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## Earth retaining structure in Tirana



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### ABSTRACT

A large cinematographic and shopping centre is designed to be built in Tirana. It will be a special structure, partially underground, situated in an excavation of depth 22 m, with a minimum distance of 10 m to a large existing shopping centre. For the first phase of the project, the main engineering challenge was to design a safe and economic structure to ensure the stability of the neighbouring existing shopping centre and the ground itself. This paper is focused on the engineering challenges of the design and construction of the earth retaining structure, which was decided to be a combination of a piled wall and reinforced concrete frames forming a rather complicated structure but a very economical solution. The solution described in this paper made the construction costs drop to 35% of the cost of the initial design. The construction of the earth retaining structure began in 2011 and was successfully completed in 2012. The rest of the project, the commercial centre itself, is still under construction.

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### Introduction

The main project consists of the design of the new commercial centre in eastern suburbs of the capital of Albania, Tirana. The architectural three dimensional view of the commercial centre is shown in Fig. 1, where it can be observed that it lies in a slope, with the back part underground.

The structural engineering team was given the duty to design an earth retaining structure for the first phase of the project. The total length of the excavation that needed protection was 190 m. Based on the architectural design and the topographic survey, it resulted that the depth of excavation would be approximately 22 m.

Besides the large depth of excavation, the problem was complicated due to the presence of an existing large shopping centre at a distance of 10 m, as illustrated in Fig. 2. The existing structure had two underground stories, which induce pressure to the new structure because of the larger depth of the new one.

Another important requirement from the Client was to ensure passage of vehicles at the top of the excavation. This means that the new retaining structure had to be designed for lateral pressure arising from moving loads too.

The new commercial centre is designed to offer lateral support for the earth retaining structure at the bottom part of excavation. However, until the construction of the underground stories of the new commercial centre, the earth retaining structure must be able to support on itself.

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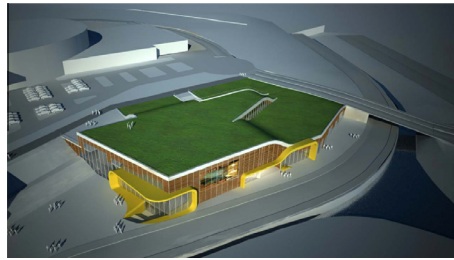


Fig. 1. Architectural three dimensional view of the proposed shopping centre.

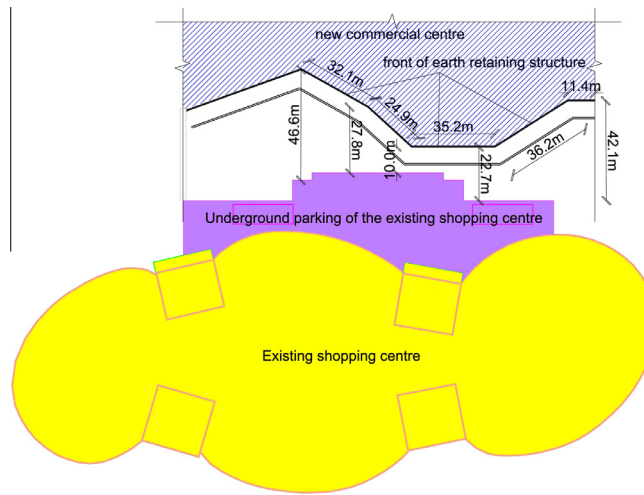


Fig. 2. General layout of new and existing structure.

## Design proposals

There was a structural design already prepared for the earth retaining structure, prepared by another design team prior to engagement of the new team. It consisted of a contiguous piled wall, whose cost was found to be unsuitable for the investor. The two main design proposals are described in the following paragraphs.

### *Contiguous piled wall*

The standard construction practice in Albania is to build contiguous piled walls for earth retaining purposes. Also, the shopping centre on top of the excavation was nearly completed and its investors required a quick solution to ensure the stability of the slope and the shopping centre areas nearby. As a result, the first proposal consisted of a “traditional” contiguous piled wall.

The piles of the piled wall had a total length of 37 m, with 15 m length below excavation and 22 m above the bottom of excavation. Due to the large height, the stability of a cantilevered wall could not be ensured, so anchoring was required. The designed anchors had a total length of 15 m and a large number of them were required. The piles themselves had a diameter of 1 m and axial distance between piles smaller than their diameter.

The main advantage of this proposal was the existing expertise of Albanian contractors in execution of similar works (although, with smaller depth). Given the time limitation induced by the construction of the shopping centre on top of the excavation, the construction of a contiguous piled wall was considered a good solution regarding construction time.

The BoQ of this proposal amounted to 2 million Euros, i.e. approximately 10,500 Euros per one metre length of the earth retaining structure.

### *Piled wall combined with reinforced concrete frames*

The new proposal consisted of a combined earth retaining structure, with a piled wall and a reinforced concrete frame as shown in Fig. 3. The basic idea that led to this design proposal was the drastic reduction of earth pressure in the upper 12 m of the structure. This was achieved by replacing the piled wall with a reinforced concrete frame at the top 12 m.

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