

HOW to Investigate In-Place Strength

If only one set of cylinders is low, often the question can be settled by comparing rebound hammer or probe results on concrete in areas represented by acceptable cylinder results. Where the possibility of low strength is such that large portions need to be investigated, a well-organized study will be needed. Establish a grid and obtain systematic readings including good and questionable areas. Tabulate the hammer or probe readings. If areas appear to be low, drill cores from both low and high areas. If the cores confirm the hammer or probe results, the need for extensive core tests is greatly reduced.

Core Strength, ASTM C 42 - If core drilling is necessary observe these precautions:

- a. Test a minimum of 3 cores for each section of questionable concrete;
- b. Obtain 3^{1/2} in. (85 mm) minimum diameter cores. Obtain larger cores for concrete with over 1 in. (25.0 mm) size aggregate;
- c. Try to obtain a length at least 1^{1/2} times the diameter (L/D ratio);
- d. Trim to remove steel provided the minimum 1^{1/2} L/D ratio can be maintained;
- e. Trim ends square with an automatic feed diamond saw;
- f. When testing, keep cap thickness under 1/8 in. (3 mm);
- g. Use high strength capping material; neoprene pad caps should not be used;
- h. Check planeness of caps and bearing blocks;
- i. Do not drill cores from the top layers of columns, slabs, walls, or footings, which will be 10 to 20 percent weaker than cores from the mid or lower portions; and
- j. Test cores after drying for 7 days if the structure is dry in service; otherwise soak cores 40 hours prior to testing. Review the recommendations for conditioning cores in current versions of ACI 318 and ASTM C 42.

Probe Penetration Resistance, ASTM C 803 - Probes driven into concrete can be used to study variations in concrete quality:

- a. Different size probes or a change in driving force may be necessary for large differences in strength or unit weight;

- b. Accurate measurement of the exposed length of the probe is required;
- c. Probes should be spaced at least 7 in. apart and not be close to the edge of the concrete;
- d. Probes not firmly embedded in the concrete should be rejected; and
- e. Develop a strength calibration curve for the materials and conditions under investigation.

Rebound Hammer, ASTM C 805 - Observe these precautions:

- a. Wet all surfaces for several hours or overnight because drying affects rebound number;
- b. Don't compare readings on concrete cast against different form materials, concrete of varying moisture content, readings from different impact directions, on members of different mass, or results using different hammers;
- c. Don't grind off the surface unless it is soft, finished or textured;
- d. Test structural slabs from the bottom; and
- e. Do not test frozen concrete.

Advance Planning - When it is known in advance that in-place testing is required, such as for shore and form removal, other methods can be considered such as: cast-in-place, push-out cylinders and pullout strength measuring techniques covered by ASTM C 873 and C 900.

References

1. In-Place Methods to Estimate Concrete Strength, ACI 228.1R, American Concrete Institute, Farmington Hills, MI.
 2. Nondestructive Tests, V.M. Malhotra, Chapter 30 in ASTM STP 169C, American Society for Testing and Materials, West Conshohocken, PA.
 3. Guide to Nondestructive Testing of Concrete, G.I. Crawford, Report FHWA-SA-97-105, Sept. 1997, Federal Highway Administration, Washington, DC.
 4. In-Place Strength Evaluation - A Recommended Practice, NRMCA Publication 133, NRMCA, Silver Spring, MD.
 5. Understanding Concrete Core Testing, Bruce A. Suprenant, NRMCA Publication 185, NRMCA, Silver Spring, MD.
 6. ASTM C 31, C 39, C 42, C 805, C 803, C 873, C 900, ASTM Book of Standards, Vol. 04.02, American Society for Testing and Materials, West Conshohocken, PA
 7. Building Code Requirements for Structural Concrete, ACI 318, American Concrete Institute, Farmington Hills, MI.
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