METHOD OF TEST FOR EVALUATION OF OPEN TIME OF FRESHLY MIXED SELF-CONSOLIDATING CONCRETE

1. SCOPE

1.1 This test method covers procedures for determination of open time of self-consolidating concrete (SCC). The procedure is suitable for use in the laboratory or in the field, and is used as a measure of flowability, stability, passing ability, and length of time the mix retains self-consolidating properties.

Note 1: This method is based on the test method outlined in the Precast/Prestressed Concrete Institute and EFNARC (European Federation of Producers and Contractors of Specialist Products for Structures) guidelines.

2. REFERENCES

2.1 MTO Test Methods

LS-438 Test for Evaluation of Freshly Mixed Self-Consolidating Concrete by Slump Flow

2.2 ASTM Standards

C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

C1621 Standard Test Method for Passing Ability of Self-Consolidating Concrete

2.3 CSA Standards

A23.2-5C Slump of Concrete

2.4 Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants, Precast/Prestressed Concrete Institute, TR-6-03, April 2003

2.5 Specification and Guidelines for Self-Compacting Concrete, EFNARC, February 2002

3. DEFINITIONS

3.1 Flowability: A measure of SCC's ability to completely fill formwork without entrapped air pockets.

3.2 Open Time: The length of time during which SCC maintains the specified slump flow.

3.3 Self-consolidating concrete (SCC): Highly flowable yet stable concrete that can spread readily into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation and without undergoing segregation or excessive bleeding.

3.4 Passing Ability: A measure of SCC's ability to pass between reinforcement and through constrictions in the forms without bridging or blocking.

4. APPARATUS

4.1 RULER OR TAPE MEASURE: Readable to the nearest 1 mm.

4.2 THERMOMETER: Meeting the requirements of ASTM C1064.

4.3 STOPWATCH: Capable of measuring to the nearest second.

4.4 J-RING: Meeting the requirements of ASTM C1621.

5. OPEN TIME PROCEDURE

5.1 Measure slump flow at 10, 30, 60, and 90 min after batching. The slump flow procedure shall be as described in LS-438, except that it shall be modified as described below by the use of the J-ring.

5.2 Start the stopwatch at the time of batching.

5.3 Dampen the slump cone and position the base plate and slump cone for testing of slump flow according to LS-438.

5.4 Place the J-ring centred around the cone on the board.

5.5 Obtain the sample.

5.6 Perform the slump flow procedure at the specified time interval. When lifting the cone, the J-ring should remain in place on the board. It may be necessary to hold it down.

5.7 Measure the final diameter of the SCC in 2 perpendicular directions, to the nearest 10 mm. Calculate the average of the two measured diameters.

5.8 Measure and record the height of the SCC patty just inside the bars, and that just outside the bars, to the nearest 1 mm. Carry out the measurement at 4 different locations evenly spaced around the diameter of the J-ring.

5.9 Measure and record the height at the centre of the J-ring, h_{centre}, to the nearest 1 mm.

5.10 Note any border of mortar or cement paste without coarse aggregate at the edge of the SCC patty.

5.11 Measure and record air temperature of the testing environment and the plastic concrete each time the slump flow is tested.

5.12 Repeat the slump flow procedure at 30, 60, and 90 min after batching.

5.13 If the SCC loses its flowing ability such that when the cone is lifted, the material has significant height instead of spread, record this height in addition to the spread diameter, and stop the test. Record any observations such as surface cracking or folding when it has slumped.

5.14 Graph the results, showing time on the x-axis and slump flow on the y-axis. If there is a temperature change in testing environment or greater than $5^{o}C$, from temperature at time 0 to the testing temperature it should be noted on the graph. Any other observations of behaviour that might impact the placement of this material in the field should be recorded.

6. CALCULATION

6.1 Calculate the average of the difference between the height of the SCC patty just inside the bars and just outside the bars:

$$A = \frac{1}{4}((h_{1inside} - h_{1outside}) + (h_{2inside} - h_{2outside}) + (h_{3inside} - h_{3outside}) + (h_{4inside} - h_{4outside}))$$

Where :

h_{inside} = height of SCC patty inside the bars of the J-ring

$h_{outside}$ = height of SCC patty outside the bars of the J-ring

6.2 Calculate the average difference in height between the centre height and the height inside the bars:

$$B = \frac{1}{4}((h_{centre} - h_{1inside}) + (h_{centre} - h_{2inside}) + (h_{centre} - h_{3inside}) + (h_{centre} - h_{4inside}))$$

Where :

h_{centre} = height of SCC patty in the centre of the J-ring

6.3 Calculate the j-ring value as follows:

$$jring = 2A - B$$

7. REPORT

7.1 Reporting shall be according to CSA A23.2-5C and in addition the following information shall be provided:

7.2 Slump flow values at 10, 30, 60, and 90 min after batching reported to the nearest 10 mm of horizontal spread of the sample during the test.

7.3 Concrete and air temperature at 10, 30, 60, and 90 min after batching.

7.4 J-ring value.

7.5 Time versus slump flow graph.

7.6 Any observations related to SCC performance.