Six-FT Core

The applicability of maturity method in predicting the strength of in situ concrete strength was tested for the mass concrete structures. The study results showed that the in situ concrete strength was accurately predicted using the measured temperature-time history. The calibration curve that represents the strength gain of the concrete was modeled using the linear hyperbolic equation. The error in estimating in situ concrete strengths was determined using 2-inch morto cubes cured in three different temperature-time histories. The apparent activation energy values for concrete mixtures, including supplementary cementitious materials were successfully determined following ASTM C109. Further study is needed to modify the maturity calculation for variable temperature curing in large structures. Six-FT core blocks were constructed at different locations in West Virginia, using four different concrete mixtures from local ready-mix plants (Table 1). Each core was instrumented with temperature loggers attached on a rebar cage and temperature-time history was recorded as shown in Figure 1.

INTRODUCTION

The strength of properly designed and mixed concrete does not depend only on the curing time, but also on the temperature history. This concept is known in the concrete industry as maturity concept. According to the maturity concept, an empirical relationship can be established between the strength development of the concrete and the measured temperature-time history. In this study, "Arrhenius Equation" was used to establish maturity-strength relationship. The actual age of the concrete was converted to its equivalent age using the linear hyperbolic equation suggested by ASTM C904. The apparent activation energy values for concrete mixtures including supplementary cementitious materials were successfully determined following ASTM C109. Further study is needed to modify the maturity calculation for variable temperature curing in large structures. Six-FT core blocks were constructed at different locations in West Virginia, using four different concrete mixtures from local ready-mix plants (Table 1). Each core was instrumented with temperature loggers attached on a rebar cage and temperature-time history was recorded as shown in Figure 1.

RESEARCH METHODOLOGY

Six-FT core blocks were constructed at different locations in West Virginia, using four different concrete mixtures from local ready-mix plants (Table 1). Each core was instrumented with temperature loggers attached on a rebar cage and temperature-time history was recorded as shown in Figure 1. Core samples were taken from the hardened concrete core blocks at 4, 28 and 56 days, and the compressive strength results from the laboratory testing were compared with the predicted strengths.

Elastic Core

A total of six full-inch cylinder specimens were prepared from the cores along the 6-ft core (Figure 7) and the compressive strength results were obtained at 4, 28 and 56 days from each core (Table 2).

Maturity Method

Maturity-Strength Relationship

In order to establish the maturity-strength relationship of each mix, a calibration curve was determined using the measured temperature-time history. The calibration curve that represents the strength gain of the concrete was modeled using the linear hyperbolic equation. The error in estimating in situ concrete strengths was determined using 2-inch morto cubes cured in three different temperature-time histories. Determination of Activation Energy

The apparent activation energy of 45,900 J/mol and 44,750 J/mol for Class A Fly Ash-D1 and Class B GGBFS-D5 concrete mixtures, respectively, were determined using 2-inch morto cubes cured in three different temperature histories. The Arrhenius equation which was used to explain the temperature dependence of the rate constant, "k", from the hyperbolic equation. The authors acknowledge the support provided by WVDOH for the project NPM0G. Research material on concrete was collected from various locations in West Virginia. Special thanks are extended to our project monitors: Michael A., Donald Williams and Ryan Arnold of WVDOH.

CONCLUSIONS

The maturity-strength age relationship was used to model strength development at different temperatures. Activation energy values for concrete mixtures including supplementary cementitious materials were successfully determined following ASTM C109. The authors acknowledge the support provided by WVDOH for the project NPM0G. Research material on concrete was collected from various locations in West Virginia. Special thanks are extended to our project monitors: Michael A., Donald Williams and Ryan Arnold of WVDOH.