



**DEVELOPMENTAL SPECIFICATIONS
FOR
HIGH PERFORMANCE CONCRETE FOR STRUCTURES**

**Effective Date
October 15, 2024**

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23062.01 DESCRIPTION.

- A.** Develop and provide high performance concrete (HPC) for bridge substructures and decks when called for in the contract documents. HPC is defined as a concrete mix providing the following:
- Desired workability.
 - Maximum 28 day permeability of 2000 coulombs for the substructure (or greater than 20 K ohm-cm surface resistivity by Wenner probe) and 1500 coulombs for the deck (or greater than 30 K ohm-cm surface resistivity by Wenner probe), as a target.
- B.** Apply [Sections 2403, 2412](#), and Division 41 of the Standard Specifications with the following modifications.

23062.02 MATERIALS.

Contractor may use other mixes than those described below provided they meet the requirements of this specification and are approved by the District Materials Engineer.

A. Substructure.

1. Apply the following conditions for substructure HPC mixes:
 - Coarse aggregate meeting Class 3i durability.
 - Basic water to cementitious material (w/c) ratio of 0.42, with a maximum w/c ratio of 0.45 in accordance with [Materials I.M. 529](#).
2. HPC mix for substructure may be a HPC-S or CV-HPC-S. Apply the following conditions:
 - a. Use one of the following cement combinations:
 - Type IS, IP or IT.
 - Type I, II or IL with a minimum of 30% weight substitution with GGBFS.
 - b. Fly ash substitution not to exceed 20% by weight of the cement.
 - c. Maximum total substitution of 50%
 - d. A high range water reducer may be used with a maximum allowable slump of 8 inches and target air content of 7.5% ± 2.0%.

B. Deck.

1. Apply the following conditions for deck HPC mixes:
 - a. Use coarse aggregate meeting Class 3i durability.
 - b. Basic w/c ratio of 0.40, with a maximum w/c ratio of 0.42 in accordance with [Materials I.M. 529](#).
2. The HPC mix for the deck may be a HPC-D or a CV-HPC-D. Apply the following conditions:
 - a. Use one of the following cement combinations:
 - Type IS, IP or IT.
 - Type I, II or IL with a minimum of 30% weight substitution with GGBFS.
 - b. Fly ash substitution not to exceed 20% by weight of the cement.
 - c. Maximum total substitution of 50%.
 - d. Combined aggregate gradation optimized in Zone II according to [Materials I.M. 532](#).

C. Contractor Designed HPC.

Other mixes meeting the above requirements may be approved by the District Materials Engineer.

23062.03 CONSTRUCTION.

A. Production Concrete.

1. Notify the Engineer at least 48 hours prior to placement of production concrete. Use only approved HPC mixes for production concrete. If a mix other than mix described in Article DS-23062.02, A or B is to be used, ensure it has same materials, proportions, and properties (including slump, air content, and w/c ratio) as approved by the District Materials Engineer.
2. District Materials Engineer will obtain random verification strength samples on a minimum of one deck placement. Strength samples will be tested at District Materials Laboratory according to AASHTO T 22. A set of four cylinders will be cast, cured, and handled according to [Materials I.M. 315](#). Three cylinders will be tested for strength at 28 days. One cylinder will be tested for permeability on a random basis by Central Materials Laboratory or Wenner probe resistivity testing by the District Materials Engineer. Permeability testing will not be evaluated on footings or drilled shafts.

B. Placing Concrete.

For the deck, placing of concrete floors shall not begin if the theoretical rate of evaporation exceeds 0.1 pounds per square foot per hour. Monitor theoretical evaporation rate at a maximum interval of every three hours during placement at a location as near the deck as possible. If the rate exceeds 0.15 pounds per square foot per hour cease placement at next location acceptable to Engineer.

C. Curing.

1. Substructure.

- a. Leave forms in place for 96 hours of curing.
- b. Apply curing protection to exposed surfaces of concrete in accordance with [Article 2403.03, E, 4, b](#). Leave curing protection in place for 96 hours.

2. Deck.

- a. Leave forms in place for 168 hours of curing.
- b. Apply water to the burlap covering for 168 hours of continuous wet sprinkling system curing.
- c. Do not place curing compound on floor.
- d. Use burlap that is prewetted by fully saturating, stockpiling to drain, and covering with plastic to maintain wetness prior to placement. Place two layers of prewetted burlap on floor immediately after artificial turf drag or broom finish with a maximum time limit of 10 minutes after final finishing. Apply water to burlap covering for entire curing period by

means of a continuous wet sprinkling system that is effective in keeping burlap wet during moist curing period.

- e. Use evaporation retardant only in situations where equipment and/or labor delays, or environmental conditions, prevent adequate protection of concrete until prewetted burlap is in place. Have an evaporation retardant, including Confilm, Conspec Acquafilm, Evapre, or Sure Film, readily available during placement for application as directed by the Engineer. Do not work evaporation retardant into concrete surface or use as a finishing aid.

D. Cold Weather Protection.

1. ~~Monitor surface temperature of concrete continuously during curing period using electronic recording type thermometers capable of recording a minimum of one reading per hour. Furnish results to Engineer in electronic format as required. Apply [Article 2403.03, F](#) of the Standard Specifications.~~
2. ~~If supplemental housing and heating is used, locate temperature monitors in the concrete at the furthest and closest point from heat source. Verify maximum temperature at monitor point closest to heat source does not exceed 150°F. Replace the provisions of [Article 2403.03, F, 5, d](#), of the Standard Specifications with the following:~~
3. ~~After required curing period, gradually reduce temperature of air surrounding concrete to outside air temperature according to [Article 2403.03, I](#), of the Standard Specifications.~~
 - a. **Substructure.**
The duration of required cold weather protection shall be the first 120 hours after placing. Ensure concrete and its surface temperature are maintained at a temperature of no less than 50°F for the first 120 hours after placing. Curing time will not be counted if concrete temperature falls below 50°F. Following completion of the cold weather protection period, regulate the rate of concrete cooling to prevent thermal shock, until the concrete temperature falls within 35°F of ambient air temperature.
 - b. **Deck.**
 - 1) ~~Covering with plastic will not be allowed as a substitute for continuous wet sprinkling system curing.~~
 - 2) The duration of required cold weather protection shall be the first 168 hours after placing. Ensure concrete and its surface temperature are maintained at a temperature of no less than 50°F for the first 168 hours of continuous wet sprinkling system curing after placing. Curing time will not be counted if the concrete temperature falls below 50°F. Following completion of the cold weather protection period, regulate the rate of concrete cooling to prevent thermal shock, until the concrete temperature falls within 35°F of ambient air temperature.

23062.04 METHOD OF MEASUREMENT.

Measurement for High Performance Concrete will be the cubic yards shown in the contract documents.

23062.05 BASIS OF PAYMENT.

- A. Payment for High Performance Concrete will be at the contract unit price per cubic yard. Payment includes cost for testing production concrete.
- B. For High Performance Concrete placed within the contract period, additional payment will be made for heating of concrete mix ingredients, cold weather protection of placed concrete, or both. Payment for heating of mix ingredients and cold weather protection will be in accordance with [Articles 2403.05, A, 3 and 4](#), of the Standard Specifications. The duration of cold weather protection eligible for payment shall be as specified in Article DS-23062, D, 2.