ABSTRACTS (MASTER THESIS)

Study of strength of timber joints with inclined screws and its application on structure

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Materials and Methods

The purpose of this study is to predict the ultimate load and the initial stiffness of timber-to-concrete joints using self-tapping threaded connectors driven into wood with inclined angles. Element test was carried out using 7types self –tapping screws with continuous threads. Test setup is shown in Figure1. Screws of 90mm in length were driven at the interface between the side (plywood 28mm) and middle (Japanese cedar 105mm square) wood member. 7types of inclination angle of screw against load direction were set (-45° to 45°). 0° is the control specimen in which screw was driven vertically to load direction. T type specimens is subjected to the tension force together with shear force due to the inclination angle. And on C type specimens screw was tapped with inclination anlge so that compression force is applied (see Figure2). To eliminate the influence of friction between members a Teflon sheet was placed at boundary of wood components.

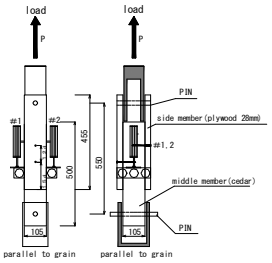

Figure 1. Tensile test setup

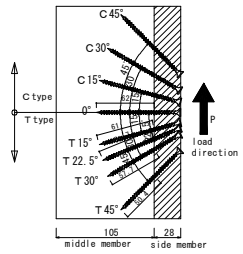

Figure 2. Inclination angle of screws

Results and Discussion

The load-deformation curves obtained in the tests are shown in Figure3 and Figure4. For the screws with an angle of T30° between the screw axis and the force direction, the load-carrying capacities was larger than the value for screws loaded perpendicular to the fastener axis. Due to the decrease of embedment length of the screws in the middle wood member with increasing angle, the load-carrying capacity for the timber-to-timber connections with an angle above T45°become smaller. Also a remarkable point is the steady rise of the initial stiffness with increasing angle between the screw axis and the grain direction in T type fasteners. The dependency of the connection stiffness on the angle between the screw axis and the force direction can be seen in Figure3. In comparison to the timber-to-timber connections with screws loaded perpendicular to their axis, the connection with T45°screws reached almost 20 times higher connection stiffness than that of usual 0° screws. On the other hand, C types did not show a remarkable improvement on load-carrying capacities or the initial stiffness due to side wood member moved apart from middle member according to loading from early timing. (see in Figure4)

As expected, the connection failure was caused by reaching the withdrawal and bending capacity of the screw and the timber embedding strength. The strength value is a total of resistance force derived from those components. Timber-to-timber connections with fasteners loaded perpendicular to their axis failed due to a combined embedding/ bending failure. With increasing angle between the screw axis and the grain direction, the ratio of withdrawal component against strength became greater.

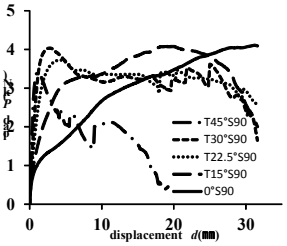

Figure 3. Load- deformation curves of T type specimens

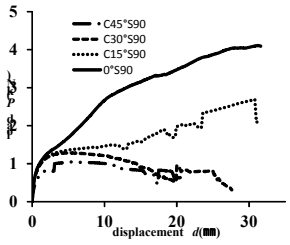

Figure 4. Load- deformation curves of C type specimens