Numerical Simulation on the Stability of Surrounding Rock of Horizontal Rock Strata in the Tunnel

Nian Zhang [a*], Weihong Wang [b], Zhuoqiang Yang [c], Jianian Zhang [b]

[a] *Associate Professor, School of Transportation and Logistics, Taiyuan University of Science and Technology, Taiyuan city, China.*

[b] *Graduate student of Transportation Engineering, Taiyuan University of Science and Technology, Taiyuan city, China.*

[c] *Lecturer,School of transportation and logistics,Taiyuan University of Science and Technology, Taiyuan city, China.*

Abstract

Horizontal rock strata is a geological condition of rock which is often encountered in the tunnel construction, and it has an important influence on the tunnel construction, it is necessary to analyze and study the stability of horizontal rock strata in tunnel construction to ensure the tunnel construction's safety and efficiency. By taking "Xishan Highway Tunnel" as the research object, and using the numerical simulation method, the numerical model of the tunnel has been established in the Midas/GTS to simulate the tunnel excavation under the horizontal rock strata condition，and the deformation and failure mechanism of surrounding rock and the influence factors of surrounding rock stability after are studied and analyzed. The research focused on the displacement of surrounding rock horizontal and vertical deformation, the results show that the vertical displacement of the surrounding rock is obviously greater than that of other parts during the excavation of the horizontal rock tunnel. According to the calculation results, the optimization measures of horizontal stratum tunnel construction method are put forward, which has important reference value for ensuring the construction safety and construction quality.

Keywords: Highway Tunnel; Horizontal Rock Strata; Stability of Surrounding Rock; Numerical Simulation.

1. Introduction

The stability of tunnel surrounding rock refers to the self-stability of the surrounding rock without any supports, mainly reflected in two aspects, which are surrounding rock deformation and failure [1-4]. The essences of the stability analysis of surrounding rock are the analysis and evaluation of rock mass medium, the relationship between stress and strain. A large number of engineering practices shows that [5-9], the stability of tunnel surrounding rock is not only associated with the quality of geological structure and groundwater, but also with the excavation and supporting of the tunnel of time and form.

Man-chao, et al.(2009) [10] proposed a new approach of Physically Finite Elemental Slab Assemblage (PFESA), in order to construct a large-scale physical model simulating the geologically horizontal strata to capture the mechanism of roadway instability in deep mines. Wang, Yonggang, et al.(2014) [11] considered the mechanical properties of the structural plane and bedrock, and established the anisotropic mechanical model of layered rock mass. The model can be applied to the calculation and analysis of layered rock mass underground engineering. Chen, Wang (2014) [12] based on the study of the surrounding rock of the 2# inclined shaft of the tunnel in the South Lvliang mountain, the main construction methods and technical measures are put forward for the horizontal rock stratum construction of the single track railway tunnel. Peng Yanyan, et al. (2015) [13] according to the mechanical behavior of deformation and failure

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