International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072

Experimental Study On Characteristic Strengths Of Steel Fiber Reinforced Concrete

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Abstract - *Most widely used construction material in the world is concrete . But, it has low tensile strength, low ductility and low energy absorption. The cause of poor tensile behavior of concrete is its low toughness and defects present in. So to improve its strength, toughness and ductility different fibers are used in concrete. Fiber reinforced concrete is a combination of cement based matrix with an ordered or random distribution of fibers. The fibers present in the concrete increases the properties of concrete such as flexural strength, tensile strength, impact strength and shrinkage strength. The main reasons for adding fibers to concrete is to provide crack resistance and crack control. Also, it helps to maintain structural integrity and cohesiveness in the material. It has been found that different type of fibers added in specific percentage in concrete improves the concrete properties, durability and life of the structural member. In this paper effect of steel fibers on the characteristic strengths of concrete for M 20 grade have been studied by using various percentage of fibers in concrete. Fiber content were varied by 1%, 1.5% and 2% by weight of concrete. Cubes of size 150mmX150mmX150mm to check the compressive strength, cylinder of size 150mm dia. & 300mm length to check split tensile strength and beams of size 100mmX100mmX500mm for checking flexural strength were casted. After 28 days of curing all the specimen were tested. After testing it has been found that there is significant strength improvement in steel fiber reinforced concrete. The optimum fiber content for compressive strength and split tensile strength is 1% and for flexural strength is 2%. Also, it has been observed that with the increase in fiber content up to the optimum value increases the strength of concrete. Slump cone test was adopted for measuring the workability of concrete. As fiber content increases in concrete workability reduces.*

Key Words - Compressive strength, Split Tensile strength, Flexural strength, Straight steel fiber, Aspect ratio, Optimum Value, Steel fiber reinforced concrete, Workability.

1. INTRODUCTION

Steel Fiber reinforced concrete is defined as concrete made with hydraulic cement, fine and coarse aggregate and ramdomly oriented fibers. In Steel Fiber reinforced concrete thousands of small and randomly distributed steel fibers used during mixing, and therefore improve concrete properties. Janesan, P. V. Indira and S. Rajendra Prasad [3]. concluded that the ultimate strength and ductility increases by adding steel fibers in concrete mix. Generally Steel fibers are used to increase the tensile strength and ductility of concrete. Fiber volume fraction of steer fiber used in steel fiber reinforced concrete should be within 0.5% to 2%. As fiber content increases it causes in reduction in workability. **A**spect ratio is defined as the ratio of fiber length to the diameter. The normal range of aspect ratio for steel fiber is from 20 to 100. Aspect ratio of steel fiber greater than 100 is not recommended, as it will affects the workability of concrete. In this experimental work adopted aspect ratio was 50. The main reasons for adding fibers to concrete matrix is to provide crack resistance and crack control. The results indicates that the addition fibers to concrete, increases its toughness and tensile strength and ductility.

2. METHODOLOGY

Ordinary Portland cement of 43 grade was used. The coarse aggregates used were crushed aggregate having maximum size of 20 mm. The fine aggregate used was locally available uncrushed sand. The mix design used in experiment was confirming to IS 10262:2009. Water cement ratio of 0.50 was adopted. M20 grade concrete was used throughout experimental work. Straight steel fiber of 1mm dia. and 50mm length have been used. Fiber content were varied by 1%, 1.5% and 2% by weight of concrete keeping aspect ratio of 50.

Fig -1: Steel fiber used for experimental work

3. TEST RESULTS AND DISCUSSION

For studying the effect of steel fibers, cubes, cylinders and beams were casted and compressive strength, split tensile strength and flexural strength were tested. By adopting slump cone test on concrete mix workability was observed. After 28 days curing period, observation were recorded and presented in the form of tables and charts.

1) The compressive strength was calculated as follows:

Compressive strength (MPa) = Failure load / cross sectional area.

2) The split tensile strength was calculated as follows:

Split tensile strength (MPa) = 2P/3.14DL

Where, P= Failure Load(N), D= Dia. Of specimen(mm)

L= Length of specimen(mm)

3) The flexural strength was calculated as follows:

Flexural strength (MPa) = (P x L) / (b x (d*d))

Where, P= Failure Load, L= Effective span of beam(mm), b= Breadth of beam(mm), d= depth of specimen(mm).

Fig -2: Testing of compressive strength test specimen

Table -1: Compressive Strength of concrete with different % of steel fiber

Percentage of fiber (%)	Compressive strength (MPa)
0%	26.90
1%	33.45
1.5%	30.90
2%	29.33

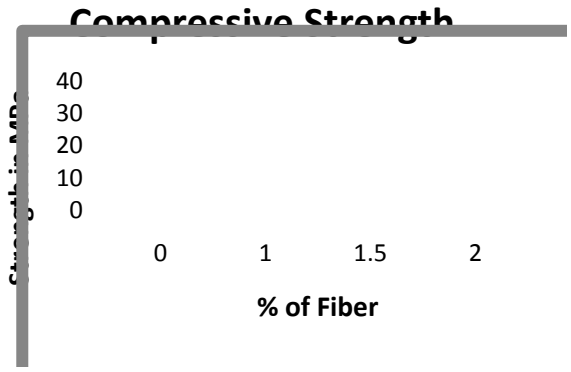

Chart -1: Variation in Compressive strength of concrete with respect to different % of fiber content

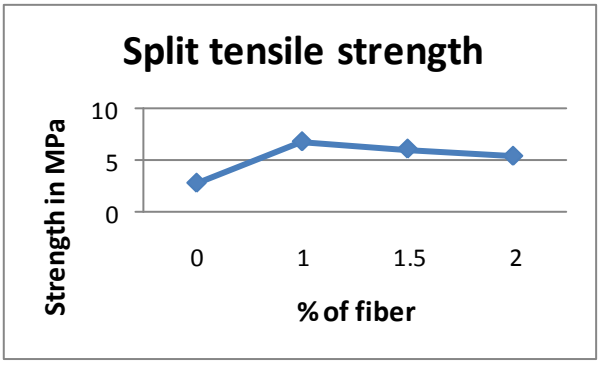

Chart -2: Variation in Split tensile strength of concrete with respect to different % of fiber content

Fig -3: Testing of tensile strength test specimen

Fig -4: Testing of flexural strength test specimen

Table -2: Split Tensile Strength of concrete with different % of steel fiber.

Percentage of fiber (%)	Tensile strength (MPa)
0%	2.80
1%	6.88
1.5%	6.16
2%	5.45

Table -3: Flexural Strength of concrete with different % of steel fiber.

Percentage of fiber (%)	Flexural strength (MPa)
0%	3.80
1%	6.52
1.5%	7.06
2%	8.24

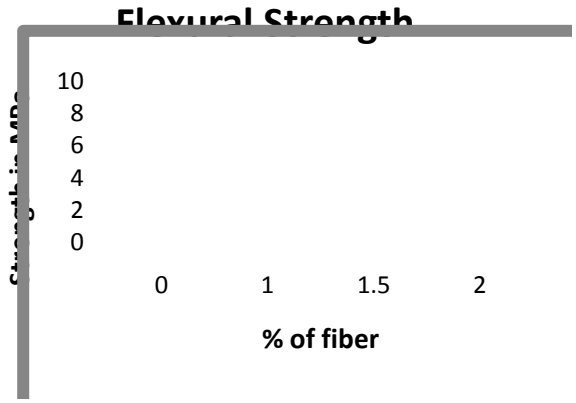

Chart -3: Variation in Flexural strength of concrete with respect to different % of fiber content

Table -4: Workability of concrete with different % of steel fiber

Percentage of fiber (%)	Workability (mm)
0%	100
1%	80
1.5%	75
2%	70

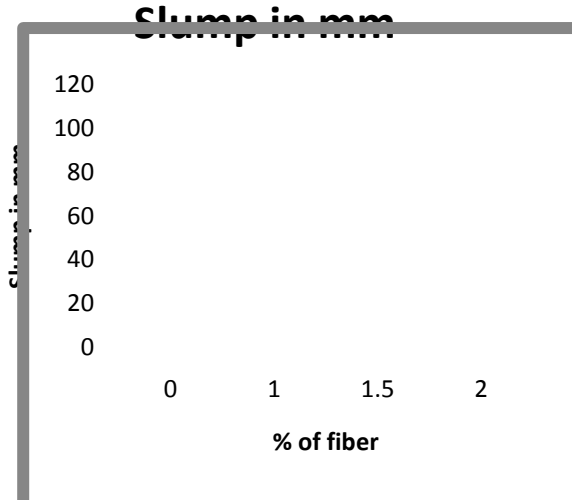

Chart -4: Variation in Slump of concrete with respect to different % of fiber content

4. CONCLUSION

1) It has been observed that with variation of percentage of fiber from 0%, 1%,1.5% and 2% of steel fiber, there is significant effect on compressive strength. The compressive strength increases at the addition of 1% steel fiber and afterwards there is slight decrease in compressive strength. The optimum value of fiber content of steel fiber reinforced concrete is 1%.

2) As steel fiber increases, workability of steel fiber reinforced concrete is decreases.

3) It has been observed that with variation of percentage of fiber from 0%, 1%, 1.5% and 2% of steel fiber, there is significant effect on split tensile strength. The split tensile strength increases at the addition of 1% steel fiber and afterwards there is slight decrease in split tensile strength. The optimum value of fiber content of steel fiber reinforced concrete is 1%. Split tensile strength goes on increasing by increase in steel fiber percentage up to the optimum value. The optimum value of fiber content of steel fiber reinforced concrete was found to be 1%.

4) The flexural strength of concrete goes on increasing with the increase in fiber content up to the optimum value. The optimum value for flexural strength of steel fiber reinforced cement concrete was found to be 2%.

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