

SOME ISSUES OF FORECASTING CRACK FORMATION ON HIGHWAYS (IN THE EXAMPLE OF TASHKENT REGION)

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Abstract. *Forecasting the appearance of cracks in the asphalt-concrete pavements of highways in the world, taking into account natural and climatic factors, which is important for the quality maintenance of roads, maintaining their value at the standard level, ensuring traffic safety, improving the quality of transport services, and the development of the population. Particular attention in this regard is paid to identifying and forecasting the causes and development of cracks in asphalt concrete pavement of Highways, their impact on the consumer properties of the road and the ability of the road bed to work, their elimination, the creation of a unified database on cracks, modeling the expansion of cracks over time and increasing the effectiveness of measures.*

Keywords: *asphalt pavement, temperature, load, cracks.*

Introduction. This article research serves to a certain extent the implementation of the tasks defined in the Decree of the President of the Republic of Uzbekistan No. PF-60 "On the Development Strategy of New Uzbekistan for 2022-2026" [1], No. PF 5890 "On Measures for Deep Reform of the Road Management System of the Republic of Uzbekistan" [2], No. PQ 4545 "On measures to further improve the road sector management system" [3] and other regulatory legal documents related to this activity [4, 5].

Scientific research works have been carried out in Uzbekistan and abroad on forecasting the appearance of cracks in asphalt concrete pavements of highways and their elimination. In abroad: Kirkner, David J, Shen, Weixin, Fromm, H.J., Phang, W.A., Haas, R., Meer, F., Assaf, G., Lee, H., Christison, J.T., Murray, D.W., Shields, B.P., Anderson, K.O., Dacyszyn, J.M., D. Sousa, P. Peris, D. Cox, P. By, K. Monosmith, F. Zou, R. Litton, W. Coghale; In the CIS: V. A. Verenko, V. N. Yaromko, V. P. Kryukov; v Rossii A. M. Boguslavsky, L. B. Gezensvei, N. V. Gorelyshev, V. D. Kazarnovsky, V. A. Kretov, A. R. Krasnoperoe, V. N. Kononov, B. S. Radovsky, A. V. Rudensky, Yu. Eat. Nikolsky and others.

The country's road network cannot fully meet the political, social and economic needs of the society at the moment. We can see that most of the roads in the approach to the big cities are losing their performance and working under the influence of overloads. In such a technical condition of roads, car users in Uzbekistan consume 1.5 times more fuel than users of developed foreign countries. As a result of the low technical level of the highways, the amount of traffic not corresponding to the parameters of the highways, the increase in the level of loading on some sections of the highways, the average speed on the roads has decreased to 40 km/h, and this serves to increase the cost of transportation of goods by 20-25%. It is observed that the cost of transportation increases by 30-50% due to the unsatisfactory level of transport and operational indicators of highways [6].

The total length of the highway network of Tashkent region is 14,288 km, of which 3,965 km are highways in general use, 1,310 km are city roads and streets, and 9,610.1 km are internal

roads. The density of highway network of Tashkent region is 24.6 km/100 km² [7] and this indicator is much less than that of Andijan, Fergana, Namangan and Khorezm regions.

The increase in the number of cars on the roads of the Republic of Uzbekistan is 21% per year [8]. The highway network of the Republic of Uzbekistan was designed and built 20-30 years ago [9], and the current loads from cars were not taken into account. The problem is that the loads on the road from the axle of the vehicle are constantly increasing, but financial and technical means are not allocated enough to strengthen the road structure.

Analysis. One of the main problems of the road sector is the occurrence of cracks in the pavements of highways. With the appearance of cracks, the passage of surface water into the structure of the road surface is observed, and it is precisely in that section of the road that rapid deterioration of the pavement and defects occur [single cracks, transverse and longitudinal cracks, network of cracks, etc.]. The following pictures show the available types of cracks.

According to the reasons for the appearance of cracks, they are divided into technological and operational cracks.

Technological cracks in asphalt concrete pavements often occur as a result of poor-quality fusion of hot and cold laying lines during the construction of the upper layer.

Operational cracks in coatings occur as a result of complex effects of external force factors. According to the reasons for their appearance, they can be divided into 3 main types: Cracks that appear under the influence of temperature, fatigue and those that are reflected on the surface of the coating.

Thermal cracks occur as a result of constant changes in air temperature, that is, from cold air to hot air and from hot air to cold air. This type of cracks develops mainly from the top down, that is, from the coating to the base.

Fatigue cracks occur when the upper layer bends under the influence of repeated traffic loads. This type of cracks develops mainly from the bottom to the top, that is, from the base to the coating.

There are several reasons for the appearance of cracks:

- insufficient strength of the road surface and base, as a result of which the road surface and base cannot withstand real loads from the vehicle, and tensile stresses and large deflections appear in the layers of the road surface;

- changes in temperature from negative to positive temperature and from positive to negative temperature cause large fluctuations. Due to changes in temperature, tensile stresses in the material increase and cause cracks to appear. In particular, the temperature at a negative value leads to the appearance of very large tensile forces on a very large road surface;

- the incompatibility of the deformation properties of bitumen, which is the binding material of the coating, with the real working conditions, leads to a decrease in the crack resistance of asphalt concrete coatings, and cracks appear in the coating before the end of its service life;

- uneven compaction of road base and road surface layers;

- the main reason for the appearance of a network of cracks in the road surface is the formation of cracks.

Cracks develop rapidly in spring and autumn, and expand rapidly in winter and spring. In the summer, as a result of softening of the bitumen, expansion of the covering material, small cracks are closed. Cracks are usually classified by their width. However, due to different classifications in different countries, they can be standardized as follows: narrow cracks up to 3-5

mm, medium cracks up to 5-10 mm, wide cracks up to 10-30 mm and very wide cracks larger than 30 mm [10].



Picture 1. Transverse cracks



Picture 2. Longitudinal cracks



Picture 3. Both transverse and longitudinal cracks



Picture 4. A network of cracks



Picture 5. The process of turning cracks into grooves



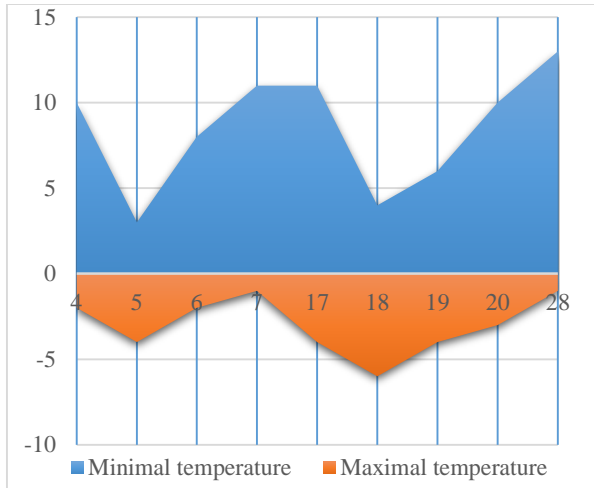
Picture 6. Y and X-shaped cracks

Methods. The area of Tashkent region is 15.3 thousand km². The population is 2.931 million people. The region includes 15 districts (Bekabad Boka, Bostonliq, Zangiota, Aqqorgon, Ohangaron, Parkent, Piskent, Upper Chirchik, Yangiyol, Qibray, Lower Chirchik).

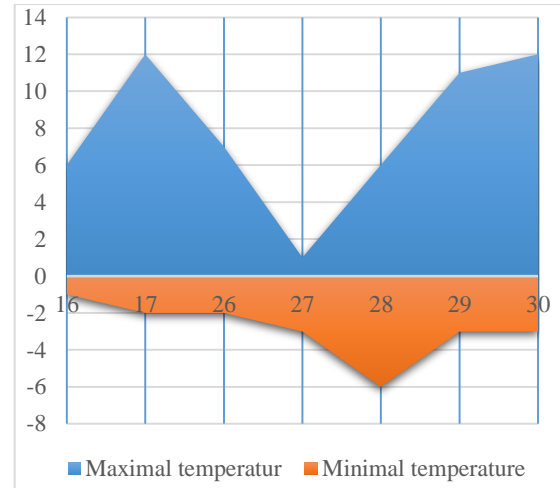
The climate is strictly continental. Winter is wet, relatively warm, summer is long, hot and dry. The average temperature in January is -1.3-1.8°C, the lowest temperature is -34°C (in the plains), -38°C (in the foothills), the average temperature in July is 26.8°C, the highest temperature

is 43-47° C. It rains 250 mm per year in the plains, 350-400 mm in the foothills, and 500 mm in the mountains. Most of the precipitation falls in spring and winter [11].

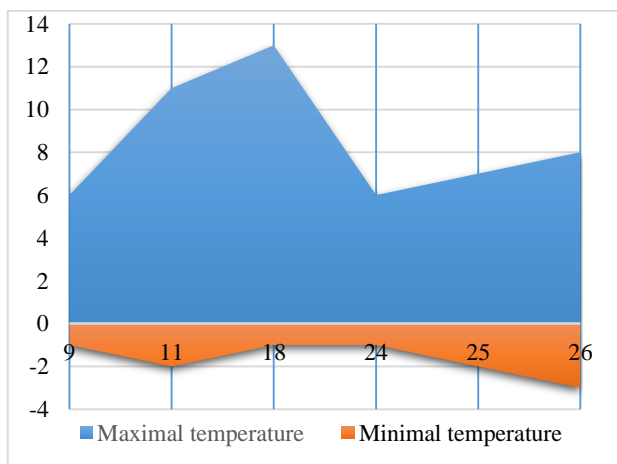
However, these data are taken from the data of Tashkent weather stations, and they do not correspond to the air temperature in real conditions. Real results when measurements are carried out at research facilities are shown as follows (Pictures 7-11).



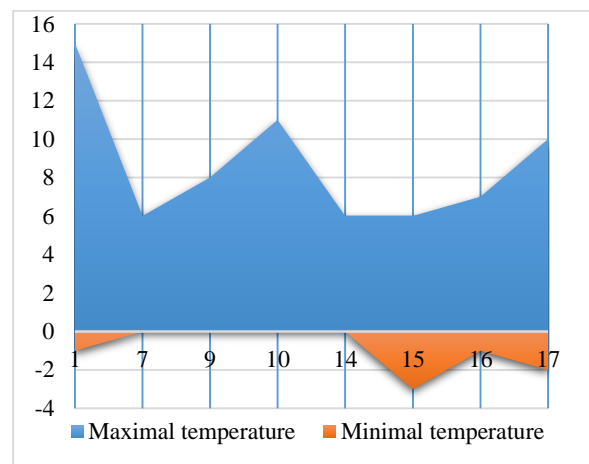
Picture 7. Daily Temperature for November 2022



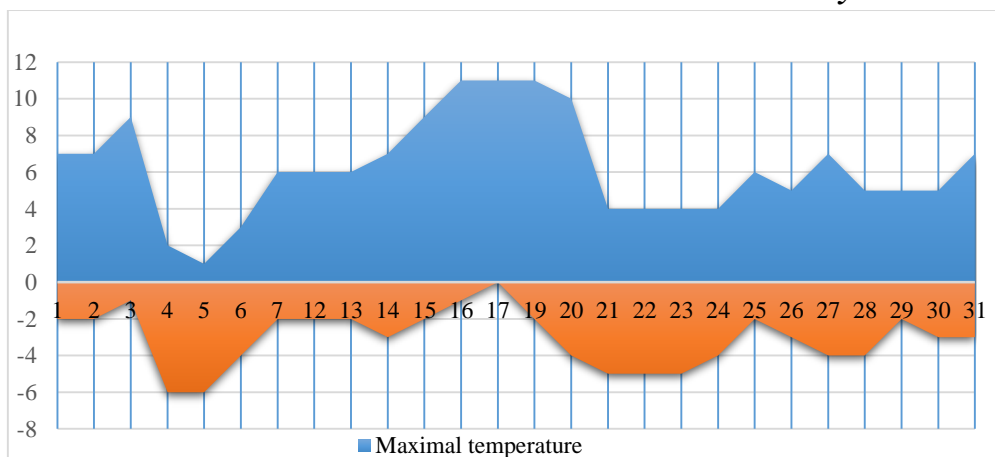
Picture 8. Daily Temperature for December 2022



Picture 9. Daily Temperature for January 2023



Picture 10. Daily Temperature for February 2023

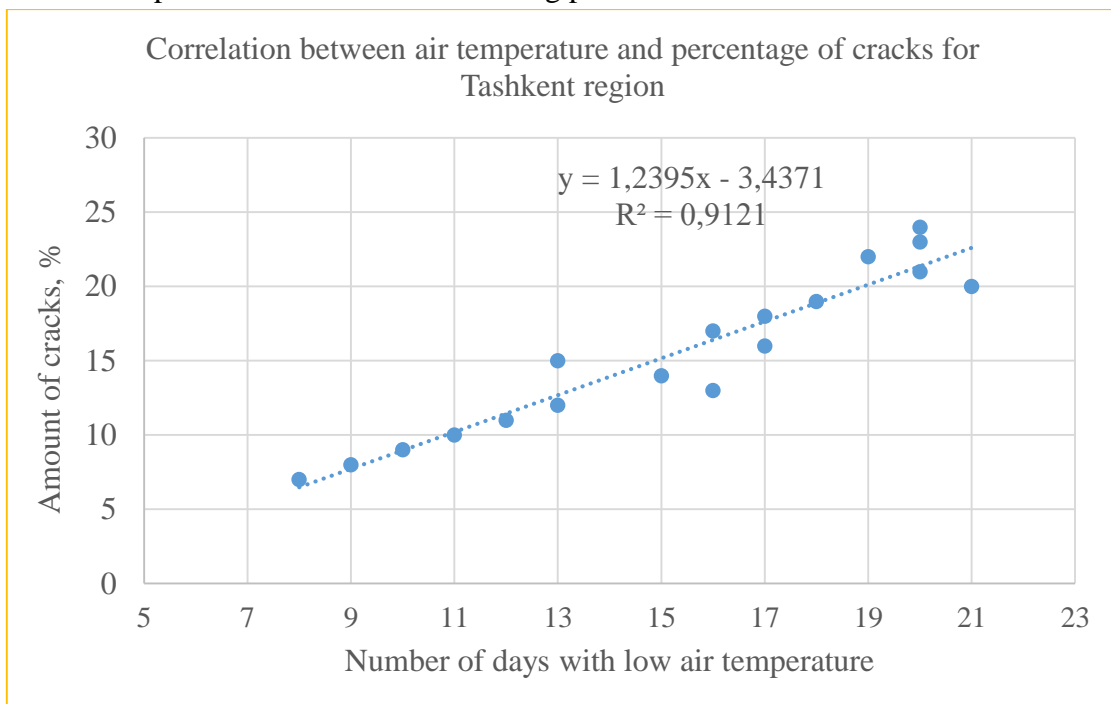


Picture 11. Daily Temperature for December 2023

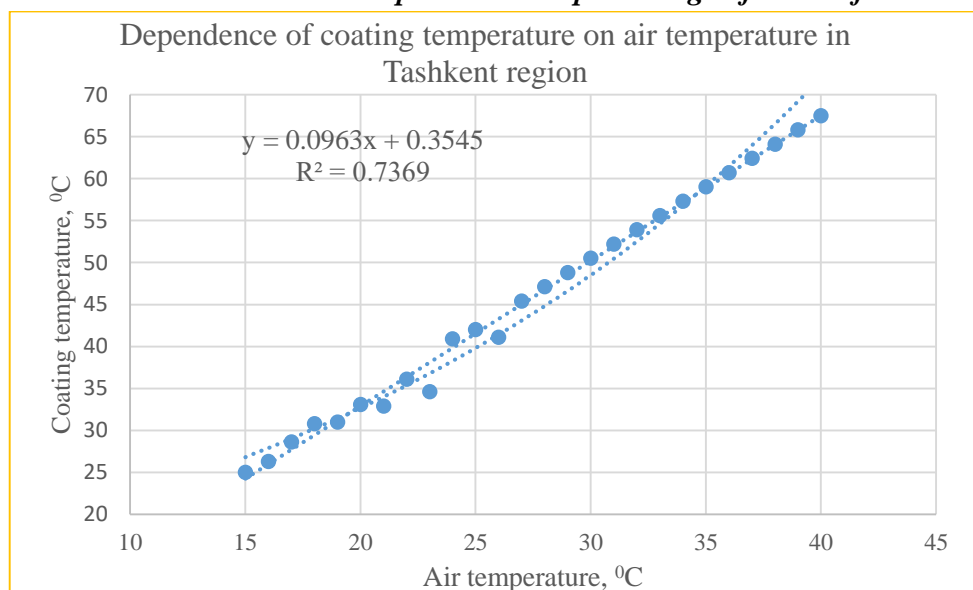
From pictures 7-11, we can see that during this period, the air temperature remained in the negative state for many days. Especially in January 2023, we see the temperature even drop to -21 °C. This, in turn, creates tensile forces in the pavement and causes cracks to appear in the asphalt concrete pavement. Asphalt-concrete coatings of highways change their physical and mechanical properties due to air temperature.

Results. Studying the patterns of changes in the temperature of the asphalt concrete pavement in different periods of the year shows that there is a difference between the low air temperature in winter and the asphalt concrete temperature in the pavement, and the sharper the drop in air temperature, the greater this difference. The temperature change of the asphalt concrete pavement has a different character in the summer-autumn period [11].

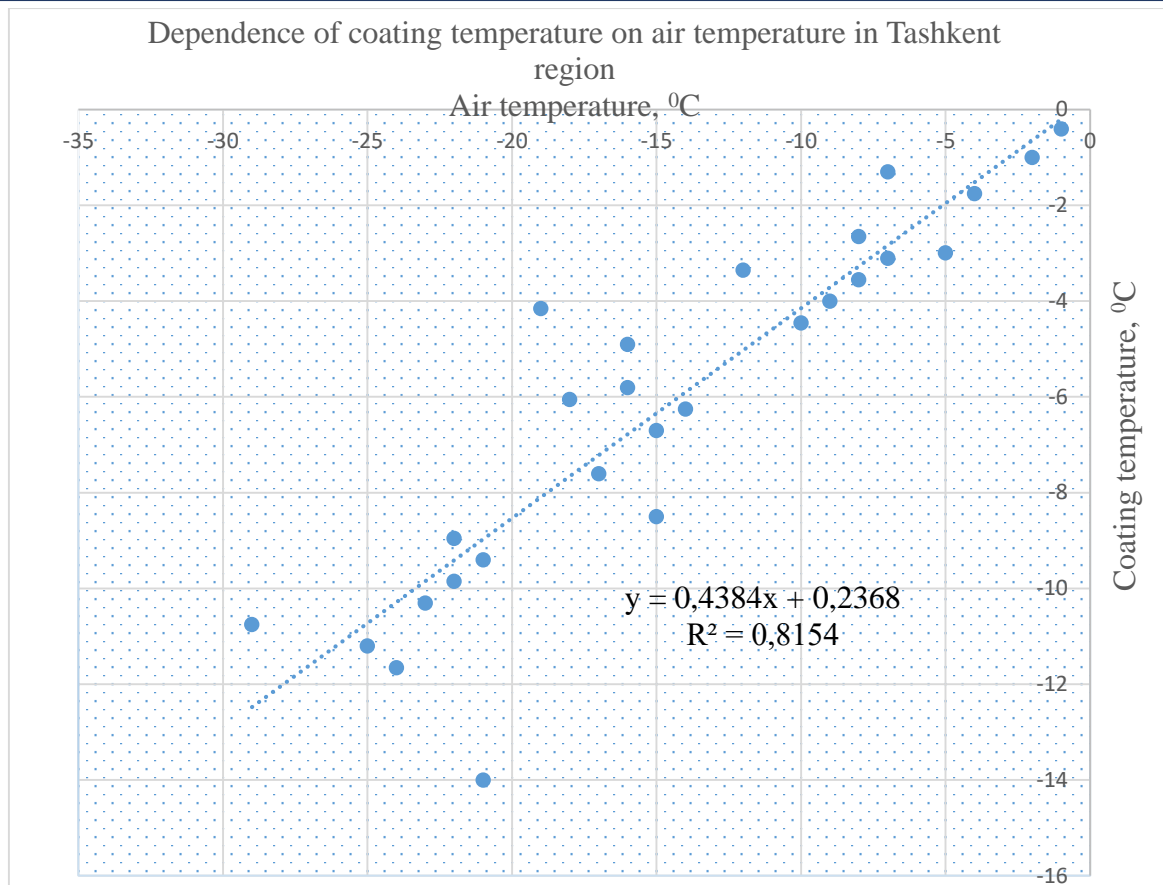
Therefore, we have studied the dependence of the appearance of cracks on the air temperature and presented them in the following pictures 12-14.



Picture 12. Correlation between air temperature and percentage of cracks for Tashkent region



Picture 13. Dependence of coating temperature on air temperature in Tashkent region



Picture 14. Dependence of coating temperature on air temperature in Tashkent region

Conclusions.

The type of road damages in Tashkent region can be grouped by 3 (three) types of damages such as:

- a) type of cracks;
 - b) type of disintegration, dominated by potholes, this one is began in the form of ravelling;
- and
- c) type of depression, it is began with the deformation.

In the CIS, many researchers have dealt with the problems of road surface cracks, but in the conditions of Uzbekistan, the dependence of cracks on the strength of the road surface and natural climatic factors has not been fully studied. The results of the research show that in order to increase the tensile strength of the lower part of the pavements, it is advisable to strengthen the lower layer with geosynthetic materials, because only the upper part of the pavement tends to stretch more under the influence of temperature when the loads work together, they reduce the tolerance of the bottom part.

Several maintenance project has been done to improve the road condition. In the future it is important to design the road which consider the factors that effect the road damages and to consider the overloading of vehicles.

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