ABSTRACTS (MASTER THESIS)

Evaluation of load carrying capacity on Japanese traditional timber joint with live oak fastener

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Introduction

Wood-to-wood joint is generally used on Japanese traditional timber buildings. Traditional timber buildings have been constructed based on empirical rules and craftsmanship of carpenters. In these days, scientific analysis of traditional timber joint requires a further progress. It is necessary to reveal a strength properties of the joints. This study discusses the three types of joint (Sya-chi-sen joint, Komi-sen joint and Hana-sen joint) for evaluation of their tensile performance. The final purpose is to propose a mechanical model. Furthermore, a material test was carried out in order to clarify the mechanical properties of live oak that have been used as a fastener.

Materials and Methods

Material test of live oak (test 1), tensile performance test of Sya-chi-sen joint (test 2) and tensile performance test of Komi-sen joint and Hana-sen joint (test 3) are discussed. Concerning test 1, its purpose was to investigate the influence of mechanical properties by the position among timber cross section, and to grasp the appropriate allowable strength. Test 2 joint specimens was composed of beam and column (Sugi), spline (Hinoki) and inclined shear key connector (live Oak). Joints of 12types was used by changing size of parts which were assumed to affect on joint strength. 3 specimens for each parameter was employed (6 specimens for control). As for test 3, The specimen is consisted of column of hinoki, spline of hinoki and dowel connector of live oak. Pull out force was applied until failure of the joint in Test 2 and 3.

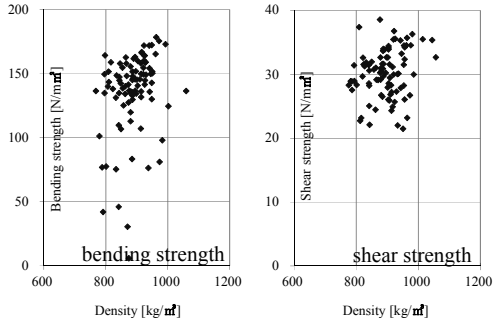

Figure 1. Results of test 1.

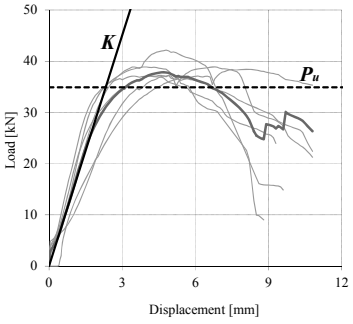

Figure 2. Results of test 2.

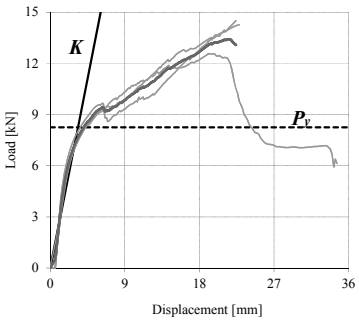

Figure 3. Results of test 3.

Results and Discussion

Figure 1, as examples, shows the relationship between the bending-shear strength and density of live oak. Consequently, it was found that result of each specimen distributed irrespective of annual ring orientation and the correlation to position was small. Furthermore, the influence of defect was remarkable on bending strength but not so significant on shear strength. Concerning test 2, many specimens caused split failure as a result of rotation of Sya-chi-sen. Thus equations to estimate the maximum strength (P_u) were proposed with consideration of splitting failure. Figure 2 shows the test result and calculated values of initial stiffness (K) and P_u. Calculated maximum strength was rather lower than test results, however, initial stiffness corresponded properly. As for test 3, bending- shear crack of key connector were observed as failure mode in most specimens. Meanwhile, in relationship between load and displacement, load succesively increased until maximum load even after yield point. As figure 3 shows, calculated characteristic values suggested by equations for dowel type fastner corresponded properly to test result.