Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

A Study on Flow Properties of Self-Compacting Concrete (SCC)

[1]Ankur Kumar, [2] Mr. Abhishek Rana
[1]M. Tech Student, ,[2 Assi] Professor
Structural Engineering,
[1] Shri Venkateshwara University Uttar Pradesh, India.

Abstract — Self-Compacting Concrete (SCC) is a highly flowable concrete that can spread into formwork and encapsulate reinforcement without vibration. The performance of SCC largely depends on its fresh-state properties, including filling ability, passing ability, and segregation resistance. This study investigates the flow characteristics of SCC using standard tests such as Slump Flow, T500 Time, V-Funnel, L-Box, and J-Ring. Different SCC mixes were prepared by varying the dosage of superplasticizer and mineral admixtures. The experimental results demonstrate the influence of mix composition on the rheological behavior of SCC. The study concludes that an optimum combination of cementitious materials and chemical admixtures significantly enhances flow performance while maintaining stability.

***Keywords: Self-Compacting Concrete, SCC, Flowability, Slump Flow, V-Funnel, L-Box, Fresh Concrete Properties*.**

I. INTRODUCTION

Concrete is the most widely used construction material in the world due to its versatility, strength, durability, and economic advantages. It is extensively employed in residential buildings, commercial structures, bridges, dams, highways, tunnels, and other infrastructure projects. Conventional concrete, however, requires adequate compaction through mechanical vibration to eliminate entrapped air and ensure proper filling of formwork. Improper compaction can lead to defects such as honeycombing, voids, segregation, and poor surface finish, ultimately affecting the strength, durability, and service life of structures.

With the rapid advancement of construction technology and increasing demand for durable and high-quality concrete structures, the limitations of conventional vibrated concrete became more apparent. In heavily reinforced structural members, such as shear walls, columns, deep beams, and congested beam-column joints, achieving proper compaction using vibrators becomes difficult. Inadequate vibration can result in incomplete filling of concrete around reinforcement bars, creating weak zones and reducing structural performance. Moreover, excessive vibration may cause segregation and bleeding, further compromising concrete quality.

To overcome these challenges, a revolutionary type of concrete known as Self-Compacting Concrete (SCC) was developed. SCC is a highly flowable and non-segregating concrete capable of spreading into place, filling complex formwork, and encapsulating reinforcement solely under its own weight without requiring any external vibration. This innovative concrete technology significantly improves construction efficiency while maintaining excellent mechanical and durability properties.

The concept of SCC was first developed in Japan during the late 1980s by Professor Hajime Okamura at the University of Tokyo. The primary motivation behind its development was to address concerns regarding the durability and quality of concrete structures caused by insufficient compaction and a shortage of skilled labour. SCC was designed to ensure uniform and reliable concrete quality regardless of the complexity of reinforcement arrangements or construction conditions.

Since its introduction, SCC has gained worldwide acceptance and has become one of the most significant developments in concrete technology. Numerous countries have adopted SCC for various applications, including high-rise buildings, bridges, tunnels, marine structures, precast elements, and architectural concrete works. The ability of SCC to flow easily through congested reinforcement, achieve superior surface finish, reduce construction time, and minimize labour requirements makes it highly attractive for modern construction projects.

The performance of SCC is achieved through a carefully designed mix proportion that incorporates a higher volume of fine materials, mineral admixtures, and chemical admixtures compared to conventional concrete. Common supplementary cementitious materials used in SCC include fly ash, silica fume, ground granulated blast furnace slag (GGBS), limestone powder, and metakaolin. High-range water-reducing admixtures, commonly known as superplasticizers, play a crucial role in providing the required flowability without increasing the water-cement ratio. In some cases, viscosity-modifying admixtures (VMAs) are also used to enhance stability and prevent segregation.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

- **MATERIAL USED**

Cement

The cement taken was Ordinary Portland Cement (OPC) of 53 grade of consistent consistency, compliant to IS 12269-1987 [15- 19]. The test for specific gravity, normal consistency, initial and final setting time and 28 days compressive strength has been conducting Table 1.

Fly Ash

In the examination Class C fly ash was used. Class C fly ash generally comes from coal which may generate an ash with higher lime content, generally more than 15%, often as high as 35%. Fly ash obedient to IS 3812 (part-1) has been used and identical merger of fly ash with cement was ensured.

The physical properties and chemical composition of pond ash is given in Table4.

Figure. 1 fly Ash

Fine Aggregate

The fine aggregate (river sand- Badarpur) used in the experimental work is nearby procured. Sieve analysis of the fine aggregate was accepted out in the laboratory as perIS383-1970, and the results are tabulated in Table 2.

Coarse Aggregate

The aggregates which are retained over IS sieve 4.75 mm are called as coarse aggregate. The coarse aggregate used in the present study was nearby available crushed stones of maximum size of 10 mm. exact gravity and other physical property of coarse aggregates are given in Table 3.

Figure- 2 Coarse Aggregate

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

Superplasticizer

Superplasticizers, typically based on Polycarboxylate Ether (PCE) technology, are indispensable in Self-Compacting Concrete. They are generally used in dosages ranging from 0.5% to 2.0% of the cementitious content and impart high flowability without increasing the water content, thereby enabling SCC to achieve excellent filling and passing ability while maintaining mechanical strength and durability.

Figure- 3 Superplasticizer

Water

The water content in Self-Compacting Concrete typically ranges from 150 to 200 kg/m³, depending on the mix design requirements and aggregate characteristics. Water plays a vital role in cement hydration and in providing the workability necessary for SCC to flow and compact under its own weight without external vibration.

Table 1: *Physical Properties of Ordinary Portland Cement.*

Sr. No.	**Characteristics**	**Values Obtained**	**Standard Values**
1.	Specific Gravity	3.17	-
2.	Normal Consistency	29%	-
3.	Initial Setting Time	1 hour 35 min	Not to be less than 30 minutes
4.	Final Setting Time	3-hour 52 min	Not to be greater than 600 minutes

Table 2: *Physical Properties of Fine Aggregate.*

Characteristics	**Type**	**Specific Gravity**	**Fineness Modulus**	**Grading Zone**	**Water absorption**
Value	Natural Sand	2.72	2.55	II	1.04%

Table 3: *Physical Properties of Coarse Aggregate.*

Characteristics	**Colour**	**Shape**	**Maxi mum Size**	**Specific Gravity**	**Fineness Modulus**	**Water absorption**
Value	Grey	Angular	10 mm	2.63	6.61	.92%

Table 4: *Physical Properties of fly Ash.*

Characteristic s	Specific gravity	Dry unit weight	Plasticity	Absorption
Value	2.1-2.7	7.07-15.72 KN/m3	None	0.8-2.0%

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

III. EXPERIMENTAL WORK

The mix constituents of the initial vibrated concrete mix and the normal strength SCC mixes (Mix 1, Mix 2 and Mix 3)

Constituents	Initial vibrated Mix	Mix 1	Mix 2	Mix 3
Cement (kg)	393	210	230	294
Ground granulated blast furnace slag (GGBS) (kg)	0	151.3	151.9	98
Coarse aggregates (kg)(crushed limestone) <10mm	982.5	839.3	842.6	896.3
Sand (kg)< 2mm	786	713.6	716.4	732.6
Water (kg)	220.1	203.3	210.3	196
Limestone (kg)	0	232	210.3	176
Super-plasticiser/water	0	0.009	0.013	0.025
Water/binder	0.56	0.56	0.55	0.50
Flow spread(mm)			700	680
t_{500} (sec)			2.65	2.35
t_{200} (sec)			0.51	0.36
t_{400} (sec)			1.04	0.80
Level-off (sec)			9.26	6.80
Compressive strength (MPa)			**45**	**60**

In the slump cone test, the time for the SCC mix to spread to a diameter of 500 mm after the cone filled with the mix has been suddenly lifted (t500) was recorded, as well as the diameter of the spread when the flow stopped (BS 12350-8, 2010). The resistance to segregation was checked visually. Figures 3, 3.1 and 3.2 show the horizontal spread of SCC Mix 1, Mix 2 and Mix 3, respectively.

Figure 3: Horizontal spread of SCC Mix 1

Figure 3.1: Horizontal spread of SCC Mix 2

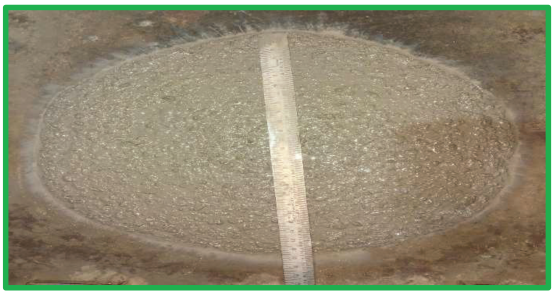

Figure 3.2: Horizontal spread of SCC Mix 3

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

The mix constituents of vibrated high-strength concrete. Mix 4 and Mix 5 are SCHSC mixes. Mix 6 is SCHSFRC mix that achieves both flow-ability and passing ability

Constituents	Initial vibrated Mix	Mix 4	Mix 5	Mix 6
Cement (kg)	500	500	500	500
Micro-silica (kg)	55	75	75	75
Limestone powder	-	200	105	200
Coarse aggregates (kg) (crushed limestone) <10mm	1105	833	990	833
Sand< 2mm	660	700	660	700
Water (kg)	161	138	133.5	138
Fibers (30mm long with crimped ends, volume fraction)	-	-	-	0.5%
Super-plasticiser/water	0.056	0.14	0.12	0.14
Water/(cement+micro-silica)	0.29	0.24	0.23	0.24
Flow spread (mm)	-	805	800	760
t_{500} (sec)	-	2.20	2.88	3
t_{200} (sec)	-	0.35	0.5	1.88
t_{400} (sec)	-	0.76	1.02	5.1
Level-off (sec)	-	7.23	9.20	38
Compressive strength (MPa)	**100**	**80**	**100**	**100**

Tests on specimens at the age of 28 days for Mix 4 reached a compressive strength of 80 MPa. That this mix fell short of the 28-day target compressive strength of 100 MPa is not surprising in view of the fact that the coarse aggregate content was reduced by nearly 24% in order to achieve the desired flow-ability and resistance against segregation.

Figure 3.3: Horizontal spread of SCC Mix 4 (left) and Mix 5 (right)

Figure 3.4: Horizontal spread of SCC Mix 6

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

We have investigated 4 types of concrete M1, M2, M3, M4 with micro-silica content 0%, 10%, 15% and 20%, respectively. They observed a significant reduction in slump as the micro-silica content increases; their results were illustrated in Figure 4.

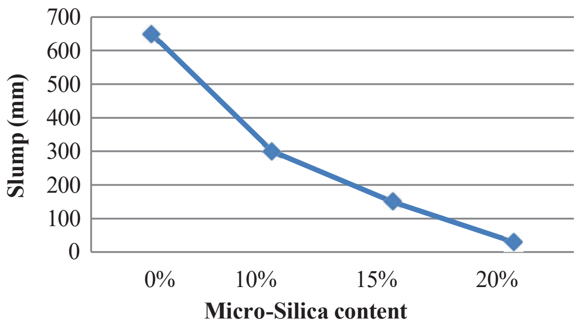

Figure 4: Reduction in slump as the micro-silica content increases

Provided standard limits for SCC flow tests:

Test	Recommended Range
Slump Flow	650–800 mm
T500 Time	2–5 sec
V-Funnel	6–12 sec
L-Box Ratio	0.8–1.0
J-Ring Difference	≤10 mm
Need for Vibration	Not Required

L-Box Test

In order to test the ability of a SCC mix to fill the formwork containing reinforcement under its own weight, the L-box apparatus with adjustable steel rods (each of diameter 12mm) was used. The vertical leg of the L-box is filled with the SCC mix. At the bottom of this leg is a gate with two or three rods in front of it. When the gate is lifted, the mix flows into the horizontal part of the L-box through the gaps between the rods. The times for the mix to reach 200 mm (t200) and 400 mm (t400) from the vertical leg is recorded, as well as the time it takes the mix to level off in the horizontal leg of the L-box. Again, it is required that no large aggregate particles or Fibers be blocked by the rods.

The clearance between the bars when using 2 bars and 3 bars is 59∓1mm and 41∓1mm, respectively as illustrated in Figure 5.

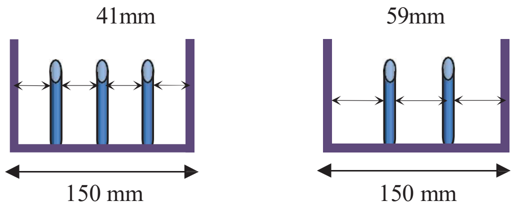

Figure 5 : Clearance when using 3 or 2 steel rod bars

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

We have 14 litres of concrete were prepared in a pan mixer and measurements were recorded.

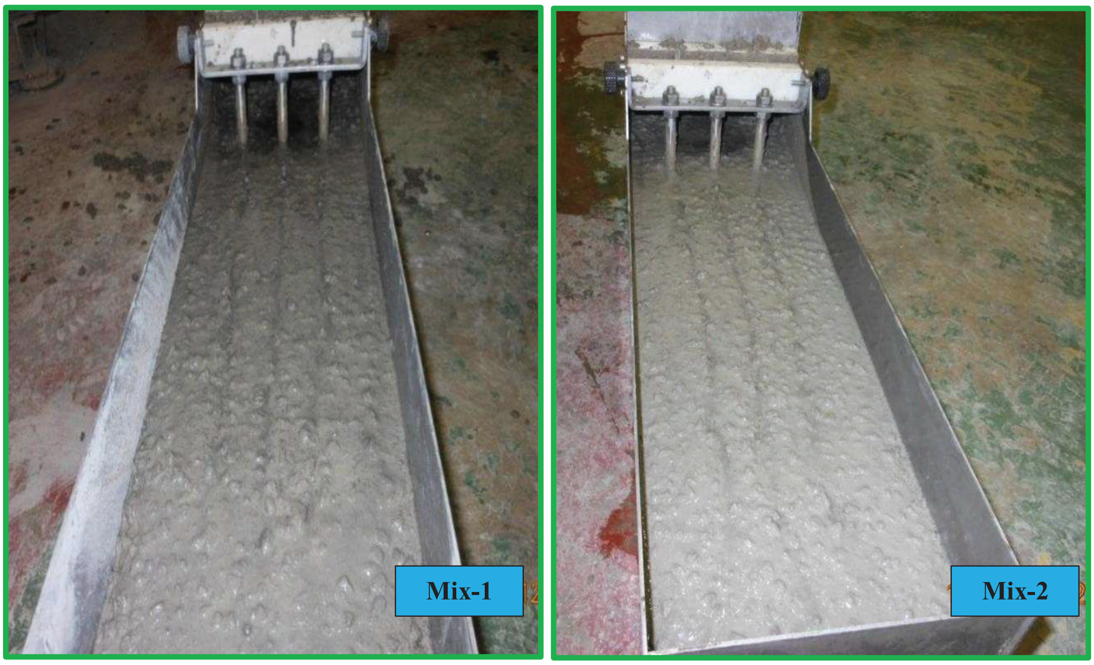

Figure 5.1 : Flow and passing ability of SCC Mix 1 (left) and Mix 2 (right)

IV. RESULT AND DISCUSSION

The experimental results indicate that superplasticizer dosage significantly influences the flow properties of SCC. Mix SCC-3 exhibited the highest slump flow and lowest V-funnel time, indicating superior filling ability. However, excessive dosage may increase segregation risk. The inclusion of fly ash improved particle packing and reduced internal friction, resulting in enhanced flow characteristics.

All mixes met the EFNARC criteria for SCC, confirming their suitability for practical applications in congested reinforcement zones.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

Mix proportions of 60 MPa SCC mixes

60MPa				
Constituents	**Mix 1**	**Mix 2**	**Mix 3**	**Mix 4**
Cement (kg)	296.1	255.1	222.8	237.6
(GGBS) (kg)	82.8	130.6	174.3	146.8
Limestone(kg)	541.5	508.9	421.5	487.8
Coarse aggregates(kg)	437.0	693.1	785.6	543.1
Sand(kg)	766.7	531.4	517.1	686.5
Water(kg)	191.0	193.9	201.0	194.1
SP (kg)	3.30	3.30	3.40	3.30
SP/water	0.02	0.02	0.02	0.02
Water/Binder	0.50	0.50	0.50	0.50
w/c	0.79	0.79	0.79	0.79
η_{NF} (Pa.s)	9.54	10.19	10.37	10.37
η_{NF} (error%)	4.82	1.86	3.57	3.57
t_{500} (Slump flow test) (sec)	2.20	2.30	2.30	2.30
t_{200} (L-box test) (sec)	0.25	0.26	0.26	0.26
t_{400} (L-box test) (sec)	0.62	0.65	0.66	0.66
Level-off time (L-box test)(sec)	6.10	6.20	6.30	6.30

V. CONCLUSION

- SCC exhibited excellent flow characteristics without mechanical vibration.
- Slump flow increased from 660 mm to 760 mm with increased superplasticizer dosage.
- V-funnel time decreased as admixture content increased.
- Passing ability improved significantly in L-Box and J-ring test.
- SCC-2 provided the best balance between flowability and stability.
- The results complied with EFNARC recommendations for SCC.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 06 , June - 2026

Reference

1. **IS 456:2000**
   - Main code for RCC design and durability requirements.
   - Used for strength, exposure conditions, cover, workability provisions, etc.
2. **IS 10262:2019**
   - Used for concrete mix design methodology.
   - Helpful for SCC mix proportion development.
3. **IS 383:2016**
   - Specifications for aggregates used in SCC.

Cement and Mineral Admixture Codes

4. IS 269
5. IS 8112
6. IS 12269
7. IS 1489
8. IS 455
9. IS 3812 (Part 1) Used for fly ash in SCC.
10. IS 12089 Useful for high-performance SCC.

Chemical Admixture Code

11. IS 9103:1999
    - Most important code for superplasticizers and viscosity-modifying admixtures used in SCC.

Testing Codes for SCC

12. IS 1199
    - Conventional workability tests.
13. IS 516
    - Compression, flexural, and split tensile strength tests.
14. IS 5816
15. IS 9399

Recommended Codes for "Flow of SCC" Topic

For your thesis specifically related to **flow characteristics/workability of SCC**, the most important references are:

- IS 9103:1999
- IS 10262:2019
- EFNARC (2005) Guidelines for SCC

EFNARC is the primary reference for SCC flow properties and acceptance criteria