

## **EXCAVATION AND SUPPORTED SOLUTIONS FOR THE UNEXPECTED FAILURE CONDITIONS AT SYMVOLO MOUNTAIN TUNNEL CONSTRUCTION**

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### **ABSTRACT**

The tunnel of Symvolo Mountain, which is 1160m long, is placed on South-west of Kavala City at Northern Greece. The tunnel consists of two bores with NW-SE direction, which are connected by two small tunnels. The variety of rock mass quality, the presence of opened faults, and the aquifer's location above the excavation, minimize the stability of rock mass during the excavation and temporary support works.

The aim of the present paper is the description of the dangerous geological status of Symvolo Mountain and the proposed excavation solutions for managing the unexpected failure conditions.

For the above reasons, the sudden changes of the rock mass quality along the tunnel excavation are described. The causes of the geological failures are investigated and the failures are classified. Furthermore, the efficacy of support measures is tested and a relationship between the apparent face of wedges and the shotcrete thickness is proposed.

**KEYWORDS:** Anchors, Bolts, Shotcrete, Support Measures, Swellex, Tunnels

### **INTRODUCTION**

The tunnel of Symbol Mountain is geotechnical located on Rodope mass. The excavation of the tunnel passes through alternations of gneiss, schists and marbles. The quality of the rock formations often changes from sound to weathered. It is, usually, heavily jointed and in many cases is folded. Furthermore, the presence of chloritic schist, lengthen 400m, causes numerous unexpected failures and support problems.

So, the excavation needed to be extremely careful, and for this reason a combination of excavation methods were used. The presences of an opened vertical fault, which is just placed at the exit of the tunnel and creates a shear zone about 400m long, increases the stability problems.

The water table is placed above the tunnel. The presence of water was taking into account during the excavations and support techniques (Anagnostou, 2006).

### **ROCK MASS QUALITY**

At the beginning of the tunnel, the rock mass consists of fair quality gneiss with pegmatite veins, although there is a part of the tunnel between ch.36+300 – ch.36+400 where the quality of a part of gneiss is very poor. Walking along the tunnel, the rock mass quality becomes poor and very poor near the schist formation. At the middle of the tunnel (ch.35+800 – ch.36+300), there is a fair quality lens of marble. Walking to the outlet of the tunnel, we meet alternations of gneiss and marble medium and poor qualified. Between ch. 36+500 and ch. 36+700, there is a formation of chloritic schist of poor quality. That geological formation caused numerous problems during the excavation, as it was weathered very quickly after it was excavated. The last part of the tunnel is placed along a shear zone of an opened vertical fault 15/70 (Figure 2).