

## **Geohazards analysis of Pisa tunnel in a fractured incompetent rocks in Zagros Mountains, Iran.**

### **ABSTRACT**

The Pisa 2 tunnel with 740 m in length and 20° N trend is located along the Kazerun fault zone in Simply Folded Belt of Zagros, Iran. This tunnel has been excavated in the fractured incompetent marl layers with high expansive pressure of up to 2 kg/cm<sup>2</sup>. In this study, the geological hazards along the tunnel have been recognized and categorized. This study revealed that, in the long-term usage of the tunnel, the lining did not endure against the loading and the secondary leakages. It is mainly attributed due to the non-efficiencies of drainage and isolation systems in the tunnel site. Therefore, it caused asphalt damage, drainage damage, and wall distortion. FLAC3D software has been used in this research. We conducted various analyses for pre-excavation stress states, syn-excavation, and post-excavation strain states. The results showed no indication of instability and critical deformations during the excavation time. It also revealed that due to the non-efficiencies of drainage and isolation systems against secondary leakages and consequently marl expansion, the volumetric and shear strains (i.e., expansions and displacements) have exceeded from the critical states of strain along the tunnel. For various remedy purpose, this paper attempted several measures that can be taken in order to modify the drainage and isolation systems along the tunnel area. The reconstruction of drainage systems with suitable reinforced concrete and adequate slope has been proposed. The width of channel and isolation of backside of lining and implementation of multi-order outlets (i.e., backside of lining) for draining of groundwater into where the main drainage systems are located in the tunnel gallery were suggested.

**Keyword:** Tunnel; Deformations; Incompetent rocks; Zagros belt; GIS; Remote sensing