

SECTION 33 49 23
STORM DRAINAGE WATER RETENTION STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes stormwater drainage systems for building roof drainage and site area drainage.
- B. Work includes the installation of the StormTech chamber drainage system.
- C. Related work includes the installation of drainage inlet structures, manholes and outlet structures.

1.02 RELATED SECTIONS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples
- B. Section 02 50 00 Site Remediation
- C. Section 03 30 00 Cast-in-Place Concrete
- D. Section 31 20 00 Earth Moving
- E. Section 31 25 00 Erosion and Sedimentation Controls
- F. Section 33 01 10 Operation and Maintenance of Water Utilities
- G. Section 33 41 00 Storm Utility Drainage Piping
- H. Section 33 49 13 Storm Drainage Manholes, Frames and Covers

1.03 ABBREVIATIONS

- A. PP: Polypropylene
- B. HDPE: High Density Polyethylene
- C. PE: Polyethylene
- D. PVC: Polyvinyl Chloride
- E. ASTM – American Society for Testing and Materials
- F. AASHTO – American Association of State Highway and Transportation Officials

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- G. ADS – Advanced Drainage Systems Inc.
- H. TSS – Total Suspending Solids

1.04 DEFINITIONS

- A. Stormwater Chamber System: All products associated with the drainage system including but not limited to chambers, end caps, pipe, fittings, stone, geotextile, and drainage structures.
- B. Subsurface Drainage System: Refers to the StormTech subsurface stormwater chamber system.
- C. Manifolds and manifold piping refer to the piping system to inlet and outlet rows of chambers.
- D. STORMTECH brand name is referred to as CHAMBER MANUFACTURER hereafter.
- E. ADS and HANCOR brand names are considered interchangeable within this section.

1.05 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO LRFD Bridge Design Specifications Section 3 – Loads and Load Factors
 - 2. AASHTO LRFD Bridge Design Specifications Section 12 – Buried Structures and Tunnel Liners
 - 3. AASHTO M 43 – Standard Specification for Sizes of Aggregate for Road and Bridge Construction
 - 4. AASHTO M 288 – Standard Specification for Geotextile Specification for Highway Applications
 - 5. AASHTO M 294 – Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM F 2418 or F 2922 Standard Specification for Polypropylene (PP) or Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers
 - 2. ASTM F 2787 Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers
 - 3. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 4. ASTM F 2306 – Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings
 - 1. A preinstallation meeting between StormTech representative and general contractor is recommended to discuss the chamber system installation.
 - a. StormTech offer installation consultations to installing contractors.

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- b. Contact StormTech at least 30 days prior to system installation to arrange a pre-installation consultation.

B. Sequencing

1. Contractor is responsible for coordinating the installation of the subsurface stormwater chamber system with the installation of permanent structures on site.
 - a. Construction loads for permanent structures may require the subsurface chamber system to be installed after the permanent structure(s) on site.
2. Coordinate stormwater chamber system connections to off site storm sewer with the appropriate agency having jurisdiction.
3. Coordinate stormwater chamber system connections to existing on-site storm sewer
4. Coordinate with building roof drainage systems
5. Coordinate with other utility work.

1.07 SUBMITTALS

The following shall be submitted by contractor in accordance with Section 01 33 00 Submittal Procedures:

- A. Product Specifications for the following:
 1. StormTech chambers and end caps
 2. ADS PE pipe
- B. Product Installation Instructions for the following:
 1. StormTech chambers and end caps
 2. ADS PE pipe
- C. Inspection and Maintenance Instructions for the following:
 1. StormTech Isolator™ Row

1.08 QUALITY ASSURANCE

- A. Regulatory Agency Approvals:
 1. Environmental agency compliance: Comply with regulations pertaining to storm drainage systems.
 2. Utility Compliance: Comply with regulations pertaining to storm drainage systems. Include standards of water and other utilities where appropriate.
- B. Qualifications
 1. Manufacturers
 - a. All chamber and end cap products must be produced in an ISO 9001 certified manufacturing facility or shall demonstrate at least 5 years of experience in the production of similar products.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall check all materials upon delivery to assure that the proper chamber size and plastic pipe and pipe fittings have been received.

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- B. Contractor shall check the chambers for shipping damage prior to installation. Units that have been damaged must not be installed. Contractor shall contact chamber manufacturer immediately upon discovery of any damage. Chambers may be left palletized until the units are ready to be installed.
- C. All chambers, pipe and pipe fittings shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care.
- D. Protect chamber and chamber fittings from dirt and damage.
- E. All pipe and chambers shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of the pipe on the job shall be in accordance with the pipe manufacturer's recommendations.
- F. Contractor shall refer to the fabric manufacturer's guidance handling and storage of fabric products on site.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers
 - 1. StormTech, Inc.
 - 2. Advanced Drainage Systems, Inc.
 - 3. Hancor, Inc.

2.02 STORMWATER CHAMBER SYSTEM

- A. Chamber Options
 - 1. Only stormwater chamber systems evaluated by a licensed design engineer and found to meet AASHTO section 12.12 safety factors are allowed.
 - 2. Stormwater chambers must be designed in accordance with ASTM F 2418-16a or F 2922 Standard Specification for Polypropylene (PP) or Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers
 - 3. The structural design of the chambers, the structural backfill, and the installation requirements shall ensure that the load factors specified in the aashto LFRD bridge design specifications, section 12.12, are met for: 1) Long-duration dead loads and 2) Short-duration live loads, based on the aashto design truck with consideration for impact and multiple vehicle presences.
 - 4. Stormwater chambers shall be designed, tested and allowable load configurations determined in accordance with ASTM F 2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers". Load configurations shall include: 1) Instantaneous (<1 min) AASHTO design truck live load on minimum cover 2) Maximum permanent (75-yr) cover load and 3) Allowable cover with parked (1-week) AASHTO design truck.

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5. Chamber systems allowed under this specification include:
 - a. StormTech SC-160LP
 - b. StormTech SC-310
 - c. StormTech SC-740
 - d. StormTech DC-780
 - e. StormTech MC-3500
 - f. StormTech MC-4500

B. Performance

1. Requirements for handling and installation:
 - a. To maintain the width of chambers during shipping and handling, chambers shall have integral, interlocking stacking lugs.
 - b. To ensure a secure joint during installation and backfill, the height of the chamber joint shall not be less than:

SC-160LP	1.5 in.
SC-310	2 in.
SC-740	2 in.
DC-780	2 in.
MC-3500	3 in.
MC-4500	3 in.
 - c. To ensure the integrity of the arch shape during installation, a) The arch stiffness constant as defined in section 6.2.8 of ASTM F 2922 shall be greater than or equal to:

SC-160LP	400 lbs/in/in.
SC-310	400 lbs/in/in.
SC-740	550 lbs/in/in.
DC-780	550 lbs/in/in.
MC-3500	500 lbs/in/in.
MC-4500	500 lbs/in/in.

And b) To resist chamber deformation during installation at elevated temperatures (above 73° f / 23° c), chambers shall be produced from reflective gold or yellow colors.
2. Only chambers that are approved by the site design engineer will be allowed. Upon request by the site design engineer or owner, the chamber manufacturer shall submit a structural evaluation for approval before delivering chambers to the project site as follows:
 - a. The structural evaluation shall be sealed by a registered professional engineer.
 - b. The structural evaluation shall demonstrate that the safety factors are greater than or equal to 1.95 for dead load and 1.75 for live load, the minimum required by ASTM F 2787 and by sections 3 and 12.12 of the AASHTO LFRD bridge design specifications for thermoplastic pipe.
 - c. The test derived creep modulus as specified in ASTM F 2922 shall be used for permanent dead load design except that it shall be the 75-year modulus used for design.

3. Only mechanical and material properties that were determined in accordance with ASTM test methods shall be allowed for structural design of the chambers.
4. Only chambers affixed with the ASTM F 2418-16a or F 2922 designation shall be considered as meeting ASTM F 2418-16a or F 2922.
5. Performance of the stormwater treatment system shall be in accordance with Section 2.03 of this specification.
6. The contractor shall submit design summary by the manufacturer that demonstrates that the system is designed to convey peak flow rates without scour of foundation stone.

C. Materials

1. Chamber

- a. Chambers shall be arch-shaped and shall be manufactured from virgin, impact-modified polypropylene or polyethylene copolymers.
- b. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels in order to provide ease of access for inspection and maintenance functions.
- c. Inspection ports shall be installed and constructed per project plans. Note that inspection ports shall only be installed along the Isolator™ Row to allow for inspection of the sediment build up over time.
- d. The chambers shall be open-bottomed.
- e. The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be built. Chamber models may be cut at the job site to improve site optimization and reduce product waste.

2. Chambers and end caps shall be produced at an ISO 9001 certified manufacturing facility.

3. End Caps

- a. End caps shall be injection molded or roto molded from polyethylene or polypropylene resin and allow pipe connections with polyethylene pipe. End caps shall have a curved face capable of resisting typical horizontal and vertical loads. End caps for MC-3500 and MC-4500 chambers shall be corrugated.
- b. All chamber rows shall be terminated with an end cap. End cap placement on end of chamber will vary depending on chamber model.
- c. End caps may incorporate cutting guides to allow easy field cutting for various diameters of pipe. Cutting guides shall be located at both the top and bottom of each end cap.

4. Manifold Piping

- a. Manifold piping shall be designed to ensure that peak flows are distributed to the rows of chambers without scour of foundation stone.
- b. Manifold piping shall be of dual wall HDPE piping such that accepted equations of hydraulics can be used as a basis for design.

5. Stone

- a. The foundation, embedment and cover stone shall be in accordance with the chamber manufacturer's installation instructions.

6. Fabric

- a. Fabric between the chamber bottom and the stone foundation located along the entire length of the Isolator Row and the first 10.5 ft (SC-310, SC-740, DC-780) or 14.5 ft (MC-3500, MC-4500) of all inlet rows. Fabric shall be AASHTO M288 Class 1 Woven for sediment capture, filtration and scour protection.

- b. Fabric between the top of the Isolator Row chambers and the embedment stone and surrounding the entire chamber system shall be AASHTO M288 Class 2 Non-Woven for filtration. (not required over DC-780, MC-3500, or MC-4500 Isolator Row)
- c. If required, a thermoplastic liner may be installed around the entire system to prevent water migration. See manufacturer's Tech Sheet #2 for guidance on thermoplastic liners for the system.

2.03 STORMWATER TREATMENT SYSTEMS

- A. The stormwater chamber system shall incorporate an Isolator Row for stormwater treatment and system maintenance. An Isolator Row is a chamber row enclosed in geotextile fabric for sediment capture and maintenance.
- B. The stormwater treatment system shall remove a minimum of 80% of Total Suspended Solids (TSS), 80% Total Petroleum Hydrocarbons (TPH), 80% Suspended Sediment Concentration, 60% Total Phosphorus, and 60% Total Zinc as verified by 3rd party testing.
- C. Stormwater treatment system inspection and maintenance shall be in accordance with section 3 of this specification and the product manufacturer's published guidance.

2.04 ACCESSORIES

- A. Spacers can be used to obtain the required minimum spacing between chamber rows.
- B. During construction FlexStorm Catch It inlet filters or pipe plugs on all inlet pipes to the stormwater chamber system can be used to prevent construction sediment from entering the Isolator Row system. Pipe plugs to be removed once construction of the system is complete and no further construction sediment loading is expected.

PART 3 EXECUTION

3.01 PREPARATION

- A. General
 - 1. Installing contractors are required to use and understand the latest manufacturer's installation instructions prior to beginning system installation.
 - a. See Section 1.06 for manufacturer preinstallation meeting information.
 - b. Chamber products must be designed and installed in accordance with the manufacturer's minimum requirements. Failure to do so will void the manufacturer's limited warranty.
 - 2. The contractor shall install all drainage structures, pipe and chambers in the locations shown on the design engineer's drawings and/or as approved by the Owner. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.
 - 3. Chambers, pipe and drainage structures shall be inspected prior to installation and any defective or damaged product shall be replaced accordingly.
 - 4. Contact local underground utility companies prior to construction.

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5. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.

B. Site Preparation

1. Excavation must be free of standing water. Dewatering measures must be taken if required.
 - a. When groundwater is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom.
2. Prepare the chamber bed's subgrade soil as outlined in the engineer's drawings. Requirement for subgrade soil bearing capacity should meet or exceed the chamber manufacturer's required allowable subgrade soil bearing capacity. The contractor must report any discrepancies with subgrade soil's bearing capacity to the design engineer.

3.02 CHAMBER INSTALLATION AND BACKFILLING

- A. Install chamber system flat or at constant slope between points an elevations indicated.
- B. Construct fabric and stone foundation per chamber manufacturer's installation instructions.
- C. Construct the chamber bed by joining the chambers lengthwise in rows. Attach chambers by overlapping the end corrugation of one chamber onto the end corrugation of the last chamber in the row.
- D. See pipe manufacturer's installation instructions for pipe assembly.
- E. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of the chamber manufacturer's installation instructions.
- F. The contractor must refer to the chamber manufacturer's installation instructions for a table of acceptable vehicle loads at various depths of cover. The contractor is responsible for preventing vehicles that exceed the chamber manufacturer's requirements from traveling across or parking over the chamber system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.
- G. Refer to the chamber manufacturer's installation instructions for minimum requirements for backfill material above the stormwater chamber system.
- H. See pipe manufacturer's installation instructions for guidance on installing the plastic pipe fittings to the chamber system.

3.03 PROTECTION

- A. Protect all inlets to the stormwater chamber system during construction. As noted in Section 2.05, pipe plugs in the inlet manhole pipes or FlexStorm Catch It inlet filters may be used to

prevent construction sediments from clogging the system. Once construction has ceased, the pipe plugs are removed to allow normal system functionality.

- B. All inlet and outlet structures should be protected against construction sediments.

3.04 INSPECTION AND MAINTENANCE

- A. As noted in Section 2.02, chambers may incorporate an optional inspection port to allow for inspection of the stormwater system during normal operations.
 - 1. Inspection can also be accomplished through the inlet manhole connected to the Isolator Row which may require confined space entry certification of the inspector.
- B. Refer to the chamber manufacturer's Isolator Row Operation and Maintenance manual for guidance on inspection intervals during normal system operation
- C. Maintenance of the Isolator Row shall utilize a JetVac process to remove sediments that have accumulated in the Isolator Row over time.

END OF SECTION 33 49 23