

Vladislav KŘIVDA¹, Ivana MAHDALOVÁ²**USE OF VIDEO ANALYSIS OF CONFLICT SITUATIONS BY THE EVALUATION
OF INAPPROPRIATELY DESIGNED BUILDING ELEMENTS ON ROUNDABOUTS****VYUŽITÍ VIDEOANALÝZY KONFLIKTNÍCH SITUACÍ PŘI HODNOCENÍ NEVHODNĚ
NAVRŽENÝCH STAVEBNÍCH PRVKŮ NA OKRUŽNÍCH KŘÍŽOVATKÁCH****Abstract**

The article deals with possibility of use of video analysis of conflict situations during observation of damaged inappropriately designed building elements and the other problems on roundabouts. This article analysis selected situations for example wrong way of drive vey near curb, problems during exiting the double-lane roundabout and influence of near intersection with traffic lights.

Keywords

Video Analysis, Conflict Situation, Roundabout.

Abstrakt

Článek se zabývá možnostmi využití videoanalýzy konfliktních situací při sledování poškození nevhodně navržených stavebních prvků a jiných problémů na okružních křižovatkách. Článek rozebírá vybrané situace jako například špatná jízda vozidel v těsné blízkosti obrubníku, problematika výjezdu z dvoupruhového okružního pásu a vliv blízké křižovatky se světelným signalizačním zařízením.

Klíčová slova

Videoanalýza, konfliktní situace, okružní křižovatka.

1 INTRODUCTION

The road transport brings to human society many advantages on the one hand, but many other problems on the other hand. One of the major problems in road traffic is dubious, arguable, doubtful or otherwise problematic behavior of the participant of road traffic. Such a behavior can eventually cause a traffic accident and it is questionable, whether this accident could or could not be averted. The accident may be caused partly by the heedless driver (traffic participant) and partly by the "wrong infrastructure" (e.g. inappropriately designed road, intersection, pedestrian crossing etc.) causing wrong driver's behavior and other subsequent problem, i.e. a conflict situation (almost accident) or directly a traffic accident.

¹ Ing. Vladislav Křivda, Ph.D., Department of Transport Constructions, Faculty of Civil Engineering, VSB-Technical University of Ostrava, Ludvíka Podéště 1875/17, 708 33 Ostrava - Poruba, Czech Republic, phone: (+420) 597 321 315, e-mail: vladislav.krivda@vsb.cz.

² doc. Ing. Ivana Mahdalová, Ph.D., Department of Transport Constructions, Faculty of Civil Engineering, VSB-Technical University of Ostrava, Ludvíka Podéště 1875/17, 708 33 Ostrava - Poruba, Czech Republic, phone: (+420) 597 321 342, e-mail: ivana.mahdalova@vsb.cz.

The statistics of the accident frequency survey give some overview about numbers and causes of traffic accidents however, the statistics of so-called almost accidents are logically non-existent and therefore, if necessary, one should make analysis of the road participants behavior on the particular place by applying a video analysis of conflict situations. The conflict situation, as defined by assoc. prof. Jan Folprecht (see e.g. [1] a [2]), is such a situation when arises, for some traffic participants, more than usual degree of risk. It can be said, that the conflict situation is a potential accident situation which may result to an accident or not.

An invaluable helper for analysis of conflict situations is exactly the usage of video-apparatus partly for possibility to slow down or repeat made video-record, partly for possibility usage of video-recording for analysis of other traffic engineering data (volumes, composition of traffic flows, etc.). For conflict situations we then monitor the participants of conflict, source of conflict and its seriousness. The conflict monitoring methodology is, of course, constantly evolving, as well as evolves the way of description of the particular observed situation (see e.g. [3] and [4], topically [5]).

The basis of video analysis is to acquire at least one hour video-record of the analyzed place (situated on the highest observation point, if possible). Further, an evaluation of this record is carried out (for the sake of the conclusion's objectivity it is necessary to monitor the record by more than one person simultaneously) followed by the data analysis (tabular and graphical). One can apply, as a quantity which would give us some idea about the degree of traffic dangerousness at the place, so-called coefficient of relative conflictness defined as number of conflict situations by one hundred passed vehicles. Based on this analysis, the responsible person (designer, traffic engineer), by a mere consideration of these outputs, would be able to draw out an adequate design for modification of given place.

The paper refers to some of monitored situation on roundabouts which can lead in traffic accidents caused not only by the drivers themselves, but also by an inappropriately designed intersection. We were treating situations that had been discovered from a video analysis of conflict situations conducted on selected roundabouts in the Czech Republic under the research project [6]. In total, 16 roundabouts were monitored. These are of different types for example; three roundabouts were of double-line circulating roadway (all others were of single-lane only). Most of monitored roundabouts had four legs, with the exception of two which had three legs, one five legs and one six legs. All records were taken in 2010, saying that some intersections were observed repeatedly.

2 MONITORED CONFLICT SITUATIONS

In this chapter we will describe in detail selected conflict situations, such as for example: driving near the curb on roundabout exit, damage of the curb of the central island, or curb of the bypass, problems of the exit from double-line roundabout and the influence of other nearby intersection with traffic lights.

2.1 Driving near the curb

The analysis outlined fact that the most important conflict situations occur, when vehicle exiting the roundabout, goes the right guide strip very close to curb (see Figure 1). The curb of this exit is damaged on two places (see Figure 2) and obviously, there has been a traffic accident. According to § 47 of Law No. 361/2000 (Czech Highway Code) the traffic accident is also an incident in which there is a damage to the property in direct connection to the operation of a vehicle in motion. The question whether it was a unique event, or such dangerous situation occurs regularly, was answered by here accomplished exactly video analysis.

During one hour observation this situation occurred 23 times, in most cases trailer sets (61 %), following by lorries (26 %), road trains (9 %) and buses (4 %) – with the traffic flow 1290 vehicles per hour on the whole roundabout and 512 vehicles per hour on the monitored exit (from that 83 vehicles of aforementioned types, i.e. lorries, road trains, trailer sets and buses).

This situation can generally occur either due to wrongly designed exit (can be verified by the rupture curves) or due to wrongly turn maneuver. In the case of the monitored intersection (Masarykova – parking Tesco in Valašské Meziříčí) which is the first roundabout in direction from Hranice na Moravě, the drivers exiting the roundabout in direction to Hranice (e.g. from the city) are, by the view of large roadway next to them, incited to speed up. This behavior is evidently unacceptable; nevertheless the hard shoulder of sickle shape would be of great use here.



Figure 1: Roundabout Masarykova – parking Tesco in Valašské Meziříčí (up) and detailed views of exit guide strip (down)

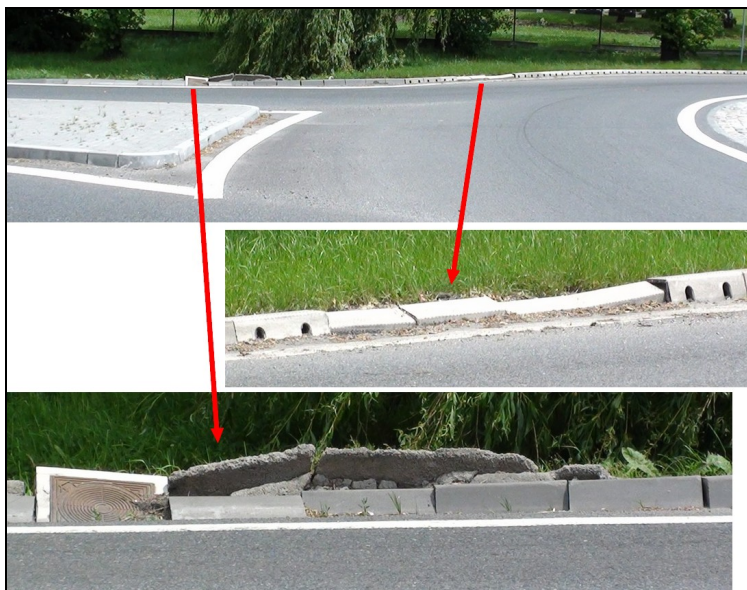


Figure 2: Detailed views of damaged curb on the exit from the roundabout Masarykova – parking Tesco in Valašské Meziříčí

2.2 Damage of the curb of the central island

Other problems are related to the curbs of central islands. As shown in Figure 3 (upper picture), drivers are going over optical truck apron near of the curb. The cause of such a behavior can be either a wrong circulating roadway passage (intentionally) or a by-passing the queue of vehicles which was caused in front of the pedestrian crossing, as shown on the lower pictures of Figure 3.

Although this problem can be solved by a move of the pedestrian crossing further from the circulating roadway, it would generate other problems, such as pedestrian path extension, higher vehicles speed (drivers are, at the crossing, further from roundabout – it can cause other dangerous situations). The cancellation of this pedestrian crossing is not always convenient because of the intensity of pedestrians (this applies to a roundabout presented on Figure 3 also).

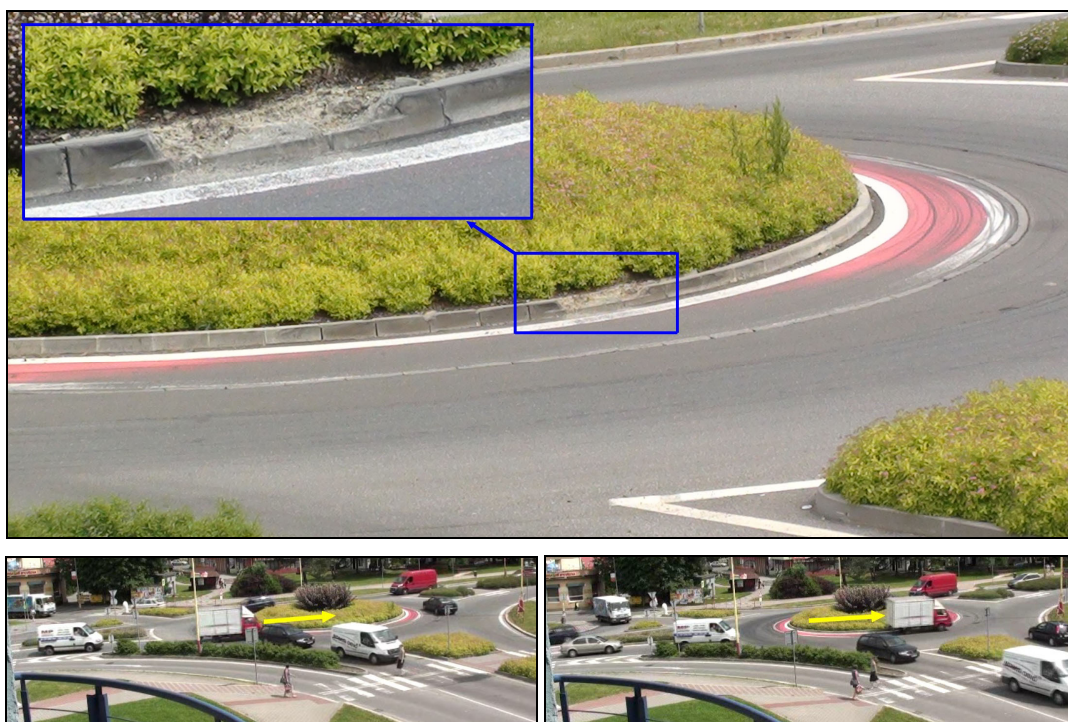


Figure 3: Formation of vehicles queue in front of the pedestrian crossing on the roundabout Vsetínská – Sokolská – Žerotínova in Valašské Meziříčí

Figure 4 exhibits the conflict situations and their numbers monitored during one hour on the roundabout Vsetínská - Sokolská - Žerotínova in Valašské Meziříčí (with the total traffic volume of 2115 vehicles per/hour).

The graph on figure 5 presents, for curiosity, the delays caused by stopped traffic flow in front of pedestrian crossing.

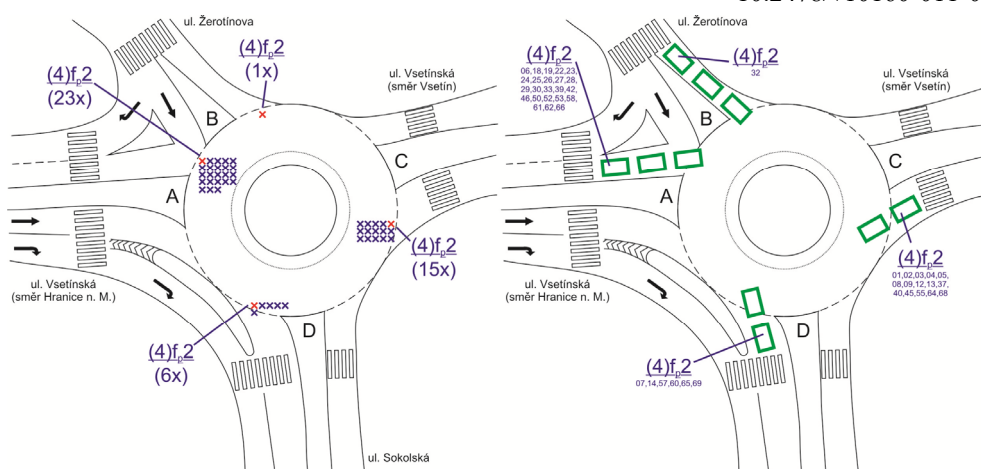


Figure 4: Schematic representation of conflict situations arising from stopped traffic flow in front of pedestrian crossing on roundabout Vsetínská – Sokolská – Žerotínova in Valašském Meziříčí

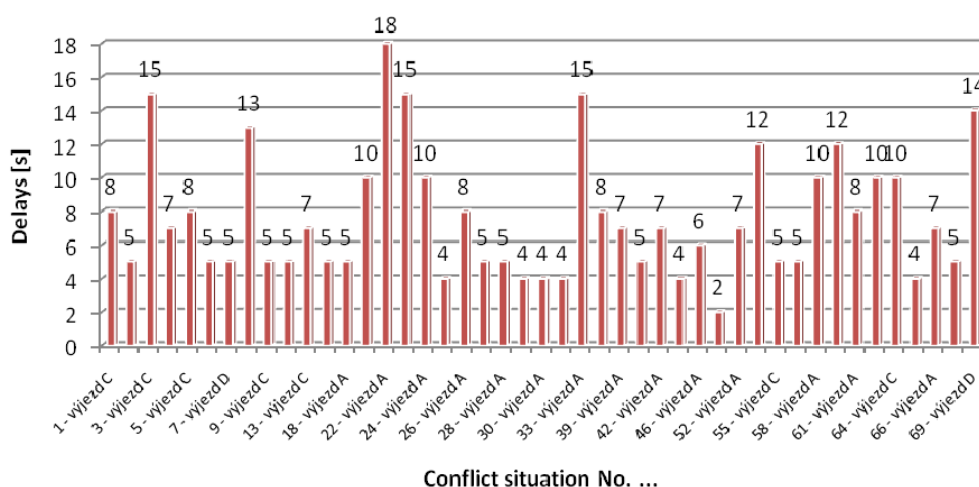


Figure 5: Vehicles delays caused by stopped traffic flow in front of pedestrian crossing on the roundabout Vsetínská – Sokolská – Žerotínova in Valašském Meziříčí (“výjezd” = exit)

2.3 Damage of the curb of the by-pass

On the same roundabout (see previous sub-chapter 2.2) is also evident damage on outer curb of the by-pass (Figure 6). As can be seen on the figure 4 (this is a direction from Žerotínova street to the right to Vsetínská street), the outer curb radius is rather small, and is the cause of the drive of the lowered curb on this place. It would be convenient to use the hard shoulder of sickle shape, with the respect to the pedestrian security on the sidewalk in proximity of this place.



Figure 6: Damage of the curb of the by-pass on the roundabout
Vsetínská – Sokolská – Žerotínova in Valašské Meziříčí

2.4 Exit from double-lane roundabout

The exiting double-line circulating roadway is always problem and is an origin of many conflict situations. Figure 7 presents schematically the situations on single-line exit, while Figure 8 shows the situations on double-line exit. Three characters symbol determines the conflict situation [5]: the first character (here “6”) denotes a situation between cars, second character (here “o”) means a restriction or danger in driving; respectively “D” - possible danger of rear-end collision; and third character represents seriousness of the conflict (here, simply speaking, “2” – weak reaction, “3” – strong reaction, “4” – traffic accident). These conflict situations were observed on all monitored roundabouts of this type.



Figure 7: Possible conflict situations during exiting double-line circulating roadway to single-line exit

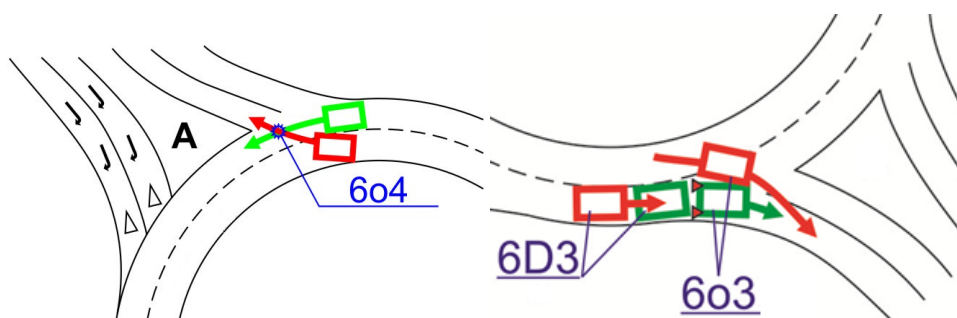


Figure 8: Possible conflict situations during exiting double-line circulating roadway to double-line exit

Conventional double-lane roundabouts are already obsolete. They are currently replaced by different alternative types, so-called turbo roundabouts. Unfortunately, problems can arise even on them. This topic is to be the subject of separate article.

2.5 Nearby intersections with traffic lights

The last situation we are presenting here, although not directly related to building elements of intersection, is rather related to the selection of suitable type of intersection. Roundabout in Figure 9 is at a distance of about 140 meters from the control junction (on the picture to the left of the roundabout in question). At higher volumes on the control junction cause formation a queue of vehicles which extend the roundabout where the traffic is either limited or completely stopped.

This example clearly shows the inappropriately combination of two different types of intersections, situated short distance apart. The control junction would be better type of intersection instead of roundabout. However, it is evident that the use of exactly roundabout at this place (in front of the City Hall's lookout tower) has rather an esthetic reason.



Figure 9: Stopped traffic on the roundabout Sokolská – 30. dubna
influence of the queue on near control junction Sokolská - Českobratrská

3 CONCLUSION

The article presented some types of conflict situations on the roundabouts being caused by inappropriately arranging of building elements on intersection. The video analysis (which was used) proved excellently as method for monitoring of inappropriately designed building elements. The video-recording, among others, is reliably documenting vehicle's driving near curbs on the roundabout entries and exits and curb of the central island. The video-recording shows that on inappropriately designed roundabout the drivers of large vehicles are unable, with their highest effort, to realize a smooth passage without repeated stopping. As consequence, we record a large amount of events, such as damage of curbs, eventually other damages in areas behind the curb (delineator posts, road signs etc.). According to Highway Code, all these are considered as an accident because there is damage to another's property, but are essentially unreported accidents, thus not reflected in any record.

Finally, it should be noted that the above results represent a small sample of the hourly records taken within the project [6].

ACKNOWLEDGMENT

This article is the result of the project implementation “The influence of structural elements geometry on the safety and fluency of operation in roundabouts and possibility of rise crashes prediction” (CG911-008-910 supported by the Ministry of Transport in the Czech Republic) [6].

REFERENCES

- [1] FOLPRECHT, J. *Metoda sledování a hodnocení konfliktních situací v silniční dopravě a její význam pro zvyšování bezpečnosti provozu*. Mezinárodní vědecká konference při příležitosti 50 let působení VŠB v Ostravě. Ostrava: VŠB-TU Ostrava, 1995. 419 s.
- [2] FOLPRECHT, JAN; KŘIVDA, VLADISLAV. *Organizace a řízení dopravy I*. Ostrava: VŠB - Technická univerzita Ostrava, 2006. 158 s. ISBN 80-248-1030-1
- [3] KŘIVDA, VLADISLAV. *Posouzení účinnosti okružních křižovatek*. Disertační práce. Ostrava: Fakulta strojní, VŠB - Technická univerzita Ostrava. ISBN 80-248-0207-4 (autoreferát). 2003
- [4] KŘIVDA, VLADISLAV. *New Findings in the Sphere of the Conflict Situations Analysis on the Czech Republic Road Traffic*. ss. 161-169, Sborník vědeckých prací FS. Ostrava: VŠB – TUO Ostrava, 2009, ISBN 978-80-248-1633-3, ISSN 1210-0471
- [5] KŘIVDA, V. Video-Analysis of Conflict Situations on Selected Roundabouts in the Czech Republic. *Communications*. Nr. 3/2011. Žilina: University of Žilina, Slovakia, EV 3672/09, ISSN 1335-4205
- [6] *Vliv geometrie stavebních prvků na bezpečnost a plynulost provozu na okružních křižovatkách a možnost predikce vzniku dopravních nehod*. Projekt výzkumu a vývoje č. CG911-008-910 Ministerstva dopravy ČR. Řešitel Katedra dopravního stavitelství, Fakulta stavební, VŠB – Technická univerzita Ostrava. 2009 – 2010

Reviewers:

Doc. Ing. Daniela Ďurčanská, CSc., Faculty of Civil Engineering, University of Žilina.

Prof. Ing. Bystrík Bezák, PhD., Department of Transportation Engineering, Faculty of Civil Engineering, Slovak University of Technology in Bratislava.