Utilization of Jute Fiber in Plain Concrete and Concrete Reinforcement

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Abstract— The natural jute fiber can be the effective material to reinforce concrete strength which will not only explore a way to improve the properties of concrete; it will also explore the use of jute and restrict the utilization of polymer which is environmentally detrimental. In Gorakhpur uttar pradesh, jute is locally available and, hence, less expensive. To achieve this goal, 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. Flexural, compressive, and tensile strength tests have been conducted on the prepared samples by appropriate testing apparatus according to standard specifications. The results of JFRCC were also compared to the plain concrete. The large cut length and higher content of reinforcing materials (jute fiber) result to the unfortunate tendency of balling formation and high porosity of composites followed by the degrading of mechanical properties of JFRCC in reference to plain concrete. But in the incorporation of short and low fiber content, an intact structure develops which enhances the mechanical properties of the same composite. It was also noted that all the remarkable increment values were found mostly in the presence of higher cement content. So it can be concluded that the presence of jute fiber with more cement content strengthens the concrete in greater extent.

Key words: Jute Fiber Reinforced Concrete Composites (JFRCC)

I. INTRODUCTION

The sustainable development with higher strength is the growing demand of construction industry. Concrete reinforcement by natural fibers are more promising to insure the concrete strength improvement with non-hazardous impact on environment as well as the effective use of available natural assets. Among two different types of fibers, i.e., natural fibers and artificial polymer-based fibers, natural fibers are promising to use as reinforcement to overcome the inherent deficiencies in FRCC reinforced with polymer-based fiber (Ramakrishna and Sundararajan 2005). The main deficiencies associated with the use of artificial fibers are relatively high cost and health and environmental hazards.

On the contrary, natural fibers which are biodegradable, inexpensive, environmental friendly, and easily available are produced from naturally available resources, for instance, coconut tree, banana tree, cotton, and jute. Researchers have conducted numerous studies on the effect of natural fibers on the mechanical and physical behavior of concrete to investigate the extent of improvement. In recent years, unrelenting efforts have been observed for using natural fibers in FRCC for improving the energy efficiency, economy, and eco-friendliness flavor (Ramakrishna and Sundararajan 2005). Hence, the demands to utilize natural fibers for making good-quality and low-cost sustainable FRCC for housing and other necessities are increasing. Additionally, the other potential application of natural fiber-reinforced cement composites are limited to those area where energy are to be absorbed or the areas prone to impact damage. Accordingly, natural fiber-reinforced cement composites are most suitable for shatter- and earthquake-resistant construction, foundation floor for machinery in factories, fabrication of lightweight cement-based roofing and ceiling boards, wall plaster, and construction materials for low-cost housing Variety of factors influences mechanical properties of FRCC reinforced with natural fiber. The factors are characteristics of fibers, nature of the cement-based matrix, and the way of mixing, casting, and curing the composite Among these parameters, the type of fiber and their characteristics have a significant influence on the mechanical properties of these composites). Jute fibers, which come from annual plants, are available in Gorakhpur in India. It is a prospective material for cement-based matrix.

To this end, it is very much rationale to determine the effect for exploring potential use of jute for obtaining enhanced concrete with low cost, without affecting the environment and minimum health hazard. With this background, the main objective of the study is to develop jute fiber to reinforce concrete composites and to investigate the effect of fiber length and content (volume fraction) on its mechanical behavior.

II. CONCLUSIONS

Concrete with jute fiber is an aspiring step towards the sustainable development in Bangladesh where the jute are abundantly cultivated. In the experimental investigations conducted in the study, 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. So JFRCC can be developed with locally fabricated jute in Bangladesh. The least cost of jute, its being renewable resources, the reduced weight of the JFRCC, and the environmental compatibility would clearly show the socioeconomic viability of JFRCC. Based on the insights gained from the test results and analyses of the JFRCC, the incorporation of jute fiber in making FRC composite would be one of the promising strategies to improve the performance of concrete.

III. RESULTS

The mechanical behavior of fiber-cement composite, which basically accounts for the bond between fiber and surrounding concrete, largely depends on many factors like the physical characteristics of the fibers such as geometry, type and surface characteristics, fiber orientation, fiber volume ratio and fiber distribution, the chemical composition of the fiber, and so on.

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