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RESEARCH ARTICLE

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Abstract

Despite of the current positive road safety development within EU (particularly in the category of drivers and passengers of personal cars), the road users are still facing high risk of being involved in road accidents, especially in former eastern European countries. This article presents the results of a case study that was conducted within the project PROSAFE and that dealt with the topic of road safety of tourists from Visegrad countries (V4) on the popular roads in the Czech Republic. The regions that are most attractive for the tourists from V4 countries were identified, together with most popular and important roads. The roads were compared according to their accident rates. Road safety inspection and accident analysis were carried out on one of the roads, aiming at identifying the road safety problems the road users have to face on their journeys.

Keywords

Road safety · Accidents with foreign drivers · Visegrad countries · Road safety inspection

1 Introduction

In total, 22.7 million of visitors from abroad arrived at the Czech Republic in 2012. 8.9 million (39.3%) can be categorized as several-day tourists, 11.6 million as oneday visitors and 2.2 million as transit tourists. Based on the data obtained from the Czech Statistical Office, tourists from Slovakia form the 3rd most populous group from all countries (382,000 tourists), tourists from Poland are the 4th most populous group (370,000 tourists) and tourists from Hungary are the 18th most populous group (111,000 tourists). The most popular tourist destination in the Czech Republic is the capital Prague, attracting more than 65% of visitors. Prague is well connected with the rest of the country and with neighboring states by motorways, the safest category of roads with lowest risk of accidents for all road users. When travelling to Prague, visitors very often use the safer travel modes such as trains, buses or airplanes. It can be assumed that the level of risk for foreign tourists is lower when travelling to Prague than to other Czech regions. Therefore, it was decided to eliminate Prague from this study.

2 Road Safety

It is evident from the long-term international comparisons that the Czech Republic belongs to countries with poorest road safety performance in EU (Figure 1).

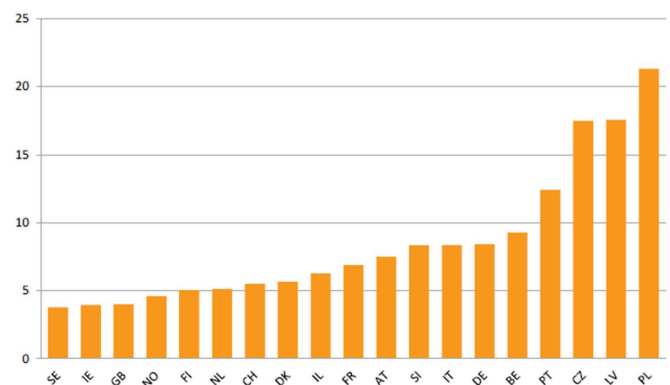


Fig. 1. Number of road deaths per billion vehicle kilometers. Average for the latest three years for which both road deaths and the estimated number of vehicle kilometers are available (source: 7th Road Safety PIN Report, ETSC, 2013)

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The annual average reduction was 9,4% for fatalities, 5% for serious injuries and 2% for slight injuries in period 2007 – 2012 in the Czech Republic. The total number of fatalities was 681 in year 2012 (and 2,986 serious and 22,590 slight injuries).

There are three main categories of foreign drivers:

- Transiting drivers
- Tourists with a destination in the Czech Republic
- Foreigners living in the Czech Republic

There is no distinction between these drivers' categories in road safety statistics. In 2012, road users from abroad were involved in 4,850 accidents (7% of accidents in the Czech Republic) that resulted in 46 fatalities (7.3%) and 1,302 injuries. The number of accidents is higher than in 2011 by 6%¹. Drivers from Poland and Slovakia are the most frequent offenders among foreign drivers (see Figure 2).

3 Selection of regions and roads

Three regions that are popular for tourists from V4 countries² and that are also used for the transit traffic were selected for the purposes of this study. These regions are: Kralovohradecky, Jihomoravsky and Moravskoslezsky regions (Figure 3).

The Kralovohradecky region is situated in northeastern Bohemia. With an area of 4,758 square kilometers and population of about 550,000 inhabitants, it belongs among the smaller regions of the Czech Republic. It is bordered to the north by the Liberec Region, to the west by the Central Bohemia region and to the south by the Pardubice Region. Part of its northern and eastern border creates the state frontier with Poland. The region is thus most popular for tourists from Poland (more than 30,000 visitors a year, about 9% of all Polish visitors in CZ). The main tourist attractions are: the National park Krkonose, the Orlicke Mountains and the Natural reserve Czech Paradise. The road E67 (nr. I/33 in CZ) is the main road connection with Poland, connecting Wroclaw with Hradec Kralove.

The Moravskoslezsky region is located in the easternmost part of the Czech Republic, in north Moravia. It is bordered by Poland and Slovakia. Its size is 5,427 square kilometers, with a population of 1,230,613 inhabitants. The region is attractive mainly for tourists from Slovakia. The main tourist attractions are: the city of Ostrava and the Natural Reserves Jeseniky and Beskydy. Roads nr. E442 (nr. I/35 in CZ) and E75 (nr. I/11 in CZ) are the most important road connections with Slovakia. There are also two important transit routes for

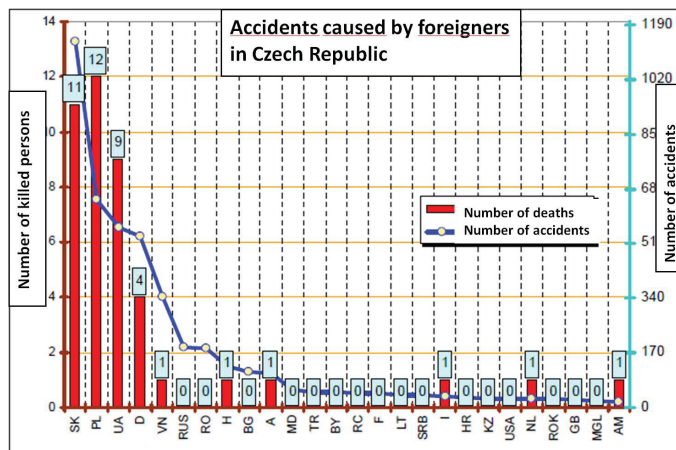


Fig. 2. Accidents caused by foreigners in the Czech Republic – data for 2012 (source: Ministry of Transport of the Czech Republic)



Fig. 3. Most popular regions for visitors from V4 countries. The flags in the map indicate popularity of the regions according to the nationality of visitors.

tourists from Poland travelling to Southern Europe, motorway D1 connecting Katowice with Ostrava and R48/S1 connecting Krakow with Frydek Mistek.

The Jihomoravsky region is among the most significant tourist destinations within the Czech Republic. Its size is 7,196 square kilometers, with population of 1,140,000 inhabitants. The region is situated in the southeast of the Czech Republic on the borders with Austria and Slovakia. The region is very popular among visitors from all V4 countries, with majority of tourists from Poland and Slovakia. The main tourist attractions are: the National park Moravsky kras, the wine region Palava, Lednicko – Valticky area and the city of Brno. Motorway D2 from Bratislava and road E50 (nr. I/50 in CZ) from Trencin are the main road connections with Slovakia. Road E461 (nr. I/52 in CZ) connects Brno with Vienna.

The sections of roads (based on their position, design category, traffic volume and estimated share of foreign drivers) that are the most important for tourists from V4 countries in three selected regions are:

¹ As a reaction to the negative trend, Ministry of Transport of Czech Republic and its Road Safety department prepared a leaflet for foreign drivers to inform them about Czech road safety rules. The leaflet can be download here: <http://www.ibesip.cz/en/road-safety/road-safety-rules-in-the-czech-republic>

² According to data from the Czech Statistical Office, based on number of foreign guests at collective accommodation establishments in 2012.

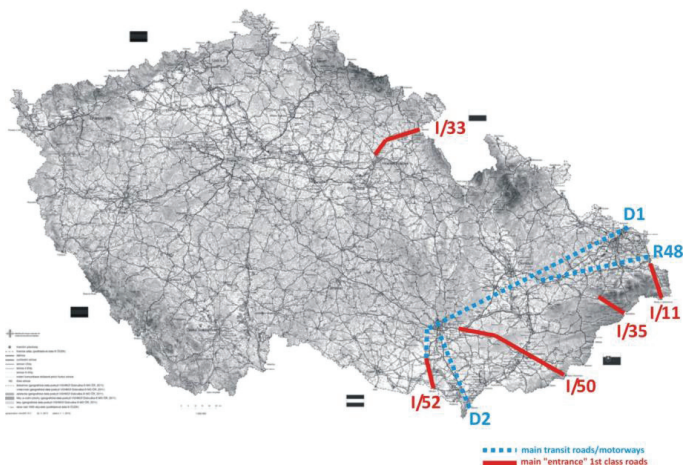


Fig. 4. Most important „V4 roads” in selected tourist regions

Roads to access touristic regions	Nr. of personal injury accidents in 2010 - 2012	Length of route [km]	Traffic in 2010 [vehicle / day]	nr. of accidents correlated to length and traffic [accident/10 ⁷ vehicle km] in 1 year
I/52: Mikulov/Drasenhofen - Pohorelice	32	23	8 600	1,47
I/50: Stary Hrozenkov/Drietoma – Holubice	211	98	9 700 ¹	2,05 ¹
- Section I	38	24	6 000	2,41
- Section II	111	57	10 000	1,78
- Section III	39	10	12 000	2,97
- Section IV	23	7	17 000	1,76
I/35: Velke Karlovice/Makov – Roznov pod Radhostem	34	22	4 800 ¹	3,21 ¹
- Section I	21	15	3 500	3,65
- Section II	13	7	7 500	2,26
I/11: Jablunkov - Trinec	91	36	8 700 ¹	2,30 ¹
- Section I	14	14	6 000	1,52
- Section II	72	15	12 000	3,65
- Section III	5	7	7 000	0,93
I/33: Nachod/Kudowa – Hradec Kralove	129	36	9 500	3,44

¹ Weighted by length of sections

Fig. 5. Detailed characteristics of selected 1st class roads

Motorway D1 – motorway with four (in some sections six) traffic lanes, going from Poland southward to Brno and further westward to Prague.

Motorway D2 – motorway with four traffic lanes, connecting Slovakia (capital Bratislava) and motorway D1 in Brno.

Express road R48 – mostly four-lane road, in some sections it has layout of motorway, it connects Poland with Cesky Tesin and further southwards with motorway D1.

Road I/11 – 1st class road with two traffic lanes, part of international route E75. It connects north part of Slovakia with Trinec and Moravskoslezsky region. The section starts on border crossing with Slovakia (Jablunkov) and ends in Trinec.

Road I/33 – 1st class road with two traffic lanes, connecting Hradec Kralove with Poland (Vratislav and Warsaw), international road E67. The section starts on border crossing with Poland (Nachod/Kudowa) and ends in Hradec Kralove.

Road I/35 – 1st class road with two traffic lanes, part of international route E442. It connects northern Slovakia with Moravskoslezsky region. The section starts on the border crossing with Slovakia (Velke Karlovice/Makov) and ends in Roznov pod Radhostem.

Road I/50 – 1st class road with two traffic lanes, part of international route E50. It connects Slovakia with Jihomoravsky region and motorway D1. The section starts on border crossing with Slovakia (Stary Hrozenkov/Drietoma) and ends in Holubice.

Road I/52 – 1st class road with two traffic lanes (with short section of motorway layout), part of international route E461. It connects Brno with Jihomoravsky region and Austria. The section starts on border crossing with Austria (Mikulov) and ends in Pohorelice.

The simple graphical illustration of the location of selected sections can be seen in Figure 4.

The motorways were excluded from further study because they represent the safest road category³. Five 1st class roads were selected for further analysis (Figure 5). The relative accident rates for selected roads were calculated based on the number of accidents resulting in injury and/or fatality in period 2010 - 2012.

4 Case Study

Although the safety characteristics (accident rate and density) of the road I/52 are not so critical compared to other roads in the sample (see Figure 5), it was selected for more detailed investigation. The aim of the study was not to solve the most dangerous road, but to demonstrate the usage of simple

³ The accident rates on motorways are approximately ten times lower than rates on two lanes roads.

analyzing tools for the identification of factors contributing to the development of accidents. The corroborative reasons for the selection of the road I/52 were as follows:

- It is very important road both for international transit (north – south direction) and access to the Jihomoravsky region
- Jihomoravsky region is the most popular tourist region for tourists from all V4 countries
- The road is part of TEN-T

For the purposes of the analysis, following tools were used:

- Basic road safety inspection
- Basic accident analysis

Term “basic” means that the road safety problems/factors were identified, but no countermeasures were suggested for improving road safety.

The road I/52 is located southern from city of Brno. The analysed section of the road is going from Pohorelice to Mikulov (state border with Austria) and is 22 km long. It starts where motorway R52 (a four-lane road with central reserve) ends. Following road I/52 is two-lane road that goes through rural area. The analysed section ends at the entrance to Mikulov. The speed limit is 90 km/h. AADT is approx. 9000 veh./day with 16% share of heavy vehicles. There is heavy cycle traffic along some parts of the road.

The main tourist attractions connected with the road I/52 are:

- Natural reserve Palava with beautiful landscape, archaeological sites, traditional villages and wine culture
- Valticko – Lednický area - „garden of Europe“, registered in the UNESCO World Heritage list since 1996
- City of Brno – second largest city in the Czech Republic

5 Basic Road Safety Inspection

The road was inspected by the team of two road safety auditors (authors of this article) in September 2013. Such a procedure could be compared to regular road safety inspection (defined in Directive 2008/96/ES) and it represents a proactive approach to improve road safety.

The following road safety deficiencies, which could influence the safety of foreign drivers on the road I/52, were identified:

Problem of consistency

The road I/52 is connected with motorway R52 in the north and road I/7 in Austria in the south. It forms an isolated segment within the international route with not self-explaining design of its layout as the other parts of the route.

Level of Enforcement

Compared to Austria, the level of enforcement in the Czech Republic is lower and the traffic rules are less respected. Thus, some drivers' behavior is more hazardous upon entering road I/52 from Austria. The risk of being involved in an accident with personal consequences is more than twice as high in the Czech Republic as in Austria (Figure 1).

Fatigue

The road I/52 is part of the north-south transit (with main destinations in Croatia and Alps), with intensive holiday traffic. The probability of fatigue is expected to be higher than on “common” national roads.

Layout of intersections

There are several four-arm intersections along the road I/52 that have a similar layout, characterized by large pavement areas with no physical separations of traffic. Such intersections are considered to be dangerous (see descriptions of black spots 1 and 3 below).

Layout of road

The layout of road I/52 (width of traffic lanes, road alignment) encourages speeding and risky overtaking.

6 Basic Road Safety Analysis

The road was analysed based on accident data recorded by the Police in 2010 – 2012. In total, 32 accidents resulting in injury were recorded by the police along the section of road I/52 in that period. There were six fatalities, six serious injuries and forty slight injuries recorded in these accidents. The most frequent types of accidents are collisions with another vehicle (72%) and collisions with a fixed obstacle (13%). When a collision between two vehicles occurred, the most frequent types were side by side collisions (22%) and rear-end collisions (19%). Single vehicle collisions were recorded in 28% of accidents. More than half of accidents (53%) occurred on straight sections, 31% at intersections and only 10% in curves. Drivers of passenger cars were the most involved road users in accidents (70%), followed by drivers of heavy vehicles (14%) and motorcyclists (11%). The majority of accidents (84%) occurred on dry surface, under good weather conditions. Most of accidents were recorded during the summer (August and September) and in typical traffic peak hours. Most of the characteristics correspond with typical values for relevant road category, except the very low share of accidents in curves (but there are not many curves along the analysed section), higher share of accidents on dry surface and higher share of motorcycles.

According to the Police, the most frequent causes of accidents were lack of attention of drivers, not respecting the STOP sign and insufficient distance between vehicles. It is necessary to point out that causes of accidents identified by Police are categorized according the types of breaking the traffic laws and rules and the “real” contributory factors can be different in some cases, especially on spots where the road layout and alignment can play an important role in accidents occurrence. The aim of the case study was to try to identify such contributory factors, which are related to road layout and can have negative influence on driver performance.

The distribution of accidents along the section is shown in Figure 6. The accidents are spread along whole section but it is

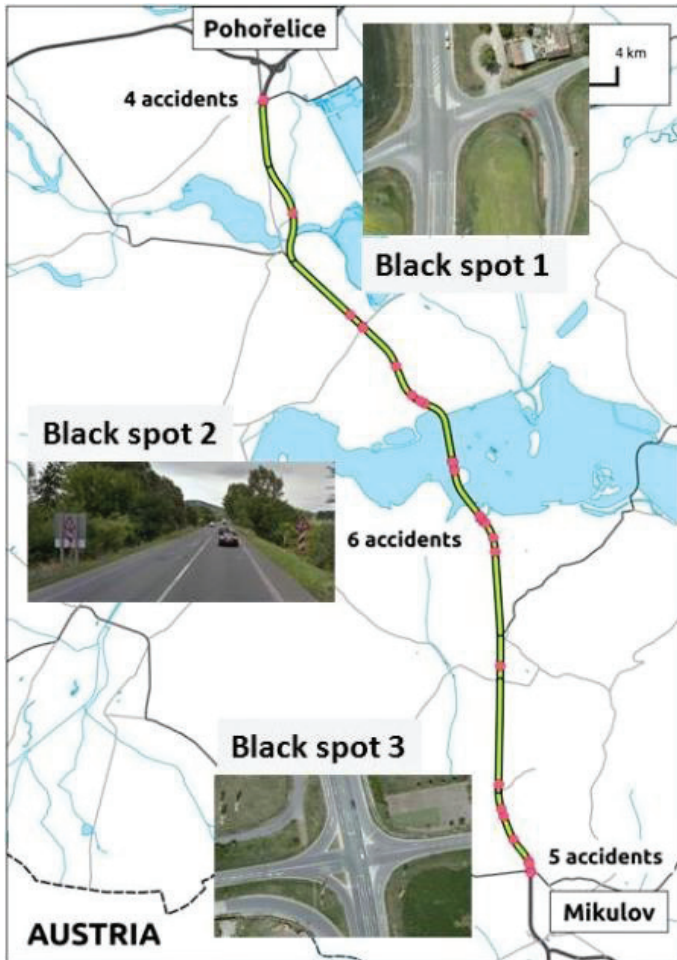


Fig. 6. Distribution of personal accidents along the road I/52 and black spots

also possible to identify three main clusters (black spots) where the accidents are concentrated.

Black spot 1

The first black spot is situated at the start of the section, near Pohorelice. The four-lane road R/52 with central reserve ends here as the four-arm intersection and continue further as two-lane road I/52 without central reserve. Such a sudden change in road category can surprise drivers from both directions. The other risk factor is the layout of the intersection itself. The area of intersection is too large without any physical measures to assist drivers in desired movements. The pressure put on drivers when crossing the main road is enormous, both due the large dimensions of intersection and speeding of drivers on main road.

Black spot 2

The second black spot is situated just behind the dam on the Dyje River going southward on the road I/52. The alignment of the road is straight; overtaking is prohibited by traffic signs, but not by road marking. The frequent cycle route crosses/goes along the road I/52 in the analysed section, without any physical features for protecting cyclists. The only measures trying to improve the safety of cyclists are based on red road area



Fig. 7. View from road I/52 to road R/52



Fig. 8. Location of cycle route crossing with red road marking on the main road



Fig. 8. The view from main road direction to city of Mikulov

marking on the main road surface in front of the crossing, decreased speed limit to 70 km/h and warning signs (see Figure 8). The layout of the road encourages the speeding and overtaking and together with high traffic volumes of motor vehicles contributes to increased risk to vulnerable road users.

Black spot 3

The third black spot is situated just before the road I/52 enters the city of Mikulov from the north (from Brno), between Bavory and Mikulov. It is a two kilometers long section that ends with four-arm intersection with typical shortcomings similar to those mentioned in black spot 1. The large pavement area of whole intersection without sufficient fragmentation encourages speeding, dangerous behavior and does not support desirable movements (paths) of vehicles. The section prior to the intersection has very comfortable layout, so it encourages speeding and risky overtaking.

7 Conclusions

The aim of the study was to select the roads in the Czech Republic that are important for the tourists from V4 countries, to collect basic data about these roads and to choose one road for more detailed road safety analysis in order to demonstrate the usage of tools for identification of factors contributing to accidents of foreign drivers.

The most attractive regions were identified together with most popular and important roads. The roads were compared according to their accident rate. The section of the road I/52 in the Jihomoravsky region was selected (although it is one of the safer roads from the sample according to the accident rate). Basic road safety inspection and accidents analysis were conducted on the road I/52. Based on the road safety inspection, the factors, which could influence the safety of foreign drivers, were identified:

- Problem of Consistency
- Level of Enforcement
- Fatigue of drivers
- Layout of intersections
- Layout of road

Acknowledgements

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