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DESIGN AND BEHAVIOR OF STEEL-PLATE COMPOSITE (SC) MODULAR SLAB-TO-WALL CONNECTIONS

Steel-plate composite (SC) systems have recently emerged as an efficient structural solution in several sectors, including nuclear powerplants, high-rise commercial buildings, and defense facilities. SC offers benefits over traditional reinforced concrete in these applications including increased ductility and modular design reducing construction timelines. SC systems are comprised of two components: a steel module and a concrete infill. Steel modules are typically prefabricated, made with faceplates which are interconnected by a form of tie. Due to the ductility that SC technology can offer, it is being researched for its blast resistance in protective structure applications. It is critical for blast-resistant structural elements to exhibit ductility before failure. Research has been conducted on various SC elements to evaluate their available strength and ductility, but there is limited research on the behavior of connections between SC modules, including T-shaped connections (T-joints). Particularly, the gap in knowledge exists for modular slab-to-wall T-joints, and for simple connections for SC. T-joints are a vital component to the overall strength, stiffness, and ductility of an SC structure. The performance of joints may control the strength and ductility that members can develop. Furthermore, existing SC structures have incorporated a design approach that directly considers the available strength and ductility of their components. This study investigated the behavior of four SC slab-to-wall T-joints through large-scale experimental testing, with a focus on connection designs that can be field-implemented (i.e. no or limited field welding). Each tested connection was then classified based on its available moment strength and rotational ductility from criteria in codes and specifications. An analysis of the available strength of two-way SC slabs with various boundary condition combinations determined by the slab-to-wall T-joints is included. This study also benchmarked finite element models to the experimental results of each connection. A tested fully restrained SC T-joint achieved the plastic moment capacity of connected members subjected to bending moment and a significant rotation capacity. Tested simple SC T-joints transferred nearly negligible bending moment and achieved a significant rotation capacity.