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The Reviewing of Compression Strength and Moisture Content of Gigantocloa Albociliata

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Abstract : Nowadays, plywood is widely used in life, especially in the construction and furniture industries. This has become a trend for those who are interested in decorating the house with wooden elements. Nevertheless, the world is facing some problems for which bamboo may offer some solutions. The aim of this study is to innovate a bamboo in manufacture of plywood. Besides that, compared the new type of bamboo for innovating the current ply bamboo, to test the mechanical properties of the ply bamboo such as compression test and moisture content and finally analyze the result of ply bamboo and make a review with a Malaysian Standard MS544. The method that are used are comparing the result with MS544. This also includes finding materials cutting bamboo, treatment and testing. The bamboo, Gigantocloa Albochiliata that we have used is able to withstand a sustainable load of 25.4 MPa which is higher than the sustainable value of merbau wood and bamboo. However, the moisture content value of Gigantocloa Albochiliata bamboo is 21.1% which is higher than other species except for Schizotachyum Grande bamboo. The bamboo selected meets with Malaysia Standard MS544 Part 3. As a conclusion, the study and project we completed demonstrated that this bamboo is suitable for furniture and finishing in the construction area.

Keywords: Bamboo, Borax, Acid Boric, Moisture, Compression

1. Introduction

Bamboo is the world's fastest growing woody grass. Bamboo grows at three times the rate of most other plants [1] . Bamboo is a versatile and renewable material with great strength and low weight that may be easily worked with simple tools. Due to the great socio-economic benefits of bamboo-based goods, it is widely acknowledged as one of the most important non timber forest resources [1]. Bamboo

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has similar or greater physical and mechanical qualities than several commercial wood species, making it an excellent candidate for processing into composites bamboo-based panels as a wood alternative [2].

The study of this project focused on the comparison between new type ofbamboo samples using bamboo Gigantochloa albociliata that treated by acid boric and borax [2]. Mechanical properties test analysis conducted according to Malaysian Standards (MS544) [3], namely compressive strength, tensile strength, and the moisture content [3]. The results compared with the type of plywood classification in Malaysian Standard 544 (MS544) a contribution to the public, especially the furniture industry [4]. The importance of this project is to prioritize bamboo material in the manufacture of plywood because bamboo also has the same strength as wood which is the basic material in the manufacture of plywood.

2. Materials and Methods

This part mention every component involved in conducting this project from researching, applying and directing the process to obtain the result. The technique relates to the process of gathering information to carry out the analysis and points out the issues addressed in more depth regarding the method's project execution to be interpreted . The kinds of the test used in this project are compression strength and moisture content.

2.1 Materials

There are various materials used for this ply bamboo making process. These materials include the materials used from the machine to the glue that will be used in this ply bamboo manufacturing process. Bamboo, borax and boric acid are used to conduct this project.

2.2 Methods

The methodology of this study is explained in detail in Figure 1. First, the bamboo needs to be cut to facilitate the treatment process. To ensure that the bamboo can last for a long period of time, it will be cleaned and preserved. Bamboo is a material that has the potential to be used as ply bamboo, but it is a material that decomposes easily due to weather and insects. To overcome this problem, the bamboo will be treated to ensure that the bamboo can last longer. To ensure that samples meet design specifications, it will be subjected to some kinds of testing. Compression strength and moisture content were performed. Compression tests are performed using Universal Testing Machine or UTM in the concrete laboratory while Moisture content test was performed using a dry oven with a temperature of 103 degrees Celsius for 24 hours in the highway laboratory. After all tests are completed, data and analysis were made using graphs. The test results were then compared with other species. Finally, conclusions are drawn and included in the report.

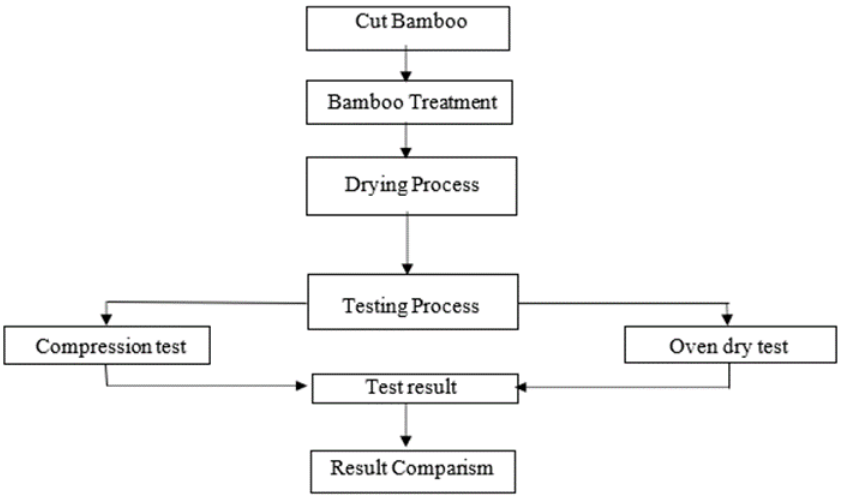

Figure 1: The flowchart of the study

2.3 The calcuations of the moisture content and compressive strength.

The values of moisture content and compressive strength is calculated for testing and it is importance to differentiate the level of the test.

a) Equation for moisture content:

$$MC = \frac{w-d}{w} \times 100 \quad \textbf{Eq. 1} \text{ [5]}$$

w = wet weight

d = dry weight

b) Equation for compression strength:

$$CS = \frac{F}{A} \quad \textbf{Eq. 2} \text{ [6]}$$

F = the force or load at point of failure

A = the initial cross-sectional surface area

3. Results and Discssion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

3.1 The results of compressive strength bamboo

Table 1 shows the Compression Strength Parallel to Grain Test results. The results are tabulated after tests are conducted on 4 samples.

Table 1: Compression Strength Parallel to Grain Test

Test No.	Area (mm^2)	Max. Load (kN)	Compressive Strength (MPa)
1	1256.637	28.964	23.049
2	1256.637	24.740	19.688

3	1256.637	41.866	33.316
4	1256.637	31.845	25.341
Average Compressive Strength Parallel to Grain Test (MPa)			25.349

In **Table 1**, bamboo that has been treated with a solution of boric acid and borax for 2 weeks and dried for a week we have used to do laboratory tests on it. Compression strength and moisture content tests were conducted using bamboo with a diameter of 40mm and a length of 80mm. Next the compression strength test is carried out by applying a load on the bamboo until the bamboo fails. The test results show that the value of the load that can be borne by the bamboo is for Sample 1 which is 23.049 MPa, Sample 2 19.688 MPa, Sample 3 33.316 MPa and Sample 4 25.341 MPa.

This shows that Gigantochloa Albociliata bamboo can withstand a maximum load of 41.866kn and an average compression value of 25.4 MP which is equivalent to the standard MS544 Part 3 which is 23.0 MPa which is the value of wood, Balau used for plywood production. This has been proven by **Table 1** and **Figure 2** which is the compression strength test result.

Figure 2 shows the result for four samples under the same UTM compressive test. The highest value of compression strength before failure is sample 1 which is 43kN. While the lowest value is before failure is sample 3 which is 24.1kN.

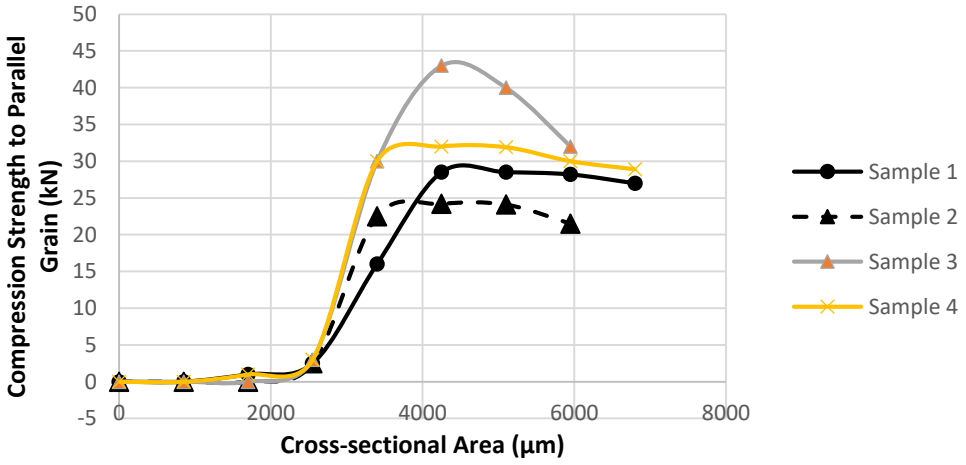

Figure 2: Compression Strength Test Result

3.2 Moisture Content of Bamboo

Table 2 shows the result of moisture content after conducted oven drying test. Four samples are analysed on this test.

Table 2: Moisture Content Test

Test No.	Before Drying (g)	After Drying (g)	Moisture Content (%)
1	38.8	32.6	12.98
2	49.1	34.4	29.94
3	43.6	34.3	21.33
4	48.9	40.5	17.18
Average Moisture Content (%)			21.11

From **Table 2**, among the 4 samples that were conducted for moisture content, it was found that the value of water content for bamboo Gigantochloa Albociliata is high. The average value of moisture content for all 4 samples was 21.1%. However, the value of this water content has not met the standard

MS837 that is the average moisture content is 17% (less than 18%). This has been proven by **Table 2** moisture content test result.

3.3 Reviewing of tested data with MS 544 Part 3.

Table 3: Review of Experimental Data with MS544 Part 3

Species	Grade	Compression Strength (MPa)	Moisture Content (%)
Merbau	HS	15.7	12.0
Balau	HS	23.0	12.0
Gigantocloa Albochiliata	-	25.4	21.1
Schizotachyum Grande	-	28.6	21.2
Bambusa Vuulgarsi	-	67.6	18.0

Table 3 shows the review of experimental data with MS 544 Part 3. In this table, there are five types of bamboo that are reviewed. The difference in **Table 3** above shows the value of compression strength and moisture content for 2 types of wood that are often used to produce plywood, namely Balau and Merbau and 2 types of bamboo that will also be reviewed with the types of bamboo that have been used for this project, namely Bambusa Vulgaris, Schizotachyum Grande and Gigantocloa Albochiliata. The value of compression strength indicates the rate of compression that can be borne by the wood and bamboo.

Next, the value of moisture content is to determine the water content in each type. As such, the bamboo, Gigantochloa Albociliata that we have used is able to withstand a sustainable load of 25.4 MPa which is higher than the sustainable value of merbau wood and bamboo. However, the moisture content value of Gigantochloa Albociliata bamboo is 21.1% which is higher than other species except for Schizotachyum Grande bamboo. This has been proven by table 2 Review of Experimental Data with MS544 Part 3.

4. Conclusion

The bamboo selected meets with Malaysia Standard MS544 Part 3. The first objective is to review the new type of bamboo for innovating the currently ply bamboo. This objective is achieved because the manufacture of plybamboo not only depends on one type of bamboo that is commonly used such as Schizostacyum Grande to make plybamboo, but also bamboo type Gigantochloa albociliata can also be used.

In addition, the second and third objectives namely to test the mechanical properties of the bamboo ply such as compression test and moisture content and to analyze the result of bamboo ply and make a comparison with a Malaysian Standard MS544 have also been achieved. The study completed demonstrated that this bamboo, Gigantocloa Albochiliata is suitable for furniture and finishing in the construction area.

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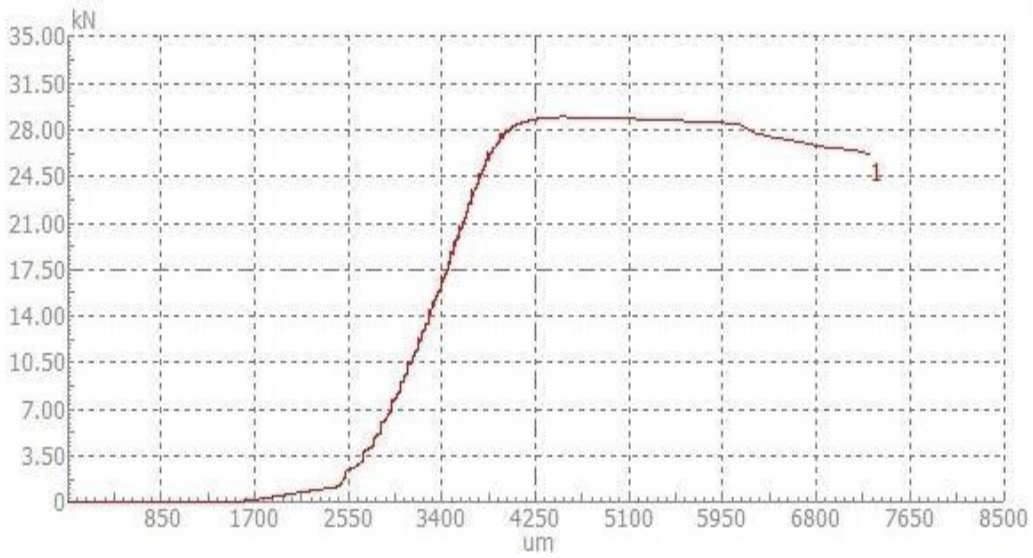
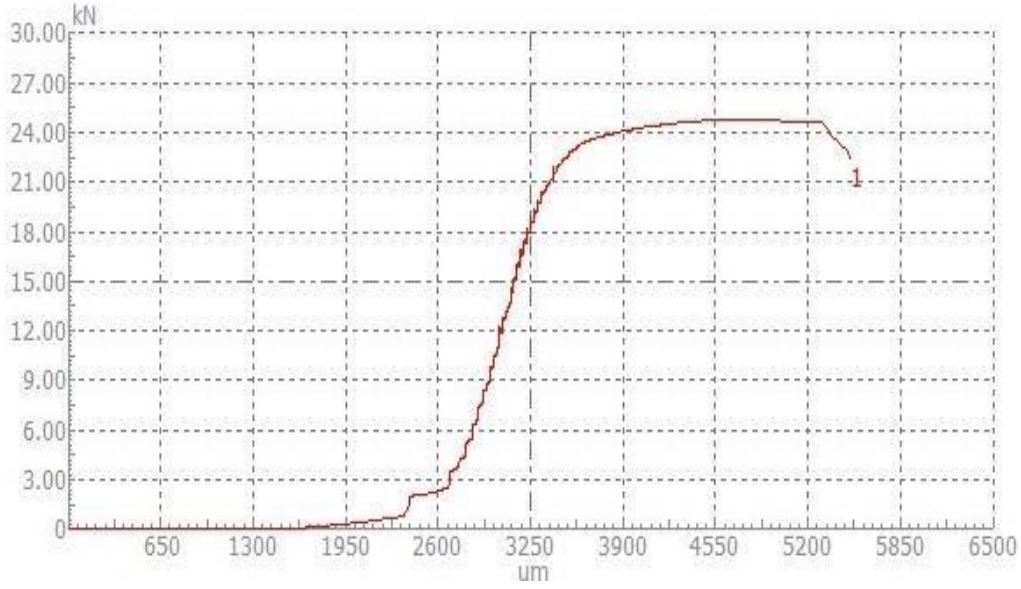
Appendix A

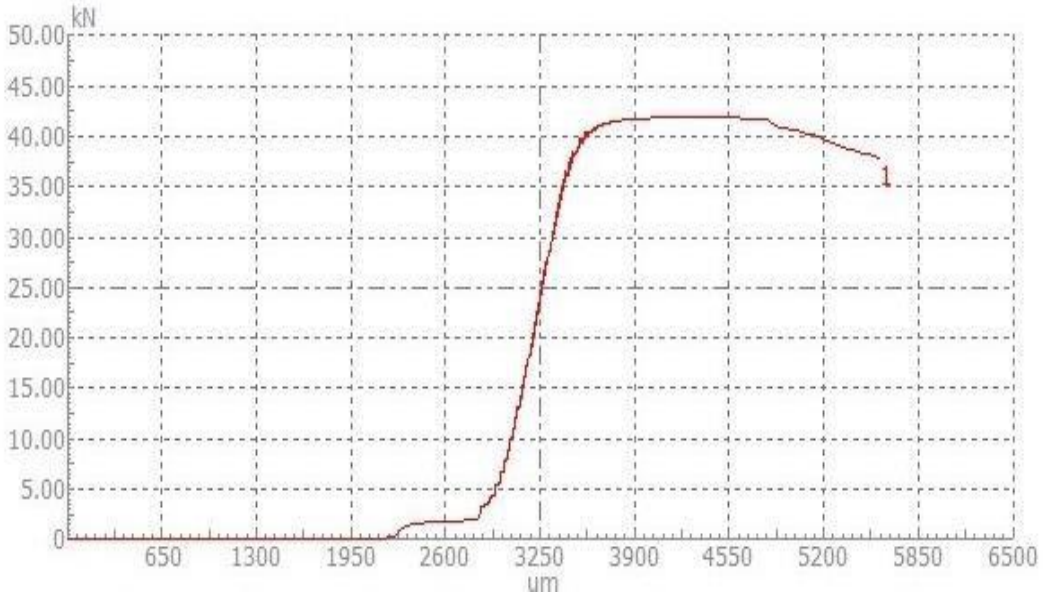
Results of compression strength parallel to grain test raw data from Universal Testing Machine (UTM) test.



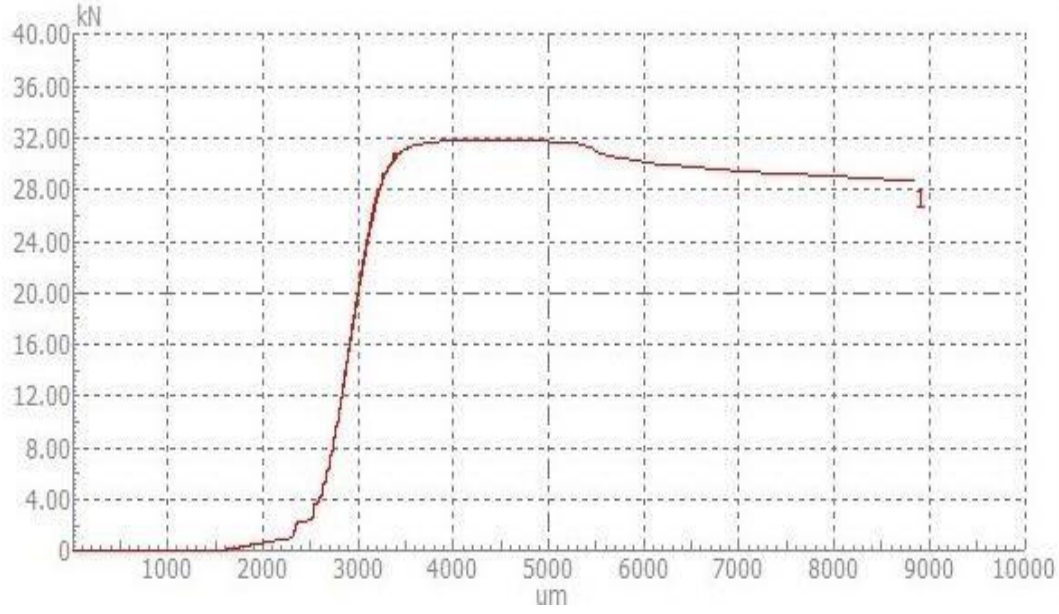
Sample 1



Sample 2



Sample 3



Sample 4

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