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Pull-out strength properties of Lagscrewbolt connection for CLT construction

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With the availability of new engineered wood products such as cross laminated timber (CLT), it becomes possible to build a wide variety of wooden construction of frame structures of large height and long span. One of the most important design aspects for these structures is the connection. The lagscrewbolt (LSB) was first developed by Komatsu [1] as a rigid connector for wooden structures. A lot of the research was done with a focus on use of LSB in glulam construction.

This study was aimed at examining the structural performance of a single or double LSBs inserted into CLT in terms of the insertion direction, the edge distance, and the distance of both LSBs. In Figure 1 was shown the LSB and CLT. The several parameter's specimens were tested for evaluating this aims.

In this report, many types of specimens were used to examine the effect of edge distance, grain direction and multiple LSBs. It could be concluded as follows:

Figure 1. Shape of a Lagscrewbolt and Cross Laminated Timber

1. The pull-out strength of LSB when inserted through the perpendicular-to-grain direction with enough resisting area into CLT layers was higher than that when inserted in the parallel-to-grain direction, but the stiffness showed an opposite trend; the narrower specimens failed in a less ductile manner than wider ones; and the in-between inserting specimen had both strength and stiffness values between the perpendicular and parallel specimens. These results showed the same tendency as those in Glulam.
2. When inserted through the perpendicular-to-grain direction, it was found that the edge distance should be larger than 4d, and when using double LSBs, the strength and energy absorption decreased compared with single ones.
3. When inserted through the parallel-to-grain direction, it seemed that a 2d edge distance was not enough, because of failure mode. Therefore, to insert LSB more than 2d edge distance is recommended.
4. It was found that the formula in CLT Handbook and NDS for calculating the pull-out strength of lag screws was promising to adopt on perpendicular-to-grain direction.

It is recommended to conduct future work: to investigate the effect of edge distance and the distance between LSBs when increasing the inserting length; and to develop a prediction model or experimental formula for LSB connection in CLT.

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References

[1] K. Komatsu, Y. Hara, Y. Nanami, and T. Ikki: Development of Lagscrewbolt as a connector for Glulam moment-resisting joints, *Proceedings of Pacific Timber Engineering Conference*, pp.2.349-2.354, Rotorua, New Zealand, 1999.