International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Effect of Fly Ash and GBFS on Strength Parameters of Concrete

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Abstract: ***Concrete is widely used material for various types of structures due to its structural stability and strength. To reduce cost by using partial replacement of cement by fly ash and sand by GBFS it is economically better than normal concrete. And to reduce the volume of waste material from industries. By using these products in concrete it is safe in environment. Our aim is to study the properties of concrete by partially replacing cement by fly ash and fine aggregate (sand) by granulated blast furnace slag for m30 grade of concrete . Now in this project only 53 grade of cement is used. This paper reports comparative study on effects of concrete properties by partially replacement of OPC of 53 grade with fly ash and sand were partially replaced by blast furnace slag. The main variable investigated in the study of variation of fly ash dosage of 10% and slag dosage of 10%, 20%, and 30%. The compressive strength and split tensile strength of m30 grade of concrete was mainly studied. Test results shows that, inclusion of fly ash and GBFS generally improves the concrete properties up-to certain percentage of replacement in53 grade of cement.***

Keywords: Compressive strength, Workability, Split tensile strength .Fly ash and granulated blast furnace slag.

1. Introduction

Concrete is a widely used construction material for various types of structures due to its structural stability and strength. The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Hence it is inevitable either to search for another material or partly put back it by some other material. The search for any such material, which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact.

In this thesis, the different admixtures were used to study their sole and combined effects on the resistance of concrete in addition to their effects on mechanical and stability properties by the replacement of cement by 10% fly ash and sand replacement 10%, 20%, 30% of slag, cement by 20% fly ash and sand replacement 10%, 20, 30% of slag, cement replacement of 30%fly ash and sand replacement 10%, 20%, 30% of slag.

2. Material Specifications

2.1. Cement

Ordinary Portland Cement of Anjani brand of 53 grade confirming to IS: 4031 (Part 4): 1988 was used in the present study. The properties of cement are shown in Table 1.

Table 1: Properties of Cement

S.NO	Property	Result
1.	Normal consistency	32%
2.	Initial setting time	45 min
3.	Specific gravity	3.15
4.	Fineness of cement	5%

2.2 Fine Aggregate

Natural sand as per IS: 383-1987 was used. Locally available River sand having bulk density 1860 kg/m^3 was used The properties of fine aggregate are shown in Tab 2.

Table 2: Properties of fine aggregate

S.NO	Property	Result
1.	Specific gravity	2.7
2.	Fineness modulus	3.12
3.	Grading zone	IV

2.3 Coarse Aggregate

Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20mm and 12.5 mm of specific gravity 2.84 and fineness modulus 8.47 were used.

2.4. Fly Ash

Fly ash used was confirming to grade1 of IS: 3812-1981 and was supplied by Fly ash is collected from RTPP. The fly ash is used as a partial replacement of cement. The properties of fly ash are shown in Table 3.

Table 3: Properties of fly ash

Specific gravity	2.5
Physical form	Powder
Size (Micron)	0.1
Colour	Dark grey
SIO_2	(60-65)%
Al_2O_3	(20-25)%

2.5. Granulated Blast Furnace Slag:

Blast furnace slag is a non-metallic product consisting essentially of calcium silicates and other bases. The size of slag is that passing through 4.75mm IS sieve is also used as sand up to 30% replacement of sand. The used slag contains

sized particles only.

Table 4: Physical properties of slag

S.NO	Property	Result
1.	Specific gravity	1.71
2.	Physical form	Sized particles
3.	Colour	Pale white

2.6. Water

According to ACI water used for preparing concrete should be of potable quality. In this investigation ordinary tap water, which is fit for drinking, has been used in preparing all concrete mixes and curing.

3. Methodology of the Study

The following are to be carried out in order to achieve the research objectives.

- To collect the fly ash from thermal power plant RTPP and collect the blast furnace slag from steel plant.
- Sieve the slag by using of 4.75mm sieve.
- To study about the fly ash and slag.
- To study about the strength of replacement of fly ash and slag in concrete.
- Study on acid attack in concrete

Analysis of experimental results to draw conclusions.

4. Test Results and Discussions

This section describes the results of the tests carried out to investigate the various properties of the concrete when partially replacements of cement by fly ash and sand by GBFS. In the succeeding parts, the results for workability, compressive strength, splitting tensile strength are presented.

4.1. Fresh Concrete Properties

4.1.1. Workability Test

Workability is defined as the properties of freshly mixed concrete or mortar which determines the ease and homogeneity with which it can be mixed, placed, consolidated and finished. The workability was measured by conducting slump cone test and compaction factor test in accordance with IS: 1199-1959.

Figure 1: Slump Test

4.2. Hardened Concrete Properties

The different tests that have been carried out to establish the hardened properties of the concrete samples produced were; determination of compressive strength, splitting tensile strength tests.

4.3. Experimental Procedure

The specimen of standard cube of (150mm x 150mm x 150mm) and standard cylinders of (300mm x 100mm) were used to determine the compressive strength, split Tensile strength. Three specimens were tested for 7 & 28 days with each proportion of Fly ash and GBFS replacement. Totally 30 cubes and 30 cylinders were cast for the strength parameters and the constituents were weighed and the materials were mixed by hand mixing. The water binder ratio (W/B) (Binder = Cement + Partial replacement of fly ash and GBFS as per procedure) adopted was 0.45 weight of binder. The concrete was filled in different layers and each layer was compacted. The specimens were remolded after 24 hrs. Cured in water for 7 & 28 days, and then tested for its compressive and split tensile as per Indian Standards.

5. Test Results and Discussions

Results of fresh and hardened concrete with partial replacement of fly ash by cement and by GBFS are discussed in comparison with those of normal concrete

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Table 5: Results of Compressive strength for M30 grade of concrete

Mix	% of FA+ % of GBFS added		Compressive strength (N/mm^2)	
	% of FA	% of GBFS	7 Days	28 Days
M1	0	0	28.74	39.25
M2	10	10	42.66	46.88
M3	10	20	33.99	35.99
M4	10	30	30.66	32.88

5.1. Compressive Strength

The results of compressive strength were presented in Table 3. The test was carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7 and 28 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 2000Kn. From table.3 the compressive strength is up to 42.66 N/mm^2 and 46.88 N/mm^2 at 7 and 28 days. The maximum compressive strength is observed at 10% replacement of fly ash and 10%, 20%, 30% replacement of GBFS. There is a significant improvement in the compressive strength of concrete when addition of fly ash and GBFS in the concrete.

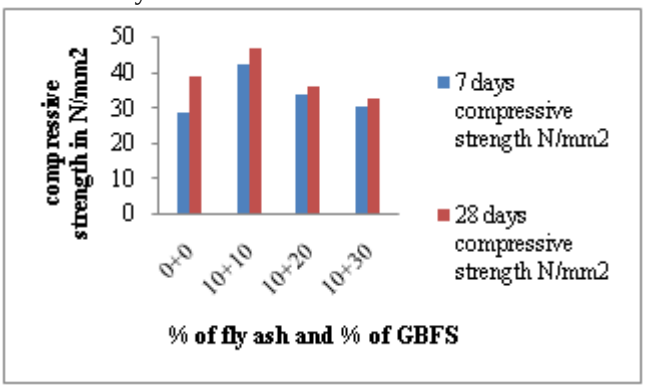

Figure 2: Effect of fly ash and GBFS on compressive strength of concrete

5.2. Split Tensile Strength

The results of Split Tensile strength were presented in Table 3. The test was carried out conforming to IS 516-1959 to obtain Split tensile strength of concrete at the age of 7 and 28 days. The cylinders were tested using Compression Testing Machine (CTM) of capacity 2000Kn.From table.3the increase in strength is 2.76N/mm^2 and 3.97N/mm^2 at 7 and 28 days. The maximum increase in split tensile strength is observed at 10% replacement of Fly ash and 10% Replacement of GBFS. The optimum10% replacement of Fly ash and 10% replacement of GBFS percentages for tensile strengths have been found to be a function of w/cm ratio of the mix. The optimum 28-day split tensile strength has been obtained in the range of 0–10%.

Table 6: Results of Split Tensile Strength for M30 grade of concrete

Mix	% of FA and % of GBFS added		Split Tensile Strength (N/mm^2)	
	% of FA	% of GBFS	7 Days	28 Days
M1	0	0	3.48	3.68
M2	10	10	2.76	3.97
M3	10	20	2.32	3.61
M4	10	30	2.41	3.04

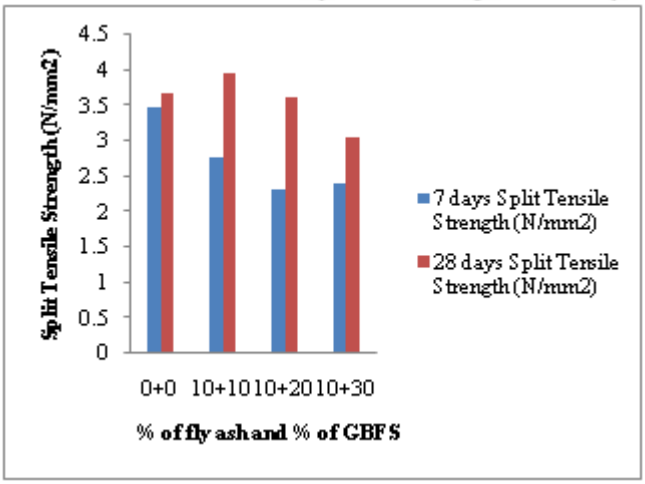

Figure 3: Effect of Fly ash & GBFS on split tensile strength of concrete

6. Conclusions

Consistency of cement depends upon its fineness. With increasing of fly ash and slag percentages in concrete then the workability should be increased gradually as compared to normal concrete. The physical properties of cement with the replacement of fly ash and slag were found to be increase with the increasing of the percentages of admixtures. Although the soundness of cement was found to be increase after replacement of admixtures. The Compressive strength of concrete for 10% FA and 10% GBFS is more compared to that for 10% FA and 20% GBFS and 10% FA and 30% GBFS. The split tensile strength values were found to be gradually decreased while the combination of percentage replacement of admixtures is increased.

References

[1] B. Mather, "Concrete--Year 2000, Revisited", ACI journal, vol-144, pp. 31-40, 1994
[2] Taiwan, Concrete International, vol-17, pp 71-76, 1995 etc.
[3] International Symposium on "innovative world of concrete", Vol- II, IWC-98 proceedings.
[4] Proceedings of Seventh International Conference on Fly Ash, Silica Fume,Slag and Natural Pozzolans in Concrete, Vol-II Editor, V.M.Malhotra.
[5] The Indian Concrete Journal, Vol.80, June 2006.
[6] Magazine of Concrete Research, Vol.58, June 2006.