Application of the Traffic Conflict Technique in the Czech Republic

Josef Kocourek, Tomáš Padělek

Abstract — **The paper presents the methodology for application of traffic conflict technique in Czech Republic and aims to answer the question are traffic conflicts good estimators of road accident. The results of traffic conflict observations are used to diagnose safety and operational problems and to evaluate the effectiveness of treatments. We applied traffic conflict technique to estimate the traffic safety at uncontrolled intersections (roundabouts).**

Index Terms — **safety analysis, traffic accident, traffic conflict, traffic conflict technique**

I. Introduction

The basic task in road safety is to describe the existing situation – the magnitude of the road safety problem. It is easy and too common to focus exclusively on the number of accidents, injuries and fatalities, which are the effects or consequences of the danger that characterize road traffic. However, in order to compare and rank road safety problems it is also necessary to find out the magnitude, characteristics and risk by considering the fundamental elements that can be described road safety in a quantifiable manner.

Over the years, different tools have been proposed to assist safety analysts in making these field observations and formalized techniques have been developed (e.g. traffic conflict techniques, road safety audits …). In a traffic conflict study, trained observers watch the traffic and note the frequency and types of conflicts that occur at a specific location. Traffic conflict studies are primarily conducted at urban intersections, where these events are more frequent. Since conflict studies imply direct observations of road user's behaviour, they help in identifying manoeuvres that are particularly hazardous and in finding improvements that could alleviate these problems. It should be noted that the introduction of traffic conflict techniques initiated a long-standing debate concerning their validity as an accident estimator [1]. A clear answer to this question has yet to be found, but research has shed some interesting light on the topic.

Our research is focused on traffic conflicts as an alternative to accident data [3]. Conflicts occur far more frequently in traffic and can include the whole range of incidences where the actual accident is just at one end of the scale. Techniques range from subjective to the more objective where conflicts are rated by measurements such as time to collision or post encroachment time.

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II. Traffic Conflict Technique

The main advantage of conflict studies over accident studies is that it is not necessary to wait several years before gathering sufficient data to complete the evaluation. A conflict study can be conducted soon after the work has been completed and negative can be made quickly if anticipated benefits have not been achieved (or if unexpected side effects have been created). In these studies, traffic conflicts need to be observed before and after the implementation of the treatment. A well-accepted definition of traffic conflict is [2]:

"an observable situation in which two or more road users approach each other in space and time to such an extent that there is a risk of collision if their movements remain unchanged".

For traffic conflict techniques 5 basic questions are necessary to define:

a) Why to analyze traffic conflicts;
b) Conflict severity;
c) Types of traffic conflicts;
d) How to conduct a traffic conflict study;
e) Traffic conflict summary – presentation.

A. Why to analyze traffic conflicts

A traffic conflict study can be used:

- to make progress in a safety diagnosis (to evaluate the effectiveness of a safety treatment);
- to compare the safety performance of different road features or traffic rules.

B. Conflict severity

Most traffic conflict techniques categorize conflicts based on their severity (e.g. serious or non-serious). Some techniques use subjective criteria to determine conflict severity.

For the purposes of the traffic conflict technique have been defined three levels of conflicts. For the complex analysis of the studied locality even so called level 0 and level 4 can be monitored. Thus, there are 5 levels altogether (see Fig. 1). We will describe the constituent levels of conflict severity now.

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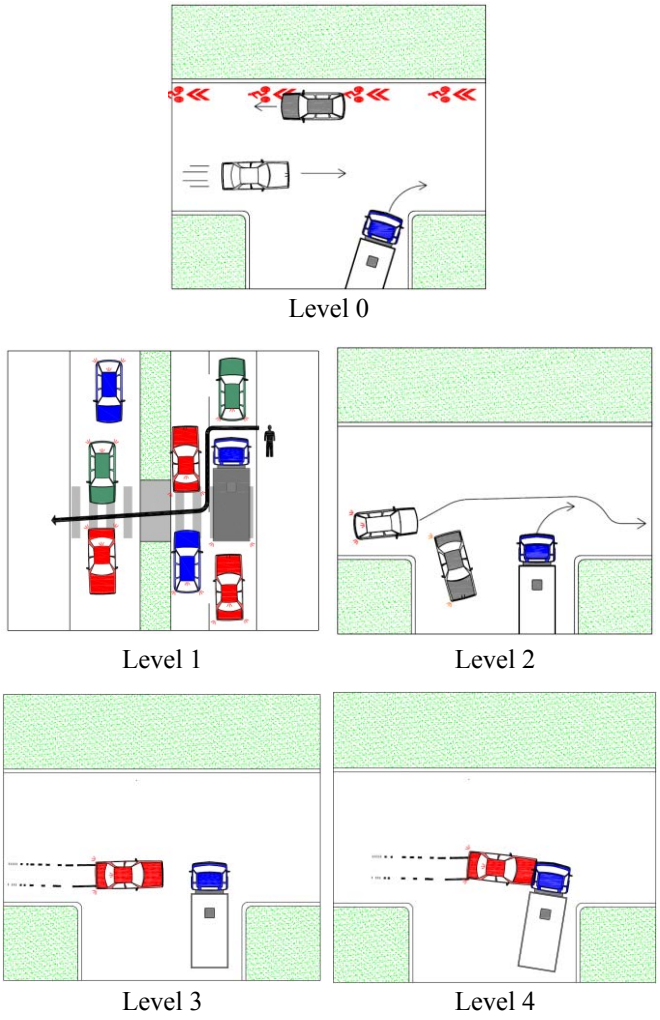

Fig. 1. Examples of traffic conflict severity

The first level is level 0. This level is used for the record of more breaking road traffic rules of the isolated vehicle (in the case of the roundabout this kind of manoeuvre was for example not to signalize stream compulsory direction change while leaving the roundabout).

The level 1 is assigned to the controlled manoeuvre without any limitation or just with minor limitation. The example of this level is a conflict between a vehicle which is standing on the pedestrian crossing, for example, because of the traffic jam (this is not a conflict of level 1 yet), and pedestrian, which would like to use this pedestrian crossing and has to go around the vehicle (see Fig. 1 – Level 1).

The difference between level 1 and level 2 is minor. In spite of that, it is necessary to realize, that in some specific situations (the example with pedestrians – see above) it is necessary to sort out this kind of conflict into less severe and more severe (Level 2).

The conflict of level 3 is assigned to such situations when the road users are threatened and sharp manoeuvre (loud breaking supplemented for example with beeping) is necessary to avert traffic accident.

Level 4 is the traffic accident that means the collision of two or more vehicles.

An example of the traffic conflict record is illustrated in Fig. 2.

Traffic conflict record **O / B – 1** **Problem creator / Respondent – Conflict severity**			
Comment:			
O	passenger car	B	bus
N	small cargo vehicle	T	tramway vehicle
NT	long cargo vehicle	Ch / C	pedestrian / cyclist

Fig. 2. Example of traffic conflict record

C. *Types of traffic conflicts*

As in the case of accident analyses it is quite useful to subdivide traffic conflicts into different categories based on their type. This allows the preparation of summary tables, graphs and diagrams that facilitate the interpretation of results (comparison of sites having similar characteristics and detection of deviant types of traffic conflicts).

Our research has defined 14 types of conflicts between two vehicles (one example for all is illustrated in Fig. 3).

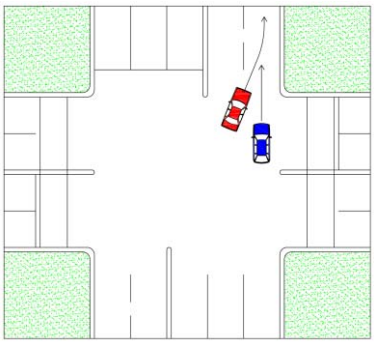

Fig. 3. Conflict between two vehicles (lane change conflict)

However, some of these conflicts have very low rates of occurrences which reduce their usefulness. The number of conflict types rises quickly when those that may occur between motorized and non-motorized road users are added to the list (pedestrians, cyclists, others).

The list of conflict types that may be observed at a site depends upon its prevailing traffic rules and geometric characteristics; this list should be determined prior to initiating the study. It is not necessary to observe all traffic conflicts that may occur at a site in all conflict studies. If, for example, the objective is to compare the performance of two left-turn treatments at intersections, it might very well be sufficient to collect conflicts that are related to this manoeuvre.

D. *How to conduct the traffic conflict study*

In the planning of a traffic conflict study a number of elements need to be considered:

- personnel training;
- observation technique;

- observation period.

The special web application for observers training [3] was created as a part of our research.

E. Traffic conflict summary – presentation

Before initiating the analysis, the observer must complete all the information on the record form heading to ensure that the location and observation conditions will be readily recognized in the future: municipality, intersection, approach, date, time, weather conditions and other comments.

Once the observations have been completed, data must be reduced and summaries prepared. Results are presented either in summary table or in traffic conflict diagram (see Fig. 4).

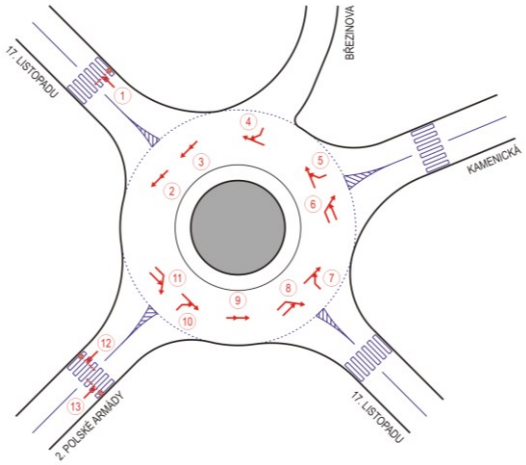

Fig. 4. Example of traffic conflict diagram

Summary tables allow comparisons of conflict rates between the analyzed site and sites with similar characteristics which is useful in detecting deviant patterns.

The logic behind these analyses is similar to that of the accident pattern analysis. Traffic conflict diagrams are quite similar to the collision diagrams. They facilitate the identification of repetitive conflict patterns that are concentrated in some travel directions and intersection areas.

As a result of the traffic conflicts survey has been chosen simple relative index k_R.

$$k_R = \frac{N_{TC}}{I} \cdot 100 \quad (1)$$

(conflict situations / 100 unit vehicles)

N_{TC}.... number of conflict situations per hour (only conflict situations with conflict severity 1 to 3);
I ..... traffic intensity (unit vehicles per hour).

III. Traffic Conflicts as Estimators of Road Accidents

Are the traffic conflicts good estimators of traffic accidents? This is a question that has been debated since the introduction of traffic conflict studies. While everybody agrees that a higher conflict rate is an indicator of a lower level of safety, it is much more difficult to determine, without ambiguity and controversy, whether traffic conflicts are good estimators of traffic accidents or not.

If we compare the relative accident rates [4] and the relative conflict rates (see Fig. 5) it is apparent that traffic conflicts are not directly correlated to traffic accidents. Both data sets are, considered in terms of events and periods of observing, quite different.

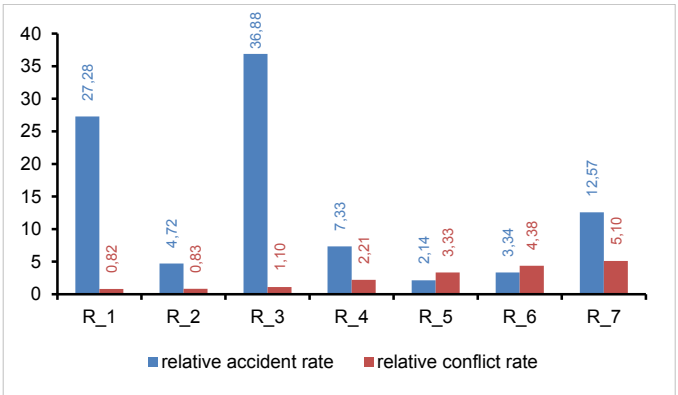

Fig. 5. Comparison of relative traffic accident rates and relative traffic conflict rates k_R on 7 roundabouts

If we make a microanalysis of observed localities we find the correlation between traffic conflicts and traffic accidents of the same type (see Fig. 6a and Fig. 6b).

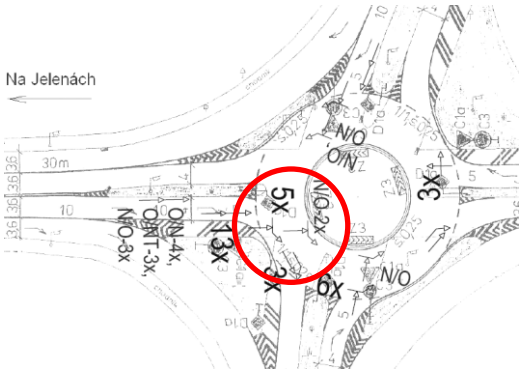

Fig. 5a Traffic conflict diagram for the specific locality

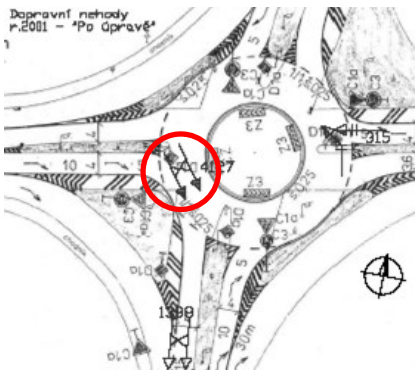

Fig. 5b Traffic accident diagram for the specific locality

IV. CONCLUSION

Our aim was to find out whether traffic conflicts are good estimators of traffic accidents. We found low correlations between the type of traffic accident and the type of traffic conflict observed during traffic conflict study.

This research effort further enhances the usefulness of the traffic conflict technique as a tool to evaluate the safety of intersections. The traffic conflict technique enables to study hazards in traffic in an uncomplicated way.

There are many possibilities for searching risks in the traffic environment, depending on the available information. If accident data, traffic conflict data, road data and traffic data can be linked, queries that integrate these various types of information can be made (e.g. a search for urban intersections with a high proportion of right-angle accidents and heavy conflicting traffic flows at peak hours, that may be potential candidates for traffic signals). Moreover, when the cost of a treatment and the cost of accidents it could eliminate are also known, the identification can go one step further and include a preliminary estimate of the cost-effectiveness of a given type of action. With current technologies and knowledge, identification procedures can now be much more sophisticated than a few decades ago. Analysts should make good use of these possibilities in order to improve the efficiency of their work, rather than relying only on traditional identification methods.

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REFERENCES

[1] PIARC; *Road Safety Manual*; 2003
[2] Parker, M. jr. – Zeeger, C.; Traffic *Conflict Techniques for Safety and Operations - Observer Manual*; Georgetown Pike (USA), 1989
[3] Ambros, J. – Kocourek, J. – Kočárková, D. – Padělek, T.; *Metodika sledování a vyhodnocování dopravních konfliktů*; ; Brno (CZ): CDV & ČVUT FD, 2013
[4] Andres, J. – Mikulík, J.; *Metodika identifikace a řešení mist častých dopravních nehod*; Brno (CZ): CDV, 2001

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