Study on Compressive Strength of Self Compacting Concrete with Partial Replacements of Cement and M-Sand with Granite Sludge & GGBS

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***Abstract*— In the past few years use of Self Compacting Concrete (SCC) is growing tremendous and much research and modification has been done to produce self compacting concrete which has the desired characteristics. There is a current trend in all over the world to utilize the treated and untreated industrial by products, domestic wastes etc. as raw materials in concrete. These not only help in the reuse of the waste materials but also create a cleaner and greener environment. The present study focuses on utilization of Ground granulated blast-furnace slag (GGBS) and granite sludge in SCC as a partial replacement of fine aggregate (M-sand) and cement respectively. In this project, work done on experimental study on fresh and hardened properties such as flow ability, passing ability, compressive strength of M50 grade of SCC. In this investigation SCC was made with partially replacing fine aggregate with GGBS and cement with granite sludge. Five mixes with different percentages of Granite Sludge (0%, 5%, 10%, 15% and 20%) as partial replacement for cement (0%, 10%, 20%, 30% and 40%) of GGBS as partial replacement for fine aggregate (M-sand) is considered. For each mix workability and hardened tests are carried out respectively. The test results for hardened properties are carried out at 7, 28 days respectively. The aim of this research is to know the behavior and mechanical properties of self compacting concrete after addition of industrial waste in different proportion by tests like compressive strength. The obtained results are discussed and finally conclusions are made accordingly.**

***IndexTerms*— SCC, GGBS, Granite Sludge, Conplast SP 430 (Super Plasticizer) , Compressive strength.**

I. INTRODUCTION

The improvement of new innovation in the material science is advancing quickly. In most recent three decades, a great deal of research was completed all through globe to enhance the execution of Self compacting concrete as far as strength and Durability qualities. Consequently concrete has never again remained a construction material consisting of cement, aggregate, and water just, however has turns into a designed uniquely customized material with a few new constituents to meet the particular needs of construction industry. A focus on utilization of granite sludge and GGBS in SCC as a partial replacement of fine aggregate (M-sand) and cement respectively. Self compacting concrete (SCC) is a streaming concrete mix that can consolidate under its own particular weight. The extremely fluid nature of SCC makes it reasonable for placing in difficult conditions and in section with congested reinforcement. Utilization of SCC can likewise help limit hearing related harms on the worksite that are incited by vibration of concrete. Another advantage of SCC is that the time required to place huge section is extensively condensed. The insertion of concrete in limited regions, where consolidation may not be reasonable. For instance, the repair of the base sides of pillars, girders, and slabs often necessitates filling limited and hard to get access areas. Different ranges where SCC can be utilized to encourage concrete placement and assure durability can include the filling of complex formwork and the casting of tunnel lining sections with restricted access to consolidation. Because of industrialization there is enormous quantify of Granite waste, GGBS and so on are industrial Waste and causing threat to environment so the lessen the cost of the construction likewise to make structure more durable, diminish issue of this materials.

GGBS and granite sludge is used in Self compacting concrete to reduce the cost of construction. In the present investigation, the quantities of cement is replaced with different percentages of granite sludge 0%, 5%, 10% , 15% & 20% and also the quantities of sand is replaced with different percentages of GGBS 0%, 10%, 20% ,30% & 40%. The design strength and workability of the concrete, water demand and relative cost of granite sludge and GGBS as compared to fine aggregate and cement. Various laboratory studies such as workability, compressive strength test were conducted on these mixes and are compared with ordinary SCC without granite sludge and GGBS. Test on hardened concrete were done on 7th and 28th days of casting.

A. SIGNIFICANCE OF THIS PROJECT

The project has been undertaken so that it can be used for construction trend subsequent points attempted.

- To study the properties of self compacting concrete
- Designed by replacing cement by granite sludge and M-sand by GGBS
- To ascertain fresh and harden properties of SCC by different methods
- To study the comparativeness

II. LITERATURE REVIEW

Now a day's Concrete is all around approved and most generally utilized construction materials. Essentially concrete is made out of cement, Fine aggregate, Coarse aggregate, Water and furthermore a few times with the increments of Mineral and chemical admixture. Because of increment in development the demand of concrete is raising and at one point of time the accessibility of cement and different constituents of concrete may be exhausted. This can diminish by the utilization of industrial by products as a substitution material which won't influence the properties of concrete. Past research have reasoned that utilization of Granite waste and GGBS builds the mechanical property of concrete and furthermore expansion of these materials in Self compacting concrete the properties won't change much. In [1,2,3] The quantify of aggregates, binders, mixing water and in addition type and dosage of super plasticizer to be utilized are the major point affecting the properties of SCC. Thus they proposed another mix design method for self-compacting concrete. Finally Nan Su method could be used to produce effectively SCC of high quality. Compared with the other technique created by the Japanese Ready-Mixed Concrete Association (JRMCA), this method is less complex, easier for implementation and less time-consuming, requires a smaller amount of binders and saves cost. From [4, 5, 6, 7, and 8] Maximum 20% partial replacement of cement with granite waste has expanded the quality parameter of self compacting concrete. In [9, 10, 11, 12] fine aggregate replaced with GGBS up to 30%.. It has been found that with an increasing in replacement rate of fine aggregate with GGBS the compressive strength, split tensile strength and flexure strength increments. To keep up same trade for concrete the replacement rate kept as 0%, 5%, 10%, 15% and 20%, and fine aggregate is replaced by GGBS as 0%, 10%, 20%, 30% and 40%.

III. MATERIALS USED

A. Cement:

The choice of the type of cement and its substance depend on strength. In present study Ordinary Portland bond of BIRLA 53 Grade conforming it with IS 8112-1989 is used. The specific gravity was observed to be 3.15.

B. Water:

Versatile water was utilized as a part of present investigation for both casting and curing.

C. Fine Aggregate:

The sand used for the investigative work was locally procured and conformed to with Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm strainer to remove any particles more prominent than 4.75 mm and afterwards washed to expel the dust. The fine aggregate belonged to grading zone III. The specific gravity was observed to be 2.6.

D. Coarse Aggregate:

The material which is held on IS sieve no. 4.75 is named as a coarse aggregate. The crushed stone is generally used as a coarse aggregate. The way of work chooses the most maximum size of the coarse total. Locally accessible coarse aggregate having the maximum size of 10-12.5 mm was utilized as a part of our work. The aggregates were washed to remove dust and mud be dried to surface dry condition. The aggregates were tested according IS: 383-1970. The specific gravity was observed to be 2.74.

E. GGBS:

Ground granulated Blast furnace slag cement is in use for moderately long period due to the overall economic system in their creation as good as their enhanced performance characteristics in aggressive environments. GGBS is received by using quenching molted iron slag from a blast kiln in water or steam to supply a glassy grainy product. Then it is dehydrated and grounded in to a best powder. In the last decade a fine deal of study work has been performed addressing the effectively of GGBS. Table 4 shows Physical properties of GGBS.

Sl.No.	Properties	Value
1.	Specific Gravity	2.78
2.	Water absorption	20-25%
3.	Fineness modulus	89% passing through 45 micron sieve
4.	Colour	Pink, light grey, dark grey.

F. Super plasticizer:

Chemical admixture CONPLAST SP 430 is used. CONPLAST SP 430 depends on sulphonated naphthalene polymers and provided as a brown colored fluid in a flash dispersible in water. Conforming in with IS 9103-(1999).

G. Granite Waste:

Were granite waste is replaced by cement. granite waste is a Mineral admixture which is waste item acquired during the way toward sawing of rock shakes in granite industries. This dust is creating great issues because of transfer, as it is making ecological risks. The specific gravity was observed to be 2.63

IV. EXPERIMENTAL PROGRAM

A. Mix Proportion:

The mix proportion was chosen in order to satisfy all the criteria for the concrete in both fresh and hardened state. Since there is no particular methods for SCC mix design many academic institutions, precast and contracting companies have developed their own proportioning methods. The use of ultrafine materials and chemical admixture is a must in case of SCC. The components are better coordinated one by one preventing segregation, bleeding and sedimentation. Based on the [19] EFNARC guidelines are used for developing a mix proportion for M-50.

B. Mix design procedure for M-50

This SCC mix design was proposed by Nan-Su, method: Characteristic Strength = 50 Mpa
Maximum size of aggregates = 12 mm Specific gravity of coarse aggregates, Gg = 2.74 Specific gravity of fine aggregates, Gs = 2.65
Bulk density of loose coarse aggregates = 1385.50 kg/m³ Bulk density of loose fine aggregates = 1450.19 kg/m³ Specific gravity of cement, Gc = 3.15
Volume of fine/course aggregate ratio(s/a) = 0.55

1. Determination of Coarse aggregate

Wca = PF x Wcal x (1-s/a) Assume P.F = 1.15
Amount of coarse aggregate, Wca = 1.15 x 1385.50 x 0.45 Wca = 717.177 kg/ m³

2. Determination Fine aggregate

Wfa =PF x Wfal x (s/a)
Amount of fine aggregate, Wfa = 1.15 x 1450.19 x 0.55 Wfa = 917.125kg/m³

3. Determination of cement

C = F´c/0.110 given 0.11 Mpa C = 58.25/0.110
C = 529.540 kg/m³

4. Determination of water

For W/C ratio for 58.25 Mpa is = 0.34 W/C = 0. 34 W = (W/C)xC
= 0.34 X (529.54) W = 180.64kg/m³

5. Determination of SP dosage

SP dosage = 1.2 % of (529.54) SP = 6.35 kg/ m³

RATIO OF M50 GRADE OF SCC- 1:1.73:1.35 W/C ratio = 0.34

V. RESULTS AND DISCUSSION

The hardened properties of self-compacting concrete for various replacement percentages of Foundry Sand and granite waste are determined.

A. FRESH PROPERTIES

In order to find out the fresh properties of SCC Slump flow, J-ring, L-Box, V-funnel were conducted for each combination. The Fresh properties of SCC mix results are given Table 1.

TABLE 1: FRESH PROPERTIES RESULTS OF SCC

Sl.No.	% replacement of granite sludge	% replacement of GGBS	Slump Test (mm)	J-Ring (mm)	L-Box test	V-Funnel (Sec)
1.	0	0	690	8	0.85	14.5
2.	5	10	705	8.6	0.9	13.2
3.	10	20	695	8.7	0.92	12.45
4.	15	30	685	8.9	0.87	13.20
5.	20	40	680	8.9	0.89	14.5

B. HARDENED PROPERTIES

The mechanical properties are determined by conducting Compressive strength tests at 7 and 28 days of cube (150 x 150 x 150 mm) specimens. Three specimens were tested for each combination. Test results are discussed in below tables.

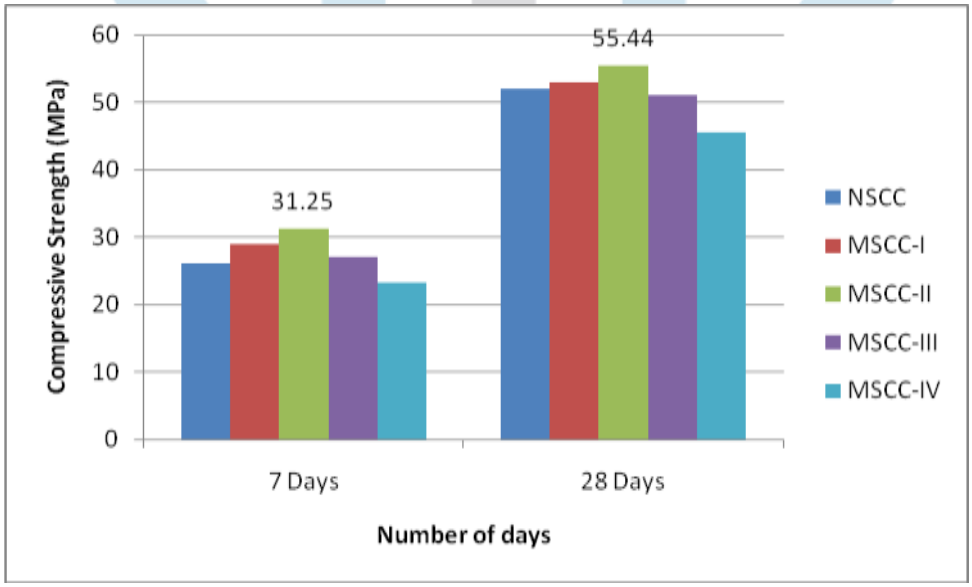
TABLE II: COMPRESSIVE STRENGTH RESULTS AT 7-DAYS

Title	% replacement		Compressive Strength (MPa) 7 Days
	Granite Sludge	GGBS	
NSCC	0	0	26.06
MSCC-I	5	10	29.01
MSCC-II	10	20	31.25
MSCC-III	15	30	27
MSCC-IV	20	40	23.2

TABLE II: COMPRESSIVE STRENGTH RESULTS AT 28-DAYS

Title	% replacement		Compressive Strength (MPa) 28 Days
	Granite Sludge	GGBS	
NSCC	0	0	52.05
MSCC-I	5	10	52.89
MSCC-II	10	20	55.44
MSCC-III	15	30	51.00
MSCC-IV	20	40	45.45

Fig.1. Comparison between 7 and 28 days Compressive Strength



VI. CONCLUSION

Based on the results of this study, the following conclusions are drawn:

- Due to industrialization there is huge amount of granite sludge and GGBS construction and demolition waste is created. These wastes causing threat to environment can be effectively incorporated in the concrete to reduce the cost of construction also to make structure more durable.
- From the results obtained, concrete up to 10% partial replaced of cement by Granite sludge and M-sand by GGBS 20% has got the required standard strength for 28 days of curing for M50 grade Concrete.

- Further increase in percentage of granite sludge and GGBS waste results in reduction of compression strength of concrete.
- It is seen that Density is directly proportional to Strength, as the Density increases, strength increases where as the density decreases, strength also decreases.
- Granite sludge and GGBS are very good replacement for cement and M-sand with respect to economy, strength and considerations of availability of resources.
- The Granite Sludge in place of cement shall be very economical and can also help in the utility of industrial wastes and in maintaining the ecological balance, thus reducing the consumption of cement.

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