Preparing Activity: USACE Superseding without Revision
UFGS-33 46 13 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 46 13

FOUNDATION DRAINAGE

05/20

PART 1 GENERAL

1.1 REFERENCES
1.2 SYSTEM DESCRIPTION
1.2.1 Extent
1.2.2 Outlet Connections
1.2.3 Drainage Lines
1.2.4 Outlet Lines
1.3 SUBMITTALS
1.4 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Clay Pipe
2.1.2 Perforated Clay Pipe
2.1.3 Concrete Pipe
2.1.4 Perforated Concrete Pipe
2.1.5 Porous Concrete Pipe
2.1.6 Clay Drain Tile
2.1.7 Perforated Clay Drain Tile
2.1.8 Concrete Drain Tile
2.1.9 Cast-Iron Soil Pipe
2.1.10 Perforated Corrugated Steel Pipe
2.1.11 Perforated Corrugated Aluminum Alloy Pipe
2.1.12 Perforated Asbestos-Cement Underdrain Pipe
2.1.13 Plastic Pipe
2.1.13.1 Corrugated Polyethylene (PE) Drainage Pipe
2.1.13.2 Acrylonitrile-Butadiene-Styrene (ABS) Pipe
2.1.13.3 Polyvinyl Chloride (PVC) Pipe
2.1.13.4 Circular Perforations in Plastic Pipe
2.1.13.5 Slotted Perforations in Plastic Pipe
2.1.14 Fittings
2.1.15 Cleanouts and Piping Through Walls

2.1.16 Cover and Wrapping Materials for Open Joints in Drain Tile
2.1.17 Bedding and Pervious Backfill for Foundation Drains
2.1.18 Protective Covering for Pervious Backfill

PART 3 EXECUTION

3.1 INSTALLATION
3.1.1 Trenching and Excavation
3.1.2 Bedding
3.1.3 Pipe Laying
3.1.4 Jointing
3.1.4.1 Perforated and Porous Pipes
3.1.4.2 Nonperforated Drain Tile
3.1.4.3 Perforated Corrugated Metal Pipe
3.1.4.4 Joints of Concrete or Clay Sewer Pipe
3.1.4.5 Joints of Cast-Iron Pipe
3.1.4.6 Perforated Asbestos-Cement Pipe Joints
3.1.4.7 Plain-End Perforated Clay
3.1.4.8 ABS Pipe
3.1.4.9 PVC Pipe
3.1.4.10 Corrugated Polyethylene
3.1.5 Outlet Lines
3.1.6 Cleanouts
3.2 Backfilling

-- End of Section Table of Contents --

Preparing Activity: USACE

Superseding without Revision
UFGS-33 46 13 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

SECTION 33 46 13

FOUNDATION DRAINAGE
05/20

NOTE: This guide specification covers the requirements for foundation drainage system using clay, concrete, cast iron, corrugated steel, corrugated aluminum, and plastic pipe.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: The following information should be shown on the drawings:

Location, extent, type, and sizes of foundation drainage system, including designations of drainage lines and outlet lines.

Locations and invert elevations of cleanouts and drainage structures.

Cross section of system showing bedding and backfill with protective covering.

Jointing details.

Cleanout details.

Connections between foundation drainage and related storm drainage systems.

Outlet details.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 252	(2009; R 2017) Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 294	(2021) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A74	(2021) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A760/A760M	(2015, R 2020) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM B745/B745M	(2015; R 2021) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains

ASTM C4	(2004; R 2014) Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile
ASTM C14	(2020) Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C14M	(2020) Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C412	(2011) Concrete Drain Tile
ASTM C412M	(2011) Concrete Drain Tile (Metric)
ASTM C425	(2021) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C444	(2017) Standard Specification for Perforated Concrete Pipe
ASTM C444M	(2017) Standard Specification for Perforated Concrete Pipe (Metric)
ASTM C508/C508M	(2000; R 2015) Asbestos-Cement Underdrain Pipe
ASTM C654	(2011) Porous Concrete Pipe
ASTM C654M	(2011) Porous Concrete Pipe (Metric)
ASTM C700	(2018; R 2022) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM D2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F667/F667M	(2016; R 2021) Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F758	(2014) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for

	Highway, Airport, and Similar Drainage
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.2 SYSTEM DESCRIPTION

1.2.1 Extent

Furnish and install foundation drainage as a complete system [to 1.5 m 5 feet beyond the building] [as shown].

1.2.2 Outlet Connections

[Connect foundation pipe to the storm drainage system as shown and specified in Section 33 40 00 STORMWATER UTILITIES.] [Terminate foundation pipe as shown.]

1.2.3 Drainage Lines

Construct drainage lines of drain tile, perforated pipe, or porous pipe.

1.2.4 Outlet Lines

Construct outlet lines of closed-joint nonperforated, nonporous pipe.

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification

and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Materials.

SD-07 Certificates

Materials.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect materials placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Do not expose plastic pipe to direct sunlight for more than 6 months from time of manufacturer to installation.

PART 2 PRODUCTS

2.1 MATERIALS

****

NOTE: Select materials for contract requirements. Correlate material with other sections. When design requires pipe to be of a particular quality, strength, or bituminous coated, acceptable options should be retained and specification requirements modified accordingly. Thickness of metal pipe will be shown on the drawings. Drain tile should not be used for drains crossing or adjacent to paved areas. Special-quality concrete drain tile should be specified for tile laid in soils that are acidic or contain unusual quantities of sulfates; porous concrete pipe and perforated corrugated aluminum alloy pipe will not be used. Where required by soil or water conditions, perforated asbestos-cement pipes should be specified by types.

****

Provide pipe for foundation drainage system of the type and size indicated. Use appropriate transitions, adapters, or joint details where pipes of different types or materials are connected. Submit two randomly selected samples of each type of pipe and fitting, prior to delivery of materials to the site, and certifications from the manufacturers attesting that materials meet specification requirements.

2.1.1 Clay Pipe

ASTM C700, standard or extra strength.

2.1.2 Perforated Clay Pipe

ASTM C700, standard or extra strength.

2.1.3 Concrete Pipe

Conform to ASTM C14MASTM C14, Class [1][2][3].

2.1.4 Perforated Concrete Pipe

Conform to ASTM C14MASTM C14, Class [1][2][3] with perforations conforming to ASTM C444MASTM C444, Type [I][II].

2.1.5 Porous Concrete Pipe

Conform to ASTM C654MASTM C654, standard or extra strength class.

2.1.6 Clay Drain Tile

ASTM C4, [standard][extra-quality][heavy-duty] class.

2.1.7 Perforated Clay Drain Tile

ASTM C4, [standard][extra-quality][heavy-duty] class.

2.1.8 Concrete Drain Tile

Conform to ASTM C412MASTM C412, [standard-][special-][extra-][heavy-duty-extra-]quality.

2.1.9 Cast-Iron Soil Pipe

ASTM A74, [extra-heavy][service].

2.1.10 Perforated Corrugated Steel Pipe

ASTM A760/A760M, Type III.

2.1.11 Perforated Corrugated Aluminum Alloy Pipe

ASTM B745/B745M Type III, Class [I] [II].

2.1.12 Perforated Asbestos-Cement Underdrain Pipe

ASTM C508/C508M.

2.1.13 Plastic Pipe

Provide plastic pipe containing ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.13.1 Corrugated Polyethylene (PE) Drainage Pipe

****

NOTE: AASHTO M 252 and AASHTO M 294 both provide

for stiffer pipe than the equivalent ASTM standards. When pipe strength is a critical concern, use the AASHTO standard.

****

Furnish ASTM F667/F667M heavy duty for pipe 80 to 150 mm 3 to 6 inches in diameter inclusive, ASTM F667/F667M for pipe 200 to 600 mm 8 to 24 inches in diameter; or AASHTO M 252 for pipe 80 to 250 mm 3 to 10 inches in diameter or AASHTO M 294 for pipe 300 to 600 mm 12 to 24 inches in diameter. Furnish pipe manufacturer's standard fittings and conforming to the indicated specification.

2.1.13.2 Acrylonitrile-Butadiene-Styrene (ABS) Pipe

ASTM D2751, with a maximum SDR of 35.

2.1.13.3 Polyvinyl Chloride (PVC) Pipe

ASTM F758, Type PS 46, ASTM D3034, or ASTM F949 with a minimum pipe stiffness of 317 kPa46 psi.

2.1.13.4 Circular Perforations in Plastic Pipe

****

NOTE: Perforation and slot sizing is based on embedment gradation, flow requirements, and structural considerations. The embedment material gradation is in turn based on the gradation of the surrounding soil. To minimize the migration of fines into the coarser material, while maintaining adequate permeability, the following criteria should be met:

a. All soils except clays without a sand or silt fraction must meet the following requirements:

(15 percent size of drainage or filter material)/(85 percent size of material to be drained) less than or equal to 5

(50 percent size of drainage or filter material)/(50 percent size of material to be drained) less than or equal to 25

b. Clays without a sand or silt fraction must meet the following requirements:

(15 percent size of drainage or filter material)/(85 percent size of material to be drained) less than or equal to 5

15 percent size of drainage or filter material less than or equal to 0.4 mm

c. All soils, in addition to the previous requirements, must meet the following requirements:

(15 percent size of drainage or filter material)/(15 percent size of material to be drained) less than or

equal to 5

(85 percent size of drainage or filter material)/(slot width) greater than or equal to 1.2 mm

(85 percent size of drainage or filter material)/(hole diameter) greater than or equal to 1.0

****

Cleanly cut circular holes no more than 8 mm 5/16 inch or less than 5 mm 3/16 inch in diameter, and arrange in rows parallel to the longitudinal axis of the pipe. Place perforations approximately 75 mm 3 inches apart, center-to-center, along rows. Place rows approximately 38 mm 1-1/2 inches apart and arrange in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. Space rows no more than 155 degrees of circumference. Do not perforate the spigot or tongue end of the pipe for a length equal to the depth of the socket and continue perforations at uniform spacing over the entire length of the pipe. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

2.1.13.5 Slotted Perforations in Plastic Pipe

Cleanly cut circumferential slots so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots exceeding 3 mm 1/8 inch or less than 0.79 mm 1/32 inch is not permitted. Length of individual slots exceeding 32 mm 1-1/4 inches on 75 mm 3 inch diameter tubing is not permitted; 10 percent of the tubing inside nominal circumference on 100 to 200 mm 4 to 8 inch diameter tubing; and 65 mm 2-1/2 inches on 250 mm 10 inch diameter tubing. Symmetrically space rows of slots so that they are fully contained in quadrants of the pipe. Center slots in the valleys of the corrugations of profile wall pipe. Provide water inlet area consisting of a minimum of 1058 square mm/linear meter 0.5 square inch/linear foot of tubing. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

2.1.14 Fittings

Provide fittings consisting of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

2.1.15 Cleanouts and Piping Through Walls

Provide cleanout pipe and fittings and piping through walls and footings consisting of cast-iron soil pipe. Each cleanout must have a brass ferrule and a cast-brass screw-jointed plug with socket or raised head for wrench.

2.1.16 Cover and Wrapping Materials for Open Joints in Drain Tile

Cover material may be tar paper, roofing paper, reinforced building paper, glass fiber fabric, or other similar type material. Wrapping material must be 18-14 mesh, 0.25 mm 0.01 inch diameter nonferrous wire cloth.

2.1.17 Bedding and Pervious Backfill for Foundation Drains

Provide bedding and pervious backfill [in accordance with Section 31 00 00 EARTHWORK] [coarse aggregate conforming to ASTM C33/C33M, size number [2.36] [4.75] mm [8] [4] inch] [_____].

2.1.18 Protective Covering for Pervious Backfill

Provide protective covering that is [building paper] [fiberglass mat of lime borosilicate glass fibers. Provide fibers that are 8 to 12 microns in average diameter, 50 to 102 mm 2 to 4 inches in length, and bond with phenol formaldehyde resin. Provide roll type, nonperforated, water permeable mat with thickness between 6 and 13 mm 1/4 and 1/2 inch and density of 12 Kg/cubic meter 3/4 pcf] [filter fabric conforming to Section 33 46 16 SUBDRAINAGE SYSTEM].

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Trenching and Excavation

Perform required trenching and excavation in accordance with Section 31 00 00 EARTHWORK. Keep trenches dry during installation of drainage system. Make changes in direction of drain lines with 1/8 bends. Use wye fittings at intersections.

3.1.2 Bedding

Place graded bedding, minimum 150 mm 6 inches in depth, in the bottom of trench for its full width and length compacted as specified prior to laying of foundation drain pipe. Rest each section firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, fully support the lower quadrant of the pipe.

3.1.3 Pipe Laying

Lay drain lines to true grades and alignment with a continuous fall in the direction of flow. Face bells of pipe sections upgrade. Clean interior of pipe thoroughly before being laid. When drain lines are left open for connection to discharge lines, temporarily close the open ends and mark the location with wooden stakes. Lay perforated pipe with perforations facing down. Remove and relay any length that has had its grade or joints disturbed at no additional cost to the Government. Install perforated corrugated polyethylene drainage tubing and plastic piping in accordance with manufacturer's specifications and as specified herein. Do not install tubing and piping with physical imperfections.

3.1.4 Jointing

3.1.4.1 Perforated and Porous Pipes

Lay perforated and porous types of drain pipes with closed joints.

3.1.4.2 Nonperforated Drain Tile

Lay nonperforated and plain-end drain tile with 3 to 6 mm 1/8 to 1/4 inch open joints. Cover or wrap open joints. Place one thickness of the cover

material over the joint of covered joints. Overlap the joint no less than 100 mm 4 inches on each side and cover the tile for no less than the upper half or more than the upper two-thirds of the circumference of the tile. Use strips of wire cloth wrapping material 75 mm3 inches wide for wrapped joints, with ends fastened together.

3.1.4.3 Perforated Corrugated Metal Pipe

Join perforated corrugated metal pipe sections with standard connecting bands and bolts furnished by the pipe manufacturer.

3.1.4.4 Joints of Concrete or Clay Sewer Pipe

Caulk joints of concrete or clay sewer pipe with oakum and fill solid with cement mortar except where compression joints conforming to ASTM C425 are used on vitrified clay pipe.

3.1.4.5 Joints of Cast-Iron Pipe

Caulk joints of cast-iron pipe or connections between cast-iron and porous concrete pipes with oakum gasket and fill with lead.

3.1.4.6 Perforated Asbestos-Cement Pipe Joints

Make perforated asbestos-cement pipe joints with tapered couplings or with sleeve-type couplings suitable for holding the pipe firmly in alignment without use of sealing compound or gaskets.

3.1.4.7 Plain-End Perforated Clay

Make plain-end perforated clay drain tile joints with spring-wire clips, coated with a rust preventive, that will maintain a taut but elastic joint between sections when laid.

3.1.4.8 ABS Pipe

Join ABS pipe using solvent cement or elastomeric joints and in accordance with ASTM D2751, with dimensions and tolerances in accordance with TABLE II therein.

3.1.4.9 PVC Pipe

Furnish PVC pipe joints in accordance with ASTM D3034, ASTM D3212, or ASTM F949.

3.1.4.10 Corrugated Polyethylene

Furnish corrugated polyethylene (PE) pipe joints in accordance with ASTM F667/F667M or ASTM F667/F667M.

3.1.5 Outlet Lines

The outlet end of drain lines connecting with an open gutter or outfall must be [covered with a removable wire basket of 16-mesh copper or bronze wire cloth fastened with brass or wire straps] [finished as shown].

3.1.6 Cleanouts

Provide cleanouts in locations indicated. Set cleanouts in unpaved areas

in 305 by 305 by 102 mm 12 by 12 by 4 inch concrete blocks.

3.2 Backfilling

After joints and connections have been inspected and approved, place the specified pervious backfill material [a minimum width of 150 mm 6 inches on each side of the pipe or tile] [for the full width of the trench and full width between pipe and adjacent walls] and 300 mm 12 inches above the top of the pipe. Place the backfill preventing displacement of or injury to the pipe or tile. Place a protective covering, as specified, over the pervious backfill for the full width of the trench before regular backfill is placed. Compact backfill as specified in Section 31 00 00 EARTHWORK.

-- End of Section --