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DYNAMICS OF VEHICLE LOADS ON THE ASPHALT PAVEMENT OF EUROPEAN ROADS WHICH CROSS LITHUANIA

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Abstract. The largest damage to the road pavements is caused by the heavy goods vehicles (HGV's). Due to large axle loads, which often assume a dynamic effect, the HGV's account for almost the total destructive impact on the road pavement, though they make about 15 % of the total traffic flows on the main roads of Lithuania. A continuous increase in the transit HGV's on the Lithuanian roads causes the permanent deformations of road pavements. Due to the insufficient pavement strength the ruts, waves, displacements and potholes are initiated. Based on the analysis of traffic volume it could be stated that the amount of vehicles on our roads has been annually growing. The largest loads are caused by HGV's, the average annual increase of which is 17 %. Based on the traffic volume measurement data of the Transport and Road Research Institute (TRRI) the annual average daily traffic (AADT) and the impact of the HGV's on the road pavements was identified on separate sections of the roads E85 and E67. The impact was determined by calculating the equivalent standard axle (ESA).

Keywords: asphalt pavement, traffic volume, heavy goods vehicle (HGV), axle loads, equivalent of standard axles (ESA), dynamic loads.

1. Introduction

The most important designation of the main roads is to ensure the inter-state communication. These roads guarantee the largest traffic volume, the highest speed, comfort and safety. Therefore the road pavement must be even and strong throughout the economically justified time of its operation [1].

In Lithuania, like in many European countries and other continents, pavement of streets and roads is usually constructed of hot asphalt mix (HAM), suitable for laying pavement layers. Asphalt pavement made of a proper mix and laid on a strong foundation, following the technological requirements, remains sufficiently smooth, strong and durable only if it is affected by the permissible loads of vehicles [2, 3].

Road asphalt pavement affected by non-extreme climatic conditions usually functions for a determined number of years, provided it was constructed within a technological regime, the emerging defects were properly eliminated and the traffic loads meet the calculated values. Actually, the vehicle loads have a stochastic effect on the structural road pavement layers and they continuously increase, while the parameters of climate and weather conditions, especially the temperature and moisture, vary within the interval itself [4, 5].

The increase in traffic loads making the impact on the roads of national importance started to intensively increase after restoration of Lithuania's independence, after the increase of transit vehicles within the total traffic flow. The loads have especially increased after Lithuania joined the European Union. Ten years ago in the article [6] for the first time the need for strengthening asphalt pavements on Lithuanian roads was scientifically justified due to continuous increase in the number of transit heavy goods vehicles (HGV's). It was proved there that the growing flows of transit traffic destroy the road pavement and thus require additional funds for the road repair strengthening.

The increase in the road pavement unevenness and in the rut depth is mostly determined by the HGV's. The damage caused by the axle loads is proportional to the load value raised to the fourth power; therefore a negative impact of the average two-axle truck on the road pavement is equal to that of 500 cars, while the negative impact of a moderately loaded five-axle truck is equal to the impact of 50 000 cars. Even if the total mass of the vehicles does not exceed but it is only improperly distributed for the vehicle axles, the damage of the truck to the road pavement is by 70 000 times higher, if compared to that of the car. In 2004 the traffic volume of HGV's increased by 1,5 times, if compared to the year 2003. This means that a negative impact on the road pavement has increased by 5 times [7].

The lifetime of a flexible pavement is influenced by the inter-bonding of its structural layers. The early deterioration of pavement sections due to the layer separation is quite frequent, especially in those sites where vehicles cause horizontal forces [8]. When the cores from a two-layer asphalt pavement of the motorway were taken, it was determined that in sites of the unbounded upper and lower layers the pavement surface had a more intensive failure, since the accumulated water between the layers penetrated upwards and froze in the pores.

The unevenly distributed loads between the vehicle axles impact on the road pavement, on the structure of bridges and viaducts. Road pavement unevenness still adds a negative effect on the balance of vehicle axles during the vehicle movement. A correct distribution of loads between the vehicle axles and a possible composition of vehicles are one of the main traffic safety factors [9].

The problem of rutting is the result of 3 initial mechanisms: consolidation of excessive traffic on the upper part of the pavement, plastic deformations depending on insufficient stability of the mixture, and the variability caused below the asphalt pavement. Rutting is mostly dependent on traffic loads, the module of bitumen mixture and its sensitivity to further pressure, also on the strength of subgrade [10].

The increasing flows of heavy goods transit vehicles on Lithuania's roads cause the permanent deformations in the road pavements which are further progressing. Because of the insufficient pavement strength the potholes appear [6, 11]. Due to the increase in the traffic volume, in the number of HGV's and in the axle loads of vehicles the deformations of a plastic character, such as ruts or waves, are formed on the roads and streets of Lithuania. Rutting of asphalt pavements indicates a low strength of the road pavement structure. Therefore, when designing the composition of asphalt mixture, it is very important to select a proper percentage of components, to use a rational technological process for erecting new asphalt pavement and to prepare new normative documents corresponding to the change in climatic parameters and the continuously increasing traffic of HGV's [12].

The plastic deformations are mostly formed in the upper layer of asphalt pavement when pavement temperature is from +30 to +60 °C, and the pavement structure is affected by heavy loads, braking and acceleration forces [11, 12].

Hot asphalt road pavement is cracking under the repeatable permanent loads. Higher bitumen content results in a more flexible pavement mix which is more prone to rutting, particularly at high temperatures [13].

In Indonesia [14] to reduce a possible rutting of the upper asphalt pavement layer it is suggested when designing the composition of hot asphalt mixture to identify a transversal shear modulus showing the resistance to share deformation. When strengthening the road pavement structures in Lithuania by the overlays, the reinforcing geosynthetic grids are used [15]. The road pavement structure could be renewed, strengthened and reconstructed by applying progressive methodologies [16].

In Taiwan [17], due to financial restrictions, which are relevant also to Lithuania, the main transport projects are rated in an analytical and hierarchical process, using the Monte Carlo method. In this way the project implementation priorities are determined and a budget is allocated.

Main roads network will be developed (expanded), because of increasing traffic. The best construction method could be determined by Germany experience, using software LEVI 3.0 [18]. To improve asphalt pavement quality of new and reconstructing roads is rational to use three-level quality control system – strategic, tactical and operative [19].

The drivers have a possibility to choose the most rational route determined according to several optimal criteria modelled by the Geographic Information System (GIS) [20]. Most often they choose the main road which is also used by the HGV's causing the largest damage to the road pavement.

Modelling public transport routes [21] it is necessary to evaluate passenger vehicles axle loads and road pavement structural stiffness.

Though Lithuania is not listed among the countries of hot climate, the influence of vehicles on the dynamics of rutting of the main asphalt roads in recent years have no sufficient investigations yet.

The aim of this paper – by using the recent data of traffic counts and vehicle axle loads to determine the dynamics of the traffic volume on the main Lithuanian roads and the dispersion of HGV's loads in separate sections of the same road based on the equivalent standard axle (ESA).

2. Traffic counts and traffic flows on the roads of Lithuania

Traffic counts are carried out in all developed countries having a good road infrastructure. The counts are necessary when preparing programs for road development, renovation and repair. The lack of accurate data on traffic volume leads to mistakes in choosing the road pavement structure and this reduces the service life of the pavement structure.

In Lithuania, traffic volume has been identified for a number of years. At present the Transport and Road Research Institute (TRRI) stores data on the annual average daily traffic (AADT) from 1987 to 1996, when traffic volume was determined by counting the travelling vehicles and filling in special sheets. Then the results of visual counts were re-calculated to AADT. Since 1997 the traffic counts are performed automatically using the special equipment [22]: the counters-classifiers Marksman 400 and Marksman 660. The counters-classifiers perform the following functions:

- calculate the number of passing vehicles in a given time interval;
- carry out classification of vehicles. The device calculates the number of vehicle axles and the distance between them and makes the vehicle classification.
- measure the speed of the moving vehicles.

Based on the TRRI data of traffic volume from 2002 to 2006 and on the analysis of European motorways, crossing Lithuania in all directions, the majority of which coincide with the Trans European Network (TEN) corridors (Table 1), it could be stated that the total AADT on Lithuania's roads has been increasing every year. After the traffic flow was classified into the light and heavy vehicles according TRRI using international EUR6 and EUR13 classification system, it was noticed that the annual increase in the percentage of light vehicles was 7,4 % (Fig 1). The increase is almost stable, with its average values close to 7 % and almost unchanged since 1995.

The annual increase in the total number of HGV's in 1995–2006 was 17,3 % on average, whereas in 1995–2001 the annual increase was only 10,5 % (Fig 2).

3. HGV's loads and their restrictions in Europe

The structure and the type of road pavement shall be selected taking into account the traffic volume and its composition, the road category, climatic and geological conditions, also the availability of local building materials [1]. Pavement structures could be selected by special calculation methods, the standard structures – according to the HGV's index. The HGV index describes the impact of heavy traffic on the pavement structure. The HGV index is determined by taking into consideration: the designed traffic volume of HGV's with the gross vehicle mass of more than 5,0 t, the increased axle load (11,5 t) on he main roads; the number of traffic lanes, their width and the gradient of longitudinal section. The HGV index is applied when selecting the standard pavement structures.

When designing Lithuanian roads in the past, the maximum axle load was 100 kN. After Lithuania became independent and the borders were opened, there was an international need to increase the maximum axle load up to 115 kN, since this and even larger permissible axle loads were applied in the most European countries (Table 2).

Not necessarily a heavier truck has to make a larger damage to the asphalt pavement. A 44 t truck having 6 axles and an evenly distributed load can do less damage than a 40 t truck with 4 or 5 axles. Some countries of the European Union allows the gross mass of the truck to reach 50 or 53 t, but it is very important that the axle load would not exceed the limit value for the load (Table 2).

Table 1. European motorways and TEN corridors crossing the Republic of Lithuania

E-roads	TEN corridors
E85 (Klaipėda–Kaunas–Vilnius–Lida–Cernovcy–Bucharest–Alexandropoulos)	**IX B** (Minsk–Vilnius–Klaipėda)
E67 Via Baltica (Helsinki–Tallinn–Riga–Panevėžys–Kaunas–Warsaw–Wroclaw–Praque)	**I** (Via Baltica)
E77 (Pskov–Riga–Šiauliai–Kaliningrad–Warsaw–Krakow–Budapest)	**I A** (Riga–Šiauliai–Tauragė–Kaliningrad)
E262 (Kaunas–Utena–Daugavpils–Rezekne–Ostrov)	–

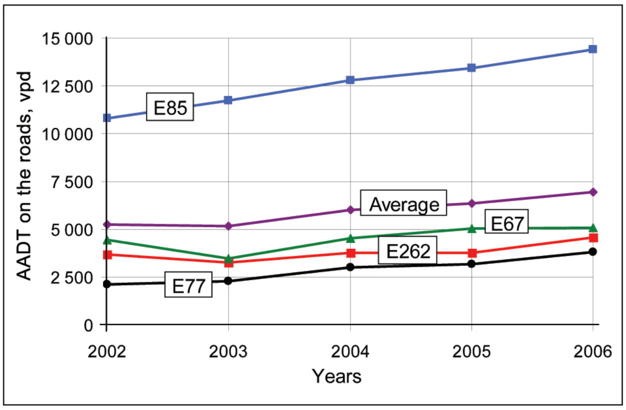

Fig 1. Dynamics in the AADT of light vehicles on E-roads crossing the Republic of Lithuania

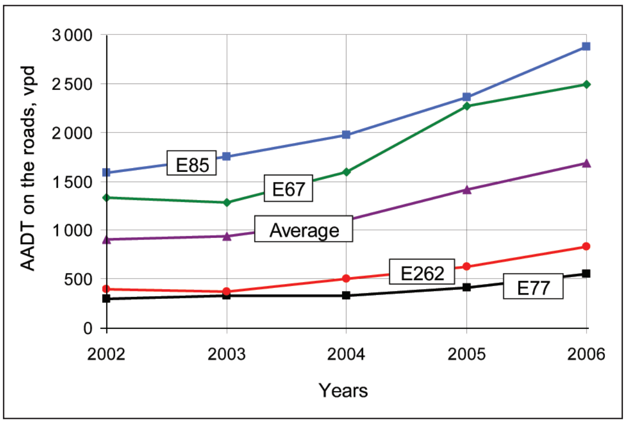

Fig 2. Dynamics in the AADT of heavy vehicles on E-roads crossing the Republic of Lithuania

Table 2. Limits for the mass (t) of vehicles with trailers and semitrailers in the European Union

Country	Truck mass (t) and the number of axles			Permissible axle load, kN
	4	5	6	
Austria	38	38	38	115
Belgium	39	44	44	120
Denmark	38	44	48	115
Finland	36	44	53	115
France	38	40*	40*	130
Germany	36	40	40*	115
Greece	38	40	40	115
Ireland	35	40	44	105
Italy	40	44	44	120
Luxembourg	38	44	44	120
Netherlands	41	50	50	115
Portugal	38	40	40	120
Spain	38	40	40	115
Sweden	38	40	40	115
United Kingdom	38	40	44	115
Restrictions of EC for international transportations	38	40*	40	115

*for articulated road trains 44 t are allowed, if their axle load is less than 100,5 kN.
Austria allows a 5 % tolerance up to 40 t. Austria also allows 42 t for container transport.
In Sweden a higher mass is allowed for certain articulated road trains.
In UK the excise duties on 4-axle and 38 t trucks are significantly higher, thus such trucks are not often used.

Loads on the road pavement depend on the total weight of the truck and the trailer and on how evenly this weight is transmitted to the road through the truck axles. Namely the load of each axle, but not the maximum weight of the truck causes more rapid pavement deterioration. If the load is evenly distributed and a large load on one axle is avoided, it is possible to reduce pavement deterioration. The occurrence of plastic deformations in road pavements is also influenced by the distances between the axles.

Besides the axle loads and the limits to the maximum weight set by the European Union there are more factors determining a more rapid pavement deterioration. These are decisions on the design of trucks because of which the static and dynamic loads are increased [23, 24]:

- wide single wheels can cause static larger than the tandem;
- single wheels are from 1,5 to 2 times more dangerous to the appearance of ruts than the tandem;
- the driving wheels of trucks cause a higher damage to the road pavement than that of their trailers;
- pneumatic suspension, otherwise called „a road friendly suspension“ causes less damage than a steel suspension spring.

Dynamic loads having the effect on the road pavement are from 10 to 30 % larger than the static. This depends on the vehicle speed and road roughness. However, if a permissible maximum axle load (115 kN) assumes a dynamic character, it will increase by 30 % and can reach even 150 kN. When designing roads it is necessary to significantly strengthen some places of the road pavement in order to take the account of dynamic loads. If we design pavement taking into account the static loads, only this can result in the reduction of its lifetime by one fourth. The road pavements must be designed of a uniform strength and rigidity in the whole road section. Weak locations, affected by the dynamic loads, start to speedily break, crack or fail. If the traffic lane is narrow, the tensile strains in the road pavement are bigger and the pavement lifetime could be reduced even by 40 % [24].

4. The impact of vehicle axle loads on the road pavement

Road reliability is characterised by a probability to guarantee the average annual technical speed of the transport flow, which is close to an optimal speed throughout the designed period of the road pavement structure. This probability is quantified by a proportion between the number of vehicles, the speed of which is not lower than the optimum speed, and the total number of vehicles. If the traffic volume is increasing in a geometric progression, the calculated lifetime of the road pavement structure is defined by the following formula [25]:

$$t_f = 1 + \frac{1}{\lg q} \lg\left(\frac{1}{T_f} \frac{q^{T_f} - 1}{q - 1} \right), \quad (1)$$

where q – the denominator of a geometric progression which shows the annual increase in the traffic volume; T_f – the factual (real) lifetime, years.

A sharp decrease in the road reliability, varying by an exponential function, starts after 12 years of the use of the road pavement structure. The decrease in the road reliability starts after the calculated lifetime T_f of the road pavement structure [25].

Reliability of the road pavement structure is identified by the following equation [25]

$$p = 1 - r_i, \quad (2)$$

where p – reliability of strength of the road pavement structure; r_i – deformation degree of the road pavement structure:

$$r_i = 1 - \frac{1}{\sigma_k \sqrt{2\pi}} \int_{K_{st_1}}^{K_{st_2}} \exp\left[\frac{(K_{st} - \overline{K}_{st})^2}{2\sigma_K^2} \right] dK_{st}, \quad (3)$$

where σ_K – standard deviation of the strength coefficient of the road section with the permanent deformations; $\overline{K}_{st}$ – the average strength coefficient of this road section, usually $\overline{K}_{st} = 0{,}7$; $K_{st} = E_f / E_r$ – the factual and the required e-modulus of the road pavement structure, correspondingly; K_{st_1}, K_{st_2} – numerical value of strength coefficients, between which r_1 is determined.

At present Lithuania uses the ESA of the impact of traffic flow on the pavement, expressed by the index ESA, which is commonly used all over the world. This calculation method of the load impact on the pavements is applied in Lithuania because of its compatibility with the Highway Design and Maintenance Standards Model HDM-3/HDM-4. In pavement design systems there is a commonly used method to evaluate the impact of vehicle axles on the deterioration of road pavements based on which the impact of the axle with a certain standard load (usually 80 kN or 100 kN) is equated to one. The impact on the pavement deterioration which is exerted by the axle which load differs from the standard is called the equivalent of standard axles. The impact on the road pavement deterioration of all the axles of a certain vehicle is calculated according to the formula:

$$ESA80_V = \sum_{i=1}^{n} \left(\frac{A_i}{80} \right)^4, \quad (4)$$

$$ESA100_V = \sum_{i=1}^{n} \left(\frac{A_i}{100} \right)^4, \quad (5)$$

where $ESA80_V$ – total equivalent of vehicle standard axles (when the assumed standard load is 80 kN), units.; $ESA100_V$ – total equivalent of the standard axles of a vehicle (when the assumed standard load is 100 kN), in units; n – total number of axles of a vehicle; A_i – i-axle load of a certain vehicle, kN; 80, 100 – standard axle load, kN.

The fourth-power equation indicates the structure of the road pavement and thickness of the layers [26].

The average annual daily impact of traffic flow on the deterioration of pavement of a given road section is calcu lated as:

$$ESA80_R = \sum_{i=1}^{n} N_j \times ESA80_{Vj}, \quad (6)$$

$$ESA100_R = \sum_{i=1}^{n} N_j \times ESA100_{Vj}, \quad (7)$$

where $ESA80_R$, $ESA100_R$ – average annual daily impact of traffic flow on the deterioration of pavement of a given road section, in units; j – the number of vehicle classes according to the classification table; N_j – average annual daily traffic volume of j-class of vehicles, vpd; $ESA80V_j$, $ESA100V_j$ – the average of the standard axle equivalent of j-class of vehicles which is identified by the statistical analysis.

During the tests of TRRI the average axle loads of the different vehicle classes were determined which are necessary to calculate the ESA index. These values are given in Table 3.

Let's make the analysis of the mostly loaded Lithuanian roads in respect to traffic volume as well as the flows of heavy traffic. These are the roads E85 and E67. The roads run to the East–West (E85) and South–North (E67) directions. They both cross each other in the central part of Lithuania, at the Kaunas city. Having analysed and systematised data on traffic volume collected by the counters-classifiers in 2006, we draw the curves (shown in Figs 3–6) which show the distribution of AADT of light vehicles and the impact of their axles on the road pavement according to *ESA*80 index on the whole road Vilnius–Kaunas–Klaipėda.

For example, calculate the biggest light vehicles $ESA80_R$ value from Fig 3. Total number of AADT is equal to 33109 vpd (27 motorcycles, 28866 cars, 2442 minibuses and 1774 light goods vehicles – this is N_j from Eq (6)) in 98[th] kilometer where traffic intensity is counting. If we multiply each particular light vehicle class AADT value with each particular light vehicle class $ESA80_V$ (Table 3)

Table 3. Average ESA's of different classes of vehicles

Vehicles types	Classes	$ESA80_V$, kN	$ESA100_V$, kN
Motorcycles	MOTOC	–	–
Cars	LA	0,000 3	0,000 1
Minibuses	MINIAUT	0,027 4	0,012 1
Buses	BUS	2,663 7	1,179 3
Light goods vehicles	LS	0,026	0,011 5
Medium class trucks	VS1	0,027 4	0,012 1
Medium class trucks	VS2	0,600 8	0,266
HGV 3 axle	3AŠ	2,625	1,162 1
HGV 4 axle	4AŠ	2,343 7	1,037 6
HGV 5axle	5AŠ	4,645 4	2,056 6
Tractors	TRA	0,041 5	0,018 4

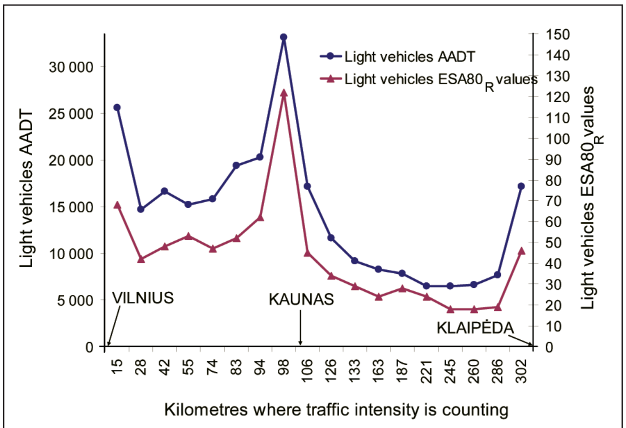

Fig 3. AADT of light vehicles and the impact of their axle loads on the pavement of E85 (Vilnius–Kaunas–Klaipėda)

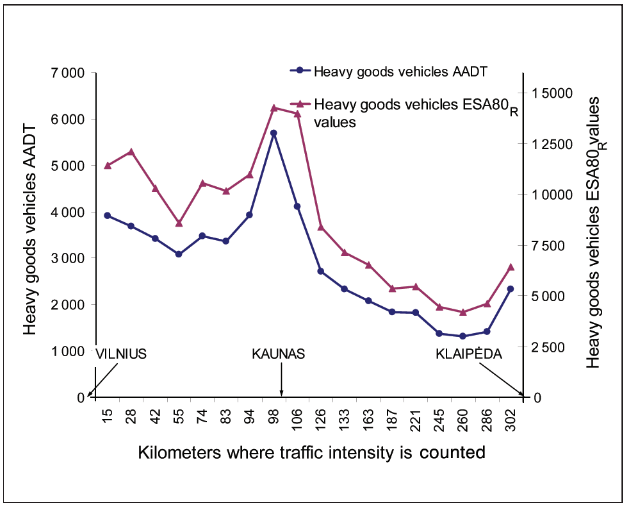

Fig 4. AADT of HGV's and the impact of their axle loads on the pavement of the road E85 (Vilnius–Kaunas–Klaipėda)

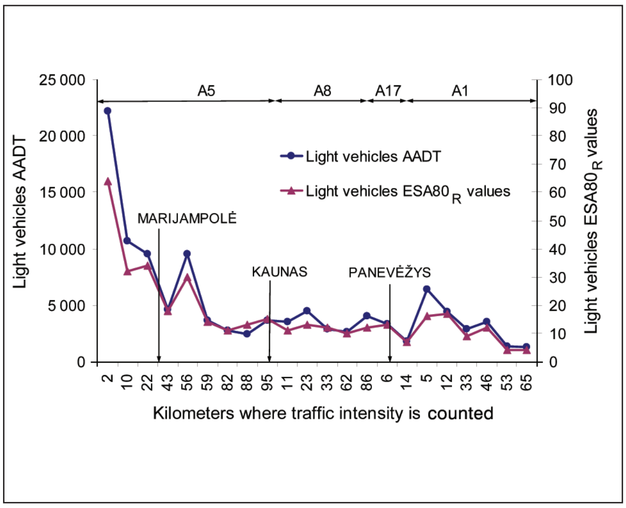

Fig 5. AADT of light vehicles and the impact of their axle loads on the pavement of the road E67 (Via Baltica)

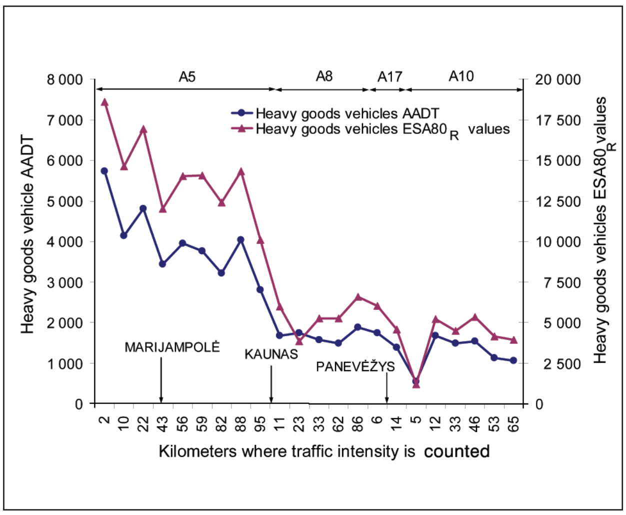

Fig 6. AADT of HGV's and the impact of their axle loads on the pavement of the road E67 (Via Baltica)

and sum results, we will get the total number of light vehicles ESA index $ESA80_R$ rate in 98th km – $ESA80_R$ = 121,7 units.

The graph shows that the largest traffic flows are concentrated at the biggest cities of Lithuania. In 2006 the average number of vehicles on this road was 17 281, of which 14 402 were light vehicles making on average 83 % of the total traffic flow. Traffic volume of the whole road is not evenly distributed, a higher volume could be observed on the Vilnius–Kaunas road section. The calculated average annual daily impact of light vehicles on the pavement deterioration on the whole road sections allows to state that, in spite of a high flow of light vehicles on this road section, the index of the impact of light vehicle axles on the pavement is not high. The highest value reaches $ESA80_R$ = 122 units. If we compare the volume of HGV traffic and its average annual daily impact of axle loads on pavement deterioration (Fig 4), the result would be just the opposite. The flow of HGV traffic makes 17 % of the whole traffic volume and the highest average annual daily value of HGV traffic volume was recorded at the city of Kaunas, where it reaches 5685 vpd; however, the impact of a HGV axles on the deterioration of road pavement is more than 10 times higher than that of light vehicles. The highest value reaches $ESA80_R$ = 14 251 units.

The transport corridor Via Baltica consists of several main roads of Lithuania: A5 (Kalvarija–Kaunas), A8 (Kaunas–Panevėžys), A17 (the Panevėžys by-pass) and A10 (Panevėžys–Pasvalys–Bauska). The traffic volume of light vehicles is large only on the border crossing section with Poland. The highest AADT of light vehicles is 22 192 vpd (Fig 5). At Marijampolė the traffic flow is distributed into different directions, and on further sections of the Via Baltica the AADT is not high.

The impact of light vehicle axles on the deterioration of pavement of this road is high, the average ESA of light vehicles in Lithuania makes approximately 0,5 % of the total impact on road pavements. However, when analyzing the impact of HGV axles on the pavements an opposite result could be noticed once again, especially on the Lithuanian-Polish border (Fig 6). On this section an especially high annual daily equivalent index of standard axles was calculated $ESA80_R$ = 18 579 units.

Average values are usually applied in the methodology of calculating the ESA. However, when using the average values, the errors could be made in estimating traffic loads on the road pavement. Knowing that the road pavement is least resistant to plastic deformations in a hot summer period, when the pavement temperature reaches 30°–60 °C; having taken into account a seasonal increase in the traffic volume and having chosen the maximum values of traffic volume, it could be predicted that the real impact on the road pavement would be significantly higher, if com-

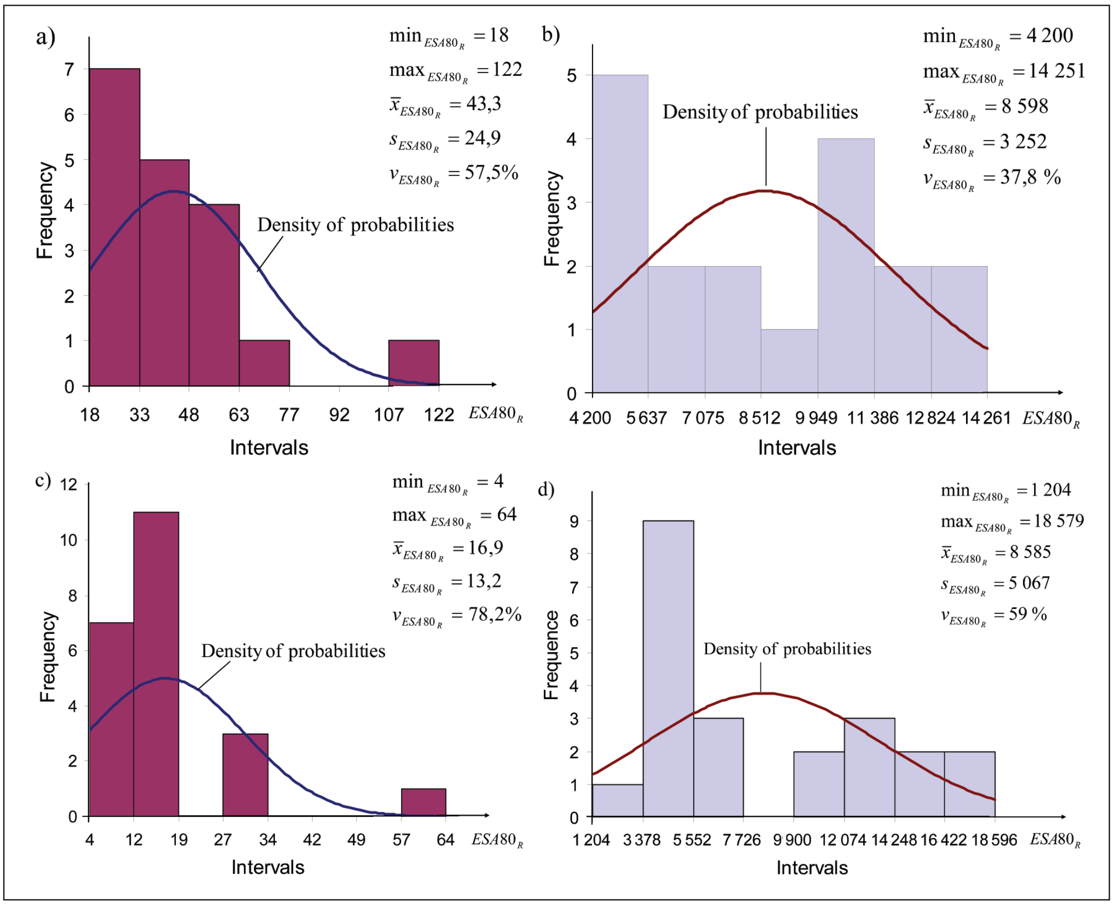

Fig 7. Distribution of statistical indexes of ESA loads $ESA80_R$ on the main roads of the Republic of Lithuania belonging to the European road network : a – light vehicles on the road E85; b – HGV's on the road E85; c – light vehicles on the road E67; d – HGV's on the road E67

pared to the calculated impact based on the average values of the whole year.

In order to analyse how the ESA loads $ESA80_R$ are distributed on roads E85 and E67, the histograms were plotted according to the empirical data (Fig 7). It was expected that the $ESA80_R$ index will be distributed by a normal distribution. Empirical frequencies were levelled by a normal distribution, theoretical frequencies of which are showed in a curve of density of probabilities. The calculated arithmetical average $\bar{x}_{ESA80_R}$ of index $ESA80_R$, standard deviation s_{ESA80_R} and variation coefficient v_{ESA80_R} show different characteristics of the position and dispersion on the study roads and for the vehicles compared (Fig 7). The dispersion of light vehicles $ESA80_R$ is similar to both roads – the curve of normal distribution has a positive skew, but the dispersion of $ESA80_R$ of HGV's has two peaks. This means that the distribution is bimodal.

5. Conclusions

1. Two decades ago the main reason for the deterioration of road asphalt pavements in Lithuania was the insufficient cold resistance resulting in the crumbling of surface layer and appearance of transverse temperature cracks. Currently, the old pavement and what is important the new asphalt pavements become plastically (irreversibly) deformed causing ruts, displacements and waves. The character of this deformation is determined not by climatic factors but by the significantly increased traffic loads per one axle on the main roads and their intensive (frequent) recurrence in a summer period. Inadequacy between the structural strength of road pavement and a mechanical destructive impact of vehicles determines a rapid increase in their irreversible deformations.

2. From 2002 to 2006 the AADT of light vehicles on the main roads of Lithuania grew by 7 % on average, whereas the AADT of HGV's – even by 17 %. Though the traffic volume of HGV's is from several to many times lower than that of the light vehicles due to the impact of HGV axles on the structure of road pavements, it was noticed that 99,5 % of damage to the road pavement is made by the traffic of HGV's.

3. The analysis of the traffic volume and the impact of vehicle axle loads on the pavement of the roads E85 and E67 showed that that the largest traffic volume and the impact of ESA loads could be noticed at the biggest Lithuanian cities and at the Polish border crossing section.

4. The equivalent index of standard axles ESA is calculated in Lithuania based on the AADT and this does not correspond to the maximum values of traffic volume. For this reason during the seasonal increase in the traffic volume the real impact of the axle loads on the road pavement is higher than the average.

5. The average values of $ESA80_R$ of light vehicles show that the road E85 is loaded more than the road E67. The averages values of $Esa80_R$ of the HGV's are almost the same, though on the road E67 the loads vary in a more wide range; the loads on both roads are distributed by a bimodal law.

6. Because of the high traffic volume of HGV's and the tendency for its further growth the road pavements designed several or more years ago are not able to resist the destructive loads of HGV's and this causes a rapid pavement deterioration, appearance of ruts, development of cracks and potholes. It is necessary to immediately strengthen the continuously destroyed asphalt pavement by using advanced technologies. The sections to be strengthened and their length shall be selected by determining the priorities of implementation and by allocating the available financial resources.

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