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EXPERIMENTAL INVESTIGATION ON STRENGTH CHARACTERISTICS OF SHEAR STRENGTH OF METAKAOLIN BLENDED GLASS FIBRE REINFORCED CONCRETE

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ABSTRACT

Research for high strength and better performance characteristics of concrete are leading the researchers for developing better structural concrete. New type of concrete have come in application in construction by using different type of fibers for achieving better performance concrete than the normal concrete.In the present experimental investigation a mix design of concrete M30 is tried using with glass fibres .The various proportions of glass fibers are added at 0%, 0.25%, 0.5%, 0.75% and 1% as total fiber percentages to the volume of concrete.The project aims at finding the shear carrying capacity of fiber reinforced concrete beams without web reinforcement by adding glass fibers, to check weather how much shear is resisted by fibers in beams for which 15 simply supported beams were casted of size (1200mmx100mmx150mm),15 standard cylinders were casted of size (150mmx300mm) and 15 standard cubes were also casted of size(150mmx150mmx150mm) and tested to check the compressive strength of concrete. The cast specimens were tested for the change in compression, and shear strength at 28 days for M30.

KEYWORDS: fiber reinforced concrete, glass fiber, metakaolin , fine aggregate ,coarse aggregate.

INTRODUCTION

Concrete has become so popular and indispensable, as aforementioned, due to its inherent characteristics and advantages. The use of reinforcement in concrete brought a revolution in the application of concrete. However generally despite this compared to other building materials such as metals and polymers, concrete is significantly more brittle and exhibits a poor tensile strength. Based on fracture toughness values steel in the form of reinforcement, is at least 100 times more resistant to crack growth than concrete. Concrete in service thus cracks easily, and this cracking creates easy access routes for deleterious agents resulting in early saturation, freeze-thaw damage, scaling, discoloration and steel corrosion. fibers are generally randomly distributed in the concrete so that after processing the concrete, the fibers become aligned in the direction of the applied stress and will thus result in greater tensile and flexural strength & shear strength. Fiber reinforced concrete is slowly becoming a well accepted mainstream construction material. Significant progress has been made in the last thirty years towards understanding the short and long-term performances of fiber reinforced cementitious materials, and this has resulted in a number of novel and innovative applications. There are numerous fiber types, in various sizes and shapes, available for commercial and experimental use. The basic fiber categories are steel, glass, synthetic and natural fiber materials. However, in slabs on grade, steel, polypropylene and structural synthetic fiber reinforced concrete is the three main types of fiber, which are used as a replacement for conventional steel fabric reinforcement.Glass fibers, Synthetic Fibers, Polypropylene Fibers ,Structural Synthetic Fibers.

LITERATURE REVIEW

Liaqat A.Qureshi , Adeel Ahmed (2013): The authors have casted total 8 mixes with different percenatges of glass fibres by weight of cement like 0%,0.5%,1%,1.5%,2%,2.5%,3% and 3.5%.The tests results have shown that flexural strength of glass fibre reinforced concrete increases more than 1.5 times at 1.5% and 2.0%mix ratios with respect to control is mix.Compressive strenght of glass fibre reinforced concrete is more than control sample at 1.5% mix ratio.Split tensile strength also maximum at 1.5% mix ratio .The values of split tensile strength is 18%,26%,13% & 11% more than control sample at 3,7,28 and 56 days of curing respectively. **K. Halvax, É. Lublóy**,**(2012**) based on their experimental studies concluded that the beams contains only stirrups or only fibers as reinforcement were nearly identical only a slight increase was observed in the ductility and ultimate shear strength in the case of steel fibers with a decreased crack width it is also observed that increasing fiber volume (Above 1 percent) can avoid the beams shear failure. **Craig, R.J (1984).** Has made an attempt to find the shear strength of fiber reinforced concrete and concluded that addition of fibers increases shear capacity of reinforced concrete beams up to 100 percent. Addition of randomly distributed fibers increases shear-friction strength, the first crack strength, and ultimate strength.

EXPERIMENTAL INVESTIGATION

PREPARATION OF TEST SPECIMENS

Mixing

Mixing of ingredients was carried out in a rotating drum. Thorough mixing by hand, using trowels was also done.

The cementitious materials were thoroughly blended with hand and then the aggregate was added and mixed followed by gradual addition of water ,mixing in case of fiber reinforced concrete was done such that the fiber was sprinkled evenly during mixing of the matrix. Wet mixing was done until a mixture of uniform color and consistency was achieved before casting the specimens, workability of the mixes was found by compaction factor test.

Casting of Specimens

The cast iron moulds were cleaned of dust particles and applied with mineral oil on all sides before concrete was poured in the moulds. The moulds are of size (150x150x150) mm for cubes, cylinders size (150 dia x 300height) mm and iron moulds for beams of (1200x100x150) mm were used for the beam specimens the moulds are placed on a level platform. The well mixed concrete was filled in to the moulds by vibration with needle vibrator. Excess concrete was removed with trowel and top surface was finished level and smooth.

Curing of Specimens

The specimens were left in the moulds undisturbed at room temperature for about 24 hours after casting. The specimens were then removed from the moulds and immediately transferred to the curing pond containing clean and fresh water for 28days.

Testing of Specimens

A time schedule for testing of specimens was maintained to ensure their proper testing on the due date and time. The cast specimens were tested as per standard procedures, immediately after they were removed from curing pond the test results are tabulated.

Description of Compression Testing Machine

The compression testing machine used for testing the cube specimens was of standard size. The capacity of the testing machine is 200 Tonnes or 2000 kN. The machine has a facility to control the rate of loading with a control valve. The machine has an ideal gauge on which the load applied can be read directly. The oil level was checked, the MS plates were cleaned and the machine was kept ready for testing specimens.

Testing Arrangements

The specimens were removed from the curing pond just before testing on the specified due date and time and cleaned to wipe off the surface water. The cube specimen was placed on the lower plate such that the load was applied centrally on the faces other than top and bottom faces of casting. The top plate was brought in contact with the specimen by rotating the handle. The oil pressure valve was closed and the machine was switched on a uniform rate of loading was maintained. The maximum load at failure i.e., the load at which the specimen breaks and pointer starts moving back was noted. The test was repeated for the three specimens and the average value was taken as mean strength. The compressive strength was taken as load applied on the specimen divided by the area of the load bearing surface of specimen (P/A).

Tests Conducted

Compressive Strength of Concrete Specimens

The compressive strength of control concrete (ordinary concrete), fiber reinforced concrete with various percentages of fibers having W/C of 0.43, were tested.

Shear Strength of Concrete Specimens: All beams and cubes specimens were tested under the, loading frame machine in the Structures Laboratory of the Department of Civil Engineering .The specimens were simply supported on loading frame machine and a two-point loading scheme was used to apply loading on the specimens. The distance separating the two loading points was constant for all the specimens at (380 mm). The shear span separating the loading points from the supports was equal on both ends of the specimens creating a zero shear region between the two loading points. The load transfer from the loading frame machine to the specimens was through a load cell, or ball bearing joint.

The loading was applied monotonically with load, deflection values being recorded at small increments of loading. For each percentage of fibers three samples were made for equal lengths of beams were casted of 1.2m . Therefore total 15 numbers of beams were tested on loading frame machine.

Figure 3.1: Shear Force and Bending Moment Diagram of a Simply Supported Beam.

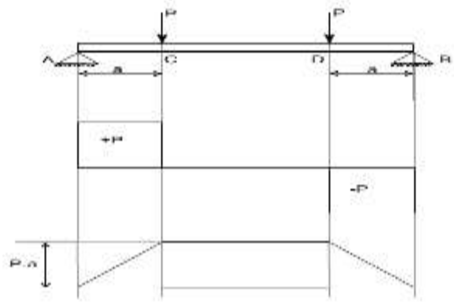

Fig.3.3.Beam specimen testing machine.

DISCUSSION OF TEST RESULTS

Compressive Strength

Cube specimens were tested for compression and ultimate compressive strength was determined from failure load measured using compression testing machine. The average value of compressive strength of 3 specimens for each category at the age of 28 days are tabulated in the table 5.2.

Concrete with Glass Fiber

Compressive strength of concrete was found to increase with increase in fiber content. The 28 days strengths were found to increase marginally over the control mix. The maximum strength is achieved with.0.50% addition of fiber.

INFERENCESONTEST RESULTS

There is a considerable improvement in the compressive strength of concrete with addition of Glass fibers of 0.50%, Fibers are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. It is observed that the compressive strength is increased with increasing age of curing.The maximum 28 days cube compressive strength for a mix with 0.50% of glass fiber is 38.7 MPa,

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Shear Strength

Preliminary statements

Beam specimens were tested for shear strength. The tests were carried out confirming to IS 516-1959, the specimens were tested under two point loading the average value of 3 specimens for each category at the age of 28 days is tabulated in the table 5.2. The percentage increase in shear strength of various concrete mixture over the plain concrete is shown the graphical representation of variation of shear strength of metakaolin blended glass fiber reinforced concrete mixture with various percentages of fiber at the age of 28 days.

Shear strength of concrete was found to increase with increase in fiber content. The maximum shear strength is achieved with 0.50% addition of fiber. The increase was observed as 9.03% over the concrete at the age of 28 days.

Inference on Test Results

There is substantial improvement in the shear strength of concrete with 0.50% addition of glass fibers. As expected plain concrete specimens showed no ductility resulting in brittle failure when the first crack forms. After the initial cracking in the fiberreinforced concrete the specimen exhibited a sudden drop in load carrying capacity but had some post peak resistance due to the presence of fiber that were bridging the cracks. This indicates that the addition of fiber to the concrete improves its ductility and energy absorption capacity.The maximum 28 days shear strength for a mix with (0.50%) addition of glass fiber is 1.81 MPa i.e., 9.03% increase over control mix.

Fig 3.2: A Simply Supported Beam Subjected to Two Point Loads 1.2m

Table 5.2: Showing the values of Actual and Theortical bending strength.

S.no	Percentage of fibres	Theortical bending strength	Actual bending strength
1	0 %	7.41	7.8
2	0.25 %	7.41	8.29
3	0.50 %	7.41	8.42
4	0.75 %	7.41	8.24
5	1 %	7.41	7.85

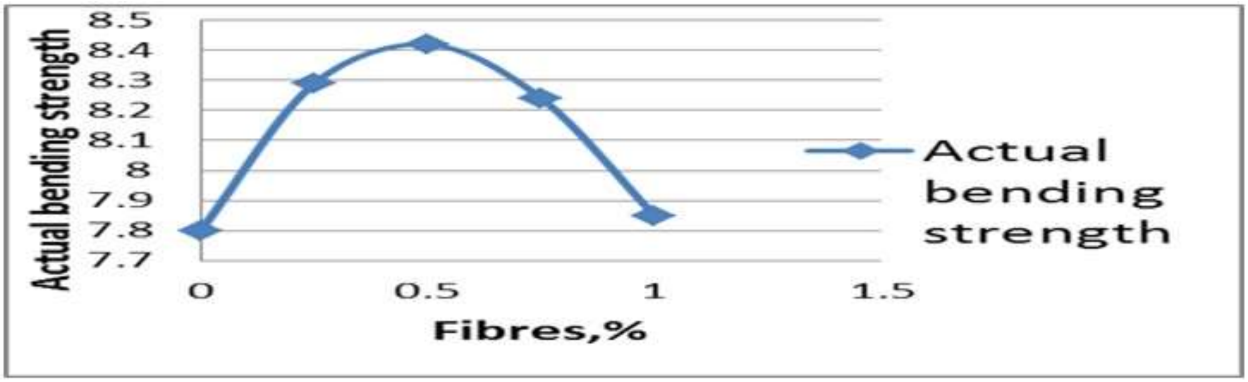

Figure 5.2: The above graph shows the Actual bending strength vs fibre %.

S.no	Percentage of Fibers	Shear strength (MPa)
1	0 %	1.62
2	0.25 %	1.66
3	0.50%	1.81
4	0.75%	1.77
5	1%	1.69

Figure 5.3 : Showing the values of percentage of fibers and shear strength.

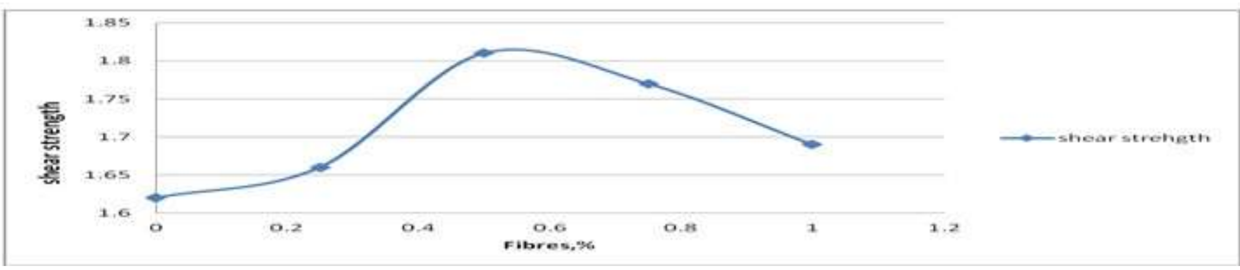

Figure 5.3: The above graph shows shear strength vs % of fibre.

INFERRING STATEMENT

From the above conclusions it is observed that optimum strength was obtained from glass fibers with (0.50%) it substantially improves compressive strength and shear strength.

CONCLUSIONS

- Beams have been casted & tested then it was found that shear caring capacity of concrete increases with increase in percentage of fibers for (0%.0.25%,0.5%, 0.75%, 1%)
- The percentage increase was found to be for (0.25%) was 2.46%, then on (0.5%) was 9.03% but on (0.75% & 1%) was decreasing because of balling effect
- Addition of glass fibers ranging from 0% to 1.0% by volume of concrete. The maximum increase in strength is achieved for concrete mix having 0.50% fiber content. Shear strength were increased by 9.03%.
- An effective and efficient fiber reinforced concrete mix can be prepared with the addition of 0.50% of glass fibers. This mix is not only cost effective also it renders the concrete to achieve several beneficial properties.

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