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Experimental Study on Glass Fiber Reinforced Concrete

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Abstract*— Concrete is most widely used construction material in the world. 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. Fibre 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, impact strength and shrinkage strength.The main reasons for adding fibres to concrete matrix 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 to concrete improves the mechanical properties, durability and serviceability of the structure. In this paper effect of fibers on the strength of concrete for M 20 grade have been studied by varying the percentage of fibers in concrete. Fiber content were varied by 1%, 1.5% and 2% by weight of concretet. 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. All the specimens were cured for the period of 28 days before crushing. The results of fiber reinforced concrete for 28days curing with varied percentage of fiber were studied and it has been found that there is significant strength improvement in glass 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.

Keywords*— Compressive strength, Tensile strength, Flexural strength, Glass fiber, Aspect ratio, Optimum Value, Glass fiber reinforced concrete(GFRC), Workability.

I. INTRODUCTION

Glass Fibre reinforced concrete (GFRC) is defined as concrete made with hydraulic cement, fine and coarse aggregate and randomly distributed fibers. In GFRC, thousands of small fibres are dispersed and distributed randomly in the concrete during mixing, and therefore improve concrete properties. Glass Fibre reinforced concrete is being increasingly used to improve tensile strength, energy absorbing capacity and better fatigue strength. Fibre volume fraction used in producing glass fibre reinforced concrete should be within 0.5% to 2% as the fiber content increases it may reduce the workability of the mix. **A**spect ratio is referred to the ratio of fibre length over the diameter. The normal range of aspect ratio for steel fibre is from 20 to 100. Aspect ratio of glass fibre greater than 100 is not recommended, as it will cause inadequate workability, formation of mat in the mix and also non uniform distribution of fibre in the mix. To avoid any honeycombing, bleeding, segregation and heterogeneous features by improving the workability, use less water and paste. In this experimental work aspect ratio adopted was 50 that is 1mm diameter and 50 mm length glass fiber were used.

II. 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 sand. The mix design was confirming to IS 10262:2009. Water cement ratio of 0.50 was adopted. Throughout the test the concrete used was M20 grade. Glass fibre of 1mm dia. and 50mm length have been used.Fiber content were varied by 1%, 1.5% and 2% by weight of concrete mix keeping aspect ratio of 50.

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Fig 1: Glass fiber used for experimental work

III. TEST RESULTS AND DISCUSSION

Effect of glass fibre reinforcement for studying the parameters of like compressive strength, split tensile strength and flexural concrete were studied. Workability of concrete was studied by the slump cone test. After curing period of 28 days the strength, cubes, cylinder and beams were casted and tested. The effect of increase in glass fiber percentage by weight of observation were recorded and presented in the form of tables and charts.

A. The compressive strength was calculated as follows

Compressive strength (mpa) = failure load / cross sectional area.

B. 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)

C. *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).

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Fig 2: Testing of compressive strength test specimen

Table 1: Compressive Strength of concrete with different % of glass fiber

Percentage of fiber (%)	Compressive strength (MPa)
0%	26.90
1%	30.00
1.5%	26.22
2%	24.22

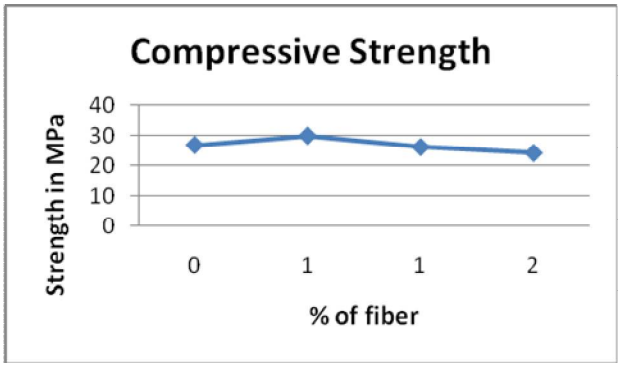

Chart 1:Variation in Compressive strength of concrete with respect to different % of fiber content

Fig -3: Testing of tensile strength test specimen

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Table 2: SplitTensile Strength of concrete with different % of glass fiber.

Percentage of fiber (%)	Tensile strength (MPa)
0%	2.80
1%	5.02
1.5%	4.59
2%	4.23

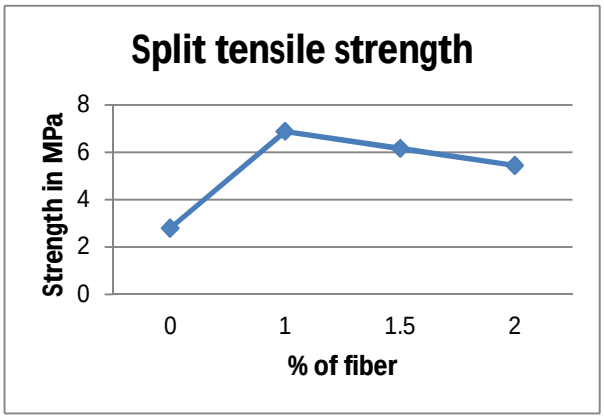

Chart 2: Variation in Split tensile strength of concrete with respect to different % of fiber content

Fig 4: Testing of flexural strength test specimen

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

Percentage of fiber (%)	Flexural strength (MPa)
0%	3.08
1%	3.14
1.5%	3.70
2%	4.40

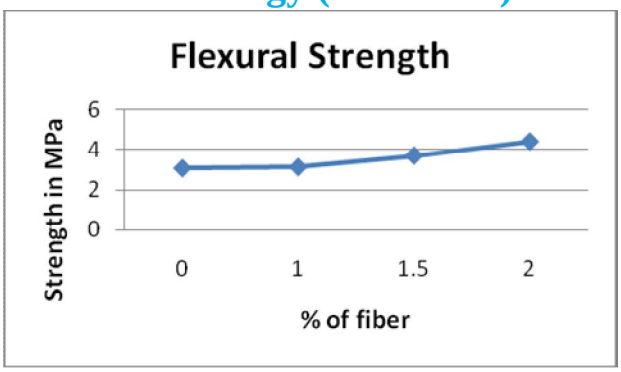

Chart 3: Variation in Flexural strength of concrete with respect to different % of fiber content

Table 4: Workability of concrete with different % of glass fiber

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

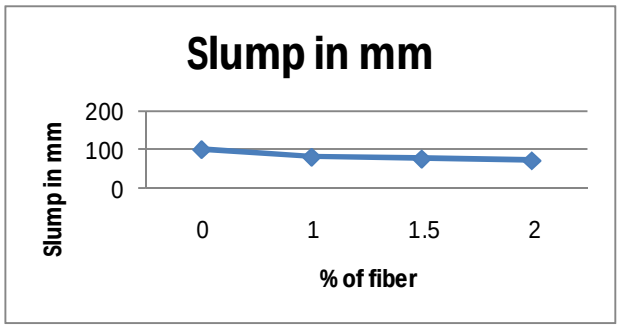

Chart 4: Variation in Slump of concrete with respect to different % of fiber content

IV. CONCLUSION

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

B. As glass fiber increases workability of GFRC is decreases.

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

D. The flexural strength of concrete goes on increasing with the increase in fibre content up to the optimum value. The optimum value for flexural strength of glass fibre reinforced cement concrete was found to be 2%.

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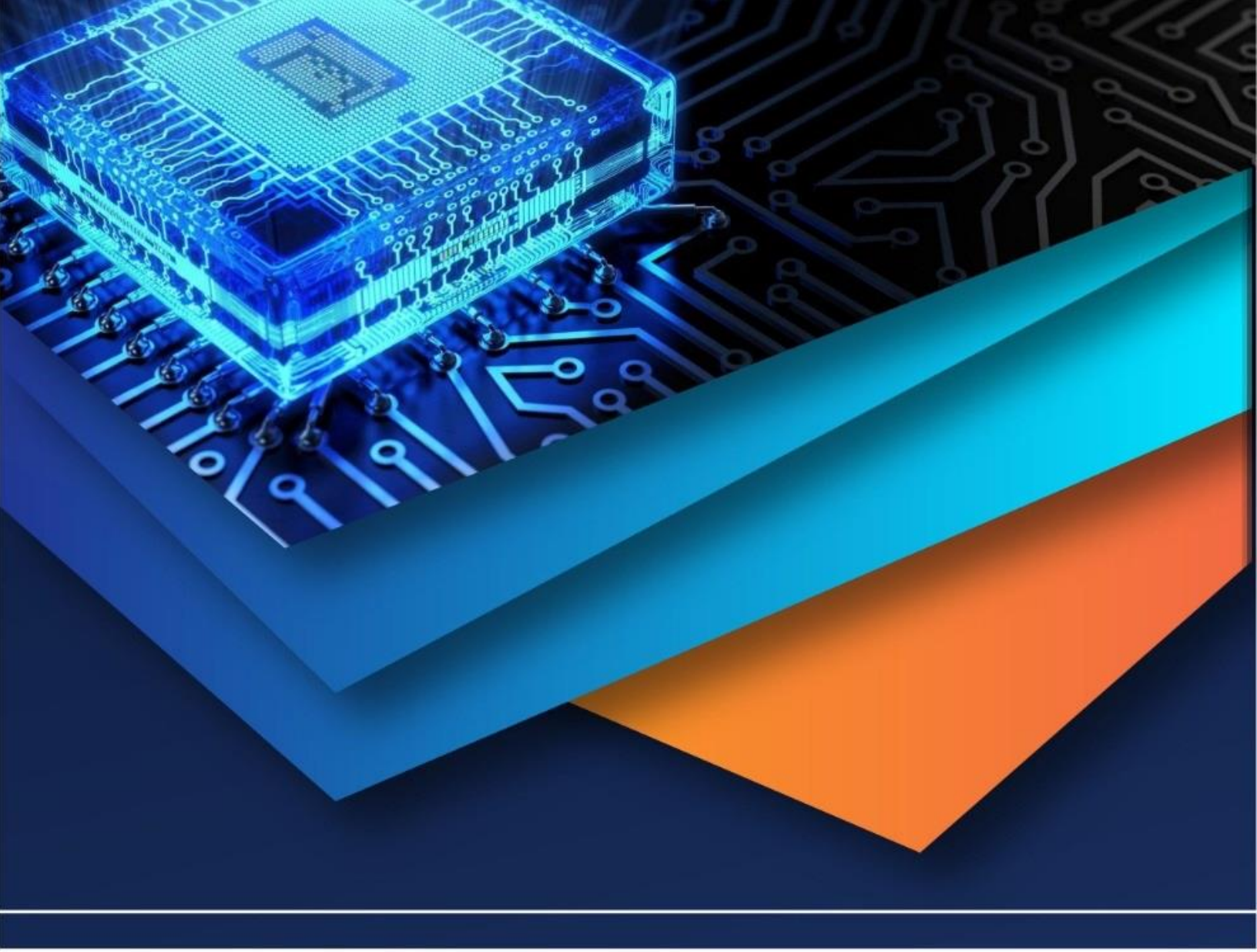

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