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Enhancement of Concrete Properties By Using "Fibre"

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Abstract: Experimental study on M-20 grade of concrete having mix proportion 1:1.5 :3 with water cement ratio 0.5 to find out the compressive strength,compaction factor of fibre reinforced concrete (FRC) containing fibres of 0.1% to 1 % volume by weight of cement. A result data obtained has been analysed and compared with a control specimen (0% fibre). A relationship between percentage fibre vs. Compressive strength, percentage fibre vs. compaction factor is represented graphically. Result data clearly shows percentage increase in 28 days Compressive strength for M-20 Grade of Concrete. Keywords -fibres , Compressive strength, Flexural strength workability of Concrete.

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I. INTRODUCTION

The concept of using fibres as reinforcement is not new. Fibres have been used as reinforcement since ancient times.Historically, horsehair was used in mortar and straw in mud bricks.In the early 1900s, asbestos fibres were used in concrete, and in the 1950s the concept of composite materials came into being and fibre reinforced concrete was one of the topics of interest. There was a need to find a replacement for the asbestos used in concrete and other building materials once the health risks associated with the substances were discovered.By the 1960s ,steel ,glass(GFRC)and synthetic fibres such as polypropylene fibres were used in concrete, and research into new fibre reinforced concrete continues today.Fibre reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented.

The fibre used in this project is a type of POLYMER FIBRE.Polymer fibres are subset of man made fibres,which arebased on synthetic chemicals.They can thermally degrade at high temperatures and do not melt.These fibres have strong bonding between polymer chain.

Specification

Raw Material	Polymer
Type	Monofilament
Shape	Triangular
Cut Length	6mm
Melting Point	>250C
Dispersion	Excellent
Alkali Resistance	Good
Acid Resistance	Excellent
Density	0.91 ±0.01%g/cm^3
Water Absorbency	No

Why use fibre in concrete?

Fibres are usually used in concrete to control plastic shrinkage, cracking and drying. They also lower the permeability of concrete and thus reduce bleeding of water. Some types of fibres produce greater impact, abrasion and shatter resistance in concrete. Generally fibres do not increase the flexural strength of concrete, so it can not replace moment resistance of structural steel reinforcement. If the modulus of elasticity of the fibre is higher than the matrix (concrete or mortar binder), they help to carry load by increasing the tensile strength of the material. However, fibres which are too long tend to " ball" in the mix and create workability problems.

Due to its strong bonding properties, it binds the material of concrete properly. This material greatly improves the flexibility of concrete through resistance of shrinkage cracks.Fibre makes concrete tough in

tension and prevent cracks during curing and thermal expansion/contraction over a period. Fibres are environmental friendly and non hazardous. They easily disperse and separate in the mix.

II. EXPERIMENTAL PROGRAM

Materials and Properties the materials selected for this experimental study includes normal coarse aggregate, natural sand as fine aggregate, cement, polymer fibre and portable drinking water.

2.1 Materials

Cement : PPC (Fly Ash Based)
Aggregate : 1) Course -25mm down
2) Medium -20mm down
3) Fine – 12.5mm down
Fibre - In steps of 0.1% of weight of cement upto 1%
Sand : Standard
Sand: Standard
Water : Tap Water
W/C Ratio : 0.5
Mix Proportion : 1:1.5:3(M20)
Mixing Procedure – Hand Mixing
Compaction - Table Vibration
Curing Practice – Moist curing by ponding
Cube Size – 15cm x15cm x15cm
Testing of Cubes – Compressive strength after 28 days
Machine used for testing – compressive testing machine and compaction factor testing apparatus

2.2methodology

Compressive strength test: For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M20 grade of concrete. Fibre was added to in the ratio 0.1% to 1% by weight of cement. Cubes were cast and tested after 28 days of curing on digital compression testing machine as per I.S. 516-1959. The failure load was noted. In each category three cubes were tested and their average value is reported. The compressive strength was calculated as follows. Compressive strength (MPa) = Failure load / cross sectional area.

Fig. 1 "Testing of compressive strength test specimen"

Compaction Factor Test: Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. The apparatus used is Compacting factor apparatus. Compacting factor = (Weight of partially compacted concrete)/(Weight of fully compacted concrete)

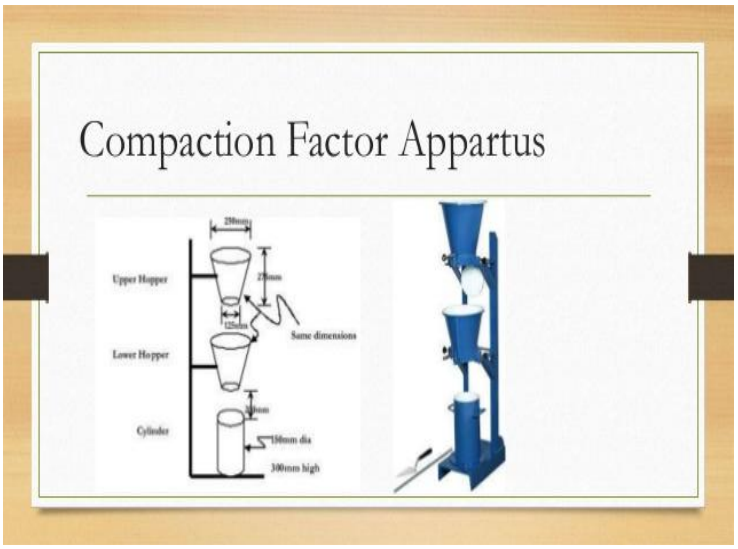

Fig. 2 "Testing of compaction factor test specimen"

2.3experimental Result

Table1. Compressive strength and compaction factor for different percentage of fiber

Sr. No	% of fibre	Avg Strength(N/mm^2)	Compaction Fcator
1	0	26.67	0.9
2	0.1	31.85	0.9
3	0.2	34.44	0.94
4	0.3	34.07	0.94
5	0.4	27.55	0.94
6	0.5	30.52	0.93
7	0.6	27.11	0.92
8	0.7	29.19	0.9
9	0.8	31.85	0.9
10	0.9	32.15	0.89
11	1	27.26	0.88

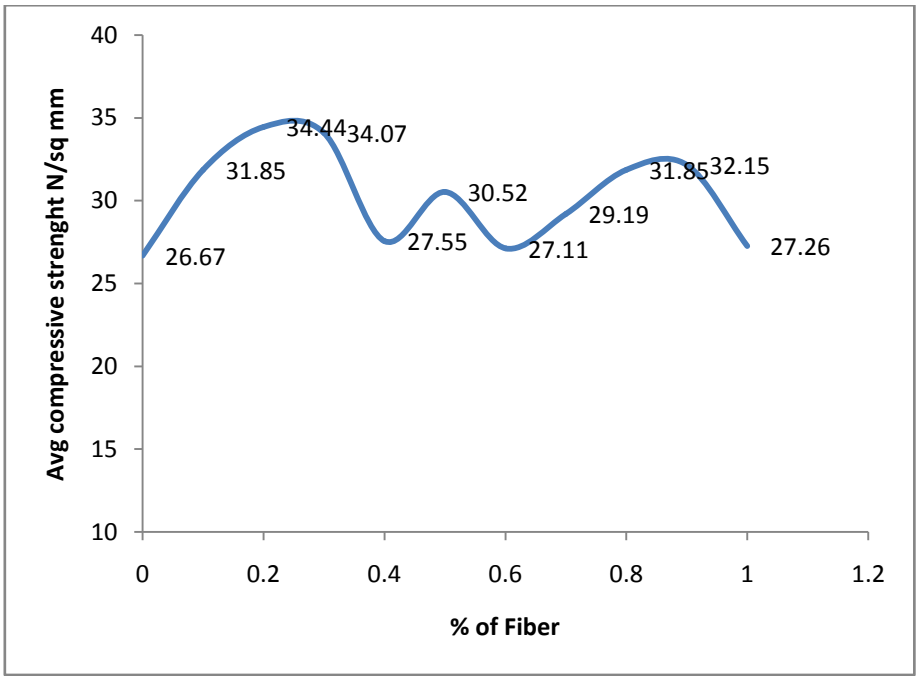

Fig 3. Increase in compressive strength of M20 grade of concrete

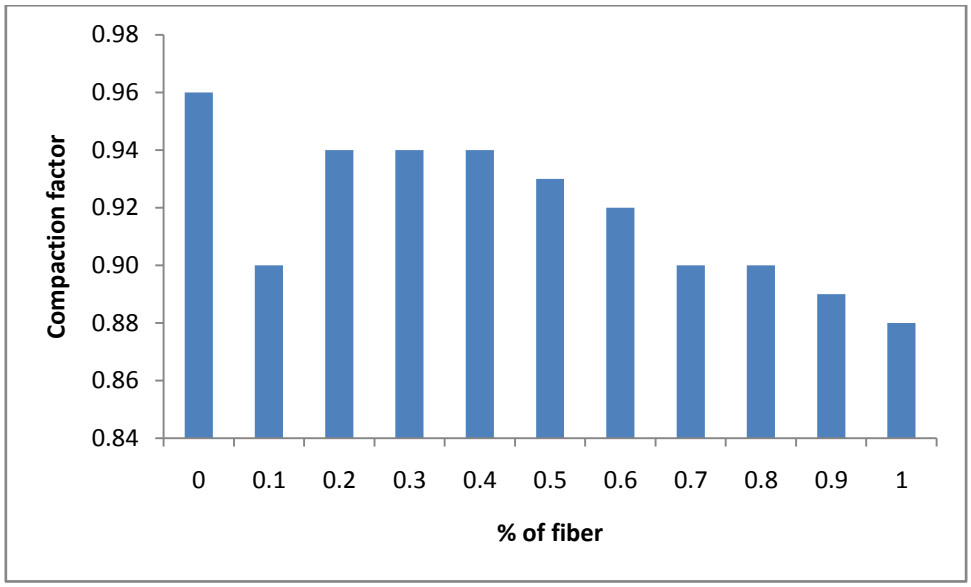

Fig. 4 Compaction factor for M20 grade of concrete

II. CONCLUSIONS

The following conclusions could be drawn from the present investigation.

1. For all percentage of fibre concrete gives more strength as compared to ordinary concrete.
2. Compaction factor value is maximum for ordinary concrete as compared to any percentage of fibre.
3. 0.2% of fibre by weight of cement is gives maximum compression strength after 28 days. Therefore addition of 0.2% of fibre by weight of cement is economical rather than other percentages of fibre.
4. 0.2% of fibre by weight of cement will increase near about 40 % more strength than ordinary concrete.
5. Addition of 0.2% of fibre by weight of concrete will increase the cost of concrete approximately 14% by cost of cement.

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