

ANALYSIS OF ROAD BLACK SPOTS IDENTIFICATION METHOD IN REPUBLIC OF CROATIA

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Abstract: In the Republic of Croatia in the last ten years, the number of persons killed in road traffic is reduced. However, it is still not enough to be compared with the developed countries of the European Union. According to the international experience, identification of black spot and hazardous locations in road traffic is one of the most effective ways to reduce the number of traffic accident. Identification of black spot locations has a long tradition in the traffic engineering, but it is evident that European countries still don't have same principles for identifying black spot. One of the reasons is their general level of traffic safety. The countries which have developed methodology for identifying black spot a long time ago today have a very high level of traffic safety. Methodology for the identification black spots range from simple marking of dangerous locations to more sophisticated techniques used to assess the expected number of accidents and determines the potential for improving road safety. In this paper it is analyzed the current methodology and the impact of black spot identification on the road safety in the Republic of Croatia. Based on the analysis are recommended measures for improvement the black spots identification system.

Keywords: Black spot, traffic accidents, traffic safety

1. INTRODUCTION

Identification and remediation of black spot is one of the most effective ways to increase the road safety. A prerequisite for identification of black spot and management of road traffic safety is the systematic collection of data in traffic accidents. The most important stage in black spot management, except analysis and treatment, is the identification of black spot, which include a series of procedures to detect black spot on the road network. Methodology of the identification the black spot is in range from simple marking of black spot to sophisticated techniques which implies evaluating the expected number of traffic accidents and determination of potential for the safety improvement. Countries that have developed system and methodology for identification of black spot before many years now have a very high level of traffic safety.

Croatia does not have a methodology for determination of black spot for all types of roads, in most cases the black spot are identified on the basis of ranking the number of traffic accidents on specific location. With this approach, which does not take all relevant parameters or systematically identification characteristic of black spot, is possible that some black spot remain unidentified. This approach may have negative effect to the road safety.

2. ANALYSIS OF ROAD TRAFFIC SAFETY IN REPUBLIC OF CROATIA

Road traffic safety in Croatia is regulated by the Law of road traffic safety, which has been in use since 4. June 2008th. The level of the road traffic safety usually is defined by the number of persons who died in traffic accidents in certain period of time. Depending of methodology, the number of person died in road traffic accidents could be shown in ratio 100 000 inhabitants, 100 000 drivers or 100 000 vehicles.

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Information's about the number of traffic accidents are collected, in the margin of their authority, by the Croatian Ministry of Interior. The Ministry of Interior is publishing collected information's, once a year in the Report of road safety. The collected information's represents statistical data which are used for the analysis of road safety.

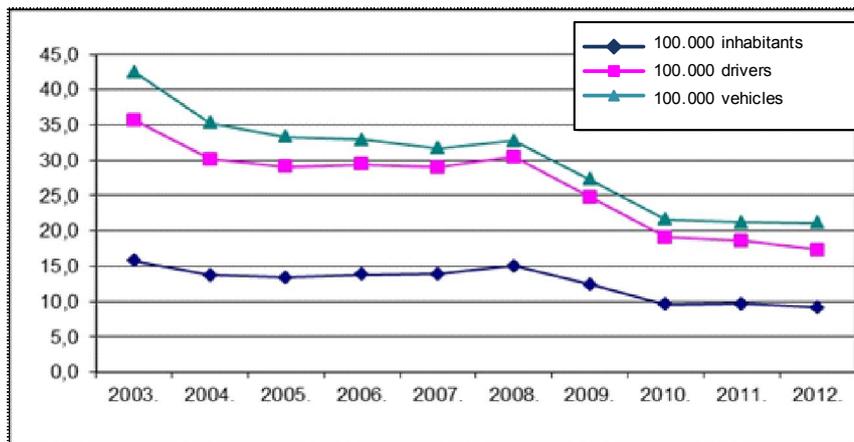


Figure 1. The number of people died in ration per 100.000 inhabitants, drivers and vehicles. (Report of road safety, the Republic of Croatia, Ministry of Interior, Zagreb, 2012)

According to available data, in the past 10 years in the Republic of Croatia, the number of registered motor vehicles drivers is increased for 15.4%, while the number of registered motor vehicles has increased for 13.0%. (Report of road safety, the Republic of Croatia, Ministry of Interior, Zagreb, 2012)

During the period between 2003 till 2012, there has been 574.000 traffic accidents which caused death of 5.590 people, the 40.000 people were difficultly injured, and 177.000 people were slightly injured. The biggest increase of the traffic accidents was in 2003, when there were 92.102 traffic accidents. Secondly, in the 2003 there was the biggest number of deaths – 701, and after this, the number of deaths in traffic accidents was decreased in 2012. to the number of 393. In the past ten years, it is shown decreasing of the number of deaths regardless of the methodology which was used to display it (Figure 1).

Location of traffic accidents shows that the most traffic accidents in past two years was occurred in the city of Zagreb and in the Splitsko – dalmatinska county.

Accordingly to the Law of Roads, in the Republic of Croatia, public roads include: highways, state roads, county roads and local roads. Except the above mentioned roads, there are specially defined non categorized roads as public roads.

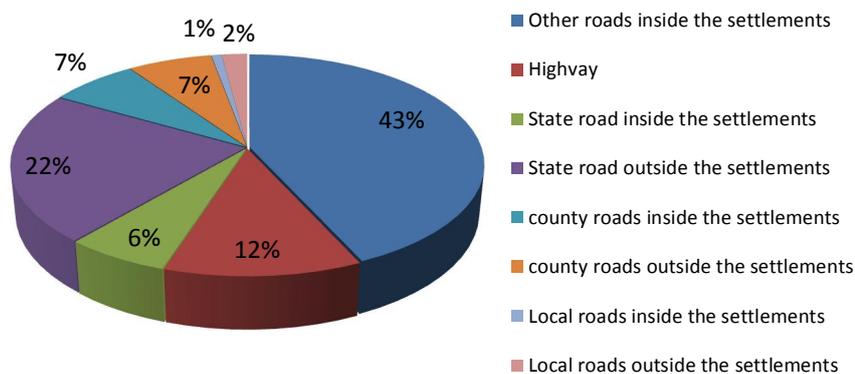


Figure 2. Deaths according to categorization of roads in 2012. (Report of road safety, the Republic of Croatia, Ministry of Interior, Zagreb, 2012)

According to the statistic, the most accidents happens on the roads in the settlements (43%), followed by state roads outside of the settlements (22%), highways (12%) and other roads (Figure 2). The Ministry of Interior also collects data about causes of road traffic accidents, based on the investigation of the police officers after traffic accidents. However, this data could show certain inconsistency taking into account that the data are not based on valid court decisions or professional traffic-technical expertise.

According to the statistic, the Republic of Croatia has been in 21st position of 24 European countries, in 2011th, in the number of deaths in traffic accidents per 100.000 inhabitants. These data indicate the need for additional and enhanced engagement so it could be able to follow the trends of highly developed country.

3. NATIONAL ROAD TRAFFIC SAFETY PROGRAMME OF CROATIAN REPUBLIC

One of the elements which have contributed to reducing of the number of traffic accidents, among the stricter law regulations, is systematic implementation of National Safety Road Programme. First programme of National Programme was adopted in 1994, for the period of two years, and immediately brought good results. After the first, next National Programme was adopted for period between 1996 till 2000, in which there were intention to connect with positive movement of European countries. The next programme which was adopted for period between 2001 and 2005, the sources of financing were defined (the budget, part of the budget collected from technical inspection of vehicles and part of necessary vehicle insurance). National Programme which were adopted for period between 2006. till 2010., set the concrete objective which was to decrease number of deaths in traffic till 2010, to the 10 deaths per 100 000 inhabitants. Considering that in 2010 was 9,6 deaths per 100 000 inhabitants, the goal of the National Programme was reached. (Figure 3.). One of the reasons for decreasing of deaths was remediation of black spots, which was one of the strategically objectives in programme. In the last ten years, with the budget of the National Programme has been made project documentation for fixing of 64 black spots on state roads, county roads and local roads in the whole territory of the Croatian Republic. In all remediated black spots, the number of traffic accidents and deaths has been decreased significantly, or the accidents do not happen at all. After last successful National programme of road safety, government of Croatian Republic adopted fifth National program of road safety of the Republic of Croatia 2011.-2020., and its frame and duration are based on provisions and guidelines of the Moscow declaration of the 2009th, the United nations declarations 62/244 from March 2010., and on the basis of adopted fourth action program of the European Commission.

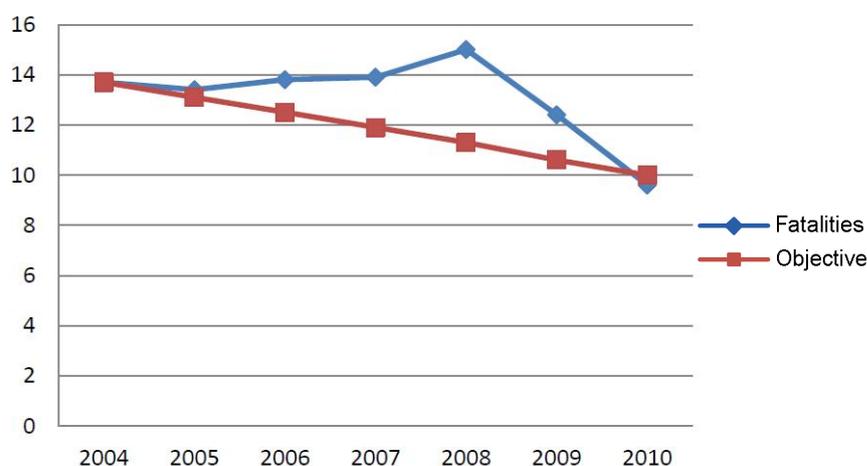


Figure 3. Number of deaths between 2006 and 2010. (Report of road safety, the Republic of Croatia, Ministry of Interior, Zagreb, 2012)

Measures which should lead to success will be conducted in following fields of action:

- Changing of traffic behaviour
- Improved road infrastructure
- Safer vehicle
- Effective medical care after traffic accidents
- Other areas of activity.

Till now, results do not show good results, because there were not reached annual objectives. In 2012 there has been 2,6% of deaths more than the National programme predicted.

4. BLACK SPOTS IN ROAD TRAFFIC

Black spot in road traffic generally represents the location in which above-average number of traffic accidents occurs. Should be considered that the term *black spot* is not regulated by the law, there are several derivatives of this term. In our national literature this spots are also named as dangerous road location or “hot spots” of road traffic.

National authors are differently interpreting the term of black spot, so black spots are defined as parts of road on which increase number of accidents with deaths and higher material damage occurs.(Cerovac et al, 2001:19).

Dangerous road locations or black spots on the road are places on which the risk of traffic accident is significantly higher than on the other road locations (Gledec et al, 2009:34). Also some authors explain the distribution of black spot on roads in Croatia. (Brek et al, 2004:81)

The locations of accumulation of traffic accidents (especially dangerous places) or black spots

Black spot is considers as location on which more of the twelve accidents with injuries and deaths occurred, on the length of 100 (m) from the intersection or 300 (m) of segment of the road in the past five year. If the length of the section between two intersections is less than 250 (m), the intersections are included in the section. The intersection as a dangerous place, are attributed also traffic accidents that occur 20 (m) outside edges of the roadway intersections final lanes (pouring, spilling).

Intersections are mostly tested separately from the road section. The large uneven intersections are complex and may be consisted of sections and parts of intersections (pouring, spilling)

Black spots

Black spots are places in which higher than average number of traffic accidents occurs, but less than on the places of accumulating traffic accidents. Such black spots could be classified in different ways, according to the different criteria. In the professional international literature, dangerous spots are also defined in various terms, the most common terms are: Black spot, Hot spot, hazardous Road locations. In the most cases, the authors in their articles are using one of the terms and some authors identify those terms. (Elvik et al, 2008:1831; Cheng et al, 2008:76) Although there is no standardized terminology, from analysis of national and foreign literature it could be conclude that the black spot in road traffic are defined as locations on which above-average number of accidents occurs in comparison with other similar locations. This definition is the most common and it is also mentioned in the final report of the project RIPCORDER ISEREST PRIORITY 1.6., Sustainable development, global change and Ecosystem 1.6.2: sustainable Surface Transport from sixth framework program of the European Union. In the Republic of Croatia, as in some countries of the European union, there is no standard definition of black spot in road traffic. However, some countries such as Norway, have introduced a formal definition of hazardous places (Eng. Black Spot) which is: „*Black spot is considered as every section of road, length not greater than 100(m), with at least four traffic accidents with injuries registered in the past five years*“ (Sørensen and Elvik et al, 2008:21).

5. ANALYSIS OF ROAD BLACK SPOTS IN REPUBLIC OF CROATIA

In Croatia, as mentioned, there is no systematic model of identification dangerous area, which is applicable to all types of roads as is used in the countries of the European Union. The only known criteria for determining black spots is one that is used for state roads that are under the authority of the Croatian roads. According to these criteria the black spot could be called an intersection or road segment in length of 300 (m), or as black spots may be called a part of road length of 300 (m) to 1000 (m), with the condition that satisfy one of the next three criteria:

- If on the critical location has occurred 12 or more road traffic accidents with injured persons in past three years,
- If in the monitored location 15 or more accidents are recorder regardless to the consequences, in past three years
- If in the critical location three or more identical accidents has occurred with the same group of participants, with the same moving direction and with the same conflict area etc.

The company Hrvatske ceste d.o.o., has processed, till now, 336 locations defined as state roads as locations on which the number of accidents, and with this the number of injured persons, may reduce with construction-technical or traffic remediation measures. (Table 1). Every located place is defined by the information of location and description of black spot, and data of relevant offices for maintenance and in competence of the Police administration. Except mentioned, information's of road and the technical characteristic of the location, category and number of the road, the type of the road curtain, signalling, speed limits and the information's about black spot: alignment gradient, width of traffic lanes, transverse and longitudinal gradient, visibility length with supporting graphic processing, cartographic view, macro and micro of the location and photos of the road and its surrounding from drivers perspective. Within the catalogue there are also the data about traffic accidents and their consequences for the period of the past five years, so as the proposed measures for fixing.

From the analysis of the information from this catalogue can be concluded that the most common black spots on state roads appear as sharp turns, to be specific in unclear views turns. In further analysis it is evident that the following are the intersections with different modalities, especially the intersection of secondary and main roads with the form of T-intersection, where for the (left) turn off the main road has no special lane (“called deflectors left”) as the most common.

Table 1. Number of Black spots in Republic of Croatia counties

| County | Black spots |
|------------------------|--------------------|
| Bjelovarsko-bilogorska | 15 |
| Brodsko-posavska | 6 |
| Dubrovačko-neretvanska | 14 |
| Istarska | 37 |
| Karlovačka | 12 |
| Koprivničko-križevačka | 13 |
| Krapinsko-zagorska | 12 |
| Ličko-senjska | 14 |
| Međimurska | 8 |
| Osječko-baranjska | 11 |
| Požeško-slavonska | 14 |
| Primorsko-goranska | 28 |
| Sisačko-moslavačka | 8 |
| Splitsko-dalmatinska | 48 |
| Šibensko-kninska | 17 |
| Varaždinska | 9 |
| Virovitičko-podravska | 5 |
| Vukovarsko-srijemska | 9 |
| Zadarska | 40 |
| Zagrebačkoj županiji | 19 |

Within the comparison of information about traffic accidents which were recorded in three-year period before and in the same period after fixing black spots, it has determined that there was overall decrease of traffic accidents for 76,2%, the number of deaths for 90,3%, seriously injured for 75,3% and number of slightly injured for 72,3% (<http://www.hrvatske-ceste.hr/default.aspx?id=60-20.01.2014.>).

6. CONCLUSION

Identification and black spots management has long tradition in traffic engineering, but it is visible that European countries do not use fully similar principles of identification of black spots. The cause for this is different traffic and technology factors of the countries and general level of their traffic safety.

From the analyses, it is evident that the current level of road safety in the Republic of Croatia is not at a satisfactory level, and new methods are needed to increase road safety.

According to national and international experience, one of the most effective ways is relevant to the identification and fixing of black spots.

The method also shows some weaknesses because it does not take into account the parameter of density of traffic in black spots which can display more relevant results and help in the ranking of dangerous places.

From the analysis presented in this paper, it is evident that the existing methodology for determining black spots can only partially be used for local roads. Although the values of certain parameters of the existing methodology (period of time, the length of the observed section) may be used to determine black spots on local roads, such a methodology, because of its high sensitivity to the number of registered accidents, is not suitable for urban areas. In this field it is necessary primarily determine the institutions which would be the holder of this work and after that step it will be possible to, based on professional and scientific analysis, define the relevant methodology for determination of black spots on local roads.

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