

PERFORMANCE OF HIGH-STRENGTH CONCRETE INCORPORATING MINERAL ADMIXTURES

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ABSTRACT

This research was undertaken to investigate performance of high-strength concrete incorporating mineral admixtures, fly ash and silica fume. For modern construction, the use of new construction materials is increasing to achieve economy and improved final results. An extensive literature search was carried out to review various engineering properties of high-strength concrete.

In this study, three different mix proportions for high-strength concretes were developed. One mix was proportioned with fly ash consisting of one third of total cementitious materials, and was designed to achieve 10,000 psi (70 MPa) compressive strength at 28 days. The other two mixes included both fly ash and silica fume to obtain 11,000 psi (77 MPa) and 12,000 psi (85 MPa) compressive strength at 28 days. All mixes were produced at a ready mixed concrete plant. Various tests, to determine physical properties of as delivered concrete, such as slump, density, air-content, etc. were carried out. Twenty-seven 6 x 12 in. (150 mm x 300 mm) cylinders were cast for each mix for measuring modulus of elasticity and compressive strength of concrete at various ages. Additional twenty-seven 6 x 12 in. (150 mm x 300 mm) cylinders were also cast for measuring splitting tensile strength for each mix at various ages. Furthermore, forty-six 4 x 8 in. (100 mm x 200 mm) cylinders were cast and tested for compressive strength for each mix for various ages up to one year. Testing work is still in progress to obtain long-term strength properties. Standard 6 x 12 in. (150 mm x 300 mm) cylinder tests data are compared with 4 x 8 in. (100 mm x 200 mm) cylinders; and all cylinder test results are also compared with 4 x 8 in. (100 mm x 200 mm) cores obtained from companion concrete structural members. All tests were conducted in accordance with appropriate ASTM standards. Core test specimens obtained from beams made with the three mixes were also tested for chloride permeability using the AASHTO T-227 test method. Test results revealed that high-strength concrete can be made using high volumes of Class C fly ash to obtain strength levels in the range of 14,000 psi (100 MPa) at 1 year age and beyond. Reinforcement corrosion potential data are also planned for up to five years of this study. All of the available data is analyzed and graphs are plotted to derive useful conclusions and recommendations for testing and use of high-strength concrete with and without fly ash and silica fume.