UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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05/20

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 33 46 13

FOUNDATION DRAINAGE
05/20

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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).

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PART 1 GENERAL

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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.

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1.1 REFERENCES

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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.

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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	(2017) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A74	(2020) 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) 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 Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C14M	(2020) Standard Specification for 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	(2004; R 2013) 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	(2013) 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	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F667/F667M	(2016) 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

Foundation pipe shall be [connected to the storm drainage system as shown and specified in Section 33 40 00 STORM DRAINAGE] [terminated 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

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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.
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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

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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.
****

Pipe for foundation drainage system shall be 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

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.13.1 Corrugated Polyethylene (PE) Drainage Pipe

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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.

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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. Fittings shall be pipe manufacturer's standard type and shall conform 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

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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

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Circular holes shall be cleanly cut, not more than 8 mm 5/16 inch or less than 5 mm 3/16 inch in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 75 mm 3 inches apart, center-to-center, along rows. The rows shall be approximately 38 mm 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket and perforations shall continue 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

Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 3 mm 1/8 inch or be less than 0.79 mm 1/32 inch. The length of individual slots shall not exceed 32 mm 1-1/4 inches on 75 mm 3 inch diameter tubing; 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. Rows of slots shall be symmetrically spaced so that they are fully contained in quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe. The water inlet area shall be 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

Fittings shall be of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

2.1.15 Cleanouts and Piping Through Walls

Cleanout pipe and fittings and piping through walls and footings shall be cast-iron soil pipe. Each cleanout shall 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 shall be 18-14 mesh, 0.25 mm 0.01 inch diameter nonferrous wire cloth.

2.1.17 Bedding and Pervious Backfill for Foundation Drains

Bedding and pervious backfill shall be [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

Protective covering shall be [building paper] [fiberglass mat of lime borosilicate glass fibers. Fibers shall be 8 to 12 microns in average diameter, 50 to 102 mm 2 to 4 inches in length, and bonded with phenol formaldehyde resin. Mat shall be roll type, nonperforated, water permeable, 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. Changes in direction of drain lines shall be made 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. Each section shall rest firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall 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. Bells of pipe sections shall face upgrade. Clean interior of pipe thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and relaid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.

3.1.4 Jointing

3.1.4.1 Perforated and Porous Pipes

Perforated and porous types of drain pipes shall be laid with closed joints.

3.1.4.2 Nonperforated Drain Tile

Nonperforated and plain-end drain tile shall be laid with 3 to 6 mm 1/8 to 1/4 inch open joints. Open joints shall be covered or wrapped. Covered joints shall have one thickness of the cover material placed over the joint. Material shall overlap the joint not less than 100 mm 4 inches on each side and cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. Strips of wire cloth wrapping material 75 mm3 inches wide shall be used for wrapped joints, with ends fastened together.

3.1.4.3 Perforated Corrugated Metal Pipe

Perforated corrugated metal pipe sections shall be joined with standard connecting bands and bolts furnished by the pipe manufacturer.

3.1.4.4 Joints of Concrete or Clay Sewer Pipe

Joints of concrete or clay sewer pipe shall be caulked with oakum and filled 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

Joints of cast-iron pipe or connections between cast-iron and porous concrete pipes shall be caulked with oakum gasket and filled with lead.

3.1.4.6 Perforated Asbestos-Cement Pipe Joints

Perforated asbestos-cement pipe joints shall be made 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

Plain-end perforated clay drain tile joints shall be made 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

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

3.1.4.9 PVC Pipe

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

3.1.4.10 Corrugated Polyethylene

Corrugated polyethylene (PE) pipe joints shall be 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 shall 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. Cleanouts in unpaved areas shall be set 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 --