Discussion on Underground Engineering Construction Technologies of Urban Rail Transit

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Abstract: Urban rail transit underground engineering construction can effectively improve people's travel efficiency. The urban terrain and terrain of our country are more complex, so the construction technology should be selected according to the actual situation of the city to ensure the smooth development of urban rail transit underground engineering. This paper first describes the main characteristics of urban rail transit underground engineering construction, and then carries out research on common urban rail transit underground engineering construction technology. Finally, we put forward some management measures to ensure the quality and safety of rail transit construction.

1. Introduction
With the development of social economy and the acceleration of urbanization, a series of problems have been brought about, which have brought great influence on people's daily life. At present, traffic congestion is an urgent problem in most cities of China, and the emergence of urban subway, intercity railway and light rail has greatly alleviated the problem. For urban rail transit underground engineering, the choice and application of construction technology can directly determine the success or failure of underground engineering. Therefore, in the process of urban rail transit underground project construction, we must comprehensively consider the actual situation of the project, select the most suitable construction technology, to ensure the smooth and orderly development of the project.

2. Characteristics of Underground Engineering Construction of Urban Rail Transit
Urban rail transit covers a wider area and population, so it has a high coverage rate. At the same time, urban rail transit construction mainly exists as an industrial system. Therefore, urban rail transit construction has many characteristics, including high costs, high technical requirements, long period and complex system construction.

2.1. High Costs.
Urban rail transit is an indispensable part of the city, providing a more convenient lifestyle for people’s daily life. However, due to the high coverage rate of urban rail transit in the city, the construction scale is relatively large compared with other projects. Therefore, it is necessary to find multiple units to invest in urban rail transit before project investment, and the construction of urban rail transit needs high cost.

2.2. High Technical Requirements.
Urban rail transit is not a simple way to deal with traffic problems. In the era of deepening modernization, information engineering, civil engineering, transportation functions and so on are integrated into the scope of urban rail transit construction. The scope of urban rail transit technology is becoming wider and wider, so the technical requirements are getting higher.
2.3. Long Construction Period.
Generally speaking, the construction period of a single rail transit project takes at least four to five years. Moreover, as the technical requirements of urban rail transit are getting higher and higher, the construction period is increasing unabated.

2.4. Complex System Construction.
In the specific construction process, there is a relatively complex system construction. Therefore, during the construction process, the engineer needs to discuss the countermeasures with the construction personnel, and only after the handover work is done can some project plans be carried out. This method can make the urban rail transit construction proceed in a smoother state.

3. Key Technologies of Underground Engineering Construction of Urban Rail Transit
After a long period of research and innovation, the construction technology of urban rail transit underground engineering has been continuously improved. At present, common urban rail transit underground engineering construction technologies mainly include open-cut construction technology, shallow excavation construction technology, underground tunnel boring machine (TBM) construction technology and special shaped shield construction technology.

3.1. Open-Cut Construction Technology.
Open-cut construction technology requires first to excavate all the rock and soil and rock mass contained in the tunnel location, and then build the tunnel portal and tunnel body at the construction site, and finally backfill the construction site, so as to complete the open cut construction. The key procedures of open-cut construction technology mainly include: lowering groundwater level → slope support → earthwork excavation → structural construction → waterproof engineering.

In the construction of open cut method, attention should be paid to the construction of side slope drainage holes. Slope construction will be plagued by drainage problems at the beginning. It is necessary to set drainage holes on the slope to fundamentally reduce the mountain water pressure and damage the slope, and finally realize the smooth development of urban rail transit underground engineering construction. The advantages of open cut construction technology are that the construction speed is fast and the operation is relatively simple, which can effectively improve the project quality.

In the actual construction process, the ground traffic and surrounding environment will be affected due to the large area, large amount of earthwork and large number of underground pipeline demolition. If the groundwater level is high, the cost of construction and tunnel reinforcement will be increased. Therefore, the stability parameters of foundation pit support should be calculated strictly to ensure that the subsequent construction can be carried out smoothly.

In addition, combined with the geological conditions and the surrounding buildings of the construction site, the structural support methods adopted by the open cut method mainly include anchor retaining wall, pile anchor support, pile plus internal support, etc.

3.2. Shallow Excavation Construction Technology.
Shallow excavation construction technology belongs to the new Austrian method technology for loose ground. Its main principle is to use the bearing capacity of the surrounding rock and the space restraint ability of the excavation surface, and use bolts and shotcrete as the main support method to strengthen the surrounding rock and reduce the relaxation or deformation of the surrounding rock. Then, guide the design and completion of underground engineering through monitoring and measurement. The construction process of shallow burying and undercutting method is shown in Figure 1.
The following aspects need to be paid attention to in the construction of shallow burial and undercut:

a) Shotcrete: as one of the most common construction methods in slope excavation and support technology, shotcrete is mainly used to seal the foundation surface of the excavated slope, which can fundamentally reduce the influence of crustal movement and groundwater level on the foundation surface due to long-term construction.

b) Monitoring: The monitoring is mainly aimed at the internal structure of the excavation site. Through the monitoring, the instability and sliding of surrounding rock can be effectively predicted, and the dynamic change of surrounding rock deformation body can also be effectively detected, which provides help for tunnel excavation and subsequent construction. Monitoring work can be realized through geophysical analysis. In general, geophysical analysis is to set up long-term observation hole and acoustic hole at the left bank abutment slope to realize Geophysical Monitoring, so as to reduce the probability of instability or sliding of surrounding rock.

Generally, in the construction of shallow excavation, the construction content of shallow support technology mainly includes drainage hole, shotcrete, bolt bundle, etc. The implementation of shallow support technology can make full use of XZ-30 drilling rig and full hydraulic drilling rig to complete drilling construction. After the bent erection work is completed, the XZ-30 drilling rig can be used to complete the slope drilling work. The construction process of bolt bundle is as: firstly, complete the construction of complete rock stratum by grouting first and then inserting rod; secondly, the construction efficiency can be effectively improved by grouting first and then inserting rod at the position of easy collapse and easy broken rock stratum. In the process of drilling slope drainage hole, we not only need to use the XZ-30 drilling rig, but also need to provide the corresponding personnel for the equipment, so as to ensure that the personnel can realize the installation and hole cleaning.
construction. In addition, attention should be paid to the construction of shallow support technology. The installation of filter pipe can only be carried out after the drilling construction reaches the rich water layer.

3.3 Underground TBM Construction Technology.

The construction technology of full-face tunnel boring machine is a construction technology integrating mechanical, electrical, hydraulic, sensing, information and other technologies. The application of this technology can realize one-time excavation of tunneling, rock slag loading and unloading, tunnel wall support and so on. It is also one of the most advanced construction technologies in modern tunnel construction. Full face road header has the characteristics of high efficiency, safety, environmental protection and high quality. It has been used in the construction field since the 1950s, and has become one of the main construction equipment used at home and abroad.

3.4 Special Shaped Shield Construction Technology.

From the early 1980s to the mid-1990s, the special-shaped section shield is mainly circular. With the continuous development of urban underground space, the resources of urban underground space in China are becoming increasingly tense. The traditional unit multi tube shield tunnel has the disadvantages of low utilization rate of section space in application. In order to make rational use of underground space, special-shaped cross-section tunnels with high utilization rate of space development, outstanding economy, short construction period and rich functions have gradually emerged in recent years. Among them, the most representative tunnels are double circular tunnels and rectangular tunnels. The cross section of the double circular tunnel is shown in Figure 2.

![Figure 2 Cross section of the double circular tunnel.](image)

During the start-up stage of shield machine, the maximum displacement of cutterhead is located at the edge, and the deformation is 0.017mm. Compared with the maximum thrust and the normal operation of the shield machine, the cutter head deformation is smaller in the start-up stress stage. When the maximum torque of shield machine is started, the maximum torque of cutterhead is 155MPa. The torque is within the allowable range of cutter head design material, so it will not affect the normal driving.

In the stage of shield tunneling, if we want to achieve efficient tunneling, we must fully analyze the cutter head deformation and stress distribution. In addition, high attention should be paid to the edge of cutterhead, that is, the most easily deformed part, so as to ensure the overall stability of cutterhead during shield tunneling, and it can also ensure that the wear degree of cutter head edge and center is the same as the excavation strength, so as to effectively realize the efficient excavation of the project.

4. Management Measures for Underground Engineering Construction of Urban Rail Transit

4.1 Control the Construction Cost and Duration.

The construction volume of rail transit engineering projects is large, and the initial operation cost is relatively large. Therefore, it is required to prepare a reasonable construction engineering plan at the
beginning of the implementation of each rail transit project construction plan, and divide each rail transit construction project into several steps and procedures reasonably, so as to effectively manage each construction step and process cycle.

4.2. Strengthen Risk Management of Construction Site.
In the process of rail transit engineering construction, the production and management concept of safety first should always be implemented. Due to the technical complexity of the construction management of rail transit tunnel engineering, it is often faced with harsh construction environment, and there are many potential safety hazards that will lead to construction accidents. Therefore, in the construction management of rail transit, it is necessary to strengthen the risk management of the construction site and eliminate the potential safety hazards. In addition, in view of the factors that are easy to cause construction safety accidents, forecast, analyze and deal with them, and implement risk emergency treatment to minimize the safety loss. If there is a safety accident in the construction of rail transit, the emergency plan should be started quickly to deal with the accident as soon as possible, so as to avoid the increase of accident loss, ensure the smooth progress of the rail transit project, and ensure the construction progress, quality and safety management of the rail transit project.

In addition, strengthen construction safety management through monitoring. Limited to the narrow construction site, there are many rail transit construction personnel, so it is necessary to carry out multi-disciplinary cross construction of rail transit at the same time. At the entrance of the edge line, it is easy to have major safety accidents such as falling objects. In order to effectively avoid safety problems, in the rail transit construction, it is necessary to reserve a safe passage at the entrance of the rail transit stairs and elevators, and a protective shed should be established at the entrance and exit of the construction site in time to effectively protect the safety of the construction personnel on site.

4.3. Improve the Quality of Management and Technical Personnel.
Improving the professional basic quality of management personnel is very important to continuously strengthen the quality management of rail transit engineering construction. To improve the quality of personnel, we can start from the following three aspects:

a) Continuously improve the sense of management responsibility and service concept of construction management personnel. This is an important basis for continuously strengthening the construction quality management, and also conducive to promoting the construction quality management.

b) Gradually improve the technical management level of professional construction project management personnel. Strengthen the theoretical knowledge training of construction management personnel, effectively improve the comprehensive ability of construction management personnel to deeply analyze practical problems and timely solve practical problems in construction management, so as to continuously improve the work efficiency and construction efficiency of construction management.

c) Formulate and update the project management system and measures in a scientific and reasonable manner. Some diversified project management control methods can be considered to improve the level of project management.

4.4. Improve the Construction Management System of Rail Transit.
In the early stage of strengthening the rail transit construction project, the engineering construction management unit strives to improve the new rail transit safety management system in combination with the actual construction situation of the rail transit construction project, so as to provide important system guarantee for the rail transit construction, so that the whole construction process can be carried out under the system, so as to ensure the effectiveness of the system management. In the construction management system, it is necessary to clearly define the specific construction tasks and construction objectives of each construction link, and scientifically divide the responsibilities.
5. Conclusion
In the process of selection and application of urban rail transit underground engineering construction technology, the actual situation of the project must be comprehensively considered to ensure that the selected construction technology has sufficient applicability and pertinence. Only in this way, can we fully reflect the advantages of underground engineering construction technology, effectively improve the stability and strength of surrounding rock structure, further ensure that the whole project can be carried out smoothly, orderly and safely, and provide more safe, reliable and convenient travel mode for people.

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