ABSTRACT

Geopolymer concrete (GPC) is one of the most recently developed structural concretes, where industrial wastes like flyash, rice husk, ground granulated blast furnace slag (GGBS) are utilized for total replacement of ordinary portland cement in concrete. A major contribution to structural concrete in the form of Geopolymer concrete was developed by many investigators with lesser grade of concrete. In the present investigation high strength geopolymer concrete of M60 grade has been developed, using mineral admixtures like flyash and GGBS with polymerization chemicals without using any type of cement.

Many parameters are involved in the production of GPC, out of which alkaline liquid mineral admixtures ratio and superplasticiser are important. Sulphonated Napthalene based dispersing agents are adopted as super plasticizers to obtain better mechanical properties of GPC. Low calcium flyash gives better results from the point of view of chemical composition. GGBS is used to fill the voids between flyash and fine aggregate and this helps in the degree of particle aggregation, nature and quantity of impurities and basic particle size. Sodium hydroxide and sodium silicate solutions used as alkaline liquids react with flyash and GGBS to form the geopolymer gel binding the aggregates to produce GPC. The final product was cured in steam curing chamber at 60°C for 24 hours.
The durability of concrete structures is one of the major interests of the construction industry and there is a necessity of producing durable concrete. A concrete structure is considered to be durable, if it performs in accordance with its intended level of functionality and serviceability over an expected lifecycle. Durable concrete must have the ability to withstand the potentially deteriorative conditions to which it is exposed. Concrete deterioration can be due to adverse mechanical, physical, or chemical causes. It is often the case, where one or more deteriorative mechanisms are at work by the time a problem is identified. Durability of concrete is an important aspect for the structure to have a long life. The durability tests included in this study are acid test, sulphate resistance test, chloride resistance test, corrosion test, and fire resistance. The durability of GPC is compared with traditionally vibrated concrete (TVC) when subjected to the above tests.

The behavior of GPC is quite similar to that of the TVC with respect to properties such as compressive strength, shrinkage, and creep. In the present study, the flexural behavior of high strength GPC beams were investigated and compared with high strength TVC beams. The main variable was reinforcement ratio, the size of the beams was kept constant. Six beams of GPC and six of TVC beams were tested. The load-deflection behavior, ultimate load and the crack widths were recorded. The analytical work consists of evaluating the cracking load, ultimate load, deflections at service load using different codes and expressions
proposed by earlier researchers. Finally, the ductility analysis has been carried out using elastic cracked-section theory and empirical relations for beams.

An attempt has been made to cast six high strength GPC and TVC beams of size 125×250×2000 mm and tested under shear. The grade of concrete used was M60 and the beams were divided into two series according to the longitudinal tensile reinforcement ratio and three transverse reinforcement ratios were obtained by varying the stirrup spacing. The cracking load, ultimate load and mid span deflections and crack widths were measured for the specimens. The available codal provisions for their validation with respect to shear strength, deflection, and cracking were studied. The analytical work consisted of calculation of shear force using different codal provisions, using Bentz software and researcher’s equation. The computations of the ultimate shear force show that the codal provisions applicable for TVC predicts lesser ultimate shear forces than experimental values.

An attempt has been made to cast and test (under short term distributed loading) sixteen high strength one way slabs with fully and partially restrained supports, out of which eight were made up of GPC and other eight were TVC. In these slabs, the reinforcement percentages were varied. The thicknesses of the slab were adopted as 50 mm and 65 mm respectively. The slabs had overall dimensions of 1080 × 500 mm. The reinforcement adopted was 5mm in both the directions. Partially
restrained slabs were supported at the ends by edge beams of different sizes. The cracking load, ultimate load and mid span deflections and crack widths were measured for the specimens. The analytical work consists of evaluating the cracking load, ultimate load, deflections at service load using different codes and expressions proposed by researchers.

The present investigation aims at providing a method for predicting the load deflection behavior (under short term uniformly distributed loading) of laterally restrained and partially restrained one-way slab strips. The proposed method has been applied to study the load deflection behavior of slab strips made of TVC and GPC. The load deflection behavior obtained by the proposed method has been compared with the experimental data and also the results predicted by the analytical methods given by Rankin et al., Robert’s and Eyre & Kemp. Rankin et al., and Eyre & Kemp was used for fully restrained slabs and all the three for partially restrained slabs. It is found that the proposed analytical method gives satisfactory results in comparison with experimental data.

Based on the above experiments GPC can be considered as a very good environmental friendly concrete saving precious energy and making use of waste materials.