

[Include the following for contracts that require self-consolidating concrete for drilled cast-in-place concrete shaft construction. This is a base document that may require revision on a project by project basis. Review with Project Engineer the need for SCC concrete versus Class A concrete.]

NOTE TO DESIGNERS:

The following section is “non-standard”. It shall be numbered consecutively in the supplementary specifications starting with number 428 regardless of the number shown. For example, if you want to use section 431 - Vertical Realignment of Deck Joint at Structure, but no other non-standard section, it shall be renumbered 428. If another non-standard section is required, it shall be numbered 429., etc.

The following Section is added:

SECTION 437 – SELF-CONSOLIDATING CONCRETE (SCC) FOR DRILLED SHAFTS

437.01 DESCRIPTION.

This work consists of the use of Self-Consolidating Concrete (SCC) for drilled shaft construction. SCC is a highly flowable, non-segregating concrete that can spread into place without any mechanical consolidation.

437.02 MATERIALS.

The design, control and acceptance testing requirements of a SCC mixture will be according to Section 905, except as modified herein.

Materials shall conform to the following Sections and Subsections:

*Fine Aggregates902.04
Coarse Aggregates902.05*

SCC shall use a water-reducing, high-range admixture (HRWR) to reduce the required water content for a concrete mixture by 5 to 10%. The admixture shall meet the requirements of ASTM C494/ C494M-08(a), Type F. Samples of the admixture necessary for the acceptance tests will be selected at random from stockpiled supplies. The use of air entrainment admixtures will not be required except as noted on the Plans.

A viscosity modifying admixture (VMA) may be used and will be evaluated according to the test methods and mix design proportions referenced in ASTM C494/ C494M-08a, Type S. The following physical requirements shall be met:

- 1. For initial and final set times, the allowable deviation of the test concrete from the reference concrete shall not be more than 1.0 hours earlier or 1.5 hours later.*
- 2. For compressive and flexural strengths, the test concrete shall be a minimum of 90 percent of the reference concrete at 3, 7 and 28 days.*
- 3. The length change of the test concrete shall be a maximum 135 percent of the reference concrete. However, if the length change of the reference concrete is less than 0.030 percent, the length change of the test concrete shall be a maximum 0.01 percentage units greater than the reference concrete.*
- 4. The relative durability factor of the test concrete shall be a minimum 80 percent.*

Admixtures shall be free of calcium chlorides or any other chlorides that may initiate or promote corrosion of the reinforcement steel. Locate bulk storage tanks for chemical admixtures inside a heated area with an ambient temperature of not less than 32°F. Chemical admixtures that have been allowed to freeze shall not be allowed for use until they have been agitated and retested.

The samples of the admixtures shall be tested as per the requirements of the respective ASTM Standards stated above and the test results shall be submitted to the Engineer for approval.

437.03 MIX REQUIREMENTS.

The SCC mix shall conform to the criteria for strength, slump flow, visual stability index, passing ability and water to cement ratio as specified herein.

The SCC shall conform to Class A concrete strength requirements provided in Subsection 905.05(A), Portland Cement Concrete, Composition of Mix, and Subsection 905.21, Quality Acceptance Limits for Portland Cement Concrete Pay Adjustment.

The slump requirements in Section 905 do not apply. The fresh concrete for slump flow retention testing will be sampled at the point of discharge into the tremie or pumpline and stored in a sealed container that is not exposed to direct sunlight or vibration. The concrete for slump flow retention testing shall be stored for a minimum of one hour longer than the duration of the concrete placement operations as indicated in the contractor's installation plan. The SCC shall be in accordance with the criteria included in Table 1 for air content, slump flow and visual stability index.

Table 1 - Requirements for SCC for Drilled Shafts

Property	Test Method	Criteria
Coarse Aggregate		
No. 89		6.5 ± 2.0%
No. 8		7.5 ± 2.0%
Fresh Concrete Slump Flow	ASTM C1611 / C1611M-05	18-24 inches
Slump Flow Retention	ASTM C1611 / C1611M-05	14 inches minimum
Visual Stability Index		
Plastic Concrete	ASTM C1611 / C1611M-05	1 maximum
Passing Ability	ASTM C1621 / C1621M-08	1.5" maximum

The water to cementitious materials ratio (W/C) shall be 0.40, +/- 0.05 after including any reductions for admixtures. The test methods and frequency for W/C shall be in accordance with Subsection 905.22 (A), Quality Assurance Testing Standards and Frequency of Testing. The quantity of retarding admixture stipulated in the submitted mix design shall be adjusted as required to accommodate temperature variations. A table stipulating the required retarding admixture for temperature ranges anticipated during concrete placement operations shall be submitted as a Shop Drawing with the mix design and installation plan in accordance with Section 104.08 of the Standard Specifications.

The aggregates shall be proportioned so that the fine aggregate is less than 50 percent by weight of the total aggregate.

437.04 VERIFICATION OF PUMPABILITY.

A verification of pumpability will be performed at least 10 days before the placing of the SCC in the drilled shaft by pumping a trial batch through the proposed pump for the placement of the SCC into the drilled shaft. The proposed methods for mixing the concrete, including any anticipated time delays, shall be simulated for verification.

Perform slump flow, and visual stability index (plastic concrete), passing ability testing on the verification batch. Make concrete cylinders for compression testing as specified in Subsection 905.05 (C).

The mix shall be approved based on the criteria for the compressive strength provided in Subsection 905.21 (A)(1) and the criteria provided in Table 1 above.

437.05 CONTROL AND ACCEPTANCE TESTING.

The Engineer will perform acceptance testing as specified in Section 905 at a rate according to Subsection 905.22, Quality Acceptance Testing, Sampling, and Inspection for Portland Cement Concrete Pay Adjustment. The Engineer will perform visual stability index test for plastic concrete, according to ASTM C 1611/C1611M-0.5, at a rate of at least 1 test per day. The Engineer will perform the passing ability test at the same rate as the slump flow test.

If any of the properties provided in this section do not conform to the respectively criteria, redesign of the mix shall be considered at the discretion of the Engineer.