



October 15, 2018

RE: Street, Storm Drain, and Sanitary Sewer Specifications and Standards
Addendum #1

Dear Sir or Madam:

The City of Columbia's revised Street, Storm Drain, and Sanitary Sewer Specifications and Standards was adopted in October of 2016. Addendum #1 to the specifications is effective as of October 1 of this year. In this addendum, Sections 201, Section 500, and many of the standard details have been revised to align with current practices. A summary of the revisions and the revised specifications and details are posted on the City's website:

www.como.gov/publicworks/specs-and-standards

Feel free to contact Allison Anderson, of my staff, if you have any questions. Her number is (573) 874-2489 and her email is allison.anderson@como.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "David Nichols".

David Nichols, P.E.
Director



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573.874.7266 fax



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Our vision: Columbia is the best place for everyone to live, work, learn and play.



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October 2018

Street, Storm Drain, and Sanitary Sewer Specifications and Standards

 city of Columbia <i>Public Works</i>		
City of Columbia, MO 701 E Broadway P.O. Box 6015 Columbia, MO 65205 (573) 874-2489	David Allen Nichols Registered Professional Engineer E-24212	
Approved By: 		10-16-18
Public Works Director		Date

 city of Columbia <i>Sewer & Stormwater Utilities</i>		
City of Columbia, MO 701 E Broadway P.O. Box 6015 Columbia, MO 65205 (573) 441-5530	David Alan Sorrell Registered Professional Engineer PE-2009001129	
Approved By: 		10-16-18
Assistant Director of Utilities		Date

Street, Storm Drain, and Sanitary Sewer Specifications and Standards

Revisions

Section 201: Excavation and Embankment for Street and Storm Sewers

- 201.12.b.1. Materials and Unsuitable Foundation Bedding revised.
- 201.12.b.1. Rock Backfill gradation and requirements inserted.
- 201.12.b.6. Deleted

Section 500: Excavation and Trenching for Sanitary Sewers

- 500.12.g. Artificial Foundations in Trenches revised.
- 500.13.a. Bedding material revised.
- 500.14 Trench backfill revised.
- 500.14.a.3. Lawn area backfill revised.
- 500.14.b. Deleted

Standard Details:

- Table of Contents: Temporary Turn Around details added.
- 120.01: Backfill material revised, note 4 added.
- 140.01A: Ornamental Fence Detail revised.
- 140.01B: General Notes 1 & 2 revised.
- 160.01: Temporary Turn Around within Plat Boundary detail added.
- 160.02: Temporary Turn Around outside Plat Boundary detail added.
- 410.01: Driveway Locations table revised.
- 410.02A: Maximum driveway width revised.
- 410.02B: Maximum driveway width revised.
- 420.02: Sidewalk minimum width revised.
- 500.04: Weep hole location note added.
- 505.01C: Weep hole placement note added, filter fabric added.
- 540.01: Bedding and backfill material revised.
- 540.02: Backfill material revised.
- 541.01: Bedding and backfill material revised.
- 4: Dimensions added.
- 5: Dimensions added.
- 7: Bedding material revised.
- 8: Note 4 revised.
- 15. Backfill material revised.
- 16: Bedding material revised.

SECTION 201

EXCAVATION AND EMBANKMENT FOR STREET AND STORM SEWERS

201.1. Description. Excavation shall consist of removing all materials necessary for the proper construction of the work and disposing of this material in a satisfactory manner as approved or directed by the Engineer. Embankment shall be formed of suitable material taken from roadway and drainage excavation, borrow excavation and excavation for structures, and placed in successive horizontal layers distributed uniformly over the full width of the cross section. Embankment shall be made of sufficient height and width so that at the time of acceptance by the City, they will conform to the typical section shown on the plans.

201.2. Classification of Excavated Materials. In these specifications, excavating is divided into two classifications, earth and rock, which shall cover all materials encountered. The determination and classification of such excavated materials will be based on the following definitions:

- a. Earth excavation will include all materials not otherwise classified. Decomposed or disintegrated shale which, in the opinion of the Engineer can be effectively plowed, spaded, or removed with power driven excavating equipment, as well as blacktop pavement and gravel base, will be classified as earth.
- b. Rock excavation is defined as being sandstone, limestone, flint, granite, quartzite, or similar material, in masses measuring more than one (1) cubic yard in volume or in ledges four (4) inches or more in thickness, and which requires blasting or jack hammering for its practical and effective removal. Should rock be encountered in two (2) or more ledges, each ledge being not less than three (3) inches thick and with inter-lying strata or earth not over twelve (12) inches thick in each stratum, the entire volume from the top of the top ledge to the bottom of the bottom ledge of rock will be classified as rock.

201.3. General. After all stripping has been done, excavation of every description and of whatever substances encountered within the clearing limits of the project shall be performed to the lines and grades indicated on the drawings. All suitable excavated material shall be transported to and placed in fill areas within the limits of the work as specified and shown on the drawings. All excavated materials which are considered unsuitable by the Engineer and any surplus of excavated material which is not required for fill will be known as "waste" and shall be disposed of by the Contractor at his own expense and responsibility and to the satisfaction of the Engineer. Any additional fill material required which is not available from excavation within the project area shall be supplied by the Contractor. All such material brought to the site by the Contractor shall be subject to the approval of the Engineer. During construction, excavation and fill shall be performed in a manner and sequence that will provide positive drainage at all times.

- a. Unsuitable Material is defined as muck, frozen material, organic material, top soil, rubbish, and rock with a maximum dimension greater than 24 inches.
- b. Suitable Material. Suitable material is defined as entirely imperishable with that portion passing the No. 40 sieve having a liquid limit not exceeding 40 and a plastic

index not exceeding 25, when tested in accordance with ASTM D-423 and D-424, respectively.

1. Rock Embankment. Material for rock embankment shall be free of unsuitable material and shall contain, by volume, greater than 10 percent rock or gravel having a maximum dimension greater than 3 inches but not greater than 24 inches.

2. Earth Embankment. Material for earth embankment shall be free of unsuitable material and shall, contain by volume, less than 10 percent rock or gravel having a maximum dimension greater than 3 inches.

201.4. Excavation for Structures. All structures shall be founded on undisturbed subsoil. Unauthorized excavation below the specified structure subgrade shall be replaced with concrete, at the expense of the Contractor.

Excavation shall be made in open cut to alignment and depth as shown on the profiles and drawings, except as otherwise indicated in the specifications and drawings. The Contractor shall make all necessary excavations for work included in this Contract.

Excavation for manholes, curb inlets, junction boxes and similar structures shall be sufficient to leave at least twelve (12) inches in the clear between their outer surfaces and the embankment or timber which may be used to hold and protect the excavation. In all cases the clearance between the outer face of structures and the surrounding excavation shall be sufficient to allow the proper performance of the work including the plastering of exterior wall surfaces where required by the specifications or plans.

The Contractor shall not open more trench in advance of construction than necessary to expedite the work, and in no case shall the length of open trench be greater than 300 feet. The trench shall be backfilled at the end of each day except as may be required to begin the next day's work. In no case shall more than ten (10) feet of pipe be left exposed. Trenches in the road shall be plated with steel sheets or patched with cold patch overnight. Plates shall be properly anchored and all edges of the plate shall be ramped with asphalt surface mix to prevent rattling.

Wherever necessary to prevent caving, the excavation shall be adequately sheeted, braced and drained so that workmen may work therein safely and efficiently. An engineered plan shall be submitted to Public Works for any sheeting, cribbing or bracing. Where trench bottom is in rock, the excavation limits shall allow solid rock to be exposed and cleaned of all loose material and cut to a firm surface before any foundation concrete is placed.

Whenever wet or otherwise unstable soil that is incapable of properly supporting the structures, as determined by the Engineer, is encountered such soil shall be removed to the depth required and the excavation backfilled to the proper grade with coarse sand, fine gravel, or other suitable material as may be authorized. All excavations for structures shall be kept dry and no pipe or reinforcing steel shall be installed in water and no water shall be permitted to inundate the reinforcing steel before concrete has been placed. All excavations shall be kept dewatered to the extent that water will not come in contact with any concrete within twelve (12) hours after

placing. When excavations are carried below ground water elevations such excavations shall be dewatered by lowering and maintaining the ground water level at least twelve (12) inches below such excavations during all construction, including subgrade excavation, placing of reinforcing steel or pipe, placing of concrete, plastering of masonry, and shall be maintained in a dry condition until all concrete has been placed and allowed to harden for at least twelve (12) hours as specified above.

201.5. Excavation for Roadway. Grading shall conform to the typical sections shown on the drawings and shall be finished within a tolerance of one-half (1/2) inch of the grades indicated. Any soft and unsatisfactory material within the limits of the pavement areas shall be removed and disposed of as directed by the Engineer, and the basis of payment shall be the same as for excavation. Fill material required in excess of that produced by normal grading operations shall be excavated from areas indicated on the drawing or as directed by the Engineer. Excavated material not acceptable for use as fill shall be disposed of by the Contractor at his own expense as directed by the Engineer.

Cut compaction shall be performed at proposed roadway pavement after removal of the roadway excavation material to the required section. A surface parallel to the pavement slope, 12 inches below the bottom of the pavement or lowest base course, shall be temporarily exposed for the full width below roadway inslopes. The exposed material shall be manipulated and compacted to no less than the required density to a depth of 6 inches. The material above this compacted plane shall be spread in layers not exceeding 8-inch loose thickness, each layer being wetted or dried as necessary and compacted to the specified density. The entire volume of material so handled and compacted, including the 6-inch layer compacted in place, will be considered as Cut Compaction. All cut compaction shall be tested per 201.11.b.

Cut compaction shall be performed an additional depth of 12 inches for 50 feet on each side of the intersection of the natural ground and the top of the subgrade, then uniformly graded for 30 feet to meet the depth requirements above.

The existing ground for the full width between roadway slopes under embankments less than 18 inches high shall have cut compaction to a depth to ensure that 18 inches of material of the required density and moisture is below the top of the finished grade.

201.6. Excavation for Storm Sewers.

a. General. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and disposed of off the site, by and at the expense of the Contractor. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and to maintain the flow of water in natural water courses on or adjacent to the site. Any water accumulating in trenches or other excavations, shall be removed by pumping or by other approved methods. Unless otherwise indicated or authorized, excavation shall be by open cut. The use of excavation machinery will be permitted except in places where operation of same will cause damage

to trees, buildings, or existing structures above or below ground, in which case hand methods shall be employed.

b. Trench Bracing and Sheeting. If trench box construction is used, the trench box shall not extend below the top of the pipe. An engineered plan shall be submitted to Public Works for any sheeting, cribbing or bracing. The plan must be approved by the Engineer prior to beginning work.

c. Dewatering of Trenches. During excavation, pipe laying and jointing, or other work necessary for the installation of the storm sewers, trenches shall be kept free from water and in a workable condition. Where the trench bottom is found to be unstable or unsatisfactory because of water, and in all cases where the trench bottom falls below the ground water level by means of well points, pumps or by other means acceptable to the Engineer a sufficient amount to keep the trench free from water and the trench bottom stable at any time that work within the trench is in progress. As specified herein before the Contractor shall take all necessary measures to prevent surface water from entering the trench and he shall further take all necessary measures to prevent the inundation or damage to any private property or structures adjacent to the site of the work.

d. Trench Alignment and Grade. The alignment, depth, and grade of all storm sewer trenches shall be maintained as shown on the drawing. Establish required uniform line and grade in trench from benchmarks identified by the Engineer. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work.

e. Trench Width. Width shall be no wider than is necessary for the proper jointing of the pipe and in no case shall exceed the trench widths in the corresponding bedding details, unless specifically authorized by the Engineer.

f. Unauthorized Trench Widths. Where trench widths as specified above, are exceeded for any reason other than by order of the Engineer, either special pipe embedment, concrete cradle, concrete encasement, or other suitable methods shall be required as demanded by loading conditions and as ordered by the Engineer. Any additional work required, as stipulated above, as a result of unauthorized over excavation shall be performed by and at the expense of the Contractor.

g. Preparation of Pipe Subgrade. Pipe subgrade shall be prepared after rough trenching is complete and shall be done with hand tools immediately prior to installing pipe. The bottom of the trench shall be prepared so as to provide uniform support of the bottom quadrant of the pipe and bell holes or depression shall be hand excavated where bell and spigot pipe is used. The trench bottom shall be evenly graded as indicated on the plans and areas which are too high shall be shaved as required. Any portions of the trench bottom which are found to be too low shall be filled with suitable material, thoroughly rammed and tamped and brought to true grade.

h. Replacement of Unsuitable Pipe Foundation Material. Where, in the opinion of the Engineer, the trench bottom is found to be of a wet or otherwise unstable material or where it is impossible to provide proper bearing for the pipe, or where it is found to be

impossible to carry on construction operation due to the condition of the trench bottom, the Contractor shall remove all unstable or unsuitable material to a depth of not less than four (4) inches below the elevation of the pipe subgrade over the entire width of the trench and shall replace and backfill with a suitable finely divided material of acceptable quality and sufficiently damp for proper compaction. Such material shall be thoroughly compacted by tamping or rolling over the entire width of the trench and shall be brought to proper grade and shape and the proper elevation for the installation of the pipe as shown on the plans.

201.7. Blasting. Contractor is responsible to comply with all regulations and permitting for blasting.

All excavated rock or shale which cannot be handled and compacted as earth shall be kept separate from earth and shall not be mixed with other backfill except as specified and directed.

201.8. Excavation through Pavement. Pavement, pavement base course, concrete walks, and concrete curbing shall be cut and removed only where shown on the plans, where specified or where directed and authorized by the Engineer. Cuts shall be no larger than necessary to provide adequate working space for installation of the pipe appurtenance or structure, except where other miscellaneous removals are required on the drawings. Payment for removal of concrete pavement, sidewalk, floor slabs, and curbing shall be made according to the unit prices shown in the bid form. Measurement of quantities so removed shall be as specified hereinafter in the applicable sections.

All cuts in pavement, walks or curbing shall be neatly sawn and shall be straight and parallel to existing construction joints. Any pavement, curbing, gutter or sidewalks, the removal of which was not required in conjunction with construction under this Contract, which is damaged due to construction operations by the Contractor shall be removed and replaced by the Contractor in first class manner, as hereinafter specified, at his own expense.

201.9. Protection of Existing Utilities. Due care must be taken not to disturb inlet covers, manhole frames, valve boxes, fire plugs, house connections or private water pipes. If not set to the proper grade they will be adjusted by the various City Departments or public utility corporations or private Owners, unless otherwise directed by the Engineer.

The Contractor will be held responsible for any damage done to house connections or private water pipes and accessories, if two (2) feet or more below top of curb and one (1) foot or more back of face line of curb, in the case of street construction, or if two (2) feet or more below the grade of finished pavement in connection with alley construction.

201.10. Pavement Replacement. All pavement, curbing, gutter, or sidewalks removed during construction of the project for any reason shall be replaced unless otherwise shown on the drawings or directed by the Engineer, the replacement construction conforming in type, quality, and dimensions to that of the portion so removed. Replacement shall conform to City patching details where applicable.

201.11. Embankment.

a. Preparation of Ground Surface for Fill. All vegetation, such as roots, brush, heavy sod, heavy growth or grass, and all decayed vegetable matter, rubbish, and other unsuitable material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. In no case will such objectionable material be allowed to remain in or under the fill area. Sloped ground surfaces steeper than one (1) vertical to four (4) horizontal on which fill is to be placed, shall be plowed, stepped (benched), or broken up in such manner that the fill material will bond with the existing surface.

b. General. Where filling is required to raise the subgrade under areas to be paved or surfaced, all fill materials shall consist of earth or other approved material. All organic or other undesirable material shall be removed. Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inch rises as the new fill is brought up in 8 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density. Material cut out, bladed into place and compacted shall not be measured and paid for directly but will be considered as incidental work.

All fill under paved surfaces such as streets and parking lots shall be compacted by a power roller or other approved equipment and the subgrade brought to a reasonably true and even plane. Earth used for fill shall be placed in layers not more than eight (8) inches thick, an uncompacted measurement, and shall be compacted as specified before the next layer is placed. Each layer shall be wetted or dried as necessary, and shall be compacted to the required density. Regardless of the type of equipment used, the roadway shall be compacted uniformly and the surface kept reasonably smooth at all times. If large pieces of heavy clay are encountered, the material shall be broken down by suitable manipulation to permit satisfactory embankment construction. If shale is encountered, the shale shall be broken down as much as practical and compacted at or above optimum moisture.

Each layer shall be uniformly spread, moistened as required, and then compacted to ninety percent (90%) of maximum density, obtained at the optimum moisture content, as determined by AASHTO Method T-99-38. The top eighteen (18) inches shall be compacted to ninety-five percent (95%) of maximum density. The field density of the lift will be determined in accordance with AASHTO T 191 or T 205, using the total material or T238, Method B Direct Transmission, for wet density. If nuclear density methods are used, moisture content will be determined in accordance with AASHTO T239. One test shall be taken for every 1,000 linear feet or fraction thereof for each lift. Testing is to be done by a third party independent testing agency or by the Contractor if the Contractor has demonstrated to the Engineer that Contractor employs qualified persons and maintains qualified equipment to conduct density testing. Test results shall be furnished on forms acceptable to Engineer. Contractor shall proof roll the final lift of fill material in accordance with the proof rolling requirements of Section 205.2. Costs of all testing and retesting are the responsibility of the Contractor.

201.12. Backfill.

Classification of backfill materials. Backfill materials in these specifications shall conform to the Standard Installation Direct Design (SIDD) categories per the chart below.

SIDD Soil	USCS	Standard AASHTO
Gravelly Sand (Category I)	SW, SP, GW, GP	A1, A3
Sandy Silt (Category II)	GM, SM, ML, Also GC with less than 20% passing #200 sieve	A2, A4
Silty Clay (Category III)	CL, MH, GC, SC	A5, A6

a. Roadway Backfill. After completion of roadway, curb and gutter, and other construction below the elevation of final grades, all forms shall be removed and the excavation shall be cleaned of trash and debris. Backfill shall be free of all objectionable material and shall be placed in horizontal layers not more than eight (8) inches thick, and shall have a proper moisture content for the required degree of compaction. All parking areas, driveways, streets, and other paved areas shall be backfilled with approved material and compacted to ninety-five percent (95%) of maximum density obtained at the optimum moisture content. Testing is to be done by a third party independent testing agency or by the Contractor if the Contractor has demonstrated to the Engineer that Contractor employs qualified persons and maintains qualified equipment to conduct density testing. Test results shall be furnished on forms acceptable to Engineer. Tests shall be taken once for every 1,000 linear feet or fraction thereof for each lift. Costs of all testing and retesting shall be borne by the Contractor.

Backfilling and grading behind curbs shall be performed to the lines and grades indicated on the drawings. The backfilled area shall provide a smooth, even transition from the existing lawn grades to the curb and shall be done so as to assure desired drainage.

When indicated on the plans and included as a bid item, the top four (4) inches of backfill behind curbs shall be topsoil, free from rocks, gravel, and any undesirable material. This material may be either topsoil available within the limits of the project or it may be topsoil furnished by the Contractor. Payment for topsoil will be made on the basis of the bid quantity, except when:

- Errors are found in the original computation or ground elevations.
- An authorized change in grade or typical section is made.
- An unauthorized deviation decreases the quantities on the plans.
- All driveways, paved or unpaved, which are disturbed by grading or excavation of any kind shall be graded and shaped to provide a reasonable approach, and shall upon completion of the job be left in passable condition. All driveway approaches except those which the Owner is having paved at the time of this Contract shall receive four (4) inches of crushed rock to the extent of the portion disturbed. Crushed rock shall be a

maximum size of one (1) inch surface rock.

b. Trench Backfill

1. Materials. All materials which are to be compacted by tamping or rolling, including all tamped embedment, shall be free from sticks, large roots, or other organic matter coarser than grass roots, stones, hard lumps, and clods, and shall have a moisture content such that optimum compaction is obtained when properly tamped or rolled. Debris, frozen material, large clods, stones, organic matter, or other unstable materials shall not be used for final backfill within 2' of the top of pipe.

Unsuitable Foundation Bedding. Granular material for replacement of unsuitable foundation material removed from trench bottoms shall consist of 6" gabion rock.

Flowable Backfill. Flowable backfill shall be a Controlled Low Strength Material (CLSM). CLSM shall be composed of Portland cement, fly ash (optional), fine aggregate, coarse aggregate (optional), water, and a shrinkage compensator. Cement shall be either Type I or Type II Portland cement. Mixing water shall be potable. Air entrainment admixture shall consist of an organic compound which will result in air contents as prescribed by ASTM C 173 or C 231. Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without mineral filler. Aggregate shall be free of injurious amounts of salt, alkali, vegetable matter or other objectionable material. Coarse aggregate shall be sound, durable, clean rock or broken concrete (2" to 8" square) to minimize the quantity of CLSM. The CLSM shall be placed to a depth of 2 feet then coarse aggregate may be added to the CLSM mixture until the top of the CLSM and top of aggregate are approximately equal. The process may be repeated until the fill is completed. CLSM shall be removable (less than 100 PSI) and comply with the following mix design:

Cement	144 lbs
Water	396 lbs
Sand	2,698 lbs
Air entrainment	13%

Where CLSM is being placed over or adjacent to crushed stone backfill, a layer of filter fabric shall be installed between the two materials.

Inundated sand backfill is not acceptable.

Coarse aggregate (1-1/2") may also be added at the batch mix plant. Coarse aggregate is not to replace fine aggregate.

Rock Backfill. Rock backfill shall consist of 1" Road Rock. The rock shall be brought up in 6" lifts and have the following gradation.

Sieve Size	% Passing
1"	100
3/4"	85-93
1/2"	65-75
3/8"	52-64
#4	25-45
#30	10-15
#200	5-10

Other gradations may be approved by the engineer provided the material is compactable with minimal settlement and will not provide a conduit for water to enter the subgrade surrounding the trench.

Backfill material shall be near optimal moisture content as determined by the modified proctor.

2. Compaction. All backfill shall be thoroughly compacted by pneumatic tampers, or other approved methods, to the original state of consolidation of the soil encountered. Backfill shall be placed in uncompacted lifts not to exceed six (6) inches and each lift shall be thoroughly and adequately compacted. Care shall be exercised not to disturb the pipe when placing backfill. The compacted earth backfill shall be brought to an elevation of approximately six (6) inches below the finished surface grade and then surface grade constructed. Testing shall be similar to that required at embankments per 201.11.b except that tests shall be taken once for every three hundred (300) linear feet of trench or fraction thereof for every other lift. Backfill using 1" clean aggregate does not require testing.

After backfill and compaction is complete trenches shall be leveled off and grading shall be performed as is necessary to restore yards or other grassed or sodded areas to their original condition or better.

Backfill under pavements shall be flowable fill. Flowable fill shall be placed from a maximum of one foot (1') above top of utility to the underside of pavement base course. If pavement does not have a base course, stop flowable fill six inches (6") below bottom of pavement and provide a six inch (6") cushion course of 1" clean aggregate.

3. CLSM Maximum Depth. – The depth of flowable fill shall comply with the following:

- a. If the distance from the top of the utility/pipe to the subgrade is five feet or less, the entire depth from subgrade to twelve (12) inches above the top of utility/pipe shall be flowable fill.
- b. If the distance from the top of the utility/pipe to the subgrade is over five feet, the top four feet below subgrade shall be flowable fill. The remainder of the backfill may be overfill soil compacted per the specifications or flowable fill at the contractor's option.

4. Utility Crossings. – Where a utility is located above another utility or where two utilities cross, the bedding material shall be extended to properly bed the higher utility then the overfill soil and flowable fill placed per specifications.

5. Plates. – Flowable Fill requires a minimum of 24 hours to set. This will require trenches with flowable fill to be plated or barricaded trenches with traffic detoured in accordance with MUTCD standards. Maximum trench width requiring flowable fill is six (6) feet wide. See details 540.01 and 9A for maximum trench width.

When a backfilling operation of an excavation occurs in the traveled way, whether transverse or longitudinal, and the project cannot be properly completed within a standard work day as defined by section 12A of the City of Columbia Code of Ordinances, steel plate bridging with a non-skid surface and shoring will be required to preserve unobstructed traffic flow. In such cases, the following conditions shall apply:

- a. Steel plates used for bridging must extend a minimum of 12” beyond the edges of the trench.
- b. Steel plate bridging shall be installed to operate with minimum noise.
- c. The trench shall be adequately shored, as mentioned in Section 201, to support the bridging and traffic loads.
- d. Temporary paving with fine graded asphalt concrete shall be used to feather the edges of the plates, if plate installation is used.
- e. Bridging shall be secured against displacement by using adjustable cleats, shims, or other devices.

Approach plate(s) and ending plate (if longitudinal placement) shall be attached to the roadway by a minimum of 2 dowels pre-drilled into the corners of the plate and drilled 2” into the pavement. Subsequent plates shall be butted to each other. Fine graded asphalt concrete shall be compacted to form ramps, maximum slope 8.5% with a minimum 12” taper to cover all edges of the steel plates. When steel plates are removed, the dowel holes in the pavement shall be backfilled with either graded fines of asphalt concrete mix, concrete slurry or equivalent slurry that is satisfactory to the City of Columbia.

The contractor is responsible for maintenance of the steel plates, shoring, asphalt concrete ramps, and ensuring that they meet minimum specifications. Unless specifically noted in the special provisions, or approved by the City of Columbia, use of steel plate bridging should not exceed 4 consecutive working days in any given week. Backfilled excavations shall be covered with a minimum 3 inches temporary layer of cold asphalt concrete until permanent surface can be installed.

Trench Width	Minimum Plate Thickness
1'	1/2"
2'	3/4"
3'	7/8"
4'	1"
5'	1.25"
6'	1.25"

6. Removed.

7. Trenches wider than 6 feet. – When excavation becomes wider than six (6) feet adhere to the following:

a. Residential Streets

1. Concrete

- Minimum of two entire concrete panels are to be removed.
- May close street (except in cul-de-sacs) or provide MUTCD compliant traffic control.
- Excavate all subgrade within one (1) foot of existing panels to a minimum depth of eighteen (18) inches.
- Backfill to be brought up with compacted aggregate in six (6) inch lifts and tested per specifications OR flowable fill may be used.
- Four (4) inches of type 3 aggregate base is to be placed under the street.
- Dowel Panels per specifications.

2. Asphalt

- Minimum size of replacement to be ten (10) foot by ten (10) foot square.
- Two (2) foot minimum clearance to be left between edge of pavement replacement and leading edge of gutter.
- May close street (except in cul-de-sacs) or provide MUTCD compliant traffic control.
- Excavate all subgrade within one (1) foot of existing pavement to a minimum depth of eighteen (18) inches.
- Backfill to be brought up with compacted aggregate in six (6) inch lifts and tested per specifications OR flowable fill may be used.
- Four (4) inches of type 3 aggregate base is to be placed under the street
- Pave per asphalt paving specifications

Arterials and Collector Streets – Will be handled on a case by case basis with City of Columbia Public Works Department.

8. Required Testing. – Testing shall follow section 201.11b, except proof rolling shall not be required.

c. Structure Backfill. Backfilling of all structures shall be permitted only after an adequate curing time, as determined by the Engineer, has elapsed.

All excavations shall be backfilled to the lines and grades shown on the drawings.

In no instance shall backfill be dumped, bull-dozed, or otherwise deposited in bulk upon the newly-constructed structure. After the required curing time, the excavation shall be backfilled by depositing, entirely without shock and with careful pneumatic tamping, suitable earth, sand, or other acceptable material in lifts not to exceed six (6) inches in compacted thickness. Backfill shall be deposited at approximately the same elevation on opposite sides of the structure and shall be compacted in place to a density equal to or greater than ninety-five percent (95%) of maximum density as determined by the Standard AASHTO Method T-99-38. Inundated sand backfill shall not be used.

No trench backfill material containing rock, or debris from rock excavation, shall be placed in the upper eighteen (18) inches of the excavation except with the specific permission of the Engineer. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill compaction will result.

Any deficiency in the quantity of material for backfilling the excavation, or for filling depressions caused by settlement, shall be supplied by the Contractor. All excavated material in excess of that necessary to fill the trench to the grade shown on the drawings shall be removed and disposed of by the Contractor.

- d. Responsibility of Contractor for Backfill Settlement. The Contractor shall be responsible for the satisfactory compaction and maintenance thereof, for all trenches and structural excavation of any description required under this Contract. Contractor shall warrant their work for a period not less than the correction period from the date of acceptance. If prior to the expiration of this warranty, any trenches or other excavations are found to have settled they shall immediately be reworked by the Contractor and restored to the specified grades. Any sod, paving, or other surfacing damaged by settlement of trenches shall be replaced by and at the expense of the Contractor.

201.13. Method of Measurement and Basis of Payment.

a. Roadway Excavation. Final measurement of roadway excavation will not be made unless otherwise designated in the Contract. A partial check of existing ground elevations will be made at the time slope stakes are set, and of the finished work for deviations in the grade, widths or slopes from the authorized grade or typical section. Plan quantities will be used for final payment of Earth Excavation except when:

- Errors are found in the original computation or ground elevations.
- An authorized change in grade or typical section is made.
- Unauthorized deviations decrease the quantities on the plans.
- Rock Excavation is encountered. Roadway excavation will be re-computed for these sections where the ground elevations shown on the plans are found to be erroneous. No re-computation of plan quantities will be made when the actual

ground elevations are considered to generally agree with the ground line shown on the plans. Where the Engineer authorized a change in grade or typical section affecting the volume of excavation, the volume of excavation allowed for payment will be determined by the average end area method on the basis of the revised grade or typical section. Where unauthorized deviations result in a decrease in the quantities the plans, the deviations will be measured and deducted from the plan quantity. The volume of rock excavation will be determined by the average end area method. The volume of earth excavation allowed for payment will be the total volume of roadway excavation shown on the plans or the revised quantity, regardless of classification, minus the measured volume of rock excavation.

Basis of Payment. Payment for roadway excavation will be made at the Contract unit price per cubic yard (for each class of excavation) which price shall be full compensation for the excavating and hauling; placing and forming of embankments; preparation of subgrade; clearing grubbing, and any work noted on the plans to be included in the price bid for excavation. Payment will be made under:

Item No. 201.1. Earth excavation, per cubic yard.
Item No. 201.2 . Rock excavation, per cubic yard.

b. Trenching.

1. Earth. Payment for all trench excavation and backfill in earth shall be included in the Contractor's unit price per lineal foot for storm sewer construction as set forth in the proposal. Such unit price shall include cost of all equipment, labor, and materials used in conjunction with the trenching operations. Payment will be made under:

Item No. 201.3. Storm sewer construction, per lineal foot.

2. Rock. Payment for all trench excavation and backfill encountered in rock, as defined in this section of the specifications, shall be made at the unit price per cubic yard for rock excavation, storm sewer as set forth in the proposal. Upper pay limit for rock excavation shall be the top surface of the rock and lower pay limit shall be the bottom stratum or layer of the rock or the flow line of the pipe, whichever is higher in elevation. Width limit for payment for rock excavation shall be per pipe embedment details 540.01 and 540.02. Payment will be made under:

Item No. 201.4. Rock excavation, storm sewer, per cubic yard.

c. Structural Excavation.

1. Earth. Payment for all earth excavation and backfill required in constructing drainage structures such as catch basins, curb inlets, junction boxes, and headwalls, shall be included in the unit price for each such structure as set forth in the proposal. Payment for earth excavation and backfill required in construction of the reinforced concrete boxes and retaining walls shall be included

in the unit price for structural reinforced concrete as set forth in the proposal. No separate pay item for this structural earth excavation shall be included in the Contract.

2. Rock. Where rock, as defined herein, is encountered in the excavation for structures such as those listed above, it shall be paid for at the unit price per cubic yard for rock excavation, storm sewer as set forth in the proposal. Upper and lower pay limits shall be as defined hereinbefore for trenching in rock and the later limits shall be defined as vertical planes spaced eight (8) inches outside the walls of any structure. Payment will be made under:

Item No. 201.5. Rock excavation, storm sewer, per cubic yard.

d. Crushed Rock for Driveways. Crushed rock for driveway approaches shall be paid at the Contract unit price per ton for crushed rock in place. Payment will be made under:

Item No. 201.6. Crushed rock for driveway approaches, per ton.

e. Topsoil for Backfill in Lawns. Topsoil for backfill in lawns shall be paid at the Contract unit price per cubic yard for topsoil in place. Payment will be made under:

Item No. 201.7. Topsoil for backfill in lawns, per cubic yard.

SECTION 500

EXCAVATION AND TRENCHING FOR SANITARY SEWERS

500.1. Description. This section covers excavation and trenching work and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; site restoration; and other appurtenant work.

500.2. General Requirements. Excavation shall provide adequate working space and clearance for the work to be performed therein. In no case shall excavation faces be undercut.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed undercut.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed by the Engineer.

500.3. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes except for rock excavation as specifically noted in the project proposal. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Contract work, regardless of the type, character, composition or condition thereof except for rock excavation. Payment for rock excavation shall be based upon the depth of rock encountered and standard details 540.01 and 540.02. Payment for rock excavation at manholes or other structures shall be based on the outside diameter or dimensions plus 4 feet to allow a working space of 2 feet beyond each exterior wall.

500.4. Site Preparation. All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. In addition, subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by the Contractor and at his expense. Topsoil shall be stripped and stockpiled for reuse as specified herein.

500.5. Clearing. The Contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipelines and appurtenant structure.

Contractor shall do all clearing necessary for performance of his work and shall confine his operations to that area provided through easements, licenses, agreements and rights-of-way. The contractor's entrance upon any lands outside of that area provided by easements, licenses, agreements or public rights-of-way, shall be at the Contractor's sole liability.

Property owners shall be notified by the contractor at least two (2) weeks prior to the proposed construction starting date. The notification will allow property owners to remove any small plants or flowers they desire to save.

Clearing along creek banks, ditches, swales, etc. shall be kept to a minimum as necessary for sewer or force main installation, to minimize bank erosion prior to riprap installation.

500.6. Use of Explosives. The Contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives, and the protection of life and property. The Contractor shall be responsible for all damage caused by his blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.

All rock which can't be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

500.7. Unauthorized Excavation. Except where otherwise authorized, shown, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, by the Contractor and at his expense, with concrete placed at the same time and monolithic with the concrete above.

500.8. Dewatering. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure is to be built, or the pipe to be installed herein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations 12 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

500.9. Sheet piling and Shoring. If any sheet piling or shoring is to be done an engineered plan shall be submitted to Sanitary Sewer Utility. The plan will be reviewed for loadings on the pipe. The plan must be approved by the Engineer prior to beginning work. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be sheeted, braced, and shored, as necessary, to prevent caving or sliding.

Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting, nor shall sheeting be pulled after backfilling. With the concurrence of the Engineer, sheeting shall be left permanently in the trench.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts in the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

500.10. Stabilization. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms, which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one (1) or more layers of crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches, which shall be furnished and installed as specified for granular fills. Not more than 1/2-inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations indicated on the drawings.

All stabilization work shall be performed by and at the expense of the Contractor.

500.11. Topsoil Removal and Replacement. In all areas of the construction easement for sanitary sewers, in all areas to be graded or where fills or embankments are to be constructed and any other areas of the project where the original topsoil will be covered, damaged, or disturbed, the topsoil shall be removed, stockpiled, and replaced.

Topsoil shall be removed to a minimum depth of 6 inches or to the actual depth of the topsoil where greater than 6 inches, and shall be carefully segregated and stockpiled for replacement after construction has been completed. No mixing with other excavated materials or waste granular bedding materials will be permitted.

500.12. Trench Excavation. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. The trench shall be backfilled at the end of each day except as may be required to begin the next day's work. Trenches in the road shall be plated with steel sheets or patched with cold patch overnight. The maximum length of open trench on any line under construction shall be 300 feet.

Except where tunneling is indicated on the drawings, or is permitted by the Engineer, all trench excavation shall be open cut from the surface.

- a. Alignment and Minimum Cover. The alignment of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe. Establish required uniform line and grade in trench from benchmarks identified by City Engineer. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use

laser beam equipment to establish and maintain proper line and grade of work.

- b. Limiting Trench Widths. Trenches shall be excavated to a width which will provide adjacent working space and sidewall clearances for proper pipe installation, jointing, and embedment and shall follow the minimum trench width (payline) shown on standard details 540.01 and 540.02.

1. Minimum Sidewall Clearance. Minimum permissible sidewall clearance between installed pipe and each trench wall, expressed in inches, shall be the outside diameter of the pipe divided by six (6) ($D_o/6$). Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") on each side of all pipes.

The stipulated minimum sidewall clearance is not minimum average clearance, but is minimum clear distances which are required.

2. Maximum Trench Widths. The maximum trench width for sanitary sewer pipe is shown on standard details 540.01 and 540.02.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, the banks may be cut back on slopes and shall not extend lower than 1 foot above the top of the pipe.

- c. Unauthorized Trench Widths. Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing specifications: either; pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by the loading conditions and with the concurrence of the Engineer, shall be furnished and installed by the contractor and at his expense.
- d. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, other existing property, utilities, or structures above or below ground. In all such locations, hand excavation methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be such operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation of one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

- e. Cutting Asphalt or Concrete Pavement. Cuts in asphalt or concrete pavement or sidewalks shall be not larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a

concrete saw in a manner which will provide a clean groove at least 1-1/2 inches deep along each side of the trench and along the perimeter of cuts for structures.

Pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 12 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Where necessary, trench banks may be sloped back as needed, and the width of pavement removed shall be adjusted accordingly. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines that, unless otherwise required, shall be parallel to the centerline of the trench. Temporary pavement patches shall contain a minimum of 3 inches of cold mix as noted in the Street and Storm Sewer Specification Standard Details–Pavement Replacement (120.01).

- f. Excavation Below Pipe Subgrade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as shown on the Pipe Embedment Detail 540.01, and 540.02, to provide for the installation of granular embedment pipe foundation material. Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4”) below all pipes.
- g. Artificial Foundations in Trenches. Whenever so ordered by the Engineer, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with crushed stone foundation material, or such material as the Engineer may order installed. All timber, concrete, or other foundations made necessary by unstable soil shall be installed as directed by the Engineer. Compensation for extra excavation and timber, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.

Where crushed stone artificial foundations in trenches are required, the material shall be placed on suitably prepared subgrades and shall conform to the requirements of section 201.12.b.

- h. Bell Holes. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

500.13. Pipe Embedment. Embedment materials for the sanitary sewer, both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment material shall conform to the requirements shown on the Pipe Embedment Details 540.01 and 540.02 and to the following supplementary requirements. RCP, VCP, and DIP shall be considered rigid pipes. PVC, HDPE and CMP shall be considered flexible pipe however, HDPE and CMP are not acceptable for sanitary sewer uses.

Embedment material shall contain no cinders or other material which may cause pipe corrosion.

- a. Placement and Compaction. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, 3/4" clean rock material shall be placed under the center of the pipe a distance of $D_o/3$ before the pipe is placed). 3/4" clean rock bedding material shall be deposited and compacted to 95% on either side of the loosely placed bedding material and around each side of the pipe up to the springline and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

- b. VCP. Pipe shall be bedded according to ASTM C12 and details for rigid pipe bound in this manual.
- c. RCP. Pipe shall be bedded according to the Type 3 installation as recommended by the American Concrete Pipe Association and the details bound in this manual for rigid pipe.
- d. DIP. Pipe shall be bedded according to ASTM A746 and the details for rigid pipe bound in this manual.
- e. PVC. Pipe shall be bedded according to ASTM D2321 and the details for flexible pipe bound in this manual.

500.14. Trench Backfill. All trench backfill above the springline of the pipe embedment shall conform to section 201.12 and as shown in details 540.01 and 540.02.

If concrete arch encasement is required, a layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement until the concrete has been in place for at least three (3) days.

- a. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in the following locations:
1. Where beneath pavements, surfacings, driveways, curbs, gutter, walks, or other surface construction, or structures.
 2. Where in street, road, or highway shoulders.
 3. In established lawn areas, backfill may be suitable job excavated material or as specified in section 201.12
- b. Omitted

- c. Responsibility of Contractor for Backfill Settlement. The Contractor shall be responsible for the satisfactory compaction and maintenance thereof, of all trenches and structural excavation of any description required under this Contract. Contractor shall warrant their work for at least the correction period from the date of acceptance. If prior to the expiration of this warranty, any trenches or other excavations are found to have settled they shall immediately be reworked by the Contractor and restored to the specified grades. Any sod, paving, or other surfacing damaged by settlement of trenches shall be replaced by the Contractor and at his expense.
- d. Topsoil Replacement. Topsoil removed and stockpiled in advance of trench excavation shall be replaced after trench backfilling operations are completed and initial settlement has taken place. Trench backfill shall be completed to such elevation as required to allow settlement and to permit the replacement of all topsoil which had been removed and stockpiled.

500.15. Fill and Embankments. Where filling is required to raise the subgrade under areas to be paved or surfaced, all fill materials shall consist of earth or other approved material. All organic or other undesirable material shall be removed. Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inch rises as the new fill is brought up in 8 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density. Material cut out, bladed into place and compacted shall not be measured and paid for directly but will be considered as incidental work.

All fill under paved surfaces such as streets and parking lots shall be compacted by a power roller or other approved equipment and the subgrade brought to a reasonably true and even plane. Earth used for fill shall be placed in layers not more than 8 inches thick, an uncompacted measurement, and shall be compacted as specified before the next layer is placed. Each layer shall be wetted or dried as necessary, and shall be compacted to the required density. Regardless of the type of equipment used, the roadway shall be compacted uniformly and the surface kept reasonably smooth at all times. If large pieces of heavy clay are encountered, the material shall be broken down by suitable manipulation to permit satisfactory embankment construction. If shale is encountered, the shale shall be broken down as much as practical and compacted at or above optimum moisture.

Each layer shall be uniformly spread, moistened as required, and then compacted to 90% of maximum density, obtained at the optimum moisture content, as determined by AASHTO Method T-99-38. The top 18 inches shall be compacted to 95% of maximum density. The field density of the lift will be determined in accordance with AASHTO T 191 or T 205, using the total material or T238, Method B Direct Transmission, for wet density. If nuclear density methods are used, moisture content will be determined in accordance with AASHTO T239. One test shall be taken for every 1,000 linear feet or fraction thereof for each lift. Testing is to be done by a third party independent testing agency or by the Contractor if the Contractor has demonstrated to the Engineer that Contractor employs qualified persons and maintains qualified equipment to conduct density testing. Test results

shall be furnished on forms acceptable to Engineer. Costs of all testing and retesting are the responsibility of the Contractor.

500.16 Structural Backfill. Backfilling of all structures shall be permitted only after an adequate curing time, as determined by the Engineer, has elapsed.

All excavations shall be backfilled to the lines and grades shown on the drawings. In no instance shall backfill be dumped, bull-dozed, or otherwise deposited in bulk upon the newly-constructed structure. After the required curing time, the excavation shall be backfilled by depositing, entirely without shock and with careful pneumatic tamping, suitable earth, sand, or other acceptable material in lifts not to exceed 6 inches in compacted thickness. Backfill shall be deposited at approximately the same elevation on opposite sides of the structure and shall be compacted in place to a density equal to or greater than ninety-five percent (95%) of maximum density as determined by the Standard AASHTO Method T-99-38. Inundated sand backfill shall not be used.

No trench backfill material containing rock, or debris from rock excavation, shall be placed in the upper 24 inches of the excavation except with the specific permission of the Engineer. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill compaction will result.

Any deficiency in the quantity of material for backfilling the excavation, or for filling depressions caused by settlement, shall be supplied by the Contractor. All excavated material in excess of that necessary to fill the trench to the grade shown on the drawings shall be removed and disposed of by the Contractor.

500.17. Final Grading. After other outside work has been finished, and backfilling and embankments completed and settled, all areas on the site of the work which are to be graded shall be brought to grade at the indicated elevation, slopes, and contours. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise shown, a slope of at least one percent shall be provided.

Topsoil removed and stockpiled as part of site preparation work shall be used to surface and finish all fills and embankments which do not require gravel surfacing.

Grading and surfacing shall be completed to the satisfaction of the Engineer.

500.18. Tests. As stipulated in the quality control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of the Contractor. A gradation test shall be made for each type of embedment or backfill material and one additional gradation test shall be made for each additional 500 tons of each material. Contractor shall furnish compaction test reports by a third party certified testing agency which is acceptable to the City. Tests shall be taken once for every 300 linear feet or fraction thereof for each lift. Costs of all tests and retesting shall be borne by the contractor.

500.19. Tunnel Excavation. Pipelines shall be constructed in tunnels of the type designated on the contract plans, in conformity with the following requirements: Before starting work on any

tunnel, detailed drawings, specifications, and other data covering the lines to be used shall be submitted in accordance with the submittals section.

The minimum clear inside diameter of the tunnel liner shall not exceed the outside diameter of the carrier pipe joints or couplings by 4 inches unless specifically indicated on the drawings.

- a. Casing Pipe. New, smooth, wall, welded steel pipe fabricated from ASTM A36 plate or ASTM A 570 sheet with a minimum yield point of 36,000 psi conforming to AWWA C200. The casing pipe shall have a wall thickness as follows:

Wall Thickness		
Casting Diameter (inches)	Under Highways (inches)	Under Railroad (inches)
Under 14	0.188	0.250
14 to 16	0.188	0.281
18	0.250	0.312
20	0.250	0.344
22	0.250	0.375
24	0.281	0.406
26	0.281	0.438
28 to 30	0.312	0.469
32	0.312	0.500
34	0.312	0.531
36	0.344	0.531
38 to 40	0.344	0.563

- b. Coatings and Linings. The casing pipe shall be cleaned and coated both inside and outside with two (2) coats of coal tar paint, Kippers "Bitumastic Super Service Black", Mobil "High-Build Bituminous Coating 35-J-10", or Tnemec "46-449 Heavy Duty Black".
- c. Joints. All joints in steel pipe casings shall be field welded to conform to API 1104 or AWWA C206.
- d. Casing Installation. The casing shall be installed by jacking into place . Earth displaced by the conduit shall be removed through the interior of the conduit by hand, by auger, or by other acceptable means. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing pipe conduit in its final position shall be straight and true in alignment and grade, as required on the drawings. There shall be no space between the earth and the outside of the casing.
- e. Casing spacers. Type 1 or Type 2 casing spacers shall be used in bores where sanitary sewer pipe is 15 inches in diameter and smaller, length of bore is 250 linear feet or less.

Type 2 casing spacers shall be used in bores where the sanitary sewer pipe diameter is larger than 15 inches or longer than 250 linear feet.

1. Type 1 Casing Spacers. Casing spacers shall be non-metallic, molded in segments for field assembly without any special tools. The casing spacers shall have minimum compression strength of 3,000 psi and minimum impact strength of 1.5 ft-lbs/inch. The casing spacers shall have full length, integrally molded skids designed to provide a minimum of 0.75 inches of clearance between the carrier pipe's greatest outside diameter and the casing pipe's inside diameter. The skids shall be beveled with high abrasion resistance and a low friction coefficient. Metal, Type 304 (18-8) stainless steel bolts may be used to secure the segments together. Acceptable manufactures and models are: PSI Ranger II, Advance Products & System Model CI.
2. Type 2 Casing Spacers. The casing spacers shall have a bolt on shell made in two (2) sections. All metal components shall be Type 304 (18-8) Stainless Steel. It shall have an elastomeric liner to isolate the shell from the carrier pipe. It shall have runners attached to the shell and be designed to provide a minimum of 0.75 inches clearance between the carrier pipe's greatest outside diameter and the casing pipe's inside diameter. The chock runners shall be beveled with high abrasion resistance and a low friction coefficient. Acceptable manufacturers and models are: PSI S8G-2 and PSI S12G-2, Power Seal #4810, Cascade CCS series and Advance Products & Systems Model SSI.

- f. End Seals. Both ends of each tunnel liner shall be closed seamless pull-on-type synthetic rubber end seals. The end seals shall be secured to the casing and carrier pipe with T-304 stainless steel banding straps with a 100% non-magnetic worm gear mechanism. The end seal installation shall not require any special tools. Acceptable manufacturers and models are: Advance Products & Systems Models AC & AM, PSI Models C & S.
- g. Boring and Jacking Pipe. After dewatering as required, the casing pipe shall be installed by boring and simultaneously jacking the pipe in place. There shall be no annular space between the outside of the casing pipe and the undisturbed earth. If necessary to reduce friction and ensure that the entire length of casing pipe can be jacked in place, bentonite slurry or a suitable chemical gel shall be pumped to the head of the bore to lubricate the exterior casing pipe walls.

500.20. Stream Crossings.

- a. Cover Depth. The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, the following cover requirements must be met:
 1. One foot (1') (0.3 m) of cover is required where the sewer is located in rock;
 2. Three feet (3') (0.9 m) of cover is required in other material. In major streams, more than three feet (3') (0.9 m) of cover may be required;

3. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement; and
 4. Less cover will be approved only if the proposed sewer crossing will not interfere with future modifications to the stream channel. Justification for requesting less cover shall be provided to the Engineer.
- b. Structures. The sewer outfalls, headwalls, manholes, gateboxes, or other structures shall be located as not to interfere with the free discharge of flood flows of a stream.
 - c. Materials. Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.
 - d. Aerial Crossings. Aerial crossings will be considered on a case-by-case basis and if approved by the City shall meet the following requirements:
 1. Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement.
 2. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.
 3. For aerial crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50)-year flood.
 4. Aerial crossings shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so that they will remain watertight and free from changes in alignment or grade.

500.21. Drainage Maintenance. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

500.22. Protection of Trench Backfill in Drainage Courses. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds one (1) percent, ditch checks shall be installed. Unless otherwise indicated on the drawings, ditch checks shall be concrete. Ditch checks shall extend not less than 2 feet below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

500.23. Disposal of Excess Excavated Materials. Insofar as needed, suitable excess excavated materials shall be used in fills and embankments indicated on the drawings. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way in such a way that the finish grade of the replaced topsoil will be 6 inches above the original ground surface elevation at and across the trench and sloping uniformly each way. Material thus distributed shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. At previous natural drainage ways crossing the sewer alignment, the mounded finish grade shall be sloped to form a drainage swale suitable to allow runoff to drain and shall not cause ponding. Placement of excavated material in the above manner will not be permitted where the line of trench crosses or is within a public road or highway right-of-way.

The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the Contractor and no separate payment will be made there for.

500.24. Settlement. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Requirements Section 5.9.

The Contractor shall make, or cause to be made, all repairs or replacements, including reseedling or resodding as required, made necessary by settlement within 30 days after notice from Engineer or Owner.

500.25. Erosion Control. To prevent erosion of creek banks at points where the sewer crosses, the removal of trees and vegetation along the creek banks shall be minimized.

At each creek crossing, where indicated on the plans, a one-foot high and 4-foot wide berm shall be constructed adjacent and parallel to the top of each bank, so runoff will flow along the berm and be deflected to undisturbed vegetated areas before entering the creek.

At each creek crossing, where indicated on the plans, the restored creek bank shall be protected by 2 feet of riprap on top of 6 inches of filter blanket rock which shall be placed on top of a 4-foot thick ground water barrier. The riprap and filter blanket rock shall cover an area from the bottom of the channel to the top of the berm and extend 5 feet into undisturbed earth on each side. The ground water barrier shall cover an area from the bottom of the sewer trench to the top of the berm for the full trench width.

- a. Materials. The material for riprap shall consist of a predominantly one-sized, durable stone, shot rock or broken concrete. Acceptance by the engineer may be made by visual inspection. Riprap material shall be either Type 1, or 2, per below.

Type 1 Riprap shall consist of at least 40 percent of the mass being pieces having a volume of one cubic foot or more.

Type 2 Riprap shall consist of at least 60 percent of the mass being pieces having a volume of one cubic foot or more.

A geotextile material shall separate the subgrade from the riprap. Geotextile material shall be AASHTO M288-96 Class 2 with a minimum permittivity of 1.0 sec^{-1} and an apparent opening size of 0.22 mm MARV. Lap seams per manufacturers recommendations.

Riprap shall be placed to the approximate shape and thickness shown on the plans for the specified ditch or as directed by the Engineer. The rock shall be dumped on a subgrade of reasonably uniform density and left in a rough condition meeting the approval from the Engineer.

Grouted riprap shall not be allowed unless approved by the Engineer.

- a. Filter Blanket Rock. The material shall be durable and may be either crushed stone or gravel of a combination of both. The rock shall be reasonably well graded with a maximum size of 4 inches in diameter and an average size of one inch in diameter.
- b. Placement. The ground water barrier shall be placed and compacted in one-foot layers for the total thickness below the filter blanket rock. The geotextile is to be placed on top of grade. The filter blanket rock shall be carefully dumped in place so as to prevent damage to the filter blanket layer. The completed riprap shall form a uniform 2 foot thick layer with a tight surface. Each layer need not be compacted, but shall be graded in a manner to ensure that the larger fragments are uniformly distributed and that the smaller fragments serve to fill the voids between the larger fragments. Hand placement of fragments or compaction will be required only to the extent necessary to obtain the required results. A trench at the toe of the slope shall be excavated to the depth shown on the plans, or to a depth of 2 feet if not otherwise shown on the plans.

All costs in connection with erosion control, including ground water barrier, filter blanket, and riprap shall be included in the cost of sewer pipe in place.

- c. Ground Water Barrier. Ground water barriers shall impede passage of water through the pipe embedment material. Barrier material shall meet soil classification GC, SC, CL, or ML-CL, and shall be compacted to 95% of maximum density. Material may be finely divided suitable job excavated material, free from stones, organic matter and debris. Ground water barriers shall be compacted soil the full depth of granular material plus 1 foot above the granular material, the full trench width, at least 4 feet long with a minimum depth of 4 feet.

- d. Stream Crossing Cleanup. Cleanup of stream crossings shall begin immediately after sewer construction and backfilling can be completed. Exposed disturbed areas in stream crossings shall not remain unprotected for more than seven (7) days.

500.26. Cleanup Work. The Contractor shall provide sufficient labor forces and equipment to maintain cleanup operations closely behind pipe laying operations. Every advantage shall be taken of periods of good weather for general cleanup, grading, topsoiling, seeding, sodding, etc. Items of work such as manhole construction, road cuts, pavement replacement, and all other restoration work shall not be allowed to lag behind the pipe installation. Special attention shall be given to maintaining road crossings. Streets to be opened to local traffic at the end of the day's operation shall be cleaned of dirt and mud. Streets which are not open to traffic shall be cleaned regularly to be kept free of dirt and mud. Street sweeping equipment shall capture and contain dust and debris. Powered broom attachments shall be of the pick-up type. All equipment and material stockpiles shall be secured for safe passage of vehicles and pedestrians. Traffic control in conformance with the Manual of Uniform Traffic Control Devices shall be in place prior to opening the road to traffic.

All temporary pavement patches must be kept flush with adjacent paved surfaces between asphalt paving seasons. Ruts and other depressions caused by settling, vehicular traffic, etc., shall be continuously filled and graded for maintenance of a smooth traveled surface and minimum inconvenience to the public. All material stockpiles shall be secured for safe passage of vehicles and pedestrians. If, in the opinion of the Engineer, cleanup and miscellaneous items of work and construction are allowed to lag, the Contractor will be required to stop pipe installation until such work is caught up.

A percentage of the unit and lump sum prices will be withheld from payments for pipe installation, manhole construction, etc., in areas where cleanup and restoration have not been completed. This percentage will be in excess of the specified 10% retained for completed work.

STANDARD DETAILS

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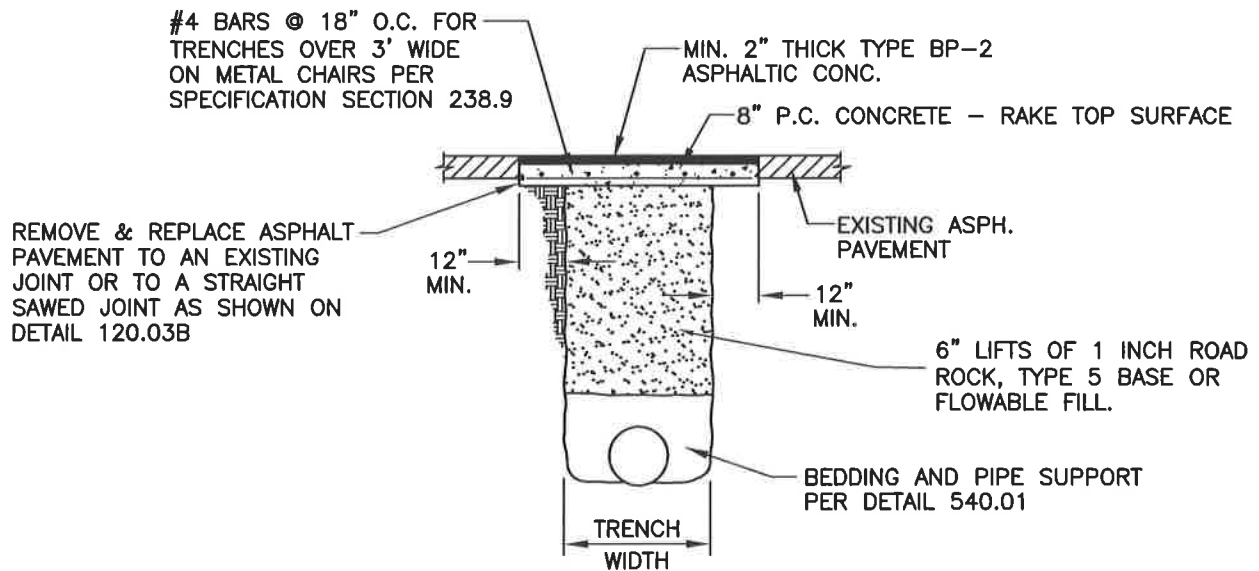
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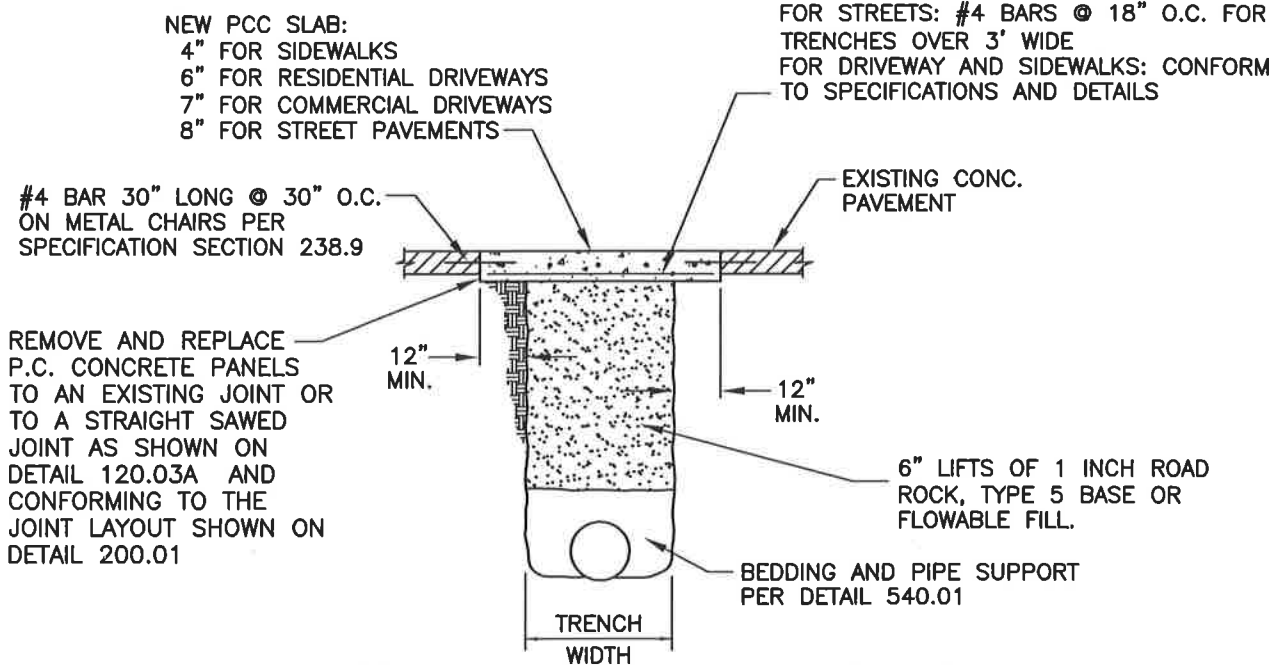
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EXISTING ASPHALTIC PAVEMENT



EXISTING CONCRETE PAVEMENT

NOTES:

1. CONCRETE SHALL BE MoDOT PAVEMENT CONCRETE. REINFORCING STEEL SHALL BE GRADE 60.
2. FOR BRICK STREETS W/ASHPALTIC OVERLAY THE TOP OF 8" P.C.C. SLAB SHALL MATCH THE TOP OF BRICKS AND THE NEW ASPHALT THICKNESS SHALL MATCH EXSTING ASPHALT THICKNESS.
3. FOR BRICK STREETS THE TOP OF 8" P.C.C. SLAB SHALL MATCH TOP OF SUBGRADE.
4. SEE SECTION 201.12.10.1 FOR 1" ROAD ROCK GRADATION

Approved

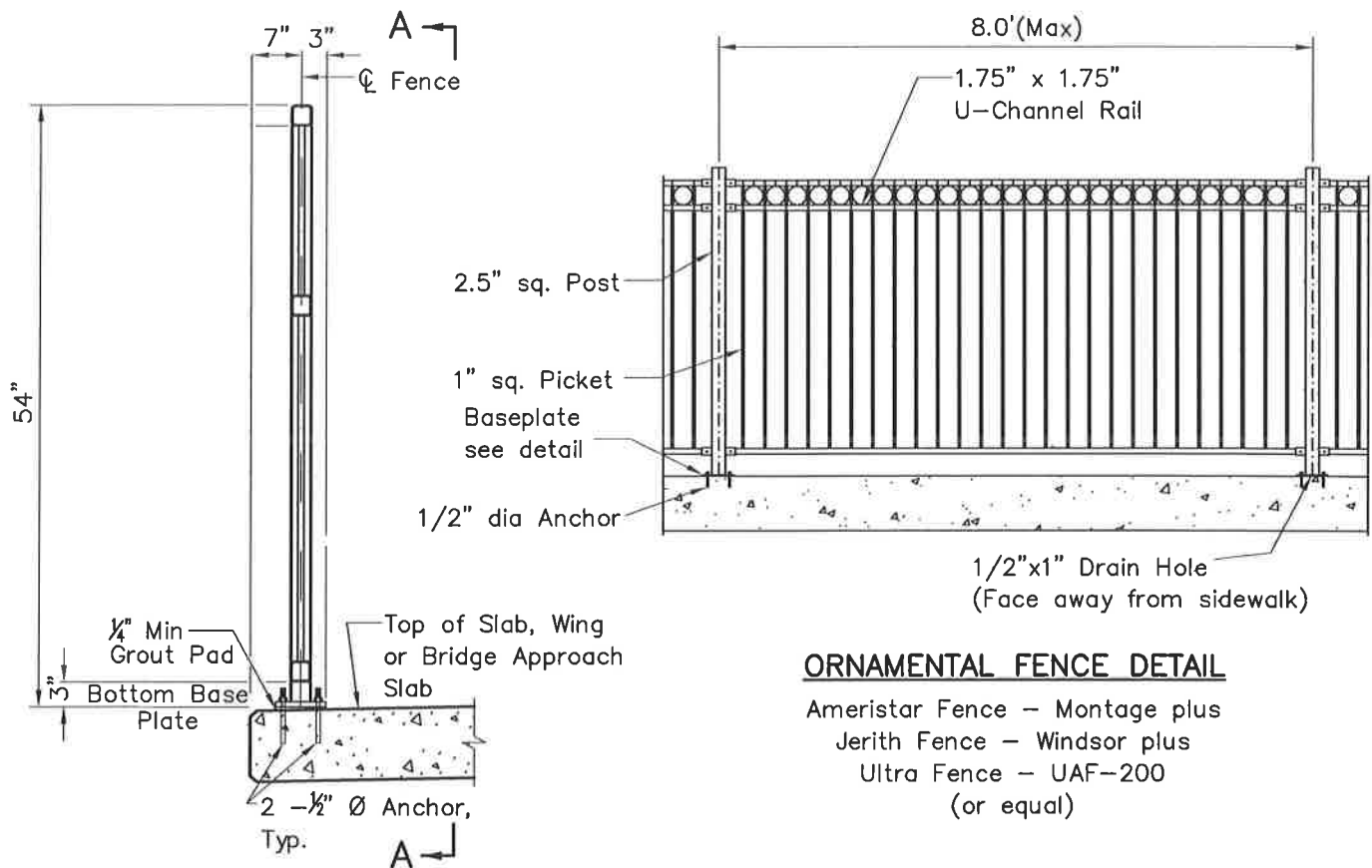
10/01/18
Date

Revisions



PAVEMENT PATCHING

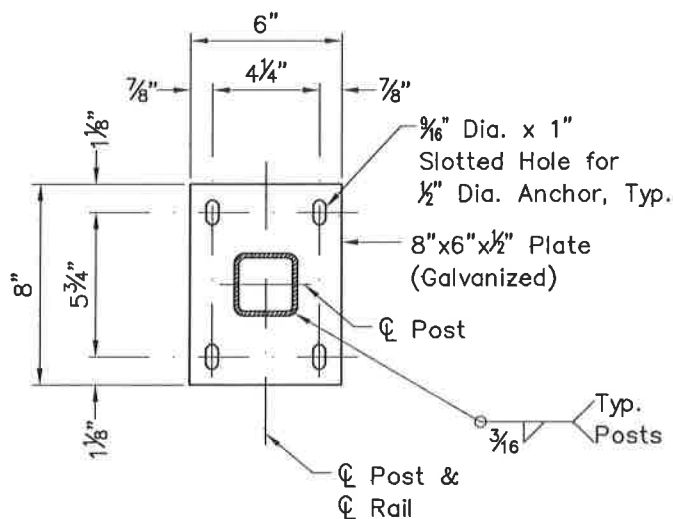
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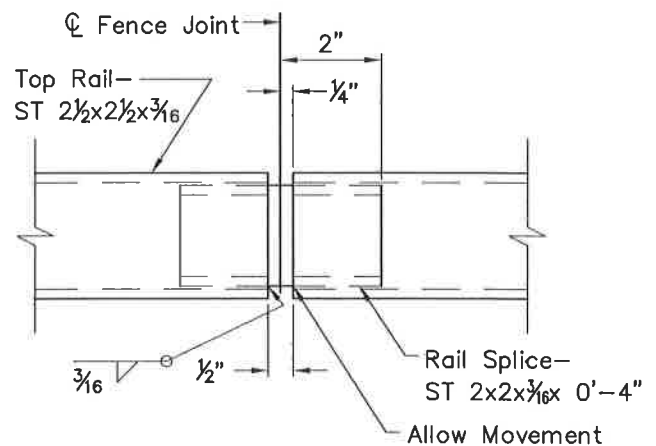
TYPICAL SECTION

NOTE:

Anchors shall be drilled in place. Exposed portion of anchors, nuts and washers shall be field painted after installation.



BASE PLATE DETAIL



EXPANSION JOINT DETAIL

Shown at Top Rail.
Middle and Bottom Rail similar.

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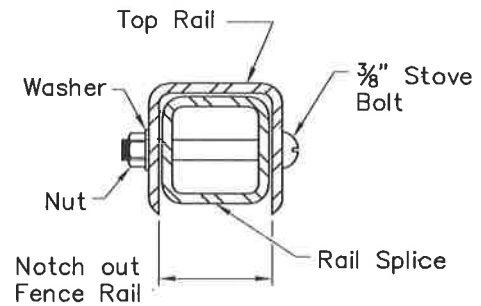
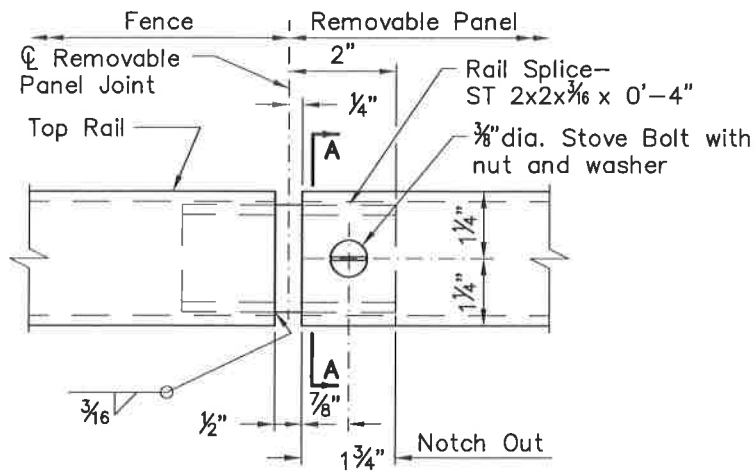
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City of Columbia
Public Works Department

STEEL PEDESTRIAN FENCE

140.01A



SECTION A-A

REMOVEABLE PANEL JOINT DETAIL

Shown at Top Rail.
Middle and Bottom Rail similar.

GENERAL NOTES:

1. Materials. Handrail shall be ornamental steel of the size as detailed. Tailings shall be constructed of bar sections as detailed
2. The fence shall be Montage Plus 2/3 Rail Majestic (by Ameristar Fence), Windsor Plus (by Jerith Fence), UAF-200 (by Ultra Fence), or approved equal. The color of the fence shall be black. The maximum fence post spacing shall be 8'.
3. Rails and base plates shall be set parallel to top of slab. All posts and balusters shall be set vertical. Grout shall be used between concrete and base plate of post.
4. All rail-to-post welded connections shall be ground smooth. No field welding will be permitted. The Contractor shall submit shop drawings to the Engineer for approval prior to fabrication of the fence.
5. Use E70 XX electrodes for all welding.
6. All material, labor, splices, grout, and installation shall be paid for under the bid item "Pedestrian Fence" per linear foot.
7. A grouted leveling pad shall be used to erect the posts vertical. The leveling pads shall be a non-shrink grout as approved by the Engineer. The grout shall be mixed, applied and cured according to the manufacturer's recommendations.
8. Concrete anchors, nuts and washers shall be galvanized in accordance with ASTM A153 and Sec.1081.
9. Nuts shall conform to ASTM A307. Nuts shall be regular hexagon type. Washers shall be of standard commercial quality.
10. The concrete anchors shall have a minimum ultimate pullout strength of 7900 lbs. based on the concrete. The length of embedment into concrete shall conform to manufacturer's recommendations.


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10/01/18
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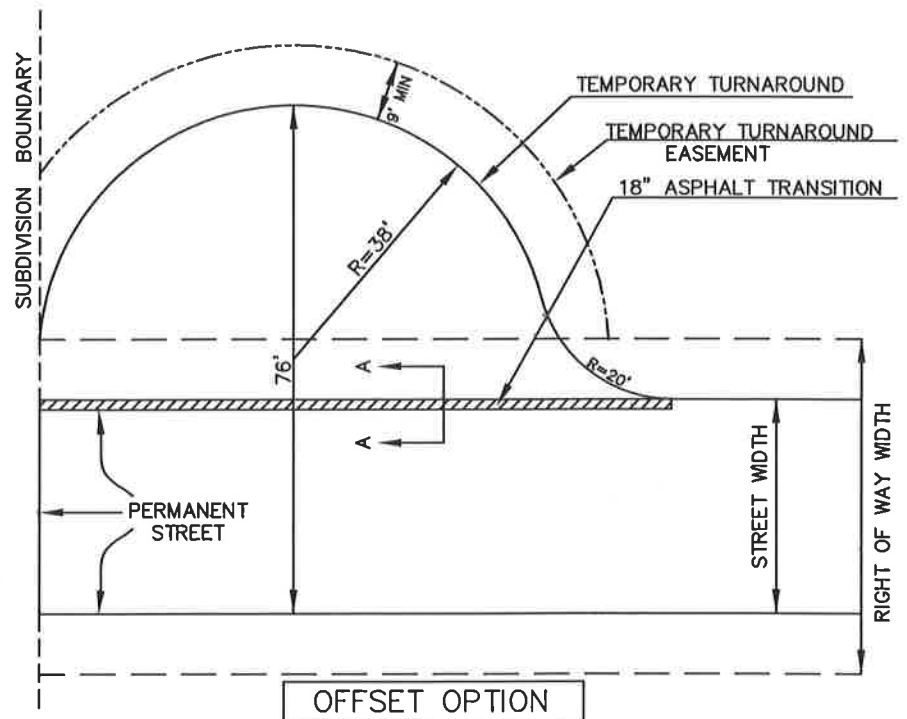
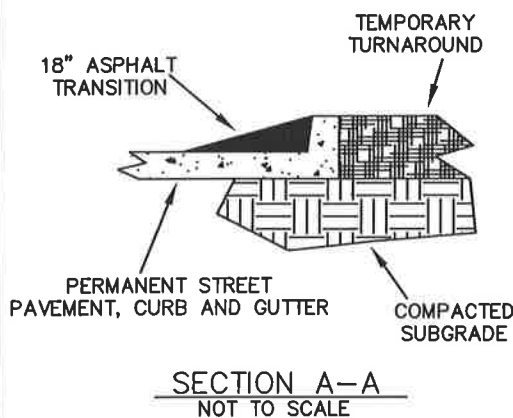
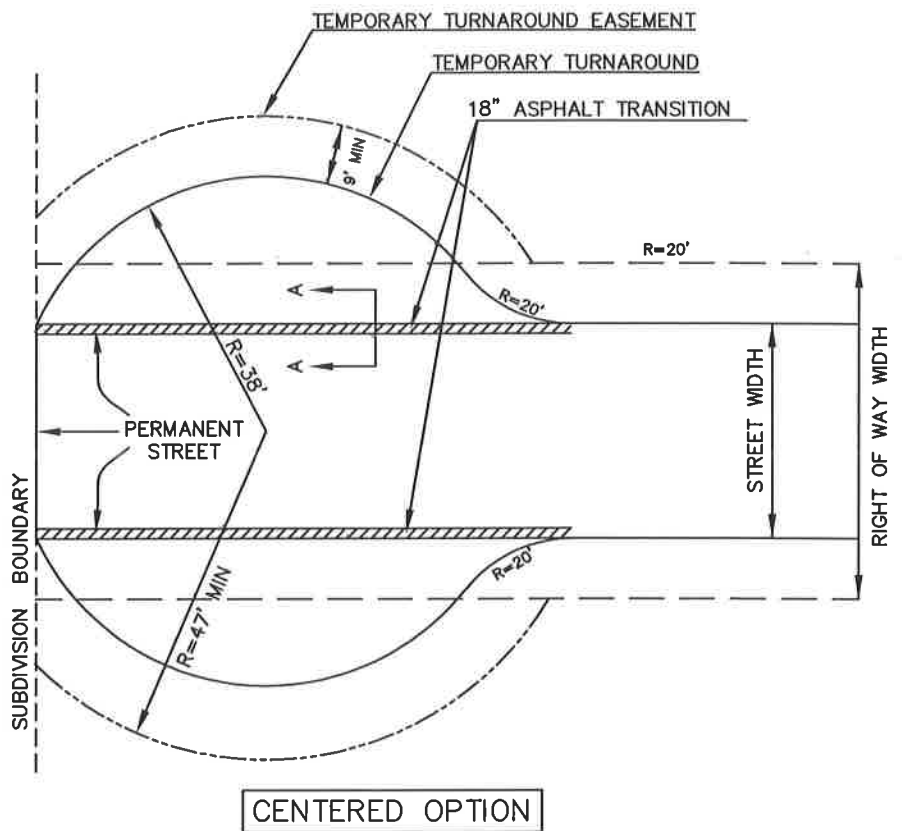
City of Columbia
Public Works Department

STEEL PEDESTRIAN FENCE

140.01B

- 1) PERMANENT STREET MUST BE EXTENDED TO BOUNDARY OF SUBDIVISION
- 2) FOR RESIDENTIAL OR LOCAL NON-RESIDENTIAL STREETS TEMPORARY TURNAROUND SURFACE TO CONSIST OF A MINIMUM OF 8" OF COMPACTED TYPE 3 AGGREGATE OVER NON-WOVEN GEOTEXTILE OR EQUIVALENT

SURFACE FOR COLLECTOR OR ARTERIAL STREETS TO CONSIST OF A MINIMUM OF 3" OF ASPHALTIC PAVEMENT OF TYPE SPECIFIED FOR STREET CONSTRUCTION, OVER 8" OF COMPACTED TYPE 3 AGGREGATE OVER NON-WOVEN GEOTEXTILE, OR EQUIVALENT
- 3) DEVELOPER IS RESPONSIBLE FOR PROPER MAINTENANCE OF TEMPORARY TURNAROUND
- 4) DIRECTION OF DRAINAGE AND EROSION CONTROL TO BE APPROVED BY THE ENGINEER. DESIGN MUST ADDRESS GUTTER FLOW AT STREET TERMINUS
- 5) LOT(S) CONTAINING TEMPORARY TURNAROUND OR ITS EASEMENT ARE NOT AVAILABLE FOR DEVELOPMENT UNTIL STREET IS EXTENDED AND EASEMENT IS NULL AND VOID. DEVELOPER IS RESPONSIBLE FOR REMOVAL OF ALL TEMPORARY TURNAROUND MATERIAL AND ANY REPAIRS TO PERMANENT STREET STRUCTURE PRIOR TO DEVELOPMENT OF LOT.



Approved

10/01/18
Date

Revisions



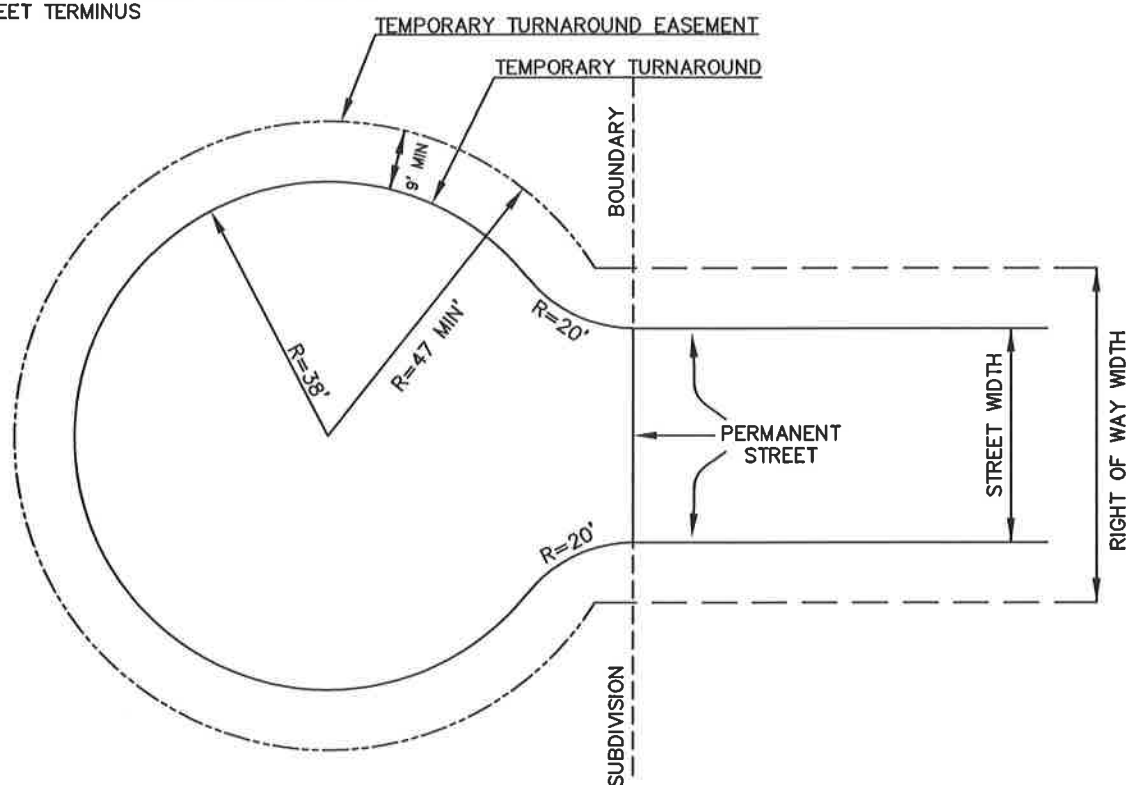
City of Columbia
Public Works Department

TEMPORARY TURN AROUND WITHIN PLAT BOUNDARY

160.01

- 1) PERMANENT STREET MUST BE EXTENDED TO BOUNDARY OF SUBDIVISION
- 2) FOR RESIDENTIAL OR LOCAL NON-RESIDENTIAL STREETS TEMPORARY TURNAROUND SURFACE TO CONSIST OF A MINIMUM OF 8" OF COMPACTED TYPE 3 AGGREGATE OVER NON-WOVEN GEOTEXTILE OR EQUIVALENT

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[Signature]
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10/01/18
Date

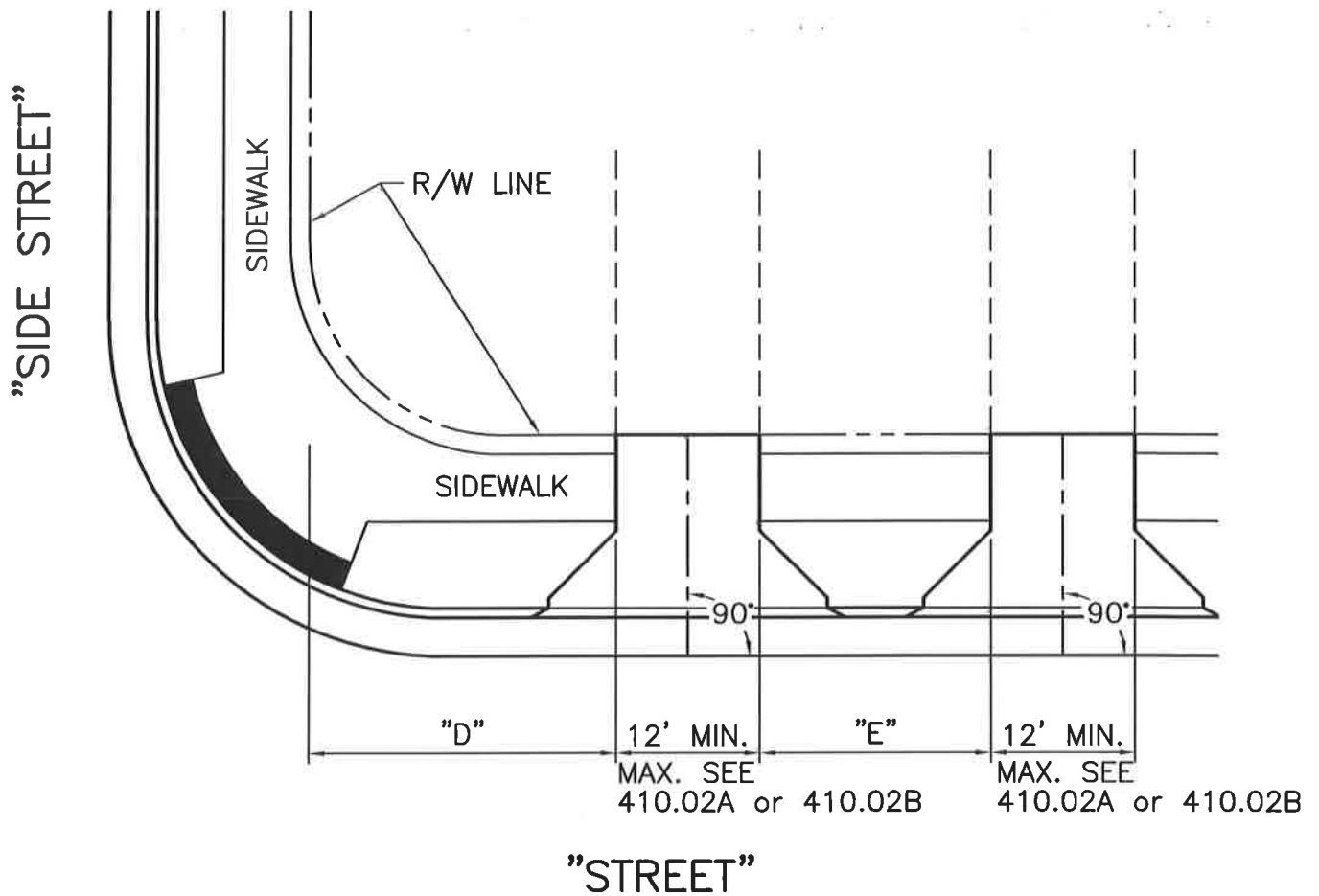
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City of Columbia
Public Works Department

TEMPORARY TURN AROUND OUTSIDE PLAT BOUNDARY

160.02



TYPE OF STREET	MINIMUM DISTANCES	
	"D"	"E"
LOCAL RESIDENTIAL	20'	—
LOCAL NON-RESIDENTIAL	20'	20'
FOR COLLECTOR & ARTERIAL SPACING, WIDTH AND IF "SIDE STREET" IS AN ARTERIAL OR COLLECTOR, SEE CHAPTER 29 OF THE CITY OF COLUMBIA ORDINANCES		


Approved

10/01/18
Date

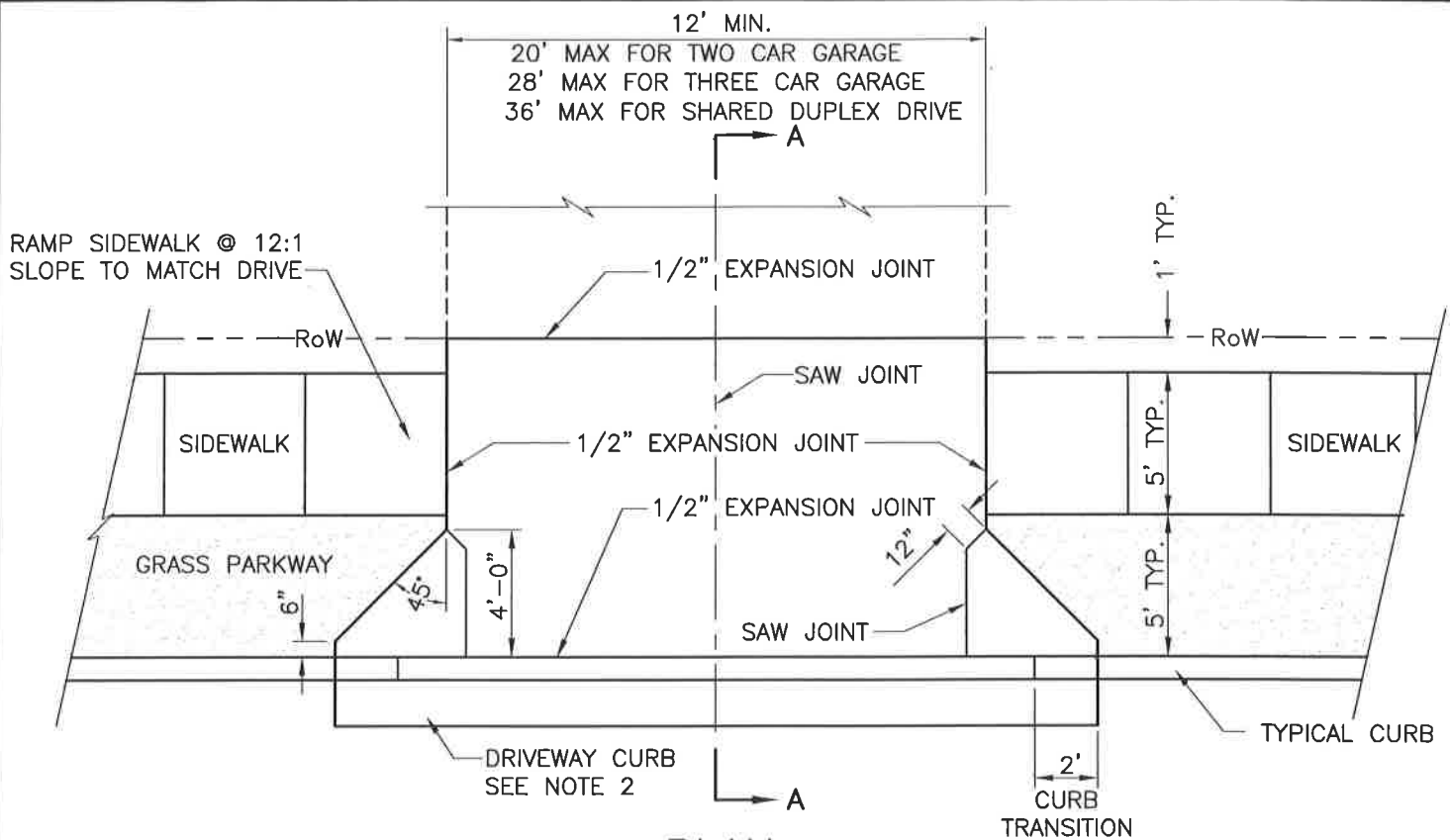
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City of Columbia
Public Works Department

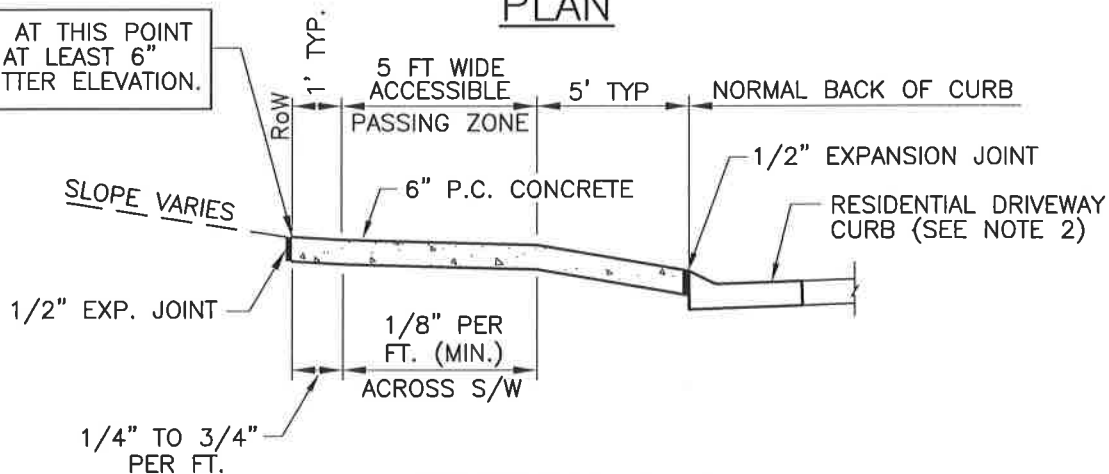
DRIVEWAY LOCATIONS

410.01



PLAN

ELEVATION AT THIS POINT
MUST BE AT LEAST 6"
ABOVE GUTTER ELEVATION.



SECTION A-A

NOTES:

1. DRIVEWAY APPROACH SHALL BE 6" THICK MoDOT PAVEMENT CONCRETE ON COMPACTED SUBGRADE.
2. REPLACE STANDARD CURB & GUTTER SECTION WITH DRIVEWAY CURB SECTION. SEE DETAIL 400.02.
3. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
4. ALL DRIVEWAY APPROACHES SHALL SLOPE TOWARD THE STREET.
5. ALL DRIVEWAY APPROACHES SHALL BE CONSTRUCTED TO ACCOMMODATE SIDEWALKS. (EXISTING AND FUTURE) STANDARD SIDEWALK LOCATION IS 1 FT OFF OF RoW LINE
6. DRIVEWAY APPROACH SHALL PROVIDE A MINIMUM 5' WIDE ACCESSIBLE SIDEWALK PASSING ZONE.
7. DRIVEWAY SLOPE ACROSS ACCESSIBLE SIDEWALK PASSING ZONE IS 1/8" PER FT. CROSS SLOPE SHALL NOT EXCEED 2.00%.
8. MINIMIZE SIDEWALK WARPING ADJACENT TO DRIVEWAY APPROACH.
9. GREENSPACE SLOPE WITHIN RIGHT OF WAY SHALL NOT EXCEED 3/4" PER FOOT.
10. DRIVEWAY MAY BE REINFORCED AT OWNER'S OPTION. ON CITY BID PROJECTS DO NOT REINFORCE.
11. MEASURE FROM TOP OF CURB.


Approved

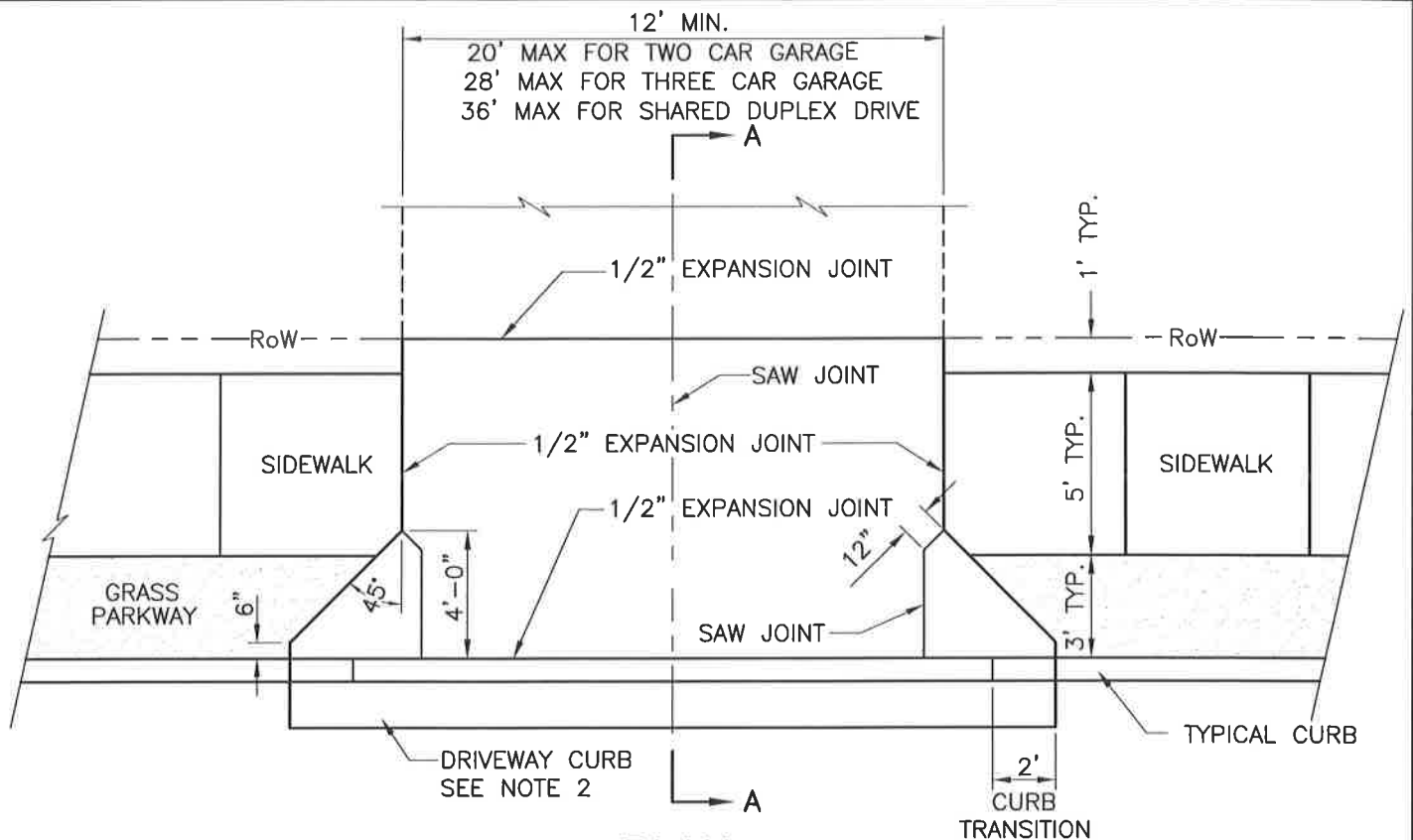
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Revisions



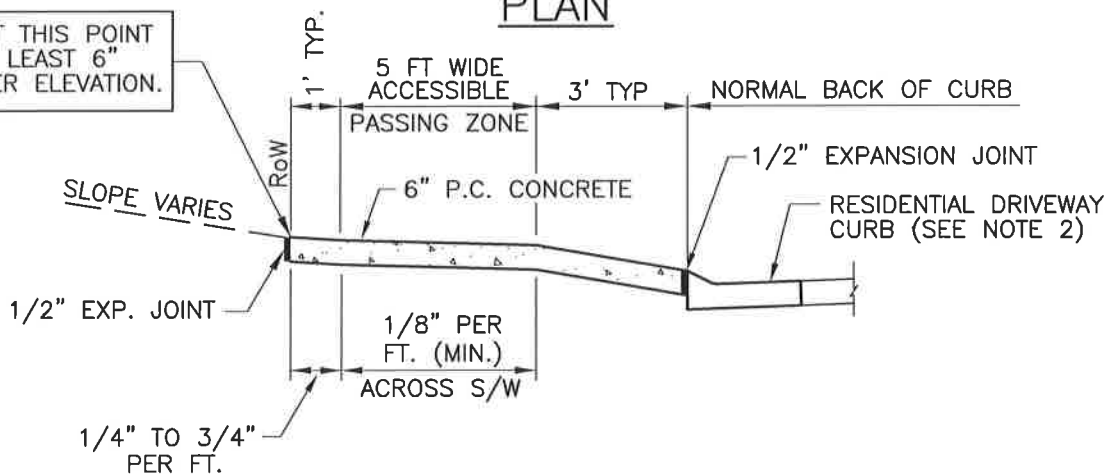
DRIVEWAY
(Residential, 28' street)

410.02A



PLAN

ELEVATION AT THIS POINT
MUST BE AT LEAST 6"
ABOVE GUTTER ELEVATION.



SECTION A-A

NOTES:

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10. DRIVEWAY MAY BE REINFORCED AT OWNER'S OPTION. ON CITY BID PROJECTS DO NOT REINFORCE.
11. MEASURE FROM TOP OF CURB.


Approved

10/01/18
Date

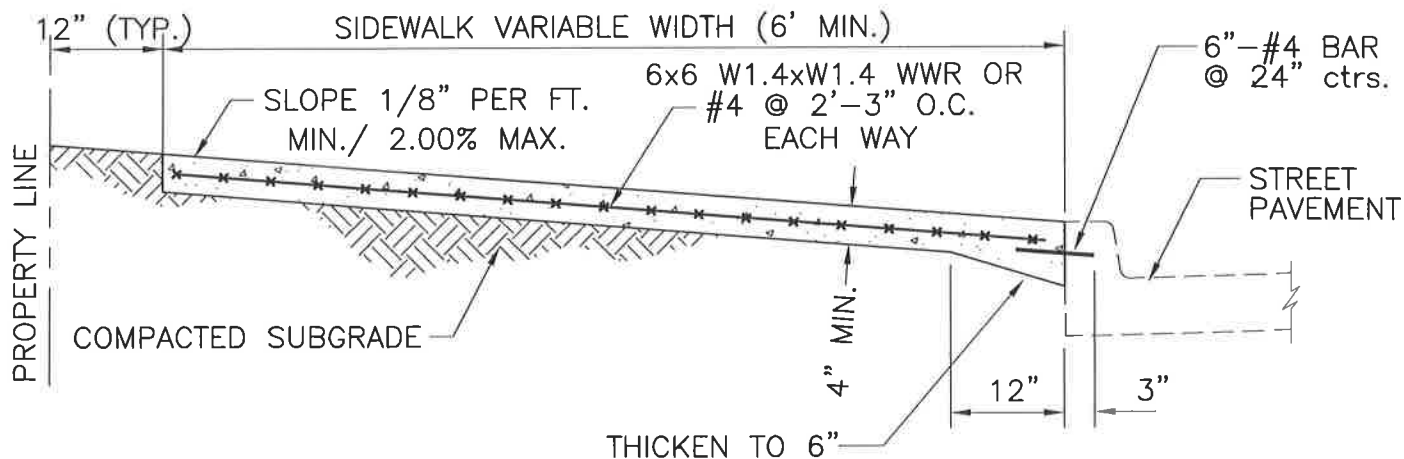
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City of Columbia
Public Works Department

DRIVEWAY
(Residential, 32' street)

410.02B



NOTE:

1. SIDEWALK SHALL BE 4" THICK MoDOT PAVEMENT CONCRETE.
2. INSTALL 1/2" TRANSVERSE EXPANSION JOINTS TO MATCH STREET OR CURB AND GUTTER EXPANSION JOINTS AND AT ALL DRIVEWAY APPROACHES, AND SIDEWALK RAMPS.
3. INSTALL TRANSVERSE SAW JOINTS AT SPACING EQUAL TO SIDEWALK WIDTH.
4. FOR DOWNTOWN SIDEWALK DETAIL SEE SECTION 1000.
5. NO STEEL TO BE PLACED THROUGH EXPANSION JOINT
6. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2.00%.
7. NEW SIDEWALK MUST BE PINNED TO EXISTING SIDEWALK.
8. WWR OR REBAR SHALL BE ACCURATELY PLACED AND FIRMLY HELD IN PLACE DURING CONCRETE PLACEMENT BY APPROVED METHODS, SEE SECTION 238.9.


Approved

10/01/18
Date

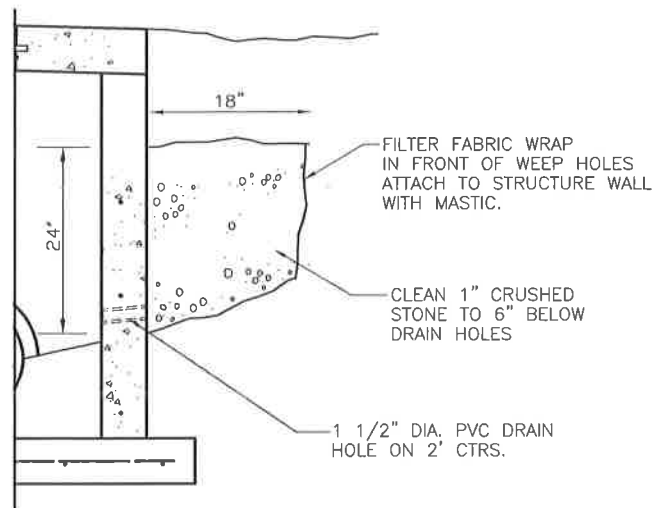
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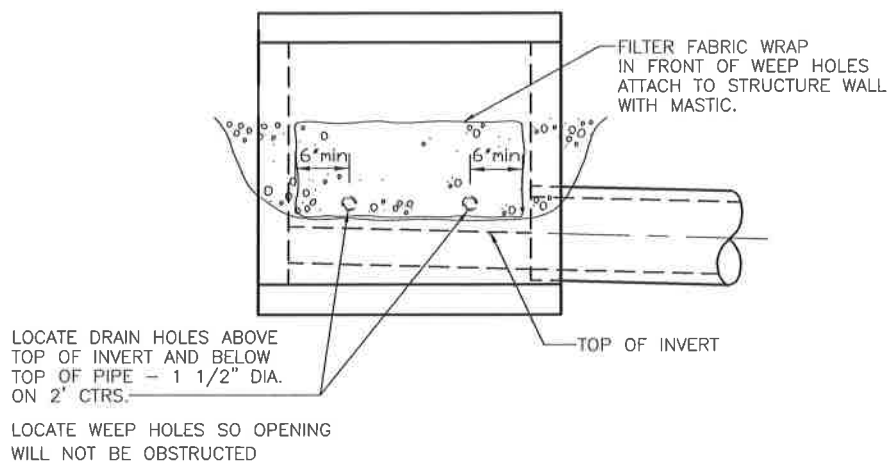
City of Columbia
Public Works Department

SIDEWALK AT BACK OF CURB

420.02



PARTIAL SECTION



FRONT ELEVATION

NOTE:

1. PLACE WEEP HOLES ON UPSTREAM FACE OF ALL STRUCTURES AND ON ROADWAY FACE OF CURB INLET STRUCTURES.
2. WEEP HOLE FILTER FABRIC SHALL CONSIST OF A NON-WOVEN, POLYPROPYLENE TYPE FABRIC SUCH AS: AMOCO 4553 NON-WOVEN GEOTEXTILE FABRIC OR APPROVED EQUAL.

[Signature]
Approved

10/01/18
Date

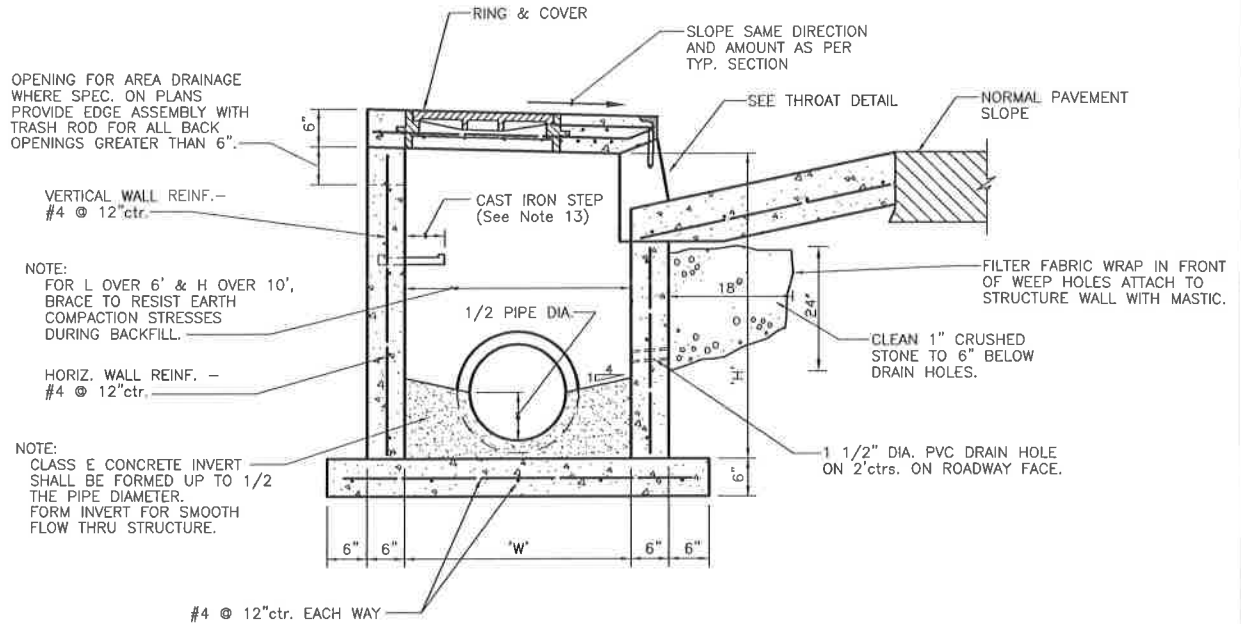
Revisions



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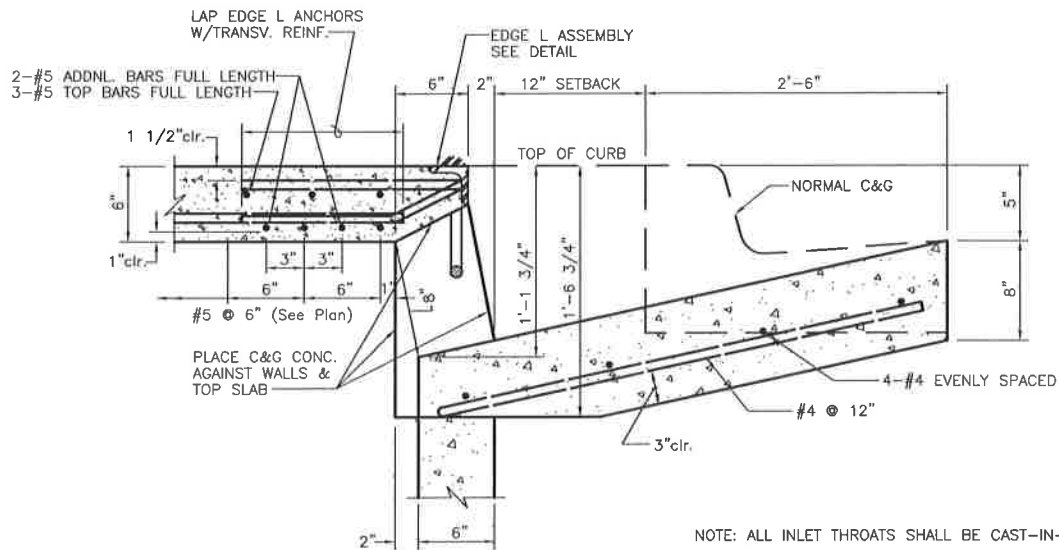
DRAINAGE STRUCTURE WEEP HOLES

500.04



SECTION D-D

NOTE: PLACE WEEP HOLES ON UPSTREAM FACE AND ON ROADWAY FACE. SEE DETAIL 500.04



THROAT DETAIL

Approved

10/01/18
Date

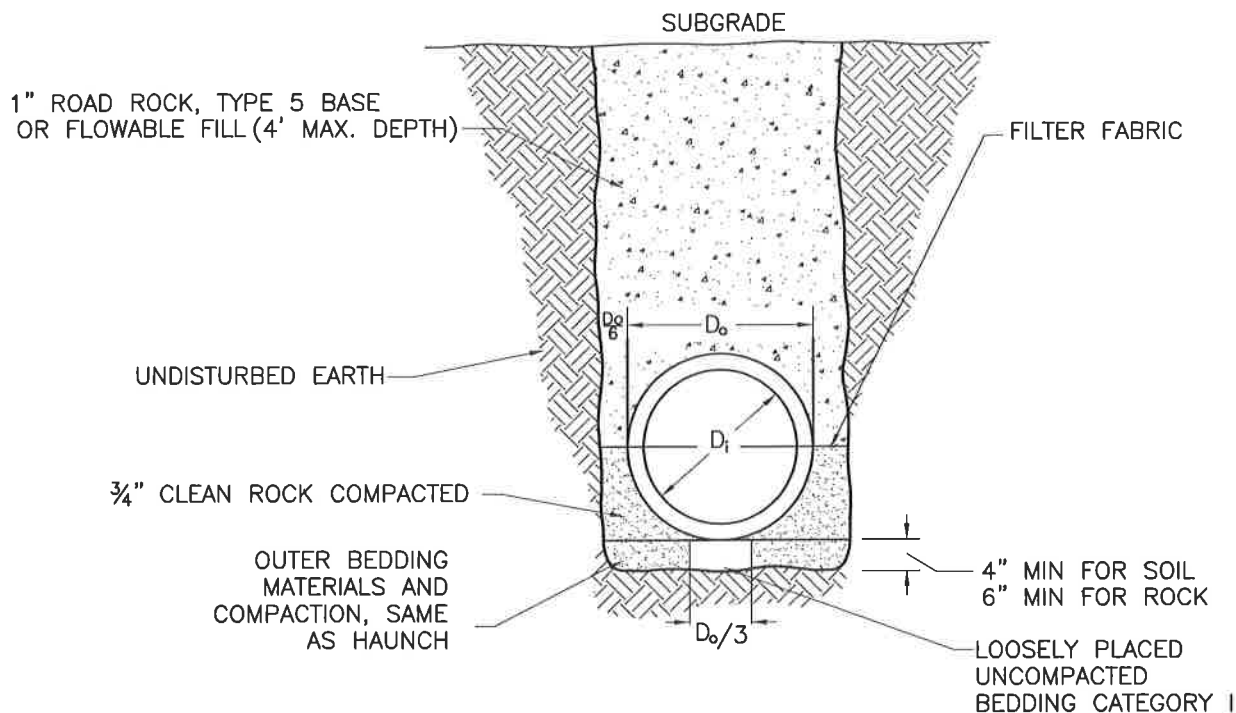
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TYPE M INLET SECTION AND DETAIL

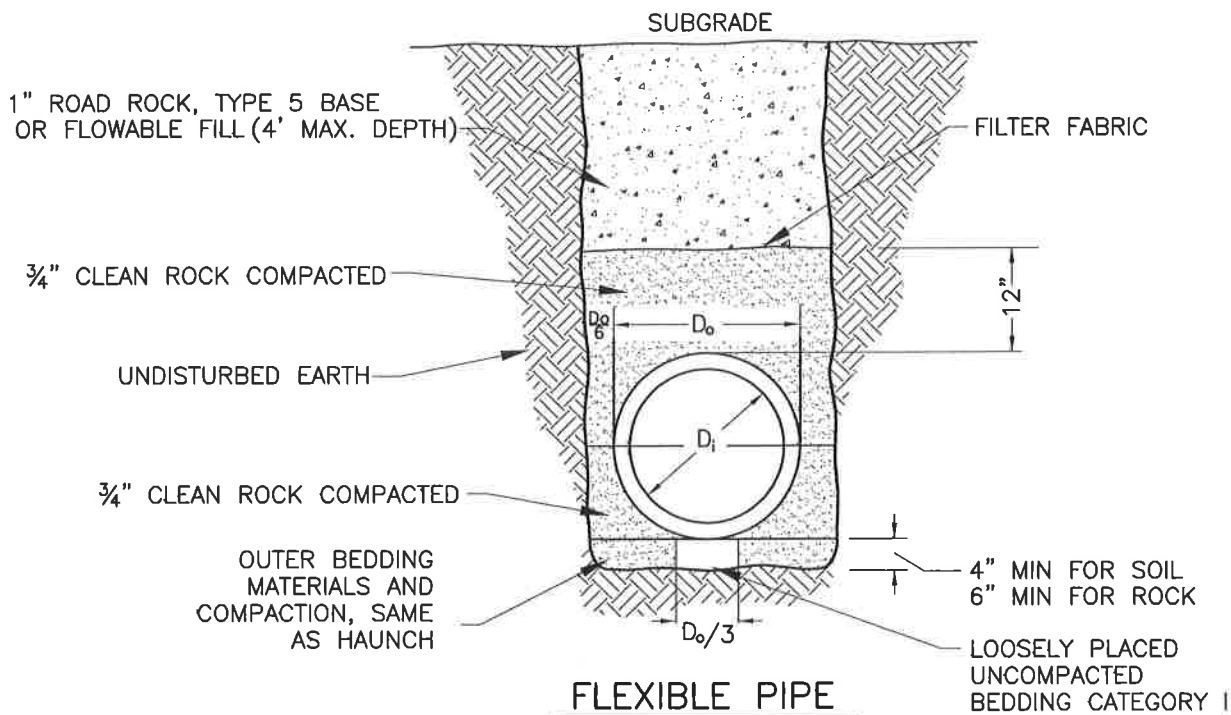
505.01C



RIGID PIPE

NOTE: SEE SECTION 201.12.10.1 FOR 1" ROAD ROCK GRADATION AND FOR CATEGORY I, II, AND III SPECIFICATIONS

PIPE DIAMETER	PAYLINE/ MIN. TRENCH WIDTH	MAX. TRENCH WIDTH
8"-36"	$D_o + 12"$	$D_o + 24"$
42"-72"	$D_o + (D_o/3)$	$D_o + 30"$
72"+	$D_o + (D_o/3)$	$D_o + 48"$



FLEXIBLE PIPE

[Signature]
Approved

10/01/18
Date

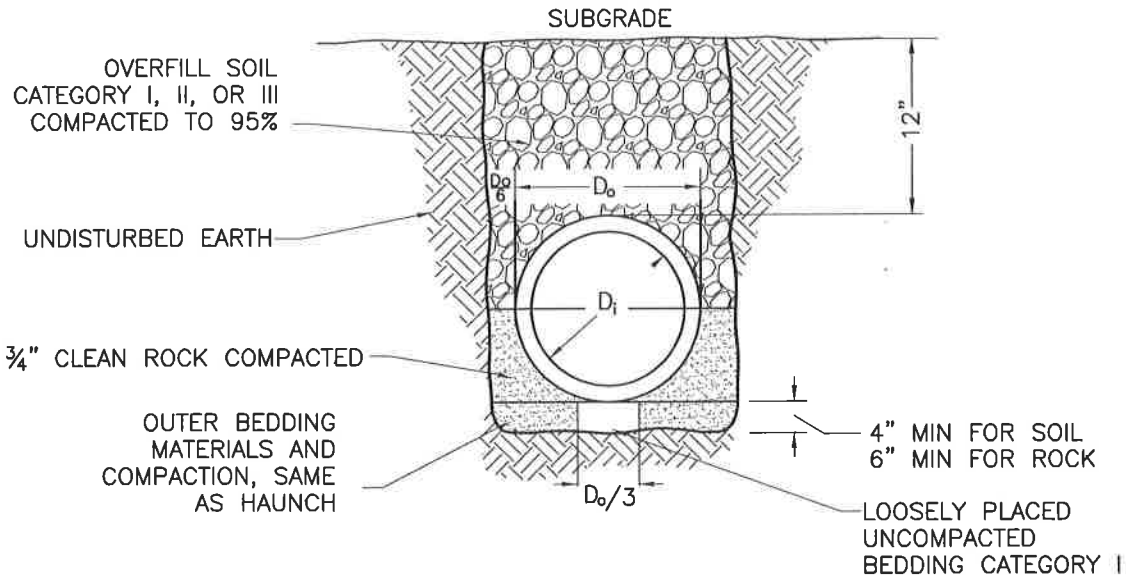
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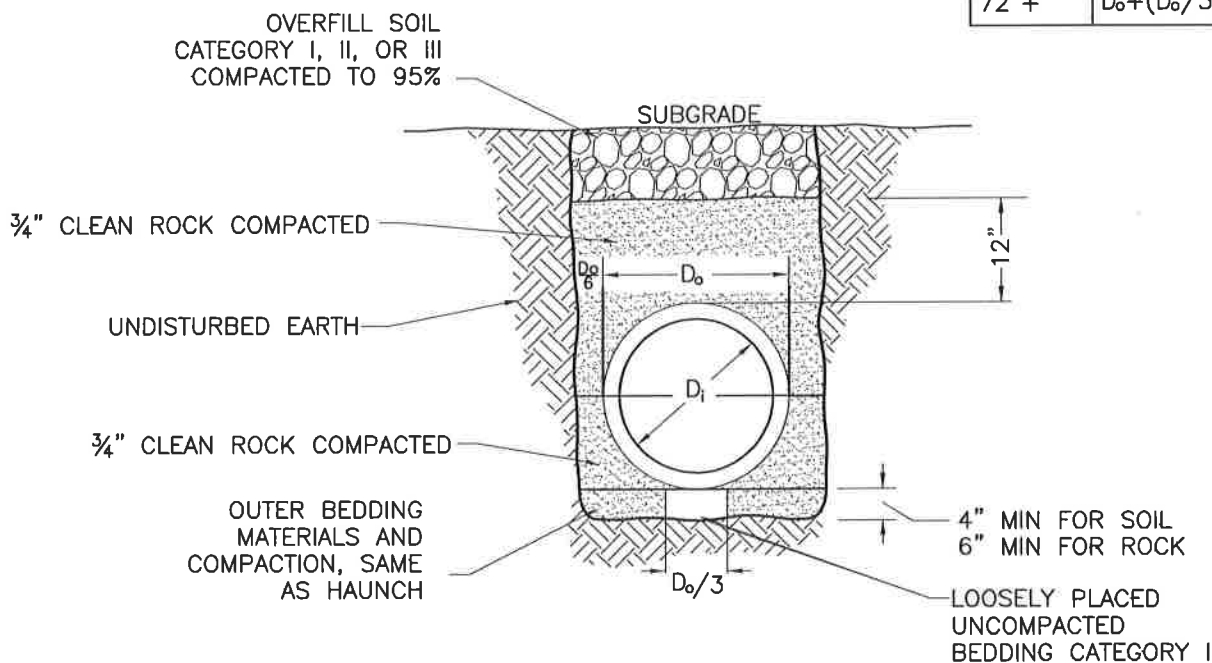
PIPE EMBEDMENT
(In the Right of Way)

540.01



RIGID PIPE

PIPE DIAMETER	PAYLINE/ MIN. TRENCH WIDTH	MAX. TRENCH WIDTH
8"-36"	$D_o + 12"$	$D_o + 24"$
42"-72"	$D_o + (D_o/3)$	$D_o + 30"$
72"+	$D_o + (D_o/3)$	$D_o + 48"$



FLEXIBLE PIPE

[Signature]
Approved

10/01/18
Date

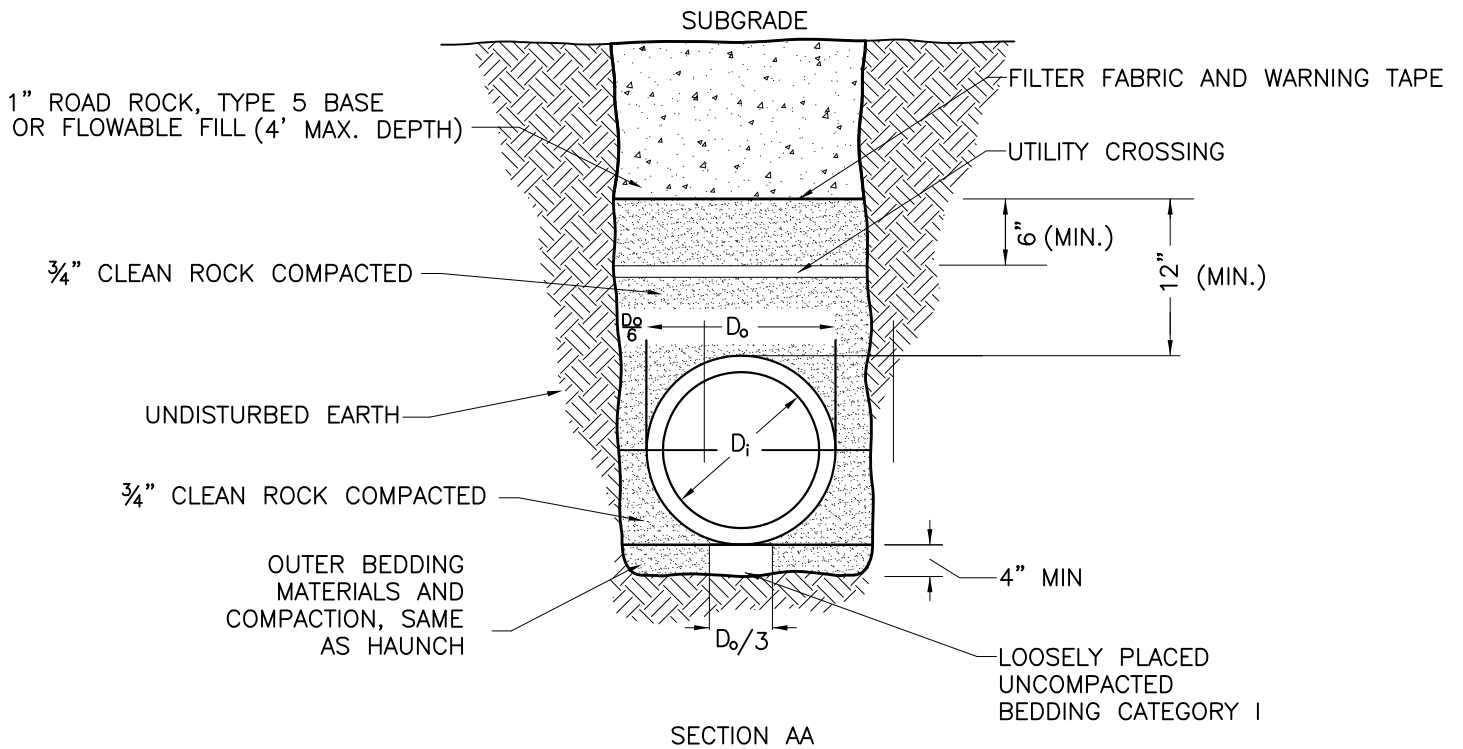
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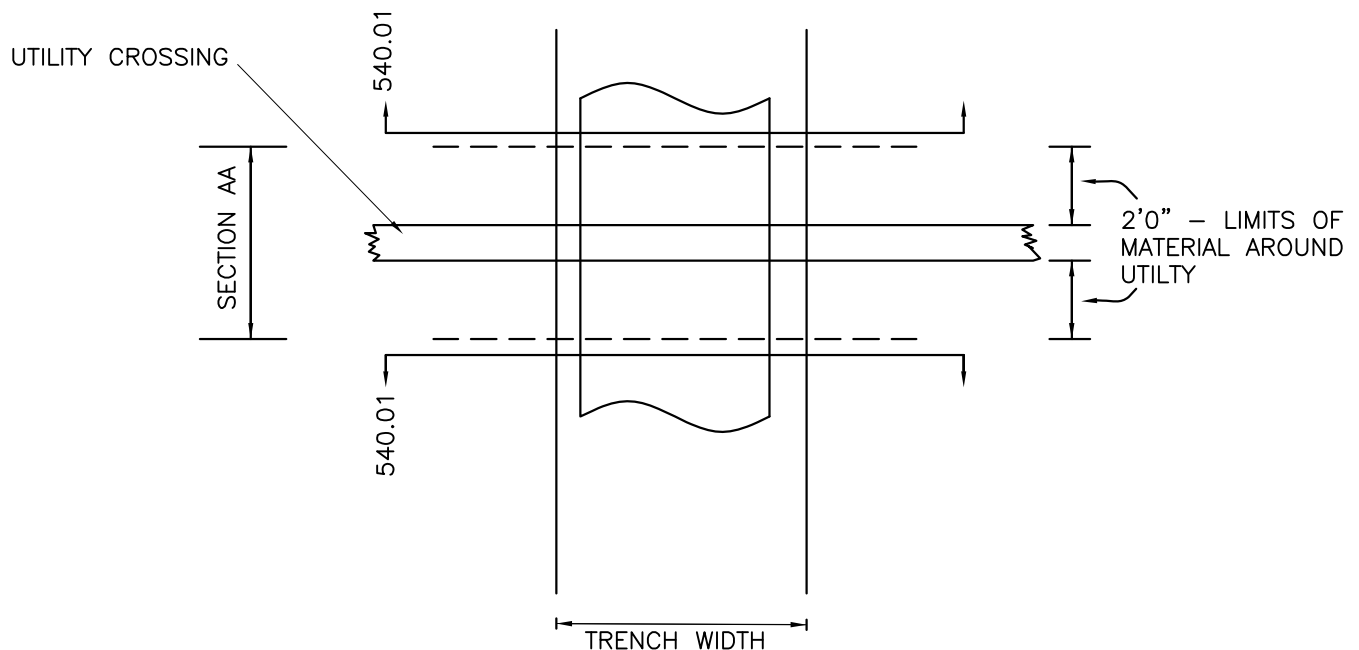
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PIPE EMBEDMENT (Out of the Right of Way)

540.02



PIPE DIAMETER	PAYLINE/ MIN. TRENCH WIDTH	MAX. TRENCH WIDTH
8"-36"	$D_o + 12"$	$D_o + 24"$
42"-72"	$D_o + (D_o/3)$	$D_o + 30"$
72"+	$D_o + (D_o/3)$	$D_o + 48"$



UTILITY CROSSING (In the Right of Way)

541.01

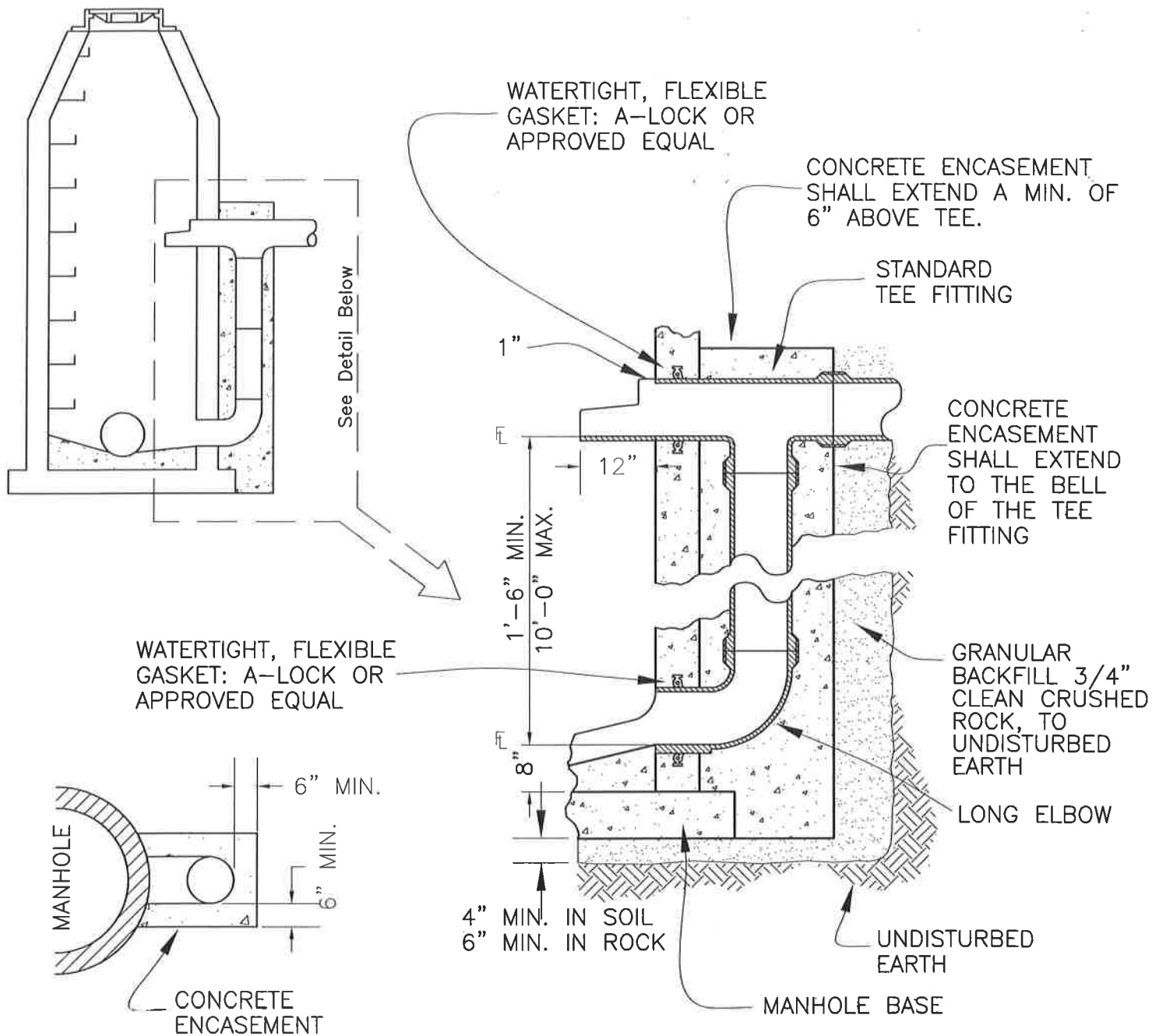
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NOTES:

1. DROP INLET PIPE TO BE SAME SIZE AND MATERIAL AS SEWER MAIN.
2. ALIGNMENT OF TEE: DROP INLET PIPE AND LONG ELBOW MAY BE ADJUSTED TO MAXIMUM OF 5% DEFLECTION TO COMPENSATE FOR SLOPE OF SEWER LINE.

DAS
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10/01/18
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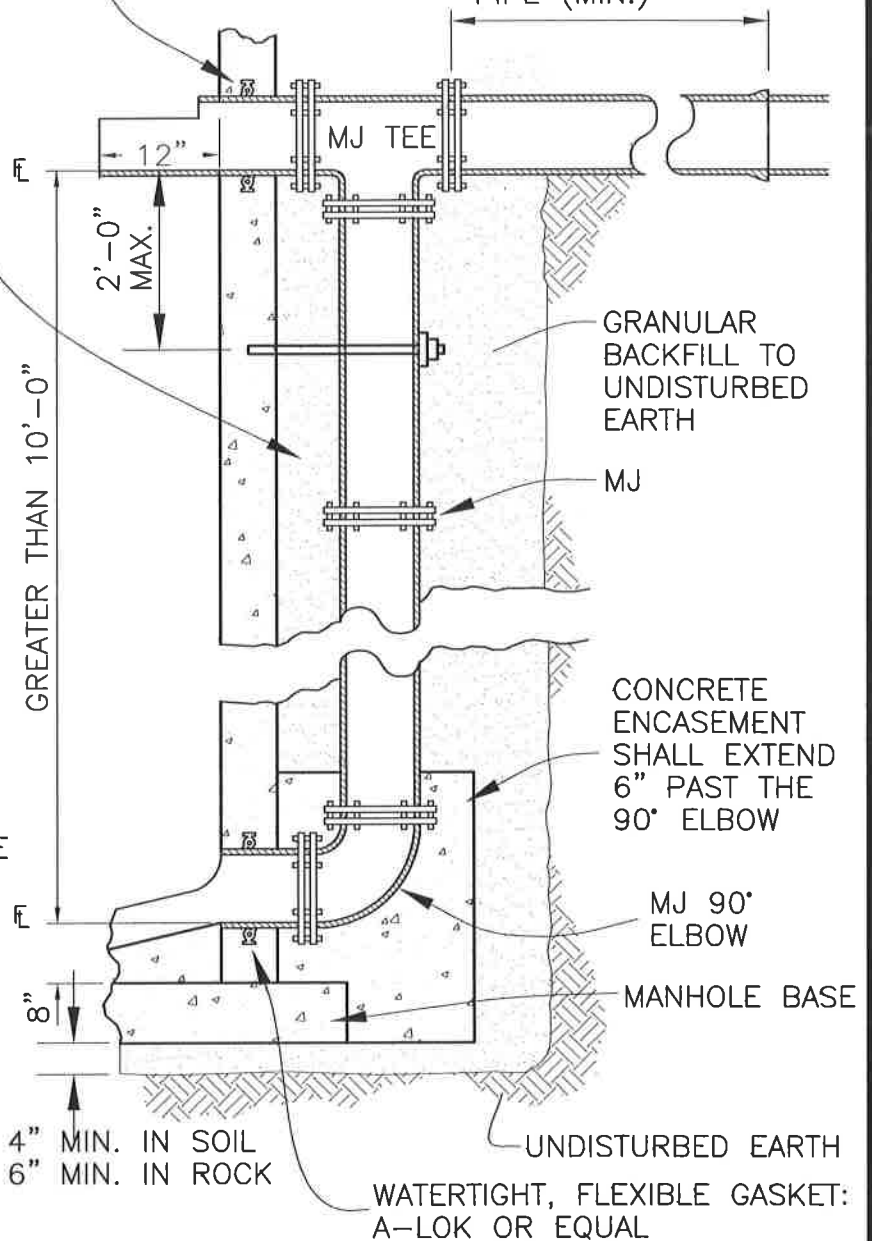
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STANDARD DROP MANHOLE

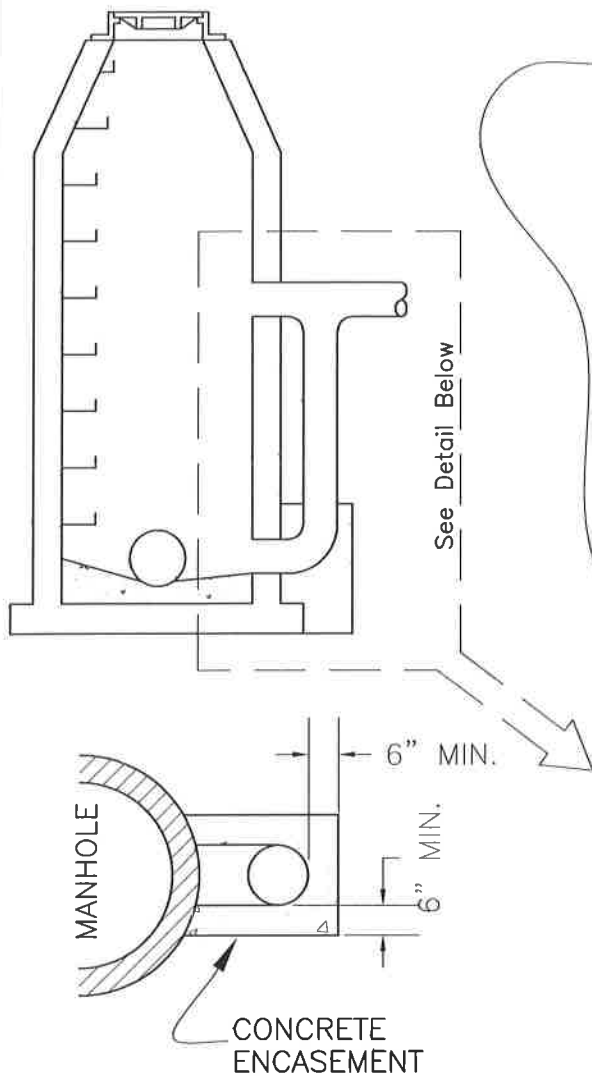
STAINLESS STEEL HALF CLAMP
ATTACHED WITH 2-3/4" STAINLESS
STEEL ANCHORS, MAX. 6' VERTICAL
SPACING.

WATERTIGHT, FLEXIBLE GASKET:
A-LOK OR EQUAL

ONE FULL SECTION
OF DROP ASSEMBLY
PIPE (MIN.)



See Detail Below



NOTES:

1. DROP INLET PIPE TO BE SAME SIZE AND MATERIAL AS SEWER MAIN.
2. ALIGNMENT OF TEE: DROP INLET PIPE AND LONG ELBOW MAY BE ADJUSTED TO MAXIMUM OF 5% DEFLECTION TO COMPENSATE FOR SLOPE OF SEWER LINE.
3. PIPE MATERIAL IN THE DROP ASSEMBLY SHALL CONFORM TO SECTION 505.2.b OF THE STANDARD SPECIFICATIONS.
4. DROP ASSEMBLY SHALL UTILIZE MECHANICAL COUPLINGS. THE COUPLINGS SHALL BE A MEGALUG MECHANICAL JOINT RESTRAINT, OR APPROVED EQUAL.

PHS
Approved

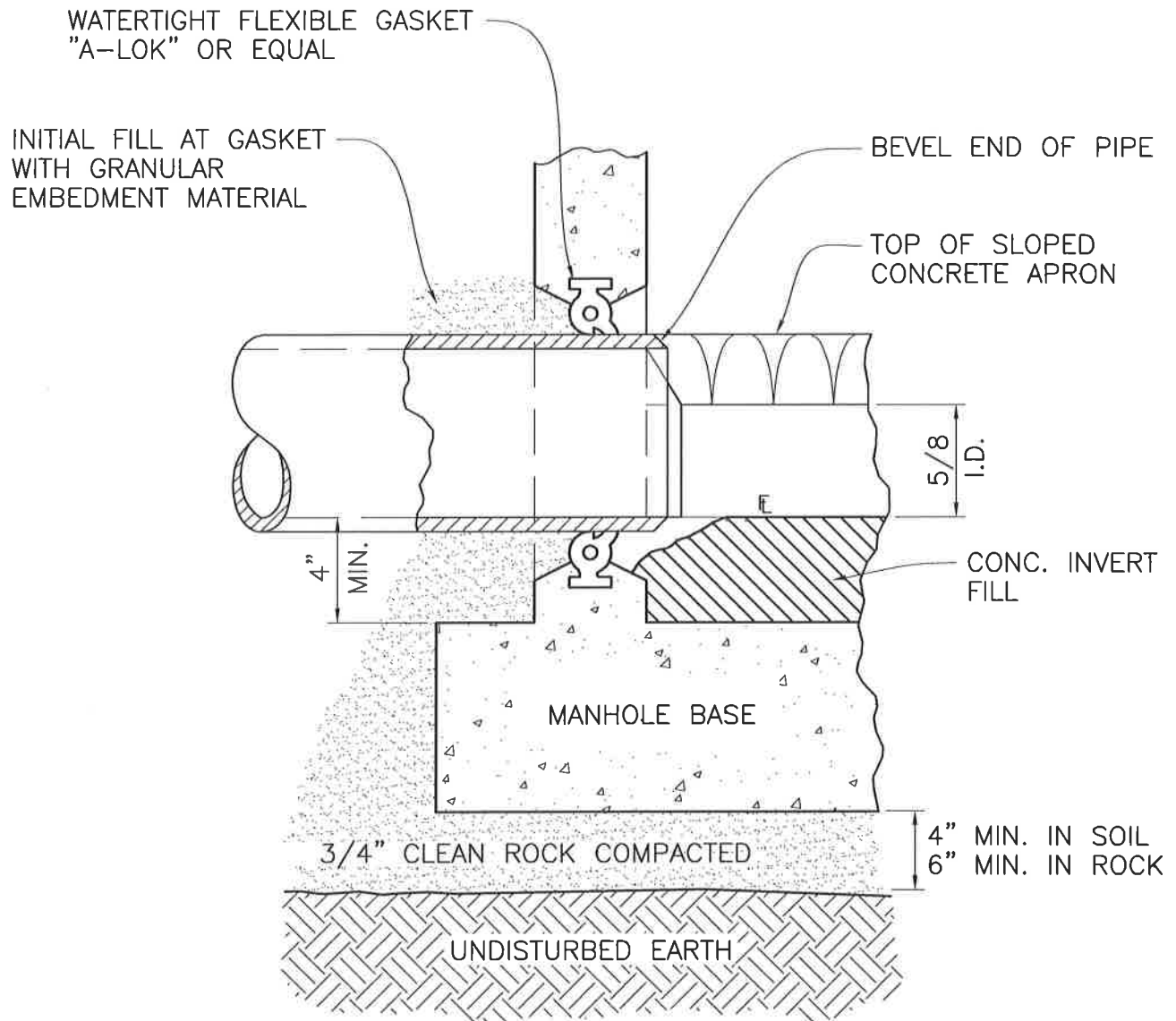
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DEEP DROP MANHOLE



NOTE:

1. BITUMINOUS COATING ON EXTERIOR SURFACE OF MANHOLE SHALL NOT COME IN CONTACT WITH PIPE GASKET.
2. FOR CAST-IN-PLACE CONCRETE MANHOLES OR PRE-CAST WITH BOX-OUTS, THE PIPE GASKET SHALL BE A RUBBER LABYRINTH WATERSTOP WITH STAINLESS STEEL CLAMPING BANDS LOCATED AT CENTER OF WALL AND THE SPACE BETWEEN PIPE & WALL COMPLETELY GROUTED WITH NONSHRINKING MORTAR.
3. PIPE MAY PROJECT 1" MAXIMUM PAST INSIDE WALL OF MANHOLE. NO CONTACT BETWEEN PIPE & INVERT MAY OCCUR.

RAS
Approved

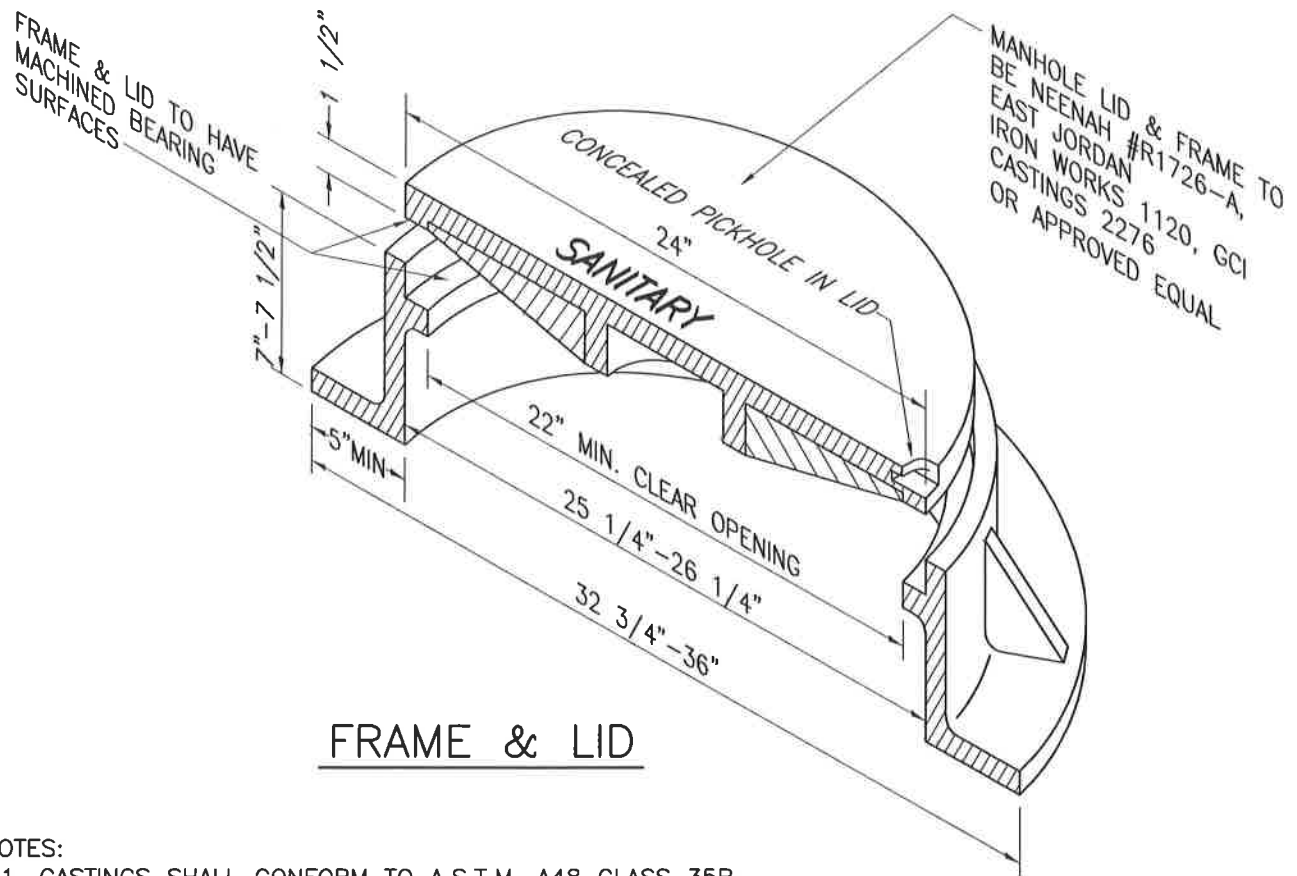
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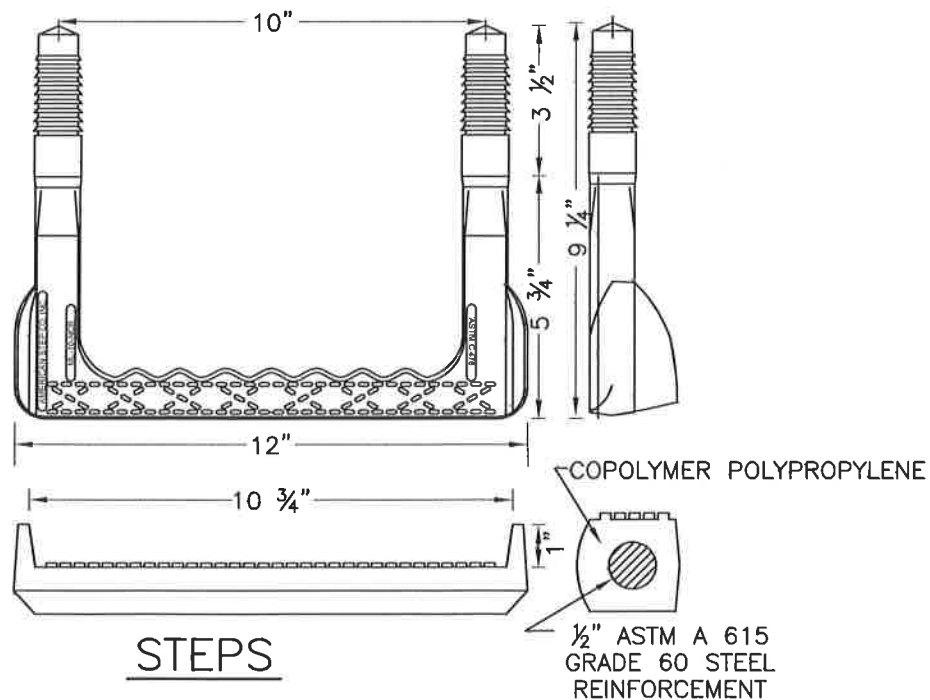
MANHOLE GASKET (Pipe Gasket Detail)



FRAME & LID

NOTES:

1. CASTINGS SHALL CONFORM TO A.S.T.M. A48 CLASS 35B.
2. LIDWEIGHT 135 lbs. $\pm 5\%$. TOTAL WEIGHT OF 350 lbs. $\pm 5\%$.
3. WATERTIGHT LID AND FRAME TO BE NEENAH #R-1916-F, OR APPROVED EQUAL
4. MANHOLE STEP AMERICAN ML-10-NCR OR APPROVED EQUAL
5. BOLT DOWN LIDS SHALL HAVE FRAMES BOLTED TO THE CONE SECTION



STEPS

DAS
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10/01/18
Date

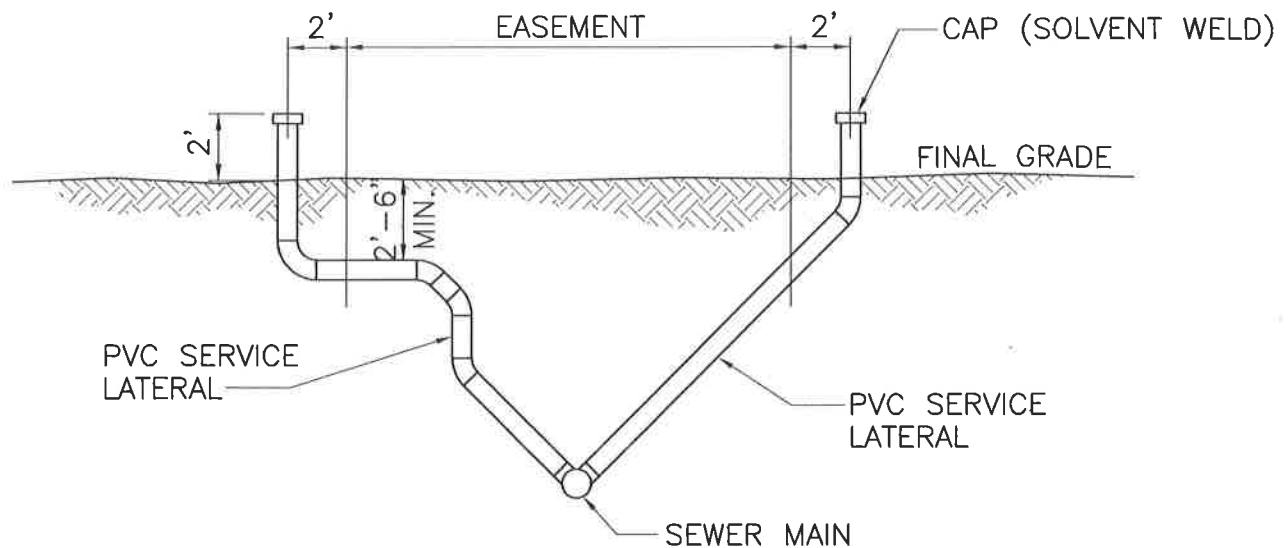
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Revised casting weight

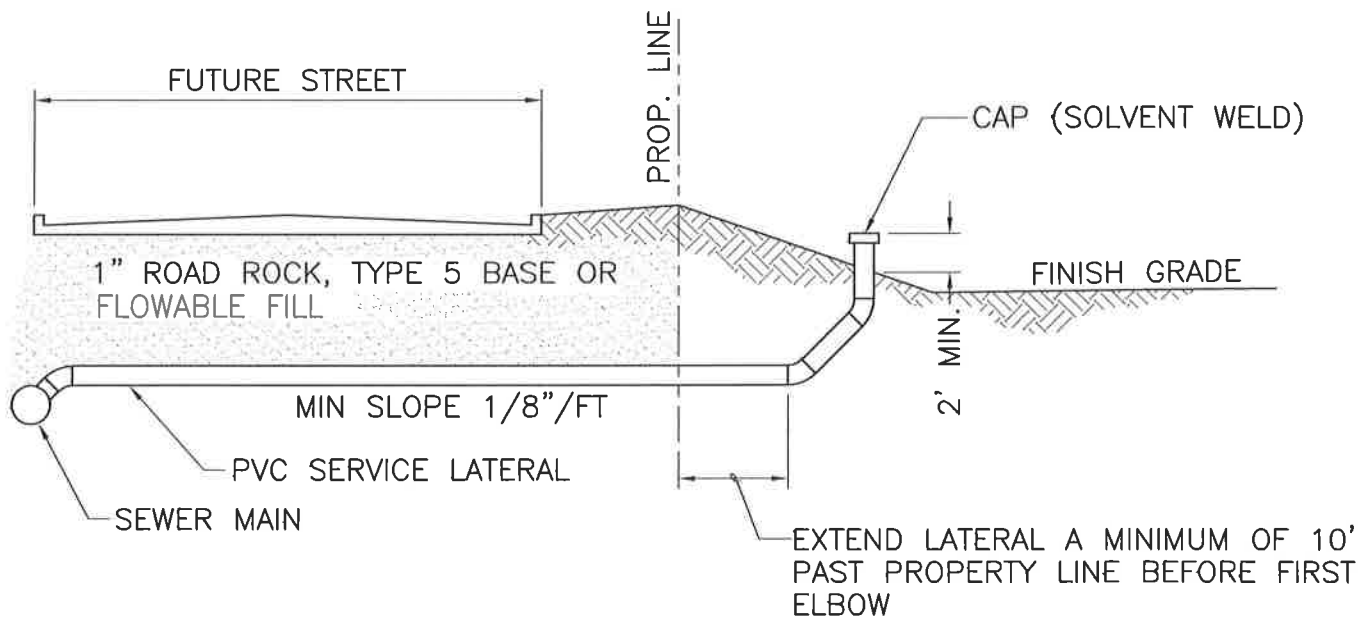


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MANHOLE CASTINGS (Frame, Lid & Steps)



SERVICE LATERAL EXTENSION FROM DEEP SEWER



SERVICE LATERAL EXTENSION UNDER FUTURE STREETS

NOTE:

THIS DETAIL IS FOR USE WHENEVER LATERALS ARE EXTENDED FROM THE SEWER MAIN DURING NEW CONSTRUCTION. IN ALL CASES WHEN SERVICE LATERALS ARE EXTENDED THE PIPE SHALL EXTEND A MINIMUM OF TWO (2) FEET ABOVE THE PROPOSED FINAL GRADE AND SHALL BE FITTED WITH A CAP THAT IS SOLVENT WELDED IN PLACE.

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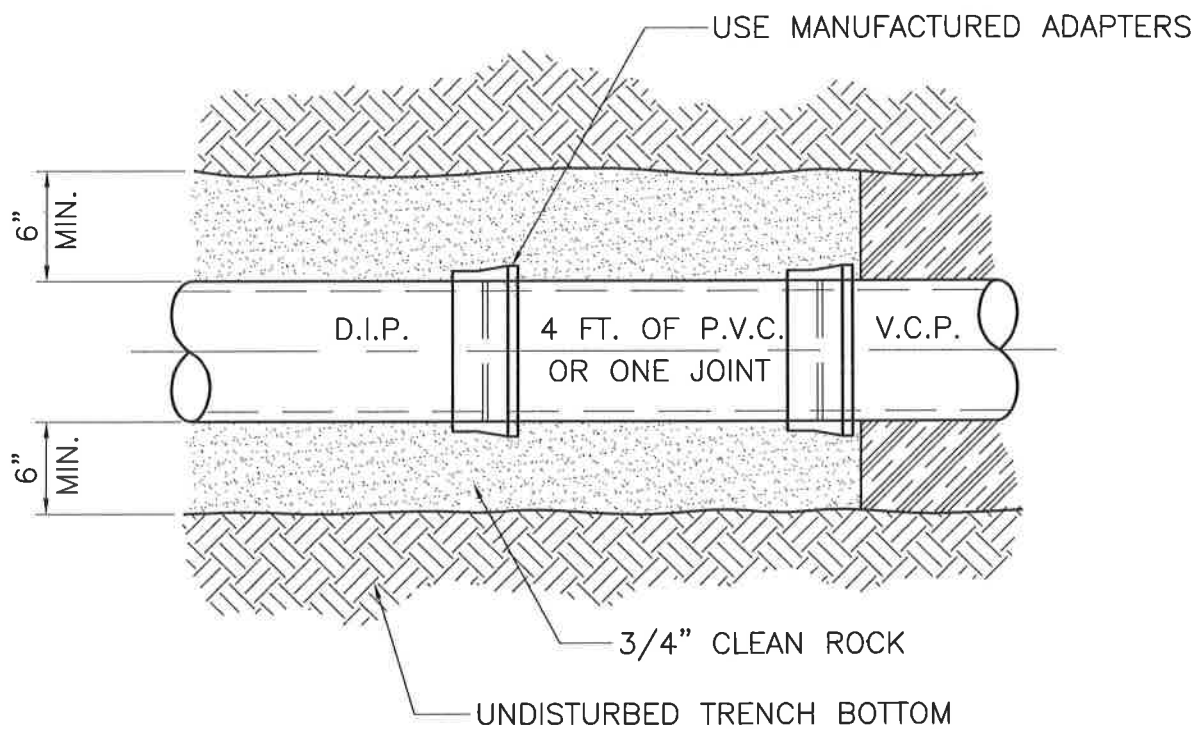
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LATERAL EXTENSION FOR NEW CONSTRUCTION



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V.C.P. / D.I.P. CONNECTION

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