

TRAFFIC CALMING MEASURES INSIDE SETTLEMENTS: SLOVENIAN EXPERIENCES

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Abstract: Traffic calming began simultaneously in Europe and Australia when efforts were made to change driver's behaviour to make streets safer for children, pedestrians and cyclists. In The Netherlands traffic calming was "developed by urban planners and traffic engineers who realized that the well-being of people was influenced not only by housing but also by the surrounding streets. It was not enough to improve housing without making the roads more congenial places."

Today it is already common knowledge that traffic calming is a "combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver's behaviour and improve conditions for non-motorized street users."

Main goals of traffic calming could be defined as:

- increasing the quality of life,
- incorporating the preferences and requirements of the people using the area (e.g. working, playing, residing) along the street(s) or at intersection(s),
- creating safe and attractive streets,
- helping to reduce the negative effects of motor vehicles on the environment (e.g. pollution, sprawl), and
- promoting pedestrian, cycle and transit use.

Traffic calming measures (all kind of devices, applications etc.) are becoming more frequent in Slovenia as well, especially in the last twenty years. Our *Law about public roads* define measures and devices for traffic calming. According to the Law traffic calming devices are physical, lighting or others devices and obstructions that:

- physically prevent the participants in road traffic to drive with inappropriate speed and
- warn the participants in road traffic to speed limit on dangerous sections of road.

Physical obstructions could be set down (only) on regional state roads and local roads inside the settlement / city. Before schools, kindergartens and other objects, along which the speed is limited (due to traffic safety of all participants), usage of physical traffic calming devices is obligatory.

In the article we will present Slovenian experiences with traffic calming devices in Slovenian settlements. Analysis will be focused on traffic calming devices (a) at the beginning of the settlement, (b) on the road sections inside settlement and (c) at the intersections inside settlement.

Key words: traffic safety, traffic calming, traffic calming measures

1. INTRODUCTION

Traffic calming generally represents a combination of different measures which reduce negative influence of motorised traffic, change style of behaviour motor vehicles drivers and improve traffic conditions for non-motorised traffic users. Main goal of traffic calming should be improvement of traffic safety for pedestrians and cyclist without severely limiting vehicles travel or significantly effecting emergency vehicles. Purpose of traffic calming is not to block vehicle traffic, but to slow it down.

It is especially in the last twenty years that traffic calming measures (all kind of devices, applications etc.) are also more and more frequent in Slovenia. The Slovenian act about public roads defines measures and devices for traffic calming. According to our law the traffic calming devices are physical, light or other

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devices and obstructions that physically prevent the participants in road traffic to drive with inappropriate speed or they warn them to limit the speed on dangerous road sections.

Physical obstructions in Slovenia could (only) be set down on regional national roads and community (local) roads inside the settlement/city. Usage of physical traffic calming devices is obligatory near schools, kindergartens and other objects, along which the speed is limited (due to traffic safety for all participants).

One of the main goals of installing traffic calming measures – especially the physical ones – is to reduce speed of motor vehicles. With lower vehicles speed we normally achieve traffic accident reduction; the number of traffic accidents and their consequences, especially when a vehicle/pedestrian (cyclist) is involved, lowers.

According to NTF - The Swedish National Society for Road Safety policy [1] we could say, that if the average speed on a road is changed by x per cent, the number of accidents changes by twice x per cent, the number of injured by three times x per cent and the number of people killed by four times x per cent. Therefore, if we reduce the average speed for 10%, we could say that we will have 20% less traffic accidents in which there will be 30% less injured people and 40% less death casualties.

Similarly, we could say also for traffic calming measures: as much as we reduce the speed of the motor vehicles as better results we could get from the traffic safety point of view. But this does not work always and everywhere, there could be some exceptions as well.

2. TRAFFIC CALMING DEVICES AND MEASURES AT THE BEGINNING OF THE SETTLEMENTS

2.1. "Optical breaks, optical obstacles" (rumble strips)

Optical breaks (Fig. 1) or optical obstacles (in some countries they called them "rumble strips" [2]) are the so-called "mild" measures (slightly raised strips of different colored surfacing (normally white) set across the width of the driving lane). The appearance and feel of the strips is intended to cause drivers to reduce their speed. Normally they are used before areas with speed limits (for example, at the beginning of the settlements) and are laying in non-equal distances perpendicular to the driving direction. They are normally forty centimeters wide.



Fig. 1. Optical breaks (rumble strips) before intersection (Murska Sobota)

2.2. Central islands ("midblocks medians")

One of the traffic calming measures are also raised traffic islands which are located along the centerline of road or street (Fig. 2). They could be combined with lane narrowing. Center islands are sometimes called midblock medians, median slow points or median chokers. Center islands on the roads and in the streets of cities (settlements etc.) are often likable landscaped. They provide visual amenity and also neighborhood identity. As one of the important traffic calming measures center islands could also help to make our roads and streets more "pedestrian friendly"; they work very well when they are combined with crosswalks (center island represents a mid-point refuge for pedestrian crossings). Like I already mentioned before, center islands could be also used on wide streets to narrow travel lines. In Slovenian roads and streets center islands as traffic calming measure are used above all:

- at the beginning of cities and settlements; the drivers are warned that they should reduce their speed to the limited value;
- at cities/settlements; pedestrian protection at crosswalks prevents prohibited vehicle maneuver, etc.



Fig. 2. Central island (Cerklje ob Krki)

The advantage of central islands is that if they are well designed such a center island narrowing increases pedestrian safety. They can also have positive aesthetic value and they reduce traffic volumes. The disadvantage is that the speed-reduction effect is somewhat limited and they may require elimination of some on-street parking. There has also been some specific research about central islands as traffic calming measures in Slovenia [3, 4].

3. TRAFFIC CALMING DEVICES AND MEASURES ON THE ROAD SECTIONS INSIDE SETTLEMENT

Traffic calming measures on road sections are widely used in Slovenia. Mostly traffic calming measures represent speed humps (different shapes, sizes), speed tables, roadway narrowing, central islands, deviation of road axe etc.

3.1. Speed humps ("speed bumps")

Speed humps (some call them also "speed bumps", Fig. 3) are round raised areas placed across the roadway. The profile of a speed hump can be circular, parabolic, or sinusoidal. Speed humps are good for locations where very low speed is desired and reasonable, and noise and fumes are not of a major concern [5].

The advantages of speed humps are that they are relatively inexpensive and easy for bicycles to cross if designed appropriately and they are very effective in slowing travel speed. They have several disadvantages as well: they cause a "rough ride" for all drivers, they force large vehicles, such as emergency vehicles and those with rigid suspensions, to travel at slower speed, they may increase noise and air pollution and they have questionable aesthetics.



Fig. 3. Speed humps (Izola)

3.2. Trapezoidal humps, speed platforms ("speed tables")

Trapezoidal humps (Fig. 4) are flat-topped speed humps that are often constructed with brick / stone or other textured materials on the flat section. Speed tables are usually long enough for placing the entire pedestrian crossing. Their long flat fields give speed tables higher design speed than speed humps. Speed tables are also good for locations where low speed is desired but a somewhat smooth ride is needed [5].



Fig. 4. Speed platform (Rače)

The advantages of speed platforms are: they are smoother than speed humps and very effective in speed reduction. But they have questionable aesthetics, especially if no textured materials are used, textured materials can be expensive and trapezoidal humps may increase noise and air pollution [5].

3.3. Roadway narrowing

One of the traffic calming measure, which is not widely spread on Slovenian roads is roadway narrowing (Fig. 5). Roadway narrowing could be done from one side or from the both side of the road.



Fig. 5. Roadway narrowing (Maribor)

4. TRAFFIC CALMING DEVICES AND MEASURES AT THE INTERSECTIONS INSIDE SETTLEMENT

Traffic calming measures could be used also at level non-signalised intersections. Despite the fact that we already have some experiences with that kind of traffic calming measures we must admit, that those measures are not widely known.

4.1. Raised intersections

Raised intersections (Fig. 6) are flat raised areas covering the entire intersection, with ramps on all approaches and often with brick or other textured materials on the flat section. They are usually raised to the level of the sidewalk. By modifying the level of the intersection the crosswalks are more readily

perceived by motorists to be "pedestrian territory". Raised intersections are good for areas where other traffic calming measures would be unacceptable [5].



Fig. 6. Raised intersection (Maribor)

The advantages of raised intersections are: they improve safety for pedestrians and vehicles, they can have positive aesthetic value and they can calm two streets at the same time. On the other hand they tend to be expensive, depending on the materials used, and they are less effective in reducing speed [5].

4.2. Small roundabouts (one-lane roundabouts, mini roundabouts)

Small roundabouts (one-lane roundabouts (Fig. 7) or mini roundabouts (Fig. 8)) are usually located in areas with a "history of accidents", in intersections where queues need to be minimized and in intersections with irregular approach geometry, where there is a high proportion of U-turns, and also on locations with abundant right-of-way.



Fig. 7. One-lane roundabout (Maribor)

Roundabouts can moderate traffic speed on an arterial, they are generally aesthetically pleasing, they enhance safety compared to traffic signals, they can minimize queuing at the approaches to the intersection and they are less expensive to operate with than traffic signals. These are the advantages of roundabouts but on the other hand they may be difficult for large vehicles, they must be designed so that the circulating lane does not encroach on the crosswalks and they may require the elimination of some on-street parking [5].



Fig. 8. Mini roundabout (Sl. Bistrica)

5. EFFECTIVENESS OF TRAFFIC CALMING MEASURES IN SLOVENIA

In the past we already observed effectiveness of traffic calming measures on Slovenian roads. For example, in year 2005 we collaborate at research on national level [6]. We could point out effect of different traffic calming measures on driving speeds (results were already published [7]). One of the aims of the already mentioned research [6], which was done in Slovenia (from 2003 to 2005), was also to define real effect of speed reduction on different types of traffic calming measures across Slovenia. In research we selected 32 "typical" locations in Slovenia, where six different types of traffic calming measures appear. The main aim of this part of the research was to establish the effectiveness of different types of traffic calming measures. For this purpose hidden speed measurements with laser measurement instrument *Riegl LR90-235/P* were used (Fig. 9). At that time we also performed measurements of some other dimensions (e.g. precise dimensions of traffic calming device, dimensions of road elements and its surroundings, traffic counting, a questionnaire etc.). In the Table 1 we present main findings from our research.



Fig. 9. Laser measurement instrument Riegl LR90-235/P

Table 1: Results of hidden speed measurement at different types of traffic calming measures

Type of traffic calming measure	Speed humps	Speed platforms	Raised intersections	Optical breaks	Central islands	One-lane roundabouts
Number of observed locations	3	5	4	6	5	3
Number of measurements	166	344	352	516	446	367
V_{max} [km/h]	35–39	28–44	29–43	59–93	61–96	45–50
V_{aver} [km/h]	16,8–24,5	15–22	16,2–22	42,5 – 60,6	43,7–66,1	24–26,9
V_{85} [km/h]	21–30,5	18,5–25,1	20,4–27,5	50,4–70,7	51,1–81,8	31,8–34,4
$V_{85 aver}$ [km/h]	27,03	22,6	23,4	58,43	60,9	32,77

6. CONCLUSION

In Slovenia we still have problems with speeding inside urban areas (settlements, cities). According to that there are still locations on our roads, where we need to reduce speeds of motor vehicles with physical measures. Based on foreign experience (Netherlands, Germany, Austria), we began to install traffic calming measures, especially over last 20 years. Over those years, we have found that identical measures may not have the same results - due to different mind-sets in different countries.

In the article are presented - most common - traffic calming measures, which we use in Slovenia at (a) beginning of the settlements, (b) at the road sections inside settlements and (c) at the intersections inside settlements.

7. REFERENCES

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