

Experimental Study on Strength Development of Low Cement Concrete Using Mix Design for Both Binary and Ternary Mixes

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Abstract : Due to the design versatility, availability, and cost efficiency, concrete is continuing to be the most used construction material on earth. However, the production of Portland cement, the primary component of concrete mix is causing to have a serious effect on environmental and economic impacts. This shows there is a need to study using of supplementary cementitious materials (SCMs). The most commonly used supplementary cementitious materials are wastes and the use of these industrial waste products has technical, economical and environmental benefits besides the reduction of CO₂ emission from cement production. The study aims to document the effect on strength property of concrete due to use of low cement by maximizing supplementary cementitious materials like fly ash or marble powder. Based on the different mix proportion of pozzolana and marble powder a range of mix design was formulated. The first part of the project is to study the strength of low cement concrete using fly ash replacement experimentally. The test results showed that using up to 85 kg/m³ of cement is possible for plain concrete works like hollow block concrete to achieve 9.8 Mpa and the experimental results indicates that strength is a function of w/b. In the second part a new set of mix design has been carried out with fly ash and marble powder to study the strength of both binary and ternary mixes. In this experimental study, three groups of mix design (c+FA, c+FA+m and c+m), four sets of mixes for each group were taken up. Experimental results show that c+FA has maintained the best strength and impermeability whereas c+m obtained less compressive strength, poorer permeability and split tensile strength. c+FA shows a big difference in gaining of compressive strength from 7 days to 28 days compression strength compared to others and this obviously shows the slow rate of hydration of fly ash concrete. As the w/b ratio increases the strength decreases significantly. At the same time higher permeability has been seen in the specimens which were tested for three hours than one hour.

Keywords : efficiency factor, cement content, compressive strength, mix proportion, w/c ratio, water permeability, SCMs

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