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Cantilever Steel Industrial Building Located on a Rocky Hill

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Abstract

The object of the paper is an industrial building, part of a vineyard, located in a rocky zone of Arad County Romania. The investor and architect requirements led to locate the building at a height of 14.00 m, partially supported by the rocky wall of the hill at one end, while the other end is supported by a reinforced concrete rectangular tower, built near the hill. The show room area (located into a glazed cantilever zone of the building) spans 10.0 m beyond the support tower. Thus, most of the building spans in the air, creating an impression of "suspension". The paper describes some of the problems confronted by the structural engineer during the design phase, also influenced by architectural concepts.

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1. Introduction

The subject of present paper is a new industrial building, part of a wine production complex, located in a rocky zone of Arad County (western Transylvania) with a particularly difficult ground configuration. This site characteristic (i.e. abrupt slope of the hill) has generated considerable difficulties to the whole design team, both architect and structural engineer, imposing as final solution a two level structure. By this solution, the lower building, with a function of wine storage (cellar), was located at the bottom of the slope while the upper one (quite unconventional and actual object of the paper) spans over it, partially supported by the rocky wall. Being involved as a structural engineer in the

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design process, the authors describe the encountered problems and subsequent solutions adopted, focusing on some sensitive aspects of the project.

2. Site description and ground condition

Fig. 1 – Abrupt 14.0 m rocky wall.

A short description of the site, from ground condition point of view, is quite relevant and fully justifies further technical solutions. Figure 1 presents the site configuration and the abrupt 14.0 m step represented by the existing rocky wall. As a result of the performed geotechnical survey (following two 8.0 m deep rock drilling), starting from the surface, successive layers of vegetal soil, then altered / cracked volcanic rock and deeper compact volcanic rock have been found. At 2.50...2.80 m depth (recommended depth of foundation), semi-compact rock with a conventional allowed pressure p-conv=500 kPa has been identified. Furthermore, a low geotechnical risk of foundation ground damage has been estimated by this study, by underground water or cracking of the rock.

At the same time, landslide danger still persisted, starting from the top of the presented wall, under upper building pressure. Besides the conclusions of the geotechnical survey issued after two drillings only, supplementary caution had to be taken with the occasion of up-hill infrastructure excavations, trying to identify ground aspect and possible rock crack initiating (in order to avoid an overall collapse of the rocky wall by global shear).

3. Architectural concept

Considering the investment character and the site characteristics previously described, the architect had to respond to a very complex task, partially imposed by the technological flowchart and partially by client requirement of aesthetic and commercial brand nature [1]. The technological flowchart is presented in figure 2, for both buildings, i.e. the lower building having mostly a function of wine storage (wine cellar) respectively the upper building with double function of industrial processing and commercial (show room for wines).

As for the aesthetic and brand requirement, the Italian investor has required a specific (or “customer tailored”) architecture for the type of commerce in which the company is involved, in other words wine market. The new erected constructions, sheltering modern technology (symbolized by the spots in fig.2), had to be “hidden” under a special finishing adapting them to the rocky environment, to the vegetation and to region traditions. Thus, the upper building (45,0 m long, 20,0 m wide and 6,30 m high) completely built of steel and having an actual cladding of sandwich panels [2], was required to have the outer layer of ivy leafs (hedera) over its whole perimeter, in complete agreement with