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Comparison of Traditional Concrete with Self-Compacting Concrete along with its Properties

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ABSTRACT

The advantages of SCC over normal concrete or traditional concrete are well known. But the period wise study of comparison of compressive and flexural strength for normal concrete and SCC is needed especially for higher grade of concrete because it's always been a challenge to maintain both strength as well as good workability. In this research work, after the extensive literature survey, we made the number of trials for normal concrete and self-compacting concrete for M50 grade. Then results are compared for both compressive and flexural strength. It was found that the rate of gain of compressive strength of SCC on 7 and 14 days were less but increases considerably up to 28 days. The reduction in the flexural strength was found for SCC. Also, the conclusions were drawn for the use of super plasticizer and fly ash in concrete.

Key Words: *SCC, Normal concrete, Compressive and Flexural Strength, Higher grade*

INTRODUCTION

For over 150 years, concrete has been mixed, placed, and compacted to ensure complete coverage of reinforcement and uniform density. Incomplete compaction compromises strength and performance. High reinforcement percentages hinder compaction, leading to challenges and increased noise levels. Self-compacting concrete addresses these issues effectively.

Self-compacting concrete (SCC), a highly flow able type, eliminates the need for compaction equipment due to its ability to settle into formworks. With advantages such as reduced construction time, labour, and equipment needs, SCC maintains standard concrete's mechanical and durability properties. It incorporates significant binder, super plasticizer, and/or viscosity modifying admixtures (VMA), along with SCMs like fly ash or silica fume. The incorporation of powders and supplementary materials can enhance deformability and reduce the water-cement ratio, lowering demands for high-range water reducers and viscosity-enhancing admixtures. By increasing the volume of paste and packing density, SCC achieves proper stability without excessive additives. As such, SCC offers significant potential for improving construction efficiency and quality, particularly in scenarios where traditional compaction methods are impractical or labour-intensive.

METHODOLOGY

The present research work is experimental and requires preliminary investigations in a methodological manner.

a) Comparing properties of Self-Compacting concrete with Traditional concrete

Self-compacting concrete (SCC) offers distinct advantages compared to traditional concrete. SCC flows easily without the need for external compaction, ensuring better filling of forms and tight reinforcement sections. It reduces labour and equipment requirements while improving construction speed. Additionally, SCC enhances working conditions by reducing noise and health hazards. Traditional concrete, on the other hand, requires compaction to remove air voids, increasing labour and time. However, SCC may incur higher material costs due to the use of additional binders and admixtures.

b) Study of Various tests on Traditional concrete and Self-Compacting concrete

a. **Slump Test:** Traditional concrete undergoes the slump test to measure its workability, while SCC

typically exhibits a higher slump due to its flow ability.

b. **Slump Flow Test:** Measures the flow ability of SCC by observing the spread of the concrete after being released from a slump cone. It indicates the ability of SCC to flow and fill forms without segregation.
c. **V-Funnel Test:** Evaluates the flow ability and viscosity of SCC by measuring the time it takes for the concrete to flow through a funnel. This test helps assess the SCC's ability to pass through congested reinforcement without segregation.
d. **L-Box Test:** Determines the passing ability and filling ability of SCC through narrow spaces and around obstacles. The concrete is poured into an L-shaped box, and the ability to flow and fill the box indicates its passing ability.
e. **J-Ring Test:** Assesses the passing ability of SCC by measuring the flow of concrete around a J-shaped obstacle. It evaluates the ability of SCC to flow through congested reinforcement without segregation.
f. **Fill Box Test:** Assesses how well SCC fills confined spaces and around obstacles in formwork without segregation, ensuring uniform distribution and consolidation for structural integrity.
g. **Orimet Test:** To evaluate its resistance to segregation, ensuring uniform distribution of aggregates and mortar within the SCC mix, crucial for structural integrity.
h. **Compressive Strength Test:** Measures the ability of Traditional Concrete and SCC to withstand compressive loads. Samples are tested in a compression machine to determine their compressive strength.
i. **Flexural Strength Test:** Measures the ability of Traditional Concrete and SCC to resist bending or breaking when subjected to bending loads. It indicates the maximum tensile stress that concrete can withstand before fracturing under bending.

c) Design of concrete mix for higher grades of Self-Compacting concrete

Higher grades of concrete mix are prepared for self-compacting concrete (SCC) to meet the specific requirements of SCC, which demands superior flow ability, passing ability, and segregation resistance compared to traditional concrete mixes. These higher grades typically incorporate a higher proportion of fine aggregates, specialized chemical admixtures, and sometimes supplementary cementitious materials to achieve the desired rheological properties and performance characteristics of SCC.

d) Comparison of results for Traditional concrete and Self-Compacting concrete

After testing on concrete, comparing the results of self-compacting concrete (SCC) with traditional concrete, several differences and advantages become apparent. SCC typically exhibits superior flow ability, allowing for easier placement and better filling of forms, even in congested reinforcement areas, without the need for compaction. This results in reduced labour and equipment requirements, faster construction times, and improved working conditions due to decreased noise levels. Additionally, SCC generally demonstrates better uniformity of distribution of aggregates and mortar, leading to enhanced strength and durability.

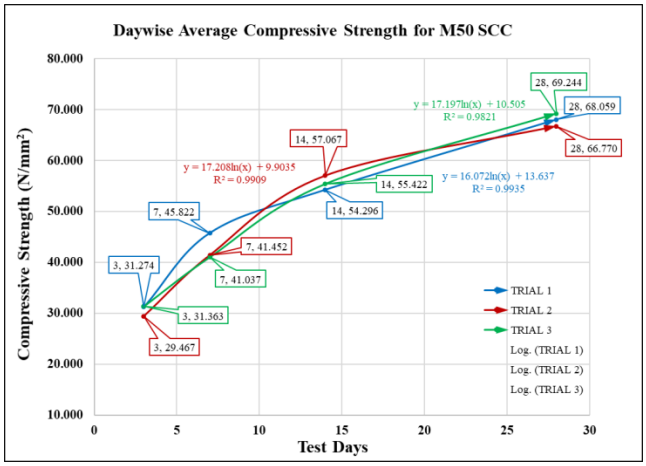
The results are being concluded form following graphs showing compressive strength of test specimen also the comparison of compressive strength of SCC with Traditional Concrete.

RESULTS AND DISCUSSION

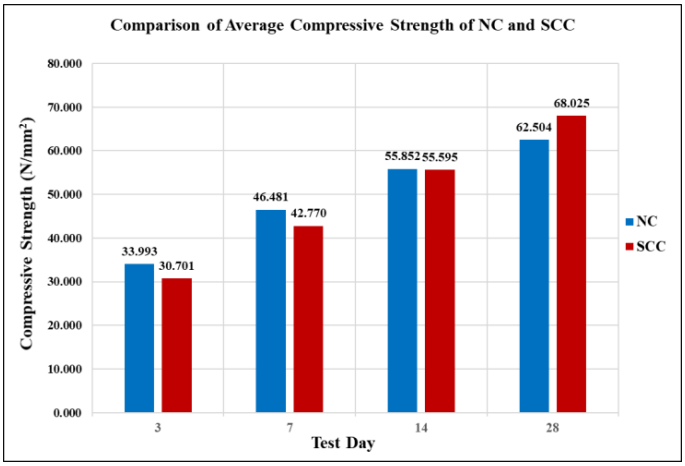
Table 1: Mix Design for one m^3 concrete of SCC

Mix	Mortar (in Kg/m^3)			Aggregates (in Kg/m^3)		Coarse Aggregate (in %)		W/C Ratio	Water/ Powder Ratio (By Volume)	Super Plasticizer (Kg/m^3)
	Cement	Fly Ash	Silica	Coarse	Fine	10 mm	20 mm			
SCC 1	425	148	18	691	900	50	50	0.33	0.84	5.91
SCC 2	392	136	16	838	888	50	50	0.34	0.84	5.44
SCC 3	381	133	16	778	988	50	50	0.33	0.80	5.30

Graph 1: Day wise Average Compressive Strength for M50 SCC



Graph 2: Comparison of Average Compressive Strength of NC and SCC



CONCLUSION

- In our project, we found that for normal concrete; the gain of compressive strength of used cementations material is higher upto 7th Day but then gets reduced significantly upto 14th day. After that, the rate of gain of strength increases upto 28th Day.
- The gain of compressive strength for used cementitious material along with silica is also higher upto 7th Day and reduced significantly upto 14th Day. But, the rate of gain of strength is much more at 28th Day for Trial 2 than Trial 1.
- The compressive strength test results of SCC are found to be more by 55.36 % in 3 days, 54.34% in 7 days, 50.23% in 14 days and 45.93% in 28 days than that of NC. Overall, the compressive strength of M50 SCC is found to be 50.43% more than that of M50 NC.
- Also, the flexural Strength of M50 SCC is found to be 0.04% less than that of M50 NC.
- Although results obtained from all of the mixes satisfy the lower and upper limits suggested by EFNARC (The European Federation of Specialist Construction Chemicals and Concrete Systems), all mixes had good flow ability and possessed self-compaction characteristics.
- The strength of SCC is higher than NCC because of addition of super plasticizer in SCC to maintain flow ability gives proper compaction of concrete which enhance all properties of SCC.
- Also, the addition of fly ash in SCC improves microstructure of concrete that also helpful to enhance all mechanical properties with the durability of concrete.

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