South Carolina Department of Transportation

Engineering Directive

Directive Number: **ED-24** **Effective Date: March 17, 2014**

Subject: **Selection of Drainage Pipe**

References: **23 Code of Federal Regulations, Part 635.411**

Purpose: **Provide Direction for Selection of Drainage Pipe**

Summary of Changes: **Specifying Corrugated Wall Pipe Is No Longer Mandatory**

This Directive Applies To: **All Employees**

1. Pipe used in highway applications should be designed and constructed in accordance with the standard and site-specific criteria provided in the SCDOT Standard Specifications for Highway Construction (Standard Specifications), Supplemental Technical Specification SC-M-714 (SC-M-714), the Standard Drawings for Roadway Construction (Standard Drawings), the plans, special provisions, contract documents, instructional bulletins, and other engineering directive memorandums.

2. Use the Smooth Wall Pipe pay item on all projects. Include details in the design plans specifying the size, class, type or gage for each acceptable type of smooth wall pipe Reinforced Concrete Pipe (RCP), Spiral Ribbed Aluminum Pipe (SRAP), or High Density Polyethylene Pipe (HDPE).

3. Specifying Corrugated Wall Pipe is no longer mandatory. If Corrugated Aluminum Alloy Pipe (CAAP) is selected for use, specify CAAP as an alternate or show it as a normal pay item by selecting the Corrugated Wall Pipe pay item. Include details specifying the size and gage in the plans.

4. These procedures are for the selection of standard drainage pipe (12-inch diameter and larger) for use in the maintenance and construction of roads in the state highway system. Install permanent pipe to obtain the maximum service life of the pipe material used. Install temporary pipe to obtain the service life required of the application.

5. Permanent Applications.

   a. Use pipe structural backfill material for all pipes meeting the material and installation properties listed in SC-M-714.

   b. The following pipe materials are allowable.

      (1) Smooth Wall Pipe.

         (a) Reinforced Concrete Pipe (RCP) – see Qualified Products List (QPL) 69. RCP is an allowable permanent pipe type. RCP is a rigid pipe that must meet the requirements of AASHTO M 170. Joint material and details should meet the requirements of SC-M-714 and the Standard Drawings for the joint type specified in the plans. Use a pipe joint detail and sealant material that has been laboratory tested and certified and that is listed on QPL 69. Acceptable minimum and maximum fill

heights are found in the Standard Drawings for this pipe. Install structural backfill and all pipe embedment zone material as indicated in SC-M-714 and the Standard Drawings to protect pipe. A design analysis will be performed when custom pipe is used or when loading or fill heights exceed those published in the Standard Drawing fill height tables.

(b) Spiral Ribbed Aluminum Pipe (SRAP) see QPL 68. SRAP meeting AASHTO M 196 is an allowable permanent pipe type. Gaskets meeting ASTM D 1056 are required on all joints of aluminum alloy pipe. Use a pipe joint detail and sealant material that has been laboratory tested and certified and that is listed on QPL 68. Rerolled ends are permitted. Fully corrugated coupling bands are required and should have fasteners as tested and listed on QPL 68. Acceptable minimum and maximum fill heights are found in the Standard Drawings for this pipe. Install structural backfill and all pipe embedment zone material as indicated in SC-M-714 and the Standard Drawings to protect pipe. A design analysis will be performed when loading or fill heights exceed those published in the Standard Drawing fill height tables.

(c) High Density Polyethylene (HDPE) Pipe – see QPL 30. HDPE pipe (Type S) meeting AASHTO M 294 is an allowable permanent pipe type. Acceptable pipe sizes are those permitted in AASHTO M 294 and shown on Standard Drawings. Only smooth interior wall (Type S) HDPE pipe is approved for permanent applications by the Department. Joints will be bell and spigot type with factory-installed gaskets. Use a pipe joint detail and sealant material that has been laboratory tested, certified, and listed on QPL 30. When the pipe is outside of the roadbed and not affecting the foundation of a structure, including sidewalk, and at the discretion of the engineer, a field splice between sections of pipe with no bell may be constructed with a gasketed split coupling band, wrapped with a geotextile. Care should be taken to minimize the percentage of split coupling bands used on each project. Acceptable minimum and maximum fill heights are found in the Standard Drawings for this pipe. Install structural backfill and all embedment zone material as indicated in SC-M-714 and the Standard Drawings to protect pipe. A design analysis will be performed when loading or fill heights exceed those published in the Standard Drawing fill height tables.

(2) Corrugated Wall Pipe. Corrugated Aluminum Alloy Pipe (CAAP) - see QPL 68. CAAP meeting AASHTO M 196 is an allowable permanent pipe type. Gaskets meeting ASTM D 1056 are required on all joints of aluminum alloy pipe. Use a pipe joint detail and sealant material that has been laboratory tested and certified and that is listed on QPL 68. Rerolled ends are permitted. Fully corrugated coupling bands are required and should have fasteners as tested and listed on QPL 68. Acceptable minimum and maximum fill heights are found in the Standard Drawings for this pipe. Install structural backfill and all pipe embedment zone material as indicated in SC-M-714 and the Standard Drawings to protect pipe. A design analysis will be performed when loading or fill heights exceed those published in the Standard Drawing fill height tables.

6. Temporary Applications.

a. The following pipe materials are allowable.

(1) All types listed above for permanent applications.

(2) Galvanized corrugated steel pipe (CSP), sometimes referred to as corrugated metal pipe (CMP). CSP and CMP, coated or uncoated, are not permitted in permanent installations on South Carolina highways due to the high acidity of South Carolina soils.

CSP may be used only in temporary drainage applications. When used, it shall meet the specifications of AASHTO M 36 and the minimum requirements of the Standard Specifications. Minimum and maximum fill heights will be limited to each CSP pipe manufacturer's recommendations for the loading conditions described in the Standard Drawings.

(3) Polyvinyl chloride (PVC) pipe. When used, it shall meet the material specifications of AASHTO M 304. Minimum and maximum fill heights will be limited to each PVC pipe manufacturer's recommendations for loading conditions described in the Standard Drawings.

(4) Corrugated HDPE pipe – Type C. See the Standard Specifications for material properties.

(5) Other materials approved by the engineer of record or the resident engineer.

b. Follow the pipe manufacturer's fill height recommendations for all pipe used in temporary applications.

7. Other Applications.

a. In some applications, box culverts, floorless culverts, aluminum structural plate pipe, aluminum structural plate arch, or bridges may be preferred. Site environmental conditions may result in the preference of one system over the others.

b. Pipe types not listed in this document may be used for trenchless installations if documentation is provided that shows the structural and hydraulic performance meets or exceeds those parameters for the pipe types listed. Install trenchless pipe in accordance with the special provision, "Trenchless Pipe Installation".

8. Design Considerations.

a. The engineer of record or the designer, in collaboration with the project's hydraulic design lead engineer and the roadway design lead engineer, will determine which pipe types are acceptable on each project to be let to contract. The structural design lead engineer will provide a structural analysis of the pipe when fill heights are outside the limits of the fill height tables found in the Standard Drawings.

(1) Hydraulic Considerations. Design storm sewer applications in accordance with the Department's "Requirements for Hydraulic Design Studies", (latest edition). Analyze each system for smooth wall or corrugated wall pipe where appropriate. Selection of pipe material may be dependent on the availability of the pipe size required to meet the hydraulic design. The Standard Drawings list the most commonly available pipe sizes.

(2) Structural Considerations. Selection of pipe material may be dependent on the loading type, burial depth, or other structural requirements. The Standard Drawings list the maximum burial depths based on common highway loading criteria up to 30 feet, as well as minimum burial depth requirements for both construction and highway loading. When burial depths deeper than 30 feet are required, perform a structural analysis to determine the type and strength of pipe needed. The Standard Drawings list the general requirements for pipe foundations, and specify when improved foundations are required.

(3) Environmental Considerations. The evaluation of abrasion, soil pH, and soil resistivity will not be required in determining the selection of pipe types. If an area has a history of poor pipe performance, investigate to determine the cause of the deficiency. During a field review of the project site, the project development team should observe existing pipe in

the area and discuss with the appropriate maintenance office prior history of pipe performance in the area of the future project.

b. When site conditions indicate poor pipe performance, consult and work with pipe industry professionals to determine an appropriate pipe design. Adverse environmental conditions may result in additional protection being required in the pipe. Additional protection (liners, paved inverts, thicker wall (beyond structural requirements)) should not reduce the hydraulic capacity of the pipe and should allow the pipe to meet required structural capacity after all expected deterioration has occurred. Changes to the inside geometry of the pipe culvert require additional hydraulic analysis by the hydraulic engineer. Extreme environmental conditions beyond those listed above may result in changing the design of the pipe to a box culvert, floorless culvert, aluminum structural plate arch, or bridge.

c. When it is necessary to extend existing pipe within SCDOT rights-of-way or drainage easements, the original pipe type may be used as long as the pipe meets the criteria for permanent pipe as described herein. The responsible engineer for the project shall make an engineering review of the existing pipe to determine that no significant deterioration or functional problems are present throughout the entire length of the existing pipe. The extension of existing pipe must be included in the hydraulic analysis and design of the drainage system.

d. If the existing pipe shows any signs of deterioration or functional problems, repair or replacement of these sections may be necessary. When repair is required, consult with the manufacturer of the pipe type to determine acceptable repair procedures. If replacement is required, use only one of the acceptable permanent pipe types listed in the standard specifications. Always use a standard drainage structure or designed interface at the junction between different pipe types, classes, or details.

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