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Investigation of the factors affecting the deformation and stability of deep excavation walls with the guardian truss structures under Pseudo-Static seismic analysis and its comparison with Static analysis

Mahdi maleki[1]*, Ali nabizadeh[2]

1- Master of Science of Civil Engineering-Geotechnics, Industrial University of Amirkabir, Tehran, Iran
2- Faculty Member of Civil Engineering, Industrial University of Amirkabir, Tehran, Iran

mahdi1793@aut.ac.ir

Abstract

Since the control of deformation and stability of the deep excavation walls under seismic and static loads is one of the important issues in geotechnical engineering. Therefore, in the present study, using finite element method and taking into account Mohr-Coulomb's behavioural model, the effect of different parameters affecting the performance of the deep excavation walls with the guardian truss structures in a quasi-static analysis and its comparison with static analysis has been studied. According to the most important results, the increase in soil resistance parameters (adhesion, friction angle and elastic modulus) reduced horizontal displacement (vertical trench wall) and settling (in the adjacent ground) and swelling (in the bottom of the excavation) and increase the factor of safety of stability will be and by increasing the horizontal distance between the trusses, contrary of this issue is true. In addition, the responses obtained from the quasi-static seismic analysis of the vertical trench restrained by the structure of guardian truss structure (the horizontal displacement of vertical trench wall and the settling in the adjacent ground and the swelling of the floor) are much more than the analysis static.

Keywords: Finite element, Quasi-static seismic analysis, Static analysis, Guardian truss structures

1. INTRODUCTION

The Pseudo-static method is one of the methods of seismic analysis of structures and the first method by which seismic design was possible. In the seismic analysis of the trenches, with this method, instead of applying cyclic earthquake loads to the model, they are eliminated and the forces generated by the earthquake In the form of static forces (KW) where (K) the seismic coefficient and (W) the weight of the structure and in both horizontal and vertical directions, in the form of vertical inertial forces (F_V) and horizontal inertial forces (F_h) where ($F_h=K_hW$) and ($F_v=K_vW$) are applied to the center of the failure wedge and the problem is statically examined. The similarity of the quasi-static method with equilibrium analysis (static method) used by a geotechnical engineer, It makes it easy to understand and do its calculations. The pseudo-static method is used for stability and determination of coefficient of reliability of circular and non-circular linear sliding surfaces of slops is used. earthen slops after excavating and eliminate the stress balance in them tend to move downwards. From the statically point of view, slip occurs when thrust forces overcome the forces of resistance that derive from the shear strength of the soil at the sliding surface [1]. In controlling the safety and stability of the slop, the shear stresses created along the most critical and most likely slip surface should be calculated and compared with the shear strength. There are several methods for stabilizing the trenches. Among these, one of the most widely used methods for deep excavation and stabilization of vertical trenches is the implementation of truss guarding structures that are abundant in the excavation of urban areas with the aim of minimizing the excavation effects onto adjacent structures. To carry out this type of guardian structure, firstly, at the location of the vertical member of trusses, which is located in the vicinity of walls of the trench, wells are drilled, whose depth is equal to the sum of the depth of excavation and an additional amount for the implementation of the underneath pile of vertical member of trusses. In the next step, to create appropriate support for the vertical member of the truss, the end of the well by bars is reinforced and then the