An Experimental Study on Impact Strength of Self Compacting Concrete

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Abstract- **This project presents an experimental investigation on the main characteristics of Self compacting concrete properties in the fresh state like workability and mechanical properties of hardened self compacting concrete like compressive strength and impact strength .And also the determine mechanical properties of hardened conventional concrete like compressive strength and impact strength. The fly ash are replaced 20% in cement. To prevent the environment from noise and to make the work easy for the workers, self compacting concrete is used in this project .The ingredients used for SCC are 53 grade Ordinary Portland cement, Fine aggregate, Coarse aggregate, Super plasticizer, class-F Fly ash from Thermal power plant, Viscosity modifying agent. The basic properties of Cement, Fly ash, and Coarse aggregate, Fine aggregate are studied. The Mix design is carried out for approximately M30 grade of concrete by trial and error method. The Workability tests such as Slump Flow, V-Funnel, L-box, U-box test are carried out for self-compacting concrete. They slab was prepared on both self compacting concrete and conventional concrete by using weld mesh. The specimens for impact studies were tested by drop weight method. The slabs are tested at 7 and 28for self-compacting concrete and its impact test results are compared with Conventional M30 grade concrete.**

***Keywords- Self compacting concrete (SCC), Fly ash, SCC mix design,Impact strength*.**

I. INTRODUCTION

There has been a growing interest in the past few decades among the engineering community to understand the response of reinforced concrete structures subjected to extreme loads due to blast and impact. Although these severe transient dynamic loads are rare in occurrence for most structures, and sudden structural failure. Self-compacting concrete (SCC) is considered as a concrete which can be placed and compacted under its own self-weight and no require vibration, and handled without segregation or bleeding. It is used to proper filling and good structural performance of restricted areas and heavily reinforced structural members. In seismic regions, SCC mainly used for highly congested reinforced structures. Recently, this concrete has gained wide use in many countries for different applications and structural configurations.

SCC can also provide a better working environment by eliminating the vibration noise. The super plasticizer addition of concrete mixture the slump value is highly are easily can be achieved. However, for such concrete to remain cohesive during handling operations, special attention has to be paid to mix proportioning. The addition of super plasticizer to avoid segregation, a simple approach consists of increasing the sand content at the cost of the coarse aggregate content by 4% to 5% . But the reduction in aggregate content results in using a high volume of cement which, in turn, leads to a higher temperature rise and an increased cost.The viscosity-modifying admixture is an alternative approach consists of incorporating to enhance stability.

Self-compaction is often described as the ability of the fresh concrete to flow under its own weight over a long distance without segregation and without the need to use vibrators to achieve proper compaction. The main functional requirements of fresh self-compacting concrete(SCC) have been well documented and discussed by many workers . It is generally recognized that for SCC to perform efficiently, it should have an adequate plastic viscosity together with a low yield stress approaching the behavior of a Newtonian fluid. To achieve these, some of the basic requirements are for mixes to have high powder content and the incorporation of surface-active agents, such as super plasticizers. Inert fillers such as limestone are traditionally used to increase the powder content of SCC mixes. More recently, mineral admixtures have also been considered.

II. STUDY ON MATERIAL

A. Fine aggregate

The fine aggregate used for experimental program was locally procured and conforming to zone II. The fine aggregate was first sieved through 4.75 mm. The Indian Standard Specification of IS: 383-1970 are used by the fine aggregates are tested. The fine aggregate with specific gravity 2.60 and fineness modulus of 2.70.

B. Coarse aggregate

The coarse aggregate was sieved though 12.5mm sieve. The coarse aggregate with specific gravity 2.70.The cement used for the concrete mixtures was 53 grades Ordinary Portland Cement conforming to IS: 8112-1989.

C. Fly ash

Fly ash consists of fine, powdery particles that are predominantly spherical in shape, either solid or hollow, and most glassy in nature. Class F Fly ash as per IS 3812-2000 is used.

D. Super plasticizers

Glenium sky 8233 is an admixture of a new generation based on modified polycarboxylic ether. The super plasticizers for applications in high performance concrete where the highest durability and performance is required. GLENIUM sky 8233 is free of chloride and low alkali. It is compatible with all types of cements.

E.Viscosity modifying agents

The sequence of addition of VMA and super plasticizer into the concrete mixture is important. If VMA is added before the super plasticizer, it swells in water and it becomes difficult to produce flowing concrete.VMA should be added after the super plasticizer has come into contact with the cement particles to avoid this swells in concrete.. In this project, we use Matrix-2 an viscosity-modifying agent.

III.EXPERIMENTAL INVESTIGATION

A.Mix design

The desired properties of concrete can be obtained by using the ingredients in a certain proportion. Thus determining the relative amounts of materials is known as mix design. Thus it can be defined as the process of selecting suitable ingredients of concrete and determining their relative quantities for producing the concrete of desired properties strength, durability and consistency, etc., as economical as possible.

The object of mix design is to decide the properties of material, which will produce concrete having the required properties. The mix proportions should be selected in such a way that the resulting concrete is desired workability while fresh and it could be placed and compacted easily for the indented purpose.

Table 1 Trial Mix Proportions of SCC

S. No	Mix	Cement	Fly ash	F.A	C.A	Water	S.P	VMA
		(Kg/m³)					%	
1	SCC1	439	89	750	750	249	1.14	0.57
2	SCC2	445	89	790	720	270	1.14	0.57
3	SCC3	450	90	820	690	252	1.14	0.57
4	SCC4	455	91	850	650	257	1.14	0.57
5	SCC5	460	92	880	610	255	1.14	0.57
6	SCC6	470	94	920	590	253	1.14	0.57
7	SCC7	480	96	950	575	250	1.14	0.57
8	SCC8	485	100	980	560	254	1.14	0.57

Table 2 Final Mix Proportions of SCC

Water *litre/m³*	Cement *kg/m³*	FA *kg/m³*	CA *kg/m³*
244	485	980	560
0.5	1	2.02	1.15

B. WORKABILITY TEST ON FRESH SCC

1. Slump flow test

The slump flow test aims at investigating the filling ability of SCC.The slump flow test are used two parameters, flow spread and flow time T50 (optional).This is a simple, rapid test procedure, though two people are needed if the T_{50}time is to be measured. The T_{50}time is used on site, though the size of the base plate is somewhat unwieldy and level ground is essential. The slump flow test gives a good assessment of filling ability. The slump flow test gives no indication of the ability of the concrete to pass between reinforcement without blocking, but it gives some indication of resistance to segregation.

Fig 1 Slump flow test

2.V funnel test and V funnel test at T_5minutes

The described V-funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum aggregate size of 12mm. The funnel is filled with about 12 liters of concrete and the time taken for it to flow through the apparatus measured. After this the concrete refilled in the V-funnel and left for 5 minutes to settle.The concrete shows segregation then the flow time will increase significantly.The test is designed to measure flow ability.

Fig 2 V funnel test

3. L box Test

This test are suitable for laboratory and site. It assesses filling and passing ability of SCC, and serious lack of stability (segregation) can be detected visually. The segregation may also be detected by subsequently sawing and inspecting sections of the concrete in the horizontal section.

Fig 3 L Box test

4. U – Box Test

U - Box test is used to measure the filling ability (flow ability) and segregation properties of the SCC. In this test, the degree of compatibility can be indicated by the height that the concrete reaches the other part of box after flowing through an obstacle. The test measures filling and segregation properties of Self Compacting Concrete.

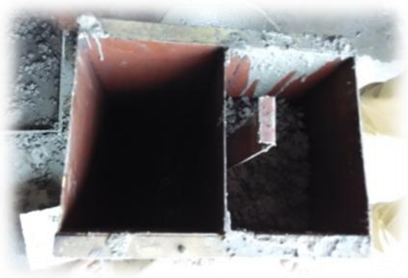


Fig 4 U Box test

C. Workability Test results for SCC

Table 3 Workability test results for SCC

S. No	Workability Test Methods	Minimum	Maximum	SCC
1	Slump flow (mm)	600	800	700
2	T_{50} cm Slump flow(sec)	2	5	3
3	V – funnel test (sec)	6	12	8
4	V – funnel test at T_5 min (sec)	0	+3	10
5	U – box test (sec)	0	30	24
6	L-box test(H2/H1)	0.8	1	0.89

D. COMPRESSIVE STRENGTH RESULTS

1. Conventional concrete

Table 4 Compressive strength conventional concrete at 7 days

S. No	Days	Compressive strength		Average compressive strength (N/mm^2)
		Load (KN)	Stress (N/mm^2)	
1	7	486	21.6	20.53
2	7	438	19.47	

Table 5 Compressive strength conventional concrete at 28 days

S. No	Days	Compressive strength		Average compressive strength (N/mm^2)
		Load (KN)	Stress (N/mm^2)	
1	28	682	30.3	29.7
2	28	661	29.2	

2. Self Compacting Concrete

Table 6 Compressive strength self compacting concrete at 7days

S. No	Days	Compressive strength		Average compressive strength (N/mm^2)
		Load (KN)	Stress (N/mm^2)	
1	7	500	22.22	23.11
2	7	540	24	

Table 7 Compressive strength self compacting concrete at 28 days

S. No	Days	Compressive strength		Average compressive strength (N/mm^2)
		Load (KN)	Stress (N/mm^2)	
1	28	712	31.6	31.2
2	28	694	30.8	

IV. STUDY AND RESULT ON IMPACT STRENGTH

A. Impact strength

There has been a growing interest in the past few decades among the engineering community to understand the response of reinforced concrete structures subjected to extreme loads due to blast and impact. Although these severe transient dynamic loads are rare in occurrence for most structures, their effect can result in sudden structural failure. Some example of structures and their impact design requirements are:

- The Bridge piers must be designed to resist accidental impact by heavy vehicles.
- The Nuclear power facilities must be designed to resist aircraft impact.
- The Military structures and critical civilian infrastructure must be able to survive impact and blast.
- The Offshore structures must be designed to sustain repeated impact loads from docking ships.

In this paper the effect of granite powder on impact resistance of the self compacting concrete is going to be analyzed.

B. Methods of Impact test

There are two methods of impact test are analyzed in concrete.

1) Weight varying method
2) Height varying method.

In this my project the impact test are analyzed by height varying method.

C. Procedure of Impact test

The impact resistance of the specimen was determined by using drop weight method. The size of the specimen 1m length,1m breadth and 2 inch thickness. The weight of hammer is 6 Kg with a drop of 1m and 2m height. The impact resistance of the specimen was determined at 7 days and 14days. The specimens placed on the base plate with the finished face up and positioned within four lugs of the impact testing equipment. The drop hammer is then placed with its base upon the steel ball and held vertically. The hammer is dropped repeatedly. The number of blows required for the first visible crack to form at the top surface of the specimen is to be recorded and also for ultimate failure to be recorded. The first visible crack (N1) and then cause ultimate failure (N2) were noted for all the specimens.. The impact energy delivered to the specimen are calculated by,

$$EI = Nmgh$$

Where, EI is impact energy (N m), N is the number of blows, m is mass of the drop hammer (kg), g is gravity acceleration (N/kg),and h is height of drop hammer (meter).

D. Specimen of Impact test

Fig 5 Specimen of Impact test

E. Impact test apparatus

Fig 6 Impact test apparatus

Fig 7 The specimen before the Impact test

F. Result on Impact Strength

Table 8 Number of blows on concrete slab at 1m height

Type of Concrete	Number of blows on concrete slab at 1 m height			
	Age of curing	First crack (N1)	Failure crack (N2)	N2-N1
Conventional concrete 1:1.7:2.2	7 days	46	59	13
	28 days	122	143	21
Self-Compacting concrete 1:2.02:1.15	7 days	53	64	11
	28 days	138	161	23

Table 9 Number of blows on concrete slab at 2m height

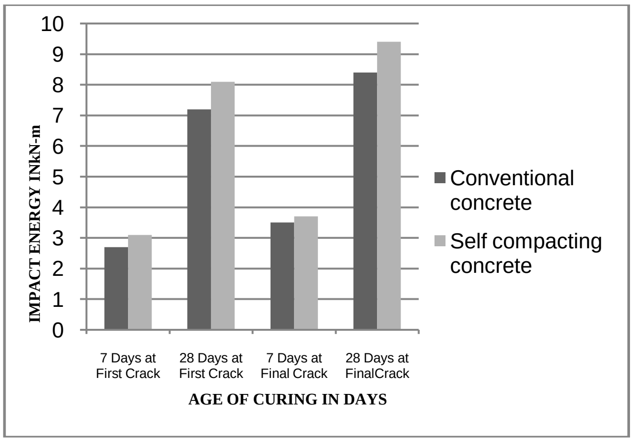
Type of Concrete	Number of blows on concrete slab at 2 m height			
	Age of curing	First crack (N1)	Failure crack (N2)	N2-N1
Conventional concrete 1:1.7:2.2	7 days	19	24	5
	28 days	28	37	9
Self-Compacting concrete 1:2.02:1.15	7 days	23	30	7
	28 days	31	45	14

Table 10 Impact strength on concrete slab at 1m height

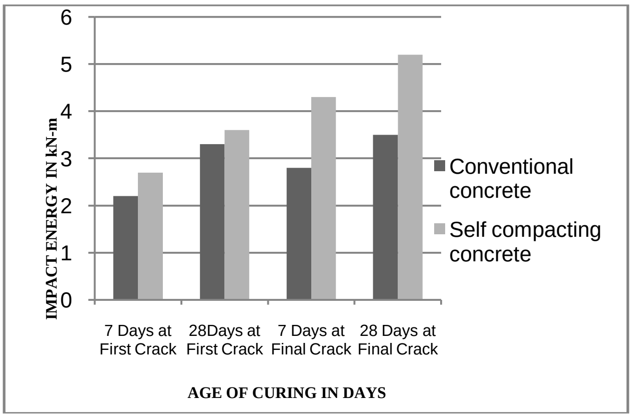
Type of Concrete	Impact energy on concrete slab at 1 m height		
	Age of curing	Impact energy at First crack (kN-m)	Impact energy at Failure crack (kN-m)
Conventional concrete 1:1.7:2.2	7 days	2.7	3.5
	28 days	7.2	8.4
Self-Compacting concrete 1:2.02:1.15	7 days	3.1	3.7
	28 days	8.1	9.4

Table 12 Number of blows on conventional concrete slab at 2m height

Type of Concrete	Impact energy on concrete slab at 2 m height		
	Age of curing	Impact energy at First crack (kN-m)	Impact energy at Failure crack (kN-m)
Conventional concrete 1:1.7:2.2	7 days	2.2	2.8
	28 days	3.3	4.3
Self-Compacting concrete 1:2.02:1.15	7 days	2.7	3.5
	28 days	3.6	5.2



Impact energy are compared between CC and SCC at 1m height



Impact energy are compared between CC and SCC at 2m height

G. Figure on failure specimens

Fig 8 Initial failure on specimen

Fig 9 Ultimate failure on specimen

V CONCLUSION

The basic properties of materials were tested and results tabulated .The Self Compacting Concrete mix proportions are determined by using various trial and error method of SCC. In this project the used two admixtures such as super plasticizers and viscosity modifying agent. The Self compacting concrete is achieved by Cement, Fly ash, Coarse aggregate, Fine aggregate, super plasticizer, viscosity modifying agent and water. The flyash are replaced in cement at 20%.

The fresh concrete test are conducted and to find out the workability. The fresh concrete tests like L box, V funnel, U box and slump flow tests were conducted and results tabulated.

The prepared cube, cylinder and beam. And the mechanical properties are find out, such as compressive strength, spilt tensile strength and flexural strength on both conventional concrete and self compacting concrete at 7 and 28days.The test result are compared by using chart.

The slab was prepared by using weld mesh in slab. The impact strength will be carried out both conventional concrete and Self compacting concrete at 7 and 28 days. And also to compare the conventional concrete and Self compacting concrete by using chart.

In this my project the test results showed that the compressive strength, the split tensile and the flexural strength was good for self compacting concrete when compare to conventional concrete. And also the test results showed that the impact energy was good for self compacting concrete.

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