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Mechanical Test of Gigantochloa Apus by Drying

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***Abstract*— Bamboo forms an important component in the traditional material building of Indonesia Rural. Bamboo known live any place at Indonesia, is a renewable material with extensive application prospects. It has been expected to be a sustainable alternative for more traditional construction materials, such as steel, light weight steel, alminum and timber. As known tensile strength of Mild Steel between 45 and 50 N/mm^2, lightweight steel between 25 and 30 N/mm^2, timber between 14 and 16 N/mm^2, bamboo between 16 and 18 N/mm^2. Tensile strength is defined as a stress, which is measured as force per unit area, for some non-homogeneous materials (or for assembled components) it can be reported just as a force or as a force per unit width. In the International System of Units (SI). This paper presents the mechanical test properties of Gigantochloa apus in the top, middle, and top part. Recording average mechanical test of Gigantochloa apus in the top part 15.5 N/mm; Middle part 17.8 N/mm^2; Rear part 16.4 N/mm^2. The Conclusion average of mechanical properties of Gigantochloa apus above 17-18 N/mm^2 (hard timber about 15-16 N/mm^2), Gigantochloa apus is very cheap, easy getting anywhere.**

Keywords*— *Tengsile Strength Test, Gigantochloa apus

I. INTRODUCTION

Wood supply for industry has dropped dramatically from 35 million m³ per year to 7 m³ [1]. The use of bamboo as a plywood material has been introduced by Guisheng (1985), Bamboo Information Centre (1994), Subiyanto and Subyakto (1996). Bamboo layers have high strength against abrasion and bending moments. The resistance of bamboo floors to abrasion has been studied by Mohmod and his friends (1990). Bamboo is a renewable (renewable) building material, fast harvesting, abundant potential and not yet maximally used, see Fig 1.

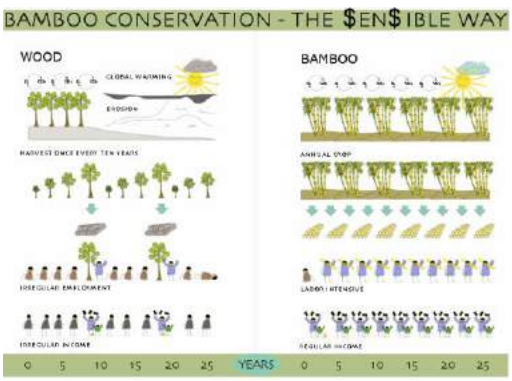

Fig 1. Comparison of the age of harvesting bamboo and wood

Fig 2. Popular bamboo in Indonesia

The advantages of traditional bamboo construction have actually been proven in the construction of houses in the earthquake area, where post-disaster (earthquake) house construction with a bamboo or wood frame system is still intact standing while many buildings with masonry or concrete frame construction have collapsed meaningfully, this construction is very suitable for use in potential earthquake areas in Indonesia because they are more elastic to earthquakes [2, 3].

The problem that occurs is that the type of bamboo in Indonesia is more than 100 pieces and there is no technology that can be used as a reference in working with bamboo. making it difficult to assess or determine the reliability value of bamboo construction designs [4]. Without standards, the use of bamboo cannot be measured, both from uniformity and the quality of its products, remembering. Of the hundreds of species of bamboo grown in Indonesia the most popular used for construction components is the type of bamboo apus (Gigantochloa Apus). Some bamboo generally have a length 15-20 m, diameter 15-20 cm, thickness 12-15 mm. Specific gravity is equivalent to hardwood ranges 0.7-0.85, tensile strength which are range 17-20 kg/cm^2. The durability of bamboo for building materials can reach 25 years. The price of bamboo is cheap and easy to get anywhere. Bamboo have the potential to replace hardwood, aluminum, light steel roofs as a component of building materials [1,2].

Some construction materials are already available in nature without having to be in a factory with certain characters. As an illustration, there are some construction

materials that can be compared to their properties and performance as in Table I:

Table I. Mechanical properties of some construction materials

Structural attributes of bamboo against conventional materials					
Building Material	**Modulus of elasticity (MPa)**	**Working stress (MPa)**	**Density (kg/m^3)**	**Efficiency for stiffness**	**Efficiency for strength**
Steel	210.00	160	7800	27	0.02
Concrete	25.000	8	2400	10	0.003
Timber	11,000	7.5	600	18	0.013
Bamboo	20,000	10	600	33	0.017

II. METHODS

Manajemen mechanical test of Gigantochloa Apus by drying according to:

A. Measurement

We search bamboo by more thickness, we measure outlet and inlet diameter, thickness at base, middle, and top.

B. Grouping

Making a group breakdown of bamboo components into several parts (8 parts and/or 6 per 1 bamboo sphere) to illustrate the maximum utilization of the bamboo, see fig 4.

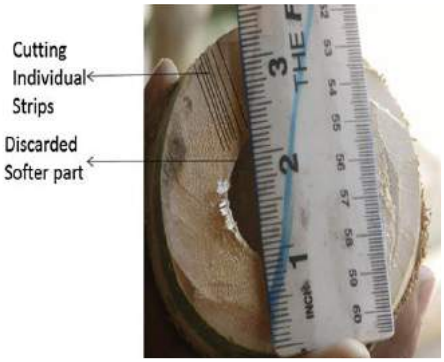

Fig 3. Raw material.

Fig 4. Raw material.

This method will test the mechanical properties of [5] bamboo apus (Gigantochloa Apus) on tensile, specific gravity with the following treatments:

C. Specific gravity

Specific gravity and mechanical properties of some types of material have different values. Some materials have the possibility to be technically or economically contracted. Final report of specific gravity divided by weight (gram) and volume (mm^3) by Eq. (1)

$$\rho = \frac{m}{v} \tag{1}$$

by:

ρ = density (gram/cm^3)

m = mass (gram)

v = volume (cm^3)

D. Dryness

Specific gravity test the dry weight of bamboo to be tested has a minimum dryness of 0.95, see Eq. (2). Dimensions of length, thickness, and width in mm. Weight measuring instrument with accuracy of 0.001 (gold scales), see Fig 2.

$$w = \frac{(m_1 - m_2)}{m_2} \times 100\% \tag{2}$$

by:

w = dryness (%)

m_1 = mass before drying (gram)

m_2 = mass after drying (gram)

Fig 5. Specific gravity test specimens

E. Tensile test

The choice of this type of bamboo apus is based on bamboo that is cut during the dry season. Bamboo is bought on the market. Bamboo tensile testing is carried out on the base, middle, and top. The length of bamboo is selected at least 12 m, cut 10% at the base, 20% from the top. Bamboo treatment for tensile testing by oven drying and nature drying. Tensile testing equipment is of international standard and is well calibrated, see Fig 3 and 4.

Fig 6. Tensile test specimens.

The machine tensile test have many characteristic likes: mechanical property test, elongation, force graph and output characteristic base data and result.

Fig 7. Machine Tensile test.

Specimen test bamboo apus have to characteristic of material (thinness and shortness) not like specimen steel and hardwood.

Fig 8. Tensile testing process.

III. RESULTS AND DISCUSSION

Test results of specific gravity obtained from measurements, calculations, selection of bamboo places (base, middle, and end) are as follows:

A. Specific gravity

TABLE I. Result of specific gravity for natural drying and oven drying

No.	Part	Rate of Result		Sum of sample
		Natural drying (gr/mm^3)	Oven drying (gr/mm^3)	
1.	Base	0.77	0.76	15
2.	Middle	0.81	0.80	15
3.	Top	0.78	0.79	15

Result of specific gravity test on bamboo apus by specifications at base, middle, and top places with natural drying and oven drying, the weight obtained between the above drying is not much different.

B. Typologies graph mechanical test of bamboo apus

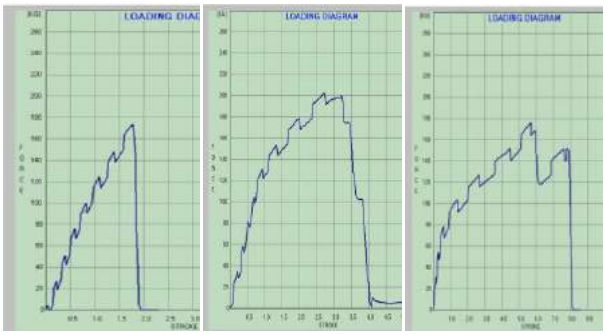

Fig 9. Typologies graph mechanical test of bamboo apus

Typology graph tensile strength of the apus bamboo at above does not have enough elongation, until the breakout unlike steel, aluminum.

C. Tensile test

TABLE II. Result of tensile strength for natural drying and oven drying

No.	Part	Rate of Result		Sum of sample
		Natural drying (kg/cm^2)	Oven drying (kg/mm^2)	
1.	Base	18	18,1	15
2.	Middle	18,5	18,4	15
3.	Top	17,5	17,6	15

Result of specific gravity test on bamboo apus by specifications at base, middle, and top places with natural drying and oven drying, the weight obtained between the above drying is not much different.

IV. CONCLUSION

Based on the results of testing on bamboo apus (Gigantochloa Apus) for 3 place categories (base, middle, top) with natural drying and oven treatment obtained an average density of 0.82 gr/mm^3. The average tensile strength is 18.1 kg/cm^2. Tensile strength, hardness bamboo apus like hardwood. But aluminum have tensile strength bamboo and hardwood [2]. Bamboo is prospected for material building looklike aluminum and hardwood. Apus bamboo is not good for transverse forces.

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