

ITEM 557.32 18 LIGHTWEIGHT, HIGH-PERFORMANCE CONCRETE FOR THIN STRUCTURAL APPLICATIONS

DESCRIPTION. Prepare the surface and place lightweight high-performance concrete for thin structural applications. Limit the depth of the placement to 40- 125 mm.

MATERIAL REQUIREMENTS. Use materials meeting the requirements of 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 10 mm to 2.36 mm size designation in ASTM C330, Table 1.

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 masses 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 Material Method 9.1, or current Department directives.

B. Stockpile Handling. Construct lightweight aggregate stockpile(s) 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. At the end of the wetting period, or after the rain ceases, 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.

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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), and 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 a blended cement - weigh cumulatively in the following order: blended cement and 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 compression strength of 25 MPa, or greater, with no individual cylinder compressive strength less than 21MPa.

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.

A. Concrete Manufacturing and Transporting. Apply the provisions of §584-3 and 557-3.01 with the following modifications:

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 described in ASTM C173. Air content and slump placement limits are:

	Minimum	Desired	Maximum
Air Content (%)	5.0	6.5	8.0
Slump (mm)	65	65- 90	100

2. If the lightweight coarse aggregate moisture content is less than saturated surface dry, introduce lightweight coarse aggregate, along with approximately 2/3 of the total mixing water, into the mixer and mix for a minimum of 10 minutes. Add the fine aggregate, admixtures, cement, Fly ash (or GGBFS), microsilica, and remaining mixing water and mix completely.

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

B. Handling, Placing and Finishing. Handle and place the lightweight concrete according to 584-3.05 except that pumping will not be permitted. Place the concrete in one lift. Finish the concrete within 10 minutes after placement. In the event a delay prevents finishing within the 10 minute time limit, stop further placement and cover the unfinished concrete with plastic curing covers. Resume placement after the ability to finish the concrete within the 10 minute time limit was been restored. Apply curing within 10 minutes after finishing. Provide uniform, continuous

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wetting with wet burlap for 7 days after curing has begun. In cold weather, the requirements of 557-3.12 apply.

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. Repairs. Make any repairs as per the provisions of §557-3.13. Proposed repairs require Deputy Chief Engineer, Structures approval.

E. 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.

METHOD OF MEASUREMENT. The quantity to be measured for payment will be the number of square meters satisfactorily installed, measured to the nearest 0.1 square meter. No measurement will be made for slab reconstruction concrete.

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