ABSTRACTS (MASTER THESIS)

The development of optimal CLT floor with two-by-four

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

Soichi Abe

Introduction

Cross-Laminated Timber (CLT), illustrated as Fig.1, is used for the wall or floor of buildings and supports the structure. CLT panels consist of some timbers, which is called laminae. Usually in Japan, CLT laminae is cut from logs and CLT consists of laminae having equal thickness. Then there are few examples that the laminae which is now generally on sale is used for CLT laminae. We can save time and cost on the manufacturing process if CLT constructed by laminae now generally on sale are made happen in realty. It is also beneficial that we can sell these laminae as original use. Two-by-four and stud are focused on in this research as laminae on sale. Two-by-four is the timber used for platform flame construction. Stud is the timber put between posts and nonstructural member of the building.

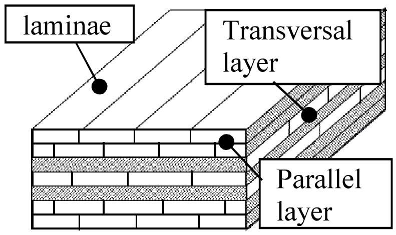

Figure 1. Typical CLT in Japan

More stress occurs in outer layers than inner layers when CLT panels are used for floors. The transversal layers don't contribute to CLT bending strength. Therefore, the transversal layers have the role in fixing the effect of swelling and shrinkage of cross laminae.

The purpose of my research is to develop CLT floor panels using 204 and stud, and to reduce CLT volume and cost.

Method

Laminae bending test and CLT out-of-plane bending test were conducted. The cross section of two-by-four is 38mm×89mm and stud is 27mm×105mm. Thirty CLT specimens were divided into three groups, which were H (height) 190mm, H179 and H211. H190 has 5 layers 5 ply cross section, and all layers constructed with two-by-four. H179 has 3 layers 5 ply, and outer layers constructed with two-by-four and inner layer constructed with stud. H211 has 5 layers 7 ply cross section, and only outermost layers constructed with two-by-four and the others' layers with stud. Then each type of laminae has about 150 specimens. And all was conducted by bending tests.

Optimal arrangement of the laminae for various types regarding length and design loads, were decided after calculated values with experimental results of two types of laminae.

Results and discussion

Each experimental date was put into Table.1, which include bending Young's modulus and 5% lower limit value of bending strength ($F_{b\_5\%}$). It was found that all $F_{b\_5\%}$ of two-by-four was over strength criteria, being set on two-by-four, and that has higher bending strength. Therefore, it is suggested that optimal arrangement for CLT need two-by-four outermost layers and stud transversal layers. The higher the strength of CLT is on strong axis in general, the less ratio of transversal layers for cross section. However, transversal layers have an important role to keep dimensional stability. In fact, a layer of CLT can have two plies at most. It is suggested that we can manufacture more improved CLT on bending performance if CLT with less ratio of transversal layers for cross section can keep dimensional stability.

Table 1：CLT out-of-plane bending

	Young's modulus (kN/mm^2)	$F_{b\_5\%}$ (N/mm^2)
H190	5.46	17.6
H179	6.81	23.4
H211	6.47	20.3

Table 2：laminae bending

204	6.90	26.8
Stud	6.93	16.8