International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION OF SCC USING M-SAND WITH LIME STONE AS PART REPLACEMENT FOR CEMENT

[Praveen Kumar M, Punith Kumar, Ravikiran V, Yogesh J] [1], [Khalid Nayaz Khan] [2]

[1]*Bachelor of Engineering (Civil Engineering) UG Students, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India*
[2]*Associate Professor, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India*

Abstract - *Self Compacting Concrete (SCC) is one of the most significant advance in concrete technology in the last decades. SCC was mainly developed to ensure adequate compaction through self-compaction and facilitate placement of concrete in structures with congested reinforcement and in restricted areas. SCC is a very fluid concrete and a homogeneous mixture and solves most of problem related to ordinary concrete. SCC gets compacted under its own weight and there is no need of internal vibration. In this work an attempt as been made to make a comparative study on the fresh and hardened properties of M40 grade of plain concrete mixes to self-compacting concrete. An experimental investigation are carried out to study the properties of SCC by manufacture sand and partially replacing cement with percentage of Lime stone of (0%,10%,20%,30%,40%). Further workability test (Slump, V-funnel, L-Box, U-Box, J-Ring and T-50) and mechanical properties such as compressive strength, Split tensile Strength, Flexural strength are studied on this SCC mix proportions.*

1. INTRODUCTION:

In the last 3 decades, several experimental investigations have been conducted all over the globe to explore the ways to improve quality of concrete with regards to durability and strength. Also concrete has a building material consisting of fine aggregate (sand), coarse aggregate, cement and water. The increased utilization of concrete in form works of odd shapes has made it very significant to prepare concrete that ensures structural performance, durability and packing ability. From 1980's onwards Concrete technology has undergone several investigations to improve its durability properties and strength. Till 1980's the experimental works were concentrated only on the flow ability of concrete to improve its strength and not much emphasis was given to the aspects. This kind of research has evolved the improvement of Self compacting concrete in concrete infrastructures. SCC has the ability to fill every nook and corner of formwork under its self-weight. The concrete that gets placed and compacted under its own weight and satisfactorily packs the surrounding of confined reinforcing bars is known as self-compacting concrete (SCC) . Also it fills spaces of any shape and size without bleeding and segregation. When placing of concrete is complicated, this kind of SCC offers various advantages and preferences over traditional concrete. This incorporate an enhanced nature of concrete, quicker development times, reduction of onsite repairs, lower general expenses into concrete development. A vital change of well-being and security is additionally accomplished through removal of handling of vibrators.

The main aim of this thesis is to discover the fresh state properties (slump cone, V-funnel, J-ring, L-box and U-box test), mechanical properties like split tensile strength (150mm diameter X 300mm height), compression strength (150x150x150mm cube) and flexural strength (100x100x500 mm beam) of concrete made utilizing M-sand and replacing cement by Lime stone. The mix design calculation for M40 grade concrete is chosen according to Indian standard code specification of IS 10262-2009.

The flexural strength, compressive strength and split tensile strength tests are carried out using manufactured sand in place of river sand and replacing cement by mineral admixtures like Lime stone placing 28 days cured specimen subsequent to drying for 24 hours utilizing compressive testing machine and UTM. The workability test is directed for the measure of water substance needed for mixing with suitable W/C proportion and compaction to keep away from bleeding and segregation.

1.1. Production of SCC

SCC can be categorized into 3 types.

a. Powder type SCC: The required self-compaction is obtained by decreasing amount of water added to concrete. Also super plasticizers and air entraining agents are used to render the required characteristics.

b. Viscosity agent type SCC: This kind of SCC is proportioned to give self-flowing ability by the utilizing viscosity altering admixtures to prevent segregation. Admixtures such as air entraining agents and super plasticizers are utilized to obtain the necessary workability.

c. Combination type SCC: The kind of SCC is manufactured to offer self-compaction essentially by decreasing the water cement ratio and viscosity altering admixtures are added to control segregation of fresh concrete.

Table 1: Typical Acceptance Criteria for SCC

Sl No	Methods	Unit	Typical ranges of values	
			Minimum	Maximum
1	Slump flow by Abram's cone	mm	650	800
2	T50cm Slump Flow	sec	2	5
3	V-Funnel	sec	8	12
4	L-Box	h1/h2	0.8	1.0
5	U-Box	(h2-h1)	0	30
6	J-Ring	mm	0	10

2. AIM AND OBJECTIVES

1. To study workability properties like V-funnel, L-box, Slump flow, U-box and j-ring for concrete with 0%, 10%, 20%, 30% and 40% replacement of cement with Lime stone.
2. To study properties of hardened concrete such as flexural strength (7 and 28 days), compressive strength (7 and 28 days) and split tensile strength (7 and 28 days) and for 0%,10%, 20%, 30% and 40% replacement of Lime stone.
3. To compare flexural strength, compressive strength and split tensile strength variations for 0%, 10%, 20%, 30% and 40% replacement of Lime stone.
4. To compare performance of concrete for similar replacement percentages of Lime stone.

3. MATERIAL PROPERTIES

3.1.Cement

The most widely used cement is type I/II Pozzolona Portland cement. The strength of cement complies with the requirement of a type I and the C3A content confinement of a type II. This sort of concrete is generally utilized as a part of development and is rapidly accessible from mixed sources. Ultra-tech Portland pozzolana cement confirming IS code 1489-1991 was used for tested chemical and physical properties of concrete.

Table 2 Physical Properties of Cement

Sl no	Test on cement	Observation
1	Specific gravity	3.10
2	Normal consistency	30%
3	Initial setting time	55 min
4	Final setting time	300 min
5	Compressive strength 7 days 28 days	 31.18 N/mm2 56.40 N/mm2

3.2. Fine Aggregate (M-Sand)

M-sand is used in this experimental work. The crushed aggregates whose size is less than 4.75 mm are used and obtained from the local crushing plant; (Bidadi, Karnataka) is utilized in this experimental work. M-sand as replaced to river sand has become economical, beneficial and now a days common in the world. The code book used for present study is IS: 383-1970.

Table 3: Properties of Fine Aggregate

Properties	Observations
Fineness Modulus	3.08
Specific Gravity	2.64
Bulk Density(kg/m3)	1665

3.3. Coarse Aggregate

Coarse aggregate obtained from the local crushing plant (Bidadi, Karnataka) is utilized in this experimental work. The size of the aggregate used is 20mm down.The physical properties of coarse aggregate are tested in this experimental work.

Table 4: Properties in Coarse Aggregate

Properties	Observation
Fineness Modulus	4.89
Specific Gravity	2.70
Bulk Density (kg/m3)	1785

4. CONPLAST SP 430

The admixture Conplast SP 430 is new invention produced by the Forsoc organization. The product has been fundamentally produced for application in high performance cement where the high strength and execution is needed. Conplast SP 430 is free from alkali and chloride. It is preferred with a wide range of concrete. The specific gravity is 1.145 and brown in color.

5. LIME STONE

Lime Stone utilized in this experimental work is obtained from Rashmitha enterprises Ramanagara. The specific gravity of Lime Stone is 2.2 and white in color.

Table 5: Mix Proportion For M40 Grade For Lime Stone

Percentage	Lime stone 0%	Lime stone 10%	Lime stone 20%	Lime stone 30%	Lime stone 40%
Cement (kg/m3)	394.3	354.8	315.4	276.0	236.5
Lime stone (kg/m3)	-------	39.43	78.86	118.2	157.7
W/C ratio	0.40	0.40	0.40	0.40	0.40
F.A (kg/m3)	956	956	956	956	956
C.A (kg/m3)	781	781	781	781	781
Super plasticizer (kg/m3)	7.7	6.93	6.13	5.39	4.62

6. EXPERIMENTAL RESULTS

6.1. Fresh State Properties

The workability properties such as V-funnel, J-ring, Slump flow, U-box and L-box test are studied to find flow ability, passing ability and the experimental results are recorded.

Table 6: Workability Test results

Sl No	Lime stone Mixture in %	Slump(mm)	T 50cm Slump Flow (sec)	V-Funnel (sec)	L-Box (h2/h1) mm	U-Box (h2-h1) mm	J-Ring (mm)
1	0%	675	4	9	0.80	15	8
2	10%	670	3	9	0.80	20	7
3	20%	690	4	10	0.75	18	8
4	30%	675	2	8	0.90	17	6
5	40%	660	3	11	0.80	15	7

6.1. Specimen Details

1. Cubes of 150 mmx150 mm x 150 mm size
2. Cylinder of 150 mm dia and 300 mm length
3. Beam of 100 mm x 100 mm x 500 mm size

6.2. Hardened State Properties

1. Compressive strength
2. Split tensile strength
3. Flexural strength

Fig. 1 Compressive strength test

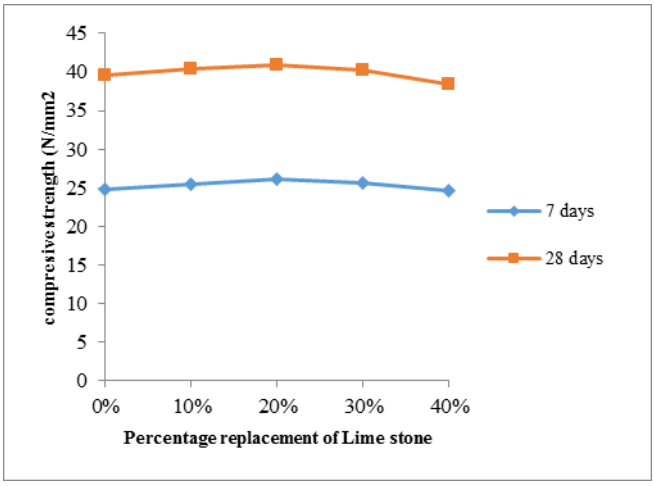
Fig. 2 Split tensile strength test

Fig. 3 Flexural strength test

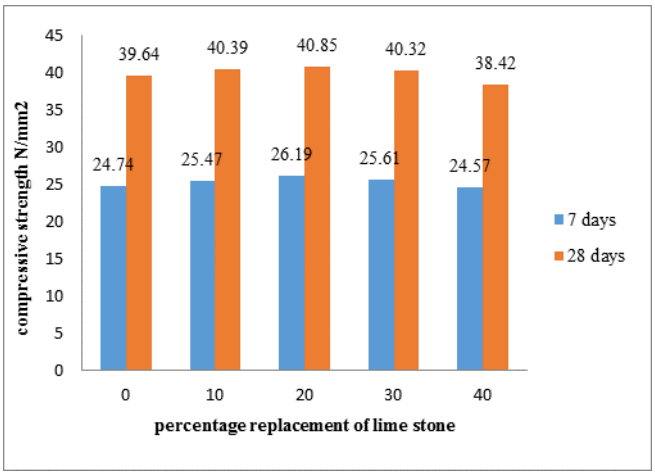
7. TEST RESULTS

Table 7 Compressive strength after 7 & 28 days

Lime stone %	Compressive strength (N/mm²)	
	7 days	28 days
0%	24.74	39.64
10%	25.47	40.39
20%	26.19	40.85
30%	25.61	40.32
40%	24.57	38.42



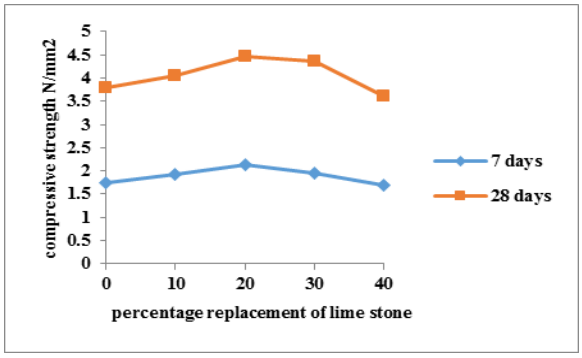
Graph 1 Compressive strength for M40 grade after 7 and 28 days



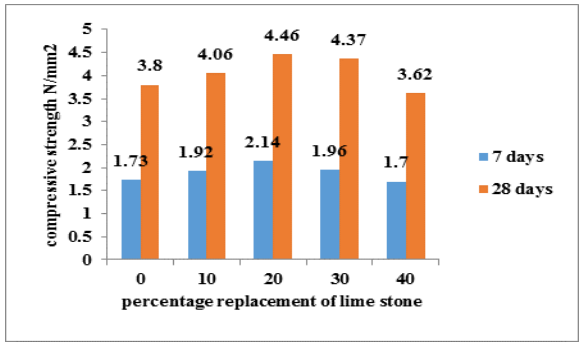
Graph 2 Compressive strength for M40 grade after 7 and 28 days

Table 8 Split tensile strength after 7 & 28 days

Lime stone %	Compressive strength (N/mm²)	
	7 days	28 days
0%	1.73	3.80
10%	1.92	4.06
20%	2.14	4.46
30%	1.96	4.37
40%	1.70	3.62



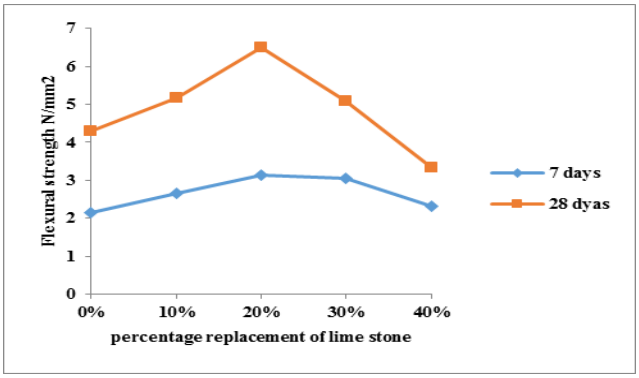
Graph 3 split tensile strength for M40 grade after 7 and 28 days



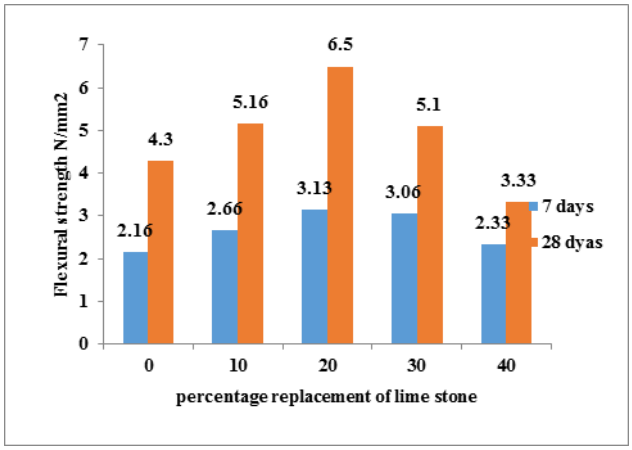
Graph 4 Split tensile strength for M40 grade after 7 and 28 days

Table 9 flexural strength after 7 & 28 days

Lime stone %	Compressive strength (N/mm²)	
	7 days	28 days
0%	2.16	4.30
10%	2.66	5.16
20%	3.13	6.50
30%	3.06	5.10
40%	2.33	3.33



Graph 5 Flexural strength for M40 grade after 7 and 28 days



Graph 6 Flexural strength for M40 grade after 7 and 28 days

CONCLUSION

1. Manufactured sand is well graded material and it falls within the grading limits specified by BIS Guidelines IS: 383-1970 code for getting zone II sand classification.
2. For M40 grade mixes, when converted to SCC mix as per guidelines given in EFNARC, the desired requirement criteria in V-funnel, Slump flow, J-ring, L-box and U-box tests is obtained.
3. The cube compressive strength after 7 and 28 days has shown an increase in strength with increase in percentage of Lime stone from 0-20%. It is maximum at 20%. There after there is a decrease in compressive strength for 30% and 40% replacement. (Graph No 6.1, 6.2, 6.3, 6.4).
4. The split tensile strength and flexural strength is maximum for 20% replacement for Lime stone.
5. Increase in compressive strength from 0-20% Lime stone replacement is about 5.86% and 3.05% for 7 and 28 days respectively.
6. Increase in split tensile strength from 0-20% Lime stone replacement is about 23.64% and 17.36% for 7 and 28 days respectively.
7. Increase in flexure strength from 0-20% Lime stone replacement is about 44.90% and 51.16% for 7 and 28 days respectively.

SCOPE FOR FUTURE INVESTIGATION

1. Further studies can be carried out using varying percentage of other mineral admixtures such As Rice husk ash and Fly ash as cement replacement.
2. Studies can be carried out using varying percentage of fibers such as steel, polyester polypropylene glass fibers etc.
3. Studies can be carried out on durability of concrete for resistance to acid attack, sulphate attack etc.
4. Permeability tests and sorptivity tests (relative measure of permeability) can also be conducted on SCC and its effects can be investigated.
5. Work can be carried out to find the mechanical properties of SCC under extreme temperature exposures such as very high and very cold conditions.

REFRENCES

1. **Priyanka A. Jadhavaand Dilip k. Kulkarni**, "An Experimental Investigation on the Properties of Concrete Containing Manufactured Sand", International Journal of Advanced Engineering Technology Vol.III/ IssueII/ April-June, 2012.
2. **Nimita Vijayaraghavan1* and A S Wayal1** "Effects of Manufactured Sand On Compressive Strength and Workability of Concrete" Int.J.Struct. & Civil Engg.Res.2013.
ISSN 2319-6009 www.ijscer.comVol.2, No.4, November 2013@2013 IJSCER.
3. **S. Sesha Phani1, Seshadri Sekhar T2, Srinivasa Rao3, Sravana4, Sarika.P5** "Studies on Effect of Mineral Admixtures on Durability Properties of high Strength Self Compacting Concrete"IJRET: International Jurnal of Research in Engg. And Technology ISSN: 2319-1163 IISN: 2321-7308.
4. **RaminVafaei Pour Sorkhabi 1,*, AlirezaNaseri 2** "Studying the Strength of self-Compacting Concrete According to the Ratio of Plasticizer and Slump Flow Using Experimental Method" Life Science Journal 2013;10(6s).
5. **Mallikarjuna Reddy V1, SeshagiriRao M V2, Srilakshmi P2, Satsesh Kumar** "Effect of W/C Ratio on Workability and Mechanical Properties of High Strength Self Compacting Concrete (M70 Grade)" International Journal of Engg Research and Development e-ISSN:2278-067X,p-ISSN:2278-800X,
www.ijerd.comVolume 7,Issue 1(May 2013),pp.06-13.
6. **1Krishna Murthy.N, 2Narasimha Rao A.V, 3 Ramana Reddy I. V and 4 VijayaSekharReddy.M** "Mix Design Procedure of Self Compacting Concrete" IOSR Journal of Engg (IOSRJEN) e-ISSN: 2250-3021,p-ISSN: 2278-8719, www.iosrjen.org Volume 2, Issue 9 (September 2012.
7. **Pradnya P. Urade1,Chandrakant U.Mehetre2 & Shriran H. Mahure3** "Comparative Study of Properties of Self Compacting Concrete With Ground Granulated Blast Furnance Slag and Fly Ash as Admixtures" International Journal of Civil, Structural, Environmental and Infrastructure Engg Research and development (IJCSEIERD) ISSN (P): 2249-6866; ISSN (E): 2249-7978 Vol.4, Issue 2,Apr 2014,127-130
8. **B. Beeralingegowda1, V. D. Gundakalle2**. "The Effect of Addition of Limestone Powder on the Properties of Self Compacting Concrete" International Journal of Innovative Research in Science, Engg and Technology (An ISO 3297:2007 Certified Organization) Vol. 2, Issue 9 September 2013.

9. **Barge Johannes Wigum, Syein Willy Danielsen(editors) Odd Hotvedt & Bard Pedersen** "production and utilization of Manufactured sand" State-of-the-art Report in 2009.
10. **Manguriul,G.N,Karugu2,C.K,Oyawa3,W.O.,Abuodha4, S.O And Mulu5,P.U.** "particle replacement of natural river sand with crushed rock sand in concrete production" Global engineering and technologists review in 2013.
11. **IS: 456-2000,** Indian standard and Reinforced concrete code of practice.
12. **IS: 10262-1982,** Indian standard concrete mix proportioning-Guidelines.
13. **IS: 10262-2009,** Indian standard concrete mix proportioning-Guidelines.
14. **IS: 383-1970,** Specification for coarse and fine aggregate from natural source for concrete Indian: Bureau of Indian standard.
15. **IS: 2386-1975,** Indian standard methods of test for aggregates for concrete.
16. **EFNARC,** Specification and guidelines for self-compacting concrete.
17. **Meghana K, Ghousia college of Engg. Ramanagara.** "Experimental investigation of SCC Using M-Sand with GGBS & Silica Fume as part replacement for cement" 2015.
18. **Jarjish Alam, Ghousia college of Engg. Ramanagara.** "Experimental investigation of SCC using M-Sand with Fly ash as part replacement for cement" 2016.

BIOGRAPHIES

Associate Professor, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India.

Bachelor of Engineering (Civil Engineering) UG Student, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India.

Bachelor of Engineering (Civil Engineering) UG Student, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India.

Bachelor of Engineering (Civil Engineering) UG Student, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India.

Bachelor of Engineering (Civil Engineering) UG Student, Department of civil Engineering, Ghousia College Of Engineering Ramanagaram, Karanataka, India.