

**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF ENGINEERING SERVICES**  
Transportation Laboratory  
5900 Folsom Boulevard  
Sacramento, California 95819-4612



## **METHOD OF TEST FOR PROPORTIONS OF COARSE AGGREGATE IN FRESH CONCRETE**

### **A. SCOPE**

This test method describes the procedure to measure the proportion, by mass or volume, of coarse aggregate in fresh portland cement concrete. The test result may be used to determine compliance with the Caltrans Standard Specifications. If tests are performed on separate portions of a batch, the results furnish a measure of the effectiveness of mixing. An Approximate Test Method and a Referee Test Method are described.

In the Approximate Test Method, the density of the fresh concrete is assumed. Test results (California Test 518) from other batches of concrete should be used as the basis for the assumption. The Referee Test Method requires measurement of the density of the sample being tested. The Approximate Test Method uses the damp drained mass of the aggregate as an approximation of the Saturated Surface Dry (SSD) mass. The Referee Test Method aggregate is brought to SSD.

In both methods the bulk specific gravity, in accordance with California Test 206, must be known if the volume of the coarse aggregate is desired.

### **B. REFERENCES**

California Test 206 - Specific Gravity and Absorption of Coarse Aggregate  
California Test 223 - Surface Moisture in Concrete Aggregates by the Displacement Method  
(Field Method)  
California Test 518 - Unit Weight of Fresh Concrete  
Caltrans Standard Specifications - Section 90 Concrete

### **C. APPARATUS**

For the Approximate Test Method, the following equipment is needed:

1. Scales: Capacity of 105 lb with accuracy of 0.01 lb
2. U.S. No. 4 or  $\frac{3}{4}$  in. sieve, brass, full height, 12 in. in diameter, for wet sieving fresh concrete. A rigid type handle may be attached to facilitate washing. The sieve to be used depends on the test information wanted.
3. Three wash tubs or large buckets in which to submerge sieve-containing concrete in water while wet sieving. Use of hose and running water may be substituted.
4. Small scoop.
5. Dishpans: 24 qt capacity or other containers to sample concrete and use for weighing washed concrete aggregate. Tared mass should be established for each weighing container before starting any test.

The following additional equipment is needed to perform the Referee Test Method:

6. Approximately 1 yd<sup>2</sup> absorptive fabric for surface drying coarse aggregate.
7. Measure: A cylindrical, watertight, steel measure having a minimum volume of ½ ft<sup>3</sup>, provided with handles. It shall have an inside diameter of about 10 in. and an inside depth of about 11 in. It shall be constructed of No. 10 to No. 12 U.S. gage steel and shall be reinforced around the top with a steel band of the same gage, 1½ in. wide.
8. Tamping rod: A round, straight, steel rod with a diameter of ⅝ in. ± 1/16 in. and length of at least 4 in. greater than the depth of the measure in which rodding is to be performed, but not more than 24 in. One or both ends of the tamping rod must be rounded to a hemispherical tip of the same diameter as the rod.
9. Glass cover plate, approximately 12 in.<sup>2</sup>, at least ¼ in. thick and wire-reinforced, or acrylic plastic plate at least ½ in. thick.

NOTE: Items 1, 7, 8, and 9 are part of the test equipment used for California Test 518 and are available as a unit from the Division of Procurement and Contracts.

#### **D. TEST REPORT FORM**

No specific form is provided for reporting results.

#### **E. TEST PROCEDURE FOR APPROXIMATE TEST METHOD**

1. a. Assume the unit weight of the fresh concrete based on any available test data. The bulk specific gravity SSD of the coarse aggregate must be known in order to calculate the absolute volume of coarse aggregate.
- b. Obtain a sample of concrete representative of the portion of the batch to be tested. The mass of the sample must be at least 100 lb.
2. Weigh out 75 lb of the sample into a container for wet sieving.
3. a. Using scoop, place small quantities of concrete from the 75 lb sample into the chosen sieve (¾ in. or No. 4). Immerse the sieve in water and agitate it with a rotary motion while, at the same time, raising and lowering the sieve beneath the surface of the water. In lieu of the immersion method, material may be washed through a No. 4 sieve by using a hose if running water is available.
- b. During the sieve operation, transfer the sieve to fresh containers of water twice, the last transfer being made after sieving is nearly completed.
- c. Continue sieving until it is evident that all undersize material has been removed. Take care not to spill any of the sample out of the sieve while wet sieving the submerged sample.
- d. Dump washed retained aggregate into a clean pan.

- e. Repeat operations until all of the sample has been wet sieved.
  - f. After sample has been wet sieved and transferred to a clean weighing container, allow water to drain from aggregate for three minutes.
4. Drain off free water and weigh to the nearest 0.05 lb.
  5. Calculate the approximate mass or absolute volume of coarse aggregate per cubic foot of concrete. Use the following formulas:

$$(1) \quad W_A = (a/b) \times c$$

$$(2) \quad V_A = (a/b) \times c / (G \times 62.4)$$

where:

$W_A$  = approximate weight in lb of coarse aggregate per ft<sup>3</sup> of concrete

$a$  = assumed unit weight of the concrete in lb/ft<sup>3</sup>

$b$  = the total weight of sample before sieving (75 lb)

$c$  = weight in lb of coarse aggregate retained on No. 4 (or ¾ in.) sieve determined by test of 75 lb sample.

$V_A$  = approximate absolute volume in ft<sup>3</sup> of coarse aggregate per ft<sup>3</sup> of concrete.

$G$  = bulk specific gravity (SSD) of coarse aggregate.

#### F. TEST PROCEDURE FOR REFEREE TEST METHOD

1. Obtain a sample of concrete representative of the portion of the batch to be tested. The weight of the sample must be at least 100 lb.
2. Determine the actual density of the fresh concrete in accordance with California Test 518. Use the measure specified for 1½ in. maximum size aggregate even if the specified aggregate is smaller.
3. Wet sieve the sample from the ½ ft<sup>3</sup> measure as described in E. Test Procedure for Approximate Test Method, Sections 2 and 3.
4. Place the coarse aggregate on canvas or other absorbent material. Roll or stir the aggregate until surface moisture just starts to leave in order to bring aggregate to required SSD condition. Weigh immediately to nearest 0.05 lb.
5. Calculate weight or absolute volume of coarse aggregate per cubic foot of concrete

by the following formulas:

$$(3) \quad W = (u/d) \times e$$

$$(4) \quad V = (u/d) \times e / (G \times 62.4)$$

where:

$W$  = SSD weight in lb of coarse aggregate per ft<sup>3</sup> of concrete.

$u$  = density in lb per ft<sup>3</sup> of fresh concrete as determined by California Test 518.

$d$  = weight in lb of sample of concrete placed in the density measure.

$e$  = weight in lb of saturated, surface dry aggregate retained on sieve as determined by test of sample from the density test.

and

$V$  = absolute volume in ft<sup>3</sup> of coarse aggregate per ft<sup>3</sup> of concrete.

$G$  = bulk specific gravity (SSD) of coarse aggregate.

#### **G. TEST PROCEDURE FOR ALTERNATE REFEREE TEST METHOD**

1. If facilities are available for weighing the coarse aggregate in water similar to the arrangement described in California Test 223, the volume of coarse aggregate can be obtained without surface drying the material. The bulk specific gravity (SSD) of the coarse aggregate must be known.
2. Attach a brass wire bale to the No. 4 sieve and determine its apparent tare weight while suspended in water.
3. Place the washed coarse aggregate in the sieve and determine its apparent weight to the nearest 0.05 lb while suspended in water. The sieve and the coarse aggregate must be entirely submerged and the sieve should be at the same level as when the tare weight was determined.
4. Subtract the tare weight from the weight of the sieve containing coarse aggregate. The net weight will be the weight of coarse aggregate in the test sample while suspended in water.
5. Calculate the weight of the SSD aggregate in air by use of the following formula:

$$(5) \quad e = D \times G / (G - 1)$$

where:

$e$  = SSD weight in lb of the coarse aggregate in wet sieved sample

$D$  = submerged apparent weight in lb of coarse aggregate

$G$  = bulk specific gravity (SSD) of the coarse aggregate

6. Use the SSD calculated weight of coarse aggregate of the wet sieved sample formula (5), to calculate the weight of coarse aggregate in a ft<sup>3</sup> of concrete by use of the following formula:

$$(6) \quad W = eu/d$$

where:

$W$  = weight in lb of coarse aggregate per ft<sup>3</sup> of concrete

$e$  = SSD weight in lb of coarse aggregate in test sample as determined above

$u$  = density in lb/ft<sup>3</sup> of fresh concrete, as determined in accordance with California Test 518

$d$  = weight in lb of sample of concrete from density measure

7. Calculate the absolute volume of coarse aggregate per ft<sup>3</sup> of concrete by use of the following formula:

$$(7) \quad V = W / (G \times 62.4)$$

where:

$V$  = absolute volume in ft<sup>3</sup> of coarse aggregate per ft<sup>3</sup> of concrete.

$W$  = weight in lb of coarse aggregate per ft<sup>3</sup> of concrete.

$G$  = bulk specific gravity of the coarse aggregate.

## H. NOTES

When wet screening the fresh concrete, do not overload the sieve. Use small amounts and repeat the operation until the washed aggregate is free from sand and cement. Change wash water as necessary to facilitate washing of coarse aggregate.

Before weighing the total amount of clean, washed aggregate in the approximate method, drain off all free water.

## I. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory

practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

[http://www.dot.ca.gov/hq/esc/ctms/pdf/lab\\_safety\\_manual.pdf](http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf)

Users of this method do so at their own risk.

**End of Text  
(California Test 529 contains 6 pages)**