

# **DEVELOPMENT OF LOW-COST CONCRETE UTILIZING FOUNDRY INDUSTRY BY-PRODUCTS**

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## **ABSTRACT**

This Final Report (October 15, 1996 to October 15, 1997) deals with the activities related to the manufacture and testing of concrete containing used foundry sand. A total of eleven ready-mixed concrete mixtures, consisting of four non-air entrained, and seven air entrained, were manufactured. Each mixture was batched and mixed at the facilities of the Advance Cast Stone Company, Random Lake, Wisconsin. The Advance Cast Stone Company manufactures precast architectural and structural concrete elements. Mixtures were manufactured in a conventional manner in a one cubic yard capacity mixer used by the Advance Cast Stone Company for their daily concrete production. Fresh concrete tests were performed and many test specimens were cast.

One non-air entrained mixture without used foundry sand was manufactured as a Control mixture. Three non-air entrained concrete mixtures were proportioned to have foundry sand concentrations of 15%, 20%, and 45% as a replacement of concrete sand from the Control mixture. Since the Control mixture contained 20% fly ash, mixtures with used foundry sand were proportioned to have an additional 10 to 15% fly ash content. These mixtures were proportioned to maintain a slump in the range of approximately 4 to 8 inches.

Two air entrained reference mixtures were proportioned without foundry sand. Additional air entrained mixtures were proportioned to contain used foundry sand at concrete sand replacement levels of 14%, 20%, and 45%; and, fly ash content levels of 34%, 37%, and 40% of total cementitious materials.

For all non-air entrained concrete mixtures, test specimens were evaluated for compressive strength, abrasion resistance, and chloride-ion penetration as a function of age. For air entrained concrete mixtures, test specimens were evaluated for compressive strength, salt scaling resistance, freezing and thawing resistance, abrasion resistance, and chloride-ion penetration resistance as a function of age.

In general, as expected, the very early-age strength properties such as compressive strength, decreased with increasing foundry sand and fly ash concentration. At later ages, the rate of strength development of fly ash concrete mixtures increased due to the pozzolanic contribution at fly ash. This will also help increase durability and decrease the difference between the reference mixtures and the foundry sand mixtures substantially as the age increases.

The non-air entrained concrete mixtures attained compressive strength in the range of 3,500 - 6,000 psi at the age of 28 days. The air entrained reference concrete mixture attained strength of approximately 5,000 psi at the 28-day age. The results obtained indicate that the air entrained mixtures with and without foundry sand are appropriate for

applications in normal construction work in Wisconsin. Durability properties (abrasion, chloride permeability, resistance to freezing and thawing) of all non-air entrained and air entrained mixtures were all very good.