Method of Post-Tensioned Box Girder Precast Construction Craft and the Tensioning Process Control Research

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Abstract: The construction of prestressed box girder is the main component of bridge construction, which plays the role of gravity sharing and structural integrity protection in the process of bridge construction. With the gradual expansion of the scope of civil construction in China, the prestress problem occupies more and more prominent position in the project analysis, and becomes a benign resource control means. In this paper, combining the concrete situation in the field of civil engineering, this paper takes the theoretical and practical analysis ideas to explore the construction technology of the post-Zhang Fa prestressed box girder in the current bridge engineering construction in China, so as to achieve the purpose of clarifying the construction key points and ensuring the construction quality of the project.

1. Introduction

The post-Zhang Fa prestressed beam box construction mainly refers to the external tensile stress treatment strategy given by the local members before the construction of the building foundation after the concrete construction, and the stress members can fully stimulate the performance of the structure itself and enhance the durability index of the resources under the condition of compression or the load-bearing state of the beam. That is to say, the post-Zhang Fa prestressed beam box plays the role of gravity bearing during the construction of the bridge, which can avoid the problem of local collapse or fracture of the bridge to a certain extent, and play an important role in the process of contemporary bridge construction.

2. Construction Technology and Key Points of 1. Post-Zhangfa Prestressed Box Beam

2.1 Engineering Brief

A bridge construction project in China is located at 532 K104+ of the highway from Sunita Right Banner to Huade (Mengyi Boundary). The upper strata of the bridge site are silt and gravel sand due to Quaternary alluvial deposits. The central pile number of the bridge YK18+527.9/ ZK18YK18+530, the superstructure adopts 3 X20m assembly partial pre-stress concrete continuous box girder, the lower pier adopts column pier, the abutment adopts auxiliary slab abutment, the foundation is bored cast-in-place pile foundation, the bridge length is 65.6 m. he plane of the bridge is located in the left fan circle curve with a radius of 8500 m. the transverse slope of the bridge deck is unidirectional 2%, and the pier and abutment are arranged radially. The standard span of 20 meters is located at the center of the left and right half bridge respectively. The bridge adjusts the curvature with the change of the width of the cast-in-place middle beam. Please pay special attention to the construction lofting. Combined with the terrain at the bridge position, cone slope protection is provided on both sides of the bridge head. The construction method of the bridge is simple and continuous.

2.2 Construction Technology

The post-Zhang Fa prestressed beam box construction is the concrete link of the project operation and management practice. In order to ensure the construction quality of the project to the

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maximum extent, the technical practice process should also be combined with the standardized operation process for planning and processing. To sum up, the general process of technical operation can be summed up into the following steps: 1). cleaning the bottom mold and applying a layer of protective oil; 2). strapping the steel materials used during the construction of the project according to the requirements; 3). carrying out wave pipe laying and pre-burial treatment; 4). using steel strands to tie the steel bar model and install the formwork; 5). After adopting the post-Zhang Fa prestressed beam box construction activities and grouting treatment in the hole section, the structure of the construction beam can be stored and placed, and the end sealing planning can be carried out.

2.3 Key Points of Construction

1). Bellows buried. Corrugated pipe is the main step in the preparation of post-Zhang Fa prestressed beam box construction operation. In order to ensure its construction quality, the corresponding pipeline should be pre-buried in practice. In order to guarantee the construction quality of the project, it is necessary to make the determination of the pre-buried height and distance link of bellows according to the requirements before actual construction. One of the most used steel bars during the construction period is the well frame structure. When designing the distance between space structures, the distance between space structures is usually arranged at about 1 m, while the curve density can control the large change space at 50~80 cm, so that the corrugated pipe position can be accurately positioned and the embedded stability can be achieved. At the same time, the sealing work of the corrugated pipe connection part is also the main link of the technical operation of this part. In order to ensure its sealing, the high-grade sealed plastic bag is generally used for centralized winding, and the steel wire structure is used to reinforce the outside.

2). Strands through bundles. The main working link of the strand-piercing link is to calculate the length of the thread-piercing and the proportion of the material cut of the strand, and then analyze the information according to the relevant symbols in the formula. The formula is:

$$M=N+2(N_1+N_2+N_3+N_4+N_5) \quad (1)$$

The M is the cutting value of the steel strand; the N is the length of the channel itself; the N_1 is the size of the anchor; the N_2 is the width of the pull limit plate; the N_3 is the height of the Jack; the N_4 is the height of the tool anchor plate; and the remaining length is a variable constant, with a general value of 10 cm.

During the practical application of the steel strand, the general application interval of about 1.5 m can be bundled once, which can avoid the material displacement. At the same time, the repeated operation of the steel strand on the spacer contact part should be avoided when carrying out the concrete operation of the steel strand through the bundle, because this will cause the steel strand to wear and tear, so that the smoothness of the steel channel part is blocked, and the bearing endurance of the steel strand will be damaged. Therefore, during the concrete construction period, the transparent tape winding method can be used to cover the steel strands, which can not only guarantee the smooth working of the steel strand piercing link, but also ensure the internal cleaning of the steel bellows, which is a high level steel strand piercing way.

3). Concrete pouring. During the construction of the project, self-mixed concrete is selected, and the specific gravity of the cement, water, sand, stone, water reducer, fly ash and expansion agent in the concrete is 340:180:835:875:13.9:158:34.2. The requirements for materials during concrete mixing are summarized as follows:1.the local drinking water is selected, and the sulfate in the water body is controlled to $\geqslant$2.7 mg/cm^3, the salt content in the water is 5mg/cm^3,PH value $\geqslant$4, and the water body used for construction shall not be industrial wastewater, sewage, and acid water body, etc. 2 Use ordinary Portland cement and add 10% U expansion agent and pump agent as appropriate. The aggregate gravel particles are generally not less than 20 mm, the maximum crushing value $\leqslant$ 9% and the weathered particles content $\leqslant$2%. The use of high hardness texture, and the interior does not contain vowels, shells, organic matter and other substances of sand and stone, and to ensure that the size of sand and stone particles $\leqslant$0.074mm, containing impurities of 1%, before the use of centralized cleaning. Concrete pouring work practice operation, according to the bottom,

abdomen, roof order to control. After pouring, it is necessary to strictly carry out vibration, as far as possible to avoid the vibration mold, embedded parts and other parts of the problem of improper protection. At the same time, the steel strand twitch is carried out regularly, which can avoid the phenomenon of blockage in bellows and so on. After pouring, corresponding to do a good job of concrete follow-up care, and according to the requirements of maintenance conditions for tensile task strength construction operation can be.

4). Prestressed tensioning. Prestressed tensioning link construction is the core of technical operation. According to the design requirements, the construction strength of the beam body can be controlled at about 85%. When selecting prestressed tensioning equipment, considering the specific operation conditions of the component equipment, the auxiliary tools with similar weight are selected. The tools used in this paper are YCW150t jack and ZB4-500 high pressure oil pump. Under σ_{con}75%(i.e .σ_{con}=1395 N/mm^2) to control the tensile strength of the prestress. meanwhile, the prestressing tension strength was calculated according to $0\rightarrow0.1\sigma_{con}\rightarrow1.0\sigma_{con}$ (hold load 2min). The value of attention is that the prestress tension post-treatment should pay attention to its control strength $\leqslant1.00\delta_{con}$.To ensure the balance of gravity construction, the two sides of the symmetrical method to pull the operation. Pay attention to control prestress tension value, usually will use “double control method” to carry on the operation. That is, the prestress tensioning force and the force control in the extension direction are in place, the actual operation should be based on the length control, and the tension treatment record of the differentiation grade part should be reasonably carried out $10\%\sigma_{con}$,$30\%\sigma_{con}$,$50\%\sigma_{con}$,$90\%\sigma_{con}$,$100\%\sigma_{con,}$ and the prestress tensioning management plan should be done well. The deviation during the actual operation should be within ±6%.

3. Quality Control Measures of Prestressed Box Beam in Post-Zhangfa Construction

3.1 Prestress Loss Control

In order to carry out the construction work of prestressed box girder in post-Zhang Fa construction, the first step is to control the loss of prestress. In short, the practical measures in this section can be summarized as follows:

1). pay attention to the strength control of the friction part. On the one hand refers to the horizontal direction of tension control, on the other hand refers to the vertical direction of tension.

2). During the construction of prestressed box girde,it is also one of the links in the orderly operation to strengthen the grasp of the application link of Anchorage. Generally speaking, the tension spacing adjustment during the operation of the anchor is the best at about 1 mm. At this time, the amount of the spacer plate of the anchor should be adjusted according to the demand of the prestressed box girder in the construction of the post-Zhang Fa.

3). During the construction of prestressed box girder, reducing the temperature destructive conditions during the application of materials and doing well the temperature maintenance is also one aspect that can not be ignored in the exploration of its operation work. generally speaking, the construction temperature of prestressed box girder in post-zhangfa construction is the best at 7~10℃. after mixing concrete with steel bar, the two will be combined together. what needs to be considered at this time is that the ambient temperature will change somewhat after the combination.

4). Every step of concrete construction should be operated strictly according to the normative requirements of engineering practice, which can avoid the problem of relaxation loss of prestressed box girder in post-Zhangfa construction. At the same time, during the operation and treatment of the concrete construction link, the water control of the long part of tension extension should not be ignored during the working practice. For example, cement mixing during the addition of moisture and glue composition of the proportion of coordination, concrete during the period of tamping control, and concrete maintenance and other work.

3.2 Calculation and Verification of Tensile Length Values

(1). Tension elongation strength settlement. In order to ensure the precise operation of tensioning

and elongation operation, the practice link conforms to the construction period of the project, and needs to be analyzed according to formula (2).

$$\Delta L_{\mathrm{cp}} = \left(F_{pm} \cdot L_p\right) / \left(A_p \cdot E_p\right) \qquad (2)$$

In the formula, The L_p is the practical length of prestress; the E_p is the elastic modulus of prestressed tendons; the A_p is the cross section area of prestressed tendons; and the F_{pm} is the average tensile force of prestressed tendons.

Combining with the above formula for tension elongation strength settlement analysis, appropriate tension size positioning and exploration, also need from the tension elongation strength average tension angle of view to give the corresponding accounting, its calculation formula can be expressed as:

$$F_{\mathrm{pm}} = F_{\mathrm{con}} \cdot \left[\left(1 + \mathrm{e}^{-\mathrm{kx}-\mu\theta}\right) / \left(kx - \mu\theta\right)\right] \qquad (3)$$

The formula is: the F_{con} is the tension of the tension end of the prestressed tendons; the k is the friction coefficient produced by local friction; the μ is the friction coefficient between the prestressed tendons and the hole wall; the x is the length of the hole from the tension end to the calculated section; and the θ is the tangent angle from the tension end to the calculated section of the section curve.

(2). The tension and extension analysis should also be carried out from the data verification and analysis of the corresponding positioning. For one hand, the study of tensile elongation strength is mainly from the size and loss of prestress, rather than directly to analyze the change of prestress; on the other hand, when local tension data adjustment, as far as possible within 24 h to complete all work, so as to avoid the prestress adjustment resulting in improper grasp of strength problems.

4. Conclusion

To sum up, the technical analysis of Zhang Fa prestressed box girder after bridge engineering is the theoretical induction of the key points of bridge construction. On this basis, the article combines the actual case, carries on the overall analysis to the related control experience factor, it has brought the new thought for the domestic bridge construction work diversification development.

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