NONLINEAR SEISMIC SSI APROACH FOR REINFORCED CONCRETE BUILDINGS IN ACCORDANCE WITH ENGINEERING BEST PRACTICES IN US AND JAPAN. PART 2: APPLICATION

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ABSTRACT
The Part 2 presentation describes the application of nonlinear SSI approach presented in Part1 for evaluating the reinforced concrete (RC) shearwall structures behaviour under severe earthquakes. based on the best practices and regulatory requirements in USA and Japan.

The presentation will discuss the application details from the analyst's perspective for performing the nonlinear structure SSI analysis (described in Part 1). Before starting the nonlinear SSI analysis two preliminary preparation steps have to be executed by the analyst using the ACS SASSI UI specialized model cut commands as illustrated in Figure 1 below. Step 1 consists of building the structure FE model with separated shell element groups for each nonlinear RC wall at each floor level, while Step 2 consists of splitting the structure FE model in separate submodels for all nonlinear RC walls.

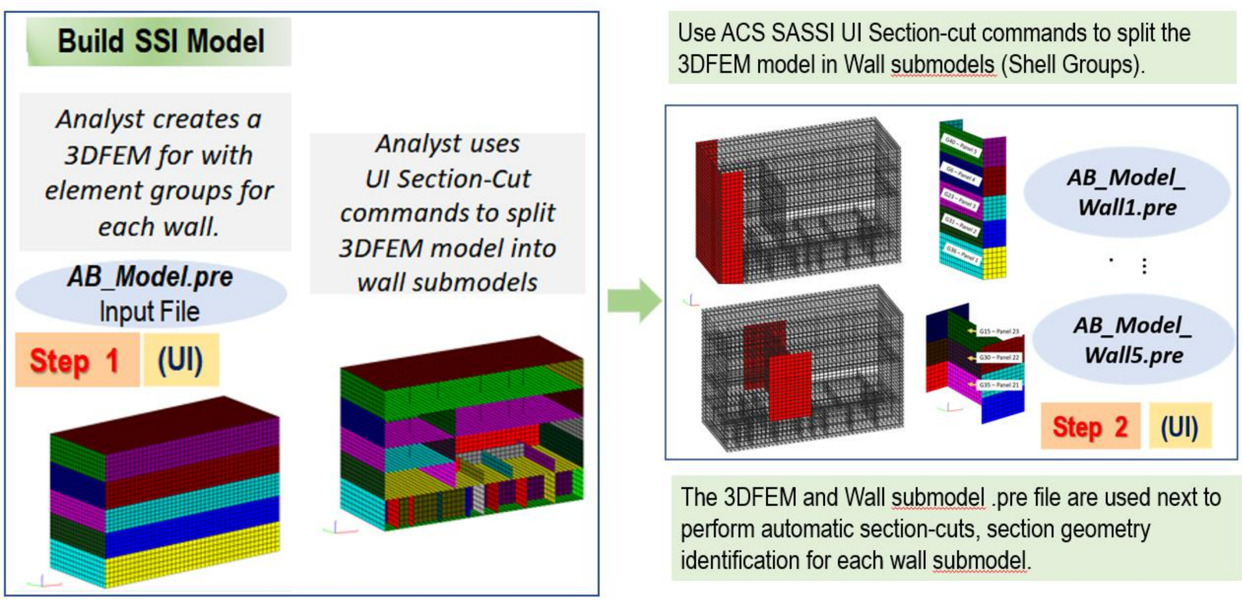

Figure 1. Preliminary Steps for Preparing Wall Submodels

After the two preliminary steps, the nonlinear SSI analysis can be executed using the structure FE model and the wall submodels, as shown in the Part 1 presentation. Additional details will be presented to improve explanations.

The Part 2 presentation will illustrate two demonstrative case studies: 1) A Shearwall RC Building and 2) Tower RC Building. For the two case studies, two severe earthquake levels, described by the RG1.60 spectrum input with 0.50g and 0.70g maximum ground acceleration, respectively.

Nonlinear ISRS, floor relative displacements, and wall hysteretic response loops for the shear and bending effects are compared for different input assumptions and wall hysteretic models. Based on results, commentaries will address the hysteretic damping effects for different hysteretic models, and the combination of the shear and bending deformation effects in walls (1).

Figure 2 shows the nonlinear ISRS computed for three assumptions for handling the interaction effects between shear and bending deformation in walls. For shown results, the shear effects are more dominant for the overall nonlinear behaviour of the structure.

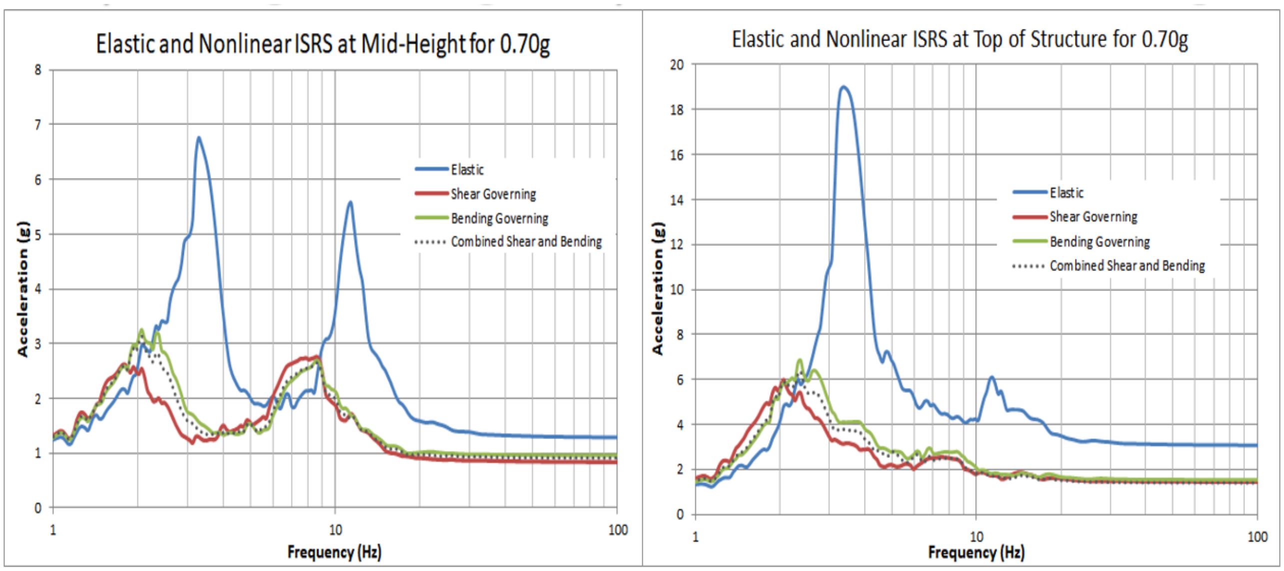

Figure 2 Nonlinear ISRS for Different Assumptions of Combined Shear and Bending Effects

Presentation will provide insightful comparisons of nonlinear SSI results based on the ASCE 4-16 and JEAC 4601-2015 recommendations, respectively. Based on the engineering interpretation of key results, important practical guidelines are formulated.

Finally, the presentation will also include a methodology validation study for the RC Tower Building using the ACS SASSI Option NON against two state-of-the-art specialized PEER OpenSees software for the RC structures using a FIBER model (2) and the MVLEM (3).

Selected References:

1) Cheng, Y. F. and Mertz, G. (1989)."Inelastic Seismic Response of R.C. Low-Rise Shear Walls and Building Structures", Dept. of Civil Engineering, Report 89-30, University of Missouri-Rolla

2) Enrico, S.,Ciampi, V., Filippou, F.C. (1992). "A Beam Element for Seismic Damage Analysis", University of California at Berkeley, Report No. UCB/EERC-92/07. *Reference for FIBER model*

3) Kolozvari K., Orakcal K., and Wallace J. W. (2015). "Shear-Flexure Interaction Modeling of Reinforced Concrete Structural Walls and Columns under Reversed Cyclic Loading", PEER Center, University of California at Berkeley. *Reference for MVLEM.*