ISSN 2616-7433 Vol. 1, Issue 2: 46-52, DOI: 10.25236/FSST.20190207

Influence of construction sequence of cable-stayed bridge on stress and cable force in cable-stayed bridge

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ABSTRACT. *This paper selects a project as an example to use finite element software to calculate and analyze three different cable and beam construction sequences, and to observe the difference between the cable tension and the main beam stress caused by different familiarities in different cable constructions. Analyze. After the results of this study, it is confirmed that the lag-tensioned zipper method accelerates the construction speed but reduces the upper edge stress reserve and the cable tension of the box girder, which confirms the construction sequence and stress and cable force of the cable area. There is a correlation between them.*

KEYWORDS: *low tower cable-stayed bridge; construction sequence; stress and cable force*

0. Introduction

With the rapid development of China's transportation industry, bridges are the key nodes of transportation across rivers, lakes and seas, existing lines and mountain valleys. In recent years, rapid progress has been made in both structural form and construction technology. Especially for railway bridges, the low tower cable-stayed bridge is just in place. Both the degree and the span can meet their requirements[1], so more and more railway lines choose the low tower cable-stayed bridge. Because the low-rise cable-stayed bridge has the characteristics of continuous beam bridge

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and cable-stayed bridge, its construction technology requirements are even higher. In particular, the different construction sequences of the low-tower cable-stayed bridges require different resource allocations, and at the same time, their effects on the deformation and stress of the bridges are also different. Therefore, this paper analyzes the influence of the construction sequence of the cable-stayed bridge on the stress and cable force.

1. Project Overview

1.1 Overview of the main bridge

The Chengdu-Kunming Railway Panzhihua Jinsha River Bridge is a double-tower double-span and three-span prestressed concrete low-rise cable-stayed bridge. The main beam span is 120m+208m+120m[2]. The structural system is consolidated with tower beams and the bottom of the beam is supported. The main beam adopts single-box double-chamber variable height box shape, straight web, box beam common section top width 13.10m, bottom width 10.6m span and side fulcrum beam height 6.8m, middle fulcrum beam height 11.3m, The bottom plate adopts a parabolic transition with a tower height of 28m.

1.2 stay cable structure

The stay cable is made of high-strength epoxy-coated steel strand cable, the strand strength fpk=1860Mpa, and the elastic modulus EP=1.95x105MPao. The stay cable is anchored to the corresponding post-casting anchor block of the beam, and is symmetrically tensioned on both sides. There are 7 pairs of cables, and the whole bridge has 28 cables, about 280 tons of steel strands (see Figure 1).

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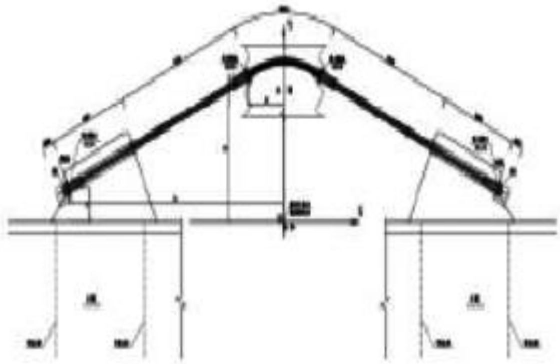

Figure 1 Schematic diagram of cable stay cable

2. three different construction sequences

Scheme 1: In order to facilitate the movement of the basket, the concrete cable-stayed anchor block with two beam sections and then the top of the beam is used, and then the prestressed steel bundles, lanyards and stay cables of the maintenance and tension anchors are sequentially completed. . Obviously, this construction scheme strictly limits the construction of the beam section and the construction of the anchor block and the stayed cable. There is no progress in the beam section during the construction of the stayed cable, which causes a lot of work, which is not conducive to the realization of the whole bridge's progress target[3] . However, according to this construction scheme, the anchorage of the cable beam to the maximum cantilever end does not exceed two beam sections. Therefore, the stress of the beam section of the cable beam anchorage is not too large, and it is easy to meet the requirements of the full prestressed structure.

Scheme 2: The three-segment cable-stayed cable is used to lag, so that the anchor block and the beam segment can be simultaneously produced and maintained at the same time, thereby saving construction time, and the third beam section is prestressed and stretched. Cable, cable work.

Scheme 3: After the production time of the anchor block is postponed to the third beam section, the anchor block can be made by the maintenance time of the beam section. After the third block section is stretched, the fourth block section is

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completed, and the anchor is completed. The block also reaches the aging period, and then the cable staying time can be used to stretch the cable.

3. Different construction sequences affect the main beam stress

The self-weight of the beam, the cable tension and the prestressed load are the three main loads during the construction of the prestressed concrete low-rise cable-stayed bridge. The root of the cantilever of the main beam is at the most concentrated part of the force arm and the most concentrated part of the prestressed steel bundle, and its internal force has been kept the largest during the construction process. Moreover, the longitudinal component force provided by the tension cable tension far exceeds the longitudinal load generated by the prestressed steel bundle. It is found that under the three construction sequences, the root of the cantilever of the main beam changes in the same trend before and after the tension cable is tensioned. [4]: After the tension cable is tensioned, the compressive stress of the upper edge is obviously increased, and the compressive stress of the lower edge is obviously reduced. Before the next stay cable is stretched, the upper edge compressive stress is reduced due to the increase of the cantilever of the beam section, and the lower edge is pressed. The stress increases and so cycles.At the same time, under the same conditions of stress change trend, the three stress modes show obvious size relationship: under the same working conditions, the compressive stress of the upper edge of the scheme is the largest, the scheme is the second, and the scheme 3 is the smallest; The edge pressure stress scheme is the largest, the scheme is second[5], and the scheme three is the smallest. The upper edge stress scheme 2 has a maximum difference of 1.25MP than the scheme one, and the scheme 3 ratio scheme 1 has a maximum difference of 2.80MP; the lower edge stress scheme 2 has a maximum difference of 157MP compared with the scheme 1 and the scheme 3 ratio scheme 1 has a maximum difference of 3.26MP. The tension tension cable of the section can reduce the compressive stress reserve of the upper edge of the maximum cantilever root. The minimum compressive stress of the second cantilever is 7.07MP, which occurs before the C1 cable tension. The minimum compressive stress of the scheme 3 is 5.65MP, which occurs in the C7 cable. Pull forward.

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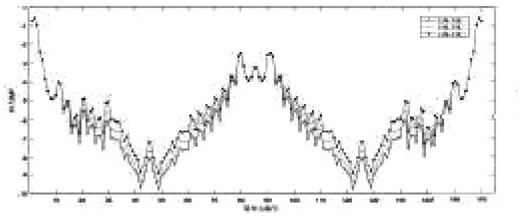

Fig. 2 Schematic diagram of the upper edge stress of the main beam unit in the bridge state

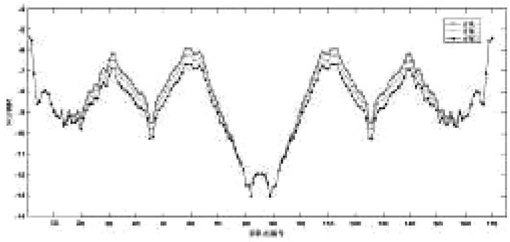

Fig. 3 Schematic diagram of the lower edge stress of the main beam unit in the bridge state

4. Different construction sequences affect cable force

The initial tension of the wooden bridges C1~C7 stay cables is SOOOKN. With the construction of the beam sections and the subsequent stay cables, the cable force values are constantly changing before the second tension[6]. The construction sequence of the three construction schemes is different, and the variation of the cable tension of the cable is also different. The comparison of the cable tension of the C1~C7 cable under different construction sequences is found under the three construction sequences before the second tension. The trend of change of cable force from C1 to C7 is the same, and the size law of scheme 1 > scheme 2 > scheme 3 is presented. This means that in order to ensure that the bridge cable force is consistent with the design, the construction sequence changes, and the secondary tension is also changed according to the specific situation. Even if necessary, the cable tension needs to start from the initial tension.

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Conclusion

The calculation and analysis of the low-rise tower cable-stayed bridge under different construction sequences are analyzed by combining engineering examples. The specific analysis methods and ideas of related problems are given. It can be used as reference for the construction of cable-stayed bridges of low-rise towers in the future. in conclusion:

(1) For long-span low-rise tower cable-stayed bridges, changing the construction sequence of cable sections and cable stays in the cable section has a certain impact on the full bridge stress and cable tension. The use of three sections of the post-delay and the four sections of the post-tensioned cable-stayed cable can speed up the construction schedule and reduce the work, but it is necessary to check the internal force and deformation changes caused by the change of the construction sequence and grasp the change range.

(2) Regardless of the construction process or the bridge stage, as the number of post-continuation beam sections increases, the compressive stress at the upper edge of the beam decreases and the compressive stress at the lower edge increases. Especially in the construction process, the maximum tensile stress of the upper edge of the scheme 3 reaches 1.52MP, which occurs in the C6 root beam before the C7 cable tensioning, and it is necessary to strengthen the monitoring of the stress in this part. However, it is also possible to adopt the construction sequence of the third scheme before the C6 cable tensioning, and adopt the construction sequence of the scheme one or the second scheme after the tensioning, thereby further optimizing the construction sequence of the cabled area.

(3) The difference in the construction sequence causes the beam stress to change, and the cable tension also changes. The more the number of rear extension beams, the smaller the cable force. The stress level of the beam section and the cable tension can be changed by changing the initial tension.

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