On-siteTest Study On Defining Loose Range Of Surrounding Rock Of High-way Tunnel sWith Multi-measuring Method

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Abstract: Determining surrounding rock loose circle of plastic surrounding rock stability evaluation was critical parameters for the rational, economic support designed to provide an effective basis. In this paper, relying on field engineering, integrated embedded surrounding rock pressure monitoring and deformation resistivity measurement systems to determine the plastic surrounding rock loose circle to give the plastic surrounding rock loose circle scope, guided the tunnel construction, and it provided an important parameter for the tunnel design.

Introduction

Tunnel excavation would get destroyed the balance of the original rock stress, rock stress redistribution occured, and the emergence of the phenomenon of stress concentration, if concentrated stress exceeds the strength of the surrounding rock tunnel surrounding rock would damage, when the damage to the development of a certain depth ,then a certain looseness extent of damage, namely the tunnel surrounding rock loose circle [1]. Loose rock macroscopic increased mainly as micro-cracks, deformation increases suddenly, cohesion, internal friction angle and deformation modulus decreased. Rock loose change was one of scope and underground engineering support and surrounding rock stability evaluation of important parameters, loose circle had become a key research and evaluation cavern cavern excavation overall stability assessment [2]. Laboratory tests and field trials had done a lot and got a set of rock loose circle theory: the size of the rock loose circle was a function of ground stress and rock strength [3]. Guo Liang based on the principle of ground penetrating radar test demonstrates the feasibility of geological radar in fractured rock zone detection for LTD-2100 using ground penetrating radar in Yunnan Fubon bias tunnel measurement [4].

Therefore, the above method had great limitations, but field data does not make any assumptions about the principles of respect, to give more accurate and reliable test results. Actual project more integrated approach to the means of surrounding rock loose circle-site measurement, thus a reasonable tunnel support parameters to ensure the stability of underground construction.

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Project summary

The tunnel was the national highway network control project for separated tunnel with two-way six lane design, the design speed was 120 km/h. The buried depth of the tunnel, into the hole at the most shallow buried depth was 5 m and the maximum depth was 52 m. The tunnel region for low mountain tectonic denudation landform, vegetation growth. Surrounding rock was granite, weathered, broken, joint development, in order to reveal the formation of planting soil, weathered granite, weathered granite. Rock crushing, coarse granular structure, into the surrounding rock grade V surrounding rock, take three step and seven step excavation method, the excavation method was shown in Fig 1.

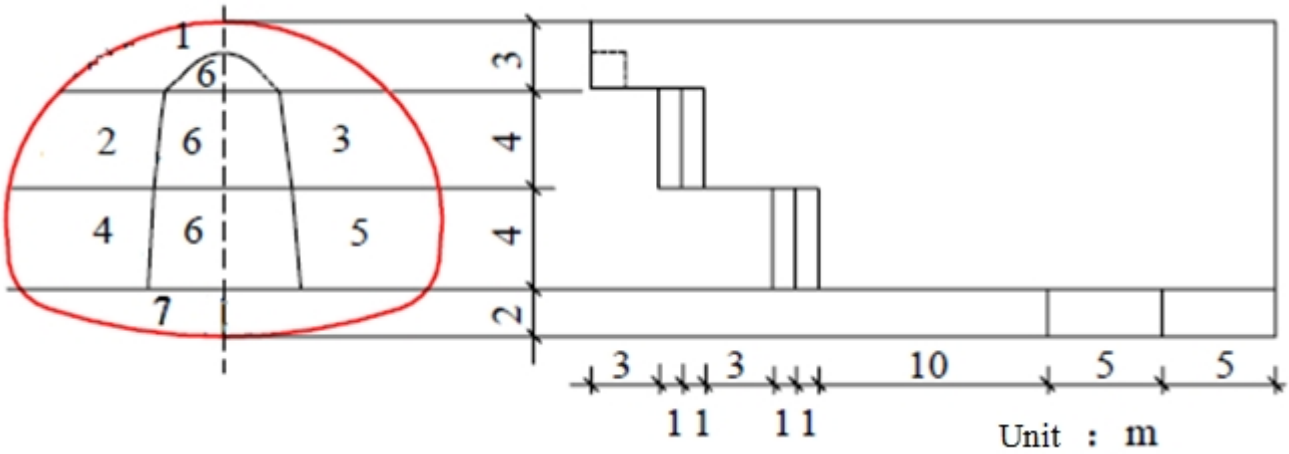

Fig 1 Tunnel excavation sequence

In order to reduce the disturbance division excavation, on the steps taken to leave an annular core soil excavation, the next step shifted around, invert timely follow-up. Core soil retention cycle footage of 1.5 m,which height was 1 m.

Surrounding rock pressure field test

Tunnel with three core specimens from seven-step method of soil excavation, excavation process and more mutual influence between the process, directly affect the tunnel rock pressure adjustment process and distribution, in order to study each step of each process to see rock pressure influence by between surrounding rock and initial support embedded pressure box to monitor the size of the rock pressure and adjust with the characteristics and distribution of rock pressure of time, to understand the state of rock pressure.

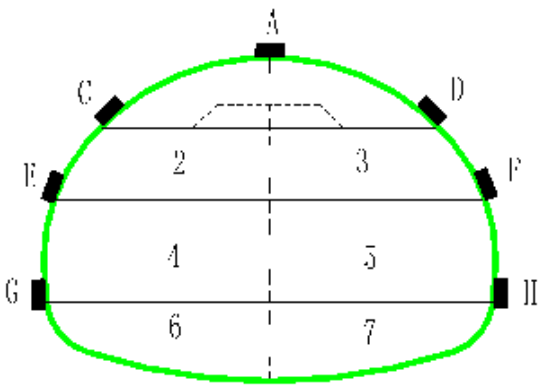

Fig 2 Surrounding rock pressure monitoring points are arranged

Vaults and arches corners of each step was concentrated loads and conversion key parts, so

choose the pressure cartridge was disposed at the crown and arch corner of each step, in order to adjust the pressure of the law of comparative analysis of the left and right sides of the stairs, in two steps side pressure symmetrically arranged boxes, detailing specific arrangement shown in fig2. Section of the surrounding rock pressure monitoring was strongly weathered granite wall rock V grade level, depth of 7.8 meters.

Surrounding rock pressure box can monitor changes in the rock pressure, which can determine the degree of stress release bearing capacity of surrounding rock and supporting structure(refer with fig3).

Fig 3 Surrounding rock pressure box installed realistic picture

Because stress adjustment was the key parts of the tunnel, the tunnel vault and rock pressure on both sides of the arch angle was concentrated area, was at the crown of surrounding rock stability 0.040Mpa, rock pressure arch left corner up to 0.062Mpa, Through the conversion,the depth of loose range of surrounding rock in the crown was 2.82m(refer with fig4).

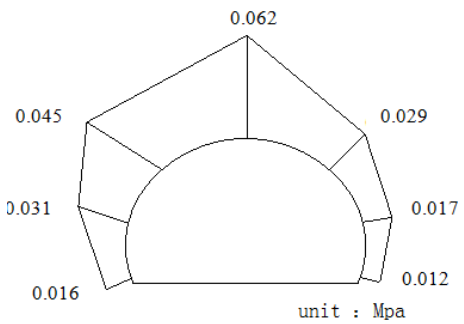

Fig 4 Surrounding rock pressure distribution

Monitoring with resistivity measurement

Resistivity measurement principle

Usually four electrode resistivity measurement, two electrodes were grounded, the electrical current into the ground, the potential of the other two electrodes measuring the resulting difference then obtained resistivity values by calculation. For the Wenner means resistivity calculated as the formula (3-1).

$$r = [\frac{2p}{(1/AM - (1/BM) - (1/AN) + (1/BN))}]\frac{\Delta V}{I} = K\frac{\Delta V}{I} \qquad (3\text{-}1)$$

In the formula:V was Electrode voltage； I was an electrode current； ρwas resistivity.

Monitoring design

Vertical drilling carried out on the surface, were measured with a deformation resistivity method

to study construction in the overlying loose rock deformation. Taking into account the impact of the construction site conditions and surface drilling on the construction, this measure section was drilled near the layout, shown in fig 5, a total of three drilling, vertical drilling were provided in the tunnel crown and two holes in the wall, where the dome drilling depth of 120dm, other drilling was 60dm.

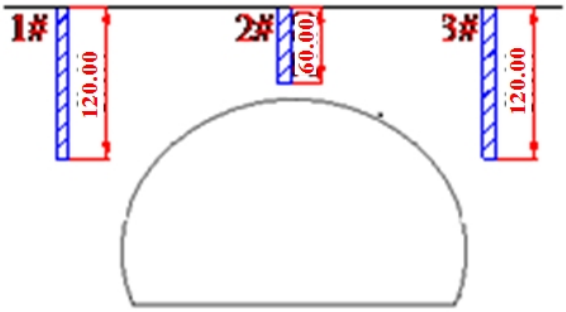

Fig 5 Resistivity method test measured hole layout (unit: dm)

Analysis of monitoring results

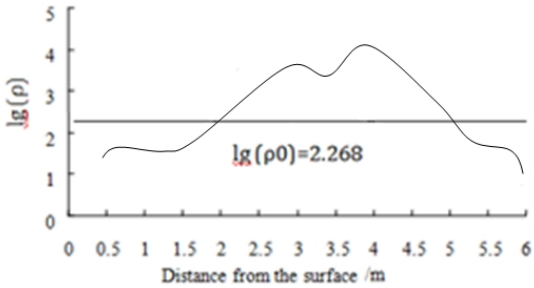

Fig 6 Resistivity curve values correlated with the depth of the# 2 hole

Fig 6 showed the resistivity measurement curve after tunnel through # 2 hole, can be obtained from the figure a lower resistivity within the range of 0-2.0 m, based on the more loose rock formations inside; within the range of 2.0-5.2 m the surrounding rock resistivity higher value can be judged more dense within the formation range by excavation smaller; surrounding rock within 5.2-6.0 m range appear abnormally low resistance, indicating significant cracks in the region, there were obvious cracks.Through the conversion,the depth of loose range of surrounding rock in the crown was 2.60m.

Conclusions

By comparing the two kinds of test results, basically the same rock loose deformation resistivity method and field rock pressure actual measurement results determined circle range.The depth of loose range of surrounding rock in the crown was determinewith 2.71m.Deformation resistivity test data was accurate, simple in principle, to adapt to different types of surrounding rock was an effective determination of rock loose circle.

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