Abstract

During an earthquake, shear walls can experience damage around corners of doors and windows due to development of stress concentration. Reinforcements provided to minimize this damage are designed for forces that develop at these corners known as transfer forces. In this thesis, the focus is on understanding the forces that develop around opening corners in cross laminated timber (CLT) shear walls and reinforcement requirements for the same.

In the literature, four different analytical models are commonly considered to determine the transfer force for design of wood-frame shear walls. These models have been reviewed in this thesis. The Diekmann model is found to be the most suitable analytical model to determine the transfer force around a window-type opening.

Numerical models are developed in ANSYS to analyse the forces around opening corners in CLT shear walls. CLT shear walls with cut-out openings are analysed using a three-dimensional brick element model and a frame model. These models highlight the increase in shear and torsion around opening corners due to stress concentration. The coupled-panel construction practice for CLT shear walls with openings is analysed using a continuum model calibrated to experimental data. The analysis shows the increase in strength and stiffness of walls, when tie-rods are used as reinforcement. Analysis results also indicate that the tie-rods should be designed to behave linearly for optimum performance of the wall.

Finally, a linear regression model is developed to determine the stiffness of a simply-supported CLT shear wall with a window-type opening. This model provides insight into the effect of various geometrical and material parameters on the stiffness of the wall. The process of model

development has been explained, which can be improved further to include the behaviour of anchors.