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Analysis on On-Site Asphalt Pavement Quality Inspection Technology in Highway Engineering

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Abstract: The acceleration of urbanization has promoted the increase in the number of urban highway projects, resulting in an increase of emphasis on the quality of urban highway projects. The quality and safety of highway construction directly affects the driving comfort, safety, and service life after it is put into operation. Among them, asphalt pavement is an important structure in highway construction, and it is also a key link that directly affects the construction quality. In order to ensure the quality of construction, it is necessary to strengthen on-site testing during the construction process to discover problems in time, and to ensure that the construction is up to standard. This paper mainly presents an analysis on the necessity and application of on-site quality inspection technology for asphalt pavement construction of highway engineering, and outlines measures to improve highway engineering construction testing technology.

Keywords: Highway engineering; Asphalt pavement; Construction site; Testing technology

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1. Introduction

Asphalt pavement is an important part of highway engineering construction. Asphalt pavement has good performance, and it is cheap and easy to maintain. However, if the ratio of material is unideal and the strength is not up to standard during the construction of asphalt pavement, the asphalt pavement might crack. Therefore, in the construction of highway asphalt pavement, it is necessary to inspect the construction site carefully to ensure that all parameters involved in the construction are up to standard. In this way, the probability of hidden problems such as cracking and bulging on the road surface can be reduced, and the safety and service life of the road surface can be improved.

2. The importance of on-site asphalt pavement quality inspection in highway engineering

Through the process of modernization, the economy has been significantly improved, and the number of car ownership has increased. At present, most households in both urban and rural areas own private vehicles, so higher requirements are placed on transportation. In addition, the development of e-commerce and the logistics industry has also increased the pressure on traffic. To ensure a safe travelling experience, it is necessary to pay more attention to the construction quality, adopt scientific quality assurance measures, improve the level of road construction, and prolong the service life of roads [1]. Asphalt pavement is widely used in highway engineering, which directly affects the development and quality of the project. At the same time, the construction of asphalt pavement is complex and difficult, and is easily affected by the external environment. Therefore, in the construction of asphalt pavement, it is important to test the road construction conditions and various parameters, look out for problems, and come up with effective solutions. At the

same time, road testing technology can improve construction safety and reduce traffic accidents.

3. Main tests and technologies in asphalt pavement quality inspection in highway engineering

3.1. Construction material tests

There are many materials used in the construction of asphalt pavement, including concrete, aggregate, and various additives. The quality of raw materials will be tested to determine whether they are up to standard. In particular, the test before the start of aggregation plays an important role in ensuring road safety. Aggregate testing is one of the most important tests. A standard mold should be used in aggregate sampling to ensure the consistency of sampling. The properties of aggregate samples should be similar to general aggregates to ensure the performance of aggregates. After the testing of the mechanical properties of the aggregate is completed, the thermodynamic properties, density and particle size content of the aggregate are determined. The particle size and diameter, and the concentration of particles of the aggregate can be determined can be measured by a vernier caliper. The thermodynamic performance is performed using the stamping method to measure the hardness. At the same time, the polished stone value of the surface of the test mold is measured by a light meter. All tests performed require the use of instruments and equipment, thus the equipment should be regularly calibrated and inspected to ensure the operability of the equipment and the accuracy of the test results. Before the construction of asphalt pavement, a suitable ratio of construction materials should be determined depending on the project, which will be the standard for testing results. In the material ratio test, a simulation test can be performed to determine the ratio of ingredients in the mixture, and adjustments can be made in combination according to test results to achieve the ideal raw material ratio [2]. The quality standards of the material test should be strictly followed, and the test content should be adjusted according to the nature of the project. The changes and the tensile and softening of the material should be observed, so as to lay the foundation for the subsequent construction work.

3.2. Asphalt mixture gradation test

The gradation of asphalt mixture directly affects the standardization of mixture construction and the quality of ingredients, which will in turn affect the quality of road construction. Therefore, it is necessary to conduct a gradation test on the asphalt mixture before construction. The test is strictly carried out according to the gradation standard of the ingredients to prevent quality issues due to poor gradation. Before the test is carried out, the situation of the road project construction is simulated and analyzed to ensure the scientificity of the mixing ratio of the materials and lay the foundation for the improvement of the road quality. In addition, the amount of asphalt filling should be calculated. Tests are generally carried out indoors, but it should be noted that there are certain differences between indoor testing and outdoor testing, so it is necessary to prepare a few asphalt mixtures and measure the parameters of different functions of asphalt mixtures in the testing process, to ensure a full understanding of the performance of asphalt mixture, and to lay the foundation for the asphalt pavement construction [3].

3.3. Asphalt pavement compaction test

After the construction of the asphalt pavement is completed, the road surface needs to be rolled to ensure the flatness of the road surface. The temperature of asphalt rolling should be reasonably controlled, and the rolling needs to be done more than 3 times at once. The degree of compaction of asphalt pavement directly affects the quality of road construction, effectively reduces hidden dangers of road construction, avoids cracks and settlements on the road surface, and ensures the service life and later maintenance of the project. Generally speaking, the technology used in highway pavement testing is core drilling, and the temperature of asphalt is detected at the same time. During the temperature inspection, the temperature can be measured by inserting a thermometer. The thermometer is inserted into the road pavement asphalt mixture to half the

depth. After compacting the surrounding area, the temperature of the mixture is recorded. Secondly, an infrared camera is used to measure the surface temperature of the entire construction area to provide reference for later works. In the temperature test, infrared camera at is placed at a point and a video is recorded. The results are documented with photographs of the temperature field. Meanwhile, the pavement should not be rolled for more than 3 times [4]. The construction work can then be carried out, and the inspection and result data comparison are carried out on samples obtained through core drilling. In some special road sections where core drilling cannot be performed, a nuclear densometer can be used. The application of the nuclear density detector is more convenient, simpler, and accurate.

3.4. Road deflection test

The pavement deflection test measures the bearing capacity of the pavement. The highway deflection value is mainly calculated through the numerical displacement of the road surface. The deflection is measured in millimeters, and the measured value directly affects the evaluation of the road surface. The main instrument and equipment used in the road surface deflection test is the automatic deflectometer, which is a relatively advanced equipment that is highly accurate. An automatic deflectometer works based on the principle of leverage to measure the condition of the road section. In this method, it is necessary to convert the measurement of the front and rear axles into the measurement of the chassis. The deflection is detected and recorded when the rear axle of the vehicle passes the probe. It is also possible to use the Falling Weight Deflectometer to measure road deflection. The advantage of this measurement technology is that it can dynamically measure the road surface and will not cause damage, and the results obtained are highly accurate. The operating principle is to use a hydraulic device to lift up the hammer, and then release it quickly, and when the heavy hammer falls on the bearing plate, the road surface will be slightly deformed. The signals of the deformation will then be sent to a computer to calculate the deflection value of the road surface. Lastly, the Benkelman Beam is the most widely used deflection testing device in highway construction that can accurately evaluate the bearing capacity of the pavement to guide pavement design. This method can also be applied to the measurement of rebound deflection of the subgrade, which is an important reference index for highway construction and maintenance. For this method, the ambient temperature should be kept at about 20 ℃. The temperature should be adjusted if it exceeds or is less than 20 ℃.

3.5. Asphalt flatness inspection

In order to ensure the quality of pavement construction, it is necessary to conduct a comprehensive inspection of the flatness of the pavement. There are a few common techniques used in the determination of flatness of a pavement. Firstly, the flatness can be detected by a ruler, and the measurement is taken at the seam position. The position where the measurement is taken should be strategically determined. Under normal circumstances, the wheel marks on the side of the roadway can be used as the test point. If ruts have formed on the road, the middle position of the ruts can be used for measurements, and the debris and gravel on the road surface should be cleaned before the test. Test points of the straightedge should be set along the longitudinal direction of the road structure, and maximum distance of the gap between the bottom position of the straightedge and the is determined by eye [5]. A feeler gauge is placed in between the gap to measure its length. The second method is by using a profilometer. The profilometer is placed at the starting position of the road surface, and the wheel of profilometer is placed along the wheel track. The profilometer is then towed using a tractor, which is operated in strict accordance with the specifications. The tractor is then driven longitudinally along the road to maintain lateral stability. The status of the profilometer is then checked, and the tractor should be driven at a uniform speed. The optimal speed is 5 km/h, and the maximum speed cannot exceed 20 km/h [6]. The last method for measuring the flatness of the pavement is

a bump integrator. Before the test starts, the test speed should be set, and the device should be preheated. The test vehicle needs to stop at a position 300 to 500 meters before the starting point to ensure the warm-up distance. The parameters of the flatness test can then be set on the device. Before entering the test road section, vehicle should be driven at a constant speed, and the system record is turned after entering the test section. During the test, it is necessary to record the starting and ending positions of the tested road, as well as any special positions that need to be recorded in the system. After the test is completed, the vehicle leaves the test site to stop data recording. The data obtained should be checked immediately to ensure the scientificity of the results. If the data obtained is incomplete, a second test will be required.

3.6. Asphalt pavement water seepage detection

The main materials used in highway asphalt pavement construction are asphalt mixture, sand, and gravel, and gaps are prone to appear between these materials. In heavy rain, the asphalt pavement will be soaked for a long time [7]; or if snow and water puddles cannot be cleaned up in time, the quality of asphalt pavement might be affected. Therefore, it is necessary to pay more attention to the water seepage detection of asphalt pavement construction. The permeability coefficient of asphalt pavement must be kept below 300 mL. If the test result largely deviates from the standard value, it means that the water permeability of the road surface is not ideal and corresponding improvement measures are needed.

4. Application of on-site testing technology for asphalt pavement construction in highway engineering

4.1. Building a scientific quality inspection system

A complete testing system needs to be used as a reference in the application of on-site testing technology for highway asphalt pavement construction. From material procurement, proportioning, to pavement strength and compaction testing after completion, relevant operations must be carried out in strict accordance with the testing system [8]. Quality inspection should be carried out in strict accordance with the requirements of the design drawings; the construction standards should be determined before the inspection; the material selection standards and road paving thickness requirements should be determined; and the construction progress should be controlled to carry out inspection works. Many mechanical equipment are needed in the construction of a highway. A proper quality inspection system acts as a guide for the scientific application of equipment, ensures the accuracy of the inspection, and helps in maintaining the equipment. The quality of asphalt pavement is directly related to its construction procedures and preparations. In order to promote the development of highway construction quality inspection system, the designation of tasks of construction personnel should be clearly defined. Before the construction begins, the construction personnel should be trained to perform the operations required [9]. Quality inspection should then be carried out according to the construction progress, and relevant improvements should be made to areas that are lacking in quality. After the construction is completed, the technical issues and contents of the construction should be discussed to ensure the scientific application of construction technology and the effective implementation of the construction quality inspection system in future projects.

4.2. Improving the technical skills of the inspection team

The quality inspection of asphalt pavement is particularly important for quality control and also the overall highway construction and maintenance. At present, the number of kilometers of highways in our country continues to increase, and the scale of construction is also expanding. Construction personnel and inspectors are the key to ensure construction quality. Construction personnel needs to perform material inspection and proportioning before construction, temperature measurement during construction, and many more. If the inspectors or technicians are not capable in performing their tasks or lack understanding of the equipment, the quality of the final product will be affected [10]. Therefore, it is necessary to strengthen the training of

inspectors and ensure that all personnel have a rigorous working attitude, a strong theoretical and practical foundation, so as to ensure the scientificity of the road test and the accuracy of the data.

5. Conclusion

In short, the application of on-site test and detection technology for asphalt pavement construction in highway engineering can effectively improve construction quality and ensure construction safety. In the construction of asphalt pavement, it is necessary to ensure the scientificity of construction materials through material test and proportion test to ensure the quality of the mixture during the construction. At the same time, the key components of the construction must be well inspected to ensure the smoothness and compactness of the road, so as to meet the driving requirements of road vehicles and prevent accidents. It is necessary to continuously introduce new technology into asphalt pavement testing to optimize the convenience, efficiency, and economy of the testing method, and rectify road construction problems in time.

Disclosure statement

The authors declare no conflict of interest.

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