10.2478/v10160-012-0020-8

Transactions of the VŠB – Technical University of Ostrava

No. 2, 2012, Vol. XII, Civil Engineering Series

paper #16

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ORIGIN OF DANGEROUS CONFLICT SITUATIONS ON INTERSECTION WITH INAPPROPRIATELY DESIGNED BUILDING ELEMENTS

VZNIK NEBEZPEČNÝCH SITUACÍ NA KŘIŽOVATCE S NEVHODNĚ NAVRŽENÝMI STAVEBNÍMI PRVKY

Abstract

The traffic safety on intersections is influenced by a lot of external factors – for example by inappropriately designed building elements. Inadequate radius of corners, narrow traffic lanes etc. can cause dangerous situations – above all, during passage by large vehicles. The paper describes conflict situations on intersection which are caused by inappropriately designed building elements above mentioned. The paper points out possibility of use of video analysis of conflict situations for monitoring of these phenomena and also necessity of correct verification of passage through intersection by rupture curves.

Keywords

Intersection, Conflict Situation, Video Analysis.

Abstrakt

Bezpečnost provozu na křižovatkách ovlivňuje řada vnějších faktorů – například nevhodně navržené stavební prvky. Nedostatečné poloměry nároží, úzké jízdní pruhy atp. mohou zapříčinit vznik nebezpečných situací a to především během průjezdu rozměrnými vozidly. Článek popisuje vybrané konfliktní situace na křižovatce, které jsou zapříčiněny výše uvedenými nevhodně navrženými stavebními prvky. Článek poukazuje na možnost využití videoanalýzy konfliktních situací pro sledování těchto jevů a také na nutnost korektního ověření průjezdnosti křižovatky pomocí vlečných křivek.

Klíčová slova

Křižovatka, konfliktní situace, videoanalýza.

1 INTRODUCTION

Road traffic safety is complex system which combines the movement of a various groups (i.e. means of transport, pedestrians, cyclists and other participants of road traffic) in specified space and time. Each of these groups has various characters and also various needs from the system. The difficult reciprocal relationships arise due to a lot of participants of road traffic and their characteristic needs. These relationships define the behavior of whole system, resulting in a various types of conflicts [1].

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To solve of conflict situations on road traffic is very difficult matter. It can be said that essential part of conflicts are caused by irresponsible drivers (or by other participants of road traffic). There are also such conflict situations in which the drivers aren't responsible, but they are caused by wrong infrastructure. This article deals with conflict situations, which can be caused by wrongly design building elements, and it pick up the threads of paper which was published in previous issue of this publication (see [2]). Now it is about various types of movement (and also other conflict situations) on monitored intersection. The video analysis of conflict situations was used for analysis. The basic information about this methodic is presented in [3], where the method is partly describe by its author (Jan Folprecht), and also in [2] or [4]. The results presented in this paper are obtained thanks to financial aid of research project [5] and they are original (next results of this project ware published for example in [6] and [7]).

2 MONITORED INTERSECTION

The observation of conflict situations was made on four-legged uncontrolled intersection on street Průběžná in Ostrava-Poruba. This intersection is situated between area of Faculty of Civil Engineering, VSB-TU Ostrava and hypermarket Globus (see Fig. 1). Near intersection the bus turning place (with bus stop Opavská) from where the buses depart. Then these buses have problems on the monitored intersection which are described below.

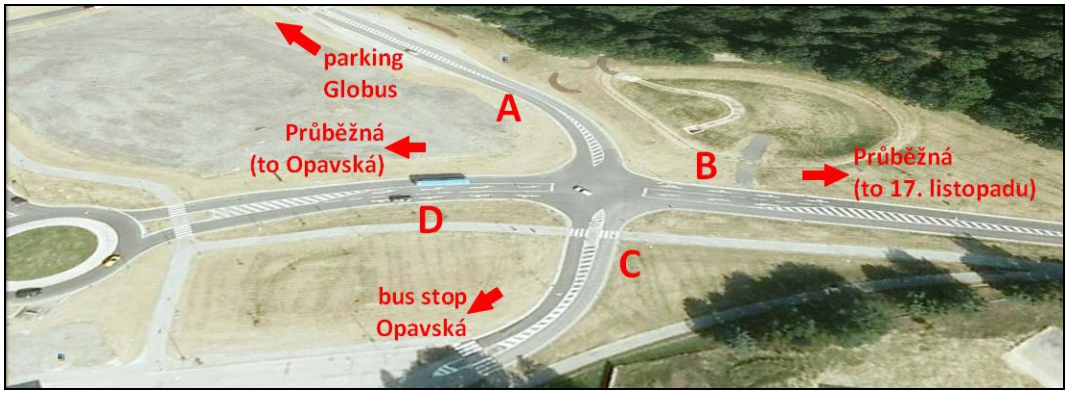

Fig. 1: Monitored intersection

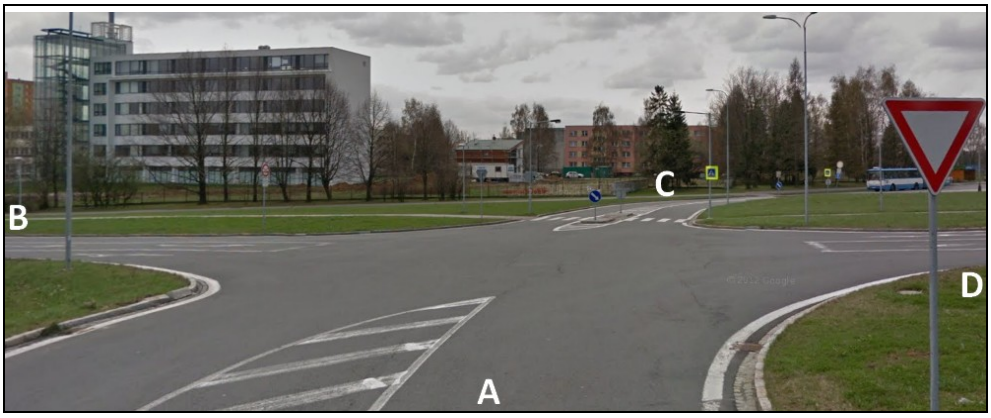

Fig. 2: Sight of intersection from leg A (traffic lane width 3.00 m, guide strips 0.50 m, right corner – compound horizontal curve with radii 21.00 m, 6.50 m and 14.50 m)

Fig. 3: Sight of intersection from leg B (traffic lane widths 3.00 m, running lane width 3.25 m, guide strips 0.50 m, right corner – compound horizontal curve with radii 30.00 m and 4.00 m)

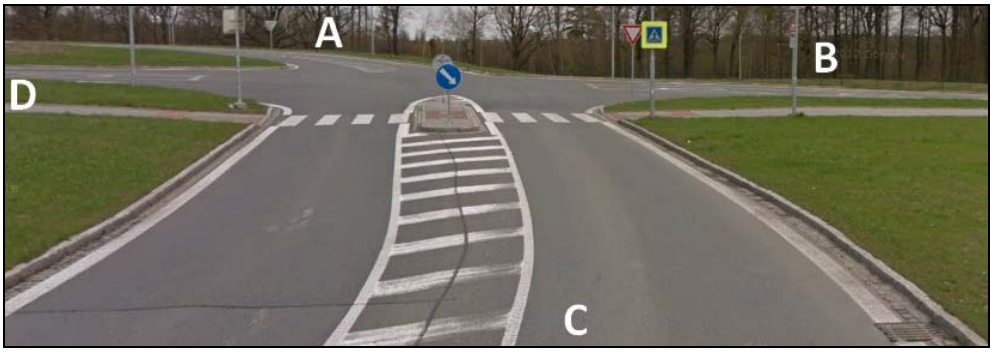

Fig. 4: Sight of intersection from leg C (traffic lane widths 3.00 m, guide strips 0.50 m, right corner – compound horizontal curve with radii 30.00 m and 4.00 m, width between curbs of left corner and refuge island amid pedestrian crossing 4.35 m, width between curbs of right corner and refuge island amid pedestrian crossing 4.05 m, width refuge island 1.75 m)

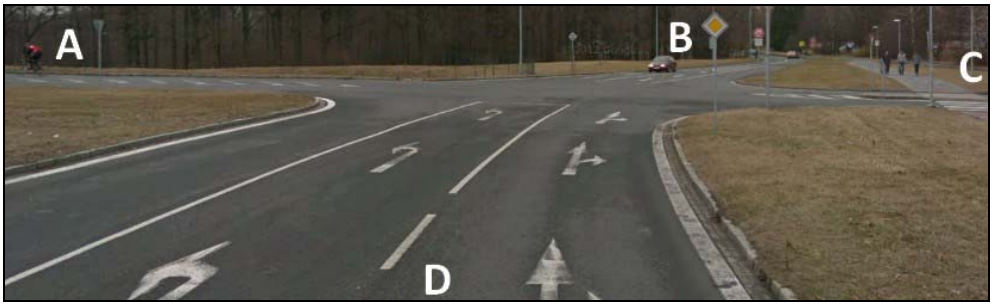

Fig. 5: Sight of intersection from leg D (traffic lane widths 3.00 m, running lane width 3.25 m, guide strips 0.50 m, right corner – compound horizontal curve with radii 15.50 m, 16.00 m and 4.50 m)

The intersection was monitored by two cameras. The first one was located on last floor of faculty for monitoring of traffic of whole intersection (so called “top” record). The second one was located on tripod on level of road (“down” record) – circa 35 m before pedestrian crossing on leg C. See paper in [2] for detailed information.

The figures 2 – 5 show detailed sight of intersection for better vision about lay-out of intersection (by use of Google Street View).

3 SELECTED CONFLICT SITUATIONS

The paper in [2] described the problematic turning of buses from street Průběžná (i.e. from legs B and D) to bus stop Opavská (i.e. to leg C). These buses were problem go into the space between refuge island and corner. Their drivers have to go with use another getting lane for safer turning maneuver. As problem was identified the inappropriately located refuge island and also inadequate radius of corner (more see [2]).

The wrong located island, inappropriate radius of corner, which connects leg C and B, and inappropriate located turning lane on leg D (its stop line) can cause next conflict situations: now for buses which go from leg C (i.e. from bus stop Opavská) and make following maneuvers (more see later):

1. right turning from leg C into leg B (problem with corner and partly with island),
2. left turning from leg C into leg D (partial problem with island and partly with island especially problem with turning lane on leg D).

The problem with right turning into leg B will be described as first. For correct turning without mounting the curb of corner the driver has to go with use opposite lane (see Fig. 6). He also goes through visual island (see Fig. 7). The "down" record shows that drivers don't go through curb but through guide line (see Fig. 8). In spite of it the curb of this corner is damaged (see Fig. 9) – due to that only the one piece of curb is damaged, we can conclude, that it was damaged by another reason than by mounting of vehicle (e.g. the wrong installation of this piece).

Fig. 6: The bus is going to opposite direction (exit B)

Fig. 7: The bus is going through visual island of refuge island

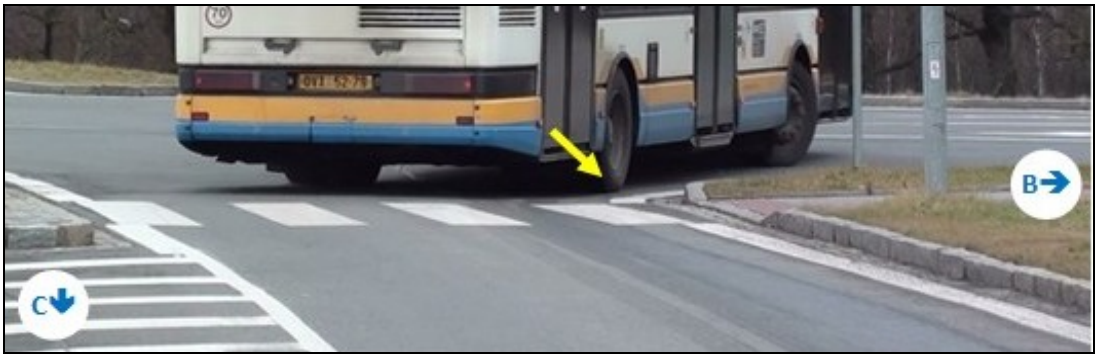

Fig. 8: The bus is going in needful space from curb

Fig. 9: The damaged curb of corner (from C to B)

The second case, when the driver is going to opposite direction, is the case of left turning from leg C to leg D. Turning lane (its stop line) is located too near to center of intersection and drivers then goes through this lane (see Fig. 10). Drivers of combinations of vehicles have similar problems when they are going from leg A to D (buses don't go by this direction). It's caused by inadequate radius of this corner.

Fig. 10: The bus is going to opposite direction (exit D)

The drivers have also a partial problem with refuge island on leg C – it's showed on Fig. 11 (however, it can be caused only by snowy island).

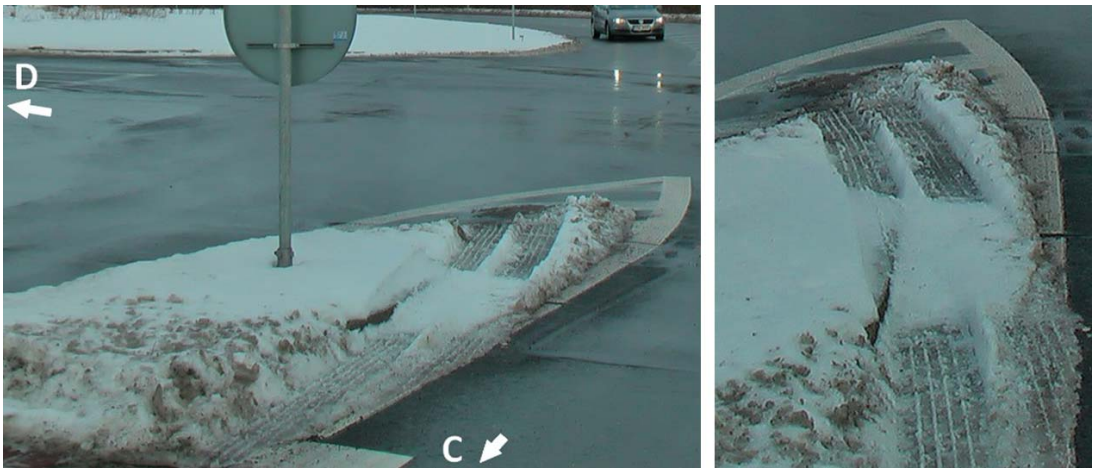

Fig. 11: The tracks in snow caused by mounting the refuge island

The Fig. 12 shows the scheme of locating and arising of conflict situations presented above. Their numbers are in Tab. 1.

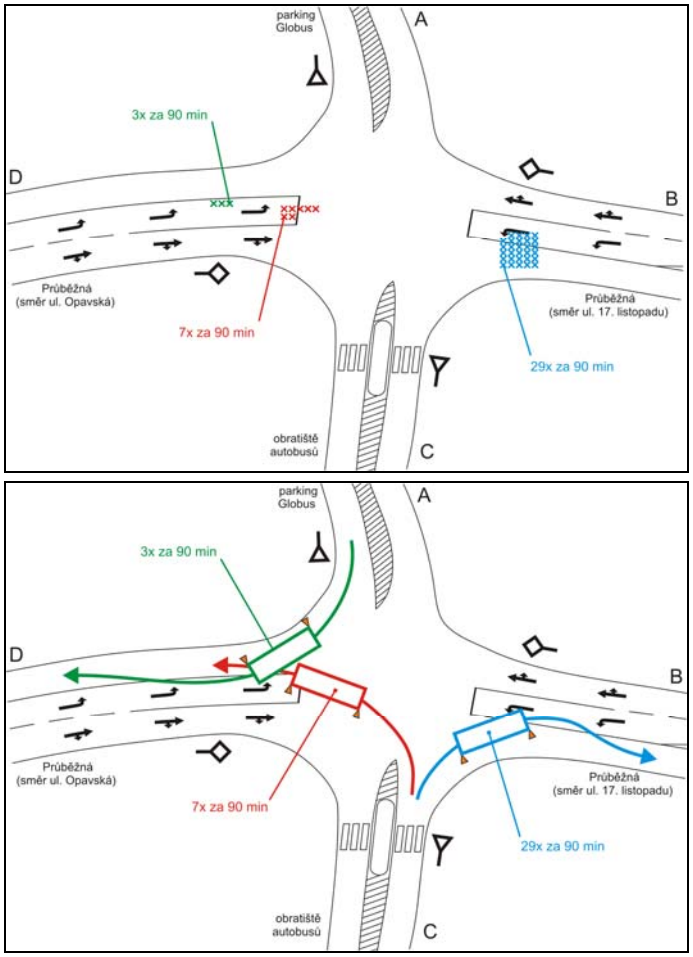

Fig. 12: Scheme of locating (up) and arising (down) of described conflict situations

Tab. 1: Numbers of conflict situations

Turning direction	Time of measuring						SUMA
	13^{30}- -13^{45}	13^{45}- -14^{00}	14^{00}- -14^{15}	14^{15}- -14^{30}	14^{30}- -14^{45}	14^{45}- -15^{00}	
right from C to B (buses)	6	4	5	4	6	4	29
right from C to D (buses)	1	3	0	2	0	1	7
right from A to D (combinations of vehicles)	0	0	1	0	2	0	3

4 RUPTURE CURVES

This capture shortly describes the problem of rupture curves for individual traffic movements described above. It's for vehicles which are the largest for given direction.

There will be described right turning of bus from bus stop Opavská (leg C) to street Průběžná (leg B) when articulated bus has to go into opposite direction (in spite of movement near refuge island) to averting of mounting the curb of corner. The situation for speed 10 km/h is showed on Fig. 13.

The similar situation also arises during left turning from bus stop Opavská (leg C) to street Průběžná (leg D), when vehicle is going into opposite turning lane (see Fig. 14). Driver has more options for selection of correct trajectory and not during higher speed the driving into opposite direction isn't considerable (e.g. 20 km/h, see Fig. 14).

During right turning from parking Globus (leg A) to street Průběžná (leg D) the driver of larger vehicle has to go through visual island on the entry of intersection and also into opposite turning lane on leg D (see Fig. 15). This trajectory has to be chosen to avert of mounting the curb corner (also during speed 10 km/h).

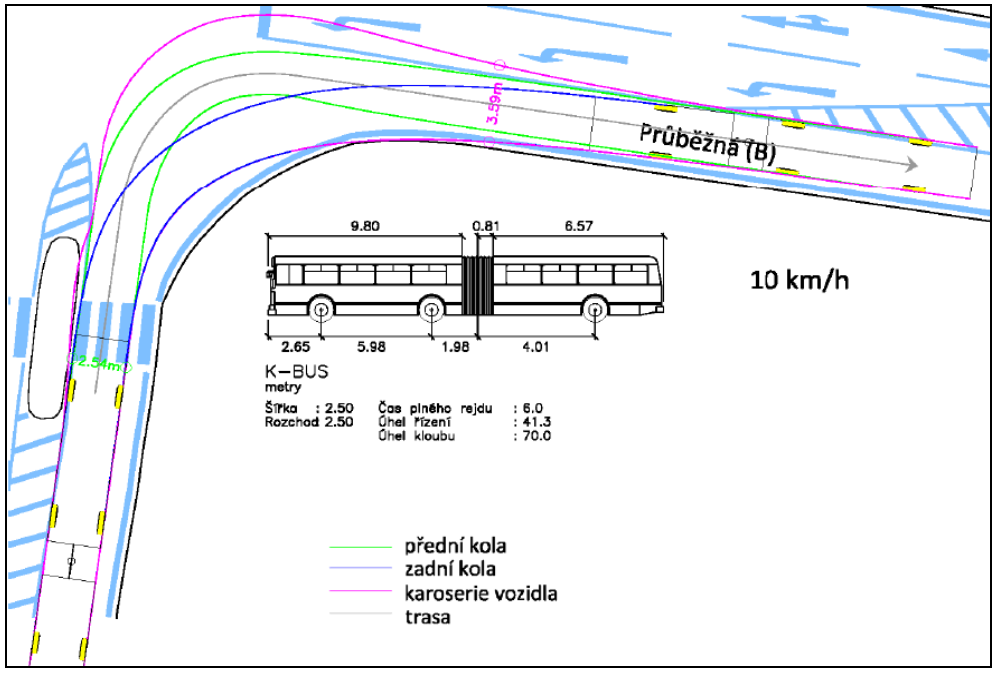

Fig. 13: Rupture curves during right turning of bus from leg C to B

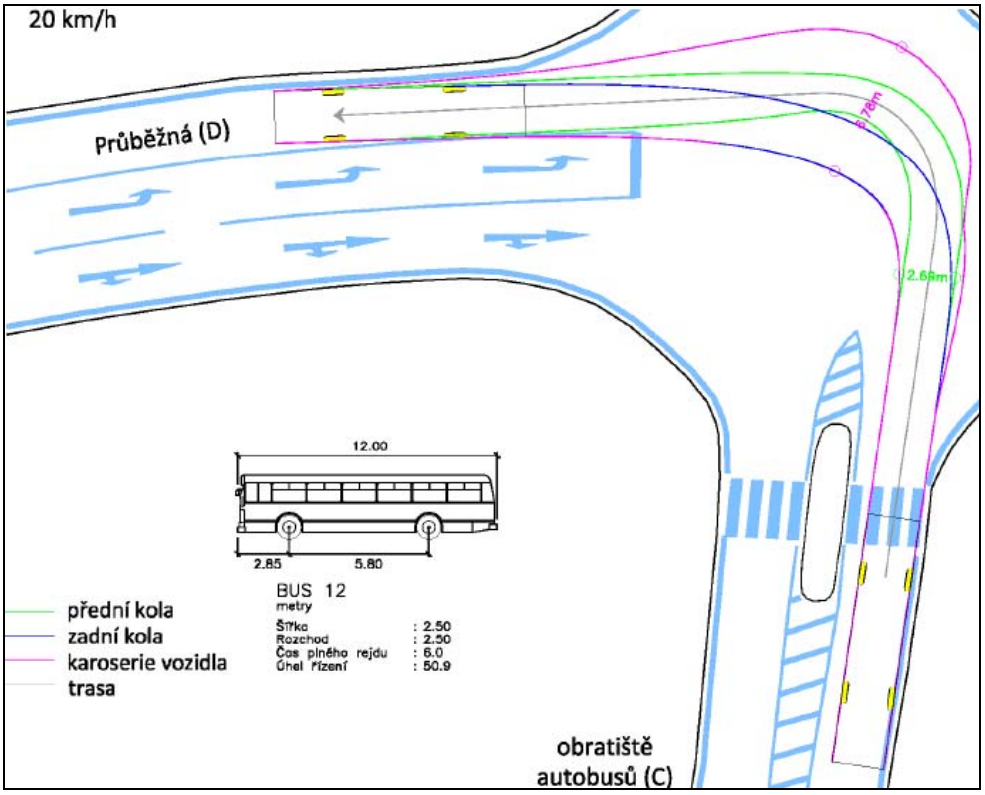

Fig. 14: Rupture curves during left turning of bus from leg C to D

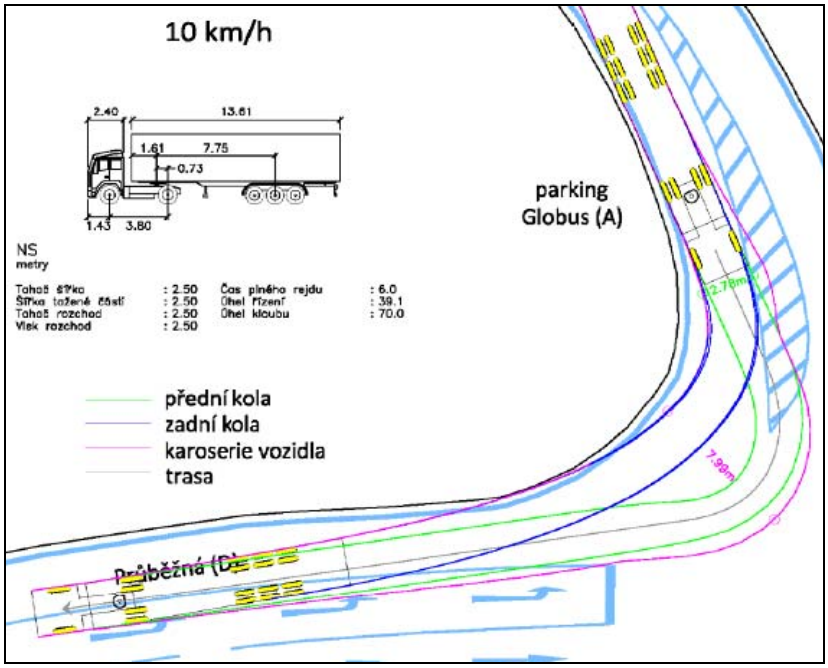

Fig. 15: Rupture curves during right turning of combination of vehicles from leg A to D

5 CONCLUSION

The presented text shows the example of monitoring of intersection with various identifying characteristics (see Fig. 16) which can point on inappropriate design building elements of intersection. Not always it's singular situation (accident, damage by winter maintenance etc.). The video analysis of conflict situations is excellent tool for detect of periodicity of incidence of these conflict situations (e.g. see also [8] and [9]).

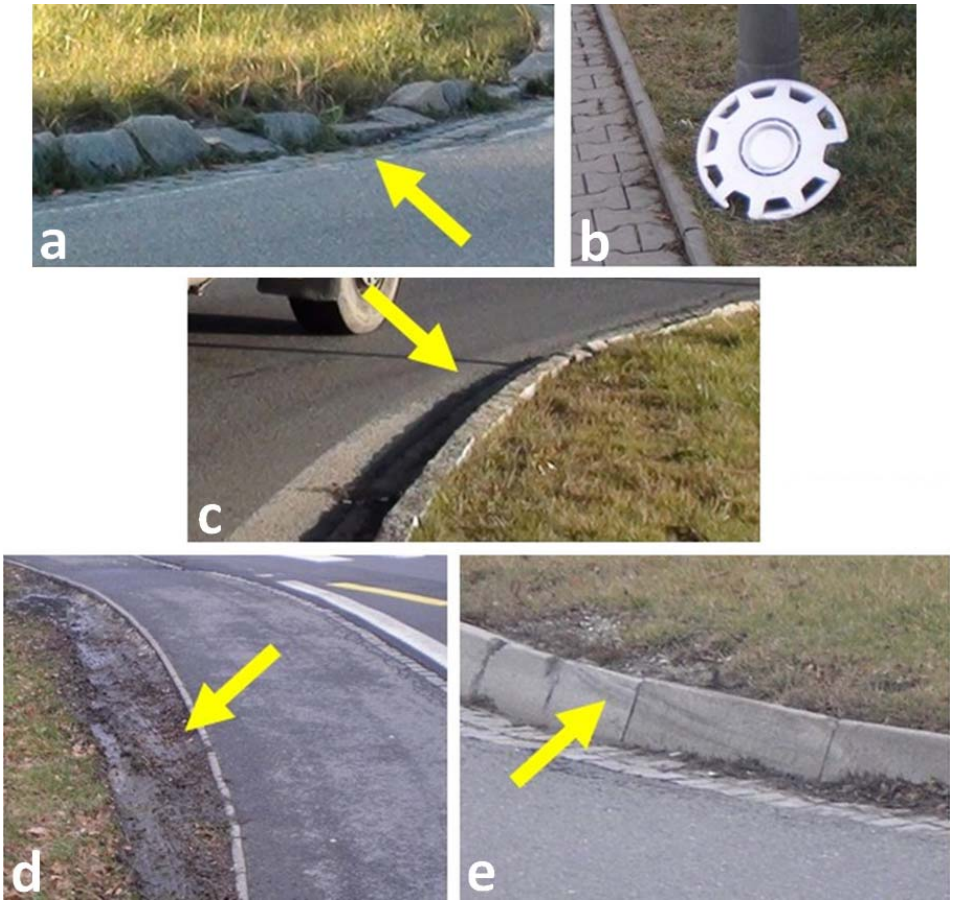

Fig. 16: Selected identifying characteristics for identification of inappropriate designed building elements (a – damage curb; b – damage wheel disc cover; c – wrong noticeable guide line; d – wheel prints on grass; e – tire smudge on curb)

The results of video analysis point out mistakes which are made already during design the intersection. Above mentioned examples in this article (or in article [2]) show that e.g. verification of passage through intersection by rupture curves wasn't made correctly, because the vehicles have the problem also in lower speeds (10 or 20 km/h). Besides, the use of standards TP 171 [10], or special software AutoTURN is only theoretical. In real traffic the driver during maneuver usually goes by higher speed and the speed is also changed according to need. It's valid also for change of turning of steering wheel. The passing of given place is often dependent on knowledge of this place and on drivers experiences.

The video analysis of conflict situations we can also very good use for safety inspection according to Law No. 13/1997 about the roads.

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) [5].

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