

## EXECUTIVE SUMMARY

*"Traffic Safety Study with detailed analysis of jeopardized micro-locations and proposal of measures for Corridor X"* was completed in the period from 2006 to 2007, with a general aim of determination of black spots (dangerous locations) on Corridor X.

During the process of study preparation and analysis of the input data, it was discovered that the existing system of collecting and processing of data on traffic accidents was old-fashioned and that it was making the modern analyses of traffic safety on road sections and even on particular locations more difficult.

Taking into consideration the existing data on traffic accidents and modern worldwide experiences in the field of black spots identification and "black spots" management, for special needs of this study and based on the Collective and Individual differences at particular location, model for determination of the black spots was accepted according to the following formulas:

$$KP = \frac{\sum_{i=1}^r PBSN_i}{G \cdot L} \cdot \left( \frac{\text{accident}}{\text{km} \cdot \text{annually}} \right)$$

$$KP = \frac{\sum_{i=1}^r PBSN_i}{L \cdot 365 \cdot \sum_{i=1}^r PGDS_i} \cdot 10^6 \left( \frac{\text{accident}}{\text{mil} - \text{veh} - \text{km}} \right)$$

Where:

- G** – number of years (period subject to analysis),
- L** – length of the observed section,
- PBSN** – weighted number of traffic accidents.

$$PBSN = (n_1 \cdot 1 + n_2 \cdot 20 + n_3 \cdot 150)$$

Where:

- n<sub>1</sub>** – number of accidents with material damage,
- n<sub>2</sub>** – number of accidents with the injured,
- n<sub>3</sub>** – number of accidents with casualties.

In cases where accidents implied occurrence of casualties (POG>0), PBSN was corrected by multiplying it with the coefficient of severity of consequences (presence of casualties in number of the injured):

$$K^* = 1 + POG / (POG + TTP + LTP)$$

where:

- POG** – number of casualties in the accidents,
- TTP** – number of heavy injuries in traffic accidents,
- LTP** – number of slight injuries in traffic accidents

In this way, corrected weighted number of traffic accidents was calculated:

$$PBSN^* = PBSN * K^*$$

$$PBSN^* = (n_1 * 1 + n_2 * 20 + n_3 * 150) * (1 + (POG / (LTP + TTP + POG)))$$

That is, corrected collective risk (KR\*):

$$KR^* = \frac{\sum_{i=1}^r PBSN_i^*}{G \cdot L} \cdot \left( \frac{\text{accident}}{\text{km} \cdot \text{annually}} \right)$$

And corrected individual risk (IR\*):

$$IR^* = \frac{\sum_{i=1}^r PBSN_i^*}{L \cdot 365 \cdot \sum_{i=1}^r PGDS_i} \cdot 10^6 \cdot \left( \frac{\text{accident}}{\text{mil} \cdot \text{veh} \cdot \text{km}} \right)$$

Thus calculated values of risk of traffic accident occurrence represent foundation for identification of the black spots in accordance with the existing conditions in the Republic of Serbia. The accepted model would give better results after introduction of modern system of traffic accidents data collecting and processing.

The most important measures were proposed based on the surveys made and these measures should be applied along the whole road direction of Corridor X as to improve traffic safety conditions and consequently level of service. These measures are listed in the Volume 6:

- Efficient and effective speed control
- Guardrails
- Intelligent transport system in the function of traffic safety,
- Toll collection system,
- Expert analysis and solution of pedestrian crossings on the motorway
- Visual division of traffic lanes (barriers along the verges),
- Billboards besides a road
- Signalization
- Lighting,
- Pavement condition,
- Drainage,
- Periodic analysis of safety conditions on public roads,
- Control of the Corridor X accesses,
- Concept of safe road surroundings ("forgiving roads)
- Work zones protection and
- Accesses for supporting facilities.

During surveys execution, a certain number of activities benefitting to achievement of the mentioned and other goals were performed.

- More than 35 professional discussions were organized, where members of the survey team were present together with representatives of relevant institutions, especially of traffic police, PE "Roads of Serbia", Ministry in line for traffic (Ministry of Capital Investments, i.e. Ministry of Infrastructure), road companies, etc.
- Relevant strategic documents were studied and presented at the open expert discussion at the Faculty of Traffic.
- Professional discussion was organized at the Directorate for Police Education, Professional Development and Science, where besides seniors of the traffic police,

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- representatives of the PE “Roads of Serbia and the Ministry of Capital Investments were present,
- Professional discussions on traffic safety – a workshop was organized, with participation of Danish experts,
  - Workshop with a field training (deep analysis of traffic accidents) was organized by Swedish experts ,
  - Workshop with a field training (deep analysis of traffic accidents) was organized by Danish experts,
  - Professional discussions in reference to the position and role of particular subjects at improvement of traffic safety on Corridor X were also organized,
  - In addition, series of professional meetings were organized, where traffic safety issues were discussed. The most important issues were:
    - 4th professional meeting of international character: “Improvement of police activities in reference to traffic safety”, where the workshop was organized with participation of representatives of police of all countries subject to Corridor X crossing (Vrnjacka banja, November 2006),
    - Scientific – professional meeting “Traffic Safety on Corridor X” (TF, December 2006)
    - Workshop “Traffic Safety on Motorways”, where besides domestic, foreign experts from France, Denmark and Holland were present (PERS, February 2007),
    - Workshop: "Role of Local Community in Regards to Traffic Safety”, where representatives of local communities and traffic police of settlement along the Corridor X also participated (*TF, May, 2007*),
    - Workshop “Improvement of police practice in the field of traffic safety”, where the most important results of the study were presented (Kladovo, June, 2007),
    - Scientific-professional meeting “Road rehabilitation and reconstruction”, where methodology of traffic safety survey on Corridor X was presented and professionally verified (Zlatibor, June 2007), etc
  - Polls with the traffic police, supervisors and experts from the road companies were organized in reference to traffic safety issues on the Corridor.
  - Visits and the field surveys were organized for all the sections,
  - Professional discussions in all traffic police stations were organized, where besides members of the survey team, representatives of traffic police (seniors of traffic safety departments, TPI managers and managers of traffic sectors on Corridor X), road companies and PERS were present,
  - Cooperation between Faculty of Traffic, Ministry of Interior and PERS was improved,
  - Making records of the traffic accidents was improved,
  - Work of traffic police was improvement, especially in the segment of sector work and traffic accidents monitoring together with identification of dangerous locations.

Survey is founded on the overview of the very voluminous literature with the most important work in this area and on data on roads, traffic, traffic accidents and casualties from the base which was established for the needs of the survey. Although the scope and structure of the survey were defined by the ToR, list of activities on study preparation significantly exceeded the previous expectations. This primarily resulted from the great support and dedication of traffic police management, all traffic police stations, seniors and sector managers of Corridor X.

The Study is organized in two segments: the basic report and attachments. The basic report was divided into three volumes referring to the following:

1. Northern segment of Corridor X (road directions Belgrade – Croatian border and Belgrade – Hungarian border),
2. Central segment of Corridor X (Belgrade crossing and road direction from Belgrade to Nis) and
3. Southern segment of Corridor X (road directions from Nis to Macedonian border and from Nis to Bulgarian border).

These working volumes were organized as particular wholes. Each volume is supported by the adequate attachments.

Based on the analyzed data, the following “black spots” were defined in the northern part of Corridor X;

No..	Volume	Chainage	Number of accidents			number of the hurt			Risks	
			material damage	injuries	casualties	slight injuries	heavy injuries	deaths	KR*	IR*
1	North II	147	7	5	3	5	4	4	121,4	31,2
2	North II	155	11	4	3	2	4	2	112,7	32,4
3	North II	122	5	2	3	11	3	7	110,0	27,4
4	North II	139	13	1	2	1	0	4	99,9	25,7
5	North II	141	14	2	2	1	3	5	91,8	23,6
6	North II	58	4	0	2	1	2	5	82,3	46,8
7	North II	87	17	7	2	16	8	2	82,0	40,6

For each of the stated dangerous kilometre (“black spot”), general analysis of the safety problem was performed, representatives of the traffic police and road companies were polled, field surveys were executed and measures proposed. However, two or three dangerous locations (dangerous spots, kilometres or sections) were identified under each volume and the most important safety problems were defined together with the proposed measures that were elaborated up to the level of the Terms of Reference. Whenever possible, particular effects of the proposed measures were estimated, i.e. effects of the system of proposed measures. Concretely, for the northern part of corridor X, two dangerous locations covering several kilometres were treated. They are: section from km 138 to 141 km (Beska Bridge) and at the 87<sup>th</sup> km (Mandić Motel zone).