ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

Theoretical Basis of Unique Road Disorders

Amirov T.Zh.

PhD, docent TASHKENT INSTITUTE FOR DESIGN, CONSTRUCTION AND OPERATION OF ROADS.

ABSTRACT: In the article, by a systematic approach, the factors affecting the accumulation of damage to non-rigid pavements are investigated. Based on the research, scientific hypotheses are accepted and conclusions are drawn.

I.INTRODUCTION

In the conditions of modern high-speed and high-speed movement of vehicles, the road surface is exposed to multiple short-term loads from vehicles. These effects are dynamic in nature, reducing the performance status of road surfaces.

Currently, in the practice of design, construction and operation of roads, the issue of determining the service life and residual resource of road pavements remains relevant. The methodology for calculating and forecasting the service life of pavements is based on the requirements of the current regulations MQN 46-08, MQN 52-2008, MQN 05-2005. The methodologies discussed here include some of the calculation models for allowable elastic bending. This is because the curvature of the pavement is a complex indicator that characterizes not only the bending but also the resistance to elongation, slippage in the footpath and road layers.

The design service life of asphalt paved roads is set at 12-16 years, depending on the type of road and traffic flow [1]. Specialists in the calculation and design of the pavement, when checking the fatigue (wear) of the pavement material, derive the number of loads from vehicles from these periods. The requirements in the normative documents (GOST, SHNQ, DSt) for road construction materials used for the construction of road pavements are also based on these terms. Criteria for assessing and controlling the quality of road construction and pavement layers are also selected for the same period.

With this in mind, it is necessary to change the strategy of planning the repair work, that is, to move to the principle of prevention, not to eliminate deformations and abrasions. This is because various disturbances occur during the operation of the pavements (Figure 1). This leads to a gradual deterioration of operational qualities and performance, such as durability and fluency.

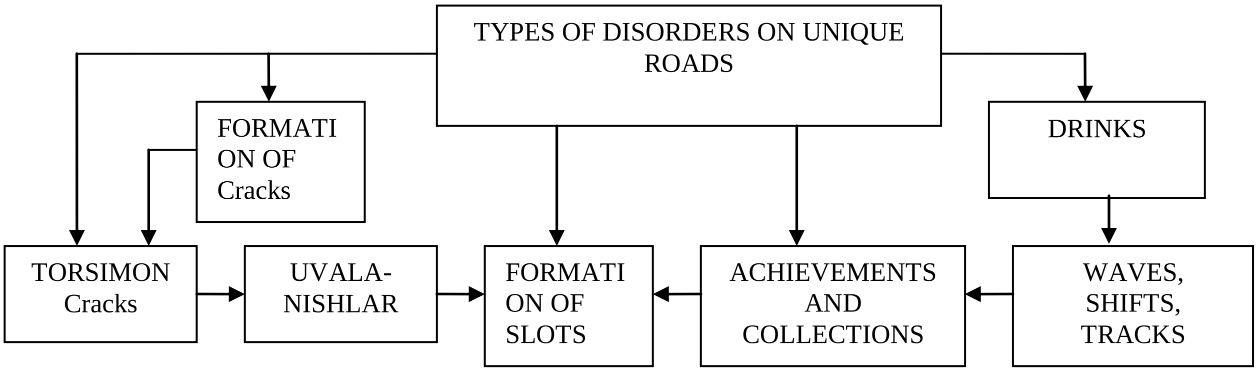

Figure 1. Types of defects in asphalt paved roads

Therefore, it is important to improve the planning of funds for repair work by studying the processes of accumulation of defects on unpaved roads, determining the service life.

Currently, HDM, RoSy PMS, BMS, ROMAPS and a number of other models and applications are used in developed countries to assess the operational condition of roads [1].

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

The Association of American Road Organizations (AASHO) has adopted the Pavement Operation Status Index (PSI) as a parameter that describes the condition of a carriageway and varies over time. As a result of the research, the current value of PSI was determined depending on the depth of the traces formed in the coating, the area of the groove, the degree of smoothness.

In Finland, a model has been developed to predict the rate of deformation and abrasion formation in asphalt concrete pavements, and it is shown in the following empirical form [2]:

$$VS = 92{,}4 + 0{,}23 \cdot T^2 + 42{,}1 \cdot \left(\frac{E_M}{E_T}\right) \qquad (1)$$

where: VS is the decay rate of the coating, m2 / 100m2; Service life of T-coating;

The calculated modulus of elasticity of the feed bed; The modulus of true elasticity of the road surface in the diagnostic period.

Under the guidance of Caesar Keyros, a professor at the World Bank's Institute for Economic Development, the following law predicts the formation of cracks after the laying of asphalt pavement in the method of predicting the condition of the roadway under the influence of traffic flow:

$$T_{тр} = 4{,}21\exp(0.319М_{од}-17.1N/М_{од}^2), \qquad (2)$$

where: N is the number of cars passing through a single lane in a year (reduced to the equivalent number of standard loads on the axles), mln.avt; M_{od} *is a generalized indicator of the thickness of the pavement;*

$$M_{од} = 0{,}0394(K_1H_1 + K_2H_2 + K_3H_3) + M_{гр};$$

K_1 *– coefficient of strength of the coating (thickness N1 mm);* K_2 *is the same, for the top layer of thickness* N_2*;* K_3 *is the same, for a substrate of thickness* N_3*;* M_{gr} *is the part (component) of the roadside soil that affects Mod.*

The following formula is proposed to determine the surface covered by cracks:

$$\delta_{тр}=1.76\omega_{min}^{0.32}T, \qquad (3)$$

here: $\delta_{тр}$ *– enlargement of the surface covered by cracks (percent of the total surface area);*

T – number of years passed; ω_{min}*- the smallest value of the initial surface covered by the cracks (% of the total surface area of the coating).*

The following formula [2] should be used to predict the time it takes for the coating to begin to crumble:

$$T=К_{пр}[10{,}5 \exp-0{,}655К_{стр}+0{,}156N_{обш}], \qquad (4)$$

Here: $К_{пр}$*- the coefficient of distribution of vacant (0.54), average (0.97) and solid (1.49) plots; - coefficient of construction quality, 0 if the quality of the coating is good, 1.0 if it is bad; - number of cars passing through the lane in a year, mln.*

U. Peterson [2] proposed the following formula, which predicts an increase in the surface area of potholes (determined in%, but not more than 10) if the road was not repaired during the period under review [1]:

$$\delta_{выб}=\omega[kN_{обш}(P+0{,}1)], \qquad (5)$$

Here: ω- the surface of the grooves at the beginning of the year (% of the total surface); the coefficient of growth of k-holes; if the base of the pavement is made of raw grain material:

$$k=(2-0{,}2H),$$

H- total thickness of asphalt pavement layers, cm; Average value of R-precipitation, mm / month.

To predict the average depth of traces (collars) formed on the road surface, T.Vatanatad proposed the following formula [2].

$$H_{из} = T_{хм}^{0{,}166} \cdot M^{-0{,}502} \cdot K_{зд}^{2{,}3} \cdot N^c \qquad (6)$$

Here: $H_{кол}$ *– average depth of traces, mm;* $T_{хм}$ *– service life, year from the date of laying or overhaul of the road surface;* $K_{зд}$ *– the degree of compaction of the coating relative to the standard according to the AASHTO methodology. N is the number of axes passing through one belt (the calculated load is reduced to 80 kN); S is the exponent (corresponding to the value of N).*

$$C=0{,}0902+0{,}0384\lambda-0{,}009J+0{,}00158P\Omega,$$

λ – bending of the coating, mm; J – relative condition of the coating after repair; 1.0 for current repairs; 0 for new coating; Ω- calculation parameter

$$\Omega = 0{,}62\omega+0{,}39\gamma,$$

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

ω- relative surface area of cracked areas,%; γ- relative surface area of wide cracks,%.

The UK Road Lab used the RTTM2 model when conducting research on Kenyan roads. Based on the results of observations in the experimental plots based on this model, the following formula was derived to determine the degree of distortion B [3]:

$$B = exp\left[-(\frac{\rho}{N})^{\beta}\right] \quad (7)$$

Here: ρ – an indicator depending on the nature of the design and traffic flow; β – shape indicator depending on the type of construction and traffic flow; N – 80кN - alone- the number of impacts of the arrows;
Degree of deterioration N=ρ, $B=e^{-1}$да 0 and 1,0 varies up to, N→∞, 1,0 asymptotic- approach.
The above methodologies have been developed based on research and statistical data obtained in European, African and American countries. Due to the different climatic conditions of Uzbekistan, local road construction materials, traffic flow characteristics and traffic speeds, it is difficult to directly use the proposed formulas.
Based on the analysis of the research conducted, it can be concluded that the main feature of road pavement constructions is that various violations accumulate during their operation. The causes of these disturbances are various physical processes that take place in the materials of construction, under the influence of moving vehicles, and the constantly changing natural climatic conditions.
The following physical and mechanical processes and events can occur during operation in the system "Road pavement - footpath":

1. The pavement changes its strength (modulus of elasticity, moisture, density and condition of the soil) and deformation (angle of adhesion and internal friction) depending on the road construction.
2. Residual deformations at the foot of the road accumulate in any case, only, at different intensities, depending on the characteristics specified at the present time;
3. The gravel-gravel-sand mixture grains laid at the base of the road surface will change significantly as a result of rubbing against each other, freezing many times, melting in water, and mixing with the soil at the bottom of the road. As the proportion of sand and dust particles increases, the modulus of elasticity of the base layer decreases;
4. Under the influence of temperature, the properties of the asphalt concrete layer change and the modulus of elasticity decreases;
5. As a result of oxidation and polymerization process, bitumen wears, cracks appear in the coating, and solar radiation accelerates this process;
6. As a result of the steady growth of large, heavy-duty transit traffic on highways, various distortions are observed in the pavement.

These are part of the physical and chemical processes in the "pavement - pavement" system, which affect the formation and development of damage to road surfaces.
1. The following hypotheses (hypotheses determine the mechanism of decay under the influence of multiple loads) can be accepted as a scientific hypothesis for the theoretical substantiation of the process of accumulation of disturbances in unpaved road surfaces:
Under each influence of the standard load on the bullet, a single distortion occurs in the structure;
2. Violations accumulate when the load is repeated many times: they consist of the sum of individual violations at the current time: this sum is called the degree of violation;
3. The degree of distortion varies from 0 to 1.0. 0 means no breakdown, 1 means complete breakdown, expiration of serviceability, unwillingness to continue operation without repair;
4. The resource of the design is determined by the number of impacts of the standard loads to be fired; the effects last until the degree of distortion reaches 1.0;
5. The value of individual failure can vary (over time) depending on the characteristics of the materials used in the construction, depending on the parameters of the pavement design and pavement.
According to the assumptions assumed, for the accumulation models of distortions, we assume that the degree of distortion in the form of arithmetic progression after each í- loading cycle increases by the value of a1 of the individual distortion B_i:

$$B_{i+1} = B_i + \alpha_i, \quad (8)$$

(i=1,2,.....)

Here: B_i – i the amount of distortion accumulated during the loading cycle; ai is the individual distortion that adds the i-cycle of the load

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

$$\alpha_i = \frac{1}{N}$$

N- the number of load drop cycles or the resource of the structure leading to complete failure of the structure.

In this case, the criterion of distortion at current time t is defined as B (t), the sum of the individual distortions - aí - s (in time t):

$$B(t) = \sum_i^C \alpha_i = \sum_i^C \frac{1}{N_i} \quad (9)$$

C- the number of repetitions of the load at any given time.

The change in B (t) makes it possible to assess the condition of the structure. The closer this size is to 1.0, the faster the coating will erode and the less the performance reserve or construction resource will be. The design resource is brought to determine the elastic bending of the structure according to the law proposed by VP Nosov. The modulus of elasticity of asphalt pavements depends on the temperature and humidity of the soil. Individual disturbances also depend on these factors (temperature and humidity). For this reason, the individual value also depends on time, as temperature and humidity change over time.

Thus, the above theoretical research allows us to draw the following conclusions:

1. Disturbances increase uniformly over time and are defined as the sum of individual disturbances depending on the level of stress caused by the vehicle traveling. The value of individual failure depends on the curvature of the structure, which in turn depends on the moisture content of the pavement soil, the temperature of the pavement and the uniformity.
2. As a result of changes in the temperature of asphalt concrete and the moisture content of the roadbed, the total modulus of elasticity of the pavement and the degree of individual deterioration change. These changes should be taken into account when designing a model that predicts the accumulation of disturbances.
3. The model of accumulation of defects reflects the deterioration of the condition of road traffic, on the basis of which it is possible to decide on the type and timing of repair work.

REFERENCES

1. Krasikov O.A. Monitoring and strategy for road repair. –Almaty: KazgosINTI, 2004.-263 p.
2. Sodiov I.S. Prediction and management of transport and operational qualities of roads. -Tashkent. Adolat, 2004
3. Grigorova T.M., Usov A.V. Analysis of systems for managing the state of the road network and traffic on them. Lead to the Automobile and Road Institute. Odessa., 2008, No. 1. from 164-170.