5.9.72 MEASURING FLOWING CONCRETE (Kansas Test Method KT-72)

1. SCOPE.

These test methods cover the procedure for determination of static segregation of self-consolidating concrete by measuring the coarse aggregate content in the top and bottom portions of a cylindrical specimen and slump flow of the same self-consolidating concrete. KT-72 reflects testing procedures found in ASTM C 1610 and ASTM C 1611.

2. REFERENCED DOCUMENTS

2.1. KDOT Construction Manual, Part V, Section 5.6.00;

2.2. KT-17; Sampling Freshly Mixed Concrete

2.3. ASTM C 1610; Static Segregation of Self-Consolidating Concrete Using Column Technique

2.4. ASTM C 1611; Slump Flow of Self-Consolidating Concrete

2.5. ASTM D 1785; Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

3. APPARATUS.

3.1. A Balance conforming to the requirements of Part V, Section 5.9; Sampling and Test Methods Forward for the class of general purpose required for the principal sample mass of the sample being tested.

3.2. Column Mold; the column portion of the mold shall be poly(vinyl chloride) (PVC) plastic pipe Schedule 40 meeting the requirements of ASTM D 1785. The column shall be 8 in (200 mm) in diameter by 26 in (660 mm) in height and separated into 3 sections. The top section shall be 6.5 in (165 mm) in height, the middle section 13 in. (330 mm) in height, and the bottom section 6.5 in (165 mm) in height, as shown in Figure 1. Each section shall have its ends flat and plane and be marked as “Top”, “Middle”, or “Bottom” relative to its location in the column. Couplers, brackets, clamps, or other equivalent fastening systems shall be used for securing the column sections together to form a mortar-tight joint and to secure the column to the base plate. The column mold shall be securely attached to a non-absorbent, rigid base plate measuring at least 12 in (300 mm) by 12 in (300 mm) square.

3.3. Collector plate, used to obtain concrete from the top section of the column, shall be made of any non-absorbent, rigid material measuring at least 20 in (510 mm) by 20 in (510 mm) square. The plate shall contain a cut out section in the center measuring 8.5 in (215 mm) across and it shall contain a rigid lip that is at least 2 in (50 mm) high running around three sides of the perimeter of the plate, as shown in Figure 2.

3.4. Strike-off bar; a flat, straight steel bar at least 1/8 by 3/4 by 12 in (3 by 20 by 300 mm) or a flat, straight bar at least 0.23 by 0.75 by 12 in (6 by 20 by 300 mm) high density polyethylene or other plastic of equal or greater abrasion resistance.
3.5. A No. 4 (4.75 mm) rectangular sieve with minimum dimensions of 13 in (330 mm) by 25 in (630 mm).

3.6. Sample Receptacle – The receptacle shall be a heavy-gauge metal pan, wheelbarrow, or flat, clean nonabsorbent board of sufficient capacity to allow easy remixing of the entire sample with a shovel, trowel, or scoop.

FIGURE 1
3.7. Tools and items such as shovels, plastic pails, trowels, scoops and rubber gloves shall be provided.

3.8. Mold or slump cone fabricated from metal not readily attacked by cement paste. The metal shall not be thinner than 0.060 in (1.5 mm) or if formed by the spinning process, there shall be no point on the mold at which the thickness is less than 0.045 in (1.15 mm). The mold shall have the shape of a frustum of a right circular cone and be equipped with handles and foot plates. The dimensions shall meet requirements in Table 1:
Table 1
Mold or Slump Cone Dimensions

<table>
<thead>
<tr>
<th>Inside diameter at top</th>
<th>Inside diameter at bottom</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 ± 1/8 in (102 ± 3.2 mm)</td>
<td>8 ± 1/8 in (205 ± 3.2 mm)</td>
<td>12 ± 1/8 in (305 ± 3.2 mm)</td>
</tr>
</tbody>
</table>

3.9. Slump Base Plate—The base plate on which the slump mold rests shall be nonabsorbent, smooth, rigid, and have a minimum diameter of 36 in (915 mm).

4. SAMPLE AND TEST SPECIMEN

4.1. Obtain a sample of freshly-mixed self-consolidating concrete in accordance with KT-17.

5. PROCEDURE FOR STATIC SEGREGATION TEST

5.1. Perform the column segregation test on a flat, level surface. Do not subject the testing surface and the column mold to any vibration or disturbance.

5.2. Remix the sample obtained in accordance with section 4 of this test method in the sample receptacle using a shovel or scoop so that the concrete is homogeneous.

5.3. Using a shovel, scoop, or plastic pail, immediately fill the column mold with concrete completely and above the rim, within 2 minutes.

5.4. After filling the mold, strike off the top surface by sliding the strike-off bar across the top rim of the mold with a sawing motion until the concrete surface is level with the top of the mold.

5.5. Allow the concrete to stand undisturbed in the column mold for 15 ± 1 min.

5.6. Immediately following the standing period, securely hold the top section of the mold and remove the fastening system. Complete steps in sections 5.7-5.14 of this test method within 20 minutes thereafter.

5.7. Place the cut out section of the collector plate around the column just below the joint between the “Top” and “Middle” section to catch and collect concrete.

5.8. Grasp the upper section of the column mold and, using a horizontal rotating motion, screed the concrete from the top section of the column on to the collector plate and then deposit it into a plastic pail.

5.9. Repeat steps in sections 5.6-5.8 of this test method to remove the concrete from the middle section of the column mold and discard the concrete.

5.10. Place the concrete sample collected from the upper section of the column onto the No. 4 (4.75 mm) sieve.

5.11. Wash the concrete on the No. 4 (4.75 mm) sieve so that only coarse aggregate remains on the sieve and then deposit the coarse aggregate into a clean plastic pail.
5.12. Repeat steps in sections 5.10-5.11 of this test method for the concrete retained in the bottom section of the mold.

5.13. Bring the coarse aggregate obtained from both the top and bottom sections of the column to a surface-dry condition by rolling it in a large absorbent cloth until all visible film of water are removed.

5.14. Determine the mass of coarse aggregate from the top and bottom sections of the column to the nearest 0.1 lb (50 g).

6. PROCEDURE FOR THE SLUMP-FLOW TEST

6.1. The slump-flow test shall be performed on a flat, level, nonabsorbent surface such as a pre-moistened concrete floor or a base plate. The base plate shall be used in conditions where a flat, level surface is not available, such as on a construction job site. When the base plate is used, position and shim the base plate so that it is fully supported, flat, and level. When performing the slump flow test-for a given study or project, do not change the base plate surface type for the duration of the study or project.

6.2. The user has the option of filling the mold by following either Procedure A or Procedure B.

6.2.1 Filling Procedure A (Upright Mold): Dampen and place the mold, with the larger opening of the mold facing down, in the center of a flat, moistened base plate or concrete surface. Firmly hold the mold in place during filling by the operator standing on the two foot pieces. From the sample of concrete obtained in accordance with Section 4. of this test method. Immediately fill the mold in one lift. Slightly overfill the concrete above the top of the mold.

6.2.2. Filling Procedure B (Inverted Mold): Dampen and place the mold, with the smaller opening of the mold facing down, in the center of a flat, moistened base plate or concrete surface. From the sample of concrete obtained in accordance with section 4. of this test method. Immediately fill the mold in one lift. Slightly overfill the concrete above the top of the mold.

6.3. Strike off the surface of the concrete level with the top of the mold by a sawing motion of the strike-off bar. Remove concrete from the area surrounding the base of the mold to preclude interference with the movement of the flowing concrete. Remove the mold from the concrete by raising it vertically. Raise the mold a distance of 9 ± 3 in (225 ± 75 mm) in 3 ± 1 second by a steady upward lift with no lateral or torsional motion. Complete the entire test from start of the filling through removal of the mold without interruption within an elapsed time of 2.5 minutes.

6.4. Wait for the concrete to stop flowing and then measure the largest diameter of the resulting circular spread of concrete to the nearest ¼ in (5 mm). When a halo is observed in the resulting circular spread of concrete, it shall be included as part of the diameter of the concrete. Measure a second diameter of the circular spread at an angle approximately perpendicular to the original measured diameter.

6.5. If the measurement of the two diameters differs by more than 2 in (50 mm), the test is invalid and shall be repeated.
7. CALCULATION

7.1. Calculate the slump flow using the following equation:

\[ \text{Slump Flow} = \frac{(d_1 + d_2)}{2} \]

where:
\( d_1 \) = the largest diameter of the circular spread of the concrete
\( d_2 \) = the circular spread of the concrete at an angle approximately perpendicular to \( d_1 \)

7.1.1. Record the average of the two diameters to the nearest \( \frac{1}{2} \) in. (10 mm).

7.2. Calculate the percent static segregation using the following equation:

\[ S = 2 \times \frac{(CA_B - CA_T)}{(CA_B + CA_T)} \times 100, \text{ if } CA_B > CA_T \]
\[ S = 0, \text{ if } CA_B \leq CA_T \]

where:
\( S \) = static segregation, percent
\( CA_T \) = mass of coarse aggregate in the top section of the column
\( CA_B \) = mass of coarse aggregate in the bottom section of the column

8. REPORT

8.1. Mixture designation.

8.2. The mass of coarse aggregate obtained from the top and bottom sections of the column separately to the nearest 0.1 lb (50 g).

8.3. The static segregation to the nearest 0.1%.

8.4. Report the use of filling procedure A or B for the slump flow test.

8.5. Report the slump flow to the nearest \( \frac{1}{2} \) in (10 mm).