AN ABSTRACT OF A THESIS

ABRASION, CHLORIDE ION PENETRATION, AND SULFATE RESISTANCE OF SELF-CONSOLIDATING CONCRETE

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The research investigation presented herein was intended to study the resistance to: wear, chloride ion penetration, and external sulfate attack of self-consolidating concrete. The matrix proportions consist of three water-to-cementitious materials ratios and four cementitious materials contents. The effect of three water-to-cementitious materials ratios and cementitious materials contents were ascertained. Raw materials were evaluated for their physico-chemical characteristics. The trial matrices were examined for fresh properties (Slump Flow, Air Content, U-Box, and V-Funnel) and bulk characteristics (Demolded Unit-Weight and Compressive Strength). The resistance to wear was measured using ASTM C 779, Procedure C, Ball Bearings. Depth of wear and rate of deterioration as functions of matrix proportions and testing age (up to 20 minutes) were determined. Rapid chloride ion permeability was measured using ASTM C 1202-91 procedure. ASTM C 1012-89 test method is used for measuring resistance to external sulfate attack. The effects of cementitious materials content and water-to-cementitious materials ratio on the ability of self-consolidating concrete to resist abrasion, chloride ion penetration, and external sulfate attack were determined. The relationships among the abrasion resistance, chloride ion penetration, and resistance to external sulfate attack and matrix proportions (cementitious materials content and water-to-cementitous materials ratio) were investigated. Predictive equations to correlate depth of wear, chloride ion penetration, and sulfate induced expansion with bulk characteristics of self-consolidating concrete were developed.

Test results concluded that the selected self-consolidating concretes improve in abrasion and sulfate resistance and compressive strength with increases in cementitious materials content and decreases in water-to-cementitious materials ratio. On the other hand, increases in cementitious materials content and water-to-cementitious materials ratio reduced the ability of selected self-consolidating concrete to resist chloride ion penetration. While a significant statistical correlation between abrasion and sulfate resistance (dependent variable) and compressive strength (independent variable) exist, no correlation was found between resistance to chloride ion penetration and compressive strength.