International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.5, No.6, June 2016 **DOI:10.15693/ijaist.2016.v5.i6.42-49**

Traffic Model for PPP Project in Bratislava

Dr.T.Schlosser
Department of Transportation Engineering
Faculty of Civil Engineering, STU in Bratislava,
Slovakia

Dr. A. Zuzulova
Department of Transportation Engineering
Faculty of Civil Engineering, STU in Bratislava,
Slovakia

Dr. P. Schlosser
DOTIS Consult, Ltd.
Bratislava, Slovakia

Dr. S. Capayova
Department of Transportation Engineering
Faculty of Civil Engineering, STU in Bratislava,
Slovakia

Abstract—The Article describes the experience of traffic modelling work on the creation of the transport model for PPP Project which will be realized in Bratislava, Capital of Slovakia. It will be the new bypass of motorway D4 and expressway R7 from east-southern part of Slovakia to the Capital. Project was managed and prepared by the Ministry of Transport. The authors are dealing with one of the options to be included in the creation of the transport model of a sufficient scale to transport data from the long term automotive surveys of car traffic from highways as well as from urbanized areas, which is required for the development projects within the city. The article refers to one of the possible options to generate the number of trips for the forecast from prepared development projects in and out of the city, which will influence the bypass of the city of Bratislava. The article describes the basic nature of modelling tools and the scenarios for different time periods of the day, the transport classes and for the forecast in year periods. There is spotted the impact of the new PPP project, which needs to be addressed also through the tunnel under the Carpathian Mountains which was confirmed by the traffic model.

Keywords: PPP project, traffic modelling, traffic surveys, urbanization, transport forecast.

I. INTRODUCTION

This article is risen up from the traffic engineering study of the D4 and R7 motorway/expressway with a traffic forecast for a decision making on the PPP project realization, which was a need for a public procurement in a PPP tender. The content of the article is fulfilled in these steps:

1. Review of the traffic infrastructure in present time and the defined new sections of the project,
2. Actual traffic loads and historic traffic development in the area of influence from motorways and all state and regional roads as a part of the traffic model,
3. Assessment of the traffic forecast included the comparison of the traffic data from automatic counting and state traffic census with the base model output,
4. Definition of the urban forecast for the agglomeration of the city and definition what could be used and why, probably some explanation how they will be used for the traffic forecast.
5. Traffic data with direction (routing) of traffic flows on all (existing) intersections on the borders of the city of Bratislava.
6. Identification of the traffic rates influencing the traffic growth in the area of influence and define the future for the years 2020 and 2050.
7. Methodology applied in the work was worked out in the environment of PTV – standard outputs for all scenarios.
8. The results of the traffic model showed that there is a need to work complexly with urban data together with detailed long term continues traffic data for creating a high quality decision tool on the side of designers, administration bodies and for the responsible project managers and financing experts.

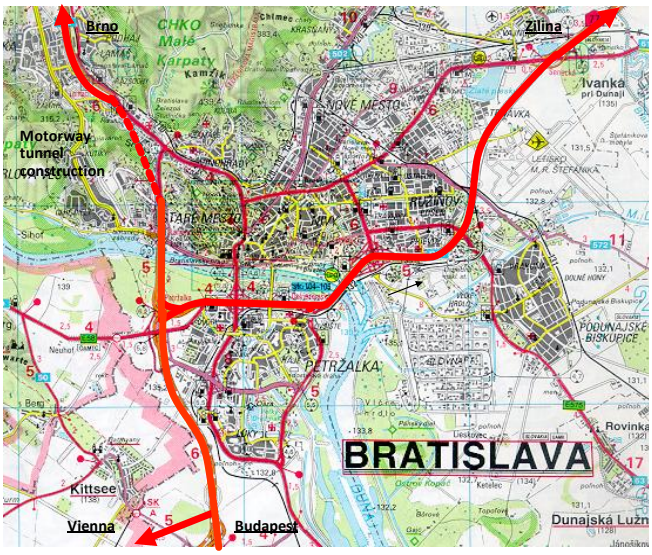
II. BRATISLAVA AND ITS ROAD NETWORK

The road network (Fig. 1 and Fig. 2) in the area of the Capital of Slovak Republic, Bratislava and its surrounding area is characterized by a high increase of the traffic load at the moment, not only by city traffic, but also transit transport as well. All the transport/traffic characteristics around the area of Bratislava and its surroundings declare about the importance of appropriate road infrastructure solutions by creating the „Zero – circuit“, constructing the D4 motorway in terms of the strategy of the road network development. These are:

- Bratislava is the capital and largest city of Slovakia,
- Bratislava is a source and destination for the car traffic. High traffic load on the entrances into the city causing a strong link of the population close to the villages to the capital, in which is realized the major part of their job opportunities, educational and other activities,
- the trend of traffic growth is fostered by the resettlement of urban population to rural sites for even higher quality housing, especially in the south-eastern and eastern parts, but also to other parts of Bratislava region,
- Bratislava is on the eccentric position in relation to the whole territory of the State and on the south-western outskirts, near the state borders with Austria and Hungary,

- for the most part of Bratislava territory is flat terrain, from one part of the north-western city, almost up to the middle of the cityextends the Little Carpathians Mountains, practically up to the largest European river - Danube, which touches the centre of the city on the length (approx. 1/3) and divides the city into two parts.

Figure 1 – Present road network of the city of Bratislava



The Land Master Plan (LMP) of Bratislava is the basic program document, through which the objectives pursued the role of spatial planning in the territory of the capital city as well as the development of transport infrastructure.

Bratislava consists of 5 districts and 17 boroughs. The transport system is developed as a radial-orbital system. It is created up of 3 urban rings, from which it is called the "Zero circuit" – outside ring creates by the D4 motorway. Radial road system creates these radials:

- Racianska from the city Pezinok and it is the road II/502,
- Trnavska formed by the motorway D1
- Senecka formed by the road I/61,
- Mostecka formed by the road II/572,
- Samorinska formed by the road I/63 from the Dunajska Streda, and it will create the R7 Expressway,
- Rusovska the road I/2 from the Hungarian border
- Viedenska from the border with Austria created by the D4,
- Hainburska formed by the road I/2 from Austria, from Berg
- Malacka formed by the highway D2 to the Czech border,
- Stupavska formed by road I/2.

2.1. D4 Motorway

The D4 motorway is part of the core network of motorways and expressways in the corridor Bratislava-Jarovce – Stupava – the State border of the Slovakia and Austria. The main goal of the D4 motorway is a detour of the transit traffic to Austria and Hungary, which in present time goes through the build-up area of the city. In this specific territory markedly helps to the service of the background of the city and relieves the villages and the existing road network form transit traffic.

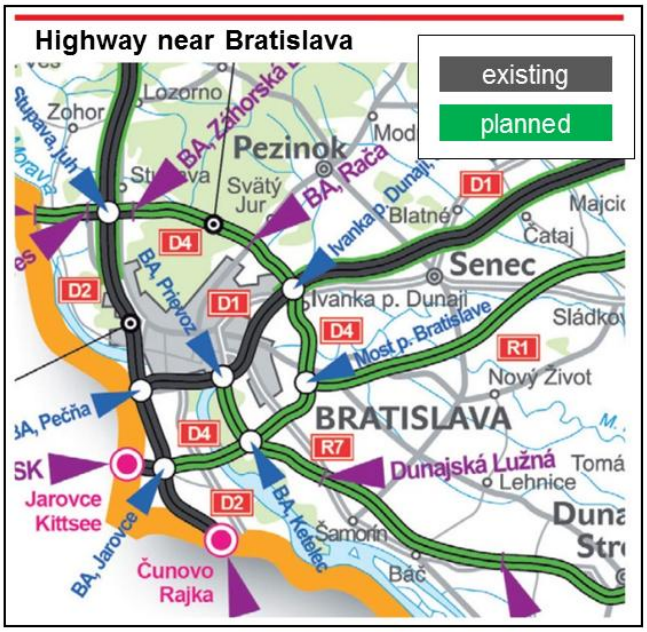
The traffic problems grow up on the existing motorway sections D1 and D2 as well. The transit traffic from Trnava on D1 goes directly through the city on the Port bridge (Pristavny most), and by Vienna route split up the trips to individual directions. Because of the „insufficiency" road network in Bratislava, the motorway network is used by inside origin/destination traffic moving from west side to east side and vice versa. This causes extra traffic loads, in particular, in the field before and on the Port Bridge, and on the all connected roads on Bratislava side and through Petrzalka borough (south part of the city) as well. After the completion of the D4 motorway, in prepared stage without the tunnel, the motorway section D2 will be fulfilled the sections on the Lanfranconi bridge and tunnel section Sitina (west side of the city). The total length of the D4 motorway sections is 22,590 km and its scheme is on Fig. 3.

2.2. R7 expressway

The R7 expressway is part of the core network of motorways in the corridor Bratislava - Dunajská Streda - Nové Zámky - Veľký Krtíš - Lučenec. It will be a part of the international European roads E 575. The R7 expressway is guided through the economic uses territory and the traffic is not directed into urbanized areas. The route of the expressway begins on Bajkalska Street in the existing interchange "Prievoz" (interchange with Port Bridge) on D1 motorway, passes through the site Palenisko near the port, crosses the Little Danube River, and runs along the western edge of the Slovnaft refinery. Then it continues on the interchange "Ketelec" with the D4 motorway.

The R7 follows southwest of the village Rovinka and Dunajska Luzna with interchange "Dunajská Luzna" (R7 with the road I/63) in direction to Samorin. The route is getting into the space between the city of Samorin and the municipality of Kvetoslavov. At this point, crosses the road II/503 "Samorin". Then continues north around the settlements Samot, and the route passes through the villages gradually Trnavka and Macov. Finally, it is the route traversed north of the village Blatna na Ostrove and is again close to the road I/63. This section finishes between the villages of Holice and Cechova with connection on road III/06324 and I/63. The total length of the R7 sections R7 is 17,380 km. Expressway R7 scheme is shown in Fig. 3.

Figure 2 Scheme of motorways and expressways in Bratislava agglomeration



Source: MDVRR SR

III. PRINCIPLES OF THE TRAFFIC MODEL (DTS)

A traffic model was developed in the years 2005-2009 on the basis of extensive origin/destination (O/D) traffic survey in the area of Bratislava in 2002 – as a city model. It can be declared the DTS Model was created on the basis of the O/D traffic survey in 2002, and is still calibrated in sequence of time. In the process the model has been modified according to available traffic information of authors. This survey was until 2014 the only source of traffic data in terms of scale and volume. These data have been analysed for the purposes of processing the traffic model, which was originated on the basis of the matrix in the range of 70 x 70 zones. The model works in an environment of PTV.

These data are additionally adjusted by own analysis of DOTIS for the year 2010 with the official coefficients for Bratislava and loaded the road network of Bratislava. These coefficients are only included for the zones inside of Bratislava and for the forecast with D4/R7 as well. Its value is 1.16.

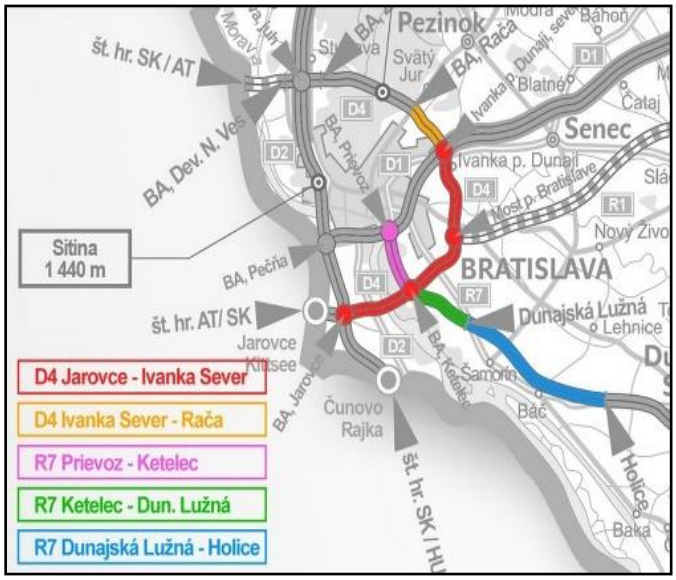
The calibration of the model for the year 2010 is carried out on the results of the surveys of automatic counting system on motorways sections within the city while maintaining mutual respect zones. At the same time it has been filled up and calibrated from the results of surveys of various traffic planning projects of developers in the city. These surveys were administrated subject to the principles of the Methodology for the capacity assessment of investments according to [3].

In any project is always carried out the survey on a defined area with ASD during one month in the defined area and complement the thematic short time O/D survey. Only the area of Petržalka should have the ASD survey over 182 days. The DTS traffic model till present time contains approx. 25 local projects.

The DTS model contains the basic attributes for the creation of the transport model. The calibration of the model consisted in the preparation of the three components of the model, i.e. the network of road infrastructure, O-D matrices and assignment functions, and consisted of the following:

- checking the condition of the road network and the establishment of the free speed,
- the logic of shortest paths from the selected origins to selected destinations,
- setting up the parameters of the impedance function for the loading of the network (mainly the exponent which has the effect of slowing down of the traffic flow due to high traffic volumes).

Figure. 3 Sections of the prepared PPP project in Bratislava



Source: MDVRR SR

IV. DETERMINATION OF TRANSIT TRAFFIC

A major lack in terms of road administration is the fact, that in spite of the existing electronic toll which is operated on Slovak motorways, which records all the details as much as possible the movement of heavy vehicles over 3,5 t, the client - Ministry of transport does not have the official statistics on the quality of the traffic flows published. One of the main requirements of the sponsor was an effort to get these data in the competitive dialogue, whereby the client did not provide the required supporting documents.

For the traffic model were used these outputs for transit transport:

- transit transport for the total values of the traffic volume at the entries of the city is limited by a time interval within 2 hours. This argument is important in view of the strong attractiveness of the city area of Bratislava, where even a short stop at the edge of or inside the territory of

the city cannot be classified as a destination and as soon as the new origin of the trip. This, however, applies only in cases where the entry and exit on the border of the city is not the same;

- with the value of 30% for transit traffic can agree only on the main back and forth directions of heavy vehicles (HV) to the entries:
- D1: Trnava – D4: A, D2: H, D2: CZ and
- R7: Dunajská Streda – D1: Trnava, D4: A, D2: H, D2: CZ;
- the value of 6% of transit traffic can be classified for traffic flows of light vehicles (LV) at all entries to the city of Bratislava;
- these values of transit, for the reasons above, are recommended to use for all the time intervals of the traffic model.

Table 1 - The percentage value of the difference between the various types of surveys - model 2010

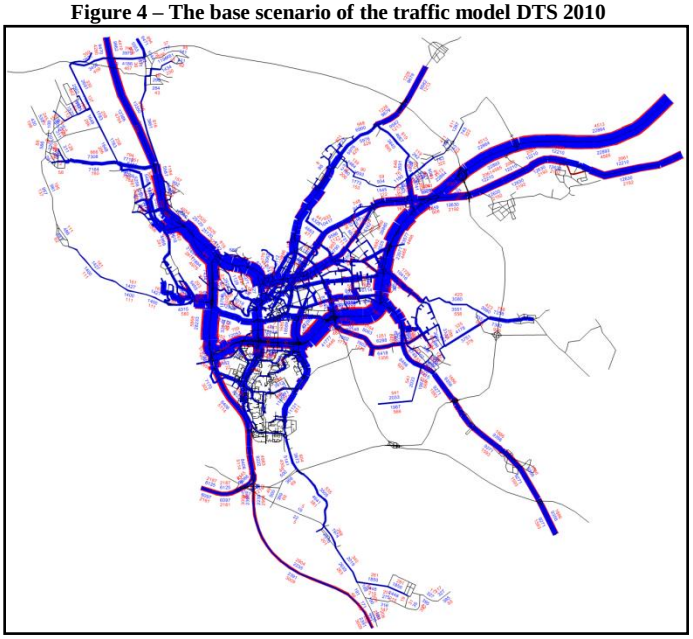
Mt	Nr. CSD	Name of the measured section	DIF ASD-DOTIS			DIF CSD-DOTIS		
			LV	HV	TOTAL	LV	HV	TOTAL
D2	87017	Stupava - DNV				-11	0	-8
D2	87 011	D2 Lamač - Sitina			-1	22	17	21
D2	87 012	D2 Sitina			12	6	24	10
D2	87 015	D2 Lafranconi	-3	0	-2	23	15	22
D2	87 013	D2 Pečňa - Jarovce			13	-14	6	-6
D2		D2 hr. MR - SR				-18	3	-6
D4	87 019	D4 Hr.Rakúsko - Jarovce				-33	-28	-32
D1	87 026	D1 Einsteinova				8	19	10
D1	87 022	D1 Prístavný most				-7	10	-5
D1	87 021	D1 Prievoz - Ružinov	-10	-16	-11	26	31	27
D1	87 023	D1 Ružinov – Trnávka	24	10	22	-7	26	-2
D1	87 024	D1 Trnávka - Letisko	-3	-12	-5	24	18	23
D1	87 025	D1 Letisko – Zlaté Piesky	45	17	40	10	15	11
D1	87 028	D1 Zlaté Piesky - Vajnory			12	4	-5	2
D1	87 020	D1 Vajnory - Senec	7	3	6	18	18	18
I/61	80 144	I/61 Ivanka západ - Metro				3	11	4
I/63	81 460	I/63 Rovinka				-12	-12	-12
		TOTAL CSD - DOTIS				7	13	8
		TOTAL ASD - DOTIS	7	-1	7			

V. COMPARISON OF THE SURVEY RESULTS WITH THE DTS MODEL

Experiences in Slovakia are very easy to forecast. So far, almost any documentations, where the prognosis have been calculated, and the same results are in the tender docs, the traffic growth of an individual link was calculated multiplying the previous traffic flow by the growth rates only. The DTS model has applied growth rates to different parts of the trip matrices, on the assumption that trips inside city, trips in/out the city and transit trips will have different growth rates. The reason is that "state development" rates are only for non-urbanised roads and the city of Bratislava has its own. In order to calibrate the "base" DTS 2010 model it was compared the model outputs with ASD (Automatic Traffic Survey) & CSD (National Traffic Survey) 2010 information. These data are in the design documentation for land permit and are the part of the tender materials. Table 1 indicates the value and percentage difference between the values of model DTS - ASD and DTS – CSD survey).

From the table 1 it was considered that the 2010 model calibrate well and to replicate correctly the base year. The zone from Austria on D4 was corrected by the ASFINAG data towards Jarovce only for LV. This change will also be introduced for the years 2015-2020 without and with the D4 and R7. The base plot of the DTS model 2010 is on the Fig. 4.

Figure 4 – The base scenario of the traffic model DTS 2010



Legend: light vehicles, heavy vehicles

VI. TRAFFIC FORECAST 2020

For the traffic model was prepared the growth rates with own analysis, which will include a specific prepared developer's activities on the area of the city of Bratislava, as well as in its background. In particular, it will go on the time schedule of gradual development of the areas. The reason is the land master plans according to the building act, which contain and confirm the demands on the development of the city and municipalities in a horizon of 15 years with the forecast of 30 years. In these documents, however, there is a lack of time sequence how to achieve a defined content and volume of the development of the territory. Therefore for the model if was proceed with own optimization and assumptions of how the agglomeration will develop, based on already planned investment projects in the field of housing, jobs and services. To determine the default values of the traffic model outgoing data were compared for 2020 in this order:

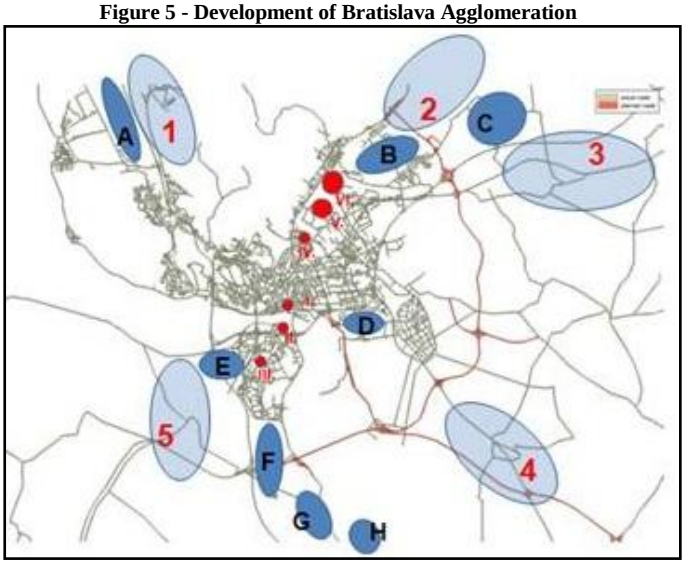
1. HV can drive through the city
2. complex restriction for transit HV through the city:
   - 2020 DTS without investment,

- 2020 DTS with investment without tunnel,
- 2020 DTS with investment, with tunnel.

5.1. Urban development of the city of Bratislava

Historically, the city development suffers of the strategy for the development during the socialism era 60 - 80. years of 20. century. The main issue is the disproportion between development areas territory and human potential on them, which reflects in terms of residence (origin) and the workplace (destination) on the territory of Bratislava. These are spatially segregated in large zones and settlement areas. This relationship brings together service and presents it to the transport system. A large disproportion in disequilibrium of spatial planning is on the basic functions on the urbanized area in the relationship between housing and employment in Bratislava. This shows an actual parameter, that only through the Danube a day shifts are more than 290 000 inhabitants (the city has only 435 000 inhabitants).

Figure 5 - Development of Bratislava Agglomeration



Legend:
Red dots:I. Chalupkova, **II.**CMC Petržalka, **III.**Petržalka City, **IV.**Pasienky, **V.**Istrochem, **VI.**Žabí majer - together developments up to 20 000 flats (50 000 inhabitans) and 25 000 jobs
Darkblue dots:A. Bory (25 000 / 10 000), **B.** Vajnory (8 000 / 5 000), **C.** Triblavina (30 000 / ???), **D.** Domové role (10 000 / 6 500), **E.** Kapitulské pole and Matador, **F.** Jarovce – Petržalka Juh, **G.** Rusovce, **H.** Čunovo – back up of Bratislava development (cca 50 000 / 25 000) – (ihabitans/jobs)
Lightblue areas: development of the satelite cities (1 – Stupava, 2 – Pezinok, 3 – Senec, 4 – Šamorín, 5 - Kittsee).

Except off to area 5, can be declared the rapid increase in these satellite cities from their LMPs in a horizon of 10-15 years, which is declared from the meetings of the work on Bratislava TMP directly by the representatives of these cities.

On the formation of values of growth rates, their confirmation or a partial adjustment of the upcoming development of the city of Bratislava and its background has been used as it is shown in Fig. 5, and their values are in table 3. The individual area developments were assigned for each section of the D4, not purposeful, but according to the already functioning traffic model of the year 2010. This model was created for the needs of the Ministry of Transport in 2010 with the ongoing review of the implementation of the tunnel to D4 under the Carpathians. This way, it can highlight the impact of the development of the agglomeration, which has a direct effect on the road infrastructure.

Table3 - Expected development of the territory in the agglomeration of Bratislava by 2050

Development in Bratislava	Nmb. of citizens	Working places	Direct influence on D4/R7 sections	N. of trips (cars) average day
Chalupkova, Pasienky	8 000	6 000	All sections	9 240
Istrochem, Žabí majer	10 000	5 000	Rača – Ivánka	11 550
Karpatský pás	15 000	3 500	Rača	17 325
Vajnory a CEPIT	15 000	20 000	Rača – Ivánka	17 325
Triblavina	35 000	8 000	Rača – Ivánka	40 425
Domové role	10 000	15 000	Prievoz – Ketelec	11 550
CMC Petržalka,	9 000	20 000	All sections	10 395
Petržalka City,	5 000	8 000	All sections	5 775
Matador, Kapitulské pole	15 000	10 000	D2, D1, Jarovce – Ketelec	17 325
Petržalka Juh, Južné mesto	55 000	15 000	D2, Jarovce – Ketelec	46 200
Jarovce, Rusovce, Čunovo	25 000	5 000	D2, Jarovce – Ketelec	28 875
Bory Devínska N. Ves	60 000	35 000	Stupava – Ivánka, D2	69 300
Satelite cities				
Pezinok	40 000		Rača – Ketelec	46 200
Senec	40 000		Rača – Ketelec	46 200
Šamorín	35 000		Prievoz – Ketelec– Ivánka	40 425
Stupava	30 000		Stupava – Ivánka, D2	34 650

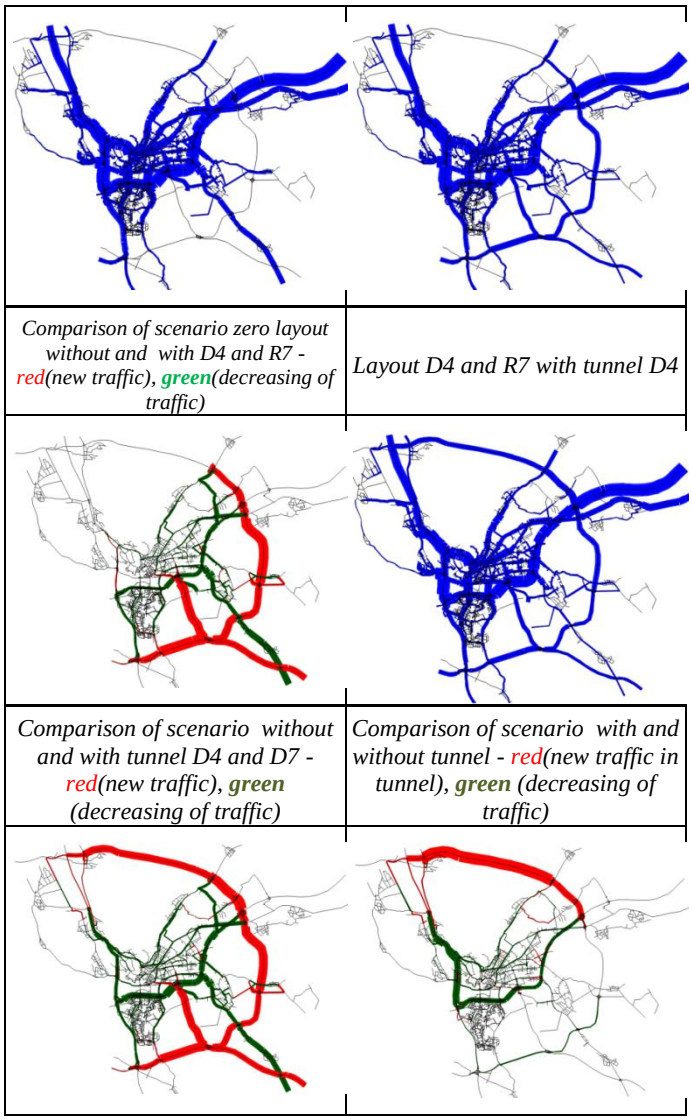
5.2. Traffic model – scenario 2020

As a first level for discussion was calculated the traffic model for the year 2020 with all scenarios (f.e. the scenario with tunnel even though is known that physically it will not by constructed). The output of the scenario 2020 from the traffic model is shown on Fig. 6 where is a complete traffic flow – light (LV) and heavy vehicles (HV) together.

The flow map o Fig. 7 expressed in green colour represents a decrease – improvement of the condition of the existing road network, which will have significant benefits for the city of Bratislava. The flow map expressed in colour represents the traffic volume, which should use the new routes of the D4 and R7.

Figure 6 – Traffic diversion on city road infrastructure in year 2020 with all scenarios

Zero layout without D4 and R7	*Layout with D4 and R7*



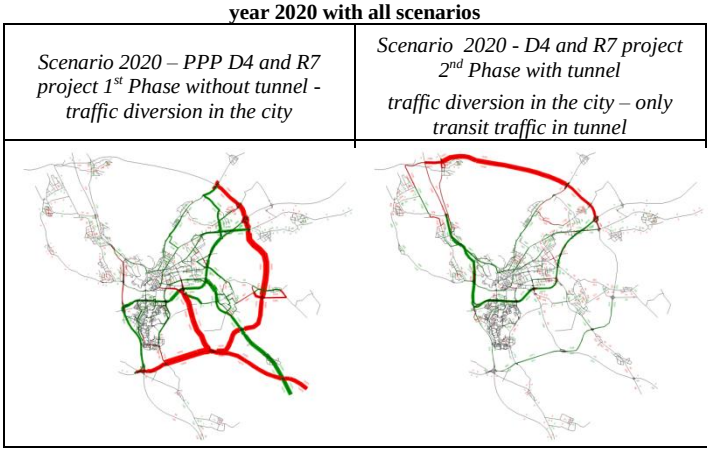
VII. TRAFFIC FORECAST AFTER 2030

The basic polemic by professional discussions is whether in 2030 there will already be a tunnel under the Carpathian Mountains to Austria with connection to the expressway S8 from the Austrian side. However, it is important to get an overview about the possibilities of the existing tunnel, because it can demonstrate other developing trends or discontinuities in the transport policy of the State.

The attribute, however, is that the model does not work comfortably with a direct links to the Austria (they are not defined the zones). It comes from the fact that there are no data from the Austrian side, in order to be able to incorporate these into the model. The advantage, however, is in this variant of scenarios with tunnel will allow without linking to Austria to demonstrate the maximum rate the traffic value, which would be subject to the "toll". On the figure 7 is the image with a decline of traffic after the opening of the tunnel. The interesting thing is that in this scenario, without the links to Austria, that the reduction of traffic is primarily from urban roads and it shows a high volumes of traffic diverged from the city road network on the bypass together with using the tunnel!

The analysis of "toll" can be demonstrated the diversion of HV´s by observation of the traffic value on the Triblavina section (main entrance to the city from the western Slovakia) from the whole network of the traffic model.

Figure 7 – Traffic decreasing and growth on city road infrastructure in year 2020 with all scenarios



Legend: decrease and growth of traffic flow on the road network in Bratislava

Comparisons have been made for the year 2020 and 2030. Cartograms for the year 2030 for both directions are shown on Fig. 8. Of these pictures can be seen:

- firstly on these pictures are toll free sections in the city without restriction, therefore the deceasing is not with a high value,
- for in both directions, it is evident that the motorway D4 also without toll is very timely and the D4 "pulls out" almost all the traffic from and through the city;
- the Reason for this is the high quality of the new infrastructure, without delay, and congestions. At present time in peak hours, through the city and Harbour Bridge are the queues from the city borders to the bridge over Danube in time loss of about 30-40 min;
- another possibility of increasing of HV traffic volumes HV/24 h, which have as their objective in the north-western part of the city, where is the factory of VW;
- more that 10% of HV are on the tunnel section without real data towards the Expressway S8 in Austria.

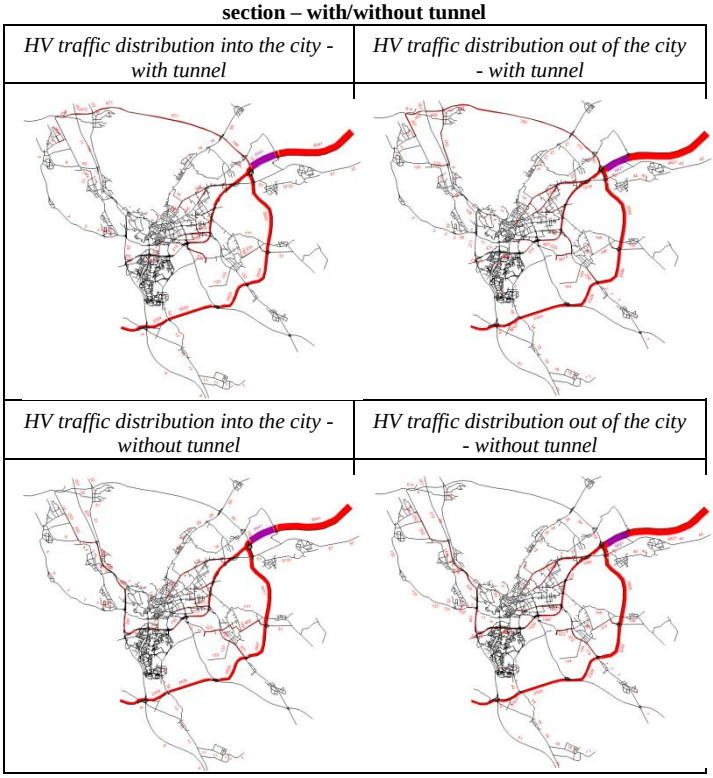
Table. 4 Differences on traffic volumes of HV – scenario 2030

	into the city		out of the city	
	with T	without T	with T	without T
Ivanka - Most	3089	3477	2950	3666
Port Bridge	274	739	215	1020

Comparisons of the scenarios for Triblavina with and without the tunnel are between the pictures on Fig. 8 and show the following differences on sections.As an example, it was used a section of motorway D4 Ivanka – Most pri Bratislave.

From the results it can be concluded the minimum detour of HV´s to motorway D4 in the case of prohibition of entry into the city. Values are for the scenario without the ban on HV /24h.

Figure 8 –The scenario 2030 - the split of HV traffic for Triblavina section – with/without tunnel



VIII. CONCLUSION

The results of this study can be summarized as follows:

- analysis of the D4 motorway and R7 expressway has been carried out on the basis of the current design documentation for land permit, which was part of the public procurement docs,
- for the analysis as well as the determination of the D4 and R7 forecast was based on the data of the CSD and ASD from 2010,
- the input model was used the transport model of DOTIS co. from 2010, which is used for the needs of the city of Bratislava and it solved in 2010 for the Ministry of transport the model with motorway D4 and with tunnel,
- as a zero option was defined the year 2020, for which the results of the DTS scenarios were compared with the distribution of the traffic flows on light vehicles (LV) and heavy vehicles (HV),
- the Zero scenario of 2020 as well as forecast 2030 has been carried out in two basic models without the tunnel and with tunnel on D4,
- the Result has shown that the PPP project has a high positive value for the city development but only if there will be continuously solved the 2nd phase of tunnel construction.

REFERENCES

[1]. Schlosser, T., Schlosser, P.: Poznatky z prípravy PPP projektu Obchvat Bratislavy (Knowledge from the Preparation of PPP Project Bypass Bratislava), International Conference "Pozemní komunikace 2016 - PRO ZMĚNU ZMĚNY", Czech Technical University, Prague, 2016

[2]. Schlosser, T., Schlosser, P.: Traffic Analysis and Forecast for D4/R7 2020-2050, DOTIS Consult, 2015

[3]. Metodika dopravno-kapacitného posúdenia veľkých investičných celkov, (Methodics of Traffic Capacity Appraisal of Big Investment Entities), Magistrát mesta Bratislavy, 2014

[4]. Draganovská, S., Hlavna, P.: *Prognózovanie výhľadových intenzít na cestnej sieti do roku 2040*, Technické podmienky 7/2013, MDVRR SR, Bratislava

[5]. Schlosser, P., Schlosser, T.: Diaľnica D4 a potreba tunela pre rozovj mesta Bratislava pod Malými Karpatmi – dopravný model 2010 (Motorway D4 and the Need of the Tunnel for the Development of the City Bratislava under Carpathians Mountains – Traffic Model 2010), DOTIS Consult, 2009 – 2010

Authors Profile

T. Schlosser,PhD,degree in civil engineering, from the Slovak University of technology Bratislava, Slovakia, in 1981.Currently Head of the Department of Transportation Engineering, Faculty of Civil Engineering, STU in Bratislava. His professional activities are oriented on Traffic planning and engineering, Intelligent transport systems. He was a former Chief Traffic Engineer of the Capital City of Slovakia – Bratislava.

A. Zuzulova,PhD,degree in civil engineering, from the Slovak University of technology Bratislava, Slovakia, in 2001 Currently Assistant of the Department of Transportation Engineering, Faculty of Civil Engineering, STU in Bratislava. Her professional activities are oriented on road and airport pavement design, technologies in road construction. She also participates in projects in the field of pavement diagnostics, traffic engineering and planning.

P. Schlosser,PhD,degree in civil engineering, from the Slovak University of technology Bratislava, Slovakia, in 1984 Currently Director of the DOTIS Consult Ltd. In Bratislava. His professional

activities are oriented on traffic engineering and planning. He is the author of national standard for motorways and roads design and technical requirements for calculation of road junctions capacity. He is a key manager of many of traffic engineering/planning studies in urban areas in Slovakia.

S. Capayova,PhD,degree in civil engineering, from the Slovak University of technology Bratislava, Slovakia, in 2011. Currently Researcher of the Department of Transportation Engineering,Faculty of Civil Engineering, STU in Bratislava. Her professional activities are oriented on technologies in road construction with a focus on environmentally acceptable technologies, laboratory verification. She also participates in projects in the field of pavement diagnostics, traffic engineering and planning.