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TRAVELLING DISTANCE OF VEHICLES IN ROAD TRAFFIC AS AN ADDITIONAL CHARACTERISTIC FOR DESCRIPTION OF ATTRACTIVENESS OF URBAN AREA

Summary. The paper points out the possibility to use the special characteristic of the traffic in urban area - travelling distance of vehicles in road traffic, easily obtained from traffic surveys carried out by recording the vehicle registration codes, as an additional characteristic for description of traffic situation in the area. The analysis and synthesis of experimental measurements were done for the city Kosice - the second largest city in Slovak Republic and the applications of travelling distance of vehicles in road traffic are presented for the description of attractiveness of urban area and the loading of its entrance roads by non-domestic vehicles.

DŁUGOŚĆ PODRÓŻY POJAZDÓW SAMOCHODOWYCH JAKO DODATKOWA CHARAKTERYSTYKA W OPISIE ATRAKCYJNOŚCI OBSZARÓW ZURBANIZOWANYCH

Streszczenie. Artykuł prezentuje możliwości wykorzystania specjalnej charakterystyki transportu w terenie długości podróży pojazdów samochodowych, łatwej do otrzymania z pomiarów, które wykonywane są metodą zapisu numerów rejestracyjnych samochodów jako przydatnej charakterystyki dla opisu sytuacji komunikacyjnej w terenie. Analiza i synteza wyników pomiarów doświadczalnych jest interpretowana na przykładzie miasta Koszyce – drugiego pod względem wielkości miasta w Republice Słowacji. Został zaprezentowany sposób opisu atrakcyjności miasta i obciążenia jego dróg wjazdowych przez samochody z zewnątrz.

1. INTRODUCTION

The data on road network load play an important role in the process of road traffic planning and design of urban road network. In connection with enormous increase of traffic volume, mainly at the entrances and through roads of an urban area, this task is more and more difficult and in the limelight is the problem to obtain as detailed characteristics (structural, traffic and other) of the urban area in question as possible since they would be very helpful to traffic engineers designing a road system with sufficient capacity - traffic, environmental and economic [1]. The knowledge on traffic on a road system mainly on its through roads play the most important role in the decision-making process on the design of a new road system (or the reconstruction of an existing one). It is necessary to characterize the

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vehicles, i.e., to find out their origin and destination, find out whether their occurrence on a given road is inevitable. We need to know for the whole road network of a city mainly:

- the direction of vehicles in the network, route, knots (crossing roads),
- the absolute and relative volume of external traffic (origin, destination, transit),
- the absolute and relative volume of internal traffic (transport relations among quarters),
- mobility and other special characteristics (accident rate, emissions, vibrations, noise, etc.) for the assessment of environmental capacity of roads [2].

Besides traditional traffic characteristics (volume, composition of traffic flows, direction of traffic flows, percentage of transit traffic) new specific characteristics are desirable which would describe better the traffic relationships between the area in question (urban unit) and surrounding area. Such characteristic is the travelling distance of vehicles in road traffic (commuting distance) although it belongs to less used ones in traffic-engineering practice.

The analysis of the possibilities of its applications is under study as a part of the research at our department [2]. In the following section we report the partial analysis and synthesis of the results of experimental measurements carried out on the road system of the city Kosice - the second largest city in Slovak Republic and we present their application for the description of attractiveness of this urban area and the loading of its entrance roads by non-domestic vehicles.

2. DEFINITION OF TRAVELLING DISTANCE OF VEHICLES IN ROAD TRAFFIC

We define travelling distance of vehicles in road traffic (further for simplicity this distance will be referred to as travelling distance) as the distance between the followed cross section of the vehicle occurrence (particular survey point or urban unit) and the capital of district (state) from which the vehicle (we assume) has come, or which is according to the vehicle registration code its residence.

Traffic surveys are necessary for obtaining data on vehicle travelling distance - carried out by the method of recording the registration codes of vehicles. The extent of surveys, their duration and methods used depend on the requirements for detailness of results on vehicle travelling distance. They range from very simple ones - profile traffic surveys in which we obtain only data on vehicle travelling distance related to a chosen profile, from the total traffic in the road profile - to direction traffic surveys in which the traffic can be divided in more detail, i.e., origin, destination and transit vehicles can be identified in relation to a chosen survey point or urban unit.

3. CASE STUDY – VEHICLE TRAVELLING DISTANCE IN KOŠICE

For obtaining detailed results on vehicle travelling distance in Kosice a direction traffic survey was chosen and was carried out by the methods of recording registration codes of vehicles in such a way that the results were obtained for all major roads of the fundamental road system of the city. The survey was carried out at all entrance radial roads of the city - at city cordon - at 9 basic survey points, Fig. 1 [3].

3.1. Brief description of the city road system

The city Kosice is located on two major through roads of international importance to Poland, Hungary and Ukraine. The basic road system of the city is radial - circular : outer ring, inner ring, major radial roads and other roads, it consists of highways, entrance road to motorway and other local roads. From the point of view of vehicle travelling distance - the

relation of the city road system to the superior road network, the following through roads going through the city have the decisive role (Fig. 1):

- I/68 - direction north - south (Poland - Hungary),
- I/50 - direction east - west (Czech Republic - Ukraine),
- II/547 Čermeľ - Jahodná,
- II/548 Pereš - Lorinčík,
- II/552 VSS - Krásna nad Hornádom and
- through roads of III. classification (III/5472, III/50192).

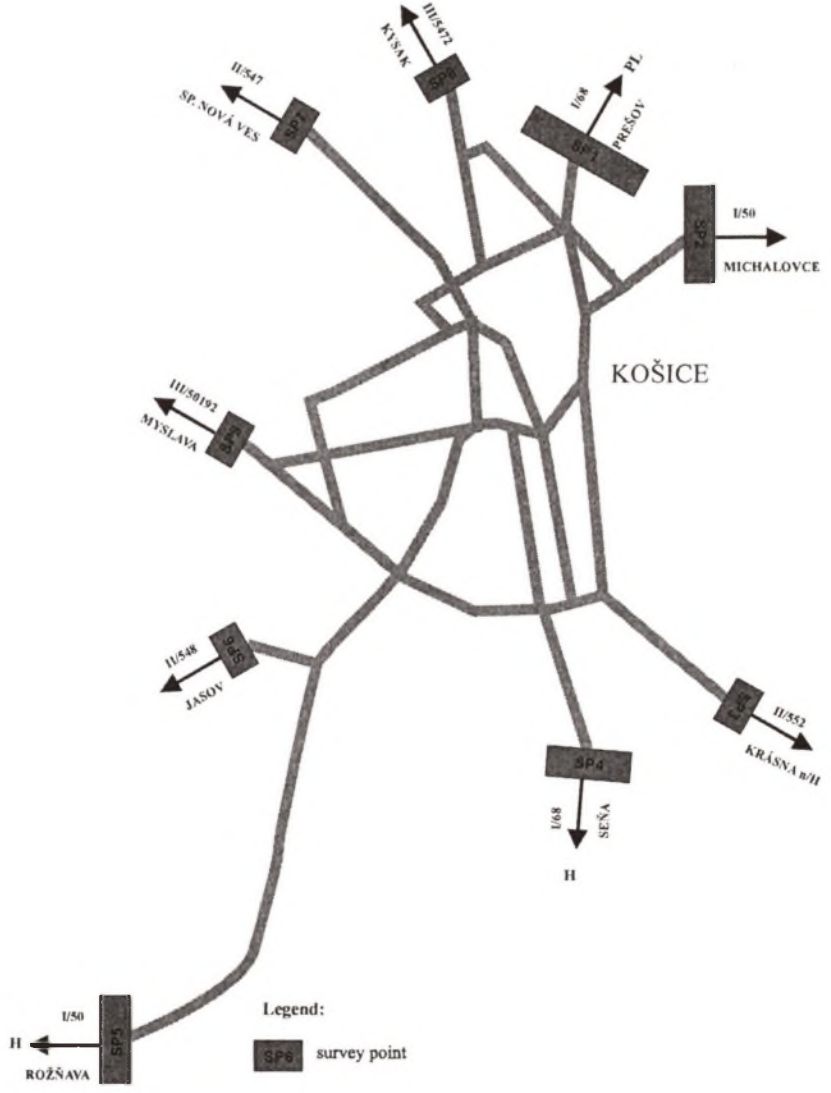
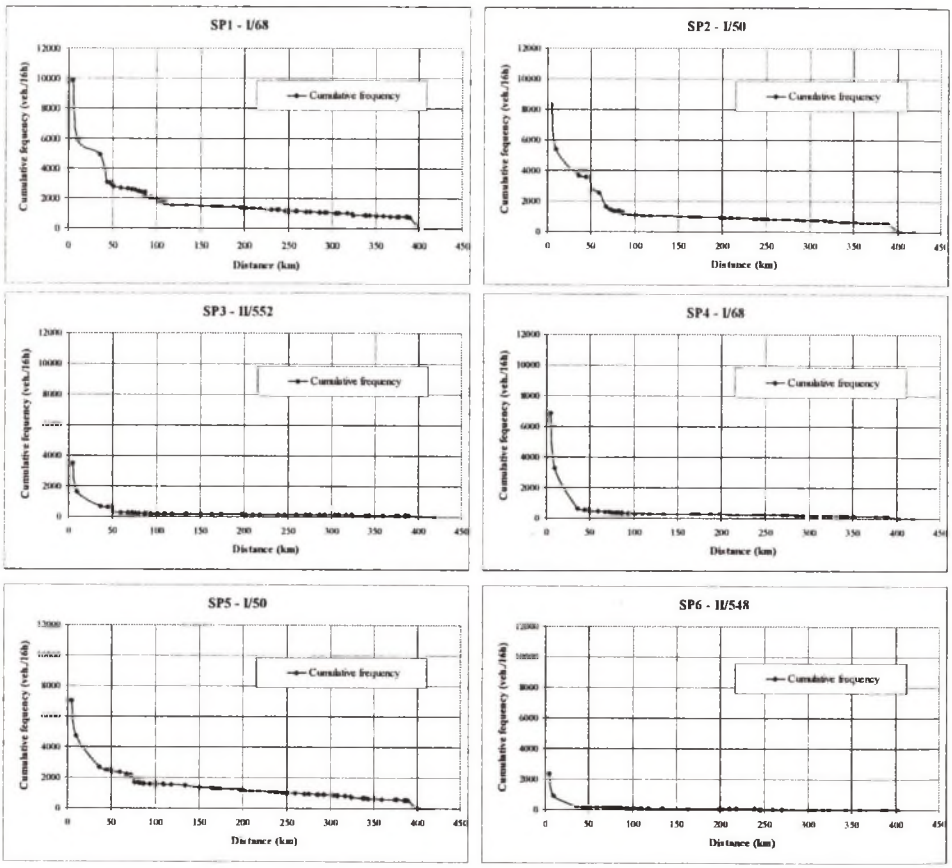


Fig. 1. Road system of the city with the localization of survey points
Rys. 1. Układ drogowy miasta z lokalizacją stanowisk pomiarowych

3.2. Analysis of results obtained on vehicle travelling distance

Recording of vehicle registration codes in traffic flows makes possible to identify the numbers of vehicles according to districts and states and determined the numbers of domestic vehicles (district Kosice-city) and non-domestic, entering and outgoing from the area (Kosice) and the distance from which they come. The data on vehicle travelling distance are listed in Tab. 1 including the ratio of domestic and non-domestic vehicles at the entrances to the city for individual survey points. Further processing, in order to describe the survey results in a better way, was done in the form of cumulative curves of number of occurrence of vehicles from a certain distance (vehicle travelling distance) shown in Fig. 2 with vehicle travelling distances for individual entrance radial roads and road classification.

At present these through roads are used for transit traffic, a part of external origin and destination traffic as well as a major part of internal traffic which includes public transportation.



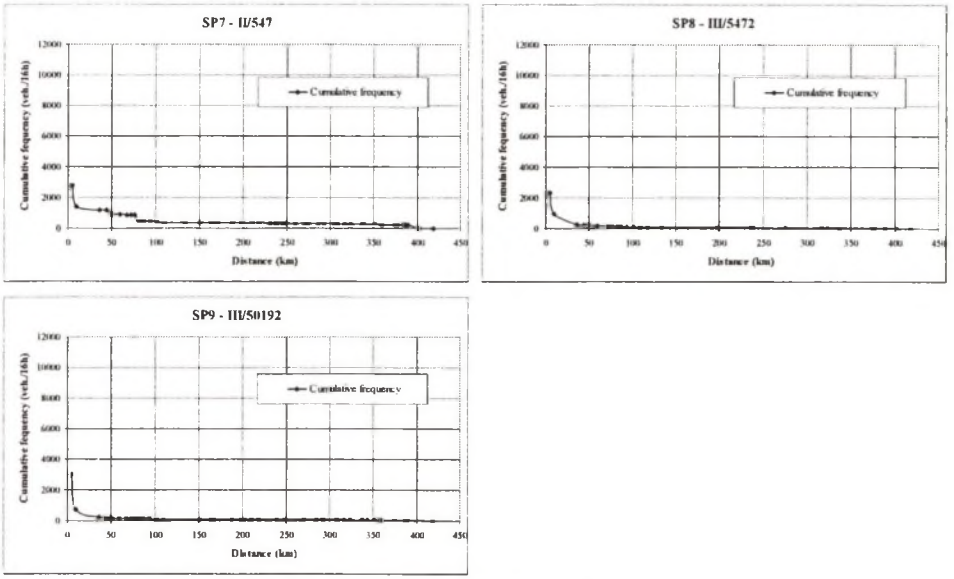


Fig. 2. Travelling distance of vehicles at individual survey points
Rys. 2. Długość podróży na poszczególnych stanowiskach pomiarowych

For better orientation in Fig. 3 there is the travelling distance of foreign vehicles in the form of a histogram from which the occurrence of foreign vehicles in Kosice is obvious. In Fig.4 a typical curve of vehicle travelling distance in Kosice, determined by regression analysis, for a working day can be seen.

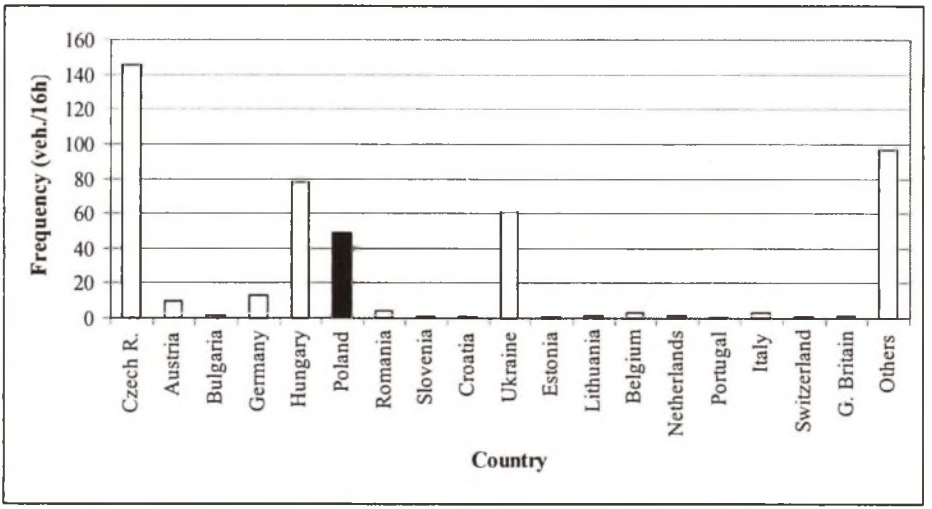


Fig. 3. Travelling distance of foreign vehicles in Kosice
Rys. 3. Długość podróży pojazdów z zagranicy w Koszycach

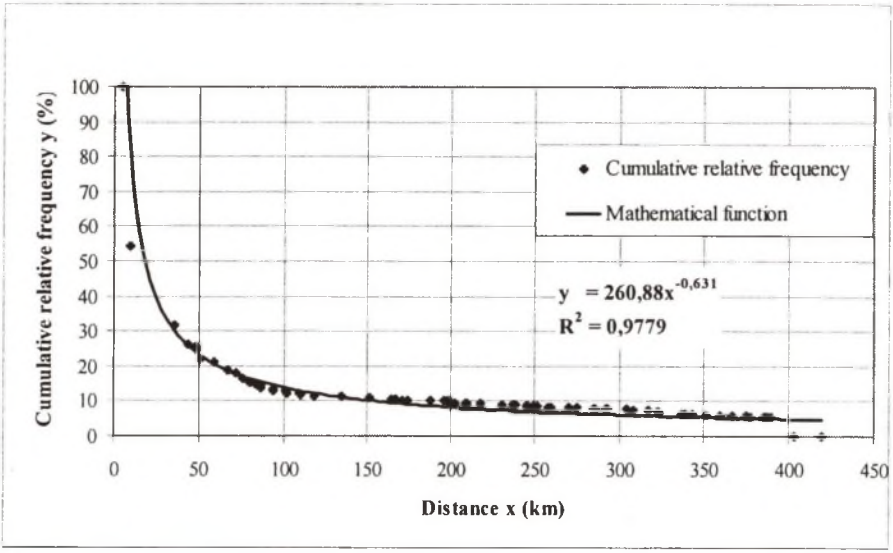


Fig. 4. Typical cumulative curve of vehicle travelling distance in Kosice
Rys.4. Typowa skumulowana krzywa długości podróży w Koszycach

Table 1
The percentage of domestic and non-domestic vehicles entering the city from various districts

Survey point	*ROAD*	Percentage of vehicles from district (%)		
		Košice	Košice - surr.	Others
SP1	**I/68 entrance from Prešov**	36	25	39
SP2	**I/50 entrance from Michalovce**	32	20	48
SP3	**II/552 entrance from Krásna n/Hornádom**	52	27	21
SP4	**I/68 entrance from Sena**	49	36	15
SP5	**I/50 entrance from Rožňava**	31	27	42
SP6	**II/548 entrance from Jasov**	56	26	18
SP7	II/547 entrance from Sp. Nova Ves	48	7	45
SP8	III/5472 entrance from Kysak	56	28	16
SP9	III/50192 entrance from Myslava	73	16	11

Based on the results obtained we can make the following statements:

- the domestic vehicles prevail in all followed traffic flows at all survey points - from district Kosice and vehicles from district Kosice - surr., the ratio can be seen in Tab. 1,
- in Fig. 2 a slight difference can be seen among the curves of vehicle travelling distance - for the roads of I. class (I/68 a I/50) and roads of II. and III. class,
- for the roads of I. class 50% of vehicles come from the distance 35 km, for the roads of II. and III. class this distance is shorter, 10-15 km,
- the highest percentages of non-domestic vehicles are from districts : Prešov, Bratislava, Trebišov, Michalovce, Rožňava,

- among foreign vehicles the vehicles from Czech Republic, Hungary, Ukraine and Poland prevail but there is also a large number of non-identified vehicles,
- on major radials, roads of I. class, the percentage of non-domestic vehicles (except Kosice and Kosice-surr.) is 50% and on the roads of II. and III. class the vehicles from districts Kosice and Kosice-surr. prevail.

Fig. 5. Attractiveness of the city Kosice expressed by means of vehicle travelling distance
Rys. 5. Atrakcyjność miasta Koszyce wyrażona za pomocą długości podróży pojazdów

The vehicle travelling distance determined in this way expresses the attractiveness of the city Kosice and graphically it is depicted in Fig. 5.

4. CONCLUSION

The concept of vehicle travelling distance as also the results in [4] indicate can be helpful to traffic engineers for :

- the determination of utilization, or loading of roads in urban units - through roads - by domestic and non-domestic vehicles,
- the characterization of attractiveness of urban area,
- the assessment of the traffic importance of roads entering the urban unit,
- the using of the vehicle travelling distance as descriptive characteristic of the road importance,
- the determination the resistance function of the gravitational model in traffic prognosis.

The vehicle travelling distance seems to be a suitable additional characteristic which can play a role in the process of decision-making on the design of road system.

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Abstract

The knowledge on traffic on a road system mainly on its through roads play the most important role in the decision-making process on the design of a new road system (or reconstruction of an existing one). It is necessary to characterize the vehicles, i.e., to find out their origin and destination, find out whether their occurrence on a given road is inevitable. Besides traditional traffic characteristics (volume, composition of traffic flows, direction of traffic flows, percentage of transit traffic) new specific characteristics are desirable which would describe better the traffic relationships between the area in question and surrounding area. Such characteristic is the travelling distance of vehicles in road traffic (commuting distance) although it belongs to less used ones in traffic-engineering practice. The results of analysis of experimental measurements and their synthesis are presented for the case study of the city Kosice (SR) with the aim to use them for the description of traffic relationships in the area and to express the attractiveness of this area from traffic point of view.