

SELF-CONSOLIDATING CONCRETE

****From Braintree BRO 1444(36)**

This provision was utilized in the Braintree BRO 1444(36) project as material for grouting precast abutment pile cavities, with payment made under the precast concrete item. Method of Measurement and Basis of Payment are included here for paying self-consolidating concrete under its own pay item.

xx. DESCRIPTION. This work shall consist of furnishing and placing self-consolidating portland cement concrete for structures and incidental construction. Self-consolidating concrete is a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight and adequately fill voids without segregation or excessive bleeding, and without the need for vibration.

The portland cement concrete shall consist of a homogeneous mixture of cement, fine aggregate, coarse aggregate, water, admixtures, and pozzolans, proportioned and mixed in accordance with these provisions.

The work under this Section shall be performed in accordance with these provisions and Section 501 of the Standard Specifications.

All references to "Table 501.03A" in Section 501 shall be read as and shall mean "Table A" of this Section.

xx. CLASSIFICATION AND PROPORTIONING. Classification and proportioning shall meet the requirements of Subsection 501.03, with the following exceptions:

Proportioning of Self-Consolidating Concrete shall meet the following requirements:

Table A

Class	Min.*** Cem. Mat. (lbs./ ft ³)	Max. Water- Cem. Mat. Ratio	Inverted slump cone Flow* (in.)		Air Content(%)	28-Day Comp. Strength (psi)	56- Day** Permea- bility, Coulomb	VSI Rating	T ₅₀ Seconds	
			Min	Max					Min	Max
SCC	611	0.44	20	28	6.5 ± 1.5	3500	2500	=/< 1	2	5

*A higher maximum flow greater than 28 inches may be allowed if the Visual Stability Index (VSI) is 1 or less.
 ** The permeability may be tested prior to 56 days but results must still be 2500 coulombs or less.
 ***A 20% fly ash or 25% GGBFS replacement of total cement content is required.

If silica fume is used, the maximum shall be 24 kg/m³ (40 lbs/yd³) and shall be a direct replacement of the cement. The total batch weight of silica fume ignored shall be substituted with portland cement. Exceptions: For a one cubic yard batch, use 50 lbs of silica fume; and for a one cubic meter batch, use 34 kilograms of silica fume.

Cylinders shall be made a minimum of 70 days prior to the pre-pour meeting and submitted when the cylinders are 14 days of age. The specimens will undergo rapid chloride permeability testing at the VAOT Materials and Research AASHTO accredited laboratory at 56 days of age. If required due to time constraints, the cylinders may be tested at an age of less than 56 days, but the permeability results shall not be more than 2500 coulombs for the results to be acceptable. The test batch shall be a minimum of 3 cubic meters (4 cubic yards).

The cylinder test specimens shall be submitted with the following additional data regarding fabrication of the specimens:

- (1) Compressive Strength at 4, 7, 14, 28 days of age (14 and 28 day strength results can be submitted at a later date);
- (2) Test Batch Results (air content, water/cementitious ratio, flow, VSI rating, and T_{50}).

The Engineer may require a period of up to 60 calendar days from the date the aggregate is available for testing to test the material(s) and redesign the mix.

Strict adherence to the requirements of Subsection 501.07 is required when using concrete with GGBFS or fly ash. The setting time may be retarded in cool weather, or accelerated in hot weather. The Engineer, after consultation with the Agency's Structural Concrete Engineer, may require that the curing period, as designated in Table 501.17A of Subsection 501.17, be extended.

- xx. BATCHING. Batching shall be performed in accordance with the requirements of Subsection 501.04, with the following exceptions:

Prior to constructing a new testing laboratory or modifying an existing laboratory, the Contractor shall submit to the Agency for approval, two sets of drawings and specifications detailing the proposed location, dimensions, and materials to be used. The details shall include the location of all testing equipment, benches, desk/file cabinet, sink, doors, windows, electrical or gas connections, and lighting, ventilating, and heating equipment.

The laboratory and all testing equipment shall be maintained in operating condition. Equipment which, during concrete operations, becomes worn or damaged to the point of being unsuitable for testing purposes, shall be replaced or repaired by the Contractor. A testing laboratory shall be required at each plant site at least one month prior to the start of batching operations, and shall remain at the site either until concreting operations on the project are completed and the concrete has been accepted, or as otherwise directed by the Materials and Research Engineer.

- xx. MIXING AND DELIVERY. Mixing and delivery shall be performed in accordance with Subsection 501.05, with the following exceptions:

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No transit mixer or agitator shall be charged with the ingredients of the concrete unless an authorized Agency representative is present.

Transit mixer maximum load size shall be limited to 80 percent of the manufacturer's rated mixing capacity; however, legal vehicle load restrictions shall not be exceeded. The mixer shall be capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

Agitators, when loaded, shall not exceed 80 percent of the manufacturer's rated mixing capacity or legal load restrictions, and shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

The mixing speed may need to be reduced to get proper mixing action due to the nature of the high flow of the concrete.

When a transit mixer or agitator is used for transporting concrete, mixing during transport shall be at the speed designated by the manufacturer of the equipment as agitating speed.

If additional mixing water is required to maintain the specified flow and is added with the permission of the Engineer, a minimum of 20 revolutions of the transit mixer drum at mixing speed shall be required before discharge of any concrete. At no time shall the total water introduced into any mix exceed the maximum water-cementitious material ratio shown in Table A.

xx. FIELD TESTS. Field tests shall be performed accordance with Subsection 501.06, with the following exceptions:

Slump tests will not be required.

Flow tests shall be performed in accordance with ASTM C 1611, Procedure B. Do not tamp the self-consolidating concrete inside the cone. The concrete flow will be tested on the first 2 loads and at a minimum of every 30 cubic meters (40 cubic yards), including the yardage of the first two loads.

Air content tests shall be made in accordance with the pressure method in AASHTO T 152, except that the air meter shall be filled in one lift by using a scoop and dropping the concrete into the center of the pot from a distance of 150 mm (6 inches) from the top edge of the pot with no rodding. Only tap the sides of the pot if needed prior to running the test.

For strength testing, if there are three or more consecutive placements of under 7.5 cubic meters (10 cubic yards), then a test shall be done on the third placement, or after 15 (20) consecutive cubic meters (cubic yards) have been placed, whichever is greater.

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Test cylinders shall be made in accordance with AASHTO T 23, except the cylinders shall be filled in one lift using a scoop and dropping the concrete into the center of the mold from a distance of 150 mm (6 inches) from the top edge. The mold shall not be rodded, vibrated, or tapped on the sides unless needed. The cylinders shall be tested for compressive strength in accordance with AASHTO T 22.

T₅₀ Spread Flow tests shall be performed in accordance with ASTM C 1611, Appendix X1. The T₅₀ test shall be done every time the flow test is run.

Visual Stability Index (VSI) tests shall be performed in accordance with ASTM C 1611, Appendix X1 and shall be done on each completed flow test.

- xx. WEATHER AND TEMPERATURE LIMITATIONS - PROTECTION OF CONCRETE. Protection of concrete shall meet the requirements of Subsection 501.07, with the following exceptions:

When using concrete with GGBFS or fly ash, strength gain may be retarded in cool weather. When the ambient air temperature is 10°C (50°F) or less, the Engineer, after consultation with the Agency's Structural Concrete Engineer, may require special preparation and protection of the concrete and its components and that the curing period, as designated in Table 501.17A of Subsection 501.17, be extended.

- xx. FORMS. Forms shall meet the requirements of Subsection 501.09, with the following exceptions:

The Contractor shall design falsework and forms for full hydrostatic head pressure of the concrete. Forms shall be water tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations, including vibration, which should not be needed.

The specifications for forms regarding design, water tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse, and oiling also apply to metal forms.

- xx. PLACING CONCRETE. Placing concrete shall meet the requirements of Subsection 501.10, with the following exceptions:

A pre-placement meeting shall take place a minimum of seven (7) calendar days prior to concrete placement. Attendees at the pre-placement meeting shall include, but not be limited to, the Contractor's Project Superintendent, the Engineer, the Agency's Structural Concrete Engineer, and the concrete producer. The Contractor shall provide a placement plan detailing the horizontal length of the pour(s), the location(s) at which the self-consolidating concrete will be deposited, and the timing of placement.

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Self-consolidating concrete shall not be deposited in the forms more than 6 meters (20 feet) horizontally from its final position.

As the final elevation is reached for the pour, the concrete will need to be placed closer to its final resting place in order to minimize the amount of manpower needed to move the concrete.

Dropping of unconfined self-consolidating concrete more than 1.5 meters (5 feet) will not be permitted.

Unless otherwise specified, self-consolidating concrete shall not be consolidated with mechanical vibrators. If the Engineer requests the use of a vibrator, it shall be of an approved type and design, operating within the concrete. It shall be used as little as possible to avoid segregation of the concrete.

xx. **METHOD OF MEASUREMENT.** The quantity of Special Provision (Self-Consolidating Concrete) to be measured for payment will be the number of cubic meters (cubic yards) of concrete placed in the complete and accepted work, as determined by the prismatic method using dimensions shown on the Plans or as directed by the Engineer, including the volume of precast concrete stay-in-place forms, but excluding the volume of steel or other stay-in-place forms and form filling materials. No deductions will be made for the volume of concrete displaced by steel reinforcement, structural steel, expansion joint material, scuppers, weep holes, conduits, tops of piles, scoring, chamfers or corners, inset panels of 38 mm (1 1/2 inches) or less in depth, or any pipe less than 200 mm (8 inches) in diameter.

xx. **BASIS OF PAYMENT.** The accepted quantity of Special Provision (Self-Consolidating Concrete) will be paid for at the Contract unit price per cubic meter (cubic yard). Payment will be full compensation for performing the work specified, including designing the mix, satisfactory finishing and curing, and for furnishing all forms, materials, including joint filler and bond breaker, labor, tools, admixtures, equipment, including automatic temperature recording units, trial batches, and incidentals necessary to complete the work.

The cost of heating materials and protecting the concrete against cold weather, and any additional cost for cement, will not be paid for separately but will be considered incidental to Special Provision (Self-Consolidating Concrete).

The cost of furnishing testing facilities and supplies at the batch plant will not be paid for separately but will be considered incidental to Special Provision (Self-Consolidating Concrete).

Costs for all materials, labor and incidentals for steel or other stay-in-place forms and form filling materials will not be paid for separately, but will be considered incidental to Special Provision (Self-Consolidating Concrete).

Payment will be made under:

10/5/2011

Pay Item

Pay Unit

900.608 Special Provision (Self-Consolidating
Concrete)

Cubic Meter
(Cubic Yard)