

PhD Candidate: Mirnes Mustafic

Dissertation Title: Out-of-Plane Behavior and Capacity of Steel-Plate Composite with Diaphragm Plates

Abstract:

Steel-plate composite (SC) is a structural system capable of being used for modular construction. The system consists of two steel faceplate connected using tie bars, to create a steel casing and act as in-place formwork for concrete poured into the system. The faceplates have shear studs welded onto the inside surfaces to develop composite action between the faceplates and concrete infill. A novel modular construction technology known as SteelBricksTM (SB) was recently developed as an alternative to conventional SC construction. SB construction differs from conventional SC construction due to the addition of diaphragm plates, replacing tie bars and resulting in individual “C-shaped” modules which further modularize the construction process. Upon initial testing, the design was improved and became known as steel-plate composite with diaphragm plates (SC-DP). SC-DP fabrication differs from SB in that two separate steel faceplates are connected by diaphragm plates. Two test specimens were fabricated using SB technology, while an additional four test specimens were fabricated using SC-DP and tested to experimentally investigate the out-of-plane behavior. The six test specimens differed in the orientation of their respective diaphragm plates, three with diaphragm plates oriented parallel to the direction of one-way shear, and three with diaphragm plates oriented perpendicular to the direction of one-way shear. Two of the test specimens failed in out-of-plane shear and exceeded the predicted capacity, while the remaining four test specimens failed in out-of-plane flexure and exceeded the predicted capacity and also exhibited large ductility prior to failure. Numerical models were benchmarked to the tested specimens so that further insight could be obtained on the out-of-plane behavior of SC-DP through numerical parametric analyses. The analyses were

performed using finite element modeling and through fiber analysis. Using parametric study data, equations for out-of-plane shear and flexure were generated or modified and were shown to conservatively estimate the out-of-plane capacity of SC-DP.