International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 3, Issue 4 (July-August 2015), PP. 163-165

SUMMARY ON SPHERICAL WEATHERING BODY PROCESSING METHOD OF SHIELD TUNNEL

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Abstract- Spherical weathering body is a complex geological process in the subway shield construction in the southeast of China. Spherical weathering body is a difficult problem in the construction of shield tunnel. Through the introduction of the mechanism of the formation of globular weathering body, law and engineering characteristics of distribution, subway shield tunnel construction process in globular weathering body dealing with three kinds of methods are analyzed and discussed: direct tunneling method, the surface pre-treatment method and the hole processing method. A comparative analysis of the advantages and disadvantages of the three kinds of ways provides a reference for the similar constructions.

Keywords- shield, metro, spherical weathering body, direct tunneling method, the surface pre-treatment method, the hole processing method.

In 1818, British engineer Brunel invented the shield construction technique [1], the advent of the first set of shield machine prototype. On 01/10/1969, Beijing subway line 1 held opening ceremony, which means China's first subway opened to traffic. After entering the 21st century, China Metro is entered a period of vigorous development. However, spherical weathering has been a difficult problem in the construction of metro shield tunnel.

In this paper, I take a subway under construction in southwest China as an engineering example to illustrate the influence of boulders on the project. In the process of shield tunneling, staff found that the sound of the propulsion pump was unusual, sound within soil bin, the knife dish appeared jam phenomenon, and then the torque increased suddenly, stopped pushing. After the blank experiment for the knife dish, staff found that it did not reduce the torque. At the bottom of the shield had vibration, sound, total thrust of 15000 kNm, advancing speed 0 mm to 15 mm. Unearthed in the engineering of a large number of water gushed out, and the slag was not smooth, and a spherical weathering slag. After verification, it was encountered in the process of shield machine by one 3.7 m (long) x5.2 m (width) boulder. The processing period about the Boulder is 67 days, which increased the construction cost RMB 2 million Yuan. With the rapid development of subway construction in China, it's common to find boulders in the process of subway shield advancing. Integrating existing literature and the construction experience of spherical weathering body further discussion is very necessary.

I. FORMATION MECHANISM AND DISTRIBUTION LAW OF SPHERICAL WEATHERING BODY

A. Formation mechanism of spherical weathering body

Three groups of primary joints divide rock into many square or rectangular shapes. With the weathering process, the primary joints intersect part is the maximum surface area, making weathering in primary joints at the intersection more concentrated. Weathering speed faster, the surface wind erosion rock becomes more pliable. Different parts of the rock weathering speed is not the same, some rock block is conducive to the improvement of the mechanical properties of micro fabric characteristics. With the passage of time, the rock weathering degree will gradually be shower less than the weathering degree of the rock and soil mass around, then it will present the state of the "boulder".

B. Distribution law of spherical weathering body

The distribution law of the weathering body can be analyzed from the macroscopic angle by two methods of surface profile adjustment and drilling. The surface profile can be investigated by the investigation of the distribution density and individual size of the weathered sphere in the surface of the earth. At the same time, through the analysis of the core, the height position of the ground and the form of the performance can be revealed. According to the analysis results of surface profile and drilling, the distribution law of spherical

weathering body is determined. Comprehensive analysis of the distribution law of the spherical weathering body has been made, and the comprehensive exploration technology of spherical weathering body can be put forward by considering the effect of the above two methods.

C. *Engineering characteristics of spherical weathering body*

Due to the presence of globular weathering body, whole weathered layer no longer has the mechanical properties of uniformity in the macro level. The deformation and failure mechanism of rock strata with spherical weathering body is different from that of the weathering layer in the presence of non-spherical weathering. Its mechanical strength between does not contain globular weathering body of regolith and weathered sphere with the same degree of weathering layer, its mechanical strength is higher than does not contain globular weathering body weathering layer, and its mechanical strength is lower than have the same degree of weathering regolith. Under the same weathering degree, the rock layer of the spherical weathering body is more likely to be destroyed. Weathering layers of the spherical weathering body cannot be considered as the "bedrock", which has the same weathering degree as the spherical weathering body, nor should it be considered as a spherical weathering body.

II. 9 PROCESSING METHODS OF SPHERICAL WEATHERING BODY

Globular weathering body processing method includes three categories, which are the method of direct tunneling, the method of pre-treatment on the surface and the method of processing method in the hole, specifically including nine, which are the method of direct tunneling, grouting reinforcement on the surface before driving through, drilling and blasting on the surface, impact drill broken on the surface, artificial dig hole pile on the surface, tunnel advance grouting before driving through, The artificial breakage or using splitting machine to break in the hole, artificial blasting in the hole, and the static breaking technology in the hole. The 9 methods have advantages and disadvantages and applicable scope. Choosing the most reasonable way and method should be based on the specific circumstances of the project.

A. Direct tunneling

For large boulders, its self-stability in soil guarantees the boulder will not move when the cutter brakes boulders. So the method of direct tunneling can be used by the way that" small thrust, low speed, low torque, low penetration" method of direct tunneling.[3] Applicable object of this method is the big boulder. This method requires that there is no significant construction and municipal pipelines around the surface.

1) Grouting reinforcement on the surface before driving through

First, workers use the sleeve valve pipe to do the grouting operation. When the Stratum is solidified by slurry, the disc cutter can cutting the boulders. Surrounding soil has no relative movement relative to the boulder, also more the posture of shield is easily controlled.

2) Borehole blasting on the surface

Workers use the small diameter bit drill blow holes in the boulder and pore the right amount of static explosive in the holes to blast the boulder. When a blasting is completed, remove orient block and do a static explosion again until the boulder is disintegrated.

3) Impact drill breakage on the surface

The impact hammer broken boulder from the surface. Boulder fragments should be carried out from the tunnel after the impact drill chops large boulders. Small boulder fragments can be carried out with the slurry and slag, and large boulders can be carried out with screw conveyor slag along with the process of tunnel boring machine.

4) Artificial dig hole pile

Artificial dig hole pile construction is convenient, fast, and don’t need of large mechanical equipment. When workers dig the hole to the boulder location, they use hydraulic splitting machine break the boulder. During the excavation process, workers use the bucket of gravel to get out the small boulder fragments vertically. Construction should pay special attention to pumping, lighting, ventilation and other safety issues, to ensure the safety of personnel. After cleaning up the boulder fragments, the hole need stratified backfill timely.

1) Grouting hole In advance before driving through

The Slurry can be chosen according to the specific situation, for example cement slurry. Boulder and surrounding soil will wrap together tightly after grouting. The Shield machine break boulders by adjusting the parameters, and then broken Boulder fragments will shield screw conveyor with slags.

2) The artificial breakage or using splitting machine to break

When the mass rating of the tunnel face rock is higher, and lithology is good, workers can open the granaries by the method of artificial breakage or using splitting machine to break directly. It's according to the size of boulders to choose the method. For boulders with small diameter, we can use the method of artificial breakage, and for boulders with big diameter, we can use the method of using splitting machine.

3) The artificial blasting, static crushing in the hole

The so-called treatment in the hole means strengthening on the surface is not required, but means reasonable way is needed to break boulders in the hole. For Artificial blasting, and we need to process grouting reinforcement in the soil in front of the cutter by pre-grouting hole of shield machine to ensure the stability of tunnel face, and then unlock the cells, drill, charge, weak blast, and slag.

The weak lasting technology should strictly follow the principle "shallow hole, close eyes, small dosage, interval charge"[4]. The steps for the static blasting are pre-grouting, opening, stable drilling, static crushing.

III. CONCLUSION

The treatment of Boulders first need us to cognitive the formation mechanism, the distribution law and the engineering characteristics of globular weathering body. According to the size, shape, spatial location of spherical weathering body, and the status of the surrounding environment, and considering the cost, schedule, risk, technology, environmental protection and other factors, we ultimately determine the method of boulder crushing. Which should be given priority is the method of direct tunneling.

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