

SECTION 02751

STF POROUS PAVING SYSTEM

PART 1 GENERAL

1.1 SCOPE:

The Work to be completed under this contract includes the furnishing of all labor, materials and equipment necessary for construction of the proposed improvements in conformance with the plans and specifications.

1.2 CONTRACTOR:

The product and work shall be supplied by a contractor having experience with the STF Porous Paving System.

1.3 REFERENCES

A. American Society for Testing and Materials

1. ASTM C29 "Test for Unit Weight and Voids in Aggregate"
2. ASTM C33 "Specification for Concrete Aggregates"
3. ASTM C42 "Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
4. ASTM C117 "Test Method for Material Finer than 75 microns (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 and II only)
8. ASTM C172 "Practice for 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 "Specification for Blended Hydraulic Cements" (Types IP or IS only)
12. ASTM 989 "Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
13. ASTM C1077 "Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and criteria for Laboratory Evaluation."
14. ASTM D448 "Specification for Standard Sizes of Coarse Aggregate for Highway Construction."
15. ASTM D1557 "Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop."
16. ASTM E329 "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 101 lb (45.4 kg) Rammer and an 18" (457 mm) Drop."

1.4 QUALITY ASSURANCE:

- A. SPECIAL EQUIPMENT: Some special equipment (compacting roller; misters, etc.) specific to porous concrete placement will need to be purchased or built by the placing Contractor.
- B. TEST PANELS: Contractor is to place, joint and cure one test panel, to be a minimum of 225 square feet at the required project thickness to demonstrate to the Engineer's and Agency's satisfaction that satisfactory pavement compaction and finish can be installed at the site location.
 - 1. Test panels may be placed at the site location. Test panels shall be evaluated for thickness, compaction and porosity.
 - 2. If the test panels are found to be insufficiently porous or insufficiently compacted, the test panel shall be removed at the Contractor's expense and disposed of in an approved landfill.
 - 3. If test panels are found to be satisfactory, they can be left in place and included in the completed work.
 - 4. Determination of thickness, porosity and compaction shall be determined by an inspector of choice of the Agency.
 - 5. Should the Contractor wish to dispute findings of inspector, acceptability shall be determined at Contractor's expense by achieving: compacted thickness according to ASTM C42 of no less than $\frac{1}{4}$ " of specified thickness, void structure of 10% minimum when tested in accordance with ASTM C140, and unit weight within ± 5 pcf of the design unit weight when tested in accordance with ASTM C140 paragraph 6.3.
- C. CONCRETE MIX DESIGN: Contractor shall furnish a proposed mix design with proportions of materials to Agency or Agent prior to commencement of work. The data shall include unit weights determined in accordance with ASTM C29 paragraph 11, jigging procedure. Compacted void content shall be a minimum of 10%. Cement content must be sufficient to hydrate cements but not enough to generate fluidity of mix.

1.5 QUALIFICATIONS

- A. Concrete installer to have 5 or more STF porous paving projects installed, totaling at least 100,000 square feet.
- B. Provide a list of projects (5) with the address of the installation, the date of the installation, the point of contact for the project and their phone number.
- B. Provide 2 photos of each project listed above representing the project/installation.
- D. Concrete company to have been in business 10 years or more. Provide three (3) references with phone numbers.

PART 2 MATERIALS

2.1 GENERAL:

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

2.2 CEMENT:

Portland Cement Type I or II conforming to ASTM C150 or Portland cement Type IP or IS, conforming to ASTM C595.

2.3 AGGREGATE:

Use 3/8" coarse aggregate which meets 3/8" to No. 16 per ASTM C33, or meeting 3/8" to No. 50 per ASTM D448. If other gradation of aggregate is to be used, submit data on proposed material to agency for approval. Larger aggregate sizes increase pore size but decrease workability. Aggregates which are well graded reduce porosity, and may require reduction of cementitious content to meet void specifications. Note that reductions below the minimums listed in Section 1.4, C of this document require written approval from the Engineer and Agency's Representative.

2.4 ADMIXTURES:

Type A Water Reducing Admixtures ----- ASTM C494
Type B Retarding ----- ASTM C494
Type D Water Reducing/Retarding ----- ASTM C494

A hydration stabilizer will be utilized and is recommended in the design and production of porous concrete. This stabilizer suspends cement hydration by forming a protective barrier around the cementitious particles, which delays the particles from achieving initial set. The admixture's primary function should be as a hydration stabilizer, however it must also meet the requirements of ASTM C494 Type B Retarding or type D Water Reducing/Retarding admixtures.

Air entraining agents shall comply with ASTM C260.

2.5 WATER:

Potable or shall comply with conventional local good concrete practice.

2.6 REINFORCEMENT:

Fiberglass reinforced plastic (FRP) reinforcing dowel shall be used to tie adjacent concrete slabs together. FRP rebar shall be of at least one-half inch diameter, uni-directionally reinforced, placed twelve inches into each slab on thirty inch or closer spacing. Steel or epoxy-coated steel shall not be used due to the exposure to moisture experienced in porous concrete.

PART 3 PROPORTIONS

3.1 CEMENT CONTENT:

For pavement subject to vehicular traffic loading, Portland Cement content shall not be less than 530 pounds per cubic yard.

3.2 AGGREGATE CONTENT:

The volume of aggregate per cubic yard shall be equal to 27 cubic feet when calculated as a function of the unit weight determined in accordance with ASTM C29 jigging procedure. Fine aggregate, if used, should not exceed 3 cubic feet and shall be included in the total aggregate volume.

3.3 ADMIXTURES:

Shall be used in accordance with the manufacturer's instructions and recommendations.

3.4 MIX WATER:

Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate.

- A. Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration.
- B. Insufficient water results in inconsistency in the mix and poor bond strength.
- C. High water content results in the paste sealing the void system primarily at the bottom and provides a poor surface bond.

PART 4 SUBGRADE PREPARTATION AND FORM WORK

4.1 SUBGRADE MATERIAL:

The top 6" shall be composed of granular or gravelly soil that is predominantly sandy with no more than a moderate amount of silt or clay. Granular subbase may be placed over the subgrade.

4.2 SUBGRADE PERMEABILITY:

Subgrade should have a reasonable level of permeability. One suggested test for subgrade permeability is a double ring infiltrometer.

4.3 SUBGRADE SUPPORT:

The subgrade shall be compacted by a mechanical vibratory compactor to 92 – 95% of a maximum dry density as established by ASTM D1557 or AASHTO T180. Subgrade stabilization shall not be permitted.

If fill material is required to bring the subgrade to final elevation (embankment), it shall be clean and free of deleterious materials. It shall be placed in 8" maximum layers, and compacted by a mechanical vibratory compactor to a minimum density of 92% of a dry density as established by ASTM D1557 or AASHTO T180.

4.4 SUBGRADE MOISTURE:

The subgrade shall be in a moist condition (+/- 3% of the optimum moisture content as determined by the modified compaction test ASTM D1557 or AASHTO T180).

4.5 FORMS:

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. Forms shall have a removable spacer of ½" to 5/8" thickness placed above the depth of pavement. The spacers are removed following placement and vibratory strike-off to allow roller compaction. Forms shall allow for tie-in to adjacent concrete via the use of fiberglass reinforced plastic (FRP) reinforcing bar.

PART 5 MIXING, HAULING AND PLACING

5.5 MIX TIME:

Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.

5.6 TRANSPORTATION:

The Portland Cement aggregate mixture may be transported or mixed on-site and should be used within one hour of the introduction of mix water, unless otherwise approved by an engineer. This time can be increased to 90 minutes when utilizing the hydration stabilizer specified in Section 2.5 of this document.

5.7 DISCHARGE:

Each mixer 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 the addition of any 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.

5.8 PLACING AND FINISHING:

Unless otherwise approved by the Agency or Engineer in writing, the Contractor shall provide mechanical equipment of either slipform or form riding with a following compactive unit that will provide a minimum of 10 psi vertical force. The porous concrete pavement will be placed to the required cross-section and shall not deviate more than +/- 3/8" in 10 feet from profile grade.

Normal placement procedures involve utilizing a mechanical vibratory screed to strike off the concrete ½" to 5/8" above final height, utilizing the form spacers described in Section 4.5 of this document. Where the use of a vibratory screed can not be used traditional manual methods may be used to strike off the concrete. Following strike-off, the spacers are removed, and the concrete compacted to form level utilizing a steel roller made from nominal 8" diameter steel pipe. Care should be taken during compaction that full compactive force is achieved without working the concrete surface enough to seal off the surface porosity. Any apparent defects in the surface can be remedied by placing some fresh mix into any depressions and compacting using a hand tamper.

After roller compacting and defect inspection/fixing, no further finishing is performed on the concrete-

5.9 CURING:

Curing procedures shall begin within 20 minutes of final placement operations.

The pavement surface shall be covered with a minimum of 6ml thick polyethylene sheet or other approved covering material. The low water/cement ratio and high amount. The cover shall overlap all exposed edges and shall be secured (without using dirt or stone) to prevent dislocation due to winds or adjacent traffic conditions.

Cure Time:

Cure times listed are ideal. Cover shall remain on during cure. No vehicular traffic shall be allowed for 10 days.

5.10 JOINTING:

Control (contraction) joints shall be installed at regular intervals not to exceed 40 feet, or two times the width of the placement. They shall be installed at 1/4 the depth of the thickness of the pavement. These joints can be installed in the plastic concrete or saw-cut. Joints installed in the plastic concrete are generally rolled in utilizing a small roller with a flange welded to the center. This type of jointing is done immediately after roller compaction and immediately prior to curing.

If joints are saw-cut, the procedure should begin as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking, normally after 24 hours. Curing cover must be removed and recovered after joint sawing. Transverse construction joints shall be installed whenever placing is suspended long enough to allow the concrete to 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 existing pavement surface edge. Isolation (expansion) joints will not be used except when pavement is abutting slabs or other adjoining structures.

These sample specifications are provided as a guideline only. Each area and project has circumstances peculiar to it, such as soil conditions or available local aggregates, which may require modifications.