Shear?flexure-interaction models for planar and flanged reinforced concrete walls

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This paper presents information on development, calibration, and validation of three companion macroscopic modeling approaches for nonlinear analysis of reinforced concrete (RC) structural walls, including: (1) the baseline two-dimensional two-node formulation of the Shear?Flexure-Interaction Multiple-Vertical-Line-Element-Model (SFI-MVLEM), (2) extension of the baseline SFI-MVLEM for modeling of squat walls (SFI-MVLEM-SQ), and (3) extension of the baseline SFI-MVLEM to a three-dimensional four-node element for simulation of non-planar RC walls under multi-directional loading (SFI-MVLEM-3D). The models are implemented in the computational platform OpenSees. Models presented are calibrated and validated against experimental results obtained from tests on RC wall specimens that cover a wide range of physical and behavioral characteristics, including: (1) one slender, two moderately-slender and one medium-rise planar RC walls tested under in-plane loading used for validation of the baseline SFI-MVLEM, (2) three squat planar RC wall specimens tested under in-plane loading used for validation of the SFI-MVLEM-SQ, and (3) one T-shaped and one U-shaped RC wall specimen tested under unidirectional and multi-directional loading, respectively, used for validation of SFI-MVLEM-3D. The comprehensive comparisons between analytically-obtained and experimentally-measured wall responses suggest that the analytical models proposed can accurately simulate both global and local wall responses, within their range of applicability. The models capture load?displacement response features of the walls, including lateral load capacity, lateral stiffness, cyclic stiffness degradation, and pinching characteristics, as well as nonlinear shear

deformations and their coupling with flexural deformations during cyclic loading. Comparisons between experimental and analytical results at local response levels suggest that the models can also replicate distributions and magnitudes of wall vertical strains and curvatures at various locations. Overall, the analytical models presented provide robust and reliable tools for nonlinear analysis of RC walls, with a wide range of applicability.