

Accessing Properties of Alkali Activated Ground Granulated Blast Furnace Slag Based Self Compacting Geopolymer Concrete Incorporating Nano Silica

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Abstract : In a world with increased demand for sustainable construction, waste product of one industry could be a boon to the other in reducing the carbon footprint. Usage of industrial waste such as fly ash and ground granulated blast furnace slag have become the epicenter of curbing the use of cement, one of the major contributors of greenhouse gases. In this paper, empirical studies have been done to develop alkali activated self-compacting geopolymer concrete (GPC) using ground granulated blast furnace slag (GGBS), incorporated with 2% nano-silica by weight, through evaluation of its fresh and hardening properties. Experimental investigation on 6 mix designs of varying molarity of 10M, 12M and 16M of the alkaline solution and a binder content of 450 kg/m³ and 500 kg/m³ has been done and juxtaposed with GPC mix design composed of 16M alkaline solution concentration and 500 kg/m³ binder content without nano-silica. The sodium silicate to sodium hydroxide ratio (SS/SH), alkaline activator liquid to binder ratio (AAL/B) and water to binder ratio (W/B), which significantly affect the performance and mechanical properties of GPC, were fixed at 2.5, 0.45 and 0.4 respectively. To catalyze the early stage geopolymerisation, oven curing is done maintaining the temperature at 60°C. This paper also elucidates the test results for fresh self-compacting concrete (SCC) done as per EFNARC guidelines. The mechanical properties tests conducted were: compressive strength test after 7 days, 28 days, 56 days and 90 days; flexure test; split tensile strength test after 28 days, 56 days and 90 days; X-ray diffraction test to analyze the mechanical performance and sorptivity test for testing of permeability. The study revealed that the sample of 16M concentration of alkaline solution with 500 Kg/m³ binder content containing 2% nano silica produced the highest compressive, flexural and split tensile strength of 81.33 MPa, 7.875 MPa, and 6.398 MPa respectively, at the end of 90 days.

Keywords : alkaline activator liquid, geopolymer concrete, ground granulated blast furnace slag, nano silica, self compacting

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