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Investigationon Characteristic Mechanic Laminated Composite Bamboo

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ABSTRACT: The Laminate Parquet or what is usually called parakeet flooring, parquet, laminated flooring is made from wood dust, or pieces of quality wood which are then ground into powder. The requirements for laminate flooring are that it is strong and durable, corrosion resistant, has high aesthetic value and can save time because the coating technique is quite easy and fast. In this study, we investigate the flexure strength of bamboo laminate composites. Three types of bamboo are used, namely, apus bamboo (Gigantochloa apus/GA), wulung bamboo (Gigantochloaatroviolacea/GV) and tutul bamboo (Bambusamaculat/BM). Lamina consists of 3 layers. The parts of bamboo used as lamina are the base, middle and tip. The adhesive used polyurethane (PUR) adhesives. From the test results of GA bamboo, the middlesection has the highest flexure strength.

KEYWORDS: Laminated flooring,Gigantochloa apus,Gigantochloaatroviolacea, Bambusamaculat, Flexure strength.

I. INTRODUCTION

Laminate parquet or what is usually called parakeet flooring, parquet, laminated flooring is made from sawdust, or pieces of quality wood which are then ground into powder. The requirements for laminate flooring are that it is strong and durable, corrosion resistant, has high aesthetic value and can save time because the coating technique is quite easy and fast.

The rise of environmentally friendly buildings (green buildings) is something that cannot be avoided in sustainable development that is environmentally friendly and low carbon. Asrenewable material carbon binder, bamboo laminate composite, withseveral characteristics, such as being easily decomposed, renewable, light in mass, and highly earthquake resistant, make it an ideal green color construction materials[1]. Especially for floors, which are commonly known as laminated flooring. Although bamboo is a promising plant as an environmentally friendly construction material, its application is limited by the diameter of the bamboo stem and its low stiffness [2][3].

Bamboo laminated composite, as a relatively new type of bamboo composite material made with bamboo strips, can be effectiveovercome the problem of raw bamboo membersfailed to meet structural infrastructure requirementsfor the cross-sectional dimensions of the member. Besides that,the strength and stiffness of bamboo laminate composites are higher than thatfrom bamboo; therefore, it is an attractive alternative to traditional building materials and is very suitable for use as columns, floors, and beams [1]. Due to their favorable mechanical properties and environmentally beneficial characteristics, bamboo laminated composites have attracted much research[4].

The bamboo used as a bamboo laminate composite specimen consists of three bamboo species, namely: apus bamboo (Gigantochloa apus/GA), wulung bamboo (Gigantochloaatroviolacea/GV) and tutul bamboo (Bambusamaculat/BM). The bamboo is supplied from people's plantations in Bentek Village, Gangga District, North Lombok Regency, West Nusa Tenggara Province, Indonesia. Bamboo has an average lifespan of three years. There are 176 species of bamboo in Indonesia out of a total of 1620 types of bamboo in the world originating from 80 countries. This means that 10% of the world's bamboo species are in Indonesia. In fact, around 105 types of bamboo in Indonesia are endemic plantswhen the tempering time exceeded 4 hours. The dimension of the carbides increased, while the volume fraction decrease .

However, the research reported to date on the linear characteristics of bamboo laminated composites is insufficient. As a contribution to this process, this paper investigates the mechanical

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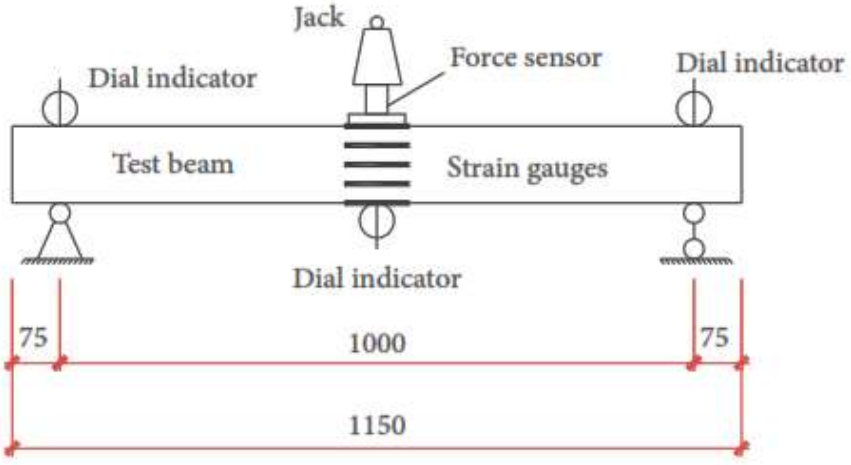
properties of bamboo bending under single point pressure. And taking into consideration the nonlinear deformation of the material under pressure, one point, provides a reference for laminated flooring applications.

II. MATERIAL AND METHODS

The bamboo used as a bamboo laminate composite specimen consists of three bamboo species, namely:apus bamboo (Gigantochloa apus/GA), wulung bamboo (Gigantochloaatroviolacea/GV) and tutul bamboo (Bambusamaculat/BM).The bamboo is supplied from people's plantations in Bentek Village, Gangga District, North Lombok Regency, West Nusa Tenggara Province, Indonesia. Bamboo has an average lifespan of three years.

Bamboo laminated composites are made through production procedures such as sorting bamboo segments (base, middle, tip), cutting, slicing bamboo for laminate layers, gluing, assembling,and hot pressing. Working environmental conditions with a measured humidity ratio of 6.2% content density of 636 kg/m^3. Based on initial experimental investigations, it shows that the compressive yield strength and ultimate strength parallel to the bamboo fiber/incision are 53 MPa and 84.9 MPa, respectively.Based on tensile tests, the tensile strength for laminated bamboo is 108.6 MPa, with an elastic modulus of 9085.6 MPa, and a Poisson's ratio of 0.32.

The specimen design for the flexibility testing method for bamboo laminate composites in this paper is in accordance with the ASTMD198-02 standard test method for wooden beams[5], citing the limitations of the flexibility testing method for bamboo laminate composites. Standardresearch concerns several factors such as height, widthratio, span to height ratio, and loading method. One-point loading method, test specimen height 120 mm, withlength 1150 mm and effective span 1000 mm.



III. RESULTS AND DISCUSSIONS

The flexure testing was carried out at room temperature 32°C. By using the one point loading method. The type of bamboo species used and the position of the bamboo segments used as a flexibility test are three variations. The bamboo spcises used are:bamboo species, namely:apus bamboo (Gigantochloa apus/GA), wulung bamboo (Gigantochloaatroviolacea/GV) and tutul bamboo (Bambusamaculat/BM), then the variations in the position of the bamboo segments used are: the base, middle, and edge position of bamboo in the same type of bamboo species.

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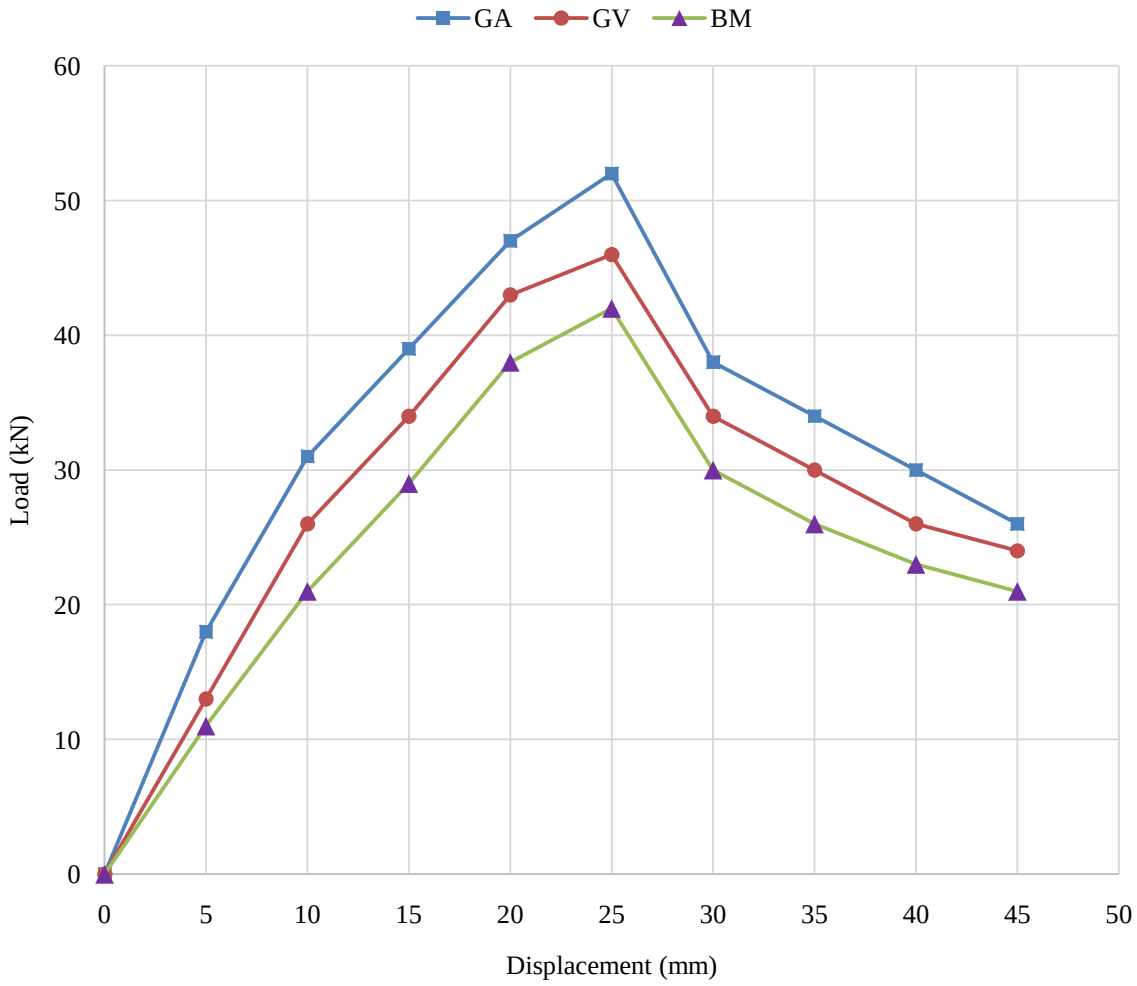
THE FLEXURE STRENGTH OF LAMINATES COMPOSITE BAMBOO

The results of flexure testing are load data and the amount of deflection (displacement).The type of bamboo species influences the flexural strength of bamboo laminate composites. This difference is caused by the different physical properties possessed by each different bamboo species.The highest flexural strength of bamboo laminate composite is 52 kN, with 25 mm. This condition is obtained when using GA species bamboo. On the other hand, the lowest flexural strength of bamboo laminate composite is 42 kN, with a displacement of 25 mm. This condition is obtained when using BM species bamboo. This phenomenon According to Weibull [6] is due to periodic brittle fracture, whichproven to influence the flexural strength of bamboo laminate composites. Apart from that, according to the results of study[7]. It was found that the influence of bamboo layer thickness on flexural strength and also the influence of length was more significantrather than the width of the bamboo layers used as the composite laminate. The work of [8]tries to apply periodicBrittle fracture was proposed by Weibull to explore the effect of component size on flexure strength.The results of the study [9]show that the side-pressure laminated bamboo beams have experienced an elastic deformation stage, an elastic-plastic deformation stage, and a failure stage; the mid-span deflection in a beam with a large span-to-height ratio is too large applied to the ultimate load, and this specimen is considered to be at the ultimate limit state; stiffness or deflection should beconsidered as a control index in the application of the side pressure laminated bamboo beam technique.



The position of the bamboo segments also influences the flexural strength of the bamboo

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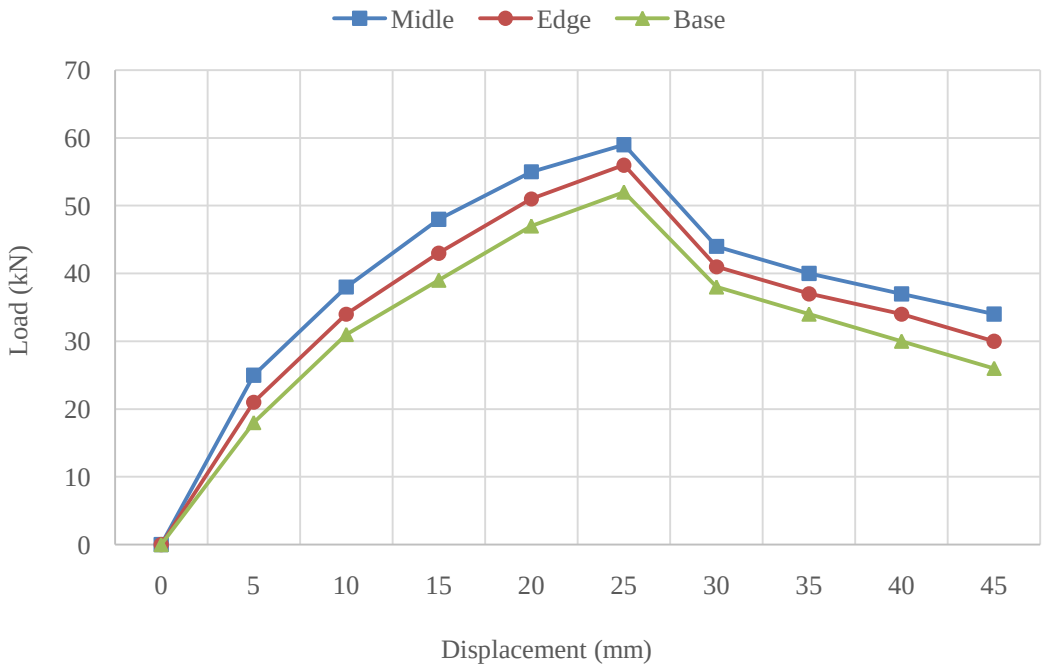
laminate composite. The highest bending strength is 56 kN, with a deflection of 25 mm, at the position of the middle bamboo segment. The lowest bending strength is 52 kN, with a deflection of 25 mm, at the bamboo base segment position.The flexible properties of split/spliced bamboo stems are higher than wood. Differences in bamboo deformation allow large bending deformations to occur because the outer layer resists tensile stress while the softer inner layer experiences large compressive deformation.



The wood shows severe and localized buckling, the interior of the bamboo specimen shows no visible buckling. In the latter case, the foam-like parenchyma cells absorb large compressive deformations through their microscopic buckling and simultaneously, the alignment of the sclerenchyma fibers is maintained by the surrounding parenchyma matrix. The bending elasticity of bamboo was compared with that of wood with respect to the remaining strain during cyclic bending tests. No clear differences were seen between the remaining strains. This fact shows that bamboo is not very flexible elastically, although the fiber-foam combination and intelligent fiber distribution increase the bending ductility.The results show that the combination of fiber-rich outer part and compressible inner part is responsible for the flexural ductility of split bamboo [Eichi 2007].To clarify the compressible nature of the bamboo interior, the longitudinal surfaces of bamboo specimens were observed microscopically before and after greater longitudinal compression.

IV. CONCLUSION

Differences in the use of bamboo species affect the flexural strength of bamboo laminate composites. The highest flexural strength of bamboo laminate composite is 52 kN, with 25 mm. This condition is obtained when using GA species bamboo. On the other hand, the lowest flexural strength of bamboo laminate composite is 42 kN, with a displacement of 25 mm. This condition is obtained when using BM species bamboo. The position of the bamboo segments also influences the flexural strength of the bamboo laminated composite. The position of the bamboo segments also influences the flexural strength of the bamboo laminate composite. The highest bending strength is 56 kN, with a deflection of 25 mm, at the position of the middle bamboo segment. The lowest bending strength is 52 kN, with a deflection of 25 mm, at the bamboo base segment position.

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