

ITEM 557.0104 18 - LIGHTWEIGHT, HIGH - PERFORMANCE SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE - BOTTOM FORMWORK REQUIRED

ITEM 557.0504 18 - LIGHTWEIGHT, HIGH - PERFORMANCE SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE - BOTTOM FORMWORK NOT REQUIRED

ITEM 557.0704 18 - LIGHTWEIGHT, HIGH - PERFORMANCE SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE - BOTTOM FORMWORK REQUIRED

ITEM 557.0904 18 - LIGHTWEIGHT, HIGH - PERFORMANCE SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE - BOTTOM FORMWORK NOT REQUIRED

DESCRIPTION. Furnish and place lightweight, high performance (Class HP) concrete to construct superstructure slabs as shown in the contract documents.

MATERIALS. Use materials meeting §557-2. 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 trial 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.
 - Cementitious 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.

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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.

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 microsilica is added independently - weigh cumulatively in the following order: cement, fly ash (or GGBFS), then microsilica. Base the batching tolerance of $\pm 0.5\%$ on the total mass of cementitious material, for each material draw mass.

- If microsilica 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 $\pm 1\%$ on the total mass of cementitious material, for each material draw mass.

E. Compressive Strength Determination. Achieve an average 28-day compressive 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 §557-3 and the following modifications:

A. Concrete Manufacturing and Transporting. Add the following to §557-3.01:

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:

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	Minimum	Desired	Maximum
Air Content (%)	5.0	6.5	8.0
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% 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 §557-3.05, except that pumping is not permitted. When an integral wearing surface is required, finish the concrete according to 557-3.07. If the concrete will be overlaid with a separate wearing surface, finish the surface according to 557-3.09.

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 shall apply.

E. Repairs. Make any repairs as per the provisions of §557-3.16. Proposed repairs require Deputy Chief Engineer, Structures approval.

F. Rejection of Concrete. The Engineer will reject any concrete represented by a 28-day cylinder set with an average compressive strength less than 25 MPa, or an individual cylinder with a compressive strength less than 21 MPa.

G. Loading Limitations. The loading limitations of §557-3.14 apply, except that concrete cylinder sets designated for early loading must attain an average compression strength of 25 MPa, or greater, with no individual cylinder less than 21 MPa.

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METHOD OF MEASUREMENT. Apply all of the provisions of §557-4.

BASIS OF PAYMENT. Apply all of the provisions of §557-5.