

Technology in Practice

What, Why & How?



TIP 1 - Quantifying Concrete Quality

This TIP explains the benefits of improved concrete quality

WHAT Does Quantifying Concrete Quality Mean?

Many ready mixed concrete producers are making significant efforts in improving quality. How does a concrete producer evaluate whether their quality initiatives and efforts are making a positive impact on the company? On the operations side they can compare their efforts to industry benchmarks, such as the ones published by NRMCA resulting from industry surveys. These benchmarks include yards/hour, delivery costs for fleets, and safety statistics. Financial benchmarks specific to the industry are also available, developed by the NRMCA. Similar benchmarks specific to quality initiatives are not generally published. However, a producer should make attempts to monitor costs that can be attributed to a reduced level of quality. Some suggestions are discussed.

HOW Does One Quantify Concrete Quality?

The cost due to a reduced level quality may be measured by monitoring the following:

- Amount of rejected concrete as a percent of the concrete produced for non-compliance with project specifications such as strength, slump, air content or other contractor requirements
- Cost to evaluate, mitigate, repair or replace hardened concrete because concrete did not meet purchaser's or specification requirements or expectation.
- Variability in compressive strength as measured by standard deviation—may be monitored by plant.
- Perception of producer's quality by customers through surveys or other means and its impact on return business by individual customers.

WHY is Quantifying Concrete Quality Important?

Quantifying concrete quality is important because some benchmark is measured and the measured factor establishes targets for continuous improvement. When this is shown to benefit the company's bottom line, it justifies the quality initiative.

Rejected concrete due to quality-related issues, even if it is beneficially reused, still represents money lost in terms of truck time and man hours. A cost that is more difficult to quantify is the customer's negative perception. Cost to repair hardened concrete can involve core tests or other evaluation that can become very expensive, even if litigation is not involved. A producer that establishes and follows a good quality management system is likely to have a lower amount of rejected concrete and reduced costs to deal with problems with placed concrete on an annual basis.

Variability in compressive strength as measured by standard deviation (s) is an excellent measure of a producer's quality. Table 1, reproduced from Table 4.4 from ACI 214R-11¹, shows that the standards of concrete control based on general construction testing can vary from Excellent ($s < 400$ psi) to Poor ($s > 700$ psi). This applies to typical concrete strengths in the range of 3000 to 5000 psi. A low standard deviation is desirable because it will result in a lower required average strength (f'_{cr}), or strength over-design that a producer needs in a mix submittal for a specified strength (f'_c). A lower required average strength will reduce the material costs for each class of concrete. Since entrained air is a factor that adds to variability of concrete, strength data for air-entrained and non air-entrained concrete might be tracked separately.