# NUMERICAL STUDY AND REGRESSION MODEL FOR LATERAL SPREADING

Mohsen MAHBOUBINIA
*M.Sc. Graduate, Shiraz University of Technology, Shiraz, Iran*
*m.mahboobinia@gmail.com*

Ali LASHKARI
*Associate Professor, Shiraz University of Technology, Shiraz, Iran*
*lashkari@sutech.ac.ir*

**Keywords:** Lateral spreading, Statistical analysis, Fully coupled dynamic analysis, Constitutive model, Liquefaction

Liquefaction usually occurs in fully saturated loose sands under cyclic loadings. Lateral spreading is one of the most destructive phenomena induced by liquefaction (Engineering & Research, 1985) that causes horizontal displacement due to the loss of stiffness and shear resistance of soil as a result of excess pore-water pressure increases.

During major earthquake events [e.g. San Francisco, 1906; Niigata, 1964; and Chi-Chi, 1999], lateral spreading caused disrupting pipelines, retaining walls as well as shallow foundations due to imposing lateral forces associated with horizontal large displacements.

The existing methods suggested to predict the horizontal ground displacement are divided into three categories: (1) analytical methods employing numerical computing; (2) empirical methods employing statistical analyses based on the field and laboratory observations; and (3) physical modeling using centrifuge and shaking table tests.

In this study, using of a fully coupled soil-fluid FEM formulation in conjunction with a kinematic hardening bounding surface plasticity constitutive model (Jeremić et al., 2008), the lateral spreading phenomenon is simulated and impact of a number of influential factors on the lateral spreading ($D_m$) such as the peak ground acceleration (A), duration of cyclic loading (T), depth of the liquefiable layer (H), ground slope (S), and the soil density (Dr) is investigated. Then, a new empirical correlation is developed for predicting the maximum ground displacement due to the lateral spreading:

$$\ln D_m = -3.3 - 0.081Dr + 0.132T + 0.338S + 0.284H + 3.186A \qquad (1)$$

Equation (1) implies that increase in the duration of cyclic loading, depth of the liquefiable layer, ground slope and the peak ground acceleration lead to increase in horizontal displacement. However, the increase in the soil density leads to the decrease in horizontal displacement. In Figure 1, predictions obtained from Equation (1) are directly compared with the simulated data of FEM analyses of lateral spreading.

(a) (b)

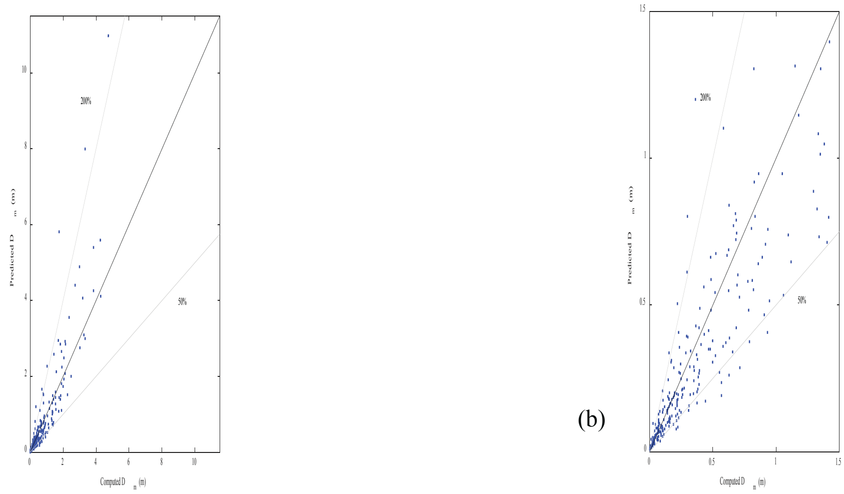

*Figure 1. Computed versus predicted displacement (a) all data (b) displacement up to 1.5 m.*

**REFERENCES**

Jeremić, B., Cheng, Z., Taiebat, M., and Dafalias, Y. (2008). Numerical simulation of fully saturated porous materials. *International Journal for Numerical and Analytical Methods in Geomechanics*, *32*(13), 1635-1660.

National Research Council (1985). *Liquefaction of Soils during Earthquakes*. Washington, DC: The National Academies Press, https://doi.org/10.17226/19275.