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The Analysis of Plain Cement Concrete for Future Scope When Mixed With Glass & Fibres

Trupti mala pattnaik[1], Akshaya Sabat[2]
1(Department of Civil Engineering, Gandhi Engineering College,India)
2(Department of Civil Engineering, Gandhi Institute For Technology,India)

Abstract: *Concrete is principally utilized material for the development of different kinds of structures in the advanced time of common foundations. Concrete is solid in pressure yet it is feeble in strain and shear. To dispense with those issues, strands were acquaint in concrete with upgrade its rigidity and shear quality. By utilizing filaments in solid blend it changes over fragile nature of cement into flexible nature. Different Efforts are being made in the field of solid innovation to grow such kind of cements which have exceptional attributes. In the old time just plain and straight steel fiber were utilized. In present day advancement of fiber fortified solid some new kind of strands like glass, carbon, polypropylene and aramid filaments are given in plain cement to the improvement in elasticity, exhaustion qualities, shrinkage attributes, sway, flexural quality, and compressive quality. The different properties of FRC rely upon fiber geometry, type, modulus of flexibility, solidness, viewpoint proportion, fiber substance and fiber direction. Total size and network quality is likewise a significant parameter of fiber fortified cement.*

To utilize concrete as a heap bearing part it is important to increment tractable opposition property of the solid part. This wonder is accomplished from multi year back or more by utilizing essential fortification and furthermore by the Application of prestressing. Both of the two strategies give rigidity to the basic component yet don't expand the innate elasticity of solid network itself. The general execution of strengthened solid composite material is influenced then the individual execution of the solid itself. This prompted the quest for new material for example two stage composite material in which powerless solid framework is fortified with solid fiber to deliver composite of unrivaled property and superior. In two stage composite sinewy material, strands hinder the disfigurement of the solid grid and import to build the properties of solidness and quality. The primary reason for consolidating natural fiber (polyamide) and inorganic strands (glass and steel) is to accomplish unrivaled properties of plain solid quality.

The principle motivation behind consolidating natural fiber (polyamide) and inorganic strands (glass and steel) is to accomplish predominant properties of plain concrete.

Keywords*: Steel, Concrete, FRC, Fibre, Aggregate, polyamides, Sub Area: Material Engineering, Broad area: Structural Engineering*

I. Introduction

In my present investigation the mechanical properties of fibres reinforced concrete is studied by using (steel fibre, glass fibre and polyamide) with different weight fraction of fibres with respect to cement.

The mix design of M25 concrete with W/C ratio of 0.42 is taken. Thirteen mixes (13) included one control mix were prepared and tested in the laboratory. The total quantity of fibres mixed in the concrete are in order of 0%, 0.75%, 1.5%, and 2.25% by weight of cement and One mix contains (0.33% of glass fibre+0.33% of steel fibre+0.33% 0f polyamide). The total tested specimens are 239. Admixture such as superplastisizer (water-reducer) namely sikament is also used with the percentage of 1.5% by weight of cement to all the mixes to improve reaction between cement and water and also avoid the concrete from corrosion. The following properties of the hardened concrete were determined:

a. Compressive strength tests,
b. Split tensile strength tests and,
c. Flexural strength tests.

In this study the cube specimen of size (150mm x 150mm x 150mm) were casted and tested in auto CTM to obtain the compressive strength of FRC.

In addition to this, cylindrical specimens of size (150mm x 300mm) were also prepared to obtain the split tensile strength FRC.

Whereas Beam specimens of size (100mm x 100mm x 500mm) were tested under two point static flexural loading to obtain the flexural strength of FRC.

7 days and 28-day compressive strength test, split tensile strength test and flexural strength tests have been performed in the hardened state of concrete. This study show mixed fibres provide better properties in controlling cracks and high strengths than single fibre and concrete without fibre. On increasing the percentage of fibres beyond 1.5%, the strength of the concrete matrix decrease due to mat form of fibres or non-uniform distribution of fibres and also decrease due to non-cohesiveness of concrete particle to each other.

Fibre reinforced concrete (FRC) may be defined as a composite materials made with Portland cement, aggregate, and incorporating discrete discontinuous fibres. The fibres used in the concrete may be natural or manufactured product: asbestos, sisal, cellulose, glass, steel, polypropylene, carbon, polymer and, Kevlar. Normally plain concrete does not give as much tensile strength as compare to compressive force. This is the main drawback in plain concrete and is necessary for the civil engineer to use conventional reinforcement to improve ductility and tensile strength of concrete member. Such type of composite material is called **fibre reinforced concrete.**

The idea for which that plain concrete can be strengthened by mixing fibres was first put forward in 1910 by porter. While polypropylene fibre is suitable for improving the impact strength of the concrete, whereas steel fibre is responsible to improve flexural strength and split tensile strength of the plain concrete. The glass fibre provides greater resistance from propagation and occurrence of early cracks. (Rajagopalan et al. 1974).

Glass fibre is also important in those respects but corroded in alkaline environment in the concrete. Sometime in bridges and pavement, flexural fatigue strength is the important parameter and it is designed on the basis of fatigue loading. One more advantage of adding fibres in the concrete gives the higher fatigue strength. Mixing of steel fibre in plain concrete give the formation of concrete composite having improved ductility and high energy absorption capacity composite (stiffness).

However due to inherent property of fibrous concrete-the presence of fibres in concrete can be expected to increase the resistance of conventional reinforced structural member against deflection, cracks and service life of concrete (Chanh 2004).

Quantity of fibres in fibre reinforced concrete is within the limit of 0.5% to 2%. As we increase the percentage beyond 2%, it may reduce the workability of the concrete mix and will give the formation of mat and balling which is difficult to separate by vibration. Whereas higher percentage of fibres are used with special fibre adding technique and different procedure of placement.

When fibres reinforced structural member or concrete beams are loaded, the fibre in the concrete will bridge the crack as shown in given Figure 1.1. The bridging action of FRC improves tensile strength and energy absorption capacity as compare to conventional concrete (Yusof et al 2011).

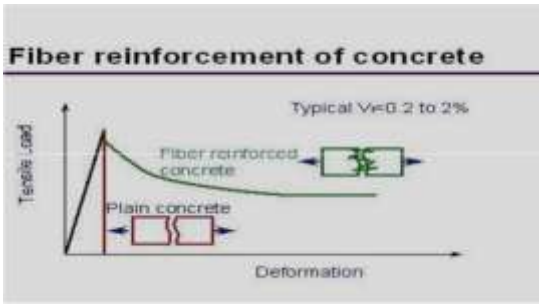
Figure 1 beam Specimen with steel fibre

Generally, the bond strength of fibres is dependent upon the surface Characteristics of fibres, and its aspect ratio. The bond can be improved by increasing the surface roughness of fibres, or by increasing the aspect ratio. Therefore, in this study, I have tried to take one additional step to complete the big issue by carrying out

the tests with high fibre content (2.0%). It is expected that with high fibre content, the tensile behaviour of concrete is quite different. Its strength is decrease as compare to lower volume content of fibres (Sukontasukkul 2003).

In this study different type of fibres are used for different purpose. One type of fibre is stronger and stiffer while the second type of fibre is flexible and leads to increase toughness and energy absorption capacity of the concrete matrix. One type of fibre is smaller, and it improves the bridges of micro-cracks, and this leads to a higher the tensile strength of the concrete. The second fibre is larger and it decreases the propagation of macro-cracks in concrete and therefore improves the toughness of concrete member.

The result shows that FRC has maximum strength at 1.5% as compare to 2.25%with little effect on compressive strength but increase tensile strength of concrete matrix (Hamrawy 2007).



Scope Of The Present Study

1) The strength of both fresh and harden state concrete should be desirable and according to requirement.
2) Behavior of fibrous concrete should be more than conventional concrete and hence fibrous concrete can be used in certain structural members.
3) The effect of fibres on compressive strength of concrete.
4) From present investigation we find the behavior of structural member cast with fibre based concrete.
5) To determine the increase in tensile strength of concrete.
6) Mechanical properties such as flexural strength, compressive strength and split tensile strength of the fibre reinforced concrete should be improved by adding fibre into it.

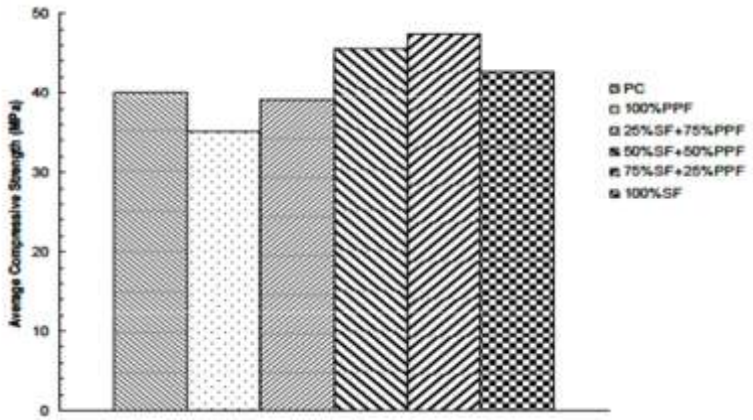


Figure 2.5 shows the result of (Singh et al 2011) on compressive strength of concrete are as under

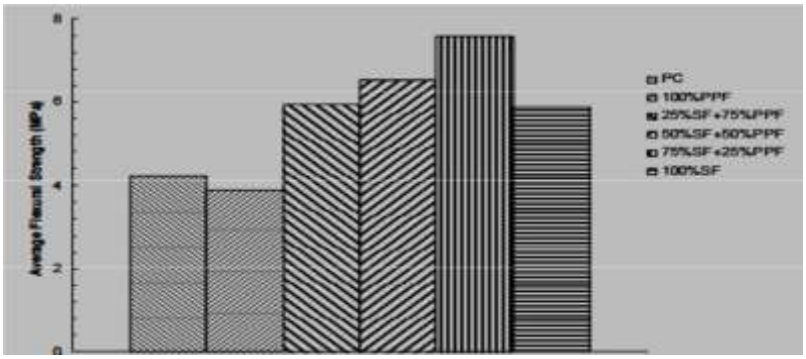


Figure 2.6 shows the result of (Singh et al 2011) on flexural strength of concrete are as under:

Table 7 days beam flexural strength of glass fibre.

S.no	Fibre%age	Peak Load (kN)	Flexural Strength f_{cf} pl/bd^2 (N/mm^2)	Average Flexural Strength (N/mm^2)	Inc. /Dec. in Flexural Strength (%)
1	0.75	11.2	5.6		
2	0.75	9.7	4.85		
3	0.75	10	5	5.15	19.42
1	1.50	14	7		
2	1.50	11.8	5.9		
3	1.50	13.5	6.75	6.55	36.07
1	2.25	12	6		
2	2.25	11.5	5.75		
3	2.25	13.5	6.75	6.16	30.65

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7-day flexural strength of fibres

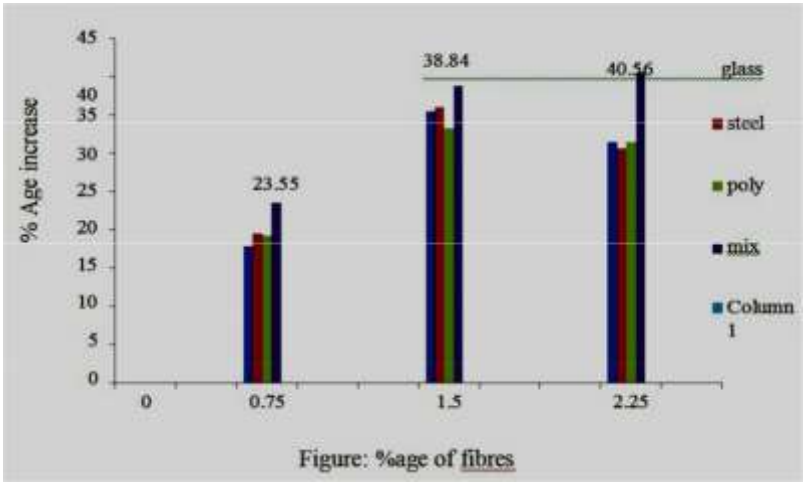

Table 28 days beam flexural strength of glass fibre.

S.no	Fibre%age	Peak Load (kN)	Flexural Strength F_{cf}= pl/bd^2 (N/mm^2)	Average Flexural Strength (N/mm^2)	Inc. /Dec. in Flexural Strength (%)
1	0.75	12.80	6.4		
2	0.75	12	6	6.41	9.45
3	0.75	13.70	6.85		
1	1.50	16	8		
2	1.50	15.50	7.75	7.55	23.04
3	1.50	13.80	6.9		
1	2.25	15	7.5		
2	2.25	14.80	7.4	7.33	20.41
3	2.25	14	7		

28-day flexural strength of fibres

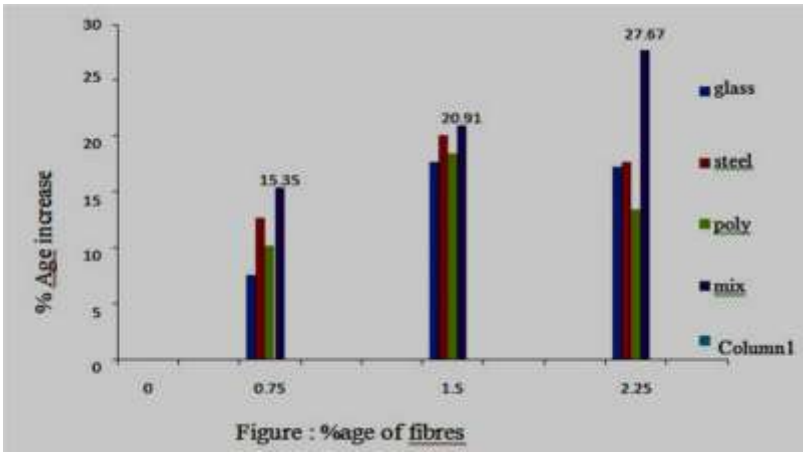

Figure : %age of fibres

Facts:

The addition of fiber in concrete convert brittle nature into ductile nature

- Flexural strength of concrete is largely affected by adding fibers in concrete almost increase up to 160%.
- Split tensile strength of glass fiber is very low as compare to normal mix.
- It should be seen that the compressive strength of steel, glass, and polyamide fiber is almost same.
- Higher percentages of fibres from 1.5 percentages affect the workability of concrete, and decrease the strength of concrete matrix.
- 1.50% Dual fibre volume can be taken as the optimum dosage.
- By using these fibers, maximum strength should be obtained at 1.5 % of fibers.
- Tensile and flexural behavior of concrete should be different for different type of fibres.
- The maximum size of course aggregate in concrete should not be more than 10mm to 20mm for better result.
- The concrete mix design should not be affected by the addition of fibers.
- Fibers at lower quantity and reasonable cost fulfill all the require condition of the concrete.
- There is no proper maintenance require during addition into the concrete.
- By using mixture of two or more fibres above 1.5 percent in concrete compressive strength do not affected but split tensile strength and flexural strength of concrete increase.

II. Conclusions

- The maximum size of course aggregate in concrete should not be more than 10mm to 20mm for better result.
- The concrete mix design should not be affected by the addition of fibers.
- Fibers at lower quantity and reasonable cost fulfill all the require condition of the concrete.

- There is no proper maintenance require during addition into the concrete.
- By using mixture of two or more fibres above 1.5 percent in concrete compressive strength do not affected but split tensile strength and flexural strength of concrete increase.

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