Nile Higher Institute of Engineering and Technology

بسم الله الرحمن الرحيم

Department of Civil Engineering

(وَمَا أُوتِيتُمْ مِنْ الْعِلْمِ إِلاَّ قَلِيلاً)

سورة الاسراء : آية (85)

صدق الله العظيم

Performance of Silica Fume Based Self – Compacted Concrete

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Introduction

Self-compacting concrete (SCC) is a specialized type of concrete that possesses excellent flowability and self-leveling properties, allowing it to fill and compact in formwork or around reinforcement without the need for external vibration or compaction. SCC is designed to flow and distribute evenly, ensuring complete filling of complex and congested formwork or areas with dense reinforcement.

Definition

The key defining characteristic of self-compacting concrete is its ability to flow under its own weight, passing through and around obstacles without blockage. It achieves this through a carefully designed mix composition that incorporates high levels of fine particles, such as cement, fly ash, and silica fume, as well as superplasticizers.

Objectives

To study the fresh properties of Silica Fume Based Self-Compacted Concrete

To study the hardened properties of Silica Fume Based Self-Compacted Concrete

Benefits of self-compact concrete

Limitations of self-compact concrete

- **Complex Mix Design**
- **Sensitive to Mix Proportions**
- **Limited Applicability for Certain Structures**
- **Setting Time and Workability Retention**

Uses of self-compact concrete

- Complex Formwork
- Reinforced Concrete Structures
- Precast Concrete Elements
- High-Rise Buildings
- Repair and Rehabilitation
- Bridge Construction

Types of self-compact concrete

Types of self-compact concrete

Conventional SCC

is the most widely type. It consists of a combination of cement, aggregates, water, and chemical admixtures, such as superplasticizers

High-Strength SCC

Is designed to achieve higher compressive strength. It utilizes a carefully proportioned mix design, including high-performance cement, fine aggregates, and optimized chemical admixtures.

Types of self-compact concrete

Lightweight SCC

Lightweight SCC is formulated using lightweight aggregates, such as expanded clay, shale, or lightweight synthetic materials. This type reduced density, such as in precast elements and high-rise buildings.

Fiber-Reinforced SCC

incorporates fibers, such as steel, polypropylene, or glass fibers, into the concrete mixture. The addition of fibers enhances the tensile strength, toughness, and crack resistance of the concrete.

Materials

Cement

Water

Silica fume

Materials

Coarse Aggregates

Viscocrete 3425

Fine Aggregates

content of mixture concrete

Mix ID	Cement	Sand	Coarse aggregate	Water	S.F.	Viscocrete
Control	500	1200	600	200	0	7.5
10%SF-1%SP	450	1200	600	200	50	5
10%SF-1.5%SP	450	1200	600	200	50	7.5
10%SF-2%SP	450	1200	600	200	50	10
15%SF-1%SP	425	1200	600	200	75	5
15%SF-1.5%SP	425	1200	600	200	75	7.5
15%SF-2%SP	425	1200	600	200	75	10
20%SF-1%SP	400	1200	600	200	100	5
20%SF-1.5%SP	400	1200	600	200	100	7.5
20%SF-2%SP	400	1200	600	200	100	10

Concrete Industry

01 **Mixing and placing**

02 **Coding**

03 **Curing**

Mixing and placing

Mixing and placing

Mixing and placing

Coding

Tests of fresh concrete

❑ Slump Flow test

Tests of fresh concrete

❑ V-Funnel test

Tests of fresh concrete

❑ L-Box test

Tests of hardened concrete

- **Compressive strength**

Cube molds:10*10*10cm

Cubes number for 7days: 3Cubes

Cubes number for 28days: 3Cubes

F=Pu/A

Tests of hardened concrete

- **Flexural strength**

Beams molds:10*10*50cm

Beams number for 28days: 2Beams

F=M/I*Y

Tests of hardened concrete

- **Tensile strength**

Cylinder molds:15*30cm

Cylinders number for 28days: 3Cylinders

F=2P/side area

Curing

- Top surface dry quickly because of the increased quantity of paste, the low water/fines ratio and the lack of bleed water at the surface

- To avoid this Initial curing should therefore commence as soon as practicable after placing and finishing in order to minimize the risk of surface crusting and shrinkage cracks caused by early age moisture evaporation.

Tests

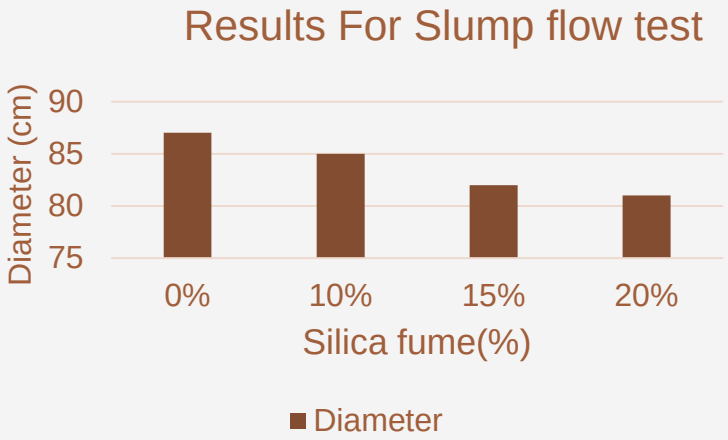
Fresh Concrete tests

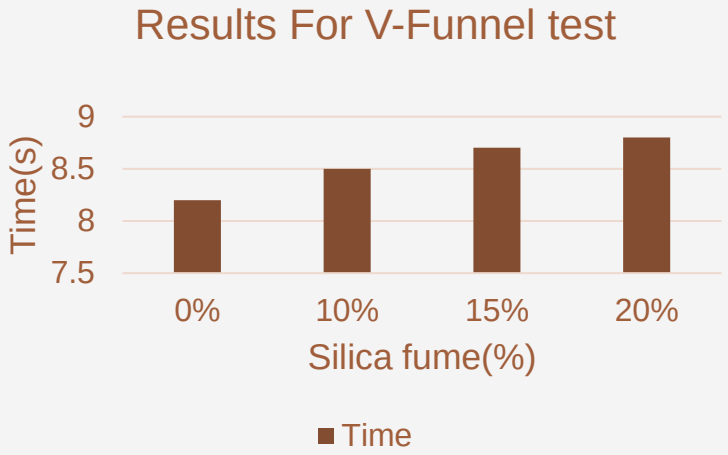
1.Slump-flow test
2.V-Funnel test
3.L-Box test

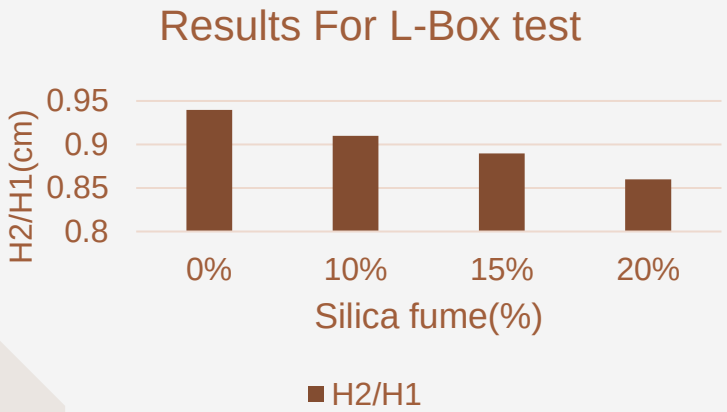
Hardened concrete tests

1.compressive strength
2.Tensile strength
3.Flexural strength

Effect of silica fume on fresh concrete(1.5%viscocrete)

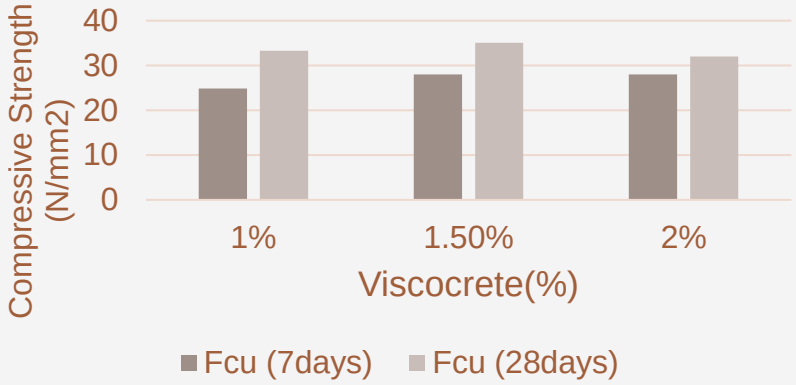




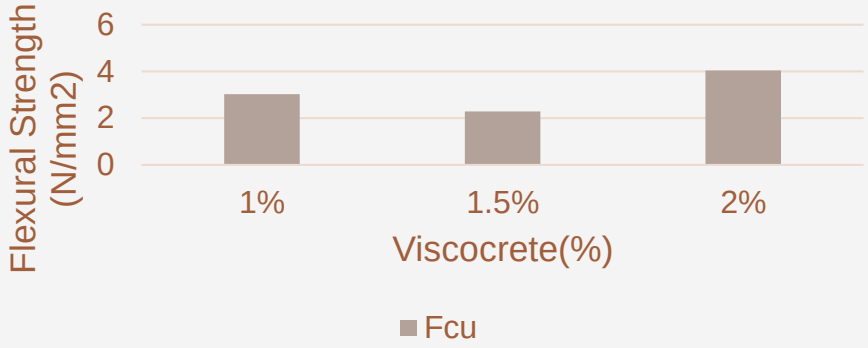


Effect of Viscocrete on hardened concrete(20%Silica fume)

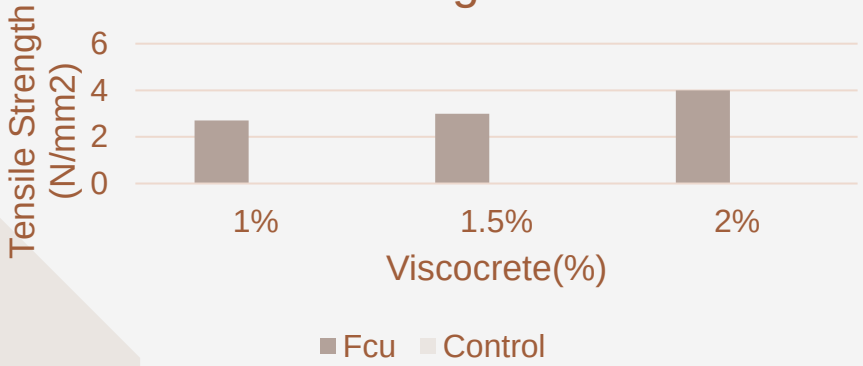
Compressive strength results



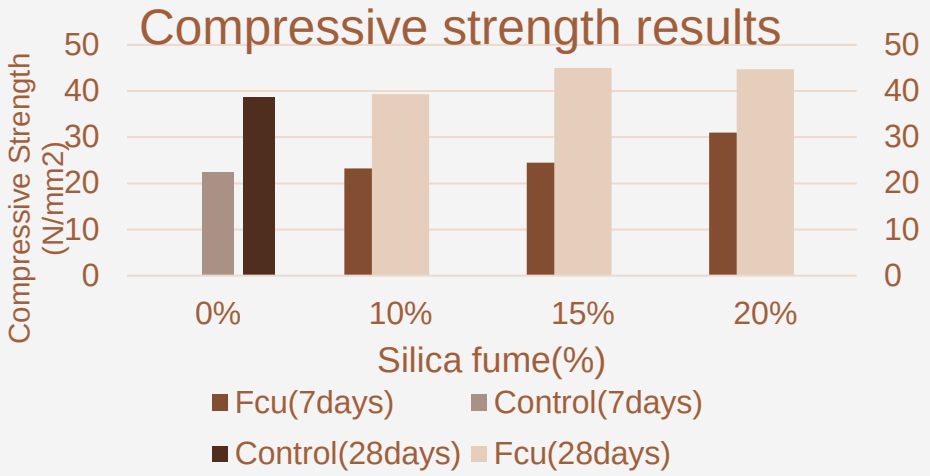
Flexural strength results

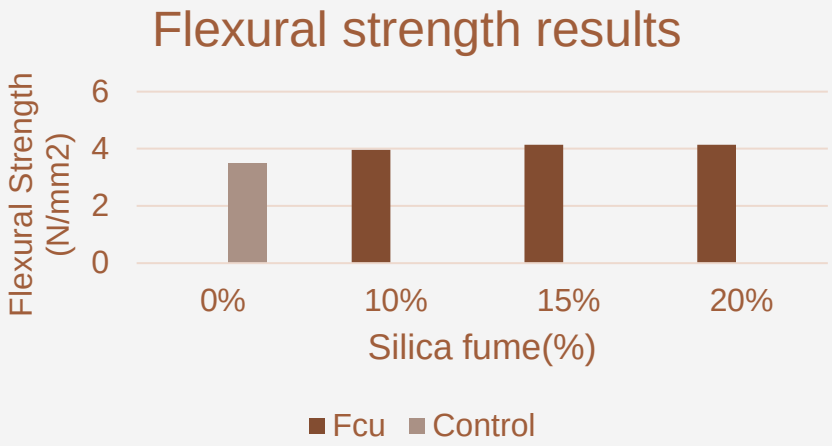


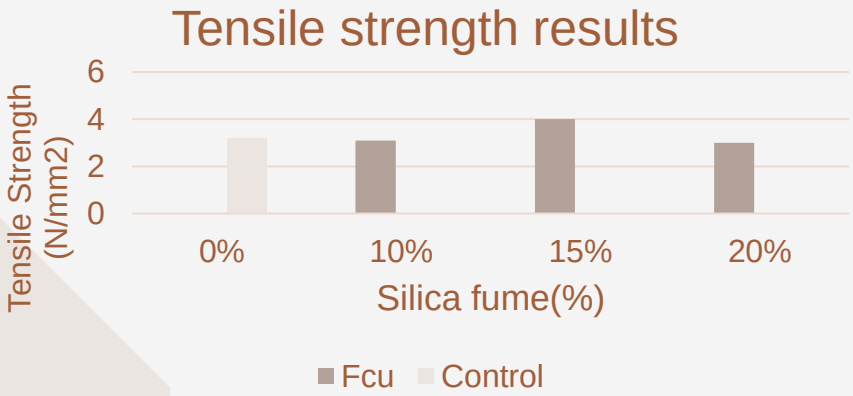
Tensile strength results



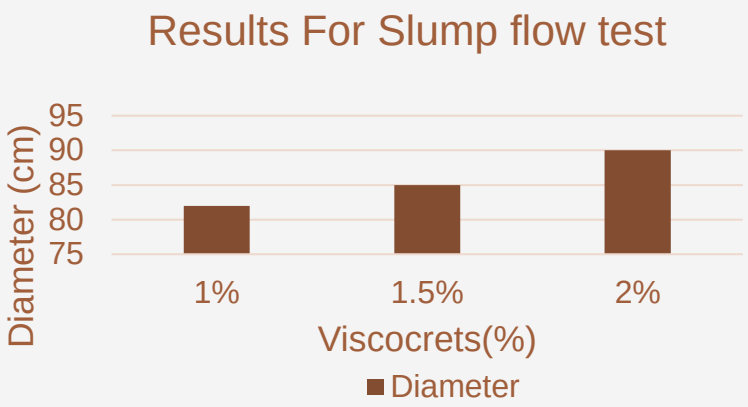
Effect of silica fume on hardened concrete(1.5%viscocrete)

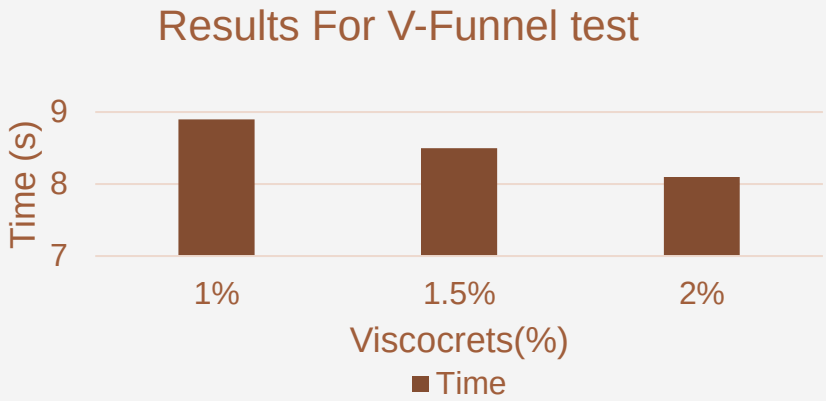


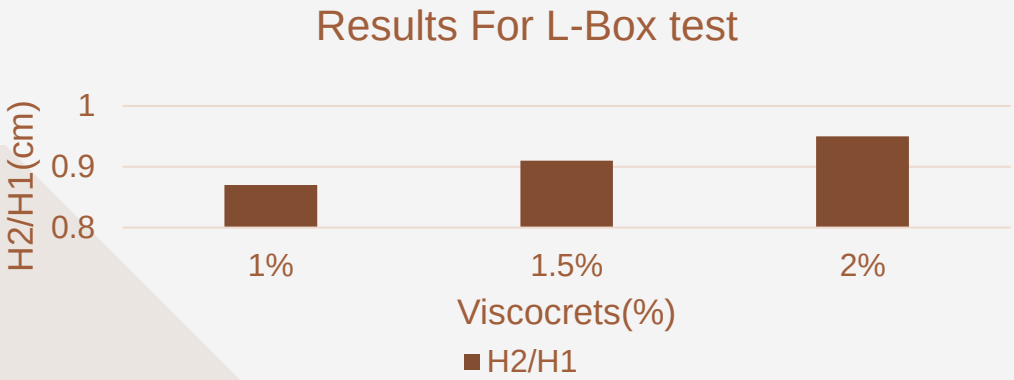




Effect of Viscocrete on fresh concrete(20%Silica fume)







Conclusions

- We can reduce the in-place cost and maker a safer working environment for the workers.
- SCC cant be produced without a sufficient amount of S.P.
- Cast-in-place concrete constriction in tight space and congested reinforcement
- In slump test, When the S.P. Increased in batches, the diameter of flowing concrete increased, and the time for SSC to reach 500mm in diameter decreased

Conclusions

- In V-Funnel test, When the S.P. Increased in batches, the time for SCC to exit the funnel decreased
- In V-Funnel test, When the S.F. Increased in batches, the time for SCC to exit the funnel increased
- In L-Box test, When the S.P. Increased in batches, the difference in height of SCC at the lower end decreased
- In L-Box test, When the S.F. Increased in batches, the difference in height of SCC at the lower end increased

THANKS