Structural Laminated Veneer Lumber (SLVL) Produced From Tropical Hardwoods as New Building Material for Malaysia

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Introduction

Many tropical hardwoods are known to be acceptably strong but the large variations within and between the species had confined their utilization into only a few applications in the construction industry. Being an engineered material, Laminated Veneer Lumber (LVL) has surpassed other wood products in many situations due to its superior mechanical properties and structural design potential. This study investigates the properties of LVL produced from tropical hardwood timbers namely, keruing, (*Dipterocarpus* spp), bintangor (*Callophylum* spp), kedondong (*Canarium* spp.), white meranti and yellow meranti (*Shorea* spp), pulai (*Alstonia* spp), sesendok (*Endospermum* spp), kekabu hutan (*Bombax* spp.), rubberwood (*Hevea brasiliensis*) and acacia (*Acacia mangium*) by applying different manufacturing variables i.e., species combination, veneer thickness, veneer joint distance, and hot pressing technique. The effects of veneer lay-up pattern and the veneer thickness on the bending and shear strengths of the panel were also examined.

Materials and Methods

Phenol formaldehyde resin (41.5% solids) was used to bond the veneers. The 1300 mm wide x 2500 mm long x 40 mm thick LVLs were manufactured in a plywood commercial line. The veneers were assembled in a symmetrical construction, with both the tight-side and loose-side facing each other. Two sets of LVL were prepared, 13-ply and 17-ply. The assemblies were hot pressed at 125°C and 9.3 kg/cm^3 for 25 and 35 minutes for 13- and 17-ply, respectively, and conditioned for a week prior to cutting into test specimens. Both the manufacturing and the strength evaluation of the LVL were carried out according to ASTM D198 Test for Structural-Sized Composite Material. The static bending was carried out on a third-point loading with the length of the test specimens being 18 times the thickness of the specimens. With shear test specimens, the length was 6 times the thickness. Special grips were fabricated for the test of tensile parallel to the longitudinal axis and for compression. The strengths of the SLVLs were then statistically analysed for the effects of wood species and veneer thickness.

Results and Discussion

The study indicates that LVL produced from tropical hardwood species has greater homogeneity than does solid wood with coefficient of variation of not more than 18% compare to >35% in the latter. Careful arrangement of species is needed when more than one wood species are used in the fabrication of LVL. The combination of high and low density wood in LVL manufacture gave a more stable panel when exposed to moisture and high temperature. Bond quality has greater influence over flatwise strength than over edgewise strength of the LVL. Combination of high and low wood density resulted in more stable panels in particular when exposed to moisture and heat. Generally, the strengths of the LVL were improved at least one grade higher than that of solid timber of the same species stipulated in the Malaysian Standard MS544 Part 2.

Conclusions

New building materials from Structural Laminated Veneer Lumber (SLVL) can be produced from lower grade timber species. Through the manipulation of timber species and processing variables such as veneer thickness, pressure level and joint distance, relatively stronger and more homogeneous composite materials can be produced.

Benefits from the study

The development of SLVL opens up new alternative for efficient utilization of timber resources through better use of inferior grade low density timber species Through this project the strength of these timbers were enhanced and the uses can be extended from a mere furniture parts to load-bearing components such as roof truss, I-column.
Introducing competitively priced new material for building construction.
Timber industry, in particular the plywood industry, will generate revenue through value adding from low grade timber species to structural grade material. This product, through perfection, can be exported to other countries under a new product range known as Structural Laminated Veneer Lumber.

The technology derived can be utilized by local timber industry in particular the plywood industry. Since the manufacturing process is very much similar to that of plywood, the SLVL can be produced and marketed immediately by the current plywood manufacturers.

Patent(s), if applicable:
Not Applicable

Stage of Commercialization, if applicable:
Not Applicable

Project Publications in Refereed Journals:
Nil

Project Publications in Conference Proceedings
1.H'ng Paik San, Paridah Md. Tahir, Wong Ee Ding and Zakiah Ahmad. 2003. Tensile Properties of Laminated Veneer Lumber Manufactured from Tropical Hardwood Species. Proceedings of the International Association of Wood Products Societies 2003 (IAWPS 2003): International Conference on Forest Products, April 21 – 24, 2003. Daejeon, Korea.

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3.Paridah Md. Tahir, H'ng, Paik San, Zakiah Ahmad. 2002 Bending Shear of Laminated Veneer Lumber Manufactured from Tropical Hardwoods and It's Relation to Glue Bond Shear. Proceedings of 7th World Conference on Timber Engineering, WCTE 2002, August 12-15, 2002, Shah Alam, Malaysia. Pp: 198-205.

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9.H'ng P. S., Paridah M. T., Zakiah A. 2001. Edgewise-Bending Properties of Laminated Veneer Lumber: Effect of Veneer Thickness and Species. Paper presented at USM – JIRCAS Joint International Symposium 'Lignocellulose – Material of the Millennium: Technology and Application', 20 – 22 March 2001. Penang.

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
H'ng Paik San	Engineering Properties of Laminated Veneer Lumber (LVL) Produced From Tropical Hardwood Species.	Wood Science	Ph.D	2004 (Expected)
Chuo Toung Wm	Properties of Bintangor LVL After Cyclic Boil Dry (CBD) Treatment.	Wood Science	M.S	2003 (Expected)

Chow Chew Chin @ Stephanie	Strength and Durability of Rubberwood Laminated Veneer Lumber (LVL) Truss Members Treated with Light Organic Solvent Preservatives (LOSP)	Wood Science	M.S	2005 (Expected)
Nornairiah Binti Adman	Developing Fire Resistant Structural Rubberwood Laminated Veneer Lumber (LVL) for Roof Truss Members	Wood Science	M.S	2005 (Expected)

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