ABSTRACT

STUDIES ON MECHANICAL PROPERTIES OF LAMINATED BAMBOO COMPOSITES

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(Awarded, 2013)

With the continued rapid development of the global economy and constant increases in population, the overall demand for timber based products will likely continue to increase in the future. The available supply of quality timber in the world is reducing rapidly. In India as in other parts of the world, many tropical and wood based products. In several European markets as well as in other parts of the world, many tropical wood based products have been either banned or discouraged. End users of wood based products have realized the serious danger to the environment if certain natural forest stands are depleted. Since the demand for these products will continue, an alternative or substitute for timber is desirable.

A suitable substitute for timber should posses properties comparable to and be compatible with existing processing technology. A fast growing and abundant species would be preferable. Bamboo is such a material which has excellent growth rate, with some species growing at the rate of 15 to 18 cm daily and maximum height achieved in just four to six months. Over 1200 bamboo species have been identified globally of which some bamboo species grow to over 30m high and have diameter of 40 to 60 cm.

Natural fiber based composites are mixtures of natural fibers such as bamboo, sisal, coir, jute (in fiber, mat or slat form) with polymeric materials, processed under controlled temperature and pressure to obtain a class of products having superior properties than the individual components. These components have high strengths to weight ratio, durability, and dimensional stability, amenability to be engineered to any complex shape or size and above all lower the cost of production. Among the various biomass sources, bamboo is one of the most rapidly generating resources. Bamboo has been processed into composites as a wood substitute and replaced timber in many applications such as door & windows and their frames, partitions, wardrobes, cabinets, flooring, furniture etc.

Over the last two decades bamboo-resin composites have been increasingly explores as a material in the construction industry because the tensile, compressive and bending strength of the composites is superior to that of both the natural material as well as resin component in the composite. Use of resin prevents cracking and deformation under relative humidity.

Also, bamboo-resin composites show higher resistance to insect pest bio- erosion. Detailed research studies on mechanical properties of bamboo polymer laminates are few. Therefore, there is need to characterize bamboo based laminates for mechanical properties including tensile strength, compressive strength and flexural strength, so that full potential of bamboo as an engineering material could be realized. One of the objectives of this research is to explore the mechanical properties of bamboo polymer laminates to be used as an environment friendly material in construction sector.

The objectives of this research are:

- Study of mechanical properties of bamboo laminae from different regions of culm of dendrocalamus strictus.
- Study of compression, tension and flexural properties of laminated Bamboo Composites incorporating dendrocalamus strictus and epoxy with different lamina angles.
- Validation of mechanical properties of Laminated Bamboo Composites using rule of mixtures and with other similar materials.

The above research objectives have been investigated through an array of tensile, flexural and compressive testing in addition to failure and validation through rule of mixture and constituting equation. The summary of research could be listed as follows:

The result of experimental evaluation of mechanical properties of bamboo laminae, prepared from bamboo slivers of 4 years old bamboo culms of Dendrocalamus strictus species show that mechanical properties such as tensile, compressive and flexural strength and their modulus of bamboo increases from inner to outer regions and with height of bamboo culms. The strength of the culms increases with height to compensate for the deterioration of rigidity due to culms geometry. Bi-linear stress strain response was observed in lamina under tensile loading. First change of slope took place at about 45% of ultimate stress. Non linear stress strain response was observed in laminae under both compressive and flesural loading for which bifurcation points are difficult to identify. Mechanical properties of laminas selected from outer regions were found to be superior to other regions due to availability of higher volume fraction of bamboo fibers