

## VIDEO ANALYSIS OF CONFLICT SITUATIONS ON PEDESTRIAN CROSSINGS

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*Summary: The article presents the results of video analysis performed on selected pedestrian crossings in the Czech Republic. This paper was prepared with financial support for research and development project No. CG911-008-910 "Influence of structural elements geometry on safety and fluency of operation on roundabouts and possibility of rise crashes prediction", the Ministry of Transport.*

*Key words: Video Analysis, Conflict Situation, Pedestrian Crossing.*

### INTRODUCTION

Road traffic safety is permanently discussed topic in all countries with developed motor road transport. All of the participants of road traffic are endangered, but the pedestrians are the most endangered, because they aren't in fact anything protected. The drivers and the passengers of vehicles are protected by construction of vehicle motorcyclists and bicyclists are at least partly protected for example by helmet.

According to Czech Highway Code (1) the pedestrian is also person which pushes or pulls sleds, baby carriage, wheelchair or hand trolley (with width max. 600 mm), moves on the ski, roller-skates or by hand or motor trolley for invalids, leads a bicycle, motor cycle (with piston swept volume max. 50 cm<sup>3</sup>), dog etc. The pedestrians must respect following rules (1).

The pedestrian must use especially sidewalk or footpath. In the roads without sidewalk (or with impassable sidewalk) pedestrians must use the left shoulder or the left ledge of road. The pedestrian must use isolated pedestrian crossing or pedestrian crossing on control junction, overpass or underpass (if they are in distance max. 50 m). On the pedestrian crossing we must go on the right hand side.

Outside of pedestrian crossing we must cross the road only perpendicularly. Before entering on pedestrian crossing the pedestrian must make sure that he can cross the road safely. The pedestrian cannot groundlessly stop or slow down on the pedestrian crossing. The pedestrian cannot enter on pedestrian crossing if the vehicle is approaching to the pedestrian crossing. The pedestrian must yield to a tram.

The pedestrian crossing is the place on the road for crossing of the road by pedestrians. The pedestrian crossing is marked by vertical and horizontal road signs (IP6 and V7). There is also so called place for crossing which is technically the same as the pedestrian crossing, but it isn't marked by road signs (see Fig. 1).

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Source: Author + (2)

Fig. 1 - Example of pedestrian crossing and the place for crossing

The drivers of vehicles (with the exception of the tram drivers) must yield to pedestrians which is on pedestrian crossing or which is proposing to crossing the road. If the driver of a vehicle is stopping before the pedestrian cross to yield to pedestrian, the second driver must also stop the vehicle (on multi-lane roads).

The paper refers to selected conflict situations on the pedestrian crossing which can be caused by pedestrian or by drivers. There are also presented some results of video analysis performed on selected pedestrian crossings under the research project (3).

## 1. VIDEO ANALYSIS OF CONFLICT SITUATIONS

The conflict situation 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.

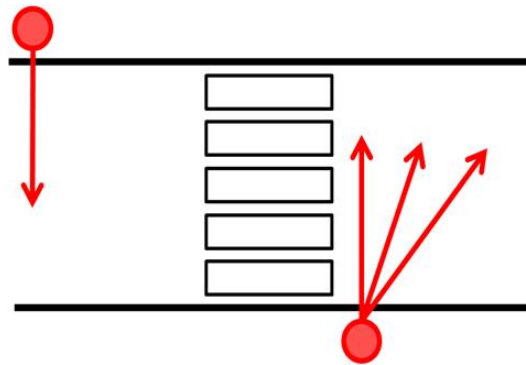
An invaluable helper for analysis of conflict situations is exactly the usage of video-apparatus partly for possibility to slow down or repeat made video-record, partly for possibility usage of video-recording for analysis of other traffic engineering data (volumes, composition of traffic flows, etc.). 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; for details see e.g. (4) – (6), topically (7).

## 2. CONFLICT SITUATIONS ON PEDESTRIAN CROSSING

The conflict situations which are caused by pedestrian are presented in the following text (on the pictures the culprit is drawn in red):

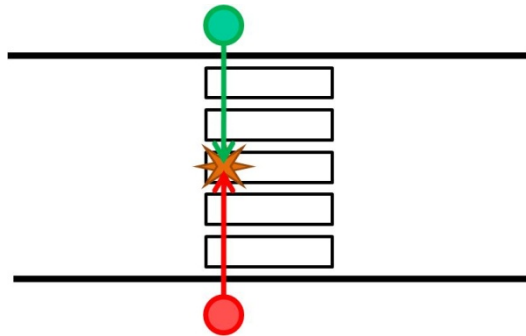
1. Pedestrian crosses outside of pedestrian crossing (see Fig. 2) – pedestrian don't use the pedestrian crossing which is in distance smaller than 50 m (according to Highway Code) or which goes only near pedestrian crossing (i.e. outside horizontal road sign V7).



Source: Author

Fig. 2 - Pedestrian crosses outside of pedestrian crossing

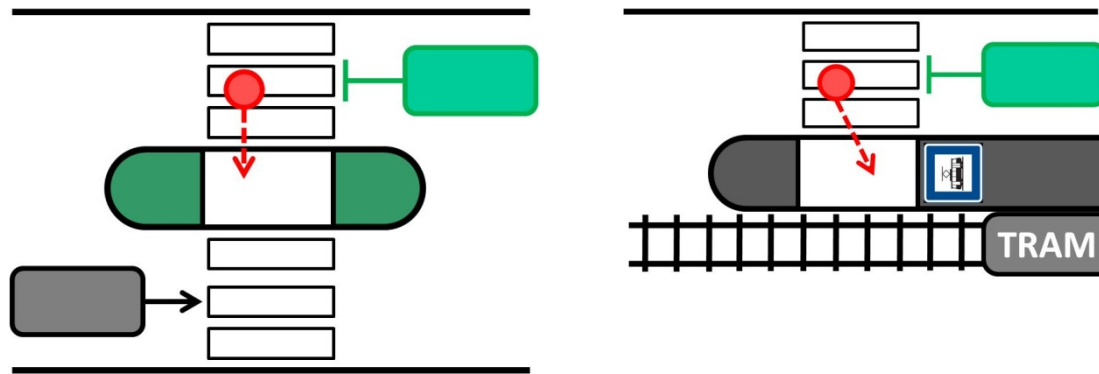
2. Pedestrian crosses of pedestrian crossing on the left hand side (see Fig. 3) – this pedestrian can collide with the other pedestrian. These pedestrians must dodge each other so process of crossing is slowed. The situation is complicated in case of group of pedestrians.



Source: Author

Fig. 3 - Pedestrian crosses of pedestrian crossing on the left hand side

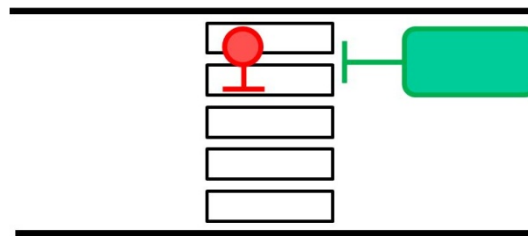
3. Pedestrian conspicuously slows down on pedestrian crossing (see Fig. 4) – there are some conflict situations, for example:
  - a. The pedestrian in the place between sidewalk and e.g. central refuge island (see Fig. 4 left) conspicuously slows down in the first part of pedestrian crossing, because he is watching another vehicle (in picture gray vehicle) which is arriving to the second part of pedestrian crossing from the right. The pedestrian then in a negative way influences traffic flow continuity.
  - b. The pedestrian quickly crosses to tram refuge island (to catch the tram; see Fig. 4 right), but he suddenly slows down (in the moment when he realize that he already need not hurry). He also in a negative way influences traffic flow continuity.



Source: Author

Fig. 4 - Pedestrian conspicuously slows down on pedestrian crossing

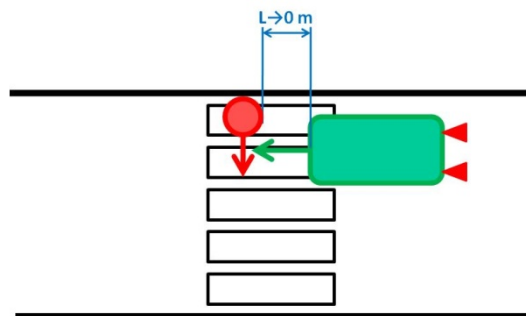
4. Pedestrian stops on the pedestrian crossing (see Fig. 5) – the reasons are similar to previous situations.



Source: Author

Fig. 5 - Pedestrian stops on the pedestrian crossing

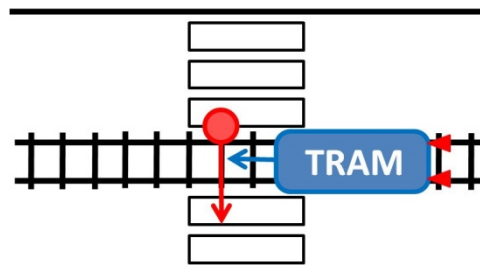
5. The pedestrian enters on pedestrian crossing immediately before approach vehicle (see Fig. 6) – it is one of the most dangerous conflict situations. The pedestrian is rash or he isn't able to estimate the distance of approach vehicle from the pedestrian crossing.



Source: Author

Fig. 6 - Pedestrian enters on pedestrian crossing immediately before approach vehicle

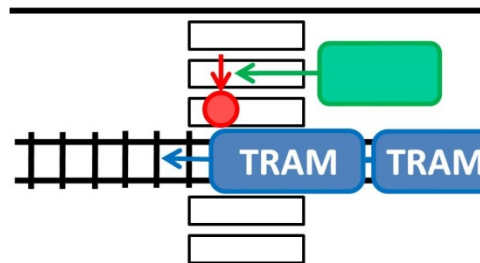
6. Pedestrian doesn't yield to the tram (see Fig. 7) – the pedestrian probably doesn't know rule of Highway Code. Braking distance of tram is longer than braking distance of road vehicles a so this conflict situation can cause very dangerous traffic accident with fatal consequences.



Source: Author

Fig. 7 - Pedestrian doesn't yield to the tram

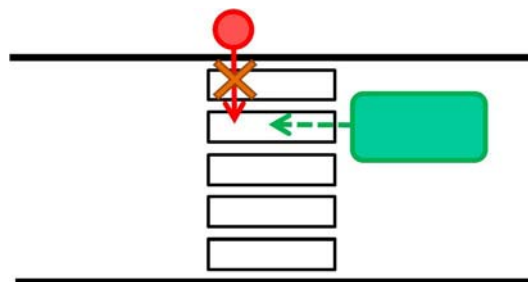
7. Pedestrian stops between road lane and tramway (see Fig. 8) – it is also very dangerous conflict situations. The driver of vehicle yield to pedestrian, but he must yield to tram and stops between road lane and tramway (if there isn't refuge island). This pedestrian is endangered partly by the vehicle and partly by the tram.



Source: Author

Fig. 8 – Pedestrian stops between road lane and tramway

8. Pedestrian stands on the edge of sidewalk near the pedestrian crossing without intention of crossing road (see Fig. 9) – some pedestrians unfortunately don't realize that in the case (e.g. when they discuss with other person) they in a negative way influences traffic flow continuity. The answerable driver (which want to yield to this pedestrian) then uselessly stops before the pedestrian crossing and detains himself and also other drivers.



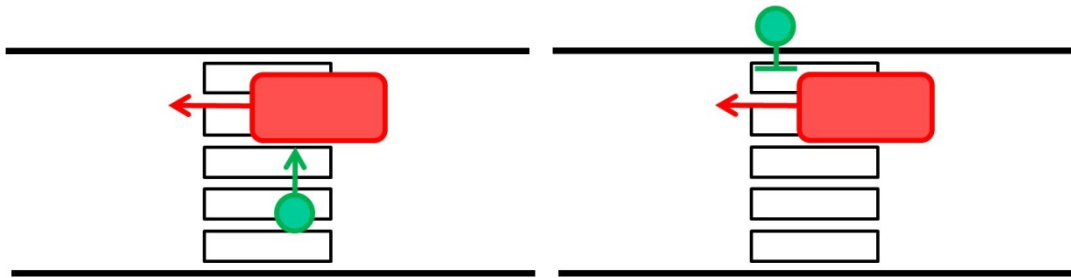
Source: Author

Fig. 9 - Pedestrian stands on the edge of sidewalk near the pedestrian crossing without intention of crossing road

The following text presents the conflict situations which are caused by the drivers of vehicles:

1. Driver doesn't yield to pedestrian (see Fig. 10) – it is the most often conflict situation on the pedestrian crossing. This driver ignores the rule of the Highway Code to yield to

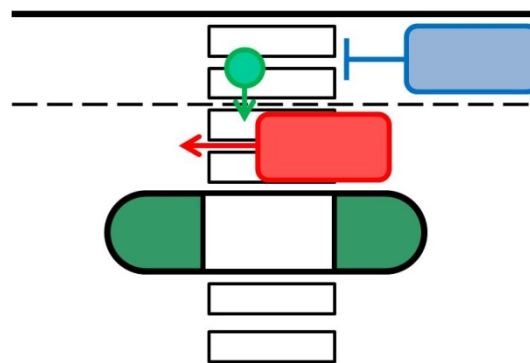
pedestrian which is on pedestrian crossing (see Fig. 10 left) or which is proposing to cross the road (see Fig. 10 right).



Source: Author

Fig. 10 – Driver doesn't yield to pedestrian

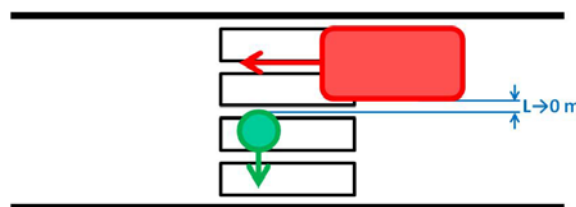
2. Driver doesn't yield to pedestrian on multi-lane road (see Fig. 11) – it is also one of the most dangerous conflict situations on the pedestrian crossing. If the driver of a vehicle is stopping before the pedestrian cross to yield to pedestrian, the second driver must also stop the vehicle (on multi-lane roads).



Source: Author

Fig. 11 - Driver doesn't yield to pedestrian (multi-lane road)

3. Driver passes immediately behind pedestrian which is on pedestrian crossing (see Fig. 12) – the impatient driver passes immediately behind pedestrian which can be endangered.



Source: Author

Fig. 12 - Driver passes immediately behind pedestrian which is on pedestrian crossing

Video analysis of conflict situations on the selected roundabouts (3) points out especially these conflict situations:

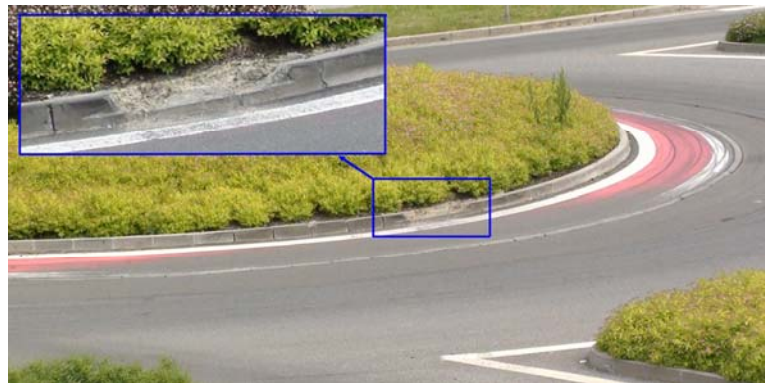
- driver doesn't yield to pedestrian (see Fig. 10),
- pedestrian crosses outside of pedestrian crossing (see Fig. 2),

- pedestrian crosses of pedestrian crossing on the left hand side (see Fig. 3),
- pedestrian conspicuously slows down on pedestrian crossing before central refuge island (see Fig. 4 left).

There was seldom also following conflict situations:

- pedestrian enters on pedestrian crossing immediately before approach vehicle (see Fig. 6),
- driver doesn't yield to pedestrian on multi-lane exit from roundabout (see Fig. 11),
- driver passes immediately behind pedestrian which is on pedestrian crossing (see Fig. 12).

The vehicles which are standing before pedestrian crossing (on a roundabout) can cause another problem. This problem is related to the curbs of central islands (see Fig. 13). The 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.



Source: Author

Fig. 13 - Damage curb of central island on roundabout

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 conflict situation was monitored on the all of monitored roundabouts.

## CONCLUSION

The conflict situations presented above are only part of possible conflict situations on the pedestrian crossing. Some situations are caused by wrong behavior of pedestrians or drivers, but some ones are caused by inappropriately designed building elements (see Fig. 13).

The usage of video-recording for analysis of conflict situations is very substantial and advantageous (above all, for possibility of repetition). It is an efficient device on the one hand for analysis of behavior of drivers, pedestrians etc. and on the other hand for monitoring of

danger places on the roads, intersections etc. However, each modification (although with good intention) can cause the other problems (often more dangerous).

## ACKNOWLEDGMENT

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## REFERENCES

- (1) *Zákon č.361/2000 Sb. o provozu na pozemních komunikacích a o změnách některých zákonů (zákon o silničním provozu) – Czech Highway Code.*
- (2) MAHDALOVÁ, I. *Přechody pro chodce a místa pro přecházení.* Materials from lectures on the subject Urban Roads and Intersections. Ostrava: VŠB-TU Ostrava, 2011.
- (3) *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.
- (4) FOLPRECHT, J., KŘIVDA, V. *Organizace a řízení dopravy I.* Ostrava : VŠB - Technická univerzita Ostrava, 2006. 158 s. ISBN 80-248-1030-1.
- (5) KŘIVDA, V. *Posouzení účinnosti okružních křižovatek.* Disertační práce. Ostrava: Fakulta strojní, VŠB - Technická univerzita Ostrava. ISBN 80-248-0207-4 (autoreferát). 2003.
- (6) KŘIVDA, V. *Analýza konfliktních situací na dvoupruhové okružní křižovatce ve Frýdku-Místku.* Perner's Contact - listopad 2011, ss. 179-187, č. IV, roč. šestý, 23/2011 [11. 11. 2011]. Elektronický odborný časopis o technologii a logistice v dopravě. Dostupné na WWW: <<http://pernerscontacts.upce.cz/>>. ISSN 1801-674X.
- (7) KŘIVDA, V. *Video-Analysis of Conflict Situations on Selected Roundabouts in the Czech Republic. Communications.* Nr. 3/2011. Žilina: University of Zilina, Slovakia, EV 3672/09, ISSN 1335-4205.