EFFECT OF ADDITION OF DIFFERENT TYPES OF FIBRE IN CONCRETE

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Abstract:*Concrete containing fibrous material is known as fibre reinforced concrete. Utilization of fibre in concrete enhances the structural properties of concrete. The fibre contain in concrete are short discrete, oriented randomly and uniformly distributed. Different types of fibre used in concrete are glass fibre, steel fibre, synthetic fibre, and natural fibre which affect the properties of concretes like increasing strength, geometries, distribution, orientation and densities of concrete. Also, the addition of fibrecontrols the property of concrete like cracking due to plastic shrinkage, drying shrinkage and reduce the permeability of concrete. Sometimes the flexural strength of concrete not increased due to the addition of fibres and hence fibre can't replace the requirement of steel reinforcement, i.e. moment resisting capacity of the member. The amount of fibre added to the concrete mix is the percentage of the total volume of concrete and fibre known as volume fraction (v.f.). Majority of fibre reinforced concrete consists of volume fraction ranges from 0.1 to 3%. The addition of fibre in concrete increases toughness and strain at peak stress of concrete.*

Keywords: Concrete, bond; Fibre reinforced concrete; Steel fibre; Glass fibre; Compressive strength

1 INTRODUCTION

Today the civil engineering industries grow very rapidly, and the use of new material for construction is a very important need because it saves our environment and natural resources. Most of the construction in now days are done with cement, sand aggregate and water mix commonly called concrete. Concrete is a versatile material it has very important properties which makes it the best constructional material used for making any structure which possesses enough strength. The best improvement in concrete achieved by utilization of fibre in it. Fibres used in concrete are of several uses and benefits. Mostly fibre used in concrete for large projects such as construction of industrial building, fly over, bridges, highway pavements, highway-overlay, etc. The type of fibre basically used in concrete are steel fibre, carbon fibre, glass fibre etc. For the development of high performance concrete, fibres in the shape of mat used. Whatever types of fibre used in the concrete, first aspect ratio of the fibre measured. Aspect ratio is nothing but the ratio of fibre length (L) to fibre diameter (d). From the literature and experimental program it was shown that if the modulus of elasticity of fibre is higher than the modulus of elasticity of concrete or mortar, the tensile strength of concrete increases.

Self-compacting concrete (SCC) defined as special type of flowing concrete that can compact or settled down by its weight. The flowing nature of SCC makes the concrete suitable for use at places in congested zone. Self-compacting concrete widely used in the long distance travelled by the concrete. In this type of concrete, we do not require vibrator, and the main thing is no skilled labours required. This type of concrete is of having highly fluidity and high workability. Therefore it is used in industrial construction to overcome placing difficulty. As we know concrete is very much weak in tension and strong in compression [3]. In olden days hair of horse was using as a reinforcement in the mortar and some of them are using straw as a reinforced material in the mud bricks. Now a days with the introduction of fibers in plain or reinforced concrete gives better solution for reinforcement in the concrete. The development of fiber-reinforced concrete (FRC) helps to achieve sustainable development.

2 MATERIALS AND METHODOLOGY

In this research work various materials used are of cement, fine aggregate, coarse aggregate, fiber, and water.Cement: The type of cement used in this project work is Ordinary Portland cement (OPC). Specific gravity of cement used is calculated as 3.10, whereas fineness of cement as per IS 8112:1989 is measured as 285 m^2/kg.Fine aggregate: As a fine aggregate locally available sand used in the project work. The specific gravity of sand used is calculated as 2.51. The bulk density of sand measured and it was found as 1650 kg/m^3. Coarse aggregate: As a coarse aggregate locally available crushed aggregate of angular shape used. The maximum size of aggregate used is 12.5 mm. The specific gravity of coarse aggregate used is calculated as 2.85. The bulk density of coarse aggregate measured and it was found as 1550 kg/m^3. Fibres: A fibre is a small sized reinforcing material produced from materials like plastic, glass, steel and carbon in various shapes and sizes. Because natural fibres are naturally available materials so their aspect ratio is not proper due to non-uniform diameter and length of the fibre. Polypropylene fibres in the form of plain and twisted shape is generally used. They are hydrophobic, so do not absorb water and hence there will be no effect on water to be mixed in concrete. The length of fibre may vary from 25 to 500 mm, whereas the aspect ratio vary from 30 to 150. Water: The water which is going to be used for the mix should be dirt free/clean and also of good quality. The pH value of the water used is in between 6 to 8 as per IS 456:2000 [4].

As Compare to conventional concrete, FRC generally required higher cement, fine aggregate, and smaller size coarse aggregate.Mixing of FRC can be done using different methods [1]. Generally two types of methods of mixing of fibers used which are wet and dry mixing. In case of wet mixing, low volume of fiber fraction is used. In both the methods mix should be uniform and homogenous so that there will be no any segregation of the fibersduring mixing. With the increase in aspect ratio, volume and

quantity of fiber, and size as well as quantity of aggregatewill increase segregation and hence there will be decrease in workability of concrete. To cover the whole surface area of the fibers with paste, water cement ratio0.4-0.6, and minimum quantity of cement 400 kg/m^3 are required [2]. Fig. 1 shows Ultratech RMC division where all testing done. Description of the plant is shown in fig. 2 with the help of flow chart.

Fig. 1: ULTRATECH RMC Division

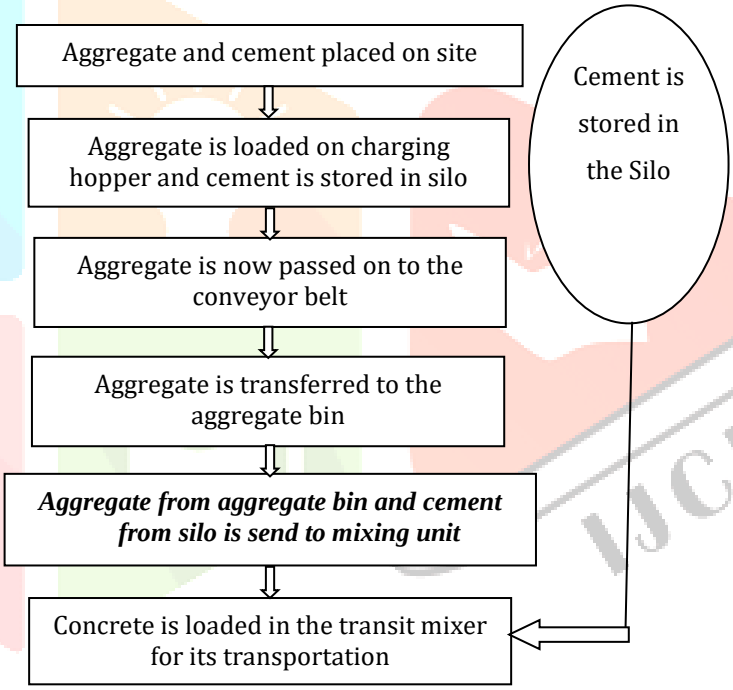

Fig. 2: Flow chart of description of RMC Plant

3 TEST ON FIBRE REINFORCED CONCRETE

Various test done on FRC are compressive strength test, flexural strength test and split tensile strength test.

Compressive strength testused for finding the compressive strength of concrete. Firstly we make a 16 sample cube of concrete having a size of the cube is 150x150x150 mm. In this sample cubes amount of plasticisers added 0.02% of the weight of cement and then added a different proportion of fibre like 0.0%, 0.4%, 0.8%, 1.2%. For self-compaction concrete preparing sample cubes to mould is filled with no vibration or ramming because it is self-compacting concrete. Then top surface of the mould was finished and levelled. Then the sample is kept for 24 hours for the settlement of concrete. After 24-hour sample cube remoulded and kept in water for curing and curing period is 28 days. After 28 days curing sample, cube tested on the universal compression testing machine for the compression test as per IS 456-2000. Then the failure load was noted. For each percent of fibre.
Compression strength can be calculated using the following formula: Compression strength of cube = failure load/(cross section area of cubes/cylinder) /Cylinder.

Flexural strength testused for finding the flexural strength of concrete. Firstly we make a 16 sample beam specimen of concrete having a size of the specimen is 450x150 mm. In this sample specimen amount of plasticisers added 0.02% of the weight of cement and then added a different proportion of fibre like 0.0%, 0.4%, 0.8%, 1.2%. For self-compaction concrete preparing, a sample specimen mould is filled with no vibration or ramming because it is self-compacting concrete. Then top surface of the

mould was finished and levelled. Then the sample is kept for 24 hours for the settlement of concrete. After 24-hour sample specimen remoulded and sample specimen kept in water for curing and curing period is 28 days. After 28 days curing sample, specimen are tested on the flexural testing machine under two-point loading as per IS 516-1959 over the effective span of 400mm for the flexural test. Then the failure load was noted for each percent of fibre. Flexural strength can be calculated using the following formula: Flexural strength of beam specimen – (PxL)/(BxD^2)

Where,
P = Failure load
L = C/c distance between the support = 450mm
B = Width of specimen
D = Depth of specimen.

Split Tensile strength testused for finding the tensile strength of concrete. Firstly we make a 16 sample cylinder of concrete having a size 150x300 mm. in this sample cylinder amount of plasticisers added 0.02% of the weight of cement and then added a different proportion of fibre like 0.0%, 0.4%, 0.8%, 1.2%. For self-compaction concrete preparing a sample, cylinder mould is filled with no vibration or ramming because it is self-compacting concrete. Then top surface of the mould was finished and levelled. Then the sample is kept for 24 hours for the settlement of concrete. After 24-hour sample cube remoulded and sample cylinder kept in water for curing and curing period is 28 days. After 28 days curing sample, cylinder are tested on the universal compression testing machine as per IS 456-2000. Then the failure load was noted for each percent of fibre. Tensile strength can be calculated using the following formula given below: Split tensile strength of beam specimen = (2P)/(πDL)

Where,
P = Tensile load
L = Length
D = Dia of cylinder.

4 ADVANTAGES

a. **S**lump value decreases fibre quality increase.
b. The variation in the percentage of fibre in concrete slight increase in flexural strength.
c. Compression strength also increases at the certain limit of the addition of fibre then it reduces.
d. And it is also found in the tensile strength of concrete.
e. The result obtained is maximum of 0.8% of fibre hence being the most desirable quantity of steel fibre.

5 CONCLUSIONS

In this study laboratory test was carried out on concrete ingredient and fiber reinforced concrete. Based on the experimental results various conclusions achieved are-

1. Normal concrete is weak in tension, and it is brittle, therefore it increases the amount of crack and hence load carrying capacity decreases.
2. To increase the performance of concrete under load fibresadded at the time of preparation of concrete. The benefit achieved after using fibre was enhanced crack resistance and ductility.
3. Fiber provide an improvement in tensile strength, fatigue characteristics, durability, shrinkage characteristics,and erosion resistance of concrete.
4. It was observed that compressive and flexural strength of FRC is higher as compared to the conventional concrete.
5. Appropriate dosage of fiber improves its flexural strength. It was also observed that fiber improves the ductility since they bind together in the concrete matrix.

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