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# STRENGTH OF GGBS AND FLYASH BASED GEOPOLYMER CONCRETE USING GEOACTIVATOR

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***Abstract*— Geopolymer concrete is a new type of concrete which is a new development in the world of concrete in which cement is totally replaced by GGBS, Flyash and Geo activator solution is to act as binder in the concrete mix.An attempt was made to achieve desire strength and durability In source of material 100%GGBS, 75%GGBS & 25%Flyash, 50%GGBS & 50%Flyash With different activator to binding materials ratio i.e, for the 1:1.3:3.1 mix proportions. The test specimens where 100×100×100mm cubes ,100mm×200mm cylinders prepared and ambient temperature curing conditions. The Geopolymer concrete specimens are tested for their compressive strength at the age of 28 days. The Geopolymer concrete mix formulations vth compressive strength ranging from 30-72Mpa have been developed. The test result indicates that the combination of Flyash & GGBS can be used for development of Geopolymer concrete.***

***Keywords— Flyash, GGBS, Geo-activator, Durability, Strength.***

## I. INTRODUCTION

To produce environmental friendly concrete, we have to replace the cement with some other binders which should not create any bad effect on environment. The use of industrial by products as binders can reduce the problem. In this respect, the new technology geo-polymer concrete is a promising technique. In terms of reducing the global warming, the geo-polymer technology could reduce the $CO_2$ emission to the atmosphere caused by cement and aggregates industries by about 80% (Davidovits, 1994c). And also the proper usage of industrial wastes can reduce the problem of disposing the waste products into the atmosphere. Our aim is to have an alternative binder instead of Cement in Concrete. The reason is during the production of cement, higher amounts of Carbon dioxide is released into atmosphere and causes global warming. In this respect Geopolymer concrete is produced by replacing cement with Geopolymer binders which consists of Flyash and ground granulated blast furnace slag (GGBS) is replaced with cement because it is most economical than cement.

## II.PROPERTIES OF MATERIALS

***2.1 Fine Aggregate*:** It has following properties**.**

**Table 2.1.1physical Properties of fine aggregate**

| **Property** | **Fine aggregate** | **Test method** |
|---|---|---|
| Specific gravity | 2.64 | IS 2386 (PartIII) 1963 |
| Sieve Analysis | Zone II | IS 383-1970 |

***2.2 Coarse Aggregate*:** Coarse aggregates of sizes 10mm and 12.5mm having following properties taken from a local supplier are used in the present study

**Table2.2 .1Properties of Coarse Aggregate**

| **Property** | **Coarse aggregate** |
|---|---|
| Specific gravity | 2.74 |
| Crushing value | 20.23% |

***2.3 Flyash:*** Flyash is taken from "GENCO" Ramgundam In Telangana.(Grade-F)

**Table 2.3.1 Chemical Composition of Flyash**

| **composition (%by mass)** | **flyash** |
|---|---|
| Sio2 | 58.2 |
| Al2O3 | 39.02 |
| CaO | 0.9 |
| MgO | 0.28 |
| Na2O3&K2O | 0.87 |

**Table :2.3.2 Properties of Flyash**

| **Property** | **Flyash** |
|---|---|
| Specific gravity | 2.36 |
| Fineness | 2.83 |

**2.4 *Ground granulated blast furnace slag (GGBS)*:** It is taken from "JSW HYDERABAD" in Telangana.

**Table : 2.4.1 Chemical composition of GGBS.**

| composition(%by mass) | GGBS |
|---|---|
| $SiO_2$ | 32.45 |
| $Al_2O_3$ | 14.46 |
| $Fe_2O_3$ | 0.31 |
| CaO | 40.74 |
| MgO | 6.99 |
| $K_2O$ | 0.29 |
| $Na_2O$ | 0.16 |

**Table:2.4.2Properties of GGBS**

| Property | GGBS |
|---|---|
| **Specific gravity** | 2.71 |
| **Fineness** | 8.33% |

***2.5 Geoactivator*:** Geoactivater collected from kiran global solutions Chennai the properties of geoactivator as follows

**Table:2.5.1 Properties Of Geoactivator**

| **Property** | **GGBS** |
|---|---|
| **Density** | **1400 kg/m$^3$** |
| **pH** | **10.5** |

## III.METHODOLOGY

### *3.1 Mix Proportions:*

There is no design mix proportion for geopolymer concrete, assumed trial mix proportion 1:1.3:3.1 is considered with different activator to binding material ratios i.e, 0.55,0.5,0.45,0.40,0.35,0.30 and different percentages of flyash and GGBS

- 100%GGBS
- 75%GGBS AND 25% FLYASH
- 50%GGBS AND 50%FLYASH

The cubes are taken of size 100mm x100mm x100mm and cylinders are taken of size 100mm x 200mm.

### *3.2 Casting Of Geo-Polymer Concrete*

The conventional method used in the making of normal concrete is adopted to prepare geo-polymer concrete. First, the Fine aggregate, coarse aggregate, Flyash and ground granuated blast furnace slag (GGBS) are mixed in dry condition for 3-4 minutes and then the Geo-activator is added to the dry mix. The mixing is done about 6-8 minutes for proper bonding of all the materials. After the mixing, the cubes are casted by giving proper compaction. The sizes of the cubes used are of size 100mm x100mm x100mm.

Fine aggregates, coarse aggregates ,flyash and GGBS are mixed in dry

Adding geoactivator to dry mix. Mixing is done

Cubes are casted by compaction in three layers .

### *3.4 Slump Flow Test*

The concrete slump test is an empirical test that measures the workability of fresh concrete. More specifically, it measures the consistency of the concrete is that specific batch. This test is performed to check the consistency of freshly made concrete.

## IV.RESULTS AND DISCUSSIONS

### *4.1 Compressive Strength*

Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. Cubes of 100mm×100mm×100mm were casted and compressive strength test was conducted on specimens at 28 days. To conduct the test the specimens are placed in a compression testing machine and the load is applied to the cube and the load at failure is noted as failure load. The compressive strength is calculated by using the formula.

$F_{ck}=P_C/A$

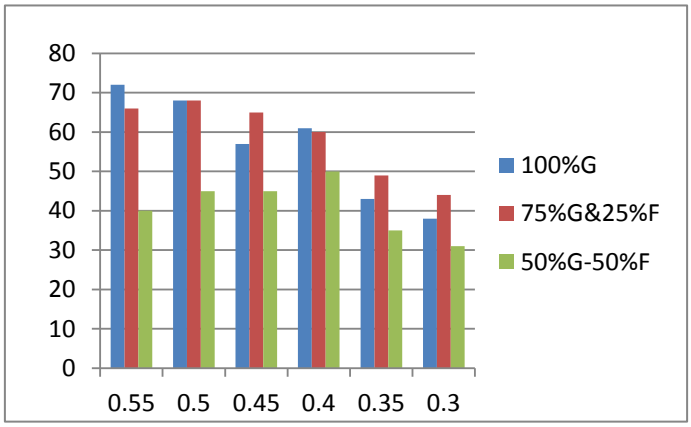
Where, $P_C$=load at failure in N

A= Loaded area in $mm^2$

Fig 4.1-load acting on cube

Compressive strength test, mechanical test measuring the maximum amount of compressive load a material can bear before fracturing.

- The test piece used , usually in the form of cube and cylinder is compressed between the platens of compression testing machine by gradually applied load.
- Compressive strength for the mix proportion 1:1.3:3.1 with different activator to binding material ratios i.e, 0.55,0.5,0.45,0.4,0.35,0.3 and by adding GGBS and flyash with different percentages.
- 100%GGBS
- 75%GGBS AND 25%FLYASH
- 50%GGBS AND 50%FLYASH




Graph 4.1-Activator/Binder ratio VS Compressive strength

***4.2 Split tensile strength***

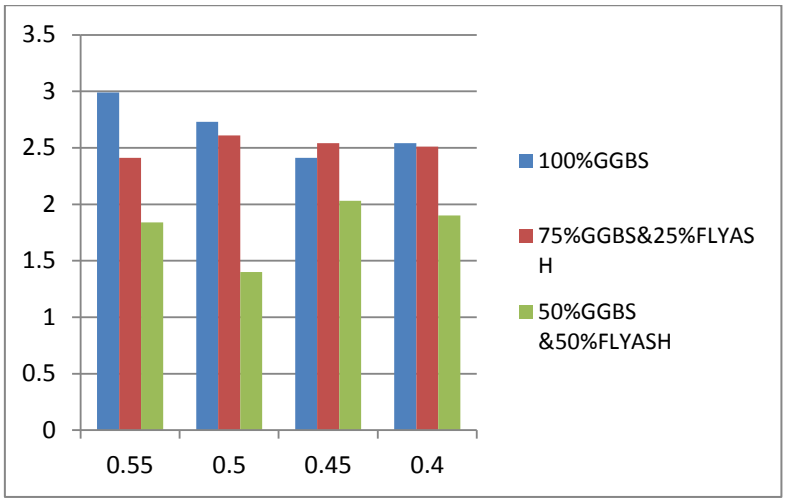
The test is carried out by placing a cylindrical specimen horizontally between the loading surface of a compression resting machine and the load is applied until failure of the cylinder, along the vertical diameter. When the load is applied along the generatix, an element on the vertical diameter of the cylinder is subjected to a vertical compressive stress and a horizontal stress of 2P/IILD. It is observed that cylinder did split into two halves silt tensile strength=2P/IILD

Where P is the maximum compressive load in the cylinder

L is the length of cylinder

D is its diameter

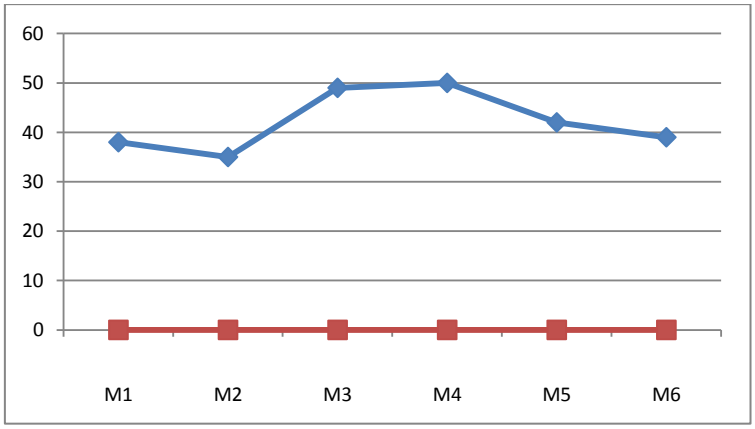
The load conditions produce a high compressive stress immediately below the two generators to which the load is applied. But the large portion corresponding to depth is subjected to a uniform tensile stress acting horizontally. In order to reduce the magnitude of the high compression stress near the point of application of the load, narrow packing strips of suitable material such as plywood are placed between the specimen and the loading platens of testing machine. The packing strips should be soft enough to allow distribution of the load over a reasonable area, yet narrow and thin enough to prevent large contact area. The details are tabulated in tables




Graph 4.2-Activator/Binder ratio VS Split Tensile strength

***4.3 Compressive Strength For Different Mix Proportions By Adding 50%Ggbs And 50% Flyash***

- From above results the maximum strength obtained at activator to binding material ratio =0.5.
- The compressive strength for different mix proportions i.e, $M_1$,$M_2$,$M_3$,$M_4$,$M_5$,$M_6$ BY considering the activator to binding material ratio =0.5.




Graph 4.3-Different mix VS Compressive strength

**NOTE**: $M_1$=1:1.8:3.6, $M_2$=1:1.6:3.2 ,$M_3$=1:1.4:2.8
$M_4$=1:1.3:2.6,$M_5$=1:1.2:2.4&$M_6$=1:1.2

## V. CONCLUSIONS

The maximum compressive strength and tensile strength obtained for the mix propotion of 1:1.3:3.1 at activator to binding material ratios = 0.55,0.5,0.45. For 100%GGBS maximum strength obtained at A/Bm ratio = 0.55. Compressive strength = 72 N/mm$^2$. Tensile strength = 2.99 N/mm$^2$. For 75%GGBS and 25%flyash maximum strength obtained at A/Bm ratio = 0.5. Compressive strength = 68 N/mm$^2$.Tensile strength = 2.61 N/mm$^2$ For 50% GGBS And 50% Flyash maximum strength obtained at A/Bm ratio = 0.45. Compressive strength = 50 N/mm$^2$.Tensile strength = 2.03 N/mm$^2$. For different mix proportions $M_1$,$M_2$,$M_3$,$M_4$,$M_5$,$M_6$ and considering A/Bm ratio = 0.5. Maximum strength obtained for the $M_4$ (1:1.3:2.6) proportion 50 N/mm$^2$.

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