

ABSTRACTS (MASTER THESIS)

Evaluation of strength performance of notched joint on Japanese traditional wooden structure

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

Fumihiro Noda

Introduction

On renewing or retrofitting of traditional Japanese wooden structures, designers have to estimate the strength of whole structures to ensure the safety. Especially the earthquake proof property is the most important subject of structural design in earthquake prone country like Japan. Whole structure's strengths are greatly depends on the performance of each joints in the structure. Therefore designers want to calculate these joints correctly. But the evaluation method of strength of these important joint has not enough developed for traditional timber joints. Especially notched joints which is commonly seen in traditional joint has difficulty in prediction due to the influence of stress concentration around notch.

The purpose of this study is to provide a strength calculation formula, as much as precisely and easily, about the Japanese traditional wooden structure joint having a notch for designers or workers. We investigated "Kanawa-tsugi" and "Konehozo-siguti" in this research, and mention by focusing on "Kanawa-tsugi" in this summary.

Experiment

"Kanawa-tugi" is the longitudinal joint used in the connection of beam-to-beam or colum-to-column joint. It is known that the joint efficiency of Kanawa-tugi in terms of strength is one of the best among traditional joints. It is composed by same shaped member interlocked each other, and fixed by key driven at the center of the joint. In this study, the tensile test for the joint was carried out. The specimens with length of 240, 360 (2 types) and 480mm at joint part composed of 2 kinds of wood species (Japanese Cedar and Cypress) are used as shown in Fig.1. In order to verify the influence of load carrying capacity of notch, one type of specimen was composed without notch part and fixed just by horizontal dowels made of Shirakashi. 6 duplicates are made for each type of specimens. We conducted a static tensile loading examination and measured the relationship between tensile force and relative displacement of two members.

Results and discussion

Almost specimens showed brittle failure mode by shear in parallel to the grain direction originated from the corner of central notch. The strength of the joint become larger when the length of the joint is longer from 240mm to 260mm. However, tensile strength of the joint did not show proportional tendency when joint length become longer than 360mm. We assumed that couple moment concentrated around the notch and the moment influenced on the untimate shear strength of the joint. Thus we introduced a formula to predict the ultimate strength of the joint (P_u) considering this phenomenon. As a result, we could confirm that the estimated value ($P_u = \min[P_{us}, P_{ub}]$) is safer than test results. Then it is concluded that the formula is useful satisfactory.

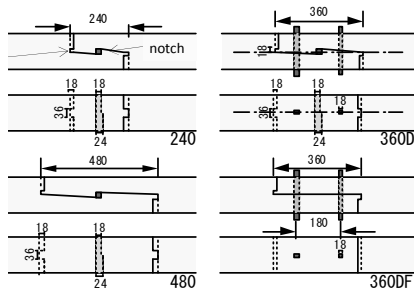


Fig.1 Examination body summary

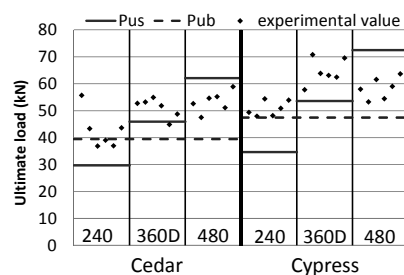


Fig.2 Test result and predicted value