

Purpose – Why Do This Test?

The unit weight of fresh concrete is a general indicator that the concrete has been batched in the correct proportions. It is a good indicator of batch-to-batch uniformity.

Principle – What is the Theory?

A concrete mixture design is composed of several ingredients: portland cement, supplementary cementitious materials (SCMs), fine aggregate, coarse aggregate, admixtures, air, and water. All of these materials have different specific gravities. A variation in the unit weight of a mixture will indicate a change in proportioning of the mixture, often in the water or air content.

Test Procedure – How is the Test Run?

A sample of mixed concrete is consolidated in a container of known volume and weighed to determine the unit weight of the mixed concrete (ASTM C 138).

Test Apparatus (figure 1)

- Measure: cylindrical container, usually a standard pressure air pot.
- Scale for weighing the sample.
- Tamping rod, vibrator, mallet, and strike-off plate for consolidating the sample in the air pot.

Test Method – Refer to ASTM C 138 for Comprehensive Guidance

1. Determine the level-full volume of the air pot.
2. Weigh the empty air pot.
3. Consolidate a sample of fresh concrete in the air pot using the tamping rod or vibrator and mallet until it is approximately $\frac{1}{8}$ in. above the top rim of the air pot.
4. Using the strike-off plate, finish the concrete so that it is level-full with the top rim of the air pot.
5. Clean off all excess concrete from the exterior of the air pot.
6. Weigh the air pot full of concrete.
7. Record the empty mass, full mass, and volume of the air pot.

Output – How Do I Interpret the Results?

The unit weight of the concrete mixture is reported in pounds per cubic foot (lb/ft^3):

$$\text{Unit weight} = (\text{full mass} - \text{empty mass}) / \text{volume}$$

The unit weight of the mixture should be compared with the unit weight of the mixture design to identify potential problems in the batching process or changes in raw materials. Typical 3s control charts should also be used to identify changes in the materials and/or processes indicated by unit weight test results.

A variability of more than $3 \text{ lb}/\text{ft}^3$ may be considered significant.

Construction Issues – What Should I Look For?

When variations in unit weight measurements are observed, the following potential causes should be reviewed:

- Sample consolidation. (Was the sample fully consolidated in the air pot?)
- Air content of the concrete.
- Water content of the concrete.
- Batch proportions of each material.
- Changes in raw material densities (specific gravities).



Figure 1. Unit weight test equipment

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