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Experimental Study on Self-Compacting Concrete with Foundry Sand and Glass Powder

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Abstract :. This paper explores an experimental study on self compacting concrete with Foundry sand and glass powder. Environmental pollution a major problem faced by mankind, mainly in the construction industry the production of Portland cement causes the emission of pollutants that causes serious threat to the environment. The pollution effects on environment due to cement production can be reduced by increasing the usage of waste products in our construction industry. Usage of Foundry sand and glass powder is such a remedial measure and in the present study, sand and cement is being replaced with Foundry sand and Glass powder. Viscocrete 20 HE preferred for admixture. The percentage replacement of glass powder with cement includes 10 percent, 20 percent, 30 percent, 40 percent, 50 percent. The fine aggregate is 90 percent of sand and 10 percent of foundry sand. The Mix design for SCC was arrived as per the guidelines of EFNARC. The mix design and the tests to be conducted like material testing, strength tests are being discussed in this paper.
Keywords : Self- Compacting Concrete, Glass Powder, Foundry Sand.

1. INTRODUCTION:

Self compacting concrete was first developed by Prof. Okamura at Ouchi University, Japan in 1986. Self compacting concrete requires no consolidation work which improves the durability and uniformity of the concrete. It is a highly flowable and non-segregating concrete filling the formwork easily. The durability of the concrete was a major problem in Japan during the period of 1983. But the creation of durable concrete structure requires adequate number of skilled workers. Elsewhere the strength of the concrete would get reduced if the labour count reduces. Due to the Lack of uniformity and complete compaction of concrete by vibration researches at the university of Tokyo started to develop SCC. A self compacting concrete is a unique type of concrete which can be compacted into every corner of a formwork purely by its own self weight, without any vibrating compaction. Several European countries recognised the significance of SCC developed in Japan and led to the development of European Federation and Natural trade Associations representing producers and applicators of specialist building products (EFNARC).

2. MATERIALS:

2.1 CEMENT:

Ordinary Portland cement of 53 grade available in local market was used in this study. The specific gravity of cement was found to be 3.15.

2.2 FINE AGGREGATE:

Natural river sand with maximum size of 4.75 mm was used in this study. The specific gravity was found to be 2.55.

2.3 COARSE AGGREGATE:

The maximum size of coarse aggregate used in SCC ranges from approximately 10 mm to 20 mm. The size of coarse aggregate used was 12.5 mm. The specific gravity was found to be 2.65.

2.4 FOUNDRY SAND:

Foundry sand consists of clean, uniformly sized, high quality silica sand that is bonded to form molds of both ferrous and non ferrous metal castings. This can be used in many ways as natural and manufactured sands.

2.5 GLASS POWDER:

Glass is amorphous material with high silica content, thus making it potentially pozzolanic when particle size is less than 75 µm. Studies have shown that finely ground glass does not contribute to alkali–silica reaction. Before adding glass powder in the concrete it has to be powdered to desired size. In the recent, various attempts and research have been made to use ground glass as a replacement in conventional ingredients in concrete production as a part of green house management. The specific gravity was found to be 2.60.

2.6 ADMIXTURE:

The use of admixtures is based on the fact that it should improve the flow characteristics and workability of the concrete. Viscocrete 20 HE is a third generation superplasticizer for concrete and mortar. Viscocrete 20 HE is especially suitable for the production of concrete mixes which require high early strength development, powerful water reduction and excellent workability.

2.7 WATER:

Potable water was used for mixing and curing.

3. EXPERIMENTAL WORK:

3.1 MIX DESIGN:

The mix design for self compacting concrete of grade M25 was carried out as per the guidelines from EFNARC.

3.2 HARDENED PROPERTIES:

The hardened properties of self-compacting concrete for various replacement percentages of Foundry Sand and Glass Powder are determined. The mechanical properties are determined by conducting Compressive strength test, Split tensile strength test, Flexural strength test.

TABLE 3.1 MIX DESIGN

SNo	% of GP Added	Binder (Kg/m^3)		FA (Kg/m^3)		CA (Kg/m^3)	Water Content (l)	SP (%)
		Cement	Glass Powder	Sand	FS			
1	10	360	40	900	100	810	180	1.5
2	20	320	80	900	100	810	180	1.5
3	30	280	120	900	100	810	180	1.5
4	40	240	160	900	100	810	180	1.5
5	50	200	200	900	100	810	180	1.5

FS- Foundry Sand; FA- Fine Aggregate; CA- Coarse Aggregate; SP- Super Plasticizer; GP-Glass Powder

TABLE 3.2 COMPRESSIVE STRENGTH OF SCC WITH FS AND GP

S.No.	Percentage replacement of materials			7 days Compressive strength (N/mm^2)	28 days Compressive strength (N/mm^2)
	Foundry Sand	Glass Powder	Super Plasticizer		
1.	0	0	0	22.66	26.22
2.	10	10	1.5	19.11	25.33
3.	10	20	1.5	17.77	24
4.	10	30	1.5	19.55	24.44
5.	10	40	1.5	19.77	24.66
6.	10	50	1.5	17.77	21.33

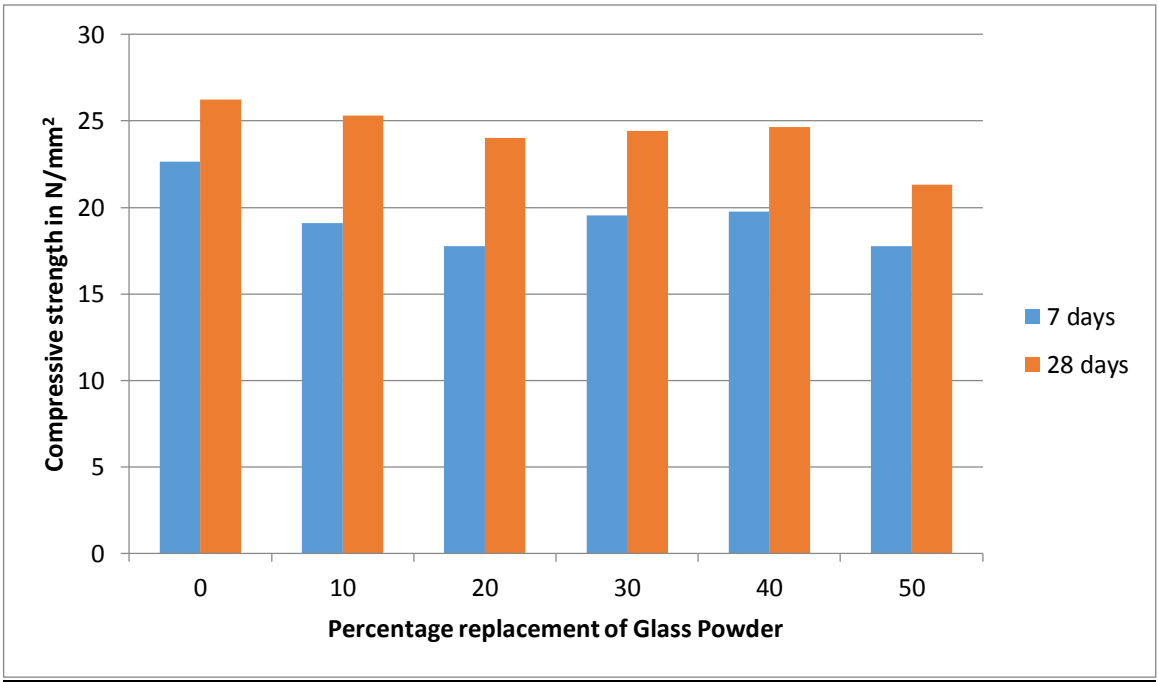

FIG 3.1 CHART FOR COMPRESSIVE STRENGTH OF SCC WITH FS AND GP

TABLE 3.3 SPLIT TENSILE STRENGTH OF SCC WITH FS AND GP

S.No.	Percentage replacement of materials			7 days Split tensile strength (N/mm^2)	28 days Split tensile strength (N/mm^2)
	Foundry Sand	Glass Powder	Super Plasticizer		
1.	0	0	0	2.51	2.90
2.	10	10	1.5	2.12	2.81
3.	10	20	1.5	1.98	2.67
4.	10	30	1.5	2.17	2.71
5.	10	40	1.5	2.20	2.74
6.	10	50	1.5	2.01	2.41

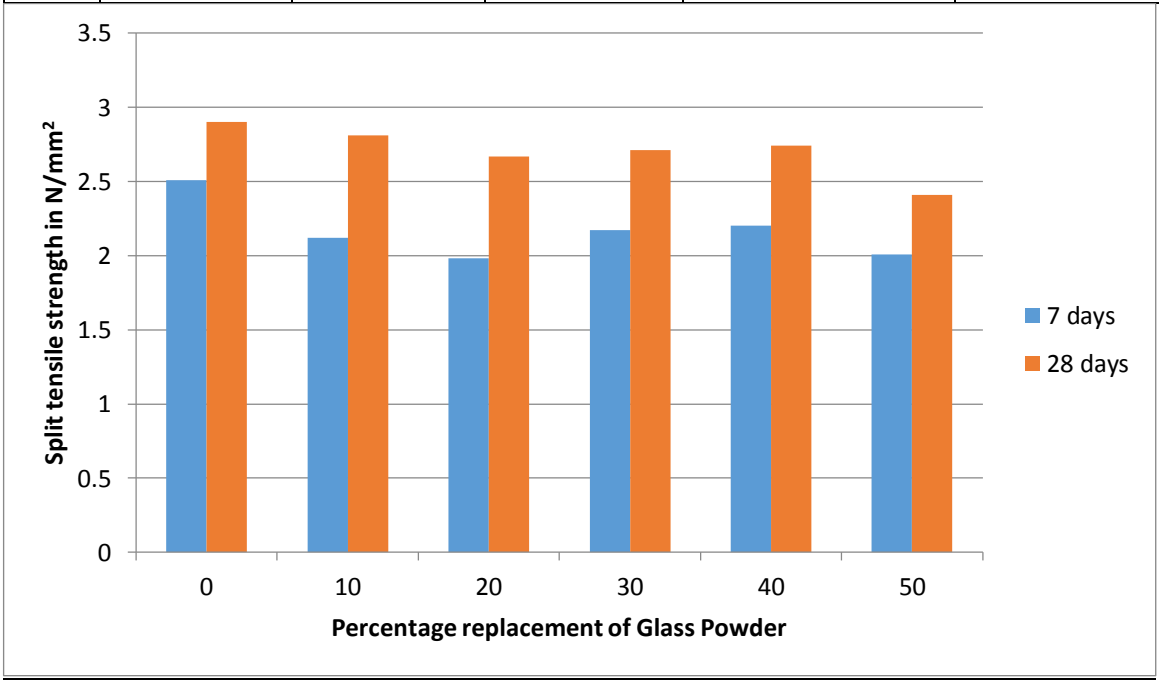

FIG 3.2 CHART FOR SPLIT TENSILE STRENGTH OF SCC WITH FS AND GP

TABLE 3.4 FLEXURAL STRENGTH OF SCC WITH FS AND GP

S.No.	Percentage replacement of materials			7 days Flexural strength (N/mm^2)	28 days Flexural strength (N/mm^2)
	Foundry Sand	Glass Powder	Super Plasticizer		
1.	0	0	0	3.35	4.69
2.	10	10	1.5	3.01	4.21
3.	10	20	1.5	2.80	3.92
4.	10	30	1.5	3.11	4.35
5.	10	40	1.5	3.20	4.50
6.	10	50	1.5	2.82	3.94

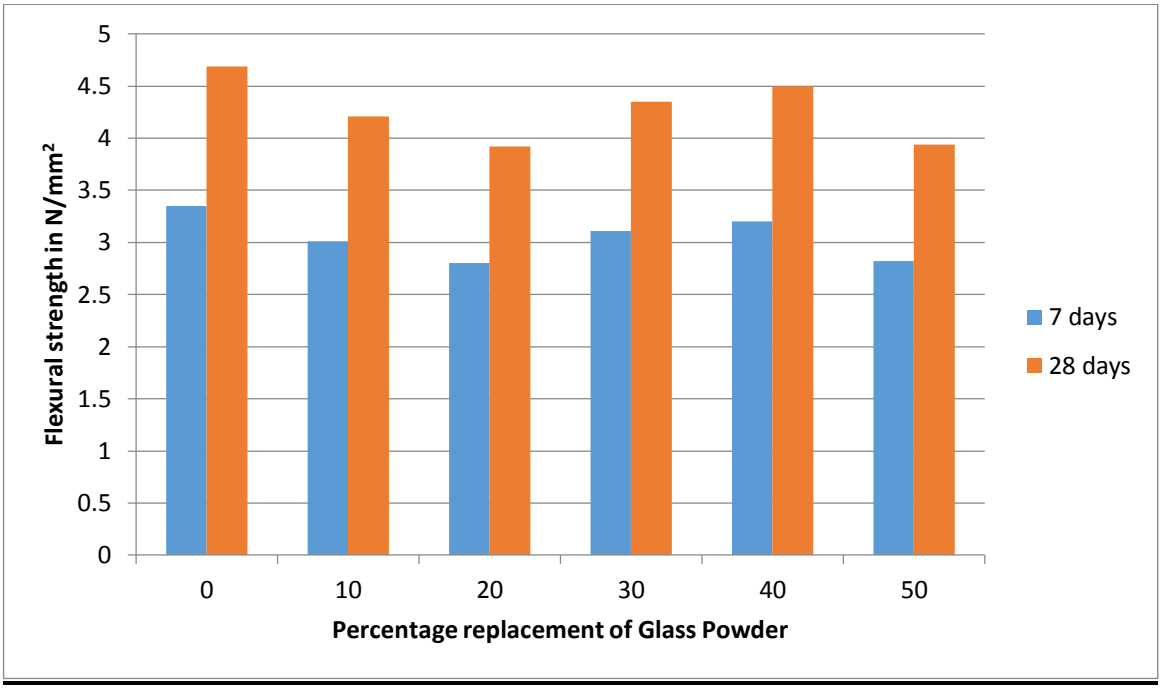

FIG 3.3 CHART FOR FLEXURAL STRENGTH OF SCC WITH FS AND GP

4. CONCLUSION:

The Self compacting concrete with the use of foundry sand and glass powder is found to be economical and environment friendly.

- The use of Glass Powder at a particular percentage increases the hardened properties of Self Compacting Concrete (say 30% - 40%).
- Usage of Foundry Sand at a percentage of about 10% has controlled the strength characteristics.
- Glass Powder when preferred above 40% reduces the hardened properties of SCC.
- Use of modified polycarboxylates based superplasticizer Viscocrete 20 HE improved the flowability of the concrete.
- The result was better achieved with 10% replacement of Foundry Sand with Sand and 40% usage of Glass Powder as a binder along with cement.

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