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A Comparative Study on Strength Properties for High Grade Blended Cement Concrete with Different Mineral Admixtures (GGBS, Fly Ash)

Samansai Srinivasa Ravikumar[1] B.Santhoshimatha[2]

[1]PG Scholar PYDAH College of Engineering, Kakinada, India

[2]M.tech, Assistant Professor PYDAH College of Engineering Kakinada, India

Abstract: ***Providing a greenery concrete is the aim to the present scenario by the mineral admixtures which having the cementing properties are used as a replacement of the cement which lead to green concrete ,and also the industrial waste have discovered the need to disposal of industrial waste, The waste that have to be disposed can be kept to use in some manner, among the industrial waste processing cementations nature can be replaced as binder matter in concrete to apart . A large volume of production of cement leads to emission of many harm full gases like green house gases in atmosphere, which are tends for global warming. Hence, the researchers are currently focused on waste material having cementing properties, which can be added as partial replacement of cement which reduces cement production then the green house gases emission is also reduced, to sustain-able management of the industrial waste, Some of the mineral admixtures like fly ash , Silica fume, Rice Husk ash, Metakoline. In this Project Fly Ash & Ground Granulated Blast Furnaces Slag (GGBS) are used as cementations materials. Fly Ash is an industrial waste products, Ground Granulated Blast Furnaces Slag,(GGBS) which waste from, from an iron manufacturing industry, which may be used as substitute of cement in concrete due to its inherent cementing properties. Due to various codal specifications the binding material replacements of Fly Ash & GGBS have been restricted up to 80% in maximum. In accordance with above restrictions the replacement variations in binding material have been decoded in a high strength concrete mixture as 10,20,30,40,50,%of replacement . The research work have been extensively executed in almost all areas of testing like compressive, spilt tensile, and flexural strength for 28,56 days.***

Keywords: GGBS, FlyAsh, Greenery Concrete, Compressive Strength

1. Introduction

Concrete is the most widely used constructional material. the concrete has different types of grades in this projects M60 grade high grade concrete is used to increase the strength properties of concrete several admixtures are used the mineral admixtures Fly Ash &GGBS as replacement of cement with different percentage of replacements. The grade of concrete depends up on the mix design of the concrete. The mixes up to M20 are nominal mix, i.e. M5, M10, M15, M20. Whereas the mix above M20 is designed mix. The mix design is based in strength criteria and durability criteria used for moderate environment. The ratios by weight of cement, fine aggregate and coarse aggregate are obtained using the specifications given in 10262-2009 are given below. These proportions are maintained strictly same throughout the casting process to obtain a uniform standard and workable concrete mix. Normally Cubes were tested for compressive strength after 7 and 28 Days curing. In this project the 3,7,14,28,56, 90 days tests are conducted. For the high grade concrete above M55 is design as the design consideration and by the trail and error method In this project the **M60 mix** design is done by considering the exposure condition as very severe, slump value as 75mm & by the physical properties of material the mix design is carried out by norms in the IS10262-2009 codal provisions

2. Scope of the Works

The aim of the project is to determine the mechanical properties such as compressive strength, split tensile, flexure strength properties for M60 grade Blended cement concrete with GGBS an mineral admixtures .

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- The aim of the project is to determine the mechanical properties such as compressive strength, split tensile, flexure strength properties for M60 grade Blended cement concrete with both GGBS ,Fly ash an mineral admixtures
- Comparing the mechanical properties with GGBS as an mineral admixture, Fly ash as mineral admixture and with combination of fly ash & GGBS as an mineral admixture.

3. Literature Review

3.1 Etaveni Madhavi

From the experiments conducted, replacement of FLY ASH and GGBS as cement can be optimized. At 0%, 5%, 7.5%, 10%, 12.5%, 15% replacement of cement with FLY ASH and GGBS the strength properties were decreased linearly were compared with conventional concrete. At 40%, 50%, 60% & 70% replacement of cement with FLY ASH and GGBS the strength properties were marginally decreased and at 80% to 100% replacement level strength properties were highly decreased when compared with conventional cement concrete. And there is no highly difference of 7 days and 28 days strength properties of compressive strength. So In the further investigation 20 % replacement of cement with FLY SH and GGBS by conventional aggregates content in concrete can be optimized

3.2B K Varun(2015)

Incorporation of Fly ash and GGBS as a partial replacement of cement in concrete gives good results in both fresh and hardened state. In low volume replacement Mix M2 (20%Fly ash +20%GGBS+60%OPC) gives good workability and strength. In high volume replacement Mix M7 (40%Fly ash+20%GGBS+40%OPC) gives good work ability and strength. The study reveals that low volume replacement mix M2 (20% Flyash+20% GGBS+60% OPC) is giving good result than high volume replacement Mix M7 (40%Flyash+20% GGBS+40% OPC) at all ages of curing.

Making concrete with the combination of Fly ash and GGBS and cement with different percentages gives good results compared to control concrete. So the best way to use these materials is in combination. Due to environmental issues in the production of cement, industrial by products like fly ash and GGBS are used as supplementary materials in concrete and it saves cost of production of concrete, and makes it eco-friendly.

4. Methodology

4.1In this paper the **M60 mix** design is done by considering the exposure condition as very severe, slump value as 75mm & by the physical properties of material the mix design is carried out by norms in the IS10262-2009 codal provisions In this paper we consider the design specifications such as grade of concrete is M 60 , exposure condition is very severe, W/C as 0.38, slump of 75mm. required quantity of cement fine aggregate coarse aggregate is designed and final mix proportions is obtained. And By considering the above design specifications and by trail & error method with considering the codal provisions in IS 10262-2009. The obtained mix design for **M 60 mix is 1: 1.36:2.7.**

4.2 Material properties

4.2.1 Cement: OPC 53
Fineness modulus of cement 90
Compressive strength of cement=55N/mm2
Specific gravity of cement=3.15
3.2**fine aggregate** :the fine aggregate is of Zone-III as per IS3838 codal provision

Table 3.5: Physical properties of fine aggregate:

Properties	Test results
Specific gravity	2.52
Fineness modulus	2.2
Bulk density	1.69

4.3 Coarse Aggregate

Table 3.6: Determined physical compositions of coarse aggregate

Properties	Test results
Specific gravity	2.52
Fineness modulus	2.2
Bulk density	1.69

5. Experimental Work

By considering the 7 days 28 days compressive strength of all trail mix design the mix proportions is considered.

Table 3.13: Compressive strength of trail mix

Mix designations'	compressive strength for 7 days N/mm2	compressive strength for 28 days N/mm2
M1	55.74	77.53
M2	47.4	59.76
M3	63.41	80.63

By considering the above trail mix calculations , as per the requirement of the project the mix proportions for M60grade concrete is
Cement = 4523 kg
Fine aggregate = 617.18 kg
Coarse aggregate = 1234.41 kg
Water = 171.9 lit, W/C = 0.38
w/c=0.38.

Batching:
By considering the mix proportions the volume of cube, cylinders, and prism are calculatedand calculating the quantity of materials required for cube, cylinders, and prism

Figure 3.6: Collected material

Mixing: The object of mixing is to coat the surface of all aggregate particles with Cement paste and to blend all the ingredients of concrete into a uniform mass. Though mixing of the materials is essential for the production uniform concrete. The mixing should ensure that the mass becomes homogeneous, uniform in color and consistency. In this study the process of hand mixing was adopted.

Figure 3.7: Mixing and Concrete

Mix calculations

s. no	Mix designation	Description
1	M0	100% CEMENT + 0% FLY ASH + 0% GGBS
2	MG1	90% CEMENT + 0% FLY ASH + 10% GGBS
3	MG2	80% CEMENT + 0% FLY ASH + 20% GGBS
4	MG3	70% CEMENT + 0% FLY ASH + 30% GGBS
5	MG4	60% CEMENT + 0% FLY ASH + 40% GGBS
6	MG5	50% CEMENT + 0% FLY ASH + 50% GGBS
7	MF1	90% CEMENT + 10% FLY ASH + 0% GGBS
8	MF2	80% CEMENT + 20% FLY ASH + 0% GGBS
9	MF3	70% CEMENT + 30% FLY ASH + 0% GGBS
10	MF4	60% CEMENT + 40% FLY ASH + 0% GGBS
11	MF5	50% CEMENT + 50% FLY ASH + 0% GGBS
12	MGF1	80% CEMENT + 100% FLY ASH + 10% GGBS
13	MGF2	60% CEMENT + 20%GGBS&Fly Ash

5.1 Compressive Strength

Result representing the compressive strength values from 3 days curing to 56 days curing at various replacement levels i.e. at 0 % to 50% replacement of GGBS& Fly Ash. By considering the M 60 mix proportions the different mix are casted the mix details are shown the table

Mix methodology table

Table 5.1: Mix proportions for 1 m^3

Mix	Cement Kg/M^3	Fly ash Kg/M^3	GGBS Kg/M^3	F.A Kg/M^3	C.A Kg/M^3	Water lit/M^3
M0	**452.3**	0	0	617.18	1234.4	171.9
MG1	**407.07**	0	45.23	617.18	1234.4	171.9
MG2	**361.84**	0	90.46	617.18	1234.4	171.9
MG3	**316.61**	0	135.69	617.18	1234.4	171.9
MG4	**271.38**	0	180.92	617.18	1234.4	171.9
MG5	**226.15**	0	226.15	617.18	1234.4	171.9
MF1	**407.07**	45.23	0	617.18	1234.4	171.9
MF2	**361.84**	90.46	0	617.18	1234.4	171.9
MF3	**316.61**	135.69	0	617.18	1234.4	171.9
MF4	**271.38**	180.92	0	617.18	1234.4	171.9
MF5	**226.15**	226.15	0	617.18	1234.4	171.9
MGF1	**361.84**	45.23	45.23	617.18	1234.4	171.9
MGF2	**271.38**	90.46	90.46	617.18	1234.4	171.9

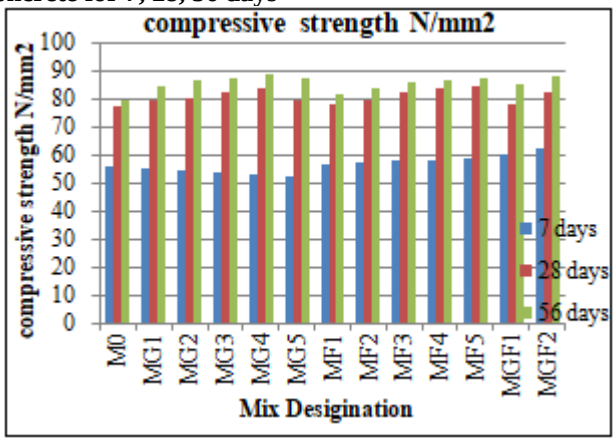
5.1 Compressive-Strength Reults

The compressive-strength of cubes for 7,28,56 days are shown in the below table

Table 5.2: Compressive strength for different days N/mm2

Mix Designation	Compressive strength n/mm2		
	7 days	28 days	56 days
M0	55.7	77.5	79.6
MG1	55	79	84.4
MG2	54.6	80	86.2
MG3	53.3	82	87.2
MG4	52.8	83.4	88.3
MG5	52	79.2	87.1
MF1	56.3	78	81.5
MF2	57	79.5	83.3
MF3	57.5	82.3	85.5
MF4	58	83.5	86.2
MF5	58.5	84.5	87.2
MGF1	60	78	85
MGF2	62	82	88.2

Comparison of compressive strength of blended cement concrete for 7, 28, 56 days



Note: Mo means the mix with 100% cement ,MG1 represents the mix with 10 % replacement of GGBS with OPC 53 in the same way in MG 20,M G30,M G40,MG50 Gives the replacements levels of Fly Ash with 20, 30, 40 ,50% replacements. Whereas the MF10 represents the 10% replacement of OPC 53 with Fly Ash , in the same way the MF20, MF30, MF40,MF50. Gives the replacements levels of Fly Ash with 20, 30, 40 ,50% replacements.MGF1 represents the mix with 80%of OPC 53 cement,10%GGBS& 10% of fly Ash MGF2 represents the mix with 60%of OPC 53 cement,20%GGBS& 20% of fly Ash

5.2 Split Tensile Strength Result

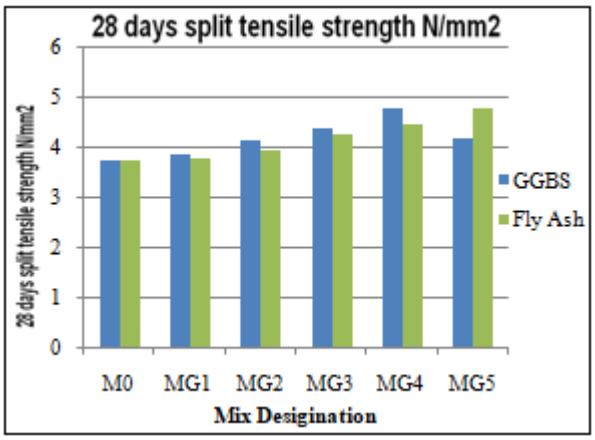
The standard size of cylinders of 300mm long and 150 mm diameter, cylinders are casted with the designed mix proportions in both OPC 53 and OPC 53 S ,and they are tested the specimens after 28 days curing in normal water.

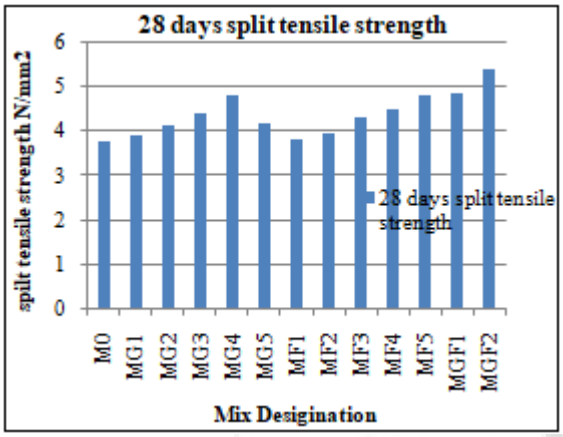
Table 5.4: Split tensile strength results

Mix Designation	Split Tensile Strength
M0	3.78
MG1	3.89
MG2	4.15
MG3	4.4
MG4	4.8
MG5	4.2
MF1	3.8
MF2	3.95
MF3	4.3
MF4	4.5
MF5	4.8
MGF1	4.85
MGF2	5.4

As per the above split tensile strength of the blended cement concrete the graphical representation is done for the both GGBS and the Fly Ash Blended cement concrete

Graph -9 compression for the split tensile strength for GGBS & Fly Ash mineral admixtures.





Graph 9: The split tensile strength for both GGBS & Fly Ash mineral admixtures

Note: Mo means the mix with 100% cement ,MG1 represents the mix with 10 % replacement of GGBS with OPC 53 in the same way in MG 20,M G30,M G40,MG50 Gives the replacements levels of Fly Ash with 20, 30, 40 ,50% replacements. Whereas the MF10 represents the 10% replacement of OPC 53 with Fly Ash , in the same way the MF20, MF30, MF40,MF50. Gives the replacements levels of Fly Ash with 20, 30, 40 ,50% replacements.MGF1 represents the mix with 80%of OPC 53 cement,10%GGBS& 10% of fly Ash MGF2 represents the mix with 60%of OPC 53 cement,20%GGBS& 20% of fly Ash

6. Conclusion

1) Early strength is compared with Fly Ash blended cement concrete is increased than the conventional concrete, where as the GGBS blended cement concrete is slightly lower than conventional aggregate concrete.
2) The compressive strength result of Fly Ash blended cement concrete when replaced up to 50 % is more than conventional aggregate concrete at the end of 28 days for normal curing .Nearly 11% of the compressive strength of fly ash blended cement concrete is more than the conventional concrete.
3) The compressive strength result of GGBBS blended cement concrete when replaced up to 40 % is more than conventional aggregate concrete at the end of 28 days for normal curing
4) Compared to the GGBS & Fly Ash admixtures the Fly Ash blended cement has the greater compressive strength at the early ages.
5) The compressive strength result of GGBBS blended cement concrete when replaced up to 40 % is more than conventional aggregate concrete at the end of 28 days for normal curing
6) The split tensile, flexure strength result of GGBS blended cement concretes when replaced up to 10 % is more than the conventional aggregate concrete at the end of 28 days for normal curing.

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Author Profile

Samansai Srinivasa Ravikumar, PG Scholar ,PYDAH College of Engineering, Kakinada, India

B. Santhoshimatha M.Tech, Assistant Professor , Department Of Civil Engineering, PYDAH College of Engineering, Kakinada, India