Study of Split Tensile Strength of the Concrete with Fibers

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Abstract— **the present research work is carried out to study the effect of incorporation of steel fiber in SCC. SCC has several advantages over NVC. The addition of fiber improves behavior of concrete under different conditions. Thus, SCC and fiber can be combined to achieve more durable concrete. The effect of steel fibers was studied on fresh, strength and durability properties of SCC. Steel fibers in varying proportions of 0%, 0.5%, 1% and 1.5% by weight of concrete mix were added to SCC with tests carried out to evaluate the results regarding fresh, strength and durability properties. This paper is focused on determine the Flexural Strength of the concrete with and without fibers.**

Index Terms **—** SSC (Self -compacting concrete), Flexural Strength, Rice Husk Ash
Sub Area : Structural Engineering
Broad Area : Civil Engineering

I. INTRODUCTION

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete.
SCC was developed in Japan by Okamura in late 1980"s to be mainly used in highly congested reinforced concrete structures in seismic region. SCC offers a rapid rate of concrete placement, with faster construction times and ease of flow around congested reinforcement as compared to normal vibrated concrete. Steel fibres when incorporated in concrete, strengthens concrete and saves it from shrinkage or micro-cracks which generally leads to failure of concrete. Also, SCC gives better quality of concrete without the requirement of skilled labour.

II. BASIC PRINCIPLES OF SCC

SCC consists of same components as the normal vibrated concrete. These components are cement, fine aggregate, coarse aggregate, water, additives and admixtures. These components are so adjusted so that concrete flows under its own weight, passes through narrow openings of reinforcement and finally, completely fills the form work without segregation of coarse aggregates in absence of vibration. Also, it gives strength equivalent to NVC. In this way, flow ability, passing ability and segregation resistance are essential properties of concrete to be considered as self-compacting concrete. However, the first two properties i.e. flow and passing ability are in opposition to the last one i.e. segregation resistance. So, SCC matrix should not only be sufficiently viscous to avoid segregation but also should have sufficient mobility to assure appropriate filling of form work. In this way, SCC in plastic state exhibits three basic characters, namely, flow ability, self-levelling ability and resistance against segregation. The flow ability of SCC is obtained by using proper admixture. Stability or and structures. There are tests like slump, V-funnel, L-box etc. to check these fresh properties of SCC.

III. ROLE OF RICH HUSK ASH IN SCC

Rice husk ash is produced by incinerating the husks of rice paddy. Rice husk is a by-product of rice milling industry. Controlled incineration of rice husks between 500^0C and 800^0C produces
non-crystalline amorphous RHA (Mehta and Monteiro 1993, Malhotra 1993). RHA is whitish or gray in color. The particles of RHA occur in cellular structure with a very high surface fineness. They have 90% to 95% amorphous silica (Mehta 1992). Due to high silica content, RHA possesses excellent pozzolanic activity.

IV. BEHAVIOUR UNDER SHEAR

The shear strength and toughness index of compact cube specimens reveals that the shear strength was not affected by fibre volume. However, the post-cracking toughness increases uniformly with increase in fibre content. This again shows a favourable FRC behaviour in earthquake and blast prone areas.

V. BEHAVIOUR IN TENSION

The most significant effect of incorporating steel fibres is to delay and control the tensile cracking of its composite material. The fibres provide a ductile member in a brittle matrix and resulting composite has ductile properties. The fibre and the matrix share the tensile load until the matrix cracks and then almost the full force gets transferred to the fibre. This mechanism gives rise to favourable dynamic properties such as energy absorption and fracture toughness. The effect of fibres in a cementitious material is principally to cause relief of tensile stress at the crack tip and prevent unstable crack propagation.
G.Suryavanshi et al (2013) were presents an experimental study on the strength parameters of SCC with Rice Husk Ash (RHA) and filtered sand (FS) as a partial replacement for cement and sand respectively in SCC of M70 grade, termed as RHA-FS SCC. The cement has been replaced by RHA in four different levels of 5%, 10%, 15% & 20%, and FS in four different levels of 25%, 50%, 75% & 100%. Strength parameters of Compressive strength, split tensile strength and flexural strengths of RHA-FS SCC are tested for 28 days & 56

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days curing periods. Strength parameters of RHA-FS SCC are compared with Conventional SCC; it is found that SCC with Filtered Sand (FS) for the replacement of sand in proportion of 50:50 along with Rice Husk Ash (5%, 10%, 15% & 20%) had more strength than the other proportions of FS & RHA.

Aijaz Ahmad Zende1 et al (2014) studied the recent which were carried out on Self Compacting Concrete (SCC) and compare it with Normal Concrete (NC). Almost all countries in the world are facing an acute decline in the availability of skilled labor in the construction industry, and hence the need of Special Concretes becomes very essential in this world where the use of concrete is just next to the water. The word "Special Concrete" refers to the concrete which meets the special performance and requirements which may not be possible by using conventional materials and normal methods of concreting. Self Compacting Concrete is one of the type of a special concrete which flows and consolidates under its own weight thereby eliminates the problems of placing concrete in difficult conditions and also reduces the time in placing large sections and at the same time giving high strength and better durability characteristics as compared to the Normal Concrete. This paper discusses the various aspects of SCC including the materials and mix design, different test methods such as V-funnel test, L-Box test etc., and also its performance characteristics and properties in the fresh and hardened.

Compressive strength test

Compressive strength test is initial step of testing concrete because the concrete is primarily meant to withstand compressive stresses. Compressive strength tests were carried out on 150 mm x 150 mm x 150 mm cubes with compression testing machine of 3000 KN capacity. The specimens after removal from the curing tank were cleaned and properly dried. The surface of the testing machine was cleaned. The cube was then placed with the cast faces in the contact with the platens of the testing machine. Cubes were tested at 3, 7, 28 and 56 days of casting.

Flexural strength test

Flexural tensile strength test is essential to estimate the load at which the concrete members may crack. The specimens cast for this test were of shape of a square prism of side 100 mm and axis length of 500 mm. Specimens were tested at 7 and 28 days of casting.

Split tensile strength

The split tensile strength of M_1 was 1.03 MPa. Split tensile strength of M_2, M_3 and M_4 was found to increase by 21%, 23% and 30% at 28 days respectively, when compared to M_1. At age of 3 days, M_1, M_2, M_3 and M_4 achieved 74%, 56%, 60% and 69% of the strength at 28 days, respectively. At age of 7 days, M_1, M_2, M_3 and M_4 achieved 85%, 90%, 80% and 80% of the strength at 28 days, respectively. At age of 56 days, M_1, M_2, M_3 and M_4, split tensile strength was increased by 14.5%, 22.8%, 19% and 21%, respectively.

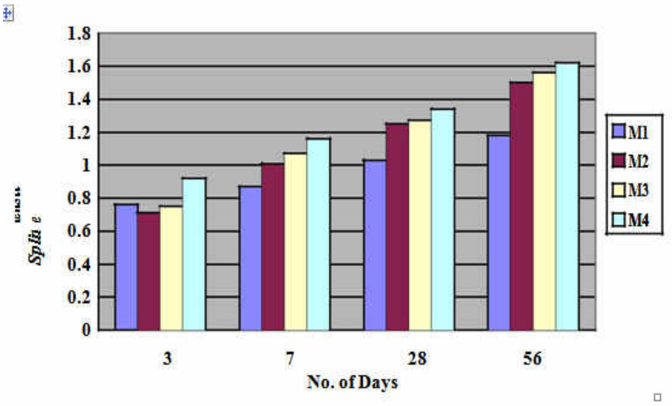

Fig 4.3 SPLIT-TENSILE STRENGTH RESULTS OF SCC-I

Mix	3 Days	7 Days	28 Days	56 Days
M1 (MPa)	0.76	0.87	1.03	1.18
M2 (MPa)	0.71	1.01	1.25	1.50
M3 (MPa)	0.75	1.07	1.27	1.56
M4 (MPa)	0.92	1.16	1.34	1.62

Table : Split tensile strength of SCC-I mixes

Split tensile strength of M_6, M_7 and M_8 was found to increase by 18%, 21% and 25% at 28 days respectively, when compared to M_5. At age of 3 days, M_1, M_2, M_3 and M_4 achieved 71%, 59%, 60% and 64% of the strength at 28 days, respectively. At age of 7 days, M_1, M_2, M_3 and M_4 - achieved 88%, 94%, 87% and 86% of the strength at 28 days, respectively. At age of 56 days, M_1, M_2, M_3 and M_4, split tensile strength was increased by 10%, 24%, 20.7% and 22%,

Respectively

Table: Split tensile strength of SCC-II mixes

Mix	3 Days	7 Days	28 Days	56 Days
M5 (MPa)	0.91	1.16	1.32	1.48
M6 (MPa)	0.92	1.41	1.56	1.90
M7 (MPa)	0.95	1.39	1.60	1.95
M8 (MPa)	1.05	1.47	1.65	2.01

In the present study, with fibre content of 1%, increase of approx. 17% and 24% at 7-day and 28-day strength was achieved respectively, when compared to mix containing 0% fibre content. On addition of 1.5% fibres, increase of approx. 30% at 28-day strength was achieved when compared to mix containing 0% fibre content.Pons et al.(2007) reported increase of approximately 11.5% at 7-day strength and approximately 31.2% at 28-day strength, on addition of fibres content of approx. 1%(approx.). Sengul et al.(2006) reported, using high performance SCC(cement content of 350 kg/m^3), increase of 15.3% at 28-day strength with fibre content of 1.5%(approx.)

CONCLUSIONS

The fresh properties of all SCC mixes satisfied the ranges specified by EFNARC except M_4

The 28-day compressive strength of SCC-I mixes with fibre content of 0.5%, 1% and 1.5%, were found to be increased by 12%, 16% and 29%, when compared to strength at 0% fibre content.

The 28-day compressive strength of SCC-II mixes with fibre content of 0.5%, 1% and 1.5%, were found to be increased by 9%, 9.7% and 19.4%, when compared to strength at 0% fibre content.

The 28-day split tensile strength of SCC-I mixes with fibre content of 0.5%, 1% and 1.5%, were found to be increased by 21%, 23% and 30%, when compared to strength at 0% fibre content.

The 28-day split tensile strength of SCC-II mixes with fibre content of 0.5%, 1% and 1.5%, were found to be increased by 18%, 21% and 25%, when compared to strength at 0% fibre content.

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