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EFFECT OF GLASS POWDER AND SILICA FUME IN CONCRETE –AN EXPERIMENTAL STUDY

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ABSTRACT

Cement contributes 7% of carbon dioxide in global warming in order to reduce carbon emission in atmosphere cement is partially replaced by silica fume in this project. The effects of partially replacing of cement with silica fume and fine aggregate with glass powder in concrete were studied and therefore found that some extent could be replaced which contributes in strength development. Cement was replaced with silica fume at a constant percentage of 10% and fine aggregate was replaced with glass powder at varying percentages such as 0%, 2.5%, 5%, 7.5% and 10% .The specimens were tested for compressive strength, split tensile strength and flexural strength at the age of 7 and 28 days and were compared with the results of conventional concrete. The overall test results indicated that the waste glass powder and silica fume could be utilized in concrete as a good substitute of cement and fine aggregate.

KEYWORDS: *Silica Fume, Glass powder, Compression Strength, Split Tensile Strength, Flexural Strength*

1. INTRODUCTION

Nowadays Concrete is widely used in construction industry because of their various advantages like accessibility, availability and economy associated with it. Generally Concrete is made by the mixing of binding material, generally cement, fine aggregate and coarse aggregate with water. Cement is the main components of concrete, which works as a binder between coarse aggregate and fine aggregate, with the help of water. It has own environmental impacts and contributes largely to concrete. However, the manufacturing of cement leads to the release of significant amount of CO_2, a greenhouse gas.Inorder to avoid such greenhouse gases effect on environment this project reduces the usage of cement by replacing silica fume.

2. OBJECTIVE

- Silica fume is a byproduct which is a hazardous material to the environment if used to in the concrete can defend environmental degradation.
- Waste glass powder can be recycled and used in concrete which leads to cause a shield to the wastage of materials by recycling.

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- It economically helps to reduce the cost of concrete by adding these waste materials and also helps to keep the surrounding sustain.

3. MATERIALS USED

Cement

43 Grade Ordinary Portland Cement (OPC) confirming to IS 8112-1989 is used in this project.

Fine aggregate

Fine aggregate used in this project was locally available and confirming to zone II with specific gravity 2.62.

The testing of Fine aggregate was done as per Indian Standard Specification IS: 383-1970.

Coarse aggregate

20 mm and down size and specific gravity 2.93 was used. Testing of coarse aggregate was done as per Indian Standard Specification IS: 383-1970.

Glass powder

Glass Waste available locally was collected and made into desired size glass powder. Glass waste is very hard material. Glass powder is used as replacement of Fine aggregate.

Silica Fume

Silica fume is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is also known as micro silica, The replacement of cement by silica fume increases compression and split tensile strength and is also a best replacement of cement.

4. METHODOLOGY

The methodology followed to carry out the project work. As the result of literature study, the properties of Glass Powder and Silica Fume are obtained regarding mix design procedures. Using that information, the preliminary tests are done to obtain the data for mix design formulation. After achieving a complete mix design procedure, Glass Powder and Silica Fume of trial mixes are prepared to check the target Strength. Then possible replacements are studied and finalized.

Materials required for the project are collected and tests are carried out on those materials to analyse the properties. Using the mix design, Glass Powder and Silica Fume are casted. After 24 hrs, the Concrete specimens are demoulded Various tests like compressive strength test, flexural strength test, split tensile strength are carried out to evaluate the performance of concrete. And from the above test results conclusion are made.

The methodology of this study was followed by the given flowchart

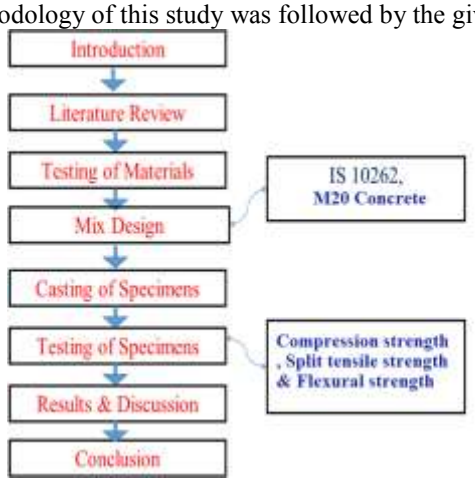

Figure 3.1 Flowchart for methodology

5. MIX PROPORTIONING

Table 5.1 Mix Proportioning

Mix	Water (Kg)	Cement (Kg)	Silica fume (Kg)	Fine aggregate (Kg)	Glass powder (Kg)	Coarse aggregate (Kg)	w/c (Kg)
M1	6.547	11.902	0	25.18	0	41.69	0.55
M2	5.251	8.591	0.955	20.194	0	33.432	0.55
M3	5.251	8.591	0.955	19.689	0.505	33.432	0.55
M4	5.251	8.591	0.955	19.187	1.009	33.432	0.55
M5	5.251	8.591	0.955	18.679	1.515	33.432	0.55
M6	5.251	8.591	0.955	18.175	2.019	33.432	0.55

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6. CASTING OF SPECIMEN

Table 6.1 Casting of Specimen

S.No	Mix	No. of Specimen			Total
		Cube	cylinder	prism	
1	M1	6	6	6	18
2	M2	6	6	6	18
3	M3	6	6	6	18
4	M4	6	6	6	18
5	M5	6	6	6	18
6	M6	6	6	6	18

7. TEST RESULTS AND DISCUSSIONS

7.1 General

Cubes were casted with W/C ratio of 0.55 by considering the replacement of bottom ash in percentages. The casted cubes are texted for 28days to study their strength performance with the conventional concrete.

7.2 Compressive strength test (conventional concrete test)

Compressive strength test was conducted by as per, "IS 516 (1959): Method of Tests for Strength of concrete". 150 mm x 150 mm x 150 mm, standard cube mould is to be used for concrete mix.

Table 7.2 Compressive Strength

Mix	Compressive Strength (N/mm^2)			Mean(N/mm^2)
	S1	S2	S3	
M1	20.85	20.89	14.71	14.71
M2	22.60	22.63	14.95	14.95
M3	23.30	23.60	16.94	16.94
M4	21.29	21.25	16.93	16.93
M5	21.03	21.10	14.04	14.04
M6	24.43	24.49	16.71	16.71

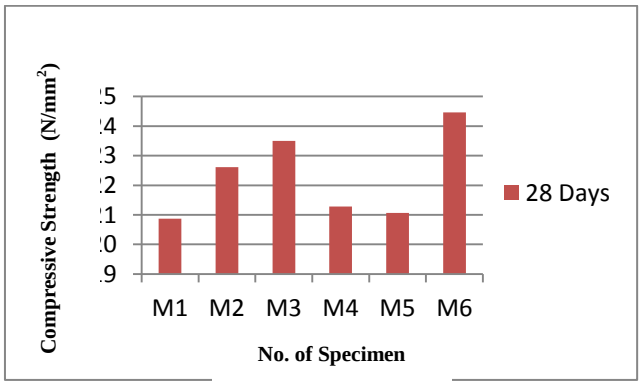

Figure 7.2 Compressive Strength

By comparing conventional and several percentage of Silica Fume and Glass Powder of 10% Glass Powder,10% Silica Fume has the higher compression strength in 28days testing of cube.

7.3 Split Tensile Strength Test

Split Tensile strength test was conducted by using 150 mm diameter x 300 mm height, standard cylinder mould is to be used for concrete mix.

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Table 7.3 Split Tensile Strength

Mix	Split Tensile Strength (N/Mm²)			Mean(N/Mm²)
	S1	S2	S3	
M1	2.05	2.01	2.05	2.02
M2	2.18	2.30	2.11	2.15
M3	1.99	2.01	2.14	2.05
M4	1.91	1.98	1.99	1.92
M5	2.05	2.10	2.11	2.10
M6	2.02	2.15	2.01	2.04

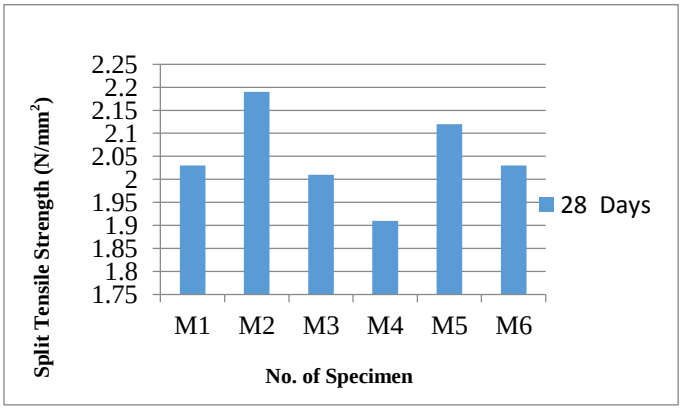

Figure 7.3 Split Tensile Strength

By comparing conventional and several percentage of glass powder and silica fume concrete 0% of glass powder and 10% of silica fume concrete has the higher split tensile strength in 28days testing of cylinder.

7.4 Flexural Strength Test Result

Flexural Strength test was conducted by using 100 x 100 x 500mm, standard prism mould is to be used for concrete mix.

Mix	Flexural Strength (N/mm²)			Mean(N/mm²)
	S1	S2	S3	
M1	2.05	2.01	2.05	2.02
M2	2.18	2.30	2.11	2.15
M3	1.99	2.01	2.14	2.05
M4	1.91	1.98	1.99	1.92
M5	2.05	2.10	2.11	2.10
M6	2.02	2.15	2.01	2.04

Table 7.4 Flexural Strength

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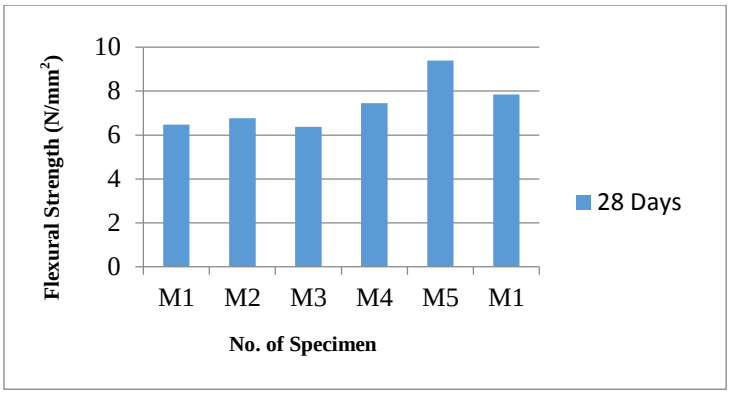

Figure 7.4 Flexural Strength

By comparing conventional and several percentage of glass powder and silica fume concrete 7.5% of glass powder and 10% of silica fume concrete has the higher flexural strength in 28days testing of prism.

8. CONCLUSION

Based on the results obtained from this study, the following conclusions can be drawn:

1. The maximum compressive strength is obtained at 10% replacement of glass powder and 10% replacement of silica fume at 28 days.
2. The maximum split tensile strength is obtained at 2.5% replacement of glass powder and 10% replacement of silica fume at 28 days.
3. The maximum flexural strength is obtained at 7.5% replacement of glass powder and 10% replacement of silica fume at 28 days.
4. The partial replacement of fine aggregate with glass powder and cement with silica fume showed better performance compared to conventional concrete.
5. It also showed increase in compression strength, flexural strength, and split tensile strength.
6. Use of waste glass powder in concrete is economical and paves way to recycling of waste glass.

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