ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

AN EXPERIMENTAL DEVELOPMENT OF M40 GRADE SELF COMPACTED CONCRETE & CAMPARISION IN BEHAVIOUR WITH M40 CONVENTIONAL CONCRETE

Matha Prasad Adari*, Prof. E.V.Raghava Rao, D.Sateesh
* Structural Engineering, Dept.of Civil Engg. Visakha Technical Campus
Visakhapatnam, Andhra Pradesh, INDIA
Head of the Department, Visakha Technical Campus Visakhapatnam, Andhra Pradesh, INDIA
Structural Engineering, Visakha Technical Campus
Visakhapatnam, Andhra Pradesh, INDIA

ABSTRACT

Conventional concrete tends to present a problem with regard to adequate consolidation in thin sections or areas of congested reinforcement, which leads to a large volume of entrapped air voids and compromises the strength and durability of the concrete. Self-compacting concrete (SCC) can eliminate the problem, since it was designed to consolidate under its own mass. Normal concrete was designed by using IS method and self-compacting concrete was designed by a simple mix design proposed by Nan Su. SCC was developed in 1988's by Prof. Hagime Okamura in Japan. SCC was one of the special concrete in across the world.

This project deals with the comparison of two different types of high strength concretes they are high strength conventional concrete and high strength self-compacting concrete.

An experimental and numerical study on mechanical properties, such as compressive strength, flexural strength and split tensile strength of self-compacting concrete (SCC) and the corresponding properties of conventional concrete (CC) were studied. The age at loading of the concretes for 7 and 28 days curing.

KEYWORDS:.

INTRODUCTION

Concrete is the most basic element for any kind of construction work. No matter what type of building structure it is, the concrete used should be sturdy and well compacted. The main reasons for compacting any type of concrete are:

- To ensure attaining maximum density by removal of any entrapped air.
- To ensure that the concrete used is in full contact with both the steel reinforcement and the form work.

Ensuring the above points not only provide additional strength to the structure but also good finish and appearance to the final product. The compacting of any conventional concrete is done through external force using mechanical device.

What is concrete?

Concrete is a composite construction material, composed of cement (commonly Portland cement) and other cementitious materials such as fly ash and slag cement,aggregate generally a coarse aggregate made of gravels or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand, water, and chemical admixtures.

Conventional concrete composition:

There are many types of concrete available, created by varying the proportions of the main ingredients below. By varying the proportions of materials, or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.
The mix design depends on the type of structure being built, how the concrete will be mixed and delivered, and how it will be placed to form this structure.

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

What is self-compacting concrete?
Unlike the conventional concrete, self- compacting concrete doesn't require compacting using external force from mechanical equipment such as an immersion vibrator; instead SCC is designed in such as way that it gets compacted using its own weight and characteristics.

Once applied, the self-compacting property enables the concrete to fully reinforce around the steel structures and completely fill the space within the framework. The self-compacting of concrete is achieved without losing any kind of strength, stability, or change in properties.

How is SCC made?
Self-compacting concrete is a type of concrete, which is not a product of mixing substances having different properties but a combination of several mixes having the same flow characteristics.
Manufacturing of a Self -Compacting Concrete requires three main aspects to be full-filled. They are as follows:

- High amount of water reducing substance or super plasticizers is added for obtaining high flowing characteristics.
- A type of aggregate mixture is added to gain the desired compactness. Note that the aggregate content is of round shape and proportional in size in order to increase the locking tendency of the concrete.
- Alteration of fluid properties is done to ensure a cohesive mix which will keep the aggregate and paste together. These fluid properties can be achieved by adding a high quantity of fine content such as cement fly-ash or by adding viscosity modifying admixtures (VMA).Two Main Methods of Making SCC:

There are two known and main methods for making SCC. They are as follows

Powder method:
In this method superplasticisers are mixed with cementitious materials such as fly ash, slag, etc. to form a paste. The paste increases the flow of the concrete and holds all the constituents together.

Admixture method:
In this method instead of the conventional superplasticisers, new types of superplasticisers known as polycarboxylate superplasticisers are used. This not only increases the flow capability of the concrete but also improves the viscosity and the constituent's retention property.Usage of Self-Compacting Cements has increased tremendously in the past few years. SCC not only ensures a structure with robust characteristics but also helps in timely completion of building structures

Self-compacting concrete composition:
Self-compacting concrete is a fluid mixture, which is suitable for placing in difficult conditions and in structures with congested reinforcement without vibration. In principle, a self-compacting or self-consolidating concrete must have:

- Fluidity
- Homogeneous
- Flow easily through reinforcement

The technology of SCC is based on adding or partially replacing Portland cement with amounts of fine material such as fly ash, blast furnace slag and **silica fume** without modifying the water content compared to conventional concrete. This process changes the rheological behaviour of the concrete.
Generally SCC has to have proper flowability and viscosity, so that the coarse aggregate can float in the mortar without segregating. To achieve a balance between flowability and stability, the content of particles finer than the 150 µm has to be high, usually about 520 to 560 kg/m^3. SCC is very sensitive to fluctuation in water content: therefore, stabilizers or viscosity modifying agents such as polysaccharides are used. In Japan, SCC are divided into three different types according to the composition of the mortar.

- Powder type
- Viscosity-modifying agent type
- Combination type

For the powder type, a high proportion of fines produce the necessary mortar volume, whilst in the stabilizer type, the fines content can be in the range admissible for the vibrated concrete. The viscosity required to inhibit segregation will then be adjusted by using a stabilizer. The combination type is created by adding a small amount of stabilizer to the powder type to balance the moisture fluctuations in the manufacturing process. However, after completion of proper proportioning, placing, curing, and consolidation, hardened concrete becomes strong, durable, and practically impermeable building material that requires no maintenance.

Properties of SCC:

Compressive strength:

At similar water/cement ratios, the characteristic strength of SCC is at least equal to that of traditional concrete, and has a similar strength development for the same Grade.

SCC with a characteristic compressive strength up to 60N/mm^2 can be easily produced. For a lower specified strength, the high fines content and low water/(cement fines) ratio required for the essential theological properties of SCC may make it difficult to keep the strength down. The benefits of higher characteristic strength should be incorporated in the structural design.

In-situ compressive strengths, measured on core samples taken from structures, are similar to those of traditional well-- compacted concrete. The low values of excess void age observed in core samples indicate that a satisfactory degree of compaction is achieved, comparable to well-compacted traditional concrete. The in-situ strength distribution in large vertical elements is also similar, i.e. higher at the bottom, lower at the top when cast vertically. This has been confirmed by other in-situ methods, such as pull-off tests.

Tensile strength:

When assessed using the cylinder splitting test, as specified in BS 1881: Part 117: 1983 Testing concrete: method for determination of tensile splitting strength, the tensile strength is comparable to the same grade of traditional concrete, as is the ratio of tensile to compressive strength.

Shrinkage:

Drying shrinkage has been shown to be similar or lower than that of traditional concrete of the same grade. This is contrary to that expected from the lower grade aggregate content, but is partially explained by the similar water content of SCC and traditional concrete. The high fines content and viscosity of SCC inhibit bleeding and, therefore, evaporation, so the total plastic settlement is reduced. However, as water lost by evaporation is not replaced by bleed water, plastic shrinkage and the associated surface cracking may be increased. Attention to curing is important, especially on large flat exposed areas.

Structural performance:

The structural performance of SCC does not differ much from that of traditional concrete. Assessment by loading to failure of 3000 x 300 x300nmm reinforced columns and 4000 x 300 x200mm beams has shown that normal fracture patterns occur in all cases, with the actual failure load exceeding the calculated ultimate load.

Durability:

Two indices of durability have been investigated: carbonation depth and surface absorption. No difference was found in carbonation depth between SCC and traditional concrete of the same grade during the same specified period, and SCC exhibited lower surface absorption, indicating lower permeability and improved durability.

Objectives of Self- Compacting Concrete:
The SCC should meet the some functions at the plastic stage are different from those on a traditional vibrated fresh concrete. Filling of formwork with a liquid suspension requires workability performance which is recommended to be described as follows:

- **Filling Ability:**
  SCC is filling of entire formwork and encapsulation of reinforcement and other inserts with maintaining homogeneity in both vertical & horizontal directions are essential.
- **Passing Ability:**
  SCC is passing through congested area such as narrow sections of the formwork even closely spaced reinforcement etc without blocking caused by interlocking of aggregate particles.
- **Resistance to Segregation:**
  SCC is maintaining of homogeneity throughout mixing and during transportation and casting. The dynamic stability refers to the resistance to segregation during placement. The static stability refers to resistance to bleeding, segregation and surface settlement after casting.

Comparison: Typical SCC vs Conventional Concrete Mix

Material, by volume	**Conventional vibrated concrete (%)**	**SCC(%)**
Admixtures	<0.01	0.01
Water	18	20
Coarse aggregate	46	28
Sand	24	34
Fines, including Portland cement	12	18

Main difference:
The main differences between conventional vibrated concrete and SCC concrete are related to the behaviour in the fresh state.
In terms of the hardened properties, at similar water/cementitious material ratio, properly proportioned, produced and placed SCC is generally denser and less variable than the equivalent conventional vibrated concrete, thereby resulting in improved strength and durability performance.
In addition, compared to conventional vibrated concrete, SCC at similar water/cementitious material ratio is expected to have:

- The same structural performance.
- Equal or higher compressive and tensile strength
- Equal to or lower shrinkage.
- Equal to or better bond to the steel reinforcement
- Lower surface absorption and therefore better durability.

- **The principal benefits of SCC are advantages derived from the properties of fresh mix itself, namely**: Ability to completely fill complex formwork and encapsulate areas of congested steel reinforcement without any compaction and yet with reduced risks of voids and honeycombing.
- Ability to develop higher early and ultimate strengths and enhanced durability properties compared with conventional vibrated concretes.
- Potential for improved surface finishes with reduced making good costs related to poorly compacted surfaces.

SCC offers many advantages for the precast, pre-stressed concrete industry and for cast-in-place construction viz :

- Low noise-level in the plants and construction sites.
- Eliminated problems associated with vibration.
- Less labour involved.
- Faster construction.
- Improved quality and durability.
- Higher strength.

Although the SCC as a material will cost slightly more than conventional concrete, significant costs savings can be realised through the whole concreting process including giving consideration to SCC at the detailed design stage of a project. Such benefits can be summarised as follows:

- Reduced construction time and labour costs.
- Reduced man power for placing and compacting
- Lower equipment costs and less noise since vibrators are not required.
- Improved Health & Safety in the workplace environment through the elimination of vibrating equipment and associated health and safety risks. Reduced noise levels, reduced trip and fall hazards, less manual handling.

EXPERIMENTAL PROGRAM

GENERAL

An experimental study is conducted to find out the 7 and 28 days Compressive, split-tensile, Flexure test were conducted on self-compacting concrete. In concrete micro silica and additives are added. The effect of addition of micro silica and additives on strength and workability of concrete over the conventional concrete are investigated.

MATERIALS

CEMENT:

Ordinary Portland Cement of 53 Grade available in local market is used in the investigation. The cement used has been tested for various properties as per IS: 4031 – 1988 and found to be conforming to various specifications as per IS: 12269 – 1987. The test results on ordinary Portland cement are shown in Table – 4.1

FINE AGGREGATE:

The locally available sand is used as fine aggregate. It should be free from clay, silt, organic impurities, etc., the sand is tested for various properties such as specific gravity, bulk density, etc., in accordance with IS: 2386 – 1963. The grading or particle size distribution of fine aggregate shows that, it is close to grading or particle size distribution of fine aggregate shows that, it is close to grading zone – II or IS: 383 – 1970. And details of sieve analysis are shown in Table – 4.2

COARSE AGGREGATE:

Machine crushed angular granite metal of 20 mm size from the local source is used as coarse aggregate. It should free from impurities such as dust, clay particles, organic matter etc., the fine and coarse aggregate are tested for its various properties as shown in table – 4.2.The grading or particle size distribution of coarse aggregate shown close for single sized aggregate of nominal size 20 mm as per IS: 383 – 1970 and details of sieve analysis are shown in table 4.3.

SUPER PLASTICIZER:

High range water reducing admixture called as super plasticizers are used for improving the flow or workability for decreased water-cement ratio without sacrifice for compressive strength. These admixtures when they disperse in cement agglomerates significantly decrease a viscosity of the paste by forming a thin film around the cement particles. In the present work water-reducing admixture Glenium B233 conforming to ASTM C494 Types F, EN934-2 T3.1/3.2, IS 9103: 1999 is used. GLENIUM B233 is an admixture of a new generation based on modified polycarboxylic ether. The product has been primarily developed for applications in high performance concrete where the highest durability and performance is required.

MICROSILICA:

Micro silica is an artificial pozzolanic admixture obtained from reduction of high purity quartz with coal in an electric furnace in the manufacture of silicon or ferrosilicon alloy. Elkom Micro silica was used in this work. Micro silica is the most reactive of several supplementary cementing materials for modifying the cement matrix to provide improved binders. In general ,all SCM's have a pozzolanic action-a secondary hydration reaction or pozzolanicity,with the weaker calcium hydroxide that is produced during the normal hydration of the cement. At low water/cement ratios and when used with advanced super plasticisers, Micro silica demonstrates multiple effectiveness. The fine particle size and high content of amorphous silica(by standard grater than 85%) makes the micro silica highly reactive with any alkalis in solution with in first few few days and weeks of the hydration process

This provides a homogeneous, fine grained, almost ceramic matrix linked with the very low water cement ratio governs the characteristic cube strength of 100Mpa concrete.

- Results in a more homogenous fine-grained cement structure.
- Fine spherical nature of Micro silica provides micro packing density and eliminates micro voids.
- Produces stronger C-S-H matrix.
- Marked changes in transition zone (between cement and aggregate),indicating non-micro cracked dense matrix as a result of removal of bleed water.
- Eliminates weak zone enabling a truly composite material in which the aggregate can be utilized as a working component and not just filler.

WATER:

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acid, alkalis, salts, organic materials or other substances they may be deleterious to concrete portable water is used for mixing as well as curing of concrete as prescribed in IS: 456 – 2000.

Tests on SCC:

1. Slump flow & T_{50} test
2. L-box test
3. V-funnel test & V-funnel at $T_{5minuts}$

List of test methods for workability properties of SCC:

No	Method	Property
1	Slump Flow Test	Filling Ability
2	T_{50cm} Slump Flow	Filling Ability
3	V-Funnel Test	Filling Ability
4	V-Funnel at $T_{5minuts}$	Segregation Resistance
5	L-Box Test	Passing Ability

Slump Flow & T_{50} test:

Slump Flow is definitely one of the most commonly used SCC tests at the current time. This test involves the use of the slump cone used with conventional concretes as described in ASTM C143 (2002). The main difference between the Slump Flow test and ASTM C143 is that the Slump Flow test measures the “spread” or “flow” of the concrete sample once the cone is lifted rather than the traditional “slump” (drop in height) of the concrete sample. The T_{50} test is determined during the Slump Flow test; it is simply the amount of time that the concrete takes to flow to a diameter of 50 centimeters. Typically, Slump Flow values of approximately 24 to 30 inches are within the acceptable range; acceptable T_{50} times range from 2 to 5 sec.

Apparatus:

1. Mould in the shape of a truncated cone with the internal dimensions 200 mm diameter at the base, 100 mm diameter at the top and a height of 300 mm, conforming to EN 12350-2
2. Base plate of a stiff non-absorbing material, at least 700mm square, marked with a circle marking the central location for the slump cone, and a further concentric circle of 500mm diameter.
3. Trowel
4. Scoop
5. Ruler
6. Stopwatch

The procedure for the Slump Flow and T50 is as follows, and the sequence is summarized in Figure.

1. Dampen Slump Flow table and slump cone.
2. Level the Slump Flow table.
3. Place cone on the centre of the table that has a circle having a diameter of 50 centimetres drawn concentrically to the location for the slump cone.
4. Using funnel and with one person holding cone down (as to avoid concrete pushing itself underneath the cone), continuously fill the cone with a representative sample concrete from bucket.
5. Screed and level the concrete from the top of the cone as to ensure the proper amount of concrete is within the cone.
6. Immediately remove funnel.
7. Immediately lift cone in an upward direction and begin to time the concrete (from the instant the lift started) for the T_{50} time (the cone should be raised at a rate of approximately one foot in two seconds).
8. Stop the timing device when the concrete reaches the T_{50} line and record this time to the nearest ½ second as the T_{50} value.
9. Once the concrete has ceased to flow (no more than one minute from the lifting of the cone) measure the width of the spread of concrete across the widest dimension through the center of the spread to the nearest ½"; measure again at a 90 degree angle.
10. Record the Slump Flow as the average of the two measurements.

L-box test:
The L-box value is a ratio of the levels of concrete at each end of the box after the test is complete. The L-box consists of a "chimney" section and a "trough" section after the test is complete, the level of concrete in the chimney is recorded as H1; the level of concrete in the trough is recorded as H2. The L-box value (also referred to as the "L-box ratio", "blocking value", or "blocking ratio") is simply H2/H1. Typical acceptable values for the L-box value are in the range of 0.8 to 1.0. If the concrete was perfectly level after the test is complete, the L-box value would be equal to 1.0; conversely, if the concrete was too stiff to flow to the end of the trough the L-box value would be equal to zero.

Apparatus:
1. L-Box of a stiff non-absorbing material
2. Trowel
3. Scoop
4. Stopwatch

The procedure for the L-box test is as follows:
1. Dampen all surfaces of the L-box that will be in contact with concrete.
2. Make sure that the gate is restrained as to avoid premature flow of concrete through the L-box.
3. Continuously fill the upper portion of the L-box with a representative sample concrete from a bucket.
4. Screed the concrete from the top of the box as to ensure the proper amount of concrete is within the apparatus.
5. Promptly open/lift the gate to allow flow of concrete through the L-box.

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

6. Once the concrete has ceased to flow (no more than one minute from the opening/lifting of the gate) measure the height of concrete at the "trough end" (record this as H2) and at the "chimney end" (record this as H1) of the L-box to the nearest ½ inch.
7. The L-box ratio is calculated as H2/ H1.For a summarized visual display of the L-box sequence refers to Figure


V-funnel test and V-funnel test at $T_{5minutes}$:
V-funnel test is used to determine the filling ability (flowability) of the concrete with a maximum aggregate size of 20mm. 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 funnel can be refilled concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increase significantly.

Apparatus:
1. V-funnel
2. Bucket (±12 litre)
3. Trowel
4. Scoop
5. Stopwatch

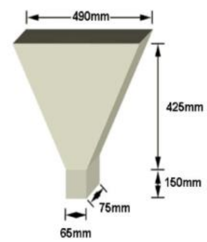


Figure 1.4 V-funnel (Dietz and Ma, 2000).

The Procedure for the flow time:
1. About 12 litres of concrete is needed to perform the test, sampled normally.
2. Set the V-funnel on firm ground. Moisten the inside surfaces of the funnel.
3. Keep the trap door open to allow any surplus water to drain.
4. Close the trap door and place a bucket underneath.
5. Fill the apparatus completely with concrete without compacting or tamping; simply strike off the concrete level with the top with the trowel.
6. Open within 10 sec after filling the trap door and allow the concrete to flow out under gravity.
7. Start the stopwatch when the trap door is opened, and record the time for the discharge to complete (**the flow time**).
8. This is taken to be when light is seen from above through the funnel. The whole test has to be performed within 5 minutes.

The Procedure for the flow time at $T_{5minutes}$:
1. Do not clean or moisten the inside surfaces of the funnel again.
2. Close the trap door and refill the V-funnel immediately after measuring the flow time.
3. Place a bucket underneath.
4. Fill the apparatus completely with concrete without compacting or tapping, simply strike off the concrete
5. Level with the top with the trowel.
6. Open the trap door 5 minutes after the second fill of the funnel and allow the concrete to flow out under gravity.
7. Simultaneously start the stopwatch when the trap door is opened, and record the time for the discharge to complete (the flow time at T 5 minutes). This is taken to be when light is seen from above through the funnel.

Figures for v-funnel test

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

Acceptance criteria for SCC:

S. No	Method	Unit	Typical Range of Values	
			Minimum	Maximum
1	Slump Flow Test	Mm	650	800
2	T_{50}cm Slump Flow	Sec	2	5
3	V-Funnel Test	Sec	6	12
4	V-Funnel at T_5minuts	Sec	6	15
5	L-Box Test	h_2/h_1	0.8	1.0

Mix Design of SCC for M 40:

Cement	Micro silica	Fine aggregate	Coarse aggregate	S.P
529.54	5.29	917.125	717.177	4.81

1	:	0.01	:	1.730	:	1.354	:	0.009

Adjustments:
After conducting no of trails we conclude that, the following SCC mix ratios are satisfying the required workability and flow ability conditions.

Water binder ratio = 0.340

Mix Proportions:

1	:	0.01	:	1.730	:	1.354	:	0.009

CONVENTIONAL CONCRETE MIX DESIGN:
DESIGN PARAMETERS (FOR M30)

Mix proportions:

Cement	Fine Aggregate	Coarse Aggregate	Water
1	1.37	2.52	0.40

TESTING OF FRESH CONCRETE:

TESTING OF CUBES FOR COMPRESSIVE STRENGTH

In the design of concrete mixes, the compressive strength of concrete is generally the main target since it usually represents an overall picture of the quality of concrete. The compressive strength is the maximum load per unit area sustained by a concrete specimen before failure under compression. Since the strength development of concrete depends on both time and temperature it can be said the strength is a function of summation of product of time and temperature. This summation is called maturity of concrete.

The cube specimens cured as above are tested as per standard procedure after removal from the curing tank and allowed to a dry under shade. The cube specimens tested under microprocessor based compression testing machine of 2000 KN capacity the results are tabulated in table

TESTING OF FLEXURAL TENSILE STRENGTH

Flexural test is intended to give flexural strength of concrete in tension. The testing of concrete in flexure yields more consistent results than those obtained with tension text on mortar. The most common plane concrete structure subjected to flexure is a high way pavements and strength of concrete for pavements is commonly evaluated by means of bending tools. Steel, prism moulds of size 100x100x500mm, tamping rod, mixer weighing machine, UTM and scale. Take 65N of cement, 130N of fine aggregate, 260N of coarse aggregate (1:2:4) mix and 3.9 liters of water(w/c ratio=0.6) mix than thoroughly in the mechanical mixer uniform color is obtained. Thus material will be sufficient for 3 prisms of size 100x100x500mm. The mould shall be filled in 2 layers and each layer to be measured more than 100 times. In place of hand ramming plate vibrators may be used. After casting the moulds shall be covered with clothes (or) gunny bags, demoulded after 24 hours and wet covered for 27 days. Specimens should be tested immediately on removal from the water while they are still in wet condition. The dimensions of each specimen shall be noted before testing. The bearing surfaces of the supporting and loading rollers shall be wiped clean and no packing shall be used between the bearing surfaces of the specimen and the rollers. The span of the specimen as kept at 40cm. Load shall be applied to the uppermost surface as last along two lines one third of the span distance apart. The load shall be applied without any shock and increasing continuously at a rate such that the extreme fibre stress increases at 0.7N/mm^2/min i.e. at a rate of loading of 1.3 kN/mm^2. The maximum loading and the distance of the first crack from the nearest support is noted.

Moment of resistance =PL/BD^2


TESTING OF CYLINDER FOR SPLIT-TENSILE STRENGTH

Of all the indirect tension test methods this method is simple to perform and gives more uniform results than other tension tests. Strength determined in the splitting test is believed to be closed to the true strength of concrete, then the modulus of rupture. Splitting strength gives about 5 to 12% higher value than the direct tensile strength. The testing arrangement and the details of testing are as follows:

The compression- testing machine employed to determine the split- tensile strength of cylinder is of standard mark AIMIL. The capacity of testing machine is 100 tones. It is provided with three different ranges of loading i.e. 0 to 25 t, 0 to 50 t, 0 to 100 tones. The machine has been calibrated to standard rate of loading. The patterns are cleaned, oil level is checked and it is kept ready in all respects for testing. The cylinders of size 150mm diameter 300mm height are tested for split tension using a 100 tones capacity-testing machine.

The test is carried out by placing a cylindrical specimen horizontally between the leading surfaces of a compression testing machine and the load is applied at a rate of 15 to 21 kg/sq. cm/min until failure of the cylinder, along the vertical diameter. When the load is applied along the generatrix, an element on the vertical diameter of the cylinder is subjected to a vertical compressive stress and a horizontal stress of $2p/\pi LD$. It is observed that cylinder did split into two halves.

Split- tensile strength=$2p / (\pi LD)$,Where
p is the maximum compressive load on the cylinder
L is the length of cylinder
D is its diameter


EXPERIMENTAL RESULTS

TABLES

TABLE 4.1

PHYSICAL PROPERTIES OF ORDINARY PORTLAND CEMENT 53 GRADE

S. No	Property	Test Results
1	Normal consistency	30 %

2	Specific gravity	3.15
3	Setting time Initial setting time Final setting time	 35 min 230 min
4	Fineness of cement (IS sieve no.9)	4.0 %
5	Compressive strength 1:3 sand mortar cubes At 7 days At 28 days	 25 Mpa 43 Mpa

TABLE 4. 2PROPERTIES OF FINE AGGREGATE:

S. No	**Properties**	**Fine aggregates**
1	Specific gravity	2.670
2	Loose bulk density	1450 kg/m^3
3	Rodded bulk density	1713 kg/m^3

TABLE 4.3 PROPERTIES OF COARSE AGGREGATE:

S. No	**Properties**	**Coarse aggregates**
1	Specific gravity	2.74
2	Loose bulk density	1365 kg/m^3
3	Rodded bulk density	1610 kg/m^3

TABLE 4.4 SIEVE ANALYSIS FOR FINE AGGREGATE:

S. No	**I.S. sieve designation**	**Weight retained (grams)**	**Cumulative weight retained (grams)**	**Cumulative % of weight retained**	**Percentage passing By weight**	**Remarks**
1	40 mm	0	0	0	100	Fine Aggregate conforming to Grading Zone II of IS: 383 – 1970
2	20 mm	0	0	0	100	
3	10 mm	0	0	0	100	
4	4.75 mm	0	0	0	100	
5	2.36 mm	20	20	2	98	
6	1.18 mm	80	100	10.0	90	
7	600 microns	344	444	44.4	55.6	
8	300 microns	329	773	77.3	22.7	
9	150 microns	199	972	97.2	2.8	
10	< 150 microns	28	1000	100	0	
	Total = 1000 grams			330.90		

TABLE 4.5 SIEVE ANALYSIS FOR COARSE AGGREGATE:

S.No	I.S. sieve designation	Weight retained (grams)	Cumulative weight retained (grams)	Cumulative % of weight retained	Percentage passing By weight	Remarks
1	40 mm	0	0	0	100	Coarse Aggregate conforming to Grading Zone II of IS: 383 – 1970
2	20 mm	0	0	0	100	
3	10 mm	9155	9155	91.55	8.45	
4	4.75 mm	750	9905	99.05	0.95	
5	2.36 mm	0	9975	99.05	0.95	
6	1.18 mm	0	9905	99.05	0.95	
7	600 microns	0	9905	99.05	0.95	
8	300 microns	0	9905	99.05	0.95	
9	150 microns	0	9905	99.05	0.95	

Total = 9905 grams 685.85

TABLE 4.6 MIX PROPORTIONS FOR M40 GRADES OF CONCRETE:

(Quantities of Materials per 1 Cubic Meter of Concrete)

Grade of Concrete	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	Water (litres)	W/C Ratio
M40	465	641	1170	186	0.4

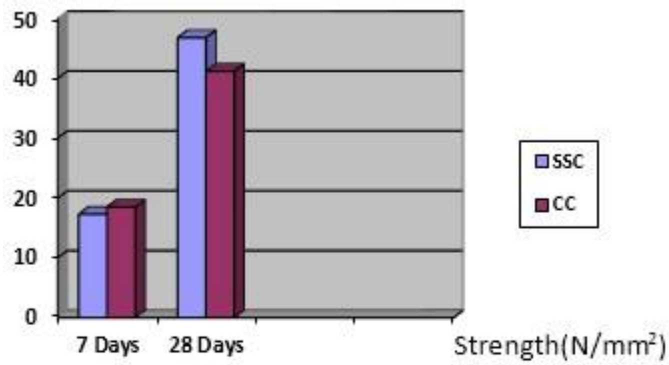
COMPARISION OF RESULTS

Table 1

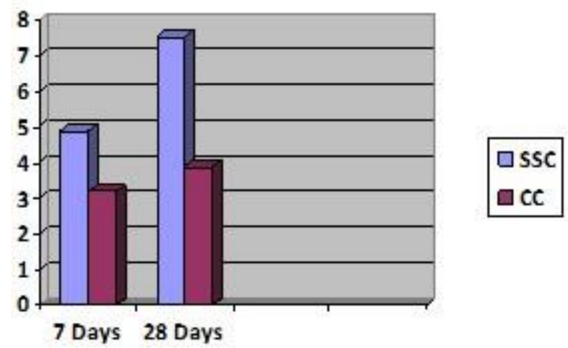
Strengths(in days)		SCC (N/mm^2)	Conventional Concrete(N/mm^2)
Compression Strength	**7**	**17.97**	**37.20**
	28	**46.5**	**41.69**
Flexural Strength	**7**	**4.9**	**3.2**
	28	**7.5**	**3.9**
Split Tensile Strength	**7**	**3.12**	**2.9**
	28	**4.05**	**3.76**

GRAPHS:

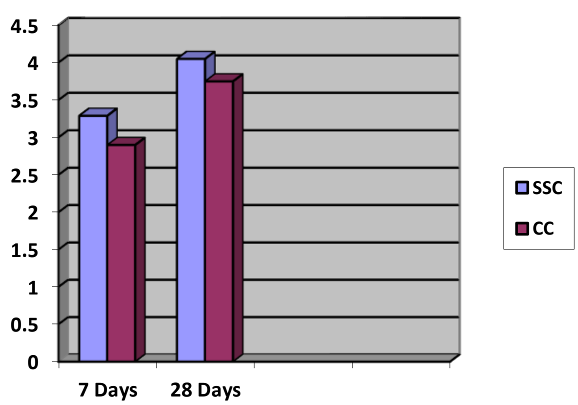
Comparison of Compression Strength:



Comparison of Flexure Strength:



Comparison of Split Tensile Strength:



CONCLUSIONS

1. After conducting various trial tests, M_{50} grade self-compacting concrete is finally obtained which satisfied all the SCC characteristics such as flowability, passing ability and segregation resistance given by European standards. As there are no Indian standards for Self compacting concrete(SCC) comparison could not be made.
2. From the observations it was found that nearly 2/3of the compressive strength is gained in 7 days curing which satisfies IS: 456-2000.
3. It was also observed that the Split Tensile strength of SCC has attained the permissible values for 7 days and 28 days as per IS: 456-2000.
4. It was also observed that the flexural strength of SCC has attained the permissible values for 7 days and 28 days as per IS: 456-2000.
5. Finally we can conclude that the strength of Self-Compacting Concrete is higher than the Conventional Concrete.

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

REFERENCES

[1] Brain Paulson. EFNARC, Secretary General, 'Specifications and Guidelines for Self-Compacting Concrete", February 2002.
[2] Nan Su, K.C.Hsu, H.W.Chai. A Simple mix design method for self-compacting concrete, cement and concrete Research 2001.
[3] Okamura.H.'Self-Compacting High Performance Concrete', Concrete International, Vol. 19, No.7, pp. 50-54, July 1997
[4] M.S. Shetty. "Concrete technology (theory and practice), S. Chand & Company LTD. 2002
[5] Subramanian S. and Chattopadhyay D.'Experiments for Mix Proportioning o Self-Compacting Concrete', The Indian Concrete Journal, January 2002, pp 13-20.
[6] IS 456-2000 Code of practice for plain and reinforced concrete (3rd revision)
[7] IS 10262-2009 Code of Practice for concrete Mix Proportioning-Guidelines (1st Revision)
[8] M.L.Gambhir. "Concrete technology (theory and practice),Fourth Edition.
[9] IS 2386(PT7) – 1963 Methods of test for aggregates for concrete.
[10] IS 516-1959 Method of test for strength of concrete.
[11] IS 383-1997 used for zonation of coarse and fine aggregate.