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A STUDY ON EFFECT OF GGBS AND FLYASH ADDITION TO BLENDED CEMENT CONCRETE

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ABSTRACT:-Need of the hour is to obtain a concrete that gives high strength and better performance characteristics. Research is being carried out on a large scale to achieve the same. Concrete as we all know is widely used in the construction industry, not only for its strength but also due to its demands of high strength, high performance and high durability at desirable cost. And also at the same time, the demand for reducing the usage of cement quantity is also essential. This, to a certain extent is being carried out using pozzolanic materials which are used as a partial replacement of cement. In recent years the word "Blended cements" has been introduced in the construction industry which is nothing but partial replacement of cement. These materials are used to increase the compressive strength of concrete and sometimes to prepare high performance concretes. Different materials like Ground Granulated Blast furnace Slag (GGBS), Silica fume, Rice husk ash, Fly ash and High Reactive Metakaolin, are some of the pozzolanic materials which can be used. One or more of these materials can be used in concrete as partial replacement of cement, which are essential ingredients to produce required strength and properties of concrete. In the present experimental investigation, high strength concretes such as M60 & M80 have been designed using triple blending techniques with ternary blend of condensed Ground Granulated Blast furnace Slag (GGBS) and Fly Ash, as partial replacement by weight of cement at various blended percentages ranging between 10% – 50%. The proportions of Fly ash are kept a constant at 10% and GGBS are added at 10%, 20%, 30%, 40% and 50% as total percentages. Trials will also be carried out with Fly Ash varying vi constantly for each trial from 10% to 30% and GGBS are added at 10%, 20%, 30%, 40% and 50%. This project aims at finding the high strength concrete using Ground Granulated Blast furnace Slag (GGBS) and Fly Ash. The workability is measured for its consistency using the slump cone test. Sufficient numbers of cubes will be casted. The cast specimens shall be tested for compression and flexural strengths at 7 & 28 days for M60 and M80. Comparative results will be recorded and tabulated.

I INTRODUCTION

Strength was emphasized without a thought on the durability of structures. As a consequence of the liberties taken, the durability of concrete and concrete structures is on a southward journey; a journey that seems to have gained momentum on its path to self–destruction. This is particularly true of concrete structures which were constructed since 1970 or thereabout by which time the following developments are came subsequently.

(a) The use of high strength rebars with surface deformations (HSD) started becoming common.

(b) Significant changes in the constituents and properties of cement were initiated.

(c) Engineers are started using supplementary cementitious materials (SCM) and admixtures in concrete, often without adequate consideration.

The setback in the health of newly constructed concrete structures prompted the most direct and unquestionable evidence of the last two/three decades on the service life performance of our constructions and the resulting challenge that confronts us is the alarming and unacceptable rate at which our infrastructure systems all over the world are suffering from deterioration when exposed to real environments.

High Strength Concrete

High strength concrete has been defined as a concrete which compressive strength is high compared to the regular grades of concrete. American Concrete Institute (ACI) defines a high-strength concrete as concrete that has a specified compressive strength for design of 6000psi(41MPa) or greater. Other countries also specify a maximum compressive strength, whereas the ACI definition is open-ended.

The strength of concrete primarily depends upon the cement paste and in more the strength of paste increases with the fineness of cement contents. Hence as the water cement (W/C) Ratio decreases the concrete gets higher Strength but concrete become unworkable.

Certain organic compounds are used in the concrete. Which having the pozzolanic properties some of cementitious materials like Fly ash, silica fume and ground granulated blast-furnace slag (GGBS), are used in different percentages for different grade of concrete. Designed with different percentage of Fly ash and ground granulated blast-furnace slag (GGBS) then it is observed in improving of flexural strength and also compressive strength of concrete, at the same time it is also observed that the cost of the concrete is reducing.The specification of high-strength concrete generally results in a true performance specification in which the performance is specified for the intended application, and the performance can be measured using a well-accepted standard test procedure. The same is not always true for a concrete whose primary requirement is durability.

II LITERATURE REVIEW

Gopalam m and haque m (1987) The Paper “effect of curing regime on the properties of fly ash concrete” published in the American concrete Institute journal reported on the effect of compressive strength and flexural strength of normal and fly ash concrete, cured in water and in uncontrolled environment. It was found that the curing conditions influenced the compressive strength significantly. The 91 days air cured concrete strength was less than the 7 days for cured concrete strength. Poor curing is concluded to be more detrimental to the compressive strength development of fly ash concrete as compared to normal concrete.

Nicholas J.Carolina And,R Clinofton (1991) in their paper "HPC Research needs to Enhance its Use" in concrete International , list out the exploitable attributes of HPC, which can be grouped into three general categories, Properties and enhanced durability properties, They are Adhesion to Hardened concrete, Abrasion Resistance, Corrosion Protection, Chemical Resistance, Durability Energy Absorption, early Strength, high Elastic module, high compressive Strength , high modulus of rupture, high tensile strength and high Strength/Density ratio, high workability and Cohesiveness, low permeability, resistance to wash out, Volume Stability.

HPC is likely to have slightly higher initial cost per unit volume than conventional concrete. However its use is likely to be justified by savings resulting from the following factors.

The enhanced workability of HPC or the high early age strength can reduce construction cost. The enhanced Mechanical properties can reduce the sizes of structural elements. The enhanced durability will increase the service life.

Michel Pigeon, Franceise Garnier, Richard Plea And Pierre-Claude Aitcin(1993) In their paper titled "Influence of drying on the chloride ion permeability of HPC" in concrete international observed that.

It is possible with the use of silica fume and water/cement ratio of 0.25 or less, to make High performance concrete that are extremely resistance to the internal damage that can result from drying, even at 110° c it is thus most probable that, under natural exposure conditions, the resistance to the penetration of chloride ions of these concrete's will not decreases significantly with time.

Z-Sweiz Etal (june1996) in their paper "the durability studies of concrete" as reported in magazine of concrete Research show a beneficial influence of addition of powered limestone on durability at lower water/cement ratios(W/C).

James R Millan Etal (April 1997) in their paper entitled "durability by Admixture" in concrete international has observed concrete with admixture tends reduce corrosion of steel due to significant permeability reduction cited on development in the application of high performance concrete. Over the last few years, the compressive strength of some of the concrete used has increased dramatically.

III MATERIALS AND METHODS

The concrete mix was designed as per of IS 10262-1984 and it was prepared by using the following materials:

- Cement- The 53 grade Ordinary Portland cement conforming to IS: 12269-1987 was used in the work with a specific gravity of 3.15.
- Fly ash- Fly ash is available in dry powder form .The fly ash produced by the company satisfies all the requirements of the IS: 3812-1981.
- GGBS conforming to IS 12089-1981 was used in the investigation.
- Fine Aggregate- Locally available river sand passing through 4.75 mm IS sieve conforming to grading zone-II of

IS: 383- 1970 was used with a specific gravity of 2.74.

- Coarse Aggregate- Crushed stone aggregate with combinations of 12 mm and 10 mm in 60% and 40% respectively from a local source having the specific gravity of 2.74 conforming to IS: 383-1970 was used.
- Water- Potable water is used for mixing and curing concrete.
- Super Plasticizers- Super plasticizer in the form of SP-420 conoplast.

3.1 CASTING AND CURING OF TEST SPECIMENS

After proper mixing, the mix poured in to the cube moulds of size 150 x 150x 150 mm, a beam of size 500mm x 500mm x 700mm and standard cylinder of 150 mm diameter and 300 mm height and then compacted manually using tamping rods. In this work, we mainly Prepared 17 different mixes of M60&M80 Grade namely conventional aggregate concrete (CAC), concrete made by replacing GGBS and fly ash.

Fig. 1: Casting of Cubes, Beams, and Cylinders

The cubes are demolded after 1 day of casting and then kept in water for curing at room temperature with a relative humidity of 85% the cubes are taken out from curing after 7days, 21 days and 28 days for testing.

3.2 WORKABILITY:-

The workability of fresh concrete was measured by means of the conventional slump test as per IS: 1199(1989). Before the fresh concrete was cast into moulds, the slump value of the fresh concrete was measured using slump cone.

Fig. 2: Workability Test Conducted in Lab

3.3 COMPRESSIVE STRENGTH TEST

The compressive strength test was carried out conforming to IS 516-1959 to obtain compressive strength for an M60& M80 grade of concretes.

Fig**. 3: Compressive Strength Test**

3.4 FLEXURAL STRENGTH TEST

Flexural strength test was conducted on beam specimens prepared as per I.S.516-1959 for an M60&M80 grade of concrete under two point loading over an effective span of 600 mm divide into three equal parts.

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Fig. 4: Flexural Strength Test

IV RESULTS

We have conducted trails for different percentage of mixes following are the results we have obtained

4.3 COMPRESSIVE STRENGTH TEST

4.3.1 FOR 7 DAYS OF CURING

For 7 days of curing, fly ash of 10 %, 20 %, 30 % and 40 % with GGBS of 10 % shows 4.66 %, 6.03 %, 7.01 % and 11 %, GGBS of 20 % shows 11.8 %, 7.46 %, 11.9 % and 13.4 %, GGBS of 30 % shows 17.13 %, 12.34 %, 13.84 % and 16.4 % and GGBS of 40 % shows 8.68 %, 5.42 %, 5.57 % and 7.91 %.

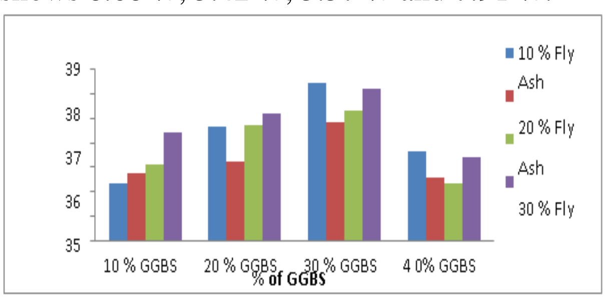

Fig. 5: Compressive Strength of Concrete at 7 Days Curing

4.3.2 FOR 21 DAYS OF CURING

For 21 days of curing, fly ash of 10 %, 20 %, 30 % and 40 % with GGBS of 10 % shows 2.94 %, 4.2 %, 5.91 % and 11.2 %, GGBS of 20 % shows 5 %, 7.9 %, 11.2 % and 11.9 %, GGBS of 30 % shows 7.13 %, 12.5 %, 11.3 % and 14.83 % and GGBS of 40 % shows 5.38 %, 6.4 3.77 % and 3.36 %.

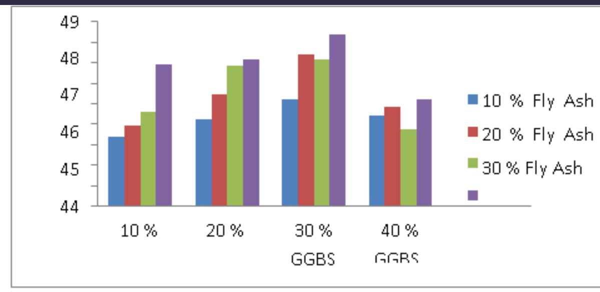

Fig. 6: Compressive Strength of Concrete at 21 Days Curing

4.3.3 FOR 28 DAYS OF CURING

For 28 days of curing, fly ash of 10 %, 20 %, 30 % and 40 % with GGBS of 10 % shows 4.76 %, 5.51 %, 8.63 % and 11.24 %,GGBS of 20 % shows 7.33 %, 8.51 %, 12.5 % and 11.24 %, GGBS of 30 % shows 10.14 %, 13.21 %, 14.23 % and 17.89 % and GGBS of 40 % shows 5.48 %, 8.61 %, 10.14 % and 12.39 %.

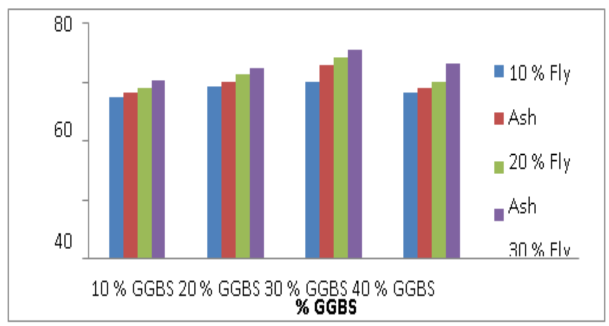

Fig. 7: Compressive Strength of Concrete at 21 Days Curing

4.3.2 FLEXURAL STRENGTH TEST

For 28 days of curing, fly ash of 10 %, 20 %, 30 % and 40 % with GGBS of 10 % shows 24.4 %, 49.5 %, 58.92 % and 74.2 %, GGBS of 20 % shows 48.8 %, 61.9 %, 92.85 % and 78.7 %, GGBS of 30 % shows 72.02 %, 78.5 %, 83.3 % and 94 % and GGBS of 40 % shows 44.8 %, 73.2 %, 89.2 % and 68 %.

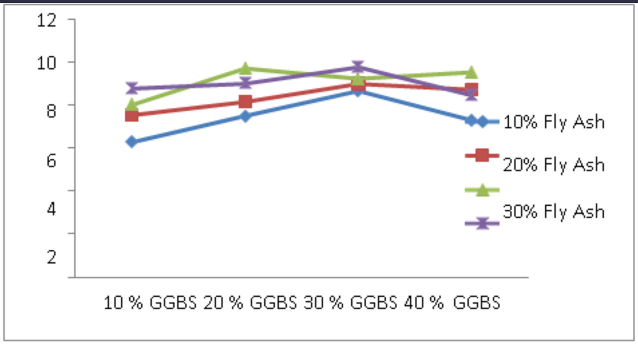

Fig. 8: Flexural Strength of Concrete at 28 Days Curing

V CONCLUSION

1. Cement replacement by in combination of fly ash and adding Ground granulated blast furnace slag leads to increase in compressive strength and flexural strength up to 40% to 50% replacement for both M60 and M80 grades of concrete. Beyond 50% replacement of fly ash and ground granulated blast furnace slag compressive strength and flexural strength decreased.
2. It is observed that at 28days compressive strength and flexural strength of M60 grade concrete are increased for different combination of mix proportions and for M80 grade of concrete is controlled concrete.
3. It is observed that at 90days compressive strength and flexural strength of M60 grade concrete are increased for different combination of mix proportions and for M80 grade of concrete is controlled concrete.
4. It is observed that at 180days compressive strength and flexural strength of M60 grade concrete are increased for different combination of mix proportions and for M80 grade of concrete is controlled concrete.
5. From the above observations we have concluded that the compressive and flexural strengths are increasing normally for 28 days and increasing rapidly for 90 and 180days when compared with controlled concrete.
6. There is a decrease in workability as the replacement level increases, and hence water consumption will be more for higher replacements.
7. From the present study it is observed that, being the fly ash is maintained 10% constant the optimum value of ground granulated blast furnace slag is 30%. i.e., the total replacement of ternary Blended cement was 40%, for the both M60 and M80 grades.
8. And it is observed that, being the fly ash is maintained 20% constant the optimum value of ground granulated blast furnace slag is 20%. i.e., the total replacement of ternary Blended cement was 40%, for the both M60 and M80 grades
9. And also it is observed that, being the fly ash is maintained 30% constant the optimum value of ground granulated blast furnace slag is 20%. i.e., the total replacement of ternary Blended cement was 50%, for the both M60 and M80 grades.
10. The addition of GGBS has further increased initial 28 days, 90 days and 180 days strength as evident from the tables.

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