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

EFFECTS OF HEİGHT OF ADJACENT STRUCTURES ON THE SEİSMİC BEHAVİOR OF MOMENT RESİSTİNG STRUCTURE

Gholamreza NOURI
Assistant Professor, Faculty of Engineering, Kharazmi University, Tehran, Iran
r.nouri@khu.ac.ir

Behrozeh SHARIFI
M.Sc. Graduate, Faculty of Engineering, Kharazmi University, Tehran, Iran
sharifi_shakib@yahoo.com

Keywords: Structure-soil-structure interaction, Adjacent structure, Seismic excitation, Direct method, Nonlinear dynamic analysis

As in cities and urban areas, the building structures are built closely to each other, the dynamic interaction and dynamic coupling of adjacent buildings via the underlying soil should not be ignored. Available evidences show that interaction of adjacent structures has not been paid comprehensive attention. In addition, major researches in this field are subjected to simulate superstructures as lumped mass with a single degree of freedom or two-dimensional models with plain strain behavior, and soil is simulated by spring, mass, and damper, an equivalent impedance function or assumption as a homogeneous, isotropic and linear elastic half-space. Because of this excessive simplification, the complex geometry of the cross-section as well as the wrapping and secondary torsion specially in complicated and massive structures, are ignored, that would be lead to obtain not so accurate and reliable seismic results rather than 3D models, so 2D simplification is potentially risky in the seismic analysis of soil structure interaction (SSI). The result of researches have shown that the structure soil structure interaction (SSSI) effects are very dependent on adjacent structures height in two structures, three structures and a group structures on shallow foundations or deep foundations.

As above, the aim of this paper is study on the effects of adjacent structures height (according to the model as shown in Figure 1 the seismic response reinforced concrete moment resisting structure under different earthquake excitations. In this study, 3D model of five-, ten-, fifteen-story RC frame structures with two (5 m) spans in X direction, two (4 m) spans in Y direction and shallow foundations are employed. OpenSees finite element analysis package is performed to model of the frame and foundation.

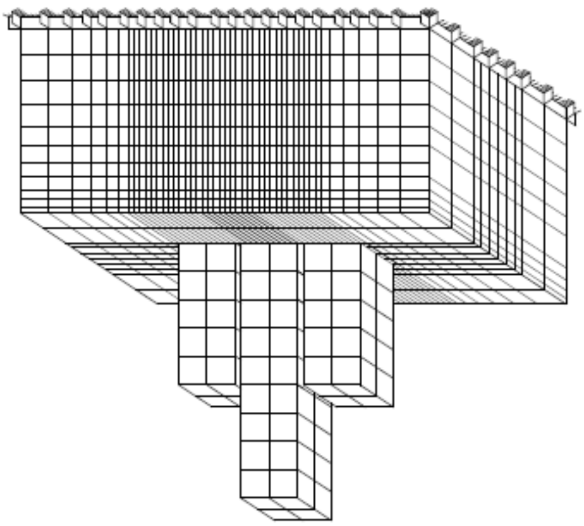

Figure 1. Structure-soil-structure interaction modeling for a group of three structures.

Since the soil media plays a key role in SSI models, by using the finite element method based on direct method, a semi-infinite soil media is modeled. The dynamic properties of the soil considered is extracted of that categorized as type III according to Iranian Seismic Code, with 30 m depth and shear wave velocity of 270 m/s^2, which includes eight-node brick elements, with three translational degrees of freedom along X, Y and Z coordinates and elastic-plastic behavior. In order to the numerous values of soil elements and to prevent excessive computation time, the element size varied from 1 m in each dimensions around the buildings as well as near the surface in the soil to 5 m far from the structures. Boundary conditions comprise fixed boundaries at the lowest level of soil, to model the bed rock and absorbent viscous boundaries, to avoid reflective waves produced by soil lateral boundaries. Absorbent boundaries are made of uniaxial and viscous material with non-linear elastic behavior that located as lateral boundaries in horizontal directions at a distance of 5 times the structure width.

Soil-structure interaction effects on seismic response of structures are examined employing interface elements. Fully nonlinear dynamic time history analysis under three different earthquake records (Iwait, Loma Prieta, Taiwan earthquakes) that have been separately scaled according to the Iranian Seismic Code, are conducted.

Earthquake records have been applied to the combination of soil and structures directly, in three different models; while 10-story structure are surrounded by two other 10-story structures (a group of 10-10-10-story structure), two 5-story structures (a group of 5-10-5-story structure) and two 15-story structures (a group of 15-10-15 story structure). In all cases the maximum value of acceleration, displacement, drift and shear force of stories of centric structure has been investigated (Figure 2). The study of the response of acceleration, lateral deflection, drift and shear force in the stories indicate that effects of SSSI, depend on dynamic characteristics of buildings, frequency content of seismic data and the height of adjacent structures. The results show that by considering different adjacent structures the responses could differ tends of percentages.

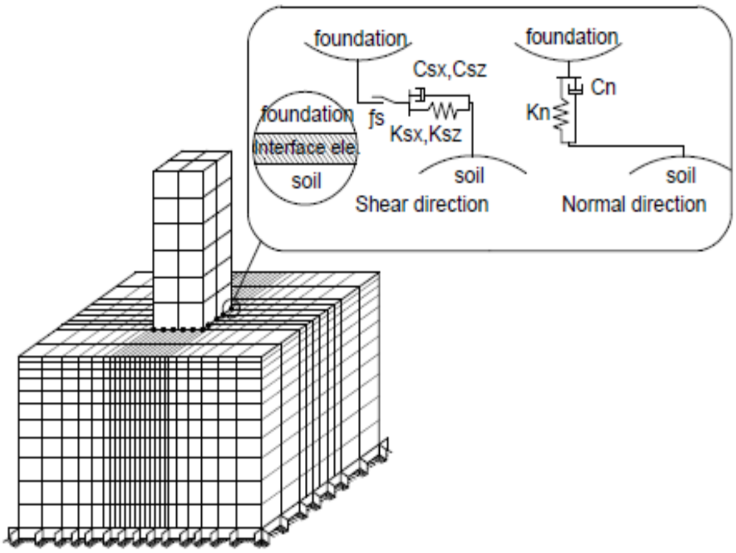

Figure 2. Interface elements in soil-structure interaction model.

REFERENCES

Aldaikh, H., Alexander, N.A., Ibraim, E., and Oddbjornsson, O. (2015). Two dimensional numerical and experimental models for study of structure-soil-structure interaction involving three buildings. *Computers and Structures*, 79-91.

Aldaikh, H., Alexander, N.A., Ibraim, E., and Oddbjornsson, O. (2015). Two Dimensional numerical and experimental models for study of structure-soil-structure interaction involving three buildings. *Computers and Structures*, 79-91.

Alexander, N.A., Ibraim, E., and Aldaikh, H. (2013). A simple discrete model for interaction of adjacent buildings during earthquakes. *Computers and Structures*, 1-10.

Chen, Z., Hutchinson, T.C., and Trombetta, N.W. (2010). Seismic performance assessment in dense urban environments. *Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics*. San Diego, California.

Lianga, J., Hana, B. Fub, J., and Liua, R. (2018). Influence of site dynamic characteristics on dynamic soil-structure. *Soil Dynamics and Earthquake Engineering*, 79-95.

Vicencio, F. and Alexander, N.A. (2018). Dynamic interaction between adjacent buildings through nonlinear soil. *Soil Dynamics and Earthquake Engineering*, 130-141.