

# Experimental Study of SCC with Different Amounts of PCE-Based Superplasticizer

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**Abstract - Self-Compacting Concrete (SCC) - an advanced concrete which can flow under its own weight without the need for vibration. SCC is characterized by favorable filling, passing and segregation resistance properties, making it practical for use in concrete structures with congested reinforcement and complex formwork. The present study is carried out on M30 grade Self-Compacting Concrete with inclusion of Polycarboxylate Ether (PCE) superplasticizer and Ground Granulated Blast Furnace Slag (GGBS) as partial replacement of cement. SCC for PCE superplasticizer at different concentrations (0% to 3%) and establishes some fresh and hardened properties. The evaluation of fresh concrete properties was done by Slump Flow Test,  $T_{50}$  Time Test, V-Funnel Test and L-Box Test for flowability, viscosity and passing ability. Various fresh and hardened properties of concrete such as compressive strength test on concrete cubes (casting, curing and crushing in the compression testing machine) were performed after 7, 14 and 28 days.**

The behaviors of SCC having 1.5% and 2% super plasticizer were tested, and the test results revealed that both mixes (SCC-1.5 PCE and SCC-2PCE) exhibited an excellent workability, flow ability, pass ability, and reduced segregation according to EFNARC specifications. Compressive strength of concrete improved using PCE and GGBS, GGBS contributed by decreasing the cement utilization and modifying durability attributes, which eventually helped towards sustainability.

## 1. INTRODUCTION

SCC is a groundbreaking and innovative construction material that flows freely on its own weight to effortlessly fill even the most complex forms and shapes without requiring any form of mechanical vibration. makes easy and efficient placement without the need for additional mechanical vibration methods. The unique properties of SCC significantly improve workability and finish quality, thereby promoting durability in the structures built with it actively reduces noise during placement, minimizes waste, and contributes to lowering overall project costs, making it an ideal choice for modern construction applications. By Hajime Okamura and Masahiro Ouchi in 1998 first working on the SCC. And EFNARC recognized and release the separate guideline and standard properties to fresh concrete and hardened concrete.

## 1.2 LITERATURE SERVEY.

**Chiranjeevi Tadi and T. Chandrashekar Rao et.al (2022)** Experimental Study on behavior of SCC Pavement with cement partial replaced with GGBS concentrated essentially towards fresh mechanical, and durability properties needed for use in pavement applications. In this context, SCC mixes were produced by partially replacing the GGBS from 0% to a maximum percentage in order to develop optimum partial replacement of GGBS. They wrote in their research, "The better the workability properties of slump flow, passing ability and segregation resistance can be attributed to the finer particle size of GGBS compared to Portland cement and hence, it provides better packing effect. The mechanical properties like compressive strength, split tensile strength and flexural strength were noticed highest when cement is replaced 40% by GGBS but then started decreasing gradually with higher levels. The samples also exhibited reduced drying shrinkage and improved abrasion resistance, parameters of interest in evaluation of rigid pavement performance. Polycarboxylate Ether (PCE) superplasticizer was used to obtain same consistency without segregations of high flowability and self-compatibility. They concluded that SCC pavement with a partial replacement of GGBS could be more advantageous for durability improvement and surface finish while providing the sustainable construction advantage, lower cement consumption and enhanced performance thus making it [2] **Ramkrishna Das, Soumya Ranjan Panda, Anil Kumar Sahoo, and Saubhagya Kumar Panigrahi et.al (2023)**. The researchers investigated the effect of various dosages of superplasticizer on workability of GGBFS based SCC. As per the result of test Polycarboxylate Ether (PCE) admixture has shown better flow characteristics as compared to conventional admixtures. This means that the higher quantity of PCE used, the higher flow diameter and decrease in V-funnel time were achieved. [3] **Shreyas Sulakshna Sanjay, Apurba Pal, Sujit Kishor Chakraborty, and Hasim Ali Khan et.al (2022)**

This study impact of Polycarboxylate Ether (PCE) on shrinkage behavior and strength properties of SCC was

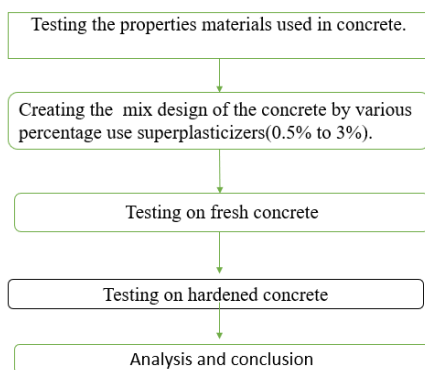
investigated. The use of PCE improved the workability and water-cement ratio, therefore resulting in lower shrinkage. The SCC mixtures showed an adequate compressive strength and other durability properties. In this research, it has been established that the addition of PCE superplasticizer improves the characteristics of SCC in fresh and hardened concrete to reducing cracking from shrinkage.[4] **Deepan Rajendran, Chella Gifta Christopher, and Malaiappan Sindhu Muthu et.al (2022)** This investigation studied SCC with limestone powder and quarry dust, with the use of a superplasticizer additive. PCE superplasticizer has been shown to highly enhance the workability and self-compatibility, without any segregation. The properties of fresh concrete such as slump flow and filling ability also met EFNARC guidelines. Optimum replacement levels resulted in the enhancement of compressive strength and density, the study noted. The authors concluded that PCE-based SCC is a potential candidate for cement reduction with sufficient mechanical properties.

## 2.MATERIALS AND METHODOLOGY.

### 2.1 MATERIALS

- i). Cement: is used as binder materials with fine and coarse aggregate.
- ii). GGBS: is replacement of the cement which act as binder material
- iii). Fine aggregate: is small filler particles between the coarse aggregate and binder material
- iv). Coarse aggregate: is larger particles, like gravel or crushed stone. It is retained on the 4.75 mm sieve is used as filler material in concrete
- v) FOSROC ARUAMIX 400: is the superplasticizer is a PCE which improving flow, spread, resistance segregation without increasing binder and water ratio

### 2.2 METHODOLOGY.



## 2.3 MIX DESING OF M30 SCC FOR 1 m<sup>3</sup>.n

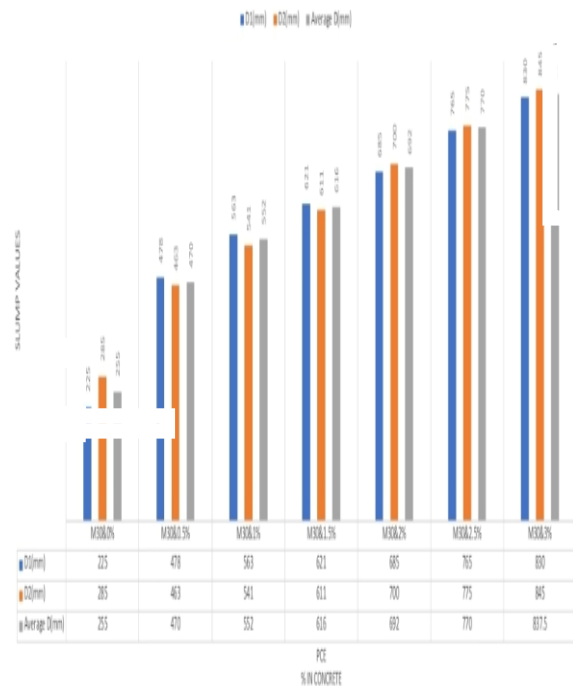
Mix ID	Cement (kg/m <sup>3</sup> )	GGBS (kg/m <sup>3</sup> )	Fine Aggregate (kg/m <sup>3</sup> )	Coarse Aggregate (kg/m <sup>3</sup> )	PCE (%)	PCE (kg/m <sup>3</sup> )
SCC-PCE0	400	240	1096	1120	0.0	0.00
SCC-PCE0.5	400	240	1096	1120	0.5	3.20
SCC-PCE1.0	400	240	1096	1120	1.0	6.40
SCC-PCE1.5	400	240	1096	1120	1.5	9.60
SCC-PCE2.0	400	240	1096	1120	2.0	12.80
SCC-PCE2.5	400	240	1096	1120	2.5	16.00
SCC-PCE3.0	400	240	1096	1120	3.0	19.20

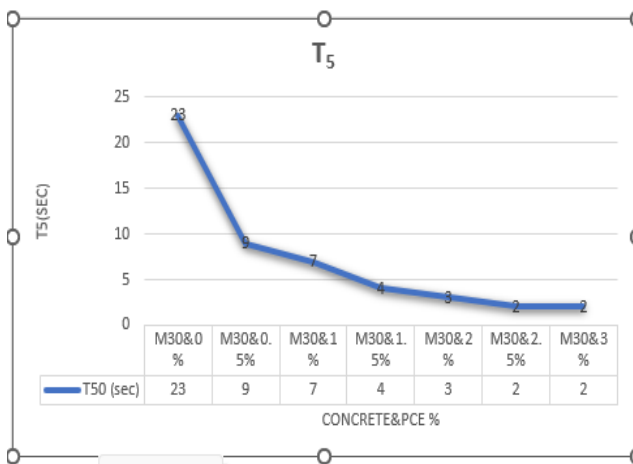
## 3.TEST AND CONCLUSION

### 3.1 FRESH CONCRETE ON SCC M30 CONCRETE

The fresh concrete test is conducted to find the properties like viscosity, flowability, passing ability, resistance to segregation of concreter. SLUMP CONE TEST, V FUNNEL TEST, L BOX TEST is conducted for the find the fresh concrete properties.

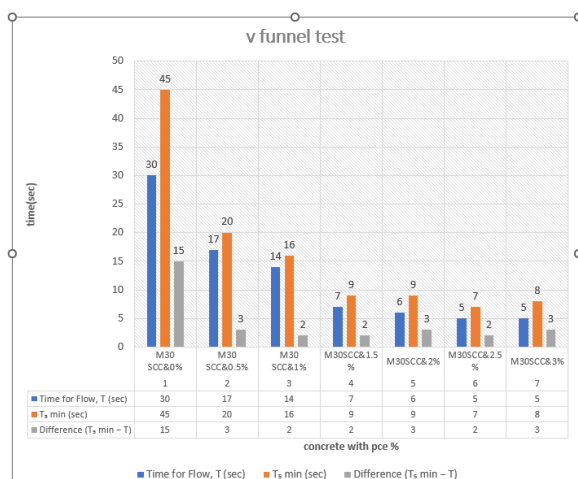
- i)The Slump cone test result is given in the graph 3.1&3.2





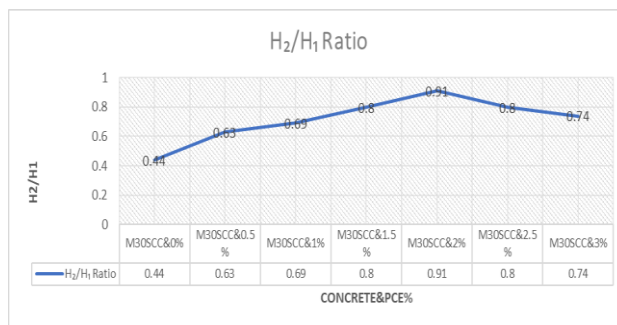
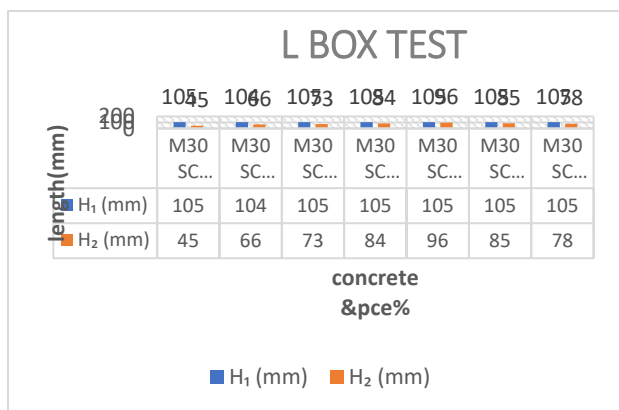
The concrete flowability is good at 1.5% and 2% without segregation

ii) The V funnel test is conducted to check the viscosity and flowability of concrete results are represented in the graph 3.3



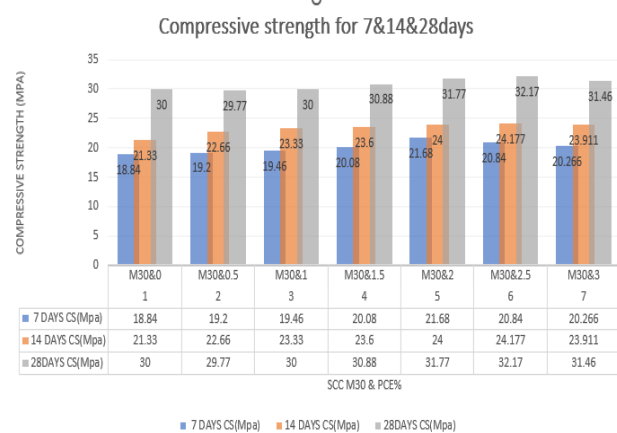
RESULT: The flow time and viscosity are acceptable 1.5% and 2% of the SCC

iii) L box test checks the passing ability of SCC through congested reinforcement. Here graph 3.4 represent the result H<sub>1</sub>&H<sub>2</sub> AND H<sub>2</sub>/H<sub>1</sub>RATIOS



RESULT: Passing ability of M30 SCC concrete is good at 2%

### 3.2. TEST ON HARDENED SCC M30 CONCRETE



Maximum compression strength is achieved at 7 days is M30 2% of PCE. And maximum compression strength is achieved at 14 & 28 days is M30 2.5% of PCE

### 3.3 Conclusion

The Flow properties of SCC was investigated by Slump Flow Test, L-Box test and, V-Funnel test for different proportions of PCE superplasticizer. Experimental results of mixes: 1.5% and 2% PCE is good than other mixes. The slump flow test in between the limits given by EFNARC for 1.5% and 2% PCE which is superior fillings ability of fresh concrete. The values are in contrast. Good viscosity and blocking resistance were confirmed from the flow time in the V-funnel test, while a reduced flow time was also observed. L-box passing efficiency without segregation. More specifically, when SCC containing 1.5% to 2% PCE superplasticizer in all trial mixes exhibited: better workability, Higher flow ability, good passing ability, Reduced bleeding and segregation. Improved self-compacting characteristics. It is clear from this that 1.5% and 2% PCE superplasticizer dosage was optimum for M30 SCC to achieve workable and stable concrete fulfilling fresh concrete requirements as per EFNARC guideline.

#### 4. REFERENCES

- [1]. CHRISTOPH SCHIEFER, JOHANN PLANK et.al The CO<sub>2</sub> Footprint of Polycarboxylate Superplasticizers (PCEs) and Its Impact on Concrete Eco Balance.: Construction and Building Materials, Elsevier,2023. [ScienceDirectLink](<https://www.sciencedirect.com/science/article/pii/S0950061823036620>) ([ScienceDirect])
- [2]. Chiranjeevi Tadi and T. Chandrashekar Rao et.al Evaluation of Self-Compacting Concrete Pavement Properties with GGBS Publication: Materials Today: Proceedings, Elsevier,2022. [ScienceDirectLink](<https://www.sciencedirect.com/science/article/abs/pii/S221478532105598X>)
- [3]. Shreyas Sulakshna Sanjay, Apurba Pal, Sujit Kishor Chakraborty, and Hasim Ali Khan et.al (2022) Reduction of Shrinkage of Self Compacting Concrete Using Polycarboxylate Ether as Shrinkage Reducing Admixture” [https://www.researchgate.net/publication/358295138\\_Reduction\\_of\\_shrinkage\\_of\\_self\\_compacting\\_concrete\\_using\\_polycarboxylate\\_ether\\_as\\_shrinkage\\_reducing\\_admixture](https://www.researchgate.net/publication/358295138_Reduction_of_shrinkage_of_self_compacting_concrete_using_polycarboxylate_ether_as_shrinkage_reducing_admixture)
- [4]. D.Suriya, S. Prakash Chandar, and P. T. Ravichandran (2023) et.al Impact of M-Sand on Rheological, Mechanical, and Microstructural Properties of Self-Compacting Concrete” [https://www.researchgate.net/publication/370245262\\_Impact\\_of\\_M-Sand\\_on\\_Rheological\\_Mechanical\\_and\\_Microstructural\\_Properties\\_of\\_Self-Compacting\\_Concrete](https://www.researchgate.net/publication/370245262_Impact_of_M-Sand_on_Rheological_Mechanical_and_Microstructural_Properties_of_Self-Compacting_Concrete)
- [5]. Deepan Rajendran, Chella Gifta Christopher, and Malaiappan Sindhu Muthu et.al (2022) “Self-Compacting Concrete Made with Partial Replacement of Limestone and Quarry Dust Powder <https://www.semanticscholar.org/paper/Self-compacting-concrete-made-with-partial-of-lime-Rajendran-Christopher/a5a4c254b5863cfa1a7bf39dff6132393a669746>
- [6]. Ramkrishna Das, Soumya Ranjan Panda, Anil Kumar Sahoo, and Saubhagya Kumar Panigrahi et.al (2023) Effect of Superplasticizer Types and Dosage on the Flow Characteristics of GGBFS Based Self-Compacting Geopolymer [https://www.researchgate.net/publication/372089108\\_Effect\\_of\\_superplasticizer\\_types\\_and\\_dosage\\_on\\_the\\_flow\\_characteristics\\_of\\_GGBFS\\_based\\_self-compacting\\_geopolymer\\_concrete](https://www.researchgate.net/publication/372089108_Effect_of_superplasticizer_types_and_dosage_on_the_flow_characteristics_of_GGBFS_based_self-compacting_geopolymer_concrete)
- [7]. (European Federation of National Associations Representing Specialist Construction Chemicals and Concrete Systems) <https://efnarc.org/publications>
- [8]. Hajime Okamura and Masahiro Ouchi self compacted concrete [https://www.researchgate.net/publication/228801921\\_Self-Compacting\\_Concrete](https://www.researchgate.net/publication/228801921_Self-Compacting_Concrete)
- [9]. 1026:2019 mix design of concrete [https://www.researchgate.net/publication/362269583\\_IS\\_Code\\_1026-2019\\_Concrete\\_Mix\\_Design\\_](https://www.researchgate.net/publication/362269583_IS_Code_1026-2019_Concrete_Mix_Design_)