Proceedings of the 33rd European Safety and Reliability Conference (ESREL 2023)
Edited by Mário P. Brito, Terje Aven, Piero Baraldi, Marko Čepin and Enrico Zio
 Published by Research Publishing, Singapore.

MULTI-STEP SOIL-STRUCTURE INTERACTION ANALYSIS OF NPP CONTAINMENT BUILDING USING BEAM-STICK MODEL CONSIDERING STRUCTURAL NONLINEARITY

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Seismic response of important structures such as a Nuclear Power Plant (NPP) can be significantly affected by soil-structure interaction (SSI) and nonlinear behavior. In particular, since the effect becomes significant when a earthquake occurs, it is essential to conduct a seismic response analysis that considers SSI and structural nonlinearity. A multi-step method is used to consider frequency-dependent soil properties and the nonlinear behavior of structure. This method transforms the impedance function in frequency-domain into an impulse response in time-domain and applies to seismic response analysis in time-domain as a sway-rocking form. The transform method used to consider the SSI effect in this method is proposed by N. Nakamura [1]. By using this method, computational cost can be reduced when performing a probabilistic seismic response analysis for the fragility evaluation of the NPP structure. However, a multi-step method has been limited to a simple beam-stick model. In this study, a multi-step method is applied to the seismic response analysis of more complicatedly modeled beam-stick structural models. NPP containment building is used as a target structure for seismic response analysis. In the previous study, a simple beam-stick model was used [2], but in this study, a strucutral model with 3 sticks is used. A multi-step method is verified through comparison with the seismic response of the structure using ACS SASSI, an SSI analysis software. Seismic response analysis is performed for various soil profiles and input earthquake intensities, and ISRS (In-Structure Response Spectrum) is compared. By comparing ISRS, the effect of SSI and nonlinear behavior of the structure on the seismic response of the structure is analyzed. Each influences the seismic response of the structure, but when both effects are considered simultaneously, the SSI effect is offset by the large nonlinearity of the structure.

Keywords:Soil-Structure Interaction, Nuclear Power Plant, Seismic Analysis, Structural Nonlinearity

Acknowledgement

This research was supported by UNDERGROUND CITY OF THE FUTURE program funded by the Ministry of Science and ICT.

References

1. Nakamura, N., 2006, Improved Methods to Transform Frequency-dependent Complex Stiffness to Time Domain, Earthquake Engineering & Structural Dynamics, Vol. 35, No. 8, pp. 1037~1050.
2. Yuree Choi, Heekun Ju,and Hyung-Jo Jung., 2022., Time-domain Seismic Analysis of Lumped-mass Model Based on Nuclear Power Plant Considering Soil Impedance Function, Trans. Korean Soc. Noise Vib. Eng., Vol.32, No. 5, pp. 517~526