Journal of Architectural Research and Development, 2023, Volume 7, Issue 2
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Technologies for Asphalt Pavement Surface Testing in Road and Bridge Construction

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**Abstract:** Asphalt pavement is currently one of the main components in the construction of roads and bridges. However, from a practical point of view, various quality problems are prone to occur in the surface layer of asphalt pavement, which will lead to the poor overall quality of road and bridge projects. Therefore, it should be applied reasonably. Advanced testing technologies are used to test the mixture quality, compaction, segregation, thickness, and other aspects of the asphalt pavement surface layer, so as to improve the quality of the asphalt pavement surface layer, and then improve the overall quality of road and bridge construction. Therefore, this paper mainly analyzes the technologies for asphalt pavement surface layer testing in road and bridge engineering construction.

**Keywords:** Asphalt pavement surface layer; Road and bridge engineering construction; Testing technology

***Online publication:*** March 28, 2023

## 1. Introduction

In recent years, China has undergone continuous urbanization, the transportation network has been improving, and the construction of roads and bridges has received more and more attention. One of the most frequently used road surfaces in contemporary China is asphalt pavement. The durability of asphalt pavement is not only the result of the rapid improvement of road and bridge construction in China, but also a reflection of the construction technical level and working attitude of construction workers. Therefore, in the process of asphalt pavement construction, it is important to carry out a detailed inspection of the pavement base to ensure its good quality [1]. Moreover, in the actual construction process, there may be situations such as uneven distribution of surface materials, insufficient tightness of pavement joints, and unqualified raw material mixture, which may affect the safety of road operation. Therefore, it is necessary to carry out reasonable quality checking for asphalt pavement surface layer. Hence, it is of great significance to analyze and study the technologies for of asphalt pavement surface layer testing in road and bridge construction.

## 2. Construction problems of asphalt pavement surface

During the construction of road and bridge projects, the construction problems of the asphalt pavement surface that may occur are cracks, upper layer problems, and raw material quality problems. These occur quite frequently, and any one of them will affect the overall quality of the road and bridge. Therefore, it is necessary to conduct in-depth exploration on the points regarding problem detection to ensure that problems can be detected quickly in the quality checking process.

(1) Crack detection and repair

Cracks are a common problem in the construction of asphalt pavement of roads and bridges. Cracks can easily affect the overall strength of the pavement and are not conducive to prolonging the service life of the road. Therefore, it is very important to effectively detect and repair cracks in the asphalt pavement surface in time. At the same time, the problem of cracks in the pavement surface can also extend to the expansion and contraction of the pavement surface. Although the possibility of debris falling is small, the waterproof performance of road bridges will inevitably be affected, and it can form a pavement, and the safety of road bridges will then be affected, so it is necessary to efficiently detect and repair cracks in the asphalt pavement surface of road bridges [2].

(2) Upper-layer problems

Upper layer problems lead to many other problems in the construction of road and bridge asphalt pavement surface. If the traces of the joints of the layers are too obvious, local segregation may occur in the beginning of construction of the pavement or near the end of its construction. At the same time, uneven compaction is also one of the important problems in the upper layer. In most cases, although the upper layer and the degree of compaction of each section of most the pavement can basically meet the relevant requirements, there are still some measuring points with low compaction degree, especially the position near the hard shoulder and the central divider, where there are many cases of the compaction degree nit meeting the requirements. The aforementioned problems will likely affect the construction effect and service life of the asphalt road bridge pavement surface layer.

(3) Raw material problems

Quality problems in the raw material will significantly affect asphalt pavement surfacing. Generally speaking, raw material quality problems are inconsistent raw material quality. For example, the content of dust particles in aggregates exceeds the standard or the size of the materials is too large, which can affect the overall quality of the raw material mixture. Moreover, due to the different sources of aggregates, the gradation of aggregates may be inconsistent, which will affect the construction effect of the asphalt pavement surface.

## 3. Asphalt pavement surface detection technology in road and bridge construction

A comprehensive inspection of the asphalt pavement surface layer is an important basis for improving the overall quality and safety, and prolonging the service life of road and bridge projects. Therefore, it is very important to analyze related detection technologies.

(1) Mixture analysis

Mixture analysis includes testing mainly the strength and toughness of the asphalt pavement surface layer mixture. Therefore, it is necessary to reasonably control the proportion of materials of the asphalt mixture while ensuring that the construction materials are most consistent with the construction requirements of the pavement surface layer. When mixing asphalt mixture, technicians should pay attention to the precise control of the time and temperature. If the mixing time is too long, too short, or the temperature is too high, asphalt aging or uneven mixing may occur. Therefore, it is necessary to properly control the quality of raw materials, proportioning, mixing time, and mixing temperature of the asphalt mixture. Afterwards, the rutting test should be carried out. Generally, the mixing temperature should be set at 60°C and a suitable load should be selected run over the test track repeatedly, and the deformation of the test piece should be calculated. The dynamic stability of asphalt mixture is determined based on the number of wheel travel. In addition, an appropriate amount of asphalt mixture can also be placed in water for freezing, and through the erosion of water, the asphalt mixture's anti-loosening, anti-dropping, anti-stripping and other anti-destructive capabilities can be determined, so as to understand its water stability [3].

(2) Compaction analysis

When performing asphalt pavement surface construction work, the asphalt material is not just pasted on the pavement, but it needs to be rolled several times. There are many precautions in the rolling process. The degree of compaction of the asphalt pavement surface layer is closely related to the smoothness of the pavement. A smooth road surface will ensure good anti-skid effect and load capacity, which is conducive to improving the safety of the asphalt pavement. Over-compaction will cause the asphalt mixture to become too dense, and the bleeding will easily occur in a high-temperature environment, which will lead to a decrease in the static friction coefficient of the road surface, which may cause accidents such as skidding, and affect driving safety. Therefore, the degree of compaction of the asphalt pavement surface must be controlled within a reasonable range, and it is of great significance to detect the degree of compaction of the asphalt pavement surface. In the past, the main method for testing the compactness of asphalt pavement was the Marshall compactness test, but with the development of modern technology, more convenient methods emerged. For example, in the wax seal method, the sample is first molded based on the Marshall method, then the weight of the specimen in air is measured. Next, the open pores of the specimen is filled with melted wax, and the specimen is immersed into the melted wax for repeated rolling to seal all the pores around it until the melted wax condenses. The wax-sealed test piece is pressed into the mold, the excess wax is scraped off using the edge of an abrasive tool, a scraper is used to repair the two sides of the test piece so that the volume of the test piece is the same as that of the test piece that has not been sealed with wax. After that, the weights of the wax-sealed specimen in air and in water are measured, and the compactness of the asphalt pavement is calculated [4].

(3) Resolution analysis

The segregation of the asphalt pavement surface layer is mainly caused by the uneven distribution of the mixture, and it causes safety hazards, especially in cases of hot weather, bad weather, overloading, and many more, which severely shortens the service life of the pavement, causing further aggravation of the hidden dangers. The determination of the particle size of the asphalt pavement surface layer can be done by eye, but this method is only suitable for large particles and coarse mixtures, which makes it highly subjective and limited, and cannot be quantified. Therefore, it is easy to cause disputes between parties [5]. The degree of segregation of the surface layer can also be determined by the sand-spreading method. After the sand-spreading operation, the surface texture depth of the area where segregation occurs and the area where segregation occurs can show significant differences, but this method is time-consuming and laborious, making it less popular. The coring method is a traditional form of destructive test. Core samples are drilled during isolation, and the gradation composition, asphalt content, density, and void ratio of the core samples are measured and compared to the standard values. The degree of segregation of the surface layer is then measured [6]. More advanced methods include infrared cameras, nuclear density meters, and ground-penetrating radar detection. The detection of segregation by temperature difference in the layers is conducive to early detection and intervention, so as to ensure the construction quality of the asphalt pavement surface layer. This method belongs to a type of segregation phenomenon detection technology with high application frequency and good application effect [7].

(4) Thickness testing

The thickness of the asphalt pavement surface layer is crucial because it determines the overall compressive capacity of the pavement. Under normal circumstances, road surface radar detection technology can be used. It is necessary for inspectors to first use ground-penetrating radar to emit electromagnetic pulses against the road surface layer. The pulses quickly pass through the road surface layer and the data acquisition system records the return time of the pulse and the sudden change of the discontinuous dielectric constant in the pavement structure. Because the material of each structural layer

in the pavement surface layer has a dielectric constant, if there is a sudden change in the dielectric constant, that position would be the interface between different structural layers [8]. Therefore, the pavement structural layer thickness can be calculated by detecting the actual dielectric constant and beam of different pavement materials obtained. It should be noted that the detection speed should be kept below 75 km/h, the continuous detection range should be within 20 km, the detection depth should exceed 60 cm, and the detection process should be controlled by a computer to ensure that data collection, storage, and radar waveform display can be carried out simultaneously. After processing the data, the three-dimensional pavement thickness profile, color plan and thickness table of the pavement will be displayed on a computer.

(5) Flatness testing

The flatness of the asphalt pavement surface has a direct and important impact on the safety and comfort of driving. Unevenness will cause more significant deformation and even lead to road collapses, which is a great safety hazard. Therefore, it is very important to check the flatness of the asphalt pavement surface. The current laser flatness meter and the please change to vehicular bump-integrator belong to the instruments with high frequency of application in flatness detection [9]. The laser level meter is combination of a laser sensor and a distance sensor. It can carry out long-distance rapid automatic detection of the road surface under normal vehicle speed conditions. A computer can also be paired with the device for on-site data analysis and evaluation. It has high detection speed and accuracy. Its detection speed can reach up to 80 km/h, so it can conduct comprehensive inspections on urban roads, airport runway surfaces, and expressways. At the same time, because it is completely automated, the accuracy of the detection results can be guaranteed. The please change to vehicular bump-integrator can quickly detect the smoothness of the road surface, and it is easy to operate and cheap. The sensor is installed on the road, so the driving speed and vibration characteristics of the vehicle can affect the detection results to a certain extent [10].

## 4. Conclusion

At present, the socioeconomic status of China is rapidly improving, and the road and bridge projects are rapidly developing. The quality of mixture, segregation, compaction, thickness, and flatness can be effectively guaranteed, which can significantly improve the overall quality of the asphalt pavement surface layer, as well as the later use effect and safety. Therefore, it is clear that advanced asphalt pavement testing technology greatly contribute to the development of roads and bridges of the country.

## Disclosure statement

The author declares no conflict of interest.

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