

# Discussion on Construction Technology of Expansive Mudstone Tunnel in Expressway

Shimin Zhang<sup>1</sup>

Xijing University, Xi'an, 710123, China

E-mail: 646708775@qq.com

Shuai Wang<sup>3</sup>

Xijing University, Xi'an, 710123, China

E-mail: 975256365@qq.com

Yonggang Wang<sup>2</sup>

Xijing University, Xi'an, 710123, China

E-mail: 791844501@qq.com

**Abstract**—In view of the characteristics of expansive mudstone water swelling, dry shrinkage, easy disturbance and rheological properties, the basic principles of the construction of the highway expansive mudstone tunnel are proposed. And the construction method of expansive mudstone tunnel is described in detail, in order to ensure the quality of highway tunnel construction.

**Keywords**—Highway; Expansive Mudstone; Tunnel; Characteristics

## I. INTRODUCTION

Our country has a vast territory, large mountainous area, the total area of 2/3, expansive rock and soil has a broad distribution, basically in each region has a certain distribution. Expansive rock and soil has the characteristics of easy to be disturbed, large deformation, high ground stress and water absorption and expansion, so it is easy to occur geological disasters, which cause great obstacles to the construction of highway tunnel. Therefore, it is necessary to combine the characteristics of the expansive mudstone, to improve the construction technology appropriately, so as to ensure the safety and quality of highway tunnel construction, to provide more safe and efficient service [1].

## II. CHARACTERISTICS OF EXPANSIVE MUDSTONE

### A. Water Swelling

The expansive rock of the mud is mainly composed of the montmorillonite in the rock. The higher the content of the material, the higher the content of the material, the higher the degree of expansion, the lower the content, the smaller the expansion [2].

### B. Desiccation shrinkage

When the water content of the rock changes, the expansive mudstone can change shape. After the tunnel excavation, the expansive mudstone will gradually dry, causing the cracking and shrinkage, once again in the case of water, it will happen expansion and disintegration. The greater the degree of water loss, the greater the amount of expansion after the water.

### C. Easy Disturbance and Rheological Property

The disturbance and rheological properties of rock are basically the relaxation and creep of rock [3]. In mudstone, the basic component is montmorillonite, its content is 98.2%, which has the characteristic of expansion, and it is easy to soften after water, the natural unit weight is  $2.4\text{g/cm}^3$ , the friction angle of the sliding zone is  $6^\circ$ . The surrounding rock is vulnerable to the influence of the disturbance of the tunnel construction, the vibration of the construction and the loose of the unloading. The ability to resist external disturbance is very low. As depicted in Figure 1

## III. CONSTRUCTION BASIC PRINCIPLE

To strengthen the advanced and radial grouting, so as to improve the supporting force in the rock, the strength of the surrounding rock is enhanced, reduce harmful displacement, and reduce the pressure of surrounding rock [4].

After the tunnel excavation, the surrounding rock should be closed as soon as possible, so that the water absorption of the surrounding rock to reduce, prevent collapse

For the initial support, to a certain extent, reduce the surrounding rock deformation, thereby preventing the collapse of the deformation caused by the occurrence of large [5].

According to the actual situation of the project, the deformation of surrounding rock is controlled in a certain range.

When lining work, the reinforced concrete structure should be used to ensure that the lining has an effective bearing capacity [6].

In the process of construction, we should strengthen the management of water, for the construction of wastewater and water seepage, to carry out a timely drainage.

## IV. CONSTRUCTION METHOD OF EXPANSIVE MUDSTONE TUNNEL

### A. Advanced Support

The stress of surrounding rock will be released, and the deformation of surrounding rock is easy to be caused by

the deformation of the rock mass, which is difficult to obtain. Therefore, in the project can use 12m R51 self-feeding anchor, and 6m long  $\phi$  42 small catheter for combined support, it can get good effect[7]. As depicted in Figure 2

In the advance support, it should be along the excavation design of the outline of the layout, the small pipe and the spacing of the self-anchored bolt, the ring spacing should be set to 0.8m. The ordinary drill of the small pipe drilling design, using special drill rig for self-feeding anchor installation. When water injection mud is carried out in the small duct and the self - feeding type, the water - glass - slurry is selected for the development of groundwater. Should be the size of the water cement ratio of 0.5 and a small pipe grouting pressure should be in 1.0MPa, so as to achieve the effect of splitting grouting.

### B. Tunnel Excavation

When the tunnel excavation, should choose circular excavation core indigenous reserve for construction. The use of excavators in the excavation, then artificial dressing molding, and for circulating footage to strictly control. Annular heading excavation, of excavation face should immediately thickness of shotcrete 2-5cm C20 steel fiber concrete to be closed, then need to erection of steel frame, and the concrete are repeatedly re spray, until it reaches the design thickness. When the excavation reaches 30cm, the construction of the inverted arch should be started, and the supporting structure can be formed in time. The construction of inverted arch should be carried out, and the length of each construction should be controlled to 3cm. Concrete construction procedures as shown in figure 1.

In construction program, I, arch of advance support and support construction; II for annular drift excavation; III is the construction of supporting and retaining structure, were erected by the steel frame, systems arrangement of bolt and steel fiber concrete injection; IV for excavation of core soil; VI was inverted arch support construction; VII for the inverted arch bar colligation operation, and inverted arch concrete pouring; VIII for binding of the arch wall reinforced to ensure jumbo in place, and arch wall of concrete pouring[8].

### C. Supporting Construction

Should the steel, spraying, mesh and anchor combined support way

#### 1) Steel Frame

Chose the 120b I-beam, and in the field directly for processing steel, set the distance is 50cm, then along the ring to use the  $\phi$  22 reinforced connection with distance of 50cm as a whole. When erecting the steel frame, the bottom should be C20 concrete cushion block is arranged, so as to avoid sinking steel, should also be arranged on both sides of the steel frame of the two rows of the feet lock bolt used to strengthen.

#### 2) System Bolt

The wall of the surrounding rock is reinforced by the choice of the hollow rock bolt and  $\phi$  42 of the grouting pipe. After selecting the R51 12m of the hollow anchor, the concentrated disposal of the arch foot and the arch, the arch and the vault at the symmetrical layout. In addition to

the surrounding rock to the radial grouting, improve its characteristics, so that its strength.

### 3) Sprayed Steel Fiber Reinforced Concrete

Normally, the actual injection thickness of steel fiber concrete is 25cm, the choice enveloped with cement sand method of wet spray process of layered construction, should first spray of steel behind, and then sprayed steel frame between the part.

### D. Inverted Arch Construction

In the construction of inverted arch, it should carry out follow with the excavation work surface, excavation of the back of the soil, and then artificial dressing. After completion of the excavation to erection of steel immediately, and connected with the arch wall at the early stage of the support bracket, and system construction of anchor, and steel fiber concrete jet was closed. After the completion of support, to invert rebar timely, pouring concrete. As depicted in Figure 3

### E. Lining Construction

In the mudstone tunnel construction of the expansion, t need to follow the construction strictly. Requirements, there is a limit on the construction time, the early construction may damage of lining structure; late construction may affect a supporting structure stability, resulting in a collapsed tunnel. Therefore, it should be combined with the actual situation of the actual situation, a reasonable construction, should be deformation in the surrounding rock in the case of the construction of the lining. To ensure it safety and stability, the overall construction method of steel die trolley is chosen, and the lining thickness should be increased, and the ratio of reinforcement was improved [9].

### F. Construction Management

In the process of construction, to carry out strict construction organization, to ensure that different processes can connection enough. To choose the reasonable construction method, it should be combined with the actual situation of the highway expansive mudstone tunnel project, choose the most suitable construction technology, improve the construction efficiency and ensure the engineering quality. In addition, we must strengthen the monitoring work, strengthen supervision and management, to strictly comply with the relevant technical standards, to ensure that the monitoring information can reflect the changes in the situation of mudstone, so as to ensure the construction quality [10].

## V. CONCLUSION

In the process of construction, to carry out construction organization strictly, to ensure different processes can connection enough and to choose a reasonable construction method, it should be combined the actual situation with highway expansive mudstone tunnel project and select the most suitable construction technology. And we should also improve the construction efficiency, ensure the project quality.

Figures and Tables

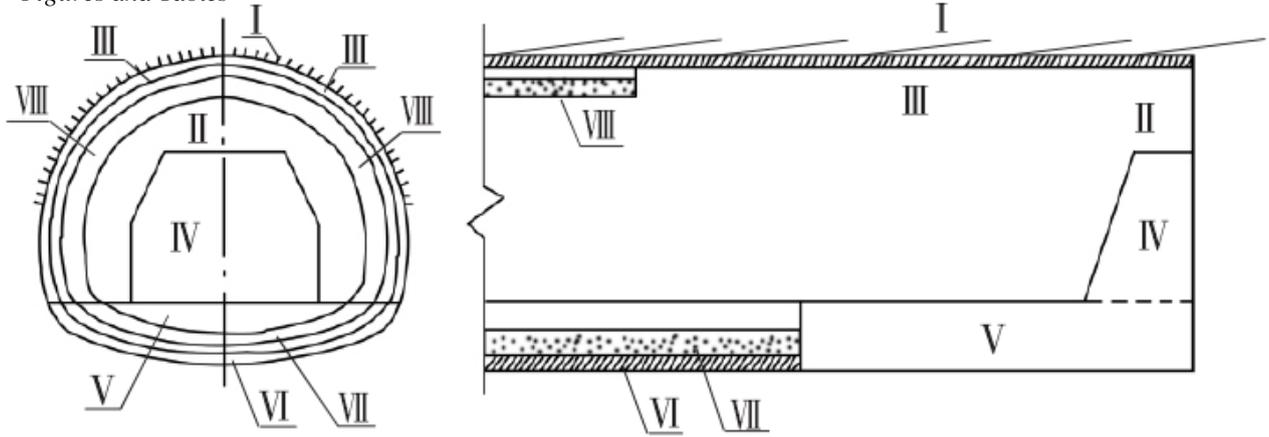


Figure 1. Construction Method of Expansive Mudstone

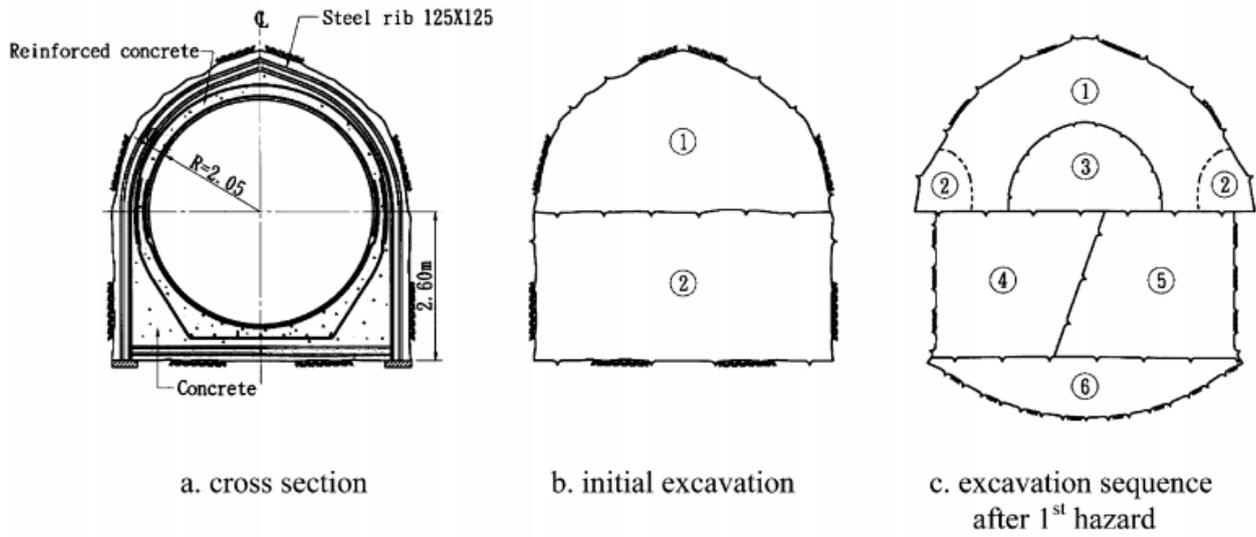


Figure 2. Cross-section and Excavation Sequence of the Pressure Tunnel of Wushantou Reservoir

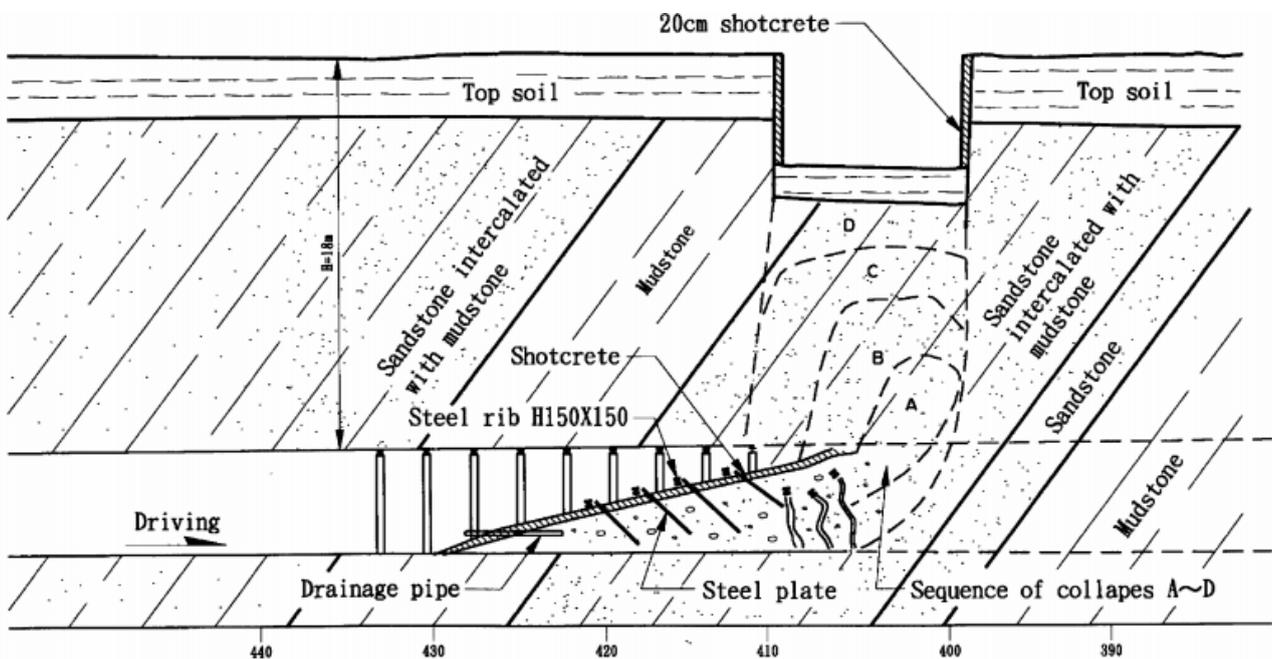


Figure 3. Profile of the First Hazard of the Pressure Tunnel of Wushantou Reservoir

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