ABSTRACT

Steel-concrete composite (SC) walls are increasingly gaining interest as an alternative to reinforced concrete (RC) walls for safety-related nuclear facilities. These structures are designed to withstand various loading conditions, including seismic loading. Seismic loading results in combined in-plane shear with axial or out-of-plane moment loading on SC structures. While the AISC N690 design code provides equations to determine in-plane shear capacity, it lacks comprehensive guidance and design equations for combined loadings, such as in-plane shear loading with axial or out-of-plane moment loading. Understanding the behavior of SC walls under these combined loadings is crucial for their optimal design.

This research addresses this gap by performing numerical investigation based on the finite element modelling (FEM) and mechanics-based approaches to analyze the behavior of SC walls under these loadings. The models were verified and validated using data from previous experimental studies. A parametric study was conducted to evaluate the impact of various design and material parameters on the in-plane shear capacity under combined loadings. Based on the parametric data and linear regression analysis, design equations were formulated to predict the in-plane shear capacity. Interaction envelopes were developed to compare the results from these models with those from previous numerical studies. Finally, practical design guidance and design equations were provided to design these structures.