Journal of World Architecture, 2026, Volume 10, Issue 2
http://ojs.bbwpublisher.com/index.php/JWA
Online ISSN: 2208-3499
Print ISSN 2208-3480

Research on Quality Inspection System and Disease Prevention and Control of Asphalt Pavement

Jianzhi Li, Linlong Wang*, Chenxi Fu, Qichao Yuan, Guixiang Rao

China Merchants Chongqing Testing Center for Highway Engineering Co., Ltd., Chongqing 400067, China

**Author to whom correspondence should be addressed.*

Abstract: To effectively prevent issues such as cracking, deformation, and surface damage in asphalt pavements, improve pavement quality and performance, and extend pavement service life, this paper studies its quality inspection system and disease prevention and control. Based on the main quality issues of asphalt pavements, a quality inspection system is constructed from three aspects: raw materials, construction process, and operation, and reasonable prevention and control strategies are proposed. It is hoped that this study can provide a scientific reference for subsequent quality inspection and control of asphalt pavements.

Keywords: Asphalt pavement; Quality inspection system; Disease prevention and control; Quality

Online publication: May 12, 2026

1. Introduction

Asphalt pavement offers numerous advantages such as convenient construction, smooth and comfortable driving, and low maintenance costs, making it widely used in current highway engineering. In practical applications, the quality of asphalt pavement directly affects highway traffic efficiency and safety, as well as the service life of the pavement. Therefore, engineering units should clarify the main quality issues of asphalt pavement, adopt reasonable measures for quality inspection, and implement targeted prevention and control for various quality issues based on actual conditions. This will further enhance the overall quality of asphalt pavement and provide strong support for its long-term, safe, and stable operation.

2. Main quality issues of asphalt pavement

2.1. Cracking issues

Cracking is one of the common quality issues in asphalt pavement, which can be classified into transverse cracks, longitudinal cracks, and reticular cracks. Transverse cracks are generally perpendicular to the driving direction, appearing as regular or irregular straight lines with widths ranging from a few millimeters to several centimeters. Longitudinal cracks are parallel to the driving direction and usually distribute along the wheel tracks of the lanes, severely penetrating the full width of the pavement. Reticular cracks are irregularly distributed in a net-like pattern, typically appearing on the pavement surface. The causes of such damage are related to factors such as thermal expansion and contraction due to temperature changes, uneven settlement of the subgrade, reflective cracking of the base layer, improper construction joint treatment, and traffic loads. If not effectively prevented and controlled, these cracks will allow rainwater to penetrate into the pavement structure, eroding the base course aggregates, softening the subgrade, and causing secondary damage such as potholes and loosening of the pavement, further reducing the pavement's bearing capacity and even threatening traffic safety.

2.2. Deformation issues

Pavement deformation damage mainly includes rutting, waves, and corrugations. Rutting is the most common pavement deformation damage, which appears as permanent depressions in the wheel track area under prolonged heavy vehicle loads, with depths typically ranging from 5 to 50 mm and becoming more pronounced at higher ambient temperatures. Waves refer to wavy undulations on the local pavement surface, while corrugations are local pavement uplifts, commonly found on uphill sections or at intersections. Generally, the main causes of deformation damage in asphalt pavement include poor high-temperature stability of the mixture, insufficient compaction of the subgrade, inadequate strength of the base layer, excessive frequency or magnitude of loads, etc. If not promptly and effectively prevented and controlled, these deformations will adversely affect driving comfort, increase driving resistance, and even cause vehicle deviation in severe cases. They will also rapidly deteriorate the pavement's health condition, further shortening its service life [1].

2.3. Surface damage issues

Surface damage in asphalt pavement mainly includes potholes, bleeding, and loosening. Potholes refer to local depressions formed after the pavement surface material peels off, characterized by varying depths and irregular shapes, commonly found on sections with poor drainage or frequent rainwater scouring. Bleeding occurs when excess asphalt in the asphalt mixture is squeezed onto the pavement surface during high-temperature seasons, forming an oil film. Loosening refers to situations where the adhesion between the asphalt mixture and the pavement surface fails, causing the pavement to sand or peel off. These damage issues are mainly related to factors such as rainwater infiltration damage, asphalt aging, poor aggregate quality, improper asphalt content, or insufficient compaction. If not promptly and properly addressed, the overall performance of the asphalt pavement will significantly decline, adversely affecting traffic safety and tire service life, further damaging the integrity of the asphalt pavement, shortening its service life, and even causing traffic accidents in severe cases.

3. Quality inspection system for asphalt pavement

3.1. Raw material quality inspection

Raw materials have a fundamental impact on the quality of asphalt pavement. During specific inspections, engineering units should focus on key raw materials such as asphalt, aggregates, mineral powder, and additives, and conduct quality inspections in strict accordance with engineering design standards. Among them, the key inspection indicators for asphalt quality include softening point, penetration, ductility, and aging performance, etc. For modified asphalt, the dosage and storage stability of the modifier should also be inspected to prevent substandard asphalt performance from causing pavement bleeding or cracking. For aggregates, engineering units should classify them into coarse and fine aggregates during inspection and focus on inspection indicators such as abrasion value, crushing value, flakiness particle content, and asphalt adhesion to prevent substandard aggregate quality from causing potholes or loosening on the pavement [2]. For mineral powder, its hydrophilic coefficient and fineness should be the focus during inspection to ensure that all indicators meet engineering design standards. For additives, engineering units should focus on inspecting their performance and dosage and ensure the rationality of the asphalt mixture mix ratio to improve the accuracy of raw material quality inspection.

3.2. Quality inspection during construction process

Quality inspection and control throughout the construction process are crucial in asphalt pavement quality inspection. During specific inspections, engineering units should inspect core construction indicators such as paving and compaction of the asphalt mixture to effectively prevent and control key quality issues such as deformation, cracking, and surface damage of the asphalt pavement. Generally, the main quality inspection indicators during the construction process should comprehensively cover all damage types such as cracking, deformation, or surface damage of the asphalt pavement, and the mix ratio of the asphalt mixture and the construction quality of mixing should also be included in the inspection system. Typically, compaction should be inspected using a nuclear density gauge or core sampling method, with a detection frequency of two points per 200m for single lanes to ensure that the compaction meets engineering design standards and prevent rutting or loosening caused by substandard compaction. For flatness, it should generally be inspected using a 3m straightedge or laser flatness meter to ensure that it meets design requirements, which will make driving more comfortable and effectively reduce the probability of cracking caused by uneven loads. The basic inspection methods and requirements are shown in **Table 1**.

Table 1. Basic inspection methods and requirements for pavement during construction process

No.	Test indicator	Test method	Test frequency	Acceptance standard
1	Compaction Degree	Nuclear densitometer, Core drilling method	Two points per 200m per single lane	≥ 98%
2	Laying Thickness	Ultrasonic thickness gauge	One cross-section every 20m, 3 points per cross-section	Deviation ± 5mm
3	Smoothness	3m straightedge, Laser profilometer	Continuous testing	Standard deviation ≤ 1.0mm
4	Laying Temperature	Thermometer	3 tests per shift	≥ 130°C

3.3. Quality inspection during the operation period

During the operational period of roads, the primary objective of inspecting asphalt pavement distress is to promptly identify various types of distress and scientifically evaluate their performance, thereby providing a solid basis for subsequent operation, maintenance, and conservation decisions. Typically, inspection contents should include pavement distress conditions, evenness, skid resistance, and structural strength, among others. Distress detection should primarily be conducted through a combination of automated detection equipment and manual inspections. For pavement distress conditions, it is necessary to investigate each type of distress, such as cracks, potholes, and rutting, along with their locations and severity levels. Laser evenness meters should be used to comprehensively inspect pavement evenness, enabling the timely identification of substandard areas. The skid resistance of asphalt pavements should be tested using friction coefficient measurement vehicles or pendulum testers to determine whether their skid resistance meets standards [3]. For structural strength, deflection meters should be used for inspection, and the pavement's load-bearing capacity should be scientifically evaluated based on the inspection results to promptly identify areas with insufficient strength and prevent the further expansion of distress such as cracks or deformations caused by inadequate strength. During the operational phase, engineering units must strictly adhere to pre-established operation, maintenance, and conservation standards and regularly inspect asphalt pavement distress. This ensures that various types of distress are identified and addressed early, effectively delaying pavement aging.

4. Main prevention and control strategies for asphalt pavement distress

4.1. Raw material optimization

As the foundational condition for asphalt pavement quality control, raw material optimization is the primary strategy for preventing pavement distress. During optimization, engineering units should scientifically determine the amount of asphalt, aggregate gradation, and additive dosage based on the climatic conditions and traffic volume in the area where the road is located. This helps to reasonably optimize the raw material mix ratio, thereby achieving good control over the high-temperature stability, low-temperature crack resistance, and water stability of the mixture. For asphalt materials, modified asphalt should be preferred during optimization to further enhance the crack resistance and aging resistance of the asphalt, significantly reducing the incidence of distress such as pavement cracks and bleeding. At the same time, aggregates should be strictly screened to ensure that the crushing value and flakiness content of coarse aggregates meet engineering design standards, and fine aggregate angularity and sand equivalents should be strictly controlled according to design values to maintain good adhesion between the aggregates and asphalt, preventing distress such as pavement potholes or raveling [4]. For all incoming raw materials, engineering units should strictly conduct batch sampling inspections as required and prohibit the transportation and use of substandard raw materials on-site, thereby effectively controlling the quality of asphalt pavements from the source.

4.2. Improvement of construction techniques

To avoid adverse effects on asphalt pavement quality caused by construction technique issues, engineering units need to standardize asphalt paving techniques during the specific distress prevention and control process [5]. The full-width multi-machine paving method should be used to reasonably reduce cold joints, and paving speed and temperature should be strictly controlled. At the same time, real-time monitoring and handling of segregation phenomena in asphalt mixtures should be carried out to prevent pavement distress caused by asphalt aging or insufficient compactness. The asphalt pavement compaction process should be divided into three stages: initial compaction, intermediate compaction, and final compaction, with strict control over the number of compaction passes, speed, and temperature at each stage. Typically, initial compaction should be achieved through static compaction with a steel-wheel roller; intermediate compaction should be carried out using a rubber-tired roller or vibratory roller; and the main objective of final compaction is to eliminate wheel marks, with a steel-wheel roller generally meeting actual construction requirements [6]. During compaction, hot joints should be set as much as possible, and the joint positions should be thoroughly cleaned and compacted to effectively control crack distress in these areas. **Table 2** presents the basic process optimization indicators for different compaction stages.

Table 2. Basic process optimization indicators for different compaction stages

No.	Parameter	Initial compaction	Secondary compaction	Final compaction
1	Number of Rolling Passes	1–2	3–4	2
2	Rolling Speed (km/h)	2–3	3–4	2–3
3	Rolling Temperature (°C)	≥ 110	≥ 100	≥ 70

4.3. Subgrade and base course reinforcement

Since the subgrade and base course also have a direct impact on the quality of asphalt pavements, engineering units should also carry out reasonable reinforcement treatments on the subgrade and base course during specific distress prevention and control processes. For the subgrade, fillers should be strictly screened during construction to ensure sufficient water stability and high bearing capacity, and the degree of compaction should be strictly controlled to guarantee the uniformity and stability of the subgrade, minimizing the occurrence probability of distress such as cracks or subsidence caused by uneven settlement [7]. For soft soil subgrades, reinforcement treatments such as grouting or replacement should be carried out during construction to ensure that the bearing capacity meets design requirements and prevent pavement deformation due to insufficient subgrade strength. During base course construction, engineering units should reasonably determine its thickness and mix ratio in strict accordance with design requirements and strengthen treatments such as compaction and curing to improve the strength of the base course, ensuring its integrity and stability and preventing reflective crack distress. Simultaneously, the pavement drainage system should be scientifically improved, with drainage ditches or side ditches reasonably set up based on the actual site conditions to promptly drain accumulated water on the pavement and prevent water from infiltrating into the internal structure of the asphalt pavement, which could cause distress such as raveling or potholes [8].

4.4. Maintenance and control during the operation period

During the operation of asphalt pavements, engineering units should establish a normalized distress inspection mechanism, with dedicated personnel responsible for regularly inspecting pavement distress. Pavement distress should be detected through a combination of automated equipment and manual inspections to promptly identify and comprehensively grasp the occurrence and development of various types of pavement distress. On this basis, a comprehensive digital archive of asphalt pavement distress should be established, with different types and severities of pavement distress recorded and classified in the archive for classified management. At the same time, engineering units should also carry out preventive maintenance work on asphalt pavements, promptly repairing minor cracks through methods such as crack sealing tapes or crack filling; implementing slurry sealing or micro-surfacing treatments on areas with surface aging or reduced skid resistance to effectively delay the development of distress [9]. For areas with severe distress, engineering units should promptly carry out repairs through methods such as partial excavation and replacement or milling and repaving to prevent further expansion of pavement distress. Moreover, during operation and maintenance, traffic management should be strengthened, with strict restrictions on overloading of heavy-duty vehicles to effectively reduce the incidence of pavement damage distress caused by vehicle loads, thereby further extending the service life of the pavement [10].

5. Conclusion

In summary, during the quality control process of asphalt pavements, the reasonable establishment of a quality inspection system can strictly control the overall pavement quality, enabling timely and accurate identification of various types of pavement distress and effective prevention of many types of distress. During specific distress prevention and control processes, through the reasonable application of measures such as raw material optimization, construction technique improvement, subgrade and base course reinforcement, and maintenance and control during the operation period, asphalt pavement distress can be effectively addressed and prevented from further developing, thereby effectively controlling the overall quality of asphalt pavements. This not only enables further improvement in the quality of asphalt pavement engineering but also reasonably extends its service life and achieves effective reduction in operation and maintenance costs.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xiao C, Wei G, 2026, Experimental Testing and Control Measures for Improving the Construction Quality of Asphalt Pavements. Popular Standardization, 2026(4): 187–189.

[2] Xie G, Xu X, Bao C, 2025, Comprehensive Evaluation of Asphalt Pavement Construction Quality based on Non-Destructive Testing Technology. Transport Energy Conservation & Environmental Protection, 21(1): 211–215.

[3] Xiang T, 2025, Experimental Testing and Quality Control in the Construction of Asphalt Concrete Pavements. Transport Manager World, 2025(3): 46–48.

[4] Xu W, 2025, Analysis of Control and Testing Technologies for the Construction Quality of Highway Asphalt Pavements. Architecture & Decoration, 2025(14): 130–132.

[5] Wang B, 2024, Experimental Testing Technologies and Quality Improvement Measures for Highway Asphalt Concrete Pavements. Engineering Technology Research, 6(2): 23–25.

[6] Feng S, 2024, Experimental Testing Technologies and Quality Control for Asphalt Concrete Pavements. Xinjiang Nonferrous Metals, 47(4): 73–74.

[7] Kang Y, 2024, Research on Experimental Testing and Quality Control in the Construction of Asphalt Concrete Pavements. Intelligent Building & Construction Machinery, 6(11): 76–78.

[8] He X, 2025, Analysis of Experimental Testing Technologies and Quality Improvement Measures for Highway Asphalt Concrete Pavements. Model World, 2025(29): 231–233.

[9] Wang B, Zhang Q, An X, 2026, Application of Rapid Testing Technologies for the Quality of Asphalt Mixtures in Municipal Road Construction. Zhongzhou Construction, 2026(1): 35–36.

[10] Xing R, 2025, Research on Construction and Evenness Testing Technologies for Highway Tunnel Asphalt Pavements. Science and Technology Innovation and Productivity, 46(7): 137–139.