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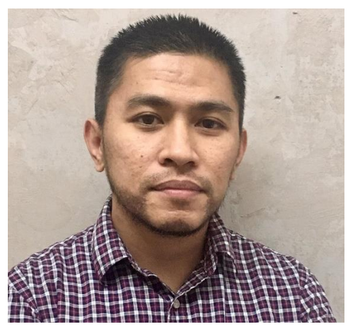
# Physico-mechanical Characteristics of Malaysia's Beting Bamboo (*Gigantochloa levis*)



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## Abstract

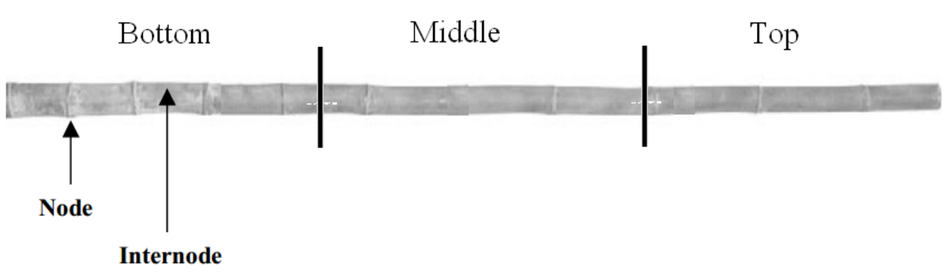
In this study, a preliminary study on a Malaysian bamboo locally known as Beting bamboo (*Gigantochloa levis*) basic properties was addressed. Characterizations of physical and mechanical properties of *G. levis* in terms of the variability of location along culm height (top, middle, bottom), culm section (nodes and internodes), fiber orientation (longitudinal, tangential and radial) and culm layer (outer and inner) were conducted. Comparison of these properties is also made to some bamboo and commercial timber species. It was found that *G. levis* has promising physical and mechanical properties although the specific gravity of *G. levis* has tendency to be on the higher side compared to many timber species. The characteristics studied were found to have some variability at different locations, sections, and directions. There was variability in terms of bending strength, compression strength along with the culm height of bamboo. This study indicated that properties of *G. levis* were found to be satisfactory, especially in bending strength, with the average value even surpassed other commercial timber species.

## Objectives

The purpose of this study is to highlight the physico-mechanical properties of *G. levis* as one of the possible renewable materials in fabrication of composite materials

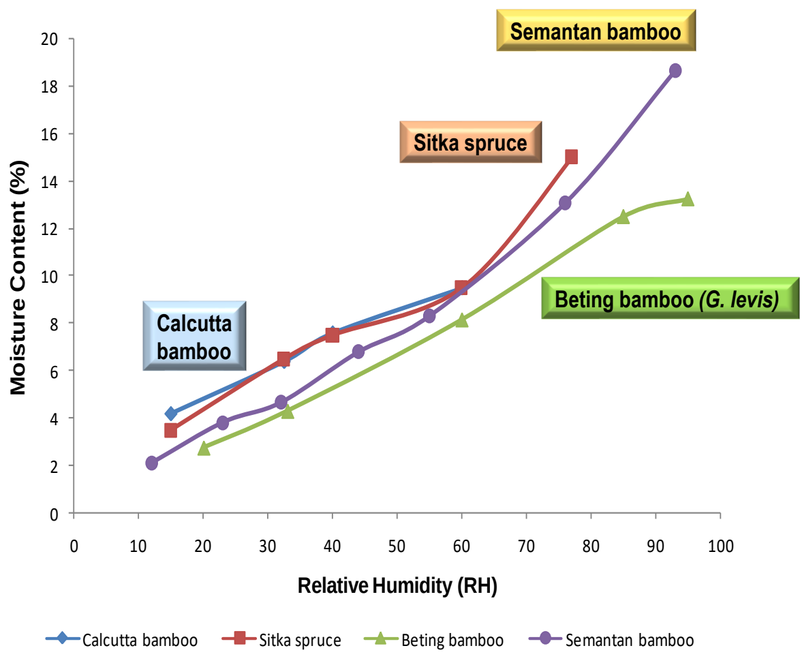
## Methodology

Three-year-old *G. levis* was obtained in bulk from the forest in State of Pahang, Malaysia by local supplier. Upon arrival, bamboo culms were divided into three sections; top, middle and bottom, with each section approximately 1.80m long (6 ft) as shown in Figure 1 and left to air dry for two weeks.



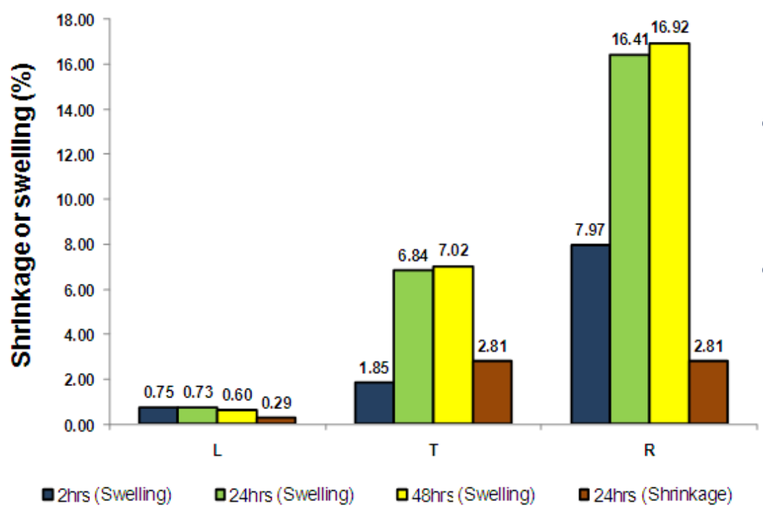

## Analysis caried out

- Specific gravity (ASTM D2395) and dimensional stability
- Equilibrium moisture content (EMC)
- Bending and Compression Strength Analysis




**EMC of *G. levis***

- Comparison was made between EMC isotherm curve of Beting bamboo with other materials **(Sitka spruce, Calcutta bamboo and Semantan bamboo)**
- EMC curve of Beting is almost similar to other materials
- However, initial and final MC of Beting is lower at similar RH% compared to other materials.




**Dimensional stability of *G. levis***

- Beting bamboo tend to shrink and swell more in tangential and radial directions compared to longitudinal direction
- Compared to wood, bamboo has excellent dimensional stability compared to other woody species that has high disparity between tangential and radial direction when dried to oven dry conditions

**Comparison of mechanical properties of *G. levis* with other species of bamboo and several types of woods**

| Species | Specific Gravity | MOE (N mm$^{-2}$) | MOR (N mm$^{-2}$) | Compression parallel to grain (kPa) |
|---|---|---|---|---|
| ***G. levis* (MC≈11%)** | 0.88 | 21470.85(Internodes) 13911.76 (Nodes) | 140.43 (Internodes) 93.08 (Nodes) | 32050 (Internodes) 30640 (Nodes) |
| ***G. Scortechinii*** | 0.765 | 6765.54 (Internodes) 4941.06 (Nodes) | 83.52 (Internodes) 70.82 (Nodes) | |
| ***D. Strictus*** | 0.64 | 10428 | 152.3 | |
| **Eastern hemlock** | 0.40 (12%MC) | 8300 | 61.0 | 37300 |
| **Douglas-fir (Coast)** | 0.48 (12%MC) | 13400 | 85.0 | 49900 |
| **Eastern white pine** | 0.35 (12%MC) | 8500 | 59.0 | 33100 |
| **Balsa*** | 0.16 | 3400 | 21.6 | 14900 |
| **Kapur*** | 0.64 | 12962.14 | 126.17 | 69600 |
| **Kempas*** | 0.71 | 18546.90 | 122.03 | 65600 |
| **Dark red meranti*** | 0.46 | 12200 | 87.6 | 50700 |
| **Light red meranti*** | 0.34 | 8500 | 65.5 | 40800 |
| **White meranti*** | 0.55 | 10300 (15%MC) | 85.5 (15%MC) | 43800 (15%MC) |
| **Yellow meranti*** | 0.46 | 10700 | 78.6 | 40700 |
| **Merbau*** | 0.64 | 15375.31 | 115.83 | 58200 (15%MC) |

## Conclusions

- Specific gravity (SG) of *G. levis* was found to be higher than most commercially available timber species. This might affect the application of *G. levis* as raw material for composite materials. Nevertheless, *G. levis* might be useful in a situation where combination of high SG and mechanical properties is required. Laminated composite product or composite product that does not require extensive compression for compression might also suitable for *G. levis*.
- Analysis of dimensional stability (DS) indicated that *G. levis* also has an excellent DS compared to wood species with high shrinkage when dried from green to oven dry and large difference instability in radial and tangential direction.
- *G. levis* exhibit excellent mechanical properties, especially in bending strength where the value of MOE was found to be higher than most commonly used timber species. However, the compression strength of *G. levis* were found to be lower than the value of MOR of other woody species. This is expected since the easy separation between fibers in the direction parallel to the fiber leads to substantial reduction on the compressive strength of *G. levis*.

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