Synthetic Geological Prediction Method Application in Shallow Buried Large-span Highway Tunnel Based on G*eological Survey*

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Abstract： The project was a shallow buried large-span highway tunnel, by means of synthetic geological prediction method before the construction of the advanced geological forecast was an effective measures to ensure the safety of tunnel construction. Based on geological exploration, used high density electrical profile method to detect the thickness of covering layer and determine the position of broken lithologic boundary with fault belt. Combined the tunnel seismic prospecting and through synthetic geological prediction method to detect the west exit tunnel geological conditions to ensure safety construction of the tunnel.

Introduction

In recent years, foreign research and development of a large number of physical and chemical detection equipment used in tunnels and other underground engineering glitches such as the US, Switzerland and other countries in research and development of TSP, ground penetrating radar and other detection technology and equipment, Hungary and other countries in research and development test drilling and test technology, research and development in Australia hole more comprehensive hydrogeologic parameters of the aquifer testing techniques, etc., in large measure contributed to the development of water inrush control techniques[1].

In the detection of tunnel geological aspects have been made since the beginning of the founding of the research work, and practice in the field of engineering, a relatively sound geological prediction theory. It has used advanced geological pilot hole, horizontal drilling and other geological forecasting method, but there are forecasting a short distance to maneuver and other issues.

Our country first proposed by means of geophysical exploration tunnel ahead of forecasts, and the first to carry out tests in Dayaoshan tunnel [2]. Chongqing Coal Research Institute made a ground-penetrating radar. In recent years, many universities, research institutes and engineering units application TSP202 and TSP203, ground penetrating radar and sonar equipment land with engineering geology of domestic law Yuanliangshan tunnel Qiyueshan tunnel, Wuchiba tunnel of Longtan Tunnel Wanzhou Railway tunnel and many were ahead of forecasts and other work[3,4].

In 2007, in Qingdao jiaozhou bay tunnel, using engineering geological exploration report of shandong university, prejudgment fault and fracture zone, at the same time, combined with the tunnel construction geology in advance, the use of TSP203, geological radar and infrared detectors,

such as a variety of forecasting methods, the tunnel across the 13 accomplished accurately forecast the fault fracture zone.

At present, the domestic construction of tunnel engineering, including urban underground railway engineering, the engineering construction will basically for advance geological forecast work before, and was mostly a variety of forecasting methods combined application, namely a comprehensive geological forecast, even so, at present the tunnel engineering geology problems emerge in endlessly, which was related to the complexity and uncertainty of the geological conditions, at the same time and the selection method about the suitability of the lack of reasonable judgment, therefore in choosing a forecasting method to do adjust measures to local conditions, also asked the combination of ground and underground engineering geology work, avoid the superposition of a variety of geophysical prospecting methods of blind and cross use at the same time, to ensure the geological forecast work effective.

Project summary

The tunnel was divided into two holes, the east of all mileage K75 + 620 ~ K76 + 370, 750 meters long, west hole of all mileage K75 + 615 ~ K76 + 390, 775 meters long, about 22 m clear distance between two tunnels, classified by the length of long tunnel.

Tunnel site area of the tunnel (north) for digging area, strong ~ weathered rock bare, rocks about 7 m. Exit (living), the west tunnel exit for a slope, slope of about 35 °, east the hole for the development of north and south gully, affected by the weather and atmospheric precipitation, no influence to tunnel site area(refer with fig1).

Fig 1 Main tunnel site area topography

On the geological structure belongs to the interpretation of lu zhongnan rise in fault block area fault zone activity area, due to the fault block differences and the interpretation of the influence of the deep fault belt, complex geological structure and magmatic activity was strong, and the new tectonic movement performance, structure plays a decisive role in the formation of landscape, its marked characteristics was fracture structure development, scale and direction of fracture was different, each other pay cut, to divide the uplift area for a variety of sizes, shapes of geological block, namely the big block and block depression.

According to the outcrop, near the mouth of the cave strata occurrence was relatively flat, vertical joints and fissures with development, weathering fracture more irregular. Out of the mouth of the cave, joint fissure development, density was larger, the grid, the original rock occurrence cannot judge, Stratum structure(refer with fig1) [5].

Fig 2 Stratum structure along the tunnel investigation

High density electric exploration

In the measurement results on the basis of first results of the measurement of discriminant analysis, exclude undesired interference and instruments to measure the stability of the outside world brings. On the basis of data processing, using the method of least squares method inversion. According to the results of the inversion, and determine the distribution of the subsurface structure.

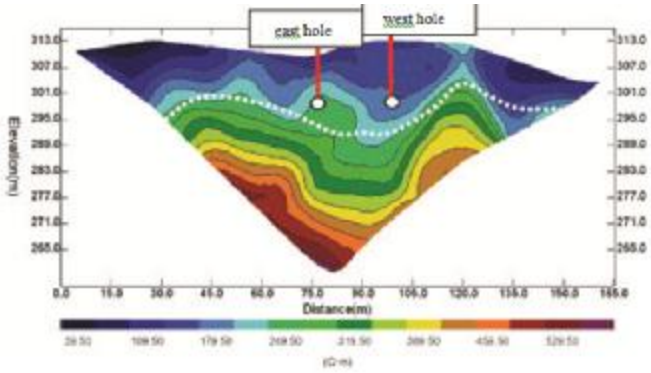

Fig 3 North Port sectional view of apparent resistivity

The result showed in the fig 3, the tunnel surrounding rock formation was related to Proterozoic granite (γ η2), granite high strength, strong wind resistance capabilities, structural fissures, strong weathering zone core was chunky, gritty; weathered with elongated core, short column, high rock strength; breeze with elongated cylindrical core, high rock strength, sound more crisp. The breeze was mainly exposed to the exit of the tunnel site, mostly strongly weathered outcrops[5].

Tunnel seismic prediction in practice

Tunnel seismic prediction measurement system was by drilling within a certain distance behind the working face to microseismic blasting to transmit signals, seismic waves caused by blasting in rock in the form of a sphere to spread around, some of which spread to the front of the tunnel, the tunnel in front of the interface was reflected back, the sensor receiving the reflected signal was converted into an electrical signal and amplified. From initiation to the transmitter signal was received this time was the distance from the reflecting surface was proportional.

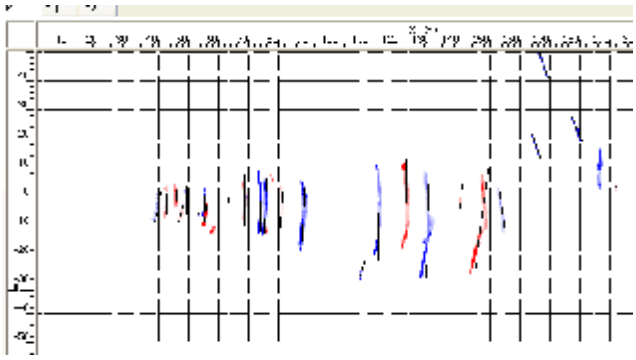

Fig 4 P wave reflection interface taken

Through fig 4 showed within the range of 116 meters in front of the tunnel face detection range inside the tunnel surrounding rock weathering weak mainly local strong weathering, locally developed high steep dip structural plane, the inner part of the structure there are muddy surface was filled fissures near surface structure, cracks mostly closed type, the general integrity of the surrounding rock, fractured local water, the surrounding rock to grade IV surrounding rock based.

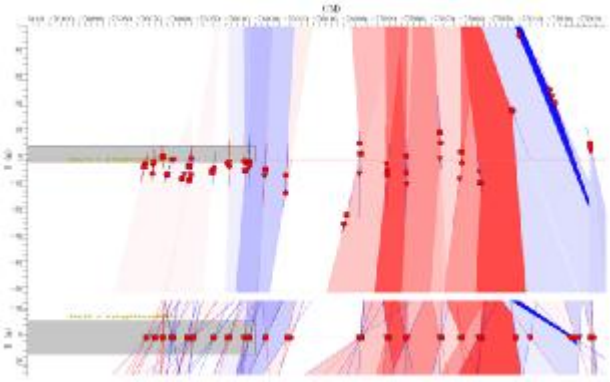

Fig5 2D figure showed results and rock properties

Through fig 5 showed K76 + 002 ~ K75 + 994, K75 + 990, K75 + 960 ~ K75 + 968 high-angle structure face steep development, there were mud filling structure near the surface joints fractured surface dense inner part of the structure, which mostly block intersections broken mosaic-like structure, surrounding rock stability from poor capacity of local water containing fracture.

Conclusions

Eastern hole discovery fracture zone, integrity was poor, with only infer that broken by external impact large tectonic zone formed, representing the degree of fragmentation light. The surrounding rock crushing hole, integrity in general, the surface structure was developed, fracture density, poor self-stability of surrounding rock, crushing zones and other geological anomalies segment should strengthen support to prevent falling rocks, landslides and other geological disasters .

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