ASCE STANDARD

ANSI/ASCE/EWRI 12–13

ANSI/ASCE/EWRI 13–13

ANSI/ASCE/EWRI 14–13

Standard Guidelines for the Design, Installation, and Operation and Maintenance of Urban Subsurface Drainage

This document uses both the International System of Units (SI) and customary units

ASCE

Approved American National Standard ANSI

EWRI ASCE ENVIRONMENTAL & WATER RESOURCES INSTITUTE

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American Society of Civil Engineers

Standard Guidelines for the Design, Installation, and Operation and Maintenance of Urban Subsurface Drainage

Three Complete Standards

Standard Guidelines for the Design of Urban Subsurface Drainage

ANSI/ASCE/EWRI 12-13

Standard Guidelines for the Installation of Urban Subsurface Drainage

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The following standards have been issued:

ANSI/ASCE 1-82 N-725 Guideline for Design and Analysis of Nuclear Safety Related Earth Structures

ASCE/EWRI 2-06 Measurement of Oxygen Transfer in Clean Water

ANSI/ASCE 3-91 Standard for the Structural Design of Composite Slabs and ANSI/ASCE 9-91 Standard Practice for the Construction and Inspection of Composite Slabs

ASCE 4-98 Seismic Analysis of Safety-Related Nuclear Structures

Building Code Requirements for Masonry Structures (ACI 530-02/ASCE 5-02/TMS 402-02) and Specifications for Masonry Structures (ACI 530.1-02/ASCE 6-02/TMS 602-02)

ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures

SEI/ASCE 8-02 Standard Specification for the Design of Cold-Formed Stainless Steel Structural Members

ANSI/ASCE 9-91 listed with ASCE 3-91

ASCE 10-97 Design of Latticed Steel Transmission Structures

SEI/ASCE 11-99 Guideline for Structural Condition Assessment of Existing Buildings

ANSI/ASCE/EWRI 12-13 Standard Guidelines for the Design of Urban Subsurface Drainage

ANSI/ASCE/EWRI 13-13 Standard Guidelines for the Installation of Urban Subsurface Drainage

ANSI/ASCE/EWRI 14-13 Standard Guidelines for the Operation and Maintenance of Urban Subsurface Drainage

ASCE 15-98 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)

ASCE 16-95 Standard for Load Resistance Factor Design (LRFD) of Engineered Wood Construction

ASCE 17-96 Air-Supported Structures

ASCE 18-96 Standard Guidelines for In-Process Oxygen Transfer Testing

ASCE 19-10 Structural Applications of Steel Cables for Buildings

ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations

ANSI/ASCE/T&DI 21-13 Automated People Mover Standards

SEI/ASCE 23-97 Specification for Structural Steel Beams with Web Openings

ASCE/SEI 24-05 Flood Resistant Design and Construction

ASCE/SEI 25-06 Earthquake-Actuated Automatic Gas Shutoff Devices

ASCE 26-97 Standard Practice for Design of Buried Precast Concrete Box Sections

ASCE 27-00 Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction

ASCE 28-00 Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction

ASCE/SEI/SFPE 29-05 Standard Calculation Methods for Structural Fire Protection

SEI/ASCE 30-00 Guideline for Condition Assessment of the Building Envelope

SEI/ASCE 31-03 Seismic Evaluation of Existing Buildings

SEI/ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations

EWRI/ASCE 33-09 Comprehensive Transboundary International Water Quality Management Agreement

EWRI/ASCE 34-01 Standard Guidelines for Artificial Recharge of Ground Water

EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment

CI/ASCE 36-01 Standard Construction Guidelines for Microtunneling

SEI/ASCE 37-02 Design Loads on Structures during Construction

CI/ASCE 38-02 Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data

EWRI/ASCE 39-03 Standard Practice for the Design and Operation of Hail Suppression Projects

ASCE/EWRI 40-03 Regulated Riparian Model Water Code

ASCE/SEI 41-06 Seismic Rehabilitation of Existing Buildings

ASCE/EWRI 42-04 Standard Practice for the Design and Operation of Precipitation Enhancement Projects

ASCE/SEI 43-05 Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities

ASCE/EWRI 44-05 Standard Practice for the Design and Operation of Supercooled Fog Dispersal Projects

ASCE/EWRI 45-05 Standard Guidelines for the Design of Urban Stormwater Systems

ASCE/EWRI 46-05 Standard Guidelines for the Installation of Urban Stormwater Systems

ASCE/EWRI 47-05 Standard Guidelines for the Operation and Maintenance of Urban Stormwater Systems

ASCE/SEI 48-11 Design of Steel Transmission Pole Structures

ASCE/SEI 49-07 Wind Tunnel Testing for Buildings and Other Structures

ASCE/EWRI 50-08 Standard Guideline for Fitting Saturated Hydraulic Conductivity Using Probability Density Functions

ASCE/EWRI 51-08 Standard Guideline for Calculating the Effective Saturated Hydraulic Conductivity

ASCE/SEI 52-10 Design of Fiberglass-Reinforced Plastic (FRP) Stacks

ASCE/G-I 53-10 Compaction Grouting Consensus Guide

ASCE/EWRI 54-10 Standard Guideline for Geostatistical Estimation and Block-Averaging of Homogeneous and Isotropic Saturated Hydraulic Conductivity

ASCE/SEI 55-10 Tensile Membrane Structures

ANSI/ASCE/EWRI 56-10 Guidelines for the Physical Security of Water Utilities

ANSI/ASCE/EWRI 57-10 Guidelines for the Physical Security of Wastewater/Stormwater Utilities

ASCE/T&DI/ICPI 58-10 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways

ASCE/SEI 59-11 Blast Protection of Buildings

ASCE/EWRI 60-12 Guidelines for Development of Effective Water Sharing Agreement

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ASCE STANDARD ANSI/ASCE/EWRI 12-13

American Society of Civil Engineers

Standard Guidelines for the Design of Urban Subsurface Drainage

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FOREWORD

The Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee and reviewing during a public comment period. All standards are updated or reaffirmed by the same process at intervals between five and 10 years. Requests for formal interpretations shall be processed in accordance with Section 7 of *ASCE Rules for Standards Committees,* which are available at www.asce.org. Errata, addenda, supplements, and interpretations, if any, for these standard guidelines can also be found at www.asce.org.

The *Standard Guidelines for the Design of Urban Subsurface Drainage* is a companion to the *Standard Guidelines for the Installation of Urban Subsurface Drainage* and *Standard Guidelines for the Operation and Maintenance of Urban Subsurface Drainage.* These standard guidelines were developed by the Urban Drainage Standards Committee, which is responsible to the Environmental and Water Resources Institute of the American Society of Civil Engineers.

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The American Society of Civil Engineers (ASCE) acknowledges the work of the Urban Drainage Standards Committee of the Environmental and Water Resources Institute of ASCE (EWRI of ASCE).

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The corresponding editor recognizes the following committee members who were particularly helpful in updating the standard guidelines: Jeffrey S. Glenn, Jay M. Herskowitz, Conrad G. Keyes, Jr., James H. Lenhart, and William J. Weaver.

CHAPTER 1
SCOPE

The intent of these standard guidelines is to present state-of-the-art design guidance for urban subsurface drainage in a logical order. It updates ASCE/EWRI 12-05 *Standard Guidelines for the Design of Urban Subsurface Drainage* with material developed within the past five years. The collection and conveyance of subsurface drainage waters are within the purview of these standard guidelines for applications such as airports; roads; other transportation systems; and industrial, commercial, residential, and recreational areas. Incidental surface water is considered.

These standard guidelines do not address agricultural drainage, landfills, recharge systems, detention ponds, conventional storm sewer design, or the use of injection systems.

Customary units and standard international (SI) units are used throughout this document.

1.1 APPLICABLE STANDARDS

The following standards are available from the offices of the cited organization: American Association of State Highway Officials (AASHTO) in Washington DC; American National Standards Institute/American Water Works Association documents from AWWA in Denver, Colorado; American Society of Civil Engineers (ASCE) in Reston, Virginia; and ASTM International (ASTM) in West Conshohocken, Pennsylvania. The standards are mentioned in these guidelines in the sections where they are applicable.

The ASTM standard and comparable AASHTO standard for a product are frequently identical; however, there may be some differences, especially when AASHTO standards lag behind ASTM standard revisions. If a separate metric edition of a standard exists, its designation includes the letter M (e.g., C444M).

AASHTO, *Standard Specifications for Highway Bridges*, HB-17, 17th Ed., 2002.

AASHTO, *Standard Specification for Fine Aggregate for Hydraulic Cement Concrete*, M6, 2008.

AASHTO, *Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes*, M145-91, 2004.

AASHTO, *Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe*, M190-04, 2004.

AASHTO, *Standard Practice for Corrugated Polyethylene Drainage Pipe*, M252-09, 2009.

AASHTO, *Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers*, M259/M259M-00, 2004.

AASHTO, *Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Feet (0.6 m) of Cover Subjected to Highway Loading*, M273/M273M-00, 2004.

AASHTO, *Standard Specification for Steel Sheet, Aluminum Coated (Type 2), for Corrugated Steel Pipe*, M274-87, 2004.

AASHTO, *Standard Practice for Corrugated Polyethylene Pipe 300- to 1500-mm (12- to 60-in.)*, M294-10, 2010.

AASHTO, *Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter*, MP 20-10, 2010.

American National Standards Institute/American Water Works Association (ANSI/AWWA) C300-04: *Reinforced Concrete Pressure Pipe, Steel Cylinder Type*, 2004.

ANSI/AWWA C301-07: *Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids*, 2007.

ANSI/AWWA C302-04: *Reinforced Concrete Pressure Pipe, Noncylinder Type*, 2004.

ANSI/AWWA C303-08: *Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type*, 2009.

ANSI/AWWA C900-07: *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. (100-mm Through 300-mm), for Water Transmission and Distribution*, 2007.

ANSI/AWWA C905-10: *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in. (350-mm Through 1200-mm), for Water Transmission and Distribution*, 2010.

ASCE, *Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations*, Standard 15-98, 1998.

ASCE, *Standard Practice for Direct Design of Buried Precast Concrete Box Sections*, Standard 26-97, 1997.

ASCE, *Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction*, Standard 27-00, 2000.

ASCE, *Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction*, Standard 28-00, 2000.

ASCE, *Comprehensive Transboundary Water Quality Management Agreement*, Standard 33-09, 2009.

ASTM, *Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Appurtenances*, A796/A796M-10, 2010.

ASTM, *Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe*, A849-10, 2010.

ASTM, *Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile*, C4-04, 2009.

ASTM, *Standard Specification for Installing Vitrified Clay Pipe Lines*, C12-09, 2009.

ASTM, *Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe*, C14-07/C14M-07, 2007.

American Society of Civil Engineers

Standard Guidelines for the Installation of Urban Subsurface Drainage

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FOREWORD

The Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee and reviewing during a public comment period. All standards are updated or reaffirmed by the same process at intervals between five and 10 years. Requests for formal interpretations shall be processed in accordance with Section 7 of *ASCE Rules for Standards Committees,* which are available at www.asce.org. Errata, addenda, supplements, and interpretations, if any, for these standard guidelines can also be found at www.asce.org.

The *Standard Guidelines for the Installation of Urban Subsurface Drainage* is a companion to the *Standard Guidelines for the Design of Urban Subsurface Drainage* and *Standard Guidelines for the Operation and Maintenance of Urban Subsurface Drainage.* These standard guidelines were developed by the Urban Drainage Standards Committee, which is responsible to the Environmental and Water Resources Institute of the American Society of Civil Engineers.

The provisions of this document are written in permissive language and, as such, offer the user a series of options or instructions but do not prescribe a specific course of action. Significant judgment is left to the user of this document.

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CHAPTER 1
SCOPE

The intent of these standard guidelines is to present installation and construction guidance for urban subsurface drainage systems. It updates ASCE/EWRI 13-05 with material developed within the past five years. The collection and conveyance of subsurface drainage waters are within the purview of these standard guidelines for applications such as airports, roads, and other commercial transportation systems and for industrial, residential, and recreational areas. Incidental surface water is considered.

These standard guidelines do not address agricultural drainage, landfills, recharge systems, detention ponds, conventional storm sewer systems, or the use of injection systems.

Customary units and standard international (SI) units are used throughout this document.

1.1 APPLICABLE STANDARDS

Standards, including those applicable to these guidelines, are given in 1.1 of ANSI/ASCE/EWRI 12.

CHAPTER 2
DEFINITIONS

2.1 GENERAL

This chapter defines specific terms for use in these guidelines. References included in Section 10 of ANSI/ASCE/EWRI 12 may also be helpful in understanding the terms of these guidelines.

2.2 TERMS

Bedding—Granular material placed around subsurface drains to provide structural support for the drain.

Drain envelope—Generic name for materials placed on or around a drainage product, regardless of whether used for mechanical support (bedding), hydraulic purposes (hydraulic envelope), or stabilizing surrounding soil material (filter envelope).

Filter envelope—Permeable material placed around a drainage product to stabilize the structure of the surrounding soil material. A filter envelope may initially allow some fines and colloidal material to pass through it and into the drain.

Geocomposite—Geosynthetic materials for collecting and transporting water while maintaining soil stability.

Geomembrane—Sheet materials intended to form an impervious barrier.

Geosynthetic—Synthetic material or structure used as an integral part of a project, structure, or system. Within this category are subsurface drainage and water control materials such as geomembranes, geotextiles, and geocomposites.

Geotextile—Woven or nonwoven engineering fabric sheet material intended to allow the passage of water (but not fines and without collecting fines at the soil–textile interface).

Grade—May refer to either (1) the slope of the drain in vertical units/horizontal units, or (2) the specified vertical location of the drain, depending on the context in which it is used.

Hydraulic envelope—Permeable material placed around a drainage product to improve flow conditions in the area immediately adjacent to the drain.

OSHA—Occupational Safety and Health Administration, the federal agency responsible for safety and health concerns on construction job sites.

Subsurface water—All water beneath the ground or pavement surface. Sometimes referred to as groundwater.

American Society of Civil Engineers

Standard Guidelines for the Operation and Maintenance of Urban Subsurface Drainage

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CHAPTER 1
SCOPE

The intent of these standard guidelines is to present operation and maintenance guidance for urban subsurface drainage systems. It updates ASCE/EWRI 14-05 with material developed within the past five years. The collection and conveyance of subsurface drainage waters are within the purview of these standard guidelines for applications such as airports, roads, and other commercial transportation systems and for industrial, residential, and recreational areas. Incidental surface water is considered.

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Bedding—Support for pipe during the construction process.

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Hydraulic envelope—Permeable material placed around a drainage product to improve flow conditions in the area immediately adjacent to the drain.

Inspection—Critical examination to determine conformance to applicable quality standards or specifications.

Iron ochre—Red or yellow gelatinous deposit formed by a combination of soluble iron deposits and bacteria.

Jetting—Method used to clean pipes involving high-pressure water.

OSHA—Occupational Safety and Health Administration, United States Department of Labor, the United States federal agency responsible for safety and health concerns on construction job sites.

Rodding—Method used to clean pipes involving mechanical means.

Record drawing—Drawings prepared during or after construction showing the final measurements of construction, including any deviations from the design drawings and certain other field observations such as tie-in locations.

Subsurface water—All water beneath the ground or pavement surface, sometimes referred to as groundwater.

USEPA—United States Environmental Protection Agency.