

CALIFORNIA COUNCIL OF TESTING & INSPECTION AGENCIES

FAQ_{10.054}

Specified Strength of Cylinders vs Cores

Q On a recent project, the concrete column strengths for one pour fell short of the specified 4000 psi. Cores were taken in accordance with CBC 2010 Section 1905.6.5 and ACI 318 Section 5.6.5. Due to project schedules and forming techniques, cores were taken vertically from the column tops. Subsequent strength testing indicated acceptable results and the project continued with only this small blip. Afterwards, our client questioned our field testing. They claimed that if the core testing results met the requirements of the Code, the cylinder testing was obviously incorrect and therefore refused to pay for the coring. What is the relationship between the strength indicated by the test cylinders compared with the strength of the concrete in the structure?

Submitted by Terry Eglund, P.E. San Leandro, California

Response Submitted by Peter Grossman, P.E.

A Test specimens (cylinders) are made, cured and tested under certain standard conditions that are usually appreciably different from the conditions existing in the structure. The value of field-cast test specimens is that they give a measure of the **strength potential** (they evaluate the materials and mix as supplied by the producer, to ascertain the concrete meets project specifications). Test specimens are not intended to yield an exact strength of the concrete in the structure, and the **actual strength of the concrete in the structure can be appreciably different**. Besides variable environmental site conditions and curing, other variables between test specimens and the concrete in the structure include variations of mix components, water content, size and shape of the structure, workmanship, degree of consolidation, possible presence of defects such as rock pockets, restraint, and combinations of loading in the structure. It is because of these unknowns that the Structural Engineer must consider a factor of safety when the structure is designed.

Variations in cylinder strengths are not always reflective of a problem in the structure. For instance, if three sets of specimens are made from one day's concrete placement and maintained under identical conditions throughout the test duration, there is no assurance they will all fail at the same strength when they are tested at the same age. In fact, each one will almost always break at a different strength. These are normal variations, and should be expected.

Cored specimens are usually obtained days or weeks, even months, after the laboratory testing of cylinders. This additional time must be taken into account when comparing cylinder and core test results. In addition, cored specimens are tested in a dry or moist condition, but rarely in the saturated condition similar to test cylinders. It is well documented that dry specimens have a higher compressive strength than saturated specimens.

We do know that there are variations in the strength of the structure that are not caused by basic variations in the concrete itself. For example when cores are taken from a column, the cores from the upper portion of the column invariably indicate lower strength than the cores from the bottom portion of the column. The reason is that the concrete near the bottom was compacted by static hydraulic head of the concrete being worked above, yet there was no change in mix or materials.

Published December 2010, Updated June 2012

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