

Research on Quality Control Technology of Bridge Pile Foundation Concrete Construction in Yushu Permafrost Regions

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Abstract: Pile foundation construction is a basic project of bridge engineering, which can ensure the safety attribute of bridge floor through the stability of pile foundation quality. Due to the existence of permafrost in Yushu, when carrying out the bridge pile foundation concrete construction project in this area, it is more necessary to carry out the construction according to local conditions, so as to ensure the quality and safety with accurate technology. This paper mainly analyzes the difficulties of bridge pile foundation concrete construction in Yushu permafrost regions to explore the technical points of engineering quality control, for reference only.

1. Introduction

Yushu is located in the hinterland of the Qinghai Tibet Plateau, with an average altitude of more than 3,600m. Many permafrost regions have been formed under the influence of climate and environment for many years. In the process of carrying out bridge construction in permafrost regions, it is necessary to fully consider the frost heave and thaw settlement of permafrost, and implement the corresponding technical requirements in design, construction, maintenance and other aspects. If there are some problems such as technical mistakes and lack of management plan, it is easy to affect the overall quality of the bridge, and people's life safety will also be threatened. Therefore, in the construction process of bridge engineering, we should attach great importance to the technical problems of quality control.

2. Difficulties in Application of Concrete Construction Technology for Bridge Pile Foundation in Permafrost Region

2.1 Problems Encountered in Concrete Pouring in Low Temperature Environment

Permafrost region is a kind of soil structure with special properties, which is very sensitive to the changes of environment and temperature, and is in an unstable state, with obvious seasonal changes. Especially in winter, the permafrost region layer can be frozen like ice, and its volume expands, and

the frozen soil shows a hardening trend. At the same time, the low temperature environment will also affect the pouring of concrete. Generally speaking, the higher the external temperature is, the faster the hydration of cement will be, and the strength of concrete hardening will be increased. However, the hydration of cement will slow down when the external temperature is lower. If the speed of hydration and hardening is inconsistent, the hardness and strength of concrete after hardening will be affected. [1] It can be said that low temperature environment will have an impact on both fresh concrete and hardened concrete. How to overcome the impact of low temperature environment on concrete pouring in the construction process is a difficult point in the application of bridge pile foundation concrete construction technology.

2.2 Influence of Hydration Heat on Frozen Soil

In the process of pile foundation construction in permafrost area, due to the influence of concrete pouring, the construction operation of pouring will bring certain heat to permafrost. This heat not only includes the heat brought by concrete into the mold, but also the heat generated by cement hydration. Under the interaction of the two kinds of heat, the heat will have a certain effect on the whole ground temperature and a certain degree of influence on the stable consolidation of the frozen soil layer, especially the hydration heat in the cast-in-place pile will have a greater disturbance on the frozen soil layer. Moreover, compared with the bridge pile foundation construction projects in ordinary areas, the bridge pile foundation in permafrost areas has the characteristics of slow formation of concrete strength and low bearing capacity due to the fusion of frozen soil around the pile foundation. This needs to pay attention to the influence of hydration heat on frozen soil in the construction process, and adopt different materials and schemes to carry out the corresponding bridge pile foundation concrete construction according to different temperature environment.

2.3 Concrete Cracking Due to Internal and External Temperature Difference

Concrete has the characteristics of thermal expansion and cold contraction. The change of external environment will have a certain constraint on the deformation of concrete, which will produce cracks when the stress exceeds the compressive strength. Whether it is annual temperature difference or sudden cooling, it will cause the deformation of concrete due to the internal and external temperature difference. In addition, in the process of practical engineering application, concrete cracks due to shrinkage are common problems in construction. For example, after the concrete hardens, the surface water will gradually evaporate; the humidity will gradually decrease, and the volume of concrete will also decrease. This form of evaporation makes the surface water loss faster and the internal water loss slower, resulting in the uneven shrinkage of large surface shrinkage and small internal shrinkage. If the reinforcement ratio exceeds 3%, the shrinkage of the reinforcement to the concrete will decrease. The binding is obvious, which is easy to cause certain cracks on the final concrete surface, so we need to focus on the cracks after construction in the construction. [2]

3. Analysis of Quality Control Technology Points of Bridge Pile Foundation Concrete Construction in Yushu Permafrost Region

Aiming at many difficult problems in the construction process of bridge pile foundation concrete in permafrost area, Yushu area needs to improve according to the local geographical location and climate characteristics, so as to realize the accuracy and cohesion of technical operation before, during and after construction. It can help ensure the hardness and bearing capacity of pile

foundation and ensure the stability of bridge structure in permafrost area. [3]

3.1 Before Construction of Bridge Pile Foundation Concrete

Before the concrete construction of bridge pile foundation, it is necessary to carry out the experiment of concrete control technology based on a certain process flow chart. In the experiment, we need to summarize the basic index of durability concrete, so as to improve the quality and safety of concrete pile foundation through relatively perfect technical ratio index.

(1) Superplasticity index. When the slump reaches 20cm, the concrete has no segregation, no bleeding, and the impermeability index is greater than 12.

(2) The enhancement effect of negative temperature is obvious. For example, under the condition of minus 20 degrees Celsius, the compressive strength of 7D and 28d should be increased by 20% - 40% and 10% - 25% compared with the reference concrete in the same period.

(3) The thermal disturbance to the frozen soil is small. When the inflow temperature is 5 degrees Celsius, the maximum temperature rise of frozen soil 20cm away from the surface of bored pile is 3 degrees Celsius, and the maximum temperature rise of frozen soil 1m away from the surface of pile is 0.66 °C.

3.2 In the Construction of Bridge Pile Foundation Concrete

In the process of bridge pile foundation construction, it is necessary to carry out technical detection on the temperature of pile foundation, and record the temperature change through the real-time detection of temperature, so as to carry out the comprehensive evaluation of data development trend based on the dynamic temperature record. In the measurement process, it is necessary to analyze the data based on a certain time interval. For example, the temperature should be measured once a day before the concrete pouring of the pile foundation, and then every two hours within 5 days after the completion of the pouring, every 24 hours within 5 to 12 days after the pouring, and so on. At the same time, in the process of bridge pile foundation construction, we should focus on ensuring the temperature of the construction environment, which requires the corresponding greenhouse temperature design and adjustment based on different construction environment temperature characteristics.

(1) When the construction environment temperature is higher than 5 degrees Celsius, no basic heating measures are needed to balance the temperature difference inside and outside the concrete.

(2) When the construction environment temperature is between 0 degree Celsius and 5 degrees Celsius, there is no need to build a warm shed. But in the construction, it is necessary to heat the water content of concrete and the mixing process to a certain extent.

(3) When the construction environment temperature is between minus 5 degrees Celsius and 0 degree Celsius, the temperature of the greenhouse in the whole construction process needs to be controlled at about 5 degrees Celsius. At the same time, the concrete transportation time needs to be kept within 45 minutes to prevent the suitable temperature in the mixing process from falling due to the long transportation time.

(4) During the construction, the temperature should be controlled from minus 10 degrees Celsius to minus 5 degrees Celsius.

(5) When the construction environment temperature is between minus 15 degrees Celsius and minus 10 degrees Celsius, the greenhouse temperature during the construction process should be about 15 degrees Celsius, and the concrete transportation time should be kept within 45 minutes as far as possible. If the concrete transportation time is more than 45 minutes, the sand should be predicted in advance before the concrete processing, so as to ensure the temperature in the transportation process.

3.3 After Construction of Bridge Pile Foundation Concrete

After the completion of bridge pile foundation concrete construction, it is necessary to carry out the superstructure and construction in this technology, which requires timely detection of the corresponding concrete quality in the construction process, timely repair for problems, and complete the technical maintenance work in the later stage, so as to ensure the safety of the basic pile foundation construction.

(1) From the perspective of energy conservation and resource protection, in order to ensure the temperature of frozen soil construction and maintenance, priority should be given to non heating maintenance methods such as heat storage method and negative temperature method.

(2) If it is difficult to guarantee the quality of the project without heating, it is necessary to focus on the greenhouse maintenance method and steam maintenance method for later maintenance, so as to ensure the temperature and quality of the construction in a short period of time.

(3) It's necessary to strengthen the construction management and later guarantee of bridge pile foundation. This needs to strengthen the management and supervision of the staff for the project operation in the later stage of the construction, ensure the standardization of the operation of the technical personnel, and avoid the technical mistakes caused by the non-standard construction.

(4) It's a must to timely adjust the project construction scheme, according to the specific actual situation and construction environment to adjust the construction scheme, so as to ensure the quality of bridge construction in the construction process of Yushu permafrost region.

4. Conclusion

To sum up, there will be a variety of unforeseen problems in the process of bridge pile foundation concrete construction. If we ignore the details of concrete pile hole positioning, preparation, pouring and other aspects, it is easy to produce technical errors in the process of operation, which will affect the stability and durability of bridges in Yushu permafrost region. In this regard, we need to strictly control the operation of equipment in the process of pile foundation construction, strengthen the supervision and inspection of professional and technical personnel, so as to ensure the process and operability of the construction process and construction links. It can ensure the stability of pile foundation, ensure the long-term stability of its bearing capacity, and build a bridge for people's travel safety with high-quality projects.

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2)General project of Qinghai Nationalities University, Study on Bond Mechanism of FRP Reinforced Magnesium Phosphate Cement Strengthened Reinforced Concrete Beams in Alpine Regions (No. 2021XJGH10)

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