

**11. HPC SPECIFICATIONS**

Note: Later corrections are shown in red.

604HP604HPS T A T EO FT E N N E S S E E

September 11, 1998

Sheet 1 of 5

Project: SP 22840-3204-04

Porter Road / SR 840

Hickman Road / SR 840

Dickson County

SPECIAL PROVISIONREGARDINGHIGH PERFORMANCE CONCRETEGeneral Provisions.

For this project, High Performance Concrete (HPC) is defined as the concrete in the cast-in-place deck, deck panels (if used), beams, and substructures for the two bridges at Porter Road over SR 840 and Hickman Road over SR 840. The work shall consist of furnishing, placing, curing, and testing the HPC in accordance with the Standard Specifications, these special provisions, and the notes and details shown on the Plans and on the approved shop drawings. The contractor shall schedule his work such that the bridge decks for these two structures are completed by June 1, 2000.

Materials.

Materials used in this construction shall meet the requirements of the Standard Specifications and these special provisions. The contractor is responsible for selecting the proper proportions to meet these special provisions, the placement conditions, and methods of placement. Silica fume, used in accordance with these special provisions, may be incorporated in the HPC to help achieve the permeability requirement. Silica fume shall conform to the requirements of AASHTO M307 or ASTM C1240. If used, silica fume shall replace between 3% to 8% by mass of the cementitious material. The contractor may use a combination of fly ash and silica fume. The maximum percentage of fly ash substitution shall be in accordance with the Specifications.

604HP

604HP  
Sheet 2 of 5Classification and Proportioning of Concrete.

The cement content, maximum allowable water/cement, the maximum slump, the proper amount of entrained air, the permeability, and the strength requirements for all classes of HPC shall conform to the requirement of these special provisions.

Class of Concrete and Application	Min. 28-day Comp. Strength PSI	Min. lb Cement per C.Y.	Max. Water Cement Ratio lb/lb	Air Content %	Slump* In.	Permeability (Coulombs)
A (HPC) Substructure	4000	620	0.45	6 ± 2	3 ± 1	<3000
D (HPC) CIP Deck	5000	658	0.43	6 ± 2	3 ± 1	<1500
P (HPC) Beams	10000	658	0.43	6 ± 2	3 ± 1	<2500

\* Prior to the addition of a high range admixture, if used. The maximum slump with high range admixture added shall be 8 inches.

If deck panels are used, the minimum strength and permeability requirements shall be the same as that for the cast-in-place deck.

Quality Assurance for High Performance Concrete

The Contractor shall submit the proposed concrete design to the Engineer for all classes of HPC used in this project. In addition to the requirements of the Specifications, the proposed concrete

604HP604HP  
Sheet 3 of 5

design submittal shall contain the following:

- source of silica fume (where applicable)
- 28 day permeability (minimum of 2 tests)
- 1 day compressive strength (prestressed concrete only, two specimen sizes, minimum of 3 cylinders each)
- 7 day compressive strength (two specimen sizes, minimum of 3 cylinders each)
- 28 day compressive strength (two specimen sizes, minimum of 3 cylinders each)
- Batching sequence (steps, material ratios, and mixing parameters)

The strength samples shall be made in accordance with the Specifications, except that both 6 in. x 12 in. and 4 in. x 8 in. cylinders shall be made. Although both sample sizes will be tested, only the results of the 6 in. x 12 in. cylinders will be used for strength acceptance. **The test value at 28 days shall be the basis for acceptance. However,** the contractor shall also make two additional cylinders of each size for 56-day testing by the Department.

The permeability samples shall be cylindrical specimens with a 4 in. diameter and at least 4 in. in length. They shall be moist cured as the strength cylinders for acceptance except that the last 3 weeks of cure shall be at  $100^{\circ}\text{F} \pm 10^{\circ}\text{F}$ . Cylinders shall be tested at 28 days in accordance with AASHTO T277 or ASTM C1202. The test value shall be the result of the average of the values from tests on two specimens from each batch. **The test value at 28 days shall be the basis for acceptance. However,** the contractor shall also make two additional cylinders ~~of each size~~ for 56-day testing by the Department.

In addition to the strength and permeability samples, the contractor shall make specimens for the Department's use in testing Modulus of Elasticity and Splitting Tensile strength of the concrete, when requested.

The HPC for the cast-in-place deck shall be substantiated at least two months prior to deck construction. At least two trial batches (using job materials) with permissible combination of cementitious materials shall be prepared, and test specimens shall be cast by the contractor and tested by the Department for permeability and strength. The contractor shall demonstrate his ability to place the deck concrete by pouring, finishing, and curing a test slab with the trial batches. The contractor shall attend a pre-pour conference to discuss and review his proposed techniques for mixing, transporting, placing, consolidating, finishing, and curing the HPC for this project.

For HPC, additional concrete will be required for making durability specimens for permeability tests. The frequency of durability testing shall be the same as for strength testing. The contractor is responsible for properly making, curing, and transporting all concrete test samples including the permeability cylinders and both size strength cylinders. Specimens for Modulus of Elasticity

604HP604HP  
Sheet 4 of 5

and Tensile splitting testing shall also be provided by the contractor as requested by the Department.

The deck concrete shall be cured in accordance with the Specifications except as modified in these special provisions. The surface of the freshly placed concrete shall be kept moist, by fogging if necessary, until the membrane curing compound is applied. Wet burlap shall be placed as soon as possible without damaging the concrete surface. A vapor barrier shall be placed over the wet burlap. The vapor barrier shall consist of two layers of at least 6 mil white polyethylene sheets overlapped and held down adequately against the wind. A composite burlap-vapor barrier material may be used subject to approval by the Engineer. The wet cure shall be continuous for 7 days. The burlap shall be frequently checked to insure it is kept wet continuously.

#### Research Activities.

The contractor and beam fabricator shall cooperate with Department personnel, or their appointed agent, in research activities associated with this project by providing information and test specimens as requested and by permitting access to areas of work for the purpose of instrumenting ~~this structure~~ these structures. Instrumentation in the beams and the bridge deck will be used to gather data. It is anticipated that the instrumentation can be installed concurrently with the contractor's or fabricator's work; however, some delays to the contractor or fabricator may occur. These occasional delays shall not be grounds for claims or contract time extensions.

The concrete for the prestressed concrete beams shall be tested using samples cured both by Specification procedures and by match-curing, subject to the Department's acquisition of the necessary match-curing equipment. Sufficient concrete strength for strand release will be determined based on the tests of the cylinders cured in accordance with the Specifications, unless specified otherwise by the Engineer.

On beams selected by the Engineer, and immediately after release of the strands, the fabricator shall measure the camber at mid-length of the beam. The camber shall be remeasured on the following schedule: 1 day, 3 days, 7 days, 14 days, and every 14 days thereafter until the beam is shipped. The prestressed concrete beams shall be at least 60 days old prior to shipping.

#### Basis of Payment.

Payment will be in accordance with the Specifications and these special provisions. Use of silica fume as a partial cement replacement shall will not be measured and paid for separately. All costs associated with the use of silica fume and fly ash shall be included in the unit price bid for concrete.

604HP604HP  
Sheet 5 of 5

High performance concrete (HPC) that fails to meet the permeability requirement may be accepted at an adjusted price as detailed below:

Coulombs above Required	% of Bid Price Paid
0 to 500	95
501 to 1000	90
1001 to 1500	80
>1501	70

The adjustment shall apply to the volume of concrete represented by the specimen that does not meet the permeability requirement. In the case where a particular volume of concrete meets neither the strength nor the permeability requirement, the percent of bid price paid will be based on the larger of the penalties for strength and permeability according to the Specifications and these special provisions.