A Study on the Out-of-Plane Stability of Ductile Reinforced Masonry Shear Walls Subjected to In-Plane Reversed-Cyclic Loading

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Abstract:

Reinforced masonry shear walls (RMSWs), often constitute the principal seismic force resisting system of masonry structures in Canada and many other countries. During an earthquake, these walls are subjected to the combined effects of in-plane shear and overturning moments from seismic inertial forces, in addition to gravity loading. This combination of loading may precipitate out-of-plane instability of the wall end zones at higher levels of drift, when the end zone longitudinal reinforcement is subjected to cycles of high tensile strain. To prevent this instability, the Canadian masonry design standard (CSA S304-14) stipulates stringent wall height-to-thickness (h/t) limits for the seismic design of ductile RMSWs in Canada. This paper focuses on the second phase of an ongoing three-phase research program with the objective of evaluating these current h/t limits and establishing rational criteria for the out-of-plane stability of RMSWs. Five full scale RMSW specimens with ductile detailing and different height-to-length and h/t ratios, reinforcement volume and layout, axial stress, and loading setup have been tested to date using a lateral in-plane reversed cyclic loading protocol until the lateral load carrying capacity reached 60% of its peak. The results indicate that h/t limits alone are not sufficient for evaluating RMSW vulnerability to out-of-plane instability. A more robust and practical set of criteria may rather be established by setting limits on the axial tensile strain at the wall ends prior to occurrence of toe crushing.

DOI: 10.70803/001c.138280

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