PROBLEMS OF PARKING ON SELECTED STREETS IN PRAGUE

Jan Petrů[1], Václav Škvain[2]

Summary: The paper deals with problems of parallel parking in selected localities of the capitol Prague. There are described the conflict situations on three streets with parking lanes and also with cycling lanes or a tramway lane. The article also presents evaluation of frequency of conflict situations in the monitored localities defining the conflict indicators (almost-accident rate). It further points at hidden factors that cannot be deduced from the project or analysis of the traffic accident rate.

Key words: Road Transport, Parking, Conflict Situation, Videoanalysis.

INTRODUCTION

Number of vehicles together with vans rises permanently every year. The roads are burdened with still bigger traffic volume. This facts cause increasing need for parking places. Due to building density and deficiency of parcels for building of parking areas the parking places are more often built along roads (parallel parking).

This way of parking brings a lot of conflicts which has impact on traffic flow continuity and traffic safety. It is especially parked vehicles which can stick out into traffic lane, drivers entering into road for getting out or getting in the vehicle or individual parked vehicles which influence traffic flow continuity and in some cases also traffic safety. The parallel parking can also cause problems of entries/exits of urban public transport vehicles to stop lanes; this also has an impact on position of the vehicle at the platform edge (1). A vehicle parking by this lane influences the traffic safety in the stop lane section (2) (3).

Within the urban environment, it is very important to harmonise the type of road and its traffic importance and type of buildings (4). This method has a major impact on consolidation of transport operations on the given road as well as on reduction of number of potential conflict situations (5) and (6)

This paper points out these problems using video-analysis of conflict situations by methodology which is described in (7).

1. SELECTION OF LOCALITIES OF PARALLEL PARKING FOR VIDEO ANALYSIS

Under the terms of the research project (4) there was made road traffic survey on selected localities of Prague - Náchodská Street (8 sections), Sokolovská Street

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(5 sections), Legerova Street (3 sections), Sokolská Street (1 section) and Českomoravská Street (2 sections).

Source: Authors

Fig. 1 - One of points for video analysis of conflict situations of parallel parking

2. VIDEOANALYSIS OF CONFLICT SITUATIONS IN MONITORED LOCALITIES

The conflict situations recorded in the monitored localities are described by a classification symbol. This symbol consists of a number, i.e. participant to the conflict situation (2 – vehicle, 4 - pedestrian x vehicle, 6 - vehicle x vehicle), a letter (type of origin of the conflict), and another number, which indicates seriousness of the situation (class 1 – the lowest degree – infringement of regulations without involving other road users; class 2 – wrongdoing and violation of traffic flow; class 3 - the highest degree – sudden braking or abrupt turning to avoid a collision). (7)

Description of conflict situations recorded in the monitored localities:

- 2b2 A public transport vehicle pulling out into the opposite lane due to a parked passenger vehicle
- 4j2 Opening door into the road area
- 4ch2,3 Pedestrians crossing the road
- 6v2,3 A car turning from the parallel parking into the through lane
- 6z2 A car turning to the parallel parking from the through lane
- 6o2,3 Vehicles turning to opposite direction
- 2c2 Parking in the cycling lane
- 6k2 Passing a badly parked vehicle via a tram lane
- 6r2 Reversing manoeuvre of a delivery vehicle into the intersection

The conflict rate (k_R) represents the rate of danger in the given section in number of conflict situations per hour (P_{KS}) divided by hourly traffic intensity (I) (number of vehicles/hour).

The recorded conflict situations in the monitored localities were put into a summary table Tab 1, which presents frequency of conflict situations in the given locality. The Table shows that the biggest problems represent pedestrians crossing the road - **4ch2**,

despite of the nearby pedestrian crossing, and sudden opening of vehicle doors and the driver entering the road – **4j2**. Among the dangerous situations, there also belong sudden turning from parallel parking into the through lane - **6v2** and vehicles turning to opposite direction. At Českomoravská street, there were recorded vehicles parking in the cycling lane **2c2**. This situation disturbs flow of passenger vehicles and turning of cyclists in the through lane, but it also causes unexpected opening of door into the road and movement of the driver in the traffic lane - **4j2**. Due to a badly parked vehicle close to a pedestrian crossing at Sokolská street, there were recorded 1070 cars passing this badly parked vehicle via the tram lane – **6k2**.

Tab. 1 – Frequency of conflict situations in monitored localities defining the conflict rate k_R

Localities	Conflict situation	P_{KS} [KS/h]	k_R [KS/100 veh]
Náchodská Street	2b2	9	0.55
1631 vph	4j2	26	1.59
	4ch2	7	0.43
	4ch3	5	0.31
	6v2	7	0.43
	6v3	5	0.31
	6z2	3	0.18
	6o2	4	0.25
	6o3	1	0.06
Total of		**67**	**4.11**
Sokolovská Street	4j2	5	0.40
1258 vph	6v2	2	0.16
	6r2	1	0.08
Total of		**8**	**0.64**
Sokolská Street	4j2	3	0.22
1338 vph	6z2	1	0.07
	6k2	1	0.07
Total of		**5**	**0.37**
Českomoravská Street	4j2	14	1.52
921 vph	4ch2	15	1.63
	4ch3	3	0.33
	6v2	1	0.11
	6z2	1	0.11
	2c2	6	0.65
Total of		**40**	**4.34**

Source: Authors

3. MONITORED LOCALITY PRAGUE – HORNÍ POČERNICE

In Horní Počernice there is selected road II/611 (Náchodská Street) for observation of conflicts situation caused by parking along the road. The parallel parking is situated along both sides of this road in total length of 2.0 km. On this road there are also stop lanes next to the parallel parking.

Source: mapy.cz

Fig. 2 - Selected locality in Horní Počernice

During the road traffic survey there were recorded the following conflict situations in this locality at 8 points.

3.1 Inappropriate vehicle stopping near stop lane

Vehicles often stop in front of or behind the stop lane. It noticeably influences driving of buses into the stop lane, its position near usable platform edge when passenger has to entry on road during getting on/off bus. And consequently bus exiting into the through lane is also influenced. Bus often drives into the opposite lane and it restricts vehicles going in opposite direction. This situation is shown in Fig. 3. This phenomenon is worse in articulated bus when the cutting of this vehicle was almost 1.15 m.

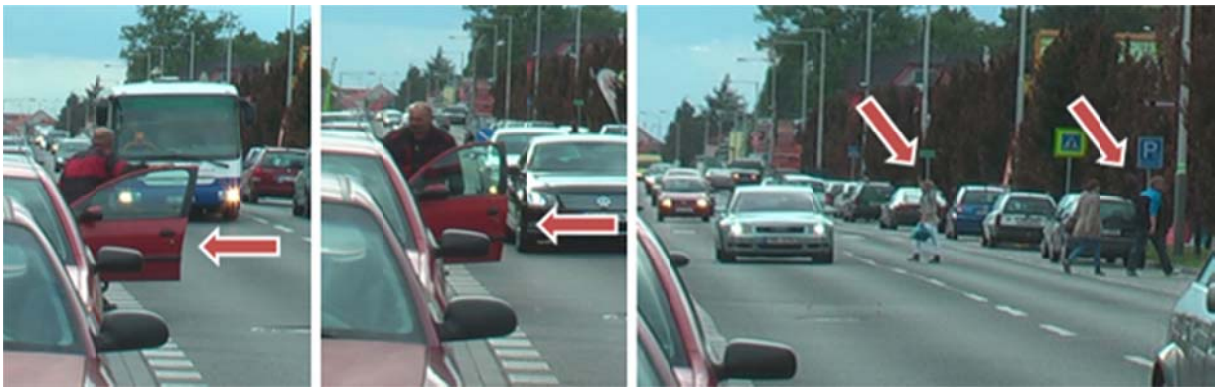
Source: Authors

Fig. 3 - Parked vehicle influencing position and exit of bus from stop lane (2b2)

3.2 Restriction of traffic flow continuity by drives of parked vehicles in parallel parking place

The other situations are caused by pedestrians. They are especially drivers of parked vehicles. Driver after parking manoeuvre must open the door during getting out and then entry into traffic lane. Open door sticks out into next traffic lane. Then the driver goes around vehicle walking on the traffic lane. This situation arises also during exiting the parallel

parking place. Vehicles in the next traffic lane are restricted and the driver of the parked vehicle is also endangered (Fig. 4).



Source: Authors

Fig. 4 - Open door during getting in/out vehicle; crossing drivers (pedestrians) (4j2 and 4ch2)

Common phenomenon is also crossing across the road to or from the parked vehicle. Drivers rarely use the nearby pedestrian crossing. In these cases the vehicles are restricted again and the driver (pedestrian) himself is also endangered – see Fig. 4 and 5.

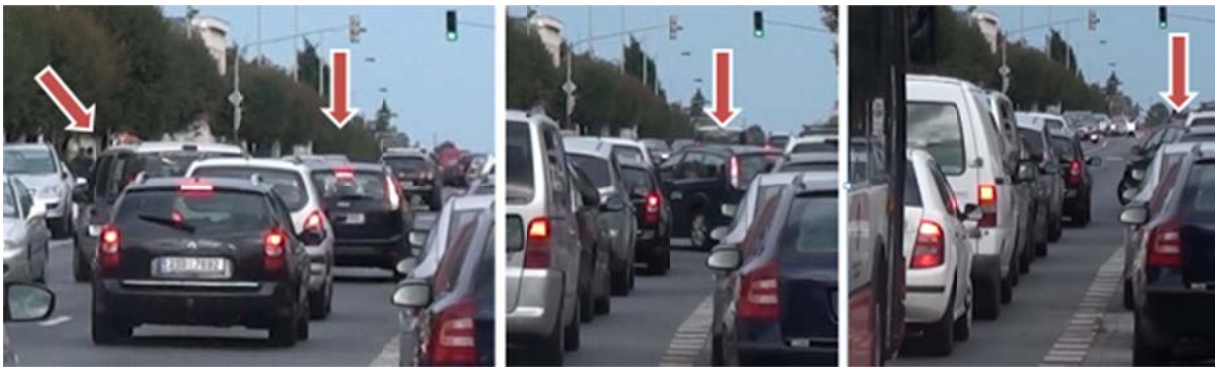
Source: Authors

Fig. 5 - Driver of van is braking before crossing driver (4ch3)

3.3 Restriction of vehicles in through lane during reversing into parallel parking place

Drivers which are parking into parallel parking can restrict or decelerate vehicles behind them. This situation arises in the through lane while the driver looks for space for parking of his vehicle. However, the considerable restriction of vehicles in the through lane arises during parking manoeuvre into parallel parking place by reversing. In these cases the driver stops in the through lane and reverse into parking place. There could also be situations in which the driver suddenly stops near space for parking of a vehicle. Another situation arises when drivers try to pass this vehicle or stop close behind it. Driver of the parking vehicle cannot enter into this place by reversing. The observed

manoeuvre is shown in Fig. 6 and it takes 35 seconds from stopping of the vehicle in the traffic lane to further movement of vehicles in the through lane.



Source: Authors

Fig. 6 - Parking by reversing (6z2)

3.4 Unexpected exits from the parallel parking place

Problematic and also potentially dangerous situations arise during unexpected exit of parked vehicles from the parallel parking place. If a car stands hidden behind other vehicles in parallel parking place and it gives a turn indicator, this signal may not be visible for other drivers. The driver drives into the through lane in the space between vehicles, but this manoeuvre is unexpected by the drivers going behind him. This manoeuvre is shown in Fig. 7. In this case the driver of the exiting vehicle did not use the turning indicator. Vehicle in the through lane had to brake suddenly in order to avoid traffic accident.

Source: Authors

Fig. 7 - Unexpected exits from parallel parking place
and danger for vehicles in through lane (6v3)

3.5 U-turn manoeuvre during exit parallel parking place

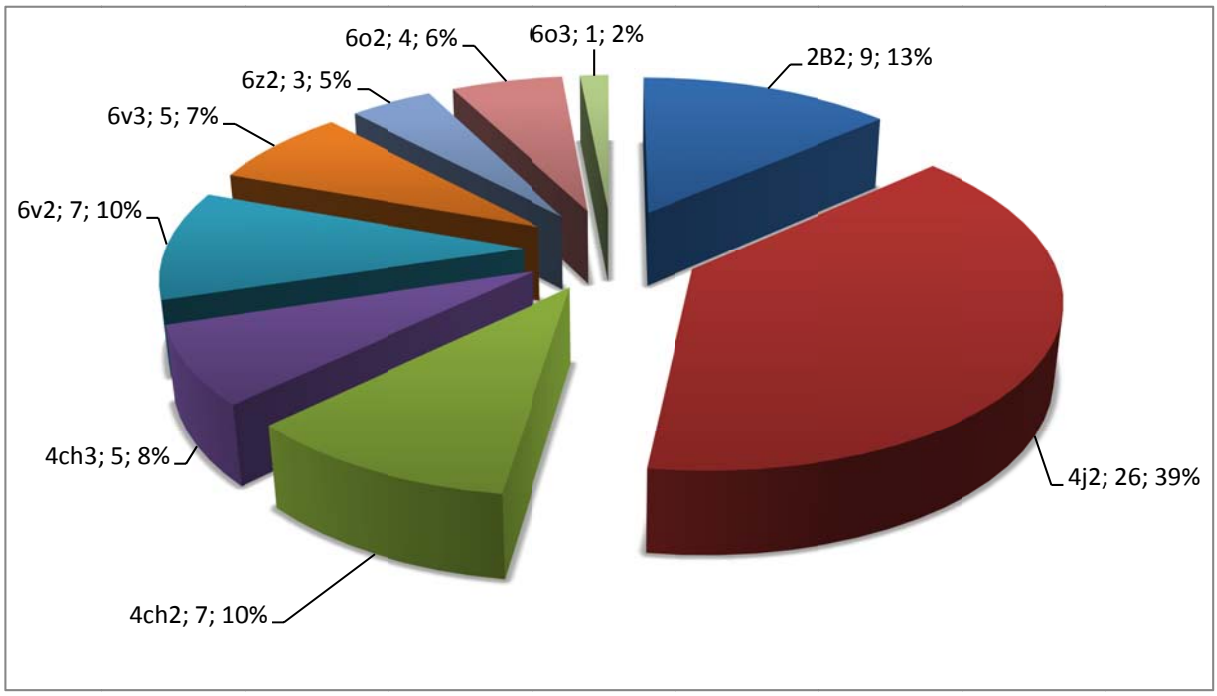
Another dangerous situation is the U-turn manoeuvre of vehicles on road during exit of the parallel parking place. In these cases the drivers in traffic lanes (especially drivers in the opposite traffic lane) do not expect a U-turn manoeuvre through the road – see Fig. 8.

Source: Authors

Fig. 8 - U-turn manoeuvre of vehicles during exit of parallel parking place (6o3)

3.6 Percentage of conflict situations in Náchodská street

Fig. 9 shows percentage of conflict situations recorded in the monitored locality. At Náchodská street there mostly appear 4j2 – opening doors into the road (total of 1.59 KS/100 veh.), 2b2 – a public transport vehicle pulling out into the opposite lane due to a parked passenger vehicle (0.55 KS/100 veh.), 4ch2 – pedestrians crossing the road (0.43 KS/100veh.) and 6v2 – turning from the parallel parking to the through lane (0.43 KS/100 veh.).



Source: Authors

Fig. 9 Total of conflict situations in Náchodská street

4. MONITORED LOCALITY PRAGUE – ČESKOMORAVSKÁ STREET

Českomoravská Street is the next selected locality. It is an urban road with two traffic lanes in each direction and a dividing tram strip. Cycling lanes are along traffic lanes of both

directions. The parallel parking is situated behind the cycling lane in length circa 0.5 km between Freyova Street and Lisabonská Street.

Source: Authors, mapy.cz

Fig. 10 - Selected locality in Českomoravská Street

4.1 Restriction of traffic flow continuity in cycling lane

As already mentioned in the previous locality, driver must open the door and enter into the road after parking manoeuvre during getting out. In this case the open door sticks out into the neighbouring cycling lane. Driver of the parked vehicle is separated from the through lane and the door does not stick out into this lane. However, in this place, there arise dangerous situations for cyclists who do not have manoeuvre place for averting this situation or they must go into the through lane or stop. This problem also arises in the case of vehicle which does not park adequately near the curb and sticks out into the cycling lane by rear part of the vehicle. Vehicle from Fig. 11 is parking outside the marked parallel parking place.

Source: Authors

Fig. 11 - Open door into the cycling lane and vehicle sticking out into this lane by its rear part (4j2)

During the measuring we have also discovered that stopping of a vehicle in the cycling lane is a common phenomenon. There is a conflict situation not only during driving around the vehicle by a cyclist, but also by movement of drivers (pedestrians) in the next traffic lane. This problem was described in the previous monitored locality. We have to mention that drivers of these vehicles usually stop in the cycling lane even in the case,

when there are places available in the parallel parking places. Vehicles from Fig. 12 were standing in these places for more than 20 minutes.

Source: Authors

Fig. 12 - Parked vehicles in cycling lane (2c2)

Open door of this parked vehicle sticks out into the next traffic lane. In this case there arise situations which were described above. Drivers moving on the road are shown in Fig. 13.

Source: Authors

Fig. 13 - Moving of drivers on the road close to vehicles sticking out into cyclist lane (4j2)

Drivers parking into the parallel parking use cyclist lane to stop their vehicles and to manoeuvre by reversing – see Fig. 14. In these cases the traffic in the through lane isn't influenced so much. Also the cyclists are influenced during this manoeuvre.

Source: Authors

Fig. 14 - Vehicle stopping in cycling lane and reversing into parallel parking lane

4.2 Percentage of conflict situations in Českomoravská street

Fig. 15 shows percentage of conflict situations recorded in the monitored locality. At Českomoravská street, the conflict situations are mainly 4ch2 – pedestrians crossing the road (total of 1.63 KS/100 veh.), 4j2 – opening the door into the road (total of 1.52 KS/100 veh.) and primarily 2c2 – parking in the cycling lane (total of 0.65 KS/100 veh.).

Source: Authors

Fig. 15 Total of conflict situations in Českomoravská street

5. MONITORED LOCALITY PRAGUE – ČESKOMORAVSKÁ STREET

Sokolovská Street is road with one traffic lane for each direction and with dividing tram strip. On traffic lanes in both directions there are parallel parking places. On the street there are buildings of civil facilities (shops, restaurants, theatres, galleries, offices, metro stop Vysočanská and also a lot of automated teller machines).

Source: mapy.cz

Fig. 16 - Selected locality in Sokolovská Street

Due to only one traffic lane there is delaying of vehicles during parking manoeuvres into the parallel parking place. The dividing tram strip is elevated and during these situations it makes passing of vehicles impossible.

Source: Authors

Fig. 17 - Parking manoeuvre into parking lane by reversing (6z2)

Close to restaurants, shops and other buildings of civil facilities there are often cases when the delivery vehicle cannot stop on the parallel parking and supply these buildings from its rear part. Such vehicles usually park on the pavement. Thus parked vehicle makes walking of pedestrians and disabled persons impossible. Traffic safety is also endangered during exiting of this vehicle. Fig. 18 shows a delivery vehicle exiting by reversing into intersection. This vehicle restricts drivers on major road, but also on minor road as the drivers do not expect this manoeuvre.

Source: Authors

Fig. 18 - Supplying vehicle exiting by reversing into intersection (6r2)

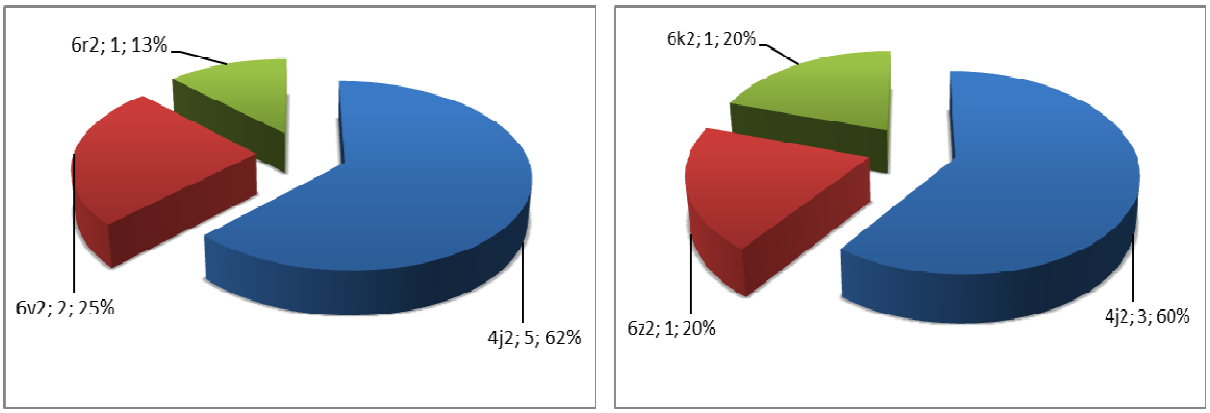
During observation on monitored localities we recorded a common phenomenon when drivers park along the road or the parallel parking place for the short period of time. Drivers in the through lane must pass this vehicle via the tram lane – see Fig. 19. There are dangerous situations when a driver passing the vehicle does not notice the approaching tram (especially in the case of bigger traffic volume in the traffic lane).

Source: Authors

Fig. 19 - Passing parked vehicles via tram lane (6k2)

5.1 Percentage of conflict situations in Sokolská and Sokolovská streets

Fig. 20 shows percentage of conflict situations recorded in the monitored locality at Sokolská and Sokolovská street. At Sokolovská street, there was recorded a potentially dangerous situation 6r2 - reversing manoeuvre of a delivery vehicle into the intersection. The primary problematic situation at Sokolská street was 6k2 – passing of a badly parked vehicles via tram lane, where the mentioned 1070 vehicles passed a vehicle parked close to the pedestrian crossing via the tram lane.

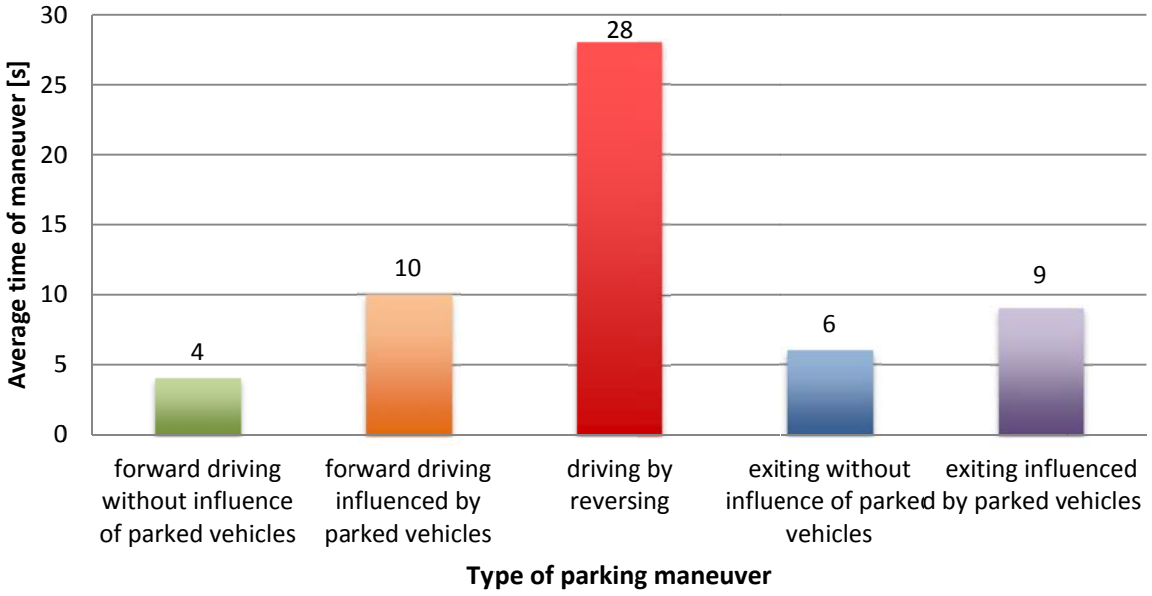


Source: Authors

Fig. 20 – Graph of conflict situations in Sokolská and Sokolovská streets

6. TIME OF PARKING MANOEUVRE

During the road traffic survey and video analysis of conflict situations there were recorded times of delay during the parking manoeuvres. Fig. 18 shows the average times of parking of vehicles according to the type of manoeuvre into the parallel parking. The graph demonstrates that the most appropriate manoeuvre is the forward driving without influence of the parked vehicles, when the driver of the parking vehicle can use one or more free parallel parking places. The most inappropriate manoeuvre is situation when the driver of the parking vehicle must use reversing for parking manoeuvre into the parallel parking place. In such case there is marked delay of flow of vehicles in the through lane.



Source: Authors

Fig. 21 - Type of parking manoeuvre and its average times

CONCLUSION

The paper describes problems which recorded during road traffic survey on selected localities in Prague. These are not only parking problems of the capitol, but the same conflict situations can be observed in a lot of cities with this type of parking.

It is important to realize that these conflict situations are caused partly by wrong behaviour of drivers or other road users, and partly by inappropriately located parking places or their sizes.

Due to the increasing traffic volume on roads and problems with building of new parking areas, the parking places are built along through lanes – the so called parallel parking. The paper deals with conflict situations on this type of parking places to draw attention to this during design of new parking places and to report on possible dangerous situations which can arise during their use. The article further points at hidden factors that cannot be deduced from the project or analysis of the traffic accident rate. Monitoring of the conflict situations is not currently used during planning of new projects or reconstructions, even though the used analysis (7) could be well used for enhancement of road traffic safety.

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