

A Review of Related Characteristics of Cable-stayed Bridges

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Abstract. Cable-stayed bridge is a structural system that is composed of tower, main beam and cable. As a cable system, it is of great important importance as one of the types of long-span bridges. This article briefly analyzes and studies the stress characteristics of cable-stayed bridges, the principles of establishment of the bridge and the adjustment of stay cables.

1. Introduction

The related research of cable-stayed bridges in the worldwide scale began in the 17th century, while the research of cable-stayed bridges in China started in the 1990s. With the continuous progress and development of Chinese economics, the design and construction of cable-stayed bridges have been successively improved. China has built more than 100 cable-stayed bridges. There are 25 bridges in China that have entered the world's top 50 long-span cable-stayed bridges. Among them, Sutong Bridge, Hong Kong Stonecutters Bridge and Hubei Edong Yangtze River Bridge are the representative projects. Cable-stayed bridges are widely used in the bridge projects due to the good mechanical properties and spanning capability, it is believed that the relevant research and analysis will lead to new theoretical and technological the development of cable-stayed bridges in the future.

2. The form and mechanical characteristics of cable-stayed bridge components

The overall structure of the cable-stayed bridge is mainly composed of three parts: the main beam, the tower and the zipper. Corresponding to the stress, the main beam is bent, the tower is under pressure, and the cable is pulled. The cable is an important part of the cable-stayed bridge which is different from other bridges and it is the main load bearing member. The number and arrangement of cables plays an extremely important role in the overall stiffness and economic rationality. There are many types of bridge layout, common forms include single-tower double-span, double-tower three-span, single-tower single-span, double-tower single-span, multi-tower and multi-span. The specific layout is determined by the local surrounding environment and geological conditions. The cable types of cable-stayed bridges are mainly divided into three types: radial type, harp type, and fan type.

Radiating type: Radial cable-stayed bridge is a cable-stayed bridge in which all cables are anchored at the top of the tower and form a radial cable. The advantage is that the vertical force component of the cable force is large, the amount of steel used for the cable is small, and the cable anchor head and the tension tonnage are both small. The disadvantages are that the anchor head at the top of the tower is crowded, the structure processing is difficult, the stress concentration is more obvious, and the current inclination is obvious. Radial cable-stayed bridges are no longer used in bridges.



Harp type: The harp type cable-stayed bridge is a cable-stayed bridge in which the cables are parallel to each other and form a harp. The advantage is that each cable's anchoring equipment has the same structure, simple construction process and simple appearance, but it is only used for small-span cable-stayed bridge projects.

Fan shape: It has the advantages of both radiation type and harp type. It can be flexibly arranged and has good torsional stiffness and wind stability.

3. Principles for establishing the state of completion of the cable-stayed bridge

The reasonable bridge state of cable-stayed bridges refers to the state that each component could achieve its optimal bridge state with certain goals under the premise of meeting the specifications and design requirements. The completion of cable-stayed bridges needs to take many factors into account. Under reasonable bridge conditions, beams, towers, and cables should meet the requirements of the corresponding design specifications.

1. The stress state of the main girder should be based on the principle of less bending stress and uniform distribution of the main girder under the action of the dead load, taking into account the influence of some live loads.

2. The stress distribution and bridge shape should be directly determined by the cable force, in total, the shorter the cable is, the smaller force it should bear, in addition, the overall distribution should be even, and the tail cable force takes the largest value;

3. The reaction force of the support of the side piers and auxiliary piers should have a certain pressure reservation when they bear dead load, so that there will not be a large negative reaction force of the support under the action of live load.

The bridged state of the cable-stayed bridge includes the internal force of the bridge dead load and the main beam linear state. For concrete cable-stayed bridges, due to the effects of shrinkage and creep of concrete, the state of constant-load internal forces and the state of main beam alignment will change with time during a certain period of time after completion of the bridge, and it is generally considered that after 5 years, it can be basically stable. The completed state of the bridge should be based on the steady state after completion of shrinkage and creep of the concrete, but the bridge should also be able to meet the requirements for use during the changing phase. The main beam linear state mainly refers to the elevation of the main beam meeting the design elevation requirements under the dead load. This is usually a clear goal in the preliminary design stage based on the use of requirements to determine the navigation clearance under the bridge, bridge slope, vertical curve. In order to reduce the influence of live load, there is usually a certain degree of pre-camber.

4. cable-stayed bridge cable force adjustment

In recent years, the design and construction technology of cable-stayed bridges has developed rapidly. However, how to perform cable force adjustment and cable force optimization is still a hot topic in this field. This article briefly describes and analyzes the cable adjustment methods of cable-stayed bridges. The determination and adjustment of the cable-stayed bridge cable force is mainly divided into the following three parts:

1. Reasonable bridge force calculation under dead load;
2. Calculation of Initial Tension Force of Cables in Construction Phase;
3. Calculation of cable force adjustment after completion;

After the establishment of the bridge establishment principle, the tuning process is performed. Firstly, the cable force is adjusted, and then the cable forces reach the standard requirements after the force state, and then the initial tension is determined according to the main beam's own weight, and the trial calculation is performed to achieve the main beam force safety, and ensure straight principle of beam and tower at the same time. Then adjust the initial pulling force during the construction phase. According to the construction plan, the cable is divided into one cable and multiple cables. Generally, the cable adjustment process is needed under most conditions. The first adjustment is to ensure the

safety of the construction, the cable is finally adjusted to meet the requirements for the design of the cable force.

5. Conclusion

In summary, we have a certain understanding of some of the relevant characteristics and theoretical principles of cable-stayed bridges. In the following development of the bridge field, cable-stayed bridges with their superior stress properties and lighter dead weight will be widely used, so the relevant research on cable-stayed bridges is also of great scientific significance. In particular, it is supposed to achieve new theoretical and technological breakthroughs in cable force optimization.

References

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