SOUTH EAST EUROPE
Transnational Cooperation Programme

ROSEE
ROad safety in South East European regions

Programme co-funded by the EUROPEAN UNION

Univerza v Ljubljani

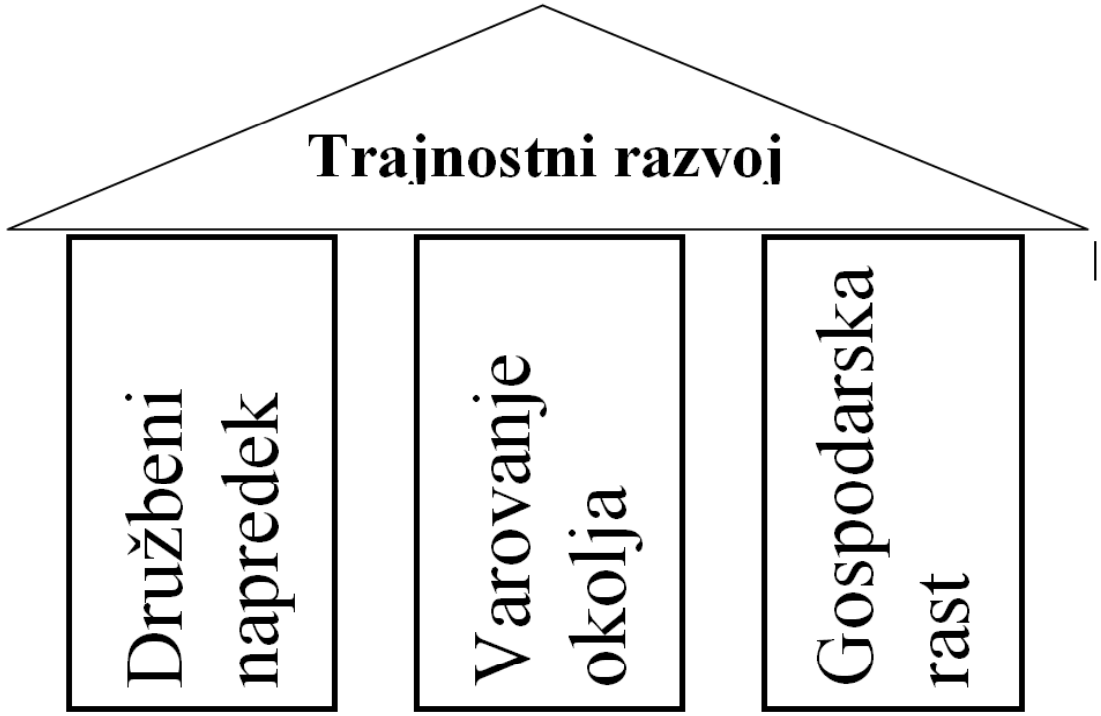
RSA/RSI Začetni - uvodni tečaj

2. Trajnostno projektiranje cest

PP8/WP4 vodja UL FGG-PTI

Trajnostno projektiranje cest

	Osnove
	Prečni prerez
	Križišča
	Projektiranje trase
	Umirjanje prometa
	Kolesarska infrastruktura
	Površine za pešce



Trije stebri trajnostnega razvoja (W.M. Adams, The Future of Sustainability)

Osnovni varnostni koncept

“človeški faktor bo vedno prisoten”

Zakaj je potrebno projektirati ceste, ki odpuščajo napake voznikov?
Ker je znano naslednje statistično dejstvo:

15% voznikov je tako ali drugače drogiranih
30% voznikov je utrujenih
nekateri od njih ne vidijo dobro
90% jih ni skoncentrirano na vožnjo

System designers are responsible for the design, operation and use of the road system and thus the level of safety in the entire system

Road users are responsible for following the rules for using the road system set by the system designers

If the users fail to comply with these rules due to a lack of knowledge, acceptance or ability…..

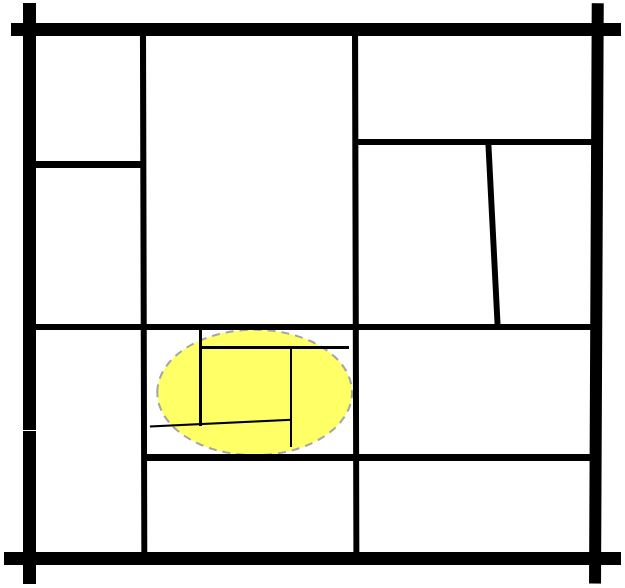
system designers are responsible for taking the necessary further steps to counteract people being killed or injured

Funkcionalna klasifikacija

(6) Prometno funkcijo ceste lahko zagotavljajo posamezne vrste ceste, kot je določeno v naslednji preglednici:

Funkcija ceste	Oznaka	Vrsta ceste	Oznaka
Daljinska cesta	DC	avtocesta, hitra cesta, glavna cesta	AC, HC, GC
Povezovalna cesta	PC	glavna cesta, regionalna cesta	GC, RC
Zbirna cesta	ZC	regionalna cesta, lokalna cesta	RC, LC
Dostopna cesta	DP	lokalna cesta, javna pot	LC, LP

Kategorizacija – klasifikacija – v urbanem okolju



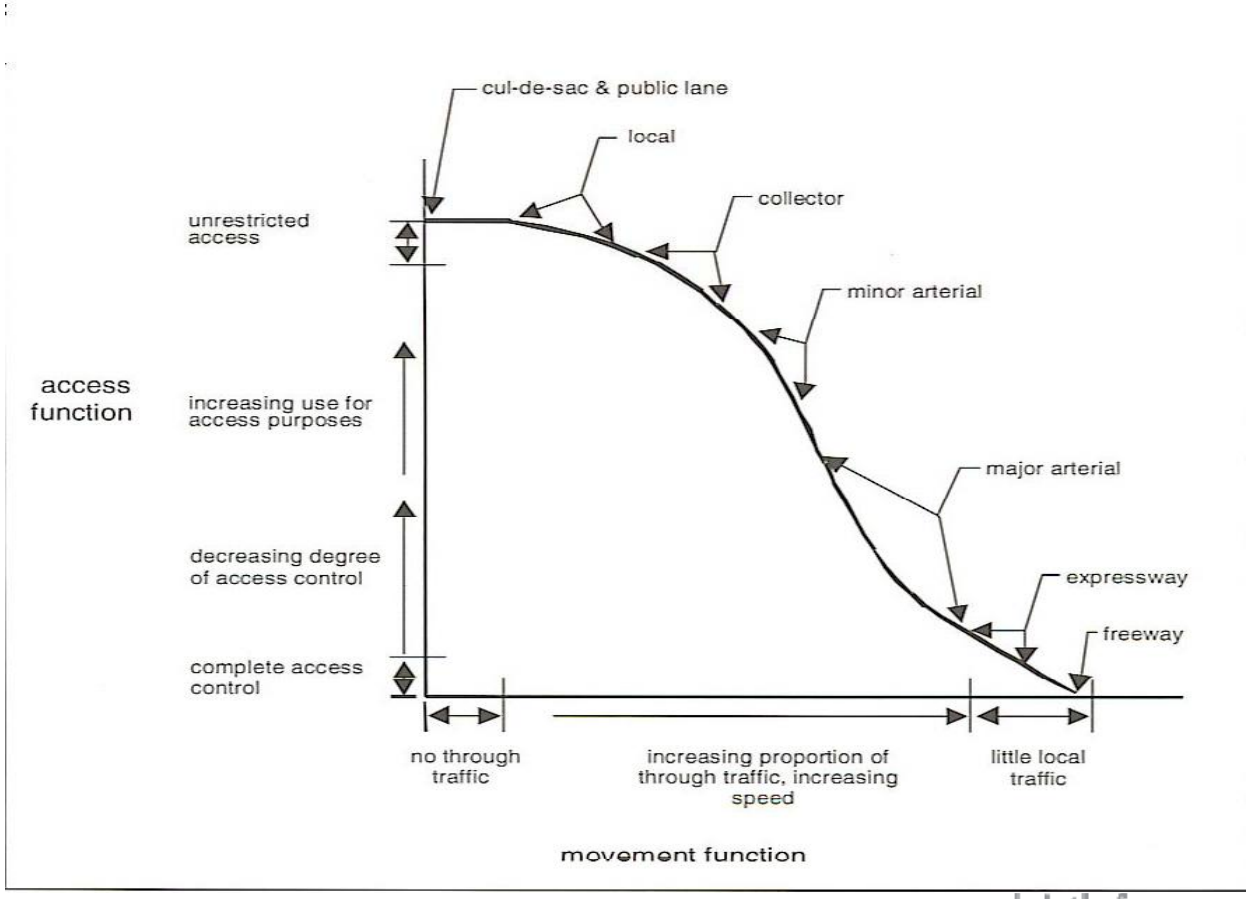
Tranzitnost

Distribucija

Dostop

Stanovanjska soseska

Funkcionalna klasifikacija cest - ZDA



AC

H1 Vipava

G1 Mislinja

G2 Male Lašče

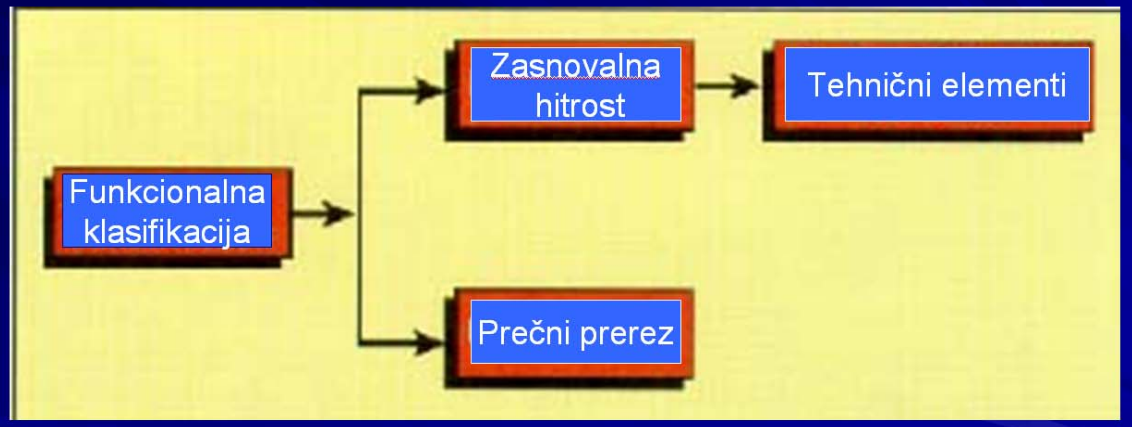
R1 cesta Poljčane

R2 Gederovci

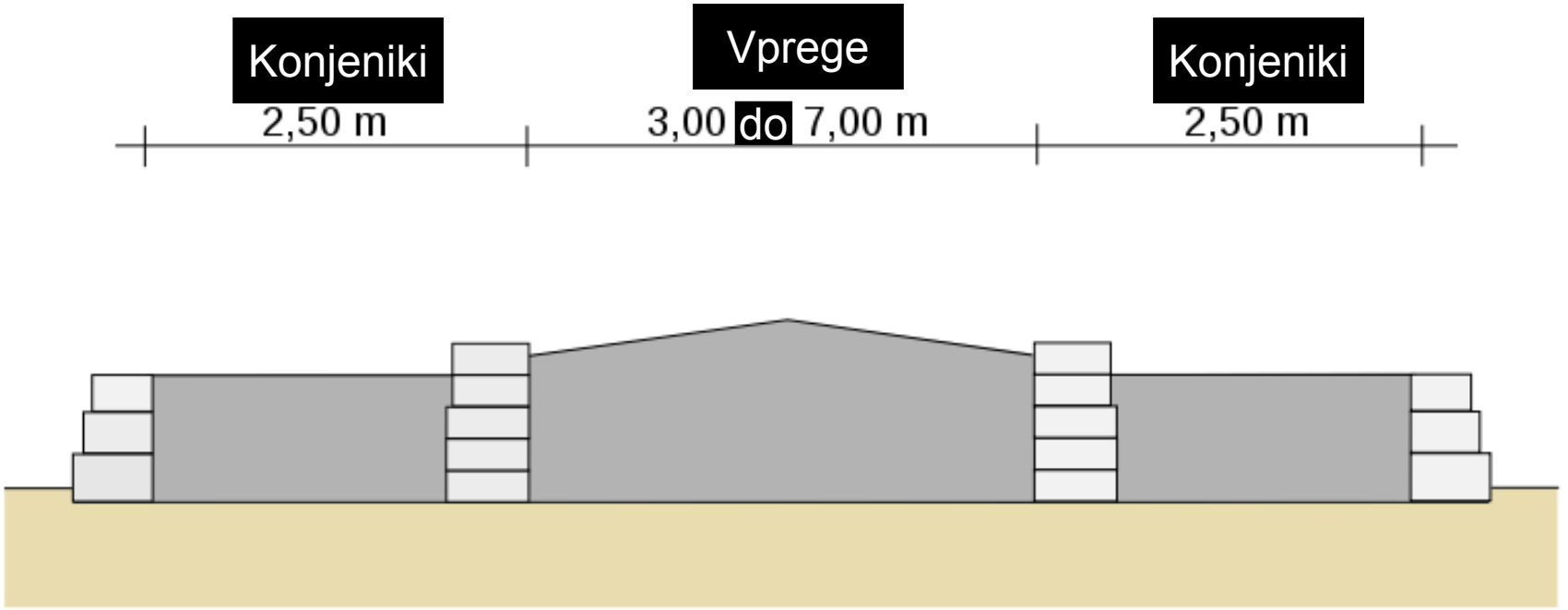
R3 Poljčane

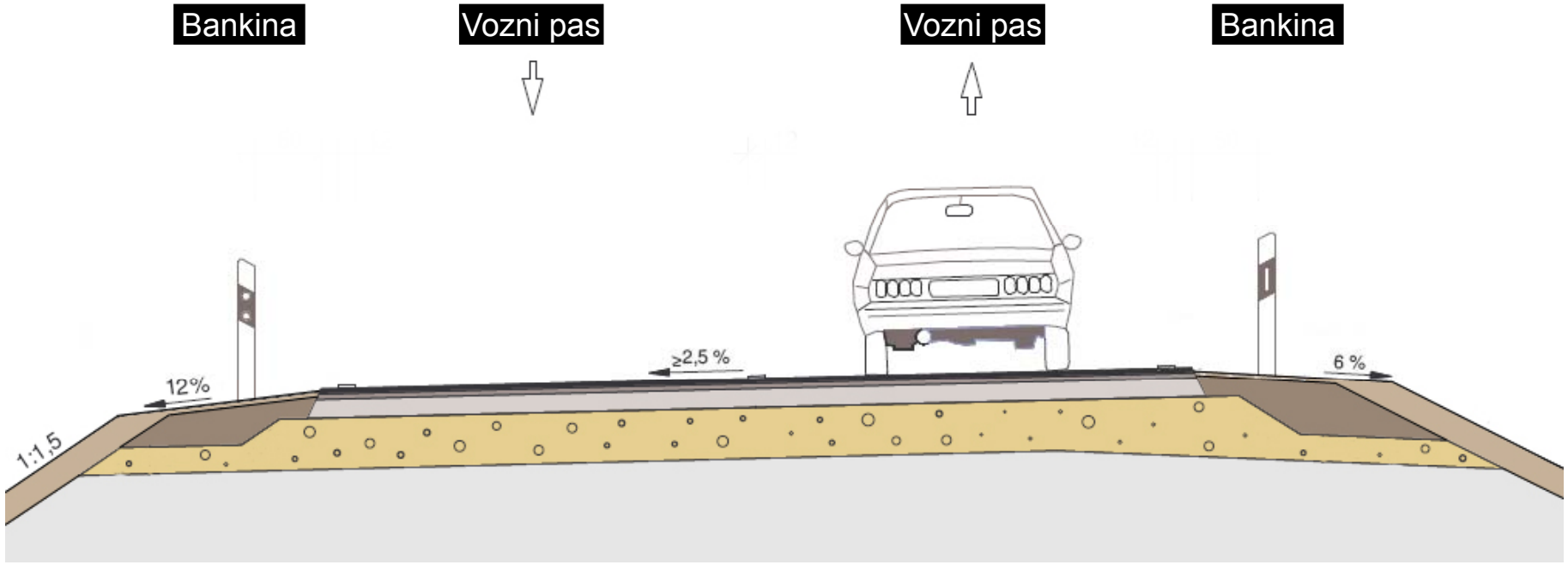
Lokalna cesta LC

Kaj sledi iz klasifikacije

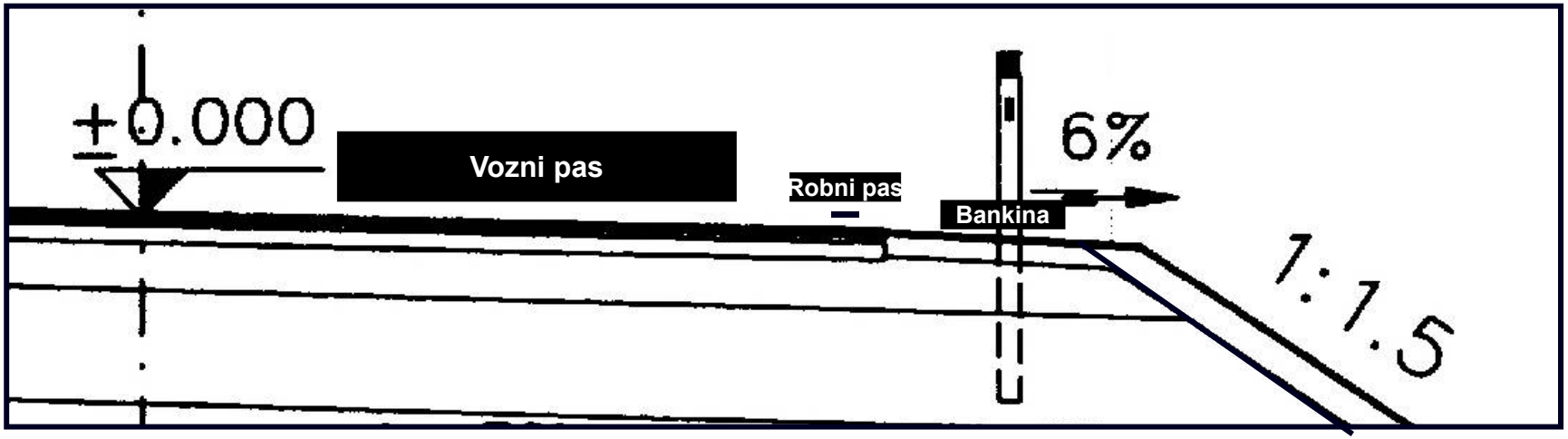


Prečni prerez - Rimska cesta




Bankina
Vozni pas
Vozni pas
Bankina
12%
≥2,5 %
6 %
1:1,5

Določitev dimenzij posameznim elementom prečnega prereza



Širina voznih pasov

Pravilnik o projektiranju cest (UL RS 91/2005)

Projektna hitrost (km/h)	≤50	60	70	80	90	100	110	120	130
Funkcija ceste	Širina voznega pasu (m)								
Daljinska cesta	–	–	3,25	3,25	3,50	3,50	3,50	3,75	3,75
Povezovalna cesta	–	2,75	3,00	3,25	3,50	–	–	–	–
Zbirna cesta	2,50	2,75	3,00	–	–	–	–	–	–
Dostopna cesta	2,50	2,75	–	–	–	–	–	–	–

Robni pas

Širina voznega pasu (m)	2,50–3,25	3,50–3,75
Širina robnega pasu (m)	0,25	0,50

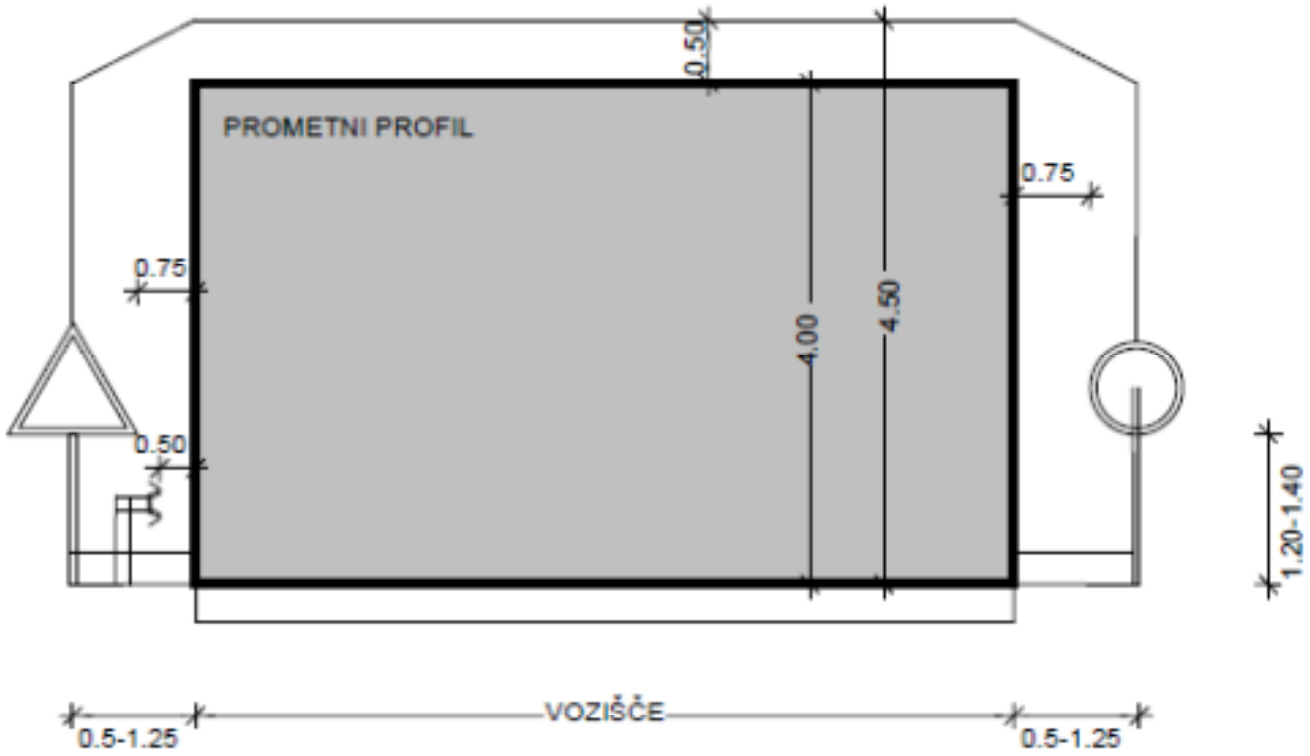
Bankina

(2) Minimalna širina bankine je določena s širino voznega pasu, kot je razvidno iz naslednje preglednice:

Širina voznega pasu	Do 2,50 m	2,50–3,00 m	3,25 m	3,50–3,75 m
Širina bankine	0,75 m	1,00 m	1,25 m	1,50 m

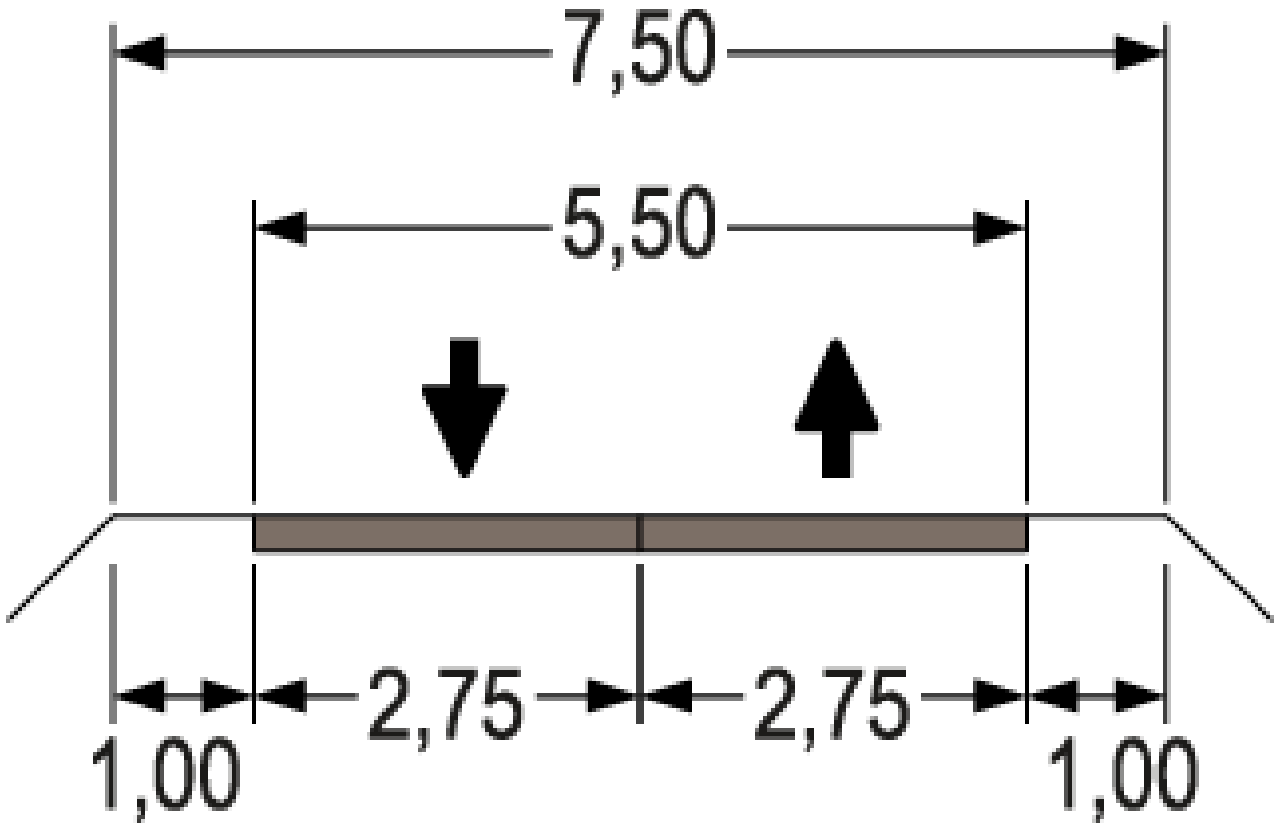
Prosti in prometni profil

Slika 1: Prometni in prosti profil zunaj naselja

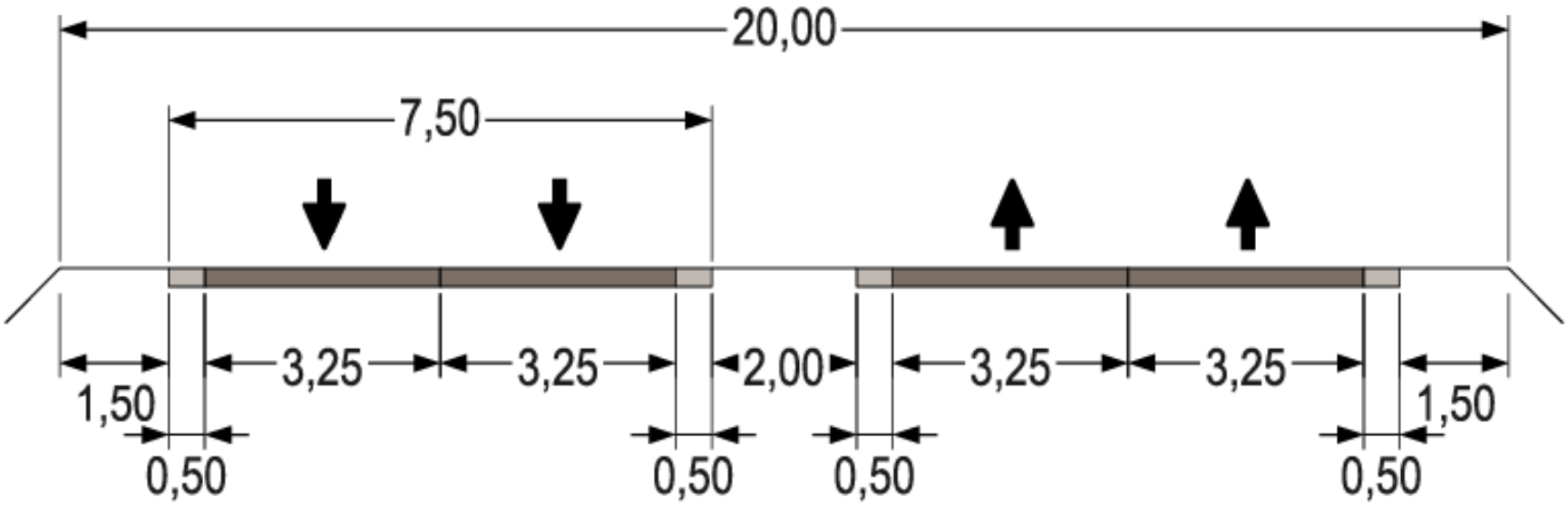


Poleg prostora za gibanje vozil (**prometni profil**) je treba na cestah zagotoviti dodaten zračni prostor (**prosti ali svetli profil**), ki je definiran z zaščitno višino in širino. V ta prostor ne smejo biti umeščene niti ne smejo segati stalne nepomične ovire.

Dvopasovna cesta - primer iz Nemčije



Štiripasovnica



Oblikovanje obcestja

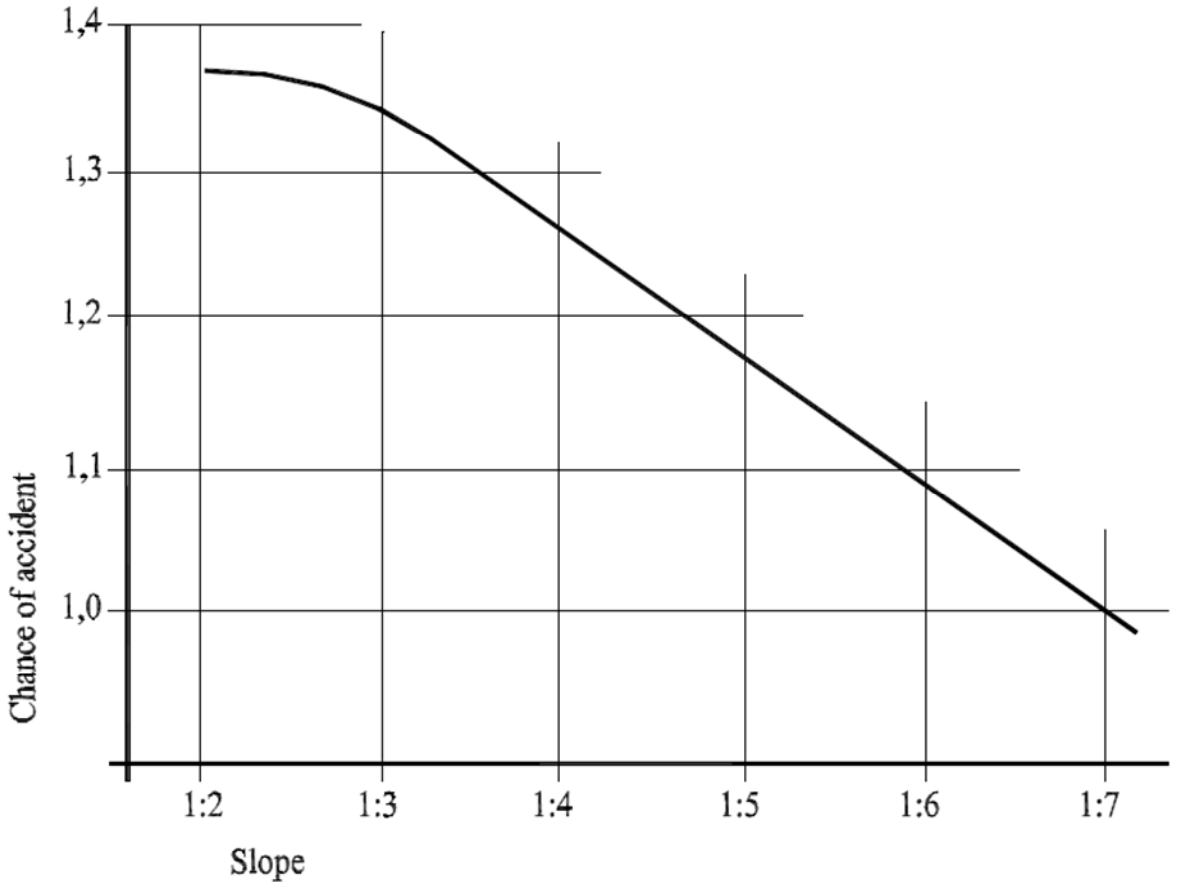
Prosta cona ob cesti

	120 km/h	80 km/h	**60 km/h**
optimum	13,0 m	6,0 m	2,5 m
minimum	10,0 m	4,5 m	1,5 m

Road edge design

Rumble strip

Stopnja nesreč v odvisnosti od nagiba brežin



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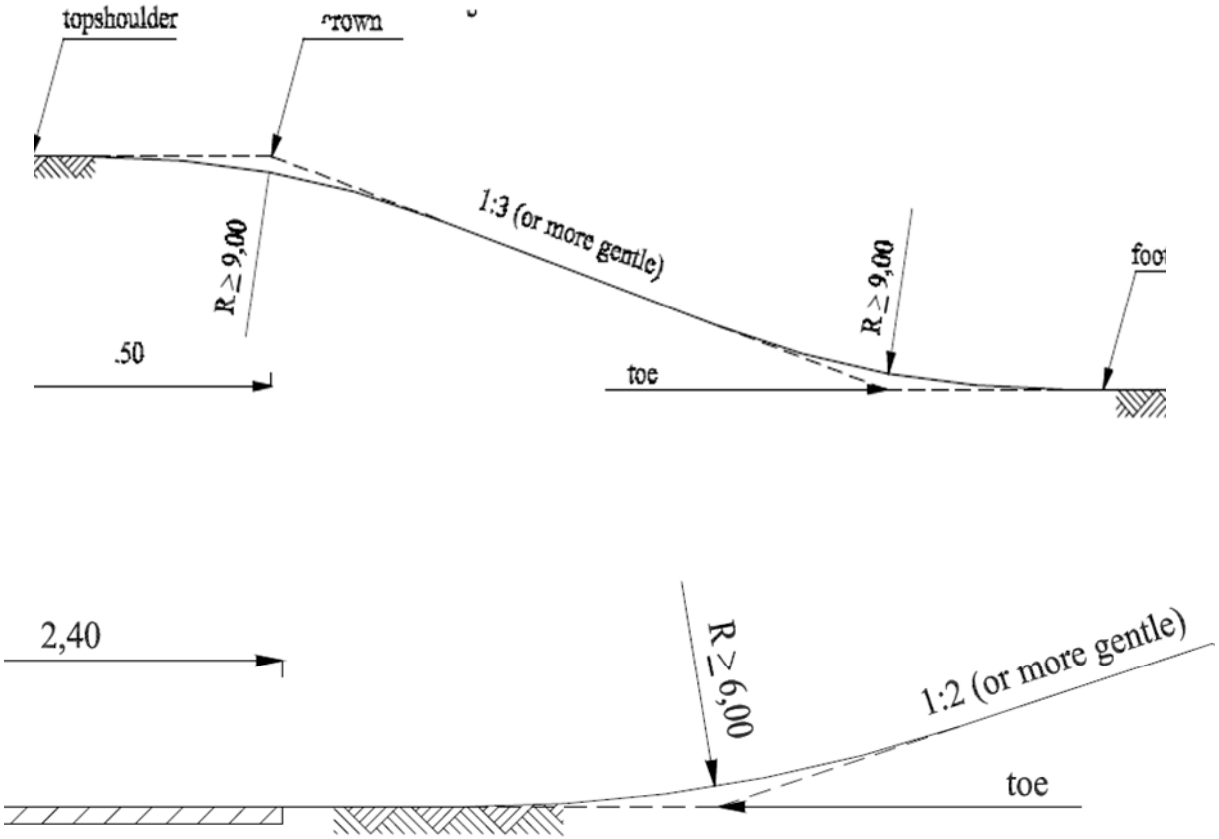
Oblikovanje brežin



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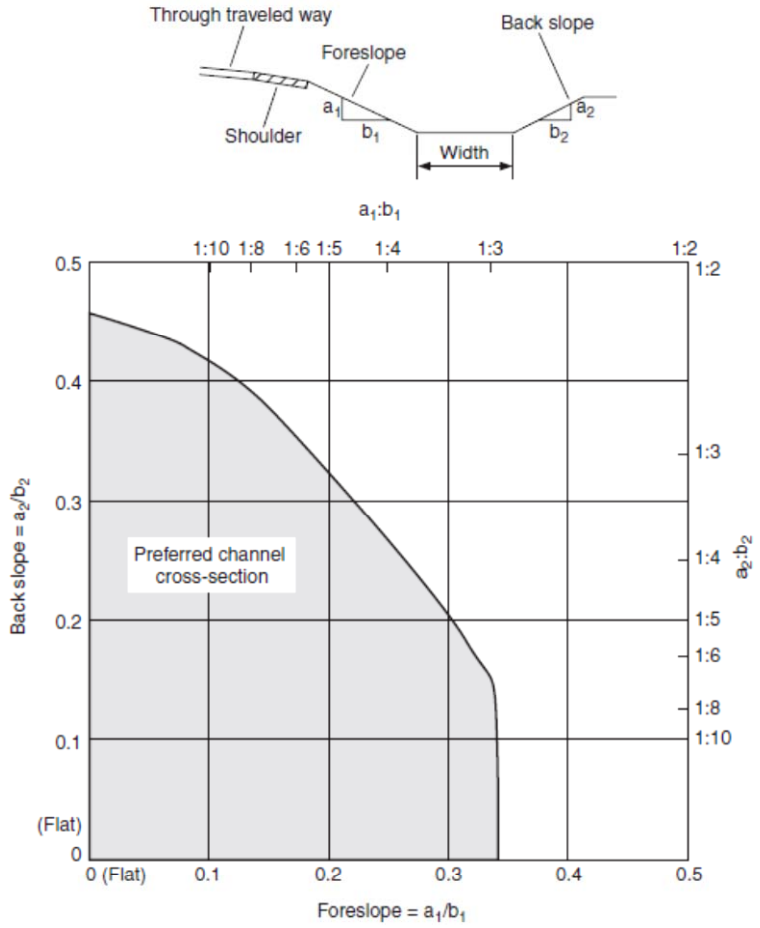
Oblikovanje odvodnih jarkov



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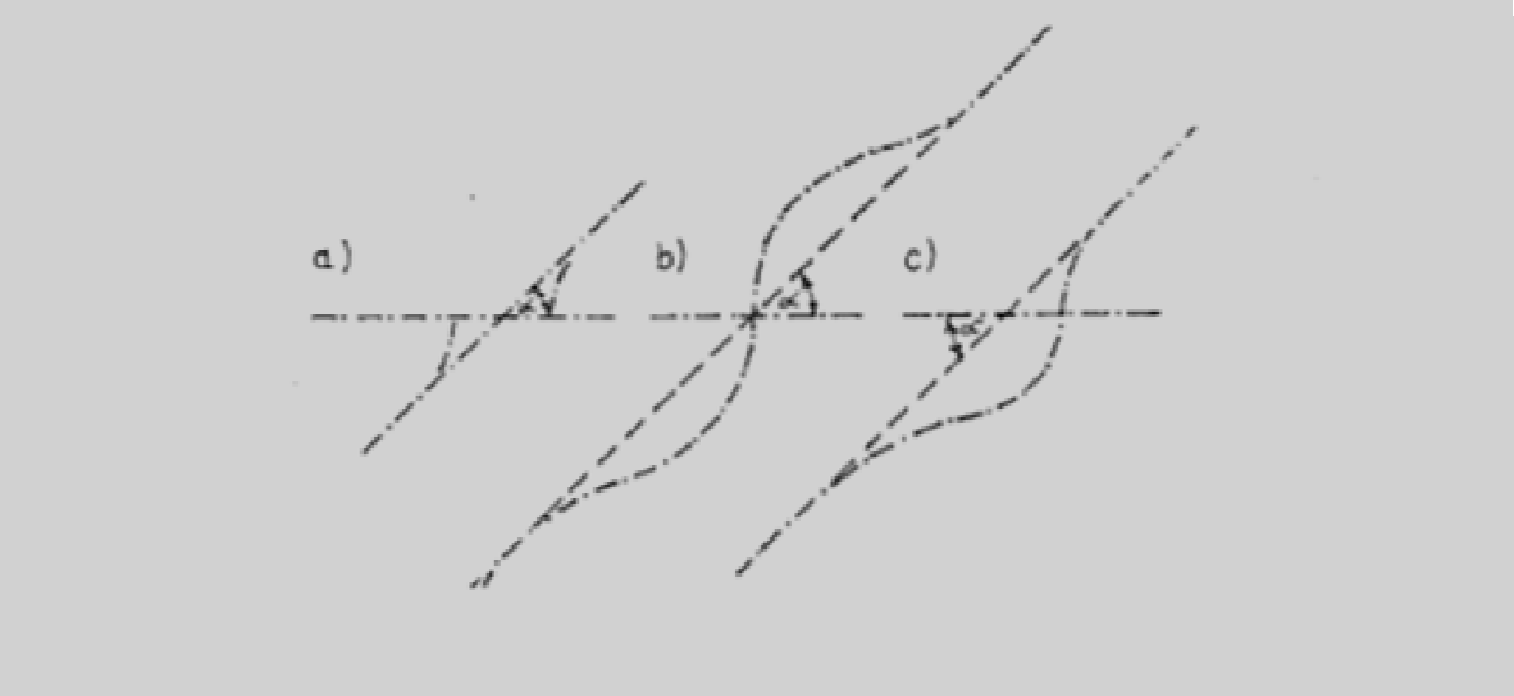
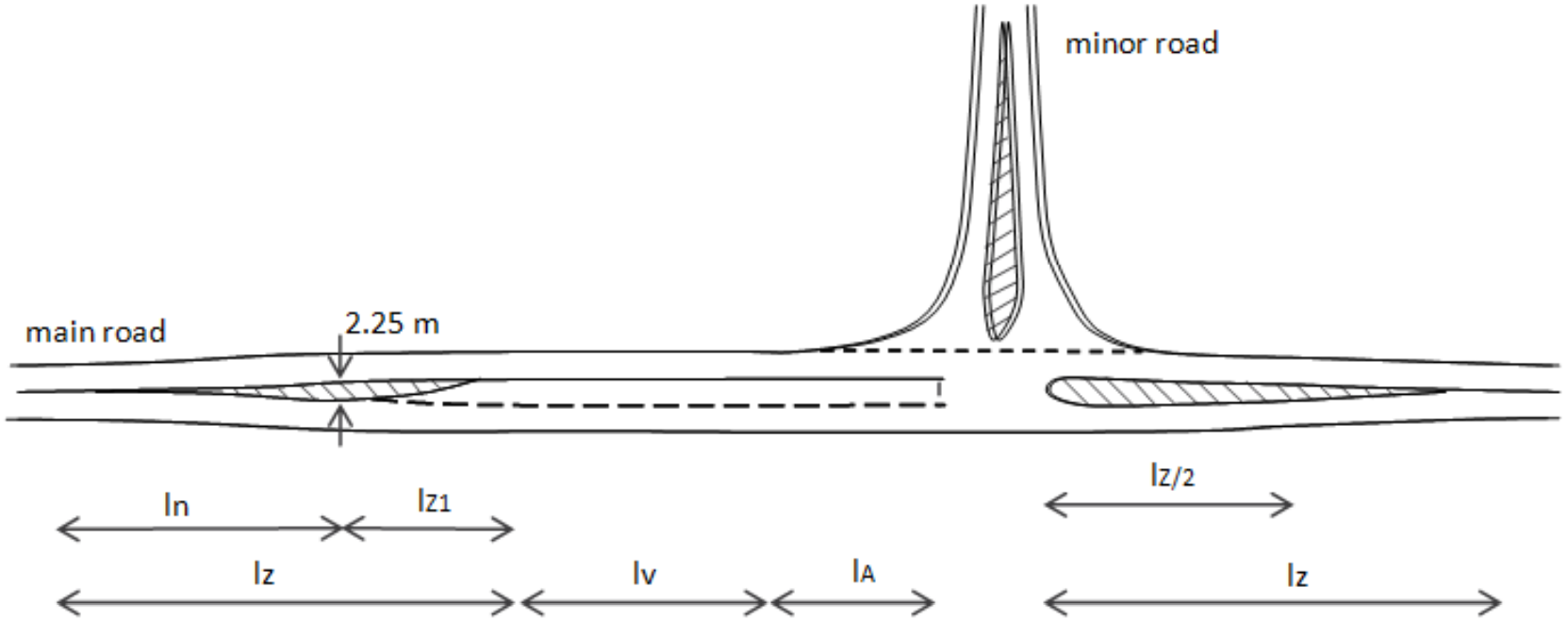
Križišča

- **Razpoznavna**
- **Vidna**
- **Pregledna**
- **Razumljiva**
- **Normalno prevozna**

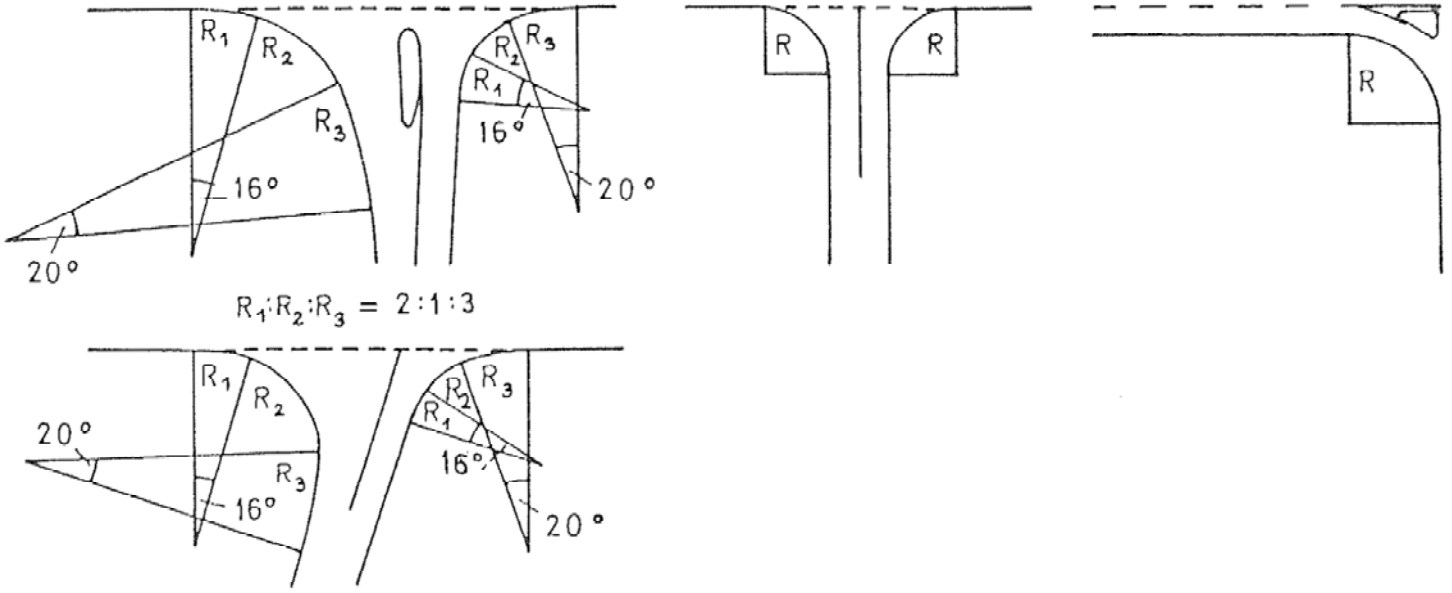
Kot križanja



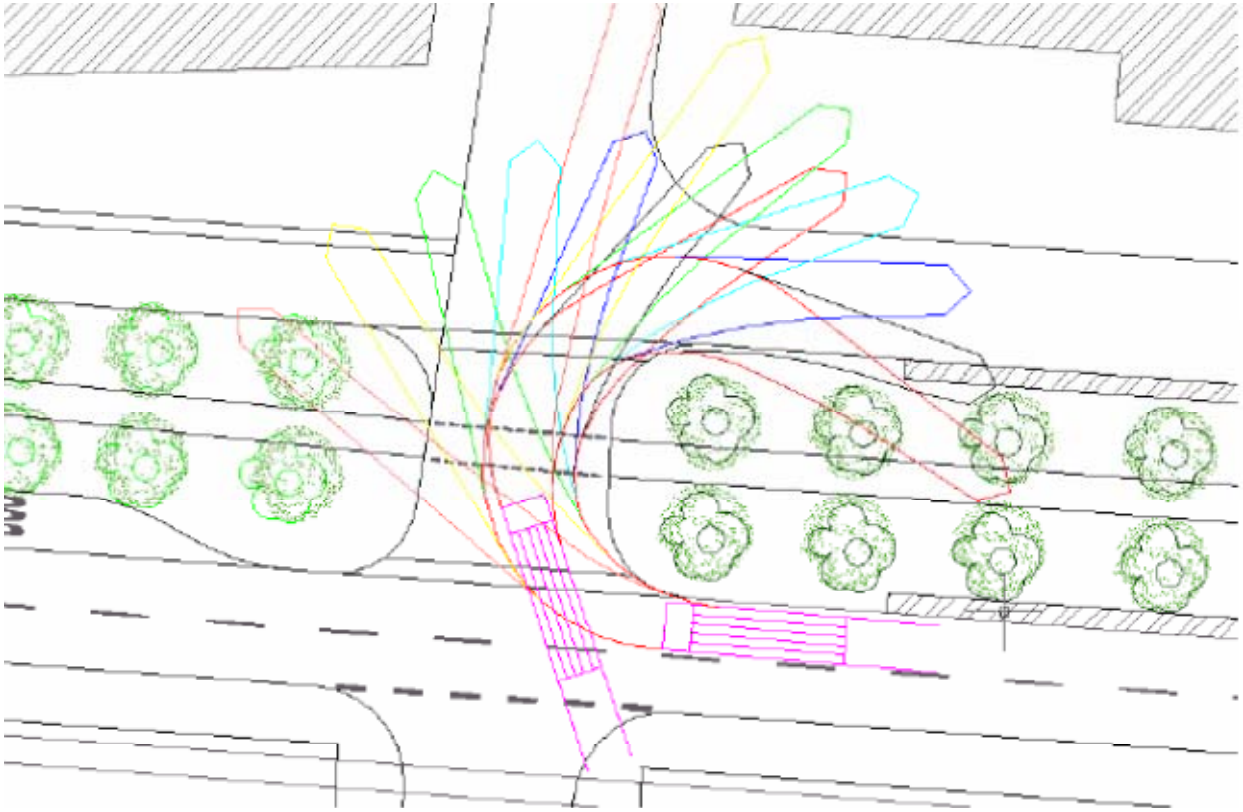
Pas za leve zavijalce



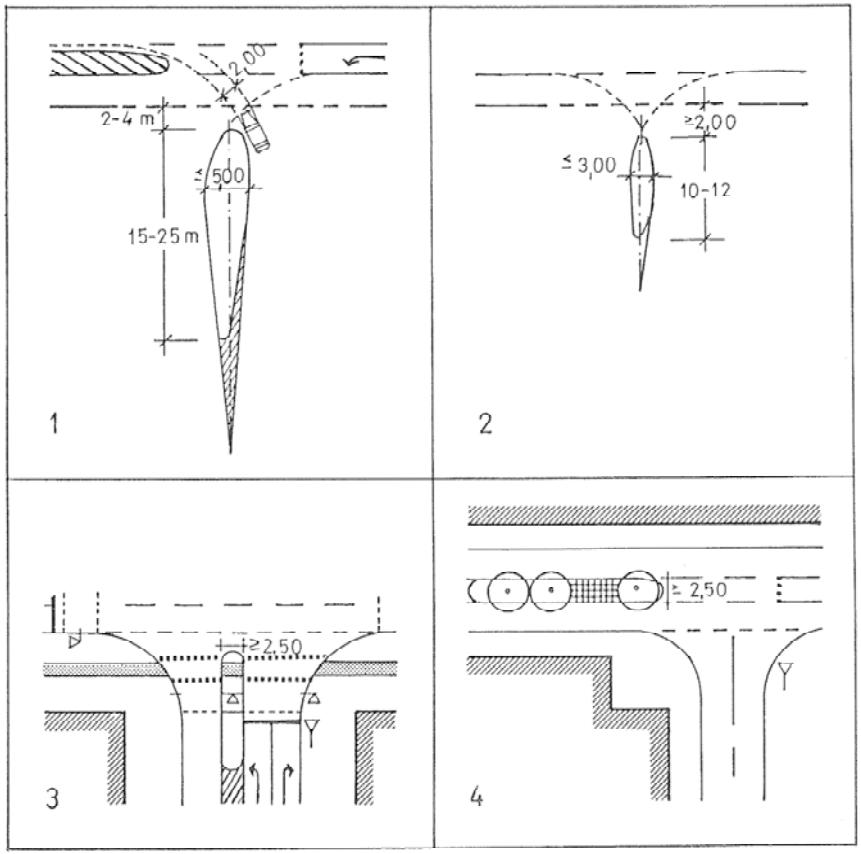
Zavijalni radiji



Zavijalne krivulje



Prometni otoki



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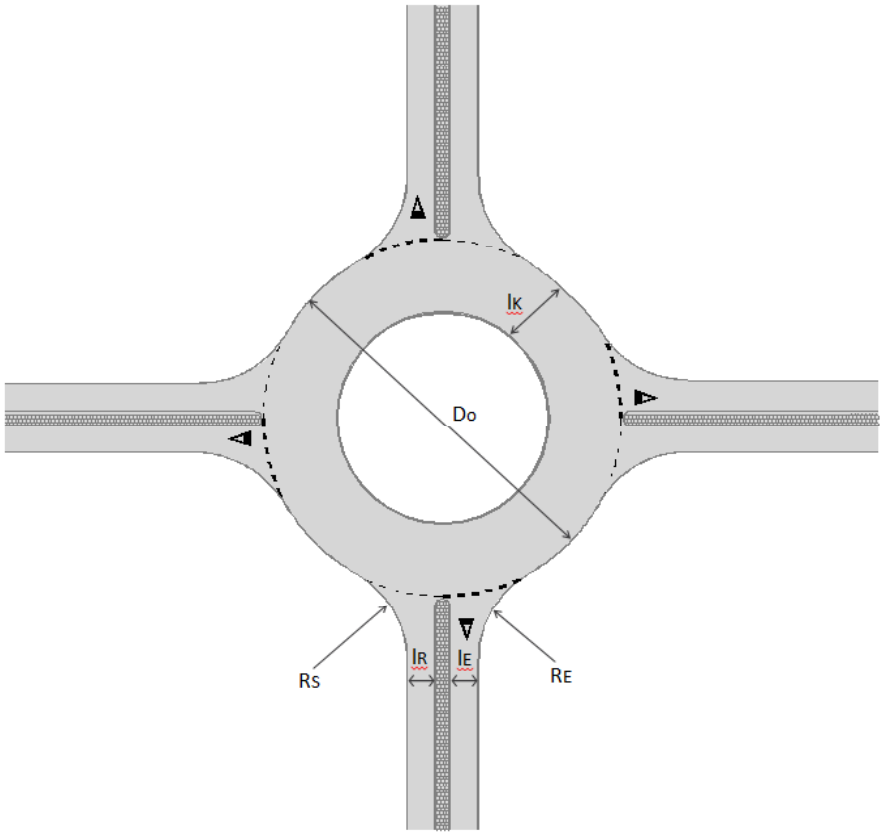
Krožna križišča



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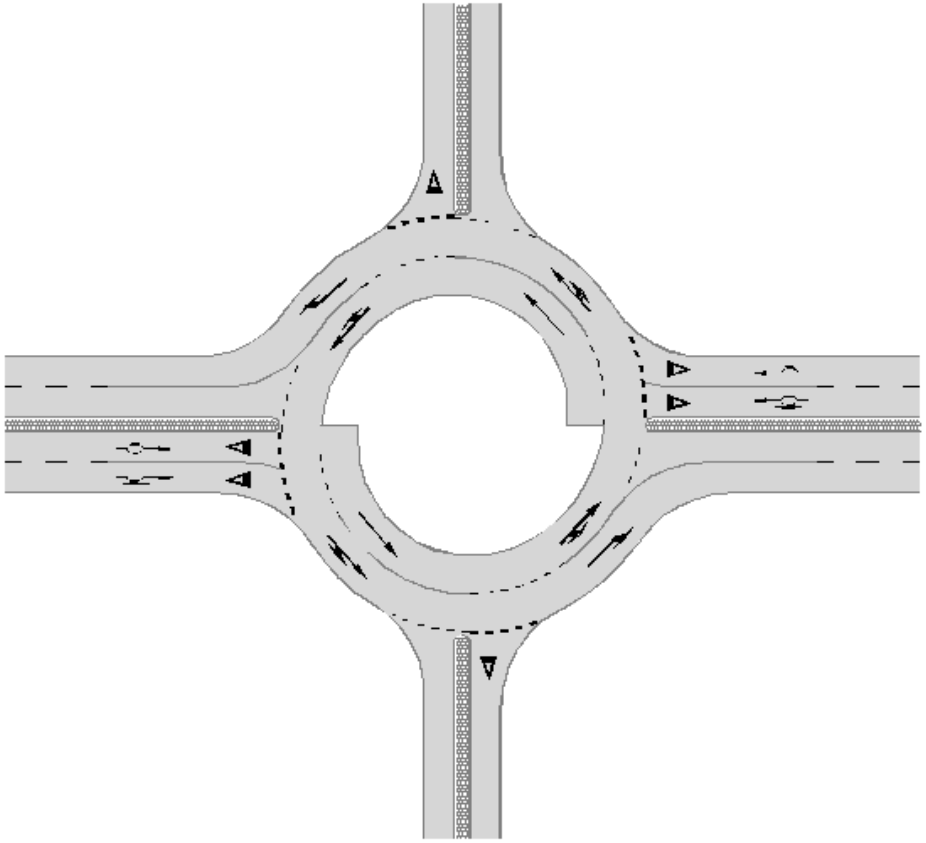
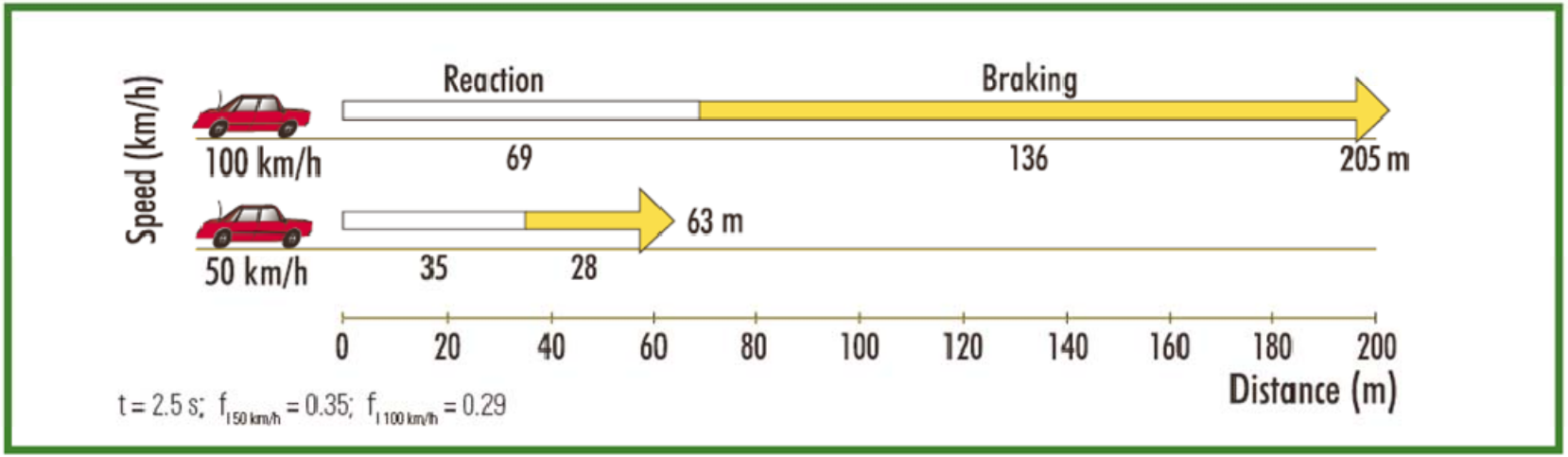
Turbo krožna križišča



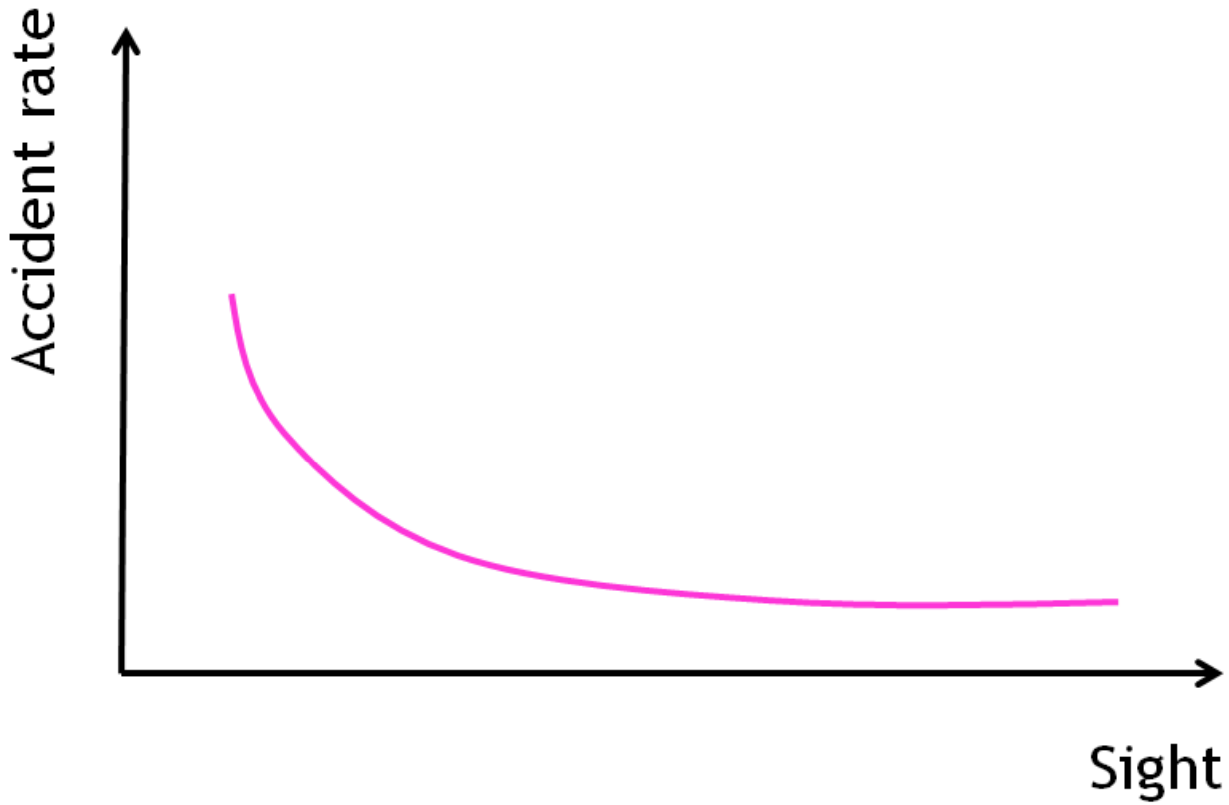
Projektiranje cestne osi

- Zavorna razdalja
- Horizontalno vodenje
- Horizontalne krivine
- Prehodnica
- Prečni skloni
- Vertikalno vodenje
- Hkratno horizontalno in vertikalno vodenje

Zavorna razdalja



Stopnja nesreč/preglednost



Priporočljiva zavorna preglednost

Table SD-5 Recommended stopping sight distances

COUNTRY	TIME (s)	SPEED (km/h)											
		30	40	50	60	70	80	90	100	110	120	130	140
		STOPPING SIGHT DISTANCE (m)											
Austria	2.0	-	35	50	70	90	120	-	185	-	275	-	380
Canada	2.5	-	45	65	85	110	140	170	210	250	290	330	-
France	2.0	25	35	50	65	85	105	130	160	-	-	-	-
Germany	2.0	-	-	65	85	110	140	170	210	255	-	-	
Great Britain	2.0	-	-	70	90	120	-	-	215	-	295	-	-
Greece	2.0	-	-	-	65	85	110	140	170	205	245	-	-
South Africa	2.5	-	50	65	80	95	115	135	155	180	210	-	-
Sweden	2.0	35	-	70	-	165	-	-	-	195	-	-	-
Switzerland	2.0	35	-	50	70	95	120	150	195	230	280	-	-
USA	2.5	35	50	65	85	105	130	160	185	220	250	285	-

Adapted from: Harwood et al., 1995

Elementi horizontalnega vodenja cestne osi

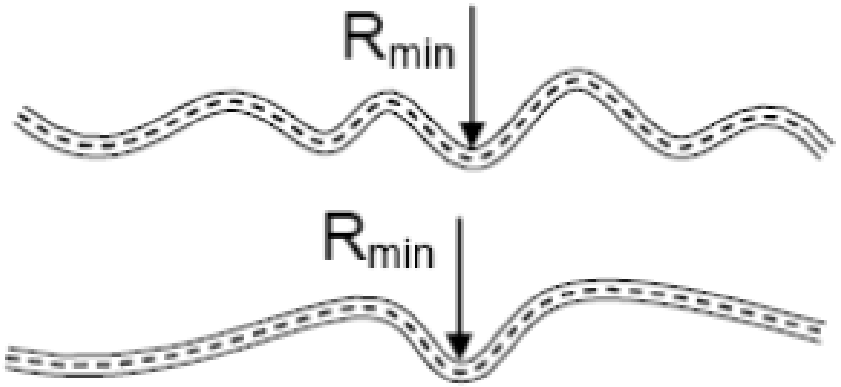
- Prema
- Krožni lok
- Prehodnica

- Na premi je:
  - otežena ocena hitrosti nasproti vozečega vozila,
  - slaba preglednost izza predhodnega vozila,
  - utrujajoča vožnja,
  - slepenje luči ponoči
  - nestabilen položaj volana pri vožnji

Minimalni polmer krožne krivine

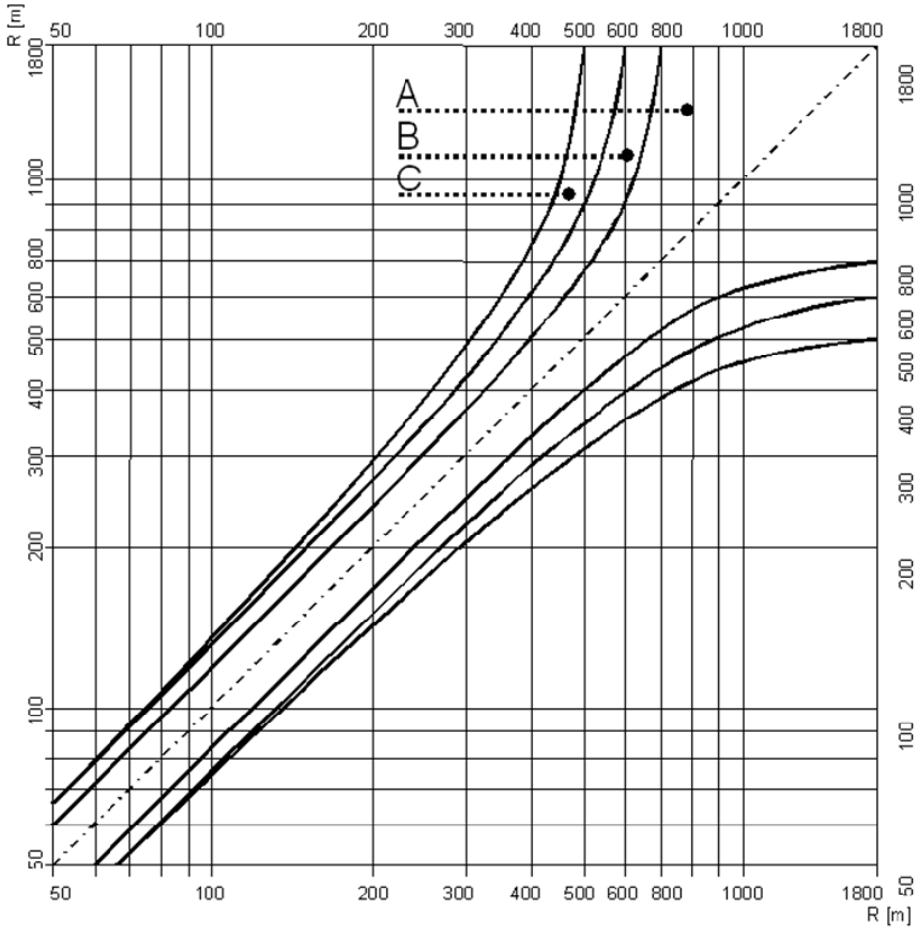
Projektna hitrost	Minimalni polmer krožne krivine za prečni nagib vozišča (m)									
	Prečni nagib									
	2,5%	3,0%	3,5%	4,0%	4,5%	5,0%	5,5%	6,0%	6,5%	7,0%
30 km/h	70	60	50	45	40	35	33	30	27	25
40 km/h	125	110	90	80	70	65	60	50	47	45
50 km/h	200	175	150	127	120	110	98	90	77	75
60 km/h	350	280	240	210	180	165	150	140	127	125
70 km/h	500	420	360	320	280	250	230	210	190	175
80 km/h	700	580	500	420	390	350	320	290	270	250
90 km/h	1000	800	700	620	550	490	450	400	370	350
100 km/h	1250	1050	920	780	700	640	580	550	480	450
110 km/h	1700	1400	1200	1050	950	850	780	700	650	600
120 km/h	2000	1750	1500	1375	1175	1050	960	900	840	750
130 km/h	3000	2100	1800	1550	1400	1250	1150	1050	950	900

Slika 31: Načini uskladitve zaporedja geometrijskih elementov



skladnost/neskladnost horizontalnih elementov

Horizontalno vodenje – sosledje horizontalnih krivin



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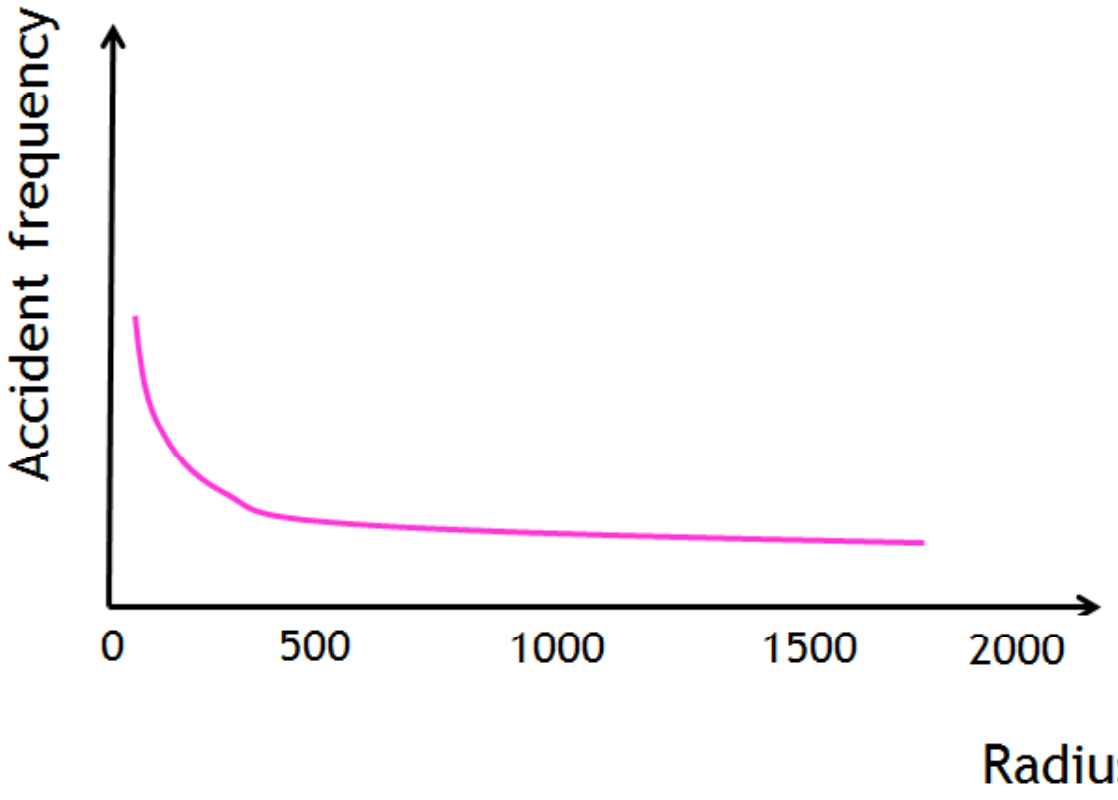
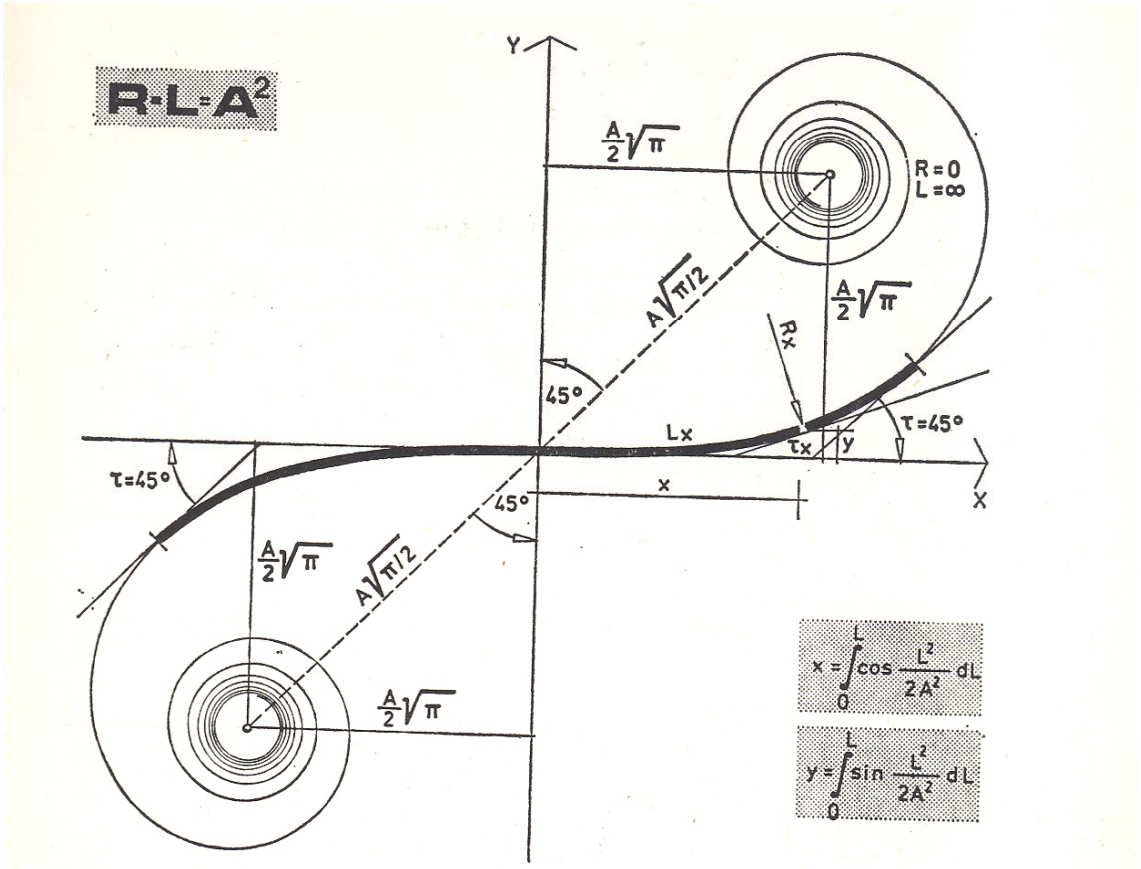
Stopnja nesreč/polmer krivine



Stopnja nesreč v krivinah

- 1.5 do 4 krat višja kot v premah ,
- 30% smrtnih nesreč se zgodi v krivinah
- Regionalne in lokalne ceste imajo zaradi tega dejstva največ nesreč,
- 60 % vseh nesreč v krivinah je zaradi zleta s ceste
- Zelo visok je odstotek nesreč na mokri cesti v krivinah
- Nesreče se zgodijo praviloma na koncu krivine

Prehodnica



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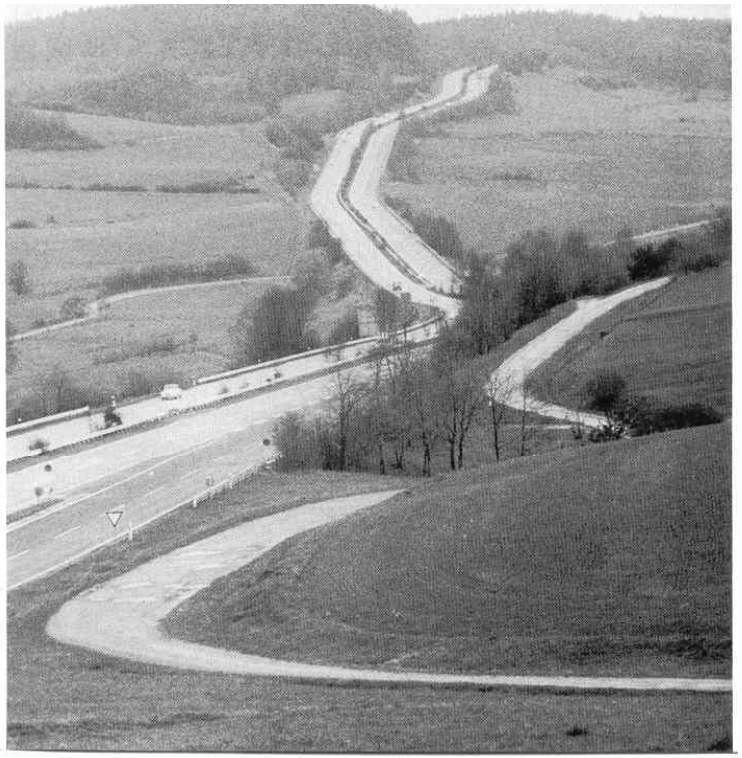
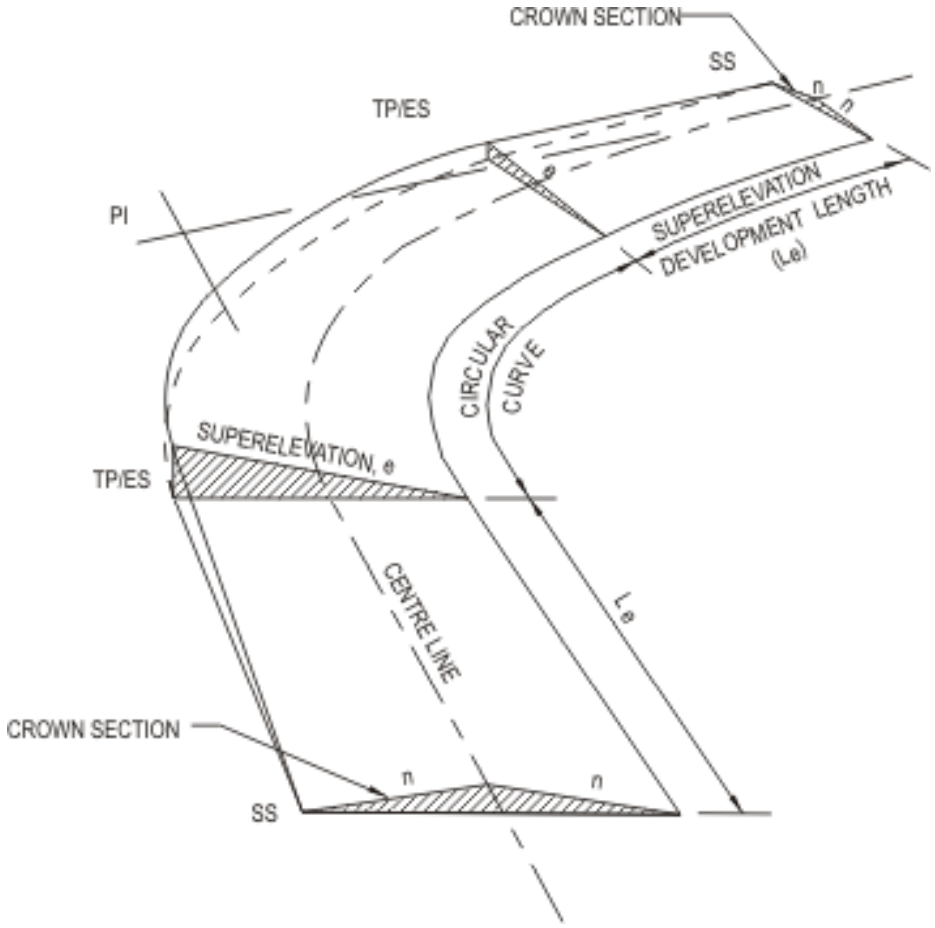
Prehodnica

brez prehodnice

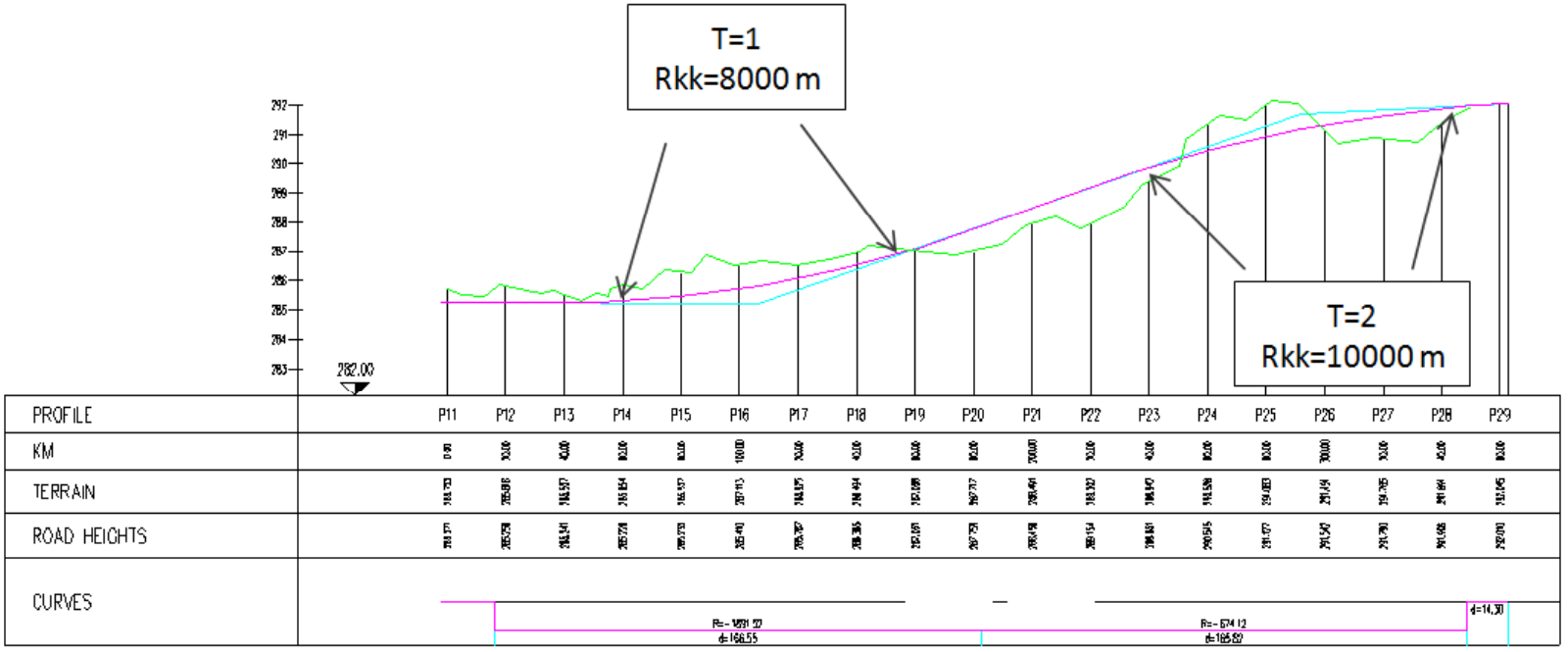


s prehodnico

Prečni sklon



Vertikalno vodenje trase



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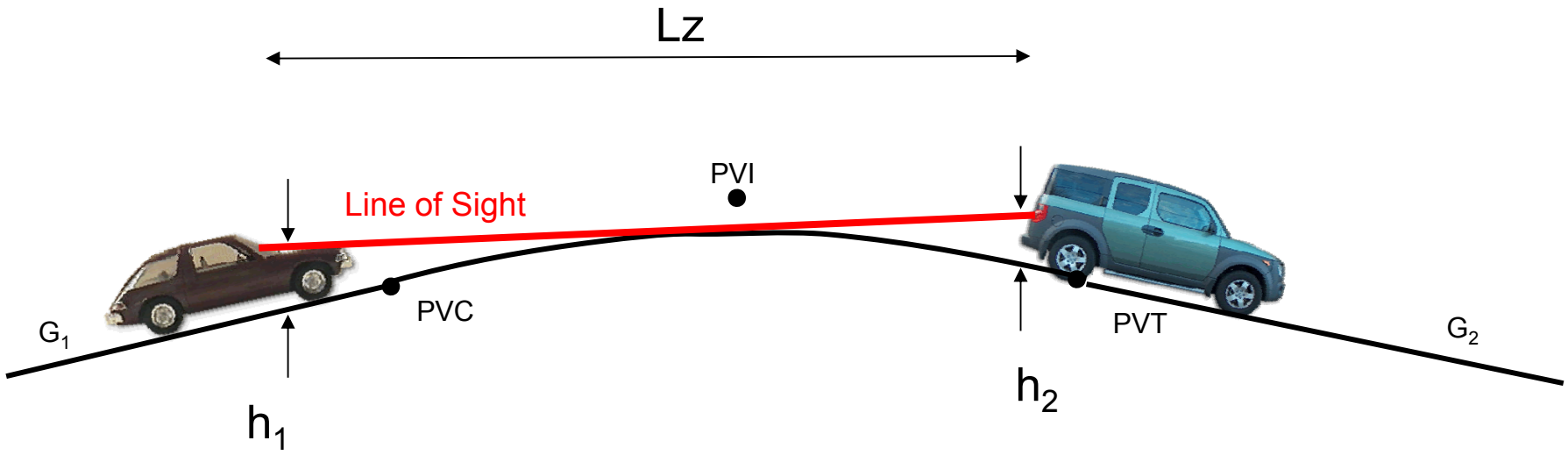
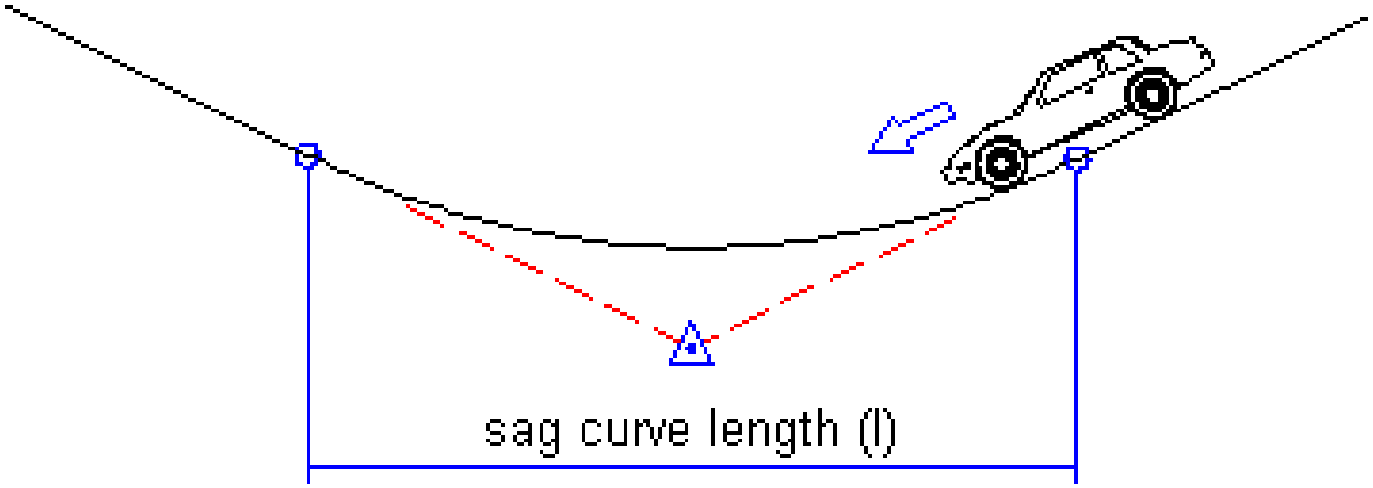
Konveksna vertikalna zaokrožitev



Konkavna vertikalna zaokrožitev



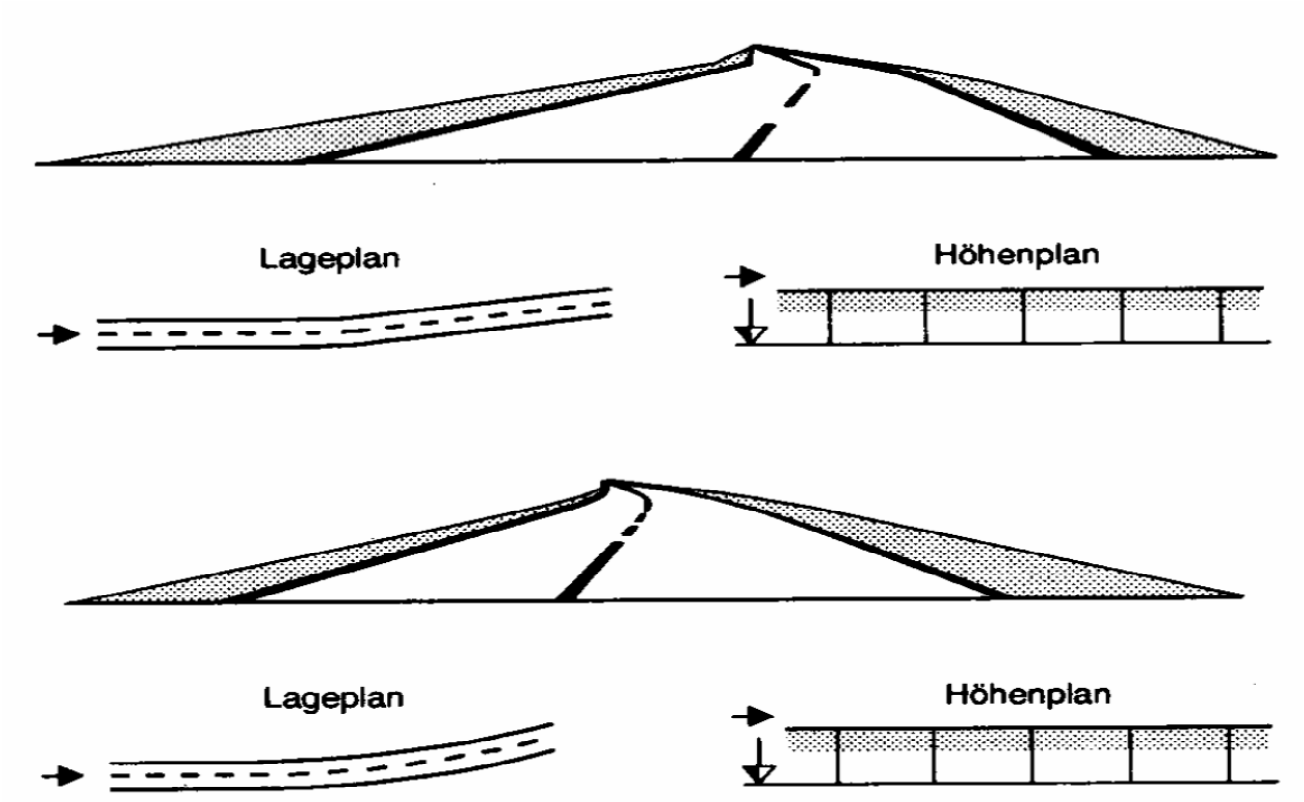
Največji dopustni nagib nivelete

Vrsta ceste	Vrsta terena			
	ravninski	gričevnat	hribovit	gorski
	Dopustni nagib nivelete %			
Avtocesta	3,0	4,0	5,0	6,0
Hitra cesta	3,0	5,0	6,0	7,0
Glavna cesta	4,0	6,0	7,0	8,0
Regionalna cesta	5,0	8,0	10,0	12,0
Lokalna cesta	6,0	10,0	12,0	15,0

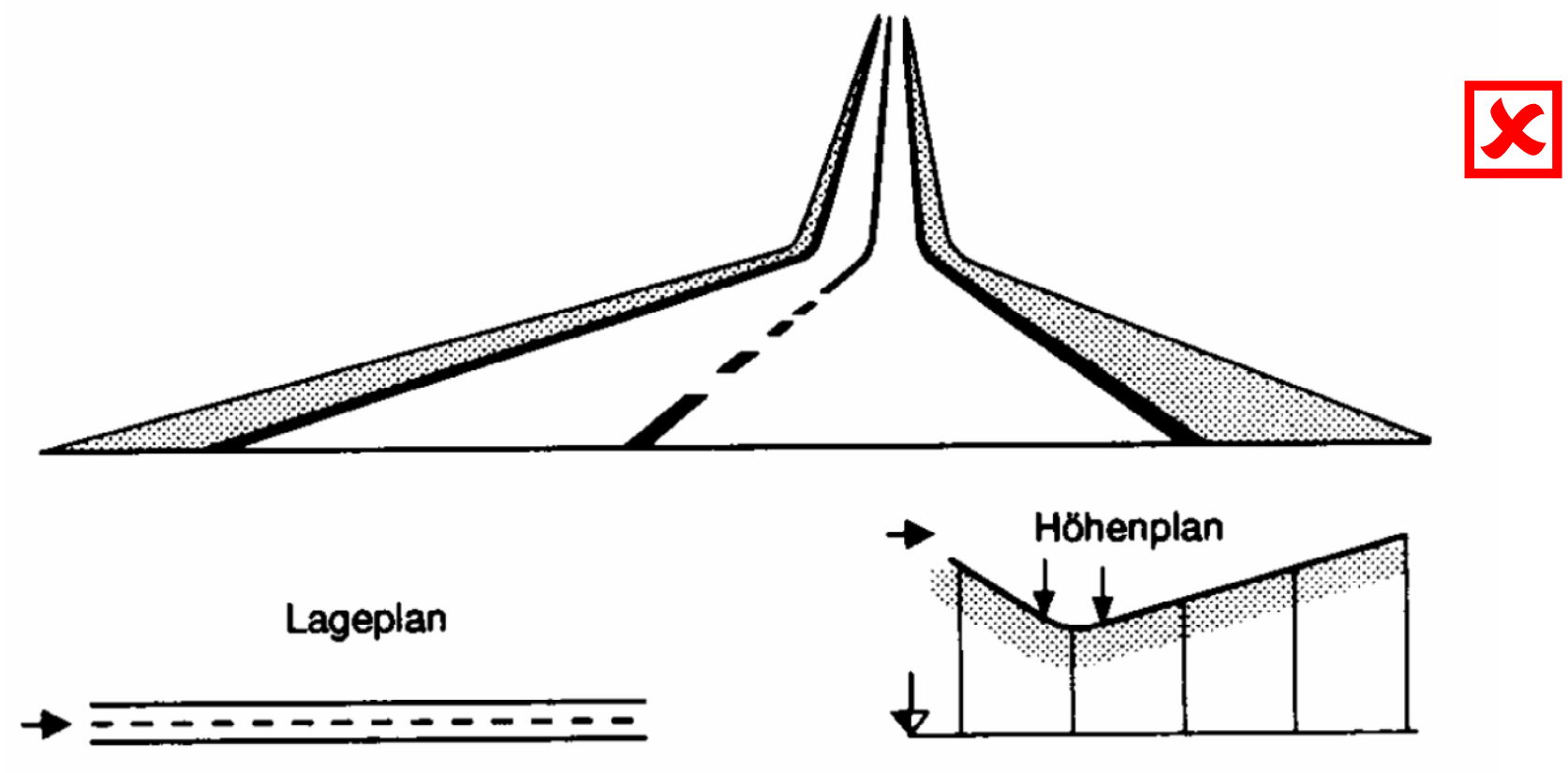
Minimalna vertikalna zaokrožitev nivelete

Hitrost km/h	30	40	50	60	70	80	90	100	110	120	130
R_{min} koveksni	400	800	1000	1500	2000	4000	6000	9000	12000	15000	20000
R_{min} konkavni	300	600	750	1200	1500	3000	4000	6000	8000	10000	15000

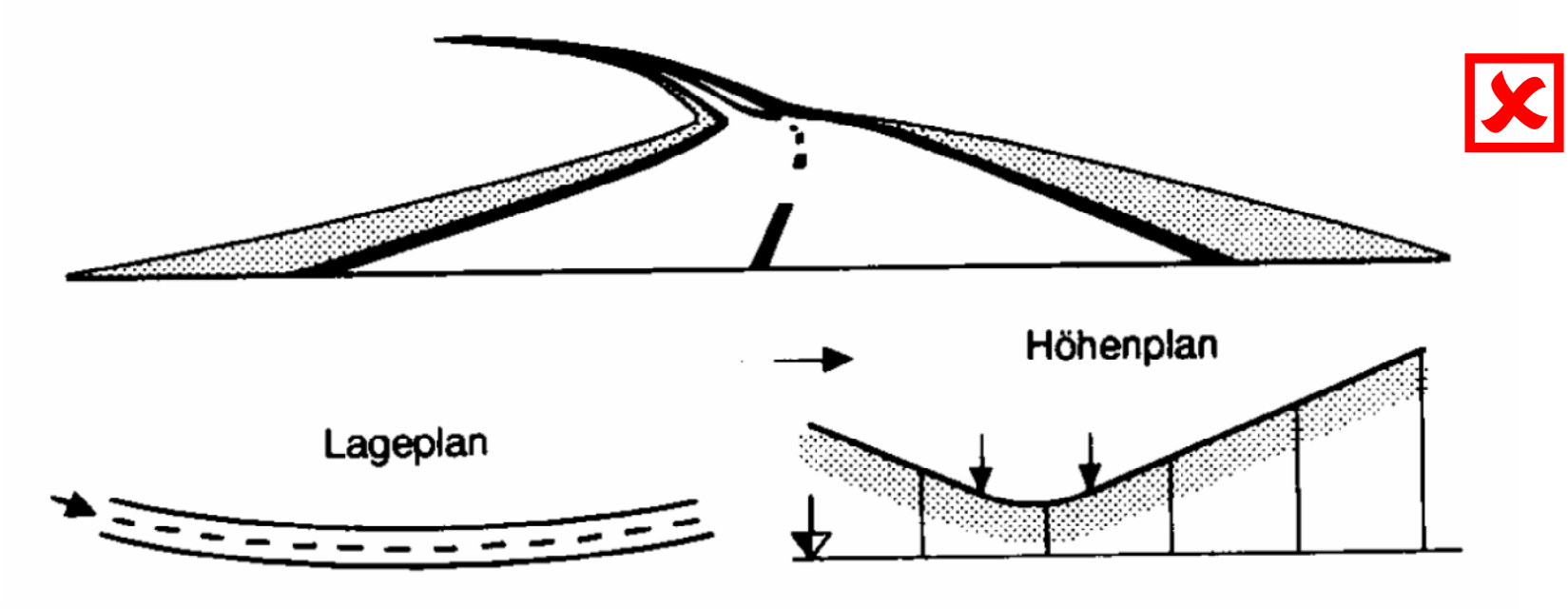
Sestavljeno vodenje trase



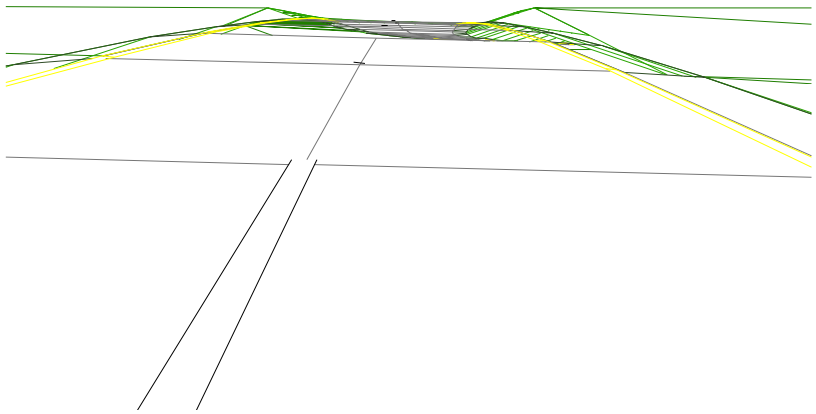
Premajhna konkavna zaokrožitev

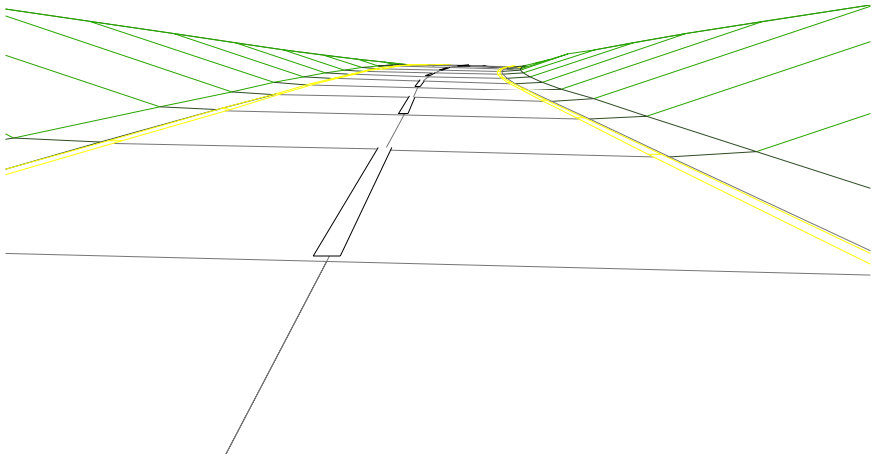


Premajhna konkavna zaokrožitev

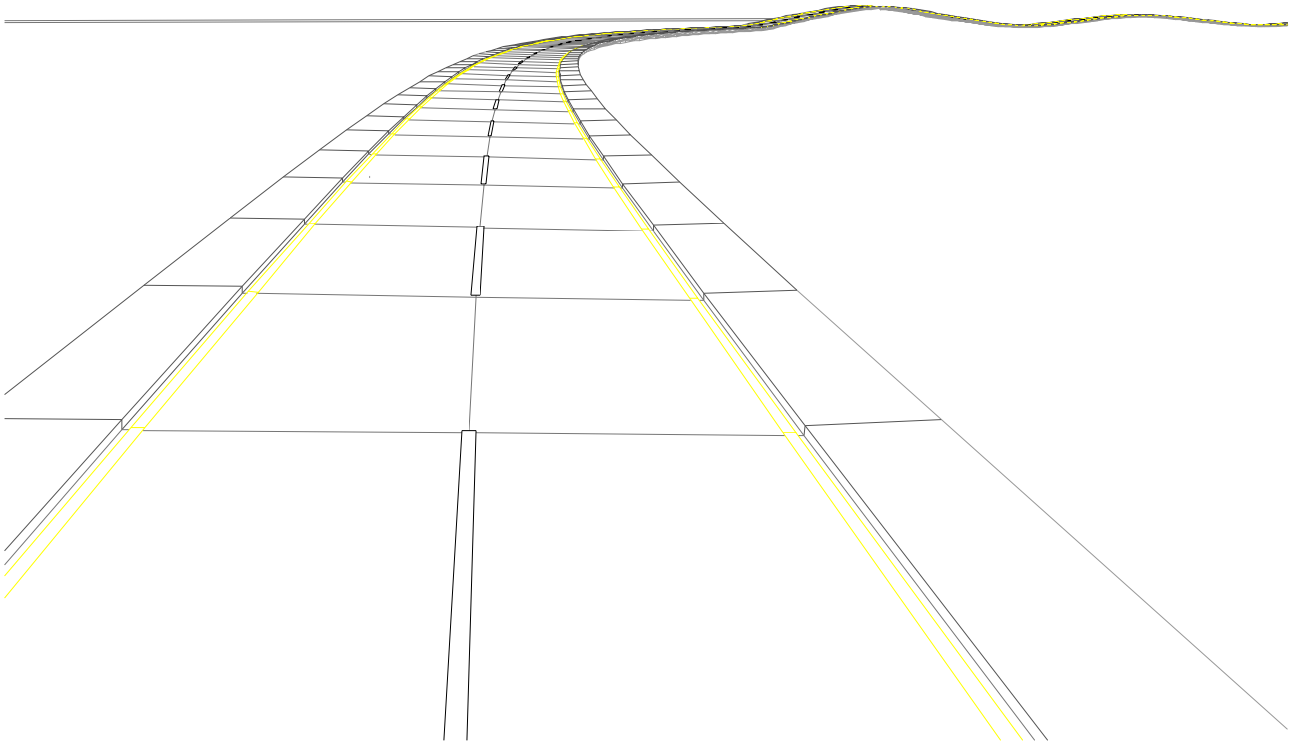


Position of crest curve in relation to position of horizontal curve

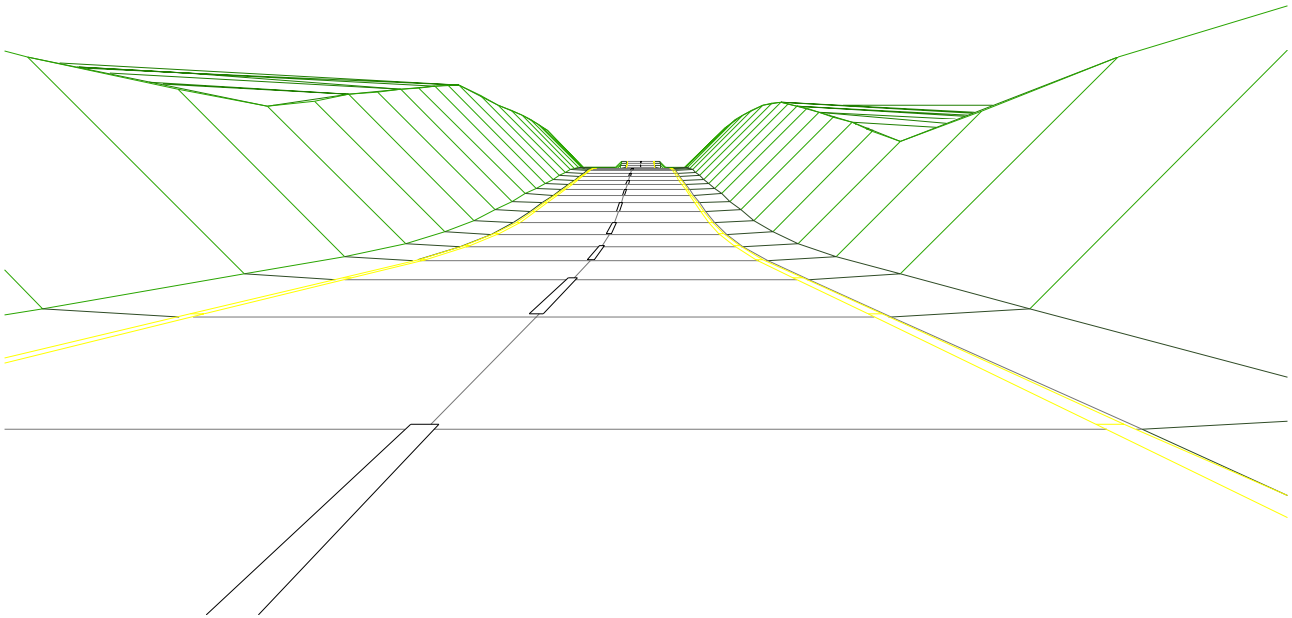




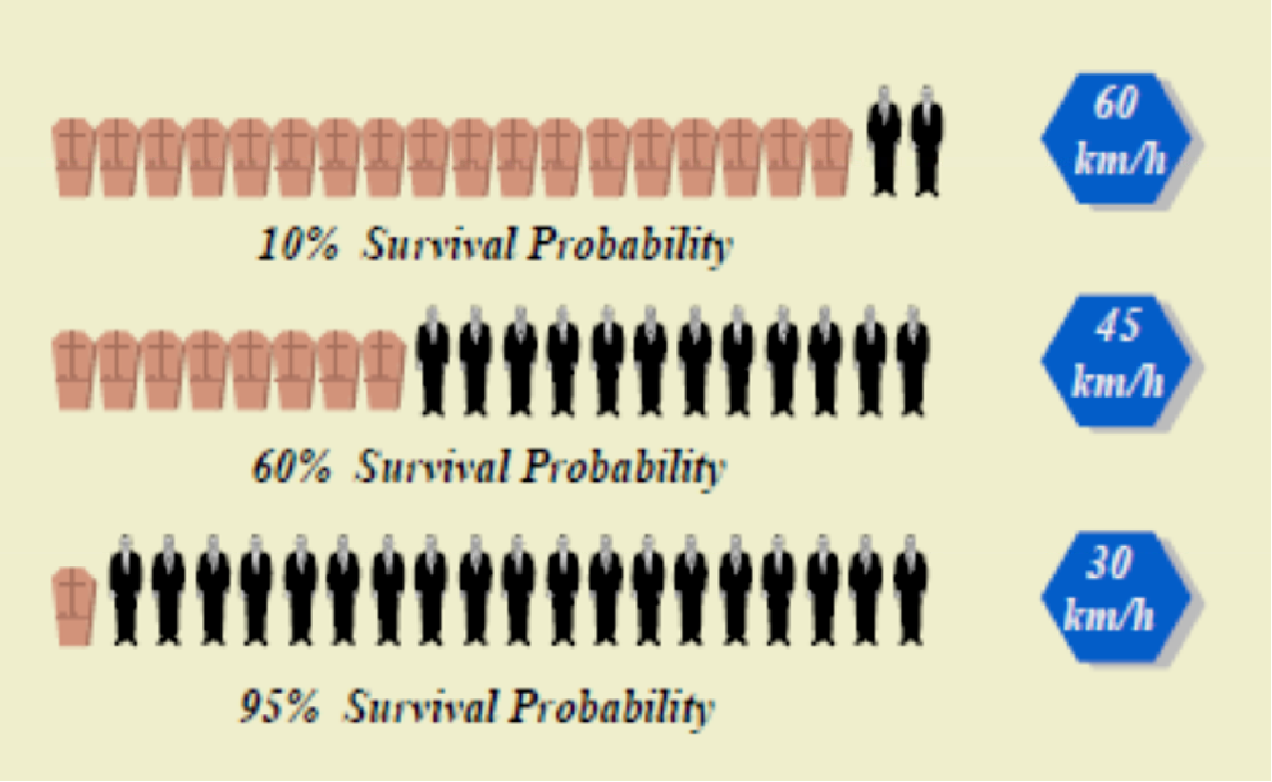
Frfotanje trase



Potopitev trase



Umirjanje prometa



Umirjanje: Woonerf

Grbine

Umirjanje: preplastitve + prehod

Otok

Otok in zamaknjen prehod

Lokalne zožitve

Zamik osi

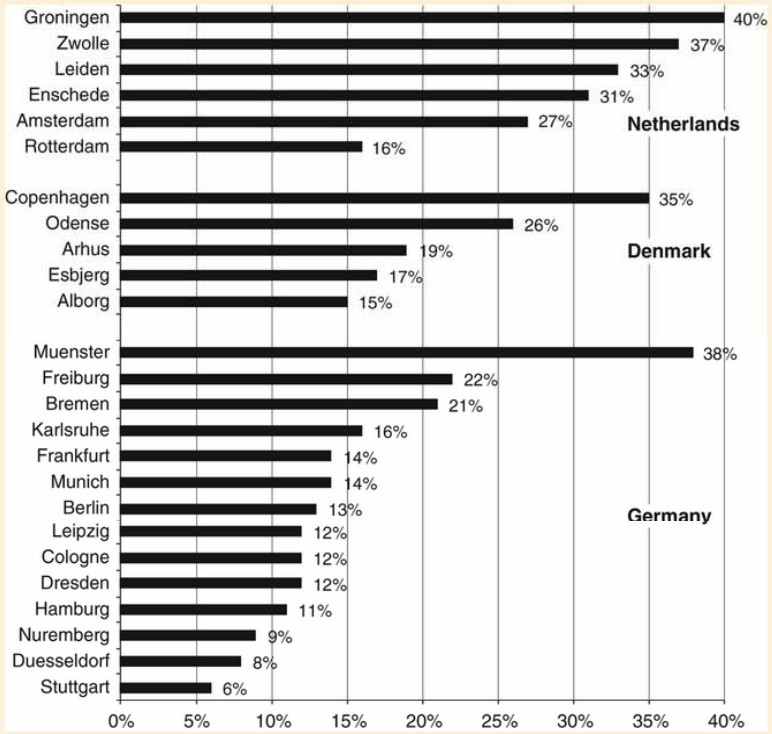
Zožitve in zamiki

Krožna križišča

Kolesarska infrastruktura

- prosti in prometni profil
- različne oblike kolesarskih površin
- izbira vrste površine
- širine različnih površin
- križanja z ostalim prometom
- detajli v križiščih

Modal split – delež kolesarjev



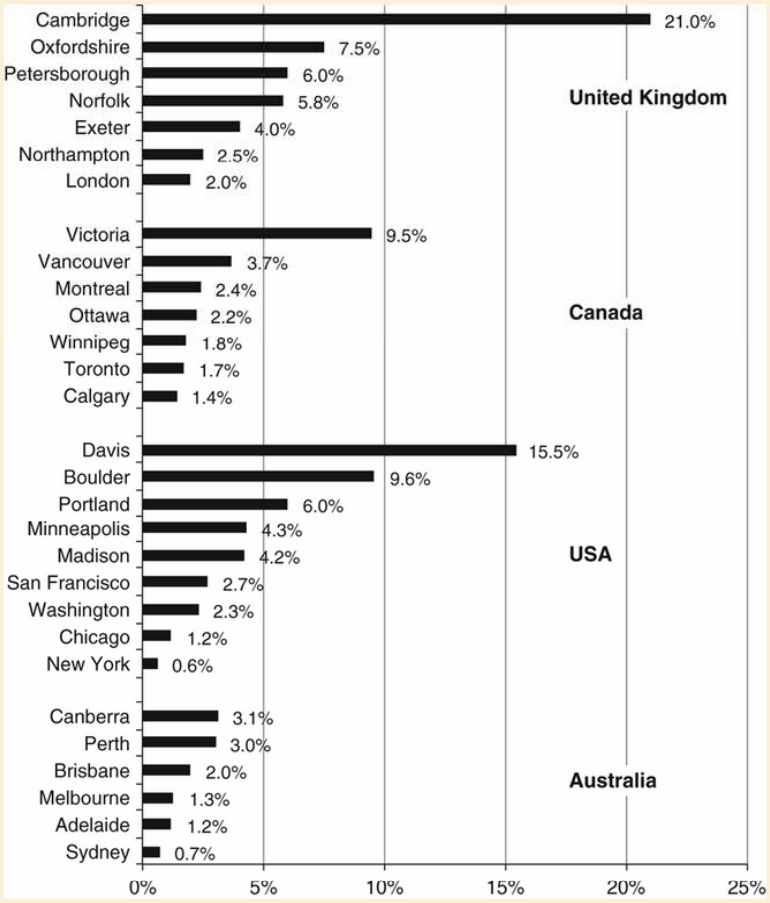
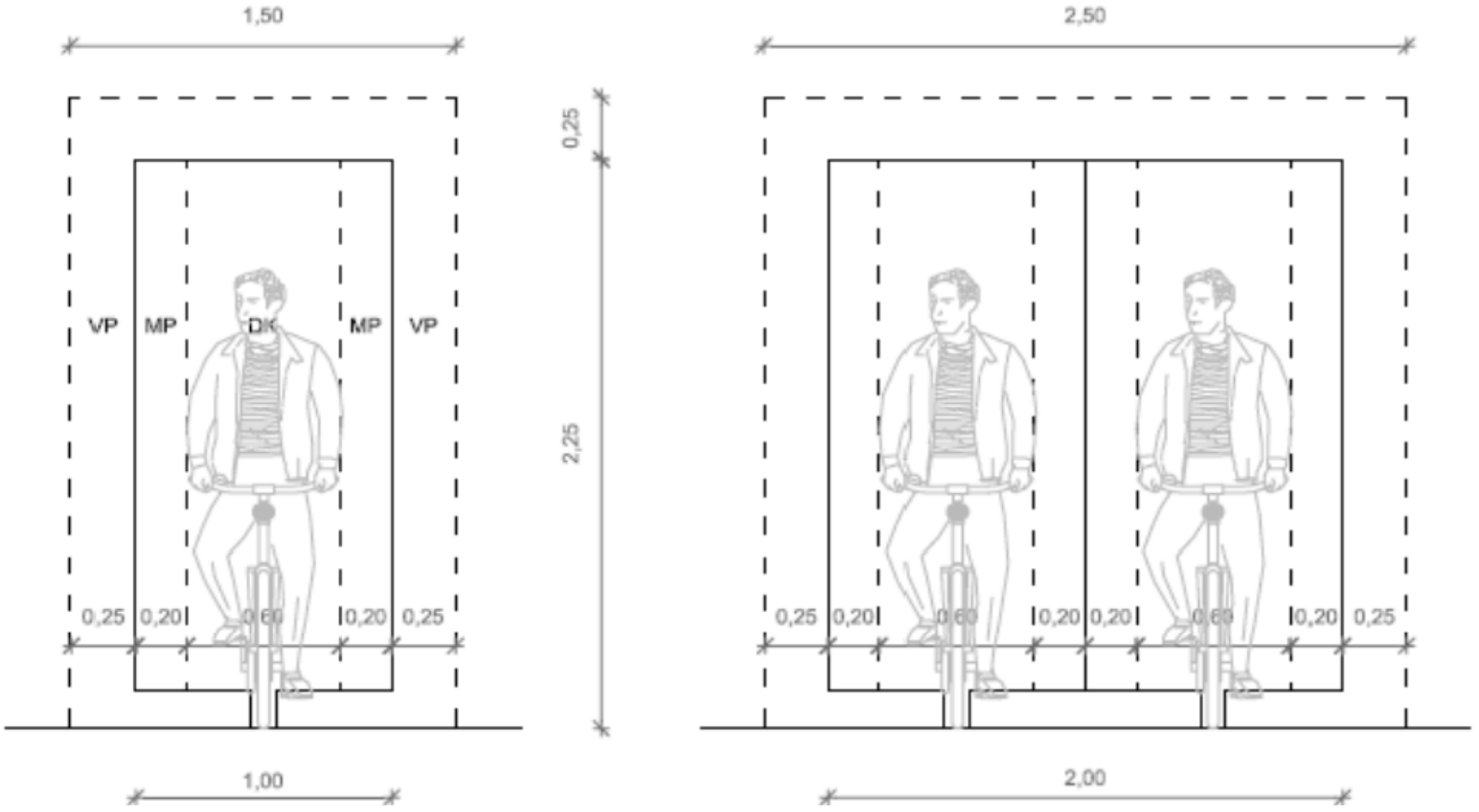


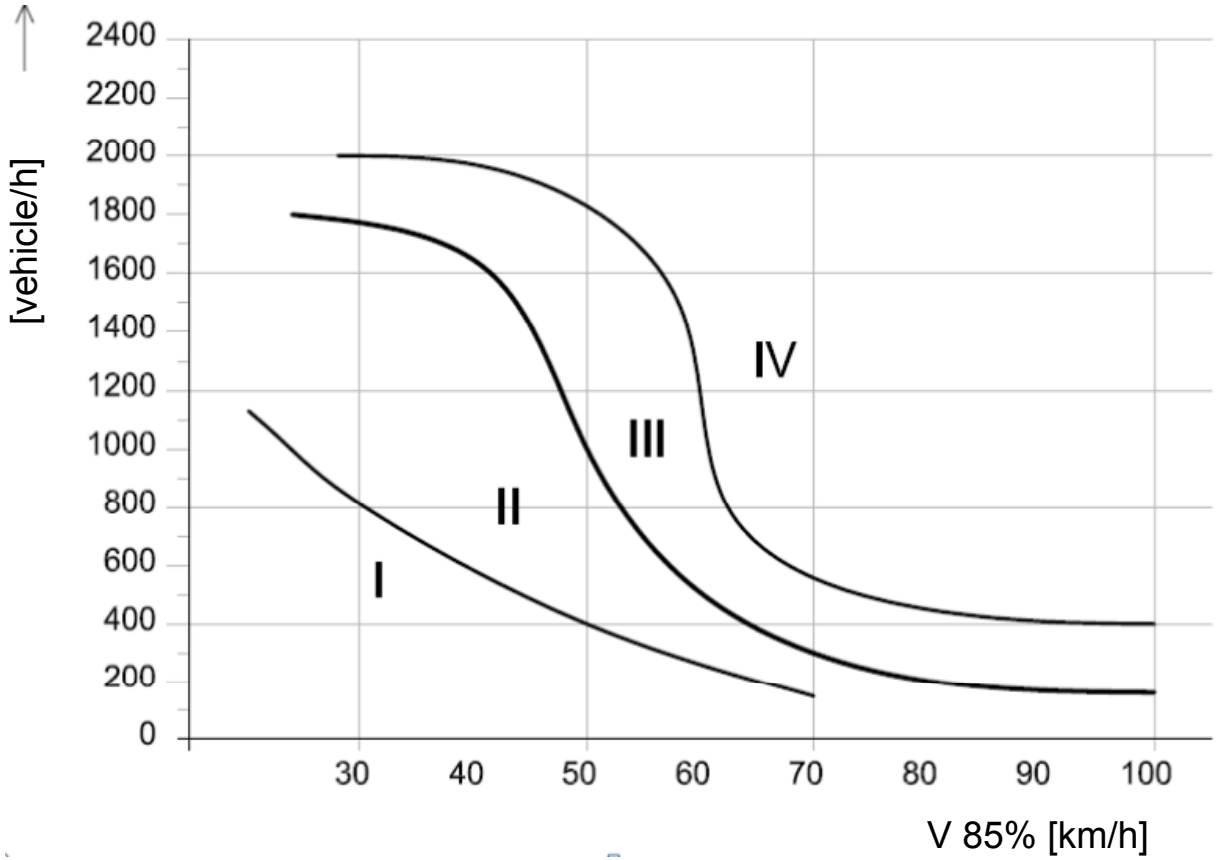
Figure 2.2
Bike share of trips in selected cities in the Netherlands, Denmark, and Germany,

Jointly for our common future

Prosti in prometni profil

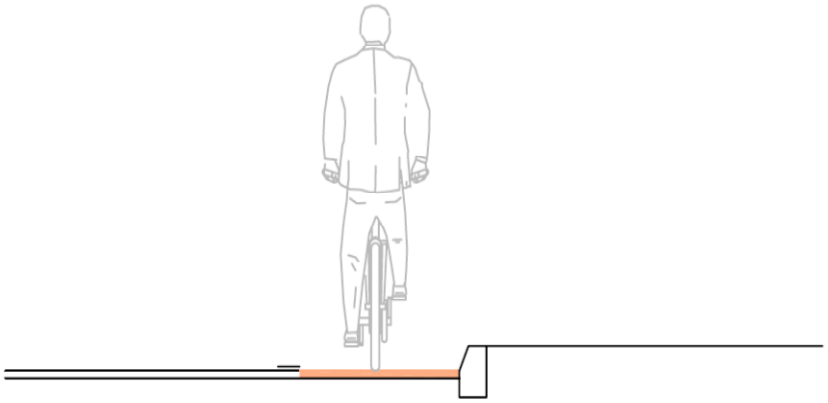


Izbira površine

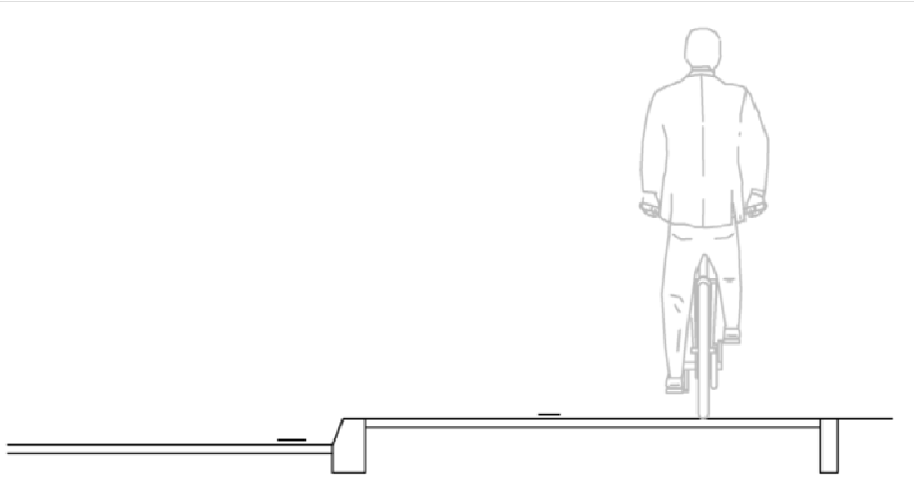


I – mešana površina
II - pas
III- steza
IV- pot

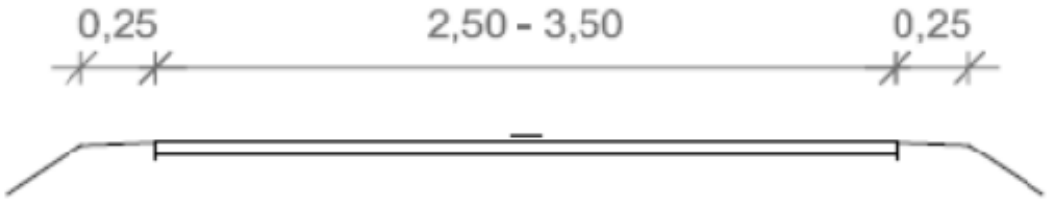
Pas



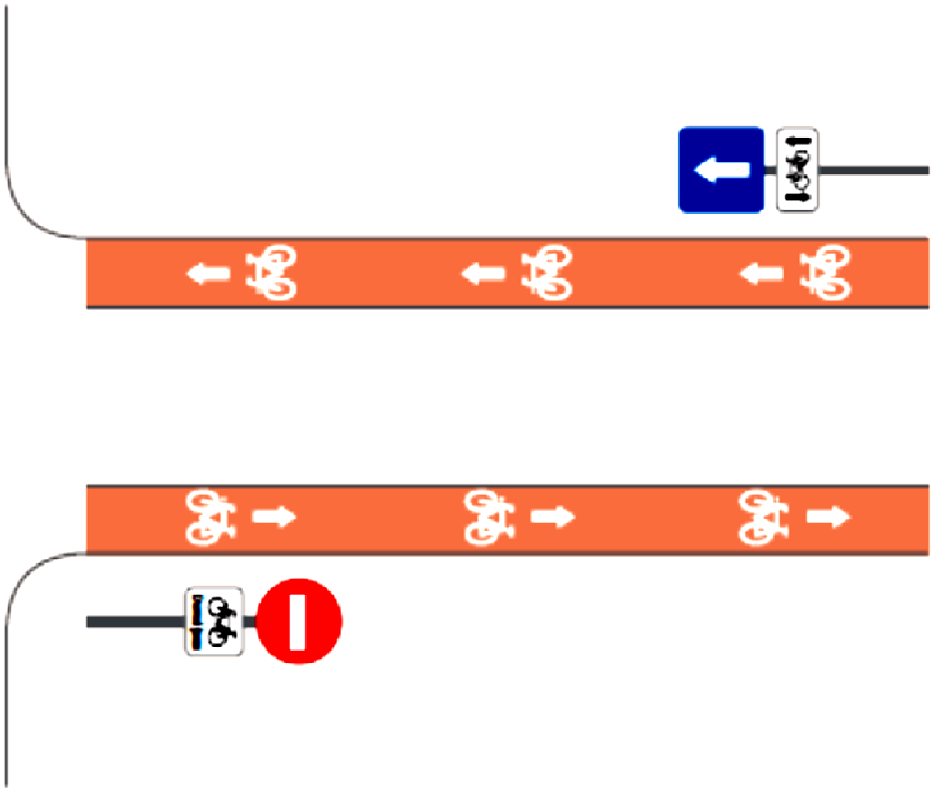
Steza



Pot

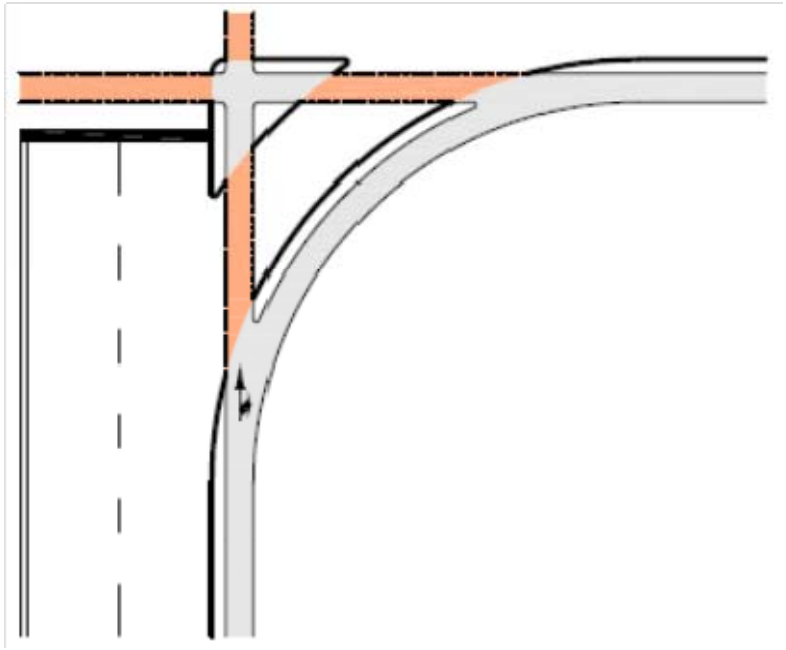


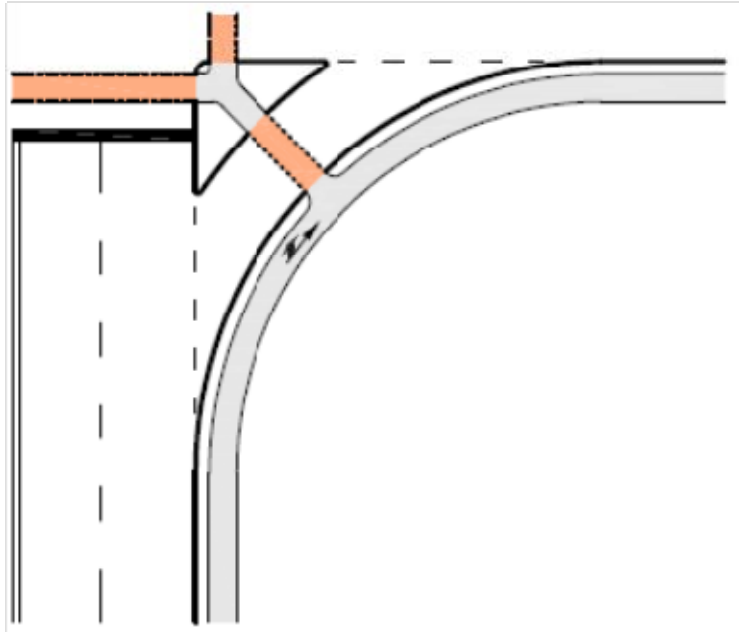
Enosmerna cesta



Sharrow

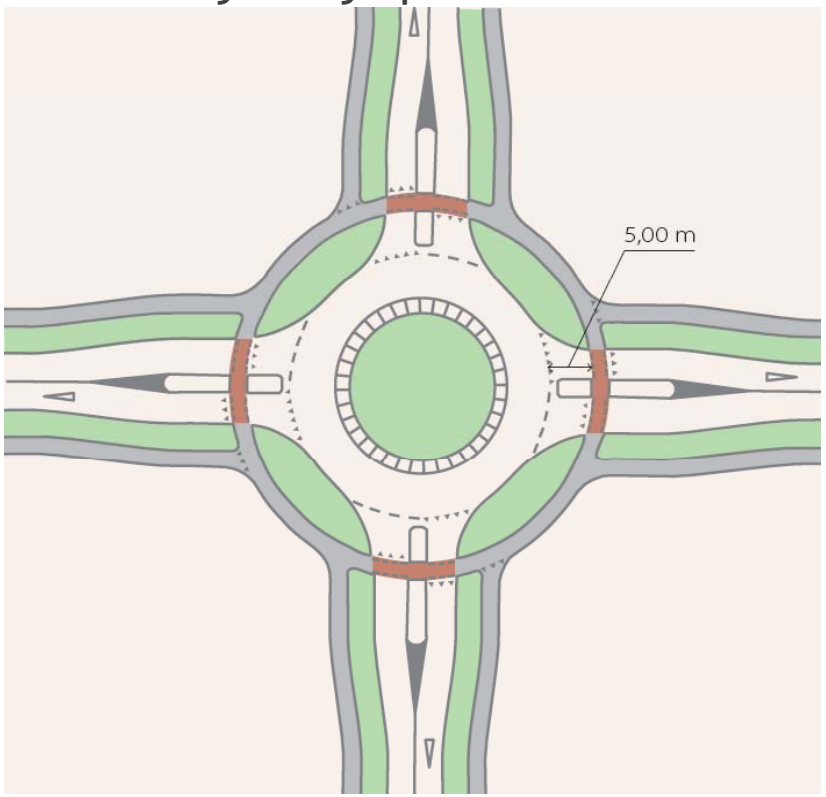
Direktno in posredno prečkanje



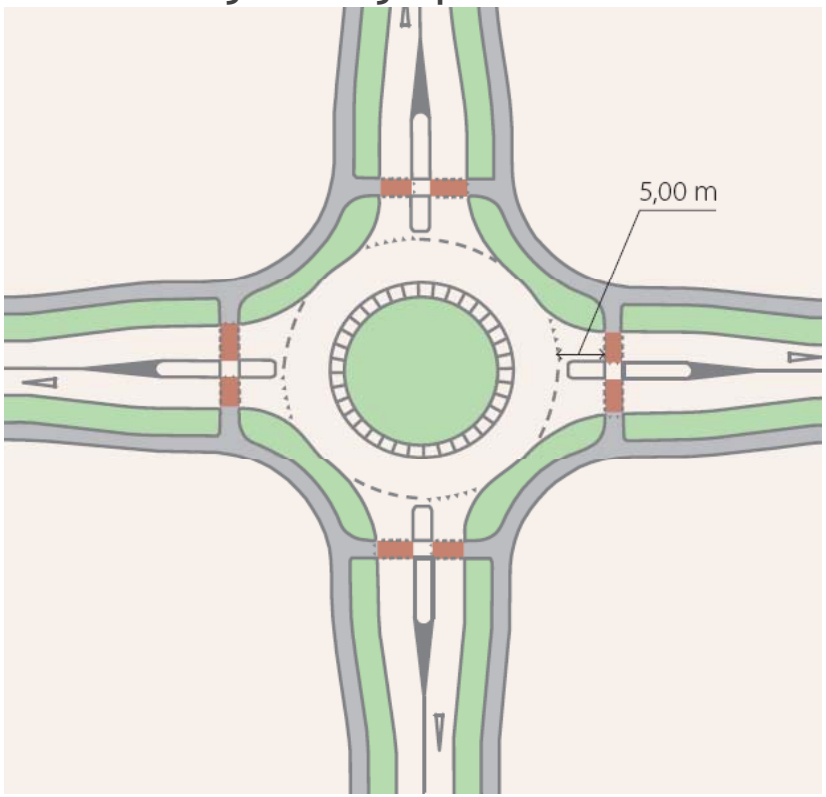


Prečkanje v krožnih križiščih

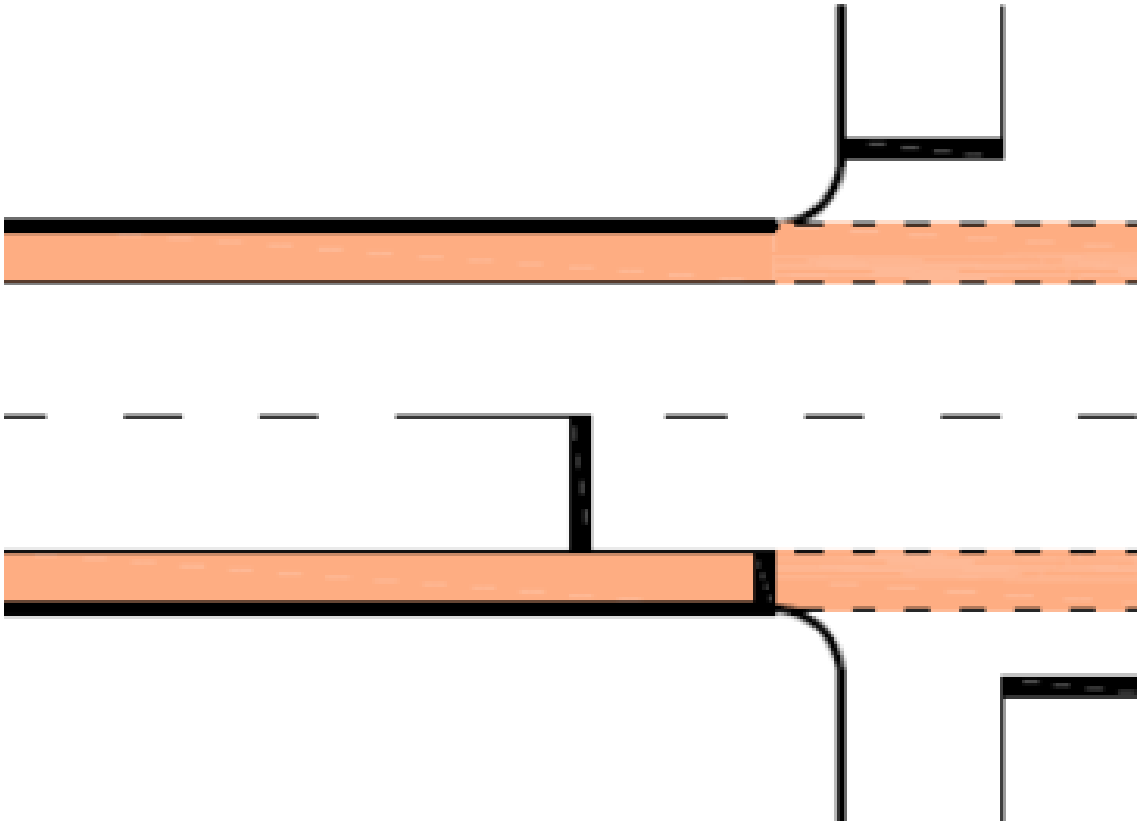
- Kolesarji imajo prednost



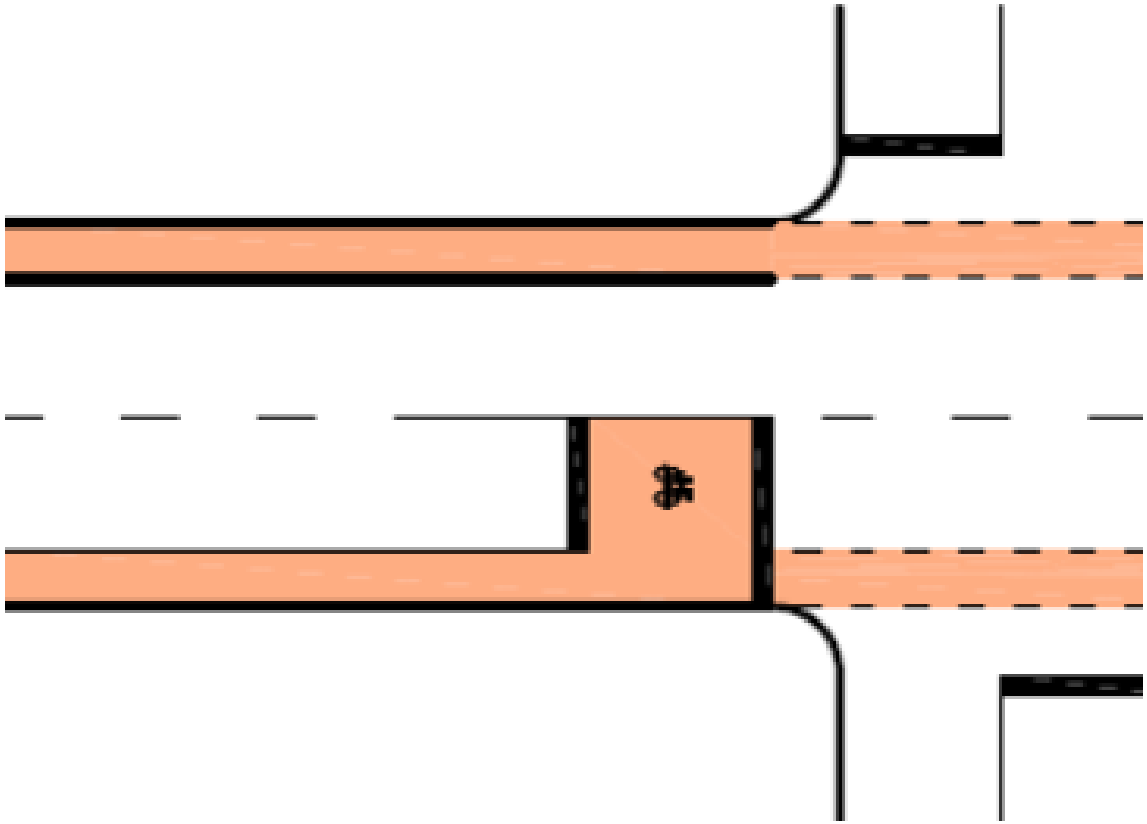
- Kolesarji nimajo prednosti



Naprej pomaknjena STOP črta



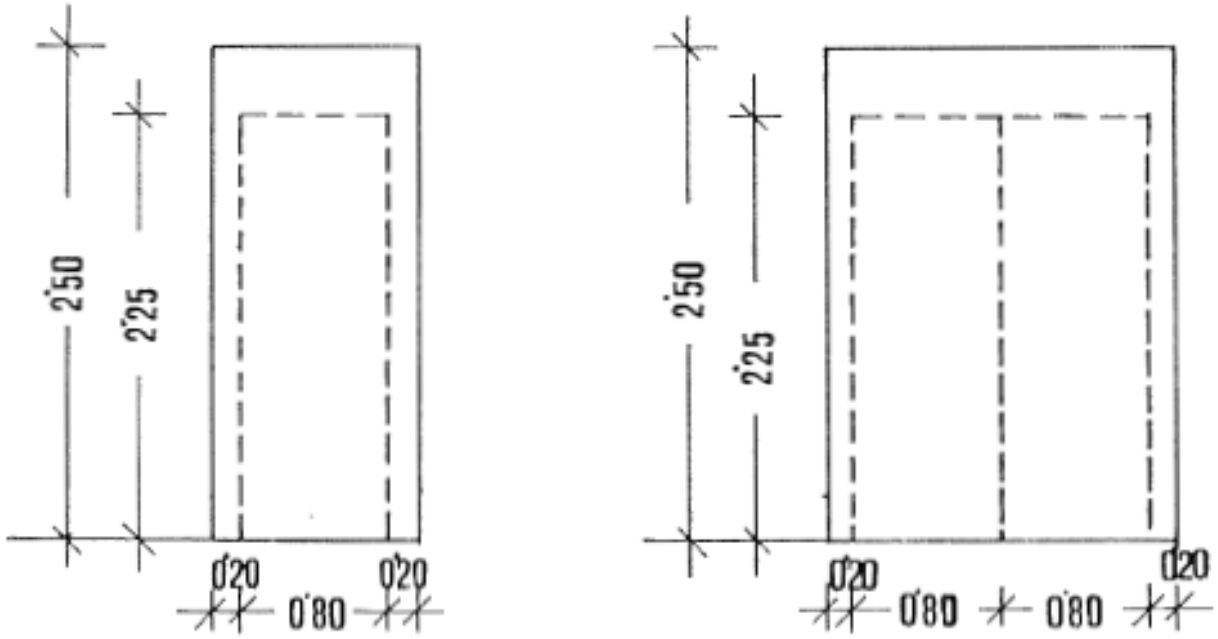
Kolesarski boks



Površine za pešce

- Prosti in prometni profil
- Določitev tipa prehoda
- Preglednost
- Tipi prehodov

Prosti in prometni profil



PREHODI ZA PEŠCE
POGOII ZA OZNAČITEV IN NAČINI OZNAČITVE

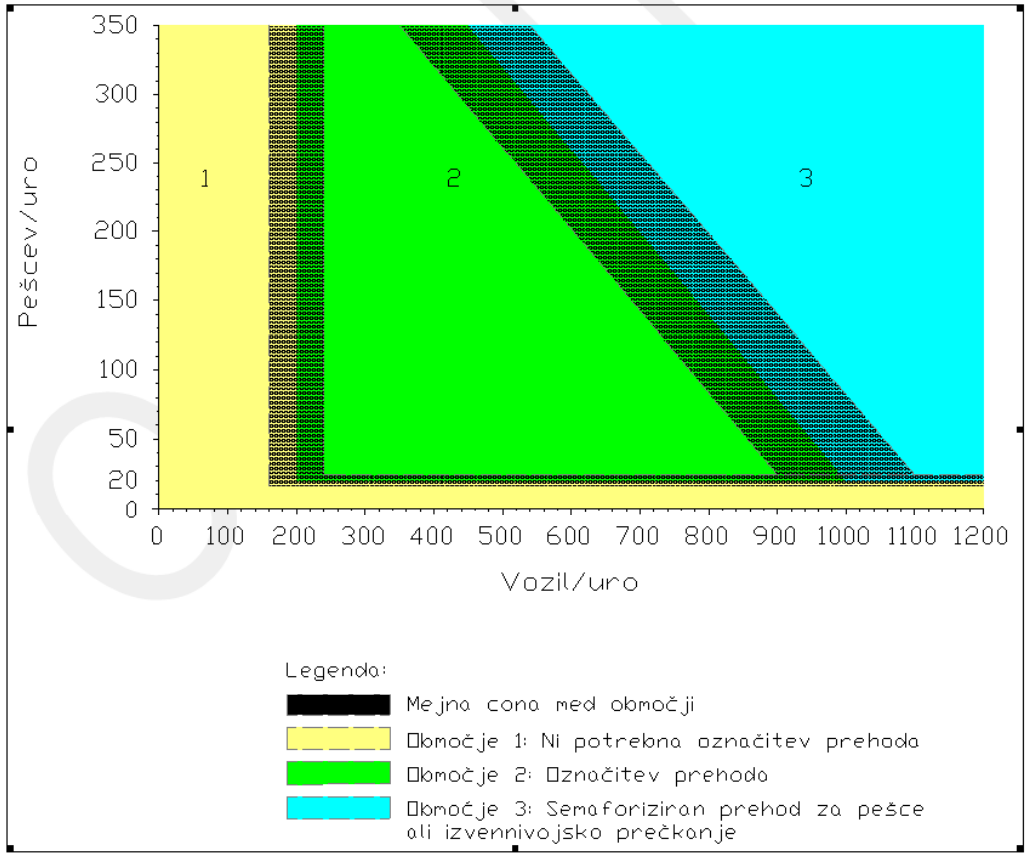
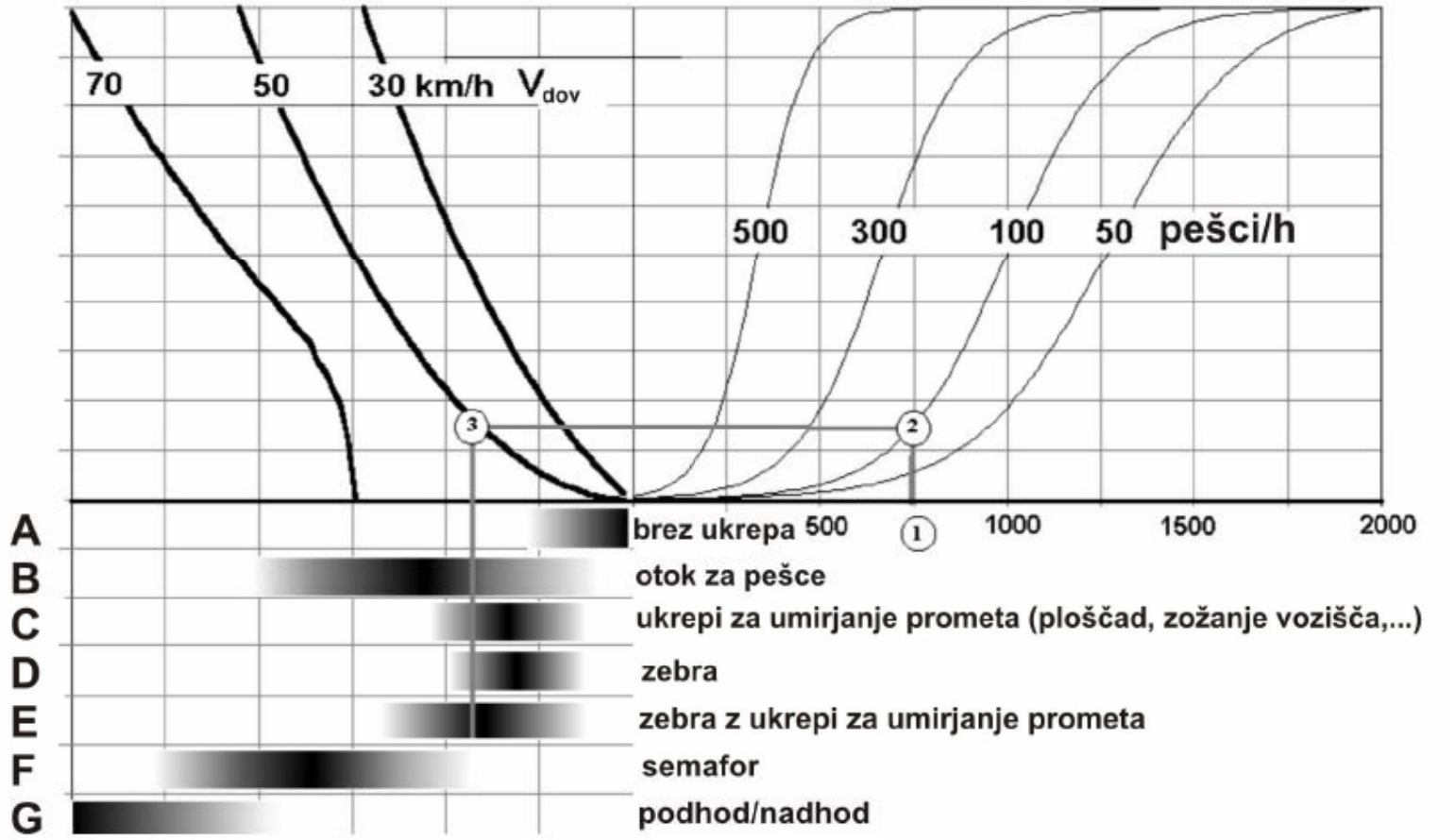


Diagram: Pogoji za določitev nivoja urejanja prehodov za pešce


70
50
30 km/h V_{dov}
500
300
100
50 pešci/h
3
2
1
500
1000
1500
2000
A brez ukrepa
B otok za pešce
C ukrepi za umirjanje prometa (ploščad, zožanje vozišča,...)
D zebra
E zebra z ukrepi za umirjanje prometa
F semafor
G podhod/nadhod

SOUTH EAST EUROPE
Transnational Cooperation Programme

ROSEE
ROad safety in South East European regions

Programme co-funded by the EUROPEAN UNION

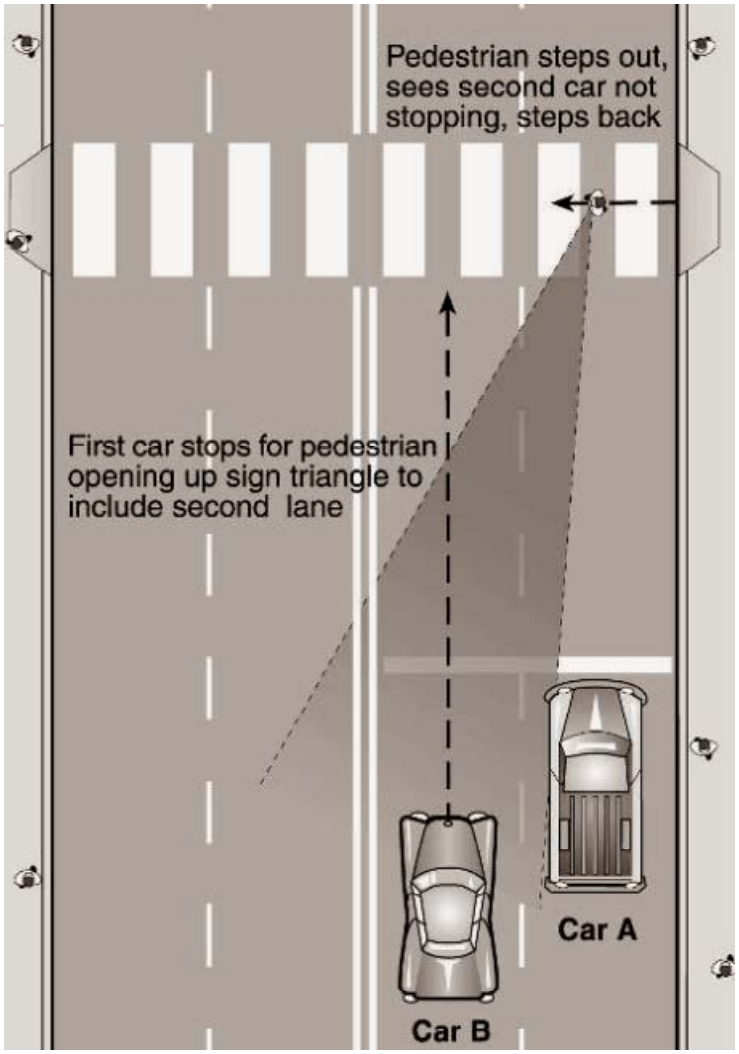
Univerza v Ljubljani

Povečanje učinkovitosti prehodov :

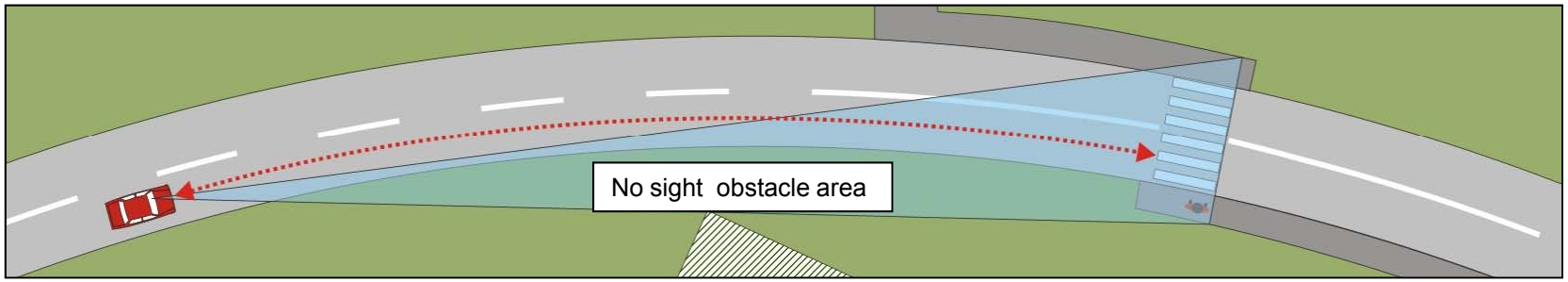
- pravilna lokacija
- dobro vidne oznake
- osvetlitev
- zamaknjene STOP črte
- sredinski otoki
- čakalne površine
- SSN

Preglednost

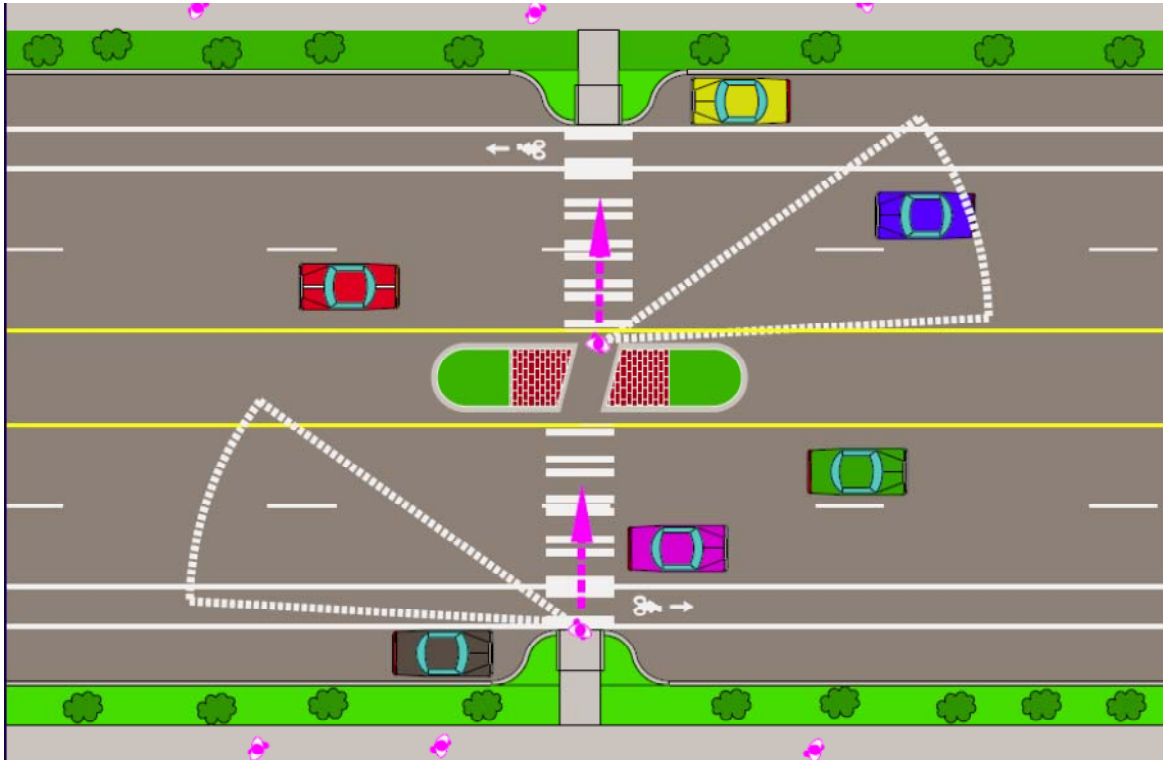
- advanced stop/yield line;



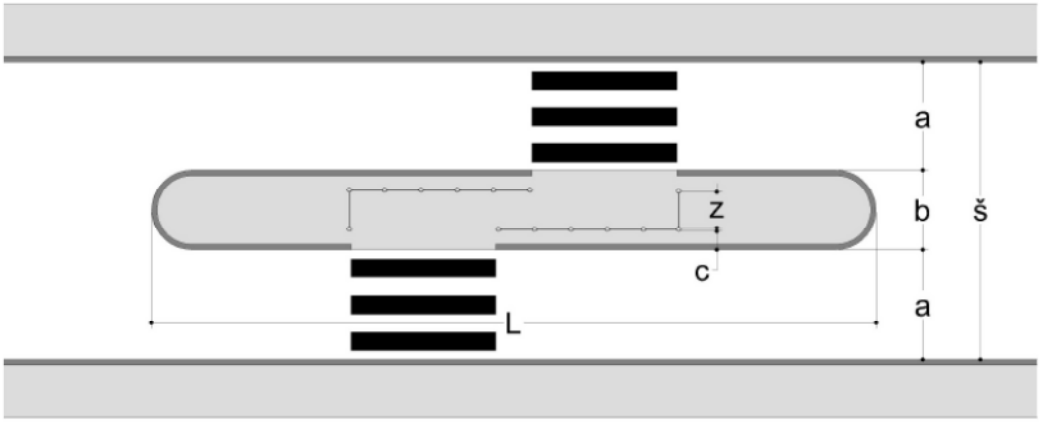
Preglednost



Prehod preko otoka

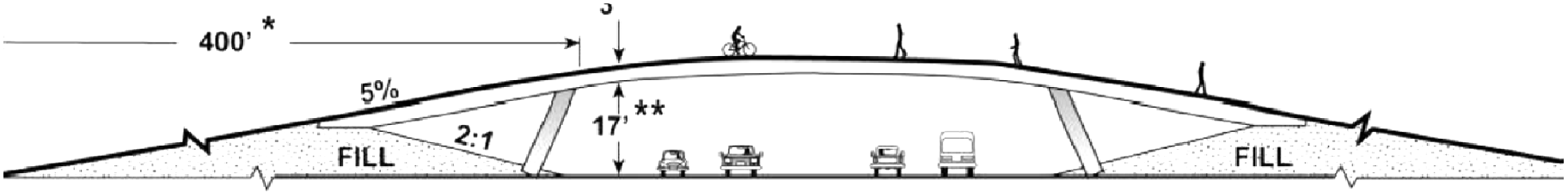


Zamaknjen prehod

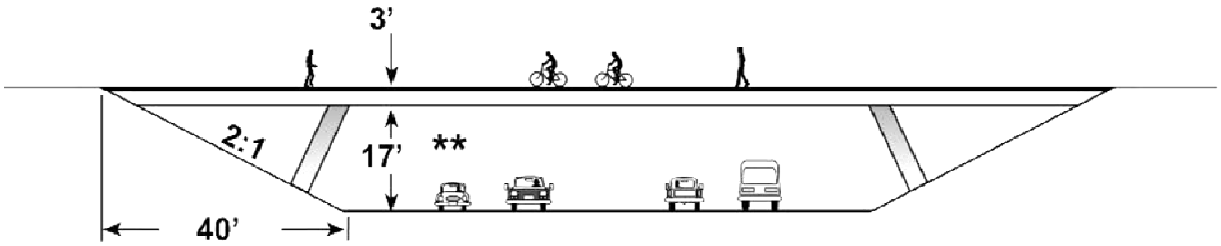


Nadhod

- Je drag zaradi potrebnih dolgih ramp

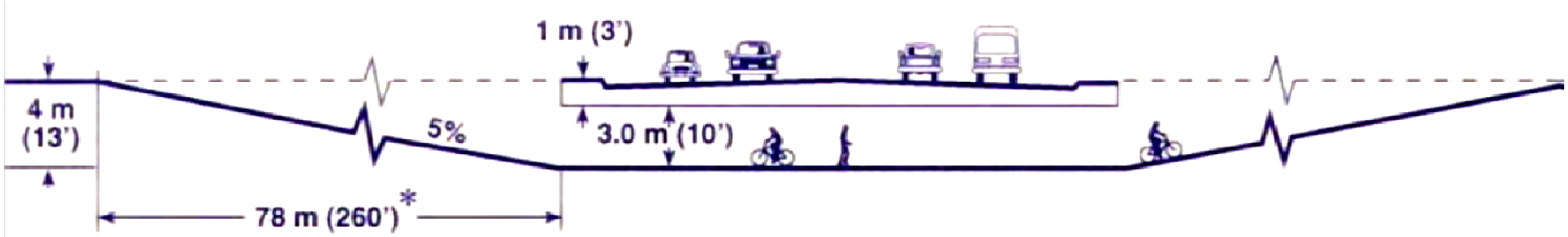


- Bolje, če je cesta spuščena in je prehod na nivoju



Podhod

- Dolge rampe – pešci morajo pod zemljo



- Bolje, če je cesta avtomobilska in je prehod na nivoju