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Department of Civil and Environmental Engineering

In-plane Response of Low Aspect Ratio, Steel-concrete Composite Shear Walls

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Abstract

An experimental study was undertaken to investigate the behavior of large-scale steel-plate composite (SC) walls subjected to in-plane cyclic loadings. The testing program involved four SC walls with an aspect ratio (height-to-length) of 1.0. A bolted SC wall to RC foundation connection was studied. A number of design parameters were investigated, including infill concrete thickness, reinforcement ratio, stud spacing, and tie bar spacing. The pre-test analyses, global force-displacement responses, contributions of the steel faceplates and concrete infill to the resistance, load transfer between the faceplates and infill, and damage to the face plates and infill are discussed. The four SC walls failed in a flexural mode characterized by tensile cracking and crushing of concrete at the toes of the wall and the subsequent outward buckling and fracture of the steel faceplates. The walls achieved the peak shearing strengths estimated using simplified procedures and ABAQUS and LS-DYNA. Pinching of the force-displacement response was observed at displacements greater than those associated with peak load. The faceplates dominated the resistance of the SC walls at the foundation level. The connection of the SC wall to the foundation block had a significant effect on the initial stiffness of the SC walls.

Bio

Andrew Whittaker is a Professor and Chair in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo, and is the Director of the engineering research center, MCEER (www.mceer.buffalo.edu). Dr. Whittaker served as the President of the Consortium of Universities for Research in Earthquake Engineering (CUREE, www.curee.org) from 2005-2011, on the Board of Directors for the Earthquake Engineering Research Institute (www.eeri.org) and the World Seismic Safety Initiative (www.wssi.org) from 2008-2011, and on the NRC committee on National Earthquake Resilience. His research interests include earthquake and blast engineering of buildings, bridges and mission-critical infrastructure, including nuclear power plants. Dr. Whittaker's research is funded by the National Science Foundation, Nuclear Regulatory Commission, Department of Energy, and the Canadian Nuclear Safety Commission. Dr. Whittaker consults to private companies and government agencies on a broad spectrum of topics including ultra-tall buildings, long-span bridges, offshore oil and gas platforms, and safety-related nuclear structures.