

# TRAFFIC CALMING ON BELEHRADSKA STREET IN PARDUBICE

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*Summary: The paper deals with the traffic calming in Belehradská Street in Pardubice. Traffic calming shares the goal of reducing vehicle speeds, improving safety, and enhancing quality of life and starts to occur in many Czech towns. There are given an examples existing traffic calming measures. In the second part of this paper the other measures is proposed – to change of the traffic organization of intersection Belehradská – Kosmonautu.*

*Key words: traffic calming, bicycle lane, roundabout*

## 1. INTRODUCTION

Traffic calming is intended to slow or reduce motor-vehicle traffic in order to improve safety for pedestrians and bicyclists and improve the environment for residents. A lot of traffic calming projects was realized in Pardubice last time. Most projects are implemented on urban streets – for example Belehradská Street. Belehradská Street is in the north-west part of Pardubice which is calling Polabiny (Fig. 1).



Source: [1]

Fig. 1 – Location of Belehradská Street in Pardubice

The part of this street, which the paper deals, is set bound by roundabout and signal controlled intersection (Fig. 2). Its' length is about one kilometer.

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Source: [1]

Fig. 2 – Belehradská Street

## 2. TRAFFIC CALMING ON BELEHRADSKA STREET

There is center island narrowing combined with the crosswalks (Fig. 3). This center island narrowing increases pedestrian safety.

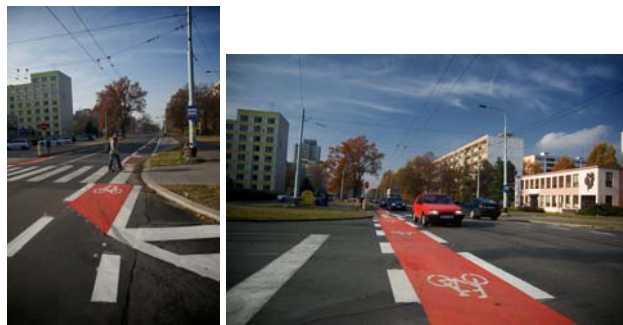


Source: [1]

Fig. 3 – Center island with the crosswalks on Belehradská Street

Pardubice is the town with favor terrain for the bicyclists. And it's could be one of the reasons why many of people use the bicycle for their travels. Pardubice is bicycle friendly town – there are about 50 km of the public ways available to cyclists. Pardubice is one of the first towns in Czech Republic, where the bicyclists can travel against the flow of traffic on a one-way street.

From October, 2010 the bicyclists could choose if they go by shared routes for pedestrians and cyclists or by new marked bicycle lanes (Fig. 4). The bicycle lines are the one of the traffic calming measures. By the redistribution of the carriageway they narrow down the vehicle lane width. Thereby can speed be reduced and driver behavior modified. Recent implementations of shared space schemes have delivered significant traffic speed reductions.



Source: [2]

Fig. 4 - New marked bicycle lanes on Belehradská street

### 2.1. Draft of traffic calming measure

The other of the traffic calming measures which could help the speed reduction to attempt by statutory speed limits and to improve road safety is the change of the traffic organization of intersection Belehradská – Kosmonautu (Fig. 5, 6). Efficient intersection form could be used is the urban single – line roundabout in term of the traffic calming.



Source: [1]

Fig. 5 – The view of intersection Belehradská – Kosmonautu (the situation before marking bicycle lanes)



Source: [2]

Fig. 6 – New marked bicycle lanes on intersection Belehradská - Kosmonautu

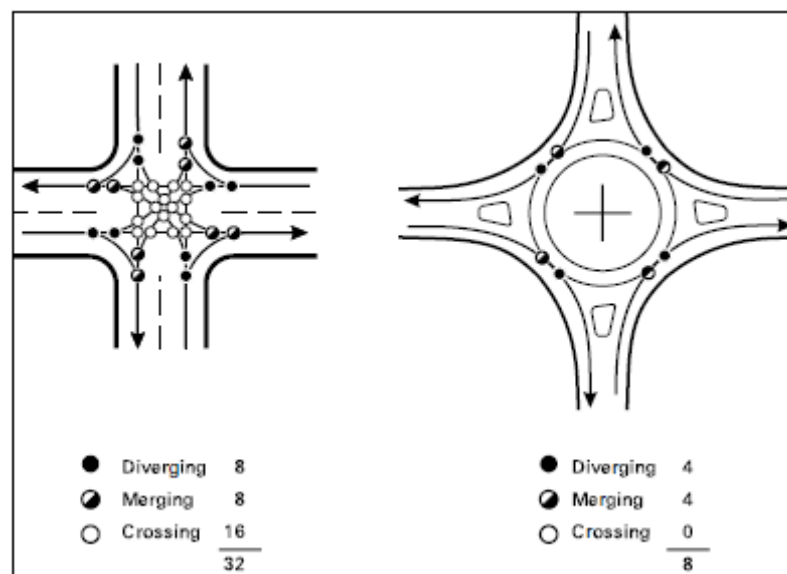
## 2.2. The roundabout as the measur of traffic calming

The urban single – line roundabout is characterized as having a single lane entry at all legs and one circulatory lane. Their design allows slightly higher speeds at entry, on the circulatory roadway, and at the exit. The geometric design includes raised splitter islands, a nonmountable central island with apron.

Roundabouts have been demonstrated to be generally safer for motor vehicles and pedestrians than other forms of other forms of at-grade intersections. Good roundabout designs encourage speed reduction and speed consistency. Speed reduction can be achieved at all times of day. Lower vehicle speeds should provide the following safety benefits, e.g. [3]:

- reduce crash severity for pedestrian and bicyclists,
- provide more time for entering drivers to judge, adjust speed for, and enter a gap in circulation traffic,
- allow safer merges into circulation traffic,
- provide more time for all users to detect and correct for their mistakes or mistakes of others,
- make collisions less frequent and less severe,
- make the intersection safer for novice users.

The roundabouts reduce in severity or eliminate many severe conflicts that are present in traditional intersections. Roundabouts eliminate crossing conflicts by converting all movements to right turns (Fig. 7).



Source: [3]

Fig. 7 – Types of intersection conflicts

## 2.3. Capacity calculation on intersection Belehradská – Kosmonautu

The students made traffic census on this intersection on Monday, 1. 3. 2010, from 3 pm to 5 pm in agreement with TP 189 [4]. Traffic census results are shown in Tab. 1.

Traffic census results were processed and traffic volumes per hour were calculated in agreement with TP 189[4]. These volumes were converting into anticipated traffic volumes in 2030. Traffic volumes are shown in Tab. 2.

Tab. 1 – Traffic volumes on entries of intersection on Monday, 1. 3. 2010, from 3 pm to 5 pm (C- car, T – truck and bus)

traffic flow		entry	traffic volume [veh/2h]	
from	to		1. 3. 2010, 3 - 5 pm	
			C	T
Belehradská E	Kosm S	A	134	13
	Bel W		845	2
	Kosm N		41	1
Kosmonautu N	Bel E	B	160	14
	Kosm S		15	0
	Bel W		169	8
Belehradská W	Kosm N	C	121	10
	Bel E		648	9
	Kosm S		20	0
Kosmonautu S	Bel W	D	15	0
	Kosm N		8	0
	Bel E		47	1

Tab. 2 – Traffic volumes per hour on entries of intersection (C- car, T – truck and bus)

traffic flow		entry	traffic volume [veh/h]			
from	to		year 2010		year 2030	
			C	T	C	T
Belehradská E	Kosm S	A	19	1	27	2
	Bel W		386	2	531	3
	Kosm N		62	8	86	9
Kosmonautu N	Bel E	B	73	8	101	9
	Kosm S		7	0	10	0
	Bel W		78	5	108	6
Belehradská W	Kosm N	C	56	6	77	7
	Bel E		296	6	407	7
	Kosm S		10	0	14	0
Kosmonautu S	Bel W	D	7	0	10	0
	Kosm N		4	0	6	0
	Bel E		22	1	31	2

Traffic volume per hour on all intersection entries will be 1453 veh/h in 2030. There is the independence between intersection type and their capacity in tab.3.

Tab. 3 – Maximum values of intersection capacity

Type of intersection	Max capacity per hour [veh/h]	Max capacity per day [veh/day]
Non controlled intersection	1500 ÷ 2000	18000 ÷ 24000
Single line roundabout	2000 ÷ 2500	25000 ÷ 30000
Double line roundabout	2500 ÷ 3500	30000 ÷ 40000
Signal controlled intersection	3000 ÷ 6400	36000 ÷ 77000

Source: [5]

If calculated values of traffic volume per hour on all intersection entries and tabled capacity values are compared, it looks the existing type of intersection is capacity convenient. But there is user problem with traffic flow from Kosmonautu north to Belehradaska east. There are generated lines of vehicle. Time delay is about 1 minute. And that it's why vehicles of public transport often are overdue.

It was made capacity calculation of all entries of this intersection in agreement with TP 188 [6]. The capacity calculation proved that entries from Belehradaska (east and west) and Kosmonautu south are at capacity but the entry from Kosmonautu is next to over capacity (Tab.4). There is reservation of capacity 80 veh/h.

Tab. 4 – Entries capacity of intersection

traffic flow		entry	capacity [veh/h]	reserve of capacity	level of capacity utilization
from	to				
Belehradaska E	Kosm S	A	1734	62%	A
	Bel W				
	Kosm N				
Kosmonautu N	Bel E	B	322	25%	E
	Kosm S				
	Bel W				
Belehradaska W	Kosm N	C	1491	65%	A
	Bel E				
	Kosm S				
Kosmonautu S	Bel W	D	405	88%	A
	Kosm N				
	Bel E				

It's necessary to calculate if all entries of propose single line roundabout (Fig. 8) are at capacity.

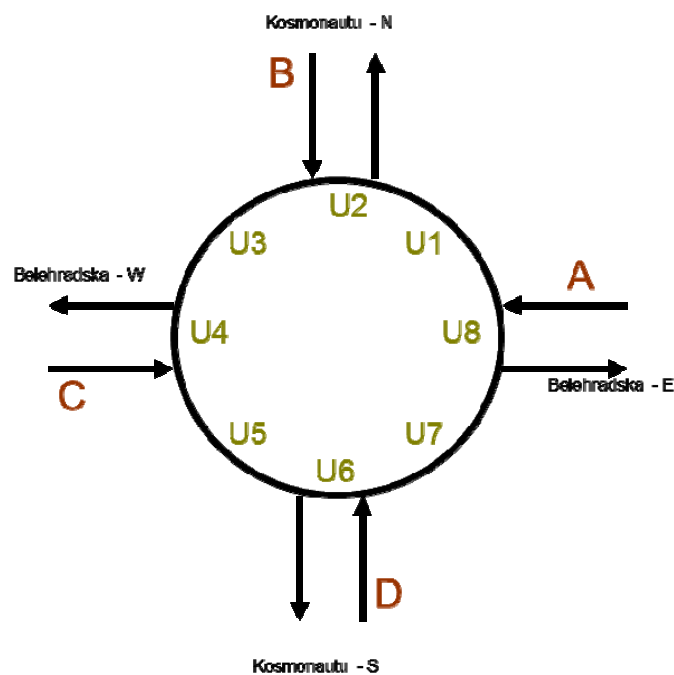


Fig. 8 – Propose single line roundabout

They say [3] that circulating flow should not exceed 1800 veh/h at any point in single line roundabout. All of sectors of propose single line roundabout meet this requirement (circulating flows are calculated in Tab. 5).

Tab. 5 – Circulation flows

sector	A→B	A→C	A→D	B→A	B→C	B→D	C→A	C→B	C→D	D→A	D→B	D→C	ΣU <sub>i</sub>
U1	104	511	29					90			6	10	750
U2		511	29									10	550
U3		511	29	118	115	10						10	793
U4			29	118		10							157
U5			29	118		10	404	90	14				665
U6				118			404	90					612
U7				118			404	90		33	6	10	661
U8								90			6	10	106

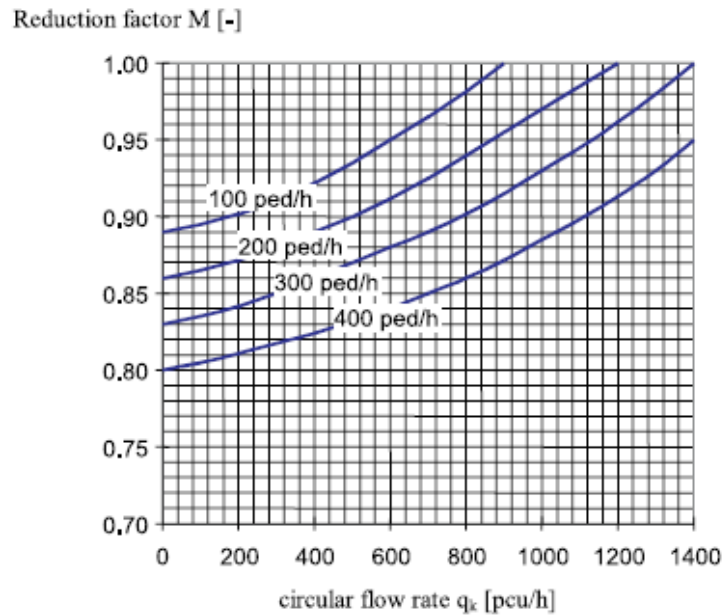
Brilon’s method was used for capacity entries calculate. The results are shown in Tab. 6.

Tab. 6 – Entries capacity

entry	circulating flow [veh/h]	capacity [veh/h]	traffic volume [veh/h]	reserve of capacity
A	106	1093	644	41%
B	550	678	243	64%
C	157	1035	508	51%
D	612	634	49	92%

The capacity calculation proved that all of entries are at capacity. There is the minimal reservation of capacity 449 veh/h (entry Belehradská east).

Pedestrian crossing at marked crosswalk that gives them priority over entering vehicles can have significant effect on the entry capacity. In such cases, if pedestrian crossing volume and circulating volume are known, the vehicular capacity should be factored according to the relationship shown in Fig. 9 [3].



Source: [3]

Fig. 9 – Capacity reduction factor  $M$  for a double-lane roundabout assuming pedestrian priority

In time of traffic census the most pedestrian crossings (cca 150 ped/h) were on entry Belehradská west. Pedestrian crossings on entry Kosmonautu south were cca 120 ped/h. There aren't marked crosswalks on other entries.

### 3. CONCLUSION

Belehradská Street is example of the street where traffic calming measures are stepwise applied. At first there were measures to improve safety for pedestrians and bicyclists (marked crosswalks, center island narrowing combined with the crosswalks, by shared routes for pedestrians and cyclists). A month ago they marked bicycle lanes which can speed be reduced and driver behavior modified.

Proposed traffic calming measures which could help the speed reduction to attempt by statutory speed limits and to improve road safety is the change of the traffic organization of intersection Belehradská – Kosmonautu. The urban single – line roundabout could be in term of the traffic calming.

The capacity calculated affirms this variant as effectible. Pedestrian crossings on marked crosswalks couldn't influence the intersection capacity.

### 4. ACKNOWLEDGEMENT

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