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EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOR OF GEOPOLYMER RCC BEAMS USING BOTTOM ASH

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ABSTRACT
Bottom ash is formed in coal furnaces. It is made from agglomerated ash particles that too large to be carried in the flue gases and fall through open grates to an ash hopper at the bottom of the furnace. Bottom ash is mainly comprised of fused coarser particles. These particles are quite porous and look like volcanic lava. Bottom ash forms up to 25% of the total ash while the fly ash is remaining 75%. The present work deals with flexural behavior of bottom ash geopolymer reinforced concrete beam. A total of six beams were cast, in which three beams were control reinforced concrete beams and thee beams were bottom ash geopolymer reinforced concrete beam. bottom ash geopolymer reinforced concrete beamwas cured at ambient temperature. The load carrying capacity, load deflection behavior and initial stiffness capacity of beams were arrived and compared with control reinforced cement concrete (RCC) specimens
Keywords—Bottom Ash, Geopolymer, RCC, Fly Ash

1. Introduction

Various industries produce numerous solid waste materials. The disposal of these solid waste materials is an environment hazard for the surrounding living beings. It is observed that because of increasing environmental concerns and sustainable issues, the utilization of solid waste materials is the need of the hour. The productive use of solid waste materials is the best way to alleviate the problems associated with their disposal.

The construction industry has enormous potential for the use of solid waste materials as construction material. Based upon their properties, the solid waste materials can either be used as supplementary cementitious materials or as replacement of fine/coarse aggregate in concrete or mortars. Based on the research reports some solid waste materials such as fly ash, silica fume, grounded blast furnace slag etc have been put in use in manufacturing of either cement or concrete. In India, about 67% of electricity requirements are fulfilled by the coal fired thermal power plants.

Electricity demand in the country is increasing every year. At present, the country is facing average energy shortage of 6.7% at national level but the southern part of the country experience 26.7% energy shortage. To fill up the exiting gap between demand and supply of power and to meet the increasing energy requirements, coal fired thermal power plants are being set up in large number in the country. Coal fired thermal power plants produce large volumes of coal bottom ash. Till now, it is treated as solid waste material and is disposed off on open land.

2. Experimental Methods or Methodology

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.

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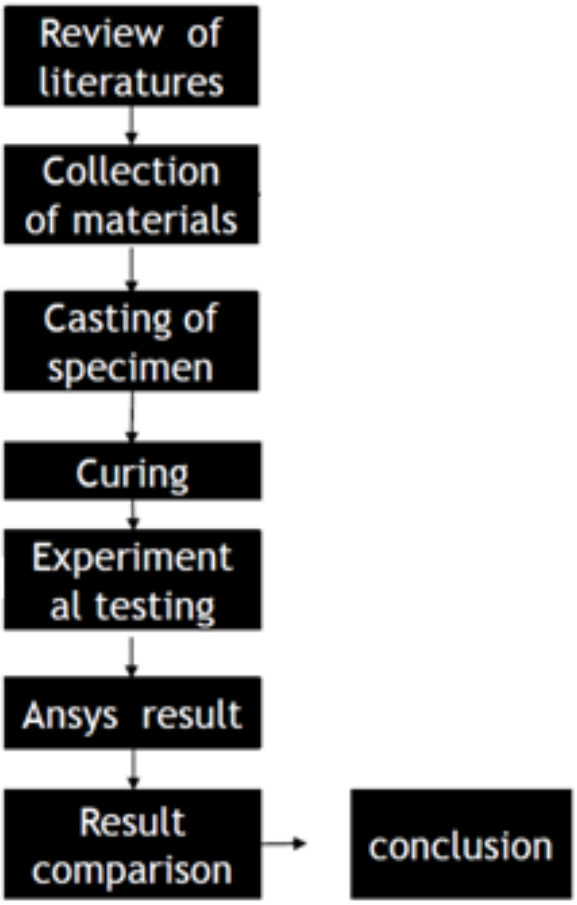

Fig 1 Methodology For The Experimental Study of Bottom Ash

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 cement 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 chains and networks to create hardened binder. It is also called as alkali-activated cement or inorganic polymer cement.

3. Results and Discussion

3.1 Introduction

Numerical simulation and experimental investigation analysis is carried out considering different concrete property on the beam to determine its structural performance.

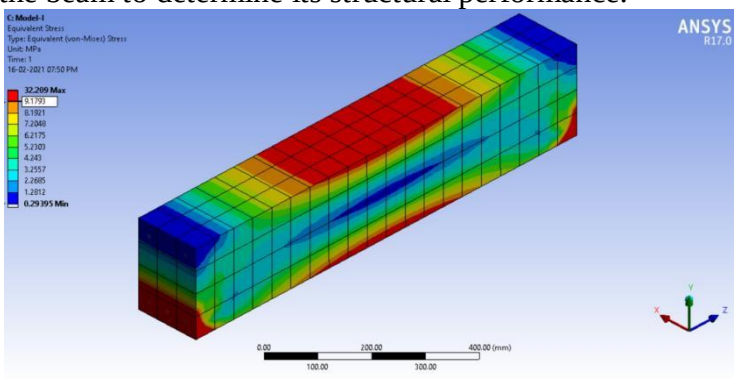

Fig. 2. Stress Contour

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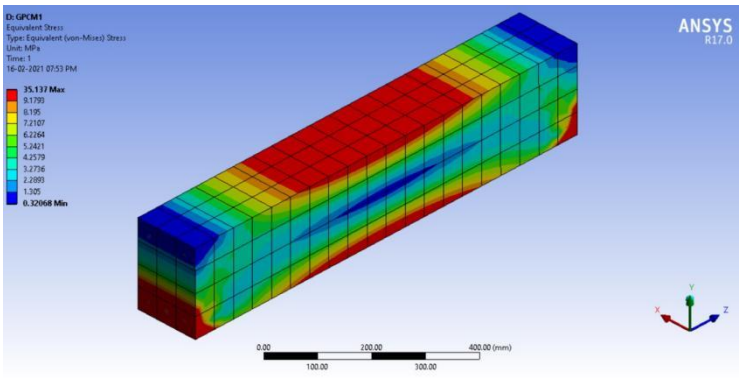

Fig. 3. Stress Contour

3.2 Numerical Results

Table.4. Numerical Result on Ansys

The parameters which are to be found such as Deflection, Maximum Equivalent stresses (Von-Misses stress) and Maximum Strain can be obtained upon selection. example, the stress contour of conventional and geo polymer concrete with bottom ash RC beam are shown in Figs shows the

SI. No	Specimen Designation	Ultimate Load (KN)	Deflection (mm)
1	RCM1	88	3.2
2	GPCM1	96	4.1
3	RCM2	106	5.4
4	GPCM2	115	6.1

load–deflection values obtained using Ansys results.

3.3 Bulk density and Workability

To measure the density of cubes first external surface of the cube is cleaned and wiped with the help of any cotton cloth. Fig. 5 shows the apparent density of the GGBS concrete mixture. The bulk density of the freshly mixed concrete mixture decreases as the percentage of GGBS increases. For GG1, GG2, GG3 and GG4 decrements are 0.17%, 0.38%, 0.43% and 0.57%.

Because the specific gravity of GGBS is 2.69, which is lower than that of cement, the decrease in the bulk density of fresh materials could be due to this. In Table 5, the percentage of superplasticizers used in concrete mixtures has been rigorously tested so that the compaction coefficient is zero.

3.4 Compressive strength

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Out of many tests applied to the concrete, this is the most important test which gives an idea about all the characteristics of concrete. By this single test one can judge that concrete is has done properly or not. For cube tests 2types of specimens are either 15cm*15cm*15cm or 10cm*10cm*10cm depending on the size of aggregate are used. For most of the works cubical moulds of size 15cm*15cm*15cm are commonly used.

The concrete is poured in the mould and tamed properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put into water for curing. The upper of mould is rough hence can be deceptive while showing results. Hence, the surface is made smooth with cement paste on specimen.

These specimens are tests by compression testing machine after 7days or 28 days of curing. Load should be applied gradually at a rate of 14kg/cm² per minute till the specimen fails. Load at failure divided by area of specimen gives the compressive strength of concrete.

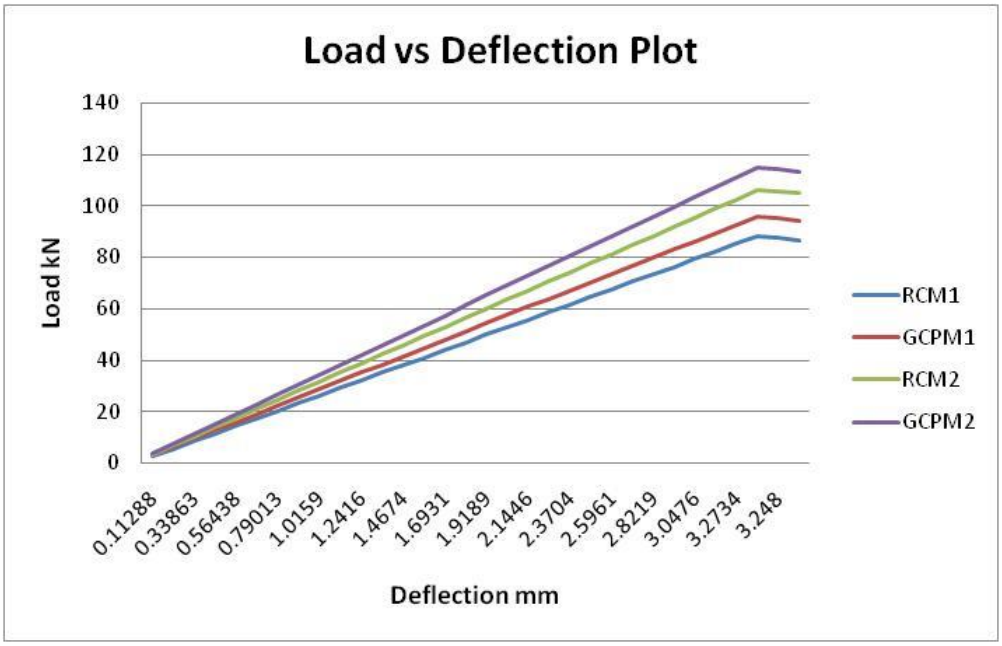

Fig. 5. Load vs Deflection Plot

Fig. 6. Compressive strength

CONCLUSION

The geopolymer reinforced concrete with bottom ash beam has much greater advantageous than the normal reinforced concrete beam. In this project, various literatures were collected to get an idea about the geopolymer concrete. Numerical and experimental analysis of various concrete property beams was done and its results are obtained.

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The beams were analyzed using 2-point load test and a flexural crack has been observed. From the study it shows that use of geopolymer concrete with bottom ash showed an improvement in both the ways and also increases the flexural capacity of the beam and it helps to increase stiffness under service loads. It also helps to reduce the deflection in both ways.

From the results the deflection values of beams are approximately near to the experimental values.

It is clearly seen that the load carrying capacity of geo polymer concrete with bottom ash increased with the increase of reinforcement with bottom ash.

Load carrying capacity of GPCM2 was 9 % higher than that of RCM2 & GPCM1 was 9.1 % higher than RCM1.

GPCM2 has the higher load carrying than GPCM1 due to the additional of reinforcement.

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