iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: https://doi.org/10.22214/ijraset.2022.44864

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Study on Fiber Reinforced Concrete Using Asbestos

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Abstract: ***Concrete is one of the widely used construction materials for structures. Cement concrete is an artificial stone produced by hardening mixture of cement, sand, stone chips and water. Since cement concrete is very good in compression but weak in tension, steel reinforcement are to be provided in tension zone. The low tensile strength and brittle character of concrete have been bypassed. Such combination of concrete and steel is called Reinforced Cement Concrete (RCC). The inclusion of small fraction (usually 0.5 to 2% by volume) of short fibers to the concrete, mortar and cement paste can enhance many of the engineering properties of basic materials such as fracture toughness, flexural strength and resistance to fatigue, impact and spalling. The incorporation of fibers into concrete has been found to improve several properties primarily cracking resistance, impact and wear resistance and ductility. For this reason, Fiber Reinforced Concrete (FRC) is now being used in increasing amounts in structures such as airport pavements, highway overlays, bridge decks and machine foundations. Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. So we can define fiber reinforced concrete as a composite material of cement concrete or mortar.***

Keywords: crack resisting, fiber reinforced concrete, wear resistance, stone chips, fine aggregate.

I. INTRODUCTION

Concrete is a composite material containing hydraulic cement, water, coarse aggregate and fine aggregate. The resulting material is a stone like structure which is formed by the chemical reaction of the cement and water. This stone like material is a brittle material which is strong in compression but very weak in tension. This weakness in the concrete makes it to crack under small loads, at the tensile end. These cracks gradually propagate to the compression end of the member and finally, the member breaks.

The formation of cracks in the concrete may also occurs due to the drying shrinkage. These cracks are basically micro cracks. These cracks increase in size and magnitude as the time elapses and the finally makes the concrete to fail. The formation of cracks is the main reason for the failure of the concrete. To increase the tensile strength of concrete many attempts have been made. One of the successful and most commonly used methods is providing steel reinforcement. Steel bars, however, reinforce concrete against local tension only. Cracks in reinforced concrete members extend freely until encountering are bar. Thus need for multidirectional and closely spaced steel reinforcement arises. That cannot be practically possible.

Fiber reinforcement gives the solution for this problem so to increase the tensile strength of concrete a technique of introduction of fibers in concrete is being used. These fibers act as crack arrestors and prevent the propagation of the cracks. These fibers are uniformly distributed and randomly arranged. This concrete is named as fiber reinforced concrete. The main reasons for adding fibers to concrete matrix is to improve the post cracking response of the concrete, i.e., to improve its energy absorption capacity and apparent ductility, and to provide crack resistance and crack control.

Also, it helps to maintain structural integrity and cohesiveness in the material. The initial researches combined with the large volume of follow up research have led to the development of a wide variety of material formulations that fit the definition of Fiber Reinforced Concrete.

II. PROPERTIES OF ASBESTOS FIBER

A good fiber is the one which possess the following qualities:

1) Good adhesion within the matrix.
2) Adaptable elasticity modulus (sometimes higher than that of the matrix
3) Compatibility with the binder, which should not be attacked or destroyedin the long term
4) An accessible price, taking into account the proportion within the mix
5) Being sufficiently short, fine and flexible to permit mixing, transportingand placing
6) Being sufficiently strong, yet adequately robust to withstand the mixingprocess.

A. Fiber Quantity

Generally quantity of fibers is measured as percentage of cement content. As the volume of fibers increase, there should be increase in strength and toughness of concrete. Regarding our fiber, we hope that there will be an increase in strength, with increase in fiber content.

B. Orientation Of Fiber

The orientations of fibers play a key role in determining the capacity of concrete. In RCC the reinforcements are placed in desired direction. But in FRC, the fibers will be oriented in random direction. The FRC will have maximum resistance when fibers are oriented parallel to the load applied.

C. Mix Design

Grade of concrete: M20
Type of cement: PPC (Fly ash based) IS 1489-IMaximum nominal size of aggregate: 20 mm Max w/c: 0.50
Workability: 0.90 compacting factor
Max.temperature of concrete at the time of placing: 35degree Celsius
Degree of quality control: Good
Type of exposure: mild
Type of aggregate: crushed angular aggregateChemical admixture: Not used
Specific gravity of cement: 3.14
Specific gravity of coarse aggregate: 2.68
Specific gravity of fine aggregate: 2.64

D. Cubes

Here for total 18 specimens are taken for 5 different ratios and cured for 7, 28 Days
Cement: 9.65kg
Fine aggregate: 13.75 kg
Coarse aggregate: 29.96kg
Water: 4.82kg
Fiber content: 5%, 10%, 15%, 20%, 25% of total volume of the concrete, for 3 cubes

E. Procedure

First the Portland pozzalona cement, fine aggregates, asbestos fiber and coarse aggregates were weighed accordingly to the mix design and proportions and mixed thoroughly, then with water ratio added to it and the above components and the water is mixed thoroughly to get uniform concrete mass.
Now the concrete mass is taken and it is tested for slump test in order to know the slump values for each ratio so after the mixing of the above components slump test shouldbe done. The values and the procedure are detailed here.

F. Slump Test

A truncated metal cone, open at both ends and sitting on a horizontal surface, is filled with concrete, and lifted quickly. The slump of the concrete is measured as shown infig. This measurement is simply used due to simplicity.
In this test, the stress is composed of the weight of the concrete per unit area. The concrete will slump or move only if the yield stress is exceeded and will stop when the stress (or weight of the concrete/area) is below the yield stress.
Therefore, the slump test is related to the yield stress. Some researchers have tried to simulate the slump test using the finite element method.

Slump test value

Fiber Ratio		Slump Value
0%	-	255mm
5%	-	261 mm
10%	-	268 mm
15%	-	270 mm
20%	-	250 mm
25%	-	247 mm

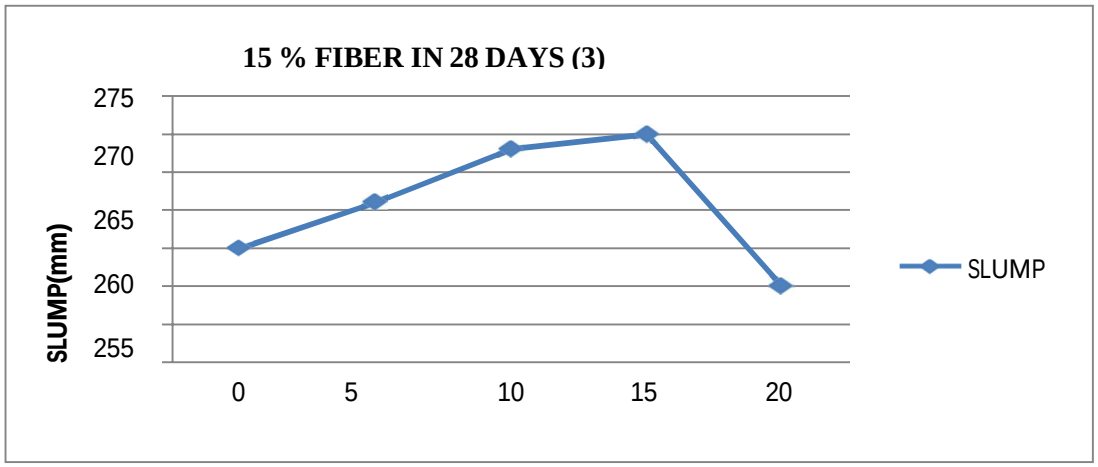
G. Testing

After the specimens are cured then compressive strength is to be done for the specimen.

H. Compressive Strength

The compressive strength is the most critical one and important one in the fiber reinforced concrete because when comparing to the normal strength concrete the strength of this AFRC should be more because of the lower water ratio and the of fiber . It is obvious to use 2000kn compressive strength.

Graph: Fiber Ratio vs. SLUMP



III. RESULT AND CONCLUSION

S.NO	CUBE.SIZE(CM)	Fiber Ratio (%)	Compression Stress (N/mm^2)	
			7 Days(Curing)	28 Days(Curing)
1	15X15X15	0%	14.3	21.1
2	15X15X15	5%	22.4	29.3
3	15X15X15	10%	28.5	31.8
4	15X15X15	15%	32.6	35.7
5	15X15X15	20%	24.4	30.6
6	15X15X15	25%	20.5	25.3

IV. CONCLUSIONS

With improved understanding of the link between fiber characteristics and composite or structural performance, the tailoring of fibers for use in high volume construction market exists, particularly for load carrying structural systems and for several applications especially in Earthquake prone areas. The time is not far that such materials will be used in building better and safe on structures for the future. It was observed that there in reduction in crack width with increase in the volume fraction of asbestos fibers when compared to control specimen. Hence the asbestos fibers act as crack arrestors.

A fiber mortar use for repair and rehabilitation work. It is use in concrete repair work by grunting. The fiber content and fiber length, because these are also important to contribute the mechanical strength of mortars similarly as a type of fiber. The fiber mortar increases the brick bond strength. Fiber mortar also increases the plaster strength and decrease the permeability.

It is observed that compressive strength varies with slump height. The deflection curve increases smoothly which is common for acceptance. Properties of the asbestos fiber reinforced concrete arrests the cracks and reduce cracks to the possible extend. So it's usefulto use the fiber in the concrete for highly rigid areas like railway platforms, road sidewalks,and concrete paths.

The fiber reinforced concrete increases the compressive strength of the concrete so as to it can be use where the high strength is necessary. Using the fiber reinforced concrete using asbestos connects bond of the brickwork and the beams and columns effectively more than the normal concrete. So it is very useful which place of work needs more strength to concrete. And usually very good strength compared to the plain cement concrete. For concrete flooring we can use the fiber reinforced concrete.

So that the fibers of the asbestos can be use in the concrete to resist the high loads after construction. Being fiber reinforced concrete the quality of the concrete increases compared with the ordinary plain cement concrete. The main use of fiber in the concrete is reduce the cracks to the great extend and increase the strength in the concrete provide the good value of the usage of the concrete in the construction of the concrete structures

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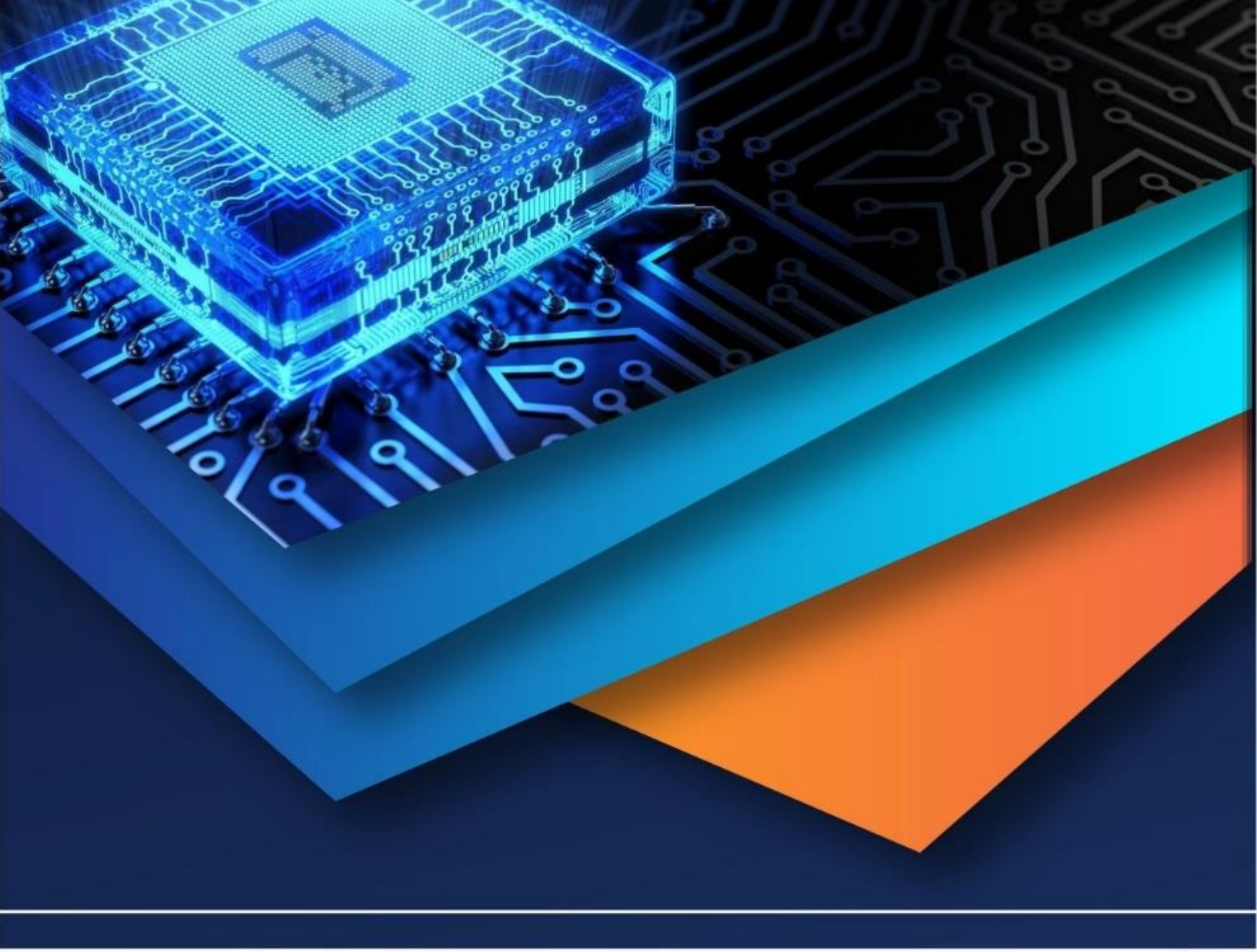

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