

Section 03001

CONCRETE (PAVEMENT & STRUCTURES)

PART 1 GENERAL

1.01 SUMMARY

This section includes storage and handling of materials as well as proportioning and mixing of concrete for reinforced concrete pavement for all precast and cast-in-place structures.

1.02 MEASUREMENT AND PAYMENT

- A. No separate measurement and payment for Work performed under this Item except as indicated below. Include cost of same in Contract price bid for Work of which this is a component part.
- B. Measure "Extra Concrete," when approved by Engineer, by cubic yard of concrete of class ordered, complete in place. Pay for "Extra Concrete" at Contract unit price bid per cubic yard for classes of "Extra Concrete" used.

1.03 REFERENCES

- A. ASTM C138/C138M – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- B. ASTM C143/C143M REV A - Standard Test Method for Slump of Hydraulic Cement Concrete
- C. ASTM C150/C150M - Specification for Portland Cement
- D. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- E. ASTM C232/C232M - Standard Test Method for Bleeding of Concrete
- F. ASTM C260/C260M REV A - Standard Specification for Air-Entraining Admixtures for Concrete
- G. ASTM C293/C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
- H. ASTM C31/C31M REV A - Standard Practice for Making and Curing Concrete Test Specimens in the Field
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregate

- J. ASTM C39/C39M REV A - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - K. ASTM C42/C42M - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
  - L. ASTM C494/C494M REV A - Standard Specification for Chemical Admixture for Concrete
  - M. ASTM C94/C94M REV B - Standard Specification for Ready-Mixed Concrete
  - N. ASTM E329 REV A - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
  - O. Corps of Engineers CRD-C 621-82B – Specification for Non-Shrink Grout
- 1.04 SUBMITTALS
- A. Samples
    - 1. Furnish material samples to approved testing laboratory for review and testing.
    - 2. Provide sufficient quantities for testing and determining mixes to produce concrete classes specified.
  - B. Mix Designs
    - 1. Submit mix designs for each different concrete strength and for each different aggregate.
    - 2. Secure confirmation of laboratory tests on proposed mix designs prior to submittal.
    - 3. Use only approved mix designs.
    - 4. Make required tests of mix as called for elsewhere in this specification under “Tests.”
  - C. Reports

Provide certified mill reports on cement and sieve analysis on aggregate.
  - D. Tests
    - 1. Make moisture tests of aggregate to ensure proper batching and proportioning.
    - 2. Provide and maintain curing facilities conforming to ASTM C31.
    - 3. For Structural Concrete

- a. Perform sufficient number of tests to maintain check on quality.
  - b. Conduct tests as per test procedures (ASTM C31 and C39 for Compression Test).
  - c. When Portland cement concrete (other than high-early-strength concrete) is used, test minimum of two standard 6-inch by 12-inch cylinders at 7 days and minimum of two 6-inch by 12-inch cylinders at 28 days for each 50 yards of concrete placed or each structure, whichever is less.
  - d. When high-early-strength concrete is used, test minimum of two standard 6-inch by 12-inch cylinders at 3 days and minimum of two 6-inch by 12-inch cylinders at 7 days for each 50 cubic yards of concrete placed or for each structure, whichever is less. Minimum strengths normally required at 7 and 28 days will be required at 3 and 7 days, respectively.
4. For paving concrete, test pavement Work as required by PLANS and/or as follows:
- a. Make four beams for each 750 square yards, or less, of pavement, or part thereof, for each day's pour.
  - b. Size of beams as required by ASTM C31.
  - c. Make one core for each 1,000 square yards of pavement or at least one core for each street, whichever is least in area.
  - d. Fill core hole with nonshrinking grout at no additional cost to Owner.
  - e. Test core for compressive strength and for thickness.
  - f. Test for flexural strength in accordance with ASTM C293, "Flexural Strength of Concrete (using simple beam with center-point loading)."
5. For air entrainment, make two tests in accordance with ASTM C138 or C173, for each day's placing.
6. Make slump tests periodically in accordance with ASTM C143.
- E. Specimen Handling
1. Mark test specimens clearly in a definite sequence.
  2. Transport and store specimens to prevent damage.
  3. Provide insulated shed for storage of cylinders and beams.

4. Provide records identifying each cylinder with locations from which specimens were taken.
5. Cure specimens under laboratory conditions, except that for a possibility of surrounding air temperature falling below 40°F; additional specimens to be cured under job conditions may be required.

1.05 RELATED REQUIREMENTS

Section 01330 – “Submittal Procedures”

1.06 QUALITY ASSURANCE

- A. Furnish laboratory reports showing proportions and materials selected will produce laboratory-mixed concrete of specified quality and having strengths 20 percent higher than 28-day strength specified, at maximum slump and maximum air content specified.
- B. Owner to select testing laboratory, conforming to ASTM E329, to make tests throughout concrete operations. When requested by Project Manager, Engineer or his representative will monitor tests and review results.
- C. Failure to Meet Specifications
  1. Concrete failing to meet specifications will be rejected.
  2. Should a 3-day (high-early cement) or 7-day (normal cement) test fail to meet established strength requirements, extended curing or resumed curing may be required.
  3. Contractor to strengthen structures, or replace portions thereof, which fail to meet established strength requirements, at Contractor’s expense.
  4. Test cores, when required, to be in accordance with procedures of ASTM C42, at no additional cost to Owner.

1.07 SYSTEM DESCRIPTION (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Cement
  1. Store in weathertight enclosures and protect against dampness, contamination, and warehouse set.
  2. Store off ground in well-ventilated building.
- B. Aggregates

1. Stockpile to prevent excessive segregation or contamination with other materials or other sizes of aggregates.
2. Use only one supply source for each aggregate stockpile.

C. Admixtures

1. Store to prevent contamination, evaporation, or damage.
2. Protect liquid admixtures from freezing or harmful temperature ranges.
3. Agitate emulsions prior to use.

1.09 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Concrete

Ready-mixed concrete conforming to ASTM C94 or site-mixed concrete (dry weight 145-150 pounds per cubic foot).

1. Cement
  - a. ASTM C150, Type I.
  - b. ASTM specifications for weight variations and length of storage.
  - c. Use no caked cement.
  - d. Deliver in bags for site-mixed concrete.
  - e. Use only one brand of cement in any one structure.
  - f. Cement for Class “P” concrete may be delivered in bulk if method of handling is approved.
2. Admixtures
  - a. Air-entraining admixtures in accordance with ASTM C260.
  - b. Water-reducing and retarding admixtures in accordance with ASTM C494, Type A or Type D admixture, modified as follows:

- 1) Bleeding water no greater than bleeding water of ASTM C494 reference concrete when tested as per ASTM C232.
  - 2) Increase durability, decrease permeability, and increase resistance to surface scaling, when compared to ASTM C494 reference concrete.
  - 3) No chlorides or alkalis added during manufacture of admixture.
- c. High-range water-reducing admixture (superplasticizer) in accordance with ASTM C494, Type F or Type G, modified as follows:
- 1) Superplasticized concrete to be non-segregating, have little bleeding, and have physical properties similar to low water-cement ratio concrete.
  - 2) Admixture composed of a synthesized sulfonated polymer to be added to the concrete mixer with gauge water at the central batch plant.
  - 3) Use only one liquid admixture to achieve the superplasticized concrete, except where air entrainment is desired, in which case, air entraining admixture to be compatible with superplasticizer admixture.
  - 4) Treated concrete must be capable of maintaining superplastic state in excess of 2 hours.
  - 5) Dosage as recommended by the manufacturer.
- d. Additional Requirements
- 1) Manufacturer to provide proof of successful field use of water-reducing and retarding admixture from recognized laboratories and other authorities.
  - 2) Manufacturer to provide local representative and warehouse facilities, when requested by Project Manager.
  - 3) Provide qualified concrete technician to assist in concrete mix design, if required.
  - 4) If required, Contractor to acquire approved commercial laboratory testing, at no cost to Owner, to furnish certification of compliance with this specification.
  - 5) Water-reducing and retarding admixtures used in Class A and Class K concrete only, unless otherwise specified.

- 6) Use manufacturer's published recommended dosage for optimum results as minimum requirements. Dosage may be varied by Engineer after analysis of results of local commercial laboratory tests using materials from sources assigned by Contractor.
    - 7) Dispensing and mixing equipment and procedures at batch plant are subject to approval.
  3. Coarse Aggregate
    - a. Durable particles of gravel, crushed gravel, crushed blast furnace slag, crushed stone, or combination thereof, conforming to ASTM C33.
    - b. Use clean, durable particles, free from frozen materials, clay, salt, alkali, vegetable matter, or other coating which would adversely affect strength of concrete or bonding of aggregate to cement paste.
      - 1) Nonprestressed concrete aggregate size from No. 4 to 1½ inches.
      - 2) Prestressed concrete aggregate size from No. 4 to 1 inch.
    - c. The maximum size coarse aggregate to be as indicated above or no greater than three-fourths of the minimum clear spacing between parallel reinforcing bars or prestressing tendons, whichever is smaller.
  4. Fine Aggregate
    - a. Natural sand as per ASTM C33.
    - b. Fineness modulus between 2.4 and 2.9.
  5. Water
    - a. Free from oils, acids, alkalis, organic matter, or other deleterious substances and not containing more than 1,000 parts per million of sulphates.
    - b. Testing not required from municipal supplies approved by Texas Department of Health, but from other sources water will be sampled and tested, at no additional cost to Owner, before use.
  6. Slump
    - a. Test method as per ASTM C143.
    - b. As indicated in Classification Table (Attachment A).

7. Mix Proportioning

- a. As per Classification Table, based on maximum water-cement ratio and minimum strength requirements, with limits set on minimum cement content.
- b. Increase cement content above minimum or use approved admixtures, without additional cost to Owner, if type, gradation, or sizes of aggregate being supplied gives concrete mixture not meeting strength and workability requirements.

8. Coring Materials

Per Item "Concrete Structures."

- B. Nonshrink Grout: Grout to have moderate fluidity and to conform to U.S. Army Corps of Engineers Specification CRD-C 621-82B.

2.03 – 2.04 NOT USED



Attachment A

CLASSIFICATION TABLE

Max. Water Content<sup>(11)</sup>

Class - Type	Min. Comp. Strength (psi)		Pounds of Water/lb Cement	Gallons of Water/Bag Cement	Min. Cement Per C.Y. <sup>(12)</sup>		Slump Range (in.)*	Total Air Content (%)
	7-day	28-day			lbs	Bags		
A - Structural	2,000	3,000	0.55	6.25	494	5.25	2½ to 4½	2½ to 4½
A <sub>sp</sub> - Structural <sup>(13)</sup>	2,000	3,000	0.50	5.65	423	4.50	7 to 10 <sup>(14)</sup>	3 to 5
B- Slope Protection	1,200	2,000	0.75	8.50	400	4.25	2½ to 4	2½
C- Pipe Blocking	-	1,500	0.97	11.00	282	3.00	3 to 5	3 to 6
D- Seal Slab	-	-	-	-	376	4.00	6 to 8	as needed
E- Monolithic Sewer	2,000	3,000	0.55	6.25	564	6.00	4 to 6	3 to 5
F- Prestressed <sup>(15)</sup>	-	5,000	0.51	5.75	635	6.75	2 to 3	as needed
G- Prestressed <sup>(5)</sup>	-	6,000	0.49	5.50	658	7.00	2 to 3	as needed
K- Structural <sup>(16)</sup>	2,800	4,000	0.45	5.65	564	6.00	3½ to 5	2½ to 4½
K <sub>sp</sub> - Structural <sup>(3)</sup>	2,800	4,000	0.45	5.00	517	5.50	7 to 10 <sup>(4)</sup>	3 to 5
P- Paving 6-Inch <sup>(8)</sup>	2,000	3,000	0.66	7.50	470	5.00	3 to 5	2½ to 4½
	500 <sup>(17)</sup>							
P- Paving 7-Inch <sup>(18)</sup>	2,000	3,000	0.66	7.50	470	5.00	3 to 5	2½ to 4½
	500 <sup>(7)</sup>							
P- Paving 8-Inch <sup>(8)</sup>	2,000	3,000	0.66	7.50	470	5.00	3 to 5	2½ to 4½
	500 <sup>(7)</sup>							

\* All Slump Ranges + 1/2-Inch Tolerance

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- (1) Include in maximum water, free water in aggregate minus absorption of aggregate based on a 30-minute absorption period.
  - (2) For concrete placed under water, minimum cement per cubic yard shall be 611 pounds (6.5 bags).
  - (3) A<sub>sp</sub> and K<sub>sp</sub> to contain approved High Range Water Reducing (HRWR) Admixture.
  - (4) Maximum 2-inch slump before addition of HRWR Admixture.
  - (5) For prestressed concrete, water reducing admixture may be used as needed.
  - (6) Use approved water-reducing and retarding admixture.
  - (7) Minimum flexural strength at 7 days.
  - (8) Slump range 1-3 inch when slip form method of construction used.

PART 3 EXECUTION

3.01 – 3.02 NOT USED

3.03 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. General

1. Provide ready-mixed concrete in accordance with requirements of current ACI building codes.
2. Postpone or delay Work during adverse weather conditions.
3. Protect dry batch material so that it reaches mixer in a dry condition.
4. Use batch mixer having approved and positive water control and measuring device for all materials.
5. Continue mixing to ensure uniform distribution of materials, but not less than 1½ minutes after all materials have been introduced into mixer drum.
6. Rotate drum at peripheral speed recommended by mixer manufacturer.
7. Mix and deliver as per ASTM C94.
  - a. Add mixing water at plant.
  - b. Mix concrete in quantities required for immediate use, and discharge at jobsite within 1 hour after introduction of cement to aggregate. If Contractor can prove that concrete consistency measured by slump will not be reduced by more than 2 inches when superplasticized concrete is used, time interval between mixing and placing may be extended to a maximum of 90 minutes or to a period in which slump loss will not exceed 2 inches.
  - c. Begin mixing operation within 30 minutes after cement and aggregates intermingled.
  - d. Ready-mixed concrete producer to furnish delivery tickets indicating.
    - 1) Delivery date and time dispatched.
    - 2) Name and location of project.
    - 3) Name of Contractor.
    - 4) Name of ready-mixed concrete producer.

- 5) Truck number.
  - 6) Number of cubic yards of concrete in load.
  - 7) Class of concrete.
  - 8) Cement content in bags per cubic yard of concrete.
  - 9) Amount of admixture in concrete, if any.
  - 10) Number of gallons of water in mixture.
  - 11) Air content.
8. Job mix concrete in approved type mixer and do not load beyond manufacturer's rated capacity.
- a. Normal Weight Concrete
    - 1) Mix batches of 1 cubic yard or less for minimum of 1½ minutes after materials are placed in mixer.
    - 2) Increase mixing time 15 seconds for each ½ yard increase over 1 cubic yard batch.
  - b. Maintain positive batch control equipment to within 1 percent accuracy.
  - c. Clean, maintain, and operate equipment so as to thoroughly mix material as required.
  - d. Hand-mixing permitted for small placements only or in emergencies, as authorized.
  - e. Hand-mixed batches not to exceed a two-bag batch in volume.
9. Do not mix when air temperature is at or below 40°F (taken in the shade away from artificial heat) and falling, or if likely to fall below 40°F in next 24 hours.
10. To produce concrete with minimum temperature of 50°F, heat aggregate and/or water uniformly as follows:
- a. Water temperature not to exceed 180°F and/or aggregate temperature not to exceed 150°F.
  - b. Heat mass of aggregate uniformly.

- c. Temperature of aggregates and water to be between 50°F and 85°F before introduction of cement.

B. Installation

- 1. In accordance with other applicable Technical Specifications.

3.04 – 3.10 NOT USED

END OF SECTION