COCONUT FIBRE REINFORCED CONCRETE

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Abstract- Reinforcement of concrete is necessary to enhance its engineering properties. For this study, coconut fibres were used as they are freely available in large quantities. The study comprises of comparative statement of properties of coconut fibre reinforced concrete with conventional concrete based on experiments performed in the laboratory. The use of coconut fibres will also lead to better management of these waste fibres. The addition of coconut fibres improved the flexural strength of concrete by about 12%, they also formed good bonding in the concrete. The study found the optimum fibre content to be 3% (by weight of cement). Further work is required by changing the fibre content and aspect ratio to determine the optimum range of fibre content so that fibre reinforced concrete can be used where high flexural strength is required.

Keywords- Coconut Fibre in Concrete, Flexural Strength of Concrete.

I. INTRODUCTION

Concrete is the most widely used construction material all over the world. With innovations in science and technology in construction industry, the scope of concrete as a structural material, has widened. Since concrete is weak in tension and flexure, most commonly, it is reinforced using steel reinforcing bars. However usage of steel reinforcement is expensive. Considerable efforts have been made world-wide to add various types of fibers to concrete so to make it more strong, durable and economical. Natural fiber such as coconut fiber has certain physical and mechanical characteristics that can be utilized effectively in the development of reinforced concrete material. In most cases, these coconut fibers are dumped as agricultural waste, so can be easily available in large quantity hence making them cheap.

The primary goal of this project is to conduct experimental studies for enhancement of properties of concrete by reinforcing it with coconut fibers. To achieve this goal, the following objectives have been identified:

1. To determine the improvement in flexural strength of concrete after addition of coconut fibers.
2. To determine the improvement in tensile strength of concrete after addition of coconut fibers.
3. To know effect of addition of coconut fibers on compressive strength of concrete.
4. To provide an alternative light weight material.
5. To evaluate the performance of coconut fiber reinforced concrete in reducing cracking.

Use of coconut fiber can lead to improvement in properties of cement concrete in addition to providing a proper solution for disposal of this natural waste. This study will comprise of the comparative statement of properties of coconut fiber concrete with conventional concrete.

The following tests are performed on concrete blocks reinforced with coconut fiber:

1. Workability
2. Compressive strength
3. Split tensile strength
4. Flexural strength

II. LITERATURE REVIEW

A. International Status

According to the research conducted by Majid Ali, et. al, from New Zealand, the mechanical and dynamic properties of coconut fibre reinforced concrete (CFRC) members were well examined. A comparison between the static and dynamic moduli was conducted. The influence of 1%, 2%, 3% and 5% fibre contents by mass of cement and fibre lengths of 2.5, 5 and 7.5 cm is investigated. Noor Md. Sadiqul Hasan, et. al from Malaysia, have investigated the physical and mechanical characteristics of concrete after adding coconut fiber on a volume basis.

They conducted a micro structural analysis test using a scanning electron microscope for understanding the bonding behaviour of the coconut fibers. Mahyuddin Ramli, et. al, from Malaysia studied the strength and durability of coconut fiber reinforced concrete in aggressive environments. Their aim was to mitigate the development of cracks in marine structures by introducing coconut fibers which would provide a localized reinforcing effect. Yalley, et.al, from United Kingdom performed various tests to study the enhancement of concrete properties after addition of coconut fiber. Their study focused on the coconut fiber obtained from Ghana Africa.

They investigated the compressive strength, tensile strength, torsional strength, toughness and its ability to resist cracking and spalling.

B. National Status

Domke P. V. from Nagpur, Maharashtra has investigated the use of natural and agricultural waste products such as coconut fibers and rice husk ash to enhance the properties of concrete. The study also

emphasizes on the fact that coconut fibers and rice husk ash not only improve the properties of concrete, but it also leads to proper disposal of these waste materials and reduces their impact on the environment. Paramasivam, et. al. have investigated the flexural strength of coconut fiber reinforced corrugated slabs in the 1980s. Finally, it was concluded that the use of coconut fibre has great potential in the production of structural lightweight concrete especially in the construction of low-cost concrete structures.

III. METHODOLOGY

A concrete mix was designed to achieve the minimum grade of M20 (by taking 1:1.5:3 as nominal mix) as required by IS 456 – 2000. The investigation was done by taking 3%, 5%, and 7 % (by the weight of cement) of coconut fibre in the concrete mix. Coconut fibres were obtained from local market. Minimum of two test specimen were taken for each analysis. The following tests were conducted on the respective specimens

1. Splitting Tensile Strength on cylinder
2. Flexural Strength on beam
3. Compressive Strength on cube

IV. OBSERVATIONS & DISCUSSIONS

A. Cubes

It was presumed that the compressive strength of concrete goes on decreasing with an increase in the fibre content of the concrete mix.

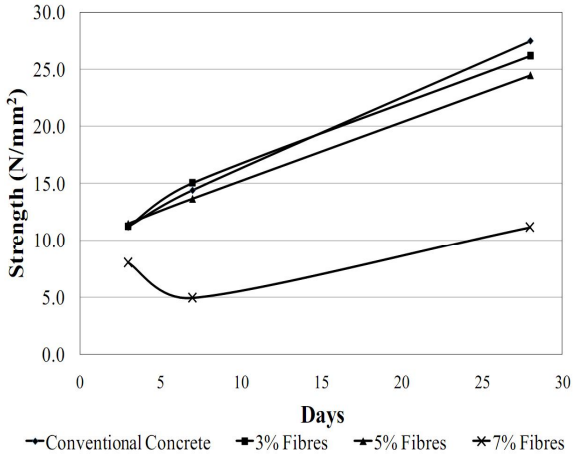

Fig. 1: Variation in compressive strength

This assumption was found to be correct based on the compressive strength test that was conducted on the cubes with varying fibre content (0%, 3%, 5% & 7%) as represented graphically above. From the graph that represents the variation in the compressive strength of concrete with as well as the fibre content of the mix, it could be seen that the 28th day compressive strength of concrete decreases with an increase in the fibre content.

B. Beams

The main purpose of including fibres in concrete is to increase the flexural strength of concrete which makes the concrete work more efficiently as a flexural member.

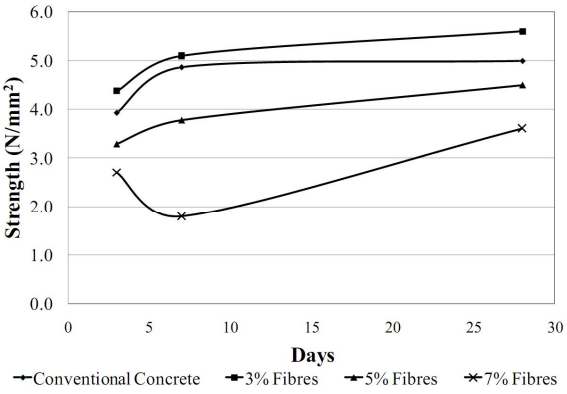

Fig. 2: Variation in flexural strength

From the graph that shows the variation of the flexural strength of concrete with the change in the fibre content, it was found that the 28th day flexural strength of concrete goes on increasing with an increase in the fibre content of the concrete mix. But, a considerable increase in the strength is observed only in the concrete mix with 3% fibres. After that the 28th day flexural strength of the concrete with the mix having 5% fibre content turns out to be less than that of the concrete mix with 0% fibre content.

C. Cylinder

According to previous studies conducted on fibre reinforced concrete, it was found that for 1% and 2% fibre content there was increase in tensile strength of concrete.

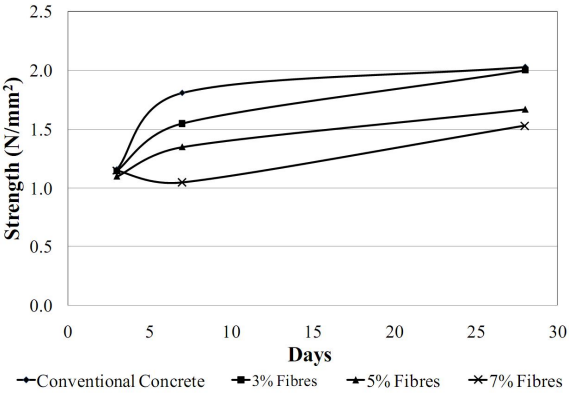

Fig. 3: Variation in tensile strength

Now, when the test was conducted on concrete with a mix containing 3%, 5% & 7% fibres and a graph was plotted representing the variation in the tensile strength of concrete with the change in fibre content, it was observed that the tensile strength of concrete goes on decreasing with an increase in the fibre content of the concrete mix. D. Unusual Behaviour

With 7% Fibre Content An unexpected variation in compressive strength of concrete with 7% fibre content was observed. One of the probable reasons for the abnormal variation could be improper mixing of concrete due to a high fibre content leading to a non homogeneous concrete mix. Another reason could be reduction in the water content due to absorption of water by fibres improper bonding & formation of air voids.

CONCLUSION

1) Coconut fibre being low in density reduces the overall weight of the fibre reinforced concrete thus it can be used as a structural light weight concrete.
2) By reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste.
3) Flexural strength increases in case of 3% fibre mix. Thus, economy can be achieved in construction.
4) Since, 5% & 7 % fibres do not show favourable results, it can be concluded that fibre content should not be used beyond 3%.

FUTURE SCOPE

1) The workability of the concrete with fibres was found to be very less. Hence, it can be improved to have a better slump value. Thus, certain admixtures such as air entraining agents and super plasticizers can be used so as to improve the flow characteristics of concrete.

2) Hand mixing becomes very tedious and leads to formation of a non homogeneous mix. Certain chemicals can be added so as to replace hand mixing by machine mixing.

3) Admixtures can also be used to reduce the number of voids which are formed to the present of fibres in the concrete. It may help improve the strength characteristics of concrete.

4) It was found that the results did not improve by addition of fibres beyond 5% of the weight of cement in the mix. Hence, the optimum increase in the strength of concrete by addition of fibres lies between addition of fibres between 0% and 3% of the weight of cement in the mix.

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