ABSTRACTS (MASTER THESIS)

A study on destruction behavior of CLT wall with openings subjected in-plane shear force

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Cross Laminated Timber is a new structural panel element consist of several layers of structural lumber boards stacked crosswise (typically at 90 degrees) and glued together. In Japan, the CLT has attracted attention of architects recently due to its environment friendly characteristics and the expectation of .light weight and low cost construction style. Although material standard of CLT has been published, CLT structural design criteria for allowable stress design method is still under discussion. Currently two CLT construction methods has been proposed in Japan. One is the method using the big panels with the openings, and the other is the method using the small panels of about 1x3m in size connected together by the metal fasteners. This paper discuss about the former method. Although using the big panel with openings enables logical construction, there has been a difficulties in the estimation of stiffness and strength. Especially the behavior of the corner panel zone has not been clarified yet. Therefore in this study, the horizontal loading test was carried out to make clear the specific destruction behavior of the corner of big CLT panels, and to lead estimation formulas of stiffness and strength.

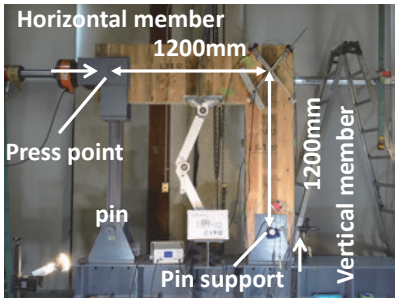

Figure 1. L-shaped CLT specimen

Experimental method and result

L and T-shaped specimens were cut out from large size CLT panels made of 5 layered Sugi laminae in Mx60B standard grade. While the specimens were fixed by the pin support, the horizontal load was applied and the relationship between moment and rotation angle at panel-zone was measured. Three kinds of loading schedules which were monotonic push over, monotonic pull over and cyclic loading were performed as parameter. In terms of L-shaped specimens, the most of pull specimens failed in bending at nearby the corner of panel zone and the most of cyclic specimens showed similar failure mode to pull specimens. As a result, the strength showed a big variation and its average value was different to the average of the bending test of straight CLT made of the same grade. From strain gauge measurement, followings were found. A non-side-bonding of lamina causes relative slip of laminas, and it was found that CLT plane section holding does not maintain. And the strain gages put near the inside-corner showed sever stress concentration. Those caused the low strength of pull specimens. As the specific failure mode, rolling-shear failure was observed in most of push specimens. It was thought caused by 3-dimentional stress transition via bonding surface of layers.

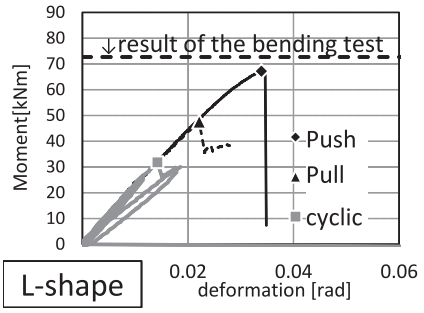

Figure 2. M-θ relationship (L-shaped CLT)

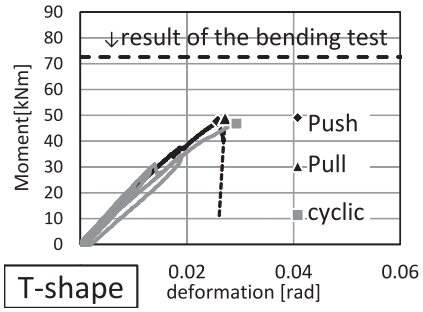

Figure 3. M-θ relationship (T-shaped CLT)

Conclusion

CLT L and T-shaped specimen tests revealed the specific behavior. The reason was partly clarified by the stress analysis and strain measurements. It is concluded the precise estimation of bending failure is important to design CLT building in the safer side.