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Study of Self-Compacting Concrete for Economical Construction

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Abstract—In India, infrastructure is given prior importance and it has been vision to make India fully developed up till 2020.But still at present the average compressive strength of concrete is in range 20.0–30.0 N/mm^2. Thus, it is challenging to produce high strength concrete and the one of the major reason for this is presence of air voids. At present to reduce these voids many compacting machines like vibrators are used in filed. But, this leads to high noise pollution and irritation the person working on site. Thus, to eliminate this problem related to compaction, strength and noise, A new concrete called Self-Compacting Concrete [SCC] is used. It reduces the voids as it flows under its own weight. The strength and durability of SCC is much higher compared to conventional concrete. It also helps in achieving high quality of surface finishes and becomes sustainable as it saves the energy. The limitation with such concrete is that cement content is high and results in increase of cost. So, our research aims to produce a self-compacting concrete and compare conventional concrete and self-compacting concrete for economical.

Keywords—Compressive strength, Conventional concrete, Mix design, Rate analysis of concrete, Self-compacting concrete [SCC].

1. Introduction

It is very important to keep in mind to have 100% of compaction of concrete. But in India, it is next to impossible to get 100% compacted concrete due to lack of skilled manpower, malpractices, lack of communication skill between designers and construction engineers, etc. Along with this, the noise produced by the vibrators and compacting machine is of very high decibel which may result into hearing losses and annoyance the person working on the site. Thus, the only one solution for all such problems is the new kind of High performance concrete i.e. Self-compacting concrete [SCC]. Basically, SCC was produced to get improve strength and durability of concrete. It enhances the quality and improves the productivity and working condition due to elimination of compaction concrete and produce sustainable concrete because of saving of energy.

- Limiting the coarse aggregate content in self-compacting concrete reduces internal stresses between aggregates.
- Addition of super plasticizers can reduce water demand of highly fluid concrete while imparting workability and resisting segregation.
- Self-compacting concrete has tendency to segregate at high workability. This problem can be overcome by adding higher proportion of mineral admixture in self-Compacting concrete

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2. Experimental work

A. Test for this research work

- Slump test [As per IS 456:2000]
- L-box test
- V-funnel test
- J-ring test
- Slump flow table test
- Compressive strength test

B. Test results

➢ Coarse aggregate: 20 mm

- Water absorption: 0.93 %
- Specific gravity: 2.89
- Flakiness index: 12.27
- Elongation index: 11.53

TABLE 1. SIEVE ANALYSIS: 20MM

Is sieve	**Cumulative percentage passing**
20 mm	99.85
16 mm	71.39
12.5 mm	19.10
10 mm	0.99
4.75 mm	0.095

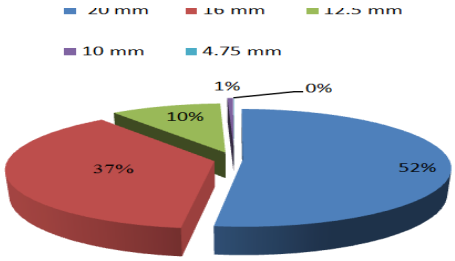


Figure 1. Seive analysis coarse aggregate: 20 mm.

➢ Coarse aggregate: 10 mm

- Water absorption: 1.32 %
- Specific gravity: 2.86

TABLE 2. Sieve analysis: 10mm

Is sieve	**Cumulative percentage passing**
10 mm	92.44
6.3 mm	33.52
4.75 mm	7.39
2.36 mm	0.33
1.18 mm	0.23

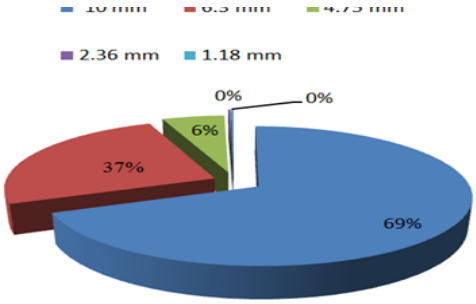


Figure 2. Seive analysis coarse aggregate: 10 mm.

➢ Fine aggregate:

- Water absorption: 0.46 %
- Specific gravity: 2.74

TABLE 3. SIEVE ANALYSIS: 10M

Is sieve	**Cumulative percentage passing**
4.75 mm	95.08
2.36 mm	93.13
1.18 mm	87.86
600 micron	62.91
150 micron	0.37
75 micron	0.18

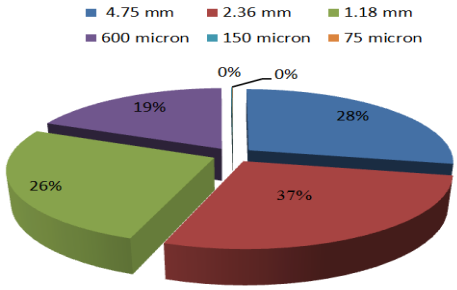


Figure 3. Seive analysis coarse aggregate: 10 mm.

➢ Fly ash:

- Specific gravity: 2.145

3. Mix design

A. Conventional concrete As per IS 10262:2009

- Concrete grade: M_{35}
- Characteristics strength [f_{ck}]: 43.25 KN/mm^2
- Max. aggregate size: 20 mm
- Type of aggregate: Angular crushed
- Exposer condition: Moderate
- Water cement ratio: 0.38
- Mineral admixture: Fly ash [Pozzocrete fly ash]
- Chemical admixture: MASTERPOLYHEED 8980

TABLE 4. Mix design of conventional concrete

	Trial – 1 [As per IS]
Cement	360.00 kg/m^3
Fly ash	90.00 kg/m^3
Water	172.00 kg/m^3
Fine aggregate	608.00 kg/m^3
Coarse aggregate: 200 mm	831.00 kg/m^3
Coarse aggregate; 10 mm	440.00 kg/m^3
Chemical admixture	2.250 kg/m^3

B. Self-compacting concrete

- There is no method for design mix. As per Indian standard.
- Max. aggregate size: 20 mm
- Type of aggregate: Angular crushed
- Exposer condition: Moderate
- Mineral admixture: Fly ash [Pozzocrete fly ash]
- Chemical admixture: MASTERGLENIUM SKY 8784

TABLE 5. Mix design of Self-compacting concrete

	Trial – 1	**Trial – 2**	**Trial – 3**
Cement	450.00 kg/m^3	425.00 kg/m^3	360.00 kg/m^3
Fly ash	135.00 kg/m^3	160.00 kg/m^3	90.00 kg/m^3
Water	194.00 kg/m^3	194.00 kg/m^3	194.00 kg/m^3
Fine aggregate	842.00 kg/m^3	840.42 kg/m^3	840.42 kg/m^3
Coarse aggregate: 20 mm	316.80 kg/m^3	316.13 kg/m^3	316.13 kg/m^3
Coarse aggregate; 10 mm	241.20 kg/m^3	240.17 kg/m^3	240.17 kg/m^3
Chemical admixture	4.40 kg/m^3	4.40 kg/m^3	4.40 kg/m^3

4. Result and Analysis

A. Result

- Conventional concrete

TABLE 6. Slum test result

Grade designation	Type of slump	Workability	Slump test result
M_{35}	True	Medium	145 mm

TABLE 7. Compressive strength result

Days	C/S area [mm^2]	Weight of sample [Kg]	Max. load [KN]	Strength [KN/mm^2]	Avg. strength [KN/mm^2]
7	225.0	8.278	745.3	33.09	34.76
	225.0	8.534	793.3	35.22	
	225.0	8.460	810.7	35.99	
28	225.0	8.506	1053.3	46.77	46.07
	225.3	8.496	1026.1	45.56	
	225.0	8.524	1032.2	45.83	

- Self-compacting concrete

TABLE 8. Test on fresh conctrete

	Slum flow test [mm]	L-box test [mm]	J-ring test [mm]	V-funnel test [mm]
SCC - 1	725	0.85	1.0	10.9
SCC -2	800	0.87	1.01	10.6
SCC – 3	669	1.1	1.33	11.2

TABLE 9. Compressive strength result [SCC – 1]

Trial NO.	Days	C/S area [mm^2]	Weight of sample [Kg]	Max. load [KN]	Strength [KN/mm^2]	Avg. strength [KN/mm^2]
1	7	225.0	8.518	797.0	35.38	32.29
		225.0	8.632	728.5	32.64	
		225.0	8.592	767.7	34.85	
	28	225.0	8.602	1310.7	58.19	52.68
		225.3	8.650	1069.1	47.46	
		225.0	8.640	1180.4	52.40	

TABLE 10. Compressive strength result [SCC – 2]

Trial NO.	Days	C/S area [mm^2]	Weight of sample [Kg]	Max. load [KN]	Strength [KN/mm^2]	Avg. strength [KN/mm^2]
2	7	225.0	8.532	796.04	35.37	33.90
		225.0	8.244	714.80	31.73	
		225.0	8.142	779.40	34.60	
	28	225.0	8.256	1154.20	51.24	51.47
		225.3	8.340	1113.10	49.42	
		225.0	8.236	1204.00	53.45	

TABLE 11. Compressive strength result [SCC – 3]

Trial NO.	Days	C/S area [mm^2]	Weight of sample [Kg]	Max. load [KN]	Strength [KN/mm^2]	Avg. strength [KN/mm^2]
3	7	225.0	8.552	712.90	31.65	34.47
		225.0	8.360	755.80	33.55	
		225.0	8.892	725.80	32.22	
	28	225.0	8.500	1093.6	48.55	47.52
		225.3	8.606	1047.3	46.50	
		225.0	8.502	1070.2	47.52	

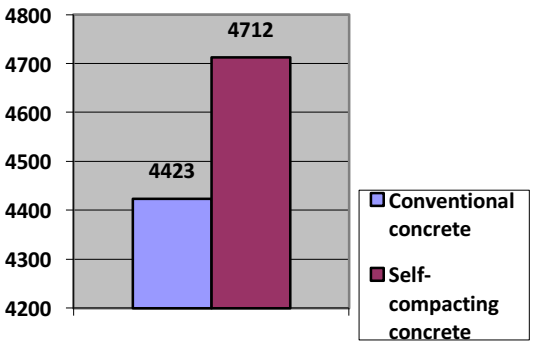
B. Analysis

TABLE 12. Material rate analysis

Material	Unit	Rates
Cement	50 Kg	325
Aggregate: 20 mm	1000 Kg	800
Aggregate: 10 mm	1000 Kg	500
Fine aggregate	1000 Kg	900
Fly ash	30 Kg	150
Chemical admixture	Liter	90 – 180

TABLE 13. Concrete Rtae analysis

Material	Conventional concrete	Self-compacting concrete
Cement	2340	2340
Aggregate: 20 mm	665	253
Aggregate: 10 mm	220	120
Fine aggregate	548	757
Fly ash	450	450
Chemical admixture	200	792
	4423	**4712**



5. Conclusion

- Use of self-compacting concrete No skill labour required.
- By practical, self-compacting concrete give us smooth outer finish as plaster
- Achieve more strength & workability.
- Use fly ash [wastage material] reduce 15 % cement content in concrete.

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