

SECTION 33 46 13
FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of foundation drainage systems, including installation, backfill, and cleanout extensions, to a point of connection to storm sewer.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples: For each type of filter fabric, pipe, and fitting indicated.
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Paragraph 1.12 PHYSICAL DATA.

1.4 DEFINITIONS

Subdrainage: Foundation drainage system that collects and removes subsurface or seepage water from building foundation from building to discharge pond.

1.5 ABBREVIATIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. HDPE: High-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 COORDINATION

- A. Coordinate connection to storm sewer main, if approved, with the Public Agency responsible for the storm sewer system.
- B. Coordinate exterior utility lines and connections to foundation building drain.

1.8 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Agency having jurisdiction over the connection to public storm sewer lines or the requirements for discharge of subsurface drainage.

1.9 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):

A48-03.....	Gray Iron Castings
C33/C33M-11.....	Concrete Aggregates
C443-10.....	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C1173-08.....	Flexible Transition Couplings for Underground Piping Systems
D448-08.....	Sizes of Aggregate for Road and Bridge Construction
D1621-10.....	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
D2235-04(2011)	Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
D2321-11.....	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2751-05.....	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
D3034-08.....	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3350-10a.....	Polyethylene Plastic Pipe and Fittings Material
D4491-99a(2009)	Test Methods for Water Permeability of Geotextiles by Permittivity
D4716-08.....	Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
D5926-09.....	Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
D6707-06 (2011).....	Circular-Knit Geotextile for Use in Subsurface Drainage Applications
F405-05	Corrugated Polyethylene (PE) Pipe and Fittings
F477-10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F667—06.....	Larger Diameter Corrugated Polyethylene Pipe and Fittings

F2648-102 to 60 Inch Annular Corrugated Profile Wall Polyethylene (PE) Pipe
and Fittings for Land Drainage Applications

1.10 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 UNDERSLAB HEADER:

- A. PVC sewer pipe and fittings per ASTM D3034, in NPS 4 to NPS 15 (DN 100 to DN 375). Joints shall be bell and spigot. ASTM F477, elastomeric seal gaskets shall be used.

2.4 PERFORATED-WALL PIPES AND FITTINGS FOR VAULTS OR MANHOLES

- A. Perforated PE Pipe and Fittings:
 - 1 . Pipe shall be ASTM D2648 Type CP; corrugated, for coupled joints.
 - 2 . Couplings: Manufacturer's standard.
- B. Perforated PVC Sewer Pipe and Fittings shall be ASTM D3034.

2.5 SOLID-WALL PIPES AND FITTINGS

- A. ABS Sewer Pipe and Fittings shall meet ASTM D2751.
 - 1 . Solvent Cement: ASTM D2235.
 - 2 . Gaskets: ASTM F477.
- B. PE Pipe and Fittings: ASTM D3350
- C. PVC Sewer Pipe and Fittings: ASTM D3034.
 - 1 . Gaskets: ASTM F477.

2.6 CLEANOUTS

- A. Cleanouts: Cast-iron parts shall conform to ASTM A48. Lid shall be secured, scoriated, Medium Loading class. Include cast-iron ferrule and countersunk, brass cleanout plug.
- B. Cleanout PVC Extension shall conform to ASTM D3034. PVC extensions shall have watertight joints and long sweep elbow fittings. PVC cleanout shall have threaded plug and threaded pipe hub.

2.7 DRAINAGE CONDUITS:

- A. Pipe, fittings, and couplings shall be perforated and smooth PVC complying with ASTM D4216 and ASTM D2729.
- B. Pipe size shall be 150 mm (6 inches) and have a high minimum flow rate equal to a NPS 4 (DN 100) pipe.
- C. Fittings shall be PVC with NPS^ø4 (DN 100) outlet connection.
- D. Couplings shall be PVC.

2.8 GEOTEXTILE FILTER FABRICS

- A. Geotextile fabric shall conform to ASTM 6707. Elongation will be greater than 50 percent and the flow rate shall range from 110 to 330 gpm/sq. ft. (4480 to 13440 L/min. per sq. m).
 - 1. Structure Type shall be Nonwoven, needle-punched continuous filament.
 - 2. Style(s) shall be Flat.

2.9 DRAINAGE MAT

Drainage mat shall be formed three dimensional polyethylene or high-impact polymeric core or compression-resistant nylon matting of open three-dimensional construction.

2.10 DRAINAGE MATERIAL:

- A. BEDDING: CRUSHED STONE, 20 MM (3/4 INCH) TO NO. 4 PER ASTM D448.
- B. FILL TO 300 MM (1 FOOT) ABOVE PIPE: CRUSHED STONE, 20 MM (3/4 INCH) TO NO. 4 PER ASTM D448

2.11 SOIL MATERIALS

- A. Drainage Material
 - 1. Bedding shall be crushed stone, 3/4 inch (20 mm) to No. 4 per ASTM D448, at a minimum or as per geotechnical recommendations.
 - 2. Fill to 1 foot (300 mm) above pipe shall be Crushed stone, 3/4 inch (20 mm) to No. 4 per ASTM D448, at a minimum or as per geotechnical recommendations.
- B. Concrete Sand shall be ASTM C33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS

- A. Underground Subdrainage Piping shall be:
 - 1. Perforated PE pipe and fittings, couplings, and coupled joints.
- B. Underslab Subdrainage Piping shall be:
 - 1. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.

C. Header Piping shall be:

1. PVC sewer pipe and fittings, couplings, and coupled joints.

3.3 CLEANOUT APPLICATIONS

A. In Underground Subdrainage Piping:

1. At Grade in Earth shall be PVC cleanouts.
2. At Grade in Paved Areas shall be Cast-iron cleanouts.

B. In Underslab Subdrainage Piping:

1. In Equipment Yards and Unfinished Areas shall be Cast-iron cleanouts.

3.4 FOUNDATION DRAINAGE INSTALLATION

A Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (150 mm) deep and 12 inches (300 mm) wide.

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with or and install drainage piping.

D. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

E. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

F. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

G. Place layer of // flat-style geotextile filter fabric // roofing felt // over top of drainage course, overlapping edges at least 4 inches (100 mm).

H. Install vertical drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing. Do not install aggregate.
3. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core.
Wrap fabric around end of remaining core.
4. Wrap bottom of panel around drainage pipe.
5. Attach panel to wall at horizontal mark and at beginning of pipe. Place core side of panel against wall.
Use concrete nails with washers through product cylinders to attach panel to wall. Place nails from 2 to 6 inches (50 to 150 mm) below top of panel, approximately 48 inches (1200 mm) apart. // Construction adhesives, metal stick pins, or double double-sided tape may be used instead of nails. // Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
6. If additional panels are required on same row, cut away 4 inches (100 mm) of installed panel core, install new panel against installed panel, and overlap new panel with installed panel fabric.

- 7 . If additional rows of panels are required, overlap lower panel with 4 inches (100 mm) of fabric.
 - 8 . Cut panel as necessary to keep top 12 inches (300 mm) below finish grade.
 - 9 . For inside corners, bend panel. For outside corners, cut core to provide 3 inches (75 mm) for overlap.
- I. Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.
- J. Place initial backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.5 PLAZA DECK DRAINAGE INSTALLATION

Horizontal Drainage Panel shall be installed between slab and floor cover. Place core on structural floor. Install panels to fit tightly around floor drains of building's storm drainage system. Provide stormwater access into floor drain.

3.6 RETAINING-WALL DRAINAGE INSTALLATION

- A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches (100 mm).
- C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with // adhesive // or // tape //. Install drainage piping.
- D. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.
- E. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.
- F. Place drainage course in layers not exceeding 3 inches (75 mm) in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.
- G. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).
- H. Install vertical drainage panels as follows:
 - 1 . Coordinate placement with other drainage materials.
 - 2 . Lay perforated drainage pipe at base of footing. Do not install aggregate.
 - 3 . Mark horizontal chalk line on wall at a point 6 inches (150 mm) less than panel width above footing bottom. Before marking wall, subtract footing width.
 - 4 . Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.
 - 5 . Wrap bottom of panel around drainage pipe.
 - 6 . Attach panel to wall at horizontal mark and at beginning of wall corner. Place core side of panel against wall. Use concrete nails with washers through product. Place nails from 2 to 6 inches (50 to 150 mm) below top of panel, approximately 48 inches (1200 mm) apart. // Construction adhesives, metal stick

pins, or double-sided tape may be used instead of nails. // Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.

- 7 . If another panel is required on same row, cut away 4 inches (100 mm) of installed panel core and wrap fabric over new panel.
 - 8 . If additional rows of panel are required, overlap lower panel with 4 inches (100 mm) of fabric.
 - 9 . Cut panel as necessary to keep top 12 inches (300 mm) below finish grade.
 - 10 . For inside corners, bend panel. For outside corners, cut core to provide 3 inches (75 mm) for overlap.
 - 11 . Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.
- I. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.7 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).
- D. Install drainage conduits with horizontal distance of at least 6 inches (150 mm) between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with tape.
- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches (300 mm) of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).
- I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.8 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
 - 1 . Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm) unless otherwise indicated.
 - 2 . Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
 - 3 . Plaza Deck Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 1.0 percent.

- 4 . Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 12 inches (unless otherwise indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
 - 5 . Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 32 inches unless otherwise indicated.
 - 6 . Lay perforated pipe with perforations down.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install ABS piping, PE piping and PVC piping according to ASTM D2321.

3.9 PIPE JOINT CONSTRUCTION

- A. Cast-Iron Soil Pipe and Fittings: Hub and spigot, with rubber compression gaskets according to ASTM A74. Use gaskets that match class of pipe and fittings.
- B. Join ABS pipe and fittings according to ASTM D2751.
- C. Join PE pipe or perforated PE pipe and fittings with couplings for soil-tight joints according to ASTM D2321.
- D. Join PVC pipe and fittings according to ASTM D2729.
- E. Join perforated PVC pipe and fittings according to ASTM D2729.
- F. Join perforated concrete pipe and fittings with gaskets according to ASTM C443.
- G. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.10 CLEANOUT INSTALLATION

- A. Cleanouts for Foundation, Retaining-Wall and Landscaping
- B. Subdrainage:
- 1 . Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
 - 2 . In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in nonvehicular-traffic areas.
 - 3 . In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (300 by 300 by 100 mm) in depth. Set top of cleanout plug 1 inch (25 mm) above grade.

3.11 CONNECTIONS

- A. Connect low elevations of subdrainage system to building's solid-wall-piping storm drainage system.
- B. Where required, connect low elevations of foundation subdrainage to stormwater sump pumps.

3.12 IDENTIFICATION

- A. Install PE warning tape or detectable warning tape over ferrous piping.
- B. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.14 CLEANING

Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

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