Analysis of Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering

Jingbo Yan*

Fushun Shuntong Highway Engineering Co., Ltd., Fushuan, Liaoning, 113000, China

Abstract: In recent years, the rapid growth of the number of private cars has greatly increased the traffic pressure, so the quality of roads and bridges should be further improved. The paper expounds the related matters of road and bridge engineering from three aspects. Firstly, it expounds the construction principles of road and bridge engineering, which are regarded as the theoretical basis of follow-up research. Secondly, it analyzes the common diseases of road and bridge engineering, including bridgehead damage, reinforcement corrosion, and subgrade uneven settlement, etc. Finally, it puts forward the construction treatment technology of road and bridge engineering on the basis of the construction principles and taking the common diseases as reference.

Keywords: Road and bridge engineering; Common diseases; Construction treatment technology

***Corresponding Author:** Jingbo Yan, Fushun Shuntong Highway Engineering Co., Ltd., Fushuan, Liaoning, China E-mail: 1214792239@qq.com

DOI: https://doi.org/10.30564/frae.v1i2.45

1. Introduction

As the time goes by, the problems of bridge surface cracks, subgrade settlement, and reinforcement structure corrosion may appear after the road and bridge are put into use, with constant loads from bearing running vehicles. Especially in recent years, due to the increasing number of running vehicles, the possibility of road and bridge disease is further increased. Light road and bridge diseases will affect the appearance of the bridge, while the heavy ones will lead to safety hazards, threatening the safety of pedestrians. In view of this, effective treatment measures must be taken against the possible diseases of the bridge, provided that these diseases are investigated and understood. Strengthening quality optimization in maintenance engineering is one of the effective measures to control the occurrence of road and bridge diseases. Therefore, the designers and constructors of the road and bridge construction unit should continue to conduct in-depth research on the issues related to bridge diseases, and take the research results as the basis to optimize the construction scheme and construction technology to improve the overall quality of road and bridge with respect to the construction process.

2. Analysis of Construction Principles of Road and Bridge Engineering

Given that the road and bridge belong to the main bearing form of road traffic, it is necessary to strengthen the exploration of relevant technologies during its application and development, integrate the application principle and control requirements into engineering design, improve the treatment technology, give full play to the maximum value of the technical mode, and the concrete road and bridge engineering construction principles include the following aspects.

2.1 Maximum Application and Emphasis on Overall Benefits

First, the principle of maximum application needs to be adhered to. In the design of road and bridge engineering, one problem that we must consider is the particularity of bridge structure itself. At the same time, in order to control the structural damage or other diseases at the later stage, it is necessary to use performance analysis and comparative analysis methods to test the bearing capacity of bridge construction and analyze its application reliability for maximizing the original construction.[1] Second,

the principle of emphasis on overall benefits needs to be followed. The reinforcement function of road and bridge is more obvious, presenting the reinforcement treatment on weak construction, which can promote the whole system to change in varying degrees; in view of this, before the implementation of reinforcement treatment, a comprehensive assessment of the overall situation of the structure needs to be carried out, to maximize the integrity of the bridge structure.

2.2 Optimizing Design Scheme and Perfecting Construction Preparation

First, the principle of optimizing design scheme needs to be adhered to. When the reinforcement of road and bridge is in the design stage, we need to prepare a variety of optional schemes, taking the existing responsibility system as the basis, considering the overall economic and social benefits of the project, and ultimately define design optimization scheme. The choice of construction scheme and construction technology has a great influence on the quality of bridge construction, and the construction period shall be shortened to meet the construction requirements if permitted. Second, the principle of perfecting construction preparation needs to be followed.[2] Before the construction of road and bridge, the building unit should do a good job in the construction site investigation, which aims to understand the actual construction conditions and incorporate them into the scheme design to ensure the feasibility of the design scheme.

3. Common Diseases of Road and Bridge Engineering

3.1 Expansion Joints

The function of expansion joints is to avoid the structural cracks caused by the change of climate temperature. The expansion joints divide the building above the foundation into two separate parts to ensure that the extension direction of the building can be extended horizontally. Expansion joint devices are mostly located at the end of the bridge, which is more susceptible to the impact of vehicle loads, and is also the most susceptible disease of roads and bridges.[3] Due to the increasing number of running vehicles, the corresponding vehicle load is increasing, which further increases the incidence of expansion joint damage. Once the bridge deck expansion joint damage occurs, it will directly affect the overall adaptability of the bridge, but also may lead to water leakage on the bridge deck, resulting in corrosion of the steel structure.

3.2 Reinforcement Corrosion

Reinforcement is the main building material during the construction of roads and bridges, which needs to be applied in large amount especially in the process of foundation construction. Although the stability of the reinforcement is relatively high, it inevitably will be affected by various natural factors for being used long time, resulting in the rusting of the reinforcement, and even corrosion if not dealt with in time.[4] If the reinforcement of road and bridge is corroded, the oxidation-reduction reaction will occur when it contacts with air. The corresponding oxidation products will increase with the time going by, and then start to expand, resulting in the loosening of the concrete structure around the reinforcement, as well as the appearance of cracks to varying degrees, leading to the reduction of the effective section of the bridge, and its bearing capacity will also be reduced accordingly. In addition, after the corrosion of reinforcement, the area of reinforcement will also be reduced, resulting in the weakening of its own bending capacity and the emergence of these problems will affect the service life of road and bridge.

3.3 Subgrade Settlement

There exists an important link between the foundation of road and bridge and its service life. The uneven settlement of the foundation may cause cracks in the concrete structure of the bridge, thereby reducing the performance of the bridge. The main factors of the uneven settlement of the subgrade include the following aspects: (1) Before the construction of the road and bridge engineering, the personnel involved in the design and construction of the engineering have not made adequate preparations, and failed to make a comprehensive investigation of the construction site, leading to the design of the construction scheme relying solely on the basic information of the project and the relevant standards, which may deviate from the actual construction conditions and result in the lack of rationality in the selection of construction technologies, thus increasing the possibility of subgrade settlement.[5] (2) The constructors, in order to obtain personal benefits, use unqualified building materials, which makes the construction quality not up to the design requirements, giving rise to the irregular settlement of the subgrade. (3) During the construction of the project, the designers and constructors lack understanding of the geological environment around the construction site, plus longer construction period, which will easily lead to the destruction of the underground surface, and the hardness of the soil cannot meet the construction needs causing the uneven stress between the road surface and the bridge deck, thus bringing about the problem of irregular settlement of the subgrade.

3.4 Cracks

The most common problem in the operation of road and

bridge is the cracks on the road surface or bridge deck. The reasons for cracks occurred include external environmental factors and construction quality factors. Roads and bridges are continuously exposed to the external environment and are subject to the erosion of wind and rain for a long time. At the same time, they also carry the load of running vehicles. For these reasons, crack problems frequently occur. During the construction of the road and bridge project, semi-rigid structures will be applied to the pavement of road surface or bridge deck. This type of structure will help to intensify the strength and bearing capacity of the pavement. However, such structure is relatively susceptible to temperature changes. The greater the difference in temperature, the likelier it is that there will be cracks on the pavement.[6] For example, during the construction of road and bridge in the northern regions with lower temperature, mostly cracks in pavement of road surface or bridge deck will occur, which is mainly caused by the large temperature difference between days and nights in the northern regions. As a result, the pressure resistance of road surface with semi-rigid structures is reduced, which makes cracks occur more easily after application in the later stage. In addition, in the long-term application process, the incidence of cracks on the roads on which vehicles run is significantly higher than the sidewalks. The reason is that vehicles overload or emergency brake will cause the ground to be squeezed, thus causing road depression.[7]

3.5 Bridgehead Damage

Bridgehead damage is a relatively common problem in road and bridge engineering, which may cause deformation at both ends of the roads and bridges. The appearance of such deformation will further affect the transition of the overall stress structures of the bridges, and the service life and safety of the engineering during operation cannot be completely guaranteed.[8] There is an important link between the occurrence of bridgehead damage and the quality of construction materials. If the building materials used in the construction process fail to meet the design standards, the supporting force of the road and bridge's structural components will be weakened, under pressure caused by running vehicles in long-term application, the bridgehead is subject to local fractures due to the continuous and relatively large loads.

4. Construction Treatment Technology of Road and Bridge Engineering

4.1 Crack Filling Technology

Comparing with repairing technology, crack filling technology performs better in reinforcement effect, and it is more suitable for application in which the crack is relatively wide and the crack problem is extremely serious. The application method of crack filling technology is to dig trenches in the longitudinal depth direction at the location of the road surface cracks, applying cement slurry and epoxy resin glue in the slots to match the specified ratio, and pour the prepared slurry into the road surface cracks.[9] It is worth noting that the performance of epoxy resin glue is relatively stable. After mixing with cement slurry, the destabilization will be further improved, and the road surface cracks can be repaired more effectively. For this reason, mixing with cement slurry should be considered as the main quality control link. In addition, if an appropriate amount of rubber material is added to the matched crack filling material, the cracks can better deal with the impact of a variety of adverse factors, thus achieving the effect of improving the repair quality of cracks.

4.2 Reinforcement Corrosion Treatment Technology

The reinforcement structure belongs to the important bearing structure of road and bridge, which has a great influence on stability and safety of the entire road and bridge. If the reinforcement structure is corroded, it will not be able to continue to be protected by the surrounding concrete. The reinforcement structure losing protection of concrete will increase contact with the outside air, as a result, the corrosion situation is further developed, and the structure toughness will decrease accordingly. In view of this situation, concrete thickness can be increased during construction operations to strengthen the protection for reinforcement structure. At the same time, covering layer and confined layer can also be added to the concrete surface to improve its resistance to external factors. In addition, in the concrete construction process, as the density of the concrete can be increased based on the conversion of ratio of the construction materials, so an appropriate amount of slag and coal ash powder can be continuously added to further enhance the anti-permeability performance of the concrete structure. In addition to the adjustments made in materials and construction methods, it is also necessary to strengthen the management of concrete construction quality and control the occurrence of cracks at the source.[10]

4.3 Subgrade Settlement Treatment Technology

During processing the subgrade, it is necessary to pay attention to the requirements of the bridge reinforcement treatment. For the surface treatment, the cross-sectional area of the bridge needs to be adjusted, which must be carried out through combining the property requirements

of structural system. For the requirements of prestress, if the road surface has irregular settlement or settlement in other forms, appropriate treatment methods should be chosen according to the degree of settlement and the form of settlement. The treatment process is as shown in Fig. 1. For the engineering with a relatively small settlement, after understanding the settlement conditions, it is necessary to carry out compaction treatment, and it is possible to select displacement or grouting means to compact the surface based on the action of the road roller. Displacement means to displace soft soil subgrade. In the process of replacement, mortar treatment method can be applied to guarantee adequate structure such as underground soft soil or concrete, and strengthen the bearing capacity and stability of the foundation.

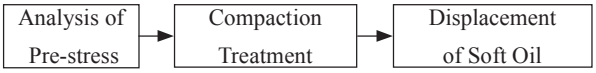

Figure 1. Application Process of Settlement Treatment Technology

4.4 Surface Dressing Technology

Surface dressing technology is ideal in application effect and convenient in operating process, therefore, the cracks existing in the construction process can be effectively treated. Considering the requirements for the bearing capacity of cracks, it is necessary to evaluate the bearing capacity during the treatment and clarify the specific treatment scheme according to the force standard. Surface dressing technology is relatively simple in application process, therefore, constructors can directly find the existing cracks in the surface structure of road and bridge, and achieve crack treatment effects by smearing the cracks. The materials used in the crack treatment include cement slurry and epoxy grout. After the smearing, the surface of the crack needs to be covered with relatively high-quality materials to prevent it from being damaged again after being put into use.

4.5 Bridgehead Damage Treatment Technology

For bridgehead damage, it can be repaired with end damage treatment technology, featured by rapider condensation speed. During the construction period, apply the jetting force of the device to spray the silicone materials to the designated position, and then perform the pouring and tamping operations so that the silicone materials and the bridge can be fully bonded. Silicone materials can meet the requirements of stiffness and flexibility, and the treatment effect obtained after application is more ideal.

4.6 Strengthening Routine Maintenance

During the long-term application of road and bridge, based on the influence of the natural environment and the running vehicles, various diseases will inevitably occur. In response to this, it is necessary to use routine maintenance to control the occurrence and development of various diseases, and to ensure the diseases existing in road and bridge discovered in time and apply reasonable methods to deal with them to avoid causing safety accidents. In the routine maintenance, attention should be paid to the following points: First, after the main construction of road and bridge is completed, it is necessary to cooperate with the traffic department to achieve traffic control to avoid the damage to the roads that are initially condensed by passing vehicles. Second, after the completion of the construction, tests such as earthquake resistance and cracks must be conducted to test the performance of road and bridge. If any index is found not to meet the standard, adjustments must be made until the overall quality of the road and bridge can meet the safety application standards. Third, after the bridges are put into use, it is necessary to regularly inspect and repair the bridges, including whether the surface structures are damaged, whether leakage occurs, whether reinforcements are corroded, and ensure prompt discovery and timely treatment.

5. Conclusion

Light road and bridge diseases will affect the appearance of the bridge, while the heavy ones will lead to safety hazards, thus threatening the safety of pedestrians. In view of this, effective treatment measures must be taken against the possible diseases of the bridge. In the analysis of diseases of road and bridge, it can be understood that cracks, uneven settlement, corrosion of reinforcement, etc. all belong to common diseases of road and bridge. If these conditions cannot be identified as soon as possible, they will be further developed, which will seriously affect the service life of the bridge, and even directly lead to traffic accident. In view of this, improvements need to be made from two levels. First, experience should be summarized in construction to control the factors that may trigger bridge diseases. Second, in the later maintenance, it should discover problems in time and choose the pointed technology for treatment.

References

[1] Rongfei Lu. Exploring Common Diseases and Construction Treatment Technologies of Municipal Road and Bridge Engineering[J]. Green Environment Protection Building Materials, 2018, 08(04): 131. (in Chinese)

[2] Qiang Zhang. Exploration on Common Diseases and Con-

struction Treatment Technologies of Municipal Road and Bridge Engineering[J]. Engineering and Technology Research, 2018, 08(01): 191-192. (in Chinese)

[3] Yabin Qu. Analysis of Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering[J]. New Technology & New Products of China, 2018, 07(05): 120-121. (in Chinese)

[4] Lijuan Liu. Discussion on Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering[J]. Live and Work, 2018, 09(02): 93-96. (in Chinese)

[5] Shiming Gao. Common Diseases and Construction Treatment Technology Key Points of Road and Bridge Engineering[J]. Popular Science (Scientific Education), 2018, 02(01): 191. (in Chinese)

[6] Xiaomei Ma. Thoughts on Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering[J]. Qinghai Jiaotong Keji, 2017, 06(06): 95-97. (in Chinese)

[7] Junbi Yan. Analysis of Construction Treatment Technologies and Common Diseases of Road and Bridge Engineering[J]. Jiang Xi Jian Cai, 2017, 07(23): 158-161. (in Chinese)

[8] Hao Hua. Analysis of Construction Treatment Technologies and Common Diseases of Road and Bridge Engineering[J]. Urban Construction Theory Research (Electronic Version), 2017, 02(33): 120. (in Chinese)

[9] Xiangjiao Liao. Analysis of Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering[J]. Urban Construction Theory Research (Electronic Version), 2017, 07(33): 154. (in Chinese)

[10] Hanfang Ye. Analysis of Common Diseases and Construction Treatment Technologies of Road and Bridge Engineering[J]. Urban Construction Theory Research (Electronic Version), 2017, 03(27): 172-173. (in Chinese)