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Study On Self Compacting Concrete with Different Minerals as Admixture

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Abstract- Self-Compacting Concrete (SCC) is an advanced type of concrete that has the ability to flow under its own weight, completely fill the formwork, and achieve full compaction without the need for external vibration. The present study focuses on the development and performance evaluation of SCC using different mineral admixtures. The main objective of this research is to investigate the effect of mineral admixtures such as Fly Ash, Ground Granulated Blast Furnace Slag (GGBS), Silica Fume, and Marble Powder on the fresh and hardened properties of concrete. The mix design for SCC was carried out based on IS 10262:2009 guidelines for M50 grade concrete. Different mixes were prepared by partially replacing cement with various combinations of mineral admixtures. Fresh concrete tests such as slump flow, L-box test, and J-ring test were conducted as per EFNARC guidelines to evaluate the workability, passing ability, and segregation resistance of SCC. Hardened concrete properties were studied through compressive strength tests at 7, 14, and 28 days. In addition to material testing, beam specimens were cast and tested under two-point loading to study the structural performance of SCC in comparison with conventional concrete. The results indicated that SCC mixes exhibited excellent flowability without segregation and satisfied all EFNARC requirements. The compressive strength of SCC was found to be higher than that of conventional concrete, with the combination of Fly Ash and Silica Fume showing the best performance. The load-deflection behavior of SCC beams demonstrated lower deflection and higher stiffness, indicating improved structural efficiency. The study concludes that the use of mineral admixtures significantly enhances the performance of SCC in terms of workability, strength, and durability. SCC proves to be an effective and sustainable alternative to conventional concrete, especially in structures with congested reinforcement and complex geometry.

Keywords: Self Compacting Concrete (SCC), Mineral Admixtures, Fly Ash, GGBS, Silica Fume, Marble Powder, Workability, Compressive Strength, Load-Deflection Behavior, High Performance Concrete

I. INTRODUCTION

Concrete is one of the most widely used construction materials in the world due to its versatility, durability, and ability to be molded into any desired shape. It plays a vital role in the development of infrastructure such as buildings, bridges, highways, dams, and industrial structures. Conventional concrete, however, requires mechanical vibration for proper compaction, which increases labor cost, time, and chances of defects such as honeycombing and segregation. In traditional concrete construction, proper compaction is essential to achieve the desired strength and durability. However, inadequate vibration or improper compaction leads to poor bonding between aggregates and cement paste, resulting in reduced structural performance. In heavily reinforced structures, it becomes very difficult to ensure proper vibration, which further affects the quality of concrete. These challenges have led to the development of advanced concrete technologies that can overcome the limitations of conventional concrete. With the advancement in construction technology and the demand for high-performance materials, Self-Compacting Concrete (SCC) has emerged as an innovative solution. SCC is a highly flowable concrete that can spread into place under its own weight, completely filling the formwork and achieving full compaction without the need for vibration.

SCC was first developed in Japan in the late 1980s by Professor Okamura to address the issue of poor compaction in heavily reinforced structures and to improve the durability of concrete structures. Since then, SCC has gained widespread acceptance across the world due to its superior performance, improved workability, and enhanced durability characteristics. The use of SCC has significantly improved construction efficiency and reduced dependence on skilled labor for vibration and compaction. SCC is achieved by carefully proportioning materials such as cement, aggregates, water, superplasticizers, and mineral admixtures. The incorporation of mineral admixtures like Fly Ash, Ground Granulated Blast Furnace Slag (GGBS), and Silica Fume plays a crucial role in enhancing the performance of SCC. In modern civil engineering practices, SCC is considered a high-performance material that meets the requirements of both structural efficiency and sustainability. Its application is continuously increasing in high-rise buildings, bridges, tunnels, and other infrastructure projects. Therefore, the study of SCC with different mineral admixtures becomes essential to understand its behavior and optimize its performance for practical applications.

II. METHODOLOGY

MATERIALS USED:
The materials used for the preparation of Self Compacting Concrete in this study include:

1. Cement
2. Fine Aggregate (Sand)
3. Coarse Aggregate
4. Water
5. Superplasticizer
6. Mineral Admixtures (Fly Ash, GGBS, Silica Fume)

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Figure 3.1: Materials Used in SCC

MIX DESIGN:

The mix design for Self-Compacting Concrete (SCC) in this study was carried out in accordance with the guidelines of IS 10262:2009, which provides standard procedures for proportioning concrete mixes to achieve the desired strength and workability. The target grade of concrete selected for this study is M50, representing high-strength concrete suitable for structural applications. Since SCC requires higher flowability and stability compared to conventional concrete, special attention was given to the selection and proportioning of materials. The mix proportion adopted for the control mix is 1 : 1.66 : 3.09, where cement, fine aggregate, and coarse aggregate are taken in the specified ratios. This proportion was selected to ensure adequate strength while maintaining good workability required for self-compacting behavior. In SCC, the use of mineral admixtures is essential to improve flow characteristics and enhance mechanical properties. Therefore, partial replacement of cement was carried out using different combinations of Fly Ash, GGBS, and Silica Fume. In this study, four different mixes were prepared. SP1 represents the control mix with 100% cement and no mineral admixtures. The other mixes (SP2, SP3, and SP4) were prepared by replacing cement with different combinations of mineral admixtures in equal proportions. These replacements were made to study their effect on the fresh and hardened properties of SCC. The combination of admixtures helps in improving particle packing, reducing voids, and enhancing the microstructure of concrete, which ultimately leads to improved strength and durability. The selection of percentages for replacement was based on previous research and practical considerations to achieve an optimum balance between workability and strength. The use of silica fume contributes to increased strength due to its ultrafine particles, while fly ash improves workability and reduces water demand. GGBS enhances long-term strength and resistance to chemical attack. By combining these materials, the study aims to evaluate the overall performance of SCC under different conditions. The mix design for SCC was carried out based on IS 10262:2009 guidelines. The concrete mix adopted was M50 grade.
Mix Proportion:

$$1:1.66:3.09$$

Where:

- 1 = Cement
- 1.66 = Fine Aggregate
- 3.09 = Coarse Aggregate

Table 2.1: Mix Proportions

Mix	Cement (%)	Fly Ash (%)	GGBS (%)	Silica Fume (%)
SP1	100	0	0	0
SP2	50	25	0	25
SP3	50	0	25	25
SP4	50	25	25	0

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METHODOLOGY:

The methodology adopted in this study is systematic and structured to evaluate the performance of Self Compacting Concrete (SCC) with different mineral admixtures. The process begins with the selection of suitable materials, including cement, fine aggregate, coarse aggregate, water, superplasticizer, and mineral admixtures such as Fly Ash, Silica Fume, and GGBS. Each material is carefully chosen based on standard specifications to ensure consistency and reliability in the experimental work. After selection, testing of material properties is carried out to determine important parameters such as specific gravity, fineness, water absorption, and grading of aggregates, which are essential for accurate mix design. Based on these properties, the mix design is prepared in accordance with IS codes to achieve the desired strength and workability of SCC. Proper proportions of all ingredients are determined to ensure high flowability, stability, and strength. Following this, the process of batching and mixing is carried out, where all materials are weighed accurately and mixed thoroughly. Dry materials are first blended uniformly, followed by the addition of mineral admixtures, and finally water mixed with superplasticizer is added gradually to obtain a homogeneous and cohesive concrete mix. Once the concrete is prepared, casting of specimens is performed using standard molds such as cubes and beams. Since SCC is self-compacting, no external vibration is required during casting. The specimens are then left undisturbed for initial setting and subsequently subjected to curing, where they are kept in water for specific durations (7, 14, and 28 days) to allow proper hydration and strength development. After curing, the concrete is tested in two stages. First, fresh concrete tests such as slump flow, L-box, and J-ring tests are conducted to evaluate workability, flowability, and passing ability as per EFNARC guidelines. Then, hardened concrete tests such as compressive strength and flexural strength tests are performed to assess the mechanical properties of the concrete. Finally, all the obtained data are compiled and subjected to analysis of results, where comparisons are made between different mixes as well as with conventional concrete. This step helps in understanding the effect of mineral admixtures on the performance of SCC and in identifying the optimum mix for better strength and durability.

This systematic methodology ensures accurate experimental results and provides a clear understanding of the behavior of Self Compacting Concrete in both fresh and hardened states.

The methodology adopted in this study involves the following steps:

1. Selection of materials
2. Testing of material properties
3. Mix design preparation
4. Batching and mixing
5. Casting of specimens
6. Curing of specimens
7. Testing of fresh concrete
8. Testing of hardened concrete
9. Analysis of results

III. RESULTS AND DISCUSSION

FRESH CONCRETE PROPERTIES:

Fresh properties of SCC are crucial to ensure proper filling, passing ability, and resistance to segregation. The results of slump flow, L-box, and J-ring tests are presented below.

Table 5.1: Fresh Concrete Test Results

Mix	Slump Flow (mm)	L-Box Ratio	J-Ring (mm)
SP1 (Conventional)	650	0.85	6
SP2 (SF + FA)	725	0.90	4
SP3 (SF + MP)	680	0.90	5
SP4 (FA + MP)	685	0.90	8

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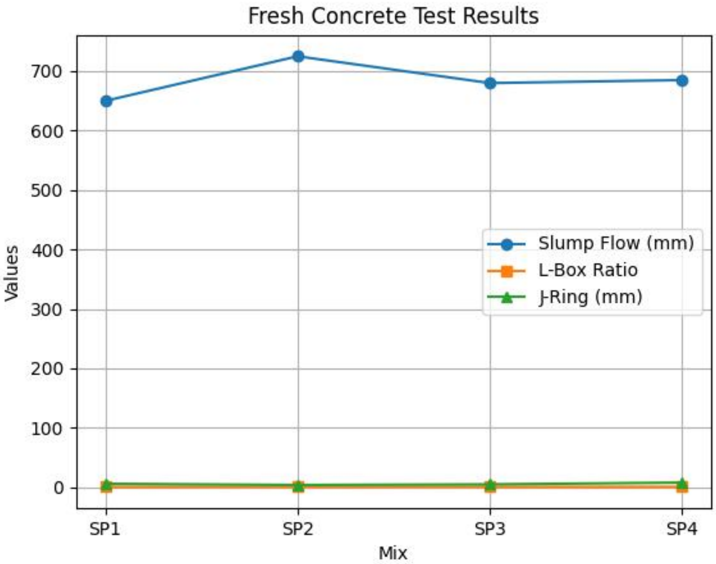

Graph 5.1: Comparison of Slump Flow Values

Discussion on Fresh Properties:

- The slump flow values of all SCC mixes lie within the acceptable EFNARC range (650–800 mm).
- Mix SP2 (Silica Fume + Fly Ash) shows the highest flowability (725 mm), indicating excellent filling ability.
- L-box ratio values close to 0.9 indicate good passing ability through reinforcement.
- J-ring values show minimal blocking, confirming good flow characteristics.

COMPRESSIVE STRENGTH RESULTS:

The compressive strength of concrete is one of the most important parameters to evaluate its performance. Cube specimens were tested at 7, 14, and 28 days.

Table 5.2: Compressive Strength Results (MPa)

Mix	7 Days	14 Days	28 Days
SP1	37.85	46.7	54.7
SP2	40.4	50.5	58.08
SP3	34.9	43.2	51.3
SP4	34.5	42.6	49.9

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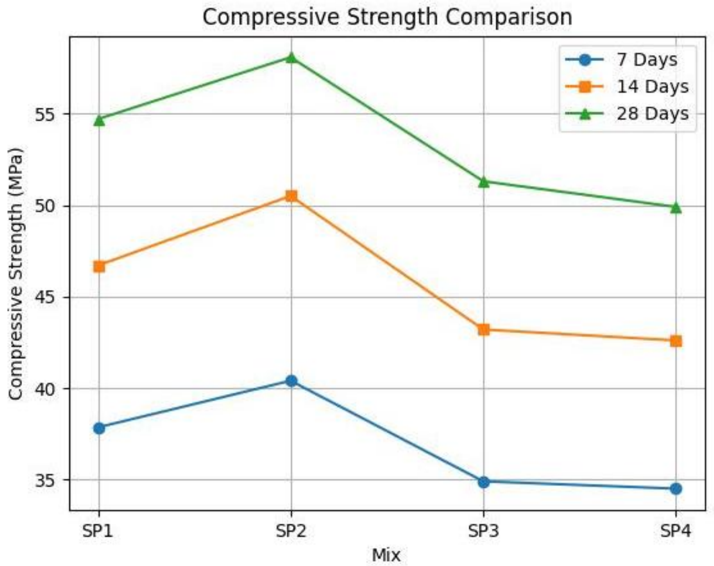


Graph 5.2: Compressive Strength Comparison

Discussion on Compressive Strength:

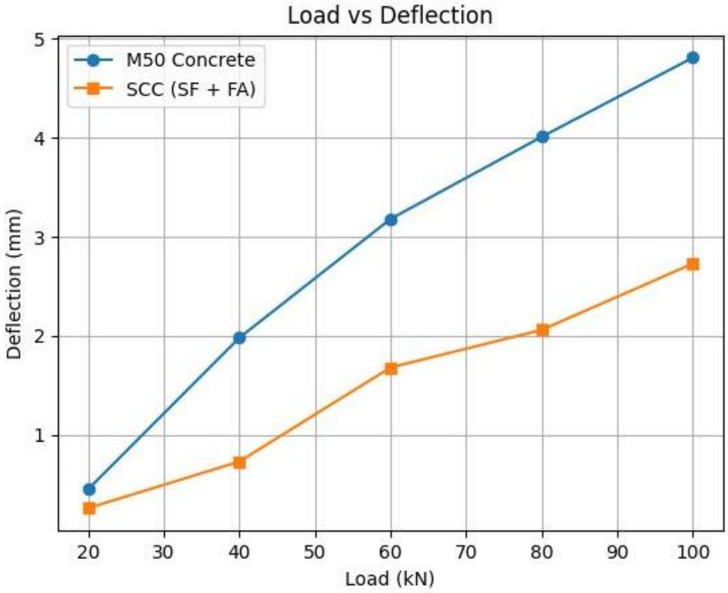
- Compressive strength increases with curing age for all mixes.
- Mix SP2 shows the highest strength (58.08 MPa at 28 days).
- Strength improvement is approximately 8% higher than conventional concrete.
- Silica fume contributes to higher strength due to its micro-filling effect.
- Mixes with marble powder show slightly lower strength due to weaker bonding characteristics.

LOAD–DEFLECTION BEHAVIOR OF BEAM:

The structural performance of SCC was evaluated using beam specimens under two-point loading.

Table 5.3: Load vs Deflection

Load (kN)	M50 Concrete	SCC (SF + FA)
20	0.45	0.26
40	1.98	0.73
60	3.18	1.68
80	4.01	2.06
100	4.81	2.73



Graph 5.3: Load vs Deflection Curve

Discussion on Beam Behavior:

- SCC beams show significantly lower deflection compared to conventional concrete.
- At 100 kN load, SCC deflection is 2.73 mm, whereas conventional concrete shows 4.81 mm.
- Reduced deflection indicates higher stiffness and better structural performance.
- Improved bonding and compaction in SCC contribute to enhanced load-carrying capacity.

CONCLUSION

Based on the experimental study on Self Compacting Concrete (SCC) with mineral admixtures, it is concluded that SCC exhibits excellent workability, flowability, and passing ability without segregation or bleeding, satisfying EFNARC guidelines. The compressive strength increases with curing age, with the mix containing silica fume and fly ash showing the highest strength, about 8% more than conventional concrete. Mineral admixtures play a significant role, where fly ash improves workability, silica fume enhances strength and durability, and marble powder contributes to sustainability. Structurally, SCC beams demonstrate better stiffness, higher load-carrying capacity, and lower deflection compared to conventional concrete. Overall, SCC eliminates the need for vibration, reduces labor, provides superior surface finish, and is highly suitable for congested reinforcement, making it an efficient and reliable alternative to conventional concrete.

REFERENCES

[1] Agnihotri, N., Agarwal, R., & Vidyarthi, U. S. (2021). Experimental study of self-compacting concrete using Portland cement and mineral admixture. International Journal of Innovative Science and Research Technology, 6(3), 595.
[2] Albiajawi, I., Embong, R., & Muthusamy, K. (2021). Influence of mineral admixtures on the properties of self-compacting concrete: An overview. Construction Journal, 1(2), 62–75. https://doi.org/10.15282/construction.v1i2.6798
[3] Amala, G., & Umarani, C. (2024). Experimental investigation on mechanical and microstructural properties of self-compacting geopolymer concrete with different mineral admixtures. Materials Research Express, 11(7), 1–20.
[4] Appaji, D. G., & Chethan, K. (2023). Study on properties of SCC mixed with mineral admixtures and fibres subjected to elevated temperature. Materials Today: Proceedings, 80(3), 3098–3110. https://doi.org/10.1016/j.matpr.2021.07.173
[5] Aravinth, S. N. (2014). Development of high strength self compacting concrete using mineral and chemical admixture. Journal of Civil Engineering and Environmental Technology, 1(4), 8–13.
[6] Athiyamaan, V. (2021). Admixture-based self-compacted concrete with self-curing concrete techniques: A state-of-the-art review. Cleaner Engineering and Technology, 5, 100250. https://doi.org/10.1016/j.clet.2021.100250

[7] Aziz, A., Mehboob, S. S., Tayyab, A., et al. (2024). Enhancing sustainability in self-compacting concrete by optimizing blended supplementary cementitious materials. Scientific Reports, 14, 12326. https://doi.org/10.1038/s41598-024-12326
[8] Balavignesh, U., & Sivasankari, S. (2018). Influence of mineral admixtures on self compacting concrete. IJERT Conference Proceedings, 6(7). https://doi.org/10.17577/IJERTCONV6IS07020
[9] Boopathi, M., & Sharmila Devi, K. (2019). Durability study on self compacting concrete with mineral admixture. IJTSRD, 3(5), 1240–1247.
[10] Bureau of Indian Standards (BIS). (2000). IS 456: Plain and Reinforced Concrete – Code of Practice. New Delhi.
[11] Bureau of Indian Standards (BIS). (2019). IS 10262: Concrete Mix Proportioning – Guidelines. New Delhi.
[12] Bureau of Indian Standards (BIS). (2016). IS 383: Coarse and Fine Aggregate for Concrete. New Delhi.
[13] Bureau of Indian Standards (BIS). (1999). IS 9103: Specification for Concrete Admixtures. New Delhi.
[14] Bureau of Indian Standards (BIS). (2018). IS 516 (Part 1): Methods of Test for Strength of Concrete. New Delhi.
[15] Bureau of Indian Standards (BIS). (2018). IS 516 (Part 2): Methods of Test for Durability of Concrete. New Delhi.
[16] Bureau of Indian Standards (BIS). (2013). IS 12269: OPC 53 Grade. New Delhi.
[17] Bureau of Indian Standards (BIS). (2013). IS 8112: OPC 43 Grade. New Delhi.
[18] Bureau of Indian Standards (BIS). (2015). IS 1489 (Part 1): PPC Fly Ash Based. New Delhi.
[19] Bureau of Indian Standards (BIS). (2015). IS 1489 (Part 2): PPC Calcined Clay Based. New Delhi.
[20] Bureau of Indian Standards (BIS). (1987). IS 12089: Granulated Slag Specification. New Delhi.
[21] Bureau of Indian Standards (BIS). (1967). IS 1727: Pozzolanic Materials Test. New Delhi.
[22] Bureau of Indian Standards (BIS). (1999). IS 5816: Splitting Tensile Strength Test. New Delhi.
[23] Bureau of Indian Standards (BIS). (2018). IS 1199: Sampling and Analysis of Concrete. New Delhi.
[24] Bureau of Indian Standards (BIS). (2003). IS 2645: Waterproofing Compounds. New Delhi.
[25] Busari, A. A., Akinmusuru, J. O., & Dahunsi, B. I. (2018). Review of sustainability in SCC. Portugaliae Electrochimica Acta, 36(3), 147–162. https://doi.org/10.4152/pea.201803147
[26] Chandramouli, K., Ramesh, B., & Suresh, A. (2023). A study on SCC with mineral admixtures. IJCIET, 14(3), 45–56.
[27] Chiranjeevi, T., & Chandrasekhar Rao, T. (2020). Properties of SCC with mineral admixtures. IOP Conference Series, 1006, 012038.
[28] Das, K., Goswami, B., Chattaraj, S., & Mukherjee, B. (2017). Effect of mineral admixtures on SCC. IRJET, 4(4), 2292–2293.
[29] Ganapathy, P. C., Sarangapani, G., & Prasanna, H. S. (2022). Comparative study on SCC design methods. IJERT, 11(10).
[30] Gnanaraj, S. C., Chokkalingam, R. B., & Thankam, G. L. (2020). Effects of admixtures on SCC. IOP Conference Series. https://doi.org/10.1088/1757-899X/1006/1/012038
[31] Goutam, P., & Tiwari, V. K. (2021). Review on mineral admixtures in SCC. IJRTI, 6(1), 40.
[32] Hodage, V., & Kulkarni, D. (2015). Polymer modified SCC with admixtures. SSRG Journal, 2(6), 10–15.
[33] Jayadurga, K., & Selvam, B. (2022). High strength SCC using admixtures. IJCRT, 10(8).
[34] Kumar, M. R., & Rao, K. N. S. (2026). SCC with mineral admixtures. IJSET.
[35] Leelavathi, A., & Sudalaimani, K. (2021). SCC with sustainable materials. Polish Journal of Environmental Studies, 30(6), 5079–5088. https://doi.org/10.15244/pjoes/135827
[36] Mahesh, S. (2014). SCC and its properties. IJERA, 4(8), 72–80.
[37] Manoharan, M., et al. (2024). Nano-mineral SCC performance. E3S Web of Conferences, 559, 04042. https://doi.org/10.1051/e3sconf/202455904042
[38] Pai, B. H. V., et al. (2014). Development of SCC with mineral admixtures. American Journal of Civil Engineering, 2(3), 77–82.
[39] Pahsha, E., Gupta, R., & Agrawal, V. (2026). Statistical evaluation of SCC. Environmental Science and Pollution Research.
[40] Patil, A., et al. (2024). SCC with artificial aggregate and fly ash. Buildings, 14(1), 143. https://doi.org/10.3390/buildings14010143
[41] Ramanathan, P., et al. (2013). Performance of SCC with mineral admixtures. KSCE Journal of Civil Engineering, 17(2), 465–472.
[42] Rawat, V. S., & Khan, M. Z. (2022). Self-compacting concrete. IJCRT, 10(6), c721.
[43] Rudnicki, T. (2024). SCC with reduced cement content. Materials, 18(1), 4. https://doi.org/10.3390/ma18010004
[44] Sathish Kumar, V., & Dilli Babu, M. (2015). SCC with mineral admixtures. Indian Journal of Science and Technology, 8(35).

[45] Sathish Raja, K., & Dinesh, A. (2016). SCC review. IJERT, 5(2), 281–286.
[46] Sekar, P. K., Murugesan, B., & Ravi, M. (2024). SCC with quarry dust. AIP Conference Proceedings, 3187. https://doi.org/10.1063/5.0236751
[47] Shaker, M., & Kumar, A. (2022). Effects of admixtures on SCC. IJIREM, 9(6), 11–17. https://doi.org/10.55524/ijirem.2022.9.6.2
[48] Tangadagi, R. B., Naresh, B., & Kumar, M. (2021). Role of mineral admixtures in SCC. Materialia, 16(6).
[49] Uysal, M., & Yilmaz, K. (2011). Effect of mineral admixtures on SCC. Cement and Concrete Composites, 33(7), 771–776. https://doi.org/10.1016/j.cemconcomp.2011.04.005
[50] Wang, Y., et al. (2025). UHPC with mineral admixtures. Coatings, 15(4), 1–18.