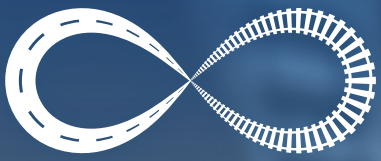

CETRA 2018

5th International Conference on Road and Rail Infrastructure
17–19 May 2018, Zadar, Croatia

Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR

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CETRA 2018
5th International Conference on Road and Rail Infrastructure
17–19 May 2018, Zadar, Croatia

TITLE
Road and Rail Infrastructure V, Proceedings of the Conference CETRA 2018

EDITED BY
Stjepan Lakušić

ISSN
1848-9850

ISBN
978-953-8168-25-3

DOI
10.5592/CO/CETRA.2018

PUBLISHED BY
Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia

DESIGN, LAYOUT & COVER PAGE
minimum d.o.o.
Marko Uremović · Matej Korlaet

PRINTED IN ZAGREB, CROATIA BY
"Tiskara Zelina", May 2018

COPIES
500

Zagreb, May 2018.

Proceedings of the
5th International Conference on Road and Rail Infrastructures – CETRA 2018
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CETRA 2018 17–19 May 2018, Zadar, Croatia
5th International Conference on Road and Rail Infrastructure

SAFETY INSPECTIONS OF ROADS

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Abstract

Evaluation of construction, technical and operational characteristics of roads on safety of road traffic when using it belongs to proactive and reactive tools of every good road manager. The authors of this article point out the safety shortcomings, defects and risks that are most frequently encountered during the road safety inspections in the Czech Republic. The risks of existing but also newly built constructions will be described on the already carried out inspections. These are the risks, which occur on local roads (suitability of suggested category of road, connection of junctions, psychological priority, view conditions, roundabouts, traffic signs, public transport stops, cycling and pedestrian transport, etc.). Further these are the risks which occur on roads in extravilan (the route and its self-explanation, junctions, railroad crossings, fixed obstacles, traffic signs, view conditions, road drainage, etc.). At the end of the article there is a statistical evaluation of identified risks with individual percentages. Further there are stated methods of how are the risks found during the safety inspections introduced to the professional public in the Czech Republic. The aim of this article is to highlight the most frequent risks and the necessity of safety inspections for increasing the safety of road traffic.

1 Introduction

Human factor is the most responsible source of the accidents. Traffic participants make mistakes in their judgement, they are often distracted easily, they show psychological and physical limitations, they sometimes even consciously violate regulations, they seek out and undergo various risks [1]. Factors, such as speeding, inattention or inappropriate way of driving, significantly predominate as main causes that contribute to the origin of the conflict situation and consequent accidents [2]. However, these factors are influenced not only by the human being (or the means of transport), but significantly also by the layout of the road and its immediate surroundings. The choice of speed is influenced by the arrangement of the road, driver's fatigue is supported by monotonous surroundings and route [3]. The expected behaviour of the driver is influenced by the consistent categorization of the roads, the safe behaviour is supported by good viewing conditions and by minimization of the occurrence of unexpected events. Also, the consequences of possible accidents are influenced by the road layout and its surroundings. Inappropriately placed fixed obstacles [4], unprotected structures of road construction, dangerous elements of drainage, etc. can significantly worsen consequences of accidents.

Because safety is a complex system with constant interactions between the road users, vehicles and infrastructure, for the increase of the safety it is necessary to affect all the parts of this system. From the perspective of the infrastructure the owners and the road manager of the roads should ensure adequate level of safety of both, the future but especially existing roads [5]. During construction and maintenance of the roads there exists a number of tools whose application reduces the risk of accidents, or eventually it reduces its consequences. One of these tools is the safety inspection.

DOI: https://doi.org/10.5592/CO/CETRA.2018.680

2 Safety Inspection

A total of 50 safety inspections were used for the purpose of this article. These included security inspection on local roads and the inspection on roads in extravilan. Within the scope of these safety inspections the risk factors were identified by the inspection teams. These risk factors are connected to the formation of the road and its surroundings. Further the measures for its elimination or reduction were suggested. The risk factors found in the solved areas were evaluated by three levels of the seriousness of the risk: low, moderate and high [1] – see table 1.

Table 1 Seriousness of the risk and its characteristics [1]

Seriousness of the risk	Colour coding	Characteristics
Low	yellow	The risk factor influences the origin of the collision situation, or increases the subjective risk (it reduces the feeling of safety) of the participants in traffic. The occurrence of the accidents with personal consequences is very unlikely. The impact on worsening the possible accidents is minimal.
Moderate	orange	The risk factor has an influence on the origin of the accidents with personal consequences and on worsening of the consequences of possible accidents. The inspection team considers its removal important.
High	red	If the risk is not removed there is a considerable possibility of occurrence of accidents with personal consequences. The impact on the worsening the consequences of possible accidents is significant. The inspection team considers its removal to be a priority and necessity.

3 Identified Risks

These are the selected examples of risks, which were repeated most frequently during the safety inspections. Further it includes the risks which were placed into a higher category of the risk seriousness – moderate and especially the high seriousness of a risk.

3.1 Width Road Layout

In particular, this includes failure in keeping the suitable width layout of the road [6]. Wrongly defined areas for dynamic and also static traffic, including the movement of pedestrians were recorder in the space (see Fig. 1). The road does not entirely meet the principle of self-explanatory road. The layout of the road, especially with local roads, encouraged speeding and, on contrary, was a barrier and risk for pedestrians and cyclists. At 50 % of localities there was static traffic in these areas (parallel, perpendicular or angle parking) and bus stops.

Figure 1 An example of a large traffic area – one-way road (the area allows any parking and it becomes a barrier for pedestrians)

In extravilan parts the category of the road did not correspond to the intensity of the traffic, or the width layout of the road was not kept.

3.2 Vertical and Horizontal Traffic Signs

The risks connected with the horizontal traffic signs were mainly in bad visibility, or the signs were completely missing. With vertical signs it was mainly about bad visibility (the signs were overgrown with vegetation), or the sign was placed inadequately, or a bad type of road sign was chosen.

3.3 Intersections

The found risks on level crossings (e.g. crossroads, junctions, offset, …) and level roundabouts (e.g. one-line, two-line, turbo-roundabouts, …) involved mainly geometric layout of the intersection ([5, 6]), unsuitable design of the construction elements, or the damage of the construction elements of the intersection. These elements in some combination were then a cause of the accidents. At turbo-roundabouts (see Fig. 2) the conflicts were caused mainly because of the absence of physical separation of the lanes on the circulatory roadway of the roundabout. With this issue the horizontal and vertical traffic signs and the lighting of the intersection [7] are closely connected.

Figure 2 An example of observed conflict situation – passage of heavy lorry over two lanes (consequently other traffic participants are influenced). There is absent the physical separation of the lanes. Various serious situations were observed on this intersection. This intersection has an annual average of daily intensity of approx. 17 000 vehicle a day.

3.4 Views

In the observed localities where the inspection took place, the view had a major impact on the safety on the traffic on the roads (causes of accidents). Sight triangles did not meet requirements of particular standards (whether it was about the triangles on local roads or other roads). In 60 % of cases the traffic signs were chosen in an inappropriate way (e.g. road sign “Give Way” used instead of the road sign “Stop, Give Way”). In the sight triangles in the areas of the intersections interfered the following: unsuitably designed car parks, landscaping (or its non-maintenance), placement of the containers for municipal waste, fencing, etc. In extravilan at direction arcs the main problem was the vegetation, grown crops (agricultural land) or unsuitably adjusted terrain – in these places the safe distance for stopping the vehicle was not kept.

3.5 Bus Stops

The risks that occur on bus stops were connected not only with the movement of pedestrians, but also with the movement of the public transport vehicles and with the movement of the traffic (see Fig. 3 and 4). The platforms of the stops were connected with risks of not securing contrasting signs of the entrance edge and the signs of the signal strip at the stop marker. The area of the platform did not meet the required width and there were fixed obstacles in this area. From the construction layout the bus stops did not meet the requirements on height of the entrance edge which is given by the standards and in many cases the surface of the road showed significant damages [8]. In 28 % of observed inspections there were exits on the entrance edge of the bus stop or there were situated pedestrian crossings. In smaller towns and villages the horizontal and vertical signs were missing.

Figure 3 An example of an inappropriate solution of the entrance area – the bus stop curb is missing and also the contrast signs of the entrance edge including the signal strip. In the area of the platform there are obstacles for the pedestrians. There is also a pedestrian crossing at the beginning of the entrance area.

Figure 4 This part of the road was reconstructed, including the new traffic signs. In this locality approximately 20 connections stop every day. But the design of the bus stop area including the access for the pedestrian was not done. According to the information there is not a plan to do it in the future – high risk.

3.6 Fixed Obstacles

According to the Czech standards any fixed obstacle is such a fixed object or an element which represents danger or risk for the traffic on the roads, and whose distance from the edge of the road is shorter than the longest possible distance according to the particular standard.

As a fixed obstacle we consider trees, bushes (with a diameter of branches › 0,10 m), columns, walls, columns of portal constructions, objects and elements protruding more than 0,2 m above the adjacent terrain, perpendicular walls of the culverts, etc. The risks were most frequently represented by trees (see Fig. C5), inclined parts of the culverts including outlet-headwall [4], poles (traction, lamps). At approx. 30 % of inspections were discovered the risks in connection to the nondeformable construction.

Figure 5 The fixed obstacle in the form of the roadside alley on the road of 2nd class with an annual average of the daily intensity of approx. 5 000 vehicles a day. The trees are very close to the road, in some parts they are in very bad conditions and there is a danger of falling of the trees on the road. In this area there were 65 accidents with fixed obstacle (tree) in last 6 years. Two of them had a loss of a life as a consequence.

3.7 Pedestrians Crossings

The pedestrian crossings most frequently observed during the safety inspections are in built-up areas [9]. The length of the pedestrian crossing does not meet the defined values in standards – the length of the pedestrian crossing at new buildings is 6,5m, at reconstructions 7,0 m over 2 lanes. The length of the pedestrian crossings in observed audits was different than the length in the standards, in some cases even twice as much (on two-lane roads). Further at the pedestrian crossings where the light signalling device is placed or at inclined crossings, the tactile strips of the crossing were missing. In case the pedestrian crossings were designed as inclined, they had an inappropriate angle of crossing. There was also a risk connected to lighting at the pedestrian crossing, barrier-free access, vertical and horizontal traffic signs.

3.8 Road Structure and Drainage of the Road

Continuous and point faults, and damages of the surface of the road occurred [8]. Especially in the places of the sewerage shafts, the longitudinal and transverse bumps, including holes and potholes. There were longitudinal cracks, transverse inequalities (ruts), especially in longer parts and also network cracks. In the observed parts, especially in the places of intersections, there was a considerably smoothed aggregate, which influences the breaking distance of the vehicles. The road and its conditions had a significant influence on the drainage of the road.

3.9 Barrier-free Adjustments

Moderate and in some cases also high risks resulting from non-compliance with the regulation about general technical requirements ensuring barrier-free access (Fig. 6) of constructions were found at 56 % of inspections. In total (low, moderate and high) safety risk was observed at 68 % of inspections. This involved improper usage of tactile strips (leading the person out of the pedestrian crossing or into the intersection, etc.). Further it was no signal when entering

the road, or insufficient leading of people in associated traffic area. Or the complete barrier environment was created, it means that the rules of the regulation were not met and there was not created at least one barrier-free route.

Figure 6 The dividing island does not meet the requirements about general technical requests ensuring barrier-free usage of constructions. The tactile line does not follow the signal and warning parts. People are led outside the pedestrian crossing into a wide and busy intersection. Further there are many obstacles on the island (difficult orientation) including insufficient waiting area.

4 Statistical Evaluation of Risks

On the basis of 50 safety inspection that were carried out, the statistical evaluation of found risks with individual percentage of identified defects (risks) was prepared – see Fig. 7. The highest number of risks were found at vertical and horizontal traffic signs – these risks occurred in more than 90 % of inspections. The obstacles in view and not keeping the required distance were also classified between the most serious risks. Further high risks involve no existing barrier-free access, the broad layout of the road and bad conditions of the road construction.

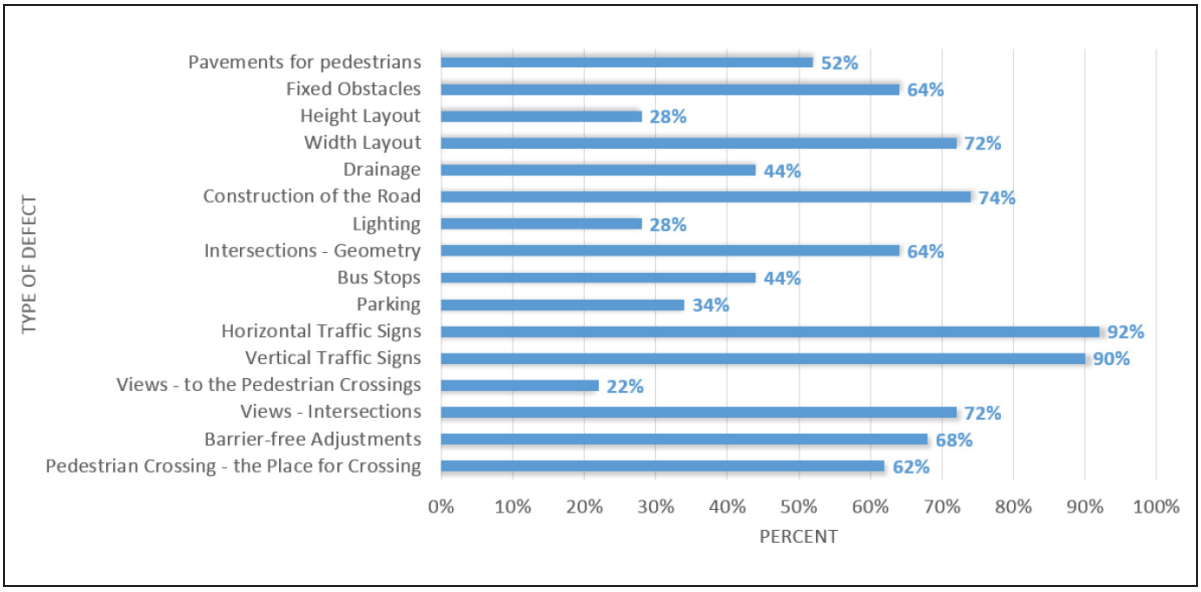

Figure 7 Percentage of identified defects

5 Conclusion

In the Czech Republic the security inspections are increasingly becoming a tool for identifying safety deficiencies, defects and risks. Many investors (especially large cities), regional authorities, Directorate of Roads and Motorways, regional administration and road maintenance, etc. order these inspections. Unfortunately, smaller towns and municipalities do not use these tools, they often do not know about them. It is in these smaller towns and municipalities where we often find moderate and especially high risks, which were mentioned in this article. Many organizations and institutions try to raise awareness about the tools for increasing road safety among expert but also general public. The issue and the necessity of safety inspection can be pointed out by the form of seminars, conferences and publishing activities.

Acknowledgement

The work was supported from the sources for conceptual development of research, development and innovations for 2018 at the VSB-Technical University of Ostrava which were granted by the Ministry of Education, Youths and Sports of the Czech Republic.

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