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# Application of Long-Span Continuous Bridge Technology in Bridge Construction

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**Abstract:** In order to promote the rapid development of urbanization in our country, it is necessary to improve the construction level and technology of bridge engineering. For long-span continuous bridge technology, it has the characteristics of wide application range, various applicable conditions, and short construction period. Therefore, it is necessary to pay attention to the application of long-span continuous bridge technology. This article mainly analyzes its application in bridge construction, hoping to provide some reference for future use.

**Keywords:** Bridge; Long-span continuous bridge technology; Construction quality

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## 1. Introduction

Our country's economy has been developing along with urbanization. Bridge engineering, which is an important part of urbanization construction, is closely related to people's lives and socioeconomic development, and it plays an important role in urban transportation. The key link in the bridge construction process is highly difficult and has many influencing factors. As a prestressed structure, the long-span continuous bridge has a continuous structural form and is integrated with the pier, which allows uniform bearing capacity and high rigidity of the long-span continuous bridge, therefore meeting the requirements of road and railway transportation. In recent years, due to the increasing number of bridge projects in China, the technology of long-span continuous bridges has entered a relatively complete development period. Long-span continuous bridges has good quality, are highly adaptable and easily maintained, and have a long service life. Moreover, the long-span continuous bridge is made of steel, which can effectively reduce negative bending moments on the structure, so that it is more stable, durable, and has good seismic performance. In the construction of a bridge, technicians should utilize technology according to the conditions of the region, to reduce the unfavorable factors for bridge construction and ensure the construction and service life of the entire bridge [1-5].

## 2. Project overview

With a bridge project in a city as an example, it is a prestressed concrete continuous bridge spanning four major rivers with a total length of 939.44 m. The construction site of the bridge is located near the river, and according to the relevant design documents, the span layout of the bridge is 35 + 72 + 70 + 72 + 50 m. Both the main span and side span were constructed by cantilever concreting with form-traveler, the beam section of the cantilever concreting with form-traveler adopts box section, and there are three forms of box girders: single box with three chambers, single box with two chambers, and two boxes with two chambers.

The side and middle spans are made of C40 concrete. The main girder is in the form of a single-box with three-chambers, and the height of the box girder is about 11 m. The superstructure of the bridge consists of prefabricated and assembled prestressed concrete T-beams. The main structures of the bridge are as follows: the main bridge is a 7–40 m prestressed concrete continuous box girder bridge; the approach is a 20–80 m prestressed concrete cast-in-place continuous box girder bridge; the abutments and anchorages are bored cast-in-place pile foundations; pier 0# and pier 1# are pier bodies; the pile foundations at pier 2#–6# are bored pile foundations with a diameter of 1.5 m. The main girder of the bridge project adopts the form of single box with single chamber, the bridge is 38 m wide, and the structure is horizontally symmetrically arranged. Among them, the two ends of the beam section are round-ended beam section, and the length of the beam section is 11.12–13.30 m. The bridge is a long-span continuous bridge, and the designed load is of a first-level highway.

The geological conditions of the bridge site of the bridge project are as follows: the upper structure and the middle and lower structure. The upper part acts as a temporary support for the main beam during the construction stage and the pouring stage of form-traveler cantilever; the middle and lower structure part is the caps, pier columns, bridge abutments of the substructure, and bored pile foundations in the foundation construction stage.

## 3. The key to the construction control of long-span continuous bridges in bridge construction

### 3.1. Difficulties in construction

The scope of the bridge construction is relatively large, and the process comes with many difficulties. The first difficulty is in scaffolding for cantilever concreting on the main girder. Besides, the large deformation in the hanging basket casting process affects the stability of the main beam and the structural safety. Thirdly, during cantilever concreting with form-traveler, it is necessary to control the concrete slump, the width of the crack, and the elevation of the beam section. Therefore, we must pay attention to the application of long-span continuous bridge technology in bridge engineering.

### 3.2. Construction with cantilever concreting method

In the process of bridge construction, it is necessary to select the most suitable construction method while considering the construction environments in order to ensure the quality of the project. In the construction of long-span continuous bridges, the cantilever concreting method is used for bridge construction, which has the several advantages.

(1) The construction will not be affected by the weather. Construction can proceed on windy or rainy days, which not only helps shorten the overall construction period, but also effectively reduces pollution of the surrounding environment [6].

(2) The structure of cantilever method is simple and adaptable. During cantilever concreting, it is necessary to reasonably select the appropriate type of form-traveler according to the construction environment. Among them, for the T-structure cantilever, steel truss beams, or steel plate trusses are generally used as form-traveler. In order to make the bridge structure stable and safe, it is necessary to select the appropriate type of form-traveler.

(3) The construction method of bridge cantilever concreting can be affected by many factors. Therefore, when carrying out bridge cantilever concreting, it is necessary to select a suitable concrete proportioning method.

(4) Since the balanced cantilever method will be affected by many factors during the application process, it is necessary to strictly control the temperature and humidity of the concrete during the pouring process. Besides, it is necessary to protect the concrete with proper measures.

(5) There are a few points to pay attention to when using the form-traveler to travel: (i) when the form-traveler travels to the position of the vertical formwork, it needs to be leveled; (ii) the connection between the bridge cantilever section and the vertical formwork scaffold must be grouted; (iii) before the form-traveler moves, it is necessary to clean the inside of the form-traveler and between the beams, as well as areas between the beam and the vertical formwork scaffold; (iv) After the bridge cantilever concreting is completed, the cantilever end needs to be dismantled. In order to avoid the affecting the beam alignment, it is necessary to strictly control the alignment of the cantilever concreting section of the bridge; (v) in order to reduce creeping caused by the temperature difference of concrete at the cantilever end of the bridge while pouring, it is necessary to optimize the construction process, specifically setting up thermal insulation measures; (vi) the maintenance work must be done well, for example, if the concrete cracks or the surface temperature is too high, etc., it is necessary to deal with them in time.

### 3.3. Stress control

Due to the unique structural characteristics of bridges, in the construction of long-span continuous bridges, the stress-influencing factors include temperature stress, load, creep, structural stress, and many other factors. When calculating the pre-load, the influencing factors of the pre-load must be fully considered, and its load and real expansion under load should be considered theoretically. In most cases, the local displacement must be analyzed, and the stress caused by it must be closely monitored. In order to accurately predict the stress of the section, a special stress tester must be used [7]. After the load condition on the bridge is understood, a suitable method of controlling the stress should be adopted. When there are obvious differences or errors between the actual load and the estimated load, structural inspection should be carried out immediately, so as to understand the location and cause of the problem. Subsequently, corresponding measures should be taken to solve the problem, so as to ensure the deviation between the designed stress and the actual stress is within an acceptable range.

### 3.4. The stability of the control structure

Due to the improvement of the technical level, many new bridge span construction techniques have emerged in the construction of long-span continuous bridges. However, during the long-term operation of many bridges, traffic accidents have been caused due to insufficient bearing capacity, resulting in the instability of the bridge. The overall stability of highway bridges is related to its actual construction and safety in future use, so it must be stabilized and reinforced, which is an important part of safety maintenance [8].

### 3.5. Control bridge alignment

Bending and deformation are the most common problems of bridges. In fact, many factors are responsible for the bending and deformation of bridges. Therefore, the structure of the bridge has changed, resulting in different positioning deviations in the original design parts. To ensure that the bridge construction are not affected by the bridge structure, it must be strictly controlled, so as to prevent deformations of the bridge [9].

### 3.6. Construction safety issues

There are often various unavoidable risk factors in the construction of bridges, which will affect the safe operation of bridge projects. In addition, the current domestic construction management system and labor laws are not perfect, leading to potential safety hazards in bridge construction. Therefore, construction enterprises should try their best to ensure the safety of the construction process and the overall construction quality to avoid safety accidents. Proper safety measures should be taken during the construction of a bridge, and it is important to follow the relevant laws and regulations. Besides, the managers of the construction site must strictly control all aspects of the construction, so as to better improve the safety of the entire construction [10] and reduce the probability of safety accidents on the passer-by. Safety management on construction sites can not only effectively manage the work of construction workers, but also reduce potential safety hazards during construction and ensure the health of construction workers.

## 4. Long-span continuous bridge technology in bridge construction

### 4.1. Construction plan

The actual situation should be considered during bridge structure design, and the construction plan should be divided into multiple stages. The main aspects of a construction plan include scaffolding, scaffold pre-loading, system conversion, and closure. The scaffolding should be consistent with the designed height of the bridge, and a flat sand layer should be laid underneath, so as to ensure the stability and safety of the construction. Before the concrete is poured, the sundries on the scaffold should be cleaned up, and the bridge should be inspected. At the same time, the concrete should be proportioned and tested to ensure that its quality is satisfactory.

### 4.2. Scaffold pre-load

Before the construction of the bridge, sufficient materials must be prepared first, and then the pre-load height of the scaffold should be calculated. It is necessary to consider the number of materials such as concrete and steel bars according to the local conditions before designing, and then prepare the correct volumes of material according to relevant regulations. In addition, it is necessary to strictly control the scaffold and concrete pre-loading process.

### 4.3. System conversion

The balanced cantilever method is usually chosen in bridge construction. Before construction, it is necessary to ensure that the length of the cantilever is sufficient, and then stabilize it by setting temporary support. The balanced cantilever method is mainly based constructing the cantilever after the installation of a form-traveler. It should be noted that the balanced cantilever method has certain limitations, and there will usually be problems such as formwork deformation and concrete cracking.

### 4.4. Closure

During the construction of the bridge, the closing work is generally carried out after the end of the No. 0 beam section. Because there is some concrete in the No. 0 beam section, cracking will occur if the closing work is not properly carried out. In addition, attention should be paid to the installation and removal of the temporary scaffold during closing to avoid damaging the scaffold.

### 4.5. Monitoring technology

In the construction of long-span continuous bridges, the monitoring work mainly consists of monitoring the stress and the temperature. These two parameters should be well-controlled before construction. The methods of monitoring can be derived from similar projects, and the temperature and stress during the construction period of the long-span continuous bridge should be carried out in real time. In addition, when carrying out stress monitoring, it is necessary to use Building Information Modeling (BIM) technology to carry out 3D simulation of the bridge and compare the simulation with the preset simulation model to find the difference between the two. A reasonable design, optimization and improvement can then be carried out to ensure the optimal stress of the project. Through real-time monitoring of the temperature of bridges, box girders, and bridges, it was found that the bridges will have different degrees of cracking in different environments, and the bridges should be modified to ensure the overall performance of the bridges.

### 4.6. Scaffolding

When scaffolding, the use of bowl scaffolding was emphasized, and the force and stability of the beam body was calculated. Before formal assembly, its actual bearing capacity should be checked first. Usually, scaffold is placed at the place without gaps, and its bearing capacity must comply with the construction regulations. C20 grade cement mortar can be used to improve the stability of the foundation. Drainage pipes were added on both sides of the reinforcement surface to avoid blockage and improve drainage efficiency. During the construction process, scaffolding was carried out along the horizontal direction of the bridge, and the distance between each scaffold should be 60 cm. In the horizontal direction of the scaffold, a scaffold device was set up at every 3 rows. A 15 cm square of material was placed above or below the stand, which can be adjusted. The square wood was covered with bamboo rubber, and its thickness was 15 mm.

## 5. Conclusion

In conclusion, with the progress of society, our country's economy is also developing rapidly. Therefore, the people's demands are also increasing, which leads to the continuous development of our country's urban traffic construction, and the pressure on urban traffic is also increasing. As an important part of urban construction, bridge engineering is of great significance to the development of modern transportation. At present, there are still some deficiencies in our country's bridge construction technology, and it is necessary to further improve the level and quality of its construction technology. In order to solve the problems in the bridge construction process, we must pay attention to the application of long-span continuous bridges, which is of great significance to the urbanization of our country. The application of long-span continuous bridge technology is analyzed in this paper. The application of this technology not only improves the quality and level of bridge construction, but also promotes urbanization in our country. Long-span continuous bridge technology is an emerging technology, and many details need to be emphasized during the construction process. Only by doing a good job in all segments before, during, and after construction can the healthy development of bridge engineering be driven.

## Disclosure statement

The authors declare no conflict of interest.

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