## Mechanical Analysis of the Failure Behavior on the Leg Joint in Wooden Portal Frame Structure

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When wooden portal frame is subjected to the external force, a composite stress mixed with shear and moment occurs on its leg joint. In current Japanese design standard, check of the leg joint strength in wooden portal frame is done on both moment and shear force. If, however, shear force is dominant, split failure might occur dominantly. Unfortunately, however, any appropriate design equations for checking the split failure of joint has not been proposed yet, therefore the brittle behavior of this split failure is one of the serious problem in design of timber portal frame structures.

In this research, we focused on the influence of shear force that tends to bring split failure on the leg joint which was composed of Lagscrewbolt(LSB). LSB is screwed into the joint and connected by bolt with the other member, which leads to relatively high initial stiffness and strength. As one of the future research needs for the design of timber portal frame composed of LSB, consideration on split failure is necessary as described above because LSB itself tends to resist against shear force.

In this paper, we developed a mechanical model to predict the ultimate force when the leg joint fails by split. In this model, it was assumed that LSB was rigid body and also that it was rigidly connected with base steel member even if shear force and moment by external force are acted on the leg joint at a same time. Due to these assumptions, it was able to obtain the embedment stress distribution along the axis of LSB by superposition of triangular distribution stress derived from rotational moment and uniformly-distributed stress induced by shear force. Finally, we assumed that the split failure at leg joint will occur when tensile stress perpendicular to the grain which is equilibrium with this embedment stress reaches to a critical value.

The static lateral loading test whose shear span is enough short to be failed on split mode was carried out to obtain the shear strength. And the tensile thin plate test whose thickness is 50mm and the other parameter is same as the leg joint specimen was carried out to obtain the tensile strength perpendicular to the grain on the split failure, then substituting it into the model. Comparing the results on the lateral loading test to that calculated by the mechanical model, the validity of the modeling was confirmed to be reasonable.

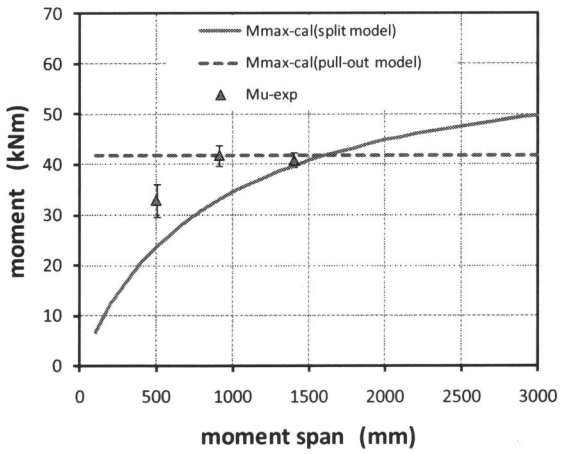


Figure. Test results of loading test on the joints and calculation for moment and moment span