A Ten-Year Multi-Phase Research Program on the Seismic Response of Reinforced Concrete Block Shear Wall Components and Systems

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Abstract:

A limited number of studies has been focused on the system-level performance of buildings constructed using reinforced masonry shear walls (RMSW) with different wall cross-section configurations (i.e., rectangular, flanged and with boundary elements) under lateral loads. In addition, within a system of two or more walls, North American design standards (TMS 402 and CSA S304) do not consider the floor slab as a wall coupling element and subsequently ignore such mechanism's influence on the building behavior and its design. The results of a ten-year (2007-2017) research program focused on quantifying the seismic performance of masonry buildings demonstrated that slab coupling increased the overall building capacity but also pushed the strength demand on some wall beyond their original design capacities. These increased demands may lead to unpredictable failure modes, and subsequently violate capacity design principles. This paper summarizes the results of the different phases of the research program which includes a series of RMSW with different end configurations tested as individual components along with other similar RMSW tested within three building systems. Following a brief description of the experimental programs, the study compares the load-displacement behavior, damage pattern, wall demands and ductility capacities between the different walls at the component and system-levels. The results show significant discrepancies between the component-level wall responses and the associated system-level responses due to the slab coupling. The results also demonstrate the enhanced overall seismic performance achieved through using boundary elements, as an alternative wall end configuration, to replace traditional walls with rectangular cross sections. The summarized research program presents key experimental and analytical data necessary to facilitate quantifying system-level seismic performance of RMSW buildings within the next editions of the TMS 402 and the CSA S304 as well as performance-based design standards.

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