AT TOP OF PIPE						FILL OVER TOP OF PIPE (FT.)
	18"	24"	30"	36"	42"	WIDER THAN 42"	
CLASS OF BEDDING							
6	B-1						6
8							8
10							10
12							12
14							14
16							16
18							18
20	A						20

10" V.C.P. 3 EDGE BEARING STRENGTH=2400#/L.F.							
FILL OVER TOP OF PIPE (FT.)	TRENCH WIDTH AT TOP OF PIPE						FILL OVER TOP OF PIPE (FT.)
	24"	30"	36"	42"	48"	WIDER THAN 48"	
CLASS OF BEDDING							
6	B-1						6
8							8
10							10
12							12
14							14
16							16
18							18
20	A						20

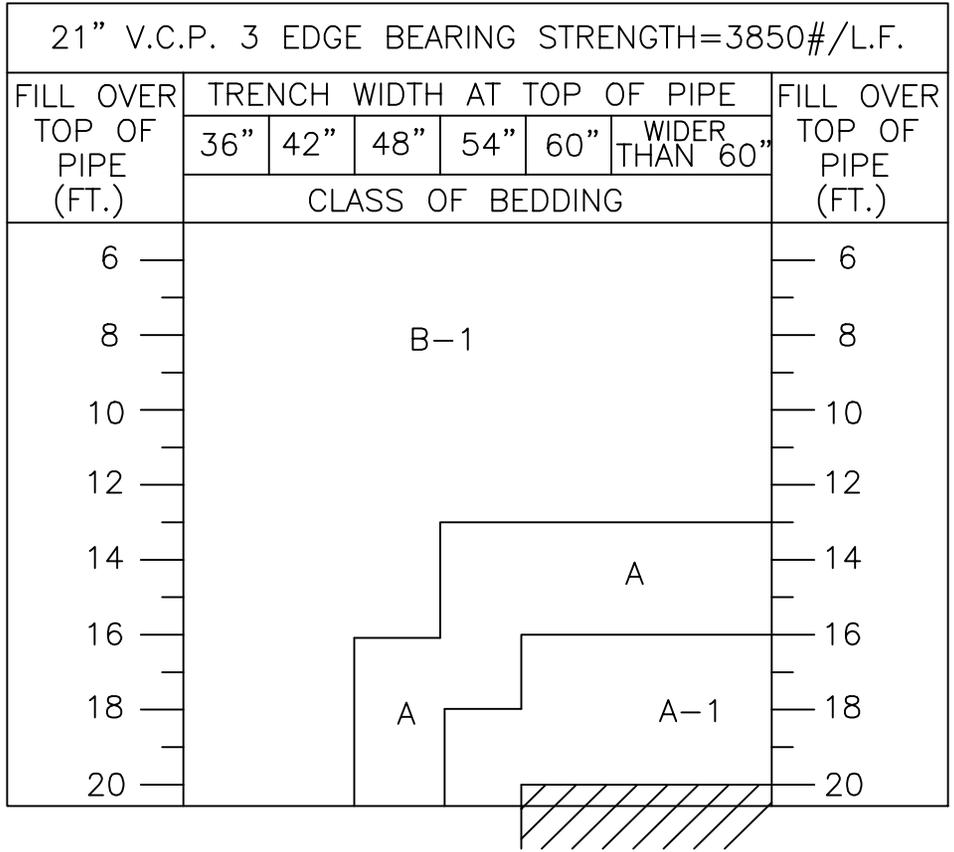
SEE DETAIL P1120 FOR BEDDING DETAILS



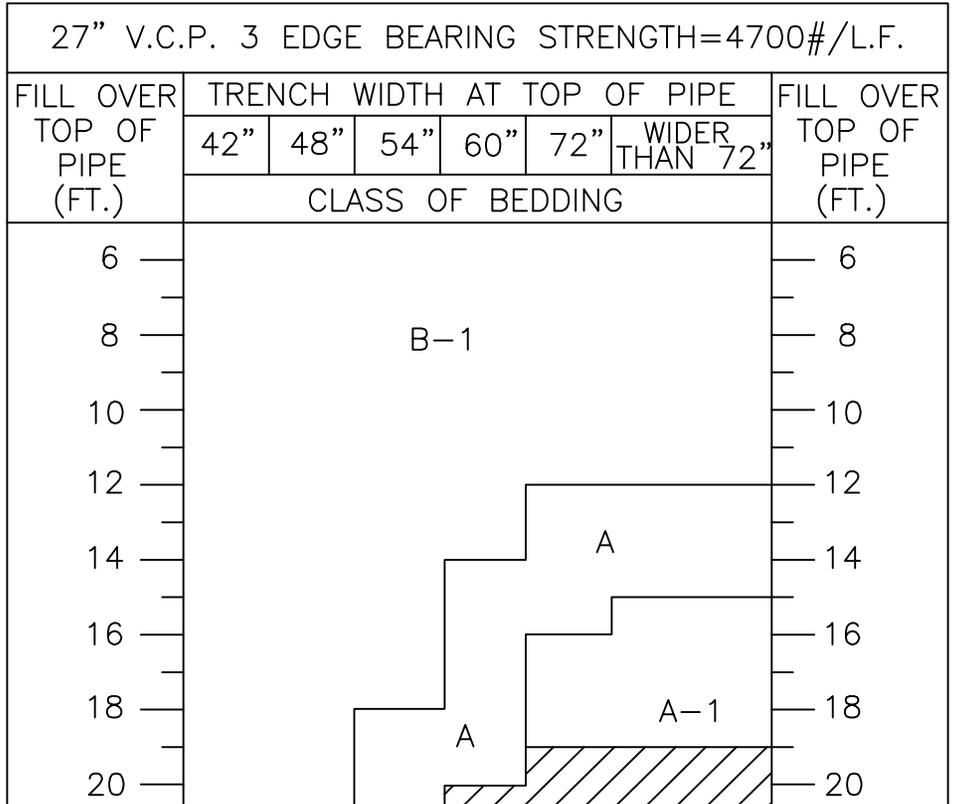
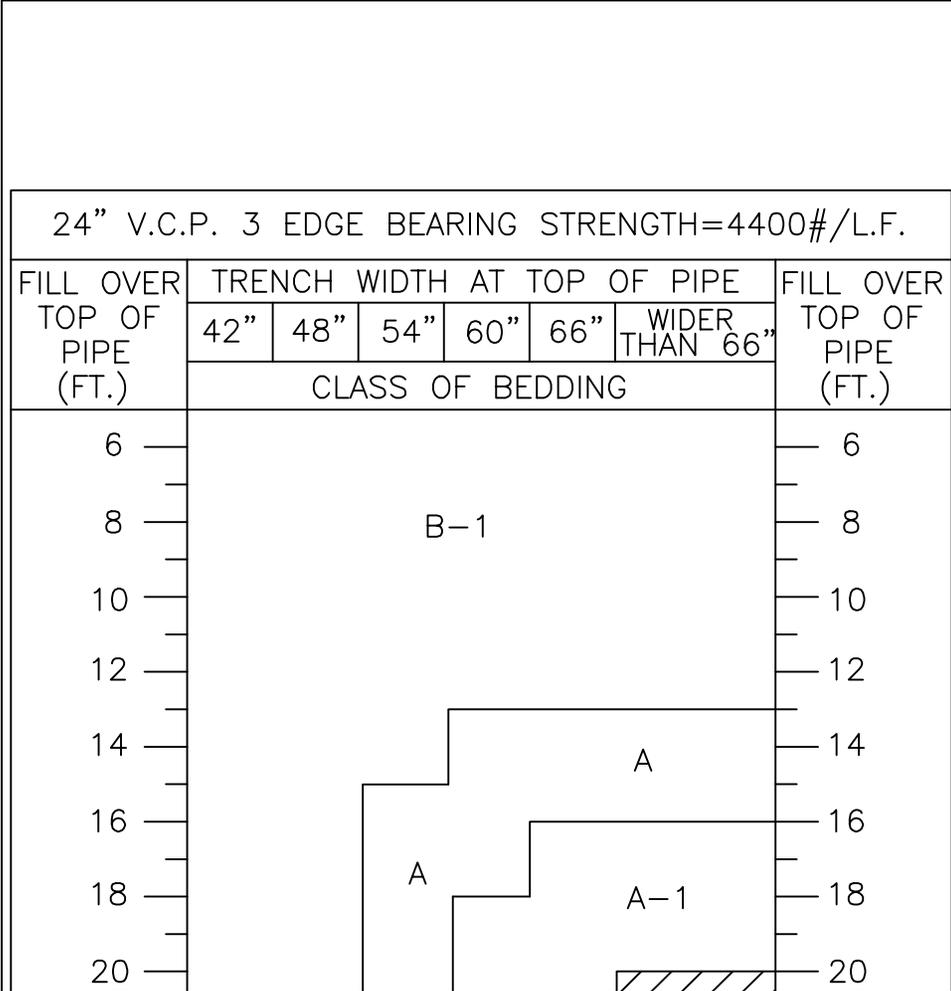
SEE DETAIL P1120 FOR BEDDING DETAILS



REQUIRES DESIGN ACTION

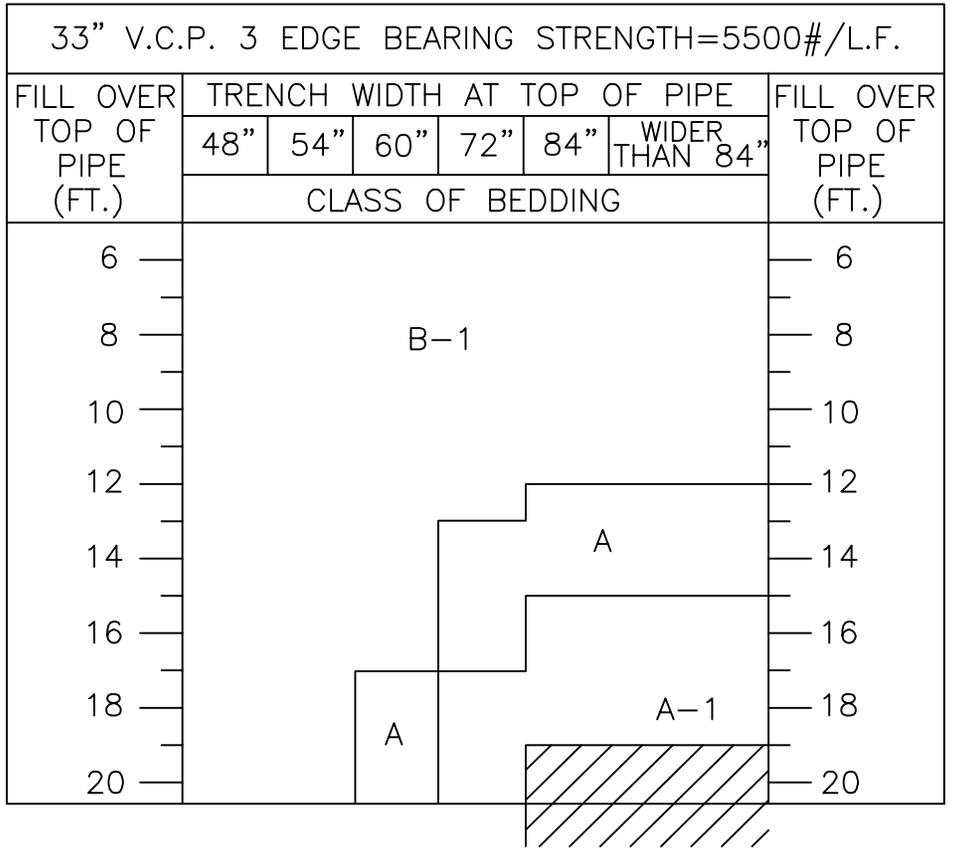
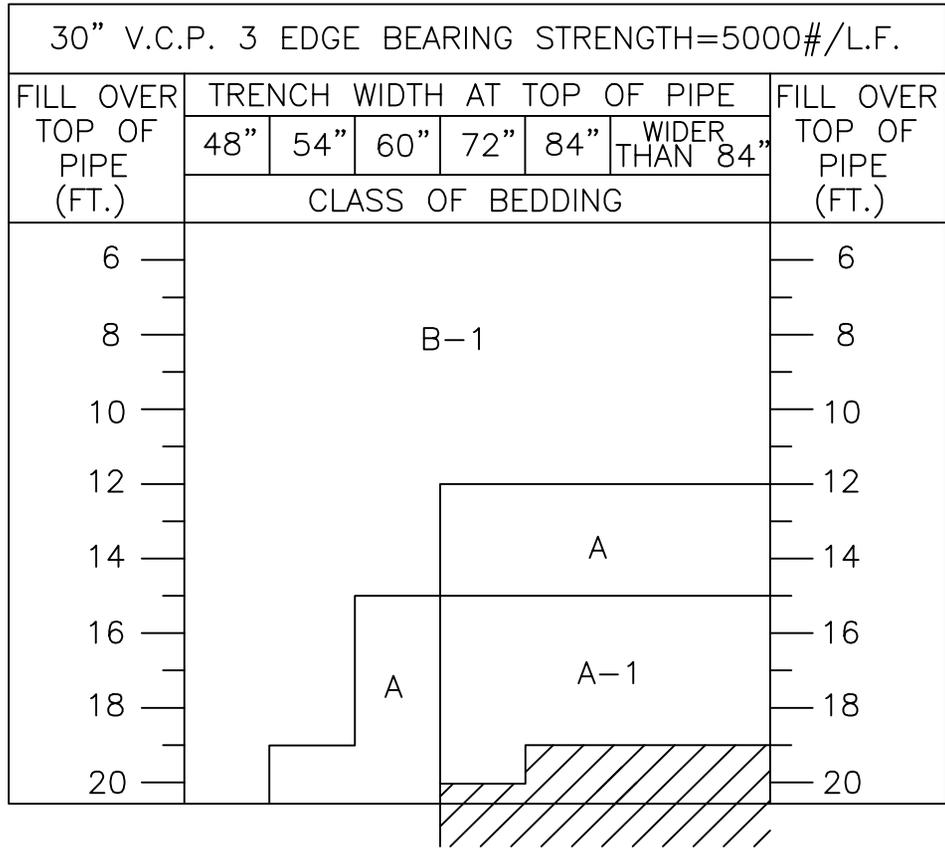


SEE DETAIL P1120 FOR BEDDING DETAILS



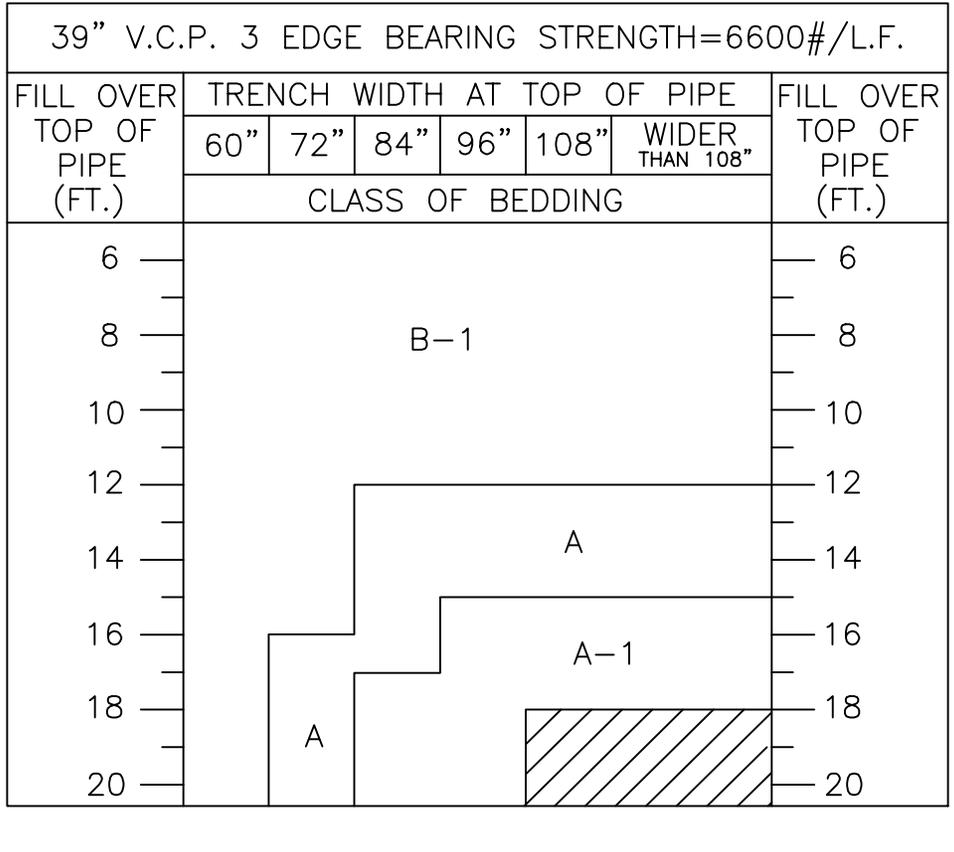
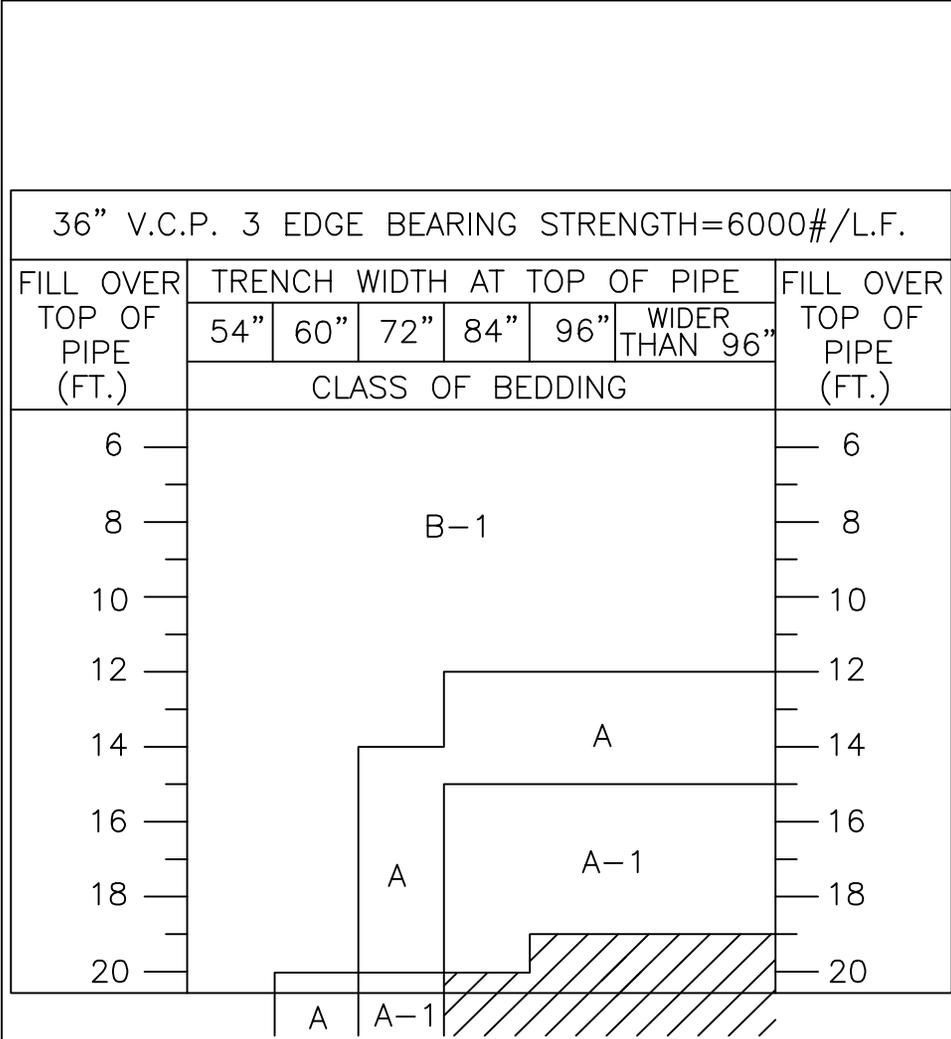
 REQUIRES DESIGN ACTION

SEE DETAIL P1120 FOR BEDDING DETAILS



 REQUIRES DESIGN ACTION

SEE DETAIL P1120 FOR BEDDING DETAILS



 REQUIRES DESIGN ACTION

SEE DETAIL P1120 FOR BEDDING DETAILS

ALLOWABLE V.C.P. TRENCH LOADING

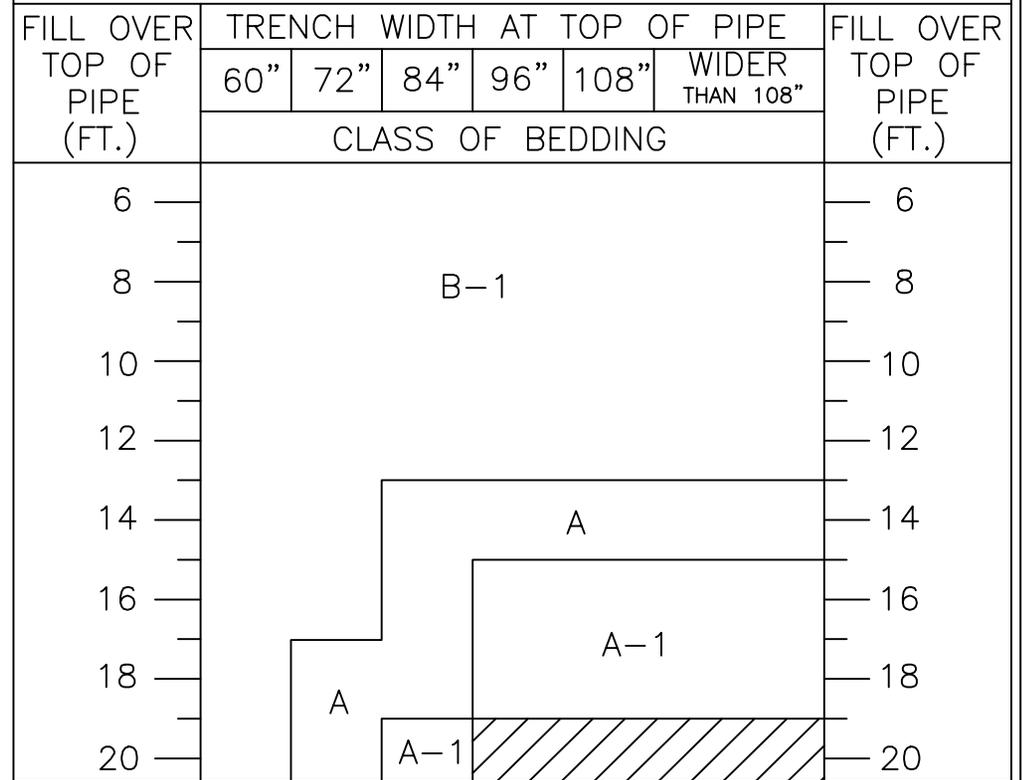
PIPE SIZE (INCHES)	V.C.P. THREE EDGE BEARING STRENGTH MIN.	ALLOWABLE TRENCH WIDTH PER CLASS OF BEDDING SOIL WT.=130#/CU.FT. SAFETY FACTOR=1.5		
		CLASS A-1 L.F.=3.4	CLASS A L.F.=2.8	*CLASS B-1 L.F.=2.2
42	7000	15867	13067	10267

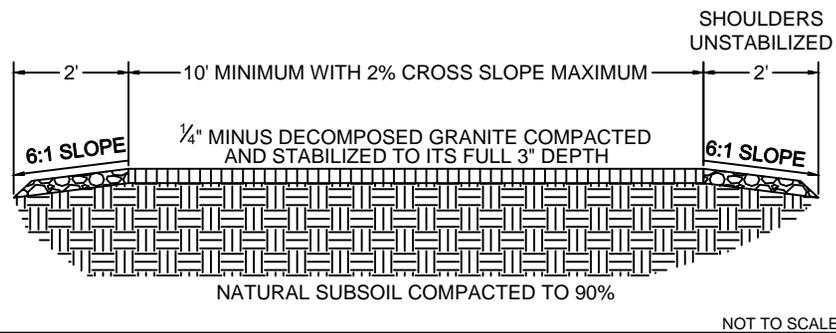
SEE DETAIL P1120 FOR BEDDING DETAILS



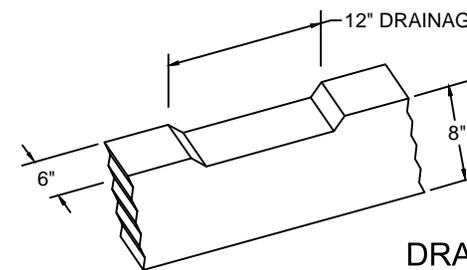
REQUIRES DESIGN ACTION

42" V.C.P. 3 EDGE BEARING STRENGTH=7000#/L.F.



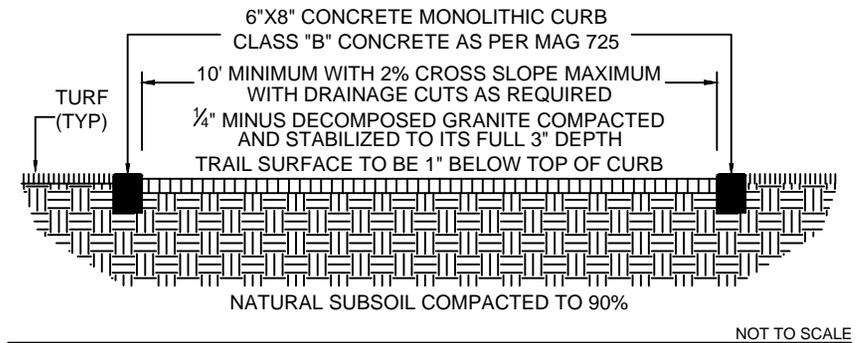


MULTI-USE TRAIL IN DECOMPOSED GRANITE

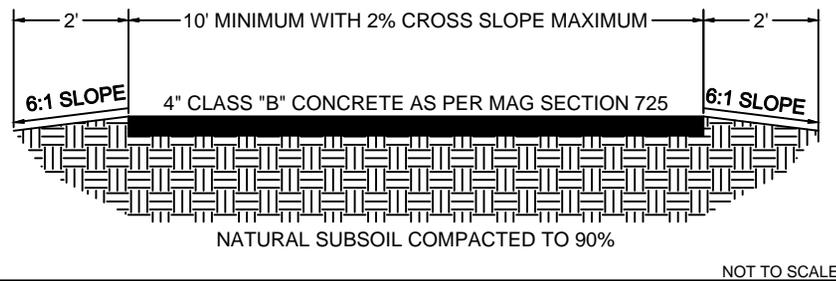


DRAINAGE CUT

NOTCH 1" DEEP WITH 45° CUT (TYP.) AS NEEDED TO PROVIDE DRAINAGE



MULTI-USE TRAIL IN TURF



SHARED USE PATH

NOTES:

1. NO RUNNING SLOPE SHALL EXCEED 5%. IF RUNNING SLOPE EXCEEDS 5%, TRAIL MUST CONFORM TO AMERICANS WITH DISABILITIES ACT GUIDELINES.
2. TRAILS WILL NOT EXCEED 8% SLOPES, SLOPES 5-8% NOT TO EXCEED 30' DISTANCE WITHOUT 5' LANDING. REFER TO U.S. DEPARTMENT OF JUSTICE WEBSITE FOR MORE INFORMATION.
3. SHARED-USE PATH WILL FOLLOW P1230 SIDEWALK DETAILS & SPECIFICATIONS FOR CONCRETE SIDEWALK.
4. MULTI-USE TRAIL TO BE LOCATED WITH AN EXCLUSIVE MINIMUM 30' PUBLIC MULTI-USE TRAIL EASEMENT THAT MAY INCLUDE A PUE.
6. SHARED-USE PATH TO BE LOCATED WITHIN A 20' PUBLIC SIDEWALK EASEMENT.
7. MULTI-USE TRAILS AND SHARED-USE PATHS LOCATED WITHIN OR ADJACENT TO OPEN SPACE OR WASH CORRIDORS WILL BE LOCATED WITHIN A MINIMUM 25' PUBLIC TRAIL EASEMENT.

DETAIL NO.  
P1130



**City of Phoenix**  
**STANDARD DETAIL**

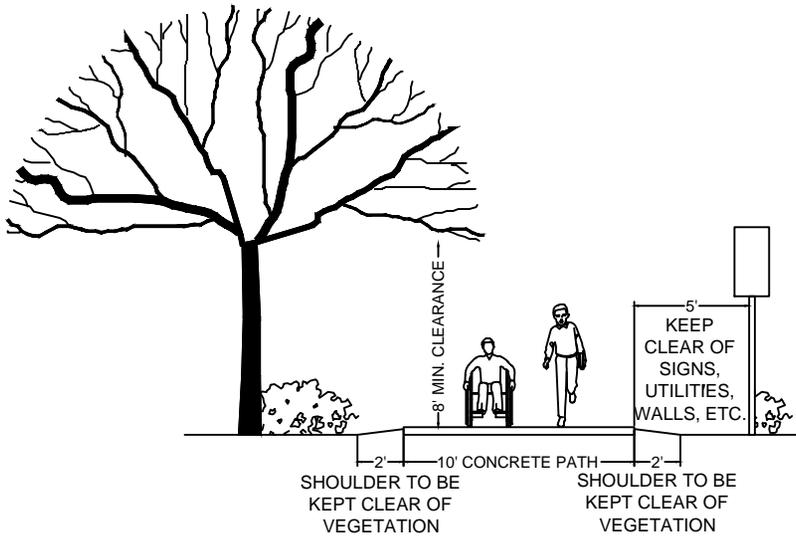
MULTI-USE TRAILS  
AND SHARED-USE PATHS

APPROVED

*[Signature]*  
ACTING CITY ENGINEER

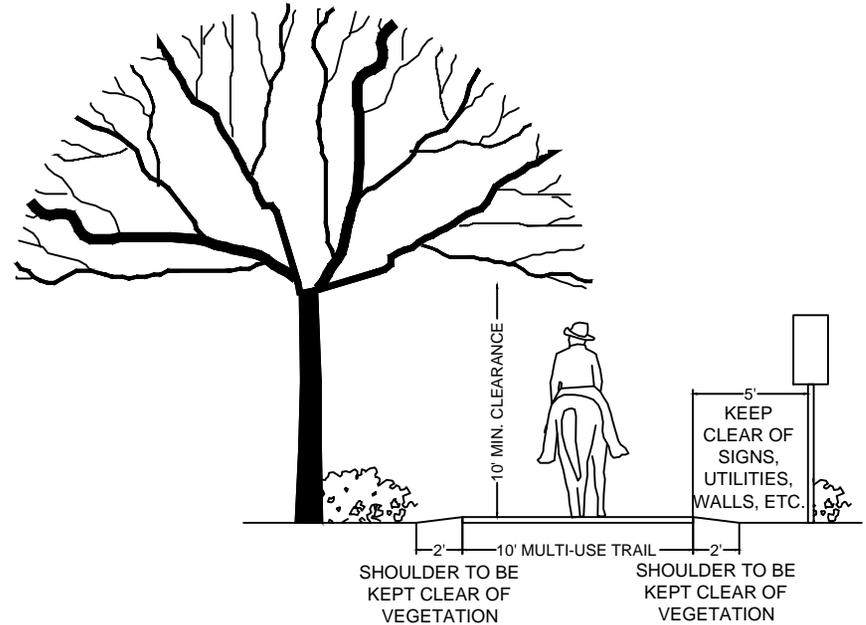
7/31/08  
DATE

DETAIL NO.  
P1130



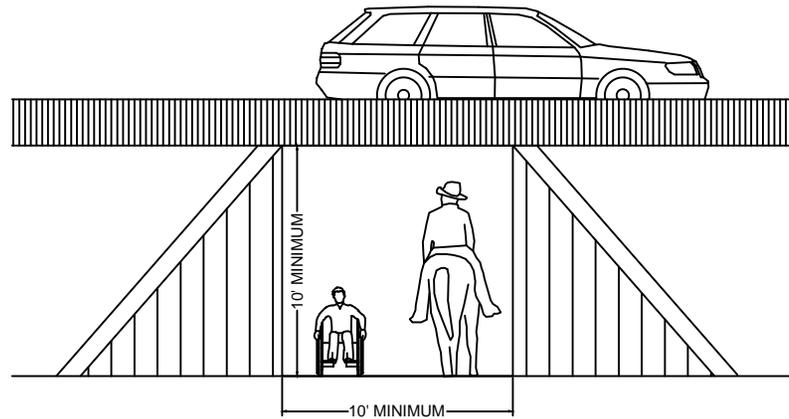
NOT TO SCALE

SHARED-USE PATHS - OBSTRUCTION CLEARANCES



NOT TO SCALE

MULTI-USE TRAILS - OBSTRUCTION CLEARANCES



NOT TO SCALE

UNDERPASS DIMENSIONS

DETAIL NO.  
P1131



**City of Phoenix**  
**STANDARD DETAIL**

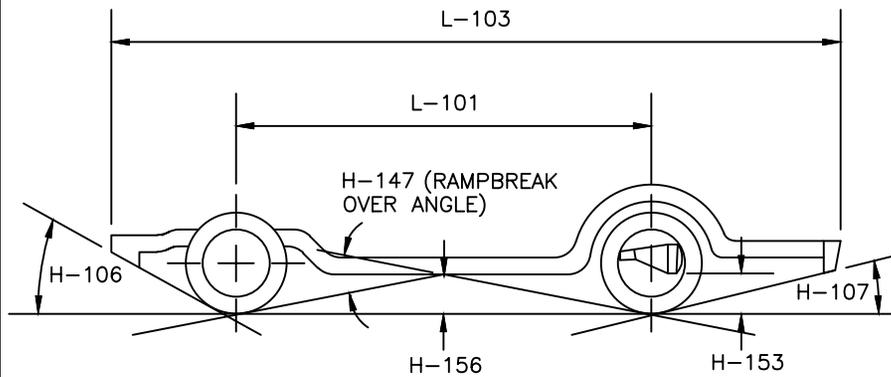
VERTICAL CLEARANCE, MULTI-USE, SHARED-USE,  
AND UNDERPASS/BRIDGE CLEARANCE

APPROVED

*[Signature]*  
ACTING CITY ENGINEER

7/31/08  
DATE

DETAIL NO.  
P1131



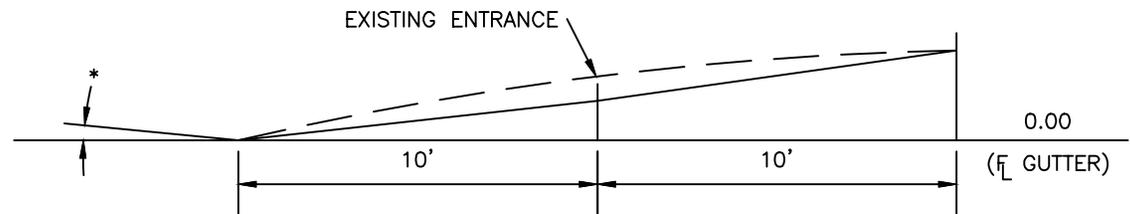
### NOTES

1. IF THE SUM OF THE STREET CROWN SLOPE, NORMALLY A NEGATIVE SLOPE OF 1.72" (0.03), AND THE POSITIVE SLOPE IF THE DRIVEWAY IS EQUAL TO OR EXCEEDS THE ANGLE OF DEPARTURE, 8.3" (0.146), THE DRIVEWAY MUST BE REDESIGNED TO A POSITIVE SLOPE OF NOT MORE THAN 6" (0.105).
2. ADDITIONAL INCREASES IN THE POSITIVE SLOPE MAY BE MADE AT TEN (10) FOOT INTERVALS. EACH CHANGE CANNOT EQUAL OR EXCEED THE ANGLE OF DEPARTURE, 8.3" (0.146).
3. CHANGES FROM A POSITIVE SLOPE TO A NEGATIVE SLOPE CANNOT EQUAL OR EXCEED THE BREAKOVER ANGLE OF 5.53" (0.097).
4. WHEN MAKING CHANGE FROM A NEGATIVE SLOPE TO A POSITIVE SLOPE, THE SUM OF THE TWO SLOPES CANNOT EQUAL OR EXCEED THE ANGLE OF DEPARTURE, 8.3" (0.146).

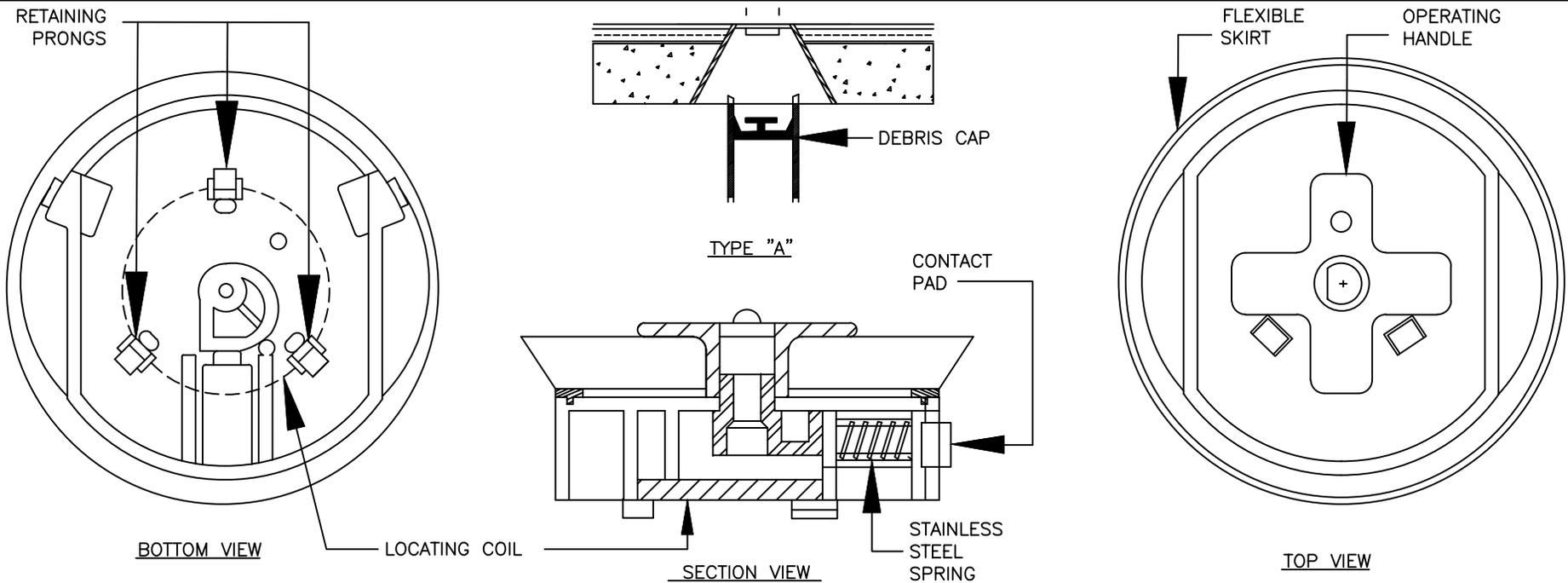
### GROUND CLEARANCE DIMENSIONS

- H-106 - ANGLE OF APPROACH = 8.6 DEGREES
- H-107 - ANGLE OF DEPARTURE = 8.3 DEGREES
- H-147 - RAMP BREAKOVER ANGLE = 5.53 DEGREES
- H-153 - REAR AXLE TO GROUND = 5.5 INCHES
- H-156 - MINIMUM GROUND CLEARANCE = 3.1 INCHES
- L-101 - WHEELBASE = 9.88 FEET
- L-103 - VEHICLE LENGTH = 18.42 FEET

THESE DIMENSIONS ARE FROM THE 1982 MOTOR VEHICLE MANUFACTURERS ASSOCIATION PUBLICATION. COPIES MAY BE OBTAINED FROM TECHNICAL AFFAIRS DIVISION, MOTOR VEHICLE MANUFACTURERS ASSOCIATION, 300 NEW CENTER BUILDING, DETROIT, MICHIGAN 48202.



\* 0.03% MAXIMUM TRANSVERSE SLOPE ALLOWABLE



### NOTES

1. DEBRIS CAP SHALL BE INSTALLED AS CLOSE UNDER THE CAST IRON COVER WITHOUT INTERFERING WITH COVER OPERATION.
2. FLEXIBLE SKIRT SHALL BE TRIMMED TO PROVIDE A SMOOTH CONTACT WITH THE INTERIOR DIAMETER OF THE PIPE.
3. THE DEBRIS CAP SHALL BE MANUFACTURED BY SW SERVICES, INC., PHOENIX, ARIZONA OR APPROVED EQUAL.
4. THE DEBRIS CAP SHALL BE COMPRISED OF A HOLLOW MEMBER HAVING A CYLINDRICAL OUTER SURFACE, A CLOSURE FOR ONE END AND THREE POINT RESILIENT CONTACT PADS PROJECTING FROM THE OUTER SURFACE. THE CAP SHALL HAVE A FLEXIBLE SKIRT PROVIDING AN OUTWARD SEAL PREVENTING DEBRIS FROM GETTING PAST THE CAP. THE CAP MUST WITHSTAND, WITHOUT SLIPPAGE, A MINIMUM VERTICAL FORCE OF 50 POUNDS, AT A LOADING RATE OF 1.0 IN/MINUTE. THE CAP SHALL BE MOLDED USING GENERAL ELECTRIC ABS #HIM 4500. THE CAP SHALL HAVE RETAINING PRONGS TO RETAIN A STANDARD LOCATING COIL. SCOTCHMARK 4" DISC MARKER 141.7khz BY 3M, OR APPROVED EQUAL.
5. DEBRIS CAPS WITH LOCATOR COILS ARE TO BE INSTALLED ON ANY NEW WATER SERVICES DEPARTMENT CIP PROJECTS, STREET TRANSPORTATION DEPARTMENT CIP PAVING PROJECTS (NEW, REPLACEMENT, AND OVERLAYS) AND PRIVATE DEVELOPMENT PROJECTS IN THE FOLLOWING VALVE BOX LOCATIONS:
  - ALL MAJOR (ARTERIAL) STREETS
  - ANY UNPAVED AREAS
  - ALL EASEMENTS
  - GUTTER LOCATIONS
  - STREETS WITHOUT CURB & GUTTER
  - COUNTY ROADS
  - GATE VALVE LOCATIONS ON WATERLINES GREATER THAN 12" IN DIAMETER
  - ANY OTHER LOCATION INDICATED ON THE PLANS PER THE DESIGNER

DETAIL NO.  
P1165



**City of Phoenix**  
**STANDARD DETAIL**

DEBRIS CAP INSTALLATION

APPROVED

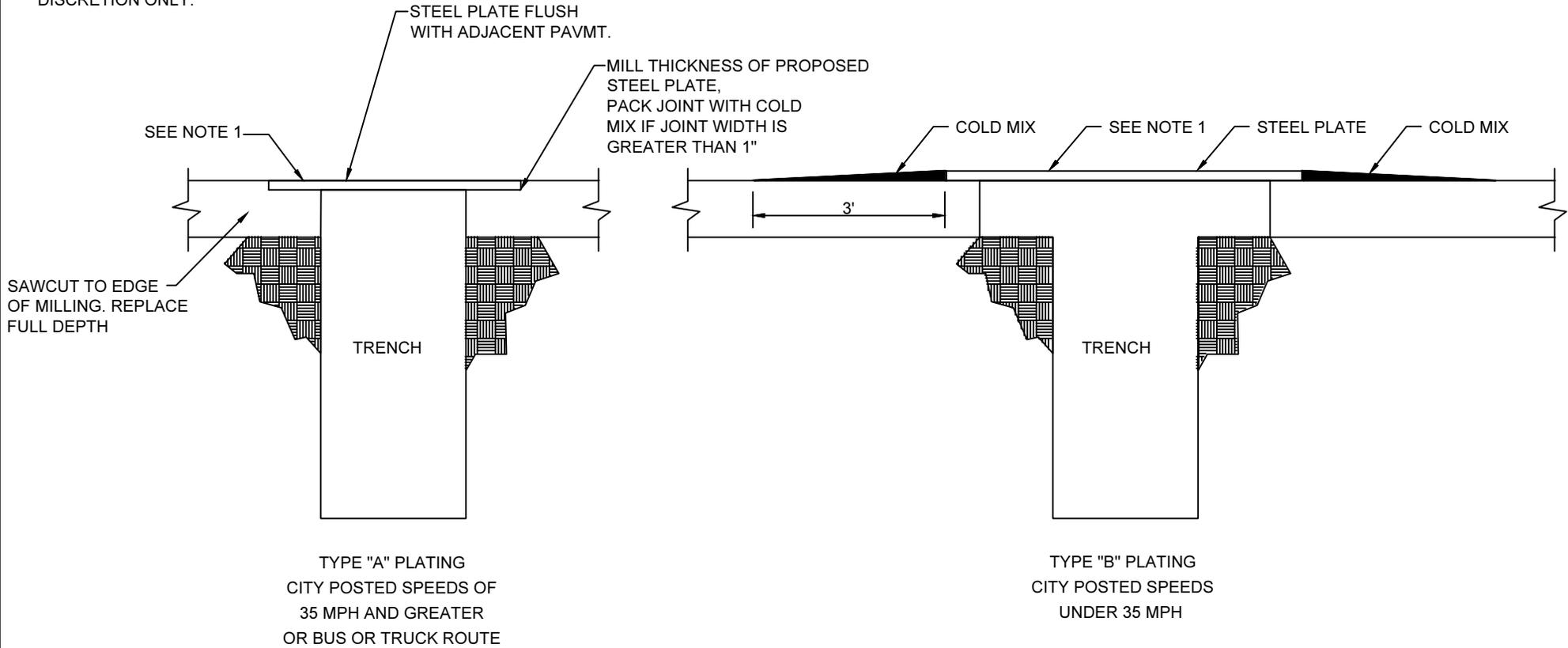
*[Signature]*  
ACTING CITY ENGINEER

7/31/08  
DATE

DETAIL NO.  
P1165

**NOTES:**

1. PROVIDE 2' MIN. OVERLAP OF PLATE ON ASPHALT TO ASSURE NO SLIPPAGE OF PLATE AND NO COLLAPSING OF TRENCH.
2. "POSTED SPEED" DOES NOT INCLUDE TEMPORARY CONSTRUCTION SIGNING.
3. METHOD OF ASPHALT REMOVAL OTHER THAN MILLING AT INSPECTOR'S DISCRETION ONLY.



IF TRENCH LENGTH IS LESS THAN 5-FEET AND STEEL PLATES WILL BE IN PLACE LESS THAN 48 HOURS, STEEL PLATES MAY BE PLACED DIRECTLY ON EXISTING ASPHALT WITHOUT MILLING. PROVIDE TEMPORARY ASPHALT TRANSITIONS EXTENDING 3-FEET BEYOND EDGE OF STEEL PLATES.

DETAIL NO.  
P1170



**City of Phoenix**  
**STANDARD DETAIL**

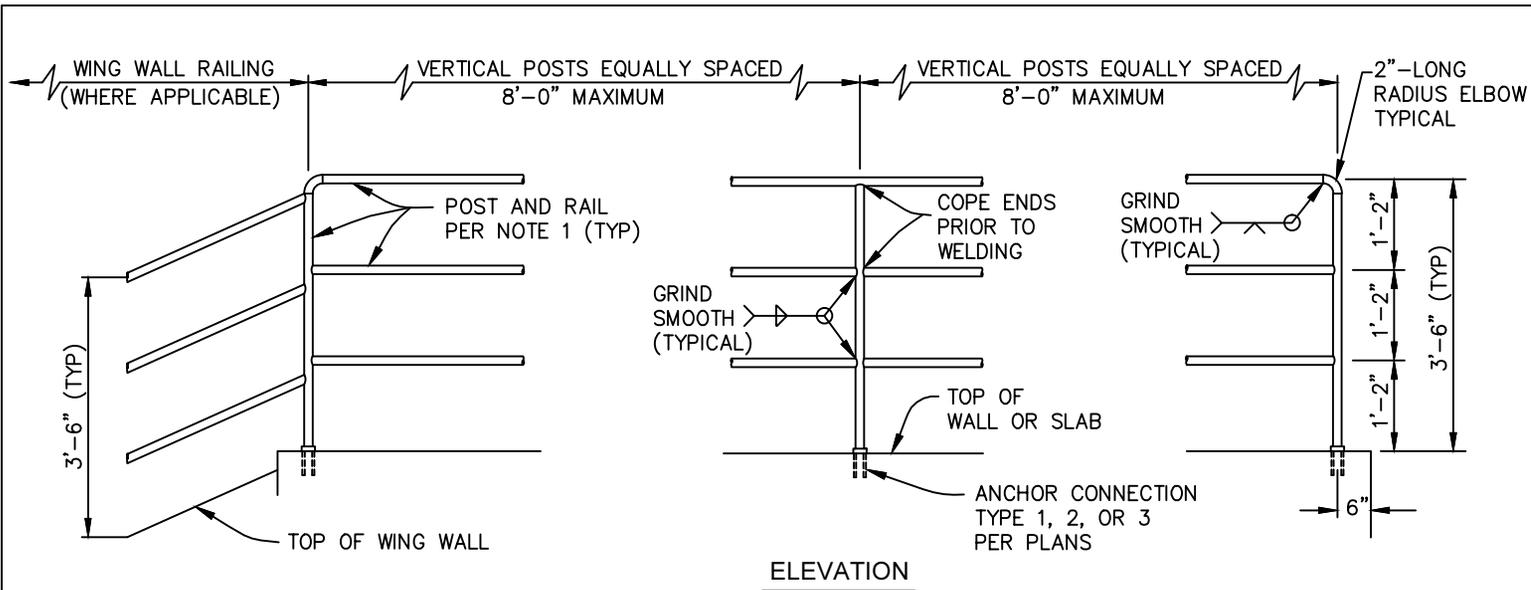
TRENCHING STEEL PLATE

APPROVED

*Maria Saldamando*  
CITY ENGINEER

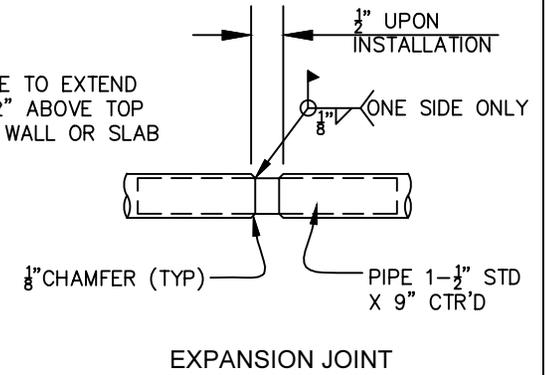
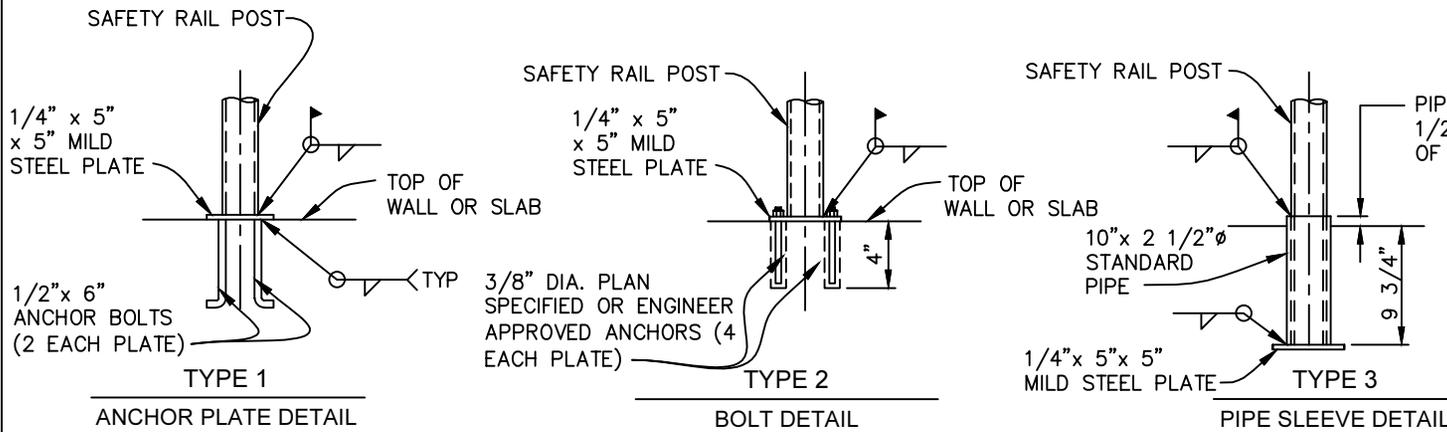
7/9/92  
DATE

DETAIL NO.  
P1170



**CONSTRUCTION NOTES**

1. PIPE 2 STD (ASTM A53 GRADE B) GALVANIZED PER SECTION 771.
2. PAINT PER SECTION 530 WHERE REQUIRED BY ORDINANCE OR PLANS. COLOR PER PLANS.
3. VERTICAL POSTS TO BE EVENLY SPACED.
4. SAFETY RAILING TO BE PLACED ON ALL HEADWALLS AND AT THE BACK OF SCUPPERS.
5. ANCHORAGE AT SCUPPERS SHALL BE PER MAG STD DETAIL 206-2.
6. EXPANSION JOINT SPACING SHALL NOT EXCEED 40FT AND SHALL BE LOCATED AT STRUCTURE EXPANSION JOINTS, WHICHEVER IS LESS.



**NOTES:**

1. FOR GROUND INSTALLATION REFER TO MAG STD DETAIL 145.
2. NOT TO BE USED AS A PEDESTRIAN BRIDGE RAIL.

DETAIL NO.  
P1173



**City of Phoenix**  
**STANDARD DETAIL**

SAFETY RAILING DETAIL

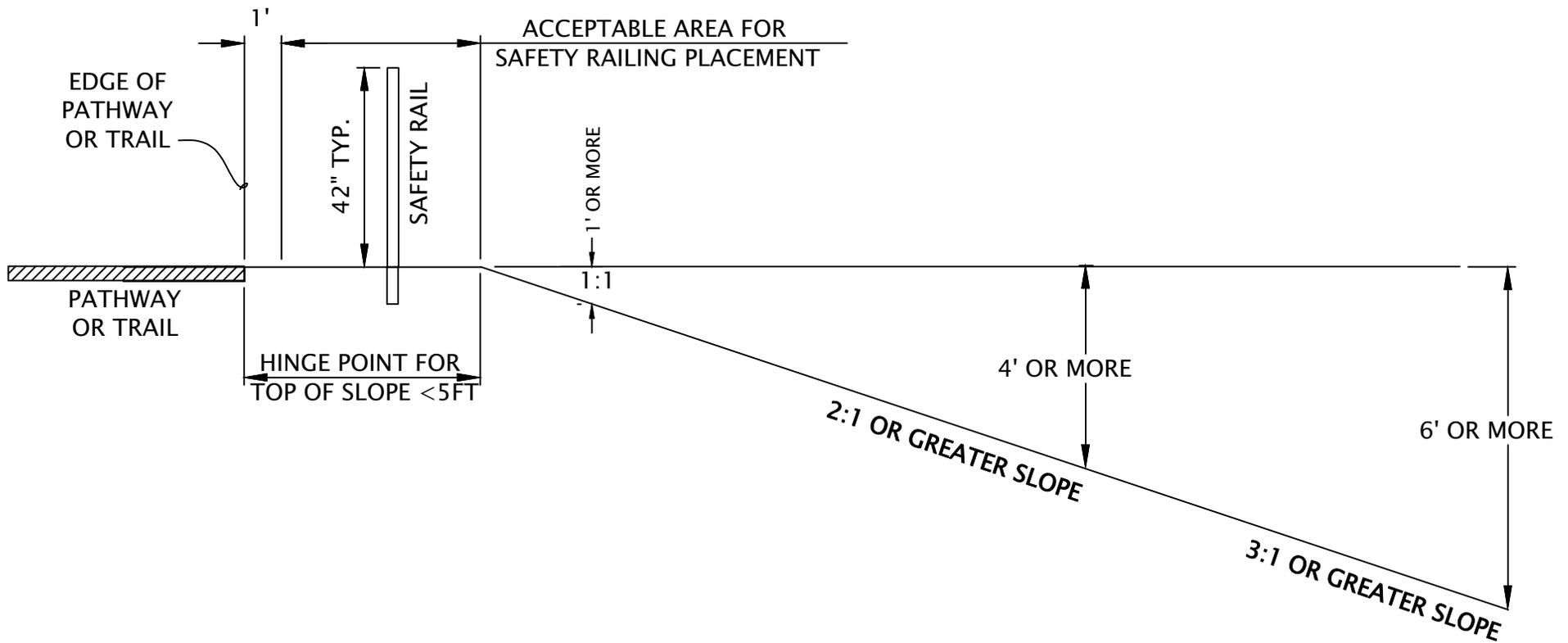
APPROVED

*[Signature]*  
CITY ENGINEER

12/10/2012  
DATE

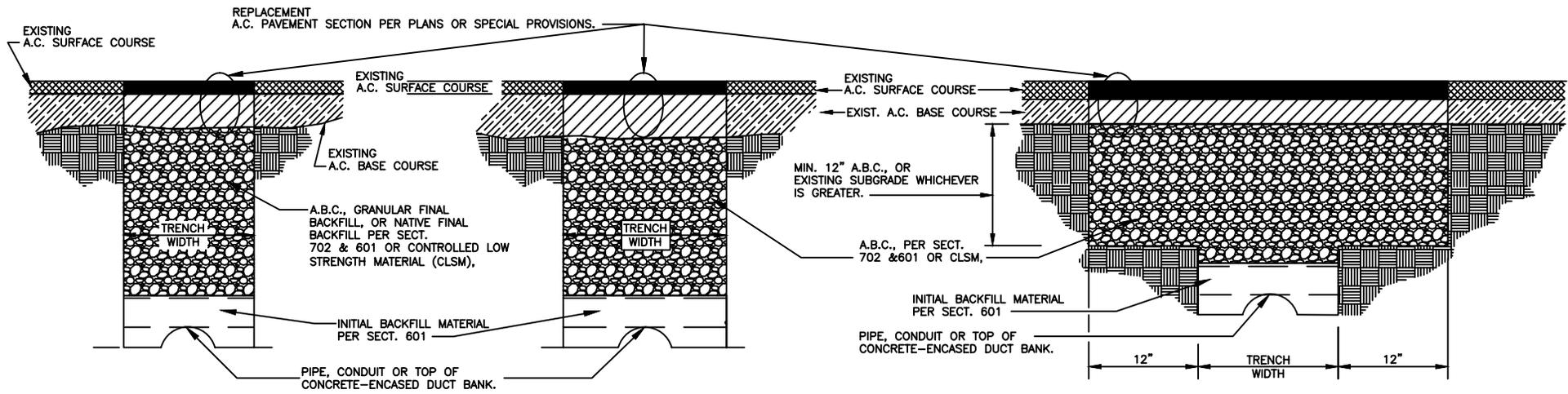
DETAIL NO.  
P1173

# CONDITIONS WHERE SAFETY RAILINGS (DETAIL P1173) ARE REQUIRED (REFER TO SAFETY RAILING MAG DETAIL 145, TYPE 4 FOR ATTACHMENT TO THE GROUND)



NOTE:  
1) SAFETY RAILS ARE REQUIRED WHERE THE CONDITIONS WILL EXCEED THE ABOVE DEPICTED LIMITS

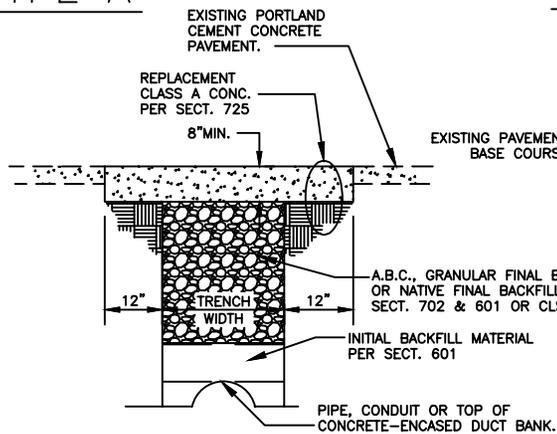
NOT TO SCALE



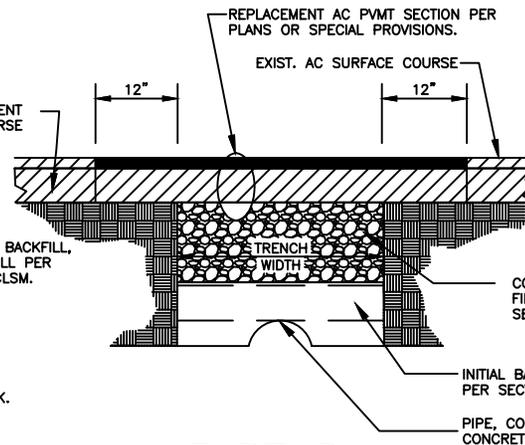
TYPE A

TYPE B

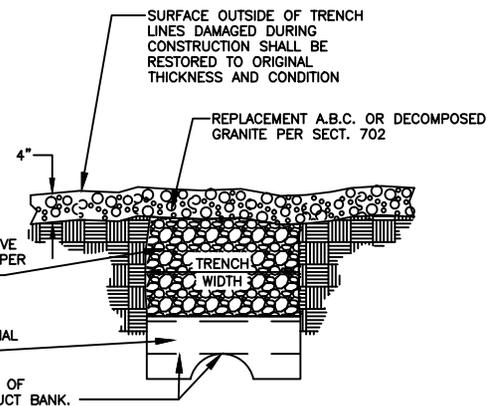
TYPE B-"T" TOP



TYPE C



TYPE D



TYPE E

**NOTES:**

1. INITIAL BACKFILL PER SECTION 601 FOR ALL TRENCH TYPES.
2. REFER TO SECTION 336.3 FOR FINAL BACKFILL & SURFACE REPLACEMENT TYPES REQ'D BASED ON TRENCH ORIENTATION IN STREETS.
3. TRENCH WIDTH PER SECTION 336 & 601.
4. EXPOSED WATER SERVICE PIPES THAT CROSS TRENCHES TO BE BACKFILLED WITH CLSM SHALL BE WRAPPED WITH MIN. 3/4" THICK CLOSED CELL FOAM INSULATION PRIOR TO PLACEMENT OF CLSM.
5. FOR TRENCHES UP TO 24" WIDE, CLSM MAY BE USED UP TO THE REPLACEMENT PAVEMENT SUBGRADE LEVEL. FOR TRENCHES BETWEEN 24" AND 6' WIDE, CLSM SHALL ONLY BE PLACED IN THE TOP 24" OF TRENCH. FOR TRENCHES WIDER THAN 6', CLSM FINAL BACKFILL SHALL NOT BE USED, UNLESS APPROVED BY THE ENGINEER.

DETAIL NO.  
P1200



**City of Phoenix**  
**STANDARD DETAIL**

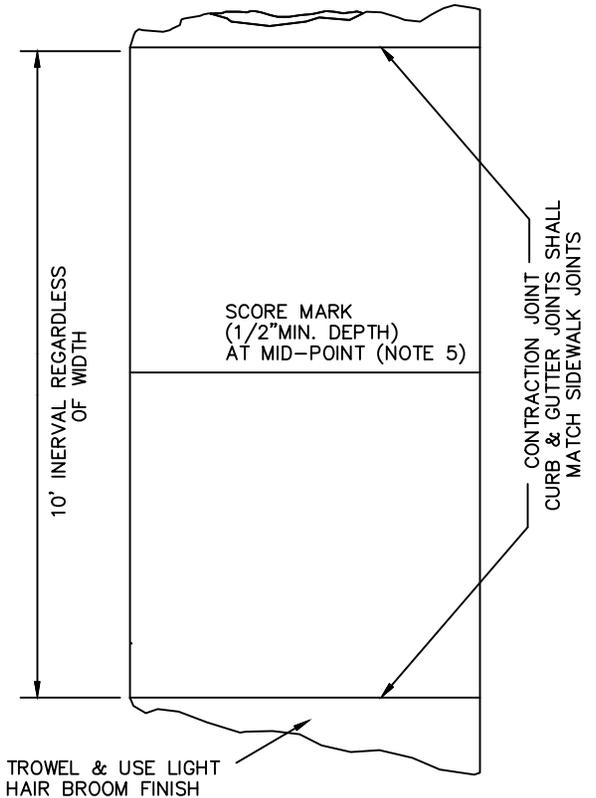
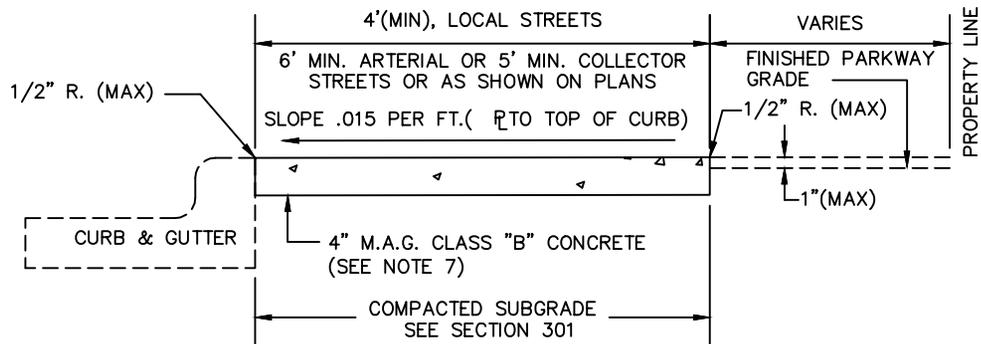
TRENCH BACKFILL  
& SURFACE REPLACEMENT

APPROVED

*[Signature]*  
CITY ENGINEER

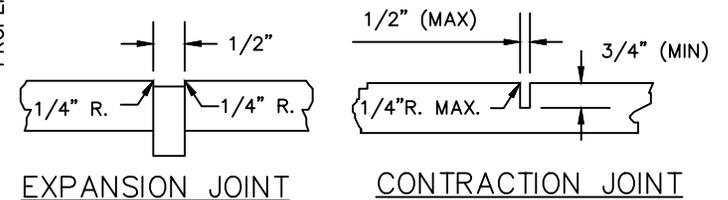
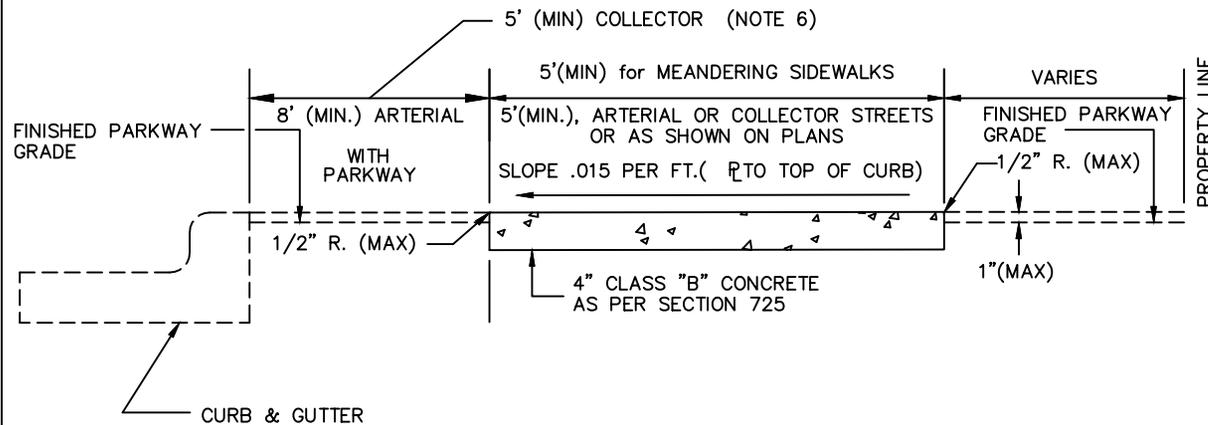
07/01/2015  
DATE

DETAIL NO.  
P1200



**NOTES:**

1. SIDEWALK CONSTRUCTION SHALL CONFORM TO SECTION 340.
2. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751.
3. EXPANSION JOINTS SHALL BE INSTALLED PRIOR TO ALL POURS, AT POINTS OF CURVATURE, AT ADJOINING STRUCTURES, AT DRIVEWAYS AND AT A MAXIMUM SPACING OF 50'. THE EXPANSION JOINT MUST PROVIDE FOR COMPLETE SEPARATION OF THE SIDEWALK FROM ADJOINING CONCRETE.
4. THE EXPANSION JOINT MATERIAL SHALL EXTEND FROM 1/4" BELOW THE TOP SURFACE OF THE SIDEWALK TO 1" INTO THE SUBGRADE.
5. WHEN SIDEWALK AND ADJACENT CURB ARE INSTALLED MONOLITHICALLY, THE MID-POINT SCORE LINE MUST EXTEND ACROSS THE CURB & GUTTER.
6. EXCEPTION TO BE APPROVED BY CITY ENGINEER.
7. CONCRETE SHALL BE M.A.G. CLASS "A" IN AREAS WITH CROSSING VEHICULAR TRAFFIC.



DETAIL NO.  
P1230



**City of Phoenix**  
**STANDARD DETAIL**

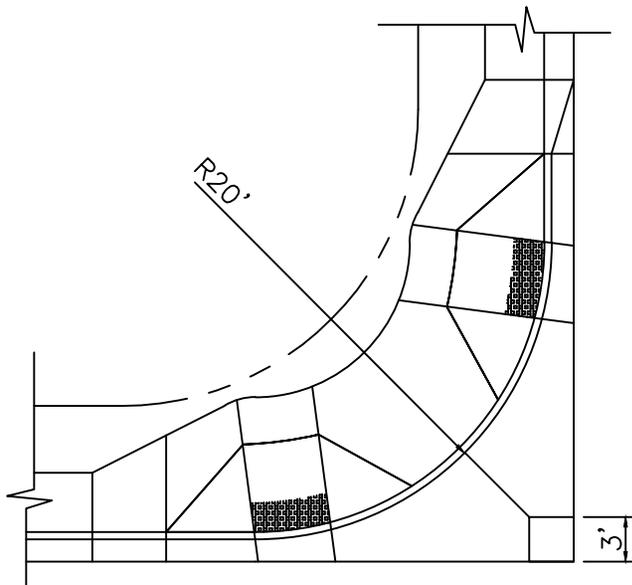
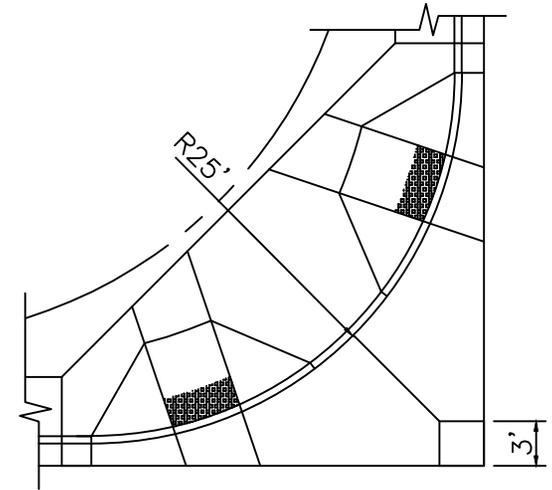
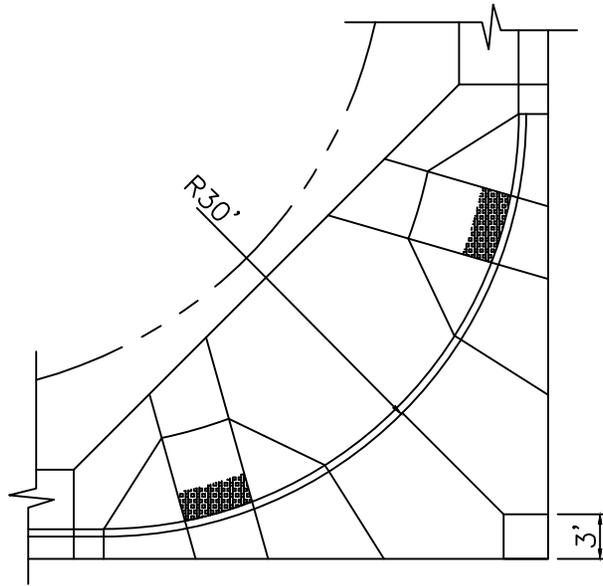
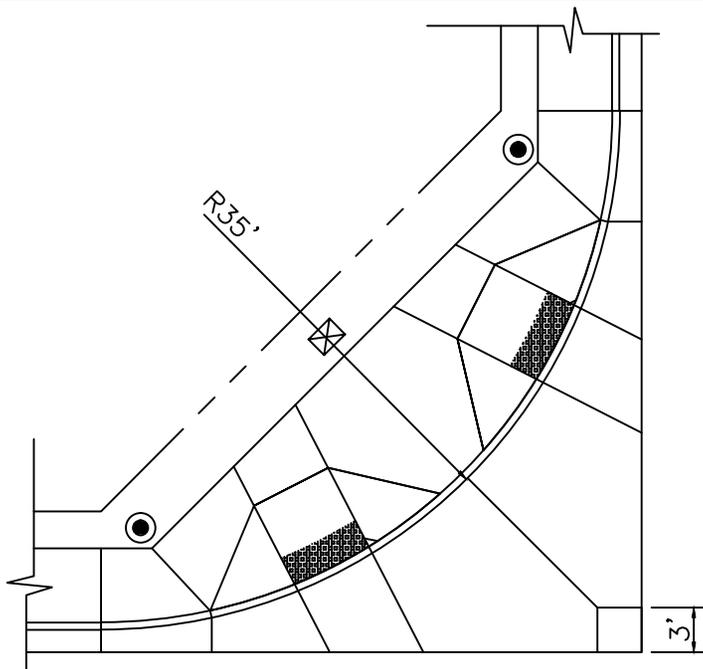
SIDEWALKS

APPROVED

*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

DETAIL NO.  
P1230



NOTES:

1. CONSTRUCT THE CONTRACTION JOINTS AS SHOWN ON CONCRETE APRON FOR THE RADIUS REQUIRED.
2. WHEN PLANS CALL FOR A CLASS "A" CONCRETE VALLEY GUTTER THE CONTRACTION JOINTS SHALL BE SPACED SYMMETRICAL WITH AT LEAST ONE JOINT EVERY 10 FEET.
3. WHEN PLANS CALL FOR A 7' VALLEY GUTTER, MAKE A 7' SQUARE INSTEAD OF A 3' SQUARE.

DETAIL NO.  
P1231



**City of Phoenix**  
**STANDARD DETAIL**

APRON JOINTS

APPROVED

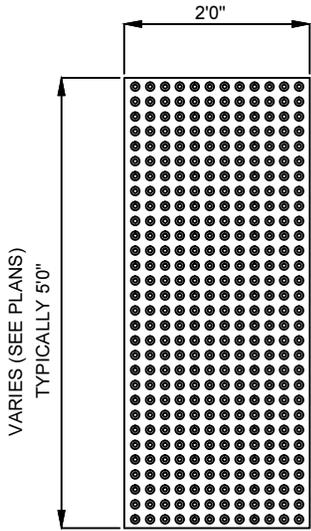
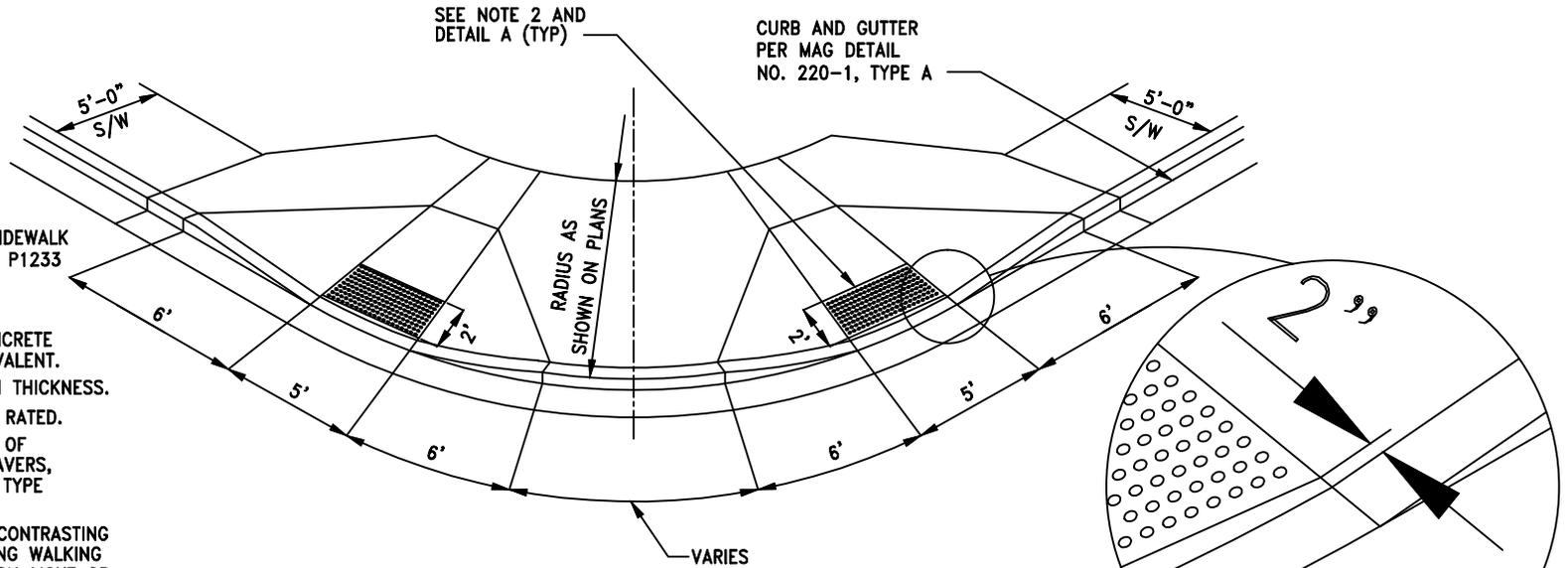
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CITY ENGINEER

07/01/2015  
DATE

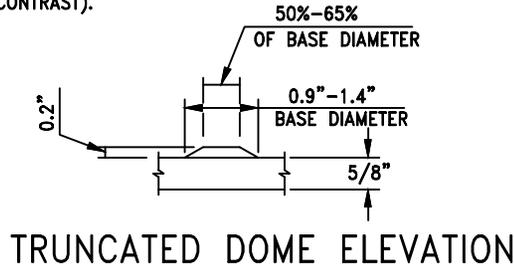
DETAIL NO.  
P1231

**NOTES:**

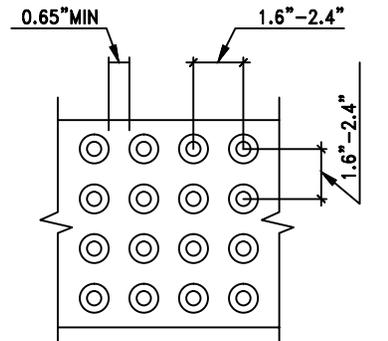
1. CONSTRUCTION DETAILS FOR ALL SIDEWALK RAMPs ARE PRESENTED IN DETAILS P1233 THROUGH P1241-3.
2. DETECTABLE WARNING STRIP:
  - 2.1 SHALL BE OF CONCRETE, CONCRETE POLYMER OR APPROVED EQUIVALENT.
  - 2.2 SHALL HAVE A 5/8" MINIMUM THICKNESS.
  - 2.3 SHALL BE 8000 PSI MINIMUM RATED.
  - 2.4 SHALL NOT BE CONSTRUCTED OF ASPHALT PAVEMENT, BRICK PAVERS, STAMPED CONCRETE, OR ANY TYPE OF GLUE-DOWN MATERIAL.
  - 2.5 DOME AREA SHALL BE OF A CONTRASTING COLOR FROM THE SURROUNDING WALKING AREAS. FOR EXAMPLE, DARK ON LIGHT OR LIGHT ON DARK (MINIMUM OF 70% CONTRAST).



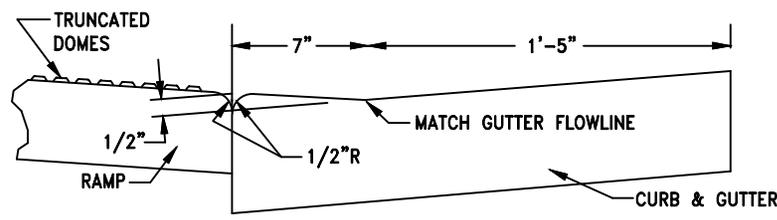
**DETECTABLE WARNING STRIP**



**TRUNCATED DOME ELEVATION**



**TEXTURE PATTERN DETAIL**



**DETAIL A (NTS)**

ICC / ANSI A117.1-2003  
705.5 TRUNCATED DOMES

DETECTABLE WARNING SURFACES SHALL HAVE TRUNCATED DOMES COMPLYING WITH SECTION 705.5 OF THE ICC/ANSI A117.1-2003, PROVIDED BELOW.

705.5.1 SIZE. TRUNCATED DOMES SHALL HAVE A BASE DIAMETER OF 0.9 INCH (23mm) MINIMUM TO 1.4 INCH (36mm) MAXIMUM, AND A TOP DIAMETER OF 50 PERCENT MINIMUM TO 65 PERCENT MAXIMUM OF THE BASE DIAMETER.

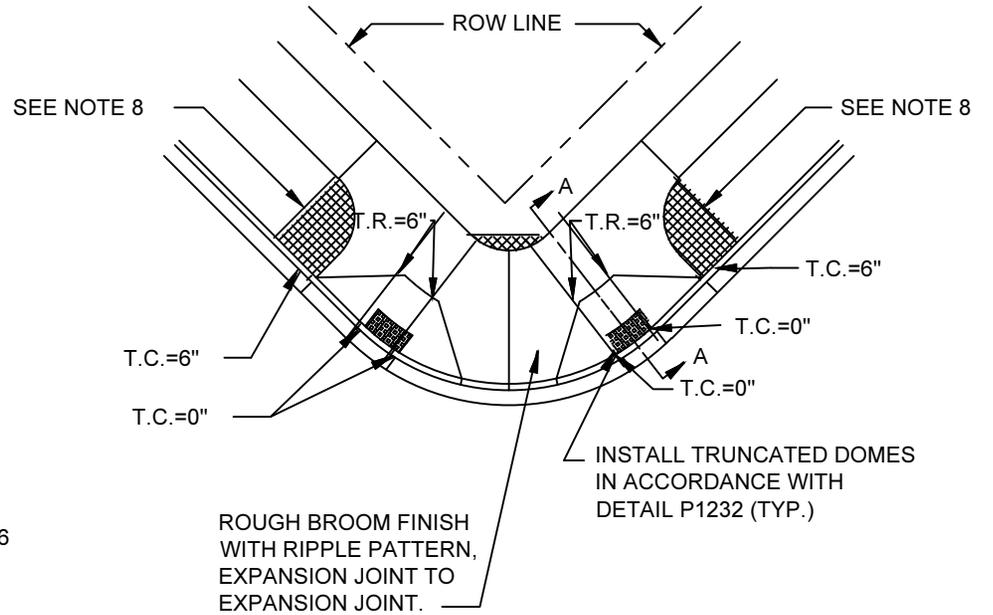
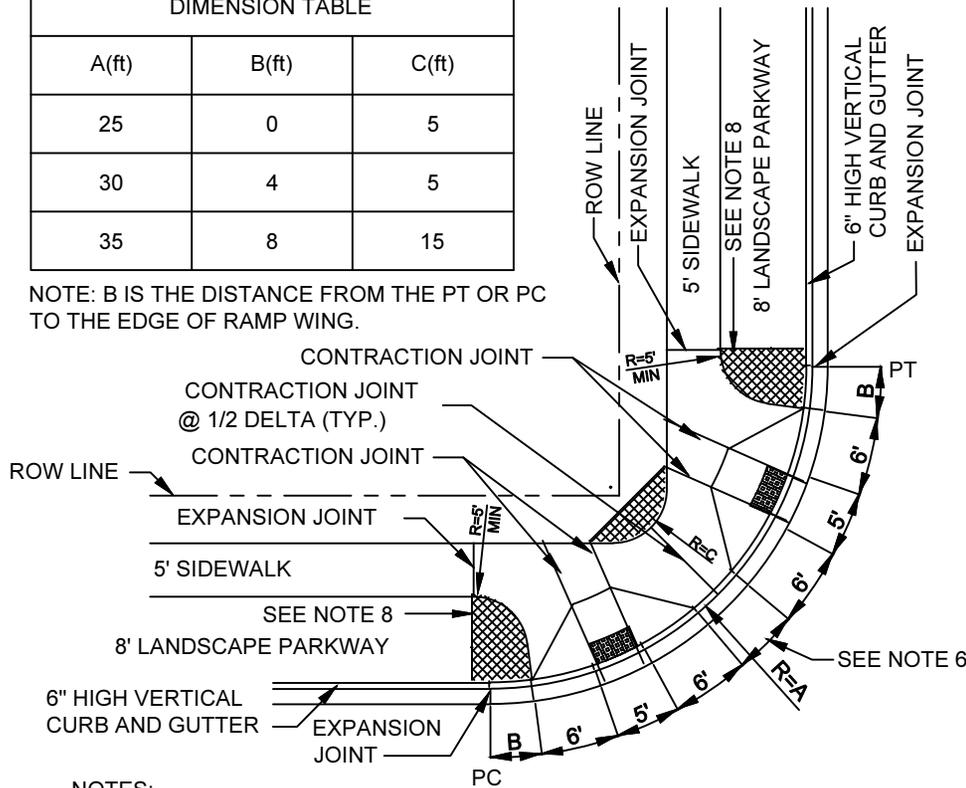
705.5.2 HEIGHT. TRUNCATED DOMES SHALL HAVE A HEIGHT OF 0.2 INCH (5.1mm).

705.5.3 SPACING. TRUNCATED DOMES SHALL HAVE A CENTER-TO-CENTER SPACING OF 1.6 INCHES (41mm) MINIMUM TO 2.4 INCHES (61mm) MAXIMUM, AND A BASE-TO-BASE SPACING OF 0.65 INCH (16.5mm) MINIMUM, MEASURED BETWEEN THE MOST ADJACENT DOMES ON THE GRID.

705.5.4 ALIGNMENT. TRUNCATED DOMES SHALL BE ALIGNED IN A SQUARE GRID PATTERN.

DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
25	0	5
30	4	5
35	8	15

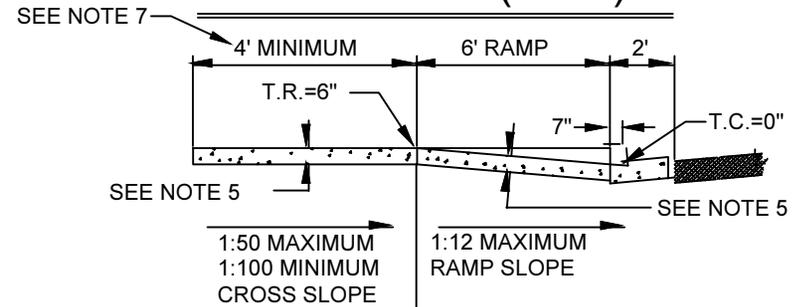
NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.



**NOTES:**

- CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
- CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
- 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
- REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

**SECTION A-A (TYP.)**



DETAIL NO.  
P1233



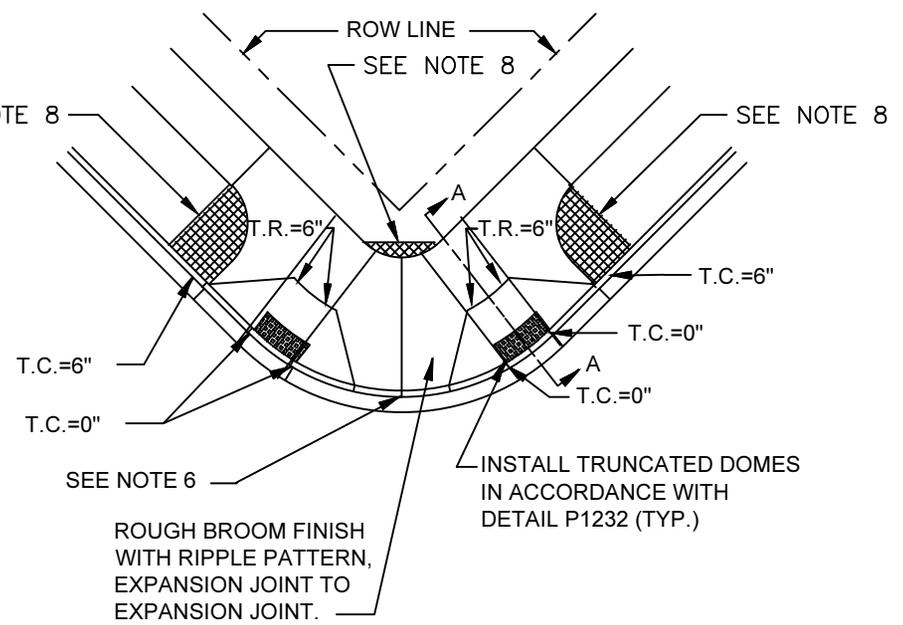
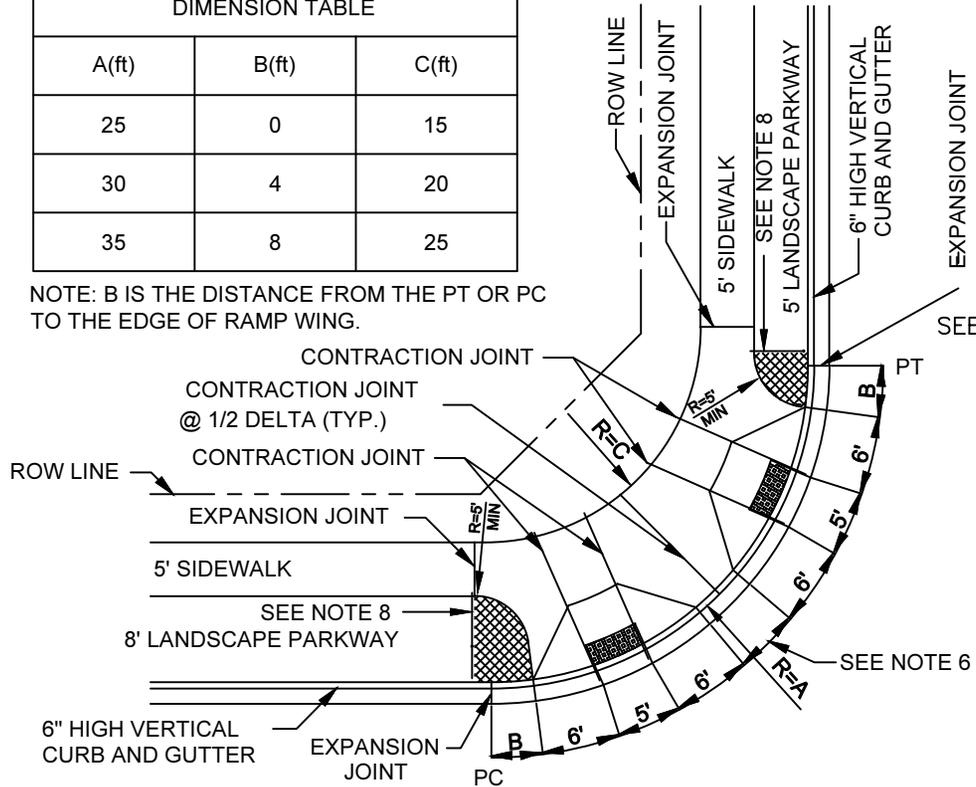
CURB RAMP DETAIL – 25', 30', & 35' RADII  
8' LANDSCAPE PLANTERS, BOTH LEGS

APPROVED  
*[Signature]*  
CITY ENGINEER  
07/01/2015  
DATE

DETAIL NO.  
P1233

DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
25	0	15
30	4	20
35	8	25

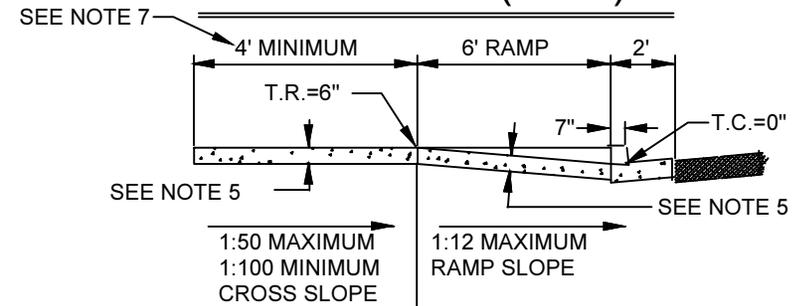
NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.



**NOTES:**

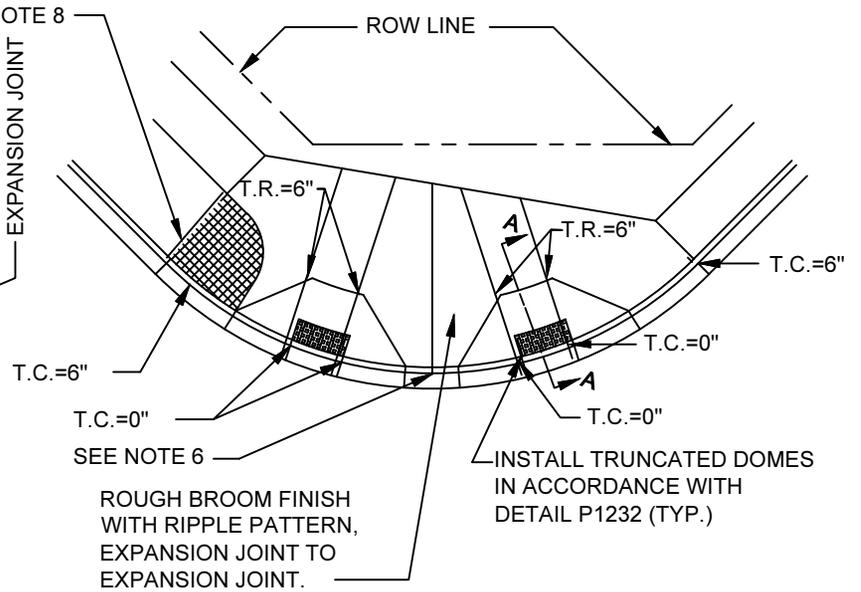
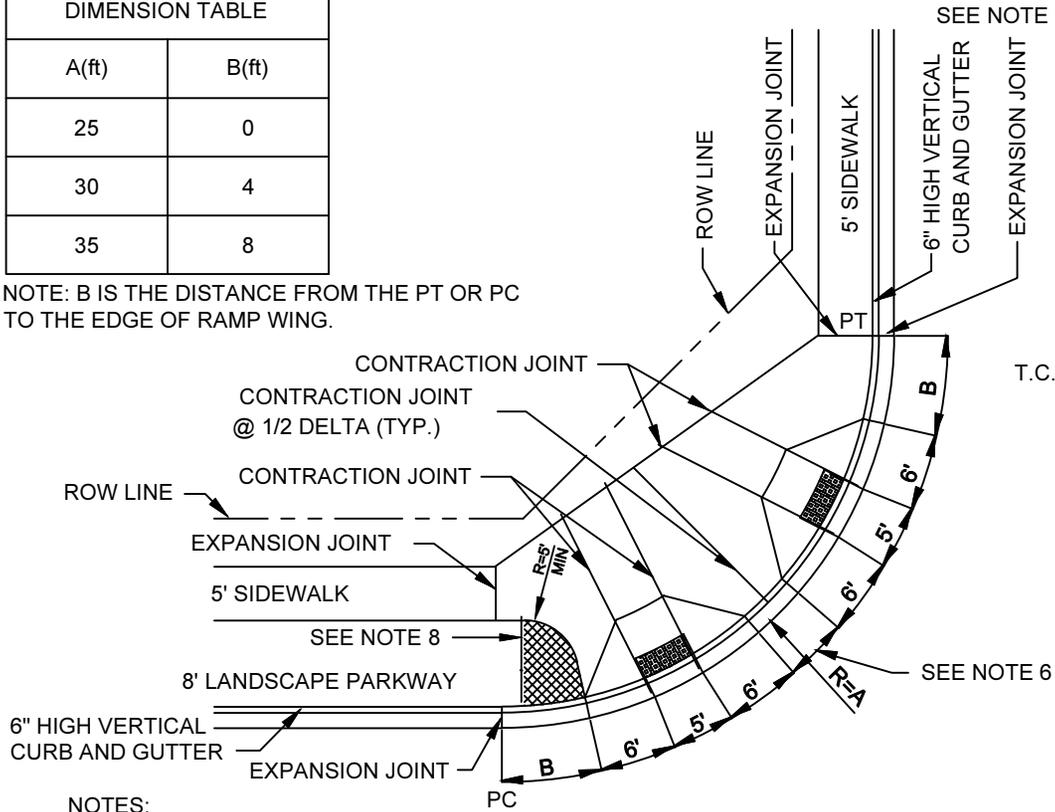
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- REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

**SECTION A-A (TYP.)**



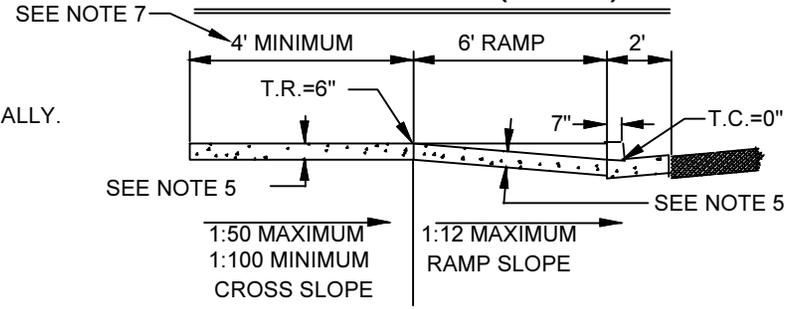
DIMENSION TABLE	
A(ft)	B(ft)
25	0
30	4
35	8

NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.



ROUGH BROOM FINISH WITH RIPPLE PATTERN, EXPANSION JOINT TO EXPANSION JOINT.

**SECTION A-A (TYP.)**

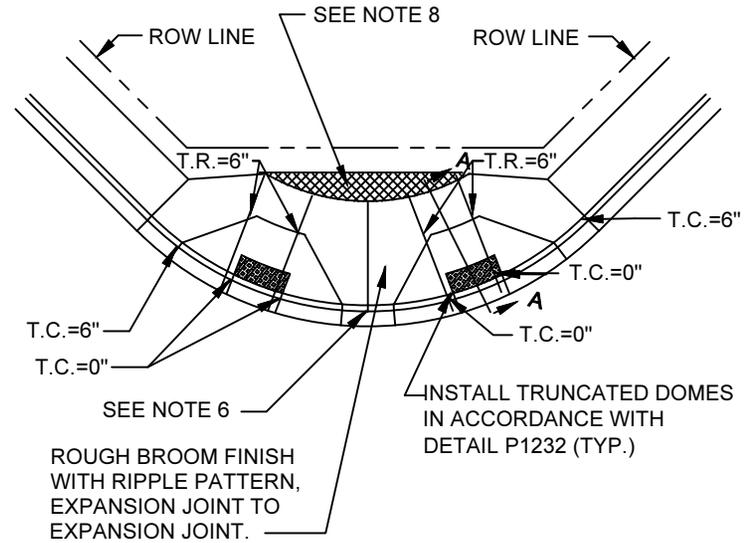
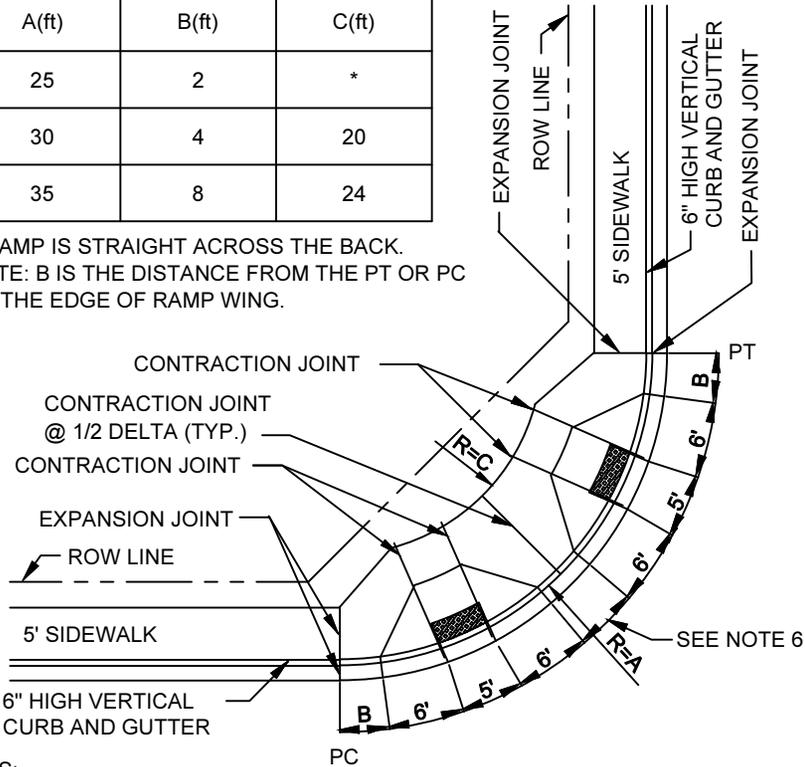


**NOTES:**

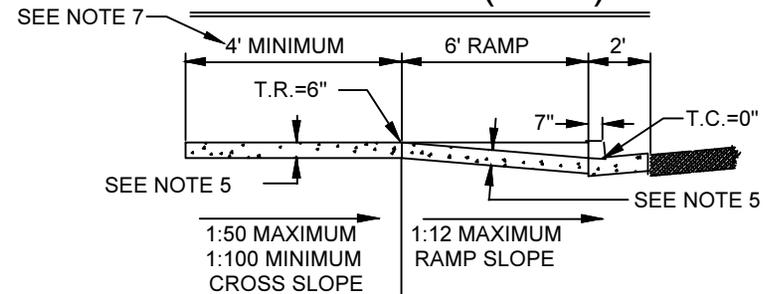
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- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
25	2	*
30	4	20
35	8	24

\* RAMP IS STRAIGHT ACROSS THE BACK.  
 NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.



**SECTION A-A (TYP.)**



**NOTES:**

- CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
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- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

DETAIL NO.  
P1236



**City of Phoenix**  
STANDARD DETAIL

CURB RAMP DETAIL – 25', 30', & 35' RADII  
NO LANDSCAPE PLANTERS

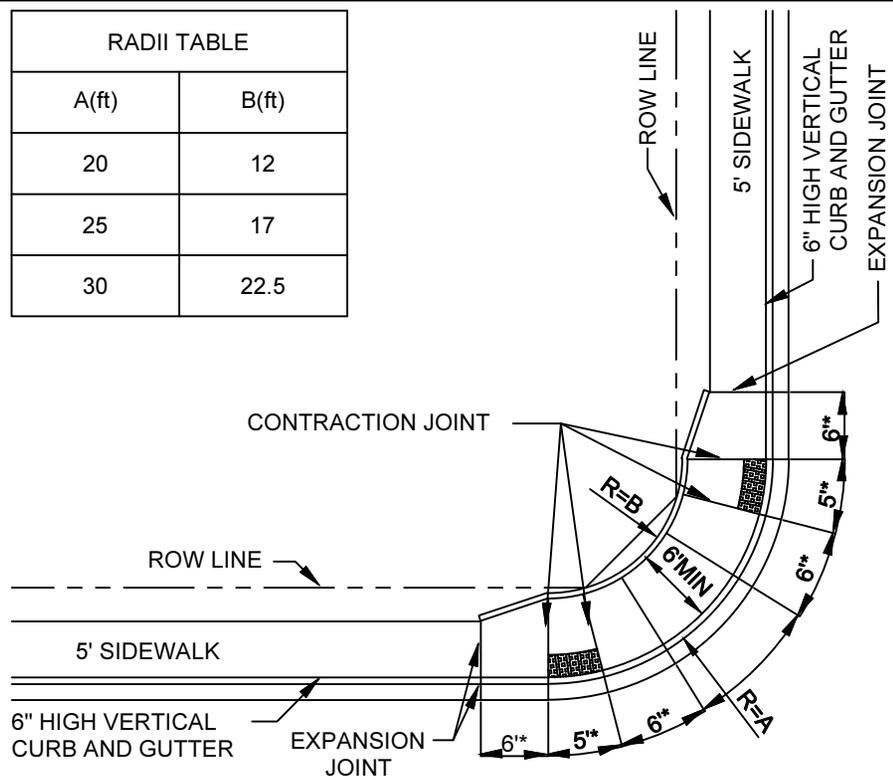
APPROVED

*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

DETAIL NO.  
P1236

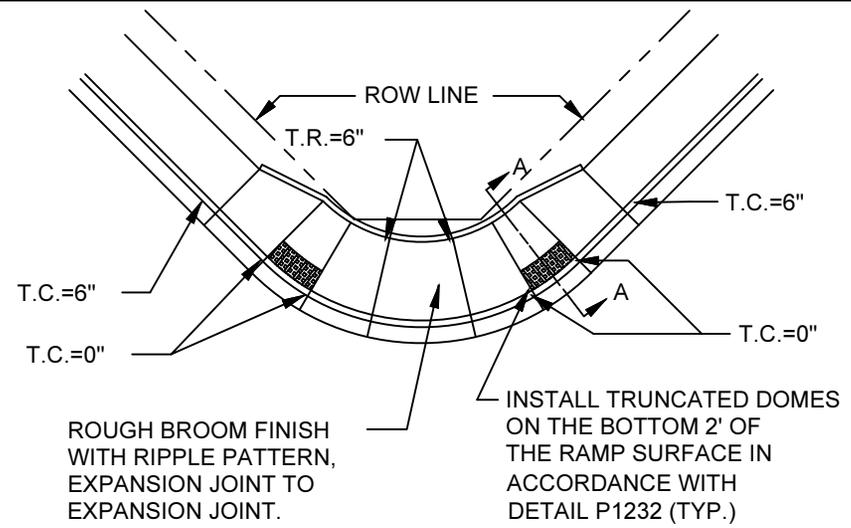
RADII TABLE	
A(ft)	B(ft)
20	12
25	17
30	22.5



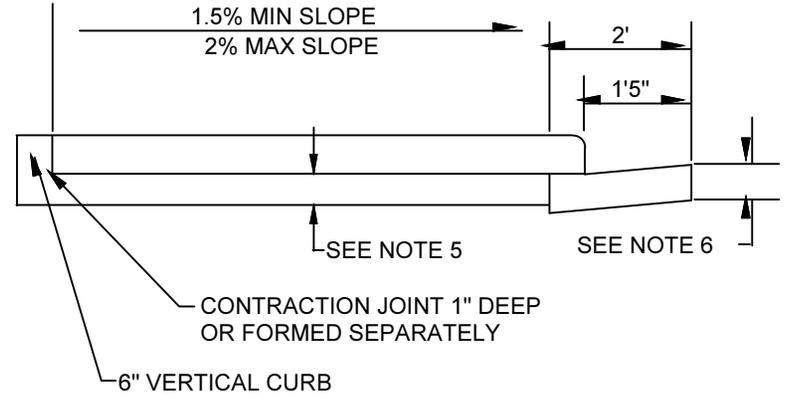
\* MINIMUM WIDTH

NOTES:

- CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADially. GUTTER ELEVATION=0".
- CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
- 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
- 9" CURB ON MAJOR AND COLLECTOR STREETS AND 6" CURB ON LOCAL STREETS.



SECTION A-A (TYP.)



DETAIL NO.  
P1237

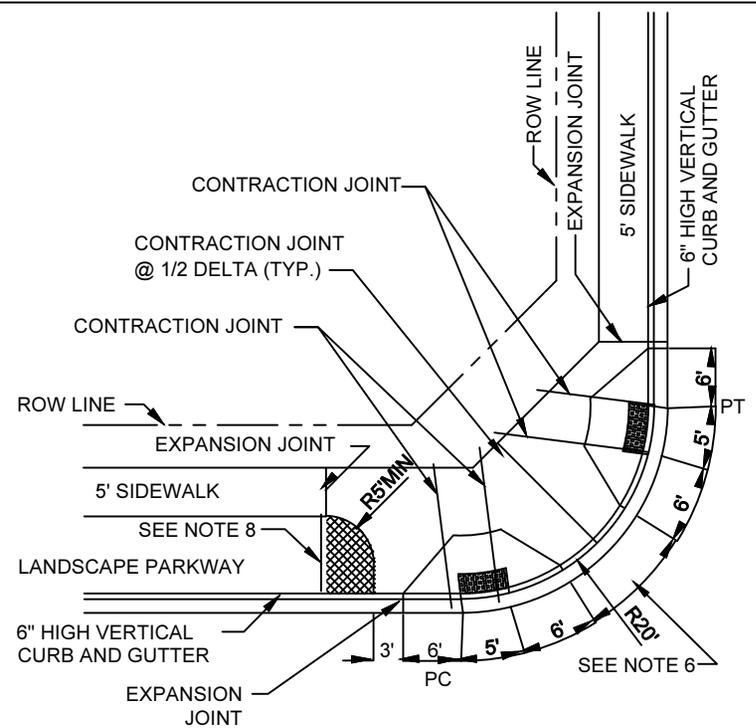
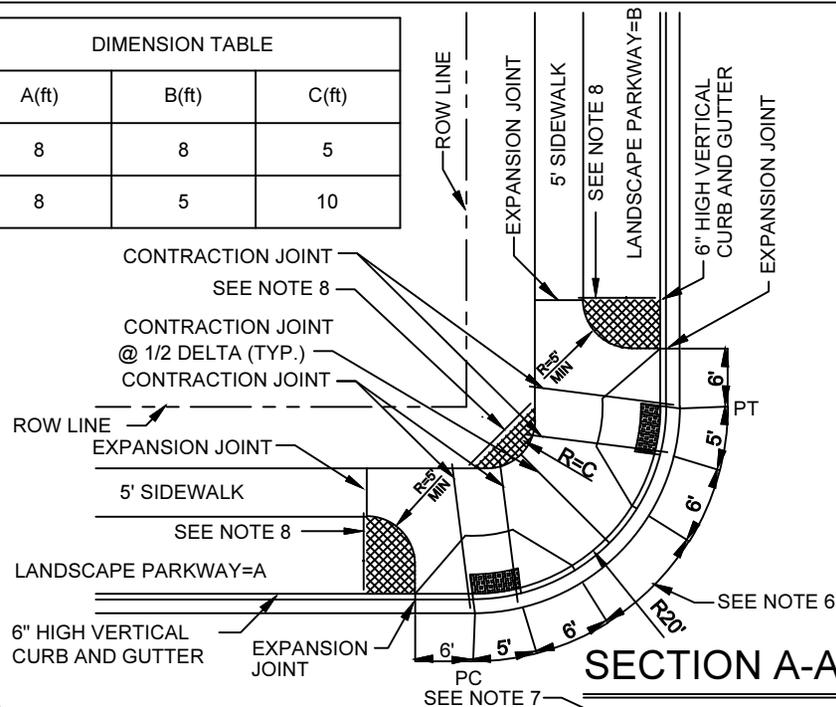


CURB RAMP DETAIL – ALL RADIUS CURB RETURNS,  
LIMITED RIGHT OF WAY

APPROVED  
*[Signature]*  
ACTING CITY ENGINEER  
7/31/08  
DATE

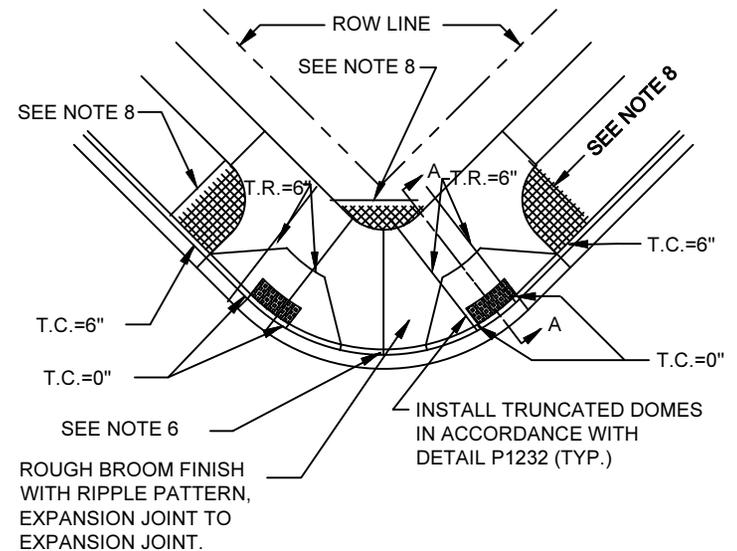
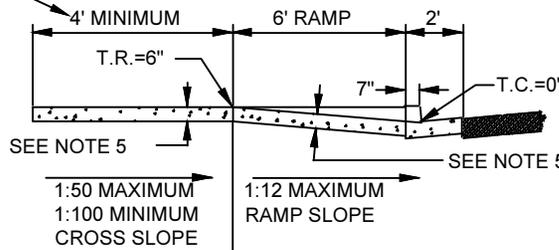
DETAIL NO.  
P1237

DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
8	8	5
8	5	10



**NOTES:**

- CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
- CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
- 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
- REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.



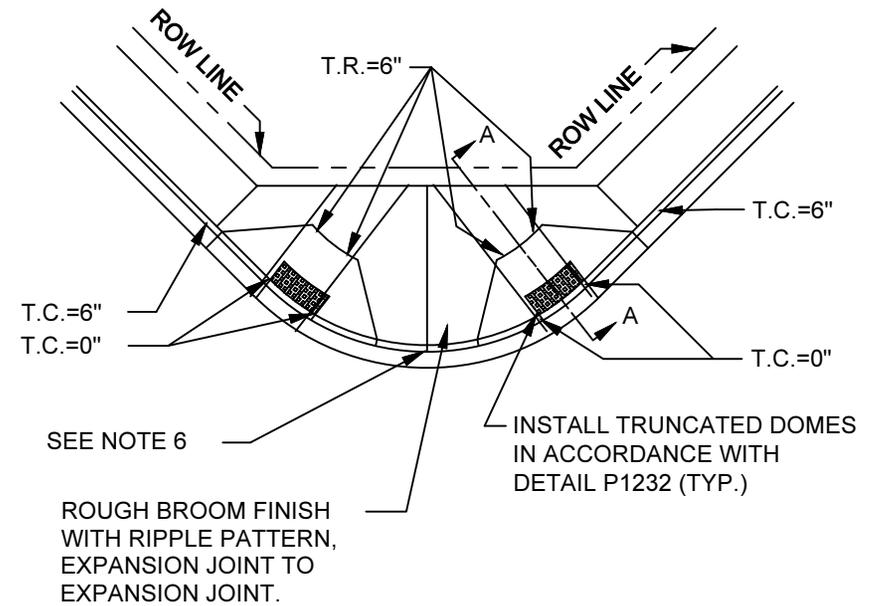
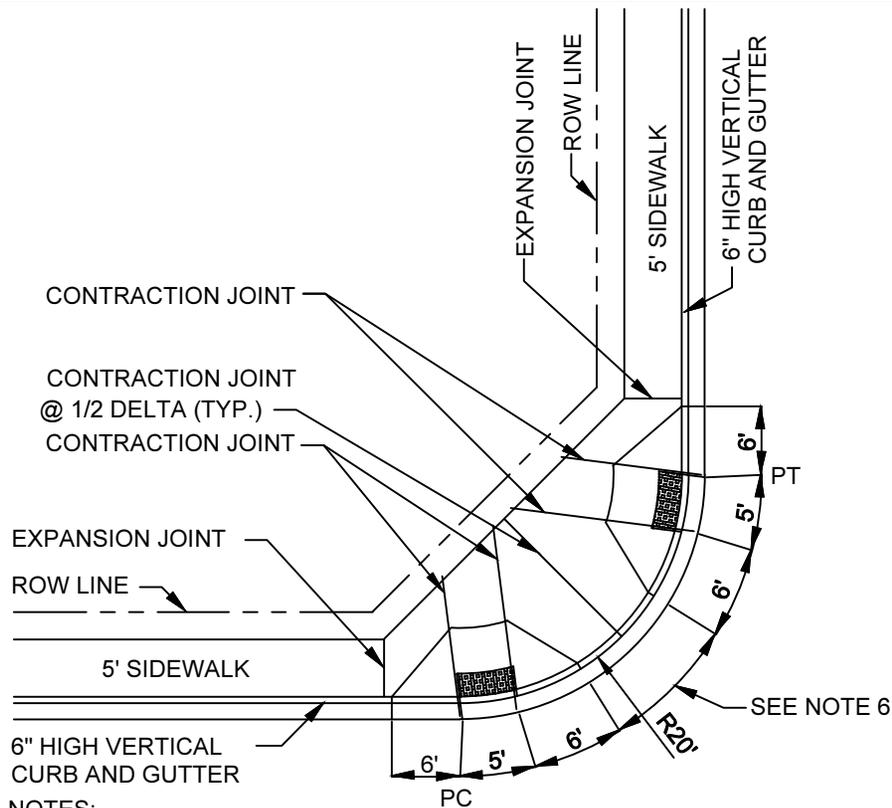
DETAIL NO.  
P1238-1



CURB RAMP DETAIL - 20' RADIUS  
LANDSCAPE PLANTERS, BOTH/ONE LEG(S)

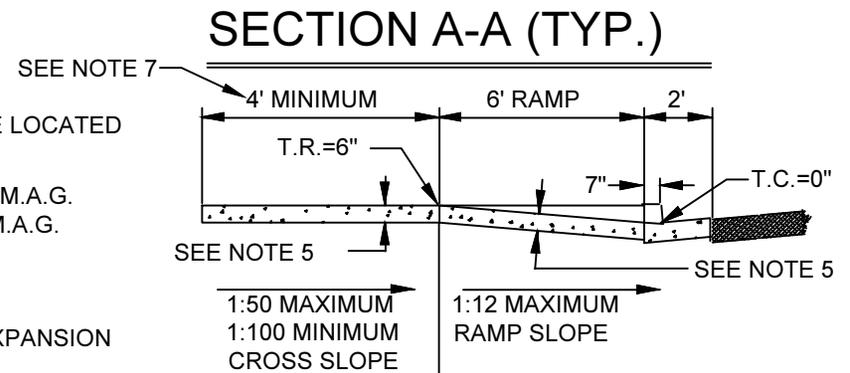
APPROVED  
*[Signature]*  
CITY ENGINEER  
07/01/2015  
DATE

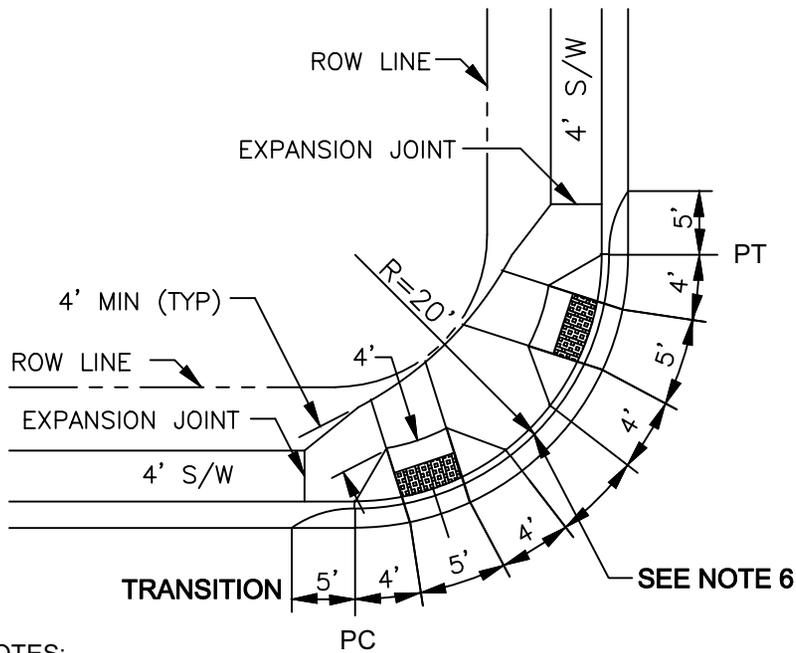
DETAIL NO.  
P1238-1



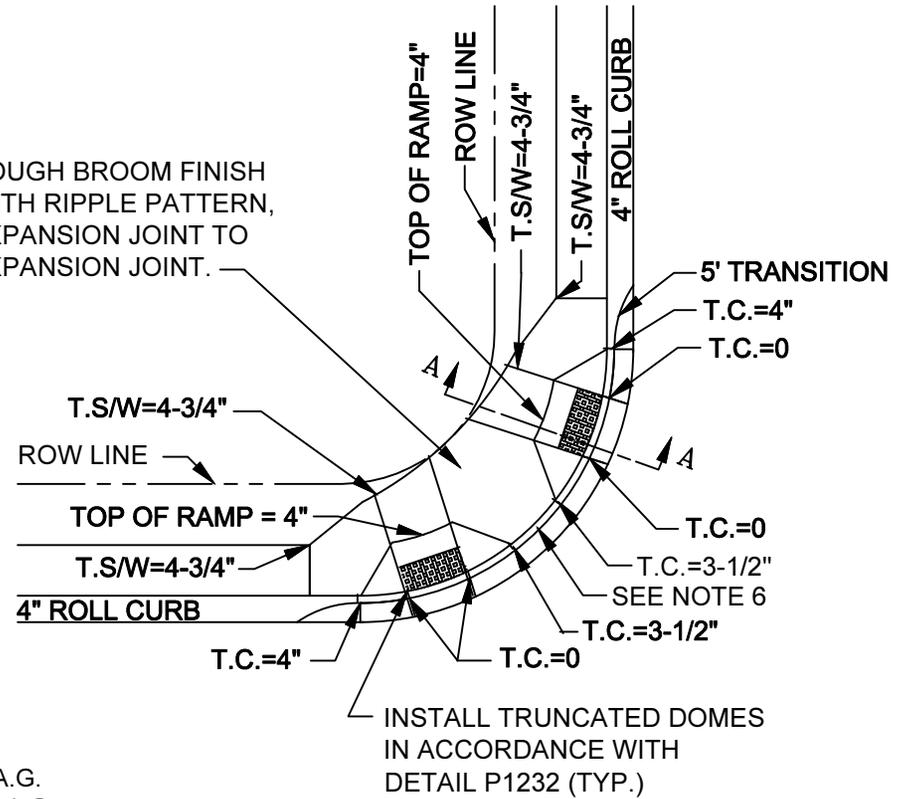
SEE NOTE 6  
 ROUGH BROOM FINISH WITH RIPPLE PATTERN, EXPANSION JOINT TO EXPANSION JOINT.

- NOTES:
1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
  2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
  3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
  4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
  5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
  6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
  7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING





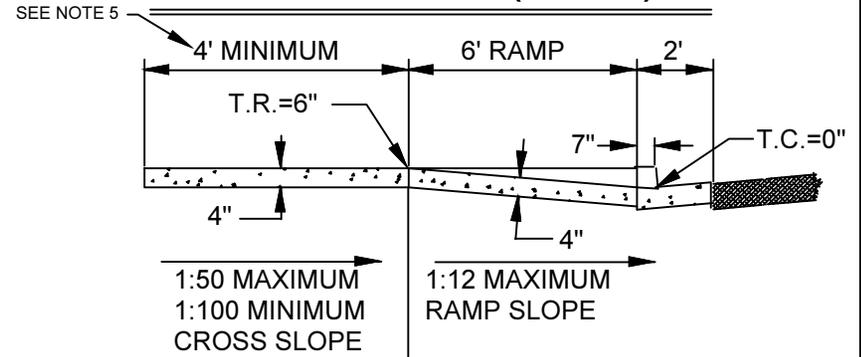
ROUGH BROOM FINISH WITH RIPPLE PATTERN, EXPANSION JOINT TO EXPANSION JOINT.



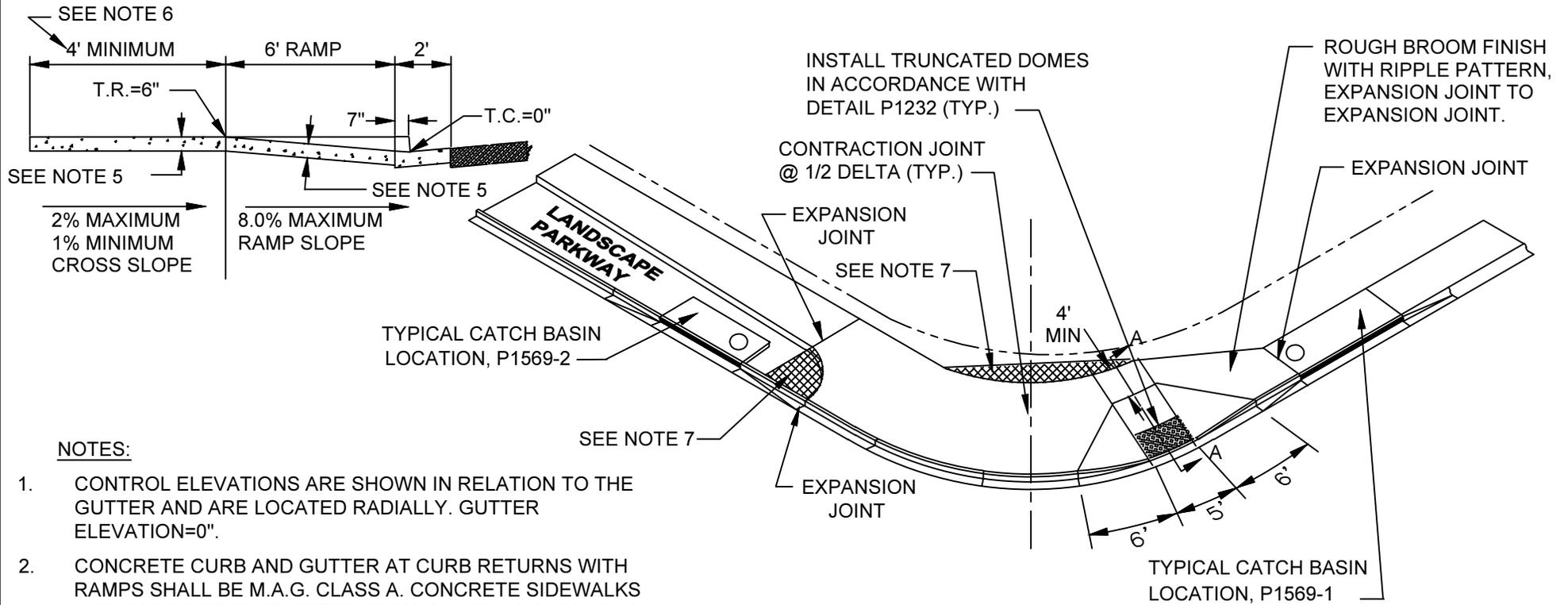
**NOTES:**

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.

**SECTION A-A (TYP.)**

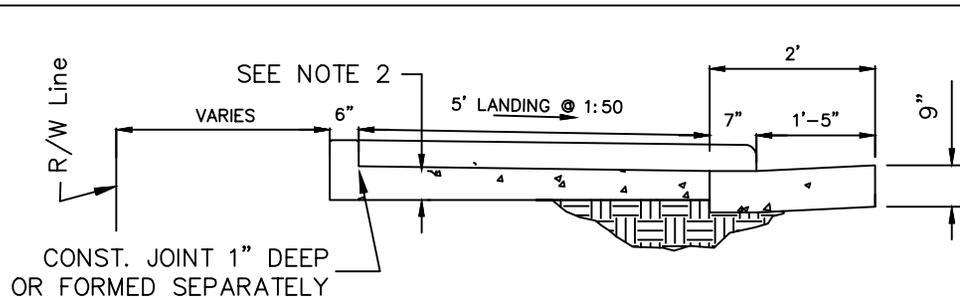


# SECTION A-A (TYP.)

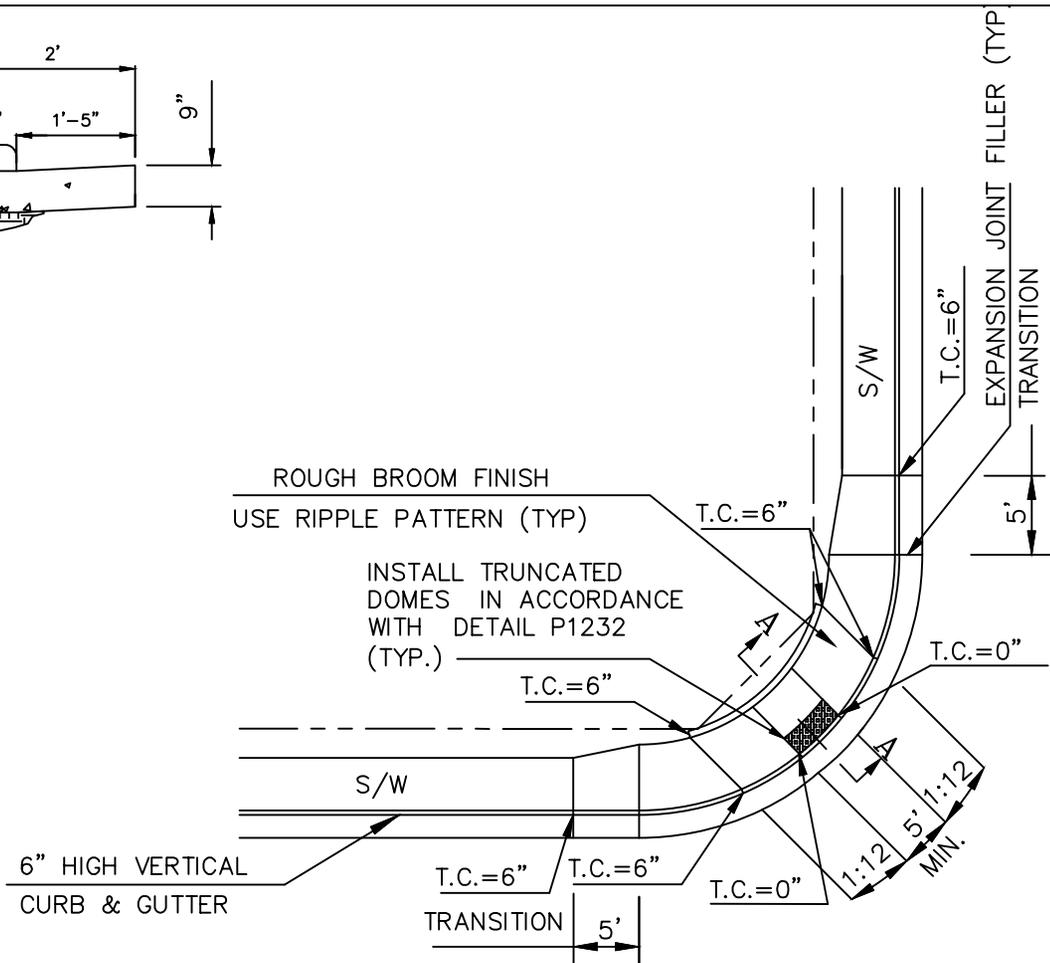


**NOTES:**

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
7. ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.



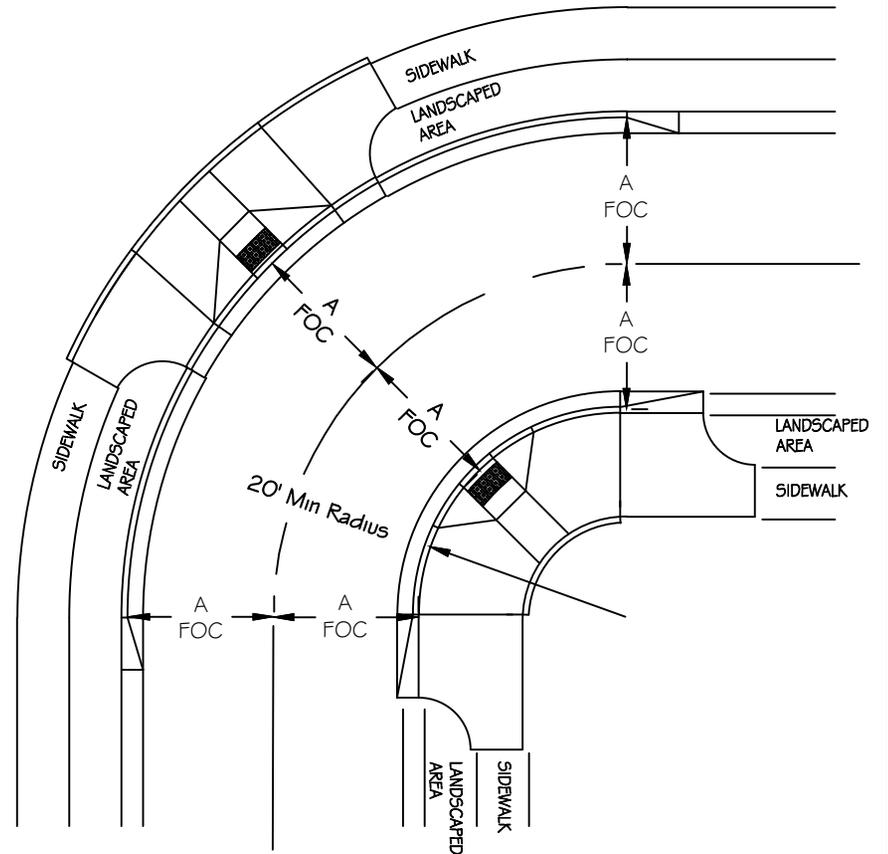
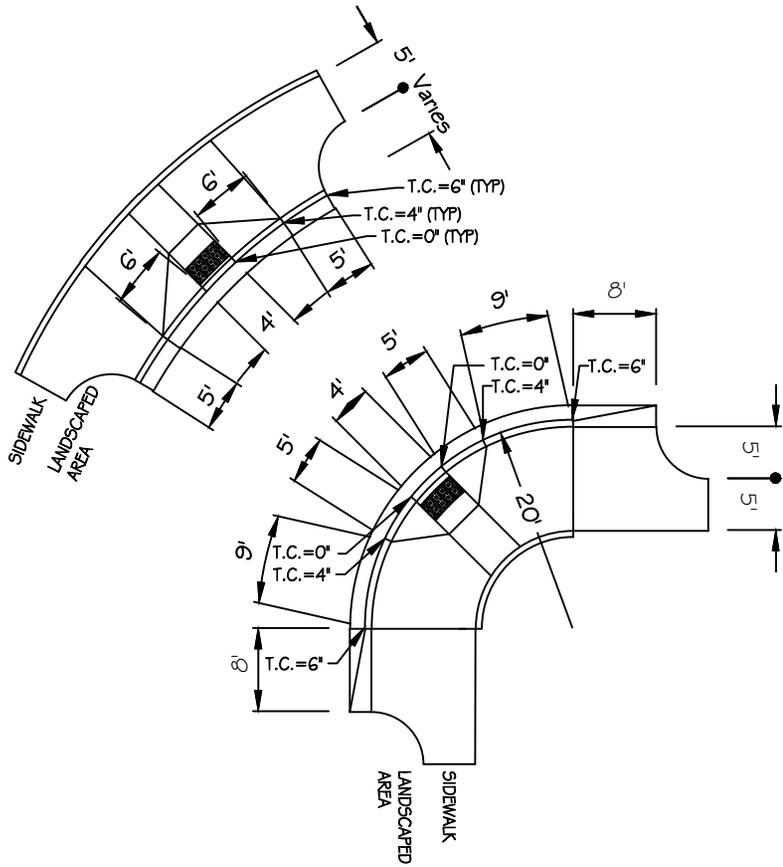
**SECTION A-A**



**NOTES:**

- 1) CONCRETE CURB & GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALK AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- 2) 9" LANDING AND RAMPS ON MAJOR OR COLLECTOR STREETS AND 4" LANDING AND RAMPS ON LOCAL STREETS.





DETAIL NO.  
P1240-3



**City of Phoenix**  
**STANDARD DETAIL**

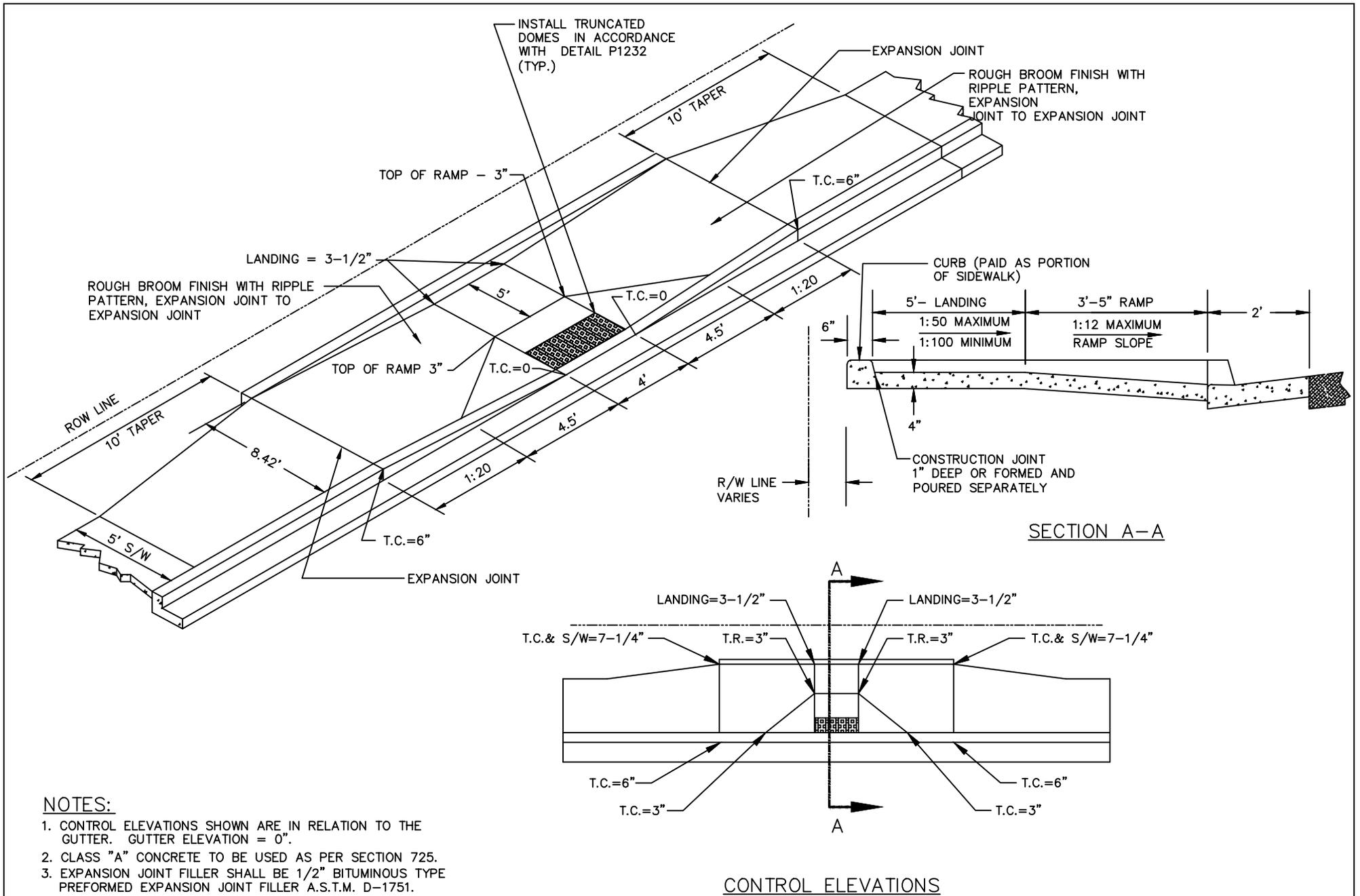
CURB RAMP DETAIL WITH  
DETACHED S/W (CORNER AT A DIAGONAL)

APPROVED

*[Signature]*  
CITY ENGINEER

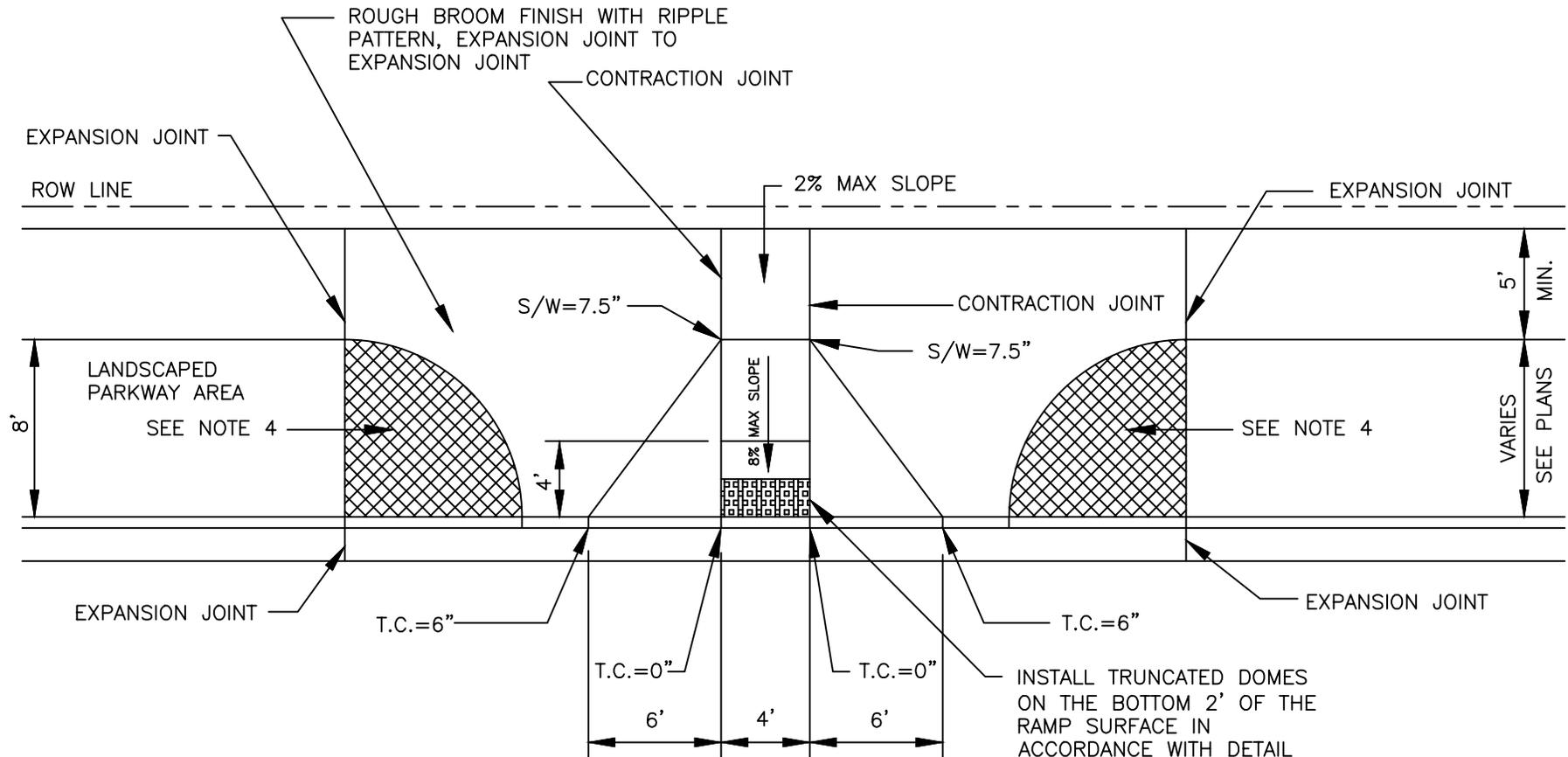
07/01/2015  
DATE

DETAIL NO.  
P1240-3



**NOTES:**

1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0".
2. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.



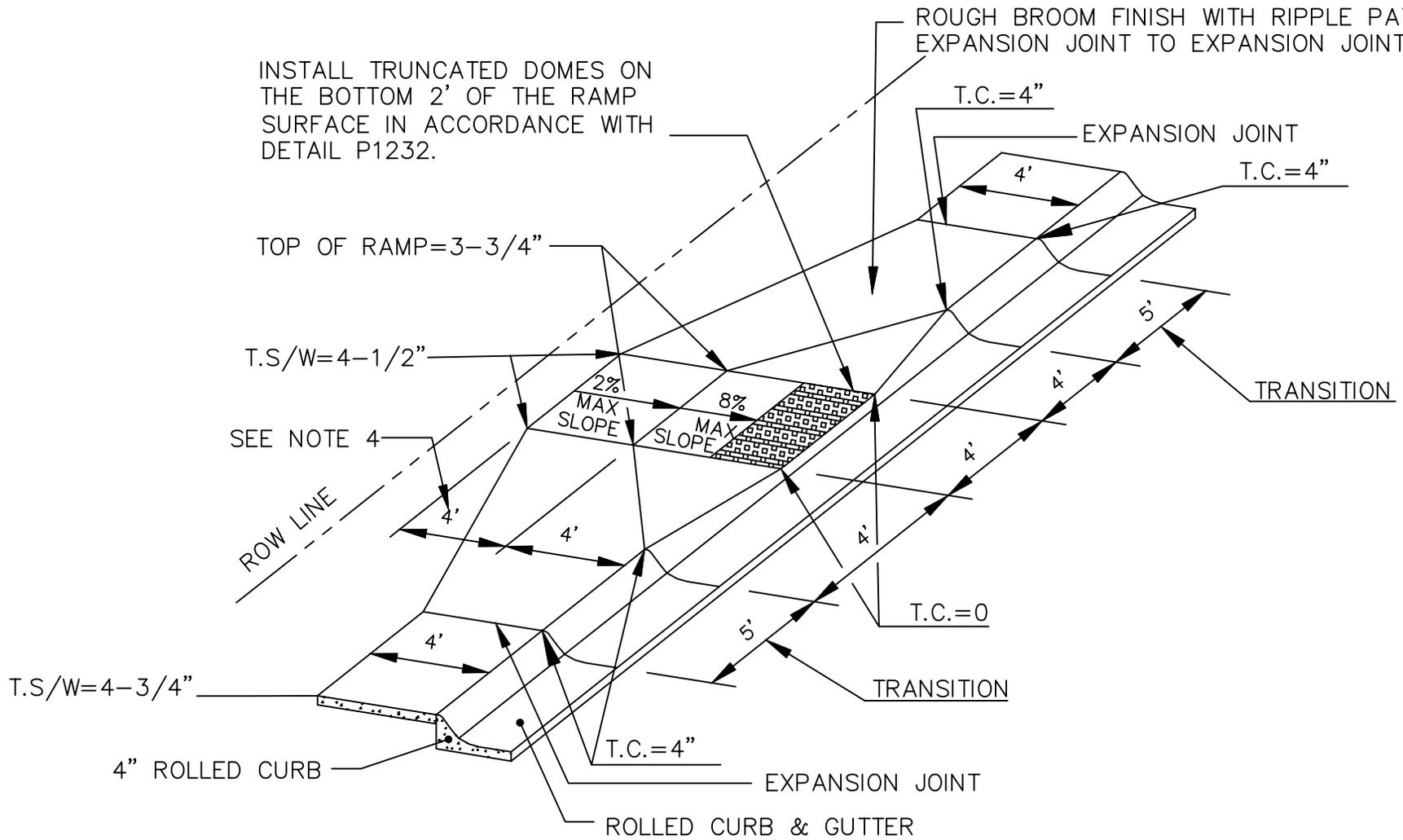
**NOTES:**

1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0".
2. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.
4. ADDITIONAL SIDEWALK PER NOTE 2 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

INSTALL TRUNCATED DOMES ON THE BOTTOM 2' OF THE RAMP SURFACE IN ACCORDANCE WITH DETAIL P1232.

INSTALL TRUNCATED DOMES ON THE BOTTOM 2' OF THE RAMP SURFACE IN ACCORDANCE WITH DETAIL P1232.

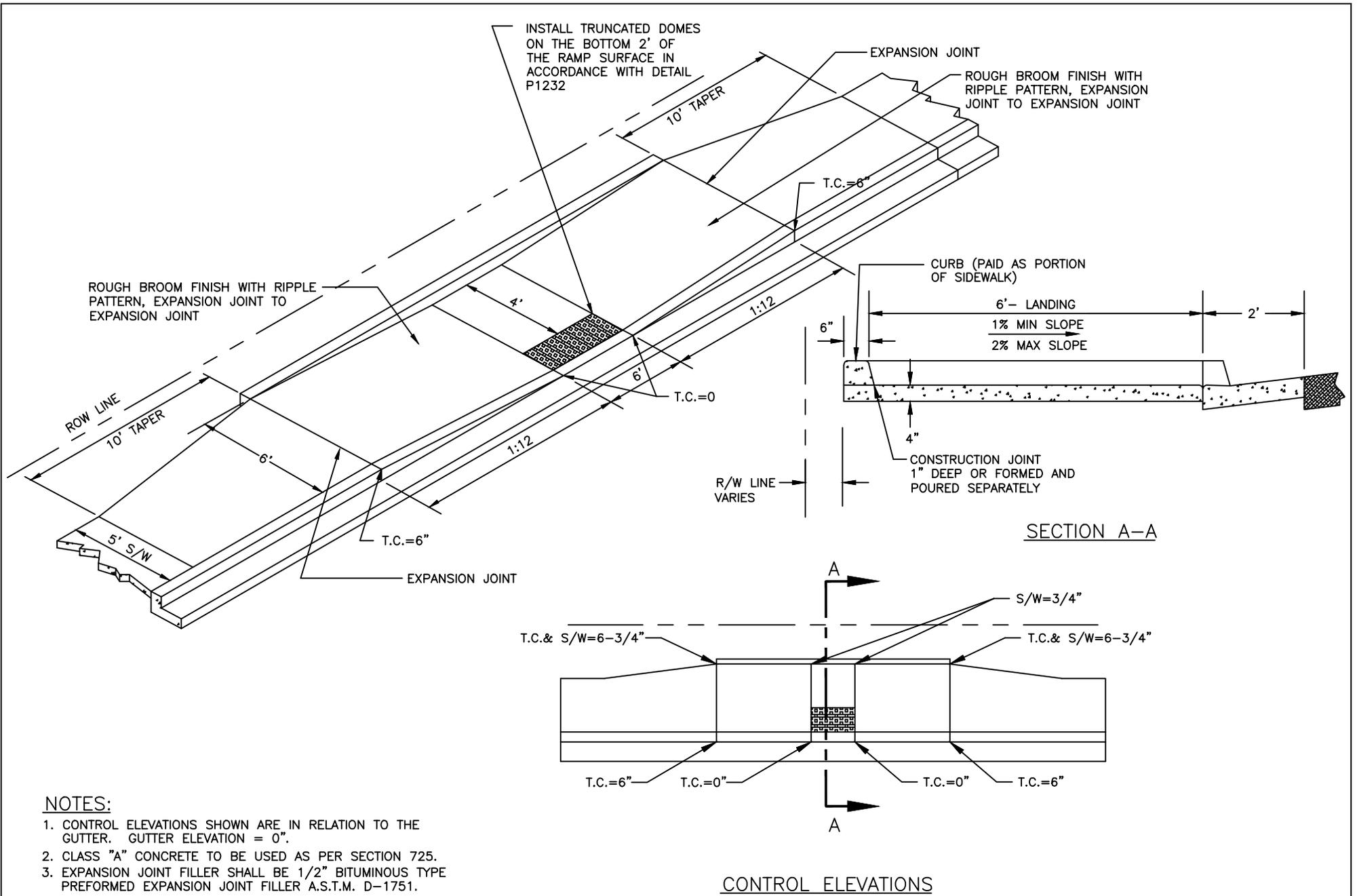
ROUGH BROOM FINISH WITH RIPPLE PATTERN, EXPANSION JOINT TO EXPANSION JOINT.



NOTES:

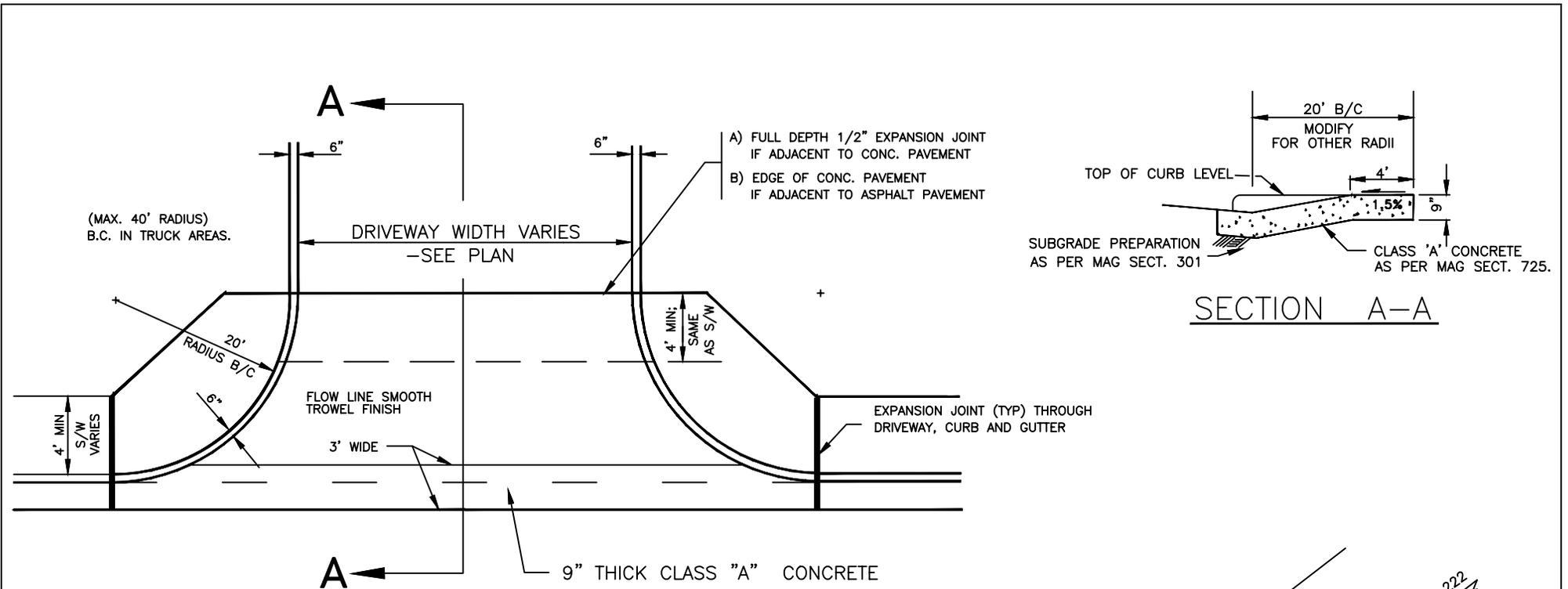
1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0".
2. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.
4. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING

DETAIL NO. P1241-3	 <b>City of Phoenix</b> STANDARD DETAIL	CURB RAMP DETAIL (MID BLOCK) WITH 4" ROLL CURB	APPROVED  CITY ENGINEER	DETAIL NO. P1241-3 12/10/2012 DATE
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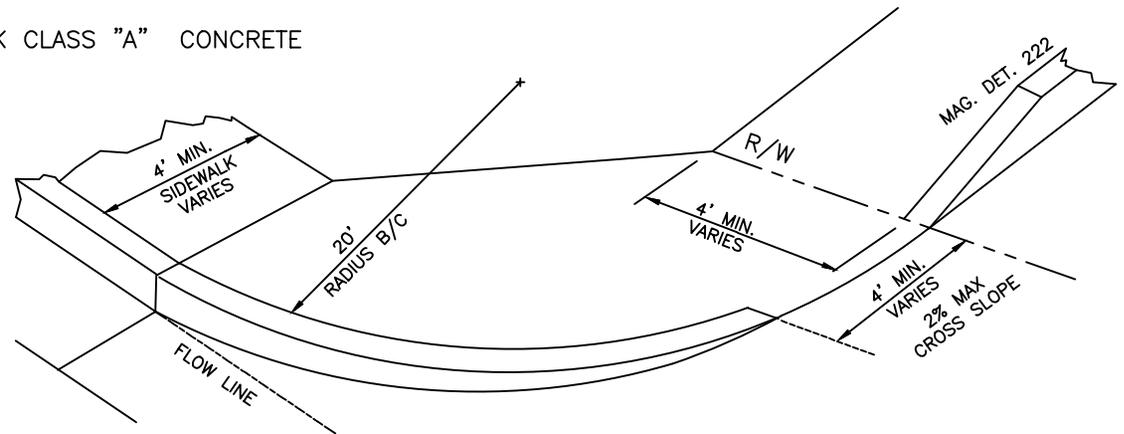
**NOTES:**

- CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0".
- CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.



NOTES:

- CONTROL ELEVATIONS ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION = 0".
- CONCRETE CURB & GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALK AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONSTRUCTION JOINT.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
- MEASUREMENT AND PAYMENT FOR CONCRETE DRIVEWAY SHALL BE BY THE SQUARE FOOT OF 9" CLASS "A" CONCRETE PLACED. MEASUREMENT AND PAYMENT FOR THE CURB RETURNS AND THE SIDEWALK AT THE RETURNS SHALL BE MADE UNDER THEIR SEPARATE PAY ITEMS.



DETAIL NO.  
P1243



**City of Phoenix**  
**STANDARD DETAIL**

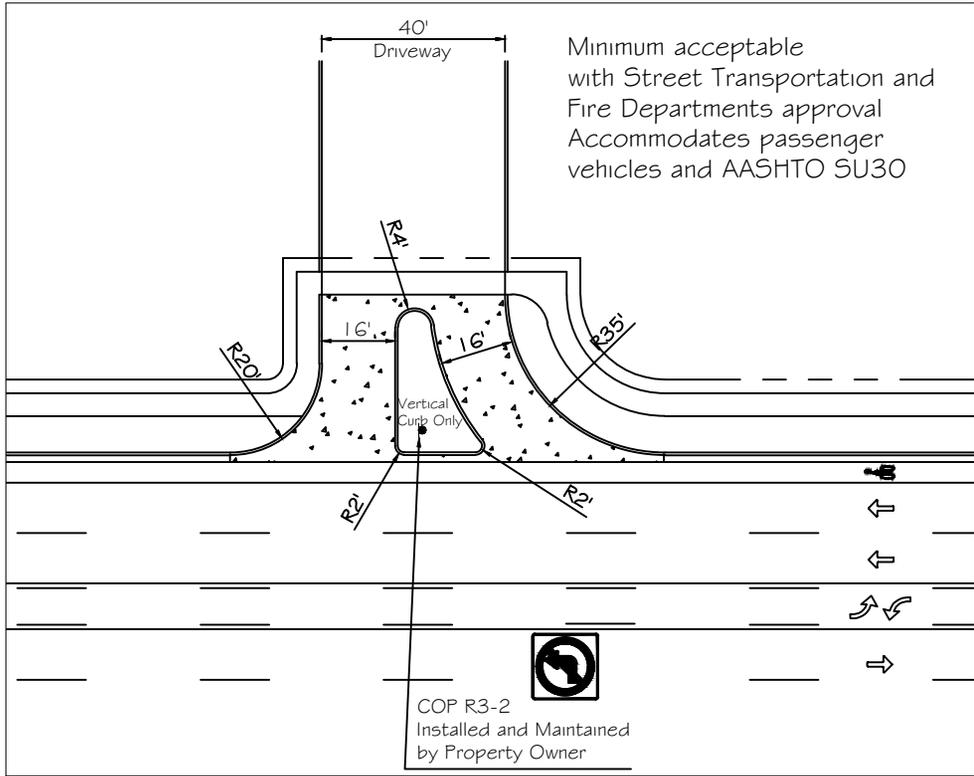
RETURN TYPE DRIVEWAYS  
WITH ATTACHED SIDEWALK

APPROVED

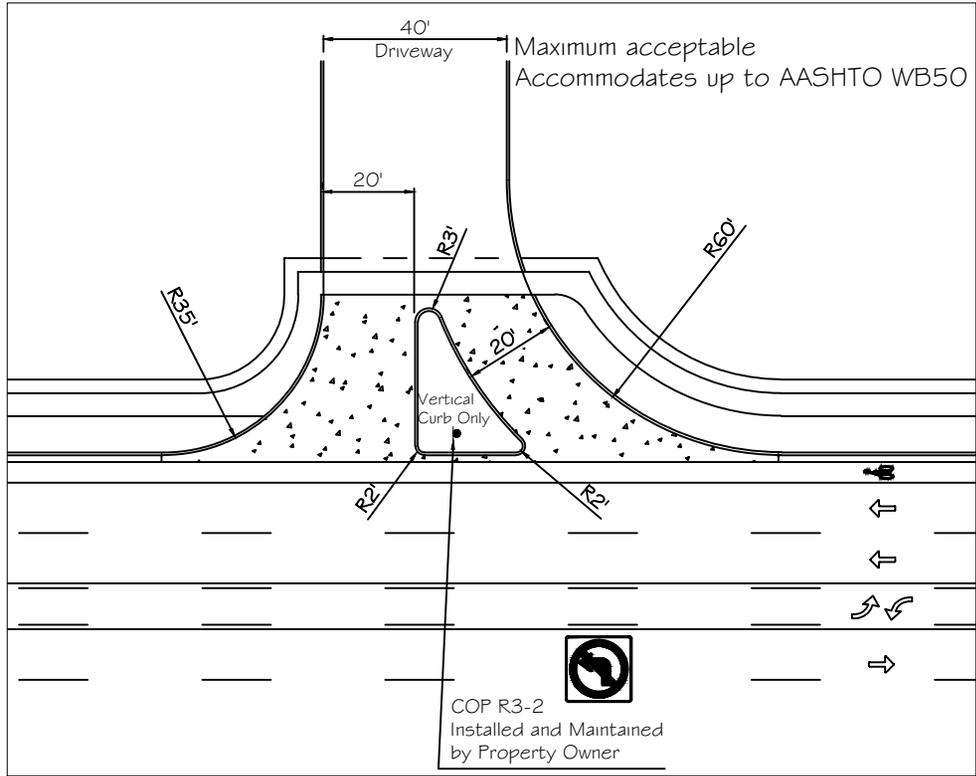
*Maria Saldamando*  
CITY ENGINEER

7/19/04  
DATE

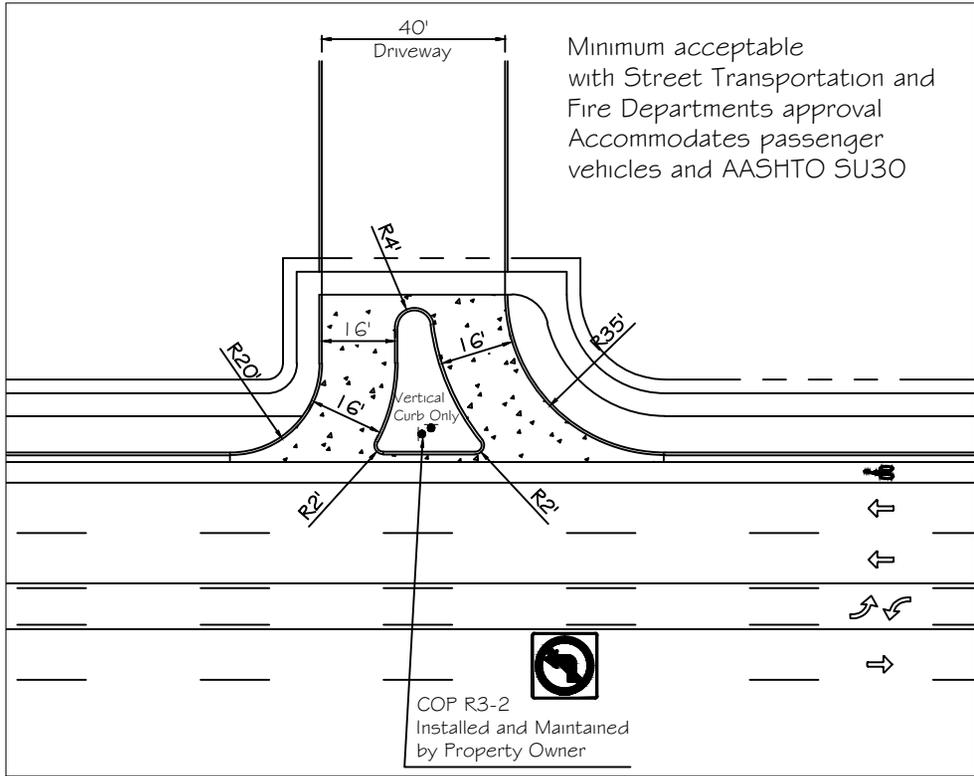
DETAIL NO.  
P1243



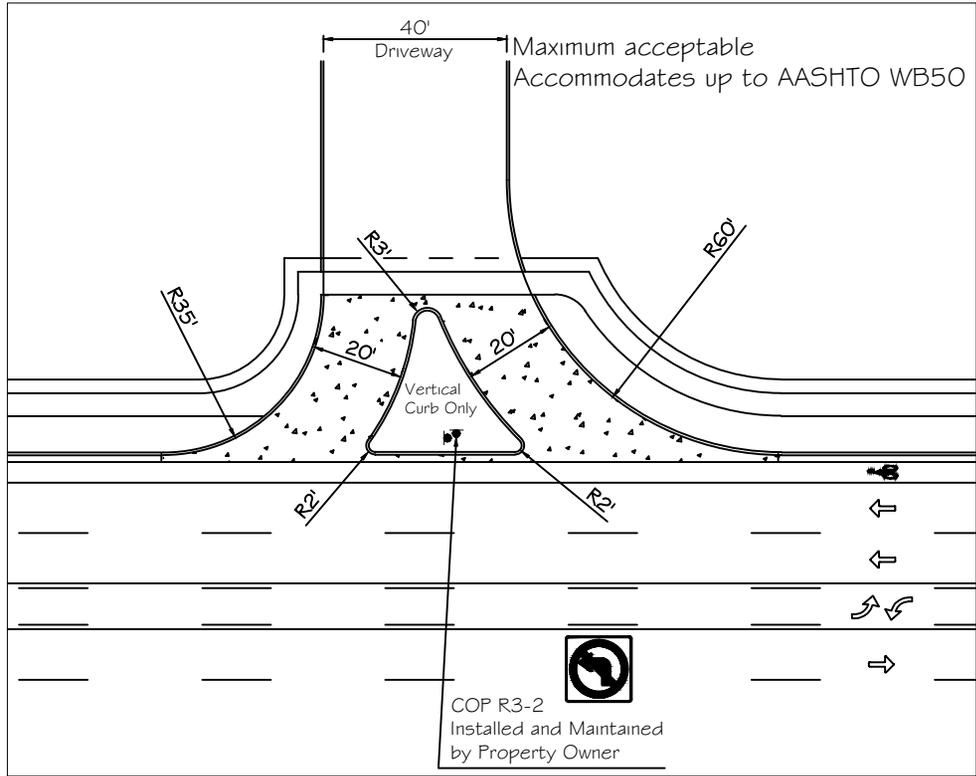
WITHOUT DECELERATION LANE  
PREVENTS LEFT TURN IN  
35' RETURN



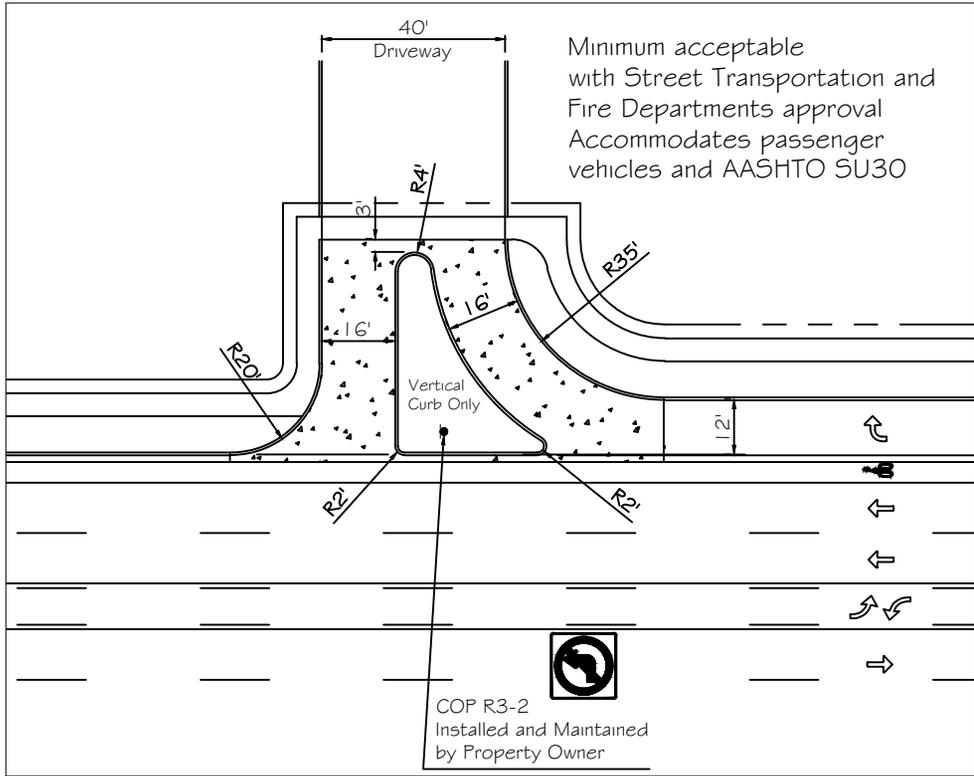
WITHOUT DECELERATION LANE  
PREVENTS LEFT TURN IN  
60' RETURN



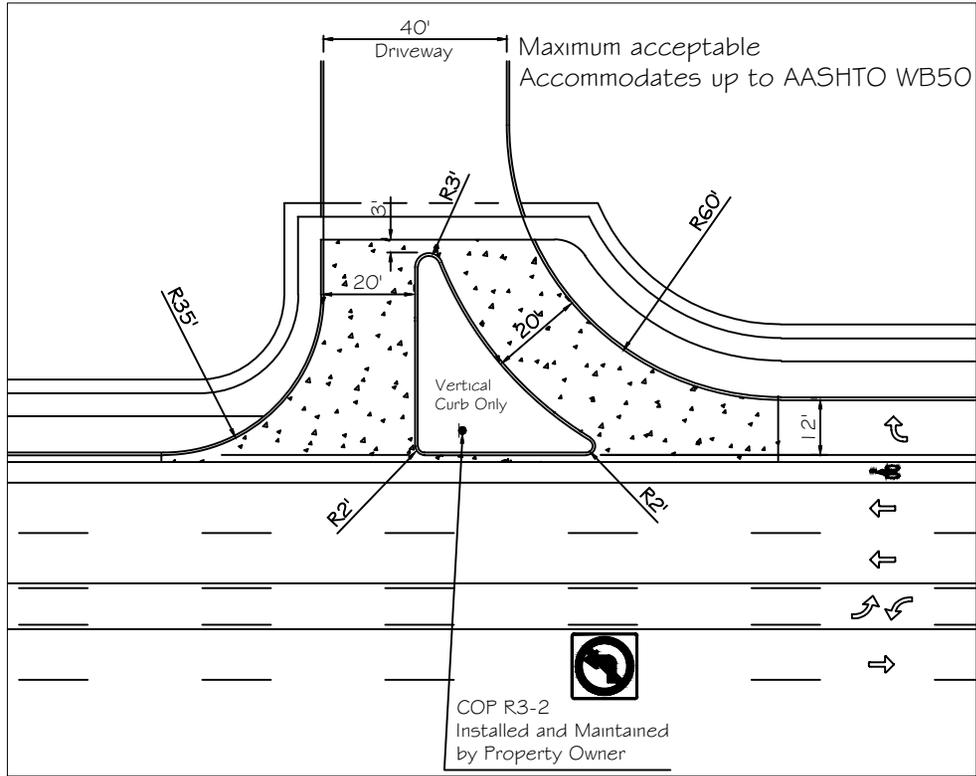
WITHOUT DECELERATION LANE  
PREVENTS LEFT TURN IN/OUT  
35' RETURN



WITHOUT DECELERATION LANE  
PREVENTS LEFT TURN IN/OUT  
60' RETURN



WITH DECELERATION LANE  
PREVENTS LEFT TURN IN  
35' RETURN



WITH DECELERATION LANE  
PREVENTS LEFT TURN IN  
60' RETURN

DETAIL NO.  
P1243-3



**City of Phoenix**  
**STANDARD DETAIL**

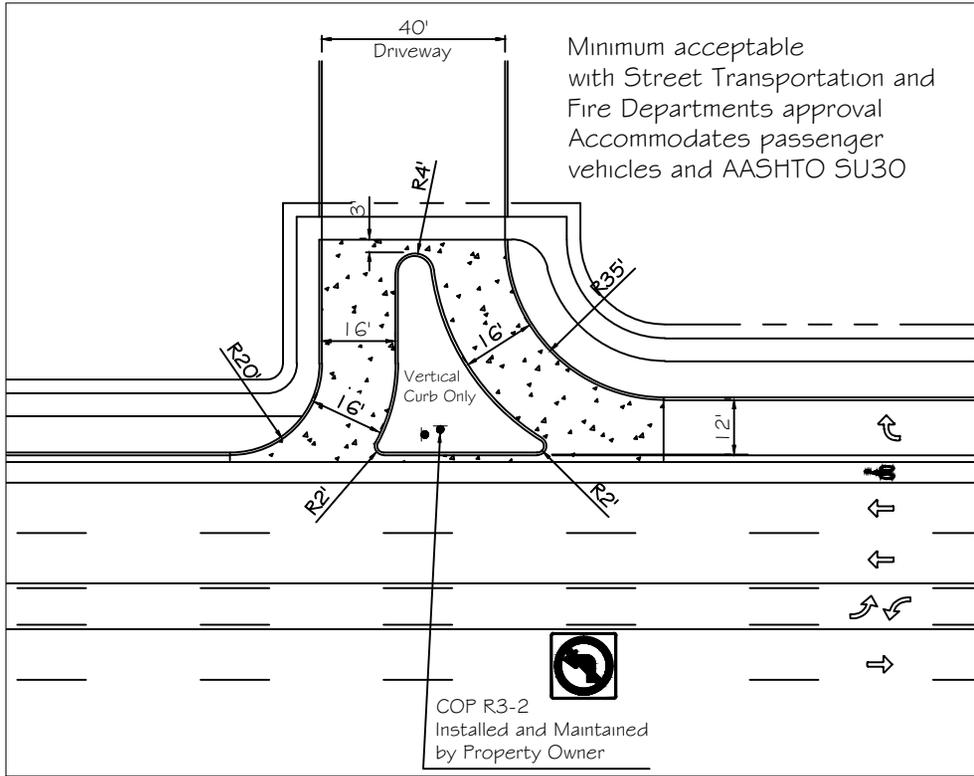
LIMITED ACCESS DRIVEWAY WITH NO LT-IN  
AND WITH DECELERATION LANE

APPROVED

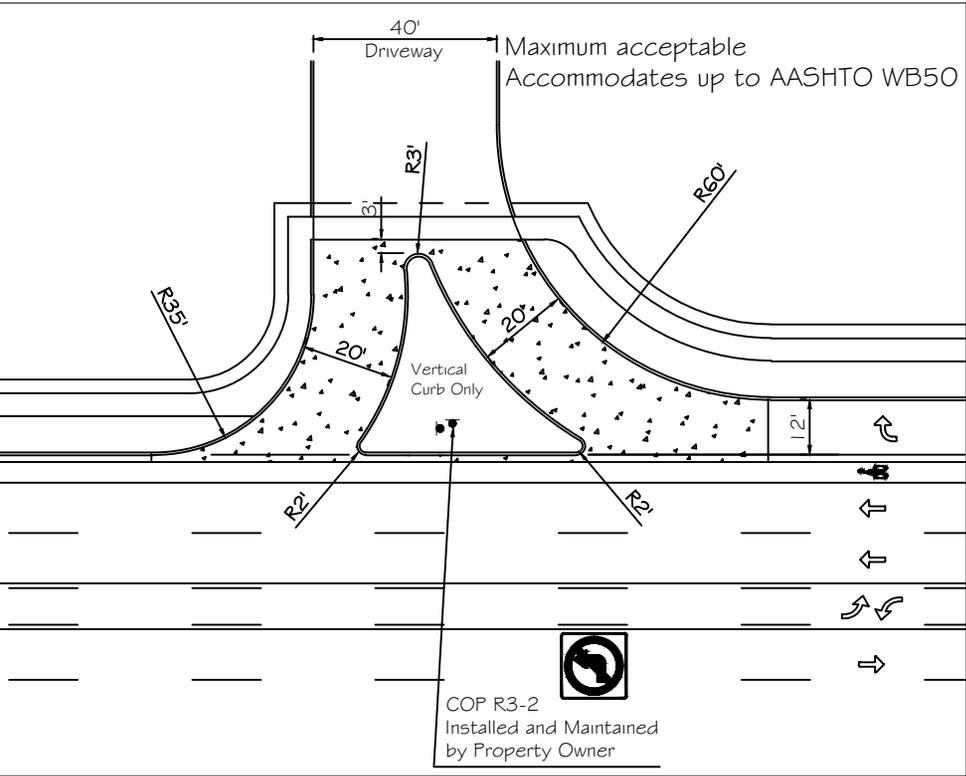
*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

DETAIL NO.  
P1243-3



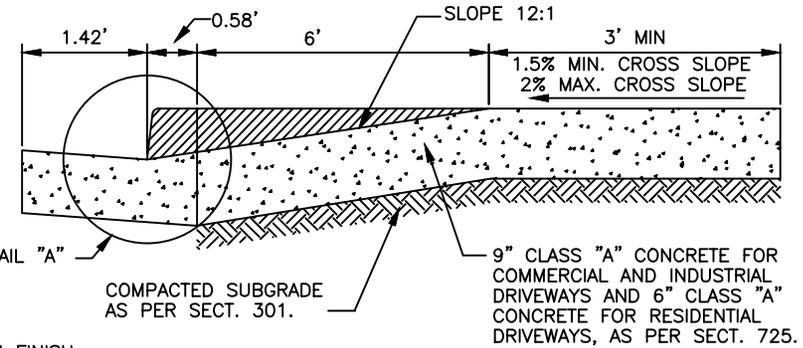
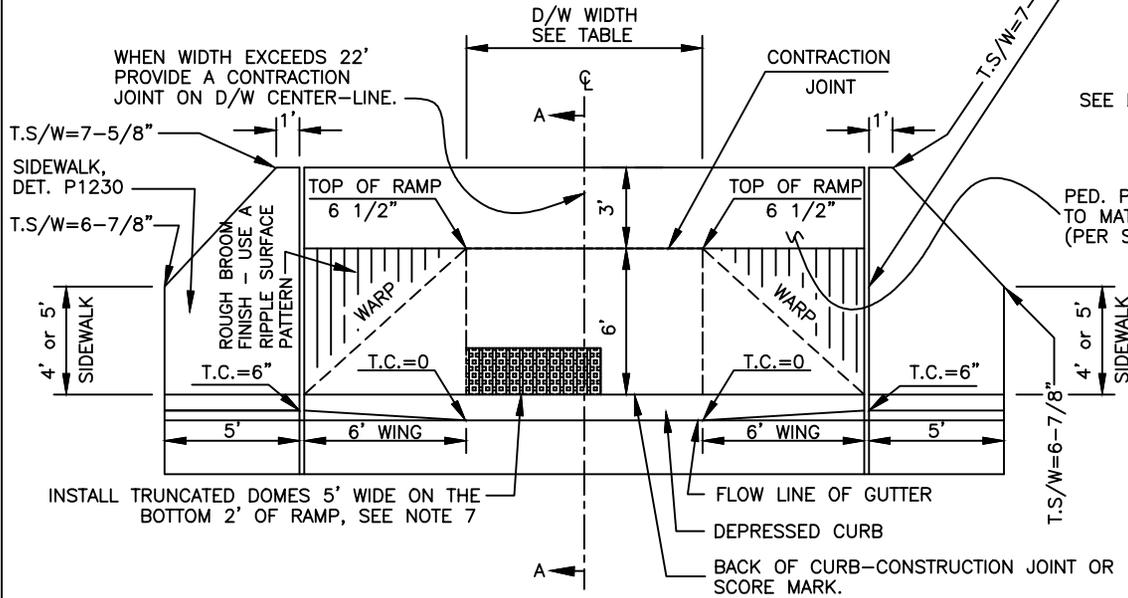
WITH DECELERATION LANE  
PREVENTS LEFT TURN IN/OUT  
35' RETURN



WITH DECELERATION LANE  
PREVENTS LEFT TURN IN/OUT  
60' RETURN

FULL DEPTH EXPANSION JOINT THROUGH DRIVEWAY,  
CURB & GUTTER. EXPANSION JOINT  
FILLER SHALL BE 1/2" BITUMINOUS TYPE  
PREFORMED EXPANSION JOINT FILLER  
A.S.T.M. D-1751.

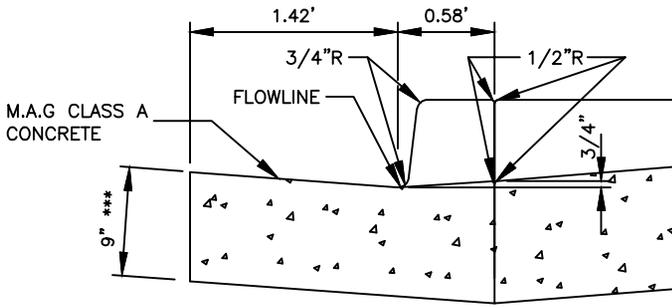
PROVIDE CONSTRUCTION JOINTS  
TO MATCH CURB JOINTS.  
(10' SPACING)



SECTION A-A

NOTES:

1. THIS DETAIL IS ONLY TO BE USED WHEN APPROVED BY THE CITY.
2. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB AND GUTTER.
3. CONCRETE CURB & GUTTER SHALL BE M.A.G. CLASS A; TOP OF WING TO TOP OF WING.
4. PAYMENT FOR DRIVEWAY SHALL BE ON A SQUARE FOOT BASIS.
5. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
6. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO GUTTER. GUTTER ELEVATION = 0
7. TRUNCATED DOMES SHALL BE INSTALLED AT THE BACK OF CURB IN A 2-FT DEEP BY 5-FT WIDE AREA LOCATED AT EITHER THE RIGHT OR LEFT END OF THE DRIVEWAY ENTRANCE, WHICHEVER WILL PROVIDE THE MOST DIRECT ALIGNMENT WITH THE RECEIVER CURB RAMP ON THE OPPOSITE CURB. TRUNCATED DOMES TO BE IN ACCORDANCE WITH DETAIL P1232.



DETAIL "A"

Refer to P1255-4 for  
Driveway Widths Policy

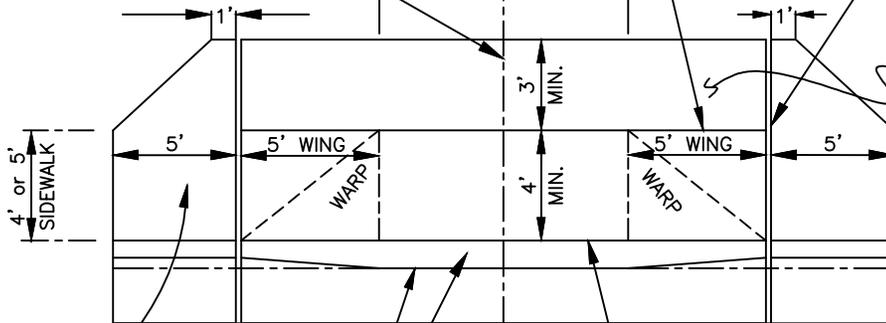
PROVIDE CONSTRUCTION JOINTS TO MATCH CURB JOINTS. (10' SPACING)

FULL DEPTH EXPANSION JOINT THROUGH DRIVEWAY, CURB & GUTTER. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.

WHEN WIDTH EXCEEDS 22' PROVIDE A CONTRACTION JOINT ON D/W CENTER-LINE.

D/W WIDTH SEE TABLE

CONTRACTION JOINT



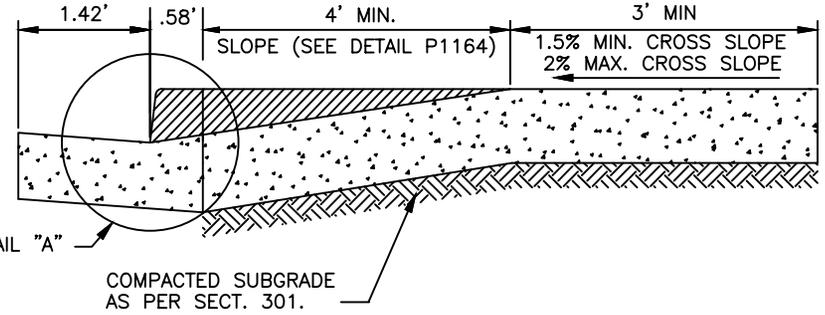
PED. PATH TO MATCH S/W. FINISH PER ST. DET. P1230

SIDEWALK, DET. P1230

FLOW LINE OF GUTTER

DEPRESSED CURB

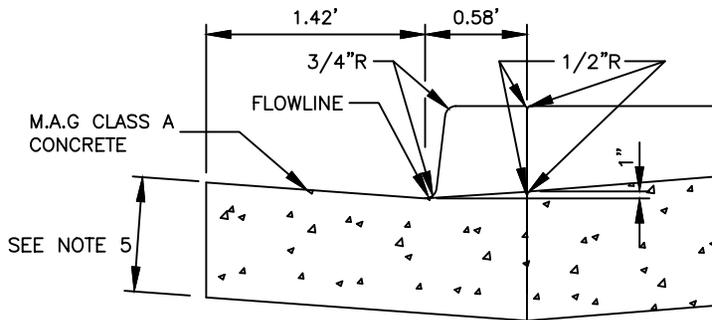
BACK OF CURB—CONSTRUCTION JOINT OR SCORE MARK.



### SECTION A-A

#### NOTES

1. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB AND GUTTER.
2. CONCRETE CURB & GUTTER SHALL BE M.A.G. CLASS A; TOP OF WING TO TOP OF WING.
2. PAYMENT FOR DRIVEWAY SHALL BE ON A SQUARE FOOT BASIS.
3. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
4. WHEN DRIVEWAY IS CONSTRUCTED AT A "T" INTERSECTION AND IS USED AS A RAMP, USE DETAIL P1244.
5. 9" CLASS "A" CONCRETE FOR COMMERCIAL AND INDUSTRIAL DRIVEWAYS AND 6" CLASS "A" CONCRETE FOR RESIDENTIAL DRIVEWAYS, AS PER SECT. 725.



DETAIL "A"

Refer to P1255-4 for Driveway Widths Policy

PROVIDE CONSTRUCTION JOINTS TO MATCH CURB JOINTS. (10' SPACING)

WHEN WIDTH EXCEEDS 22' PROVIDE A CONTRACTION JOINT ON D/W CENTER-LINE.

D/W WIDTH - SEE TABLE

BACK OF CURB - CONSTRUCTION JOINT OR SCORE MARK.

SIDEWALK SEE DET. P1230  
SIZE AS PER PLANS

CONTRACTION JOINT

PED. PATH FINISH TO MATCH S/W. PER ST. DET. P1230

8' +/- LANDSCAPED PARKWAY

5'

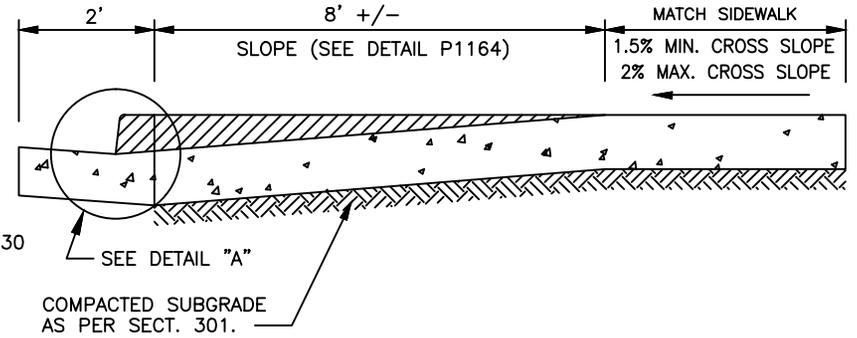
8' +/-

5'

FLOW LINE OF GUTTER

DEPRESSED CURB

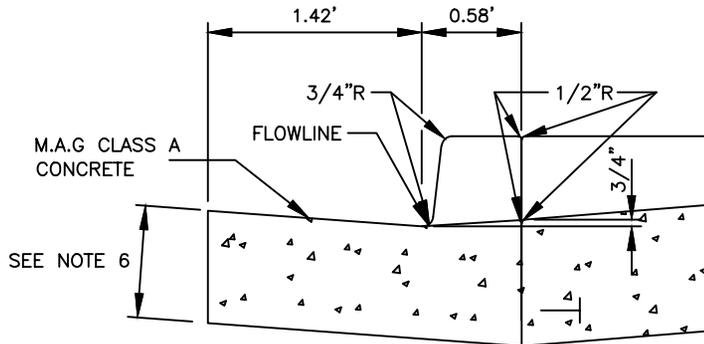
EXPANSION JOINT THROUGH SIDEWALK AND CURB & GUTTER. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.



SECTION A-A

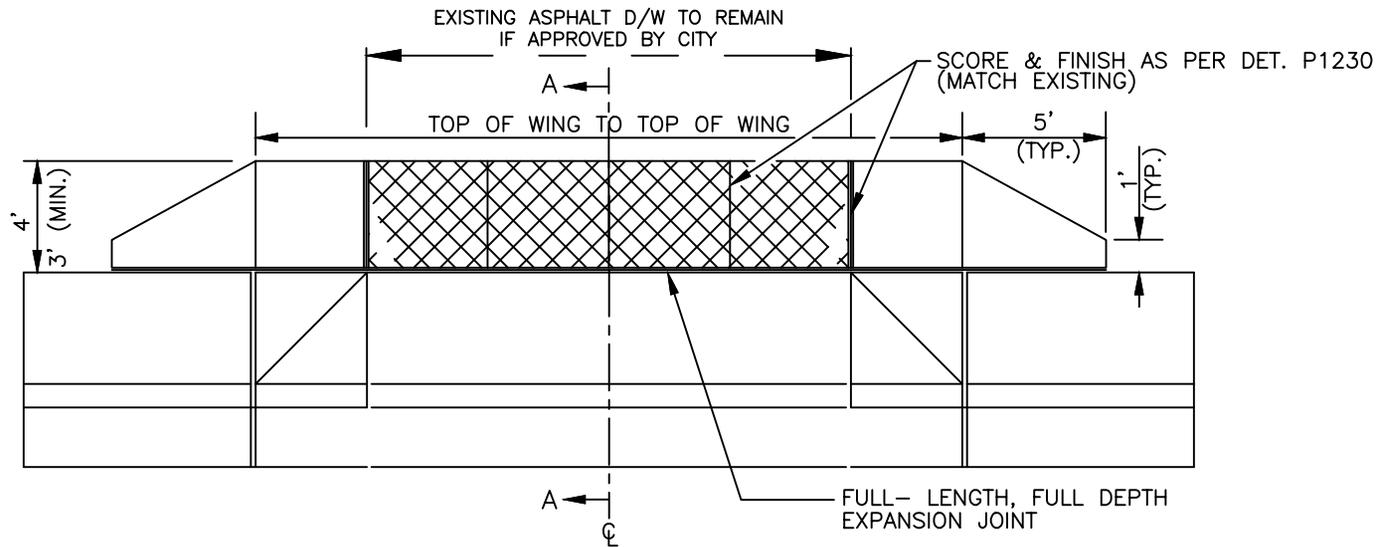
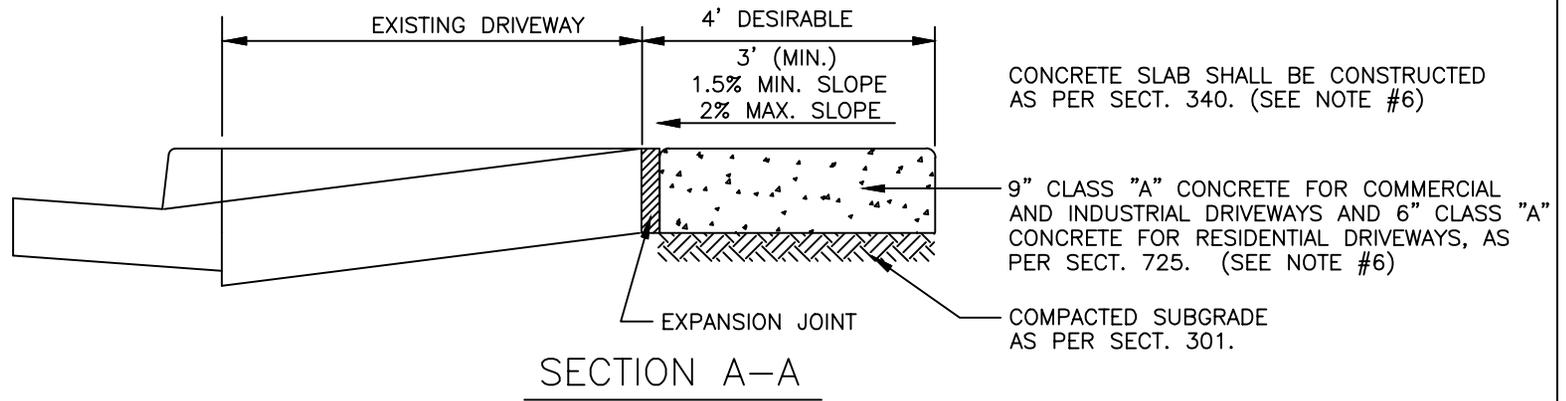
NOTES

1. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB AND GUTTER.
2. CONCRETE CURB & GUTTER SHALL BE M.A.G. CLASS A; TOP OF WING TO TOP OF WING.
3. PAYMENT FOR DRIVEWAY SHALL BE ON A SQUARE FOOT BASIS.
4. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
5. WHEN DRIVEWAY IS CONSTRUCTED AT A "T" INTERSECTION AND IS USED AS A RAMP, THE SLOPE OF THE DRIVEWAY SHALL BE A MAX OF 12:1, AND WILL HAVE TRUNCATED DOMES INSTALLED AT THE BACK OF CURB IN A 2-FT DEEP BY 5-FT WIDE AREA LOCATED AT EITHER THE RIGHT OR LEFT END OF THE DRIVEWAY ENTRANCE, WHICHEVER WILL PROVIDE THE MOST DIRECT ALIGNMENT WITH THE RECEIVER CURB RAMP ON THE OPPOSITE CURB. TRUNCATED DOMES TO BE IN ACCORDANCE WITH DETAIL P1232.
6. 9" CLASS "A" CONCRETE FOR COMMERCIAL AND INDUSTRIAL DRIVEWAYS AND 6" CLASS "A" CONCRETE FOR RESIDENTIAL DRIVEWAYS, AS PER SECT. 725.



DETAIL "A"

Refer to P1255-4 for Driveway Widths Policy

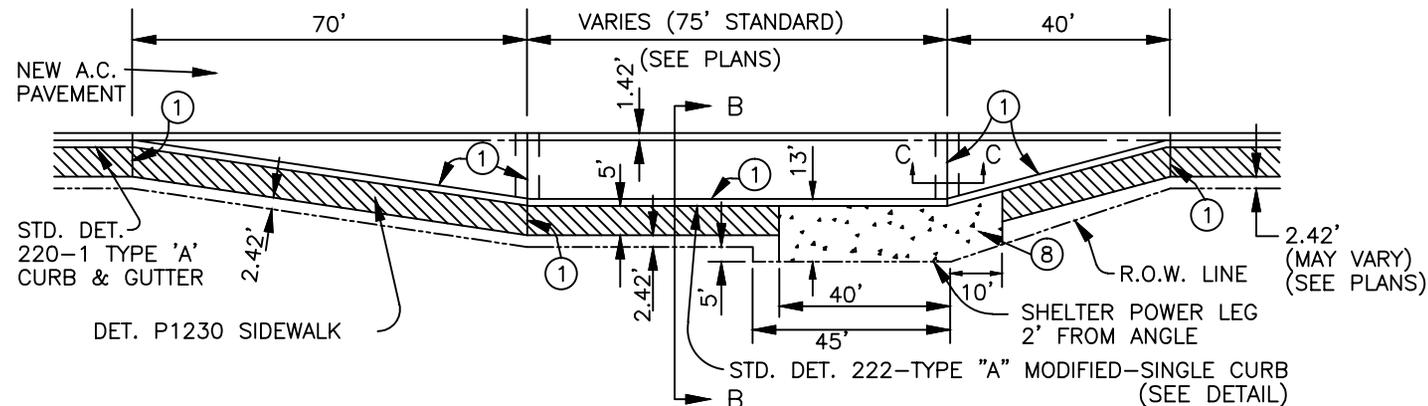


**NOTES**

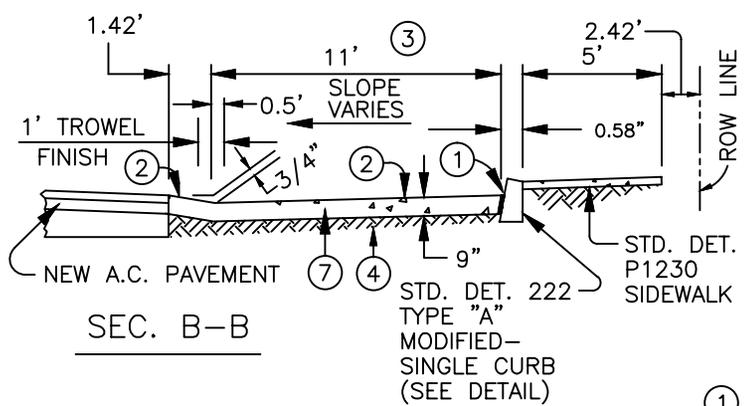
1. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751.
2. CONTROL & EXPANSION JOINTS SHALL ALIGN WITH EXISTING JOINTS IN DRIVEWAY.
3. CONCRETE SHALL BE CLASS "A", SECT. 725.
4. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
5. EXPANSION JOINT MATERIAL SHALL BE USED WHEN NEW POURING IS ADJACENT TO EXISTING DRIVEWAY AREA.
6. INDICATES AREA WHICH MAY REMAIN ASPHALT IF THE CROSS SLOPE & PAVING CONDITIONS MEET ADA STANDARDS.



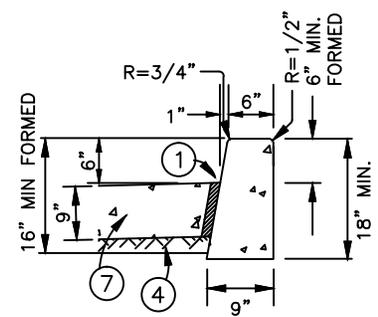
DIRECTION OF TRAVEL



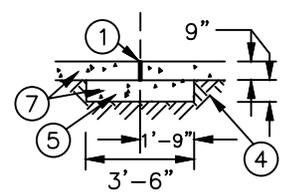
PLAN VIEW



SEC. B-B



STD. DET. 222-TYPE "A"  
MOD. SINGLE CURB

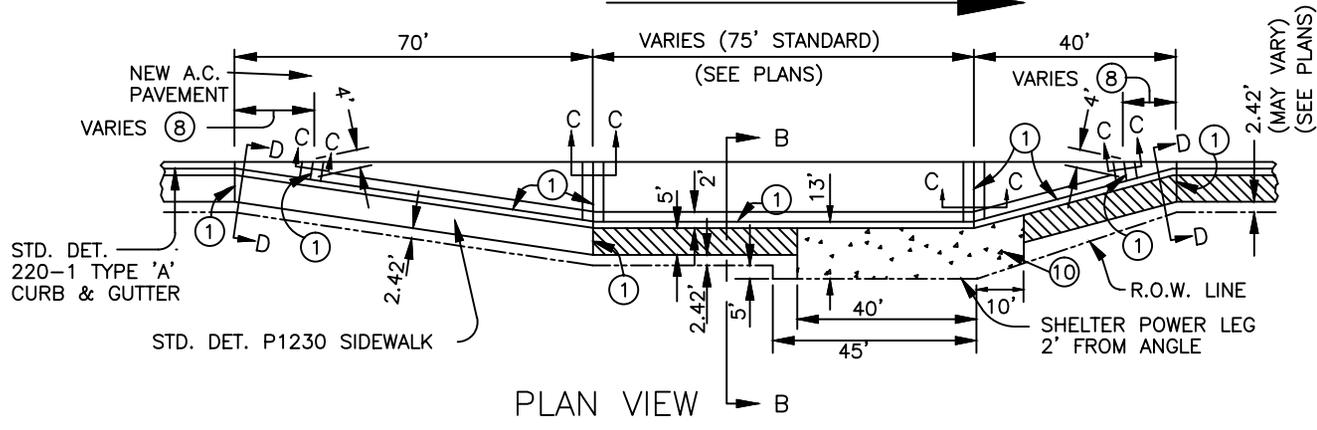


SEC. C-C

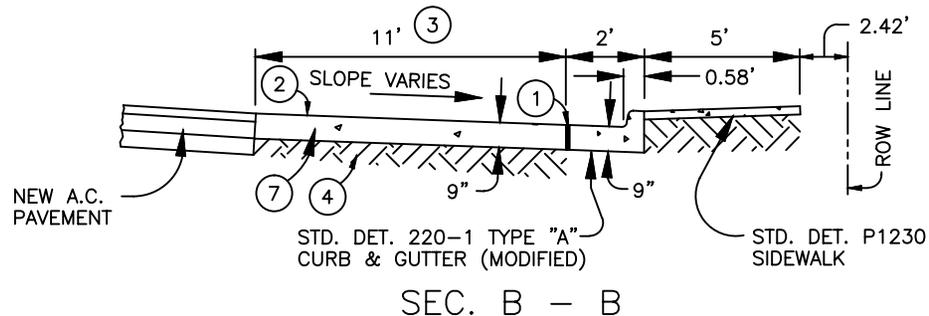
NOTES:

- ① 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751
- ② CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED, EXCEPT WHERE OTHERWISE NOTED.
- ③ MAY BE REDUCED TO 10' MINIMUM IF APPROVED BY CITY.
- ④ SUBGRADE PREPARATION PER SPECIFICATIONS.
- ⑤ CONCRETE PAD TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT. (SEE SECTION C-C)
- ⑥ CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB.
- ⑦ CONCRETE SHALL BE CLASS "A" PER M.A.G. SPECS. OR CLASS "S", F'C = 3000 PSI PER A.D.O.T. SPECS.
- ⑧ BUS SHELTER PAD, SEE DETAIL P1261
- ⑨ DRIVEWAYS SHALL NOT BE LOCATED WITHIN THE SHELTER PAD AREA.
- ⑩ CAN BE USED AT INTERSECTIONS WITH TOTAL ROADWAY WIDTHS OF 74' OR LARGER.

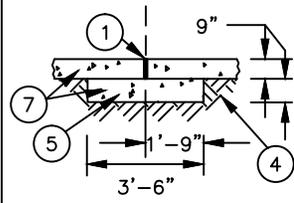
DIRECTION OF TRAVEL



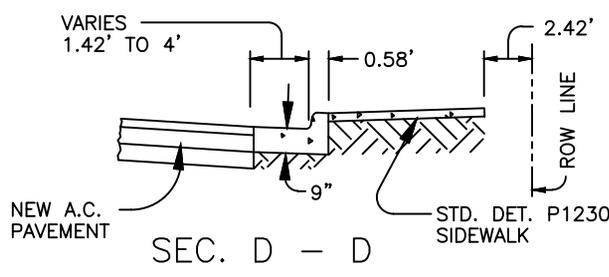
PLAN VIEW



SEC. B - B



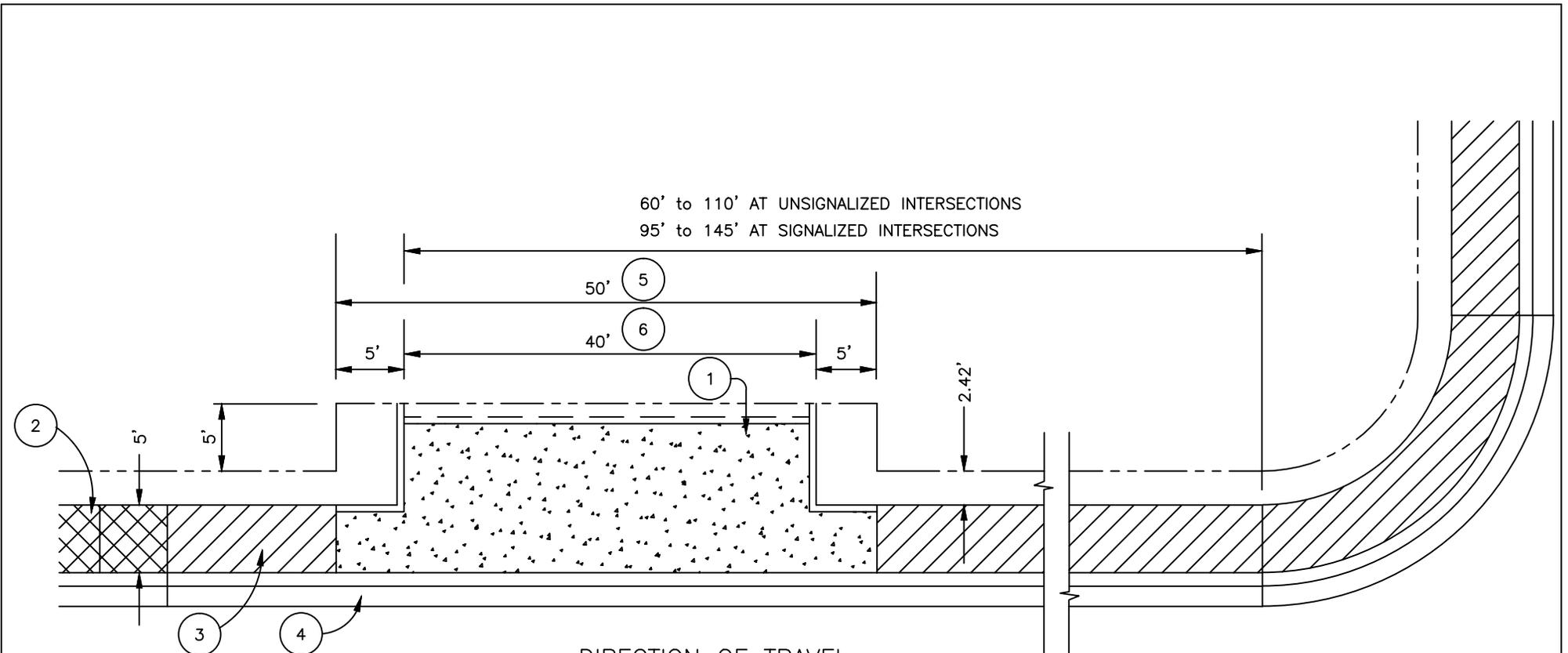
SEC. C - C



SEC. D - D

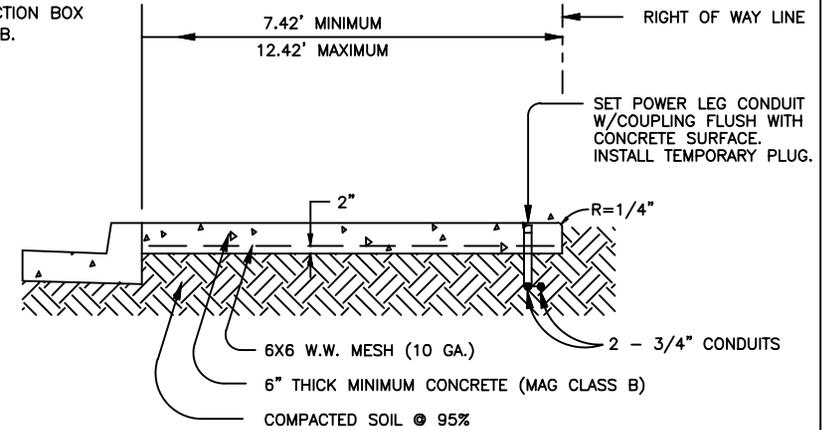
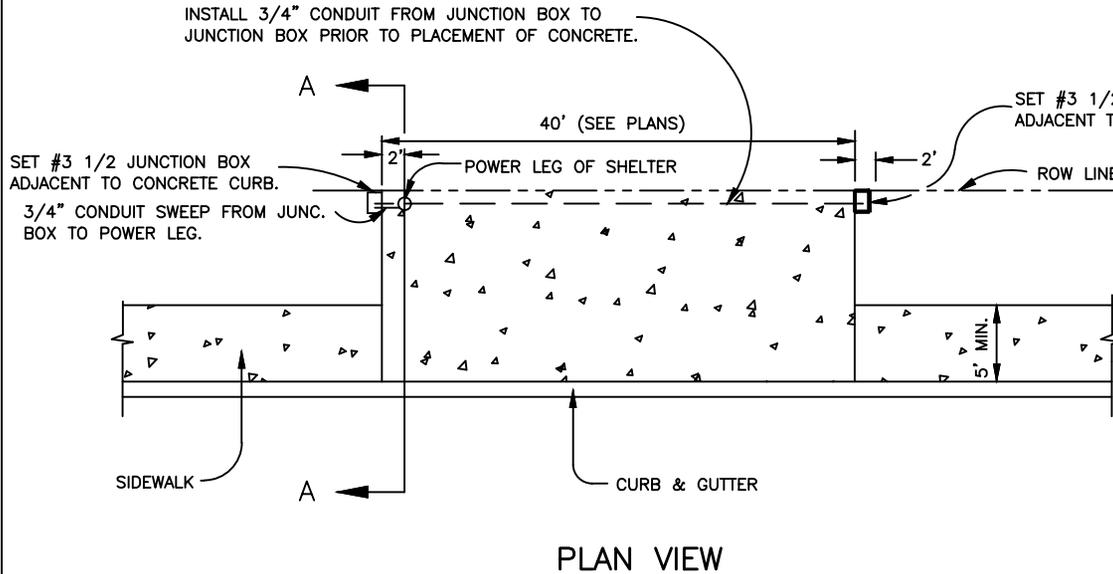
NOTES:

- ① 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751
- ② CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED.
- ③ MAY BE REDUCED TO 10' MINIMUM IF APPROVED BY CITY.
- ④ SUBGRADE PREPARATION PER SPECIFICATIONS.
- ⑤ CONCRETE PAD TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT. (SEE SECTION C-C)
- ⑥ CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB.
- ⑦ CONCRETE SHALL BE CLASS "A" PER M.A.G. SPECS. OR CLASS "S", F'C = 3000 PSI PER A.D.O.T. SPECS.
- ⑧ CURB & GUTTER-TO-BUS BAY PAVEMENT-TRANSITION (LENGTH VARIES)
- ⑨ DRIVEWAYS SHALL NOT BE LOCATED WITHIN THE SHELTER PAD AREA.
- ⑩ BUS SHELTER PAD, SEE DETAIL P1261
- ⑪ CAN BE USED AT INTERSECTIONS WITH TOTAL ROADWAY WIDTHS OF 74' OR LARGER.



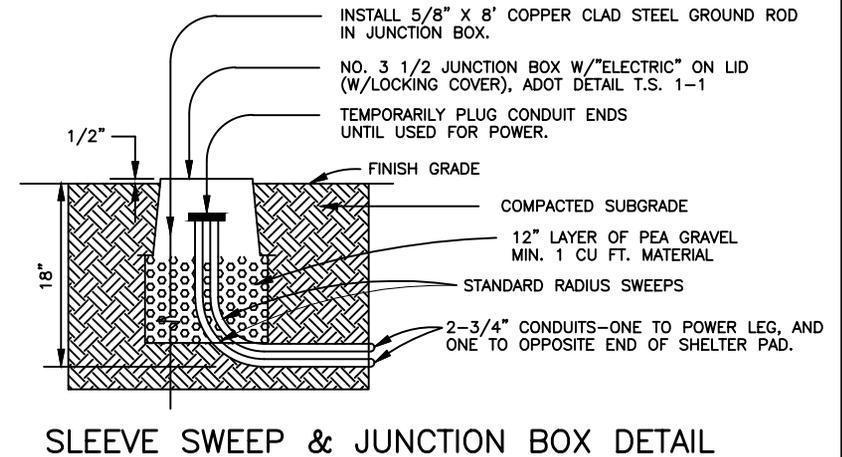
- (1) BUS SHELTER PAD.  
SEE DETAIL P1260 OR P1262
- (2) DRIVEWAYS SHALL NOT BE  
LOCATED WITHIN THE SHELTER  
PAD AREA.
- (3) SIDEWALK DETAIL P1230

- (4) CURB & GUTTER DETAIL 220-1  
TYPE "A".
- (5) REDUCE TO 30' IN  
SINGLE FAMILY RESIDENTIAL  
AREAS.
- (6) REDUCE TO 20' IN  
SINGLE-FAMILY RESIDENTIAL  
AREAS.



**NOTES:**

1. ACTUAL PLAN LAYOUT MAY VARY. ALL OTHER DETAIL INFORMATION REMAINS THE SAME. SEE PLANS FOR SPECIFIC LOCATIONS AND DIMENSIONS OF BUS SHELTER PAD.
2. ANY SHELTER OR BUS STOP FURNITURE PLACEMENT SHALL BE LOCATED TO PROVIDE A MIN. 5 ft. WIDE CLEAR SIDEWALK.
3. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.
4. ELECTRICAL CONDUITS AND JUNCTION BOXES SHALL NOT BE REQUIRED UNLESS REQUESTED.
5. ALL CONDUIT SHALL BE P.V.C. SCHEDULE 40, U.L. LISTED.
6. ALL COSTS ASSOCIATED WITH ELECTRICAL AND RELATED ITEMS SHOWN ON THESE DETAILS (CONDUITS, JUNCTION BOXES, GROUND ROD, ETC.) SHALL BE CONSIDERED INCLUDED IN THE COST OF THE PAY ITEM FOR CONCRETE BUS SHELTER PAD.
7. BUS BAY PAVEMENT, CONCRETE PAD, CONCRETE CURB, SINGLE CURB, CURB & GUTTER, SIDEWALKS, & DRIVEWAYS ARE SEPARATE PAY ITEMS.
8. SHELTER PADS AND DRIVEWAYS SHALL BE LOCATED TO PROVIDE MINIMUM INTERSECTION SIGHT DISTANCE IN ACCORDANCE WITH CURRENT AASHTO STANDARDS (CASE IIIA).



DETAIL NO.  
P1260



**City of Phoenix**  
**STANDARD DETAIL**

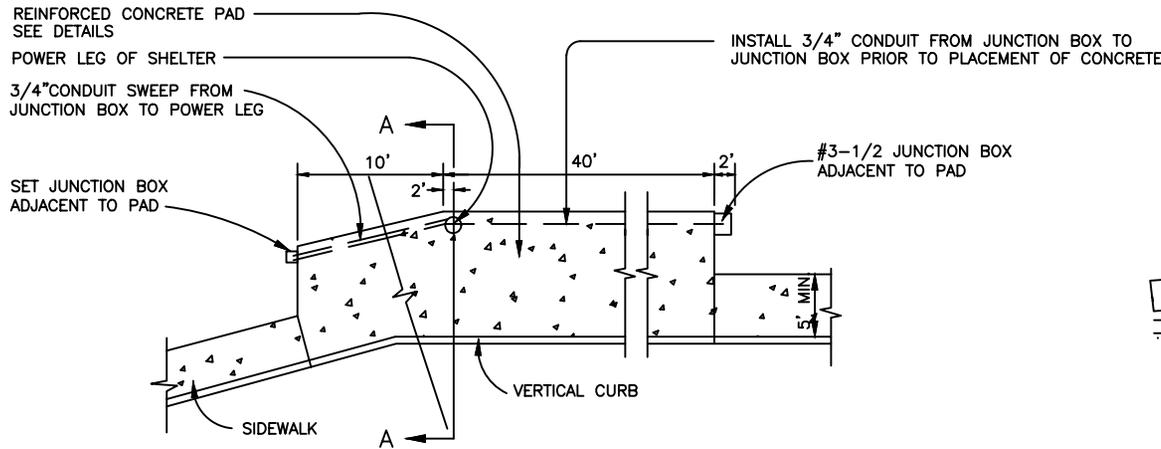
BUS SHELTER/ACCESSORY PAD  
BUS STOP

APPROVED

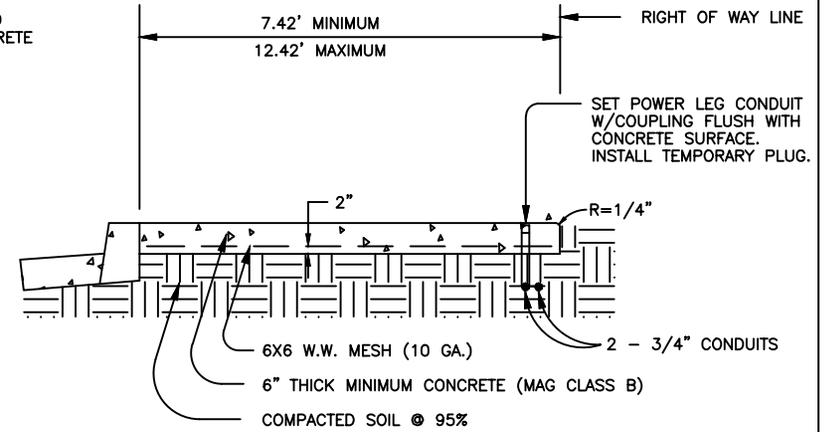
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ACTING CITY ENGINEER

7/31/08  
DATE

DETAIL NO.  
P1260



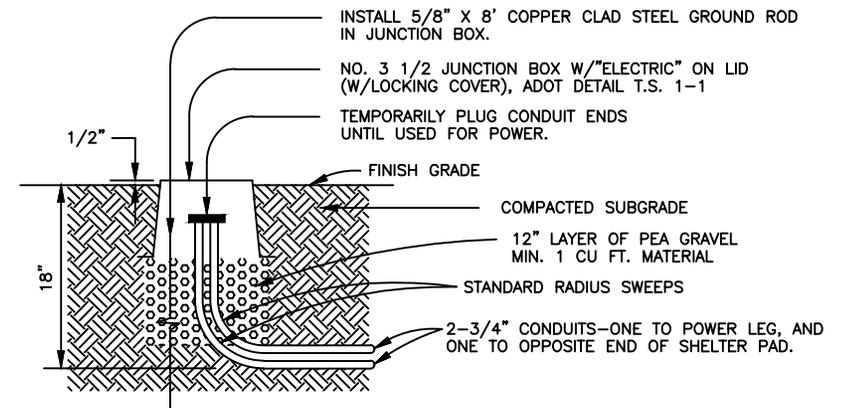
PLAN VIEW



SECTION A - A

NOTES:

1. ACTUAL PLAN LAYOUT MAY VARY. ALL OTHER DETAIL INFORMATION REMAINS THE SAME. SEE PLANS FOR SPECIFIC LOCATIONS AND DIMENSIONS OF BUS SHELTER PAD.
2. ANY SHELTER OR BUS STOP FURNITURE PLACEMENT SHALL BE LOCATED TO PROVIDE A MIN. 5 FT. WIDE CLEAR SIDEWALK.
3. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.
4. ELECTRICAL CONDUITS AND JUNCTION BOXES SHALL NOT BE REQUIRED UNLESS REQUESTED.
5. ALL CONDUIT SHALL BE P.V.C. SCHEDULE 40, U.L. LISTED.
6. ALL COSTS ASSOCIATED WITH ELECTRICAL AND RELATED ITEMS SHOWN ON THESE DETAILS (CONDUITS, JUNCTION BOXES, GROUND ROD, ETC.) SHALL BE CONSIDERED INCLUDED IN THE COST OF THE PAY ITEM FOR CONCRETE BUS SHELTER PAD.
7. BUS BAY PAVEMENT, CONCRETE PAD, CONCRETE CURB, SINGLE CURB, CURB & GUTTER, SIDEWALKS, & DRIVEWAYS ARE SEPARATE PAY ITEMS.
8. SHELTER PADS AND DRIVEWAYS SHALL BE LOCATED TO PROVIDE MINIMUM INTERSECTION SIGHT DISTANCE IN ACCORDANCE WITH CURRENT AASHTO STANDARDS (CASE IIIA).



SLEEVE SWEEP & JUNCTION BOX DETAIL

DETAIL NO.  
P1261



**City of Phoenix**  
**STANDARD DETAIL**

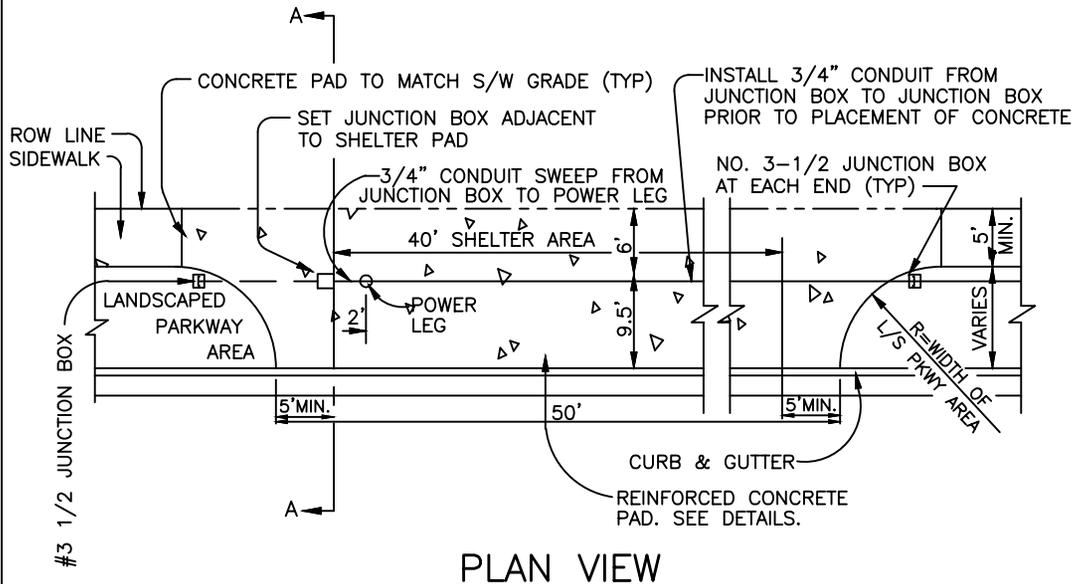
BUS SHELTER/ACCESSORY PAD  
BUS BAY

APPROVED

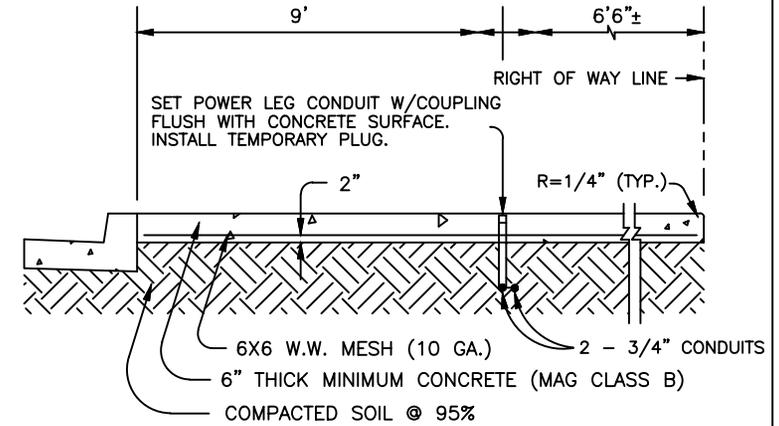
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7/31/08  
DATE

DETAIL NO.  
P1261



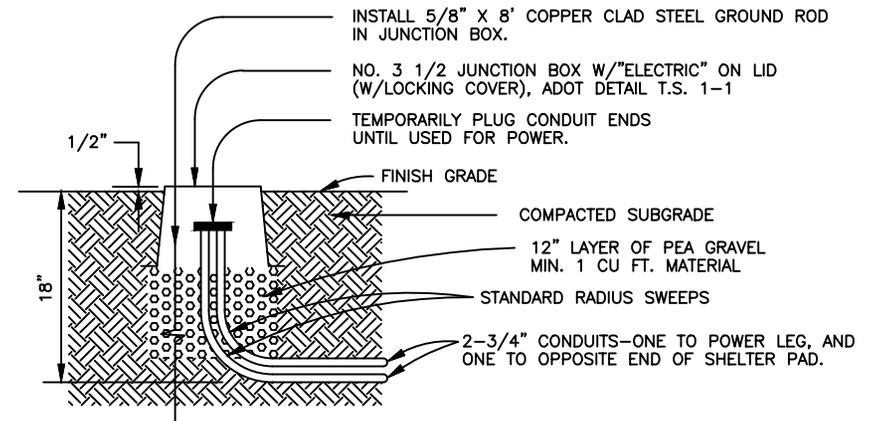
PLAN VIEW



SECTION A - A

NOTES:

1. ACTUAL PLAN LAYOUT MAY VARY. ALL OTHER DETAIL INFORMATION REMAINS THE SAME. SEE PLANS FOR SPECIFIC LOCATIONS AND DIMENSIONS OF BUS SHELTER PAD.
2. ANY SHELTER OR BUS STOP FURNITURE PLACEMENT SHALL BE LOCATED TO PROVIDE A MIN. 5 ft. WIDE CLEAR SIDEWALK.
3. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.
4. ELECTRICAL CONDUITS AND JUNCTION BOXES SHALL NOT BE REQUIRED UNLESS REQUESTED.
5. ALL CONDUIT SHALL BE P.V.C. SCHEDULE 40, U.L. LISTED.
6. ALL COSTS ASSOCIATED WITH ELECTRICAL AND RELATED ITEMS SHOWN ON THESE DETAILS (CONDUITS, JUNCTION BOXES, GROUND ROD, ETC.) SHALL BE CONSIDERED INCLUDED IN THE COST OF THE PAY ITEM FOR CONCRETE BUS SHELTER PAD.
7. BUS BAY PAVEMENT, CONCRETE PAD, CONCRETE CURB, SINGLE CURB, CURB & GUTTER, SIDEWALKS, & DRIVEWAYS ARE SEPARATE PAY ITEMS.
8. SHELTER PADS AND DRIVEWAYS SHALL BE LOCATED TO PROVIDE MINIMUM INTERSECTION SIGHT DISTANCE IN ACCORDANCE WITH CURRENT AASHTO STANDARDS (CASE IIIA).



SLEEVE SWEEP & JUNCTION BOX DETAIL

DETAIL NO.  
P1262



**City of Phoenix**  
**STANDARD DETAIL**

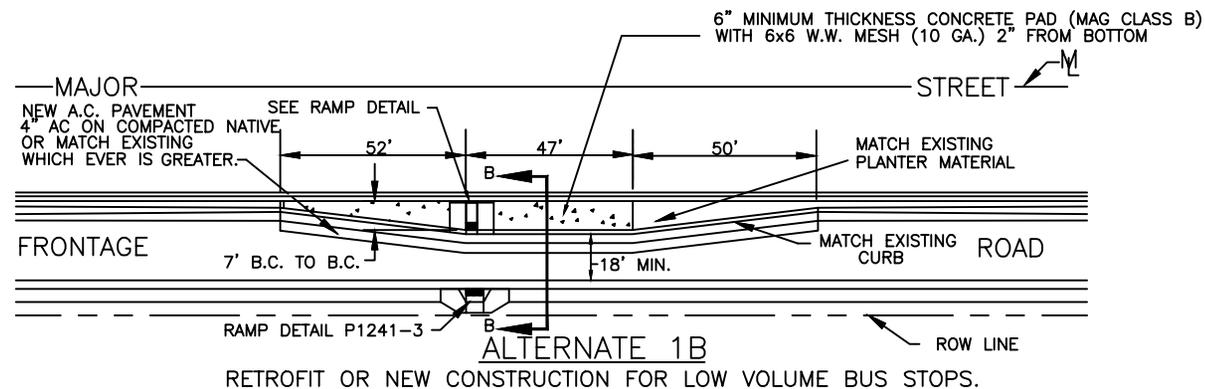
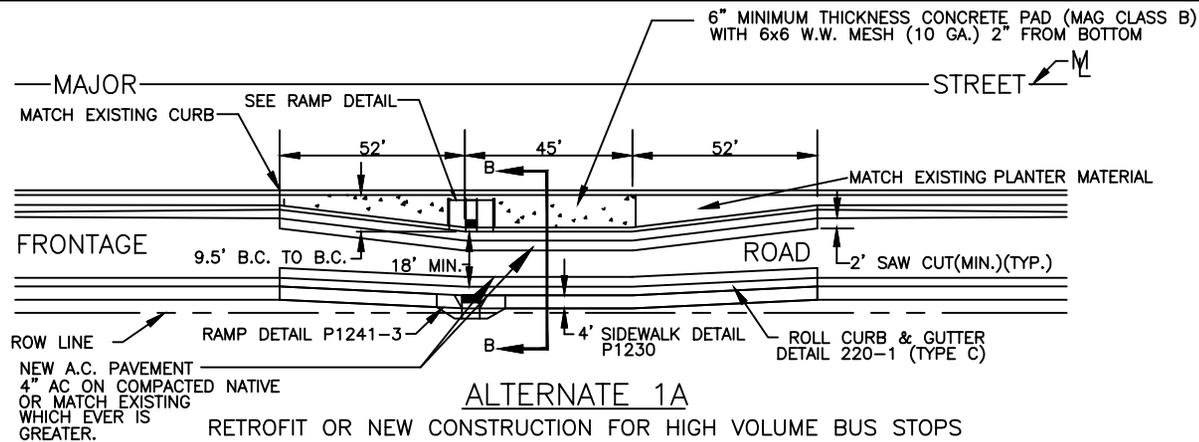
PARKWAY BUS SHELTER/ACCESSORY PAD

APPROVED

*[Signature]*  
ACTING CITY ENGINEER

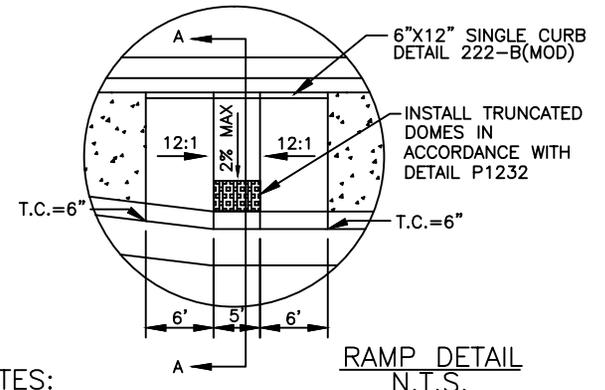
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DATE

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P1262



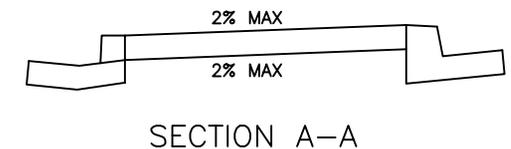
**NOTES:**

1. ALL DIMENSIONS ARE TO FACE OF CURB.
2. WHEEL CHAIR RAMP AND WING SLOPES SHALL NOT EXCEED 12:1.
3. COORDINATE REMOVAL OF LANDSCAPING WITH STREET TRANSPORTATION DEPARTMENT'S LANDSCAPE ARCHITECT.
4. EXISTING LANDSCAPE IRRIGATION LINES SHALL BE SLEEVED UNDER BUS SHELTER/ACCESSORY PAD & DECO PAVEMENT. SLEEVE SHALL EXTEND 12" BEYOND EACH SIDE OF PAVEMENT.
5. NOTIFY PARKS DEPARTMENT MAINTENANCE DISTRICT IF LANDSCAPE IRRIGATION SYSTEM WILL BE INTERRUPTED FOR MORE THAN 24 HOURS.
6. ALL CONCRETE AND ASPHALT REMOVALS SHALL BE SAW CUT. MIN. 2" ASPHALT REPLACEMENT ADJACENT TO NEW CURBS.
7. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH 4000 PSI. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.

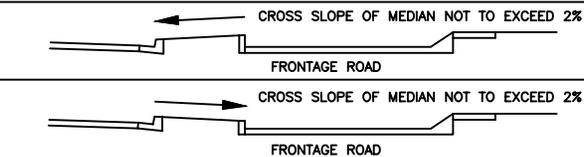


**NOTES:**

1. USE CLASS 'B' CONCRETE PER SECTION 725.
2. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0.

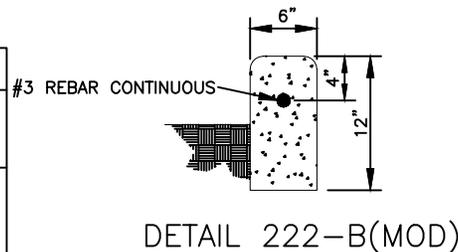


**SLOPE LIMITS FOR ALTERNATES 1A & 1B**



IF CROSS SLOPE LIMITS CANNOT BE MET, COORDINATE ANY PROPOSED DESIGN MODIFICATIONS WITH THE STREET TRANSPORTATION DEPARTMENT.

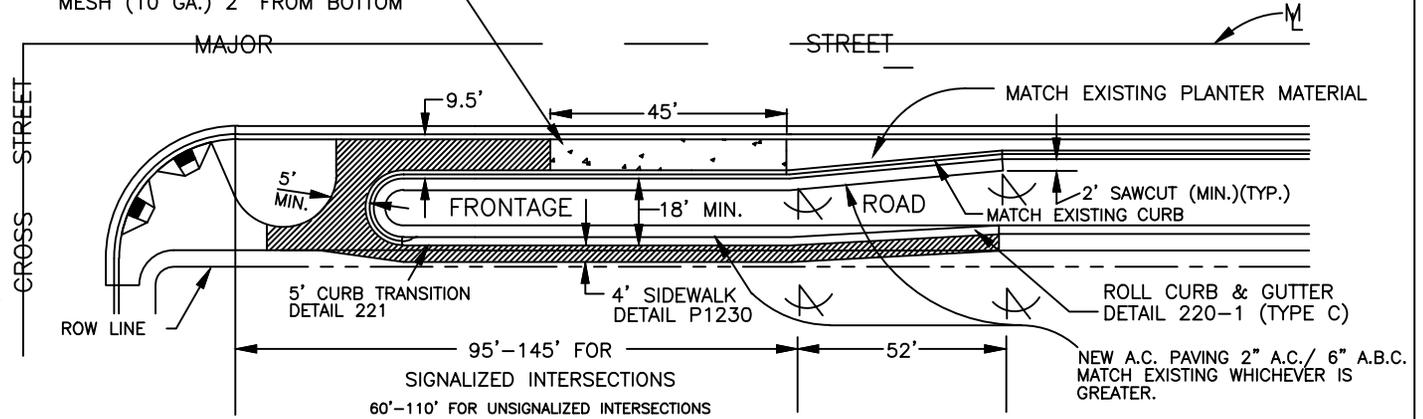
**SECTION B-B**



**NOTES:**

1. ALL DIMENSIONS ARE TO FACE OF CURB.
2. WHEEL CHAIR RAMP AND WING SLOPES SHALL NOT EXCEED 12:1.
3. COORDINATE REMOVAL OF LANDSCAPING WITH STREET TRANSPORTATION DEPARTMENT'S LANDSCAPE ARCHITECT.
4. EXISTING LANDSCAPE IRRIGATION LINES SHALL BE SLEEVED UNDER BUS SHELTER/ACCESSORY PAD. SLEEVE SHALL EXTEND 12" BEYOND EACH SIDE OF PAD.
5. NOTIFY PARKS DEPARTMENT MAINTENANCE DISTRICT IF LANDSCAPE IRRIGATION SYSTEM WILL BE INTERRUPTED FOR MORE THAN 24 HOURS.
6. ALL CONCRETE AND ASPHALT REMOVALS SHALL BE SAW CUT. MIN. 2' ASPHALT REPLACEMENT ADJACENT TO NEW CURBS.
7. SEE DETAIL P1263-1 FOR CROSS SLOPE LIMITS.
8. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.

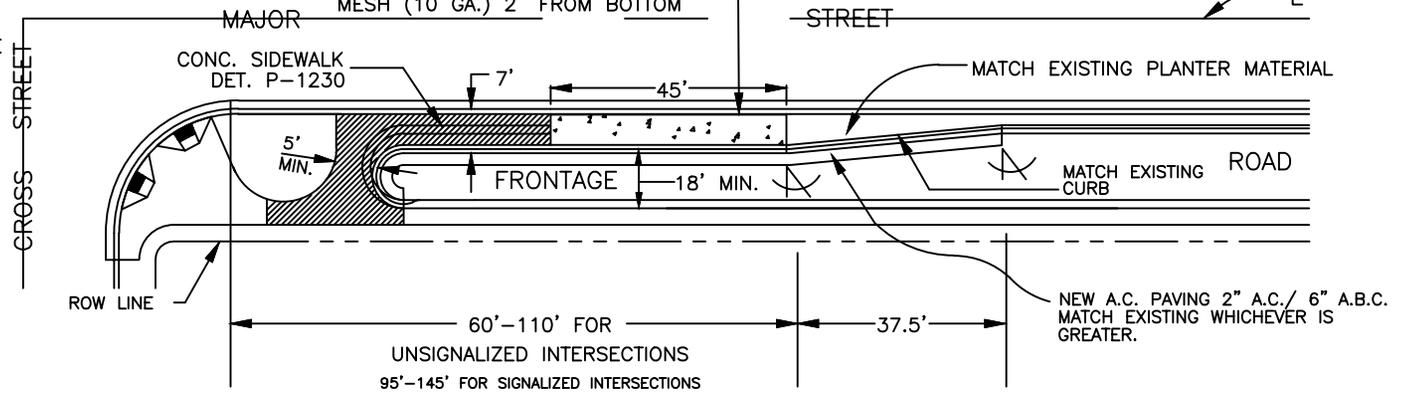
6" MINIMUM THICKNESS CONCRETE PAD (MAG CLASS B) WITH 6x6 W.W. MESH (10 GA.) 2" FROM BOTTOM



**ALTERNATE 2A**

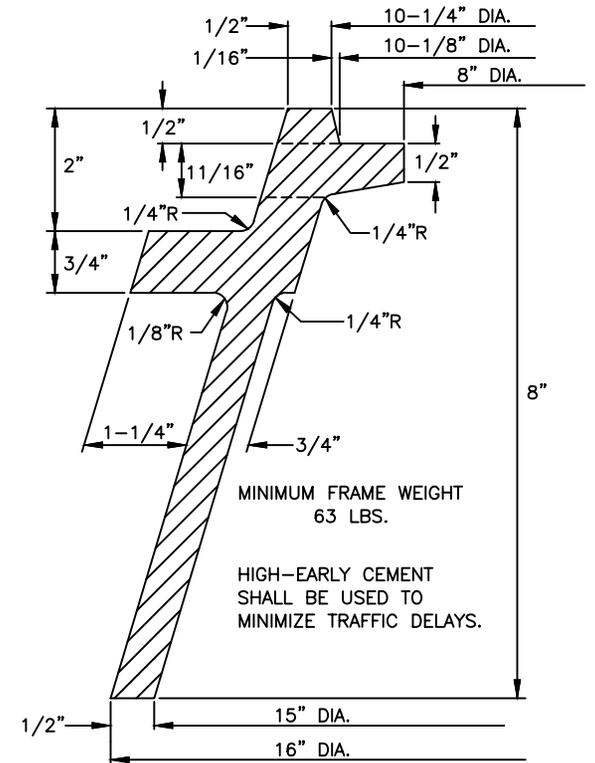
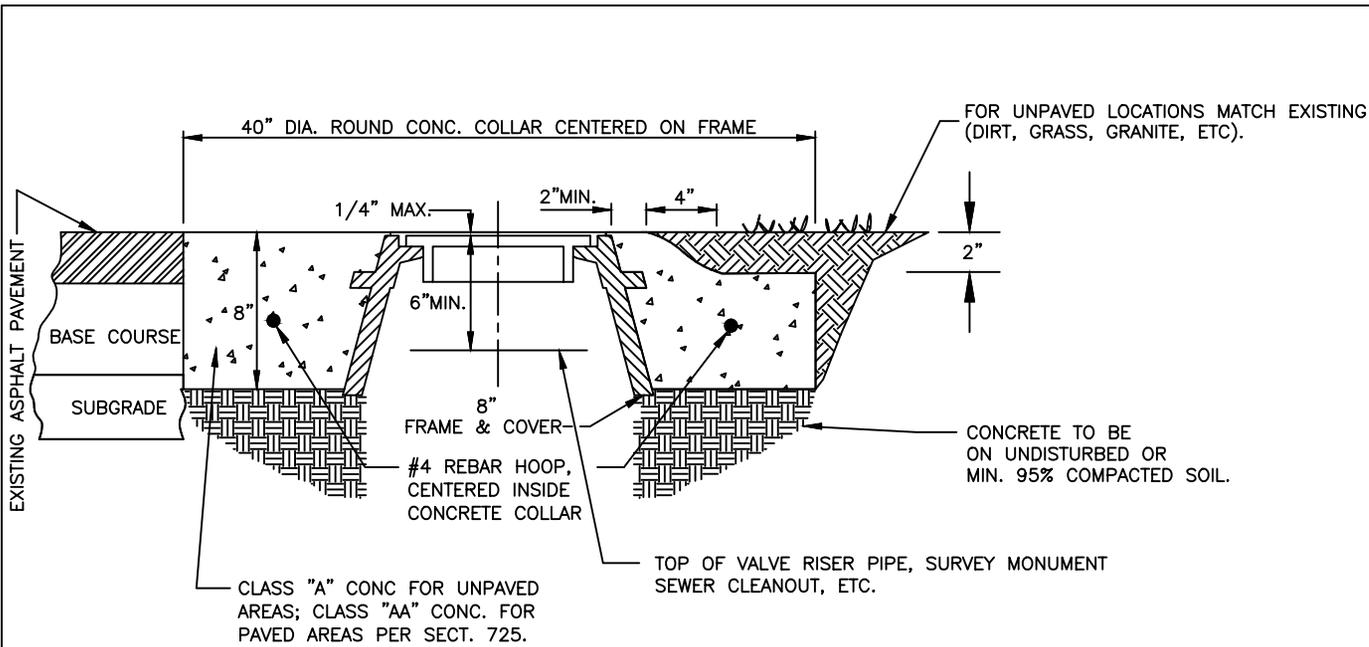
NEW CONSTRUCTION FOR HIGH VOLUME BUS STOPS

6" MINIMUM THICKNESS CONCRETE PAD (MAG CLASS B) WITH 6x6 W.W. MESH (10 GA.) 2" FROM BOTTOM



**ALTERNATE 2B**

RETROFIT OR NEW CONSTRUCTION FOR LOW VOLUME BUS STOPS.

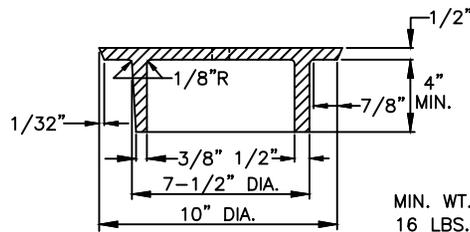


8" C.I. FRAME AND COVER

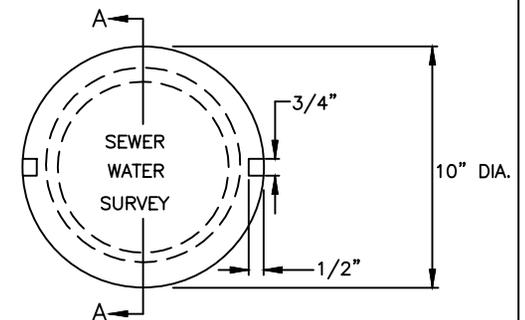
1) IN PAVED MAJOR ARTERIAL STREETS, CONCRETE COLLARS SHALL BE SCORED RADIALLY AT QUARTER-CIRCLE POINTS AND SCORES SHALL BE 1/4" WIDE BY 1/2" DEEP. CONCRETE SURFACE SHALL BE ROUGH BROOM FINISHED. NO TRAFFIC SHALL BE ALLOWED ON COLLARS UNTIL CONCRETE REACHES MINIMUM 2500 PSI ON ALL STREETS.

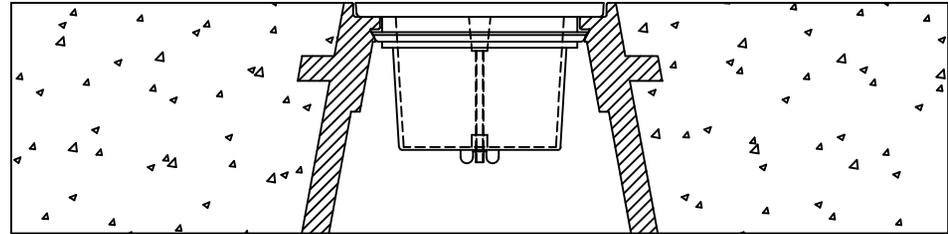
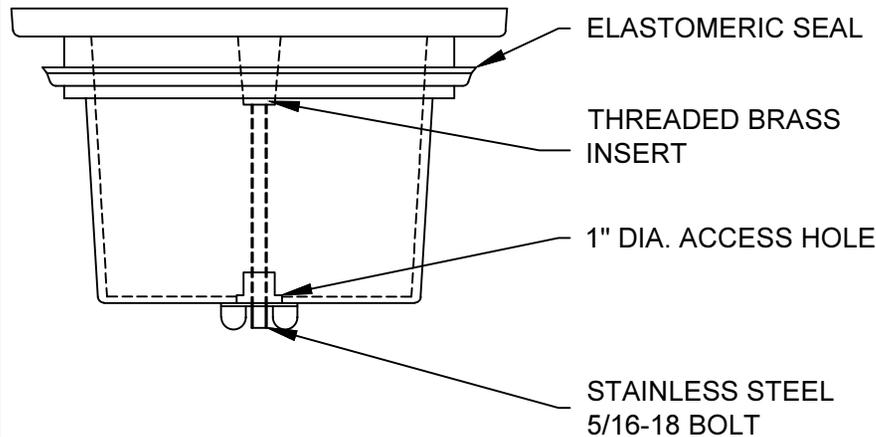
2) LETTERS ON COVER TO BE AS FOLLOWS: "SEWER", "WATER", OR "SURVEY" AS DIRECTED. TOTAL WIDTH OF WORD "SEWER" OR "WATER" 3-3/4". TOTAL WIDTH OF WORD "SURVEY" 4-1/2". LETTER SIZE 5/8" X 3/4", RAISED 1/16" ABOVE LEVEL OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. CASTINGS TO CONFORM TO SECT. 787.

3) COMPACTION TO CONFORM TO SECT. 301 OR 601.



COVER SECTION A-A

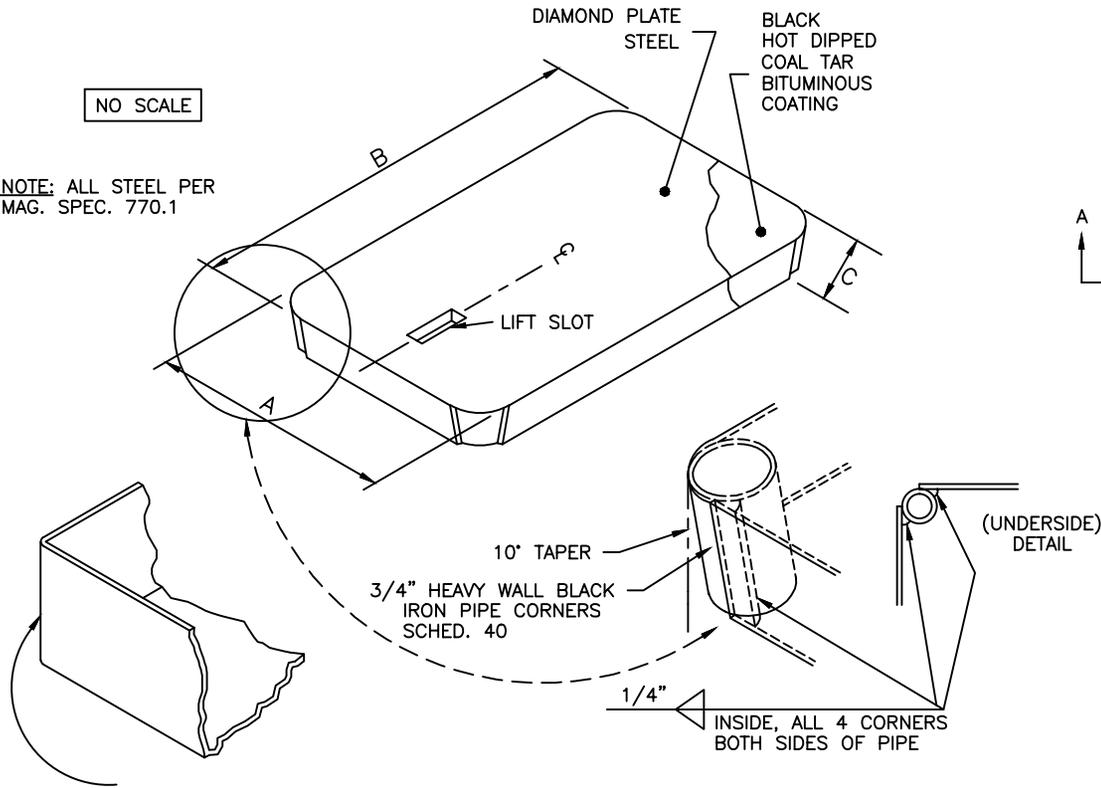




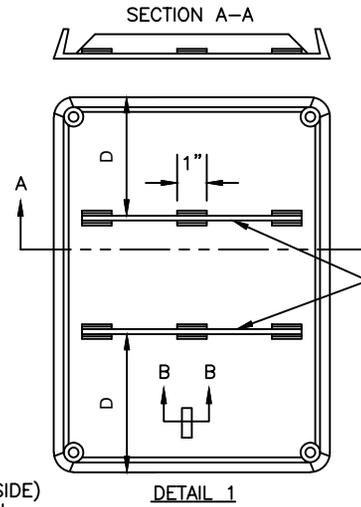
1. BODY OF THE SECURE VALVE BOX LID SHALL BE MOLDED USING AN ABS/POLYCARBONATE ALLOY, AND DISPLAY THE CITY OF PHOENIX LOGO, THE WORDS "CITY OF PHOENIX", AND "WATER".
2. WITH AN ELASTOMERIC SEAL WHICH WHEN PRESSED INTO PLACE BENEATH THE LID-SEAT, EXPANDS TO A DIAMETER GREATER THAN THE OPENING THROUGH WHICH IT WAS PASSED, BUT CAPABLE OF FOLDING BACK DURING LID EXTRACTION.
3. A HOLLOW ENCLOSURE MOLDED USING AN ABS/POLYCARBONATE ALLOY. CAPABLE OF BEING FILLED WITH A GRANULAR MATERIAL, FOR ADDITIONAL WEIGHT IF DESIRED, MUST BE AFFIXED BENEATH THE SURFACE PLATE OF LID, WITH SERIES 3400 STAINLESS STEEL 5/16"-18 BOLT INSERTED INTO THREADED BRASS INSERT MOLDED IN LID.
4. HOLLOW ENCLOSURE TO EXTEND A MINIMUM OF 4" BENEATH THE LID-SEAT, AND BE SECURED BY A STAINLESS STEEL BOLT EXTENDING THROUGH THE ENCLOSURE INTO THREADED BRASS INSERT IN LID.
5. HOLLOW ENCLOSURE MUST HAVE AN ACCESSIBLE OPENING OF AT LEAST 1" DIAMETER FOR FILLING, WHEN REQUIRED.
6. SECURE VALVE BOX LID TO BE AS MANUFACTURED BY SW SERVICES OR EQUAL.
7. SEE DETAIL P1391 FOR ADDITIONAL INFORMATION ON VALVE BOX INSTALLATIONS.

NO SCALE

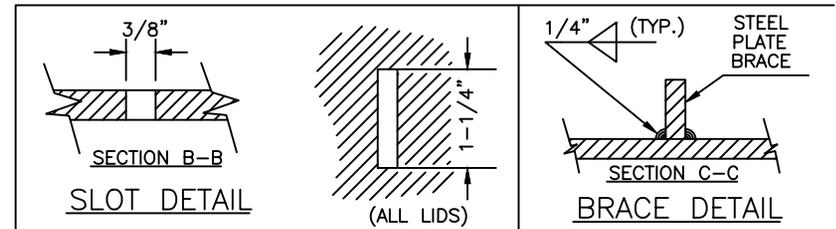
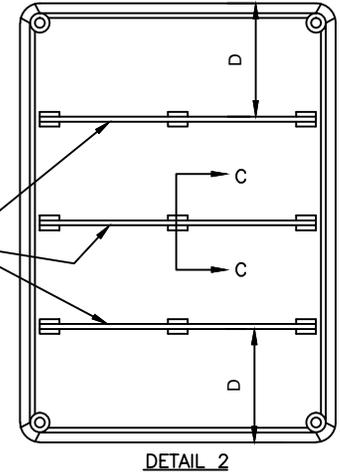
NOTE: ALL STEEL PER  
MAG. SPEC. 770.1



\*OPTIONAL 3/16" WELD IN LIEU OF IRON PIPE

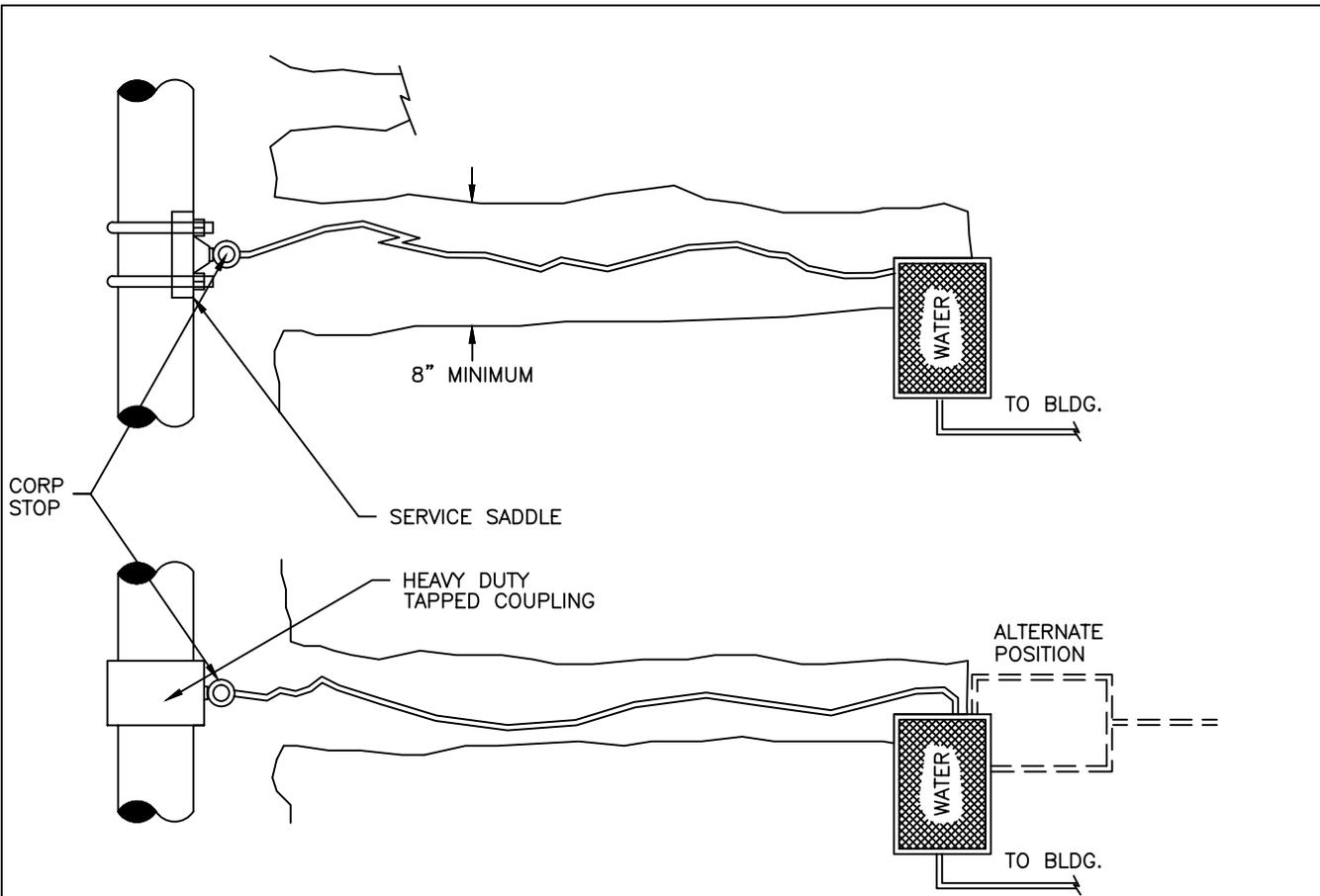


UNDERSIDE VIEWS



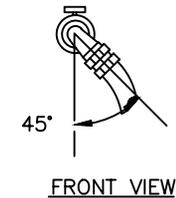
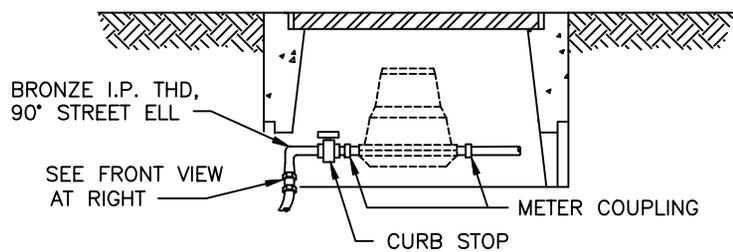
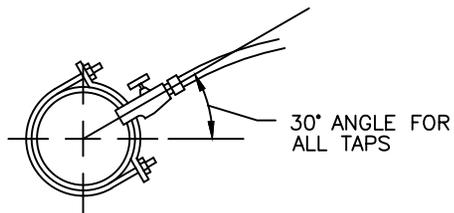
SPECIFICATIONS

NO.	A	B	C	D	E	BRACES	WEIGHT	MATERIAL
1	9"	15-7/8"	1-3/8"	NONE	NONE	NONE	5-1/4 LBS.	14 GAGE
2	14-1/8"	21-3/4"	1-1/2"	6-1/2"	3/16" X 1-1/4" X 13-1/8"	DETAIL 1	12-3/4 LBS.	12 GAGE
3	15-1/4"	26-1/4"	1-1/2"	8-1/4"	3/16" X 1-1/4" X 14-1/4"	DETAIL 1	19-1/4 LBS.	12 GAGE
4	19-1/2"	30"	1-1/2"	7-1/8"	3/16" X 1-1/4" X 18-3/4"	DETAIL 2	33 LBS.	11 GAGE



NOTES:

1. NEW WATER SERVICE TAPS SHALL BE INSTALLED USING AN ALL-BRONZE DOUBLE-STRAP TAPPING SADDLE OR A TAPPED COUPLING.
2. 30" MINIMUM COVER IS REQUIRED FOR SERVICE LINES.
3. WATER SERVICE INCLUDES THE CORP. STOP, SERVICE PIPE, APPURTENANT FITTINGS, CURB STOP, METER BOX & COVER. APPROVED WATER SERVICE COMPONENTS ARE LISTED IN CITY OF PHOENIX SUPPLEMENTS.
4. ONLY AUTHORIZED PERSONNEL OF THE WATER & WASTEWATER DEPT. SHALL INSTALL THE SERVICE CONNECTION FOR ANY EXISTING CITY WATER MAIN SERVING ALL OR PART OF A NEW SUBDIVISION.
5. WATER METER WILL BE INSTALLED BY CITY FORCES.
6. FOR 3/4" THROUGH 2" SERVICE USE COPPER PIPE.
7. FOR WATER METER LOCATION SEE CITY OF PHOENIX DETAIL P1363.



DETAIL NO.  
P1342



**City of Phoenix**  
**STANDARD DETAIL**

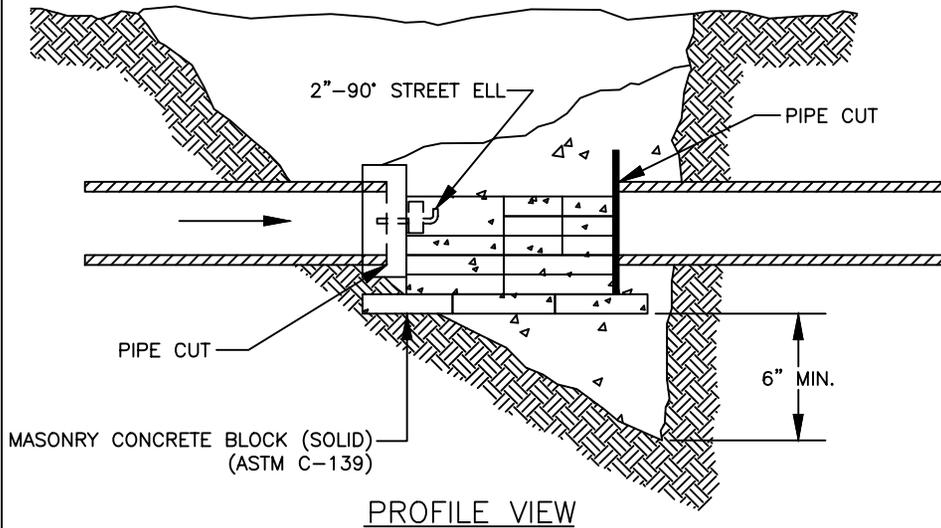
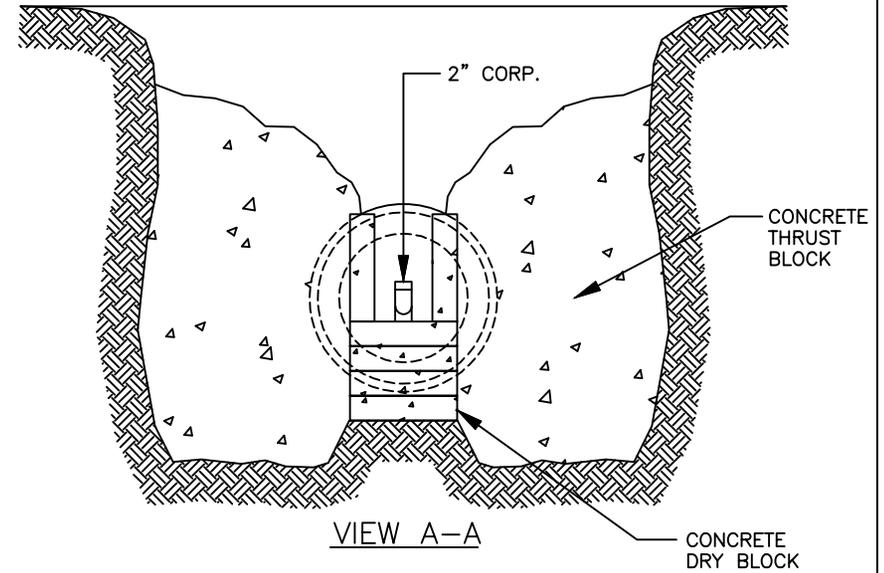
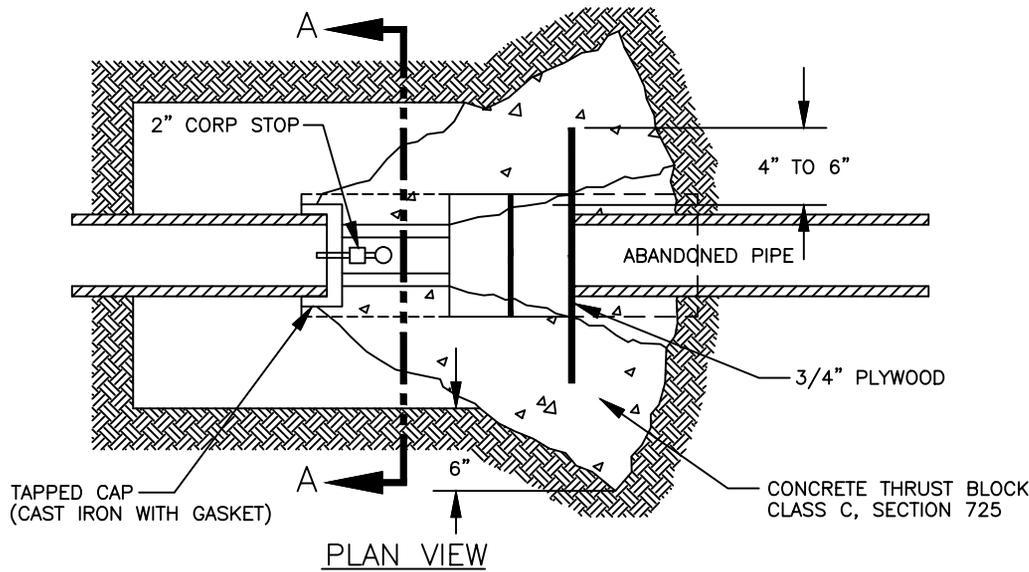
WATER SERVICE CONNECTIONS

APPROVED

*[Signature]*  
ACTING CITY ENGINEER

7/31/08  
DATE

DETAIL NO.  
P1342



#### NOTES:

1. CUT AND PLUGS MUST BE ADEQUATELY "DRY BLOCKED".
2. DRY BLOCKS SHALL BE STANDARD SIZE SOLID MASONRY CONCRETE BLOCKS. (ASTM C-139)
3. THE QUANTITY AND ARRANGEMENT OF THE BLOCKING MUST WITHSTAND LINE PRESSURE BY HOLDING THE CAP OR PLUG IN POSITION.
4. DRY BLOCKING SHALL BE PROPERLY SHIMMED TIGHT AND SECURE AGAINST THE CAP BEFORE LINE PRESSURE IS RESTORED.
5. CONCRETE THRUST BLOCKS SHALL NOT BE POURED UNTIL LINE PRESSURE IS RESTORED AND THE CAP OR PLUG IS INSPECTED FOR LEAKAGE.
6. CONCRETE SHALL NOT BE POURED OVER ANY PORTION OF THE ABANDONED PIPE.
7. MINIMUM THRUST BLOCK AREA PER M.A.G. DETAIL 380.
8. WHERE A 4" OR LARGER LINE IS SPECIFIED TO BE ABANDONED, THE CUT AND PLUG SHOULD OCCUR AT THE SUPPLY MAIN TO AVOID CREATING AN UNUSED DEAD END LINE.

DETAIL NO.  
P1343



**City of Phoenix**  
**STANDARD DETAIL**

WATERLINE - CUT AND PLUG  
FOR 12" DIA. MAIN AND SMALLER

APPROVED

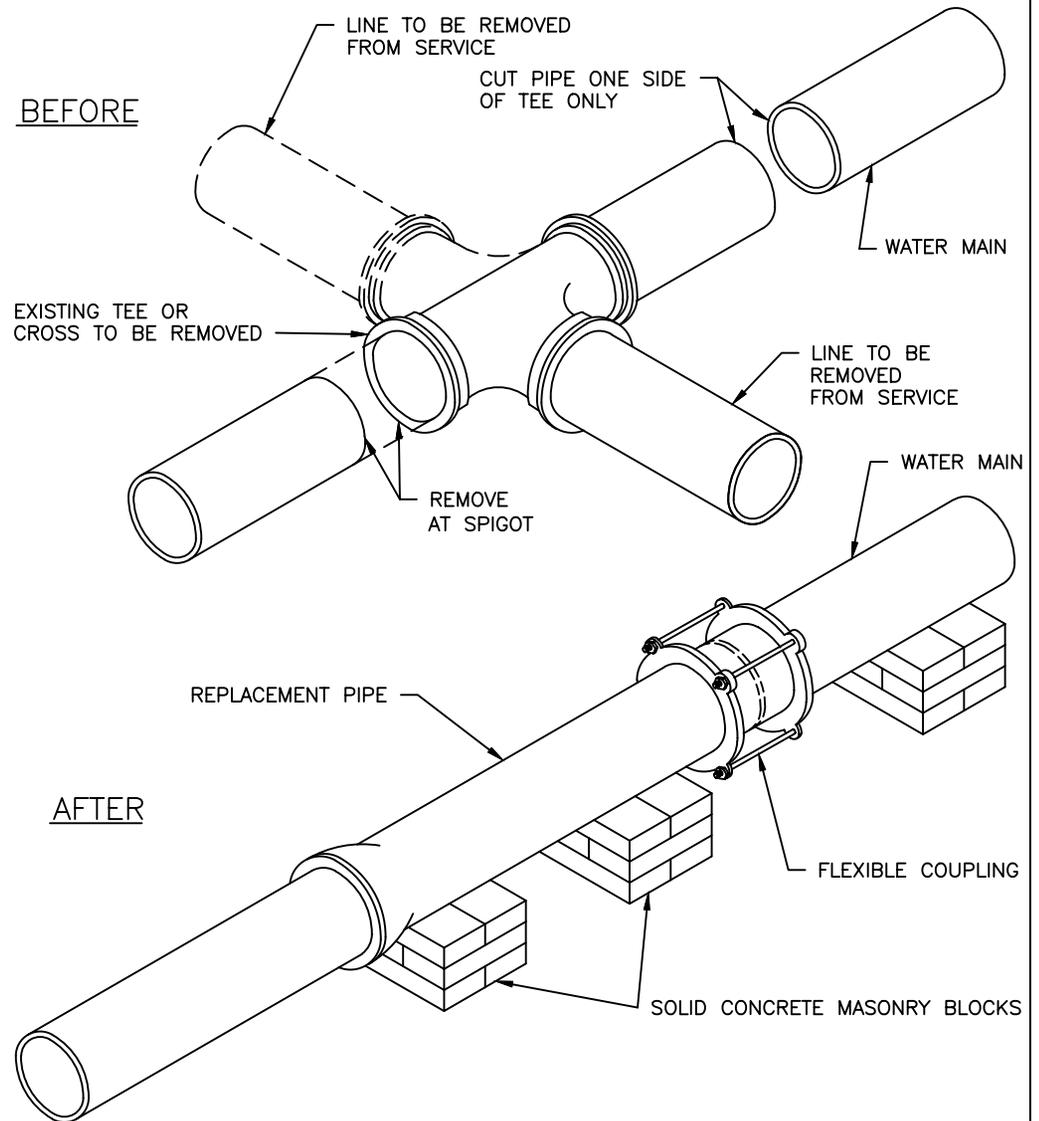
*Kenny Whelan*  
CITY ENGINEER

5/31/94  
DATE

DETAIL NO.  
P1343

**NOTES:**

1. REPLACEMENT PIPE MATERIAL SHALL BE IN KIND OR DUCTILE IRON.
2. WHERE POSSIBLE, ONE END OF THE REPLACEMENT PIPE SECTION SHALL CONNECT TO AN EXISTING BELL OR SPIGOT.
3. FLEXIBLE COUPLING SHALL BE THE CAST IRON TYPE AND SPECIFICALLY DESIGNED FOR USE ON THE PIPE SIZE AND MATERIAL(S) BEING CONNECTED. USE OF FULL CIRCLE REPAIR CLAMPS IS PROHIBITED.
4. THE NEW REPLACEMENT PIPE SECTION SHALL BE ADEQUATELY DRY BLOCKED PRIOR TO BACKFILLING.
5. BACKFILLING SHALL NOT BEGIN UNTIL LINE PRESSURE IS RESTORED AND CONNECTIONS INSPECTED FOR LEAKAGE BY WATER DEPARTMENT PERSONNEL.
6. DRY BLOCKS SHALL BE STANDARD SIZE SOLID MASONRY CONCRETE BLOCKS. (ASTM C-139)
7. REPLACEMENT PIPE SHALL BE CLEANED IN ACCORDANCE WITH SECTION 611.1.



DETAIL NO.  
P1344



**City of Phoenix**  
**STANDARD DETAIL**

WATERLINE CUT OUT (TEES & CROSSES)  
FOR 12" DIA. MAIN AND SMALLER

APPROVED

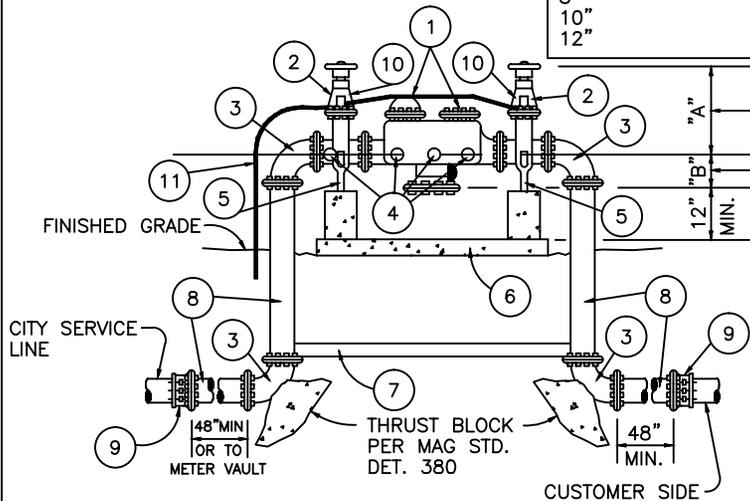
*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1344

ASSEMBLY SIZE	APPROX. DIMENSION "A"
3"	14"
4"	16"-(22" OS&Y)
6"	20"-(30" OS&Y)
8"	25"-(40" OS&Y)
10"	29"-(48" OS&Y)
12"	32"-(56" OS&Y)

ASSEMBLY SIZE	APPROX DIM "B"
3"	10"
4"	11"
6"	12"
8"	22"
10"	23"
12"	24"



REDUCED PRESSURE PRINCIPLE DEVICE

GENERAL NOTES

- ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS CONNECTION AND HYDRAULIC RESEARCH.
- CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
- FOUR (4) TEST COCKS TO BE INSTALLED PER U.S.C.
- COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
- FINISHED GRADE BELOW BACKFLOW PREVENTER SHALL BE 95% COMPACTION.
- ASSEMBLY MAY BE PAINTED TO BLEND WITH LANDSCAPE SURFACE TREATMENT OR ON-SITE STRUCTURES.
- THE ASSEMBLY MAY ALSO BE SCREENED WITH SHRUBBERY OR BE ENCLOSED WITHIN A WALL TYPE STRUCTURE. ADEQUATE DRAINAGE FOR SURFACE WATER IS REQUIRED.
- ANY SCREENING/ENCLOSURE MUST PROVIDE A MINIMUM 18" ACCESS OPENING (UNSECURED GATES ARE ACCEPTABLE) AND SIDE WALLS OR SHRUBBERY MUST BE A MINIMUM OF 24" FROM THE OUTSIDE FACE OF ANY PORTION OF THE BACKFLOW PREVENTION DEVICE.
- ASSEMBLY MAY BE PROTECTED BY GUARD POSTS (MODIFY P-1359, HYDRANT GUARDS, PHOENIX SUPPLEMENT TO MAG).

LIST OF MATERIALS

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>① APPROVED REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICE.</li> <li>② GATE VALVE, RESILIENT SEATED (NON-RISING STEM)(O.S.&amp;Y. REQUIRED ON FIRELINES).</li> <li>③ 90° ELL (FLANGED D.I.P. 3" THROUGH 12").</li> <li>④ TEST COCK, RESILIENT SEATED (4 REQUIRED) FIT WITH BRASS PLUG.</li> <li>⑤ ADJUSTABLE PIPE SUPPORT PERMANENTLY ATTACHED TO BASE (4" AND LARGER ASSEMBLY ONLY).</li> <li>⑥ CONCRETE SUPPORT PAD 4" THICK BY 18" WIDE MINIMUM BENEATH 4" AND LARGER ASSEMBLIES. (CLASS "A" CONCRETE)</li> </ul> | <ul style="list-style-type: none"> <li>⑦ 3"x3"x1/4" STEEL ANGLE. BOLT TO FLANGE, EACH END WITH ONE BOLT. COAT WITH COAL TAR EPOXY (16 MILS) REQUIRED ON 4" AND LARGER ASSEMBLIES.</li> <li>⑧ PIPE SPOOL (FLANGED D.I.P. 3" THRU 12").</li> <li>⑨ FLANGED ADAPTER (WHEN REQUIRED).</li> <li>⑩ TAMPER SWITCH (ON FIRELINE ONLY, OPTIONAL).</li> <li>⑪ ELECTRICAL CONDUIT FOR TAMPER SWITCH.</li> </ul> |
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DETAIL NO.  
P1351



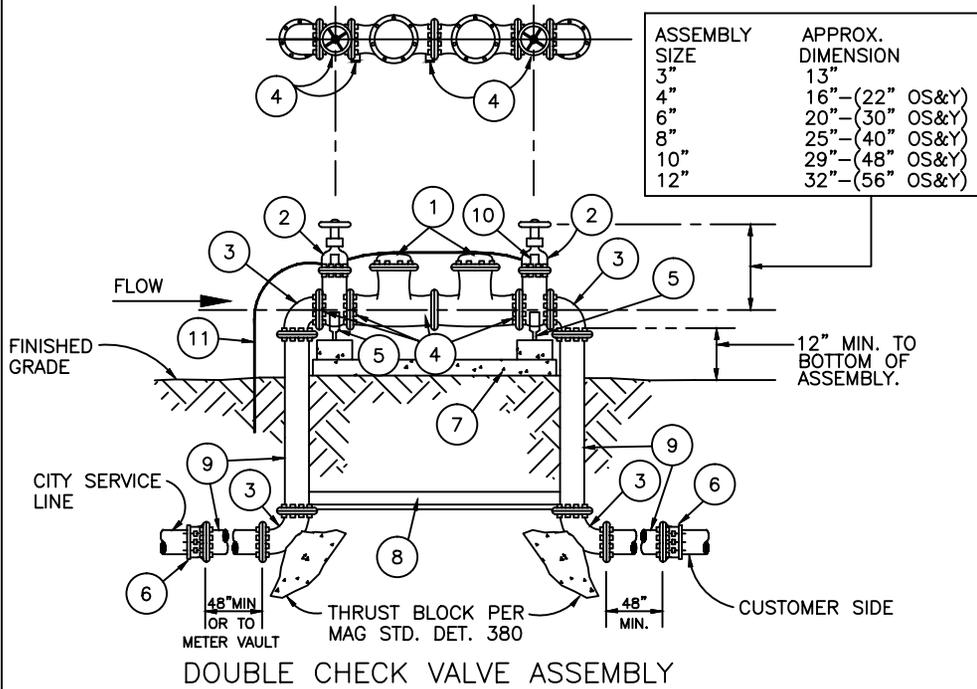
**City of Phoenix**  
**STANDARD DETAIL**

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION  
ASSEMBLY INSTALLATION - 3" AND OVER

APPROVED

*Maria S. Demando*  
CITY ENGINEER  
6/27/01  
DATE

DETAIL NO.  
P1351

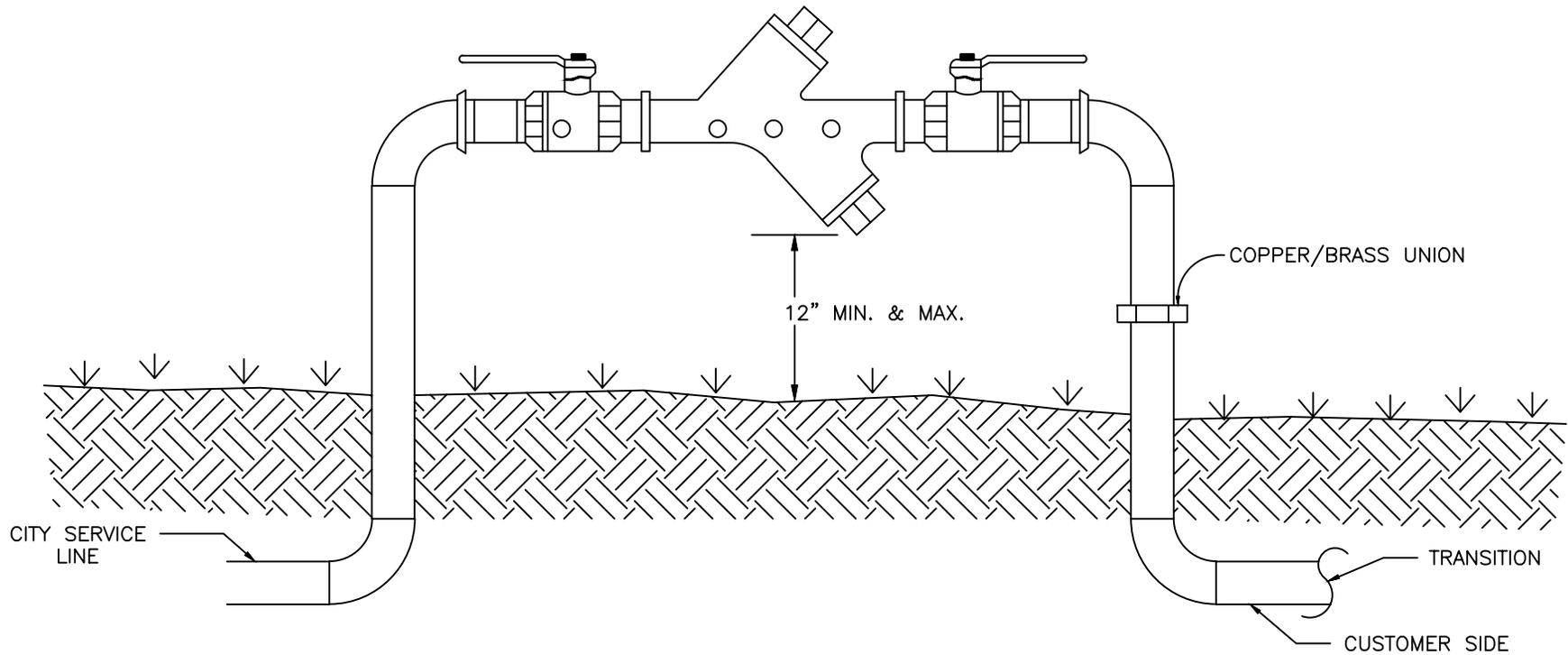


**GENERAL NOTES**

1. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS CONNECTION AND HYDRAULIC RESEARCH.
2. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
3. FOUR (4) TEST COCKS TO BE INSTALLED PER U.S.C.
4. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
5. FINISHED GRADE BELOW BACKFLOW PREVENTER SHALL BE 95% COMPACTION.
6. ASSEMBLY MAY BE PAINTED TO BLEND WITH LANDSCAPE SURFACE TREATMENT OR ON-SITE STRUCTURES.
7. THE ASSEMBLY MAY ALSO BE SCREENED WITH SHRUBBERY OR BE ENCLOSED WITHIN A WALL TYPE STRUCTURE. ADEQUATE DRAINAGE FOR SURFACE WATER IS REQUIRED.
8. ANY SCREENING/ENCLOSURE MUST PROVIDE A MINIMUM 18" ACCESS OPENING (UNSECURED GATES ARE ACCEPTABLE) AND SIDE WALLS OR SHRUBBERY MUST BE A MINIMUM OF 24" FROM THE OUTSIDE FACE OF ANY PORTION OF THE BACKFLOW PREVENTION DEVICE.
9. ASSEMBLY MAY BE PROTECTED BY GUARD POSTS (MODIFY P-1359, HYDRANT GUARDS, PHOENIX SUPPLEMENT TO MAG).

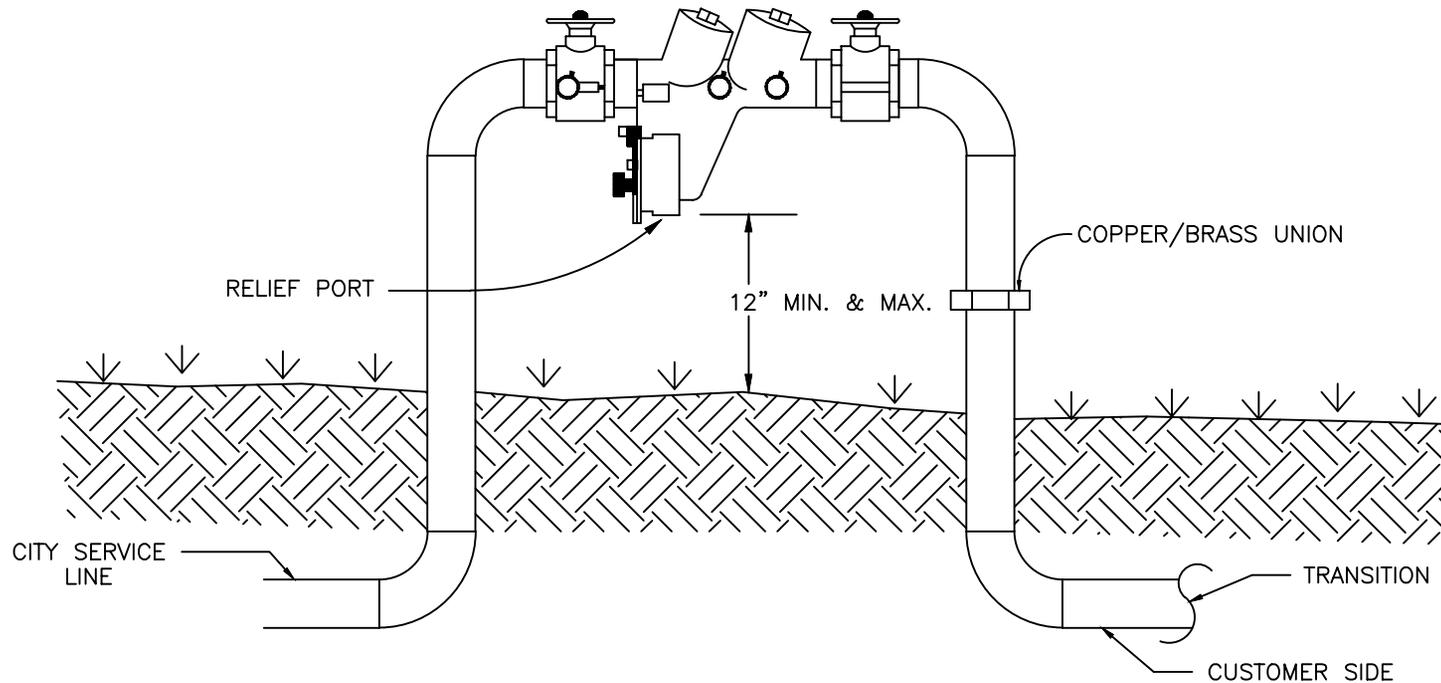
**LIST OF MATERIALS**

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>① APPROVED DOUBLE CHECK VALVE ASSEMBLY.</li> <li>② GATE VALVE, RESILIENT SEATED (NON-RISING STEM)(O.S.&amp;Y. REQUIRED ON FIRELINE).</li> <li>③ 90° ELL (FLANGED D.I.P. 3" THROUGH 12").</li> <li>④ TEST COCK, RESILIENT SEATED (4 REQUIRED) FIT WITH BRASS PLUG.</li> <li>⑤ ADJUSTABLE PIPE SUPPORT PERMANENTLY ATTACHED TO BASE (4" AND LARGER ASSEMBLY ONLY).</li> <li>⑥ FLANGE ADAPTER (WHEN REQUIRED).</li> </ul> | <ul style="list-style-type: none"> <li>⑦ CONCRETE SUPPORT PAD 4" THICK BY 18" WIDE MINIMUM BENEATH 4" AND LARGER ASSEMBLIES. (CLASS "A" CONC).</li> <li>⑧ 3"x3"x1/4" STEEL ANGLE. BOLT TO FLANGE, EACH END WITH ONE BOLT. COAT WITH COAL TAR EPOXY (16 MILS) REQUIRED ON 4" AND LARGER ASSEMBLIES.</li> <li>⑨ PIPE SPOOL (FLANGED D.I.P. 3" THRU 12").</li> <li>⑩ TAMPER SWITCH (ON FIRELINE ONLY, OPTIONAL).</li> <li>⑪ ELECTRICAL CONDUIT FOR TAMPER SWITCH.</li> </ul> |
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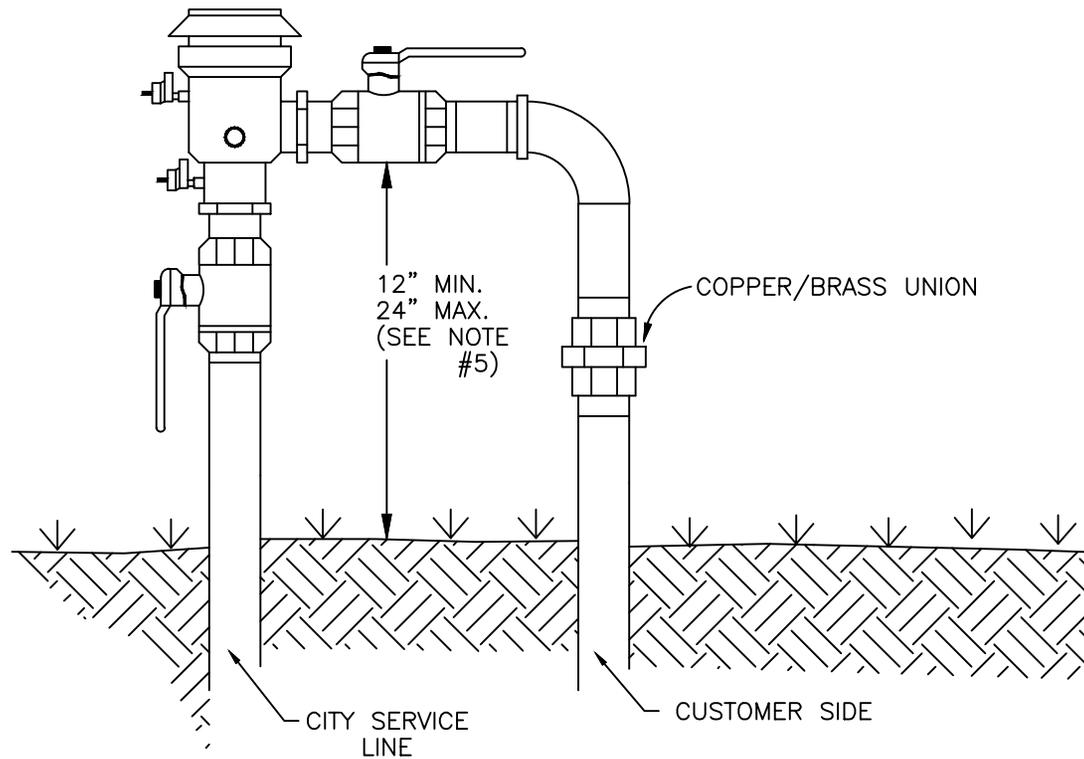
NOTES:

1. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
2. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
3. BACKFLOW PREVENTION ASSEMBLY MUST BE LEVEL AND INSTALLED A MINIMUM AND A MAXIMUM OF 12 INCHES FROM ASSEMBLY BODY TO FINAL GRADE.
4. TEST COCKS, (4) SHALL BE FITTED WITH BRASS PLUGS INSTALLED WITH TEFLON TAPE.
5. SHUTOFF VALVES TO BE RESILIENT BALL TYPE WITH REMOVABLE HANDLES.
6. COMPRESSION TYPE FITTINGS ARE NOT ALLOWED.
7. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
8. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
9. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
10. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
11. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIALS SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.



NOTES:

1. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
2. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
3. INSTALL BACKFLOW PREVENTION ASSEMBLY WITH RELIEF PORT FACING TOWARD THE GROUND.
4. BACKFLOW PREVENTION ASSEMBLY MUST BE LEVEL AND INSTALLED A MINIMUM AND A MAXIMUM OF 12 INCHES FROM RELIEF PORT TO FINAL GRADE.
5. PAVER CONCRETE BLOCK UNDER RELIEF PORT, SET AT FINAL GRADE.
6. TEST COCKS, (4) SHALL BE FITTED WITH BRASS PLUGS AND INSTALLED WITH TEFLON TAPE.
7. SHUTOFF VALVES TO BE RESILIENT BALL TYPE WITH REMOVABLE HANDLES.
8. COMPRESSION TYPE FITTINGS ARE NOT ALLOWED.
9. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
10. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
11. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
12. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINT.
13. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIAL SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.



NOTES:

1. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED PRESSURE VACUUM BREAKER ASSEMBLIES.
2. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
3. TWO (2) TEST COCKS SHALL BE FITTED WITH BRASS PLUGS INSTALLED WITH TEFLON TAPE.
4. SHUTOFF BALL VALVES MUST BE RESILIENT SEATED VALVES AS PER U.S.C..
5. ASSEMBLY MUST BE INSTALLED 12 INCHES ABOVE THE HIGHEST OUTLET ON THE SYSTEM. IF THE DISTANCE EXCEEDS 24 INCHES A REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY MUST BE USED.
6. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
7. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
8. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
9. COPPER FITTINGS TO BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
10. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIALS SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.

DETAIL NO.  
P1355



**City of Phoenix**  
**STANDARD DETAIL**

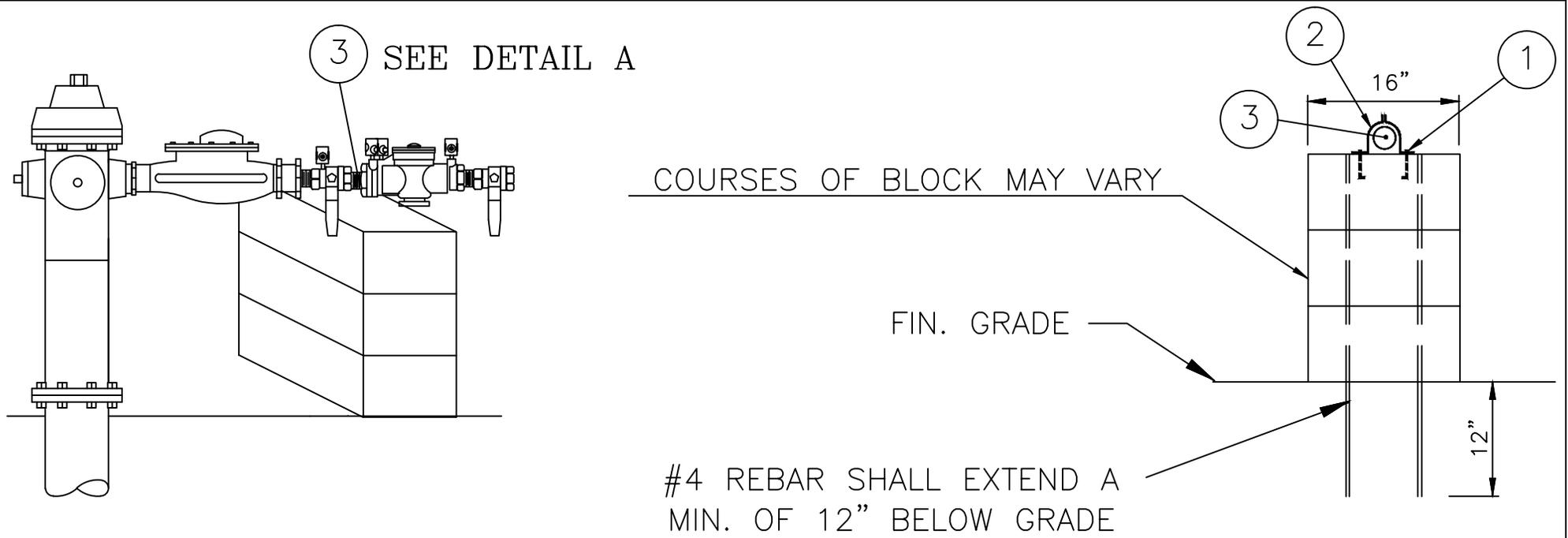
PRESSURE VACUUM BREAKER ASSEMBLY  
INSTALLATION - 2" AND UNDER

APPROVED

*Maria Saldamando*  
CITY ENGINEER

6/27/01  
DATE

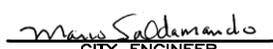
DETAIL NO.  
P1355

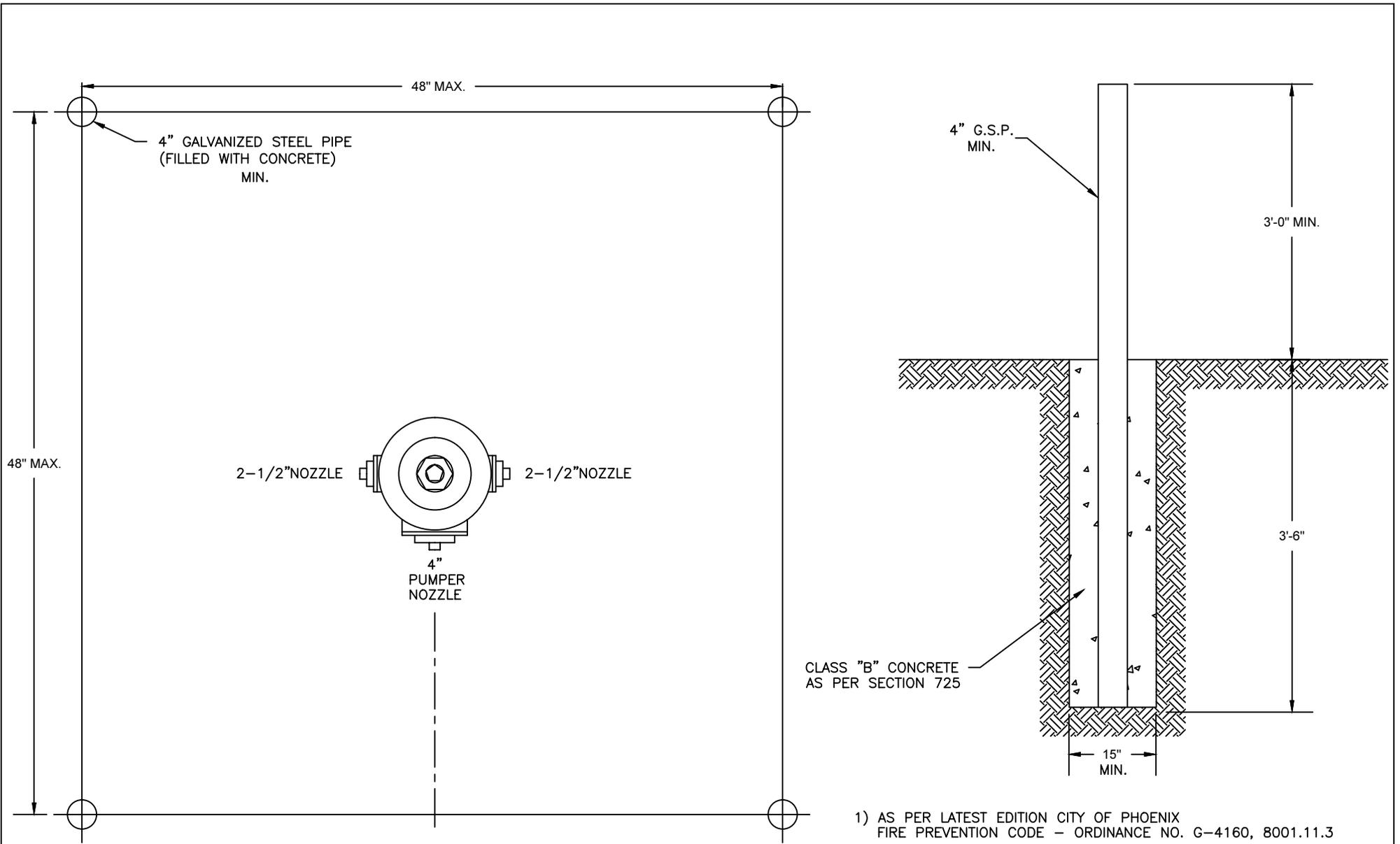


# Detail A

## NOTES:

1. SECURE BACKFLOW ASSEMBLY WITH APPROVED ANCHORS TO 8"X8"X16" TYPE "B" CONCRETE FILLED BLOCK WITH 2 #4 REBARS. ASSEMBLY SHALL BE TESTED BY CERTIFIED BACKFLOW TESTER.
2. 2-PIECE CLAMP WITH APPROVED ANCHORS.
3. BACKFLOW ASSEMBLY FOR USE WITH DETAIL P1354.
4. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.

DETAIL NO. P1356	 <b>City of Phoenix</b> STANDARD DETAIL	TEMPORARY SUPPORT FOR FIRE HYDRANT BACKFLOW ASSEMBLY	APPROVED  CITY ENGINEER	DETAIL NO. P1356 6/27/01 DATE
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DETAIL NO.  
P1359



**City of Phoenix**  
STANDARD DETAIL

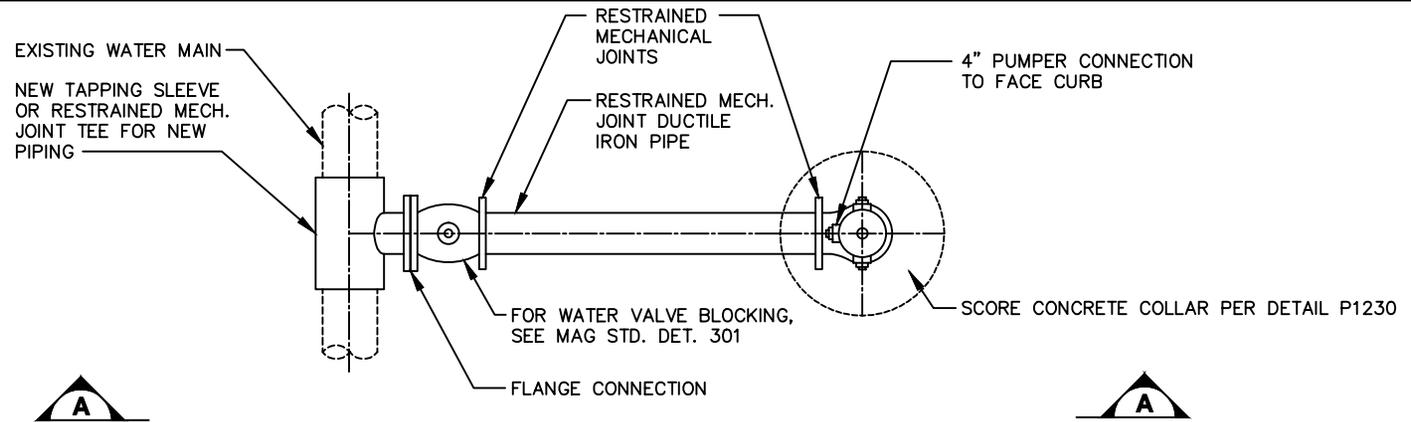
HYDRANT GUARDS

APPROVED

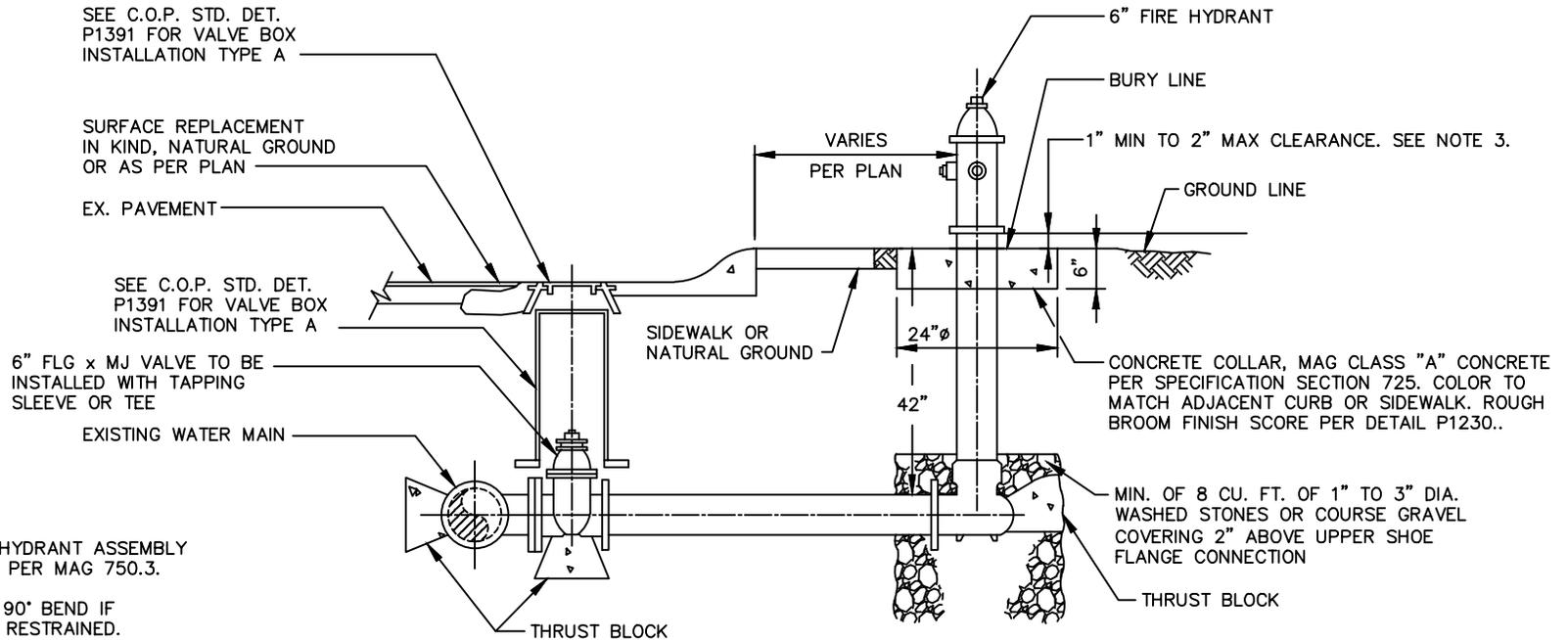
*Maria S. Demando*  
CITY ENGINEER

6/27/01  
DATE

DETAIL NO.  
P1359



PLAN VIEW



SECTION 'A-A'

NOTES:

1. ALL JOINTS IN FIRE HYDRANT ASSEMBLY TO BE RESTRAINED JOINT PER MAG 750.3.
2. REVERSE TAPS AND 90° BEND IF NEEDED SHALL BE FULLY RESTRAINED.
3. FINISHED GRADE IS DEFINED BY ADJACENT NATURAL GROUND, SIDEWALK, PAVEMENT OR CURB. FINISHED GRADE OR NEARBY OBSTRUCTIONS SHALL NOT DENY WRENCH ACCESS TO THE BOTTOM FLANGE BOLTS.

DETAIL NO.  
P1360



**City of Phoenix**  
**STANDARD DETAIL**

FIRE HYDRANT ASSEMBLY

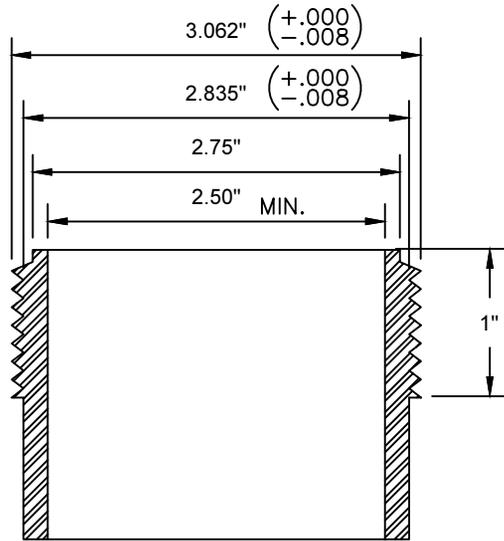
APPROVED

*[Signature]*  
ACTING CITY ENGINEER

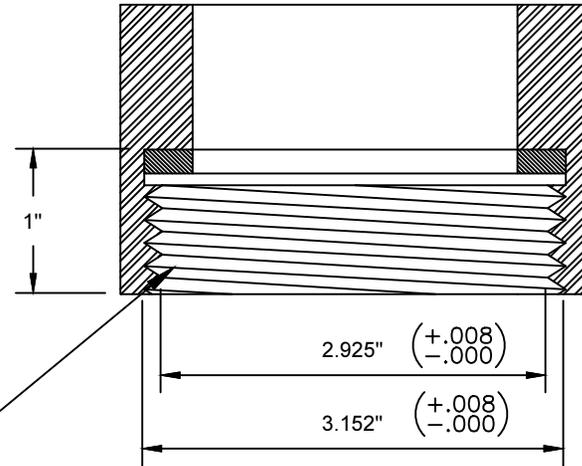
7/31/08  
DATE

DETAIL NO.  
P1360

2-1/2" HYDRANT NOZZLE

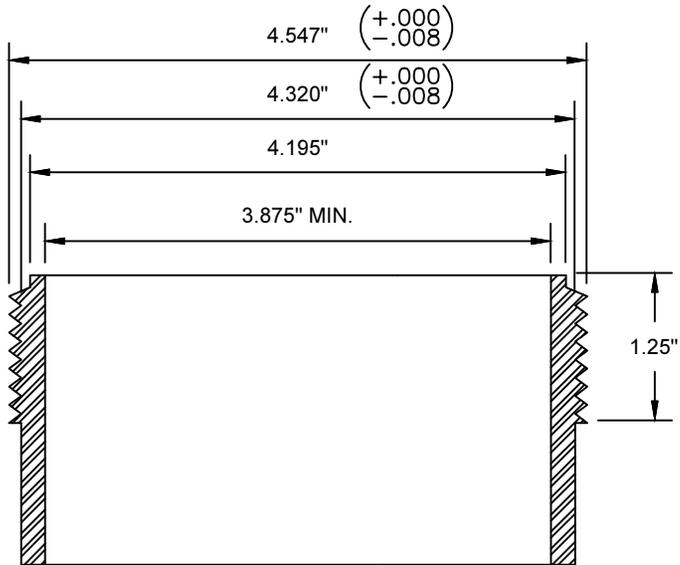


2-1/2" CAP

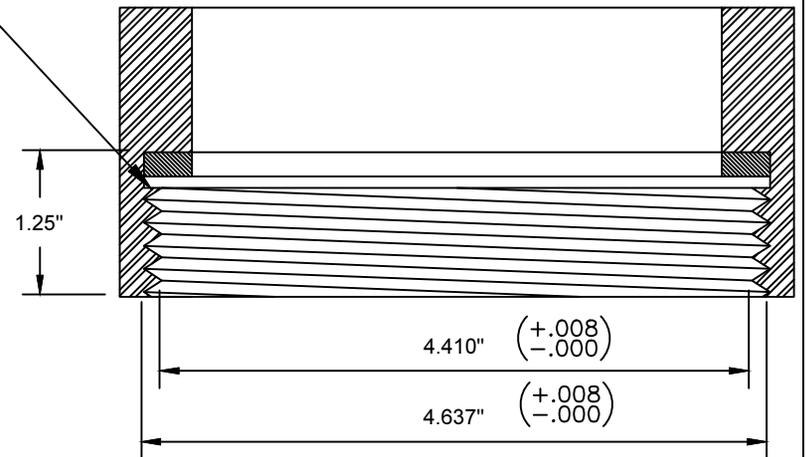


6 THREADS PER INCH

4" HYDRANT NOZZLE



4" CAP



DETAIL NO.  
P1361



**City of Phoenix**  
**STANDARD DETAIL**

FIRE HYDRANT THREADS  
2 1/2" & 4"

APPROVED

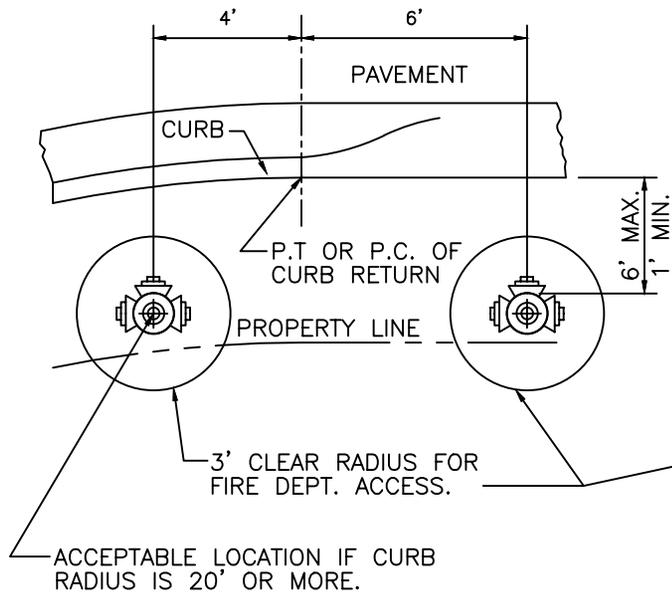
*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

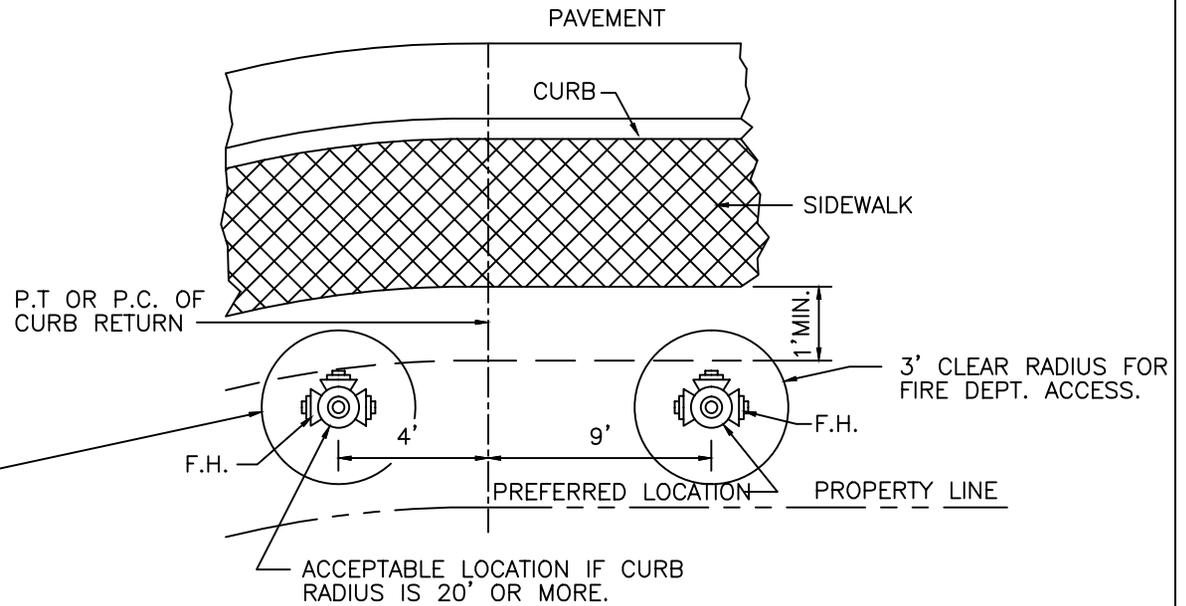
DETAIL NO.  
P1361

**NOTES:**

1. OBSTRUCTIONS SUCH AS UTILITY POLES, STREET SIGNS, IRRIGATION BOXES, FENCES, ETC., MUST NOT BE PLACED BETWEEN CURB AND HYDRANT.
2. DIMENSIONS SHOWN ON CONSTRUCTION DRAWINGS SUPERSEDE LOCATIONS SHOWN HERE.
3. ON LOCATIONS IN MIDBLOCK, THE FIRE HYDRANT WILL BE ALIGNED WITH A PROPERTY LINE.



LANDSCAPE AREA WITH PARKWAY  
OR NO SIDEWALK ADJACENT TO CURB



AREA WITH SIDEWALK ADJACENT TO CURB

DETAIL NO.  
P1362



**City of Phoenix**  
**STANDARD DETAIL**

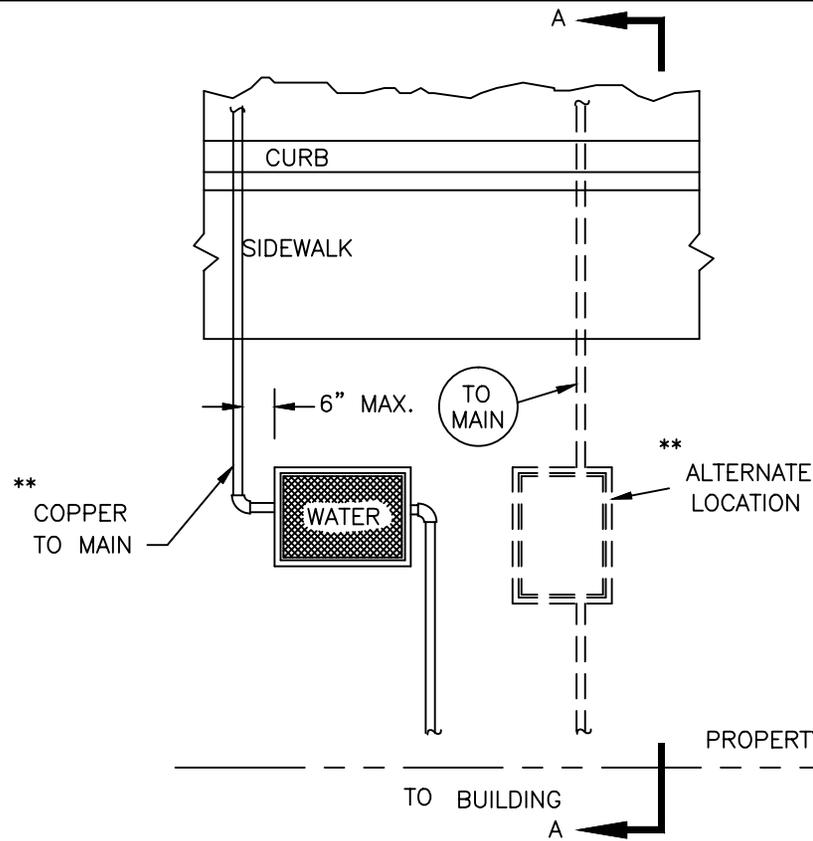
FIRE HYDRANT LOCATION

APPROVED

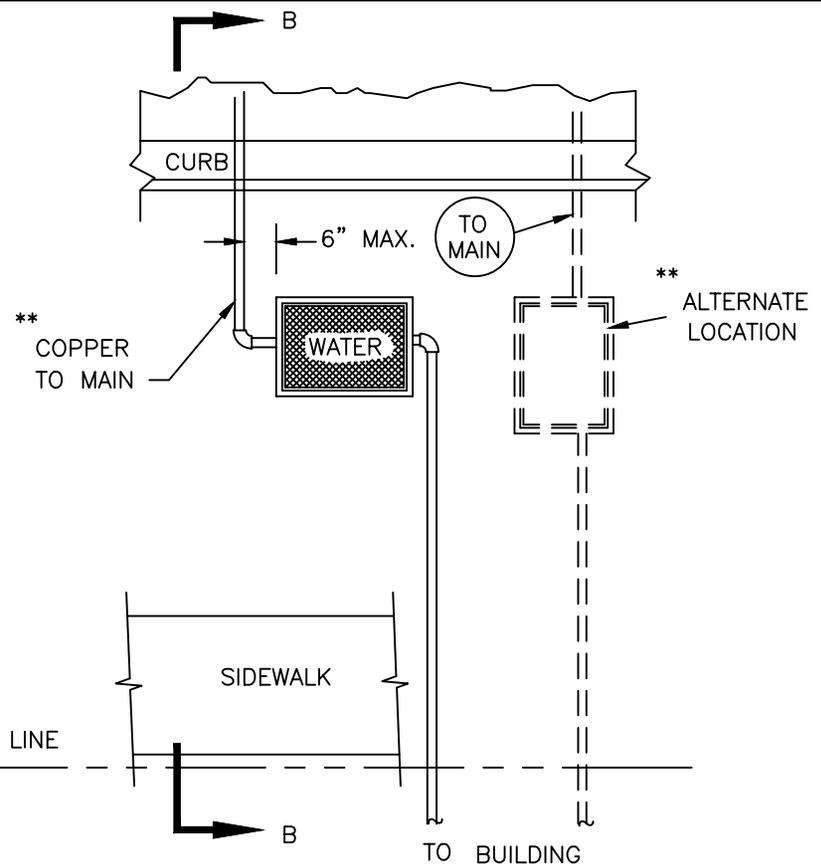
*Maria Saldamando*  
CITY ENGINEER

7/19/04  
DATE

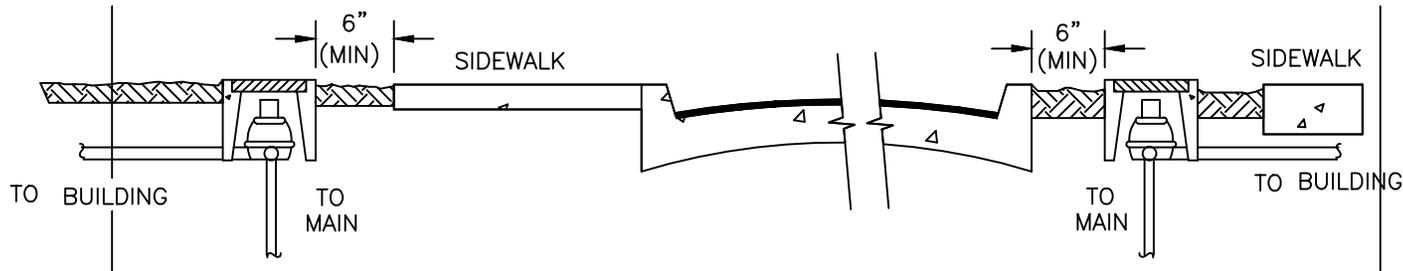
DETAIL NO.  
P1362



PLAN VIEW WITH SIDEWALK  
ADJACENT TO CURB



PLAN VIEW WITH PARKWAY  
OR NO SIDEWALK



SECTION A-A

SECTION B-B

DETAIL NO.  
P1363



**City of Phoenix**  
**STANDARD DETAIL**

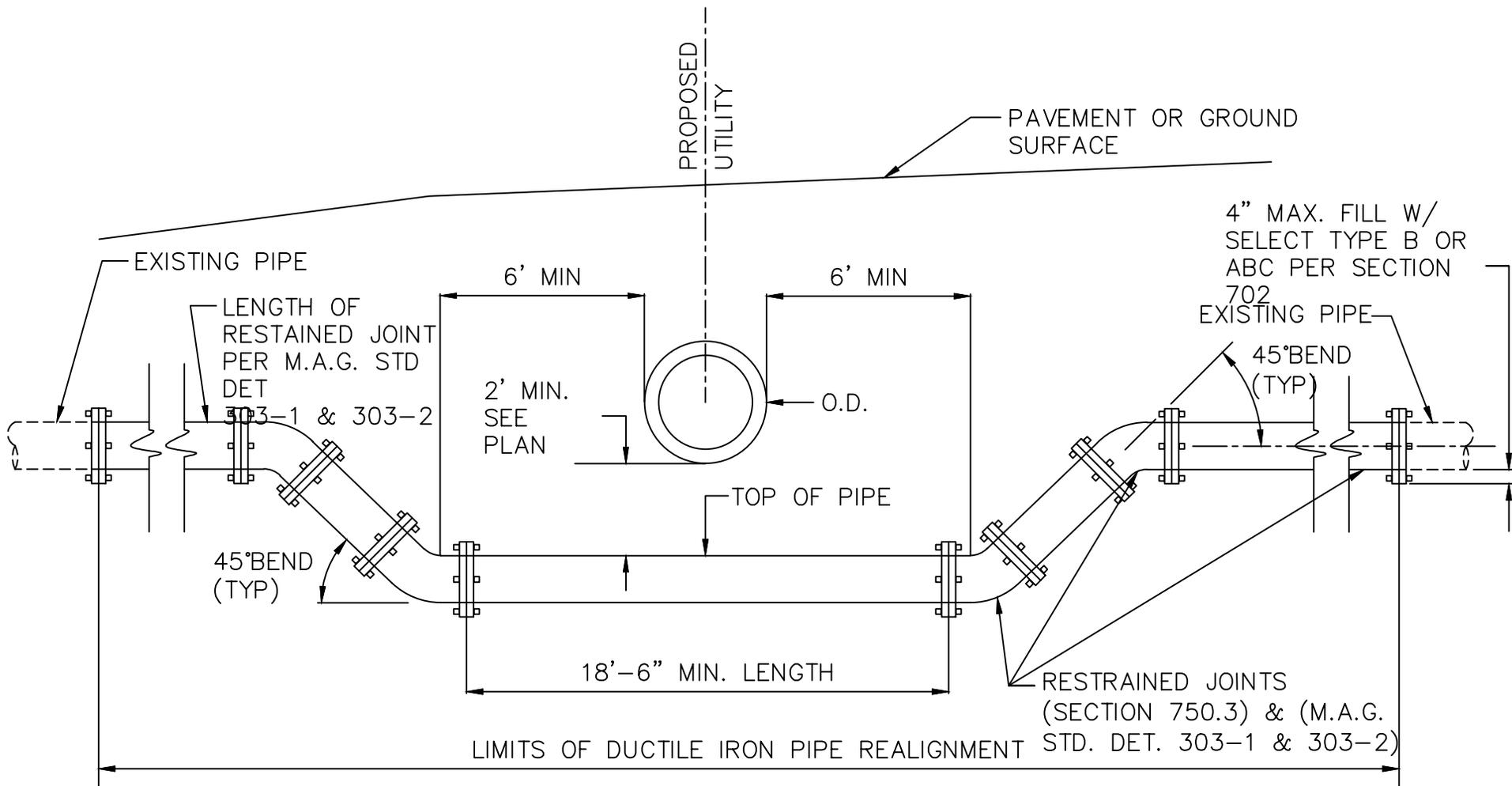
WATER METER LOCATION

APPROVED

*Maria Saldamando*  
CITY ENGINEER

7/3/00  
DATE

DETAIL NO.  
P1363



DETAIL NO.  
P1370



**City of Phoenix**  
**STANDARD DETAIL**

VERTICAL REALIGNMENT  
OF WATERLINE

APPROVED

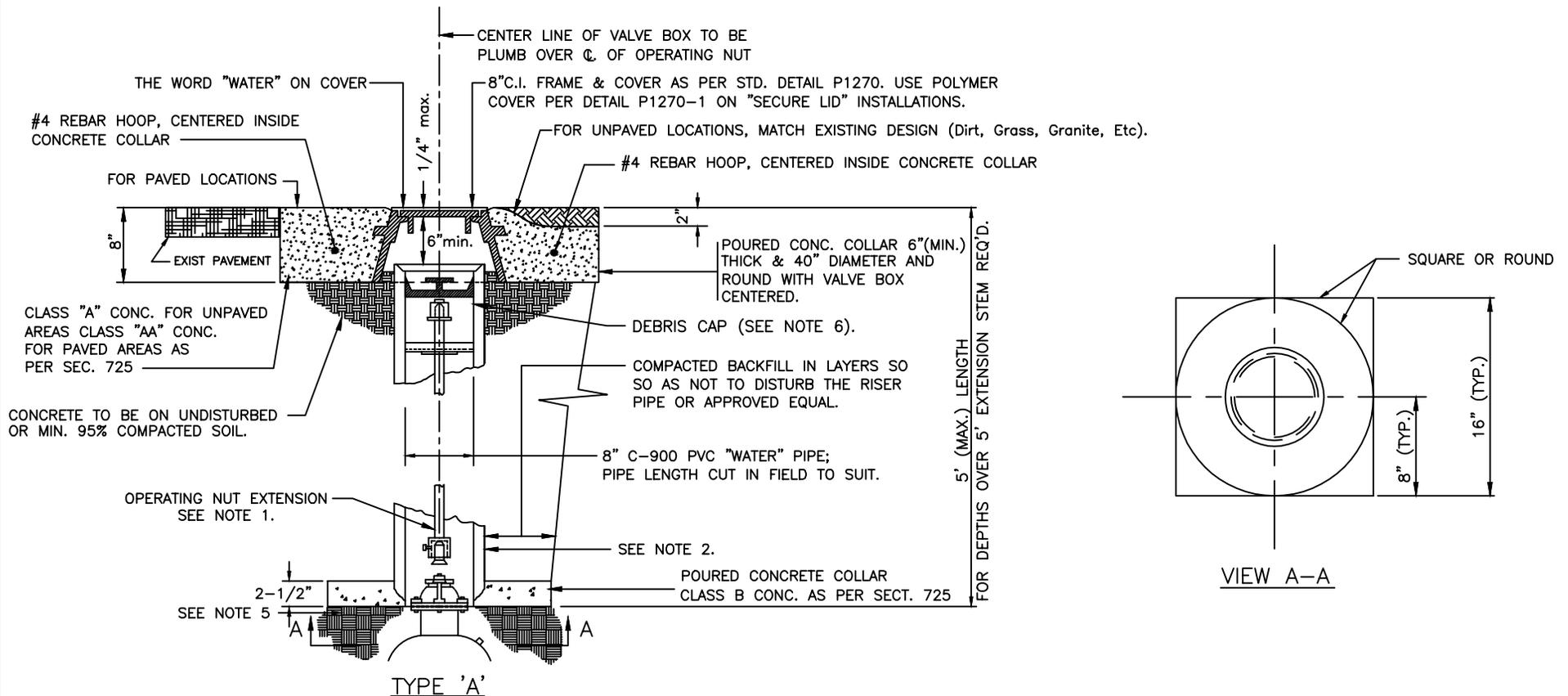
*[Signature]*  
CITY ENGINEER

12/10/2012  
DATE

DETAIL NO.  
P1370

**NOTES:**

1. VALVE OPERATION NUT EXTENSION: SEE DETAIL P1391-1  
EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES WHERE OPERATING  
NUT IS OVER 5' BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION.
2. IF TWO OR MORE JOINTS OF C900 PVC "WATER" PIPE RISER ARE NEEDED, THEY SHALL BE  
COUPLED AND GLUED WITH APPROPRIATE PVC GLUE TO FORM A DEBRIS-TIGHT JOINT.
3. VALVE BOX SHALL BE ADJUSTED TO THE FINISH GRADE AFTER PLACING  
THE ASPHALTIC CONCRETE SURFACE.
4. USE PARKSON TYLER, APCO, OR EQUAL DEEP SKIRTED COVER LID (4" DEEP OR MORE)  
C.I. MIN. T.S. 30,000 P.S.I. USE SECURE POLYMER VALVE BOX LID WITH LID-RETENTION  
ELASTOMERIC SEAL PER DETAIL P1270-1 WHERE "SECURE" LIDS ARE SPECIFIED.
5. GROUND BELOW CONCRETE PAD TO BE COMPACTED TO MIN. 95% OF MAX DENSITY.
6. INSTALL DEBRIS CAP PER DETAIL P1165.



DETAIL NO.  
P1391



**City of Phoenix**  
**STANDARD DETAIL**

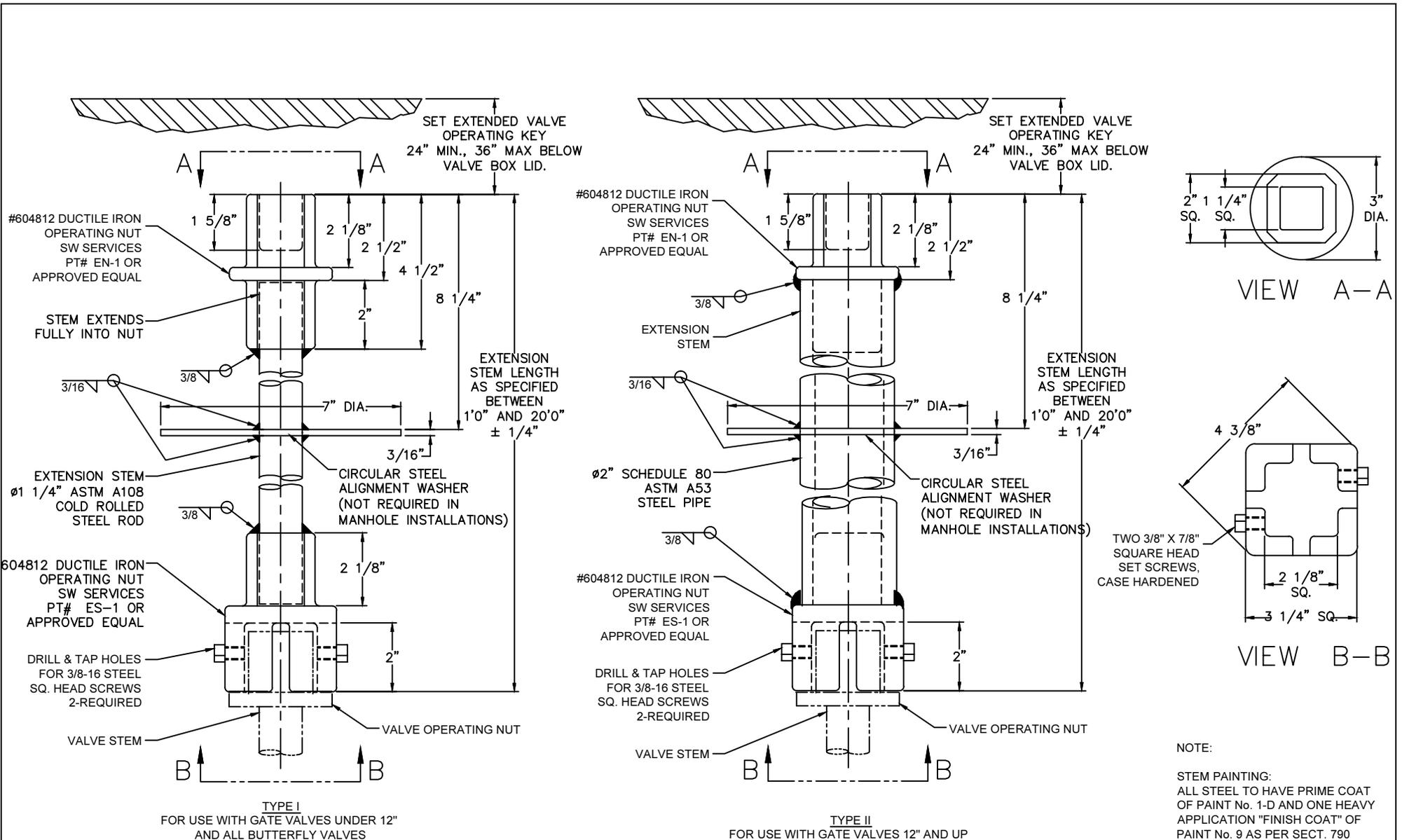
VALVE BOX INSTALLATION

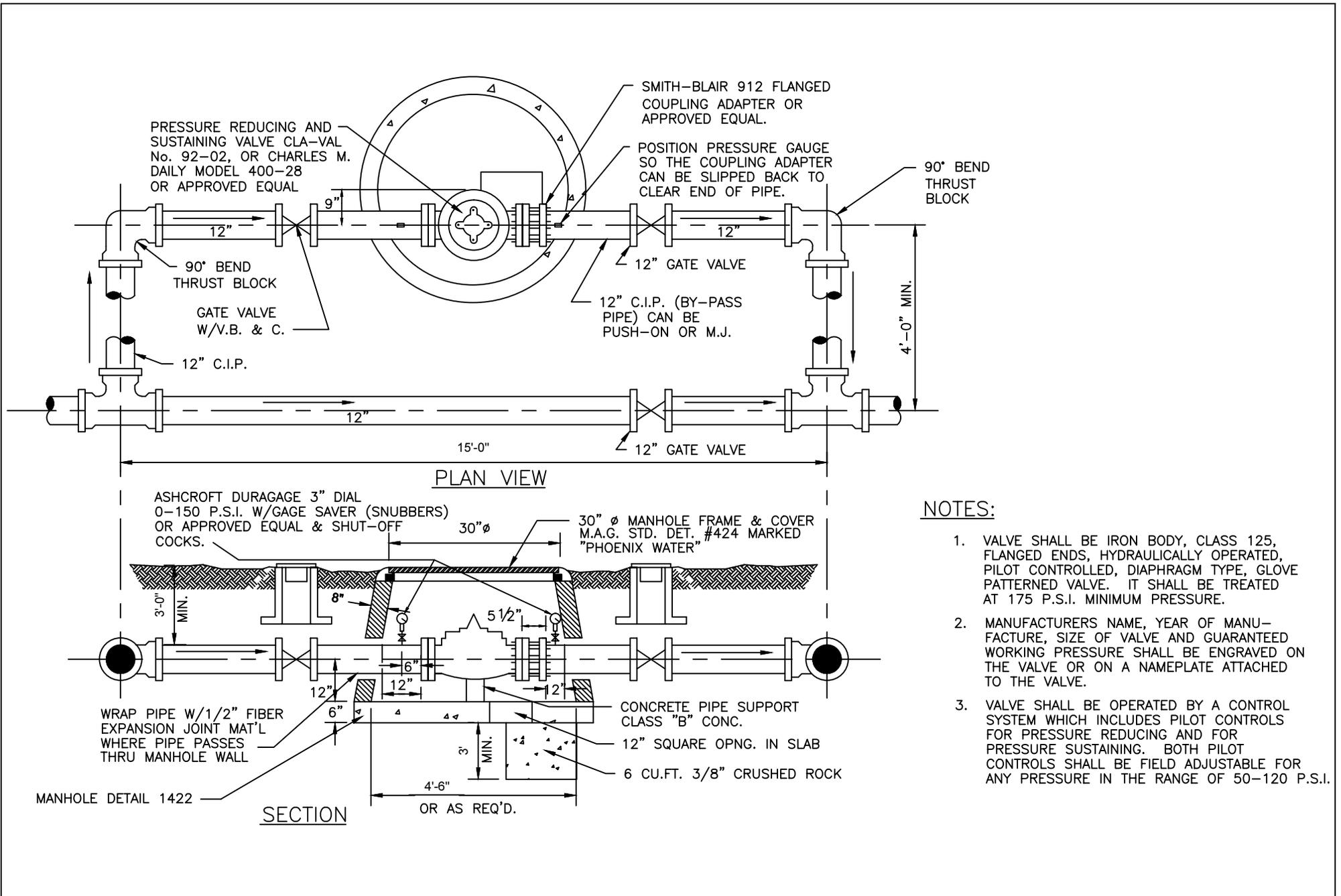
APPROVED

*[Signature]*  
ACTING CITY ENGINEER

7/31/08  
DATE

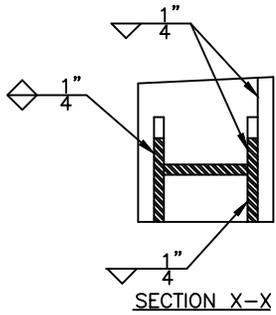
DETAIL NO.  
P1391





**NOTES:**

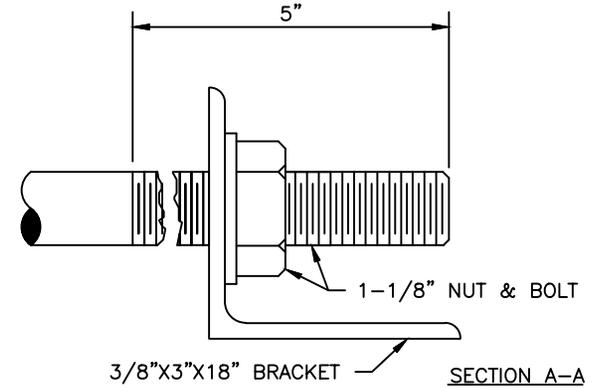
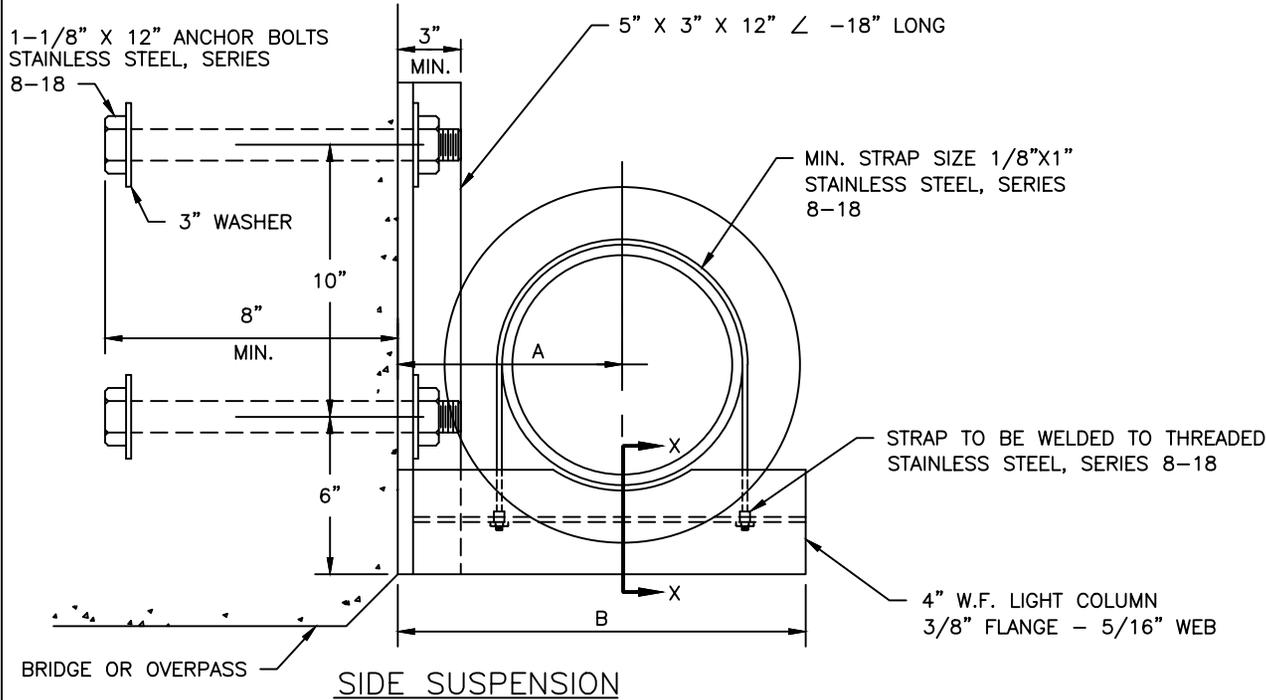
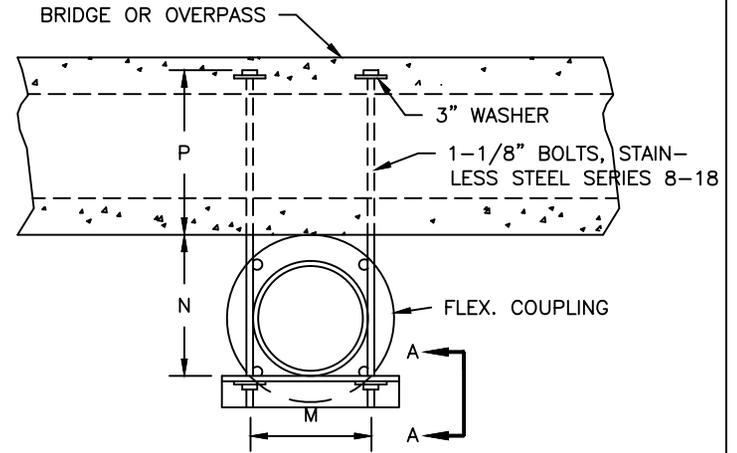
1. VALVE SHALL BE IRON BODY, CLASS 125, FLANGED ENDS, HYDRAULICALLY OPERATED, PILOT CONTROLLED, DIAPHRAGM TYPE, GLOVE PATTERNED VALVE. IT SHALL BE TREATED AT 175 P.S.I. MINIMUM PRESSURE.
2. MANUFACTURERS NAME, YEAR OF MANUFACTURE, SIZE OF VALVE AND GUARANTEED WORKING PRESSURE SHALL BE ENGRAVED ON THE VALVE OR ON A NAMEPLATE ATTACHED TO THE VALVE.
3. VALVE SHALL BE OPERATED BY A CONTROL SYSTEM WHICH INCLUDES PILOT CONTROLS FOR PRESSURE REDUCING AND FOR PRESSURE SUSTAINING. BOTH PILOT CONTROLS SHALL BE FIELD ADJUSTABLE FOR ANY PRESSURE IN THE RANGE OF 50-120 P.S.I.



PIPE SIZE	A	B
8"	8"	15"
10"	9"	17"
12"	10"	19"

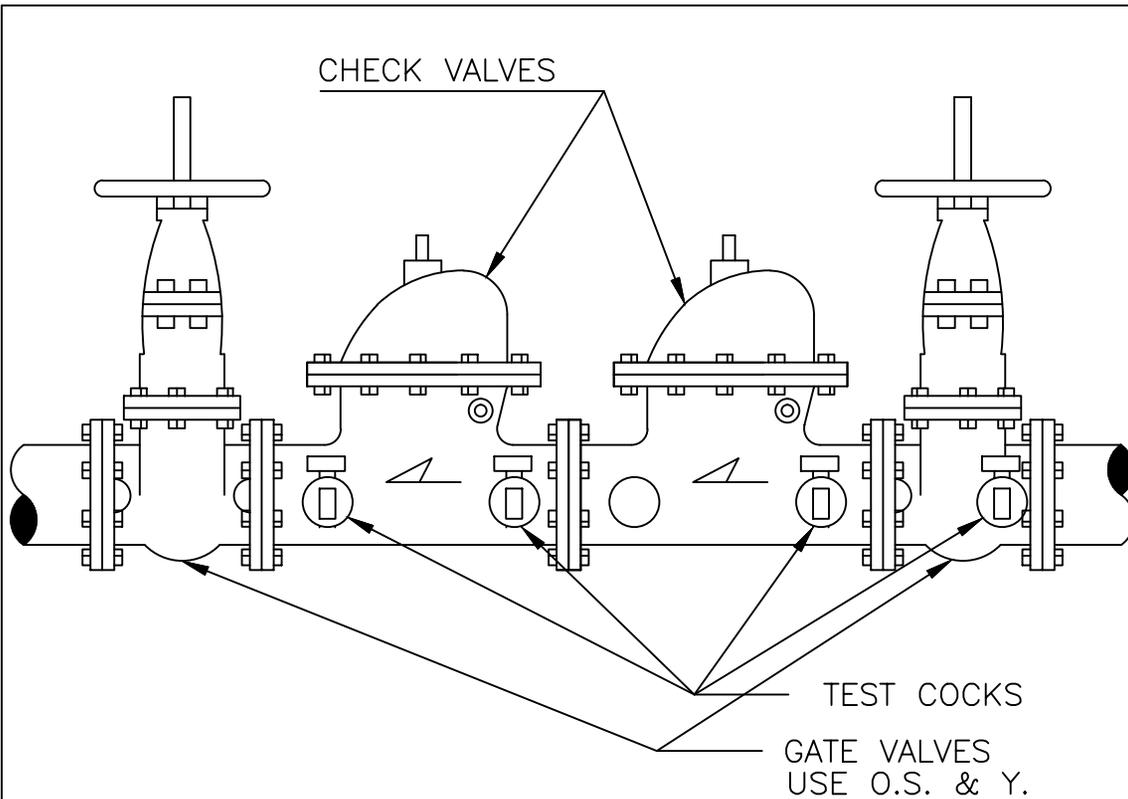
**NOTES:**

1. MINIMUM 2 SUPPORTS PER JOINT OF PIPE.
2. ALL NUTS SHALL BE STAINLESS STEEL SERIES 8-18.
3. ALL BOLTS SHALL HAVE A LOCK WASHER UNDER THE NUT.



PIPE SIZE	M	N	P
8"	10.25"	12"	8"
10"	12.5"	14"	8"
12"	15"	16"	8"

**BOTTOM SUSPENSION**



NOTES:

1. THE CHECK VALVE SHALL BE LOADED INTERNALLY SO THAT WHEN THE SUPPLY PRESSURE IS 1 P.S.I., AND THE OUTLET PRESSURE IS ATMOSPHERIC, EACH CHECK VALVE WILL BE DRIP-TIGHT IN THE NORMAL DIRECTION OF FLOW.
2. CLAPPER FACING RINGS SHALL BE MOLDED SYNTHETIC RUBBER (SHORE DUROMETER HARDNESS 35-45).
3. ASSEMBLY IS TO MEET A.W.W.A. STANDARD C 506, BACK FLOW PREVENTION DEVICES.
4. PLACEMENT & LOCATION OF DOUBLE CHECK VALVE ASSEMBLY SHALL BE APPROVED BY WATER & WASTEWATER DEPARTMENT.
5. TEST COCKS SHALL HAVE FEMALE ENDS (I.P. THREADS) ON DISCHARGE SIDE.

NOMINAL SIZE OF ASSEMBLY	MINIMUM SIZE TEST COCK
LESS THAN OR EQUAL TO 2"	1/4"
2 1/2" - 4"	1/2"
6" & OVER	3/4"

DETAIL NO.  
P1396



**City of Phoenix**  
**STANDARD DETAIL**

DOUBLE CHECK VALVE ASSEMBLY

APPROVED

*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1396



7/8" DIA. VENT HOLE  
1 OPEN PICKSLOT

OPEN PICKSLOT



7/8" DIA. VENT HOLE  
(2) CONCEALED PICKSLOTS

CONCEALED PICKSLOT

NOTES:

1. ALL LIDS AND FRAMES TO BE FURNISHED WITH MACHINED HORIZONTAL BEARING SURFACES.
2. MEET H-20 LOAD RATING REQUIREMENTS.
3. WATERTIGHT COVERS SHALL BE FURNISHED WITH T-GASKET IN FRAME OR COVER.
4. ADJUST WORDING TO "PHOENIX WATER," AS NECESSARY.



NO VENT HOLE  
(2) CONCEALED PICKSLOTS

WATERTIGHT



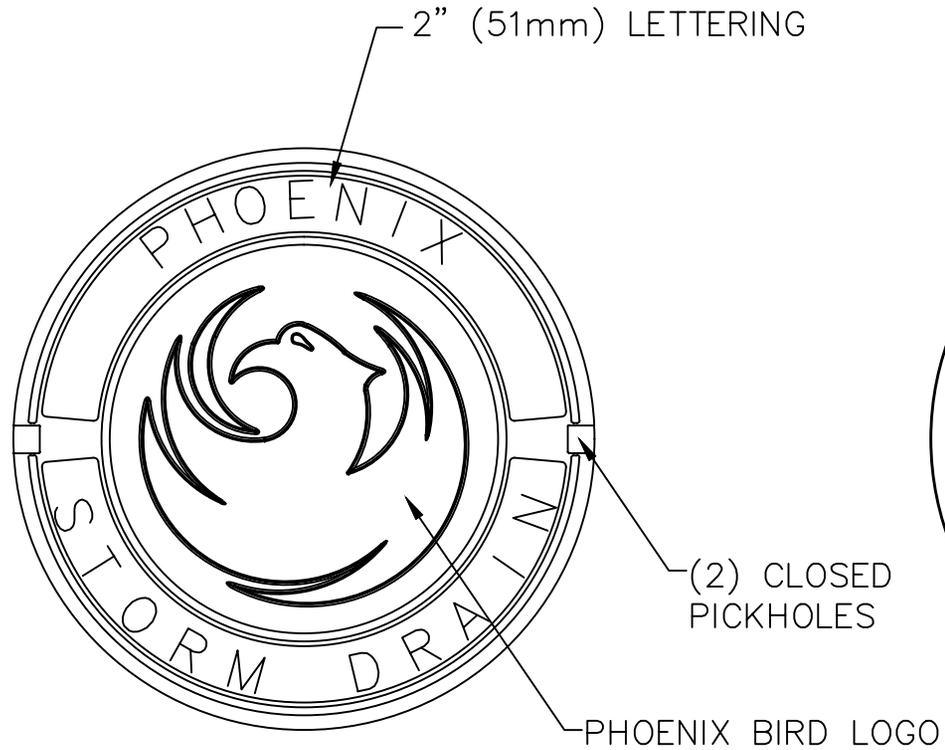
(4) 1/2" X 2" HEX-HEAD S.S. BOLTS & WASHERS  
NO VENT HOLE  
(2) CONCEALED PICKSLOTS

BOLTDOWN WATERTIGHT

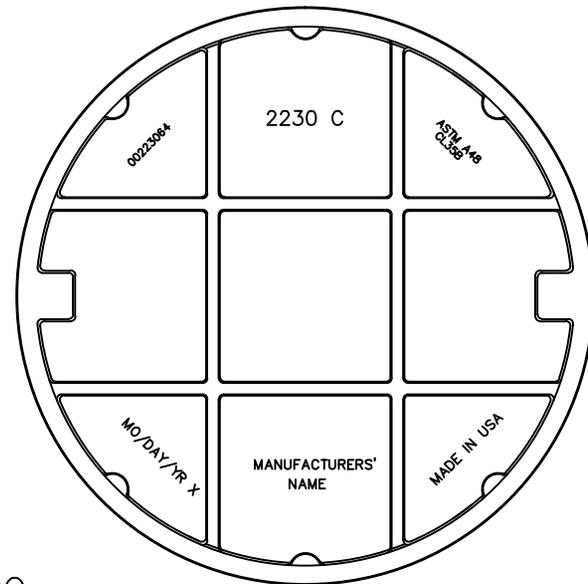
5. SEE MAG DETAIL NUMBERS: 423 & 424 FOR ADDITIONAL REQUIREMENT.



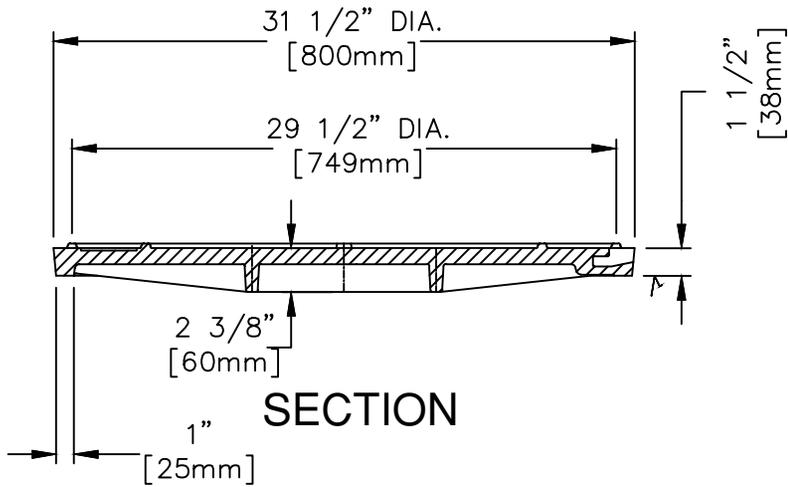
*[Signature]*  
CITY ENGINEER



PLAN VIEW

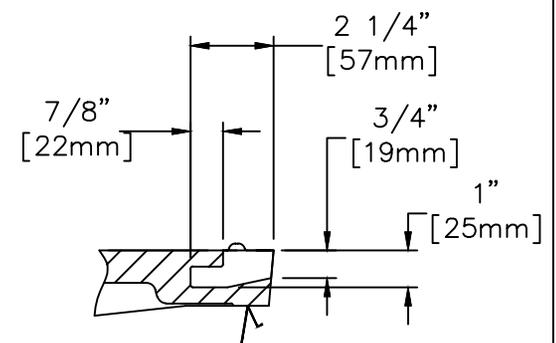


BOTTOM VIEW

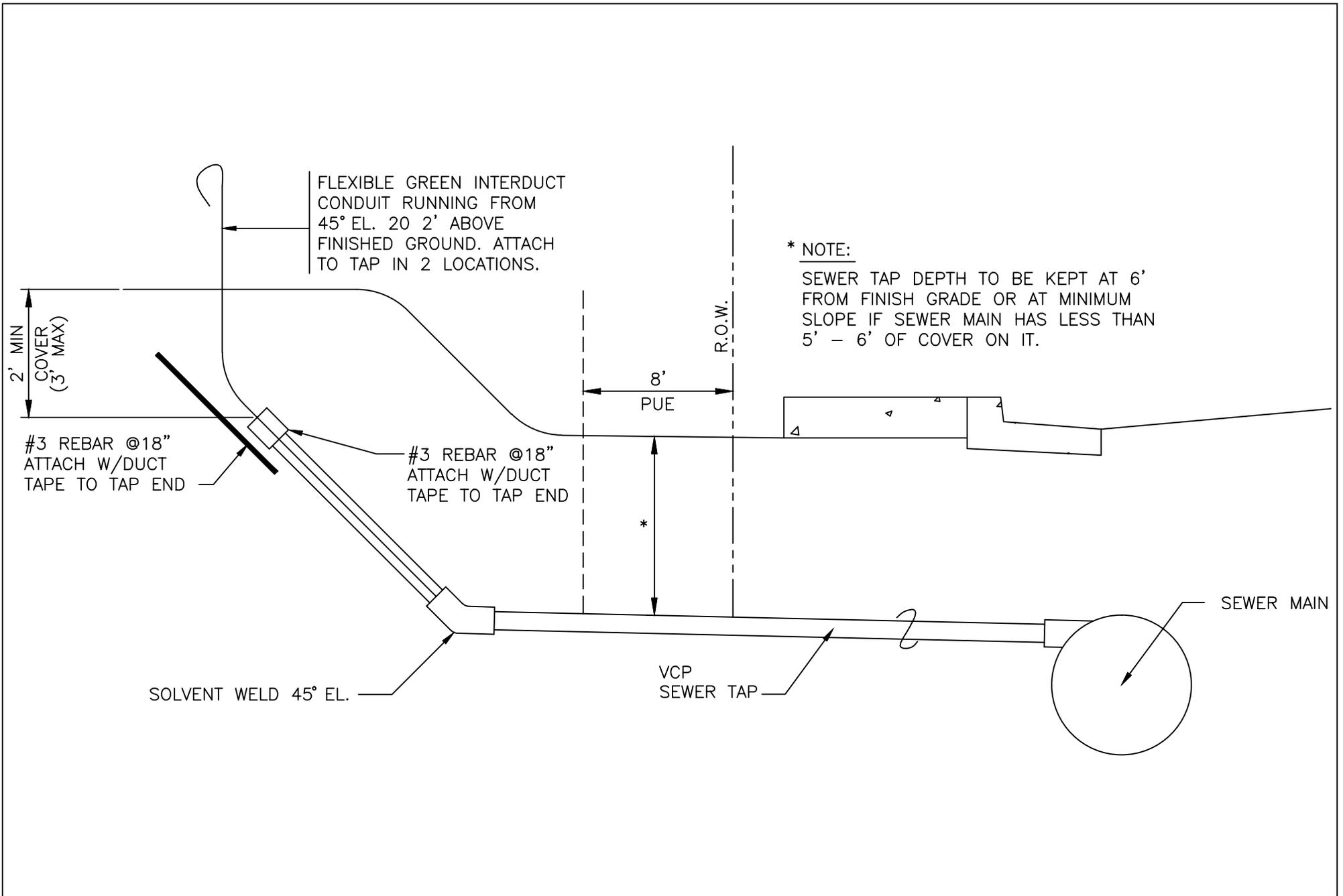


SECTION

NOTES:  
Surface of Manhole Cover  
to be machined.



PICKHOLE DETAIL



DETAIL NO.  
P1431



**City of Phoenix**  
**STANDARD DETAIL**

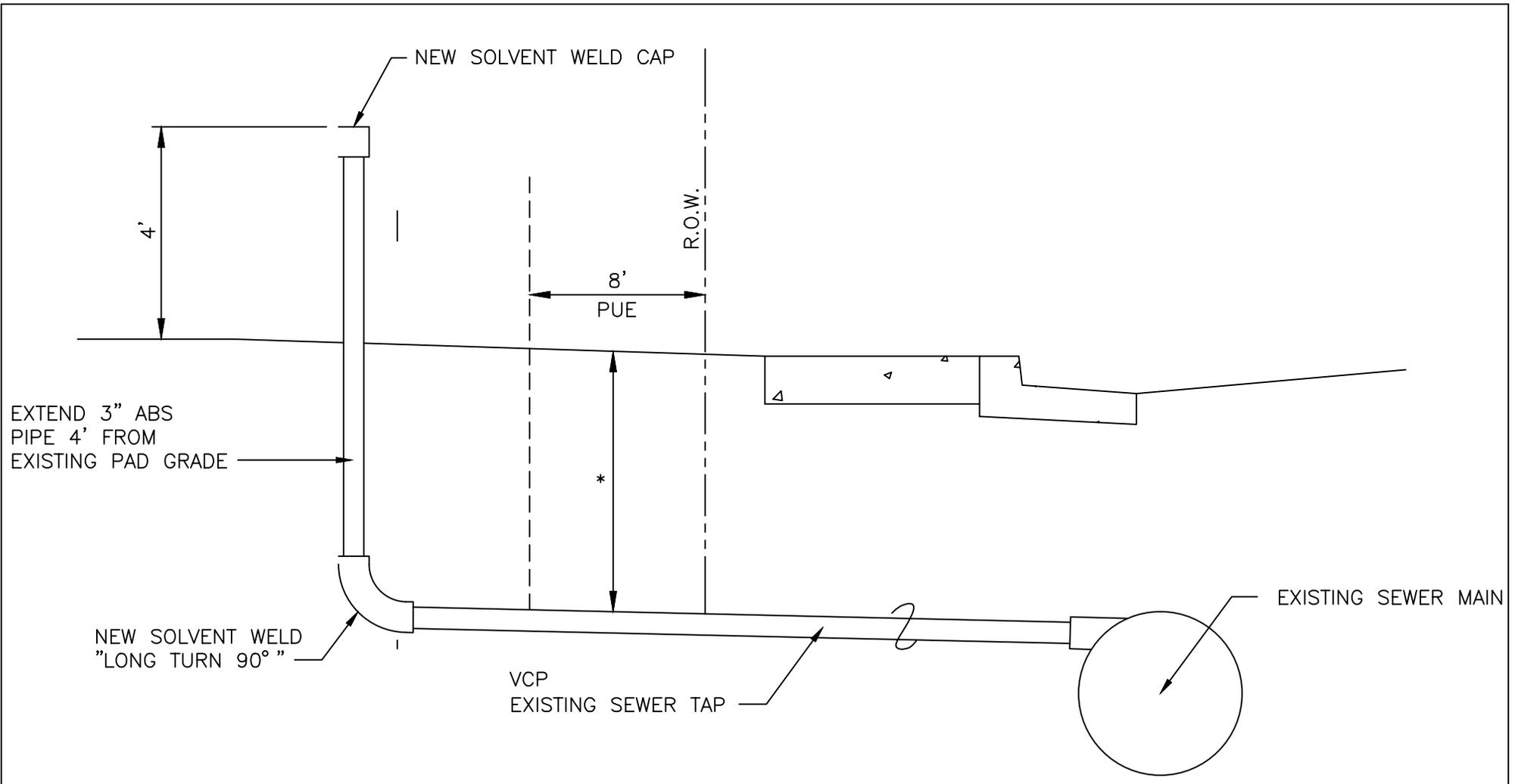
SEWER TAP DEPTH & MARKING

APPROVED

*Allen D. Connell*  
FOR CITY ENGINEER

8/6/99  
DATE

DETAIL NO.  
P1431



\* NOTE:  
 HOME SEWER LINE WOULD TIE INTO NEW VERTICAL 3" ABS PIPE APPROXIMATELY 2' - 3' BELOW PAD GRADE. CLEAN OUT CAP WOULD ALSO BE PROVIDED AT TOP OF VERTICAL PIPE. (NEW PERMIT REQUIRED) APPROXIMATELY 2' - 3' BELOW

SEWER MANHOLE  
WALL

INVERT ELEV.  
PER PLAN

PVC PIPE  
VARIES

BRICK  
&  
MORTAR

NOTE:

- 1) FOR FUTURE VCP or DUCTILE IRON PIPE INSTALLATION.
- 2) THE PVC DIAMETER SHALL BE THE NEXT SIZE LARGER (2" MINIMUM) THAN THE PROPOSED FUTURE PIPE CONNECTION.

DETAIL NO.  
P1435



**City of Phoenix**  
**STANDARD DETAIL**

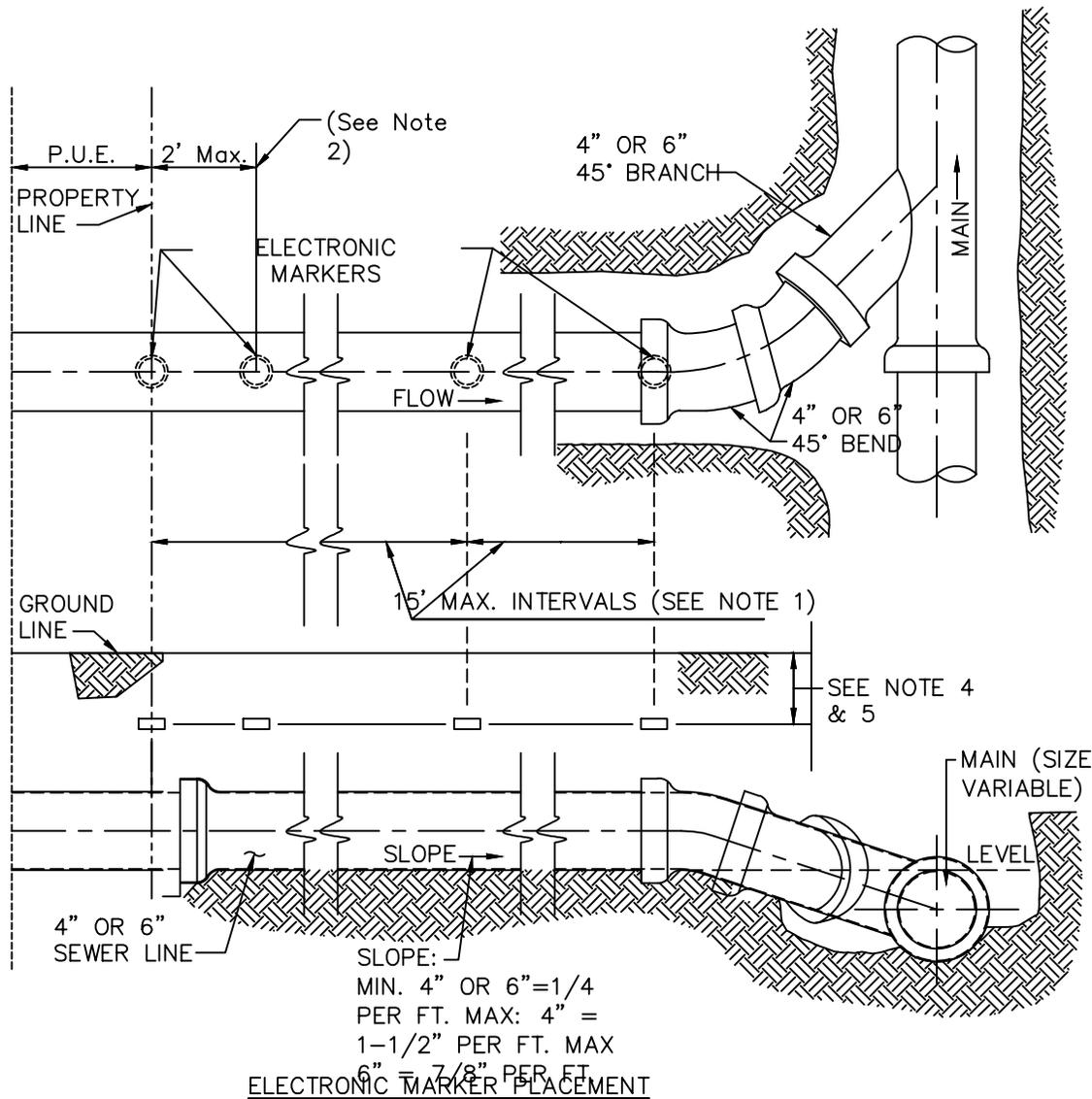
SANITARY SEWER  
MANHOLE KNOCKOUT

APPROVED

*Maria Saldamando*  
CITY ENGINEER

7/19/04  
DATE

DETAIL NO.  
P1435



**NOTES:**

1. Electronic markers shall be installed at the tap, at the property line and at all changes in horizontal direction, if any, over all building connection sewers. Additional markers shall be installed as necessary so that maximum spacing between markers shall not exceed 15 feet.
2. Markers at property line may be installed at up to 2 feet from property line into right-of-way if a fence or other obstruction is anticipated to be constructed on property line.
3. Markers shall be 3M 1253 Full Range (potty seats) capable of detection at up to 8 feet of bury, or equal.
4. Markers shall be installed in a horizontal position centered over the sewer with a 6-inch cushion of soil between pipe and marker when building sewer is 8 feet or less in depth to finish grade.
5. If building connection sewer has over 8 feet of cover, marker shall be positioned over center of sewer and buried at 7 to 8 feet of depth from finish grade.
6. Backfill material within 6-inches of any marker shall sand or well graded material with a maximum aggregate size of 1-inch.
7. Construct building connection sewer at minimum slope if cover will be less than 5 feet at the property line.
8. Aside from wye connection at tap, vertical adjustments of the building connection are not allowed in the right-of-way.
9. All fittings shall be installed in accordance with ASTM D-2321. The Contractor may vary from the drawing to use the appropriate wyes and bends to ensure no misalignment of the pipe and fittings. Joints deflections shall not exceed more than one half of manufacturer's recommendations.
10. End of building connection sewer at property line shall be sealed and marked with 2"x 4" stake extending a minimum of 2 feet above finish grade. The top six inches of the stake shall be painted green.
11. A curb stamp shall be provided per MAG Detail 440-4.

DETAIL NO.  
P1440



**City of Phoenix**  
**STANDARD DETAIL**

SEWER BUILDING CONNECTION  
& ELECTRONIC MARKERS

APPROVED

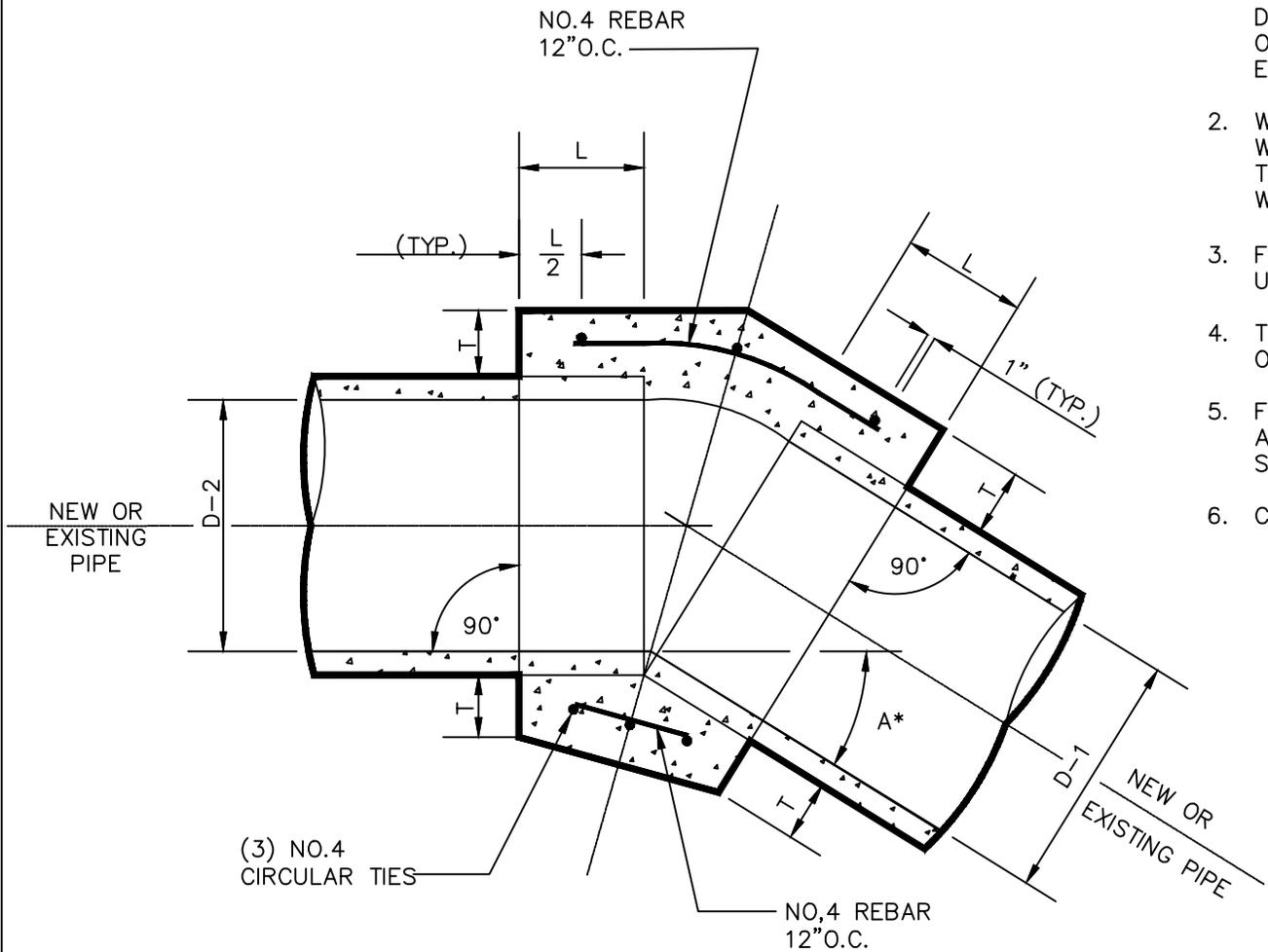
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CITY ENGINEER

12/10/2012  
DATE

DETAIL NO.  
P1440

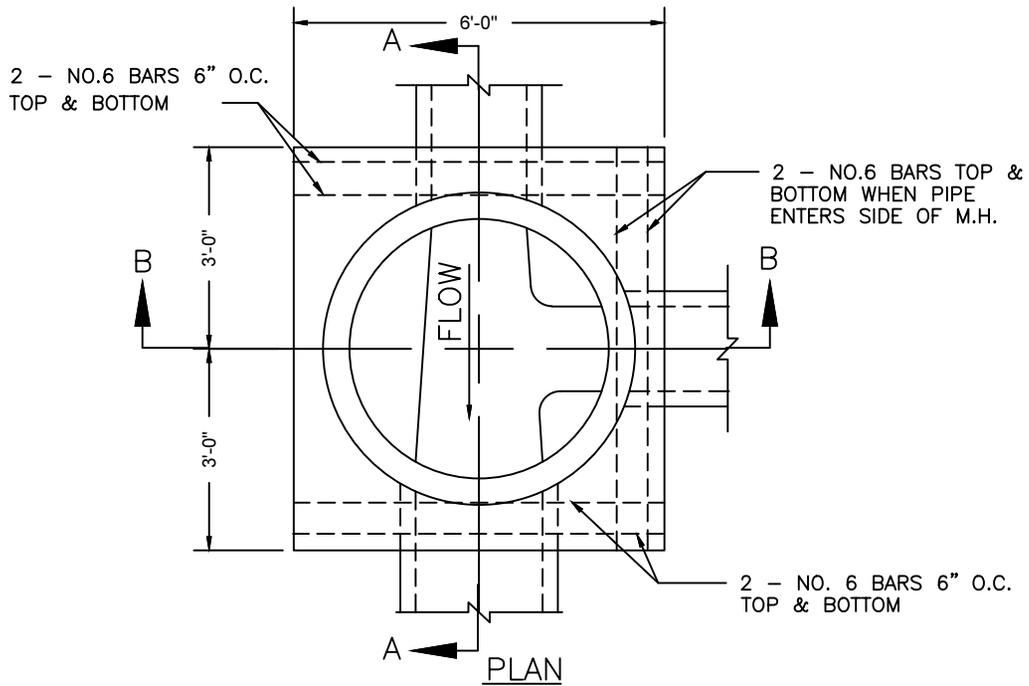
NOTES:

1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR, ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE, D-D-1, OR D-2 WHICHEVER IS GREATER.
3. FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE NEXT SIZE LARGER.
4. THE DIAMETER OF THE CIRCULAR TIES SHALL BE OUTSIDE DIAMETER OF PIPE + T.
5. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
6. CONCRETE SHALL BE CLASS B PER SECT. 725.



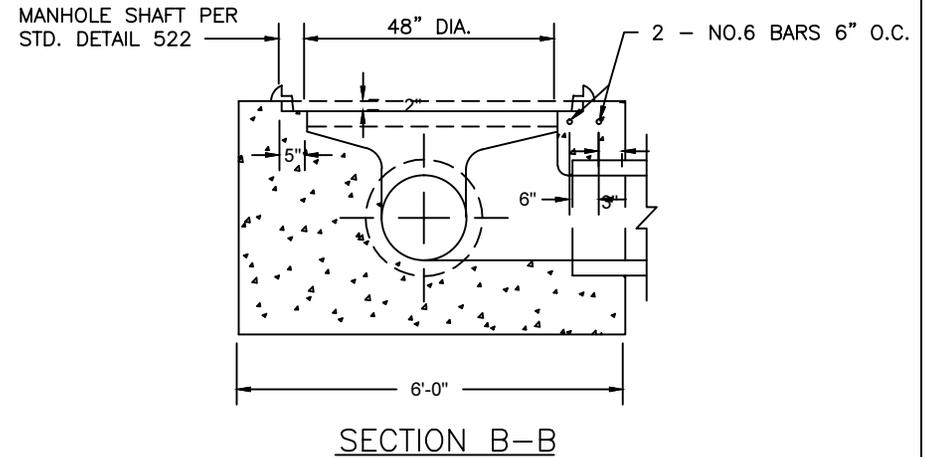
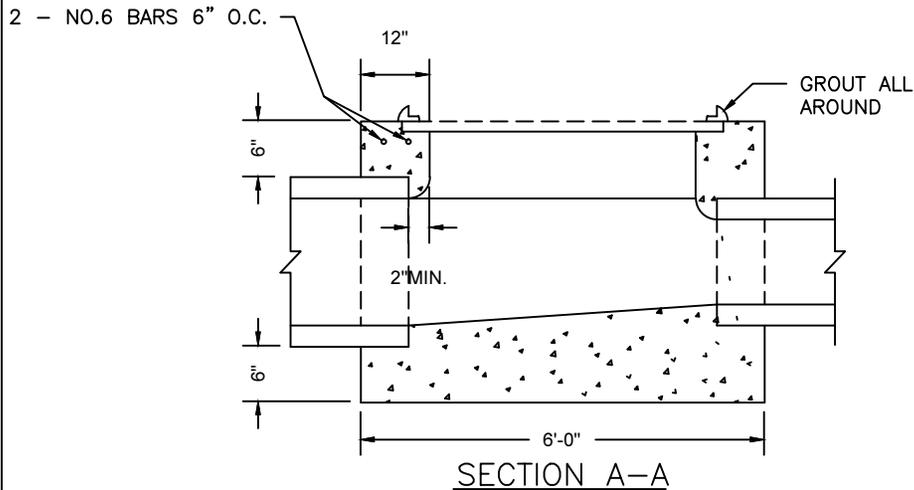
\* = ANGLE OF DEFLECTION

TABLE		
D	L	T
12"	1.0'	4"
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
48"	1.5'	10"
57"	1.5'	10"
60"	1.75'	11"
66"	1.75'	11"



NOTES

1. ALL CONCRETE TO BE CLASS "A" PER SECTION 725.
2. MATCH SPRING LINES OF PIPES ENTERING M.H. UNLESS OTHERWISE NOTED.
3. CUT PIPED TO ALLOW SETTING OF 4' DIA. CYLINDRICAL FORM FROM 6" ABOVE MAIN LINE PIPE TO SPRING LINE. CUT PIPE 2" LARGER THAN FORM TO ALLOW 2" CONC. OVER ENDS OF ALL CUT PIPE.
4. INVERT AND BASE OF M.H. TO BE POURED AND INVERT TO BE SHAPED BY HAND TO MAKE SMOOTH TRANSITION FINISH WITH RUBBER FLOAT.
5. CENTER M.H. ON PIPE JOINT WHERE PIPE CHANGES SIZES.
6. BENCH M.H. BASE TO TOP OF LARGEST PIPE.



DETAIL NO.  
P1520



**City of Phoenix**  
**STANDARD DETAIL**

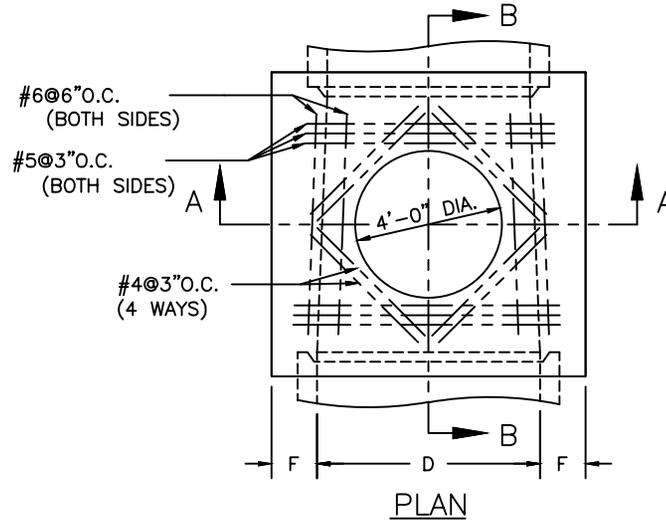
STORM DRAIN MANHOLE BASE  
48" & SMALLER

APPROVED

*Kenny Whelan*  
CITY ENGINEER

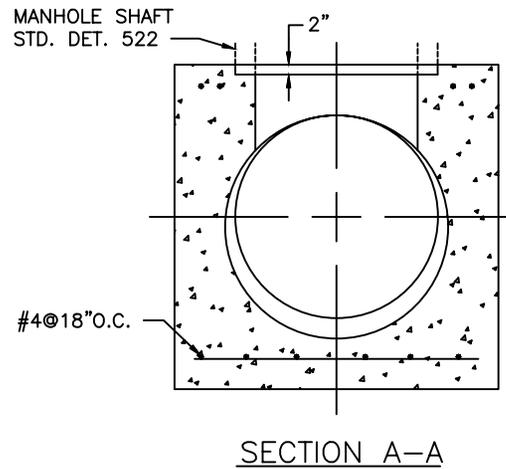
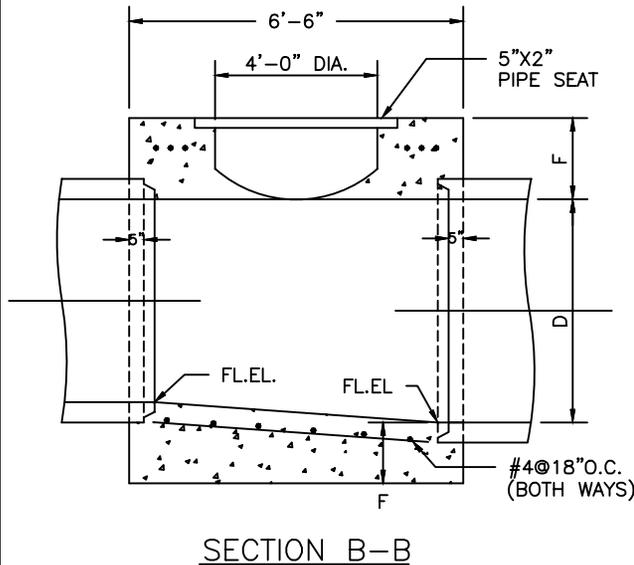
7/9/92  
DATE

DETAIL NO.  
P1520



**NOTES:**

1. THICKNESS OF DECK SHALL VARY WHEN NECESSARY TO PROVIDE LEVEL PIPE SEAT BUT SHALL NOT BE LESS THAN 'F'.
2. FLOOR OF MANHOLE SHALL BE STEEL TROWELLED TO SPRING LINE.
3. BODY OF MANHOLE SHALL BE POURED IN ONE CONTINUOUS OPERATION, EXCEPT THAT A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MAY BE PLACED AT THE SPRING LINE.
4. ALL REINFORCED STEEL SHALL CLEAR FACE OF CONCRETE BY 1-1/2" UNLESS SHOWN OTHERWISE.
5. CONCRETE SHALL BE CLASS 'A'.



**"F" DIMENSION TABLE**

D	51"	54"	57"	60"	63"	66"
F	13-3/4"	14-1/2"	15"	15-1/2"	16-1/4"	16-3/4"
D	69"	72"	78"	84"	90"	96"
F	17-1/2"	18"	19-1/4"	20-1/2"	21-3/4"	23"

DETAIL NO.  
P1560



**City of Phoenix**  
**STANDARD DETAIL**

STORM DRAIN MANHOLE BASE TRANSITION  
51" & LARGER

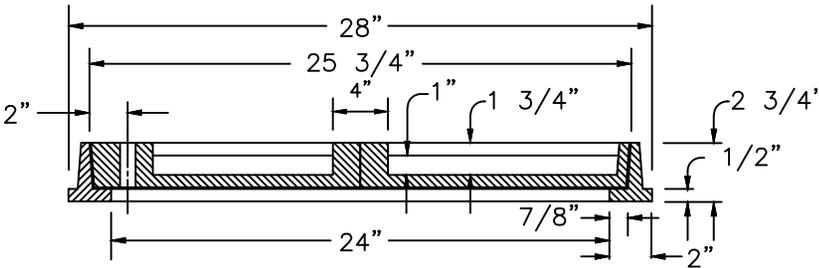
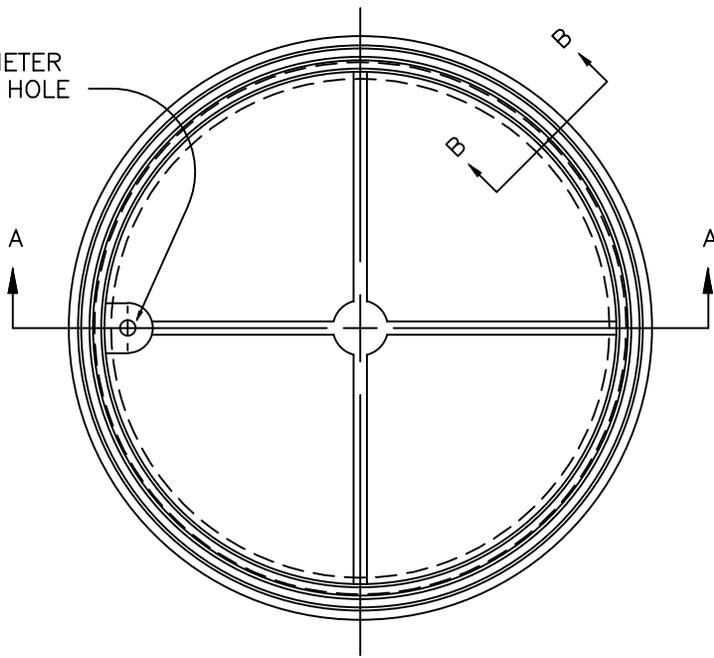
APPROVED

*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

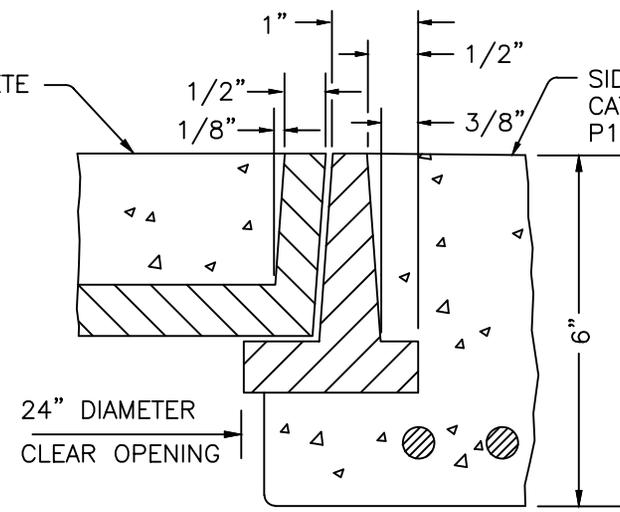
DETAIL NO.  
P1560

1" DIAMETER  
LIFTING HOLE



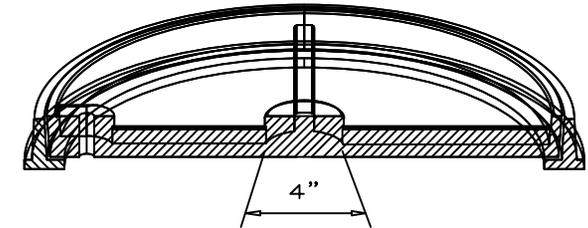
SECTION A - A

CONCRETE  
FILLER



SECTION B - B

SIDEWALK SLAB FOR  
CATCH BASIN. SEE  
P1569-2 FOR  
MODIFICATION  
WHEN LOCATED  
IN LANDSCAPE  
PARKWAY  
SECTION.



NOTES

1. COVER SHALL BE NON-LOCKING.
2. FRAME AND COVER SHALL BE CAST IRON OR STRUCTURAL STEEL.
3. CATCH BASIN ACCESS FRAME AND COVER IS FOR USE ON NON VEHICULAR TRAFFIC AREAS ONLY.
4. COVER SHALL BE FILLED WITH CONCRETE AND BROOM FINISHED.
5. SMALL VARIATIONS IN DIMENSIONS OR FEATURES OF A MINOR NATURE THAT ARE PART OF THE FOUNDRY'S STANDARD CASTING ARE PERMISSIBLE.

SIZE OF OUTFALL CONDUIT	FRAME ANGLES	SHEAR PIN CLIP ANGLES	SHEAR PINS	ANCHOR BOLTS	HINGE PINS	HINGE ANGLES	HINGE STD. PIPE	HINGE TO FRAME WELDS	ANGLE TO FRAME WELDS	BARRIER BARS PLAIN	NO. OF EQUAL BARRIER BAR SPACES (HORIZ.)	NO. OF EQUAL BARRIER BAR SPACES (VERT.)	H (OUT TO OUT FRAME ANGLES)	W (OUT TO OUT FRAME ANGLES)	A	B
15"	2X2X1/4	4X4X1/4	1-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	3	5	34"	20"	SINGLE HINGE CENTERED	
18"	2X2X1/4	4X4X1/4	1-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	3	5	34"	20"	SINGLE HINGE CENTERED	
24"	2X2X1/4	4X4X1/4	1-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	3	5	34"	20"	SINGLE HINGE CENTERED	
30"	2X2X1/4	4X4X1/4	1-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	3	5	34"	20"	SINGLE HINGE CENTERED	
36"	2X2X1/4	4X4X1/4	2-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	5	5	42"	32"	SINGLE HINGE CENTERED	
42"	2X2X1/4	4X4X1/4	2-1/8 $\phi$	5/8 $\phi$	1/2" $\phi$	2X2X1/4	3/4"	1/8	1/8	1/2" $\phi$	5	6	42"	32"	2 HINGES 0 0	
48"	3X3X7/16	5X3X1/4	2-1/8 $\phi$	5/8 $\phi$	3/4" $\phi$	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2" $\phi$	5	7	47"	38"	3"	1"
54"	3X3X7/16	5X3X1/4	2-1/8 $\phi$	5/8 $\phi$	3/4" $\phi$	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2" $\phi$	6	8	54"	44"	5"	3"
60"	3X3X7/16	5X3X1/4	2-1/8 $\phi$	5/8 $\phi$	3/4" $\phi$	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2" $\phi$	7	9	60"	50"	9"	4"
66"	3X3X7/16	5X3X1/4	2-1/8 $\phi$	5/8 $\phi$	3/4" $\phi$	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2" $\phi$	8	10	66"	56"	11"	6"
72"	4X4X5/8	5X3X1/4	2-3/16 $\phi$	5/8 $\phi$	1" $\phi$	3X3X3/8	1-1/4"	1/8	1/8	1/2" $\phi$	9	11	73"	62"	15"	7"
78"	4X4X5/8	5X3X1/4	2-3/16 $\phi$	5/8 $\phi$	1" $\phi$	3X3X3/8	1-1/4"	1/8	1/8	1/2" $\phi$	10	11	79"	68"	17"	9"
84"	4X4X5/8	5X3X1/4	2-3/16 $\phi$	5/8 $\phi$	1" $\phi$	3X3X3/8	1-1/4"	1/8	1/8	1/2" $\phi$	11	13	86"	74"	21"	10"
90"	4X4X5/8	5X3X1/4	2-3/16 $\phi$	5/8 $\phi$	1" $\phi$	3X3X3/8	1-1/4"	1/8	1/8	1/2" $\phi$	12	13	92"	80"	23"	12"
96"	4X4X5/8	5X3X1/4	2-3/16 $\phi$	5/8 $\phi$	1" $\phi$	3X3X3/8	1-1/4"	1/8	1/8	1/2" $\phi$	12	14	98"	86"	29"	12"
108"																
120"																

DETAIL NO.  
P1562



**City of Phoenix**  
**STANDARD DETAIL**

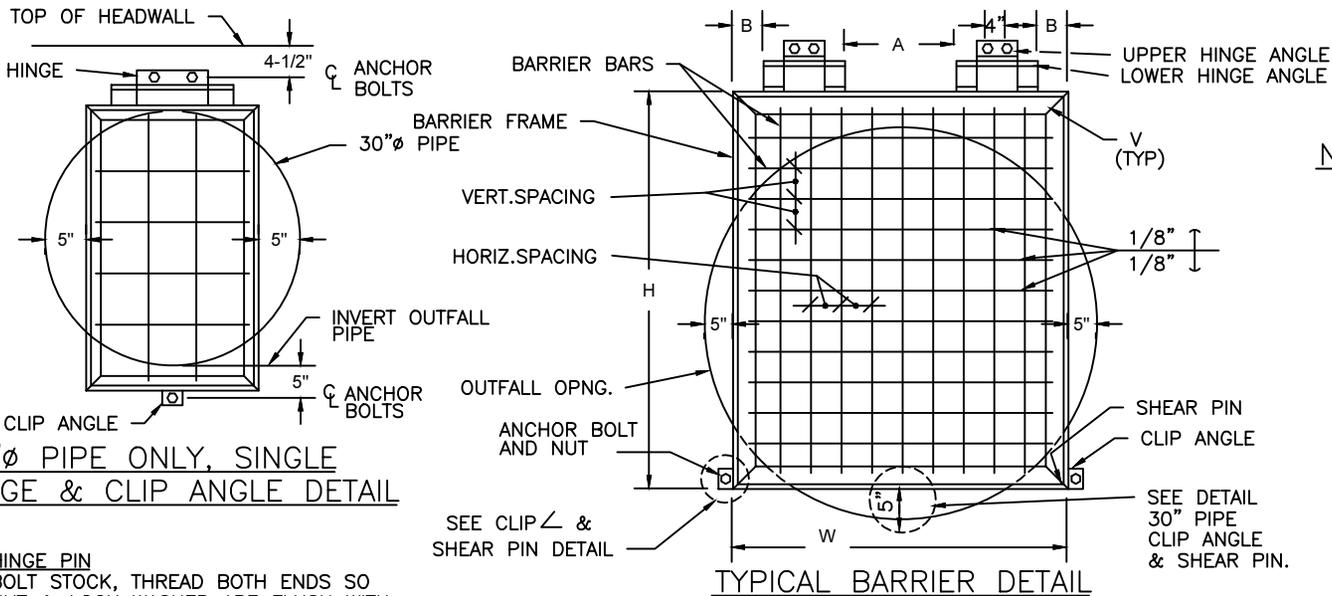
BARRIER SPECIFICATION SCHEDULE

APPROVED

*Maria S. Demando*  
CITY ENGINEER

8/8/03  
DATE

DETAIL NO.  
P1562



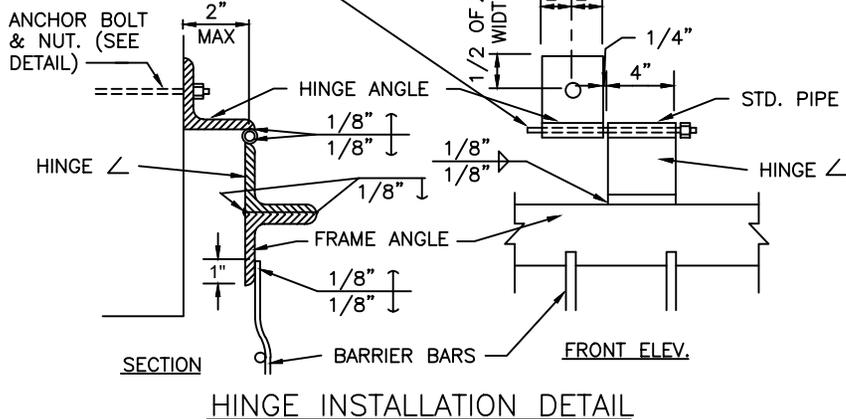
30"Ø PIPE ONLY, SINGLE HINGE & CLIP ANGLE DETAIL

**NOTES:**

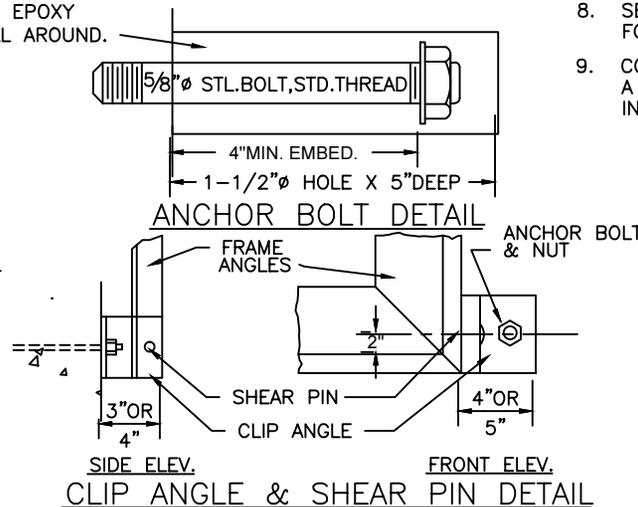
1. ALL SHEAR PIN ANGLES SHALL FIT SNUGLY AND TRULY FACE TO FACE. COVER WITH WATERPROOF GREASE PRIOR TO INSTALLATION OF PIN.
2. GALVANIZE ALL FERROUS PARTS AFTER FABRICATION.
3. THE SHEAR PIN HOLES IN THE ANGLE SHALL BE DRILLED FOR A TIGHT FIT OF THE SHEAR PINS.
4. FRAME AND HINGE ANGLES SHALL HAVE THE OUTSTANDING LEGS OUT FOR OUTLETS.
5. ALL ANCHOR BOLTS SHALL BE 5/8"Ø ANCHOR BOLTS EMBEDDED 4"(MIN.) INTO EPOXY GROUT.
6. ALL SHEAR PINS ARE TO BE PEENED BOTH ENDS AFTER INSTALLATION.
7. SHEAR PIN MATERIAL SHALL BE COMMERCIAL PURE ALUMINUM WIRE, ALLOY 1100, TEMPER O, FEDERAL SPEC. QQ-A-411.
8. SEE BARRIER SCHEDULE, DET. P1562 FOR VARIABLE DIMENSIONS.
9. COVER ALL MOVABLE CONTACT SURFACE WITH A COAT OF WATERPROOF GREASE PRIOR TO INSTALLATION.

**HINGE PIN**  
BOLT STOCK, THREAD BOTH ENDS SO NUT & LOCK WASHER ARE FLUSH WITH LOWER ∠, UPSET OR DAMAGE EXPOSED THREADS. COAT PIN WITH WATERPROOF GREASE BEFORE INSTALLATION.

FILL WITH EPOXY GROUT ALL AROUND.



HINGE INSTALLATION DETAIL



CLIP ANGLE & SHEAR PIN DETAIL

DETAIL NO.  
P1563



**City of Phoenix**  
**STANDARD DETAIL**

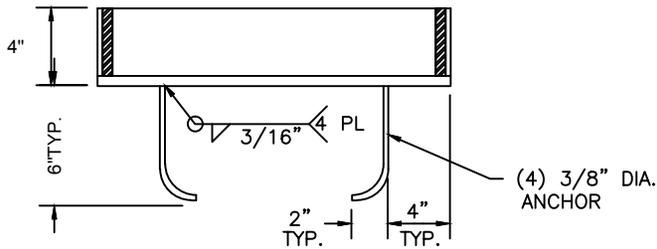
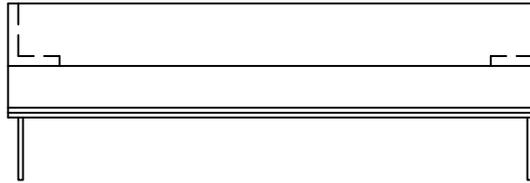
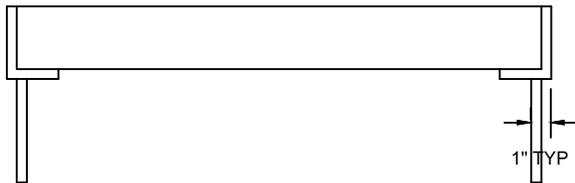
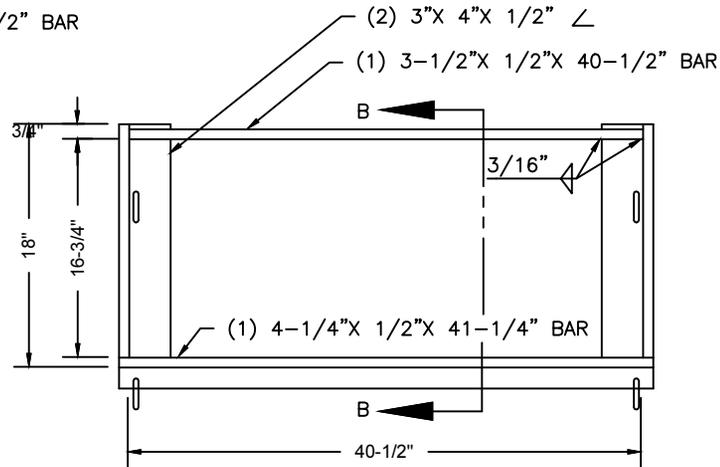
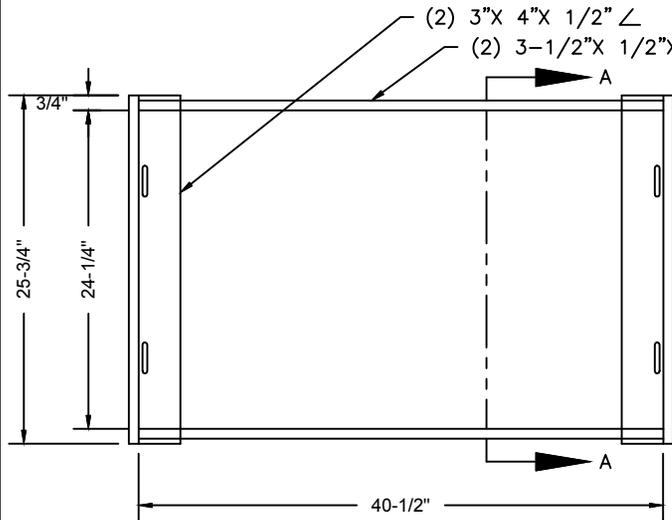
STORM DRAIN OUTFALL ACCESS BARRIER

APPROVED

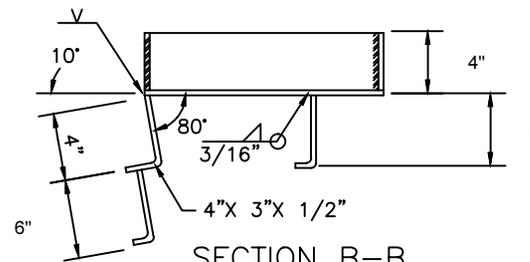
*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

DETAIL NO.  
P1563



SECTION A-A  
TYPE 1



SECTION B-B  
TYPE 2

**NOTES**

1. FRAME & FRAME SUPPORT SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED. STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH M.A.G. WELDING SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT, AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE FRAME SHALL BE FABRICATED TO WITHIN  $\pm 1/8$ " OF SPECIFIED DIMENSIONS.

DETAIL NO.  
P1564



**City of Phoenix**  
**STANDARD DETAIL**

CATCH BASIN GRATE FRAMES

APPROVED

*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

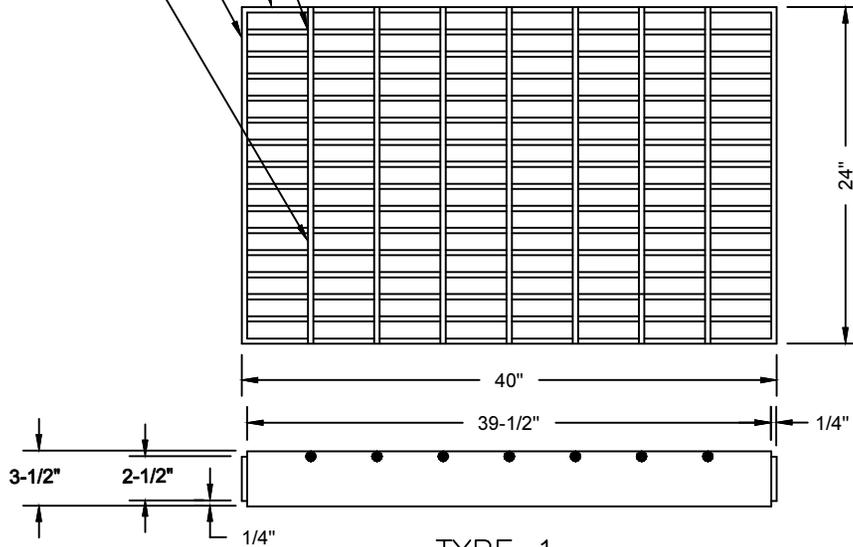
DETAIL NO.  
P1564

(7) 1/2" DIA. X 24", TRANSVERSE RODS, 5" ON CENTER, FLUSH WITH GRATE SURFACE.

(2) 2-1/2" X 1/4" X 24", END BARS

(14) 3-1/2" X 1/2" X 39-1/2" BEARING BAR APPROXIMATELY 1-7/8" ON CENTER.

3/16" EACH BAR & ROD



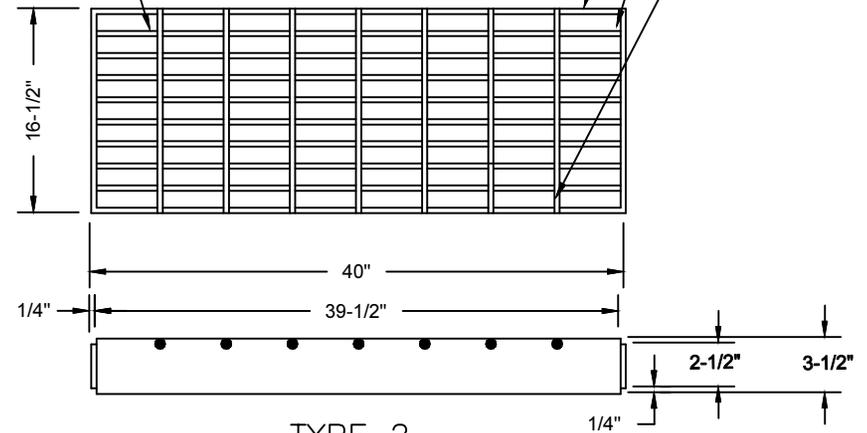
TYPE 1

(7) 1/2" DIA. X 16-1/2", TRANSVERSE RODS, 5" ON CENTER FLUSH WITH GRATE SURFACE.

(2) 2-1/2" X 1/4" X 16-1/2" END BARS

(10) 3-1/2" X 1/2" X 39-1/2" BEARING BAR APPROXIMATELY 1-7/8" ON CENTER.

3/16" EACH BAR & ROD



TYPE 2

NOTES:

1. ALL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH A.W.S. SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE GRATE SHALL BE FABRICATED TO WITHIN 1/8" OF SPECIFIED DIMENSIONS.
6. TYPE 1 AND TYPE 2 GRATES, INSTALLED IN GRATE FRAMES PER STANDARD DETAIL P1564, ARE BICYCLE FRIENDLY AND MAY BE USED WITHIN BICYCLE FACILITIES WITH BEARING BARS ORIENTED PARALLEL TO THE DIRECTION OF TRAVEL.
7. TYPE1 AND TYPE 2 GRATES ARE NOT PEDESTRIAN FRIENDLY AND SHALL NOT BE USED IN PEDESTRIAN TRAVELED WAYS.

DETAIL NO.  
P1565



**City of Phoenix**  
**STANDARD DETAIL**

CATCH BASIN GRATES

APPROVED

*[Signature]*  
CITY ENGINEER

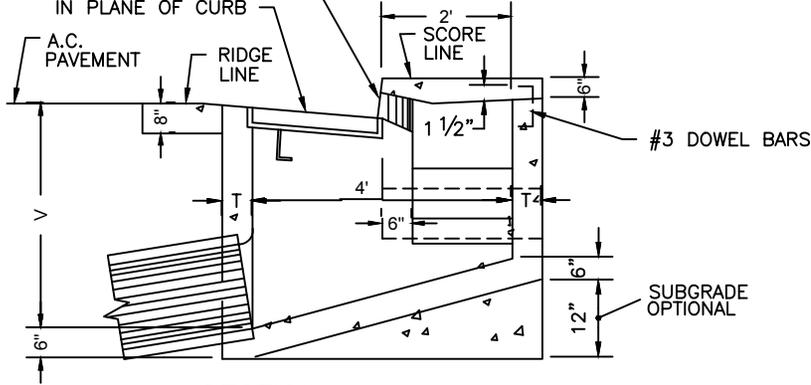
07/01/2015  
DATE

DETAIL NO.  
P1565

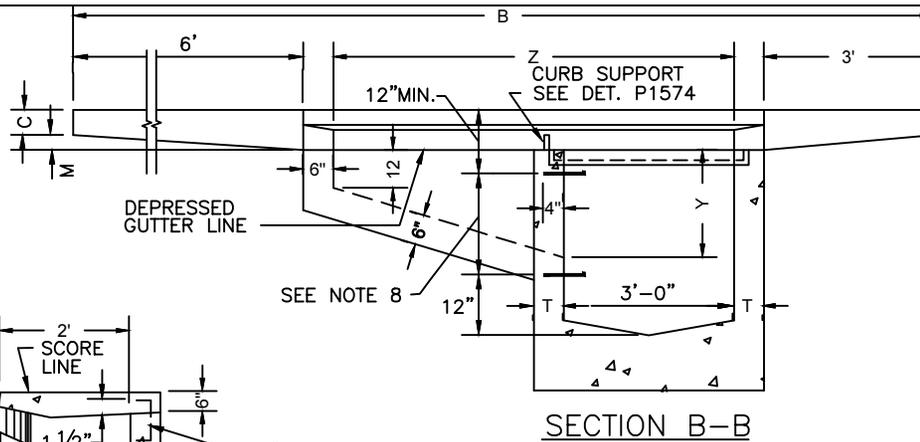
C=6" STD. CURB, M=2"  
 C=5" STD. CURB, M=3"  
 C=4" STD. CURB, M=4"

FOR INLET OPENING, SEE  
 DET. P1574

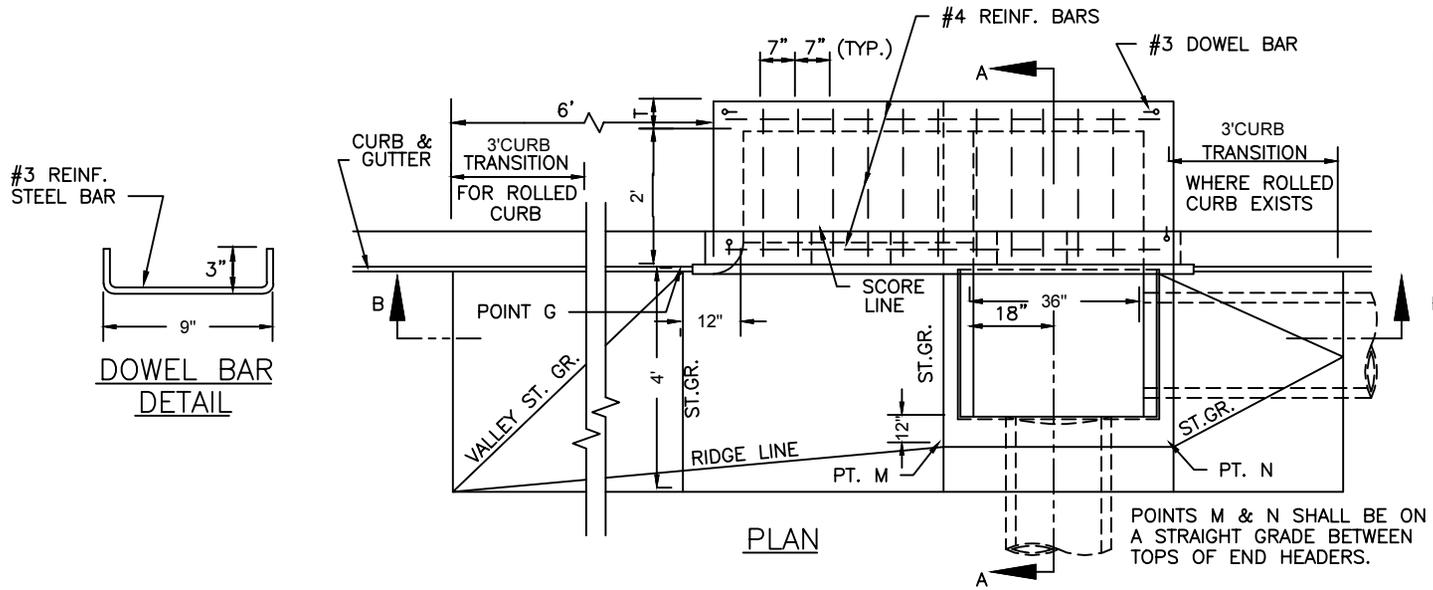
SET EDGE OF ANGLE  
 IN PLANE OF CURB



SECTION A-A



SECTION B-B



PLAN

**CATCH BASIN WALL THICKNESS**  
 T=6" IF V IS 4' OR LESS  
 T=8" IF V IS 4' TO 8'  
 IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED  
 V=4'-0" UNLESS OTHERWISE NOTED

**NOTES:**

1. DIMENSIONS 'Z' SHALL EQUAL 7' OR 14' TYPES ARE DESIGNATED AS FOLLOWS: TYPE J7, (Z=7', Y=24", B=17') TYPE J14, (Z=14', Y=30", B=24')
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPEC. 615.
4. CONNECTOR PIPES MAY BE PLACED IN ANY WALL BENEATH THE GRATE AS PER PLANS.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DET. P1575)
7. DO NOT SPECIFY THIS DETAIL FOR USE IN A MAJOR STREET.
8. THE FRAME SHALL BE DET. P1564, TYPE I AND THE GRATE SHALL BE DET. P1565, TYPE I.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

DETAIL NO.  
 P1566



**City of Phoenix**  
**STANDARD DETAIL**

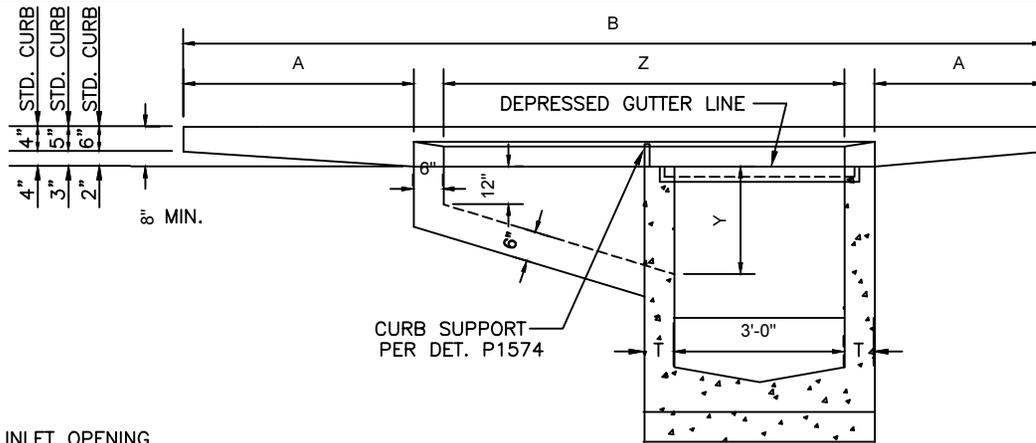
CATCH BASIN COMBINATION  
 TYPE "J" WITH CONCRETE APRON

APPROVED

*[Signature]*  
 CITY ENGINEER

12/10/2012  
 DATE

DETAIL NO.  
 P1566

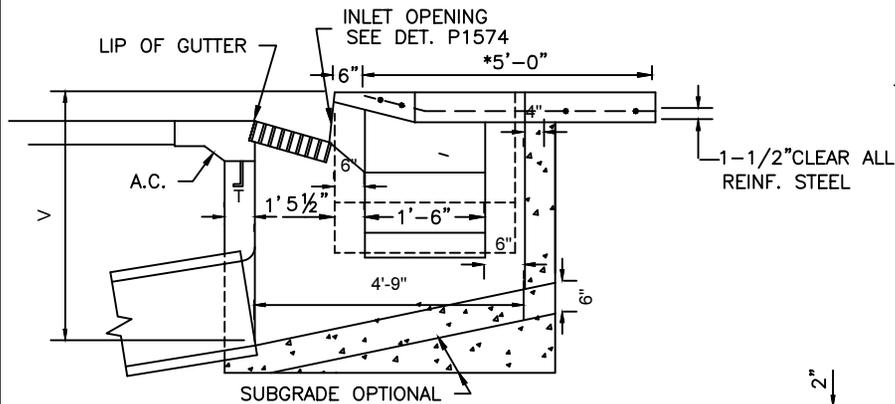


DEPRESSED GUTTER TRANSITION			
CURB HEIGHT	A	B	
		K7	K14
4"	3'-3"	14'-6"	21'-6"
5"	2'-6"	13'	20'
6"	1'-9"	11'-6"	18'-6"

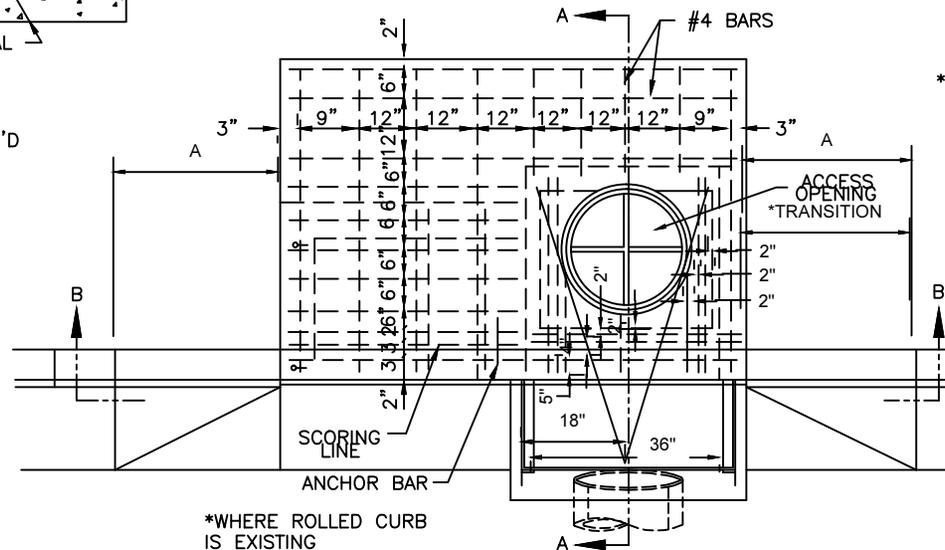
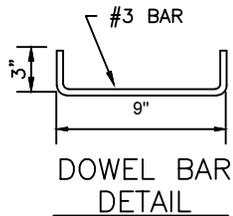
**NOTES:**

1. DIMENSION Z SHALL EQUAL 7' OR 14' TYPES ARE DESIGNATED AS FOLLOWS:  
 Δ TYPE K7 (Z=7', Y=24")  
 Δ TYPE K14 (Z=14', Y=30")
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
4. CONNECTOR PIPES MAY BE PLACED IN ANY WALL BENEATH THE GRATE AS PER PLANS.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DET. P1575).
7. ACCESS FRAME AND COVER PER DET. P1561.
8. THE FRAME SHALL BE DET. P1564, TYPE 2 AND THE GRATE SHALL BE DET. P1565, TYPE 2.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

**SECTION B-B**

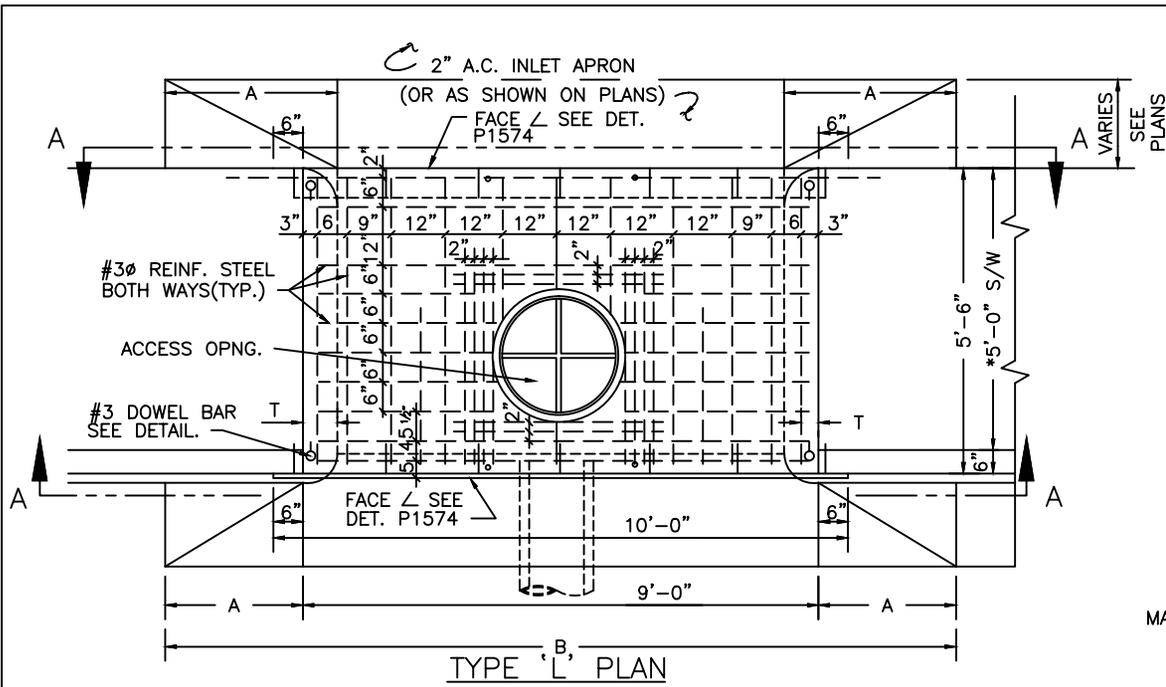


**SECTION A-A**  
 \*4'-0" IN LOCATIONS WHERE 4' S/W IS REQ'D



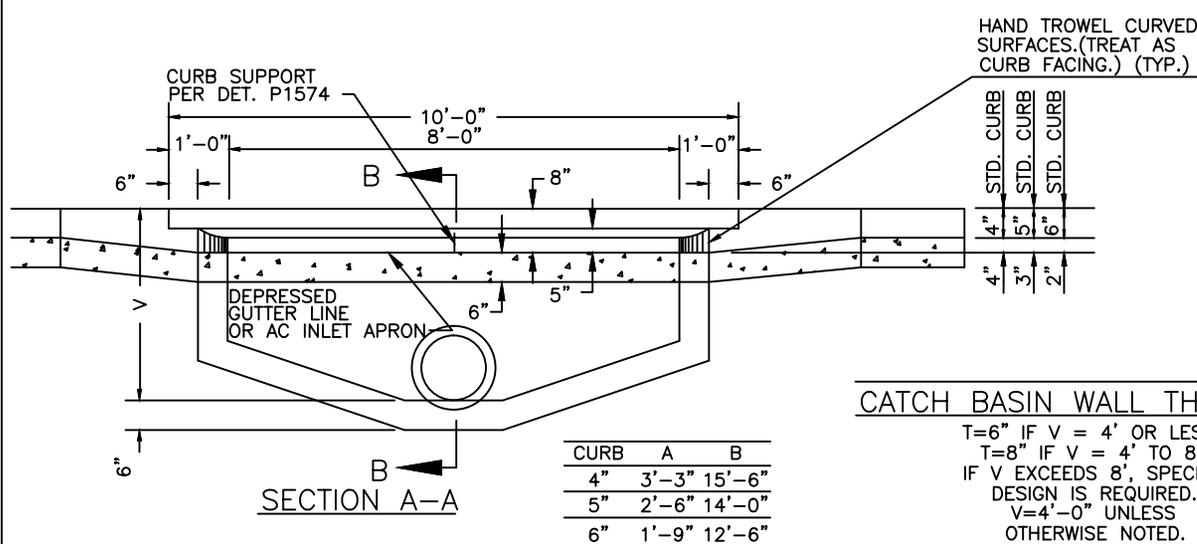
\*WHERE ROLLED CURB IS EXISTING

**CATCH BASIN WALL THICKNESS**  
 T=6" IF V IS 4' OR LESS  
 T=8" IF V IS 4' TO 10'  
 IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED  
 V=4'-0" UNLESS OTHERWISE NOTED.



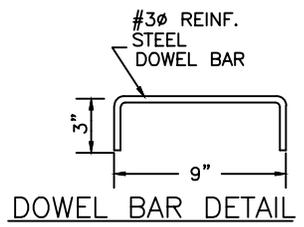
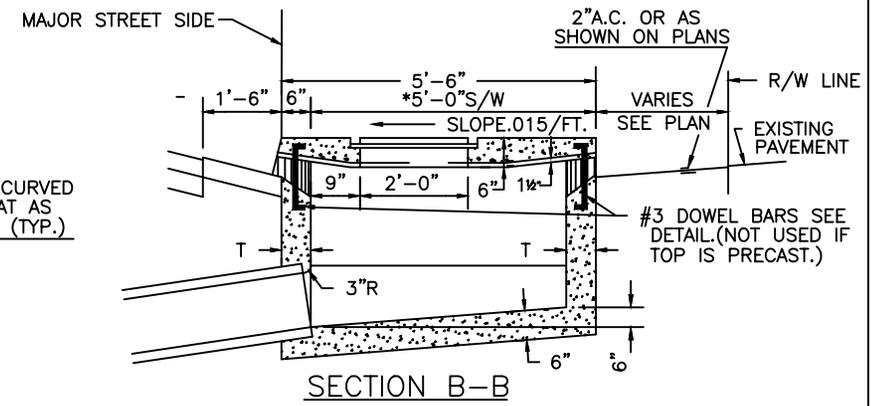
**NOTES:**

1. ALL CONCRETE SHALL BE CLASS 'A'.
  2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
  3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLANS.
  4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
  5. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN SPECIFIED. (SEE DET. P1575.)
  6. ACCESS FRAME AND COVER PER DET. P1561.
  7. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.
- \* TO BE 4'-0" IN LOCATIONS WHERE 4' S/W IS REQUIRED.

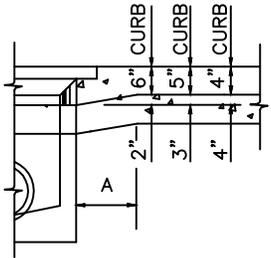


**CATCH BASIN WALL THICKNESS**

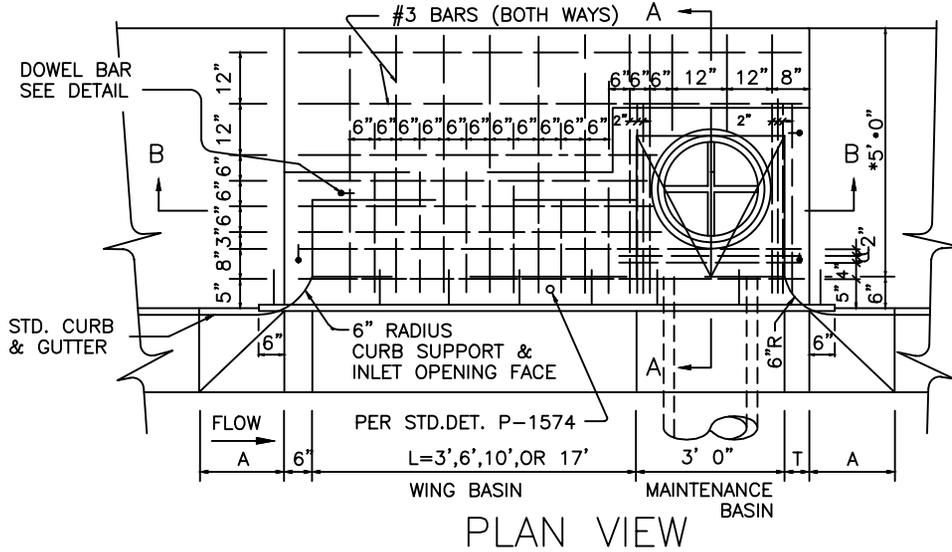
T=6" IF V = 4' OR LESS  
 T=8" IF V = 4' TO 8'  
 IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.  
 V=4'-0" UNLESS OTHERWISE NOTED.



GUTTER TRANSITION	
CURB HEIGHT	DIM 'A'
4"	3'-3"
5"	2'-6"
6"	1'-9"

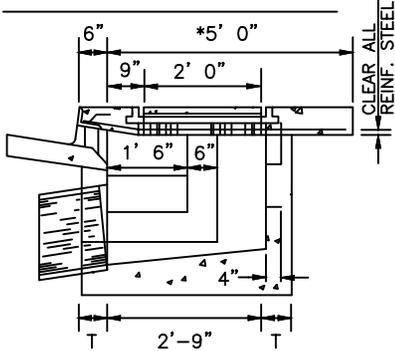


DEPRESSED GUTTER

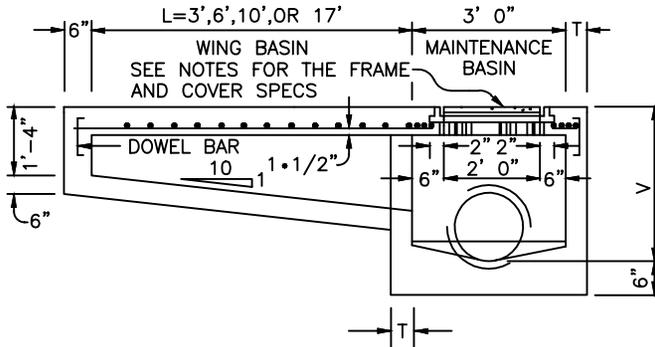


PLAN VIEW

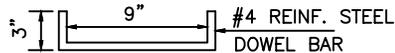
TRANSITION (BOTH SIDES)



SECTION A - A



SECTION B - B

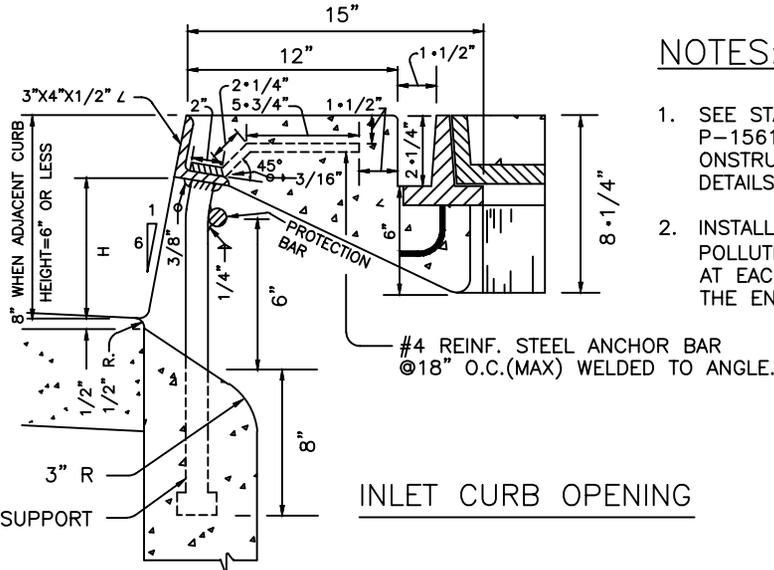
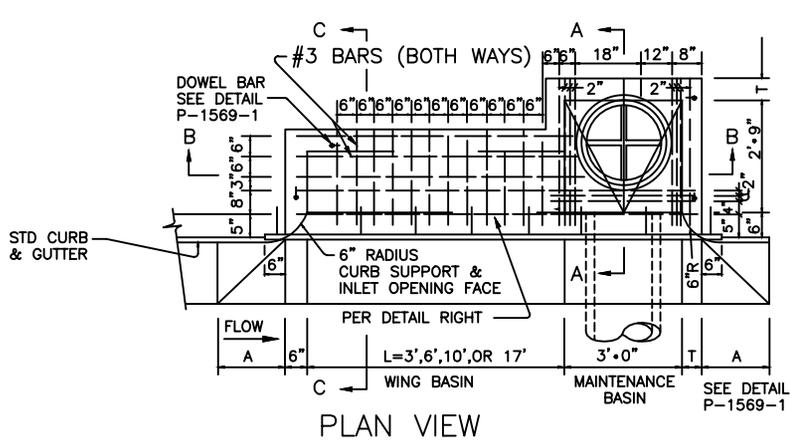


DOWEL BAR  
DETAIL

NOTES

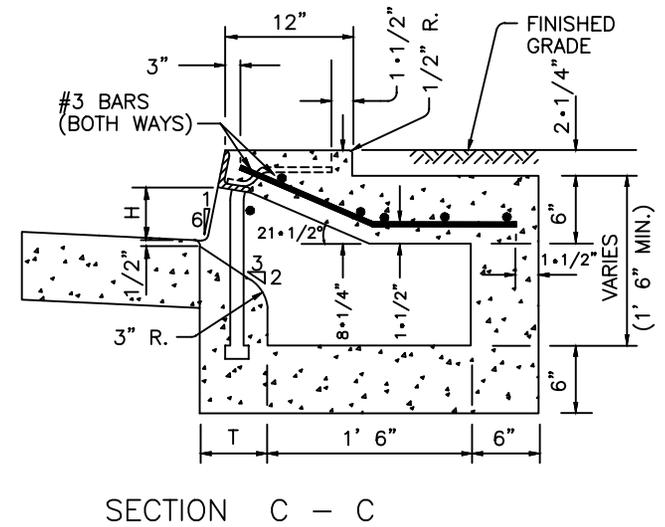
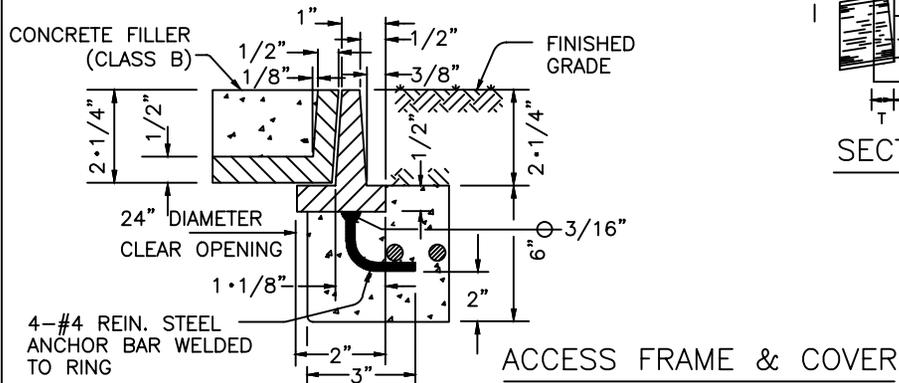
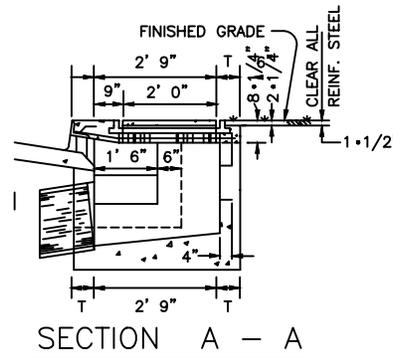
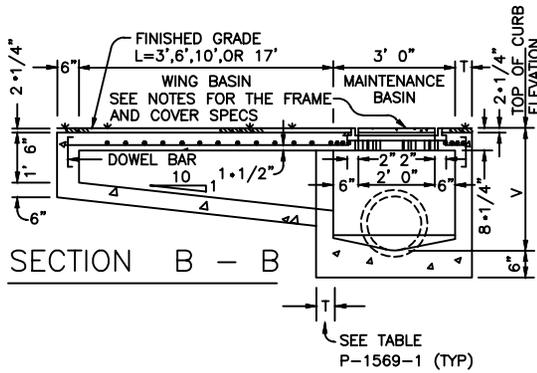
1. TYPES ARE DESIGNATED AS FOLLOWS:  
'M'.. NO WING, 'M-1'.. ONE WING,  
'M-2'.. TWO WINGS.
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
4. CONNECTOR PIPES SHALL BE PLACED IN THE APPROPRIATE WALL OF THE MAINTENANCE BASIN.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED IN WHEN NOTED. (SEE DET. P-1575.)
7. LOCATE WING BASIN ON UPSTREAM SIDE OF MAINTENANCE BASIN FOR TYPE M-1. WING BASINS FOR TYPE M-2 SHALL BE BOTH SIDES OF MAINTENANCE BASIN.
8. ACCESS FRAME AND COVER PER DET. P-1561
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

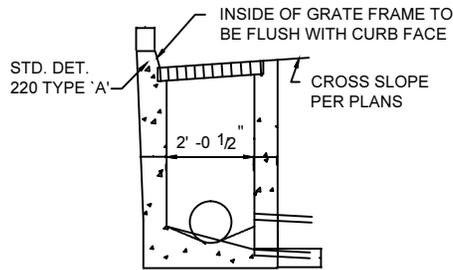
CATCH BASIN WALL THICKNESS
T = 6" IF V = 4' OR LESS
T = 8" IF V = 4' TO 8'
(IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.)
L = 0' UNLESS SPECIFIED ON THE PLANS
V = 4'-0" MIN. UNLESS OTHERWISE NOTED
*4'-0" IN LOCATIONS WHERE 4' SIDEWALK IS REQ'D.



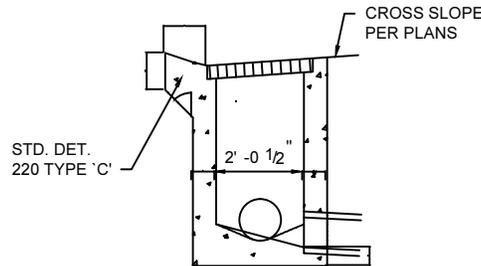
**NOTES:**

1. SEE STANDARD DETAILS P-1569-1, P-1561, AND P-1574 FOR CONSTRUCTION NOTES AND ADDITIONAL DETAILS.
2. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

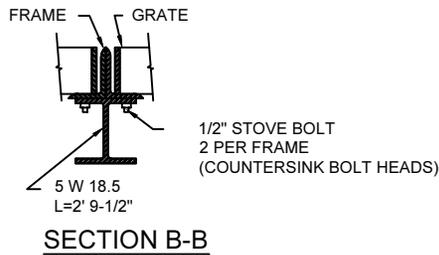




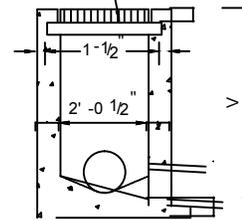
**'N' CATCH BASIN IN  
VERTICAL CURB & GUTTER**



**'N' CATCH BASIN IN  
ROLL CURB & GUTTER**



GRATE SUPPORT FOR  
DOUBLE & TRIPLE ONLY  
SEE SECT. B-B



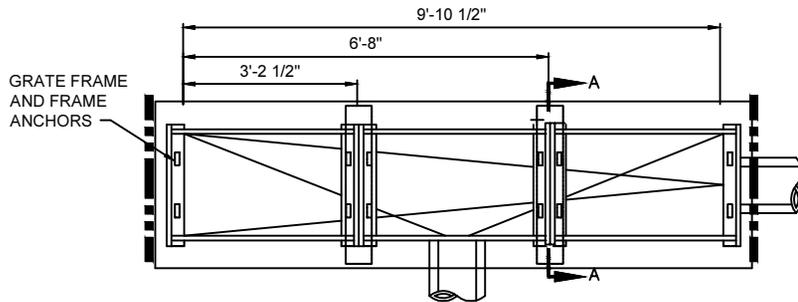
**SECTION A-A**

**NOTES:**

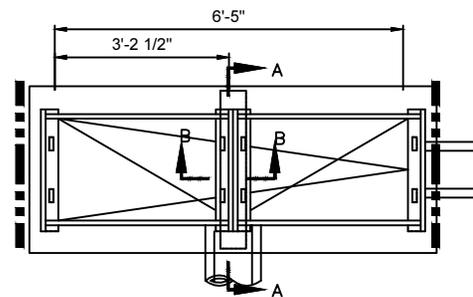
1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
4. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DETAIL P1575)
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. PLANS SHOULD SPECIFY ELEVATION AND INVERT ELEVATION.
7. THE TYPE 'N' CATCH BASIN MAY BE PREFABRICATED PROVIDING A SHOP DRAWING IS APPROVED BY THE ENGINEER PRIOR TO FABRICATION.
8. THE FRAME SHALL BE DET. P1564, TYPE 1 AND THE GRATE SHALL BE DET. P1565, TYPE 1.
9. EXPANSION JOINT (TYP)
10. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

**CATCH BASIN WALL THICKNESS**

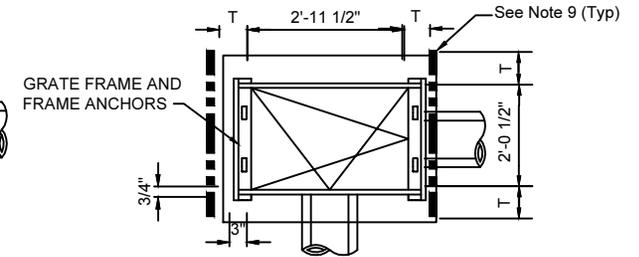
T=6" IF V = 4' OR LESS  
T=8" IF V = 4' TO 8'  
(IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED)  
V=4'-0" UNLESS OTHERWISE NOTED.



**TRIPLE CATCH BASIN PLAN**



**DOUBLE CATCH BASIN PLAN**



**SINGLE CATCH BASIN PLAN**

DETAIL NO.  
P1570



**City of Phoenix  
STANDARD DETAIL**

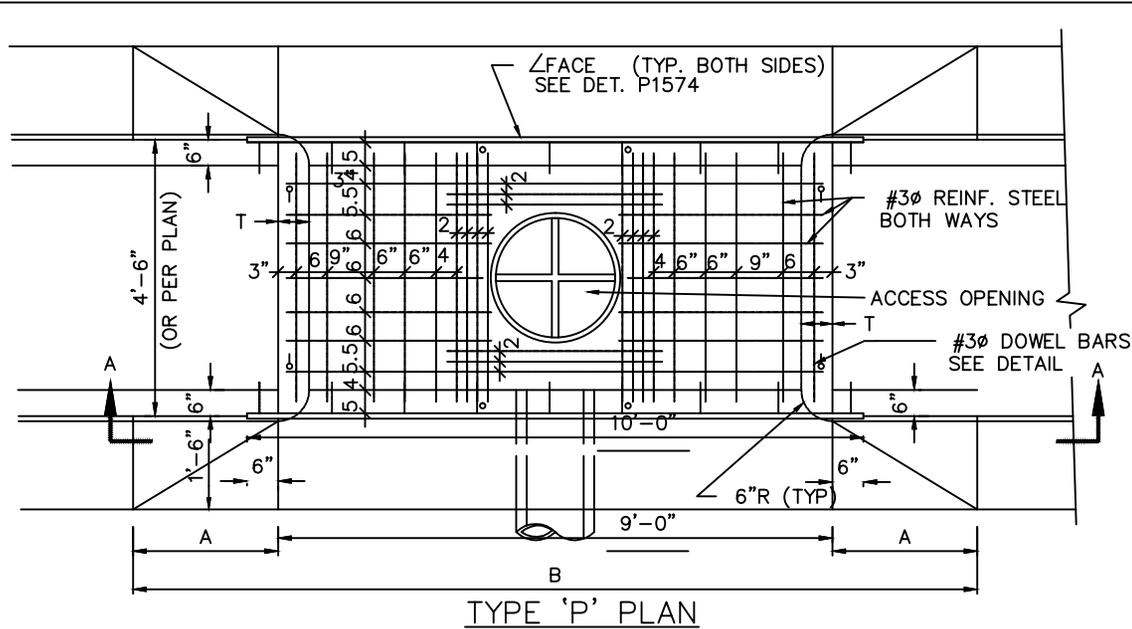
CATCH BASIN  
TYPE "N"

APPROVED

*[Signature]*  
CITY ENGINEER

12/10/2012  
DATE

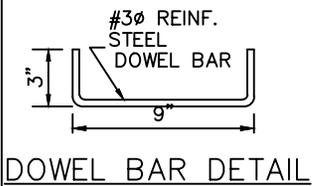
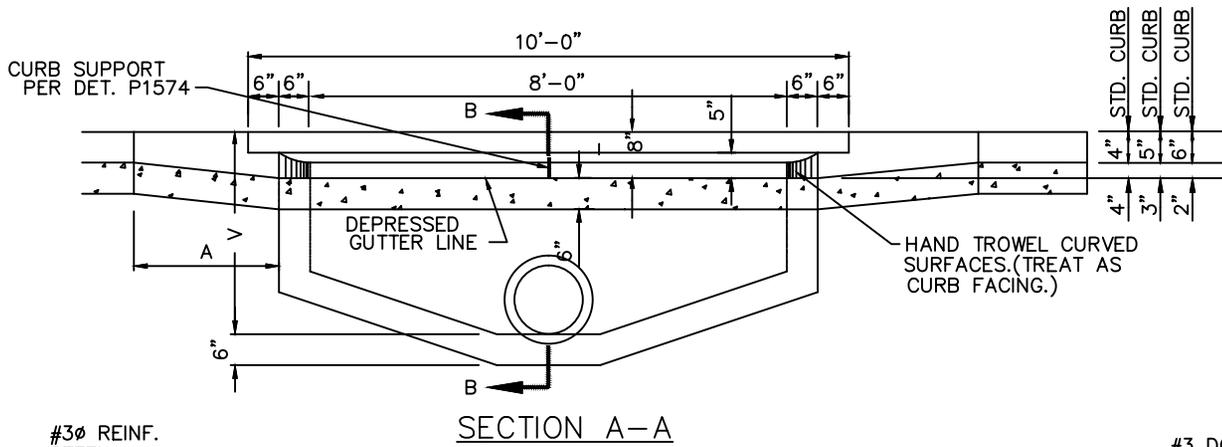
DETAIL NO.  
P1570



**NOTES:**

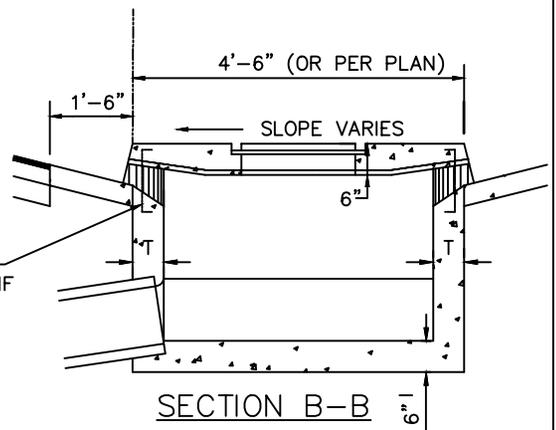
1. ALL CONCRETE SHALL BE CLASS 'A'.
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLANS.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS. (SEE DET. P1575.)
6. ACCESS FRAME AND COVER PER DET. P1561.
7. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

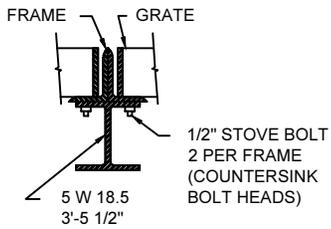
CATCH BASIN WALL THICKNESS	
T=6"	IF V = 4' OR LESS
T=8"	IF V = 4' TO 8'
IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.	
V=4'-0" UNLESS UNLESS OTHERWISE SPECIFIED.	



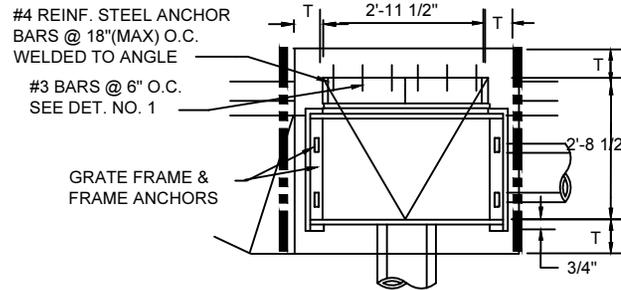
CURB	A	B
4"	3'-3"	15'-6"
5"	2'-6"	14'-0"
6"	1'-9"	12'-6"

#3 DOWEL BAR SEE DETAIL. (NOT USED IF TOP IS PRECAST).

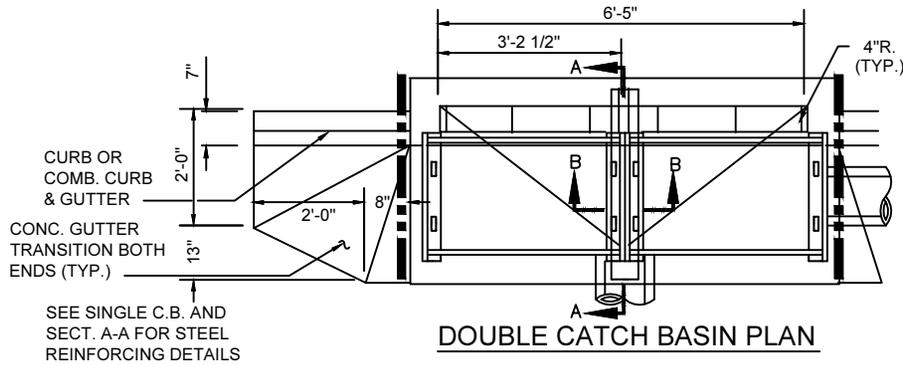




**SECTION B-B**

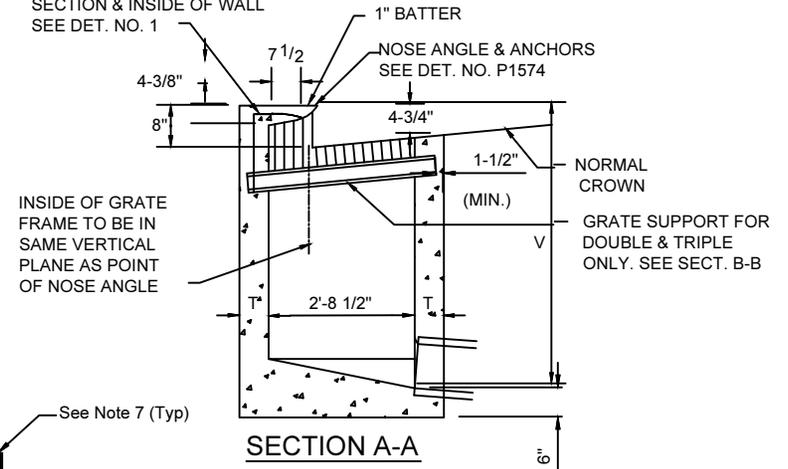


**SINGLE CATCH BASIN PLAN**

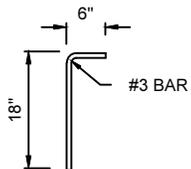


**DOUBLE CATCH BASIN PLAN**

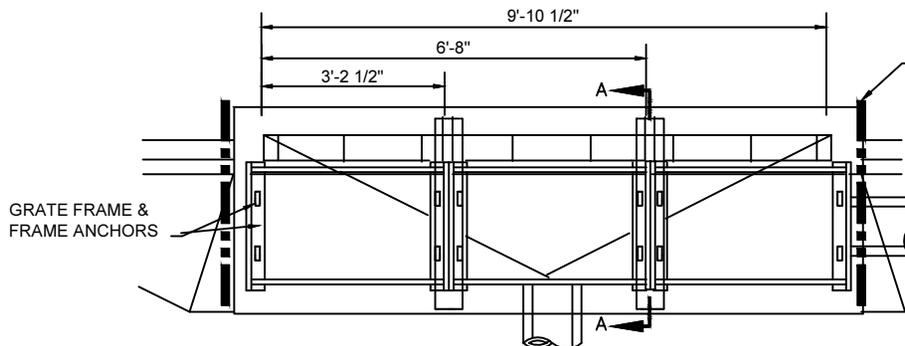
#3 BARS @ 6" O.C., 1-1/2"  
CLEAR TO TOP OF NOSE  
SECTION & INSIDE OF WALL  
SEE DET. NO. 1



**SECTION A-A**



**DETAIL 1**



**TRIPLE CATCH BASIN PLAN**

**NOTES:**

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
4. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DETAIL P1575)
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. THE FRAME SHALL BE DET. P1564, TYPE 1 AND THE GRATE SHALL BE DET. P1565, TYPE 1.
7. EXPANSION JOINT (TYP)
8. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

**CATCH BASIN WALL THICKNESS**

T=6" IF V = 4' OR LESS  
T=8" IF V = 4' TO 8'  
IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED  
V=4'-0' UNLESS OTHERWISE NOTED.

DETAIL NO.  
P1572



**City of Phoenix**  
**STANDARD DETAIL**

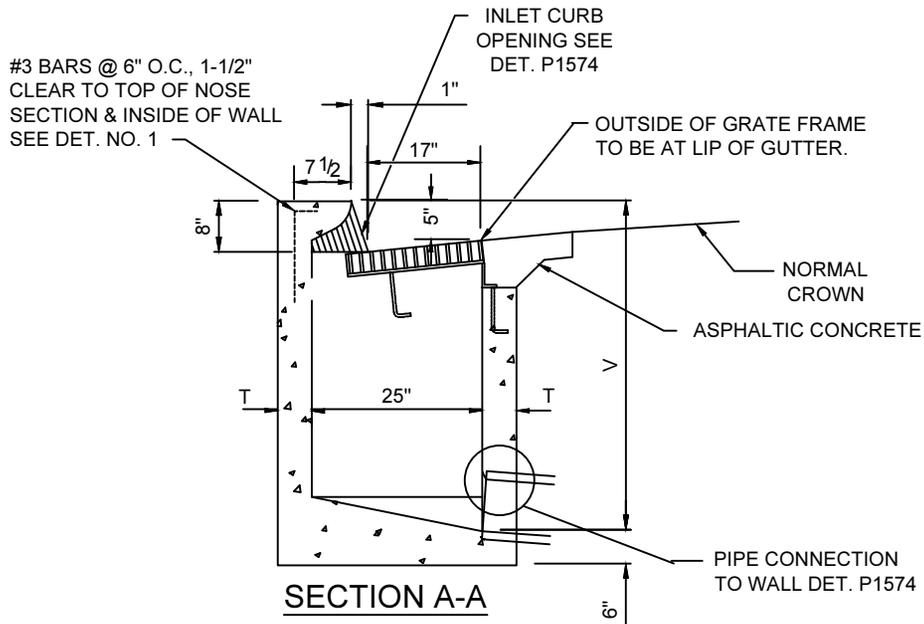
CATCH BASIN  
TYPE "Q"

APPROVED

*[Signature]*  
CITY ENGINEER

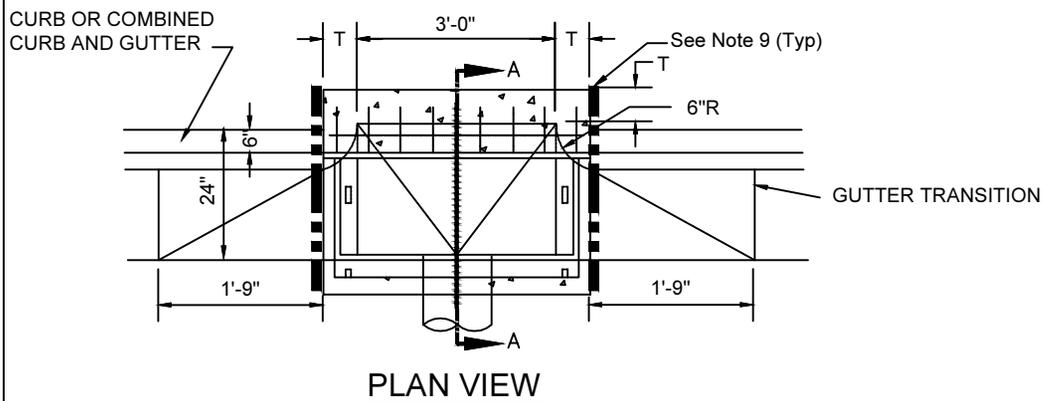
12/10/2012  
DATE

DETAIL NO.  
P1572



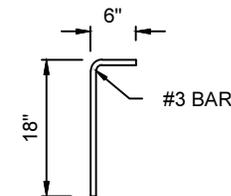
NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOP FROM ALL DIRECTIONS TO OUTLET.
4. THE CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS (SEE DET. P1575).
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. LOCATION OF THE TYPE 'R' CATCH BASIN SHALL BE RESTRICTED TO AREAS WHERE 6" VERTICAL CURB & GUTTER IS EXISTING.
7. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
8. THE FRAME SHALL BE DET. P1564, TYPE 2 AND THE GRATE SHALL BE DET. P1565, TYPE 2.
9. EXPANSION JOINT (TYP)
10. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

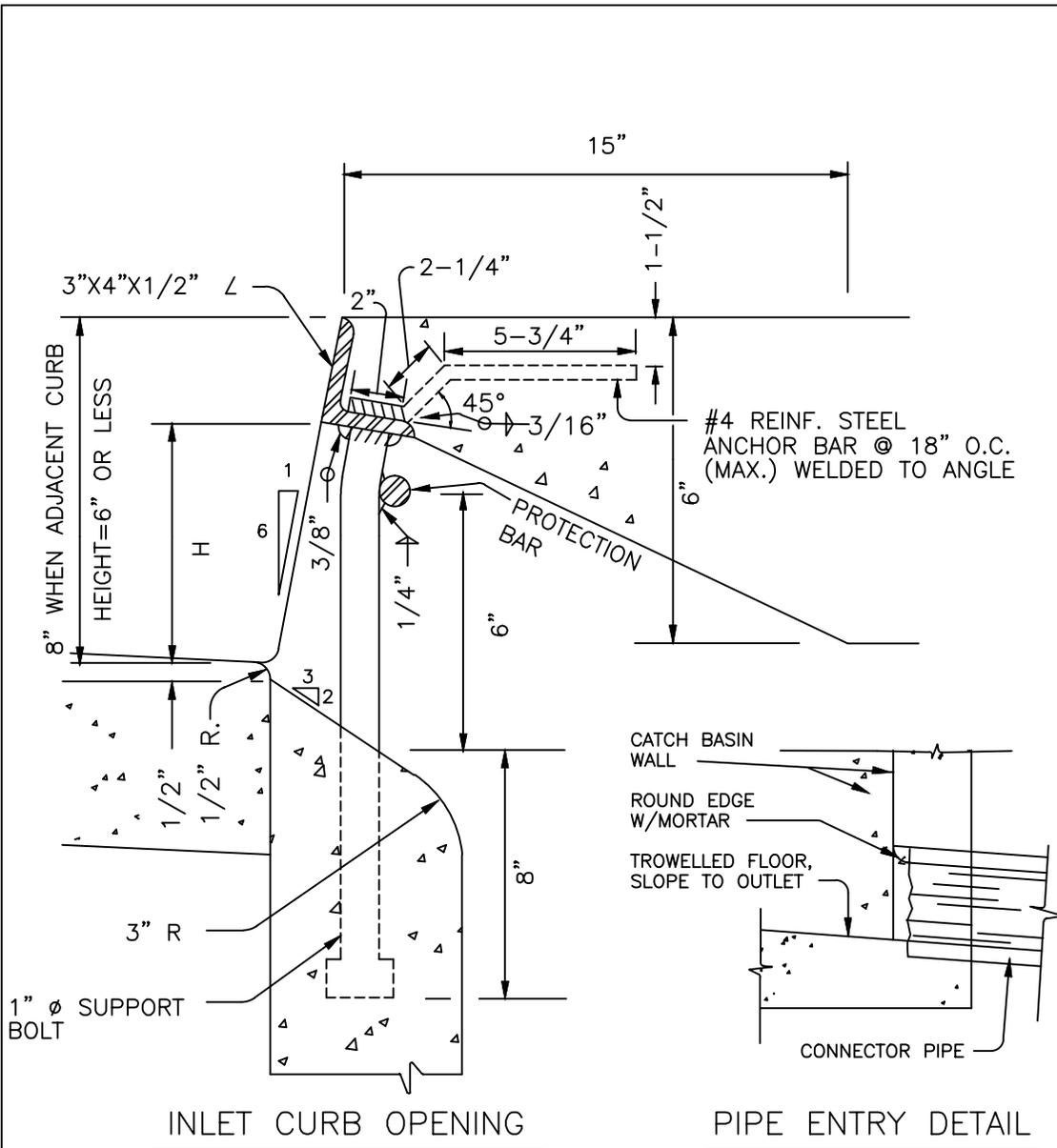


**CATCH BASIN WALL THICKNESS**

T=6" IF V = 4' OR LESS  
 T=8" IF V = 4' TO 8'  
 IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED  
 V=4'-0" UNLESS OTHERWISE NOTED.



**DETAIL 1**



### NOTES

1. CURB OPENING HEIGHT 'H' SHALL BE 5" (MINIMUM) UNLESS OTHERWISE SPECIFIED.
2. WHEN CURB OPENING HEIGHT 'H' EXCEEDS 6", INSTALL 1"Ø STEEL PROTECTION BARS. THE PROTECTION BARS SHALL EXTEND THE FULL LENGTH OF THE CURB OPENINGS AND SHALL BE EMBEDDED 3"(MIN.) AT EACH END.
3. INSTALL ADDITIONAL BARS AT 3 1/2" CLEAR SPACING ABOVE FIRST BAR WHEN OPENING EXCEEDS 13".
4. WHEN CURB OPENING LENGTH EXCEEDS 6', INSTALL 1"Ø STEEL SUPPORT BOLTS, SPACED AT NO MORE THAN 5' O.C.
5. ALL EXPOSED METAL HARDWARE SHALL BE GIVEN ONE SHOP COAT OF NO.1 PAINT AND 2 FIELD COATS OF NO.10 PAINT AS PER SECTION 790.
6. ALL METAL UNITS SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED. STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
7. WELDING SHALL BE IN ACCORDANCE WITH M.A.G. WELDING SPECIFICATIONS.
8. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
9. WHEN CATCH BASIN IS LOCATED WITHIN A LANDSCAPE PARKWAY SECTION, SEE DETAIL P1569-2 FOR INLET MODIFICATIONS.

DETAIL NO.  
P1574



**City of Phoenix**  
**STANDARD DETAIL**

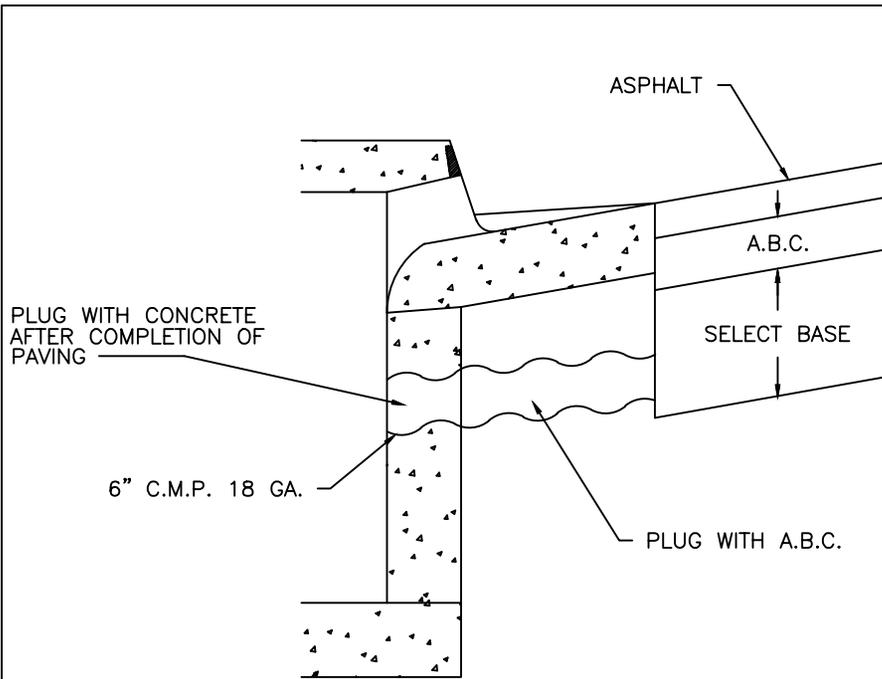
INLET CURB OPENING & PIPE ENTRY DETAIL

APPROVED

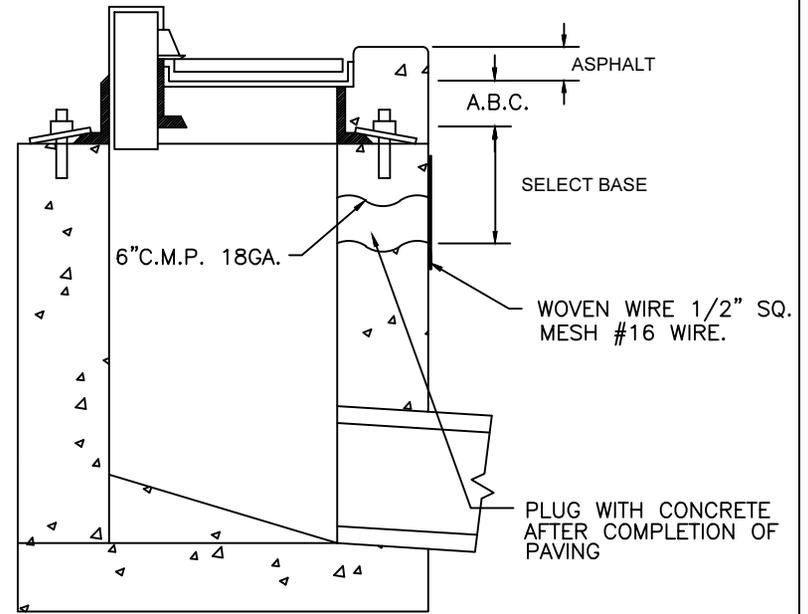
*Kenny Whelan*  
CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1574



CURB OPENING INLET



GRATE OPENING INLET

NOTES:

1. CONSTRUCTION DRAINS TO BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS.
2. SEE PROJECT PLANS FOR INLET DETAILS AND DEPTH OF PAVING.

DETAIL NO.  
P1575



**City of Phoenix**  
**STANDARD DETAIL**

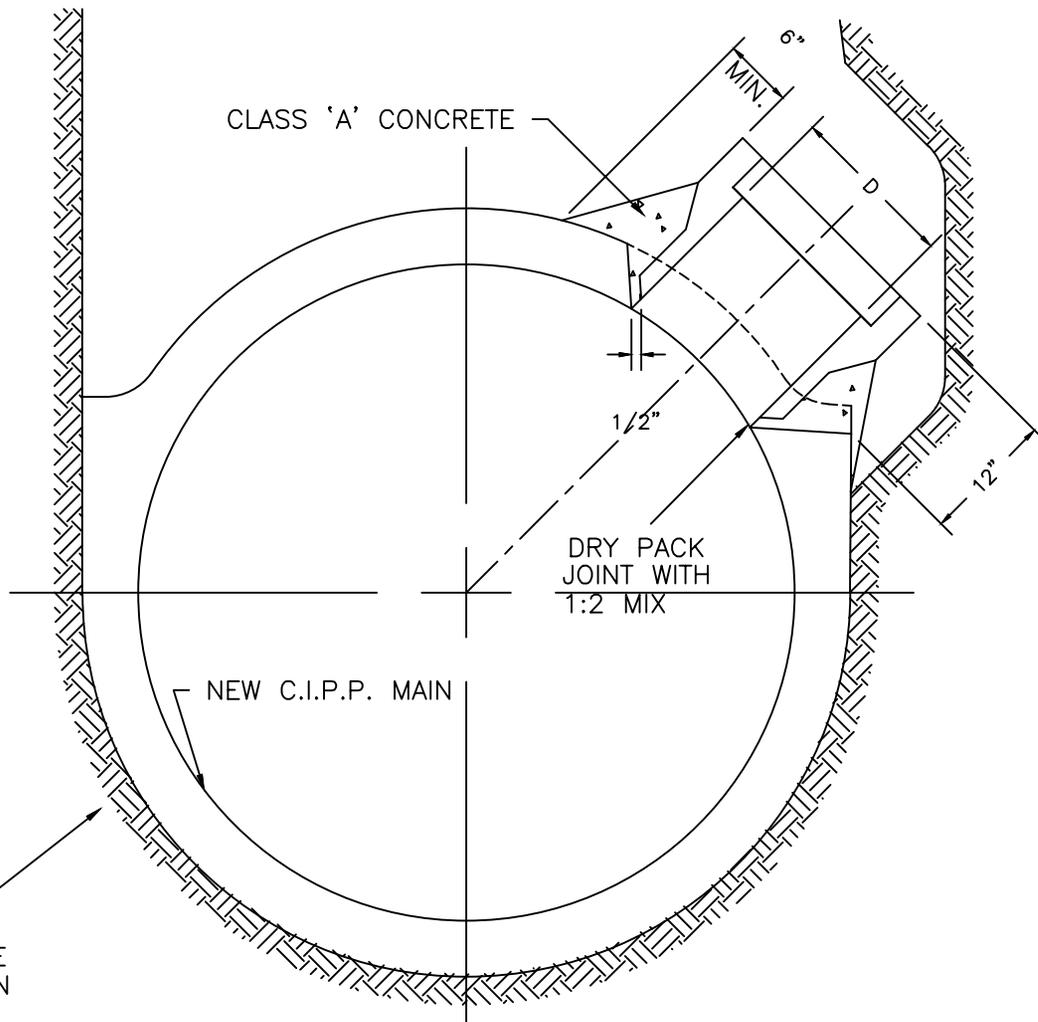
CONSTRUCTION SUB-GRADE DRAIN

APPROVED

*Kenny Whelan*  
FOR CITY ENGINEER

7/9/92  
DATE

DETAIL NO.  
P1575



NOTES:

1. "D" SHALL BE 24" OR LESS.
2. PRECAST TEE SHALL BE INSTALLED WHERE THE MAINLINE PIPE IS SMALLER THAN THE MINIMUM OR THE CONNECTING PIPE IS LARGER THAN 24".
3. THE BELL END OF THE PRECAST CONCRETE PIPE SHALL BE INSTALLED AS SHOWN WHILE CONCRETE OF MAINLINE PIPE IS WET.
4. TRENCH WALL TO BE EXCAVATED AS NECESSARY PRIOR TO POURING MAINLINE PIPE TO ACCOMMODATE LATERAL STUB.
5. AXIS OF LATERAL STUB SHALL BE AS PER PLAN AND CROSS-SECTION.
6. THE LATERAL STUB SHALL SATISFY STRENGTH REQUIREMENTS AS SPECIFIED FOR THE LATERAL PIPE.
7. LATERALS FOR FUTURE CONNECTION SHALL BE MARKED. (SEE MAG DETAIL 427)

CONNECTING PIPE SIZE	MINIMUM SIZE MAIN
15"	24"
18"	36"
21"	42"
24"	48"

DETAIL NO.  
P1576



**City of Phoenix**  
**STANDARD DETAIL**

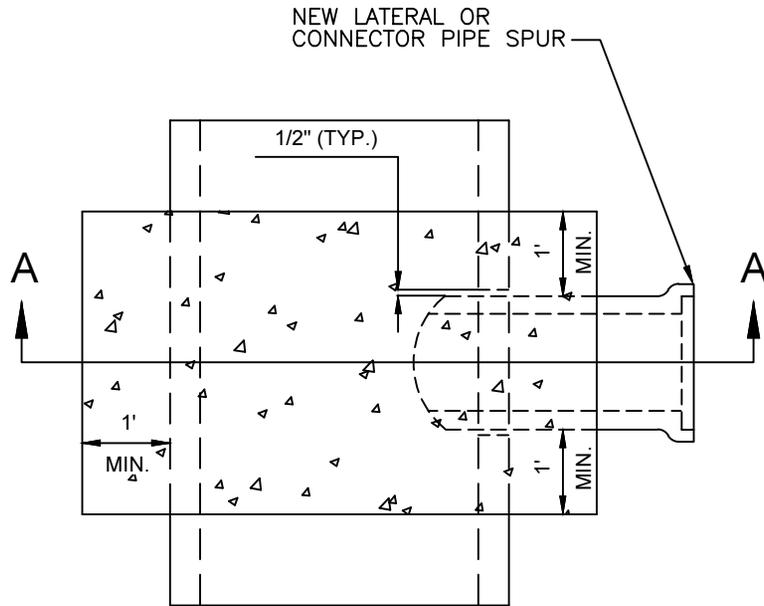
CAST-IN-PLACE PIPE  
LATERAL PIPE CONNECTION

APPROVED

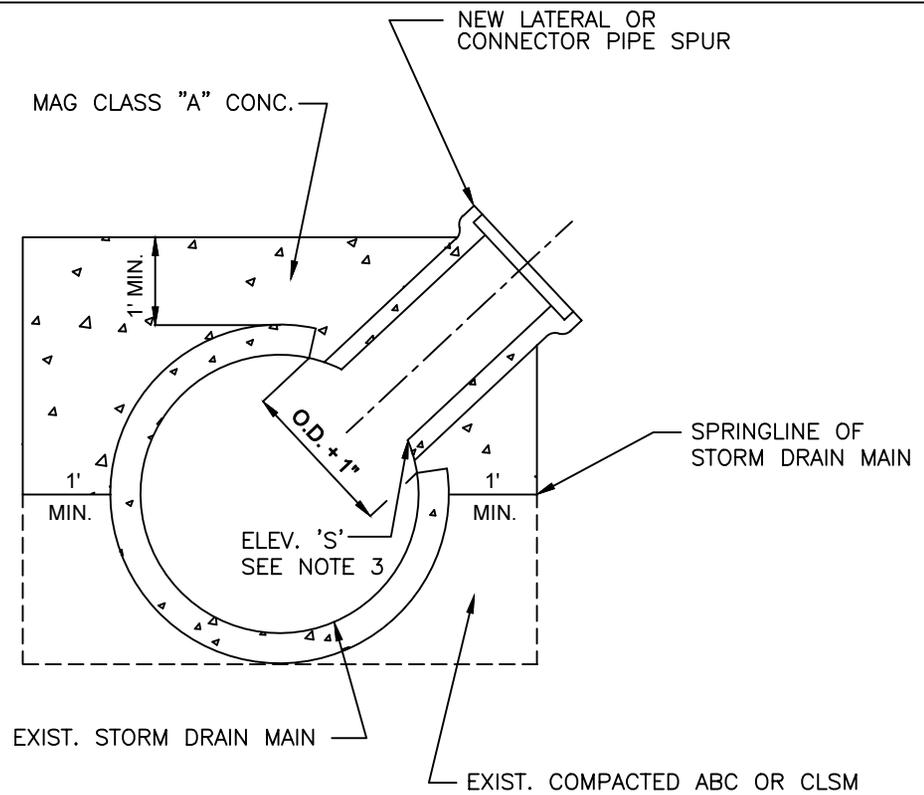
*Allen D. Connell*  
FOR CITY ENGINEER

8/6/99  
DATE

DETAIL NO.  
P1576



PLAN VIEW



SECTION A-A

NOTES:

1. THIS DETAIL SHALL BE USED FOR CONNECTING NEW SMALL STORM DRAIN LATERALS OR CATCH BASIN CONNECTOR PIPES TO EXISTING STORM DRAIN MAINS.
2. THIS DETAIL SHALL ONLY BE USED WHEN OUTSIDE DIAMETER OF NEW LATERAL OR CONNECTOR PIPE SPUR IS LESS THAN OR EQUAL TO 1/2 THE INSIDE DIAMETER OF THE EXISTING STORM DRAIN MAIN.
3. THE CONNECTOR PIPE SPUR LINE SHALL BE CONSTRUCTED RADIAL TO THE MAIN, UNLESS OTHERWISE SHOWN BY ELEVATION 'S' AS SHOWN ON PLANS.
4. THE LENGTH OF THE SPUR STUB SHALL BE A MINIMUM OF 18" TO ALLOW FULL, CLEAN PIPE CONNECTION TO THE SPUR JOINT.
5. CONCRETE SHALL BE MAG CLASS "A".

DETAIL NO.  
P1577



**City of Phoenix**  
**STANDARD DETAIL**

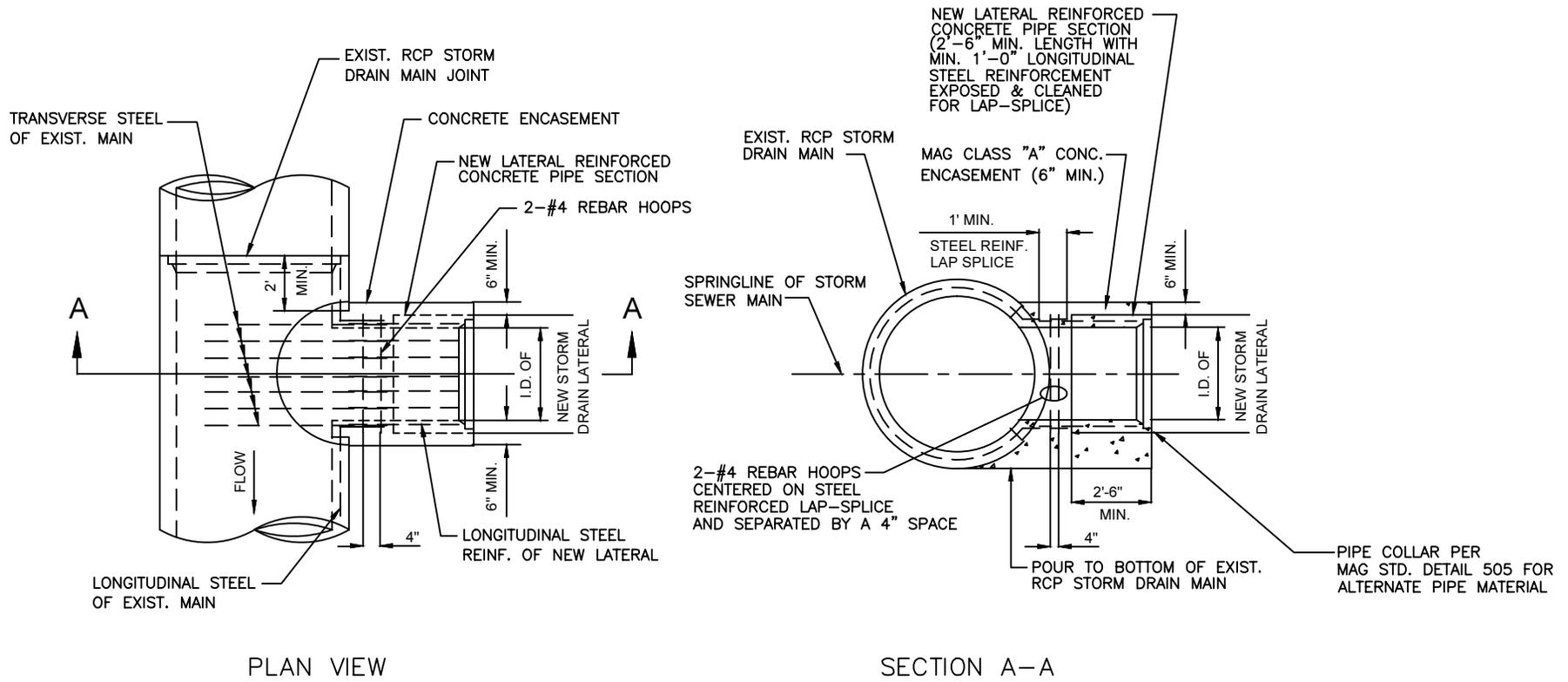
SMALL STORM DRAIN LATERAL OR CATCH BASIN  
CONNECTOR PIPE CONNECTION TO EXISTING STORM DRAIN MAIN

APPROVED

*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

DETAIL NO.  
P1577



PLAN VIEW

SECTION A-A

**NOTES:**

1. THIS DETAIL SHALL BE USED FOR CONNECTING NEW LARGE STORM DRAIN LATERALS OR CATCH BASIN CONNECTOR PIPES TO EXISTING RCP STORM DRAIN MAINS.
2. THIS DETAIL SHALL ONLY BE USED WHEN OUTSIDE DIAMETER OF NEW STORM DRAIN LATERAL OR CONNECTOR PIPE IS GREATER THAN 1/2, BUT LESS THAN THE FULL INSIDE DIAMETER OF THE EXISTING STORM DRAIN MAIN, AND NO OTHER TYPE CONNECTION (SUCH AS A MANHOLE OR SPECIAL JUNCTION STRUCTURE) IS FEASIBLE OR DESIRABLE.
3. THE EXISTING STORM DRAIN MAIN SHALL BE EXPOSED AT THE PROPOSED LOCATION OF NEW CONNECTION. IF NECESSARY, THE LOCATION MAY BE MOVED DOWN STREAM SUCH THAT THE OUTSIDE OF THE NEW OPENING WILL BE A MINIMUM OF 2' FROM THE NEAREST JOINT IN THE EXISTING PIPE MAIN.
4. A CIRCULAR OPENING IN THE EXISTING MAINLINE RCP PIPE SHALL BE CUT TO MATCH THE INSIDE DIAMETER OF THE NEW LATERAL, NORMAL TO THE PIPE SURFACE, WITHOUT DAMAGING STEEL. THE EXPOSED STEEL IN THE CIRCULAR OPENING OF THE EXISTING MAIN SHALL BE CUT TO PROVIDE RELATIVELY EQUAL-LENGTH REINFORCING STUBS AND BENT TO A HORIZONTAL POSITION IN PREPARATION FOR CONNECTION.
5. THE LONGITUDINAL STEEL ON THE END OF THE NEW STORM DRAIN LATERAL STUB SHALL BE PREPARED TO EXPOSE A MINIMUM 1'-0" OF CLEAN STEEL REINFORCEMENT FOR LAP-SPLICING AROUND THE PERIPHERY OF THE NEW STUB. THE EXPOSED STEEL OF THE EXISTING MAIN AND THE NEW STUB SHALL BE LAP-SPLICED A MINIMUM OF 1'-0" AND REINFORCE-TIED WITH 2-#4 REBAR HOOPS.
6. THE NEW STUB AND JOINT SHALL THEN BE ENCASED WITH A MINIMUM OF 6" OF MAG CLASS 'A' CONCRETE. THE ENCASEMENT SHALL EXTEND THE ENTIRE LENGTH OF THE STUB (MIN. 2'-6"). THE SPLICE-JOINT AREA BETWEEN THE PIPES SHALL BE NEATLY FORMED INSIDE TO CREATE A CLEAN, FORMED JOINT.

DETAIL NO.  
P1578



**City of Phoenix**  
**STANDARD DETAIL**

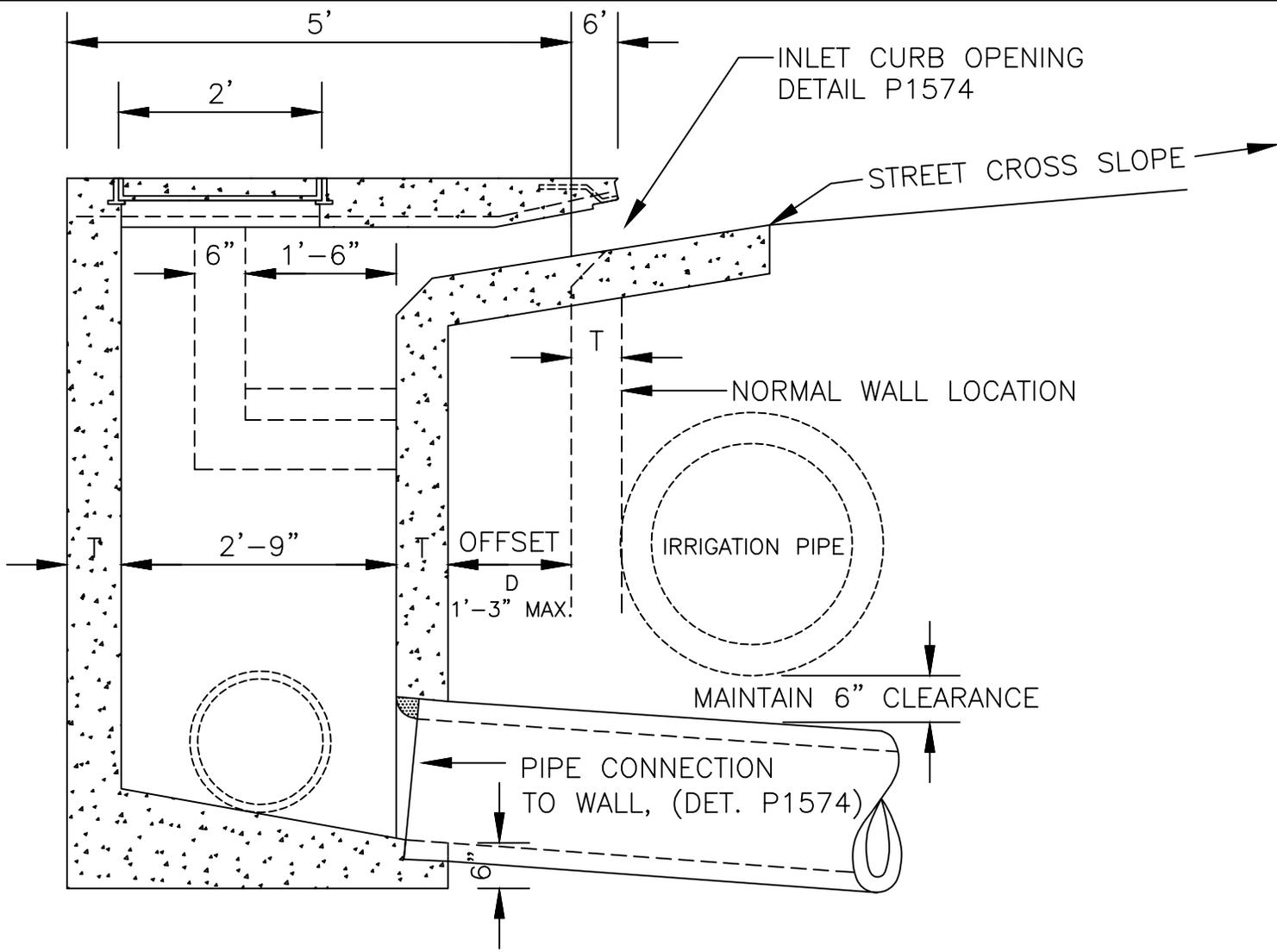
LARGE STORM DRAIN LATERAL OR CATCH BASIN  
CONNECTOR PIPE TO EXISTING RCP STORM DRAIN MAIN

APPROVED

*[Signature]*  
CITY ENGINEER

07/01/2015  
DATE

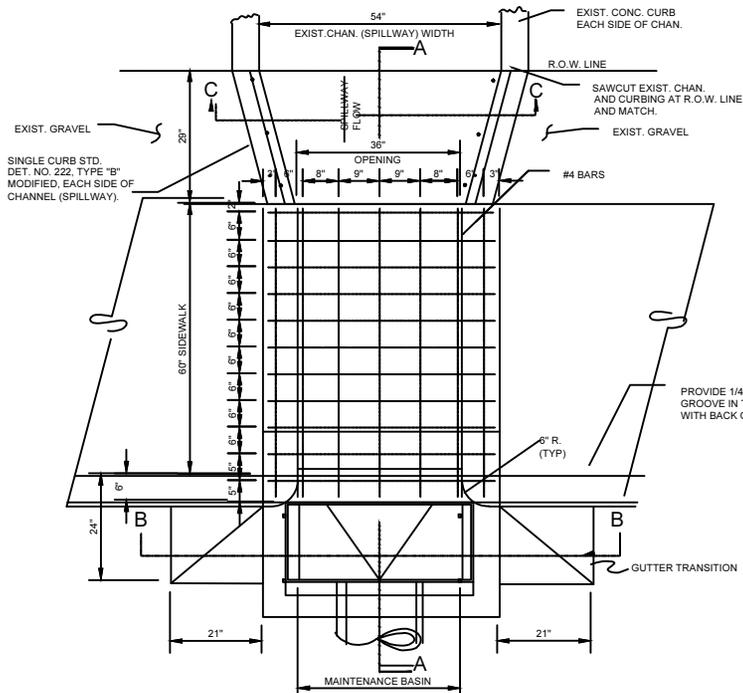
DETAIL NO.  
P1578



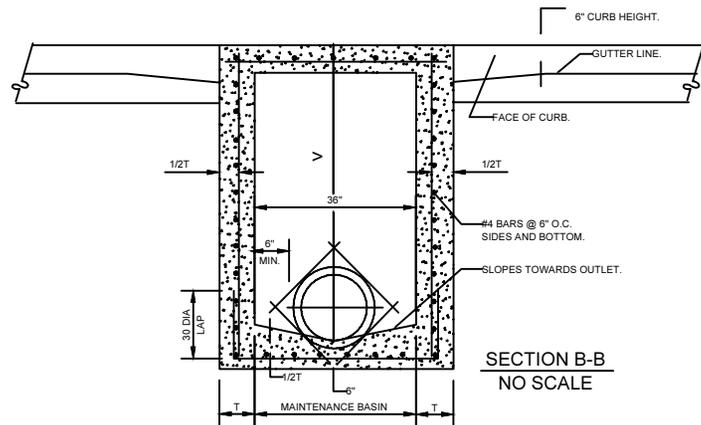
SECTION A-A

FOR ADDITIONAL INFORMATION & NOTES  
 SEE CITY OF PHOENIX DETAIL P1569-1.

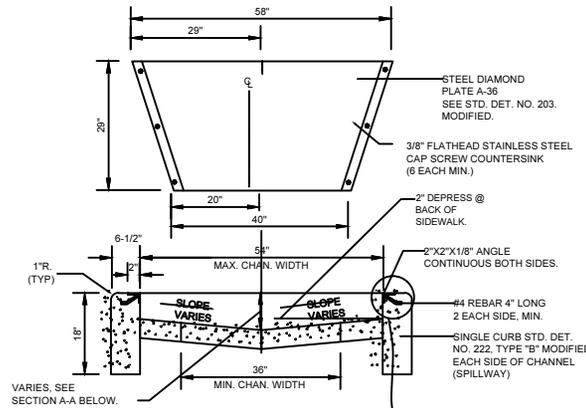
DETAIL NO. P1581	 <b>City of Phoenix</b> <b>STANDARD DETAIL</b>	CATCH BASIN - TYPE "M" MODIFIED (OFFSET OPENING)	APPROVED  CITY ENGINEER	7/3/00 DATE DETAIL NO. P1581
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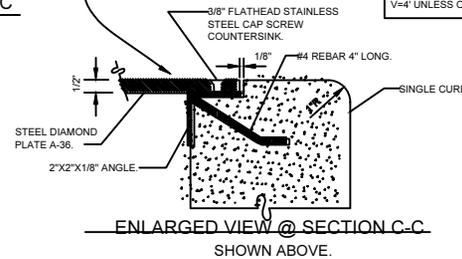
PLAN VIEW  
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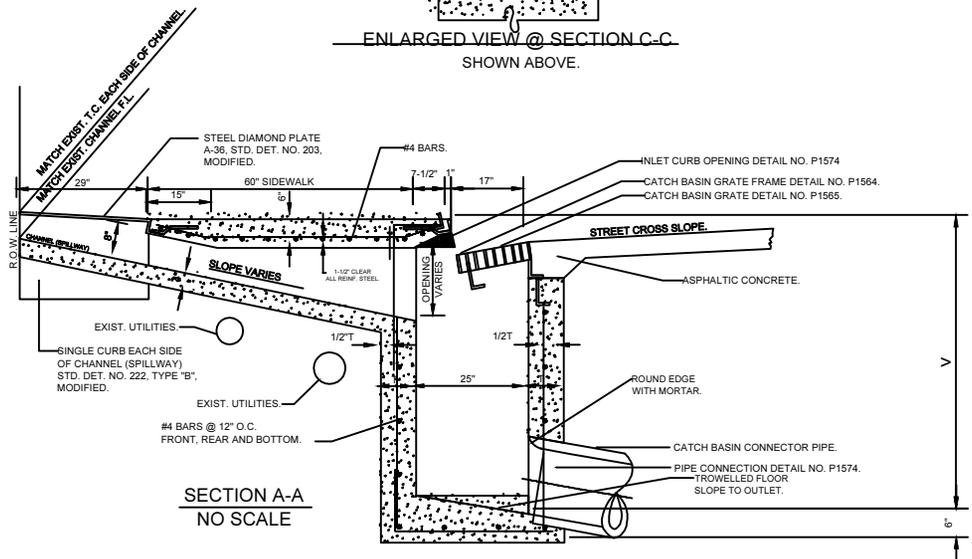
SECTION B-B  
NO SCALE



SECTION C-C  
NO SCALE



ENLARGED VIEW @ SECTION C-C  
SHOWN ABOVE.



SECTION A-A  
NO SCALE

**GENERAL NOTES:**

1. ALL CONCRETE SHALL BE CLASS "A".
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION NO. 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. THE FRAME SHALL BE DETAIL P1564, TYPE 2 AND THE GRATE SHALL BE DETAIL P1565, TYPE 2.
7. TYPE IS DESIGNATED AS FOLLOWS: COMBINATION TYPE "L-R" MODIFIED.
8. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS & DEPTH
T=5" IF V 4' ≤
T=8" IF V 4' > 8'
V=4' UNLESS OTHERWISE SPECIFIED.

DETAIL NO.  
P1583



**City of Phoenix**  
**STANDARD DETAIL**

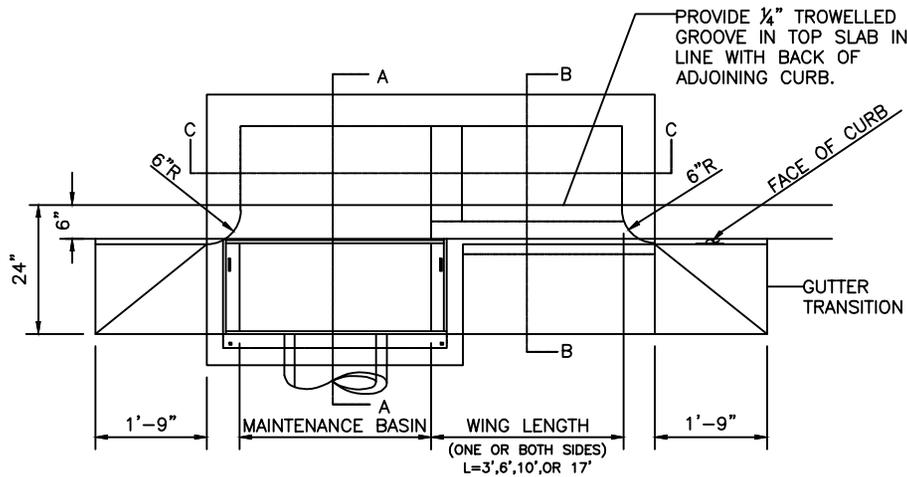
CATCH BASIN – TYPE "L-R" MODIFIED  
(WITH REAR INLET)

APPROVED

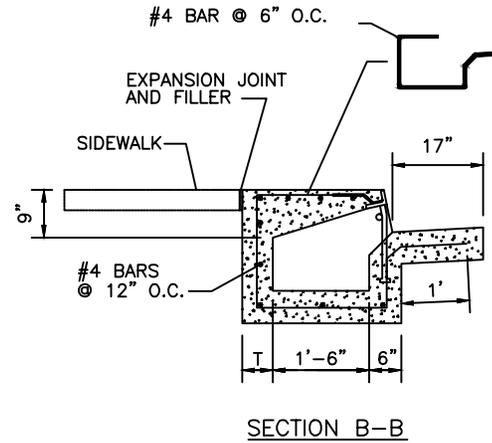
*[Signature]*  
CITY ENGINEER

12/10/2012  
DATE

DETAIL NO.  
P1583

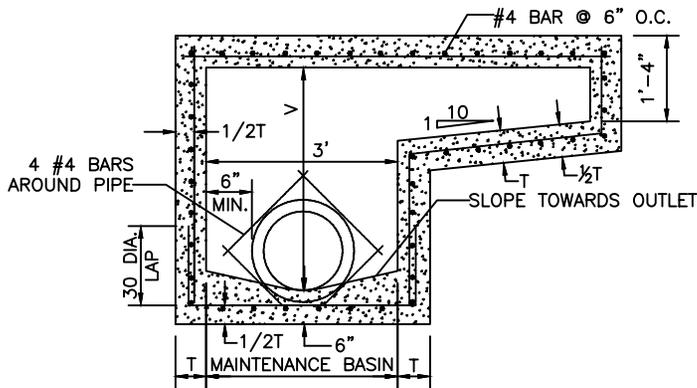


PLAN VIEW

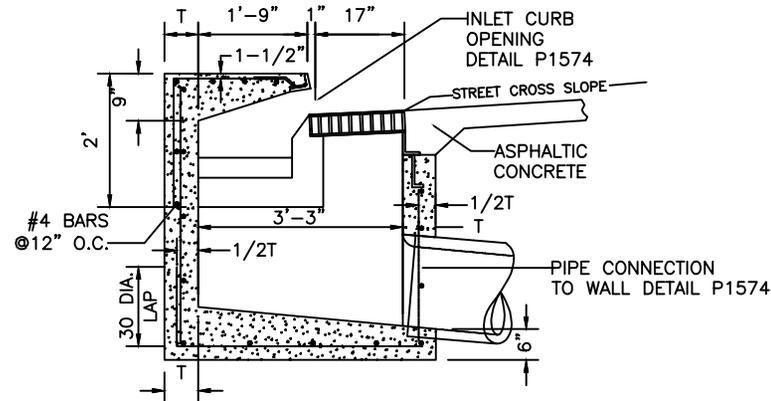


SECTION B-B

1. ALL CONCRETE SHALL BE CLASS "A".
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION NO. 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
4. FLOOR BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS (SEE DETAIL P1575).
6. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
7. THE FRAME SHALL BE DETAIL P1564, TYPE 2 AND THE GRATE SHALL BE DETAIL P1565, TYPE 2.
8. TYPES ARE DESIGNATED AS FOLLOWS:  
 "R" MODIFIED -- NO WING;  
 "R-1" MODIFIED -- ONE WING;  
 "R-2" MODIFIED -- TWO WINGS.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.



SECTION C-C



SECTION A-A

CATCH BASIN WALL THICKNESS & DEPTH
T=6" IF V=8' OR LESS.
T=8" IF V=8'-1" TO 16'.
V=4'-0" UNLESS OTHERWISE SPECIFIED.

DETAIL NO.  
P1584



**City of Phoenix**  
**STANDARD DETAIL**

CATCH BASIN - TYPE "R" MODIFIED  
(WITH WING AND OFFSET OPENING)

APPROVED

*[Signature]*  
CITY ENGINEER

12/10/2012  
DATE

DETAIL NO.  
P1584