typically require a structural rock base with structural fill between the chambers to transfer load to the subbase. Infiltration rates depend on the rates of the underlying native soils. Storage is based on the sum of the chamber volume and structural rock void. Where used, design is based on regulatory guidelines, and typically pretreatment of runoff entering the system of chambers is required to prevent clogging and reduced infiltration rates.

8.3 OTHER MATERIALS AND PRODUCTS

Some national standard specifications for geocomposites, geonets, geomembranes, geotextiles, aggregates, and wick drains (also called chimney or vertical strip drains) are listed below. Numerous additional standards for geomembranes and geotextiles exist, which the reader can locate at the standards organizations.

- ASTM C136, *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*, covers the determination of the particle size distribution of fine and coarse aggregates by sieving.
- ASTM D459, *Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method*, covers a procedure for determining the conformance of geosynthetic properties to standard specifications.
- ASTM D4716, *Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head*, covers a procedure for determining the flow rate per unit width within the manufactured plane of geosynthetics under varying normal compressive stresses and a constant head.
- ASTM D4751, *Standard Test Method for Determining Apparent Opening Size of a Geotextile*, gives a test method used to determine the apparent opening size (AOS) of a geotextile by sieving glass beads through a geotextile.
- ASTM D4759, *Standard Practice for Determining the Specification Conformance of Geosynthetics*, covers the measurement of tensile properties of geotextiles using a wide-width strip specimen tensile method. This test method is applicable to most geotextiles that include woven fabrics, nonwoven fabrics, layered fabrics, knit fabrics, and felts that are used for geotextile application.
- ASTM D5199, *Standard Test Method for Measuring the Nominal Thickness of Geosynthetics*, covers the measurement of the nominal thickness of geotextiles, smooth-surfaced geomembranes, geonets, and geocomposite drainage products.
- ASTM D5262, *Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics,* gives a test method for use in determining the unconfined tension creep and creep rupture behavior of geosynthetics at constant temperature when subjected to a sustained tensile loading.
- ASTM D6088, *Standard Practice for Installation of Geocomposite Pavement Drains*, covers recommendations and identifies pertinent areas of consideration for the installation of buried geocomposite drains used for highway edge drains, underdrains, or other pavement drainage applications meeting the requirement of ASTM D7001.
- ASTM D6244, *Standard Test Method for Vertical Compression of Geocomposite Pavement Panel Drains*, covers vertical strain and core area change of geocomposite pavement drains, such as those included in ASTM D7001, under vertical compression.
- ASTM D6364, *Standard Test Method for Determining Short-Term Compression Behavior of Geosynthetics*, covers procedures for evaluation of the deformations of a geosynthetic or combination of geosynthetics (i.e., certain geocomposites) under short-term compressive loading.
- ASTM D6707, *Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications*, covers circular-knit geotextiles for use on the outside of perforated pipes and Class B geocomposites per ASTM D7001 in drainage applications.
- ASTM D6917, *Standard Guide for Selection of Test Methods for Prefabricated Vertical Drains (PVD)*, provides recommendations for the selection of appropriate test methods for prefabricated vertical geocomposite drains (sometimes referred to as wick drains) used in geotechnical engineering applications to provide consistency in data reporting.
- ASTM D6918, *Standard Test Method for Testing Vertical Strip Drains in the Crimped Condition*, gives a performance test that measures the effect crimping has on the ability of vertical strip drains to transmit water parallel to the plane of the drain.
- ASTM D7001, *Standard Specification for Geocomposites for Pavement Edge Drains and Other High-Flow Applications*, covers geocomposite drainage panels used in highway, turf, and other high-volume subsurface drainage applications. These products consist of a geotextile wrapped around a polymer core, a minimum of 25 mm (1 in.) thick and available in 150-mm (6-in.), 300-mm (12-in.), 450-mm (18-in.), and 600-mm (24-in.) widths.
- ASTM D7005, *Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites*, defines a procedure for comparing the bond strength or ply adhesion of geocomposites.
- ASTM D7273, *Standard Guide for Acceptance Testing Requirements for Geonets and Geonet Drainage Geocomposites*, covers guidelines for the acceptance testing frequency requirements for geonet and geonet drainage geocomposite materials, describing types of tests, test methods, and recommended verifications.
- ASTM D7498, *Standard Test Method for Vertical Strip Drains Using a Large-Scale Consolidation Test*, gives a performance test that measures the effectiveness of vertical strip drains on the time rates of consolidation of compressible soils from construction project sites.

CHAPTER 9
CODES AND PERMITS

9.1 GENERAL

In the concept stages of an urban subsurface drainage project, preferably before the site analysis and system configuration phases, obtaining copies and an understanding of all applicable federal, state, and local codes is important. At the same time, all federal, state, and local permits for the project should be identified, and the requirements and submittal timing of each clearly understood.

9.2 CODES

Federal, state, and local codes that apply to the design, construction, and operation of an urban subsurface drainage system should be considered.

9.3 PERMITS

Federal, state, and local temporary permits that are necessary prior to and during construction of an urban subsurface drainage system project should be secured by the owner, owner's agent, or contractor prior to construction. Any permanent permits, such as the Corps of Engineers' 404 Permit, which must be maintained after construction of the project, should be secured by the owner and/or the owner's agent.

A copy of any temporary and permanent permits secured by the owner or owner's agent should be included as part of the contract documents. Copies of all permits secured by the owner's agent or the contractor should be furnished to the owner.

The contractor is responsible for conforming to the terms and provisions of all permits during construction as stated in the contract documents.

CHAPTER 10
REFERENCES

10.1 CITED REFERENCES

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