

ITEM 557.6101 18 - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE SIDEWALKS ON BRIDGES

DESCRIPTION. Furnish and place lightweight, high-performance (Class HP) concrete to construct sidewalks on a bridge as shown in the contract documents.

MATERIALS. Use materials meeting §555-2. Manufacture lightweight high-performance concrete according to §501, and the following modifications:

A. Design. Design a lightweight, high-performance concrete mixture, proportioned according to the American Concrete Institute Manual of Concrete Practice, ACI 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

1. Produce a homogeneous mixture of cement, pozzolan (Fly Ash or GGBFS), microsilica, fine aggregate, lightweight coarse aggregate, air entraining agent, normal range set-retarding, water-reducing admixture, and water, as designed.

2. Use Type I, I/II, II (§701-01) or Type SF (§701-03) cement. Use a minimum cementitious content of 400 kg/m³. Use 15-20% pozzolan (§711-10, Flyash, or §711-12, GGBFS), and 6-10% microsilica (§711-11).

3. Use lightweight coarse aggregate conforming to §703-10, with a gradation in the 19 mm to 4.75 mm size designation in Table 1, ASTM C330.

4. Determine the cement content for each trial batch by means of a yield test according to ASTM C138.

a. At least 10 working days prior to concrete placement, provide the Materials Engineer with a copy of the trial mix design with the following data:

- Fine and coarse aggregate (saturated surface dry condition) content in kg/m³.
- Cement content in kg/m³.
- Water content in kg/m³.
- Unit mass of freshly mixed concrete in accordance with ASTM C138.
- Dry unit mass in accordance with ASTM C567.
- 28 day compressive strengths.
- Batch quantities of all materials as they will appear on the batch record.

b. The Materials Engineer, or their representative, will approve the batch quantities prior to use. Use these values to manufacture all lightweight concrete for this project, and periodically correct the batch masses to account for changes in the fine aggregate fineness modulus and aggregate moisture contents in accordance with Materials Method 9.1, or current Department directives.

B. Stockpile Handling. Construct lightweight coarse aggregate stockpile(s) at the production facility so as to maintain uniform moisture throughout the pile. Continuously and uniformly sprinkle the stockpile(s) with water using a sprinkler system approved by the Materials Engineer. Soak for a minimum of 48 hours, or until the stockpile has achieved a minimum internal moisture content of 15% by weight. If a steady rain of comparable intensity occurs, turn off the sprinkler system. If the rain ceases prior to the end of the wetting period, restart the sprinkling system. At the end of the wetting period, or when a rainfall ceases beyond the end of the wetting period, allow stockpiles to drain for 12 to 15 hours immediately prior to use.

ITEM 557.6101 18 - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE SIDEWALKS ON BRIDGES

C. Sampling of Materials. The Materials Engineer’s representative, will take a 1 liter sample of microsilica in accordance with Materials Method 9.1, or current Department directives, for each day’s placement for testing. Sampling of other materials will be at the direction of the Regional Materials Engineer.

D. Batching. After the materials have been accepted for this work, determine the proportions for concrete and equivalent batch masses based on trials made with materials to be used in the work.

- If densified microsilica powder is used and added independently - weigh cumulatively in the following order: cement, Fly ash (or GGBFS), then microsilica. Base the batching tolerance of ± 0.5 % on the total mass of cementitious material, for each material draw mass.

- If densified microsilica powder is used as part of blended cement - weigh cumulatively in the following order: blended cement, then fly ash (or GGBFS). Base the batching tolerance of ± 1% on the total mass of cementitious material, for each material draw mass.

E. Compressive Strength Determination. Achieve an average compression strength of 25 MPa, or greater, with no individual cylinder compressive strength less than 21 MPa.

F. Density Determination. Produce concrete with an average dry unit mass ranging from 1750 to 1850 kg/m³ when tested in accordance with ASTM C567.

CONSTRUCTION DETAILS. Apply the provisions of §555-3 and the following modifications:

A. Concrete Manufacturing and Transporting. Add the following to §555-3.01:

1. Use slump, unit mass and air tests as a control measure to maintain a suitable consistency. Perform slump, unit mass and air tests according to Materials Method 9.2. Determine air content by the volumetric method (roll-a- meter) as described in ASTM C173. Air content and slump placement limits are:

	Minimum	Desired	Maximum
Air Content (%)	5.0	7.0	9.0
Slump (mm)	65	75-125	125

2. If the lightweight coarse aggregate moisture content at the time of batching is less than saturated surface dry (SSD), introduce the coarse aggregate, along with approximately 2/3 of the total mixing water, into the mixer and mix for a minimum of 10 minutes, then continue batching the remaining ingredients. If the coarse aggregate is in an SSD condition, batch the coarse aggregate routinely with the fine aggregate, admixtures, cement, fly ash (or GGBFS), microsilica, and mixing water, then mix completely.

3. Have the lightweight aggregate manufacturer supply a service representative at the site for the first two days of concrete placement operations to assist in the control of lightweight concrete mixing and placement.

B. Handling, Placing and Finishing. Handle and place concrete according to §555-3.04, except that pumping is not permitted. Finish the concrete surface according to 557-3.10. When bonding fresh concrete to hardened concrete, follow the provisions of 557-3.06.

ITEM 557.6101 18 - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE SIDEWALKS ON BRIDGES

C. Testing. Test the concrete according to Materials Method 9.2. The unit mass of the fresh concrete during placement should be compared to that which was submitted with trial mix design.

Make adjustments to the concrete mix at the batching facility based on slump, unit mass and air tests.

The Engineer will cast cylinders, in sets of 2 individual cylinders, at a frequency of 1 set for each 50 m³, or fraction thereof actually placed. A minimum of 1 set will represent each day's concrete placement.

D. Curing. Cure the concrete according to §557-3.11, except that only continuous wetting is allowed. In cold weather, the provisions of §557-3.12, Provisions for Concreting in Cold Weather shall apply.

E. Repairs. Repair damaged or defective concrete at no additional cost to the state. Damage or defects are defined as, but not limited to; spalling, irregular cracking, tearing, honeycombing, scaling, surface imperfections or irregularities, and lack of smoothness. After the concrete has hardened, the Engineer will examine it for damage as appropriate. Using the Contractor's straight edge surface irregularities and smoothness requirements will be checked. Surface irregularities greater than 5 mm in 3 m shall be corrected in a manner acceptable to the Department. Repairs to remove excess concrete or irregularities shall be performed using methods and equipment that does not damage the concrete to remain. Removal of concrete shall be performed to maintain the appropriate cover of reinforcement.

Repairs to remove and replace damaged or defective concrete shall be performed by making all repair areas rectangular in shape and as close to square as possible. Sawcut the perimeter of the repair area to a depth of 20 ± 3 mm. Chip out concrete, using chisel bits only, to a uniform level, removing all damaged or defective concrete. Angle the walls of the repair area at 45° toward the center of the repair, from the bottom of the perimeter sawcut.

Do not undercut existing concrete. Surface preparation, placement, and curing of the repair concrete shall be in accordance with specifications and Department directives for the material used.

Unless otherwise directed by the Regional Materials Engineer, the concrete used for repairs shall be of the same materials as that used for the original placement. Small repair areas may be repaired with concrete repair materials appearing on the Department's Approved List providing the repair materials have similar characteristics as the original concrete.

F. Rejection of Concrete. The Engineer will reject any concrete represented by a cylinder set with an average compressive strength less than 25 MPa, or an individual cylinder with a compressive strength less than 21 MPa.

METHOD OF MEASUREMENT. The quantity measured for payment will be the number of square meters satisfactorily installed, measured to the nearest 0.1 square meter.

BASIS OF PAYMENT. Include the cost of all labor, materials and equipment necessary to complete the work in the square meter bid price.