ISSN 2321-807X
Volume 13 Number5
Journal of Advances in chemistry

An Experimental Study on Partial Replacement of River Sand by Manufacture Sand in Self Compacting Concrete

Dr. S. Christian Johnson[1], Dr. G. Vijayakumar[2], K. Sabarinathan[3] and P. Satyanarayanan[4]
[1]Professor & Dean, [2&3]Assistant Professor & [4]M.E., Student, Dept. of Civil Engineering, Excel Engineering College, Komarapalayam, Tamil Nadu
Corresponding author: viji_beag@yahoo.co.in

ABSTRACT

Self-compacting concrete (SCC) is a very fluid concrete and a homogeneous mixture that solves most of the problems related to ordinary concrete. Self-Compacting Concrete gets dense and compacted due to its own self-weight. An experimental investigation has been carried out to determine different characters like workability and strength of Self-Compacting Concrete (SCC).Self-Compacted Concrete is generally defined as the "Concrete, which does not need Compaction." It means SCC gets compacted without external efforts like vibration, tamping etc. Due to these characteristics, SCC is ideally suited for concreting structures, which have heavily congested reinforcement or difficult access conditions. In this project, M30 grade concrete were made. 25%, 50% and 75% percentage of river sand where replaced by M-sand. The compressive strength, split tension test and flexural strength of concrete obtained at the ages of 7 and 28 days.

Keywords: Self compacting concrete, tensile strength, split tensile test, compressive strength

INTRODUCTION

Concrete technology has made tremendous strides in the past decades. The development of specifying a concrete according to its performance requirements, rather than the constituents and ingredients has opened innumerable opportunities for producers of concrete and users to design concrete to suit their specific requirements. One of the most outstanding advances in the concrete technology over the last decade is "Self Compacting Concrete" (SCC). The SCC is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement (Priyanka, 2013). The improved construction practice and performance, combined with the health and safety benefits, make self-compacting concrete a very attractive solution for civil engineering construction.

The earliest is the traditional normal strength concrete which is composed of only four constituent materials, which are cement, water, fine aggregate and coarse aggregates. At the way to achieve the high compressive beginning, reducing the water cement ratio was the easiest way to achieve the high compressive strength. Thereafter the fifth ingredient a water reducing agent or super plasticizer was indispensible. But now a day the cost of sand has been increasing beyond imagination which is resulting in the increase in concrete cost. This is because demand for sand is more than its supply to overcome this problem the experiment on concrete by partial replacement of river sand by manufactures sand in SCC (Ganeshwaran and Suji, 2013). So that we can reduce the cost of concrete and enhance the strength of concrete also manufactured sand can reduce ecological imbalance in nature. For work out this above problems, a study has been done on the compressive, flexural and split tensile strength with these various mix of SCC are designed to have fresh properties that have a higher degree of workability than conventional concrete. In view of the above fact the following aim and objectives were made to conduct the experimental study. (i) To develop the compressive strength of concrete by partial replacing of River sand by Manufacture sand and using admixture, (ii) To examine the workability of manufactured sand and using admixture in concrete by using Slump Cone Test, L Box Test and V Funnel Test, (iii) To investigate the performance of this concrete terms of its compressive strength and split tensile strength, (iv) To improve filling capacity through highly congested reinforcement by using the Self Compacting concrete and (v) To reduce the construction time in the project.

MATERAIALS AND METHODS

The following materials were used to produce Self Compacting Concrete for the experimental investigations

- Cement (OPC 53 grade)
- Coarse aggregate (10 to 12 mm)
- Fine aggregate of river sand
- Fine aggregate of Manufacture Sand
- Super plasticizers of Glenium B_{233} and VMA of Glenium stream 2 and
- water

Table 1.Physical properties of self-compacting concrete materials

Sl. No.	Particulars of Test	Observation
Cement		
1.	Specific gravity	3.10
2.	Normal consistency	30%
3.	Initial setting time	38 min
River sand		
4.	Specific gravity	2.54
5.	Fineness modulus	2.59
6.	Bulk density	1690 kg/m^3
Manufacture sand		
7.	Specific gravity	2.68
8.	Fineness modulus	2.60
9.	Bulk density	1860 kg/m^3
Coarse aggregate		
10.	Fineness Modulus	4.98
11.	Specific Gravity	2.75
12.	Bulk density	1540 kg/m^3
13.		

Table 2.Sieve analysis of River sand & M-Sand

Sieve Size	River sand % Passing	M-Sand % Passing
4.75mm	98.8	96.6
2.36mm	95.0	89.6
1.18mm	81.8	74.1
600µm	53.6	47.6
300µm	15.2	18.7
150µm	1.6	5.2

Super plasticizers

Glenium B_{233}

- Chemical base – modified poly carboxylates
- Relative density – 1.08 kg/l at 30^oc
- Effect on setting – not retarding
- Effect of overdosing – bleeding may occur

Consumption or dosage:

- For concrete of high workability, very low water/cement ration and for self-compacting concrete 1.0 to 2.0 % by weight of cement used throughout the project.

ISSN 2321-807X
Volume 13 Number5
Journal of Advances in chemistry

Self-Compacting Concrete mix design for M 30 grade concrete

Mix proportions

Cement = 489.95 kg/m^3
Water = 220.48 liters/m^3
Fine aggregate = 920 kg/m^3
Coarse aggregates = 767 kg/m^3
Super plasticizer (1%) = 4.9 kg/m^3
Super plasticizer (2%) = 9.8 kg/m^3
VMA (0.2%) = 0.98 kg/m^3

Table 3.Conventional concrete mix design for M 30 grade concrete

Cement, kg/m^3	Water	FineAggregate, kg/m^3	CoarseAggregate, kg/m^3
432	186	621	1192
1	0.43	1.44	2.76

Table 4.Acceptance Criteria for SCC

Name of the Test	Property	Unit	Minimum	Maximum
Slump flow	Filling ability	spread (mm)	650	800
V-funnel	Filling ability	Time (sec)	6	12
V-funnel(5 min)	Segregation resistance	Time (sec)	0	15
L-box	Passing ability	H2/H1	0.8	1

Table 5. Test mix details with various percentage replacement of rive sand by manufacture sand.

Sl. No.	Description								SCC properties				Compressive Strength (Mpa)	
	Trial	Cement, kg	75 % R sand, kg	25 % M sand, kg	Aggregate 10 mm, kg	W/C ratio	Super plastizer, %	VMA, %	V-Funnel, Sec	V-Funnel at T5 min, sec	L-Box, mm	Slump Flow, mm	7 days	28 days
MIX: 25% M-SAND AND 75% RIVER SAND														
	TM-01	490	690	230	767	0.45	1.0	0.2	17	25	0.5	455	-	
	TM-02	490	690	230	767	0.45	2.0	0.2	14	18	0.76	615	25.23	41.86
	TM-03	490	690	230	767	0.45	1.0	-	16	22	0.63	510	-	-
	TM-04	490	690	230	767	0.45	2.0	-	8	10	0.96	720	23.45	40.04
	Limits								6 to 12	0 to 15	0.8 to 1	650 to 800		
MIX: 50% M-SAND AND 50% RIVER SAND														

	TM-05	490	460	460	767	0.45	1.0	0.2	09	12	0.83	675	27.17	42.12
	TM-06	490	460	460	767	0.45	2.0	0.2	07	09	0.81	710	30.18	41.37
	TM-07	490	460	460	767	0.45	1.0	-	17	27	0.52	520	-	-
	TM-08	490	460	460	767	0.45	2.0	-	11	13	0.82	665	25.51	40.15
	Limits								6 to 12	0 to 15	0.8 to 1	650 to 800		
MIX: 75% M-SAND AND 25% RIVER SAND														
	TM-05	490	230	690	767	0.45	1.0	0.2	09	11	0.84	690	27.67	40.96
	TM-06	490	230	690	767	0.45	2.0	0.2	08	10	0.89	725	31.71	41.84
	TM-07	490	230	690	767	0.45	1.0	-	15	18	0.56	635	-	-
	TM-08	490	230	690	767	0.45	2.0	-	11	13	0.86	680	31.26	42.28
	Limits								6 to 12	0 to 15	0.8 to 1	650 to 800		

Fresh concrete test results

The following tests are carried out to determine the properties of fresh concrete mix. The results are shown in the table.

- Slump flow test
- V-funnel test
- L-box test
- V-funnel at T5 minutes test

Table 6.The various tests and the results of fresh concrete mix.

Particulars	Slump flow, mm	V-funnel, sec	V-funnel @ T5 mins, sec	L-box	Remarks
TM-01	455	17	25	0.5	Not Satisfied
TM-02	615	14	18	0.76	Not Satisfied
TM-03	515	16	22	0.63	Not Satisfied
TM-04	720	8	10	0.96	Satisfied
TM-05	675	9	12	0.83	Satisfied
TM-06	710	7	9	0.81	Satisfied

ISSN 2321-807X
Volume 13 Number5
Journal of Advances in chemistry

TM-07	520	17	27	0.52	Not Satisfied
TM-08	665	11	13	0.82	Satisfied
TM-09	690	9	11	0.84	Satisfied
TM-10	725	8	10	0.89	Satisfied
TM-11	635	15	18	0.56	Not Satisfied
TM-12	680	11	13	0.86	Satisfied

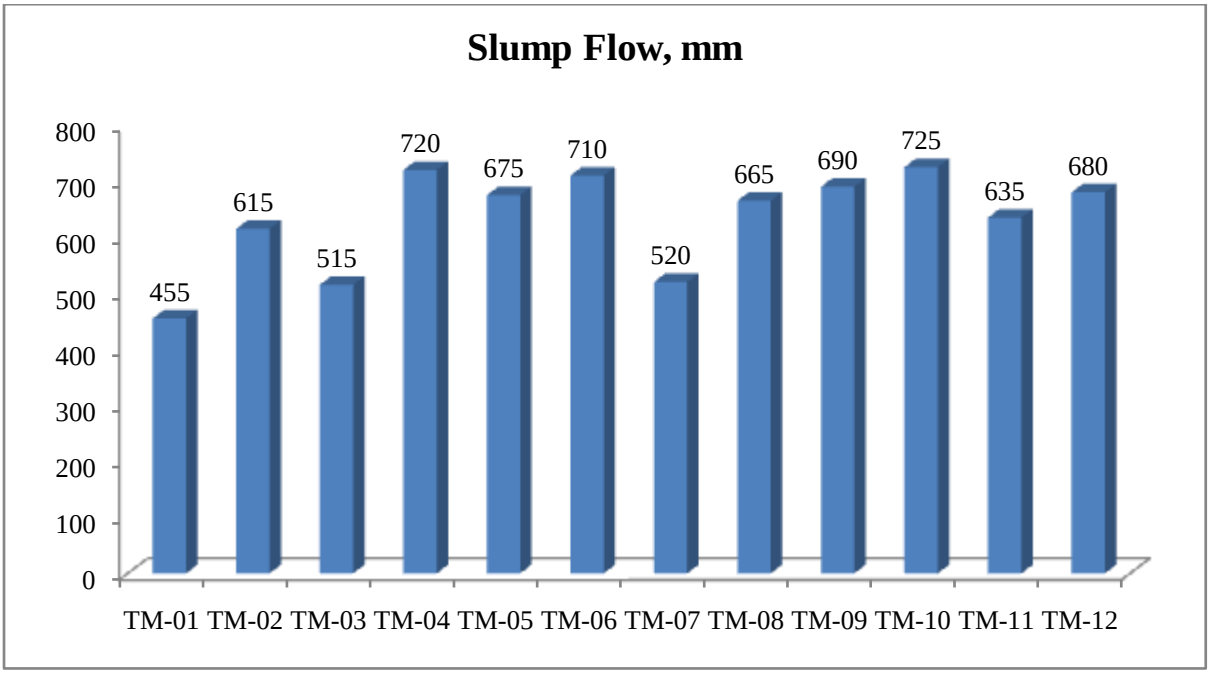

Fig. 1.Slump flow test results of SCC

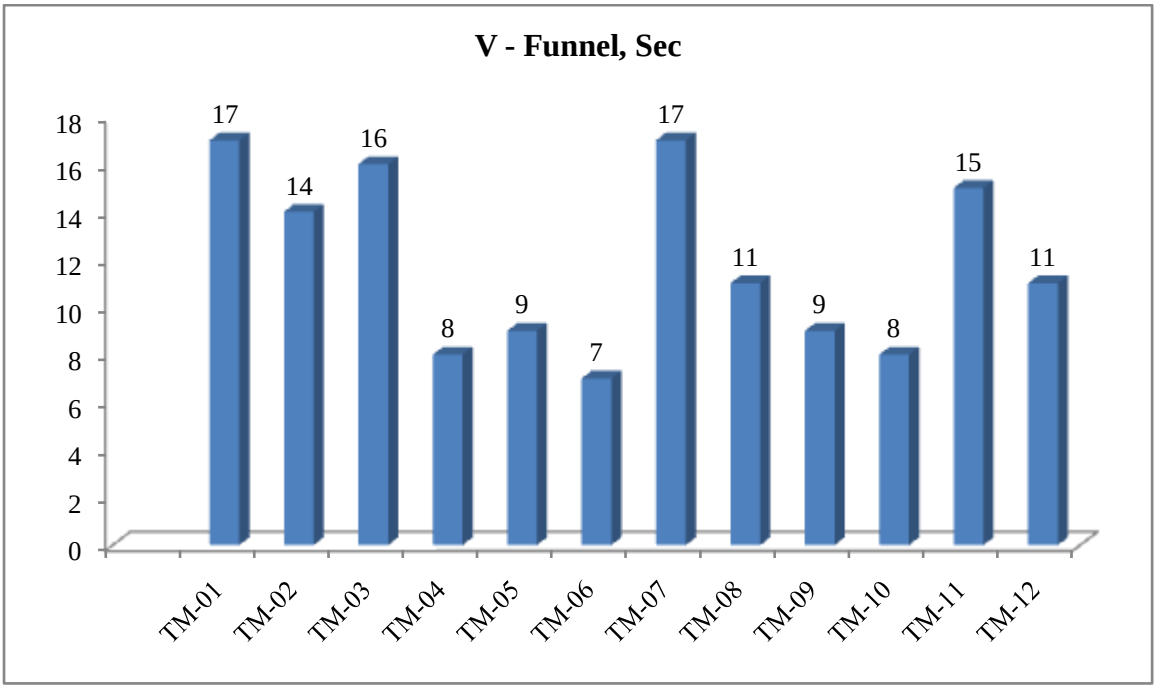

Fig. 2.V- Funnel test results of SCC

ISSN 2321-807X
Volume 13 Number5
Journal of Advances in chemistry

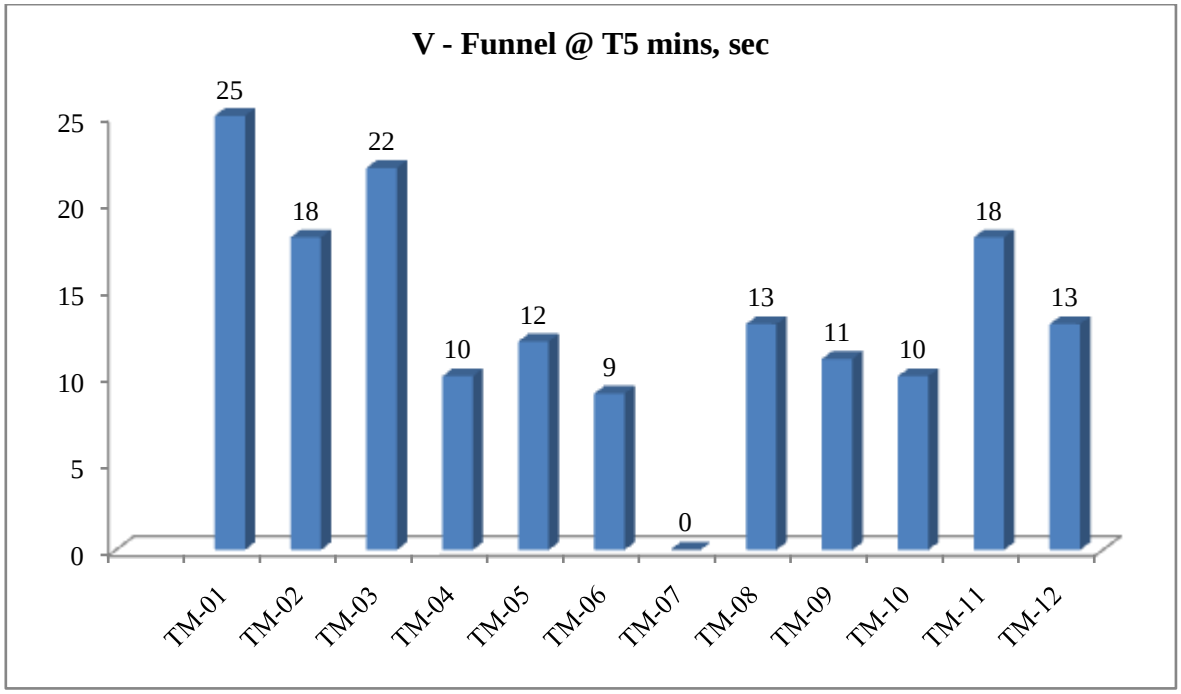

Fig. 3.V- Funnel at five minutes time interval test results of SCC

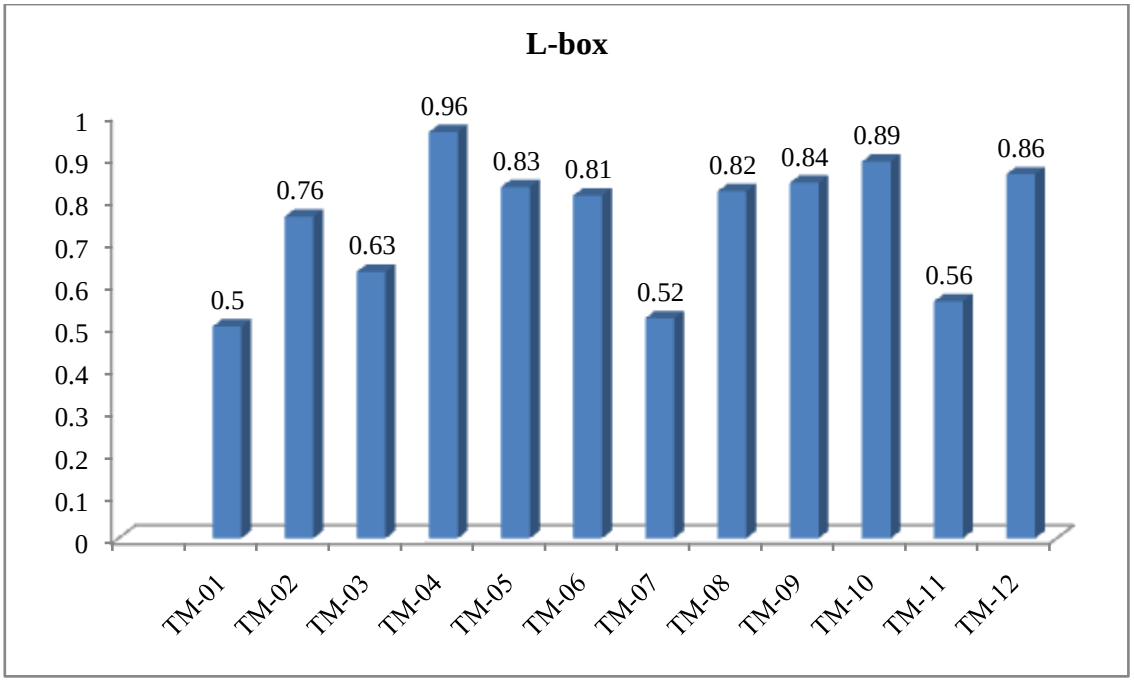

Fig. 4.L - boxtest results of SCC

Hardened concrete test results

After testing the properties of fresh concrete mix on SCC, the concrete cubes, cylinders and prisms were cast for studying the properties of hardened concrete. The following tests were carried out on hardened concrete of various SCC specimens (Raghupathi, 2010).

- Compressive strength test.
- Split tensile strength test.
- Flexural strength test

ISSN 2321-807X
Volume 13 Number5
Journal of Advances in chemistry

Table 7. Compressive, Split and flexural test results of SCC

Particulars	Cube Compression, MPa		Split tension, MPa		Flexural Strength, MPa
	7 Days	28 Days	7 Days	28 Days	28 Days
Conventional	28.34	39.24	2.153	3.036	5.490
TM-01	-	-	-	-	-
TM-02	25.23	41.86	2.100	2.940	5.729
TM-03	-	-		-	-
TM-04	23.45	40.04	2.261	2.786	5.615
TM-05	27.17	42.12	2.320	3.195	5.686
TM-06	30.18	41.37	2.217	3.378	5.772
TM-07	-	-	-	-	-
TM-08	25.51	40.14	2.674	3.703	5.526
TM-09	27.67	40.96	2.213	2.830	5.412
TM-10	32.06	41.67	2.561	3.703	5.739
TM-11	-	-	-	-	-
TM-12	31.56	44.23	2.843	3.995	5.415

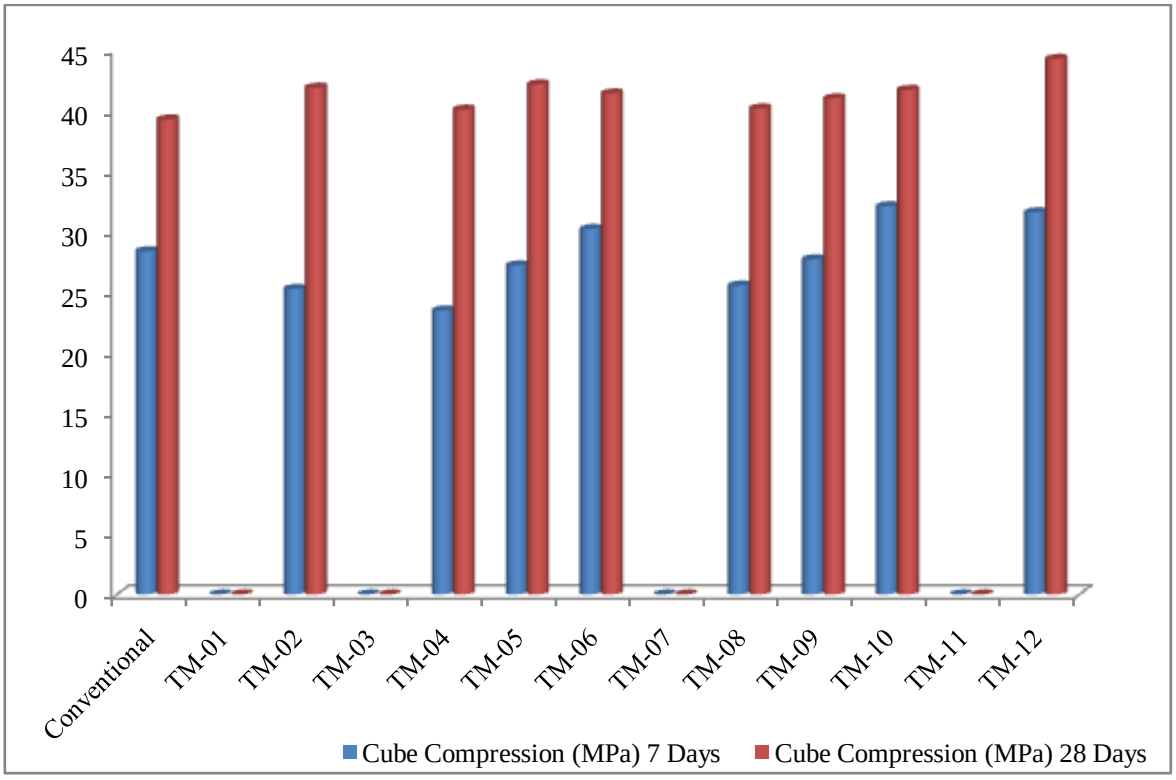

Fig. 5.Compressive strength results of SCC

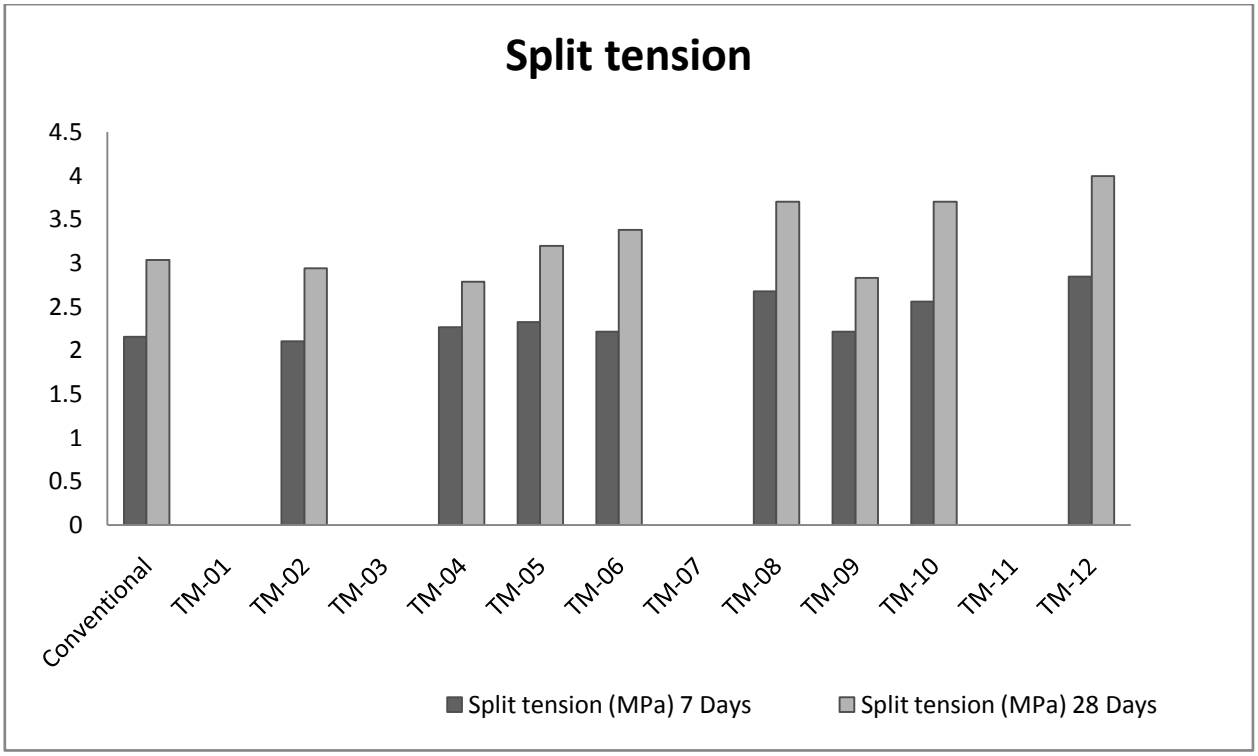

Fig. 6.Split tension results of SCC

CONCLUSION

Based on the test results carried out by the performance evaluation study of Self Compacting Concrete, the following conclusions have been made.

(i) The performance of the self-compacting concrete with partial replacement of river sand by manufactured sand is hence verified for its desired characteristics.

(ii) 25% of manufactured sand with 75 % of River sand mix had the compression strength of 40.04 MPa and high slump flow of 720mm

(iii) 50% manufactured sand with 50 % of river sand mix, three satisfied slump flow and compression strength attained comparable with trial mix-06 had the high slump flow of 710 mm and high compression strength of cube as 41.37 Mpa,

(iv) 75 % manufactured sand and 25% of river sand mix, three satisfied slump flow and compression strength attained. Comparatively TM-10 have the high slump flow of 725mm and high compression strength of cubes ad 41.84 Mpa,

(v) Among the trials conducted in the experimental investigation, TM-10 has got the highest slump flow of 725mm and compression strength of 41.84Mpa,

(vi) The SCC mix proportion that was obtained using EFNARC 2005 guidelines is capable of achieving the SCC characteristics. Cement and coarse aggregate is kept as constant throughout this study. Fine aggregate is partly replaced as Manufacture sand in the percentage of 25%, 50% and 75%

(vii) The recommended dosage of super plasticizer admixture (Glenium B233) is kept as 1and 2 percent by weight of powder content for the various mixes of concrete and the Viscosity modifying agent(Glenium stream 2) is fixed as 0.2 percent of weight of powder content, (viii) and also compared to the 7 days strength of concrete, the 28 days compressive strength and split tensile strength of concrete are increased by 41% and 55%.

REFERENCES

1. Europian Federation of National Associations Representing for Concrete (EFNARC) – Specification and guidelines for self compacting concrete, 2005.
2. Ganeshwaran, P. A. and D. Suji. 2013. Behavioural studies on potenial aspects of Self Compacting Concrete with manufactured sand and fly ash. International Journal of Emerging Technology and Advanced Engineering. Vol.3, Issue 11.
3. Priyanka, A. 2013. Effect of replacement of natural sand by manufactured sand on the properties of cement mortar. Paper presented in National conference on “advances in concrete” at IIT Bombay, 2013.
4. Raghupathi, S. C. 2010. Investigations on flexural behavior of high strength manufactured sand concrete. The Indian Concrete Journal, Vol. 3, Issue 11, pp: 60-80.