

Technology in Practice

What, Why & How?



TIP 15 - Estimating Concrete Strength using Maturity

This TIP discusses the use of the maturity method for estimating in-place strength of concrete in accordance with one of the methods in ASTM C1074

WHAT is Maturity as it relates to Concrete?

The maturity method is a relatively simple technique that considers the combined effects of time and temperature on the development of strength (and sometimes other properties) of concrete. The method is used to make reliable estimates of the in-place strength of concrete in a structure during construction. The estimate of in-place strength is typically needed at early ages and is used to remove formwork and shores, post-tensioning, opening structures to traffic and other live loads, and for other construction scheduling events. The maturity concept assumes that samples of a concrete mixture having the same maturity will have similar strengths, regardless of the combination of time and temperature yielding the maturity. The temperature history of the in-place concrete is measured and used to determine the maturity index. Using a pre-established relationship between strength and the maturity index for the specific concrete mixture, the in-place strength is estimated. Each set of materials and concrete mixture has a unique relationship of strength to maturity index.

Maturity methods are discussed in ASTM C1074. There are two methods for calculating the maturity index – the Nurse-Saul (time-temperature) and the Arrhenius (equivalent age). The Arrhenius approach has been shown to provide more accurate estimates of concrete strength but the procedures and calculations used are more involved. This TIP discusses the Nurse-Saul method due to its simplicity and broader use. The procedures described in this document do not precisely match C1074 but have been used on actual projects.

WHAT are the Steps Involved?

The following summarizes what is involved:

1. Develop a relationship between the strength and maturity index (S-M) in the laboratory for the specific concrete mixture to be used in the structure using job materials. Determine the maturity index needed to obtain the target in-place strength.
2. Verify the S-M relationship of production concrete by measuring strength of specimens in the field.
3. Measure the temperature history of the concrete in the structure; alternatively, a maturity meter can be used to determine the maturity index.
4. When the estimated in-place strength has been reached, perform applicable construction operations.

The limitations of the maturity method are:

- The concrete must be maintained in a condition that permits cement hydration.
- The method does not take into account the effects of early-age concrete temperature on the strength development and long-term strength.
- The method needs to be supplemented by other indications of the potential strength of the concrete mixture, especially when safety is involved. This is because significant changes in concrete material characteristics and batch quantities during production causes the established S-M relationship inaccurate for predicting in-place strength.