Comparative Study on Fibre Reinforced Concrete and Nominal Concrete

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Abstract— Concrete is weak in tension and possesses high compressive strength, stiffness, low thermal, brittle character and toxicity so it is have provided a technical basis for improving such deficiencies. The use of fibres is to improve the characteristics of construction materials. Fibres are small pieces of reinforcing materials added to a concrete mix. In addition with the most common fibres used is namely steel, glass, asbestos, etc. When the loads imposed on the concrete approach that for failure, crack will propagate, sometimes rapidly, fibres in concrete provides a means of arresting the crack growth. If the modulus of elasticity of fibre is high with respect to the modulus of elasticity of concrete or mortar binder the fibre helps to carry the load, thereby increasing the tensile strength of the material. Fibres increase the toughness, the split as well as compressive strength, and reduce the creep strain and shrinkage of concrete. In this paper, the aim of the study is to comparison between properties of fibre reinforced concrete at different percentage 1% to 3% with respect to 7days and 28days fresh water curing with nominal concrete at weigh batching and volume batching method. Concluded that the addition of fibres improves ductility of concrete and its post-cracking load carrying capacity. Split tensile strength of concrete goes on increasing as fibre content is increases. The compressive strength of concrete by weigh batching is higher as compared to volumetric batching method.

Key words: Fibres Reinforced Concrete; Nominal Concrete; Weigh Batching; Volumetric Batching

I. INTRODUCTION

Fibre reinforced concrete is termed as a composite materials using cement, aggregate and incorporating discrete discontinuous fibres. Then, why would we wish to add such fibres to concrete? Plain concrete is a brittle material, with a low tensile strength and having a low strain capacity. The fibres used in FRC may be of different materials like steel, G.I., carbon, glass, asbestos, polypropylene, jute etc. The addition of these fibres into concrete mass can significantly increase in the compressive strength, tensile strength of concrete. [1], [2], [5], [6]

With the use of reinforcement in concrete results tends to increases strength and ductility, which requires skilled labours for careful placement. The introduction of fibres in discrete form in plain or reinforced concrete may provide a better solution. Addition of fibres to concrete makes it isotropic and homogeneous material. When concrete cracks, the randomly oriented fibres start functioning, arrest crack formation and propagation which results into improved strength and ductility. The failure modes of FRC are either bond failure between fibre and matrix or material failure. [3], [4]

Concrete shows excellent properties rather low performance when subjected to tensile stress because of no use of reinforcement. The cement in concrete is replaced accordingly with the percentage of 10 %, 20%, 30%, and 40% by weight of slag and 0.5%, 1%, 1.5%, 2% by weight of steel fibre. The strength performance of fibre reinforced concrete is compared with the performance of nominal concrete. [7], [8], [9], [10].

II. RESEARCH SIGNIFICANCE

When the addition of steel fibres in a concrete matrix would improve significantly many of its engineering properties, however the addition of steel fibres is not mainly the part for the strength increasing point but also economical point of view as compared to conventional reinforced concrete. Superplastizer also pay an important role in modifying the microstructure of concrete and help to achieve better workability characteristics as the use of fibre in concrete it will be turn into the lower workability so it has also required to see the use of optimal fibres. Although considerable research has been carried out on the engineering properties of fibres reinforced concrete based on compressive tests but it is also required to see that which method is preferred volumetric batching or weigh batching method with the helps of compressive, split strength and also with workability test. To answer this, the present investigation has been forced on effective utilization of concrete produced with fibres and without fibres.

Therefore, to study the properties comparison between the fibres reinforced concrete and nominal concrete is also essential.

III. EXPERIMENTAL PROGRAMME

During in this study, the properties compare between the fibres reinforced concrete and nominal concrete with volumetric batching method and weigh batching method is observed.

Ordinary Portland cement of 43 grades is used in the experimentation work. Locally available river sand conforming to zone II is used as fine aggregate in concrete. For Coarse aggregate the nominal maximum size of 20mm is used which supplied by local quarry. The concrete mix is designed as per IS 10262:2009. The specific gravity of fine and coarse aggregate was 2.70 and 2.90 respectively. The experiments which corresponds to M20 grade of concrete are carried out on a mix proportion of 1:1.60:3.47 with w/c= 0.50 with weigh batching method and the same properties of the materials are used with mix proportion of 1:1.70:3.50 with w/c= 0.60 in the volumetric batching method.

The Concrete ingredients in dry state thoroughly mixing and the required quantity of water are further added in the mix. The mixing of ingredients is done by using mechanical mixer till homogenous mixture is obtained. Concrete which is prepared is placed in cubes and cylinders in three layers Each layer is well compacted by tamping rod by bullet end by giving 25 blows Further the blocks and

cylinder are placed on vibrator and compacted by starting machine. Moulds are dismantled after one day casting of cubes and concrete specimens are removed carefully. After specimens are removed from moulds they are marked by crayons and placed carefully in curing tank for submerged curing of 7 days and 28 days with increasing fiber content at different percentage of 0%, 1%, 2% and 3% of cement.

Workability test was conducted on freshly prepared concrete by using slump test. Specimens of cubes and cylinders are tested under universal testing machine under gradual increasing load. Results obtained which are compared. Nominal concrete is compared to concrete of increasing fibre content comparison is also made between weigh batching and volume batching methods.

For strength test as per IS 516: 1959, the compressive strength test of the cube of dimensions 150 X 150 X 150 mm are cast and are testing under compression testing machine as shown in Photo 3. The split tensile strength test the cylinder of size 150mm diameter and 300mm height are cast and testing under split testing machine as shown in Photo 4.

Photo 1: Cube Casting

Photo 2: Testing of Workability

Photo 3: Specimen testing under compressive testing machine

Photo 4: Specimen testing for split tensile strength

IV. RESULTS AND DISCUSSIONS

The workability of fibre reinforced concrete goes on decreasing with increasing percentage of fibre contents in concrete. The variation of workability is reveal in the form of graph as shown in figure 1.

% of steel fiber	Volumetric Batching (mm)	Weigh Batching (mm)
0	30	28
1	29	26
2	25	20
3	22	10

Table 1: Results of workability test for different percentage of steel fibres is used in volumetric batching and weigh batching

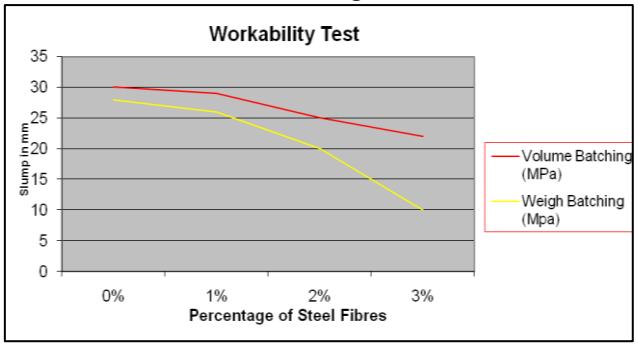

Fig. 1: Variation of slump w. r. t. percentage of steel fibres

The result of compressive strength of concrete goes on increasing as the percentage of fibre content is increases. Higher strength of compressive strength is obtained by using 3% of fibre for 7 and 28days. The variation of these strengths is shows in the form of graphs as shown in figure 2 and 3.

% of steel fiber	Volumetric Batching (MPa)	Weigh Batching (MPa)
0	11.79	18.50
1	11.98	19.08
2	12.10	20.14
3	12.84	24.97

Table 2: Results of 7days compressive strength of different percentage of steel fibres are used in volumetric batching and weigh batching

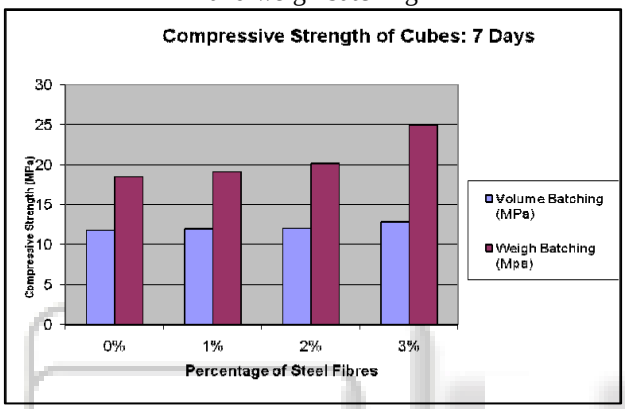

Fig. 2: Variation of compressive strength w. r. t. percentage of steel fibres

% of steel fiber	Volumetric Batching (MPa)	Weigh Batching (MPa)
0	17.34	23.89
1	19.23	26.79
2	21.22	27.28
3	23.48	34.80

Table 3: Results of 28days compressive strength of different percentage of steel fibres are used in volumetric batching and weigh batching

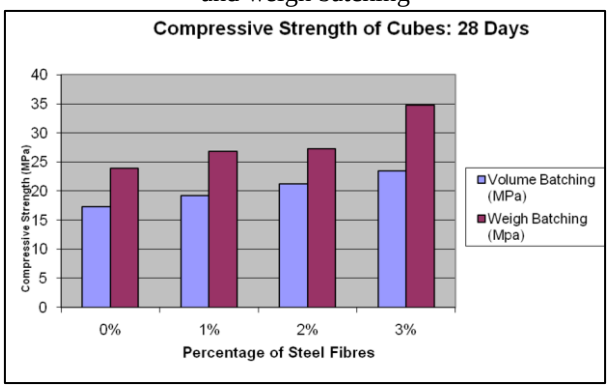

Fig. 3: Variation of compressive strength w. r. t. percentage of steel fibres

The Split tensile strength test results, strength of concrete goes on increasing as fibre content is increases. Higher strength of Split tensile strength is obtained by using 3% of fibre for 28days. The variation of these strengths is depicted in the form of graphs as shown in figure4.

% of steel fiber	Volumetric Batching (MPa)	Weigh Batching (MPa)
0	1.99	2.02
1	2.22	2.23
2	3.15	3.45
3	3.51	3.68

Table 4: Results of 28days Split tensile strength of different percentage of steel fibres are used in volumetric batching and weigh batching

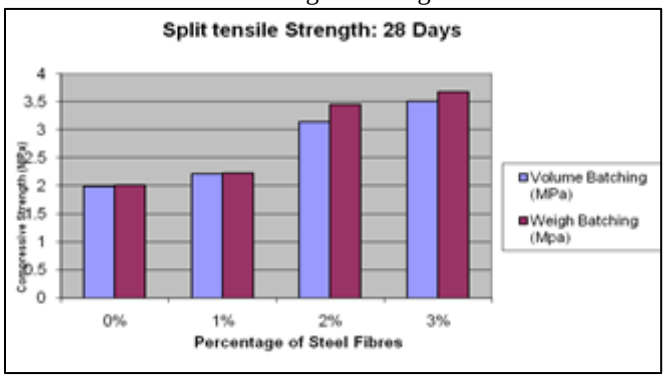

Fig. 4: Variation of compressive strength w. r. t. percentage of steel fibres

As the cement content and water content for volumetric batching method is more as compared with weigh batching method. While the comparison between the volumetric batching and weigh batching method the results are as follows,

a) A smaller amount slump is observed in weigh batching as compared to volumetric batching method.
b) Strength of concrete by weigh batching is higher as compared to volumetric batching method.

Other Improvements such as crack resistant of concrete is improvement with increasing in fibre content.

V. CONCLUSIONS

The workability of concrete is decrease with increasing in percentage of fibres in weigh batching method as well as in volumetric batching. The compressive strength of concrete is higher as increases with percentage of fibres as compared to without using fibres in concrete. From the split tensile test, the addition of fibres into the concrete increases the tensile strength of the concrete as compared to without using fibres. The cracks forming in the concrete cubes are resisted by the fibres therefore the compressive strength is also an increase due to the addition of fibres with improves after the post-cracking and the load carrying capacity of concrete.

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