NUMERICAL STUDY OF INVESTMENT BEHAVIOR CONTAINMENT WALLS (CASE STUDY STRUCTURAL GUARDIAN SYSTEMS PROJECT OF HABIB HOTEL OF MASHHAD)

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Abstract
Safe and economic design of containment walls under lateral loads (soil thrust and earthquake) is of particular importance in urban areas, especially in recent years with the increase in construction, excavation operations in some structures such as towers are necessary, despite stabilizing adjacent structures, particularly in urban areas, and to prevent damage to adjacent structures, and loss of lives and property is of the obligation. In the meantime, the use of storage systems such as tensile inhibition (Anchorage) for some reasons such as high reliability, flexibility, speed and ease of implementation are considered by civil engineers.
Recent research results and case studies show that the performance of containment walls in the stabilization and consolidation of digging trenches can be as good as other conventional methods, so that the lateral displacement of the wall based on the record of this type of monitoring, mainly has been between 3/0 to 4/0 per cent digging deep. [1] In this paper, in addition of describing the mechanism of using the inhibition of the stretching procedure for stabilizing soil sampling pit, horizontal displacement containment under wall attached vertical and lateral loads due to the complexity of the soil profile, numerical modeling of the actual situation, in this study the behavior of gravity and lateral load in 13 meter excavation of walls of commercial – residential project Habib by PLAXIS2D software in a two-dimensional form and plain strain conditions with regard to the stage construction (Staged Construction) numerical modeling is based on the actual conditions, and the results obtained from this modeling are compared with the results of the monitoring (Monitoring) horizontal displacement behavior of the different levels of containment wall height. The results show that despite the complexity of the soil and limits on numerical modeling, there is good compatibility between the numerical results and the amount of lateral deformation.

Keywords: stretching ability, Anchorage, numerical study, finite element software PLAXIS2D

Introduction

Soil reinforcement using the stretching ability is a new method that because of being economic and its unique advantages has many applications as a suitable solution for various occasions such as slopes and gables stabilization and increase the load capacity and limit deformations by creating minimum disturbance of the Earth's natural condition, extra security back sewing

method compared with other methods to protect the side slope of globs and excavation and to provide full protection to adjacent buildings and facilities projects that is influenced by the implementation progress every step of the way along the excavation, increased soil mechanical properties due to concrete injection and take advantage of all the work atmosphere to implement the desired structure, is resulted in the growing interest in methods for making containment buildings for stabilization and protection of adjacent structures and the excavation pits. [2]

Pre-stressed concrete grout and Tandem systems, including a stretching ability that is installed in rock and soil. Tractive ability systems containing flexible walls that can be used for slope stability is the best and most effective method among the method of drawing, stretching the walls of the containment walls and permanent system that a permanent wall system lifetime has 75 to 100 years old for its longevity, although it is most widely used in system of temporary walls, temporary wall system has a lifetime of 18 to 36 months, which may be more or less depending on project requirements. [1]

Consolidation grout of the tensile skills is a structural element that is used in the earth's soil and stone to transfer the tensile load that the consolidation grout is drilled through into the ground that has been entered in anchors; the basic components are added to the slurry anchor system includes: 1 - support 2 – height of the released stress (Unbounded) 3 - (Bond). [1]

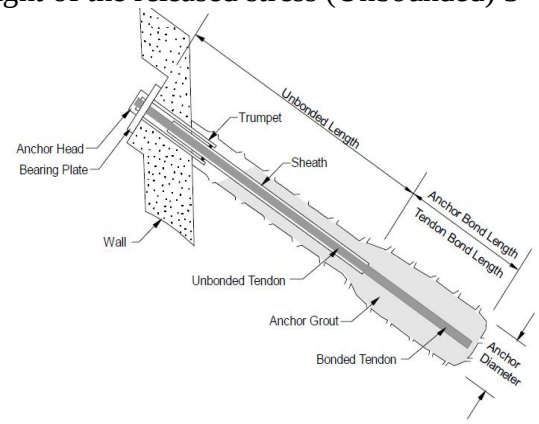


Figure 1 - different parts of the stretching ability. [1]

Research objectives

Significant advances in technology are making it possible to evaluate the behavior of the containment walls and reinforced soil mass by two-dimensional and three-dimensional modeling using finite element method; the proposed method can overcome many of the limitations of other approaches.

Further investigations to assess the horizontal shift of the containment wall tension under vertical and lateral loads, due to the complexity of the soil profile, the numerical modeling of the actual situation, the need to control the accuracy of the numerical modeling and compare them with the actual behavior, in this study the behavior of gravity and lateral loads in the 13 meters excavation of commercial-residential project of Habib Hotel of Mashhad using software, the finite elements of PLAXIS are modeled in a numerical way of two-dimensional plane strain condition, and the results of this model has been nailed to the wall with the results of the monitoring (Monitoring) different elevation levels comparable investment.

Introducing Project

Residential - commercial project of Habib Hotel is located in the province of Khorasan, the city of Mashhad, Imam Reza Street 19, avenue Humayun, No. 26, the structure occupies a surface of 1050 square meters, has 10 ceilings that 3 of the floors are below ground level. In this project the final excavation height is 13 meters.

Excavation pits' stabilization system in this project is using the implementation of inhibitory coupled soil and concrete blocks Mashhad area adjacent sections or inhibits soil-pile-steel walls of adjacent buildings and to establish a level of protection is applied shot Crete. Overview of the scope of the project site is shown in Figure 2.

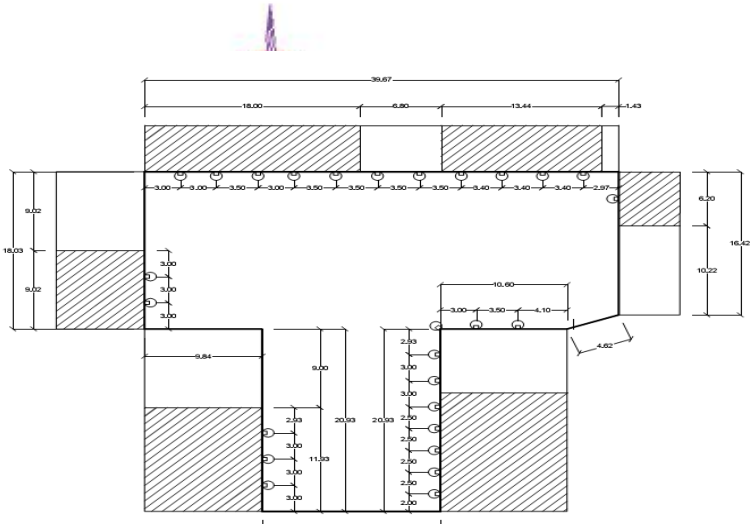
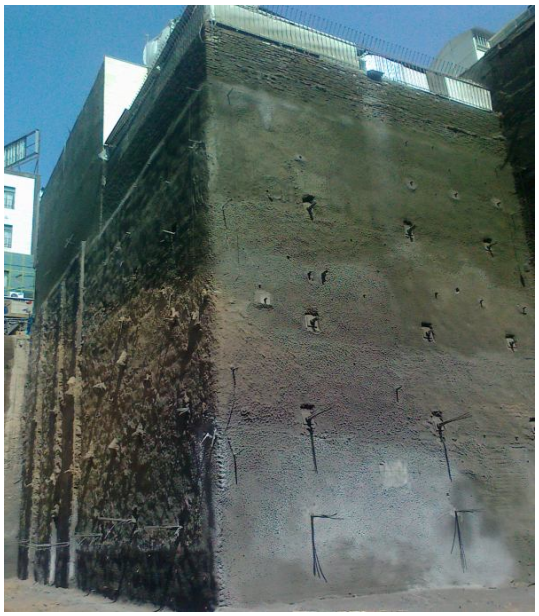


Figure 2 - Plan the project area and the excavation

The guard structure system of this project is designed to be a temporary user; wall containment system has been established as the guardian of the structural system used in this project, depending on the work front has been implemented from stretching inhibition of 3 to 4 rows of variable length from 18 to 12 m ratio of about 3 to 3.5 meter intervals along each wall.

Excavation is done at every stage of the investment to implement containment walls to a height of 5/1 to 2 m. In order to ensure stability of excavation panel, t putting the mesh, width 10 cm is sprayed the concrete (Shot Crete) above the soil surface, and then by drilling (Drill Wagon) nails were installed in accordance with the drawings and specified angle of about 10 cm diameter earthen trenches created and is performed after the insertion rod (nail) by cement grout injection, and after the closing pages of achieving compliance can be done with the safe distance of the first stretching ability drilling and injection. If the support of steel or concrete piles is not funded through stretching ability, the place of concrete bearing is designed based on the dimensions is drilled in the walls and after network install reinforcement network, they are frame-worked and concreting. Concrete block foundation behave as a single and a two-way slab, concrete block dimensions vary according to the drag force exerted on the variable inhibition, and should have sufficient strength against punching shear strength and shear strength. In Figure 3 a view of the east side of the pile steel guard with containment structures stretching and west side of the concrete block is used along with stretching has been shown with inhibit strength. Mapping operation has been recorded to check the movement and operation of the project concurrently studying the project since 26.12.1390 till 25.07.1390.



West side East side

Figure 3 - an overview of the status of containment walls mark the eastern and western side of the project (at a depth of 13 m above ground level)

Geotechnical parameters of the soil profile

Geotechnical parameters and specifications of the project are the most important factors in the design of structural guardian systems as one of Geotechnical Structures. The detailed geotechnical studies prior to stabilization operations, excavation will have an important role in promoting rational, engineering process design and implementation of wall stabilization [6].

Geotechnical studies of the current project are obtained based on the two-loop current borehole drilling machine according to the depth of about 30 meters and a depth of 16 to 23 meters in 4 rings, hand sinks, laboratory tests as well as the specific gravity- determining the natural moisture content, Atterberg Limits, direct shear and tri-axial shear on disturbed samples and intact according to ASTM standard [7], which the results of these tests that are needed for different depths are presented in Table 1.

Table 1 - geotechnical parameters of the soil profile

Poisson ratio	Modulus of elasticity (kN/m^2)	Angle of internal friction of soil	Adherence (kN/m^2)	SPT number N_{SPT}	Specific weight (kN/m^3)	Soil layer	Row
0/25	8000-9000	29	20	25	19	Gritty clay	1
0/25	10000-12000	32	5	35	20	Clay sand	2

Steel pile parameters

According to the results obtained in the project design, the steel piles 2IPE200 length of 15 m was used for the steel pile parameters are presented in Table 2.

Table 2 - Parameters of steel piles

Moment of inertia)cm^4(	Cross section)cm^2(	Poisson ratio	Modulus of elasticity (kN/m^2)	Length	steel piles	Row
38800	570	0.2	$2/05\times10^{11}$	15	2IPE200	1

Inhibition tensile parameters

As the stretching ability is composed of two parts: Bond and Unbond, in these project 4 anchors are all string-like, numerical modeling parameters required for harness tension is presented in Table 3.

Table 3: 6. Inhibition tensile parameters

Sectional area of each strand String) mm^2(	Modulus of elasticity (pa)	Length	Inhibition tensile	Row
140	$2/1\times10^{10}$	8	Bond	1
140	$2/05\times10^{11}$	variable	Unbond	2

Shotcrete parameters

Shotcrete parameter that serves as a protective layer to prevent soil weathering is presented in Table 4.

Table 4-Shotcrete parameters

Poisson ratio	Modulus of elasticity (pa)	Width)m(	Thickness) cm(	Height) m(	Row
0.2	2.7×10^{10}	3	10	13	1

Loads

Table 5 – loads

Loads) KPA(	Front	Run inhibition	Row
22.5	East side	Inhibited the tension with concrete blocks	1
33	West side	Pulling harness with metal columns	2

PLAXIS 2D was the software that was used for numerical modeling in this study, this software is a suite of powerful software simulation applications of geotechnical engineering problems that is designed based on the finite element method and can solve a wide range of geotechnical engineering problems of relatively simple linear analyzes to complex nonlinear simulations, especially considering the interaction effect of soil - structure. The software allows the modeling of soil models and the corresponding elements in the field of geotechnical and soil mechanics in a very simple graphical interface enabling a variety of modeling projects for geotechnical applications in the form of the construction phase (Staged Construction) to users for numerical modeling of reality in order to find a more accommodating. [2]. [3]

The advantage of using finite element analysis is to consider the reliability analysis of anchored wall components, soil and its interaction with respect to both parameters. Also, using this method can study any type of soil profile in a two-dimensional plane strain conditions. One of the reasons for the success of this method in analyzing problems is to use the behavioral models of soil dust which can be used with a wide range of strain soil behavior, the effects of loading rate, reducing stiffness and studied. Finite element method for correlated analysis of correlated two-l and three-dimensional different forms of soil system - structure have a good potential [6].

Numerical modeling

In order to evaluate the behavior of east side of structural systems guard (implementation of inhibitory coupled soil and concrete blocks) Western side (Ctrl soil and pile of steel) Habib Hotel Project and to compare the results of the numerical models to values obtained from the monitoring operation (Monitoring), Structural Systems Guardian project commensurate with the status of the soil profile, overheads values around the pit wall and the pit wall arrangement, placement inhibitory implemented in the finite element software PLAXIS to be two-dimensional, plane-strain conditions, and considering the developed to step built of the wall were modeled.

Numerical model is made up of four parts soil surface sprayed concrete, the harness tension (including the Bond and Ubond) and loads (Table 5) and to reduce the effects of the border, the

soil aggregates will be defined to form three systems. [5]. [8]. The border studies Briaud and Lim (1999) have been conducted based on elastic soil.

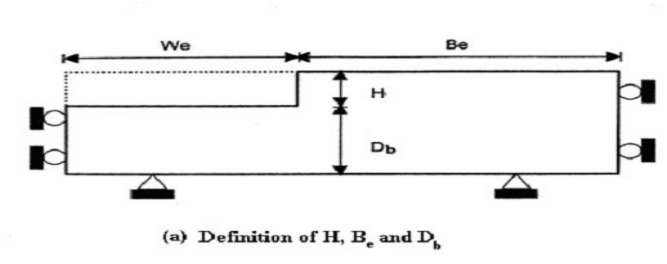


Figure 4 - Area of designation influence

In this span Db is the distance between the bottoms of excavation to a hard layer, as well as the values of B_e W_e are as follows:

$$W_e = 3D_b$$
$$B_e = 3(H + D_b)$$

Figure 4 shows an overview of geometry model with the eastern and western side of the sprayed concrete surface before applying the excavation on the numerical model.

A) Containment walls marked with steel piles B) Containment walls marked with concrete blocks

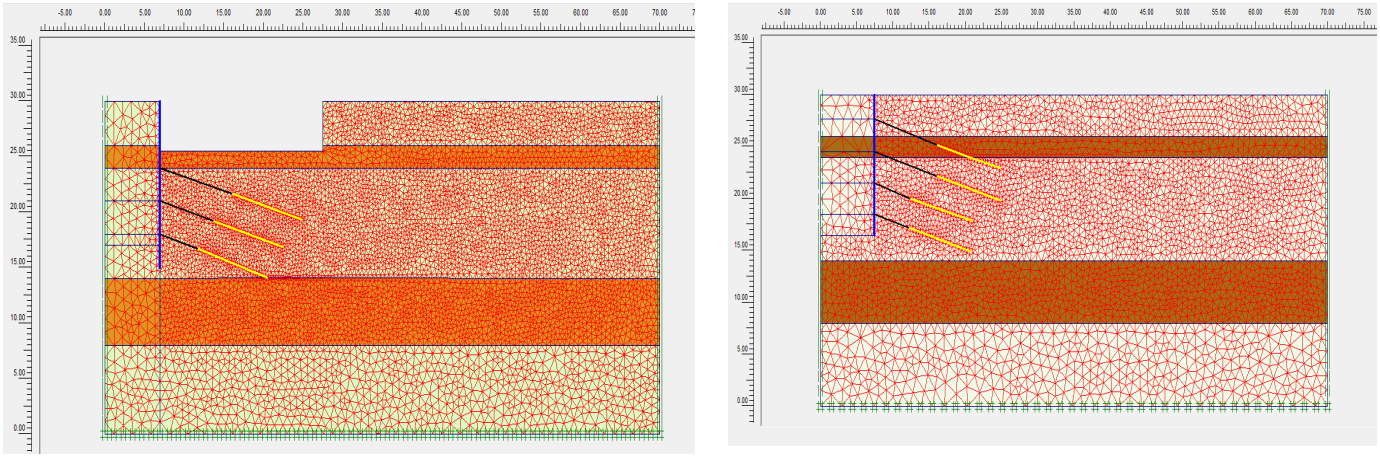


Figure 5 - an overview of the geometry of the containment wall excavation on investment before applying the numerical model

It is notable that regarding the research for modeling the soil's behavioral models Mohr - Coulomb (MC) with the assumption of homogeneity of the soil in the soil profile and the constant Young's modulus for different soil layers for modeling inhibition in the formation of Node-to-node elements having axial rigidity and the inhibitory part of Geogrid elements are used. [3]. [4].

After modeling the soil and exert marked inhibition of the excavation, removal of layers of soil and concrete procedures for the layer implementation and inhibit soil, encoded wall displacements at different depths was evaluated. Figure 6.5 shows the displacement excavation side walls at various levels.

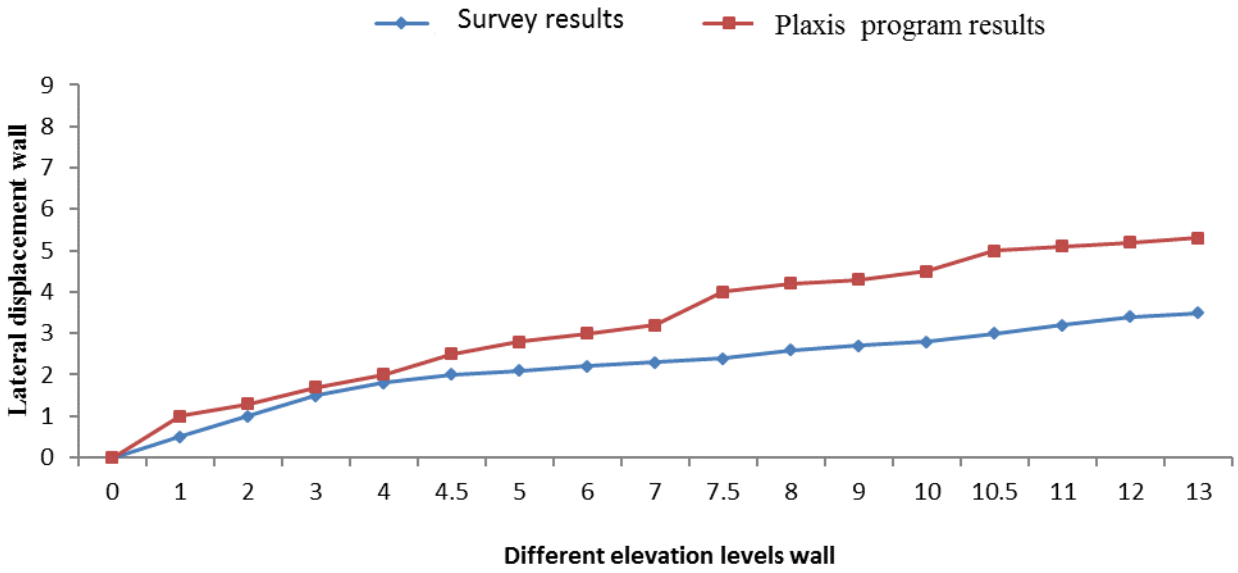


Figure 6 - lateral displacement curve changes from containment wall (west side) at different elevation levels

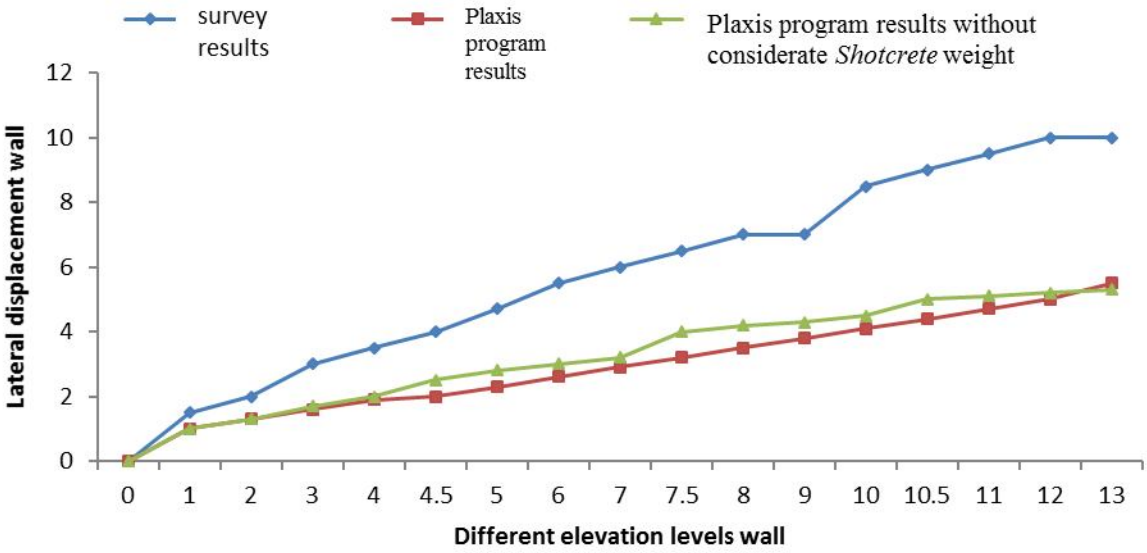


Figure 7 - Lateral displacement variation curves of containment wall (east side) at different elevation levels

As can be seen, with increasing amounts of excavation walls inhibit, the lateral deformations increases to assess the accuracy of numerical modeling, the values obtained from this model were compared with values obtained from monitoring operations, given that the monitoring operations are done at different height levels by a total of 34 pcs reflector mounted on the wall,

compared with the results of numerical modeling results of the monitoring process can be seen in Figure 6.5, there is a compliance and good agreement between the results obtained from the numerical model and the values of the lateral deformations.

Conclusion

1 - Comparison of numerical modeling and deformation values of the lateral wall shows despite the complexity of the soil and limits on numerical modeling, there is a relatively good consistency between the numerical results and the amount of lateral deformation.

2 - With digging depth increase, the deformation of the side wall will increase; increasing the amount of earthworks is consistent with progress of earthworks.

3-As can be deduced from the modeling results the weight of shot-Crete wall is used on the front stretch ability that does not affect the horizontal displacement of wall.

4 - Behavior Mohr - Coulomb model for predicting the direction of this research is to investigate the behavior of rabid walls.

5 - According to the results of displacement values is less than the allowed amount 0.004H.

6 - PLAXIS 2D software as a tool for assessment of the scope of this research is containment to investigate the behavior of containment wall.

7 - In the early stages, excavation is due to the tensile zone. This shift is greater at the edge of the pit, which is the cause of difference in the results of mapping and software.

8 - According to the model were carried out and the results of the mapping, we can conclude that Bond formation in the modulus of elasticity of the grout should be used. As can be seen, in the above chart shows less displacement mapping approach that the results are less well formed plastic parts.

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