

ABSTRACT

Ramesh, Selvarajah. Ph.D., Purdue University, May 2013. Behavior and design of earthquake-resistant dual-plate composite shear wall systems. Major Professors: Mark D. Bowman and Michael E. Kreger.

The dual-plate composite shear wall concept was introduced to reduce the construction time of tall buildings. A dual-plate composite shear wall is a concrete-filled steel plate assembly. The steel plate assembly is composed of two steel plates connected with steel rods spaced uniformly in orthogonal directions. The objective of this research was to develop details to be used in dual-plate composite shear walls and to investigate the behavior and adequacy of those details.

A 3/8-scale dual-plate composite shear wall was constructed and tested as part of the experimental evaluation conducted during this research effort. First, foundation details and the connection between the specimen and foundation were designed and investigated. Next, details of the shear wall were selected using available standard design provisions. The behavior of dual-plate composite shear walls was investigated through four distinct experimental tests to study the following features: (a) stability of plate assemblies for resisting vertical construction loads, (b) strain compatibility between steel plates and concrete - to determine whether the steel plates and concrete act together for the selected details used in the plate assembly, (c) shear strength of horizontal splice connections between adjacent plate assemblies, and (d) behavior of dual-plate composite shear walls under cyclic load - to determine whether composite shear walls have sufficient strength and ductility to resist earthquake and wind loads.

From the experimental and analytical investigation of the stability behavior of a 3/8-scale two-story dual-plate assembly, it was determined that the plate assembly was able to resist a maximum load of 18 times the maximum expected construction load. Behavior of the composite shear wall under cyclic lateral loading was investigated using

a 3/8-scale 5-1/2 story 30-ft tall T-shaped shear wall specimen. It was determined from the test that if buckling of the plate could be prevented, then the design approach used for the test specimen can be used to design the structural components for dual-plate composite shear walls to resist cyclic lateral loads up to at least 2% drift.