CITY OF LOUISVILLE
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

DESIGN AND CONSTRUCTION STANDARDS

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CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

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CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 1
GENERAL

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CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 1
GENERAL

100 PURPOSE

These design and construction standards are a guide for the design and construction of public facilities within the City of Louisville. They are intended to insure equitable application of ordinances, rules and regulations. These are minimum standards and minor modifications may be allowed for sound engineering reasons but the burden of proof will be on the consulting engineer or contractor.

101 ABBREVIATIONS AND DEFINITIONS

Many commonly used abbreviations appear in these design and construction standards. These abbreviations normally require no explanation of definition beyond that contained in standard dictionaries and many technical handbooks.

Abbreviations of technical and construction terms used in these Design and Construction Standards are explained or defined in Section 101.1.

Technical and construction terms used in these Design and Construction Standards are defined in Section 101.2.

101.1 Abbreviations

Whenever references are made to the following Design and Construction Standards, methods of testing materials, codes, practices and requirements it shall be understood that the latest revision of said references shall govern unless a specific revision is stated. Wherever any of the following abbreviations appear they shall have the following meaning:

AASHTO	American Association of State Highway & Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
ASA	American Standards Association
ATSSA	American Traffic Safety Services Association
AWWA	American Water Works Association
CDOT	Colorado Department of Transportation
OSHA	Occupational Safety Health Administration
USGS	United States Geological Survey
MUTCD	Manual on Uniform Traffic Control Devices
MTC	Model Traffic Code for Colorado Municipalities

101.2 Definitions

Wherever in these standards the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as shown below. Working titles having a masculine gender, such as "workman" and "journeyman" and the pronoun "he", are utilized in these standards for sake of brevity, and are intended to refer to persons of either sex.

APPROVED	Items reviewed by the City of Louisville Public Works Department and found to meet or exceed the requirements of these Design and Construction Standards.
CITY	The City of Louisville, in the State of Colorado, acting by and through its City Administrator.
CITY CODE	The official adopted Louisville Municipal Code Louisville, Colorado.
CONTRACTOR	The individual, firm or corporation contracting for the construction of public improvements.
CONTRACTORS LICENSE	Applicable licenses to conduct work or construction in the City of Louisville in accordance with the requirements of the Louisville Municipal Code.
DESIGN ENGINEER	The individual, firm or corporation responsible for the preparation of public improvement plans.
DEVELOPER	The individual, firm or corporation who is developing a project.
ENGINEER	Public Works Director, City Engineer of the City of Louisville, or his authorized representatives acting on behalf of the City.
INSPECTOR	Authorized representative of the Engineer.
PROFESSIONAL ENGINEER	Professional Engineer licensed in the State of Colorado.
REGISTERED LAND SURVEYOR	Registered Land Surveyor licensed in the State of Colorado.
RIGHT-OF-WAY	All streets, highways, avenues, lanes, alleys, courts, places, squares, curbs, or other public ways in the City which have been or may hereafter be dedicated and open to public use, or such other public property so designated in any law of this state.

SHOP DRAWINGS	All drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by the Contractor, Subcontractor, manufacturer, supplier, or distributor, which illustrate how specific portions of the work shall be fabricated or installed.
SPECIFICATIONS	Contract document specifications.
STANDARDS	City of Louisville Design and Construction Standards.
SUB-CONTRACTOR	An individual, firm or corporation having a direct contract with the Contractor or with any other Sub-contractor for the performance of a part of the work at the site.
WRITTEN NOTICE	Any written notice from the City, which notice shall be deemed to have been properly served and delivered when posted by the sending party by certified or registered mail to the receiving party at the receiving party's last given address or when delivered in person to the receiving party or to his authorized representative.

102 IMPROVEMENT PLANS

102.1 Submittal Procedure

Anyone seeking approval of public improvement plans is required to follow the procedures outlined below. All improvement plans will be checked for conformance with the minimum design criteria set forth in these Standards prior to approval for construction. **Should the plan set submitted for review not conform to these Standards, the review process shall cease and the plan set returned to the Design Engineer.**

Any modifications to the drafting standards and plan set requirements specified herein must be approved by the Engineer prior to document submittal. The Engineer will review all documents for conformance with these Standards and return said documents no later than 30 days from the date of submittal.

The Design Engineer shall submit to the Engineer three complete plan sets for review. The plan set will be reviewed and one redlined set returned to the Design Engineer for correction. After correction, the Design Engineer shall resubmit one plan set and the original redline set for final review.

If all corrections have been made, the Design Engineer will be notified that the plans are ready for approval. Upon notification, the Design Engineer shall submit the original mylars for approval. The Approved mylars will be returned to the Design Engineer who shall then submit to the Engineer one set of mylar sepias and three signed and sealed blue line copies of the approved set.

The improvement plans shall be valid for one year from the date of approval and construction must be completed within that time period. If the construction is not completed within one year, the plans must be resubmitted for review and approval. Resubmitted plans will be reviewed in accordance with the Standards that are in effect on the date of resubmittal.

102.2 Plan Sheets - General

All plan sheets shall meet the following standards:

1) Each sheet shall be 24" x 36" mylar.
2) Drawings shall meet City of Louisville drafting standards. Lettering shall be scribed or legibly printed as approved by the Engineer. All proposed improvements shall be shown as solid lines and all existing improvements shall be shown as dashed lines.

3) Title blocks shall be on each sheet. Title blocks shall include the project name or subdivision name (filing and or phase number); sheet title and location; name, address, and telephone number of the Design Engineer; date; revision box; sheet number (i.e. Sheet ___of___); and a City approval box.

4) The seal and signature of the Professional Engineer under whose supervision the plans were prepared shall be on each applicable sheet of the reproduced plans.

5) Private improvements such as streets, utilities, etc., shall be clearly noted as such on each sheet of the improvement plans. Where private improvements occur the following note shall appear on each sheet of the improvement plans.

   "City of Louisville is not responsible for the maintenance of (name specific improvement)."

102.3 Plan Sets

All plan sets shall include but not be limited to the following sheets:
If one or more of the following items are incomplete the plans shall be considered incomplete for review and will be returned.

1) Cover Sheet
2) Final Plat
3) Public Improvements Phasing Plan (if applicable)
4) Master Utility and Surface Improvement Plan
5) Final Drainage Plan
6) Overlot Grading Plan
7) Street and Storm Sewer Plan and Profile
8) Water and Sanitary Sewer Plan and Profile
9) Details
10) Temporary Drainage and Erosion Control Plan
11) Construction Signing Plan
12) Permanent Signing and Striping Plan

102.4 Plan Sheets - Specific

Each plan sheet shall include the items listed under each respective sheet.

102.4-1 Cover Sheet

1) Project title or subdivision name (include filing number and phase).
2) "City of Louisville, Colorado".
3) "Prepared for: Developer or Owner name, address and phone number".
4) "Prepared by: Name of Design engineer, address and phone number".
5) Sheet Index indicating each sheet number and title.
6) Vicinity Map (3 mile diameter showing site location and names of arterial streets and other major streets in the vicinity of proposed project). Map scale = 1":2,000'. North Arrow. A current map is required.
7) Legend (including abbreviations) and notes as applicable.
8) Project benchmark.

102.4-2 Final Plat

1) Subdivision or development final plat.

102.4-3 Public Improvements Phasing Plan

1) Scale: 1" = 100'. North arrow.
2) Property lines. Lots and blocks numbered.
3) Streets and street names.
4) Indicate each phase and all public improvements included in each phase of construction.
5) Highlight all offsite public improvements relating to each construction phases.

102.4-4 Master Utility and Surface Improvement Plan

1) Scale: 1" = 100'. North Arrow.
2) Property lines. Lots and blocks numbered.
3) Streets and street names.
4) Location and elevation of City or USGS Benchmarks. All Benchmarks shall be referenced to a USGS datum.
5) Legend.
6) Proposed and existing utilities and surface improvements.

A) Sanitary Sewer Mains

1) Existing sanitary sewer mains and manholes. Include pipe size, flow direction, and type.
2) Proposed mains including manholes and appurtenances plainly labeled. Number manholes, indicate size, and type of pipe between manholes.

B) Water Mains

1) Existing water mains and fire hydrants. Include size and type of pipe.
2) Proposed mains, include appurtenances plainly labeled. Indicate size and type of pipe between all bends, valves, tees, crosses and hydrants.

C) Storm Sewer Facilities

1) Existing storm sewer facilities, storage facilities and outlet works. Include pipe size, flow direction and type and inlets.
2) Proposed storm sewer facilities, include appurtenances plainly labeled. Number manholes, number and size of inlets, size and type of pipe between manholes and inlets.

D) Surface Improvements

1) Existing streets and sidewalks. Include ramps and driveways.
2) Proposed streets and sidewalks. Include ramps and driveways.
3) Label flow line radius
4) Label type of concrete (30" Vertical curb and gutter, curbwalk, walk etc.)
5) Size and location of all bike paths, and walks in open space areas.
6) Size and location of all trickle channels and drainage structures.

102.4-5 Final Drainage Plan

1) Scale: 1" = 50 feet to 1" = 100 feet. North arrow.
2) A topographic map shall be provided with two foot existing and proposed contours tied to the City of Louisville Benchmark data. Monument information may be obtained from the City. The mapping shall extend a minimum of 250' beyond the property lines.
3) Property lines.
4) Streets and street names.
5) Existing drainage facilities and structures. Include irrigation ditches, roadside ditches, drainage ways, gutter flow directions and culverts. All pertinent information such as materials, size, shape, slope and location shall also be included.
6) Overall drainage area boundary and drainage sub-area boundaries.
7) Proposed type of curb and gutter and gutter flow directions, including crosspans.
8) Proposed storm sewers and open drainage ways. Include inlets, manholes, culverts and other appurtenances.
9) Proposed outfall point for runoff from the developed area and facilities to convey flows to the final outfall point without damage to the downstream properties.
10) Routing and accumulation of flows at various critical points for the initial storm runoff.
11) Routing and accumulation of flows at various critical points for the major storm runoff.
12) Details of detention
13) Location and elevations of all defined flood plains affecting the property.
14) Location and elevations of all existing and proposed utilities affected by or effecting the drainage design.

15) Routing of offsite runoff through the development.

102.4-6 Overlot Grading Plan

The overlot grading plan shall show the general extent of cut and fill for site grading purposes. The plan shall also include existing and proposed contours (2' max. contour intervals) and all grading work for drainage purposes.

1) Scale: 1" = 20' to 1" = 50'. North arrow.
2) Property lines. Lots and blocks numbered.
3) Streets and street names.
4) Proposed drainage facilities.
5) Existing drainage swales, pipes, crossings etc.

102.4-7 Street and Storm Sewer Plan and Profile

A) Plan

1) North Arrow
2) Bar scale (horizontal) 1" = 20' to 1" = 50'; vertical scale 1" = 5'.
3) Key map (vicinity map) scale 1" = 500' nor less than 1" = 1000' showing the location on that sheet in relation to the total development.
4) Property and/or ROW. lines, easements and/or tracts. Type and dimension of easement or tract is to be clearly labeled. Property lines and ROW. lines to be dimensioned.
5) Lots and blocks numbered.
6) All concrete walks, curb & gutter, crosspans, drainage channels, etc., to be shown.
7) Survey lines and stations, based on centerline stationing. Stationing is to be equated to flow line at bubbles, cul-de-sacs, horizontal curves and other departures from normal street cross-section, and 200' from all intersections.
8) Streets and street names, indicate street width.
9) Match lines referring to next sheets of design.
10) Station and elevation (flow line) of all curb returns, horizontal P.C.'s, P.T.'s etc., existing and proposed. Also, the high or low point on all vertical curves.
11) Directional flow arrows on each side of the street.
12) Curb return radius, existing and proposed.
13) Complete horizontal curve data (radius, delta ,length, tan, chord and chord bearing).
14) Centerline stations of all intersecting streets.
15) Survey line ties to section corners and quarter corners.
16) Handicap and mid-block ramp locations.
17) All storm sewer laterals, mains or trunk lines shall be tied to the centerline stationing of the street or easement and dimensioned perpendicular off the centerline.
18) Storm sewer manholes shall be numbered and stationed.
19) Inlets shall be numbered and stationed.
20) Size, type of pipe and footage noted between all manholes, appurtenances and inlets.
21) Benchmark description with elevation tied to Louisville data. Monument information may be obtained from the City.

B) Profile

1) Vertical Scale: 1" = 5'.
2) Vertical and horizontal grids with scales left and right sides of the sheet and stationing at the bottom of page for horizontal grid.
3) Existing ground profile (dotted or dashed) and labeled.
4) All design elevations shall be centerline, flow line or invert of pipe. Top of pipe is acceptable for existing utilities.
5) Centerline or flow line stationing continuous for entire length of street of project with centerline station of all intersection streets.
6) Existing improvements to be shown in the profile shall include but not be limited to sidewalks, curbs, gutters and street with certified as-built grades and elevations.
7) Existing and proposed utilities including but not limited to water, gas, telephone, storm sewer, sanitary sewer, irrigation ditches, electric, structures, cable, conduits and under drains where crossed with grades and elevations.
8) Station and elevation of all horizontal PC, PT, etc., existing and proposed.
9) Station and elevation of grade breaks, existing and proposed.
10) Proposed construction (vertical curves, with VPI, VPC and VP high and low point, not the middle ordinate. Stations and elevations, sight distance, safe speed per the AASHTO recommendations.
11) Curb return profiles.
12) Storm sewer manholes numbered, stationed, rim elevation, and invert elevations (E.W.N. and S.) and dimensioned offset from centerline.
13) Size, type of pipe, footage and slope (%) of storm sewer between manholes and inlets.
14) Match lines indicating references to previous and next corresponding sheets.

102.4-8 Water and Sanitary Sewer Plan and Profile

A) Plan

1) North Arrow
2) Bar Scale (Horizontal) 1" = 20' to 1" = 50'; vertical scale 1" = 5'.
3) Key Map (vicinity map), scale 1" = 500', nor less than 1" = 1000', showing the location on that sheet in relation to the total development.
4) Street R.O.W. with dimensions.
5) Property lines, lots and blocks numbered.
6) Street names and easements with dimensions.
7) Centerline street stationing.
8) Existing utilities including but not limited to water, gas, telephone, storm sewer, sanitary sewer, under drains, irrigation ditches, electric and cable.
9) Match lines indicating references to previous and next corresponding sheets.
10) All sanitary sewer laterals, mains or trunk lines shall be tied to the centerline stationing of the street or easement and dimensioned perpendicular off the centerline.
11) Manholes to be stationed and numbered.
12) Size, type of pipe, footage of sewer main shall be labeled between manholes.

13) Water mains, bends, valves, tees, crosses and hydrants shall be stationed off centerline stationing and dimensioned perpendicular off the centerline.
14) Water lines shall have size, type of pipe and length noted between all bends, valves, tees, crosses and hydrants.
15) All concrete walks, curb & gutter, crosspans etc., shall be shown on water and sanitary sewer plan.
16) Size, and stations of all water services and sanitary sewer services to be included on the plan.
17) Benchmark description with elevation tied to Louisville data. Monument information may be obtained from the City.

B) Profile

1) Vertical Scale: 1" = 5'.
2) Vertical and horizontal grids with scales. Left and right sides of sheet and stationing at bottom of page for horizontal grid.
3) Existing ground profile and labeled.
4) Proposed ground profile and labeled.
5) Existing and proposed utilities including but not limited to water, storm sewer, sanitary sewer, gas, telephone, irrigation ditches, electric, structures, cable, conduits and under drains with grades and elevations where crossed.
6) Manholes numbered, stationed, rim elevation, and invert elevation (E.W.N. and S).
7) Size, type of pipe, footage and slope (%) of sanitary sewer main and under drains between manholes.
8) Size, type and slope (%) of water mains as directed by the Engineer.
9) Match lines indicating references to prior and next corresponding sheets.

102.4-9 Details

Details to be included on the drawings, but not limited to are as follows:

A) Water Details

1) Class B pipe bedding detail and typical trench section.
2) Polyethylene wrap detail.
3) Thrust block and offset detail.
4) Waterline lowering detail.
5) PVC valve wire detail (if applicable).
6) Water service detail.
7) Fire hydrant details.
8) Blowoff detail.

B) Sanitary Sewer Details

1) Class B pipe bedding detail and typical trench section.
2) Manhole section detail.
3) Manhole base detail.
4) Sanitary service detail.

5) Lot service detail.
6) Manhole false bottom detail.
7) Manhole ring and cover detail.

C) Storm Sewer Details

1) Pipe bedding detail.
2) Manhole ring and cover detail.
3) Type R curb inlet detail.
4) Inlet or outlet structures (if applicable).
5) Trickle channel details (if applicable).

D) Street Details

1) Street classification and typical cross-sections.
2) Curbwalk and walk detail.
3) Vertical curb and gutter detail.
4) Ramp drive detail.
5) Street crosspan.
6) Handicap ramp details.
7) Street conduit crossing details.

102.4-10 Temporary Drainage and Erosion Control Plan

This plan shall indicate measures to be implemented to control and prevent erosion during the construction process through temporary piping, outlets, ponding areas etc., to protect the City's property, private property, and property adjacent to the site of the work.

A statement shall also be added to include measures to control dust nuisance and prevent dust originated from construction operations.

102.4-11 Construction Signing Plan

1) This plan shall indicate signing required per the MUTCD.

102.4-12 Permanent Signing and Striping Plan

1) The permanent signing and striping plan shall specify all the various types and combinations of signs and striping to be placed permanently, including but not limited to street name signs, stop signs, etc. as required by the MUTCD.

103 PRE-CONSTRUCTION

103.1 Pre-Construction Conference

A Pre-construction conference shall be held prior to the start of any construction work involving public improvements in the City right-of-way or proposed development. When construction plans have been approved by the City, the Developer shall schedule a

pre-construction conference. The Contractor, Developer, Design Engineer, Engineer, Inspector and utility representatives shall be in attendance.

103.2 Pre-Construction Submittals

At or prior to the pre-construction conference the Developer shall submit to the Engineer the following:

1) A list of all Contractors and consultants who will be working on the project. The list shall include the name and phone number of an authorized representative who shall have the authority to represent and act for the Contractor or Consultant. The list shall also include each contractor's City of Louisville Contractor's License Number.
2) A materials list. The list shall identify all materials by name, manufacture and model number or classification. Only the materials on the Approved materials list will be allowed to be used in the construction of the project. An approved materials list will be issued with the notice to proceed.
3) Mix designs. Mix designs certified by the supplier shall be submitted for all concrete, asphalt and aggregate. Only the Approved mix designs will be allowed to be used in the construction of the project.
4) A project schedule. Schedule shall include the start date and duration of each major item of work.
5) An application for a City Right of Way Permit.
6) Copies of executed permits required by any other agency or organization.

103.3 Notice to Proceed

Construction shall not commence until the Developer or Contractor has been issued a notice to proceed by the Engineer. A notice to proceed will not be issued until the Developer has successfully completed the following:

1) The submittal procedure for improvement plans.
2) The preconstruction conference.
3) The preconstruction submittals.
4) All applicable requirements of the subdivision agreement.

Under no circumstances shall the Contractor begin work on any portion of the public improvements prior to the date of the notice to proceed.

104 CONTROL OF WORK

The Contractor will be held in strict conformance to these Standards in regard to the quality of materials and workmanship. Non conformance shall constitute a stop work order and/or rejection of the work.

104.1-1 Authority of the Engineer

The Engineer shall exercise all authority on behalf of the City to ascertain that all construction of improvements is equal to or better than the minimum construction requirements set fourth in these Standards. The Engineer shall have the authority to assign

an Inspector to check any and all work performed within the City right-of-way. The Engineer shall have the authority to approve in writing, any deviations from the provisions of these Standards or changes to any previously approved drawings.

The Engineer shall not be responsible for the construction means, supervision, controls, techniques, sequences or procedures.

The Engineer may suspend or stop the work, wholly or in part until defective workmanship has been corrected, for any of the following reasons:

1) For such period of time deemed necessary due to unsuitable weather conditions.

2) Contractor's failure to perform according to these Standards.

3) Contractor's failure to provide safe working conditions.

104.1-2 Authority of the Inspector

The Inspector is assigned by the Engineer to insure the Contractor is complying with these Standards and Approved plans.

The Inspector has the authority to reject defective materials, inferior materials, defective workmanship and to suspend or stop the work which is not in accordance with these Standards or Approved plans until such time as the work is in compliance with the Approved plans and/or the Standards. The Inspector is not authorized to alter any provisions or to issue instructions contrary to these Standards or to make any changes to any previously Approved plans. **Any deviation from the Approved plans which have been Approved by the Engineer must be received by the Inspector prior to implementing the deviation.**

The Inspector must be notified at least 24 hours prior to any construction. Failure to notify the Inspector 24 hours prior to any construction shall be a cause for rejection of the work. Work installed without an inspection is cause to have the work re-excavated for inspection at the contractor’s expense.

104.1-3 Interpretations

Any interpretation of these Standards shall be made by the Engineer. Work performed not conforming to these Standards and prior to Engineer's approval shall be at the Contractors risk.

104.2 Conformity with Plans and Standards

All work performed and all materials furnished shall comply with the lines, elevations, grades, cross sections, dimensions and material requirements, including tolerances, indicated on the approved plans and these Standards. Materials or finished products incorporated in the work that do not conform to the approved plans, specifications, and these Standards will be rejected and shall be removed by the Contractor.

THE CONTRACTOR SHALL HAVE A COPY OF THESE STANDARDS AND A COMPLETE SET OF APPROVED PLANS ON SITE AT ALL TIMES. FAILURE TO COMPLY WITH THIS PROVISION SHALL RESULT IN THE SUSPENSION OF ALL WORK UNTIL THE PROVISION HAS BEEN MET.

104.3 Inspection Facilities

Inspection of the work by the Engineer or his authorized representative shall be not be considered as direct control of the work. The direct control of the work shall be the sole responsibility of the Contractor.

The Engineer shall have access to the work at all times and the Contractor shall furnish all reasonable facilities and shall assist the Engineer as necessary for the proper inspection of materials to be used and the workmanship involved in the construction. The Contractor shall provide all testing and inspection services required by these Standards or as required by the Engineer.

Inspections, tests or approvals by the Engineer shall not relieve the Contractor from his obligations to perform the work in accordance with the requirements of these Standards and the approved plans.

Authorized representatives or agents of participating Federal or State Agencies shall be permitted to inspect the work. The Contractor shall provide access to the work for inspection or testing thereof.

104.4 Supervision by Contractor

The Contractor shall supervise and direct the work. He shall be solely responsible for the means, methods, techniques, sequences and procedures of construction.

The Contractor shall at all times be present at the work site in person or represented by a competent superintendent who shall supervise and direct the work.

Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

The Engineer may require the Contractor to stop work on a specific part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses and telephone numbers of representatives who can be contacted at any time in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice.

104.5 Clean Up and Maintenance During Construction

On a daily basis the Contractor shall clean up all refuse, mud and dirt on streets, rubbish, scrap materials and debris so that at all times, the site of the work and surrounding area shall present a neat and orderly appearance.

Upon completion of the work, the Contractor shall remove from the site and any occupied adjoining property, all plants, buildings, rubbish, unused materials, lumber, and other materials belonging to him or his subcontractors. Any costs incurred by the City due to failure by the Contractor to clean up to the City's satisfaction will be at the Contractor's expense.

The Contractor shall maintain the work and public improvements during construction and until Final Acceptance by the City. This maintenance shall constitute continuous and effective work daily, to insure roadways and structures are kept in satisfactory condition at all times.

Should the Contractor fail to perform maintenance during construction, the Engineer will notify the Contractor of such noncompliance. If the Contractor fails to comply within the time specified by the Engineer after receipt of such notice, the Engineer will proceed to maintain the work at the expense of the Contractor.

104.6 Removal of Unacceptable and /or Unauthorized Work

The Contractor shall remove from the premises, all work or materials rejected by the Engineer for failure to comply with the Approved plans or these Standards.

In the event the Contractor fails to remove rejected items from the job site within a reasonable length of time, the Engineer may arrange for such removal at the expense of the Contractor.

104.7 Cooperation of Contractor

The Contractor shall be responsible for ascertaining the nature and extent of any work being conducted by other forces within or adjacent to the worksite of the project. The City, utility companies and other contractors shall have the right to operate within or adjacent to the worksite. The Contractor shall conduct his operations in such a manner as not to cause any unnecessary delay of hindrance to the work being performed by other such forces. Wherever necessary, the work of the Contractor shall be coordinated with the work of others so that no discrepancies result in the whole work and he shall be responsible for arranging with the proper representative of other such forces for the coordination of the work.

Also, emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared to do all such work promptly upon notification from the Engineer.

105 CONTROL OF MATERIALS

105.1 Source and Quality of Materials

The Contractor shall furnish all materials required to complete the work and all materials shall meet or exceed all quality requirements of these Standards. The materials furnished and used shall be new, except as may be provided elsewhere in these Standards or on the Approved plans.

All construction materials to be used on the work or incorporated into the work shall be subject to the inspection and approval or rejection by the Engineer.

Manufacturers' warranties, guaranties, instruction sheets and parts lists, which are furnished with certain articles or materials incorporated in the work, shall be delivered to the Engineer prior to construction acceptance of the project.

105.2 Samples and Testing of Materials

All materials to be incorporated into the work may be subject to sampling, testing and approval prior to installation. The Engineer may select samples or require that samples be delivered by the Contractor to a laboratory. Costs for sampling and testing shall be at Contractors expense. Samples furnished shall be representative of the materials to be used.

The Engineer may permit the use of some manufactured materials prior to sampling and testing provided they are delivered with a Certificate of Compliance stating that the materials comply with the requirements of the Approved plans and specifications. Each certificate shall be signed by a person having legal authority to bind the supplier or manufacturer. Each certificate shall be delivered to the Engineer.

Whenever a reference is made in these Standards to a specification, manual or test designation either of the ASTM, AASHTO or any other nationally recognized organization, and the number or other identification representing the year of adoption or latest revision is omitted, it shall mean the specification, manual or test designation in effect on the day the notice to proceed for the work is dated.

105.3 Storage of Materials

The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment approved for storage. Stored items shall be located so as to facilitate their prompt inspection. Portions of the right-of-way or easements not required for public travel may be used for storage purposes when approved by the Engineer. Any additional storage area required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. The Engineer shall be provided with copies of such written permission agreements prior to storing materials.

105.4 Handling of Materials

Materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work. Manufacturers written requirements may be followed upon written approval of the Engineer if different than accepted local practices.

106 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

106.1 Indemnification

The Contractor agrees to indemnify and hold harmless the City of Louisville, its officers, employees, insurers and self insurance pool, if any, from and against all liability, claims and demands, on account of injury, loss or damage, including without limitation, claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arises out of or are in any manner connected with the project or performance of the work, if such injury, loss or damage is caused in whole or in part by, or is claimed to be caused in whole or in part by, the act, omission, error, professional error, mistake, negligence or other fault of the Contractor, any agent of the Contractor or any subcontractor of the Contractor. The Contractor agrees to investigate, handle, respond to and to provide defense for and defend against, any such liability, claims or demands at the sole expense of the Contractor. The Contractor also agrees to bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not such liability, claims or demands alleged are groundless, false or fraudulent.

The indemnification obligation in any such claim against the City or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly employed by any of them, or anyone for whose acts any of them may be liable shall not be limited in the amount or type of damages, compensation, or benefits, payable by or for the Contractor or any Subcontractor under Workmen's Compensation Acts, Disability Benefit Acts, or other employee benefits acts.

106.2 Laws to be Observed

The Contractor shall keep fully informed and comply with all Federal, State and local laws, ordinances and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which may affect those engaged or employed on the work, or affect the conduct of the work. The Contractor shall protect and indemnify the City and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by the Contractor, the subcontractors, suppliers of materials or services, or their employees.
If any discrepancy or inconsistency is discovered in the plans or these Standards in relation to any such law, ordinance, regulation, order or decree, the Contractor shall forthwith report the same to the Engineer in writing.

106.3 Permits and Licenses

The Contractor shall procure all permits and licenses, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the project. Prior to

beginning work the Contractor shall furnish the Engineer a written list of all permits required for the proper completion of the project. The Contractor shall furnish to the Engineer, copies of the fully executed permits.

106.3-1 City Permits

All work within the City right-of-way requires a Right-of-Way Permit. Contractors working in the right-of-way without a Right-of-Way Permit will be issued a stop work order and shall remove all obstructions until a permit is issued.

The following is a list of permits issued by the Public Works Department:

1) Right-of-Way permit.
2) Blasting permit.
3) Building moving permit.
4) Bulk Water permit.

106.4 Safety, Health and Sanitation Provisions

The Contractor shall provide and maintain neat, sanitary and convenient accommodations for his employees use as may be necessary to comply with the requirements and regulations of the Colorado State Department of Health and OSHA. Full use of the Contractor's accommodations shall be provided to the Engineer.

The Contractor shall at all times provide an abundant supply of safe drinking water for his employees and shall give orders against the use of water in the vicinity of the work, known to be unsafe. At convenient places, the Contractor shall provide fly-proof outside toilets which are to be maintained in a sanitary condition. Privy toilets which require a hole in the ground shall not be allowed.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other actions reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the work.

Precautions shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws pertaining to such protection, including all Federal and State occupational safety and health acts, standards, and regulations promulgated thereunder.

The Contractor shall comply with the rules and regulations of the Industrial Commissions of Colorado, OSHA and all applicable rules and regulations adopted by the City of Louisville and any applicable contract, permit or license provision.

106.5 Maintenance of Traffic

The Contractor shall insure that any portion of the project being used by the public shall be maintained in such condition that vehicular and pedestrian traffic shall be adequately accommodated. He shall also provide and maintain safe temporary approaches, crossings

and intersections for agencies and facilities that provide emergency services or necessary services to the public. Traffic shall be maintained in accordance with the MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).

A traffic control plan shall be prepared by the Design Engineer or the Contractor and submit to the Engineer for review prior to beginning construction. The traffic control plan shall be prepared in accordance with the MUTCD. All traffic control devices shall be listed on the traffic control plan and reviewed by the Engineer.

The Engineer reserves the right to make modifications to the traffic control plan at any time and the Contractor shall adjust the traffic control accordingly. The Engineers requested modifications shall be accomplished promptly or a stop work order will be issued.

Traffic control and implementation of the traffic control plan for the construction area is the responsibility of the Contractor and shall include furnishing, installing, moving, maintaining and removing all traffic control devices required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" and the latest revisions of the Colorado Supplement thereto and in accordance with Section 630 of the "State Department of Highways, Division of Highways, State of Colorado Standard Specification for Road and Bridge Construction", latest edition. The Contractor shall conform strictly to the guidelines established in the referenced manuals.

The plan shall consider differing site conditions, construction phases, median configurations, and intersection locations. The Contractor shall develop and submit a method for handling traffic for each different phase of construction which shows the Contractor's proposed construction phasing and proposed traffic control devices consistent with the traffic control plan. If at any time the Contractor desires to change the method for handling traffic, it shall be considered a different phase requiring a new method for handling traffic.

Each proposed method for handling traffic shall be reviewed by the Engineer before the corresponding phase of construction will be allowed to begin.

Any portable device that requires weight to prevent overturning shall be weighted with appropriate sized sand bags. Rocks, asphalt, or any other debris will not be permitted.

ALL TRAFFIC CONTROL MUST BE SET UP PRIOR TO ALL AND ANY PART OF CONSTRUCTION ACTIVITIES. THE ENGINEER MAY DIRECT MODIFICATIONS TO THE APPROVED TRAFFIC CONTROL PLAN AT ANY TIME OR TO STOP WORK UNTIL APPLICABLE OR REMEDIAL SAFETY MEASURES ARE TAKEN.

It is imperative that the City of Louisville Police and Louisville Fire Protection District be notified 48 hours prior to closing and immediately after opening of any street, alley or fire lane. Notification to the Police and Fire Protection District shall be the responsibility of the Contractor.

106.5-1 Temporary Traffic Lanes

1) No arterial, collector or local street may be closed without prior approval of the Engineer.
2) Unless approved by the Engineer, construction operations are limited to one-half of the roadway at any time.
3) All temporary lanes shall be a minimum of 12' in width.
4) Temporary lanes shall have a surface suitable to the Engineer.
5) The Contractor shall remove existing striping and restripe as needed or as directed by the Engineer.
6) The Contractor shall provide a flagman whenever separate lanes of traffic for each direction of flow cannot be maintained or as directed by the Engineer.
7) A copy of the Contractor's traffic control plan shall be submitted to the Engineer for review prior to construction.

106.6 City Utilities

The Contractor shall at all times coordinate his work with the City of Louisville. When it is necessary to close existing portions of any water or sewer system due to construction operations, at least 48 hours prior notification must be given the Engineer. **All water valves that are in service shall only be operated by the City.** The Contractor shall conduct his operations in such a manner as to minimize inconvenience to the public due to disconnected utility services.

Should it become necessary to temporarily disconnect any utility, the Contractor shall first obtain the approval of the Engineer and provide notification in writing 48 hours in advance to the utility customer regarding any disconnection of service. Such utility shall then be disconnected after 9:00 a.m. and shall be restored by 4:00 p.m. the same day.

If the Contractor's operations require or cause the utility service to be disconnected beyond the limits stated above, he shall make arrangements to provide temporary utility service. In the event a utility is disconnected beyond the hours stated above, the Engineer shall have the authority to order a temporary utility service installed either by City forces or by a third party at the Contractor's expense.

106.6-1 Contractor's Responsibility for Utility Property and Services

The Contractor shall be responsible for determining the exact location of all existing utilities and protecting them from any damage. Prior to any excavation, the Contractor, by potholing, shall verify the actual types, locations (vertical and horizontal) and sizes of all existing utilities within the work area. In the event that the Contractor discovers utilities either not identified or not identified properly on the Approved plans, the Contractor shall immediately notify the Design Engineer, Engineer and utility owner in the most expeditious manner available and later confirm in writing. The fact that any underground utility is not shown on the Approved plans shall not relieve the Contractor of his responsibility for the utility.

The Contractor shall contact the City and owners of existing utilities for stake and locates whether above ground or underground, prior to any excavation at the **Utility Notification**

Center of Colorado (1-303) 534-6700 or 1-800-922-1987.

The Contractor shall cooperate with the owners of underground or overhead utilities in order that the work may progress in a reasonable manner and that duplication of work may be minimized.

The Contractor shall not commence works at points adjacent to the property, equipment or service facilities of utilities until arrangements for protection, removal or movement thereof have been made. The Contractor shall not undertake work adjacent to fire hydrants until the local fire authority and Engineer have approved provisions for continued use and service.

The Contractor shall immediately notify the utility owner if any utility service is interrupted as a result of the Contractor's operations. The Contractor shall assist and cooperate with the utility in the restoration of the service. The Contractor shall not attempt to make repairs to damaged utility lines without written authorization from the effected utility. A copy of said written authorization shall be submitted to the Engineer. Utility service interruptions or damages caused by the Contractor's negligence, carelessness or failure to utilize the utility's capabilities in locating services shall be the sole responsibility of the Contractor. The Contractor shall be liable for all damages to such existing facilities and structures, as herein provided, and he shall indemnify, hold harmless and defend the City from any liability or expense for injuries, damages, or repairs to such facilities.

106.7 Protection of Work, Property and Persons

The Contractor shall be responsible for initiating, maintaining and supervising all safety programs in connection with the work. He shall take precautions necessary to provide for the safety of the employees and the public. He shall protect materials and equipment that are to be incorporated into the work.

He shall provide protection to prevent damage to City property and other property at or adjacent to the site. Property to be protected shall include, but not be limited to, pavements, roadways, alleys, bikeways, sidewalks, structures, utilities, trees, lawns, and shrubs. The Contractor shall provide and maintain all passage ways, guard fences, lights, and other facilities for protection required by public authority or local conditions. He shall protect carefully from disturbance or damage all land monuments until a registered land surveyor has witnessed or otherwise referenced their location, and shall not remove them until directed by the Engineer. The Contractor is subject to State statutes regarding destruction of monuments.
The Contractor shall comply with all legally applicable laws, orders, ordinances, rules or regulations enacted by the public body having jurisdiction over the work. He shall erect and maintain all necessary safeguards for safety and protection as required by the progress of the work. He shall notify owners of adjacent utilities at such time as progress of the work may directly effect them.

When any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect or misconduct in the execution of the work, or in consequence of the non-execution thereof on his part, such damaged property shall be restored by the Contractor at his own expense to a condition similar or equal to that existing

before such damage or injury. The Contractor shall act promptly in emergencies to prevent threatened damage, injury or loss to the work or persons or property at or adjacent to the site. In emergency situations, the Contractor is expected to act promptly and without special instruction or authorization from the Engineer.

106.8 Public Convenience and Safety

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

Access to private property shall be maintained in order to minimize inconvenience to the property owner or lessee. The Contractor shall notify the property occupant 48 hours in advance of any construction in front of driveways. Inconvenience caused by construction across driveways and sidewalks shall be minimized by restoring serviceability.

106.9 Use of Explosives

The use of explosives will not be permitted unless authorized in writing by the Engineer and after the Contractor has obtained the necessary permits. The Engineer reserves the right to order the discontinuance of blasting operations at any time.

106.10 Prevention of Water Pollution

The Contractor shall comply to all applicable Federal, State and Local laws, orders, and regulations concerning the control and abatement of water pollution.

106.11 Prevention of Air Pollution

The Contractor shall comply to all applicable Federal, State and Local laws and regulations concerning the prevention and control of air pollution.

Unless otherwise shown on the Approved plans, material to be disposed of shall not be burned, either inside or outside of the project.

106.12 Dust Control

The Contractor shall comply to all applicable Federal, State and Local laws and regulations concerning the prevention and control of Dust Abatement.

107 ACCEPTANCE OF WORK

107.1 Construction Acceptance

Construction Acceptance is documented by the issuance of a construction acceptance letter from the Engineer at which time a warranty period begins. Construction Acceptance shall be granted based on submittal and completion of the following.

1) Written request for construction acceptance from the Owner/Developer.

2) All public improvements have been completed in accordance with the approved plans and subdivision agreements and these Standards.

3) "As Built" drawings, certified by the Design Engineer have been received, reviewed and Approved by the Engineer.

4) Certification of construction costs have been received and reviewed by the Engineer.

5) All testing has been completed and required results have been met and submitted to the Engineer.

6) All items on the public improvement punch list have been completed.

107.2 As-Built Drawings

Prior to granting construction acceptance, as-built drawings are required on all construction. As-built drawings shall be signed and sealed by a Professional Engineer. The as-built drawings and elevations shall be field checked by the Design Engineer.

Should the Engineer determine that the as-builts do not correctly represent constructed field data, the as-builts will be returned for verification and correction.

As-built drawings shall include but not be limited to the following information.

STREET AND STORM SEWER PLAN AND PROFILE

A) PLAN

1) Property and/or R.O.W. lines, easements and/or tracts. Type and dimension of easement or tract is to be clearly labeled. Property lines and R.O.W. lines shall be dimensioned.
2) Lots and blocks numbered.
3) All concrete walks, curb & gutter, bike paths crosspans, drainage channels, etc., shall be shown.
4) Survey lines and stations, based on centerline stationing. Stationing shall be equated to flow line at bubbles, cul-de-sacs, horizontal curves, and other departures from normal street cross-section, and 200' from all intersections.
5) Streets and street names, indicate street width.
6) Match lines referring to previous and next corresponding sheets.
7) Station and elevation (flow line) of all curb returns, horizontal P.C.'s, P.T.'s etc. Also, the high or low point on all vertical curves.
8) Directional flow arrows on each side of the street.
9) Curb return radius, existing and proposed.
10) Complete horizontal curve data. radius, delta ,length, tan, chord, chord bearing).
11) Centerline stations of all intersecting streets.
12) Survey line ties to section corners and quarter corners.

13) Handicap and mid-block ramp locations.
14) All storm sewer laterals, mains or trunk lines shall be tied to the centerline stationing of the street or easement, and dimensioned perpendicular off the centerline.
15) Storm sewer manholes shall be numbered and stationed.
16) Inlets shall be numbered and stationed.
17) Size, type of pipe, and footage noted between all manholes, appurtenances and inlets.
18) Benchmark description with elevation tied to Louisville data. Monument information may be obtained from the Engineer.

B) PROFILE

1) Existing ground profile (dotted or dashed) and labeled.
2) All as-built elevations shall be centerline, flow line, or invert of pipe. Top of pipe is acceptable for existing utilities.
3) Centerline or flow line stationing continuous for entire length of street of project with centerline station of all intersection streets.
4) Existing improvements to be shown in the profile shall include but not be limited to sidewalks, curbs, gutters, and with **certified as-built grades and elevations.**
5) Existing and proposed utilities including but not limited to water, gas, telephone, storm sewer, sanitary sewer, irrigation ditches, electric, structures, cable, conduits and under drains where crossed with grades and elevations.
6) Invert elevations at all stubs.
7) Station and elevation of all horizontal PC, PT, etc., existing and proposed.
8) Station and elevation of grade breaks, existing and proposed.
9) As-built construction (vertical curves, with VPI, VPC, and VP high and low point, not the middle ordinate. Stations and elevations, sight distance, safe speed per the AASHTO recommendations).
10) Curb return profiles.
11) Storm sewer manholes numbered, stationed, rim elevation, and invert elevations (E.W.N. and S.) and dimensioned offset from centerline.
12) Size, type of pipe, footage and slope (%) of storm sewer between manholes and inlets.
13) Match lines indicating references to next sheets.

WATER AND SANITARY SEWER PLAN AND PROFILES

A) PLAN

1) Street R.O.W. with dimensions.
2) Property lines, lots and blocks numbered.
3) Street names and easements with dimensions.
4) Centerline street stationing.
5) Existing utilities including but not limited to water, gas, telephone, storm sewer, sanitary sewer, under drains, irrigation ditches, electric and cable.
6) Match lines indicating references to next sheets of design.
7) All sanitary sewer laterals, mains or trunk lines shall be tied to the centerline stationing of the street or easement, and dimensioned perpendicular off the centerline.

8) Manholes to be stationed, and numbered.
9) Size, type of pipe, footage of sewer main shall be labeled between manholes.
10) Water mains, bends, valves, tees, crosses, and hydrants to be stationed off centerline stationing, and dimensioned perpendicular off the centerline.
11) Water lines shall have size, type of pipe, and length, noted between all bends, valves, tees, crosses and hydrants.
12) All concrete walks, curb & gutter, crosspans etc., to be shown on water and sanitary sewer plan.
13) Size, and stations of all water services and sanitary sewer services.
14) Benchmark description with elevation tied to Louisville data. Monument information may be obtained from the Engineer.

(B) PROFILE

1) Existing ground profile labeled.
2) As-built ground profile labeled.
3) Existing and proposed utilities including but not limited to water, storm sewer, sanitary sewer, gas, telephone, irrigation ditches, electric, structures, cable, conduits and under drains with grades and elevations where crossed.
4) Manholes numbered, stationed, rim elevation, and invert elevation (E.W.N. and S).
5) Size, type of pipe, footage and slope (%) of sanitary sewer main and under drains between manholes.
6) Size, type, and slope (%) of water mains as directed by the Engineer.
7) Match lines indicating references to next sheets of the design.
8) Invert elevations on all water and sanitary sewer lateral stubs.

C) DETAILS

Details of special conditions and construction shall be as-built.

107.3 Warranty Period

Should any failure of the work occur within one year after the date of the construction acceptance, the Contractor shall make all necessary repairs and/or replacements to restore the work in conformance with these Standards and the Approved Plans.

107.4 Final Acceptance

Following the warranty period after construction acceptance, Final Acceptance shall be requested in writing from the owner or Developer. If all conditions of final acceptance are met and all deficiencies, if any, are repaired to the satisfaction of the Engineer, final acceptance will be granted by issuing a final acceptance letter.

If conditions of final acceptance, completion of deficiencies and repairs are not undertaken in a timely manner, the Engineer may schedule correction of the work. All costs incurred from correction and completion of the work to achieve final acceptance will be charged to either the owner, Developer or Contractor.

CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 2
SANITARY SEWER

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SECTION 2
SANITARY SEWER

200 GENERAL

The City of Louisville Design and Construction Standards apply to all sanitary sewer construction within the City of Louisville.

201 DESIGN

All sanitary sewer systems shall be designed in accordance with these Design and Construction Standards and criteria established by the Colorado Department of Health.

There shall be no vertical or horizontal curves in sanitary sewers.

The design flow velocity shall not exceed 10 feet per second using Manning's Formula and n=0.009.

When water mains cross sanitary sewer mains, the water main must be installed above the sanitary sewer main with 24 inches minimum vertical separation between the outside of the water main and the outside of the sanitary sewer main.

If the water main separation is less than 24 inches, concrete encasement of the sanitary sewer main ten feet each side of centerline of the water main shall be required.

In the case where the water main can not be installed above the sanitary sewer main, both the water main and sanitary sewer main shall be encased in concrete ten feet each side of centerline.

201.1 ALIGNMENT

The general location of all sewer mains and manholes shall be on the downhill side of the centerline of the street. The general location shall be six (6) feet from the centerline of local and collector streets and six (6) feet from median flowline on arterial streets. In all cases manhole placement shall not interfere with the vehicular tire traffic pattern. Curvilinear alignment is strictly prohibited. All piping shall be constructed to the lines and elevations shown on the approved plans.

Where on street parking is approved, a sewer main or manhole shall be placed not closer than ten (10) feet to an existing or future curb flow line.

Sanitary sewer mains shall be installed at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge.

201.2 SLOPE

All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013. The following are the minimum slopes, which shall be provided; however, slopes greater than these are desirable:

Sewer Size	Minimum Slope in Feet Per 100 Feet
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

202 POLYVINYL CHLORIDE PLASTIC GRAVITY SEWER PIPE

All material, manufacturing operations, testing and inspection of PVC sewer pipe shall be in conformity with the requirements of ASTM D 3034. All pipe shall be new.

202.1 DIAMETER OF PIPE

The diameter indicated on the approved construction drawings shall mean the nominal diameter of the pipe. The minimum allowable size for a sanitary sewer main is eight (8") inch diameter.

202.2 WALL THICKNESS DESIGN OF PIPE

The standard dimension ratio of the diameter to the wall thickness shall not be greater than SDR 35 for 4" PVC Pipe and SDR 35 for pipes larger than 4" and conforming to ASTM D 3034.

202.3 PIPE, FITTINGS AND SPECIALS

All fittings and specials shall conform to the requirements set forth in ASTM D 3034, shall have the same structural properties, and the same bell and/or spigot configurations as an adjoining pipe.

All sewer fittings associated with the construction of new sewer pipe, including wyes, bends, and plugs shall be manufactured of the same material, to the same specifications,

and with the same specified joints as is the installed sewer main. All materials shall be clearly marked on the exterior surface of all pipe and fittings with the following:

1) ASTM designation
2) Class and size
3) Date of manufacture
4) Name or trade mark of manufacturer

202.4 JOINTS

All PVC joints shall be of bell and spigot type. The bell shall conform to ASTM D 3034. The rubber ring shall be in accordance with ASTM D 1869. The joint shall meet the requirements of ASTM D 3212. Spigot and bell ends shall be smooth and free of burrs, and foreign particles prior to making the joint.

An approved lubricant shall be applied to the sealing ring to prevent damage to the ring and aid in making a tight joint. The gasket shall comply with ASTM F 477.

202.5 MATERIAL TESTING

All PVC Gravity sewer pipe shall be capable of passing all of the following tests at 73^{o} F (plus or minus 3^{o} degrees F).

A. STIFFNESS The minimum "pipe stiffness: (F/ Y) at 5% deflection shall be 46 psi. For all sizes, when tested in accordance with ASTM Method of Testing D-2412, External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

B. FLATTENING There shall be no evidence of splitting, cracking, or breaking when a section of pipe six inches long is compressed between parallel plates until the distance between the plates is forty percent of the outside diameter of the pipe. The loading shall be a uniform rate and shall be completed between two to five minutes.

C. DROP IMPACT TEST A six inch long section of pipe shall be subjected to a free falling tup in accordance with ASTM Method Testing D-2444. No shattering or splitting shall be evident when the following energy is impacted:

Nominal Size (inches)	4	6	8	10	12
Ft. - lbs.	150	210	210	220	220

203 HANDLING AND INSTALLATION FOR SANITARY SEWER PIPES

Unless otherwise specified all pipe handling, laying and jointing shall be based upon the manufacturer's recommended practice for installation of each specified type of pipe. Provisions of this section shall augment those recommendations.

203.1 MATERIAL HANDLING

Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. If any part of the coating or lining is damaged, the Contractor shall repair or replace the material affected at his expense as required by the Engineer or Inspector. All pipe and culverts shall be handled in accordance with the appropriate AWWA and ASTM Standards.

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Every precaution shall be taken to prevent foreign material from entering the pipe.

If the pipe-laying crew cannot put the pipe in the trench and in place without getting earth in it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly-woven canvas bag of suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

204 MATERIAL STORAGE

Care shall be taken to store all pipe and fittings to maintain the condition of the pipe as manufactured new. Pipe shall be stored on a flat surface to prevent the pipe from deformation due to temperature fluctuations and stress fatigue. Pipe shall be stored to prevent dirt or mud from entering the pipe and necessitating extensive cleaning procedures. Pipe shall, at all times, be protected from exposure to ultraviolet radiation (sunlight). Any discoloration of the pipe material shall be evidence of ultraviolet damage and the pipe shall be rejected and removed from the project.

205 INSTALLATION

Pipe shall be installed in full compliance with the Recommended Practice for "Underground Installation of Flexible Thermoplastic Sewer Pipe", ASTM Standard D 2321.

Pipe shall be installed with Granular Bedding Material. Bedding shall be installed 6" below the pipe and to a minimum of 12" depth over the top of the pipe. Bedding material shall be hand placed under haunches of pipe to insure uniform support. Bell holes shall be made at each joint. Bottom of trench shall be firm and on grade.

Pipe installation shall start and end at manholes. Connections to pipe of other than PVC material shall be accomplished by matching plain ends of each pipe and by use of an adaptor or such method that will insure a smooth water tight, air tight transition of the invert at the connection as approved by the Engineer.

Backfilling of acceptable material shall not be placed in lifts to exceed one foot (1') and shall be compacted to City of Louisville Standards. Random tests for compaction shall be made at all elevations of the trench sections to insure firm support around the pipe and the backfill above the pipe.

Bell grooves and gasket shall be cleaned of dirt or foreign matter before the lubricant is applied to the joint. The spigot end of the pipe shall be thoroughly cleaned and lubricated before insertion of the bell end. Cut ends of pipe shall be filed to an approximate angle of 30 degrees before being inserted into the bell end. All gaskets and fittings used in the sewer line installation shall have the same cleaning and care before insertion into the line.

Sufficient backfill shall be placed on the barrel of each pipe section to secure the pipe against flotation from water in the trench or subsurface water.

Care shall be taken to insure a clean line. Pipe plugs shall be used in each end of the sections of pipe as installed, whenever pipe laying is not in progress. A wooden bulkhead shall be installed at the upper end of the project in addition to the pipe plug.

205.1 WYES, AND RISERS FOR SERVICE CONNECTIONS

The Contractor shall place wyes, stubs and risers where required by the approved construction plans. Wyes shall be angled upwards so that the upper invert of the one-eighth bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. Riser connections shall be installed where the elevation of the top of the branch is more than 12 feet below finished ground. Riser connections shall ordinarily reach to a grade 10 feet below finished ground surface. Watertight plugs shall be installed in each branch pipe or stub. Wye and riser location shall be marked with a piece of treated 2" x 4" lumber from the plugged end to the surface.

See the City of Louisville Standard Sanitary Sewer Service Line Construction Details on service stub-ins and house service connections. As-built measurements shall be made to the nearest manhole before backfilling.

206 PROGRESSION OF WORK

The laying of pipe shall commence at the lowest point and proceed upgrade so that the pipe is laid with the bell ends facing in the direction of laying and at the correct grade and alignment. The pipe shall be placed in such a manner that the specified bedding provides a solid, uniform bearing surface for the full length of the barrel. Bell holes shall be provided at all joints. Equipment used in handling and jointing the pipe shall have adequate capacity to handle the pipe smoothly and assure the proper closure of joints.

All pipe shall be carefully constructed so that when joined together they will form a conduit with a smooth, uniform invert. The pipe shall be laid accurately to the grade and alignment specified on the drawings. Blocking or wedging of the pipe to achieve proper positioning and grade shall not be permitted, except where required for proper construction of cradles or encasements.

207 JACK AND BORE

Should sanitary sewer main construction involve the crossing of an existing arterial or collector street, the crossing shall be jack and bored with a steel casing and carrier pipe.

208 SANITARY SEWER MANHOLES

Manholes shall be constructed of precast concrete. A maximum of 3 service lines may be allowed to empty directly into a terminal manhole and service inverts shall be 0.5 ft. above effluent invert. Clean-outs shall not, under any circumstances, be installed in lieu of a manhole. **The minimum drop through manholes with directional changes shall be 0.2 feet. On straight through manholes, the minimum drop shall be 0.1 feet.**

208.1 MANHOLE SPACING

Manholes shall be installed: at the end of each line, at all changes in slope, size, or alignment; at all intersections; and at distances not greater than 400 feet for sewers 15 inches or less, and 500 feet for sewers 18 inches to 30 inches.

208.2 BARREL SIZE

The internal diameter of the manhole barrel shall not be less than 48 inches for sanitary sewers of sizes 12 inches or less; 60 inches for sizes 15 inches and larger.

208.3 MATERIALS

The materials to be used in the construction of manholes shall conform to the following requirements:

208.4 CONES

All cones shall be eccentric. Flat top sections may be used, upon written permission of the Engineer, on shallow lines where standard cone sections will not conform to specified elevations. Flat top sections shall be designed for H-20 loadings and conform to ASTM C 478.

208.5 FALSE BOTTOMS

False bottoms shall be installed after all sanitary sewer testing has been completed and prior to any street subgrade or preparation.

208.6 PRECAST MANHOLES

Precast manhole risers and cones shall be manufactured to conform with ASTM C 478.

208.7 CAST IN PLACE MANHOLES

Cast in place manholes will not be allowed.

208.8 CEMENT

All cement used in concrete and mortar shall conform to ASTM Designation C 150 Type II, Type IIA or when deemed necessary Type V.

208.9 AGGREGATE

Aggregate shall conform to Standard Specifications for Concrete Aggregates ASTM Designation C 33.

208.10 CONCRETE FOR MANHOLES

Concrete used in precast manhole sections shall conform to ASTM C 478 and the manhole foundation shall have a 28-day strength of 3750 psi and shall have a maximum water cement ratio of 0.45.

208.11 MANHOLE STEPS

Manhole steps shall be corrosion resistant and shall be cast into the manhole wall at the same time the manhole section is cast. The steps shall be Alcoa No. 12653B, as manufactured by the Aluminum Company of America or M.A. Industries Inc. PS2-PF or approved equal. Manhole steps shall be no more than 24 inches nor less than 18 inches from the top of the manhole ring or from the bench of the manhole.

208.12 RING AND COVER

Manhole rings and covers shall be 24-inch diameter for 48 inch diameter manhole barrels and 30-inch diameter for 60 inch and 72 inch diameter manhole barrels. The word "SEWER" shall be marked with raised lettering on sanitary sewer covers. Construction castings #J-1361 or approved equal shall be used . Metal used for castings shall conform to ASTM A48 83 Class 25B gray cast iron, no aluminum castings or riser rings shall be allowed.

The cover shall be machined to fit the ring to exclude surface water and be level with the top of the ring. Covers shall have one lifting notch of 1" x 1 1/4".

The ring shall be held in place by being set on ramneck and by asphalt being placed over the ring from the edge of the support structure to the top edge of the ring. A maximum of 18" of concrete adjustment rings will be allowed between the last manhole section and finished grade.

208.13 FLEXIBLE JOINT SEALING COMPOUND

Kent-Seal No. 2 as manufactured by Hamilton-Kent Company, or other approved plastic joint material shall be used in all concrete joints and between the cast iron ring and cover and cone section. Sealing compounds shall conform to Federal Specifications SS-S-00210 and shall remain pliable to -20 degrees Fahrenheit and shall not become excessively pliable at +120 degrees Fahrenheit.

208.14 EPOXY COATING

Where required or shown on the drawings, the epoxy coating shall be similar or equal to "PREBOUND CONCRETE BONDING AGENT ET-150H".

208.15 CONSTRUCTION

Manholes shall be constructed at the locations and to the elevations indicated on the drawings.

Manholes shall be constructed so as to form a circle in a horizontal plane. The internal diameter of manhole barrels shall be maintained to a distance of not more than five (5) feet below finished grade and vertically plumb. From that point the manhole barrel shall be tapered to the 24 inch internal diameter for 4 foot diameter manholes, and 30 inch internal diameter for 5 foot diameter manholes and larger as shown on the standard manhole drawings. The manhole barrels shall be watertight at all joints.

All manholes under construction shall be sealed tightly to prevent storm or other non-sewage flows from entering the sanitary sewer system.

208.16 HORIZONTAL JOINTS

Flexible plastic joint sealing compound in accordance with Section 208.13 of these Design and Construction Standards shall be applied to all manhole joints. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions. The joint materials shall conform to the approximate manufactured shape at the time of installation. The joint materials shall not be stretched or in any other way distorted.

208.17 MANHOLE BASES

Except as otherwise shown on the approved plans, the manhole bases shall be constructed as shown on the Manhole Base Detail. **Precast manhole bases are preferred** over cast-in place manhole bases. Changes in direction of flow through the manhole shall be made with a smooth curved channel having as large a radius as possible. The change in size of channels shall be made gradually and evenly and shall be formed directly in the concrete. The floor of the manhole outside of the channel shall be finished to a smooth surface and shall slope to the channel. The thickness of the base shall not be less than eight (8) inches nor more than twelve (12) inches under the invert of the channel and have a mat of #4 rebar 12" o.c. each way. The elevation of the subgrade for the manhole shall not vary more than 0.05 feet. The diameter of manhole bases shall be 6' for 4' barrels, 7' for 5' barrels and 8' for 6' barrels.

Concrete bases shall be placed on undisturbed ground. The ground surface below the precast concrete base shall be excavated three inches below the elevation of the bottom of the base and backfilled with 1 1/2" fractured rock or other material approved by the Engineer.

The 1 1/2" rock shall be carefully leveled to give uniform support to the precast base over the entire area. The precast base shall be set at the proper location to center the manhole.

209 CONNECTIONS TO EXISTING MANHOLES

Sewer pipe connections, to existing manholes where there are no existing pipes stubbed out, shall be made in such a manner that the finished work will conform to the requirements specified for new manholes. The Contractor shall drill and break out as small an opening in the existing manhole as necessary to insert the new water stop gasket and sewer pipe. The existing concrete foundation bench shall be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Non-shrink, non-metallic grout 3M 5600 or an approved equal shall be used to smoothly finish the new invert and to seal the new line so the junction is watertight.

210 TRENCH BACKFILLING

Backfilling shall be in accordance with Section 7 of these Design and Construction Standards, with the exception that compaction tests on the service trench within City R.O.W. must be reviewed by the Engineer prior to patching the street.

211 TESTING AFTER CONSTRUCTION

PVC gravity sewer pipe shall be tested in accordance with this section as well as in accordance with other sections of these Design and Construction Standards. The Engineer may require that alignment, infiltration, exfiltration and deflection tests be completed by the Contractor at the Contractor's expense. In addition, when the Engineer determines that it is warranted, he may require the Contractor at the Contractor's expense, to jet the sewer mains and have the pipe inspected with TV video equipment (a copy of the tape must be supplied to the City).

211.1 MAXIMUM DEFLECTION TEST

PVC gravity sewer pipe shall not deflect more than 5% of the diameter of the pipe. The deflection shall be tested in every section by the Contractor with a Pin-Type Go-No-Go Gauge, in no case shall the deflection test be performed within 30 days after the completion of the air test. When the test fails, the line shall be repaired and retested at the Contractors expense. The Inspector shall be present during the test and shall verify the accuracy of the equipment.

211.2 AIR TEST

All lines shall be tested for exfiltration by low pressure air testing in accordance with ASTM C 828. Testing must be completed with the Inspector present.

211.3 MANHOLE LEAKAGE TEST

At the discretion of the Engineer vacuum testing manholes may be required. All pipes entering the manhole shall be plugged and braced and a vacuum of ten inches (10") of mercury shall be drawn. The vacuum pump shall be turned off and the time monitored as

the vacuum drops on inch (1"). The vacuum must not drop more than one inch (1") for the duration of the time indicated in the following table:

Specified Test Duration for Diameter of Manhole
(duration indicated in min:sec)

Manhole Diameter (inches)		
48"	60"	72"
1:00	1:15	1:30

Manholes, which fail the vacuum test shall have the defects located and repaired and the test shall be repeated. Repair and retesting shall be continued until the test meets the requirements.

In lieu of vacuum testing of manholes the Engineer may require water testing of manholes. Manholes shall be tested separately from the pipe. The sewer pipe in the manhole will be plugged. If the ground water table is below the invert, the manhole shall be filled to a depth of five (5) feet above the invert. If the ground water level is above the invert of the manhole, then the manhole will be filled to level at least three (3) feet above the ground water level or to the top of the upper most precast manhole section whichever is less, but not less than five (5) feet above the invert. After soaking for one hour, the manhole shall be filled to the original level. It shall then be tested for two hours. The allowable drop of water shall be one quarter (1/4) inch.

No manhole will be accepted when there is any visible infiltration when empty.

At the discretion of the Engineer, at least twenty (20) percent of all manholes installed will be tested. Based on these tests, and visual inspection of all the manholes, additional tests may be required for other manholes. Any manhole whose test is unsatisfactory shall be repaired and retested until satisfactory results are obtained.

Failure of either test is considered failure of the section involved.

211.4 RETESTING OF PIPE AFTER WARRANTY

The City, may at its option, reinspect the project and use closed circuit television, air test, and Pin-Type Go-No-Go Gauge to verify that the line is free of defects prior to the warranty expiration and granting final acceptance. The Contractor shall be responsible for replacing all defective sections of pipe at no expense to the City.

A defective section shall be any section with excessive infiltration or exfiltration, any section with deflection in excess of 5% of the diameter, any section with structural failure, any section with a defect that prevents the designed discharge from flowing through the pipe or any section that would cause an abnormal amount of maintenance due to construction. The Inspector shall witness each repair or replacement.

212 CLEANING THE LINE

When all of the pipes have been installed, the line and manholes shall be cleaned and be free of sand, dirt and debris. If the line must be flushed, it shall be done by the use of a high pressure jet or sewer balling method. Care shall be taken to insure that no non-sewage water enters the existing sanitary system. Should the Contractor allow water to enter the existing system, damages to the system, costs of treating the water, and fines in accordance with the City Code shall be at the Contractor's expense.

213 UNDERDRAIN PIPE

Underdrain pipe shall be installed as required per the recommendation of a Geotechnical Engineer.

213.1 P.V.C. PIPE

Pipe shall be perforated or non-perforated and conform to ASTM Standard D 3034 SDR 35. The pipe shall be installed and in full compliance with ASTM Standard D 2311. The system shall not be watertight unless designated by the Design Engineer on the approved plans.

213.2 BEDDING

Bedding for underdrain pipe shall be installed per the recommendation of the Geotechnical Engineer.

213.3 ALIGNMENT

The grade of the underdrain pipe shall be parallel to and 1 foot below the flow line of the main line pipe as measured from the main line invert to top of underdrain pipe.

The underdrain shall end in a storm sewer or drainage course. At no time shall an underdrain be unable to drain. The underdrain connection shall be properly grouted into a storm sewer pipe. When emptying into a water course, the outlet shall be protected with an approved outlet structure.

214 SANITARY SEWER SERVICE LINE CONSTRUCTION

All sanitary sewer lines which connect to the City of Louisville sanitary sewer system shall adhere to this section, these Design and Construction Standards, and the Uniform Plumbing Code.

214.1 LICENSES AND PERMITS REQUIRED

All sanitary sewer service construction shall be done by a Contractor who is licensed to work in the City of Louisville. Work within the City right-of-way requires a permit for which the Contractor must be licensed.

The permit shall be secured from the City a minimum of 48 hours prior to commencing construction of the sewer service. Connections shall not be put into service prior to inspection.

214.2 MATERIALS

Following are the approved materials for sewer service lines:

All pipe shall be subject to inspection at the point of delivery in Louisville. The purpose of the inspection is to pull and reject pipe that fails to conform to the requirements of these Standards.

Materials to be used for sanitary sewer services shall meet the requirements of Section 202.2 of these Design and Construction Standards. Other materials used for sanitary sewer services may only be used upon written approval of the Engineer.

214.3 SERVICE LINE INSTALLATIONS

In general, all installation work shall conform to applicable portions of ASTM C 12 and to the pipe manufacturer's installation instructions.

Pipe shall be installed in accordance with these Design and Construction Standards. Sanitary sewer service lines and water service lines must be a minimum of ten feet apart horizontally measured edge to edge or concrete encasement of the sanitary sewer service line will be required.

When water service lines cross sanitary sewer service lines, the water service line must be installed above the sanitary sewer service line with 24 inches minimum vertical separation between the outside of the water service line and the outside of the sanitary sewer service line.

If the water service line separation is less than 24 inches, concrete encasement of the sanitary sewer service line ten feet each side of centerline of the water service line shall be required.

In the case where the water service line can not be installed above the sanitary sewer service line, both the water service line and sanitary sewer service line shall be encased in concrete ten feet each side of centerline.

Sanitary sewer services shall be bedded in granular bedding material 6" below the pipe and to a minimum of 12" over the top of pipe. The pipe shall be protected during handling against impact shocks and the joint material shall be protected from damage at all times.

The grooves shall be cleaned so as to be free from all foreign materials prior to assembling the joint and the compression ring shall be placed on the pipe in the trench. The pipe shall be laid with the spigot ends pointing in the direction of the flow.

All joints shall be watertight. Jointing dissimilar materials, like clay pipe to ductile iron pipe shall be done by means of a "Can-Tex" adaptor or other approved method. Trenches shall be kept free of water during laying and jointing. The minimum grade of a line built with pipe sections 8 feet long or less, shall be 1/4" per foot. The City shall have the authority to require that the exact grade of the line be determined prior to backfilling the trench.

Lines longer than 50 feet shall be laid with a laser. The grade and alignment on service lines longer than 50 feet shall be verified to be straight and the exact gradient shall be determined. Inspection of the service line from the main to the property line is required.

214.4 SERVICE STUB-IN TO PROPERTY LINE

Service stub-ins shall, at a minimum, be extended from the main to the property line and be plugged with a compression stop. Sanitary sewer services shall be installed with 6" of Granular Bedding Material below the pipe and to a minimum of 12" over the top of pipe. Measurements of the service from the main to the property line and depth of stub at property line shall be taken by the Contractor and provided to the City of Louisville on the "As-Built" drawings.

214.5 PREPARATION OF TRENCH BOTTOM

Trenches shall be dry in order that the bottom may be prepared in accordance with the Standard Detail Drawings.

This work shall be carefully done so that the pipe when laid will be true to a straight line and grade. When crushed rock bedding or an underdrain is required, the trench bottom shall be prepared in accordance with the Design and Construction Standards for Sanitary Sewer Main Construction.

214.6 TAPPING THE MAIN

Whenever the diameter of the service line is equal to or greater than 75% of the sewer main, a manhole shall be installed in place of service tap. **The Construction Inspector shall inspect the main, the saddle and the service line up to the property line and wye prior to backfilling.** A twenty-four (24) hour notice must be given the to Inspector prior to an inspection.

In the event the tap and service line are covered before it is inspected, it shall be re-excavated by the Contractor, and any concrete or mortar around the fitting shall be removed to allow visual inspection of the tap and the main. If the sewer main is cracked or broken during the process of locating or tapping, it shall be repaired immediately at the expense of the Contractor.

214.7 P.V.C. MAINS

Where P.V.C. wyes have not been installed in the main, a P.V.C. epoxy solvent saddle wye shall be installed in accordance with the manufacturer's recommendations and these Design and Construction Standards. All taps shall be machine tapped. The hole and saddle shall be installed so that nothing will catch on the connection. All edges shall be filed smooth.

The surfaces to be jointed shall be wiped clean, etched and the primer applied. With primer still wet, apply an approved epoxy resin cement and install the saddle. The wye saddle shall be securely fastened to the pipe by means of an epoxy resin or adhesive.

214.8 CLEAN OUTS

Clean outs shall be constructed in accordance with the Standard Details. Clean outs shall be constructed so that no surface load will be transferred to the main, wye, 1/8 bend, or riser pipe. The area around a clean out shall be graded so that water runs away from the clean out.

214.9 SIDEWALK OR CURB CROSSING

In no instance, shall a trench extend beneath an existing sidewalk or curb. The pipe must be bored, or jacked through the earth under the curb or sidewalk.

215 DISCONTINUATION OF SEWER SERVICE

Whenever a sewer service will be discontinued permanently, the service line shall be uncovered at the sewer main and the service connection removed, plugged and sealed with concrete. The Inspector shall inspect the disconnection prior to backfilling the trench. Backfilling shall be in accordance with Section 7 of these Design and Construction Standards.

216 CRADLES AND ENCASEMENTS

Prior to placing concrete for cradles or encasement, temporary supports consisting of concrete blocks or bricks shall be used to support the pipe in place. Not more than two supports shall be used for each pipe length; one adjacent to the shoulder of the bell, and the other near the spigot end.

217 CONCRETE WORK FOR UTILITIES STRUCTURES

All Concrete work shall comply with Design and Construction Standards set forth in Section 6.

218 REFERENCE MARKERS

Whenever a manhole is located outside of a traveled street or walkway, a reference marker shall be installed.

The reference marker shall be a 3" galvanized pipe filled with concrete. The pipe shall be 9 feet long, set in at least an 8" diameter hole a depth of 4 feet and filled with concrete.

The pipe shall be painted with alternating stripes of yellow and silver each being 4 inches in width. The pipe shall have reflectors as required by the Engineer. Reference information shall be painted on the reference marker per the direction of the Engineer.

219 WORK IN IMPROVED AREAS

All work in improved areas of the City of Louisville shall comply with Design and

Construction Standards set forth in Section 1.

220 CONSTRUCTION SITE RESTORATION

The construction site shall be restored in accordance with Section 1 of these Design and Construction Standards.

221 ACCEPTANCE

The Contractor/Developer shall be responsible for the maintenance on the main and all service lines installed during the warranty period after construction acceptance has been granted. The City will be responsible for maintenance of the main only, after final acceptance has been granted.

CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 3
POTABLE WATER DISTRIBUTION

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SECTION 3
POTABLE WATER DISTRIBUTION

300 CHECK LIST FOR WATER MAIN PLANS

These are the minimum standards to be adhered to in the design, construction and installation of water line facilities. All water main plans shall be checked for compliance with the minimum design criteria set forth in these Design and Construction Standards prior to approval for construction.

301 DESIGN CRITERIA

All additions to the City of Louisville water system shall be designed in accordance with the criteria set forth in this and other sections of these Design and Construction Standards, or as approved by the Engineer. Ductile iron pipe or polyvinyl chloride pipe shall be used exclusively unless special approval of alternate materials is granted by the Engineer.

302 MAIN SIZE

The water distribution system shall be designed to meet the maximum hourly water demand (9 gpm per acre) plus the fire flow demand as determined by ISO Criteria. During peak demand and fire demand, the water pressure shall not be less than 20 psi at any point in the water distribution system. The velocity of the water in the water system shall not exceed 15 feet per second. Design parameters and the critical conditions shall be shown on an overall plan of the study area. Under separate cover, the conditions shall be shown which isolates the critical condition. A complete analysis shall be submitted for any fire demand in excess of 1,500 gpm.

In addition to the critical condition design, the following minimum conditions shall be met:

The minimum diameter for water mains in residential areas shall be eight (8) inches. Smaller sizes may be installed only upon the approval of the Engineer. Schools, shopping centers and high-density residential areas shall be looped with at least 8 inch diameter lines. Twelve (12) inch diameter feeder lines shall be spaced between transmission lines a maximum distance of 3,000 feet apart and looped to provide water from more than one source. In no case shall a line of less than 6 inches in diameter be used to serve a fire hydrant. Ten (10) inch lines are not allowed.

303 ALIGNMENT AND DEPTH

The general location of all water mains shall be on the uphill side of the centerline of the street. The location shall be six (6) feet from the centerline of local and collector streets

and six (6) feet from median flow line on arterial streets. In all cases water valve placement shall not interfere with the vehicular tire traffic pattern.

Where on street parking is approved, a water main line or water valve shall be placed not closer than ten (10) feet to and existing or proposed curb flow line.

A minimum cover of (4.5') four and one-half feet below final grade shall be maintained over all water mains.

When water mains cross sanitary sewer mains, the water main must be installed above the sanitary sewer main with 24 inches minimum vertical separation between the outside of the water main and the outside of the sanitary sewer main.

If the water main separation is less than 24 inches, concrete encasement of the sanitary sewer main ten feet each side of centerline of the water main shall be required.

In the case where the water main can not be installed above the sanitary sewer main, both the water main and sanitary sewer main shall be encased in concrete ten feet each side of centerline.

When water mains cross above or below storm sewer mains, the minimum vertical separation shall be 18 inches. If 18 inches of vertical separation cannot be maintained, the crossing shall be installed as directed by the Engineer.

Water transmission mains and mains larger than 12 inches in diameter shall be strictly laid to approved grades to allow proper installation of air relief and air vacuum valves and blow-off valves. All pipe shall be constructed to the lines, grades and elevations shown on the approved drawings. All pipe shall be laid to straight lines as staked between specified or otherwise authorized angles, bends or points of tangency of horizontal or vertical curves. **Deflection at field joints shall not exceed the maximum deflection recommended in AWWA C600.**

304 DUCTILE IRON PIPE

All material, manufacturing operations, installation, testing, inspection and marking of ductile iron pipe shall be in conformity with the requirements of ANSI A21.51, AWWA C600, and in accordance with any special requirements of the Engineer. All material shall be new.

304.1 MARKINGS ON THE PIPE

Water pipe and fittings shall be marked by the manufacturer with the appropriate AWWA designations. Any pipe and fittings not properly marked will be rejected and removed from the site. All materials shall be clearly marked on the exterior surface of the pipe and fittings with the following:

1) AWWA designation
2) Size and class

3) Date of manufacture
4) Name and trademark of manufacturer

304.2 DIAMETER OF PIPE

The diameter indicated on the drawings shall mean the nominal inside diameter of the pipe.

304.3 WALL THICKNESS DESIGN OF PIPE

The minimum wall thickness for each section of the pipe line shall conform to ANSI Standard A21.50 for the specified laying condition and for 150 psi minimum working pressure. The following are the minimum allowable thicknesses of pipe that may be installed.

Pipe Size	Thickness Class
4"	52
6"	50
8"	50
12"	50
16"	50

304.4 GRADE OF IRON

The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi and a minimum percent of elongation of 10%.

304.5 PIPE LENGTHS

Pipe sections shall be furnished in not less than 18 foot nominal lengths, except bends, reducers, and specials which may be of shorter lengths.

304.6 FITTINGS AND SPECIALS

Fittings shall be new and conform to ASA Standard A21.10 (AWWA C110) and shall be cast iron or ductile iron. Fittings shall be Class 250 through 12" lines, and Class 150 for 16" and larger lines.

The designer shall furnish for approval by the Engineer, details of all specials, and other fittings which are not covered by ANSI A21.10. All fittings shall be either flanged or mechanical joints.

304.7 TAPPING SADDLES AND TEES

Tapping saddles shall be new and either cast iron or ductile iron only, and conform to Section 304.6 of these Design and Construction Standards. Wet taps must be approved by the Engineer.

304.8 FIELD JOINTS

1) FLANGED JOINTS Flanged joints shall conform to ASA Standard A21.10 (AWWA C110).

2) MECHANICAL AND PUSH-ON JOINTS Mechanical & push-on joints shall conform to ASA Standard A21.11 (AWWA C111).

3) BOLTS Bolts for flanged and mechanical joints shall be of Cor-Ten steel by United States Steel, or approved equal.

304.9 PROTECTIVE COATINGS

The surface coatings of all ductile iron pipe shall conform to the following:

1) EXTERIOR The exterior coating shall be the standard outside bituminous coating as specified in ASA Standard A21.51 (AWWA C151).

2) INTERIOR Normally, no interior coating other than a cement mortar coating as specified in ASA Standard A21.4 (AWWA C104) will be required.

304.10 CORROSION PROTECTION

Cast and ductile iron pipe and all fittings shall be wrapped in polyethylene tubing to prevent corrosion. Polyethylene tubing tape and installation shall meet the requirements of AWWA C105 and these specifications:

Thickness		8 mills
Pigmentation	1)	Natural where exposure to ultra-violet light (sunlight, for example) will be or short duration (less than 48 hours).
	2)	Black - 2.0 to 2.5% well dispersed carbon black with stabilizers-where exposure to ultraviolet light (sunlight) may be prolonged (2-10 days).
	3)	The polyethylene materials shall be of virgin polyethylene produced from DuPont Alathon resin or USI Petrothene resin or equal.
Tape		2" approved #900, Scotchrap #50 or approved equal.

1) INSTALLATION Prior to installing polyethylene tubes, clumps of mud or other contaminants shall be brushed off the pipe surface. Polyethylene tubes shall be installed in accordance with ANSI A21.5 Method A. Method A requires tubes to be overlapped one (1') foot and secured with tape, and the slack width to be taken up on top of the pipe and taped at the quarter points.

All rips, punctures or other damage to the polyethylene shall be repaired with tape or with a short piece of tubing cut open, wrapped around the pipe and secured in place.

304.11 CATHODIC PROTECTION AND MONITORING SYSTEMS

A soil resistivity survey of the construction area must be performed. The survey data and calculations, together with the service history of other existing pipe in the area shall be submitted to the Engineer.

Upon the review of the soil survey, the Engineer may require metallic water transmission mains to be cathodically protected by means of a National Association of Corrosion Engineers (NACE) designed sacrificial anode system or an impressed current cathodic protection and monitoring system.

Where soils adjacent to construction areas are determined to have a resistivity of less than 1000 Ohm-Cm, or where stray current corrosion is, in the opinion of the Engineer, expected to be severe, the Engineer may approve a non metallic pipe system. Additional measures may be required by the Engineer to insure protection from corrosion.

305 POLYVINYL CHLORIDE PIPE

All polyvinyl chloride (P.V.C.) pipe shall be new, manufactured and designed according to A.W.W.A. Standard C 900, "Polyvinyl Chloride (P.V.C.) Pressure Pipe, 4" through 12", for water, unless otherwise noted in these Design and Construction Standards. No P.V.C. over 12" in diameter will be installed. Water mains larger than 12" shall be ductile iron.

305.1 JOINING OF PIPE AND TYPE

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint. Push on joints shall be accomplished in accordance with AWWA M-23 "PVC Pipe - Design and Installation".

Mechanical joints shall be accomplished in accordance with AWWA C-600 "Installation of Ductile Iron Water Mains and Their Appurtenances".

305.2 CLASS AND TYPE

All sizes of pipe shall be minimum of Class 150, dimension ratio 18 (DR 18) minimum. The Engineer may require under certain circumstances Class 200 be installed.

305.3 TAPPING OF PVC WATERLINE

Tapping of P.V.C. mains from 3/4" up to and including two (2) inch services shall be installed only with an approved double brass tapping saddle. The double brass tapping saddle must be preapproved by the Engineer prior to installation. The Contractor will be responsible for supplying and installing the approved double brass tapping saddle and

installation of the physical tap on the main. Taps shall be machine tapped so that the core or plug is removed from the main. The City shall supply the corporation to be installed. Inspection of all taps is required prior to backfilling.

305.4 LOCATOR WIRE

Locator wire shall be installed on the top of the pipe and taped every ten (10) feet. Locator wire shall be 12 AWG 600 volt for direct burial. For installation see standard detail.

305.5 LOCATOR TAPE

Warning locator tape with WATER LINE BURIED BELOW printed on the tape shall be installed on top of the bedding material.

306 WATER PIPE HANDLING, STORAGE AND INSTALLATION

Water pipe shall be handled, stored and installed in accordance with the following specifications. The more stringent requirements shall govern in the event of a conflict.

1) American Water Works Standard C600.
2) American Water Works Standard C601.
3) City of Louisville, Colorado, Design and Construction Standards.
4) The Water Works Manufacturer Recommendations.

306.1 CONTAMINATION

Contamination shall be considered as the presence of any visible foreign material that will be in contact with the potable water supply. Contamination shall include, but not be limited to: dust, dirt, mud, petroleum products, trench water, paint, pesticides, stones, animals, and insects.

306.2 MATERIAL STORAGE

All materials shall be delivered to the construction site free of contamination. All materials shall be stored in a manner which will prevent contamination of the surfaces which will be in contact with the potable water supply. Storage shall include protection from the weather at all times. To prevent contamination, materials shall be distributed along the project only to the extent that the materials will be installed on that same day.

306.3 MATERIAL HANDLING

The Contractor shall have proper implements, tools and facilities for the safe and convenient prosecution of work. Precautions shall be taken to prevent contamination of the materials. The Inspector shall stop all work when he deems the work to be unsafe, inconvenient or when proper contamination control is not exercised.

Pipe fittings and accessories shall be handled in a manner which will avoid shock or damage. No pipe, fittings or accessories shall be dropped from any height. Pipe

handled on skid ways shall not be skidded or rolled against pipe already on the ground. If the coating or lining is damaged, it shall be repaired to the satisfaction of the Engineer or removed from the construction site.

306.4 PROGRESSION OF WORK

The laying of pipe shall commence so that the pipe is laid with the bell ends facing in the direction of laying and at the correct grade and alignment. Pipe shall be placed in such a manner that the specific bedding provides a solid uniform bearing surface for the full length of the barrel.

Bell holes shall be provided at all joints. Equipment used in handling and jointing the pipe shall have adequate capacity to handle the pipe smoothly and assure the proper closure of joints. Pipe shall be laid accurately to the grade and alignment specified on the drawings. Blocking or wedging of the pipe to achieve proper positioning and grade shall not be permitted, except where required for the proper construction cradles of encasement. When pipe laying is not in progress, all open ends of pipe shall be closed by a watertight plug.

The plugging of pipe shall apply to noon time, breaks, as well as overnight. The cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damaging the pipe coating or lining and so as to leave a smooth end at right angles to the long axis of the pipe. Flame cutting of pipe not be allowed.

307 FITTING AND SPECIALS

Fittings and specials shall be new and installed as detailed on the drawings and shall be properly anchored against thrust and uplift forces.

308 RUBBER GASKET JOINTS

Rubber gasket joints shall be in accordance with AWWA Standard C111 and these Specifications.

1) LUBRICANT The lubricant shall be suitable for lubricating the parts of the joint in assembly. The lubricant shall be non- toxic, shall not support the growth of bacteria, and shall not have deteriorating effects on the gasket material. It shall not impart taste or odor to water in the pipe. The lubricant containers shall be labeled with the trade name or trademarks and the pipe manufacturer's name. The lubricant shall be supplied by the pipe manufacturer and approved by the Engineer.

2) GASKETS Gaskets shall at all times be protected from damage and contamination. Gaskets which display any imperfection in manufacturing, any damage, or any contamination shall not be used.

3) INSTALLATION All surfaces in contact with the rubber gasket shall be thoroughly cleaned just prior to installation to such an extent that it is free of all visible contamination. All contaminants, excess coating, rust or any other foreign

material shall be removed from the gasket groove and the spigot end to be installed.

309 WATERLINE VALVES

All valves shall be manufactured in accordance with AWWA Standards and **shall open by turning counter clockwise (left).** Valve ends shall be mechanical joint and shall be equipped with a two (2) inch square operating nut. Valves and flanges shall be a minimum of Class 150 unless otherwise specified.

Waterline operator valves shall be installed in the distribution system so that no more than 600 feet of water line will be shut off in the event of a water line failure. Operator valves shall also be installed at other places as designated by the Engineer. Operator valves shall also be located so that any extension can proceed, be pressure tested and chlorinated without affecting the existing system. Temporary blow-offs shall be installed as required by the Engineer for chlorination and flushing.

309.1 GATE VALVES

Gate valves shall be used on all water lines of six (6) inch to twelve (12) inch size. Gate valves shall be furnished with mechanical end connections and be manufactured in accordance with AWWA Standard C-500. Gate valves shall be double disc or resilient seat. All material shall be new.

309.2 BUTTERFLY VALVES

All valves having a nominal inside diameter of greater than 12 inches will be geared butterfly valves designed for direct burial and shall conform to AWWA C-504. Valves will be tight closing rubber seat type with the seats bonded to the body. No metal to metal surfaces will be permitted. All valves will open left (counterclockwise). The Engineer may require Butterfly valves to be installed in a vault.

309.3 PRESSURE REDUCING, REGULATING, AND SUSTAINING VALVES

Pressure reducing and regulating valves shall be of a type capable of maintaining preadjusted downstream pressures with varying rates of flow and upstream pressure without causing water hammer. Pressure reducing and regulating valves shall be installed in concrete valve vaults. Pressure reducing and regulating valves shall be of flanged, globe body, fully bronze mounted, external pilot operated, piston type with the following requirements.

1) The pressure reducing valves shall be hydraulically operated with a free floating guided piston having a seat diameter equal to the size of the valve. The valve shall be fully bronze mounted and all packing shall have either leather or rubber seals to provide tight closure and prevent metal to metal friction.

   An indicator rod shall be furnished as an integral part of the valve to show the position of the piston within the valve body. The valve shall be designed to

provide an access opening in the valve body for removing the piston and other internal parts without removing the main valve body from the line.

2) Have a position indicator rod firmly attached to the piston and passing through a stuffing box in valve top for external, visual piston position indication.

3) Cast iron for valve body, flanged, and covers shall conform to ASTM Standard Designation A-126 Class B. Bronze castings or parts for internal trim shall conform to ASTM Standard Designation B-26.

4) Be furnished with renewable leather cup power piston seals.

309.4 AIR AND VACUUM VALVES

Where necessary, combination air and vacuum release valves shall be installed at each high point in water mains. Air and vacuum release valves shall be installed in precast concrete manholes or vaults fitted with air vents open to the atmosphere and in accordance with the Standard Details.

309.5 BLOW-OFF VALVES

A 2" blow-off valve assembly is required at the end of mains. Temporary blow-offs shall be installed in those portions of the water mains which could not be chlorinated, flushed or tested by other means.

Blow-off assemblies consist of all valves, pipe and material necessary to install the blow-off valve complete in place, and shall be constructed in accordance with the Standard Details.

309.6 INSTALLATION

Valves in water mains shall be installed where possible, at a point on the main just off tees or crosses at intersections. Valves shall be installed so the operator is in a vertical position and can easily be operated from above ground. Valves shall be adjusted to seat properly. Valves shall not be placed in a crosspans or curb and gutter.

309.7 VALVE BOXES

All gate valves shall be provided with a 6 inch cast iron valve box Buffalo type. The valve box shall be of a design which will not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve, with the box cover flush with the surface of the pavement. Special care shall be taken to insure proper compaction around valve boxes. Compaction tests are required around the valve boxes.

310 FIRE HYDRANTS

Normally, fire hydrants shall be spaced 500 feet apart as measured along public right-of-way. Closer fire hydrant placement shall be required when the fire flow

requirements, as determined by ISO Criteria, exceed 2,000 gallons per minute. Fire hydrants shall not be located within ten (10) feet of a curb inlet.

310.1 PLACEMENT

Fire hydrants shall be placed with the pumper nozzle facing the street. In single family residential areas the fire hydrant shall be a minimum of 1 1/2 foot behind the back of walk, and no closer than one (1) foot to the edge of the street right of way.

310.2 HYDRANT

Hydrants shall conform to AWWA C502. Only approved traffic model fire hydrants shall be installed. The hydrant shoe shall have a mechanical connection to the lateral line, and shall be properly thrust blocked. The word OPEN and an arrow showing the hydrant opens left shall be embossed on every fire hydrant. **Mueller "Centurion", Waterous "Pacer" Model No. WB-67, American-Darling B-84-B or approved equal by the Engineer.**

310.3 NOZZLES

All fire hydrants shall have two (2) hose nozzles and one (1) pumper nozzle. The hose nozzles shall be 2 1/2" in diameter with National Standard threads.

The pumper nozzle shall be 4 1/2" diameter with National Standard threads. The nozzle caps shall have chains attaching the cap to the hydrant. The centerline of the hose nozzles shall be set a minimum of 18 inches and a maximum of 21 inches above finished grade.

310.4 MATERIAL

All fire hydrants, risers, laterals, and valves shall be constructed of new materials. The hydrant, riser, and **lateral shall be ductile iron.**

310.5 VALVES

All valves shall open left (counter clockwise).The hydrant valve opening shall be 5 1/4 inches.

310.6 LATERAL

The lateral from the main to the riser shall be constructed of **six (6) inch ductile iron, Class 50.**

310.7 COLOR

All exposed body and dome sections shall be painted fire hydrant red. The nozzle caps shall be painted reflectorized white.

310.8 SPACING

Fire hydrants shall be spaced per the recommendation of the Louisville Fire Protection District or as required by the Engineer.

310.9 OPERATING NUT

The operating nut shall be one and one half inch (1 1/2") brass pentagon.

311 CRADLES AND ENCASEMENTS

Prior to placing concrete for cradles or encasement, temporary supports consisting of concrete blocks or bricks shall be used to support the pipe in place. Not more than two supports shall be used for each pipe length; one adjacent to the shoulder of the bell and the other near the spigot end.

312 THRUST BLOCKS

All bends, tees, fire hydrants, plugs, and plugs with blow-offs at dead-ends, shall be protected from thrust using concrete thrust blocks. When a line is wet tapped a thrust block shall be installed. All concrete thrust blocks shall be designed for shape and size as required by the internal pressure of the pipe being 250 psi minimum.

Standard sizes and shapes of thrust blocks are shown in the standard details.

The thrust blocks shall be constructed of six (6) sack concrete with a 3750 strength after 28 days. Care shall be taken not to block outlets or to cover bolts, nuts, clamps or other fittings or to make them inaccessible. A bond breaker shall be installed between the pipe or fittings and the thrust block to aid in ease of future removal.

If in the opinion of the Engineer, the soil bearing capacity is not sufficient to provide adequate restraint based on minimum bearing areas, then the minimum bearing area shall be increased to a size that will ensure adequate restraint or the Engineer may require restrained pipe be installed. In every instance, the thrust block shall bear against undisturbed earth.

313 RESTRAINED FITTINGS

Restrained fittings shall be installed at all bulkheads, horizontal bends, branches and valves or as directed by the Engineer. Under certain circumstances the Engineer may require that restrained pipe be installed.

314 PRECAST CONCRETE MANHOLES AND VAULTS

Manholes and vaults shall be constructed in accordance with these Standards.

A. MATERIALS The materials to be used in the construction of manholes shall conform to the following requirements:

1) Cones. All cones shall be eccentric.

2) Precast manholes and Vaults shall be manufactured in conformity with ASTM Designation C478. The internal diameter of the manhole barrel shall be 60 inches unless otherwise specified.

3) Cast-in-place Manholes will not be allowed. Vaults may be cast in place upon the approval of the Engineer.

4) Brick. No brick manholes shall be constructed.

5) Cement. All cement used in concrete shall conform to ASTM Designation C-150 Type II, Or 504 resistant (type V) where required.

6) Aggregate. Aggregate shall conform to Standard Specifications for Concrete Aggregates ASTM Designation C33.

7) Concrete. Concrete used in precast sections and the foundation shall have a maximum water cement ratio of 0.45.

8) Manhole steps. Manhole steps shall be corrosion resistant and shall be cast into the manhole wall at the same time the manhole section is cast. The steps shall be Alcoa No. 12653B, as manufactured by the Aluminum Company of America or M.A. Industries Inc. PS2-PF or approved equal. Manhole steps shall be no more than 24 inches nor less than 18 inches from the top of the manhole ring or from the bench of the manhole. Manhole steps shall be located directly beside the operator.

9) Ring and Cover. Manhole rings and covers shall be 30 inch diameter for 60 inch and 72 inch diameter barrels.

The manhole ring and cover shall be cast iron Louisville Standard C1360 wt. 630 lb. for 30" diameter unless otherwise authorized in writing by the Engineer. The word "WATER" shall be marked with raised lettering on water manhole covers.

The cover shall be machined to fit the ring to exclude surface water and be level with the top of the ring. Covers shall have one lifting slot 1" x 1 1/4".

The ring shall be held in place by being set on ramnek.

10) Flexible Joint Sealing Compound. "Kent-Seal No. 2" as manufactured by Hamilton-Kent Company, or other approved plastic joint material shall be used in all concrete joints. Sealing compounds shall conform to Federal Specifications SS-S-00210 and shall remain pliable to -20 degrees Fahrenheit and shall not become excessively pliable at +120 degrees Fahrenheit.

314.1 MANHOLE CONSTRUCTION

Manholes shall be constructed at the locations and to the elevations indicated on the drawings. When the overall possible height above the base is less than 8', a flat top

H-20 section shall be installed. Manholes shall be constructed in a manner as to allow operation of all valves from above the ground.

The cone or flat top section shall not extend closer than 18 inches, nor more than 24 inches, from the top of the manhole cover. Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade.

Flexible joint sealing compound in accordance with Section 314 of this section shall be applied to all manhole joints, and to all precast vault joints. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions. The joint materials shall conform to the approximate manufactured shape at the time of installation. Any materials not conforming shall be rejected and not used. The joint materials shall not be stretched or in any way distorted.

Manhole and vault bases may be either precast or cast in place. **Precast bases are preferred** and shall conform to C 478. The minimum thickness of the base shall not be less than six (6) inches.

Special care shall be taken to insure compaction around manholes. Compaction tests are required around manholes.

314.2 VALVE VAULTS

All valve vaults shall be designed to adequately house the valves and fittings therein contained as well as to withstand all external loadings imposed by earth, thrust, and AASHTO-H20 highway live loading.

Vaults shall be furnished with removable roof slabs or manholes of sufficient size to allow removal of all valves and fittings, shall be constructed in such a manner as to allow operation of all valves from above the surface, and shall be fitted with air vents open to atmosphere. Vaults shall be constructed in accordance with the approved drawings and these Design and Construction Standards. **Special care shall be taken to insure proper compaction around vaults.** Compaction tests are required around vaults.

315 UTILITIES COORDINATION

The Contractor shall at all times coordinate his work with the City of Louisville. When it is necessary to close existing portions of any water or sewer system due to construction operations, at least 24 hours prior notification must be given to the City. **All water valves that are in service shall be operated only by authorized City Water Department Personnel.**

316 EXCAVATION BEDDING AND BACKFILLING

The minimum bedding requirements for all classes of pipe are given in the Section 7. Excavation, backfilling and compaction are specified in Section 7 of these Design and Construction Standards.

317 DISINFECTION OF WATER LINES

All potable water lines shall be disinfected and pressure tested prior to being put into service or being tapped. Disinfection shall be accomplished by the Chlorine Concentration Test followed by the Bacteria Test, as hereafter specified.

All chlorine and bacteria testing shall be conducted by the City at the expense of the Contractor.

A. CHLORINE CONCENTRATION TEST The chlorine concentration shall be tested at accessible locations and as required by the Engineer. This shall include but not be limited to; fire hydrants, blow-offs and stubs lines. Chlorine shall be tested by either Amperometric Titration[1] or the DPD Test[2] . Orthotolidine colorimetric testing shall not be an acceptable means of testing the chlorine concentration.

B. TABLET METHOD Calcium Hypochlorite Tablets shall only be used for chlorination when contamination control has been exercised during installation of the pipe because the line cannot be flushed prior to chlorination. The tablet method shall not be used when trench water or foreign materials have entered the water line or the temperature is below 5 degrees centigrade (41 degrees F.). The tablets shall be secured to the pipe wall by use of Permatex No. 1[3] or other adhesive which had been approved by the Engineer.

The tablets shall be at the top of the water line after installation of the pipe and the pipe shall be marked to assure that the tablets are so located.

1) Number of Tablets After the water line has been filled, the concentration of chlorine shall be at least 50 milligrams per liter at all test locations. After the line has set for 24 hours, the chlorine concentration shall be at least 25 milligrams per liter. Under normal conditions, the following table should produce the required concentrations using 3 3/4 grams available chlorine per gram tablet.

Diameter of Pipe (inches)	6	8	10	12	16
Length of Pipe Section (Feet)	Number of Tablets				
less than 18	2	2	3	5	9
18	2	3	5	6	12
20	2	3	5	7	14
30	3	5	7	10	20
40	4	6	9	14	25

1. Standard Methods for Water & Wastewater Examination, 14th Ed., 1975.

2. IBID, Page 329.
3. A product of the Permatex Company, Brooklyn, New York and Kansas City, Kansas.

2) FILLING THE LINE The line shall be filled with potable water at a velocity of less than 1-ft./sec. **The Inspector must be notified 24 hours in advance of filling the line.** When the line is full, all valves shall be operated to insure total chlorination.

3) FLUSHING THE LINE When the chlorine test has been successfully completed, the line shall be flushed until the chlorine residual is less than one milligram per liter. **The Inspector must be notified 24 hours in advance of any flushing.** Care shall be taken to prevent erosion or to kill desirable vegetation during flushing procedures.

C. CONTINUOUS FEED METHOD This method shall be used if it is necessary to flush the water line prior to chlorination or for rechlorination if the tablet method fails.

1) APPLICATION OF CHLORINE Water from the existing distribution system shall be made to flow at a constant rate through the line to be disinfected. **The Inspector must be notified 24 hours in advance of filling the line.** Chlorine is then pumped into the line at the source of fresh water at a rate which will result in a chlorine concentration of at least 50 milligrams per liter measured at all accessible locations and as required by the Engineer.

All valves shall then be operated to insure total chlorination. After setting in the line for 24 hours, the chlorine residual shall be not less than 25 milligrams per liter measured at all accessible locations and as required by the Engineer. The following table should meet these requirements under normal conditions.

CHLORINE REQUIRED TO PRODUCE 50 MG/L CHLORINE CONCENTRATION PER 100 FEET OF PIPE

Pipe Size (Inches)	100 per cent Chlorine (lb.)	1 per cent Chlorine Solution (gal.)
6	0.061	0.74
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

2) FLUSHING THE LINE When the chlorine test has been successfully completed, the line shall be flushed until the chlorine residual is less than 1 milligram per liter. **The Inspector must be notified 24 hours in advance of flushing.** Care shall be taken to prevent erosion or to kill desirable vegetation during the flushing process.

D. SLUG METHOD The slug method shall be used for large mains when continuous feed or tablet methods are not practical.

1) CHLORINE APPLICATION Chlorine shall be applied continuously at a rate so that all interior surfaces will be exposed to a concentration of at least 300 milligrams per liter of chlorine for at least 3 hours. All valves, fire hydrants and blow-offs shall be operated as the slug passes to insure total chlorination.

2) FLUSHING THE LINE The line shall be flushed until the chlorine residual at all required locations is less than 1 milligram per liter. **The Inspector must be notified 24 hours in advance of flushing.** Care shall be taken to prevent erosion or killing of desirable vegetation during the flushing.

E. SPECIAL CONDITIONS When water mains are cut into or repaired, precautions shall be taken to avoid contamination. When it is possible to isolate the section of line, the continuous feed or slug methods of chlorination shall be used, followed and preceded by thorough flushing. The absolute minimum amount of disinfection shall be swabbing all couplings, tapping sleeves and any other materials to be used with a 5 percent Sodium Hypochlorite solution or a 350 mg/l available Chlorine solution made from Calcium Hypochlorite* just prior to being installed.

**One 5g tablet of Calcium Hypochlorite (70% available Chlorine) per 10 liter of water is equal to 150 mg/l of available Chlorine.*

F. BACTERIA TEST Following chlorination, all treated water shall be thoroughly flushed from the pipe line at its extremities until the replacement water throughout its length shall, upon tests, be proved comparable in quality to the water served the public from the existing water supply system as required by law. **The Inspector must be notified 24 hours in advance to obtain samples for testing.** If there is undesirable bacteria present, the line shall be re-chlorinated as directed by the Engineer. No main shall be placed in service until test results are received and approved by the Engineer.

G. FLUSHING THE LINE Water lines shall be flushed at a velocity of at least 2.5 feet per second through the line. Flushing shall be performed after the tablet method but prior to the continuous feed method and the slug method. **The Inspector must be notified 24 hours in advance of flushing.** Flushing shall always be performed prior to pressure testing to expel all air from the line.

318 PRESSURE TEST

After the pipe has been laid and backfilled except for the joints, or completely backfilled when so directed by the Engineer, the pipe shall be filled with water and all air expelled from the pipe. If hydrants or blow-offs are not available at high points, the Contractor shall make the necessary taps at high points to expel the air and insert plugs after the air is expelled. The hydrostatic test pressure shall be 150 psi at the lowest point in the line or section under test and shall be maintained for one hour. Pressure shall be

applied in a manner satisfactory to the Engineer with all testing apparatus furnished by the Contractor.

319 CONCRETE WORK FOR UTILITY STRUCTURES

All concrete work shall comply with Standards set forth in Section 6 on these Design and Construction Standards.

320 REFERENCE MARKERS

Whenever a valve is located outside of a traveled street or walkway, a reference marker shall be installed. The reference marker shall be a 3" galvanized pipe, filled with concrete. The pipe shall be painted with alternating stripes of yellow and silver each being 4 inches in width. The pipe shall have reflectors as required by the Engineer. Reference information shall be painted on the reference marker per the direction of the Engineer.

321 WATER SERVICE LINES AND FIRE LINES

All water service lines and fire line construction connecting to the City of Louisville Water System shall be constructed in accordance with these Design and Construction Standards and Louisville Fire Protection District. Standards shall cover all new and replacement water service lines from the water main to the right-of-way property line.

321.1 MATERIALS

All materials used on water service line installations from the water main to the property line or curb stop shall be in accordance with this section and the standard details.

All piping shall be new, installed clean and shall be of the following materials:

1) Copper tubing type "K" (soft drawn) shall be used.

2) For taps larger than 2", Ductile iron may be used upon written approval of the Engineer.

3) Only flared fittings permitted, no compression or sweated joints allowed.

4) Curb stops shall be buffalo type and installed within 12" behind the sidewalk or curb.

5) A ten (10) foot pigtail shall be installed into the property from the curb stop.

321.2 CROSSING SIDEWALK OR CURB EXISTING OR PROPOSED

In no instance, shall a trench extend beneath an existing sidewalk or curb. The pipe must be bored or jacked, or tunneled through the earth under the curb or sidewalk.

321.3 TAPPING THE MAIN

City of Louisville Water Department must be notified 24 hours in advance to schedule water taps on ductile iron mains. At the time the tap is to be made, the service trench must be excavated from the main to the property line.

321.4 SERVICE LINE INSTALLATION

All service line work shall conform to the standard details. Per the Municipal Code of the City of Louisville, The City shall provide a meter, a yoke, a corporation valve, a meter pit (if required) and all labor involved in installing the corporation valve on ductile iron pipe.

The Owner shall be responsible for all excavation, earthwork and materials for installation of the service from the water main to the structure served.

322 ADDITIONAL REQUIREMENTS FOR WATER SERVICES

All water meter pits and backflow prevention device pits shall at all times be maintained by the owner. On new water services, no meter shall be installed until the installation is in accordance with Section 322.4. Any deviation from these Design and Construction Standards requires written approval from the Engineer. The Engineer shall establish the requirements of the deviations.

322.1 3/4" WATER SERVICES

12/12/25 CLF

1) ~~In most cases the water meter is installed inside the building with remote readout on 3/4" water services.~~

2) ~~The meter pit shall be supplied by the City. A 48 hour notice is required for meter pit delivery to the site. All plumbing inside the meter pit shall be the responsibility of the contractor.~~

3) Should meter pits be required, meter pits shall not be installed in or under driveways, sidewalks, streets or parking areas. The contractor will be responsible for setting of the meter pit per the standard detail.

4) The meter pit shall be at the final grade at the time the meter is to be installed. Any adjustment in the grade of the meter pit, meter yoke or brace shall be by and at the expense of the owner.

5) The meter pit shall be installed in a workmanlike manner. The rings and hood shall not have spaces between them. The pit shall be free of trash. The meter pit shall have a minimum depth of four (4) feet from finished grade.

6) The yoke brace (if required) shall be installed on a diameter between the top two rings. The yoke shall be secured in the notch with wire.

7) Pits shall be vertically plumb.

8) Hoods shall be raised with riser rings only.

9) All materials shall be of new quality and free of defects.

10) Meter pits shall be located away from hazards, ie, steam vents, electrical equipment.

11) Backfill around meter pit and in the trench shall be compacted to 95% of the maximum density per AASHTO T180 or T99 as applicable to soil type.

12) All bends in the service line shall have a minimum radius of 12".

13) The meter pits, and service lines shall be inspected by the City prior to backfilling.

14) The copper service shall be bedded 6" below to 12" over the top of the service with granular bedding material.

15) A ten (10) foot type k copper pigtail shall be installed into the property from the curb stop.

322.2 1" WATER SERVICES

1) If the water meter cannot be installed in the building Section 322.1 shall apply.

322.3 1 1/2" - 2" WATER SERVICES

1) ~~At the option of the Owner the water meter may be installed in the building with a remote readout. In the event the Owner cannot accommodate the meter in the building a meter pit shall be installed.~~

12/12/25 CLF

2) ~~The meter pit shall be supplied by the City. A 48 hour notice is required for meter pit delivery to the site. All plumbing inside the meter pit shall be the responsibility of the contractor.~~

12/12/25 CLF

3) The contractor will be responsible for setting concrete footings and setting of the meter pit per the standard detail.

4) A locking meter setter with locking by-pass shall be supplied by the contractor.

5) Buffalo type curb stop boxes are required.

6) A check valve is required.

322.4 WATER METER INSTALLATION

Prior to the City of Louisville Water Department setting a water meter the following conditions are required.

1) The structure is enclosed and heated (between the September 1 and May 1).

2) Curb stop valve box is centered and vertically plumb over the curb stop and cover above grade.

3) The contractor must be present to flush water service.

4) For basements that will be finished, or on bi-level construction, prewiring is required for the remote readout.

5) A 72 hour advance notice is required for water meter installations.

323 DISCONTINUATION OF WATER SERVICE

Whenever a building is torn down or removed, the service line shall be uncovered at the water main and the service corporation closed. A section of the service line one (1) foot in length shall be removed at the corporation to physically disconnect the line. The Engineer shall inspect the disconnection prior to backfilling the trench. Backfilling shall be in accordance with Section 7 of these Design and Construction Standards.

If a building permit has been obtained for another building in that location which will utilize the same water service line, the service line shall be turned off and locked within the meter pit by Water Personnel.

324 JACK AND BORE

Should water line construction involve the crossing of an existing arterial or collector street, or at the discretion of the Engineer, the crossing shall be jack and bored.

CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 4
STORM SEWER SYSTEMS

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SECTION 4
STORM SEWER SYSTEMS

400 USE OF STORM SEWER STANDARDS

These are the minimum standards for storm sewer construction, and must be supplemented by the City of Louisville's **"Storm Drainage Design and Technical Criteria Manual" for the design of the storm drainage system.**

401 HANDLING AND INSTALLATION FOR PIPES AND CULVERTS

Unless otherwise specified all pipe handling, laying and jointing shall be based upon the manufacturer's recommended practice for installation of each specified type of pipe. All appropriate provisions of this section shall also apply to the installation and construction of storm sewers.

401.1 MATERIAL HANDLING

Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. If any part of the coating or lining is damaged, the Contractor shall repair or replace the material affected at his expense as required by the Engineer. All pipe and culverts shall be handled in accordance with the appropriate AWWA and ASTM Standards.

401.2 ALIGNMENT

All piping shall be constructed to the lines and to the grades and elevations shown on the drawings.

All pipe shall be laid to straight lines as staked between specified or otherwise authorized angles, bends or points of tangency of horizontal or vertical curves. Installation of pipe on horizontal or vertical curves will depend on the length of pipe sections furnished and upon the type of field joint, which is furnished. Deflection at field joints shall not exceed the maximum deflection recommended by the pipe manufacturer.

When water mains cross above or below storm sewer mains, the minimum vertical separation shall be 18 inches. If 18 inches of vertical separation cannot be maintained, the crossing shall be installed as directed by the Engineer.

In all cases storm sewer manhole placement shall not interfere with the vehicular tire traffic pattern. Where on street parking is approved, a storm sewer manhole shall be placed not closer than eight (8) feet to an existing or proposed curb flowline.

401.3 INSTALLATION

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Every precaution shall be taken to prevent foreign material from entering the pipe. If the pipe-laying crew cannot install the pipe in the trench and in place without getting earth in it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly-woven canvas bag of suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. When pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer.

The cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damaging the pipe coating or lining and so as to leave a smooth end at right angles to the axis of the pipe.

The laying of pipe shall commence at the lowest point and proceed upgrade so that the pipe is laid with the bell ends facing in the direction of laying and at the correct grade and alignment. The pipe shall be placed in such a manner that the specified bedding provides a solid, uniform bearing surface for the full length of the barrel. Bell holes shall be provided at all joints. Equipment used in handling and jointing the pipe shall have adequate capacity to handle the pipe smoothly and assure the proper closure of joints.

All pipe shall be carefully centered, so that when joined together they will form a conduit with a smooth, uniform invert. The pipe shall be laid accurately to the grade and alignment specified on the drawings. Blocking or wedging of the pipe to achieve proper positioning and grade will not be permitted, except where required for the proper construction of concrete cradles or encasement.

402 STORM SEWER PIPE

Only those pipeline materials described in this section will be approved for storm sewer installations. All pipe materials to be incorporated in the construction of storm sewers shall conform to the requirements specified herein or as modified elsewhere in these Design and Construction Standards.

403 PRECAST CONCRETE PIPE

All concrete pipe shall new and be minimum of Class III reinforced meeting the requirements of ASTM C-76. Infiltration shall be limited to 200/gal. per inch of diameter per mile per day when R-4 joints are required.

403.1 CEMENT

Unless otherwise required by the Engineer, type II portland cement complying with the requirements of ASTM Designation C-150 will normally be acceptable in the manufacture of concrete pipe.

403.2 DIAMETER OF PIPE

The diameter indicated on the drawings shall mean the inside diameter of the pipe or the inside span dimension for arch pipe. The minimum allowable pipe diameter for concrete storm sewer main lines shall be 18 inches. The minimum allowable pipe diameter for storm sewer lateral lines shall be 18".

403.3 FITTINGS AND SPECIALS

Details of all fittings and specials shall be submitted to Engineer for approval. Fittings and specialties shall be made up of pipe segments having the same structural qualities as the adjoining pipe and shall have the interior treated the same as the pipe. The deflection of all elbows shall be as shown on the drawings and the centerline radius shall not be less than the internal diameter of the pipe. Installation diagrams shall be approved by the Engineer prior to construction.

403.4 MATERIAL INSPECTION

In addition to deficiencies covered by the applicable ASTM Specifications, concrete pipe which has any of the following visual defects will not be accepted and rejected.

1) Porous areas on either the inside or outside surface of a pipe having an area of more than five square inches and a depth of more than one-half inch.

2) Pipe which has been patched or repaired without approval of the Engineer.

3) Exposure of the reinforcement.

4) Pipe damaged during shipment or construction.

5) Out of round pipe.

403.5 MARKINGS

The following shall be clearly marked on the exterior surface of all pipe:

ASTM Specifications
Class and size
Date of manufacturer
Name or Trade Mark of Manufacturer.

403.6 JOINTS

Unless otherwise specified, joints shall be in accordance with ASTM C-76. Joint sealer shall be required. When water-tight joints are specified, joints and gasket material shall be R-4 in accordance with ASTM C-443. All other joints shall be sealed with Ram-nek, or approved equal.

404 CORRUGATED STEEL PIPE

Except as modified herein, all materials shall be new and manufacturing operation, testing, inspection and marking of corrugated steel pipe and pipe arch shall conform to requirements of AASHTO M-36 latest revisions. Corrugated steel pipe may only be used upon written approval of the Engineer for use in non roadway areas.

404.1 WALL THICKNESS AND GAUGE

The minimum allowable wall thickness for a given diameter shall not be less than those set forth below.

Diameter	2-2/3" x 1/2" Corrugations	3" x 1" Corrugations
21"-30"	.064"	.064"
36"-48"	.064"	.064"
54"	.079"	.064"
60"	.109"	.064"
66"	.109"	.064"
72"	.138"	.064"
78"-96"	.168"	.064"
102"	-	.064"
108"	-	.079"
114"	-	.079"
120"	-	.109"

404.2 FITTINGS AND SPECIALS

Details of all fittings and specials shall be furnished for approval by the Engineer prior to construction. Fittings and specials shall be made of the same material and shall have the same structural qualities as the adjoining pipe. Under no conditions shall the wall thickness be less than the adjoining pipe.

404.3 CONNECTING BANDS

The base metal of connecting bands shall be the same base metal as that of the pipe. The gauge of the connecting bands for pipe arched and helically corrugated pipe shall be the same as for an equivalent diameter of circular pipe. The band couplers shall be connected with galvanized steel bolts of not less than 1/2 inch diameter. All joints shall be watertight.

404.4 PROTECTIVE COATINGS

Unless otherwise specified on the drawings or otherwise required by the Engineer, no additional coatings except zinc coating, per AASHTO M-36, of the pipe, fittings, specials and coupling bands will normally be required.

BITUMINOUS LININGS Bituminous linings and paved inverts shall conform to AASHTO M-190.

SPUN ASPHALT LININGS Pipe shall be coated per AASHTO M-190, Type A, and shall be lined on the inside of the pipe so that a smooth surface will be formed by filling the corrugations to a minimum thickness of 1/8" above the crests of the corrugations. The interior lining shall be applied by a centrifugal or other approved method and shall be free from sags and runs. The lining shall meet the requirements of AASHTO M-190. Pipe that is fabricated by lap joint construction shall have the rivets located in the inside valleys of the corrugations.

405 CORRUGATED ALUMINUM PIPE AND PIPE ARCHES

Corrugated aluminum pipe, pipe arches, and connectors shall be new material and manufactured and inspected in conformance with the requirements of AASHTO M-196, M-197, and M-221, and as specified herein. The size, type, and gauge of the pipe to be furnished shall be as shown on the plans. Corrugated aluminum pipe may only be used upon the written approval of the Engineer in non roadway areas.

Corrugated aluminum pipe arches shall consist of corrugated aluminum pipe which has been reformed to multi-centered pipe having an archshaped top with a slightly curved integral bottom. The minimum radius of any part of the pipe section shall be not less than 3 inches, (76mm).

The standards contained herein for pipe shall also apply to pipe arched. Nominal diameter, as referred to in AASHTO M-196, M-197, and M-211, shall be defined as meaning the minimum inside dimension of the pipe.

405.1 MATERIALS

Corrugated aluminum sheets covered by this section shall be fabricated from alloy Alclad 3004 with Temper H-34 and shall conform to ASTM B209 and the following mechanical properties.

Thickness, inches	0.051 to 0.113	0.114 to 0.249
Thickness strength	31,000 psi min.	31,000 psi min.
Yield strength (2% offset)	24,000 psi min.	24,000 psi min.
Elongation in 2 inches (51mm)	4% min.	5% min.

The gauges and thickness referred to in these standards are as follows:

Thickness in Inches	Guage Number (U.S. Standard)
0.060	16
0.075	14
0.105	12
0.135	10
0.165	8

The cladding thickness shall be 5 percent of the total composite thickness.

Rivets shall conform to ASTM B316 for Alloy 6053 with Temper T-4 and the following physical properties:

Tensil strength	25,000 psi min.
Yield strength (2% offset)	14,000 psi min.
Shear strength	15,000 psi min.
Elongation in 2 inches (51mm)	16% min.

405.2 CORRUGATION WIDTH AND DEPTH REQUIREMENTS

DIAMETER INCHES	WIDTH INCHES	DEPTH (MIN.) CORRUGATION	TYPE OF CORRUGATION
6 and larger	2 1/4 - 2 3/4	1/2	Annular
6 through 10	1 3/8 - 1 7/8	1/4	Helical
12 through 21	1 7/8 - 2 3/4	7/16	Helical
24 through 48	1 7/8 - 2 3/4	1/2	Helical

The lengths and thickness of sheet width of laps and computed weight per lineal foot of finished corrugated aluminum pipe and arches, shall be as specified in Table 4 of AASHTO M-196. The dimensions of the corrugated aluminum pipe arch shall be as shown in Table 4 of AASHTO M-36.

405.3 CONNECTING BANDS

The connecting bands shall conform to the requirements of M-196, except the minimum width of band for helical pipe shall be 12 inches. The base metal of connecting bands shall be the same base metal as that of the pipe. The gauge of the connecting bands for pipe arched and helically corrugated pipe shall be the same as for an equivalent diameter of circular pipe. The band couplers shall be connected with galvanized steel bolts of not less than 1/2 inch diameter. All connections shall be watertight.

406 MANHOLES

Manholes shall be constructed of precast concrete.

406.1 BARREL SIZE

The internal diameter of the manhole barrel shall not be less than 48 inches for storm sewer of sizes 36 inches or less; for pipes larger than 36 inches, CDOH manhole M-604-20 shall be installed.

406.2 MATERIALS

The materials to be used in the construction of manholes shall conform to the following requirements.

1) Cones: All cones shall be eccentric.

2) Precast Manholes: Precast manhole risers and cones shall be manufactured in conformity with ASTM Designation C478.

3) Precast Manhole Bases: Precast manhole bases shall conform to ASTM C478.

4) Cast-in-place Manhole Bases: Concrete used in cast in-place manhole bases shall have a 28 day strength of 3750 psi and shall contain not less than six (6) sacks of Portland cement per cubic yard. Concrete shall be Class A, Type lI.

5) Brick Manholes: No brick manholes shall be constructed.

6) Concrete for Manholes: Concrete used in precast manhole sections and the manhole foundation shall have 28 day strength of 4000 psi and shall contain not less than six (6) sacks of Portland cement per cubic yard. Concrete shall be Class A, Type II. Precast manholes shall meet the requirements of ASTM C478.

7) Manhole Steps: Manhole steps shall be aluminum and shall be cast into the manhole wall at the same time the manhole section is cast. The steps shall be Alcoa No. 12653B, as manufactured by the Aluminum Company of America, or approved equivalent. Manhole steps shall be no more than 24 inches from the top of the manhole nor more than 18 inches from the bench of the manhole.

8) Frame and Cover: Manhole frames and covers shall be 24 inch diameter. The cover shall fit the ring in accordance with the manufacturers dimensions. Covers with more than one 1 lifting notch will not be accepted. The lifting notch shall be 1" x 1 1/4". The word **"STORM"** shall be marked with raised lettering on the cover.

   The ring shall be held in place by being set on ramneck. A maximum of 18" of concrete adjustment rings will be allowed between the last manhole section and finished grade.

9) Aggregate: Aggregate shall conform to Standard Specifications for Concrete Aggregates ASTM, Designation C33.

10) Flexible Plastic Joint Sealing Compound: The performing flexible plastic joint sealing compound shall be "RAMNEK" as manufactured by K. T. Snyder Co., or equal. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions, as to the quantity of material, the grade of the materials, and the application temperatures. Plastic joint compound shall be applied to all manhole joints.

406.3 CONSTRUCTION

Manholes shall be constructed at the locations and to the elevations indicated on the drawings.

Manholes shall be so constructed so as to form a circle in a horizontal plane. The internal diameter of four (4) foot manhole barrels shall be maintained to a distance of not more than

five (5) feet below finished grade. From that point the manhole barrel shall be tapered to the 24 inch internal diameter. The manhole barrels shall be tight at all joints.

The cone section shall not extend closer than 18 inches to nor more than 24 inches from the top of the manhole cover. Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade.

407 EXCAVATION, BEDDING AND BACKFILLING

The minimum acceptable class of bedding for all classes of pipe are given in Section 7. Excavation, and backfilling and compaction are specified in Section 7 of these Design and Construction Standards.

408 OBSTRUCTIONS

The Contractor shall "lamp" and "ball" all sewer pipe to insure that there are no obstructions within the pipe. All obstructions shall be removed prior to final inspection of the pipe. Any misalignment of pipes, culverts or appurtenances, both vertically and horizontally, or any visible structural defects of same shall be basis for rejection of the drainage system. The defective sections or misaligned sections shall be removed and replaced, in a manner satisfactory to the Engineer, at the Contractors expense.

409 TESTING

Storm sewers shall meet the following Infiltration/Exfiltration requirements:

Storm sewers shall pass a low pressure air test in accordance with ASTM C828.

In the absence of a low pressure air test, the sewer pipe, all connections and all appurtenances shall not leak, under ground water pressure or with a six foot head of internal pressure, more than two hundred gallons per inch of inside diameter per mile of sewer per twenty-four hours.

Sections of pipe that have infiltration rates above the maximum shall be repaired or replaced at the Contractor's expense. The loss of all water from any portion of the completed drainage shall be investigated and immediate measures taken to correct said loss. The Infiltration/Exfiltration requirements may be waived at the discretion of the Engineer.

411 CRADLES AND ENCASEMENTS

Prior to placing concrete for cradles or encasement, temporary supports consisting of concrete blocks or bricks shall be used to support the pipe in place. Not more than two supports shall be used for each pipe length; one adjacent to the shoulder of the bell and the other near the spigot end.

CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 5
ROADWAY CONSTRUCTION WORK

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SECTION 5
ROADWAY CONSTRUCTION WORK

500 ROADWAY CONSTRUCTION

The City of Louisville Design and Construction Standards apply to all roadway construction work within the City of Louisville.

501 DRAWING SUBMITTAL PROCEDURE

Design Engineers and Developers seeking approval of civil engineering design and construction drawings for roadway construction shall follow the procedures and drafting standards as outlined in Section 1 of these Design and Construction Standards.

502 GENERAL CRITERIA FOR ROADWAY DESIGN

502.1 SIDEWALKS, CURB AND GUTTER

All sidewalks shall have a minimum width of 4 feet 0 inches (4'-0")or as otherwise determined by the Engineer. Combination curb and gutter may be approved for usage on local streets only. Vertical curb and gutter shall be used for all other streets.

Minimum curb return radius shall be as shown in Table 502.1. Minimum fall around curb returns shall be 0.3 feet to 3.0 feet. The maximum fall shall not exceed six (6) percent between curb returns.

Storm waters from downspouts shall not be allowed to flow over sidewalks. Handicap ramps shall be shown at all curb returns and at all "T" intersections. Curb cuts shall be constructed in accordance with the standard drawings.

The top of the curb elevation shall be the same on both sides of a street. Except at intersections or where super elevation is required, differences in elevation of more than 0.50' must be approved by the Engineer.

TABLE 502.1

Curb Return Radii At Intersections

	Local	Collector	Arterial
Local	15'	20'	25'
Collector	20'	25'	30'
Arterial	25'	30'	35'

502.2 DRAINAGE

Drainage systems shall be in accordance with City of Louisville Storm Drainage Design and Technical Criteria Manual. Drainage plans must be approved before final approval of street plans. Drainage works shall not impair the drivability of the streets.

502.3 CROSSPANS

The use of double crosspans shall not be allowed. Crosspans may be used at the intersection of local streets only upon approval of the Engineer. Crosspans shall not be approved across collector or arterial streets. Crosspans are not allowed on streets with storm sewer systems.

502.4 INLETS

Inlets shall be located to intercept the major curb-flow. Due to the presence of handicap ramps, inlets are not allowed in the curb return. Multiple inlets shall be located at the tangent points of the curb returns. All inlets in streets shall be the curb opening Type R in accordance with these Design and Construction Standards. The minimum curb opening length shall be five (5) feet.

502.5 CROSS SLOPE

Cross slope or crown shall be 2% as measured from centerline to lip of curb or lip of median curb to lip of outside curb on streets with raised center islands. Parabolic or curved crowns will not be allowed.

502.6 HANDICAP RAMPS

State law requires that handicap ramps be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk (CRS 43-2-107 (2)). Handicap ramps shall be shown at all curb returns and at all "T" intersections and as directed by the Engineer.

502.7 CUL DE SACS

The maximum allowable length for a cul-de-sac shall be 600 feet. A turn around right-of-way diameter of 100 feet shall be provided.

502.8 CURVE RADII

The minimum centerline curve radii shall be as follows:

Local	150 ft.
Collector	625 ft.
Arterial	1050 ft.
Alley & Marginal Access	100 ft.

502.9 TANGENTS

The minimum tangents between curves and at intersections shall be as follows:

Local ..... 50 ft.
Collector..... 100 ft.
Arterial ..... 200 ft.

502.10 MINIMUM STREET CONSTRUCTION

STREET TYPE	LOCAL	COLLECTOR*	ARTERIAL	ALLEY
Minimum Street Pavement Thickness	6" Full Depth	7" Full Depth	9" Full Depth	3" asphalt 10" base
Minimum dedicated right-of-way width	50'	60'	120'	30'
Minimum street width flow line to flow line	36'	42'	70'	20'

* Values indicated are for typical residential collector. Additional right-of-way and street width shall be required when considering commercial and industrial areas, traffic volumes, level of service, speed change lanes, and on street parking.

TYPE OF SIDEWALK, CURB AND GUTTER

Local: Combination gutter and walk or vertical curb and gutter

Collector: Vertical curb and gutter, 4'-0" walk, 8' bike path

Arterial: Vertical curb and gutter detached 5'-0" walk, 8' bike path (16' median curb and gutter minimum center island)

Eight foot (8') wide bicycle paths are required on all arterial streets and selected other streets as required by the City.

Temporary access: Per Louisville Fire Protection District

502.11 HORIZONTAL ALIGNMENT

All streets shall intersect at right angles. "T" type intersections are not permitted on streets with a radius of less than 250 feet. Whenever a residential or collector street intersects another street, a minimum tangent length measured from the nearest right-of-way line of the intersected street to the point of curvature in the intersecting street shall be provided.

The minimum allowable intersection turning radius for any street shall be 50 feet. Horizontal alignment design speed shall be consistent with requirements for vertical alignment design and speed. Super-elevation shall be as recommended by AASHTO and approved by the Engineer.

The rate of super-elevation shall be shown on the drawings along with exaggerated (1" =10' H, 1" =1' V) profiles of the centerline and both top of curbs.

The super-elevation runout length, crown runout length and point at which full super-elevation is reached shall be clearly shown. Super-elevation shall be required for curves on all arterial streets and selected collector streets. Super-elevation shall not be used on local service streets.

Drainage water shall not be allowed to cross the pavement when the crown slope is reversed for transitions into or out of super-elevation.

502.12 VERTICAL ALIGNMENT

The minimum allowable grade for any street shall be .5%, the maximum allowable grade for any street shall be as shown on Table 502.12. The minimum grade for alleys shall be .5%, the maximum grade shall be subject to the approval of the Engineer. All vertical curves shall be labeled with length, sight distance, safe speed as listed by AASHTO, and K (K=L/A). Continuous changing of grades that create a roller coaster effect shall not be permitted.

Connection with existing streets shall be smooth transitions and existing grades shall be shown for at least 300' on each side of the intersection. The grade and ground lines of all streets that dead end, except cul-de-sacs, shall be continued for 500' or to its intersection with an arterial street. The grade and ground lines for arterial streets shall be continued 1000' beyond their ends.

Design controls for vertical alignment shall be as shown in Table 2. The grades at intersecting arterials and collectors shall not be greater than 2% for 200' on either side of the intersection. On all other streets, the grade shall not be greater than 3%. The more important street at an intersection shall govern the through grade.

Grade breaks may be allowed if the algebraic difference in grade (A) is less than 0.4%.

TABLE 502.12

Vertical Alignment Controls

	Speed V	Minimum L	Crest K(min)	Sag K(min)	Maximum Grade G
Arterial	50	150	160	110	5%
Collector	40	120	80	70	6%
Local	25	75	20	30	8%

NOTES TO TABLE 502.12:

1. All vertical curves shall be labeled with length of curve (L), stopping sight distance (SSD), or headlight sight distance (HSD), safe speed (S), and K (=L/A) where A equals algebraic difference in grade per cent.

2. The minimum speeds listed shall also apply to horizontal alignment. Horizontal curve radius and super-elevation shall be in accordance with the recommendation of AASHTO.

3. Vertical curves are not necessary when A is less than 0.4%. For "A" between 0.4% and 0.8%, L need not exceed 50'.

503 DESIGN PROCEDURE FOR FLEXIBLE PAVEMENT

The design procedure for flexible pavements follows the method presented in the Colorado Department of Highways Roadway Design Manual, Section 600, Design of Pavement Structures, which is based on the concepts originally developed in the AASHTO Road Test at Ottawa, Illinois, in 1962, and modified according to the most recent formulation of a design procedure by AASHTO in the 1986 AASHTO Guide for Design of Pavement Structures.

The elements to be considered in this design procedure consist of the following:

A. Soils Analysis
B. Traffic Analysis
C. Serviceability Loss
D. Reliability
E. Drainage Characteristics
F. Layer Strength Coefficients

503.1 PAVEMENT DESIGN REPORT

The pavement design report shall include the following minimum information:

- Design factors used for the pavement design.
- Design nomograph showing the lines connecting the design factors.
- Design calculations for each pavement section.
- Discussion of any unusual design or construction problems or requirements.
- Soils report specified in Section 503.2.

503.2 SOILS ANALYSIS

Flexible pavement design shall be based on a soils report signed and stamped by a registered professional engineer competent in the field of Geotechnical Engineering.

Minimum information required:

- Map with location and depth of test holes
- Ground water elevations, if encountered
- Drill logs
- Grading analysis curves
- Atterberg limits
- AASHTO soil classification
- ASTM D2487 soil classification
- Moisture-density curves
- "R" value
- Depth of bore hole or test pit
- Location or limits or different soil types on a map

In addition, the Geotechnical Engineer shall investigate and recommend solutions to problems of:

1) Expansion of cohesive soils
2) Frost heave in silty soils
3) Potential ground water problems
4) Any other matter that may adversely affect the design and life of the pavement.

Soil samples shall be taken at the proposed subgrade elevation and shall represent the soil of the subgrade. All borings shall be for a minimum of 5 feet. If more than one type of soil is encountered in the boring, they shall be logged and tested separately. The pavement shall be designed for the worst soil encountered from the standpoint of subgrade support.

Note: **No mixing of separate soil samples for testing will be allowed.**

The poorest soils encountered shall be used to determine an "R" value. The "R" value shall be determined by the Hveem stabilometer test performed in accordance with AASHTO Designation T190 or ASTM D2844.

The "R" values used shall be at 95% of the maximum dry density for the soil compacted as

specified below:

(Unified) ASTM D2487 Soil Classification	Minimum Compaction	Minimum Depth
GW, GP, GM, GC SW, SP, SM, SC	95% AASHTO T180 B or D or ASTM D1557, B or D	6 inches
ML, CL, MH, CH	95% AASHTO T99, B or D or ASTM D698, B or D	1 foot

The Effective Roadbed Soil Resilient Modulus, M_R (psi) is used in the design nomograph for flexible pavements. The following soil strength - correlation equations shall be used to convert values to the Resilient Modulus, M_R.

To convert "R" to Soil Support, S_1:

$$S_1 = \left[\text{("R" - 5)/11.29} \right] + 3$$

To convert S_1 to M_R

$$M_R = 10^{\left[\frac{(S_1 + 18.72)}{6.24} \right]}$$

503.3 TRAFFIC ANALYSIS

The "design traffic number" (DTN) is the estimated average daily number of equivalent 18 Kip single-axle-load applications for the design lane during the design period. The design period is 20 years. Maximum DTN's are listed in the table below. The Engineer may increase the DTN on any street if in his opinion traffic conditions warrant it.

TABLE 503.3

CITY OF LOUISVILLE
MINIMUM DESIGN TRAFFIC NUMBERS (DTN)
FOR USE IN PAVEMENT DESIGN

Street Classification	LAND USE			
	Single Family Residential	Multi-family Residential	Commercial and Business	Industrial
Arterial	Consult Engineer (200 Min.)	Consult Engineer (200 Min.)	Consult Engineer (200 Min.)	Consult Engineer (200 Min.)
Collector	30	30	80	Consult Engineer (100 Min.)
Local	10	10	30	Consult Engineer (70 Min.)

Note: When different land use occurs on both sides of a street the higher use shall apply. Streets leading to or from areas of different land use, the higher shall apply.

The traffic number to be used directly in the flexible pavement design nomograph is in the form of 18 Kip equivalent single axle load applications (18K ESAL). The DTN from the table shall be converted to ESAL for use in the nomograph.

To convert DTN to ESAL:

DTN x 365 days/yr x 20 years = ESAL

EXAMPLE: 100 x 365 days/yr x 20 years =730,000

503.4 SERVICEABILITY LOSS

Serviceability of a pavement is the pavements ability to provide adequate support and a satisfactory ride at any specific time. The Serviceability Index is a number which is indicated of the pavement ability to serve traffic at any specific time.

The Design Serviceability Loss (PSI) is determined by subtracting the terminal Serviceability Index at the end of the design period from the initial Serviceability Index at initial construction. The Index at initial construction will normally fall in the range of 4.2 to 4.6 and generally can be assumed to be 4.5.
The Index at the end of the design period is the worst case allowable condition that the pavement reach. A terminal Serviceability Index of 2.5 is generally accepted for arterial and collector roads and 2.0 accepted for local roads.

The values for PSI listed in Table 503.4 shall be used in the flexible pavement design nomograph.

TABLE 503.4

	PSI
Arterial	2.0
Collector	2.0
Commercial and Industrial - All	2.0
Local Residential	2.5

503.5 RELIABILITY

The following general definitions describe the concept of pavement Reliability in terms of the other components considered in flexible pavement design.

Reliability is the probability that the pavement system will perform its intended function over its design life and under the condition encountered during operation.

Reliability is the probability that serviceability will be maintained at adequate levels from a users point of view, throughout the design life of the facility.

Reliability is the probability that the load application a pavement can withstand, in reaching a specified minimum serviceability level, is not exceeded by the number of load applications that are actually applied to the pavement.

The reliability component gives the option of incorporating a risk reduction factor into the pavement design process. The reliability factor is determined based on the functional classification of the street. Ranges of factors and the factors to be used in design are presented in Table 503.5.

The Engineer shall assign the reliability factor for arterials.

TABLE 503.5

RELIABILITY

Street Classification	Range	Recommended Design Factor
Arterials	70-95	70
Collectors	50-90	50
Local	50-80	50

503.6 DRAINAGE CHARACTERISTICS

The treatment for the expected level of drainage for a flexible pavement is through the use of modified layer coefficients (e.g., a higher effective layer coefficient would be used for

improved drainage conditions). The factor for modifying the layer coefficient is referred to as an m_i value and has been integrated into the structural number (SN) equation along with layer coefficient (a_i) and thickness (D_i); thus:

$$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

(The possible effect of drainage on the asphalt concrete surface course is not considered.)

The conversion of the structural number into actual pavement layer thicknesses is discussed in the next section.

The Table below presents the recommended m_i values as a function of the quality of drainage and the percent of time during the year the pavement structure would normally be exposed to moisture levels approaching saturation. Obviously, the latter is dependent on the average yearly rainfall and the prevailing drainage conditions. As a basis for comparison, the m_i value for conditions at the AASHTO Road Test is 1.0, regardless of the type of material.

TABLE 503.6

Recommended m_i values* for modifying structural layer coefficients of untreated base and subbase materials in flexible pavements.

Quality of Drainage	Percent of Time Pavement Structure is Exposed to Moisture Levels Approaching Saturation			
	Less Than 1%	1-5%	Greater Than 5-25%	25%
Excellent	1.40-1.35	1.35-1.30	1.30-1.20	1.20
Good	1.35-1.25	1.25-1.15	1.15-1.00	1.00
Fair	1.25-1.15	1.15-1.05	1.00-0.80	0.80
Poor	1.15-1.05	1.05-0.80	0.80-0.60	0.60
Very Poor	1.05-0.95	0.95-0.75	0.75-0.40	0.40

*Designer is to use a value of m_i=1.0 unless specified drainage information indicate otherwise.

Note: For full depth asphalt street section, no M_i value is needed.

503.7 LAYER STRENGTH COEFFICIENTS

A strength coefficient expresses the empirical relationship between Structural Number and thickness and is a measure of the relative ability of the material to function as a structural component of the pavement. The strength coefficients of the various layers of the pavement structure shall be determined from the Table below.

TABLE 503.7

STRENGTH COEFFICIENTS*

COMPONENT	LIMITING TEST CRITERIA	COEFFICIENT
Hot bituminous Pavement	R_t = 95	0.44
Hot bituminous Pavement	R_t = 90-94	0.40
Hot bituminous Pavement	R_t = 87-89	0.35
Hot bituminous Pavement	R_t = 84-86	0.30
Hot bituminous Pavement	R_t = 83	0.25
Road Mix Bituminous Pavement		0.20
Existing Bituminous Pavement		0.20 to 0.44
Plant Seal Mix		0.25
Plant Mix Bituminous Base		0.30
Aggregate Base Course	"R" = 84	0.14
Aggregate Base Course	"R" = 78-83	0.12
Aggregate Base Course	"R" = 70-77	0.11
Aggregate Base Course	"R" = 50-69	0.10
Emulsified Asphalt Treated Base		0.15
Cement Treated Aggregate Base		**
Hydrated Lime Treated Aggregate Base	**	

** Consult Engineer

Notes:

1) For purposes of design, strength coefficients for aggregate base course shall be .14, for hot bituminous pavement shall be .40.

2) Material suppliers shall submit "R" values and "R_t" for their materials from an approved laboratory.

503.8 SEQUENCE OF DESIGN PROCEDURES FOR FLEXIBLE PAVEMENT

Design Factors and their sources necessary for the design procedure are as follows:

M_R Value of the Subgrade	Calculated from R value
18K ESAL	Table 503.3
Serviceability Loss PSI	Table 503.4
Reliability R	Table 503.5
Drainage Coefficient	Table 503.6
Layer Strength Coefficients, a	Table 503.7
Overall Standard Deviations, S_o	0.44 (Standard for flexible pavement)

503.9 USE OF THE NOMOGRAPH

Figure 503.9 presents the nomograph recommendation for determining the design structural number (SN) for flexible pavement. The nomograph is used as follows:

1) Enter the nomograph at the left with the level of Reliability required. The Reliability component should then be connected with a Standard Deviation value of 0.44, for use in all designs. This line is then extended to a turning line.

2) From the turning line intercept, a line should be taken through the appropriate value for estimated traffic, the 18K ESAL. This line is also extended to another turning line.

3) From this turning line intercept, a line should be taken through the appropriate soil support value, the roadbed soil Resilient Modulus, M_r, and extended to the Design Serviceability Loss figure.

4) Plot the horizontal line intercepting the selected PSI value and from this turning point, a vertical line is plotted to the resultant Design Structural Number, SN.

5) Once the Structural Number (SN) has been determined, the design thickness of the pavement structure can be determined by the general equation:

$SN = a_1D_1 + a_2D_2M_2 + a_3D_3M_3$ where:

a_1,a_2,a_3 = strength coefficients

D_1 = thickness of bituminous pavement surface course (inches)

D_2 = thickness of base course (inches)

D_3 = thickness of subbase (inches)

M_2 = drainage coefficient of base course

M_3 = drainage coefficient of subbase

Note: Minimum street pavement thickness shall be in accordance with Section 502.10.

FIGURE 503.9 (Graph)

Design Nomograph - Flexible Pavements

504 SUBSURFACE DRAINAGE SYSTEMS

The aim of the subsurface drainage is the removal of detrimental amounts of groundwater to provide a stable roadbed and sideslope. When the water table is encountered within 3 feet of the proposed subgrade, underdrain systems and/or dewatering systems will be required.

504.1 DESIGN OF SUBSURFACE DRAINAGE SYSTEMS

The aim of subsurface drainage is the removal of detrimental amounts of ground water to provide a stable roadbed and sideslopes based on the recommendations of a Geotechnical Engineer.

1) SIZE REQUIREMENTS

The minimum single diameter for a standard perforated collector pipe shall be 8 inches. Perforated cross drains shall have a minimum inside diameter of 6 inches.

2) SEPARATION OF DRAINAGE

Surface drainage shall not be permitted to discharge into an underdrain. The discharge from a subsurface drainage system into a roadway drainage system or a culvert is permissible if the outfall for the underdrain is not under pressure.

3) CLEANOUTS

A terminal cleanout is required at the upper end of the subsurface drainage system (collection and cross drain). Intermediate cleanouts are required at maximum 300-foot intervals. These are made by bringing the pipe to ground level on a 45 deg. angle. The diameter of the riser shall be at least the diameter of the conduit.

4) GRADE REQUIREMENTS

The grade should shall not be flatter than 1.0 percent.

5) DEPTH AND SPACING OF UNDERDRAINS

The depth of the underdrain depends on the permeability of the soil, the elevation of the water table, and the amount of drawdown needed to ensure stability. Whenever practicable, a subsurface drainage system should be set in the impervious zone below the aquifer and at least 36 inches deep to protect the drain from frost penetration. The following table gives suggested depths and spacing of underdrains according to soil types. It is only a guide and should not be considered a substitute for field observations or the design and recommendations of a Geotechnical Engineer.

TABLE 504.1

Suggested Depth and Spacing of Underdrains for Various Soil Types

Soil	Classes	Soil Composition			Drain Spacing (Feet			
		% Sand	% Silt	% Clay	3 Ft.	4 Ft.	5 Ft.	6 Ft.
Clean	Sand	80-100	0-20	0-20	110-150	150-120	-	-
Sandy	Loam	50-80	0-50	0-20	50-100	100-150	-	-
Loam		30-50	30-50	0-20	30-60	40-80	50-100	
	60-120							
Clay	Loam	20-50	20-50	20-30	20-40	25-50	30-60	
	40-80							
Sandy	Clay	50-70	0-20	30-50	15-30	20-40	25-50	
	30-60							
Silty	Clay	0-20	50-70	30-50	10-25	15-30	20-40	
	25-50							
Clay		0-50	0-50	30-100	15(max)	20(max)	25(max)	
	40(max)							

Note: Depth is measured to invert of pipe.

In hilly terrain, the flow paths in subsurface drainage layers should never be allowed to reach excessive lengths. To prevent this, it is recommended that cross drains be required wherever needed to prevent the flow paths from exceeding 150 feet.

6) FILTER FABRIC

Filter fabrics are required in all subsurface drainage system designs.

7) OUTLETS

Outlets should be provided at intervals of not more than 1,000 feet. Outlets should be carefully located to eliminate the possibility of clogging and should be protected against intrusion of small animals. The outlet end of the outlet pipes shall be at least 12 inches above the flow line of the roadside drainage ditch.

8) REFERENCE MARKERS

Outlets and cleanouts shall be marked with a 3" galvanized pipe. The pipe shall be 9' long, set in an 8" diameter hole depth of 4' and filled with concrete. The pipe shall be painted with alternating stripes of yellow and silver being 4 inches in width. The pipe shall have reflectors as required by the Engineer. Reference information shall be painted on the reference marker.

505 CLEARING AND GRUBBING

Clearing and grubbing shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the right-of-way and easement areas and from borrow pits and such other areas required by the Engineer. Vegetation and objects designated to remain shall be reserved free from injury or defacement.

All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed.

The clearing of growth shall not extend more than eight feet beyond the toes of fills or the tops of cut slopes as treated. Except in areas to be excavated, stump holes and other holes from which obstructions are removed, shall be backfilled with suitable material and compacted in accordance with these Design and Construction Standards.

Burning shall not be permitted.

All refuse material removed by clearing and grubbing becomes the property of the Contractor. The Contractor shall make all necessary arrangements in obtaining suitable disposal locations.

Branches on trees or shrubs shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

The Contractors shall scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

506 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

This work shall consist of the removal and disposal of trees, slope and ditch protection, abandoned utility services, curb and gutter, pipes, sidewalk, structures, bridges or parts of bridges, railroad appurtenances, traffic control devices, fences, foundations, detours, pavement markings, pavement, and any other obstructions that are not designated or permitted to remain.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with plan details, and in such manner that materials to be left in place shall be protected from damage. All damage to portions of structure to remain in place shall be repaired by the Contractor at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension. Dowels as required by plans are to be securely grouted with approved grout.

Culverts and sewers to be abandoned shall be filled with concrete or as directed by the Engineer to prevent future settlement of embankments.

506.1 REMOVAL OF BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES

Materials deposited on the pavement as a result of removal of structures and obstruction during construction shall not interfere with roadway drainage. Operations that may damage or constitute a hazard to the traveling public or pedestrians will not be permitted. Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Unless otherwise directed, the substructures of existing structures shall be removed down to one foot below natural stream bottom or ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

506.2 REMOVAL OF PAVEMENTS, SIDEWALKS, CURBS, ETC.

Concrete or asphalt that is to remain shall be in a straight and true line with a vertical face. Concrete or asphalt shall be cut with a cutting wheel, jackhammer, saw or broken to the directed point of removal.

The Contractor shall be responsible for replacement of all overbreak. The Contractor shall maintain a straight, true break line. The sawing shall be done carefully, and all damages to concrete or asphalt to remain in place, due to Contractor's operation, shall be repaired by the Contractor. The minimum depth of saw cut in concrete shall be 2 inches.

506.3 DISPOSAL

Unusable materials and surplus excavated materials shall be properly disposed of off site by the Contractor. All private and public property occupied by the Contractor in connection with the work and construction shall be cleared of all rubbish, debris, and excess materials. All parts of the construction site shall be left in a condition acceptable to the Engineer. The Contractor shall make all necessary arrangements for obtaining suitable disposal locations.

506.4 BACKFILL

Except in areas to be excavated, all cavities left by structure removal shall be backfilled with suitable material and compacted in accordance with applicable sections in these Design and Construction Standards. Jetting or puddling will not be allowed.

507 EXCAVATION AND EMBANKMENT

Excavation and embankment shall consist of excavation, disposal, or compaction of all material encountered, including excavation for ditches and channels, and not being removed necessary for the construction of the roadway in accordance with these Standards and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans or as staked.

All excavation will be classified, "rock excavation," "unclassified excavation," "stripping," "muck excavation," or "borrow" as hereafter described. All embankment will be classified "embankment material, "borrow," or "rock fill" as hereafter described.

507.1 UNCLASSIFIED EXCAVATION

1) Unclassified excavation shall consist of the excavation of all materials of whatever character required, obtained within the right of way, including surface boulders and excavation for ditches and channels and not being removed.

   Overhanging rock or other rock considered dangerous shall be removed. This material will be classified "Unclassified Excavation".

2) Stripping shall consist of removing overburden or other specified material from material pits before removal of other material for use in the roadway and when shown on the plans, the replacement of overburden or other specified material over the original site or pit, after the underlying material has been removed.

3) Muck excavation shall consist of the removal of mixtures of soils and organic matter not suitable for foundation material.

4) Rock excavation shall consist of igneous, metamorphic and sedimentary rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 1/2 cubic yard or more, as determined by physical or visual measurement.

507.2 EMBANKMENT MATERIAL

1) Embankment material shall consist of approved material by the Engineer acquired from excavations, hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses and typical cross sections shown on the plans.

   The degree of relative compaction required shall be as called out in these Standards.

   The embankment material shall be approved by the Engineer.

2) Rock fill, when called for on the plans, shall be constructed of sound, durable stones, boulders or broken rock not less than six inches in least dimension. At least 50 percent of the rock used shall have a volume of two cubic feet or more.

507.3 BORROW

Borrow shall consist of approved material by the Engineer obtained from outside the right-of-way, required for the construction of embankments or for other portions of construction.

507.4 TOLERANCES

Where bituminous surfacing materials are to be placed directly on the subgrade, the

subgrade plane shall not vary more than .04 ft. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed.

Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 505.

507.5 EXCAVATION

1) **ROCK**. Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 ft. below subgrade, within the limits of the roadbed, and the excavation backfilled with material designated on the plans or approved. When rock has been excavated greater than 0.5 ft. below subgrade, within the limits of the roadbed, the excavation shall be backfilled to within at least 0.5 ft. below subgrade.

2) **UNCLASSIFIED**. All excess or unsuitable excavated material, including rocks and boulders, that cannot be used in embankments may be placed on the side slopes, upon the approval of the Engineer.

   Wherever shown on the plans or considered necessary by the Engineer, intercepting ditches shall be made above the top of cut slopes and carried to outlets near the ends of the cuts. In order to blend the intersection of cut slopes with the slope of the adjacent natural ground surfaces in a uniform manner, the tops of all cut slopes, except those in solid rock, will be staked for flattening and rounding. Earth overburden lying above solid rock cuts shall be treated in the same manner as earth cuts.

3) **MUCK**. Where excavation to the finished grade section results in a subgrade or slopes of unsuitable soil, the Engineer may require the Contractor to remove the unsuitable materials and backfill to the finished graded section with approved material.

4) **BORROW**. The finished borrow areas shall be approximately true to line and grade established or specified and shall be finished, where practicable, so that water will not collect or stand therein, unless otherwise specified.

   When necessary to remove fencing, the fencing shall be replaced to original condition or better. The Contractor shall be responsible for the confinement of livestock when a portion of fence is removed.

507.6 EMBANKMENT CONSTRUCTION

Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area.

Only approved materials shall be used in the construction of embankments and backfills.

Free running water shall be drained from the material before the material is placed on the roadway. Rocks, broken concrete, or other solid materials shall not be placed in embankment areas.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built half width at a time, the slopes that are steeper than 4:1 when measured longitudinally or at right angles to the roadway shall be continuously benched over those areas where it is required as the work is brought up in layers. Benching shall be well keyed and where practical, a minimum of eight feet wide. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense.

Where embankments encroach on stream channels or lakes, the largest available rock from the excavation shall be placed along the toes of slopes to protect the embankments against erosion from water action.

Where embankment is to be placed and compacted, end dumping is permitted. The slopes of the original ground or embankment shall be deeply plowed or cut into before starting end dumping.

Unless shown otherwise on the plans where an embankment of less than four feet below subgrade is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing, scarifying or stepping to a minimum depth of six inches. This area shall then be recompacted.

If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of or excessive pressure against the structure.

When noted on the plans, the fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall of the abutment until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

Roadway embankment of earth material shall be placed in horizontal layers not exceeding eight inches (loose measurement) and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting.

As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Bridging across streams, ponds and swampy ground may be placed in layers greater than eight inches as directed.

When the excavated material consists predominately of rock too large to be placed in eight inch layers, the Engineer may permit the material to be placed in thicknesses up to the

average rock dimension, but not to exceed three feet. Placing of occasional boulders of sizes larger than the maximum layer thickness may be authorized by the Engineer. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments on earth. If a situation exists wherein the above method of construction is not practicable the Engineer may permit rock fill material to be cast or end dumped. In such case sufficient hand or machine work will be required to construct a compact stable fill and to finish the slopes to a neat, workmanlike appearance. Each layer shall be compacted as specified in subsection 507.7.

Embankments consisting predominately of rock larger than eight inches in greatest dimension, either placed in layers, cast, or end-dumped, shall not be constructed above an elevation two feet below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding eight inches in loose thickness and compacted as specified for embankments.

Cross hauling or other action as appropriate may be ordered when necessary to insure that the best available material is placed in critical areas of embankments, including the top two feet of all embankments.

Frozen materials shall not be used in construction of embankments.

During the construction of the roadway, the roadbed shall be maintained in such condition that it will be well drained at all times.

507.7 CONSTRUCTION OF EMBANKMENT AND TREATMENT OF CUT AREAS WITH MOISTURE AND DENSITY CONTROL

The plans will show the areas in which embankments are to be constructed with moisture and density control, and the distance below subgrade to which such methods shall be applied.

Within the areas indicated on the plans and to the designated depth below subgrade, for the full width of roadbed in all cut sections, earth shall be thoroughly scarified and the moisture content increased or reduced, as necessary, to bring the moisture to the content specified. This scarified layer shall then be compacted to the degree of compaction specified.

The remainder of the area up to subgrade elevation shall be constructed of suitable material placed at the moisture content specified and compacted to the percent compaction specified.

Maximum dry density of all soil types encountered or to be used will be determined in accordance with AASHTO T99, or AASHTO T 180. The amount of water to be used in compacting all materials shall not deviate from optimum on the dry side by more than two percentage points as determined by AASHTO T 99 or T 180.

The percent of compaction specified shall be equal to or greater than minimum values as shown in the following table for the various classes of soil and type of compaction.

Soil Classification (AASHTO M 145)	AASHTO T 99 Minimum Relative (Percent)	AASHTO T 180 Minimum Relative (Percent)
A-1 through A-5		95
All Others	95	

507.8 COMPACTION OF EMBANKMENTS CONSTRUCTED WITHOUT MOISTURE AND DENSITY CONTROL

Earth embankment materials shall be deposited in layers not exceeding eight inches in thickness before compaction. Rock embankment shall be placed in accordance with the requirements of subsection 507.7. Rock embankments permitted to be placed in layers, cast, or end-dumped shall be spread in layers.

Each layer of embankment material shall be compacted by routing construction equipment, compactors, or both, uniformly over the entire surface of each layer before the next layer is placed and tested. At least one compactor shall be in simultaneous operation with each separate rock embankment placement operation.
Rock embankment is defined as materials with 50% or more by weight, at field moisture content, of particles larger than a No. 4 sieve.

A lift shall not be covered by another lift until compaction complying with the above requirements is obtained.

508 PREPARATION OF SUBGRADE

All subgrade preparation shall conform to the standards and requirements herein. Work in this section shall pertain to the preparation of natural, excavated, or embankment subgrade areas prior to the placement of road base material, pavement, curb and gutter, driveways, sidewalks or structures.

508.1 SUBGRADE SCARIFICATION AND COMPACTION

Subgrade preparation in both excavation and embankment areas shall consist of scarifying, blading, shaping, and compacting the subgrade with moisture and density control. A minimum of the top six (6) inches of the entire width of the roadway subgrade shall be thoroughly scarified, the moisture content adjusted as necessary to meet density requirements. The scarified layer shall then be compacted to the compaction specified. Compaction test results on utility trenches must be on file with the City prior to placing any layer of roadbase or pavement section on the subgrade. Compaction tests shall be taken by a Geotechnical Engineer on the subgrade. Compaction test results on the subgrade shall be submitted to the Engineer within 24 hours after the tests have been taken for review and approval.

Formal compaction test reports shall be submitted as soon as possible during applicable construction phases. The Geotechnical Engineer shall take a sufficient number of

compaction tests to assure himself that the street subgrade is ready for roadbase or paving and shall so certify on his compaction report. Formal compaction reports shall be signed and sealed by a registered professional Engineer.

Compaction tests shall include but not be limited to trenches for water main, sanitary sewer main, storm sewer main, water services trenches, sanitary sewer service trenches, gas mains, and service trenches, electric trenches and services, sleeve or conduit trenches, around manholes, water valve boxes, inlets, and under curb, gutter and sidewalk. If the subgrade does not have the specified density and moisture content prior to placing roadbase or pavement the Geotechnical Engineer shall require scarifying, wetting, rerolling, and retesting.

If the specified compaction cannot be obtained, CBR or R value shall be adjusted accordingly and a new pavement section determined and designed. If more than 24 hours has elapsed between the time compaction tests are taken and the time the next layer in the pavement sections is placed, the area shall be retested.

508.2 SUBGRADE TOLERANCES

After scarifying and compaction has been completed, the subgrade surface shall not vary above or below the lines and grades as staked by more than 0.08 foot, if roadbase is to be installed. Where asphalt pavement is to be installed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot.

Bluetop stakes are required to set street centerline grade and verify tolerances.

508.3 PROOF ROLLING SUBGRADE

Proof rolling will be required on the subgrade. Proof rolling shall be completed after specified compaction has been obtained. Areas found to be weak and those areas, which failed shall be reworked or repaired or other measures taken to correct subgrade problems per the recommendations of the Geotechnical Engineer and approval of the Engineer.

Proof rolling shall be performed by the City. A 24-hour notification is required for scheduling a proof roll.

509 AGGREGATE BASE COURSE

Untreated roadbase shall consist of furnishing and placing one or more courses of aggregate base on a prepared and approved subgrade in accordance with these standards in close conformity with lines, grades, and typical cross-sections shown on approved plans or as required by the Engineer.

509.1 AGGREGATE MATERIALS

Aggregates for bases shall be crushed stone, crushed slag, crushed gravel or natural gravel which conforms to the quality requirements of AASHTO M 147 except that the requirements for the ratio of minus No. 200 sieve fraction to the minus No. 40 sieve fraction, stated in AASHTO M 147 shall not apply. The requirements for the Los Angeles wear test (AASHTO T96) shall not apply to Class 1,2, and 3. Aggregate for bases shall

meet the grading requirements of the following table for the specified class of aggregate.

Under certain conditions, the Engineer may approve the substitution of class 4 aggregate for class 6 or class 5 aggregate after review of a design section signed and sealed and submitted by a Geotechnical Engineer. The Engineer will consider the substitution if the liquid limit of the class 4 material does not exceed 25, the CBR is a minimum of 80 and the depth is at least two (2) times the maximum size of the course aggregate. If class 4 material is approved, it shall be over laid with 4" minimum of class 6 or class 5 material, and shall be finish rolled with a steel wheel roller. Class 6 roadbase shall be used for construction of roadways in the City of Louisville unless otherwise approved by the Engineer in writing.

The liquid limit shall be as shown in the table and the plasticity index shall not exceed 6 when the aggregate is tested in accordance with AASHTO T 89 and T 90 respectively.

Aggregate Base Course shall be in conformance with the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

Note: Class 3 material shall consist of pit run material.

509.2 PLACING AGGREGATE BASE

Base course material shall only be placed on the previously prepared and approved subgrade. Placing and spreading shall be done by means of spreader machine, moving vehicle, motor grader, or other approved equipment methods. Material shall be placed without segregation. Segregated areas shall be removed and replaced with uniformly graded material. If the required compacted depth of aggregate base course exceeds (6) inches, it shall be constructed in two or more layers of approximately equal thicknesses. The maximum compacted thickness of any one layer shall not exceed six inches. If uniform density cannot be obtained in six (6) inch lifts, the maximum lift shall not exceed (4) four inches in final thickness.

509.3 SHAPING AND COMPACTION

Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density. Compaction tests shall be taken by a Geotechnical Engineer on the prepared roadbase. Compaction test results on the roadbase shall be submitted to the Engineer within 24 hours after the tests have been taken for review and approval. Formal compaction test reports shall be submitted as soon as possible during applicable construction phases.

The Geotechnical Engineer shall take sufficient compaction tests to assure himself that the street roadbase is ready for paving and shall so certify on his compaction report.
Formal compaction reports shall be signed and sealed. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates firmly keyed. Water shall be uniformly applied during compaction in the amount necessary for proper consolidation. Blue tops shall be used on all new construction.

The prepared surface upon which the surface course is to be placed may be tested with a 10-foot straightedge, or other approved device which shall be provided by the Contractor. The surface shall be tested prior to the application of any primer or pavement. The variation above or below the testing edge of the straightedge between any two contacts with the surface shall not exceed l/4 inch. Any areas not complying with these tolerances shall be reworked to obtain conformity.

509.4 PROOF ROLLING AGGREGATE BASE COURSE

Proof rolling will be required on the roadbase. Proof rolling shall be completed after specified compaction has been obtained. Areas found to be weak and those areas which failed shall be reworked and repaired or other measures taken to correct roadbase problems per the recommendation of the Geotechnical Engineer.

Proof rolling shall be performed by the City. A 24 hour notice is required for scheduling a proof roll.

510 PRIME COAT, TACK COAT AND REJUVENATION AGENTS, BITUMINOUS MATERIALS

Work shall consist of preparing and treating an existing surface with bituminous material. The bituminous material for all coatings shall meet the applicable requirements of Bituminous Material in the State Department of Highways, Standard Specifications for Road and Bridge Construction.

510.1 ASPHALT CEMENTS

Asphalt cements shall conform to the requirements for bituminous materials found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

510.2 TARS

Tars for road construction shall conform to the requirements of AASHTO M 52.

510.3 LIQUID ASPHALTIC MATERIALS

Liquid asphaltic materials shall conform to the requirements of AASHTO M81, M82, and ASTM D 2026 for the designated types and grades.

510.4 EMULSIFIED ASPHALT

Emulsified asphalts shall conform to AASHTO M 140 or M 208 for the designated types and grades. When grade CSS-1h or SS-1h emulsified asphalt is used for tack coat, residue penetration test values shall be between 40 and 120.

510.5 REJUVENATING AGENTS

Asphalt rejuvenating agents shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the following physical and chemical requirements for bituminous materials found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

510.6 RECYCLING AGENTS

Asphalt recycling agents shall conform to the following physical and chemical requirements found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

510.7 WEATHER LIMITATIONS

Prime coat and tack coat shall not be applied under the following conditions:

1) When the surface is wet.
2) When weather conditions would prevent the proper penetration or curing of the prime or tack coat.
3) When the temperature in the shade is below 55 degrees F.

510.8 EQUIPMENT

The Contractor shall provide necessary equipment for heating and uniformly applying bituminous material and blotter material when required.

The distributor and equipment shall be capable of uniformly distributing bituminous material at even temperature and uniform pressure on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard. The allowable variation from any specified rate shall not exceed plus or minus 0.02 gallon per square yard.

Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically. The distributor for rejuvenating agent shall conform to the foregoing and shall also be equipped with the following:

1) Heating facilities with controls to reach a temperature of 130 degrees F.

2) Circulating system to maintain proper mixture of the rejuvenating agent.

510.9 PREPARATION OF SURFACE

Preparation of the surface to be treated shall include all work necessary to provide a smooth, dry, uniform surface. Work shall include patching, brooming and shaping to the required grade and section, compaction removal of unstable corrugated areas and removal of all vegetation. The edges of existing pavements which are to be adjacent to new pavement, shall be cleaned to permit the adhesion of bituminous materials.

510.10 APPLICATION OF BITUMINOUS MATERIAL

Bituminous material shall be applied to the width of the section to be coated by means of a pressure distributor in a uniform and continuous spread. When traffic is maintained, not more than 1/2 of the width of the section shall be treated in one application, or sufficient width shall be left to adequately handle traffic. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be removed or distributed as directed. Skipped areas or deficiencies shall be corrected. Bituminous material shall not be placed on any surface where traffic will be forced to travel upon the freshly applied material.

510.11 APPLICATION RATES AND CURING

Prime coat shall be applied to the entire roadway aggregate base course surface at a rate of not less than 0.25 gal. per square yard nor more than 0.35 gal. per square yard or as directed by the Engineer.

The primed surface shall cure for 24 hours or more if required for thorough penetration before placing any bituminous material. A cutback tacked surface shall cure, or break. Surfaces tacked with asphalt emulsion shall be free from residual moisture before placing any bituminous surface. Coating sprayed on the exposed surfaces of curbs, walks, or other structures shall be cleaned by the Contractor.

The application rate, temperature limits and curing time for rejuvenating agent shall be as specified by the Engineer.

Tack coat shall be applied to the vertical gutter surface and 12" in on the subgrade the entire length of the roadway where bituminous material will be placed directly on a subgrade surface. Tack coat shall be applied prior to placing any bituminous material.

Tack coat shall be applied to the entire surface of the roadway between asphalt lifts at a rate of not more than 0.10 gal. per square yard unless otherwise directed by the Engineer. Application temperature of bituminous material shall be between 80 degrees F. and 130 degrees F.

511 PLANT MIX HOT BITUMINOUS PAVEMENT

These standards include general requirements that are applicable to all bituminous pavements of the plant mix type irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use.

511.1 JOB MIX FORMULA

At least (2) two weeks prior to paving, the Contractor, at his expense, shall submit suitable samples of all materials proposed for use on the project to a materials testing laboratory, approved by the Engineer. The testing laboratory shall, at the Contractor's expense, test all materials for compliance with these Design and Construction Standards and the Colorado Department of Highways Standard Specifications for Road and Bridge

Construction, 1991 Edition, and establish a job mix formula for each mixture proposed for the use on the project.

The testing laboratory shall submit to the Engineer for approval two copies of all test data, including graphs, tables, charts, aggregate gradation, asphalt cement content, optimum density, and type of anti-stripping additive. The report shall bear the seal and signature of a Professional Engineer licensed in the State of Colorado and competent in asphalt concrete mix design and construction. The testing laboratory shall certify that the proposed materials and job mix are within the scope of these Design and Construction Standards and the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction. The job mix design shall be done in accordance with ASTM D1559 (Marshall Method) using fifty blows.

511.2 MATERIALS

The bituminous plant mix shall be composed of a mixture of aggregate, filler or additives if required and approved, bituminous material and reclaimed material if permitted and used. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula.

The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and a single temperature for the mixture at the discharge point of the plant.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

TABLE 511.2

*Bitumen content	± 0.3%
Asphalt recycling agent	± 0.2%
Temperature of mixture when discharged from mixer	20º F
**Hot Bituminous Pavement	
Passing No. 8 and larger sieves	± 8%
Passing No. 30	± 6%
Passing No. 200 sieve	± 2%
**Plant Mixed Seal Coat	
Passing No. 4 sieve	± 8%
Passing No. 8 to No. 50 sieves (inclusive)	± 6%
Passing No.200 sieve	± 2%

* The bitumen content range of tolerance shall be ± 0.4% when the reclaimed asphalt pavement (RAP) percent of the total mixture in 11 percent or greater.

** When 100% passing is designated, there shall be no tolerance.

Requests made in writing by the Contractor for changes in the job-mix formula may be considered. The job-mix formula may be changed by the Engineer if the change will produce a mixture of equal or better quality as verified by the new job mix formula. The Contractor shall submit the following to the Engineer:

1) A proposed job-mix gradation which shall be wholly within the Master Range for Hot Bituminous Pavement found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction when the tolerances shown in Table 511.2 are applied.

2) Source, approximate gradation, and percentage of each element used in producing the final mix.

3) The name of the refinery, which will supply the asphalt cement.

4) A quantity of each aggregate, mineral filler, reclaimed material, and additive proposed for use, which is sufficient for the required Laboratory tests.

511.3 AGGREGATE FOR HOT PLANT MIX BITUMINOUS PAVEMENT

Aggregates for hot plant mix bituminous pavement shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, natural gravel, or crushed slag. Excess of fine material shall be wasted before crushing.

Reclaimed material shall be of uniform quality. The maximum size of the reclaimed material shall be 1 1/2 inches prior to introduction into the mixer. The maximum aggregate size contained in the combination of reclaimed material and new aggregate shall not exceed the maximum specified in the Master Range for Hot Bituminous Pavement found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

The material shall not contain clay balls, vegetable matter, or other deleterious substances. The aggregate for Grading C, CX, and G, shall have a percentage of wear not more than 45 when tested in accordance with AASHTO T 96.

Master Range for Hot Bituminous Pavement shall be in conformance with the latest revision of the State Department of Highways Standard Specifications for Road and Bridge Construction.

Aggregates for cover coat material shall be crushed stone, crushed slag, crushed gravel or natural gravel. Aggregates shall be composed of clean, tough, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces and free from fragments coated with dirt or other objectionable matter. Slag shall be air-cooled blast-furnace slag reasonably uniform in density.

Only one type of aggregate shall be used on the project unless alternate types are approved by the Engineer.

When tested in accordance with AASHTO T 182, aggregate shall have retained bituminous film above 95 percent.

Gradation for Cover Coat Aggregate shall be in conformance with the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

511.4 MINERAL FILLER

Mineral filler shall conform to the requirements of AASHTO M 17 and shall consist of rock dust, slag dust, hydrated lime, hydraulic cement, fly ash or other suitable mineral matter. It shall be free of organic impurities and agglomerations. When used, it shall be dry enough to flow freely.

Mineral filler shall be graded within the following limits:

Sieve Size	Mass Percent Passing
No. 30	100
No. 50	95-100
No. 200	70-100

Mineral filler shall have a plasticity index not greater than 4 excluding hydrated lime and hydraulic cement.

511.5 HYDRATED LIME

Hydrated lime for aggregate pretreatment shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200-mesh sieve shall not exceed 10% when determined in accordance with ASTM C 110. (Drying of the residue in an atmosphere free from carbon dioxide will not be required.)

511.6 BITUMINOUS MATERIALS

Asphalt shall conform to the requirements of bituminous materials found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

Emulsified asphalts shall conform to the requirements of AASHTO M140 or M208, for the specified types and grades.

When grade CSS-1h or SS-1h emulsified asphalt is used for tack coat, residue penetration test values shall be between 40 and 120.

511.7 BITUMINOUS MIXING PLANT

The bituminous mixing plant shall be capable of producing a uniform material, have adequate capacity and be maintained in good mechanical condition. Any defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the hot bituminous plant mix in any manner.

Dust, smoke or other contaminants shall be controlled by means of appropriate devices at the plant site to meet all air quality requirements of the State.

Acceptable safety equipment shall be provided by the Contractor to accommodate sampling and testing and shall be subject to approval.

Hot bituminous plant mix shall not be stored longer than nine hours, unless additional protective measures are used and approved.

511.8 HAULING EQUIPMENT

Trucks used for hauling bituminous mixtures shall have tight, clean smooth metal beds which have been thinly coated with a minimum amount of paraffin oil, lime solution or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Except as otherwise permitted, each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather.

511.9 BITUMINOUS PAVERS

Bituminous pavers shall be self-contained, power propelled unit, provided with a vibrating, activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in widths applicable to the specified

typical section and thickness.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The paving machine shall be equipped with an automatic control system which will control the elevation of the screed and which is automatically actuated by a system of sensor-operated devices which sense and follow reference lines or surfaces on one or both sides of the machine as required.

The screed shall be maintained at the proper elevation at each end by controlling the elevation of one end and automatically controlling the transverse slope or by controlling the elevation of each end independently.

The transverse slope controller shall be capable of maintaining the screed at the desired slope to within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed. Extensions will be allowed provided the extensions have a vibrating screed.

The automatic control system shall be capable of working with the following devices:

1) Ski-type device at least 30 feet in length
2) Short ski or short shoe
3) At least 2500 feet of control line and stakes

Device (2) shall not be used on the surface course when the length to be paved is greater than 750 feet.

Control lines shall be required at the crown line of all streets that do not have median curbs, and at the inside or outside edges of all streets that do not have curbs installed.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire and accessories necessary for satisfactory operation of the automatic control equipment. Control lines shall be maintained taut and to the grade and alignment established.

Manual operation will be permitted in the construction of irregularly shaped and minor areas.

Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually (or by other methods only) for the remainder of the normal working day on which the breakdown or malfunction occurred provided this method of operation will produce results otherwise meeting specifications.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

511.10 SPREADING AND FINISHING

The mixture shall be laid upon an approved surface, spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately six inches. The joints in any pavement layer shall not fall in a wheel track. The joints in the top layer shall be located as follows:

1) For two-lane roadways, at the centerline of the pavement and at the outside edge of the travel lanes.

2) For roadways of more than two lanes, at the lane lines and at the outside edge of the travel lanes.

Where paving operations are on the present traveled roadway, the Contractor shall arrange his paving operations so that there will be no exposed longitudinal joints between adjacent travel lanes at the end of a day's run. In lieu of this requirement, with the approval of the Engineer, the Contractor may be permitted:

1) A vertical or tapered exposed longitudinal joint when the thickness of the pavement course being placed is one inch or less.

2) A tapered exposed longitudinal joint when the thickness of pavement course being placed is greater than one inch. Minimum width of taper shall be three times the thickness of the pavement course.

Transverse joints shall be offset that in the layer immediately below by 10 feet.

When production of the mixture can be maintained and when practical, pavers shall be used in echelon to place the wearing course in adjacent lanes.

The bituminous mixture shall be transported and placed on the roadway in such manner as to minimize segregation. All segregated areas behind the paver shall be removed immediately at the time of discovery.

The segregated material shall be replaced with specification material before the initial rolling has taken place. If more than 50 square feet of segregated pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, paving operations with the paving machine involved shall be discontinued until the source of the segregation has been found and corrected.

The Engineer will determine by judgment the extent of segregated areas. It is not intended that each segregated area be sampled and tested; however segregation is defined as follows: Representative samples of allegedly segregated areas will be tested.

511.11 ROLLERS AND COMPACTION

The plant mix bituminous pavement shall be compacted by rolling. Both steel wheel and pneumatic tire rollers will be required, unless otherwise approved. The number, weight and type of rollers furnished shall be sufficient to obtain the required density while the mixture is in a workable condition. Compaction shall begin as soon as possible after the mixture is placed and when rolling does not cause undue displacement cracking or shoving and be continuous until the required density is obtained. When the mixture surface temperature falls below 185 Degrees Fahrenheit, further compaction shall be at the Contractors risk.

Any displacement occurring as a result of the reversing of the direction of the roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required.

Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall thoroughly be compacted with hand tampers, or with mechanical tampers.

Any mixture that becomes loose and broken, segregated, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced. **Except for leveling courses or, the minimum compacted depth of pavement placed in one layer shall be l 1/2 inches, unless approved by the Engineer. The maximum compacted depth shall be three (3) inches.**

Initial or breakdown rolling shall be done with a steel-wheeled roller of not less than 8 to 12 ton Class. When a pneumatic-tired roller is used, tire contact pressure shall be as high as possible without causing displacement of the mix. Finish rolling shall be done with steel-wheel rollers. Rollers shall move at a uniform speed with the drive roll or wheels nearest the paver.

Steel-wheel rollers shall be operated at a maximum speed of 3 miles per hour and pneumatic rollers at a maximum speed of 5 miles per hour. Rolling shall be continued until **all roller marks are eliminated** and minimum density of 95 percent of a laboratory specimen made in the proportions of the job-mix formula and in accordance with the Marshall Method ASTM D1559 has been obtained.

Compaction tests shall be taken by a Geotechnical Engineer on each section or lift of asphalt installed.

In no case shall a lift of asphalt be placed upon another lift until compaction tests have been taken and passed. Compaction shall not be less than 95%. Compaction tests results on asphalt paving shall be submitted to the Engineer within 24 hours after the tests have been taken for review and approval.

Formal compaction test reports shall be submitted as soon as possible during applicable construction phases. The Geotechnical Engineer shall take sufficient compaction tests to assure himself that each lift of asphalt meets 95% and shall so certify on his compaction report.

Formal compaction reports shall be signed and sealed by a registered professional Engineer.

511.12 JOINTS

Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized.

Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course, 10 feet in length and offset 10 feet to the adjacent pavement. When directed by the Engineer, a coat of bituminous material shall be used on contact surfaces of all joints just before additional mixture is placed against the previously rolled material.

Where the final lift of asphalt is being installed and terminates where a final lift is not installed the transverse joints will be formed by cutting back on the previous run to expose the full depth of the course 10 feet in length and offset 10 feet to the adjacent pavement. A paper resin joint or wood bulkhead with a ramp will be installed where the final lift terminates to the lower lift.

Dirt joints are strictly prohibited.

511.13 PAVEMENT SAMPLES

Samples of the plant mix material or the compacted pavement are required at random locations on the project for testing. Where samples have been taken from the surface, new material shall be placed and compacted by the Contractor to conform with the surrounding areas.

511.14 SURFACE TOLERANCES

The variation between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material or by overlaying (not patching) as directed by the Engineer.

For new streets the final surface pavement adjacent to concrete gutter shall be finished from 1/8 inch to 1/4 inch above the lip of the gutter into which it drains.

Any surface pavement that is above the lip more than 1/4 inch shall be removed and replaced to the specified height. Any surface pavement that is below the lip of the gutter shall be corrected as specified above, for new street construction. For street overlays the surface pavement may be 1/2" above the lip.

511.15 MANHOLES AND VALVE BOXES

All manholes, valve boxes and survey range boxes shall be 1/4" to 1/2" below the final compacted asphalt surface. Only cast iron riser rings will be permitted. Any manhole covers, water valve covers or survey range boxes which do not conform to 1/4" to 1/2" below the final finished asphalt surface shall be removed corrected.

Asphalt on valve box and manhole covers shall be removed.

511.16 PREPARATION OF BITUMINOUS MATERIAL

The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature.

511.17 PREPARATION OF AGGREGATES

Heating and drying of the aggregates shall be accomplished in a manner that does not damage the aggregate.

Preparation of aggregates shall meet the requirements of pavements found in the latest revision of the State Department of Highways, Standard Specifications for Road and Bridge Construction.

511.18 MIXING

The aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles is secured. The temperature of the mixture when discharged from the mixer shall be as shown in the following table:

Asphalt Grade	Job-mix Temperature (Degrees F)
AC 20 (Rubberized)	320
AC-20	290
AC-10	280
AC-5	275

Regardless of the job-mix temperature, the mixture shall not be delivered for use on the roadway at a temperature lower than 235 degrees F for mixes not containing rubberized asphalt, or 260 degrees F for mixes containing rubberized asphalt.

511.19 WEATHER LIMITATIONS

Bituminous plant mix shall be placed only on properly constructed surfaces that are free from water, frost, snow or ice. The bituminous mixtures shall be placed within the air temperature limitations of the following table, when the temperature is rising and only when weather conditions otherwise permit the pavement to be properly placed and finished as determined by the Engineer.

	Placement Air Temperature Limitations	
Compacted Thickness	Top Layer	Layers Below Top
1" or less	60 Deg. F.	55 Deg. F.
>1" to 2 1/2"	50 Deg. F.	40 Deg. F.
Greater than 2 1/2"	40 Deg. F.	35 Deg. F.

Placement temperatures as stated in the above table shall be increased by 5 Degrees for each 10 miles-per-hour wind velocity to a maximum of 70 degrees F.

When it is in the public interest and taking in consideration the construction season, the Engineer may waive minimum temperature requirements for placing prime coats and layers of bituminous mixtures below the top layer of the completed pavement. Pavement operations will be suspended when density requirements are not met.

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SECTION 6
CONCRETE WORK

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SECTION 6
CONCRETE WORK

600 CONCRETE STANDARDS

This section covers all concrete work to include; but not limited to: Footings, structure walls, slabs, beams, thrust blocks, curb and gutter, sidewalks, inlets, manhole, drainage works and structures. All materials or work that does not meet these Design and Construction Standards shall be rejected.

601 MATERIALS

601.1 CEMENT

All cement used in concrete work shall be Portland cement conforming to all requirements of AASHTO M85. Type II or Type IIA shall be used except that high-early-strength.

601.2 WATER

Water used in mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, organic matter, or other substance injurious to the finished product. Water will be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials. In addition the pH shall be between 4.5 and 8.5. Neutralization by chemical additives will not be permitted.

601.3 ADMIXTURES

Water-reducing and set controlling admixtures shall conform to AASHTO M 194 according to the following types:

Type A - Water Reducing.
Type B - Retarding.
Type D - Water Reducing and Retarding.
Type E - Water Reducing and Accelerating.

Written approval of the Engineer shall be obtained prior to the use of any admixture except air entrained admixtures. Application of admixtures shall be as per admixture manufacturer's specifications.

Admixtures may be used, if advance written permission is obtained from the Engineer and satisfactory certified field performance records to substantiate any and all claims made for the product are submitted with the request for permission to use admixtures. Admixtures shall conform to ASTM C 494, ASTM C 618, or AASHTO M-194 and be limited to Types A, B, or D.

1) Use of calcium chloride will be permitted upon the written approval of the Engineer, and then not to exceed two percent (2%) by weight of cement.

2) Use of admixtures containing calcium chloride will be permitted upon written approval of the Engineer and in accordance with the manufacturer's recommendations or specifications.

3) Admixtures and air-entraining agents shall be added to the mix water, each agent introduced separate from the other. Under no circumstance are these agents to be combined prior to their introduction in the mixing unit.

601.4 AIR-ENTRAINING AGENTS

An air-entraining agent shall be added to the concrete mixture. Air entraining admixtures shall conform to ASTM C 260. All air-entraining agents shall be reasonably new material, thoroughly mixed and protected at all times from freezing. The air-entraining agent being used shall not be changed without permission of the Engineer.

601.5 FINE AGGREGATE

1) Composition: Fine aggregate shall consist of natural sand, composed of clean, hard, durable, uncoated grains, preferably of silicous materials.

	Maximum Percent by Weight
Clay Lumps	1.0
Coal, Lignite, or Shale	1.0
Material Passing No. 200 Sieve	4.0

The sum of the above materials and other deleterious substances such as shale, alkali, mica, coated grains, or soft and flaky particles shall not exceed four percent by weight.

2) Deleterious Substances: The maximum percentage of deleterious substances shall not exceed the following values:

Material finer than 200 mesh sieve	3%	by weight
Shale	1%	by weight
Coal and lignite	□%	by weight
Clay lumps	1%	by weight
Other deleterious substances	2%	by weight

The sum of the percentages of the above deleterious substances shall not exceed five per cent (5%) by weight. All fine aggregate shall be free from injurious amounts of alkali and organic impurities.

3) Grading: Fine aggregate shall be well graded from coarse to fine, and when tested by standard laboratory sieves, shall conform to the following:

	Per Cent by Weight
Passing 3/8"	100
Passing No. 4 Sieve	95 - 100
Passing No. 16 Sieve	45 - 80
Passing No. 50 Sieve	10 - 30
Passing No. 100 Sieve	2 - 10

4) Other Requirements: The fine aggregate shall conform to AASHTO M6.

601.6 COARSE AGGREGATE

1) Composition: Coarse aggregate shall consist of crushed limestone, trap rock, granite, washed gravel or other approved inert materials having clean, hard, strong, durable pieces, free from adherent coatings and conforming to the requirements of these specifications.

2) Deleterious Substances The maximum percentage of deleterious substances shall not exceed the following values:

Material finer than 200 mesh sieve ..... 1% by weight
Coal and lignite ..... 1/4% by weight
Clay lumps ..... 1/4% by weight
Soft fragments ..... 3% by weight
Other deleterious substances ..... 2% by weight

The sum of the percentages of the above deleterious substances shall not exceed five per cent (5%) by weight.

3) Grading: Coarse aggregate shall be well graded between the limits specified and shall conform to the following requirements:

Nominal Maximum Maximum Size	Percentages by Weight Passing Standard Laboratory Sieve having Square Openings					
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4
l 1/2"	95-100		35-70		10-30	0-5
1"		90-100		25-60		0-10
3/4"		100	90-100		20-55	0-10

Not more than 5% shall pass a No. 8 sieve.

4) Wear and Soundness: Coarse aggregates for concrete shall have a percentage of wear of not more than 40 when tested in accordance with AASHTO T-96 or show a sodium sulphate loss not to exceed 12 percent (12%) when tested in accordance with AASHTO T-104. The wear and soundness requirements may be waived, or modified, by the Engineer provided that the coarse aggregate has a proven service

record for similar service and exposure.

5) Other Requirements: Coarse aggregate shall conform to the requirements of AASHTO M80.

602 CONCRETE PROPORTIONING

The proportions of materials to be used shall produce a workable concrete having a slump of 1" to 4" with air content and minimum 28-day compressive strength as specified below. Minimum cement content shall be 564 lb. (6 sacks) per cubic yard with a maximum 33.7 gallons of water (including surface water on the aggregates) per cubic yard of concrete (Max Water/Cement ratio = 0.51). Where "Water Tight" concrete is specified, the water/cement ratio shall not exceed 0.48.

An approved air-entraining agent shall be used in all concrete.

The class of concrete specified shall conform to the following:

	Maximum Size Course Aggregate	(f'c) Minimum 28-day Strength (PSI)	Per Cent Air
Class I	3/4"	3,750	6% 1
Class IA	1 1/2"	3,750	6% 1

Class I will be used in all construction including but not limited to sidewalk, curb gutter, pavement, curb cuts, crosspans, driveways, retaining walls, storm drainage structures, slabs, and structural members. For sections greater than 6 inches thick, Class IA concrete may be used only on approval of the Engineer.

A mix design is required to be made by a certified testing laboratory, and submitted to the Engineer for approval two weeks prior to the placing of any concrete. Batching proportions shall conform to the approved mix design.

603 READY-MIXED CONCRETE

Ready-mixed concrete shall be used in lieu of concrete mixed at the job. The use of ready-mixed concrete in no way relieves the Contractor of sole responsibility for proportioning, mixing, delivering, or placing concrete as required in these standards. Ready-mixed concrete shall conform to all the requirements of these standards and ASTM C 94.

The Engineer shall have free access to the mixing plant at all times. Ready-mixed concrete shall be continuously mixed or agitated from the time the water is added until the time of use. The concrete shall be completely discharged from the truck mixer or truck agitator within one and one half (l 1/2) hours or before the drum has revolved 300 revolutions after the cement comes in contact with the mixing water, or with the aggregates (retempered concrete shall not be allowed). The organization supplying ready-mixed

concrete shall have sufficient plant and transportation facilities to assure continuous delivery of concrete at the required rate.

The Contractor shall collect delivery or batch tickets from the ready-mix driver for all concrete used on the project and submit them to the Engineer upon request. Batch tickets shall provide the following information: Weight and type of cement, weights of fine and coarse aggregates, weight (or gallons) of water, including surface water of aggregates, quantity (cu. yd.) of batch, times of batching and discharging of the concrete, name of batch plant, name of Contractor, starting revolution count, name and amount of all admixtures used, date and truck number. Deletion of any item listed above for inclusion on the batch ticket shall be cause for rejection of the entire load of concrete.

604 PLACING CONCRETE

Before placing concrete, debris shall be removed from the space to be occupied by the concrete, and the forms, including any existing concrete surfaces, shall be thoroughly wetted. Concrete shall not be placed until all forms and reinforcing steel have been inspected and approved by the Engineer.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of ingredients. It shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be deposited in continuous layers, the thickness of which generally shall not exceed twelve (12) inches. Concrete shall be placed in a manner that will avoid segregation and shall not be dropped freely more than five (5) feet. If segregation occurs, the Engineer may require the concrete to be removed and replaced at the Contractor's/Developer's expense. Concrete shall be placed in one continuous operation, except where keyed construction joints are shown on the plans or as approved by the Engineer. Delays in excess of 45 minutes, may require removal and replacement of that pour, as determined by the Engineer.

Concrete shall not be placed on soft, spongy, frozen, or otherwise unsuitable subgrade. Subgrade preparation shall conform to section 505 of these Design and Construction Standards. The finished subgrade shall be kept smooth and compacted prior to placing concrete.

604.1 VIBRATING

Concrete shall be thoroughly compacted or vibrated. All concrete shall be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks or curb and gutter not poured against form lining shall be either tamped or vibrated.

Care shall be taken in vibrating concrete to vibrate only to bring a continuous film of mortar to the surface. Vibration shall stop before any segregation of the concrete occurs. Mechanical vibrators shall not be used to move or spread the concrete. Any evidence of lack of consolidation or over-consolidation shall be regarded as sufficient reason for requiring the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor shall be responsible for any defects in the quality and appearance of completed work.

604.2 WORKABILITY

The consistency of concrete shall be kept uniform for each class of work and shall be checked by means of slump tests conforming to ASTM C-143. The workability of the concrete shall be varied as directed by the Engineer. Concrete shall at all times be of such consistency that it can be worked into corners and angles of the forms and around joints, dowels and tie-bars by the construction methods used without excessive spading, segregation or undue accumulation of water or laitance on the surface. If through accident, intention or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete shall not be incorporated in the work, but shall be discarded off the project site as waste material at the Contractor's expense. **NO WATER MAY BE ADDED AT THE JOB SITE WITHOUT THE PERMISSION OF THE ENGINEER.** If approval is obtained and water is added at the job site, slump tests shall be run and test cylinders cast following the addition of the water. Any expense incurred, in excess of ordinary tests, in such testing will be borne by the Contractor.

604.3 PUMPING CONCRETE

Methods, materials, and equipment to be used in placing concrete by pumping shall conform to ACI 304. A separate mix design may be required in accordance with Section 602.

605 TESTING

All concrete testing shall be performed by a certified concrete tester (ACI Certified Concrete Field Technician) and approved testing laboratory. All tests shall be certified to be correct by a registered Professional Engineer. All tests shall be at the expense of the Contractor.

605.1 COMPACTION TESTING

All preparation of the subgrade in which concrete is to be placed shall conform to Section 504.7 of these Design and Construction Standards.

605.2 SAMPLING

1) AGGREGATE: The Contractor shall, before starting concrete work, furnish representative samples of concrete aggregate proposed for use to a testing laboratory designated by the Engineer and sampled in accordance with ASTM D 75.

2) CONCRETE: Concrete shall be sampled in accordance with ASTM C 172, "Sampling Fresh Concrete".

605.3 SLUMP TESTS

During each day's placement, the consistency of the concrete shall be checked by means of a slump test. A slump test shall also be made each time that a test cylinder is made. Slump tests shall be made in accordance with ASTM C 143, "Method of Test for the Slump of Portland Cement Concrete". The frequency of the testing shall be at the discretion of the Engineer.

605.4 COMPRESSION TESTS

The degree and frequencies of all concrete testing beyond normal standard frequencies, if necessary to assure quality control, shall be determined by the Engineer.

Cylinders shall be made and tested for every concrete placement, and one set of 4 - 6" test cylinders shall be made for every 100 yards of concrete or fraction thereof placed in each placement. Mold and cure specimens shall be in conformance with "Method of Making and Curing Concrete Compression and Flexural Specimens in the Field", ASTM C 31.

Specimens shall be tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders", ASTM C 39. Two specimens shall be tested at 28 days for acceptance. The others may be tested at an earlier time at 7 days for informational purposes.

Cylinders shall be tested by an independent testing laboratory, as approved by the Engineer, by a certified concrete technician.

Of each of the four cylinders taken for a pour, two shall be tested for strength at seven days and two tested for strength at 28 days.

To conform to the requirements of this specification, the average of any three consecutive strength tests of the laboratory-cured cylinders representing each class of concrete shall be equal to or greater than the specified strength, and not more than 20% of the strength tests shall have values less than the specified strength. A test shall consist of two cylinders broken at 28 days.

When concrete fails to conform to the requirements above or when tests of field-cured cylinders indicate deficiencies in protection and curing, the Engineer may order tests on the hardened concrete as described in the ACI Building Code (ACI 301) for that portion of the structure where the questionable concrete has been placed at the contractors expense.

In the event the load or core tests indicate that the structure is unsatisfactory, the Contractor shall, at his own expense, make such modifications as required by the Engineer to make the structure sound.

605.5 AIR CONTENT

During each day's placement, a check of the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231) or "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM

C-173). An air content test shall be made each time a compression test cylinder is made and when required by the Engineer.

605.6 CONCRETE CORING

At the discretion of the Engineer core samples may be required for depth and strength.

606 UNIT WEIGHT

Each time a compression test cylinder is made, a unit weight test shall be made in accordance with ASTM C-138, "Test for Unit Weight Yield and Air Content (Gravimetric) of Concrete".

607 ENFORCEMENT OF STRENGTH REQUIREMENTS

Strength requirements shall be in accordance with ACI 301, Chapters 16 & 17, and Section 602 of these Standards.

608 REINFORCING STEEL

1) Bars: Reinforcing steel bars shall conform to the requirements of the "Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement" of ASTM. Bars shall be new billet steel conforming to AASHTO M31.

2) Fibermesh: Approval of the Engineer must be obtained prior to using Fibermesh reinforcement in place of Welded Wire Fabric.

3) Shop Drawings: Before fabrication of the reinforcement, the Contractor shall prepare or have prepared complete bending, fabrication, setting drawings and bar lists covering all required reinforcement steel. Such drawings and bar lists shall be submitted to the Engineer for his check and approval for general conformity to specified requirements. The approval of the shop drawings by the Engineer, in no way relieves the contractor of sole responsibility for correct placement of reinforcing steel.

4) Placing: Reinforcing steel, before being placed, shall be thoroughly cleaned of coatings that will destroy or reduce bond. A light coating of rust may be allowed by the Engineer. Reinforcement shall be carefully formed to the dimensions indicated on the Plans. It shall not be bent or straightened in a manner that will injure the material. THE USE OF HEAT IN BENDING BARS SHALL NOT BE PERMITTED. Bars with kinks or bends not shown on the plans shall not be used.

   Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or suitable clips at intersections and where necessary, shall be supported by metal chairs or spacers, precast mortar blocks, or metal hangers. Reinforcing bars shall not be spliced at points of maximum stress. Splices, where permitted, shall be as specified in ACI 318. All reinforcing steel shall be placed in the position and at the spacings shown on the plans with the tolerance specified in ACI 301 Section 5.4.

5) Cover: The minimum clear cover for reinforcing steel in cast-in-place (non prestressed) concrete shall be as specified in ACI 318, Section 7.7, unless otherwise shown on the plans.

609 FORMS

Forms shall conform to the shape, lines and dimensions as shown on the plans. Approved flexible forms shall be used for construction where the radius is 150 feet or less. Unexposed surfaces shall have forms of No. 2 common (or better) lumber. Forms shall not be disturbed until the concrete has adequately hardened.

The Contractor or his superintendent shall be present at the time forms are removed and shall be responsible for the safety of this operation at all times. In no case shall the minimum time between placing concrete and removal of forms be less than the following:

	Time
Curb and Gutter	12 Hrs.
Side forms for footings and slabs	12 Hrs.
Side forms for walls, beams and columns (Non-structural)	24 Hrs.
Forms under structural beams and slabs requiring shoring	7 days, or when concrete has reached 2/3's strength as indicated by compressive strength tests on field cured specimens, which ever is longer

610 JOINT MATERIALS

Joint materials shall conform to AASHTO Specifications according to type as follows:

Concrete Joint Sealer, Hot-poured Elastic	M 173
Preformed expansion Joint Filler (Bituminous Type)	M 33
Preformed sponge rubber and cork expansion joint filler	M 153
Preformed expansion joint fillers-nonextruding and resilient bit.	M 213

611 JOINTS

611.1 EXPANSION JOINTS

Expansion joint material shall be provided as shown on the plans or as directed by the Engineer. Expansion joints shall be installed at existing joints, structures, PCR's, and every 100 feet.

611.2 CONTRACTION JOINTS

Transverse joints shall be placed at maximum intervals of ten (10) feet to control random cracking. The joints shall be formed, sawed or tooled to a minimum depth of one quarter (1/4) of the total thickness.

If divider plates are used, the maximum depth of plates shall not be greater than one-half (1/2) the total thickness.

The joints shall be finished with a jointer having a width no greater than 5/16 inch and a depth not less than 3/4 inch. A maximum joint width at the finished surface shall be no greater than 5/16 inch.

Contraction joints must be straight (± 1/4") and perpendicular (± 1/2") to the longitudinal axis of work.

611.3 TOOL JOINTS

Tool joints shall be spaced as follows:

1) Not more than ten (10) feet nor less than five (5) feet apart in curb and gutter and combination curb-walk.

2) Not more than five (5) feet nor less than four (4) feet apart in sidewalk.

3) In driveways at least two joints equally spaced at not greater than ten (10) foot intervals, as applicable.

4) As directed by the Engineer.

612 FINISHING

Exposed faces of curbs and sidewalks shall be finished to true lines and grade as shown on the plans. The surface shall be floated to a smooth but not slippery finish. Sidewalk and curb shall be broomed or combed and edged, unless otherwise indicated by the Engineer. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms shall be tooled with an edger having a 3/8 inch radius.

No dusting or topping of the surface, or sprinkling with water to facilitate finishing shall be permitted.

612.1 TYPES OF FINISH

1) Medium Broom Finish - All curb-gutter and sidewalk, unless otherwise directed by the Engineer.

613 MARKINGS

Concrete used in curb and gutter, sidewalk, curb cuts, driveways, inlets, bicycle paths, retaining walls, and slope paving shall have the name of the contractor and the year of construction impressed therein using letters not less than one inch high and three-eights inch deep.

Impressions shall be made in the concrete at the beginning and end of each pour and in each driveway. Structures shall have the year constructed impressed therein using letters 3" high x 1/2" deep. Additional markings of "W" where the water, and "S" where sewer crosses the curb.

614 CURING COMPOUND

White-pigmented, Liquid, Membrane-forming compounds shall conform to AASHTO M148, Type II, Class B.

615 CURING CONCRETE

White pigmented curing compound conforming to Paragraph 614 shall be used unless another method conforming to ACI 308, Chapter 2 is approved by the Engineer in writing. All concrete, regardless of temperature, weather or season, shall be protected from premature drying for a period of not less than seven (7) days after the concrete is placed, except that where concrete is being protected from freezing, the time period for concrete saturation shall be one (1) day less than that of the frost protection.

The application rate shall be as per manufacturer's recommendation (approximately 150 sq.ft./gal.). Curing will not be required longer than 72 hours if high-early strength concrete is used. It shall be the contractor's responsibility to protect the concrete being cured, from the elements, traffic, and vandalism. Curing methods applied to other surfaces shall be applied to those surfaces covered by forms as soon as the latter are removed. Inadequate protection by the Contractor shall be cause for suspension of concreting operations and damaged concrete shall be replaced at the expense of the Contractor.

616 HOT AND COLD WEATHER REQUIREMENTS

616.1 COLD WEATHER PROTECTION

When concrete is placed when ambient temperatures are expected to fall below 40` F, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing.

Concrete delivered in outdoor temperatures lower than 40 degrees F. shall arrive at the work having a temperature not less than 50 degrees F. nor greater than 90 degrees F. Aggregates and mixing water shall be heated to a temperature of at least 70 degrees F., but not more than 150 degrees F., the aggregates may be heated by either steam or dry heat. Heating equipment or methods which alter or prevent the entrainment of the required amount of air or which develop hot spots in the aggregate shall not be used. Placing of concrete may be started in the morning if the contractor desires, but shall be discontinued at 3 P.M. of the same day if freezing weather threatens. The concrete or aggregates shall be protected during transit, mixing and before and after placing, as directed by the

Engineer, to retain all heat possible in the concrete mix.

After the concrete has been placed, the contractor shall provide sufficient protection such as insulating blankets, canvas, framework, heating apparatus, etc., to enclose and protect the concrete and maintain the temperature of the concrete at not less than 50^{o} F. For 7 days.
Except as provided above, cold weather concreting shall be in accordance with ACI 306. If in the opinion of the Engineer, the protection provided is inadequate, concreting shall cease until conditions or procedures are satisfactory to the Engineer.

616.2 HOT WEATHER CONCRETING

Except by written authorization, concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at 90^{o} F. or lower. The placement of concrete in hot weather shall comply with ACI 305.

617 FINAL SURFACE TEST

All work shall be true to line and grade per the approved plans or as directed by the Engineer. Prior to acceptance of the work, the Contractor shall test the surfaces with a 10' straightedge. Any areas higher than 1/8" but not higher than 1/4" above the correct surface thus indicated, shall be ground to the correct surface by the Contractor at his expense. When the deviation exceeds the foregoing limits, that portion of the work shall be removed and replaced by the Contractor at his expense, as directed by the Engineer.

Any areas low, which hold or cause water to pond shall be removed and replaced at the expense of the Contractor.

618 REPAIRS

If after stripping of forms any concrete is found to be not formed as shown on the plans, or is out of alignment or level, or shows a defective surface, it shall be considered as not conforming with the intent of these Design and Construction Standards and shall be removed and replaced by the Contractor at his expense unless the Engineer gives written permission to patch the defective area, in which case patching shall be done as described in the following paragraphs.

Defects that require replacement are those that consist of honeycomb, damage due to stripping of forms, and loose pieces of concrete. Bolt-holes, and tie-rod holes may be repaired. The repaired area shall be patched with a non-shrink, non-metallic epoxy grout with a minimum compressive strength of 5,000 psi in 28 days. All repair areas shall be treated with an epoxy bonding agent before the repair filling is placed.

Bolt-holes, tie-rod holes and other minor imperfections, as approved by the Engineer, shall be filled with an approved epoxy grout. Repairs shall be placed in layers and thoroughly compacted by suitable tools per the manufacturer recommendations. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted grout.

619 MISCELLANEOUS

619.1 BACKFILLING

When side forms are removed and the concrete has gained sufficient strength the space adjoining the concrete shall be promptly backfilled with suitable materials, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface.
In embankments the backfill shall be level with the top of the concrete for at least two (2) feet and then sloped as shown on the plans or as directed by the Engineer.

619.2 REMOVAL, REPAIR, AND REPLACEMENT OF EXISTING CONCRETE

Where repairs are made in existing sidewalks, curb and gutter etc. all edges of the existing concrete allowed to remain shall be sawcut to a minimum depth of two (2) inches and removed. No rough or broken edges will be permitted where new construction joins old. Unless directed by the Engineer, no section less than five (5) feet in length shall be placed or left in place.

619.3 CONNECTION WITH EXISTING SIDEWALKS

Where new sidewalk construction abuts existing sidewalks, the work shall be accomplished so that no appreciable change in grade results.

619.4 REMOVAL OF EXISTING CONCRETE

Removal and replacement of existing concrete features (curb-gutter, sidewalk, curb cuts, crosspans, etc.) beyond the limits shown on the plans, or required by the Engineer, shall be at the Contractor's expense.

619.5 OPENING TO TRAFFIC

Walks shall not be opened to pedestrian traffic for at least twenty-four (24) hours after placement. Driveways, curb-gutter, and crosspans shall not be opened to vehicular traffic for at least seven (7) days after placement. The Contractor shall maintain suitable barricades to comply with foregoing requirements.

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SECTION 7
PIPELINE EXCAVATION, BEDDING AND COMPACTION

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SECTION 7
PIPELINE EXCAVATION, BEDDING AND COMPACTION

700 PIPELINE EXCAVATION, AND BEDDING

The minimum class of bedding shall be granular bedding material in accordance with these Design and Construction Standards. The Contractor may select a higher class bedding at his option and approved by the Engineer. In the event the Contractor does not comply with the minimum bedding requirements, the next higher class of bedding shall be used.

701 GRANULAR BEDDING MATERIAL

Granular bedding material shall comply with the following sieve analysis. Alternative bedding must be approved by the Engineer prior to construction.

SQUEEGEE

SIEVE SIZE	PERCENT PASSING
3/8"	100%
#200	0 - 5%

701.1 COMPACTION OF GRANULAR BEDDING MATERIAL

Granular bedding material shall be compacted with a hand-operated, vibratory device to a minimum density of 95% of the optimum density determined by AASHTO T180.

702 COMPACTION OF BACKFILL MATERIAL FOR THE BEDDING SECTION

Compaction of backfill material for the bedding section shall mean that AI to A5 soils shall be compacted to 95% of the optimum density determined by AASHTO T180 and A6 and A7 soils shall be compacted to 95% of the optimum density determined by AASHTO T99.

702.1 COMPACTION TESTING

Compaction testing shall be in accordance with ANSI/ASTM D 1556. The compaction of the bedding and the backfill shall be tested at a rate of at least five (10) tests per 1,000 feet or portions thereof or as directed by the Engineer. The testing shall be at varying depths and locations as determined by the Engineer. Testing around manholes and valve boxes shall be taken.

Test results shall be certified by a Registered Professional Engineer specializing in soils analysis, to be correct and shall be submitted to the City within 24 hours of the test or the next City working day. Compaction testing shall be at the expense of the Contractor.

703 CLASSES OF BEDDING

GRANULAR BEDDING MATERIAL: The trench shall be excavated to a depth below the established grade a minimum of 6 inches. Granular bedding material shall be placed and compacted under the pipe and around the sides of the pipe and to the minimum depth over the top of pipe as shown on the plans and Standard Details. The granular bedding material shall be consolidated and compacted by hand operated mechanical vibrators.

704 BACKFILL AND COMPACTION

Backfilling shall be performed as soon as practicable, but only when authorized by the Engineer. The amount of open trench or uncompacted backfill or sum of both shall not be more than 500 feet at any time. Jetting or ponding shall not be allowed. Backfill material which is above the optimum moisture content shall be removed from the site and disposed of by the contractor at his expense.

Unless specified otherwise, all excess backfill shall be disposed of off the rights-of-way and public property by the Contractor at his expense. Special care shall be taken to insure proper compaction around valve boxes and manholes.

Backfilling of acceptable material shall not be placed in lifts exceeding eight inches (8") in depth (uncompacted).

704.1 ORDINARY BACKFILL MATERIAL

Ordinary backfill shall consist of material which has been excavated from the trench except for rubbish, frozen material, broken pavement, other debris, stones greater than 3 inches in diameter, organic material, or other materials considered deleterious by the Engineer. When in the opinion of the Engineer, the excavated material is not satisfactory for use as backfill, whenever there is a shortage of satisfactory backfill material from any approved source.

The Contractor shall furnish all necessary suitable backfill material and shall dispose of the rejected excavated material at the Contractor's expense. Clay and similar material with a plasticity index as determined by ASTM in excess of 10 shall not be considered suitable for backfilling the trenches located in improved streets, roads, highways and thoroughfares.

704.2 SELECT BACKFILL MATERIAL

Select backfill shall be used in roadways whenever ground water of clay soil with a plasticity index as determined by ASTM in excess of 10 is encountered within three feet of the surface per the recommendation of a Geotechnical Engineer and approval of the Engineer. Select backfill shall be road base or pit run, as approved by the Engineer.

704.3 COMPACTING ORDINARY BACKFILL

Ordinary backfill shall be placed from one foot above the pipe to the surface, compacted in 8" maximum lifts. Backfill shall be placed to a minimum depth of 30 inches above the top of the pipe before vibratory roller or compacting hammer is used over the pipe.
Ordinary backfill in roadways shall be compacted as follows: A1 to A5 soils shall be compacted 95% of the optimum density as determined by AASHTO T180. A6 and A7 shall be compacted to 95% of the optimum density as determined by AASHTO T99.

At the discretion of the Engineer, compaction in unimproved areas (out of the R.O.W.) may be reduced to 90% of optimum density as determined by AASHTO T180 or T99 as applicable for the said soil type. The backfill may be tested at any depth and shall be properly compacted at all depths. The time and depth of testing shall be at the discretion of the Engineer. Testing shall be in accordance with Section 702.1 of these Design and Construction Standards.

705 IMPROVEMENTS WITHIN EXISTING STREETS

Whenever favorable weather conditions do not exist, the Engineer may require that temporary bituminous cold mix 3" in depth be installed immediately in the trench section in all paved streets. As the temporary cold mix surface settles or is displaced by traffic, it shall be replaced immediately and the surface maintained until the placement of permanent paving.

This surfacing shall be removed by the Contractor as soon as weather conditions permit or as directed by the Engineer and replaced with permanent hot mix bituminous paving at a minimum depth of 6" depth. Should the full depth section of an asphalt street exceed 6", the asphalt patch shall not be less than the existing full depth section. Installation of the hot bituminous patch shall be installed in lifts and compacted between each lift.

Compaction tests are required on the backfill of the trench section. Test results shall be submitted to the Engineer for review prior to installation of the asphalt patch.

CITY OF LOUISVILLE
DESIGN AND CONSTRUCTION STANDARDS

SECTION 8
MISCELLANEOUS

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SECTION 8
MISCELLANEOUS

800 BIKEPATH DESIGN CRITERIA

800.1 HORIZONTAL DESIGN CRITERIA

Independent bikepath shall be separated from the edge of the roadway curb and gutter by a minimum of 5 feet.

Design speed shall be 20 mph.

Minimum horizontal turning radius shall be 95 feet (defined to centerline) unless approved by the Engineer.

Landscaping treatment within the 3 feet adjacent to bikepath must conform to the following standards:

1) Plant material shall not be thorn bearing or of woody material.

2) Nearby sprinkler systems shall be designed in such a way as to not spray bikepath.

3) Final design is subject to the review and approval of the City.

800.2 VERTICAL DESIGN CRITERIA

Superelevation rates for bikepaths shall be 0.10 ft/ft.

Stopping site distances:

1. Descent	Grade	Stopping Sight Distances
	0-4	140'
	5-9	160'

2. Ascend	Grade	Stopping Sight Distances
	0-4	130'
	5-9	120'

Bikepath Sight Distance for Crest Vertical Curve

Algebraic Difference in Grades	Minimum Length of Vertical Curve
0-5%	60
6%	90
7%	110
8%	130
9%	140
10%	150

Grades:

1) Maximum unrestricted grade = 3%

2) 5-8% grades will be allowed for distances not to exceed 200'.

3) Over 5% grades must be reviewed and approved by the Engineer.

4) Grades shall not exceed 8%.

800.3 PAVEMENT DESIGN

All detached bikepaths shall be constructed of Type I concrete or as approved by the Engineer.

Thickness - The minimum thickness for bikepaths is 6 inches in all areas.

The bikepath shall be constructed with a 2% cross slope.

Weakened Plane Placement - tooled or sawcut joints are required at 10 feet intervals.

Expansion joints at new or existing structures and every 100'.

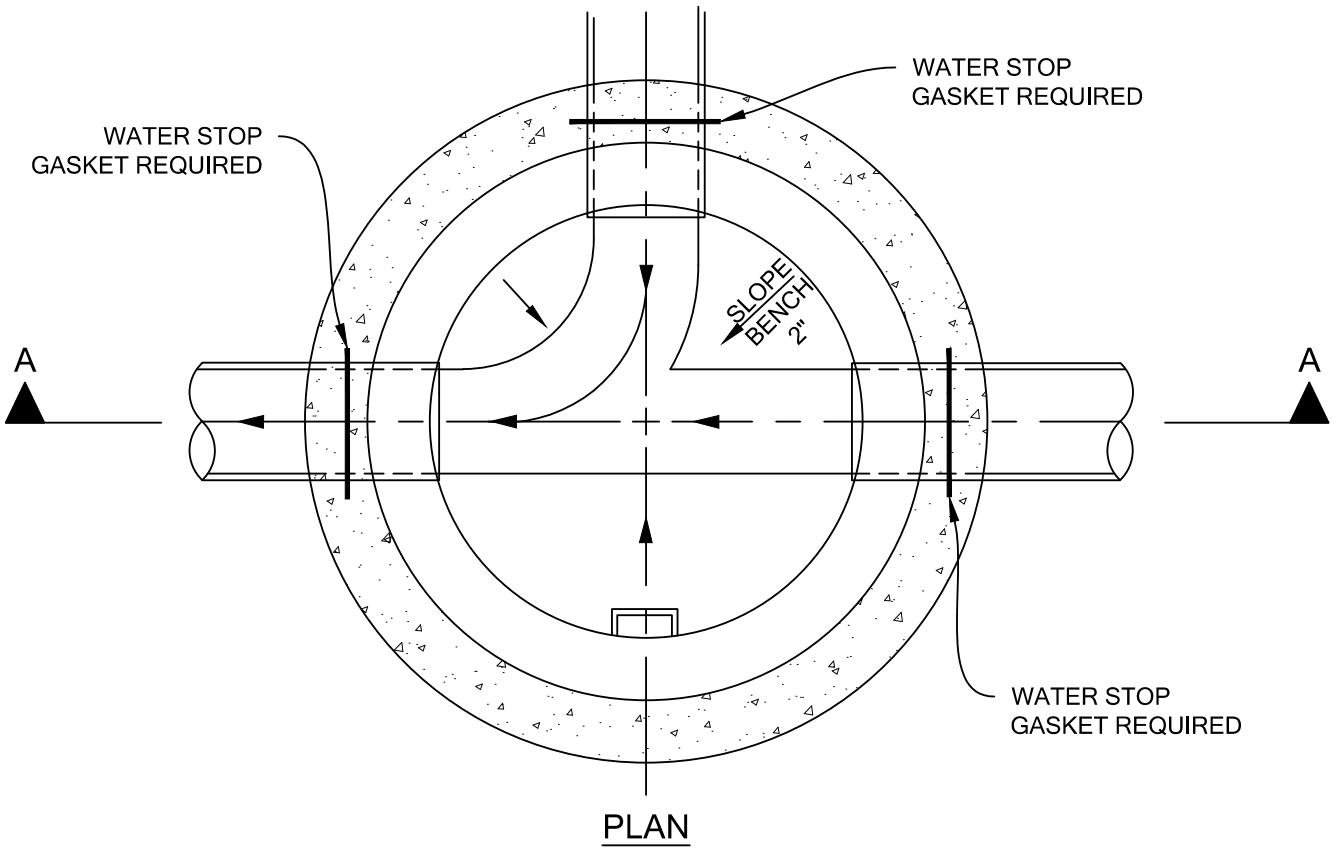
Depth of joint shall be 1" in 6" thick concrete.

800.4 BIKEPATH PAVEMENT MARKING AND STENCILING

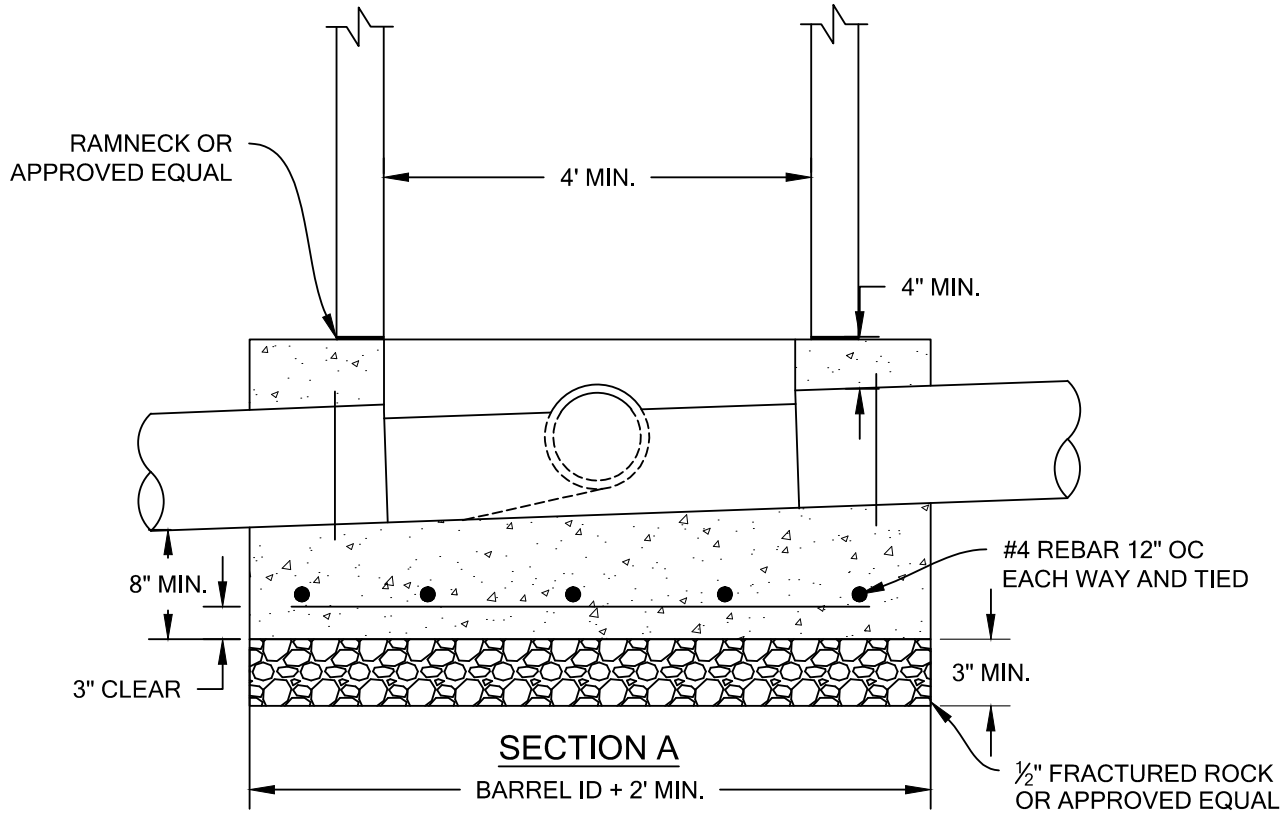
All markings shall conform to the "Manual on Uniform Traffic Control Devices".

LOUISVILLE STANDARD DETAILS

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PLAN



SECTION A

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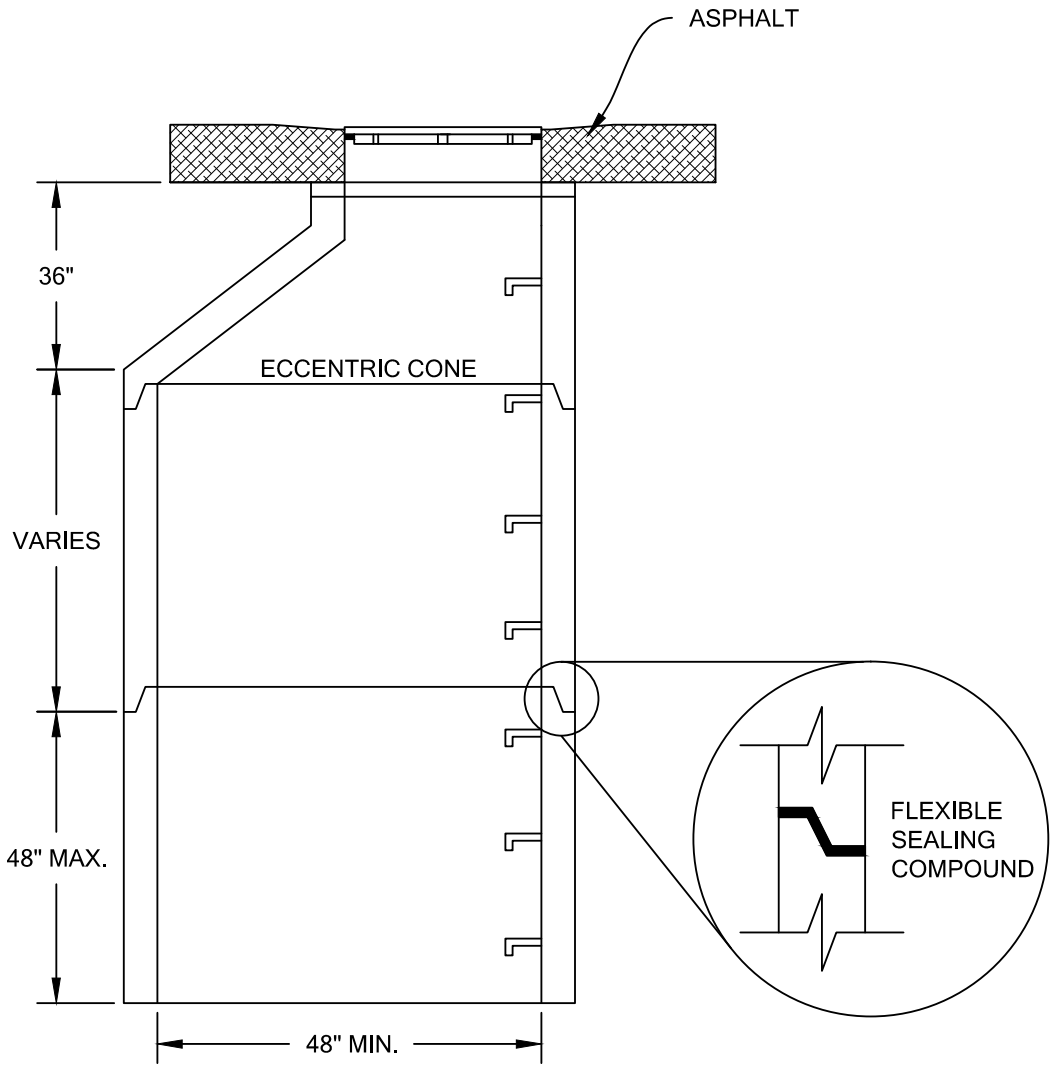
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MANHOLE BASE

SHEET
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MANHOLE SECTION
W/ ECCENTRIC CONE TOP

NOTES:

1. STEPS SHALL BE LOCATED ABOVE THE BENCH.
2. MANHOLE STEP SPACING SHALL BE 12"- 18" OC.
3. HDPE / TAPERED GRADE RINGS SHALL BE USED FOR GRADE ADJUSTMENT.
4. STEPS SHALL BE VERTICALLY PLUMB ± 1" AND SHALL HAVE EQUAL SPACING.
5. FLEXIBLE SEALING COMPOUND SHALL BE RAMNECK OR APPROVED EQUAL.
6. MANHOLE STEPS SHALL BE NO MORE THAN 24" NOR LESS THAN 18" FROM THE TOP OF THE MANHOLE RING OR FROM THE BENCH OF THE MANHOLE.
7. STEPS SHALL CONFORM TO AASHTO M 199.
8. PRECAST MANHOLES SHALL COMPLY WITH ASTM C 478.

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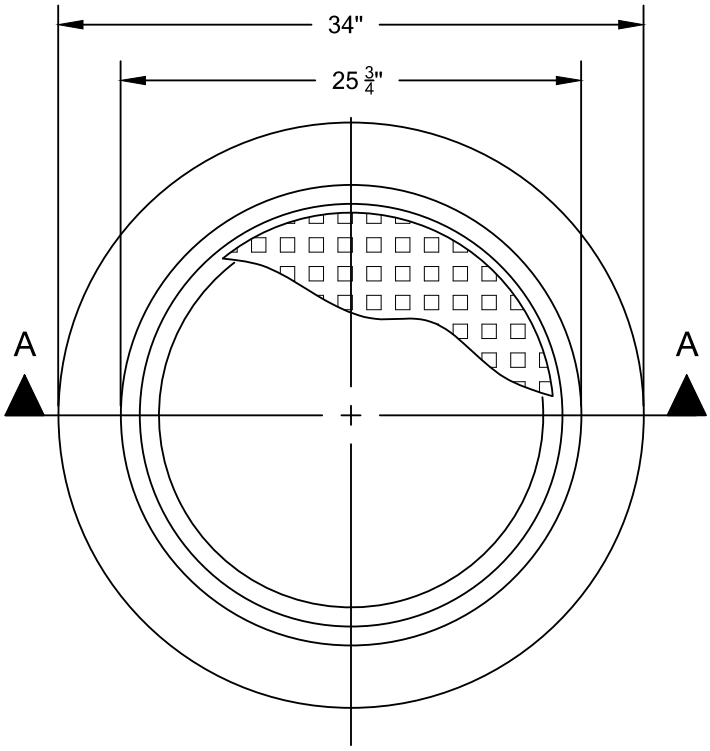
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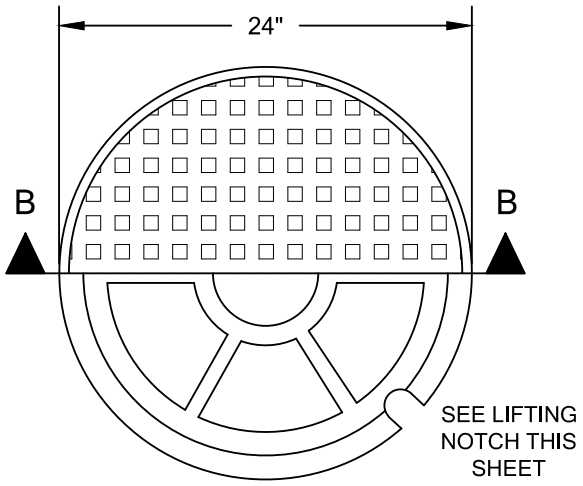
MANHOLE SECTION

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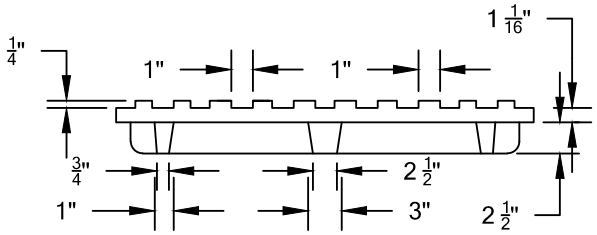
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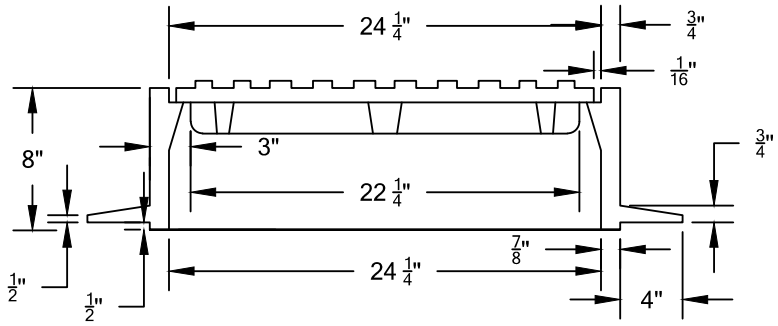
PLAN



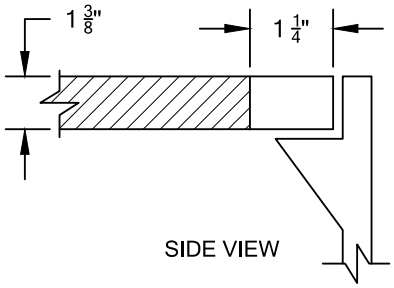
HALF PLAN



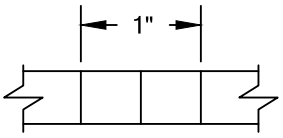
SECTION B-B



SECTION A-A



SIDE VIEW



FRONT VIEW

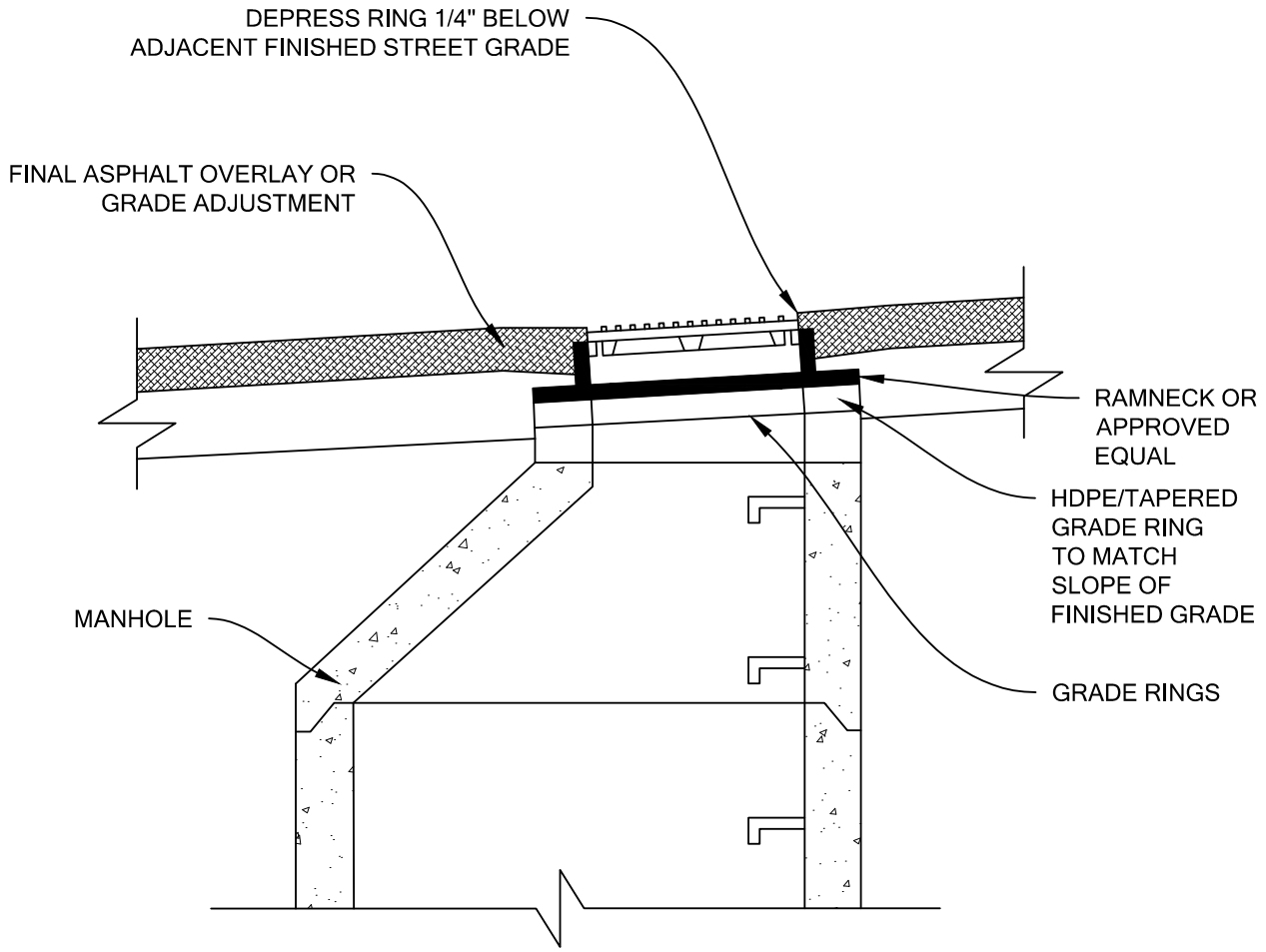
LIFTING NOTCH

NOTES:

1. ASTM DESIGNATION A-48 CLASS 25.
2. ALL BEARING SURFACES TO BE MACHINED.
3. LETTERING ON COVER AS REQUIRED (WATER, SEWER, OR STORM).
4. TOTAL MINIMUM WT. APPROX. 405 LBS.
5. LIFTING NOTCH 1" x 1 1/4" .
6. 24" RING & COVER FOR 48" DIAMETER MANHOLE BARRELS.
7. 30" RING & COVER FOR 60" & 72" DIAMETER MANHOLE BARRELS.

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		24" MANHOLE RING & COVER		3 OF 74

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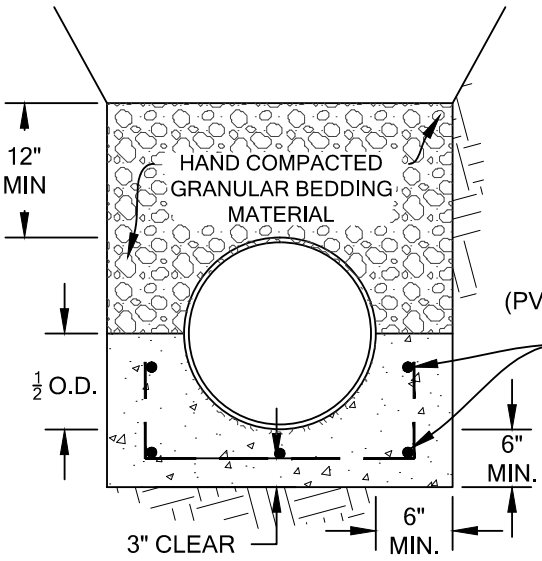
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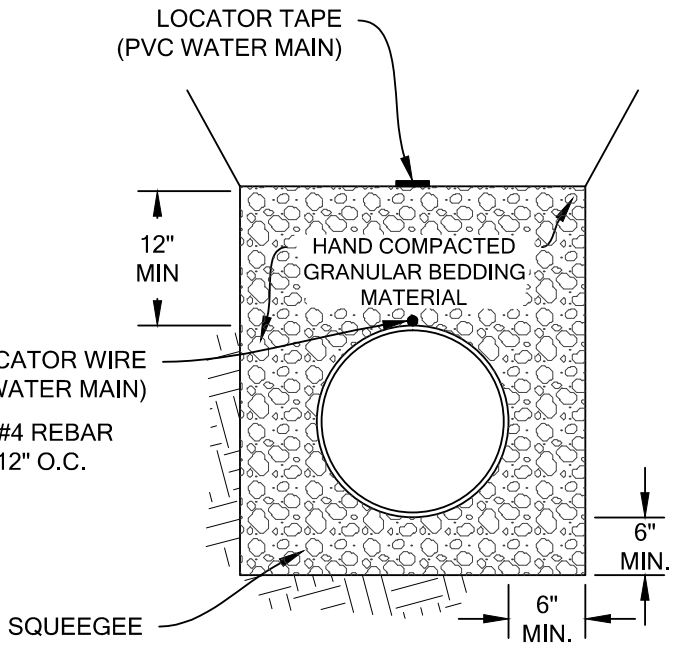
MANHOLE & COVER ADJUSTMENT

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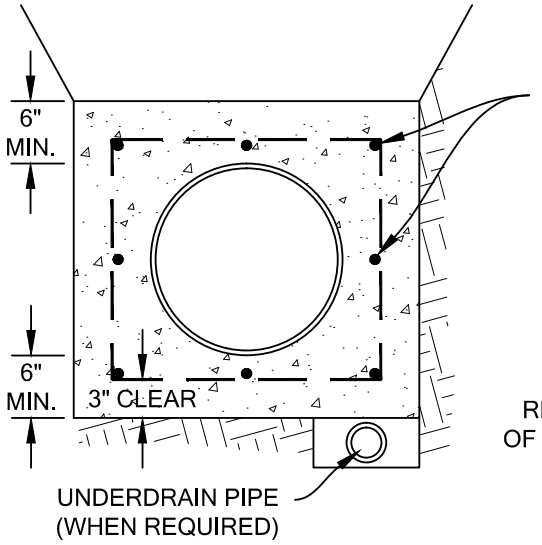
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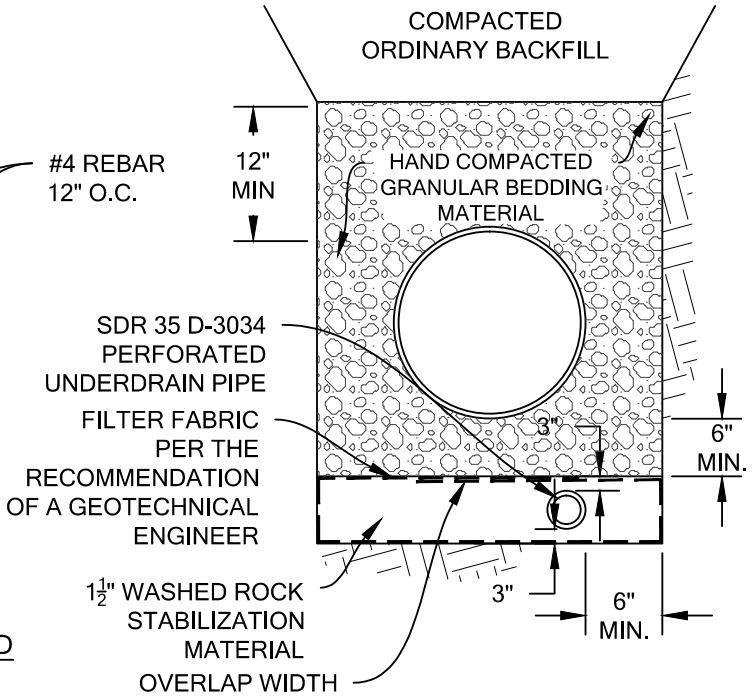
TYPICAL CONCRETE CRADLE SECTION



TYPICAL WATER & SAN. SEWER GRANULAR BEDDING SECTION



TYPICAL CONCRETE ENCASEMENT AND UNDERDRAIN SECTION

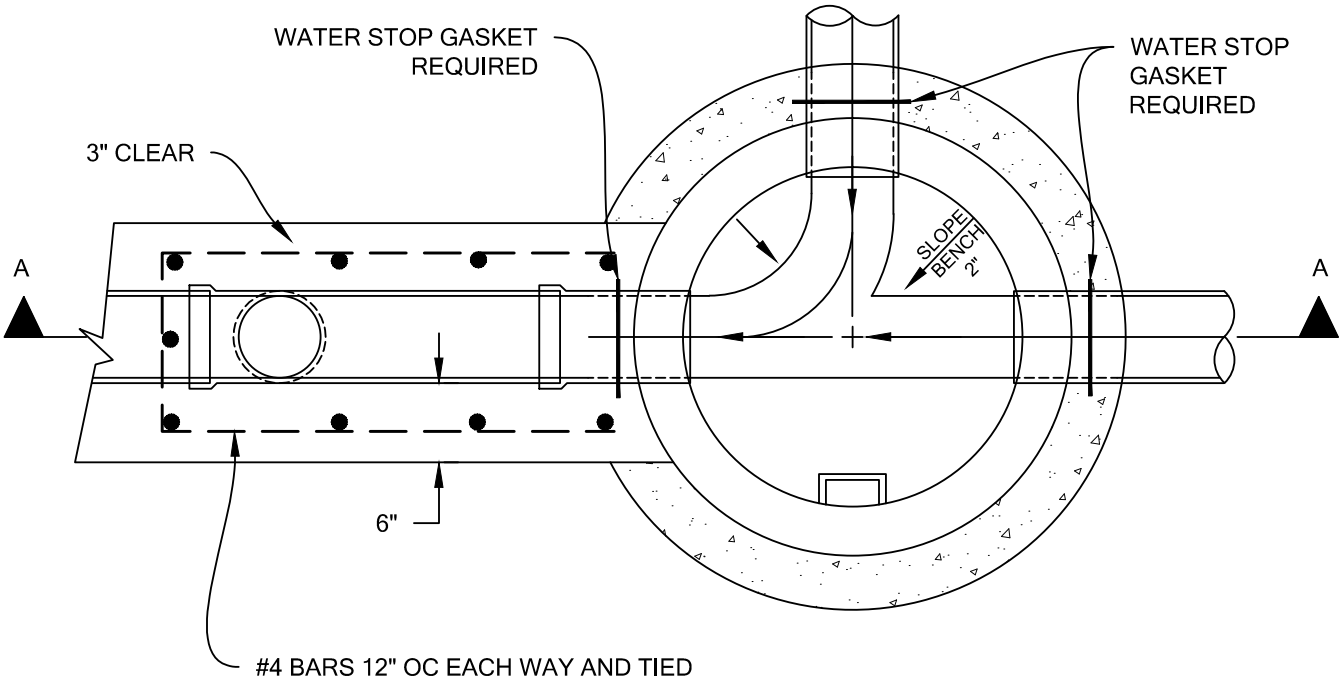


TYPICAL UNDERDRAIN SECTION

NOTE:
THERE SHALL BE A MINIMUM OF 30" OF BACKFILL OVER THE PIPE BEFORE ANYTHING OTHER THAN HAND COMPACTION EQUIPMENT IS USED IN THE TRENCH.

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NOTE:

1. SEE SHEET 7 FOR SECTION A-A
2. DROP MH'S SHALL BE USED WHEN THE DIFFERENCE IN ELEVATION BETWEEN THE INCOMING AND OUTGOING PIPE CENTERLINE EXCEEDS 18"

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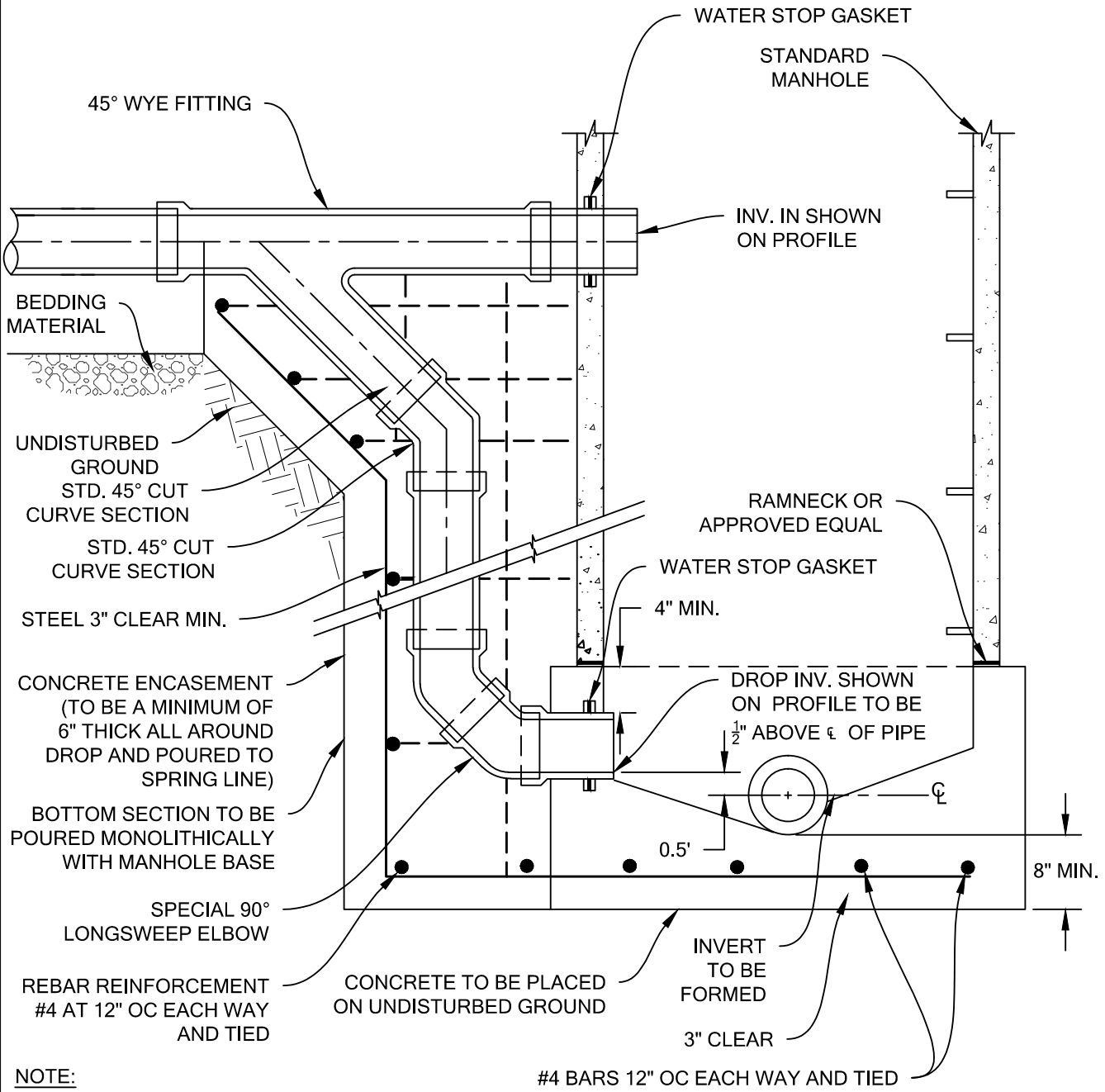
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DROP MANHOLE BASE PLAN

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SECTION A-A

NOTE:

1. SEE SHEET 6 FOR PLAN VIEW.
2. DROP MH'S SHALL BE USED WHEN THE DIFFERENCE IN ELEVATION BETWEEN THE INCOMING AND OUTGOING PIPE CENTERLINE EXCEEDS 18"

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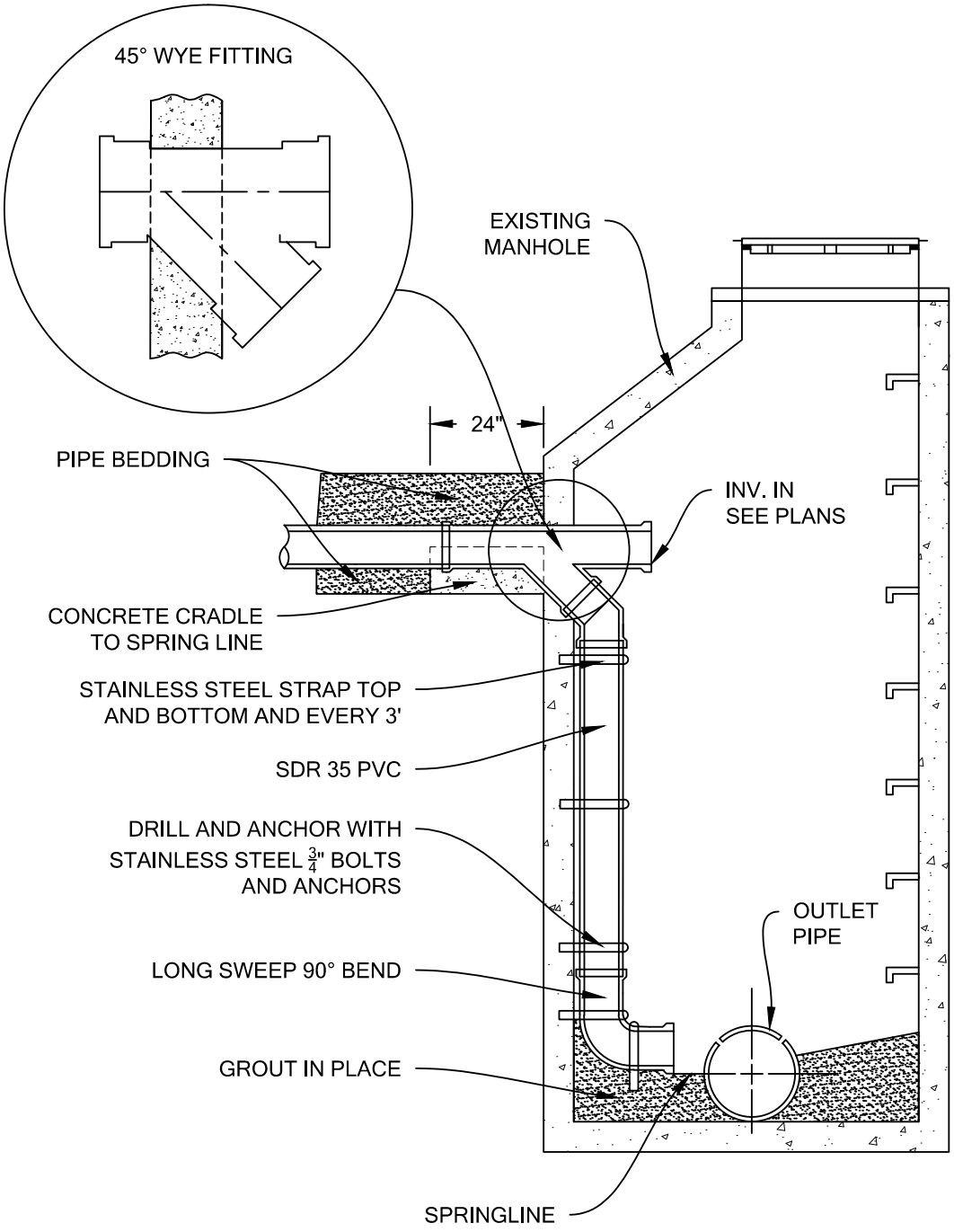
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DROP MANHOLE BASE SECTION

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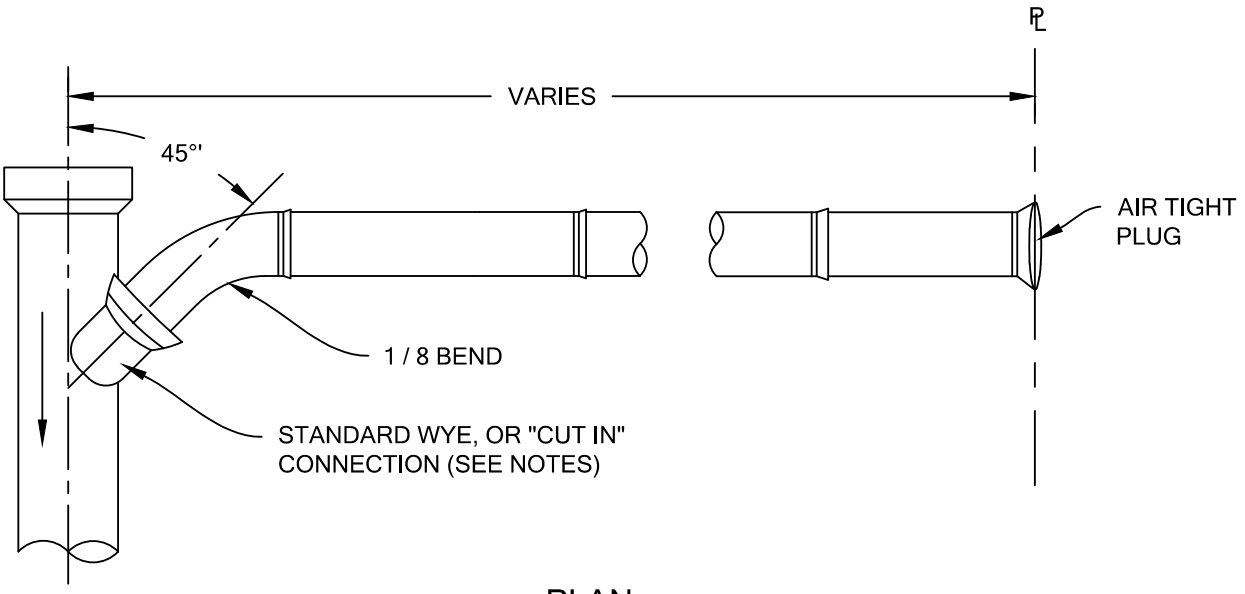
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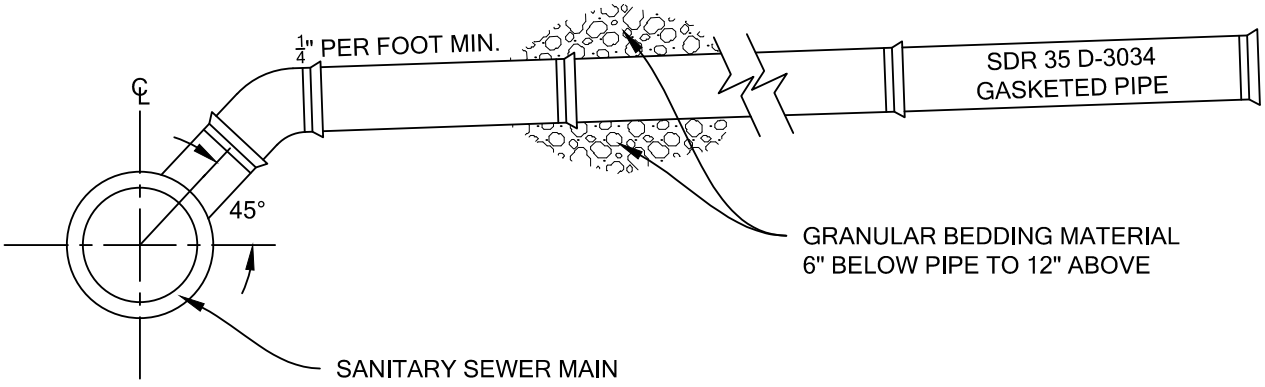
INTERIOR DROP MANHOLE CONNECTION

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PLAN



SECTION

NOTES:

1. BELLS SHALL NOT TOUCH THE SIDES OR BOTTOM OF THE BELL HOLE.
2. THE BARREL SECTION SHALL BE SUPPORTED THROUGHOUT ITS LENGTH.
3. SERVICE TAPS SHALL BE IN LINE WYES ON NEW MAINS, AND MACHINE TAPPED AND WYE SADDLE ON EXISTING MAINS. HAND TAPS SHALL NOT BE ALLOWED.
4. SERVICE LINES SHALL BE LOCATED FIVE FEET DOWNHILL FROM THE CENTERLINE OF THE LOT.
5. THE CURB SHALL BE MARKED WITH "S" OR "X" WHERE THE SEWER SERVICE LINE CROSSES THE CURB.
6. THE MIN. SERVICE LINE SHALL BE 1/4" PER FOOT.
7. ALL JOINTS SHALL BE GASKETED WATER TIGHT.
8. ALL SERVICE LINES SHALL BE 4" UNLESS OTHERWISE APPROVED.
9. INSPECTION REQUIRED PRIOR TO BACKFILL.

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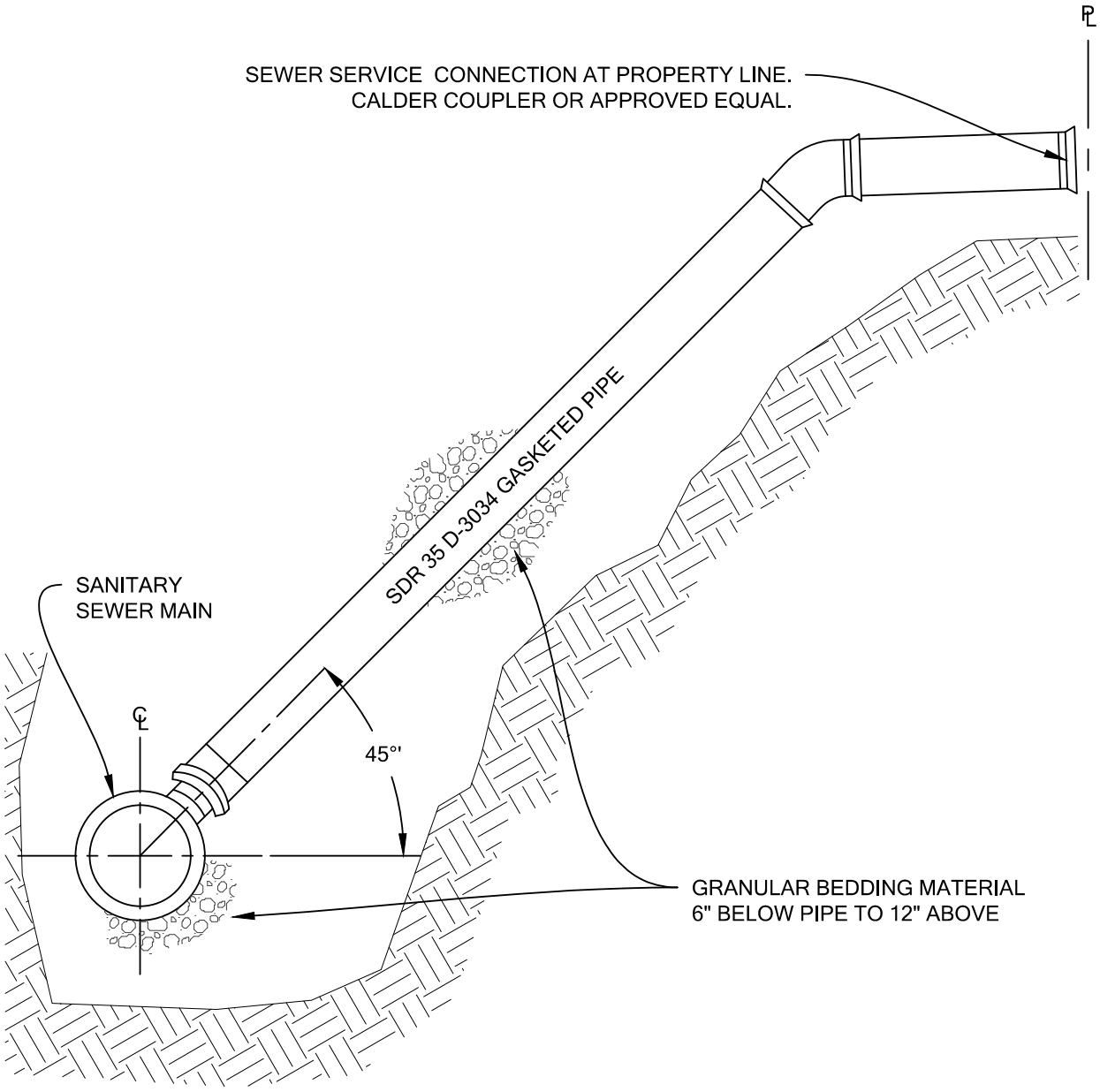
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SANITARY SEWER SERVICE

SHEET
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SECTION

NOTES:

1. BELLS SHALL NOT TOUCH THE SIDES OR BOTTOM OF THE BELL HOLE.
2. THE BARREL SECTION SHALL BE SUPPORTED THROUGHOUT ITS LENGTH.
3. SERVICE TAPS SHALL BE IN LINE WYES ON NEW MAINS, AND SHALL BE MACHINE TAPPED AND WYE SADDLED ON EXISTING MAINS. HAND TAPS SHALL NOT BE ALLOWED.
4. THE CURB SHALL BE MARKED WITH "S" OR "X" WHERE THE SEWER SERVICE LINE CROSSES THE CURB WHERE APPLICABLE.
5. ALL JOINTS SHALL BE GASKETED WATER TIGHT.
6. ALL SERVICE LINES SHALL BE 4" UNLESS OTHERWISE APPROVED.
7. INSPECTION REQUIRED PRIOR TO BACKFILL.

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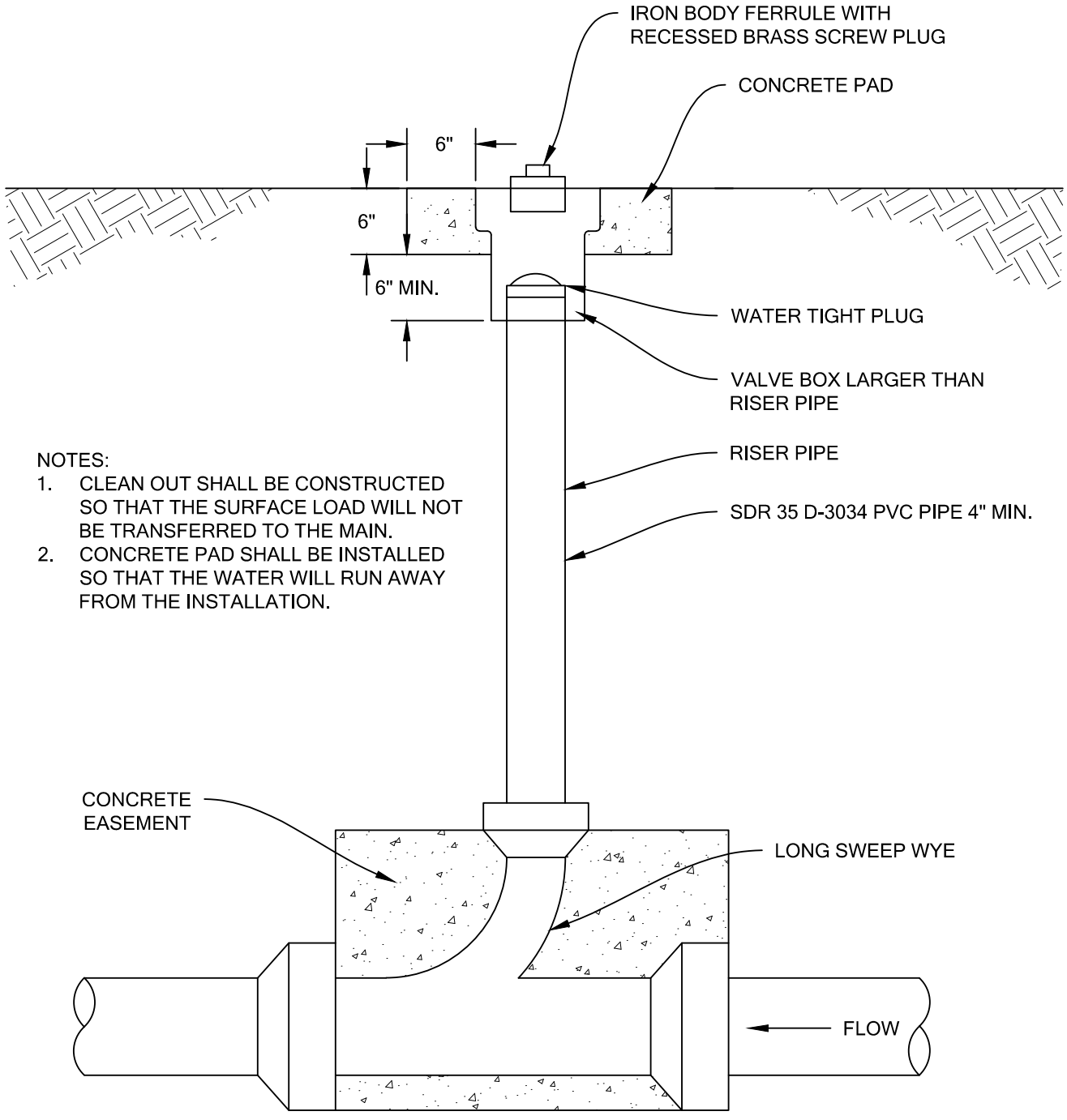
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DEEP TRENCH SEWER SERVICE

SHEET
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NOTES:

1. CLEAN OUT SHALL BE CONSTRUCTED SO THAT THE SURFACE LOAD WILL NOT BE TRANSFERRED TO THE MAIN.
2. CONCRETE PAD SHALL BE INSTALLED SO THAT THE WATER WILL RUN AWAY FROM THE INSTALLATION.

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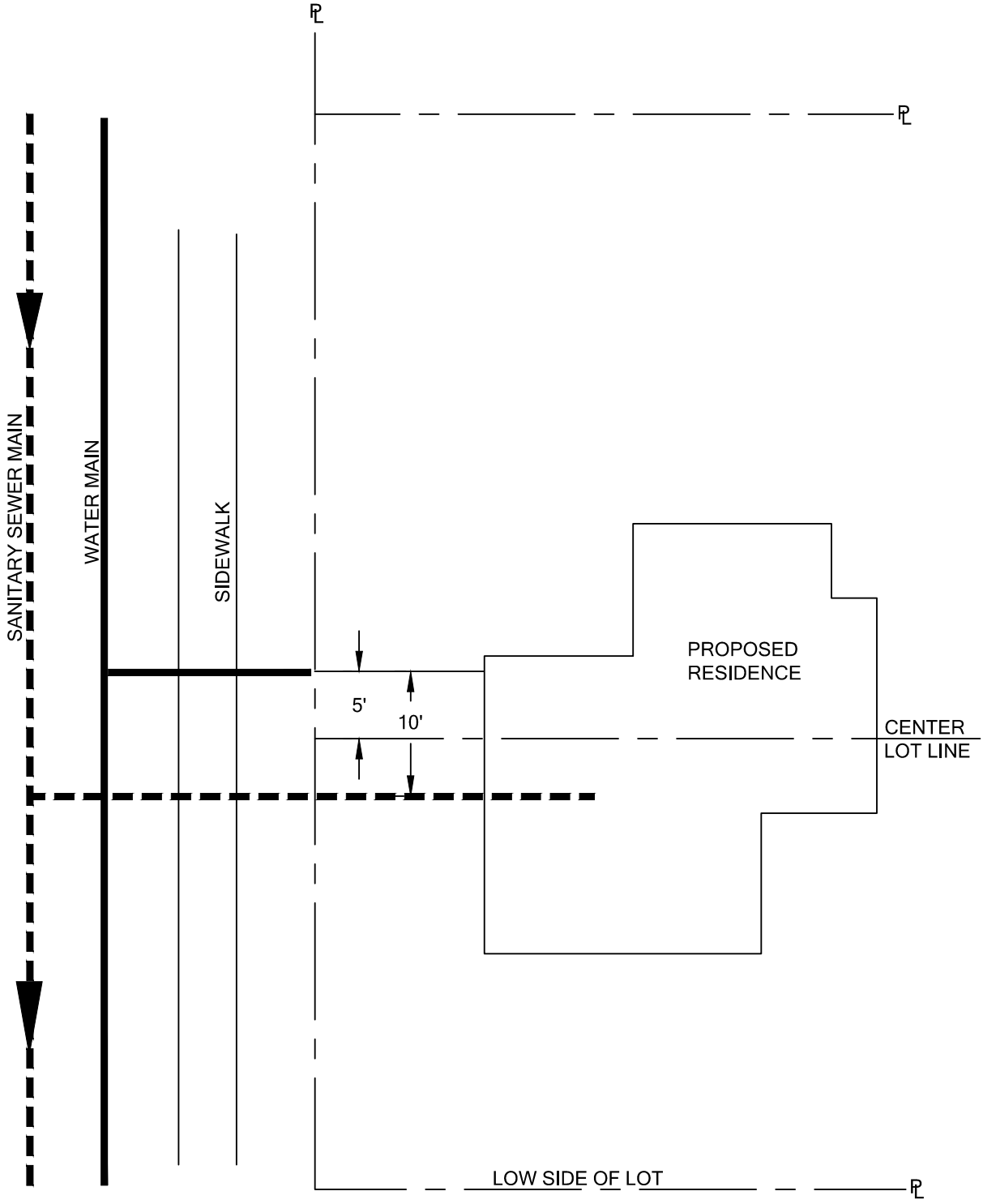
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CLEAN OUT

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City *of* Louisville
COLORADO - SINCE 1882

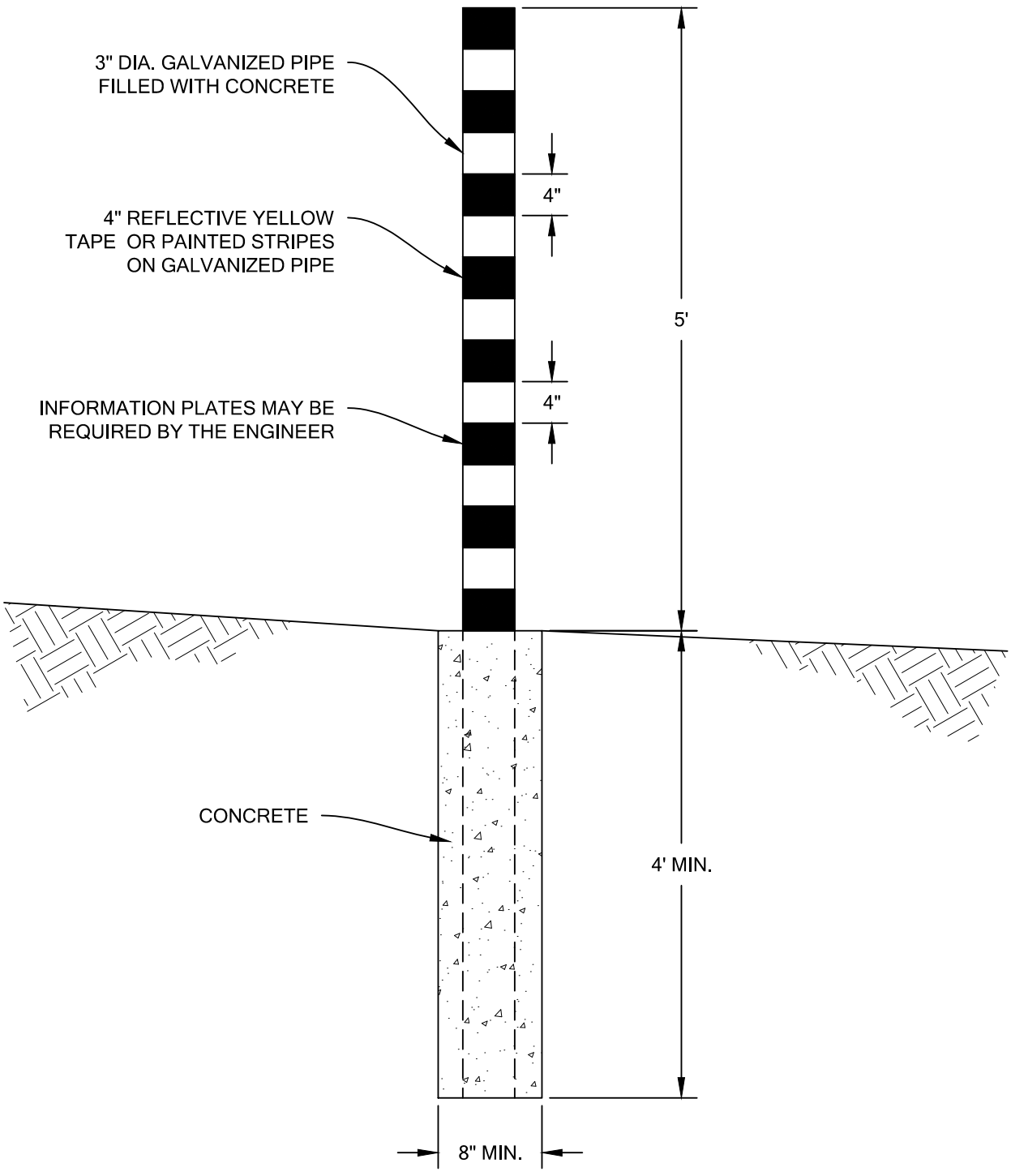
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TYPICAL RESIDENTIAL WATER & SEWER SERVICE

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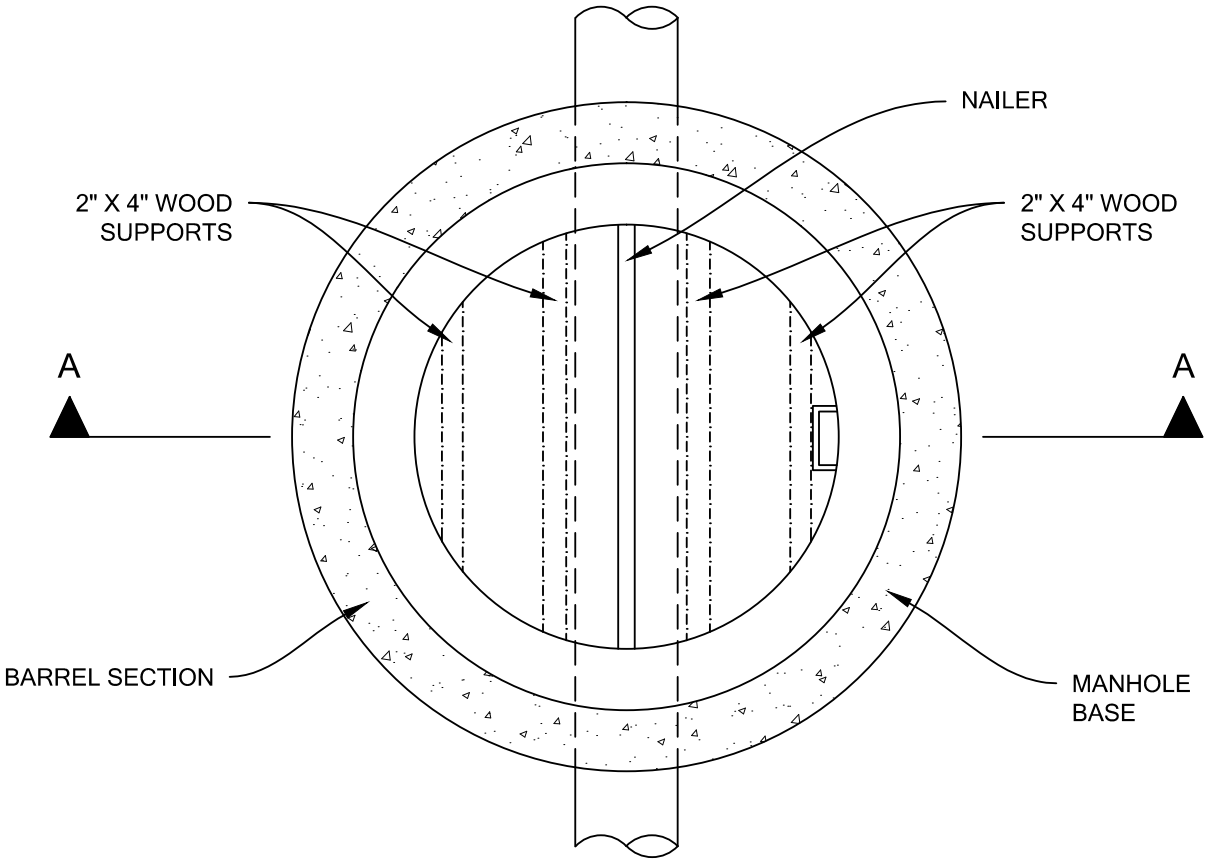
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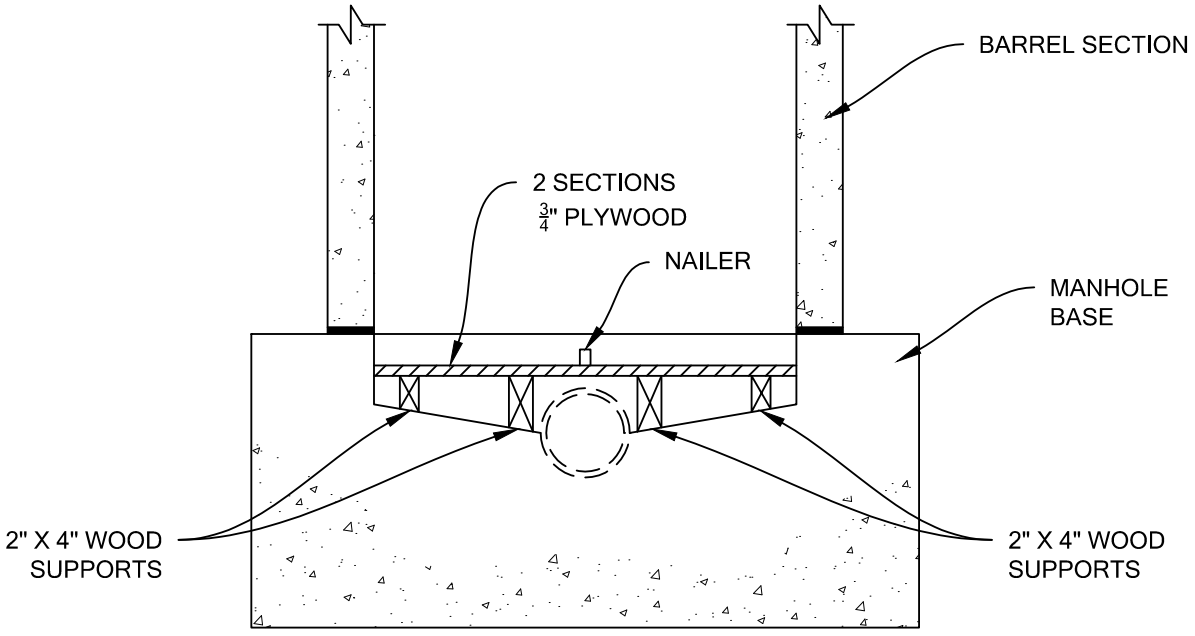
REFERENCE MARKER

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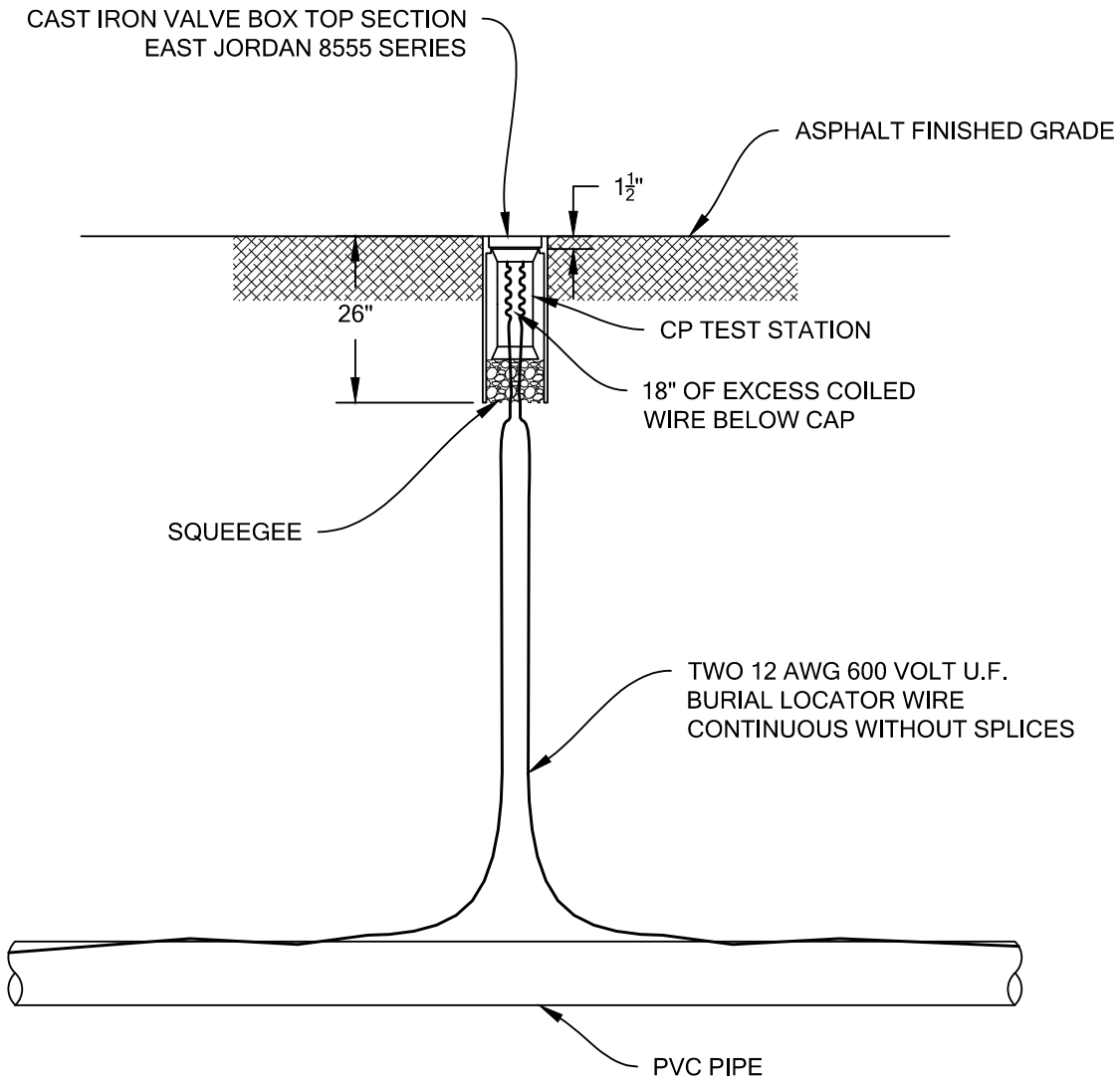
PLAN



SECTION A-A

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		FALSE BOTTOM MANHOLE		14 OF 74

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NOTES:

1. CP TEST STATION SHALL BE 2 POINT TERMINAL WITH LOCKING CAP, 2½" ID MINI BOX, GLENN SERIES OR APPROVED EQUAL.

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City *of* Louisville
COLORADO - SINCE 1882

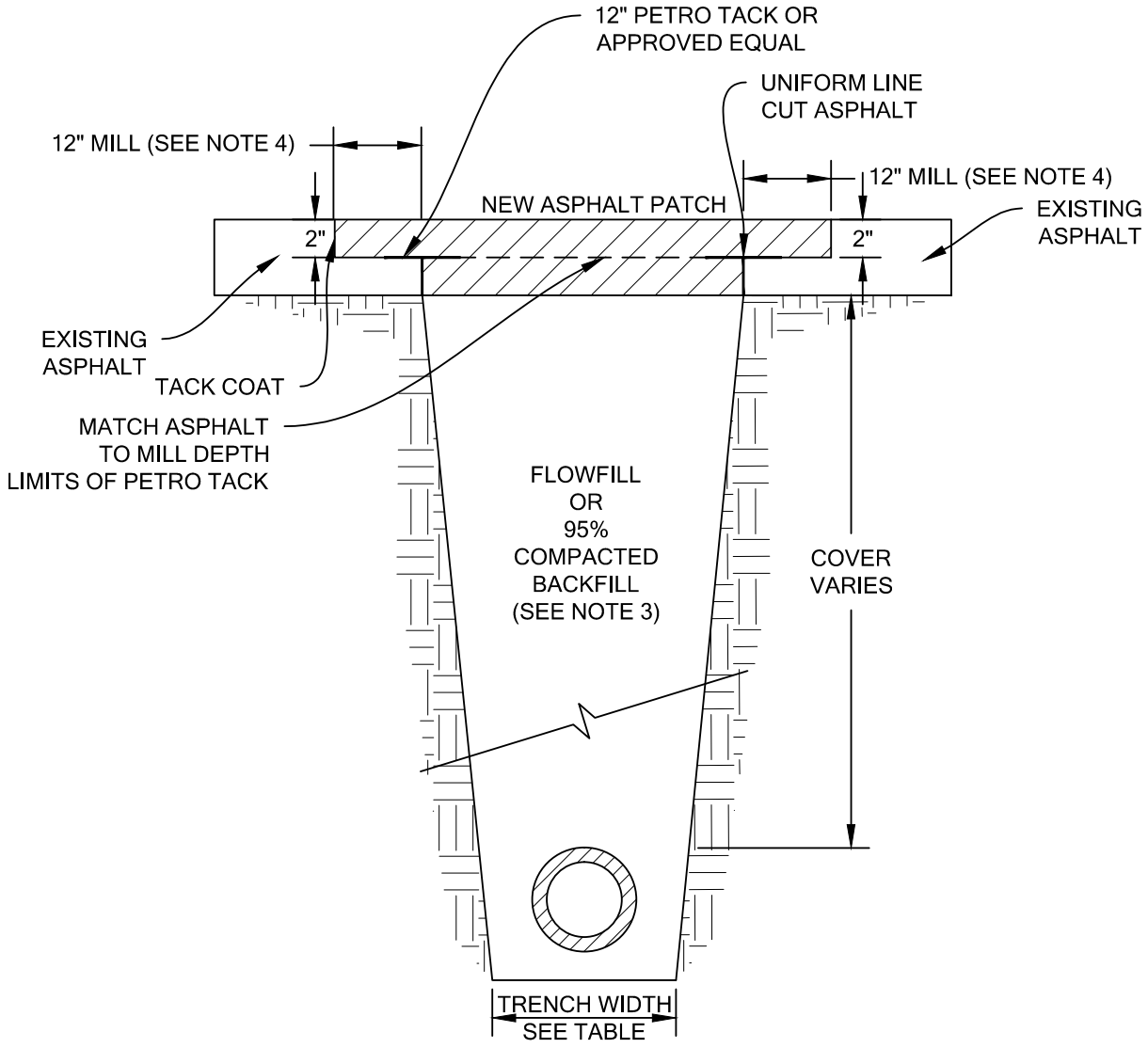
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FORCEMAIN LOCATOR WIRE

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NOTES:

1. TRENCH TO BE SLOPED OR BRACED AND SHORED AS REQUIRED.
2. 6" MIN. ASPHALT PATCH OR COMPLETE FULL DEPTH ASPHALT PATCH OF EXISTING STREET SECTION. INSTALL ASPHALT IN LIFTS AND COMPACT TO 95% MIN.
3. COMPACTED BACKFILL ONLY AS DIRECTED BY ENGINEER.
4. 12" MILL ONLY REQUIRED IF PAVEMENT IS 5 YEARS OLD OR LESS OR AS DIRECTED BY THE CITY.

PIPE DIAMETER	6"	8"	12"
MINIMUM WIDTH	1' 10"	2' 0"	2' 4"
MAXIMUM WIDTH	2' 6"	2' 8"	3' 0"

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City *of* Louisville
COLORADO - SINCE 1882

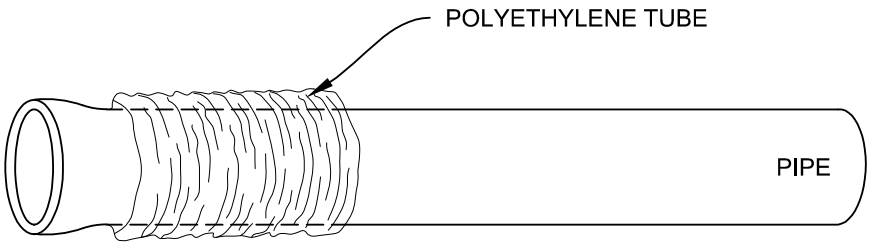
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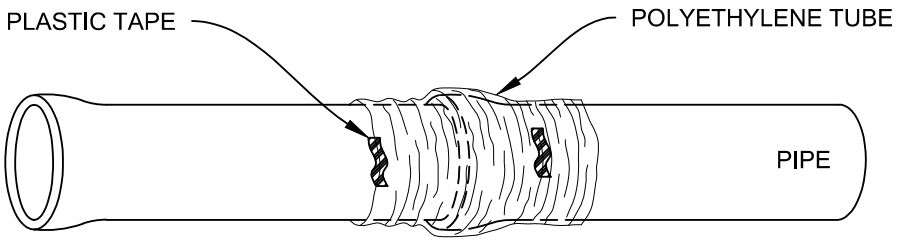
TYPICAL TRENCH T PATCH SECTION

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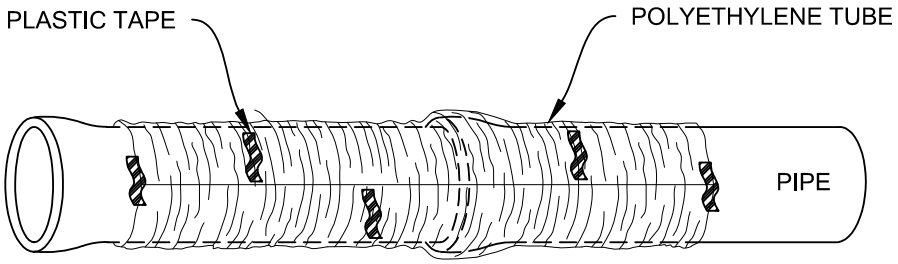
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STEP 1



STEP 2



STEP 3

FIELD INSTALLATION - POLYETHYLENE WRAP

STEP 1 - PLACE TUBE OF POLYETHYLENE MATERIAL ON PIPE PRIOR TO LOWERING IT INTO TRENCH.

STEP 2 - PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH TAPE TO HOLD THE PLASTIC TUBE IN PLACE.

STEP 3 - OVERLAP FIRST TUBE WITH ADJACENT TUBE AND SECURE WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE SHALL BE LOOSE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF THE PIPE AND TAPED IN PLACE.

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City *of* Louisville
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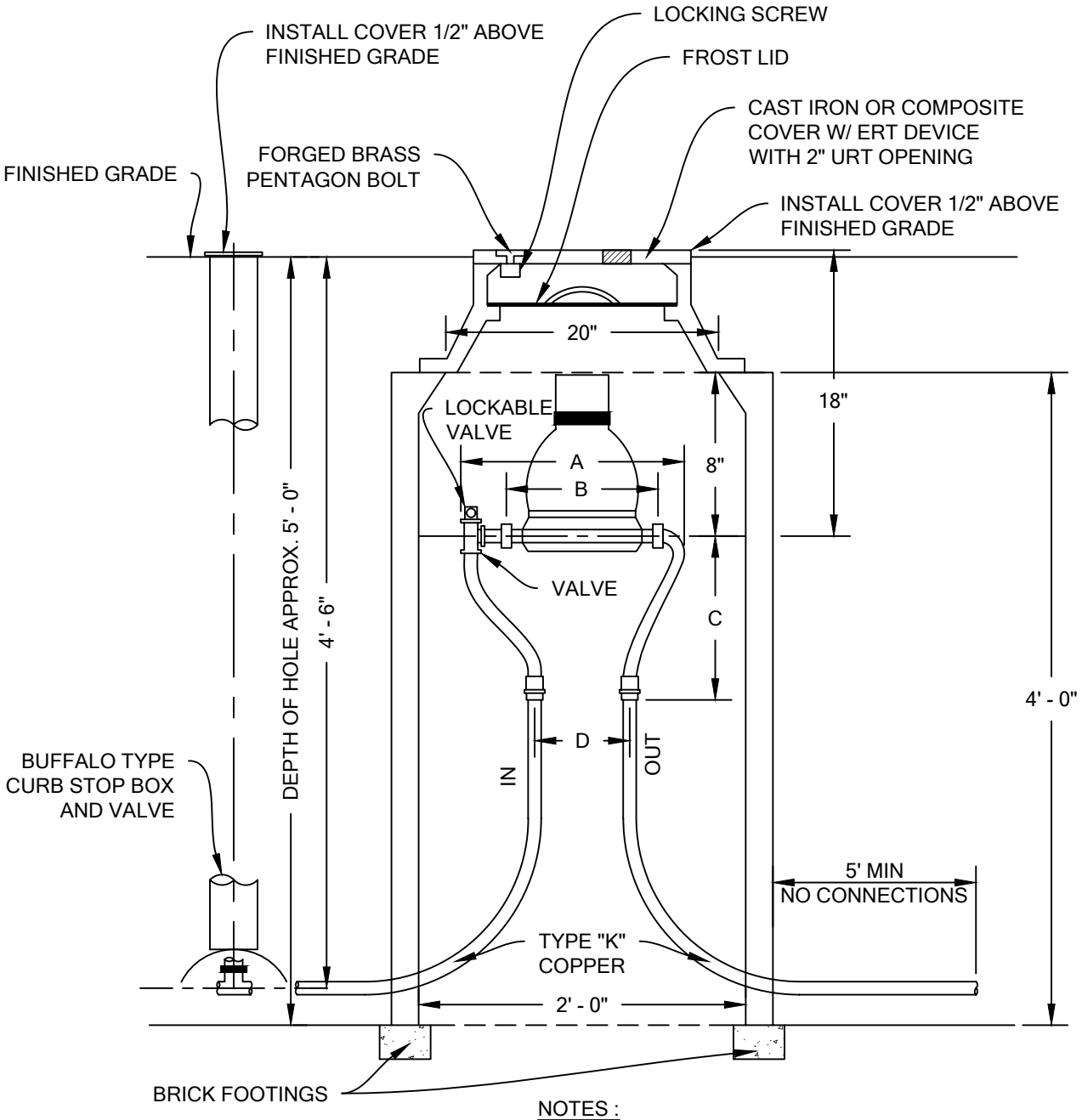
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POLYETHYLENE WRAP

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NOTES :

1. METER PIT SHALL NOT BE INSTALLED IN ROADWAYS, PARKING AREAS, OR ASPHALT, UNLESS APPROVED BY A CITY OF LOUISVILLE ENGINEER.
2. SET METER PIT COVER 1/2" ABOVE SURVEYED FINISHED GRADE. IF SURFACE IS NOT TO FINISHED GRADE AT TIME OF INSTALLATION OF METER PIT, OWNER SHALL RAISE/LOWER PIT AND MODIFY SERVICE LINE PLUMBING AS NEEDED.

METER SIZE	A	B	C	D
$\frac{3}{4}$"	$14\frac{1}{4}$"	$7\frac{7}{8}$"	$8\frac{15}{16}$"	5"
1"	$17\frac{1}{4}$"	$11\frac{1}{8}$"	$11\frac{1}{4}$"	6"

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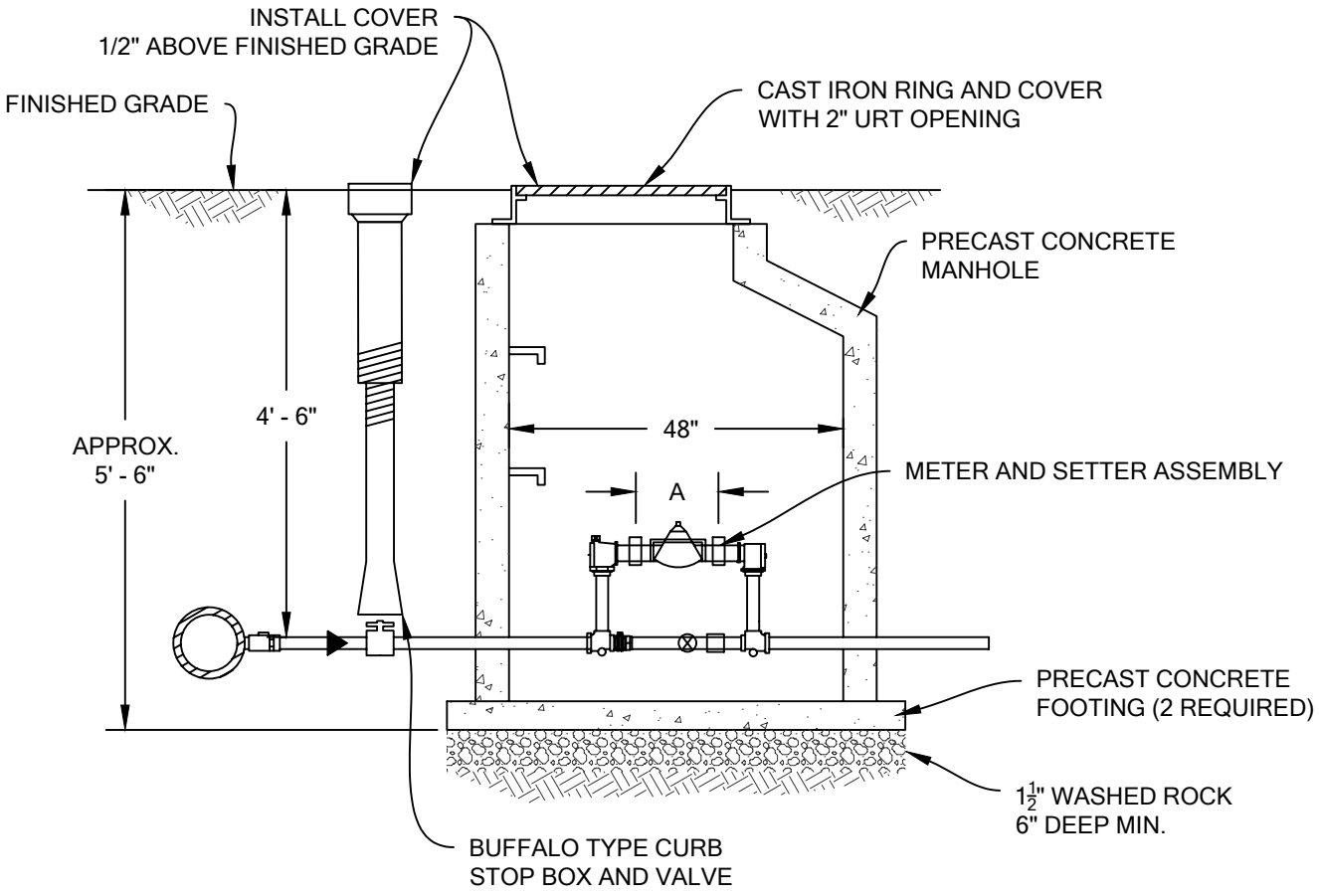
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3/4" & 1" METER PIT INSTALLATION

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METER SIZE	A
1 1/2"	13 1/4"
2"	17 1/4"

NOTES:

1. CITY WILL SUPPLY AND INSTALL METER AFTER ALL PLUMBING IS INSTALLED, TESTED AND FLUSHED.
2. CONTRACTOR TO SUPPLY AND INSTALL PRECAST CONCRETE MANHOLE (PIT), FOOTINGS, CAST IRON RING AND COVER, AND METER SETTER.
3. CONTRACTOR TO SUPPLY AND INSTALL STRUCTURAL SUPPORT FOR METER AND SETTER AS DIRECTED BY CITY.

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City *of* Louisville
COLORADO - SINCE 1882

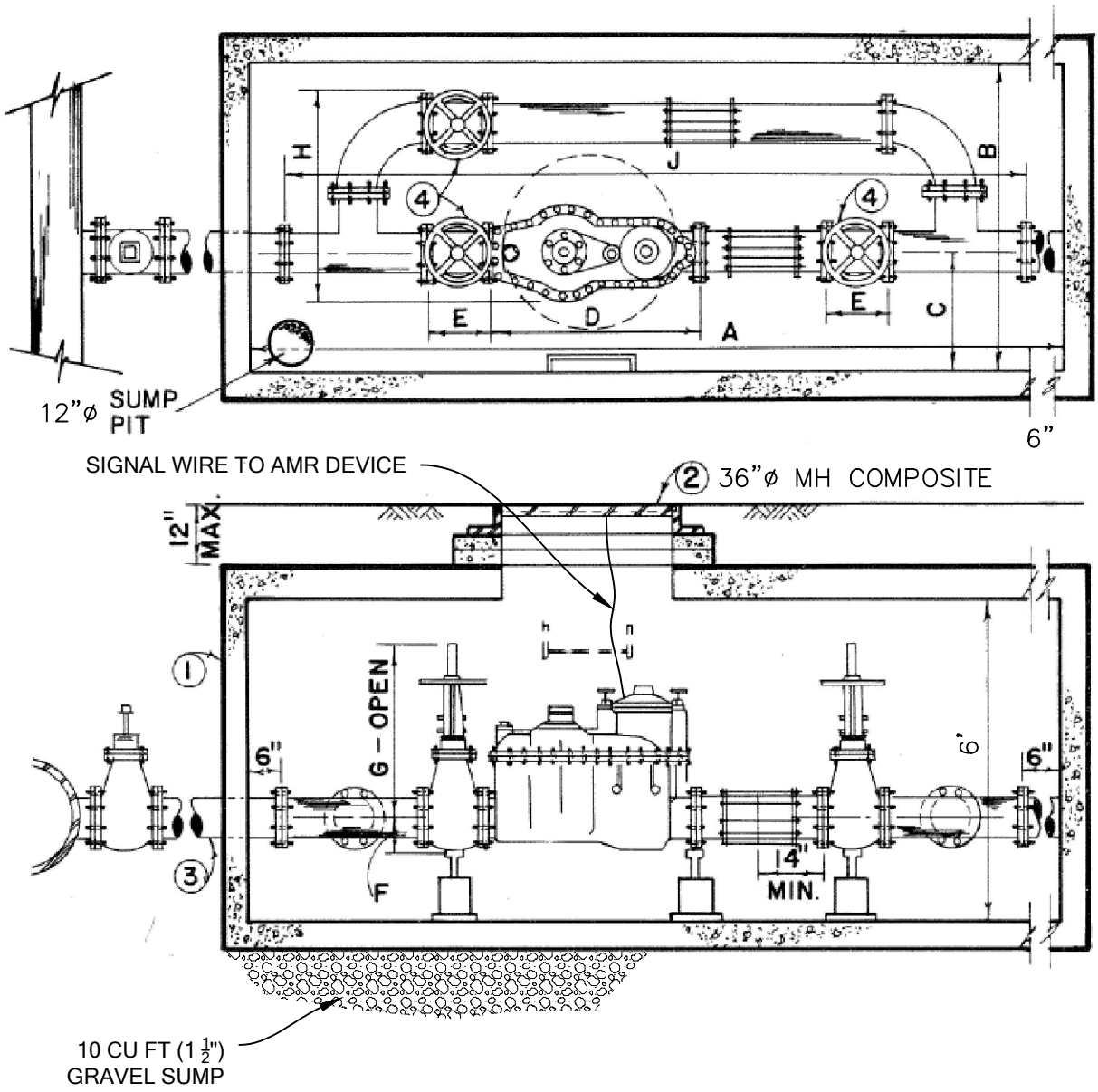
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1 1/2" & 2" METER PIT INSTALLATION

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10 CU FT (1 ½") GRAVEL SUMP

MINIMUM DIMENSIONS										
METER SIZE	COVER DIAMETER	A	B	C	D	E	F	G	H	J
3"-6"	36"	96"	84"	17"	12"	8"	4"	19 ½"	20"	81"

NOTES:

1. VAULT-WALL THICKNESS 6", FLOOR THICKNESS 6".
2. RING AND COVER-SIZE PER TABLE WITH 2" URT OPENING, WATER CAST INTO TOP. TRUMBULL OR APPROVED EQUAL.
3. SERVICE LINES SHALL BE DUCTILE IRON CONFORMING TO A.W.W.A. AND THE SAME DIAMETER AS THE METER.
4. GATE VALVES SHALL BE USED, CLASS 150 CONFORMING TO A.W.W.A. C500 FLANGE TYPE.
5. BACKFLOW PREVENTION DEVICE TO BE LOCATED INSIDE BUILDING.
6. TOP STEP TO BE 12" - 18" BELOW THE SURFACE, STEPS TO BE SPACED 12"VERTICALLY.

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City *of* Louisville
COLORADO - SINCE 1882

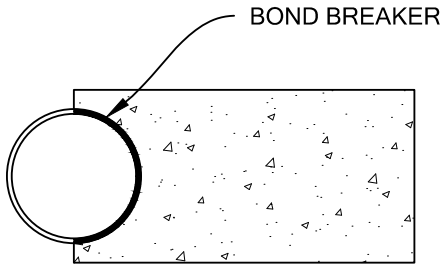
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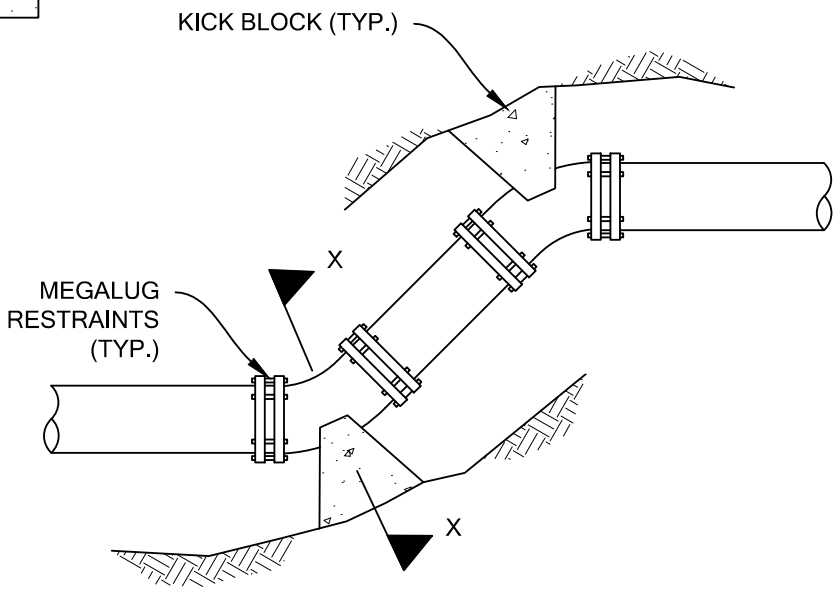
3 ,4 & 6 METER PIT INSTALLATION

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SECTION X-X



THREE PIECE
HORIZONTAL OFFSET

NOTES:
1. ALL FITTINGS SHALL BE RESTRAINED WITH MEGALUGS.
2. ALL METAL SHALL BE WRAPPED IN POLYETHYLENE.

BEARING DIMENSIONS FOR PIPE 250 P.S.I. SURGE 3000 LB/SQ FT. SOIL PRESSURE = 3K					
OUTSIDE DIAMETER	CAP, TEE, PLUG & DEAD END	BENDS			
		90°	45°	22 $\frac{1}{2}$°	11 $\frac{1}{4}$°
4" 3K	1.5	1.5	1.0	1.0	1.0
6" 3K	2.5	3.5	2.0	1.0	1.0
8" 3K	4.5	6.0	3.5	2.0	1.0
12" 3K	9.5	13.5	7.5	4.0	2.0
16" 3K	7.0	24.0	13.0	7.0	3.5
24" 3K	38.0	53.5	29.0	15.0	7.5

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COLORADO - SINCE 1882

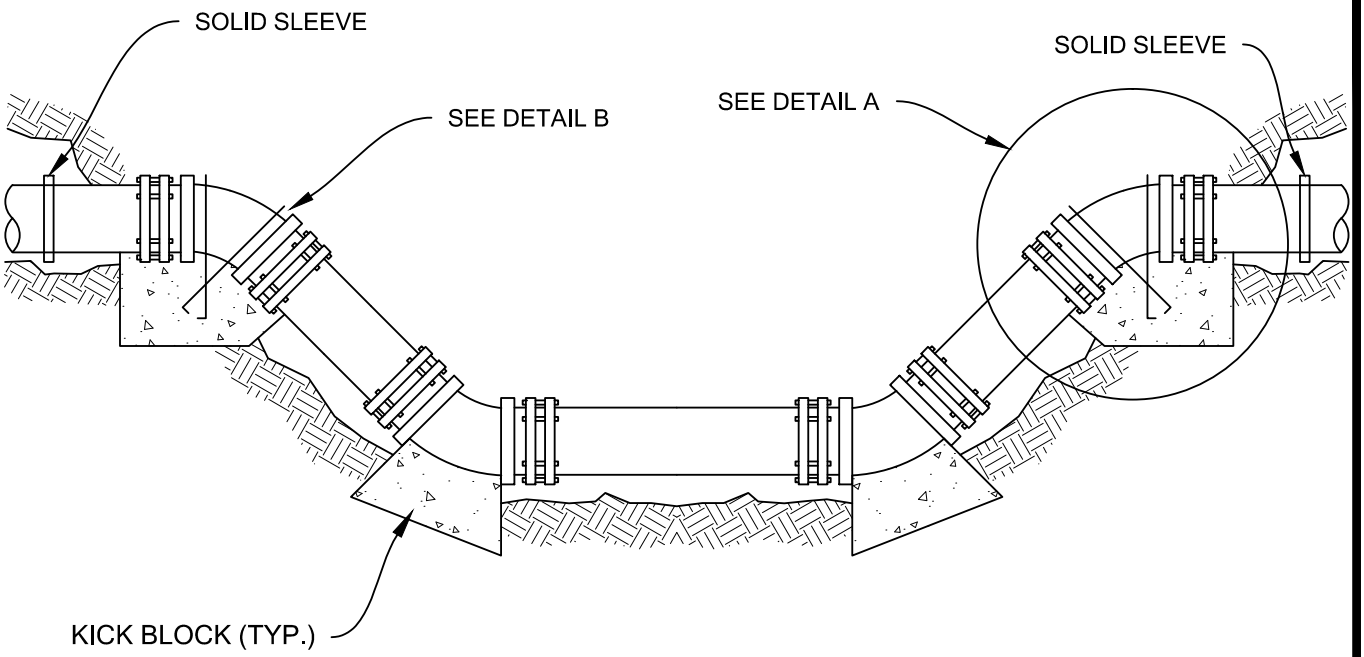
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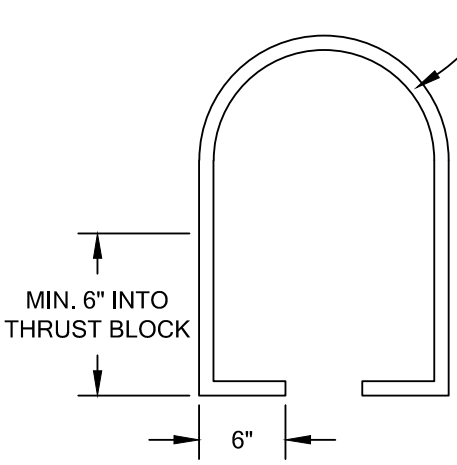
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HORIZONTAL OFFSET

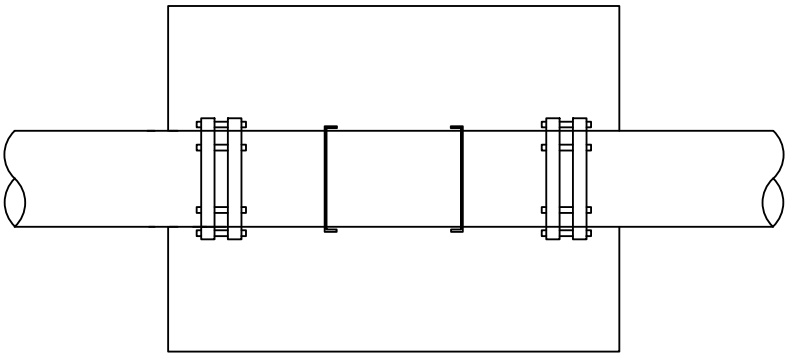
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DETAIL B



DETAIL A

NOTES:

1. M.J. ANCHORING FITTINGS SHALL BE MEGALUG.
2. ALL PIPES SHALL BE WRAPPED IN POLYETHYLENE AND TAPED.
3. 45° FITTINGS SHALL BE USED.
4. RESTRAINED JOINTS BETWEEN THE FITTINGS UPON ENGINEERS APPROVAL ONLY.

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City *of* Louisville
COLORADO - SINCE 1882

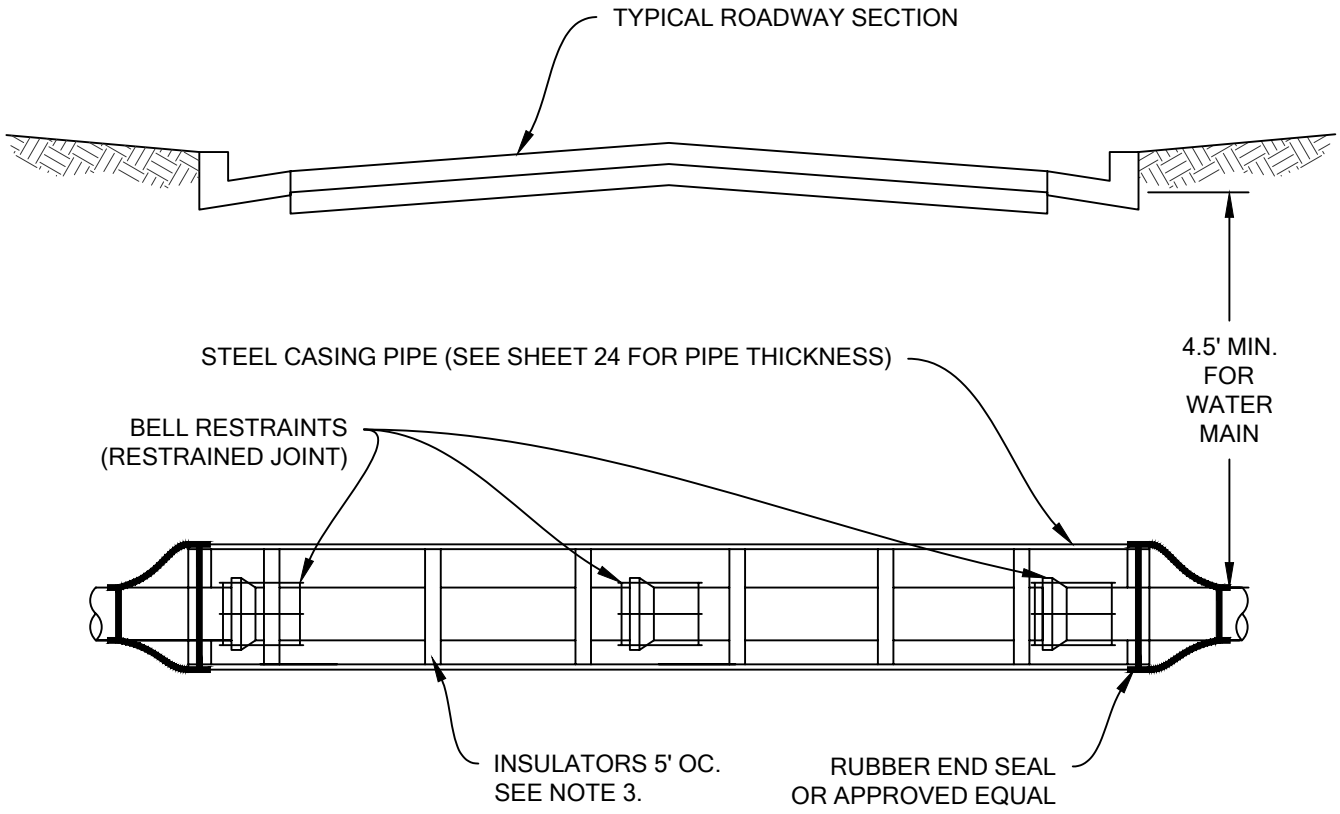
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WATERLINE LOWERING

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NOTES:

1. IF THE BORE IS NOT CONSTRUCTED TO THE PROPER GRADE, AN ADDITIONAL MANHOLE SHALL BE USED.
2. THE CASING SHALL BE SEALED WITH MODEL W END SEAL WITH STAINLESS STEEL STRAPS AS MANUFACTURED BY CALPICO INC.OR APPROVED EQUAL.
3. THE PIPE AND CASING SHALL BE INSULATED BY CASING INSULATORS, MIN. OF 5' OC. INSULATOR SHALL BE MODEL M SERIES AS MANUFACTURED BY CALPICO INC. OR APPROVED EQUAL.

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City *of* Louisville
COLORADO - SINCE 1882

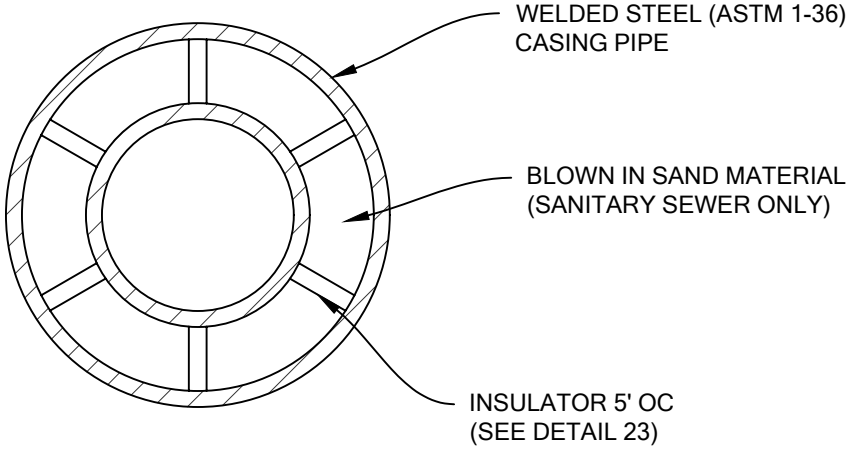
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ROADWAY BORE

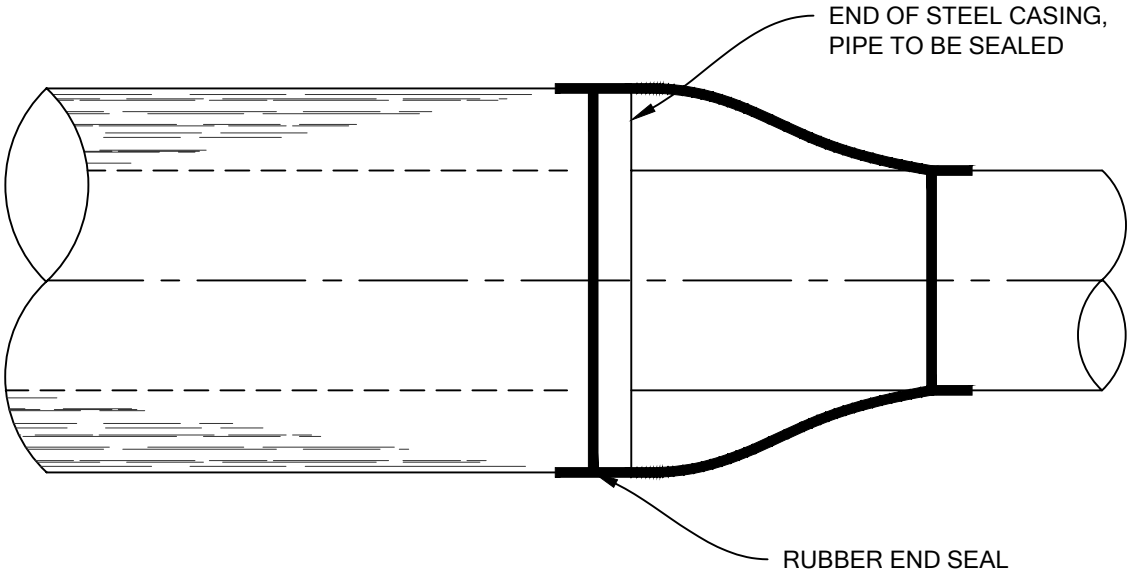
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CARRIER PIPE	CASING DIAMETER	MIN. PIPE THICKNESS
12"	22"	0.344"
16"	28"	0.406"
20"	32"	0.469"

TYPICAL SECTION



SIDE ELEVATION

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City *of* Louisville
COLORADO - SINCE 1882

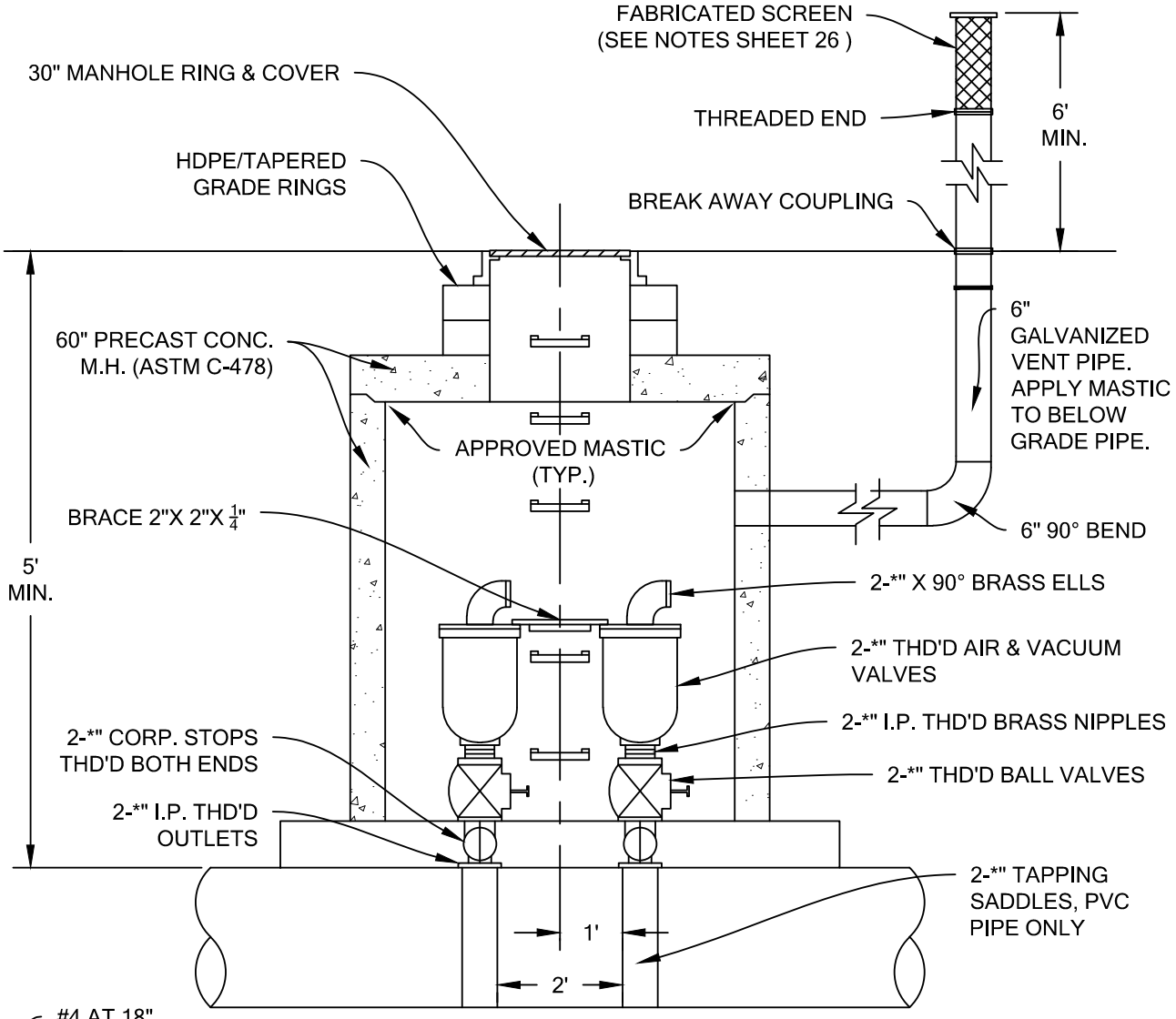
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CARRIER & CASING PIPE

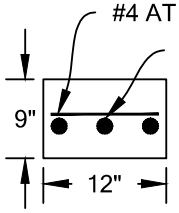
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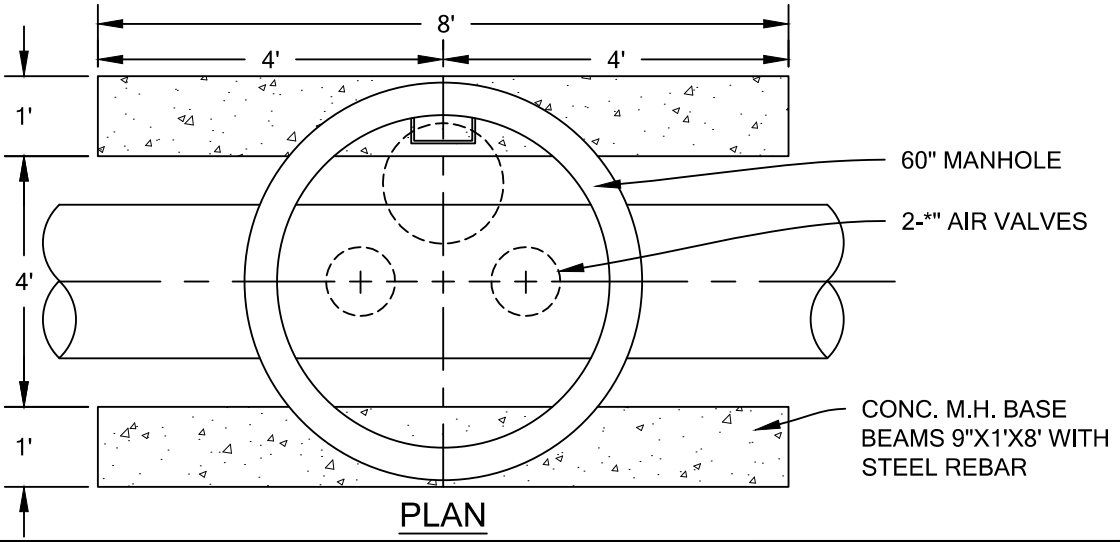


ELEVATION

* SIZE AS REQUIRED



FOOTING
DETAIL



PLAN

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City *of* Louisville
COLORADO - SINCE 1882

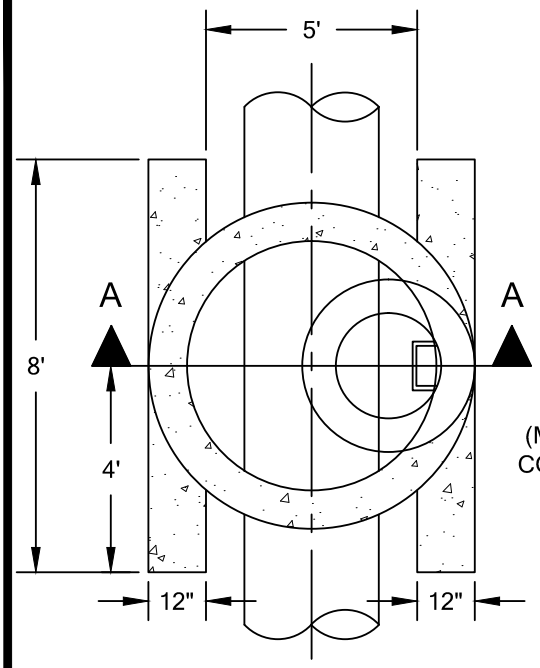
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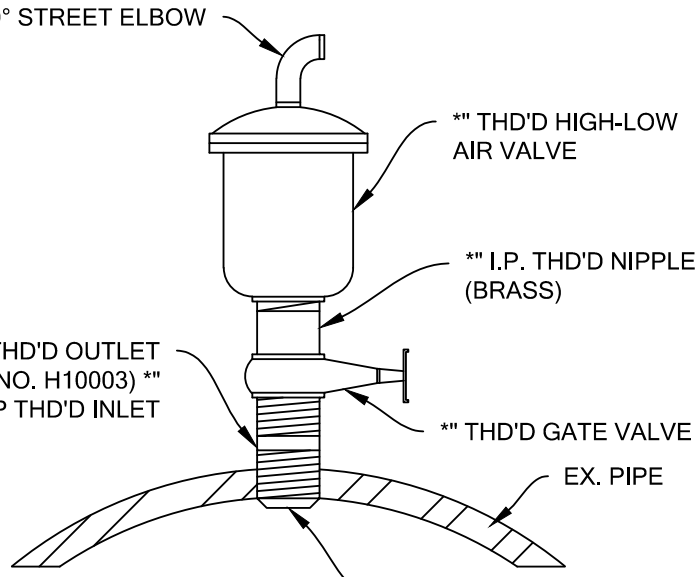
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AIR & VACUUM VALVE INSTALLATION

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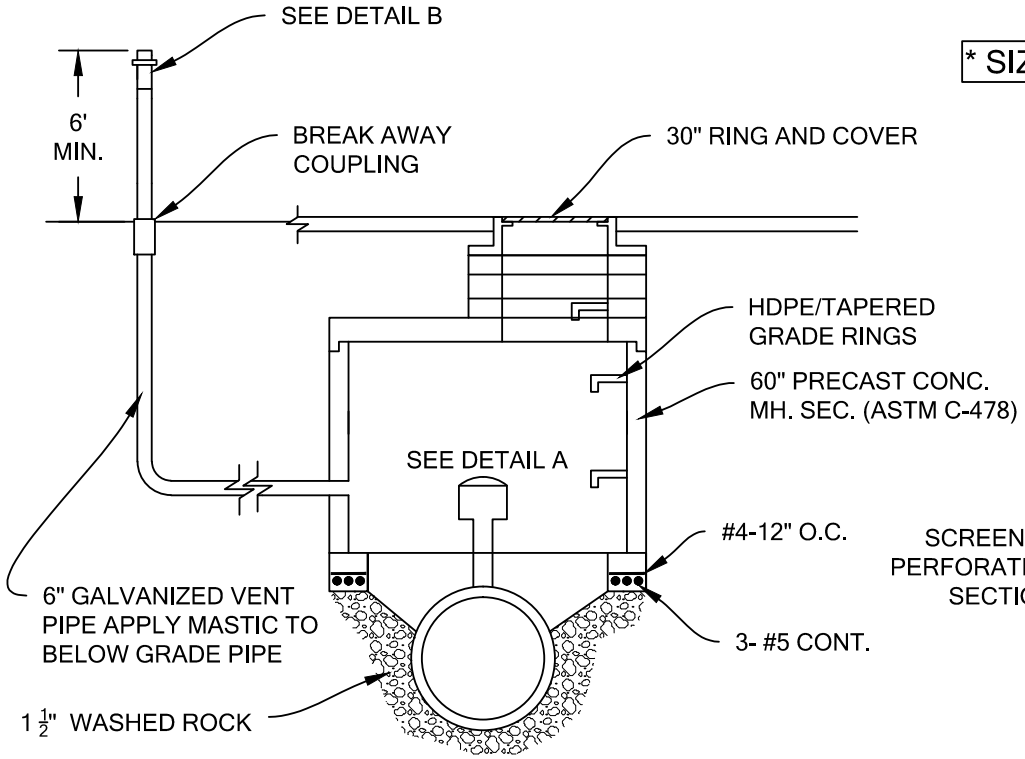
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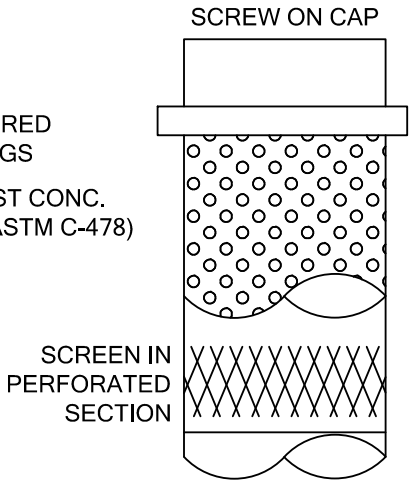


DETAIL A

* SIZE AS REQUIRED



SECTION A-A



DETAIL B

NOTES:

1. THE UPPER 2' SHALL BE PERFORATED AND PAINTED SILVER.
2. THE LOWER 4' SHALL BE YELLOW.

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City *of* Louisville
COLORADO - SINCE 1882

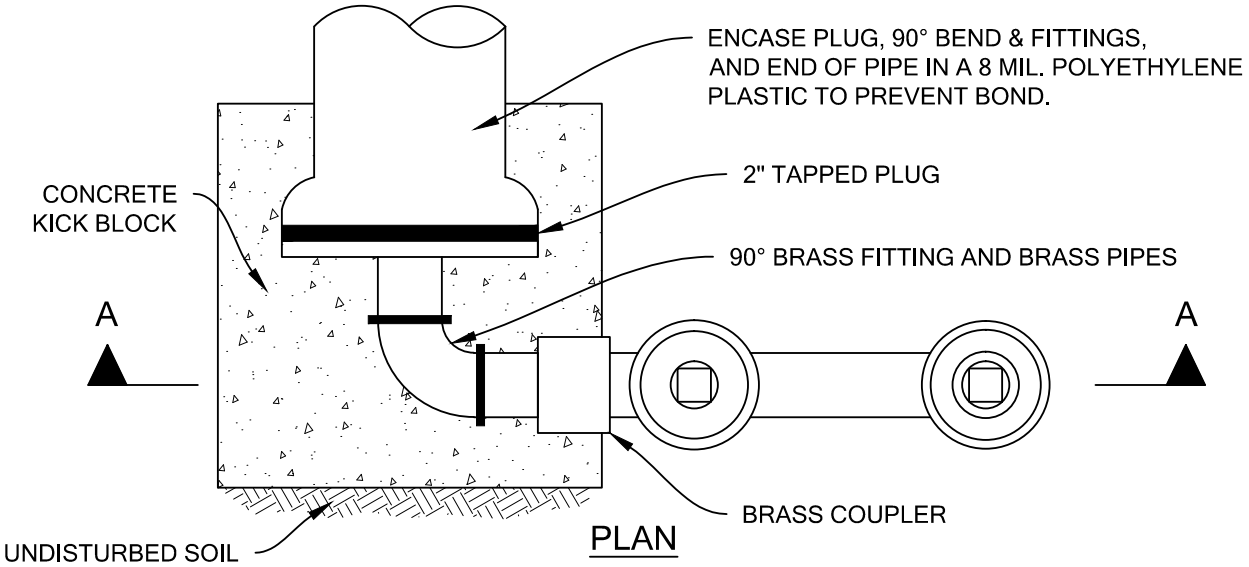
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AIR RELEASE VALVE

SHEET
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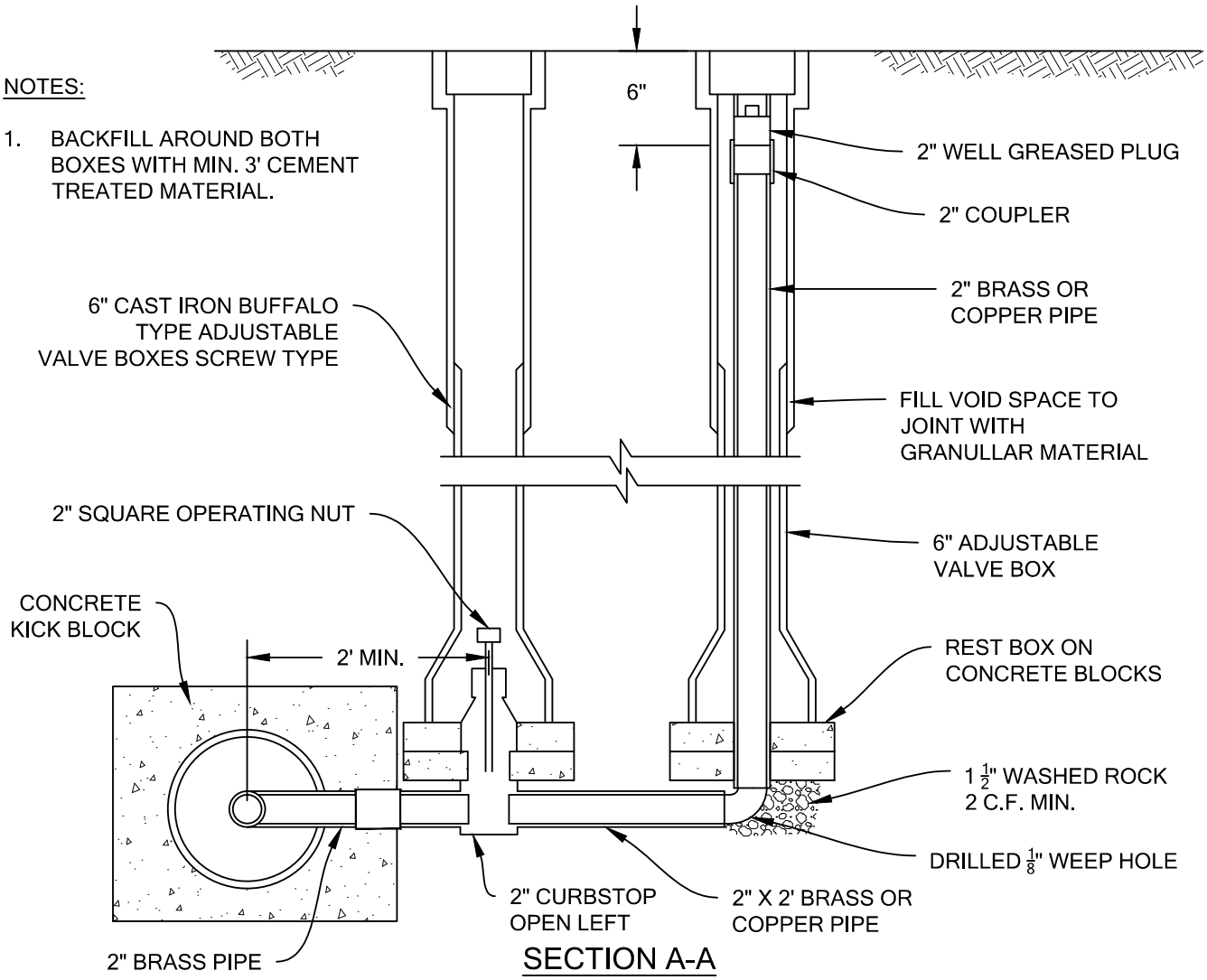
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PLAN

NOTES:

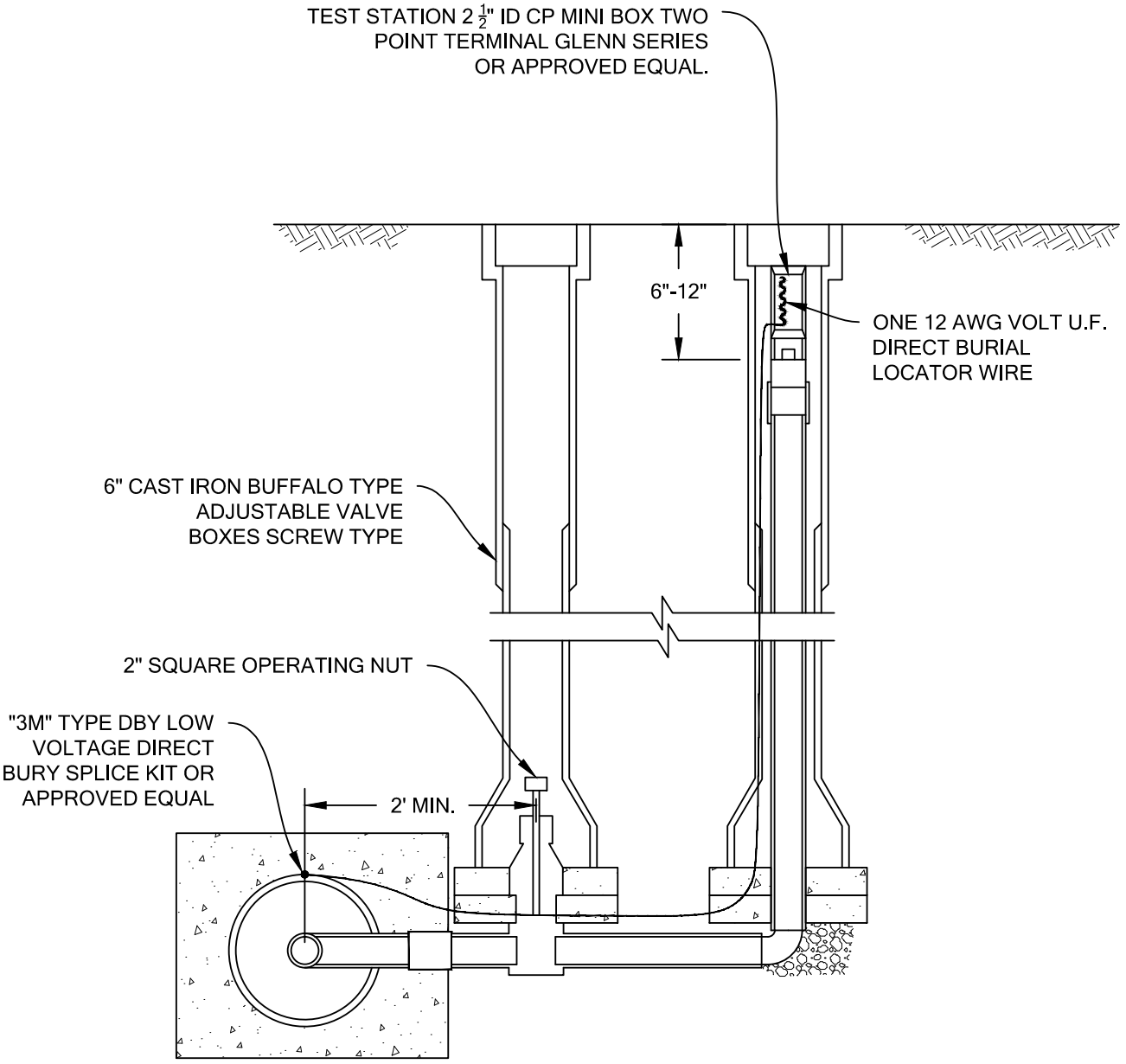
1. BACKFILL AROUND BOTH BOXES WITH MIN. 3' CEMENT TREATED MATERIAL.



SECTION A-A

REVISIONS		City *of* Louisville COLORADO - SINCE 1882	DEPARTMENT OF PUBLIC WORKS	DRAWN BY: ML JAN 94 APPROVED BY: CMD MAR 15
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			BLOW OFF VALVE	27 OF 74

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City *of* Louisville
COLORADO - SINCE 1882

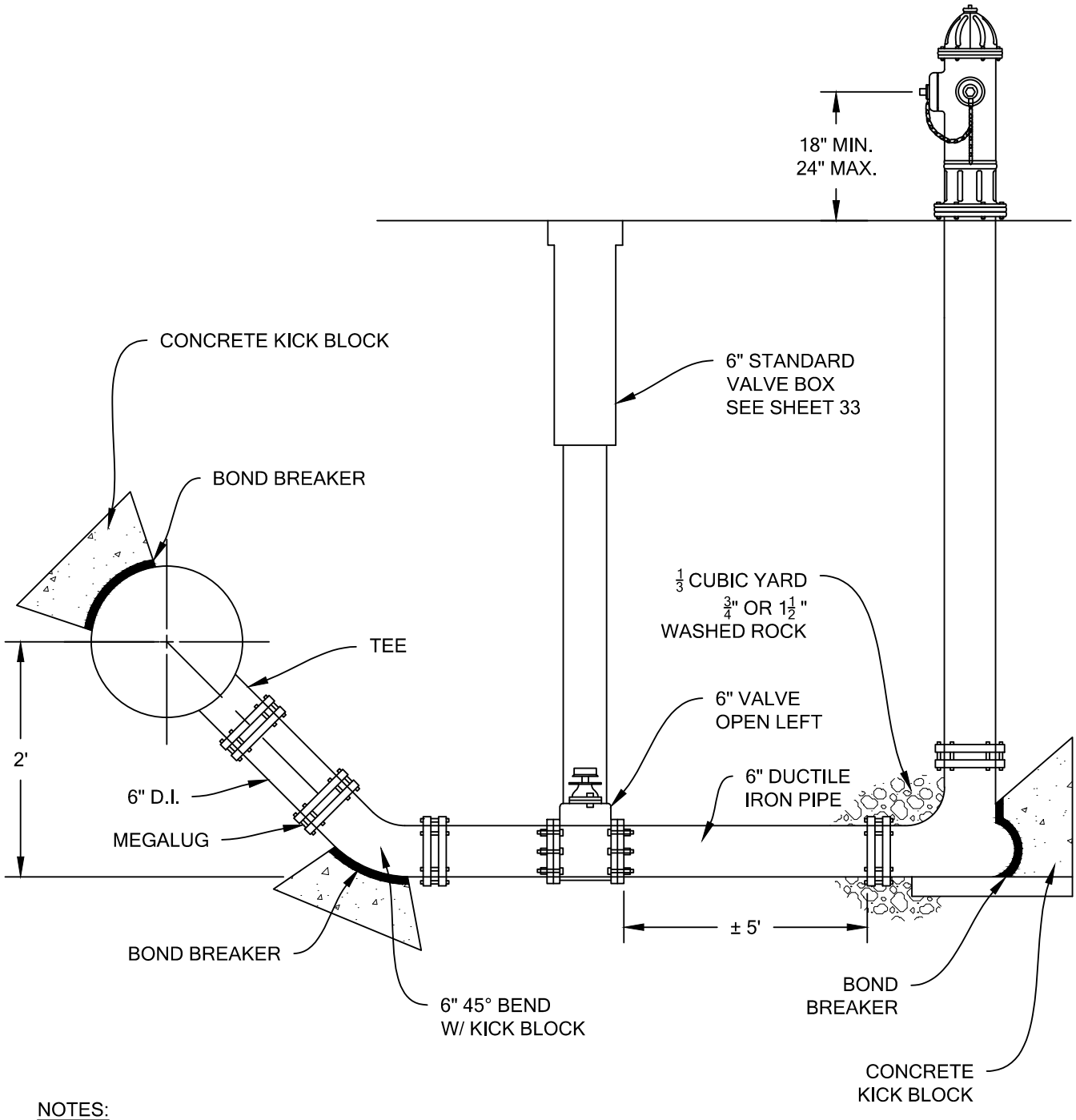
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PVC WATER MAIN LOCATOR WIRE & TEST STATION AT BLOWOFF

SHEET
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G:\STANDARDS DETAILS\DETAILS\WATER\28 PVC WATER MAIN LOCATOR WIRE & TEST STATION AT BLOWOFF.DWG



NOTES:

1. ALL FITTINGS SHALL BE RESTRAINED WITH MEGALUGS.

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City *of* Louisville
COLORADO - SINCE 1882

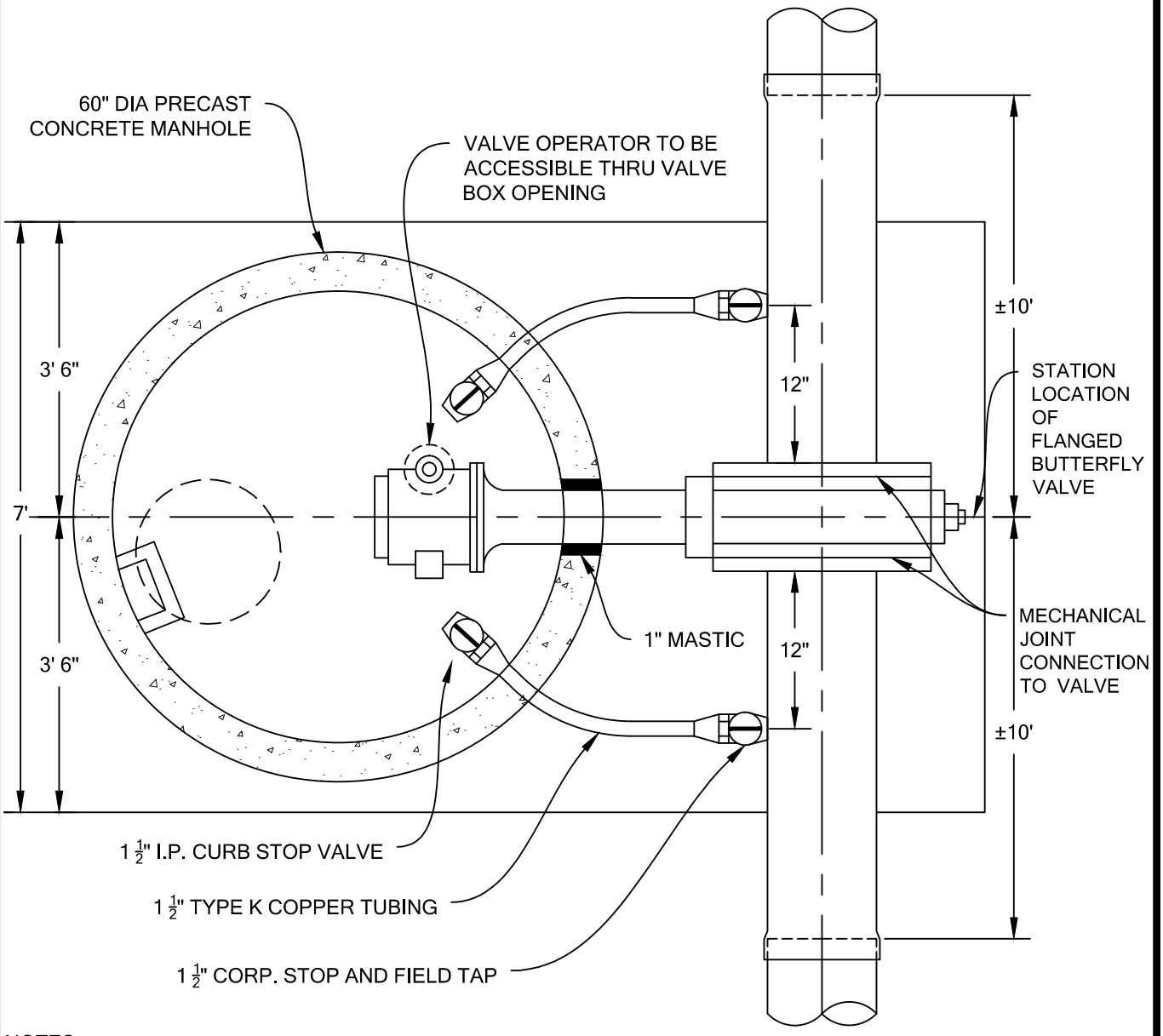
DEPARTMENT OF PUBLIC WORKS

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APPROVED BY: CMD MAR 15

LARGE DIAMETER WATER MAIN BLOW OFF

SHEET
29 OF 74

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NOTES:

1. MANHOLE STEP SPACING SHALL BE 12"- 18" OC.
2. HDPE GRADE RINGS SHALL BE USED FOR GRADE ADJUSTMENT.
3. STEPS SHALL BE VERTICALLY PLUMB ± 1" AND SHALL HAVE EQUAL SPACING.
4. FLEXIBLE SEALING COMPOUND SHALL BE RAMNECK OR APPROVED EQUAL.
5. MANHOLE STEPS SHALL BE NO MORE THAN 24" NOR LESS THAN 18" FROM THE TOP OF THE MANHOLE RING OR FROM THE CONCRETE PAD OF THE MANHOLE.

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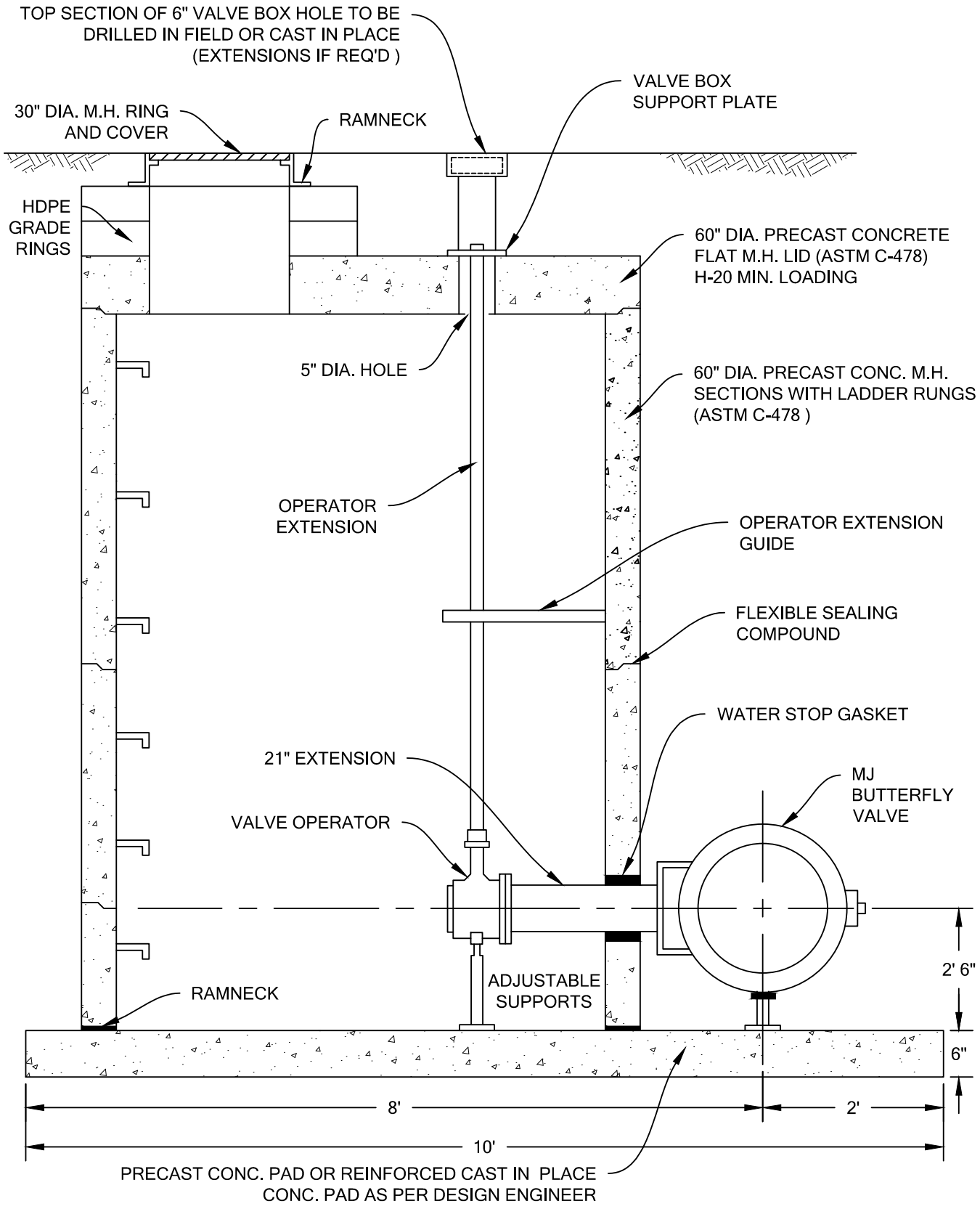
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30" AND LARGER VALVE VAULT PLAN

SHEET
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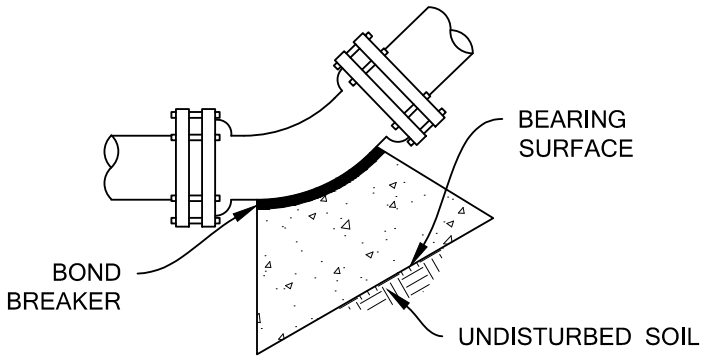
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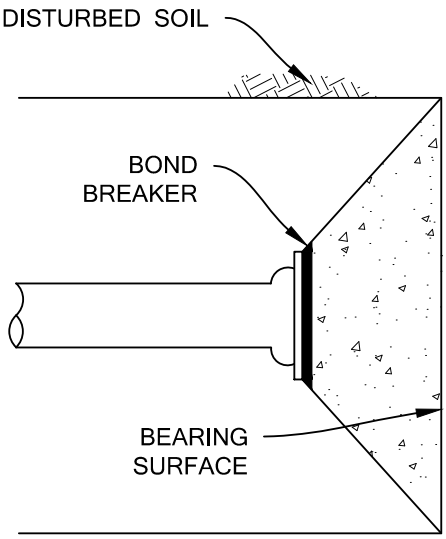
30" AND LARGER VALVE VAULT SECTION

SHEET
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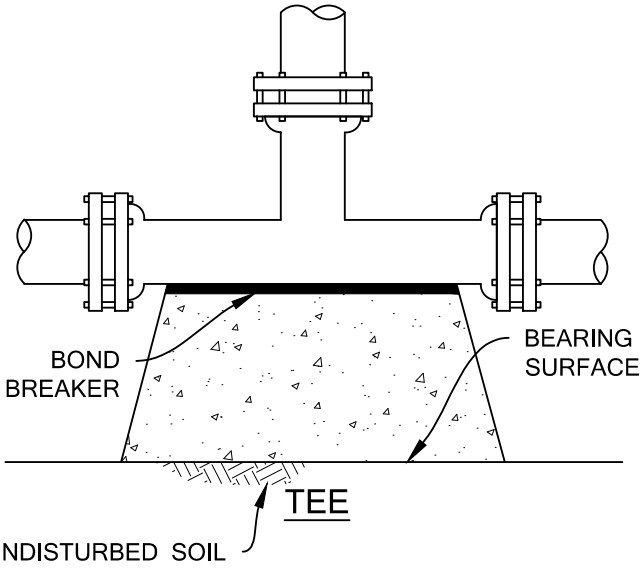
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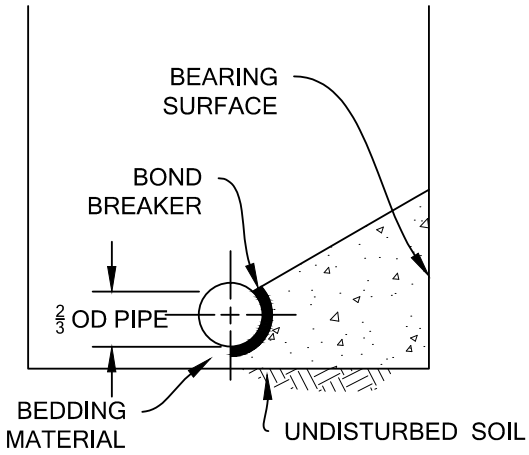
45° AND 90° BENDS



END PLUG



TEE



TYPICAL CROSS SECTION

NOTES:

1. ALL FITTINGS SHALL BE MEGALUG.
2. BEARING SURFACES SHOWN IN CHART ARE MINIMUM.
3. 6 SACK CONCRETE SHALL BE REQUIRED.
4. ALL DUCTILE & CAST IRON SHALL BE WRAPPED IN POLYETHYLENE.

BEARING DIMENSIONS FOR PIPE 250 P.S.I. SURGE 3000 LB/SQ FT. SOIL PRESSURE = 3K					
OUTSIDE DIAMETER	CAP, TEE, PLUG & DEAD END	BENDS			
		90°	45°	22 1/2°	11 1/4°
4" 3K	1.5	1.5	1.0	1.0	1.0
6" 3K	2.5	3.5	2.0	1.0	1.0
8" 3K	4.5	6.0	3.5	2.0	1.0
12" 3K	9.5	13.5	7.5	4.0	2.0
16" 3K	7.0	24.0	13.0	7.0	3.5
24" 3K	38.0	53.5	29.0	15.0	7.5

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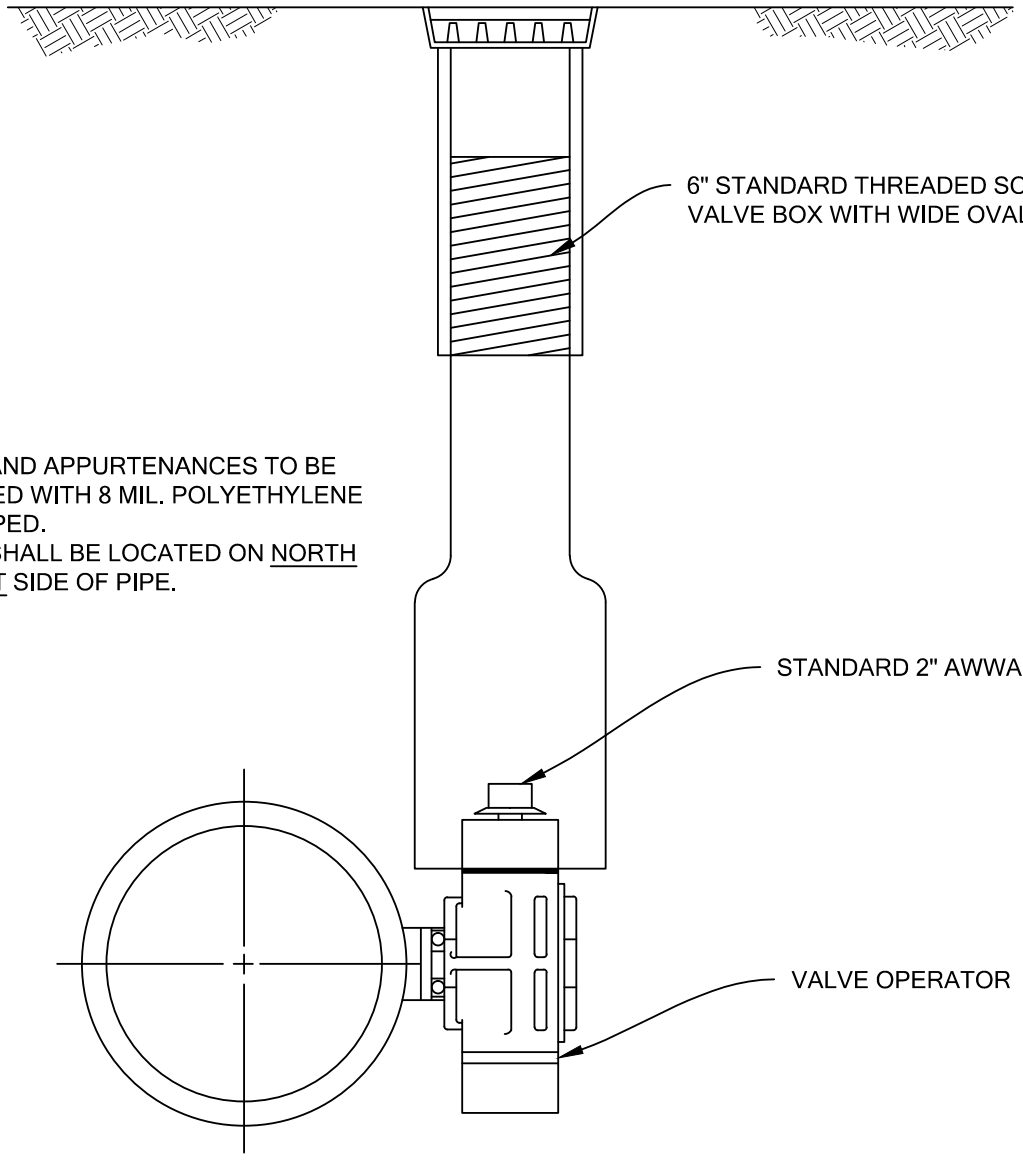
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CONCRETE KICKBLOCK

SHEET
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NOTES:

1. VALVE AND APPURTENANCES TO BE WRAPPED WITH 8 MIL. POLYETHYLENE AND TAPED.
2. VALVE SHALL BE LOCATED ON NORTH OR EAST SIDE OF PIPE.

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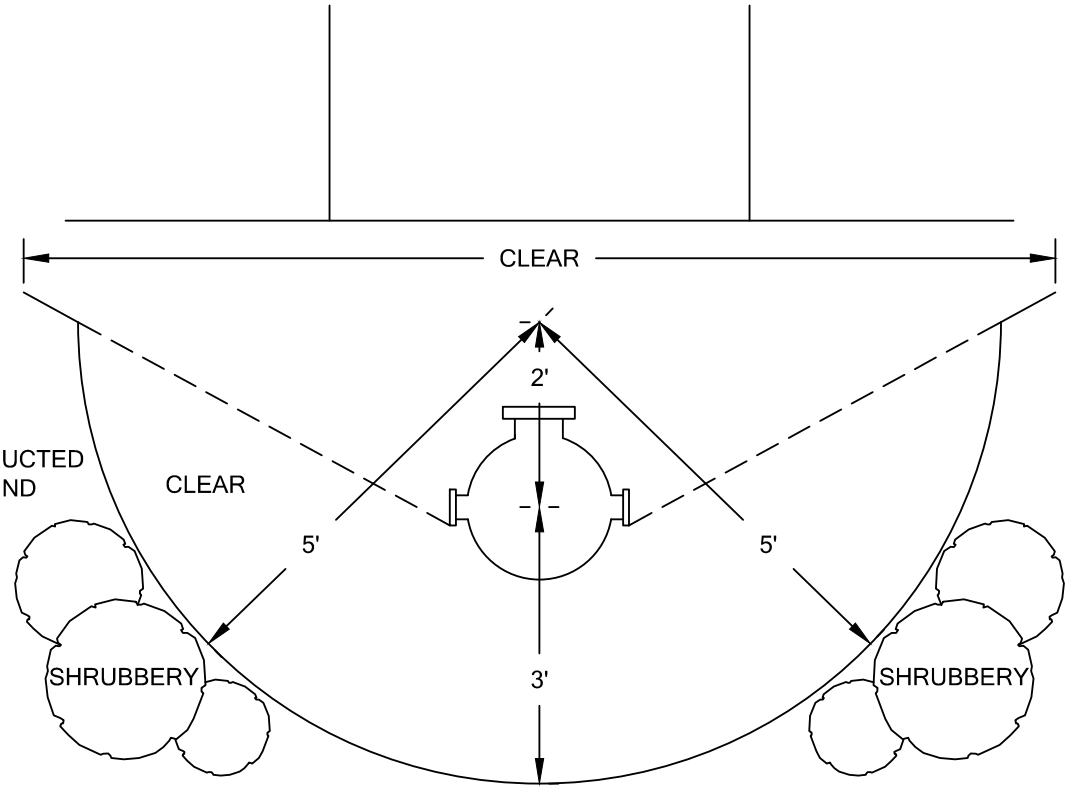
BUTTERFLY VALVE

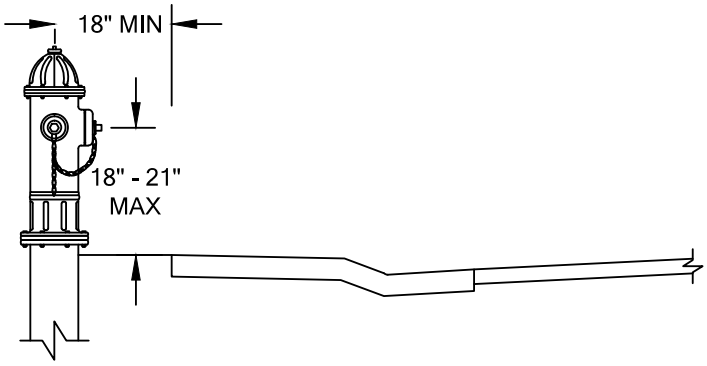
SHEET
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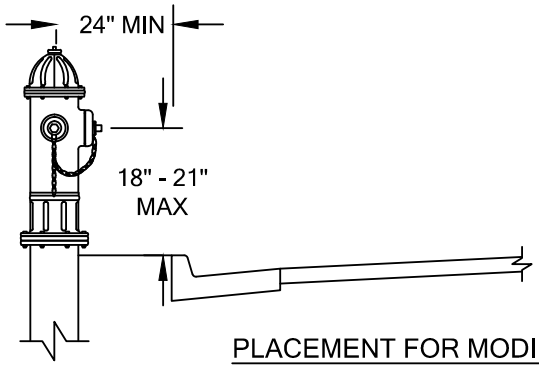
NOTES:

5' UNOBSTRUCTED AREA AROUND HYDRANT





PLACEMENT FOR CURBWALK AND SIDEWALK



PLACEMENT FOR MODIFIED CURB & VERTICAL CURB AND GUTTER

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FIRE HYDRANT PLACEMENT

SHEET
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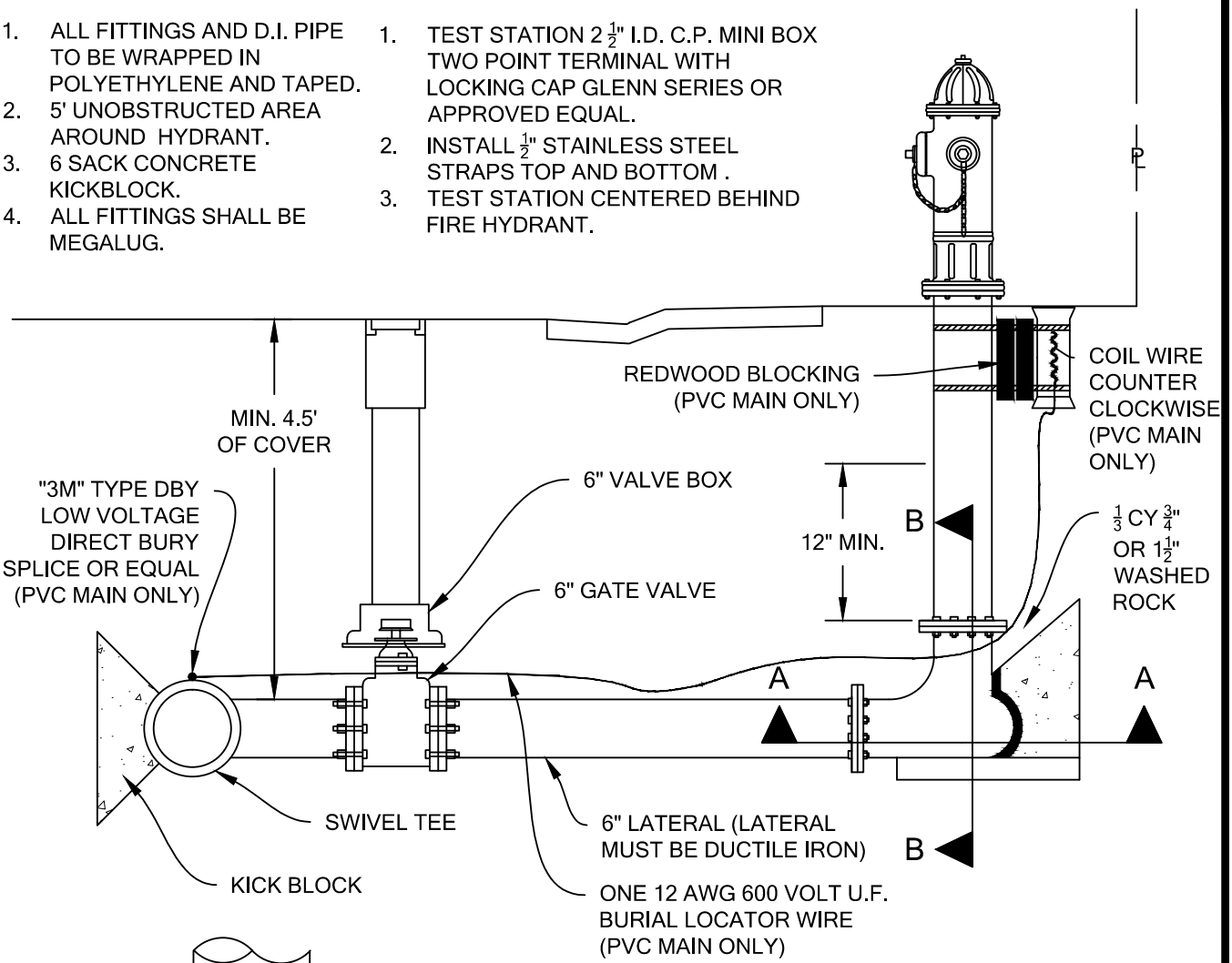
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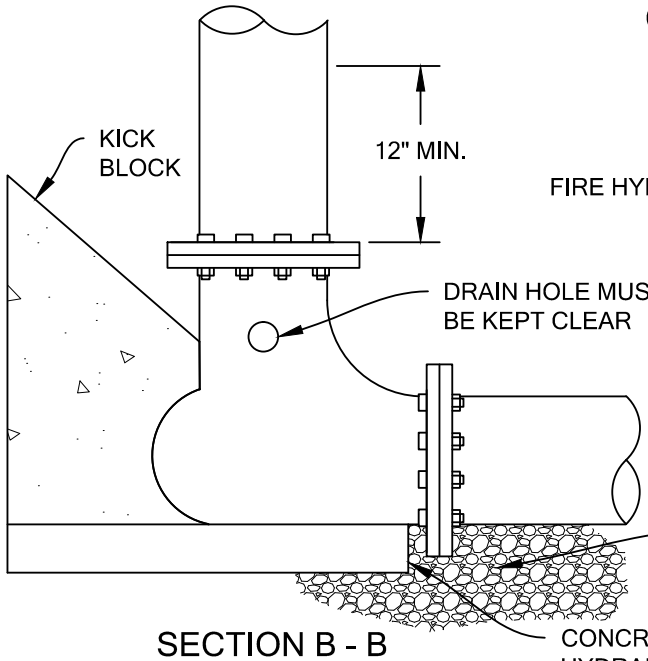
HYDRANT NOTES:

1. ALL FITTINGS AND D.I. PIPE TO BE WRAPPED IN POLYETHYLENE AND TAPED.
2. 5' UNOBSTRUCTED AREA AROUND HYDRANT.
3. 6 SACK CONCRETE KICKBLOCK.
4. ALL FITTINGS SHALL BE MEGALUG.

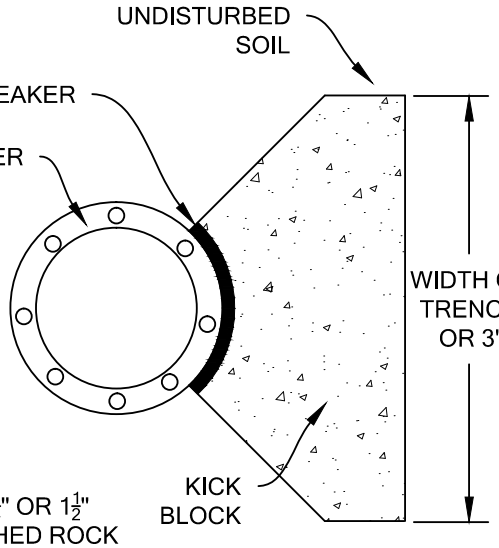
TEST STATION NOTES (PVC MAIN ONLY):

1. TEST STATION 2 $\frac{1}{2}$" I.D. C.P. MINI BOX TWO POINT TERMINAL WITH LOCKING CAP GLENN SERIES OR APPROVED EQUAL.
2. INSTALL $\frac{1}{2}$" STAINLESS STEEL STRAPS TOP AND BOTTOM .
3. TEST STATION CENTERED BEHIND FIRE HYDRANT.





SECTION B - B



SECTION A - A

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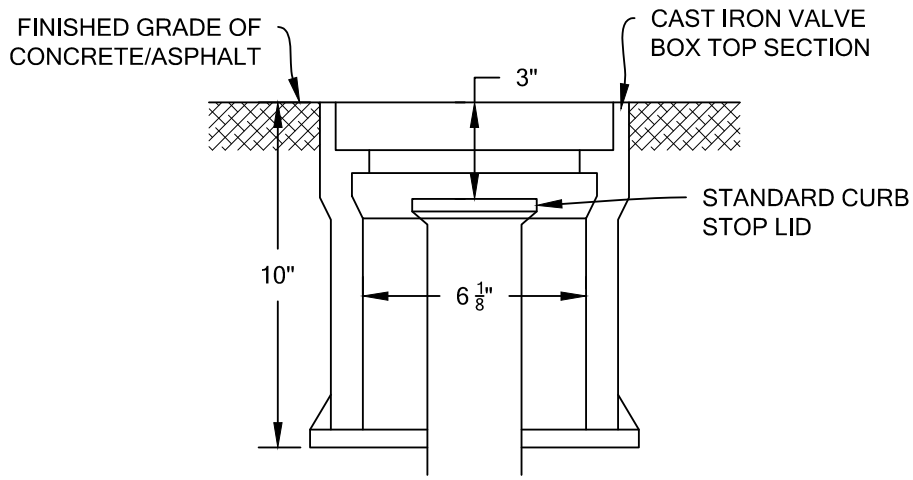
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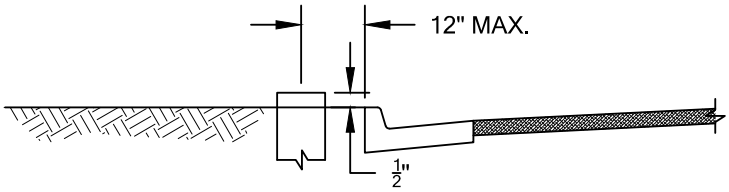
FIRE HYDRANT INSTALLATION

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CURB STOP BOX IN PAVEMENT



PLACEMENT FOR MODIFIED CURB & VERTICAL CURB AND GUTTER

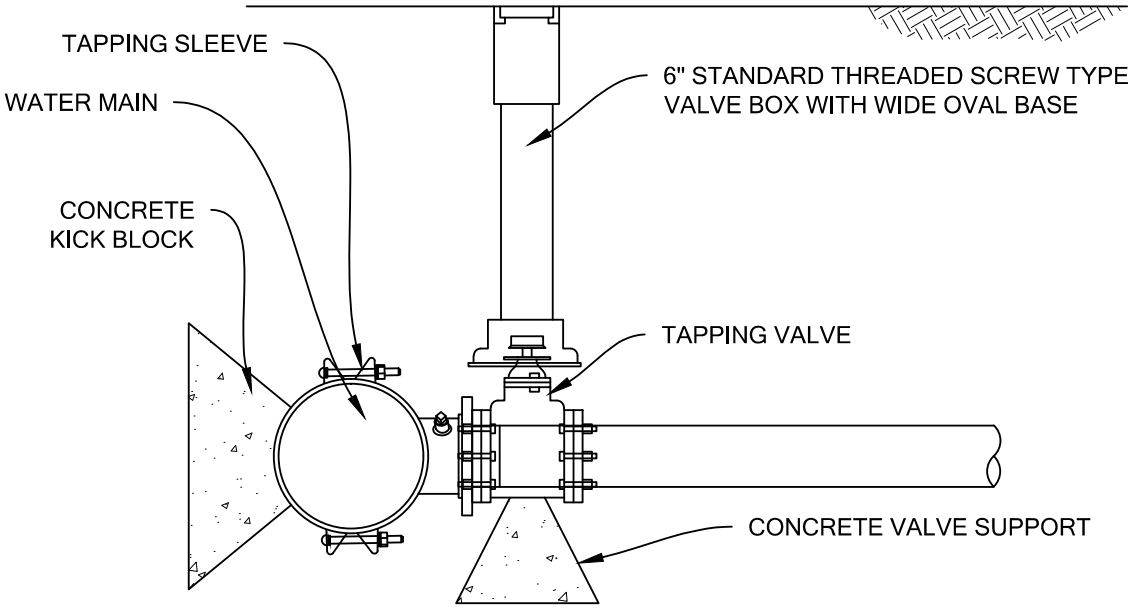
PLACEMENT FOR CURBWALK AND SIDEWALK

NOTES:

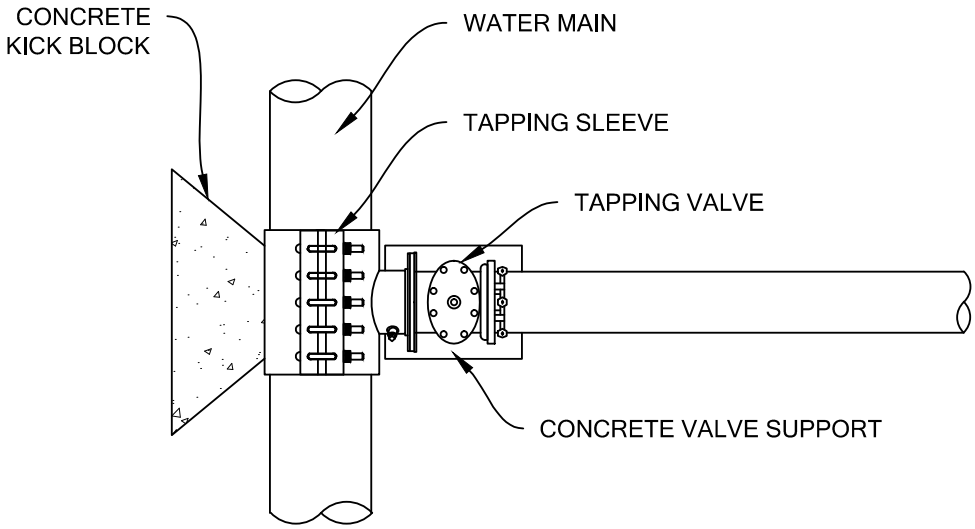
1. ANY DEFICIENCY IN CURB STOP INSTALLATION SHALL BE CORRECTED PRIOR TO WATER METER INSTALLATION.

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		CURB STOP INSTALLATION		36 OF 74

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SECTION



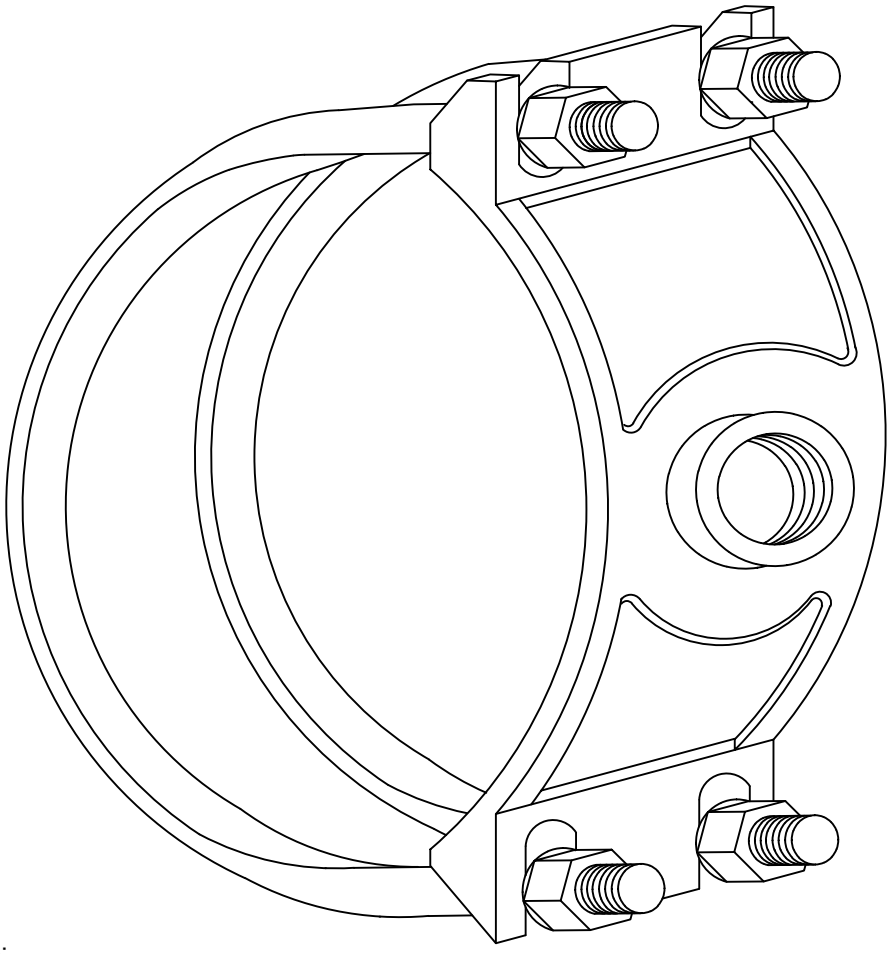
PLAN

NOTES:

1. THIS DETAIL SHALL BE USED FOR ALL WATERLINE 14" AND LARGER. FOR ALL 12" AND SMALLER WATERLINES, A STANDARD DUCTILE IRON TAPPING SADDLE SHALL BE USED.
2. ALL BOLTS SHALL BE STAINLESS STEEL.
3. ALL TAPPING SLEEVES SHALL BE CONSTRUCTED OF STAINLESS STEEL THAT MEETS OR EXCEEDS ASTM A240 TYPE 304 UNS DESIGNATED S30400.
4. TAPPING SLEEVES SHALL BE “ROMAC INDUSTRIES” SST III, “MUELLER” H-304MJ, “MUELLER” H-304SS OR APPROVED EQUIVALENT.
5. SLEEVE AND VALVE SHALL BE WRAPPED IN 8 MILL POLYETHYLENE AND TAPED.

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		LARGE DIAMETER TAPPING SLEEVE		37 OF 74

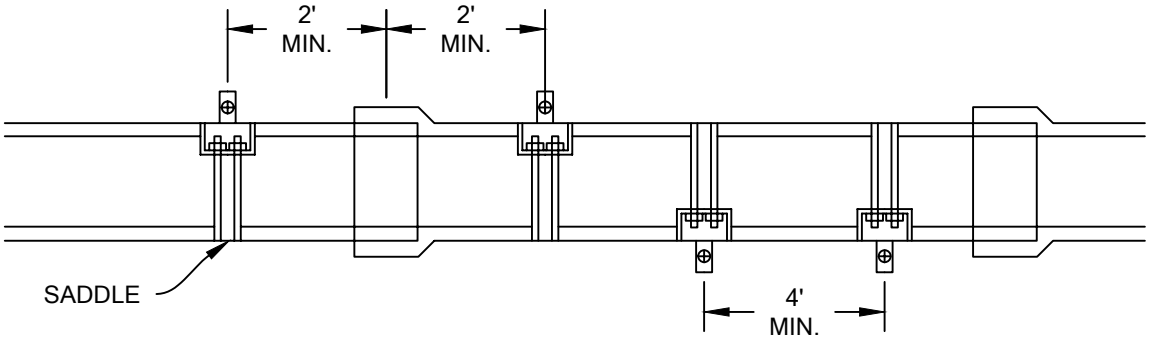
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NOTES:

1. ONLY SOLID BRASS DOUBLE STRAP TAPPING SADDLES WITH AN "O" RING SEAL ARE APPROVED FOR PVC WATER MAINS. NO DIRECT TAPS SHALL BE MADE.
2. DOUBLE BRASS TAPPING SADDLES SHALL BE PROVIDED AND INSTALLED BY THE CONTRACTOR.
3. CONTRACTOR SHALL TAP ALL PVC WATER MAIN CONNECTIONS

BRASS TAPPING SADDLE



PVC WATER TAP SPACING

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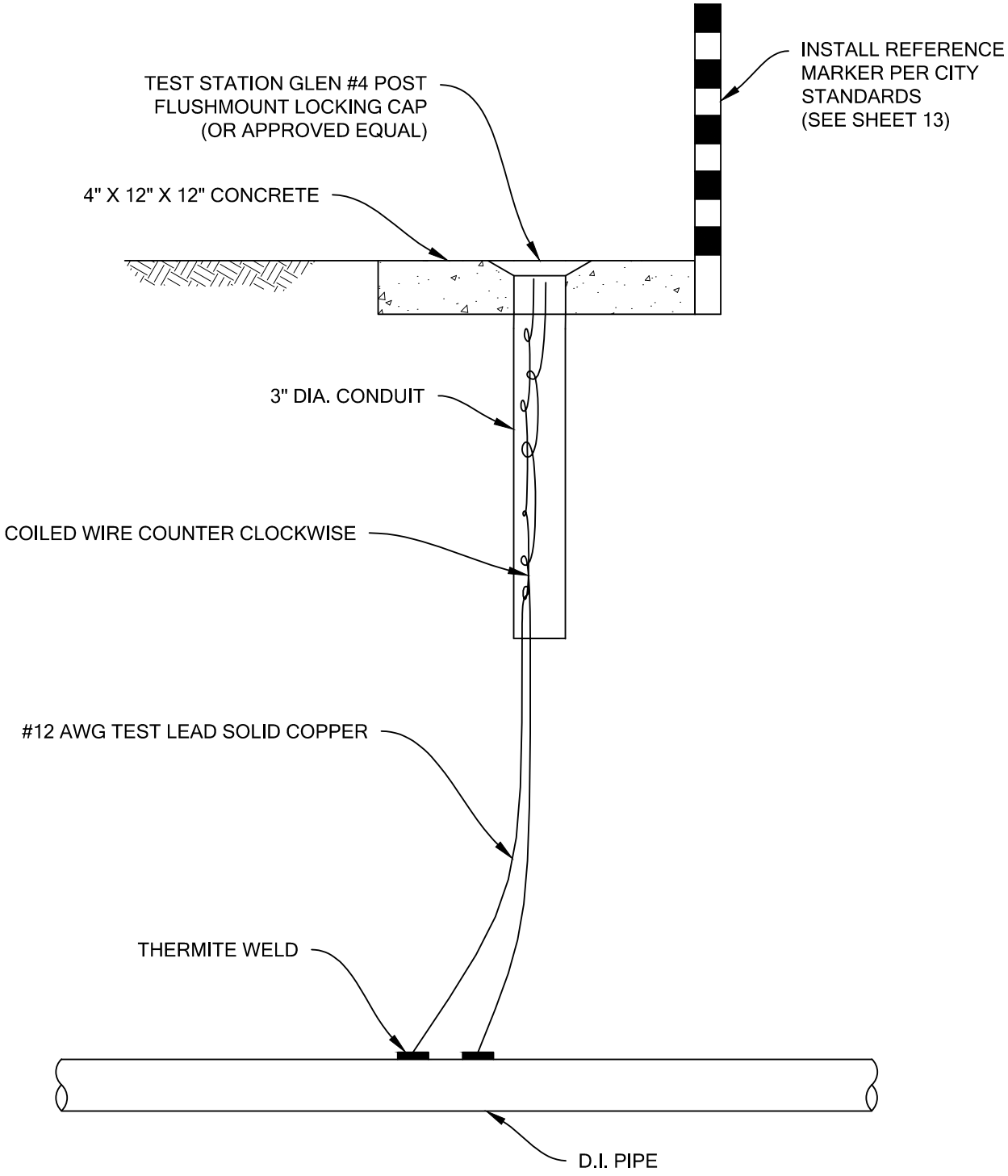
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PVC MAIN TAPPING

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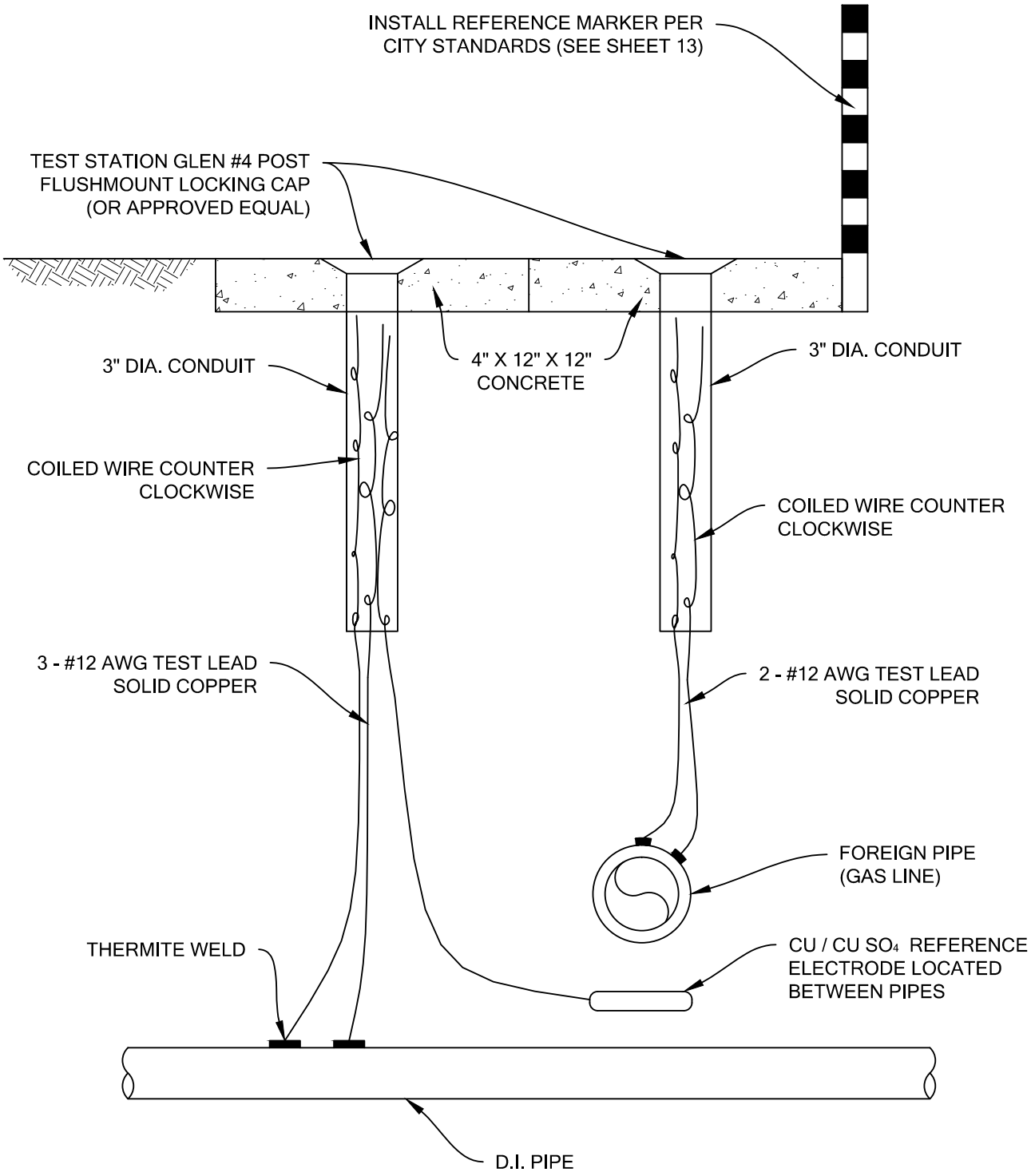
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TEST STATION - 1

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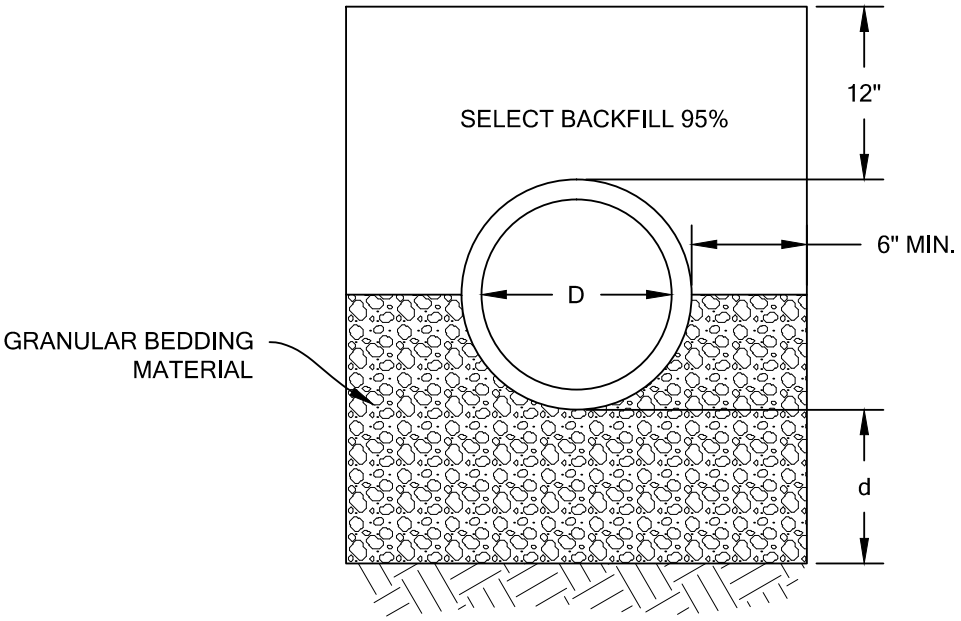
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TEST STATION - 2

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STORM SEWER GRANULAR BEDDING SECTION

NOTES:

1. DEPTH OF BEDDING BELOW PIPE:

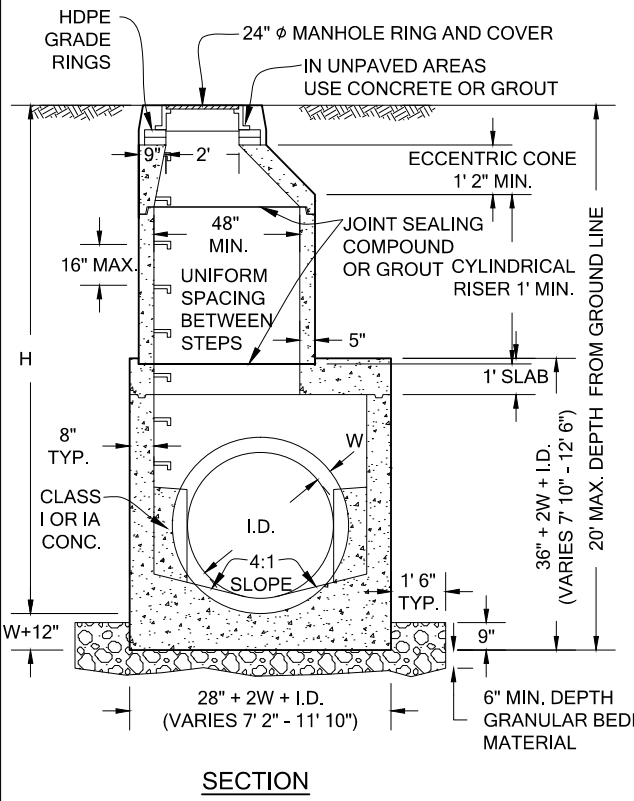
D	d(MIN.)
27" & SMALLER	3"
30" - 60"	4"
66" & LARGER	6"

2. GRANULAR BEDDING SHALL BE PLACED FROM THE TRENCH BOTTOM TO THE HORIZONTAL CENTERLINE OF THE PIPE.
3. SELECT BACKFILL FROM THE CENTERLINE TO 12" ABOVE THE PIPE SHALL BE PLACED IN 6" LIFTS AND HAND COMPACTED TO 95%.

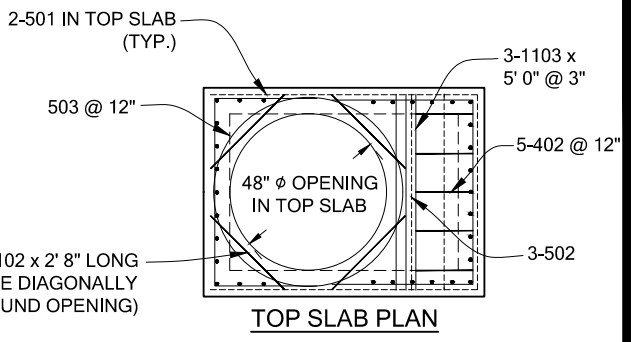
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MAR 2015	CMD		TYPICAL STORM SEWER TRENCH	41 OF 74

G:\STANDARDS DETAILS\DETAILS\STORM\41 TYPICAL STORM SEWER TRENCH.DWG

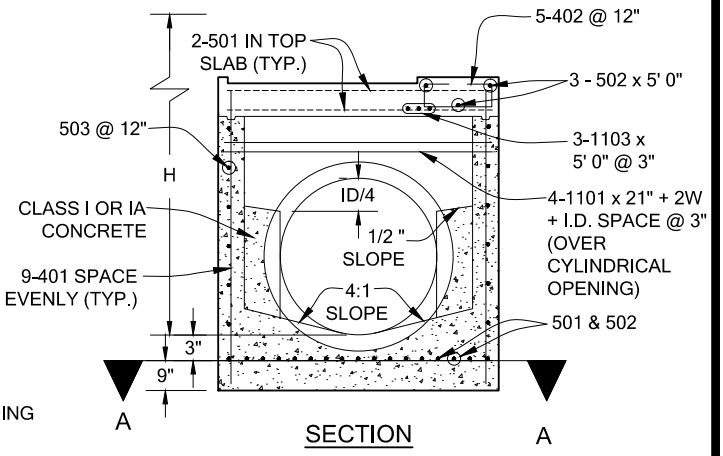
NOTE: BOX BASE MANHOLES SHALL BE USED FOR PIPES LARGER THAN 36" (I.D.)



SECTION



TOP SLAB PLAN



SECTION

MANHOLE BOX BASE

QUANTITIES FOR CONCRETE MANHOLE BOX BASE

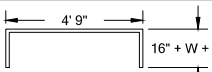
MARK	SIZE	TYPE	WT. #/FT.	BARS	I.D. 54"	60"	66"	72"	84"	96"	FORMULAS
401	4	I	0.668	NO. REQ'D.	18	18	18	18	18	18	401 BAR LENGTH = 32"+2W+I.D.
				LENGTH	8'-1"	8'-8"	9'-3"	9'-10"	11'-0"	12'-2"	
				WEIGHT #	97.2	104.2	111.2	118.2	132.3	146.3	
402	4	III	0.668	NO. REQ'D.	5	5	5	5	5	5	402 BAR LENGTH = I.D. + 2W
				LENGTH	5'-5"	6'-0"	6'-7"	7'-2"	8'-4"	9'-6"	
				WEIGHT #	18.1	20.0	22.0	23.9	27.8	31.7	
501	5	I	1.043	NO. REQ'D.	17	17	17	17	17	17	501 BAR LENGTH = 24" + I.D. + 2W
				LENGTH	7'-5"	8'-0"	8'-7"	9'-2"	10'-4"	11'-6"	
				WEIGHT #	131.5	141.8	152.2	162.5	183.2	203.9	
502	5	I	1.043	NO. REQ'D.	22	23	25	26	29	32	502 NUMBER BARS REQ'D. = $3+\left(\frac{24+I.D.+2W}{@\ 5"}+1\right)$
				LENGTH	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	
				WEIGHT #	114.7	119.9	130.4	135.6	151.2	166.9	
503	5	II	1.043	NO. REQ'D.	16	16	18	18	20	24	503 NUMBER BARS REQ'D. = $2\left(\frac{13+I.D.+2W}{@\ 12"}+1\right)$ BAR LENGTH = 4' 9"+2(16+W+I.D./2)
				LENGTH	12'-10"	13'-5"	14'-0"	14'-7"	15'-9"	16'-11"	
				WEIGHT #	214.2	223.9	262.8	273.8	328.5	423.5	
504	5	I	1.043	NO. REQ'D.	12	14	14	16	18	20	504 NUMBER BARS REQ'D. = $2\left(\frac{2W+I.D.-4}{@\ 12"}+1\right)$ BAR LENGTH = 32"+2W+I.D.
				LENGTH	8'-1"	8'-8"	9'-3"	9'-10"	11'-0"	12'-2"	
				WEIGHT #	101.2	126.6	135.1	164.1	206.5	253.8	
1101	11	I	5.313	NO. REQ'D.	4	4	4	4	4	4	1101 BAR LENGTH = 21" + I.D. + 2W
				LENGTH	7'-2"	7'-9"	8'-4"	8'-11"	10'-1"	11'-3"	
				WEIGHT #	152.3	164.7	177.1	189.5	214.3	239.1	
1102	11	I	5.313	NO. REQ'D.	4	4	4	4	4	4	
				LENGTH	2'-8"	2'-8"	2'-8"	2'-8"	2'-8"	2'-8"	
				WEIGHT #	56.7	56.7	56.7	56.7	56.7	56.7	
1103	11	I	5.313	NO. REQ'D.	3	3	3	3	3	3	
				LENGTH	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	
				WEIGHT #	79.7	79.7	79.7	79.7	79.7	79.7	
REINFORCING STEEL TOTAL #					965.6	1,037.5	1,127.2	1,204.0	1,380.2	1,601.6	
CONCRETE - CUBIC YARDS - TOTAL					6.0	6.6	7.3	8.0	9.5	11.1	

NOTE: QUANTITIES ARE BASED ON SAME SIZE PIPE ENTRANCE TO AND EXIT FROM, BASE AND A 4 FT. MANHOLE ENTRANCE INTO TOP SLAB OF BASE.

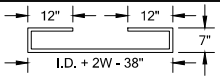
BENDING

TYPE I — STRAIGHT

TYPE II



TYPE III



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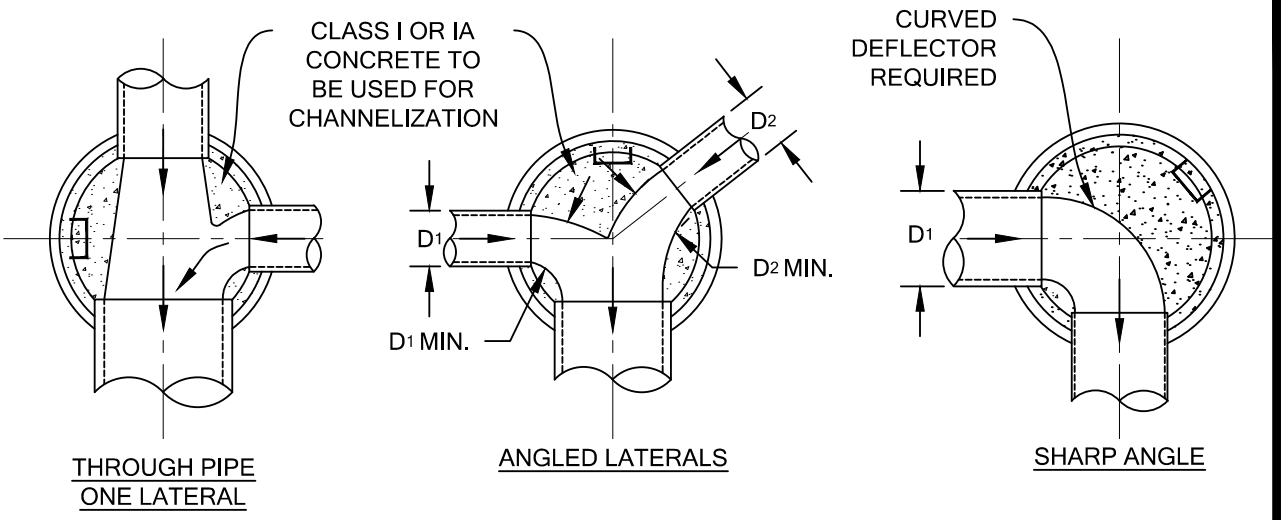
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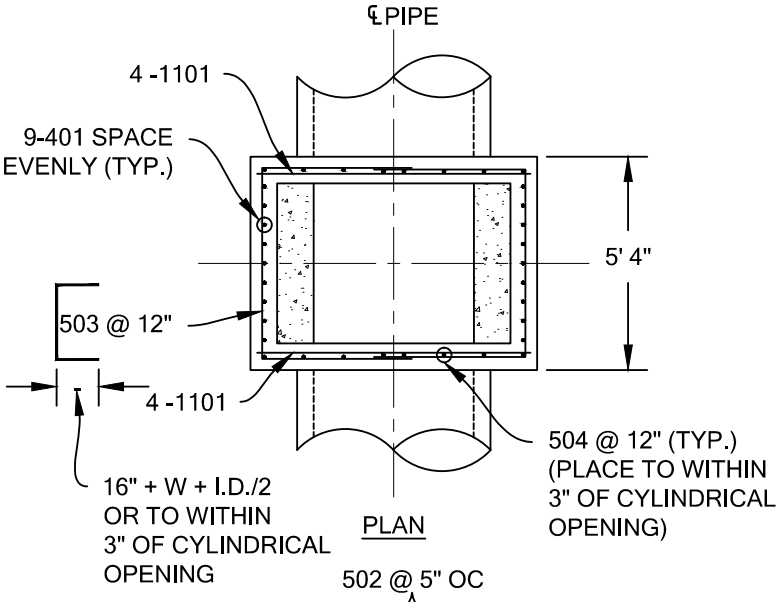
CONCRETE MANHOLE & BOX BASE

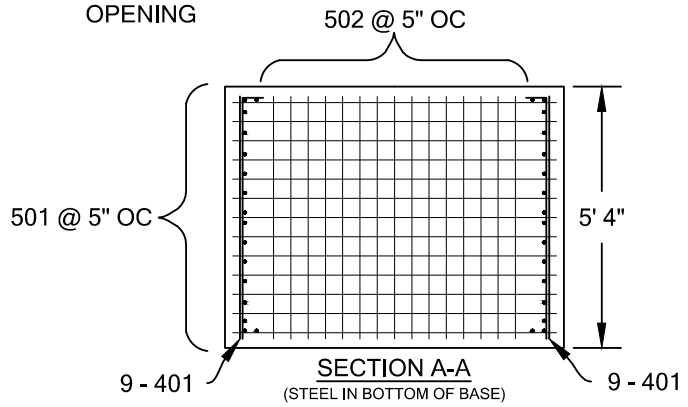
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TYPICAL CHANNELIZATION DETAILS





NOTES

1. SINCE ALL PIPE ENTRIES INTO THE BASE ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK.
2. THE MH RING (FRAME) SHALL BE SET IN A BED OF GROUT. THE FRAME SHALL BE SURROUNDED WITH A CEMENT GROUT IN UNPAVED AREA, OR A CONCRETE COLLAR IN PAVED AREA. SEE DETAILS.
3. DESIGN OF BOX BASE IS BASED ON STRAIGHT RUNS OF CONDUIT OR CHANGE IN DIRECTION OF LESS THAN 45°. SPECIAL DESIGN IS REQUIRED FOR 45° OR GREATER.
4. PRECAST MANHOLES AND REINFORCEMENT SHALL CONFORM TO ASTM C 478 (AASHTO M 199).
5. CAST-IN-PLACE MANHOLES SHALL BE CLASS I OR IA CONCRETE.
6. STEPS SHALL BE REQUIRED WHEN THE MANHOLE DEPTH EXCEEDS 3' 6" AND SHALL BE IN ACCORDANCE WITH AASHTO M 199.
7. MANHOLE PLATFORMS SHALL BE REQUIRED IN DEEP MANHOLES AS DIRECTED.
8. ALL REINFORCING STEEL SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI. VERTICAL STEEL SHALL BE PLACED AT ℄ OF WALL. ALL BARS SHALL HAVE A 2" MINIMUM CLEARANCE.
9. ALL PIPE ENTRIES INTO THE BASE OF MANHOLE SHALL BE CONNECTED BY OPEN CHANNELIZATION ADJUSTED FOR PIPE SIZE, SHAPE, SLOPE, AND DIRECTION OF FLOW. DETAILS SHOWN ARE TYPICAL FOR INSTALLATIONS WITH ALL INVERTS OF SAME RELATIVE ELEVATION. FOR EXCESSIVE ELEVATION DIFFERENCE BETWEEN INVERTS, SPECIAL BASE/CHANNEL DETAILS WILL BE SHOWN ON THE PLANS.
10. FLOW CHANNELS AND INVERTS SHALL BE FORMED BY SHAPING WITH CLASS I OR IA CONCRETE OR APPROVED GROUT.
11. STUB-OUTS SHALL EXTEND 2' MINIMUM BEYOND OUTSIDE WALL SURFACE OF MANHOLE AND BE SATISFACTORILY PLUGGED.
12. THE SLOPE OF THE MANHOLE COVER SHALL MATCH THE ROADWAY PROFILE AND CROSS SLOPE.

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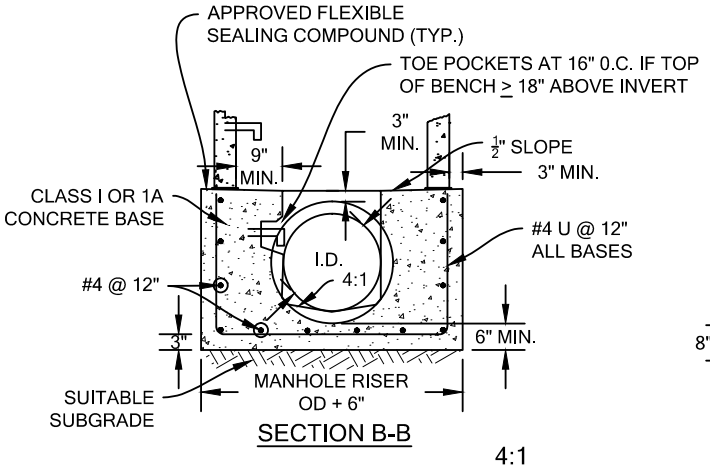
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CONCRETE MANHOLE & BOX BASE NOTES

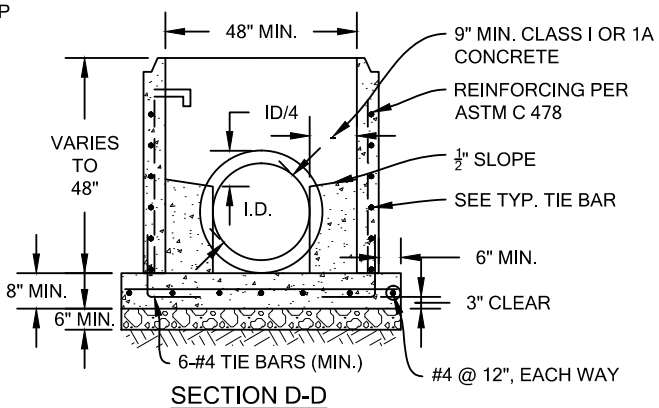
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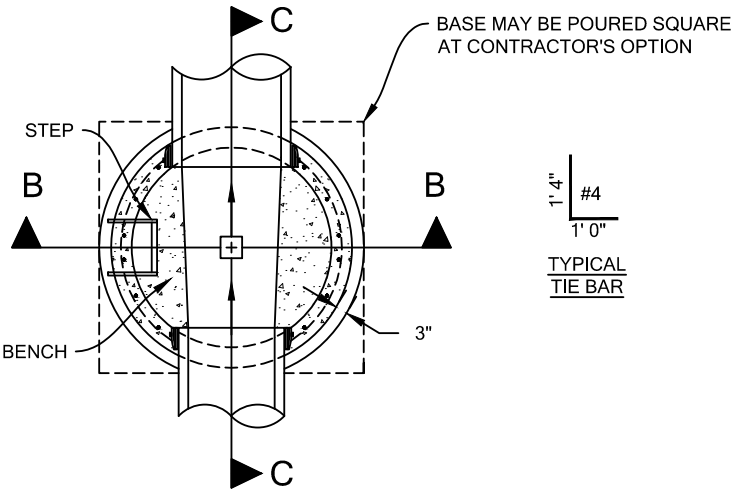


SECTION B-B

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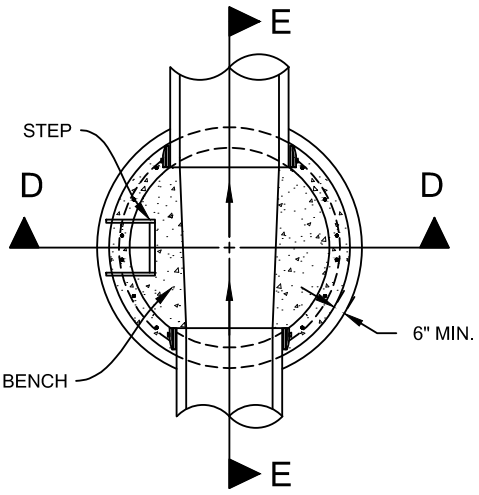


SECTION D-D

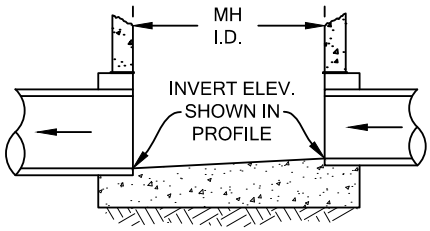


PLAN

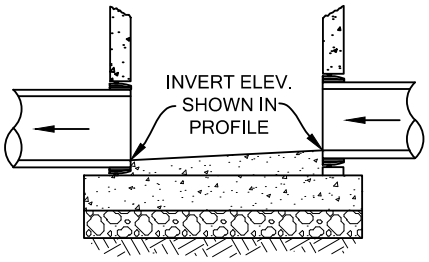
TYPICAL TIE BAR



PLAN



SECTION C-C
CAST-IN-PLACE
SLAB BASE



SECTION E-E
PRECAST SLAB BASE

LEGEND

- SUITABLE SUBGRADE
- GRANULAR BEDDING
- MATERIAL CONCRETE

PRECAST MANHOLE BASES:

1. THE BASE SLAB SHALL BE POURED MONOLITHICALLY WITH BOTTOM RISER SECTION.
2. PRECAST MANHOLE BASES SHALL FIT THE CONDITIONS AND LOCATIONS FOR WHICH THEY ARE INTENDED WITHOUT ANY FIELD MODIFICATIONS. ANY MANHOLE BASE WHICH REQUIRES FIELD CUTTING OR MODIFICATION IN ORDER TO FIT THE LOCATIONS INTENDED WILL BE REJECTED BY THE ENGINEER AND REMOVED AND REPLACED BY THE CONTRACTOR AT NO COST TO THE DEPARTMENT.
3. PRECAST MANHOLE BASES SHALL BE BEDDED ON AN APPROVED GRANULAR BEDDING MATERIAL AS SHOWN ABOVE.

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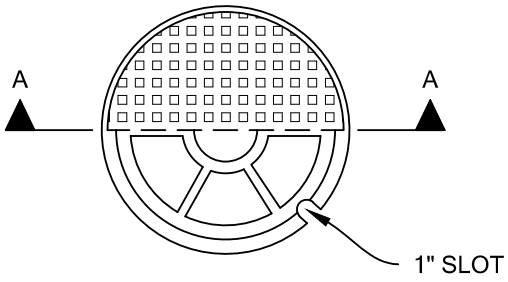
DEPARTMENT OF PUBLIC WORKS

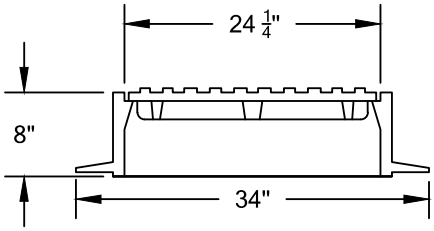
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CONCRETE MANHOLE & SLAB BASE - 1

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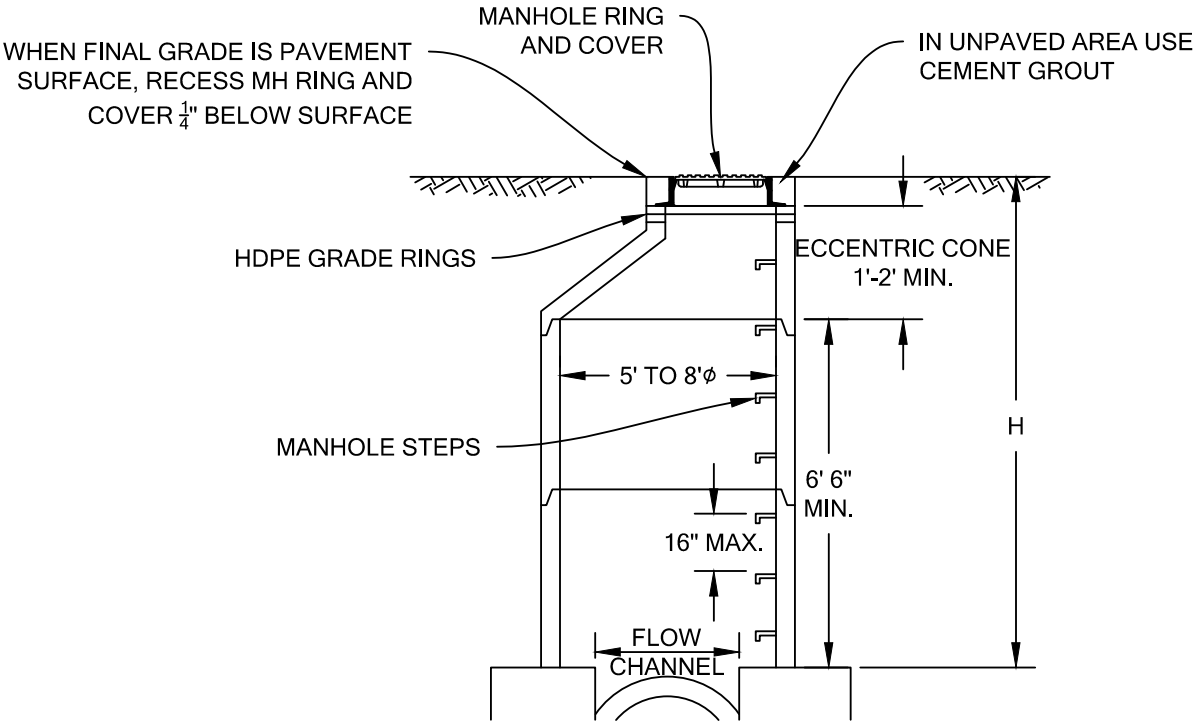
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*SEE 24" MANHOLE RING & COVER DETAIL SHEET 3

SECTION A-A
MANHOLE RING AND COVER*



MANHOLE SLAB BASE

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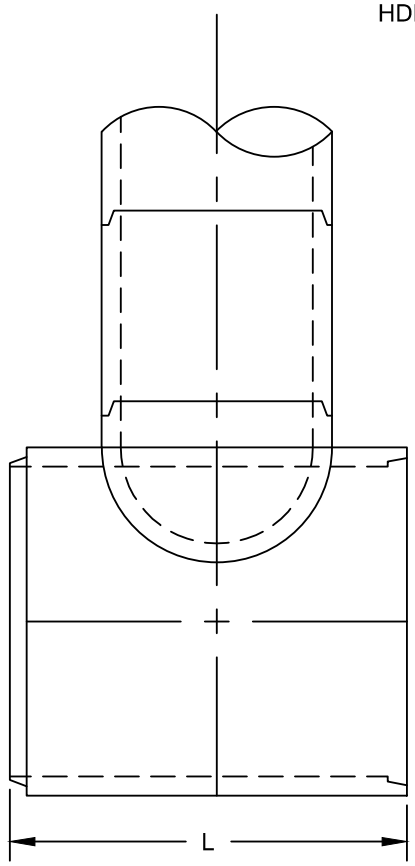
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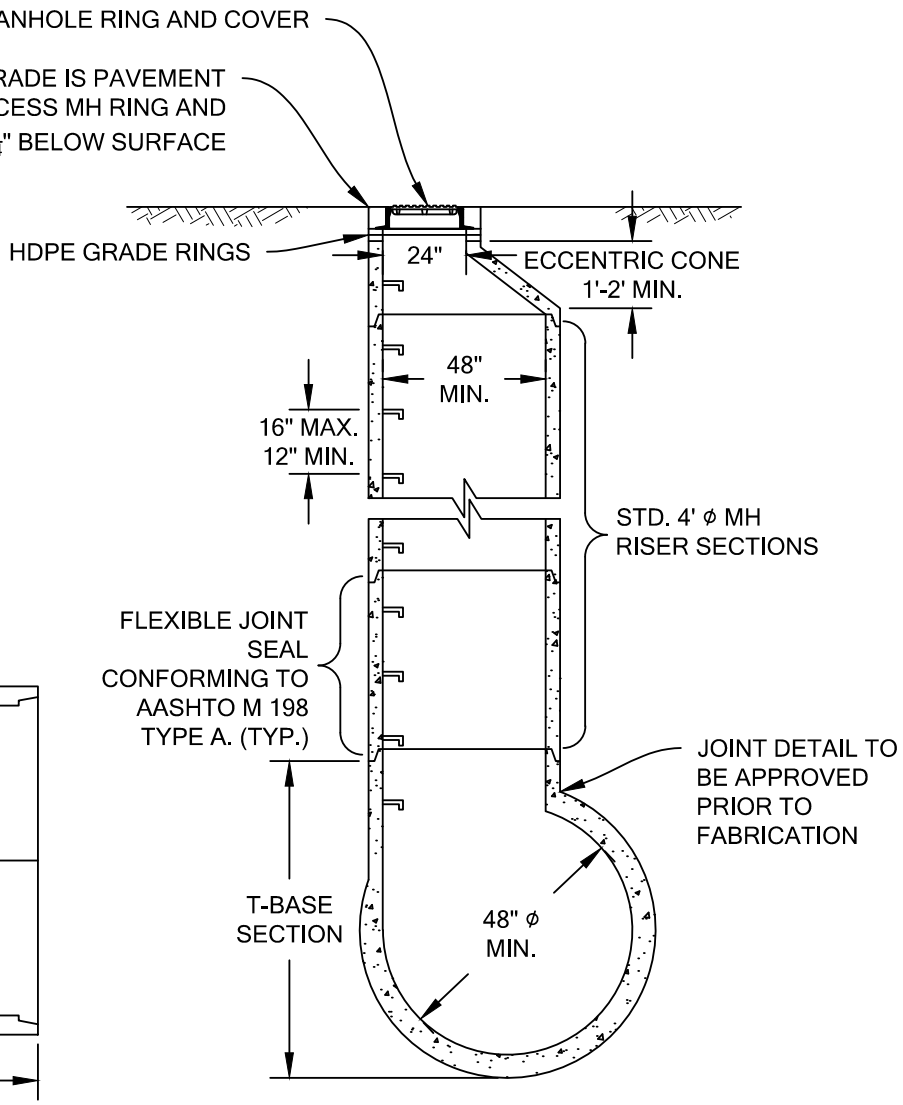
CONCRETE MANHOLE & SLAB BASE - 2

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CIRCULAR RCP
(LONGITUDINAL SECTION)



CIRCULAR RCP
(TRANSVERSE SECTION)

T-BASE MANHOLES:

1. THE T-BASE SECTION SHALL BE SHOP-FABRICATED FOR DELIVERY TO THE CONSTRUCTION SITE AS A COMPLETE UNIT.
2. THESE DETAILS SHALL ONLY BE CONSTRUED TO SHOW CONCEPTUAL AND STANDARD DIMENSIONAL REQUIREMENTS FOR TYPE T-BASE MANHOLES. THE CONTRACTOR SHALL FURNISH DETAILED SHOP DRAWINGS FOR APPROVAL PRIOR TO FABRICATION. THE DETAILS SHOWN HEREIN APPLY ONLY TO 48-INCH DIAMETER PIPE AND LARGER.
3. EXCEPT FOR CLASS OF PIPE, SPECIFICATIONS TO BE MET FOR THE MANHOLE SHALL BE THE SAME AS THOSE REQUIRED FOR THE ADJOINING PIPE CULVERT OR SEWER.
4. THE T-BASE SECTION SHALL MAINTAIN ITS INTERNAL SHAPE AND FLOW AREA WITH ANY GROUTING, ETC. APPLIED SO AS TO NOT DISTURB THE NORMAL FLOW OR REDUCE THE AREA.
5. T-BASE MANHOLES SHALL BE APPROVED BY THE ENGINEER ON A PER PROJECT BASIS.

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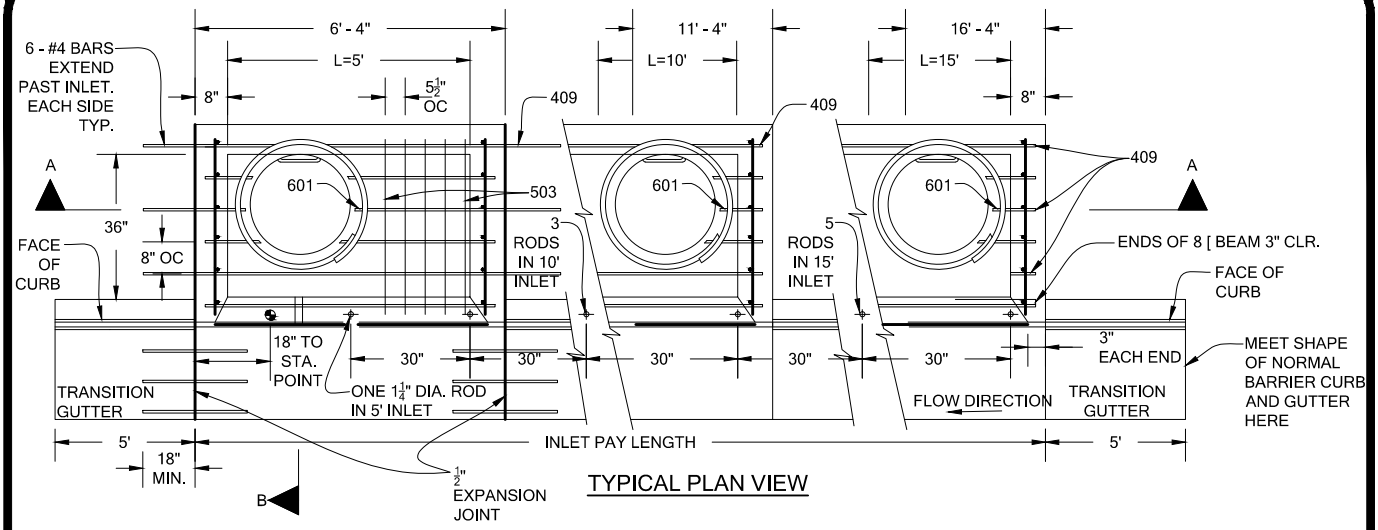
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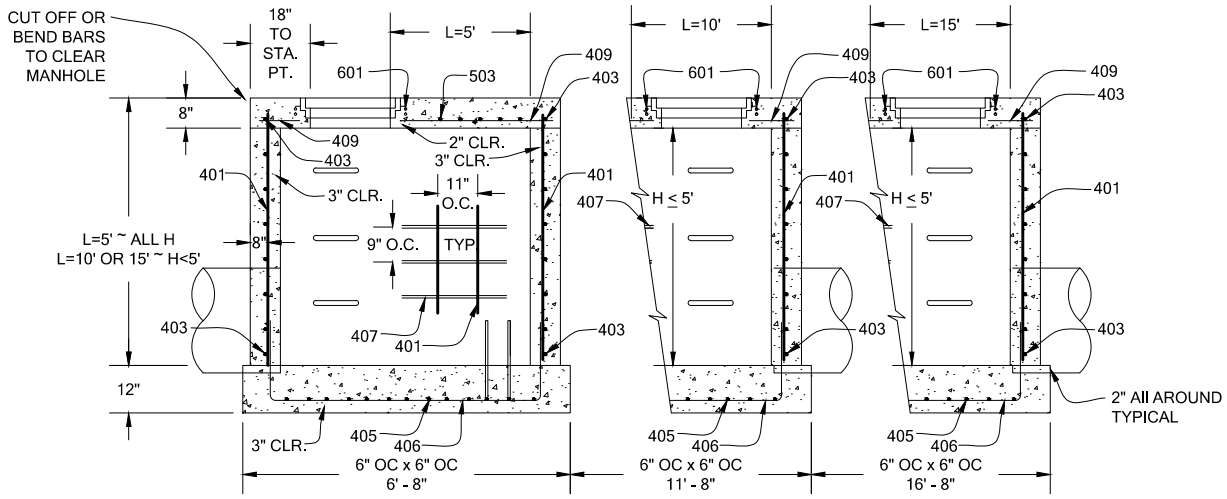
CONCRETE MANHOLE & T BASE

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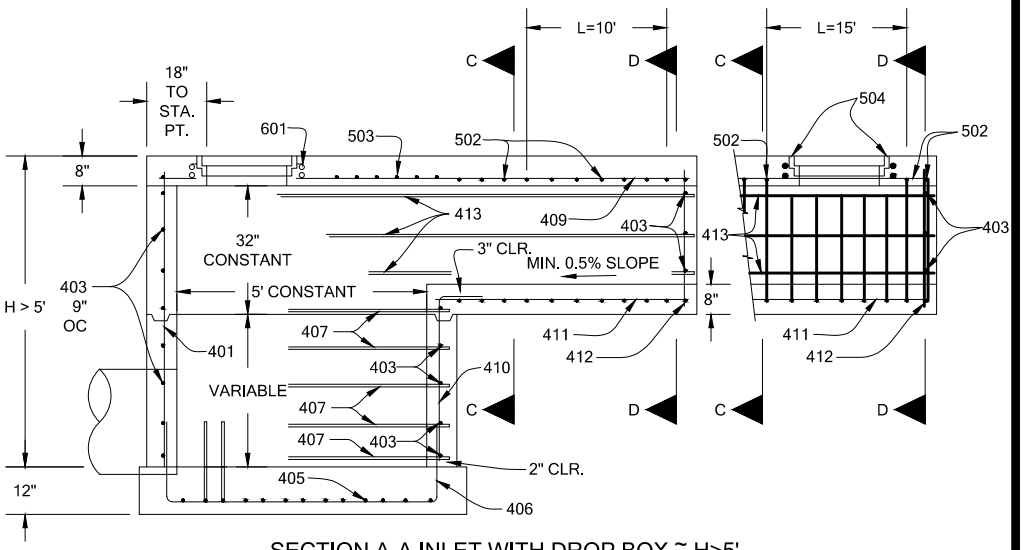
TYPICAL PLAN VIEW



SECTION A-A REGULAR INLET

NOTES:

1. FOR LENGTH GREATER THAN 5' PROVIDE ACCESS AT BOTH ENDS.
2. ADDITIONAL MANHOLE RING AND COVER REQUIRED WHEN L=10' OR MORE. CUT REINFORCEMENT BAR ACCORDINGLY.
3. SEE SHEET 48 FOR SECTION DETAILS
4. SEE SHEET 49 FOR NUMBERED CALL OUT DESCRIPTIONS



SECTION A-A INLET WITH DROP BOX ~ H>5'

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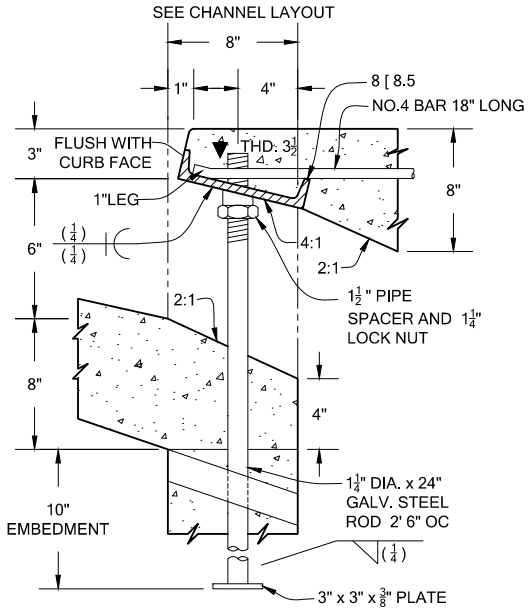
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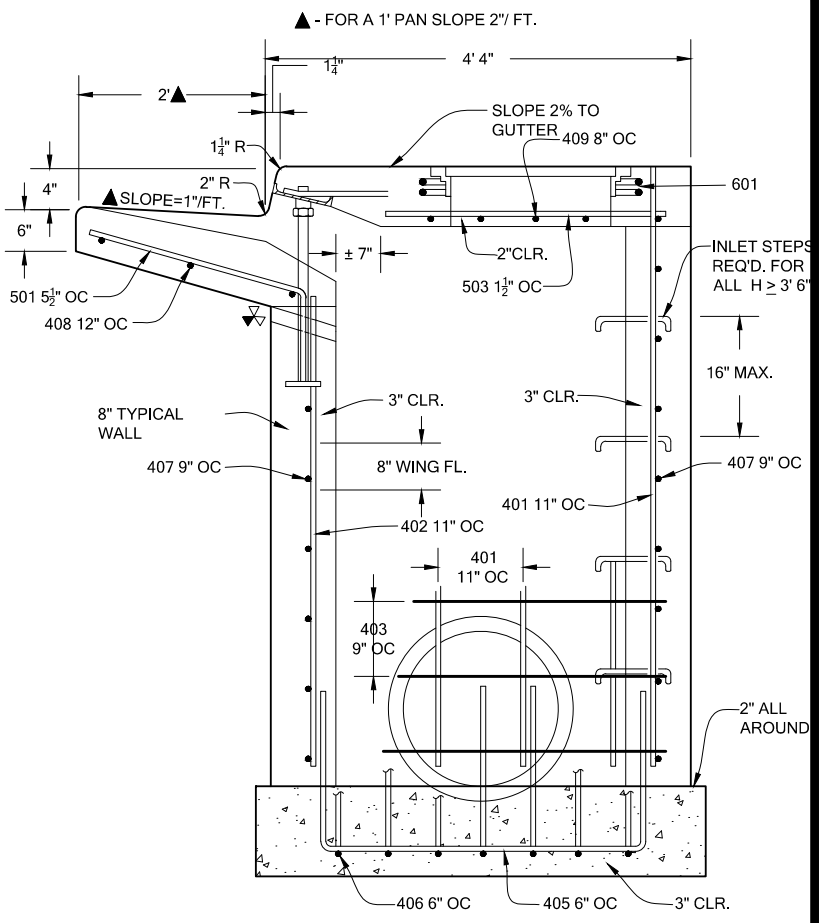
TYPE R CURB INLET - 1

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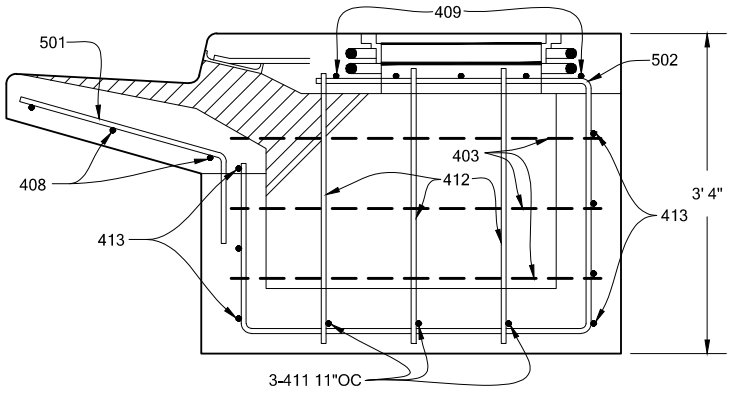


▼ CURB FACE ASSEMBLY
PLACE ENTIRE ASSEMBLY BEFORE POURING CONCRETE



SECTION B-B
TYPICAL END VIEW

NOTE: MANHOLE RING & COVER, STATION POINT AND OUTFLOW PIPE SHALL BE LOCATED AT THE SAME END OF THE INLET.



SECTIONS C-C & D-D
(DOTTED BARS ARE IN SECTION D-D)

NOTES:

1. SEE SHEET 49 FOR NUMBERED CALL OUT DESCRIPTIONS

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TYPE R CURB INLET - 2

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TABLE ONE
BAR LIST FOR CURB INLETS, TYPE "R"

MARK	ø INCH	OC SPACE	TYPE	ALL INLETS L = 5' # REQ'D	ALL INLETS L = 5' LENGTH	INLETS: H≤ 5' L = 10' # REQ'D	INLETS: H≤ 5' L = 10' LENGTH	INLETS: H≤ 5' L = 15' # REQ'D	INLETS: H≤ 5' L = 15' LENGTH	INLETS: H > 5' L = 10' # REQ'D	INLETS: H > 5' L = 10' LENGTH	INLETS: H > 5' L = 15' # REQ'D	INLETS: H > 5' L = 15' LENGTH
401		11"	II	15	*	21	*	26	*	11	*	11	*
402		11"	II	7	*	13	*	18	*	7	*	7	*
403		9"	II	*	4' 0"	*	4' 0"	*	4' 0"	*	4' 0"	*	4' 0"
405		6"	VI	11	6' 10"	21	6' 10"	31	6' 10"	11	6' 10"	11	6' 10"
406		6"	VIII	7	8' 10"	7	13' 10"	7	18' 10"	7	8' 10"	7	8' 10"
407	1/2"	9"	II	*	5' 10"	*	10' 10"	*	15' 10"	*	5' 10"	*	5' 10"
408		12"	II	3	6' 10"	3	11' 10"	3	16' 0"	3	11' 10"	3	16' 0"
409		8"	II	6	5' 10"	6	10' 10"	6	15' 10"	6	10' 10"	6	15' 10"
410		11"	VII							3	*	3	*
411		11"	II							3	5' 2"	3	10' 2"
412		11"	II							3	2' 9"	3	2' 9"
413		9"	II							7	10' 10"	7	15' 10"
501	5/8"	5 1/2"	IV	11	3' 4"	22	3' 4"	33	3' 4"	22	3' 4"	33	3' 4"
502		5 1/2"	III							11	11' 5"	17	11' 5"
503		5 1/2"	II	5	3' 6"	16	3' 6"	27	3' 6"	6	3' 6"	6	3' 6"
504		5 1/2"	IX									5	8' 4"
601	3/4"	2 1/2"	V	2	8' 10"	2	8' 10"	2	8' 10"	2	8' 10"	4	8' 10"
ø8[8.5				1	5' 10"	1	10' 10"	1	15' 10"	1	10' 10"	1	15' 10"
				2BARS,1 ROD		4 BARS,3 RODS		8 BARS,5 RODS		4 BARS,3 RODS		8 BARS,5 RODS	

REGULAR INLETS | DROP BOX INLETS

TABLE TWO
BARS AND QUANTITIES VARIABLE WITH "H"

H	LENGTH 401	LENGTH 402	LENGTH 410	# REQ'D REGULAR 403	# REQ'D REGULAR 407	# REQ'D DROP BOX 403	# REQ'D DROP BOX 407	L = 5' CONCRETE CUBIC YD.	L = 5' STEEL LBS.	L = 10' CONCRETE CUBIC YD.	L = 10' STEEL LBS.	L = 15' CONCRETE CUBIC YD.	L = 15' STEEL LBS.
3' 0"	2' 8"	1' 8"		10	7			3.2	285	5.3	497	7.4	706
3' 6"	3' 2"	2' 2"		10	7			3.4	305	5.7	528	7.9	747
4' 0"	3' 8"	2' 8"		12	9			3.7	326	6.0	559	8.4	786
4' 6"	4' 2"	3' 2"		12	9			3.9	334	6.4	571	8.8	803
5' 0"	4' 8"	3' 8"		14	11			4.1	354	6.7	602	9.3	844
5' 6"	5' 2"	4' 2"	3' 5"	16	13	15	6	4.4	375	6.0	607	7.4	850
6' 0"	5' 8"	4' 8"	3' 11"	16	13	16	6	4.6	382	6.2	616	7.6	860
6' 6"	6' 2"	5' 2"	4' 5"	18	15	18	8	4.8	402	6.4	637	7.8	880
7' 0"	6' 8"	5' 8"	4' 11"	20	17	19	10	5.0	423	6.6	654	8.0	897
7' 6"	7' 2"	6' 2"	5' 5"	20	17	20	10	5.3	430	6.9	664	8.3	907
8' 0"	7' 8"	6' 8"	5' 11"	22	19	22	12	5.5	451	7.1	684	8.5	927
8' 6"	8' 2"	7' 2"	6' 5"	24	21	23	14	5.7	471	7.3	702	8.7	944
9' 0"	8' 8"	7' 8"	6' 11"	24	21	24	14	6.0	479	7.6	711	9.0	954
9' 6"	9' 2"	8' 2"	7' 5"	26	23	26	16	6.2	499	7.8	732	9.2	974
10' 0"	9' 8"	8' 8"	7' 11"	28	25	27	18	6.4	520	8.0	749	9.4	992
10' 6"	10' 2"	9' 2"	8' 5"	28	25	28	18	6.7	527	8.3	759	9.7	1001
11' 0"	10' 8"	9' 8"	8' 11"	30	27	30	20	6.9	547	8.5	779	9.9	1022

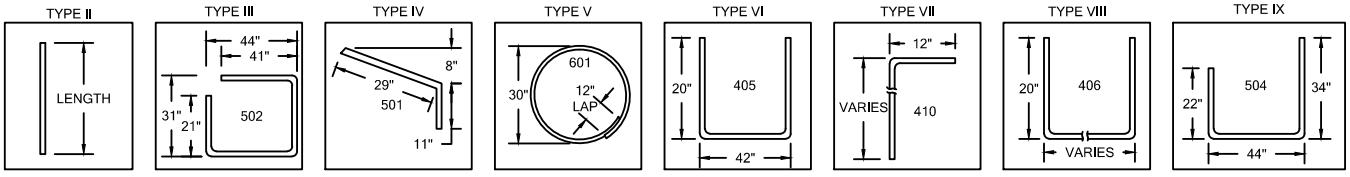
NOTE:
FOR L=5', L=10' AND L=15'

- REGULAR INLETS: TOTAL QUANTITIES NEEDED ARE OUTSIDE OF THE HEAVY BLACK LINE.

- DROP BOX INLETS: TOTAL QUANTITIES NEEDED ARE INSIDE OF THE HEAVY BLACK LINE

* STEEL WEIGHTS DO NOT INCLUDE STRUCTURAL STEEL.

BAR BENDING DIAGRAMS
(DIMENSIONS ARE OUT-TO-OUT OF BAR)



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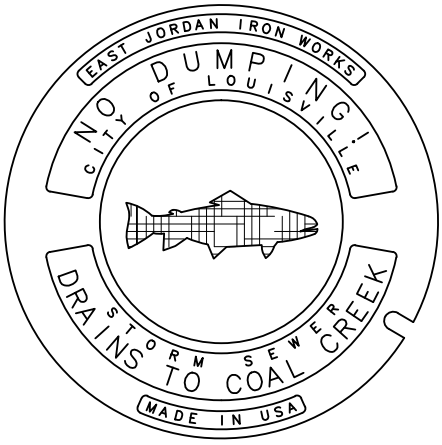
TYPE R CURB INLET NOTES - 1

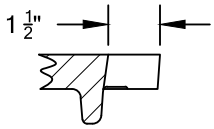
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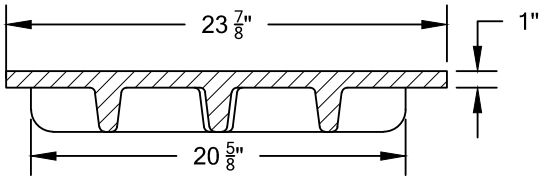
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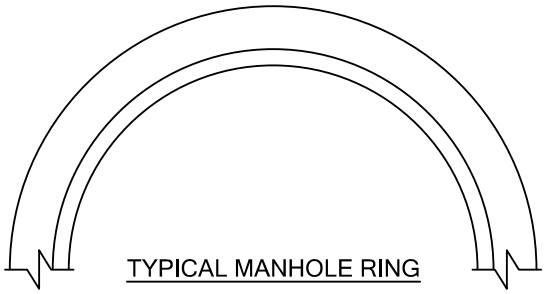
NOTES:

1. ALL CONCRETE SHALL BE CLASS I OR 1A
2. CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES AND SHALL BE 8" THICK.
3. INLET STEPS SHALL BE IN ACCORDANCE WITH AASHTO M 199.
4. CURB FACE ASSEMBLY SHALL BE GALVANIZED AFTER WELDING.
5. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$". CURB AND GUTTER CORNERS SHALL BE FINISHED TO MATCH THE EXISTING CURB AND GUTTER BEYOND THE TRANSITION GUTTER.
6. REINFORCING BARS SHALL BE DEFORMED AND SHALL HAVE A 2" MINIMUM CLEARANCE. ALL REINFORCING BARS SHALL BE EPOXY COATED.
7. DIMENSIONS AND WEIGHTS OF TYPICAL MANHOLE RING AND COVER ARE NOMINAL.
8. MATERIAL FOR MANHOLE RINGS AND COVERS SHALL BE GRAY OR DUCTILE CAST IRON CONFORMING TO 712.06. (CDOT)
9. SINCE PIPE ENTRIES INTO THE INLET ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK. QUANTITIES INCLUDE VOLUMES OCCUPIED BY PIPES.
10. STRUCTURAL STEEL SHALL BE GALVANIZED AND SHALL CONFORM TO THE REQUIREMENTS OF 712.06. (CDOT)
11. SEE SHEET 51 FOR COVER DETAILS *IF COVER WILL NOT BE PROVIDED BY CITY*.

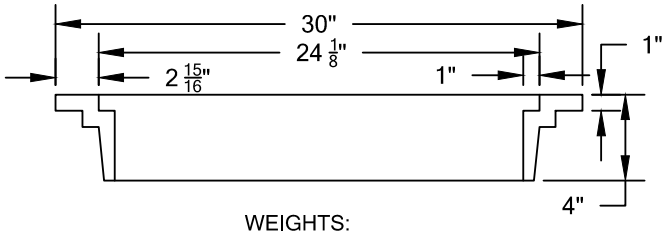




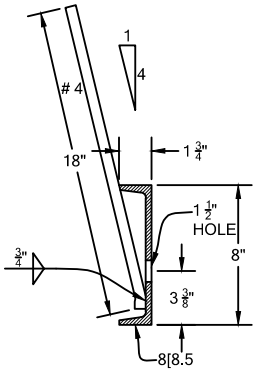




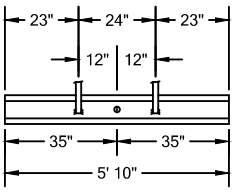
TYPICAL MANHOLE RING

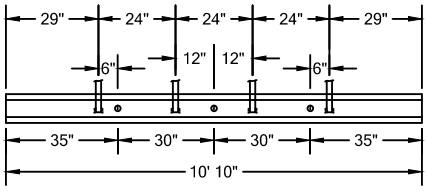


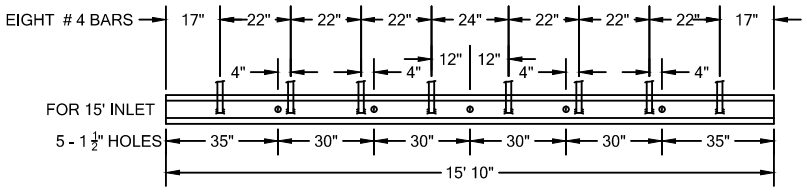
WEIGHTS:
COVER = 125 LBS.
RING = 135 LBS.
TOTAL = 260 LBS.



TYPICAL SECTION AT HOLE







CHANNEL LAYOUT DETAILS

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

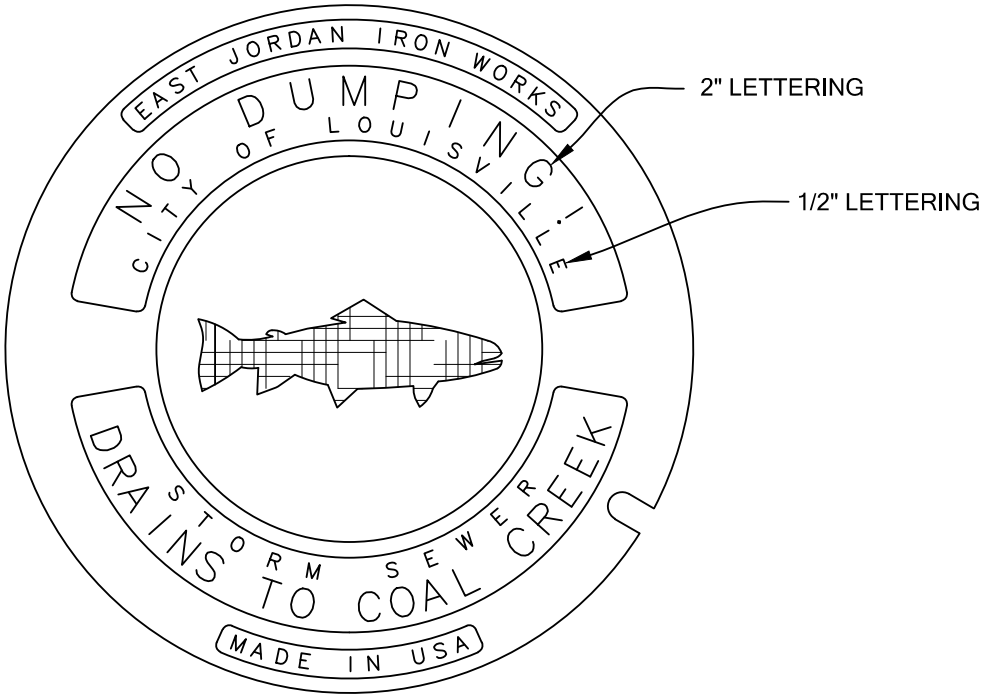
DEPARTMENT OF PUBLIC WORKS

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APPROVED BY: CMD MAR 15

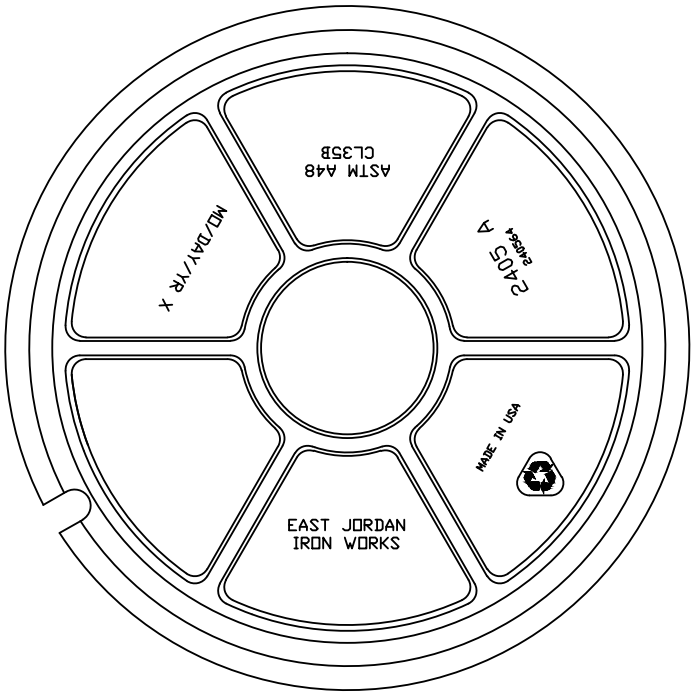
TYPE R CURB INLET NOTES - 2

SHEET
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COVER TOP



COVER BACK

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

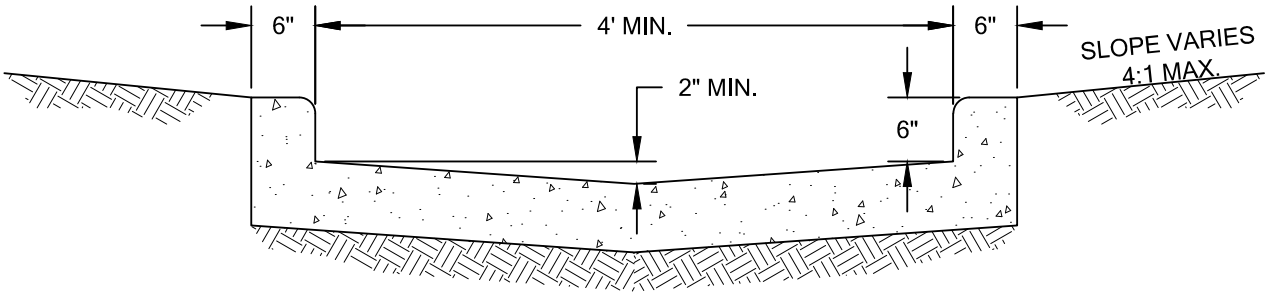
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STORM MANHOLE COVER

SHEET
51 OF 74

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95% COMPACTION

NOTES:

1. CONCRETE WITH FIBERMESH REQUIRED.
2. CONTRACTION OR WEAKENED PLANE SHALL BE PLACED EVERY 10'.
3. EXPANSION JOINTS SHALL BE INSTALLED EVERY 100'.

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MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

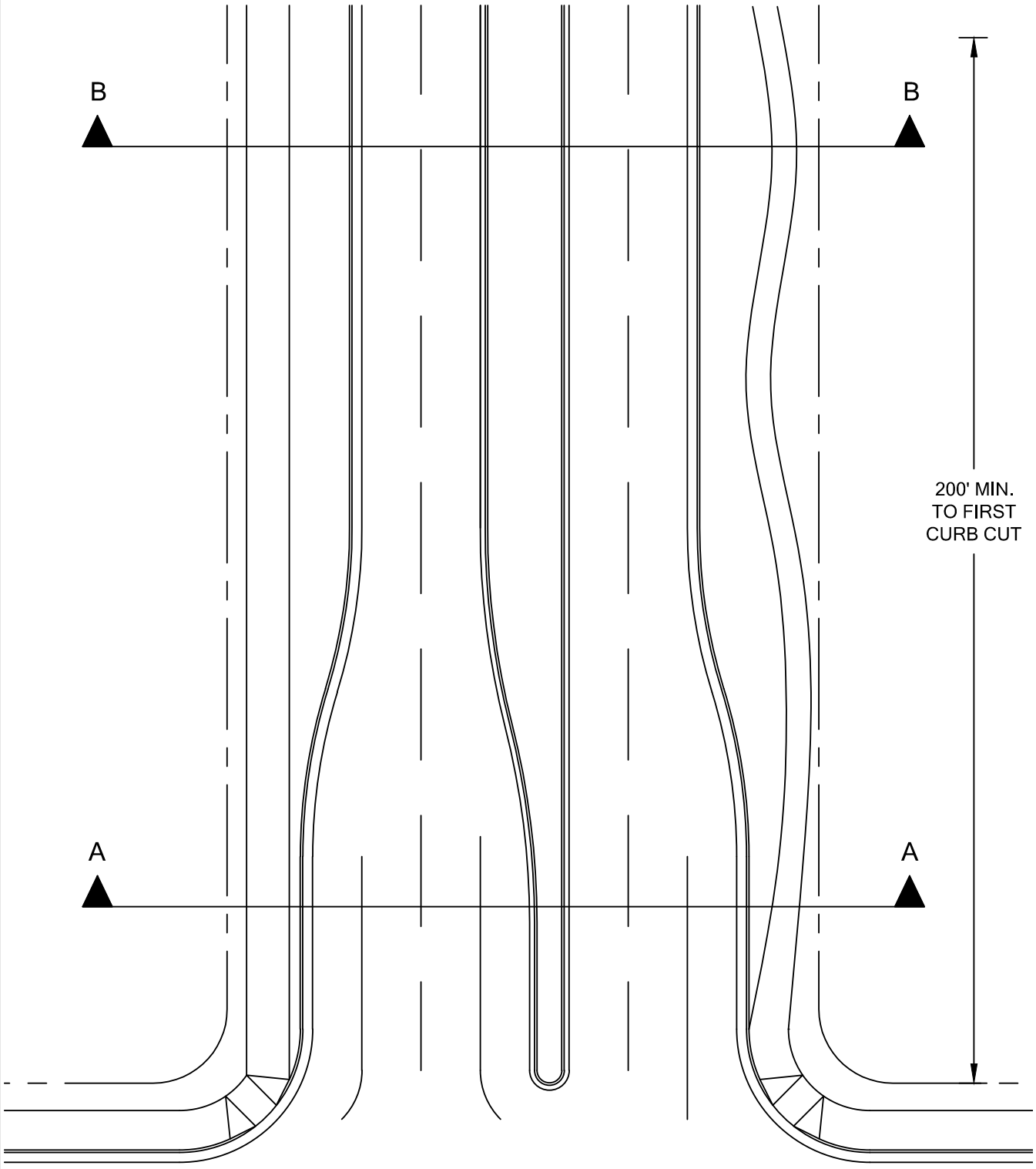
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TRICKLE CHANNEL WITH CURB & GUTTER

SHEET
52 OF 74

G:\STANDARDS DETAILS\DETAILS\STORM\52 TRICKLE CHANNEL WITH CURB & GUTTER.DWG



CURB RETURN RADII AT INTERSECTIONS

	LOCAL	COLLECTOR	ARTERIAL
LOCAL	15'	20'	25'
COLLECTOR	20'	25'	30'
ARTERIAL	25'	30'	35'

NOTE: FOR SECTION A-A & B-B SEE SHEET 54

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

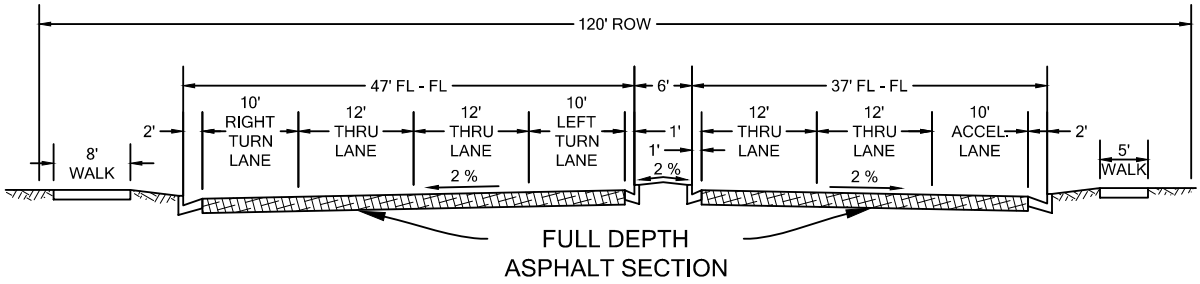
DEPARTMENT OF PUBLIC WORKS

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ARTERIAL STREET PLAN

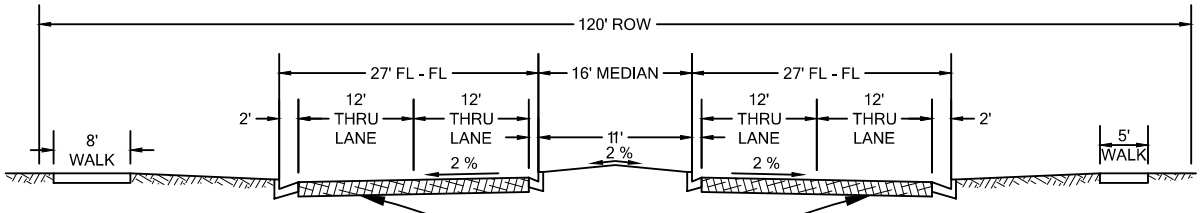
SHEET
53 OF 74

G:\STANDARDS DETAILS\DETAILS\STREET\53 ARTERIAL STREET PLAN.DWG



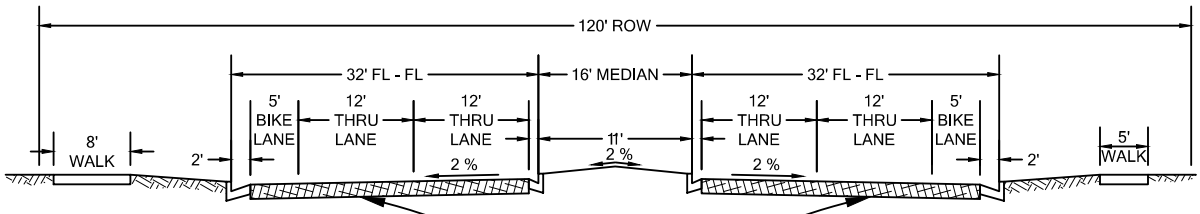
FULL DEPTH
ASPHALT SECTION

SECTION A-A



FULL DEPTH
ASPHALT SECTION

SECTION B-B



FULL DEPTH
ASPHALT SECTION

ON STREET BIKE LANE

NOTES:

1. PLACEMENT OF 8' BIKE PATH AND 5' WALK TO BE DETERMINED BY THE CITY ENGINEER.
2. FOR CURB DETAILS SEE SHEET 58

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

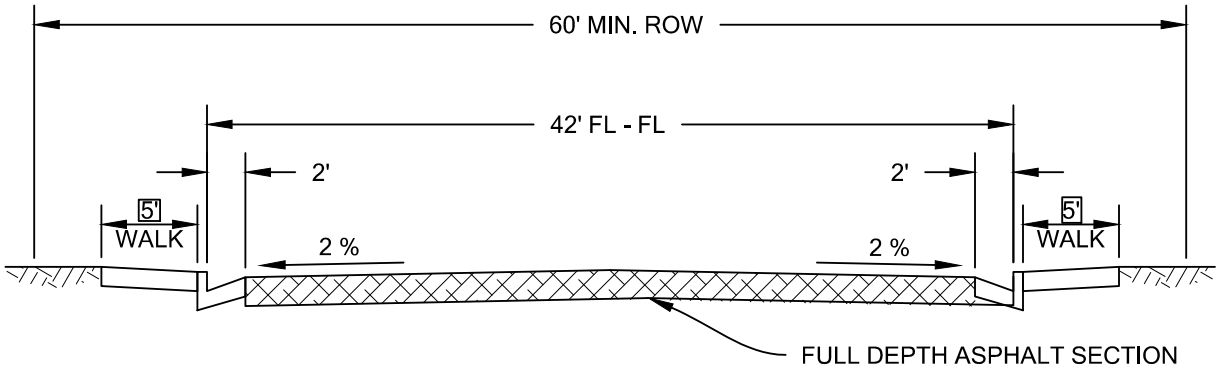
DEPARTMENT OF PUBLIC WORKS

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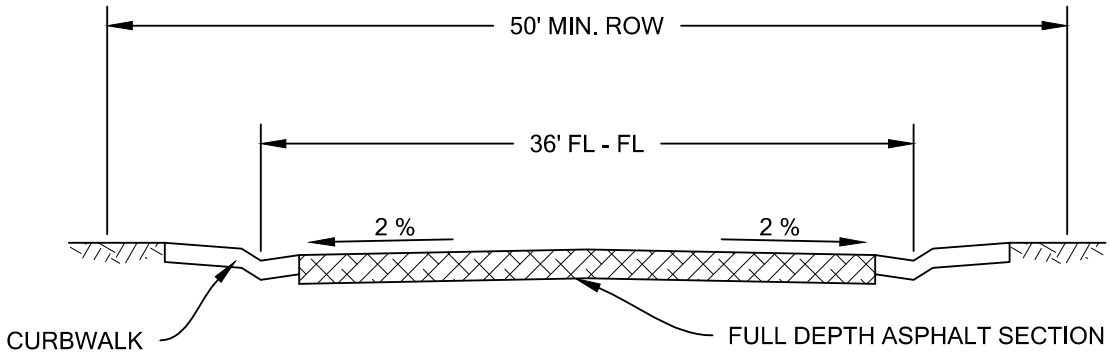
ARTERIAL CROSS SECTIONS

SHEET
54 OF 74

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COLLECTOR

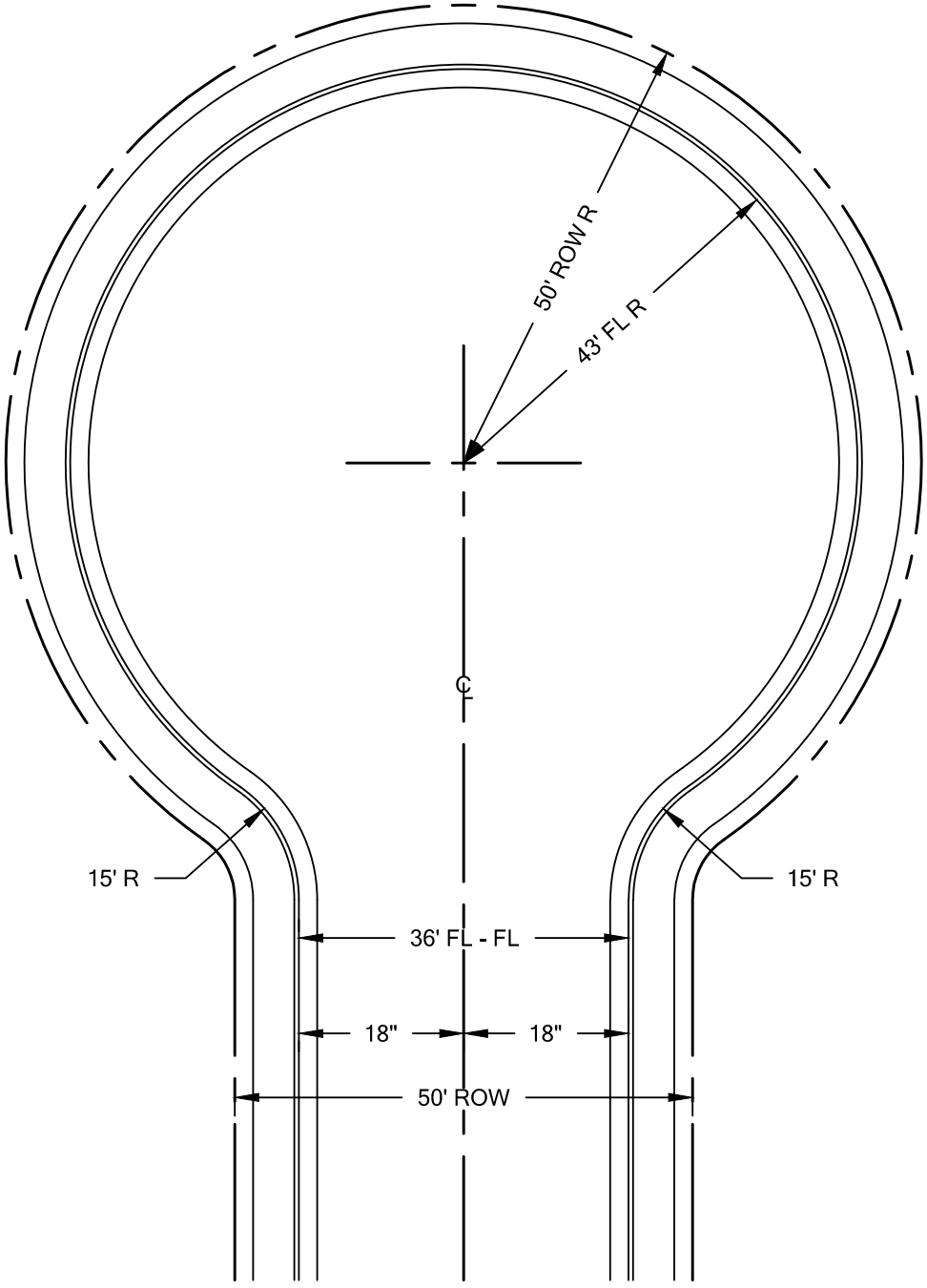


LOCAL

NOTE: ROW WIDTHS MAY BE CHANGED AT THE DISCRETION OF THE ENGINEER

REVISIONS		City *of* Louisville COLORADO - SINCE 1882	DEPARTMENT OF PUBLIC WORKS	DRAWN BY: ML JAN 94 APPROVED BY: CMD MAR 15
DATE	BY			
MAR 2015	CMD			SHEET
			STREET CROSS SECTIONS	55 OF 74

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NOTE: NO ISLANDS SHALL BE PLACED IN
CAL-DE-SACS UNLESS APPROVED BY ENGINEER

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

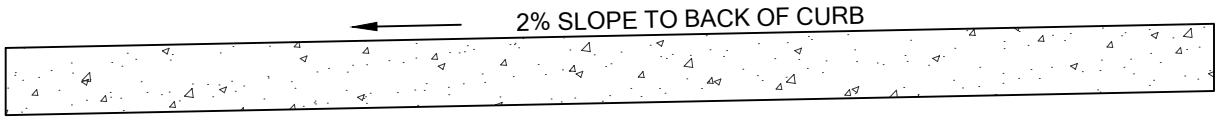
DEPARTMENT OF PUBLIC WORKS

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CUL - DE - SAC PLAN

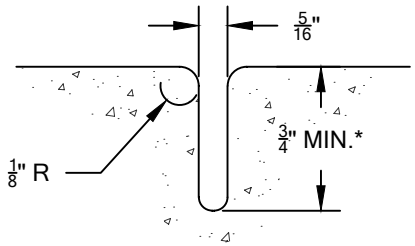
SHEET
56 OF 74

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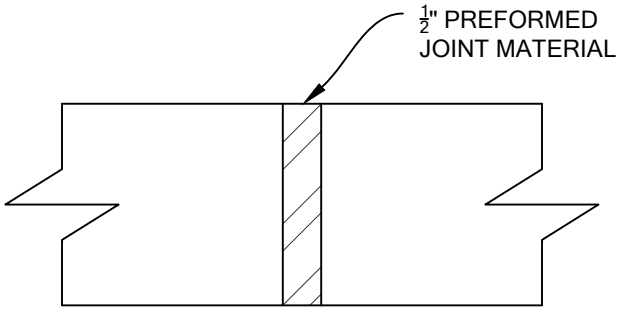
ATTACHED OR DETACHED WALK

- 4' OR 5' WIDE WALKS SHALL BE 6" THICK
- 8' WIDE WALKS SHALL BE 6" THICK
- ALL WALKS AT RESIDENTIAL DRIVEWAYS SHALL BE 6" WITH FIBERMESH

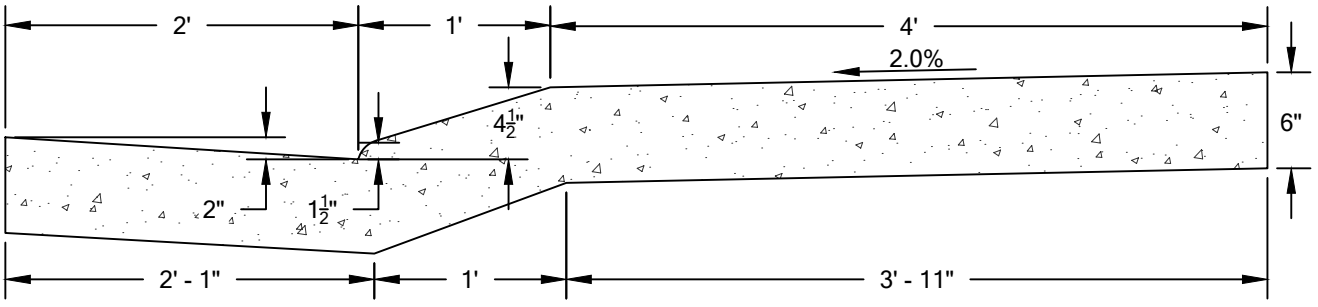


* 1/4"D. IF TEMPLATES ARE NOT USED

CONTRACTION OR WEAKENED PLANE JOINT



EXPANSION JOINT



CURBWALK

REVISIONS	
DATE	BY
MAR 2015	CMD
NOV 2026	CF

City *of* Louisville
COLORADO - SINCE 1882

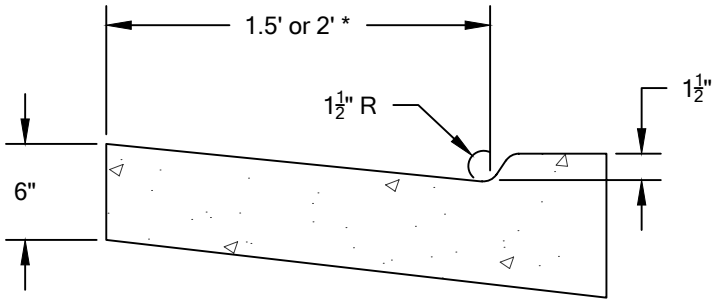
DEPARTMENT OF PUBLIC WORKS

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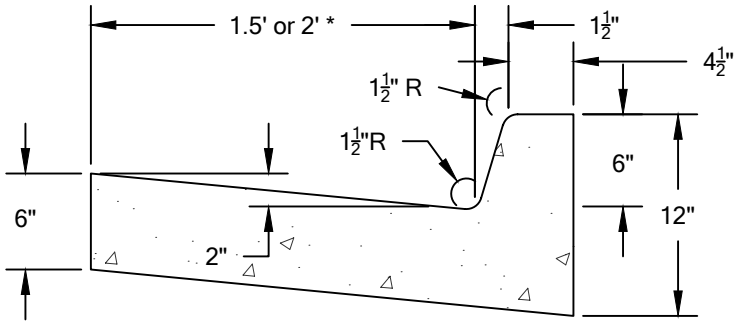
CURBWALK & WALK

SHEET
57 OF 75

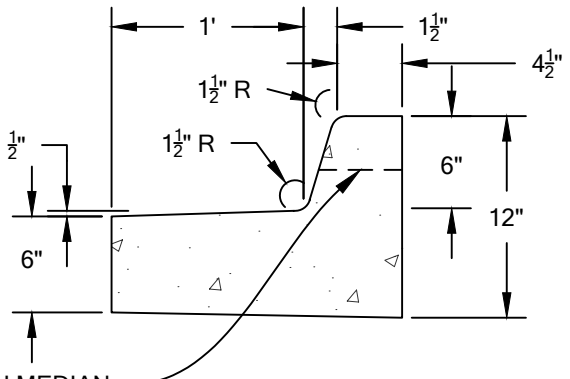
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TYPICAL CURB & GUTTER
AT DRIVEWAY



VERTICAL CURB & GUTTER



* - WIDTH TO BE DETERMINED BY CITY ENGINEER

AT THE LOW POINT(S) OF EACH MEDIAN, A 1"X 4" BOARD SHALL BE USED TO FORM A SLOT IN THE MEDIAN C & G

MEDIAN CURB & GUTTER

REVISIONS	
DATE	BY
MAR 2015	CMD
NOV 2026	CF

City *of* Louisville
COLORADO - SINCE 1882

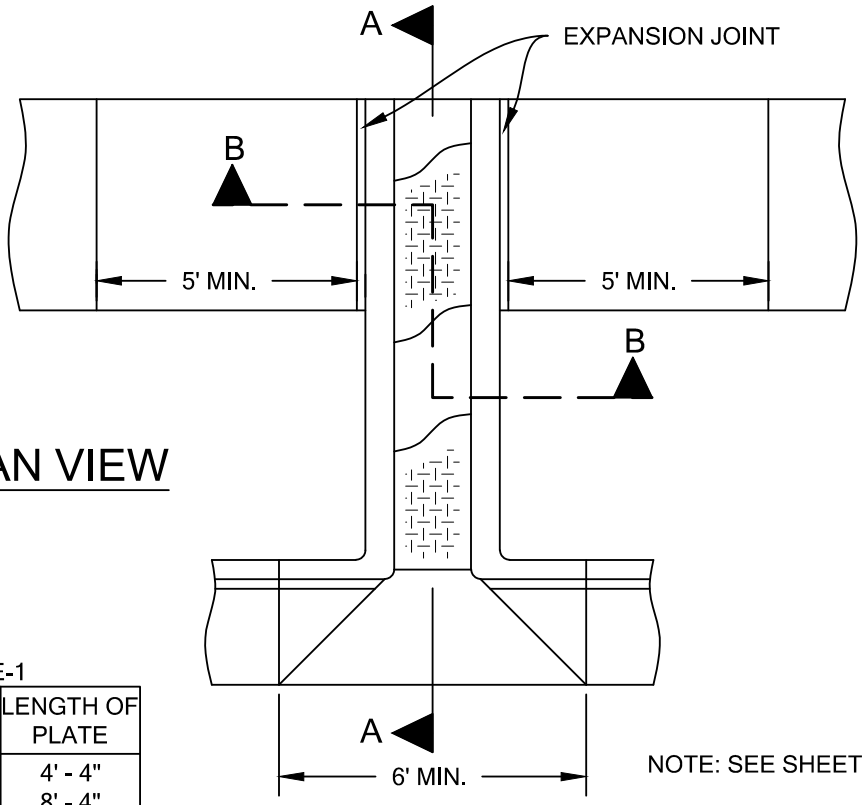
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CURB & GUTTER

SHEET
58 OF 75

G:\STANDARDS DETAILS\DETAILS\STREET\58 CURB & GUTTER.DWG

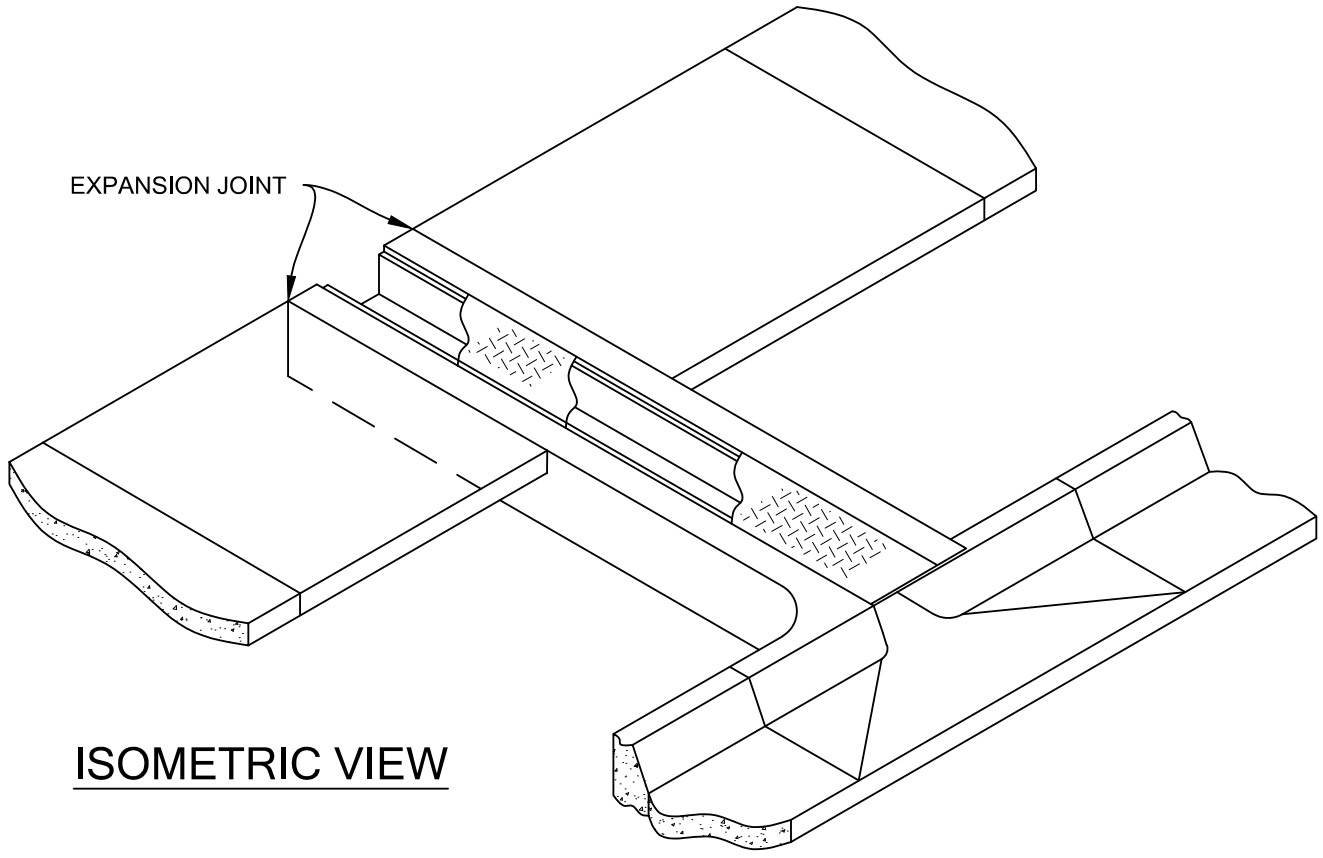


PLAN VIEW

TABLE-1

TYPE OF WALK	LENGTH OF PLATE
4' ATTACHED	4' - 4"
8' ATTACHED	8' - 4"
4' DETACHED	VARIES

NOTE: SEE SHEET 60 FOR SECTIONS



ISOMETRIC VIEW

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

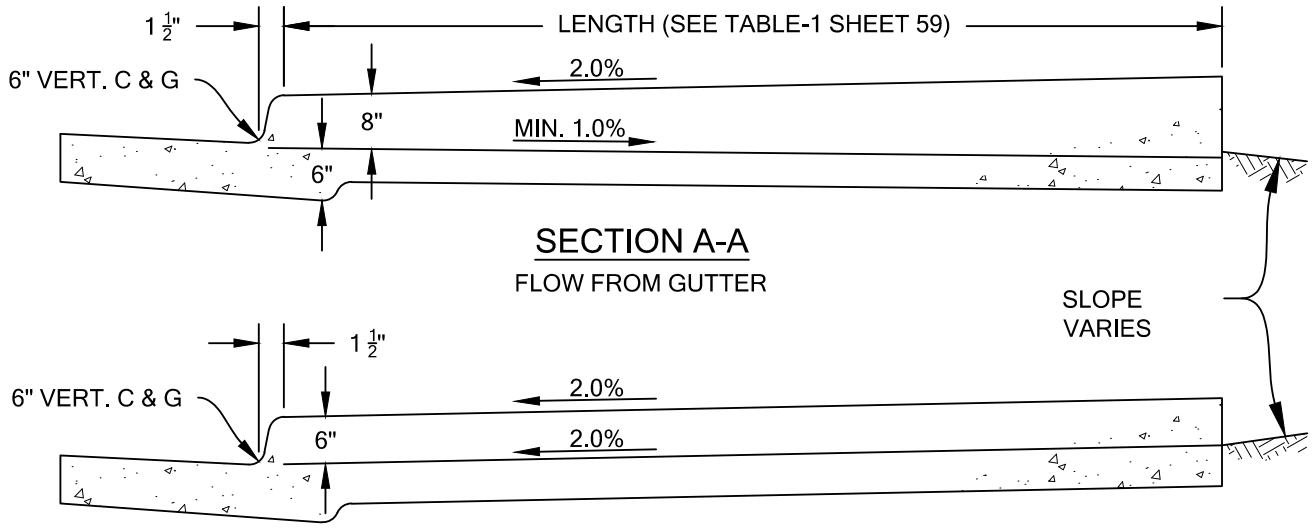
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SIDEWALK CHASE

SHEET
59 OF 74

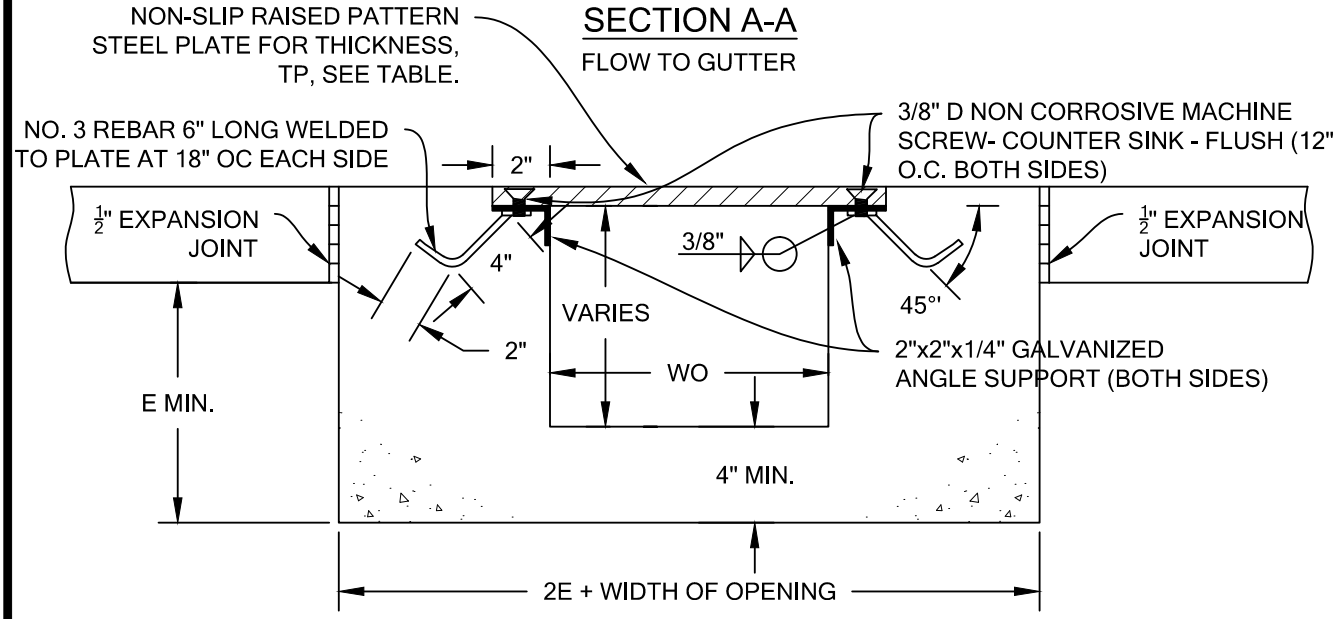
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SECTION A-A
FLOW FROM GUTTER

SLOPE VARIES

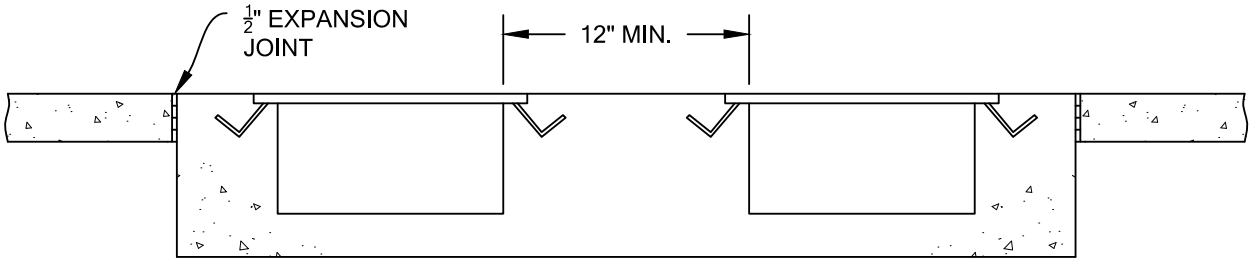
SECTION A-A
FLOW TO GUTTER



E= 8" WHEN FLOW IS FROM GUTTER
E= 6" WHEN FLOW IS TO GUTTER

SECTION B-B

WO WIDTH OF OPENING	TP THICKNESS OF PLATE
6"	3/8"
6"-12"	1/2"
12"-18" MAX.	9/16"



MULTIPLE CHASE
WHEN OPENINGS ARE LARGER THAN 18"

REVISIONS	
DATE	BY
MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

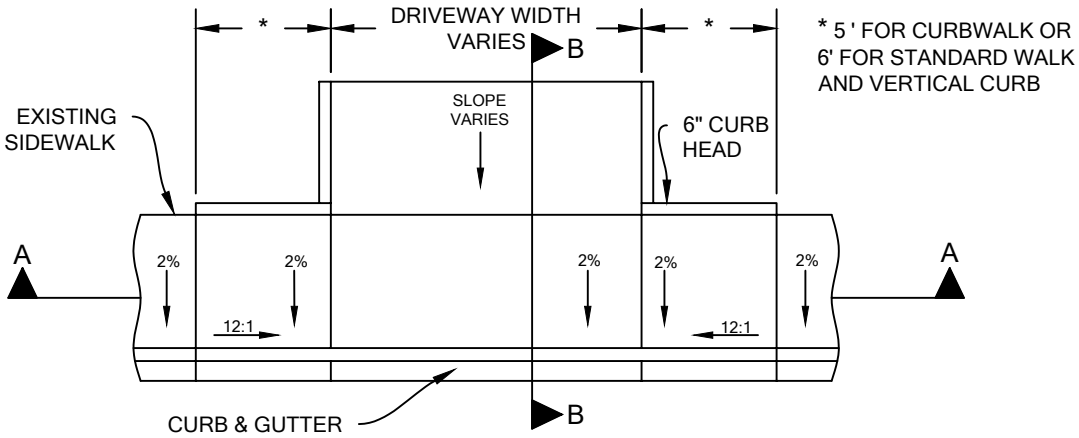
DEPARTMENT OF PUBLIC WORKS

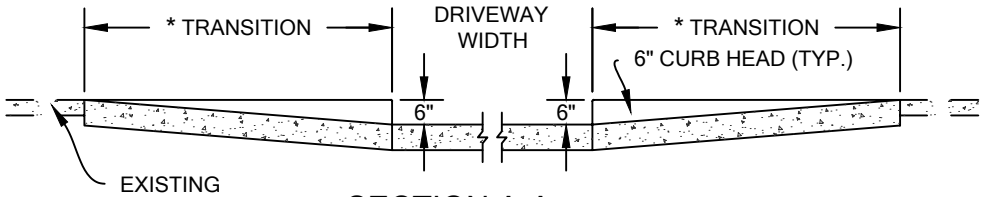
DRAWN BY: ML JAN 94
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SIDEWALK CHASE SECTION

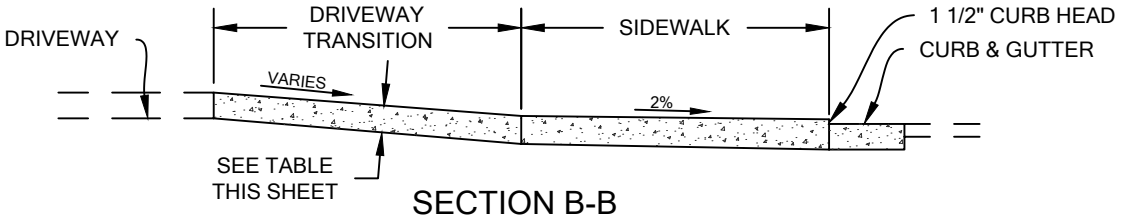
SHEET
60 OF 74

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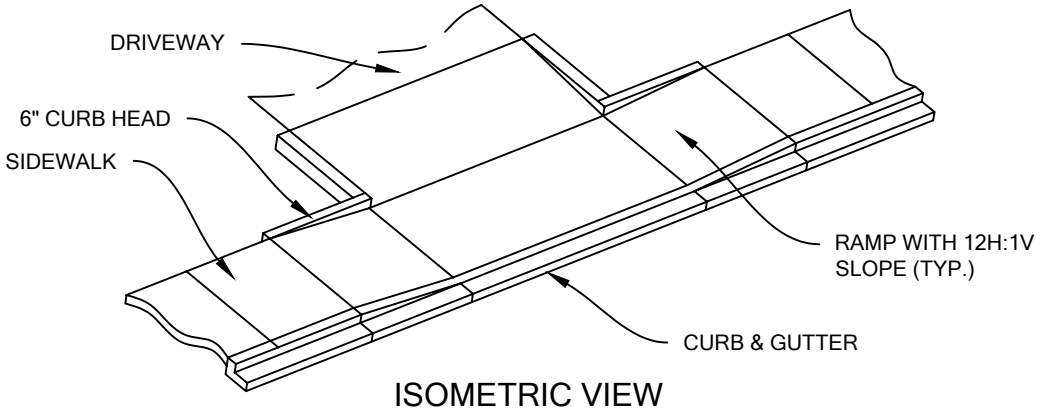




SECTION A-A



SECTION B-B



ISOMETRIC VIEW

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH SIDE OF WARPED SECTION AND EVERY 10' (MAX) ALONG THE DRIVEWAY.
2. EXPANSION JOINT REQUIRED IF DRIVEWAY IS CONCRETE BEHIND CURB CUT.
3. BACK OF CURB CUT EXTENDS TO BACK OF WALK OR BIKE PATH.
4. NO END OF CURB SHALL BE CONSTRUCTED WITHIN 5' - 0" OF A PROPERTY LINE OR 30'- 0" OF A PROPERTY CORNER.
5. TRAFFIC ENGINEER SHALL APPROVE LOCATION OF CURB CUT BEFORE CONSTRUCTION.
6. CONCRETE WITH FIBERMESH REQUIRED.

TYPE OF CUT	WIDTH OF CURB CUT	TOTAL WIDTH	MINIMUM THICKNESS
SINGLE FAMILY	12' - 16'	22' - 26'	6"
MULTI-FAMILY	16' - 25'	26' - 35'	8"
COMMERCIAL	30' - 40'	40' - 50'	10"
ALLEYS	- -	- -	8"

REVISIONS	
DATE	BY
MAR 2015	CMD
NOV 2026	CF

City *of* Louisville
COLORADO - SINCE 1882

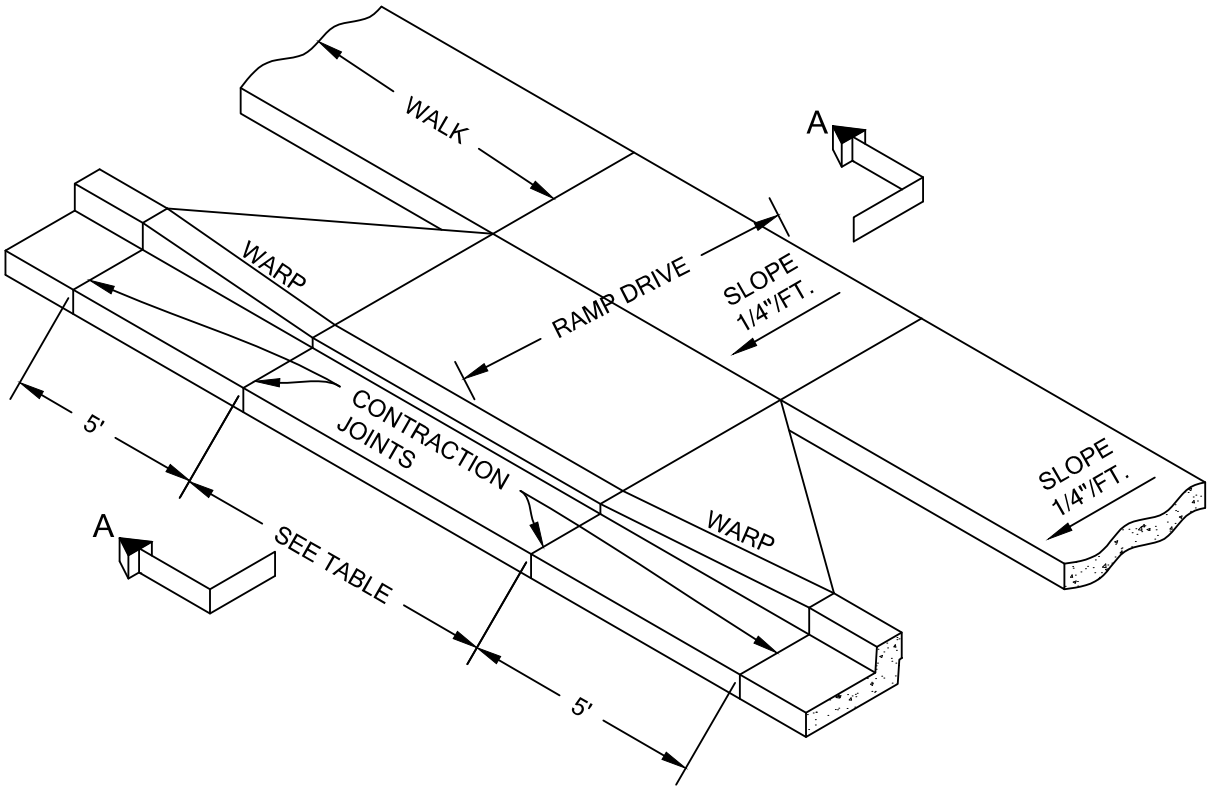
DEPARTMENT OF PUBLIC WORKS

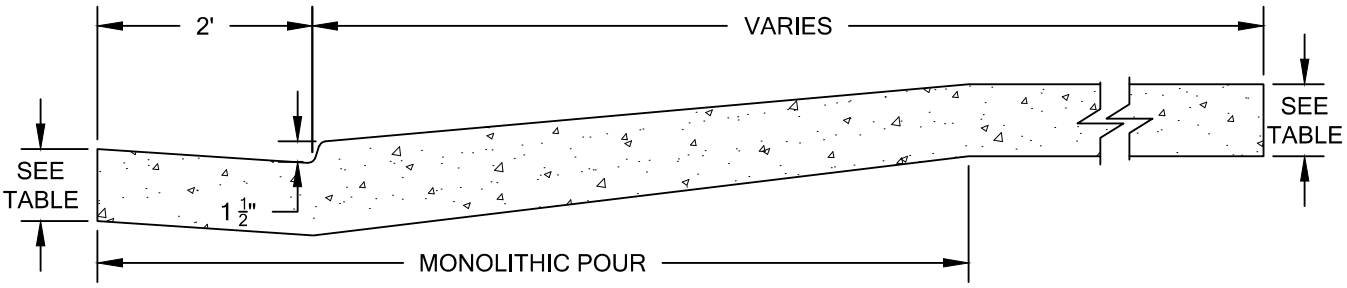
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RAMP DRIVE AT ATTACHED WALK

SHEET
61 OF 75

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SECTION A-A

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH SIDE OF WARPED SECTION AND EVERY 10' (MAX) ALONG THE DRIVEWAY.
2. EXPANSION JOINT REQUIRED IF DRIVEWAY IS CONCRETE BEHIND CURB CUT.
3. BACK OF CURB CUT EXTENDS TO BACK OF WALK OR BIKE PATH.
4. NO END OF CURB SHALL BE CONSTRUCTED WITHIN 5' - 0" OF A PROPERTY LINE OR 30'- 0" OF A PROPERTY CORNER.
5. TRAFFIC ENGINEER SHALL APPROVE LOCATION OF CURB CUT BEFORE CONSTRUCTION.
6. 6.5 SACK CONCRETE WITH FIBERMESH REQUIRED.

TYPE OF CUT	WIDTH OF CURB CUT	TOTAL WIDTH	MINIMUM THICKNESS
SINGLE FAMILY	12' - 16'	22' - 26'	6"
MULTI-FAMILY	16' - 25'	26' - 35'	8"
COMMERCIAL	30' - 40'	40' - 50'	10"

REVISIONS	
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City *of* Louisville
COLORADO - SINCE 1882

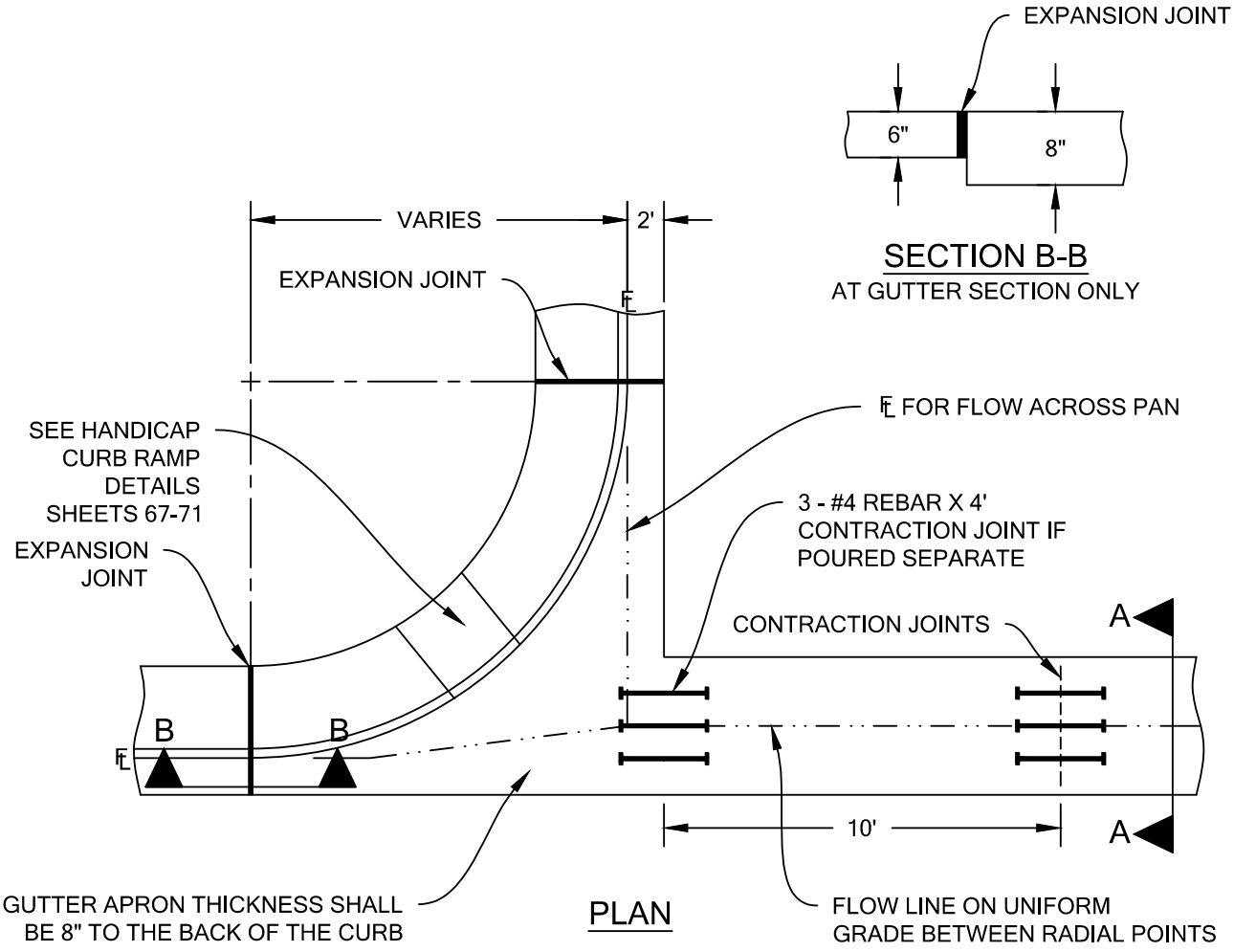
DEPARTMENT OF PUBLIC WORKS

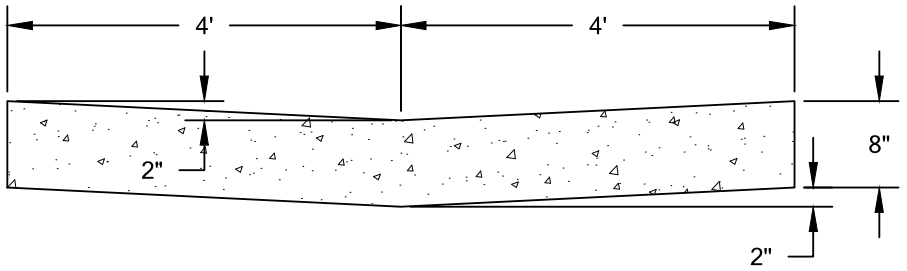
DRAWN BY: ML JAN 94
APPROVED BY: CMD MAR 15

RAMP DRIVE AT DETACHED WALK

SHEET
62 OF 74

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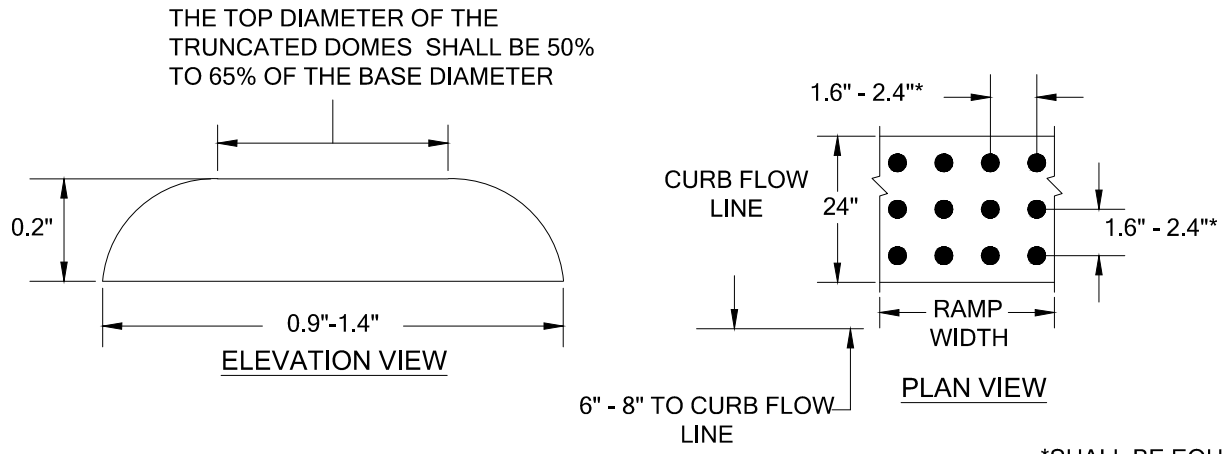
SECTION A-A

NOTES:

1. 6 $\frac{1}{2}$ SACK CONCRETE MIX WITH FIBERMESH REQUIRED.
2. CONTRACTION JOINTS SHALL BE PLACED EVERY 10' MAXIMUM IN CROSSPAN.

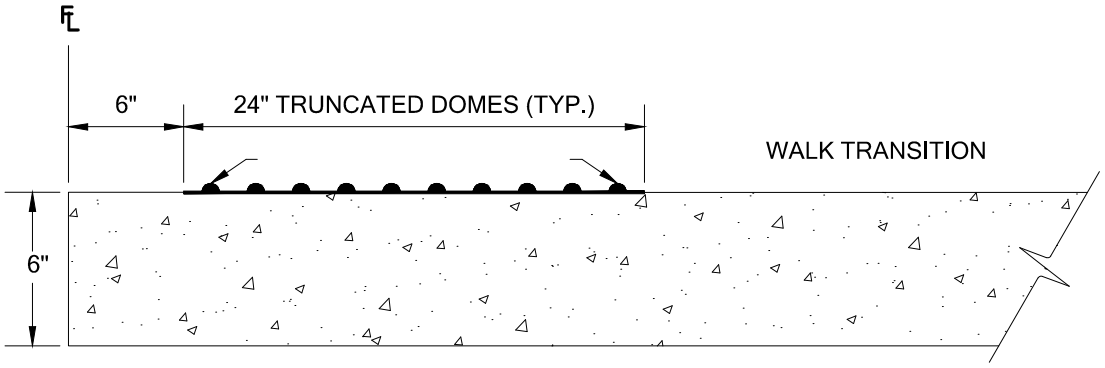
REVISIONS		City *of* Louisville COLORADO - SINCE 1882	DEPARTMENT OF PUBLIC WORKS	DRAWN BY: ML JAN 94 APPROVED BY: CMD MAR 15
DATE	BY			
MAR 2015	CMD			SHEET
		CROSSPAN		63 OF 74

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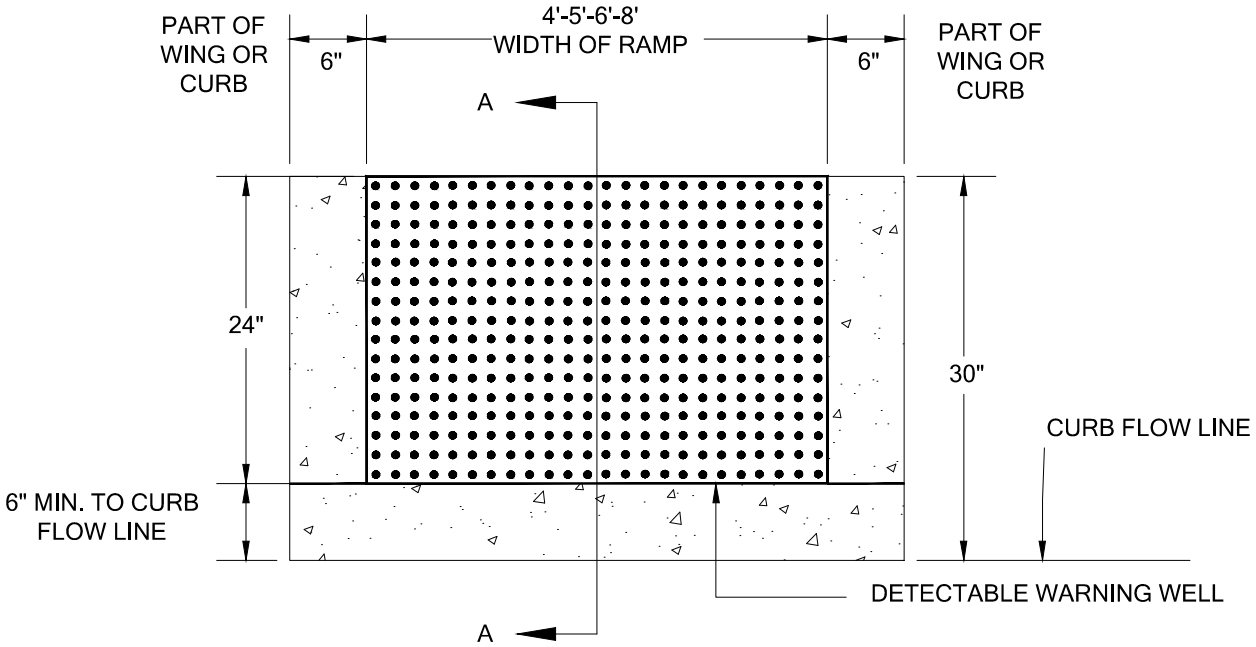


DOME AND DETECTABLE WARNING DETAILS

*SHALL BE EQUAL IN BOTH DIRECTIONS.



DETECTABLE WARNING AND WELL SECTION A-A



DETECTABLE WARNING AND WELL PLAN

(TRUNCATED DOMES NOT DRAWN TO SCALE)

REVISIONS	
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MAR 2015	CMD

City *of* Louisville
COLORADO - SINCE 1882

DEPARTMENT OF PUBLIC WORKS

DRAWN BY: ML JAN 94
APPROVED BY: CMD MAR 15

DETECTABLE WARNING DETAIL 1

SHEET
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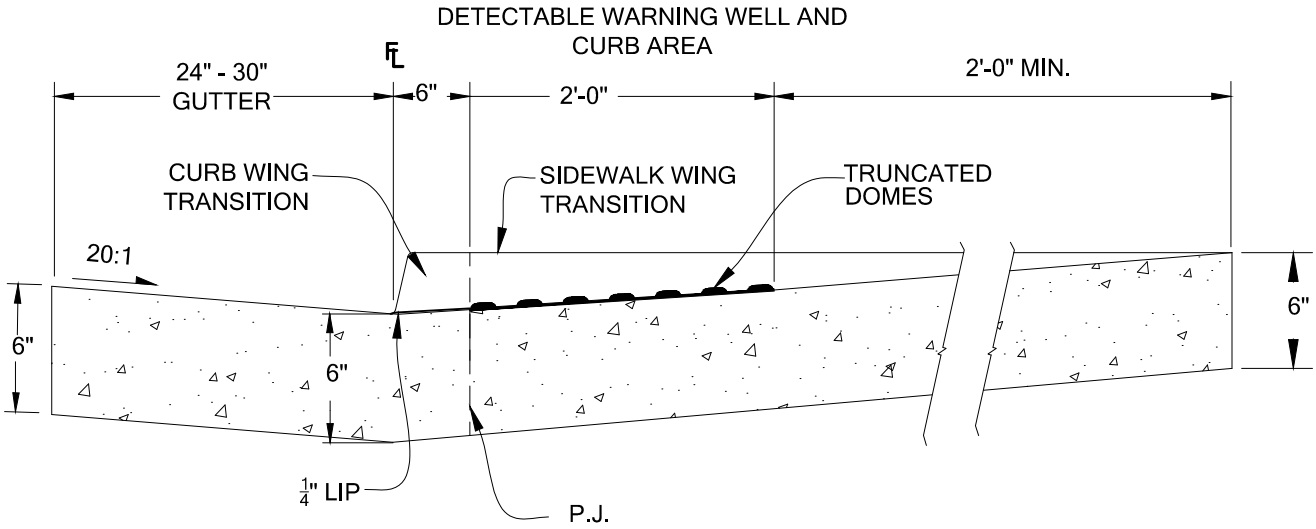
GENERAL NOTES:

1. THE DETECTABLE WARNINGS SHALL BE INSTALLED AT CURB RAMPS. MATERIALS TO BE USED SHALL BE 24"X24" CAST IRON DETECTABLE WARNING PLATE, RED IN COLOR MANUFACTURED BY EAST JORDAN IRON WORKS OR APPROVED EQUAL. A DETECTABLE WARNING AREA SHALL BE INCLUDED IN THE BID PRICE FOR THE CONCRETE CURB RAMP.

2. ALL DETECTABLE WARNING AREAS SHALL START A MINIMUM OF 6 INCHES FROM THE FLOW LINE OF THE CURB. ALL DETECTABLE WARNING AREAS SHALL BE 24 INCHES WIDE AND COVER THE COMPLETE WIDTH OF THE RAMP AREA ONLY.

3. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1 OR 2% AS NOTED. THE CURB AND GUTTER SLOPES SHALL NOT BE STEEPER THAN 20:1.

4. DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES AND OTHER OBSTRUCTIONS SHOULD NOT BE PLACED IN FRONT OF THE RAMP ACCESS AREAS.

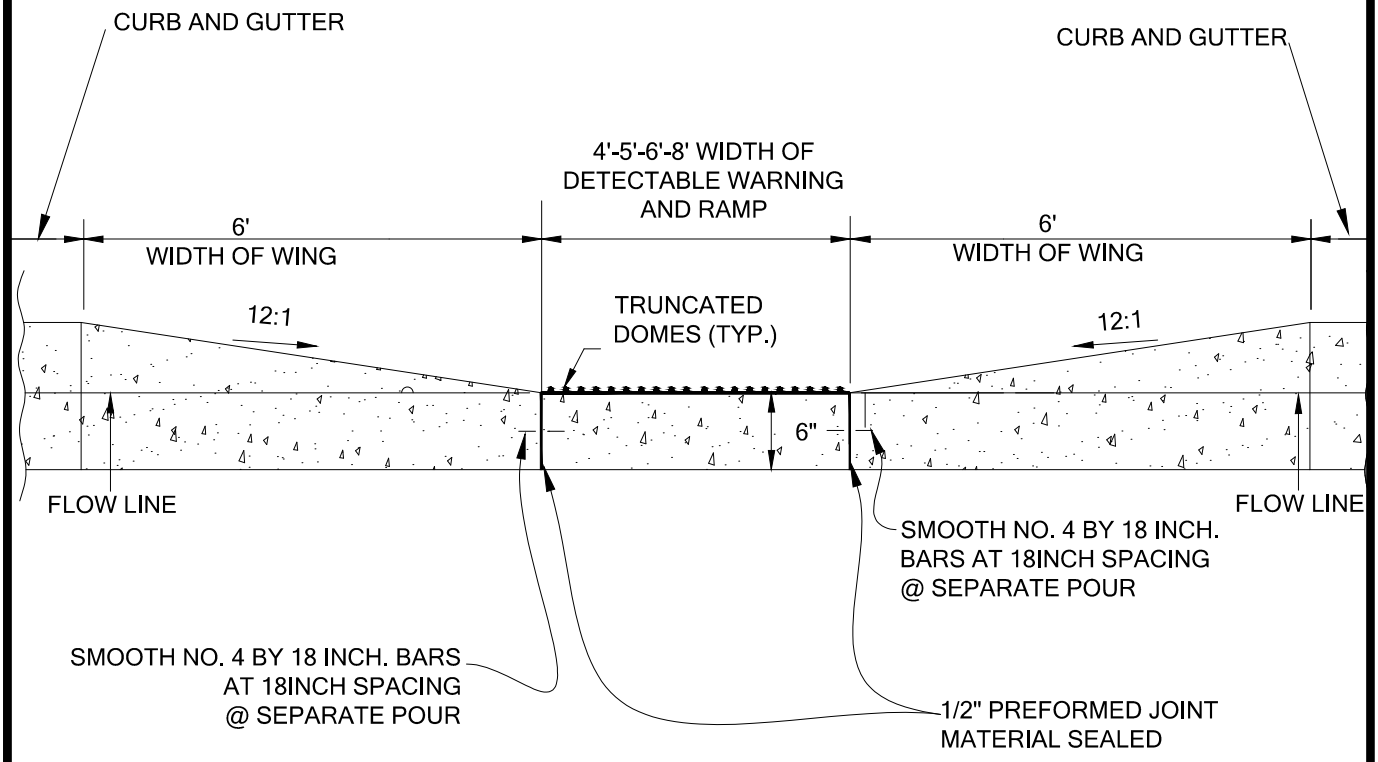


CURB RAMP SIDE CROSS SECTION VIEW OF DETECTABLE WARNING, WELL, CURB, AND GUTTER

P.J. = PERMISSIBLE JOINT WITH EPOXY-COATED DEFORMED NO. 4 BY 18 IN. BARS CONFORMING TO AASHTO M 284 AT 18 IN. SPACING.

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FRONT SECTION VIEW OF DETECTABLE WARNING, WELL, CURB, AND GUTTER CURB RAMP

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COLORADO - SINCE 1882

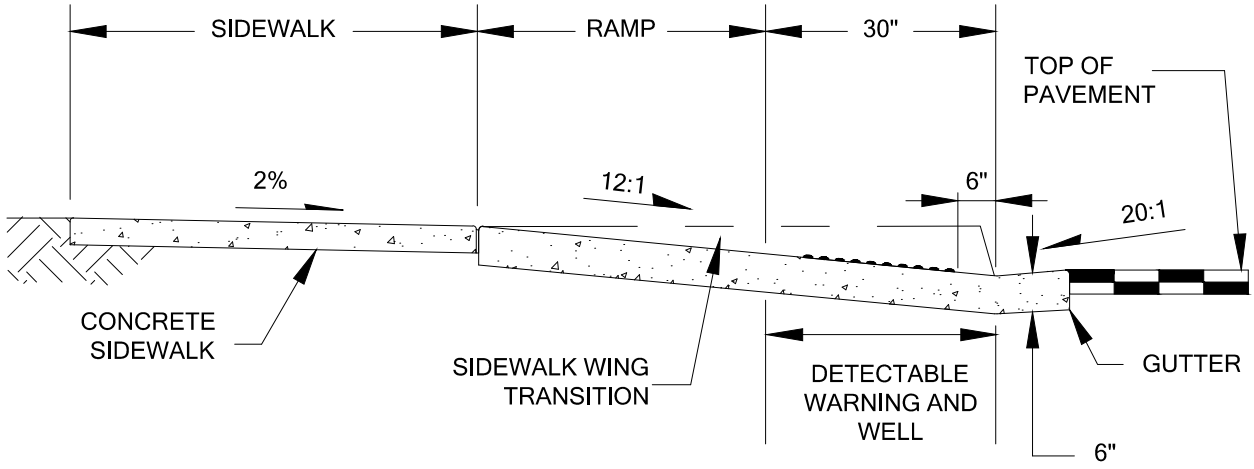
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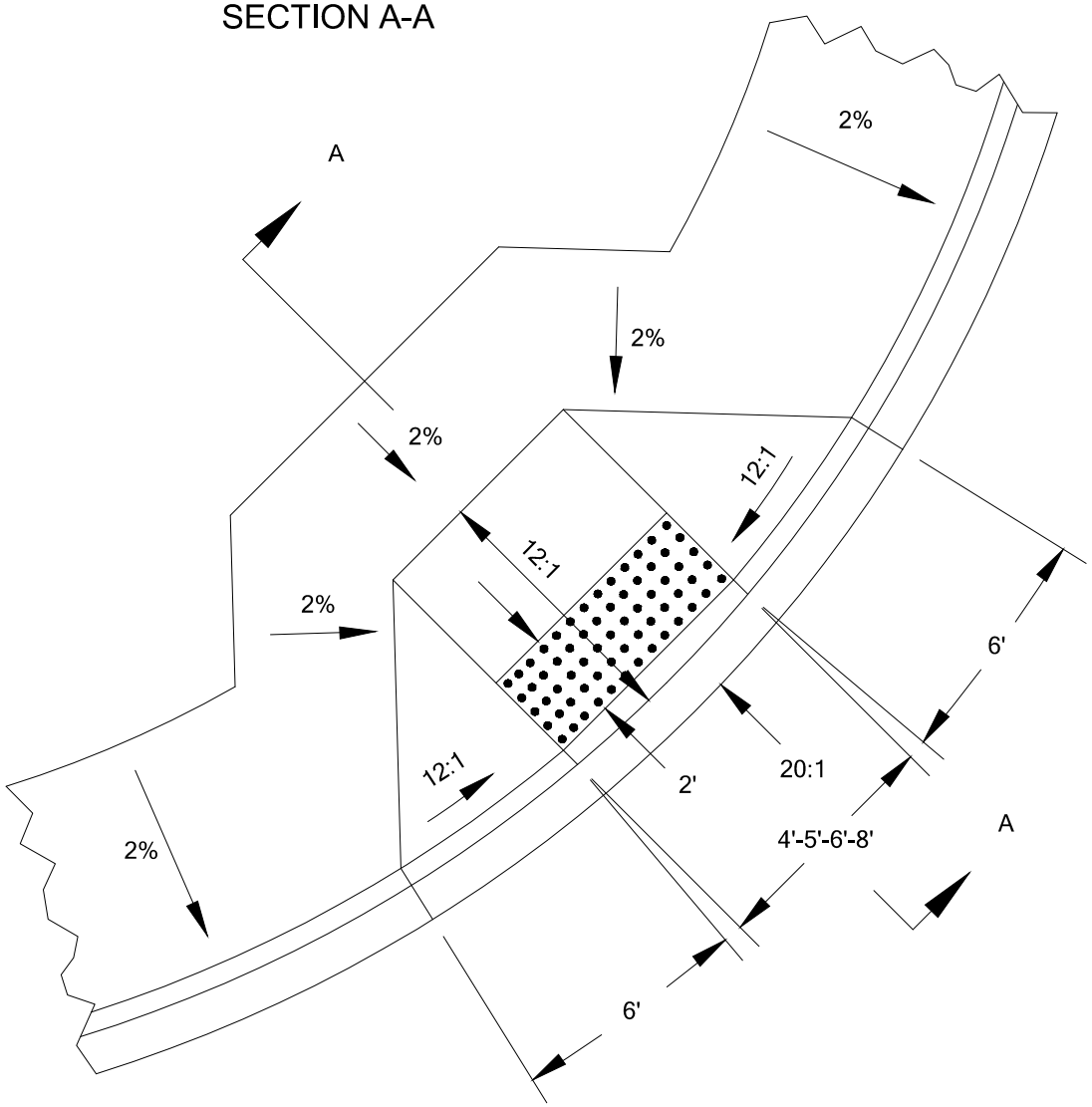
DETECTABLE WARNING DETAIL 3

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TYPICAL CURB RAMP
SECTION A-A



TYPICAL CURB RAMP PLAN

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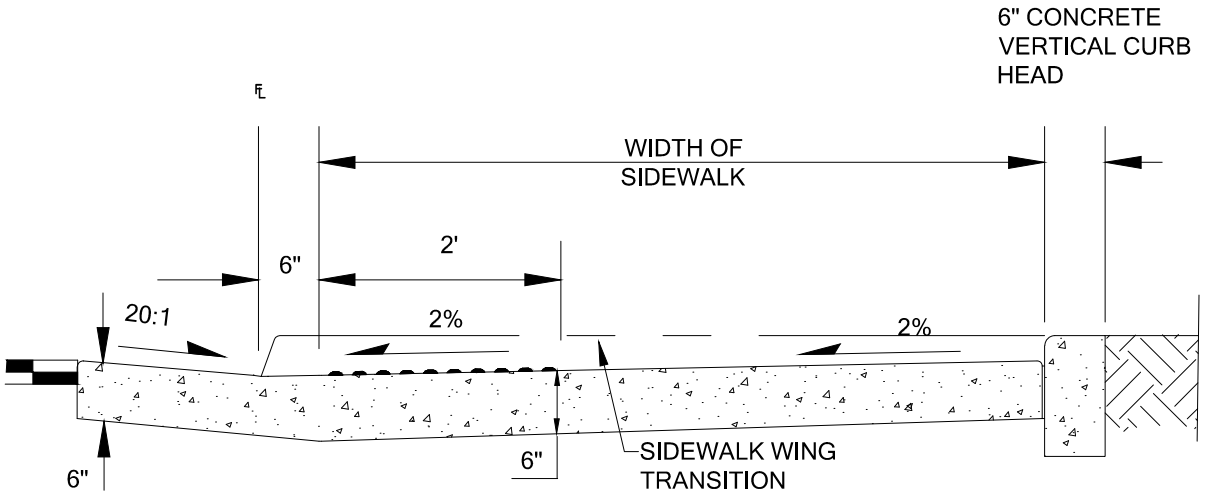
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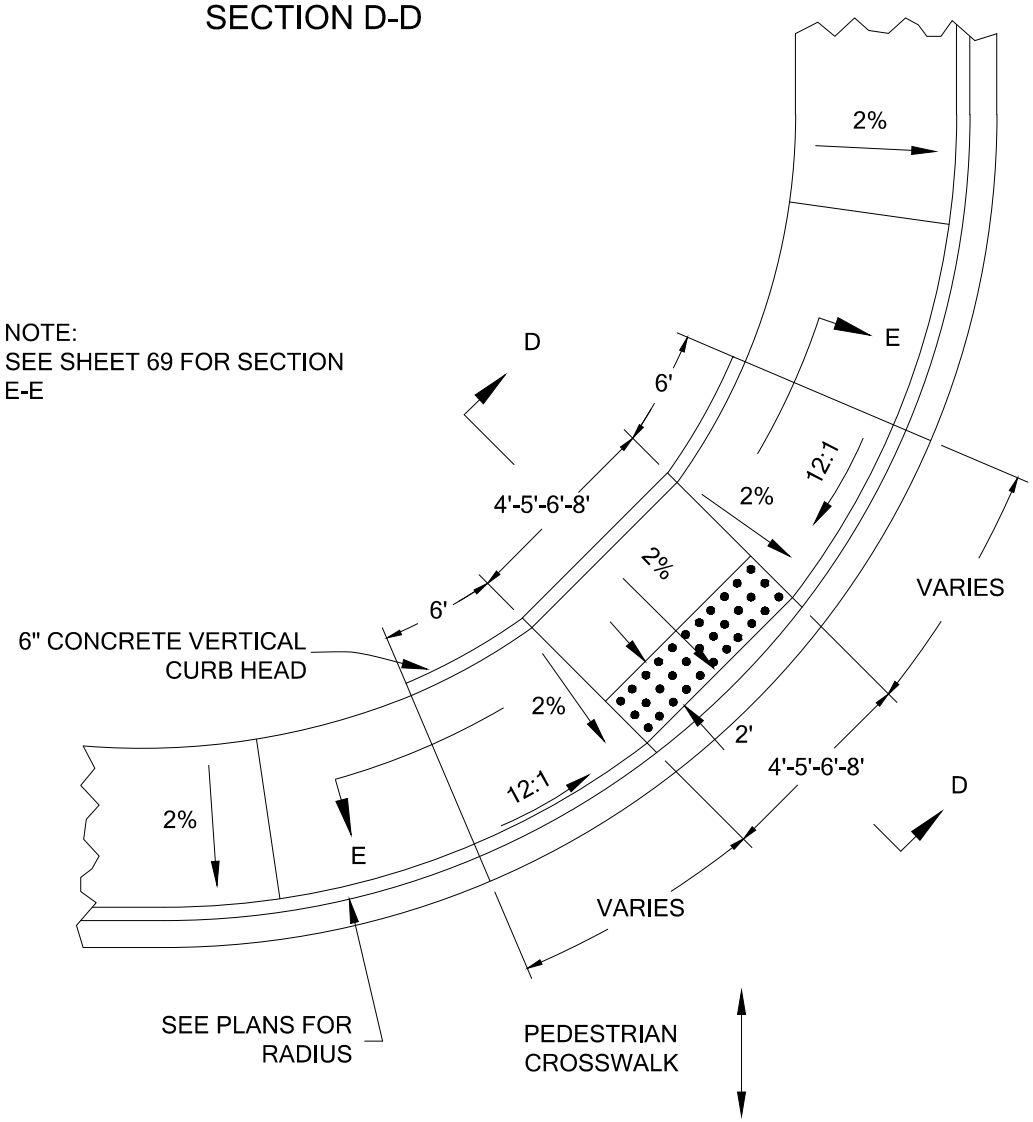
HANDICAP CURB RAMP 1

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TYPICAL CURB RAMP
SECTION D-D



TYPICAL CURB RAMP PLAN

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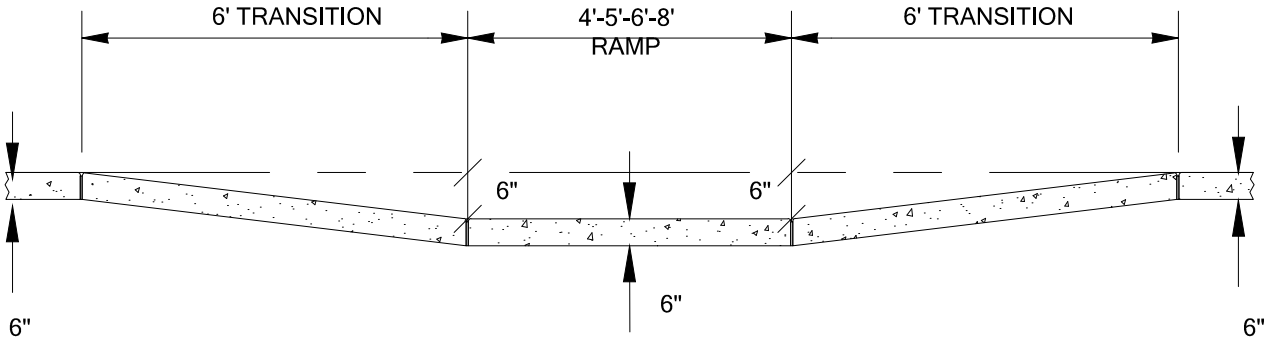
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HANDICAP CURB RAMP 2

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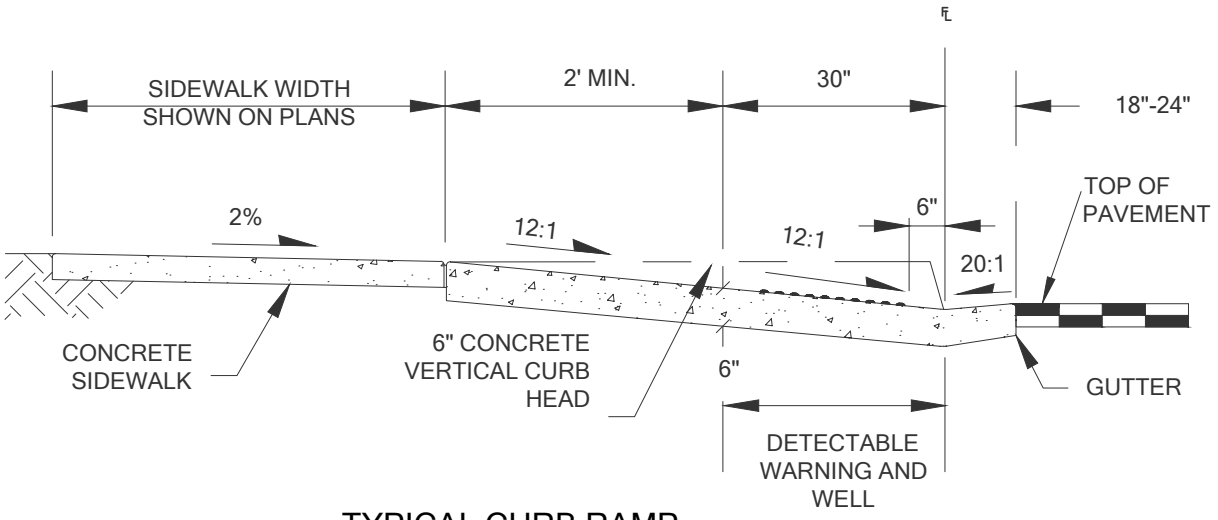
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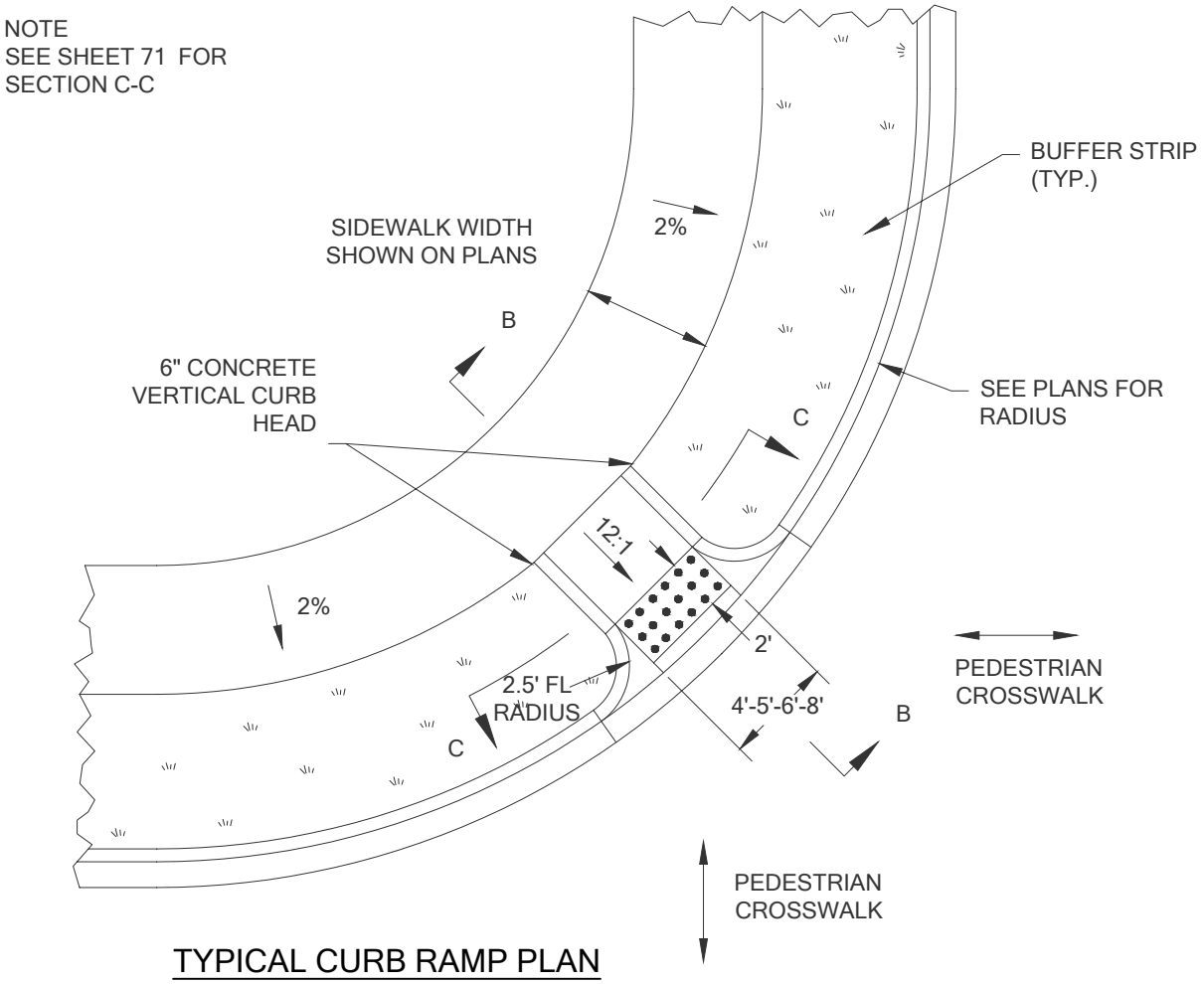
TYPICAL CURB RAMP
SECTION E-E

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TYPICAL CURB RAMP
SECTION B-B



TYPICAL CURB RAMP PLAN

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City *of* Louisville
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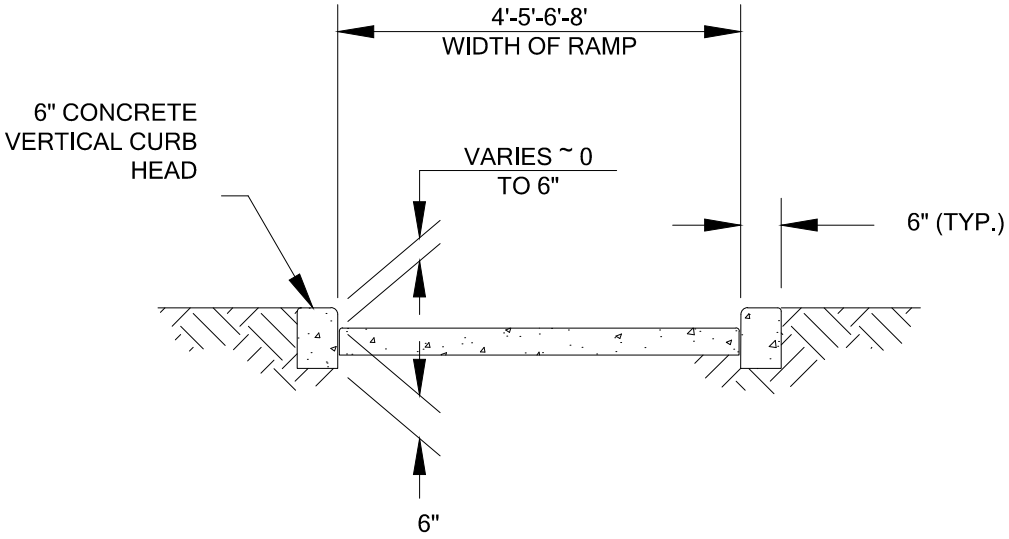
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HANDICAP CURB RAMP 3

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TYPICAL CURB RAMP
SECTION C-C

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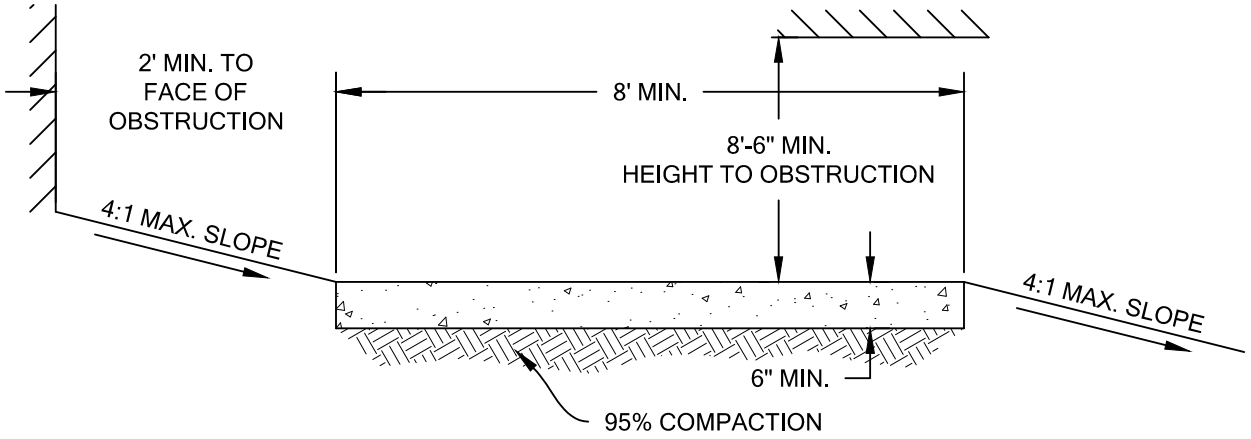
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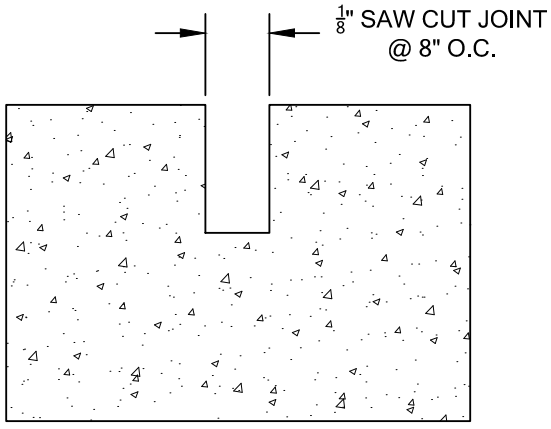
HANDICAP CURB RAMP 3A

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CROSS SECTION - PATH ON INDEPENDENT ROW



SAW CUT JOINT

DEPTH OF JOINT SHALL BE 1" DEEP IN 6" THICK CONCRETE

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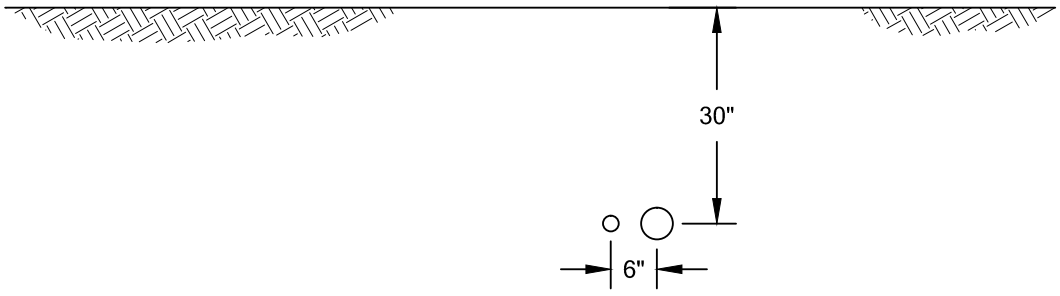
BIKEPATH DESIGN

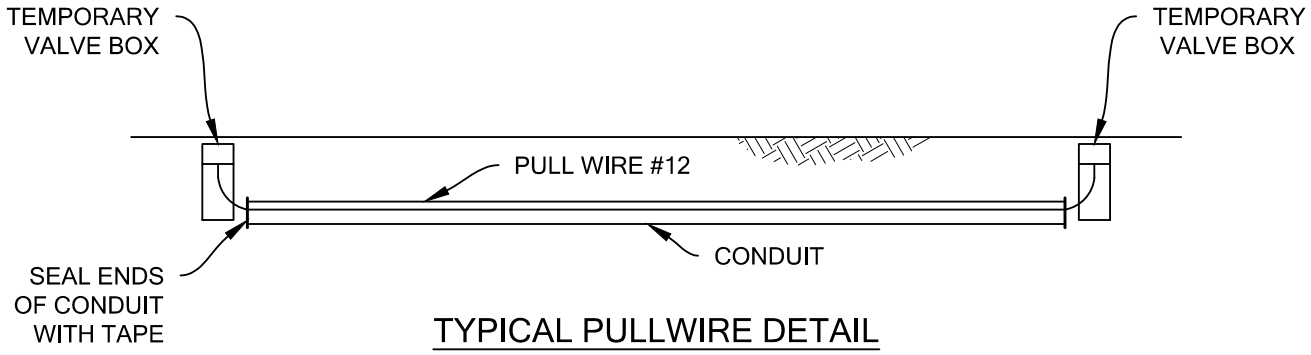
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NOTES:

1. ALL CONDUIT TO BE SCHEDULE 40 PVC.
2. ALL CONDUIT TO BE PROVIDED WITH PULL WIRE.
3. CONDUITS TO BE BEDDED WITH GRANULAR BEDDING MATERIAL 6" BELOW TO 12" OVER TOP OF PIPE.





TYPICAL PULLWIRE DETAIL

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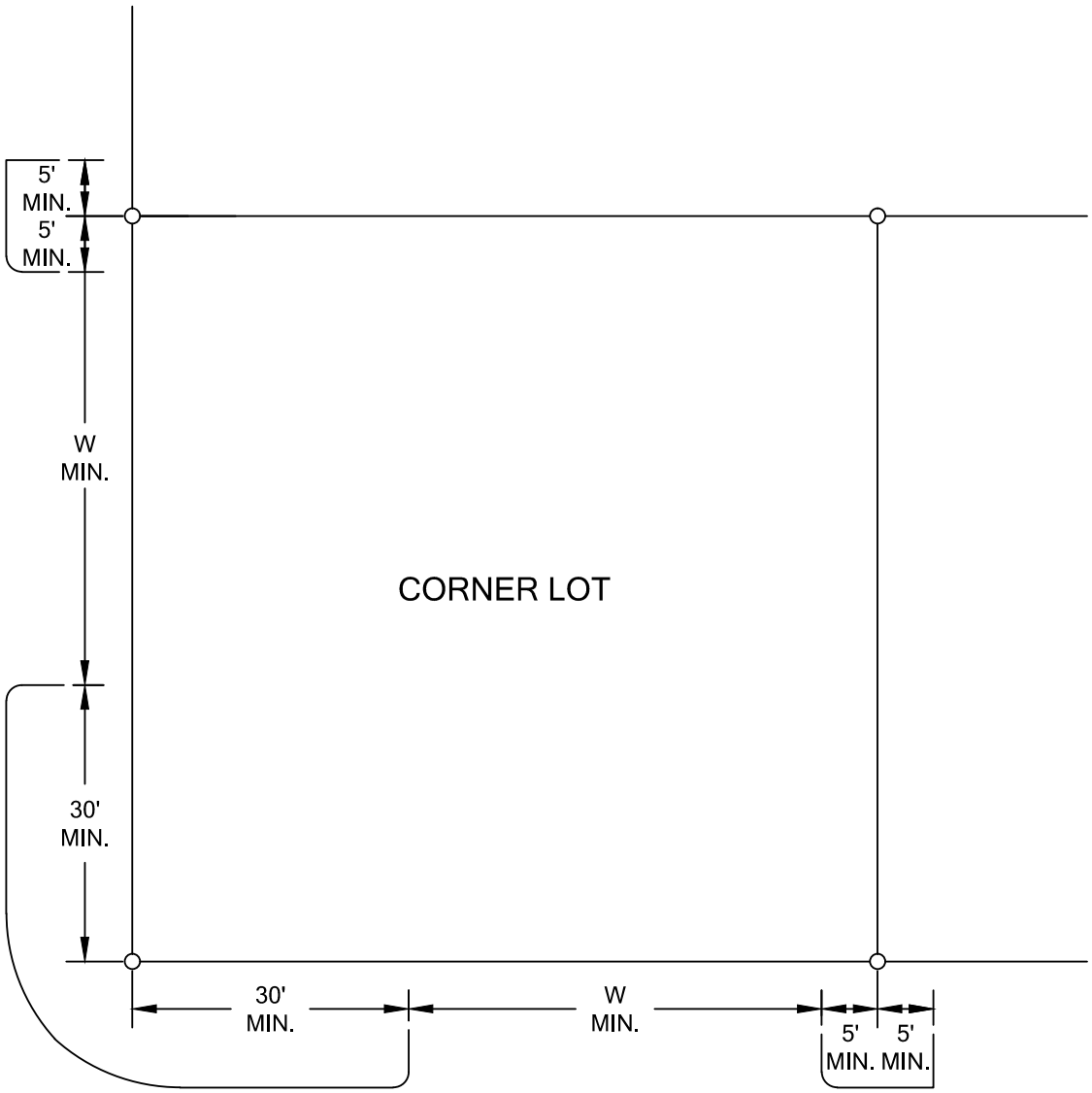
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CONDUIT CROSSING

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NOTES:

1. CURB CUTS ON COMMERCIAL AND INDUSTRIAL STREETS WILL BE EVALUATED ON AN INDIVIDUAL BASIS BY THE PUBLIC WORKS DEPARTMENT.
2. FRONTAGES ON CUL-DE-SACS AND ODD SHAPED LOTS REQUIRE SPECIAL REVIEW.
3. ALL DRIVE CUTS TO BE APPROVED BY ENGINEER.
4. AT INTERSECTION INCLUDING AN ALLEY, MINIMUM DISTANCE SHALL BE 15'.

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