SEISMIC SSI ANALYSIS OF RB COMPLEX ON PILE FOUNDATION INCLUDING SOIL NONLINEAR HYSTERETIC BEHAVIOR

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ABSTRACT

The paper investigates the SSI effects for a nuclear complex founded on piles. Both floating piles and peak-bearing piles are considered. The paper investigates the effects of the local nonlinear soil behaviour in the vicinity of piles. The effects of inclined S-P incident waves are also included. The paper presents various SSI result comparisons including nuclear complex ISRS, structural displacements, and pile forces and moments. Comparisons between SSI results for the "without piles" and the "with piles" cases are included.

The seismic SSI analysis is performed using the ACS SASSI software (Ghiocel, 2019) that can simulate incoherent motion random wavefields via an accurate Monte Carlo method implementation and include the local soil nonlinear hysteretic behaviour using an efficient iterative equivalent-linearization numerical procedure.

The paper describes an accurate and efficient SSI modelling for the pile foundation within the SSI flexible volume substructuring approach. The SSI model captures accurately both the kinematic and inertial SSI effects that are both important for an accurate prediction of the pile foundation SSI behaviour. In addition, the local soil nonlinear hysteretic behaviour in the vicinity of piles is included.

Computed SSI results show that the pile influence on various SSI responses is weak for the floating piles, and much more significant for the peak-bearing piles. The motion incoherency effects are less significant since the SSI system is a low frequency oscillating system with SSI dominant frequency in the 1-2 Hz range. However, the motion incoherency can increase the pile axial forces and bending moments.

The nonlinear hysteretic soil behaviour in the vicinity of the piles reduces significantly the RB complex ISRS spectral peaks due to the large increase in the local soil material damping in the vicinity of piles, but also could increase significantly bending moments in the piles.

REFERENCES

1) Ghiocel, D. M. (2019). "Sensitivity Studies for Nuclear Island Founded on Piles Including Effects of Seismic Motion Spatial Variation and Local Nonlinear Behavior", SMiRT25 Conference, Division 3, Charlotte, NC, August 4-9.

2) Ghiocel Predictive Technologies, Inc. (2019). "ACS SASSI - An Advanced Computational Software for 3D Dynamic Analyses Including SSI Effects", ACS SASSI Version 4 User Manuals, Revision 1, Rochester, New York, October 28