



РЕПУБЛИКА СРПСКА
МИНИСТАРСТВО САОБРАЋАЈА И ВЕЗА
АГЕНЦИЈА ЗА БЕЗБЈЕДНОСТ САОБРАЋАЈА

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Mjere za smirivanje saobraćaja



Univerza v Mariboru

Fakulteta za gradbeništvo,
prometno inženirstvo in arhitekturo

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-

Introduction

- ❑ Traffic calming generally represents a combination of different measures, which:
 - ❑ reduce negative influence of motorized traffic,
 - ❑ change style of behavior 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
-

Introduction

- ❑ 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
 - ❑ According to our law, *the traffic calming devices are physical, light or other devices and obstructions that (a) physically prevent the participants in road traffic to drive with inappropriate speed or (b) 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
-

Introduction

- ❑ 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 speeds we normally achieve traffic accident reduction; the number of traffic accidents and their consequences - especially when a vehicle/pedestrian (cyclist) is involved - are lower
-

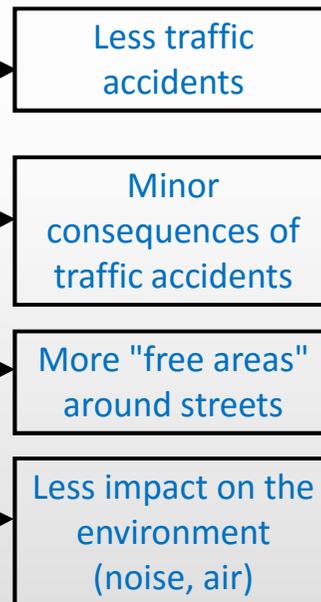
Why we need traffic calming?

□ What we would like, what are our benefits and our goals?

OUR WISHES..



OUR BENEFITS..



OUR GOALS..



Regulativa (Slovenija)

- ❑ Zakon o pravilih cestnega prometa, 46. člen
 - ❑ Zakon o cestah, 21. člen
 - ❑ Pravilnik o projektiranju cest, XV. VAROVANJE OKOLJA OB CESTI, 65. člen
 - ❑ Tehnična specifikacija TSC 03.800: 2009 Naprave in ukrepi za umirjanje prometa
 - ❑ Tehnična specifikacija TSC 02.203: 2009 Naprave in ukrepi za umirjanje prometa v nivojskih nesemaforiziranih križiščih
-

Postopek uvajanja umirjanja prometa

- Pobuda s strani večine "prizadetega" prebivalstva (ulica, območje ipd.)*
 - Presoja upravičenosti izvedbe ukrepov*
 - Izdelava strokovnega elaborata, ki vsebuje:*
 - ugotavljanje obstoječega stanja*
 - inventarizacija*
 - prometna varnost - prometne nesreče*
 - skrite meritve hitrosti motornih vozil*
 - izdelava več variantnih rešitev - predlogov*
 - predvideno "zaporedno" izvajanje ukrepov (od "blažjih" k "strožjim")*
 - Seznanitev prebivalcev z možnimi rešitvami*
 - Izvedba rešitev*
 - Spremljanje "učinkovitosti" rešitev*
-

Kriteriji - "vplivni faktorji"

- funkcija ceste (tranzitna, zbirna, dostopna)*
 - hitrost vožnje (V85, Vž, Vprev)*
 - prometni pogoji (PLDP, urna obremenitev)*
 - širina prometne površine*
 - avtobusni promet, kmetijska mehanizacija*
 - škodljive emisije*
 - hrupna obremenitev*
 - zamude intervencijskih vozil (gasilci, rešilec ...)*
 - vzdrževanje*
 - urbanistični pogoji in arhitekturno oblikovanje*
 - posledice - preusmeritve prometa itd.*
-

Vrste ukrepov in naprav za umirjanje prometa

- *1. Sistemski ukrepi,*
 - *2. Regulativni ukrepi,*
 - *3. Fizične naprave in ukrepi:*
 - *opozorilne naprave,*
 - *grbine in ploščadi,*
 - *zožitve vozišča in razmejitve smernih vozišč,*
 - *zamik osi smernih vozišč.*
-

Izbor ukrepov in naprav za umirjanje prometa

UKREP / kategorija LOKACIJA	Kategorija ceste											
	AC, HC			G1, G2			R1, R2			R3, RT, LC, JP		
	I	P	N	I	P	N	I	P	N	I	P	N
5.1												
5.2												
5.3.x	1	1	1	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
5.4.x								(1), (3)	(1), (3)		1,2, 3	1,2, 3
5.5.x					2.1, 2.1.1, 3	1.1, 1.4, 2.1, 2.1.1, 3		2.1, 2.1.1	1.1, 2.1, 2.1.1, 3		1.1, 1.4, 1.5, 2.1, 2.1.1	1.1, 2.1, 2.2, 3
5.6.x					3	3		3,4	3,4		3,4	3,4

Razpredelnica 1: Kategorije cest na katerih se sme uporabljati določene naprave in ukrepe za umirjanje prometa

UKREP / kategorija	Kategorija ceste				Območje s posebno prometno ureditvijo	
	LG	LZ	LK	JP	Območje omejene hitrosti	Območje umirjenega prometa
5.1						
5.2						
5.3.x	1, 2	1, 2	2			
5.4.x		(1), (3)	1, 3	1, 2, 3	1, 2, 3	
5.5.x		1.1, 1.4, 2.1, 2.2, 3	1.1, 1.4, 1.5, 2.1, 2.2, 3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3	
5.6.x	3	3, 4	1, 3, 4	1, 3, 4	1, 3, 4	2

Razpredelnica 2: Kategorije lokalnih cest v naselju na katerih se sme uporabljati določene naprave in ukrepe za umirjanje prometa

UKREP / hitrost	Hitrost (V ₈₅)			
	90 km/h	50 – 70 km/h	30 – 50 km/h	Do 5 km/h
5.1				
5.2				
5.3.x	1, 2	1, 2		
5.4.x		1	1, 2, 3	
5.5.x			1.1, 1.2, 1.3, 2.1, 2.1.1, 2.2, 3	
5.6.x		3	1, 2, 3, 4	2

Razpredelnica 3: Hitrost in dopustne naprave in ukrepi za umirjanje prometa.

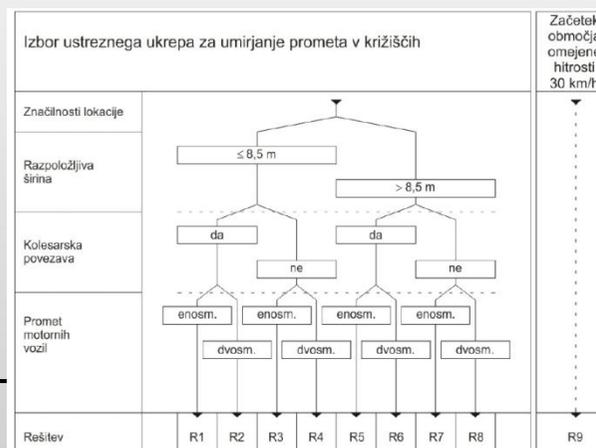
na vseh kategorijah cest in za vse hitrosti vožnje
 ().....v posebnih primerih (glej opise pri posameznih napravah in ukrepih)
 I.....zunaj naselja
 P.....na prehodu v naselje
 N.....v naselju

Kategorija ceste Vrsta ukrepa	Kategorija ceste											Območje s posebno prometno ureditvijo	
	G1	G2	R1	R2	R3	RT	LC	LG	LZ	LK	JP	Območje omejene hitrosti	Območje umirjenega prometa
7.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7.3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7.4							✓				✓	✓	✓
7.5											✓	✓	✓
7.6.x							1, 3				1, 2, 3, 4	1, 2, 3, 4	2, 5
7.7.x					2	2	1, 2		1, 2		1, 2	1, 2	
7.8											✓	✓	✓
7.9											✓	✓	✓

Razpredelnica 1: Kategorije cest v naselju, na katerih se sme uporabljati določene naprave in ukrepe za umirjanje prometa v križiščih

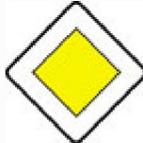
Vrsta ukrepa	Hitrost	Hitrost V ₈₅ po [km/h]			
		od vklj. 50 do 70	od vklj. 30 do 50	od vklj. 10 do 30	do 10
7.1		✓	✓	✓	✓
7.2		✓	✓	✓	✓
7.3		✓			
7.4				✓	
7.5				✓	✓
7.6.x			1,2,3,4	1,2,3,4	2,5
7.7.x		2	1,2	1	
7.8			✓	2	
7.9			✓	✓	✓

Razpredelnica 2: Hitrost vožnje in dopustne naprave in ukrepi za umirjanje prometa v križiščih znotraj naselja



Slika 1: Diagram za izbor ustreznega ukrepa za umirjanje prometa v križiščih

Sistemski ukrepi

- ❑ določeni so s prometno ureditvijo, ki jo za cesto ali njen del oz. za naselje in njegov del določi upravljavec ceste
- ❑ prometna ureditev obsega:
 - ❑ določanje prednostnih smeri ter sistema in načina vodenja prometa, 
 - ❑ omejitve uporabe ceste glede na vrsto prometa, 
 - ❑ omejitve hitrosti, 
 - ❑ ureditev mirujočega prometa, 
 - ❑ določanje območij umirjenega prometa, območij omejene hitrosti in območji za pešce



III-33



III-34



III-29



III-30

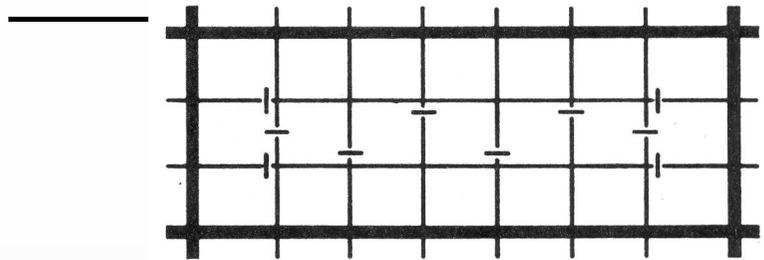


III-31

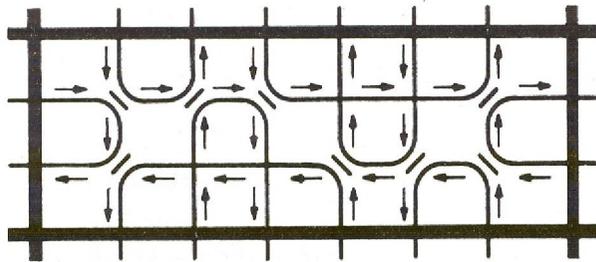


III-32

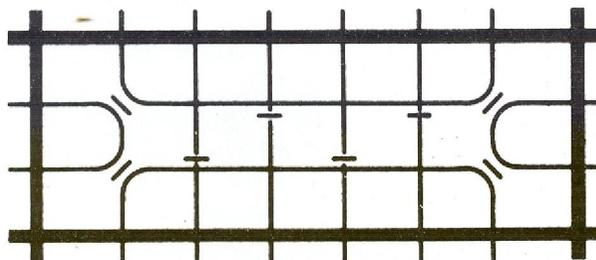
Sistemski ukrepi



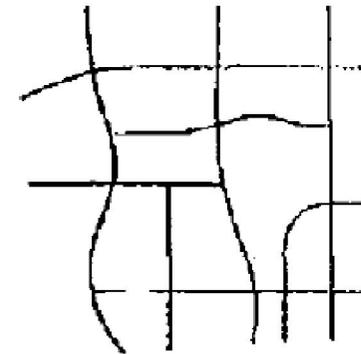
Slika 56: a) Sistem slepih ulic, ki onemogoča tranzitni promet ter hkrati zagotavlja varnost na kratkih povezovalnih ulicah



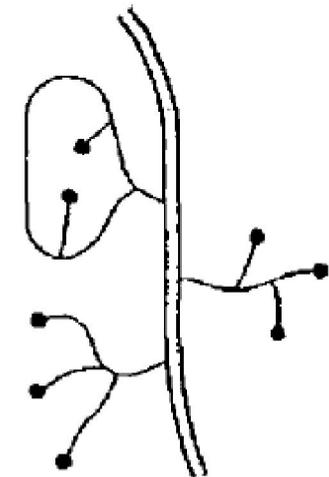
b) Sistem enosmernih ulic v obliki zank



c) Kombinacija slepih ulic, zank in diagonalnih zapor



Slika 1: Tradicionalno cestno omrežje

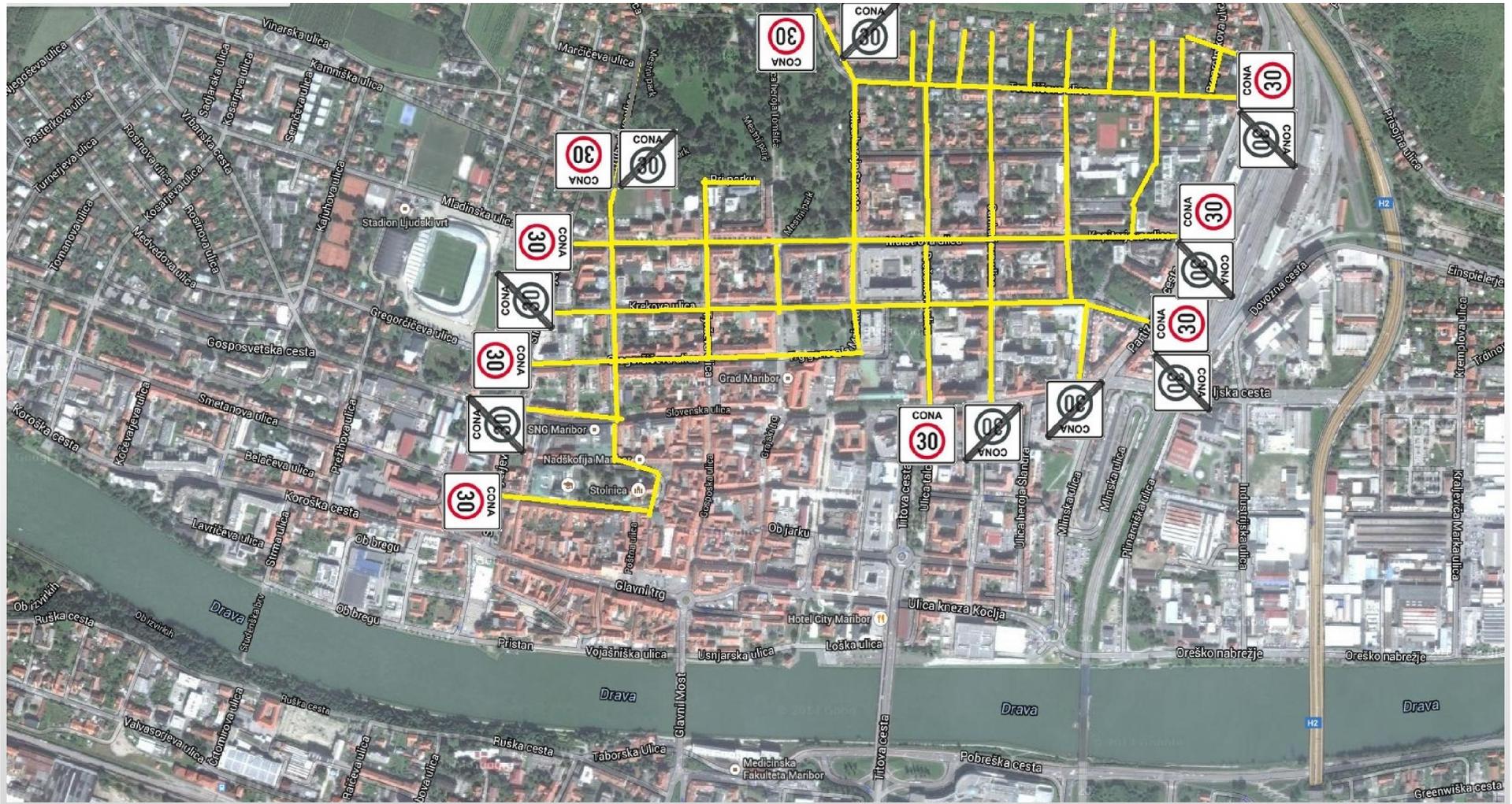


Slika 2: Sodobno cestno omrežje

Regulativni ukrepi

- Predstavljajo niz prometnih pravil, ki jih definira ZVCP.*
 - V naravi se odražajo s postavitvijo ustrezne prometne signalizacije*
 - Ti ukrepi nimajo posebnega vpliva na umirjanje prometa oz. je njihov vpliv omejen*
 - Z njimi se jasno definirajo pravila za cesto ali njen del oz. naselje in njegov del*
-

Sistemski / Regulatorivni ukrepi



Traffic calming measures in settlements

- A) At the beginning of the settlements
- B) On the road sections
- C) At the intersections



A) Traffic calming measures at the beginning of the settlements

❑ "Optical breaks":

- ❑ 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.



A) Traffic calming measures at the beginning of the settlements

❑ "Central islands":

- ❑ Raised traffic islands located along the centerline of road / street
- ❑ They could be combined with lane narrowing
- ❑ They could be likable landscaped - to provide visual amenity and neighborhood identity
- ❑ They could also help to make our roads and streets more "pedestrian friendly" - they work very well when they are combined with crosswalks
- ❑ 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, ..



A) Traffic calming measures at the beginning of the settlements

□ "Central islands"



B) Traffic calming measures on the road sections inside the settlements

□ "Re-arrange the road / different road elements":



B) Traffic calming measures on the road sections inside the settlements

❑ "Speed humps / "Speed bumps":

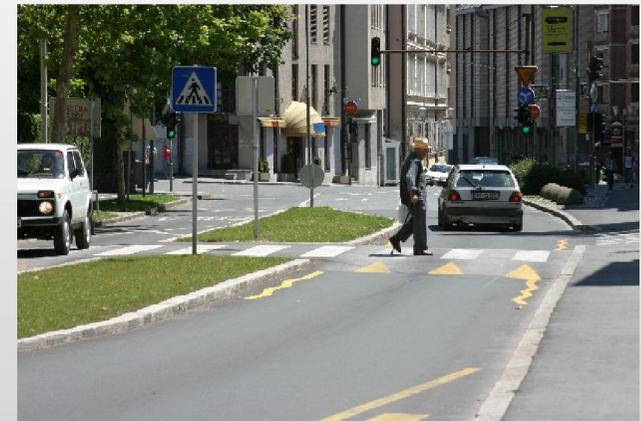
- ❑ They are round raised areas placed across the roadway,
- ❑ The profile of a speed hump can be circular, parabolic, or sinusoidal,
- ❑ Speed humps are good for locations where very low speed is desired and reasonable, and noise and fumes are not of a major concern
- ❑ The advantages of speed humps are that they are relatively inexpensive,
- ❑ They are very effective in slowing travel speed,
- ❑ But, 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.



B) Traffic calming measures on the road sections inside the settlements

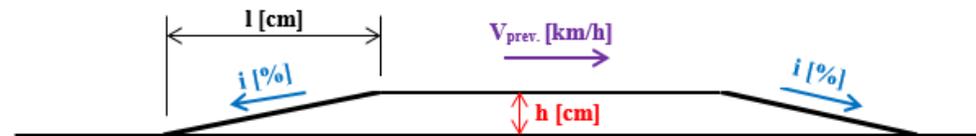
❑ "Trapezoidal humps" / "Speed platforms" / "Speed tables":

- ❑ They 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,
- ❑ The advantages of speed platforms are:
 - ❑ they are smoother than speed humps and
 - ❑ very effective in speed reduction.



B) Traffic calming measures on the road sections inside the settlements

□ "Trapezoidal humps" / "Speed platforms" / "Speed tables"



$V_{prev.}$ [km/h]	20	25	30	35	40	45	50	55	60
i [%]	15	12,5	10	7,5	5	3,75	2,5	2,25	2
h [cm]	Dolžina rampe l [cm]								
5	33,3	40,0	50,0	66,7	100,0	133,3	200,0	222,2	250,0
6	40,0	48,0	60,0	80,0	120,0	160,0	240,0	266,7	300,0
7	46,7	56,0	70,0	93,3	140,0	186,7	280,0	311,1	350,0
8	53,3	64,0	80,0	106,7	160,0	213,3	320,0	355,6	400,0
9	60,0	72,0	90,0	120,0	180,0	240,0	360,0	400,0	450,0
10	66,7	80,0	100,0	133,3	200,0	266,7	400,0	444,4	500,0
11	73,3	88,0	110,0	146,7	220,0	293,3	440,0	488,9	550,0
12	80,0	96,0	120,0	160,0	240,0	320,0	480,0	533,3	600,0
13	86,7	104,0	130,0	173,3	260,0	346,7	520,0	577,8	650,0
14	93,3	112,0	140,0	186,7	280,0	373,3	560,0	622,2	700,0
15	100,0	120,0	150,0	200,0	300,0	400,0	600,0	666,7	750,0
16	106,7	128,0	160,0	213,3	320,0	426,7	640,0	711,1	800,0
17	113,3	136,0	170,0	226,7	340,0	453,3	680,0	755,6	850,0
18	120,0	144,0	180,0	240,0	360,0	480,0	720,0	800,0	900,0
19	126,7	152,0	190,0	253,3	380,0	506,7	760,0	844,4	950,0
20	133,3	160,0	200,0	266,7	400,0	533,3	800,0	888,9	1000,0
21	140,0	168,0	210,0	280,0	420,0	560,0	840,0	933,3	1050,0
22	146,7	176,0	220,0	293,3	440,0	586,7	880,0	977,8	1100,0
23	153,3	184,0	230,0	306,7	460,0	613,3	920,0	1022,2	1150,0
24	160,0	192,0	240,0	320,0	480,0	640,0	960,0	1066,7	1200,0
25	166,7	200,0	250,0	333,3	500,0	666,7	1000,0	1111,1	1250,0

B) Traffic calming measures on the road sections inside the settlements

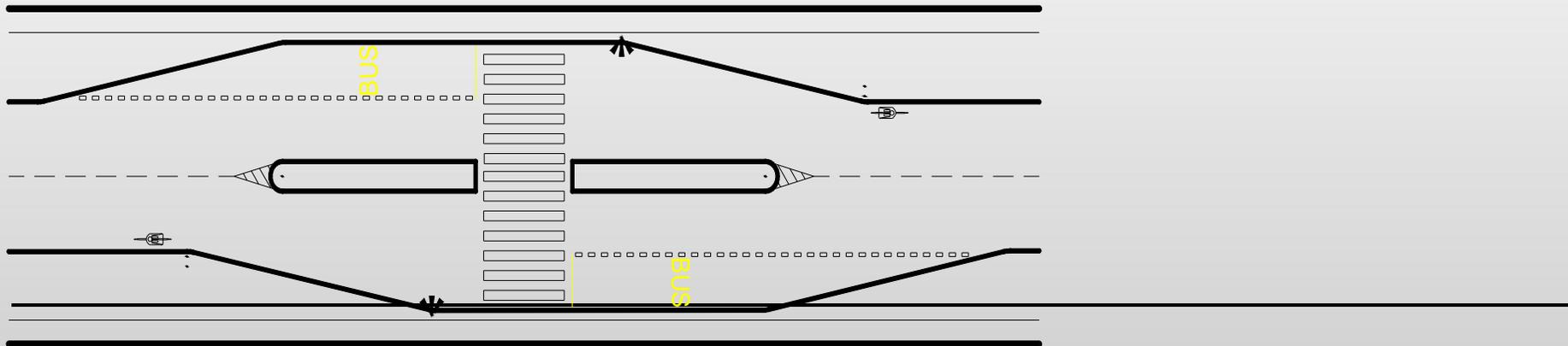
"Roadway narrowing":

- Roadway narrowing is not (currently) widely spread on Slovenian roads,
- It could be done from one side or from the both side of the road.



B) Traffic calming measures on the road sections inside the settlements

□ "Roadway narrowing"



B) Traffic calming measures on the road sections inside the settlements

□ "Chicane"



C) Traffic calming measures at the intersections inside the settlements

□ "Raised intersection":

- They 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
- 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.



C) Traffic calming measures at the intersections inside the settlements

"Realigned / modified intersection":

- Realigned intersections means changes in alignment
- Often convert T-intersections with straight approaches into curving streets
- They are one of the few traffic calming measures for T-intersections
- Realigned Intersections can be effective reducing speeds and improving safety at T-intersection



C) Traffic calming measures at the intersections inside the settlements

□ "Small roundabouts (one-lane roundabouts, mini roundabouts)":

- They 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.
- 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.



Effectiveness of traffic calming measures in slovenia

- ❑ In the past we already observed effectiveness of traffic calming measures on Slovenian roads,
- ❑ One of the aims of the research, 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,
- ❑ 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,
- ❑ We preform hidden speed measurements with laser measurement instrument Riegl LR90-235/P were used,
- ❑ 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.).



Effectiveness of traffic calming measures in slovenia

□ 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
$V_{85 \text{ aver}}$ [km/h]	27,03	22,6	23,4	58,43	60,9	32,77

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.
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provjerivače bezbednosti saobraćaja
Banja Luka, 16.09.2016**

ХВАЛА НА ПАЖЊИ!

16.09.2016, Бања Лука