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COMBINED ASYMPTOTIC METHOD FOR SEISMIC SOIL-STRUCTURE INTERACTION ANALYSIS OF THE MULTIPLY-SUPPORTED STRUCTURES

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Summary

The author extends the previously proposed combined asymptotic method of seismic SSI analysis for the multiply-supported structures. One of the examples of such structures in Nuclear Power Plant is the transportation portal linked to the reactor building by horizontal beams.

The first step still is (like for single-base structure) to develop the dynamic stiffness matrices condensed to the rigid contact surfaces in the frequency domain separately for the soil foundation and for the structure.

For the soil foundation special computer codes like SASSI are used for this purpose. Seismic forces acting to the fixed basements from the soil are obtained along with impedance matrix at this step.

Modal characteristics calculated by FEM computer codes like ABAQUS for the fixed-base structural models are used to develop impedance matrix for the structure. The key step forward from the single-base system was to obtain the dynamic stiffness matrix condensed to the contact surfaces for the multiply-supported system. Dynamic inertia matrix is still used. However, static part appears in the stiffness matrix unlike the singly supported structure. Simple and very fast procedure is developed to avoid any special calculations above usual procedures.

Response seismic motion of rigid basements is obtained as a result of this first step. Seismic excitation may be both common for different basements and different for different basements.

At the second step the platform soil-structure model with "soil" springs and dashpots (different from the above mentioned "wave solution") is analyzed in the time domain using general FEM computer codes like ABAQUS. Platform excitation for this model is specially developed (modified as compared to the seismic motion of rigid weightless basements) to reproduce the previously obtained "true" basements' response motion in the time domain.

The key modification of the initial seismic excitation is that the additional excitation appears in the platform model to account for the difference between the "wave" impedances got from SASSI and the "platform" impedances provided by "soil" springs and dashpots inevitable in the time-domain calculations. This additional excitation in the frequency domain is still (like for the single-base structure)

proportional to the above mentioned difference, but is no longer proportional to the second degree of the current frequency.

Benchmark analyses show the applicability of the proposed formulae.