On any job site, the strength of a concrete pour is a critical piece of information. Concrete cylinder tests have been the mainstay for compression strength in the construction industry for more than 180 years (Concrete Network). Generally speaking, this method has proven to be a reliable and economical way to verify the quality and the strength of the concrete in a structure.

How are Concrete Cylinder Break Tests Done in Third-party Labs?

There are two types of specimens that field technicians can collect to test the strength of concrete (in accordance with ASTM C31):

1. Standard-cured Cylinders
2. Field-cured Cylinders

In standard or lab curing, concrete cylinders are sent to the lab and subjected to standard temperatures and humidity conditions —23.0 ± 2°C and relative humidity that's greater than 95%. They are generally used for quality control and standard acceptance purposes.

As the name suggests, field-cured cylinders are subjected to the same temperature and humidity that the completed structure will actually experience in its environment. Unlike the standard-cured cylinders, field-cured specimens are kept right beside the concrete slabs on site. They are predominantly used for determining whether a structure is ready for critical operations like removing formwork, tensioning, and road openings.

When the specimens (e.g. drilled cores and molded cylinders) are ready to be tested in the lab, the lab technicians follow these steps:

- Examine the concrete cylinders to ensure that there are no defects
- Measure and weigh the cylinders and prepare the samples by grinding or capping the ends
- Place the samples in the hydraulic compression testing machine and carefully align them with the loading axis
- Allow the machine to compress the sample until it splinters or breaks
- Record the compressive strength and type of failure

The cylinders are then tested usually 3 days, 7 days, and 28 days after field installation to determine the concrete's compressive strength. Sometimes tests will also be carried out at 24 hours, 14 days, and/or 56 days depending on the project specifications.

The Pros of Using Third-Party Concrete Testing Labs

"ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens" has been in existence for many decades and outlines specific rules and conditions to ensure that labs properly test cylindrical concrete samples. As the construction industry's most utilized method of concrete compression strength testing, engineers, project managers, and contractors can trust that it will provide accurate measurements (most of the time).

As long as the procedure adheres to the standard, and test reports are accurate, it's nearly impossible to falsify the strength of the concrete with this method. For example, fly ash can be added to concrete to improve its strength and durability. However, there have been some cases where, in order to cut corners, material providers replace fly ash with fillers in their

concrete mix. In this scenario, the strength of the concrete may meet the industry standard after 24 hours, but thanks to the concrete cylinder test, labs will discover that the strength diminishes to well below the minimum accepted strength after only a few weeks. This gives the construction company the knowledge they need to avoid building a weak structure made of sub-par concrete.

Thanks to the method's highly established reputation, companies also understand that they don't have to spend too much of their time or financial resources to find qualified labs and technicians to carry out break tests.

Furthermore, concrete cylinder tests are quite cheap to execute as the molds are made of plastic (some are made of metal which means they can be reused) and the test itself can cost anywhere from $70 to $250 to break a set of three concrete cylinders.

The Cons of Using Third-Party Concrete Testing Labs

Despite the benefits of using third-party labs for concrete cylinder testing, this method isn't completely foolproof. There's a lot of room for improvement when it comes to optimizing the use of resources, minimizing costs, increasing accuracy, and reducing the time it takes to measure concrete strength.

As everyone in the construction industry knows and has simply accepted, completing a concrete cylinder test from start to finish is a time-consuming process. Once concrete is poured the cylinders are made by a technician and placed in an adequate curing environment. For standard-cured specimens, they must sit for 8-24 hours before they can be collected and transported to the lab for a break test to be completed.

Even though desired strength can be reached well before standard curing periods, field personnel and project managers still need to wait for labs to complete break tests before they can move onto the next steps in the construction process, which further prolongs deadlines. This is especially true when doing field-cured cylinders.

While the test results of fresh concrete are known immediately, at least by the technician, results for compressive, or other harden properties such as flexural strength, for example, are not normally available until formal test reports are released (Concrete Construction). Needless to say, break tests don't allow for real-time results.

The concrete cylinder test isn't an inefficient method as a whole but there has been a considerable amount of "bad" or low breaks recorded, which could be attributed to technicians failing to follow the standard's specifications rather than the standard itself. For example, if the cylinders aren't cured in the right way, this can result in a low break. Unfortunately, low breaks caused by human error aren't the only concern that concrete companies have with regards to inaccurate results. There have been cases of labs manipulating and falsifying results, even for major buildings that see a lot of traffic on a daily basis. Furthermore, there has been documentation of the wrong concrete mix being delivered to the jobsite, resulting in even more delays, if it's caught in time.

While individual break tests are inexpensive, these costs add up over time, especially on large construction projects. The costs incurred due to errors made on the part of the field technician or lab also need to be considered. For example, if the field technician fails to

properly consolidate the concrete cylinder by rodding the sample or using a vibration machine, it can result in a bad sample. Mistakes can also occur in the lab and during transportation. A lab technician could accidentally allow the perpendicularity of a cylinder's axis to deviate by more than half a degree, for example. Or, cylinders may not be stored properly during transportation and may cause micro-cracking, reducing the overall strength of the cylinder during testing and affect the accuracy of the data.

But before the break tests can even happen, construction companies first need to be able to hire people that want to do the manual labor of filling and transporting concrete cylinders. Headhunting requires a lot of time, financial resources, and human capital. With the severe labor shortage that the construction industry has been facing, the problem is only getting worse as time goes on.

Why the Construction Industry is Afraid to Adopt Alternative Concrete Testing Methods

While breaks tests are generally reliable and inexpensive (mainly for small to medium-sized projects), there are better ways to measure concrete strength that are less costly in the long run. For example, wireless maturity sensors allow for real-time temperature and strength monitoring and eliminate the need for time-consuming break tests. Armed with this knowledge at any given time means that contractors and project managers know exactly when their slab is strong enough to begin the next phase of the project.


Making Concrete Cylinders 1930s

The question is, why are people reluctant to use other methods? The construction industry

isn’t known for welcoming innovation with open arms (although that’s starting to change). After all, the first compression strength test was completed in 1836 and this method is still being used today. Old habits die hard and when something has carved itself a lasting place in history, people are afraid to challenge the status quo.
Ultimately, the construction industry simply doesn’t realize that problems with concrete cylinder testing exist because it’s the accepted standard. As a result, many people don’t know that there are other viable options available to them.

If someone spends their entire life riding a horse and buggy, would the thought of driving a high-speed piece of metal with four wheels and an engine enter their mind? The quote widely attributed to Henry Ford illustrates it best: “If I had asked people what they wanted; they would have said faster horses.”

Sources:
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