

Construction Management and Installation Quality Control Strategy of Steel Bridges

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Abstract: At present, China's bridges are mostly made of concrete, which contain a large amount of cement, sand and gravel and other materials, which can easily cause environmental pollution. At the same time, China's total steel production continues to rank first in the world. The construction and development of steel bridges have sufficient basic support. At the same time, steel is more environmental-friendly than concrete, with higher strength, lower weight, and can reduce construction waste significantly, so the development of steel bridges has been on the rise. To optimize the application effect of steel structure bridges, it is necessary to analyze the construction management and installation quality control strategies of steel bridges for reference.

Keywords: Steel bridge; Construction management; Installation quality; Control strategy

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1. Introduction

Under the background of the increasing demand for transportation in China and the continuous improvement of the speed of transportation, bridge construction has received much attention, and steel structure bridges have gradually dominated the construction of long-span bridges. Compared to traditional concrete bridges, steel structure bridges are more environmental-friendly and structurally stable. At the same time, they can realize industrial production, have a short construction period, not prone to traffic jams, and can withstand large spans and loads^[1]. However, in the construction of steel bridges is not managed and controlled properly, it may cause serious safety hazards and even cause accidents. Therefore, it is necessary to deeply analyze the construction management measures and installation quality control strategy of steel structure bridge.

2. Status of steel structure bridge construction

Steel bridges have been around for more than 200 years, and the application of steel bridges in China has also exceeded 100 years. In these years, the number and scale of steel structure bridges in China have continued to develop. The truss structure is currently a mixture of various forms, such as long-span suspension bridges or cable-stayed bridges with a length of more than 500 meters, in which steel box girders are mainly used as the main girder. Overall, steel structure bridges have good structural performance, low cost, short construction period, and high overall strength. However, the level of construction technology will affect the overall quality of the bridge. There is still an imperfect management system, incomplete implementation of management measures and insufficient quality control in the construction of steel structure bridge in our country, affecting the construction process, and the quality of installation. At the

same time, the use of steel structure bridges in China also has the phenomenon of reduced application rate and insufficient promotion, which cannot fully match the rapid development of the steel industry in China. Therefore, the related work of steel bridges and steel-concrete bridges still needs to be fully optimized, so as to improve the application frequency and the quality of steel bridges.

3. Construction management of steel structure bridges

(1) On- site management

The construction of steel structure bridges is easily affected by the surrounding environment, and many technologies and departments are involved in the construction process, so it is more complex than the construction of ordinary concrete bridges. Therefore, it is necessary to optimize the management of the construction environment and to ensure adequate preparation. First, the advantages and characteristics of the project should be fully understood, an appropriate construction method should be used, advanced construction technology should be applied accordingly, and all equipment needed should be readily available. Besides, it is necessary to carry out on-site survey work in advance, clarify the project plan, and formulate a traffic diversion plan to avoid situations like traffic jams. If the construction site is in a mountainous area or in the outer suburbs, attention should be paid to setting up environmental protection workers to avoid damaging the ecological environment or occupying the farming areas. At the same time, the quality of construction materials should be strictly controlled, because the amount of prefabrication of steel structure bridges is relatively large, and the degree of prefabrication is relatively high, and the quality of materials and accessories will significantly affect the service life and safety of bridges. Therefore, the construction party should conduct strict qualification review for material suppliers, and the staff involved in the procurement must complete real-name registration to ensure that the performance, quantity, specification, and appearance of the materials are up to the required standards, with certificates of qualification and relevant proof^[2]. In addition, it is also necessary to predict possible emergencies and safety risks based on on-site survey results and various objective factors and propose reasonable prevention and treatment measures to ensure that the construction site environment can meet the construction needs, which allow better preparatory work^[3].

(2) Progress management

Before construction, the construction progress plan should be formulated according to the overall construction period objectives and site construction conditions. Moreover, organizational, technical, and quality assurance measures should be carefully formulated. During the construction process, the construction progress should be strictly controlled, and the work should be carried out step by step according to the construction plan. After each process is completed, the staff should first conduct a self-inspection, and then the quality inspection personnel will conduct an in-depth inspection. If there are deficiencies, it should be rectified in a timely manner to ensure high quality construction. During the entire construction process, the inspection work must not be neglected just to keep up with the construction progress, so as to avoid needing huge rework, which will prolong the construction period^[4].

(3) Technology management

Steel bridges are complex, thus the construction organization design and technical plan should be fully discussed and formulated before construction to ensure that the plan is reasonable and feasible. In particular, the installation of steel structure bridges is difficult, and the technical requirements are relatively high. If the construction work is not carried out in accordance to the regulations, the overall structure may be affected, which will lead to the construction quality not meeting the relevant standards. Therefore, when lifting the steel structure, not only should the quality of lifting components meet the relevant regulations, but the lifting method should also be adapted to the steel structure. Hence, it is

necessary for the staff to fully analyze the weight distribution and actual shape of the components, reasonably select the lifting method according to the hoisting equipment that can be applied on the construction site, and accurately control the lifting position and speed, and gradually complete the hoisting of the steel structure ^[5].

(4) Installation management

The installation effect of the steel structure base frame of the bridge should be guaranteed. The size of the foundation stone of the top support of the bridge pier needs to be compatible with the size of the backing plate, the elevation and plane position needs to comply with relevant regulations, and the horizontal deviation between the horizontal and vertical planes should be within 2 mm. The centerline of the girder on the top of the pier and the centerline of the support can be in a state of complete coincidence, and the offset error must be controlled below 2 mm ^[6]. At the same time, the steel structure base frame should be built in an all-round way. It is necessary to carefully inspect the steel plate unit and all parts in all aspects to confirm that they are up to standard, only then can the parts be welded. When welding the bottom plate unit, two or more base plate units are welded into a complete base plate according to the actual situation of the base frame, and then placed on the steel base frame and welded on the base frame. The welding operating procedures should be strictly followed to improve the installation quality ^[7].

(5) Personnel management

Construction personnel is the key to a construction process, and their professional skill level and comprehensive quality greatly affects the end product. Therefore, in personnel management, we should focus on improving their skill level and comprehensive quality. Skill trainings and education should be regularly provided to promote the continuous improvement of their professional skills and safety awareness. Especially when it comes to highly professional construction operations, it is required that the staff is officially certified to perform the required job. During the construction process, all staff should be well-behaved, and violations of regulations must be strictly prohibited to ensure the safety of the construction site ^[8]. At the same time, the installation of steel structure bridges requires modularization and high efficiency, which requires the coordination of multiple departments. To ensure that construction operations can be carried out in an orderly manner, especially for operations with high risks, a strict accountability system must be established to ensure their safety as much as possible. In this way, adverse situations can be dealt with effectively in a timely manner, and relevant responsible persons can be identified in time ^[9].

4. Quality control measures for steel structure bridge installation

The preparation stage, construction stage, and subsequent evaluation and acceptance stage of steel bridge installation all can affect overall quality of the steel bridge. Moreover, the high-altitude construction work included in the installation is more difficult and dangerous, which requires stricter quality control. Therefore, each stage contains key points of quality control, so it is necessary to carry out the discussion in stages:

(1) Preparation stage before installation

A comprehensive inspection should be carried out before installing the steel structure to ensure that the processing quality meets the relevant requirements. Therefore, in the early stage, the construction of the components should strictly adhere to the design drawings to ensure that parameters like the size, thickness, weight, and other aspects of the steel structure meet the design standards. During the construction of the structure, the components should also be measured regularly. Any deficiencies discovered should be rectified in time to provide a good basis for subsequent installation operations ^[10].

(2) Installation and construction stage

After the construction of the concrete pier columns, evaluation and acceptance should be carried out first, followed by the installation stage. However, if there are unqualified concrete pier columns, reasonable solutions should be designed according to the elevation, position, plane size and other aspects of the pier column foundation, so as to improve the quality of bridge construction ^[11].

During the installation of the steel structure, the correct installation sequence should be strictly followed. During the construction process, various operations such as arc striking, knocking, and welding must not cause damage or deformation to the beam body, so as to avoid affecting the overall stability of the beam body later. The overall stability of the body is affected by the installation of the steel structure, and based on the actual situation, the pre-camber is adjusted reasonably to ensure the safety of the overall structure ^[12]. Especially when piercing, because the connecting steel structure needs to be drilled on both sides, it is more likely to affect the stability of the beam body, so the control should be increased, and the use of flame reaming is strictly prohibited to avoid damage to the steel. Before installing components and steel plate units, a comprehensive inspection should be carried out before they can be built on the base frame. At the same time, appropriate welding technology should be applied, and then the welding effect should be checked to make sure that it meets the relevant standards before the next step is carried out. If it does not meet the relevant standards, it should be reworked in time. In addition, the steel should be kept in a completely clean and dry state throughout the process to reduce the possibility of rusting ^[13].

(3) High-altitude construction

High-altitude construction process is highly dangerous, so before entering the high-altitude construction stage, education and training must be given to the construction personnel to increase their safety awareness. Besides, before starting work, they must wear safety clothing in full compliance with relevant regulations, non-slip shoes and fasten their seat belts. Moreover, the staff should also comprehensively inspect high-altitude construction machinery and equipment and ensure that they are continuously in a safe operation state, so as to create a good working environment for high-altitude construction personnel. If bad weather occurs during high-altitude construction, the high-altitude work should be suspended, and the completed parts should be well-protected ^[14].

(4) Installation acceptance stage

Evaluation and acceptance should be done after the steel structure installation work is completed. During this process, the construction party needs to provide construction drawings, inspection reports, certificates of conformity, repair records, inspection records, and other materials to the acceptance party. This is to ensure that the steel bridge meet all the relevant regulations ^[15].

5. Conclusion

The construction of steel structure bridges is not only conducive to improving the overall quality and application effect of bridges, but also help drive the economic development. Therefore, it is necessary to strengthen construction management and quality control to ensure the safety and stability of steel structure bridges, so as to bring relevant economic, environmental, and social benefits through the construction of steel structure bridges.

Disclosure statement

The author declares no conflict of interest.

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