

SECTION 32 13 13.29
PERVIOUS CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for construction of pervious concrete pavement

1.2 REFERENCE DOCUMENTS

- A. American Society of Testing and Materials

1. ASTM C29 - Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
2. ASTM C33/C33M - Standard Specification for Concrete Aggregates
3. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
4. ASTM C117 - Standard Test Method for Material Finer than 75 um (No. 200) Sieve in Mineral Aggregates by Washing
5. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
6. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units
7. ASTM C150/C150M - Standard Specification for Portland Cement
8. ASTM C172/C172M - Standard Practice for Sampling Fresh Concrete
9. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete
10. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete
11. ASTM C595/C595M - Standard Specifications for Blended Hydraulic Cements
12. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
13. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars
14. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
15. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction
16. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft-lbs.ft³ (2,700 kN-m/m³))
17. ASTM D3385 - Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer
18. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

- B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a (454-kg (10-lb) Rammer and an 457-mm (18-in) Drop

- C. Florida Department of Transportation (FDOT), Standard Specifications for Road and Bridge Construction

1. Section 345-10 Plant and Equipment
2. Section 350-18 Thickness Determinations
3. Section 923-1 -Chemical and Physical Requirements of Water for Concrete

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1.3 QUALITY ASSURANCE SUBMITTALS

- A. Use of an American Concrete Institute Certified Flatwork Finisher is required.
 - 1. Provide a copy of the ACI Certification.
- B. The Contractor shall demonstrate the following previous experience:
 - 1. Completion of at least two pervious concrete projects within the last 2-years:
 - a. Minimum size of each project shall equal or exceed 5,000 square feet.
 - b. Provide location and contact reference for each project.
- C. Schedule a pre-placement meeting with the District Senior Project Administrator or designee.
- D. As an alternate to the required experience, the Contractor may install a test panel to demonstrate expertise.
 - 1. The test panel shall have a surface area of at least 225 sq. ft and the panel thickness shall match the project design thickness.
 - 2. Construct the test panel at any suitable location within the overall project.
 - 3. Check the test panel for thickness and core unit weight in accordance with ASTM C42/C42M.
 - a. Passing thickness results shall be $\frac{1}{4}$ " of the design thickness.
 - b. Passing core unit weight values shall be within 5 lb./cu ft. of the mix design unit weight for hardened density.
 - 4. Check the test panel for required void structure in accordance with ASTM C138/C138M.
 - a. Passing void structure results shall be within 5% of the mix design void percentage.
 - 5. May leave a passing test panel as part of the project but remove a failed panel at the Contractor's expense.
- E. The Contractor shall provide a mix design for review and acceptance prior to construction.
 - 1. The mix design shall include unit weights determined in accordance with ASTM C29.

1.4 WARRANTY

- A. Provide a 1-year warranty for all pervious concrete.
 - 1. The warranty shall commence at the date of beneficial use by the District.
 - 2. The Contractor shall provide a letter, which identifies the warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Forms
 - 1. Use steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
 - 2. Use straight forms, free of distortion and defects.
 - 3. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 4. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.
 - 5. No Earth Forming allowed.
- B. Concrete Materials
 - 1. Cement: Portland Cement Type I or II conforming to ASTM C150/C150M or Portland Cement Type IP or IS conforming to ASTM C595/C595M.
 - 2. Aggregate, shall be Florida Department of Transportation (FDOT) No 8 coarse aggregate (3/8 to No. 16) per ASTM C33/C33M or No. 89 coarse aggregate (3/8 to No. 50) per ASTM D448.

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- a. If using other gradation of aggregate, submit data on proposed material to Owner or Agent for approval.
 3. Air Entraining Agent: Shall comply with ASTM C260/C260M.
 4. Admixtures:
 - a. Type A Water Reducing Admixtures – ASTM C494/C494M
 - b. Type B Retarding – ASTM C494/C494M
 - c. Type D Water Reducing/Retarding – ASTM C494/C494M
 - d. Hydration stabilizer complying with either Type B or D admixture requirements
 5. Water shall be from a potable source and shall comply with FDOT Standard Specifications, Section 923.
 - C. Expansion Joint Materials
 1. Comply with requirements of Sections for performed expansion joint fillers and sealers.
- 2.2 CONCRETE MIX DESIGN
- A. Cement content shall be 500-550 pounds per cubic yard.
 1. Five percent (5%) silica fume is optional and must be part of the mix design.
 - B. Aggregate content shall be not less than 27 cubic feet per cubic yard when determined in accordance with ASTM C29, jiggling method.
 1. Fine aggregate, if used, shall not exceed 3 cubic feet per cubic yard and shall be included in the total aggregate measurement.
 - C. Use admixtures in accordance with the manufacturer's requirements.
 1. All admixtures shall be designed for use in pervious concrete.
 - D. The water / cement ratio (W/C) shall be between 0.32 and 0.37.
 1. Add mix water so that the cement paste displays a wet metallic sheet without causing the paste to flow from the aggregate.

PART 3 EXECUTION

3.1 SITE ACCESS

- A. Maintain site access for related educational and construction functions at all times.

3.2 SUBGRADE

- A. Top six inches of the sub-grade shall be composed of gravel, sand, or a combination thereof.
- B. Test the sub-grade for rate of permeability by double ring infiltrometer, or other suitable test of sub-grade soil permeability.
 1. The tested permeability must reasonably compare to the design permeability.
 2. The compacted soil permeability shall be no less than 1 inch per hour.
- C. The sub-grade shall be compacted by a mechanical vibratory compactor to a maximum density of 92% of a maximum dry density as established by ASTM D1557 or AASHTO T180.
 1. Do not stabilize the subgrade.
- D. The sub-grade shall be in a moist condition (within +3% of the optimum moisture content as determined by the compaction test method of ASTM D1557 or AASHTO T180).
- E. The sub-grade surface shall not slope at a grade in excess of 0.3%.
- F. The sub-grade surface shall be at least two feet about the seasonal high water table elevation.

3.3 EMBANKMENT

- A. If fill material (embankment) is required to bring the sub-grade to final elevation, it shall be clean and free of deleterious materials.

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1. Place in 8-inch maximum layers, and compacted by a mechanical vibratory compactor to a maximum density of 92% of a maximum dry density as established by ASTM D1557 or AASHTO T180.
 - B. Embankment permeability shall be no less than 1 inch per hour.
- 3.4 MIXING
- A. Operate truck mixers at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.
- 3.5 HAULING
- A. Transport to the site or mix the pervious concrete mixture on-site.
 1. Use the pervious concrete within one (1) hour of the introduction of mix water, unless otherwise approved. Increase this time to 90 minutes maximum when utilizing a hydration stabilizer.
- 3.6 DISCHARGE
- A. Inspect each mixer truck for appearance of concrete uniformity according to paragraph 2.2.D.
 - B. May add water to obtain the required mix consistency, but it Contractor is responsible to obtain the proper mixture workability and ensure proper performance of pervious concrete after placement.
 1. Do not add water after the initial tampering of the mix.
 2. A minimum of 20 revolutions at the manufacturer's designated mixing speed shall be required following any addition of water to the mix.
 - C. Discharge shall be a continuous operation and completed as quickly as possible.
 - D. Deposit concrete as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete.
 1. Do not discharge onto sub grade or use pulling or shoveling for final placement.
- 3.7 PLACING AND FINISHING
- A. The Contractor shall provide mechanical equipment of either slip-form or form riding configuration with a towed compaction unit that will provide a minimum of 10-psi vertical force.
 - B. Place the pervious concrete pavement to the required cross section and do not deviate more than +3/8 inch in 10 feet from profile grade.
 - C. If placing equipment does not provide the minimum specified vertical force, use a full width roller or other full width compaction device that provides sufficient compaction effort.
 1. Accomplish compaction immediately following the strike-off operation.
 - D. Do not allow finishing operations after mechanical or other approved strike-off and compaction operations are complete.
 - E. A maximum of ½ in. of pervious concrete shall be compacted to final elevation.
 - F. Immediately stop surface vibration when forward progress stops for any reason, if vibration is used.
 - G. The Contractor will be restricted to pavement placement widths of a maximum of fifteen (15') feet unless the Contractor can demonstrate competence to provide pavement placement widths greater than the maximum specified.
 - H. Border pervious concrete with curbing or a header curb, especially when it butts up to an asphaltic pavement, and
 1. Extend curbs six (6) inches below the bottom of the pervious concrete system.
- 3.8 CURING
- A. Start curing procedures immediately or within 20 minutes after placement of pervious concrete.

- B. Cover the pavement surface with a minimum 6-mil thick polyethylene sheet or other approved covering material.
 - 1. The cover shall overlap all exposed edges and be secured (without using dirt or stone) to prevent dislocation due to winds or adjacent traffic conditions.
- C. Spray a fog or light mist above the surface when required due to ambient conditions (temperature, wind, and humidity), prior to covering.
- D. Curing time
 - 1. Portland Cement Type I, II, or IS cures for 7 days minimum.
 - 2. Portland Cement Type I or II with Class F Fly ash (as part of the 500-550 lbs./cy. minimum cementitious) or Type IP cures for 10 days minimum.
 - 3. Allow no truck traffic for 10 days (no passenger car/light trucks for 7 days).

3.9 JOINTS

- A. Install control (contraction) joints at maximum 20-foot intervals. Use smaller joint spacing as needed to meet performance requirements.
 - 1. Joint depth shall equal $\frac{1}{4}$ the thickness of the pavement.
- B. Install joints in the plastic concrete using the tool or early-entry saw-cut method.
 - 1. Install tooled joints within 20 minutes after pervious concrete placement.
 - 2. Install saw cut joints as soon as the pavement has hardened sufficiently and operation shall not cause surface deformation and raveling of the joint edges.
- C. Minimize surface exposure to the saw-cutting operation by only removing and recovering the curing sheet in the immediate work area.
- D. Install transverse construction joints whenever placing pauses long enough for cold joints to form when placing resumes.
- E. In order to assure aggregate bond at construction joints, apply a bonding agent suitable for bonding fresh concrete to existing concrete via brushing, rolling, or spraying on the existing concrete edge.
- F. Use isolation (expansion) joints when pavement is abutting hardened slabs or other adjoining structures.

3.10 TESTING

- A. Laboratory
 - 1. The Contractor will retain an independent testing laboratory.
 - a. The testing laboratory shall conform to the applicable requirements of ASTM E329 "Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction"
 - b. ASTM C1077 "Standard Practice for Testing Concrete and Concrete Aggregates for use in Construction, and Criteria for Laboratory Evaluation" and shall be inspected and accredited by the Construction Materials Engineering Council, Inc. or by an equivalent recognized national authority.
 - 2. The Agent of the testing laboratory-performing field sampling and testing of concrete shall be certified by the American Concrete Institute as a Concrete Field Testing Technician Grade I, or by a recognized state or national authority for an equivalent level of competence.
- B. Testing
 - 1. A minimum of one (1) gradation test of the sub-grade is required every 5000 square feet to determine percent passing the No. 200 sieve per ASTM C117.
 - 2. Conduct a minimum of one test for each day's placement of pervious concrete in accordance with ASTM C172/C172M and ASTM C29 to verify unit weight.

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- a. Delivered unit weights are to be determined in accordance with ASTM C29 using a 0.25 cubic foot cylindrical metal measure. The measure is to be filled and compacted in accordance with ASTM C29 paragraph 11, jiggling procedure. The unit weight of the delivered concrete shall be +5 pcf of the design unit weight for fresh concrete.
3. The test panel shall have two cores taken from each panel in accordance with ASTM C42/C42M at a minimum of seven (7) days after placement of the pervious concrete. Measure cores for thickness, void structure, and unit weight. Use untrimmed, hardened core samples to determine placement thickness. The average of all production cores shall not be less than the specified thickness with no individual core being more than ½ inch less than the specified thickness. After thickness determination, the cores shall be trimmed and measured for unit weight in the saturated condition as described in paragraph 8.3.1 'Saturation' of ASTM C140/C140M "Standard Methods of Sampling and Testing Concrete Masonry Units". Immerse the trimmed cores in water for 24 hours, allowed to drain for one (1) minute, surface water removed with a damp cloth, then weighed immediately. Range of satisfactory unit weight values are +5 pcf of the design unit weight. Calculate void structure in accordance with ASTM C138/C138M.
4. After a minimum of 7 days following each placement, take three cores in accordance with ASTM C42/C42M. Measure the cores for thickness and unit weight determined as described above for test panels. Fill core holes with concrete meeting the pervious mix design.

END OF SECTION