

The Modeling of Travel Demand in the Road Network of Pristina Region

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Abstract – In this paper is analysed the current situation of demand in the road transport network in Pristina region and is predicted the traffic flow in the future. The inputs of the model consists of social and economic data, current traffic statistics, previous road-side survey, estimating base year and infrastructure scenarios.

Keywords – Traffic volume, Model, Forecast, Modeling, PTV Visum.

I. INTRODUCTION

This research describes the process and results of traffic forecast for Prishtina region Road Network. The forecast is necessary to find out if road network expansions shall meet the demands for transport. The outputs of this model are predicted road traffic volumes between origin and destination municipalities.

To forecast future road traffic, it is necessary to first contract base year demand matrices. Base year demand matrix which forms the basis of future traffic forecast indicates the amount of traffic between each origin-destination pair at current stage. Year 2017 is considered as the base year of the traffic forecast because it is the most recent year when yearly figures for input data are available. Base year demand is shown in the format of origin-destination (OD) matrices. The unit is in cars for 24 hours.

Since car OD demand is only available in 2011, an extrapolation factor is needed to estimated 2017 car OD demand. Number of car trips can be related to population and the number of registered private car, although population is decreasing, the number of registered private car is growing. Therefore, in this case, the number of registered private cars is better for estimating car passenger traffic than population. For forecasting in 2025, three scenarios are introduced:

- “Do – minimum” scenario in which at the end of the period in 2025
- “Do – something” scenario and
- “Do – maximum” scenario.

The transport modeling is done with PTV Visum software.

II. GENERAL DATA OF KOSOVO AND PRISTINA REGION

The territory of the Republic of Kosovo counts the surface

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of 10.905,25 km² with 1.798.506 inhabitants. It is situated in south-east Europe, limited with Albania on south-west part, Monte Negro at north-west, Serbia at north-east and with Macedonia at the south. The territory is situated at geographic latitude 41° 51’ and 43° 16’, and within geographic longitude 19° 59’ and 21° 47’.

In terms of regions, Kosovo has got seven regions, 38 municipalities and 1469 settlements. The regions of Kosovo are: Ferizaj, Gjakovë, Gjilan, Mitrovicë, Pejë, Prishtinë and Prizren, as presented in figure 1.



Fig. 1. Map of seven regions of Kosovo

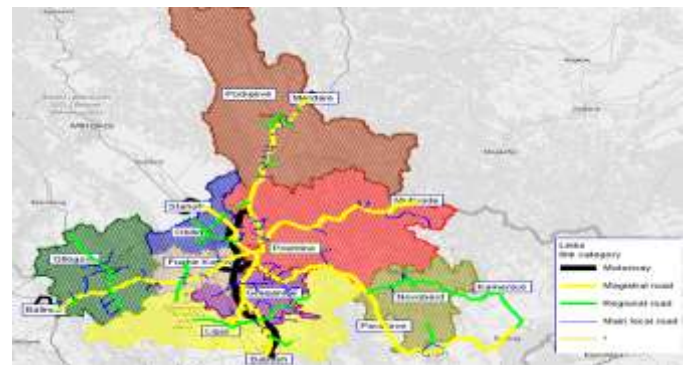


Fig. 2. Prishtina region and road categorization

Prishtina region has got eight municipalities, as: Glllogoc, Graçanica, Fushë Kosova, Lipjan, Novobërdë, Obiliq, Podujevë dhe Prishtina with total 296 settlements, with the surface of 2,285 km² and with 491 068 inhabitants.

III. GROWTH FACTOR METHOD – TRIP GENERATION

In order to predict the future number of journeys, basic equation is presented below:

$$T_i = F_i \cdot t_i, \quad F_i = \frac{f(P^d, I^d, C^d)}{f(P^c, I^c, C^c)}$$

T_i – future trips in zone i
 t – Current trips in zone
 F_i – growth Factor
 P – population
 I – income
 C – Car Ownership
 d – design year
 c – current year.

IV. TESTING AND COMPARISON OF RESULTS THROUGH GEH-TEST

The GEH Statistic is a formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes. The GEH formula gets its name from Geoffrey E. Havers, who invented it in the 1970s while working as a transport planner in London, England. Although its mathematical form is similar to a chi-squared test, is not a true statistical test. Rather, it is an empirical formula that has proven useful for a variety of traffic analysis purposes. Comparison results by traffic flow counting of 2011 year and modeling using PTV Visum is done by GEH test. The formula for the “GEH Statistic” is:

$$GEH = \sqrt{\frac{2(M - C)^2}{M + C}}$$

Where are:

M - peak hour from current model (or new counts),
 C - peak hour from current of counting (or previous counts).
 Presentation of comparison of these results according to traffic counts and modelling by PTV Visum with application of GEH formula test is shown in the following table.

TABLE III
COMPARISON OF RESULTS ACCORDING TO AUTOMATIC COUNTERS, MODELLING BY PTV VISUM AND GEH TEST

	The Points of traffic counting	Traffic counting September 2011	Modeling by PTV Visum	Difference in numbers	GEH test (%)
Vranidol	C12	11 285	11 449	-164	1.54%
Slivove	C10	5 162	5457	-292	4.00%
Llugagji	C8	12 852	12 728	124	1.09%
Konjuh	C6	12 864	12 881	-17	0.15%
Sllatine	C9	23 690	23 223	467	3.05%
Milloseve	C13	14 163	13 764	399	3.37%

Source: Prepared by author

The comparison show that for all locations results are fulfilled under condition $< 5\%$, and by comparing results gained by traffic counting with results by modeling using PTV Visum we can conclude that they are under acceptable level.

V. SCENARIOS

For the scenario of base year 2017 the modeling is done and compared with below of three scenarios.

For the base year 2017 scenario (S0) the technical conditions of the road network are:

- Prishtine – Podujeve (Magistral road 1+1 lane, 80km/h);
- Prishtine – Mutivode (Magistral road 1+1 lane, 80km/h);
- Prishtine – Gjilan (Magistral road 1+1 lane, 80km/h);
- Prishtine – Hani Elezit (Motorway, 130km/h + Magistral road 1+1 lane, 80km/h);
- Prishtine – Peje (Magistral road 2+2 lanes, 100km/h) and
- Prishtine – Mitrovice (Magistral road 2+2 lanes, 80km/h)

The number of scenarios taken is three:

- The first scenario “do - minimum” (S1) in which at the end of the period in 2025:

Without interventions in the existing situation of roads in Prishtina region.

- o Prishtine – Podujeve (Magistral road 1+1 lane, 80km/h);
- o Prishtine – Mutivode (Magistral road 1+1 lane, 80km/h);
- o Prishtine – Gjilan (Magistral road 1+1 lane, 80km/h);
- o Prishtine – Hani Elezit (Motorway, 130km/h + Magistral road 1+1 lane, 80km/h);
- o Prishtine – Peje (Magistral road 2+2 lanes, 100km/h) and
- o Prishtine – Mitrovice (Magistral road 2+2 lanes, 80km/h)

- The second scenario “do – something” (S2) in which at the end of the period in 2025:

With interventions in magistral road Prishtine – Podujeve road and construction of Prishtine – Lipjan – Gjilan Motorway:

- o Prishtine – Podujeve (Magistral road 2+2 lanes, 80km/h + Motorway);
- o Prishtine – Mutivode (Magistral road 1+1 lane, 80km/h);
- o Prishtine – Gjilan (Magistral road 1+1 lane, 80km/h + Motorway);
- o Prishtine – Hani Elezit (Motorway, 130km/h + Magistral road 1+1 lane, 80km/h);
- o Prishtine – Peje (Magistral road 2+2 lanes, 100km/h) and
- o Prishtine – Mitrovice (Magistral road 2+2 lanes, 80km/h)

- The third scenario “do – maximum” (S3) in which at the end of the period in 2025: The same situation of the second scenario it is also added the construction of Prishtina city’ ring (road).

VI. MODELLING OF TRANSPORT DEMAND MODELLING OF TRANSPORT DEMAND B PTV VISUM

The modeling of S0 and S1 Scenario are presented hereinafter.

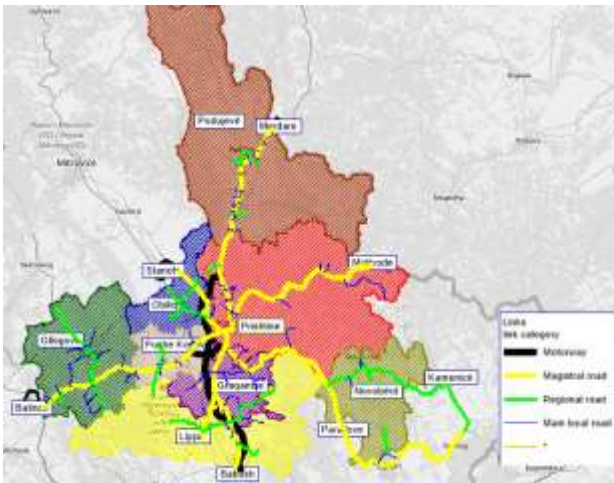


Fig. 4. The road categorization of the scenario S0

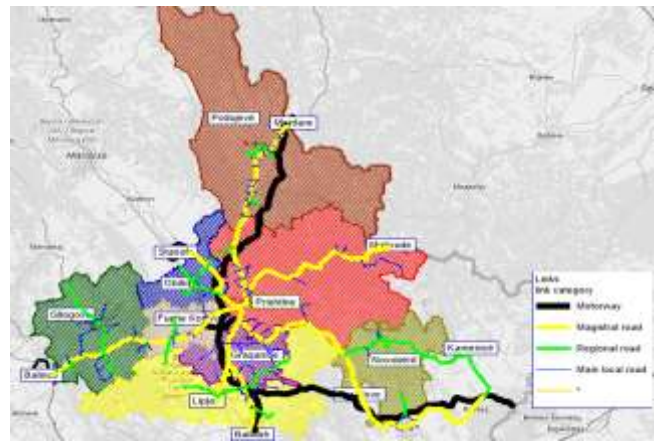


Fig. 7. The road categorization



Fig. 5. Modelling of transport demand for Prishtina region according to existing situation through PTV VISUM software – base year 2017, scenario S0



Fig. 8. Modelling and forecasting travel demand in Prishtina region using for year 2025 – scenario S2

Fig. 6. Modelling of travel demand for Prishtina region



according to existing situation through with traffic forecasting of year 2025 – scenario S1

The modeling of S2 scenario is presented below. In this variant it is anticipated to widen the traffic lanes in Prishtine – Podujeve (Magistral road 2+2 lanes, 80km/h) and construction of Motorway in Prishtine – Lipjan – Gjilan and Prishtine – Podujeve.

The Modeling of the scenario “do – maximum” (S3) - In this scenario the situation is the same as medium scenario it is also added the construction of Prishtina city’ ring (road).



Fig. 9. The road categorization



Fig. 10. Modelling and forecasting travel demand in Prishtina region using for year 2025 – scenario S3

While, the modelling of transport demand within the ring road is presented hereinafter figures.

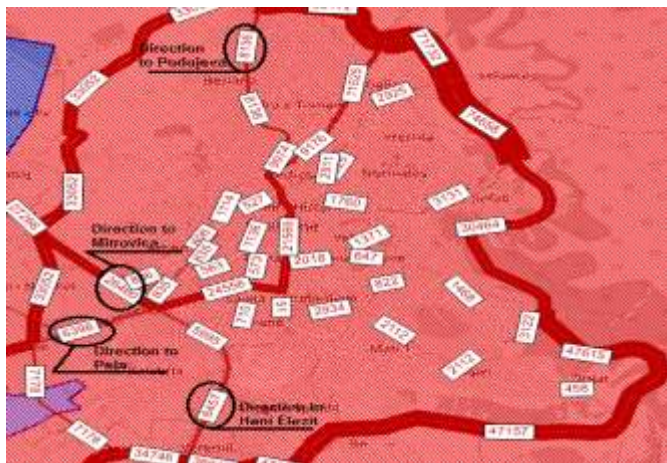


Fig. 11. The volume of traffic within the ring road

As it can be seen from the figure 14, the advantage of this scenario is the decongestion of city centre with the construction of Prishtina ring. Thus this investment discharges highways that pass through the city of Prishtina.

VII. CONCLUSIONS

In this research the variables that are get in consideration are: population, car owners, traffic flow, and road network. While, the modeling and forecasting of transport demand until 2025 it was decided to use PTV Visum software which resulted in creating the macro model.

After modelling and forecasting of transport demand for the year 2025 in line with four scenarios, also the level of service is calculated, and then the assessment is done in order to know which the best variant is.

From the modelling results made with PTV Visum software we have:

For base year 2017 or scenario S0, the highest traffic flow is recorded in the Motorway Fushe Kosove - Prishtine, while the highest traffic flow in magistral road is recorded in segment Prishtine – Balince – Peje, whereas the lowest values are registered in the road segment Prishtine – Babush – Hani Elezit.

For “do – minimum” scenario (S1), certainly that without intervention to road geometry and with increasing traffic, the road loads are larger in comparison with the scenario S0.

Furthermore, the results of level of service (LOS) when we comparison two scenario S0 and S1 told as, that the situation of traffic flows will remain difficult because in some segments the service level will reach level F and this means that they need additional capacities until 2025 and particular attention should be paid to improve this current situation, all roads have been downgraded to the service level.

For “do – something” scenario (S2) the construction of motorways has withdrawn the traffic from magistral roads.

The highest traffic flow is recorded in the Motorway Prishtine – Hani Elezit, than in magistral road Prishtine – Peje, Prishtine – Mitrovice, Prishtine – Hani Elezit, Prishtine – Gjilan, whereas the lowest values are registered in the magistral road Prishtine – Podujeve.

While, from the results of LOS we have upgraded of level in some directions, as: Prishtine – Gjilan and Prishtine – Podujeve with construction of two motorways.

For “do – maximum” scenario (S3), the condition in magistral roads and motorways is the same, the advantage of this scenario is the decongestion of city centre with the construction of Prishtina ring. Thus this investment discharges highways that pass through the city of Prishtina.

It is also clear that application of scenarios of investments according to LOS this situation would be improved significantly in particular by application of scenario S3.

Based on above elaboration we can conclude that the scenario S3 would be the best choices for Prishtina region.

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