## Abstract

Wood as building material is gaining more and more attention in the 21st century due to its positive attributes such as light weight, renewability, low carbon footprint and fast construction period. Cross-laminated timber (CLT), as one of the new engineered wood products, requires more research emphasis since its mechanical performance can allow CLT to be utilized in massive timber structures.

This thesis focuses on revealing one of the key failure mechanisms of CLT, which is usually referred to as the rolling shear failure. The scientific research conducted in this thesis combined both analytical modelling and experimental material testing.

The stresses in CLT cross-layers obtained from a finite-element model were analyzed to differentiate various failure modes possible. Tension perpendicular to grain stress was found to cause cross-layer failure in combined with the rolling shear stress. Experimentally, specimens prepared from 5-layer CLT panels were tested under center-point bending condition. Detailed failure mechanism of CLT cross-layers were recorded with high speed camera to capture the instant when initial failure happened. It is evident that some of the specimens failed in tension perpendicular to grain which verified the modelling results. Variables such as the rate of loading and the manufacturing clamping pressure were designed in experiments to compare their influence to the failure of CLT specimens.

In this research, the failure of CLT cross-layer was updated to a combined consequence of both rolling shear stress and tension perpendicular to grain stress. Future research topics and product improvement potentials were given by the end of this thesis.