SEISMIC DESIGN COEFFICIENTS FOR COMPOSITE PLATE SHEAR WALLS - CONCRETE FILLED (C-PSW/CF)

This study aims to recommend seismic design coefficients for Composite Plate Shear Walls – Concrete Filled (C-PSW/CF). These design coefficients include the seismic response modification factor, *R factor*, deflection amplification factor, C_d, and overstrength factor, Ω_o. C-PSW/CFs are an efficient seismic force-resisting system, and seismic design coefficients for the system are already listed in ASCE 7-16. ASCE 7-16 prescribes a response modification factor of 6.5, a deflection amplification factor of 5.5, and an overstrength factor of 2.5 for C-PSW/CF. These values were selected based on the performance of similar systems and engineering judgment of the committee. This study seeks to validate these seismic design coefficients and factors and propose any changes required based on the results.

The procedure to quantify these design coefficients is detailed in FEMA P695. These guidelines are designed to either establish seismic performance parameters of a new seismic resisting system or to check the reliability of the existing system.

The C-PSW/CF system is typically provided in the building's elevator core with coupled walls in one direction and uncoupled walls in the perpendicular direction. A previous study on coupled C-PSW/CF system found that a higher *R* factor of 8 better captures coupled C-PSW/CF behavior. As the uncoupled C-PSW/CF system is not expected to provide a similar level of ductility, the original R factor of 6.5 is expected to be sufficient. This difference in ductility is expected because coupled wall systems can rely on coupling beams to provide additional energy dissipation.

This study evaluated the behavior and performance of four planar (3-story, 6-story, 9-story, and 12-story) and three C-shaped (15-story, 18-story, and 22-story) C-PSW/CF walls. The FEMA P695 procedure included the development of representative planar and C-shaped C-PSW/CF archetypes, developing and calibrating numerical models for these archetypes, and subjecting these models to nonlinear static (pushover) analysis and incremental dynamic (time history) analysis. OpenSees, an open-source structural analysis software, was used to develop the nonlinear FEA model and conduct the nonlinear analyses. The behavior of walls without closure plates was also analyzed and compared to the performance of walls with closure plates/boundary elements.

The results of this study indicate that seismic design coefficients of an R factor of 6.5, C_d factor of 5.5 and the Ω_o factor of 2.5 for the C-PSW/CF system appropriately quantify the seismic performance and should be specified in ASCE7. Although no formal study was performed on walls with semicircular or circular boundary elements, the findings in the study can be reasonably extended to these walls as the ductility in these walls is greater due to limited stress concentrations at the corners. Walls without closure plates were also analyzed and determined to have insufficient ductility to meet the performance objectives when designed using an R factor of 6.5, C_d factor of 5.5 and the Ω_o factor of 2.5. Therefore, the table should be updated to differentiate the performance of C-PSW/CFs based on the inclusion of boundary plates.