8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

AN INVESTIGATION ON THE ACCURACY OF AVERAGING METHOD IN FOUNDATION INPUT MOTION PREDICTION OF 3D EMBEDDED FOUNDATIONS CONSIDERING INCOMPLETE WALL CONTACT TO SURROUNDING MEDIUM

Masoud TAHERI
Ph.D. Student, IIEES, Tehran, Iran
masoud.taheri@iiees.ac.ir

Pouran FALLAHZADEH FARASHAHI
Ph.D., IIEES, Tehran, Iran
p.fallahzadeh@iiees.ac.ir

Hossein JAHANKHAH
Assistant Professor, IIEES, Tehran, Iran
h.jahankhah@iiees.ac.ir

Keywords: Kinematic interaction, Averaging method, Incomplete contact, Free field motion, Simplified approach

Averaging method is one of the most commonly used approximation methods in calculating horizontal and rotational components of foundation input. As a pioneer of this technique, Iguchi (1984) presented the equations using the averaging method for calculating the input motion based on the surface ground motion vector and the traction on the foundation. Since calculating the exact stresses on foundation perimeter is complex, in another study using equivalent equations, the same author proposed an alternative simplified solution to solve kinematic interaction problems. Such equations were developed based on Luco's (1986) formulation that only requires the impedance and free field motion of the ground surface at the control points. In another simplified approach, Mori and Suzuki (2012) also developed two methods for calculating foundation input motions. In the first method, using least squares of errors, an algorithm is presented implementing just the geometric characteristics of foundation. The second method, using the weighted average of impedance functions and input driving forces, calculates the foundation input motion.

In current research, one of the conventional approximated methods, called averaging (AV) method, is compared by results came from finite element method, calculated in this study, and also benchmark outcomes based on boundary element concept. The focus of this research is on the embedded foundations with incomplete wall contact to the surrounding soil. At first, foundations with full contact to nearby medium, i.e. d/D=1, are examined. Here D is the embedment depth and d stands for contact length. From the literature of the field, it is known that the AV method would be weak in prediction of horizontal foundation input motion in a range of excitation frequencies, as illustrated in Figure 1-a. However, it provides somehow good predictions on rotational input motion, as depicted in Figure 1-b. Here it is shown that when incomplete foundation-soil contact is introduced to the problem, even predictions on rotational input motion would also be calculated totally wrong through implementation of AV method. At worst case, given zero side wall contact to the surrounding soil, i.e. d/D=, the divergence of predicted horizontal component from benchmarks is more intensified, as shown in Figure 1-c. However, the greatest mismatch of the results between the AV method and the benchmark takes place in rotational input motion. In this case, as shown in Figure 1-d and unlike the reality, the rocking component of foundation is predicted to be zero at all frequencies of excitation. That's while, the real intensity of this component would be more severe than its counterpart for the foundation with complete contact to surroundings. The main reason of such miscalculation is that free field motion, used in AV method, is incapable of introducing through tractions at the base slab of the foundation. This point rises from the fact that conditions are different in the case of a surface foundation in the bottom of an excavation and the case of a surface foundation on the top of the ground. Hence, it concluded that the AV method would not be a suitable approach in estimating foundation input motion when soil-foundation incomplete contact is probable.

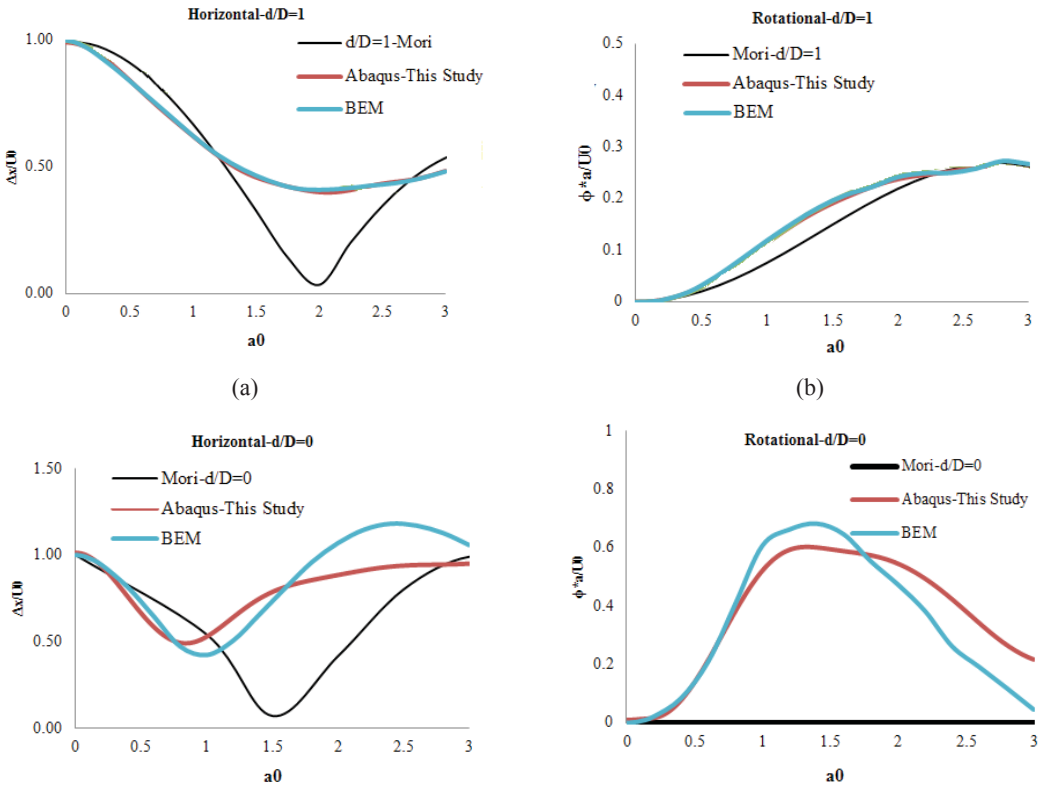

Figure 1. Comparison of averaging method with numerical methods for calculation foundation input motion.

REFERENCES

Iguchi, M. (1984). Earthquack response of embedded founadtion to SH and Sv wave. *Proceedings of 8th World Conference on Earthquake Engineering,* San Francisco (CA), 1082-1088.

Iguchi, M. (2001). On effective input motions: Observations and simulation analyses. *The 2nd UJNR Workshop on Soil-Structure Interaction*, March 6 to 8, Tsukuba, Japan.

Luco, J.E. (1986). On the relation between radiation and scattering problems for foundations embedded in an elastic half-space. *Soil Dynamics and Earthquake Engineering, 5*(2), 97-101.

Mori, M. and Suzuki, T. (2012). Simplified evaluation methods for impedance and foundation input motion of embedded foundation. *Proceedings of the 15th International Conference on Earthquake Engineering,* Lisbon, Portugal.