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ABSTRACT

Composite materials have different effective material properties with different combinations of material components. Recently, composites are growing in mechanical, automotive and other usages owing to many of their benefits. Natural are receiving considerable attention as a substitute for many conventional materials, such as plastics, in industrial applications. Especially in countries like India, the rich supply of bamboo makes it a sustainable source of natural fiber to be used for composite manufacturing. Conventional material alone is not enough to meet the diverse requirements of design engineers. The fiber-matrix-filler interfacial adhesion of composites with fiber and filler reinforcement greatly enhances their mechanical performance. Composite structures' stiffness is frequently decreased by dynamic loads in various environments. To enhance the mechanical characteristics of such structures, nano particles such as carbon nanotubes and grapheme have been incorporated into composites. The composite material can be fabricated by stir casting technique, compression molding, hand lay-up process etc. Mechanical, metallurgical and thermal properties of the fabricated materials can be done. The recent literature revealed the different combinations and different process in the fabrication of composites. The addition of bamboo fiber reinforced polymer composite with natural coconut shell carbon nano filler as additive proves to be very novel and has a possibility to explore in many upcoming mechanical and automotive applications.

Key words: Natural fiber, filler, bamboo fiber, properties, coconut shell

1 Introduction

There is an urgent need for the repair and reinforcement of degraded and damaged structures. Structures can deteriorate for a variety of causes, including environmental impacts, insufficient design and construction, or the need for structural upgrades to meet new seismic design criteria. The new design requirements, deterioration owing to corrosion in steel caused by exposure to an aggressive environment, and accident occurrences such as earthquakes, excessive deflections, and poor concrete quality, etc., or even to remedy execution errors committed during construction, etc. Various strengthening strategies have been developed to meet these requirements for strengthening. The development of fiber reinforced polymer (FRP) materials in various forms such as non-woven, loose fibers, woven, braided fibers, textile or fabric,



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strongly braided along with a backing material such as latex backing or natural rubber backing, etc. and configurations provides an alternative design approach for the strengthening of new and existing structures. FRPs provide designers with an excellent combination of properties not found in other materials and present a potential solution to the civil infrastructure crisis, making them suitable materials for structural retrofitting. FRP composite materials also offer an appealing alternative to any other retrofitting technique in the field of concrete element repair and strengthening. FRP has numerous advantages, including a high strength-to-weight ratio and a high specific strength.

2 Materials

The bamboo fabric was gathered from the Calcutta, West Bengal, India bamboo development. Both of the FRP fibers used in this project, carbon fiber CF 230, 200gsm, and glass fiber EU 900, were purchased from the Asian Polymer Association in Mumbai, India. Additionally, every additional chemical utilized in the production of the synthetic carbon and glass textile composite as well as the natural bamboo fiber textile composite such as Saturate, which is made up of Part A resin and Part B hardener was purchased from the Asian Polymer Association in Mumbai, India. Additionally, employing artificial carbon and glass textile composites as well as bamboo fiber textile, strengthening of the RC beams with textile wrapping was carried out. For each of the three different types of textile composite samples made of bamboo, carbon, and glass, two mechanical tests were conducted. Tensile strength testing and flexural strength testing are the two tests. By applying a uni-axial load through both ends of the specimen and utilizing the appropriate jaws as an attachment to the UTM (universal testing machine), the tensile test was conducted. The HEICO Digital Universal Testing Machine was used for the tensile test, and the digital data gathering system was used to generate digital results. The specimens' dimensions met ISO requirements. Given that bamboo is a Type-2 material, the tensile strength test for bamboo textile composite was performed in accordance with ISO 527-4:1997(E).

Mechanical property	Bamboo composite	Carbon composite	Glass composite
Tensile strength MPa	177	922	680
Flexural strength MPa	210	1599	669

Given that both carbon and glass are Type-A materials, the tensile strength test for the carbon and glass textile composite was performed in accordance with ISO 527-5:1997(E). Each result was averaged out over five different samples. In the textile composite samples, different types of fractures were seen. For example, bamboo textile FRP showed a diagonal fracture as well



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as a straight fracture perpendicular to the textile direction, whereas carbon and glass FRP showed an uneven tearing fracture. According to ISO 527-4:1997(E) and ISO 527-5:1997(E), respectively, all of these fracture forms are recognized tensile fracture modes. The flexural strength of the textile composites was evaluated following the tensile strength testing

3 Preparation of compositions

All textile samples used for tensile testing of bamboo composites were cut in sizes according to ISO 527-4:1997(E), Part-4, which lays down the guidelines for determining the tensile properties of isotropic and orthotropic fibre-reinforced plastic composites and carbon and glass were cut in sizes according to ISO 527-5:1997(E), Part-5, which lays down the guidelines for the determi The textile samples used for flexural testing of bamboo, carbon, and glass composites were cut to size according to ISO 14125:1998, which specifies the parameters for the assessment of flexural strength. The textile samples used for flexural testing of or bamboo carbon, and glass composites were cut to size according to ISO 14125:1998, which specifies the standards for determining the flexural properties of fiber-reinforced plastic composites. The textile composite sheets were cast using a plastic bit mould of appropriate size. The samples were prepared using the standard hand lay-up process. To avoid air entrapment, a calculated amount of epoxy resin and hardener was completely combined with moderate stirring. A mould release agent was also utilized to facilitate the quick and simple removal of composite sheets. Under the plastic bit mold, electrical insulating paper was placed, and silicone grease or polyvinyl alcohol was applied to the inner surface of the mold as a mold-releasing agent. The mold was kept on the insulating sheet, and then a thin (2 mm thick) coating of an epoxy and hardener combination was placed on top. Then, the cloth mats were dispersed in distinct portions over the mixture in various molds. After that, the remaining mixture was added to the mold and placed on top of the cloth mats. It was carefully avoided that air bubbles would form. Next, pressure was put on top of the composite while also applying pressure from the top into the mold.FRP (fibre reinforced polymer)

A sturdy, lightweight composite material consisting of natural fibers is called natural fiber reinforced polymer (NFRP). As bamboo fiber textile reinforced polymer, the bamboo fiber in woven textile form, also known as bamboo fiber textile, was employed to reinforce the polymer. As a glass fiber reinforced polymer, the E-glass, glass fiber EU 900 in the form of fabric or textile was utilized. One of the most used reinforcement materials for FRP and civil structures is e glass.

Mechanical property	Carbon fibre	Glass fiber
Young's modulus	240	73
Tensile strength	4900	3400



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Weight	200	350
Density	1.7	2.6
Thickness	0.117	0.067
Ultimate strain	1.55	4.5
Colour	Black	white

Carbon fiber reinforced polymer was made using carbon fibers, namely carbon fiber 230 and 200gsm in the form of fabric or textile. Epoxy resin known as Saturant was employed in this project. Epoxy resin known as "saturant" is used in conjunction with FRP sheets. The saturant resin creates a high performance composite system using the selected FRP fiber for applications such as structural upgrading, repair, or blast mitigation. The hardener and saturant Part A resin are combined to create a composite system that also includes the fibers. The manufacturers supplied saturant, glass fiber, and carbon fiber characteristics are outlined.

4 Experiment & Analysis

This study's primary objective was to examine the flexural strength of a novel, environmentally friendly material that was employed as reinforcement when making a FRP composite. Natural bamboo cloth reinforcement was employed to fabricate the FRP composite while keeping sustainability in mind. Because the research strongly supports the use of naturally occurring sustainable reinforced textile composite for the flexural strengthening of RC beams in practice, it was crucial to assess the performance of natural bamboo textile reinforced FRP composite while keeping practical considerations in mind. The idea behind employing FRP composites to flexural and shear strengthen RC beams is relatively simple and is quite comparable to the steel reinforcement used in standard RC construction. Passive confinement is provided by high strength, low weight fiber wraps, which improves the strength and ductility of the beam overall, including the tension zone, which is the most crucial zone. Due to the concrete's confinement, wrapping also improves the behavior when subjected to flexure. The term "containment" refers to the enclosing of concrete, which has a positive impact on the strength and ductility of the concrete. Given that beams and slabs are always cast simultaneously for the monolithic effect in real field applications, the top surface of the beam will always be below the slab region. As a result, the sheets cannot be wrapped completely around the four sides of the beam. cycling, UV exposure, etc., the beam strength would then get significantly reduced, leading to the eventual. Strip wrapping showed a lower load carrying ability than full wrapping as the FRP's width increased. In comparison to controlled beams, the load deflection behavior was better for beams strengthened with FRP. This ductile behavior acquired by using FRP provided us with sufficient

Conclusions

Through various experimental works of mechanical characterization of the FRP and strengthening effects provided by bonding of bamboo textile FRP to beams over bonding of



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carbon textile FRP and glass textile FRP, the applicability of bamboo textile FRP as a strengthening material was investigated in the study herein. Tensile strength for the bamboo textile FRP was 189.479 N/mm², which is 21% less than carbon FRP's (923.056 N/mm²) and 28% less than glass (E-glass) FRP's (678.571 N/mm²) tensile strengths. The flexural strength of the bamboo textile FRP was 208.705 N/mm², which is 13% less than that of carbon FRP (1587.134 N/mm²) and 32% less than that of glass (E-glass) FRP (666.871 N/mm²). As soon as bamboo fiber textile matting With fully wrapped bamboo textile FRP, JF1, JF2, the strengthening effect was very noticeable with one layer of bamboo FRP alone, providing an increase in the load carrying capacity by 62.5%, as well as promoted ductile failure without any concrete crushing, FRP rupture, or deboning, even at extremely high loads. These specimens also had higher deformability index as compared to all other specimens, so it can be concluded that bamboo textile FRP strengthened the material. Therefore, a stronger improvement could be achieved with a greater number of layers. The load carrying capability of the specimens enhanced with one layer of totally wrapped carbon FRP, CF1, CF2, and glass FRP, GF1, GF2, was increased.

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