EXPERIMENTAL INVESTIGATION OF MECHANICAL PROPERTIES OF FLY ASH BASED GEO-POLYMER CONCRETE USED AS PAVER BLOCKS

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Abstract

The main objective of the present study is to find out a suitable, effective and alternative material for partial replacement of cement and fine aggregate, to find out possible utilization of waste materials in construction industry that in turn considerably minimize the usage of cement and coarse aggregate and ultimately reduce construction cost, to explore possibilities of improving mechanical properties of concrete using copper slag & pond ash instead of fine aggregate partially, to evaluate the effect of using fly ash and GGBS in concrete and to investigate the strength of replaced concrete with that of conventional concrete. This project is mainly undertaken to study the behavior and performance of concrete using waste materials such as fly ash and GGBS. This type of use of a waste material can solve problems of lack of aggregate in various construction sites and reduce environmental problems related to sand mining and waste disposal. The use of fly ash and GGBS can also reduce the cost of the concrete production and increase the workability.

Keywords Cement Concrete, flexural strength, fly ash and GGBS, Strength parameters, water absorption, Workability.

1 Introduction

Geopolymer concrete is an innovative and eco-friendly construction material and an alternative to Portland cement concrete. Use of geopolymer reduces the demand of Portland cement which is responsible for high CO emission.

Geopolymer was the name given by Daidovits in 1978 to materials which are characterized by chains or networks or inorganic molecules. Geopolymer cement concrete is made from utilization of waste materials such as fly ash and ground granulated blast furnace slag (GGBS). Fly ash is the waste product generated from thermal power plant and ground granulate blast furnace slag is generated as waste material in steel plant. Both fly ash and GGBS are processed by appropriate technology and used for concrete works in the form of geopolymer concrete. The use of this concrete helps to reduce the stock of wastes and also reduces carbon emission by reducing Portland demand. The main constituent of geopolymers source of silicon and aluminum which are provided by thermally activated natural materials (e.g. kaolinite) or industrial byproducts (e.g. fly ash or slab) and an alkaline activating solution which polymerizes these materials into molecular chain networks to create hardened binder. It is also called as alkali-activated cement or inorganic polymer cement.

2 Objectives

Following are the objectives of this work

- To Design a mix for M 30 grade of concrete with optimum proportion of alkali accelerators and fly ash to make geopolymer concrete as per the is code 10262:2019.
- To evaluate strength parameters like compressive strength and flexural strength of paver blocks with geopolymer concrete.
- To compare the above parameters for paver blocks prepared having different concrete mixes.
- To find out water absorption and abrasion values of paver blocks with geopolymer concrete.

3 Methodology Adopted

In this work, the mix design and testing method is used to perform Utilisation of Fly ash Based Geo-polymer Concrete as per IS-standards. In order to study the effect of fly ash as a partial replacement.

Table 1: Cases considered for study

		Total Binder = C+FA		Using GGBS as Sand Replacement	
S.No.	**Sample ID**	**Cement %**	**Fly Ash %**	**Sand %**	**GGBS %**
1	CONC 0	30	70	100	0
2	SR 10	30	70	90	10
3	SR 20	30	70	80	20
4	SR 30	30	70	70	30
5	SR 40	30	70	60	40
6	SR 50	30	70	50	50

According to IS 15658: 2006, compressive strength of paver block was resolved at 7 , 28 and multi day utilizing Compression testing machine (CTM). Least 3 examples were tried for 7 and multi day strength. The normal strength of 3 examples at 28 days were taken as compressive strength of paver block. The clear compressive strength of paver block was increased with adjustment factor as it is referenced in IS 15658: 2006 of table 5 Annex D to get amended compressive strength of paver block.

5 Conclusion

The GPC, in general, has exhibited relatively higher compressive strength at specific amount of alkali accelerator than control concrete. The GPC has shown significantly higher compressive strength than the control concrete at all ages.

The GPC, offers sufficet amout of flexural & tensile strength as required for paver blocks.

Trials confirm that higher curing temperature is required for higher compressive strength, for both 6 hours and 24 hours of curing.

The abrasive resistance of the specimen decreases for geopolymer concrete of FA.

The optimum level for the replacement (by weight) of RHA for light traffic condition i.e. M35 grade, I - shaped paver blocks made with hydraulic press/mechanical hydraulic machine is found to be 20%.

FA based geopolymer concrete paver blocks are an economic environmental friendly solution to developing nations like India. The price of 1 ton of FA is only a small fraction of one ton production of Portland cement. Higher performance life has been achieved through this replacement and lower capital cost compared to the conventional concrete paver blocks. Due to replacement of specific industry waste material.

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