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THE RESEARCH OF POSSIBILITY OF USING RUBBER ELEVATED PEDESTRIAN CROSSING

The probability to get in road accident with lethal outcome in Ukraine is five times higher than in Western European countries. The main causes of road accidents that lead to deaths are: inappropriate speed (49%); coming out onto oncoming lane (20%). The experience of many countries shows that the installation of road signs that limit the speed does not give the desired effect without additional measures.

In the speed range of 40 - 60 km per h there is a high probability of death of a pedestrian. The explanation is that when emergency braking (on dry surfaces) vehicle moving:

- at a speed of 40 km per hour it will stop through 20 meters;
- at a speed of 60 km per hour - through 20 m vehicle is still moving at a speed of 55 km per hour.

In some countries, the combination of trapezoidal hamp with pedestrian crossing is widely practiced, forming the so-called elevated pedestrian crossing. Its goal is additional safety for pedestrians. Hamps are artificial inequalities on the driveway, arranged to hold the speed of the vehicles in areas of potential danger of road accident. The use of hamps can provide a reduction in the number of road accidents to 60%. Adopting the progressive world practices it is offered to use the elevated pedestrian crossings made of rubber.

When making and arranging the elevated pedestrian crossing the following technical conditions must be taken into consideration:

- the process of vehicle tracking on the increased inequality and moving out from it ;
- physical and mechanical features of the rubber type of coating crossing.

There is a hit on the obstacle when rolling wheel meets with the increase in coverage accompanied by compression springs and tires (or strut). Impact force depends on the height and form of obstacles, wheel elasticity and speed. The higher the obstacle is, the more intense is the second hit in the fall of wheels on the pavement after the descent of the obstacles. When hitting the pavement tire is compressed. As the tire is being compressed the pressure on pavement increases. The greater rigidity tire module is, the shorter the stroke is and therefore higher speed and compression acceleration are. If we denote the maximum compressing of the tire when hitting on coating u_{max}, so the maximum dynamic force applied to coating at tire stiffness modules k

$$G\partial = ku_{\max} . \qquad (1)$$

When considering hit on the hard road pavements it is possible to neglect its deformation, comparatively small to the deformation of the tire, so the module of pavement hardness is considered to be large. In this case, the energy acquired by wheel at compression on $u_{max}=(u+\Delta)$, equal $k(u+\Delta)$ x $(u+\Delta)$, should be equal to the energy of wheel drop in cavity

$$G=(h+u), \tag{2}$$

where h – a deep of cavity.

So,

$$u=\sqrt{\frac{2Gh}{k}-\Delta^2}, \tag{3}$$

where $\Delta=\frac{G}{k}$ - static pressure of tire;

u – impact additional tire pressure.

A measure of energy loss can serve as a coefficient of impact restitution. The coefficient of impact restitution ranges from 0.60 to 0.82 by changing the air pressure in the chamber in the range of 0 to 5 at for lorry tires and hard surfaces. Thus, taking into account the impact energy loss the wheel against coating, the value of dynamic compression of the tire,

$$u=e\sqrt{\frac{2Gh}{k}-\Delta^2}, \tag{4}$$

and maximum acceleration of wheel, that falling from height h

$$w_{\max}=n^2u_{\max}=\frac{kg}{G}e\sqrt{\frac{2Gh}{k}-\Delta^2}=eg\sqrt{\frac{2kh}{G}-1}, \tag{5}$$

where n – the circular frequency of natural oscillations of the wheel.

Through the emergence of dynamic forces when driving on uneven road surface wheel pressure on pavements is heavier than at the static impact. In determining the dynamic coefficient as the ratio of sum static and dynamic power to the static, we get the expression for wheel weights G, falling in pothole deep h

$$\gamma=1+e\sqrt{\frac{2kh}{G}-1}. \tag{6}$$

The criterion for assessing longitudinal stability is the critical angle of ascent overcome with constant speed without slipping driving wheels and is given by:

$$\alpha=arctg\left(\frac{a\cdot\phi}{L-h_{ц.т.}\cdot\phi}\right), \tag{7}$$

where a - distance from the center of gravity of the vehicle to its front axle, m;

L - base of car, m.

Performed calculations for the vehicle when empty and laden at different values of coefficients φ was summarized in the table. 1.

Table 1

The critical angle of ascent

The critical	The coefficient of tire adhesion

angle of ascent,°	Surface dry - 0,6	Surface wet - 0,5
Without load	44	37
With full load	45	39

The minimum critical angle of ascent for asphalt and cement-concrete cover is minimum, and it is the maximum at ice. Table 2 shows the design parameters of elevated pedestrian crossings and the desired speed limit of vehicles.

Table 2

Design options elevated pedestrian crossings and the desired speed limit of vehicles

Maximum speed, indicated on the sign, km / h.	Wavelike profile			Trapezoidal profile			
	Length (L), m	The maximum height of the crest (H), m	The radius of the curved surface (R), m	The length of the horizontal platform (Lr), m	The length of the sloping section (L_H), m	The maximum height of the crest (H),m	The angle of the inclined surface, %
20	3,0-3,5	0,07	11,0-15,0	2,0-2,5	1,0-1,15	0,07	14,1
30	4,0-4,5	0,07	20,0-25,0	3,0-5,0	1,0-1,4	0,07	10,0
40	6,25-6,75	0,07	48,0-57,0	3,0-5,0	1,75-2,25	0,07	6,0

Conclusion: the reduction of vehicle speed by applying elevated rubber pedestrian crossings will reduce the number of road accidents.