The effect of networks cracks on the strength of pavement

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Abstract. The analysis of the methodology for determining the coefficient of strength of pavement, based on the results of a visual assessment of the condition of pavement is performed. The traditional classification of the networks of cracks is considered, and the reasons for their arising on the Bolshie Uki - Znamenskoe road are analyzed. Traditional fatigue cracking and temperature tensile stresses are defined as main causes of cracks network. The feature of the emergence of networks of cracks on the pavement of the road Bolshie Uki - Znamenskoe, which consists in the appearance of these defects in sectors located on terrain with long standing groundwater, is revealed. Therefore, as a related cause of the appearance of a network of cracks, the effect of insufficient strength of a subgrade of cohesive soils and increased humidity was noted. Experimental work was carried out to determine the elastic deflections in the sectors with networks of cracks and the reference sector without defects. According to the experimental work, safety factors are determined, and mathematical models of the dependence of the coefficient of strength from the cell size of the cracks network are developed.

1. Introduction

In Russia, the federal priority project «Safe and high-quality roads» is being implemented. As part of the project, in Omsk and the Omsk region, road construction works are carried out every year with a total funding of more than 2×10⁹ rubles. In the process of implementing the program, new roads are being built in Omsk, existing roads are being repaired and reconstructed. A feature of restorative repair is the legal ability to perform work within the framework of budget documentation, without developing a detailed project. In this case, the condition of the road pavement is rated by the value of the strength coefficient \( k_{str} \), which is established either by the results of instrumental measurements of deflections, or by a simplified method based on visual assessment data.

The essence of the simplified technique is to calculate the strength coefficient according to the empirical formula recommended by ODM 218.4.039-2018. The formula is given as a linear equation of regression:

\[
k_{str} = 0.5 + \frac{B_{med}}{10},
\]

where \( B_{med} \) — score of visual assessment of a characteristic sector, calculated as a medium average value.
Using the strength factor, the actual modulus of elasticity of the pavement is calculated. The calculation is performed according to the formula

$$E_{\text{real}} = E_{\text{req}} \cdot k_{\text{str}},$$

where $E_{\text{req}}$ – the required modulus of elasticity of the pavement, set for the total estimated number of load applications, MPa.

The value of assessing the condition of the sector of road $B_{\text{med}}$ is calculated in accordance with certain rules. For this it is necessary:

– perform a visual assessment of the condition of the coating, in which all defects found on the coating of the surveyed sector of the road are recorded in the defective sheet;

– for each defect recorded in the defective sheet, give a $B_{\text{def}}$ score, the value of which is regulated by ODM 218.4.039-2018 for each specific defect;

– analyzing the defective sheet, the examined sector of length $L$ is divided into private sectors of length $l_i$ from 20 to 50 m;

– on each private sector, compared the values of the score of defect $B_{\text{def}}$ and selected the smallest of them $B_{\text{def(min)}}$, which is a general assessment of the state of the coating on the private sector $B_i$ (i.e., $B_i = B_{\text{def(min)}}$);

– by analyzing defects and score of nearby small sectors $B_i$, we unite them by similar defects into a characteristic homogeneous sector, the length of which is from 100 to 1000 m;

– calculate an assessment of the state of a characteristic sector $B_{\text{med}}$.

Calculation of assessment are according to the formula:

$$B_i = \frac{\sum_{i=1}^{n} B_i \cdot L_i}{\sum_{i=1}^{n} L_i},$$

where $B_i$ and $L_i$ – corresponding score and length of private sectors with almost the same condition of pavement; $n$ – number of private sectors as part of a characteristic one type sector.

Evaluation in points is carried out in accordance with the recommendations of ODM 218.4.039-2018, evaluating each defect separately. Table 1 shows the estimates of the various networks of cracks.

| Type of network of cracks according to the classification of ODM 218.4.039-2018 | Defect assessment $R_{\text{def}}$ | $k_{\text{sr}}$ |
|---|---|---|
| Single network of cracks on the area up to 10 m$^2$ with cells with length of side $> 0.5$ m | 3.0 | 0.80 |
| | $< 0.5$ m | 2.5 | 0.75 |
| Alligator cracking on the area up to 10 m$^2$ | 2.0 | 0.70 |
| Network of cracks over an area of more than 10 m$^2$ with a relative area 10–30 % from the area of a private sector | 2.0–2.5 | 0.70–0.75 |
| 30–60 % from the area of a private sector | 1.8–2.0 | 0.68–0.70 |
| 60–90 % from the area of a private sector | 1.5–1.8 | 0.65–0.68 |

The types of crack networks indicated in table 1 differs from the classification used in the standards AASHTO PP44-00, ASTM D 6433–18 and reports [1] for assessing the condition of road surfaces. Therefore, the classification of crack networks used by Russian specialists does not correspond to the classifications used in world practice [2–5].

Figure 1 shows the network of cracks corresponding to the classification presented in table 1.
Considering the causes of cracks and networks of cracks in asphalt concrete pavements, temperature stresses [6, 7] and fatigue cracking [8, 9] are usually indicated. Definitely, when stresses of any nature occur in asphalt concrete, microdamages accumulate in this material. Such damages is taken into account when calculating asphalt concrete pavements by entering fatigue functions, which determines the pattern of decrease of strength from tension in bending at an increase in the number of loads. A second method is also known for taking into account the influence of microdamage, which consists in introducing a special scalar quantity called material damage into the calculation [10]. An increase in damage leads to a decrease in the wholeness of the section of the asphalt concrete sample and an increase in the value of stresses [10–12], and hence, to an increase in the intensity of fatigue processes. In addition, damage is used to calculate the deformability parameters of damaged bodies, for example, the elastic modulus. A change in the elastic modulus of asphalt concrete in the process of deformation and accumulation of damage has been proved experimentally [13]. Therefore, fatigue cracking of asphalt concrete layers of pavement is one of the causes of cracks and networks of cracks.

Note that the intensity of damage accumulation in asphalt concrete layers depends on the value of the stresses. The value of the stresses depends on the parameters of the calculated load, the parameters of the materials used in the constructive layers of the pavement and the thickness of the layers. Analysis of various methods for calculating asphalt concrete pavements on the impact of transport load showed that the value of the stresses is higher, the lower the bearing capacity of the base underlying the coating. An analysis of the work, the purpose of which is to derive formulas for calculating the limit pressure on the soil base from various loads [14–16], including the moving wheel [17], shows that the value of the limited pressure is lower, the smaller the cohesion and the angle of
internal friction of the soil. The angle of internal friction and cohesion of cohesive soils depends on their moisture content. Hence the conclusion that asphalt concrete pavements with the same road constructions on the subgrade of the same soil accumulate damage more intensively when the soil moisture increases. Therefore, on sections of roads located in areas with stagnant water, the accumulation of damage in the asphalt concrete pavement occurs more intensively compared to sections of the road located in dry places.

Figure 2 shows sections of the road Bolshie Uki - Znamenskoe located in the Omsk region.

![Figure 2](image.png)

**Figure 2.** Sections of the road Bolshie Uki - Znamenskoe with good and bad condition of the coating, located on dry and wet places of terrain.

A feature of these sections is the relatively rapid loss of strength of the asphalt concrete pavement at the areas of the subgrade located in wet areas related to the second and third types of terrain by moisture conditions. A notable feature of such places is the appearance of a plant called in Latin *Typha* (English name – reed mace, Russian name – rogoz). In figure 2 this plant grows in the lateral ditches of the embankment with bad coverage. The asphalt concrete pavement in sections of embankments located in dry places is in good and satisfactory condition, having defects in the form of transverse temperature cracks.

Both sections shown in figure 2 were repaired in 2015. But already in 2016, longitudinal fatigue cracks and single crack networks appeared in the second section, and in 2017, crack networks began to occupy up to 30% of the area of private sections highlighted by visual assessment of the condition. In the same 2017, the formation of dense networks of cracks (alligator cracking) was noted. The defective section shown in the foreground figure 2, with a length of 1820 m was rebuilt.

Immediately after the repair, we made an instrumental assessment of strength and decided to annually measure the deflections and assess the strength of the pavement of this section as defects appear on it. This publication is given a detailed description of the measurement methodology, presents the results of our research and set forth the rules for statistical processing.
2. Materials and methods

Testing of coatings of roads with measuring deflection of coatings began with the invention of special equipment by Benkelman, called Benkelman Beam. Russian analogues of this equipment are deflectometers. Two types of deflectometers are known: short-base and long-base. The advantage of the long-base deflectometer is that the indicator, according to the readings of which determine the deflection, is located outside the deflections bowl. Therefore, they give preference. The deflectometer is used for static tests under load from a car wheel or under a load transmitted through a hard round stamp. In addition to static tests, dynamic tests are used, creating a load by a falling load for these purposes, in Russia, DINA 3M and DINA 4 installations are used. Illustrations of tests by these devices, performed by us on different roads, are shown in figure 3.

Choosing a method for measuring deflections on the experimental section, we took into account the subsequent formation of a network of cracks. During operation, the cell size of the network cracks decreases, and the cells lose their stability, they become loosen. At loosen cells, measuring deflections from the car wheel is difficult. This is explained by the fact that the probe of the deflectometer has a small area, it is installed between the twin tires of the right wheel of the rear axle of a biaxial truck on figure 3a. This measurement method works well on whole coatings, on coatings with transverse and longitudinal cracks, as well as on coatings with a network of cracks, the cells of which are large and stable, that is, they do not stagger when the wheel leave the measurement point. When applying this method on a coating with a network of cracks with loosen cells, a problem arises at taking readout of indicator after the wheel has exited the measurement point. The essence of this problem is that after wheel out the deformation of the coating is restored, which is visible by the movement of the measuring arrow on the indicator. But in the process of restoring the deflection, the loosen cell of the

![Image](image-url)
network of cracks experiences distortions. This leads to the fact that during the measurement process, the arrow of the indicator may unexpectedly change the direction of its movement.

Given this feature, we have applied the stamped test method. This method is based on measuring the deformation of the coating from the load transmitted through a hard round stamp. A feature of the instrumental assessment of the strength of pavement is that when processing its data, the ultimate goal is to calculate the total modulus of elasticity, the value of which is reduced to the calculated state. To do this, when measuring deflections, the locations of the control points are assigned. At such points, in addition to measuring deflections, they measure the temperature of asphalt concrete in the pavement, and a pit is drilled on the side of the road. In the pit establish the pavement structure, measuring the thickness of the layers, and soil samples are taken. Soil samples are used for laboratory determination of its species and varieties, as well as moisture at a time point corresponding to measurements. The data obtained allow us to recalculate the value of modulus of elasticity of the pavement, corresponding to the moment of measurement, in the value of the reduced modulus of elasticity. The value of the reduced modulus of elasticity corresponds to the estimated period of the year for which the required modulus of elasticity is determined. The ratio of the reduced and the required modulus of elasticity determines the value of the coefficient of strength. Therefore, an assessment of the reduced modulus of elasticity at different times after repair makes it possible to identify a change in the coefficient of strength during the operation of the road, which means that it is possible to establish a change in the coefficient of strength with the growth of networks of cracks.

The first tests were carried out in 2017, immediately after the repair work. In the process of repair, restoration of the pavement structure was completed without its necessary reinforcement due to the presence of wet places in the embankment area. In 2018, the first networks of cracks appeared. These networks of cracks had a spreading area of up to 10 m² and large and small cells. In some places, networks of cracks arose with a spreading area of 15–25 m², which amounted to 10–30% from the area of a private coating sector with a length of 20 m and a width of 6 m. In the second year of operation, the number of crack network increased, and the existing crack network increased their area. Therefore, in 2019, we had almost all types of crack networks listed in table 1.

Figure 4 shows the measurement steps on the repaired area of the coating. The first measurements are illustrated in figure 4a, they were carried out in the summer of 2017 on a new, absolutely whole asphalt concrete pavement. In figure 4b, shows the final tests performed in the summer of 2019 on a section with a network of cracks that occupy 30-60% of the area of a private site. The load on the coating was transmitted through a hard round stamp equipped with a hydraulic jack. The measuring probe of the deflectometer was located in the center of the stamp on figure 4c. Stamp diameter 33 cm. To take readout, an indicator with a division price of 0.01 mm was used. The measuring tip of indicator was mounted on a wedge support in such a way as to ensure the necessary arrow travel during transmission and removal of the load on figure 4d. The load on the coating was created with a jack, bringing its value to 50 kN, and the load value was monitored using an electronic dynamometer on figure 4e. At control points, the coating temperature was measured on figure 4f. In the control points at the wayside, the pits are drilled, from which are taken the soil sample. For measurements, the laboratory of the Department of "Construction and Operating of Roads" of the Siberian State Automobile and Highway University is involved. The laboratory is certified, and all equipment has verification certificates. The department staff annually performs quality control of road construction works within part of the federal priority project "Safe and high-quality roads". In our opinion, all of the above demonstrates the correctness of the tests and the reliability of the results.
Figure 4. Stamp tests: a – coating tests after area repair (summer 2017); b – testing of the same area with a network of cracks 2 years after repair (summer 2019); c – installation of the tip of the deflectometer in the center of the stamp; d – installing the measuring rod on the wedge support; e – load measurement by electronic dynamometer; f – temperature measurement with a bimetallic thermometer.

When performing stamp tests, we made:

1. Depending on the reliability of the tests, the number of measurement points is determined. According to the guidelines of ODN 218.1.052-2002, when testing pavements with a transitional type of coating on roads of category IV in III road building climatic zone, it is necessary to ensure reliability of at least 0.80. This requires at least 12 tests per 1 km of road. Considering the length of the coating 1820 m, in 2017 tests were carried out at 30 measurement points. Points are located at equal distances from each other. As the appearance and growth of crack network, the total length of the network of crack of the same type was determined and deflections were measured in these crack network. A prerequisite was that, regardless of the total length of the networks of cracks, 30 measurements were taken. For example, in 2018, the total length of single network of crack, the area of each of which was less than 10 m², with a large cell was 376 m². On
these crack network, 30 measurements were performed. The total area of single crack network with a small cell was 192 m², and 30 measurements were made in such areas. The same approach to assigning the number of measurement points was applied in 2019 when testing areas with dense networks of cracks (alligator cracking) and with crack networks, the area of which was 10–30% and 30–60% of the area of a private site.

2. Installation of a heavy truck at the measuring point. Mounting of a stamp installation and long-base deflectometer. Expectation of stabilization of deformation of the coating from the load from the rear axle of the car. The deformation was considered stabilized if the rate of change of the indicator reading did not exceed 0.1 mm / min.

3. With stable deformation, a hydraulic jack created a load of 50 kN. The load was maintained throughout the test. Under load, stabilization of the deformation of deflection was expected. The stabilization criterion is accepted the same, that is, a decrease in the rate of change of the indicator readings to 1 mm / min. After stabilization, the first readout was taken from indicator S₁. Точность снятия отчета составляла 0.01 мм.

4. We reset the load value to zero, and again expect the stabilization of elastic deflection. With a decrease in the rate of change of the indicator readings to 0.01 mm / min and a zero load indication on the dynamometer, the second reading S₂ was taken from the indicator. The accuracy of taking the readout was 0.01 mm.

The readings of indicators for each measuring section are recorded in the field sheet, which was processed in office conditions. Deflections were determined by the multiplication of the difference of the indicator readings by a coefficient determined by the ratio of the lengths of the shoulders of the deflectometer, which is equal to two for the used long-base deflectometer. Therefore, the deflection of each measurement point was determined by the formula:

\[ l = 2( S₁ - S₂). \]  

(4)

The test results are presented as a sampling representing the variational series of deflections. Each sampling of deflections corresponds to a certain state of the coating. For example, sampling 1 contains the deflection values of the whole coverage. Sampling 2 contains the values of deflections on coatings with single networks of cracks with an area of up to 10 m² with a large cell (cell side is more than 0.5 m). Sampling 3 includes deflection of the coating with single networks of cracks up to 10 m² with a small cell (cell side is less than 0.5 m). And so on, for each type of network of cracks a separate sampling is formed.

Sampling of deflections are accepted to statistical processing, at which:
- Determining the average value of the sampling.
- Breakdown of the interval of variation of the deflections in the sampling into category.
- Determination the number of deflections in each category.
- Calculation of the frequency of getting in each category of deflections.
- Calculation of the accumulated deflection frequency.
- Building the curve of the accumulated frequencies and determining the calculated value of the deflection.
- Calculation of the actual modulus of elasticity corresponding to the test period. The calculation is performed according to the calculated deflection.
- Calculation of the reduced modulus of elasticity, taking into account the temperature of the coating and the difference in soil moisture during the test period from the calculated soil moisture.

3. Results
All statistical processing was performed in accordance with the requirements of ODN 218.1.052-2002, and the modulus of elasticity of the pavement corresponding to the test period was calculated by the formula of the model of elastic half-space when exposed to a load on it transmitted by a hard round
stamp. The formulas of performed statistical processing and calculation of the elastic modulus are given below.

1. Determining the average value of the sampling

\[ \bar{l} = \frac{1}{n} \sum_{i=1}^{n} l_i, \]  

where \( n \) - number of tests in a characteristic area; \( i \) - test serial number; \( l_i \) - deflection at \( i \)-th test, mm.

2. Definition of category length

\[ \delta = \bar{l} \cdot \left( \frac{\Delta l}{100} + 1 \right), \]

where \( \Delta l \) - deviation of the deflection value from the arithmetic mean value, % (take a multiple of 10% in both directions from the average)

3. Determination of the frequency of getting in the interval the deflections

\[ f_j = \frac{n_j}{n}, \]

where \( n_j \) - the number of deflections getting in the \( j \)-th interval.

4. Determination of accumulated frequency

\[ F_j = f_j + f_{\sum_{i=1}^{j-1}}, \]

where \( f_{\sum_{i=1}^{j-1}} \) - the accumulated frequency of deflections that fall into the intervals located before the interval \( j \), in which the accumulated frequency is determined.

5. Determine the acceptable probability of damage to the coating \( r_{\text{dam}} \).

\[ r_{\text{dam}} = 1 - K_{rel}, \]

where \( K_{rel} \) - calculated (design) or normative level of reliability of pavement, adopted according to the directions of ODN 218.1.052-2002.

6. Plotting the accumulated frequency curve and determining the calculated deflection using the graphical method. To determine the calculated value of the deflection \( l_f \) from a point on the ordinate axis with an allowable probability of damage to the coating \( r \), a horizontal line is drawn to the intersection with the curve of accumulated frequencies. From the intersection point, lower the vertical to the abscissa axis, where they find the desired value of \( l_{\text{act}} \). In figure 5, the curve of the accumulated frequencies and the determination of the calculated deflection according to the test results in areas with a network of cracks with an average cell length of 0.68 m are shown.
Figure 5. Determination of the calculated deflection by the curve of accumulated frequencies in areas with a network of cracks with an average cell length of 0.68 m.

7. Determination of the modulus of elasticity of pavement during the test period

\[ E_{\text{act}} = \frac{\pi}{4} \cdot \frac{p \cdot D \cdot (1 - \mu^2)}{l_{\text{act}}} \]

where \( p \) - pressure, MPa; \( D \) - diameter of a hard stamp, mm; \( \mu \) - Poisson's ratio, which is assumed to be 0.3; \( \pi/4 \) - correction coefficient when testing by a hard stamp; \( N \) – mass transferred by the jack to the hard stamp, kg; \( g \) – gravity acceleration, m/s\(^2\); \( 10^{-6} \) – multiplier of dimension for the transition from H to MN or from Pa to MPa. where \( p \) - pressure, MPa; \( D \) - diameter of a hard stamp, mm; \( \mu \) - Poisson’s ratio, which is assumed to be 0.3; \( \pi/4 \) – correction coefficient when testing by a hard stamp; \( N \) – mass transferred by the jack to the hard stamp, kg; \( g \) – gravity acceleration, m/s\(^2\); \( 10^{-6} \) – multiplier of dimension for the transition from H to MN or from Pa to MPa.

8. The calculation of the reduced modulus of elasticity \( E_{\text{real}} \)

\[ E_{\text{real}} = E_{\text{act}} \cdot \frac{1}{K_\theta} \cdot \left( \frac{1.5 \cdot D \cdot K_1}{H_k} \cdot \left( 1 - \frac{W_{\text{act}}}{W} \right) \right) \cdot K_2 \cdot K_3 \]

where \( K_\theta \) – temperature coefficient; \( H_k \) - thickness of the pavement at the control point, cm; \( K_1 \) - empirical coefficient depending on the type of soil of the subgrade at the location of the control point; \( W_{\text{act}} \) - the measured relative soil moisture of the subgrade at the control point during the test period, \%; \( W \) - relative estimated soil moisture of the subgrade, \%; \( K_2 \) - an empirical coefficient depending on the state of coverage in the area of the control point; \( K_3 \) - the empirical coefficient of reduction the road structure to a typical state.

The coefficients \( K_1, K_2 \) and \( K_3 \) are determined according to the directions of ODN 218.1.052-2002, and the coefficient \( K_\theta \) is determined graphically using the deflection – temperature graph, the data for which are obtained by measuring deflections at a control point at different coating temperatures.

The calculation results of the reduced modulus of elasticity of the pavement are given in table 2.
According to the second and third types of terrain, pavement decreases as the average length of the network of the cracks decreases. Therefore, in the performed experiments show that the relative value of strength coefficient of the pavement without defects $K_{str}$ is a traditional concept, it is determined by the ratio of the reduced modulus of elasticity of the pavement to the required modulus of elasticity. The second coefficient of strength is a relative value, which is determined by the ratio of the traditional coefficient of strength $k_{str}$ to the coefficient of strength of pavement without defects $k_{str(C)}$. This relative coefficient of strength allows us to judge the value of the decrease in the strength of pavement in areas of occurrence of networks of cracks.

For mathematical modeling of the dependence of the relative coefficient of strength of pavement, a regression analysis was used with the calculation of the parameters of empirical formulas using the least difference of squares method. The results of the selection of empirical formulas are given in Table 3.

### Table 2. The results of the calculations of the reduced modulus of elasticity of the pavement.

| Calculated parameter                          | Numerical value by sampling |
|----------------------------------------------|-----------------------------|
|                                              | №1 | №2 | №3 | №4 | №5 | №6 |
| The calculated value of the deflection, mm   | 0.61| 0.63| 0.66| 0.69| 0.74| 0.80|
| Pressure from a stamp, MPa                   | 0.57| 0.57| 0.57| 0.57| 0.57| 0.57|
| The modulus of elasticity during the test period, MPa | 220.4| 213.4| 203.7| 194.8| 181.7| 168.0|
| $K_0$                                        | 1.22| 1.19| 1.20| 1.22| 1.23| 1.25|
| $H_k$                                        | 0.48| 0.48| 0.48| 0.48| 0.48| 0.48|
| $K_1$                                        | 2.15| 2.15| 2.15| 2.15| 2.15| 2.15|
| Reduced modulus of elasticity $E_{real}$, MPa | 1.00| 0.90| 0.90| 0.90| 0.90| 0.90|
| $W_{act}$                                     | 1.10| 1.10| 1.13| 1.10| 1.10| 1.10|
| $W$                                          | 0.64| 0.67| 0.66| 0.67| 0.68| 0.69|
| $E_{real}$                                    | 0.70| 0.74| 0.74| 0.74| 0.74| 0.74|
| $K_{str} = k_{str}/k_{str(C)}$                | 153 | 133 | 123 | 118 | 114 | 108 |
| The required modulus of elasticity $E_{req}$, MPa | 150 | 150 | 150 | 150 | 150 | 150 |
| Strength factor $k_{str}$                     | 1.02| 0.89| 0.82| 0.79| 0.76| 0.72|
| Relative strength factor $K_{str} = k_{str}/k_{str(C)}$ | 1.0 | 0.87| 0.80| 0.77| 0.75| 0.71|

Note: sampling № 1 - continuous, undamaged coating; sampling № 2 - № 6 — networks of cracks with an average cell side length of 2.27; 1.32; 0.68; 0.34; 0.14 m respectively. Relative soil moisture $W_{act}$ is determined by the ratio of actual humidity established by laboratory tests of soil samples taken from the subgrade to moisture at the liquid limit. The calculated relative humidity is determined by the ratio of the calculated modulus calculated according to the guidelines of ODN 218:046-01 to the moisture at the liquid limit. The estimated relative humidity of the subgrade soils in sampling № 1 is 0.7, it is determined for areas belonging to the first type of terrain according to humidification conditions. In sampling № 2 – № 6 the calculated relative soil moisture is 0.74, it is determined for areas belonging to the second and third types of terrain according to the moistening conditions.

### Table 3. Empirical formulas for calculating the relative coefficient of strength $K_{str}$ of pavement in areas with a network of cracks at different average cell lengths $S$.

| Function name         | Empirical formula                          | Coefficient of determination, $R^2$ |
|-----------------------|--------------------------------------------|-------------------------------------|
| Second degree polynomial | $K_{str} = 0.7104+0.083\cdot S -0.0057\cdot S^2$ | 0.971                              |
| Linear                | $K_{str} = 0.0684\cdot S +0.715$             | 0.969                              |
| Exponential           | $K_{str} = 0.717\cdot \exp(0.0863-S)$       | 0.961                              |
| Power                 | $K_{str} = 0.8028\cdot S^{0.0668}$          | 0.936                              |
| Logarithmic           | $K_{str} = 0.0523\cdot \ln S +0.8044$      | 0.920                              |

### 4. Conclusion

The results of the performed experiments show that the relative value of strength coefficient of the pavement decreases as the average length of the network of the cracks decreases. Therefore, in the
process of growing a network of cracks, the strength of the pavement decreases. The performed mathematical modeling allows us to assert the existence of a model that describes the regularity of decreasing the coefficient of strength of pavement with decreasing average cell length.

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