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Alfonso Arellano, Assistant Laboratory Supervisor, Southwest Inspection and Testing Laboratory, recording the results from a concrete compression test.

A Day at the Lab with Roy Fewell, Building Official

Do you know what goes on in an accredited materials testing laboratory to validate compliance of construction materials on the projects your department regulates?

Roy Fewell, building official for the City of La Habra, California recently visited an accredited testing laboratory located in his jurisdiction to observe, first hand, their testing equipment and procedures. He says, "My goal was to get a clearer understanding of the testing laboratories' equipment and capabilities that help support our enforcement activities. Our building department continually approves projects through reliance on accredited laboratories and special inspectors. I wanted to witness, first hand, the equipment used and the procedures followed by an accredited laboratory."

Fewell gained a familiarization with the capabilities of an accredited laboratory by visiting Southwest Inspection and Testing Laboratory (Southwest). Fewell's visit was arranged by International Accreditation Service (IAS) which accredits the laboratory under the IAS Accreditation Criteria for Testing Laboratories AC89.

"This was a useful experience. I am familiar with the usual concrete tests such as testing for compressive strength at 28 days, but Southwest had a number of other capabilities that may be useful in addressing some of our more problematic projects in the City," says Fewell.

LABORATORY SERVICES

Southwest is a full-service laboratory that offers complete materials testing services including special inspections for the construction industry. Southwest's scope of accreditation with IAS includes:

A Day at the Lab *(continued)*

concrete; masonry; grout; iron and steel, and spray-applied fire-resistive material.

After a brief tour of the administrative offices, Renan Cruz, P.E., Quality Control Laboratory Manager with Southwest took Fewell out to the laboratory testing facilities for a closer look at the equipment and processes necessary to make sure concrete and reinforcing systems are constructed to the required design standards.

The first stop on the tour was an assessment of various concrete compression testing procedures that can be performed in the field or in the lab. Concrete compressive strength dictates the load that a given slab can withstand. For instance, conventional concrete has a compressive strength between 1,400 psi and 5,800 psi while high strength concrete has compressive strength higher than 6,000 psi to over 14,000 psi and is typically used in high-rise buildings.

Determining concrete compressive strength requires an understanding of numerous factors including the concrete mix, thickness of the slab, surface conditions and much more.

During his tour of the Southwest facility, Fewell had an opportunity to evaluate the equipment used to assess other properties of concrete. For instance, the lab is equipped with a spring-driven steel rebound test hammer designed to assess the in-place uniformity of concrete or to determine regions in a structure of poor quality or deteriorated concrete. It is also used to estimate in-place strength.

Its operation is fairly straightforward. The hammer device is pressed against a concrete structure. Once in place, the test engineer fires the hammer and records a rebound number from a scale on the device. The test is repeated 10 times. Using the average rebound number, the technician can convert the rebound number to pounds per square inch using industry standardized charts.

Renan Cruz, P. E., Quality Control Laboratory Manager with Southwest shows Roy Fewell a spring-driven steel rebound test hammer used to determine the compressive strength of in situ hardened concrete per ASTM 805.

Southwest's Cruz explains, "It's a quick, non-destructive, on-site concrete slab and wall test to estimate the surface compressive strength. Owners or contractors often have us check existing slabs to make sure the concrete is continuing to maintain its design strength requirements and that it meets building code requirements."

Fewell noted that this test was of particular interest to Building Officials who are often approached with the problem of how to provide after-the-fact documentation of room additions and other miscellaneous structures that have been built without permits. "We often hear tales of woe," Fewell noted, "from unsuspecting homebuyers who buy a residence only to discover, after-the-fact, that it has an un-permitted room addition. When they come to us to try to obtain permits and demonstrate compliance, non-destructive methods like the rebound hammer test could prove especially useful."

CODE APPLICATIONS

Most building departments require that structural slabs, such as those in post tension, must undergo extensive testing in the lab per ASTM C39 Compressive Strength of Cylindrical Concrete Specimens.

Compressive strength is evaluated by testing cylinders of concrete and measuring the force needed to break the cylinders at prescribed intervals as they harden. According to Building Code Requirements for Reinforced Concrete (ACI 318), as long as no single test is more than 500 psi below the defined design strength of the structure, and the average of three consecutive tests equals or exceeds the design strength, then the concrete is deemed acceptable.

For example, the engineer might require that the concrete slab-on-grade foundation for a two story residential home must carry a compressive strength of 3,000 psi at 28 days.

In this case, Southwest inspectors would collect concrete cylinder samples from the site. Cruz showed Fewell how the time/day stamped cylinders are stripped

A Day at the Lab *(continued)*

from cylinder molds, marked and prepared for curing. He was then given a tour of the curing room.

Laboratory mixing and curing rooms must follow strict ASTM C511 guidelines in order for a testing lab to earn accreditation. That means the rooms must be capable of maintaining temperature at 72 degrees, plus or minus 3 degrees Fahrenheit, and have a fog device capable of maintaining 95% or higher relative humidity, 24 hours a day, 7 days a week. Calibrated recorders and measuring devices must be in place to continuously monitor the temperature and humidity over the course of days and months.

Normal design criteria will require concrete cylinders to be tested for 28-day strength. That means the cylinders are left in the curing room for 28 days. Once the curing process is completed, the cylinders are removed from the curing room, prepared for testing and placed on a compression test machine. Load is applied at a loading rate of 20-50 psi/second until failure. The time to failure for 3000 psi concrete is 1 to 2.5 minutes.

ACCREDITATION

Southwest laboratory is accredited by IAS, a nonprofit subsidiary of the International Code Council. "A laboratory's product—its test report—must be dependable and carry the mark of an accreditation body that is independent and that has the safety of the public as its guiding purpose. Independence and concern for public safety are the qualities to look for in any organization that accredits laboratories, and these are the qualities embodied in International Accreditation Service (IAS)," said Chuck Ramani, President of IAS.

Steve Godbey, President of Southwest, and Roy Fewell look at a concrete cylinder mold used to prepare samples for testing the compressive strength of fresh concrete.

IAS accredits testing laboratories by verifying technical competence and assessing their quality management systems to the international standard ISO/IEC 17025. The process for becoming an IAS-accredited testing laboratory begins with a review of the laboratory's quality manual and the requested scope of accreditation. Once the quality manual has been reviewed and approved, IAS selects an assessment team based on the requested scope of accreditation. The assessment team conducts an on-site assessment of the laboratory and develops an assessment report. Once a laboratory has satisfied IAS accreditation requirements and demonstrated competence, an accreditation certificate is issued.

CONCLUSION

Most Building Officials are familiar with the fundamentals of materials testing, but don't normally visit testing labs with any regular frequency. It is useful to walk through a lab with a knowledgeable lab technician or testing engineer just to watch them operate their equipment and hear them discuss the challenges and problems associated with gathering, tracking, and recording the test results for the materials on which they constantly report to Building Officials. Just having that concrete point of reference (no pun intended) makes a Building Official more effective at understanding and evaluating the test reports that are so essential to the proper application of the Code.

Accreditation certificates for all IAS accredited entities, including the scope of their accreditation qualifications are available on the IAS website at www.iasonline.org.