

# **BEHAVIOR OF HIGH-PERFORMANCE CONCRETE IN SUMMER WEATHER**

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## **ABSTRACT**

This research was carried out to investigate the effects of temperature on the strength and durability of high-performance concrete (HPC) systems. Two series of concrete mixtures were evaluated. Series I were selected from the existing mixtures presently used in a typical construction. The first concrete mixture of Series I (Mix 12.5P) was proportioned to produce an average compressive strength of 12,500 psi at the age of 28 days. It contained 20% Class C fly ash and 5% silica fume by the weight of total cementitious materials. The second mixture of Series I (Mix 15P) was proportioned to attain an average compressive strength of 15,000 at the age of 28 days. It contained 14% silica fume and 9% Class C fly ash. Series II concrete mixtures were economically optimized mixtures based on previous investigations conducted at the UWM Center for By-Products Utilization. The first concrete mixture of Series II (Mix 12.5E) contained a blend of 30% Class C and 20% Class F fly ash (percentages on the basis of total cementitious materials). The second mixture of Series II (Mix 15E) contained a blend of 25% Class C fly ash, 17% Class F fly ash, and 6% silica fume. Series II concrete mixtures produced an equivalent compressive strength and durability as Series 1.

Two types of curing, the standard moisture curing and the Variable Temperature Curing Environment (VTCE), were used for all concrete test specimens. The VTCE was designed to simulate the temperature variation that occurs in summer in many parts in USA. Concrete specimens were subjected to the temperature of 75 +/- 5 deg. F for 12 hours each day, and 110 +/- 5 deg. F for the remaining 12 hours each day. They were protected from losing moisture during the curing.

For each mixture, the compressive strength, resistance to chloride penetration, air and water permeability, resistance to sulfate attack, and alkali-silica reaction were evaluated. Test results indicate that the concrete specimens subjected to VTCE curing had slightly higher strength than those subjected to standard curing up to the 28-day age. At the ages of 182-day and beyond a strength reduction was observed for all concrete mixtures cured in VTCE. All HPC mixtures with the designation "E" were considerably less costly due the use of blended fly ash and reduced amount of silica fume.