FLORIDA DEPARTMENT OF TRANSPORTATION
State Materials Office
5007 NE 39th Avenue
Gainesville, Florida 32609

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Florida Method of Test for Aggregate Distribution of Hardened Concrete Using a Mockup Product

Designation: FM 5-617

1. SCOPE

1.1. This method covers procedures for determining the aggregate distribution of self-consolidating concrete (SCC) and flowing concrete mixes.

1.2. The concrete used to cast the mockup shall be sampled after all on-site adjustments have been made to the mixture proportions, including the addition of mix water and admixtures.

1.3. The text of this method references notes and footnotes that provide explanatory information. Notes and footnotes (excluding those in tables and figures) shall not be considered as requirements for this method.

1.4. The values stated in SI units are to be regarded as the standard. The inch-pound equivalents of SI units may be approximate.

1.5. This method does not purport to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1. PCI/FHWA (Precast/Prestressed Concrete Institute/Federal Highway Administration) International Symposium on High Performance Concrete, Orlando, Florida, October 2003.

2.2. AASHTO Standards:

M 205	Molds for Forming Concrete Test Cylinders Vertically
R 60	Sampling Freshly Mixed Concrete
T 22	Compressive Strength of Cylindrical Concrete Specimens
T 24	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

2.3 ASTM Standards:

C470	Molds for Forming Concrete Test Cylinders Vertically
C172	Sampling Freshly Mixed Concrete
C39	Compressive Strength of Cylindrical Concrete Specimens
C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

2.4. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction.

3. SIGNIFICANCE AND USE

3.1. This method provides a quantitative assessment of the aggregate distribution of SCC and flowing concrete using a sawn mockup, or core specimens taken from a mockup, as described herein.

3.2. If the mockup product is made and cured as specified in this test method, the aggregate distribution test data may to be used for the following purposes:

3.2.1. Acceptance testing for specified static segregation limit;

3.2.2. Checking the adequacy of mixture proportions to resist static segregation and;

3.2.3. Quality control.

4. APPARATUS

4.1. Mockup - Experimental structure to determine the aggregate distribution of concrete.

4.1.1 The base of the mockup may be circular, square, or rectangular and have a minimum cross-sectional area of 325 cm^2 (50 in^2), with none of the cross-section dimensions less than 150 mm (6 in). The height shall be greater than or equal to 75 cm (30 in).

4.1.2 Any other available mold can be used if it meets the dimensional requirements (ex. Florida I-beam, pole base molds, etc.) The structure must be suitably braced to avoid any overturning or displacement during the placement operation.

4.2. Tools – Shovel, rake or hoe.

4.3. Miscellaneous Small Tools - Handheld wood or metal float or trowel, hammer, chisel, metal tape measure, ruler.

4.4. Concrete Saw - The saw shall have a diamond or silicon-carbide cutting edge and shall be capable of cutting specimens without excessive heating or shock.

4.5. Core Drill - for obtaining cylindrical core specimens with diamond impregnated bits attached to a core barrel.

4.6. Container (as needed) - A suitable container for collecting the cored specimens extracted from the mockup.

5. SAMPLING HARDENED CONCRETE

5.1. Cored test specimens taken from hardened concrete shall be obtained in accordance with ***ASTM C42***, except for the following:

5.1.1. Cored test specimens shall be taken so that the axis is perpendicular to the concrete mockup major axis as it was originally placed.

5.1.2. Cored test specimens shall be at least 150 mm (6 in) in length with a minimum diameter of 100 mm (4 in) to assess the extent of aggregate distribution.

5.2. Record the identification of the cored test specimens with respect to the location of the concrete represented (see ***Figure 2***).

6. MOLDING AND CURING MOCKUP PRODUCT

6.1. Concrete Placement:

6.1.1. For SCC, the mockup shall be filled in one lift, without vibration, rodding, or tapping. Use a rake or hoe to accommodate the concrete.

For flowing concrete, the mockup shall be subjected to vibration practices of the same type and frequency as the production method it is representing.

6.1.2. Strike off the surface of the concrete level with the top of the mockup using a float or trowel.

6.2. Curing:

6.2.1. Immediately after casting the mockup, it shall be cured in accordance with ***FDOT Specifications Section 400***.

7. PROCEDURE

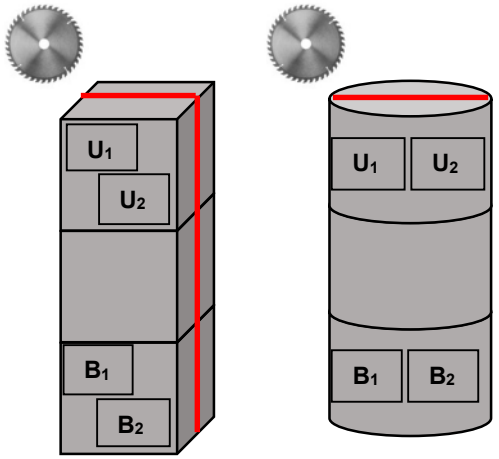
7.1. Before subjecting the mockup to sawing or coring, it either shall have a minimum curing period of 24 h or shall attain a minimum compressive strength of 900 PSI (6200 kPa), tested in accordance with ***ASTM C39***.

7.2. If the mockup cannot be satisfactorily cored or sawn smooth due to lack of curing, then the mockup shall remain undisturbed for an additional curing period of at least 24 h (48 h total) before being subjected to sawing or coring.

7.3. Mark the mockup into three equal parts with respect to its height.

7.4. Select four locations of about 20 cm (8 in) x 20 cm (8 in) along the lateral surface of the mockup and designate them as U_1, U_2, B_1, and B_2. Locate U_1 and U_2 on the upper third, and B_1 and B_2 on the bottom third of the elevation view of the mockup, as indicated in ***Figure 1.***

7.5. The aggregate distribution test shall be performed by measuring the aggregate content of the concrete directly at each of the selected areas. The mockup must be cut completely through the cross-sectional area to expose the aggregate, as indicated in ***Figure 1***.



(exposed aggregate of saw-cut mockup)

Figure 1

7.6. Another option is to obtain core samples from each of the selected areas of the mockup. The core samples may be taken from a saw-cut mockup or from the end as cast, as shown in ***Figure 2***.

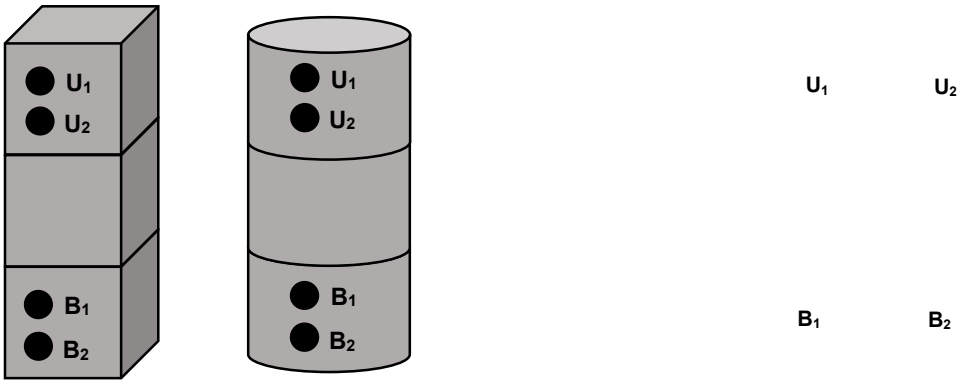


Figure 2

7.7. Cored test specimens shall be sawn lengthwise down the center. Coarse aggregate measurement shall be taken along the length of the core sample, as indicated in ***Figure 3.***

Figure 3

7.8. For location U_1, draw two straight horizontal lines along the surface, dividing the 20 cm (8 in) x 20 cm (8 in) area of the sawn specimen, or the cored specimen, into thirds. Designate these lines as $U_{1\text{-}a}$ and $U_{1\text{-}b}$. (red dotted lines in **Figure 4**).

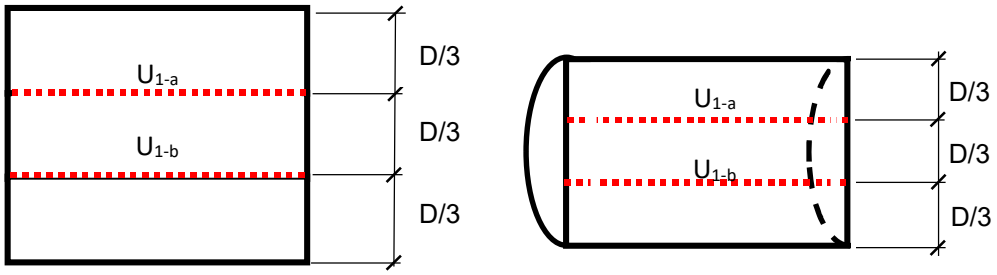


Figure 4

7.9. Make a lengthwise assessment of the cut planes of the sawn or cored specimen. The cut planes shall be wetted to facilitate measurements.

7.10. By placing the ruler on line $U_{1\text{-}a}$, measure the size of each piece of aggregate, along the line, greater than or equal to 2.5 mm (0.1 in).

7.11. Determine the total length of the aggregates along line $U_{1\text{-}a}$ by summing the sizes of all measured aggregates.

7.12. Determine the coarse aggregate ratio (C.A.) as a percent by dividing the total length of measured aggregates on line $U_{1\text{-}a}$ by the total length of the drawn line.

$$\text{C. A.} = \left(\frac{\text{Total Length of aggregates}}{\text{Length of the drawn line}}\right) \text{x } 100$$

7.13. Repeat the same process for $U_{1\text{-}b}$ as described in 7.9 - 7.12

7.14. Report the C.A. of the location, U_1, by averaging the results of the C.A. content of $U_{1\text{-}a}$ and $U_{1\text{-}b}$.

7.15. Follow the same procedure as described in 7.9 - 7.14 for locations U_2, B_1, and B_2.

7.16. Calculate the average C.A. content of the upper part of the mockup (**C.A. Average Upper**) by considering specimens U_1 and U_2. Round calculation to the nearest whole number.

7.17. Calculate the average C.A. content of the bottom part of the mockup (**C.A. Average Bottom**) by considering specimens B_1 and B_2. Round calculation to the nearest whole number.

7.18. Calculate the Coarse Aggregate Index (C.A.I)

C.A.I = ABS (**C.A. Average Bottom – C.A. Average Upper)**.

8. REPORT

8.1. Report the following information:

8.1.1. Mix design number; production facility ID and FDOT District number.

8.1.2. Date and time of molding the mockup, and when the C.A.I. was performed.

8.1.3. C.A. for each drawn line with the location of concrete represented.

8.1.4. C.A.I.

8.1.5. Include photos of the sawn mockup or core specimen with the drawn lines labeled.

9. REPORT FORMAT

FM 5-617

AGGREGATE DISTRIBUTION OF HARDENED CONCRETE USING A MOCKUP PRODUCT

Mix Design Number		Date/Time Mockup Molded	
Production Facility ID		Date/Time C.A.I. Performed	
FDOT District			

Position			Individual sizes of coarse aggregate ≥ 0.1 in. along drawn line (mm)	Total length of coarse aggregate along drawn line (mm)	Length of drawn line (mm)	Coarse Aggregate Ratio (C.A) (%)	C.A. Average (%)	Coarse Aggregate Index (C.A.I) (%)
Upper	U_1	a					U	ABS (B – U)
		b						
	U_2	a						
		b						
Bottom	B_1	a					B	
		b						
	B_2	a						
		b						