

Arrangement Selection and Construction Quality Control Measures of Bridge Support

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Abstract: Bridge bearings are a small part of the whole bridge structure, but it can affect the corner of the bridge, and the stability and quality of the bridge deck, so the performance of the bridge bearing can directly determine the quality and lifespan of the entire bridge. The bridge bearing connects the upper and lower parts of the whole bridge. In order to improve the quality and structure of the whole bridge, the layout and selection of bridge bearings needs to be done well, the construction process needs to be closely monitored, and the whole process needs to be well-managed. The existing problems should be analyzed in detail and solved in time to ensure the quality of the bridge project.

Keywords: Bridge bearing; Layout selection; Construction quality control; Measures

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1. Introduction

Bridge bearings account for a small proportion in bridge structures, so designers and constructors have ignored the importance of bridge bearings. In recent years, more and more bridges have collapsed due to bearing damage in China, which caused people to pay more attention to bridge supports and improve their understanding and knowledge of bridge bearings. At present, bridge bearings is given emphasis in both the design and construction of a bridge. However, there are still many problems in the actual application process. This paper analyzes these problems and proposes strategies for optimizing the layout and selection of bridge bearings, as well as construction quality control strategies, so as to drive the development of the bridge industry.

2. Development status of bridge bearings

Before the 1960s, the bridges with small redundant total length in China were only paved with rubber sheets and asphalt felt. Concrete bearings or steel bearings were usually used for long bridges. Pot bearings and rubber bearings began to appear and be applied in the early 1960s^[1]. In the 1980s and 1990s, our country paid more attention to bridge construction, and had also put forward many related regulations and standards, which made pot bearings become the main bearing form in China. At present, pot bearings and rubber bearings are the most used in bridge construction in China, except for bridges with special requirements. The manufacturing technology and manufacturing quality of bridge bearings in China are constantly improving, and are also under constant research and innovation. Some bearings with special purpose are designed, for example, adjustable pot bearings are designed for earthquake prone areas, which can help reduce vibration in the application process. At the same time, spherical seismic bearing, lead core isolation rubber bearing and HDR series high damping isolation rubber bearing are also designed. Through

continuous optimization of bridge bearings, the development of China's bridge industry can be further accelerated.

3. Layout and selection principles of bridge bearings

The selection and layout of bridge bearings are directly related to the overall structure of the bridge, and the layout of bridge bearing directly affects the service life of the bridge. Therefore, the following principles should be followed in the selection and layout process. Firstly, during the selection of bridge bearings, it should be ensured that the transverse displacement, longitudinal position, transverse angle, and longitudinal angle due to beam deformation will not be affected. If the upper part of the contest is a spatial structure, the deformation direction of the bridge bearing should be consistent with the direction of the bridge. Secondly, during the selection of bridge bearings, it is necessary to ensure that the bearings can effectively transmit horizontal and vertical forces ^[2]. Thirdly, in the process of bridge construction, each link needs to be installed with fixed bearings. If the horizontal force of the bridge is too high, the number of horizontally dispersed bearings should be increased to avoid excessive pressure on a single brake pier. Besides, if there is not enough lateral stiffness at the top of the pier, then bearings that can rotate laterally and easily should be installed in the bridge. Bearings set on each pier lock shall have similar rotational stiffness. Moreover, the lateral pre-stress shall not be affected during the installation of the beam support with predetermined force, and excessive pre-stress shall not be transferred to the pier. The sixth point is, rocker bearings and roller bearings should not be used in skew bridges, nor should they be used in bridges that are prone to deformation. Lastly, in earthquake prone areas, energy dissipation bearings can be arranged on piers and abutments, which will create a strong buffer effect and dispersion effect. During the selection and layout of bridge bearings, it is not only necessary to transfer the reaction of bearings, but also to effectively adapt to the free deformation of the beam body and strengthen the overall quality of the bridge ^[3].

4. Role and function of bridge bearing

In the construction of a bridge, the bearing is an important connection point between the upper and lower parts of the bridge. The function of the bridge bearing is to transfer the load of the upper part of the structure to ensure that the upper part of the structure can deform freely under temperature and load changes, so that the overall structure still meets the design requirements, and the stress situation also conforms to the calculation diagram ^[4]. The bridge bearing can also protect the pier cap and both ends of the bridge from damage. This requires that the bridge bearing has sufficient elasticity and high stiffness to relieve the stress on the pier and ensure the normal and stable operation of the bridge. Although the bearings can still be replaced after the bridge is put into use, the replacement cost is high and there are certain technical problems ^[5]. At present, most of the bridge bearings in our country are permanently installed, and there is no room for midway replacement. Therefore, the service life of the bearing can directly affect the service life of the bridge, so the bridge bearing should be selected wisely ^[6]. Although the cost of bridge bearings occupies a small proportion in the whole bridge construction process, bridge bearings have a great impact on the whole project. The main functions of bridge bearings include the following: Firstly, it can transfer the load of the main structure of the bridge to ensure that the superstructure can achieve free deformation under the influence of many external factors ^[7]. Second, it acts as a buffer for the overall structure of the bridge and reduce the wear and tear of the bridge while vehicles move through the bridge. Thirdly, in earthquake-prone areas, bridge bearings can reduce the impact of earthquakes on bridges. Therefore, in the process of bridge construction, emphasis should be given to bridge bearings, and the bearings should be reasonably selected and arranged.

5. Layout method of bridge bearing

The layout of bridge bearing mainly depends on the seismic situation of the bridge construction area, the width of the bridge and the overall structure of the bridge. If the bridge construction is not in an earthquake-prone area, fixed bearings can be installed at one end of the bridge, and then movable bearings can be installed at the other end of the bridge. If the bridge to be built is a municipal bridge or a highway bridge, which requires a wide deck, it is necessary to fully consider the movement of the transverse bridge [8]. During the layout of bridge bearings, a fixed bearing needs to be set on the fixed pier first, and one-way bearings that are fixed longitudinally and movable transversely are installed at adjacent locations. At the same time, longitudinal movable bearings are set on the movable pier corresponding to the fixed bearing, and multi-directional movable bearings are set at other locations. In the process of continuous bridge construction, each piece shall be installed with a fixed bearing, and the fixed bearing shall be installed at the center of each link to avoid the expansion joint at the movable end of the bridge becoming larger during installation. However, if the pier shaft is high, targeted measures should be taken to avoid excessive horizontal force on the pier shaft, as shown in **Figure 1**.

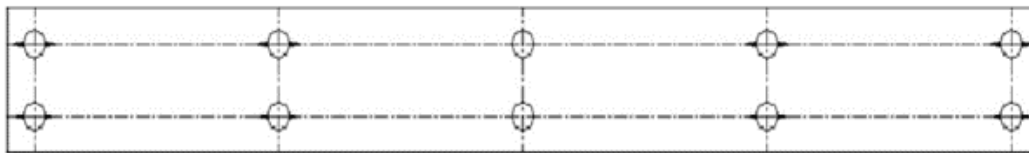


Figure 1. Layout of continuous bridge bearings

If bridge construction is carried out in earthquake prone areas, and if the overall structure of the bridge is too small to arrange seismic bearings, plate rubber bearings can be installed at both ends of the bridge. If the overall structure of the bridge is large and there is sufficient space to install seismic bearings, High Damping Rubber (HDR) bearings can be placed at both ends of the bridge, or Linear Natural Rubber Bearing (LNR) horizontal force dispersion rubber bearings can be placed, as shown in **Figure 2**.



Figure 2. Layout of bridge bearings in seismic region

In addition, the role of bridge bearings in the actual application process can directly affect the use effect of bridges. Therefore, when installing the bridge bearing, the position of the upper bearing should correspond to the lower center position, but it is difficult to achieve complete accuracy during the installation process. Therefore, it is necessary to install the bearing within the specified range to minimize the impact on the working effect of the bearing [9].

6. Quality control measures for bridge bearing construction

(1) Reasonably control the quality of bearing pad stone

Before construction, it is necessary to check the setting out of the center of the plane and ensure the correct installation of the formwork and the qualified installation of the reinforcement mesh. Before the installation of the bearing, thorough cleaning needs to be done by chiseling and sprinkling the surface.

The supervision and management personnel should carefully inspect every step of the process before beginning the next step^[10]. The failure of effective bonding between abutment cap top and bearing pad stone due to the failure of a certain link will lead to displacement or fracture of pad stone during the future formal operation of the bridge, causing the whole bridge deck to sink, and bringing greater potential safety hazards to driving vehicles^[11]. Before construction, it is also necessary to strictly inspect the bearing pad stone by knocking the pad stone with a special small hammer, and evaluating the condition of the pad stone by the sound produced. If there is any void, the pad stone must be chiseled off in time and rebuilt^[12]. The bearing pad stone is relatively thin, so during the pouring process, the staffs need to strictly control the proportion of concrete and do a good job in curing, so as to ensure the quality of the pad stone.

The height of the top surface of the bearing pad stone shall be strictly controlled during construction. In the case of similar slopes, the height of the pad stones at both ends of the bridge should be controlled at the same level as much as possible, and the maximum error should not exceed 2 mm. If the slope bridge is constructed, the embedded steel plate at the beam's bottom support shall be horizontally fixed according to the requirements of the design drawings^[13]. The top surface of the bearing pad stone shall also be leveled, and the concrete on the pad stone support surface should be flat. At present, in order to improve the flatness of the embedded steel plate, construction personnel have gradually integrated new technology into embedding steel plate, so as to improve the overall quality of the bridge.

(2) Reasonable control of the quality of pot type rubber bearing

Before installation, the cleanliness of the fabrication shall be ensured, and the storage and safekeeping of the bearing shall be strengthened to avoid damage due to mechanical impact and scratch. During installation, the support shall be scrubbed with alcohol or acetone, and then silicone grease lubricant shall be injected into the storage tank of the polytetrafluoroethylene (PTFE) sliding plate. The sealing neoprene plate in the steel basin shall be well stuck and air shall be discharged, otherwise the bearing capacity of the bearing will be greatly reduced. During installation, carefully read the design drawings to avoid installation errors that may lead to bearing damage. During the installation of the top plate and bottom plate, the pot bearing should strictly comply with relevant regulations and requirements. The top plate of the pot bearing shall be welded with the top surface of the pier and abutment, and the bottom plate of the pot bearing shall be welded with the embedded steel plate on the bottom surface. The concrete shall not be avoided in the welding process^[14].

(3) Reasonably control the installation quality of bearing

In the process of bridge bearing installation, if the bearing and beam bottom become hollow, the bearing will sink under the load of moving vehicles during the construction phase, which will affect the bearing capacity of the bridge and reduce the service life of the bridge. Under the action of load, cracks will also occur on the bridge deck. No matter how it is repaired, it will still occur repeatedly, bringing greater potential safety hazards to vehicles. Before the installation of bridge bearings, the elevation of the top of bearing pad stone shall be measured and determined repeatedly. Corresponding remedial measures should be taken in time if there is any difference with the design drawings. Before installing the beam and slab, the position around the bearing pad stone should be cleaned and leveled in time^[15]. During the installation of beam and slab, specialized staff should check the condition of the support to ensure that there is no void before the next construction. After the installation of beams and slabs, the supervision and management personnel need to conduct a comprehensive inspection to ensure that the installations are up to standards.

7. Conclusion

In conclusion, bridge engineering is one of the most important projects in China at present. Bridge

construction can effectively alleviate the traffic in China and reduce traffic accidents, so it is necessary to increase bridge construction appropriately. The selection and layout of bridge bearings is an important aspect in the process of bridge construction. Through relevant examples and research, it is shown that bridge bearings can directly affect the overall quality and service life of the bridge. Therefore, it is necessary to optimize the selection and layout of bridge bearings. In this paper, the selection and layout principles and layout methods of bridge bearings are analyzed in detail. At the same time, strategies for reasonable control of bridge bearing construction quality are proposed to effectively improve the quality of bridge bearings and the overall quality of bridge engineering.

Disclosure statement

The author declares no conflict of interest.

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