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Application and Development Prospect of Metro Shield in Tunnel

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Abstract

In recent years, with the development of urban metro, the safe, environmental and rapid construction methods in the metro construction have gradually become hot research topics at home and abroad. In the construction of urban metro projects, shield technology has been widely used in tunnel construction with its unique safety and speed features, and construction personnel are proficient in the construction technology control focus and method of metro tunnels, it is of great significance to ensure the safe production and quality of the tunnel. Modern cities are paying more and more attention to underground development, in the construction of underground tunnels, the application of shield construction technology not only has less impact, but also has faster speed and can better meet the needs of actual engineering. This paper starts with an overview of the development trend of tunnel shield construction technology, and discusses its application and development prospects.

Keywords

Shield technology; tunnel, application, development.

1. Introduction

The large traffic volume and high on-time rate of metro transportation play an important role in the transportation of modern cities, which greatly facilitates people's travel and improves people's work efficiency. With the increasing tension of land resources, the construction space of metro tunnels has gradually decreased, and gradually developed towards a large depth, in addition, there are many problems in the construction process, which makes the construction of metro tunnels more difficult. The application of shield method can effectively alleviate the above problems, it not only can effectively ensure the safety during the construction process, but also guarantee the construction quality.

2. Overview of the Shield Method

The shield method is a fully mechanized construction method in the construction of the undercutting method, it pushes the shield machinery in the ground, and supports the surrounding rock through the shield shell and the segment to prevent collapse in the tunnel, moreover, in front of the excavation surface, the excavation of the soil is carried out by the cutting device, and the soil is transported out of the cave by the machine, and the jack is pressed in the rear part to jack up, and the precast concrete segemnt is assembled to form a mechanized construction of the tunnel structure.

Tunnel excavation is conducted by shield. The shield is a special device with a shield, it advances with the lining block that has been installed at the tail as a fulcrum. Cut the soil with a cutter while draining and assembling the precast concrete lining blocks behind. The shield was invented in 1874, the first was the use of a air pressed shield to excavate the Thames underwater tunnel in London. The mucking way of the shield machine are mechanical and hydraulic, it is mostly hydraulic, the hydraulic shield has a sealed chamber filled with swelling soil solution at the working surface. The swelling soil solution is used not only to balance the soil pressure and groundwater pressure, but also transport

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the soil, the shield construction has the characteristics of fast construction speed, stable cavity quality and less impact on surrounding buildings, it is suitable for construction in soft soil foundation. Development of shield technology in different years as shown in Fig.1.

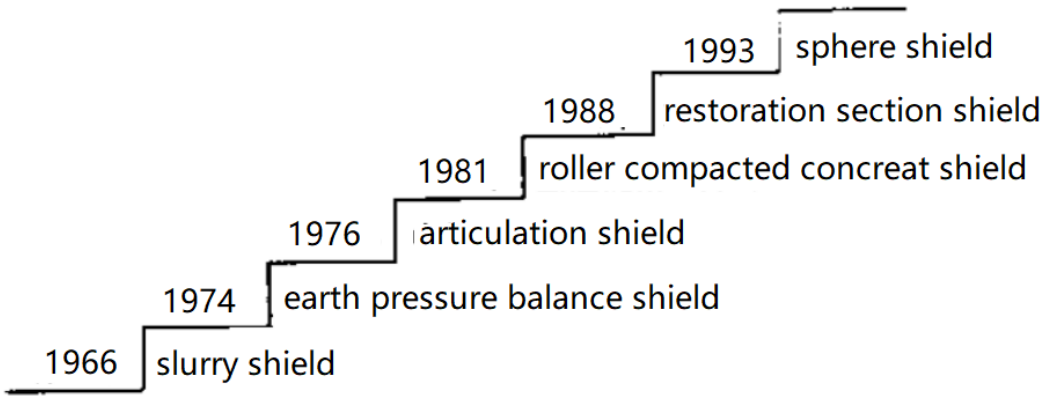

Fig.1 development of shield technology in different years

3. Characteristic Analysis of Shield Method in Metro Tunnel Construction

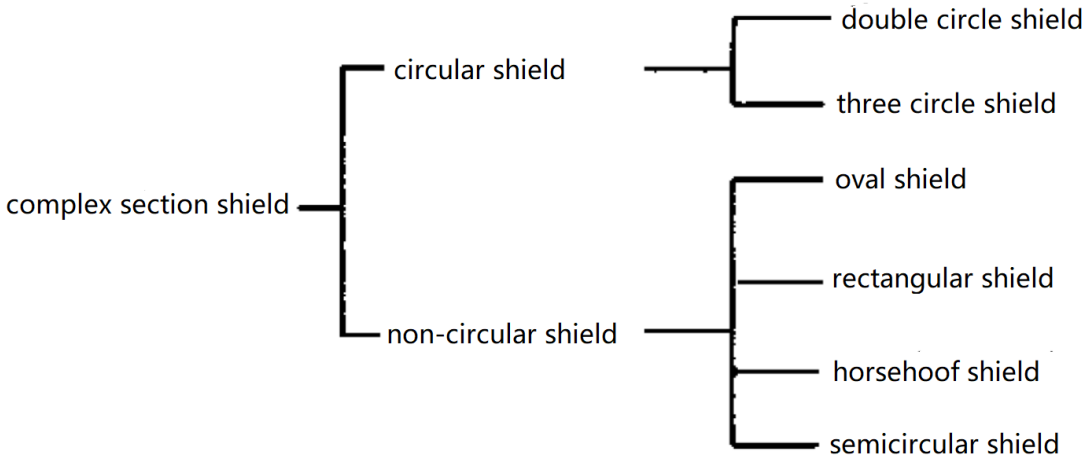

Fig.2 types of complex section shields in metro construction

The shield method has the following characteristics in comparison with other metro tunnel construction methods: it has less impact on surrounding buildings and people. In addition to the need for a certain construction space in the shield shaft or foundation pit, the construction along the metro tunnel has lower requirements on the construction space, the construction noise is small, the vibration is small, and the interference to the ground traffic is small, which is suitable for loose formations with large buried depth, its construction accuracy is high. The shield method can effectively ensure the construction accuracy and quality and safety, due to the high precision of the manufacturing of the shield machine, the error generated during the application is relatively small, the error range of the tube production is controlled within 0.5mm, and during the forward process of the shield, it is required to strictly control the deviation of the tunnel axis, and it is suitable for metro tunnel construction. When the tunnel construction is carried out by the shield method, since the shield machine and the tunnel construction section are strictly targeted, in order to achieve efficient construction, the shield machine needs to be modified and optimized according to the tunnel section structure, so as to ensure the smooth progress of tunnel construction. Types of complex section shields in metro construction as shown in Fig.2.

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4. Technical Status and Safety Measures For Construction of Metro Tunnels By Shield Method

4.1 Technical status

4.1.1 Technical control of the shield machine when entering and exiting the hole

In the practical application, the shield method needs to control the operation of the shield machine, the control of the shield machine entering and exiting the hole is very important, which is of great significance to ensure the quality and safety of the whole project. Once the control of the shield machine is not in place, it is very likely that the tunnel construction will be in danger. Therefore, it is necessary to strictly control the entry and exit of the shield machine to achieve the following two points: (1) before the shield machine enters the hole, it is necessary to reinforce the soil, and also survey the surrounding environment to ensure the normal and orderly tunneling of the shield machine, in case of unexpected situations, it is necessary to start the emergency plan at the first time to ensure the safety of the metro tunnel construction; (2) before shield machine is out of the hole, the staff needs to carry out a rigorous analysis of the exiting conditions of the shield machine to ensure that the conditions meet the requirements and standards before performing the exiting operation.

4.1.2 Technical control during the excavation of shield machine

Shield machine tunneling is an important link of the construction and application of shield tunneling, because the shield machine will cause the surrounding soil to be affected during the tunneling process, once the impact is too large, it will not only cause abnormality in the tunnel section structure, In case of seriousness, there may even be a collapse accident, it poses a threat to the safety of the staff. Therefore, in order to avoid the impact on the soil structure of the shield machine during the tunneling process, it is necessary to combine the tunnelling conditions and strictly control the tunnelling parameters to ensure the normal and orderly operation of the shield machine. In addition, the control of the shield attitude during the tunneling process of the shield machine is also very important, the shield attitude is a main indicator for evaluating the design deviation of the shield axis, the control of this index will directly affect the line shape of the tunnel, in order to ensure in order to ensure the efficient construction of metro tunnel, It is necessary for the staff to control the shield attitude reasonably to ensure the construction quality and safety.

4.2 Safety measures

4.2.1 Safety measures for the construction when shield machines enter and exit the tunnel

The control of shield machine entering and exiting the hole mainly includes the following points: (1) the stratum structure of the shield machine entering and exiting the end of the hole has a great influence on its construction. Therefore, strict investigation and control are required in actual construction to ensure that the end stratum reinforcement length is greater than the shield length, moreover, for some areas with unstable the soil layer, in order to ensure the normal entry and exit of the shield machine, the precipitation method should be used for reinforcement; (2) Before entering and exiting hole, the stratum reinforcement condition should be tested, if the test is passed, the next step of construction can be carried out; once the test fails, the relevant parameters need to be adjusted until the standards and specifications are met; (3) At the beginning of the tunnelling, it is necessary to properly control the speed of the shield machine.

4.2.2 Preventive measures for settlement during shield construction

First of all, before the shield construction, professional personnel should be arranged to inspect the surrounding pipelines and buildings, and the inspection data should be strictly analyzed, once there is data information that does not meet the standards, the construction plan should be adjusted in time to ensure the orderly construction of metro tunnels and achieve the ultimate goal of informatization construction. In addition, the settlement of the project area should be effectively treated, and the detailed settlement record should be made, ground surface grouting can be used to reinforce the

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settlement area in the treatment, improve the foundation strength and effectively prevent the area from twice settlement occurring.

5. Development Prospect of the Construction of Metro Tunnel By Shield Method

The development prospect of future shield construction technologies mainly include the following aspects: the manufacturing and application of special section shield machines. As far as urban metro tunnel construction is concerned, its main features are many curves and small radius. Therefore, the application of the future metro tunnel shield method will be developed towards special equipment, for example, mother-child shield, variable-section shield, etc., the research and application of these special section shield machines can effectively solve the problems of complex crossover and narrow space in the construction of iron tunnels. Although the shield method is more and more widely used in metro construction, the most used one is still the cut and cover method, which is an important way to build a metro station. In the metro tunnel construction in some developed countries, the shield method has been widely used, it is very common to use the shield method to construct station, for example, the former Soviet cities of Moscow and Tokyo, Japan have used the shield method to build three parallel tunnel station, it is of great practical significance for coordinating the difference between the station and the section tunnel, maximizing the advantage of the shield construction.

6. Conclusion

In summary, with the continuous expansion of urban traffic pressure, the scale of metro construction is growing. In the construction of metro tunnels, in order to ensure construction quality and safety, the shield method is usually used for construction, thus effectively improving the safety and reliability of construction. With the continuous development of the social economy, the research on the shield method will be more in-depth and specific, which lays a solid foundation for the development of China's metro engineering. Today, with the rapid development of tunnel shield construction technology, we must closely combine the characteristics of actual tunnel engineering, specifically determine the technical scheme of tunnel shield construction, only by strictly controlling its technical quality can the quality of the whole tunnel project be better ensured..

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