Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 04, April-2018

Comparative Study of Crushing Strength of Conventional and Self Compacting Concrete

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***Abstract*- This paper deals with comparison of self compacting concrete with conventional concrete. Various parametric tests were performed on samples prepared using both types of concrete. It was observed that the self compacting concrete has higher crushing strength than conventional concrete.**

I. INTRODUCTION

Self-compacting concrete (SCC) can be described as a concrete which has the ability to compact itself only by means of its own self weight without the requirement of any type of vibrations. Self-compacting concrete can be also known as Self Consolidating Concrete or Self Leveling Concrete. Self compacting concrete is placed or poured in the same or the usual way as ordinary/normal concrete but the fact is without vibration. It comes in a form of a very fluid and can pass around obstructions and can automatically fill all the nooks and corners without any risk of either mortar or other ingredients of concrete without separation, at the same time there are no problems of appearing entrapped air or rock pockets. The result which we get from the surface finishing which is produced by self-compacting concrete is exceptionally good and there will no requirement of patching.

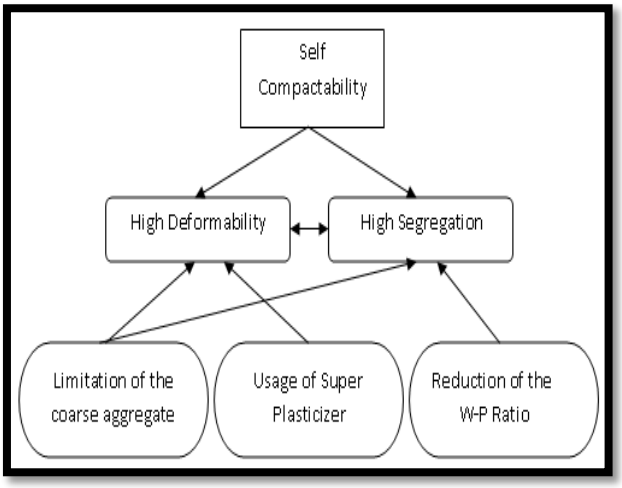

Fig. 1. Nature of self compacting concrete

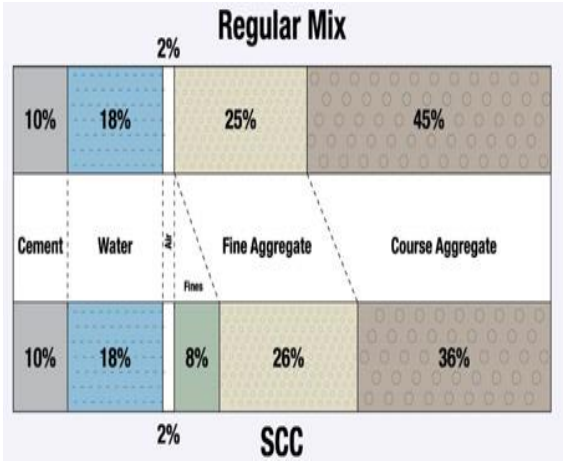

Fig. 2 Comparison between SCC and conventional concrete

SCC is characterized by a low yield stress, high deformability and moderate viscosity necessary to ensure uniform suspension of solid particles during transportation, placement (without external compaction), and thereafter until the concrete sets. Such concrete can be used for casting heavily reinforced sections, places where there can be no access to vibrators for compaction and in complex shapes of formwork which may otherwise be impossible to cast, giving a far superior surface than conventional concrete.

II. METHODOLOGY

The procedure for preparation of cube of concrete (M-25) is as follows:

- Intial step in mould preparation is fixing and oiling
- Then ensure that proper shape is there in mould or not
- Preparation of concrete mixture in sufficient quantity to fill the cubical moulds
- Filling and Compaction in 3 Equal layers with minimum of 35 strokes
- Identification and marking of respective cube samples for tests
- Removal of cube samples from mould with utmost care to ensure that no damage is done to the sample
- Carrying and displacing cube samples must be done with proper care

International Journal of Engineering Research & Technology (IJERT)
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Fig. 3. Cube preparation

Various steps that are involved in the study was:

- Preparation phase
  - Preparation of conventional concrete mixture
  - Preparation of conventional concrete cube (M25)
  - Preparation of Self compacting concrete mixture
  - Preparation of Self compacting concrete cube (M25)
- Testing phase
  - Slump flow test, L box apparatus test and J ring flow test were performed for all above types of mixtures
  - Compression tests were performed mainly using compression test machine on conventional concrete, Self compacting concrete and fiber reinforced concrete.
- Analysis Phase
  - Crushing strength and crushing load of all type of samples were noted and calculated.
- Reading were repeated to achieve repeatability of results
- Crushing strength of self compacting concrete was compared to the crushing strength of conventional concrete

III. RESULTS AND DISCUSSION

Self compacting concrete and conventional concrete mixtures were used for preparing cube samples of same size (M25). Prepared cubes were subjected to compression tests under compression testing machine after weighing. Compression tests of prepared samples were carried out after 7 days, 14 days and 28 days respectively. It was a known fact that initial crushing strength was observed after 7 days while crushing attains its maximum and true value after 28 days due to proper setting of core structure and water.

TABLE.I Cube Testing Results of Normal Concrete (7 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
NC-1	8.740	451	20.04	19.98(N/mm^2)
NC-1	8.615	422	18.75	
NC-1	8.518	476	21.15	

TABLE.II Cube Testing Results of Normal Concrete (14 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
NC-2	8.580	595	26.44	25.7(N/mm^2)
NC-2	8.600	599	26.22	
NC-2	8.720	550	24.44	

TABLE .III Cube Testing Results of Normal Concrete (28 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
NC-3	8.455	723	32.13	31.12(N/mm^2)
NC-3	8.560	628	27.91	
NC-3	8.495	750	33.33	

Self compacting concrete mixture was prepared and then poured into the constructed cubical mould in order to attain a cube of M25 grade since the cube was made based on ASTM standard all the dimension of the cube was known. Known dimensions were basically useful for calculating the area and volume of concrete cube. Various cube samples were prepared and cured. Samples were tested under compressive loads after 7, 14 and 28 days respectively. It can be observed from the below tables that with the increase in number of days crushing strength and crushing load carrying capacity of the structure continues to increase and attains maximum value after 28 days.

TABLE.IV Cube Testing Results of Self Compacting Concrete (7 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
SCC-1	8.590	517	22.97	22.33(N/mm^2)
SCC-1	8.660	502	22.31	
SCC-1	8.725	489	21.73	

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TABLE.V Cube Testing Results of Self Compacting Concrete (14 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
SCC-2	8.710	603	26.8	26.97(N/mm^2)
SCC-2	8.690	591	26.26	
SCC-2	8.645	627	27.86	

TABLE .VI Cube Testing Results of Normal Concrete (28 Days) Grade of Concrete= M25

Cube I.D	Weight of Cube	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength
SCC-3	8.510	785	34.88	36.39(N/mm^2)
SCC-3	8.740	843	37.46	
SCC-3	8.645	829	36.84	

Conventional concrete and Self compacting concrete were compared to each other on the basis of crushing strength and crushing load carrying capacity. It was observed that fiber reinforced concrete has more crushing load than conventional concrete for same weight samples under all categories i.e. after 7 days curing, 14 days curing and 28 days curing respectively. It was also observed that mean compressive strength of fiber reinforced concrete was higher than that of conventional concrete.

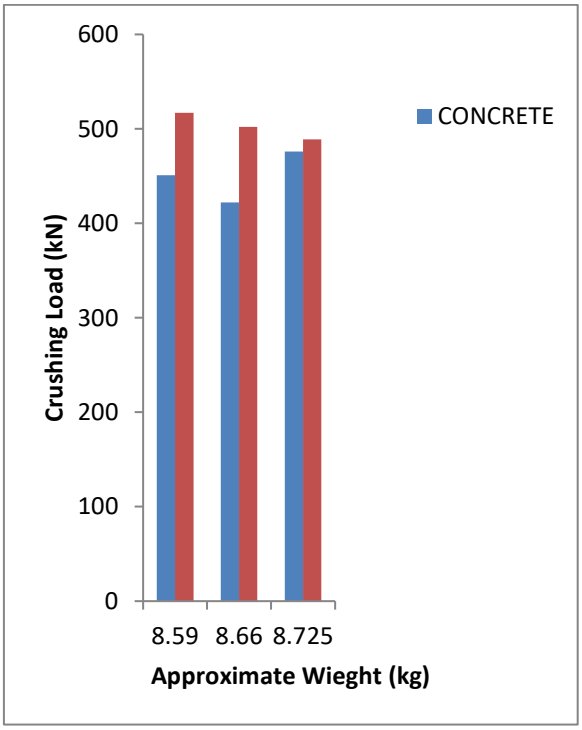

Fig 4 Crushing load vs Weight of cube cured for 7 days

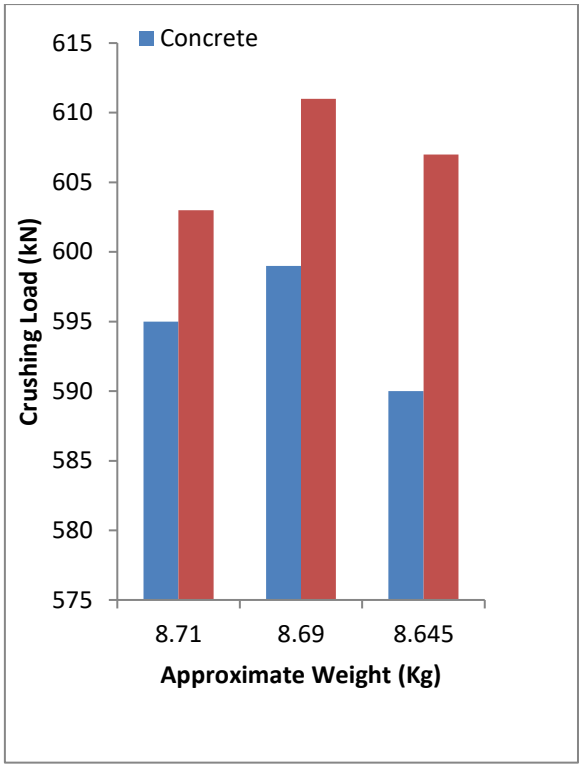

Fig 5 Crushing load vs Weight of cube cured for 14 days

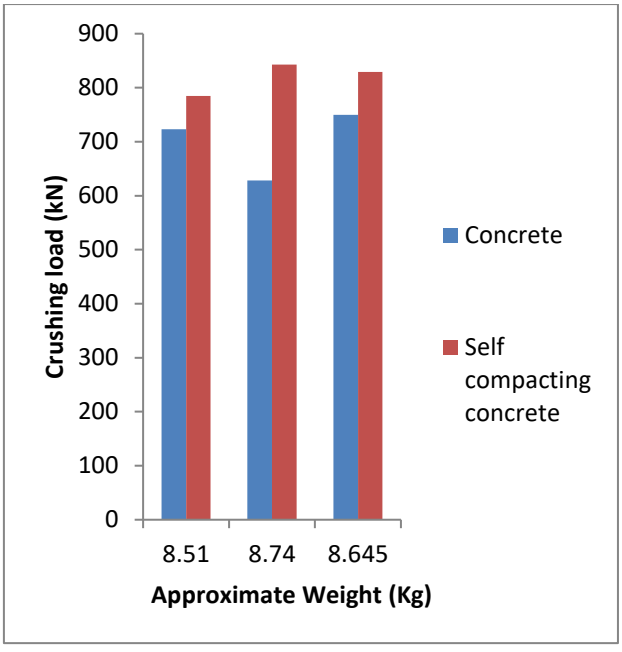

Fig 6 Crushing load vs Weight of cube cured for 28 days

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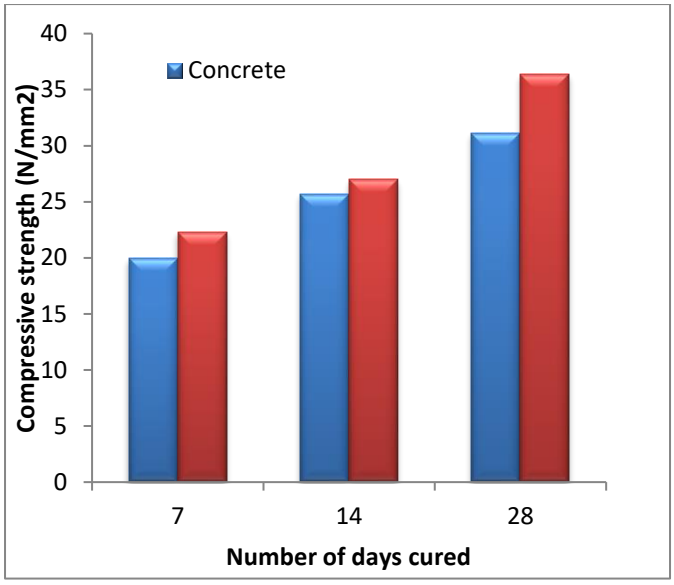

Fig. 7 Comparison of compressive strength of concrete and Self compacting concrete

It can be seen from the diagram below that self compacting concrete has higher strength on comparison with conventional concrete. It was observed that Self compacting concrete has 16.9% higher compressive strength on comparison with concrete.

IV. CONCLUSIONS

Some of the major observations of the study are:

- Conventional concrete and self compacting concrete mixtures were prepared.
- Compression test cubes for conventional concrete and self compaction concrete were prepared.
- Slump test, L box apparatus test and J ring test for both types of concrete mixture were performed.
- Self compacting concrete has higher crushing load than conventional concrete for all types of cured cube test i.e. 7 days cured cube, 14 days cured cube and 28 days cured cube respectively.

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