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# *Research on Signal Acquisition and Imaging Method of Tunnel Geological Forecast Based on Risk Assessment*

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***Abstract:*** In order to ensure that the construction of high-risk highway( railway) tunnels can be carried out safely, relevant management departments, survey and design departments and corresponding construction units have carried out a lot of research on the methods and means of advanced geological forecasting. For tunnels under complex geological conditions, geological advance forecasts should be carried out before and during construction, to discover in advance the geological diseases that may be encountered during the tunnel excavation process, and to forecast possible accidents and dangers, so that timely measures can be taken to prevent problems. To ensure construction safety; by comparing several commonly used tunnel geological hazard risk assessment methods at present, the analytic hierarchy process is selected to assess the tunnel geological hazard risk. Therefore, we should study effective means, forecast and study the unfavorable geology and ensure the smooth progress of the project, which is a very important work in the future. Therefore, in the process of construction, reasonable use of comprehensive advanced geological prediction technology, short-term and long-term advanced geological prediction, and matching, have played an active and effective role in accurately formulating the construction plan, accelerating the construction progress and ensuring the construction safety.

## 1. Introduction

Karst tunnel site often has the characteristics of fault development, high water pressure and rich water. Compared with other types of tunnels, the probability of risk is relatively high[1]. In many underground projects, there are many geological disasters that cannot be caused by experience or manpower, such as the risk level of tunnel surrounding rock, collapsible loess, bad fill and so on. Therefore, there are many adverse factors in the design and construction of the tunnel, especially in the construction period of the tunnel[2]. At this time, it is necessary to do a good job in the risk assessment before tunnel construction to reduce unnecessary losses. Using a single forecast method often cannot meet the construction requirements, and the applicability of different forecast methods is limited. How to effectively improve the forecast accuracy and avoid construction risks is particularly important. In order to ensure that the construction of high-risk highway(railway) tunnels can be carried out safely, relevant management departments, survey and design departments

and corresponding construction units have carried out a lot of research on the methods and means of advanced geological forecasting[3]. In order to ensure the safe production of high-risk tunnel engineering, highway(railway) construction management departments, survey and design units and construction units have made extensive and in-depth research on the methods and means of advanced geological prediction. Therefore, effective means should be studied to predict and study the adverse geology and ensure the smooth progress of the project, which is a very important work in the future.

## 2. Risk Assessment Process and Methodology

### 2.1 Process of Risk Assessment

The risk assessment before tunnel construction can be divided into four steps:

(1)Risk discrimination, that is to find out the risk: analyze the risk factors that may be encountered in the construction of the project, and then summarize them, focusing on finding out the potential risks that have a great impact on the construction of the project.

(2)Risk analysis: carefully analyze the identified risks, find out the possible locations, causes and probability distribution of risks.

(3)Risk assessment: professional evaluation of the data obtained.

(4)Risk control: through risk assessment, find ways to avoid risks or reduce risks, so as to achieve risk control. The tunnel fault prediction procedure is shown in Figure 1.

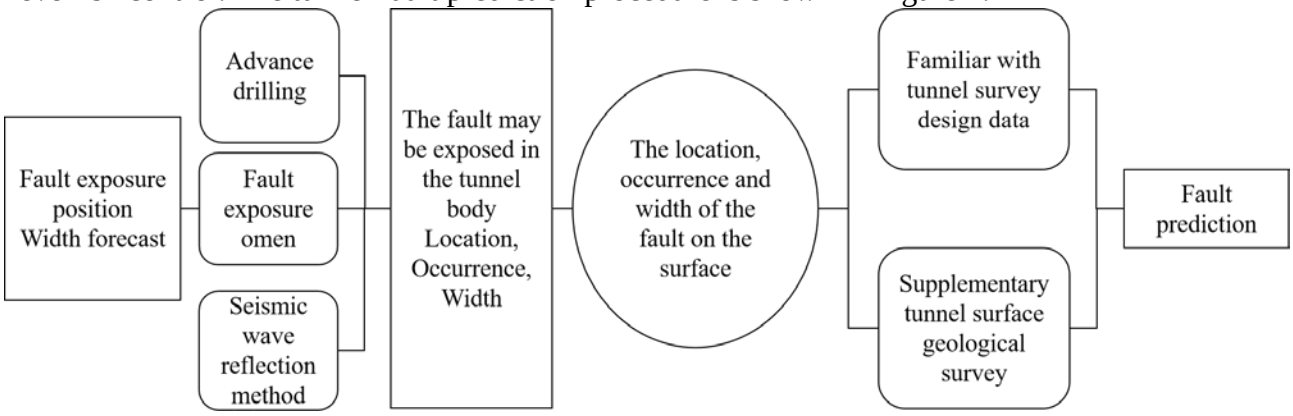


*Fig.1 Fault Prediction Program Diagram*

### 2.2 Methods of Risk Assessment

At present, the commonly used advanced geological prediction methods for high-risk highway(railway) tunnel engineering mainly include geological survey method, advanced drilling method (advanced geological drilling, deepening blast hole detection), geophysical exploration method (TSP seismic wave reflection method, geological radar, infrared water exploration) and advanced heading prediction method..

#### 2.2.1 Geological Survey Method

Geological survey method will survey the tunnel geology before the construction of high-risk highway(railway) tunnel, so there are many relevant survey data, such as geological sketch in the tunnel, survey data and supplementary geological survey data on the surface[4]. The so-called geological survey method is to compare the stratigraphic sequence of the construction section with the help of these existing data, Carry out correlation analysis on the underground and surface of the

tunnel bottom boundary and structural line, carry out precursor analysis on the adverse geological body existing in the tunnel, carry out correlation analysis on the fault elements and geometric parameters in the tunnel, and make use of geological theory, geological mapping and trend analysis, Predict the possible geological conditions ahead during construction.

### 2.2.2 Infrared Detection

Infrared detection infrared detection is a test technology based on the principle of infrared radiation, combined with geological survey method, using infrared detectors and supporting analysis software system, and arranging a certain number of survey lines and points at the site to determine whether there are hidden disaster sources in front of the tunneling section and the periphery of the tunnel.

### 2.2.3 TSP Detection Method

TSP detection method component-Dangerous Road Advance Forecast and Measurement System (TSP) is a forecast system specially developed by Swiss Survey Technology Company in the early 1990 s for tunnel advance forecast. This technology has been widely used in Europe and Asia, and was officially introduced into my country at the end of the 20th century[5]. It has also become one of the widely used earthquake advance prediction methods in China.

## 3. Contents and Means of Risk Assessment of Construction Advance Geological Forecast

### 3.1 Fault Fracture Zone

Predict the nature, occurrence, location and width of the fault, judge whether there is water filling in the fault and judge the stability, use the address analysis method to predict the location and scale of the fault, and correctly predict the fracture zone. Related locations, use the TSP method to make long-term forecasts, and use ground-based radar to assist in short-term prediction of the corresponding fractured zone positions and fault positions, and use the advanced drilling method to predict the scale and position of the fractured zone, or for the scale and position of the fault. predict.

### 3.2 Forecast of Water Gushing and Mud Outburst

Water inrush and mud inrush of high-risk tunnel are closely related to the water bearing structure (broken water bearing rock mass with dense joints and fissures and fault fracture zone with water bearing and water diversion) in front of the excavation work. The advance geological prediction of water gushing and mud outburst is based on geological logging, mainly advanced geological drilling, and comprehensive prediction is carried out by combining with various geophysical methods.

### 3.3 Karst

It is generally required to make geological sketch of the tunnel face after each excavation cycle of the dangerous road, so as to record the real lithology index, integrity state and water bearing state of the surrounding rock of the tunnel face. Therefore, the development of large-scale karst, taking the envelope of karst form as the reflection surface, can form a continuous and regular phase axis in the seismic record, The small-scale karst caves show obvious diffraction wave characteristics in the seismic records, so as to provide the most direct data for the classification of the surrounding rock in front, and accurately predict the karst scale and karst location.

### 3.4 Special Lithologic Strata

Extrusion fracture zones, cooling joints and contact metamorphic zones formed by rock vegetable intrusion, especially basic rock dikes, are prone to weathering, low strength, poor engineering geological conditions, and prone to landslides[6].The intrusive rock mass itself has high strength and high density, so it will form strong reflection on the contact surface. These special lithologic sections are easy to form strong reflected waves and diffracted waves in the elastic wave field.

## 4. Key Analysis of Forecast

### 4.1 Forecast Content

AcknowledLocation, scale and property prediction of fault fracture zone, influence zone and joint fissure dense zone; Prediction of development location, direction, scale and properties of unfavorable geological bodies[7]; Location, water volume and water pressure prediction of water and mud inrush in the tunnel[8]; The possibility, distribution and characteristic prediction of geothermal occurrence[9]; Prediction of grade change and distribution position of tunnel surrounding rock. ements.

If any, should be placed before the references section without numbering.

### 4.2 Forecast Time

As the field work of forecast mainly focuses on the construction constraints, the forecast is for the construction service[10]. In order not to affect the normal construction progress of constraints, the general geological logging, TSP203, geological radar, infrared water exploration and other forecasting methods are mainly selected from the period from the slagging to the blasting, and the 30m advance drilling without coring is completed within 12 ~ 24h.

### 4.3 Analysis of Construction Schedule and Construction Cost

High-risk highway(railway) tunnel construction work space is narrow, the environment is harsh, and it is generally a single-headed excavation, the working face is limited, the team personnel and construction machinery and equipment investment in tunnel excavation and subsequent operations are relatively fixed, generally not due to advanced geological forecast work adjusted for the implementation. In the process of such advance prediction, the appropriate evaluation scheme and prediction system shall be selected in combination with the inside and outside of the tunnel, the length, geophysical exploration and address content. In the selection process, the whole tunnel shall be run through, reasonably matched, and scientifically managed according to local conditions. The corresponding prediction process and prediction scheme shall be selected according to the characteristics of different addresses, In terms of the matching of geological prediction schemes, it should have certain advantages and disadvantages, so as to ensure that all the prediction schemes can adapt to the relevant conditions.

The cost can be determined by referring to “Charging Standard for Engineering Survey and Design”, fully considering the design of advanced geological forecast and the workload, and combining with the actual situation of the project, it is reasonably determined by means of public bidding.

## 5. Conclusions

At present, the development speed and level of tunnel advanced geological prediction technology are unprecedented. It mainly depends on geological analysis, drilling analysis and geophysical prediction. In addition, it also includes borehole camera and infrared water exploration method. Combined with the tunnel conditions, the corresponding mathematical simulation is carried out in theory to obtain the application conditions of various observation methods and the best observation system, so as to meet the urgent needs of advance prediction. In order to ensure the safe investment of high-risk tunnels, it is suggested that the relevant departments should study and formulate a single cost quota for advanced geological forecast, which should be included in the budget quota management. By establishing the judgment matrix between risk factors and geological influencing factors in the hierarchical system, and after the matrix meets the conditions through consistency test, the weight of each factor is obtained, and then after comprehensive sorting, the weight of each factor in geological technical factors is obtained, and finally the risk assessment result is obtained. By using TSP geological advance prediction method and geological disaster risk assessment method, the comprehensive advance prediction can more accurately and effectively determine the geological conditions of the tunnel face in front of the tunnel construction and the corresponding possible risk events, more targeted construction preparation and preventive measures, and play an important guiding role in the safe and smooth progress of tunnel construction.

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