ABSTRACTS (MASTER THESIS)

Estimation of in-plane bending strength considering lamination effect

**(Graduate School of Agriculture,
Laboratory of Structural Function, RISH, Kyoto University)**

Tsuyoshi Aoyama

A simulation model based on Monte-Carlo method was developed to estimate in-plane bending strength of cross laminated timber (CLT). The model used mechanical characteristics of lamina obtained from edgewise bending test of them. To consider the effect of gluing each layer, bending test on lamina with cross layer was carried out. Experimental value of in-plane bending strength of CLT and calculated value were compared. The result indicates that cross layer raises the distribution of bending strength and that in-plane bending strength can be estimated by the model.

The model on estimation of in-plane bending strength of CLT

The model assumes that longitudinal layer only can resist against bending moment and that bending strength (MOR)of base material of each lamina is unique in direction of the length of lamina. Knots and finger joints (FJ) are generated as random number according to probability distributions. MOR of each defect is given using regression equations obtained in edgewise bending test of single lamina. The failure of lamina occurs at the moment that the bending stress on the edge of tension side reaches MOR on any point of lamina (base material, knot or FJ) and CLT failed simultaneously with the failure of the first lamina.

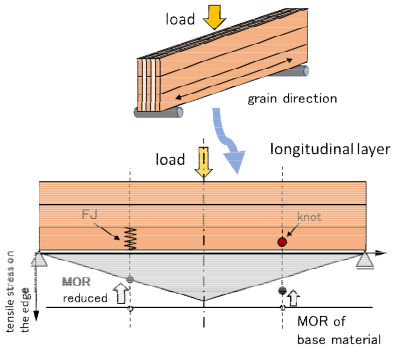

Figure 1. Overview of the model

Bending test of lamina with cross layer

Bending test of lamina with cross layer as shown in Figure 2 was carried out. Specimens were chosen so that they have knot or FJ between the loading points. Table 1 shows comparison in average MOR between specimens with and without cross layers. The result indicates that MOR of specimens with knot was raised by lamination, while in the specimens with FJ the tendency was not found.

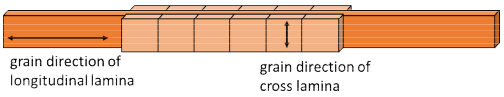

Figure 2. Specimen with cross layer

Table 1. The result of lamina bending test

	MOR without cross layers (MPa)	MOR with cross layers (MPa)
knot	37.5	45.4
FJ	36.6	38.3

Estimation of in-plane bending strength of CLT

Bending strength of seven-layered CLT was compared between experimental value [1] and estimated value obtained from the model described above. Lamination effect was calculated as strength of knots was multiplied by 1.2. The experimental value and cumulative curve of estimated value are shown in Figure 3. It shows that estimated value with lamination effect was larger than the value without the effect, especially in specimens with relatively low strength. In addition, the agreement between experimental and estimated value was better in calculation with lamination effect. In conclusion, in-plane bending strength of CLT can be estimated employing the model and its accuracy would be improved by considering lamination effect.

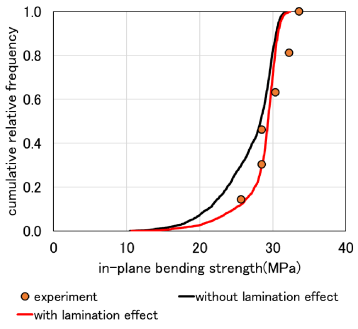

Figure 3. Experimental and estimated value of seven-layered CLT

Reference

[1] Forest products Research Institute, Progress report of promotion of CLT utilization, 2015 (in Japanese)