

## ABSTRACT

Kurt, Efe G. Ph.D., Purdue University, May 2016. Seismic Behavior, Analysis and Design of Steel-Plate Composite (SC) Walls to Basemat Connections. Major Professor: Amit H. Varma

SC wall piers are composite alternatives to conventional reinforced concrete (RC) shear walls where the steel rebar curtains are replaced by steel faceplates on the exterior surfaces of the walls. This approach expedites construction by eliminating the need for additional formwork and staging of concrete casting. This approach can also provide structural efficiency if the SC wall cross-section is detailed appropriately with adequate connector elements, i.e. shear connectors and tie bars. The connector elements provide composite action and also restrain the steel faceplates from buckling prematurely (before yielding). Additionally, the concrete infill prevents the steel faceplates from buckling inwards thus improving their stability.

Steel-plate composite (SC) walls are being used in the third generation (Gen. III) of safety-related nuclear facilities and they are also being considered for small modular reactors (SMRs) of the future. There is also growing interest in the use of SC walls for commercial building applications in seismic regions. This interest stems from the perceived structural efficiency and construction (or schedule) economy of modular composite construction. This study describes the seismic behavior, analysis and design of steel-plate composite (SC) walls and their basemat anchorage connections. Three sets of large scale

tests were conducted to investigate: (i) the in-plane behavior and design of rectangular SC wall piers without boundary elements, (ii) the performance of two different SC wall pier-to-concrete basemat connections, and (iii) the direct shear strength of reinforcement bar-coupler anchors for SC walls. Test results were used to benchmark 3D nonlinear inelastic finite element models including material inelasticity and geometric nonlinearity. The benchmarked models were used to conduct parametric studies to evaluate the effects of reinforcement ratio, wall thickness, and aspect ratio (wall height/wall length) on the in-plane behavior of SC wall piers. Results of the tests and parametric studies were used to propose preliminary design equations and recommendations for predicting the lateral load capacity of SC wall piers with full-strength and overstrength connections, respectively.