



Design & Construction Standards

August 31, 2007

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FOREWORD

The “Design and Construction Standards – City of Rensselaer” have been prepared to identify the City’s minimum criteria for construction within its jurisdiction.

All construction projects which are to become part of the City's system, to be operated and maintained by the City, shall conform to these standards. Construction drawings and specifications must be approved by the city and a written permit obtained in accordance with existing ordinances before construction begins. In addition, sanitary sewer and water main projects must be submitted to the Indiana Department of Environmental Management (IDEM) for approval. The City will not approve a sanitary sewer or water main project for construction until an approval from IDEM is received.

Construction observation shall be provided by the City. A minimum of 72 hours’ notice shall be given prior to starting construction.

These standards were prepared with the intent of obtaining high quality construction consistent with accepted industry practices and specifications. As new materials become available and acceptable, the standards may be revised and updated.

- All sanitary sewer, pump station and water facilities shall meet the requirements of “Recommended Standards for Wastewater Facilities” and “Recommended Standards for Water Facilities” (commonly referred to as “10 States Standards”).
- An authorized city representative must be present to witness all tests required by these standards or other standards referenced herein.

Copies of the standards may be obtained from the City Building Inspector - City Hall, Rensselaer, Indiana, (219) 866-2311.

**I. BUILDER GUIDELINES FOR SITE DEVELOPMENT
AND BUILDING CONSTRUCTION**

00015 - BUILDER GUIDELINES FOR SITE DEVELOPMENT AND BUILDING CONSTRUCTION

1.1 The following guidelines have been prepared to assist in placing responsibility and providing criteria for orderly development of home sites in Rensselaer, Indiana.

A. Streets and Curbs

1. Once streets and curbs have been inspected and accepted for use, any damage from construction work, including but not limited to tracked equipment, backhoe outriggers, water tap construction, sump pump line construction, fuel and oil spills, or carelessness by employees of the building contractor, or any subcontractors and material suppliers, must be repaired (to the satisfaction of the City) at the building contractor's expense.
2. Streets must be kept clear of debris, construction materials (stone, sand, etc.) and erosion sediment on a daily basis. This includes mud deposited on the street as a result of vehicles leaving the construction site.
3. If necessary, the developer and/or City representative will notify the builder to thoroughly clean the street, including any adjacent street areas that have been "dirtied" as a result of construction activities at a particular building site. If the street is not cleaned by a given date, the developer or the City may clean the street and backcharge the building contractor.
4. Curbs must be protected from damage by tracked and heavy construction equipment that access the building site. Curbing that is cracked, crushed, gouged, scarred or otherwise damaged by carelessness of employees of the building contractor, or any subcontractors and material suppliers must be repaired (to the satisfaction of the City) at the building contractor's expense.

B. Drainage

1. All storm manholes, inlets, drains, and drainage structures (including culverts) must not be disturbed in any manner without permission from the developer and appropriate City representative. If a structure needs to be raised, lowered, moved, or otherwise modified from the plan grade and elevations, it is the building contractor's responsibility to make sure that all work is completed in accordance with granted approvals, by an approved contractor, and at the building contractor's expense. This includes changes necessary to accommodate site grading and landscaping for the building site. Any changes that are made must not reduce the

capacity or in any way change the function of the affected drainage system.

2. All manhole rims must be at or slightly above the finished grade elevation when the final grading and landscaping is completed. Manholes must not be left in a covered (buried) condition. Costs to raise or lower manhole elevations, or to uncover buried manholes, are the responsibility of the building contractor.
3. Any existing drainage swales serving the building site are the responsibility of the building contractor to maintain during construction. Swales have been graded to specific elevations and slopes to provide continuous and uninterrupted drainage for the building site, as well as providing drainage for adjacent properties. The swales have been constructed and seeded in accordance with the subdivision erosion control plan. If the swales are damaged, it is the responsibility of the building contractor, at his expense, to regrade, repair, and reseed the swales to conform to the size, shape, and slope contained in the development and erosion control plan. This includes repair and reconstruction of swales on adjacent properties that have been damaged by carelessness or negligence on the part of the building contractor's employees, subcontractors, or suppliers.
4. Storm sewer inlets and drains on and adjacent to the building site must be protected from sand, stone, mud, silt, and other foreign materials that can accumulate in the inlet, drain, or storm sewer. The building contractor is responsible, at his own expense, for removing such materials in inlets and drains which was caused by carelessness and negligence on the part of his employees, subcontractors, or suppliers, and for cleaning storm sewers of accumulated materials so as to return them to an open and free flowing condition. Upon notice by the developer or City representative to clean storm inlets, drains, or storm sewers, and given a reasonable time to comply, the developer or the City may have the structures cleaned and backcharge the building contractor.
5. New developments have dedicated sump pump and foundation drain collection systems with connection points at each lot within dedicated easements or rights-of-way. In some developments, alternate drainage connections may be available for such connections. Sump pumps must not surface discharge into streets or curbs. Check the development plan or contact the developer regarding the location of said connection points.
6. Downspouts should not be connected to the building foundation drains or to perforated pipe provided for subbase drainage at the curb. Downspouts should surface discharge to the lawn area adjacent to the home or to dedicated sump pump and foundation drain systems.

7. **DO NOT** discharge sump pumps, foundation drains, or downspouts to the sanitary sewer system. Likewise, **DO NOT** drain, directly or indirectly, basement or foundation excavations to the sanitary sewer to remove groundwater or rainfall accumulations. Should such an incident occur, the building contractor will be held responsible for the cost of cleaning and possibly televising sewer segment(s) found to be affected by the introduction of muddy water. These activities are illegal and will be pursued vigorously to the maximum extent possible. The contractor may be liable for costs to treat the extraneous water at the wastewater treatment plant.

C. Sanitary Sewers

1. Sanitary sewers and manholes must not be disturbed in any manner without permission of the developer and appropriate City representative. If the manhole needs to be raised, lowered, moved, or otherwise modified from the plan grade and elevations, it is the building contractor's responsibility to make sure that all work is completed in accordance with granted approvals, by an approved contractor, and at the building contractor's expense. This includes changes necessary to accommodate site grading and landscaping for the building site.
2. All manhole rims must be at or slightly above the finished grade elevation when the final grading and landscaping is completed. Manholes must not be left in a sump condition where accumulated rain or groundwater can accumulate on the cover. Manholes must not be left in a covered (buried) condition. Costs to raise or lower manhole elevations, or to uncover buried manholes, are the responsibility of the building contractor.

D. Excavations

1. All excavations within 5 feet of the back of curb must be backfilled with compacted granular material (#8 stone) or flowable fill. (Example: When tapping water mains, the tap or receiving pit (or any other excavation) must be backfilled as noted.)
2. If the curb or street is undermined when making the excavation, the developer and City representative must be contacted to inspect the excavation and approve the method of backfill. An inspection may also be made of the underdrain to determine if any damage has occurred. All costs to place compacted granular backfill, as well as costs for any curb, street, or underdrain repair associated with the undermining, will be the building contractor's responsibility.

E. Sidewalks at Driveway Crossing

1. Sidewalks must be 6 inches thick (minimum) for the length of sidewalk through driveway crossings. Expansion joint material must be used between the sidewalk and driveway pavement (each side of walk) when concrete drives are constructed. The walkway and subgrade must be constructed in accordance with the detail information contained in the Rensselaer Construction Standards.

F. Erosion Protection

1. Developments of 1 acre or more are required (by state law) to have an approved erosion control plan for the development. The erosion control measures must be in accordance with requirements contained in the state regulation known as "Rule 5". It is the developer's responsibility to obtain the Rule 5 approval.
2. Erosion protection measures, which have been implemented by the developer (for any development), must be restored on those properties that have been damaged as a result of carelessness or negligence of the building contractor's employees, subcontractors, or suppliers. The cost of restoration is the responsibility of the building contractor, and may be backcharged by the developer after sufficient time and notice has been given to make the repairs.
3. Erosion from the building contractor's site must be controlled so that erosion of soils and the deposit of silt does not occur on streets or adjacent property. Erosion protection should be accomplished using industryaccepted measures, such as silt fence, straw bales, etc. Inlets and drains which receive stormwater runoff from the building site must be protected from deposition of silt. (See DRAINAGE)

G. Maintenance of Site

1. Damage to any lot in the development which is attributable to or the result of construction activities on the building contractor's site is the responsibility of the building contractor to repair and return the site to the conditions that existed prior to start of construction. The cost for taking corrective action shall be paid by the building contractor. This includes damage by employees, subcontractors, and material suppliers. Damage includes, but is not limited to, parking or driving any type of vehicle on property other than the property for which the builder is responsible; cleaning of concrete trucks and depositing of leftover materials; placing or storing of building materials; and depositing of dirt, stone, gravel, or any other leftover materials.

2. Costs for removing unwanted deposited materials, and repairing damage to other property, may be backcharged to the building contractor after sufficient time and notice has been given by the developer or the City.
3. All loose trash and leftover material must be controlled and disposed of in an acceptable manner. This includes cleaning up trash and materials that have been allowed to scatter to adjacent or nearby properties. Cleanup of materials and trash should be made on a daily basis to maintain a safe and presentable work site. Costs for cleanup of materials are the responsibility of the building contractor.
4. Once sufficient time and notice has been given, the developer or the City may backcharge the building contractor for any cleanup of extraneous materials or trash that results from the building contractor's work site.

H. Fire Department Connections

1. Where required - In any building or structure required to be equipped with a sprinkler or standpipe system, the fire department connection shall be a 5-inch storz type and shall be located within one hundred (100) feet of a fire hydrant and within fifty (50) feet of a twenty (20) foot wide minimum paved driveway or street.
2. Location of fire department connection shall be approved by the fire chief or his authorized representative prior to construction.

END OF 00015

II. DESIGN STANDARDS FOR STORMWATER AND SUBSURFACE DRAINAGE

DESIGN STANDARDS FOR STORMWATER AND SUBSURFACE DRAINAGE

PART 1 - GENERAL

1.1 GENERAL

- A. The major water transporting components of the stormwater management system, such as storm sewers, grassed waterways and detention basins, shall be constructed at the same general time as the initial street construction.
- B. It shall be illegal for sump pumps, downspouts, or foundation drains to outlet directly to the street or into the right-of-way of the street, or to be connected to the sanitary sewer. Provisions shall be made for sump pumps to be connected to the subsurface drainage system described in Paragraph 1.2.
- C. These standards are to be used in conjunction with the Subdivision Control Ordinance.

1.2 SUBSURFACE DRAINS

- A. The subdivider shall direct his engineer to design a subsurface drainage system to be placed along both sides of the subdivision streets and wherever else within the subdivision that it is determined to be necessary. The purpose of the subsurface piping system is to provide drainage for the street subbase and to create an outlet for foundation drains, and sump pump drains from residences. The subsurface drainage system shall discharge to the storm sewer system or to the surface drainage system upon approval from the City's authorized representative. No subsurface drainage system connections will be permitted to the sanitary sewer system.
- B. Capped, plugged, or exposed connections, terminated at the property line, shall be provided for each subdivided parcel along the subsurface drainage system. The location of each connection termination shall be adequately marked so that it can be field located when the corresponding parcel is developed.
- C. Subsurface drains are required for any grass waterway which drains three (3) acres or more.
- D. Minimum size subsurface drains at the street curb and back yard swales (grassed waterways) serving more than one (1) lot shall be six (6) inches in diameter.

1.3 STORMWATER DETENTION FACILITIES

Plans for stormwater drainage shall include details for stormwater detention. Detention facilities shall be designed using the following guidelines to limit the peak discharge from a development.

- A. For development with drainage areas (tributary to stormwater detention facilities) equal to or greater than ten (10) acres, peak discharge from the detention facility shall be limited to the five (5) year frequency storm peak discharge for the twenty-four (24) hour duration storm.
- B. For developments with drainage areas (tributary to detention facilities) less than ten (10) acres, peak discharge from the detention facility shall be limited to the ten (10) year frequency storm peak discharge for the twenty-four (24) hour duration storm.
- C. The five (5) year/ten (10) year peak discharge shall be based on land use conditions prior to development, using corresponding runoff characteristics and other basin parameters.
- D. Inflow (runoff) to all stormwater detention facilities shall be determined using a one hundred (100) year twenty-four (24) hour storm to develop an inflow hydrograph.
- E. The one hundred (100) year twenty-four (24) hour peak discharge (and inflow hydrograph) shall be based on land use conditions representing fully developed conditions, using corresponding runoff coefficients, travel times, and other basin parameters.
- F. A routing procedure shall be used to demonstrate that the stormwater detention facility will reduce the one hundred (100) year peak discharge, from the developed area, to a peak discharge equal to or less than five (5) year/ten (10) year peak discharge using the pre-development conditions.
- G. The results of the routing procedure shall demonstrate that adequate storage volume has been provided. The detention facility shall not be overtopped from the one hundred (100) year twenty-four (24) hour storm event, and shall have a minimum freeboard of two (2) feet between the maximum routed pool elevation and the top of the facility embankment.
- H. An emergency spillway shall be provided to discharge flow resulting from pool elevations greater than the one hundred (100) year-twenty-four (24) hour pool elevation. The spillway shall have a minimum size adequate to pass the routed one hundred (100) year twenty-four (24) hour storm (assuming that the primary spillway is plugged and non-functional)

without overtopping the detention facility embankment. The elevation of the emergency spillway shall not be placed lower than the routed one hundred (100) year twenty-four hour pool elevation.

- I. Erosion protection shall be provided for the primary outlet and emergency spillway so that the detention facility embankment will be adequately protected. Location of the emergency spillway shall be in undisturbed material, unless otherwise approved by the City's authorized representative.
- J. The minimum allowable size for the primary outlet conduit from the detention facility shall be twelve (12) inches. If further restriction of the outlet conduit is required, the restriction shall be made to the inlet end of the conduit. Restrictions smaller than 12 inches need to have appropriate measures, such as a grate or an inverted elbow, to prevent clogging.
- K. In those instances where the discharge velocity from the primary outlet or emergency spillway is excessive in the opinion of the City's authorized representative, energy dissipation may be required.
- L. Detention facilities, which are designed to have dry bottoms, must be designed to include underdrains to drain the bottom of the detention facility so that the facility can be maintained. Also, the bottom of the facility shall be designed to have longitudinal and transverse grade to the outlet so that the facility will empty leaving no ponded water. See Section (P) below for wet detention facility requirements.
- M. Methodology for developing peak discharges and runoff hydrographs shall be the Natural Resources Conservation Service (NRCS) TR-55 procedure or another comparable procedure approved by the City's authorized representative.
- N. Peak discharge calculations shall be submitted for the five (5) year/ten (10) year pre-development and one hundred (100) year post-development conditions. The calculations shall show the drainage area, the NRCS runoff curve numbers, the time of concentrations, and other basin parameters used to develop the appropriate peak discharges.
- O. Calculations shall be submitted which show stage-discharge relationships (rating curves) for the primary outlet and emergency spillway, the stage-storage relationship for the detention facility, the inflow hydrograph for the one hundred (100) year twenty-four (24) hour storm, and the routed one hundred (100) year-twenty-four (24) hour discharge hydrograph.
- P. Wet Detention Basin Design Requirements – Refer to Indiana Storm Water Quality Manual: Planning and Specification Guide for Effective

Erosion and Sediment Control and Post-Construction Water Quality,
IDEM, October 2007.

- Q. Maintenance Plan and Responsible Party Designation - A maintenance plan is required for all detention facilities. All cost for detention pond maintenance and inspection is the responsibility of the owner of the detention facility. The City will not participate in such cost. The maintenance plan shall include:
1. Identification of the responsible party for the operation, maintenance and documentation of the plan. The funding source for these activities shall be identified. A signed letter from the responsible party stating that they agree to maintain the detention facility (or facilities) shall be submitted to the City. If the property is sold, the new owner must resubmit a letter of responsibility.
 2. Inspection for damage to insure structural integrity of spillway and embankments and proper function of inlet and outlet structures. Inspections shall be done quarterly, at a minimum, and accumulated debris shall be removed. All inspection reports shall be done using the form at the end of this section and completed inspection forms shall be submitted to the City Street Superintendent.
 3. Establishment of grass or other suitable vegetative cover throughout the entire basin area, except in the permanent pool area for a wet detention basin. Grass should be cut regularly at approximately monthly intervals during the growing season or as required.
 4. Removal of debris and trash in the facility, especially from inlet and outlet structures and the emergency overflow to assure continued operation in conformance with the design. This should be done during the quarterly inspections or as necessary.
 5. Clearing embankments of woody vegetation, and providing access to perform the operation and maintenance activities annually or as needed
 6. Repair of undercut or eroded areas as needed

For wet detention facilities:

7. Monitoring for sediment accumulation in the wet detention facility and sediment forebay area
8. Removal of sediment from the forebay every five (5) to seven (7) years or more often if needed
9. Removal of sediment from the permanent pool when sediment reaches two (2) feet below the normal water level or it becomes eutrophic. This should be done about every twenty (20) to twenty-five (25) years or as appropriate for the individual facility

10. If a wetland component is present, inspect for invasive vegetation and remove semiannually

1.4 STORMWATER SEWER SYSTEM

- A. The subdivider shall provide the subdivision with an adequate stormwater sewer system whenever curbs and gutters are installed and whenever the evidence available to the City indicates that natural surface drainage is inadequate. When the surface drainage is adequate, easements for such surface drainage shall be provided. Curbs and gutters along streets are required; however, if the City finds it necessary to waive this requirement, a shallow swale with its low point at least three (3) feet below the elevation of the subgrade of the pavement shall be installed. In this case, one of the following types of improvements shall be furnished by the developer / owner at driveway crossings:
 1. A corrugated metal pipe, at least twelve (12) inches in diameter and fourteen (14) feet in length, to be placed where required for each driveway; or
 2. A properly dipped or swaled concrete pavement, twenty-four (24) feet in length, six (6) feet in width, and six (6) inches thick, designed so as not to create a hazard to the under parts of automobiles, at the entrance of each driveway.
- B. The stormwater drainage system shall be separate and independent of any sanitary sewer system.
- C. Storm drainage facilities shall be located in the street right-of-way, where feasible, or in perpetual, unobstructed easements in accordance with the details on the Construction Plans provide by the subdivider's engineer. The following easement widths shall apply:

<u>Area or Situation</u>	<u>Easement Width</u>
Storm Sewer (up to 24")	25 feet
Storm Sewer (24" or larger)	25 feet
Grassed Waterways (including equivalent sized lined channels)	Width of channel plus 15 feet
Subsurface Drain	20 feet
Open Outlet Channel (including equivalent sized lined channels)	20 feet from top of each bank
Detention Basins	Elevation of the emergency spillway design flow, plus 20 feet horizontally

- D. Storm sewer inlets shall be provided so that surface water is not carried across or around any intersection and does not travel a distance of more

than 600 feet in the gutter. In addition, the following spread requirements shall be met:

Type of Facility	Design Frequency	Allowable Spread
Multilane Non-Freeway	10-year	Across one-half travel lane
All Two-lane Facilities	10-year	4 ft onto travel lane
Bridge Deck (Non-Freeway)		
$V \geq 50$ mi/h	10-year	Edge of travel lane
$V < 50$ mi/h	10-year	3 ft onto travel lane

Adopted from the Indiana Department of Transportation Design Manual, August 1999, Figure 36-7A

- E. It is the responsibility of the subdivider to keep all major watercourses, drainage systems, etc., not under the jurisdiction of any public agency, open and free flowing.
- F. Drainage facilities shall be capable of accommodating a one hundred (100) year rainfall intensity without endangering the public safety and health or causing significant damage to property as determined by the City. In addition;
 - 1. Open channels within public drainage easements shall be capable of accommodating a fifty (50) year rainfall intensity within the drainage easement; and,
 - 2. Culverts shall be capable of accommodating a twenty-five (25) year rainfall intensity (no road overtopping) when crossing under a road which:
 - a. Carries a higher volume of traffic than other adjacent routes, or has the potential for carrying such volumes; and
 - b. Is a part of a pattern of arterial routes for the entire urban area; and,
 - c. Is oriented primarily to moving traffic rather than serving abutting land use.
 - 3. Minimum pipe size shall be twelve (12) inches reinforced concrete or fifteen (15) inches corrugated metal pipe.
- G. Any alteration of an existing open outlet channel, traversing a development, shall be sized to contain a minimum twenty-five (25) year frequency storm or the capacity of the existing channel, whichever is greater.

H. Design Calculations. Design calculations are required as part of the drainage plan and shall specifically include:

1. Estimate of stormwater runoff:
 - a. Drainage area map, including indication of drainage patterns for lots and blocks.
 - b. Weighted runoff coefficient computations.
 - c. Time of concentration computation indicating overland flow time and flow time in the swale, gutter, pipe, or channel.

Runoff coefficients and rainfall intensity-duration-frequency values to be used for the analysis are provided in Table II-A, II-B, II-C and II-D below.

TABLE II-A – Values Used to Determine a Composite Runoff Coefficient⁽¹⁾

<u>Type of Surface</u>	<u>Runoff Coefficient “C”</u>
Asphalt	0.82
Concrete	0.85
Roof	0.85
<u>Lawns (Sandy)</u>	
Flat (0-2% Slope)	0.07
Rolling (2-7% Slope)	0.12
Steep (greater than 7%)	0.17
<u>Lawns (Clay)</u>	
Flat (0-2% Slope)	0.16
Rolling (2-7% Slope)	0.21
Steep (greater than 7%)	0.30

The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

<u>Return Period (years)</u>	<u>Multiply “C” by</u>
25	1.1
50	1.2
100	1.25

⁽¹⁾ Adopted from Jasper County Indiana Drainage Specifications, 1997, Table 1

(1)

TABLE II-B – Rural Runoff Coefficients

Type of Surface	Runoff Coefficient “C”
Woodland (Sandy)	
Flat (0-5% Slope)	0.10
Rolling (5-10% Slope)	0.25
Steep (greater than 10%)	0.30
Woodland (Clay)	
Rolling	0.30
Steep	0.35
Steep	0.50
Pasture (Sandy)	
Flat	0.10
Rolling	0.16
Steep	0.22
Pasture (Clay)	
Flat	0.30
Rolling	0.36
Steep	0.42
Cultivated (Sandy)	
Flat	0.30
Rolling	0.40
Steep	0.52
Cultivated (Clay)	
Flat	0.50
Rolling	0.60
Steep	0.72

The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

<u>Return Period (years)</u>	<u>Multiply “C” by</u>
25	1.1
50	1.2
100	1.25

(1) Adopted from Jasper County Indiana Drainage Specifications, 1997, Table 1A

(1)

TABLE II-C – Runoff Coefficients “C” by Land Use and Typical Inlet Times

Land Use	Runoff Coefficients			Inlet Times (minutes)
	Flat	Rolling	Steep	
Commercial (CBD)	0.75	0.83	0.91	5
Commercial (Neighborhood)	0.54	0.60	0.66	5 – 10
Industrial	0.63	0.70	0.77	
Garden Apartments	0.54	0.60	0.66	
Churches	0.54	0.60	0.66	
Schools	0.31	0.35	0.39	10 – 15
Semi Detached Residential	0.45	0.50	0.55	
Detached Residential	0.40	0.45	0.50	
Quarter Acre Lots	0.36	0.40	0.44	
Half Acre Lots	0.31	0.35	0.39	
Parks	0.18	0.20	0.22	To Be Computed

General Notes:

1. Flat terrain is 0 – 2% slopes
2. Rolling terrain is 2 – 7% slopes
3. Steep terrain is greater than 7% slopes
4. Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgment.
5. The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

<u>Return Period (years)</u>	<u>Multiply “C” by</u>
25	1.1
50	1.2
100	1.25

(1) Adopted from Jasper County Indiana Drainage Specifications, 1997, Table 2

Table II-D – Rainfall Intensities for Various Return Periods and Storm Durations						
Intensity (Inches/Hour)						
Duration	Return Period (Years)					
	2	5	10	25	50	100
5 Min.	5.04	6.24	7.08	8.16	9.00	9.84
10 Min.	3.84	7.74	5.46	6.24	6.90	7.50
15 Min.	3.20	3.96	4.52	5.16	5.72	6.20
20 Min.	2.85	3.51	4.02	4.59	5.10	5.55
30 Min.	2.22	2.74	3.12	3.58	3.96	4.32
40 Min.	1.85	2.28	2.61	2.99	3.30	3.60
50 Min.	1.60	1.97	2.24	2.57	2.83	3.10
1 Hr.	1.40	1.73	1.97	2.25	2.49	2.72
1.5 Hrs.	1.13	1.39	1.59	1.82	2.02	2.20
2 Hrs.	0.86	1.06	1.21	1.38	1.53	1.67
3 Hrs.	0.61	0.76	0.87	0.99	1.10	1.20
4 Hrs.	0.52	0.64	0.73	0.83	0.92	1.00
5 Hrs.	0.43	0.53	0.61	0.70	0.77	0.84
6 Hrs.	0.37	0.46	0.52	0.60	0.66	0.72
7 Hrs.	0.33	0.41	0.47	0.53	0.59	0.64
8 Hrs.	0.29	0.36	0.42	0.47	0.53	0.57
9 Hrs.	0.27	0.33	0.38	0.43	0.48	0.52
10 Hrs.	0.25	0.31	0.35	0.40	0.44	0.48
12 Hrs.	0.22	0.27	0.30	0.35	0.38	0.42
14 Hrs.	0.19	0.24	0.27	0.31	0.34	0.37
16 Hrs.	0.17	0.21	0.24	0.28	0.31	0.34
18 Hrs.	0.16	0.19	0.22	0.25	0.28	0.31
20 Hrs.	0.14	0.18	0.20	0.23	0.26	0.28
24 Hrs.	0.13	0.15	0.18	0.20	0.22	0.24

Source: Jasper County Indiana Drainage Specifications, 1997, Table 5A

2. Closed conduit and open channel design computations:
 - a. Size of pipe or channel cross section.
 - b. Pipe or channel invert slope in percent.
 - c. Roughness coefficient.
 - d. Flowing velocities in feet per second.
 - e. Design capacity in cubic feet per second.
 3. Head loss computations in manholes and junction chambers.
 4. Hydraulic gradient computation, wherever applicable.
- I. On-site drainage facilities shall be sufficient to accept:
1. The stormwater runoff from the parcel after development; and
 2. The present stormwater runoff from developed areas upstream; and
 3. The present stormwater runoff from undeveloped areas upstream; and
 4. The part of the stormwater runoff attributable to future development in undeveloped areas upstream, which is not reasonably likely to be accommodated in such upstream areas as determined by the City:
- J. Each applicant, person, corporation, or other entity which makes any surface changes shall be required to:
1. Collect on-site surface runoff and springs and dispose of it to the point of discharge into an adequate outlet approved by the City.
 2. Handle existing and potential off-site runoff through the development by designing to adequately handle storm runoff from a fully developed area upstream.
 3. Pay his proportionate share of the total cost of offsite improvements to the common natural watercourse, based on a fully developed drainage area.
 4. Provide and install at his expense, in accordance with the requirements of the Ordinance, all drainage and erosion control improvements.
- K. When a proposed drainage system shall carry water across private lands outside the subdivision, appropriate drainage rights must be secured by the subdivider and indicated on the plat as determined by the City.
- L. The approval of the Indiana Department of Natural Resources and the U.S. Army Corps of Engineers must be obtained and their requirements must be followed for all areas within their jurisdiction.

1.5 SURFACE GRADING FOR DRAINAGE

- A. In order to provide more suitable sites of building and other uses, improve surface drainage, and control erosion, the following requirements shall be met:
1. The locations, grading, and placement of subgrade (base) material of all street, public driveway, and public parking areas shall be accomplished as 'the first work done on a development plan.
 2. All lots, tracts, or parcels shall be graded to provide for proper drainage away from the buildings and for proper disposal without ponding, and all land within the development shall be graded to drain and dispose of surface water without ponding, except where approved by the City. Around each permanent building foundation there shall be a slope with a minimum vertical fall of six (6) inches for the area measured from the foundation to a point ten (10) feet from the building foundation or to the property line, whichever is closer.
 3. All drainage provisions shall be of such design to adequately handle the surface runoff and carry it to the nearest suitable outlet such as a curbed street, storm drain, or natural watercourse. Where drainage swales are used to divert surface waters away from buildings, they shall be sodded or planted, as required, and shall be of such slope, shape, and size as to conform with the requirements of the City.
 4. Concentration of surface water runoff shall only be permitted in swales or watercourses.
 5. Land alteration shall be accomplished in such a way that the grades left at the time that the work is completed will be permanent and stable.
 6. Excavation and Fills
 - a. Cut and fill slopes shall not be steeper than three to one (3:1), unless stabilized by a retaining wall or cribbing as approved by the City when handled under special conditions.
 - b. Provisions shall be made to prevent surface water from damaging the cut face of excavations or the sloping surfaces of fills, by installation of temporary or permanent drainage across or above this area.
 - c. Cuts and fills shall not endanger adjoining property.
 - d. Fill shall be placed and compacted so as to prevent sliding or erosion of the soil.
 - e. Fills shall not encroach or impede flows of natural watercourses or constructed channels.

- f. Fills placed adjacent to natural watercourses or constructed channels shall have protection against erosion during this period of construction as required by the City and State.
- g. Grading shall not be done in such a way so as to divert water onto the property of another land owner without the expressed consent of the land owner and the City.
- h. During grading operations, necessary measures for dust control shall be exercised.
- i. Grading equipment shall not be allowed to cross live streams. Provision shall be made for the installation of temporary or permanent culverts or bridges.

1.6 RESPONSIBILITY FOR DRAINAGE AND EROSION CONTROL

- A. Whenever sedimentation is caused by stripping of vegetation, regrading, or other development activities, it shall be the responsibility of the applicant, person, corporation, or other entity causing such sedimentation to remove it from all adjoining surfaces, drainage systems, and watercourses, and to repair any damage at his expense within seven (7) days.
- B. Maintenance of all driveways, parking areas, drainage facilities, and watercourses within any development plan area is the responsibility of the applicant or developer, provided that said facilities have not been dedicated to the public and accepted by the appropriate authority for public maintenance.
- C. It is the responsibility of the applicant and any person, corporation, or other entity doing any action on or across a communal stream, watercourse, or swale, or upon the flood plain or floodway of any watercourse during the period of development, to return these areas to their original or equal conditions upon completion of said activities.
- D. No applicant or person, corporation, or other entity shall block or impede the flow, construct any structure or alteration, deposit any material or thing, or commit any act which will affect normal or flood flow, in any communal stream or watercourse without having obtained prior approval from the County Drainage Board and/or the Indiana Department of Natural Resources, Division of Water, whichever is applicable.

City of Rensselaer
Storm Water Detention Facility Quarterly Inspection Form

SUBMIT FORM WITHIN 30 DAYS OF THE END OF EACH QUARTER TO THE CITY
(Form due dates: January 1, April 1, July 1, and October 1)

Detention Facility Property Owner: _____
Detention Facility Structure Responsible Party (if different than Owner): _____
Detention Facility Location: _____
Phone Number of Owner or Responsible Party: _____
Detention Facility/ Structure Type (circle one): Wet Detention Dry Detention
Name of Person Conducting the Inspection: _____
Signature: _____
Inspection Date: _____

QUARTERLY INSPECTION ITEMS
CIRCLE "YES" OR "NO" FOR ALL ITEMS BELOW

- | | | |
|---|-----|----|
| A. Has debris or trash accumulated in the basin or at the inlet, outlet or emergency spillway structures? | YES | NO |
| B. Are noxious weeds present that prevent the desired vegetation from growing properly? | YES | NO |
| C. Is woody vegetation growing on the embankments? | YES | NO |
| D. Is there adequate access to perform operations and maintenance activities? | YES | NO |
| E. Is there exposed soil not covered with vegetation, mulch, or other non-erodible material? | YES | NO |
| F. Is algae or stagnant moisture present in the detention facility? | YES | NO |
| G. Are unpleasant odors emerging from the detention facility? | YES | NO |
| H. Has sediment accumulated in the detention facility? | YES | NO |
| I. Is soil erosion present along standing or moving surface water? | YES | NO |
| J. Is soil erosion present at the basin sides, inlet, or outlet? | YES | NO |
| K. Are there any signs of damage to the inlet, outlet or emergency spillway structures? | YES | NO |
| L. Are holes present from animals or undesirable soil loss? | YES | NO |
| M. Are wet or soggy areas present that prevent desired vegetation from growing? | YES | NO |
| N. Is runoff entering or leaving the detention facility in a manner that prevents proper function of its inflow or outflow systems? | YES | NO |
| O. Does flow out of the detention facility occur in a manner that creates erosion or damage to adjacent property? | YES | NO |
| P. Are the detention facility functions impaired? | YES | NO |
| Q. Other items and comments: _____ | | |
| P. Corrective action for all "YES" answers above: | | |

<u>Inspection Item Letter</u>	<u>Corrective Action</u>	<u>Status or Date Complete</u>
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(Attach additional sheets as necessary)

III. GENERAL

SECTION 01001 - GENERAL REQUIREMENTS

1.1 DEFINITIONS

- A. Whenever used in these specifications the following terms have the meanings indicated which are applicable to both the singular and plural thereof:
1. City - The City of Rensselaer, represented by the City Council, having the authority of approval of the plans, specifications and acceptance of the final construction.
 2. Engineer - City Engineer or representative to act on behalf of the City.
 3. Owner - Person or firm having control of the development site, and management of the project.
 4. Contractor - The person, firm or corporation with whom the developer has entered into an agreement for construction of the project.
 5. Project - The total construction of which the work to be provided may be the whole or part.
 6. Work - The entire completed construction or the various separately identified parts thereof required to be furnished.

1.2 WORK TO BE PERFORMED

Work to be performed shall be in accordance with drawings and specifications approved by the City.

1.3 LOCAL LABOR AND MATERIALS

- A. Whenever possible, the Contractor, his subcontractors, material men, or others who employ labor, shall employ such labor locally.
- B. The Contractor shall purchase materials such as sand, cement, gravel, pipe, steel, lumber, etc., from local dealers wherever such local dealers' prices meet competitors' and where such materials meet the specifications.

1.4 SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction."

1.5 DISCOVERY OF HAZARDOUS MATERIAL

If, during the course of this work, the existence of hazardous material, including asbestos containing material, is observed in the work area, the Contractor shall immediately notify the Owner in writing. The Contractor shall not perform any work pertinent to the hazardous material prior to receipt of special instructions from the City of Rensselaer. Asbestos containing material includes transite pipe.

1.6 EASEMENTS

- A. The Developer will obtain right-of-way easements over and through certain private lands for the construction and rehabilitation. The width or limits of such rights-of-way will be defined by the City before the work or construction shall begin. If the methods of construction employed by the Contractor are such as to require the use of land beyond the limits obtained, he shall make his own agreements with the property owners affected for the use of such additional land.
- B. In all such right-of-way easements, the Contractor shall be required to carefully remove the property owner's fences, or other obstacles to the construction procedure, and replace the same after the work is installed. The backfilling shall be to the grade of the existing ground level or to the grade as established by the property owner in the event the property owner permits the deposit of excess material upon such land.
- C. The cost of all such restoration of property shall be included in this work.

1.7 OPERATIONS WITHIN RIGHT-OF-WAY

In public thoroughfares, all operations of the Contractor, including those of temporary nature, must be confined within the applicable right-of-way limits after having obtained approval of the City. If the methods of the construction employed by the Contractor are such as to require the use of land beyond the public thoroughfares, he shall make his own agreements with the property owners affected for the use of such additional.

1.8 PERMITS

- A. The Developer will obtain permits which relate to the completed facilities. Permits obtained by the Developer include permits from the following:
 - 1. Indiana Department of Environmental Management
 - 2. Department of Natural Resources
 - 3. Corps of Engineers
 - 4. Indiana Department of Fire Prevention & Building Safety

5. Indiana Department of Transportation
6. Railroads

B. The Contractor shall obtain permits which relate to construction procedures.

1. All necessary permits or licenses required from the State, County, or City in connection with construction procedures under or along existing highways shall be obtained by and at the expense of the Contractor. The construction shall be performed by the Contractor in full accordance with any and all requirements of the Indiana Department of Transportation or County Road Commission, including those applying to barricades, watchmen, guarding, lighting, storage of supplies, equipment and excavated materials, method of backfilling, final grading, replacement of pavement or road surface, and all other conditions or requirements which may be stipulated by the Indiana Department of Transportation or County Road Commission, whether specifically shown on the drawings or mentioned in the specification.
2. The Contractor shall obtain all blasting permits required.

1.9 MAINTAINING TRAFFIC

- A. Before closing any thoroughfare, the Contractor shall notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county, or city.
- B. The Contractor shall notify the City of his intention to close a particular street 72 hours in advance of the proposed closing. The Contractor shall place all proper detour signs and barricades prior to the actual street closing.
- C. During the construction, the Contractor shall be responsible for maintaining and protecting the pedestrian and vehicular traffic at all times on all streets involved and providing access to all residential and commercial establishments adjacent to the construction area. The Contractor shall furnish and maintain signage, barricades, flares, etc., in accordance with Indiana Manual on Uniform Traffic Control Devices. The signage, barricades, etc., must be in good condition.
- D. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Insofar as it is practicable, do not locate excavated material and spoil banks in such manner as to obstruct traffic. Keep the traveled way of all street, roads, and alleys clear and unobstructed insofar as is

possible. Do not use streets, roads, or alleys for the storage of construction materials, equipment supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed, except when and where necessary, and then only upon due advance notice to the Engineer or City and Owner and for the shortest practicable period of time, consistent with efficient and expeditious construction. The Contractor shall be liable for any damage to persons or property resulting from his work.

- E. Streets in which excavation has occurred shall be temporarily restored to receive traffic as soon as possible. Permission to close additional streets shall be denied the Contractor if, in the opinion of the City or the Engineer, the restoration on streets where excavation has occurred has not progressed satisfactorily.

1.10 WALKS AND PASSAGEWAYS

The Contractor, when required, shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise. Do not obstruct the sidewalks, gutters, or streets, or prevent in any manner the flow of water in streets. Use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter, exercising such precaution as may be directed by the Engineer. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.

1.11 WARNING LIGHTS AND ARROW BOARDS

The Contractor shall place sufficient warning lights and arrow boards on or near the work and keep them illuminated during periods of construction and reduced visibility (from twilight in the evening until sunrise) and shall be held responsible for any damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

1.12 UTILITIES

- A. Temporary Removal: All existing utility systems which conflict with the construction of the work herein which can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work

shall be done by the utility unless the utility approves in writing that the work may be done by the Contractor.

- B. Permanent Relocation of Utilities: Water mains, storm sewer inlets, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light and traffic standards, cable ways, signals, and other utility appurtenances located in the public right-of-way which would permanently interfere with the proposed improvements will be moved by the utility involved and paid for by the Contractor.
- C. Payment for Utilities: The Contractor shall make all necessary applications and arrangements and pay all fees and charges for electrical energy for power and light, a gas energy, water service, sewer service, and telephone service required for the construction of this Contract during its entire progress. He shall provide and pay for all temporary wiring, switches, connections, and meters.

1.13 DUST, NOISE, AND EROSION CONTROL

Dust shall be minimized by use of water and deliquescent salts. Noise shall be minimized by use of properly constructed and maintained equipment provided with suitable mufflers, snubbers, and other sound attenuating devices and supports. Construction activity shall be restricted to 7:00 a.m. to 7:00 p.m. Monday through Saturday, unless otherwise approved by the City. Erosion shall be controlled in such manner that soil particles from the construction site are prevented from entering public waters or from being deposited on neighboring property, streets, and highways.

1.14 SUBMITTALS - CERTIFICATE OF COMPLIANCE

The Contractor shall submit to the City a Certificate of Compliance from the manufacturer and/or supplier of each and every specified material or manufactured equipment item. The Certificate shall state that the material or the item of equipment to be furnished has been manufactured with materials in accordance with the applicable sections of all required codes, specifications, and standards as required by the specifications.

1.15 MANUFACTURER'S SERVICE TIME

- A. When a pump station or other equipment is to be furnished by the Contractor and maintained by the City, service by the manufacturer is required to be furnished as part of the work and shall be at the Contractor's expense.

- B. The service provided shall be by a qualified representative to check the completed installation, place the equipment in operation, and instruct the City's operators in the operation and maintenance procedures. Such services are to be for a period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.
- C. The services shall further demonstrate to the City's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.16 GUARANTEE/WARRANTY

The Contractor shall provide a minimum one (1) year written or typed warranty for all equipment installed.

1.17 RECORD DRAWINGS

- A. Developer shall prepare or be responsible for preparation and submittal of one (1) set of half-size (11 " x 17") record drawings, one (1) set of full size reproducible drawings and one (1) set in an electronic file (compact disk, 3.5" disk, or electronic file transmission) utilizing AutoCAD (Release 14) or comparable computer-aided design software in "DWG" and/or "DFX" format.
- B. Record drawings shall be a full set of drawings showing all details of the sewer construction project reflecting any changes from the approved drawings and showing accurate locations of manholes, structure, sewers, housebuilding services, utility crossings and other pertinent features.
- C. Record drawings shall be certified to accuracy by a registered professional Engineer.
- D. Record drawings shall be submitted to the City Building Department within thirty (30) days after the completion of construction.

END OF SECTION 01001

IV. SPECIFICATIONS AND REQUIREMENTS RELATED TO MULTIPLE UTILITIES

SECTION 02101 - TEMPORARY EROSION AND DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of temporary and permanent control measures as required by 327 IAC 15-5, shown on the plans or as ordered by the Owner during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- B. Temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.
- C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment, and material storage sites, waste areas, and temporary plant sites.

1.2 AUTHORITY

- A. Developer is the Owner for the purposes of the Notice of Intent (NOI) letter, Notice of Termination (NOT) request, and any other documents requiring the Owner's signature under this Specification Section 02101 and 327 IAC 15-5.
- B. Developer's signatory shall comply with requirements of 327 IAC 15-4-3(g).

1.3 SUBMITTALS

- A. Submittals, to Jasper County Soil and Water Conservation District (SWCD) and the Indiana Department of Environmental Management (IDEM) described below, are in the instance where the total area disturbed by the project is greater than one (1) acre. (This includes other areas outside the site itself that are disturbed by activities related to the project.) If less than one (1) acre is disturbed and the Developer provides drawings that demonstrate this to the City, the NOI letter described in Paragraph 1.3 E., the NOT request described in 1.3 H., and other submittals to Jasper County SWCD and IDEM are not required. The Developer must still submit the Stormwater Pollution Prevention Plan, which will describe the

type and location of erosion control measures at the construction site, to the City for review.

- B. Developer shall develop a Construction Plan, including the Stormwater Pollution Prevention Plan (SWPPP). Evaluate the site, review the rule requirements, utilize the Indiana Stormwater Quality Manual (formerly Indiana Handbook for Erosion Control in Developing Areas) for guidance in developing the plan. Copies of the manual may be obtained by calling (317) 234-3980 or (800) 451-6027, extension 43980.
- C. Developer shall submit the Construction Plan to the Jasper County Soil and Water Conservation District (SWCD), for review with a copy to the Engineer. (The reviewing authority has up to 28 days from the date of submittal to review the plan. If the Contractor as the duly authorized representative of the project site owner has not received notification that the plan is deficient within the 28-day review period, the NOI letter may be submitted to IDEM. If notice of a deficient plan is received, the plans must be revised to satisfy the deficiencies and resubmitted to the reviewing authority, at which time the 28-day review period starts over.)
- D. Receive Construction Plan approval from the Jasper County SWCD. (Modifications to the plan may be requested by the reviewing authority before approval is granted.)
- E. Developer shall submit Notice of Intent (NOI) letter (with a copy to the Engineer, including attachments) to IDEM a minimum of 48 hours prior to initiation of land disturbing activities. A complete NOI letter submittal must include:
 - 1. Proof of publication in a newspaper of general circulation in the project site area
 - 2. Proof of Construction Plan approval or expiration of the 28-day review period from the reviewing authority
 - 3. \$100 general permit filing fee
- F. Construction activities may not begin prior to Construction Plan approval and submittal of NOI letter. The Contractor, as the duly authorized representative of the project site owner, must also notify IDEM and the reviewing authority of the actual start date within 48 hours of starting land disturbing activities. Provide a copy of this notification to the City.
- G. Developer / Contractor shall implement the approved Construction Plan throughout construction. (Revise the plan and make changes on the project site, as necessary, to prevent pollutants, including sediment, from

leaving the project site. Communicate with the reviewing/inspecting authority, especially when significant changes are made.)

- H. Developer shall submit a Notice of Termination (NOT) request to Jasper County SWCD using the form prescribed by IDEM, including:
 - 1. Prepare a complete NOT with all required supporting documentation.
 - 2. Receive verification from Jasper County SWCD that the project meets the termination requirements as specified in Rule 5.
 - 3. Once verified by Jasper County SWCD, submit the NOT form to IDEM for final approval.
 - 4. Provide a copy of NOT request and any other correspondence with the reviewing agency or IDEM to the Owner and the Engineer.

PART 2 - PRODUCTS

2.1 GRASS

Grass which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

2.2 MULCHES

Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

2.3 FERTILIZER

Fertilizer shall be a standard 10-10-2 commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

2.4 STRAW BALE DIKE

- A. Straw bale dikes, as illustrated in Detail 1 at the end of this Section, are used to trap sediment from small, sloping disturbed areas and decrease velocities of sheet flow. They should be placed at the toe of disturbed areas to provide a broad, shallow sediment pool.
- B. Straw bale dikes shall not be used in drainage areas with concentrated and high flows or in ditches and swales. They should be used where the size

of the drainage area is less than one-fourth of an acre per 100 feet of barrier length, the slope length behind the barrier is less than 100 feet, and the maximum slope gradient behind the barrier is less than 50 percent (2:1). They should be placed at least 10 feet from the toe of slope and should follow the land contour.

- C. The straw bale dike should use a double row of straw bales with the joints staggered. If a single row is used, silt fence shall be installed on the upstream face of the straw bales.
- D. Per the 2007 Indiana Storm Water Quality Manual developed by IDEM, straw bale dams should not be utilized as a first choice when selecting a sediment barrier or filter measure. This option should only be used when other materials are not available. Straw bales are not recommended for use as a diversion and should not be used across a stream, channel, ditch, swale, or anywhere that concentrated flow is anticipated or on paved surfaces, because of the lack of a secure anchoring system. Straw bales are often specified when clear zone issues are associated with a highway project. This application will require intensive maintenance.

2.5 FILTER TUBE / FILTER SOCK

- A. A filter tube / filter sock is a temporary barrier consisting of permeable material (i.e., aggregate, compost, excelsior, mulch, straw, etc.) contained in a permeable geotextile fabric or non-biodegradable net matrix installed to intercept and treat sediment-laden runoff from small, unvegetated drainage areas. This product performs a similar function to a straw bale dike but is much more efficient and may be used in certain applications where this Section prohibits the use of straw bale dikes.
- B. Filter tubes / socks trap sediment by intercepting runoff and reducing the velocity of sheet flow or concentrated flow (limited application). Filter socks capture sediment by ponding water to allow settling and deposition. Note: A filter sock may be used as a diversion and across shallow swales where concentrated flow is anticipated.
- C. The drainage area served by a filter sock / tube shall be limited to one-quarter acre per 100 linear feet of barrier. The size requirements for various slopes are shown in the table below.

Slope		Maximum Distance above Filter Sock (linear feet) For Minimum Filter Sock Sizes (diameter of sock)			
		8-inch	12-inch	18-inch	24-inch
0% - 2%	<50:1	125	250	300	350
2% - 10%	50:1 to 10:1	100	125	200	250
10% - 20%	10:1 to 5:1	75	100	150	200
20% - 33%	5:1 to 3:1	25	50	75	100
>33%	>3:1	10	25	50	75

- D. See Chapter 7 of the Indiana Storm Water Quality Manual for installation requirements:
http://www.in.gov/idem/stormwater/docs/web_files/chap7.pdf
- E. Other proprietary devices approved by the City or their engineer may be used as alternatives. Examples include Triangular Silt Dike™ or Nilex GeoRidge®.

2.6 ROCK CHECK DAM

- A. A rock check dam is a series of runoff control structures, consisting of geotextile fabric and aggregate, placed across swales or drainage ditches to slow the velocity of concentrated storm water runoff and reduce erosion of the swale or ditch. Check dams also provide limited effectiveness as a sediment control measure by allowing larger particles to settle out.
- B. Rock check dams should be used in small open channels that drain two (2) acres or less. They should never be used in a live stream.
- C. See Chapter 7 of the Indiana Storm Water Quality Manual for installation requirements:
http://www.in.gov/idem/stormwater/docs/web_files/chap7.pdf

2.7 SLOPE DRAINS

Where construction disturbs grassy slopes equal to or steeper than 3:1 the slope shall be protected with an erosion control mat as illustrated in Details 1.A and 1.B at the end of this Section. Slope drains may be constructed of pipe, fiber mats, rubber, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

2.8 SILT FENCING

Silt fencing shall be used to prevent soil erosion at top-of-slope locations as indicated on the site plans. The silt fence shall be installed as illustrated in Detail 2.

2.9 CONSTRUCTION ENTRANCES

Construction entrances, as illustrated in Detail 3 at the end of this section, shall be utilized to prevent soil erosion due to construction traffic from established roads, streets or highway onto unpaved project areas. Contractor to notify City 48 hours prior and in writing. City to inspect upon completion.

2.10 INLET PROTECTION

- A. Weighted fiber rolls, as illustrated in Detail 4 at the end of this section, are intended for placement around drainage inlets on construction sites or in areas subject to erosion to prevent sediment from entering the storm drain system.
- B. Inlet protection shall be provided by weighted fiber rolls: SlopeGard™ 3 as manufactured by KriStar Enterprises, Inc., Santa Rosa, California; Mirafi® Dandy Drop or Curb Inlet Protection, manufactured by Ten Cate Geosynthetics North America; or City-approved equal.
- C. Weighted fiber rolls shall be assembled from a machined mat or blanket of shaved aspen wood curled excelsior or reticulated polyurethane and shall have a "weighted" inner core contained in a photodegradable, extruded, "high visibility" netting tube and, for ease of handling, a handle on each end.
- D. Weighted inner core shall hold the device in place, thereby eliminating the need for securing in place with either sandbags or stakes.
- E. The weighted fiber rolls shall be placed end-to-end in a circle around a construction site drainage inlet to prevent runoff and silt, sediment and debris from entering the inlet.
- F. The weighted fiber rolls shall conform to the following specifications:

Diameter (in)	Length (ft)	Weight (lb)	Sediment Retention Capacity (ft ³)	Functional Life (months)
8	6	50	1.5	24-36

- G. Weighted fiber rolls must be installed perpendicular to the expected water flow (parallel to the slope contour).
1. On steeper slopes, dig small trenches across the slope for the rolls. The trench should be deep enough to contain the bottom-half of the roll.
 2. Begin installation from the bottom of the slope and continue uphill.
 3. Lay the rolls in the trenches, fitting them snugly against the soil to make sure no gaps exist between the roll and the rear wall of the trench.
 4. When the rolls are placed end to end, the ends of each roll should be snugly abutted to the end of the roll next to it.

2.11 OTHER

All other materials shall meet commercial grade standards and shall be approved by the City before being incorporated into the project.

PART 3 - EXECUTION

3.1 GENERAL

The Developer / Contractor shall comply with all federal, state and local erosion control laws.

3.2 SCHEDULE

Prior to the start of construction, the Developer / Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, construction, paving, and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction contained in the SWPPP have been accepted by the Jasper County Soil and Water Conservation District and the Engineer.

3.3 AUTHORITY OF OWNER

The City has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary control measures to

minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

3.4 CONSTRUCTION DETAILS

- A. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.
- B. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.
- C. The City will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- D. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the City, such work shall be performed by the Contractor at his/her own expense.
- E. The City may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

- F. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.
- G. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures shall be provided.
- H. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

3.5 MAINTENANCE INSPECTION PROCEDURES

A. Inspections

1. An inspection of erosion control measures in place shall be made at least once every seven days.
2. All erosion control measures in place shall be inspected within 24 hours after any storm even greater than 0.5 inches of rain per 24-hour period.
3. Qualified personnel shall conduct a weekly inspection of the construction site to identify areas contributing to stormwater discharges associated with construction activity.
4. Disturbed areas, material storage areas, and equipment storage areas that are exposed to precipitation shall be inspected on a regular basis for evidence of, or the potential for, pollutants entering the drainage system.
5. Stormwater discharge locations shall be inspected to determine if erosion control measures are effective in preventing significant impacts to receiving waters.
6. Erosion control devices installed as specified shall be observed to ensure that they are operating properly.
7. Haul routes and construction entrances to work areas shall be periodically inspected for evidence of off-site vehicle tracking of mud and dirt.
8. The Contractor's staging area shall be inspected to ensure that solid and liquid wastes are being properly disposed of and not allowed to be discharged into stormwater runoff.

- B. Inspection Reports: A report shall be completed summarizing the results of each inspection. Inspections will be made by the Contractor at least once a week and more frequently if conditions dictate. The report shall include the name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the

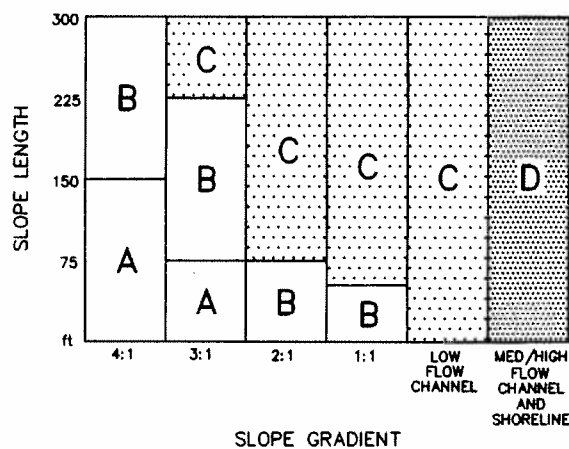
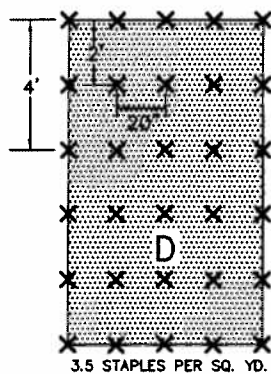
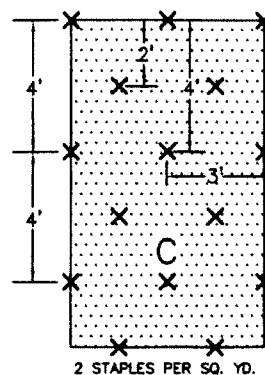
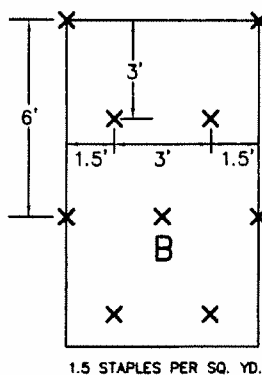
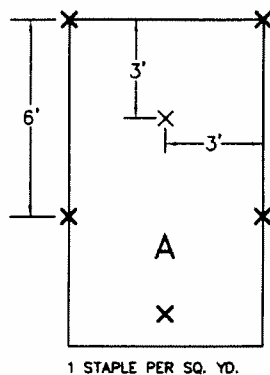
implementation of the erosion control plan, a certificate that the facility is in compliance with the plan, and identification of any incidents of non-compliance.

1. An inspection report form shall be used to record information obtained from field investigations of the erosion control measures. Inspection reports shall be conducted and documented using the form titled, "Construction Site Inspection and Maintenance Log," pages 02101 – 16 and 17. The record and certification shall be signed in accordance with the signatory requirements of the permit. Contractor shall maintain a log of all such activities that is accessible to the Owner on-site.
 2. Inspection reports shall be maintained by the Contractor for two (2) years following Owner approval of the final payment.
- C. Maintenance: All erosion control measures shall be maintained throughout the project and until such time as the disturbed area has been completely stabilized or other provisions have altered the need for these measures. The Contractor shall:
1. Replace mulch materials to their original level when the level has been substantially reduced due to decomposition of the organic mulches and displacement or disappearance of both the organic and inorganic mulches.
 2. Remove rubbish and channel obstructions from bare and vegetated channel within the project limits. The Contractor shall repair damage from scour or bank failure, rodent holes and breaching of diversion structures. Excessive wear, movement or failure of erosion control blankets shall be repaired immediately. Deposits of sediment shall be removed from the channel.
 3. Repair any damage to silt fence barriers immediately and monitor barriers daily during prolonged rainfall.
 4. Repair or replace any silt fence fabric which has decomposed or become ineffective prior to its expected usable life.
 5. Remove sediment deposits after each storm event. Sediment must be removed when deposits reach approximately half the height of the barrier.
 6. Till and smooth to conform with the existing grade and reseed any sediment deposits remaining in place after the silt fence barrier is no longer required.
 7. Maintain the construction entrances in a condition to prevent tracking or flowing of sediment onto roads. This could require periodic top dressing with additional surface materials as conditions demand. Repair and clean out any features used to trap

sediment and remove all sediment spilled, dropped, washed or tracked on road and return to the point of likely origin.

8. All temporary erosion and sediment control practices shall be removed and disposed of within 30 days after site stabilization is achieved or after the temporary practices are no longer needed. Trapped sediment shall be permanently stabilized to prevent further erosion.

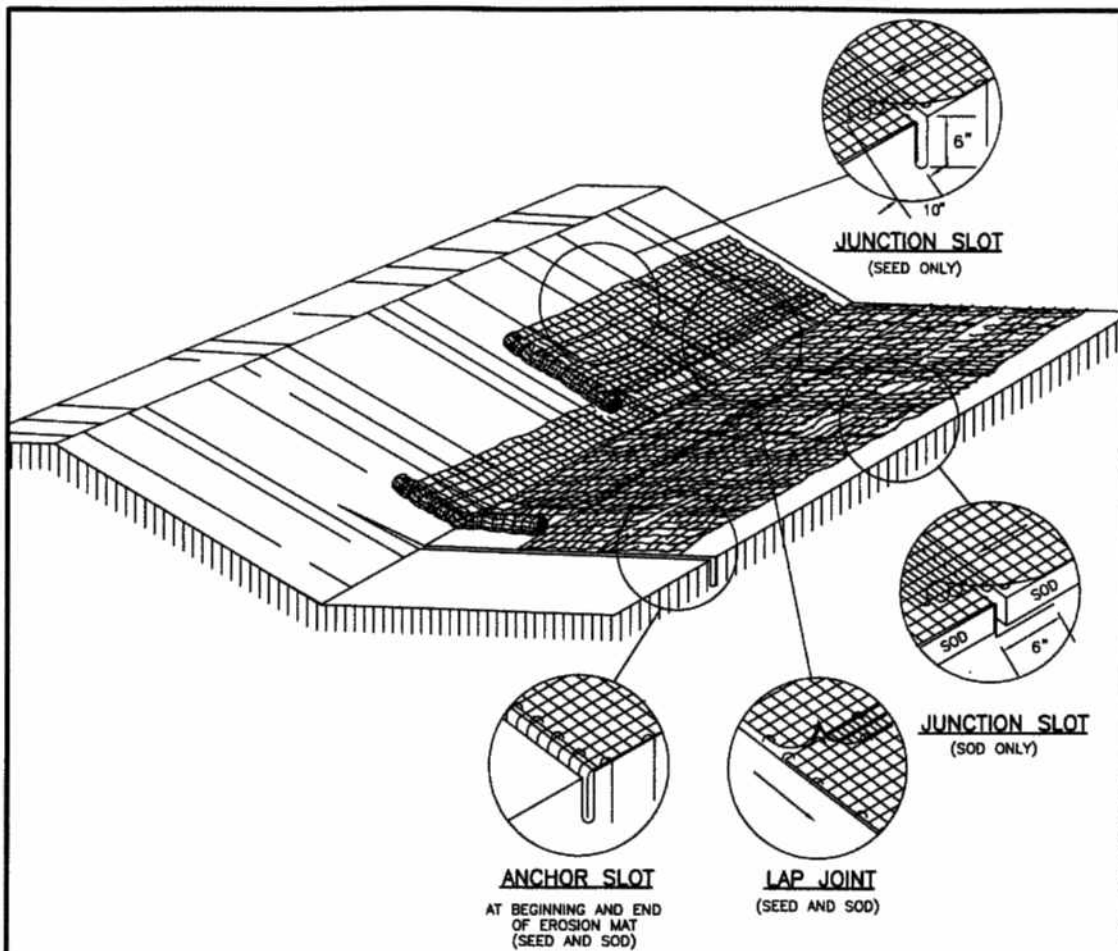
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EROSION CONTROL MAT-STAPLE GUIDE N.T.S.

DETAIL 1A
EROSION CONTROL MAT - STAPLE GUIDE

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GENERAL NOTES

1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING APPLICATION OF LIME, FERTILIZER AND SEED.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
3. ROLL CENTER BLANKET IN DIRECTION OF WATER FLOW ON BOTTOM OF CHANNEL.
4. PLACE BLANKETS END OVER END (SHINGLE STYLE) WITH A 6" OVERLAP. USE A DOUBLE ROW OF STAGGERED STAPLES 4" APART TO SECURE BLANKETS.
5. FULL LENGTH EDGE OF BLANKETS AT TOP OF SIDE SLOPES MUST BE ANCHORED IN 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. BLANKETS ON SIDE SLOPES MUST BE OVERLAPPED 4" OVER THE CENTER BLANKET AND STAPLED.
7. IN MEDIUM/HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT INTERVALS. USE A ROW OF STAPLES 4" APART OVER ENTIRE WIDTH OF THE CHANNEL. PLACE A SECOND ROW 4" BELOW THE FIRST ROW IN A STAGGERED PATTERN.
8. THE TERMINAL END OF THE BLANKETS MUST BE ANCHORED IN A 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.

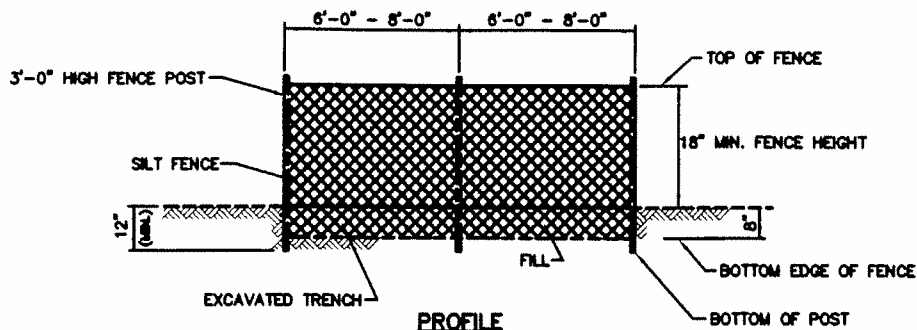
EROSION CONTROL MAT-SLOPE DETAIL

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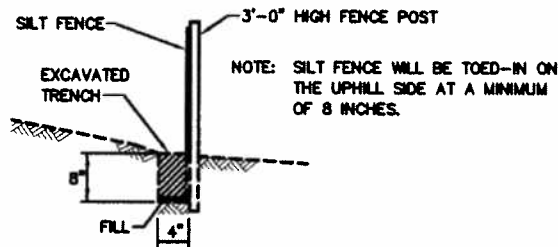
DETAIL 1B

EROSION CONTROL MAT - SLOPE DETAIL

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PROFILE



SECTION

SILT FENCE DETAIL

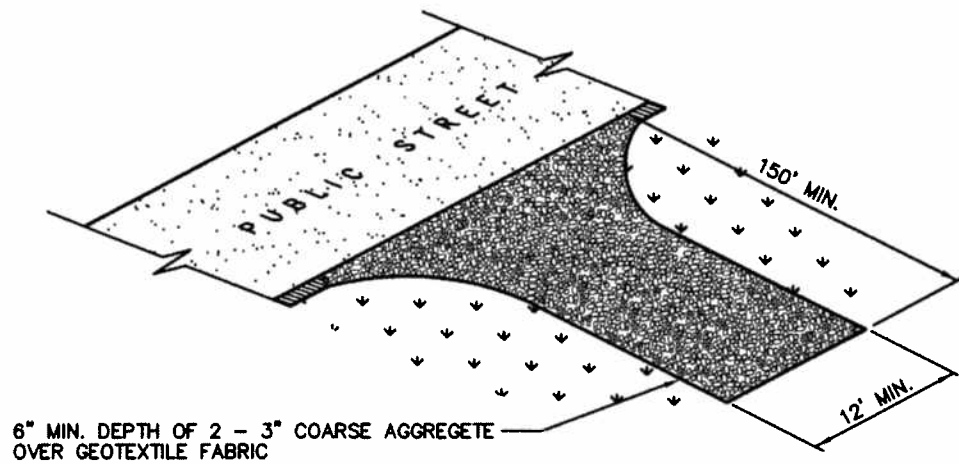
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INSTALLATION PROCEDURE

1. 2" x 2" x 36" HARDWOOD OR STEEL FENCE POSTS ARE INSTALLED 6' APART (w/ EXTRA STRENGTH FABRIC WITHOUT WIRE BACKING) OR 8' APART (w/ WIRE BACKING), ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE.
2. A TRENCH 4" WIDE BY 8" DEEP IS DUG ALONG THE UPHILL SIDE OF THE FENCE LINE.
3. THE SILT FENCE IS UNROLLED AND LAID OUT ALONG THE FENCE LINE.
4. A BUILT-IN ATTACHMENT CORD RUNS THROUGHOUT THE FULL LENGTH OF EACH 150 LINEAR FOOT ROLL. ONE END OF THE ROLL HAS APPROXIMATELY 5' OF CORD. THE OTHER END HAS APPROXIMATELY 20' OF CORD. THE END WITH 5' OF CORD IS WRAPPED AROUND THE FIRST POST AND SECURED.
5. THE FENCE IS PULLED TO THE NEXT POST AND A 1.5" SLIT IS MADE IN THE HEM DIRECTLY ABOVE THE CORD. THE CORD IS PULLED OUT OF THE HEM AND PULLED TAUT FROM THE PRECEDING POST AND WRAPPED TWICE AROUND THE POST.
6. THE SLITTING OF THE HEM ON EACH POST IS REPEATED UNTIL THE FINAL POST IS REACHED, AT WHICH TIME THE MATERIAL IS WRAPPED AROUND THE LAST POST AND SECURED WITH THE ENCLOSED CORD.
7. AT THIS TIME THE LOWER 8" OF THE FENCE IS LAID IN THE TRENCH AND CURLED TOWARD THE EROSION SOURCE. THE TRENCH IS THEN BACKFILLED WITH SOIL.

DETAIL 2
SILT FENCE DETAIL

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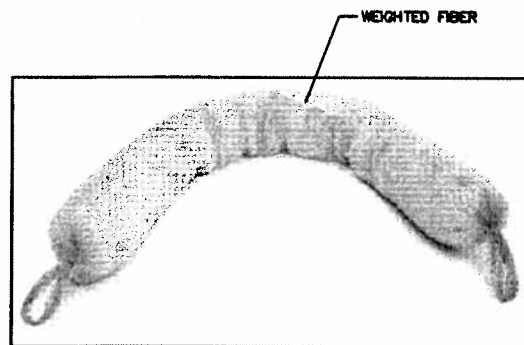
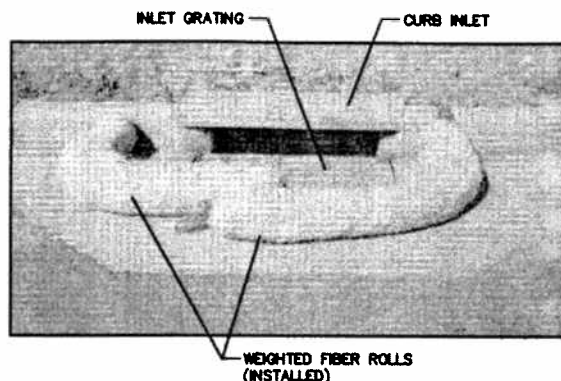


CONSTRUCTION ENTRANCE DETAIL

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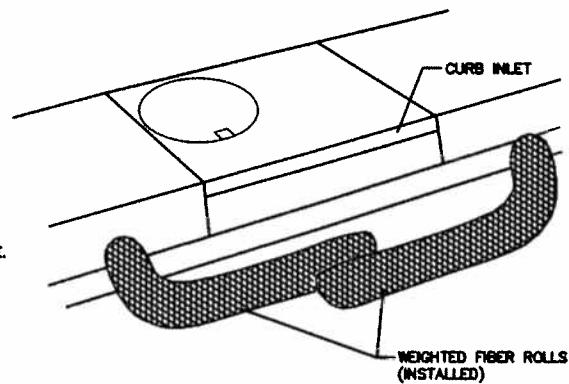
DETAIL 3
CONSTRUCTION ENTRANCE DETAIL

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NOTES:

1. PLACE AN ADEQUATE NUMBER OF WEIGHTED FIBER ROLLS AROUND THE INLET TO PROVIDE COMPLETE PROTECTION. LEAVE APPROXIMATELY 3"-6" BETWEEN THE WEIGHTED FIBER ROLLS AND THE INLET. ENDS SHOULD OVERLAP ABOUT 2 INCHES
2. INSPECT INLET PROTECTION DEVICE BEFORE AND AFTER RAIN EVENTS, AND WEEKLY THROUGHOUT THE RAINY SEASON. DURING EXTENDED RAIN EVENTS, INSPECT AT LEAST ONCE EVERY 24 HOURS.
3. REMOVE AND PROPERLY DISPOSE OF ACCUMULATED SILT AND DEBRIS TO ALLOW FOR PROPER FUNCTION OF DEVICE.



EROSION CONTROL — WEIGHTED FIBER ROLL

NO SCALE

DETAIL 4
WEIGHTED FIBER ROLL DETAIL

Date: _____
 Project: _____
 Inspected by: _____
 Type of Inspection: ☐ Scheduled Weekly ☐ Rain Event

City of Rensselaer
CONSTRUCTION SITE INSPECTION AND MAINTENANCE LOG
 (To be completed by Property Owner or Agent)

All stormwater pollution prevention BMPs shall be inspected and maintained as needed to ensure continued performance of their intended function during construction and shall continue until the entire site has been stabilized and a Notice of Termination has been issued. An inspection of the project site must be completed by the end of the next business day following each measurable storm event. If there are no measurable storm events within a given week, the site should be monitored at least once in that week. Maintenance and repair shall be conducted in accordance with the accepted site plans. This log shall be kept as a permanent record and must be made available to the City of Rensselaer in an organized fashion, within forty-eight (48) hours upon request.

Yes	No	N/A	
			1. Is the site information posted at the entrance?
			2. Are all necessary permits attained and special provisions being implemented?
			3. Is a construction entrance installed and functioning properly?
			4. Are construction staging & parking areas restricted to areas designated on the plans?
			5. Are public and private streets clean of sediment, debris and mud?
			6. Are appropriate practices installed where stormwater leaves the site?
			7. Are all discharge points (outfalls) free of erosion or sediment transport?
			8. Has all silt fence been installed properly and being maintained? <i>(entrenched - upright - fabric not torn - terminated to higher ground - properly joined at ends)</i>
			9. Are sediment basins & traps installed according to plan & pipe or rock spillways functional?
			10. Are other sediment control barriers in place and functioning properly?
			11. Is the earthwork for erosion control practices properly graded, seeded and/or mulched?
			12. Are diversion swales and/or waterbars installed to plan & protected?
			13. Do perimeter practices have adequate capacity & do they need to be cleaned out?
			14. Is inlet protection installed properly on all functioning inlets & being maintained.
			15. Is catch basin insert protection installed where required & being maintained?
			16. Have swales and ditches been stabilized or protected?
			17. Are stormwater outlets adequately stabilized?
			18. Has temporary stabilization of disturbed ground been addressed? <i>(dormant for 15 days?)</i>
			19. Is permanent stabilization of disturbed ground progressing on all completed areas?
			20. Has hard or soft armoring been installed where natural vegetation will erode?
			21. Do water pumping operations have a protected outlet and discharge clear water?
			22. Are all dewatering structures functioning properly?

Yes	No	N/A	
			23. Is a designated equipment washout area established, clearly marked and being utilized?
			24. Is solid waste properly contained & a stable access provided to the storage & pickup area?
			25. Are fuel tanks and other hazardous materials safely stored and protected?
			26. Is spill response equipment on-site and easily accessible?
			27. Are temporary soil stockpiles in approved areas & properly protected?

If you answered "no" to any of the above questions, describe any corrective action which must be taken to remedy the problem and when the corrective actions are to be completed.

Signature: _____

Printed Name: _____

END OF SECTION 02101

SECTION 02222 - EARTHWORK FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Specifications for clearing and disposal of vegetation, stripping of topsoil, excavation, trenching, bedding, filling, backfilling, compaction and related work in connection with the installation of water mains, gravity sanitary sewers, storm sewers and force mains as included in this Section.
- B. Definitions
 - 1. Excavation: Removal of earth and rock to form a trench for utilities.
 - 2. Earth: Unconsolidated material derived by weathering and erosion. Earth includes:
 - a. Materials of both inorganic and organic origin;
 - b. Boulders less than 1/3 cubic yard in volume, gravel, sand, silt and clay;
 - c. Materials which can be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift or similar excavating equipment without the use of explosives, rock rippers, rock hammers or jack hammers.
 - 3. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes:
 - a. Limestone, sandstone, dolomite, granite, marble and lava;
 - b. Boulders 1/3 cubic yard or more in volume;
 - c. Materials which cannot be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift or similar excavating equipment without the use of explosives, rock rippers, rock hammers or jack hammers.
 - 4. Undercutting: Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.
 - 5. Subgrade: Undisturbed bottom of a trench.
 - 6. Bedding and Haunching: Material approved for placement in the bottom of the trench and to the centerline of the pipe.
 - 7. Initial Backfill: Material approved for placement from the centerline to one foot above the pipe.

8. Backfill and Fill: Earth placed in trench from the top of bedding to finished grade, or to subbase of pavement.
9. Topsoil: Earth containing sufficient organic materials to support the growth of grass.

1.2 QUALITY ASSURANCE

- A. The blasting supervisor shall have no less than five (5) years experience in explosive demolition and excavation, and both the supervisor and crews shall have all appropriate licenses for the handling and use of explosives.
- B. Blasting Monitoring and Control Program
 1. A Blasting Monitoring and Control Program shall be developed by the Contractor and submitted to the Engineer for approval, prior to the commencement of blasting operations.
 2. The Blasting Monitoring and Control Program shall indicate the blasting area, charge locations, number of explosive rounds at each charge location, the maximum charge per delay in pounds and the maximum charge per round in pounds.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions and Section 01001, General Requirements.
- B. Submit:
 1. Materials analysis and compaction test reports.
 2. Blasting supervisor's experience record.
 3. Blasting Monitoring & Control Program.
 4. Storage procedures for explosives.
 5. Erosion and sediment control plan.

1.4 JOB CONDITIONS

- A. All information given in the Contract Documents, including drawings relating to borings, materials encountered, and rock elevations, is from surveys performed by other consultants. Such information is furnished only for the information and convenience of the Contractor. The Engineer does not warrant or guarantee that the materials and conditions encountered during construction will be the same as indicated by the boring samples or by information shown on the drawings.

- B. Existing storm sewers, sanitary sewers, water mains, gas mains, electric ducts, telephone ducts, steam mains and other underground structures, lines and their house connections have been shown on the plans according to the best available information. The exact location and protection of these facilities and structures, their support and maintenance in operation during construction (in cooperation with the proper authorities), is the responsibility of the Contractor in the performance of his contract.

PART 2 - PRODUCTS

2.1 BEDDING, HAUNCHING AND INITIAL BACKFILL

- A. Material to be used for bedding, haunching and initial backfill shall be No. 8 crushed limestone.
- B. Class I bedding shall be angular 6 to 12 mm (1/4 to 1/2 inch) graded stone, cinders, crushed stone or crushed shells.
- C. Class II bedding shall be coarse sands and gravels with maximum particle size of 20 mm (3/4 inch). Class II bedding includes variously graded sands and gravels containing small percentage of fines generally granular and non-cohesive, either wet or dry. Soil types GW (well-graded gravel), SW (well-graded sand), and SP (pea gravel and/or crushed stone mixed with sand) are included in this class.

2.2 BACKFILL

- A. Backfill shall be excavated material of such gradation and moisture content that the soil will compact to the specified density and remain stable. Unsuitable materials shall not be used.
- B. Pipe cover material, from one foot above the pipe, shall be No. 8 crushed limestone.
- C. Granular or special backfill, when indicated on the plans or ordered by the Engineer, shall be used. It shall be No. 8 crushed limestone.
- D. Suitable excavated material shall be used when earth backfill is specified on the plans, or where granular backfill is not specifically specified, provided that such material consists of loam, clay or other materials approved by the Engineer. Unsuitable backfill or frozen backfill material shall not be used. Suitable backfill shall be soils, GW, GP, GM, GC, SW, SP, SM, SC, ML and CL, classified by the Unified Soil Classification System, ASTM D2487.

- E. Materials which are unsuitable for backfill include stones greater than 3 inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic and soils, OL, MH, CH, OH and PT, classified by the Unified Soil Classification System, ASTM D2487.

<u>Group Symbols</u>	<u>Typical Names</u>
GW	Well-graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
SW	Well-graded sands and gravelly sands, little or no fines
SP	Poorly graded sands and gravelly sands, little or no fines

- F. Gravel Backfill: When the material excavated from the trench is suitable for granular backfill, the Engineer reserves the right to order, in writing, the use of this excavated material in place of the granular backfill specified to be paid for as a separate pay item.
- G. Suitable Excavated Materials as Backfill: Excavated material shall be used when earth backfill is specified on the plans or where granular backfill is not specifically specified, provided that such material consists of loam, clay, or other materials which, in the judgement of the Engineer, are suitable for backfilling. Unsuitable backfill or frozen backfill material shall not be used. Suitable backfill shall be the following soils, classified by the Unified Soil Classification System, ASTM D-2487:

<u>Group Symbols</u>	<u>Typical Names</u>
GW	Well-graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands and gravelly sands, little or no fines
SP	Poorly graded sands and gravelly sands, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays

- H. Unsuitable Materials: Materials which are unsuitable for backfill include stones greater than 8 inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic, and the following soils, classified by the Unified Soil Classification System, ASTM D-2487:

<u>Group Symbols</u>	<u>Typical Names</u>
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH	Inorganic clays of high plasticity
OH	Organic clays of medium to high plasticity
PT	Peat, muck, and other highly organic soils

- I. Concrete Backfill: Concrete used for backfill around sewers, water mains, or other utility piping shall be Class B concrete.
- J. Cellular Concrete: Light weight cellular concrete may be used for filling of abandoned sewers as a grouting mixture for filling voids and as a substitute for backfill concrete in tunnels or casing pipes. The cellular concrete shall be produced by blending preformed foam with cement-sand grout slurry to produce a concrete having a fresh weight per cubic foot of not less than 75 pounds.

PART 3 - EXECUTION

3.1 UTILITIES, STRUCTURES AND PROPERTY

- A. The Contractor shall be responsible for construction means, methods, techniques and procedures, and for providing a safe place for the performance of the work by the Contractor, Subcontractors, suppliers and their employees, and for access use, work, or occupancy by all authorized persons.
- B. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under CFR 29 Parts 1900 through 1910 and 1926.
- C. Adequate supporting systems, such as sheeting, shoring, piling, cribbing and bracing shall be furnished and installed by the Contractor as required to protect personnel, existing buildings, utilities and property from damage during the progress of the work.

- D. All fences, utilities, structures and property along the routes of water mains, force mains, and sewers shall be supported and protected from damage by the Contractor.
- E. Movable items such as mail boxes may be temporarily relocated during construction. Place movable items in their original location immediately after backfilling is completed, unless otherwise shown on the drawings, replace those that are damaged during construction.
- F. The Contractor shall proceed with caution in the excavation and preparation of trenches so that the exact location of underground utilities and structures, both known and unknown, may be determined. The Contractor shall be responsible for the repair of utilities and structures when broken or otherwise damaged.
- G. The Contractor shall explore and excavate to determine the location of underground structures when the Engineer believes it is necessary.
- H. Wherever sewer, gas, water or other pipes or conduits cross the trench, the Contractor shall support them without damage and without interrupting this Contract. The manner of supporting such pipes, etc., shall be subject to the approval of the utility involved.
- I. When utility lines that have to be removed or relocated are encountered within the areas of operations, the Contractor shall notify the Engineer or the City in ample time for the necessary measure to be taken to prevent interruption of the service.
- J. The Contractor shall conduct the work so that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the work unless he shall have first obtained the property owner's written consent thereto and shall have shown said written consent to the Engineer or the City.
- K. All excavated material shall be piled in a manner that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.
- L. All streets, alleys, pavements, parkways and private property shall be thoroughly cleaned of all surplus materials, earth and rubbish placed thereon by the Contractor.

3.2 CLEARING

- A. Clear and remove logs, stumps, brush, vegetation, rubbish and other perishable matter from the project site, as required, to perform work.
- B. Do not remove or damage trees that do not interfere with the work. Completely remove trees required to be removed, including stumps and roots. Properly treat damaged trees which can be saved.
- C. Debris from tree removal, including trunk, branches, leaves, roots and stumps, shall not be buried or burned on the job site; however, they must be hauled away and disposed of at the Contractor's expense.

3.3 STRIPPING AND STOCKPILING OF TOPSOIL

- A. Strip topsoil and vegetation from the excavated areas. Clean topsoil may be stockpiled for reuse as the upper 6 inches of the areas to be seeded. Additionally, suitable excavated material may be stockpiled, in onsite locations approved by the City, for filling and backfilling.
- B. Do not intermix grass, weeds, roots, root mat, brush and stones larger than 3 inches with stockpiled topsoil. Dispose of root contaminated topsoil; and, unsuitable materials, as excavated, and surplus suitable materials shall be removed from the job site as trenches are backfilled.

3.4 PAVEMENT AND WALK REMOVAL

- A. Remove existing pavement and walks from the excavated areas. Remove excavated asphaltic and concrete materials from the job site as these materials are excavated.
- B. The width of pavement removed along the normal trench for the installation of pipe and structures shall not exceed the width of the trench by more than 12 inches on each side of the trench when the amount of pavement removed is less than 75% of the total existing pavement width. Remove all existing pavement when the excavation requires the removal of 75% or more of the total existing pavement width.
- C. Remove walks completely when excavation is along the length of a walk and requires the removal of part of the walk. Remove walks to existing joints in the walks when excavation crosses walks. If there are no joints in an existing walk, the width of walk removed shall not exceed the width of the trench by more than 12 inches on each side of the trench.

- D. Use methods to remove pavement and walks that will assure the breaking or cutting of pavement and walks along straight lines. The face of the remaining pavement and walk surfaces shall be approximately vertical.

3.5 EXCAVATING

- A. General: After stripping of topsoil and vegetation, perform excavations of every description regardless of material encountered within the grading limits of the project to lines and grades as indicated on the drawings or as otherwise specified.
- B. Keep all excavations free from water until the components to be constructed are completed. Provide sufficient dewatering equipment for the disposal of water without undue interference with work, damage to property or the environment.
- C. All hazardous encumbrances, including trees and boulders, involved in the vicinity of the excavation work shall be removed or made safe before excavating.
 - 1. Except by permission of the Engineer, not more than 450 feet of trench shall be opened at any one time. Not more than 30 feet of trench may be opened in advance of the completed pipe laying operation, and not more than one street crossing may be obstructed by the same trench at any one time.
 - 2. Use diversion ditches, dikes or other suitable means to prevent surface water from entering an excavation and provide adequate drainage of the area adjacent to the excavation. Do not allow water to accumulate in an excavation.
 - 3. Excavations shall be inspected by a competent Contractor's representative after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased, if necessary.
 - 4. Do not store excavated or other material nearer than 4 feet from the edge of any excavation. Store and retain materials as to prevent materials from falling or sliding back into the excavation. Install substantial stop log or barricades when mobile equipment is utilized or allowed adjacent to excavations.
 - 5. The width of trenches in earth for water main pipe, sanitary and storm sewers, sewer laterals and other drains up to and including 33 inches in internal diameter shall provide a clearance of not less than 8 inches or more than 10 inches on each side of the pipe. Trenches for pipe larger than 33 inches in internal diameter shall provide a clearance of not less than 10 inches or more than 14 inches on each side of the pipe.

6. Provide adequate barriers and physically protect all remotely located excavations. Barricade or cover all wells, pits, shafts and similar excavations, and backfill upon completion of exploration and similar operations.

3.6 BLASTING

- A. Removal of rock from the excavation may be facilitated by the use of controlled explosives.
- B. Blasting supervision and Monitoring and Control Programs shall meet the requirements of this Section.

3.7 SHEETING

- A. The Contractor shall be responsible for construction means, methods, techniques, and procedures, and for providing a safe place for the performance of the work by the Contractor, Subcontractors, suppliers and their employees, and for access use, work, or occupancy by all authorized persons.
- B. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction."
- C. Adequate supporting systems, such as sheeting, shoring, piling, cribbing, and bracing shall be furnished and installed by the Contractor as required to protect existing buildings, utilities, and property from damage during the progress of the work.

3.8 STORAGE AND REMOVAL OF EXCAVATED MATERIAL

- A. Suitable excavated material required for filling and backfilling operations may be stockpiled in on-site locations as approved by the Engineer, until the material is ready to be placed.
- B. Remove unsuitable materials from the job site as unsuitable materials are excavated. Remove surplus suitable materials from the job site as trenches are backfilled.

3.9 TEMPORARY PLUGS

Prevent foreign matter from entering pipe while it is being installed. Do not place debris, tools, clothing, or other material in the pipe. Close the open ends of pipe

by watertight plugs when pipe laying is not in progress. Remove any earth or other material that enters pipe, lateral pipe, or appurtenances through any open pipe end. Remove earth and other materials at no additional cost to the Owner.

3.10 BACKFILLING OF UTILITY AND PIPING TRENCHES

- A. Prevent foreign matter from entering pipe while it is being installed, and remove any that should enter the piping, at no additional cost to the Owner. Close the open ends of pipe by watertight plugs when pipe laying is not in progress.
- B. Backfilling of water and force main trenches shall meet the requirements of ANSI/AWWA C600.
- C. Do not backfill trenches and excavations until all underground utilities and piping systems have been inspected by the Engineer and are installed in accordance with the specifications and drawings. Required hydrostatic tests may be applied to the line either before or after the trench is backfilled, as approved by the Engineer.
- D. Place and tamp bedding and haunching material in accordance with the manufacturer's recommendations, and do not damage pipe coating, wrapping or encasement.
- E. Place initial backfill from the centerline of the pipe to 1 foot above the pipe, and compact it to the density required.
- F. Do not use the following materials for any backfilling:
 - 1. Unsuitable materials;
 - 2. Frozen materials;
 - 3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.
- G. Where the edge of the trench is within 5 feet of or crosses the existing or proposed roadway pavement, it shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density, according to AASHTO T99, Method A. In all areas, cuts and trenches shall be backfilled with granular backfill to within 1 foot of the paved surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall add crushed stone and grade until sufficient settlement has taken place and final restoration is made.

- H. Backfill trenches not requiring granular backfill with suitable excavated material. Fill and restore any settlement of the backfill. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.
- I. Bedding procedures for sanitary and storm sewers shall be as specified in the Section for the applicable pipe material.

3.11 MAINTAINING TRAFFIC

- A. At least 72 hours before closing any thoroughfare, the Contractor shall notify and obtain permits from the appropriate authorities.
- B. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic flow. Private driveways shall only be closed when necessary and for the minimum amount of time. Also, the Engineer shall be notified in advance. The Contractor shall be liable for any damages to persons or property resulting from his work.

3.12 WALKS AND PASSAGEWAYS

The Contractor shall make provisions at cross streets for the free passage of vehicles and foot passengers. Nothing shall obstruct the sidewalks, gutters or streets, nor prevent the flow of water. The Contractor shall immediately haul away all offensive matter and exercise precaution, as directed by the Engineer. All material excavated shall not cause the public or adjacent tenants inconvenience, and the Contractor shall ensure that injury to trees, sidewalks, fences and adjacent property of all kinds has been prevented. The Contractor may be required to erect suitable barriers to prevent inconvenience or injury.

3.13 WARNING LIGHTS

The Contractor shall place sufficient warning lights on or near the work and keep them illuminated during periods of reduced visibility. He shall also be held responsible for any damages that any party sustains from neglecting the necessary precautions.

3.14 CLEANUP AND MAINTENANCE

- A. Cleanup the job site as backfilling is completed. Remove excess earth, rock, bedding materials and backfill materials. Remove unused piping materials, structure components, and appurtenances. Restore items

moved, damaged, or destroyed during construction. Grade area to be restored. Level backfill mounded over trenches, which are not backfilled with Special Backfill. Cleanup and restoration specified in this paragraph shall be completed within 1,000 feet of excavation.

- B. Restoration of grass, bushes, trees and other plants shall be as specified in Section 02902, Landscaping for Utilities.
- C. Restoration of pavement and walks shall be as specified in Section 02500, Paving and Surfacing. A temporary driving surface, such as crushed stone, shall be compacted in place in the trench area as backfilling is completed and prior to opening the road to traffic. When a temporary compacted aggregate surface is installed, calcium chloride shall be applied at the rate of 0.4 lb. per square yard per inch of compacted depth for dust control, unless otherwise approved by the Engineer. Cold-mix asphalt patching material may be used as a temporary driving surface at the Contractor's option or when specifically called for in the plans or specifications. When the finished pavement is bituminous materials, placement may be delayed until all other heavy construction is completed. Temporary pavement placement shall not be more than 300 feet behind the excavation.
- D. Provisions shall be made for prompt removal from traveled roadways of all dirt and other materials that have been deposited thereon by operations concerned with the project whenever the accumulation is sufficient to cause the formation of dust or mud, interfere with drainage, damage pavements, or create a traffic hazard. Construction methods and means shall be employed to keep flying dust and air pollution to a minimum. Provisions shall be made for the control of dust on the project and on road and streets, and other areas affected by the project wherever such dust affects traffic or buildings, or construction materials are affected. Keep dust conditions to a minimum by the use of water, salt, calcium chloride, oil, or other means. The materials and methods used for dust control shall be subject to approval. The cost of controlling dust and air pollution shall be included in the cost of other pay items and no additional payment will be made.
- E. Maintain the job site until the work has been completed and accepted. Fill trenches when settlement is visible. Restore items damaged by construction or improper restoration.

END OF SECTION 02222

SECTION 02224 - CONDUIT CONSTRUCTION - SPECIAL CROSSINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install tunnels and casing pipes beneath streets, highways and railroads and do related work necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by number or title in shall be adhered to, and this specification thereto. Latest revisions shall apply to all cases.
- C. Abbreviations: ASTM - American Society for Testing and Materials.

1.2 PERMITS

The permits for crossings shall be obtained by the Owner. The Contractor shall give notification to the Owner prior to the start of the work. Do not start work until all arrangements are completed and permission is given by the Owner to start the work.

1.3 BORINGS AND CASING

The Contractor shall be responsible for installing welded steel pipe casings as shown or specified, in accordance with approved jacking and boring methods. Do not proceed with the work until plans and methods have been reviewed for conformity with the approved permit by the City. The review by the City of any plan or method shall not relieve the Contractor of his responsibility in any way.

1.4 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions. and Section 01001, General Requirements.
- B. Submit the following:
 - 1. Plans and details describing materials and methods proposed by the Contractor for use in special crossings.
 - 2. Detailed design calculations and drawings of the proposed support systems for the tunnel construction, prepared and certified by a registered structural engineer.

1.5 GENERAL PROCEDURES

- A. The Contractor shall be prepared to attend all meetings and provide any necessary data, reports, information, details and construction schedules as requested by the Owner or any other involved agency.
- B. The City, Owner or other involved agency shall review and modify, as necessary, the scheduling of any or all construction activities under the construction area in order to prevent interruption of traffic or service. The Contractor shall include the cost for such procedures in his bid and not be entitled to any change in contract amount from such procedures.
- C. All work shall be done in a careful, workmanlike manner to the satisfaction of both the proper officials and the City.

PART 2 - PRODUCTS

2.1 STEEL CASING

- A. Casing pipe and joints shall be of steel construction, capable of withstanding the load of railroad roadbed, track and traffic or the loads of pavement, subgrade and traffic, as applicable. The casing pipe and joints shall be constructed to prevent leakage of any matter from the casing or conduit throughout its entire length, except at open ends of the casing.
- B. The casing pipe shall be welded steel pipe, new and unused material, in accordance with ASTM A-139 Grade B for "Electric Fusion of Welded Steel Pipe," with a minimum yield of 35,000 psi. The inside diameter shall be at least 4 inches greater than the largest diameter of the conduit's main joint.
- C. The minimum wall thickness of the casing pipe shall be as shown in the following table:

Diameter of Casing	Minimum Wall Thickness			
	Under Highway		Under Railroad	
	Inches	Millimeters	Inches	Millimeters
Under 14"	0.250	6	0.250	6
14"	0.250	6	0.250	6
16"	0.250	6	0.250	6
18"	0.250	6	0.250	6
20"	0.250	6	0.375	10
22"	0.250	6	0.375	10
24"	0.250	6	0.375	10

Diameter of Casing	Minimum Wall Thickness			
	Under Highway		Under Railroad	
	Inches	Millimeters	Inches	Millimeters
26"	0.250	6	0.375	10
28"	0.375	10	0.375	10
30"	0.375	10	0.375	10
32"	0.375	10	0.500	13
34"	0.375	10	0.500	13
36"	0.375	10	0.500	13
38"	0.375	10	0.500	13
40"	0.375	10	0.500	13
42"	0.375	10	0.500	13
Above 42"	0.500	13	0.500	13

- D. The exterior walls of casing shall be coated, after the welding of each joint has been completed, with protective coal tar epoxy or bitumastic material.
- E. When casing is installed without the benefit of a protective coating, and it is not cathodically protected, the wall thickness shown above shall be increased to the nearest standard size, a minimum of 0.063 inches greater than the thickness shown, except for diameters under 12-3/4 inches.
- F. The ends of the casing shall be suitably protected against the entrance of foreign material.

2.2 CARRIER PIPE CASING SPACERS

- A. Casing spacers shall be polyethylene or stainless steel, manufactured by APSOR as approved by the City.
- B. Polyethylene casing spacers shall be manufactured by injection molding using high density virgin polyethylene.
- C. Stainless steel casing spacers shall be 10 gauge, Grade T-304L with PVC liner.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF CASING PIPE - JACKING AND BORING METHOD

- A. The casing operation and installing shall proceed from a pit, excavated at a safe distance from the edge of the highway or railroad, and be constructed without interruption to highway or rail traffic.

- B. The conduit shall be installed inside a casing pipe of the length shown on the plans. Except as otherwise permitted by the Railroad or Highway authorities, or other agencies involved the casing pipe shall be bored or jacked into place, maintaining exact lines and grades as shown on the drawings for its entire length.
- C. The jacking pipe shall be constructed to provide not less than 20 feet clearance between the side of the pit adjacent to the track or road and the centerline of the track or road measured at right angles. Open trenches shall be properly sheeted and braced when and where necessary to provide safe working conditions and protection for track, highway, roads, structures and utilities.
- D. During casing and conduit installation, provide and maintain pits for the work at locations shown on the plans or as directed by the City. Excavation for pits shall be sheeted as necessary. Pits are to be backfilled when installation is complete. Excavation and backfilling shall be as specified in Section 02222, Earthwork for Utilities.
- E. Remove all excavated material and replace or change existing structures or utilities encountered to the satisfaction of the City.

3.2 CONSTRUCTION OF CASING PIPE - OTHER METHODS

The installation of the casing pipe by methods other than the jacking method must be performed in a manner which meets with prior approval of the authorities. Any expense incurred in connection with the construction of the crossing, removal, replacement or maintenance resulting from the construction of the casing pipe and the conduit shall be at the expense of the Contractor.

3.3 INSTALLATION OF CARRIER PIPE

- A. The carrier pipe designated on the drawings shall be as specified in the appropriate Section for the type of carrier pipe, i.e., water main, gravity sanitary sewer, storm sewer, force main or electrical conduit.
- B. Jointing of the conduit pipe shall be as specified in the appropriate Section for the type of pipe material and joint fittings.
- C. As the work of installing the conduit progresses, fill the space between the outer shell of the conduit and the tunnel liner or casing. The City shall have the right to limit the length of conduit placed in any one step before filling the space to ensure that said space is completely filled in a satisfactory manner.

- D. Place the conduit into and through the tunnel liner or steel casing at locations shown on plans. Employ suitable methods to maintain tight joints, to the satisfaction of the City.
- E. Stainless steel or polyethylene casing spacers shall be used to center the carrier pipe inside the casing.
- F. Casing spacers shall be spaced a maximum of one foot from each side of the joint and a maximum of 12 feet between spacers for stainless steel, and 8 feet for polyethylene.
- G. Polyethylene spacers shall be used only with stainless steel, not ductile iron piping.

END OF SECTION 02224

SECTION 02558 - IDENTIFICATION/LOCATION TAPE

PART 1 - GENERAL

1.1 SCOPE

Furnish and install identification/location and warning tape over the centerline of buried non-metallic piping.

PART 2 - PRODUCTS

2.1 IDENTIFICATION TAPE

A. Identification/Location Tape

1. Identification/location tape shall be manufactured of inert polyethylene so as to be highly resistant to alkalis, acids and other destructive agents found in soil, and shall have a minimum thickness of four mils. Tape width shall be a minimum of three inches and a maximum of six inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every two feet for entire length of tape.
2. Identification/location tape shall include a solid foil core which can be detected by cable locator.
3. Warning tape shall be as described above except no solid foil is required.

B. Tape background colors and imprints shall be as follows:

<u>Imprint</u>	<u>Background Color</u>
"Caution - Water Line Buried Below"	Blue
"Caution - Sanitary Force Main Buried Below"	Green

C. Identification tape shall be as follows:

1. For PVC Water Pipe: Terra Tape Sentry Line or approved equal.
2. For PVC Sanitary Force Main Pipe: Terre Tape Sentry Line or approved equal.

D. Products above are as manufactured by Reef Industries, Inc., Houston, Texas.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION TAPE

- A. Identification tape shall be installed over all buried non-metallic piping in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape shall be installed one foot over centerline of pipe unless otherwise noted on plans.
- C. Warning tape shall be installed two feet below final grade over centerline of pipe.

END OF SECTION 02558

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and place plain and reinforced concrete and do related work necessary to complete work shown or specified.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.
 - 1. Following is a partial list of American Concrete Institute publications which are applicable to concrete construction:
 - a. ACI 318 Building Code Requirements for Reinforced Concrete.
 - b. ACI 211.1 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 - c. ACI 211.2 Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.
 - d. ACI 347 Recommended Practice for Concrete Formwork.
 - e. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - f. ACI 308 Recommended Practice for Curing Concrete.
 - g. ACI 306 Recommended Practice for Cold Weather Concreting.
 - h. ACI 305 Recommended Practice for Hot Weather Concreting.
 - i. ACI 304 Recommended Practice for Measuring, Mixing, and Placing Concrete.
 - j. ACI 503.1 Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive.
 - k. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

1.2 QUALITY ASSURANCE

- A. Testing Laboratory Services: The Contractor shall employ and pay for the services of an independent testing laboratory to perform specific services and necessary tests as outlined below:
1. Tests: Establish each proposed design mix prior to placing the first concrete at the job site. Make a set of four test cylinders for each proposed mix. Break one cylinder from each set at seven days. Break the remaining cylinders at 28 days. A mix will be considered satisfactory if the average strength of three 28-day breaks equals or exceeds the specified 28-day strength. Adjust the design mix and repeat the test procedure if the average strength of three 28-day breaks is less than the specified 28-day strength.
- B. Tolerances: Finish concrete shall meet the following tolerances:
1. Variations from Plumb: $\pm 1/4$ -inch per 10 feet but not more than 1 inch.
 2. Variations from Level or Indicated Grade: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch.
 3. Variations from Horizontal: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch.
 4. Variations in Size and Locations of Openings or Sleeves: $\pm 1/4$ -inch.
 5. Variation in Steps:
 - a. Flight of Stairs:
 - (1) Riser: $\pm 1/8$ -inch
 - (2) Tread: $\pm 1/4$ -inch
 - b. Consecutive Steps
 - (1) Riser: $\pm 1/16$ -inch
 - (2) Tread: $\pm 1/8$ -inch
 6. Reinforcing Steel Placement: $\pm 3/8$ -inch

1.3 SUBMITTALS

A. Submit the following:

1. Certified copies of test reports of concrete mixes required by the applicable standards.
2. Shop and placing drawings, bending diagrams, and mill test reports for reinforcing steel bars for cast-in-place concrete structures.
3. Samples of waterstops, vapor barrier, and perimeter insulation.
4. For concrete restoration and repair work, submit complete description of proposed method of repair, including sequence of work, dimensions, method of surface preparation, protection of existing structures and materials.
5. Sample and test reports of fly ash.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged or unsuitable products from the job site. Replace damaged products with undamaged products. Replace unsuitable products with suitable products.

1.5 JOB CONDITIONS

- A. Follow methods outlined in ACI 306 if concrete is to be placed when the atmospheric temperature is expected to be less than 40°F.
- B. Calcium chloride will not be considered for approval as an accelerating admixture during cold weather construction.
- C. Follow methods outlined in ACI 305 if concrete is to be placed when the atmospheric temperature is expected to exceed 90°F.
- D. Manufacturer's recommendations shall be strictly followed in regard to atmospheric temperature limitations during application of epoxy or acrylic polymer modified concrete materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C 150, ACI 301, and ACI 318. Cement shall be Type 1 for normal use, Type 1A where air-entrainment is desired, or Type III or Type IIIA where high early strength is desired and authorized by the Engineer. Blended hydraulic cements which meet the requirements of ASTM Specification C-595 Type 1-P Portland-pozzolan cement may be used where a more water-tight concrete is required. Fly ash may also be used as a partial cement replacement for Types 1 or 1A.
- B. Aggregate
 - 1. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of 3/4 inch, except in mass concrete the maximum size may be 1-1/2 inches.
 - 2. Lightweight fine and coarse aggregates shall meet the requirements of ASTM Specification C 330.
 - 3. Insulating fine and coarse aggregates shall meet the requirements of ASTM Specification C 332.
- C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. A maximum of 500 mg/L of chloride ion may be present in the water.
- D. Admixtures
 - 1. Air-entraining admixtures shall meet the requirements of ASTM Specification C 260.
 - 2. Water-reducing and retarding admixtures shall meet the requirements of ASTM Specification C 494, Type A or Type D, except that they shall contain no chlorides, shall be non-toxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification.
 - 3. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 6%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.

E. Reinforcement

1. Reinforcing steel shall meet the requirements of ASTM Specification A 615, Grade 60.
2. Welded wire fabric or wire mesh shall meet the requirements of ASTM A 185.

F. Joint Filler

1. Preformed expansion joint filler shall be chosen to suit the job requirements as follows:
 - a. Type A: Asphalt filler for unsealed expansion or isolation joints in sidewalks, driveways, floor slabs on-grade, and elsewhere as indicated on the drawings. Filler shall meet the requirements of ASTM Specification D994.
 - 1) Sealtight asphalt expansion joint filler, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
 - b. Type B: Self-expanding cork filler for standard or waterproof sealed expansion joints in walls, slabs, and elsewhere as indicated on the drawings. Sealing shall be installed in accordance with the details shown on the drawings. Filler shall meet the requirements of ASTM Specification D1752, Type III.
 - 1) Sealtight self-expanding cork expansion joint filler as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
2. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D1190.
 - a. Sealtight No. 164, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.

G. Waterstops shall meet the requirements of Corps of Engineers CRD-C572. Waterstops shall be of the configurations as shown on the standard detail drawings or as specified.

H. Curing Compounds: Curing compounds shall meet the requirements of ASTM Specification C 309, Type I.

I. Epoxy Adhesive and Grout

1. Epoxy adhesive and grout shall be epoxy-resin systems meeting the requirements of ASTM C 881 and the additional requirements herein.
2. The proper type, grade, and class (ASTM C 881) shall be chosen to suit the job requirements as follows:
 - a. Type
 - 1) I - For bonding hardened concrete and other materials to hardened concrete and setting anchor bolts and reinforcing bars in hardened concrete.
 - 2) II - For bonding freshly mixed concrete to hardened concrete.
 - 3) III - For bonding skid resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concrete.
 - b. Grade
 - 1) 1 - For crack injection and spray application, light viscosity.
 - 2) 2 - For brush application, medium viscosity.
 - 3) 3 - For trowel or caulking gun application, non-sagging heavy viscosity for filling voids and gaps.
 - c. Class
 - 1) A - For use below 40°F.
 - 2) B - For use between 40°F and 60°F.
 - 3) C - For use above 60°F.
 - d. Color: All epoxy adhesives and grouts shall be concrete grey or clear if they will be visible on the final concrete surface.
3. The epoxy material shall consist of a two-component system conforming to the following requirements:
 - a. Properties of mixed components shall meet the following requirements:
 - 1) Solids Content: 100% by weight

- 2) Pot Lift: 30 minutes (minimum) @ 75°F
 - 3) Contact Time: 2 hours @ 75°F
 - 4) Tack Free Time: 4 hours minimum @ 75°F
- b. Properties of cured material shall meet the following requirements:
- 1) Neat Binder
 - a) Tensile Strength ASTM D-638: 3200 psi minimum 14 @ days, 75°F cure
 - b) Tensile Elongation ASTM D-638 (Modified): 1% minimum @ 14 days, 75°F cure
 - c) Compressive Strength ASTM D-695: 12,000 psi minimum @ 14 days, 75°F
 - d) Compressive Modulus: 400,000 psi minimum @ 28 days, 75°F
 - e) Water Absorption: 1% by weight, maximum 14 days 75°F cure 24 hours immersion
 - 2) Grout: One part Binder to three-and-quarter parts Aggregate by loose volume
 - a) Compressive Strength ASTM C-109 (Modified) (2" cubes): 12,000 psi minimum @ 28 days, 75°F cure
 - b) Compressive Modulus (Modified): 1,250,000 psi minimum @ 28 days, 75°F cure
- c. Aggregate shall meet the requirements of the resin manufacturer.
- d. Chemical acceptance for SPI Classification -2- ('A' Component).
- 1) The cured system shall meet the requirements of the U.S. Department of Agriculture for use in food processing plants.
 - 2) The cured system shall meet the requirements of U.S. Government regulations requiring water extractables of less than 0.5 MG per square inch of exposed surface for potable water containers. Tests for water extractables shall meet the requirements of

the Environmental Control Administration of the
U.S. Public Health Service.

- e. The following epoxy manufacturers' products, or equal products, will be considered for approval:
 - 1) SIKADUR as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
 - 2) EPOTOX as manufactured by Toch Division, Carbolina, St. Louis, Missouri.
 - 3) SONOBOND as manufactured by Sonneborn - Contech, Minneapolis, Minnesota.
 - 4) PROBOND as manufactured by Protex Industries, Denver, Colorado.

J. Modified Concrete

- 1. Polymer Modified Concrete: The purpose of this specification is to describe a two-component, polymer-modified, cementitious, fast-setting, trowel grade, structural repair mortar. This system shall be used on horizontal, vertical, and overhead surfaces, on grade, above and below grade on concrete and mortar.
 - a. The polymer-modified cementitious system shall consist of a factory pre-proportioned two-component system whose components conform to the following requirements:
 - 1) Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. This acrylic copolymer shall have the following properties:
 - a) Ph: 4.5 - 6.5
 - b) Minimum Film Forming: Temperature - approx. 68°F; Tear Strength - approx. 990-1420 psi
 - c) Elongation at Break: 500-900%
 - d) Particle Size Range: Less than 0.1 micron
 - 2) Component B shall be a blend of selected Portland cements, specially graded aggregates, organic accelerator, and admixtures for controlling setting time, water reducers for workability, and a corrosion inhibitor.

- 3) The component ratio A:B shall be as required by the manufacturer. The system shall not contain chlorides, nitrates, added gypsum, added lime, or high alumina cements. The system shall be non-combustible, either before or after cure.
- 4) Typical properties of mixed components:
 - a) Application Time (Working Time): 15 min. combining components.
 - b) Finishing Time: 20-60 min. after combining components
 - c) Color: Concrete Grey
- 5) Typical properties of cured material:
 - a) Abrasion Resistance: 6 times that of controlled concrete
 - b) Bond Strength Substrate (Pull Off Method): 100% concrete failure.
 - c) Modulus of Elasticity: 4.5×10^6
 - d) Surface Scaling (De-icing Salt Solution Freeze/Thaw): No deterioration after 120 cycles
 - e) Compressive Strength (2 Hours 50% RH): 150 minimum.
 - f) Compressive Strength: 28 Days 50% RH): 5,500 psi minimum.
 - g) Flexural Strength (28 days 50% RH): 1,300 psi minimum
 - h) This system shall conform with ECA/USPHS Standards for surface contact with potable water.
 - i) This system shall not produce a vapor barrier.
 - j) This system shall be thoroughly compatible with concrete.

2. Epoxy-Modified Concrete: The purpose of this specification is to describe a two-component, 100% solids, liquid epoxy-resin system which is formulated as an additive to Portland cement concrete or mortar mixes to produce a high strength structural repair concrete

or mortar. This system shall be applicable for use on horizontal, vertical, and overhead surfaces, on grade, above or below grade.

- a. The concrete or mortar mix shall be in accordance with the manufacturer's recommendations. Cement, aggregate, sand, and water shall meet the requirements specified elsewhere in this Section.
- b. If the color of the cured epoxy modified concrete does not reasonably match the color of the existing concrete to the satisfaction of the Engineer, the Contractor shall apply an approved surface coating, suitable for the intended exposure of the patched area, to blend the patchwork into the surrounding concrete.
- c. The following manufacturer's products, or equal products, will be considered for approval:
 - 1) SIKADUR 362 as manufactured by Sika Corp., Lyndhurst, New Jersey.
 - 2) DURALGUARD Modifier E Gel as manufactured by Dural International Corp., Deer Park, New York.

K. Type 1 Grout

1. Type 1 grout shall be expansive grout.
2. The grout shall be composed of selected silica sands, modified cements, pozzolanic, plasticizing, and water reducing admixtures.
3. The grout shall be entirely non-metallic and shall be suitable for both interior and exterior applications.
4. The grout shall be a one-step product delivered to the job site in bags containing a premixed formulation requiring only the addition of water prior to use.
5. The physical properties of the grout shall meet the following requirements:
 - a. Initial Set (ASTM C 191) 45 min.
 - b. Final Set (ASTM C 191) 180 min.
 - c. Compressive Strength (ASTM C 109)
 - 1) 24 hours: 5,000 psi
 - 2) 3 days: 6,000 psi
 - 3) 7 days: 8,000 psi
 - 4) 28 days: 10,000 psi

d. Volume Change (ASTM C 827)

- 1) 24 hours: +0.032%
- 2) 3 days: +0.033%
- 3) 7 days: +0.035%
- 4) 28 days: +0.035%

e. Tensile Strength

- 1) 24 hours: 400 psi
- 2) 3 days: 460 psi
- 3) 7 days: 550 psi
- 4) 28 days: 600 psi

6. The following grout manufacturers' products, or equal products, will be considered for approval:

- a. SONOGROUT as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.
- b. FIVE STAR GROUT as manufactured by U.S. Grout Corp., Old Greenwich, Connecticut.
- c. SET NON-SHRINK GROUT as manufactured by Set Products, Macedonia, Ohio.
- d. SEALTIGHT 588 as manufactured by W. R. Meadows, Elgin, Illinois.

L. Bonding Agents: The following bonding agent manufacturers' products, or equal products, will be considered for approval:

1. EPOXTITE BINDER as manufactured by Construction Products Div., W. R. Grace & Co., Cambridge, Massachusetts.
2. SIKADUR HI-MOD EPOXIES as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
3. SONOBOND as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.

M. Cement Based and Acrylic Polymer Compounds: The following cement based or acrylic polymer compound manufacturers' products, or equal products, will be considered for approval:

1. THOROSEAL as manufactured by Standard Dry Wall Products, Inc., Miami, Florida.
2. LATEX LIQUID FLOOR as manufactured by the Camp Co., Inc., Chicago, Illinois.

2.2 CONCRETE

A. General

1. Concrete shall be Class A, B, C, or D as specified in this Article. All concrete shall be assumed to be Class A, unless specifically excepted.
2. The slump of all concrete shall be not more than 5 inches or less than 2 inches unless specifically excepted by the Engineer.
3. The air content by volume of all concrete shall be 6% plus or minus 1%.
4. Class A concrete shall contain a water-reducing and retarding admixture, unless specifically excepted. Use of a water-reducing and retarding admixture in Class B, C, or D concrete is optional. Use of a retarding admixture with fly ash concrete is optional.
5. Do not exceed the water-cement ratio of the design mix which includes all water added. The water-cement ratio shall not exceed 0.45. The water-cement ratio shall be based on the total cementitious materials content.
6. The water reducing and retarding admixture shall be in accordance with the manufacturer's requirements.
7. Class A concrete shall have a minimum cement content of 564 lbs./cubic yard.
8. An approved fly ash may added to the cement in Class A or B concrete in an amount not to exceed 15% by weight of cement, provided all applicable requirements for these classes of concrete are met and proposed mix designs are approved.

B. Class A Concrete

1. Class A concrete shall be structural concrete with a 28-day compressive strength of 4,000 psi.
2. Proportion Class A concrete in accordance with ACI 211.1.

C. Class B Concrete

1. Class B concrete shall be plain concrete with a 28-day compressive strength of 2,000 psi.
2. Proportion Class B concrete in accordance with ACI 211.1.

D. Class C Concrete

1. Class C concrete shall be structural lightweight concrete with a 28-day compressive strength of 3,000 psi.
2. Proportion Class C concrete in accordance with ACI 211.2.

3. The maximum density shall be 115 pcf.
- E. Class D Concrete
1. Class D concrete shall be insulating concrete with a 28-day compressive strength of 140 psi.
 2. The minimum density shall be 24 pcf.
- F. Type 2 Grout: Type 2 grout shall be cement mortar grout. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion materials to produce a grout which is suitable for the intended application.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Subgrade shall be free of sawdust, debris, water, ice, snow, frozen material, extraneous oil, mortar, or any other substances that may be deleterious to the concrete.
- B. Clean rock surfaces by air-water cutting, wet sandblasting, or wire brush scrubbing. Wet rock surfaces immediately prior to placement of concrete.
- C. Earth surfaces shall be firm and damp.
- D. Do not place Class A concrete on mud, dried earth, uncompacted fill, or frozen subgrade. Mud mats of Class B concrete will be permitted upon written approval of the Engineer.
- E. When Class A concrete is to be placed on highly pervious materials which might allow flowing groundwater to damage fresh concrete, the contact surface shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete.

3.2 FORMWORK

- A. All formwork shall be done in accordance with recommended practices contained in ACI 347.
- B. Forms shall be of wood, plywood, steel, or other approved materials and shall be mortar-tight.

- C. Construct forms and associated falsework so finished concrete conforms to the dimensions and contours shown on the drawings.
- D. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.
- E. Coat forms with a non-staining oil before being set in place.
- F. Metal ties or anchorages within the forms shall be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete.
- G. Remove forms in a manner and at such time to ensure complete safety of the structure. Do not remove supporting forms or shoring until sufficient strength has been developed in the concrete to support weight and load.

3.3 REINFORCING STEEL

- A. Reinforcement shall be free from excessive amounts of scale, rust, form oil, or any other coating that will reduce bond.
- B. Cut and bend reinforcement in accordance with recommended practices contained in ACI 315.
- C. Bar supports shall conform to standards recommended in ACI 315.
- D. Any dowel or lap shown on the drawings and not dimensioned and any splices required but not shown shall be the minimum allowable Class C tension splice according to ACI 318, based on Grade 60 steel reinforcing and 4,000 psi 28-day concrete.
- E. A mat of steel shall be considered as two layers of reinforcing bars forming a grid. When one mat of steel is to be placed in a wall or slab, place the mat in the center of the section unless specifically excepted. When two mats of steel are to be placed in a wall or slab, place one mat in each face of the section utilizing the minimum allowable clear distance per ACI 318, unless specifically excepted.

3.4 CONCRETE

- A. General: Measure and mix concrete in accordance with ACI 614.

B. Class A Concrete

1. Concrete shall be Class A concrete, unless otherwise shown on the drawings or specified in this Section.
2. No measurable amount of water shall pass through structural concrete when a head of water equal to 12 inches of depth per inch of concrete is applied.
3. Use one brand of cement only in concrete which will have exposed surfaces.

C. Class B Concrete: Fillets shall be Class B concrete, unless fillets are constructed monolithic with walls or slabs. Mud mats shall be Class B concrete, unless specifically excepted.

D. Class C Concrete: Use Class C concrete where shown on drawings.

E. Class D Concrete

1. Insulating concrete on roofs shall be Class D concrete.
2. Class D concrete shall not be less than 1 inch or more than 8 inches thick.
3. Application of Class D concrete shall meet the requirements of the concrete manufacturer.
4. Limit foot traffic on new concrete until roof material has been applied.

F. Ready-Mixed Concrete

1. Mix, deliver, and place ready-mixed concrete in accordance with ASTM Specification C 94.
2. Discharge concrete from a truck within 1-1/2 hours after water has been added to the mix in the truck.
3. The delivery ticket shall contain the cubic yards in the load, the percent of air, the total number of bags of cement in the load, and the total gallons of water in the load. Copy of delivery ticket shall be given to the Engineer's representative.
4. Water may be added at the job site if the water-cement ratio after the addition of the water does not exceed the water-cement ratio of the applicable design mix. When water is added at the job site, there shall be a minimum of 1-1/2 minutes of mixing per each cubic yard remaining in the truck.

G. Site-Mixed Concrete

1. Thoroughly mix site-mixed concrete in an approved type batch mixer having a capacity of not less than 1/2 cubic yard. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer.
2. The mixing time for each batch, after addition of water to cement and aggregate, shall not be less than 1-1/2 minutes for each 1 cubic yard of materials. Operate the mixing drum at the speed for which it was designed, provided the speed is more than 14 rpm and less than 20 rpm.

3.5 WATERSTOPS

- A. Waterstops shall be placed in all walls and floor slabs where earth or air is on one side and fluid on the other side.
- B. Waterstops shall be placed in all walls and floors slabs where it is possible to isolate one tank or structure from each other.
- C. Waterstops will not be placed in divider walls where fluid is on either side, except in the case where tank or structure can be isolated.

3.6 EQUIPMENT MOUNTING PADS

All floor mounted equipment shall be installed on a minimum 4" concrete pad as shown on standard detail drawings. Type 1 grout shall be used on all equipment mounting pads, unless otherwise directed by the Engineer.

3.7 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304. Provide chutes, drop pipes, and other placing equipment properly designed and appropriate for the intended use to prevent segregation of coarse aggregate.
- B. Remove construction debris and extraneous matter from within the forms.
- C. Remove temporary struts, stays, bracing, and blocks serving to hold the forms in correct shape and alignment until concrete is placed.
- D. Place concrete on clean, damp surfaces, free from running or standing water.
- E. Deposit concrete in approximately horizontal layers, not to exceed 18 inches.

- F. Consolidate concrete by means of mechanical vibrating. Insert and remove vibrators vertically at regular intervals to ensure uniform consolidation. Do not use vibrators to transport concrete inside the forms. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute when in operation. At least one standby vibrator shall be on hand at all times during placing.

3.8 CURING

- A. Prevent concrete from drying for a period of 7 days after it is placed.
- B. Curing may be accomplished by any of the approved methods as listed in ACI 308.
- C. Concrete with fly ash may require longer curing time. Curing shall be continuous for a minimum of 7 days or for the time necessary to attain 70% of the specified compressive strength, whichever is greater.

3.9 EPOXY ADHESIVE AND GROUT

- A. Use epoxy-resin system in accordance with ACI 503.1 when it is required to grout reinforcing bars or non-expansive anchors into existing concrete.
- B. Use epoxy-resin system in accordance with ACI 503.2 when it is required to bond fresh (plastic) concrete to hardened concrete.
- C. Joining of new and old concrete shall meet the requirements of the epoxy-resin system manufacturer.
- D. Install reinforcing bars and non-expansive anchors as follows:
 - 1. Non-expansive anchors shall be threaded at least the full length of the embedded portion.
 - 2. Concrete strength shall be a minimum of 3,000 psi before starting the embedment procedure.
 - 3. Embedment length shall be a minimum of 10 times the nominal anchor or bar diameter but not less than 6 inches.
 - 4. Diameter of hole shall be a minimum of 1/2 inch and a maximum of 1-1/2 inches greater than the anchor or bar, bolt-head diagonal or washer diameter, whichever is greater.
 - 5. Vacuum or blow out the hole using oil-free compressed air when a dry drilling method is used.

6. When the drilling process requires the use of water, carefully wash out the hole after drilling to remove residue of drilling slurry. Hole should then be dried if possible.
7. Condition materials to approximately 75°F for ease of mixing and handling of grout prior to mixing epoxy-resin system.
8. Premix components for one minute with mixing paddle attached to low-speed (400-600 rpm) electric drill. Pour equal volumes of each component into clean pail. Mix to uniform color. Add approximately a third of the aggregate; mix for another minute. Add remaining aggregate; continue mixing for two to three minutes until grout is thoroughly blended. Move drill continuously to thoroughly mix components. Keep paddle below surface of material to avoid whipping air into mix. Mix only that quantity which can be placed within 30 minutes.
9. Anchors or bars shall be clean, dry, degreased, and free of rust and scale.
10. Vertical Installation
 - a. Anchor bolts, dowels, and reinforcing bars may be installed by either of the following methods:
 - (1) Pour grout to a predetermined level in bolt hole and insert bolt into grout. Work bolt up and down while tapping lightly to ensure complete embedment.
 - (2) Insert bolt and pour grout into annular space between bolt and hole.
 - b. Use templates or wedges to hold bolts, dowels, or reinforcing bars in position until grout sets.
11. Horizontal Installation: Install anchor bolts, dowels, and reinforcing bars as follows:
 - a. Place grout using a hand- or power-operated caulking gun with a large-diameter tip and polyethylene-tube extension. Install grout to a predetermined depth in bolt hole; insert bolt in grout. Work back and forth, up and down to ensure complete embedment. Pack grout in tightly at the surface; trowel even with the concrete. Position bolt, dowel, or bar in center of drill hole with template or wedges until grout sets.

3.10 MODIFIED CONCRETE

A. Surface Preparation

1. Remove all loose deteriorated concrete, soil, dirt, and any deleterious material down to sound concrete. Undercut concrete a minimum of 1/2 inch. Do not feather edge patch material.
2. Sandblast or wirebrush clean concrete and reinforcing steel.
3. Moisten surface and allow to dry until damp.

B. Epoxy Modified Bond Coat: Prior to placing epoxy modified concrete or mortar, coat surface of existing concrete and reinforcing steel with epoxy modified bond coat in accordance with the manufacturer's recommendations.

C. Curing: Immediately after placing patch material, cover with wet burlap or polyethylene sheeting for a minimum of 24 hours and protect from heat, sunlight, and wind.

3.11 TYPE 1 GROUT

A. Use Type 1 grout in all areas where the grout could be expected to have some structural requirements such as under column base plates, and all equipment mounting pads.

B. Grout storage, handling, mixing, and placing shall meet the requirements of the grout manufacturer.

C. The clearance between foundations and base plates or equipment bases shall not be less than 1 inch for each 16 inches the grout must flow horizontally.

D. All areas to be grouted shall be clean and free of oil, grease, dirt, and contaminants. Remove all loose material. Provide air relief openings where required to avoid entrapment of air. All metal components to be in contact shall be derusted and free of paint or oils. All concrete to come into contact with the grout shall be rough finished and shall be thoroughly saturated by dampening or soaking prior to placement of grout. Remove excess water from holes and voids.

E. Use forming procedures that allow proper and complete placement of the fluid grout, including the use of head forms. Support elements to be anchored so that no movement is possible. Remove support only after grout has hardened sufficiently. Pretreat wood surfaces that can absorb

moisture with forming oils. Cut back edges of concrete to be grouted which are less than 1-inch thick to form a uniform butt.

- F. Place grout in accordance with standard grouting procedures and recommendations of ACI for placing and curing of concrete. Use chains, rods, or tamping devices to compact grout tightly, completely removing all air voids. Place grout quickly and continuously, striking off exposed areas. Cure finished grout by standard methods.
- G. Grout protection shall meet the requirements of the grout manufacturer.

3.12 TYPE 2 GROUT

- A. Use Type 2 grout for leveling courses, screeded toppings for tank base slabs, and other similar applications.
- B. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion the materials to produce a grout that is suitable for the intended application.
- C. Use a bonding agent to bond the grout to the surface receiving the grout. Use of the bonding agent shall meet the requirements of the bonding agent manufacturer's requirements.
 - 1. The surface to which grout is applied shall be clean and sound. Remove oil, grease, and similar substances. Remove unsound concrete, loose material, and foreign matter by scarifying or other mechanical means. Etch all concrete, whether new or old, with a 1:1 muriatic acid solution (approximately 14%) and thoroughly rinsed with water to remove all traces of acid.
 - 2. Mix and place bonding agent according to bonding agent manufacturer's instructions.

3.13 FINISHING

- A. All concrete and grout surfaces shall be true and even, and shall be free from open or rough spaces, depressions, or projections.
- B. Accurately screed exposed surfaces of concrete to grade and then float prior to final finishing. Do not use excessive floating or trowel while concrete is soft. Do not add dry cement or water to the surface of screeded concrete to expedite finishing.

- C. After removal of forms, remove all bulges, fins, form marks, or other irregularities that may adversely affect the appearance or function of the concrete.
- D. Clean and patch all cavities left by form ties or any other device. Use expansive grout for patching.
- E. Finish concrete in accordance with the following schedule, unless specifically excepted.

<u>Surface</u>	<u>Finish</u>
All exposed vertical surfaces from inches below grade or minimum operating level	Smooth rubbed finish
Floor slabs of tanks and channel floors which will not receive leveling grout	Smooth floated finish
Floor slabs of tanks or channel floors which will receive leveling grout	Brushed finish
Interior building floors not receiving fluid applied resilient flooring	Steel trowel finish
Interior building floors which will receive fluid applied resilient flooring	Brushed finish
Leveling grout for tank slabs and channel floors	Screeded with trowel finish
Exterior horizontal traveled surfaces	Brushed finish
Exposed exterior horizontal surfaces except as listed above	Smooth rubbed finish

- F. Cement based or acrylic polymer compounds will be considered as an alternative to rubbing. Preparation and application shall meet the requirements of cement based and acrylic polymer compound manufacturers.

3.14 TESTING

- A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform the following tests as specified below and as requested by the Engineer.
 - 1. Perform tests in accordance with the following ASTM Specifications:

<u>Test</u>	<u>ASTM Specifications</u>
Slump	C 143
Air Content	C 173

<u>Test</u>	<u>ASTM Specifications</u>
Test Cylinders	C 31 or C 513
Core Samples	C 42
Fly Ash	C 311

- B. The Contractor and the Engineer's representative shall measure slump each time test cylinders are to be made and at any other time requested by the Engineer. The slump limits given hereinbefore shall not be exceeded unless specifically excepted by the Engineer.
- C: Measure air content each time test cylinders are to be made and at any other time requested by the Engineer. The field test may be omitted if the air content is known prior to taking samples. The field test may not be omitted if fly ash is used in the mix.
- D. Make test cylinders in sets of four. Field cure one cylinder. Break field cured cylinder at seven days. Laboratory cure the remaining three cylinders from each set of four. Break laboratory cured cylinders at 28 days. The Contractor shall be responsible for handling and transportation of cylinders. If fly ash is used in the mix, a total set of seven cylinders shall be taken. The additional three cylinders shall be laboratory cured and broken at 56 days, if the 28 day strength does not meet specifications.
- E. Make one set of test cylinders for each 50 cubic yards, or fraction of 50 cubic yards, of concrete placed, or at other times requested by the Engineer.
- F. Fly ash shall be sampled and tested as specified in ASTM C 311 prior to use as an admixture in concrete.

END OF SECTION 03300

V. WATER MAINS

SECTION 02660 - WATER MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install pipe, fittings, valves, hydrants and appurtenances necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions
 - 1. Abbreviations
 - a. ANSI - American National Standards Institute.
 - b. ASTM - American Society for Testing & Materials.
 - c. AWWA - American Water Works Association.
 - 2. All pipe, fitting and valve sizes and references to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 QUALITY ASSURANCE

- A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.
- B. The Contractor shall test and disinfect water mains constructed under this Contract, as specified in this Section.
- C. The Contractor shall collect samples of water from water mains constructed under this Contract, after the piping has been disinfected. Submit the samples to the applicable regulatory agency for bacteriological analysis. Collection and submittal of these samples shall meet the requirements of the applicable regulatory agency. If samples do not pass the requirements of the bacteriological analysis, the water main will be disinfected and sampled again. This procedure will be followed until the samples pass the analysis.
- D. A performance test may be required by the Engineer, at any time, for each crew installing water mains. The Contractor shall perform these tests at no

additional cost to the Owner. When required by the City, the Contractor shall test a given section of water main installed by a given crew. The section shall be a continuous section of water main which can be isolated by valves shown on the drawings. The Contractor shall not install water mains in other sections until the first section has been successfully tested.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions and Section 01001, General Requirements.
- B. Submit:
 - 1. Certified copies of test reports of factory tests required by the applicable standards.
 - 2. Tabulated layout schedule for prestressed concrete cylinder pipe shall include:
 - a. Water main diameter;
 - b. Numerical designation, laying length and grade of each pipe, fitting, adapter and valve;
 - c. References to stationing or total water main length.
 - 3. Shop drawings with performance data and physical characteristics for valves and hydrants.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products.
- B. Load and unload all pipe, fittings, valves, hydrants and appurtenances by hoists or skidding, and do not drop, skid or roll products. Pad slings, hooks and pipe tongs, and use in such a manner to prevent damage to the products.
- C. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings, valves, hydrants and appurtenances free from dirt or foreign matter. Drain and store valves and hydrants in a manner that will protect them from damage by freezing. Store gaskets, polyvinyl chloride pipe and other products, which deteriorate in sunlight, in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products and shall be used on a first-in, first-out basis.

- D. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of prestressed concrete cylinder and polyvinyl chloride pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings, valves and hydrants.
- E. Promptly remove damaged products from the job site and replace with undamaged products, at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, hydrants and appurtenances shall be as shown on the drawings or as required by the manufacturer's and ANSI/AWWA specifications. All pipe, fittings, valves, hydrants and appurtenances shall be new and unused.

2.2 BURIED WATER MAIN PIPE AND FITTINGS

A. Ductile Iron Water Mains

1. Pipe

- a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51. Design and manufacture pipe for the pressure class listed plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications, shall be included. Minimum thickness class shall be as follows:

<u>Size Range</u>	<u>Pressure Class</u>
4" - 12"	350
14" - 20"	250

- b. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA C111/A21.11.

2. Fittings

- a. Fittings shall be ductile iron. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA C110/A21.10. Compact or short body fittings 3 inches through 16 inches shall meet the requirements of

ANSI/AWWA C153/A21.53. Design and manufacture fittings for a pressure rating of at least 150 psi.

- b. Fitting joints shall be restrained mechanical joints with Mega-Lugs. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Thrust block all mechanical joints as indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications. Pipe connecting to restrained joint fittings shall be restrained as indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications.

3. Adapters

- a. Adapters from ductile iron water mains to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure class rating of 150 psi.
- b. Adapter ends connecting to ductile iron water mains shall be one of the following: plain end mechanical joint. Adapters with plain ends or mechanical joints may be used where restrained joints are not required. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte or as approved by the Engineer.
- c. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

- 4. Line the inside surfaces of all pipe, fittings and adapters with single layer cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104. Coat the outside surfaces of all pipe, fittings and adapters with a bituminous coating, complying with ANSI/AWWA C151.

- 5. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.

6. Nuts and Bolts

- a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
- b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

7. Polyethylene encasement for ductile iron water mains shall meet the requirements of ANSI/AWWA C105/A21.5. Install polyethylene encasement only when indicated on the drawings.
8. Gaskets for prestressed concrete cylinder pipe joints shall be continuous, solid-ring, natural or synthetic rubber with a circular cross-section. Gaskets shall follow ANSI/AWWA C301.
9. Nuts, bolts, snap-rings and clamps shall meet the requirements of the joint manufacturer.

2.3 PIPE AND FITTINGS SMALLER THAN 4-INCH

- A. Pipe shall be Type K drawn copper and shall meet the requirements of ASTM B88.
- B. Fittings and couplings shall be cast bronze and shall meet the requirements of ASTM B16.18. Construct and manufacture fittings and couplings for a pressure rating of 150 psi.
- C. Unions shall be bronze and shall meet the requirements of ASTM B16.18. Design and manufacture unions for a pressure rating of 150 psi.
- D. Flanges for connection of screwed joint pipe to flange joint valves or fittings shall be 125-16 cast iron, screwed companion flanges, complying with both ASTM A126 and ANSI B16.1.
- E. Tape for screwed joints shall be teflon.
- F. Gaskets for flange joints shall be 1/16-inch thick, full face and conform to ANSI/AWWA C111/A21.11. Gaskets shall be rubber or as approved by the Utilities Superintendent.
- G. Bolts for flange joints shall be steel, heavy hexagon head machine bolts. Nuts shall be steel, semi-finished, heavy hexagon nuts. Nuts and bolts shall meet the requirements of ASTM A307 for Grade B and be zinc-coated alloy steel.

2.4 VALVES

- A. Gate Valves
 1. Buried gate valves 4-inches and larger shall be iron body, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and have mechanical joint ends. Mechanical joints and joint accessories shall comply with ANSI/AWWA C111/A21.11. Valve opening direction shall be

consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Engineer.

2. Three-inch buried gate valves shall be iron body, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509; except, ends shall be screwed. Screwed ends shall conform to ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Engineer.
3. Gate valves 4-inches and larger installed above ground or in structures shall be iron body, outside screw and yoke gate valves. Valves shall correspond to ANSI/AWWA C500 or C509. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall be as specified in ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel. Gaskets shall be full face and rubber, or as approved by the Engineer.
4. Gate valves smaller than 4-inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels.

- B. Buried valves 2-inch and smaller shall be curb stops. Curb stops shall meet the applicable requirements of ANSI/AWWA C800, ASTM B-62 for 85-5-5-5 composition bronze, and USAS B2.1. Curb stops shall be Ford Meter Box or as approved by the City. Following are the Ford Meter Box catalog numbers:

Curb Stop Size	Catalog Number
3/4"	Ford B44-333
1"	Ford B44-444
2"	Ford B44-777

- C. Tapping Valves

1. Tapping valves shall comply with both ANSI/AWWA C500 or C509 and have flange mechanical joint ends. Double disc gate valve gates, gate rings and body-seat rings shall be oversized to permit entry and exit of tapping machine cutters.
2. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue which fits a recess in the sleeve. Tongues shall meet the requirements of MSS SP-60. Resilient seated gate valves having a port diameter equal to or exceeding 1/4 inch over nominal diameter shall not require a

tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts, bolts, and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel, and gaskets shall be rubber, or as approved by the Utilities Superintendent. Mechanical joints and accessories shall meet the requirements of ANSI/AWWA C111/A21.11. A full nominal diameter cutter shall be used for tapping.

Tapping valves 14-inch and smaller shall be installed vertically. Tapping valves 16-inch and larger shall be installed horizontally and shall have bypass valves. Tapping valves installed horizontally shall have rollers and tracks. Valves 16-inch and larger shall have gear operators with enclosed gear cases suitable for buried service. Gear cases shall be extended type or totally enclosed type. Extended type gear cases shall have bolted side plates to cover stem and stuffing box.

2.5 VALVE BOXES

- A. Valve boxes for butterfly valves and gate valves shall be cast iron. Valve boxes shall be two piece or three piece type. Each two piece box shall be complete with bottom section, top section and cover. Each three piece box shall be complete with base, center section, top section and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16-inch. Cast the word "WATER" in each valve box cover.
- B. Valve boxes for curb stops shall be cast iron. Curb boxes shall be extension type. Each curb box shall be complete with curb box base, curb box, and lid. Curb box shall be the following or as approved by the Engineer:

<u>Curb Stop Size</u>	<u>Foot Piece</u>	<u>Curb Box with Lid & Plug</u>
3/4"	Sigma 45311-1-600	N/A
1"	Sigma 45311-1-600	N/A
2"	Sigma 45311-1-600	Ford CB-7

2.6 FIRE HYDRANTS

- A. Fire hydrants shall be dry-barrel, compression shutoff, traffic model and comply with AWWA C502. Main valve size shall be 5-1/4 inch. Inlets shall be 6-inch mechanical joint. Each hydrant shall have two 2-1/2-inch nozzles and one 4-1/2-inch Storz pumper nozzle. Nozzle threads and

hydrant opening direction shall be consistent with existing fire hydrants in the waterworks in which the fire hydrants are installed, unless otherwise directed by the City of Rensselaer. Each hydrant shall be the proper length for the water main to which the hydrant is connected. Fire hydrant coating shall meet the requirements of AWWA C502. Fire hydrants color shall be MAB Caution Yellow (7077). Hydrants shall be Model No. A423 Super Centurion, as manufactured by Mueller Company or Waterous Pacer No. WB-67, as manufactured by Waterous Company.

- B. Fire Hydrant Placement - Fire Hydrants shall be placed no farther apart than 300 feet in all residential subdivisions, subdivision sections, and other residential areas in which dwelling density meets or exceeds three dwelling units per gross acre. Fire hydrants shall be placed no further apart than 300 feet in all Industrial, Business, and Commercial areas, and all Industrial, Business, and Commercial uses. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the local fire department. For residential uses with densities less than three dwelling units per gross acre, the requirements as established in Table No. III-B-A of the Uniform Fire Code shall apply. Where there is any ambiguity or dispute concerning the interpretation of this requirement, the decision of the Chief of the local fire department shall prevail subject to appeal.

2.7 WATER SERVICES

- A. Pipe shall be seamless copper tubing and shall meet the requirements of ASTM B 88, Type "K".
- B. Fittings and Couplings: Couplings for copper tubing shall be copper to copper or copper to iron as required, and shall meet the applicable requirements of AWWA C800, ASTM B-62 for 85-5-5-5 composition bronze, and ANSI B2.1. Fittings and couplings shall be Ford Products, Pack Type Compression Joints, or equal.

2.8 METERS

Meters shall be displacement type magnetic drive, 5/8" x 1/2" SR Meters, Touch Read Pit Lid (TRPL), as manufactured by Sensus Technologies. Flow measurement reading shall be in 100 cubic feet. Meter shall be supplied with housing assembly and cast iron bottom.

2.9 TAPPING SLEEVES

- A. Tapping sleeves shall be all stainless steel flanged split sleeves. Each sleeve shall have a branch connection with a flange end. The inside diameter of each branch shall be over-sized to permit entry and exit of

tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameters shown in ANSI/AWWA Standards.

- B. Tapping sleeves for 4-inch through 16-inch pipe shall be designed and manufactured for a working pressure of 200 psi.
- C. Tapping sleeves for 18-inch and larger pipe shall be designed and manufactured for a working pressure of 150 psi.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, after delivery to the site or at both places; and the products shall be subject to rejection at any time for failure to meet any of the specifications' requirements, even though sample products may have been previously accepted as satisfactory at the place of manufacture.
- B. Prior to being installed, each pipe and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and removed immediately from the work.

3.2 LAYING OF WATER MAINS

- A. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
- B. Lay and maintain pipe to the lines and grades shown on the drawings or to the minimum depth specified in this Article. Install fittings, valves and hydrants in the locations shown on the drawings.
- C. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Engineer.
- D. Water mains shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from

edge to edge of the pipe. Water mains crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. The 18-inch separation shall apply whether the water main is over or under the sewer or force main. Lay water mains at crossings of sewers and force mains so a full length of water main pipe is centered on the sewer or force main whenever possible. No water main shall pass through or come in contact with any part of a sanitary sewer manhole.

- E. Water main pressure piping shall be laid at a depth that provides at least 5'-0" of cover. This depth of cover applies unless otherwise depicted on the drawings or specified by the Engineer. Furthermore, cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.
- F. Stream crossing pipe shall be laid at a depth that provides at least 4'-0" of cover from the channel bottom to the top of the pipe. However, if the pipe is laid in rock, at least 1'-0" of cover shall be present.
- G. Laying of water mains shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.
- H. Shape the bottom of the trench to give uniform circumferential support of the lower quarter of each pipe. Also, all trench excavation shall be in accordance with federal, state and local OSHA requirements.
- I. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.
- J. As each length of pipe is placed in a trench, joint the pipe being laid to the previously laid pipe. Bring the pipe to correct line and grade. Secure the pipe in place with bedding tamped under the pipe. Tamp bedding up to the centerline of the pipe.
- K. Deflection from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.
- L. Provide thrust restraint at horizontal and vertical deflection fittings and at tees, plugs, tapping sleeves and tapping saddles. Restraint shall be concrete thrust blocking or restrained joint piping.

- M. Where concrete thrust blocking is used, cover the fitting to be blocked with visqueen or a heavy duty grease to prevent adherence of the concrete to the fitting.
- N. Block the open end of the pipe at the close of each day's work to prevent contamination from dirt or rain water and entry of any animal or foreign material.
- O. Lower pipe, fittings, valves and hydrants into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe, fittings, valves, or hydrants into the trench.

3.3 SETTING VALVES, VALVE BOXES AND FIRE HYDRANTS

- A. Clean the interiors of valves and hydrants of foreign matter before installation. Tighten stuffing boxes. Inspect valves and hydrants in opened and closed positions to ensure all parts are in working condition.
- B. Set valves and valve boxes plumb. Center valve boxes on the valves or valve operators. Locate valves outside the area of roads and streets where feasible. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet. Tamp minimum of one (1) foot of #8 stone around valve box bottom enough to cover hub on box.
- C. Obtain final location of hydrants from Owner's representative. Set hydrants plumb with the pumper nozzle facing the street. The centerline of the outlet nozzles shall be at least 18 inches or at most 30 inches above finished grade at a hydrant. Install hydrant extensions where required to bring hydrant to proper elevation. Set each hydrant upon a slab of stone or concrete not less than 4 inches thick and 15 inches square. Wedge the side of each hydrant opposite the pipe connection against the undisturbed trench face to prevent the hydrant from blowing off the branch connection. Compact the backfill around each hydrant to finish grade. Tamp #8 stone around bottom of hydrant a minimum of two (2) feet deep. Furnish and install a gate valve and valve box in each hydrant branch connection. In the field, apply two coats of polyurethane epoxy to the fire hydrants installed. The color shall be selected by the Owner.

3.4 CONNECTING TO EXISTING MAINS

- A. The Contractor shall locate and verify exact size of all existing mains, both horizontally and vertically. Contractor to connect to main at any location along right-of-way at their expense. This could require crossing of

roadways. Additionally, allow adequate time, after location and prior to making new connections, for changes in the connection location and size. Backfill excavation immediately after main is located and measured.

- B. Make each wet connection with a tapping valve and sleeve. Install and hydrostatically test each tapping valve and sleeve assembly prior to tapping the existing water main. Open and close tapping valves, and inspect tapping valves in both positions to ensure all parts are in working condition. To ensure that the tapping valve is open, inspect each tapping valve prior to connecting the tapping machine. Install watertight plug on the tapping valve outlet and backfill excavation if new or existing water main is not connected to tapping valve within 48 hours.
- C. Make each dry connection with fittings and valves indicated on the drawings. Furnish and install sleeves required to complete connections. All required pipe, fittings, valves, tools and equipment shall be at the connection site prior to starting connection. Wash interior of new pipe, fittings and valves with a solution containing 50 mg/l of chlorine, prior to making a connection. Install sufficient water main and restrain joints so existing water mains can be put in service immediately after connection is completed. Inspect joints and eliminate leaks immediately after connection is completed and existing mains are put in service. Install watertight plugs on open ends of pipe and valves, and backfill excavation if new or existing water main is not connected to dry connection within 48 hours.

3.5 JOINTING

- A. Ductile Iron Push-on Joints
 - 1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
 - 2. For restrained push-on joints, move the loose retainer ring into position against the retainer bar on the spigot end of the pipe being installed. Loosely assemble the joint bolts and nuts.
 - 3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
4"	5°	18-1/2"
6"	5°	18-1/2"
8"	5°	18-1/2"
10"	5°	18-1/2"
12"	5°	18-1/2"

4. For restrained push-on joints, pull the nuts to a uniform tightness by hand or with a short wrench. Do not pull the spigot of the pipe being installed against the back of the bell of the receiving pipe. Engage at least a full nut on each bolt when joint deflection is required.

B. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

<u>Pipe Size</u>	<u>Bolt Size</u>	<u>Torque Range</u>
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Mega-Lug restraint shall be installed at all mechanical joints.
4. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
4"	8°	31"
6"	7°	27"
8"	5°	20"
10"	5°	20"
12"	5°	20"

C. Threaded Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtighten joints.
3. Backing off made-up threaded joints to facilitate fit-up or alignment will not be permitted.

D. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtorque nuts and bolts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of at least 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall be at least the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

- B. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings.

C. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings and valves.
2. Support piping by suitable saddle stands, concrete piers or hangers.
3. Locate supports where necessary, at least 8 feet on center.

3.7 HYDROSTATIC TEST

- A. Test procedures shall meet the requirements of ANSI/AWWA C600.
- B. Hydrostatic tests shall be performed on all water mains installed. The Contractor shall make arrangements with the Engineer for scheduling each test. Each test shall be performed on the day mutually agreed upon and in the presence of the Engineer.
- C. The Contractor shall furnish equipment, temporary piping, pumps, fittings, gauges and operating personnel necessary to conduct the tests. Water for testing may be obtained from the Owner.
- D. The water mains may be tested in sections between valves when there is one or more intermediary valves in a water main.
- E. Each section of water main shall be complete, and thrust blocks shall have been in place for not less than 10 days prior to being tested.
- F. Expel all air from the water main test section during the filling of the main and prior to the application of test pressure. Tap the water main at high points, if necessary, to release all air from the water main. Plug taps after the test is successfully completed. Plugs shall be watertight. Water should be introduced into the main at the lowest point in the line in order to facilitate the expulsion of air from the line.
- G. Test water mains at a static pressure of 1-1/2 times the working pressure over a period of not less than two (2) consecutive hours. The test will be considered successful when the pressure drop is zero. If the test fails, repair the leaks and repeat the test. Repair leaks and repeat the test until there is no pressure drop.

3.8 FLUSHING

- A. Flush water mains and fire hydrants prior to disinfection. Flush water mains with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

<u>Pipe Size</u>	<u>Inside Diameter</u>	<u>Flow at a Velocity of 2.5 Feet per Second</u>
1/2"	0.622"	2.4 gpm
3/4"	0.824"	4.2 gpm
1	1.05"	6.8 gpm
1-1/4"	1.38"	12 gpm
1-1/2"	1.61"	16 gpm

Pipe Size	Inside Diameter	Flow at a Velocity of 2.5 Feet per Second
2"	2.07"	27 gpm
2-1/2"	2.47"	38 gpm
3"	3.07"	58 gpm
4"	4"	98 gpm
6"	6"	220 gpm
8"	8"	390 gpm
10"	10"	620 gpm
12"	12"	880 gpm

- B. Flush water mains and hydrants until the water discharged is clear.

3.9 DISINFECTION

- A. Disinfect all new and repaired water mains prior to placing them in service. Disinfect pipe, fittings, valves and hydrants with a chlorine solution containing 50 mg/l \pm 5 mg/l of available chlorine.
- B. The chlorinating material shall be chlorine gas, calcium hypochlorite or sodium hypochlorite. Calcium hypochlorite shall have 70% available chlorine by weight, and sodium hypochlorite shall have 5.25% to 14.7% available chlorine. Placing chlorine tablets in the mains during construction is not an acceptable method of disinfection. The following table shows the quantity of chlorine or hypochlorite required to produce 50 mg/l of available chlorine per 100 feet of pipe.

Pipe Size	Inside Diameter	Pounds		Ounces			Quarts	
		Cl ₂	Ca(OCl) ₂ (70%)	Ca(OCl) ₂ (70%)	NaOCl (14.7%)	NaOCl (5.25%)	NaOCl (14.7%)	NaOCl (5.25%)
1/2"	0.622"	0.00066	0.00094	0.015	0.072	0.20	0.0022	0.0063
3/4"	0.824"	0.0012	0.0017	0.026	0.13	0.35	0.0039	0.011
1"	1.05"	0.0019	0.0027	0.043	0.20	0.57	0.0064	0.018
1-1/4"	1.38"	0.0032	0.0046	0.074	0.35	0.99	0.011	0.031
1-1/2"	1.61"	0.0044	0.0063	0.10	0.48	1.3	0.015	0.042
2"	2.07"	0.0073	0.010	0.17	0.79	2.2	0.025	0.069
2-1/2"	2.47"	0.010	0.015	0.24	1.1	3.2	0.035	0.099
3"	3.07"	0.016	0.023	0.37	1.7	4.9	0.055	0.15
4"	4"	0.027	0.039	0.62	3.0	8.3	0.093	0.26
6"	6"	0.061	0.087	1.4	6.7	19	0.21	0.58
8"	8"	0.11	0.16	2.5	12	33	0.37	1.0
10"	10"	0.17	0.24	3.9	19	52	0.58	1.6
12"	12"	0.24	0.35	5.6	27	75	0.83	2.3

- C. Tap water mains where required to inject chlorine solution into all pipe, fittings, valves and hydrants installed and repaired. Inject chlorine solution into water mains. Leave the chlorine solution in the water mains for 24 hours or longer. Open and close valves in lines being disinfected

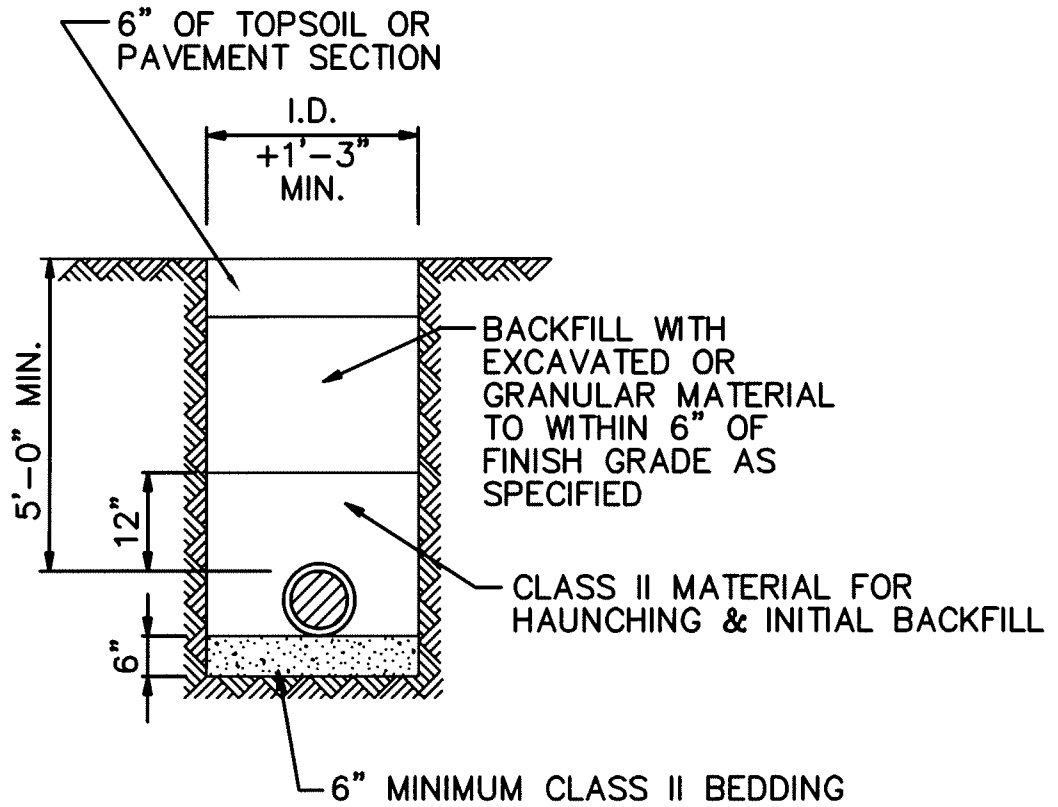
several times during contact period. Following the contact period, flush the water mains with potable water until the chlorine residual is 1.0 mg/l or less.

- D. Bacteriological Tests - The water main shall be tested for bacteriological quality after disinfection and final flushing. Two or more successive sets of bacteriologically satisfactory samples taken at 24-hour intervals must be recorded before the facilities are released for use. Bacteriological testing shall meet the requirements of the applicable regulatory agency. Disinfection shall be repeated if the piping is not bacteriologically acceptable. Repeat disinfection and testing until the mains are approved for service by the applicable regulatory agency.
- E. Hose connections on fire hydrants shall not be used for collecting samples. Contact the applicable regulatory agency for sampling criteria and procedures.
- F. The time for disinfection, bacteriological testing, and approval of the main for service shall be included in the contract time.

3.10 COMPLETION SCHEDULING

Complete water mains as they are installed. Test, flush, sterilize, and place in service each part of the water main which is complete and can be placed in service without preventing work to continue on uncompleted parts of the new water mains.

END OF SECTION 02660



WATER MAIN INSTALLATION DETAIL

HNTB

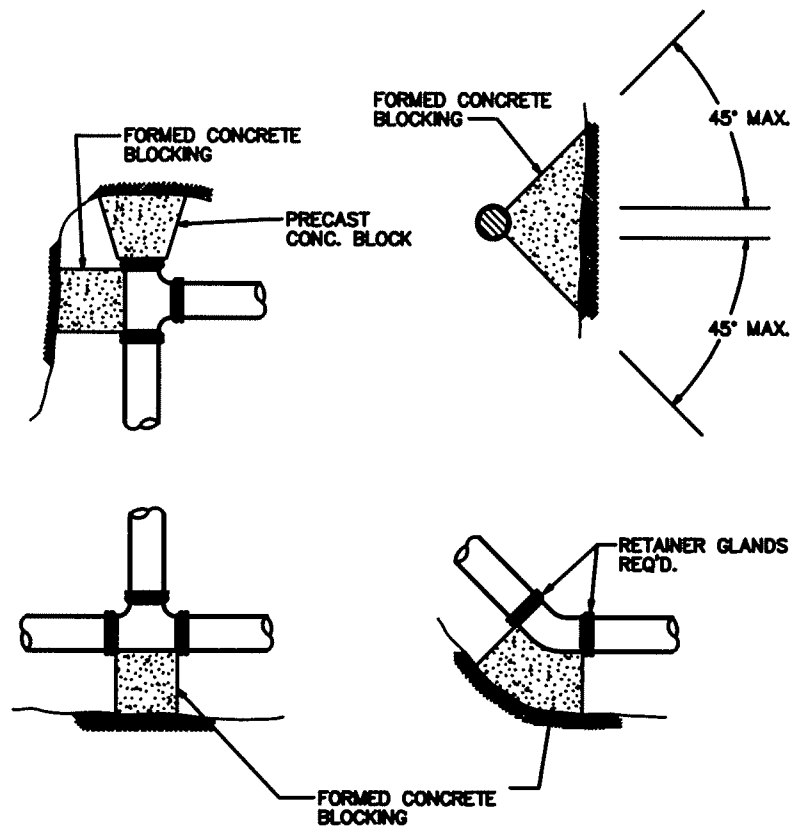


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RENSELAER, INDIANA

AUGUST, 2007

FIGURE W-1

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SIZE	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
4"	2.0	2.5	1.5	1.0	1.0
6"	4.0	5.5	3.0	1.5	1.0
8"	6.5	9.0	5.0	2.5	1.5
10"	10.0	14.0	7.5	4.0	2.0
12"	14.0	20.0	11.0	5.5	3.0
14"	19.0	27.0	14.5	7.5	4.0
16"	25.0	35.0	19.0	10.0	5.0
18"	31.5	44.5	24.0	12.5	6.5
20"	40.0	54.0	31.0	16.5	7.5
24"	55.5	78.5	42.5	22.0	11.0
30"	86.5	122.0	66.0	34.0	17.0
36"	124.0	175.5	95.0	48.5	24.5
42"	168.0	237.5	128.5	65.5	33.0
48"	212.0	366.0	160.0	85.0	42.0

(AREA IN SQ. FT. REQUIRED FOR CONCRETE THRUST BLOCKING)

NOTE:

THE THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING LOAD OF 2,000 LB./SQ. FT.

GREASE ALL WATER MAIN SURFACES PRIOR TO PLACEMENT OF CONCRETE

THRUST BLOCK DETAILS

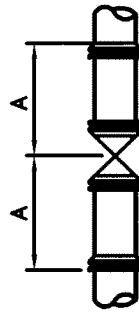
HNTB



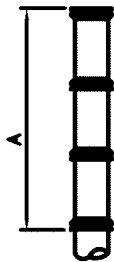
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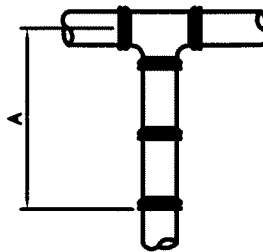
FIGURE W-2



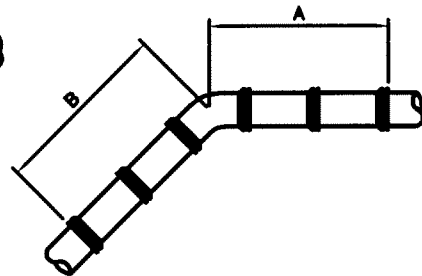
IN-LINE VALVE



DEAD END PLUG



BRANCH FOR
TAPPING SLEEVE
OR TEE



ALL BENDS

RESTRAIN	A & B	A & B	A & B	A & B	A	A
FITTING SIZE	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND	BRANCH FOR TAPPING SLEEVE OR TEE	DEAD END PLUG OR IN-LINE VALVE
6"	15'-0"	6'-0"	3'-0"	2'-0"	10'-0"	32'-0"
8"	19'-0"	8'-0"	4'-0"	2'-0"	10'-0"	42'-0"
12"	27'-0"	11'-0"	5'-0"	3'-0"	24'-0"	59'-0"

NOTE:

RESTRAIN ALL JOINTS WITHIN THE SPECIFIED
DISTANCE FROM ANY FITTING.

RESTRAINED JOINT DETAILS

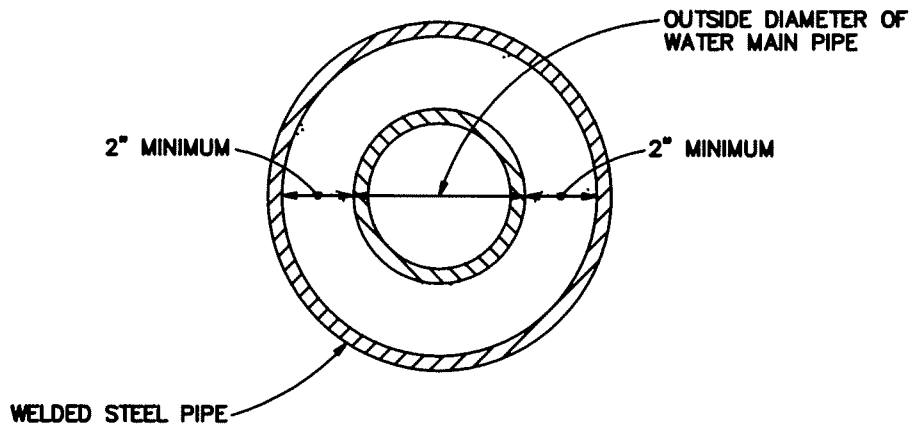
HNTB



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RENSSELAER, INDIANA

AUGUST, 2007

FIGURE W-3



DIAMETER OF CASTING	WALL THICKNESS (INCHES)	
	UNDER HIGHWAY	UNDER RAILROAD
UNDER 14"	0.250	0.188
14"	0.250	0.219
16"	0.250	0.219
18"	0.250	0.250
20"	0.375	0.281
22"	0.375	0.312
24"	0.375	0.344
26"	0.375	0.375
28"	0.500	0.406
30"	0.500	0.406
32"	0.500	0.438
34"	0.500	0.469
36"	0.500	0.469
38"	0.500	0.500
40"	0.500	0.500
42"	0.500	0.500

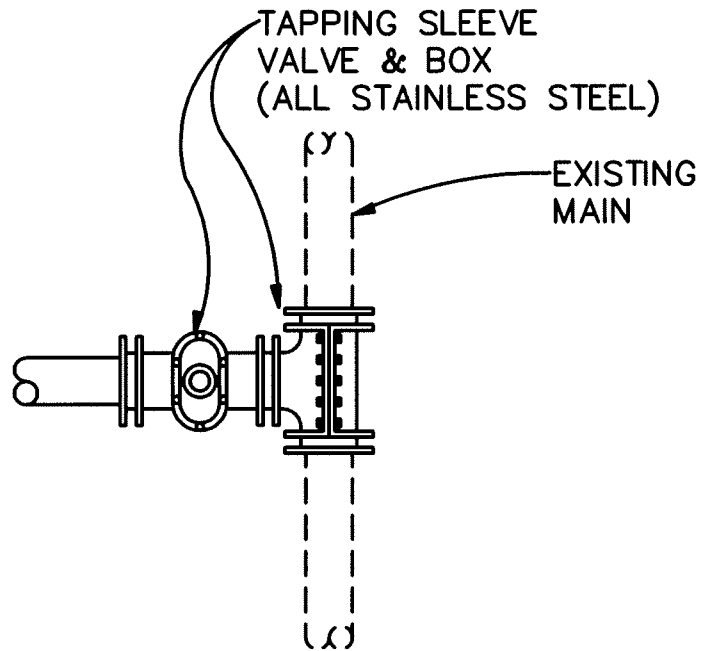
STEEL CASING DETAIL

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FIGURE W-4



NOTE:

BENDS & FITTINGS AS REQUIRED
SEE PLAN SHEETS FOR DETAILS

CONNECTION TO EXISTING MAIN

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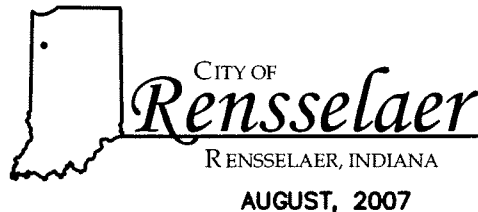
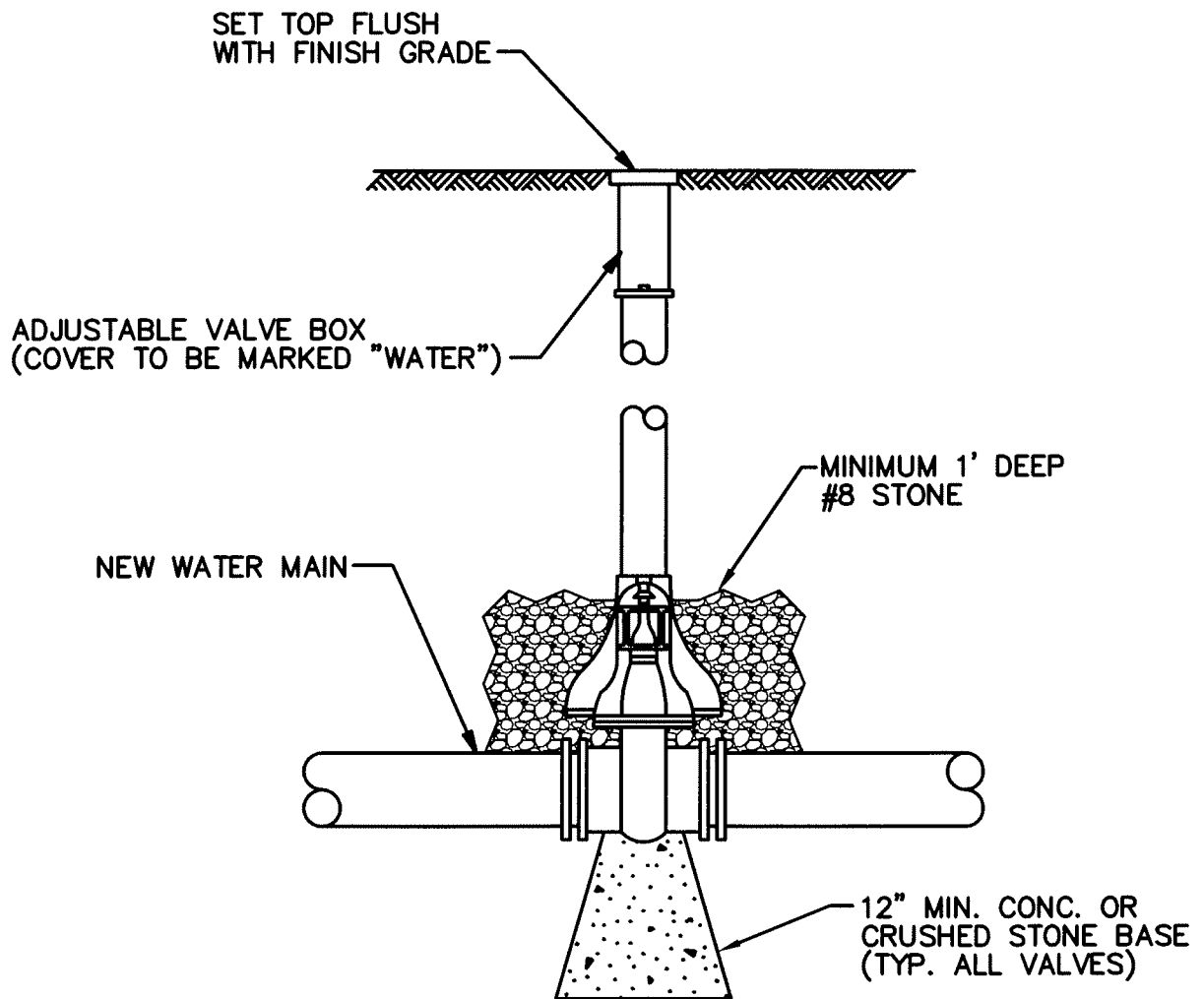


FIGURE W-5

P:\46028_Rensselaer_zoning_subdivision\TechnicalDesign\Water\W-6.dwg, Figure W-6, 4/9/2008 9:43:06 AM, RMcClellan



GATE VALVE AND BOX DETAIL

HNTB

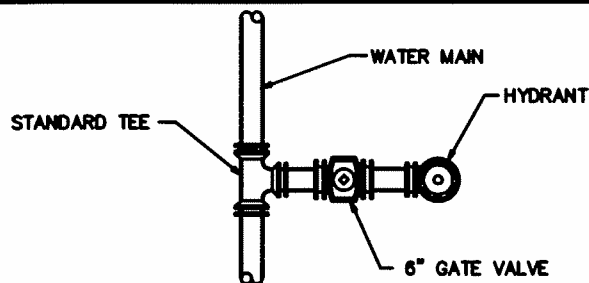


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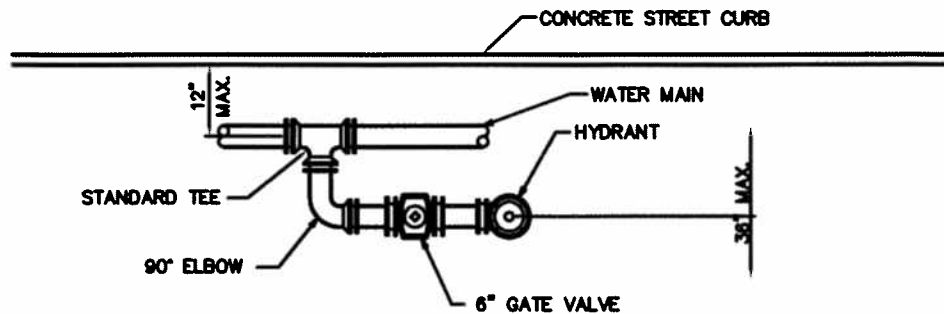
RENSSELAER, INDIANA

AUGUST, 2007

FIGURE W-6



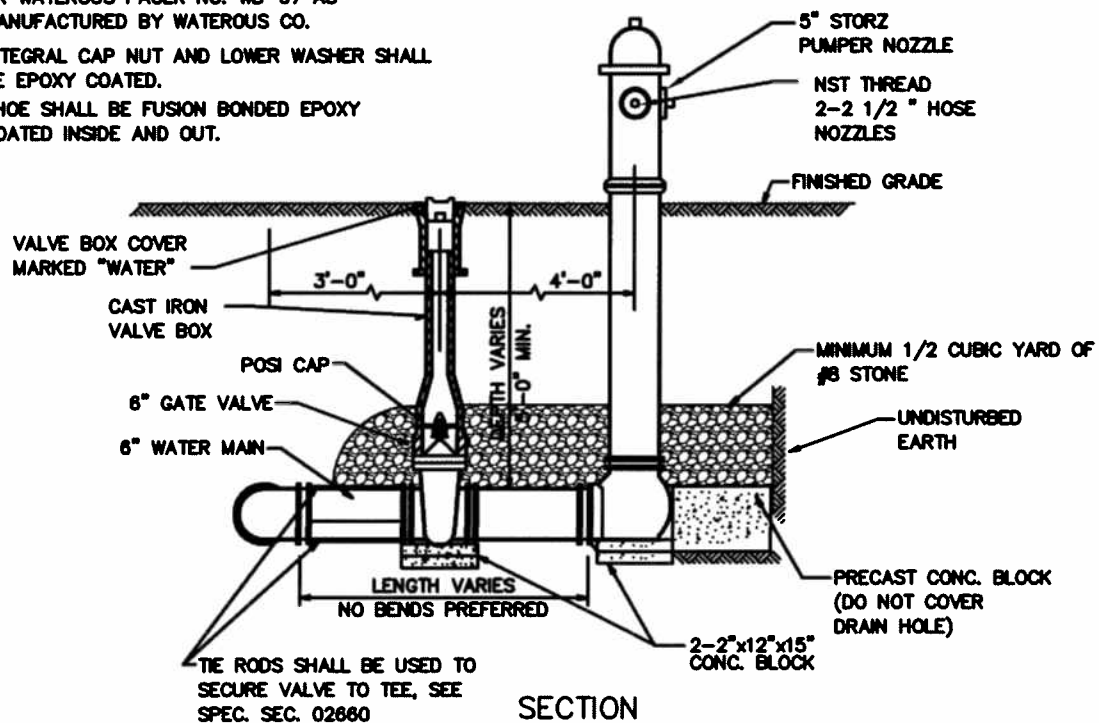
INSTALLATION PERPENDICULAR TO MAIN PLAN



INSTALLATION PARALLEL TO MAIN PLAN

NOTE:

1. HYDRANT SHALL BE MODEL NO. A-423 AS MANUFACTURED BY MUELLER CO. OR WATEROUS PACER NO. WB-67 AS MANUFACTURED BY WATEROUS CO.
2. INTEGRAL CAP NUT AND LOWER WASHER SHALL BE EPOXY COATED.
3. SHOE SHALL BE FUSION BONDED EPOXY COATED INSIDE AND OUT.



FIRE HYDRANT DETAIL

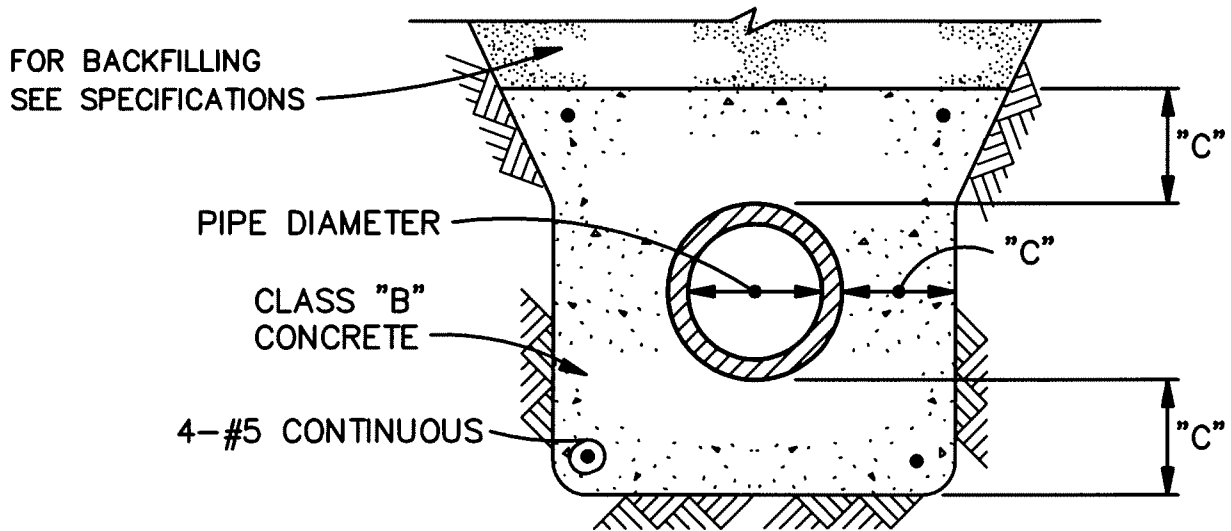
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FIGURE W-7



NOTE:

"C" = 6" MINIMUM
UNLESS INDICATED
OTHERWISE ON PLANS.

CONCRETE ENCASEMENT DETAIL

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RENSELAER, INDIANA

AUGUST, 2007

FIGURE W-9

VI. SANITARY SEWERS AND FORCE MAIN

SECTION 02731 - GRAVITY SANITARY SEWERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install all pipe, fittings, manholes, service laterals and appurtenances necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions
 - 1. Abbreviations
 - a. ANSI American National Standards Institute
 - b. ASTM American Society for Testing & Materials
 - c. AWWA American Water Works Association
 - 2. All pipe, fittings and references to pipe diameter on the drawings or in specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 QUALITY ASSURANCE

- A. Mark pipe and fittings according to the applicable specification or standard.
- B. Perform factory and field tests in accordance with the applicable specification or standard.
- C. Performance Testing
 - 1. The Contractor must test all gravity sewers, including manholes and service lateral connections.
 - 2. An initial performance and leakage test will be performed on the first sections of sanitary sewer constructed of approximately 600-feet in length of each size and type sewer material installed. No additional sewer pipe shall be installed until the first section of sewer of each size and type of sewer material has satisfactorily passed the test for line and grade and the leakage test.

3. After the initial performance test and leakage test and as work progresses, the Engineer may designate additional sections for testing as conditions in his opinion warrant. If a review of the Contractor's workmanship leads the Engineer to question whether or not the tolerances and standards specified are being met, the Engineer reserves the right to select other locations and lengths to be tested. The Engineer shall notify the Contractor of the location where a test is to be required not later than 15 days after the sewer installation has been completed. Unless otherwise authorized, the Contractor shall arrange to commence the test within 15 days after the sewer has been installed or 15 days after receiving notification by the Engineer, whichever date is later.
4. Before acceptance and final payment for all new sanitary sewers, the Contractor and the Engineer or the Engineer's representative shall check all sewers, even if previously checked, for accurate alignment and grade. Also, all sanitary sewers shall be tested as specified in Articles 3.6 through 3.11 of this Section for watertightness. The program of testing whether by infiltration, exfiltration, airtesting, or vacuum testing shall be determined by the Engineer.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions and Section 01001, General Requirements.
- B. Submit shop drawings with performance data, physical characteristics and dimensioned layouts for piping and joints. Additionally, submit calculations on thickness and strength class for piping and joints. Also submit shop drawings with physical characteristics of precast manholes.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products.
- B. Load and unload all pipe, fittings and appurtenances by hoists or skidding, and do not drop, skid or roll products. Pad slings, hooks and pipe tongs, and use in such a manner to prevent damage to the products.
- C. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings and appurtenances free from dirt or foreign matter. Store gaskets, plastic pipe and fittings, and other products, which deteriorate from sunlight, in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products.

- D. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of cast iron, clay, concrete, copper, plastic and steel pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.
- E. Promptly remove damaged products from the job site and replace with undamaged products at no cost to the owner.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings and appurtenances shall be new, unused and as shown on the drawings or as required by the manufacturer and ANSI/AWWA or ASTM Specifications.

2.2 SEWER PIPE 15 INCHES AND SMALLER

- A. Sewers 15-inches or smaller shall be polyvinyl chloride pipe.
- B. Polyvinyl Chloride Pipe
 - 1. Polyvinyl chloride pipe and fittings shall conform to ASTM D3034 SDR 35, Type PSM.
 - 2. Ductile iron pipe and fittings shall meet ANSI/AWWA C151/A21.51.
 - 3. Joints on PVC sewer pipe shall be the integral bell type gasketed joint designed so that when assembled the elastomeric gasket inside the bell is compressed radially on the spigot to form a positive seal. The joint shall comply with the physical requirements of ASTM D3212, and the gasket shall be the only element depended upon to make the joint flexible and watertight.
 - a. All PVC pipe entering a manhole shall have a manhole waterstop gasket as supplied by the manufacturer firmly clamped around the pipe at the manhole. If flexible entry type manhole system is used, the waterstop gasket is not required.
 - 4. Joints on ductile iron pipe shall be push-on type conforming to ANSI/AWWA C151/A21.51. Fittings shall be ductile iron, conforming to ANSI/AWWA C110, with push-on or mechanical joints designed for 150 psi working pressure.

5. Polyethylene encasement for ductile iron sewers shall meet the requirements of ANSI/AWWA C105/A21.5.
- C. Fittings such as wyes, tees and bends shall be constructed of the same material and class as the main line pipe, and these shall meet all relevant specifications. Joints shall be of the same type as used on the adjoining pipe.
1. Fabricated branches for wyes and tees shall be securely attached to the wall of the pipe in a watertight manner and flush with the inside surface of the pipe. The branches shall have their axes perpendicular to the longitudinal axis of the pipe. Wye branches shall have their axes approximately 60 degrees for clay pipe and 45 degrees for concrete pipe from the longitudinal axis of the pipe, measured from the bell end. Pipe reinforcement shall not be interrupted beyond a radial distance of 3-inches outside of the fitting.

2.3 MANHOLES AND OTHER STRUCTURES

- A. Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to ASTM C478, except as modified herein:
1. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.
 2. The joint shall consist of a round rubber gasket confined in a groove in the spigot end of the precast manhole section, conforming to ASTM C443.
- B. Openings in manhole sections for sewer connections shall be cast into the manhole as specified by the connector manufacturer. A flexible pipe-to-manhole connector shall be employed in the connections of the sanitary sewer pipe to precast manholes. The connector shall be the sole element relied on to assure a flexible, watertight seal of the pipe to the manhole. The connector shall be constructed solely of polyisoprene or natural rubber, and shall meet and/or exceed the requirements of ASTM C923. The resilient connectors shall be A-Lok Products, Inc., Press-Seal Gasket Corp., or similar manhole connectors approved by the Engineer.
- C. In the field, any additional openings needed shall be made by core drilling and booted as approved by the Engineer. A flexible pipe-to-manhole connector shall be employed in the connection of the sanitary sewer pipe to precast manholes. The connector assembly shall be the sole element

relied on to assure a flexible watertight seal of the pipe to the manhole. The rubber gasket shall be constructed solely of polyisoprene or natural rubber and shall meet/exceed the requirements of ASTM C923. If metal, the internal expansion sleeve and the external compression clamps shall be constructed of Series 304 and Series 305 nonmagnetic stainless, and shall utilize no welds in its construction.

- D. Materials for manholes, junction chambers, diversion chambers and miscellaneous concrete structures shall comply with the following:
1. Concrete shall be 3000 psi concrete for precast manhole sections and 4000 psi for monolithic manholes. Ready-mix concrete shall conform to ASTM C94, Alternate 2. Maximum size of aggregate shall be 1 1/2 inches. Slump shall be between 2 and 4 inches.
 2. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
 3. Reinforcing steel shall conform to ASTM A615 or A616, with Grade 40 deformed bars.
 4. Mortar Materials
 - a. Sand shall comply with ASTM C144, passing a No. 8 sieve.
 - b. Cement shall conform to ASTM C150, Type 1.
 - c. Water shall be potable.
 5. Rubber gaskets for precast concrete manhole sections shall meet the requirements of ASTM C443, and the gasket shall be the sole element depended upon to make the joint flexible and watertight.
 6. The manufacturer shall provide openings for sewers entering and leaving the manhole. In the field, any additional openings needed shall be made by core-drilling.
 7. Precast or monolithic manhole sections shall be cured. These shall not be shipped from the point of manufacture for at least five days after having been cast. The exterior surface of each section shall be thoroughly coated with a coal tar epoxy type coating as manufactured by TNEMEC, Series 46H413 Hi-Build Theme-Tar; or approved by the Engineer. Final dry mils thickness shall be a minimum of 12 mils. Monolithic concrete manholes and other concrete structures shall be cured for a minimum of seven days, then coated in the field with the epoxy type coating. This coating shall be 8 mil minimum dry thickness.
 8. Manhole frames and lids shall be East Jordan Iron Works 1022-3WT or as approved by the Engineer. Also, all manhole frames and lids shall comply with ASTM A48. Castings shall have four

bolt holes equally spaced around base of frame and be securely anchored to the cone section with four 3/8-inch stainless steel bolts nuts and washers.

9. Manhole steps shall be made from a steel reinforcing rod, encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed both federal and state OSHA requirements. Steps are to be 16-inches on center.
10. Any other special manholes, junction chambers, diversion chambers or miscellaneous concrete structures shall be constructed as detailed on the drawings.
11. The Contractor may, at his option, furnish and install a combination precast concrete base and first section, with precut openings for services. Detailed drawings shall be submitted to the Engineer for approval, prior to manufacture.

2.4 STARTUP SERVICE

The manufacturer of the pipe material and fittings shall provide installation advice and bedding, haunching and backfill instructions to the Contractor's work force when first installing the pipe and fittings. The service of an experienced installation representative shall be provided for a minimum of two days at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer or the City. Such inspection may be made at the place of manufacture, on the work after delivery or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.
- B. Variance from established line and grade shall not be greater than 1/32 of an inch per inch of pipe diameter and not to exceed 1/2-inch, provided that such variation does not result in a level or reverse sloping invert; provided also that the variation in the invert elevation between adjoining ends of pipe, due to nonconcentricity of joining surface and pipe interior surfaces, does not exceed 1/64-inch per inch of pipe diameter or 1/2-inch maximum.
- C. Except by permission of the Engineer or the City, not more than 450 feet of trench shall be opened at any one time. Not more than 30 feet of trench

may be opened in advance of the completed pipe laying operation, and not more than one street crossing may be obstructed by the same trench at any one time.

- D. Prior to being installed, each pipe and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and replaced at the Contractor's expense.

3.2 RELATION TO WATER MAINS

- A. Sewers must be laid at least 10 feet horizontally from any existing or proposed water main. The distance is to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation. Special conditions may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18-inches above the top of the sewer. It may be necessary to install 150 psi water main pipe and joints as sewer pipe for the congested areas.
- B. Whenever the sewer crosses a water main, it should be laid at least 18-inches below the main, or the water main should be relaid with fittings to cross over the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
- C. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling.

3.3 INSTALLATION OF PIPING

- A. Laying Piping
 - 1. All excavation shall be in accordance with federal, state and local OSHA requirements. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
 - 2. Every pipe and fitting shall be cleaned of all debris, dirt and other foreign material before being laid, and it shall be kept clean until accepted in the completed work.
 - 3. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and removed immediately from the work site.

4. All pipe shall be laid accurately to the required line and grade as shown on the drawings. Variations from the uniform line and grade depicted on the drawings shall be cause for the line to be rejected. The supporting of pipe on block will not be permitted.
5. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.
6. Practically watertight work is required, and the Contractor shall construct the sewers with the type of joint specified.
7. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in accordance with the manufacturer's recommendations on that type of joint and the directions of the Engineer. All joint work shall be done by experienced workmen.
8. PVC (polyvinyl chloride) gravity sewer pipe and fittings, ASTM D3034 SDR 35, shall be installed in accordance with the manufacturer's specifications.
9. All pipe entering a manhole shall utilize a resilient, watertight, flexible connection.
10. Laying of ductile iron piping shall meet the requirements of ANSI/AWWA C600 or as approved by the Engineer.
11. The Contractor shall use laser beam equipment, surveying instruments or other proven techniques to maintain accurate alignment and grade.
12. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.
13. The Contractor shall conduct a leakage test as described in Sewer Tests of the specification on the first section of sewer of each size and type sewer material installed. No additional sewer pipe shall be installed until the first reach of sewer of each size and each type sewer material has satisfactorily passed the leakage test.

B. Pipe Bedding, Haunching and Initial Backfill

1. Each pipe section shall be laid in a firm foundation of bedding material, then haunched and backfilled with care, see Standard Detail Sheet.

2. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 3. When Class I material is used for bedding, little or no compaction is necessary, due to the nature of the angular particles. A depth of 4 to 6-inches is generally sufficient to provide uniform bedding. This material must also be utilized for haunching, and initial backfill, to a plane 12-inches above the pipe.
 4. Beneath the pipe bedding material shall have a minimum thickness of 4-inches, or a thickness of one-eighth of the outside diameter of the pipe, whichever is greater. This material shall also extend up the sides of the pipe to a height of one-sixth of the pipe's outside diameter.
 5. In yielding subsoils, Class II material shall be used unless a concrete cradle is ordered for bedding; and the trench bottom shall be undercut to the necessary depth and backfilled with graded, crushed stone to form a firm foundation. See the Standard Detail Sheet for additional information. No additional payment shall be made for stabilizing yielding subsoils.
 6. When excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6-inches of crushed stone bedding shall be placed prior to pipe installation. No additional payments shall be made for rock removal.
 7. Bell holes shall be excavated in advance of pipe laying so the entire barrel will bear uniformly.
- C. Where the edge of the trench is within 5 feet of or crosses the existing or proposed roadway pavement, it shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density, according to AASHTO T99, Method A. In all areas, cuts and trenches shall be backfilled with granular backfill to within 1 foot of the paved surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall add crushed stone and grade until sufficient settlement has taken place and final restoration is made.
- D. Backfill trenches not requiring granular backfill with suitable excavated material. Fill and restore any settlement of the backfill. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.

- E. Concrete cradles shall be constructed of Class "B" concrete and of the design shown on the detailed drawings. When so ordered in writing, concrete cradles not shown on the drawings will be paid for at an additional price per linear foot of pipe.
- F. Jointing
 - 1. Clean the ends of the pipe satisfactorily just before laying. Subsequently, the joint shall be made in a satisfactory manner according to the manufacturer's recommendations for that specific joint and as approved by the Engineer. All joint work shall be done by experienced workmen.
 - 2. Joints shall be as specified in this Section.
 - 3. Each length of pipe shall be installed in accordance with the manufacturer's recommendations and ASTM requirements.
 - 4. Piping shall be tested as specified in this Section.
- G. Manholes and Other Structures
 - 1. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet, or monolithic base and first section combination. Manhole bases shall be cast or placed on a minimum of 6 inches of compacted crushed stone.
 - 2. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semicircular shaped smooth channel directing the flow to the downstream sewer.
 - 3. All manhole frames shall be cast or drilled with four holes equally spaced around base of frame and securely anchored to cone section with four (4) 3/8-inch stainless steel bolts, nuts and washers. The joint between the casting frame and cone section shall be sealed with a pliable butyl rubber and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.

3.4 HOUSE SERVICES

- A. The Contractor shall install 6-inch diameter house service sewers indicated on the drawings and as shown on the Standard Detail Sheet. The house service shall extend from a "wye" or "tee" fitting in the main sewer line to the property line or easement line, unless otherwise shown on the drawings or approved by the Engineer.
- B. The Contractor shall contact the individual property owners for the preferred location of the house service to best suit the property owner's

needs. If the Contractor is unable to contact the property owner in advance of laying the main sewer by or across the property, the Contractor shall notify the Engineer in writing.

- C. Fittings for house service connections on a main sewer line 15-inches in diameter or smaller shall be tees or 45-degree wyes and of the same material as the main sewer line, unless otherwise approved by the Engineer.
- D. Six-inch lateral pipe shall connect to the main sewer line at an angle of 15 degrees to 45 degrees from the spring line and shall include the necessary bends and straight pipe sections to reach the property line at the elevations specified. A pipe stopper or a bell cap shall be placed on/in the last bell. This stopper or bell cap should be compatible with the type of infiltration/exfiltration test performed on the sewer.
- E. The Contractor shall furnish and use the proper fittings, couplings and adapters suited to make the transition between different pipe materials which will maintain the structural integrity and the watertightness of the entire sewer system.
- F. At the discretion of the Engineer or the City, when and where he feels that improper installation practices are suspected, or questionable bedding materials and methods are employed, or where the installations are severe, the Contractor will have to perform deflection testing on the 6-inch house laterals as specified in Article 3.6.
- G. Backfill around fittings and lateral pipe shall be carefully placed and compacted to prevent damage from backfill settlement.
- H. The Contractor shall mark the end of each house lateral with a 5/8-inch steel rod 5 feet long placed vertically over the end of the lateral. The rod shall be painted yellow and left sticking above the existing ground not more than 1-inch.
- I. The Contractor shall keep accurate horizontal and vertical location measurements of each house service installed. Copies of these measurements shall be furnished to the Engineer as the work progresses. The accuracy of the measurements shall be the Contractor's responsibility.

3.5 STUBS, CONNECTIONS, BULKHEADS AND MISCELLANEOUS ITEMS OF WORK

- A. Where special junction chambers are to be constructed or where existing sewers carrying sanitary sewage are encountered, the Contractor shall

provide and maintain temporary connections to prevent a nuisance. All such temporary connections, pumping, and diversion shall be included in the price bid for this work.

- B. Where called for on the drawings, shop connections and stubs for future sewer connections shall be provided. The cost of this work shall be included in the price for manholes.
- C. New sewer connections to existing manholes shall be neatly made by cutting a hole in the existing structure, concreting the sewer in place and providing a watertight connection. Such connections shall be included in the bid price for this Contract.
- D. The Contractor shall not connect any existing sewers or house services prior to the completion of the exfiltration/infiltration tests, air tests, and acceptance of the sewer without the written permission of the Engineer.

3.6 VERTICAL DEFLECTION TESTING

For PVC sewer pipe, the entire length of installed mainline pipe shall be tested for acceptance with an approved go/nogo mandrel under the observation of the Engineer. The testing shall be conducted after the final backfill has been in place for at least 30 days. No pipe shall exceed a deflection of 5% as defined in ASTM Specification D 3034 for PVC Sewer 15-inch diameter and smaller, and ASTM Specification F679 for 18-inch diameter pipe and larger. The deflection test shall be run using a mandrel having a diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without a mechanical pulling device. All pipe exceeding the allowable deflection shall be replaced, repaired and retested.

Testing Device for PVC SDR 35 Pipe

Nominal Size (Inches)	Minimum Diameter (Inches)
8	7-1/4
10	9-1/16
12	10-3/4
15	13-3/4
18	16-7/16
21	19-15/16

For sizes not listed in the above table, see ASTM Specification D3034 or F679.

3.7 INFILTRATION LIMITS

Maximum infiltration/exfiltration limits for all new sanitary sewers shall not exceed 100 gallons per inch of diameter per mile of pipe per 24 hours. This standard is for the overall project and includes all manholes and house service connections. All sections of the sewer shall be tested, and any sections not meeting this infiltration standard shall be repaired and retested.

3.8 SEWER WATERTIGHTNESS TESTING

- A. Tests for watertightness shall be conducted on all installed sewers in the presence of and in the manner accepted by the Engineer or the City. The Contractor shall furnish and install all equipment necessary for the sewer tests.
- B. Watertightness tests shall be conducted on short sections of the sewer as soon as the manholes have been constructed and the backfilling completed.
- C. Where the section tested is in excess of the allowable limits, the Contractor shall correct the construction of the sewer so that the section tested is within the allowable limit. All methods and materials used in the repair shall be approved by the Engineer, at no cost to the Owner.
- D. The program of testing shall fit the conditions as determined by the Engineer using: (1) Infiltration Test for Leakage; (2) Exfiltration Test for Leakage; or (3) Air Test for Leakage. When ductile iron pipe with push-on type joints is for sewer construction, a hydrostatic pressure test shall be performed.
 - 1. Infiltration Test for Leakage
 - a. The infiltration test may be used where the natural groundwater table is at least 2 feet above the pipe in the section being tested.
 - b. The groundwater level at each manhole on the section being tested shall be determined by the Contractor providing a 3/8-inch I.D. pipe through each manhole at an elevation near the invert. Aggregate shall be placed on the outside of the pipe to prevent clogging. The end of the pipe on the inside of the manhole shall contain fittings, together with a vertical transparent pipe to determine the groundwater level. The pipe through the manhole shall be permanently sealed after the tests have been completed.

- c. The test shall be conducted by plugging off the upper end of the pipe section being tested and placing a weir or other approved measuring device in the pipe at the lower end of the section. Sufficient time shall be allowed for the water level over the weir to stabilize before reading the flow. The groundwater table shall be checked at the manholes, on the section being tested, because at least 2 feet of head must be present above the pipe at the time of the test.
- d. The total allowable infiltration into the completed sewer section, including connections, manholes, and structures, shall not exceed 200 gallons per inch of internal diameter per mile of sewer per 24 hour period for concrete pipe and 50 gallons per inch of internal diameter per mile of sewer per 24 hour period for ductile iron and PVC pipe.

2. Exfiltration Test for Leakage

- a. The exfiltration test for leakage may be used where the natural groundwater table is less than 2 feet over the top of pipe in the section being tested.
- b. The test shall be conducted by plugging off the ends of the pipe being tested and filling the section with water. A standpipe shall be provided at one end of the pipe section so that a minimum internal pressure of 5 feet can be maintained above the top of pipe. If a manhole or stubout is included in the section tested, the manhole can be used in place of the standpipe; and the allowable leakage from the manhole riser and stubout shall be calculated as for the respective diameter pipe.
- c. The total allowable exfiltration from the completed sewer section shall not exceed 200 gallons per inch of internal diameter per mile of sewer per 24 hour period.

3. Air Test for Leakage

- a. The air test for leakage may be used in lieu of either the infiltration or exfiltration test or when directed by the Engineer.
- b. The ends of the sewer section being tested shall be sealed and properly blocked. The seal at one end shall have an orifice through which to pass air into the pipe. An air supply shall be connected to the orifice at one end of the section. The air supply line will contain an on/off gas valve and a pressure gauge having a range from 0 to 25 psi. The gauge shall have minimum divisions of 0.10 psi and shall

have an accuracy of the nearest ± 0.1 psi. The seals at each manhole shall be properly blocked to prevent displacement while the line is under pressure.

4. Procedure for Conducting a Low Pressure Air Test
 - a. Clean pipe to be tested by propelling a snug fitting inflated ball through the pipe by water pressure or other adequate method. This step is important because it not only flushes out construction debris, but the water used to flush the ball through the pipe dampens the pipe wall. The rate of air loss through pipe wall permeation can be significant on dry pipes.
 - b. Plug all pipe outlets with pneumatic plugs having a sealing length equal to or greater than the diameter of the pipe to be tested. The pneumatic plug shall be able to resist internal testing pressures without requiring external bracing.
 - c. Once the pipe outlet plugs are securely in place, pressurized air is introduced to the system. The air shall be fed through a single control panel with three individual hose connections as follows:
 - (1) from control panel to pneumatic plugs for inflation in sewer pipe;
 - (2) from control panel to sealed line for introducing the pressurized air;
 - (3) from sealed line to control panel. This line will enable continuous monitoring of the air pressure rise in the sealed line.
 - d. The air shall be introduced slowly to the section of pipe under evaluation until the internal air pressure is raised to 4.0 psig greater than the hydrostatic pressure head created by the existence of groundwater that is over the pipe section.
 - e. A minimum of two minutes shall be provided for the air pressure to stabilize to conditions within the pipe. (This stabilization period is necessary for variations in temperature to adjust to the interior pipe conditions.) Air may be added slowly to maintain a pressure to 3.5 to 4.0 psig for at least two minutes.
 - f. After the stabilization period, when the pressure reaches exactly 3.5 psig, the stopwatch shall be started; and when the pressure reaches 2.5 psig, it is stopped. The portion of the line being tested shall be acceptable if the time in

minutes for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than the time shown in the following table.

Pipe Diameter (Inches)	Time (Minutes)
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
27	13.0

- (1) In areas where the groundwater is above the top of the pipe, the test pressures shall be increased by 0.433 per foot of groundwater. (e.g., if the groundwater is 11 1/2 feet, the 3.5 to 2.5 pressure drop will be increased by 5 psi. The time then will be measured for a pressure drop from 8.5 psi to 7.5 psi.) Groundwater level will be determined by one of the procedures outlined in this Section.

5. Safety Precautions During Air Test

- a. The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
- b. As a safety precaution, pressurizing equipment should include a regulator set at perhaps 10 psi to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.9 HYDROSTATIC TESTING

- A. All ductile iron sewer pipe with push-on type joints, installed by the Contractor in this Contract, shall be hydrostatically tested. The Contractor shall make arrangements with the Engineer for scheduling the test after the sewer pipe has been accepted as being ready for testing. The test shall be performed in the presence of the Engineer on the day mutually agreed upon.
- B. Water for testing may be obtained from the Owner. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges and operating personnel to properly conduct the test.
- C. Hydrostatic test on ductile iron pipe with push-on type joints installed as gravity sewers and siphons shall be in accordance with the following provisions:
 - 1. The ends of the sewer section being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
 - 2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The benchwall shall be formed in the manhole after the test section has been approved.
 - 3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water. All air shall be expelled from the pipe.
 - 4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
 - 5. The system shall be tested in conformance with Section 13 of AWWA Specifications 600, at 50 pounds per square inch over a period of not less than one hour. The system will not be acceptable until all leaks have been repaired.
 - 6. Hydrostatic test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. Inasmuch as a force of 2500 pounds is exerted on an 8inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.

- D. A hydrostatic test on ductile iron pipe with push-on type joints installed as force main shall be in accordance with Article 3.12, paragraph D., with the following exception:
 - 1. The force main shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.

3.10 MANHOLE VACUUM TESTING

- A. A vacuum test shall be conducted by the Contractor on all manholes to ensure watertightness and manhole integrity. The Engineer or his representative must be present when the manhole vacuum testing is being conducted.
- B. The equipment required to conduct a vacuum test on manholes includes inflatable pipe plugs, test head, vacuum pump, flexible air hose, and a vacuum gage. The test equipment shall be capable of drawing a vacuum of 10inch Hg. The equipment shall be designed specifically for the purpose of testing manholes and shall be as manufactured by P.A. Glazier, Inc., Worchester, Massachusetts 10002 or as approved by the Engineer.
- C. The procedure for conducting an air test on manholes shall be in accordance with the following procedure:
 - 1. Each manhole shall be tested after assembly and setting of the casting.
 - 2. All lift holes shall be plugged with nonshrink grout.
 - 3. All visible leaks will be repaired as directed by engineer.
 - 4. All pipes entering the manhole shall be securely plugged and adequately braced against the inside of the manhole to prevent being drawn out of the pipe.
 - 5. The test head shall be placed on the inside of the cone section and sealed with an inflatable seal.
 - 6. A vacuum of 10-inches of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than the following:

<u>Manhole Size (Inches)</u>	<u>Minimum Test Time</u>
48	60 seconds
60	75 seconds
72	90 seconds
84	105 seconds

3.11 CLOSED CIRCUIT TELEVISION INSPECTION

- A. All sections of sewers installed under this Contract shall be inspected by closed circuit television and shall be repaired as directed by the Engineer prior to acceptance.
- B. The Contractor shall furnish a qualified television technician, a trained supervisor, and sufficient personnel to perform all the work required in the inspection operation.
- C. The Contractor shall furnish spare cameras and related equipment to prevent delays due to equipment breakdowns. Cameras shall be equipped with remote control focusing devices, remote control devices to adjust the light intensity, and enough cable shall be furnished to inspect 1,000 linear feet of sewer in a continuous operation. One camera shall be small enough to pass through a 6-inch opening.
- D. The Contractor shall clean the sewer one section at a time. After the sewer is cleaned, the television camera shall be attached to end of a rod or line so that it can be pulled through the pipe line. The camera shall trail a line of steel cable which will be attached to a winch of sufficient size to be able to pull back or retrieve the camera whenever necessary.
- E. The camera shall transmit a continuous image to the television monitor. This image shall be clear and sharp enough to enable those viewing the monitor to be able to easily see the interior condition of the pipe line being inspected.
- F. For each television inspection unit being used, the Contractor shall provide a mobile air-conditioned viewing room large enough to accommodate at least three people for the purpose of viewing the monitor while the inspection is in progress. Minimum size of the monitors shall be 17-inches, measured diagonally across the viewing screen. Electrical power to operate the equipment shall be provided by the Contractor.
- G. The Contractor shall furnish all equipment required for making a continuous video tape of the view which appears on the monitor.

- H. The Engineer or his representative shall be present at all times during television inspection of the sewers and will indicate to the Contractor whatever data may be required to be logged and prepared for record purposes. The Contractor shall prepare and furnish to the Owner not less than two copies of the complete record, video tape and report of all inspection work done.
- I. The cost of this work shall be included as part of the bid under Pay Item No. 1, and no additional compensation will be made to the Contractor.

END OF SECTION 02731

SECTION 02732 - FORCE MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Specifications for force main pipe, fittings, valves, and appurtenances are included in this Section.
- B. Related Work Specified in Other Sections
 - 1. Section 02222 - Earthwork for Utilities
 - 2. Section 02224 - Conduit Construction - Special Crossings
 - 3. Section 02731 - Gravity Sanitary Sewers
 - 4. Section 02902 - Landscaping for Utilities
- C. Definitions: All pipe, fitting and valve size, and all reference to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.
 - 1. AWWA, where used in these specifications, shall mean American Water Works Association.
 - 2. ANSI, where used in these specifications, shall mean American National Standard Institute.
 - 3. ASTM, where used in these specifications, shall mean American Society for Testing & Materials.

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 RELATION TO WATER MAINS

- A. Sanitary force mains must be laid at least 10 feet horizontally from any existing or proposed water main. The distance to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation.

- B. Whenever the force main crosses a water main, it should be laid to provide a minimum vertical distance of 18 inches between the outside of the force main and the outside of the water main. The force main can be either above or below the water main.

1.4 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions.
- B. Submit the following:
 - 1. Certified copies of test reports of factory tests required by the applicable standards.
 - 2. Shop drawings with performance data and physical characteristics for valves.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Load and unload all pipe, fittings, valves, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Slings, hooks, and pipe tongs shall be padded. Use sling, hooks, and pipe tongs in such a manner to prevent damage to products.
- C. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings, valves, and appurtenances free from dirt or foreign matter. Drain and store valves in a manner that will protect valves from damage by freezing. Store gaskets and other products which will be deteriorated by sunlight in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Use gaskets on a first-in, first-out basis.
- D. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Do not stack fittings and valves.
- E. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, and appurtenances shall be as shown on the drawings and specified in this Section. All pipe, fittings, valves, and appurtenances shall be new and unused.

2.2 FORCE MAIN PIPE AND FITTINGS

- A. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151 A21.51 and the additional requirements specified herein. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness class shall be as follows:

<u>Location</u>	<u>Pressure Class</u>
Buried	350

1. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA-C111/A21.11.
 2. Mark each length of pipe. Marking shall include pipe class, casting period, manufacturer's name or trademark, and year of manufacture. Marking shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151).
- B. Polyvinyl chloride pipe shall meet the requirements of AWWA Standard C900. The color of the pipe shall be blue. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. The dimension ratio shall not be greater than 18.
1. Polyvinyl chloride pipe shall have cast-iron-pipe-equivalent outside diameter.
 2. Pipe joints shall be push-on type. Joints shall meet the requirements of AWWA Standard C900. Do not use solvent-cement joints.
 3. Mark each length of pipe. Markings shall meet the requirements of AWWA Standard C900.

- C. Fittings shall be ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53. Design and manufacture fittings for a pressure rating of 150 psi.
1. Fitting joints shall be restrained mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Thrust block all mechanical joints as indicated on the drawings or as required by the manufacturers and ANSI/AWWA Specifications. Pipe connecting to restrained joint fittings shall also have restrained joints as indicated on the drawings and specified in this Section.
 2. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.
- D. Adapters from polyvinyl chloride force mains and ductile iron force mains to victaulic or flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
1. Adapter ends connecting to ductile iron force mains shall have plain ends, push-on joints, mechanical joints, or restrained push-on joints. Adapters with plain ends, push-on joints, or mechanical joints may be used where restrained joints are not required. Adapters shall have restrained push-on joints where restrained joint piping is required as indicated on the drawings and specified in this Section. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA A21.11/C111.
 2. Adapter ends connecting to victaulic or flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.
- E. Lining and Coating: Outside surfaces of the pipe and fittings shall be bituminous coated complying with ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10.
1. The inside surface of the pipe for pipe 4 inches and larger shall be mechanically grit blasted to white metal and then lined with a cement mortar lining or virgin poly-ethylene material having a nominal thickness of 40 mils for corrosion or a two-component coal tar epoxy compound (Duraline) having a nominal thickness of 45 mils.
 2. The linings shall have a minimum dry film thickness of 40 to 45 mils. The thickness shall generally equal or exceed 40 to 45 mils throughout the pipe, except at the ends where the thickness may taper for a distance of 4 inches to a minimum 10 mils thickness.

- F. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of AWWA Standard C900.
- G. Nuts and bolts for mechanical joints shall be high strength, heat treated, cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
 - 1. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.
- H. Polyethylene encasement for ductile iron force mains, when specifically called for on the drawings, shall meet the specification requirements of ANSI/AWWA C105/A21.5.

2.3 VALVES AND VALVE BOXES

- A. Eccentric Type Plug Valves: Plug valves shall be nonlubricated eccentric type with resilient faced plugs having mechanical joint or flanged ends.
 - 1. Port areas of 4-inch to 20-inch valves shall be at least 80% of full pipe area. Port area for 24-inch and larger valves shall be at least 70% of full pipe area.
 - 2. Valve seats, valve plug stem sleeves and plug stem bushings shall be fabricated of materials which are corrosion and abrasive resistant. The corrosion resistance shall be such that exposure over a period of five years to domestic wastewater, industrial wastewater, domestic sludges or industrial sludges containing sulfuric acid, hydrochloric acid, acetic acid, mineral oils, vegetable oils, polymers, esters or acetones shall not result in sufficient corrosion to interfere with the serviceability of the plug valve.
 - 3. Seals shall be capable of being replaced while the line and valve remain in service, if under submerged conditions, thereby eliminating the need to take process units out of service.
 - 4. All exposed nuts, bolts, springs, and washers shall be plated with corrosion resistant material. Means of actuation shall be by lever, gear actuator, tee wrench, extension stem, or floor stand, as indicated.
 - 5. All plug valves shall be equipped with an underground operator.
 - 6. Plug valves 10-inch and larger shall be equipped with gear actuators. All gearing shall be enclosed and lubricated with seals provided on all shafts to prevent entry of dirt and fluid into the actuator. All shaft bearings shall be furnished with permanently

lubricated bronze bearing bushings. Actuator shall clearly indicate valve positions, and an adjustable stop shall be provided to set closing torque. Valve stop shall be positive and shall not move due to repeated operation of the valve.

7. Valves shall be DeZurik Series 100, or equal.

2.4 SEWAGE AIR AND VACUUM VALVES

- A. Sewage combination air and vacuum valves shall be as follows:

<u>Size</u>	<u>Specification</u>
2" x 1"	Apco No. 401 SC, Val-Matic Co. No. 301 BWA, or equal
2' x 2"	Apco No. 402 SC, Val-Matic Co. No. 302 BWA, or equal
3"x 3"	Apco No. 403 SC, Val-Matic Co. No. 303 BWA, or equal
4" x 4"	Apco No. 404 SC

2.5 AIR AND VACUUM VALVE CHAMBERS

- A. Air and vacuum valve chambers shall be 4-foot diameter precast concrete manhole barrels with precast concrete flat slab tops. Precast manhole barrels shall meet the requirements of ASTM C478.
- B. Air and vacuum valve chamber access frames and cover shall be Neenah R-1915-G, or equal. Cast the word "SEWER" in each cover.

PART 3 - EXECUTION

3.1 HANDLING AND CUTTING PIPE

- A. Pipe and fittings shall be handled carefully to avoid cracking or abrasion of the pipe coating.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.

- D. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose. All cut ends shall be examined for possible cracks caused by cutting.

3.2 INSTALLATION OF PIPING

- A. All piping shall be installed to accurate lines and grades and shall be supported, guided, or anchored as shown, as specified, or as necessary.
- B. Restrained joints shall be provided at vertical and horizontal deflection points, tees, and crosses, or as directed by the Engineer.
- C. All piping installations shall be done in a neat and workmanlike manner.

3.3 LAYING PIPE AND FITTINGS

- A. No defective pipe or fittings shall be placed in the work, and any piece found to be defective after having been placed shall be removed and replaced by a second piece and at the expense of the Contractor.
- B. Every pipe and fitting shall be cleaned of all debris, dirt, and other foreign material before being laid, and shall be kept clean until accepted in the completed work.
- C. When bell and spigot pipe is laid, the bell of the pipe shall be cleaned of tar or other obstruction and wiped out before the clean spigot of the next pipe is inserted into it. The new pipe shall then be shoved home firmly against the back of the bell and securely held until the joint has been completed.

3.4 PIPE BEDDING AND HAUNCHING

- A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.
- B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 - 1. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. When Class I material is used for bedding, it must also be utilized for haunching up to 1 foot above the pipe to avoid loss of side

support through migration of Class II haunching material into the bedding.

- C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.
- D. For ductile iron pipe, backfill between the bedding material and a plane 12-inches (300 mm) over the top of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.
- E. For flexible pipe such as PVC, the placement of embedment material, consisting of bedding, haunching, and initial backfill, must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Crushed stone shall be used to backfill between the bedding material and a plane 12-inches over the top of pipe, and shall be hand placed. Care must be taken to not cause damage by compacting the material directly over the pipe.
- F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
- G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6-inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation shall be made on "unit cost" projects only, and as prescribed under basis for payment.

3.5 JOINTING

A. Polyvinyl Chloride (PVC) Push-On Joints

- 1. Clean the bell and spigot of the pipe sections being joined. Wipe the outside of each spigot and inside of each bell clean of all dirt and other foreign matter. Wipe each bell and spigot dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
- 2. Seat a gasket in the bell of the receiving pipe. Thoroughly lubricate the spigot end of the pipe being installed. Use the lubricant furnished by the pipe manufacturer. Center the spigot end of the pipe being installed in the bell of the receiving pipe. Support the pipe being installed so the pipe being installed is jointed along the centerline of the receiving pipe. Push or pull the

pipe being installed home. After jointing, check the gasket to ensure the gasket has not pushed out of its seat and the gasket is uniformly compressed around the pipe.

3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe manufacturer.

B. Mechanical Joints

1. Remove lumps, blisters, and excess bituminous coating from the bell and spigot end of each iron pipe, fittings, and valve. Wire brush the outside of each iron pipe or fitting spigot and inside of each bell. Wipe each bell, spigot, and ring gland clean of all dirt, oil, grease, and other foreign matter. Wipe each bell, spigot, and ring gland dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Brush each spigot and gasket with soapy water. Slip a ring gland followed by a gasket over the spigot. Center the end of the pipe, fitting, or valve being installed on the end of the receiving pipe, fitting, or valve. Support the pipe, fitting, or valve being installed so the pipe, fitting, or valve being installed is jointed along the centerline of the receiving pipe, fitting, or valve. Push or pull the pipe, fitting, or valve being installed home. Push the gasket into position. Move the gland into position against the face of the gasket. Loosely assemble the joint bolts and nuts. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

<u>Pipe Size</u>	<u>Bolt Size</u>	<u>Torque Range</u>
4" thru 24"	3/4"	75 to 90 ft.-lb.
30" and 36"	1"	100 to 120 ft.-lb.
42" and 48"	1-1/4"	120 to 150 ft.-lb.

3. Deflect pipe, fittings, or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
4"	8°-18'	31"
6"	7°- 7'	27"
8"	5°-21'	20"
10"	5°-21'	20"
12"	5°-21'	20"

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
14"	3°-35'	13-1/2"
16"	3°-35'	13-1/2"
18"	3°- 0'	11"
20"	3°- 0'	11"
24"	2°-23'	9"
30"	2°-23'	9"
36"	2°- 5'	8"
42"	2°- 0'	8"
48"	2°- 0'	8"

C. Flange Joints

1. Remove antirust coating from machined surfaces. Clean joint surfaces of the pipe, fittings, and valves being joined. Wipe surfaces clean of all dirt, oil, grease, and other foreign matter. Wipe surfaces dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Align the flange of the pipe, fitting, or valve being installed with the flange of the receiving pipe, fitting, or valve. Support the pipe, fittings, and valves being joined so the flanges are properly aligned. Lubricate bolts and nuts with a graphite and oil mixture prior to installation of bolts and nuts. Install gasket between the flanges. Loosely assemble bolts and nuts. Check gasket to ensure the gasket is in proper position. Evenly tighten bolts and nuts. Tighten bolts and nuts so the joint will not leak. Do not overtorque bolts and nuts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of not less than 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings to be restrained and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall not be less than the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

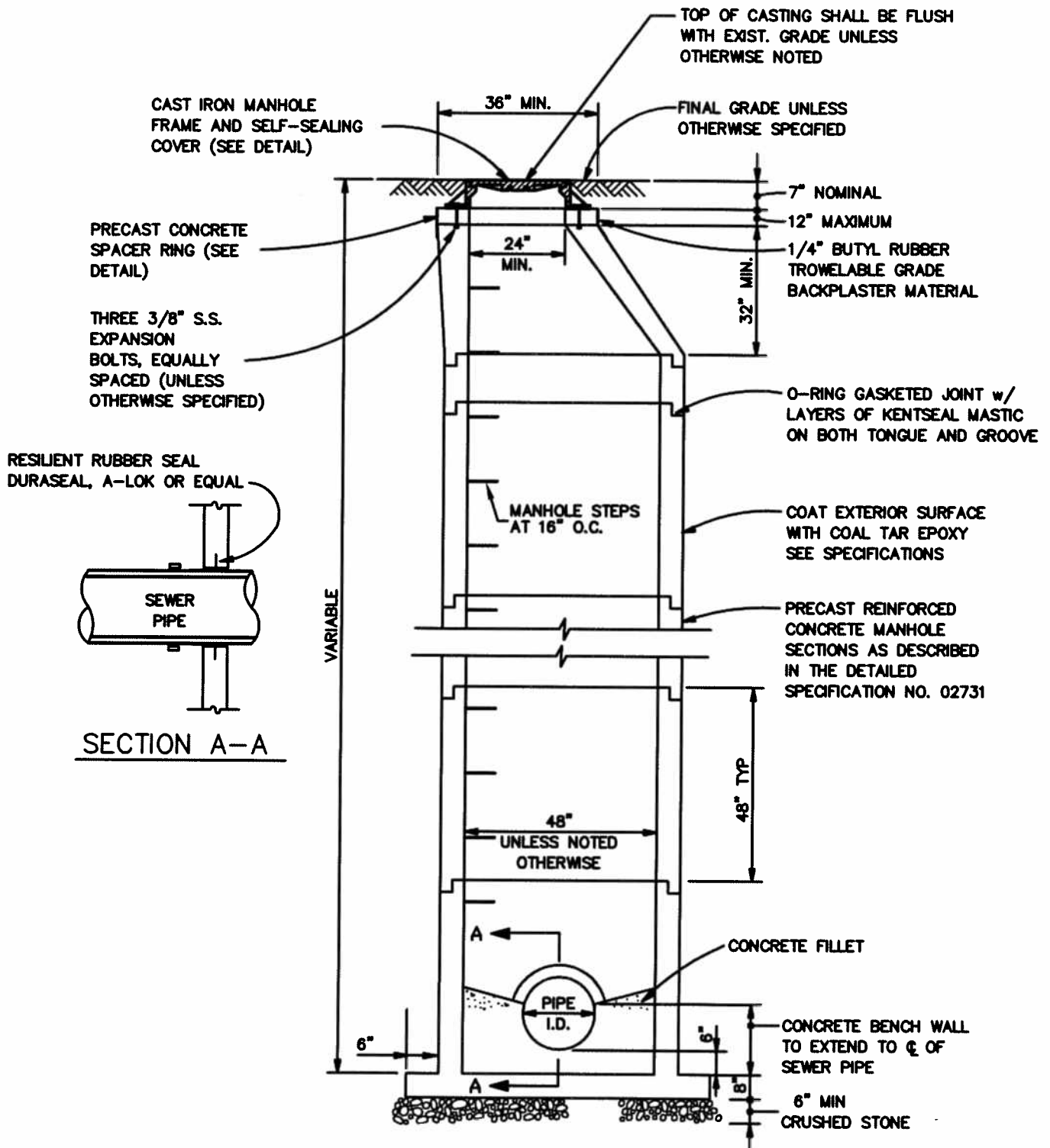
- B. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings.
- C. Pipe Supports
 - 1. Furnish and install supports required to hold pipe, fittings, and valves at the lines and grades indicated on the drawings and without strain upon pipe, fittings, and valves.
 - 2. Support exposed piping by suitable saddle stands, concrete piers, or hangers.
 - 3. Locate supports where necessary and not less than 8 feet on center.

3.7 HYDROSTATIC TEST

- A. A leakage test must be successfully performed on the new force main in accordance with the following provisions:
 - 1. Said test shall include all force main in this contract as shown on the drawings. The Contractor shall make arrangements with the Engineer for scheduling the test after the piping has been accepted as being ready for testing. All concrete thrust blocks shall have been in place for a period of at least ten days prior to the test. The test shall be performed on the day mutually agreed upon and in the presence of the Engineer.
 - 2. Water for testing will be obtained by the Contractor at his cost. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test. The system shall be tested in conformance with Section 13 of AWWA Specification C600 at static pressure of 100 pounds per square inch over a period of not less than eight consecutive hours. The system will not be acceptable until all leaks have been repaired to the satisfaction of the Engineer.
 - 3. At the option of the Contractor, the force main may be tested in sections approximately 500 feet in length (subject to the approval of the Engineer); and upon satisfactory completion of the leakage test, the trench shall be backfilled as specified.
 - 4. During the filling of the pipe and before the application of the specified test pressure, all air shall be expelled from the pipe line, if necessary, by means of taps at points of highest elevation; and after completion of the test, the taps shall be tightly plugged, unless otherwise specified.

- B. When push-on type joints are used, the Contractor shall completely fill the pipe with water and apply sufficient pressure to set the joint gaskets before commencing the leakage test outlined above.

END OF SECTION 02732



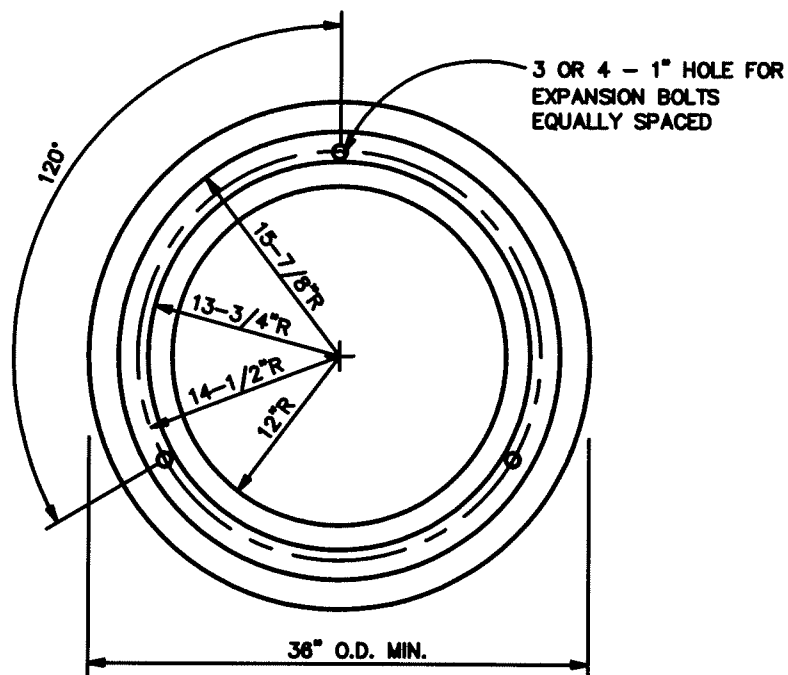
STANDARD SANITARY MANHOLE DETAIL

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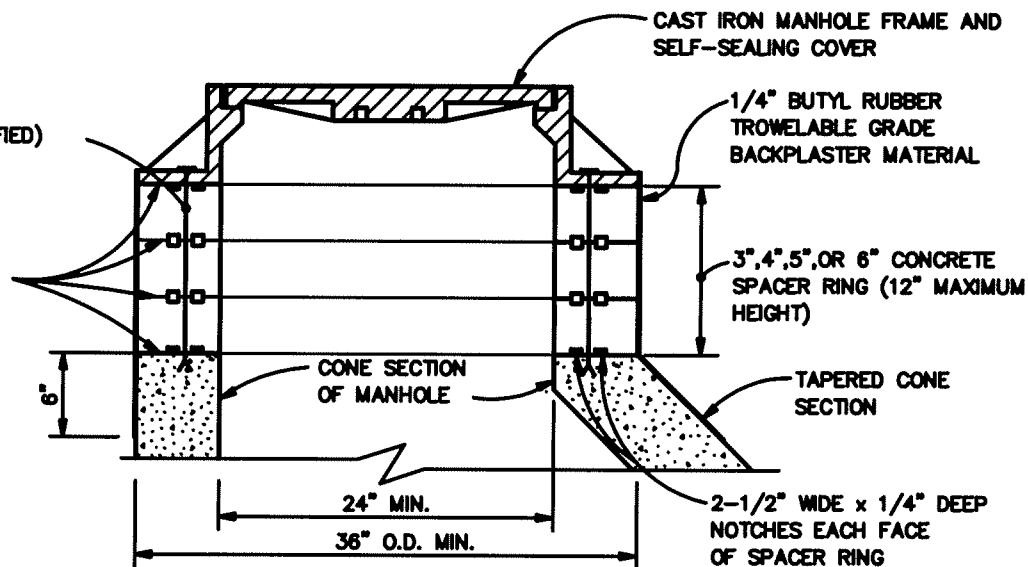
FIGURE S-1



PLAN

3/8" S.S.
EXPANSION
BOLTS (UNLESS
OTHERWISE SPECIFIED)

FLEXIBLE BUTYL
JOINT SEALANT
BETWEEN JOINTS



SECTION

STANDARD SANITARY MANHOLE SPACER RING DETAIL

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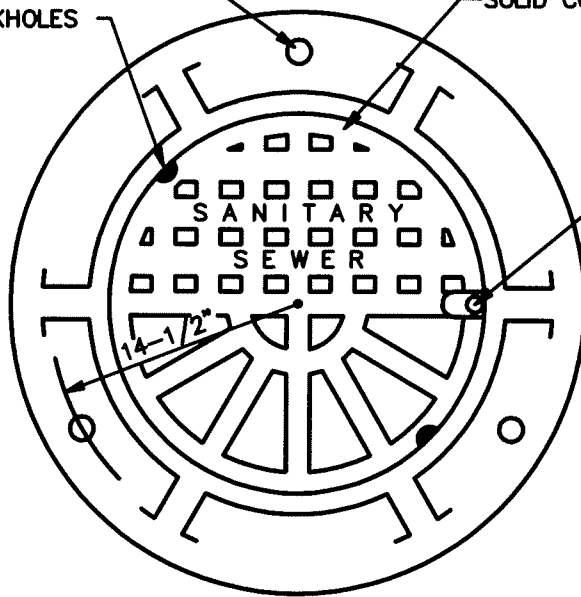
FIGURE S-2

3 OR 4 - 3/8" S.S.
EXPANSION
BOLTS, EQUALLY
SPACED APART

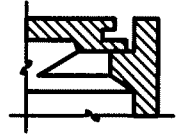
TWO CONCEALED
PICKHOLES

SOLID COVER

COVER BOLT
SEE NOTE 2



PLAN

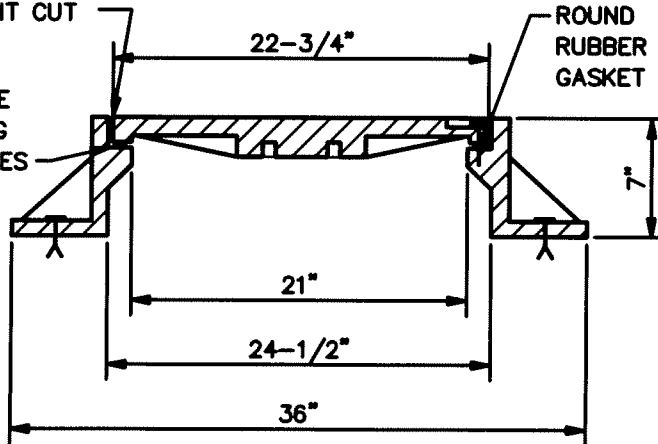


PICKHOLE
DETAIL
NO SCALE

VERTICAL
BEARING
STRAIGHT CUT

MACHINE
BEARING
SURFACES

ROUND
RUBBER
GASKET



SECTION

NOTES:

1. TOTAL WEIGHT OF FRAME AND LID = 335 lbs
TYPE I SELF SEALING COVER IS NOT BOLTED TO FRAME AND SHALL BE USED UNLESS TYPE II IS SPECIFICALLY INDICATED
2. TYPE II SELF SEALING COVER IS BOLTED TO FRAME WITH FOUR 1/2" BRONZE HEXAGONAL HEAD COUNTERSUNK BOLTS
3. CASTING SHALL BE CATALOG NO. 1022-2 AS MANUFACTURED BY EAST JORDAN IRON WORKS, INC. OR NEENAH R-1772 AS MANUFACTURED BY NEENAH FOUNDRY

STANDARD SANITARY MANHOLE FRAME AND COVER DETAILS

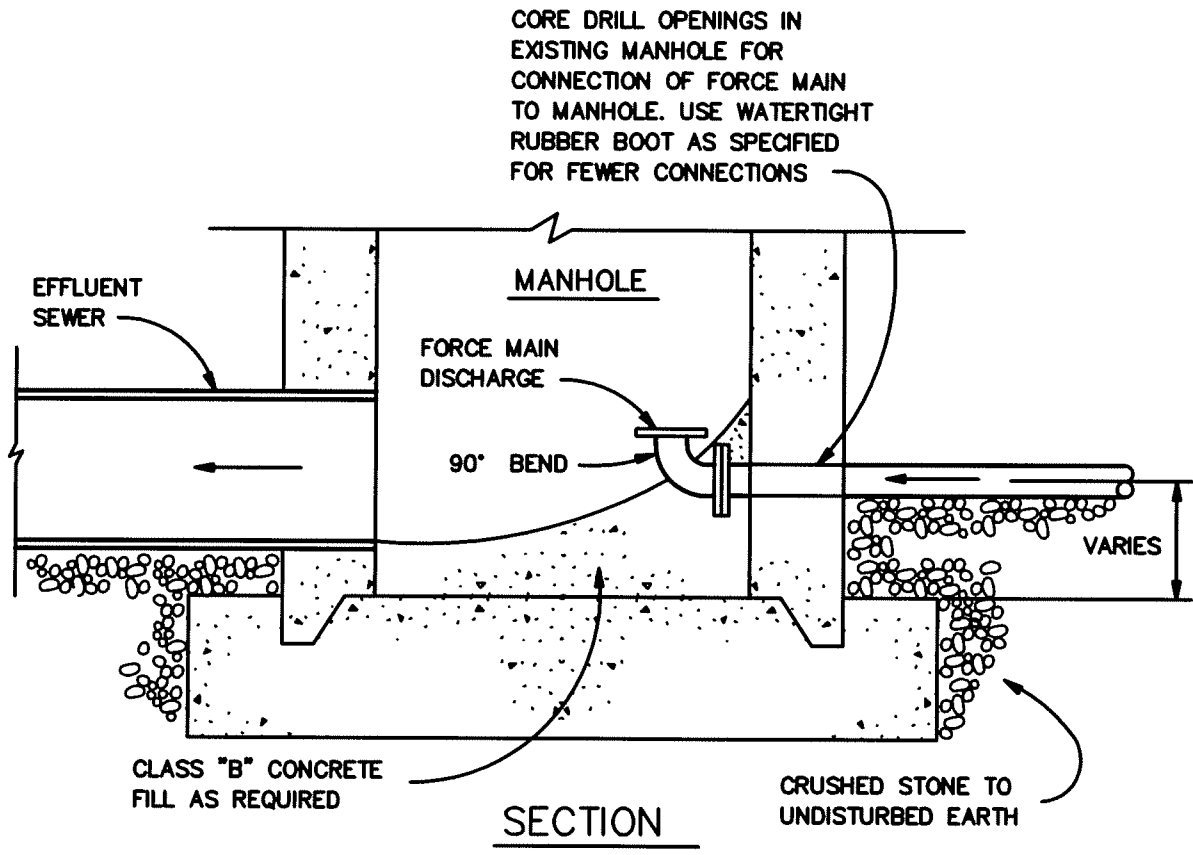
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FIGURE S-3

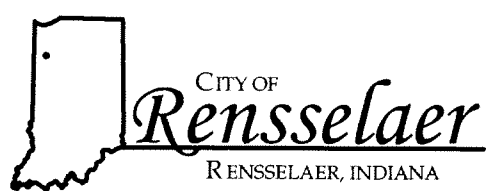
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NOTE:
1. SEE SECTION 03300
FOR CONCRETE SPECIFICATIONS

FORCE MAIN DISCHARGE DETAIL

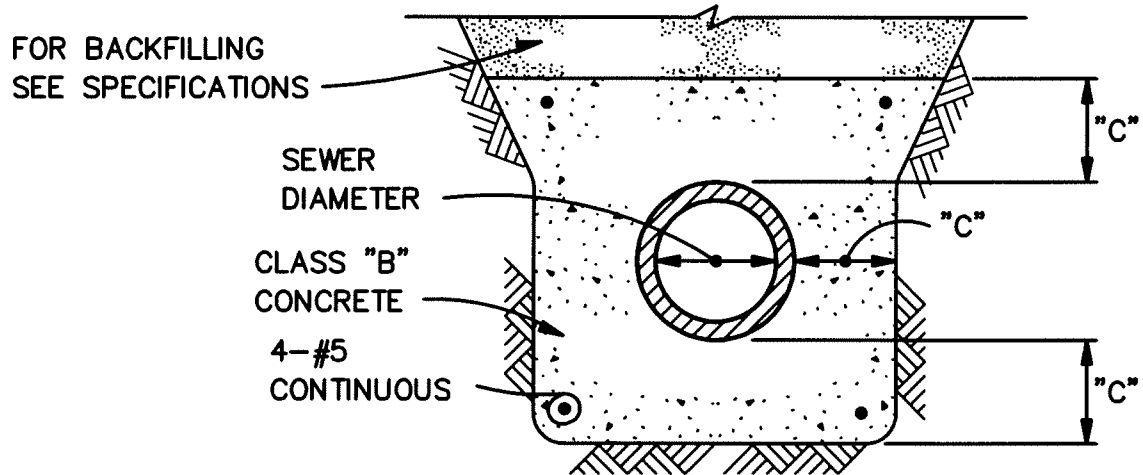
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FIGURE S-4

FIGURE S-5



NOTES:

1. "C" = 6" MINIMUM
OR AS INDICATED
ON THE PLANS.
2. SEE SECTION 03300
FOR CONCRETE
SPECIFICATIONS

CONCRETE ENCASEMENT DETAIL

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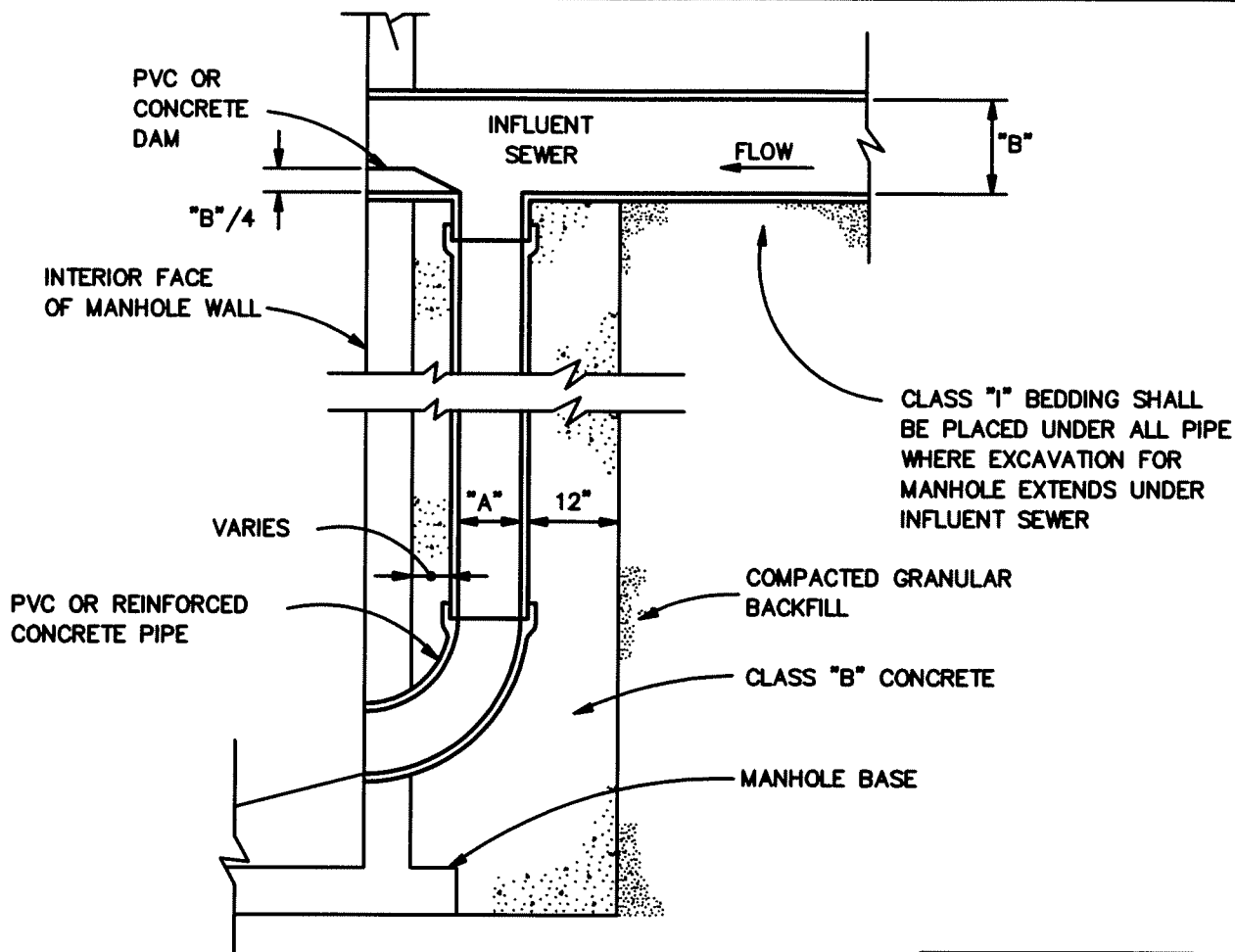


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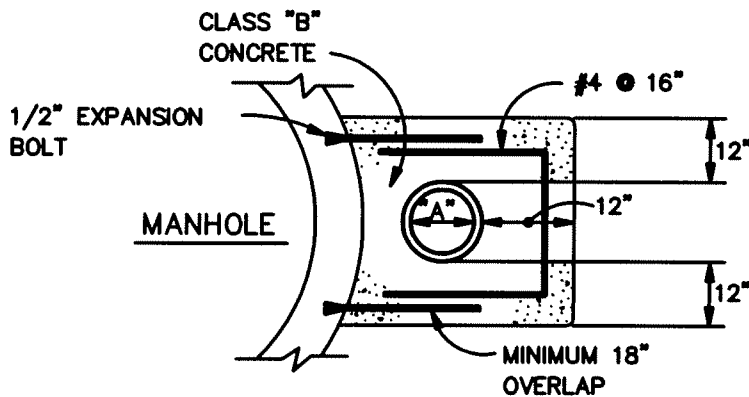
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FIGURE S-6



SECTION

"A"	"B"
8"	21" OR LESS
12"	24" TO 36"



SECTION PLAN

NOTE:

1. SEE SECTION 02222 FOR BEDDING SPECIFICATIONS
2. SEE SECTION 03300 FOR CONCRETE SPECIFICATIONS

DROP PIPE DETAILS

HNTB

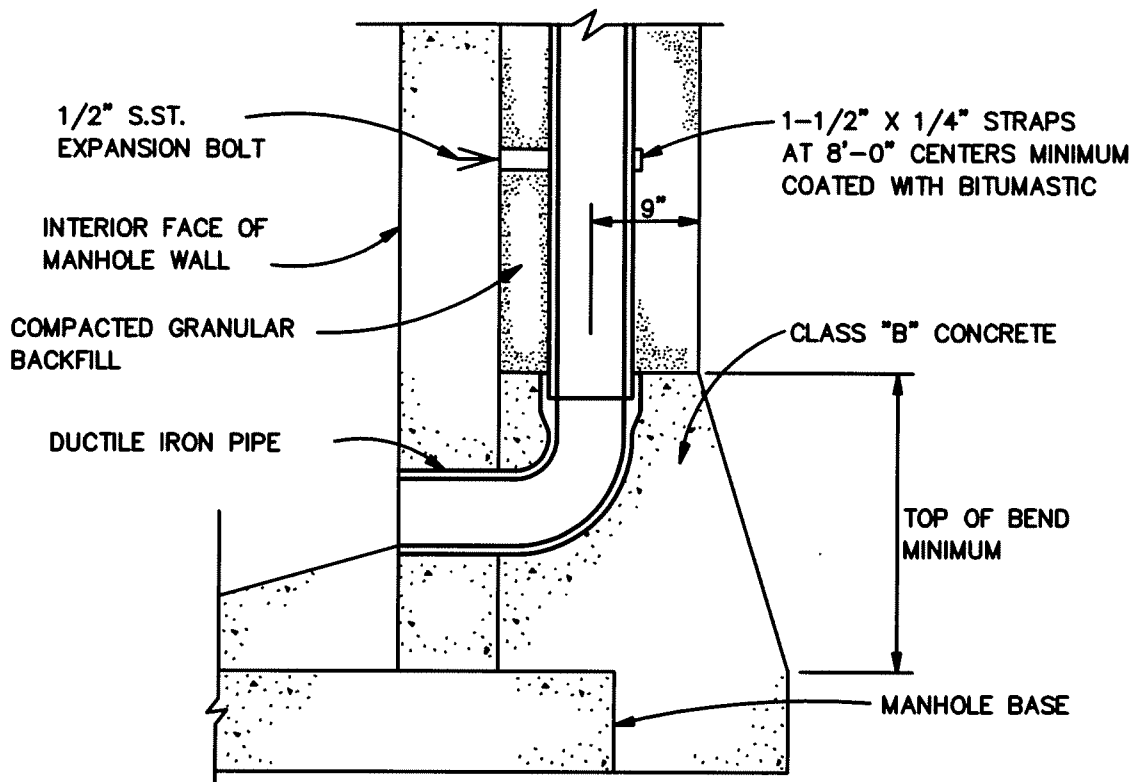


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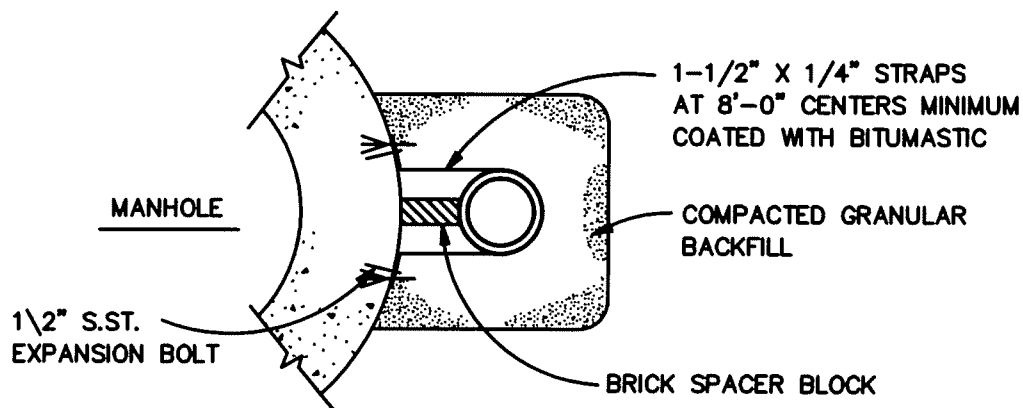
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FIGURE S-7



SECTION



SECTIONAL PLAN

NOTE:

1. SEE SECTION 03300 FOR CONCRETE SPECIFICATIONS

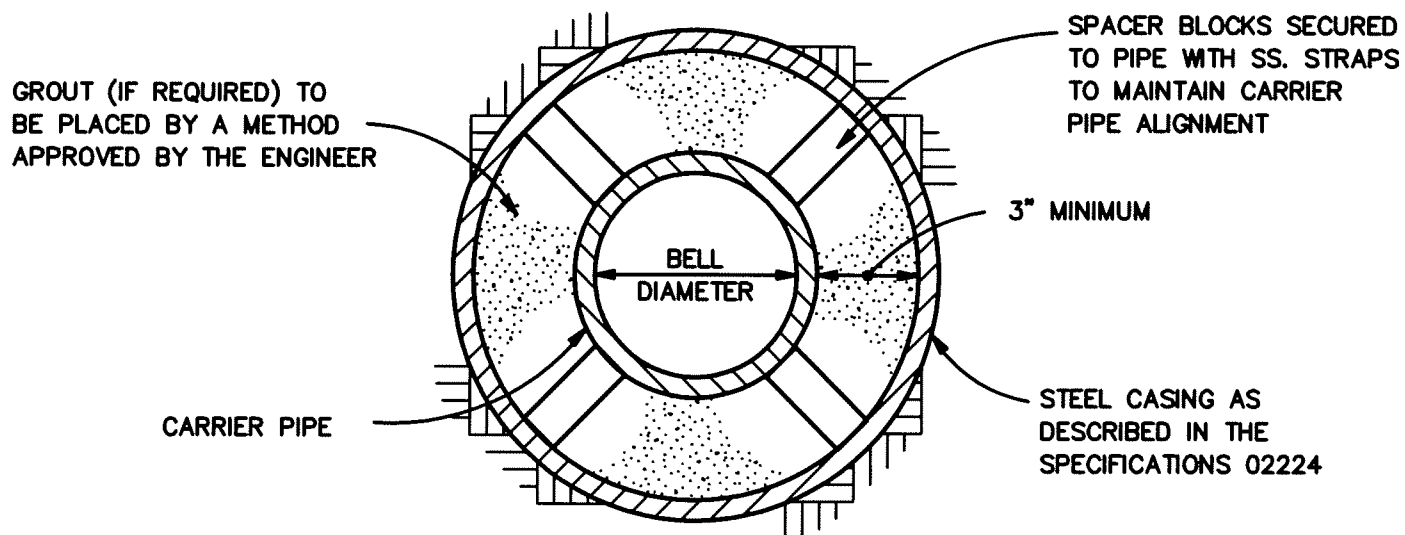
ALTERNATE DROP PIPE DETAILS

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FIGURE S-8



JACKING AND BORING DETAIL

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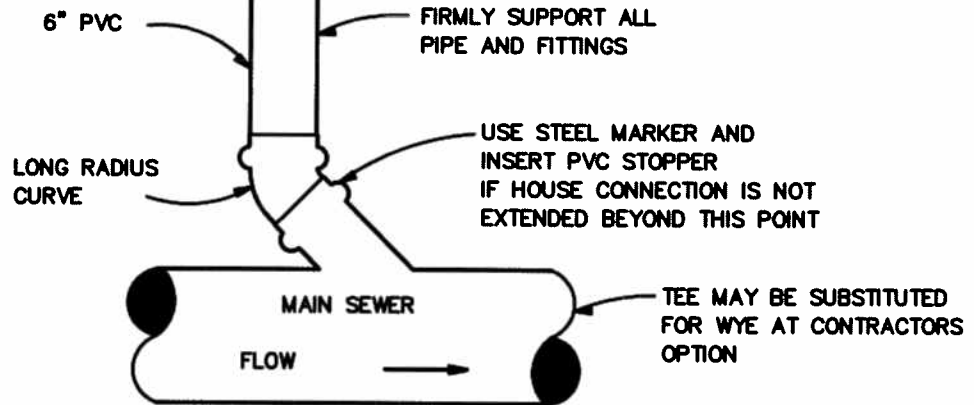
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FIGURE S-9

INSERT WATERTIGHT PLUG.

HOUSE CONNECTION SHOULD NOT BE EXTENDED FOR USE UNTIL THE MAIN SEWER AND HOUSE CONNECTION HAVE PASSED THE AIR TEST AND BEEN ACCEPTED BY THE OWNER.

CONTRACTOR TO MARK END OF EACH LATERAL WITH 5/8" DIAMETER, 5'-0" LONG STEEL ROD PLACED VERTICALLY. ROD SHALL BE PAINTED YELLOW AND DRIVEN FLUSH WITH EXISTING GROUND. ACCURACY OF THE MEASUREMENTS LOCATING LATERALS SHALL BE THE CONTRACTOR'S RESPONSIBILITY. TO BE USED ONLY IF LATERAL IS NOT EXTENDED FOR IMMEDIATE USE.



PLAN VIEW

NOTES:

1. WYE BRANCHES OR TEES SHALL BE INSTALLED WHERE DESIRED BY PROPERTY OWNER OR WHERE INDICATED ON THE DRAWINGS. THEY SHALL BE EXTENDED TO PROPERTY LINE OF STREETS OR ALLEYS OR TO DISTANCES AS SHOWN ON THE DESIGN DRAWINGS AND SHALL BE OF 6" PVC SDR 26 UNLESS OTHERWISE SHOWN.
2. DEPTH AT PROPERTY LINE SHALL BE APPROXIMATELY 8'-0" UNLESS SEWER DEPTH IS LESS, IN WHICH EVENT A MINIMUM SLOPE OF 1/8" PER 1'-0" SHALL BE USED.
3. HOUSE SERVICE PIPE SHALL BE PVC SDR 26 CONFORMING TO ASTM D3034 WITH GASKETED JOINTS CONFORMING TO ASTM D3212 UNLESS OTHERWISE INDICATED.
4. HOUSE SERVICE PIPE SHALL BE INSTALLED PER SAME SPECIFICATIONS & DETAIL AS FOR MAIN LINE SEWER.

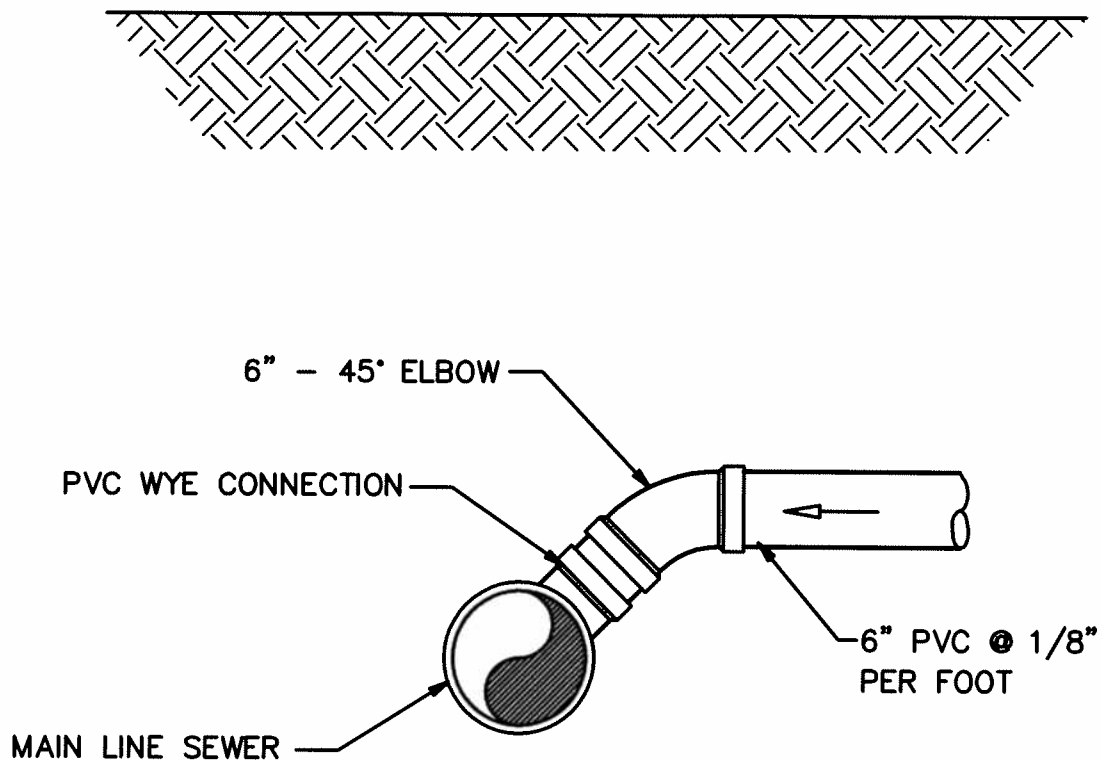
HOUSE/BUILDING SERVICE CONNECTION DETAIL 1

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FIGURE S-10



SECTIONAL VIEW

HOUSE/BUILDING SERVICE CONNECTION DETAIL 2

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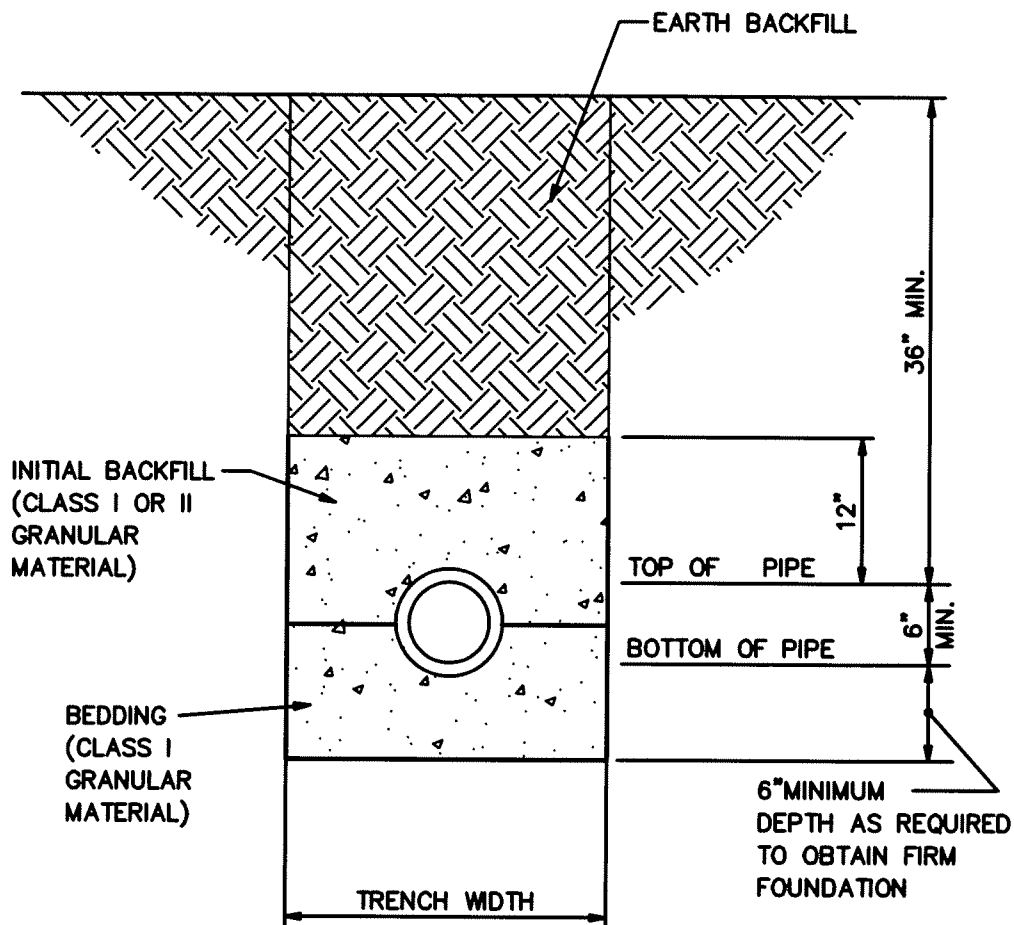


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FIGURE S-11



NOTES:

1. NOMINAL PIPE SIZE. (6" MIN.)
2. INSTALLATION OF FLEXIBLE PVC PIPE SHALL BE IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN ASTM D-2321
3. CLASS I GRANULAR MATERIAL SHALL BE 1/4" TO 1 1/2" GRADED STONE, PER ASTM D2321 (#8 CRUSH STONE)
4. CLASS II GRANULAR MATERIAL SHALL BE COARSE SANDS AND GRAVELS MAX. PARTIAL SIZE OF 3/4"
5. SEE FIGURE S-5 FOR MAIN LINE SEWERS PIPE BEDDING DETAILS.
6. SEE SECTION 02222 FOR BEDDING SPECIFICATIONS

HOUSE/BUILDING SERVICE BEDDING DETAILS

HNTB

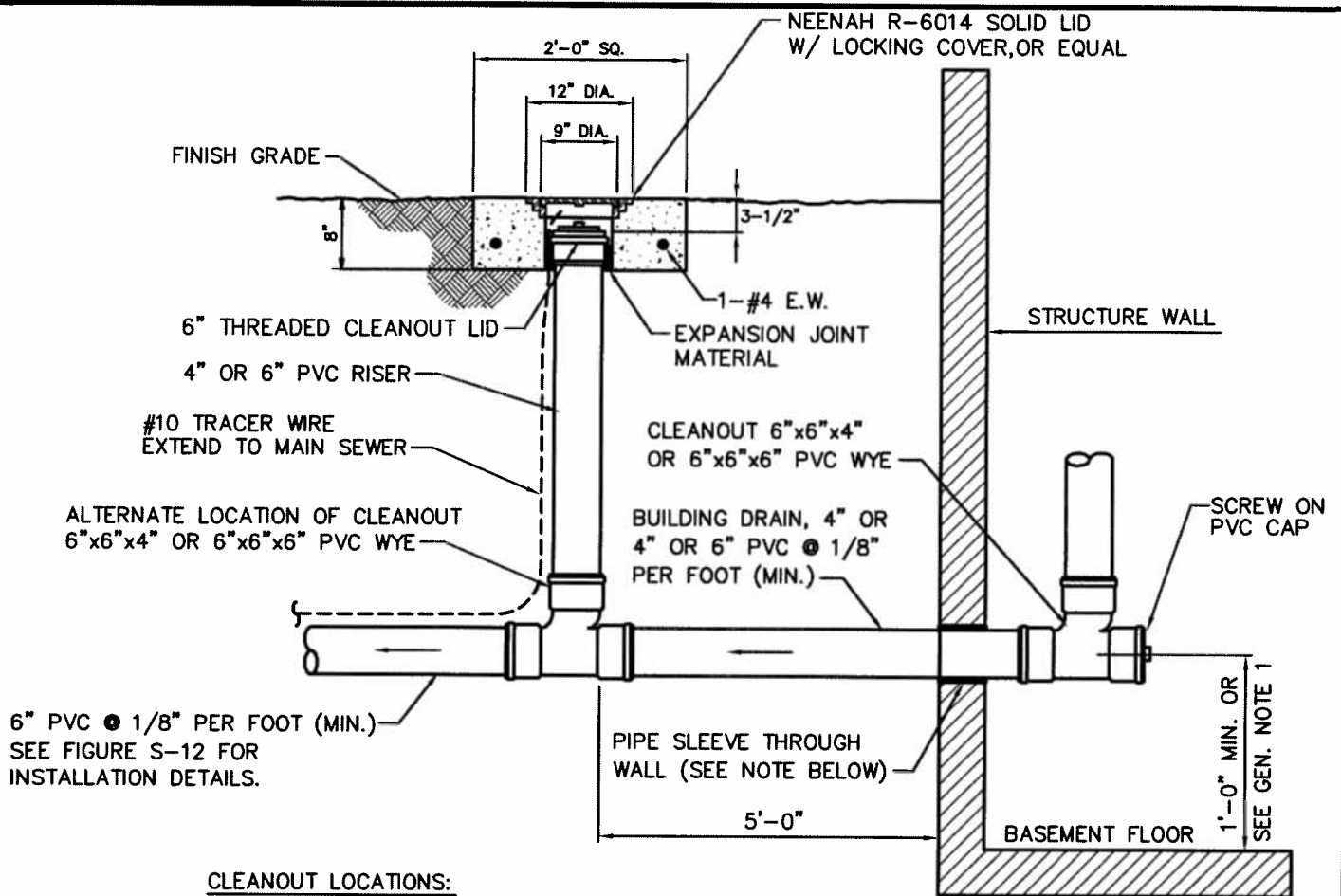


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FIGURE S-12



CLEANOUT LOCATIONS:

1. AT THE JUNCTION OF BUILDING DRAIN AND BUILDING SEWER
(NEAR EXTERIOR FACE OF BUILDING)
2. IF BUILDING SEWER IS MORE THAN 100 FEET FROM MAIN LINE SEWER,
CLEAN-OUTS SPACING SHALL NOT EXCEED 100 FEET.
3. A CLEANOUT IS REQUIRED AT EACH BEND THAT
IS GREATER THAN 45 DEGREES.
4. THERE SHALL BE NO BASEMENT DRAINS CONNECTED
TO SERVICE CONNECTION.

GENERAL REQUIREMENTS

1. THE LOWEST FLOOR ELEVATION RECEIVING GRAVITY SERVICE MUST BE A MIN. ONE (1.0) FOOT ABOVE TOP NEAREST MANHOLE RIM.
2. AN APPROVED TYPE OF TWO-WAY CLEANOUT FITTING SHALL BE INSTALLED WITHIN 5 FEET OF THE OUTSIDE OF A BUILDING, AS SHOWN ABOVE. THE PIPE PENETRATION THROUGH A BUILDING WALL SHALL BE PROTECTED FROM BREAKAGE BY MEANS OF A SLEEVE. THE SLEEVE SHALL BE ONE PIPE SIZE LARGER THAN THE DIAMETER OF THE PIPE PENETRATING THE WALL, AND BE SEALED WITH AN APPROPRIATE WATERPROOF SEALANT IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES.

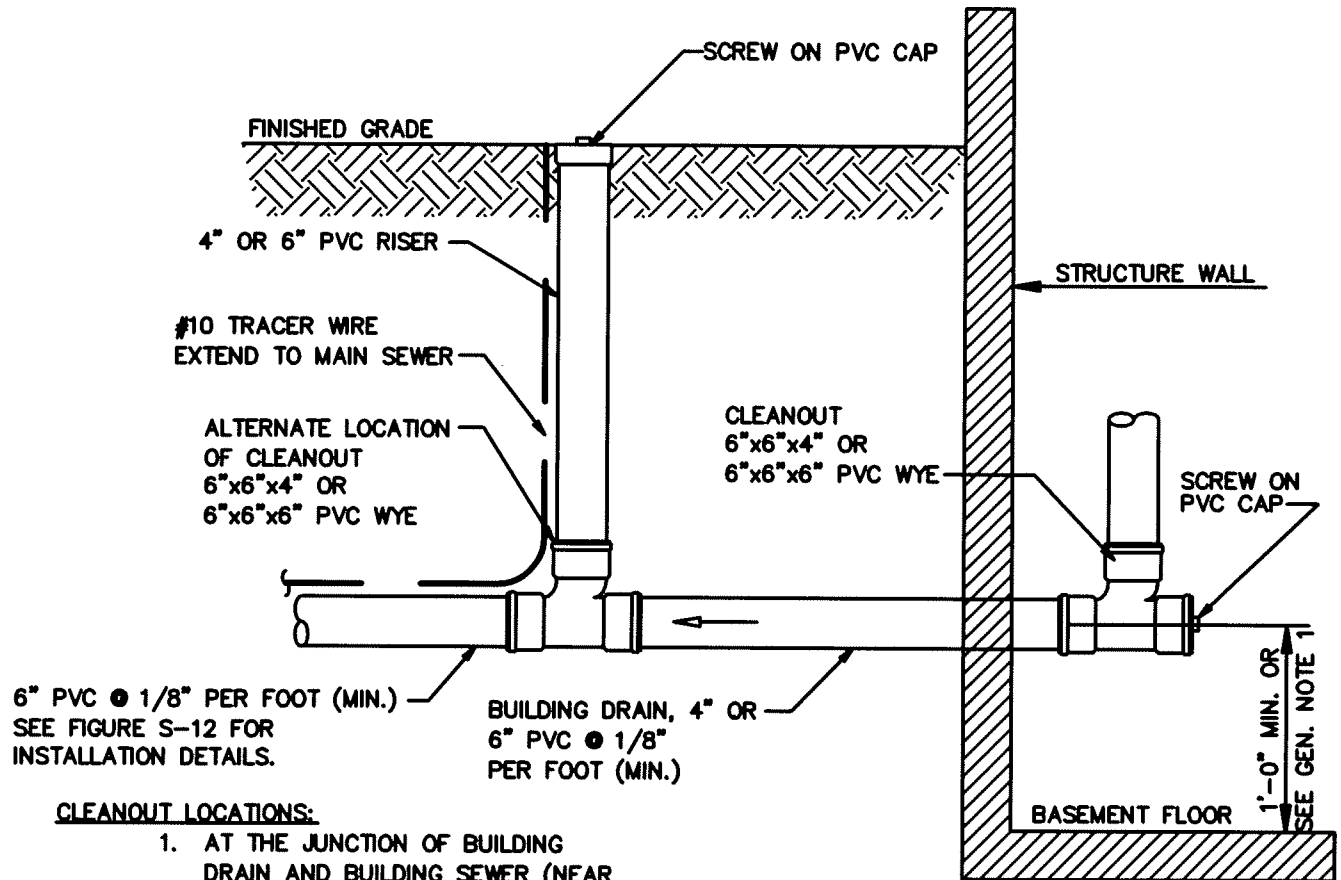
HOUSE/BUILDING SERVICE CLEAN-OUT DETAIL



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FIGURE S-13



CLEANOUT LOCATIONS:

1. AT THE JUNCTION OF BUILDING DRAIN AND BUILDING SEWER (NEAR EXTERIOR FACE OF BUILDING)
2. IF BUILDING SEWER IS MORE THAN 100 FEET FROM MAIN LINE SEWER, CLEAN-OUTS SPACING SHALL NOT EXCEED 100 FEET.
3. A CLEANOUT IS REQUIRED AT EACH BEND THAT IS GREATER THAN 45 DEGREES.
4. THERE SHALL BE NO BASEMENT DRAINS CONNECTED TO SERVICE CONNECTION

GENERAL REQUIREMENTS

1. THE LOWEST FLOOR ELEVATION RECEIVING GRAVITY SERVICE MUST BE A MIN. ONE (1.0) FOOT ABOVE TOP NEAREST MANHOLE RIM.

HOUSE/BUILDING SERVICE CLEAN-OUT DETAIL

HNTB

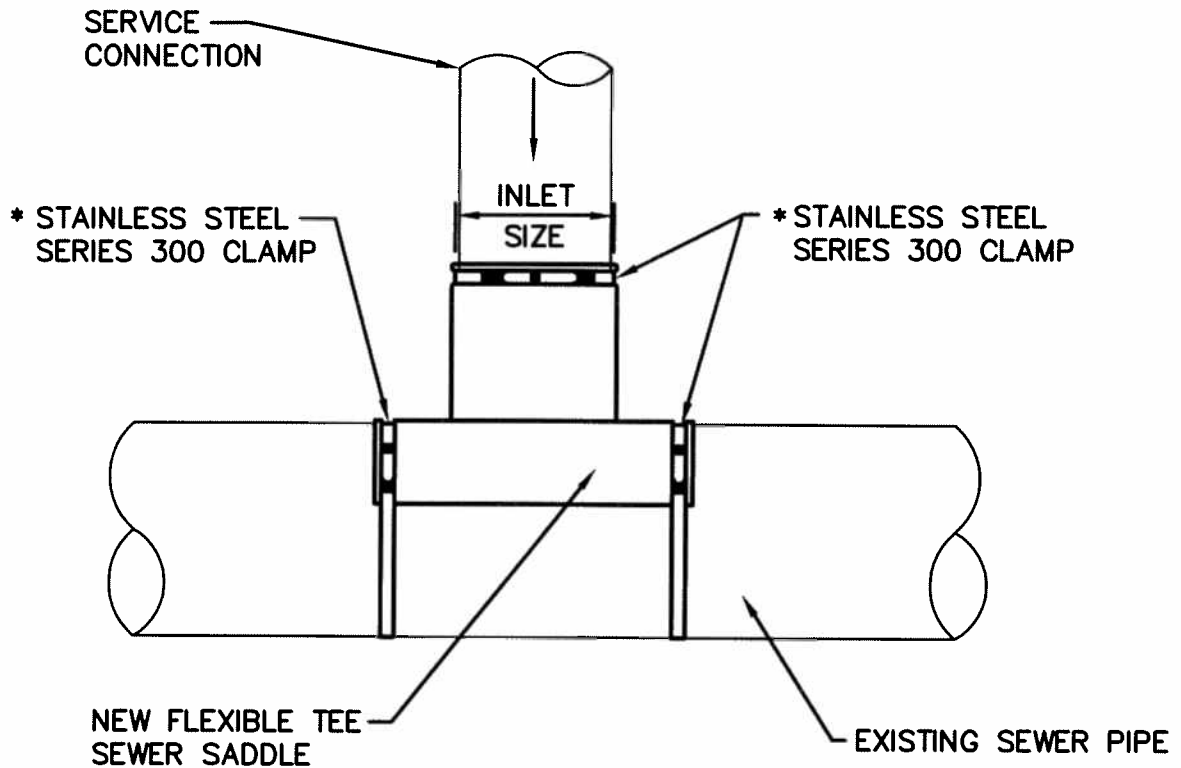


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FIGURE S-13

* NOTE:
TIGHTEN STAINLESS STEEL SERIES 300
CLAMPS TO A MINIMUM OF 60 INCH LBS.
OF TORQUE.



DESCRIPTION	INLET SIZE
4"-12" FLEXIBLE TEE SADDLE	4"
	6"

INLET RANGE FROM SCH-40 PIPE DOWN TO SDR-35 PIPE
WHICH INCLUDES STANDARD WEIGHT SOIL PIPE.

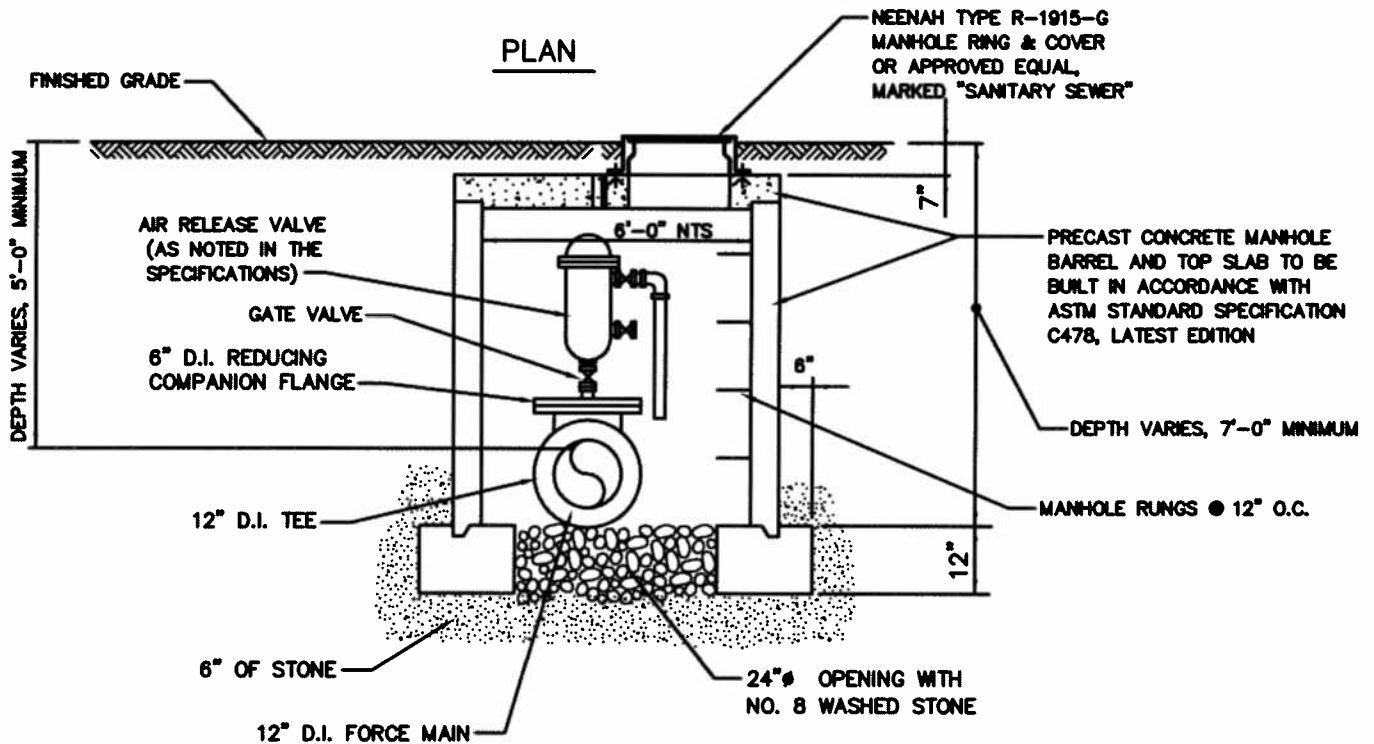
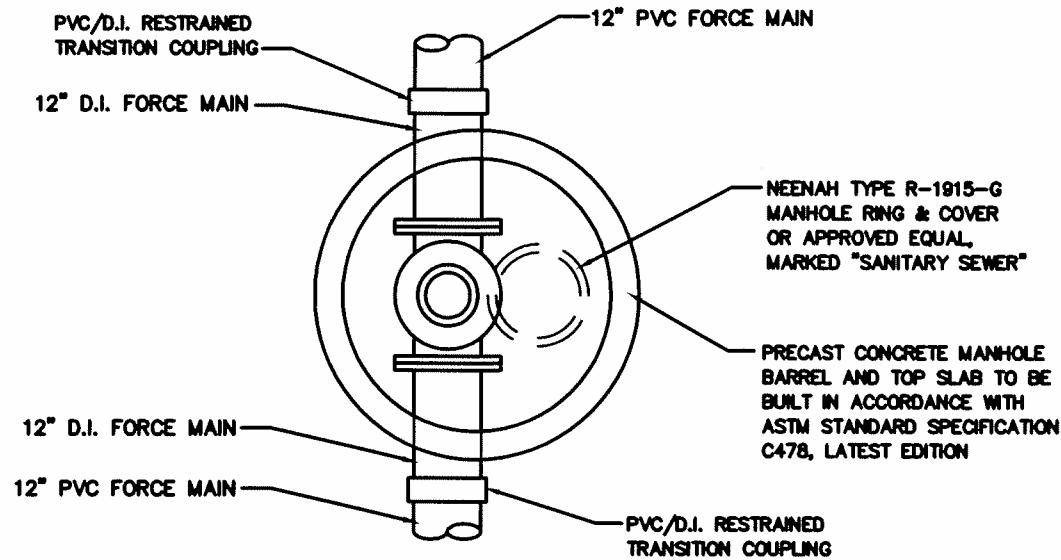
FLEXIBLE TEE SADDLE DETAIL

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FIGURE S-14



SECTION

SEWAGE AIR & VACUUM RELEASE VALVE DETAIL

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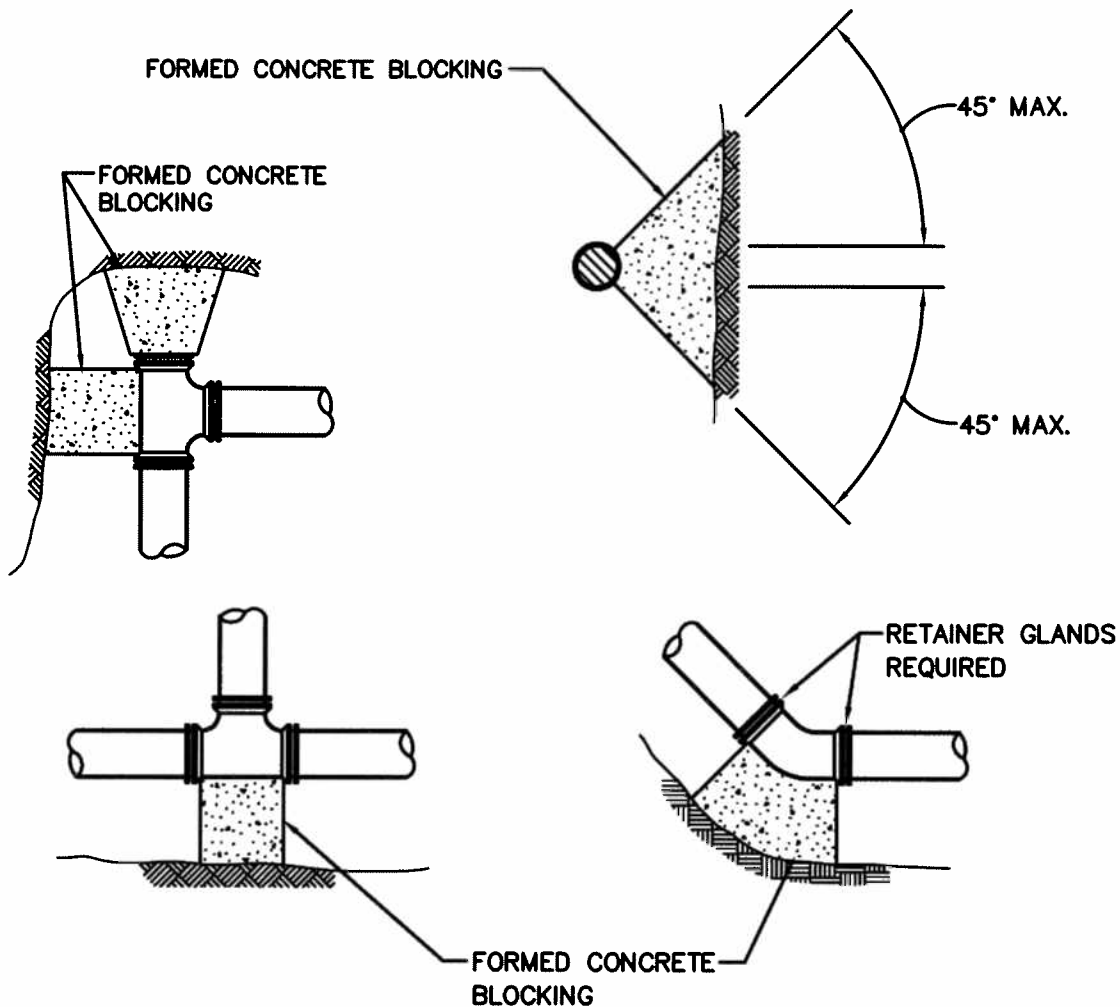


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FIGURE S-15



NOTE:

1. THE THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING LOAD OF 2,000 LB./SQ. FT.
2. GREASE ALL FORCE MAIN SURFACES PRIOR TO PLACEMENT OF CONCRETE

SIZE	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
10"	10.0	14.0	7.5	4.0	2.0
12"	14.0	20.0	11.0	5.5	3.0
14"	19.0	27.0	14.5	7.5	4.0

(AREA IN SQ. FT. REQUIRED FOR CONCRETE THRUST BLOCKING)

FORCE MAIN THRUST BLOCKING DETAILS

HNTB

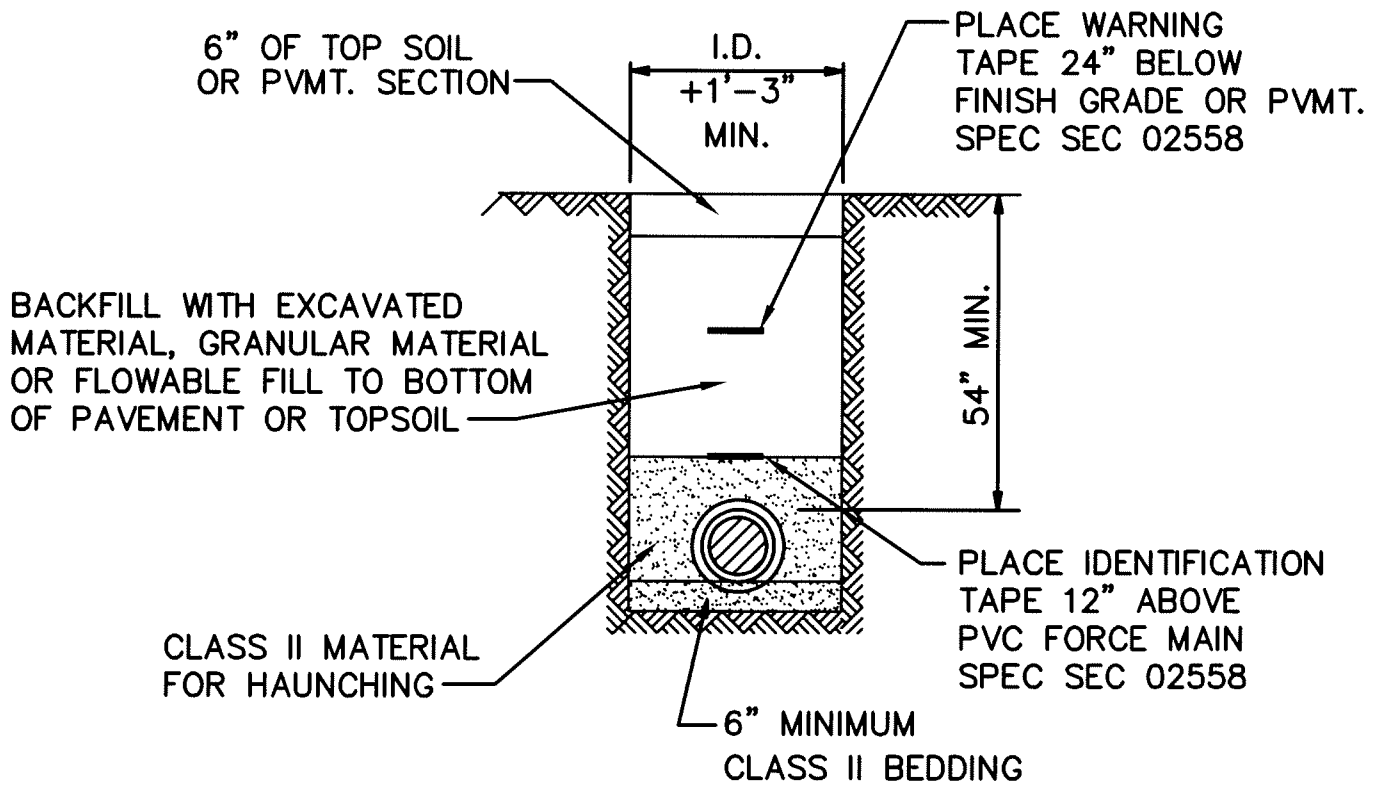


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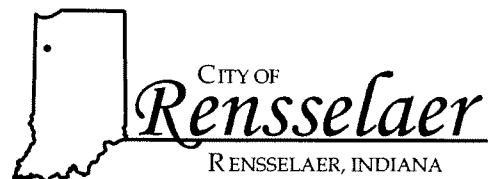
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FIGURE S-16



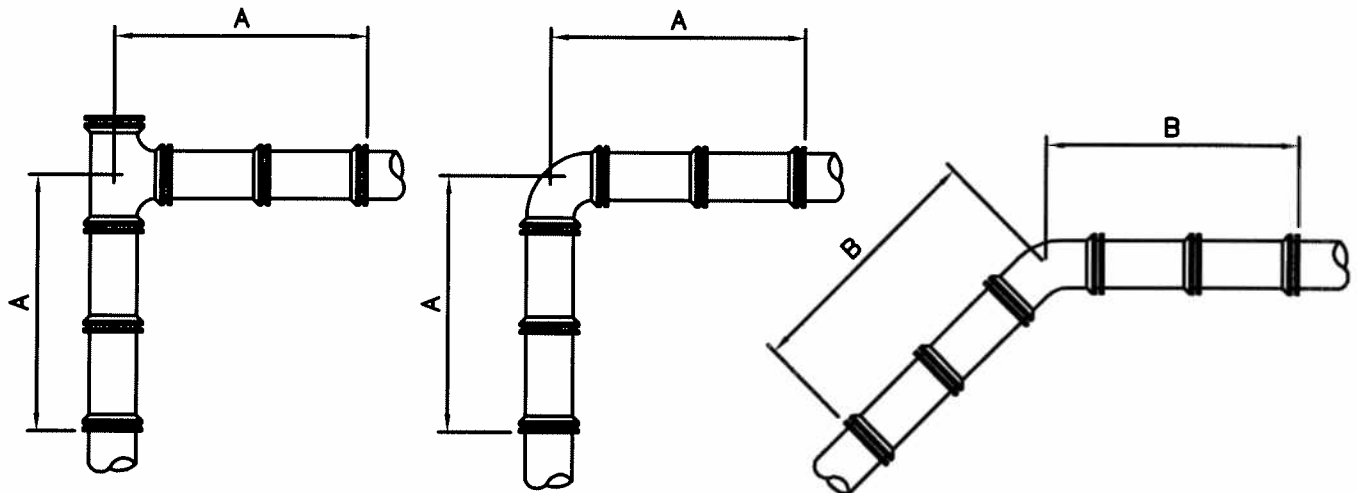
FORCE MAIN INSTALLATION DETAIL

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FIGURE S-17



NOTE:

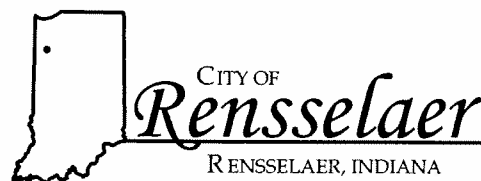
THE LENGTHS OF PIPE WITH
RESTRAINED JOINTS ARE BASED
ON A COMPACTED SILTY SOIL
SURROUNDING THE PIPE

SIZE	A		B		
	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
24"	41'-0"	58'-0"	34'-0"	19'-0"	10'-0"

(LENGTH IN FEET REQUIRED FOR RESTRAINING JOINTS)

FORCE MAIN RESTRAINED JOINT DETAIL

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FIGURE S-18

**VII. SANITARY PUMP STATION / SUBMERSIBLE
PUMP STATION**

SECTION 11319 - SUBMERSIBLE PUMP STATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A Scope: Furnish and install one submersible, non-clog pump station and all appurtenances necessary to complete same as shown or specified.
1. The pump station shall be complete with submersible sewage pumps, motors, discharge elbows, access hatch, portable hoist guide system, piping, valves, electrical controls, and appurtenances. All components of the pump station shall be furnished by one manufacturer.
 2. All equipment located in the wet well shall be rated for a Class 1 Division 1 Groups C & D hazardous location. Area adjacent to the wet well shall be considered a Class 1 Division 2 Groups C & D hazardous location as indicated on the Drawings.
- B Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
1. ANSI - American National Standards Institute.
 2. ASTM - American Society for Testing & Materials.
 3. HI - Hydraulic Institute.
 4. NEMA - National Electric Manufacturer's Association.

1.2 QUALITY ASSURANCE

- A The pumping unit manufacturer shall test each pump for mechanical and electrical correctness.
- B Perform field tests specified in this Section.

1.3 SUBMITTALS

- A Submit the following:
1. Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards.
 2. Certified copies of reports of factory tests specified in this Section and required by the referenced standards.

3. Copy of manufacturer's standard warranty for each type of equipment provided.
4. Shop drawings with performance, descriptive literature, weights and dimensions and other physical characteristics verifying compliance with this section, including motor starting and full-load amps, motor horse power, and motor data.
5. Manufacturer's installation instructions and recommended testing procedures.
6. Manufacturer's operation and maintenance (O&M) manuals and materials.
7. Electrical:
 - a. Submit all electrical requirements for each piece of equipment including voltage, phase, and load data.
 - b. Provide interior and exterior layouts of control panels where applicable. Layouts shall be to scale and a bill of material shall be included.
 - c. Submit information on all pilot and control components. This includes but is not limited to: pilot lights, relays, push buttons, and timers.
 - d. Provide wiring and interconnection diagrams for each piece of equipment. For example, submitting one diagram for all screening equipment is not acceptable. Differentiate between panel and field wiring.
 - e. "Typical" diagrams are not acceptable. Manufacturer's standard diagrams may be submitted if they are made specific for this project by:
 - 1) Showing all included options, special items, etcetera.
 - 2) Unused options or features shall be crossed out or deleted.
 - 3) Identify the drawing with project name, equipment name, and tag number.

8. Provide Start-Up Certification Report.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A Thoroughly clean all equipment, components, and subassemblies of all water, sand, grit, weld splatter, grease, oil, and other foreign materials before preparation for shipment. Protect all machined surfaces against physical damage and exposure to the elements during shipment, handling, storage, and installation.

- B Pack pumps to provide ample protection from damage during shipment, handling, and storage. Cap and seal all openings.
- C The Contractor shall be responsible for the delivery, storage, and handling of products.
- D Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in such a manner to prevent damage to products.
- E The pumps furnished shall be packaged in such a manner as to provide ample protection from damage during handling, shipment, and outdoor storage at the pump station site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.
- F Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish complete a submersible pump station consisting of submersible non-clog sewage pumps, motors, piping, valves, reinforced concrete wet well and valve vault, electrical controls, guide system, and other appurtenances as specified in this Section and as shown on the drawings.
- B. Pumping units shall meet the requirements of HI standards.
- C. Pump materials shall meet the requirements of the latest editions of the following specifications:

<u>Material</u>	<u>ASTM or ANSI Designation</u>
Cast Iron	A-48 Class 30
Stainless Steel	ANSI Type 316L, 304, and 431
Bronze	B-144 Class 3B
Hot Rolled Steel	A 107-50-T Gr. 1015 .20 Cu. Min.
Cold Rolled Steel	A 108-50-T Gr. 1141 Turned, Ground & Polished
Pipe	ANSI A21.51

- D. Where applicable specifications are not designed herein, supply high class commercial grades of materials that meet the requirements specified and which are satisfactory to the Engineer.

2.2 PUMP DESIGN

- A. Pumps shall be capable of handling raw, unscreened sewage.
- B. The design shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, which shall be permanently installed in the wet well.
- C. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wet well.
- D. Each pump shall be fitted with a stainless steel lifting chain of adequate strength and length to permit raising and lowering the pump for inspection and removal. The lifting system must permit the pump to be removed in one continuous motion, without intermediate hooking.
- E. The pump, with all its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65 feet.

2.3 PUMP CONSTRUCTION

- A. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- B. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
- C. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No

secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

- D. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to ensure sealing as described above.
- E. Each unit shall be provided with an integral motor cooling system. A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable. Pumping units which utilize an oil-filled motor and which operate considerably cooler than air-filled motors shall not require additional cooling to be considered equal.
- F. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal.
- G. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
- H. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper secondary seal unit, located between the lubricant

chamber and the motor housing, shall contain one stationary ceramic seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

- I. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members; or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
- J. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. Seal lubricant shall be FDA Approved, nontoxic.
- K. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be AISI type 431 stainless steel.
- L. The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge. The impeller(s) vanes shall have screw-shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect or the handling of sludge and rag-laden wastewater. Impellers shall be locked to the shaft and shall be coated with alkyd resin primer.
- M. The pump volute shall be of A48 Class 35B gray cast iron and shall have (an) integral spiral shaped cast groove(s) at the suction of the volute. The internal volute bottom or insert ring shall provide effective sealing between the pump volute and the multi-vane, semi-open impeller. The sharp spiral groove(s) shall provide the shearing edge(s) across which each

impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.

2.4 MOTOR

- A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and the pump shall be produced by the same manufacturer.
- B. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
- C. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- D. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

- E. The motor shall be designed for continuous duty, capable of sustaining a minimum of 10 starts per hour. No motor winding damage shall result from operating the pumping unit out of its liquid environment for extended periods of time.
- F. Pump motor cable installed shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Unless otherwise noted, provide adequate cable to complete the installation shown on the drawings.

2.5 GUIDE SYSTEM

- A. A sliding guide bracket shall be an integral part of each of the pumping units. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection which, when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps, or similar devices.
- B. Installation of a pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by two guide rails, a T-bar, or other suitable guide system.
- C. Guide rails or pipes or other suitable guide system shall be constructed using stainless steel material or pipe (Schedule 40, Grade 304).
- D. No other motion of the pump unit, such as tilting or rotating, shall be required. Sealing of the discharge interface by means of a diaphragm or other devices will not be considered acceptable nor equal to a metal to metal contact of the pump discharge flange and mating discharge connection specified and required. No portion of the pump unit shall bear directly on the floor or wet well. There shall be no more than one 90 degree bend allowed between the volute discharge flange and station piping.

2.6 ACCEPTABLE PUMP MANUFACTURER

Acceptable pump manufacturer is ITT Flygt, an ITT Industries Company.

2.7 ELECTRICAL CONTROLS

- A. Provide a NEMA 4X stainless steel starter panel, which shall be sized to accommodate starters and controls for specified pumps. Pump sizes shall be as indicated in the pump data sheet.
- B. Area in and around the wet well is considered either a Class 1 Division 1 or a Class 1 Division 2 groups C & D hazardous location as indicated on the Drawings and per NFPA 820. All conduits entering or leaving this space shall have explosion proof conduit seals as indicated on the Drawings.
- C. The starter panel shall consist of the following:
 - 1. NEMA 4X stainless steel enclosure, with padlocking hasp and staple, and provided with matching stainless steel drip shield.
 - a. Provide two 1/2 inch drains at the bottom of the enclosure. Locate at opposite sides of the enclosure. Drains shall be similar to Crouse Hinds No. ECD 17.
 - b. Furnish two 1/2 inch breathers at the top of the enclosure. Locate at opposite sides of the enclosure. Breathers shall be similar to Crouse Hinds No. ECD 16.
 - c. Provide an internal mounting panel and a swing out panel.
 - d. Install properly sized industrial grade corrosion inhibitors.
 - e. Provide thermostatically controlled, properly sized condensate heater. Mount the heater on the lower portion of the enclosure internal mounting panel.
 - f. Furnish a door limit switch actuated panel fluorescent light, similar to Hoffman Catalog No. A LFDA2.
 - g. Install all wiring within the enclosure plastic wiring ducts. Do not mix low level signal wiring with high voltage (110 Volts AC or greater) wiring in the same duct.
 - h. Terminate all wiring at terminal blocks. Splices are not permitted within the enclosure.
 - i. Seal all conduits originating from the wetwell with explosion-proof conduit seals.
 - j. Include reference sheet in an archival quality acid-free sheet protector. It shall list initial pump setpoints, float switch setpoints, and wet well elevations. Include level controller 'zero' elevation.
 - k. Main fusible or circuit breaker 100 amp disconnect, externally operable. Disconnect shall be service entrance rated. Provide fuses class RK-1.
 - 2. Terminate incoming power wiring at distribution lugs.

3. Install voltage surge arresters to protect all equipment inside the enclosure from switching surges and lightning induced surges. Locate surge arresters in such a manner as to facilitate inspection and future replacement of damaged units.
4. Distribute power through thermal magnetic circuit breakers and motor circuit protectors. Their operators shall be accessible from the front of the swing out panel. Provide the following:
 - a. A motor circuit protector for each pump starter.
 - b. A circuit breaker for a 480/120 Volt AC transformer (only if the incoming power is 480 Volts AC).
 - c. Circuit breakers shall have minimum interrupting rating of 25,000 Amperes.
5. Provide a transformer to obtain 120 Volts AC power (non 120/240 station).
 - a. Transformer shall be high efficiency type, with 105 ° C temperature class, extra regulation and low losses.
 - b. Size transformer to feed all 120 Volts AC within the enclosure. Minimum size of the transformer shall be 1.0 KVA.
6. Provide intrinsic safety barriers for the float switches and for the continuous level sensor.
7. Distribute 120 Volt AC power through single pole, 15 Ampere circuit breakers, which shall have minimum interrupting rating of 10,000 Amperes. Provide a circuit breaker for each of the following items:
 - a. Motor control circuit.
 - b. Panel light and thermostatically controlled enclosure heater described above.
 - c. Convenient receptacle.
8. Install a duplex convenient receptacle, which shall be accessible from the front of the swing out panel. Receptacles shall be 15 Ampere, GFI (Ground Fault Interrupting) types.
9. Protect each starter power with magnetic only motor circuit protector. Motor circuit protectors shall be as follows:
 - a. Size, voltage and configuration shall be as required.
 - b. Provided with adjustable instantaneous trips.
 - c. Minimum rating: 25,000 AIC (Amperes Interrupting Capacity).

10. Motor starters shall be NEMA rated, full voltage, non reversing type. (IEC type starters are not acceptable.) Size starters and thermal overloads according to motor nameplate data.
11. Control devices shall be industrial grade oil-tight and watertight types. Pump controls shall be accessible from the front of the swing out panel. Confirm pilot light colors with Owner. Pilot lights shall be high intensity protected push-to-test LED type. Provide with the following controls for each pump:
 - a. HAND - OFF - AUTO (H-O-A) selector switch
 - b. JOG pushbutton
 - c. Amber "MOTOR HI-TEMPERATURE" pilot light
 - d. Amber "SEAL FAILURE" pilot light
 - e. Red motor "RUN" pilot light.
 - f. Green motor "OFF" pilot light.
 - g. Pump Sensor "RESET" push button to clear alarms.
 - h. Non-resettable elapsed time meter.
12. Provide each pump starter with the following:
 - a. A minimum of two sets of normally open starter auxiliary contacts.
 - b. A minimum of two sets of normally closed starter auxiliary contacts
 - c. One set of normally open auxiliary overload alarm contacts.
13. Design control circuit for each pump as follows:
 - a. When the H-O-A selector switch is in the "H" position, the pump motor shall run. Pump shall stop at LOW level. In HAND mode, pressing the JOG button shall override the low level stop and allow the pump to run as long as the button is depressed. JOG button is not enabled in OFF or AUTO modes.
 - b. When the switch is in the "O" position, the pump motor shall be off.
 - c. When the switch is in the "A" position, the pump shall operate based on contacts from the pump controller.
 - d. If the HIGH level float switch is activated, then start the LEAD pump. After a short delay, start the LAG pump. Stop both pumps when the level falls below the LOW float switch.
 - e. Energize "SEAL FAILURE" light when seal failure contacts trip.
 - f. Energize "FAIL" light on motor high winding temperature condition, and on starter thermal overload trip.

- g. Include a time delay, 0 to 999 seconds, for system restart after a power outage and restoration. Initial setting shall be 60 seconds.
- D. Provide each pump with motor high winding temperature and seal failure detector as described in Article "Protection".
 - 1. Detector circuit shall shut down motor and energize "FAIL" pilot light when the motor winding temperature detector trips. The motor shall remain shut down until its' associated "RESET" push button is depressed.
 - 2. Detector circuit shall energize "SEAL FAILURE" pilot light when seal failure detector trips. Seal failure detector shall automatically reset when moisture is no longer detected in the motor housing.
- E. Furnish the following dry contacts for remote monitoring:
 - 1. H-O-A Switch in "A" for each pump
 - 2. Pump On/Off status for each pump
 - 3. Pump FAILED status (overload, over temperature, moisture)
 - 4. Power NORMAL - LOSS
 - 5. High level alarm
- F. Provide terminal blocks, which shall be grouped together, for remote control and monitoring wiring.
- G. Provide all electro mechanical relays as necessary to achieve the intended operation as described. Relays shall be plug-in ice-cube style, 3PDT or 4PDT, with manual operator and indicator light. Contacts shall be rated a minimum of 10 amps at 240 VAC.
- H. Manufacturers
 - 1. Motor starters shall be as manufactured by Allen-Bradley, or Square D.
 - 2. Circuit breakers and motor circuit protectors shall be Square D.
 - 3. Pilot and control devices shall be as manufactured by Allen-Bradley, or Square D.
- I. Provide a duplex alternator as manufactured by Time Mark, Diversified Electronics, or equal. Alternator shall include a 1 - 2 / AUTO / 2 - 1 selector switch.

2.8 PROTECTION

- A. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.
- B. A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. **USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.**
- C. The thermal switches and FLS shall be connected to a Mini-CAS (Control and Status) monitoring unit. The Mini-CAS shall be socket mounted inside of the control panel.

2.9 LEVEL CONTROL SYSTEMS

- A. Float Switches
 - 1. Pump station shall be provided with a HIGH level alarm float switch and a LOW level shutdown float switch.
 - 2. Dropout of the LOW level float switch shall prevent pump operation in all modes except HAND - JOG.
 - 3. Float switches shall be watertight, encapsulated mercury switch type, encased in a chemical-resistant stainless steel casing.
 - 4. Each float switch shall be attached to a common stainless steel cable. Provide a stainless steel or a vinyl coated anchor weight, cast iron weight, or similar. Strap float switch cables individually to support cable to allow removal of any float without affecting the others. Weight shall rest on bottom of wet well.
 - 5. Each float switch shall have cable length long enough to reach the bottom of the wet well and be installed without splices to the junction box on the electrical equipment rack.
 - 6. Float switch elevations shall be adjustable over the entire wet well depth.
 - 7. Float switches shall be Flygt type ENH, Consolidated Electric model 9G-CC, or equal. Stainless steel cable mounting kit shall be Flygt, Consolidated Electric model CBM, or equal.
- B. Continuous Level System
 - 1. Station shall be provided with a submersible hydrostatic pressure type level sensor.

2. Level sensor shall be mounted to the side wall of the wet well as indicated in the detail sheets.
 3. Sensor shall be large diaphragm type, minimum 2" diameter, and have stainless steel construction.
 4. Level sensor shall be Viatran WW517, US Filter/Consolidated Electric Corporation, model A1000, or equal..
- C. All installation hardware shall be of 316 stainless steel.
- D. Level Controller
1. An electronic pump controller shall be provided and shall be mounted on the inside swing-out panel of the control enclosure. The electronic pump controller shall have the following features:
 - a. Shall accept a 4 to 20 mA DC, 2-wire level signal, and shall indicate the wet well level digitally in direct engineering units (feet). The level shall be displayed on a bargraph or similar display integral to the controller.
 - b. A minimum of four pump control outputs, with independent adjustment for each starting and stopping setpoint.
 - c. In addition to the pump control outputs, the unit shall provide outputs for the following points:
 - 1) High Water Alarm
 - 2) Low Water Alarm
 - 3) Level Sensor Failure or signal loss with built-in adjustable time delay for each actuation point shall be provided to permit level signal to stabilize before control actions are initiated.
 - 4) Interposing relays shall be provided for each control output to provide signal isolation.
 - d. The electronic pump controller shall be Essex Engineering Corporation, model 2410, or equal.

2.10 ALARM TELEMETRY

- A. Provide a cellular based alarm notification system. Unit shall be Omni-Site model XR-50 Micro RTU, or equal. Include power supply, battery back up, charger, local antenna, and other appurtenances as required for a complete operating system.

- B. Coordinate with the City of Rensselaer to set up local service, notification schedules, web page monitoring, etc. Provide wiring for all points whether used or not.
- C. Unit shall be contained in a NEMA 4X enclosure and accept up to 10 discrete inputs (DI). Monitor the following points: AUTO, RUNNING, and FAILED (moisture, temperature, overload) for each pump; float switch HIGH, level controller failure, POWER LOSS, and the spares as directed by the Owner.

2.11 CONCRETE WET WELL AND VALVE VAULT

- A. The Contractor shall furnish and install a monolithic concrete or precast manhole type wet well as indicated on the drawings. Pump and related equipment shall be installed and/or mounted as shown.
- B. A concrete valve vault shall be furnished and installed to house the valves and appurtenances.
- C. Precast manhole sections shall conform to requirements of ASTM Specification C478.
- D. Contractor may offer wet well sections conforming to ASTM C-76, Class IV, Wall B pipe sections if shown on the drawings.

2.12 ALUMINUM ACCESS HATCHES

- A. The access hatches will be the size shown on drawing and be manufactured from 6061-T6 aluminum for bars, angles and extrusions. One-quarter inch (1/4") diamond plate shall be 5086 aluminum.
- B. Each hatch shall be designed to combine covering of the hole per OSHA standard 1910.23 and shall include fall-through protection and controlled confined space entry. Cover will be designed for a minimum live load of 300 lbs/sq. ft. with maximum deflection of 1/150 of the span. Each hatch shall be designed using a maximum design stress of 17,300 psi as per the Aluminum Association, Inc. "Specification for Aluminum Structures."
- C. Each door shall be equipped with an aluminum hold open arm. Door shall lock open in 90-degree position. Each hold open arm shall have a red vinyl grip handle. Hold open arm shall be fastened to frame with 1/2" 316 stainless steel bolt.
- D. Angle frame shall be of extruded aluminum with a continuous 1-1/2" anchor flange and be a minimum 1/4" thick. Hinges shall be 316 stainless

steel. Each hatch shall have exposed padlock clip and an aluminum lift handle which is flush with top of diamond plate.

- E. The safety grate shall be made of 6061-T6 aluminum with a minimum ultimate strength of 38,000 psi and a minimum yield strength of 35,000 psi, per ASTM B221. Grate design shall use safety factors as defined in the "Specifications for Aluminum Structures" by the Aluminum Association, Inc., 5th Edition, December 1986 for "Bridge Type Structures."
- F. Aluminum grating shall be designed to withstand a minimum live load of 300 lbs. per sq. ft. Deflection shall not exceed 1/150 of the span. Aluminum grate openings shall be 5" x 5", which will allow visual inspection of the pit once the access hatch is opened. Each aluminum grate shall be provided with a permanent hinge system which will lock the grate in the 90-degree position once opened.
- G. Design of the system must assure fall through protection is in place after the door has been closed, thereby protecting the next operator.
- H. Each grate shall have an opening arm with a red vinyl grip handle, which will allow opening of the grate while providing the grate as a barrier between the operator and the pit. The opening arm shall also be equipped with a controlled confined space entry locking device (lock provided by others). This locking device will prevent unauthorized entry to the confined space. The grating system will allow anyone to make visual inspection and float adjustments without entering the confined space. Grate shall be painted with OSHA type safety orange paint.
- I. Welding shall be in accordance with ANSI/AWS D1.2-90 Structural Welding Code for Aluminum.
- J. The access hatches shall be Flygt Model FLE with Safety Grate, or an approved equal.

2.13 PIPING MATERIALS

- A. Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C 15 1). Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness class shall be 350.

- B. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte, or equal.
- C. Fittings shall be cast iron or ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi. Fitting joints shall be mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Thrust blocking or restrained joints may be as required or necessary.
- D. Gate valves 4-inch and larger shall be full ductile iron body, epoxy fusion bounded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and shall have mechanical joint ends. Exposed bolts and nuts shall be stainless steel. Joint accessories shall meet the requirements of ANSI/AWWA C11/A21.11. Valve opening direction shall be counter-clockwise.
 - 1. Gate valves 4-inch and larger installed in structures shall be full ductile iron body, outside screw, and yoke gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509, except those parts of ANSI/AWWA C500 or C509 only applicable to non-rising stem gate valves and wrench nuts. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be stainless steel. Gaskets shall be full face and shall be red rubber or equal.
 - 2. Gate valves shall be as manufactured by Waterous, U.S. Valve, or equal.
- E. Single disc, swing check valves, 4-inch and larger, shall be used in sewage pump stations and shall be iron body, bronze-mounted, swing check, bolted cover, flanged ends, 125 psig working pressure, AWWA Standard C508, suitable for use in a horizontal position. Flanges shall conform in dimensions and drilling to ANSI B 16.1.
 - 1. Swing check valves shall have outside weight and lever.

2.14 PORTABLE HOIST

- A. Provide and install surface-mounted stainless steel floor sockets for the portable hoist at appropriate locations such that all pumps under this section may be removed by insertion of the portable hoist into floor sockets. All anchor bolts shall be stainless steel.

- B. The portable hoist floor sockets shall be furnished to match the portable hoist the City presently uses for maintenance..

PART 3 - EXECUTION

3.1 INSPECTION

Inspect all pumps, motors, and appurtenances prior to installation in the work. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with new, undamaged and suitable products.

3.2 INSTALLATION

- A. Install the submersible pumps in accordance with the drawings and manufacturer's written instructions.
- B. The discharge elbow of each pump shall be securely anchored to the wet well base and properly aligned with the guide system and upper guide bracket.
- C. The discharge piping shall be properly anchored and supported inside the manhole.
- D. All electrical work shall be done by a qualified electrician and shall conform to the National Electric Code.
- E. Pumping unit base shall be finish coated prior to installation with Tnemec 66HB Epoxy, or equal. Each unit shall be leveled and all voids beneath the base filled with non-shrink grout so that it is uniformly supported on the concrete base. Following grouting, all excess grout shall be removed, and the exposed portions of the bases shall be cleaned and recoated.

3.3 TESTING

- A. The manufacturer's representative shall perform a pumping test for each new pumping unit as soon as practical after the pumping equipment and controls are installed. The pumping test shall determine the capacity, discharge pressure, and estimated horsepower draw of each pumping unit under actual operating conditions. The duration of each pump test shall be at least thirty (30) minutes of continuous operation. If the units have adjustable frequency drives, the test shall be performed over the entire range of the pump. The representative shall also test the new pumps in parallel operation in all the various combinations, and record all test data

listed above. Include all as-installed test data and adjustable speed pump curves in Start-Up Certification Report. All work shall be coordinated with the Owner.

- B Flow meters, level sensors and pressure gauges installed as a part of the project shall be used to determine the pumping rates and pressures. The Contractor will not be required to install temporary flow meters and gauges for pump testing.
- C Any defects in the new equipment or failure to meet the specified performance shall be corrected by the Contractor. The Owner reserves the right to reject the pump if the Contractor fails or refuses to make the corrections required to meet the specified performance.

3.4 MANUFACTURER'S SERVICE AND START-UP CERTIFICATION REPORT

- A The Contractor shall provide the services of a qualified representative of the manufacturer for a minimum of five (5) days to perform the following tasks:
 - 1. Inspect the installation of the equipment.
 - 2. Place the equipment in operation and make any necessary adjustments.
 - 3. Perform tests specified in this Section and recommended by the equipment manufacturer.
 - 4. Instruct Owner's personnel in the proper operation and maintenance (O&M) of the equipment.
- B If equipment is not completed for proper start-up and training procedures, the representative shall reschedule another visit at no additional cost to the Owner. Training will not be permitted without proper start-up and operation of the equipment. Training shall be performed separate and distinct from start-up and testing tasks. An abstract or outline of the start-up, testing and training procedures shall be provided to the Engineer at least five days prior to the scheduled visit. Manufacturer's operation and maintenance manuals and materials and audio-video cassette, when included under submittal requirements, shall be incorporated in the training procedures, with emphasis on items or materials of greatest importance.
- C A typed, bound report covering the manufacturer's representative's findings shall be submitted to the Engineer for review and approval. The report shall:
 - 1. Describe the start-up procedures taken;

2. Include any inspections performed;
3. Outline in detail any deficiencies observed along with the corrective actions taken;
4. Include the results of all field tests, including necessary graphs, charts, tables, etc., specified in this Section or required by the referenced standards; and,
5. Certify that the equipment is properly installed and functioning for the purpose intended.

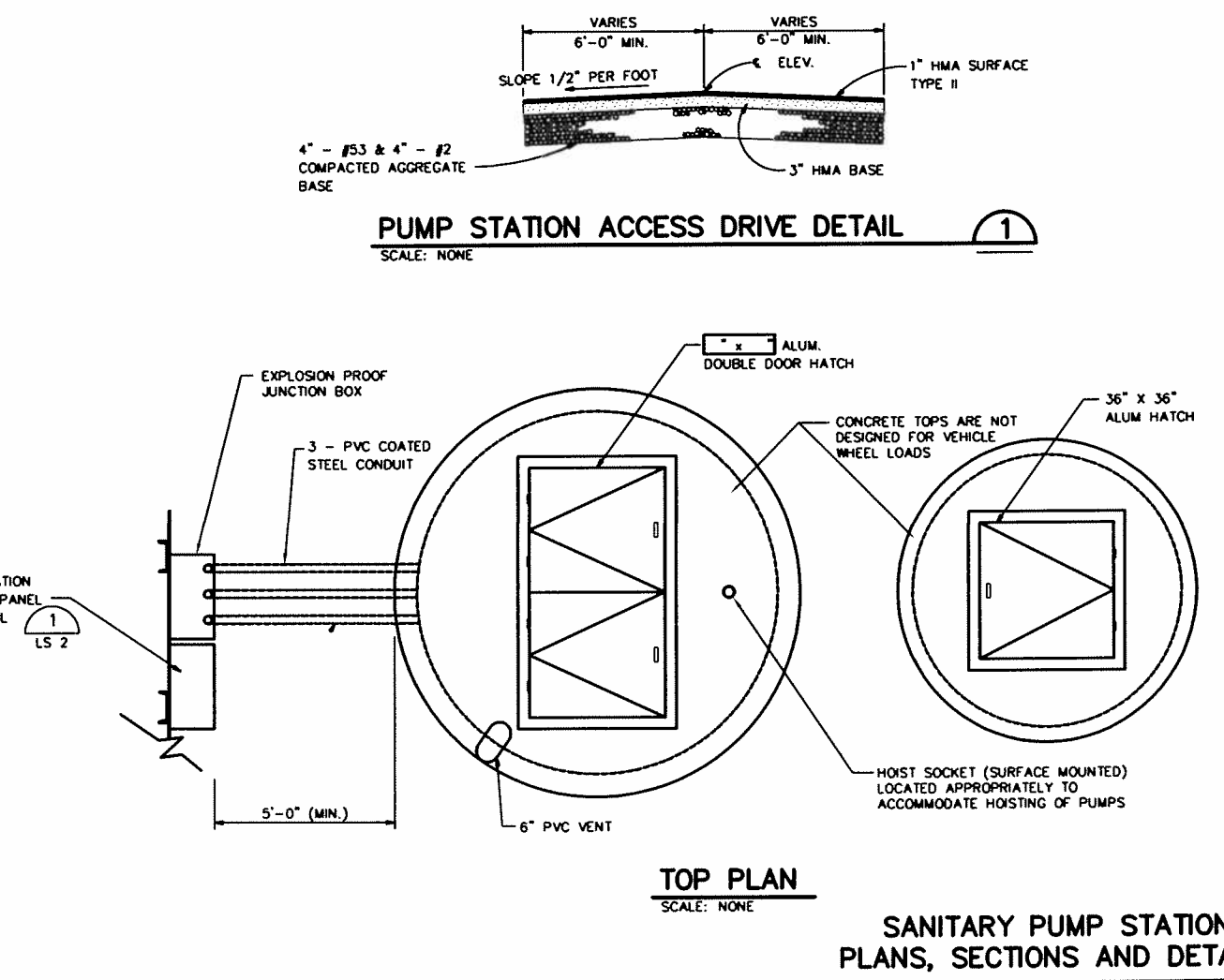
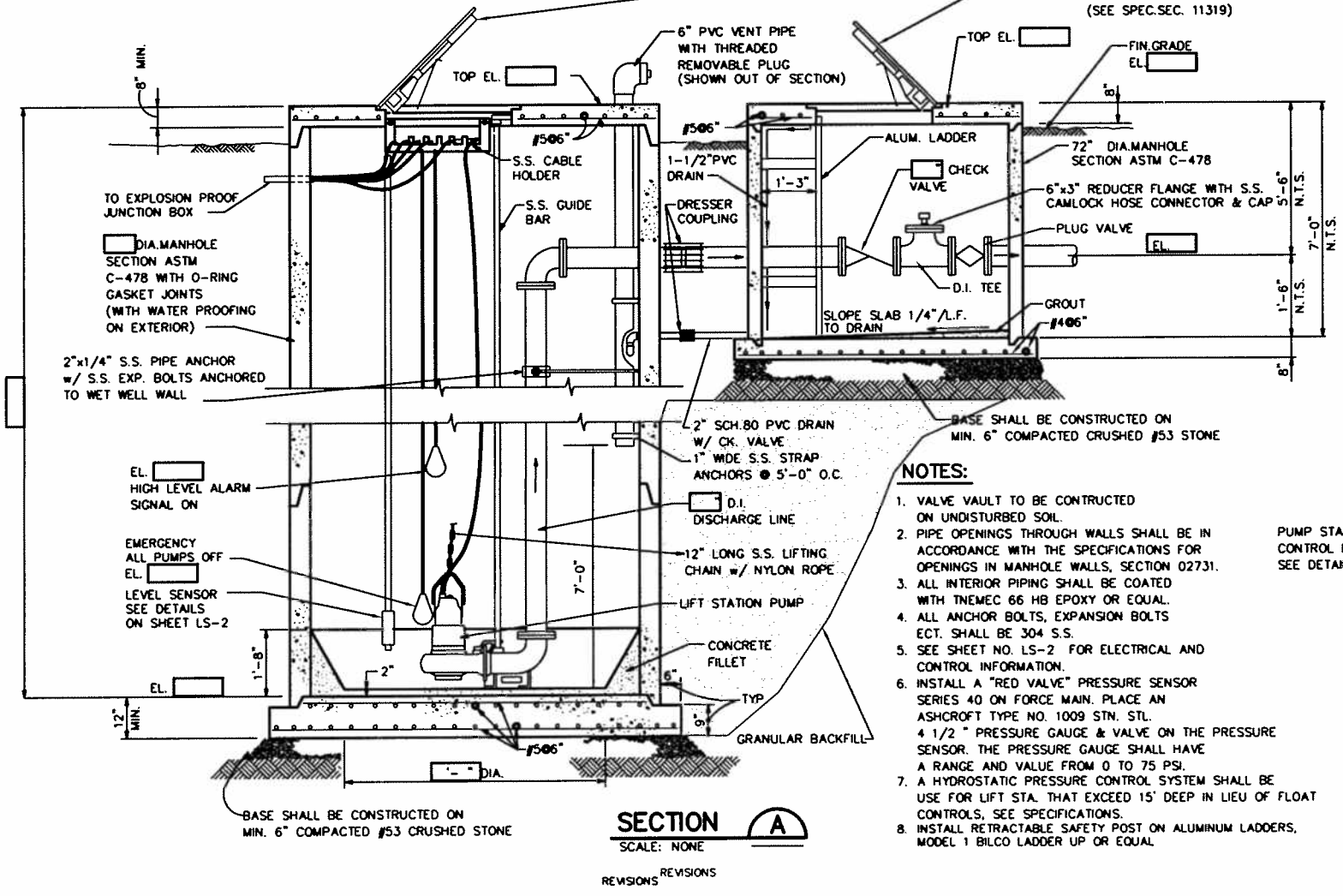
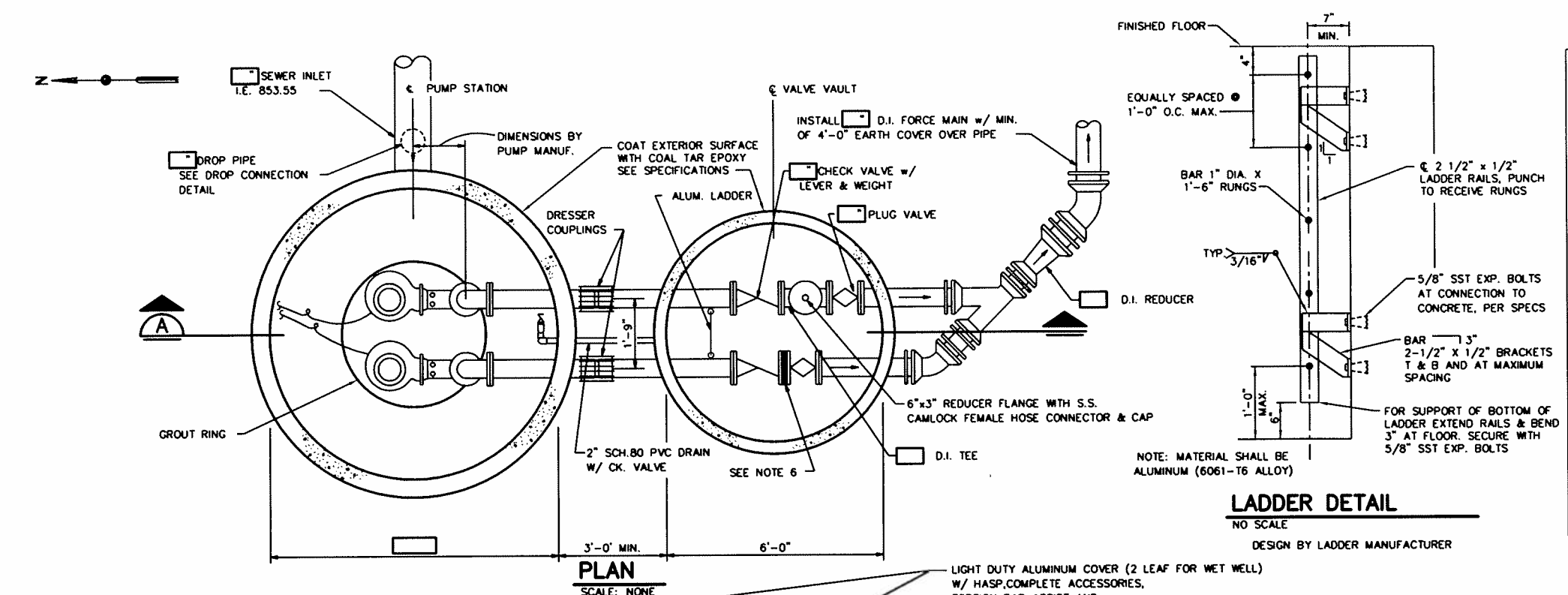
- D The Contractor shall bear all expenses associated with the start-up, testing and training procedures and report described above, including labor, transportation, lodging and material costs.

3.5 WARRANTY

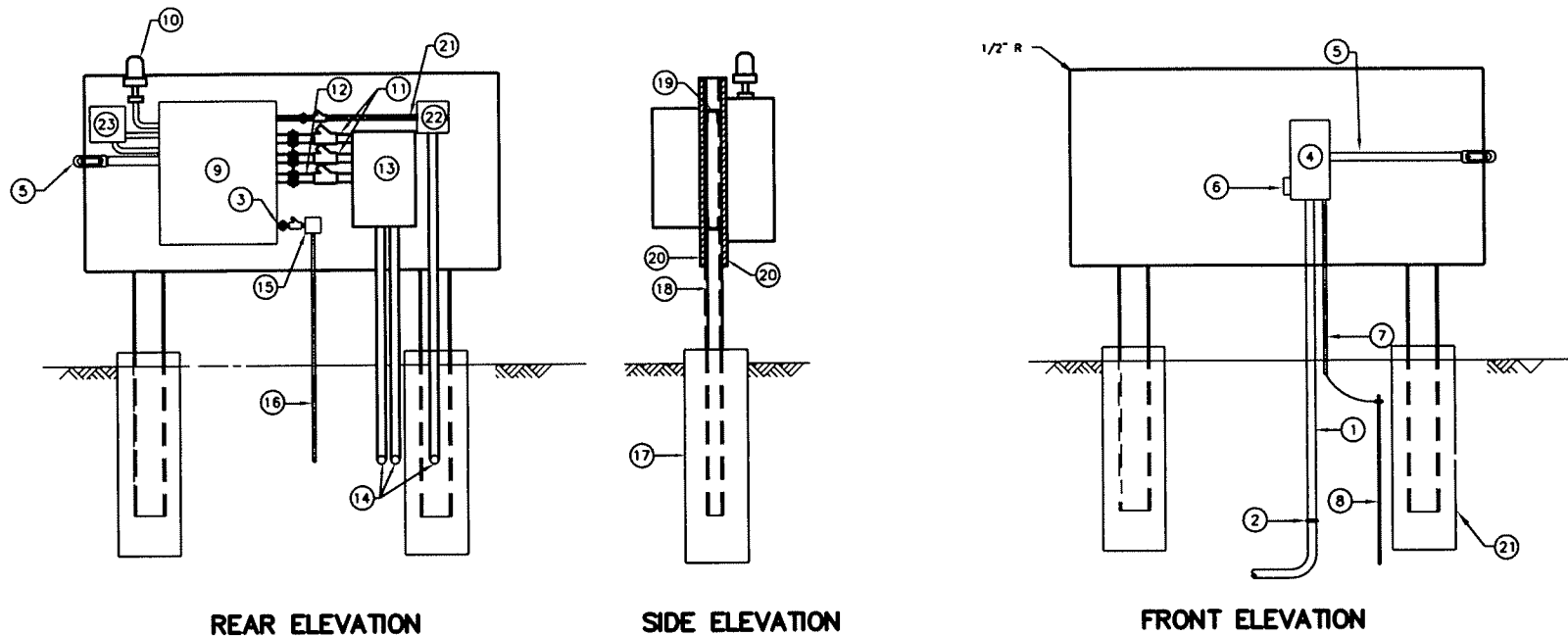
- A The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of five years under normal use, operation, and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear or a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring, and ball bearings. The warranty shall be in published form and apply to all units.
- B All equipment supplied and installed under this item of the specifications shall meet the requirements of the OSHA.

END OF SECTION 11319

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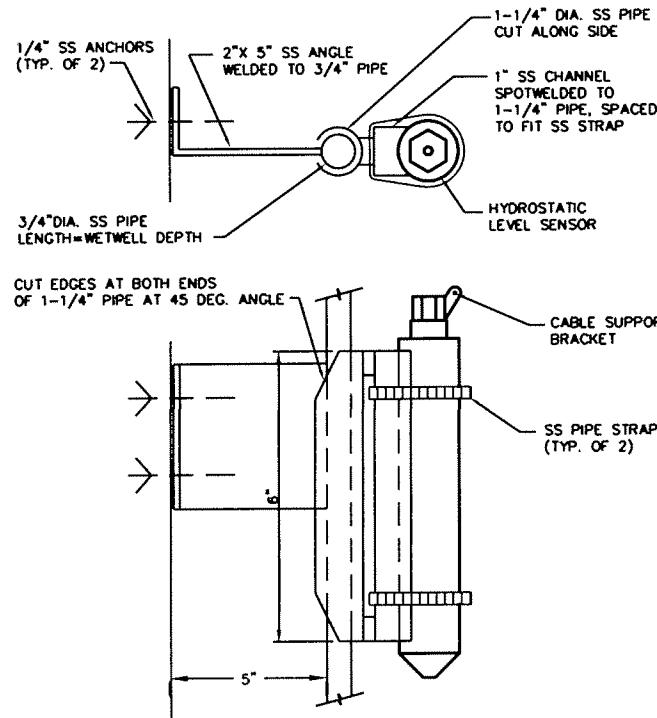


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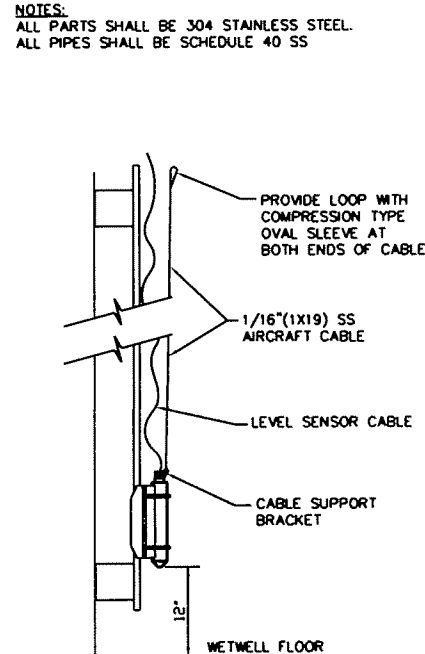
PUMP STATION CONTROL PANEL INSTALLATION DETAIL
NOT TO SCALE

1



LEVEL SENSOR MOUNTING BRACKET DETAIL
SCALE: NONE

3



CONCRETE FOOTING DETAIL
SCALE: 1/2" = 1'-0"

2

GENERAL NOTES:

- 480Y/277 VOLT SERVICE SHALL BE PROVIDED IF IT IS AVAILABLE FROM THE UTILITY COMPANY. USE THIS SHEET FOR 480Y/277 VOLT SERVICE.
- THE AREA AROUND THE LIFT STATION SHALL BE CLASSIFIED AS A HAZARDOUS LOCATION. ANY SPACE WITHIN 3' (ANY DIRECTION) FROM A VENT IS CLASSIFIED AS CLASS I, DIVISION 1, GROUPS C & D; WITH THE SPACE FROM 3' TO 5' FROM A VENT CLASSIFIED AS CLASS I, DIVISION 2, GROUPS C & D. IN ADDITION, ANY SPACES EXTENDING OUTWARD 3' PAST THE EDGE OF ANY HATCH OPENINGS IN THE TOP OF THE STRUCTURE, TO A HEIGHT OF 18", SHALL BE CLASSIFIED AS CLASS I, DIVISION 2, GROUPS C & D. ALL ELECTRICAL WORK MUST CONFORM WITH THE N.E.C. REQUIREMENTS FOR THESE AREAS. EXPLOSION-PROOF CONDUIT SEALS MUST BE INSTALLED WHEREVER THE CONDUITS PASS THROUGH THE BOUNDARIES OF THE HAZARDOUS LOCATION.
- THE DESIGN SHOWN ON THIS DRAWING IS BASED ON A MAXIMUM PUMP SIZE OF 10 HP.
- COORDINATE WITH RENSSELAER ELECTRIC UTILITY COMPANY. CONTACT PERSON IS LINE SUPERINTENDENT, TOM PHEGLEY, 219-866-6965.
- RENSSELAER ELECTRIC UTILITY COMPANY SHALL PROVIDE PRIMARY CABLES, TRANSFORMER PAD, TRANSFORMER, AND METERING EQUIPMENT.
- CONTRACTOR SHALL EXTEND SECONDARY CONDUCTORS TO TRANSFORMER AS INDICATED. FINAL CONNECTIONS AT TRANSFORMER SHALL BE BY RENSSELAER ELECTRIC UTILITY COMPANY.
- NOTIFY THE CITY OF RENSSELAER WITH ANY EXCEPTIONS TO THIS SHEET.
- SERVICE SIZE OF 100 AMPS IS BASED ON MAXIMUM OF TWO PUMPS AT 20 HORSEPOWER, ASSUMING BOTH PUMPS OPERATING TOGETHER DURING HIGH FLOWS. CONTRACTOR TO VERIFY SERVICE SIZE REQUIRED.

KEYED NOTES:

- INCOMING 100 AMP, 480/277 VOLT, 3 PHASE, 4 WIRE SERVICE FROM UTILITY TRANSFORMER BY CONTRACTOR, 1-1/2" PVC COATED RIGID STEEL CONDUIT WITH 3/2 THWN, 1/6 THWN NEUTRAL.
- USE PVC CONDUIT UNDERGROUND, AND PVC COATED RIGID STEEL CONDUIT FROM 24" BELOW GRADE TO ABOVE GROUND, AND FOR ALL ABOVE GROUND WORK.
- 3/4" PVC COATED RIGID STEEL CONDUIT WITH SEALING FITTING AND UNION. INSTALL 2 #18 TWISTED SHIELDED PAIRS (1 SPARE) FOR LEVEL SENSOR CABLE.
- METER SOCKET; PROVIDED AND INSTALLED BY CONTRACTOR. INSTALL AT A HEIGHT OF 5'-6" ABOVE GRADE TO CENTER OF METER USING STAINLESS STEEL HARDWARE. COORDINATE WITH UTILITY COMPANY. BOND THE SERVICE GROUNDED CONDUCTOR TO THE GROUNDING ELECTRODE CONDUCTOR INSIDE OF THE METER SOCKET.
- 1-1/2" PVC COATED RIGID STEEL CONDUIT WITH 4 #2 THWN/THWN COPPER CONDUCTORS AND 1 #6 THWN/THWN COPPER GROUND CONDUCTOR.
- SURGE ARRESTER. SQUARE D TYPE SDSA OR EQUAL.
- 1/2" PVC CONDUIT WITH 1 #6 GROUNDING CONDUCTOR.
- 3/4" x 10' LONG COPPER GROUND ROD. PROVIDE DIRECT BURIAL RATED MECHANICAL GROUND CLAMP AS REQUIRED.
- PUMP CONTROL PANEL; REFER TO SPEC. SECTION 11307. CONTRACTOR SHALL INSTALL USING STAINLESS STEEL HARDWARE. TOP CONDUIT ENTRIES ARE PROHIBITED.
- ALARM BEACON LIGHT. REFER TO SPEC. SECTION 11307.
- CONTRACTOR SHALL INSTALL TWO 1" PVC COATED RIGID STEEL CONDUITS WITH 3 #10 AND 1 #10 GROUND, AND EXPLOSION PROOF CONDUIT SEALING FITTINGS AND UNIONS. THESE CONDUCTORS SHALL BE SPLICED WITH THE PUMP CABLE POWER CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX.
- CONTRACTOR SHALL INSTALL ONE 1" PVC COATED RIGID STEEL CONDUIT AND UNION WITH 10 #18 CONTROL CONDUCTORS (INCLUDES SPARES), AND EXPLOSION PROOF CONDUIT SEALING FITTING. THESE CONDUCTORS SHALL BE SPLICED WITH THE THERMAL & MOISTURE SENSING FLOAT SWITCH CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX. USE SILICONE FILLED WIRE NOTS FOR ALL CONNECTIONS.
- 10"x12"x6" NEMA 7 (EXPLOSION PROOF) JUNCTION BOX WITH ROUND SCREW-ON COVER AND O-RING SEAL. ADALET TYPE XJK OR EQUAL. USE SILICONE FILLED WIRE NOTS FOR ALL CONNECTIONS.
- CONTRACTOR SHALL INSTALL THREE 2" PVC COATED RIGID STEEL CONDUITS BETWEEN THE LIFT STATION AND THE EXPLOSION PROOF JUNCTION BOX, TWO FOR PUMP CABLES AND ONE FOR FLOAT SWITCH CABLES. CABLES SHALL EXTEND TO NEAR THE HATCH OPENING TO ALLOW FOR MAINTENANCE OF THE PUMPS AND FLOAT SWITCHES. CABLES SHALL BE SUPPORTED WITHIN THE WET WELL FROM A CABLE RACK USING STAINLESS STEEL OR NON-METALLIC "KELLUMS GRIP" CABLE SUPPORTS.
- LEVEL TRANSMITTER JUNCTION BOX. CONTRACTOR SHALL INSTALL USING STAINLESS STEEL HARDWARE. NEMA 7, NOMINAL 6"x6"x4". ADALET TYPE XJL WITH ROUND SCREW-ON COVER AND O-RING SEAL, OR EQUAL. INSTALL ATMOSPHERIC COMPENSATION DEVICE ON SENSOR CABLE. USE SILICONE FILLED WIRE NOTS FOR ALL CONNECTIONS.
- 1" PVC COATED RIGID STEEL CONDUIT INSTALLED JUST UNDERNEATH THE TOP SLAB OF THE WET WELL COVER, EXTENDED TO JUST NEXT TO THE HATCH COVERS. EXTEND SENSOR CABLE TO THE LEVEL SENSOR.
- CONCRETE FOOTING; REFER TO DETAIL ON THIS SHEET.
- 8" x 4.25 ALUMINUM CHANNEL. EACH CHANNEL SHALL BE INSTALLED IN CONCRETE BASES AS SHOWN IN THE CONCRETE FOOTING DETAIL. CHANNEL SHALL BE COATED WITH BITUMINOUS COATING UP TO 4" ABOVE THE TOP OF CONCRETE.
- 3 x 2 x 1/4" ALUMINUM ANGLE STIFFENERS, WELDED TO ALUMINUM CHANNELS.
- 1/4" THICK ALUMINUM MOUNTING PLATE, WELDED TO ALUMINUM CHANNELS FOR EQUIPMENT MOUNTING. SIZE SHALL BE AS REQUIRED TO ACCOMMODATE THE EQUIPMENT BEING MOUNTED. ALL CORNERS SHALL BE ROUNDED TO 1/2" RADIUS, AND ALL SHARP EDGES SHALL BE FILED SMOOTH. ALL PANEL MOUNTING HARDWARE SHALL BE STAINLESS STEEL.
- CONTRACTOR SHALL INSTALL ONE 1" PVC COATED RIGID STEEL CONDUIT WITH 10 #18 CONTROL CONDUCTORS (INCLUDES SPARES), UNION AND EXPLOSION PROOF CONDUIT SEALING FITTING. THESE CONDUCTORS SHALL BE SPLICED WITH THE FLOAT SWITCH CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX.
- FLOAT SWITCH JUNCTION BOX. CONTRACTOR SHALL INSTALL USING STAINLESS STEEL HARDWARE. NEMA 7, NOMINAL 6"x6"x4". ADALET TYPE XJL WITH SCREW-ON COVER AND O-RING SEAL, OR EQUAL.
- OMNI-SITE STATION MONITORING UNIT IN A NEMA 4X ENCLOSURE. INSTALL USING STAINLESS STEEL HARDWARE. INCLUDE BATTERY BACKUP. PROVIDE 3/4" PVC COATED RIGID STEEL CONDUIT WITH 2 #12 AND 1 #12 GROUND FOR POWER, AND 3/4" PVC COATED RIGID STEEL CONDUIT WITH 12 #18, 1 #12 GROUND FOR ALARM AND STATUS MONITORING.

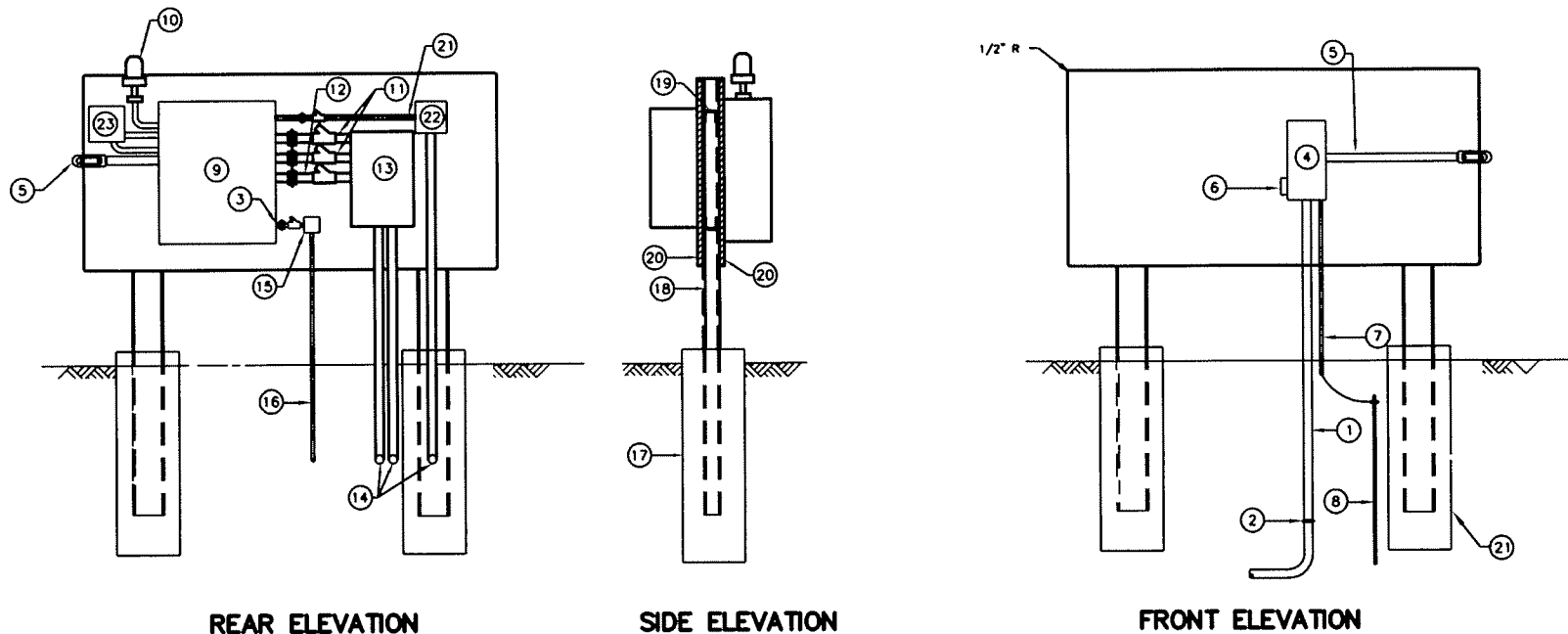
**SANITARY PUMP STATION
ELECTRICAL DETAILS FOR 480Y/277 VOLT SERVICE**

HNTB



FIGURE PS-2a

P:\46028_Rensselaer_zoning_subdivision\TechnicalDesign\Wastewater\Lift Station\sh_1, 4/9/2008 10:56:08 AM, RMcClellan

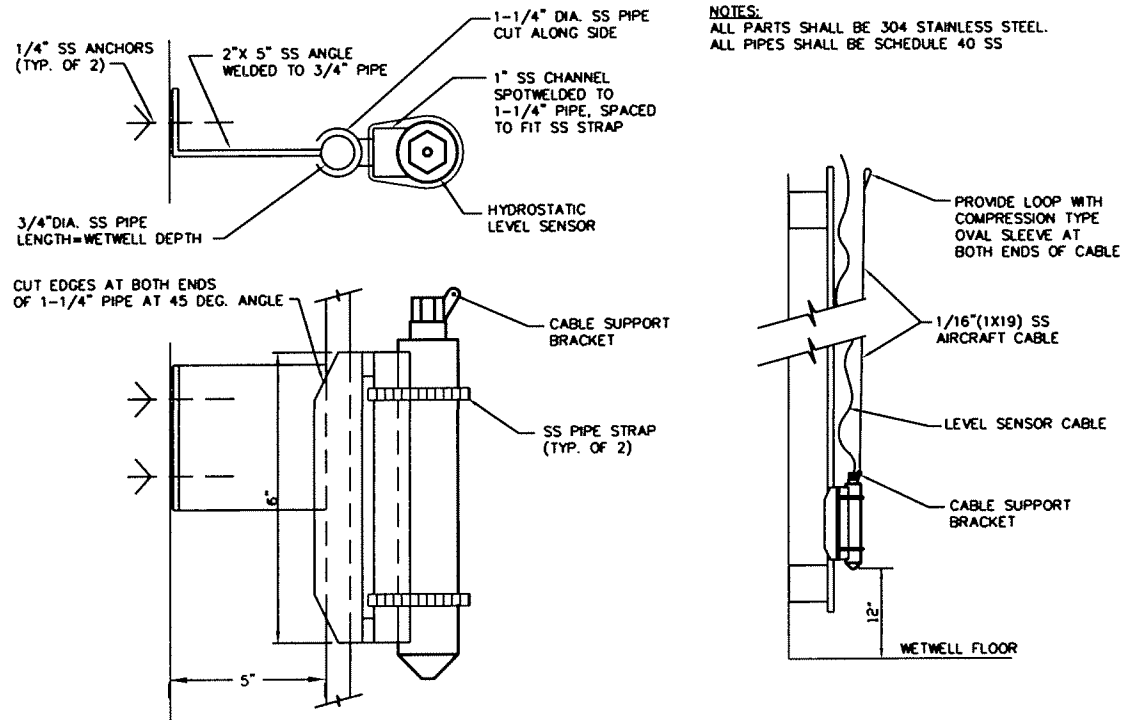


PUMP STATION CONTROL PANEL INSTALLATION DETAIL
NOT TO SCALE

1

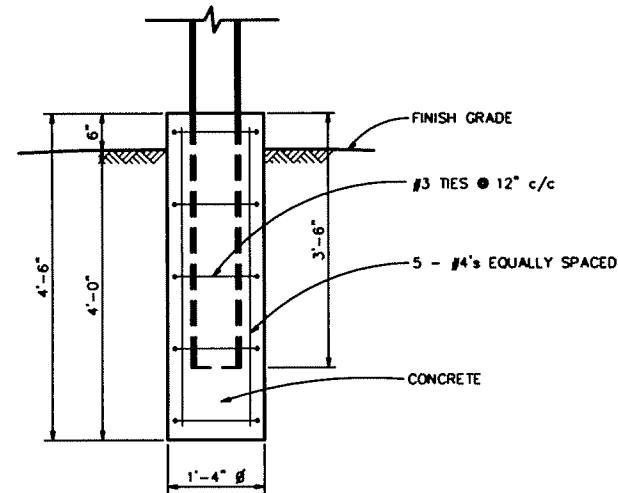
KEYED NOTES:

- INCOMING 100 AMP, 120/240 VOLT, 1 PHASE, 3 WIRE SERVICE FROM UTILITY TRANSFORMER BY CONTRACTOR, 1-1/2" PVC COATED RIGID STEEL CONDUIT WITH 2#2 THWN, 1#2 THWN NEUTRAL.
- USE PVC CONDUIT UNDERGROUND, AND PVC COATED RIGID STEEL CONDUIT FROM 24" BELOW GRADE TO ABOVE GROUND, AND FOR ALL ABOVE GROUND WORK.
- 3/4" PVC COATED RIGID STEEL CONDUIT WITH SEALING FITTING AND UNION. INSTALL 2 #18 TWISTED SHIELDED PAIRS (1 SPARE) FOR LEVEL SENSOR CABLE.
- METER SOCKET; PROVIDED AND INSTALLED BY CONTRACTOR. INSTALL AT A HEIGHT OF 5'-6" ABOVE GRADE TO CENTER OF METER USING STAINLESS STEEL HARDWARE. COORDINATE WITH UTILITY COMPANY. BOND THE SERVICE GROUNDED CONDUCTOR TO THE GROUNDING ELECTRODE CONDUCTOR INSIDE OF THE METER SOCKET.
- 1-1/2" PVC COATED RIGID STEEL CONDUIT WITH 3 #2 THHN/THWN COPPER CONDUCTORS AND 1 #6 THHN/THWN COPPER GROUND CONDUCTOR.
- SURGE ARRESTER. SQUARE D TYPE SD5A OR EQUAL.
- 1/2" PVC CONDUIT WITH 1 #6 GROUNDING CONDUCTOR.
- 3/4" x 10' LONG COPPER GROUND ROD. PROVIDE DIRECT BURIAL RATED MECHANICAL GROUND CLAMP AS REQUIRED.
- PUMP CONTROL PANEL; REFER TO SPEC. SECTION 11307. CONTRACTOR SHALL INSTALL USING STAINLESS STEEL HARDWARE. TOP CONDUIT ENTRIES ARE PROHIBITED.
- ALARM BEACON LIGHT. REFER TO SPEC. SECTION 11307.
- CONTRACTOR SHALL INSTALL TWO 1" PVC COATED RIGID STEEL CONDUITS WITH 3 #10 AND 1 #10 GROUND, AND EXPLOSION PROOF CONDUIT SEALING FITTINGS AND UNIONS. THESE CONDUCTORS SHALL BE SPLICED WITH THE PUMP CABLE POWER CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX.
- CONTRACTOR SHALL INSTALL ONE 1" PVC COATED RIGID STEEL CONDUIT AND UNIONS WITH 10 #18 CONTROL CONDUCTORS (INCLUDES SPARES), AND EXPLOSION PROOF CONDUIT SEALING FITTING. THESE CONDUCTORS SHALL BE SPLICED WITH THE THERMAL AND MOISTURE CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX. USE SILICONE FILLED WIRE NUTS FOR ALL CONNECTIONS.
- 10"x12"x6" NEMA 7 (EXPLOSION PROOF) JUNCTION BOX WITH ROUND SCREW-ON COVER AND O-RING SEAL. ADALET TYPE XJK OR EQUAL. USE SILICONE FILLED WIRE NUTS FOR ALL CONNECTIONS.
- CONTRACTOR SHALL INSTALL THREE 2" PVC COATED RIGID STEEL CONDUITS BETWEEN THE LIFT STATION AND THE EXPLOSION PROOF JUNCTION BOX, TWO FOR PUMP CABLES AND ONE FOR FLOAT SWITCH CABLES. CABLES SHALL EXTEND TO NEAR THE HATCH OPENING TO ALLOW FOR MAINTENANCE OF THE PUMPS AND FLOAT SWITCHES. CABLES SHALL BE SUPPORTED WITHIN THE WET WELL FROM A CABLE RACK USING STAINLESS STEEL OR NON-METALLIC "KELLUMS GRIP" CABLE SUPPORTS.
- LEVEL TRANSMITTER JUNCTION BOX. CONTRACTOR SHALL INSTALL USING STAINLESS STEEL HARDWARE. NEMA 7, NOMINAL 6"x6"x4". ADALET TYPE XJL WITH ROUND SCREW-ON COVER AND O-RING SEAL, OR EQUAL. INSTALL ATMOSPHERIC COMPENSATION DEVICE ON SENSOR CABLE. USE SILICONE FILLED WIRE NUTS FOR ALL CONNECTIONS.
- 1" PVC COATED RIGID STEEL CONDUIT INSTALLED JUST UNDERNEATH THE TOP SLAB OF THE WET WELL COVER, EXTENDED TO JUST NEXT TO THE HATCH COVERS. EXTEND SENSOR CABLE TO THE LEVEL SENSOR.
- CONCRETE FOOTING; REFER TO DETAIL ON THIS SHEET.
- 8" x 4.25 ALUMINUM CHANNEL. EACH CHANNEL SHALL BE INSTALLED IN CONCRETE BASES AS SHOWN IN THE CONCRETE FOOTING DETAIL. CHANNEL SHALL BE COATED WITH BITUMINOUS COATING UP TO 4" ABOVE THE TOP OF CONCRETE.
- 3 x 2 x 1/4" ALUMINUM ANGLE STIFFENERS, WELDED TO ALUMINUM CHANNELS.
- 1/4" THICK ALUMINUM MOUNTING PLATE, WELDED TO ALUMINUM CHANNELS FOR EQUIPMENT MOUNTING. SIZE SHALL BE AS REQUIRED TO ACCOMMODATE THE EQUIPMENT BEING MOUNTED. ALL CORNERS SHALL BE ROUNDED TO 1/2" RADIUS, AND ALL SHARP EDGES SHALL BE FILED SMOOTH. ALL PANEL MOUNTING HARDWARE SHALL BE STAINLESS STEEL.
- CONTRACTOR SHALL INSTALL ONE 1" PVC COATED RIGID STEEL CONDUIT WITH 10 #18 CONTROL CONDUCTORS (INCLUDES SPARES), UNION AND EXPLOSION PROOF CONDUIT SEALING FITTING. THESE CONDUCTORS SHALL BE SPLICED WITH THE FLOAT SWITCH CONDUCTORS IN THE EXPLOSION PROOF JUNCTION BOX.
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- OMNI-SITE STATION MONITORING UNIT IN A NEMA 4X ENCLOSURE. INSTALL USING STAINLESS STEEL HARDWARE. INCLUDE BATTERY BACKUP. PROVIDE 3/4" PVC COATED RIGID STEEL CONDUIT WITH 2 #12 AND 1 #12 GROUND FOR POWER, AND 3/4" PVC COATED RIGID STEEL CONDUIT WITH 12 #18, 1 #12 GROUND FOR ALARM AND STATUS MONITORING.



LEVEL SENSOR MOUNTING BRACKET DETAIL
SCALE: NONE

3



CONCRETE FOOTING DETAIL

2

SCALE: 1/2" = 1'-0"

GENERAL NOTES:

- 120/240 VOLT SERVICE SHALL BE PROVIDED WHERE 480Y/277 VOLT SERVICE IS NOT AVAILABLE FROM THE UTILITY COMPANY. USE THIS SHEET FOR 120/240 VOLT SERVICE.
- THE AREA AROUND THE LIFT STATION SHALL BE CLASSIFIED AS A HAZARDOUS LOCATION. ANY SPACE WITHIN 3' (ANY DIRECTION) FROM A VENT IS CLASSIFIED AS CLASS I, DIVISION 1, GROUPS C & D; WITH THE SPACE FROM 3' TO 5' FROM A VENT CLASSIFIED AS CLASS I, DIVISION 2, GROUPS C & D. IN ADDITION, ANY SPACES EXTENDING OUTWARD 3' PAST THE EDGE OF ANY HATCH OPENINGS IN THE TOP OF THE STRUCTURE, TO A HEIGHT OF 18", SHALL BE CLASSIFIED AS CLASS I, DIVISION 2, GROUPS C & D. ALL ELECTRICAL WORK MUST CONFORM WITH THE N.E.C. REQUIREMENTS FOR THESE AREAS. EXPLOSION-PROOF CONDUIT SEALS MUST BE INSTALLED WHEREVER THE CONDUITS PASS THROUGH THE BOUNDARIES OF THE HAZARDOUS LOCATION.
- THE DESIGN SHOWN ON THIS DRAWING IS BASED ON A MAXIMUM PUMP SIZE OF 5 HP.
- COORDINATE WITH RENSSELAER ELECTRIC UTILITY COMPANY. CONTACT PERSON IS LINE SUPERINTENDENT, TOM PHEGLEY, 219-866-6965.
- RENSSELAER ELECTRIC UTILITY COMPANY SHALL PROVIDE PRIMARY CABLES, TRANSFORMER PAD, TRANSFORMER, AND METERING EQUIPMENT.
- CONTRACTOR SHALL EXTEND SECONDARY CONDUCTORS TO TRANSFORMER AS INDICATED. FINAL CONNECTIONS AT TRANSFORMER SHALL BE BY RENSSELAER ELECTRIC UTILITY COMPANY.
- NOTIFY THE CITY OF RENSSELAER WITH ANY EXCEPTIONS TO THIS SHEET.
- SERVICE SIZE OF 100 AMPS IS BASED ON MAXIMUM OF TWO PUMPS AT 7.5 HORSEPOWER, ASSUMING BOTH PUMPS OPERATING TOGETHER DURING HIGH FLOWS. CONTRACTOR TO VERIFY SERVICE SIZE REQUIRED.

SANITARY PUMP STATION
ELECTRICAL DETAILS FOR 120/240 VOLT SERVICE

HNTB

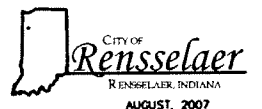
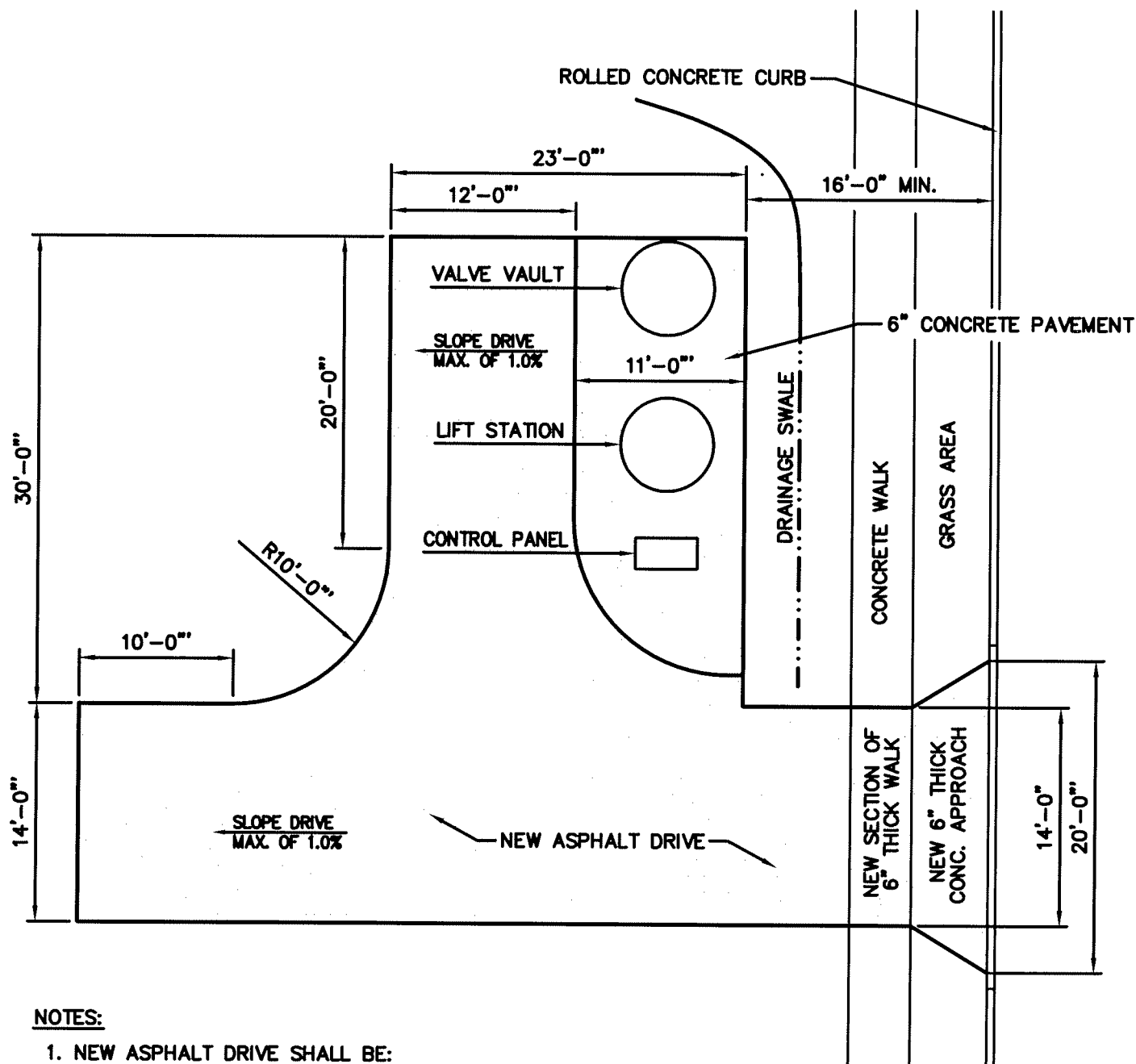


FIGURE PS-2b



NOTES:

1. NEW ASPHALT DRIVE SHALL BE:
 4" OF #2 STONE
 4" OF #53 STONE
 3 OF HMA #8 BINDER
 1" OF HMA # 11 SURFACE
2. CITY MAY REQUIRE PVC COATED CHAIN LINK FENCE
 AND GATES AROUND PUMP STATION SITE.

TYPICAL PUMP STATION SITE PLAN

HNTB



AUGUST, 2007

FIGURE PS-3

VIII. ROADWAYS

SECTION 02501 - STANDARDS OF ROADWAY GEOMETRIC DESIGN

PART 1 - GENERAL

1.1 Secondary Plats shall conform to the following requirements and standards:

A. Minimum Pavement Width

1. Minimum pavement widths, to be installed at the subdivider's expense, shall be as follows:
 - a. Primary Arterials: Four (4) lanes at 12 feet, 16 feet center turn lane (where warranted), plus two (2) feet curb and gutter. (See Figure R-1 for representative sketch.)
 - b. Secondary Arterials: Four (4) lanes at 12 feet OR two (2) lanes at 12 feet plus two (2) parking lanes at ten (10) feet, plus two (2) feet curb and gutter. (See Figure R-1 for representative sketch.)
 - c. Collector Streets: 36 feet back of curb to back of curb (2 feet curb and gutter). (See Figure R-1 for representative sketch.)
 - d. Local Streets: 30 feet back of curb to back of curb (2 feet curb and gutter). (See Figure R-1 for representative sketch.)
 - e. The pavement of a turning circle at the end of cul-de-sacs shall have a minimum radius of 50 feet. (See Figure R-12 for representative sketch.)
 - f. Alleys: full width of the right-of-way.
 - g. In all commercial areas, the minimum pavement width shall be 36 feet back of curb to back of curb.
 - h. In all industrial areas, the minimum pavement width shall be 24 feet with 8 feet of shoulder on each side of the pavement with "No Parking" on the shoulders.

B. Street Grades, Curves, and Sight Distances

1. The minimum vertical grade for all streets shall be 0.5%.
2. Maximum Vertical Grades
 - a. The maximum vertical grade for Primary Arterials and Secondary Arterials shall be 5.0%.
 - b. The maximum vertical grade for Collectors shall be 8%.
 - c. The maximum vertical grade for Local Roads or Streets shall be 8%.

- d. The first 25 feet of an intersecting roadway, from the outer edge of a through roadway, shall be designed with a two percent (2%) downward grade. With a sag vertical curve situation, the two percent grade shall connect with the remaining street profile grade using a minimum vertical curve length of 50 feet. This sag vertical curve may start at the edge of the through roadway. With a crest vertical curve at the approach to an intersection, the two percent downward grade shall extend 25 feet from the edge of the through roadway and the crest vertical curve can begin at that point. The length of the crest vertical curve shall meet the requirements of the 2004 AASHTO Standards for crest vertical curves.
3. Vertical curves shall be designed to meet or exceed 2004 AASHTO Standards for sag and crest vertical curves as shown in Exhibits 3-72 and 3-75 of the AASHTO Standards.
 - a. Local Roads or Streets shall have a design speed of 30 mph.
 - b. Collectors shall have a design speed of 30 mph.
 - c. Primary Arterials and Secondary Arterials shall have a minimum design speed of 40 mph.
4. Horizontal centerline curve radius shall meet or exceed 2004 AASHTO Standards and shall correspond to the following design speeds:
 - a. Local Roads or Streets and Collectors shall have a design speed of 30 mph and require a 300 foot minimum centerline radius.
 - b. Primary Arterials and Secondary Arterials shall have a design speed of 40 mph and require a 675 foot minimum centerline radius.
 - c. Tangent distance between reverse curves shall be 100 feet.
5. The maximum length cul-de-sac length shall be 600 feet measured along the centerline from the intersection at the origin to the center of circle. Each cul-de-sac shall have a terminus of circular shape with minimum right-of way diameter of 100 feet for residential use and 120 feet for industrial use. Reference Figure R-12.

C. Intersections

1. At street and alley intersections, property line corners shall be rounded by an arc, the minimum radius of which shall be 20 and

- ten (10) feet respectively. In business districts, a chord may be substituted for such arc.
2. Street curb intersections shall be rounded by radii of at least 25 feet. A radius of 40 feet shall be used at the intersection with a Primary Arterial, Secondary Arterial or Collector street.
 3. The above minimum radii shall be increased when the angle of street intersection is less than 90 degrees.
 4. Intersections of more than two (2) streets at one point will not be allowed.
 5. Street jogs with centerline offsets of less than 125 feet shall not be permitted.
 6. All streets shall intersect at 90 degrees whenever possible for a minimum distance of 100 feet; however, in no instance shall they intersect at less than 80 degrees onto Primary Arterials, Secondary Arterials, or Collectors; or at less than 70 degrees onto Local Roads or Streets.
 7. The following paragraphs shall be required as provisions of restrictive covenants of all Secondary Plats to which they apply:
 - a. No fence, wall, hedge, tree or shrub planting which obstructs sight lines and elevations between three (3) and nine (9) feet above the street shall be placed or permitted to remain on any corner lot within the triangular area formed by the street right-of-way lines and a line connecting points 40 feet from the intersection of said street lines 40 feet for Collectors and Local Roads and Streets; and 75 feet for Primary Arterials and Secondary Arterials, or in the case of a rounded property corner, from the intersection of the street right-of-way lines extended.
 - b. The same sight line limitations shall apply to any lot within ten (10) feet of the intersection of a street right-of-way line with the edge of the driveway pavement or alley line. No driveway shall be located within 75 feet of the intersection of two streets.
 8. At the intersection of any proposed Local Road or Street with a Primary Arterial, Secondary Arterial, or Collector, acceleration and deceleration lanes, passing blisters or left turn lanes shall be provided on the Primary Arterial, Secondary Arterial, or Collector. Reference Figure R-2.

D. Easements

1. Where alleys are not provided, easements for utilities shall be provided. Such easements shall have minimum widths of 30 feet,

and where located along lot lines, one-half the width shall be taken from each lot.

2. Where a subdivision is traversed by a watercourse, drainage ditch, channel, or stream, adequate areas for storm water or drainage easements shall be allocated for the purpose of widening, deepening, sloping, improving or protecting said watercourses in accordance with the requirements of the County Drainage Board or the Rensselaer Utilities Department.
3. The subdivider shall be encouraged to design for the placement of utility lines underground, following the required standards and specifications established by each utility company. The location of each underground utility system shall be shown by appropriate easement lines on the proposed plat.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 02501

SECTION 02502 - STANDARDS OF ROADWAY CONSTRUCTION

PART 1 - GENERAL

1.1 Road construction shall conform to the following requirements and standards:

A. Streets, General

1. Streets and alleys shall be graded, surfaced, and improved to the dimensions required by the cross-sections and the work shall be performed in the manner prescribed in Section 2500 and the Indiana Department of Transportation (INDOT) Standard Specifications.
2. Prior to placing the street and alley surfaces, adequate subsurface drainage (underdrains) for the street shall be provided by the subdivider. Underdrain pipe shall conform to Section 2500 and the INDOT Standard Specifications.
3. Concrete and bituminous asphalt paving mixes shall comply with specifications contained in Section 2500.
4. Before any bond covering a street installation is released, the Rensselaer authorized representative may request that core borings of the street be provided, at the subdivider's expense, for thickness determination.
5. Prior to the acceptance of asphalt streets, the subdivider shall employ and pay for the services of an independent testing laboratory to take cores at selected locations and perform Marshall stability, flow and density test, and percent of compaction determination on completed asphalt work if so directed by the Rensselaer authorized representative.
6. Prior to acceptance of concrete streets, subdividers must provide satisfactory test results from an independent testing laboratory to the Rensselaer authorized representative.
7. A developer may request permission from the Rensselaer authorized representative to delay the installation of the 1-inch surface layer of asphalt until the binder layer of asphalt has had sufficient time to prove its durability under the stress of heavy construction traffic, but not to exceed one (1) year. The developer shall be required to submit a separate performance bond to cover the cost of the installation of the 1-inch surface layer of asphalt.
8. All traffic control devices shall comply with guidelines and requirements of the current edition of the Indiana Manual on Uniform Traffic Control Devices.

B. Subgrade for Street Pavements

1. Preparation

- a. After all earth work is substantially complete and all drains installed, the subgrade shall be brought to the lines and grades shown on the plans.
- b. Unless otherwise provided, the upper six (6) inches of all subgrade shall be uniformly compacted to at least 95 percent standard density as determined by the provisions of AASHTO, T99, "Compaction and Density of Soils". During subgrade preparation and after its completion, adequate drainage shall be provided at all times to prevent water from standing on the subgrade. Subgrades shall be so constructed that it will have uniform density throughout. After compaction and final grading, the subgrade shall be finished with a three-wheel roller weighting not less than ten (10) tons. For areas not accessible to the roller, the required compaction shall be obtained by using mechanical tampers.
- c. All soft yielding or otherwise unsuitable material which will not compact properly shall be removed. All rock encountered shall either be removed or broken off to conform with required cross sections. Any holes or depressions resulting from the removal of such unsuitable material shall be filled with approved material and compacted to conform with the surrounding subgrade surface. No placement of pavement shall be permitted on uninspected or unapproved subgrade and, at no time, when the subgrade is frozen or muddy. No hauling shall be done nor equipment moved over the subgrade when its condition is such that undue distortion results. If these conditions are present, the subgrade shall be protected with adequate plank runways, mats, or other satisfactory means if hauling is to be done thereon.
- d. The subgrade shall be prepared sufficiently in advance to facilitate proper inspection of final elevations and compactions by the Rensselaer authorized representative.
- e. All utility and drainage excavations under pavement shall be backfilled with # 8 stone around pipes, and #53 stone compacted to street level. These locations shall be illustrated on construction drawings submitted to the City of Rensselaer.

2. Geogrid Stabilization of Soft Yielding Subgrades

- a. If proof rolling reveals areas of soft, yielding subgrade, the areas shall be aerated, dried and re-compacted to 100% maximum dry density. Soft yielding soils that remain after aeration, drying and re-work may require stabilization using a geogrid and stone as directed by the City of Rensselaer representative.
- b. A test area will be excavated to 18 inches below finished subgrade elevation. This undercut area shall extend a minimum of 5 feet beyond the limits of the soft area in each direction. A type I geogrid from INDOT list of approved geogrids (see list - <http://www.in.gov/indot/files/apl13.pdf>). The grid shall be installed with the narrow dimension of the roll perpendicular to centerline of the road. Care must be exercised to install the geogrid flat and not allow the geogrid to become slack or bunch up. Geogrid shall be overlapped 24 inches side to side and end to end. No machines or trucks will be allowed to run directly on the geogrid. Backfill material shall be #53 crushed stone and shall be placed and compacted in three 6-inch lifts. Compaction shall be 100% of maximum dry density.
- c. Proof rolling of the stabilized test area shall be witnessed by a representative of the City. If the test area passes the proof roll and has the proper compaction and moisture content, the City representative will approve this method for general use. If the repaired area still exhibits rutting or pumping, the City representative may require a deeper undercut or may seek a geotechnical recommendation.

3. Rigid Pavement Construction - When concrete is placed, the subgrade shall be properly dampened. Concrete pavement shall be constructed in accordance with Section 2500 and INDOT Standard Specifications.

C. Pavement Section - Typical pavement sections shall conform to the cross sections shown by Figures R-3.1 through R-3.3. The use of alternative cross sections shall be approved by the Rensselaer authorized representative.

D. Curbs and Gutters

1. Wherever a proposed subdivision lies adjacent to or in proximity of other developed areas currently provided with curbs and gutters or that have more than three (3) lots per acre of land plotted into lots, the subdivider shall provide curb and gutter on each side of the street surface in the proposed subdivision.
2. Curbs and gutters shall comply with standard details shown by Figure R-8. As an alternate, curb sections which comply with INDOT standard details will be permitted upon approval of the City of Rensselaer.
3. All curb and gutter sections placed on Primary Arterials, Secondary Arterials, or Collectors shall be of the barrier type. Roll-type curb and gutter sections will be permitted for Local Roads and Streets.
4. Curbs and gutters shall be constructed according to Section 2500:
 - a. The minimum grade of any street gutter shall be not less than three-tenths percent (0.3%).
 - b. Inlet grates shall be heavy duty type recommended for bicycle traffic. Reference Section 2721.

E. Sidewalks, Pedestrian Paths, Jogging Paths, and Bicycle Paths

1. Sidewalks shall be at least six (6) inches thick at drives and at least four (4) inches thick at all other locations. Sidewalks shall be at least five (5) feet wide adjacent to Primary Arterials, Secondary Arterials, Collectors and in commercial, industrial or multi-family developments. Sidewalks shall be at least five (5) feet wide at all other locations. Sidewalks shall be concrete in accordance with Section 2500. Expansion joints shall be located every 48 feet and control joints every six (6) feet.
2. Curb ramps shall comply with Rensselaer Standard Pavement Details. Reference Figure R-11.
3. Pedestrian paths, other than sidewalks, shall be constructed to a minimum width of five (5) feet. The paths shall be constructed of asphalt, crushed stone, bark chips, paving stones, or other similar surface material.
4. Bicycle ways/jogging paths shall be constructed to a minimum width of eight (8) feet with a maximum grade of eight percent (8%). The ways/paths shall be constructed of concrete or asphalt. Concrete ways/paths shall be at least four (4) inches thick and shall include wire fabric reinforcing of a size "6 x 6 - W2 x W2". Asphalt ways/paths shall be constructed using the following as a minimum requirement:
 - a. Four (4) inches Compacted Aggregate Size No. 53, stone base

- b. Two (2) inches Bituminous Binder No. 8 or 9
 - c. One (1) inch Bituminous Surface No. 11
- 5. All ways/paths shall be placed on properly prepared and compacted subgrades. Materials shall be furnished and installed in accordance with Section 2500 and INDOT Standard Specifications.
- 6. When sidewalks or pathways cross major street intersections within or adjacent to a subdivision, necessary traffic control devices such as painted crosswalks and signs shall be installed at the subdivider's expense.
- 7. If not located within public rights-of-way, easements of at least ten (10) feet in width shall be provided for sidewalks, pedestrian paths, or bicycle paths.
- F. Easements - Whenever possible, easements for poles or underground conduits for electrical power, or telephone lines shall be provided along rear lot lines.
- G. Plans - Construction plans for improvements to be installed shall be furnished in accordance with the specifications of the Rensselaer authorized representative and/or, when appropriate, to the Jasper County Highway Department. Such plans must receive all appropriate approvals before improvements are installed. Upon completion of streets and alleys improvements, as-built plans shall be filed with the City of Rensselaer and when appropriate, to the proper governing body of Jasper County. All construction plans shall include the following:
 - 1. Horizontal geometry of each proposed street, with centerline and curb radii shown.
 - 2. The profile of each proposed street, with grades indicated, and lengths of vertical curves.
 - 3. The cross-section of each proposed street, showing the width of pavement, the location and width of sidewalks, and the location and size of utility mains.
- H. Inspection - Prior to starting any construction, arrangements shall be made for inspection of work to ensure compliance with plans and specifications approved by the City of Rensselaer or, when appropriate, the Jasper County Highway Department.
- I. All construction must be approved by the Rensselaer authorized representative, and notice of construction must be given to the Rensselaer authorized representative 48 hours prior to beginning work.

- J. Allowable Modifications - Where unusual or exceptional factors or conditions exist, the Rensselaer authorized representative may allow minor modifications of any provision of this Section. When such modifications are allowed, a detailed written statement of the reasons for such modifications shall be attached to all copies of construction plans.

PART 2 - PRODUCT

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 02502

SECTION 02504 – ADJACENT ROADWAY IMPROVEMENTS

PART 1 - GENERAL

1.1 Roadways adjacent to proposed developments shall conform to the following requirements and standards:

A. Adjacent Roadway Improvements

1. Developers shall be responsible for improvements to the existing roadway(s) that front their property. These improvements shall include, but are not limited to, the following items:
 - a. In order to construct adequate passing blisters, right-of-way shall be obtained which has a width consistent with the standard typical sections. Reference Section 2501 and Figure R-1. The developer is responsible for the purchase of the right-of-way, at fair market value. The City will offer assistance in obtaining right-of-way if the initial purchase offer is unsuccessful. A written offer to the property owner is required.
 - b. Construction of acceleration lanes, deceleration lanes, and passing blisters for each entrance or street intersection. Reference Figure R-2.
 - c. The existing two (2)-lane roadway(s) that front(s) the property shall be widened and overlaid to provide dimensions in accordance with Figure R-1.
2. Additional improvements may be required depending on field conditions and as determined by the Rensselaer authorized representative.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION 02504

SECTION 02721 - STORM SEWERS

PART 1 - GENERAL

1.1 GENERAL

- A. This section covers all work necessary for the construction of the storm sewer piping systems and related items complete, including catch basins and inlet drains, manholes, junction chambers, diversion chambers, outfall structures, and miscellaneous structures.
- B. This section shall be used only when non-watertight joints will be allowed, and hydrostatic or air testing will not be required for storm sewers unless because of suspected leakage or other problems the City Engineer deems necessary.
- C. This specification covers the following types of materials for storm sewers, culverts, underdrains, inlet drains, conduits, and miscellaneous applications:
 - 1. Reinforced Concrete Pipe and Fittings
 - 2. Polyvinyl Chloride Pipe (PVC)
 - 3. Corrugated Polyethylene Pipe
- D. Sewer pipe shall be of the size shown on the drawings and shall meet all requirements of these specifications.
- E. This specification requires project plans and construction specifications to be submitted to and approved by all appropriate regulatory agencies prior to beginning any work.

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 SUBMITTALS

Before construction and preferably before fabrication, the Contractor shall submit to the City Engineer for approval calculations on the thickness or strength class and drawings showing pipe lengths, joints, and other construction and installation

details. All pipe furnished under this Contract shall be fabricated only in accordance with the drawings and these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

The City and its Engineer may, at their option, specify a material to be used on the drawings; and the developer or Contractor shall furnish and install the pipe material or materials specified and will only offer other equal materials.

2.2 REINFORCED CONCRETE PIPE AND FITTINGS

- A. Reinforced concrete pipe and fittings shall conform to ASTM C76, latest revision, for circular pipe and ASTM C507 for elliptical pipe.
- B. Reinforced concrete pipe and fittings for normal conditions shall be reinforced in accordance with ASTM C76, Class III, Wall B (minimum). Acceptance shall be on the basis of Subsection 4. 1.1 of ASTM C76.
- C. Circumferential reinforcing in circular pipe shall be required. No elliptical reinforcing or combination of elliptical and circumferential reinforcing or part circular reinforcing shall be permitted in circular pipe.
- D. Concrete pipe shall be steam cured and shall not be shipped from point of manufacture for at least five days after having been cast.
- E. Joints shall conform to the requirements of ASTM C443. Gaskets shall be of an oil resistant type having a maximum swell of 90% when tested in accordance with ASTM D471. Lubricant for jointing shall be approved by gasket manufacturer.
 - 1. All rubber gasket similar to and equal to "Press-Seal" or "Tylox" conforming to ASTM Designation C443, latest revision. The gasket shall be attached to the spigot of the pipe and shall be the sole element depended upon to make the joint flexible and practically watertight.
 - 2. Butyl mastic joint sealant in rope or trowel applied form specifically made for permanently sealing joints in tongue and groove concrete sewer pipe. The material shall adhere tightly to the pipe surface and form a tight, flexible joint. The material shall have been in use for at least five years. Test results and material specifications shall be submitted to the City Engineer and shall have been approved prior to use on the project.

2.3 POLYVINYL CHLORIDE PIPE AND FITTINGS

Polyvinyl chloride (PVC) pipe and fittings shall comply with ASTM D 3034.

2.4 CORRUGATED POLYETHYLENE PIPE AND FITTINGS

- A. Pipe Materials: Corrugated polyethylene pipe shall comply with the requirements for materials, test methods, dimensions, and marking in accordance with AASHTO M-252 for pipe diameters 4" - 10", AASHTO M-294 for pipe diameters of 12" - 48", and AASHTO MP7 for 54" and 60".
- B. The resin material shall meet ASTM D3350 cell classification 335400C.
- C. Pipe Joints: The pipe lengths shall be connected using a gasketed, bell and spigot joint. This joint shall consist of either a factory installed, gasketed double bell polyethylene coupling, a factory welded bell or integral bell. The spigot end of the pipe shall be furnished with a factory installed elastomeric profile "O-ring" rubber gasket that meets ASTM F-477.
- D. The pipe shall be shipped with a removable wrap to protect the gasket. Provide lubrication to the joint prior to pushing together. At least two (2) corrugations of the spigot end must insert into the bell end.
- E. Certification: All HDPE pipe shall be certified through the Plastic Pipe Institute (PPI) Third Party Certification Program. All HDPE pipe delivered and installed shall bear the Third Party Administered PPI Seal.

2.5 MANHOLES AND OTHER STRUCTURES

- A. Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to requirements of ASTM Specification C478, latest revision.
- B. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:
 - 1. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C150, ACI 301, and ACI 318. Concrete for precast manhole sections shall be 3000 psi concrete. Monolithic manholes shall use 4000 psi concrete. Ready-mix concrete shall conform to ASTM C94, Alternate 2. Maximum size of aggregate shall be 3/4 inch. Slump shall be between 2 and 5 inches.

2. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
3. Reinforcing steel shall conform to ASTM A615, Grade 60 deformed bars, or ASTM A616 Grade 60 deformed bars.
4. Mortar Materials:
 - a. Sand - ASTM Designation C144, passing a No. 8 sieve.
 - b. Cement - ASTM Designation C150, Type 1.
 - c. Water - shall be potable.
5. The manufacturer shall provide openings for sewers entering and leaving the manhole. Any additional openings needed to be made in the field shall be made by drilling holes at least 1/2 inch in diameter with a maximum spacing of 3 inches.
6. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Castings shall have a total weight of not less than 355 pounds and shall conform to the design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch bolts, nuts, and washer.
7. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements.
8. Any other special manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall be constructed as detailed on the drawings.

2.6 DRAIN INLETS

Cast iron or ductile iron frames and gratings for drain inlets shall be as shown on the drawings. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blow holes, shrinkage, cold shuts, and all defects and shall conform to ASTM A48 Class No. 30-B. During construction, precautionary measures, such as adequate screening of grates, shall be maintained to deter earth and other materials from entering the drains.

PART 3 - EXECUTION

3.1 INSPECTION AND REJECTION OF PIPE

- A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the City Engineer. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.
- B. Prior to being lowered into the trench, each pipe shall be carefully inspected and those not meeting the specifications shall be rejected and at once removed from the work.
- C. The City Engineer shall have the right to cut cores from such pieces of the concrete pipe as he desires for such inspection and tests as he may wish to apply.
- D. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.
- E. The City Engineer shall also have the right to take samples of concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.
- F. Any pipe which has been damaged after delivery will be rejected and replaced solely at the Contractor's expense.

3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the City Engineer approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

3.3 NOTICE TO CITY

The City Engineer shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

3.4 LAYING PIPE

- A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and shall be removed immediately from the site of the work.
- B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.
- C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.
- D. Practically watertight work is required, and the Contractor shall construct the sewers with the type of joint specified.
- E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.
- F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the recommendations of the manufacturer on particular type of joint and the directions of the City Engineer. All joint work shall be done by experienced workmen.
- G. All pipe shall be bedded as described in this specification under Pipe Bedding. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.
- H. Each length of pipe shall be mechanically pulled "home" with a winch or come- along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place.
- I. The Contractor shall use laser beam equipment, surveying instruments, or other proven techniques to maintain accurate alignment and grade.

- J. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense.

3.5 PIPE BEDDING AND HAUNCHING

- A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.
- B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 - 1. When Angular 60 to 12 mm (1/4 to 1/2-inch) clean graded stone, slag or crushed stone material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. If Class I material is used for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe to avoid loss of side support through migration of Class H haunching material into the bedding.
 - 2. Take care with coarse sands and gravels and maximum size 20 mm (3/4- inch) material, to provide a uniformly compacted bedding. Excavate the bedding material or place it to a point above the pipe bottom, determine such point by the depth of loose material resulting in the preparation of the bedding and the amount of compaction that will be required to bring the material to grade. Use hand or mechanical tamping to compact the bedding material to a minimum 85% Standard Proctor Density.
 - 3. Slightly damp material will generally result in maximum compaction with a minimum of effort. If water is added to improve compaction or if water exists in the trench, take care to avoid saturation of Class II material, which could result in additional stability problems. Check grade of bedding after compaction.
- C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.

- D. The rigid pipe, such as concrete, or ductile iron, backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe shall be hand placed finely divided earth, free from debris and stones, or granular backfill if required.
- E. For flexible pipe, corrugated metal pipe, the placement of embedment material or haunching around the pipe must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. If crushed stone, pea gravel, or graded gravel or sand is used to backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe, it shall be hand placed. If fine sand, silt, or clayey gravels are used for initial backfilling over the pipe, the material shall be hand placed in 6 to 8-inch layers and hand compacted on both sides of the pipe to an elevation 12 inches (300 mm) over the top of the pipe. Care should be taken so not to compact directly over the pipe.
- F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
- G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation shall be made on "unit cost" projects only, and as prescribed under basis for payment.

3.6 CONCRETE CRADLE (CLASS "A" BEDDING)

Concrete cradles shall be constructed of Class "B" concrete and of the design shown on the detailed drawings.

3.7 MANHOLES AND OTHER STRUCTURES

- A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:
 - 1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:
 - a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.

- b. The joint shall consist of a flat rubber gasket attached to the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation 443, latest revision.
2. Openings in manhole sections for sewer connections shall be cut at the point of manufacture and shall be circular or horseshoe shaped with grooved or roughened surfaces to improve mortar bond. Any additional holes cut in the field shall be accomplished in a manner approved by the City Engineer.
3. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet. Manhole bases shall be cast on a minimum of 6 inches of compacted #8 crushed stone.
4. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.
5. Manhole frames and lids shall weigh not less than 355 pounds and be of good quality cast iron, conforming to ASTM Designation A48 and as shown on Detail #2 on the Standard Detail Sheet. Unless specifically designated otherwise, manhole castings shall be the non-locking type. All manhole frames shall be cast or drilled with three holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch bolts, nuts, and washers. The joint between the casting frame and cone section shall be fully mortared or gasketed and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.
6. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. Steps shall be placed as shown on the drawings.

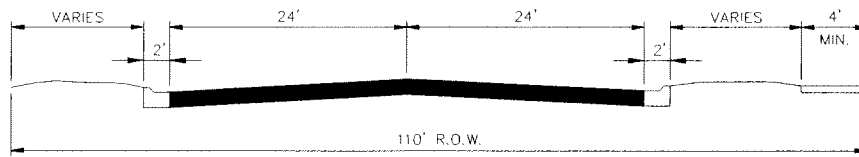
3.8 FINAL SEWER CLEANING

- A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by the City Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon the City Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

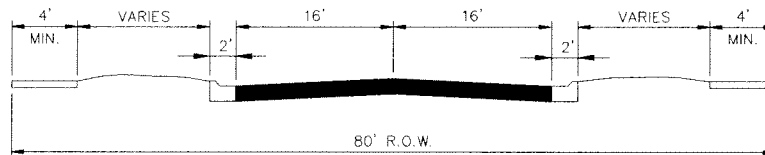
3.9 CLOSED CIRCUIT TELEVISION INSPECTION

- A. All sections of sewer shall be inspected by closed circuit television.
- B. All unacceptable conditions found during television inspection must be corrected by the Contractor and re-televised.
- C. Unacceptable conditions are conditions that adversely affect the ability of the system to function as designed or to be properly maintained and may include, but are not limited to, the following:
 - 1. Protruding taps
 - 2. Cracked or faulty pipe
 - 3. Misaligned or deformed pipe
 - 4. Debris in line
 - 5. Infiltration / exfiltration
 - 6. Excessive gaps at joints
 - 7. Bellies or sags with a depth greater than or equal to 10% (or a maximum of 3 inches) of pipe diameter and/or a length greater than 25 feet.
- D. See specification section 02750 Sewer Televising for procedures.

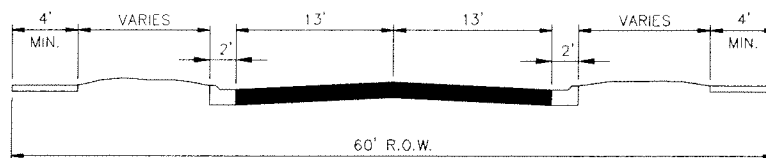
END OF SECTION 02721



PRINCIPAL OR MINOR ARTERIAL (2 LANE)



COLLECTOR (NO PARKING)



LOCAL (NO PARKING)

MINIMUM PAVEMENT CROSS SECTIONS

HNTB



CITY OF
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RENSELAER, INDIANA

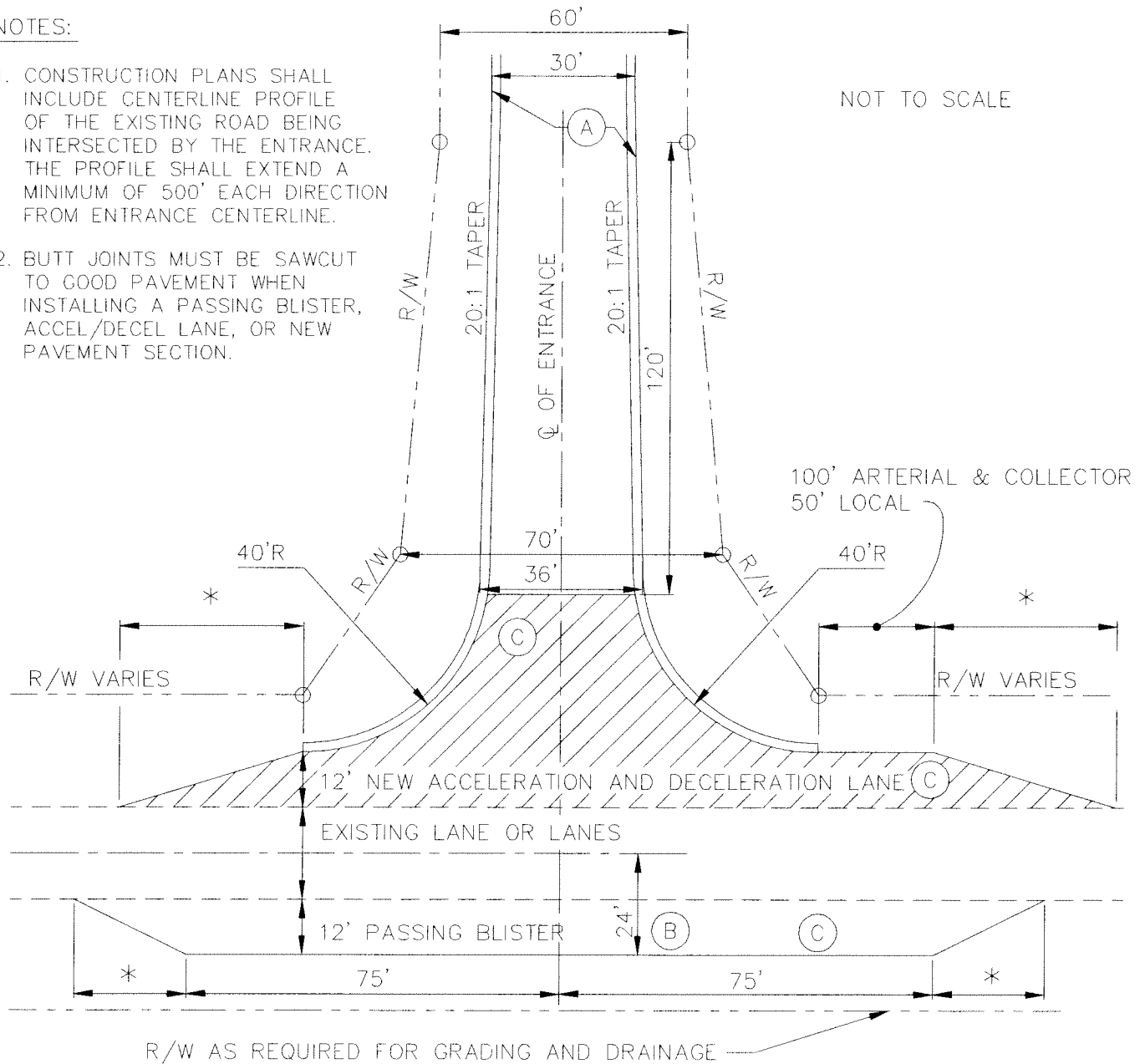
AUGUST, 2007

FIGURE R-1

NOTES:

1. CONSTRUCTION PLANS SHALL INCLUDE CENTERLINE PROFILE OF THE EXISTING ROAD BEING INTERSECTED BY THE ENTRANCE. THE PROFILE SHALL EXTEND A MINIMUM OF 500' EACH DIRECTION FROM ENTRANCE CENTERLINE.
2. BUTT JOINTS MUST BE SAWCUT TO GOOD PAVEMENT WHEN INSTALLING A PASSING BLISTER, ACCEL/DECEL LANE, OR NEW PAVEMENT SECTION.

NOT TO SCALE



(A) 2' CURB & GUTTER

(B) PASSING BLISTER WHEN REQUIRED

(C) LANE WIDENING SHALL MATCH EXIST. PAVEMENT SURFACE TYPE

* 150' ARTERIAL
100' COLLECTOR
75' LOCAL

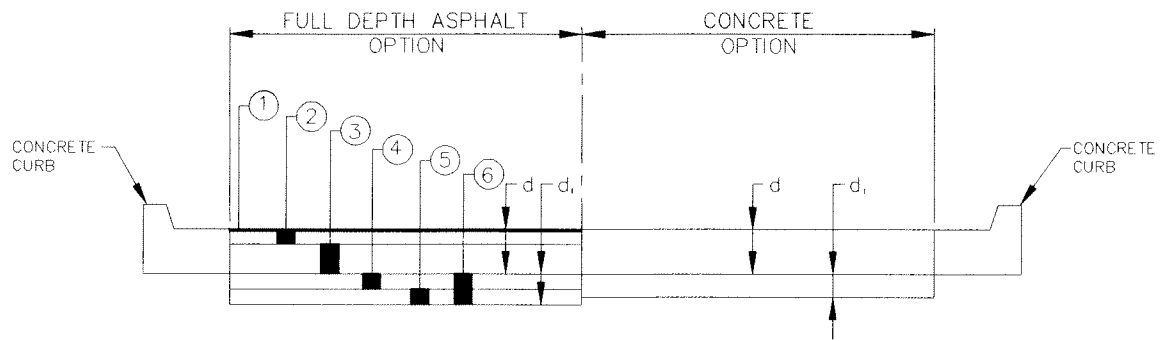
MINIMUM STANDARDS FOR DRIVE OR STREET ENTRANCES
(NOT FOR INDIVIDUAL SINGLE-FAMILY RESIDENCES)

HNTB



AUGUST, 2007

FIGURE R-2



LOCAL STREETS

	ASPHALT (d=8 1/2")	ASPHALT ALTERNATIVE 1 (d+d ₁ =6"+8"=14")	ASPHALT ALTERNATIVE 2 (d+d ₁ =6"+12"=14")	CONCRETE ALTERNATIVE
1	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	d=5 1/2" CONCRETE ON...
2	2 1/2" BINDER #9	2" BINDER #9	2" BINDER #9	d ₁ =4" COMP. AGGR. (SIZE 53)
3	5" BASE #5D	3" BASE #5D	3" BASE #5D	
4	N.A.	N.A.	N.A.	
5	N.A.	N.A.	N.A.	
6	N.A.	6" #2 STONE ON 6" #53 STONE	12" LIME TREATED • SUBBASE	

* LIME MODIFICATION SHALL BE BETWEEN 3% AND 6% BY WEIGHT WITH THE SOIL TEMPERATURE 45° OR ABOVE MEASURED 4"(100mm) BELOW THE SUBGRADE SURFACE WITH THE AIR TEMPERATURE RISING, ALL IN ACCORDANCE WITH THE LATEST AMENDED VERSION OF THE INDIANA DEPARTMENT OF TRANSPORTATION'S SPECIAL PROVISION FOR LIME MODIFICATION.

NOTE: * ADD 1" TO ALL TOTAL BITUMINOUS AND CONCRETE THICKNESSES IF ANTICIPATED TRUCK TRAFFIC IS GREATER THAN 10%.
* DEPTH OF CONCRETE GUTTER SHALL EQUAL DEPTH OF CONCRETE PAVEMENT.

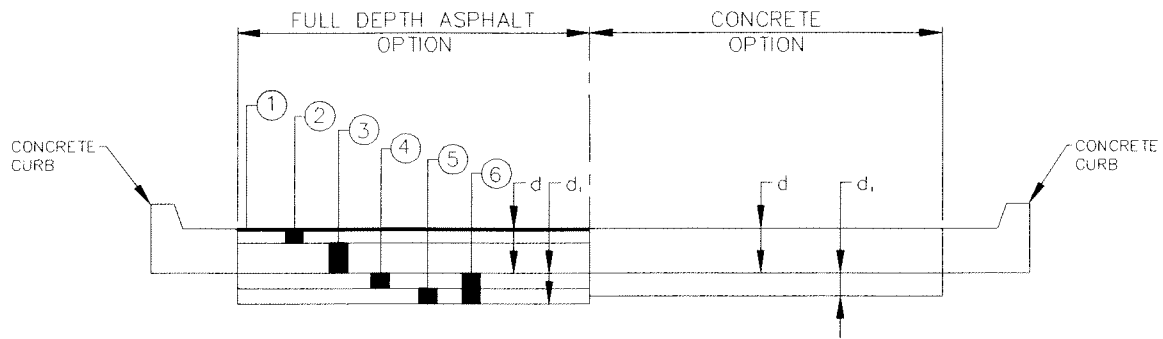
TYPICAL PAVEMENT SECTIONS

HNTB



AUGUST, 2007

FIGURE R-3.1



COLLECTOR STREETS

	ASPHALT ($d=10\ 1/2"$)	ASPHALT ALTERNATIVE 1 ($d+d_i=7"+8"=15"$)	ASPHALT ALTERNATIVE 2 ($d+d_i=7"+12"=19"$)	CONCRETE	CONCRETE ALTERNATIVE
1	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	$d=8"$ CONCRETE	N.A.
2	2 1/2" BINDER #9	2" BINDER #9	2" BINDER #9		N.A.
3	7" BASE #5D	4" BASE #5D	4" BASE #5D		
4	N.A.	N.A.	N.A.		
5	N.A.	N.A.	N.A.		
6	N.A.	6" #2 STONE ON 6" #53 STONE	12" LIME TREATED SUBBASE		

* LIME MODIFICATION SHALL BE BETWEEN 3% AND 6% BY WEIGHT WITH THE SOIL TEMPERATURE 45° OR ABOVE MEASURED 4"(100mm) BELOW THE SUBGRADE SURFACE WITH THE AIR TEMPERATURE RISING, ALL IN ACCORDANCE WITH THE LATEST AMENDED VERSION OF THE INDIANA DEPARTMENT OF TRANSPORTATION'S SPECIAL PROVISION FOR LIME MODIFICATION.

NOTE: * ADD 1" TO ALL TOTAL BITUMINOUS AND CONCRETE THICKNESSES IF ANTICIPATED TRUCK TRAFFIC IS GREATER THAN 10%.
* DEPTH OF CONCRETE GUTTER SHALL EQUAL DEPTH OF CONCRETE PAVEMENT.

TYPICAL PAVEMENT SECTIONS

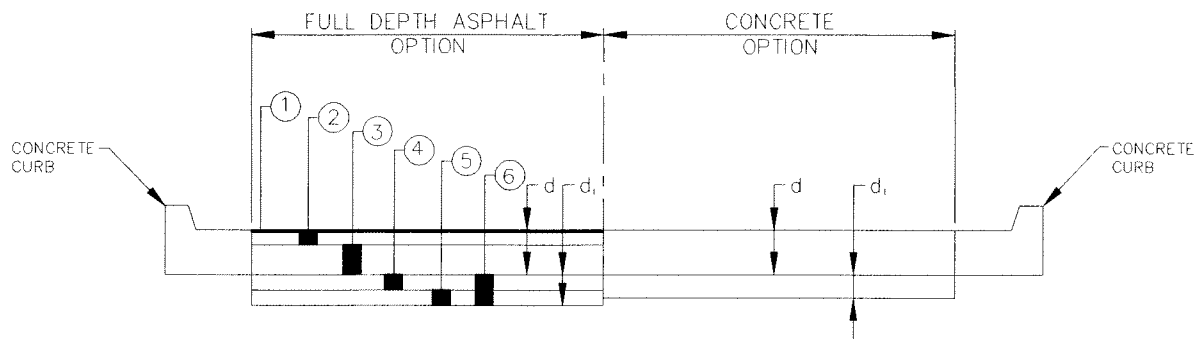
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RENSELAER, INDIANA

AUGUST, 2007

FIGURE R-3.2



INDUSTRIAL AND ARTERIAL

	ASPHALT (d=12 1/2")	ASPHALT ALTERNATIVE 1 (d+d ₁ = 9"+9"=18")	ASPHALT ALTERNATIVE 2 (d+d ₁ = 9"+12"=21")	CONCRETE	CONCRETE ALTERNATIVE
1	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	1" SURFACE #11 OR #12	d=8" CONCRETE	N.A.
2	2 1/2" BINDER #9	2" BINDER #9	2" BINDER #9		
3	9" BASE #5D	6" BASE #5D	6" BASE #5D		
4	N.A.	N.A.	N.A.		
5	N.A.	N.A.	N.A.		
6	N.A.	9" COMP. AGGR. (SIZE No. 53)	12" LIME TREATED • SUBBASE		

* LIME MODIFICATION SHALL BE BETWEEN 3% AND 6% BY WEIGHT WITH THE SOIL TEMPERATURE 45° OR ABOVE MEASURED 4"(100mm) BELOW THE SUBGRADE SURFACE WITH THE AIR TEMPERATURE RISING, ALL IN ACCORDANCE WITH THE LATEST AMENDED VERSION OF THE INDIANA DEPARTMENT OF TRANSPORTATION'S SPECIAL PROVISION FOR LIME MODIFICATION.

NOTE: * ADD 1" TO ALL TOTAL BITUMINOUS AND CONCRETE THICKNESSES IF ANTICIPATED TRUCK TRAFFIC IS GREATER THAN 10%.
* DEPTH OF CONCRETE GUTTER SHALL EQUAL DEPTH OF CONCRETE PAVEMENT.

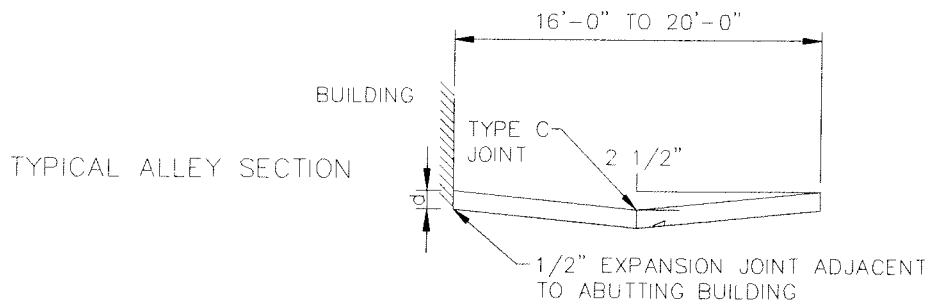
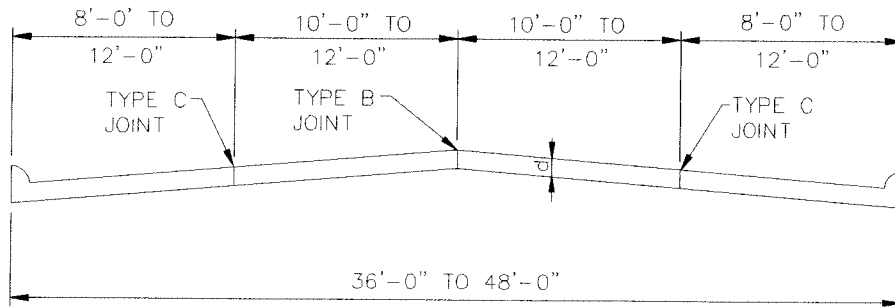
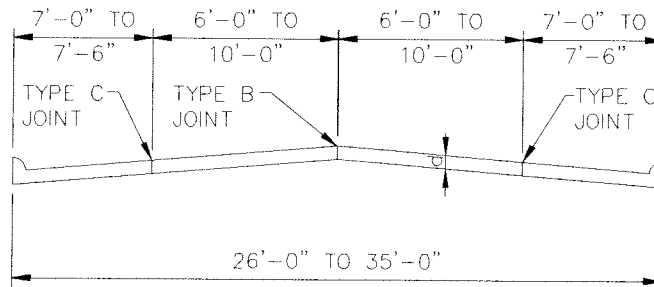
TYPICAL PAVEMENT SECTIONS

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FIGURE R-3.3



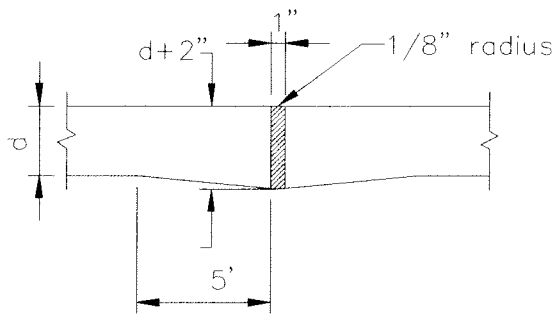
PAVEMENT CROSS SECTIONS—JOINT LOCATIONS

HNTB

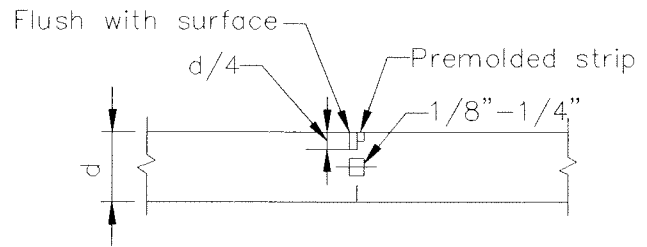


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FIGURE R-4

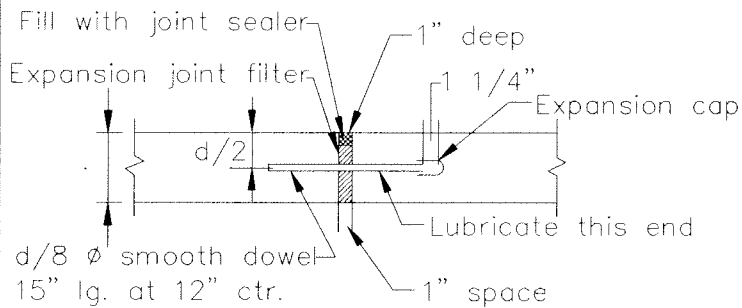


TYPE A
EXPANSION JOINT

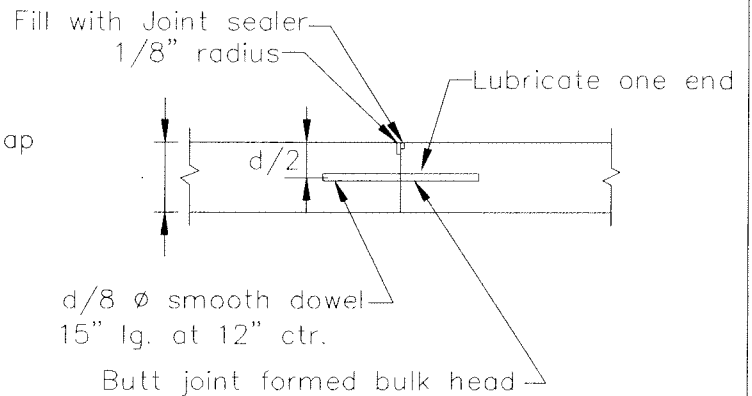


TYPE C

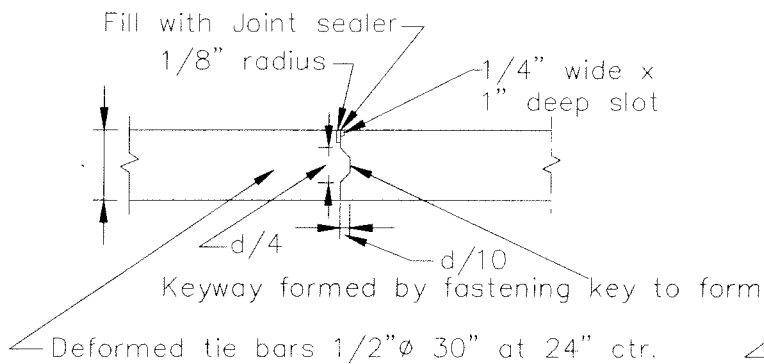
SAWED OR PREMOLDED STRIP
Longitudinal or Transverse



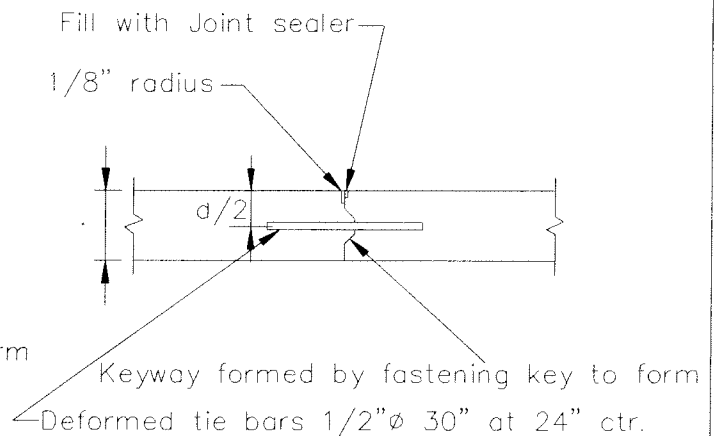
TYPE A-ALTERNATE
EXPANSION JOINT



TYPE D
TRANSVERSE CONSTRUCTION JOINT



TYPE B
LONGITUDINAL CONSTRUCTION JOINT



TYPE E
TIED TRANSVERSE CONSTRUCTION JOINT

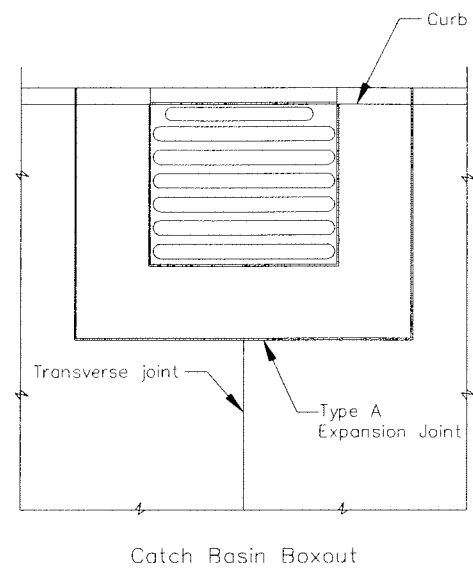
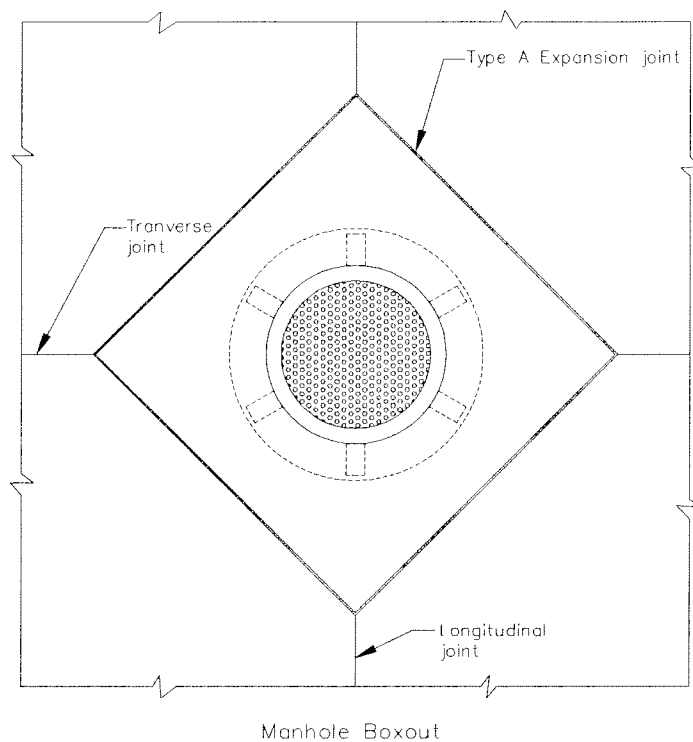
JOINT DETAILS

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FIGURE R-5



1. All catch basins shall be separated from the pavement and curb by boxing out around basin as shown above. Expansion joint material shall extend completely through curb and slab. Manhole castings within the pavement limits shall be boxed in like manner except when telescoping-type castings are used.
2. When a joint falls within 5 ft. of or contacts basins, manholes, or other structures, shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.

STRUCTURE DETAILS

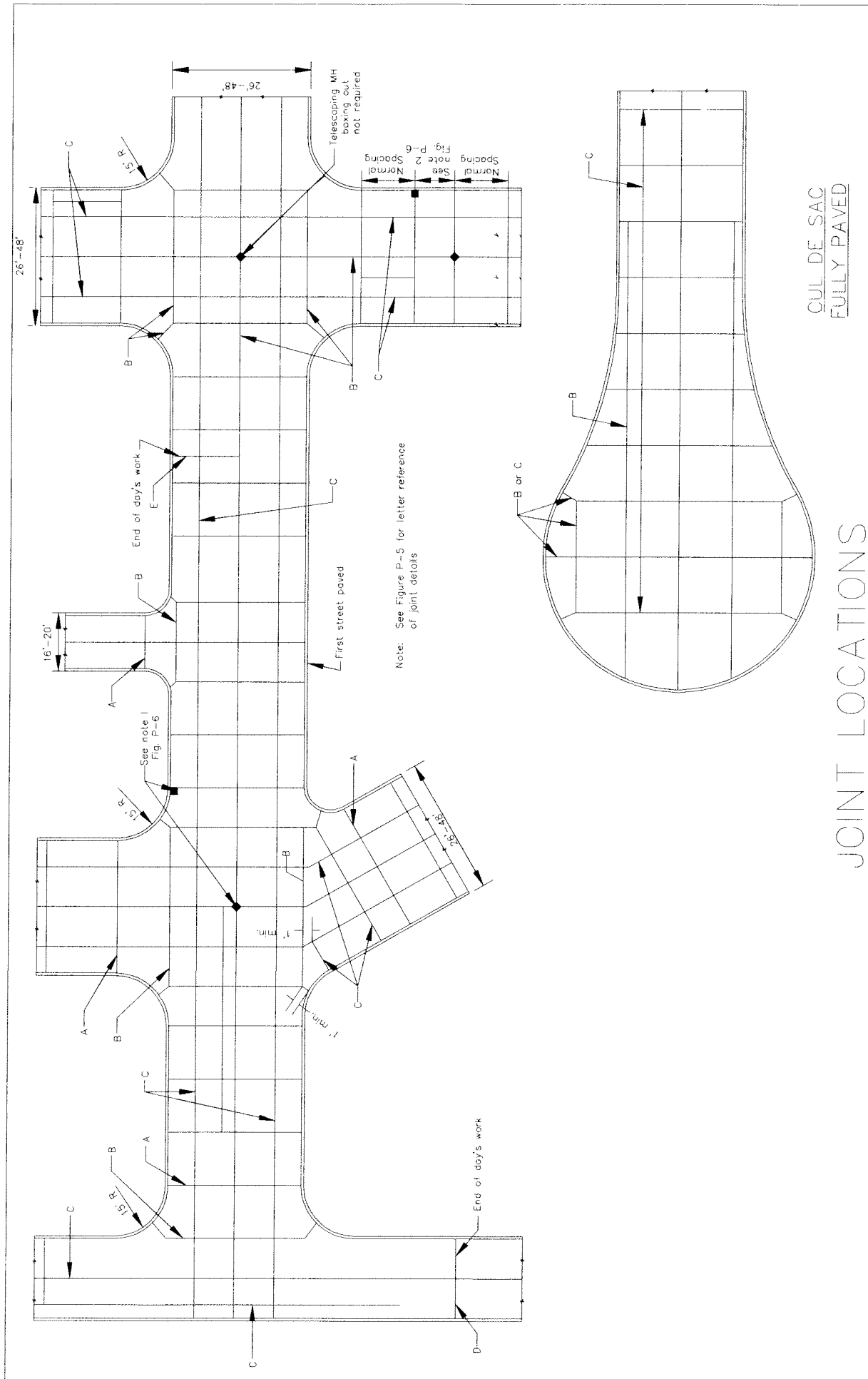
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FIGURE R-6

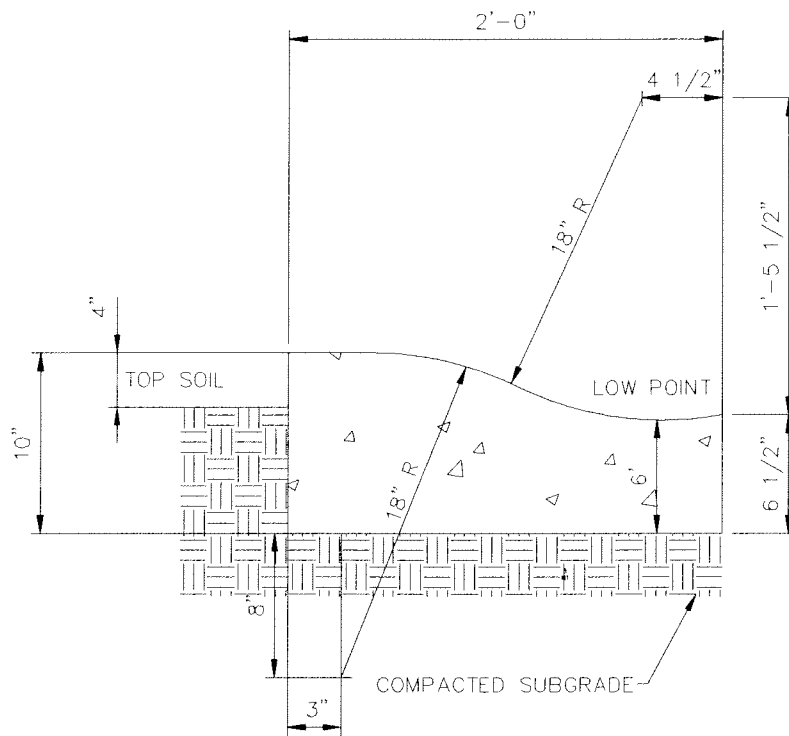




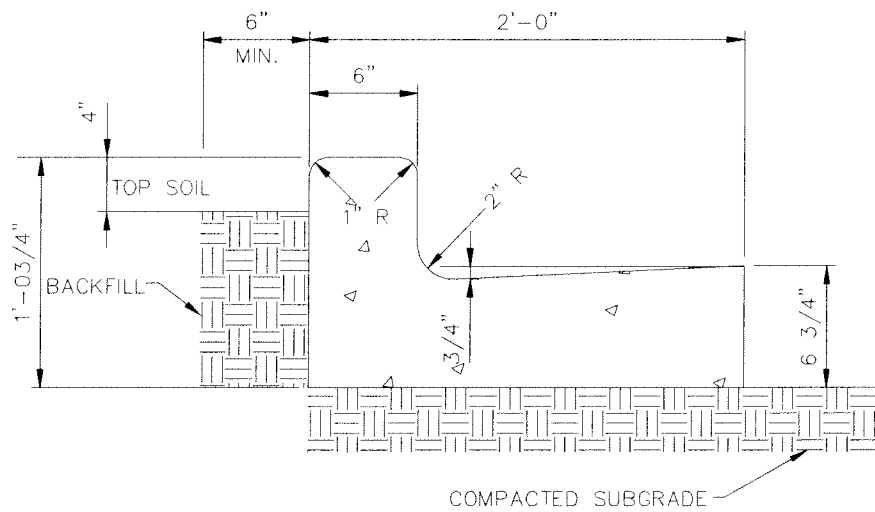


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FIGURE R-7



TYPE I



CONCRETE CURB & GUTTER TYPE I & II

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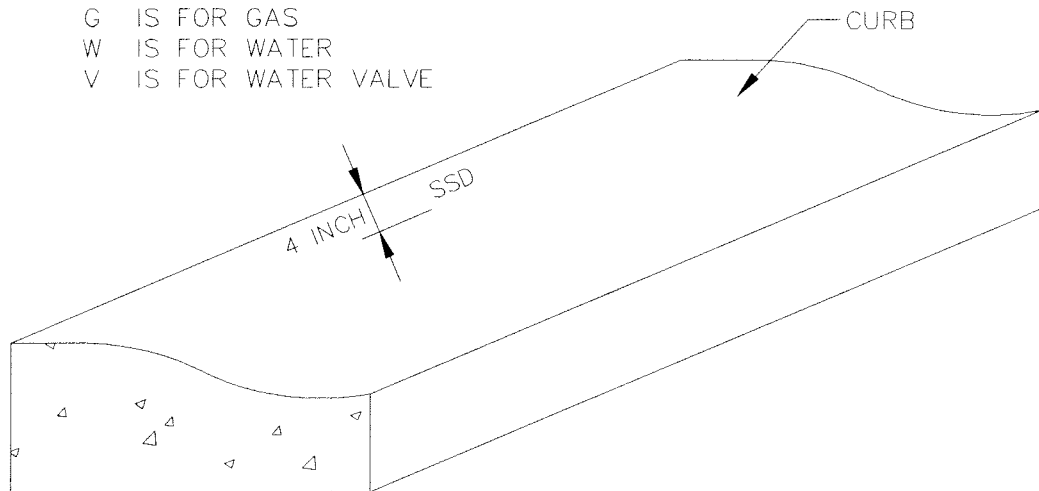


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FIGURE R-8

3" TO 4" HIGH LETTER TO BE STAMPED AS FOLLOWS:

S IS FOR STORM SEWER
SS IS FOR SANITARY SEWER
MH IS FOR SANITARY MANHOLE
SSD IS FOR SUBSURFACE OR BASE DRAIN
C IS FOR CONDUIT
G IS FOR GAS
W IS FOR WATER
V IS FOR WATER VALVE



NOTES:

1. CURB TO BE STAMPED AT ALL LOCATIONS WHERE ANY OF THE ABOVE CROSS UNDER OR PERPENDICULAR TO THE CURB.
2. LETTER TO BE STAMPED PRIOR TO CONCRETE SETTING UP, WHENEVER POSSIBLE.
3. STAMP TO BE A MINIMUM OF 1/2 INCH DEEP.

CURB STAMP

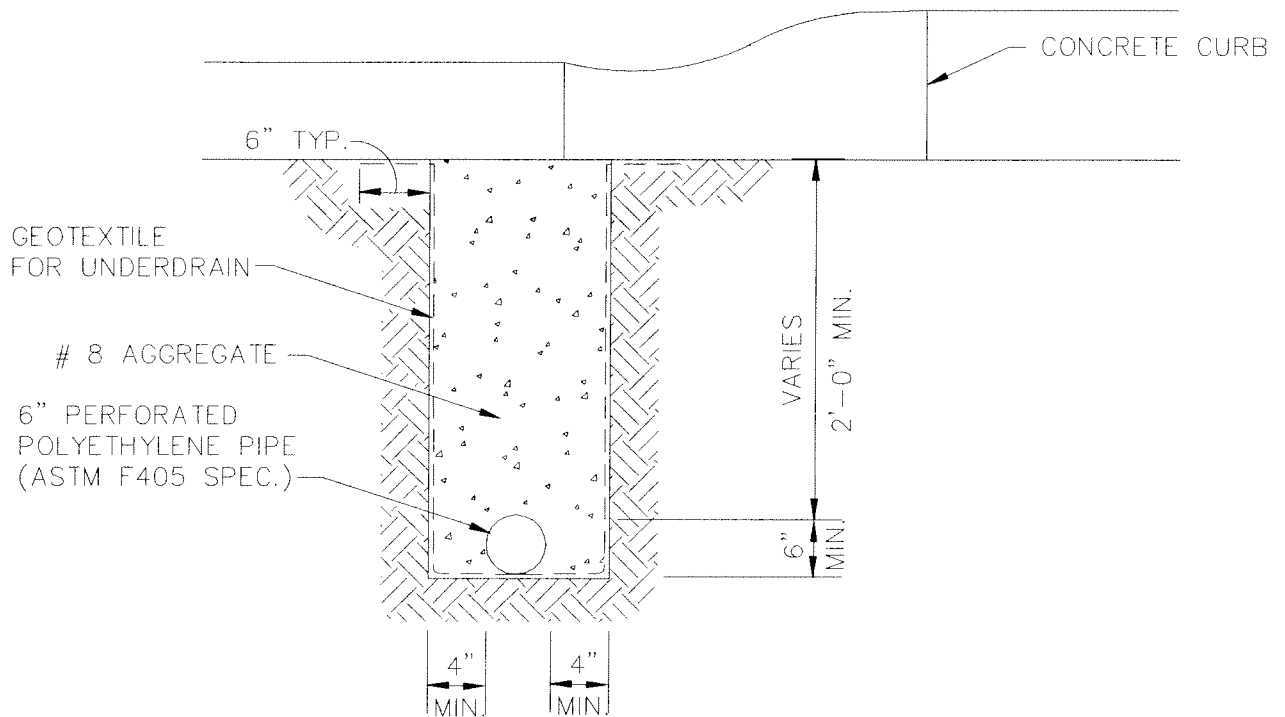
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FIGURE R-8a



NOTE: MATERIALS AND INSTALLATION SHALL MEET THE INDOT STANDARDS AS SPECIFIED IN SECTION 718 "UNDERDRAINS"

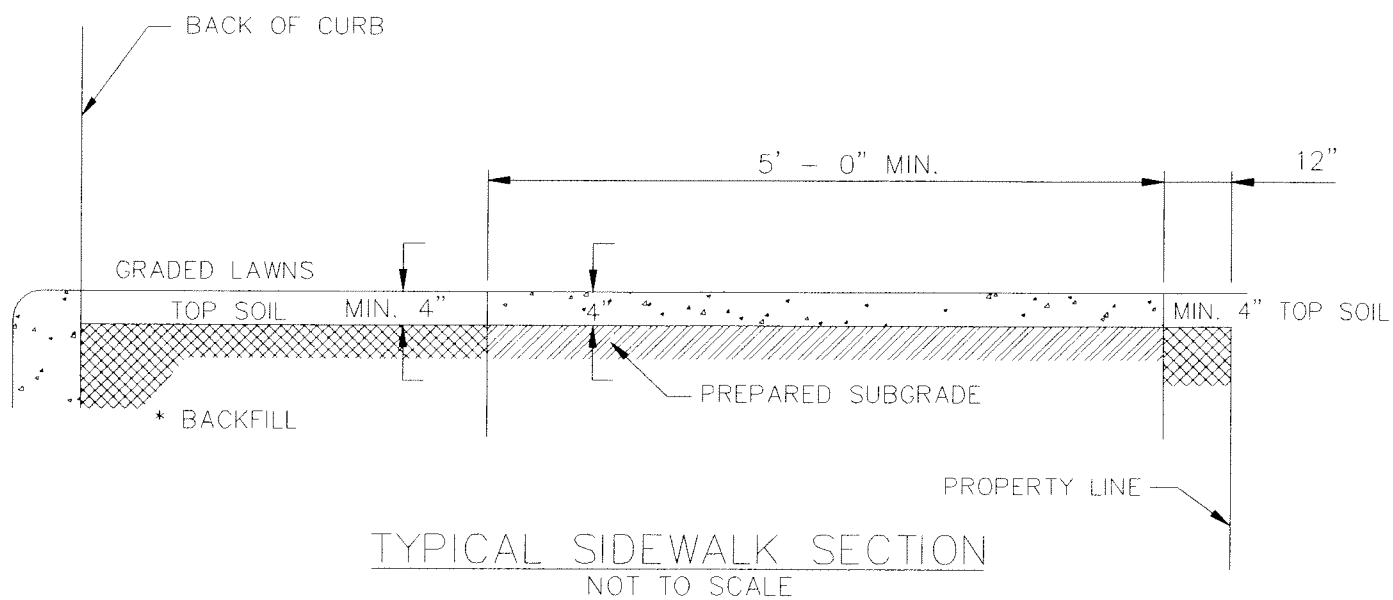
PIPE UNDERDRAIN DETAIL

HNTB



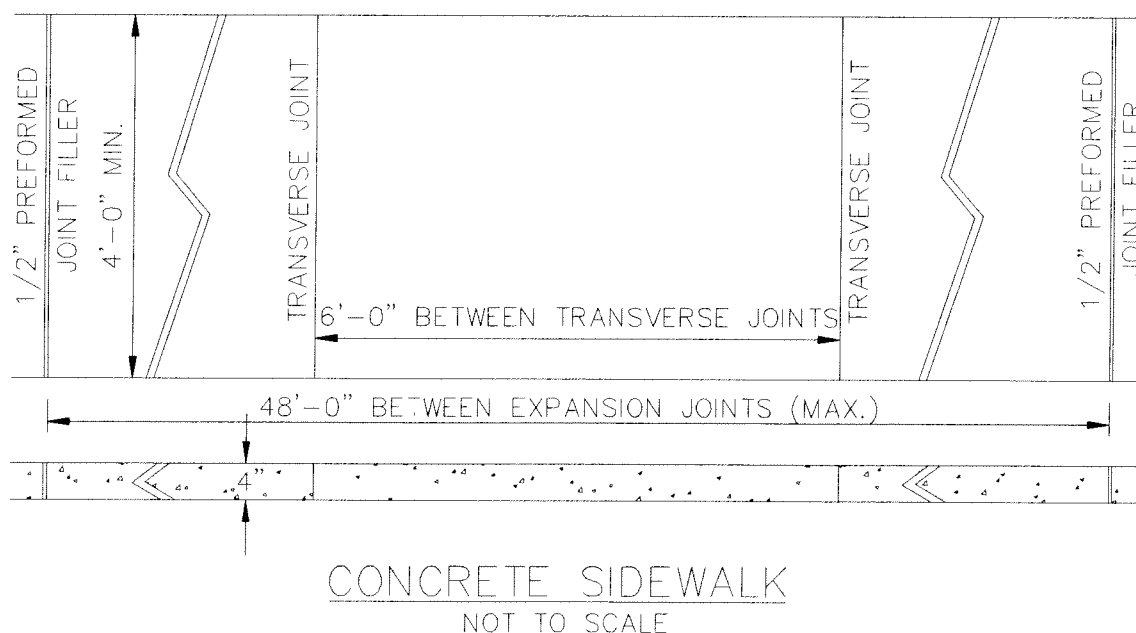
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FIGURE R-9



* THE SPACE BEHIND THE CURB SHALL BE FILLED WITH SUITABLE MATERIAL TO THE REQUIRED ELEVATION AND COMPACTED IN LAYERS NOT TO EXCEED 6" IN DEPTH.

SUBGRADE UNDER ALL CURBS, SIDEWALKS, AND DRIVES SHALL BE COMPACTED IN ACCORDANCE WITH I.N.D.O.T. SPECIFICATIONS.



SIDEWALK DETAILS

HNTB

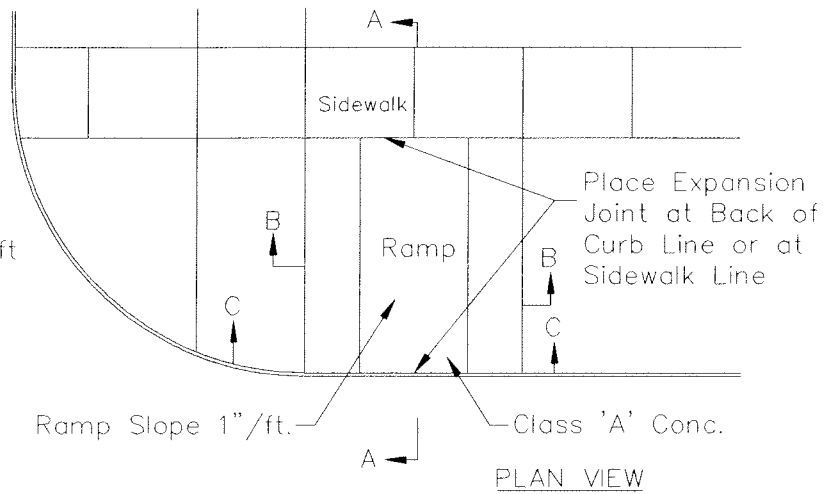


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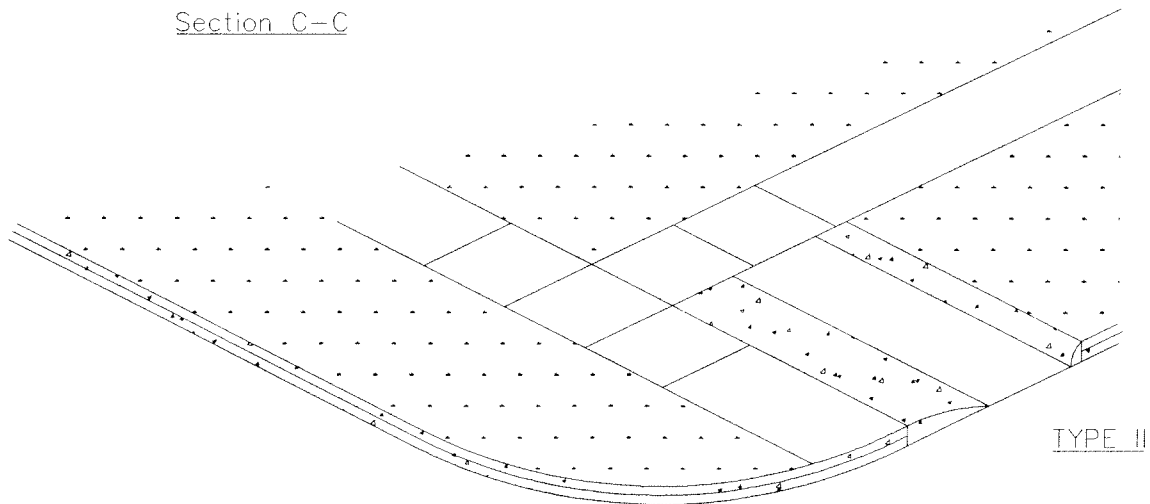
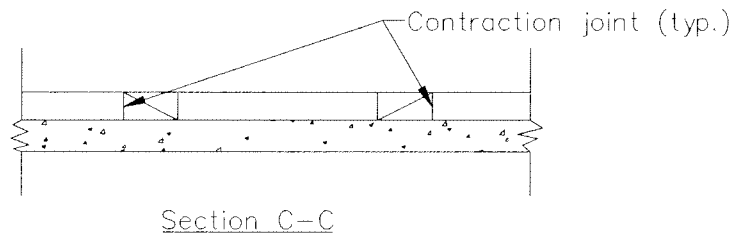
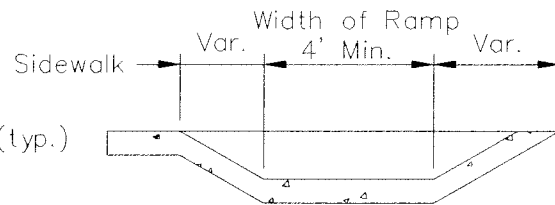
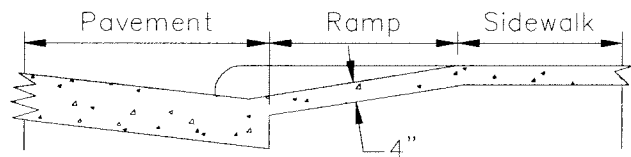
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FIGURE R-10

Side Slope Varies uniformly to a maximum of 4"/ft of Gutter Line



NOTE: DIMENSIONS SHOWN SHALL BE USED AND THE LATEST INDOT UPDATE



SIDEWALK RAMP FOR HANDICAPPED

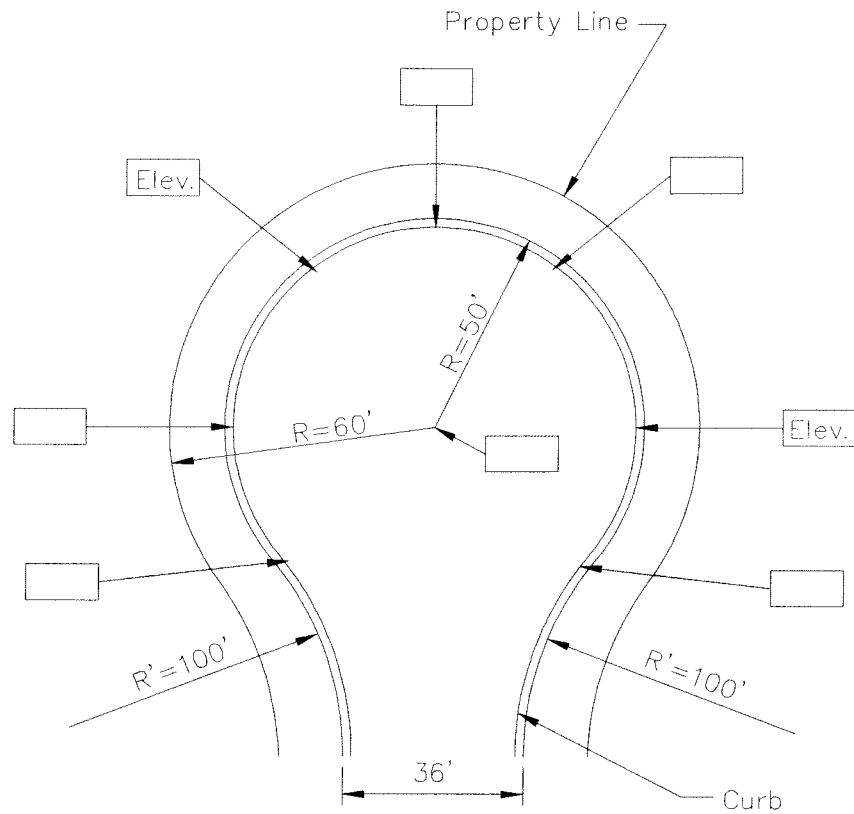
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FIGURE R-11



GENERAL NOTES:

1. Warning signs shall be posted at entrance to street, indicating no outlet.
2. Detail shall be identified by street name.
3. Elevations provided shall be proposed flow line of gutter.
4. One detail shall be provided for each cul-de-sac.
5. Scale shall be $1"=40'$ or larger.
6. Type 1 (Rolled Curbs) shall be used.

SUBDIVISION CUL-DE-SAC

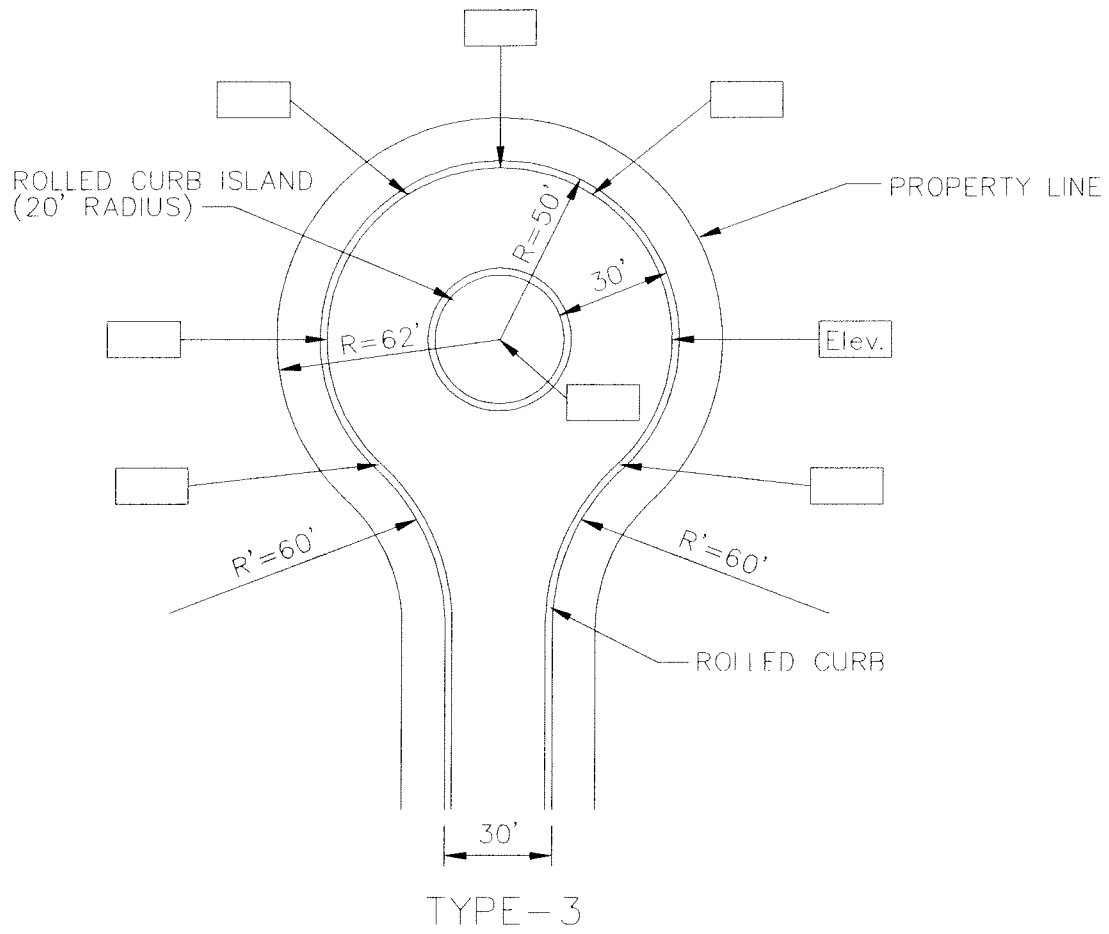
HNTB



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FIGURE R-12



GENERAL NOTES:

1. WARNING SIGNS SHALL BE POSTED AT ENTRANCE TO STREET, INDICATING NO OUTLET.
2. DETAIL SHALL BE IDENTIFIED BY STREET NAME.
3. ELEVATIONS PROVIDED SHALL BE PROPOSED FLOW LINE OF GUTTER.
4. ONE DETAIL SHALL BE PROVIDED FOR EACH CUL-DE-SAC.
5. SCALE SHALL BE 1"=40' OR LARGER.
6. TYPE 1 (ROLLED CURBS) SHALL BE USED.
7. STREET WIDTH AND RADIUS LENGTHS ARE MEASURED TO BACK OF CURB.

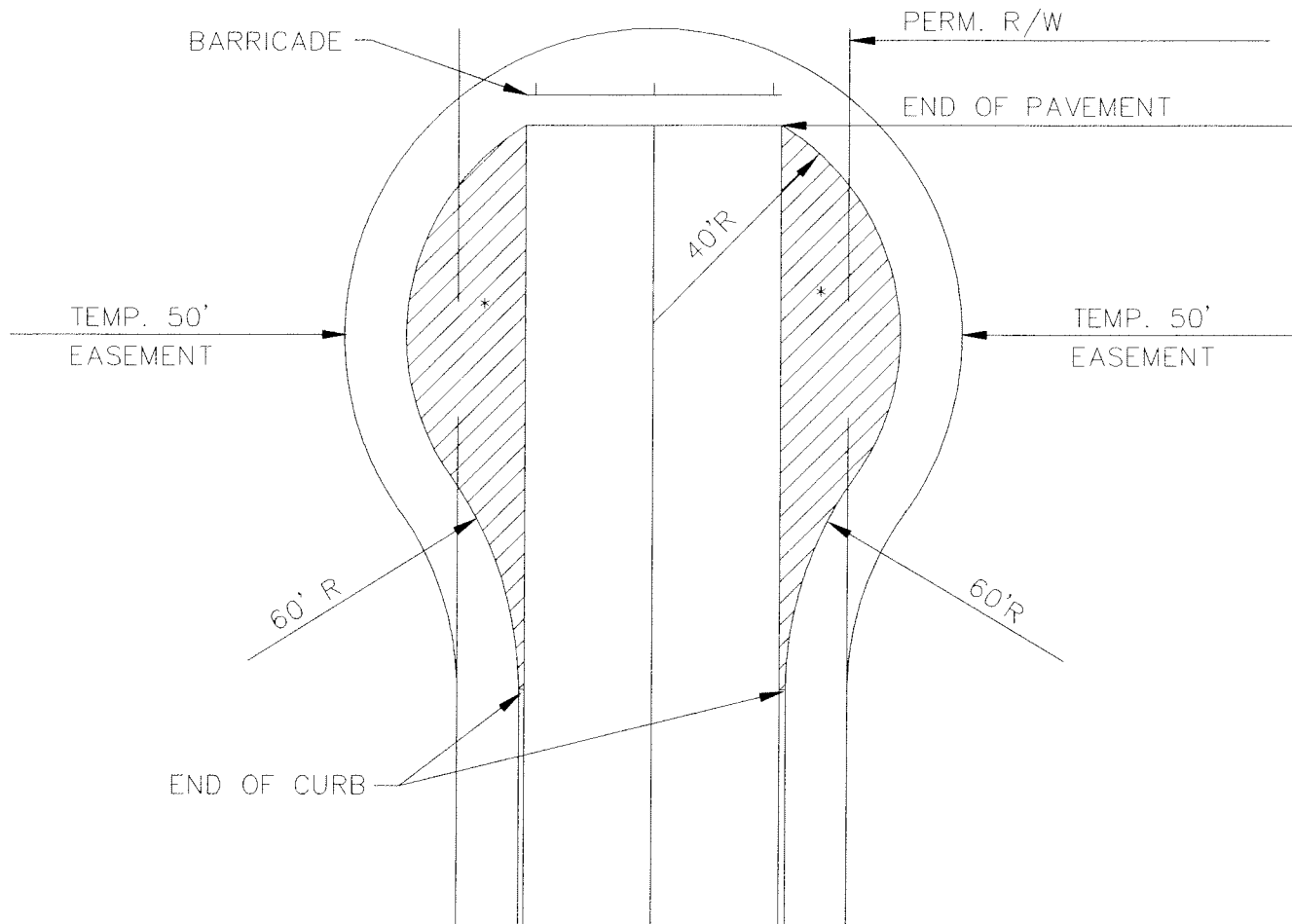
SUBDIVISION CUL-DE-SAC WITH ISLAND

HNTB

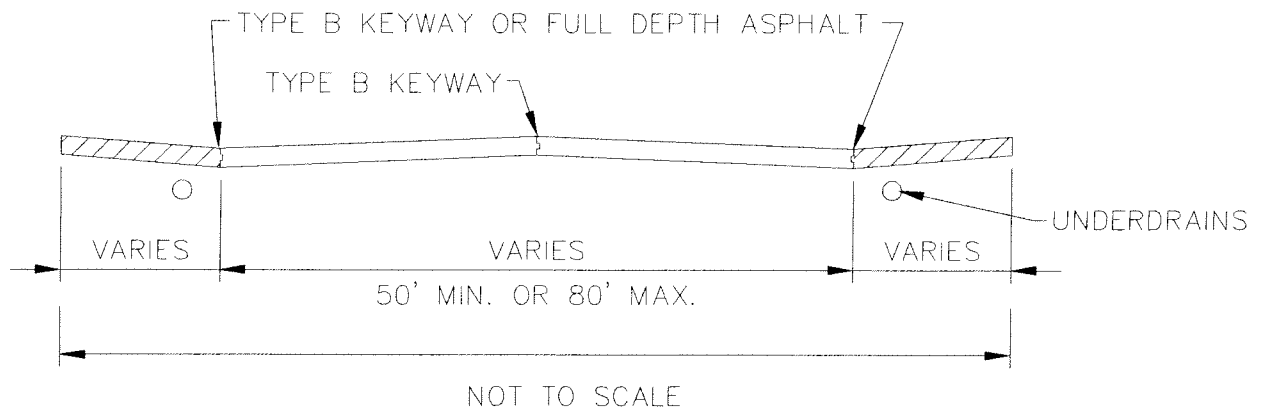


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FIGURE R-12a



* TO BE REMOVED WHEN THE STREET IS CONTINUED.
THICKNESS AND TYPE TO MATCH PERMANENT PAVEMENT.



SUBDIVISION TEMPORARY CUL-DE-SAC

HNTB

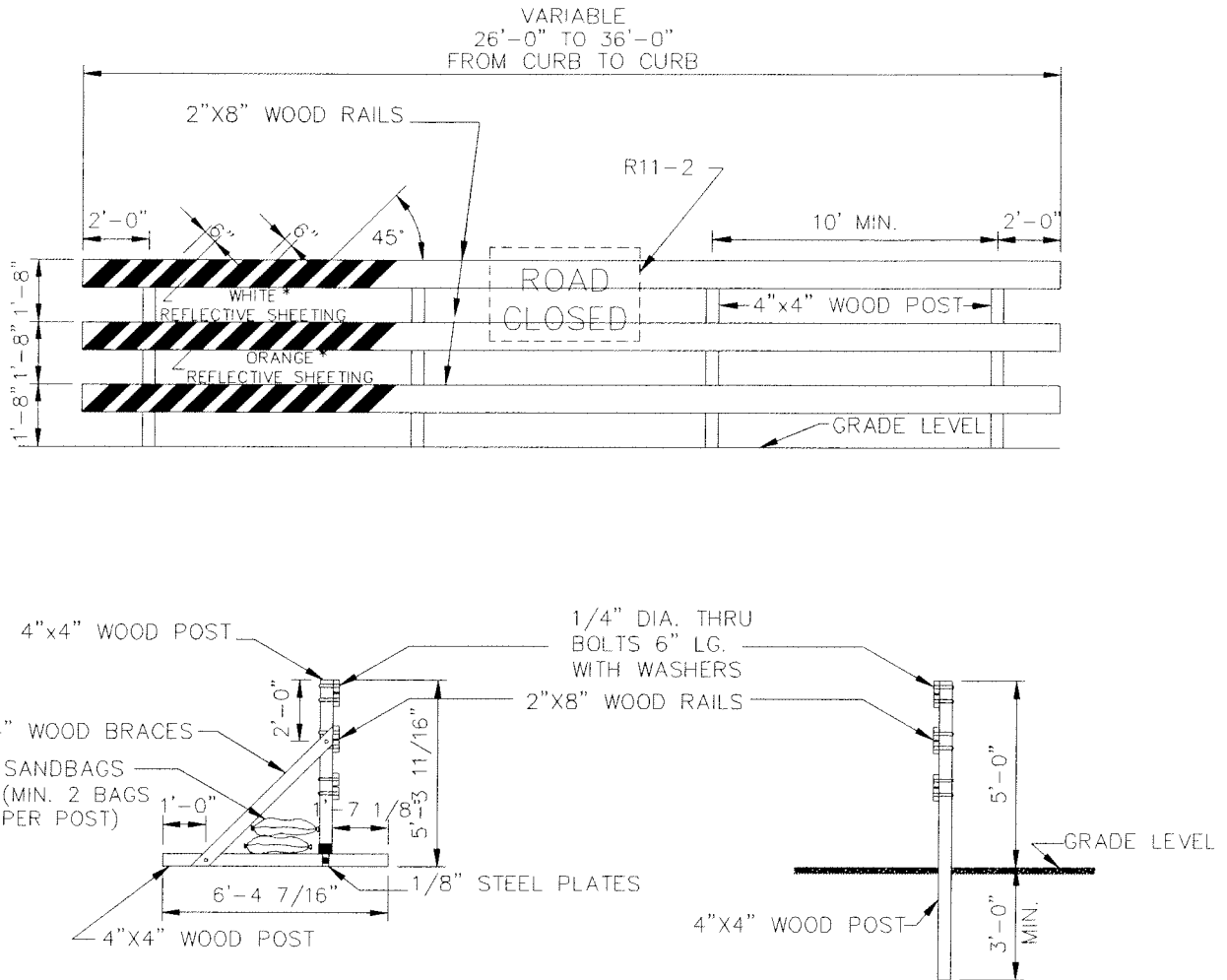


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FIGURE R-13

RESIDENTIAL STREETS ONLY



- ① ALL WOOD POST AND SUPPORT MEMBERS SHALL BE PAINTED WITH TWO (2) COATS OF WHITE PAINT.
- ② LOCATION OF BARRICADE AS PER PLANS.
- ③ *REFLECTIVE SHEETING TO BE IN ACCORDANCE WITH I.N.D.O.T. STANDARD SPECIFICATIONS.
- ④ REFER TO SECTION 801 OF THE INDIANA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS AND LATEST ADDITION OF INDIANA MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
- ⑤ WHEN THE PROPOSED EXTENSION OF THE STREET IS TO BE a) LESS THAN TWO (2) YEARS USE THE SANDBAGS ON POSTS b) GREATER THAN TWO (2) YEARS USE THE GROUND POSTS.

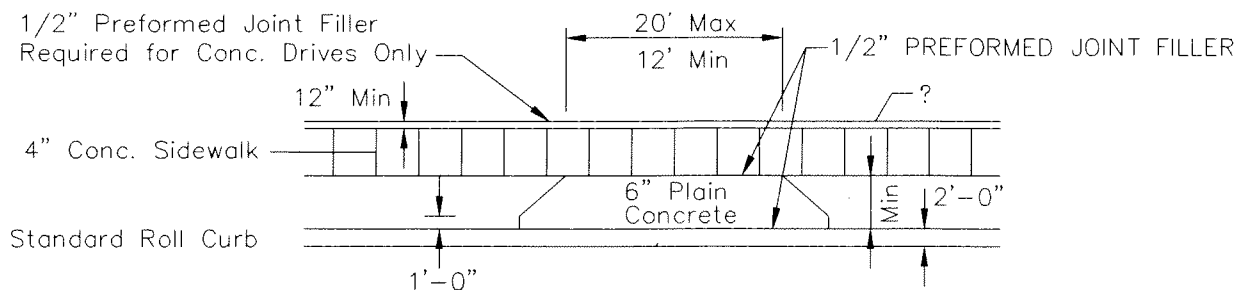
STANDARD BARRICADE

HNTB

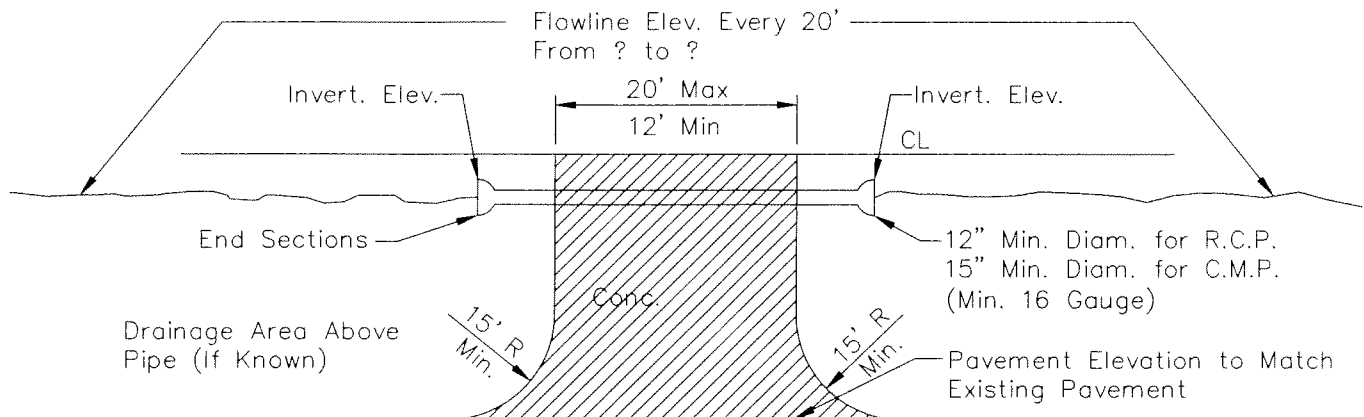


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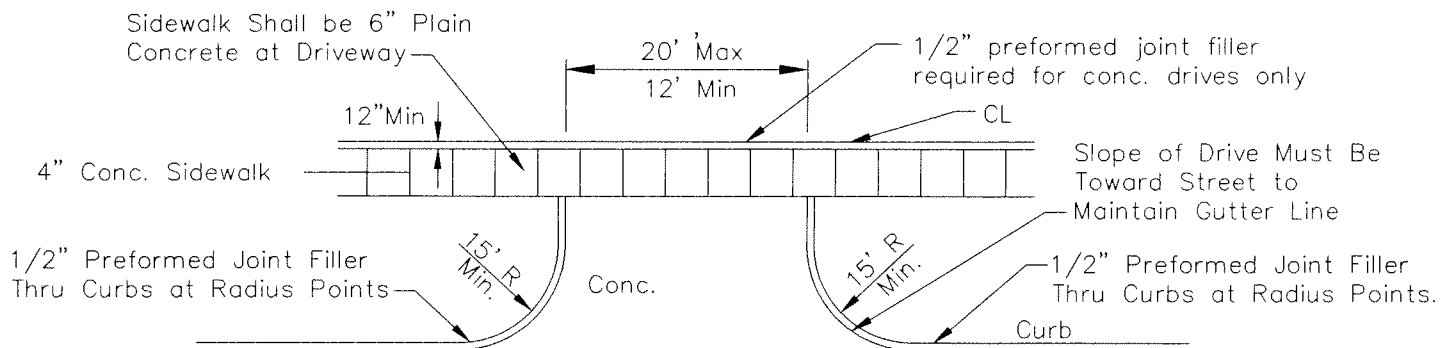
FIGURE R-14



PRIVATE DRIVE WITH ROLLED
CURB AND GUTTER WITH SIDEWALK



PRIVATE DRIVE WITH OPEN DITCHES



GENERAL NOTES

1. Cross-hatched areas shall be either 6" plain concrete or 1" bituminous surface on 2" bituminous base on 4" No. 53 compacted aggregate base extending to the sidewalk or R/W Line whichever is nearest to the roadway.
2. Metal or Concrete end section shall be constructed on all pipes.
3. Subgrade under all curbs, sidewalks and drives shall be compacted in accordance with I.N.D.O.T.
4. Sidewalks shall be constructed in accordance with the appropriate standard and shall be continuous across the driveway.
5. Butt joints must be sawcut to good pavement when installing a passing blister, accel/decel lane, or new pavement section.

RESIDENTIAL DRIVEWAYS

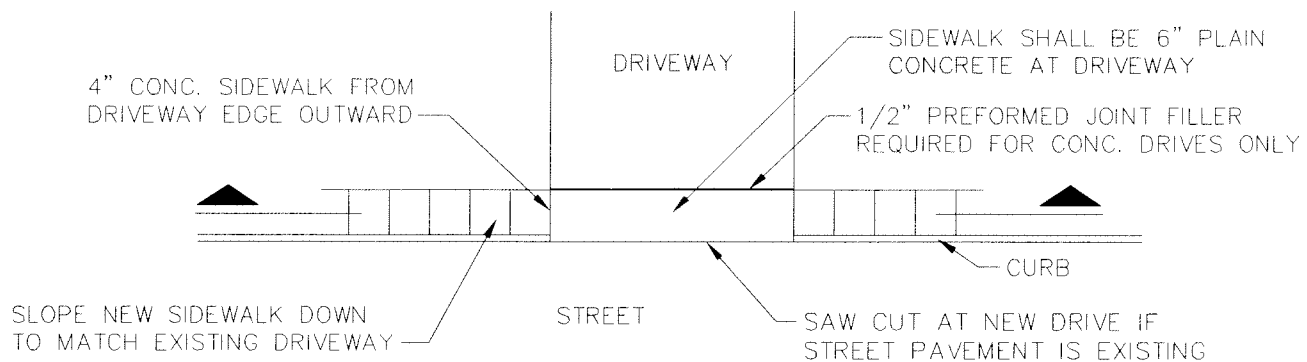
HNTB



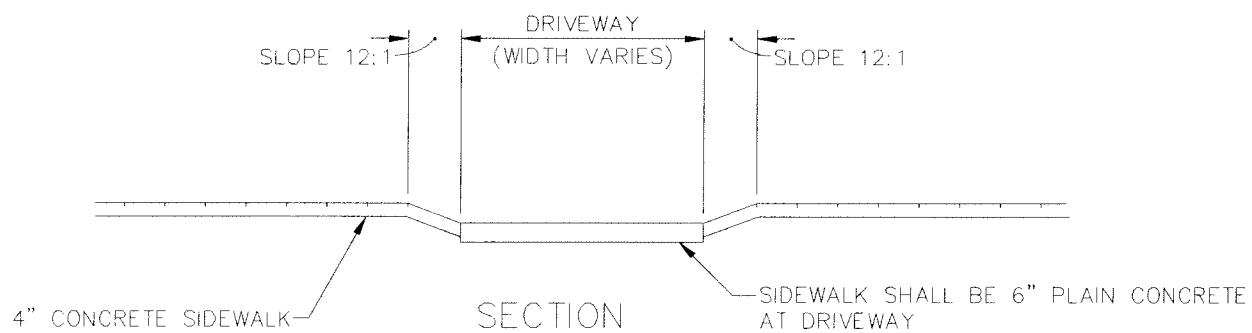
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FIGURE R-1F



PLAN VIEW



GENERAL NOTES

1. Butt joints must be sawcut to good pavement when installing a passing blister, accel/decel lane, or new pavement section.

RESIDENTIAL SIDEWALK AT DRIVEWAYS

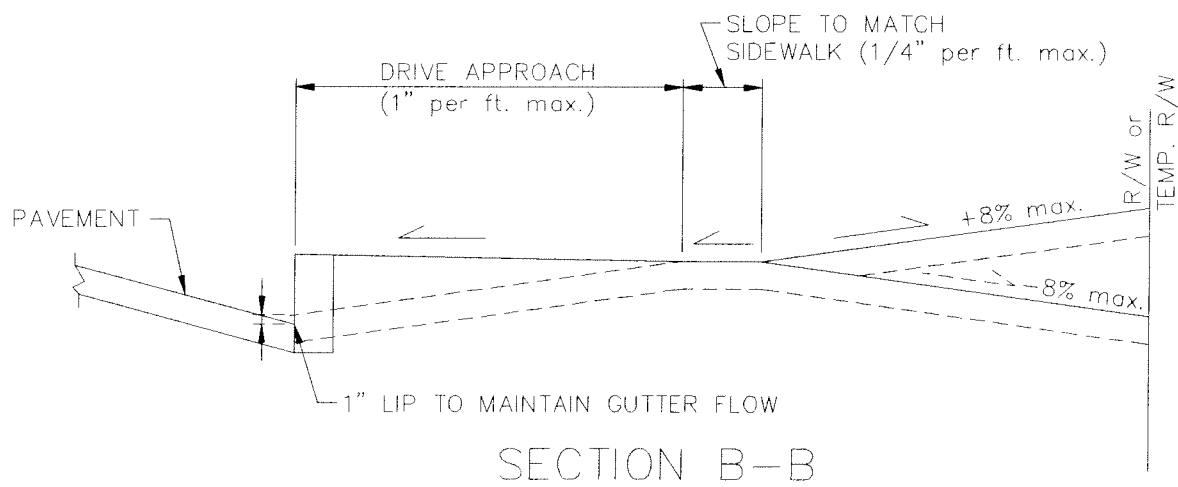
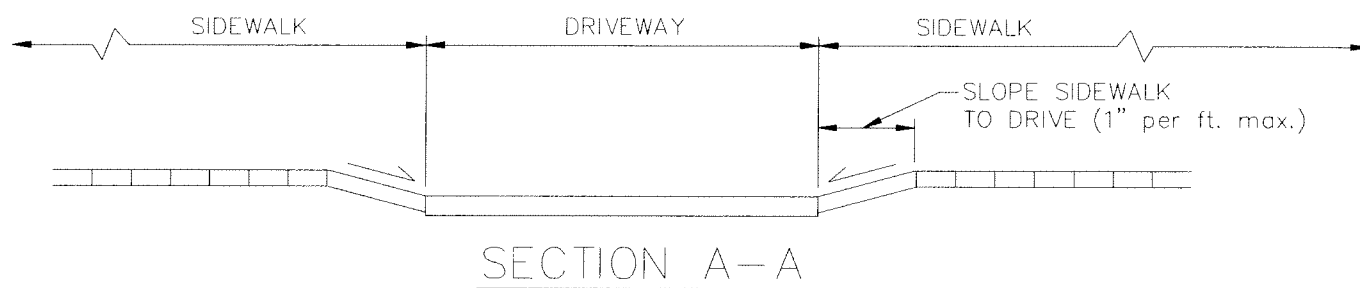
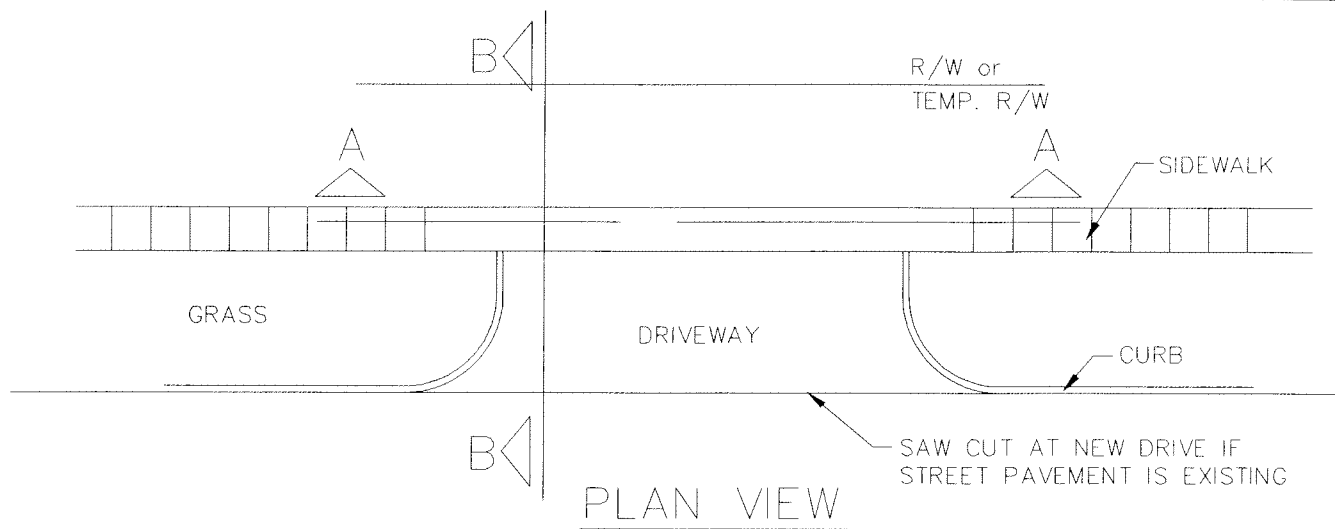
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FIGURE R-16



TYPICAL DRIVEWAY SECTION

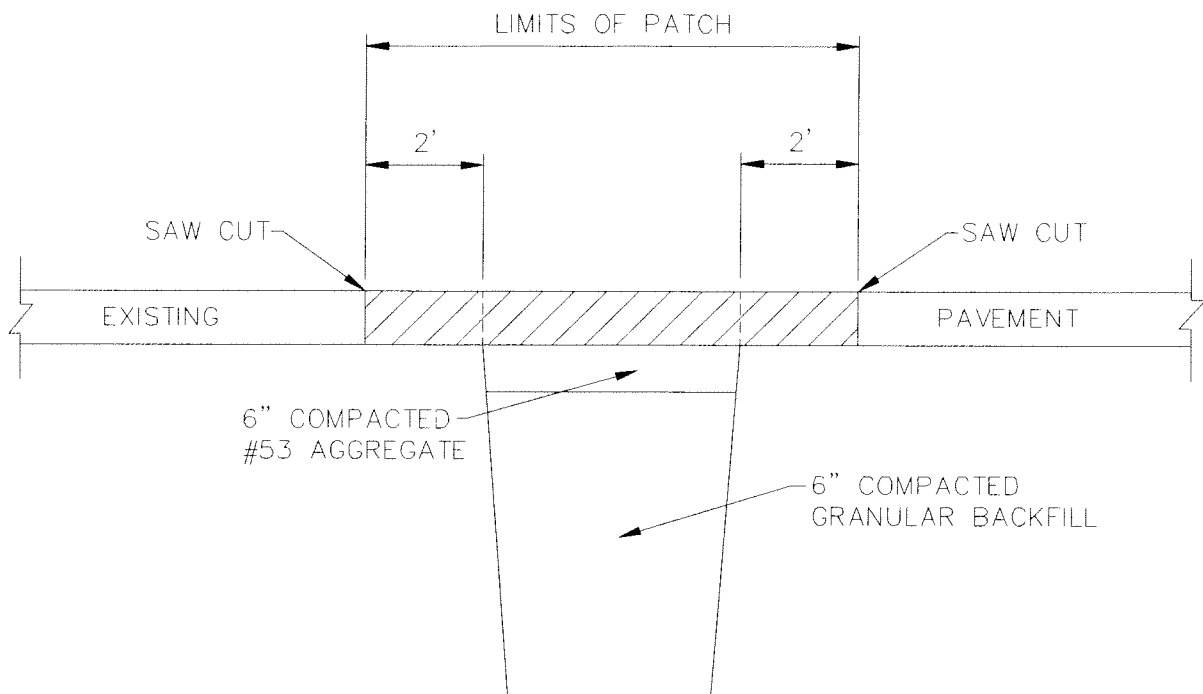
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FIGURE R-17



GENERAL DETAIL

NOTES:

1. SAW CUT 1/3 PAVEMENT THICKNESS THEN BREAK OUT.

NOT TO SCALE

REPAIR CUTS WITHIN PAVEMENT LIMITS

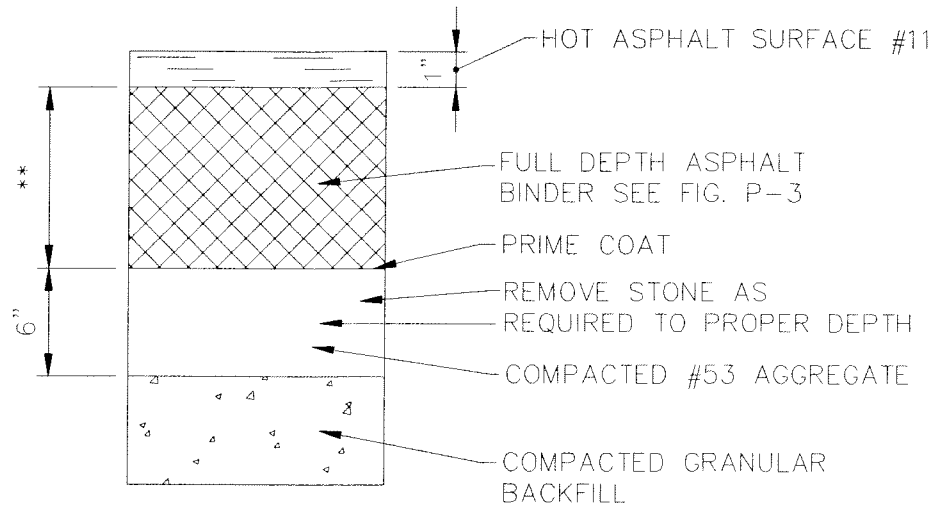
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FIGURE R-18

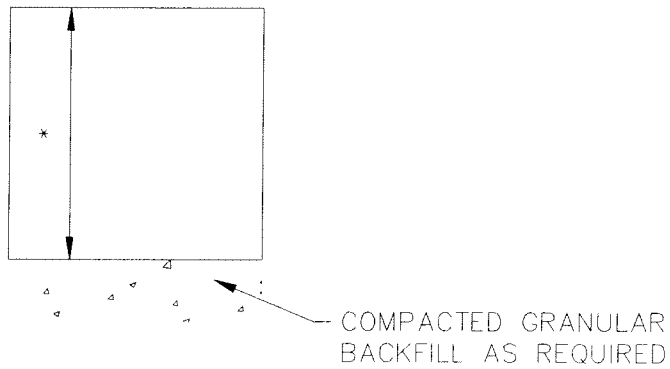
** ARTERIAL-10 1/2"
COLLECTOR-8 1/2"
LOCAL-6 1/2"



BITUMINOUS PATCHING

FIGURE I

* ARTERIAL- 8"
COLLECTOR - 7"
LOCAL-6"



PLAIN CEMENT CONCRETE PATCHING

FIGURE II

NOT TO SCALE

REPAIR CUTS WITHIN PAVEMENT LIMITS - CONT.

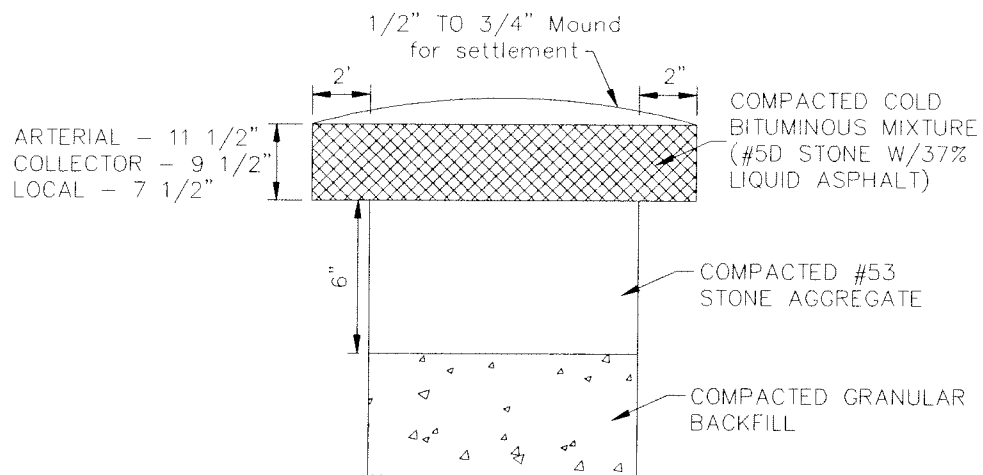
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FIGURE R-19



TEMPORARY PATCH
(FROM NOV.10-APRIL 15)

NOT TO SCALE

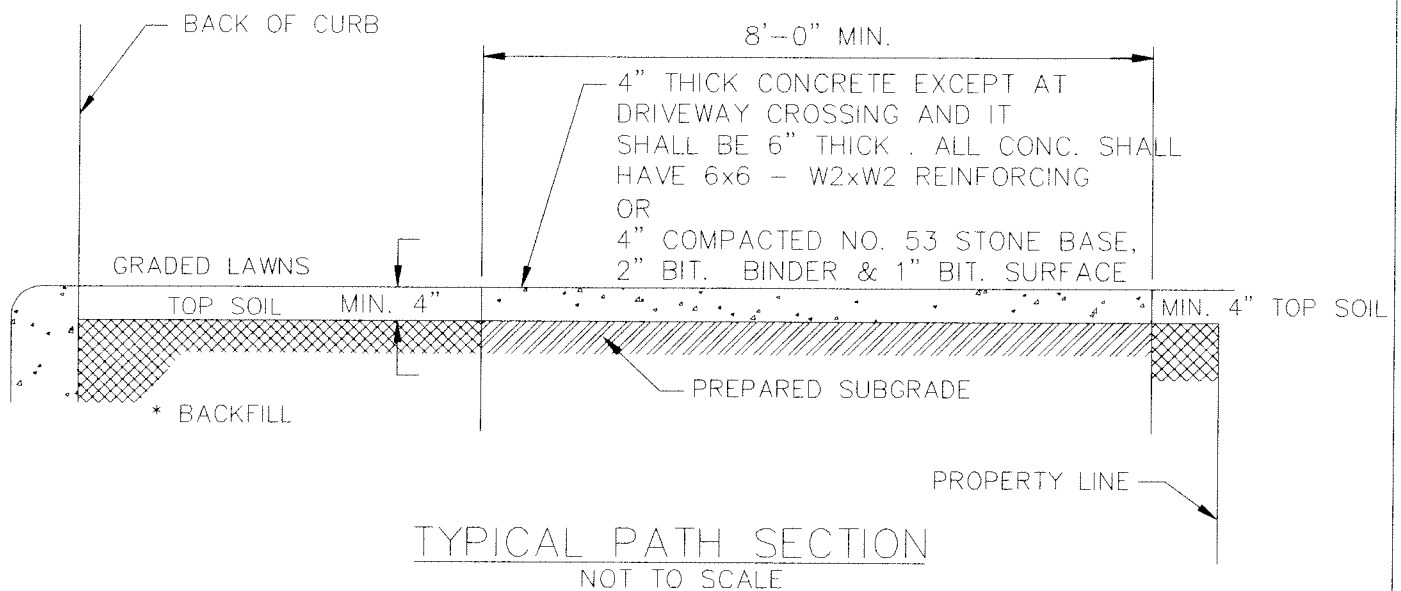
REPAIR OF CUTS WITHIN PAVEMENT LIMITS - CONT.

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FIGURE R-20



* THE SPACE BEHIND THE CURB SHALL BE FILLED WITH SUITABLE MATERIAL TO THE REQUIRED ELEVATION AND COMPACTED IN LAYERS NOT TO EXCEED 6" IN DEPTH.

SUBGRADE UNDER ALL CURBS, SIDEWALKS, PATHS AND DRIVES SHALL BE COMPACTED IN ACCORDANCE WITH I.N.D.O.T. SPECIFICATIONS.

SEE SECTION 02502 (STANDARDS FOR ROADWAY CONSTRUCTION) FOR DETAILED DISCRPTION OF BICYCLE/JOGGING PATH CONSTRUCTION

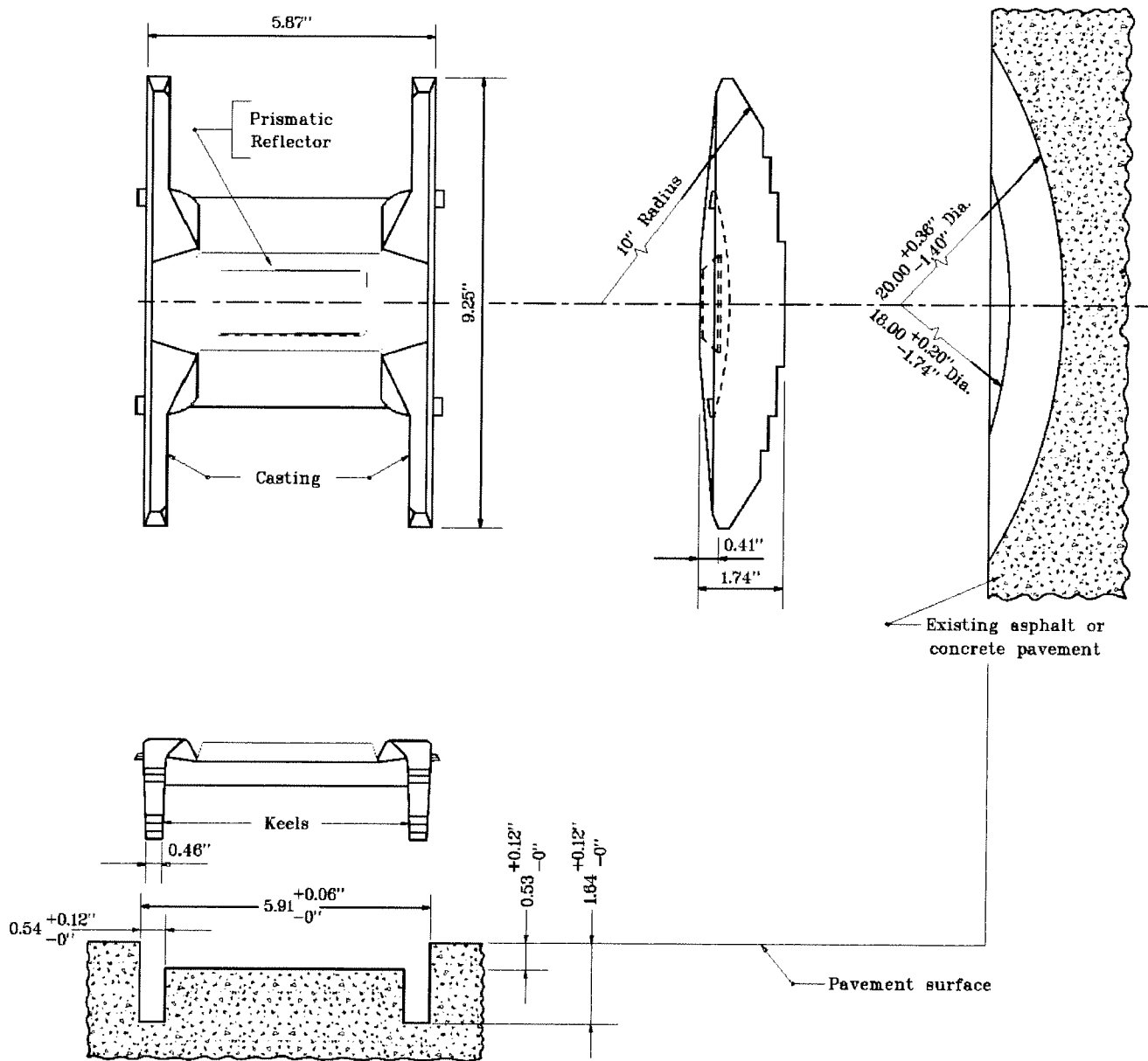
BICYCLE/JOGGING PATH DETAIL

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FIGURE R-21



INDOT Drawing. No. E 808-MKRM-10

RAISED PAVEMENT MARKER

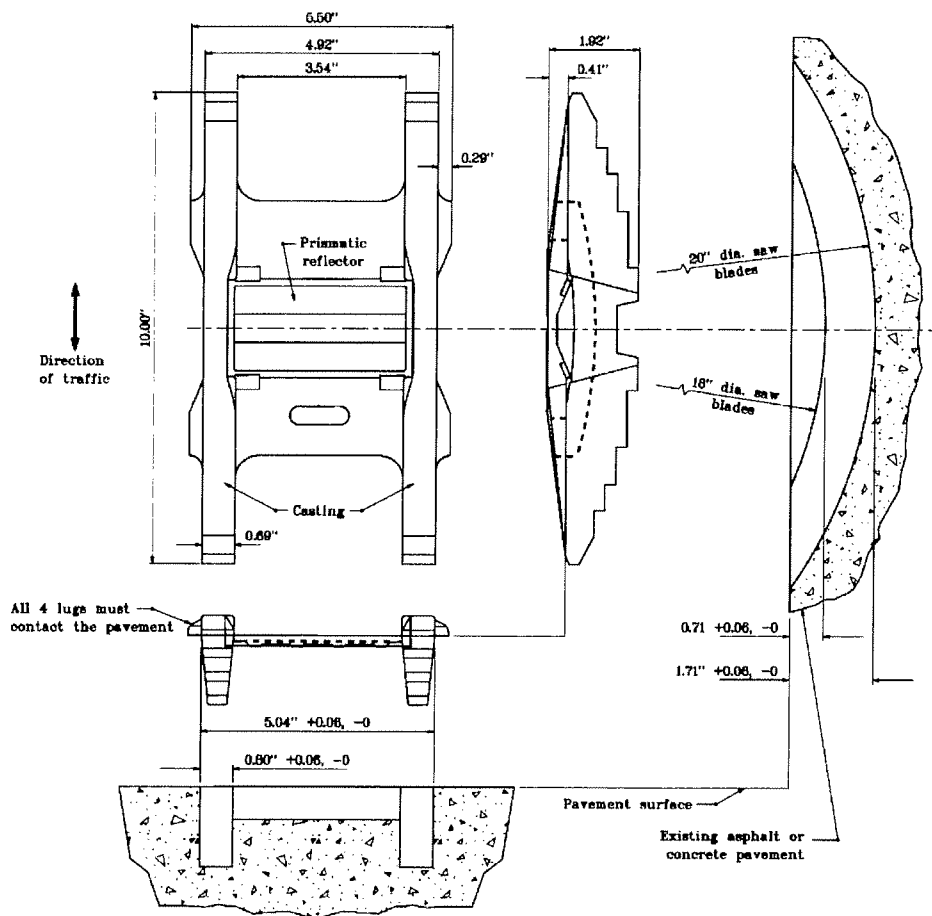
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FIGURE R-22



INDIANA DEPARTMENT OF TRANSPORTATION	
RAISED PAVEMENT MARKERS	
CAST METAL BASE, TYPE 2	
JANUARY 2000	
STANDARD DRAWING NO. E 808-MKRM-11	
 <p>ANTHONY L. URSACH No. 18035 STATE OF INDIANA PROFESSIONAL ENGINEER</p>	<p><i>/s/ Anthony L. Ursach</i> 1-83-00 DESIGNED BY ANTHONY L. URSACH DATE</p> <p><i>/s/ Peter Bondi</i> 1-03-00 CHECKED BY PETER BOND DATE</p>

INDOT Drawing. No. E 808-MKRM-11

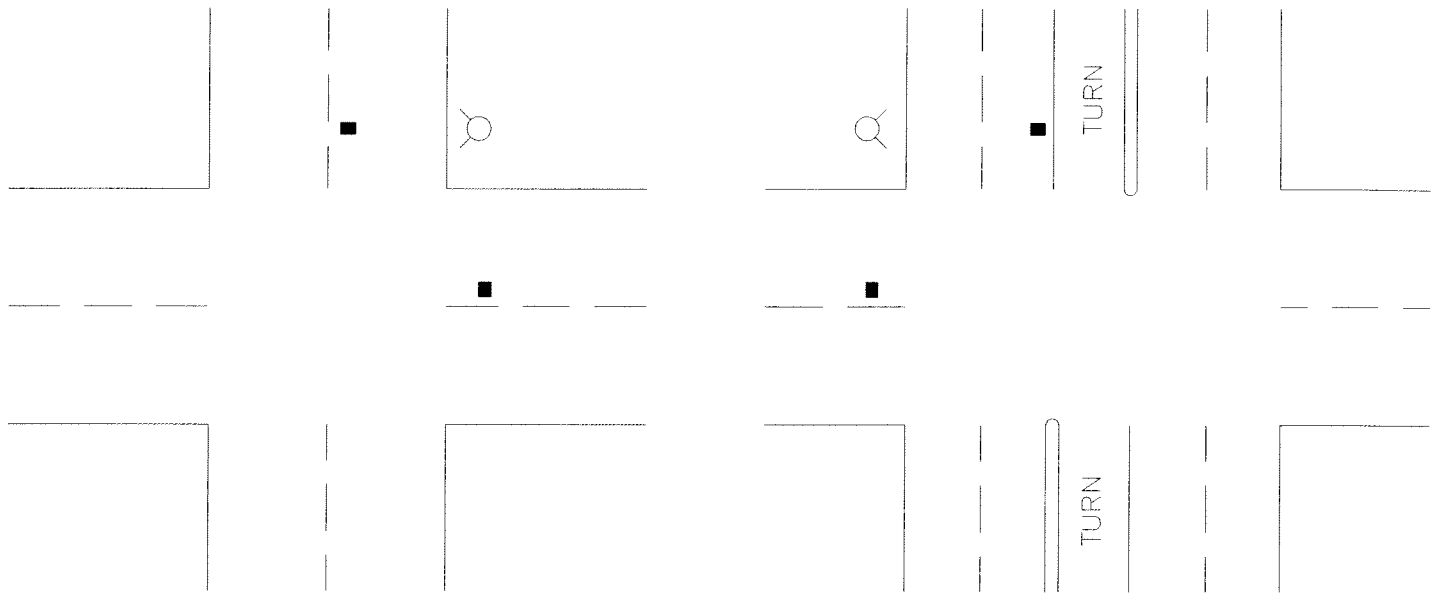
RAISED PAVEMENT MARKER

HNTB



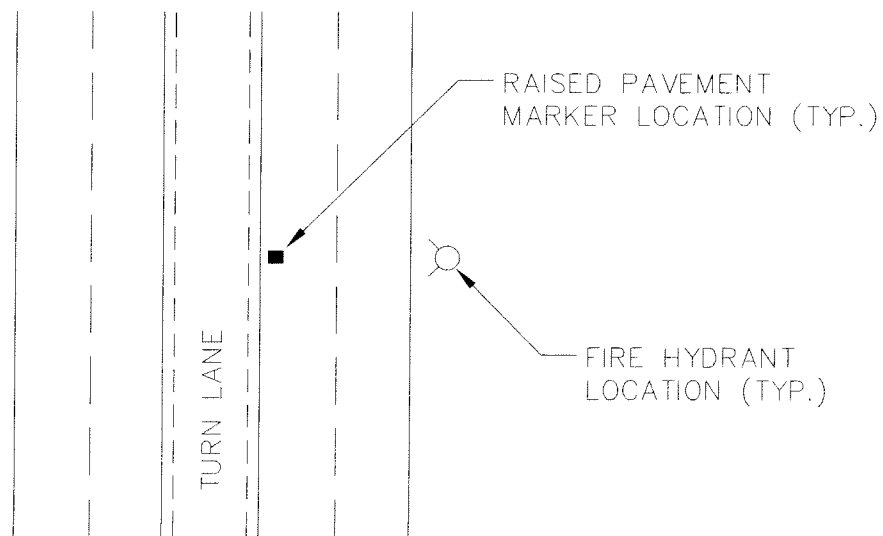
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FIGURE R-22a



TWO-LANE STREET
AT INTERSECTION

FOUR-LANE STREET
WITH TURN LANE
AT INTERSECTION



MULTI-LANE STREET
WITH TURN LANE

RAISED PAVEMENT MARKER

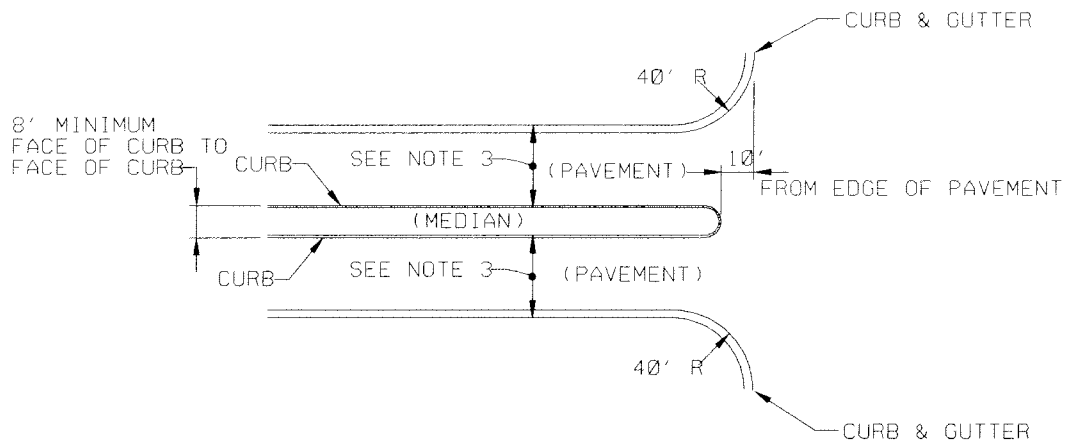
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FIGURE R-22b



NOTES:

1. MAXIMUM LENGTH BETWEEN BREAKS IN THE MEDIAN SHALL BE 600 FEET.
2. MINIMUM LENGTH BETWEEN ISLANDS SHALL BE 30 FEET.
3. 20 FEET (Back of Curb to Back of Curb) FOR INTERNAL SUBDIVISION ROADWAY AND 26.5 FEET (Back of Curb to Back of Curb) FOR SUBDIVISION ENTRANCE INTERSECTION APPROACH. SEE FIGURE P-25 FOR LENGTH, TRANSITION TAPER AND SIGNAGE.

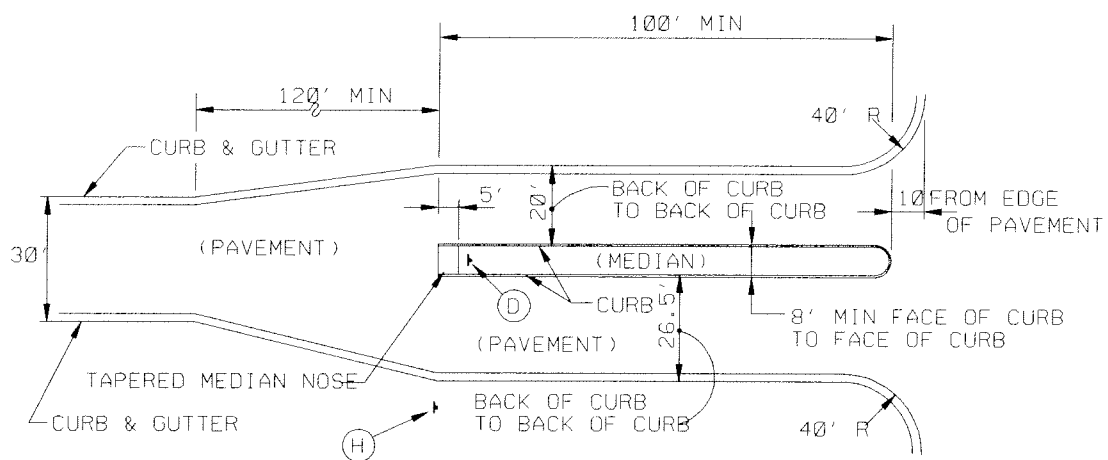
BOULEVARD SECTION

HNTB



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FIGURE R-23



KEYED NOTES:

- (D) KEEP RIGHT & TYPE 3 OBJECT MARKER (L)
R4-7 & OM-3L
- (H) NO PARKING HERE TO CORNER R7-2A

NOTE:

1. PLANTING MATERIALS WITHIN CENTER ISLANDS MUST BE IN ACCORDANCE WITH ARTICLE 11 OF THE CODE OF ORDINANCES FOR THE TOWN OF ZIONSVILLE

DIVIDED SUBDIVISION ENTRANCE
INTERSECTION APPROACH

HNTB

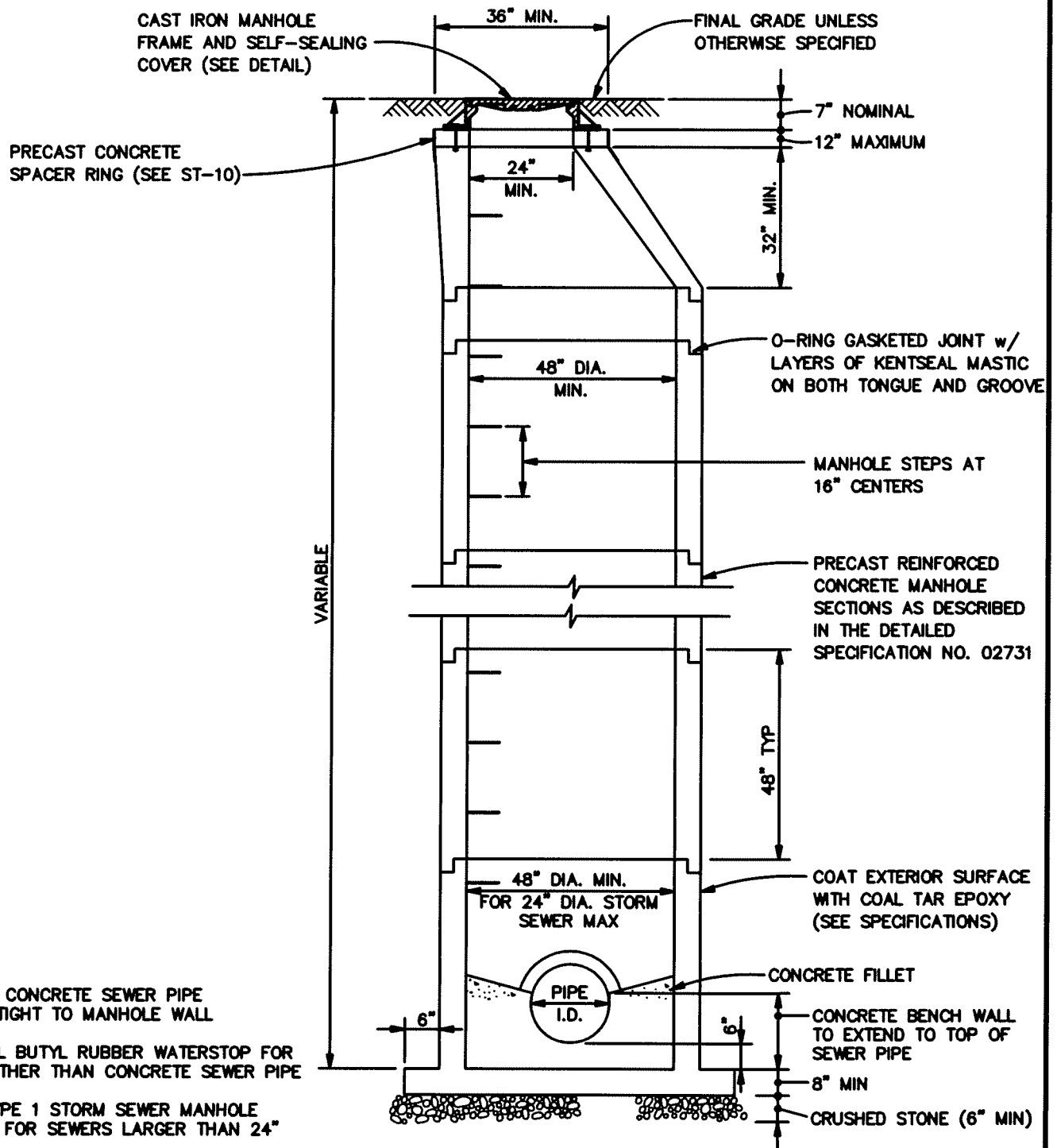


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FIGURE R-24

P:\46028_Rensselaer_zoning_subdivision\TechnicalDesign\Storm\Zionsville Storm_sewer\ST-1.dwg, Figure ST-1, 4/14/2008 9:30:54 AM, rmcclellan



NOTES:

1. GROUT CONCRETE SEWER PIPE WATERTIGHT TO MANHOLE WALL
2. INSTALL BUTYL RUBBER WATERSTOP FOR PIPE OTHER THAN CONCRETE SEWER PIPE
3. SEE TYPE 1 STORM SEWER MANHOLE DETAIL FOR SEWERS LARGER THAN 24"
4. SEE SECTION 03300 FOR CONCRETE DEFINITIONS
5. TO JUSTIFY FABRICATION OF THE MANHOLE STRUCTURE WITHOUT THE REQUIRED LIP EXTENSION, ENGINEERING CALCULATIONS PREPARED, STAMPED AND CERTIFIED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF INDIANA MUST BE SUBMITTED FOR REVIEW. CALCULATIONS MUST TAKE INTO ACCOUNT SPECIFIC SOIL AND ANTICIPATED GROUND WATER INFORMATION PERTINENT TO THE MANHOLE LOCATION AND MUST BE IN ACCORDANCE WITH GENERALLY ACCEPTED ENGINEERING PRINCIPLES.

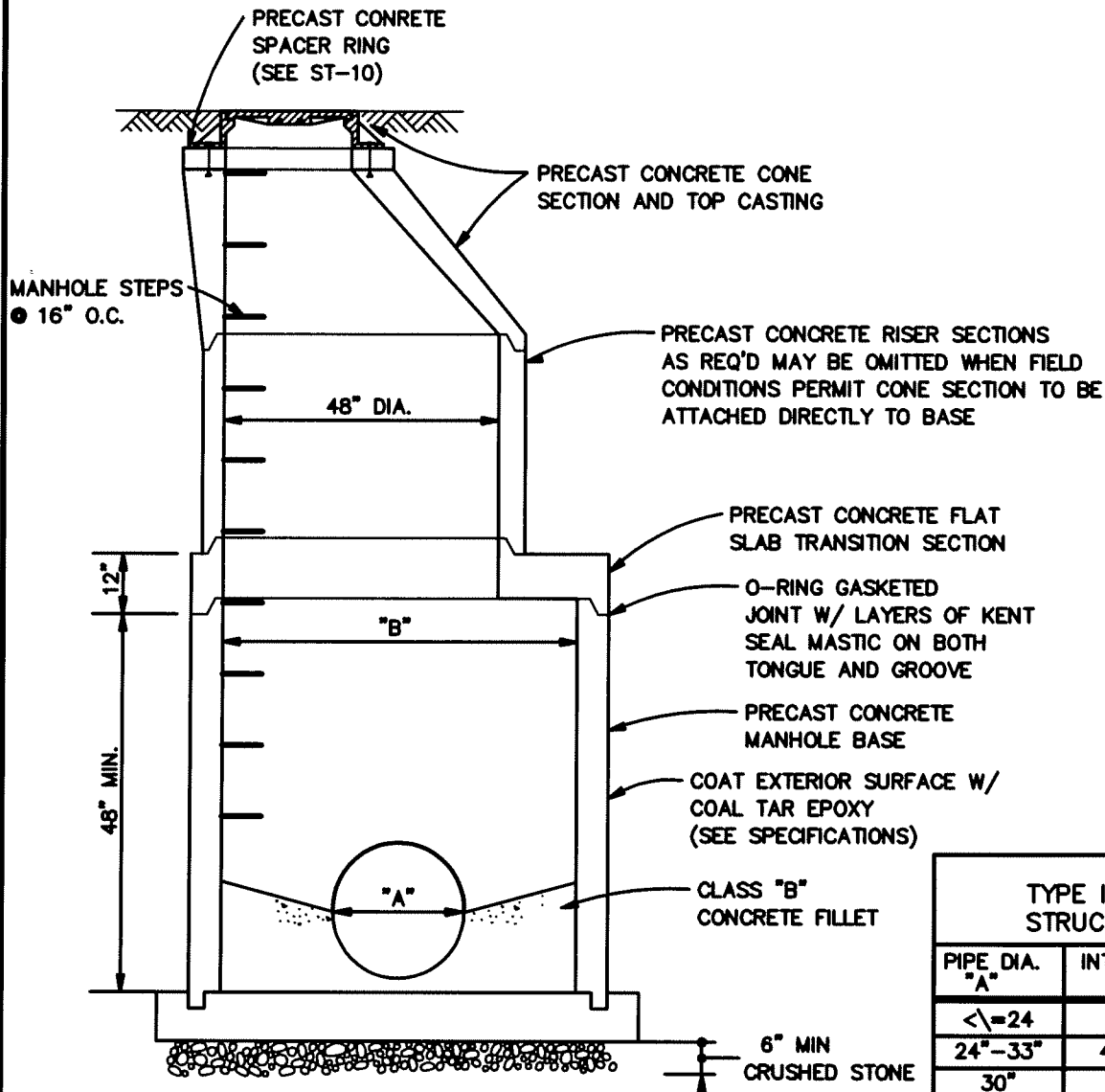
STANDARD STORM MANHOLE DETAIL

HNTB



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FIGURE ST-1



NOTES:

1. SEE STANDARD STORM SEWER MANHOLE DETAIL FOR OTHER DETAIL & DIMENSIONS
2. RISER & CONE SECTIONS SHALL BE AS SHOWN ON STANDARD STORM SEWER MANHOLE DETAIL
3. SEE SECTION 03300 FOR CONCRETE DEFINITIONS

TYPE I MANHOLE STRUCTURE DATA		
PIPE DIA. "A"	INTERSECTING ANGLE	PIPE DIA. "B"
<24"		48"
24"-33"	45° - 90°	60"
30"	0° - 44°	60"
30"	45° - 90°	72"
36"	0° - 44°	60"
36"	45° - 90°	72"
42"	0° - 44°	72"
42"	45° - 90°	84"
48"	0° - 44°	84"
48"	45° - 90°	96"
54"-66"	0° - 44°	96"
66"	45° - 90°	102"
72"	0° - 44°	102"
72"	45° - 90°	108"
84"	0° - 44°	108"

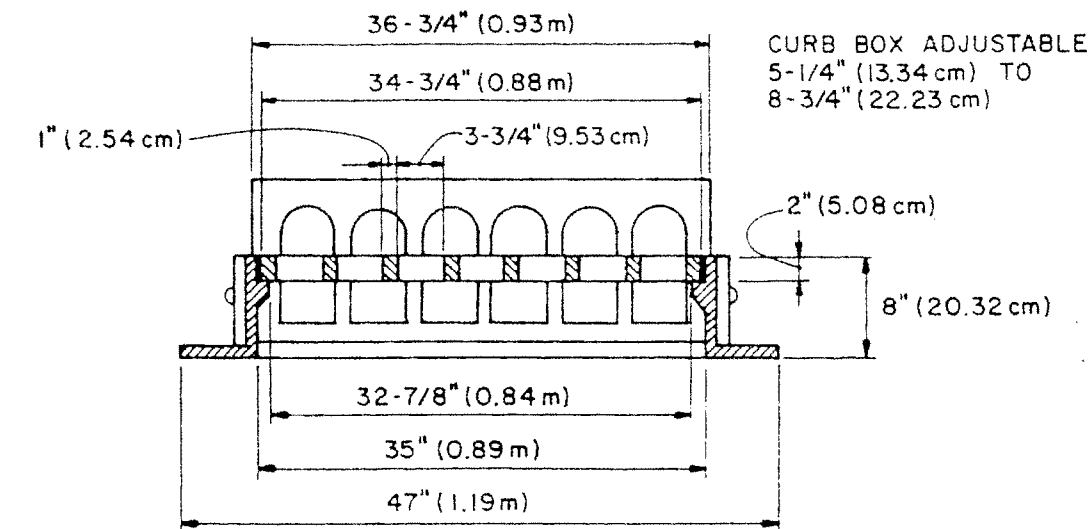
TYPE 1 STORM MANHOLE DETAIL

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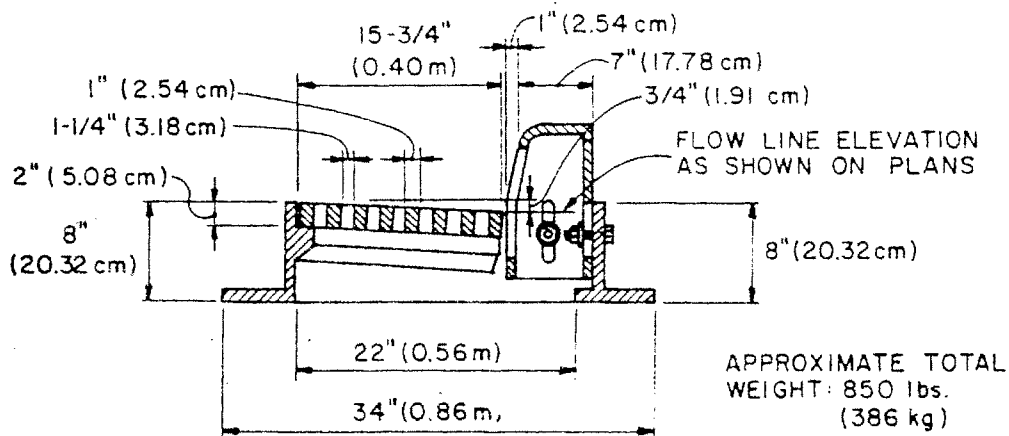


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FIGURE ST-2



ELEVATION



SECTION

MANUFACTURER	CATALOG NO.
NEENAH	R-3287, 10V
	R-3287, SB10

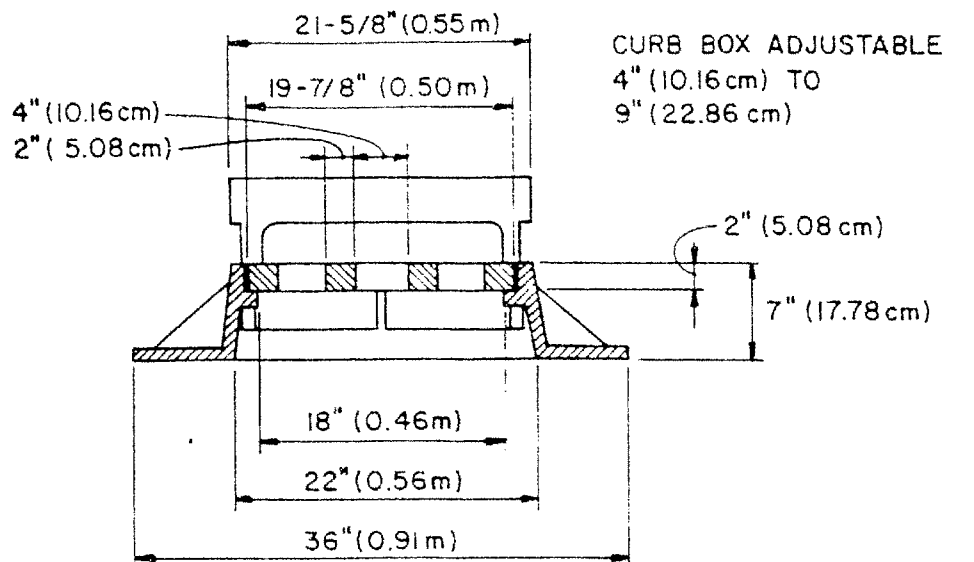
STRAIGHT CURB INLET CASTING TYPE 1

HNTB

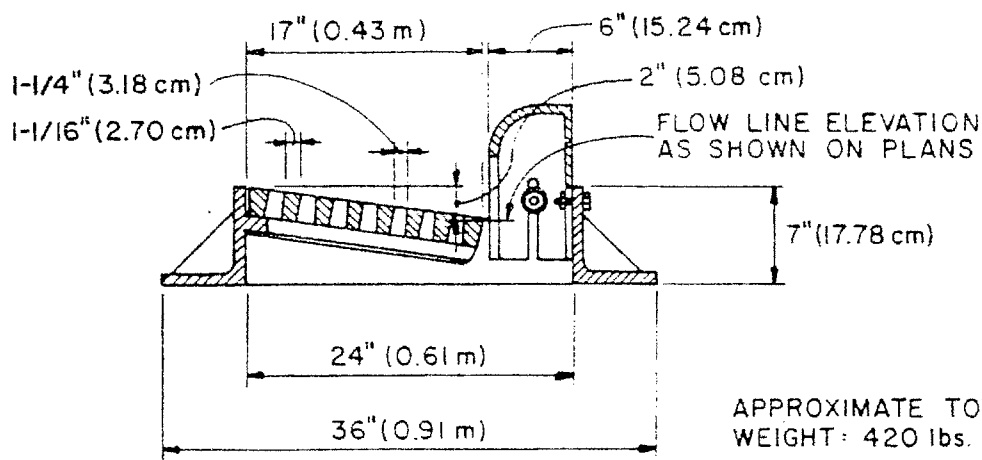


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FIGURE ST-3



ELEVATION



SECTION

MANUFACTURER	CATALOG NO.
NEENAH	R-3235
EAST JORDAN	7010

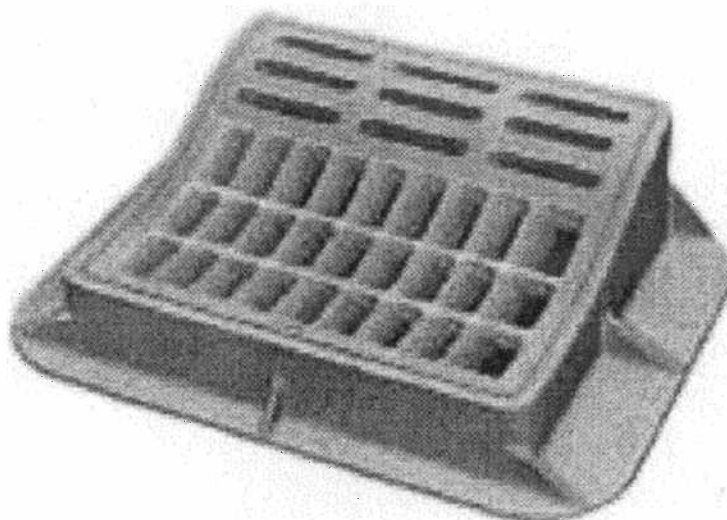
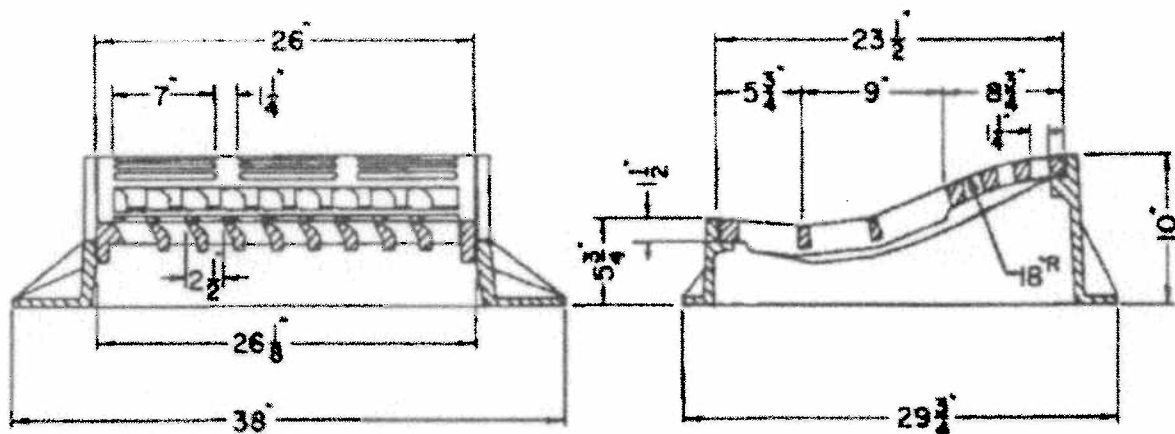
STRAIGHT CURB INLET CASTING TYPE 2

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FIGURE ST-4



MANUFACTURER	CATALOG NO.
NEENAH	R-3501-TR/TL
EAST JORDAN	7495

ROLLED CURB INLET CASTING TYPE 3

HNTB

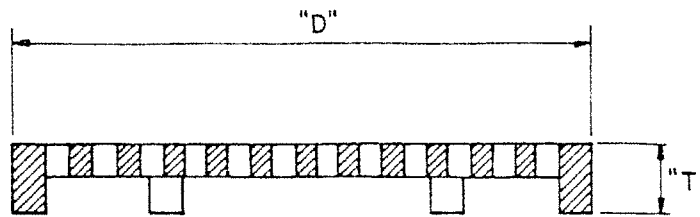


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FIGURE ST-5



SECTION

PIPE SIZE	"D"	"T"	APPROX. WEIGHT
12" (30.48 cm)	14-3/4" (37.47cm)	2-1/2" (6.35 cm)	32 lbs. (15 kg)
15" (38.10 cm)	18-1/4" (46.36cm)	2-3/4" (6.99 cm)	55 lbs. (25 kg)
18" (45.72 cm)	22" (55.88 cm)	2-3/4" (6.99 cm)	75 lbs. (34 kg)
24" (60.96 cm)	29" (73.66 cm)	3-1/4" (8.26 cm)	140 lbs. (64 kg)

MANUFACTURER	CATALOG NO.
NEENAH	4030
EAST JORDAN	.6000

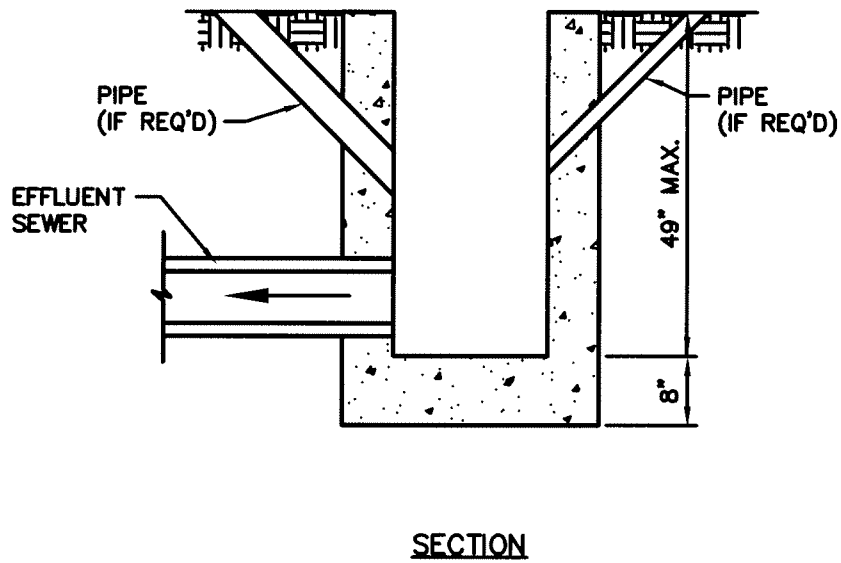
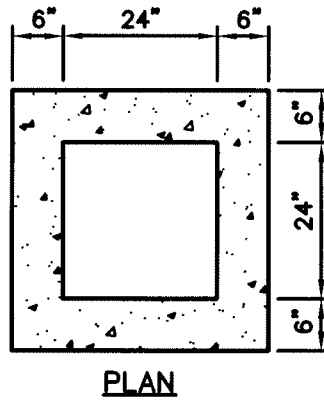
FLAT INLET CASTING TYPE 5

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FIGURE ST-7



NOTES:

1. IN ACCORDANCE WITH INDIANA STATE HIGHWAY SPECIFICATONS
2. MIN. CONCRETE COMPRESSIVE STRENGTH 4000 P.S.I.
3. PRECAST ADJUSTING SECTIONS AVAILABLE

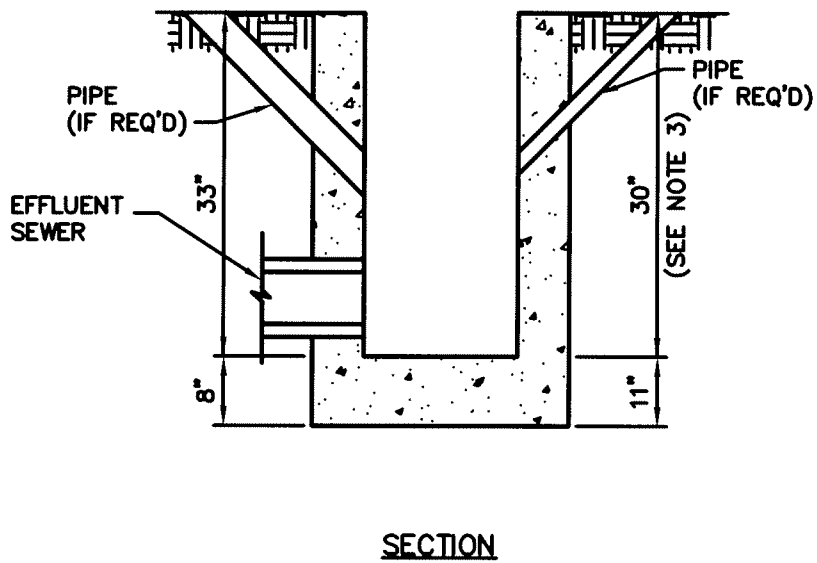
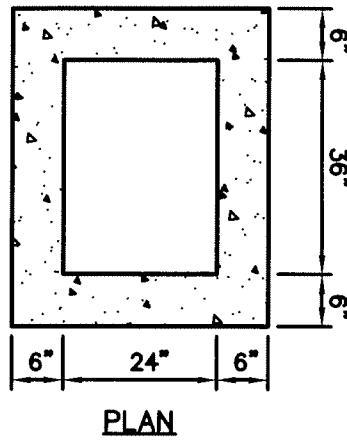
INLET STRUCTURE TYPE 1A

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FIGURE ST-8



NOTES:

1. IN ACCORDANCE WITH INDIANA STATE HIGHWAY SPECIFICATIONS
2. MIN. CONCRETE COMPRESSIVE STRENGTH 4000 P.S.I.
3. IN/DOT DIMENSIONS, OTHER DIMENSIONS AVAILABLE
4. PRECAST ADJUSTING SECTIONS AVAILABLE

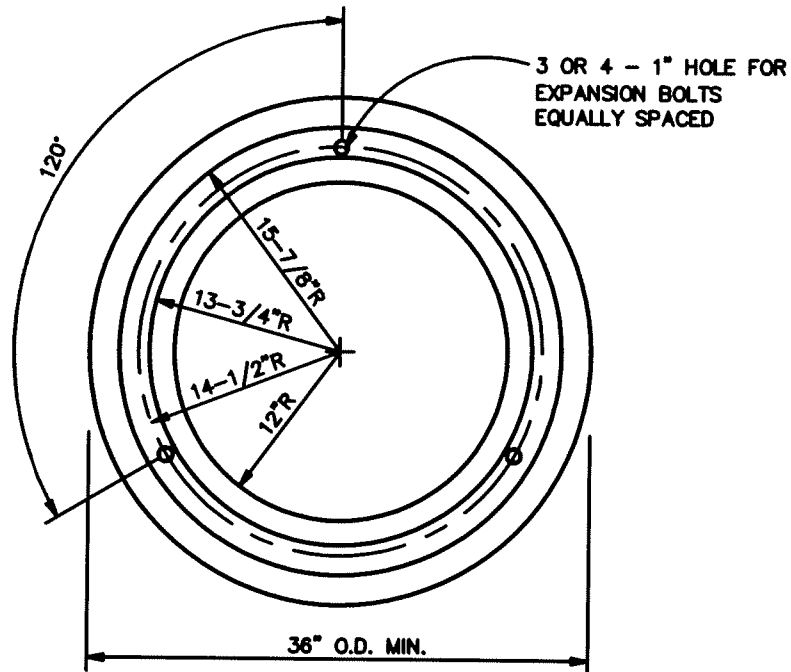
INLET STRUCTURE TYPE 1B

HNTB

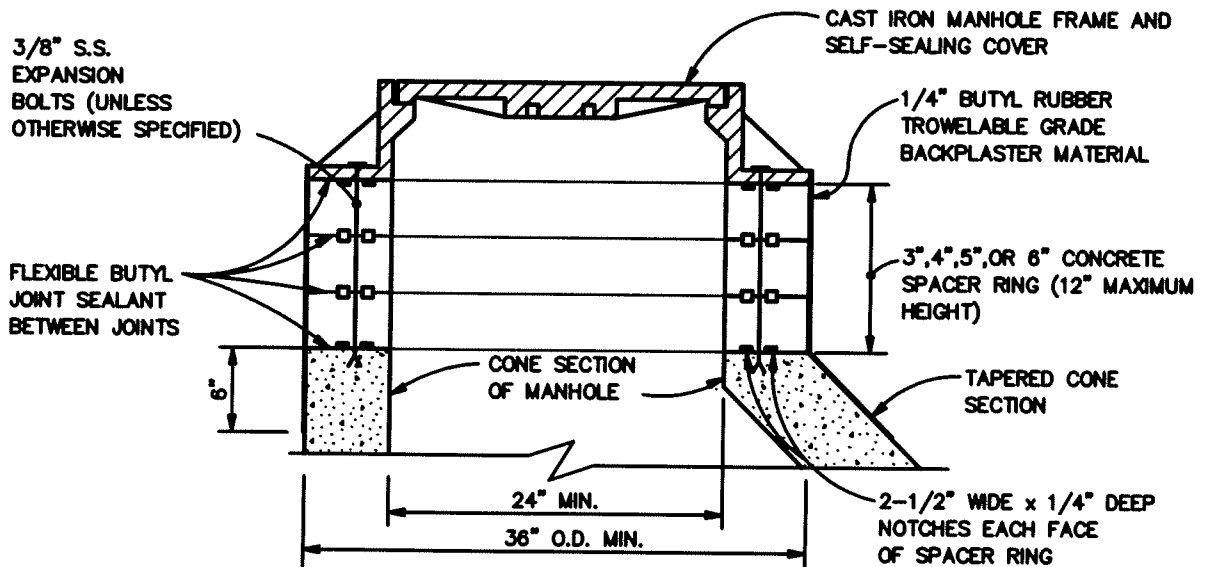


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FIGURE ST-9



PLAN



SECTION

STANDARD MANHOLE SPACER RING DETAIL

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FIGURE ST-10