Abstract

This thesis presents an investigation of the in-plane stiffness of wood-frame diaphragms. Studying the stiffness of the diaphragm is important since it affects the distribution of lateral loads to shear walls. In order to determine the force in each shear wall, it is common to classify a diaphragm as either flexible in engineering design. Wood-frame diaphragms have generally been treated as flexible, which distributes the lateral loads using the straightforward "tributary area" approach. The accuracy of this assumption is investigated in this study.

A detailed numerical model is developed for the study of the in-plane behaviour of wood-frame diaphragms. The model is validated with full-scale diaphragm tests, which has not been done so far for other diaphragm models in previous studies. As such, the model can be used as a "virtual laboratory" to predict the in-plane behaviour of wood-frame diaphragms with various configurations. A simplified model is developed based on the detailed diaphragm model to be used in the building analysis. The simplified model consists of "truss units", which can be calibrated using analytical methods. In previous studies, wood-frame diaphragms were generally simplified as beam or spring models, where individual calibration is required for diaphragms with various configurations. Compared with these models, the simplified model developed here is obtained as an assembly of truss units, thus the number of calibration times can be considerably reduced. A case study of a one-storey wood-frame building is conducted to investigate the distribution of lateral loads to shear walls under different diaphragm flexibility conditions. It is found that the wood-frame diaphragm in this work is rather rigid, but is found that the distribution of lateral loads to the shear walls is strongly dependent on the relative stiffness of the diaphragm and the shear walls.