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Boundary Conditions for 2D Site Response Analysis in OpenSees

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Abstract : It is observed from past experiences of earthquakes that local site conditions can significantly affect the strong ground motion characteristicssuch as frequency content, amplitude, and duration of seismic waves. The most common method for investigating site response is one-dimensional seismic site response analysis. The infinite horizontal length of the model and the homogeneous characteristic of the soil are crucial assumptions of this method. One boundary condition that can be used in the sides is tying the sides horizontally for vertical 1D wave propagation. However, 1D analysis cannot account for the 2D nature of wave propagation in the condition where the soil profile is not fully horizontal or has heterogeneity within layers. Therefore, 2D seismic site response analysis can be used to take all of these limitations into account for a better understanding of local site conditions. Different types of boundary conditions can be appliedin 2D site response models, such as tied boundary condition, massive columns, and free-field boundary condition. The tied boundary condition has been used in 1D analysis, which is useful for 1D wave propagation. Employing two massive columns at the sides is another approach for capturing the 2D nature of wave propagation. Free-field boundary condition can simulate the free-field motion that would exist far from the domain of interest. The goal for free-field boundary condition is to minimize the unwanted reflection from sides. This research focuses on the comparison between these methods with examples and discusses the details and limitations of each of these boundary conditions.

Keywords : boundary condition, free-field, massive columns, opensees, site response analysis, wave propagation
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