

# Research on the Influence of Groundwater on the Construction of Mountain Tunnel and the Prevention and Control Measures

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## Abstract

The rapid development of the national economy has promoted the construction of the transportation industry, and mountain tunnels, as a key component of transportation facilities, are closely linked to the construction and development of the transportation industry. Compared with traditional transportation methods, tunnels can realize direct connection between two places without taking up ground space, which plays a great role in the construction of transportation. However, the construction of tunnels differs from the traditional types of engineering construction, mainly in the construction process. In the process of tunnel construction, the treatment of groundwater has been a difficult problem. The role and activities of groundwater will have a certain impact on the tunnel water environment, and if effective control measures cannot be taken, it will have an impact on the stability of mountain tunnels, so it is especially important to analyze the impact of groundwater on mountain tunnel construction.

## Keywords

Groundwater, mountain tunnel construction, underground engineering, prevention and control measures

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## 1. Introduction

Along with the rapid development of China's road transportation industry, the road grade is also rising, and the mileage is increasing year by year. In the construction process of highways such as hills and mountains, the design and construction of tunnels are reasonably promoted, which can effectively shorten the mileage, and also play a certain role in protecting the surrounding ecological environment. The impact of groundwater environment is an important factor in the design and construction of tunnels, because the excavation process of tunnels may affect the groundwater system in the region, it is necessary to take effective preventive and control measures.

## 2. Impact of groundwater on tunneling works

Tunnel engineering geological problems are the main factors triggering tunnel accidents, the activity and role of groundwater is one of the representatives, many engineering accidents are actually triggered by the role of groundwater, in the tunnel through some karst fissures and loose rocky soil, will produce a hydraulic connection to the groundwater in the current area, especially through some large caves and fault fracture zone, the tunnel ridge tunnel will be divided into some units with hydraulic connection, for the stability and durability of the entire building structure, but also on the later operation and maintenance of the tunnel will have a greater impact.

The analysis of the possible hazards of groundwater on the safe construction and stable operation of tunnels enables different anti-drainage measures to be taken for different tunnel construction problems, and it is worth noting that the hydrogeology and engineering geology of the surrounding strata and other factors are closely linked. When the head of

groundwater is relatively high, the general use of waterproofing measures based on blocking, but easy to make the water pressure in the tunnel further increase, the role of the tunnel structure will also produce a certain shift in location, so in the tunnel drainage construction needs to be combined with the actual needs of drainage work, take a variety of drainage methods, uphold the "site-specific, comprehensive management" the prevention and control principle, not only can achieve the ideal waterproof goal, but also to ensure the safety and stability of all kinds of operating equipment and tunnel structure, for the subsequent tunnel construction task to promote a great help [1].

### **3. The influence of groundwater on the surrounding rocks of the mountain tunnel**

#### **3.1 Separation role**

Water has a certain partitioning effect on the rock, and the potential shear force of the rock will be reduced by friction in the process of bearing water pressure, which creates favorable conditions for water intrusion into the rock formation. In addition, water also has a certain chemical corrosion effect on the rock, with some dissolved water elements in the rock to produce chemical reactions, eventually leading to many voids in the rock body, the negative impact on the strength of the rock.

#### **3.2 Expansion effect**

Different rock masses have different water absorption properties. This property will also have a certain swelling effect on the rock, which in turn will have an impact on the internal and external strain stresses of the rigid, especially some rock masses with more voids and a constant accumulation of loess in the holes. These loesses are prone to swell when they encounter water and cause damage to the mountain tunnels.

#### **3.3 Softening effect**

The physical effect of groundwater on the tunnel ridge tunnel has many manifestations, such as freezing and thawing, disintegration, lubrication, softening and splitting, etc. It is actually a comprehensive softening effect. When groundwater infiltrates the rocks, the physical state of the rocks will change to a certain extent by the influence of water molecules, and this is also true for the particles inside the rocks, the strength of the rocks will change, thus also intensifying the process of rock movement. If the sandstone component of the rock is elevated to 4%, there will be a corresponding decrease in strength, the support of the sand and gravel clay is affected, the support is constantly reduced, and this is especially true for some clay minerals, which are relatively fine grained and also more hydrophilic, and therefore a layer of water molecules will be formed between the mineral clay, and the mineral cell layer will also enter the water molecules, forming a class of water layers in the internal layers The clay minerals will appear to swell to a certain extent and the rock strength will be reduced to a certain extent, which is the softening effect of the rock [2]. It is worth noting that there is a close connection between the cementation composition and the cementation strength of the rock.

### **4. The key points of tunnel engineering anti-drainage construction**

#### **4.1 Tunnel water surge type**

Combined with the use of groundwater and management, the type of groundwater can be subdivided into concentrated gushing water, diving seepage gushing water, pressurized water seepage gushing water and precipitation seepage gushing water four categories. Different types of water surges have different characteristics, and therefore need to take different management and response methods. Concentrated gushing water generally appears in the tunnel through the underground dark river some fault broken belt, these gushing water will be in a short period of time quickly into the tunnel drainage system, not only the amount of water is relatively large, while the water point is also relatively concentrated. Once the emergence of such gushing water, need to take effective countermeasures in a short time; diving seepage gushing water groundwater level is relatively stable, while the water table surface is mostly higher than the tunnel longitudinal drainage tube elevation; pressurized water seepage gushing water groundwater pressure is relatively large, but also relatively stable, after the emergence of such problems need to respond in a timely manner to avoid triggering the tunnel pavement overflow and other problems; precipitation under seepage gushing water seepage Flow generally along the rock layer dominant fracture direction downward seepage, seepage line intercepted by the tunnel part will be discharged from the tunnel, if not intercepted, and will not be affected by the tunnel [3].

#### **4.2 Purpose of drainage design**

Before moving forward with the subsequent drainage design work, the drainage design purpose of the project needs to be clarified. This requires the relevant construction team to have a correct and comprehensive understanding and knowledge of the drainage needs of tunnel construction [4]. In the anti-drainage design work adhere to the drain-

age-based, supplemented by certain ways such as blocking and leading, combined with the actual situation of the construction of the project, the drainage facilities are reasonably arranged. In the tunnel groundwater relatively more lots, generally need to increase the drainage facilities. Engineering construction personnel in the later stages of construction, especially in the excavation process of the tunnel to combine the actual situation of the water surge, do a good job of recording the relevant work, while completing the lead drainage work, you can play a leading role in the lead conduit. In the initial support work to build the foundation of the drainage facilities, can play a good waterproof effect, of course, this is a new challenge for the engineering construction unit.

### 4.3 Tunnel drainage prevention line

As the first line of defense against tunnel drainage, the initial support work is particularly important, the second line of defense is achieved through the cooperation of initial masonry flexible drainage and back drainage, in the secondary lining process, some uneven parts and anchors need to be repaired and replaced when necessary to ensure the smoothness of the concrete surface, which can create favorable conditions for the subsequent construction; subsequently, combined with the engineering design The actual needs and the situation of concrete leakage are guided by the use of permeable water pipes, and the use of circular flexible drainage pipes can also be enhanced. It is worth noting that in the process of arranging the plastic anchor bolts, it is necessary to combine the actual size of the flashing and select a reasonable installation method, and in the process of hanging the flashing, it is necessary to control the width of the hanging so that it is within a reasonable range [5].

## 5. Groundwater prevention and control measures for mountain tunnel construction

### 5.1 Collecting tunnel construction information

The relevant construction team needs to arrange professional construction technicians to go to the construction site to obtain some important information and parameters before the construction, especially the relevant information of tunnel construction, and also the tunnel ground exploration information, and hand over to the professional data collection team to integrate and analyze a large amount of data and information, combine with the construction characteristics of the project, and promote the subsequent arrangement and finishing work. Analysis of the relevant experience and results can provide a correct understanding of the groundwater movement pattern, thus providing the correct guidance and direction for the subsequent construction, especially the topography of the construction site, which is a key reference factor in the construction of the project, as the basis and prerequisite for the construction of mountain tunnels, this is a particularly important step, which also puts forward higher requirements for the relevant construction team This is a particularly important step as the basis and prerequisite for the construction of mountain tunnels.

### 5.2 Improve the tunnel drainage design

Before carrying out the subsequent construction tasks, often need to carry out the relevant design work, so to combine the actual needs of the tunnel drainage design, to promote the optimization and improvement of the relevant design, drainage design is generally based on drainage, while combining the application of a variety of ways to lead, intercept and plug, while combining the previous experience in drainage prevention, the specific design optimization, in some areas of the tunnel groundwater more Need to increase the amount of drainage facilities, can create convenience for the later drainage work. In the initial support work needs to be the first process of the implementation of the drainage means to lead the cut-off row, in the late excavation of the mountain tunnel, the actual situation of water gushing to record and analyze, and promote the relevant drainage work, play the role of water diversion conduit and concrete guidance and blocking, can form a set of perfect drainage facilities, to enhance the drainage effect of the project has a huge help.

### 5.3 Reasonable selection of control measures

For different types of water problems, need to take different preventive and control measures, combined with the design and construction of this type of project, the main prevention and control measures are as follows: first is the fissure water, if you can not take effective countermeasures in a timely manner, will make the tunnel in the fault fracture zone collapse problem. For the treatment of this kind of problem, need to choose a reasonable method to carry out thickening repair work on the inside of the collapsed part, can control the scope of the collapse, for the location of the collapse has appeared need to take effective remedial measures, the quality of the tunnel situation to test, can avoid further deterioration of the problem; second is the solution gap water, can play the advantages of high-tech, inferred and bad geology and structure grasp, can help the construction team to prepare the tunnel construction materials and information required before construction, effectively avoid stoppage and construction problems; finally is the pore water, the relevant construction team to give full play to their own initiative, in the tunnel prone to water problems in some sections of the borehole test work, the reasonable use of conduits and grouting materials, to promote thickening treatment work, to

avoid some common construction problems have great help [6].

#### **5.4 Promote professional talent training**

Professional construction technicians can significantly improve the relevance of engineering construction, and also effectively avoid some common construction quality problems, but combined with the construction and construction of this type of project, professional technical personnel are relatively scarce, so it is necessary to promote the cultivation of professional technical personnel. For the cultivation of professional technical talents: firstly, we should analyze the construction demand of the project and improve the rationality of the talent cultivation work; secondly, we should keep pace with the development of the industry and the times, grasp the talent demand of engineering construction in the current era, constantly enrich the specific content of the talent cultivation work, formulate different talent plans for different talent gaps, and promote the talent cultivation work through technical research meetings and talent exchange meetings, etc. We promote the cultivation of talents in various forms.

### **6. Conclusion**

To ensure the steady advancement of mountain tunnel construction is not only an inherent requirement for tunnel construction quality improvement, but also an inevitable requirement for the long-term healthy development of China's transportation industry. The relevant departments should give full play to their own initiative, increase the prevention of various problems, develop different emergency plans for different construction problems, do a good job of collecting information and data, promote the construction site selection in an orderly manner, analyze the impact of water layer on mountain Tunnel construction impact analysis, for different groundwater hazards to take different countermeasures, for the construction of the transportation industry to escort, for the construction of economic and social development and lay a solid foundation.

### **References**

- [1] Wang Zhaoming. Research on the influence of groundwater on the construction of mountain tunnel and the prevention and control measures [J]. *Construction & Design for Engineering*, 2021.
- [2] Jiao YJ, Li YN, Huo SP. Environmental Impact Assessment and Protective Measures of Groundwater in Purification Plants [J]. *Environmental Science and Management*, 2022(4).
- [3] Ding Xuan. Influence of mine hydrogeological types on groundwater exploitation and engineering preventive measures [J]. *World Nonferrous Metals*, 2021(15):2.
- [4] Zhou Pengfei. Experimental Study on Water Plugging Effect of Advance Grouting in High Pressure Water-rich Section of Mountain Tunnel Water-rich Section of Mountain Tunnel [J]. *Guangdong Architecture Civil Engineering*, 2021.
- [5] Zhang Xudong. Analysis on Influence of Overlapping and Overpassing Construction and Operation of a Mountain Tunnel on the Existing Metro Section Tunnel [J]. *Northern Communications*, 2022(002):000.
- [6] Wang L, Bao H-T, Yang Xun. Influence and application of water pressure on tunnel structure in water-rich mountain tunnel [J]. *Shanxi Architecture*, 2022(048-016).