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NORMS ACCORDING TO THE INTERNATIONAL ROUGHNESS INDEX OF ROAD PAVEMENTS IN THE REPUBLIC OF UZBEKISTAN

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Annotation. *This scientific article presents an analysis of the norms of the roughness of road pavement in foreign country. Based on the results obtained from the experimental research work on measuring the international roughness index (IRI) of road pavements on many years of various highways by studying their experience, norms on the roughness of road pavements in the Republic of Uzbekistan are recommended.*

Key words: *Automobile roads, road pavements, elements of the road pavement, road roughness index, road roughness measurements, asphalt, concrete, international roughness index (IRI).*

Introduction. Roughness is an important pavement characteristic because it affects not only ride quality but also vehicle delay costs, fuel consumption and maintenance costs. Roughness measurements are used for dividing the road section into statistically homogeneous units, establishing the preferences for maintenance and rehabilitation, and in other aspects of pavement surface characterization. Currently, one of the problems of the road industry is to increase the performance of pavements and increase their exploitation life. Road pavement is one of the most important components of the road. The cost of its devices in some cases reaches 50-70% of the total cost of construction. The condition of the pavement greatly affects the speed, safety and comfort of traffic. Road pavement is a complex structure consisting of successively laid layers of road building materials with different strength characteristics. These indicators must be carefully taken into account so that the road pavement can meet all the requirements for it and ensure the safe movement of cars at any time of the year at the calculated speed and convenience of car

traffic. It is known that the road structure consists of the following elements: pavement, bases, additional base layers and the active zone (working layer) of the subgrade.

Methods. In this paper, research is specialized to survey by using statistic analyzing and rewriting new recommendation by getting correlation. The designed and built pavement should not only be reliable and durable, but also even, as well as economical and should comply with environmental requirements. Roughness, strength and other indicators of pavement must be assigned on the basis of standards.

Result and Discussion. Currently, many countries have developed various standards for roughness, strength and other indicators of pavement. In most CIS countries and far abroad, standards have been developed to assess the roughness of the pavement surface. In the countries of the customs union (Russia, Belarus, Kazakhstan, etc.), standards for the equality of roads during the period of construction and overhaul (or reconstruction) on the IRI scale have been developed, which are shown in table 1 and the standards during the period of road operation are given in table 2.

Table 1.

№	Countries	Category and type of coverage	The number of the international index of equality IRI (m(km) with different estimates			
			Perfectly	Good	satisfactorily	unsatisfactory
1	Russia [1]	I - Category HAC and CC	Till 1,2	1,2-1,7	1,7-2,1	>2,1
		II - Category HAC and CC	Till 1,7	1,7-2,2	2,2-2,6	>2,6
		III- Category HAC and CC				
		III- Category CAC, black rubble and stone	Till 3,2	3,2-3,7	3,7-4,1	>4,1

		materials treated with binders				
2	Kazakhstan [2]	I - Category HAC and CC	Till 2,0	2,0-2,3	2,3-2,4	>2,4
		II- Category HAC and CC	Till 2,5	2,5-2,8	2,8-3	>3,0
		III- Category HAC				
		III- Category CAC, black rubble, and stone materials treated with binders	Till 3,5	3,5-3,8	3,8-4,2	>4,2
3	Belarus[3]	I- Category HAC and CC	-	-	-	>1,5(2,0)[x]
		II- Category HAC and CC	-	-	-	>2,0[x]
		III- Category HAC and CC				
		III- Category CAC	-	-	-	>2[x x]

Note to table 1: X - H norm 1.5 for new construction, norm 2.0 after reconstruction or repair; XX-norm only for cold asphalt concrete. HAC

hot asphalt concreate - hot asphalt concrete, CC - cement concrete (cement concrete) , CAC (CAC) - Cold asphalt concrete.

Table 2.

№	Countries	Category of road and type of coverage	Valid value IRI (m/km)
1	Russia [1]	I - Category HAC and CC	Till 3,4
		II- Category HAC and CC	Till 3,5
		III- Category HAC and CC	Till 4,2
		III- Category CAC	Till 4,9
2	Kazakhstan [2]	I- Category HAC and CC	Till 3,4
		II- Category HAC and CC	Till 3,8
		III- Category HAC and CC	Till 4,1
		III- Category CAC	Till 4,8
3	Belarus [3]	I- Category HAC and CC	Till 4,5
		II- Category HAC and CC	Till 5,5
		III- Category HAC and CC	Till 6,2
		III - Category CAC	Till 6.2

Note: HAC-hot asphalt concrete, CC- cement concrete , CAC-cold asphalt concrete.

Data from far abroad standards for equality in table 3 after construction and during the operation of roads are given in table 4.

Table 3.

No.	Countries	The value of the international indicator IRI (m / km) with the following quality characteristics of roughness				
		Great	Fine	satisfies eloquently	dissatisfied eloquently	Very bad
1	Finland[4]	Till 1.7	1.7-1.9	1.9-2.1	> 2.1	>4.2
2	Canada [5]	Till 1.0	1.0-2.0	2.0-3.5	3.5-5.0	> 5.0
3	Brazil The World Bank [6]	Till 1.3	-	-	>3.5	-
4	The IRI roughness Scale [7]	Till 1.3	-	-	>3.5	-

Table 4.

No.	Countries	Horn categories and coverage type	Allowable IRI value (m/km)
1	Belgium [8-9]	I- Category HAC and CC	Till 2.0
		II - Category HAC and CC	2.0-4.0
		III - Category HAC and CC	4.0-6.0
		III - Category CAC	Till 6.0
2	USA [10-11]	I - Category HAC and CC	Till 2.4
		II- Category HAC and CC	Till 3.2
		III-Category HAC and CC	Till 3.2
3	Sweden [12]	I - Category HAC and CC	Till 1.5
		II- Category	1.5/2.5
		III-Category	2.5/3.5
		III - Category CAC	3.5/4.5
4	Brazil, World Bank [6, 13]	I- Category HAC and CC	4.0
		II- Category	4.0/6.0
		III-Category	6.0/8.5
5	Germany (FILTER PLARC) [14]	I- Category HAC and CC	Till 1.5
		II- Category	Till 1.5
		III-Category	1.5-3.5

The table which given above, the international fluency index is IRI (International Roughness Index) assessment is used in many countries. For this reason, using the equipment of the mobile "TRASSA" laboratory of the State unitary enterprise "Road Expertise" under the "Uzavtoyol" committee of the Ministry of Transport of the Republic of Uzbekistan, on the basis of the cooperation with them, for many years, joint measurement of traffic flow was carried out on different categories of highways in the

Republic of Uzbekistan. International Roughness Index IRI(International Roughness index) , represents the ratio of the total displacement of the unsprung mass of the car (this is its wheels) relative to the sprung mass (this is the body of the car) to the length of the road section (m/km or mm/m). It is determined by calculation as a result of modeling the movement along the microprofile of ¼ of the reference car at a speed of 50-80 km/h. When measuring with a profilometer, the calculation of the IRI index (m/km or mm / m) is carried out by using the software included in the measuring equipment. The evenness index IRI is determined by the following algorithm. The movement at a speed of 50-80 km/h of a two-mass model of ¼ of a car part is considered. The well-known model for measurements with a profilometer used in the calculation of the IRI index is shown in fig. 1.

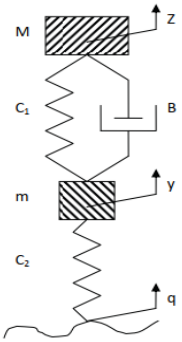

Fig. 1. Two-mass model adopted for the calculation of IRI:

M - sprung mass, kg; m - unsprung mass, kg;
C 1 - suspension stiffness, N / m;
C 2 - tire stiffness, N / m;
B is the coefficient of viscous friction of the suspension, N · s/m;
z - vertical displacement of the sprung mass, m ;
y - vertical displacements of the unsprung mass, m ;
q – vertical disturbance from the surface of the carriageway (microprofile), m .

The equations of motion for the presented model have the form:

$$\begin{cases} Mz + B(z-y) + C_1(z-y) = 0 \\ my - B(z-y) + C_1 z + (C_1 + C_2) = C_2 q \end{cases}$$

$C_1/M = 63.3\ s^{-2}$; $C_2/M = 653c^{-2}$; $B/M = 6c^{-1}$; $m/M = 0{,}15$.

In calculations, it is allowed to take M = 1.

The IRI indicator is determined by the formula:

$$IRI = 1/L \cdot \int_0^T |z - y| dt$$

Where: T is the travel time on the road section, s ;

L is the path (km) traveled in time T at a model speed of 50 - 80 km/h.

Using the mobile "TRASSA" laboratory shown in Fig. 2, the IRI of various types of car roads was determined.

The data collected on the international flow index IRI measured by the portable "TRASSA" laboratory for many years, of different categories and with different coatings were analyzed, and the evaluation values based on the international flow index IRI required by the importance, category and type of coating of highways in Uzbekistan are given in table 5

Fig. 2. A view of the TRASSA mobile laboratory with measuring instruments

Table 5. Requirements for assessing evenness according to the International IRI indicator depending on the functional value, road category and types of surface

No	The value of the road	Road category	Coating type	The value of the international evenness index IRI at its various estimates, (m / km)				
				Great	Very good	Fine	Satisfactory	Unsatisfactory
1	International	I (I a and I b)	Hot asphalt concrete	Till 2,1	2,1 – 2,5	2,5 – 3,1	3,1 – 3,9	Over 3,9
			Cement concrete					
2	State	II	Hot asphalt concrete	Till 2,8	2,8 – 3,3	3,3 – 4,0	4,0 – 4,9	Over 4,9
			Cement concrete					
		III	Hot asphalt concrete	Till 3,2	3,2 – 3,8	3,8 – 4,7	4,7 – 5,8	Over 5,8
			Cold asphalt concrete	Till 3,5	3,5 – 4,2	4,2 – 5,1	5,1 – 6,2	Over 6,2
3	Local	IV	Cold asphalt concrete	Till 4,4	4,4 – 4,9	4,9 – 5,6	5,6 – 6,5	Over 6,5
			Black rubble	Till 4,7	4,7 – 5,3	5,3 – 6,1	6,1 – 7,2	Over 7,2
			Stone materials treated with binders					
		V	black rubble	Till 6,1	6,1 – 7,1	7,1 – 8,5	8,5 – 10,1	Over 10,1
			Stone materials treated with binders					
			Crushed stone or gravel	Till 6,5	6,5 – 7,6	7,6 - 8,9	8,9 – 10,6	Over 10,6

Conclusion. The following conclusions can be made based on the results of the experiment surveyed through the years to determine the flow of traffic on the highways of the Republic of Uzbekistan:

1. The standard for assessing the roughness of newly constructed road surfaces has been developed and its results are recommended.

2. As a result of the assessment of the highways in operation based on the recommended norms, it allows to carry out capital repair works.

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