

Research on Construction Techniques of Hanging Basket in the Bridge Project

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ABSTRACT Under the background of increasingly expanded road traffic network in China, it is highly necessary to construct bridges. Upgrading the bridge construction technique can upgrade the road quality to the maximum extent. In order to upgrade the construction technique, this article elaborates on the construction techniques of hanging basket in four aspects: definition and design principle of hanging basket; key application points of construction techniques of hanging basket in the bridge project; frequent quality accidents and preventive and curative measures of hanging basket; on-site management of hanging basket and upgrading of safety.

KEYWORDS

Bridge project
Hanging basket
Construction technique

1. Introduction

With rapid development of science, technology and equipment manufacturing industry, various equipment are manufactured. In the bridge project, the hanging basket is a very important construction tool and plays an important role in the construction. In order to assure the bridge quality, we need to analyze the bridge construction equipment. It requires us to research into the design and construction techniques of hanging basket and thus better construct the bridges.

2. Definition and design principle of hanging basket

2.1. Definition of hanging basket

In the construction of bridge project, hanging basket is frequently adopted in the cantilever grouting. The hanging basket is roughly divided into four categories according to the structure: oblique pull type, truss type, section steel type and mixed type. The components of hanging basket include the hanging system, travelling system, bearing structure, anchor unit and operation platform. The most

important component is the bearing structure. The quality of bearing structure directly affects the quality of grouting section project because it has to not only bear the weight of whole bearing structure, but also bear the quality of grouting section. Besides, the bearing structure transfers the load to the beam body. We can easily discover that weighing structure in the hanging basket plays a very important role in the normal operation of hanging basket equipment and it is a key component.

In order to avoid unstable rail coverage in the project construction, the back anchor is installed at the tail of hanging basket to upgrade the overall stability. If the unit fails to meet the demand, more weight is added to the tail to upgrade the stability of hanging basket. The operation platform mainly plays the role of making a timely adjustment to the elevation and providing suitable construction site. Therefore, the hanging basket plays a very important role in the whole project construction. In the bridge project, we set up very requirements to the hanging basket: not only require an adequate bearing strength, rigidity and structural stability in the hanging basket, but also require rather high flexibility and elevation adjustment timeliness [1,2].

2.2. Design principle of hanging basket in the bridge project

2.2.1. Reduction of weight of hanging basket

In the design, the efforts involved to reduce the weight of hanging basket to the maximum extent is a very important principle. In the assembly of hanging basket, the weight of hanging basket has a great impact. Therefore, the designer

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has to make an utmost effort to reduce the weight of hanging basket on the basis of construction requirements.

2.2.2. Reduction of construction cycle

In the normal operation of hanging basket, numerous beam sections can launch out full-section construction at one time in order to reduce construction cycle to the maximum extent.

2.2.3. Effective improvement in the construction conditions and environment

In the normal operation of hanging basket, various box beam sections reserve a certain construction joint so that construction personnel can organize construction flexibly and improve the construction environment.

2.2.4. Assurance of suspended concrete grouting quality and construction safety

In order to assure the suspended grouting quality and construction safety, further requirements are raised to the design of whole formwork. At the same time, the design of hanging basket is in accordance with the building demand at various heights [3].

2.2.5. The weight of hanging basket is confirmed according to the actual construction demand.

In the design of hanging basket, the designer designs the product to change the weight of hanging basket and thus adapt to different construction stages. However, the weight cannot be increased without any limit or exceed the stipulated limit. Besides, the designer makes an adequate consideration of the equipment operation stability.

3. Key application points of construction techniques of hanging basket in the bridge project

3.1. Preparation before technical construction of hanging basket

In order to launch out project construction in a better manner, we have to operate the hanging basket as follows: (1) Before construction of hanging basket, consistently apply to the superior management department for construction plan in a timely manner, organize various works and thus construct the project according to the design requirements; (2) Before project construction, formulate and adopt safety protective measures, upgrade the safety of construction environment, safeguard the safety of workers and equipment and thus upgrade the construction quality; (3) Before construction, the on-site commander launches out a detailed analysis and research of the design drawings, clearly knows about various construction procedures and avoid technical errors. In the project construction, it prepares all the necessary materials and equipment, especially plastic film and water transportation tools. In the selection of springboard, it must assure a certain firmness and adequate quantity in order to bear the construction load [4–6].

3.2. Design of hanging basket

The hanging basket constitutes an important equipment of project construction and has a great impact on the construction progress and weight. In the design of hanging basket, the designer has to reduce its weight. The frequently adopted method is to adopt the structure with a simple structure but strong bearing capacity. We can design the hanging basket according to its length and loading capacity. In order to assure the scientific and reasonable properties of design, we often adopt the following methods to calculate the data:

3.2.1. Designed length of hanging basket

The length of hanging basket is designed according to the maximum length of cantilever grouting process. The cross section of hanging basket mainly depends on the bridge width and box beam section. If the cross section of bridge is a box shape, only one hanging basket is collocated for the whole section. However, if the box beam is in multi-box structure, numerous hanging baskets are collocated to assure flexibility.

3.2.2. Designed load of hanging basket

The formwork is composed of the side formwork, bottom formwork, inner formwork and end formwork; each formwork is 0.8–1.30 kPa on average; upon confirmation of formwork dimension, a detailed calculation is made. The vibrator and vibration force are confirmed according to 4 times of the vibrator weight. The construction personnel's load on the bridge is calculated according to 2 kPa. The concrete weight is calculated according to the weight of maximum section [7].

3.2.3. Verification of hanging basket

The hanging basket is verified according to the balance data under idled status to maintain the concrete grouting stable. In the design of hanging basket, it assures an adequate stability and safety factor as wells as personnel safety. The weight of hanging basket is compatible with the designed weight; the on-site data is fed back to the main beam design department in a timely manner in order to make subsequent stage verification.

Besides, the designer makes an adequate consideration of the bridge form in order to construct the project in different hanging baskets.

3.3. Quality control in the construction of hanging basket

In the installation and construction of hanging basket, we have to upgrade the installation quality since its quality affects the project quality.

We can control the quality of hanging basket in three aspects: components fabrication, installation quality and travelling protection. The jack and reverse chain must be collocated in the fabrication of hanging basket. The jack

controls the elevation of long and short derricks while the reverse chain controls the displacement of main truss and bottom formwork of hanging basket and plays a fixation role to the front cross beam and main truss. The reserved holes and pre-embedded components in the bottom plate and roof plate of block section are carefully located to avoid deviation. In the project construction, special attention is paid to no damage against corrugated pipe in the contact between saw blocks of bottom plate; it is forbidden to displace the corrugated pipe. In the reservation of rebar of saw block, it has to play a consolidation role to the surrounding rebars [8].

3.4 Dismantle process of hanging basket

After the combined construction of bridge, the hanging basket is dismantled according to the standard procedure. First, dismantle the hoist and collocate on the ground with the help of crane. Before the combined construction of the bridge, the construction unit dismantles the inner formwork and travelling beam of hanging basket in order to reserve an adequate outlet in the ultimate dismantle. Then, it can dismantle the front upper cross beam; make use of the machinery to remove and dismantle the main structural components. Ultimately, it dismantles the rail.

4. Frequent quality accidents and preventive and curative measures

4.1. Plugging of vertical pre-stress pipe

In the section construction, numerous quality problems are produced such as shrinkage hole and duct plugging. If the concrete chiseling method is adopted in the settlement, the beam structural strength is affected and construction progress is affected. We can adopt the following measures: (1) Select PVC lining pipes with high quality, light weight, high strength and favorable tenacity and durability. In case of tamping delay in the concrete grouting, flush the lining pipe with fresh water to prevent condensation; (2) Upon final condensation of concrete, take out the lining pipe and flush the pipe with fresh water; (3) In the installation of pre-stress pipe, stretch the pipe for a certain length and plug up the pipe opening; (4) In order to assure the firmness of joint, install two locating nets at both ends of the joint and maintain a joint length of above 30cm; align the piping and avoid too large clearance.

4.2. Peeling of bottom plate concrete

In the combination section of adjacent beam section, the bottom plate concrete is stratified due to the extrusion of curve collocated pre-stress; the bottom plate concrete is peeled off so that concrete is crushed away.

Numerous factors can affect the construction quality, such as pre-stress pipe, concrete strength, bottom plate's anti-collapse rebar quantity and bottom plate concrete thickness. We can adopt the following preventive and curative measures: (1) In the project construction, strictly

adhere to the process flow; before construction, verify the formwork dimension and bottom plate thickness; inspect the coordinate of corrugated pipe in each section to meet the requirements; (2) In the tensioning of pre-stress rebar, settle the concrete strength according to the design requirements; in the tensioning of anchor tools at the end, prevent extruding the concrete; (3) In the installation of anti-collapse rebar and hook rebar in the bottom plate, strictly adhere to the construction process standard. In the installation of hook in two adjacent bottom plates, control the length properly and fasten rebar meshes in the upper and lower layers firmly; (4) In the concrete tamping, make concrete in the combination section meet the needed density; (5) Before grouting, clean up impurities by high-pressure water such as wood scrap in the bottom plate [9].

5. On-site management and upgrading of safety of hanging basket

The on-site management department is the key control department of safety and stability of hanging basket. Therefore, the management department must formulate effective measures to assure the construction safety of hanging basket.

5.1. Selection and adoption of eligible materials

In the selection of raw materials of hanging basket, the materials procurement department selects eligible products from formal manufacturers. It is a fundamental factor to assure the construction safety and stability of hanging basket. In particular, the raw materials and structural components are strictly controlled in such weak procedures as connection of combined beams, anchorage of back anchor rod, connection of wind cables, installation of reverse pressure wheel, hinged connection of sling and welding of section steel. It is able to fundamentally remove unfavorable factors against construction safety.

5.2. Strict control of splicing quality of hanging basket

In the splicing of hanging basket, the qualified construction unit is selected and hired to process, fabricate and install it. The operator first installs the triangle combined beam and upper cross beam and set up support to the pull anchor to prevent tilting; then installs the front and back suspension system in sequence, installs front and back lower cross beam of bottom formwork support and installs lower vertical beam and bottom formwork.

In the splicing of hanging basket, the on-site management personnel make a frequent inspection to the connection of connectors and welding quality of welding components. They also need to assure the eligible quality of weak procedures in order to assure the construction safety of hanging basket. In particular, special attention is paid to the anchorage and overlapping quality of anchor rod.

5.3. Analog load test

Upon splicing, the construction personnel must test the

bearing capacity and deformation of various positions of hanging basket. According to the construction load, adopt analog load method to inspect the general stress of hanging basket and add symmetrical load to two hanging baskets by sand bag level by level: loading weight is 1.2 times of the construction load. The load is added in three levels and 50%, 100% and 120% of total weight is added each time. Upon load adding in each level, the construction personnel maintains the load for 2–3 h and measures the deformation value of various positions under the load by a dial indicator. Upon load adding in 3rd level, it maintains for 24 h, measures the deformation value of various positions under the load, discharges the load in three levels and measures the elastic deformation value in the stage and maps out the elastic deformation curve as the control elevation of various grouting sections. Ultimately, integrates with the designed elevation and makes an adequate consideration. At the same time, the on-site construction and management personnel must observe the main stressed components of hanging basket [10].

5.4. Enhancement of travelling protective measures of hanging basket

In the travelling process of hanging basket, some potential safety hazards are foreseen. In order to assure the travelling safety of hanging basket, the on-site management personnel adopt timely counter-measures such as travelling reverse pressure wheel under each main guide beam and wind cable in the vertical pole. They have to observe the operation status of reverse pressure wheel at any time and make a frequent inspection of the connection of back pull pre-embedded components in the wind cable and beam.

6. Conclusion

In the construction of bridge, the hanging basket is widely applied to upgrade the construction progress and quality. However, China's concrete bridge construction techniques developed at a later time and lacked related research. In the subsequent project construction, special attention is paid to positive collection of data and convenience for research department's further research. Under the background of constant expansion of China's road traffic network, it is highly necessary to enhance the road and bridge construc-

tion, upgrade the bridge construction quality, level up the construction techniques of hanging basket and assure the safety of construction personnel.

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