CHAPTER-1

INTRODUCTION

1.1 General

The development of major constructions is largely associated with resolving the problems of improving the efficiency of building industry, reducing cost and labour of technological processes, economic utilization of materials and power resources and adoption of new advanced material. Concrete lends itself to a variety of innovative designs as a result of its many desirable properties. Not only it can be cast in diverse shapes; but it also possesses high compressive strengths, stiffness, low thermal and electrical conductivity and low combustibility and toxicity. Two characteristics, however, have limited its use; it is brittle and weak in tension. For past two decades, the research work has improved compressive strength of concrete substantially but there was no noticeable improvement in either of its tensile strengths or extensibility. Development of new type of concrete with improved performance will be very important issue for the whole building industry in the near future. The problems of low tensile strength and poor fracture toughness of cement based materials are serious short comings that not only lead to constraints in structural designs, but also affect the long term durability of structure.

An important aspect today is the economy of power required for producing various building materials. It is well known that the quantum of power required for producing concrete in minimal compared to that required for manufacturing steel, aluminum, glass, bricks and plastic materials. Moreover, the production of concrete materials, compared to that of steel, requires less water and causes less environmental contamination. The reinforcement of concrete adds to the energy content of the material. Since steel-reinforced concretes are used on a large scale, the utmost reduction of metal consumption and its most rational utilization in concrete are problems of vital concern.

Concrete compositions with compressive strength up to 80 to 100 MPa were thus developed. However, the tensile strength of mortar and concretes remains many times below that of the compressive strength. So the use of fibers as reinforcement to overcome inadequate tensile strength of concretes materials could be the key to new types of concrete with very wide potential use in construction.

As in the case of conventional reinforced structures, reinforcing with fibres is based on the assumption that the material of the concrete matrix transmits the applied load to the fibres as tangential forces acting on the interface. If the modulus of fibre is more than that of the matrix, the fibres bear the greater share of applied stresses and the overall strength of the composition will be proportional to the content.

Two directions are discernible in research dealing with dispersion strengthening of concrete material. To resolve the problem, one direction suggests the use of special additives which intensify the concrete hardening process and improve its physical and mechanical properties. The second direction is based on the use of reinforcing fibres to increase the strength of the concrete matrix. These fibres differ in composition from the matrix material and, during exploitation, the composite martial is capable of taking very high tensile stresses compared to the matrix. The resultant strengthening depends largely on the type of fibres used, the nature of their bond, their orientation in the concrete body and chemical resistance to the hydration products of cement binders.

Reinforcement of concrete with randomly distributed short fibres improves the toughness of cementitous materials by preventing or controlling the institution, propagation and coalescence of cracks. Well dispersed fibres in the concrete act to bridge the cracks that develop in concrete. Dispersed reinforcement is effected by uniformly spreading fibres throughout the body of the concrete matrix. Quite a variety of metallic and non metallic fibres of mineral or organic origin are used, giving rise to the popular name in technical literature of fibre reinforced concrete or depending on the type of fibres used, steel fibre reinforced, reinforced concrete etc.

The range of synthetic fibres is very wide from rate to scarce, such as carbide or nitride of silicon, boron, carbon, sapphire and tungsten, to comparatively readily accessible for mass utilization, e.g., steel, glass, basalt and polymer. Natural fibres can also be used as reinforcements for concrete: wood (cellulose), sisal, bamboo, reed, jute etc. these natural fibres are inferior to synthetic ones, however, for building purposes.

Material such as asbestos – cement and reinforced cement also fall in class of concerts with dispersed reinforcement. The concept of concretes with dispersed reinforcement' is quite broad. It is possible to produce diverse verities of such concrete with various combinations of fibres as well as various inorganic matrices, not only based on cement and gypsum, but also using phosphate binders, ceramics and other materials.

Methods of dispersed reinforcements provide for directed and random orientation of fibres in the concrete body. Directed orientation is realized mainly by using continuous filaments, plaits, various types of fabric and non-fabric nets, dispersed tissues and other similar materials. This type of orientation can also realized by reinforcing the concrete with short fibres, especially steel fibres, during the moulding of component as for example, in a magnetic field.

1.2 Role of fibres

The tendency of concrete to crack has for years been accepted as natural to its use. The one and the main reason that cracks occur in concrete is stresses exist which exceed the strength of the concrete at a specific time. Stresses from external sources can be offset by providing higher structural strength to concrete structures. However the intrinsic stresses caused by shrinkage within the concrete itself have historically been a problem to control because of their unpredictable variety and occurrence.

It has been found that the addition of small closely spaced and uniformly distributed fibres to concrete would act as crack arrestors and substantially improve the tensile strength, cracking resistance, impact strength, wear and tear and fatigue resistance. The ductility of the concrete increases by the addition of fibres and such a composite material is called Fibre Reinforced concrete (FRC).

The strengthening mechanism of the fibers involves transfer of stress from the matrix to the fibre by interfacial shear or by interlock between the fibre and matrix, if the fibre surface is deformed. When the loads imposed on concrete approach that for failure cracks will propagate, sometimes rapidly; fibres in concrete provide a means of arresting the crack growth. That is these fibres provide bridging forces across cracks and thus prevents them from growing. The fibres substantially reduce the formation of plastic settlement and shrinkage cracks by increasing the tensile strain capacity of plastic concrete. This reduction or elimination of plastic cracks enables the concrete to develop its optimum long – term integrity.

Random orientation is usually realized by using short fibres