EXPERIMENTAL STUDIES ON FIBER-REINFORCED CONCRETE

Er.Vikas Kumar[1],Er.Vasu Chhabra[2] ,Dr.Sukhdeep Singh[3] , Er.Simranpreet Singh[4]

[1]M.Tech Scholar, Dept. of Civil Engineering, CT University, Ludhiana
[2]Assistant Professor, Dept. of Civil Engineering, CT University, Ludhiana
[3]H.O.D, Dept. of Civil Engineering, CT University, Ludhiana
[4]M.Tech Scholar, Dept. of Civil Engineering, CT University, Ludhiana

Abstract –
Concrete is one of the most widely recognized development material for the most part delivered by utilizing locally accessible ingredients. The present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction. The main aim of the study is to study the effect of glass fibre and steel fibers in the concrete. FRC has the high tensile strength and fire resistant properties thus reducing the loss of damage during fire accidents. In the present work the strength studies are carried out to compare the glass and steel fiber concrete. The FRC is added 0.5, 1, 2 and 3% are added for M20 grade concrete. Result shows the percentage increase in compressive strength, flexural strength and split tensile strength for 28days
Cement and concrete matrices reinforced with randomly oriented short fibers are finding increasing applications in both precast and in situ concrete construction. Fibers made of steel, polypropylene, and glass are already being used in load-bearing structural members; attention is turning now to using organic and natural fibers as macro reinforcement in cement and concrete matrices.
Fiber Reinforced Concrete (FRC) is gaining attention as an effective way to improve the performance of concrete. Fibers are currently being specified in tunneling, bridge decks, pavements, loading docks, thin unbonded overlays, concrete pads, and concretes slabs. Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers This study presents understanding strength of fibre reinforced concrete. Mechanical properties and durability of fiber reinforced concrete.

Keywords: Steel Fibre Reinforced Concrete, tensile strength, compressive strength, glass fiber, steel fiber and strength studies

1) INTRODUCTION

One of the most well-known building materials is concrete, which is often produced using materials that are readily available nearby. The growth of concrete has created a critical demand for chemical and mineral additives to enhance concrete performance. So far, many admixtures like fly ash and coconut iber have been employed. Over the past 30 years, glass fibre has been utilised in a variety of construction elements, primarily non-structural ones, such as façade panels, piping for sanitary purposes, aesthetic non-recoverable form work, and other goods. One of the strongest building materials is concrete. Compared to timber construction, it offers higher fire resistance and gets stronger over time.

2.a) HISTORY OF REINFORCED CONCRETE

In the year 1849, a French gardener by the name of Joseph Monier created reinforced concrete for the first time. Most modern structures would not be standing today if it weren't for reinforced concrete. Frames, columns, foundations, beams, and other structures can all be made out of reinforced concrete. Used reinforcement materials must to have good thermal compatibility, high tensile strength, and great bonding properties When using reinforcement, it is necessary for the weight to be smoothly transferred from the concrete to the area where the reinforcement material and concrete meet. Therefore, the strain on the concrete and the reinforced material must be equal.

2.b) NECESSITY OF REINFORCED CONCRETE

Concrete's shortcomings, such as brittleness, weak tensile strength, poor impact resistance, fatigue, low ductility, and low durability, to some extent limit its usage as a structural material. Its ability to withstand dynamic forces brought on by explosions is likewise severely constrained. By adding reinforcement or pre-stressing steel to the tensile zone, structural members' brittleness is compensated. However, it does not change concrete's fundamental quality. It is essentially a technique for using two materials to complete the task at hand.

Fig.1(Glass Fibre)

Fig.2 (Steel Fibre)

Due to its higher static and dynamic tensile strength, energy-absorbing properties, and improved fatigue strength, fiber-reinforced concrete is becoming more and more popular

Fibre-reinforced concrete sometimes called fibrous concrete is manufactured under the trade name "Wirand Concrete". After extensive research, Wirand Concrete is widely used in the United States.

3) RESULTS & DISCUSSIONS

In the current work, M20 grade concrete is chosen with a water cement ratio of 0.45, a ratio of 1:1.96:2.63, and various tests are carried out to track the results. Steel and glass fibres are added in percentages of 0, 0.5, 1, 2, and 3 to the main constituents.

COMPRESSIVE STRENGTH (N/mm²)			
S.NO	% of addition	Steel fiber	Glass fiber
1	0	22.56	22.56
2	0.5	24.06	27.06
3	1	26.00	28.46
4	2	27.66	26.98
5	3	28.15	26.10

a) Compressive strength of FRC

FLEXURAL STRENGTH (N/mm²)			
S.NO	% of addition	Steel fiber	Glass fiber
1	0	3.73	3.73
2	0.5	3.9	2.45
3	1	4.4	2.94
4	2	4.75	2.6
5	3	5.20	2.45

b) Flexural strength of FRC

FRC has been used extensively in the manufacture of precast manhole covers and frames, which combine steel and polypropylene fibres. Using SFRC, SERC created the design and manufacturing technology for light-, medium-, and heavy-duty manhole covers and frames

The FRC manhole covers and frames are more affordable than similar cast iron manhole covers and frames and have higher ductility and impact resistance

FRC sheets can be made easily and without the need for specialised knowledge; all that is required is a metal frame, a workbench, moulds, plastic sheets, and standard masonry equipment. On top of the table is first set the plastic sheet. The 10-mm-thick metal frame is then laid on top of the sheet. In addition, based on SERC research and development, it is anticipated that polymer-impregnated precast FRC components and in-situ overlays would soon find field use.

4) CONCLUSIONS

A succinct summary on fibre reinforced concrete's state-of-the-art is provided. We have made significant progress in our understanding of fiber-matrix interaction, reward processes, and performance traits. A potential material for long-lasting and sustainable concrete structures in the Middle East is fibre reinforced concrete. Its effectiveness has already been established in other dry, hot regions and chemically hazardous situations

The test findings are used to draw the conclusions.

a) The strength increases linearly with the addition of steel fibre in compressive strength, flexural strength, and split tensile strength, but it increases and then decreases with glass fibre up to 2%.

b) It is established that as the percentage of steel fibre rises, strength does as well. However, the strength of glass fibres is rising by up to 1%. The strength starts to decline at 1%.

Commercial steel fibre production is predicted to begin within the next few years, which might enhance the use of FRC composites for a variety of projects. Natural fibres are increasingly being used in residential construction projects as a result of their success and utility in the production of cost-effective roofing sheets and tiles.

This manuscript sets out to compare the mechanical properties of concrete reinforced with steel fibre and macro synthetic fibre. The literature review identified a gap in knowledge on the mechanical properties when fibre type is varied. The mechanical behaviour of the URW1050 steel and the HPP45 synthetic fibres have been investigated in this study in the same design mix and fibre dosage of 7kg/m3 . The compressive strength was averaged from nine cube specimens, three tested at each age, on the 7th, 14th and 28th day.

Tensile splitting strength was estimated from six cylindrical specimens, three tested on the 7th and the other three on the 28th day. The flexural strength was deduced from six beams, each set of three tested on either the 7th or 28th day.

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