Evaluating the Behavior of Shear Walls Under Cyclic Loading Three-Dimensionalby Providing Macro Models

Abstract

The prediction of seismic behavior of walls requires proper applied modeling which could offer a behavior similar to reality. The developed model should be able to predict characteristics of periodic response of shear walls such as initial stiffness, yield point, stiffness degradation, strength deterioration, hysteresis curve and energy loss of walls. In the present study, the two methods of micro and meso modeling are reviewed and compared. The micro model is applicable as long as the local behavior of a structure is concerned, while the meso model is used when significant local behavior is detected only in certain areas. To perform micro modeling, the software ABAQUS 6.13.1 is used and software OPENSEES 2.4.6 is used for meso modeling and non-linear static analysis of shear walls. Three samples of reinforced concrete shear walls are selected and their unilateral and cyclic behavior are compared. Considering insufficiency of experimental studies, design of shear walls with H, L, T sections is conducted using the ETABS software so as to analyze their unilateral and cyclic behavior. The micro and meso models are accompanied with precise information of local behavior but complexity and time-consuming nature of these methods as well as necessity for predicting behavior of walls leads to paying attention to the macro modeling method. Therefore, the shear walls are modeled using two members in OPENSEES; a rotational spring at foot of the wall which simulates non-linear behavior and an elastic member along the wall which represents elastic behavior of the wall. The parameters of the suggested macro model depend on geometrical characteristics of wall and mechanical characteristics of its materials. In sum, 189 models of shear walls are analyzed using macro and meso methods and all models showed a proper match. Then, the macro model is compared with experimental models and efficiency of the macro model is established. The developed macro model is able to predict the general shape of the hysteresis curves, energy loss and initial stiffness.

Keywords: Nonlinear analysis, macro model, cyclic Load, shear wall, reinforced concrete, hysteretic behavior