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Using Jute Fiber in Cement Concrete Pavement with IRC Mix Design and Ambuja Mix Design

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Abstract - *The aim of this study is to investigate the properties of cement concrete pavement by using jute fiber with IRC mix design and Ambuja manual mix design. As concrete is weak in tension and has brittle character. Use of natural fiber can improve this behaviour of concrete. Among all the natural fibers, the jute fiber is an ideal material to replace synthetic fibers to produce composite material due to its higher tensile strength and special microstructure. This project deals with the tests on concrete's compressive strength and split tensile strength with different portion of jute fiber like 0.5%, 1.0% and 1.5%. Also comparison of IRC mix design method and Ambuja manual mix design method is done according to strength wise and cost wise and content wise.*

1. INTRODUCTION

India is the largest jute producing country. India is account for nearly 60% of the world's jute production. The annual production of jute fibre in India alone is about 1968000 tonnes. Currently, the main industrial use of jute fibres in India is for making ropes, carpets, doormats, foam-backed carpets and other decorative items.

The traditional products consume only a small percentage of the total production of coconut husk. Hence apart from the conventional uses of jute fibre it can be used in cement concrete for its betterment. Concrete is a combination of binding materials, fine aggregate, coarse aggregate and water. Concrete is hard and strong like stone, this is caused by the chemical reaction which take place between water and cement. The only disadvantage of cement concrete is its brittleness, with relatively low tensile strength.

To overcome these discrepancies reinforcement with dispersed fibers might play an important role. The type of fibers currently been used include steel, glass, polymers, carbon and natural fibers. Natural fibers have the potential to be used as reinforcement to overcome the inherent deficiencies in cementitious materials

The advantages of natural fibers over the conventional reinforcing fibers like glass, synthetic (e.g., polypropylene, polyethylene and polyolefin, polyvinyl alcohol), carbon, steel etc., are:

[1] Abundant availability

[2] Low cost

[3] Less abrasiveness

[4] Ability to absorb mechanical impact

[5] Easy to handle and process

[6] Environment Friendliness

2. Basics of Concrete Mix Design

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required strength, durability, and workability as economically as possible, is termed as the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in 2 states, namely the plastic and the hardened states. The concrete mix design proportions are either by volume or by mass. The water-cement ratio is usually expressed in mass.

The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends on the many factors, e.g. quality and quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing. The cost of concrete is total of the cost of materials, plant and labour. The variations in the cost of materials arise from the fact that the cement is several times costly than the aggregate, thus the aim is to produce as lean a mix as possible.

The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of the structure. The extent of quality control is often an economic compromise, and depends on the size and type of jute fiber.

Different methods of mix design:

[1] IRC: 44-2008

[2] IS 10262:2009

[3] A.C.I method

[4] Road Note 4(U.K. Method) method

[5] Arbitrary method

[6] Maximum Density method

[7] Fineness Modulus method

[8] Surface Area method

[9] DOE(British) method

[10] Ambuja manual mix design method

3. CRITICAL LITERATURE REVIEW

The following are the previous research review based on application of value engineering in building construction project.

Mohammad Zakaria, Mashud Ahmed, Md Mozammel Hoque and Shafiqul Islam(2016) conducted an experimental investigation of the compressive, flexural, and tensile strengths of Jute Fiber Reinforced Concrete Composites (JFRCC) has been conducted. Cylinders, prisms, and cubes of standard dimensions have been made to introduce jute fiber varying the mix ratio of the ingredients in concrete, water-cement ratio, and length and volume of fiber to know the effect of parameters as mentioned. It was found that the addition of jute fiber contributes enriched results for mechanical properties of concrete composites for a particular length and content of fiber. More specifically, compressive, flexural, and tensile strength are found to enhance significantly for volume content of 0.1 and 0.25 % and the fiber cut length of 10 and 15 mm. However, with larger fiber length and content, the mechanical properties were found to affect adversely. Finally, it can be stated that the maximum increment is observed for tensile strength which is 35 % with reference to the plain concrete.

Priyanka Goel, Mohd. Usman, Sandeep Panchal (2017) studied the effect of jute fibre reinforcement on the strength and ductility properties of concrete. Flexural and compression characteristics of the fibre reinforced concrete were measured experimentally. The results of the compression test indicated that the presence of jute fibre tends to reduce the compressive strength of concrete at higher fibre content. Despite the minimal reduction in the compressive strength at higher jute fibre content, there is an improvement of ductility after cracking of concrete. Similarly, the bending test results indicated that the modulus of rupture of concrete increases by 50% at 0.50% jute fibre content. Jute fibre significantly improves the toughness behavior of concrete.

Tara Sen , Ashim Paul(2014) they carried out experimental investigation on the confinement strength and confinement modulus of concrete cylinders confined using different types of natural fibre composites and a comparative performance analysis with different artificial fibre based composite materials. The paper describes a suitable mechanical treatment method like high temperature conditioning, which aids us in further improving the properties of these woven natural materials like sisal and jute for composite fabrication and utilization. Heat treated natural fibres of woven sisal and jute were utilized for confining concrete cylinders similar to CFRP and GFRP confinement and their confinement characteristics were obtained and compared. Heat treated jute FRP composites displayed a tensile strength of 189 N/mm2 and flexural strength of 127 N/mm2. It was observed that the tensile strength as well as the flexural strength of woven natural fibre composites enhanced with high temperature conditioning due to better cross-linkage, better adhesion characteristics, and demoisturizatio.

Bei Liu, Lizhe Zhang, Qixia Liu and Tao Ji(2013) in this study, jute fibers were added into cement based materials to improve their compressive strength, flexural strength and early-age crack resistance. Results showed that the compressive and flexural strength of the fiber reinforced concrete were significantly enhanced with 30mm length jute fiber at the mixing amount of 0.5-0.6 kg·m-3. For early-age crack resistance test, the effective mixing amount would be 0.9 kg·m-3 and the fiber should be shorter than 20mm. The compressive strength was improved by at most 20.44% and the flexural strength was 53.47%.Compared with the pure mortar, the number as well as the maximum length and width of cracks in jute fiber reinforced mortar were reduced significantly. The optimum mixing amount was 0.9 kg/m^3.

Pooja Warke and Shrinkhala Dewangan(2016) conducted study to investigate the properties of concrete by using of jute fiber. Different percentage of jute fiber is used in concrete as 0.2%,0.3%,0.4% volume of concrete and analyze the property of concrete. The compressive test was carried out at concrete ages of 7 and 28 days. As the different proportion of the jute fiber is mixed with concrete and cast cube. Final strength of cube were casted for 7 days and 28 days curing. The addition of jute fibers increased compressive strength higher with the 0.2% fiber-cement ratio and little decreases compressive strength with 0.3% fiber-cement ratio and 0.4% fiber cement ratio of compressive strength little decreases as compared to 0.3% of fiber-cement ratio. As the percentage of jute fiber cement ratio increases, sudden failure, brittle failure and cracking is avoided. They found out by Ultra pulse velocity, higher percentage of jute fiber-cement ratio gives greater value of ultra-pulse velocity before and after compressive strength of concrete. Fiber –cement ratio of 0.2% gives highest compressive strength and 0.4% fiber cement ratio gives highest ultra-pulse velocity value (km/sec).

Bharti Sharma, Vijay Kumar Shukla, Amarnath Gupta (2016) In this experiment they used coconut jute are used as fiber in M20 grade of concrete specially check their effect on flexural strength of concrete. In this experiment percentage of coconut jute fiber used as 0. 5%, 1%, 1.5%, 2%, of the total weight of concrete. The testing of concrete

making materials was carried out by using various IS - codes. The compressive strength and flexural strength of concrete mix are found after 28 days of curing period. As compare to conventional concrete, the flexural strength of concrete increases by 40.058% and 26.32% with inclusion of 0.5% and 1% of Coconut jute fiber respectively. The compressive strength of concrete also increases with the inclusion of Coconut jute fiber in concrete. As the percentage of Coconut jute fiber increased in concrete the density of concrete is decreased which make light weight concrete and reduce the dead weight of structure also.

T. Sai Vijaya Krishna, B. Manoj Yadav(2016) they made a total of 24 mortar specimens for compressive strengths and 144 concrete specimens i.e. 48 cubes, 48 prisms and 48 cylinders each consisting of ordinary concrete, 0.5%, 1% and 2% Jute fiber reinforced concrete are tested for their compressive, flexural and split tensile strengths respectively for different curing periods such as 7, 28, 56 and 90 days. For extension in period of curing i.e. 56 and 90 days the compressive strength increases up to 1% and then decreases with further increase jute loading. Flexural strength and split tensile strength of concrete increases up to 1% of jute loading and decreases with further increment. The maximum value of mechanical strength properties of JFRC i.e. 1% JFRC with curing period of 56 days are compared with 90 days of ordinary concrete are as follows:

Mechanical Properties	Increase in strength
Compressive strength	4.93%
Flexural strength	9.43%
Split tensile strength	6.23%

Mr.S.Sabarinathan, D.Devaraj, M.Jeyamani, D.Priyadharshini(2017) they added jute fiber as the percentage of 0.5%, 1%, 1.5%, and 2%. Project deals with the test on concrete strength. Strength test like compressive strength, split tensile strength. The compressive strength and split tensile strength of jute fiber reinforced concrete test results shown that the strength of jute fiber reinforced concrete is increased gradually when we increase the percentage of fiber. It has been clearly noted that adding fiber gives good strength with ratio 0.45.

Xiangming Zhou, Seyed Hamidreza Ghaffar, Wei Dong, Olayinka Oladiran, Mizi Fan(2013) This paper conducted research on fracture and impact properties of short discrete jute fibre reinforced cementitious composites (JFRCC) with various matrix for developing low-cost natural fibre reinforced concretes and mortars for construction. Fracture properties of JFRCC were tested on notched concrete beams at 7, 14 and 28 days and the results were interpreted by the two-parameter fracture model (TPFM). Impact resistance of JFRCC were examined on mortar panels with the dimensions of 200× 200×20 mm 3 at 7, 14 and 28 days through repeated dropping weight test. JFRCC with GGBS/PC matrix achieved higher compressive strength, splitting tensile strength, and flexural strength than that with PFA/PC matrix. JFRCC mortar panels with PFA/PC matrix possessed higher impact resistance than those with GGBS/PC matrix.

4. SUMMARY

Now a days concrete pavements are being constructed more and more. The only deficiency in the concrete is its tensile strength. It can be improved by using jute fiber which is the most commonly available fiber and being wasted in large quantity. As for rigid pavement the flexural strength is important and this also can be enhanced by using jute fiber. Only 0.5% of jute fiber w.r.t. cement content can give optimum results. The comparison between two mix designs IRC mix design and Ambuja mix design can help to choose the most economical mix.

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REFRENCES

[1] Mohammad Zakaria, Mashud Ahmed, Md Mozammel Hoque and Shafiqul Islam(2016) “Scope of using jute fiber for the reinforcement of concrete material” Zakaria et al. Textiles and Clothing Sustainability (2016) 2: 11.

[2] Priyanka Goel, Mohd. Usman, Sandeep Panchal (2017) “Experimental study of jute fiber reinforced concrete” ICETETSM-2017 pg 593-598.

[3] Tara Sen , Ashim Paul(2015) “Confining concrete with sisal and jute FRP as alternatives for CFRP and GFRP” International Journal of Sustainable Built Environment (2015) 4,248-264 ELSEVEIR.

[4] Bei Liu, Lizhe Zhang, Qixia Liu and Tao Ji(2013) “Study on behaviors of jute fiber reinforced cement based materials” Applied mechanics and materials vols. 253-255 (2013) pg 508-511

[5] Pooja Warke and Shrinkhala Dewangan(2016) “Evaluating the Performance of Jute Fiber in Concrete” IJTRD, Volume 3(3), ISSN: 2394-9333

[6] Bharti Sharma, Vijay Kumar Shukla, Amarnath Gupta (2016) “Fiber Reinforced Concrete – Use of Coconut Jute as a Fiber” IJESC Volume 6 Issue No.7

[7] T. Sai Vijaya Krishna, B. Manoj Yadav "A COMPARATIVE STUDY OF JUTE FIBER REINFORCED CONCRETE WITH PLAIN CEMENT CONCRETE" IJRET-2016

[8] Mr.S.Sabarinathan, D.Devaraj, M.Jeyamani, D.Priyadharshini(2017) "A Study on Mechanical Properties of jute Fiber Reinforced Concrete" ICET-2017

[9] Xiangming Zhou, Seyed Hamidreza Ghaffar, Wei Dong, Olayinka Oladiran, Mizi Fan "Fracture and impact properties of short discrete jute fibre-reinforced cementitious composites" Materials and Design 49 (2013) 35-47