



## TRANSPORT AND OPERATIONAL FACTORS OF DEFORMATION OF ROAD STRUCTURES

Tashpulatova Gulzoda Kadyrovna

Assistants of the Termez Institute of Engineering and Technology, Uzbekistan.

Amanov Zakir Charyevich

Assistants of the Termez Institute of Engineering and Technology, Uzbekistan

### Annotation

This article discusses the issues of studying main elements of highways; impact study car on the road; strength and strain measurements road clothes; evenness pavement; calculation of key quality indicators section of the road.

**Keywords:** Road structure, road surface irregularities, forecast of further development of deformations, transport and operational parameters of the road, traffic load

### Introduction

Currently, there is an increase in the number of vehicles along with an increase in their carrying capacity, which leads to an increased transport impact on the road surface with the premature appearance of deformations and destruction. A further increase in the load from vehicles on the road structure requires scientific research on the operational impact on the pavement. This is due to the fact that the fundamental regulatory documents were developed more than 20 years ago and did not take into account the rapid development of the transport industry. The main element of the road structure, on which the motor vehicle moves, is the road surface. The road structure consists of several structural layers, including subgrade soil and pavement - a multi-layer structure within the carriageway of a highway that receives the load from a vehicle and transfers it to the ground. The energy of the vehicle is spent on moving along the road, maneuvering in the traffic flow and on overcoming the rolling friction forces resulting from the reaction of the road surface from the impact of the traffic load through the wheels, causing the appearance of elastic deformation and, subsequently, the appearance of irreversible deformations of the pavement. The quantitative and qualitative dynamics of changes in traffic loads requires constant improvement of the design of pavements and methods for its calculation, at the same time, researchers noted the difference in the process of formation of irreversible deformations on roads with the same design with different parameters of the impact of the traffic flow. Foreign and domestic authors have shown that at a certain value, the irreversible deformation of the road surface begins to affect the safety of the vehicle, which necessitates a more detailed study of the causes of the formation of defects that appear on the road surface in conditions of heavy traffic. Road pavement perceives various types of static and dynamic impact from the wheel load of a vehicle. The horizontal stresses arising during braking and acceleration in the upper layer of the road surface lead to the appearance of waves involved in the process of formation of irreversible deformations that correlate with the magnitude of the traffic impact.

Improving the methods of calculation, control of the construction technology of road structures contributes to the improvement of performance, reliability and safety of road

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traffic. The integrity and evenness of the road surface is one of the main factors of traffic safety. However, during operation, various deformations and damage to the coating inevitably appear, such as rutting, cracks, potholes, etc., thereby preventing the safe movement of vehicles. This article will provide a brief overview of the main types of deformations, their causes and control over their occurrence.

The most common type of clearly visible deformation on the pavement is rutting. Track - a type of deformation of the transverse profile of the roadway with the formation of recesses along the rolling strips with or without ridges of uplift.

There are three types of rutting:

1. Plastic or deep;
2. Abrasive or overrun;
3. Over the entire width of the pavement or surface.

Deep rutting occurs due to the accumulation of minor deformations, mainly in the top layer of the pavement. The reason for the formation of surface ruts is the abrasive effect of car tires, and primarily studded tires.

The surface rut occurs due to the insufficient strength of the pavement, including the bearing layer. The main reason for the formation of ruts is the wear of the top layer of the pavement as a result of the combined effect of wear and premature unnormalized destruction of the asphalt concrete layer under the influence of external factors, which include, along with the impact of wheels, precipitation, temperature changes and exposure to the sun. This rut of destruction and wear is formed in the upper layers of the pavement, in addition to longitudinal deformations on the roadway, transverse deformations can also occur, as a result of which the surface of the roadway becomes wavy.

Basically, if we are talking about small frequent deformations (in increments of 0.2-2 m), this effect appears on coatings containing a large amount of organic binder (bitumen). This type of deformation occurs due to excessive plasticity of the coating, insufficient heat resistance of the mixture at high temperatures, or insufficient crushed stone content. If the foundation soils are not sufficiently compacted or have the effect of frost heaving, local subsidence and precipitation occur.

In addition to violations of the geometric parameters and shape of the road surface, discontinuities also occur. These types include: transverse and longitudinal cracks, chipping, potholes and holes, breaches. In most cases, the initial stage of the occurrence of potholes and pitting coincides with a period of adverse weather conditions, especially with the spring period of frequent transition from positive to negative air temperature, excessive moisture of the subgrade soil and layers of pavement. Water, getting into cracks, enhances the corrosive physical and chemical processes in pavement materials, and when it freezes, it has a tensile effect on the walls of cracks and individual particles of materials. In combination with the dynamic impact from traffic loads, the coating material in the crack formation zone begins to collapse and break out, and the crack quickly develops into a pothole. Therefore, an unfilled crack is always a potential source of potholes.

Another source of potholes is the unevenness of the road surface, ranging from unevenness made during the construction of layers of pavement, when the requirements for evenness and uniformity in the process of leveling and compacting materials are not



met, including unevenness in the form of cracks, shifts and sagging that occur during operation. asphalt concrete pavements from mixtures with increased plasticity. Immediately after the car wheel passes through the protrusion of an irregularity in the form of a crack or pothole, a dynamic impact occurs on the pavement at some distance behind the pothole. Repeated repetition of such an impact leads to loosening of the structure of the material, the appearance and development of even larger cracks or potholes, which then merge into one large pothole. Another source of pothole formation is pavement areas where peeling and chipping of stone material occurs.

The appearance of irregularities adversely affects the efficiency of road transport, contributes to a decrease in traffic safety, and reduces the durability of the road. Irregularities lead to an oscillatory state of the car when it is moving. When the body vibrates with a frequency of 0.7 Hz, passengers experience discomfort, which at 5-20 Hz reach a pronounced degree (loss of visual acuity, changes in breathing and heart activity - motion sickness, which, by analogy with seasickness, can be called car sickness).

Poor maintenance of roads and their untimely repair exacerbate the degradation of the pavement surface. The unevenness of the road surface is not constant over time. During the operation of roads, they change their character, shape, place and size. Most often, this process develops for the worse and stopping it is the primary task of road organizations. In the practice of road operation, irregularities are divided into periodic and random. Most of the road surface irregularities are random. Their analysis is a rather complex task and can be successfully carried out on the basis of the theory of mathematical statistics. On various sections of the highway there are irregularities of the most varied shapes and sizes, and it is impossible to establish any definite regularity in their alternation. A vehicle moving along a road at any time may find itself on a ledge or depression of various shapes of the road surface - this is a random phenomenon. This means that the impact of the road profile on the vehicle is a random process and the road profile can be mathematically described by a random function. The magnitude of the roughness of the road surface profile varies depending on the location. Consequently, the profile of irregularities in the period under consideration can be mathematically described by a stationary random function in the form of harmonic oscillations with random amplitudes and random phases. When a vehicle moves along a section of a highway at a constant speed, the forces that arise do not depend on the time it takes to pass this section. Therefore, the random process of the impact of the road surface on the vehicle is a stationary process that does not depend on the origin of time. Road surface irregularities are distributed according to the normal distribution law (Gaussian law).

Flatness measurement is the process of determining both the irregularities themselves and the nature of the impact of irregularities on the measuring installation. In world practice, there are many designs of devices for measuring the evenness of coatings. According to the principle of operation, devices are distinguished: registering the geometric parameters of irregularities - rails, profilers, viagraphs, inclinometers, profilers, levels and others; impulse action, measuring vibrations or movements of individual elements of the car - various push meters (devices with feedback), accelerometers; inertial action, dynamically transforming the longitudinal profile of the road. Flatness measurement methods are divided into contact and non-contact, discrete and continuous, simple and with an analyzing device. When using these methods,





pushers are used that measure the amount of deflection of the springs while the car is moving; accelerometers registering vertical accelerations; dyno trailers.

To date, there are a number of measures to identify and predict the further development of these deformations. They can be divided into two groups: visual inspection - with the determination of the intensity and composition of traffic, the condition of the pavement, roadsides and drainage structures, and subgrade. Instrumental survey - determine the transport and operational parameters of the road (longitudinal and transverse slopes, width, evenness, grip qualities of the carriageway, modulus of elasticity of the road structure, and so on), test the adhesion of the coating to the car wheel, take samples from the structural layers of pavement

In conclusion, I would like to note the importance of quality control of construction. It is more effective to prevent the development of negative processes in time than to eliminate their consequences.

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