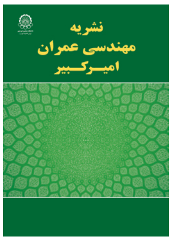

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Evaluation of Soil-Structure Interaction Parameters in Static and Dynamic Response of the Retaining Wall

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ABSTRACT: Doing deep excavation in urban limited spaces, stabilization of massive soil slopes and construction of large coastal walls require using the new methods and accurate calculation and analysis. So, in this study the finite element method (FEM) with ABAQUS software was used to modeling of the retaining wall. To evaluation of wall and soil behavior accurately, solid element and non-linear behavior material was used to demonstrate more exactly responses of retaining wall. Also the structure response calculated for different parameters in concrete and soil. More than 50 analysis were used in this study. Sensitive analysis in interaction parameters and material behavior was considered to calculate the maximum displacement at the top and shear stress at button. It is shown that density changes are more important in the static and dynamic response of structures, "and in dynamic analysis, the sensitivity parameter will increase about 30 percent more comparing static analysis"

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1- Introduction

Development of the construction and the growing scarcity of land, the construction of civil projects has been posted in hilly areas. So, the most benefit way to prevent of this structure and sliding of the soil is using of the retraining walls. Rankine [1] with negligible of the internal friction angel between soil and wall also assuming the angel of critical failure wedge is $45+\varphi/2$, obtained this parameters for vertical walls. Also, Coulomb [2] for soil without cohesion, conclude the wall pressure. Maleki and Mahjoubi [3] reach to the new method to description dynamic pressure of soil in backward the wall that in accuracy is more exact from Monobe-Okabe famous relationship.

2- Equations of Motion Interaction

Conversional method to solution soil-structure interaction issue is sub-structure method. In this method has been assumed soil-structure interaction accrue just between common border of sub-structures. Equation of sub-structure motion that has been shown in Figure 1, can be write as matricidal form according to Equation 1.

$$[M]\{\hat{\ddot{u}}\}+[K]\{\hat{u}\}=\{\hat{Q}\} \qquad (1)$$

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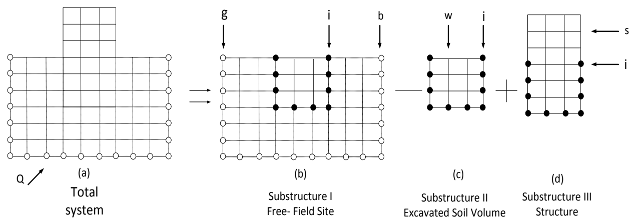


Figure 1: Sub-structure separation in order to simplify the calculations [6]

3- Material Characters

3- 1- Drucker-Prager Model

Simulation of non-linear part of soil behavior has been adapt from modified Drucker-Prager (capping) [7].

Table 1: Mechanical characteristics of soil

ρ	φ	fs	ϕ	Damping		E	υ
kg/m^3				γ	η	N/m^2	
1700	35	0.8	4.81	10	0	107.1e6	0.4

3- 2- Concrete Behavior Model

This model using non-linear behavior, descripts compression and tension of concrete that shown in Figure 2 [7].

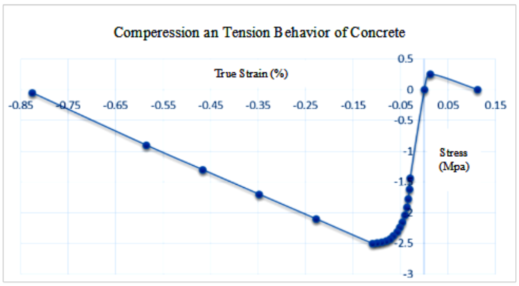


Figure 2: Compression and tension behavior model for concrete

4- Finite Element Model

The ABAQUS software was used to modeling and solution the coupled interaction equations.

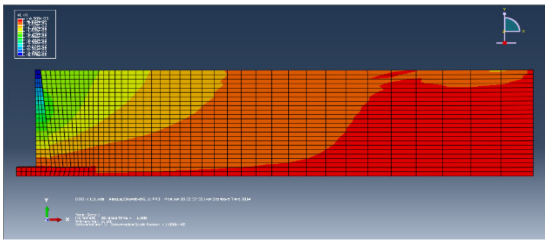
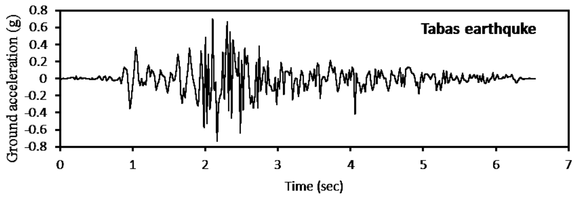


Figure 3: The retraining wall was be modeled in ABAQUS

5- Loading

The loading applied in two parts as static and dynamic load. In static part, gravity effect and in the dynamic part, Tabas earthquake was be selected that shown in Figure 4.



"Figure 4: Ground Motion Time History of Tabas"

6- Finite Element Numerical Analysis

6- 1- Static Analysis

Maximum displacement in earthquake direction at the top of the wall was be considered as response. Since the parameters have not same dimensions so, dimensionless parameter β has been define and could be obtain from Equation 2.

$$\beta = \left| \frac{R}{\alpha} \right| \qquad (2)$$

β = Sensitive parameter
R= Variation response percent
α = Variation intended parameter percent

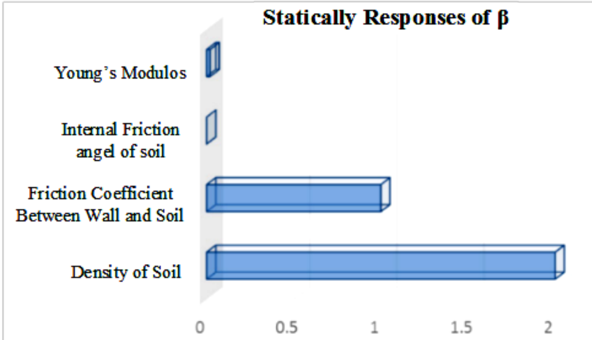


Figure 5: The rate of statically response curve according to the β

According to the Figure 5, the sensitive of structure response dependent to the parameters like density of soil, soil and wall friction coefficient have huge sensitive with 2 magnitude. Furthermore, internal friction angel and elasticity module have a bit impact to the wall response.

6- 2- Dynamic Analysis

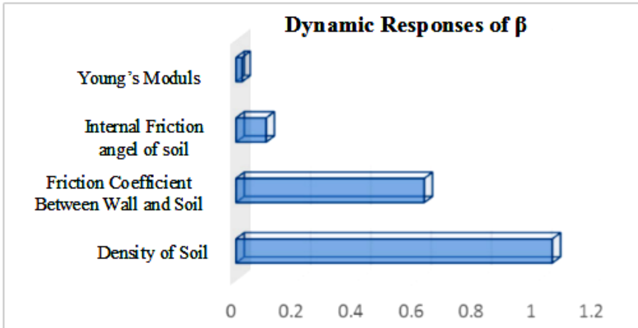


Figure 6: The rate of dynamic response curve according to the β

According to the dimensionless curve of Figure 6, structure response curve depend on evaluated parameters is clearly comparable. So, the parameters like density, soil and wall friction coefficient have huge sensitivity and their magnitudes are 1 and 0.6 respectively. Also, the parameters like internal friction angel and elasticity module of concrete have a bit effect on wall response.

7- Conclusions

In this paper, the effect of interaction parameters have been evaluated. In static analysis, with doubling of soil density, the structure response has been 1.5 time more while, in dynamic analysis, with doubling of soil density, the structure response has been 2 time more. It means that firstly, the parameter of the soil density (soil type) has huge effect on interactional response and secondly, this effect will be more important due to earthquake higher than about 50%.

8- Table of symbol

ρ Density

φ Internal Friction Angel

fs Flow Stress Ratio

ϕ Dilation Angel

γ, η Damping Confessions

E Elasticity Module

υ Poisson's Ratio

β Sensitive parameter

R Variation response percent

α Variation intended parameter percent

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