On the Application of Anchor Frame Beam Technology for Subgrade High Slope in Construction

Dongxia Liu

Chongqing Vocational College of Transportation, Chongqing, 402247, China

Keywords: Subgrade high slope, Anchor frame beam, Subgrade construction

Abstract: Combined with the actual situation of a highway project, the construction technology of anchor frame beam used in the protection of the high slope of its roadbed is analyzed, the main points of different construction links are proposed, and the construction of the anchor frame beam of this project is successfully completed through practice. After inspection, it is confirmed that the quality is qualified, the construction technology used is reasonable and feasible, and it is worth drawing conclusions from similar projects, and ultimately achieve the fundamental goal of improving the safety protection technology level of the roadbed high slope.

1. Introduction

In the construction of highway subgrade, the protection of high slope is very important, which should be attached great importance to by the relevant construction personnel. The characteristics of bolt technology should be clarified, the influence of various factors should be grasped, and the key points of surveying lofting, drilling, making and installing anchor rod, steel bar construction and anchoring grouting construction should be done well. Take effective measures to bring them into line with prescribed standards, pay attention to environmental protection, green and sustainability.

Section K82 + 096-K82 + 179 of a highway project has a high slope on the right side, which is supported by anchor frame beams, the beam height is 10m, and the length of a single frame is 15m. It is composed of ribs and beams, of which ribs The distance between them is 3m.The vertical ribs and beams are the same size, both 0.3m×0.3m. Anchors are installed at the nodes, and the slope is 25°downwards. The borehole diameter and length are 90mm and 12.4m, respectively. The total length of the pole is 12.0m. The ground beam needs to enter the rock body 30cm, and both the ground beam and the frame are cast with concrete of strength class C25. Now based on the actual situation of this project, the following analysis of the concrete construction process of its anchor frame beam is performed.

2. Preparation for Construction

2.1 Material Preparation

(1) With a rod of 32 mm in diameter as the material of the rod body, the surface of the reinforcing bar should be kept straight and without rust.

(2) The cement is ordinary silicon cement, and the fine aggregate is medium-fine sand with a particle size of less than 2mm. Water should meet the design requirements. Sewage and water with a pH lower than 4 cannot be used.

(3) Performance inspection and testing of materials before use, including anchors, steel bars, aggregates, mortar, and concrete. Those that do not pass the testing test and the test failing the test are not allowed to be used in construction. And design requirements to be stored on site.

2.2 Operating Conditions

(1) Before the construction of the anchor rod is started, based on the design requirements, combined with the soil layer and environmental conditions, select the appropriate construction process method and equipment.

  DOI: 10.25236/acete.2019.078

(2) Based on the design requirements of the project, and in accordance with the actual conditions of the models and specifications of the machinery and equipment used, the construction site is leveled.

(3) Before starting construction, check all raw materials and anchors to confirm whether their performance meets the requirements of design and specifications.

2.3 Measurement Stakeout

The protection project must follow the excavation, and based on the excavation slope surface, accurately release the platform position of the slope, and according to the design requirements, combined with the actual situation of the surrounding rock, determine the specific location of the borehole and make corresponding marks.

3. Construction Technology, Quality Standards and Precautions

3.1 Drilling

(1)Before drilling commences, determine the specific location of the borehole and make corresponding marks in accordance with the design requirements in combination with soil conditions.

(2)The construction site must be solid and flat, and drainage ditches must be set up.The width of the construction site should be more than 4m.

(3)After setting the drilling rig in place, it should be kept stable.The vertical shaft should have the same inclination angle with the drill pipe, and at the same time be on the same axis.The inclination angle of the rig is controlled at 25 °, and the rig is reliably fixed.

(4)Carefully operate, pay attention to the correct rig parameters while drilling, and strictly control the actual drilling speed to avoid stuck and buried drilling.If an accident occurs, it should be handled immediately.

(5)After drilling is completed, use an air compressor to clear the holes.

3.2 Rod Assembly and Installation

(1)The production of anchor rods according to design requirements. In order to make the anchor rods be in the exact center of the drilling hole, the centering frame needs to be set on the rods, and the spacing distance is 2m.

(2)Rebars of members shall be kept straight and without rust.

(3)In the process of installing the rod body, it is necessary to avoid bending and twisting of the rod body.The grouting pipe and anchor rod are simultaneously placed in the borehole. The distance between the bottom of the borehole and the pipe end is controlled according to 400mm. The angle of inclination and the installation angle of the rod should be exactly the same.After the rod is installed, it should be in the center of the hole.

(4)If the hole wall collapses during the construction process, drilling and clearing holes shall be carried out again until the anchor rod can be lowered normally.

3.3 Grouting

(1)Anchor holes are filled with cement mortar. The water-cement ratio of the mortar is in the range of 0.4 to 0.5, and the ratio of cement to sand is 1: 1. The mortar strength is required to be above 30 MPa. The grouting starts from the bottom of the borehole. Until the orifice begins to return to the slurry, the pressure during grouting should be controlled within the range of 0.6 ~ 1.2MPa.

(2)The slurry must be stirred evenly before use and sieved. Use it as soon as it is mixed. The slurry must be used before the initial setting, and the pipeline must always be open.

(3)If the grout cannot be filled with anchor solids, grouting is required.

(4)During the grouting process, the grouting pipe should be taken out at the same time as the grouting, but it should be noted that the nozzle must always be below the liquid level of the mortar, and the grouting pipe should be properly moved according to the actual situation and wait for the

hole. After the slurry flows out of the mouth, pull out the entire grouting tube.

(5)During the process of extubation, pay attention to check whether the steel bar is taken out, if it is taken out, it should be pressed back, and then continue extubation.

(6)After the grouting is completed, clean the exposed steel bars and perform necessary protection.

3.4 Frame Construction

According to the design, the frame is to be grooved, and the ground beam should be embedded in the rock mass at least 30cm. After mortar is used to level the bottom groove, the steel bars in the groove are installed and set, and the formwork is used for concrete pouring. The strength grade of the concrete used should reach C25, and the frame should be cast in its entirety, instead of being completed at one time. Expansion joints should be arranged in the two frames, and bituminous hemp should be used for filling in the joints.

According to the actual situation of this project, the anchor rod uses the full length adhesive anchor rod, and the HRB335 steel bar is selected as the rod body material.

The anchor rod is designed according to the axial hand pull member, and the area of anchor bar is as follows: $A = K\frac{N}{F}$;A represents the cross section area of the steel bar, K represents the load safety coefficient, N represents the axial tensile force of the anchor rod, and f represents the tensile design strength of the steel bar. For the stable slope with no unfavorable structural surface, it is only necessary to consider the shallow layer. In this project, a singleφ18 steel bar with a length of 4.0 m and a diameter of 50mm anchor rod is selected. For the excavated high slope with unstable slope, the bolt length needs to be calculated according to the slope stability, and the effective anchor end length should not be less than 2.0 m.

The construction of frame beam mainly includes four processes, namely, foundation excavation of frame beam, steel bar binding, formwork installation and concrete pouring. Its construction technology is similar to that of general reinforced concrete structure, so it is necessary to strictly refer to the requirements of relevant construction standards to ensure the construction quality. It is worth noting that if the anchor rod is too large from the center of the frame beam, the anchor end should be properly adjusted and the hole should be filled immediately.

3.5 Quality Standards

3.5.1 Allowable Deviation

(1)The measurement and stakeout of the anchor hole position must be accurate, and the actual deviation is controlled within±3cm.

(2)The borehole should be kept at a depression angle of 25°from the horizontal direction, and its deviation must not exceed±2°.

(3)Drilling hole depth must meet the design requirements, and at the same time, it cannot be greater than the design length + 1%.

3.5.2 Measured Items

(1)Concrete strength: It is required to be within the allowed range and tested by standard methods.

(2)Mortar strength: It is required to be within the allowable range and tested by standard methods.

(3)The length of the anchor rod: meet the design requirements, and use the ruler method to detect at a frequency of 20 m5 each.

(4)Anchor rod spacing: The maximum deviation cannot exceed ± 20mm, and the method is used to detect at a frequency of 5 roots per 20m.

(5)The connection between the anchor rod and the panel: meet the design requirements, and use the visual inspection method to detect at a frequency of every 20m5.

(6)Anchor protection: meet the design requirements, use visual inspection to detect at a

frequency of every 20m10.

(7)Anchor pull-out force: The average value of the pull-out force of the anchor cannot be less than the design value, and the pull-out force in special cases cannot be less than 90% of the design value, and the detection test is performed at a frequency of 1% of the total, and not less than 3.

3.6 Construction Precautions

In order to ensure the normal and smooth completion of the construction, the following matters should be paid full attention during the actual construction process:

(1)According to the design requirements, combined with the soil conditions, compile a complete application plan, determine the appropriate drilling method, and carefully operate to avoid problems such as diameter reduction, collapse, and block loss, so that the installation of the anchor rod can be successfully completed.

(2)Assemble the anchor rod according to the design requirements to ensure the installation and construction quality of the anchor rod.

(3)Strictly control the mortar mix ratio according to the design requirements, control the quality of mixing, and ensure that the grouting equipment and pipelines are in the best working condition.

(4)Do a good job of technical and safety before the official start of construction. During the construction, a clear division of labor should be made, and a special person should be arranged for unified command. The grouting pipeline should always be kept open to avoid blockage. Safety protection should be done in the transmission part of the mechanical equipment. All machinery and equipment at the site should be reliably grounded and installed and operated by special personnel. Wires and cables at the site should be set up overhead. Construction workers on site must wear safety helmets in accordance with requirements and strictly follow relevant safety regulations and requirements. Adopt a safe and stable reaction force device. When drilling is required in formations with confined water, it is necessary to arrange a blowout prevention device at the orifice, and immediately block it when water leakage occurs.

4. Conclusion

At present, the anchor frame beam is an ideal way to protect the excavated high slope, which can reduce the project cost, save the engineering materials, and also has a good greening effect. It is convenient for the construction personnel to adjust the construction scheme in time according to the change of geological information. It basically realizes the information management of the high slope subgrade protection work, and has ideal social and economic benefits. This model is worth popularizing and using in highway construction in mountainous areas.the construction of this project has been successfully completed. After inspection, the quality is qualified, and it meets the requirements of design and specifications. It shows that the construction method used in this project is reasonable and feasible, and it is worthy of reference for similar projects to improve the construction technology level of anchor frame beams.

References

[1] Xu Hongwan, Yuan Jinwen.(2018). Application of soil and water conservation frame beam greening technology to slope treatment of a road project. Heilongjiang Hydraulic Engineering. Health, no,12.pp:200-201,204.

[2] Tang Xinjian, Cheng Xueming, Li Yu, et al.(2018). Research on influence of frame beam size on slope seismic performance. Engineering Technology Research.Health,no,15.pp:50-52.

[3] Liao Wenbin, Zhou Fuliang, Yang Guolin, et al.(2018).Field test of high slope of expansive soil reinforced by anchor frame beam under rainfall conditions.Highway Engineering. Health, no,2.pp:60-63,71.