World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:17, No:09, 2023

Implementation of Free-Field Boundary Condition 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 characteristics experience at the site. One-dimensional seismic site response analysis is the most common approach for investigating site response. This approach assumes that soil is homogeneous and infinitely extended in the horizontal direction. Therefore, tying side boundaries together is one way to model this behavior, as the wave passage is assumed to be only vertical. However, 1D analysis cannot capture the 2D nature of wave propagation, soil heterogeneity, and 2D soil profile with features such as inclined layer boundaries. In contrast, 2D seismic site response modeling can consider all of the mentioned factors to better understand local site effects on strong ground motions. 2D wave propagation and considering that the soil profile on the two sides of the model may not be identical clarifies the importance of a boundary condition on each side that can minimize the unwanted reflections from the edges of the model and input appropriate loading conditions. Ideally, the model size should be sufficiently large to minimize the wave reflection, however, due to computational limitations, increasing the model size is impractical in some cases. Another approach is to employ free-field boundary conditions that take into account the free-field motion that would exist far from the model domain and apply this to the sides of the model. This research focuses on implementing free-field boundary conditions in OpenSees for 2D site response analysisComparisons are made between 1D models and 2D models with various boundary conditions, and details and limitations of the developed free-field boundary modeling approach are discussed.

Keywords : boundary condition, free-field, opensees, site response analysis, wave propagation
Conference Title : ICSMGE 2023 : International Conference on Soil Mechanics and Geotechnical Engineering
Conference Location : Rome, Italy
Conference Dates : September 11-12, 2023