

Causes of Cracks in Road and Bridge Concrete Construction and Preventive Measures

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Abstract: Concrete cracking is a common problem in road and bridge construction, which is directly related to the construction quality of road and bridge projects. Since the concrete cracks cannot be completely eliminated, it is necessary to ensure that the cracks are controlled within a certain range, reduce property losses as much as possible, and prevent the cracks from harming the safety of pedestrians and vehicles. Therefore, it is necessary to study the causes of concrete cracks and formulate corresponding prevention measures to avoid further expansion of concrete cracks.

Keywords: Road and Bridge Construction; Concrete Cracks; Cause of Formation; Preventive Countermeasures

Introduction

In road and bridge engineering, due to the role of various factors, concrete cracking occurs. Corresponding countermeasures must be formulated according to its causes to ensure that the concrete construction meets the actual needs, prevent cracks, and ensure the safety and quality of road and bridge. In order to prevent the occurrence of concrete cracks, the road and bridge construction shall be comprehensively controlled from the key links such as materials, construction technology and load, so as to improve the overall quality of engineering construction and promote the sustainable development of China's road and bridge industry.

1. Types of road and bridge cracks

There are different types of road bridge concrete cracks, which can be divided into horizontal cracks and X-shaped cracks. Horizontal cracks: the compactness of concrete during construction is not enough or uniform, and cutting the concrete surface prematurely will cause horizontal transverse cracking of pavement and bridge. In addition, in different areas of roads and bridges, cracks should also be divided according to their development status, location, causes, etc. The shape of the X-shaped crack is similar to "X". The formation mechanism of the X-shaped crack is relatively complex, which is due to the non-uniformity of the temperature field, resulting in the X-shaped crack (as shown in the figure).



Horizontal crack and X-shaped crack

2. Causes of concrete cracks in road and bridge construction

2.1 Load causes

There are two types of cracks caused by road and bridge load factors: first, the bearing capacity of some structures

exceeds the design requirements due to the illegal storage of various construction machinery raw materials and equipment during construction; Second, the construction personnel did not strictly follow the design drawings, and the construction technology or construction technology was improperly selected, resulting in insufficient concrete bearing capacity and concrete cracking; In the later stage of the viaduct, the frequent overloading of vehicles will increase the pressure, which will easily lead to pavement concrete cracking.

2.2 Causes of foundation deformation

After the non-uniform settlement of the foundation, tensile stress will be formed between the components, so that the concrete structure has tensile strength. The causes of uneven settlement cracks are: inaccurate geological survey, lack of understanding of engineering geological conditions, and failure to deal with them in time before construction, resulting in uneven settlement. Cracks are easy to appear in the construction of road and bridge foundations. The main reason for this is the lack of basic stability. The foundation soil belongs to soft soil or the foundation structure has non-uniform deformation. The settlement of road and bridge foundation acts on the main beam in many directions, that is, the longitudinal and transverse tensile stresses, and also bears the load of the bridge deck itself and the load of vehicles. In the pavement, bridge and other parts, when the multiple stress exceeds its limit, cracks will appear.

2.3 Cause of plastic shrinkage

In the construction of road and bridge projects, shrinkage cracks are easy to occur. For example, in the construction of road and bridge concrete pouring, due to the intense effect of hydration heat, the moisture content of concrete decreases rapidly, which leads to concrete solidification, shrinkage and cracking. In addition, in terms of the collection, distribution and management of concrete aggregates, the cement raw materials with low hydration heat are not selected, the unreasonable water cement ratio, and in the construction of roads and bridges, plastic shrinkage will be caused due to improper concrete pouring and vibrating construction technology. The cracking of road and bridge caused by concrete shrinkage is common. Shrinkage cracks have a small impact on the stress of the structure, but have a greater impact on the appearance of the structure, which is called "shrinkage cracking": after the concrete is formed, the surface water will evaporate, and the whole process of vaporization starts from the surface, and then develops from the inside to the inside. Due to various drying shrinkage effects inside and outside, under the internal constraint of the concrete, tensile stress will appear in the concrete, which will lead to concrete cracking.

2.4 Reasons for rebar corrosion

Corrosion of reinforcement is an important factor that causes cracking of road and bridge. After corrosion, the surface area and cross section of concrete reinforcement will increase, so its compressive strength will decrease accordingly. At the same time, the gap between the reinforcement and the concrete will gradually expand, and finally form cracking and peeling. Concrete cracking is an important factor causing steel corrosion, and steel corrosion is an important reason for concrete cracking and growth.

2.5 Reasons for construction process quality

The concrete cracking of road bridges is caused by many reasons, among which the low quality of construction technology is also an important reason. In the process of pouring and formwork hoisting, if the concrete construction technology is unreasonable, it is easy to produce various cracks.

3. Preventive measures for concrete cracks in road and bridge construction

3.1 Prevention of load cracks

During the construction of the superstructure of the bridge, the setting of transverse distributed reinforcement must be considered when pouring the beam and slab. The rebar with small diameter can be selected, and the rebar spacing shall be controlled within 10cm. The distributed reinforcement shall be strengthened at the edge of the component and the changing part of the section, and the reinforcement mesh shall be placed on its surface. Shear reinforcement can be used for the design and construction of mass concrete. In order to prevent the corrosion of steel bars, the concrete mixing water shall be strictly tested to prevent the harm of chloride ions, ensure that the thickness of the protective layer meets the specified requirements, or add additives to increase the durability of the concrete. In order to prevent uneven settlement in engineering construction,

comprehensive geological survey shall be carried out for the foundation to solve the problem of foundation quality.

3.2 Prevention of foundation deformation cracks

The pile column foundation is adopted for the foundation, and the cushion cap structure should be added to avoid uneven settlement of the foundation. In the north, the influence of frozen soil on the buried depth of the foundation base should be fully considered; The extended rigid foundation and the bottom foundation can be combined. The bearing capacity of the new foundation must be improved. The transverse connection must be strengthened to prevent the joint of new and old cracks from being affected; When paving cement concrete on the bridge deck, in order to ensure the overall stability of the bridge deck, the rigidity of the bridge deck should be ensured.

3.3 Prevention of shrinkage cracks

The water consumption of concrete shall be strictly controlled to ensure that the amount does not exceed 170 kg/m³; Before pouring, the concrete slump and water cement ratio must be checked to ensure that the water cement ratio does not exceed 0.6; The mixing time limit of concrete mixing shall be reasonably inspected to ensure uniform mixing and avoid segregation; During construction, ensure sufficient vibration to avoid accumulation; In summer, measures such as wetting and covering shall be taken to avoid a large amount of evaporation of water in the concrete; When the aggregate sediment content is high, the tension of concrete will be reduced. Concrete mixed with harmful expansion agent will cause concrete cracks. Therefore, when selecting slag type Portland cement, it belongs to selecting the appropriate cement; With the increase of water consumption of concrete, its drying shrinkage also increases, so the water consumption of concrete is strictly controlled; Additives can be added to the concrete to reduce the amount of water. The water reduction rate of additives should be high and the dispersion performance should be good; In addition, in order to ensure the dryness of concrete, slag, diatomite and other powder additives can also be added; During curing, steam can be used for strengthening in order to maintain humidity; The mechanical vibration of concrete is controlled, and the vibration time should be reasonably controlled every 5-15 seconds; Adding structural reinforcement to concrete can effectively prevent shrinkage deformation and effectively improve the crack resistance of concrete. In the actual project $\phi 8 \sim \phi 14$ mm small diameter reinforcement is used as structural reinforcement, and its reinforcement ratio is generally 0.3%~0.5% in the whole section.

3.4 Prevention of reinforcement corrosion cracks

It is an effective measure to improve the protective performance of concrete to enhance the protective performance of concrete, reduce the entry of harmful ions and reduce the alkaline loss of concrete. The concrete materials shall be selected according to the specifications, and the water cement ratio and cement consumption shall be strictly controlled. In order to improve the density of concrete, vibration must be well controlled. The special reinforcement with epoxy coating and galvanization can effectively isolate the intrusion of harmful ions into the concrete to avoid contacting the reinforcement and cause corrosion.

3.5 Prevention of construction cracks

Pour as required. If construction joints are unavoidable during construction, the concrete surface must be cleaned, and the surface to be poured must be coated with cement mortar before concrete pouring. When the cast-in-place concrete is used to erect the formwork, the stress analysis shall be carried out to prevent eccentricity. The stress deformation of formwork, foundation and support system is the main problem of construction cracks. In order to prevent foundation settlement, jacks and wedges can be used for adjustment. During the construction, the pouring sequence of concrete shall be determined in advance and the pouring procedure shall be strictly followed. The starting time of hardening of cement can be adjusted by adding retarder. In order to achieve better crack resistance, the concrete with maximum deformation can be poured first, and then poured in the middle of the crack to play a good crack resistance role.

4. Conclusion

To sum up, roads and bridges have played a great role in promoting China's economic and social development. In China's road engineering, bridge engineering is a very important project. In road and bridge engineering, cracks are a common phenomenon, which is very prone to safety accidents. Engineering personnel should have a comprehensive understanding of the concrete cracks in road and bridge construction, and take corresponding preventive measures. Therefore,

it is of great practical significance to analyze the causes of road bridge concrete construction cracking and propose corresponding preventive measures.

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