

TENNESSEE READY MIXED CONCRETE ASSOCIATION

PRELIMINARY SPECIFICATIONS FOR PORTLAND CEMENT PERVIOUS CONCRETE PAVEMENT

1. SCOPE

The work to be performed under this specification will be in conformance with the appropriate referenced plans and drawings for the construction of the proposed pervious concrete pavement. Included in the performance of work is the furnishing of all labor, materials, and necessary equipment.

Traditional Portland cement pavement testing procedures based on strength, air content and slump control are not applicable to this type of pavement material. As continued testing of this product yields test methods that are reproducible in the field, these recommended specifications will be modified.

2. REFERENCES

ASTM C 29, Test for Unit Weight and Voids in Aggregate

ASTM C 33, Specifications for Concrete Aggregates

ASTM C 42, Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C 117, Test Method for Material Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 150, Specifications for Portland cement (Types I or II only)

ASTM C 494, Specification for Chemical Admixtures for Concrete

ASTM C 595, Specifications for Blended Hydraulic Cements (Types IP or IS only)

ASTM C 618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

ASTM C 989, Specification for Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars

ASTM C 1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

ASTM C 1116, Standard Specification for Fiber-Reinforced Concrete and Shot Crete

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ASTM C 1157, Performance Specification for Hydraulic Cement

ASTM D 448, Specification for Standard Sizes of Coarse Aggregates for Highway Construction

ASTM D 1557, Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop

ASTM E 329, Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction

ACI 211.3R-97, Guide for Selecting Proportions for No-Slump Concrete

ACI 305R-99, Hot Weather Concrete

ACI 396R-88, Cold Weather Concrete

American Association of State Highway and Transportation Officials (AASHTO)
AASHTO T-180, Moisture-Density Relations of Soils Using a 10-Pound (454kg) Rammer and an 18-inch (457mm) Drop

Tennessee Department of Transportation (TDOT), Standard Specifications for Road and Bridge Construction

3. QUALIFICATIONS

3.1 Contractor

Pervious concrete contractors must demonstrate their qualifications and experience by submitting a list of at least three completed projects performed according to the job's owner, engineers' or architects' satisfactions at that time, or completion of the Pervious Concrete Sales and Installation Training course at TRMCA. Upon request, any applicable test results shall be provided.

3.2 Pre-Construction Meeting

Prior to any placement of material, the Owner, General Contractor, Sub-Contractor, engineer or architect representing the concerns of the owner, Ready-Mix producer, testing laboratory representative and anyone with technical knowledge of the product, shall meet to discuss the production, placement, and testing of this product.

3.3 Trial Placement

Contractor without prior experience is to place, joint and cure a small trial placement of no less than 200 sq. ft. so all parties get familiar with producing and placing the product. He must demonstrate to all parties concerned that he can meet the specifications for

pavement thickness and in-place unit weight and a satisfactory pavement can be installed at the site location.

1. The test panel or panels may be placed at any of the specified Portland cement pervious locations. The test panel or panels shall be tested for thickness in accordance with ASTM C 42; void structure in accordance with ASTM C 138; and for core unit weight, in accordance with ASTM C 140, paragraph 6.3.
2. Satisfactory performance of the test panel or panels will be determined by:
 - a. Compacted thickness to be not less than 1/4" below specified thickness
 - b. Void Structure: 20% +/- 5% for low porosity, normal strength
30% +/- 5% for high porosity, low strength
 - c. Unit weight +/- 5 pcf of the design unit weight
3. If the requirements in item 2 are not met, the test panel shall be removed at the contractor's expense and disposed of in the proper manner.
4. If the test panel or panels meet the above-mentioned requirements, it can be left in-place and included in the completed work.
5. The color and texture of the test panel or panels should not be used as a guide for the remaining portion of the job.

4. MATERIALS

4.1 Portland Cement

Cement shall be Portland cement conforming to ASTM C 150 (Type I or II) or ASTM C-595 (Type IP, IS).

4.2 Fly Ash

Fly ash should conform to ASTM C 618.

4.3 Ground Granulated Blast Furnace Slag

Slag should conform to ASTM C 989

4.4 Aggregates

Aggregates shall be furnished in sizes: No. 7, No. 8 or No. 89, as described in Section 903.03, TDOT Standard Specifications or ASTM C 33. Other sizes of aggregates may be used upon approval of engineer, architect, or owner's representative.

4.5 Water

Water shall be potable or shall be in accordance with Section 918.01 of the TDOT Standard Specifications.

4.6 Admixtures

Type A Water Reducing Admixtures shall comply with ASTM C 494.

Type B Retardation Admixtures shall comply with ASTM C 494.

Type D Water Reducing/Retarding Admixtures shall comply with ASTM C 494.

Hydration stabilizers may be used but must meet ASTM C 494, Type B or D.

4.7 Fibers

Fibers must conform to ASTM C 1116.

5. PROPORTIONS

5.1 Cement and /or Cementitious Content

For pavements being used by vehicular traffic, the total cementitious material shall not be less than 600 lbs / cu. yd.

5.2 Fly ash and Ground Granulated Blast Furnace Slag

Fly ash conforming to ASTM C618 may be used in amounts not exceeding 20 percent by weight of the total cementitious material. Ground Granulated Blast Furnace Slag conforming to ASTM C989 may be used in amounts not exceeding 50 percent by weight of the total cementitious material.

5.3 Water

Water quantity shall be such that the cement past displays a wet metallic sheen without causing the cement past to flow from the aggregates. A dull-dry appearance mix may be produced if insufficient mix water has been used.

5.4 Aggregate Content

The volume of aggregate specified above shall be equal to approximately 27 cu. ft per cu. yd. when calculated as a function of the unit weight determined in accordance with ASTM C 29 dry rodded procedure. If fine aggregate is used, its volume should not exceed 3 cu. ft. and should also be included in the total aggregate volume. Final aggregate content will depend upon the specific gravity of the aggregate to be used, and the desired void content to be obtained in the hardened pervious concrete. Please see the table below for a calculation example.

Table 1, Aggregate content example

Bulk Density as per ASTM C 29 rodding procedure		Multiply bulk density by 27	Weight of Aggregate per cubic yard
Sample 1	96 lbs	X 27	2592
Sample 2	98 lbs	X 27	2646
Sample 3	100 lbs	X 27	2700

5.5 Admixtures

Admixtures shall be used according to manufacture's instructions.

5.6 Fibers

Fibers shall be added at a rate of not less than 0.75 lbs. per cubic yard or as recommended by the manufacture.

6. SUBGRADE PREPARATIONS AND FORMWORK

6.1 Subgrade Material

A subgrade with a minimum of 6" of a granular or gravelly soil shall be assured before the installment of the pervious concrete pavement.

6.2 Subgrade Permeability

Subgrade shall be tested for permeability by the double ring infiltrometer or other suitable tests that are agreed upon by all parties concerned.

6.3 Subgrade Support

Subgrade shall be compacted to a density of 95% minimum of a maximum dry density as determined by AASHTO T-99 or ASTM D 698. Sub grade stabilization may be performed if, and as, directed by a qualified engineer. If embankment is used, it shall be placed in layers not exceeding 8" and compacted as mentioned above. It should be clean and free of deleterious materials.

6.4 Subgrade Moisture

The subgrade must be moist before concrete placement with no freestanding water (within $\pm 3\%$ of the optimum moisture content as determined by the modified compaction test, AASHTO T-180 or ASTM D 698).

6.5 Forms

Forms shall be made of wood or steel. Forms shall be of ample strength and stability to withstand loads during concrete placement operations. They should be set accurately to the required grade and alignment.

6.6 Pervious Concrete Thickness

Pervious concrete for use in light duty parking stalls shall be a minimum of 5 inches thick, and for use in light duty drive lanes shall be a minimum of 6 inches thick. Thickness for pavements with void contents in excess of 25% should be increased.

7. MIXING AND TRANSPORTATION

7.1 Mix Time

The truck mixer shall be operated at the drum speed recommended by the manufacturer and shall not be less than 70 nor more than 300 revolutions.

7.2 Transportation

The pervious concrete can be transported by either a ready-mix truck or a dump truck. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed 90 minutes, unless otherwise approved by an engineer. This time may be increased to 120 minutes when utilizing an approved retarding admixture or the hydration stabilizer specified in Section 4.6.

7.3 Discharge

The pervious concrete contractor or his qualified agent will inspect each batch for appearance of concrete uniformity according to Section 5.3. This person will be determined at the Pre-Construction Meeting. A slight adjustment of water may then be required at the work site to achieve the proper consistency. A minimum of 20 revolutions at the manufacturer's designated mixing speed shall be required following any such adjustment. Mixture discharge shall be rapid and continuous as possible. Concrete shall be deposited as close to its final position as practicable and at a point so that fresh concrete enters and adheres to the mass of previously placed unhardened concrete. As deposited, the mixture shall be placed where it will require as little rehandling as possible

7.4 Placing and Finishing Equipment

Conventional paving equipment or, manual and vibrating screeds may be used for the strike off operation. It is recommended to allow for 1/2 to 1/4-inch additional thickness above the forms to eliminate surface raveling after compaction. A full width heavy roller or other full width compaction devices that provide 5-10 psi vertical force shall be used, immediately following the strike off operation and removal of the additional thickness. The pervious concrete pavement cross section shall not deviate more than $\pm 3/8$ " in 10' from the required grade. No other finishing operation is required after mechanical or other approved strike off and compaction operations. Placement width should not exceed 15 feet unless a contractor has sufficient mechanical consolidating equipment.

7.5 Curing

The pavement surface shall be covered with a minimum four- (4) mil thick polyethylene sheeting **immediately** following compactive rolling. If adverse ambient conditions exist (temperature, wind and humidity), a fog or light mist shall be sprayed above the surface prior to covering. Sheeting must be secured during cure time and must cover all edges of the placed pavement. Sand or dirt should not be used to hold down sheeting. No traffic shall be allowed during cure time.

Recommended cure times:

1. Portland Cement Type I, II, or IS - 7 days minimum.
2. Portland Cement Type I or II with Class F or C Fly-ash or Type IP - 10 days minimum.

7.6 Jointing

Joints shall be constructed of the type and dimensions and at the locations required by the Plans and in accordance with the provisions of these Specifications. Control (contraction) joints shall be spaced at 20' centers and they shall be at a depth of 1/4 of the thickness of the pavement. Longitudinal control joints shall be installed at the mid-point of the constructed pavement if the pavement width exceeds 15 feet. Both types of joints can be installed in the plastic concrete or saw cut after the pavement has hardened sufficiently (normally after curing). Installation of saw cut joints may be delayed until the completion of the recommended curing period. Transverse construction joints shall be constructed when placing is interrupted a sufficient length of time so that concrete begins to harden. A bonding agent suitable for bonding fresh concrete to existing concrete shall be brushed, rolled or sprayed on the existing pavement surface edge. Expansion joints shall be formed when pavement is abutting slabs or other adjoining structures by the use of premolded joint filler.

8. TESTING, INSPECTION AND ACCEPTANCE

8.1 Laboratory Testing

All laboratory test procedures shall be established by the mutual consent of the Owner, General Contractor and any engineer or architect representing the concerns of the Owner, or any other entity having a financial interest in the project.

The Owner or General Contractor may retain an independent testing laboratory. The laboratory must provide evidence of conforming to the requirements of ASTM E-329 "Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials used in Construction," and ASTM C 1077 "Standard Practice for Testing Concrete and Concrete Aggregates for Use in Construction, and Criteria for Laboratory Evaluation".

All samples shall be identified by date and batch mix or truckload. Laboratory testing shall be done expeditiously, and results communicated to all concerned in a timely manner.

8.2 Testing and Acceptance

The contractor shall be responsible to require pervious concrete material supplier to provide a mix compliance statement on each shipping document. No deviation of the approved mix design will be accepted without the concurrence of the owner's engineer or agent. At owner's request, if batch certification is not adequate, a minimum frequency of one (1) test for each day of placement shall be conducted to verify the rodded weight of material as delivered. The test shall be conducted in accordance with ASTM C172 and C-29. Mix shall be within \pm (5%) five percent of the design unit weight.

After a minimum of 7 days following each placement, three samples should be core drilled. The cores shall be measured for thickness, void structure, and unit weight. Untrimmed, hardened core samples shall be used to determine placement thickness in accordance with ASTM C 42. The average of all cores shall not be less than the required thickness with any core being more than 1/2-inch less than the required thickness. After thickness determination, core ends shall be trimmed to facilitate void structure determination in accordance with ASTM C 138. The void content of 20% +/- 5% for low porosity, normal strength pervious and 30% +/- 5% for high porosity, low strength pervious should be met.

Unit weight determination in the saturated condition shall be in accordance with ASTM C-140, paragraph 6.3. Ranges of satisfactory unit weight values are \pm 5 pcf of the design unit weight.

Note: For technical assistance, contact your local Tennessee Ready Mixed Concrete Association Producer or contact the association directly at 1-800-765-4382 or at www.trmca.org. This specification represents the best knowledge obtained to date, and may be modified as additional information becomes available. Design professionals and

other organizations should use this document as a guideline, but must insure that the provisions discussed in this document are applicable to any specific jobsite where the use of pervious concrete is anticipated.

Last Revision Date: July 3, 2003