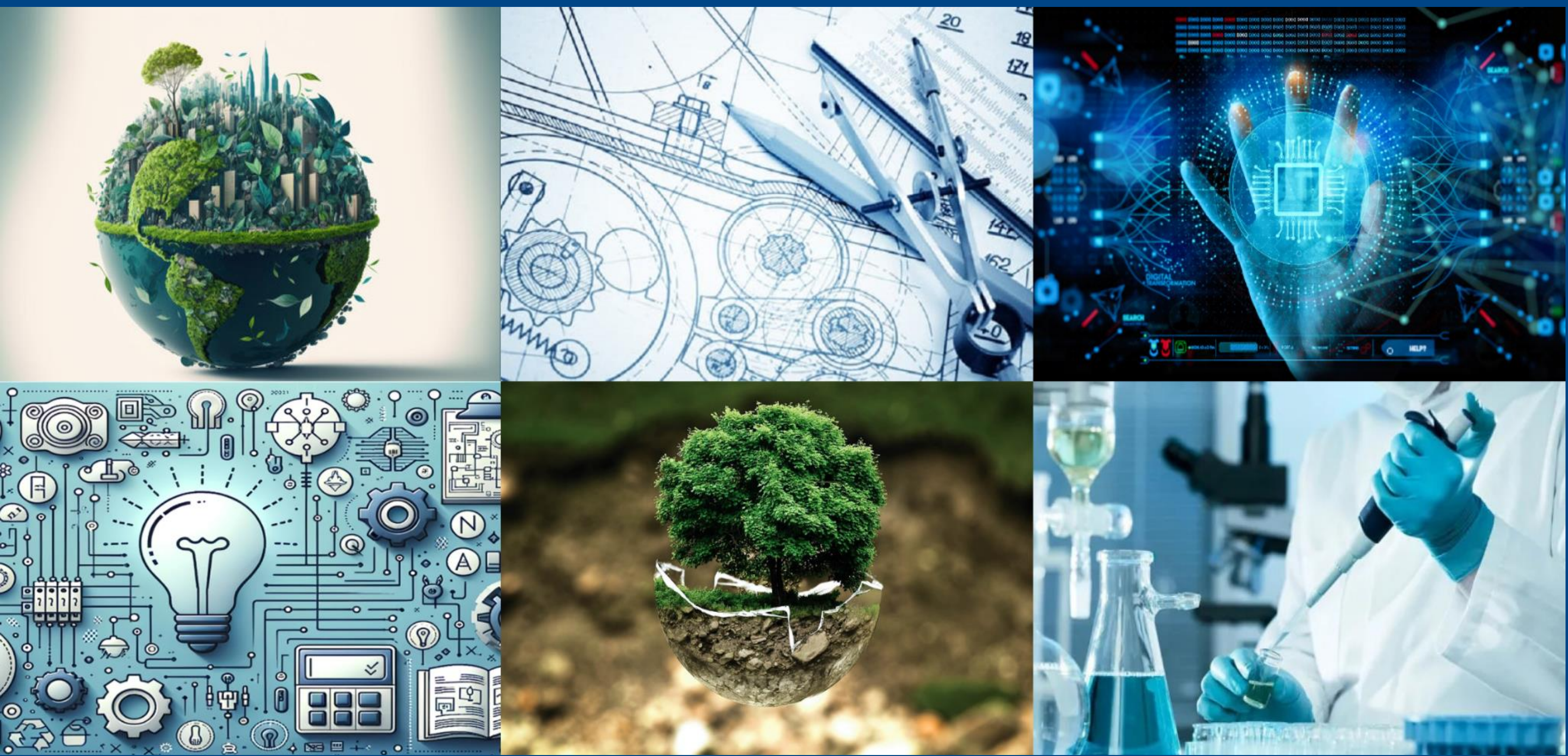
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 3, March 2025

www.ijmrset.com ijmrset@gmail.com +91 6381 907 438 +91 63819 07438

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803303

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

A Review on Feasibility of Self Compacted Concrete for Short Column using Steel Fiber

Mr. Ganesh D. Phuse[1], Prof. Vishal Sapate[2]

Student M. Tech. Dept. of Civil Engineering, G. H. Raisoni University Amaravati, Maharashtra, India[1]

Assistant Professor, Dept. of Civil Engineering, G. H. Raisoni University Amaravati, Maharashtra, India[2]

ABSTRACT: Self-compacting Concrete is most commonly used material throughout the world due to its facility to be cast in any desired shape and high compressive strength concrete structures may either be pre cast or cast in situ. As a structural material, Self- compacting concrete is being successfully used in three different forms i.e. plain, reinforced and prestressed. Plain self-compacting concrete is extremely used for structural elements, experiencing primarily compressive stresses only whereas reinforced and pre-stressed concrete are suitable for resisting both tension and compression. The richness of concrete mix depends up on the nature of the requirement as regards strength, environment and durability.

Research carried out in various parts of the world has established that addition of fibers improves the static flexural strength, fatigue, ductility and fracture toughness of material. Recent investigations have also given rise to highly reinforced SFRSCC containing up to 20% volume of steel fibers. The recent developments are due to the introduction of a new generation of additives such as super-plasticizers and fly ash, which allow the use of high volume of steel fibers and high strength self-compacting concrete.

Fiber-reinforced plastics and fiber-reinforced concrete (using different type of fibers) have shown better behavior because of their inherent ability to stop or delay crack propagation. Reinforcing fibers stretch more than concrete under loading. Materials used in fiber reinforcing include acrylic, asbestos, cotton, glass, nylon, polyester, poly ethylene rayon, rock wool and steel. Acid resistive glass and steel are common. Plastic fibers are used because of their ability to resist corrosion. Natural fibers have little value because they are prone to decay. The percentage of fibbers in concrete mix is based on volume and is expressed as a percentage of mix 0.5%, 1.0%, 1.5% of fibers is common

The main purpose of SFRSCC in tension, compression and shear are influenced by the type of fiber, volume fraction fibers, aspect ratio (the length of the fiber divided by its diameter) and the orientation of fiber in the matrix.
In recent years fiber reinforced self-compacting concrete composite have found increasingly wide applications in civil engineering. SFRSCC composite is having steel fiber embedded in transition zone between cement mortar and aggregate interface. Ductility is the main requirement of earthquake resistant structures. Self-compacting concrete can be modified to perform in a more ductile form by the addition of randomly distributed discrete fibers in the concrete matrix. It has been noticed from the experimental investigation that the behavior of SFRSCC column is relatively better than plain reinforced self-compacting concrete column in all respects. The term Fiber Reinforced self-compacting Concrete (FRSCC) can be defined as a concrete structure having randomly oriented and dispersed fibers. Also, Fiber Reinforced self-compacting Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete along with discontinuous, discrete, uniformly dispersed fibers. Fibers can be defined as small wire like reinforcements which are made of steel or polymers having high ductility.

KEYWORDS: To study the Feasibility of Self Compacted Concrete for Short Column using steel fiber

I. INTRODUCTION

The objective of this experimental work is to study the flow characteristics of SFRSCC and the influence of fibers on its mechanical properties. The scope of this work includes:

1) To design the mix by IS method in order to produce M30 grade self-compacting concrete.
2) To determine the fiber content to be added without hindering the flow characteristics of SCC.

3) Workability of SFRSCC according to EFNARC guidelines for Slump test, V– Funnel test and L–Box test.
4) To determine the effects of fibers on the hardened properties of SCC through measurements.
5) To determine the effects of fibers on the hardened properties of concrete.
6) Load- Deformation behavior of column specimen.
7) Ductility Factor of column specimen.

Need: There are the reasons why Self compacting Concrete may need to be needed:

1) To improve construction systems previously based on conventional concrete that required vibrating compaction.
2) To eliminate many undesirable properties and to enhance many desirable properties of the plain concrete.
3) To study the helping behavior of fiber to transfer loads at the internal micro cracks.
4) To improve the fatigue strength property at all stress levels
5) To arrest the early spelling of the cover and increase the load taking capacity as well as the ductility of the columns over that of comparable non-fiber-reinforced specimens.
6) To study the structural behavior of steel fiber reinforced self-compacting concrete column having square in cross section of size 150 mm X 150 mm X 600 mm under axial loading.

II. LITERATURE REVIEWS

M. Yaqub et.al [1] studied in the research work using the local material of Pakistan to develop high strength concrete. The properties of fresh & hardness concrete were examined. For that Super plasticizer (ultra type A& F) was used in order to increase workability of concrete. In the development of mix design method for high strength concrete the smaller size aggregate plays very important role in the achievement of high compressive strength. With the increase of cement contents, the strength of concrete increases.

A. Annadurai et.al [2] experimented in the research work that design developed for high strength concrete with silica fume and High range water reducing admixture (HRWR). It involves the process of determining experimentally the most suitable concrete mixes in order to achieve the targeted mean strength. Increase in the percentage of Micro silica requires more demand of water because of the Greater fineness.

Aginam C. H et.al [3] experimented in the research work that the concrete mixes are designed to achieve a defined workability, strength and durability. The design is geared towards the selection and proportioning of constituents to produce a concrete with pre-defined characteristics both in fresh and hardened states. This study investigates the variation of concrete compressive strength with mix designed methods.

Dr Deepa A Sinha [4] studied concrete mix design is the process of choosing suitable ingredient of concrete and determining their relative quantities with the object of producing as economically as possible concrete of certain minimum properties, notable workability, strength and durability. It should be explained that an exact determination of mix proportions by means of table or computer data is generally not possible.

Shri Purvansh B. Shah et.al [5] studied the SCC provides improvements in strength, density, durability, volume stability, bond, and abrasion resistance. SCC is especially useful in confined zones where vibrating compaction is difficult. The reduction in schedule is limited since a large portion of the schedule is still controlled by the time required to erect and remove formwork.

Aiswarya Sukumar et.al [6] tested the steel fiber reinforced concrete to check the influence of fibers on strength of concrete. According to various research papers, it has been found that steel fibers give the maximum strength in comparison to glass and polypropylene fibers. Hence, in this project he was interested to find the effect of steel fibers in concrete. An experimental investigation on the behavior of concrete specimens reinforced with steel fibers and subjected to compressive and flexural loading is presented.
Samadhan Garad et.al [7] experimented in the research work that develops high performance concrete by using fibers in concrete up to certain proportions. The present work deals with the results of experimental investigations on glass fiber reinforced concrete. Effect of these fibers on strengths of concrete are studied. Fiber content varied from say

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

(1.0%, 2.0%, 3.0%, 4.0 % & 5%) by weight of cement. Various strengths considered for investigation are compressive strength and flexural strength for glass fiber reinforced concrete.

Komal Chawla et.al [8] studied about the about plain concrete possess very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks. Fibers when added in certain percentage in the concrete improve the strain properties well as crack resistance, ductility, as flexure strength and toughness. Mainly the studies and research in fiber reinforced concrete has been devoted to steel fibers. Portland pozzolona cement of 43 Grade is used.

Ehab m. Lotfy [9] experimented investigation of the axial behavior of small scale squar e reinforced concrete columns with fiber reinforced polymer (FRP) bars, as a solution t o overcome the corrosion problems, where this material represents a relatively new tech nology; therefore much research is needed to determine its characteristics and gain conf idence to be accepted by engineers for practical application.Increasing of characteristic strength of concrete has significant effect on the behavior of tested columns where incr ease toughness and ductility of tested columns.So GFRP bars can be used as main reinf orcement in columns with increasing the transverse reinforcement along columns length and using high strength concrete.

Aswathy Ananthan et.al [10] studied the A tubed Steel Reinforced Short columns is a special SRC column where Reinforcement is in the cage of a outer thin steel tube but the steel tube does not pass through the beam–column connection and is shorter than concrete core. To obtain necessary information for designing and construction practices to avoid short column Failure during earthquake. The purpose of this study is to investigate the improvement of strength of a structure by adding tubed SRC columns.

Akshay P. Mote at.al [11] experimented the study related to the strengthening of R C short columns strengthened with BFRP wrap under axial loading .The columns were bonded with BFRP sheets in single layer and double layers with various configurations. The experimental results show that the columns strengthened with BFRP show high load carrying capacity and ductility index.

Payal Painuly et.al [12] studied to increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. To development of self-compacting concrete with reduced segregation potential. The systematic experimental approach showed that partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation potential as assessed by the V-Funnel test.

Mr. Dhruv kumar H. Patel et.al [13] experimented that the partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation potential as assessed by the V-Funnel test. If we add the mineral admixture replacement for we can have a better workable concrete. The composition of SCC mixes includes substantial proportions of fine-grained inorganic materials and this gives possibilities for utilization of mineral admixtures, which are currently waste products with no practical applications.

H. Achonglulut et.al [14] studied the composition of SCC mixes includes substantial proportions of fine-grained inorganic materials and this gives possibilities for utilization of mineral admixtures, which are currently waste products with no practical applications. For ex. The elimination of vibration process & reduction in labor cost. Creating working environment free from noise pollution. This new concrete not only satisfied the two basic requirement of concrete but also create the new property of concrete that is very workable, flowable and self-compacted.

S. Bullo et.al [15] the experimented in the research that the study on large-scale confined self-compacting concrete columns; this study is part of a wide national research programme regarding the behavior of self-compacting concrete and the structural effects due to its utilization. The results show that when a SCC is used instead of high flowability concrete, both the material and the structural behavior are on average similar; frequently a greater scatter of the experimental quantities distinguishes the results of the tests on SCC members.

III. RESEARCH METHDOLOGY

Literature study on the workability parameters, test methods for workability of SCC, performance of SCC in hardened state and its compression behavior.

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803303

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Mix Design of M-30 grade SCC by IS 10262-2009
Effect on properties of SCC by adding Steel fibers.
Workability study of SFRSCC mix according to EFNARC guidelines for Slump test, V–Funnel test, L–Box test.
Hardened properties of SFRSCC have been tested by Compressive Strength of cube specimens (150 mm x 150 mm x 150 mm), and axial loading of column specimens (150 mm x 150 mm x 600 mm) at 7 and 28 days of maturity in normal water curing.
Finally, discussion of all test results along with their theoretical expressions has drawn and all results have compared and justified.

DETAILED STUDY
Materials Used
Cement.
Fine Aggregates.
Coarse Aggregate.
Super plasticizer.
Viscosity modifying agent.
Steel fibers. etc.

Cement: In this present investigation Ordinary Portland Cement (OPC) of 53-grade obtained from AMBUJA Cements Pvt. Ltd was used conforming to IS 12269–2004 was used. As per IS 4032 for the chemical composition of OPC 53. Specific Gravity was found out 3.04 for OPC of 53-grade cement. Figure 4.1 shows the cement used in the experimental work.

Fine Aggregates: Locally available sand from man river with 4.75 mm maximum size was used as fine aggregate with specific gravity 2.55, Fineness Modulus = 2.65. confirming to IS 383– 1987. The sieve analysis has confirmed that fine aggregate is of zone II. Its average water absorption was found to be 1.1%.

Coarse Aggregate: Locally available crushed stone with maximum size 20mm was used as coarse aggregate with specific gravity of 2.78, fineness modulus=6.78 confirming to IS 383– 1987. Coarse aggregates having a maximum size of 20mm were used in this project work where 40% of it was passing through 20mm IS sieve and retaining on 12.5mm IS sieve and 60% was passing on 12.5mm IS sieve and retained on 4.75mm sieve.

Super Plasticizer: Commercially available super plasticizer CICO Plast Super C 300 obtained from CICO Technologies Ltd. Pune has been used as super plasticizer. Super plasticizer was mixed in the amount of 2 % of 3644ementitious material confirming to IS 9103-1999. The specific gravity and pH of super plasticizer used are 1.12 and 5.0 respectively. Super plasticizers are introduced in SCC to obtain the fluidity. Nevertheless, a high dosage near the saturation amount can increase the proneness of the concrete to segregate.

Viscosity Modifying Admixture (VMA): SPL BS 3000 Viscosity Modifying Admixture (VMA) obtained from MIDC Mumbai was used in the experimental programmed having a pH of 5.0-6.0 and Density 1.20-1.30. These products are available in transparent liquid and no chlorine content present. These products have the same role as the fine particles, minimizing bleeding and coarse aggregate segregation by thickening the paste and retaining the water in the skeleton. The introduction of such products in SCC seems to be justified in the case of SCC with high water to binder ratio.

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803303

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Steel fibers: High Tensile Hook End Steel Fibers procured from KASTURI METAL COMPOSITES Pvt. Ltd. Amravati. was used in this experimental work. The properties of the Steel Fibers used are given in Table 4.1.

Fiber Type	Aspect Ratio	Length (mm)	Diameter (mm)	Tensile Strength N/mm^2
HKL HT 80/60	80	60	0.75	1250 N/mm^2

Water: In this study, normal tap water available in the concrete laboratory was used. Water conforming to the requirements of water for concreting and curing as per IS: 456-2000.

TESTS ON FRESH PROPERTIES OF SFRSCC

Slump flow test: The simplest and most widely used test method for Self-Compacting Concrete is the slump flow test (EFNARC 2002). The test, which was developed in Japan, was originally used to measure underwater concrete and has also been used to measure highly flowable concretes. This test method evaluates the ability of the SCC to flow under its own weight in an unconfined condition. To perform the test, a conventional slump cone is placed on a rigid, non-absorbent plate and filled with concrete without tamping. The slump cone is lifted and the diameter of concrete in two perpendicular directions is measured, and the average of the two measured diameters is recorded. The higher the slump flow, the better the filling ability of concrete to fill formwork. This is usually the primary acceptance test method used on the jobsite and EFNARC (2002) requires a slump flow value between 650 – 800 mm.
For an additional measure of flowability, the time required for the concrete to spread to a diameter of 50 cm can be measured. This flow time is termed as T50 cm slump flow. A lower time indicates greater flow ability. This value of T50 generally ranges from 2- 7seconds. It is possible to assess the stability of concrete qualitatively after performing the slump flow test.

V- funnel test: V-funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum aggregate size of 20 mm. The funnel is filled with about 12 liters of concrete and the time taken for it to flow through the apparatus is measured. This test method is used to measure the flowability and dynamic stability of the SCC mixture. The funnel is filled with SFRSCC and the time required for the material to follow out is recorded. To measure segregation resistance, the V-funnel is refilled with concrete and allowed to sit for 5 minutes. The door is again opened and the flow time is recorded. The greater the increase in flow time after the concrete has remained at rest for five minutes, the greater will be the concrete's susceptibility to segregation.
This test method evaluates the viscosity of the SCC and its ability to flow through a restricted opening without segregation. The funnel flow time between 6 and 12 sec is generally desired for SCC. This test method is typically used for product prequalification.

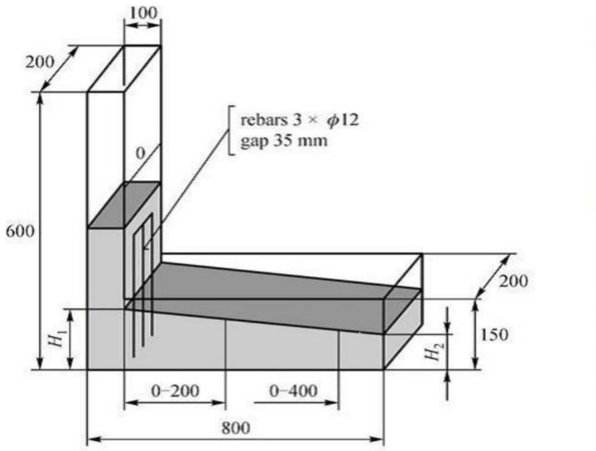
L-box test: The L-box value is the ratio of levels of concrete at each end of the box after the test is complete at each end of the box after the test is complete. The L-box consists of a "chimney "section and a "trough "section after the test is complete, the level of concrete in the chimney is recorded 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.

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803303

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Slump flow test results
Workability Results of SFRSCC

Sr. No	Fiber Content %	Slum Flow (mm)	T50 Slump Flow (sec)	V-Funnel (sec)	L-Box (H2/H1)
1	0	680	3	8	0.86
2	0.5	675	3	9	0.83
3	1	650	4	9	0.82
4	1.5	630	5	10	0.80

Acceptance Criteria for SCC Recommended by EFNARC (2002)

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803303

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

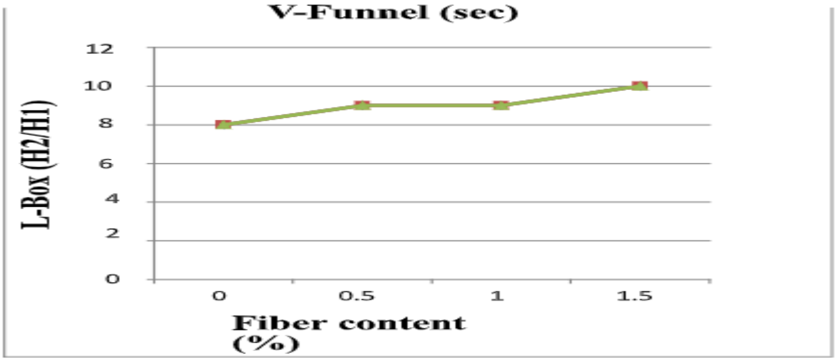
International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Sr. No	Methods	Unit	Typical range of values	
			Minimum	Maximum
1	Slump flow test	Mm	650	800
2	T50 cm slump flow	Sec	2	5
3	V-funnel test	Sec	6	12
4	L-Box test	H2/H1	0.8	1

V–Funnel test results
To assess the flowability and stability of freshly prepared concrete, all the four mixes with different contents of steel fibres were tested by V-funnel test. The flowability of the fresh concrete can be tested with the V-funnel test, whereby the flow time is measured.

The funnel is filled with concrete and the time taken for it to flow through the apparatus is measured. Further, T5 min is also measured with V-funnel, which indicates the tendency for segregation, wherein the funnel can be refilled with concrete and left for 5 minutes to settle. If the concrete shows segregation, the flow time will increase significantly. The results have been presented in Table 5.1. According to the results of test, the V-funnel flow time varies between 9 and 11 s.



L–Box test results
The L–Box test is used to check the filling and passing ability of SCC. The blocking ratio (H2/H1) of various SCC mixes is shown in Figure 4.4. The blocking ratio should be between 0.8 and 1.0. While assessing the fresh concrete for passing ability, it is observed that all the four mixes pass through the bars of L-box very easily and no blockage is seen in any of the mixes. The results of L-box test show that, although the blocking ratio (H2/H1) gradually decreases with the increase in the quantity of fiber content, the ratio (H2/H1) for all the mixes is above 0.8, which is as per EFNARC standards. Following graph shows the results of the test conducted on various mixes.

REFERENCES

[1] M. Yaqub, Imran Bukhari, 2016 Development Of Mix Design For High Strength Concrete 31st Conference on Our World In Concrete & Structures: 16 17 August 2006, Singapore.
[2] Annadurai1, A. Ravichandran2. Development of mix design for high strength Concrete with Admixtures IOSR Journal of Mechanical and Civil Engineering, Volume 10, Issue 5 (Jan. 2014) -ISSN: 2278-1684.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

[3] Aginam C. H., Umenwaliri S. N. and Nwakire, C, Influence Of Mix Design Methods On The Compressive Strength Of Concrete Arpan Journal of Engineering and Applied Sciences VOL. 8, NO. 6, JUNE 2013, ISSN 1819- 6608.

[4] Dr. Deepa A Sinha Compressive Strength of Concrete using Different Mix Design Methods Indian Journal Of Applied Research Volume: 4 | Issue: 7 | July 2014 | ISSN - 2249-5550.

[5] Shri Purvansh B. Shah1 , Shri Prakash D. Gohil2 ,Shri Hiren J. Chavda3, Shri Tejas D. Khediya4 American Journal of Engineering Research (AJER) Advancements In Concrete Technology Volume-4, Issue-12 e-ISSN: 2320- 0847.

[6] Aiswarya Sukumar, Elson John Fiber Addition And Its Effect On Concrete Strength International Journal of Innovative Research in Advanced Engineering (IJIRAE) Volume 1 Issue 8 (September 2014) ISSN: 2349-2163.

[7] 1Samadhan Garad, 2Prof.Navanath Phadtare Experimental Analysis Of Glass Fiber Reinforced Composite Beams Garad et al., International Journal of Advanced Engineering Technology J Adv Engg Tech/Vol. V/Issue II/April- June,2014/85-87 -ISSN 0976-3945.

[8] Komal Chawla1*and Bharti Tekwani1 Studies Of Glass Fiber Reinforced Concrete Composites International Journal of Structural & Civil Engineering Research Volume 7 Issue 6.

[9] Ehab M. Lotfy,Behavior of reinforced concrete short columns with Fiber Reinfo rcedInternational Journal Of Civil And Structural Engineering Volume 1, No3, 2010 ISSN 0976–4399.

[10] Aswathy Ananthan, Binu M Issac, Priya Philip Seismic Behavior And Strength Of Tubed Steel Reinforced Short Column 2nd International Conference of Science, Technology and Management 27 Sept 2015.

[11] Akshay P. Mote, H. S. Jadhav Experimental Study of Axially Loaded RC Short Columns Strengthened With Basalt Fiber Reinforced Polymer (BFRP) Sheets Int. Journal of Engineering Research and Applications Vol. 4, Issue 7(Version 4), July 2014, ISSN : 2248-9622.

[12] Payal Painuly, Itika Uniyal Literature Review On Self-Compacting Concrete International Journal of Technical Research and Applications Volume 4, Issue 2 (March-April, 2016), e-ISSN: 2320-8163.

[13] Mr. Dhruv kumar H. Patel1, Mr. Dixitkumar D. Patel2, Mr.Dhaval P. Patel3, Mr. Vivek A. Patva4, Mr.Yashasvi kumar R. Patel Literature Review On Self Compacting Concrete International Journal For Technological Research In Engineering Volume 1, Issue 9, May-2014 ISSN (Online): 2347 – 4718.

[14] H. Achong Lulut & Jara Asun Design a self-compacting concrete using local material- Study of workability and compressive strength. S Bullo, R Di Marco, V Giacomin Behavior of Confined Self-Compacting Concrete Columns 34th Conference on Our World in Concrete & Structures: 16

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com