Florida Method
for
ESTIMATING THE STRENGTH OF HIGH EARLY STRENGTH CONCRETE USING THE MATURITY METHOD

Designation: FM 3-C1074

This specification is identical to ASTM C1074 with the following provisions:

SCOPE

Replace the first sentence with, This practice provides for estimating **High Early Strength Concrete (HESC)** by means of the maturity method.

ADDITIONAL REFERENCED DOCUMENTS

ASTM Standards:

C125 Standard Terminology Relating to Concrete and Concrete Aggregates.

AASHTO Standards:

AASHTO PP 54 Standard Practice for Match Curing of Concrete Test Specimens.

FDOT Standard Specifications for Road and Bridge Construction.

Publications:

Carino and Lew (2001), “The Maturity Method: From Theory to Application,” NIST Reprint from the Proceedings of the 2001 Structures Congress & Exposition, May 21-23, 2001, Washington D.C., American Society of Civil Engineers, Reston, Virginia, Peter C. Chang, Editor, 2001.

Tia, Muszynski, and Kwon (2014), “Slab Replacement Maturity Guidelines,” FDOT Project BDK75-977-62 Final Report, Florida Department of Transportation.

ADDITIONAL TERMINOLOGY (Terms and Definitions)

Activation energy – (Carino and Lew, 2001) The classical interpretation of an activation energy is that of an energy barrier that must be overcome to initiate a reaction. Relative to the maturity method, the activation energy defines the temperature sensitivity of the rate constant for strength development of a particular concrete mixture. The rate constant is the initial slope of the relative strength-versus-age curve at constant temperature curing. Factors affecting the activation energy values measured for concrete hydration include cement fineness, mineralogical composition of the cement, supplemental cementitious materials, admixtures, and temperature.

Curing – (ASTM C125) Curing refers to the actions taken to maintain moisture and temperature conditions in a freshly-placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop.

Match curing – (AASHTO PP 54)
Match curing is a procedure for curing concrete cylinders at the same temperature as that monitored at a specific location in a concrete member during hydration

Specified temperature (Reference Temperature)
The specified temperature is the reference temperature to which maturity is normalized to allow for maturity comparison of identical cementitious mixtures with different temperature histories.

MATURITY FUNCTIONS

Insert at end of paragraph of subsection 6.4, An average activation energy of 33,500 J/mol has been determined for typical high early strength mixes (Tia, et al., 2014). This yields a value for Q of 4030 K, which should be used for equivalent age calculations, unless the procedures in Annex A1 are used to determine an accurate value for the particular mix design in use. A value of 23°C should be used for the reference temperature, T_s, in the equivalent age calculations.

NOTE: If using a maturity meter, insure that the activation energy used by the meter is 33,500 J/mol, and it should be the same model that was used for developing the strength-equivalent age curve.

PROCEDURE TO DEVELOP STRENGTH-MATURITY RELATIONSHIP

Change first sentence of subsection 8.1 with, Prepare at least 18 cylindrical specimens (3 for each test age).

Replace first sentence of subsection 8.4 with, The compression testing ages chosen depend on the relative rate of strength development and the range of maturity index being investigated. For high early strength cements, strength develops rapidly and the desired maturity is reached after 4 to 6 hours of curing. At least six test ages should be chosen for use such that the increments of strength gain between test ages are approximately equal. Choose ages such that at least four (4) occur before the target maturity, one (1) close to the target, and at least one (1) after the target.

Replace subsection 8.5 with, At each test age, record the average **equivalent age** for the instrumented specimens (the equivalent age maturity index is specified).

Replace subsection 8.5.1with, If maturity instruments are used, insure that they calculate the **equivalent age** maturity index using a value of 33,500 J/mol for the activation energy, and a value of 23°C for the reference temperature, T_S. Record the average of the displayed **equivalent age** values.

Replace subsection 8.5.2 with, If temperature recorders are used, evaluate the **equivalent age** according to equation 2, with an activation energy of 33,500 J/mol and a value of 23°C for the reference temperature, T_S. Record the **equivalent age** values obtained at the time intervals established in section 8.4.

Replace first sentence of subsection 8.6 with, Plot the average compressive strength as a function of the average **equivalent age** value.

Delete subsection 8.7

Delete subsection 8.8

PROCEDURE TO ESTIMATE IN-PLACE STRENGTH

Replace first sentence subsection 9.1 with, Secure temperature sensors within the section to be cast before concrete placement, or embed temperature sensors into the fresh concrete within 5 minutes after placement.

X1. MATURITY FUNCTIONS

Delete subsection X1.2 Temperature-Time Factor

Insert at end of paragraph of subsection X1.3.1, An average activation energy of 33,500 J/mol has been determined for typical high early strength mixes (Tia, et al., 2014). This yields a value for Q of 4030 K, which should be used for equivalent age calculations, unless the procedures in Annex A1 are used to determine an accurate value for the particular mix design in use.

Insert at end of first sentence of subsection X1.3.2, A value of 23°C should be used for the reference temperature, T_S, in the equivalent age calculations.

Delete the last sentence subsection X1.3.2

1. Replace subsection X1.3.3 with, If using a maturity meter, insure that the activation energy used by the meter is 33,500 J/mol, and it should be the same model that was used for developing the strength-equivalent age curve.