Preliminary

Manufacture and Mechanical Properties of Cylindrical Laminated Veneer Lumber*[1]

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Introduction

Laminated veneer lumber (LVL) is expected to become an important wooden structural member in the next decades for its high performance and high reliability. Advanced technology for the LVL production makes it possible to convert small diameter logs into long and large LVL products with relatively high yield.

Many attempts have been done on the effective utilization of domestic plantation softwoods such as cedar and larch however they have not fulfilled yet.

This report deals with the cylindrical LVL called MOLAM-POLE, a hollow and cylindrical LVL with a length of 500 cm and a diameter of 30 cm manufactured from thinnings of Japanese cedar. The plant system for manufacturing MOLAM-POLE was proposed. The productivity of whole process was discussed and the mechanical properties of the products were examined.

Materials and Methods

The processes for manufacturing MOLAM-POLE consist of the following steps: 1) press-drying of green veneers from Japanese cedar (*Cryptmeria japonica* D. Don.) with a thickness of 3 mm and a moisture content of 105 percent; 2) finger jointing of veneer; 3) hot pressing of 11-ply (30.4 mm thick) molded LVL with high frequency heating system; 4) grooving both edges of the molded LVL for jointing; 5) fabricating of MOLAM-POLE with six molded LVLs (Fig. 1).

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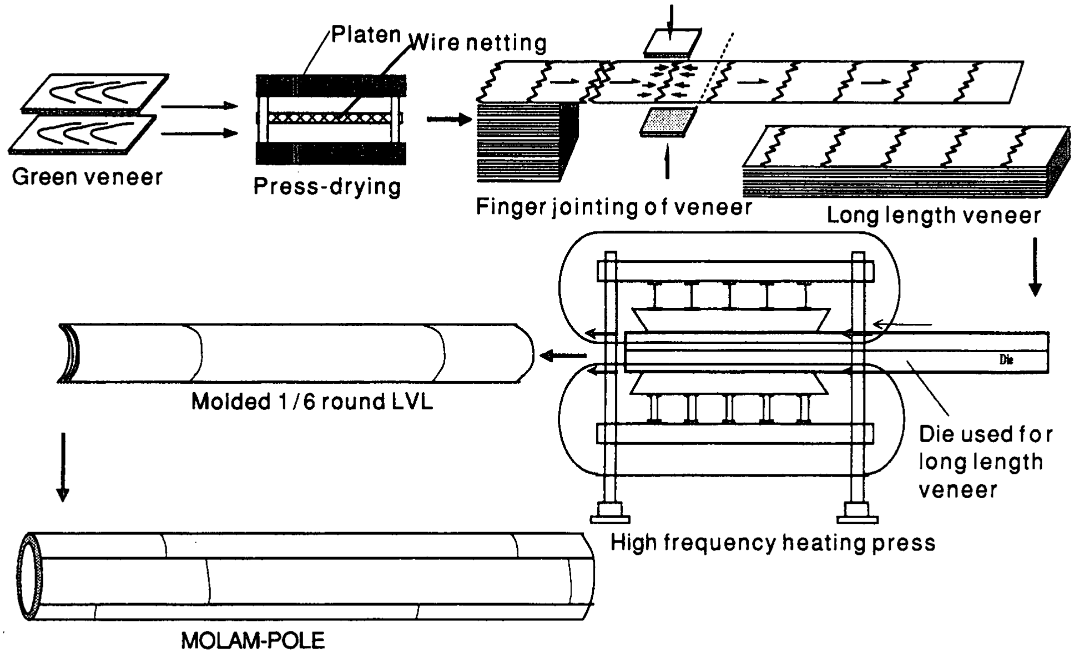

Fig. 1. Ideal system for MOLAM-POLE manufacture.

Full-scale bending and compression tests were conducted on MOLAM-POLE. After these tests, polyurethane foam was filled into the hollow core of MOLAM-POLE to keep away lateral compressive deformation.

Results and Discussion

In the press drying process, a wire mesh sheet was placed between two green veneers drying to a moisture content of 10 percent in four minutes by using a hot press with a platen temperature of 180°C. This process probably enhanced the productivity of veneer drying.

The average tensile strength of finger jointed veneers was 84 percent of that without joints. The strength of some jointed veneers exceeded that without joints. The results showed that the finger jointing of the veneers did not affect its strength for practical use.

High-frequency heating press system decreased the pressing time to manufacture LVL. However, the density profile was unbalanced along the thickness of the product . This may be due to the non-uniform heat distribution of LVL.

The modulus of elasticity (MOE) of the MOLAM-POLE was 9.2 GPa. Apparent MOE of MOLAM-POLE with a hollow core decreased to 6.0 GPa, but the specific MOE was 1.5 times as much as that of Japanese cedar log with the same diameter. On the other hand, the MOE perpendicular to grain of 1.1 GPa was only 12 percent of that of longitudinal MOE. This suggests that the structure in the lateral direction was weak so as to deform easily by bending moment. Filling the hollow core with polyurethane foam prevented from the lateral compressive deformation. The influence of stress distribution in the section filled with polyurethane foam was observed from the stress analysis of the finite element method to the MOLAM-POLE section.

The ideal plant manufacturing cylindrical LVL does not require developing special mechanical contrivance but applying the conventional LVL manufacturing machines. However, the cost of edge joint processing poses a problem. Continuous manufacturing system for structural LVL is needed. In this aspect, a continuous spiral winding & lamination process with rolled veneers is proposed to be applied to such products.

Literatures

1) H. SASAKI: Report of the Grants-in-Aid for Scientific Research from the Ministry of Education, Science, and Culture of Japan, "Development of LVL System by Using Thinnings of Japanese Cedar", 1985.
2) S. KAWAI, Q. WANG, H. SASAKI, M. TANAHASHI and C. OHOTA: Properties of Compressed Laminated Veneer Lumber Produced by Steam Pressing, *Mokuzai Gakkaishi,* **39**(5), 550–554 (1993).
3) H. SASAKI and S. KAWAI: Recent Research and Development with Wood Composites in Japan, *Wood Science and Technology,* **28**, 241–248 (1994).