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

EFFECT OF LIQUEFIABLE SOIL LAYER POSITION ON DYNAMIC PERFORMANCE OF ANCHORED DIAPHRAGM WALLS- A NUMERICAL ASSESSMENT

Saeed BAHMANI
M.Sc. Student, Faculty of Civil, Water and Environmental Engineering, Shahid Beheshti University (SBU), Tehran, Iran
s.bahmani73@mail.sbu.ac.ir

Babak EBRAHIMIAN
Assistant Professor, Faculty of Civil, Water and Environmental Engineering, Shahid Beheshti University (SBU), Tehran, Iran
b_ebrahimian@sbu.ac.ir

Keywords: Anchored diaphragm wall, Liquefaction, Non-linearity, Dynamic analysis, Deformation mechanism

In order to evaluate the effect of liquefiable soil layer position on dynamic response of anchored quay wall system, a rational numerical model is developed and analyzed using finite difference method. In the numerical simulation, the main wall toe is located in a liquefiable soil layer with relative density of 25%, while other parts of the model are considered as dense sand with relative density of 85%. The Mohr-Coulomb constitutive model is used to simulate the behavior of sandy soil in the static analysis. Moreover, the non-linear UBCSAND models are employed in order to capture pore pressure build up and seismic liquefaction behavior during effective stress based analysis. The anchored quay wall system is schematically given in Figure 1. The sea water is simulated through the hydrostatic pressures applied to the front side of the wall. A finer mesh is used in sensitive areas such as between the main and anchor quay wall, and a certain length about 3 times of each wall's height at back of the anchor wall and in front of the main wall. To save computer analysis time, coarser meshes are used for other areas. The input acceleration wave, shown in Figure 2, is selected as input base motion for the analysis with maximum acceleration of 0.25 g and constant frequency motion of 3 Hz.

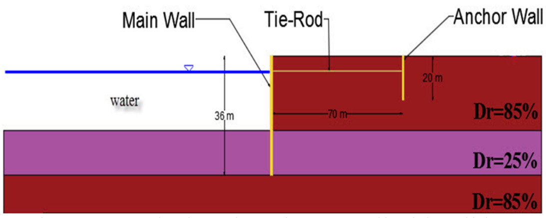

Figure 1. Typical anchored quay wall with soil layers and structural elements.

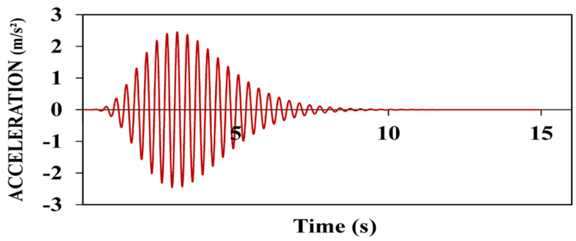

Figure 2. Base acceleration time history.

The calculated results are compared with those of 1 g shaking table tests data, but the final validation results have not been finalized, and they will be presented in the main article completely. In a new modern analysis method named performance-based design, port structures with higher performance grade should be assessed by using more sophisticated methods (Ebrahimian, 2009). After verifying the numerical model using the data obtained from shaking table tests, a series of two dimensional fully nonlinear dynamic analyses are performed to evaluate the seismic performance of anchored quay walls according to PIANC guidelines. The deformed geometry of numerical model and displacement vectors at the end of dynamic loading are shown in Figure 3. Horizontal and vertical displacements time histories of the sheet pile head are also seen in Figure 4.

Results show that soil liquefaction adjacent to the wall root is the main reason for extensive deformations within the system. Considerable movements including seaward displacement for wall, backfill settlement and sea bed heave are observed in the model. According to PIANC guidelines, the horizontal displacement of the top of anchored diaphragm wall for the input motion is less than the allowable displacement based on PIANC.

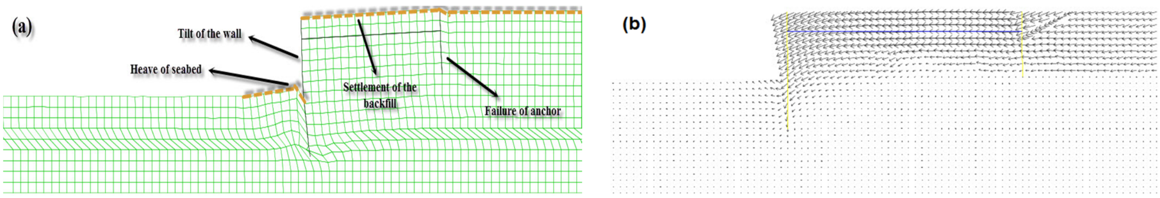

Figure 3. (a) Deformed geometry of numerical model, (b) System displacement vectors at the end of dynamic loading.

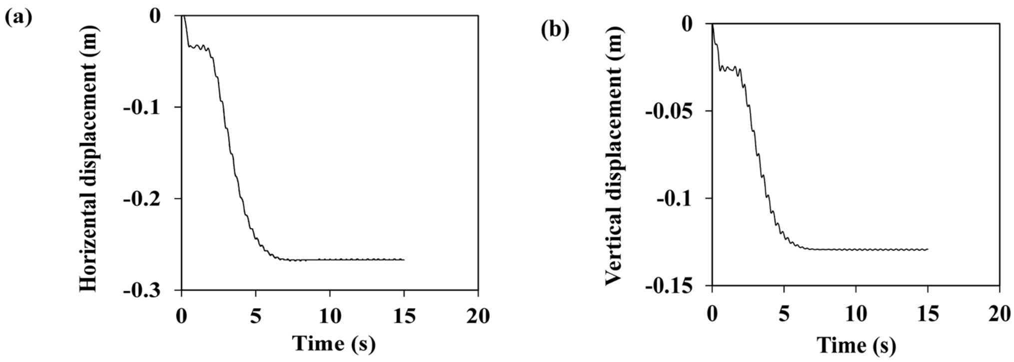

Figure 4. (a) Horizontal displacement, (b) vertical displacement time histories of the top of anchored diaphragm wall.

REFERENCES

Ebrahimian, B. (2009). Seismic performance of anchored quay walls and numerical simulation techniques. *Proceeding of Performance based Design in Earthquake Geotechnical Engineering* – Kokusho, Tsukamoto & Yoshimine (eds), Taylor & Francis Group, London, ISBN 978-0-415-55614-9, 721-729.

Ebrahimian, B. (2009). Pseudo-static and dynamic analysis for an anchored diaphragm wall according to the performance-based design method. *Proceeding of Performance based Design in Earthquake Geotechnical Engineering* – Kokusho, Tsukamoto & Yoshimine (Eds), Taylor & Francis Group, London, ISBN 978-0-415-55614-9, 801-810.

Zekri, A., Ghalandarzadeh, A., Ghasemi, P., and Aminfar, M.H. (2015). Experimental study of remediation measures of anchored sheet pile quay walls using soil compaction. *Ocean Engineering*, *93*, 45-63.