

Shake table tests of soft-story woodframe building retrofitted with CLT shear walls

J.W. van de Lindt & P. Bahmani

Colorado State University, Fort Collins, CO, USA

A. Iqbal

BRANZ Ltd., Porirua, New Zealand

G. Mochizuki

Structural Solutions Inc., Walnut Creek, CA, USA

M. Gershfeld

California State University, Pomona, CA, USA



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ABSTRACT: A large portion of the multi-story woodframe building inventory in the United States, particularly along the Pacific coast, have a soft and weak first floor used either for parking or commercial space which require large openings and few walls capable of lateral load. This open space condition results in the earthquake resistance of the first story being significantly lower than the upper stories thus creating first stories that are both “weak” (low strength) and “soft” (low stiffness) in nature. This feature has the potential to allow formation of the soft first story mechanism during earthquakes. The U.S. National Science Foundation (NSF) – funded NEES-Soft project was undertaken to develop and validate economical retrofit concepts for this type of building.

Shake table tests on a four-story full scale model building were performed with different retrofit schemes as part of the experimental investigation. One of the retrofit measures investigated was addition of Cross Laminated Timber (CLT) shear walls at the first floor level for increased seismic resistance. This paper describes implementation of the new shear walls and experimental investigation of the retrofitted building. The shear walls were designed as per U.S. Federal Emergency Management Agency P-807 guidelines to align with the San Francisco mandatory soft-story retrofit ordinance requirements. The tests confirmed the efficiency of the CLT retrofit with expected drifts throughout the structure. Moderate damage was observed at the first story level while the upper three stories exhibited very little signs of distress.