

A STUDY ON BEHAVIOUR OF STEEL FIBRE REINFORCED CONCRETE UNDER FLEXURAL FAILURE

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ABSTRACT

Steel fiber reinforced concrete (S.F.R.C) is distinguished from plain concrete by its ability to absorb large amount of energy and to withstand large deformations prior to failure. The preceding characteristics are referred to as toughness. Flexural toughness can be measured by taking the useful area under the load-deflection curve in flexure. Detailed experimental investigation was carried out to determine flexural toughness and toughness indices of SFRC the variables used in investigation were: reinforcement, steel fiber percentage by volume. The aim of this project is to present the findings of the investigation and equations obtained for predicting the desired flexural toughness and in turn the toughness indices for SFRC. These equations are dependent on the ultimate flexural strength, first crack multiple deflections and concrete specimen size. They are independent of the concrete matrix composition.

1. INTRODUCTION

1. GENERAL:

Concrete is the maximum usually used fabric in numerous types of production, from the floors of a hut to a multi storied excessive upward push structure from pathway to an airport runway, from an underground tunnel and deep sea platform to high-upward thrust chimneys and TV Towers. In the closing millennium concrete has demanding requirements each in terms of technical performance and economy whilst greatly varying from architectural masterpieces to the only of utilities. It is hard to point out

every other cloth of construction that's as versatile as concrete.

Concrete is one of the versatile heterogeneous substances, civil engineering has ever known. With the arrival of concrete civil engineering has touched highest top of era. Concrete is a fabric with which any shape can be cast and with any energy. It is the material of desire where energy, overall performance, durability, impermeability, fire resistance and abrasion resistance are required.

Cement concrete is one of the apparently easy however sincerely complex substances. The properties of concrete particularly rely on the components utilized in concrete making. The fundamental essential substances utilized in making concrete are cement, sand, overwhelmed stone and water. The properties of Cement, Sand, crushed stone and water have an effect on the satisfactory of concrete. In addition to those, workmanship, great manipulate and techniques of setting additionally play the leading function on the properties of concrete.

Fiber strengthened concrete (FRC) is Portland cement concrete strengthened with greater or less randomly allotted fibers. In FRC, hundreds of small fibers are dispersed and disbursed randomly inside the concrete during mixing, and therefore enhance concrete properties in all directions. FRC is cement-based composite fabric that has been developed in latest years. It has been successfully used in construction with its excellent flexural-tensile energy, resistance to spitting, impact resistance and fantastic permeability and frost resistance. It is an effective way to growth longevity, surprise

resistance and resistance to plastic shrinkage cracking of the mortar. Fiber is a small piece of reinforcing material owning sure characteristics properties. They can be round, triangular or flat in move-phase. The hearth is regularly described by a convenient parameter called —element ratiol. The issue ratio of the fiber is the ratio of its length to its diameter.

The principle reason for incorporating fibers into a cement matrix is to increase the toughness and tensile energy and enhance the cracking deformation traits of the resultant composite. For FRC to be a possible construction cloth, it should be capable of compete economically with present reinforcing machine. FRC composite propertiess, along with crack resistance, reinforcement and growth in durability are dependent on the mechanical propertiess of the fiber, bonding properties of the fiber and matrix, as well as the quantity and distribution within the matrix of the fibers. Fibers are commonly utilized in concrete to control cracking due to each plastic shrinkage and drying shrinkage. They additionally lessen the permeability of concrete and accordingly reduce bleeding of water. Some kinds of fibers produced more effect, abrasion and shatter resistance in concrete. Generally fibers do now not growth the flexural strength of concrete and so cannot replace moment resisting or structural metallic reinforcement. Indeed, a few fibres definitely lessen the electricity of concrete.

1.2 PROBLEM STATEMENT

The propertiess of the concrete in brittle fabric that is low in tensile electricity and occasional in strain capability. Low tensile strength and coffee pressure at fracture have been important deficiencies in undeniable concrete (Suguna. K. Et al., 2015). The low tensile power became attributed to severa micro cracks in undeniable concrete. The rapid propagation at these cracks underneath implemented pressure become answerable for low tensile strength and brittle failure of cloth. In structural software, the

concrete will provide the reinforcing bars to hold the tensile pressure once the concrete has cracked, in order that it stays largely in compression below load. As stated in advance, tensile failure strain of the bolstered concrete is drastically decrease than the yield strain of the metallic bolstered and the concrete crack earlier than any extensive load to transfer to the metallic. In enterprise software, the metallic bolstered had to bring the tension forces in the concrete.

1.3 OBJECTIVE

The objectives of this research are:

- To determine the contribution of steel fiber in reinforced concrete beam under flexural load.
- To study the effect of fiber aspect ratio to the structural behavior of reinforced concrete beam.

2. LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the characteristics of metal fiber are discussed and assists with its utility. The software of fiber broadly utilized in production, by way of adding the fiber in concrete. Referring to the preceding studies, the fibers can enhance the mechanical and ductility of concrete, reduced the plastic shrinkage and improve the abrasion.

Batson et al., 1972 is stated that fatigue energy of 74% and eighty three% of the first crack static flexural electricity at 2 million cycles of completely reversal and non-reversed masses respectively for a steel fiber content of two.Ninety eight% by means of extent .

Wei et al., 1996, Behavior of metallic fiber mortar overlaid concrete beams under cyclic loading turned into investigated whereas the behavior of composite concrete sections bolstered with conventional metal bars and metallic fibers, and subjected to flexural cyclic loading became analyzed (Spadea and Bencardino, 1997) and mechanical model of the identical became developed.

Mirzac.F, (1996) the Polypropylene fiber strengthened concrete (PPFRC) no longer boom the strength of concrete but can improve its ductility, longevity and effect resistance.

Nagakar ,(1987) indicated that the compression energy boom by using addition of SF in undeniable concrete which is the strength increase 13%- 40% for fibrous concrete.

Naaman, 1987, the energy and toughness of the composite have been found to growth the better loading based on the component ratio. Besides that, the form of metallic fiber which includes deformed fiber and hooked stop will to offer the good electricity absorption. The result indicates that the concrete improved in 60% from the plain concrete.

Jun and Stang, 1998 is reported that the accrued damage level in fiber reinforced concrete in fatigue loading turned into 1~2 order of magnitude higher than the extent recorded in static checking out of the same materials.

Olivito.R.S., 2007, the failure mode is suffering from the presence of fibers, even as concrete elements commonly fails abruptly and ruin of their middle section, metallic fiber strengthened specimen commenced micro-cracking symmetrically on their facet and fiber bridging effect rounded the sudden failure. From that, the steel fibers can improve the tensile energy of the concrete.

Then, S.Yaziciet.Al, 2007 has founded that the tensile power of SFRC are higher about 11-fifty four% than the manipulate aggregate.

Nguyen Van,2010, additionally have founded that the quantity fraction of the steel fiber affect the tensile strength.

M. Behloul, 2008, fiber strengthened concrete is this sort of new substances methods for concrete shape. Because of that, on this examine focused on the contribution of the steel fiber in mechanical properties of the strengthened concrete beam and the effect of thing ratio the metal fiber in structural behaviour also turned into investigated.

Hosseini.A, 2012. Based on the authors, everyday concrete with the high compressive energy generally show more brittle behaviour. For small amount of fiber add to concrete, the compressive electricity in concrete does no longer extensively enhance

Nguyen.V.C,(2012), the increase of the fiber content the height of stress-strain curve is boom.

Altun.F,2012, the fiber period sorts hooked cease are reduced the severity of the failure mode which could alternate from a brittle shear into a ductile flexure failure, the extent fraction of steel fiber additionally affect the enhancing power and ductility of the concrete.

Rana.A,(2013) additionally mentioned in his studies that the metal fiber utilized in concrete to control cracking because of both of drying shrinkage and plastic shrinkage. Then the fibers additionally lessen the permeability of concrete and as a result lessen bleeding of water. Among sorts of fibers together with glass, herbal and artificial polymer, the point of interest given on metal fiber because it's miles used in this studies. The cause using the steel fiber because it can improve the durability of concrete and boom the impact resistance of concrete. Then, the metal fiber having a diverse kinds with exceptional properties.

3. EXPERIMENTAL DETAILS

3.1 GENERAL

The present research with mix design has been carried out for M-25 & M- 50, concrete utilizing ISI method of blend layout using normal elements of concrete. In the present research the regular cement has been blended with metallic fiber in identical proportions in four percentages i.e 0%, 0.5% 1.00%, and 1.5%. For the look at of diverse properties, exclusive specimens have been solid and tested. Here a regular water cement ratio of 0.50 has been with the workability throughout the research. The experimental part of the investigation in

particular has been planned in the following 3 tiers.

3.1.1 MATERIALS

3.1.1.1 PORTLAND CEMENT (PC)

Fifty three grade (OPC – Ultratech Cement) became used inside the experimental research. It become tested for its physical residences in accordance with Indian Standard specifications. The excellent mixture used in this research became easy river sand, passing thru 4. Seventy five mm sieve with particular gravity of two.59. The grading area of nice mixture changed into quarter I as consistent with Indian Standard specs. Machine crushed granite damaged stone angular in shape changed into used as coarse combination. The most size of coarse mixture turned into 20 mm with particular gravity of two.60. Ordinary smooth transportable water unfastened from suspended debris and chemical substances changed into used for both mixing and curing of concrete.

3.1.1.2 CEMENT

Cement is a fabric, usually in powder form, that may be made right into a paste generally by using the addition of water and, whilst moulded or poured, will set into a stable mass. Numerous organic compounds used for adhering, or fastening substances, are referred to as cements, however these are categorised as adhesives, and the time period cement on my own means a construction material. The maximum broadly used of the construction cements is Portland cement. It is a bluish-gray powder received through finely grinding the clinker made by means of strongly heating an intimate combination of calcareous and argillaceous minerals. The leader raw material is a combination of excessive-calcium limestone, referred to as cement rock, and clay or shale. Blast-furnace slag can also be used in a few cements and the cement is known as Portland slag cement (PSC). The colour of the cement is due mainly to iron oxide. In the absence of impurities, the color might be

white, however neither the coloration nor the unique gravity is a check of exceptional..

Table 3.1: Physical properties of Cement

S.NO	PROPERTY	VALUES
1	Fineness of Cement	225 m ² /kg
2	Specific Gravity	3.15
3	Normal Consistency	33 %
4	Setting Time	
	i) Initial Setting time	39 min
	ii) Final setting time	360 min

3.1.1.3 FINE AGGREGATE

Fine aggregate / sand is an accumulation of grains of mineral count derived from the disintegration of rocks. It is prominent from gravel handiest through the dimensions of the grains or particles, however is distinct from clays which include natural substances. Sands which have been looked after out and separated from the natural fabric by way of the motion of currents of water or by means of winds across arid lands are commonly pretty uniform in size of grains. Usually commercial sand is obtained from river beds or from sand dunes in the beginning fashioned with the aid of the action of winds. Much of the earth's floor is sandy, and those sands are commonly quartz and different siliceous substances. The maximum useful commercially are silica sands, often above 98% pure. Beach sands typically have clean, round to overlaid particles from the abrasive motion of waves and tides and are freed from natural count. The white seaside sands are largely silica however can also be of zircon, monazite, garnet, and different minerals, and are used for extracting numerous elements. Sand is used for making mortar and concrete and for sprucing and sandblasting.

4. RESULTS AND DISCUSSIONS

4.1 GENERAL

The consequences offered in this research are in particular at the residences of concrete mixes organized with the substitute of Steel Fiber. The

residences like Compressive Strength and Flexural Strength, Tensile Strength were studied and the identical have been properties attain for as compared with conventional design blend concrete M-25, M-50.

Tests were conducted for workability on fresh concrete, compressive strength, split tensile strength and flexural strength on hardened specimens. Standard procedures were adopted for testing.

4.2. DISCUSSION OF THE RESULTS

The experimental program was designed to evaluate the mechanical properties i.e., Compressive Strength of Cubes & Cylinders, Flexural Strength, Splitting Tensile Strength and Modulus of Elasticity of excessive energy concrete with M-25 and M-50 grade of concrete and with specific substitute ranges of Ordinary Portland cement (Ultra Tech cement fifty three grade) with 0% zero.Five% 1.Zero% 1.Five% metallic fibres

SFRC is Portland cement reinforced concrete bolstered with more or less randomly allotted fibers. In SFRC, hundreds of small fibers are dispersed and disbursed randomly in the concrete during blending, and consequently enhance concrete properties in instructions. Dry substances (aggregates and cement) would be combined be combined in the mixer for 30 seconds. After that, metallic fibers might be added 30 seconds. Then water would be introduced steadily in 15 seconds and the integration would be persevered for 2 mins. Therefore, the whole blending time changed into three minutes for every concrete mixture. Casting of three beams with metal fibers to compare our consequences with the metal fiber bolstered concrete. Casting of approximately 84 concrete beams (700mm x 150mm x 150mm) using hook give up steel fibers in the concrete for determining flexural power of concrete .This test would require lots of trial work as I need to find out the most power at premier quantity of metallic fibers.

Determination of Flexural Strength of Steel Fiber Reinforced Beam:

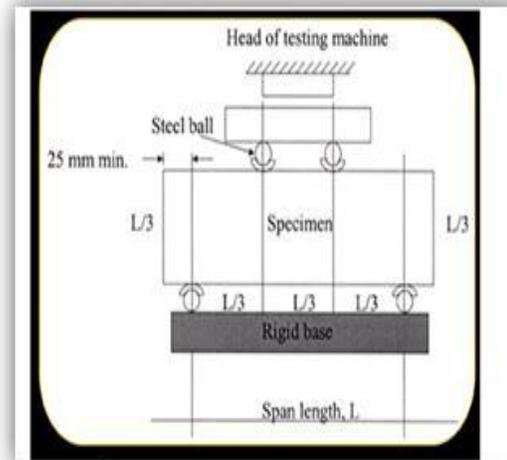
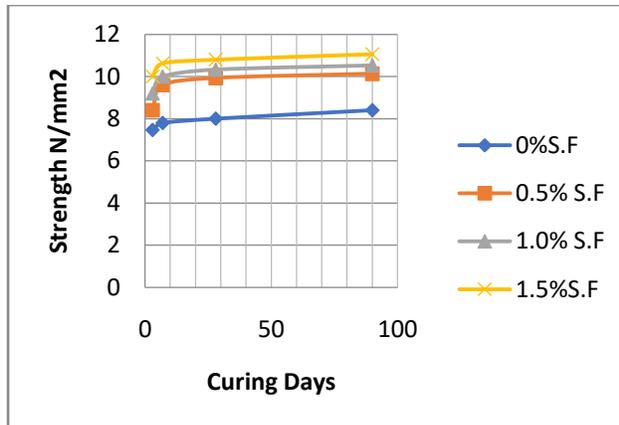
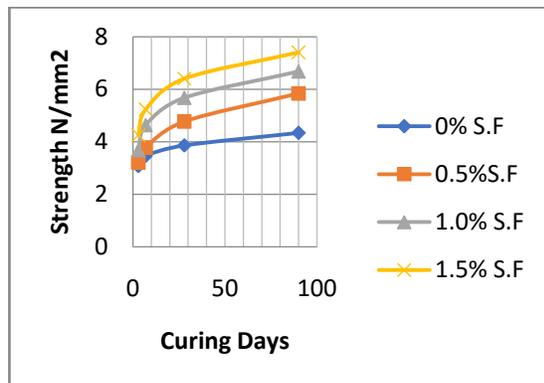


Fig 4.1 Two Point Loading for Flexural Strength

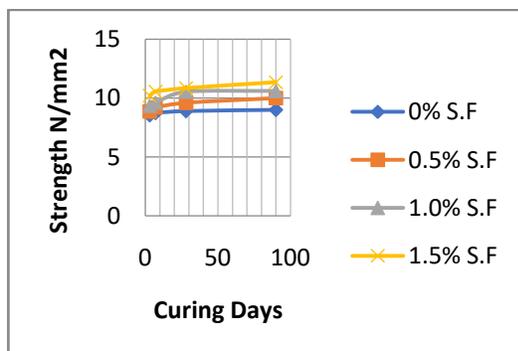
One everyday concrete beam of length (700mm x 150mm x 150mm) is casted in the mould and kept to treatment for 24 hours. It is then unmolded and stored in water tank for three, 7, 28, ninety days. The beams might be examined for his or her flexural strength within the following approach. The mattress of the testing machine have to be provided with two steel rollers, 38mm in diameter on which the specimen is to be supported. These rollers ought to be so mounted that the space from centre to centre is 60 mm for one hundred fifty mm specimen. The bearing surfaces of the supporting and the loading rollers will be wiped, easy and any free sand or other cloth should be eliminated from the surfaces of the specimen wherein they may be to make touch with the rollers. Two factors loading may be effortlessly furnished with the aid of the arrangement as shown in determine.



Graph 4.2- Test Result for Flexural strength (aspect ratio@80) @ Different curing period of SF



Graph 4.3: Test Result for Split Tensile strength (aspect ratio@65) @ Different curing period of SF



Graph 4.4- Test Result for Flexural strength (aspect ratio@80) @ Different curing period of SF

CONCLUSIONS

The following conclusions could be drawn from the present investigation.

1. It is observed that compressive strength, split tensile strength and flexural strength are on

higher side for 1.5% fibers as compared to that produced from 0%, 0.5% 1% and 1.5 fibers.

2. All the strength properties are observed to be on higher side for aspect ratio of 65 as compared to those for aspect ratio 80.

3. It is observed that compressive strength of M25 grade concrete increases from 0.24% to 11.9% with addition of steel fibers for aspect ratio 65 and compressive strength increases from 0.95% to 5.81% with addition of steel fibers for aspect ratio 80.

4. It is observed that flexural strength of M25 grade concrete increases from 23% to 38.09% with addition of steel fibers for aspect ratio 65 and flexural strength increases from 20.59% to 31.66% with addition of steel fibers for aspect ratio 80.

5. It is observed that split tensile strength of M25 grade concrete increases from 34.56% to 70.5% with addition of steel fibers for aspect ratio 65 and split tensile strength increases from 20.27% to 61.29% with addition of steel fibers for aspect ratio 80.

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