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THE IMPORTANCE OF MODERN TECHNOLOGIES IN EXTENDING THE SERVICE LIFE OF ASPHALT CONCRETE PAVEMENTS

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Abstract
This article discusses asphalt concrete pavement as the primary construction element widely used in road building. It is worth noting that almost all roads in Uzbekistan are made of asphalt concrete. This fact indicates a high demand for asphalt concrete pavement in our country. Consequently, the quality and long-term durability of asphalt concrete pavement are crucial. It should be emphasized that during extended use, the quality of asphalt concrete pavement can deteriorate due to climatic conditions, heavy vehicle loads, and improper application. This article presents the problems that arise in asphalt concrete pavement and analyzes them. It also outlines technologies for addressing existing issues with asphalt concrete pavements by implementing temporary restrictions on truck traffic during hot summer temperatures.

Keywords: Asphalt concrete, reconstruction, bitumen, temperature-induced cracks, load, drainage system, trucks, upper load limit, deformation, pavement, service life.

Introduction

In road construction, asphalt concrete pavement is the only product that surpasses cement concrete pavement in terms of application. This is due to the fact that asphalt concrete pavement has several advantages. For example, asphalt concrete pavement is quickly put into service and is used more widely than cement concrete pavement due to ease of repair, noise absorption, and cost-effectiveness. Moreover, asphalt concrete pavement has been one of the important materials in road construction for many years and is still used in road construction to this day. However, asphalt concrete pavement also has its own disadvantages and problems. During the service life of asphalt concrete pavement, the first stage of wear leads to varying degrees of hardening depending on various factors when the pavement surface is exposed to lower temperatures but environmental factors for longer periods. This stage is called long-term aging. Several factors influence the short-term aging of asphalt concrete, including external factors related to the production process of the asphalt concrete mixture, such as the type of plant, mixing conditions, and heat retention time after production. On the other hand, long-term aging is always influenced by field conditions, including temperature, ultraviolet radiation, and other environmental factors combined with time [1].

Several other external factors can affect the asphalt concrete pavement. These include problems arising from weather conditions, i.e., rain and snowmelt, and the occurrence of longitudinal depressions on roads due to the movement of heavy trucks with excessive loads, which reduces the lifespan of roads. In addition, thermal cracks, rain and snow cracks, and load cracks on roads are directly related to the causes and problems we listed above. That is, cracks caused by temperature are the result of internal pressure caused by the expansion and compression of road materials due to changes in air temperature. Rain-snow cracks are a natural factor that damages the road structure when rain or melted snow water enters the road surface or existing cracks and expands upon freezing. Load cracks are cracks formed by fatigue and deformation of road structures as a result of systematic and heavy loads on the road surface. All these problems are among the global issues arising on asphalt concrete pavements in the construction of highways. Today, it is precisely due to these problems that the pavements require maintenance before reaching their intended service life.

MATERIAL AND METHODS

Many measures are being considered for the preservation of highways, that is, to extend the reconstruction period. To maximize the satisfaction of the needs of road transport, it is necessary to gradually improve the transport and operational characteristics of roads. Experience in economically developed countries also shows that the funds allocated for improving the transport and operational quality of roads are insufficient. In modern practice, limited funds allocated to improve the transport and operational quality of highways are used to repair road sections in an unsatisfactory condition, instead of preventing their occurrence [2].

To overcome these problems, many modern technologies are being considered by scientists.

Of these;

This technology "Evaluation of Pavement Service Life Extension Due to Asphalt Surface Treatment (AST) " in this study, conducted by scientists of the Louisiana Transport Research Center, assessed the effectiveness of asphalt surface treatment (AST) methods used to extend the service life of asphalt pavements. The researchers compared the service life of road sections with AST layers and without AST layers. They developed statistical forecasting models for the types of road damage (for example, cracks, fatigue, depressions) [3].

Results: road sections with the application of AST layers significantly extended their service life. The results of the study also showed the economic efficiency of AST methods.Recommendation: The study recommends the use of AST layers, as they are effective in extending the service life of the road and reducing repair costs. The researchers compared the service life of road sections with AST layers and without AST layers. They developed statistical forecasting models for the types of road damage (for example, cracks, fatigue, depressions). Results: road sections with the application of AST layers significantly extended their service life. The results of the study also showed the economic effectiveness of AST methods. Recommendation: The study recommends the use of AST layers, as they are effective in extending the service life of the road and reducing repair costs. International experience shows that Weigh-In-Motion (WIM) technology, designed to measure the weight of moving

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vehicles in real time, plays an important role in preserving road surfaces and extending their service life [4].Including, among these proposals, if we consider new proposals and solutions, that is, if we use WIM technology on road surfaces - this could be an innovation for the roads of Uzbekistan. (WIM) technology is "Weight in motion," which means "weight in motion." This technology is a system that limits the movement of heavy trucks on the roads. In some sections of roads, weight sensing sensors are installed, and a radar camera is installed 20-25 meters from the sensors. Warning road signs will also be installed in these areas. These experiments have been confirmed in many countries and are being applied in practice. This (WIM) technology is one of the solutions to prevent the formation of longitudinal depressions in the asphalt concrete pavement caused by the movement of heavy trucks under the influence of a hot climate.It is known that asphalt concrete pavement softens to a certain extent as a result of hot climates, which leads to a decrease in the bearing capacity of the pavement. This technology helps to eliminate this problem and extend the duration of exploitation [5].

In the Netherlands, WIM systems are widely used for traffic control and cargo monitoring. They developed the WIM+VID system, which determines the weight, speed, and other parameters of vehicles through sensors and cameras installed on the road. This data is used to manage road infrastructure and identify overloaded vehicles.

In the USA, WIM technology is used to manage road infrastructure, carry out cargo control, and extend the service life of the road. Overloaded vehicles will be identified through WIM systems, and their negative impact on the road will be reduced. This prevents the rapid deterioration of the road.

Studies conducted **in Italy** show that the service life of the road can be extended by detecting overloaded vehicles through WIM systems and limiting their access to the road. This will reduce the costs of maintaining and repairing road infrastructure.

In Poland, WIM systems are effective in managing road infrastructure and identifying overloaded vehicles. Thanks to these systems, it is possible to extend the service life of the road and reduce repair costs.

In Norway, WIM technology is also used in the management of road infrastructure and cargo control. Thanks to these systems, it is possible to extend the service life of the road and reduce repair costs.

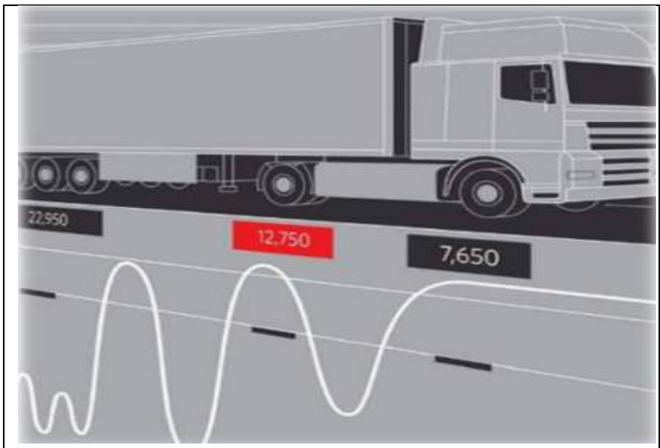

Figure 1. shows samples of test results in countries using WIM technology.

RESULTS AND THEIR DISCUSSION

Table 1 **WIM test results**

№	Indicators	Results
1	Indicator	High-speed WIM (HSWIM)
2	Sensor technology	Quartz piezoelectric and flexible radiation sensors
3	Measurement Accuracy (GVW)	+-5-7% (ASTM E1318-09) according to the standard
4	Measurement accuracy (Axial load)	+-10-15% (ASTM E1318-09 (according to the standard)
5	Climate impact	In the winter season, up to 10% of the weight on flexible radiation sensors can be underestimated.
6	Speed effect	At a speed of 30 km/h, measurement errors can increase to 25-35%
7	Calibration method	By comparison with static scales
8	Povemest Status	Smooth and even road surface is required (according to ASTM E1318-09)
9	Installation conditions	Concrete pavement depth > 250 mm, road surface evenness IRI <2.0
10	Areas of application	Cargo control, road infrastructure management, traffic flow analysis
11	Data collection	Weight, speed, axial load, etc. of moving vehicles
12	Statistical analysis capabilities	Real-time data collection and analysis

Table 1. The following table summarizes the main indicators of WIM technology. The accuracy level, operating conditions, and other factors directly affect the efficiency of WIM systems. For example, the smoothness of the road surface and the speed of vehicles significantly affect the accuracy of measurements.

Large-scale research is being conducted in our country to eliminate these problems. In particular, in studies conducted by doctoral students of the Tashkent Institute of Highway Construction, topical problems of transport loads, construction technologies, climatic conditions, and material quality were considered. In this study, intersectional deformations observed on asphalt concrete road surfaces in the city of Tashkent were studied. The authors identified the following main factors: Transport loads: The movement of vehicles with excess load causes the occurrence of intersectional deformations on road surfaces. Material quality: The use of low-quality raw materials and asphalt mixtures reduces road durability. Climatic conditions: Tashkent's sharply continental climate, especially high summer temperatures, leads to faster formation of cracks and deformations in asphalt concrete pavements. Construction technology: Incorrect placement of pavement layers and errors during the construction process negatively affect the strength of the road.

Suggested solutions: The authors recommended the following measures: High-quality materials: Improving the quality of asphalt mixtures and using materials in accordance with standards. Improvement of construction technologies: Implementation of modern construction methods and proper placement of layers. Monitoring systems: Creation of monitoring systems for continuous monitoring of the condition of road surfaces.
Adaptation to climatic conditions: The selection of road construction materials and technologies, taking into account local climatic conditions, was included as the main proposals [6].

CONCLUSION

To increase the service life of asphalt concrete pavement, it is necessary to apply solutions based on the above analysis. According to the presented proposals, we can extend the pavement's service life by promptly addressing defects in asphalt concrete pavements, strengthening weight control measures on roads, and temporarily restricting the movement of heavy trucks on asphalt concrete pavements during hot weather conditions.

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