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INFLUENCE OF SILICA FUME ON MECHANICAL PROPERTIES OF SELF COMPACTED CONCREATE

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Abstract— *Self-Compacting Concrete (SCC) that flows by its own weights without compaction or vibration, thereby no external energy from mechanical equipment. In addition to this, Fumed silica and the introduction of steel fibers have allowed the improvements in durability and hardened properties of SCC. In this materials are very important to prevent segregation, bleeding, and increase flow-ability. The addition of fibers to SCC may lead to a decline in the workability. At the same time helps to improve hardened concrete properties. This paper discusses the results of an experimental investigation on fresh and hardened properties of the self-compacting concrete mixes with three different percentages of fumed silica 0.5%, 1%, 1.5% and 1% of steel fiber addition to mix design. The workability of fresh concrete was assessed using four tests (slump flow, L- box, U- box, and V-funnel tests). The results of this study indicate that the use of silica fume as a addition for cement and incorporation of steel fiber produces more economically feasible and durable SCC. It is observed that when mineral admixtures used in compacting self- compacted concrete, only 1.5% super-plasticizer used.*

Key words- Fumed silica, steel fiber, super-plasticizer, Slump test, V-funnel test, L-box test, U-box test, Compressive strength, indirect tensile strength, Flexural strength

I. INTRODUCTION

The global use of concrete is increasing in our day-to-day life. Hence, Concrete is the most widely used material on earth after water. Concrete plays a crucial role in the design and construction of the nation's infrastructure. Many aspects of our daily life depend directly or indirectly on concrete. Concrete is prepared by mixing various constituents like cement, aggregates, water, etc. which are economically available. It is a composite material composed of granulated particles such as coarse aggregates embedded in a matrix and bound together with cement or binder, which fills the space between the particles and glues them together to produce mortar. Now-a-days Admixtures and composites are added to concrete to modify the curing rate and to enhance the properties of the material. Admixtures such as mineral admixture's super-plasticizer, VMA are added to concrete which helps to High deformability of mortar and concrete while composite material such as steel fiber also added to concrete which helps to enhance the deficient properties of the concrete. Reduction of water-binder ratio, Limitation of CA and it's maximum size, Addition of mineral Admixtures are to make self-compacted concrete.

II. MATERIAL COLLECTION

A. Cement

Ordinary Portland Cement of 43 or 53 grade can be used. The specific gravity of cement is 3.15, normal consistency values is 33%, initial setting time of cement 24mins and final setting time of cement is 410 minutes.

B. Steel Fiber

Fiber is small piece of Reinforcing material possessing certain characteristics properties. They can be circular or flat. The amount of fibers added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibers), termed "volume fraction" (V_f). V_f typically ranges from0.1% to 3%. The fiber is often described by a convenient parameter "Aspect Ratio". The aspect Ratio of the fiber is the ratio of its length to its Diameter. Typical Aspect Ratio Ranges from 30 to 150. The steel fiber transforms the brittle concrete into a ductile material. Steel fibers are the best one because it's

given more strength, ductility to concrete. Steel fibres are available in lengths between 6 and 80mm and with a cross sectional area between 0.1 and 1.52mm. The tensile strength is normally in the range between 300 and 2400Mpa.

Figure-1 Corrugated steel fiber

III. MIX PROPERTION

OPC 53 grade of cement was used as the main material and fumed silica were addition of cement in some percentage of the Self Compacted concrete. Amounts of fumed silica with varying concentrations, and 1% steel fiber of were studied. The makeup of the SCC mix followed with standard practices in development of ordinary Portland cement (OPC) concretes, with coarse aggregate making up about 54% and fine aggregates making up about 46% of the mass.

IV. TEST RESULTS AND DISCUSSIONS

The specimen of cube is casted in the size of 150 x 150 x 150 mm and prism was 100 x 100 x 500 mm imported on testing machine.

Figure-2 Casted Specimen

A. Compressive strength N/mm2

Table-1 *Average compressive strength for cubes*

Proportion	***Compressive strength (N/mm2)***	
	7 days	***28 days***
0%	*24.44*	*35.40*
0.5%	*21.47*	*33.77*
1%	*23.55*	*38.51*

1.5%	*17.92*	*32.88*

The conventional cube is casted and tested of specified dimension (150*150*150mm). The testing based on gradually fumed silica adding to the cement to cube. From the above results, the various percentage fumed silica of Self Compacted concrete cube in curing is discussed. The compressive strength of control concrete and Self Compacted concrete with 1% fumed silica addition to cement after 7 & 28 days gives more compressive strength when compared to control concrete.

Fig-3 Cube in Test Setup

Fig-4 Failure of Cube

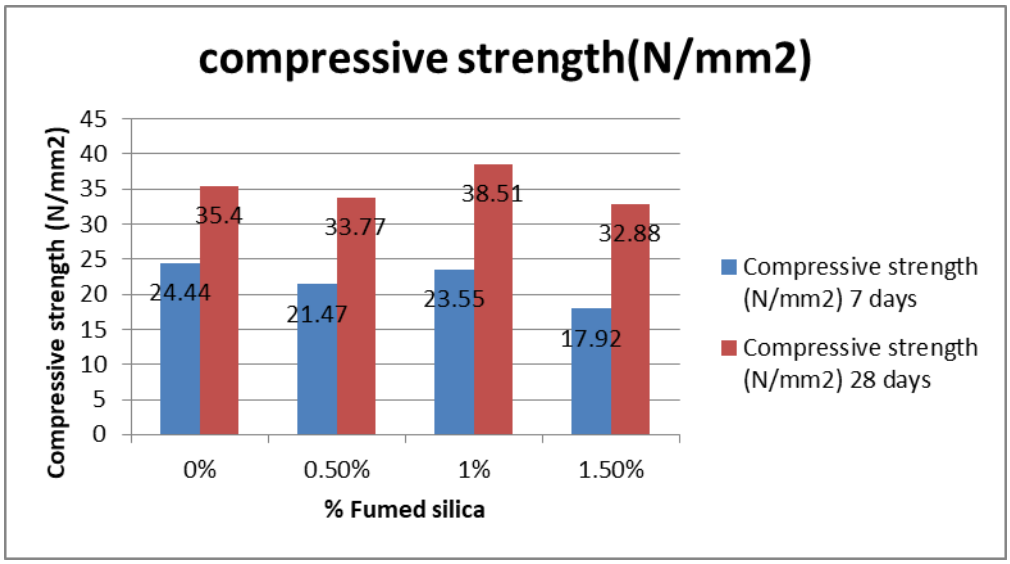

Chart-1 Comparison of Compressive strength of 7 Days & 28 Days

B. Flexural strength N/mm2

Table-2 *Average Flexural strength for cubes*

Proportion	***Flexural strength (N/mm2)***	
	7 days	***28 days***
0%	*4.33*	*5.56*
0.5%	*5.26*	*6.5*
1%	*6.1*	*6.8*
1.5%	*5.3*	*5.8*

The conventional prism is casted and tested of specified dimension (100*100*500mm). The testing based on gradually fumed silica adding to the cement to prism. From the above results, the various percentage fumed silica of Self Compacted concrete prism in curing is discussed. The compressive strength of control concrete and Self Compacted concrete with 1% fumed silica addition to cement after 28 days. It concluded that Self Compacted concrete with 1% addition to cement gives more flexural strength when compared to control concrete.

Fig-5 Prism in Test Setup

Fig-6 Failure mode of Prism

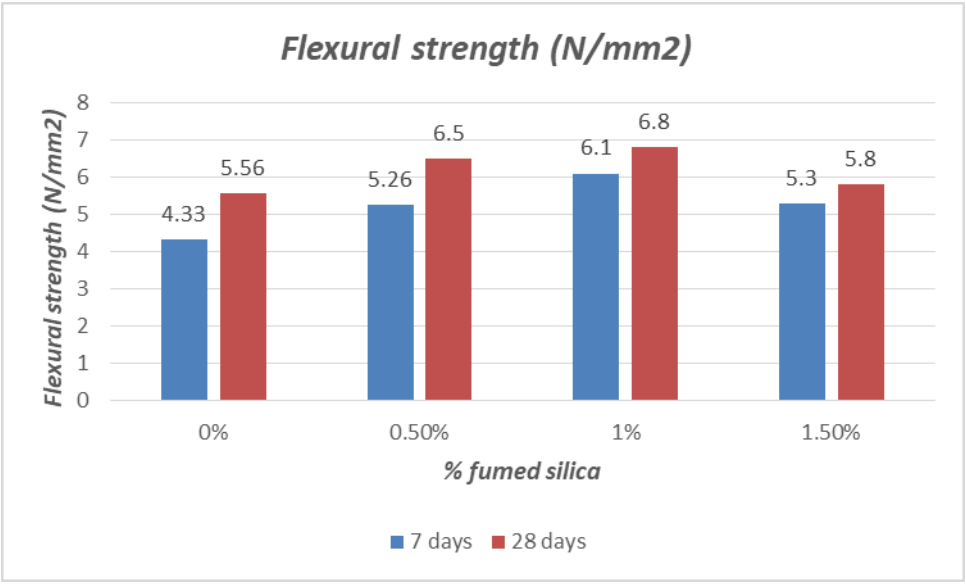

Chart-2 Comparison of Flexural strength of 7 Days & 28 Days

V. CONCLUSIONS

From the study the following conclusions are described as follows:

Based on the systematic and detailed experimental study conducted on SCC mixes with an aim to develop performance mixes, the following are the conclusions arrived.

- The mixes designed using the 1% fumed silica yielded better fresh properties than other fumed silica (1%, 1.5%).
- The 1% of fumed silica gives more compressive strength compared then other conventional and 0.5% fumed silica and 1.5% fumed silica compressive strength.
- The 1% of fumed silica gives more flexural strength compared then other conventional and 0.5% fumed silica and 1.5% fumed silica flexural strength.

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