

# Construction Technology for Roadbed and Pavement of Highway Bridge Settlement Section

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**Abstract.** In the transition area between highways and bridges, settlement often occurs. Even in the transition zone, small differences in settlement between bridge piers and embankments can easily lead to the occurrence of bridge head jumping events. Bridgehead jumping not only affects the comfort, speed, and safety of driving, but also creates a negative impression on the overall image of highways, shortening the service life of cars. At the same time, it can also affect the efficiency and availability of road traffic, and may even lead to traffic safety accidents. Based on an in-depth analysis of the settlement and deformation mechanism of highway bridge foundations, we have discussed the construction technology of road bridge settlement embankments.

**Keywords:** Highway bridges; Settlement section roadbed and pavement; Lapping board; Foundation; Filling behind the abutment.

## 1. Introduction

In modern society, highway bridges, as an important component of transportation infrastructure, carry a large amount of traffic flow and personnel travel needs. However, with the increasing demand for transportation and the increasing frequency of road use, the settlement of asphalt concrete pavement and roadbed has gradually become one of the main challenges in highway bridge construction. This sinking phenomenon not only leads to damage to the road structure and reduced road function, but may also pose serious risks to driving safety, and even cause traffic accidents, posing a serious threat to the life and property safety of the public. The occurrence of settlement in asphalt concrete pavement and roadbed is often closely related to various factors such as material selection, construction quality control, and environmental conditions during the construction process[1]. In the construction of highway bridges, especially in the construction of transitional embankments, the bearing capacity and stability of the roadbed soil are crucial for the safety of the entire bridge structure. Therefore, how to effectively prevent and control the settlement of asphalt concrete pavement and roadbed has become a key issue that urgently needs to be solved in the current construction management of highway bridges. This article aims to explore how to scientifically and effectively deal with the settlement problems of asphalt concrete pavement and roadbed during the construction process of highway bridges, and to ensure the safety and smoothness of highway bridges and promote the sustainable development of transportation through reasonable construction management and comprehensive prevention and control measures. Through in-depth analysis and discussion, we hope to provide some reference and inspiration for the construction management of highway bridges, promote the healthy development of highway transportation, and achieve safe, efficient, and sustainable development of transportation.

## 2. Principle of Settlement of Highway Bridges and Roadbed Sections

### 2.1 The basic mechanism of deformation of the foundation behind the platform

Generally speaking, the foundation of bridge and culvert structures is most prone to deformation in the channel area. The land in this area has relatively high porosity and compressibility, which means



they are more prone to compression and deformation under stress. In addition, due to the geological conditions of the channel area, the soil moisture content is usually high, which further exacerbates the compressibility and deformation possibility of the soil. In contrast, the foundation strength in the channel area is usually poor, which increases the risk of foundation deformation [2]. Therefore, once the filling is completed, we often observe more obvious deformation phenomena. In general, the filling height of the embankment at the bridgehead section should be 5 to 10 centimeters higher than that of the conventional roadbed. This additional height difference may cause some additional stress on the foundation, especially in the trench area, where the soil itself is more prone to deformation. This additional stress may lead to settlement of the foundation, thereby affecting the stability and safety of the entire bridge structure. If the density of the filling material is the same, then as the height of the filling material increases, the possibility of foundation deformation and settlement will also increase accordingly. Therefore, in the design and construction process, special attention needs to be paid to the foundation treatment of the channel area, and corresponding measures should be taken to reduce the impact of deformation, ensuring the safety and stability of the bridge structure.

## **2.2 The basic mechanism of deformation in embankments**

During the construction process, the difficulty of compacting the soil behind the abutment increases due to differences in site terrain and construction conditions. This may be due to terrain undulations, soil types, or other environmental factors. At the same time, in order to ensure the stability and bearing capacity of the soil, it is necessary to achieve the optimal moisture content of the soil. However, due to the diversity of site conditions, including changes in soil moisture, groundwater level, and other factors, achieving this goal may face challenges. In some cases, in order to achieve optimal soil conditions, a large amount of soil mixing and humidity adjustment work may be required. This not only increases the complexity of construction, but may also prolong the construction period and increase costs. In the process of soil compaction, if the moisture content of the soil is not controlled properly or the compaction process is not reasonable enough, it will lead to uneven settlement or deformation of the soil, thereby affecting the stability and safety of the abutment structure [4]. Therefore, during the construction process, it is necessary to carefully plan and manage the compaction process of the backfill soil, and take appropriate soil mixing and humidity adjustment measures according to the actual situation to ensure that the soil achieves the best engineering performance. At the same time, monitor the settlement of the soil and take timely remedial measures to reduce safety hazards caused by settlement deformation.

## **2.3 Settlement caused by the setting of bridge approach slabs**

Generally speaking, elastic supports are equipped at the approach slabs on embankments, which are usually located at the "cow legs" below the approach slabs. This design aims to reduce the pressure and stress borne by the slab, improve its bearing capacity and stability. However, the part closer to the back of the platform often bears less stress, resulting in uneven stress distribution. Especially under the action of vehicle loads, this uneven force phenomenon becomes more pronounced, as the movement of vehicles can cause vibration and deformation of the road surface. In this case, the stress on the two roadbeds will exhibit different peaks. Among them, the roadbed under the action of car load and the roadbed under the support of the approach slab bear different degrees of pressure and tension. When the vehicle drives towards the end of the ramp, the embankment at the end of the ramp will face the maximum longitudinal stress. In this case, significant plastic deformation may occur in the approach slab and roadbed, especially in the end area of the approach slab, where excessive settlement may occur. Therefore, in the design and construction process, special consideration should be given to the stress situation at the approach slab, and appropriate support and support structures should be adopted to reduce the impact of uneven stress. At the same time, timely monitoring of the deformation of the roadbed and approach slab, adjusting the construction plan and maintenance measures in a timely manner, ensuring the stability and safety of the road surface.

### **3. Construction Technology for Roadbed and Pavement of Highway Bridge Settlement Section**

#### **3.1 Setting up of scaffolding**

1. Determination of anchor bolts. In general, the approach slab is placed at one end near the bridge abutment. This setting helps to prevent the approach slab from sliding along the longitudinal direction, thus avoiding the occurrence of bridge head sinking. In order to ensure the stability and safety of the scaffolding, vertical anchor bolts and horizontal pull rods are usually installed in this situation. These support and fixing measures aim to maintain the position and stability of the approach slab, enabling it to withstand pressure from vehicle movement and other loads, while maintaining the stability of the bridge structure. During the installation of steel bars, steel bars numbered 22 are usually selected. When installing steel bars, it is necessary to ensure that the distance between the bars is between 75 and 80 centimeters, in order to ensure sufficient support and bearing capacity of the bars. Due to the fact that anchor bolts are usually in a vertical state, components such as landing plates or cow hooves may appear during installation [6]. To ensure the smooth progress of construction, measures need to be taken to adjust and adapt to these situations. If the design displacement of the bolt can be ensured to be consistent with the design value of the horizontal tie rod, better construction results will be achieved. This means that the design of bolts and tie rods should match each other in both horizontal and vertical directions to ensure the stability and safety of the landing plate and other structural components. Therefore, in the design and construction process, it is necessary to carefully consider and coordinate the relationships between various components to ensure the safety and stability of the entire bridge structure.

2. Selection of supports. At the position near the back of the platform, it is often necessary to lay a layer of felt with a thickness between 1 and 2 centimeters. The function of this layer of felt is to reduce the friction between the landing board and the back of the platform, thereby reducing the risk of damage to the landing board. By providing additional protection for the slab, the service life of the slab can be extended, and the overall stability and safety of the bridge structure can be improved. If the manufacturing material of the bracket is plate rubber, special attention should be paid to the spacing between the bracket and the bracket. Generally speaking, the spacing between these brackets should be approximately 80 centimeters. In addition, there are certain requirements for the size of the bracket, commonly ranging from 150 millimeters \* 150 millimeters \* (21-38) millimeters [7]. By ensuring that the spacing and dimensions between these supports meet the requirements, stable support between the supports can be ensured, and uniform support force can be provided for the approach board. These detailed measures in design and construction are aimed at ensuring the stability and safety of the bridge structure. In engineering practice, these small measures often have a significant impact on the performance of the entire bridge, and therefore require special attention. Through reasonable design and construction, the service life of bridges can be maximized, and their reliability and safety can be improved during use.

3. The production of chamfers. If the ramp rotates, it will cause serious damage to the pavement structure of the highway or road. Therefore, in order to reduce the possibility of such damage, it is necessary to chamfer the upper edges of the legs of the approach slab and the two parts near the bridge abutment. The purpose of chamfering is to reduce the surface area in contact with the pavement structure during the rotation of the ramp, thereby reducing the impact and friction of the ramp on the pavement structure, and protecting the integrity and stability of the pavement structure. By chamfering the upper edge of the approach board, the impact force generated during rotation can be effectively reduced, thereby reducing the risk of damage to the road structure. This treatment can not only reduce the maintenance cost of road surface structure, but also extend the service life of the road surface, improve the safety and comfort of the road surface. Therefore, in the design and construction process of roads and bridges, it is crucial to chamfer the approach slab. This measure can effectively reduce the damage caused by the rotation of the approach board to the road structure, ensure driving safety, and improve the overall performance and reliability of roads and bridges.

### **3.2 Foundation treatment**

During the construction process, the selection of foundation treatment is crucial, and reasonable decisions need to be made based on specific construction conditions and project requirements. Effectively handling the foundation can not only enhance the bearing capacity of the road, but also improve the characteristics of the road, reduce the settlement difference between the road section and the bridge abutment, reduce the possible deformation of the road caused by settlement, and thus avoid the occurrence of platform displacement. When constructing highway embankments, the characteristics of the soil, especially its high water content and large voids, are often fully utilized. This type of soil usually has good bearing capacity, but it also requires appropriate treatment to ensure its stability [8]. Therefore, the soil replacement work with the clay layer has become crucial. Generally speaking, the thickness and strength of clay layers are large, and they contain high organic matter content. Therefore, appropriate measures need to be taken during treatment to ensure their stability and reliability. When dealing with backfill layers, it is necessary to determine the optimal burial depth based on specific circumstances. For shallower backfill layers, it is usually possible to choose a shallower burial depth, while for deeper backfill layers, corresponding adjustment of treatment methods is required. During the processing, it is necessary to continuously excavate and flip the clay to meet relevant specifications and requirements. In addition, it is necessary to control the treatment of clay based on the moisture content of the soil layer and other factors to ensure the smooth progress of subsequent backfilling work. By implementing reasonable basic treatment measures, the smooth progress of road engineering can be ensured, and the performance and safety of the road can be maximized.

### **3.3 Filling behind the abutment**

The difference in embankment settlement is a common challenge in road engineering, especially between road sections and bridges. This difference is mainly reflected in the deformation and compression of the road substrate, foundation settlement, and deformation and compression of the road panel. Although compression deformation of the road surface generally does not cause serious damage to the road structure, attention should still be paid to the potential impact of this problem to ensure the long-term stability of the road. In order to better understand the settlement state of the roadbed, the method of dividing it into different stages such as same settlement, instantaneous settlement, and sub same settlement is often used. In these stages, bridge head jumping is often caused by both co settlement and sub co settlement. Therefore, special attention must be paid to the quality of the filler when selecting it. The quality of the filling material is directly related to the settlement of the roadbed. Choosing lightweight fillers can effectively reduce foundation settlement and help control deformation and compression of the foundation. Meanwhile, by appropriately compacting the filling material and increasing its compressive modulus, the cumulative deformation caused by repeated loads can be effectively reduced. When selecting the filling material behind the bridge abutment, it is necessary to ensure its excellent quality and good working performance. In general, filling will be carried out within a range of 5 to 10 meters behind the bridge abutment [9]. Choosing appropriate fillers and taking effective treatment measures is of great significance for ensuring the quality and long-term stability of road engineering. Therefore, during the construction process, it is necessary to comprehensively consider factors such as the characteristics of the filling material, working conditions, and surrounding environment to ensure that the selection and treatment of the filling material can maximize the reliability and safety of road engineering. In the process of selecting fillers, multiple factors need to be comprehensively considered. Firstly, it is necessary to consider the rigid flexible transition phenomenon between bridges and highways, so the selected filling material must have a stiffness and flexibility that matches the roadbed and abutment materials. This can ensure that the filling material can smoothly adapt to the characteristics of different materials in the transition section between the bridge and the highway, and avoid problems caused by material mismatch. Secondly, it is necessary to consider the difficulty of construction after compaction. In this case, the degree of compaction of the filling material should be strictly controlled, and a filling material that is easy to compact should be selected to ensure the smooth progress of the construction process.

Choosing fillers that are easy to compact can not only reduce construction difficulty, but also improve construction efficiency and reduce construction costs. Finally, the selected filler must have good permeability. For example, filling materials such as gravel soil, crushed stone soil, and high-strength industrial waste can be chosen. If the filler lacks permeability, materials such as lime can be added to it to improve the stability and durability of the filler [10]. By selecting and processing appropriate fillers, the stability and durability of the roadbed can be effectively improved, thereby ensuring the quality and safety of road engineering. Therefore, when selecting fillers, it is necessary to fully consider the above factors and make appropriate decisions based on specific circumstances to ensure the smooth progress and long-term reliable operation of road engineering.

#### 4. Conclusion

In the construction of highway bridges, the settlement of asphalt concrete pavement and roadbed is an urgent challenge that needs to be solved. During the construction process, it is necessary to strictly control the construction quality, select materials reasonably, and strengthen the training and management of construction personnel. Comprehensive prevention and control measures should be taken proactively to fundamentally avoid excessive settlement of road and bridge transition sections and embankments, ensuring driving safety. Therefore, only through reasonable construction management and comprehensive prevention and control measures can the occurrence of settlement problems in asphalt concrete pavement and roadbed be effectively prevented, ensuring the safety and smoothness of highway bridges.

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