



# Technical, economic, and executive survey of retaining wall using three-dimensional numerical analysis and observational data in a case study

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Received: 9 March 2022 / Accepted: 12 August 2022  
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## Abstract

A vast number of studies have been conducted on excavation and its various facets; however, the type of retaining structure and the method of construction are highly affected by executive and monetary issues which have been less taken into consideration. In this study, an excavation with the depth of 15 m in sandy soil that encounters various difficulties including a bewildering geotechnical situation, 12 m water head, so important ancient holy buildings in the vicinity, the paucity of skilled workforce, materials, and construction equipment in the project zone has been chosen as a case study. Anchor, raker, and the combination of them are compared technically and financially as temporary retaining structures. The results showed, on the one hand, anchor is technically better than raker for controlling deflection in the top of the wall. On the other hand, executing anchor under the water table is thorny and risky; therefore, in high walls, a combination of anchor and raker is proposed. The staged excavation was introduced as a competitive procedure in comparison to raker to decline deformation in the bottom of the wall. A comparison between 2 and 3D numerical models indicated the wall deflection in the middle was the same; however, approaching to the corners the results were completely different. The results exhibit wall deflection was affected by corners up to 35 m and horizontal displacement was reduced to half at a 7 m distance from them. A comparison between monitoring data, including inclinometer and micro-geodesy, with numerical analyses, revealed that Plaxis 3D is enough precise to predict deformation in excavation walls.

**Keywords** Retaining wall · Tieback anchor · Raker · Plaxis 3D · Staged excavation · Buttress wall

## Introduction

In today's world, the growing development of the cities and rapid growth of the population has resulted in an increasing need for the construction of residential, commercial, and administrative buildings with a high number of underground floors, the execution of buildings in a steep-slope topography, the implementation of urban tunnels, etc. The planning

and implementation of such structures require performing excavation operations and selecting an appropriate system for the stabilization of the excavation walls.

The stabilization of the adjacent structures and the effect of the excavation operation on them is one of the issues that must be especially taken into consideration in urban excavation operations. In addition to the inherent strength of soil that contributes to the stabilization of the structures, the retaining structures systems are utilized to improve the safety and stability of the excavation walls. There are various methods for the stabilization of the earth walls, each of which is associated with advantages and disadvantages. One of the major issues in this regard is the sensible evaluation of the displacement of excavation walls as well as its effects on the adjoining structures, thereby the selection of an appropriate method for the stabilization. This issue becomes more sensitive and the type and performance of

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