

SECTION 32 13 13.01
PORTLAND CEMENT PERVIOUS PAVEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work to be completed under this contract includes the furnishing of all labor, materials, and equipment necessary for construction of the proposed Portland Cement Pervious Pavement (hereinafter sometimes referred to as "PCP") improvements in conformance with the plans and specifications.

1.02 REFERENCES

- A. American Society of Testing and Materials:
1. ASTM C29, Test for Unit Weight and Voids in Aggregate
 2. ASTM C33, Specifications for Concrete Aggregates
 3. ASTM C42, Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 4. ASTM C117, Test Method for Material Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
 5. ASTM C138, Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
 6. ASTM C140, Methods of Sampling and Testing Concrete Masonry Units
 7. ASTM C150, Specifications for Portland Cement (Types I or II only)
 8. ASTM C172, Practice of Sampling Fresh Concrete
 9. ASTM C260, Specification for Air-Entraining Admixtures for Concrete
 10. ASTM C494, Specification for Chemical Admixtures for Concrete
 11. ASTM C595, Specifications for Blended Hydraulic Cements (Types IP or IS only)
 12. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
 13. ASTM C989, Specification for Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars
 14. ASTM C1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
 15. ASTM D 448, Specification for Standard Sizes of Coarse Aggregates for Highway Construction
 16. ASTM D 1557, Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop

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17. ASTM E 329, Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction
- B. American Association of State Highway and Transportation Officials (AASHTO):
 1. AASHTO T-180, Moisture-Density Relations of Soils Using a 10-Pound Rammer and an 18-inch Drop.
- C. American Concrete Institute (ACI):
 1. ACI 522.1-08, Specification for Pervious Concrete Pavement.
- D. Connecticut Department of Transportation (ConnDOT), Standard Specifications for Roads, Bridges and Incidental Construction.

1.03 CONTRACTOR QUALIFICATIONS

- A. The Contractor and crew shall be a Pervious Concrete Installer with a current Pervious Concrete Contractor Certification from the National Ready Mixed Concrete Association (NRMCA).
- B. Pervious concrete shall be supplied by a NRMCA producer member at a NRMCA certified plant.

1.04 SUBMITTALS

- A. Action Submittals:
 1. Sample of product
 2. Concrete mix design, including:
 - a. Proposed concrete mixture proportions
 - b. All material weights, volumes, & density (unit weight)
 - c. Water-cementitious ratio
 - d. Void content
 - e. Aggregate type, source and grading
 - f. Cement, supplementary cementitious materials and chemical admixture manufacturer certifications
 3. Pavement covers (both layers)
- B. Information Submittals:
 1. Statement attesting to pervious concrete qualifications and experience of the placing contractor and concrete supplier.

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2. Project name, location, size, and reference contact information for a minimum of two (2) completed pervious concrete projects with name and contact information for reference.
3. National Ready Mixed Concrete Association Pervious Concrete Contractor Certification and expiration date.
4. In-place pavement test results from previous pervious concrete Work within the last 12 months including void content, density, and concrete mixture proportions.
5. List of crew, crew NRMCA Pervious Concrete Installer certification number, and equipment to be used to complete concrete placement.
6. Schedule.
7. Joint layout plan.

1.05 QUALITY CONTROL

- A. Test and inspect concrete materials and operations as Work progresses as described in ACI 522.1-08, Section 1.6.5. Failure to detect defective Work or material early will not prevent rejection if a defect is discovered later, nor shall it constitute final acceptance.

1.06 TEST PANELS

- A. Test panels shall be placed using the mixture proportions, materials, and equipment as proposed for the project.
- B. Contractor shall place, joint, and cure two PCP test panels, each to be a minimum of 225 square feet at the required project thickness to demonstrate to the Contracting Officer's satisfaction that in-place unit weights can be achieved and a satisfactory PCP can be installed at the site location.
- C. Test panels may be placed at any of the specified contract site location requiring PCP. Test density of fresh concrete for the test panels in accordance with ASTM C138/C138M following the consolidation procedures described in ASTM C29/C29M, Jigging Procedure. Core hardened concrete for the test panels in accordance with ASTM C42/C42M, test thickness in accordance with ASTM C174/C174M, and test density in accordance with ASTM C140, Paragraph 9.3.
- D. Test void structure in accordance with ASTM C138.
- E. Satisfactory performance of the test panels shall be determined by:
 1. Compacted thickness shall be no less than 1/4-inch of specified thickness and no more than 1-1/2 inch of specified thickness.
 2. Void Structure: 15 percent minimum, 25 percent maximum.

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3. Unit weight \pm five (5) pounds per cubic foot (pcf) of the design unit weight.
- F. If measured void structure falls below 15 percent, or if measured thickness exceeds the 1/4 inch less than the specified thickness, or if measured weight falls less than five (5) pcf below design unit weight, the test panel shall be removed at the contractor's expense and disposed of.
- G. If the test panel meets the above-mentioned requirements, it can be left in-place and included in the completed work.

1.07 CONCRETE MIX DESIGN

- A. Contractor shall furnish a proposed mix design with proportions of materials to Contracting Officer prior to commencement of work. The data shall include unit weights determined in accordance with ASTM C29 Paragraph 11, Jigging Procedure.

PART 2 MATERIALS

2.01 GENERAL

- A. Locally available material having a record of satisfactory performance shall be used.

2.02 CEMENT

- A. Portland Cement Type I, II or V conforming to ASTM C150 or Portland Cement Type IP or IS conforming to ASTM C595.

2.03 SUPPLEMENTARY CEMENTITIOUS MATERIALS

- A. Fly ash conforming to ASTM C618.
- B. Ground Granulated Blast-Furnace Slag conforming to ASTM C989.

2.04 AGGREGATE

- A. Nominal maximum aggregate size shall not exceed 1/3 of the specified pavement thickness.
- B. Coarse aggregate shall meet the size and grading requirements as defined in ASTM D448 (or Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, 13th Ed., 1982 or later) and shall comply with ASTM C33. Use No. 67, No. 7, No. 8, No. 89 or No. 9 unless an alternate size is approved for use based on meeting the project requirements. Data for

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proposed alternate material shall be submitted for approval per Section 1.05A of this guide. Fine aggregate complying with ASTM C33, if used, shall not exceed 3 ft³ per yd³.

2.05 ADMIXTURES

- A. Air entraining agent shall comply with ASTM C260.
- B. Chemical admixtures shall comply with ASTM C494:
 - 1. Mid-range water reducing admixtures (water reducers) Type A or High Range water reducing admixtures Type F or G are permitted due to low water-cementitious ratios specified for pervious concrete.
 - 2. Extended set control admixtures (hydration stabilizers) meeting requirements of ASTM C494 Type B Retarding or Type D Water Reducing/Retarding admixtures are permitted to be used when it is necessary to increase concrete placement time to 90 minutes or to improve finishing operations. This stabilizer suspends cement hydration by forming a protective barrier around the cementitious particles, which delays the particles initial set. If this mix heats up in the truck a standard retarder will not prevent premature hydration where the stabilizer will.
 - 3. Viscosity modifying admixtures (VMA's) are permitted to facilitate discharge of the concrete from the truck and placement in the forms.

2.06 WATER

- A. Potable or comply with ConnDOT Standard Specifications for Roads, Bridges and Incidental Construction.

2.07 CONCRETE MIXTURE PROPORTIONS

- A. The Contractor shall furnish a proposed mix design with proportions of materials prior to commencement of work. The data shall include unit weights determined in accordance with ASTM C29 paragraph 11, jigging procedure. The composition of the proposed concrete mixture shall be submitted to the Contracting Officer for review and approval and shall comply with the following provisions unless an alternative composition is demonstrated to comply with the project requirements. Concrete producers may have mixture proportions for pervious concrete optimized for performance with local materials.
- B. Mixture proportion calculations shall follow the guidance provided in Appendix 6 of ACI 211.3R:
 - 1. Aggregate/cementitious ratio: range of 4:1 to 5:1.

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2. Concrete mixture unit weight: range of 105 lb/ft³ to 130 lb/ft³ per ASTM C29, paragraph 11, jiggling procedure.
3. Concrete mixture void content: range of 15 percent to 25 percent, per ASTM C138, Gravimetric Air Determination.
4. Cementitious content: range of 500 lbs/yd³ to 600 lb/yd³, total cementitious content.
5. Supplementary cementitious content: Fly ash: 25 percent maximum; Slag: 25 percent maximum, or combined supplementary cementitious content: 35 percent maximum.
6. Water - cementitious ratio: range from 0.35 to 0.45.
7. Aggregate content: The bulk volume of aggregate per cubic yard (cubic meter) shall be equal to 27 ft³ when calculated from the dry rodded density (unit weight) determined in accordance with ASTM C29 jiggling procedure.
8. Admixtures: Admixtures shall be used in accordance with the manufacturer's instructions and recommendations. Dosage of air-entraining admixture shall be a minimum of 2 oz/cwt of cementitious material.
9. Mix Water: The quantity of mixing water shall be established to produce a pervious concrete mixture of the desirable workability to facilitate placing, compaction and finishing to the desired surface characteristics. Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. (A cement paste with a dull-dry appearance has insufficient mix water for hydration.) Insufficient mix water results in inconsistency in the mix and poor bond strength. High water content results in the paste sealing the void system primarily at the bottom and poor surface bond.

2.08 SUBGRADE PREPARATION

- A. As shown on the Drawings and as specified in Section 31 23 13, Subgrade Preparation.

2.09 CRUSHED STONE

- A. As shown on the Drawings and as specified in Section 31 23 23, Fill and Backfill.

2.10 PAVEMENT COVER

- A. Polyethylene, or approved equal.

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2.11 FORMS

- A. Forms may be of wood or steel and shall be the depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations.

2.12 ISOLATION JOINTS

- A. Isolation joint materials shall be gray or black in color and comply with ASTM D994, D1751, or D1752.

PART 3 EXECUTION

3.01 SETTING FORMWORK

- A. Set, align, and brace forms so that the hardened pavement meets the tolerances specified. Apply form release agent to the form face, which will be in contact with concrete, immediately before placing concrete. The vertical face of previously placed concrete may be used as a form.
- B. Protect previously placed pavement from damage.
- C. Do not apply form release agent to previously placed concrete.
- D. Placement width shall be as specified in Contract Documents. Concrete placement width shall not exceed 20 feet unless otherwise specified.

3.02 MIXING, HAULING AND PLACING

- A. Temperature Restrictions: PCP shall not be pored on site if the ambient temperatures is below freezing or exceeds 95 degrees F or it is projected that these temperatures will be reached within 24 hours after pour is completed.
- B. Batch and mix in compliance with ASTM C94/C94M except that discharge shall be completed within 60 minutes of the introduction of mixture water to the cement. Increase time to 90 minutes when using an extended set control admixture. Any batch that exceeds these time limits will be rejected and disposed of by contractor at an approve disposal site at no cost to Contracting Officer. No additional water shall be added to the mixture after the initial introduction.
- C. Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.

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- D. Discharge: Each mixer truck will be inspected for appearance of concrete uniformity. Water may be added to obtain the required mix consistency. A minimum of 20 revolutions at the manufacturer's designated mixing speed shall be required following any addition of water to the mix. Discharge shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete. The practice of discharging onto subgrade and pulling or shoveling to final placement is not allowed.
- E. Placing and Finishing Equipment:
1. Unless otherwise approved by the owner and engineer in writing, the contractor, shall provide mechanical equipment of either slip-form or form riding with a following compactive unit that will provide a vertical force so as to achieve no less than 15 percent void volume as compared to total volume of the finished pavement. The pervious concrete pavement shall be placed to the required cross-section and shall not deviate more than $\pm 1/4$ inch in 10 feet from profile grade.
 2. If placing equipment does not provide the minimum specified vertical force, a full width roller or other full width compaction device that provides sufficient vertical pressure between 10 to 30 psi on the concrete, shall be used immediately following the strike-off operation. After mechanical or other approved strike-off and compaction operation, no other finishing operation will be allowed.
 3. If vibration, internal or surface applied is used, it shall be shut off immediately when forward progress is halted for any reason. 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 to the satisfaction of the Contracting Officer.
- F. Curing:
1. Curing procedures shall begin immediately after placement.
 2. The pavement surface shall be covered with a minimum two (2) mil thick polyethylene sheet, or other approved covering material, prior to compaction. This cover shall remain and compaction shall occur on top of the first cover.
 3. After compaction, the pavement surface shall be covered with a minimum of six (6) mil thick white polyethylene sheet, or approved equal. The covers shall overlap all exposed edges and shall be secured (without using dirt, small stone, or other similar materials that could clog the pervious concrete) to prevent dislocation.

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- G. Cure Time: Pavement covers shall remain in place for minimum 10 days. No vehicle or construction traffic will be allowed for minimum 10 days.
- H. Jointing:
1. Transverse control (contraction) joints shall not exceed 12-foot intervals. They shall be installed at a depth of 1/4 to 1/3 the thickness of the pavement. Longitudinal control joints shall be installed at the midpoint if the constructed lane width exceeds 15 feet. These joints shall be installed in the plastic concrete. Joints installed in plastic concrete shall be formed using a "pizza cutter roller" with a beveled fin welded around the circumference of a steel roller.
 2. Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden. In order to assure aggregate bond at construction joints, a bonding agent suitable for bonding fresh concrete to existing concrete shall be brushed, rolled, or sprayed on the existing pavement surface edge.
 3. Isolation (expansion) joints shall not be used except when pavement is abutting slabs or other adjoining structures.
 4. The larger horizontal dimension of a slab panel shall not exceed 125 percent of the smaller dimension.
 5. The angle between two intersecting joints shall be between 80 and 100 degrees.
- I. Edging: Edge top surfaces to a radius of not less than 1/4 inch.

3.03 TESTING, INSPECTION AND ACCEPTANCE

- A. Laboratory Testing:
1. The Contractor shall retain an independent testing laboratory. 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, and 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 Concrete Advisory Board of Georgia, Inc. or by an equivalent recognized national authority.
 2. The agent of the testing laboratory performing field sampling and testing for concrete shall be certified as both an NRMCA Certified Pervious Concrete Technician, or equivalent, and an ACI Concrete Field Testing Technician Grade I, or equivalent.

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B. Testing and Acceptance:

1. Obtain a minimum 1 ft³ sample for acceptance tests in accordance with ASTM C172. Measure a minimum of one density test during each day's placement in accordance with C138/C138M following the consolidation procedures described in ASTM C29/C29M, Jigging Procedure. Determine density using a minimum 0.25 ft³ cylindrical metal measure. Fill and compact the measure in accordance with ASTM C29/C29M, Jigging Procedure.
2. Remove three cores from each lot of 5000 ft² and two cores from the test panels, in accordance with ASTM C42/C42M, not less than 7 days after placement of the pervious concrete. Cores shall be a minimum nominal 4-inch diameter. Select locations in accordance with ASTM D3665. Measure the cores for thickness (ASTM C174/C174M) and density (ASTM C140). After thickness determination, trim and measure the cores for density in the saturated condition as described in Paragraph 9.3, Saturation, of ASTM C140. Immerse the trimmed cores in water for 24 hours, drain for 1 minute, remove surface water with a damp cloth, then weigh immediately.
3. Tolerance for thickness and density reported as the average of cores of each lot shall be as specified in Paragraph 1.06.

C. Core holes shall be filled with concrete meeting the pervious mix design.

END OF SECTION