International Journal of Intelligent Information and Management Science

Volume 5, Issue 3, June 2016

(Part I)

http://www.hknccp.org

Publisher: HongKong New Century Cultural Publishing House
Address: Unit E79, 3/F., Wing Tat Commercial Building, 97 Bonham Strand East, Sheung Wan, HK

Contents

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 5, Issue 3, June 2016

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 5, Issue 3, June 2016

Study on Comprehensive Prevention and Treatment Measures of Highway Tunnel Landslide

Baoquan LIU
School of Civil Engineering, Chongqing Jiaotong University, Chongqing, 400074, China

Abstract: Highway tunnel collapse accident with serious harm degree, treatment difficulties and other characteristics, So the possibility of the accident is reduced to the minimum, the security threat is reduced to the minimum, the accident loss control is the ultimate goal of safe comprehensive disposal. According to the features and reasons of the collapse of the tunnel collapse: geology, construction and management, puts forward some suggestions for treatment measures and the comprehensive management of highway tunnel collapse, to have very important meaning of governance construction of highway tunnel collapse accident and prevention.

Keywords: Highway tunnel; Collapse; Landslide; Prevention measures

1. Introduction

Highway tunnel collapse but not often appear in the tunnel accident, and the accident situation is more serious than the general level. Especially in highway tunnel, after the collapse caused by the accident is special major accidents. Therefore, the construction safety problem of highway tunnel is particularly prominent, already is a very difficult problem. The development of China's relatively late, but in the highway tunnel, has been the country's strong support and a lot of investment. Therefore, the construction of highway tunnel has been in rapid development in the form of. The construction of highway tunnel in China is a very big success, a lot of highway tunnel, the construction of long highway tunnel and highway tunnel enjoys a high reputation in the world, such as the two Zhuang Ke highway tunnel. In highway construction, highway tunnel construction accounted for the majority of. At the same time, because to China in the construction of highway tunnel was already very late, so in many cases is in lack of experience and technology is not mature, highway tunnel excavation part and greater, more flat, so in fact in highway tunnel construction when I have a lot of technical problems. Frequent building collapse phenomenon for many reasons, sometimes geological problems and construction technical level may cause collapse, sometimes construction and technical staff of some errors of judgment, it is possible to cause landslide and collapse of the damage is very intuitive. Sometimes we even think in the construction of highway tunnel and underground engineering construction collapse is the most injury accident on-site construction personnel safety. Landslide is a kind of common and typical tunnel construction accident. Once the collapse, not only delay time, greatly increased the cost of the project, but also endanger the safety of the construction personnel. If handled properly, it will cause the project quality, but also to bring great difficulties to the maintenance of late. However, due to the large number of landslides, forms, and so the governance must be comprehensive analysis, the introduction of a variety of situations, is extremely necessary.

2. Highway Tunnel Collapse Accident Investigation And Analysis

2.1. Factors of highway tunnel collapse

Which factors of highway tunnel collapse very much, on the basis of investigation and analysis, geology and construction and management are the main factors to cause landslides.

2.2. Main types of highway tunnel collapse

There are many types of landslides in the highway tunnel, so there are many ways to divide the type of landslide in the highway tunnel. In this paper, according to the location and size of the highway tunnel collapse and the size of the classification of categories.

1) According to the location of the Division

(1) the entrance to the cave is at the beginning of the opening of the mouth of the cave, the landslide occurred, which is also called landslide;

(2) the collapse of the cave is in the length of the distance to the entrance of the cave, the collapse occurred, the collapse is often due to the depth of the buried depth is not enough to cause the collapse to the surface;

(3) the tunnel face collapse when excavation of tunnel face, landslide;

(4) the face after the collapse when the excavating face length, landslide.

2) In accordance with the size of the division

According to our country "the engineering rock mass classification standard GB" provides that the landslide is divided into three kinds:

(1) small Landslides: the height of the tunnel collapse is less than or landslides in a certain range of small landslides.

(2) in the landslide: the height of the tunnel collapse is equal to or landslides in a certain range of landslides.

(3) the large landslide: the height of the tunnel collapse is greater than or landslide accumulation in a certain range of large landslides.

3) According to the control factors

The lithology of landslides, landslides, collapse of structure surface broken and mixed collapse

4) According to the induced factors

The construction of water gushing and collapse landslides and vibration.

5) Forms can be divided according to the landslide

Local landslides and arch collapse and special shaped landslides.

6) According to the mechanism of occurrence

Rock sliding type landslides and loose medium caving type landslides and soft rock creep collapse.

3. The Prevention Measures Of Highway Tunnel Collapse

3.1. Prevention measures for landslide in highway tunnel

Preventive measures for the highway tunnel collapse is very important, not only to prevent the collapse, but also to reduce the extent of the disaster. At present, usually from the following aspects to consider the prevention of highway tunnel collapse.

1) The perfect design work

Tunnel geological conditions are more complex and special. There are situations where it can't be sure. For design work, combined with the exploration of the geological situation of, to choose the suitable design data. Finally, we get perfect design master plan, and according to the construction site and the measured data of the overall analysis is then derived data and revise and adjust the parameters.

2) Geological prediction accurately

Highway tunnel after the bad geological section, by means of advance geological forecast, fully understand the front of the geological situation, at any time will work method to adjust, and timely amending and adjusting the support parameters, ready for the collapse of the prevention measures. By monitoring the measurement and judgment of geological prediction and advance, advance forecast factors and safety measures, so as to effectively deal with.

3) Short footage and strong support and quick closure work

Highway tunnel after the bad geological section must be strictly followed: excessive management, weak blasting, short footage, early bolting and shotcreting, strong support, early lining, ground measurements, the 16 character principle, after the excavation progress and the size of the strict control, to improve the primary support stiffness, in order to prevent landslides occurred. In addition, the requirements of the inverted arch and temporary invert primary support, to be closed in time into the ring, strict prevention work order of chaos led to the occurrence of highway tunnel collapse.

4) Strict pace of work

For step excavation has been lots of up and down the steps between the distance to strictly control the inverted arch and excavation has been working face between the distance and the second lining and excavation of the distance between the surface of the work shall strictly comply with the specifications and design requirements.

5) The amount of careful survey and monitoring data to guide the work

For surrounding rock monitoring and measurement work must conscientiously do a good job, in accordance with the monitoring and measurement data regression research conclusion, accurate judgment stress and deformation in the supporting system, in the amount of measured data on the occurrence of abnormal changes or mutations hole inside or on the ground cracks and shotcrete shotcrete appear abnormal cracking and twisted steel arch. Inside the hole or ground displacement data is greater than the given displacement values. We must immediately stop construction, until smooth deformation down, and then adjust the reference coefficient of support and construction method, and then finally to continue construction.

6) A good job of groundwater

Before entering the hole inside. First of all, the hole of the side slope protection makes perfect, cut-off water drainage works perfect to ensure slope and upward slope stable, to prevent surface water and rainfall infiltration, and endanger the tunnel construction safety issues. Also increases the early support of sprayed concrete quality, use of drainage and anti blocking treatment of groundwater comprehensive method, will improve the stability of surrounding rock, prevention outburst of water and mud and sand Chung.

7) The reinforcement and improvement of bad geological

In the already completed construction of bad geology section above, if the collapse may occur, must immediately implement remedial methods can be added bolt system, to hang steel net, steel inlaid, grouting reinforcement, ahead of the second lining reinforcement me-

thod to reinforce. An emergency can be the implementation of temporary support: temporary inverted arch, arch and the top of the column and the Zhenmu stack and so on. Then, then take a series of measures to reinforce. In no construction of the bad geological sections above, you can see into different geological conditions, the construction site has some conditions, take advanced pipe shed, advanced small pipe, surface jet, horizontal rotary jet grouting pile, radial grouting, surface grouting, well point dewatering, deep well dewatering, cold freezing method for pre reinforcement and improve strata. The ability to increase the stability of surrounding rock to prevent the occurrence of highway tunnel collapse.

8) Prevention of landslides plan work

Before the highway tunnel construction, to carefully formulated to prevent tunnel collapse, store emergency equipment and materials. Once the occurrence of landslides, to quickly rescue and to minimize the loss.

3.2. Highway tunnel collapse treatment measures

Highway tunnel collapse is more common in underground engineering construction of engineering accidents, the mechanism and influencing factors are also different, corresponding treatment methods also cannot treat as the same. Must be a correct understanding of the landslide of highway tunnel collapse treatment and general treatment principles is to consolidate the rear, so as to prevent the expansion of the collapse, and rear area security for support or cover to deal with landslide body, at the same time to strengthen the drainage, which is to adhere to the "small blockage, wearing big collapse", "treating collapse first flood and treat collapse to strengthen" principle. The general guiding ideology of the landslide treatment is to stabilize the surrounding rock, the consolidation of the collapse, the steady progress, and the safe construction.

(1) the treatment of landslides must be safe and reliable, so that personnel mechanical equipment safety.

(2) to ensure the quality of the project and shall not have any hidden dangers.

(3) the entire landslide treatment cost control to the minimum.

1) Highway tunnel collapse temporary emergency treatment measures

When the accident occurred after the highway tunnel, should be in accordance with the safety level of landslides, immediately report to the relevant units and personnel. At the same time, the implementation of contingency plans; when the gushing water and water inrush accident occurred, the water inflow and water inrush of personnel must quickly to carry out rescue work, fled the scene of the water inflow and water inrush. For the construction work in the danger zone should be immediately suspended, the all staff to evacuate to safe areas, find out a relevant number of construction, check whether there is casualties or in a dangerous state and immediately cordoned off the area, prevent the irrelevant personnel into the danger zone. If no casualties or in an unsafe state, immediately develop a plan for the rescue, all departments to start the rescue work to cooperate with each other, so as to avoid further expansion of the accident. When there are casualties, immediately sent staff to give relief organizations, to help the wounded immediately flee the danger area, according to the severity of the wounded, the implementation of rescue and rescue work, in the shortest possible time, and the nearest hospital or medical establishments get in touch, in speed as soon as possible, let the injured rescue and nursing service. Related to command department should quickly clean up the scene, and the rescue work had no relation to the evacuation went out, processing and put on the intercept barrier facilities, scene of chaos order rectification, let rescue vehicles and personnel unimpeded, in very urgent, to find the area of public security management department to help maintain and manage the scene of the order. When the rescue plan is applied to the scene of the accident treatment, it should be closely observed the situation of the surrounding rock and the situation of groundwater. When the collapse of the accident occurred, to strengthen the surrounding has not had time to collapse of the lot, to prevent the collapse of the accident occurred again. Water inflow and water inrush accident to lots of water inrush points around the reinforcement, prevent water gushing water, caused by the collapse of the accident occurred, carefully check the gushing water and water inrush may occur. The carefully analyzed the cause of the accident caused by that query and organize evidence related to the accident, the responsibility for accidents and accident investigation clearly. For the first time take revision and correction measures and accident treatment scheme as soon as possible will return to normal construction.

2) Treatment points of highway tunnel

(1) To improve the monitoring of surrounding rock work

Surrounding rock monitoring work, into the sequence of construction management to, in addition to the monitoring and measurement of conventional rock projects still need observation collapse section of the body other: each cycle, dug up the collapse of the local section of loose, above the virtual ballast thickness, rock grouting and reinforcement effect, and the carefully analysis of records of the results of, so as to guide the construction of a cycle.

(2) To improve the grouting reinforcement work

The real situation of the cave scene analysis, to grouting effect reaches the best and correct selection of a suitable grouting materials and methods is very necessary, if in the excavation process, discovered the grouting effect is not ideal, now for the first time to the collapse of the object closed and repair and grouting.

(3) Do a good job in the excavation collapse section

For the collapse of the object, in the large pipe shed and small duct grouting applied finish doing, under normal circumstances can take three steps method for excavation work. Combined with the actual situation of the construction site and stage order method of construction, the first half of the excavation work, when the jet concrete construction work ended and also half of excavation and supporting, as far as possible, to reduce the excavation work of airport surface, in the arch of the foot, take high arch foot work method, and the basement of the bearing capacity of up.

(4) To improve the work of the collapse section

The initial spray work into the process control of them, must first face early spray excavation; improve the anchorage quality of anchor bolt and anchor pipe; for the welding quality of the steel frame, must be very seriously.

4. Conclusion

Anyway, for highway tunnel collapse reason analysis and processing technology, it is necessary to improve the monitoring measurement of surrounding rock of work, in addition to the routine measurement of surrounding rock, but also to collapse at the crack section of well log analysis, to collapse at each cycle during the excavation of the bedrock, the slag loosening the thickness, the dew of the boulder, the grouting effect were recorded and studied in detail, the dynamic and flexible measures to get local reinforcement guide subsequent construction. In addition, highway tunnel collapse treatment scheme to be established on the basis on the collapse of the correct investigation and understanding, from the economic point of view, the construction difficulty degree and safety construction in all aspects to consider. Take relationship step footage, early closed ring, ground measurements, a strong support, secondary lining followed by other methods of treatment. In the collapse in the construction process should pay close attention to dynamic surrounding rock and groundwater condition, always make the remedy. In short, it is difficult to control, if not for the accident field analysis, collapse accident is very difficult to get good governance, sometimes there may be caused by side on the side to collapse. At the same time, if the treatment is not thorough enough, the project in the process of construction may have a greater risk. So in the process of highway tunnel construction must always pay attention to prevent collapse and the collapse of the rapid control of work, personnel of highway tunnel design and construction personnel are very concerned about this point. These measures are very necessary for the prevention work of highway tunnel collapse.

References

[1] SONG-Bo. Da Shan highway tunnel collapse mechanism and treatment measures research[D]. Chengdu: Chengdu University of Technology Master's degree thesis, 2011(5):32-56.

[2] CHEN-Hong. Study on landslide and disaster treatment measures of Guangzhou Expressway Tunnel [D]. Chengdu: Master's degree thesis of Southwest Jiao Tong University, 2009(4):53-76.

[3] LI-Chao. Guangxi adoration highway Sifang mountain tunnel collapse reason analysis and treatment countermeasures [D]. Xi'an: Chang'an University Master's degree thesis, 2011(7):43-67.

[4] WNG Ying-chao. mountain tunnel collapse mechanism and prevention methods [D]. Zhejiang: Doctoral Dissertation of Zhejiang University, 2010(4):43-86.

[5] KONG Da-chuan. Control factors of tunnel collapse and its prevention and cure measures [J]. Shandong traffic science and technology, 2010(6): 64-68.

[6] WANG Ke-yong. Analysis and treatment measures of landslide in expansive soil bias tunnel [J]. Shanxi architecture, 2013 (2): 161-163.

[7] HOU Wen-heng. Discussion on the prevention and treatment of tunnel collapse [J]. Journal of LanZhou JiaoTong University.2014 (1): 35-38.

[8] PAN Xue-dong. Technical measures for the prevention of tunnel collapse [J]. Shanxi building.2008 (6): 324-325.

[9] Seokwon Jeon, Jongwoo Kim,Youngho Seo,Changwoo Hong.Effect of a fault and weak plane on the stability of a tunnel in rock-a scaled model test and numerical analysis[C]//Int.J.Rock Mech.Min.Sc.i,2004 (3):1-6.

[10] QIN Hao,MAO Xian-biao,HU Jin-hai.Numerical analysis of soft surrounding rock deformation and failure of coal entry[J].Journal of Mining&Safety Engineering,2006(3):289-292.