Iranian Journal of Engineering Geology
Autumn 2024, Vol.17, No.3

Evaluation of Engineering Geology Hazards in Tunnels with Electerical Resistivity 2D Tomography (ERT)

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Abstract

The construction of underground structures, due to the direct connection with the structure of the rock mass, always has many risks and problems that can endanger the life and financial safety of the project and make the structure face many challenges. Evaluating and predicting these risks is very beneficial in the implementation of the project in all stages of feasibility and design. The use of non-destructive geophysical methods can provide suitable subsurface information to designers with low costs and little time. The intended project in Zanjan province using geoelectrical method, two-dimensional electrical resistance tomography (ERT) was used to evaluate the characteristics of layering and determine the interlayers of Soltanieh formation and by combining geological observations and electrical resistance of the earth. , the amount of rock mass quality (RQD and RMR) has been calculated and according to them, the engineering geological risks of the project have been evaluated and predicted. The results obtained from the electrical resistance measurements have confirmed and refined the stratified rock (stratigraphic column) and geotechnical (rock mass quality) measurements well and can be a suitable solution for the subsurface studies of the project in the stage of recognition and planning. Be

Keywords: *Electerrical Resistivity, Soltanie Formation, Rock Mass Quality, Geological Hazards.*

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Extended Abstract:

1. Introduction

Underground tunnels and spaces are one of the most important engineering structures in the country and due to their direct connection with the rock mass, they have the most engineering geological challenges. Also, since knowing the underground conditions of the earth is very difficult, time-consuming and expensive, therefore, the construction of underground structures is always associated with geological uncertainties. From this method, geophysical methods have been developed as a non-destructive method for identifying the subsurface of the earth. The use of geoelectric technology can be a useful, cheap and fast method to evaluate and determine the characteristics of the earth based on the electrical conductivity potential of the earth's constituents. By using these methods, the position of geological layers and their basic engineering characteristics can be evaluated. Therefore, the challenges and risks of engineering geology can be predicted and evaluated to some extent. The use of Earth Electrical Resistance Tomography (ERT) technology is a useful and practical method for evaluating the initial conditions of the earth and predicting geological hazards in the tunnel route.

2. Materials and methods

The studied area is in Zanjan province and geologically includes Barut and Soltanieh formations. After examining the geological maps and reviewing the resources obtained, the Soltanieh Formation is made up of 7 main members (three Chilean members and four Dolomite members), some of which are outcrops in the region. The electrical resistance method was first used during the years 1900 to 1970 to conduct geological studies. Based on this method, the electric current is transferred into the ground with the help of electrodes, and by measuring the potential difference between the two electrodes, the electrical resistance of the ground is measured. The presence of clay minerals, the saturation of the formations, the weathering of the rock mass, etc. can reduce the electrical resistance of the rock. From the point of view of geological hazards, dealing with faulted and fractured zones containing clay minerals, crushed zones containing water, heavily weathered and falling rocks, interlayers of shale and marl, etc. have little electrical resistance and can be easily identified with this method. are and can cause many life and financial risks during tunneling.

3. Tests results

In this project, 6 profiles with a total length of about 5400 meters were designed in different directions (four profiles along the layering and two profiles in the direction perpendicular to the layering) and the electrical resistance reading was done along them. The results show that there are two shale interlayers and two dolomite interlayers within the scope of the project in the Soltanieh formation, and there is a possibility that the tunnel will hit them. Also, in some sections, the presence of zones with low electrical resistance indicates crushed and saturated dolomite, which can cause water penetration in the tunnel. Also, the results show that the extension of strike shale layers is NW-SE and their slope is about 40 degrees to the southwest.

4. Conclusion

The results show that the geological hazards along the route of this tunnel include hitting the faulted and crushed zone (electrical resistance <150 Ωm.m), the presence of Chile fallout layers (electrical resistance <200Ωm.m), crushed and saturated zones and the possibility Water penetration into the tunnel (electrical resistance <50 Ωm.m). Also, using electrical resistance, you can calculate the RQD and RMR index limits, which results show that Chilean units have RQD=30-40% and RMR=30 and dolomite stone units have RQD=50-75% and RMR=40-60 is.

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