AN EXPERIMENTAL STUDY ON SELF COMPACTING CONCRETE BY REPLACING THE FINE AGGREGATE WITH M-SAND

S.S.Janagan[1], N.Namachivayam[2], R.Kabilan[3], R.Naveen Prasath[4], M.Naveenkumar[5]
[1]Assistant Professor, Faculty of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu. Mail : janagansiddan@gmail.com,
[2,3,4,5]Bachelor of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.

Abstract

In the present state of affairs the scarcity of natural sand has end up a trouble for the development industry, after a good deal research the developed technological know-how gave rise to new generation sand named as m-sand or manufacture sand. It will be easily flow in a position on placing on excessive reinforcement bar. It is a modern concrete that does now not require vibration for placing and compaction. The methodology adopted is that manufactured sand are changed by means of 0 %, 25%, 50%, 75%, 100%, for river sand and overall performance is measured and compared. The water cement ratio is taken as 0.5, while the rest of the aspects stored same barring the chemical admixture which has been adjusted for acquiring the self-compatibility of the concrete. Cubes, cylinders, and prism will be casted and tested compressive strength, Split tensile strength, and flexural electricity as well as for durability properties. Test on fresh concrete like slump cone, L-box, U-box, V-Funnel is carried out.

Keywords: M-Sand, self compacting concrete, cubes, cylinder, prism, slump cone, L-box, U-box, V-funnel.

1. INTRODUCTION

The improvement of new technology in the material science is progressing rapidly. In last three decades, a lot of research was carried out for the duration of globe to enhance the overall performance of concrete in terms of strength and durability qualities. Consequently concrete has no longer remained a construction material consisting of cement, aggregate, and water only, however has will become an engineered customized tailor-made material with various new ingredients to meet the particular needs of development industry.

The developing use of concrete is different architectural configurations and carefully spaced reinforcing bars have made it very important to produce concrete that ensures acceptable filling ability, suitable structural overall performance and sufficient durability. In current years, a lot of lookup was carried out during the world to improve the performance of concrete in terms of its most important properties, i.e. strength and durability.

Concrete technology has below long gone from macro to micro level find out about in the enhancement of strength and durability residences from 1980onwards. Till 1980 the lookup learn about used to be targeted only flow capability of concrete, so as to beautify the power then again durability did now not draw lot of attention of concrete technologies. This kind of study has resulted in the development of self compacting concrete (SCC), a good deal needed revolution in concrete industry. Self compacting concrete with a great deal greater fluidity without segregation and is capable of filling each corner of shape work under its self-weight solely (okamura1997).

Thus SCC eliminates the want of vibration either exterior or inside for the compaction of the concrete except compromising its engineering properties.SCC has been described as “the most innovative developments in concrete development for several decades”. Originally developed in Japan to offset a growing scarcity of knowledgeable labor, it has proved to be really useful from the following points.

Development of Concrete Mix

- Self-compacting (or consolidating) concrete (SCC) is a particular concrete mix which has a special performance requirement of self–consolidation or compaction at the time of placement.
- However, at the hardened state, there is not much difference in terms of mechanical properties and durability between SCC and other type of concrete mixes viz. high performance concrete (HPC), normal strength concrete (NSC), etc. (Subrato Chowdhuryet al. 2008).
- Concrete mix for this study was designed using EFNARC [4,5] norms as well as BIS 10262. SCC mix can be designed to provide the required hardened concrete properties for an application, similar to conventional concrete.
- SCC mix is designed to have higher paste content or fines compared to conventional concrete.

1.1 OBJECTIVE

- Study the applicability of experimental project process of M-30 grade of concrete.
- Evaluate the power of fine aggregate replaced with the aid of 0%, 25%, 50%, 75%, 100% M-Sand in self compacting concrete mix.
- For the specific percentage replacement of M-Sand for fine aggregate.
- Major goal of the study was to observe the suitability of M-Sand as fine aggregate in motors and concrete.
- Self compacting concrete produced by replacing natural sand by using M-Sand, it two is excellent bonding with other materials.
- The Objective of the present study is to determine the properties of self compacting concrete prepared by river sand (NS) as fine aggregates and at various replacement levels of M-sand.
- The properties of self compacting concrete with river sand and M-sand fine aggregate are compared to evaluate the effect of replacement of river sand by M-sand.

1.2 SCOPE

- The scope of the learn about is constrained to the following aspects. The workability, compressive strength, split tensile strength of silica fume in SCC of different combine proportions with constant w/c ratio have been investigated.
- Moisture is trapped in between the particles which is correct for concrete purposes.
- SCC can save up to 50% in labour cost and higher concrete strength compared to river sand used for concreting.
- Though M-Sand makes use of natural coarse aggregates to form, it causes much less harm to surroundings as in contrast to river sand.

1.3 SEGREGATION RESISTANCE

S .No	METHODS	PROPERTIES
1.	Slump flow	Filling ability
2.	V-Funnel	Filling ability
3.	L-Box	Passing ability
4.	U- Box	Passing ability

1.4 METHODOLOGY

- Literature Collection And Study
- Material Collection And Study
- Test On Material Study & Properties
- Mix Design M-30 Grade Of Concrete
- Testing Of Fresh Concrete
- Casting Of Specimens
- Curing Of Specimens
- Testing The Mechanical Properties Of The Concrete
- Result And Discussions
- Conclusion

2. MATERIAL PROPERTIES

2.1 MATERIAL UESD

a) Cement (OPC 53)
b) Coarse Aggregate
c) Fine Aggregate
d) M-sand
e) Mixing of water

2.1.2 Cement

OPC53 Grade conforming IS12269:1987, Minimum cement content:320 kg/m3 (IS456:2000), Specific gravity of Cement: 3.02

S. No	Test for Cement	Apparatus	Value Obtained
1.	Standard consistence test	Vicat apparatus	26.5%
2.	Initial setting time	Vicat apparatus	30 minutes
3.	Final setting time	Vicat apparatus	230 minutes
4.	Specific gravity test	Conical flask	3.02

2.1.3 Coarse Aggregate

As per IS 383:1970 the 20mm used. The shape of coarse aggregate is angular, water absorption is 1.0%. Specific gravity of nominal size of aggregate is 2.56

S.No	Test for coarse aggregates	Apparatus	Value obtained
1.	Fineness modulus	Sieve	6.73
2.	Specific gravity	Cylindrical container	2.71
3.	Water absorption	container	0.7%
4.	Impact value	Impact testing machine	10%

2.1.4 Fine Aggregate

As per IS 383:1970 fine aggregate properties were tested. Water absorption is 0.38%, Specific gravity of fine aggregate is 2.43

S.No	Test for fine aggregates	Apparatus	Value obtained
1.	Fineness modulus	Sieve	2.39
2.	Specific gravity	Pycnometer	2.43
3.	Water absorption	container	0.38%

2.1.5 M-Sand

As per IS 383:1970 fine aggregate properties were tested. Water absorption is 2.5%, Specific gravity of fine aggregate is 2.43

2.1.6 Water

According to IS 3025, water to be used for mixing and curing should be free from injurious or deleterious materials. Portable Water is generally considered satisfactory. In the present investigation, available water within the campus is used for both mixing and curing purposes.

3. MIX DESIGN

3.1 Materials and mix design

Following materials were used in the preparation of self compacting concrete (i) Ordinary portland cement(ii)River sand and M-sand (iii)Coarse aggregates (iv)Superplasticizer (v)Tap water Ordinary portland cement of 53 Grade satisfying the requirements of IS 12269:1987.

The specific gravity of cement were 3.12 . Natural sand and M-sand are used as fine aggregates(F.A). Properties of fine aggregates were 2.43 Both the fine aggregates belong to zone II of IS 383:1970.

3.2Concrete mix proportion

The mixes were designated in accordance with IS 10262-2009 mix design method. Based on the results, the mix proportions M35 was designed. Concrete mix with w/c ratio of 0.45 was prepared. The details of mix proportions for 1m^3 of concrete are given in Table below

Mix proportions for M30 Grade of Concrete (Kg/m^3)

Grade	Cement	FA	CA	Water
Mix 30	425.72	838.44	828.34	191.61
	1	1.96	1.95	0.45

4. METHODS

4.1 Tests on Concrete

Testing of concrete plays an important role in controlling and conforming the quality of cement works. The basic tests to be conducted in the field as well as in the lab based on its state of concrete are given below

4.1.1 Tests on Fresh SCC
4.1.2. Tests on Hardened SCC

4.1.1 Tests on Fresh SCC

For determining the self compatibility properties (slump flow, T-50 time, U box, L box and V funnel) tests were performed on all mixtures the order of testing was:

a) Slump flow test
b) U-box test method
c) L-box test method
d) V-funnel test method

4.1.1.1Slump Flow Test Method

The slump flow is used to assess the horizontal free flow of SCC in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concrete. The test method is based on the test method for determining the slump. The diameter of the concrete circle is a measure for the filling ability of the concrete. This is simple, rapid test procedure, though two people are needed if to be measured. It can be used on site, though the size of the base plate is somewhat unwieldy and level ground is essential. It is most commonly used test, and gives a good assessment of filling ability. It gives no indication of the ability of the concrete to pass between reinforcement without blocking, but may give some indication of resistance to segregation. It can be argued that the completely free flow, unrestrained by any boundaries, is not representative of what happens in practice in concrete construction, but the test can be profitably be used to assess the consistency of supply of ready-mixed concrete to a site from load to load.

4.1.1.2 U Box Test Method

This is a simple test to conduct, but the equipment may be difficult to construct. It provides a good direct assessment of filling ability-this is literally what the concrete has to do-modified by an unmeasured requirement for passing ability. The 35 mm gap between the sections of reinforcement may be considered too close. The question remains open of what filling height less than 30 cm. is still acceptable. The test was developed by the Technology Research Centre of the Taisei Corporation in Japan. Sometimes the apparatus is called a “box shaped” test. The test is used to measure the filling ability of self- compacting concrete. The apparatus consists of a vessel divided by a middle wall into two compartments, shown by R1 and R2 in Fig.An operating with a sliding gate is fitted between the two sections. Reinforcing bars with nominal diameters of 13mm are installed at the gate with centre-to-Centre spacing of 50mm.This creates a clear spacing of 35mm between the bars. The left hand section is filled with about 20 litre of concrete then the gate lifted and concrete flows upward into the other section. The height of the concrete in both sections is measured.

4.1.1.3 L Box Test Method

This test, based on a Japanese design for underwater concrete, has been described by Peterson. The test assesses the flow of the concrete, and also the extent to which it is subjected to blocking by reinforcement. The apparatus is shown in figure. The apparatus consists of a rectangular section box in the shape of an “L‟, with a vertical and horizontal section, separated by a moveable gate, in front of which vertical lengths of reinforcement bars are fitted. The vertical section is filled with concrete, and then the gate lifted to let the concrete flow into the horizontal section. When the flow has stopped, the height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section (H2/H1 in the diagram). It indicates the slope of the concrete when at rest. This is an indication passing ability, or the degree to which the passage of concrete through the bars is restricted. The horizontal section of the box can be marked at 200 mm and 400 mm from the gate and the times taken to reach these points measured. These are known as T20 andT40 times and are an indication for the filling ability. The sections of bar can be of different diameters and spaced at different intervals: in accordance with normal reinforcement considerations, 3x the maximum aggregate size might be appropriate. The bars can principally be set at any spacing to impose a more or Less severe test of the passing ability of the concrete.

4.1.1.4 V Funnel Test Method

The test was developed in Japan and used Ozawaetal. The equipment consists of a V-shaped tunnel, shown in fig. An alternative type of V-funnel, the O funnel, with a circular section is also used in Japan. The described V-funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum aggregate size of 20mm.The funnel is filled with about 12 litre 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. Though the test is designed to measure flow ability, the result is affected by concrete properties other than flow. The inverted cone shape will cause any liability of the concrete to block to be reflected in the result – if, for example there is too much coarse aggregate. High flow time can also be associated with low deformability due to high paste viscosity, and with high inter-particle friction.

4.1.2 Tests on Hardened SCC

The main aim of flow characteristics and strength characteristics of self-compacting concrete produced from different percentages of that material partial replacement of manufacture sand. The different percentages of replacement of m-sand experimentation are 0%, 25%, 50%, 75%, 100 % and at 7, 14, and 28 days the concrete has been tested. Casting and curing of test specimen after casting, the moulded specimens were left on the casting room at room temperature for 48h. They were than de-moulded and cured in water for 7, 14, and 28 days.

4.1.2.1 Compressive Strength

Compressive strength can be defined as the measure maximum resistance of a concrete to axial loading. The specimens used in the compressive test are: 150 mm x 150 mm x 150 mm. There are three specimen were used in the compression testing for each mixes. The compression testing machine used for testing the cube specimens is of standard make. The capacity of testing machine is 2000 KN. The machine has a facility to control the rate of loading with a control valve. The plates are cleaned before the testing of cubes. After the required period of curing, the cube specimens are removed from curing tank and cleaned to wipe off the surface water. It is placed on machines such that the load is placed centrally. The smooth surface of specimen is placed on the bearing surfaces.

4.1.2.2 Split Tensile Strength

The split tensile strength of concrete is determined by casting cylinders of size 150 mm x 300 mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing tank at the age of 7, 14, and 28 days of moist curing and tested after surface water dipped down from specimens. This test was performed on Universal Testing Machine (UTM) as shown in fig. Split Tensile strength of concrete is tested on cylinders at different percentage of cement replacements content in concrete. The strength of concrete has been tested on cylinder at 7, 14, and 28 days. 7 days test has been conducted to check the gain in initial strength of concrete. 28 days test gives the data of final strength of concrete at 28 days curing. Compression testing machine is used for testing the Split Tensile strength test on concrete along with two wooden boards. At the time of testing the cylinder taken out of water and dried and then tested.

4.1.2.3 Flexural Strength

Flexure specimens shall be beams whose cross section is a square with a side length not less than three times the maximum coarse aggregate size and not less than 100 mm. The beam length shall be at least 80 cm longer than three times the side length of the cross-section. The standard cross-sectional size of flexure specimens is 100 by 100 mm or 150 mm by 150 mm. Self compacting concrete shall not be shifted with a sieve to reduce the size of specimens as practiced for normal concrete.

5. CASTING OF SPECIMENS

a) Cubes (150x150x150mm)
b) Cylinders (150mm diameter, 300mm height)
c) Prism (500,100 and 100mm)

6. TESTING OF SPECIMENS

a) Compressive strength test
b) Split tensile strength test
c) Flexural strength test

7. RESULTS

COMPRESSION STRENTH TEST

% OF M-SAND	COMPRESSION STRENTH TEST N/mm^2	
	7 DAYS	28 DAYS
0%	20	30.07
25%	22.88	30.22
50%	21.48	31.11
75%	20.74	29.33
100%	20.44	29.33

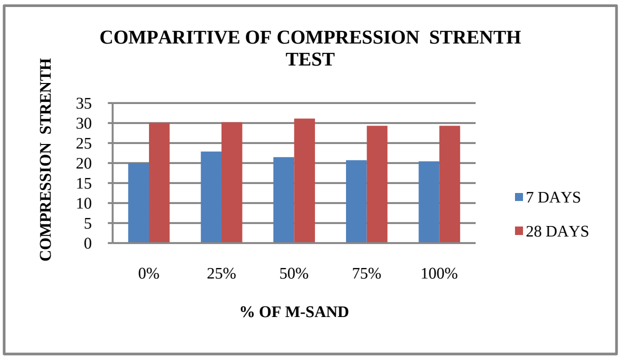

Fig 1: Compression strength for 0%, 25%, 50%, 75%, 100% Replacement of natural sand by M-sand along with varying percentages of coarse aggregate by cube at 7 days and 28 days.

SPILT TENSILE STRENTH TEST

% OF M-SAND	SPILT TENSILE STRENTH TEST N/MM^2	
	7 DAYS	28 DAYS
0%	2.03	3.01
25%	2.12	3.02
50%	2.26	3.11
75%	2.03	2.92
100%	1.93	2.92

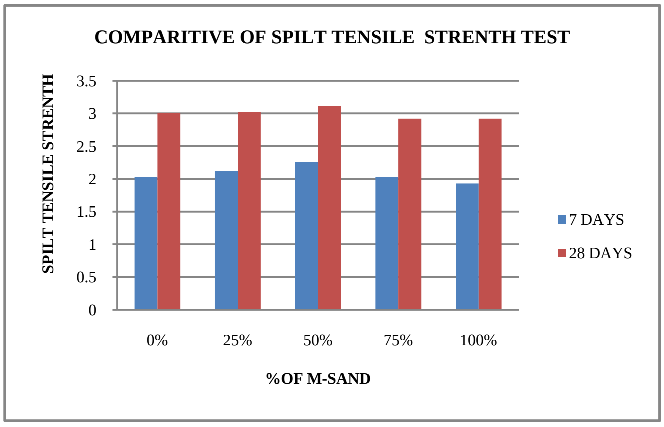

Fig 2: Split tensile strength for 0%, 25%, 50%, 75%, 100% Replacement of natural sand by M-sand along with varying percentages of coarse aggregate by cylinder at 7 days and 28 days.

FLEXURAL STRENTH TEST

% OF M-SAND	FLEXURAL STRENTH TEST N/mm^2	
	7 DAYS	28 DAYS
0%	2.47	3.06
25%	3.0	3.4
50%	3.33	4.55
75%	3.17	3.93
100%	3.07	3.34

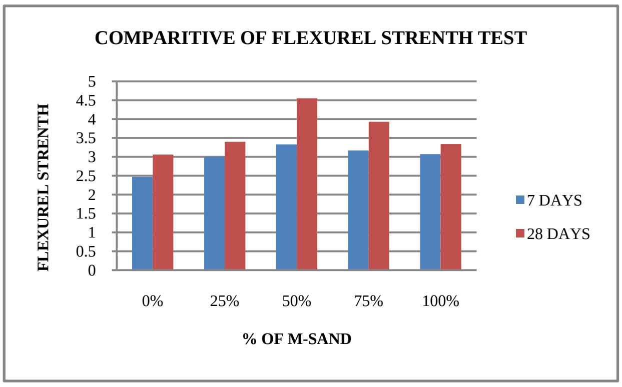

Fig 3: Flexural strength for 0%, 25%, 50%, 75%, 100% Replacement of natural sand by M-sand along with varying percentages of coarse aggregate by prism at 7 days and 28 days.

8. CONCLUSION

- From the above experimental investigation of the following conclusions are,
- Fine aggregate replacement 0%, 25%, 50%, 75%, 100% with M-Sand leads to increase in mechanical properties for M30 grade of concrete.
- From 50% there is decrease in mechanical strength for 7 and 28 days of curing period.
- The completely replacement of fine aggregate by M-Sand is given a maximum results.
- Optimum content of M-Sand for achieving higher strength is 50%.
- The strength is increased by 50% and decreased by 75% and 100% , when compared to 50% of replaced. to achieve the high strength of self compacting concrete.
- M-Sand qualifies 50% economic than the natural sand.
- The results showed good flow ability and passing ability properties with replacement of natural sand by M-Sand for self compacting concrete.

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Author Reference

[1] S.S.JANAGAN Assistant Professor, Faculty of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.
Email ID: janagansiddan@gmail.com,
[2] N.NAMACHIVAYAM Bachelor of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.
Email ID:namachivayamnatarajan@gmail.com,
[3] R.KABILAN Bachelor of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.
Email ID: kabilanravi28121997@gmail.com,
[4] R.NAVEEN PRASTH Bachelor of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.
Email ID:navinprasath22051998@gmail.com,
[5] M.NAVEENKUMAR Bachelor of Civil Engineering, Gnanamani College of Technology , Pachal, Namakkal, Tamilnadu.
Email ID:vknaveen1997@gmail.com.