The Racking Performance of Light-Frame Shear Walls

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(ABSTRACT)

The response of light-frame timber shear walls to lateral forces is the focus of the dissertation. The objective of this study was to obtain performance characteristics of shear walls with various aspect ratios and overturning restraint via experimental testing and analytical modeling. Presented are the test data of monotonic and cyclic tests on fifty-six light-frame timber shear walls with aspect ratios of 4:1, 2:1, 1:1, and 2:3. Overturning restraint conditions represent engineered construction and conventional construction practices. The walls representative of the engineered construction were attached to the base by means of tie-down anchors and shear bolts. As opposed to engineered construction, conventionally built walls were secured to the base by nails or shear bolts only. The specimens were tested in a horizontal position with oriented strandboard (OSB) sheathing on one side. To obtain conservative estimates, no dead load was applied in the wall plane during the tests. The nail-edge distance across the top and bottom plates varied from 10 mm (3/8 in.) to 19 mm (3/4 in.). Twelve walls were repaired after the initial tests and re-tested. A mechanics-based model was advanced to predict the racking resistance of conventional multi-panel shear walls using simple formulae. The deflections of engineered and conventional shear walls were predicted using the energy method combined with empirical formulae to account for load-deformation characteristics of sheathing-to-framing connections and overturning restraint. The proposed formulae were validated through comparison with test results obtained during this study. The results of the study serve to further development of a mechanics-based methodology for design of shear walls accounting for various wall configurations and boundary conditions.