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Study on Properties of Self Compacting Concrete with Glass Powder and Steel Slag

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ABSTRACT

Cement concrete possesses the most significant job in the field of common building. Cement is the most significant part in Concrete which ties the Totals together, however its creation is very vitality expending and adds to about 7% of Greenhouse gases, all around, and it is evaluated that the generation of one ton of Cement produces about 0.9 huge amounts of CO2, which is discharged in nature. The fine total or sand utilized are typically acquired from common sources exceptionally stream beds or waterway banks. Presently a day because of steady sand mining the characteristic sand is exhausting at a disturbing rate. Along these lines, there is a need to discover option in contrast to common sand and concrete. The endeavors have been made to fractional supplanting of sand with Granular Steel Slag (G.S.S) and bond with Waste Glass Powder (W.G.P) in view to diminish ecological issues like contamination, consumption of common assets and issues in squander the executives.

Granular Steel Slag (G.S.S) which is a result of steel making is delivered during the partition of the liquid steel from debasements in steel-production heaters. The Slag happens as a liquid fluid soften and is an unpredictable arrangement of silicates and oxides that cements after cooling. Expansion of steel slag improves the mechanical properties of cement. Squander Glass Powder (W.G.P) is a valuable mechanical squander. It shows pozzolanic conduct when the molecule size is under 75µ. The pozzolanic properties might be ascribed to the high measure of silica. The particles of Glass Powder are fine, filling voids between bond grains which brings about additional solid Concrete. Fine aggregate was incompletely supplanted with 25%, half and 75% Granular Steel Slag (G.S.S) and bond supplanted with 20% (steady) Waste Glass Powder (W.G.P) for M20 grade concrete. Tests were performed for crisp and mechanical properties of concrete at 7, 28 and 56 days and the outcomes appeared there is a steady increase in qualities from 25% to half of substitution.

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INRODUCTION

Self Compacting Concrete (SCC)

Self compacting or excessively serviceable cement is likewise one sort of High Performance Concrete (HPC) has been created for use in circumstance where vibration is troublesome and fortifying steel is exceptionally blocked. The advancement of self compacting non-isolations concrete using High Range Water Reducing Admixtures (HRWR) is an import achievement towards accomplishing elite cement through mechanization. From the outset it was created in Japan in 1980 to counterbalance a going deficiency of talented work, SCC innovation was made conceivable by the a lot prior improvement of super plasticizers for solid, this innovation depends on expanding the measure of fine material like fly debris, limestone and so forth., without changing the water content contrasted with the customary cement. There are different ideas for the creation of SCC blends which change mostly in the sum and sort of utilized added substances and admixtures.

The Self Compacting (or) Super Workable Concrete, likewise alluded to Self Consolidating Concrete is a profoundly flowable (or) self leveling durable solid that can spread through and around thick support under its very own weight. SCC blend has a low yield pressure and an expanded plastic thickness. The yield pressure is diminished by utilizing a propelled manufactured High Range Water Reducing Admixtures (HRWR), while the Viscosity Modifying Admixtures (VMA) (or) by expanding the level of fines fused in to the SCC blend structure, SCC is likewise alluded as self-leveling solid, very serviceable cement, non-vibrating concrete and so on. The intension behind building up this solid was the worries in regards to the homogeneity and compaction of cast in-site concrete inside exceptionally strengthened structure and improvement of generally sturdiness, nature of cement because of absence of gifted works. With Normal Cement Concrete (NCC) it is an issue as to satisfactory combination in their segments (or) territories of clogged support which prompts huge volume of captured air voids and contains the quality and solidness of the solid, utilizing self-compacting cement can limit the issue, since it was intended to solidify under its own weight. Self compacting concrete is one kind of superior concrete (HPC) with brilliant deformability and isolation opposition. It is an uncommon sort of solid that can move through and fill the holes of fortifications and corners of molds with no requirement for vibration and compaction during the setting procedure. HPC created in North America and Europe is not quite the same as SCC however it is indicating great execution. HPC which for the most part stresses on high quality and solidness of cement as far as usefulness, HPC simply improves smoothness of cement to encourage setting in any case, it can't stream openly without anyone else's input to pack each side of molds and all holes around support. At the end of the day, HPC still requires vibration and compaction in the development procedure. Current utilizations of self-compacting concrete is engaged in superior, better and increasingly dependable quality, thick and uniform surface, improved solidness, high quality and quicker development. In Japan and Europe self compacting solid innovation has been broadly utilized in extensions, structures and tunnel construction where as in USA, SCC technology has been used in precast concrete industry and in architectural concrete.

Fig. 1.1 Self Compacting Concrete

Replacing materials

The following are the replacing materials

1. Glass Powder
2. Steel Slag

Fig. 1.2 Disposal of Industrial Glass Waste

1.3 Glass Powder

A. Physical Properties:

Table 1.1: Physical Properties of Glass Powder

Specific gravity	2.71
Surface area	2120 cm^2/g
Fineness	6

Chemical properties of Glass Powder

Table 1.2: Chemical Properties of Glass Powder

Constituent	Percentage
SIO_2	68
Al_2O_3	0.9
Fe_2O_3	0.6
Cao	14.5
Na_2O_3	12.2
SO_3	0.4
Mgo	1.8
K_2O	0.8

Physical properties:

Steel slag aggregates are highly angular in shape and have rough surface texture. They have high bulk specific gravity and moderate water absorption (less than 3 percent). Table lists some typical physical properties of steel slag.

Table 1.3: Physical Properties of Steel slag

Specific gravity	3.2-3.6
Unit weight	1600-1920
Absorption	Up to 3%

Materials

The following materials are used in the experimental work

- Cement: 53 grade is used in this entire investigation.
- Fine aggregate: Locally available sand confirming to Indian standards (Zone-ii)
- Coarse aggregate: Locally available quarry stone passing through 12mm and retained on 10mm sieve.
- Glass powder: WGP was obtained from SUNTECH FIBRE PVT.LTD, Coimbatore.
- Steel slag: Steel slag was obtained from STEEL PLANT, Visakhapatnam.

The following tests were conducted for cement

1. Consistency test
2. Initial and final setting time of cement
3. Specific gravity

The following admixtures are used

1. Mineral admixtures
2. Super plasticizer

Table 6.1: V-Funnel Test Results

S. No	% of G.P+ % of S.S	Time (sec)
1	M0	6.5
2	M1	6
3	M2	7.2
4	M3	7.5
5	M4	8

Procedure for Making Concrete Trail Mixes:

- The following mixing sequence was arrived at after several trails optimizing the workability.
- All the ingredients were first mixed in dry condition in the concrete drum mixer for one minute

- Then 70% of calculated amount of water was added to the dry mix and mixed thoroughly for one minute.
- The remaining 30% of water was mixed with the super plasticizer and poured into the mixer at the final stage and mixed thoroughly for another one minute before the concrete is taken from the mixer.
- The concrete was filled in the cube moulds of 150mm×150mm×150mm. Because strengths of concrete were cast in each mix.
- A minimum of 3 cubes were tested to ascertain any particular value and the mean thereof was taken as the resul

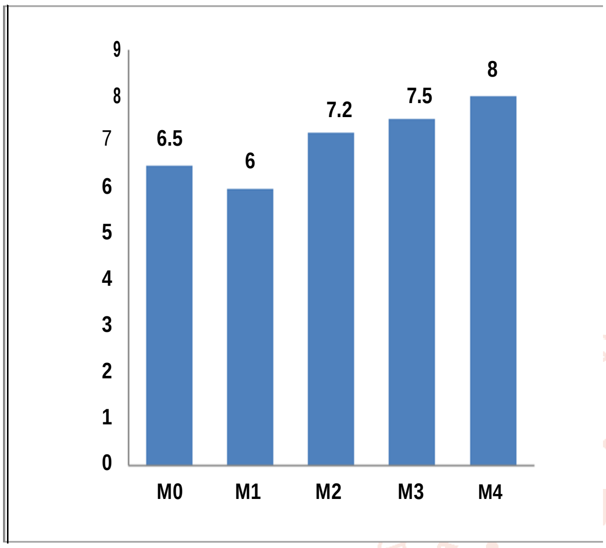

Fig. 6.1 % Replacement vs. V-Funnel Time in secs

Slump Flow Test Results:

Table 6.2: Slump Flow Test Results

S.No	% of GP+ % of S.S	Slump flow(mm)
1	M0	670
2	M1	700
3	M2	650
4	M3	630
5	M4	620

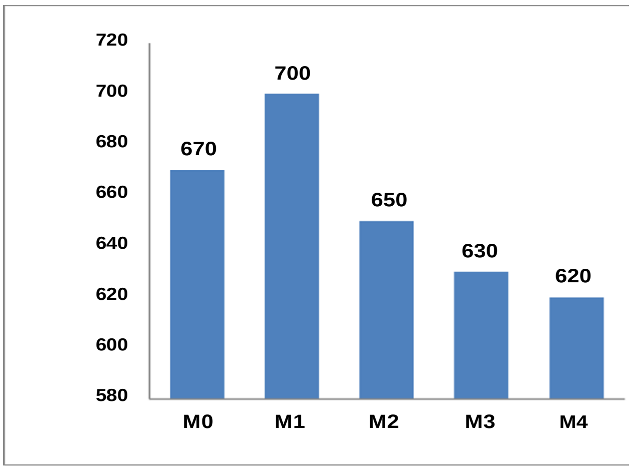

Fig. 6.2 % Replacement Vs Slump Flow Values in mm

J-Ring Test Results:

Table 6.3: J-Ring Test Results

S.No	% of GP+ % of S.S	J- Ring test(mm)
1	M0	6
2	M1	5
3	M2	7
4	M3	8
5	M4	8

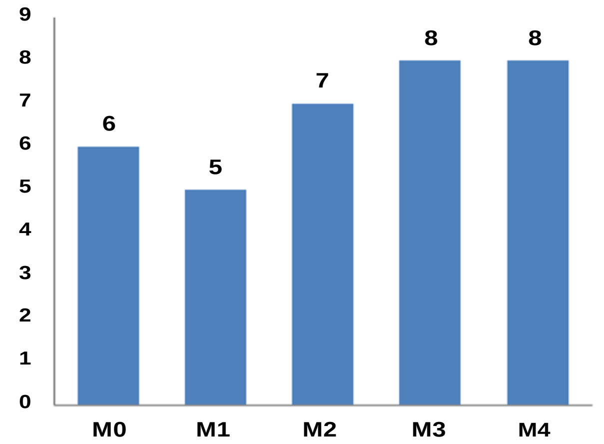

Fig. 6.3 % Replacement Vs J-Ring Test Values in mm

L-Box Test Results

S.No	% of GP+ % of S.S	Blocking ratio(mm)
1	M0	0.87
2	M1	0.9
3	M2	0.85
4	M3	0.8
5	M4	0.8

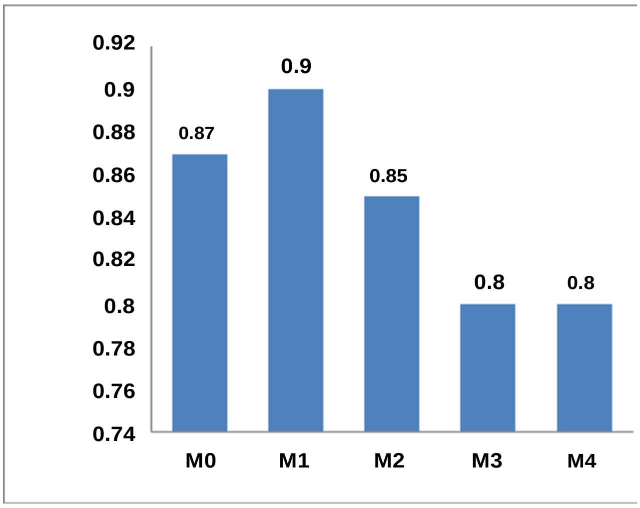

Fig. 6.4 % Replacement Vs Blocking Ratio in mm

CONCLUSIONS

This study was carried out to investigate the combined influence of G.P and S.S replacing cement and F.A, on Fresh and Hardened Properties of SCC. Following conclusions were inferred from the test results:

- The workability of concrete is more with addition of Glass Powder content which may be due to improved packing density with incorporation of G.P.
- Workability decreases gradually with the increase in Granular Steel Slag content i.e.; (25%, 50%, and 75%) which may be attributed to the porous and rough texture of Steel Slag.
- Compressive Strength, Split Tensile Strength, Flexural Strength increases with the increase in Granular Steel Slag content at constant level of Glass Powder up to 50% of Steel Slag which may be due to the pozzolanic action of Steel Slag Aggregates or difference in hardness of Steel Slag and replaced aggregates.
- The percentage variation of compressive strength is 2.35% at M1, 7.35% at M2, 20.58% at M3, 13.53% at M4 for 7 days and 2.16% at M1, 7.23% at M2, 12.7% at M3, 10.45% at M4 for 28 days and 2.26% at M1, 11.4% at M2,
- 17.96% at M3, 14.73% at M4 for 56days with respect to M0 Mix.
- The percentage variation of Split Tensile Strength Test is 2.36% at M1, 6.3% at M2, 28.34% at M3, 11.02% at M4 for 7 days and 2.86% at M1, 6.2% at M2 20.95% at M3, 12.38% at M4 for 28 days and 3.3% at M1, 5.8% at M2, 24% at M3, 12.4% at M4 for 56 days with respect to M0 Mix.
- For Split Tensile Test the maximum increase is 28.34% at 7 days, 20.95% at 28 days and 24% at 56 days for M3 Mix respectively.
- The percentage variation of Flexural Strength Test is 1.26% at M1, 9.7% at M2, 35.02% at M3, 22.36% at M4 for 7 days and 2.22% at M1, 6.66% at M2, 24.5% at M3, 15.55% at M4 for 28 days and 2.5% at M1, 6.77% at M2, 24.8% at M3, 16.05% at M4 for 56days with respect to M0 Mix.
- For Flexural Strength the maximum increase is 35.02% at 7 days, 24.5% at 28 days and 24.8% at 56 days for M3 Mix respectively.
- The waste materials i.e. Glass Powder and Granular Steel Slag may effectively be utilized in construction industry for the production of concrete, offsetting huge quantities of cement and natural aggregates. This may reduce environmental issues and land fill problems in addition to lowering the concrete production cost.
- The developed concrete may be used for residential construction, where moderate compressive strength of concrete is desired. However, durability of concrete need to be investigated to check its performance against acid attack, sulphate attack, freezing and thawing etc. before application.

References

[1] A. A. Aliabdo, A. E. M. A. Elmoaty, A. Y. Aboshama, Utilization of waste glass powder in the production of cement and concrete, Construction and Building Materials 124 (2016) , P.P 866–877.

[2] Ahmed Omran, Arezki Tagnit-Hamou, Performance of glass-powder concrete in field applications, Construction and Building Materials 109 (2016), P.P 84– 95.

[3] Ana Mafalda Matos, Joana Sousa Coutinho, Durability of mortar using waste glass powder as cement replacement, Construction and Building Materials 36 (2012), P.P 205–215.

[4] C. Venkata subramanian, The influence of combination of crushed waste glass powder (GP) and ground granulated blast furnace slag (GGBS) as a partial replacement in cement, on the behaviour of mechanical and durability properties of concrete, Construction and Building Materials 156 (2017), P.P 739–749.

[5] E. Anastasiou, K.G. Filikas, M. Stefanidou, Utilization of fine recycled aggregates in concrete with fly ash and steel slag, Construction and Building Materials. 50 (2014), P.P 154–161.

[6] Esraa Emam Ali , Sherif H. Al-Tersawy, Recycled glass as a partial replacement for fine aggregate in self compacting concrete, Construction and Building Materials 35 (2012), P.P 785–791.

[7] G. M. Sadiqul Islam, M. H. Rahman, Nayem Kazi, partial replacement of waste glass powder with cement for sustainable concrete practices, International Journal of Sustainable Built Environment (2017) , P.P 37–44.

[8] Ivanka Netinger , Damir Varevac , Dubravka Bjegovic , Dragan Moric , Effect of high temperature on properties of steel slag aggregate concrete, Fire Safety Journal 59(2013), P.P 1-7.

[9] M. M. Younes, H.A. Abdel Rahman , Magdy M. Khattab , Utilization of rice husk ash and waste glass in the production of ternary blended cement mortar composites , Journal of Building Engineering 20 (2018), P.P 42–50.