ABSTRACT

Reinforced concrete is the widely used construction material by adding the different material and volume of fibers the strength of the concrete can be improved. The most commonly used fibre is steel. Low volume fractions of fibers are used to reduce shrinkage cracking. Moderate volume fractions increase flexural strength, fracture toughness and impact resistance. High volume fractions lead to strain hardening of the composites. Effectiveness of fibers in improving the properties of concrete majorly depends upon the shape and length of the fibers. Considering the global warming issues, natural fibers are the substitution in the emerging “green” economy based on energy efficiency, the use of renewable materials in polymer products, industrial processes that reduce carbon emissions and recyclable materials that minimize waste.

Fibers are generally used as resistance of cracking and strengthening of concrete. Normally various fibers are used in the concrete mix to attain the desired strength and resistance. These will provides the various mechanical properties and design applications. The various fibers used in concrete are steel, glass, carbon, polypropylene and polyolefin. The natural fibers appears to be the currently developing choice by considering the global warming issues to reduce the CO\textsubscript{2} content and also keeping the concern for the advantages such as low cost, low density, ecologically friendly, sustainability and biodegradability. By considering cement CO\textsubscript{2} emissions and being costly it is replaced with a GGBS an industrial waste and Alccofine which reduces its impact on environment.

The importance of the study is to innovate a sustainable fiber by keeping the focus as replacement for natural plant fiber, as these have various benefits like carbon sequestrate, less price, less density, environmentally friendly, sustainable and biodegradable and available to the common man in the rural areas and to reduce the CO\textsubscript{2} content which is emitted by the use of cement by replacing with waste materials like GGBS, Alccofine
In the present research, experimental studies were carried out to investigate the mechanical, durable and seismic behavior of bamboo fiber reinforced self compacting concrete which is partially replaced cement with GGBS and alccofine.

The main objective of the study is to innovate the ecofriendly fiber which is suitable for usage in concrete to improve the strength and cracking resistance. To investigate how its fiber length to the fiber diameter ratio (l/d) of bamboo fibers effects the concrete based on mechanical properties since the aspect ratio is the important parameter and its effectiveness in terms of strength, durability in the SCC with GGBS and alccofine to reduce the carbon emissions produced by the usage of cement. Finally to assess the real seismic performance of BFRSCC peripheral beam - column joint by experimentally and analytically for further usage in the structural elements.

The method of evaluation of the L/D ratio of bamboo fibers, percentage of addition of alccofine with GGBS in SCC, effectiveness of bamboo fibers in SCC, performance of BFRSCC with GGBS and alccofine and its durability. seismic behavior of BFRSCC with GGBS and alccofine are based on the strength characteristics. Age of 3 to 5 years bamboo trees were selected and the extraction is carried out by mechanical method. The SEM analysis is carried out to find out the diameter, microstructure of bamboo and to know the failure analysis of bamboo. The two different diameters of bamboo fibers are selected with the various lengths for the desired work.

Two different diameters 1.156mm and 700 µ were selected by keeping the l/d ratios 30,40,50,60 fixed, various length of the bamboo fibers were obtained. Using the various percentages of fibers 0.25, 0.5, 0.75,1 and 1.5% by volume of concrete the desired mix of M30 grade is achieved. The mechanical properties like compressive strength maximum of 35.44 N/mm² and 41 N/mm², split tensile strength of 3.9 N/mm² and 4.8 N/mm², flexural strength of 5.9 N/mm² and 7.25 N/mm² at 28 days for 700 µ for 1.156mm respectively with 1% addition of fiber and L/D ratio 40. By comparing the strength characteristics with those of control mix without fibers, and other percentage addition of fiber mixes, the L/D ratio is evaluated as 40 with 1% addition of fiber content.
Self compacting concrete is an emerging technique in the concrete industry where almost people are using for all the type of constructions hence it has taken for investigation, by considering the global warming issues the cement is replaced with the waste material GGBS and alccofine which increases the strength and also durability which also results in reduction of carbon emissions to 40% (since cement replaced with GGBS and alccofine by 40%). Hence the percentage of addition of alccofine is optimized with GGBS content based on strength characteristics. Alccofine of 5%, 10%, 15% and 20% with fixed 30% of GGBS in SCC mix proportion were considered. The maximum of compressive strength of 42.92 N/mm\(^2\), split tensile strength of 7.91 N/mm\(^2\) and flexural strength of 7.91 N/mm\(^2\) at 28 days were found for 10% of alccofine with 30% of GGBS. Hence 10% alccofine with 30 % GGBS is considered as optimized proportion.

SCC with 0.5, 0.75 1 and 1.25 % of the fiber addition of L/D ratio of 40 is added and ensured that the effect of fibers on the SCC results in increment of strength. It’s concluded that strength has moderately increased for 1% of fibers as same observed in the normal concrete.

Finally bamboo fiber reinforced self compacting concrete (BFRSCC) partially replacing cement with 30% GGBS and 10% alccofine with 1% of addition of fibers of L/D Ratio 40 is considered for evaluation of mechanical properties. As noted from the results the strength has increased for BFRSCC with GGBS and alccofine by 5% than NSCC with GGBS and alccofine. The modulus of elasticity of BFRSCC with GGBS and alccofine found as 33694 N/mm\(^2\).

Further the durability properties of BFRSCC is studied for 180 days which has given the satisfied results and concluded as a green material which can used in construction of structural elements. These material also tested for the behavior in the exterior beam column joint structural element to find out the real performance in the building.

Overall the investigations given the satisfy performance of the fibers at all the stages and concluded bamboo fibers as good material in concrete which can be used and available to the common man in the rural areas at low cost.

**Key Words**: Alccofine, Cement, bamboo, fiber, Concrete, Mechanical properties,
Durability, Sulphate Attack, SEM, beam column joint.