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An approach study on fiber reinforced concrete in high rise construction

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ABSTRACT

The Fiber reinforced concrete in various civil engineering applications is indisputable. Fiber reinforced concrete has so far successfully used in slabs on grade, precast product, a structure in the seismic region, thin and thick repairs, crash barrier, footings, hydraulic structures, and so many other application. Fibers include steel, glass, carbon, organic, polypropylene. FRC is concrete having fibrous material which increases its structural integrity. The present paper reviews the understanding strength of fiber reinforced concrete, and also concludes with a discussion of possible future developments of this technology. This fiber-reinforced concrete increase mechanical and durable properties and also this concrete is also called economical Concrete because this is very beneficial.

Keywords— *Fiber, Mechanical properties, Polymers, Economics*

1. INTRODUCTION

Fiber reinforced concrete is a very useful composite material consisting of mixtures of cement, discontinuous, uniformly distribute suitable fibers. It is also compared to other building material such as polymers, concrete is more brittle and a low tensile strength. Fiber reinforced concrete has so far successfully used in precast material, thin and thick repairs, footing and so many. Fiber reinforced concrete is concrete containing fibrous material which increases its structural strength. The requirement of high strength, crack resistant and lighter concrete resulted in the development of FRC.

The aspect ratio of the Fiber to its diameter is known as the aspect ratio of the fiber. The aspect ratio of the fiber is less than 75 in value [1].

Fiber specifications which govern the crack control and failure reserve action include:

- High fiber area
- High bond strength
- Rupture strength [2]

FRC is widely used, with annual production of now approaching about 100 m^3 [4].

The behavior of FRC composites subjected to combined static loads and to impact, dynamic and blast loads.

Steel fiber is the most popular type of fiber used as concrete reinforced. Steel fiber is used to control plastic and drying shrinkage in concrete. Steel FRC increases its flexural strength, toughness energy absorption capacity, reduced cracking and improved durability.

2. HISTORY CONCRETE OF FIBER REINFORCED

The concept of using fibers as concrete is not new. In the 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber reinforced concrete was one of the composite materials [3].

3. PROPERTIES OF FIBRE REINFORCED CONCRETE

3.1 Workability

The effectiveness of all fiber reinforced is particularly dependent upon accomplishment of a homogeneous spreading of the fibers in the concrete, successful casting and spraying and their interface the cement. Adding more percentage of fibers especially which have a small diameter, usually, have a disintegrating effect on the workability of concrete and results in the demand for changes in the mix design. This is due to fibers with very small diameter have a much greater combined surface area [5].

3.2 Flexural Strength

Flexural strength is the resistance offered by the concrete block just before failing under the application of bending stresses induced by appropriate loading.

The flexural strength is increased by 2.5 times using 4% fibers [3].

3.3 Modulus of Elasticity

Modulus of elasticity is defined as the Slope of the stress-strain curve of the concrete, within the relative limit of the material effectively. Its value is constant for low-level stresses but reduces when concrete cracks and a higher level of stresses are developed [7].

Modulus of elasticity of fiber is increased slightly with an increase in fiber content.

3.4 Ductility

Concrete is a brittle material and usually have no sequential post cracking ductility. Addition of fiber is generally considered to increase the ductility of the material [1].

3.5 Toughness

Toughness is the amount of energy per unit volume that a material can absorb before rupturing [1].

The toughness of fiber reinforced concrete is about 10 to 40 times of plain concrete.

3.6 Shear

Addition of fiber, eliminate the sudden failure characteristic of plain concrete beams. It increases stiffness, torsion strength, ductility, rotational capacity, and the number of cracks with less crack width [3].

4. NECESSITY OF FIBER REINFORCED CONCRETE

- It increases the tensile strength of the concrete.
- It reduces the air voids and water voids the inherent porosity of gel.
- It increases the durability of the concrete.
- It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to concrete would act as crack arrester and would substantially improve its static and dynamic properties.

5. DIFFERENT TYPES OF FIBRE REINFORCED CONCRETE

Following are the different types of fibers generally used in construction:

- Steel fibers reinforced concrete
- Polypropylene fiber reinforced concrete
- Glass FRC
- Asbestos fibers
- Carbon fibers
- Organic fibers

5.1 Steel Fiber Reinforced Concrete

A no. of steel fiber types are available as reinforced. Round steel fiber is commonly used in construction. The range of diameter is 0.25 to 0.75mm. fiber construct from mild steel drawn wire. Round steel fibers are made by cutting or chopping the wire, flat sheet fibers having a typical c/s ranging from 0.15 to 0.41 mm in thickness and width of 0.25 to 0.90 mm are produced by flat sheets of silting.

Steel fiber reinforced concrete uses thin steel wire mixed in with the cement. This communicates the concrete with greater structural strength, reduces cracking and helps protect against extreme cold [3].

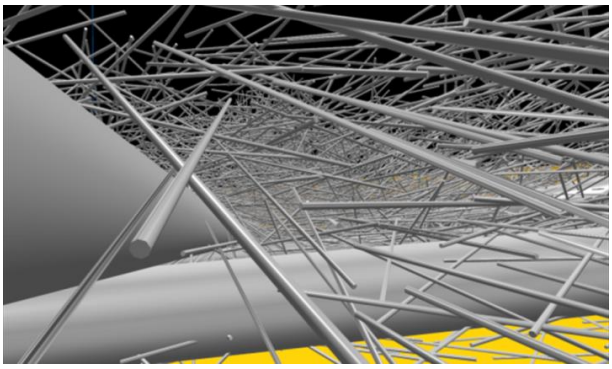

Fig. 1: Steel fiber reinforced concrete

5.2 Glass reinforced concrete

To insulate the concrete in addition to make it stronger with the help of glass fiber. Glass fiber also helps in reducing the concrete from cracking and Shrinkage. The glass fiber has very high strength 1020 to 4080 N/mm^2 [3].

Sometimes polymers are also added in the mixes to increase some physical properties such as moisture movement.

Fig. 2: Glass fiber reinforced concrete

5.3 Asbestos Fiber

Asbestos has been successfully combined with Portland cement paste to form mostly used product asbestos cement.

Asbestos which have tensile strength varies between 560 to 980 N/mm^2. Asbestos cement paste has considerably higher flexural strength than Portland cement paste [3].

Fig. 3: Asbestos fiber reinforced concrete

5.4 Carbon fiber reinforced concrete

Carbon fiber has a very high modulus of elasticity and flexural strength as compared to other fiber. Carbon fiber reinforced concrete has very high tensile strength 2110N/mm^2 and Young's modulus. Carbon fibers are expensive. Their strength

and stiffness characteristics have been found to be superior even to those of steel [3].

Fig. 4: Fiber reinforced concrete

5.5 Organic fibers

Organic fibers may be chemically more inert than either steel or glass fibers. The problem of mixing and uniform dispersion may be solved by mix superplasticizer.

Organic fibers are also low cost.

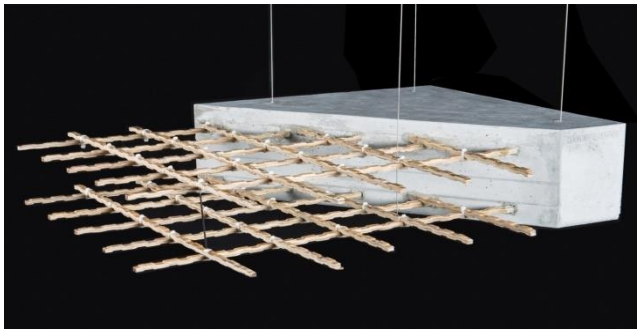

Fig. 5: Organic fiber reinforced concrete

5.6 Polypropylene fiber reinforced concrete

The melting point of polypropylene fiber reinforced concrete is 165 degrees centigrade. Polypropylene is one of the cheapest and abundantly available polymers.

Fig. 6: Poly Propylene fiber reinforced concrete

6. SOME DEVELOPMENTS IN INDIA ON FIBERS REINFORCED CONCRETE

Research efforts aiming to increase the mechanical properties of such attractive material led to the founding of pre-stressed concrete, high strength concrete [8].

High-performance fibers reinforced concrete claims 500 times more resistance to cracking and 40% lighter than as compared to general concrete.

Waste carpet fibers used in concrete as an environmentally friendly use of recycled carpet waste.

HPFRC also states it sustain strain hardening up to several percent strain, resulting in a material ductility of at least two orders of magnitude higher when compared to normal reinforced concrete.

Most of the natural fibers used for an inquisition in India are of vegetable origin. An experiment conducted on concrete cubes and flexural beams containing bamboo and coir fibers have shown that the addition of fibers effectively arrests the growth and propagation of cracks, although it does not improve compressive strength. Coconut fibers have been used in the production of roofing sheets and tiles; reportedly, the durability of these products is good. Some research has been carried out on the use of asbestos fibers in its macro fine form in a lightweight, reinforced, aerated precast concrete components. Because asbestos fibers may control some health hazard, however, further investigations are required before their use in aerated and other types of concrete can be auspicated [9].

7. CONCLUSIONS

FRC's potential is now well known in the country, but its application has not yet caught up with its position. Fiber reinforced concrete has many potential areas of applications, such as concrete structures, pavements, bridge decks, airport runways, tunnel linings, and precast products.

The technology of FRC is well understood in India, but the problem remains that metal fiber is not being manufactured in India on a commercial scale. Commercial production of steel fibers is expected to begin within the next couple of years, which may increase the use of FRC composites for a variety of structures. Natural fibers have also proved effective and useful in making low-cost roofing sheets and tiles; their use in building construction projects is increasing. Several applications of FRC using either steel or natural fibers have been reported, and the performance of structures and products construct with FRC has been commendable. Many institutions and research laboratories in the country are now conducting research and development work aimed at utilizing the full potential of FRC either alone or in combination with Ferro cement and polymer impregnation.

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