

Predicting Temperature Development Within a Mass Concrete Bridge Foundation Using ConcreteWorks

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High-temperature differentials in a mass concrete structure, such as a bridge foundation, pose great risks of temperature-induced stresses and cracking. Various preventive measures such as the installation of insulation blanket, cooling pipe, and others are taken to minimize the risk of cracking. Prior knowledge of temperature development within a mass concrete member is essential in this context. ConcreteWorks is a commonly used computer program for this purpose.

This presentation will be based on a project in which ConcreteWorks (CW) was calibrated with the measured properties of four commonly used mass concrete mixes in Iowa. These measurements were done through isothermal and semi-adiabatic calorimetry tests. The calibrated CW was then used to predict the early-age temperature development within a mass concrete bridge foundation, with an aim to prevent thermal cracking. The temperature development profile, temperature differential, maturity, and compressive strength were predicted as well as were measured through the real-time monitoring of the bridge foundation. It was observed that CW predictions were very close to their corresponding measured values. Also, three locations – centroid, top, and the face nearest to the centroid of the foundation, were found to be critical points for high-temperature differentials. A sensitivity analysis, analyzing the effects of various mass concrete parameters, will also be presented. This presentation is expected to help Engineers use CW as an important tool in developing thermal control plan for mass concrete projects.

Keywords: Mass concrete; Bridge foundation; Thermal analysis; ConcreteWorks; Calorimetry