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## **Geological evidences of collapse zones in TBM tunneling; a case study of Ghomroud water conveyance tunnel, IRAN**

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### **ABSTRACT**

There are many factors such as equipments, management, personnel skills and ground condition that affected the TBM performance and mechanized excavation. The adverse geological condition that encountered in the tunnel is one of the most important parameters that affect the excavation process. Nature of the adverse geological conditions and fuzziness of them cause to decrease the accuracy of their prediction. It seems there are some evidences that can lead us to detect the problematic zones more exactly. To research the role of the geologic evidences in the collapse zones detection, the data gathered from a water conveyance tunnel excavated in central Iran were considered and analyzed. The rock formations along the tunnel path consist of metamorphic and sedimentary rocks aged from Jurassic to cretaceous. During the tunnel excavation the adverse geological conditions several times cause to collapse of tunnel and subsequently sticking of TBM. The parameters such as quartz content, fragment size and maximum fragment size of cuttings and amount of injected pea gravel behind the lining were monitored during the excavation, especially in collapse zones. The mentioned parameters have a variable rate along the tunnel path and these variations depend on the geologic condition. Quartz content of cutting materials in the collapse zones are higher than surrounding ground of these zones and the fragment size and maximum size of fragments in the collapse zones show an increasing trend relative to the normal condition of ground. Also, the injected pea gravel in collapses decreases in respect of other parts of tunnel. The results of this study show that the monitoring of variation in some geological parameters such as the amount of secondary minerals in cutting materials and the size of cutting fragments, also the amount of injected pea behind the lining of tunnel can help us to better prediction of collapse zones in the metamorphic rocks.

### **KEY WORDS:**

TBM, collapse zone, quartz content, fragment size, cuttings.

## **1. INTRODUCTION**

Mechanical excavation especially excavation with TBM has many advantages over conventional drill and blast methods. These advantages include lower cost and higher advance rate than drill and blast excavation in most cases, improved safety, minimal ground disturbances, elimination of blast vibration, reduced ventilation requirements etc.

There are many factors such as equipments, management, personnel skills and ground condition that affected the TBM performance and mechanized excavation. Ground condition or geology is one of the most important affecting factors in mechanized excavation.

The effect of geologic condition on mechanized tunneling can be grouped into two main categories; the first one is the geologic condition that affects the machine choice and design. Such condition determined before the choice of machine and its designation. The second category consists of adverse geological condition that encountered during the tunnel

excavation and this condition mostly is unexpected or accepted. This means the second group of geological condition has an adverse effect on excavation but we accepted the presence of this condition.

In tunneling projects to determine the situations of these adverse condition, site investigation studies and surface geological surveys conducted before the beginning of excavation and geophysical studies and probe hole drilling performed during the excavation. Nature of the phenomena and fuzziness of the geological problems cause to decrease the accuracy of these determinations, so in real cases prediction of the adverse geologic condition is a rough approximation to what that happen.

To overcome this problem and reduce the fuzziness it is necessary to monitor all the excavation process and ground condition during the work. It seems there are some evidences that can lead us to detect the problematic zones more exactly.

Many researchers have studied geological parameters that affect the excavation and tunneling in difficult geological