Innovations in Self Compacting Concrete Using GGBS AS MINERAL ADMIXTURE

SCC CONCRETE

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Abstract*:* Concrete is a mixing of binding material, fine aggregate, coarse aggregate and finally water. Concrete is normally use in the frame structure. But there is a some limitation like self-compaction, surface finishes, maintains strength at congested area. Due to this limitation we are trying to make self- compacting concrete. SCC is considered a concrete that can be placed and compacted under its own weight without any vibration effort, assuring complete filling of formwork even when access is hindered by narrow gaps between reinforcement bars. Self-compacting concrete has ability involves not only high deformability of paste or mortar, but also resistance to segregation between coarse aggregate and mortar when the concrete flows through the confined zone of reinforcing bars. In recent years, self-compacting concrete (SCC) has gained wide use for placement in congested reinforced concrete structures with difficult casting conditions. For such applications, the fresh concrete must possess high fluidity and good cohesiveness.

Index Terms **- Self-Compacting Concrete; GGBS; Compressive Strength, Admixture.**

I. INTRODUCTION

The Self-Compacting Concrete is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. It Reduced costs as no vibration are required. Use of these materials not only helps it helps in reducing the cost of cement and concrete manufacturing, saving in energy. Utilization may improve the micro structure, durability of concrete, which are difficult to achieve by the use of 43,53 OPC. To avoid the toxic waste and reprocess the waste material, the present study is carried out. As the properties are as good as the cement and Ground granulated blast furnace slag (GGBS) is used as fine partial replacement in the cement in Self compacting concrete.

II. RESEARCH METHODOLOGY

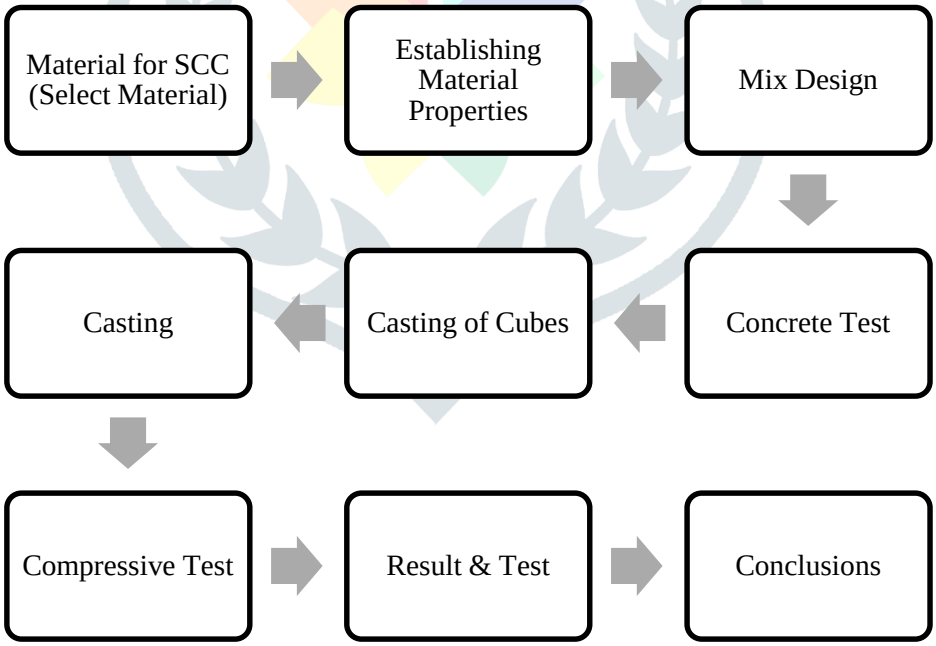

Figure 1 – Flow of Research Methodology

III. MATERIAL OF SCC

A. CEMENT

Table 1 – Cement Ingredient Content

Ingredient	% content
CaO (Lime)	60-67
SiO_2 (Silica)	17-25
Al_2O_3 (Alumina)	3-8
Fe_2O_3 (Iron Oxide)	0.5-6
MgO (Magnesia)	0.1-4
Alkalis	0.4-1.3
Sulphur	1-3

B. FINE AGGREGATES

Fine aggregates can be natural or manufactured. Particles smaller than 0.125 mm i.e. 125-micron size is considered as FINES which contribute to the powder content. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

C. COURSE AGGREGATES

Locally available coarse aggregate having the maximum size of 10 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970.

D. WATER

Ordinary potable water of normally pH 7 is used for mixing and curing the concrete specimen.

E. ADMIXTURES FOR SCC

- Chemical Admixtures
  - Super plasticizer
  - Viscosity Modifying Agent

F. CHEMICAL PROPERTIES

Table 2 – Chemical Properties

Chemical Constituent	Portland	GGBS
CaO	65%	40%
SiO2 (Silica)	20%	35%
Al2O3 (Alumina)	5%	10%
MgO (Magnesia)	2%	8%

G. PHYSICAL PROPERTIES

Table 3 – Physical Properties

Colour	Off-white powder
Bulk density (loose)	1.0–1.1 tonnes/m3
Bulk density (vibrated)	1.2–1.3 tonnes/m3
Relative density	2.85–2.95
Surface area	400–600 m2/kg Blaine

IV. MIX DESIGN

Table 4 – Mix Design of Concrete

	Cement	GGBS	Water	F.A	C.A	Super plasticizer	VMP
	kg	Kg	kg	Kg	kg	kg	kg
SCC1	550	0	175	887	800	5.5	0.825
SCC2	500	50	175	887	800	5.5	0.825
SCC3	475	75	175	887	800	5.5	0.825
SCC4	450	100	175	887	800	5.5	0.825
SCC5	425	125	175	887	800	4.4	0.825
SCC6	400	150	175	887	800	4.4	0.825
SCC7	375	175	175	887	800	4.4	0.825
SCC8	385	165	175	887	800	3.3	0.825

V. RESULTS AND DISCUSSION

Fresh Property Test

Table 5 – Test methods for workability properties of SCC.

No.	Method	Property
1	Slump flow test	Filling ability
2	T50 cm slump flow	Filling ability
3	J-ring	Passing ability
4	V-funnel	Filling ability
5	V-funnel at T5 minutes	Segregation resistance
6	L-box	Passing ability
7	U-box	Passing ability

Design	Slump flow	T50 cm slump flow	J-ring	V-funnel	V-funnel at T5 minutes	U-box Filling height H1-H2	L-box Blocking ratio H2/H1ox
	(mm)	(sec)	(mm)	(sec)	(sec)	(mm)	
SCC 1	640	6.35	14.21	17.00	21.00	18.50	0.630
SCC 2	710	3.13	9.30	8.84	9.96	13.00	0.810
SCC 3	660	5.00	10.00	9.81	13.00	3.00	0.700
SCC 4	655	6.00	10.20	10.00	13.15	0.00	0.820
SCC 5	660	5.10	9.90	8.00	11.40	2.50	0.870
SCC 6	665	3.91	9.80	11.00	13.80	0.00	0.830
SCC 7	680	2.23	9.00	13.24	4.00	3.00	0.760
SCC8	660	3.10	9.10	11.55	13.67	3.00	0.765

A. SCC 1 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 0.0 Kg (0.0%) GGBS and with combination of admixtures (SP+VMA)

Table 6 – Compressive Strength of SCC with 0.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	28.28	30.29	31.26	29.94
Day 7	31.26	33.26	34.96	33.16
Day 14	31.67	41.07	46.46	39.73
Day 28	46.25	48.36	54.50	49.70

B. SCC 2 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 50Kg (9%) GGBS and with combination of admixtures (SP+VMA)

Table 7 – Compressive Strength of SCC with 9.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	30.89	23.86	18.86	24.53
Day 7	40.59	29.07	29.16	32.94
Day 14	45.13	33.68	35.65	38.82
Day 28	51.40	57.20	52	53.53

C. SCC 3 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 75 Kg (14%) GGBS and with combination of admixtures (SP+VMA)

Table 8 – Compressive Strength of SCC with 14.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	21.56	24.74	29.14	22.14
Day 7	39.94	27.21	30.58	32.71
Day 14	38.06	46.22	34.77	39.55
Day 28	42.35	44.38	43.88	43.53

D. SCC 4 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 100 Kg (18%) GGBS and with combination of Admixtures (SP+VMA)

Table 9 – Compressive Strength of SCC with 18.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	18.92	17.09	15.48	18.16
Day 7	22.01	26.24	20.14	22.80
Day 14	27.70	29.28	24.44	27.19
Day 28	38.25	40.92	41.55	40.24

E. SCC 5 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 125 Kg (23%) GGBS and with combination of admixtures (SP+VMA)

Table 10 – Compressive Strength of SCC with 23.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	16.07	17.51	18.38	17.32
Day 7	23.86	22.14	20.65	22.21
Day 14	32.06	32.31	25.14	30.05
Day 28	34.78	38.30	40.42	37.83

F. SCC 6 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 150Kg (27%) GGBS and with combination of admixtures (SP+VMA)

Table 11 – Compressive Strength of SCC with 27.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	18.08	21.35	14.33	17.92
Day 7	22.82	20.76	25.43	24.00
Day 14	31.34	29.27	26.11	28.09
Day 28	32.83	36	28.35	32.09

G. SCC 7 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 175 Kg (32%) GGBS and with combination of admixtures (SP+VMA)

Table 12 – Compressive Strength of SCC with 32.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	18.80	17.80	16.80	17.80
Day 7	20.22	26.17	24.17	23.48
Day 14	25.93	30.90	29.30	28.72
Day 28	28.75	32.40	27.86	31.17

H.

I. SCC 8 COMPRESSIVE STRENGTH TEST

Compressive strength of SCC with 165 Kg (30%) GGBS and with combination of admixtures (SP+VMA)

Table 13 – Compressive Strength of SCC with 30.0% GGBS

	Compressive strength (MPa)			Average Compressive strength (MPa)
	1	2	3	
Day 3	18.70	16.60	16.50	16.93
Day 7	31.39	24.75	20.19	25.44
Day 14	30.36	29.23	28.23	29.27
Day 28	31.25	33.26	35.26	33.25

VI. CONCLUSION

For GGBS replacement, the fresh properties observed were good as compare to SCC without mineral admixture. Hence if we add the GGBS replacement for we can have a better workable concrete. It has been verified, by using the slump flow, T50 cm slump flow J-ring test, L-box test and U-tube tests, that self-compacting concrete (SCC) achieved consistency and self- compactability under its own weight, without any external vibration or compaction. In present study Fresh property concrete test are slump flow test SCC2, SCC3, SCC4, SCC5, SCC6, SCC7, SCC8 exhibited satisfactory slump flows in the range of 650–800 mm, In T50 cm slump flow (sec) test SCC2, SCC3, SCC6, SCC7, SCC8 exhibited satisfactory slump flows in the range of 2-5 sec, In J-ring test all SCC exhibited satisfactory J-ring in the range of 0-10 mm, IN V-funnel test results of this investigation indicated that SCC2, SCC3, SCC4, SCC5, SCC6; SCC8 mixes meet the requirements of allowable flow time 8-12sec, U box test results of this investigation indicated that all SCC mixes meet the requirements of allowable height 0-30mm and L-box test results of this investigation indicated that SCC2, SCC4, SCC5, SCC6 mixes meet the requirements of allowable Blocking ratio H2/H1 0.8-1.0 which is an indication of a good workability. The influence of GGBS on compressive strength of self-compacting concrete is given in Table 5.39 and Fig. 5.16 The percentage of GGBS was 9%, 14%, 18%, 23, %27, 32% and 30% and the water- cement ratios ranged from 0.32. The test results indicated that, 9% percent by mass replacement of GGBS for cement gives the highest strength for short and long terms and when GGBS is replaced by 14%18%,23%,27%,32% and 30% the strength decreases.

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