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A REVIEW ON MATERIALS USED AS A FIBERS IN CONCRETE

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Abstract: In this developing country, technology is fast advancing. "According to development, there is an increase in the construction process." Concrete and steel play a key part in building. Because of the wide range of steel consumption, the ore in the earth crust is also reducing, thus to prevent this sort of shortage or difficulty, we may make a fine grade reinforcing material for binding utilising natural resources. The key component of this procedure is banyan tree stalks, and we are not chopping the tree, only using AERIAL ROOTS of the banyan tree. If we cut them, they will be able to breed anew through that tree. Since ancient times, the Banyan tree, scientifically known as "FICUS BENGHALENSIS," has been used as an essential source of fibres for a variety of purposes. The banyan fibres have a great potential as a reinforcing fibre and a frequent residential and office house tree, but in the natural forest, it is a massive tree of Indian Jungles. The banyan tree begins its existence as an epiphyte growing on another tree where seed was deposited by some feeding birds. The banyan tree may grow to be 100 inches tall and spread across several acres thanks to its huge branches supported by prop roots. A renowned banyan tree at Poona, India, is claimed to be a half mile in circumference and capable of sheltering 2000 people. The banyan tree is indigenous to India, Sri Lanka, and Pakistan. The literature review and tests we are conducting have revealed scant information on the application of these fibres as reinforcing material, despite the easy availability of this new and extensive research work has been initiated in our laboratory on the synthesis study of properties of banyan tree stalks as a reinforcing binding material by adding some resins. The present work presents the results of experimental investigations carried out to evaluate the effect of partial replacement of steel in the construction of composites, which provide characteristics that are not obtained from any discrete material systems and cohesive structures made by combining two or more compatible materials.

***Index Terms* - Cement, Fine aggregates, Coarse aggregates, Banyan tree stalks, Fibers, Strength, Durability, Natural Fibers.**

I. INTRODUCTION

The increased environmental awareness and consciousness throughout the world has developed an ever-increasing interest in natural fibers and its applications in various fields. Natural fibers are now considered as serious alternative to synthetic fibers for use in various fields1. The use of natural fibers as reinforcing materials in both thermoplastic and thermoset matrix composites provide positive environmental benefits with respect to ultimate disposability and best utilization of raw materials. The advantages of natural fibers over traditional reinforcing materials such as glass fiber, carbon fiber etc. have their specific strength properties, easy availability, light weight, ease of separation, enhanced energy recovery, high toughness, non-corrosive nature, low density, low cost, good thermal properties, reduced tool wear, reduced skin and respiratory irritation, less abrasion to processing equipment, renewability and biodegradability. It has been observed that natural fiber reinforced composites have properties similar to traditional synthetic fiber reinforced composites.

Fig no 1.1 Banyan tree

II. DIFFERENT TYPES OF FIBERS

2.1 Steel Fibers Metal reinforcement in the form of steel fibers. In comparison to ordinary continuous reinforcingbars, these steel fibers are quite short and closely spaced. They are added to increase structural qualities such as tensile and flexural strength, as well as durability. Steel fibers have also been discovered to contribute to post-cracking strength due to their crack bridging mechanism, and so aid in crack restraint in concrete [2]. According to Narayanan and Darwish's research investigations, the insertion of steel fibres boosts shear strength of concrete due to their crack- arresting function [3]. Steel fibres are now employed as primary and secondary reinforcement in a variety of applications, including highway and airport pavements, hydraulic structures, refractory concrete, and precast applications [2].

2.2 Polypropylene Fibers Polypropylene fibres are synthetic fibres that are naturally hydrophobic. Alhozaimy et al. discovered no significant impacts of polypropylene fibres on compressive and flexural strengths, while impact resistance and flexural toughness increased in the presence of polypropylene fibres [4]. Toutanji et al. discovered that the addition of polypropylene fibres increases the permeability of traditional concrete, but that the addition of a cementitious material such as silica fume can diminish the permeability produced by these fibres [5]. The use of polypropylene fibres can help enhance the spalling behaviour of concrete [6]. As a result, polypropylene fibres have several uses in conventional concrete, selfcompacting concretes, high performance concretes, stiff pavements, and so on.

2.3 Glass Fibers Glass fibres are cheap, lightweight, and have a high tensile strength. Because of their great tensile strength, glass fibres may be used to strengthen cement or concrete. However, previous attempts to employ glass fibres were not particularly effective due to degradation induced by alkali particles in the cement. Majumdar and Ryder created alkali-resistant glass gibers with zircon oxide $ZrO2$ additions in 1974 [7]. Mirza and Soroushian discovered that employing alkali resistant glass fibres increased the qualities of lightweight concrete such as flexural strength, ductility, controlled shrinkage cracking, and temperature resistance [8].

2.4 Carbon Fibers Carbon fibres are expansive in nature, with a high modulus of elasticity and flexural strength. These fibres' strength and stiffness have been discovered to be superior to steel fibres. The low weight carbon fibre composites combine strong tensile strength with excellent fatigue performance [9]. According to Xiao and Wu, utilising carbon fibre composite jacketing may greatly enhance the strength and ductility of concrete [10].

2.5 Natural Fibers During the preparation of the concrete mix, discontinuous and discrete natural fibres of small diameter are randomly disseminated throughout the concrete matrix. These fibres have a low density in general and a high specific strength and stiffness. They outperform other synthetic fibres in terms of the environment, economy, energy, and resource conservation. Jute, coconut, and bamboo fibres are the most often utilised natural fibres in concrete.

2.5.1 Jute Fibers Jute fibre is a natural fibre derived from plants that is mostly made of cellulose and lignin. According to Islam and Ahmed [11], the use of jute fibre reduces the workability of the concrete matrix while increasing its compressive strength. According to Razmi and Mirsayar [12] and Zakaria et al. [13], the integration of untreated jute fibre in concrete improves the hardened concrete's compressive strength, tensile strength, flexural strength, and fracture mechanism. Coconut Fibers

2.5.2 Coconut fibre, which is produced from coconut husk, is another plant-based natural fibre. The fibres are categorised as white or brown depending on how long they take to peel off the coconut husks [14]. Brown fibres are commonly utilised as reinforcing material in concrete matrix [15]. The addition of these natural fibres in the concrete increased the strength properties such as compressive strength [16] and flexural strength [16,17].

2.5.3 Bamboo Fibers Bamboo fibre is a cellulosic fibre that is exceptionally durable, stable, and robust, with strength equivalent to traditional glass fibres [18]. Zhang et al. discovered that incorporating bamboo fibres into concrete increased its cubic compressive strength and considerably improved its splitting tensile strength [19]. The addition of bamboo fibres to concrete can help minimise fracture width and deflection while increasing beam post-cracking loadcarrying capability [20].

III. FACTORS AFFECTING FIBER SELECTION

3.1 Volume of Fiber The fibre volume has a significant impact on the characteristics of the concrete mix. Higher volume may reduce the workability of the concrete mix, while lesser volume may fail to meet the criteria of the design mix for which fibres are employed in concrete. As a result, the appropriate amount of fibre must be chosen to achieve the desired results. Fiber levels of up to 2% are often utilised in concrete mixes.

3.2 Aspect Ratio of Fiber The aspect ratio of fibre is defined as the ratio of the fiber's length to its diameter. The aspect ratio of a fibre determines its flexibility. Fibers with a reduced aspect ratio have a greater compressive strength and are a highly energy absorbent material [21].

3.3 Orientation of Fiber During the mixing process, the fibres are often spread randomly. They can, however, be orientated in the direction of load application as well as positioned perpendicular to the load application. However, fibres placed parallel to the load demonstrated higher tensile strength than randomly dispersed and perpendicularly aligned fibres.

IV. CONCLUSIONS

Plain concrete has a very low tensile strength, minimal ductility, and negligible fracture resistance. According to studies, the addition of tiny, tightly spaced, and evenly dispersed fibres to concrete improves its performance when compared to normal concrete. These fibres in concrete operate as crack stoppers and improve strength properties such as compressive strength and tensile strength. Steel fibres, polypropylene fibres, glass fibres, carbon fibres, and natural fibres such as jute fibres, coconut fibres, and bamboo fibres are among the fibres used in concrete. Volume, aspect ratio, and fibre orientation are all parameters that influence fibre selection into the concrete matrix. As a result, depending on the qualities required in the concrete construction, a specific type of fibre or a mixture of two or more fibres can be employed in the concrete mix.

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