

Experimental Study on Mechanical Properties of High Strength Concrete for M60 Grade Concrete

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Abstract: *This paper presents about the determination of the mechanical properties (compression, split tensile and flexural tests) of the specimens (cubes, cylinders and beams). The specimens are of M60 grade high strength concrete which include fly ash as the partial replacement (in percentage) of cement and Msand as complete replacement of Fine aggregate along with the polypropylene fibers using Glenium 8233 as superplasticizer. The tests are conducted after 7, 14 and 28 days of curing period. The replacement of fly ash was done at different percentages of cement content 0%, 10%, 20%, 30% & 40%. Finally after the tests on the specimens after the curing period it is noticed that 20% replacement of fly ash gave the better strength for the cube and cylinder specimens and 40% replacement of fly ash for cement for the beams.*

Keywords: Flyash, Glenium8233, Flexural and split tensile test, Manufactured Sand

1. Introduction

The High Strength Concrete is the type of high performance concrete which gives better strength with nominal quantities of the ingredients. The HSC is one which gives the compressive strength of concrete at a range of 50MPa and above (up to 120MPa). The main difference with the nominal concrete is the strength. The main requirement of HSC is that to provide the higher strength by consuming less quantity of material. When compared to the nominal concrete the ingredients used are more i.e., admixtures are added to the normal mix to give higher strength. The different types of admixtures that can be used in the concrete are silica fumes, GGBS, Flyash, etc.... The materials that can be considered in the concrete as the replacement of fine aggregate are Copper Slag, Msand, etc... For my work I'm considering the concrete of M60 grade as HSC concrete. The admixture used is Flyash. To reduce the water content in the concrete, superplasticizer is considered, the superplasticizer considered is Glenium 8233. The fine aggregate is completely replaced by the manufactured sand.

2. Objective

The main objective of this project is to determine the mechanical properties of a High Strength Concrete. For the different percentage replacement of fly ash for cement content and complete replacement of Msand for fine aggregate.

3. Materials and Methodology

River sand was considered as Fine aggregate in the concrete for construction work from the development of the concrete. From past few decades it is seen that the river sand is getting absolute. The availability of River sand from the sources has been reduced. Hence the river sand is the main ingredient used in the concrete, to balance this absolute material in the concrete the research was carried out. Of which one of the material is Msand, which is the rock dust, obtained from the crushers after crushing the rocks for coarse aggregate. This is

the raw dust that was initially discarded as the waste product. After few studies and researches on this material it is found that all the properties of this material is found almost equal to that of fine aggregate that was used as the main ingredient in the concrete. Hence by considering this material as the replacement of fine aggregate that can minimize the cost of the construction and reduce the migration charges. The specific gravity of the Msand used for my work is 2.5.

Flyash is the fine powder that is produced from the combustion of pulverized coal in the thermal power plants. This is the best suitable binder material that can be used in the concrete. This material is finer than the concrete hence gives the better bonding in the concrete. The flyash is divided in two types based on its source material class C and Class F. Class F Flyash is normally produced from burning anthracite or bituminous coal that meets the applicable requirements. The flyash used in my project is Class F type flyash. Therefore, the replacement of this material is done in the percentage of the cementitious material. The percentage replacement is considered from the past research papers and journals i.e., the replacement is considered as 10%, 20%, 30% and 40%.

The chemical admixture that is considered is the superplasticizer, which is generally considered to reduce the water content. The superplasticizer used is Glenium 8233. Master Glenium SKY 8233 is an admixture of a new generation based on modified polycarboxylic ether. This is generally designed for the better performance of the concrete i.e., better durability and strength.

The nominal ingredients used in the concrete are the cement, coarse aggregate and water. The cement used in this project work is the OPC53 grade concrete. The specific gravity of the cement used is 3.15.

The coarse aggregate adopted in the concrete mix is 20mm size and below size aggregate. The specific gravity of this aggregate is 2.67.

The water used is the pure water which is in the range of the PH requirement.

4. Mix Design

The HSC is defined as higher concrete whose characteristic strength ranges from 50 and above. Hence for my work I'm considering M60 grade concrete. The mix design for M60 grade concrete is carried out using the Indian standard code 10262:2009. For which the water cement ratio is kept as the least value of 0.3 for the slump value is assumed as 100mm, the fine aggregate of Zone II, coarse aggregate of 20mm size and below.

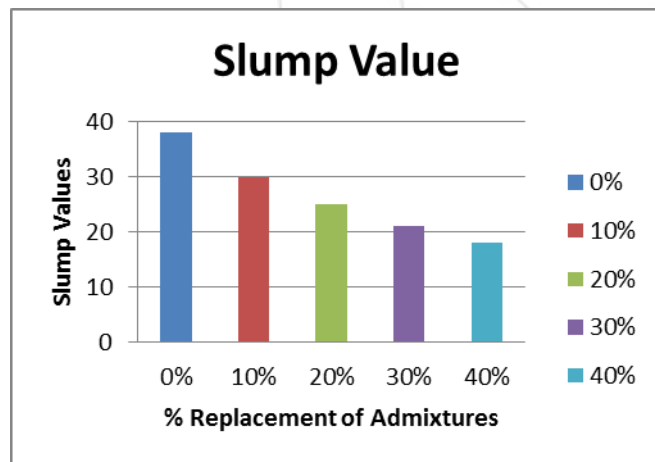
- Cement = 466.66 Kg
- Water = 140 Kg (0.3)
- Fine Aggregate = 585 Kg
- Coarse Aggregate = 1205 Kg
- Admixture = 9.33(2% of cementitious material)

The proportion for the mix is **1:1.25:2.58**

5. Experiential Investigation

The fresh property test that is considered is the slump cone test. The result obtained for the slump cone test is:-

Slump Values of different mixes	
Concrete Mix	Slump Value (MM)
0%	38
10%	30
20%	25
30%	21
40%	18



The casting of the specimens for my work is of different types and is of different quantities of the ingredients. The specimens casted are cubes cylinders and beams. The specimens are casted for different proportions of the mix quantities. The replacement of the fly ash to that of cement is in a percentage of 0%, 10%, 20%, 30% and 40%. The fine aggregate is completely replaced by Msand.

The cubes casted are of 150 x 150 x 150mm in dimension. The cylinders are of 150mm in diameter and 300mm in length. The beams are of 100m x 100mm x 500mm, these beams are casted with the steel reinforcement of 8mm diameter. Only the beams are to be tested for 28days curing

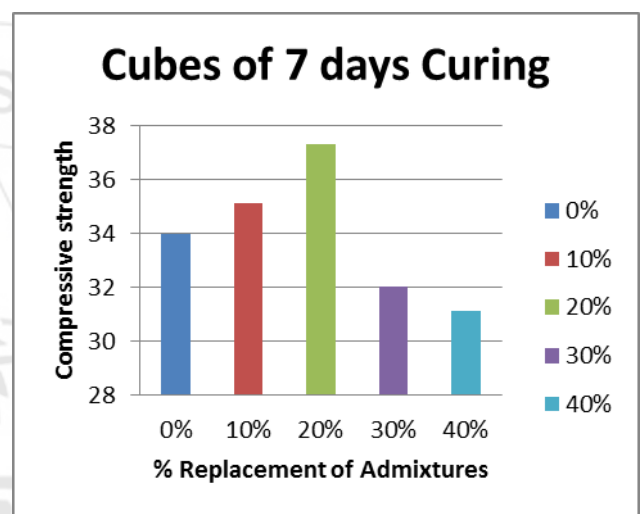
period. The cubes and cylinders are kept for curing for the duration of 7, 14 and 28 days in water.

6. Experimental Results

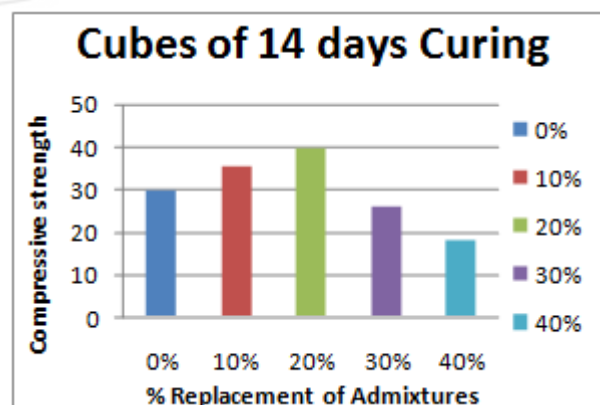
The strength test that are considered for are Compressive strength, split tensile and the flexural strength test.

6.1 Compressive Strength Test:

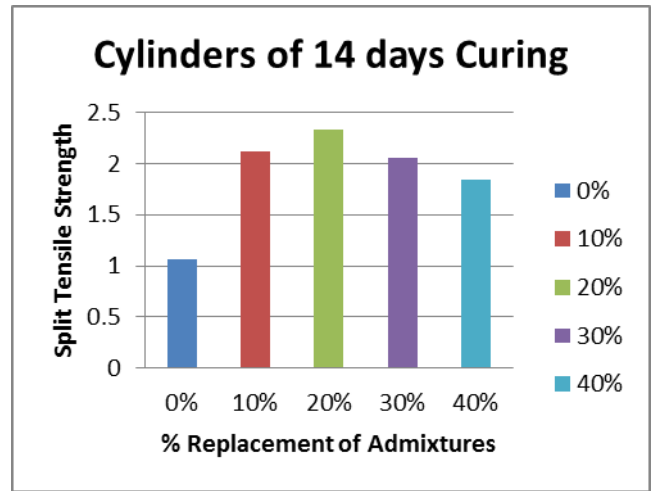
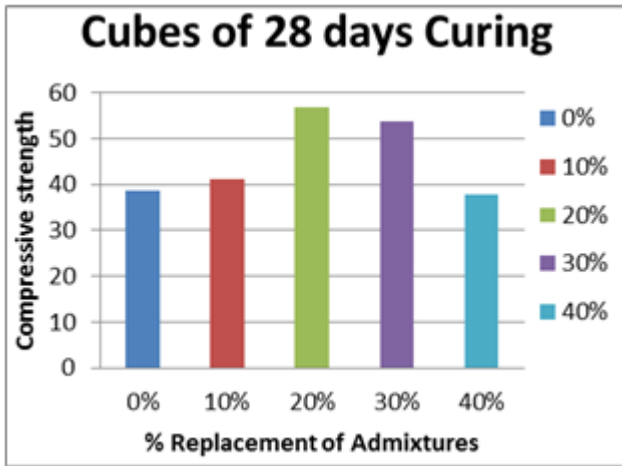
Compressive strength of cubes after 7 days curing		
% replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	765	34
10%	790	35.11
20%	840	37.3
30%	720	32
40%	700	31.1



Compressive strength of cubes after 14 days curing		
% replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	675	30
10%	800	35.55
20%	895	39.77
30%	585	26
40%	410	18.22



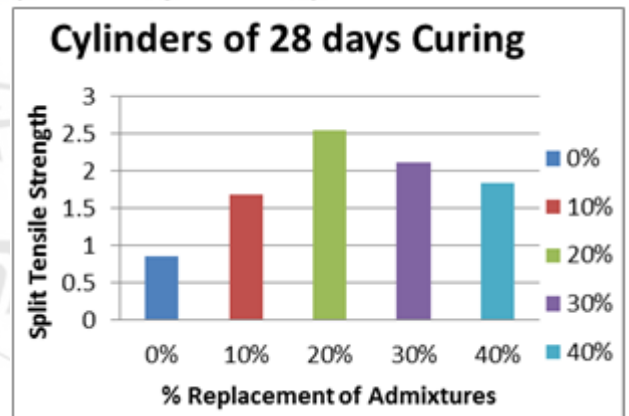
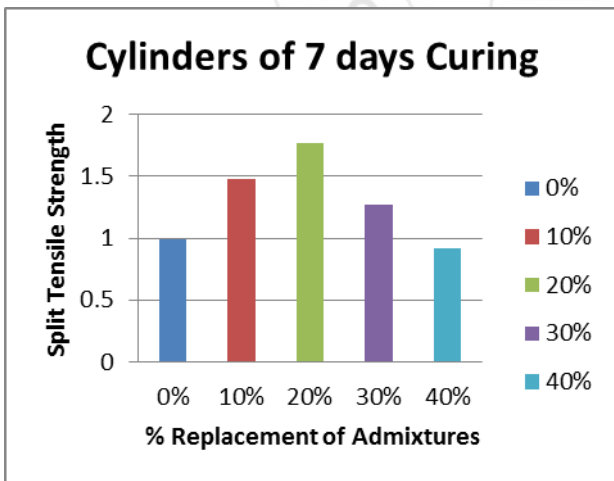
Compressive strength of cubes after 28 days curing		
% replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	870	38.66
10%	925	41.11
20%	1278	56.8
30%	1210	53.77
40%	850	37.77



Compressive strength of cylinders after 28 days curing		
% replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	60	0.85
10%	120	1.69
20%	180	2.55
30%	150	2.12
40%	130	1.84

6.2 Split tensile strength

Compressive strength of cylinders after 7 days curing		
% Replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	70	0.99
10%	105	1.48
20%	125	1.77
30%	90	1.27
40%	65	0.92

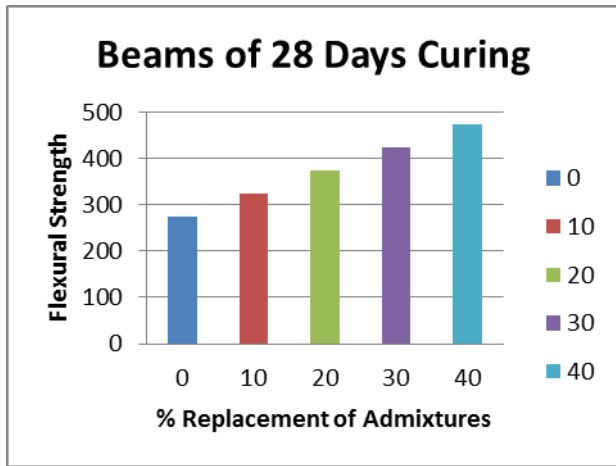


The 40% replaced admixture specimens got errored with the adjacent specimen during the curing period. The reason behind this cause was due to environment change and heavy rain, which may had led to the internal reaction in the ingredients used for casting, or the water kept for curing, or due to the higher amount of the Flyash content in the specimen.

6.3 Flexural strength test

Compressive strength of cylinders after 14 days curing		
% replacement of admixture	Average Ultimate Load (KN)	Compressive Strength (N/mm ²)
0%	75	1.06
10%	150	2.12
20%	165	2.33
30%	145	2.05
40%	130	1.84

Flexural Strength of the Beam		
% Replacement of Admixtures	Average Ultimate Load (KN)	Flexural Strength (N/mm ²)
0 %	55	275
10 %	65	325
20 %	75	375
30 %	85	425
40 %	95	475



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7. Conclusion

From above tests it can be concluded that 20% of flyash and 100 % replacement of Msand for Cement and Fine Aggregate replacement gave the better strength in case of cubes and cylinders. But in case of beams as the reinforcement was included the strength was withstood for the 40% replacement of flyash for cement and 100% replacement of Msand for fine aggregate.

8. Future Scope

For the future study on my research paper, the durability tests on the concrete can be determined for the same above considered materials or for the different materials. The strength properties of the same materials for the different grade of concrete or for higher curing period can be considered.

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