

11. HPC SPECIFICATIONS

*F.R. DIV.6 * TEXAS STP 95(208)UM ETC * SHEET

 TOM GREEN COUNTY * HWY US 67 *CONT 77-6-67,ETC

HIGH PERFORMANCE CONCRETE (HPC)

ITEMS 420, 421, 422, 424 AND 440

THE DESIGN AND CONSTRUCTION OF A PORTION OF THIS PROJECT, THE NORTH CONCHO RIVER, U.S. 87 & S.O. RR OVERPASS EASTBOUND MAINLANES, IS PART OF A FEDERAL DEMONSTRATION RESEARCH PROJECT ON THE USE OF HIGH PERFORMANCE CONCRETE (HPC) IN BRIDGE STRUCTURES. THIS STUDY IS CO-SPONSORED BY THE FEDERAL HIGHWAY ADMINISTRATION (FHWA) AND THE TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT). THE INVESTIGATING TEAM (RESEARCHERS) IS WITH THE CENTER FOR TRANSPORTATION RESEARCH OF THE UNIVERSITY OF TEXAS AT AUSTIN. THE SUCCESS OF BOTH THE CONSTRUCTION PROJECT AND THE RESEARCH REQUIRES THAT THE RESEARCHERS PLAY AN INTEGRAL PART IN THE CONSTRUCTION PROCESS, AND THAT THE CONTRACTOR AND SUBCONTRACTORS COOPERATE FULLY WITH THE RESEARCHERS. THE FOLLOWING SECTION DESCRIBES SPECIAL CONSIDERATIONS REQUIRED OF THE CONTRACTOR, AND OUTLINES THE ROLE OF THE RESEARCHERS IN VARIOUS ASPECTS OF THE CONSTRUCTION PROCESS.

THE CONTRACTOR IS GIVEN THE OPTION OF CONSTRUCTING PRECAST SUB-STRUCTURES (CAPS AND COLUMNS), OF THE SAME STRENGTHS AND DIMENSIONS AS THE CAST-IN-PLACE SUBSTRUCTURES, FOR THE NORTH CONCHO RIVER, US 87 & S. O. OVERPASS. FABRICATION SHALL BE IN ACCORDANCE WITH ITEM 424. THE CONTRACTOR SHALL SUBMIT TO THE STATE COMPLETE DETAILS, INFORMATION AND ALL APPLICABLE DRAWINGS OF THE PROPOSED METHOD, MATERIALS, EQUIPMENT AND PROCEDURES. THESE SHALL BE SUBMITTED SUFFICIENTLY IN ADVANCE OF THE START OF CONSTRUCTION OPERATIONS, TO ALLOW THE STATE NOT LESS THAN

SPECIFICATION DATA

SHEET H

GENERAL NOTES AND SPECIFICATION DATA -

HIGH PERFORMANCE CONCRETE (HPC) CONT'D
14 CALENDAR DAYS FOR REVIEW AND APPROVAL.

COORDINATION OF WORK WITH THE CONTRACTOR

ALL ASPECTS OF THE RESEARCHERS' WORK SHALL BE COORDINATED WITH THE CONTRACTOR. THE CONTRACTOR SHALL TAKE ALL ACTIONS NECESSARY TO INCORPORATE THE RESEARCH ACTIVITIES INTO THE DEVELOPMENT OF THE CONSTRUCTION SCHEDULE.

ATTENDANCE AT A PRE-BID MEETING, WHERE THE RESEARCHERS AND TXDOT PERSONNEL WILL GIVE PRESENTATIONS ON DETAILS CONCERNING THE HIGH STRENGTH CONCRETE (HPC) BRIDGE, IS MANDATORY FOR ALL CONTRACTORS BIDDING ON THIS CONTRACT. AFTER LETTING, A PARTNERING WORKSHOP IS RECOMMENDED AND A PRECONSTRUCTION MEETING WILL BE SCHEDULED WITH THE CONTRACTOR, PERTINENT SUBCONTRACTORS, RESEARCHERS AND SPONSORS.

AT ALL TIMES, INCLUDING DURING CONSTRUCTION, COORDINATION BETWEEN THE CONTRACTOR'S AND RESEARCHERS' AREA REPRESENTATIVES WILL BE REQUIRED TO ENSURE IMPLEMENTATION OF THE NECESSARY MEASURES FOR DESIGN AND CONTROL OF HPC. THE RESEARCHERS WILL BE PROVIDED ACCESS TO THE WORK AREA, AND WILL INSTALL THE INSTRUMENTATION. ANY NECESSARY FACILITIES FOR INSTALLING AND PROTECTING INSTRUMENTATION AND EQUIPMENT WILL BE PROVIDED BY THE CONTRACTOR.

DEFINITION OF HIGH PERFORMANCE CONCRETE (HPC)

FOR THIS CONTRACT, "HIGH PERFORMANCE CONCRETE" SHALL BE DEFINED AS THE CONCRETE IN THE DECK, BEAMS, CAPS AND COLUMNS OF THE EASTBOUND MAINLANES OF THE NORTH CONCHO RIVER, U.S. 87 & S.O. RR OVERPASS, THE DECK ONLY OF THE WESTBOUND MAINLANES OF THIS OVERPASS, AND THE BEAMS OF ENTRANCE RAMP E. HIGH PERFORMANCE CONCRETE BEAMS AND PRECAST CONCRETE PANELS ARE CLASS H (HPC) CONCRETE. HIGH PERFORMANCE CONCRETE CAST-IN-PLACE DECK, CAPS, AND COLUMNS OF THE EASTBOUND MAINLANES ARE CLASS K (HPC) CONCRETE AS DEFINED IN THE SPECIAL PROVISIONS TO ITEM 421. THE HIGH PERFORMANCE CONCRETE CAST-IN-PLACE DECK IN THE WESTBOUND MAINLANES IS CLASS S (HPC) CONCRETE.

HIGH PERFORMANCE CONCRETE (HPC) MIX DEVELOPMENT

THE RESEARCHERS WILL PROVIDE TECHNICAL EXPERTISE TO THE CONTRACTOR IN DEVELOPING AND EVALUATING THE HPC MIX DESIGNS. THE DESIGN AND CONTROL OF THE HPC WILL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND CONTRACT PLANS. EMPHASIS WILL BE GIVEN TO USING THE LOCAL MATERIALS AVAILABLE AS PROPOSED BY THE CONTRACTOR. HOWEVER, HIGHER QUALITY MATERIALS THAN ARE AVAILABLE LOCALLY, SUCH AS HIGH

SPECIFICATION DATA

SHEET I

*F.R. DIV.6 TEXAS STP 95(208)UM ETC SHEET

TOM GREEN COUNTY * HWY US 67 *CONT 77-6-67,ETC

GENERAL NOTES AND SPECIFICATION DATA--

HIGH PERFORMANCE CONCRETE (HPC) CONT'D
STRENGTH AGGREGATES FOR THE BEAMS, MAY BE REQUIRED TO MEET THE HPC SPECIFICATIONS.

LABORATORY AND FIELD TESTING

DURING THE TRIAL MIX PHASE OF THE HPC MIX DESIGN, AND FOR CONTROL OF THE HPC DURING FABRICATION/CONSTRUCTION, HPC SPECIMENS IN ADDITION TO THOSE REQUIRED BY THE SPECIFICATIONS/CONTRACT PLANS WILL BE MADE BY THE RESEARCHERS AND/OR TXDOT PERSONNEL. THE CONTRACTOR SHALL MAKE THE NECESSARY PROVISIONS TO ALLOW ADEQUATE SAMPLING OF THE HPC.

"SPECIAL STEEL" FOR DECK REINFORCEMENT

THE TOP MAT OF DECK REINFORCEMENT IN THE SECOND AND THIRD SPANS OF BOTH THE EASTBOUND AND THE WESTBOUND MAINLANES OF THE NORTH CONCHO RIVER, U.S. 87 & S.O. RR OVERPASS SHALL BE A "SPECIAL STEEL." THE "SPECIAL STEEL" IN THE WESTBOUND MAINLANES SHALL BE EPOXY COATED IN ACCORDANCE WITH ITEM 440, "REINFORCING STEEL."

THE "SPECIAL STEEL" CONFORMS TO ASTM A615, WITH A MINIMUM "RELATIVE RIB AREA" OF 0.12. THE "RELATIVE RIB AREA" IS THE RATIO OF BEARING AREA OF RIBS TO SHEARING AREA BETWEEN RIBS. THIS 'SPECIAL STEEL" MAY BE OBTAINED FROM CHAPARRAL STEEL CO. OF MIDLOTHIAN, TEXAS, AND BIRMINGHAM STEEL CO. OF BIRMINGHAM, ALABAMA.

PAVING ADJACENT TO HPC BRIDGE

THE LAST 100 FT OF ROADWAY PAVING ADJACENT TO THE BRIDGE ENDS SHOULD NOT BE PLACED UNTIL THE BRIDGE DECK IS CONSTRUCTED. THIS WILL PERMIT ADJUSTMENT OF VERTICAL CURVE, TO PREVENT EXCESSIVE SLAB THICKNESS, SHOULD ANTICIPATED BEAM CAMBER NOT BE ATTAINED.

STRUCTURE MONITORING

THE RESEARCHERS WILL DEVELOP A FIELD MEASURING PROGRAM TO MONITOR THE STRUCTURAL PERFORMANCE OF THE BRIDGE AND ITS COMPONENTS. THE CONTRACTOR WILL MAKE AVAILABLE SELECTED COMPONENTS TO PROVIDE ACCESS TO VARIOUS LOCATIONS TO ALLOW RESEARCHERS TO ATTACH MONITORING DEVICES. IT IS ANTICIPATED THAT THE INSTALLATION OF EQUIPMENT OR THE COLLECTION OF DATA WILL NOT CAUSE ANY SIGNIFICANT DELAYS OR WORK STOPPAGES FOR THE CONTRACTOR.

INSTRUMENTATION SHALL BE PLACED IN THE EASTBOUND MAINLANES, AND IN SPAN NO. 1 ONLY OF THE WESTBOUND MAINLANES.

SPECIFICATION DATA

SHEET J

SPECIAL PROVISIONS

TO

ITEM 420

CONCRETE STRUCTURES

For this project, Item 420, "Concrete Structures", of the Standard Specifications, is hereby amended with respect to the clauses cited below and no other clauses or requirements of this Item are waived or changed hereby.

Article 420.3. General Requirements. The first paragraph is voided and replaced by the following:

Before starting work, the Contractor shall fully inform the Engineer of the construction methods he proposes to use, the adequacy of which shall be subject to the approval of the Engineer. The researchers shall be provided access to the work, and will install the instrumentation. Any necessary facilities for installing and protecting instrumentation and equipment shall be provided by the Contractor.

Article 420.25. Payment. The last paragraph is supplemented by the following:

Any HPC concrete that fails to meet required strengths shall not be subject to the penalties shown above.

SPECIAL PROVISIONS

TO

ITEM 421

PORTLAND CEMENT CONCRETE

For this project, Item 421, "Portland Cement Concrete", of the Standard Specifications, is hereby amended with respect to the clauses cited below and no other clauses or requirements of this item are waived or changed hereby.

Article 421.2. Materials, Subarticle (2) Fly Ash. The second paragraph is voided and replaced by the following:

The Contractor shall have the option of replacing a percentage of the required cement with fly ash, on a one to one basis by absolute volume, in accordance with the following:

When aggregate sources have not been identified as potentially reactive, the Contractor may substitute up to 35 percent of the cement with fly ash.

When potentially reactive aggregates are used, the Contractor may substitute from a minimum of 20 percent to a maximum of 35 percent of the cement with fly ash.

Only Type A fly ash may be used when Type II cement is specified.

No fly ash will be permitted when a white portland cement is required and no additional fly ash will be permitted when a Type IP cement is used.

Article 421.2. Materials, Subarticle (4) Coarse Aggregate. The first sentence of the first paragraph is voided and replaced by the following:

Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag, recycled crushed portland cement concrete, crushed stone, or combinations thereof and shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter, or other objectionable material.

Article 421.2. Materials, Subarticle (5) Fine Aggregate. The first and second paragraphs are voided and replaced by the following:

Fine aggregate shall consist of clean, hard, durable particles of

natural or manufactured sand or a combination thereof, with or without a mineral filler. Fine aggregate shall be free from frozen material or

injurious amounts of salt, alkali, vegetable matter or other objectional material and shall not contain more than 0.5 percent clay lumps by weight.

When fine aggregate is subjected to the color test for organic impurities in accordance with Test Method Tex-408-A, the test result shall not show a color darker than standard.

When white portland cement is specified, the fine aggregate shall be light colored.

Unless otherwise shown on the plans, the acid insoluble residue of fine aggregate used in concrete subjected to direct traffic shall not be less than 60 percent by weight when tested in accordance with Test Method Tex-612-J.

Unless otherwise shown on the plans, fine aggregates may be blended to meet the acid insoluble residue requirements. When blended, the following equation will be used:

$$\text{Acid Insoluble (\%)} = \{(A1)(P1+(A2)(P2))\}1/100$$

where:

- A1 = acid insoluble (%) of aggregate 1
- A2 = acid insoluble (%) of aggregate 2
- P1 = percent by weight of A1 of the fine aggregate blend
- P2 = percent by weight of A2 of the fine aggregate blend

Article 421.2. Materials. Subarticle (5) Last paragraph is supplemented by the following:

For class K (HPC) concrete, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method Tex-402-A.

Article 421.8. Classification and Mix Design. The first paragraph is voided and replaced by the following:

The Contractor shall furnish the mix design, using a coarse aggregate factor acceptable to the Engineer, for the class(es) of concrete specified, to conform with the requirements contained herein and in accordance with Construction Bulletin C-11. The researchers will provide technical expertise to the Contractor in developing and evaluating the hPC mix designs. The Contractor shall bear the expense of providing adequate quantities of the HPC constituents, to the research facility located in Austin, Texas, necessary for

developing the HPC mix designs. The Contractor shall perform, at his entire expense, the work required to substantiate the design, including several 4-5 cubic yard test batches or sections of each component, except that casting and testing of strength specimens will be done by the Department. Complete concrete design data shall be submitted to the Engineer for approval.

Article 421.8. Classification and Mix Design. The eleventh (11) paragraph is supplemented by the following:

The type of admixtures utilized in the high performance concrete (HPC) shall be designated by the researchers and may preclude the requirements of the Item 437, "Admixtures".

Article 421.8. Classification and Mix Design. "Table 3, Slump Requirements", A. Structural Concrete is supplemented by the following:

(9) High strength concrete (f'c >= 9000 psi)	-----	Maximum slump may exceed 8" when approved by the Engineer
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Article 421.9. Quality of Concrete. The third paragraph is voided and replaced by the following:

Unless otherwise shown on the plans the Contractor shall furnish and properly maintain all test molds. The test molds shall meet the requirements of Test Methods Tex-418-A and Tex-448-A and, in the opinion of the Engineer, must be satisfactory for use at the time of use. For high performance concrete (HPC), extra concrete and specimen molds may be required for making research test specimens. All compressive strength specimen molds for high strength concrete (f'c >= 9000 psi) shall be 4" diameter by 8" in dimension, and shall have unbonded capping systems capable of attaining 15,000 psi, or caps made of high strength capping compound capable of attaining 15,000 psi. In addition, the Contractor shall be responsible for furnishing personnel to remove the test specimens from the molds and transport them, as needed, to the proper curing location at the schedule designated by the Engineer and in accordance with the governing specification. For all concrete items the Contractor shall have a wheelbarrow, or other container acceptable to the Engineer, available to use in the sampling of the concrete. The Contractor is responsible for disposing of used, broken test specimens.

Article 421-9. Quality of Concrete. "Table 4, Classes of Concrete", is supplemented by the following:

Class	Cement Per C.Y. Of Conc. (Sacks)	Min. Comp. Sgth. (f'c) 28 Day psi (e)	Min. Flex. Sgth. 7 day psi	Max. Water Cement Ratio Gal/sk	Coarse Aggr. Grade No.	General Usage
K (HPC)	6.5	As specified on the plans	N.A.	5.0	3-4-5-6	For cast-in-place concrete deck, caps & columns of Eastbound Mainlanes (f)
H (HPC)	6.0	As specified on the plans	N.A.	5.5	3-4-5-6	For beams of Eastbound Mainlanes and prestressed concrete panels of Eastbound & Westbound Mainlanes (f) Also for beams of Entrance Ramp E
S (HPC)	6.5	4000	570 525 (c)	5.0	2-3-4-5	For cast-in-place deck of Westbound Mainlanes (f)

(e) For high strength concrete (f'c \geq 9000 psi) the 56-day minimum compressive strength shall be as specified on the plans.

(f) The North Concho River, U.S. 87 & S.O. RR Overpass.

SPECIAL PROVISIONS

TO

ITEM 424

PRECAST CONCRETE STRUCTURES (FABRICATION)

For this project, Item 424, "Precast Concrete Structures (Fabrication)", of the Standard Specifications, is hereby amended with respect to the clauses cited below and no other clauses or requirements of this Item are waived or changed hereby.

Article 424.3. General. Subarticle (1) is supplemented by the following:

(c). The researchers shall be provided access to the work, and will install the instrumentation. Any necessary facilities for installing and protecting instrumentation and equipment shall be provided by the Contractor.

Article 424-4. Fabrication. Subarticle (3) Paragraph 2 is voided and replaced by the following:

The control of concrete shall be by compressive tests of cylinders. For prestressed and nonstressed members, the making, curing, and testing of all required cylinder test specimens for release or handling strength or design strength shall be in accordance with Test Method Tex-704-I. The control of high strength concrete ($f'c \geq 9000$ psi) shall be by 56-day compressive strength testing. Job control testing may be performed at any age equal to or greater than 7 days; however, the minimum strength requirements for job control testing shall be 100 percent of the specified 56-day compressive strength. When the required 56-day compressive strength is not attained by job control testing, the final set of compressive strength specimens shall be tested at 56 days.

Article 424.4. Fabrication. Subarticle (4)(a) Last paragraph is voided and replaced by the following:

Protection shall be provided to maintain the temperature of the concrete at all surfaces of prestressed members at 50 F or above until "Release Strength" is reached. All concrete surfaces of nonstressed members shall be maintained at 40 F or above during the specified curing period. Protection shall consist of providing additional covering and, if necessary, supplementing such covering with artificial heating. When weather conditions indicate the possibility of the need for such temperature protection, all necessary heating equipment and covering material shall be on hand ready for use before permission is granted by the Engineer to begin

placement of concrete. For high strength concrete ($f'c \geq 9000$ psi) protective measures shall be taken to assure the difference between the air temperature and the surface of the concrete shall not exceed 40 degrees F except during form removal.

Article 424.4. Fabrication. Subarticle (6) Paragraph 1 is voided and replaced by the following:

Careful attention shall be given to the proper curing of concrete. For high performance concrete (HPC), modifications to the curing requirements shall be made as required by the researchers. Prior to placing concrete, the Contractor shall submit the proposed curing methods and procedures to the Engineer for approval. Elevated temperature curing facilities shall be tested for a minimum of 48 hours prior to approval. Approved equipment and materials for curing shall be available for use prior to casting.

Article 424.4. Fabrication. Is supplemented by the following:

(7) Strand Pull-out Tests. Strand pull-out tests shall be performed by and at the expense of the Contractor. The making, curing, and testing of the strand pull-out test specimens shall be performed as directed by the researchers and as described herein.

(a) Strand pull-out test specimens and compressive strength cylinders shall be made in conjunction with 14 beams.

(b) The strand samples will be identified by the researchers.

(c) For the pull-out test procedure and any additional information regarding this procedure, call the TXDOT Design Division, Bridge Section, at 512-416-2268.

Article 424.5. Workmanship, Subarticle (2) Tolerances, Section (a) Prestressed Members. Table 1 is voided and replaced by the following:

TABLE 1
ALLOWABLE TOLERANCES

	Beams	Box Beams	Tees	Panels	Piling
Lengths (Normal to strands for panels)	+/-3/4"	+/-1"	+/-3/4"	+/-1/2"	-1"*
Width (Parallel to strands for panels)	+3/4" -1/4"	+/-1/4"	+/-3/4"	+/-1/2"	+/-1/4"
Nominal Depth (Thickness in case of panels)	+1/2" -1/4"	+/-1/4"	+/-1/4"	+1/4" -1/8"	+/-1/4"

		Beams	Box Beams	Tees	Panels	Piling
Thickness	Top Slab or Flange	+1/2" -1/4"	+/-1/2"	+/-1/4"	NA	NA
	Bottom Slab or Flange	+1/2" -1/4"	+/-1/2"	NA	NA	NA
	Web or Wall	+3/4" -1/4"	+/-1/2"	+/-1/4"	NA	NA
Horizontal Alignment (Upon Release of Stress) - Deviation from straightness of mating edge of panels.		+/-1/8" per 10' of length	+/-1/4"	+/-1/4"	+/-1/8"	+/-1/8" per 10' of length
Deviation of Ends from Shop Plan Dimension (Bearing edge in case of panels)	Horizontal Skew	+/-1/4"	+/-1/8" per 1' of width, 1/2"max	+/-1/8" per 1' of width	+/-1/2"	+/-1/8"
	Vertical Batter	+/-1/8" per 1' of depth	+/-1/8" per 1' of depth, 1/2"max	+/-1/8" per 1' of depth	NA	+/-1/8"
Notched End Area (for diaphragms)	Depth	+/-1/4"	+/-1/4"	+/-1/4"	NA	NA
	Length	+2" -1"	+2" -1"	+2" -1"	NA	NA
Bearing Surfaces	Perpendicular to Vertical Axis	+/-1/8"	NA	+/- 1/16"	NA	NA
	Deviation from Plane	+/- 1/16"	+/-1/8"	+/- 1/16"	NA	NA
Anchor Hole Location	From End of Member	+3/4" -1/4"	+/-1/4"	+3/4" -1/4"	NA	NA
	Longitudinal Spacing	+/-3/4"	+/-1/2"	+/-3/4"	NA	NA
	Transverse Location	+/-1/4"	+/-1/4"	+/-1/4"	NA	NA
Diaphragm or Lateral Tie Location		+/-1/2"	+/-1/2"	+/-1/2"	NA	NA
Position of Void** (Longitudinal for Box Beams)		NA	+/-1"	NA	NA	+/-1/2"
Position of Strands		+/-1/4"	+/-1/4"	+/-1/4"	+/-1/8" vert. +/-1/2" Horiz.	+/-1/4"
Position of Hold-Down Points		+/-6"	+/-6"	+/-6"	NA	NA
Position of Handling Devices		+/-6"	+/-6"	+/-6"	NA	+/-6"

Measured for bottom of panel.

* Maximum length approved by the Engineer.

** Length of Box Beam Void Material +1"-6".

