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Study on Comprehensive Monitoring Technology of Highway Tunnel Construction

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Abstract: In recent years, China has made great progress in highway construction. Its scale and mileage have been expanded. The development of highway tunnel construction has become very rapid. In the mountains and cities, tunnels have become more and more important.To do a good job of highway tunnel construction control work, to take scientific monitoring technology can quickly and accurately obtain the measurement information, for the specific construction to give some guidance. So it is necessary to study the new monitoring technology in the construction of tunnel engineering. Therefore the article analyzes the comprehensive monitoring technology of highway tunnel construction.

Key words: highway tunnel construction; comprehensive monitoring; technology application

1. Brief introduction of tunnel construction inspection technology

1.1 The concept of tunnel construction monitoring

Tunnel construction monitoring refers to the excavation of the tunnel when the construction, through a variety of mapping equipment, equipment and other applications, the surrounding rock and supporting structure of the strain and stress measurement, the surrounding rock and supporting the safety Sex, stability and other accurate feedback, so as to foresee a security risk and to avoid. It is very important to monitor this link during tunnel construction. The stability of the surrounding rock is based on the monitoring results.

1.2 The fundamental purpose of monitoring

1) The situation of the surrounding rock has a more comprehensive grasp and understanding, including the surrounding rock and supporting structure can be how much force and its deformation of the law; from both qualitative and quantitative assessment of the stability of the surrounding rock and support structure The construction of the situation, so as to verify the results to ensure its scientific and rational; 2) through the monitoring of information can be timely feedback, which play a role in predicting the danger, the construction unit can use this as a guide to make the tunnel smooth and safe 3)the actual measurement results, the feedback of the surrounding rock and the relevant support parameters, to optimize the engineering design, so as to be based on the construction process to adjust and optimize the

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construction of the tunnel to provide science 4) to verify the support structure, parameters and construction

1.3 basic principles of measuring points and section layout

According to the relevant technical standards, the monitoring site and the measuring point should follow certain principles: First of all, should be based on the relevant provisions of the anchor spray support, must measure the project distance control in the 20 to 50m, for the shallow section, the weak section should be controlled at 20m The following; selected project distance should be determined by the actual situation, or in a representative of the selected sections of different test sections. Important areas of engineering and geological environment should be encrypted. Second, the surrounding displacement of the line and measuring point layout, should be based on the shape of the tunnel, size, construction issues to determine, mainly triangular, multi-triangular, cross and cross. Multi-point displacement meter is usually measured in each section to take 3 to 5 points to monitor the injection of concrete stress, anchor shaft force should be taken in each section to take 3 to 7 points to monitor. Finally, when the surface of the face begins to be excavated, the stress of the surrounding rock will be redistributed and deformed in the ring direction. The stress and deformation usually change rapidly within 1 d of the excavation of the face. In order to effectively grasp the deformation characteristics of the surrounding rock after excavation, the initial data should be obtained by arranging the sections in time after excavation of the face. In order to avoid blasting and other operations to damage the monitoring section, should control the appropriate distance, usually 1.5 to 2m.

2. Specific methods of tunnel monitoring

2.1 Required items

The so-called quasi-test project, that is, in the actual tunnel design and construction should be constantly monitoring of the project is the construction site monitoring of the core content of the tunnel rock and supporting structure of the force to determine the important basis. It mainly includes: 1) the observation of the cave, that is, in the excavation of the tunnel surface, the monitoring personnel should observe and analyze the rock mass integrity, nature, groundwater development and joint development of the front and the surrounding rock in time and the hole Internal support. 2) the vault sinking and the surrounding displacement, the vault subsidence is the arch near the monitoring point relative to the invert monitoring point of the vertical displacement measurement, the measurement results is an important reference to predict the collapse of the situation. Peripheral displacement is excavated in the tunnel, the hole around the measuring point to the central part of the deformation, is the tunnel surrounding rock stability and stress of the important performance. 3) The amount of surface subsidence, the purpose of which is to determine the degree of settlement of the surface of the tunnel and to determine the settling time. The main application level is measured.

2.2 Selected test items

The construction period of the tunnel is relatively long and the monitoring items are more. Therefore, there are some selective monitoring projects. The main ones are: 1) The internal displacement of the surrounding rock is usually monitored by the displacement meter, aiming at the displacement of the rock after tunnel excavation Regular analysis, and then analyze the interaction between the surrounding rock and support the law. 2) steel support force, the main application of string-type digital steel stress gauge monitoring, the purpose is to understand the stress of steel support to determine its effectiveness in the initial support. 3) Surrounding rock pressure, usually the application of pressure box measurement, the purpose is to determine the secondary lining of the support time. 4) anchor shaft force, the application of anchor dynamometer monitoring, the purpose is to ensure that the support and the combination of the scientific and effective, to ensure the safety of construction.

3. Highway tunnel construction monitoring example

3.1 Project Overview

The tunnel lining with three heart round wall composite structure, the maximum excavation span of 12.86m, height 10.482m. The rock mass is a large-scale compacted structure, localized as a block stone-like mosaic structure, the longitudinal velocity Vp> 1800m / s, the stability is acceptable, the local will collapse, the surrounding rock does not contain groundwater, by the precipitation and surface Loess layer of pore water, local water seepage, dripping phenomenon.

3.2 Selection of monitoring items

3.2.1 Peripheral convergence

Mainly in the initial support after the completion of the measurement work, in accordance with the provisions of the provisions of every 10 ~ 50m a measurement section, each section set up 3 to 6 lines. When full-face excavation is used, the measured clearance can be displaced vertically instead of the vault subsidence. The setting of the oblique line helps to understand the vertical direction of the change. It is also possible to compare the results of the multi-point displacement meter with triangulation.

3.2.2 vaults sink

The dome subsidence is measured in principle on the vault centerline. When the hole across the larger, can also be set in the vault three measuring points. According to the provisions of the provisions of every 10 ~ 50m layout of a measurement section, the use of measuring instruments mainly for the total station and reflective film or level. In order to understand the vault and the structure of the subsidence, should be vault and structural subsidence observation. In the tunnel around the hole or the top of the pit, the side wall and the middle of the lower part of the wall at the left and right places buried measuring points, each hole or each pit laying three measuring points, the vault and structural subsidence observation.

3.2.3 Surface subsidence

The measurement of the surface subsidence should be arranged on the same cross section with the measurement of the surrounding horizontal convergence and the arch sinking measurement. When the depth of the tunnel is less than 20m, the surface subsidence monitoring of the shallow tunnel should be carried out. Generally, there should be at least 7 monitoring points for every 5 ~ 50m monitoring section. Especially when the tunnel crosses the highway section, Inside and outside the laying of two rows of 20 (10 per row) cement fixed pile, the farthest side of the fixed pile from the tunnel wall 60m, according to the accuracy of the third level measurement requirements and methods of monitoring, monitoring point of settlement monitoring sensitivity Should be less than ± 3mm. 2.4 steel support internal force using GJJ series of steel force measurement, each measurement section layout 5 to 8 points, each measuring point laying two stress gauges, measuring steel support internal force and external force, projections on the role of steel support Bending moment and the size of the axial force. Determine the steel support size, spacing and parameters. Master the actual working status of steel support to determine the safety of steel support.

3.3 Field measurement method

1) Measurement of contact pressure between surrounding rock and initial support. The contact pressure between the surrounding rock and the initial support is to understand the effect of the initial support on the surrounding rock and the actual load of the initial support. Using steel string double membrane earth pressure sensor for direct testing. 2) steel

support internal force measurement. The steel support internal force measurement is to understand the combined effect of steel support and initial support on the surrounding rock and to judge the safety of the initial support. Using steel-string reinforced dynamometer to indirectly test the upper and lower edge of steel support strain, the final conversion of steel to support the actual internal force.

3.4 Field measurement points layout and measuring instruments

1) Measurement of contact pressure between surrounding rock and initial support. Measure the layout: the vault 1, the two sides of the side wall of the 1 (horizontal upward 10^{o}), both sides of the arch of the 1 (horizontal down 30^{o}), both sides of the arch 1 (horizontal 45°upward), a total of seven points; using XYJ-4-type double-pressure box to measure the contact pressure. 2) steel support internal force measurement. Measure the layout: vault 1 cross-section, each side of the side wall of a cross section (horizontal upward 10^{o}), both sides of the arch of the 1 cross section (horizontal down 30^{o}), a total of 5 points; Measurement of Internal Force of Measuring Steel by Steel - string Reinforcement.

3.5 Numerical simulation analysis

Before the numerical simulation, this paper first corrects the contact pressure between the initial support and the surrounding rock and the internal force of the initial support steel. As a result of the XYJ-4 double-film pressure box at the same time measuring the contact pressure and steel-stringed steel force measuring steel to support the internal force, this paper will be steel-string reinforced force measurement of steel support internal force as a result of The inversion calculation is used to modify the contact pressure of the surrounding rock, and then the load structure method is used to calculate whether the tunnel lining meets the structural safety requirements under the contact pressure of the surrounding rock. When the contact pressure of the surrounding rock is corrected, the stress calculated in the lining is converted into the pressure on the concrete and the steel arch according to the composite theory, and finally the correction value is obtained. From the calculation results, the lining in the dome, left and right arch and left and right foot of the concrete at the pull, the compressive stress are less than its allowable strength, so the lining to meet the strength conditions.

Conclusion

In the construction of highway tunnel project, the application of construction monitoring technology can effectively guide the design and construction, so to clear the monitoring project, monitoring methods, design and monitoring operation modules and processes, with a view to the final through the mature computer technology to achieve comprehensive tunnel monitoring, To avoid all kinds of accidents in tunnel construction.

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