

Design Guidelines for Rural Roads in Germany - Current Situation

Rural Design Meeting

Oslo, 29-30th of March 2011

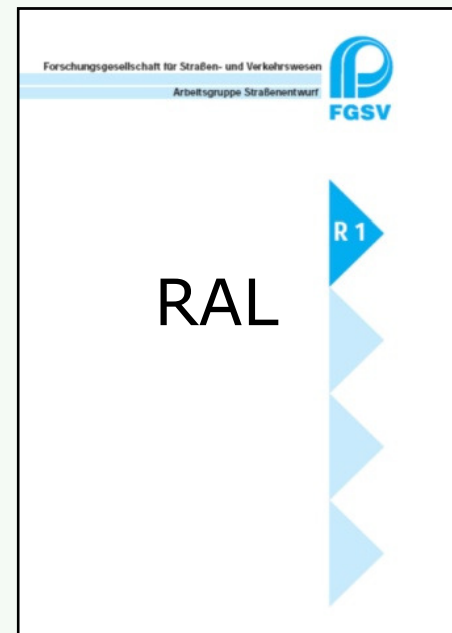
Kerstin Lemke

Rural Design Guidelines in Germany

In 2008 draft version was sent to Federal States road authorities for comments and approval.

2009/2010 Discussions with road traffic regulation authorities.

Next draft to be finished in summer.



Link Categorisation

City classes:

OZ = upper center

MZ = middle center

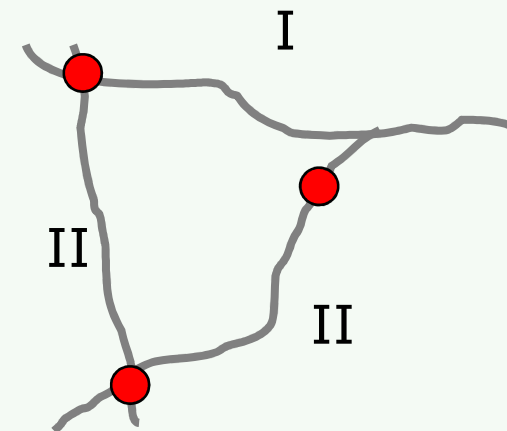
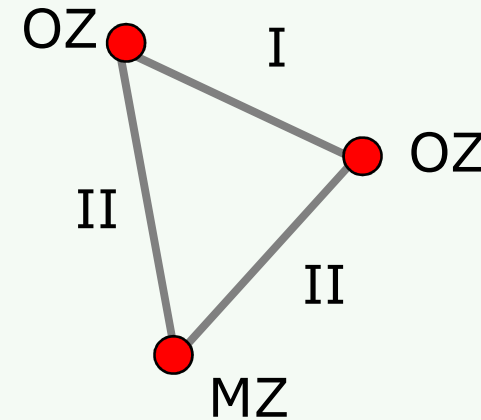
GZ = basic center

Linking classes:

OZ - OZ = I

MZ - MZ = II

...



German Road Categories (RIN)

Kategoriengruppe		Autobahnen	Rural	anbaufreie Hauptverkehrsstraßen	angebaute Hauptverkehrsstraßen	Erschließungsstraßen
Verbindungsfunktionsstufe		AS	LS	VS	HS	ES
kontinental	0	AS 0		-	-	-
großräumig	I	AS I	LS I		-	-
überregional	II	AS II	LS II	VS II		-
regional	III	-	LS III	VS III	HS III	
nahräumig	IV	-	LS IV	-	HS IV	ES IV
kleinräumig	V	-	LS V	-	-	ES V

AS I	vorkommend, Bezeichnung der Kategorie
-	nicht vorkommend oder nicht vertretbar
	problematisch

RAL

Road Category as Input Data for Design

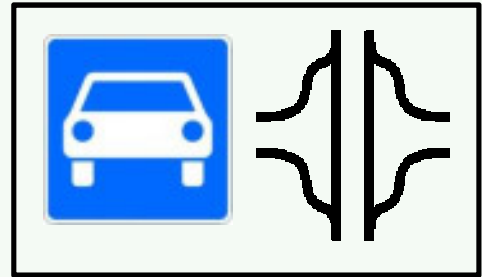
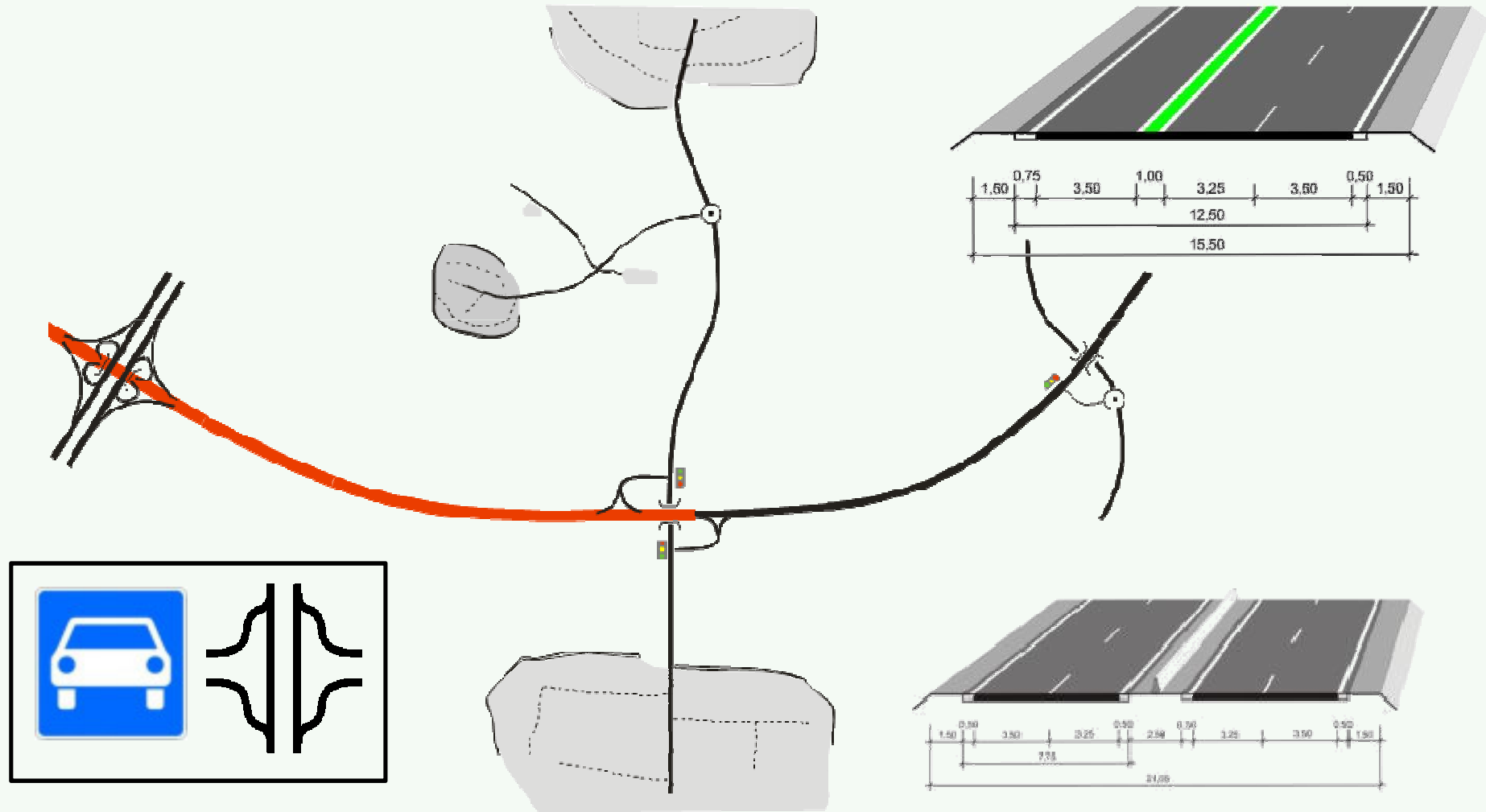
Road Category	Design Class
LS I	EKL 1
LS II	EKL 2
LS III	EKL 3
LS IV	EKL 4

Up- and Downgrade of Design Class

Road Category	Upgrade at AADT [veh/24h]	Downgrade at AADT [veh/24h]
LS I		< 10.000
LS II	> 17.000	< 7.000
LS III	> 15.000	
LS IV	> 3.000	

Values to be proved.

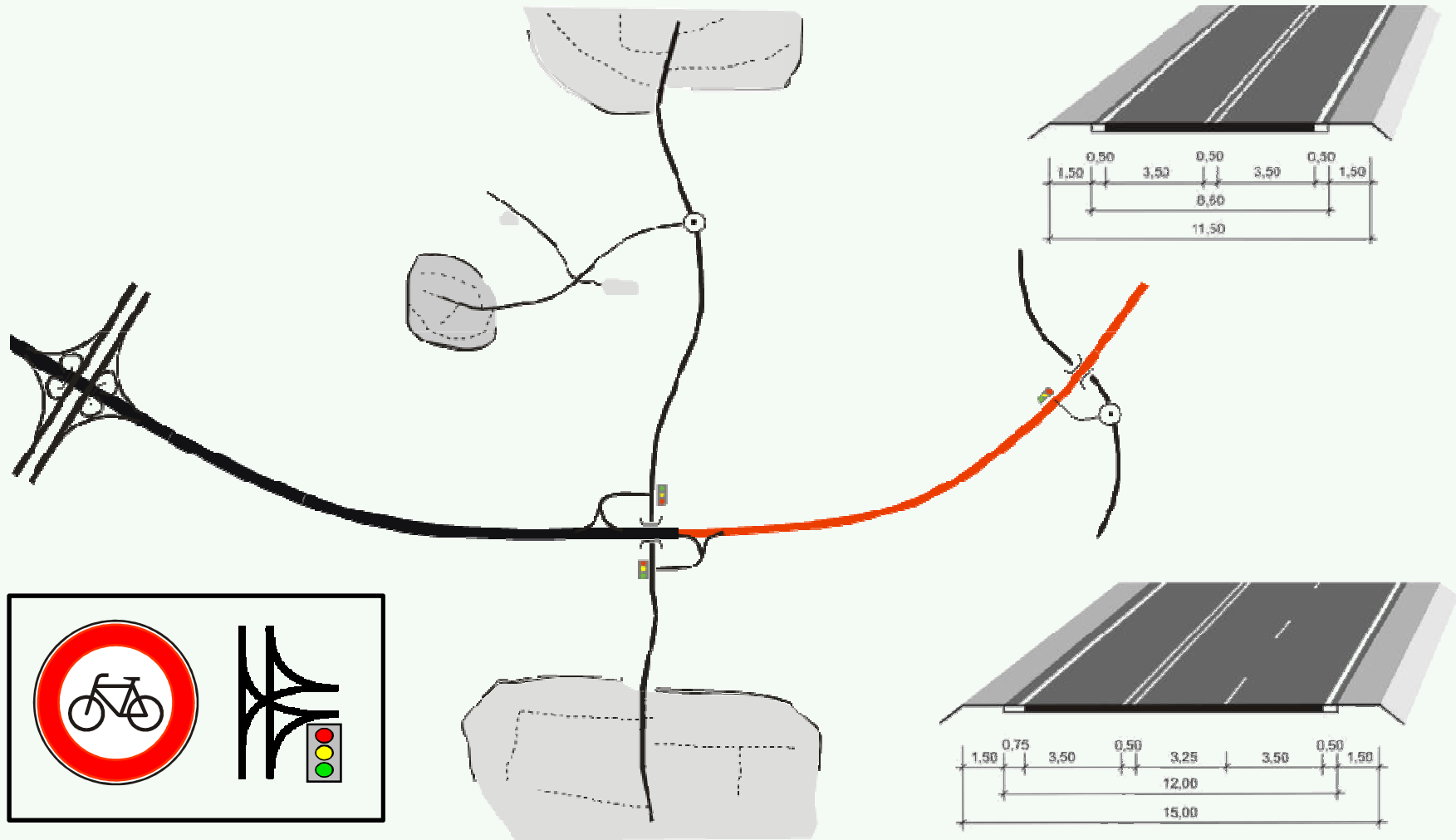
EKL 1 (RAL)



EKL 1 (RAL)



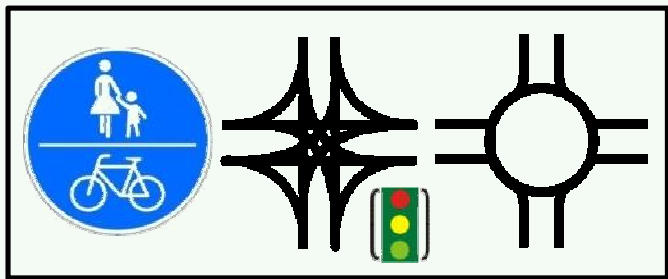
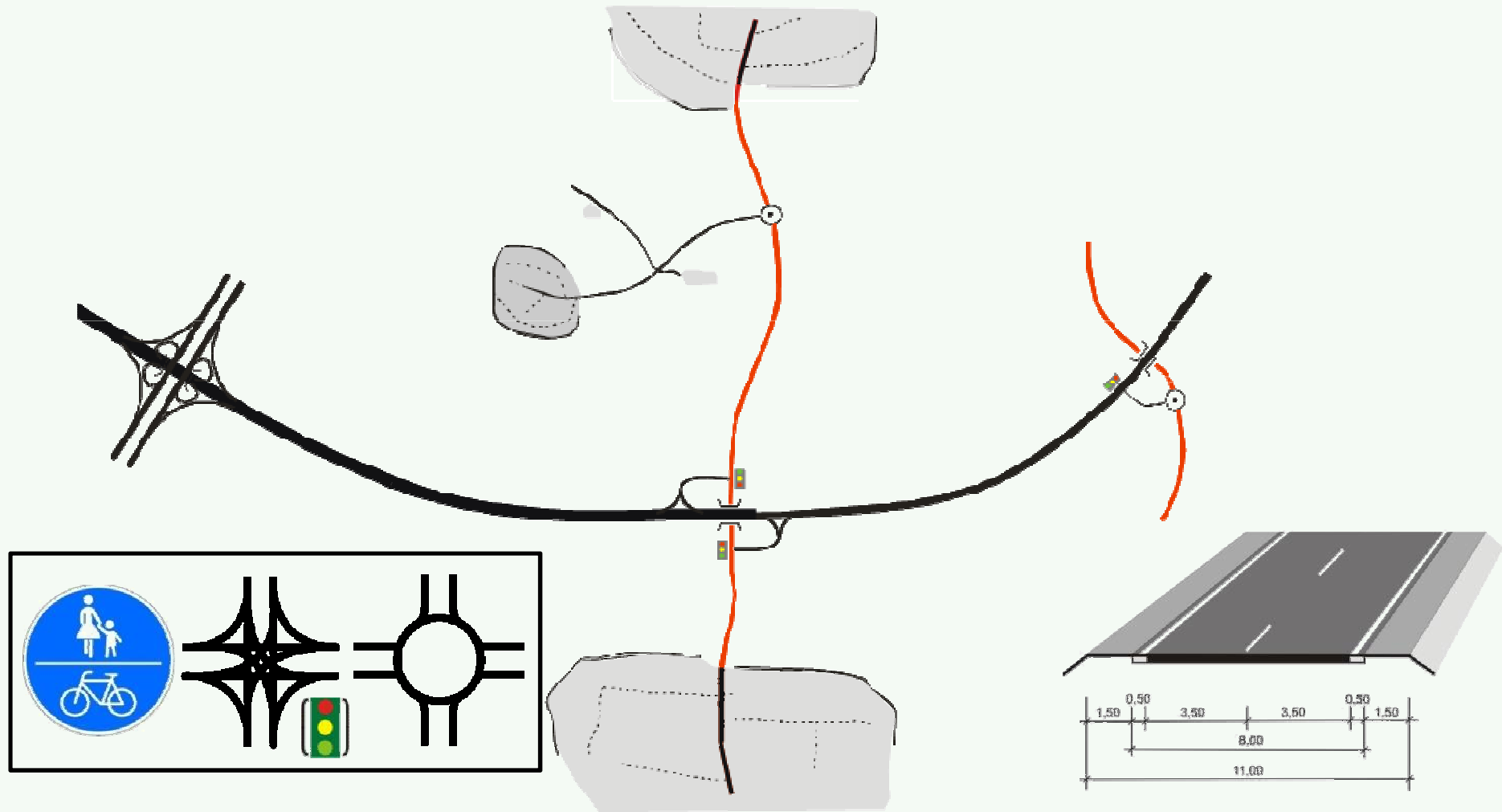
EKL 2 (RAL)



EKL 2(RAL)



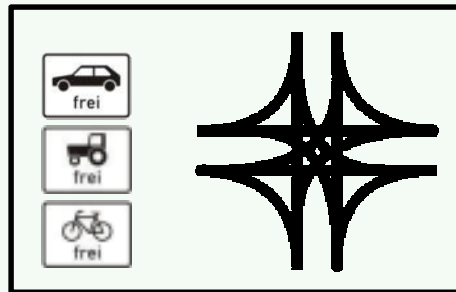
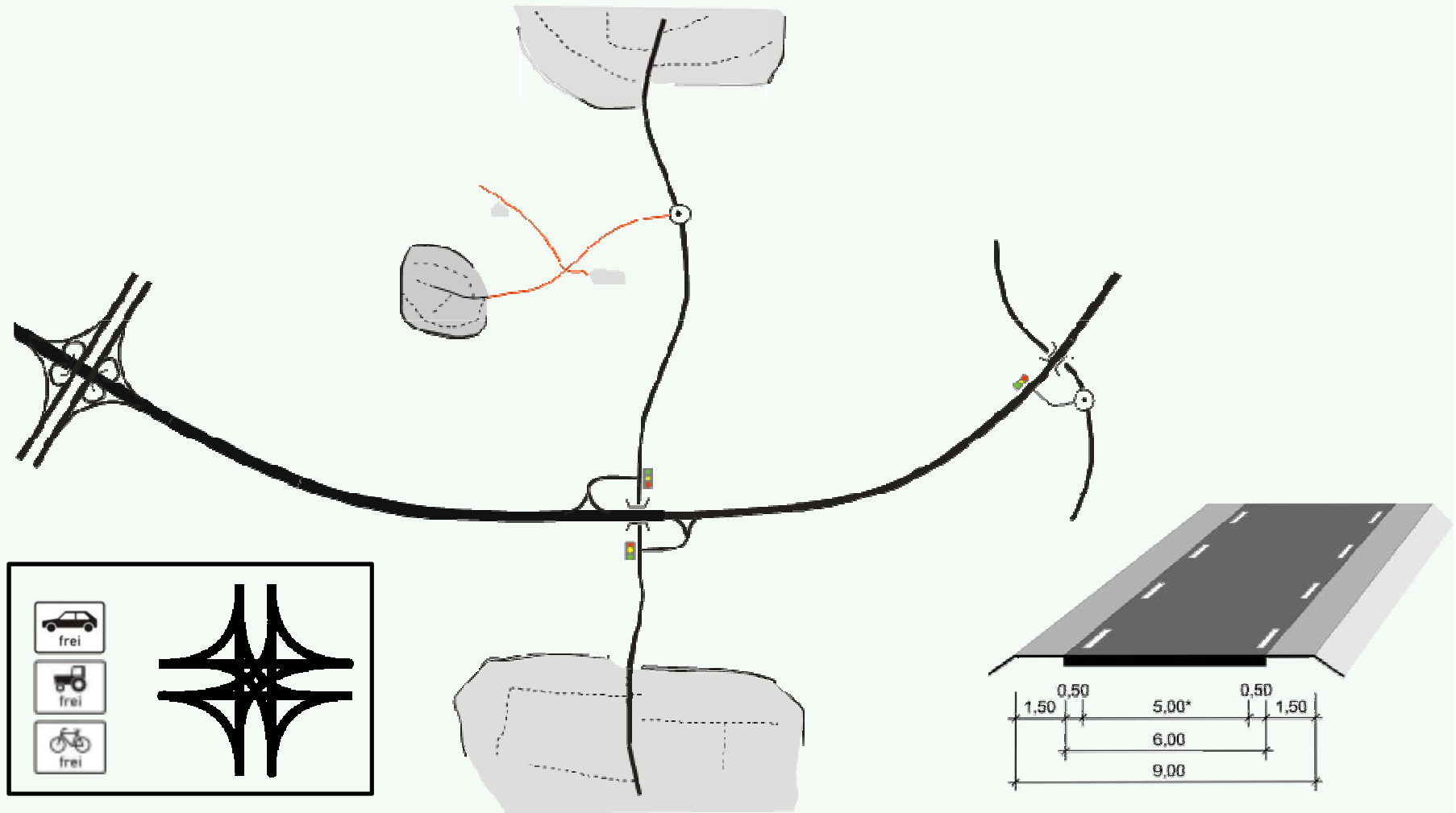
EKL 3 (RAL)



EKL 3 (RAL)



EKL 4 (RAL)



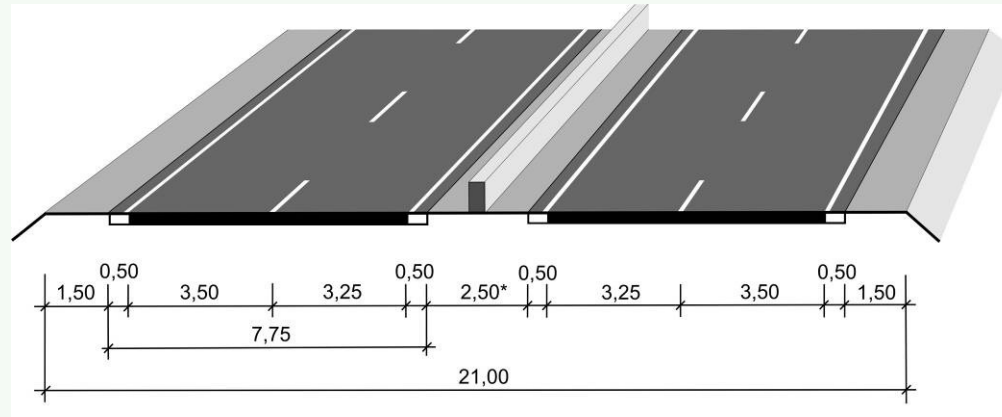
EKL 4 (RAL)



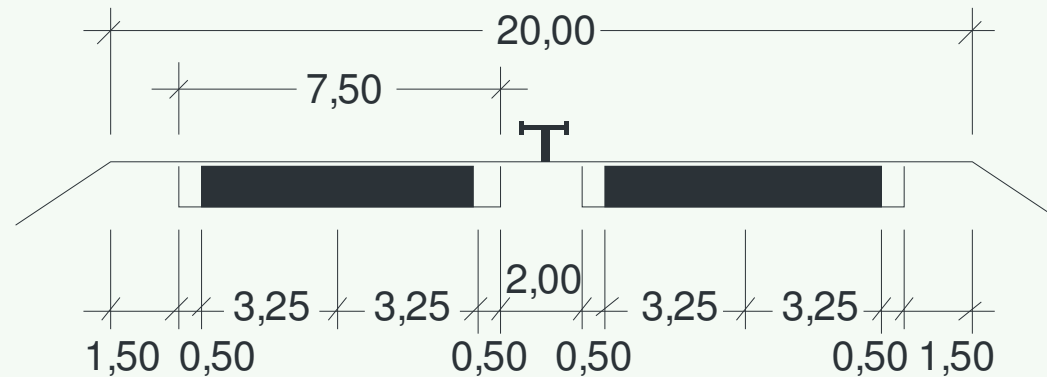
Narrow 4-lane sections for rural roads

Up to 30.000 veh/d and 15 km

RQ 21
(RAL)

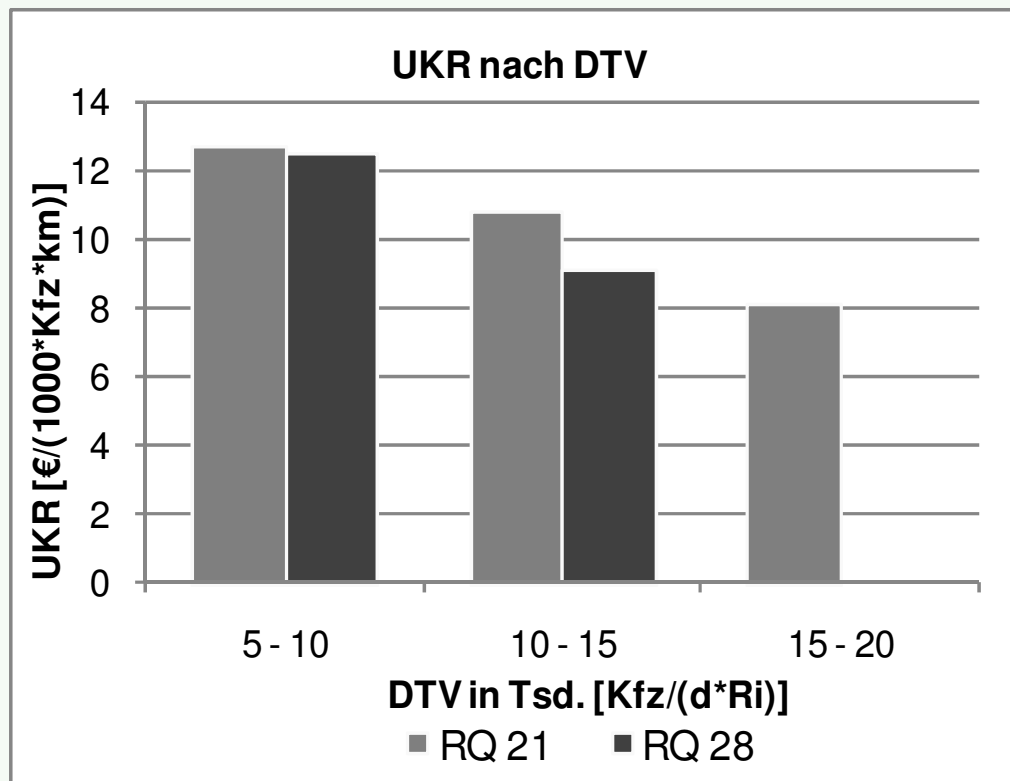


RQ 21
(RAS-Q 96)



Safety of small dual-carriageway roads

Accident cost rate per AADT in one direction



compared to
smallest
motorway cross
section (RQ 28)

Maier, Berger (2011)

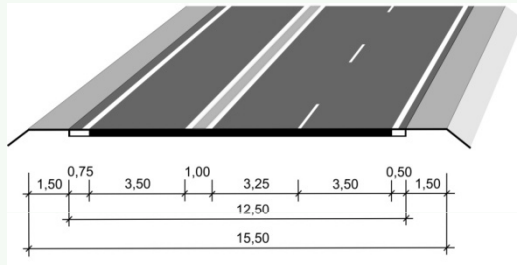
Cost-Benefit Analysis

Comparison of old and new cross sections

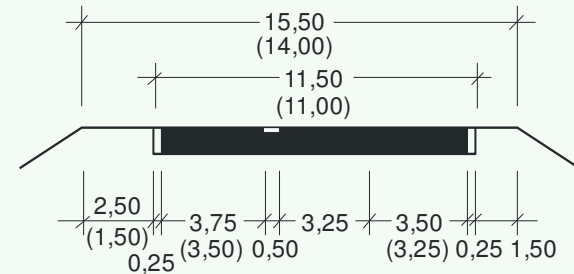
RAL draft

RAS-Q 96

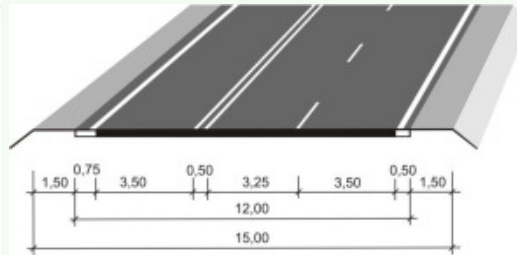
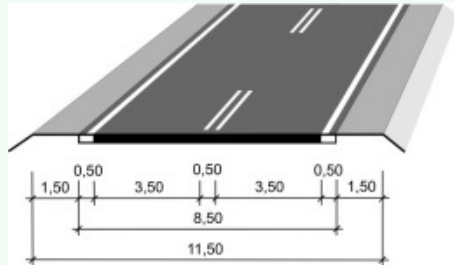
RQ
15,5



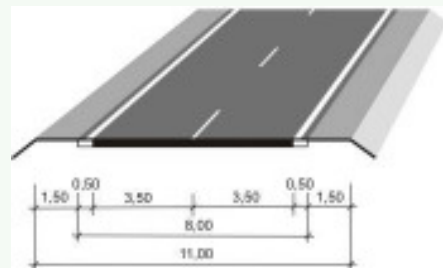
RQ 15,5



RQ
11,5+

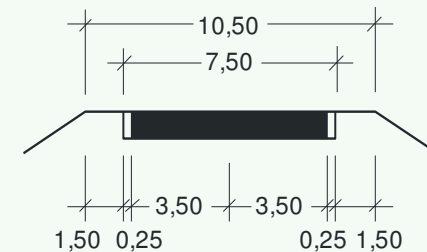


RQ 11



RQ 10,5

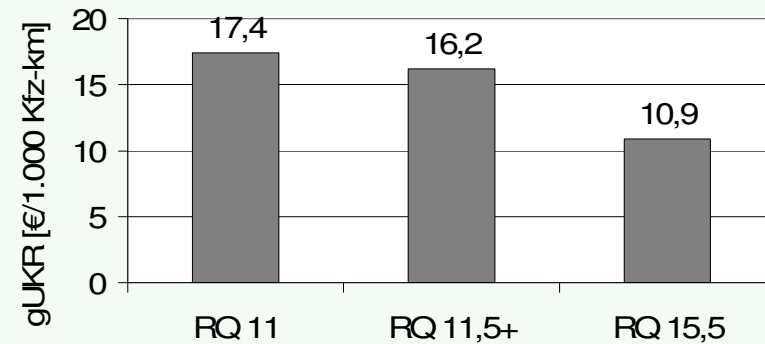
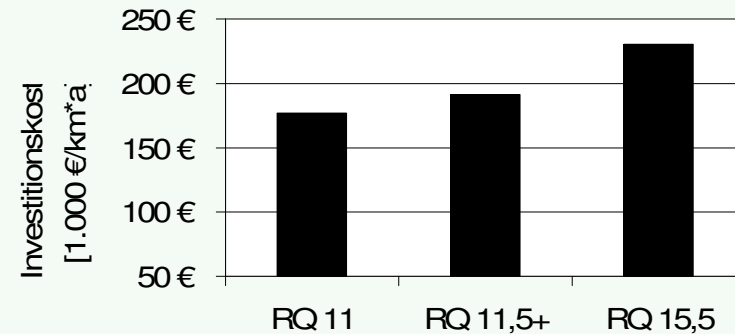
(RQ 26)



Thresholds for up- and downgrade

Cost benefit analysis with

1. Investment Costs
2. Road Operation Costs
3. Accident Costs
4. Travel Time Costs



Safety Effects

Analysis of different rural road layouts by Vieten, Dohmen (2009)

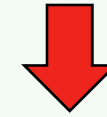
	federal	state	municipal
Datenumfang	Bundesstraßen	Landesstraßen	Kreisstraßen
Anzahl außerorts	17.045	16.439	5.033
Länge außerorts	15.673 km	19.478 km	5.679 km
Anzahl innerorts	4.416	6.563	4.430
Länge innerorts	2.204 km	3.160 km	1.765 km

Outside built-up

built-up

Road and accident data from databases.

Safety Effects of Cross Section



Fahrbahn-breite	gUR [U/1 Mio. Kfz-km]	Ø Kosten je Unfall	gUKRa [€/1.000 Kfz-km]
Einbahnige 1+1-Querschnitte			
5,00m	0,39	80.371 €	31,3
5,50m	0,34	98.089 €	33,4
6,00m	0,44	94.038 €	41,4
6,50m	0,37	92.915 €	34,4
7,00m	0,31	97.713 €	30,3
7,50m	0,30	85.250 €	25,6
8,00m	0,18	96.389 €	17,4
8,50m	0,19	92.167 €	17,5
Einbahnige 2+1-Querschnitte			
10,00m bis 12,50m	0,15	75.279 €	11,3
Zweibahnige 2+2-Querschnitte			
14,00m bis 17,00m	0,12	63.994 €	7,7

Tab. 47: Grundunfallkostenraten für freie Streckenabschnitte (Basis: UT 1-7, PS, SS)

Fahrbahn-breite	UKRa [€/1.000 Kfz-km]	gUKRa [€/1.000 Kfz-km]	Verhältnis gUKRa/UKRa
Einbahnige 1+1-Querschnitte			
5,00m	55,8	31,3	0,561
5,50m	63,8	33,4	0,524
6,00m	57,9	41,4	0,715
6,50m	44,5	34,4	0,773
7,00m	36,0	30,3	0,842
7,50m	31,2	25,6	0,821
8,00m	23,9	17,4	0,728
8,50m	23,1	17,5	0,758
Einbahnige 2+1-Querschnitte			
11,00m bis 12,00m	14,8	11,3	0,764
Zweibahnige 2+2-Querschnitte			
14,50m bis 16,50m	9,8	7,7	0,786

Tab. 49: Vergleich der mittleren Unfallkostenraten und der Grundunfallkostenraten für freie Streckenabschnitte (Basis: UT 1-7, PS, SS)

Without junctions

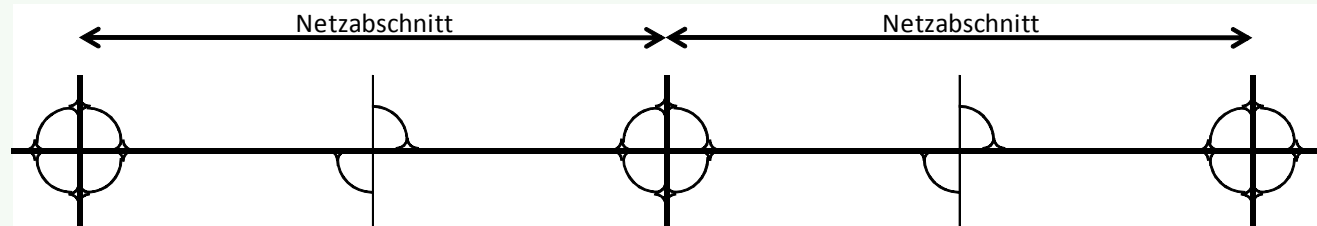
Vieten, Dohmen (2009)

Question

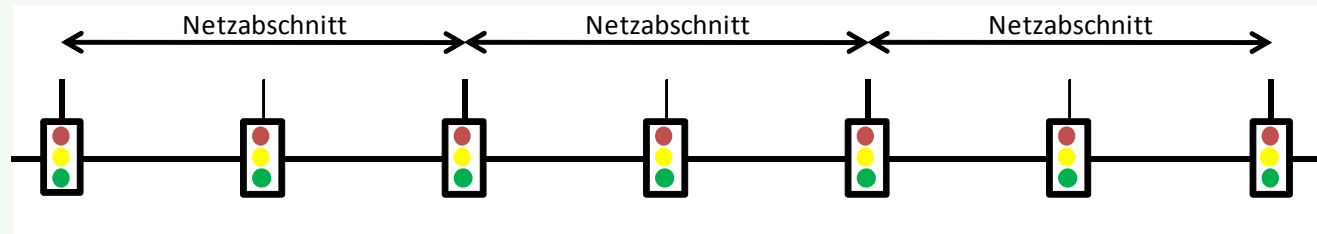
- What is the safety impact of the middle strip?

Model Stretches for Travel Time Estimation

EKL 1

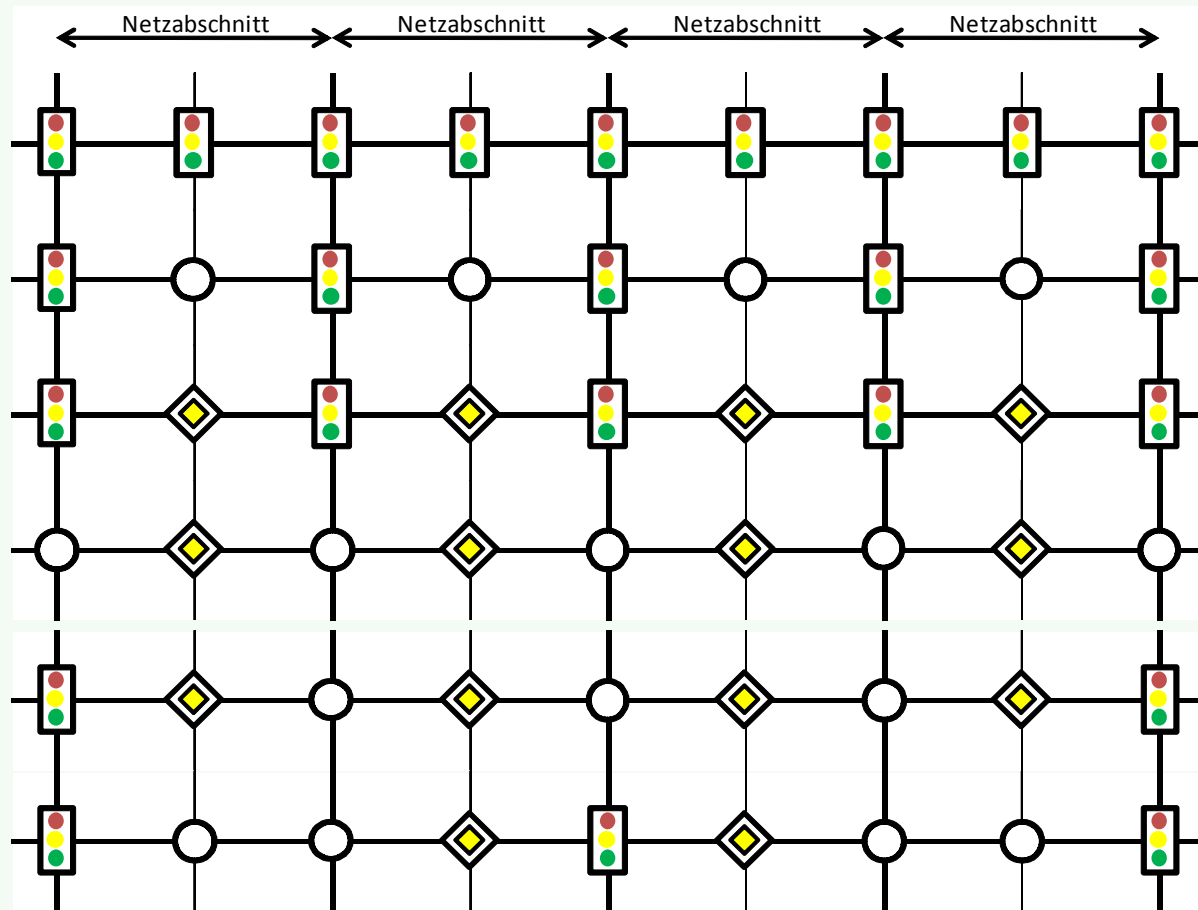


EKL 2

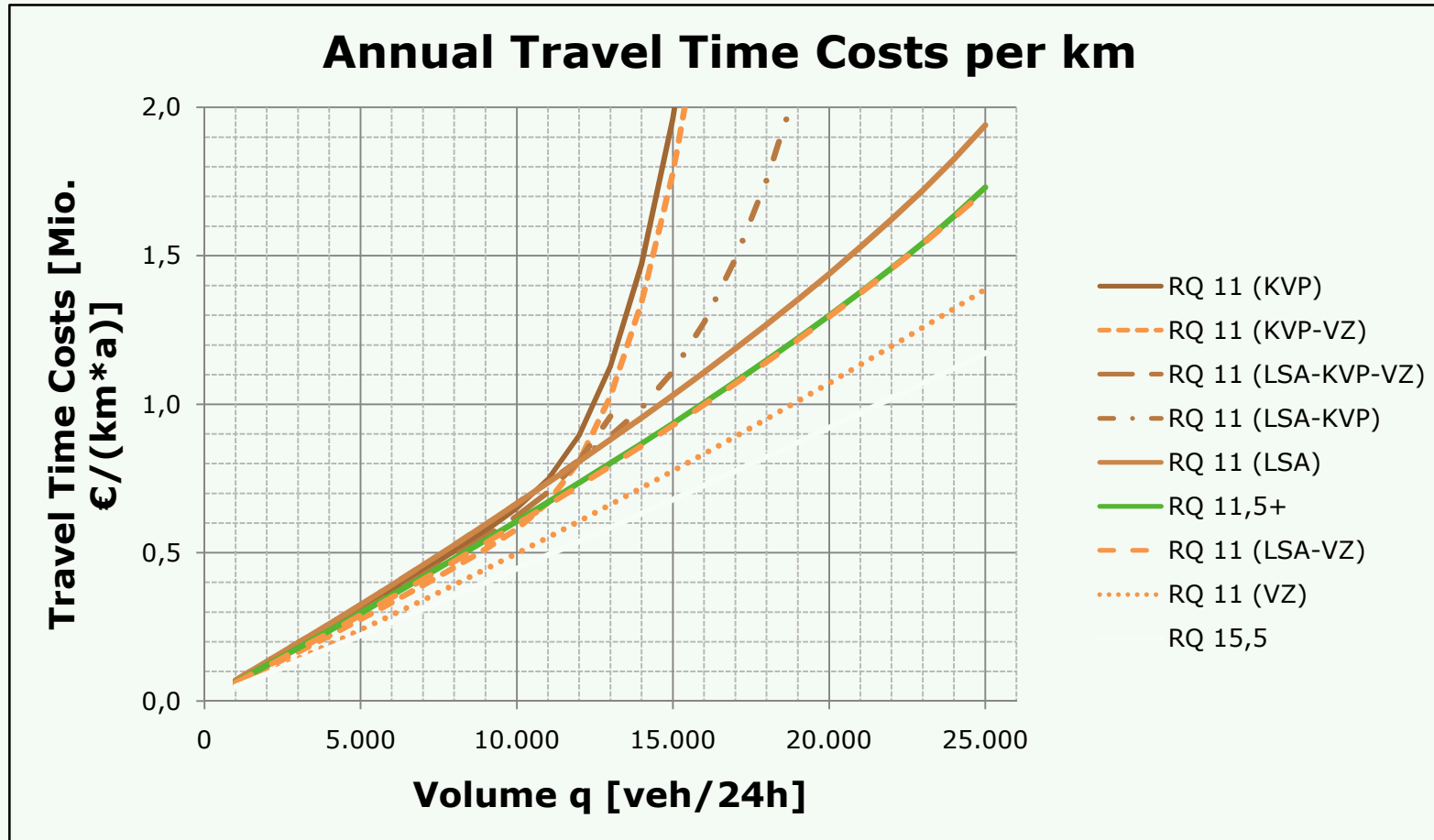


Model Stretches for Travel Time Estimation

EKL 3

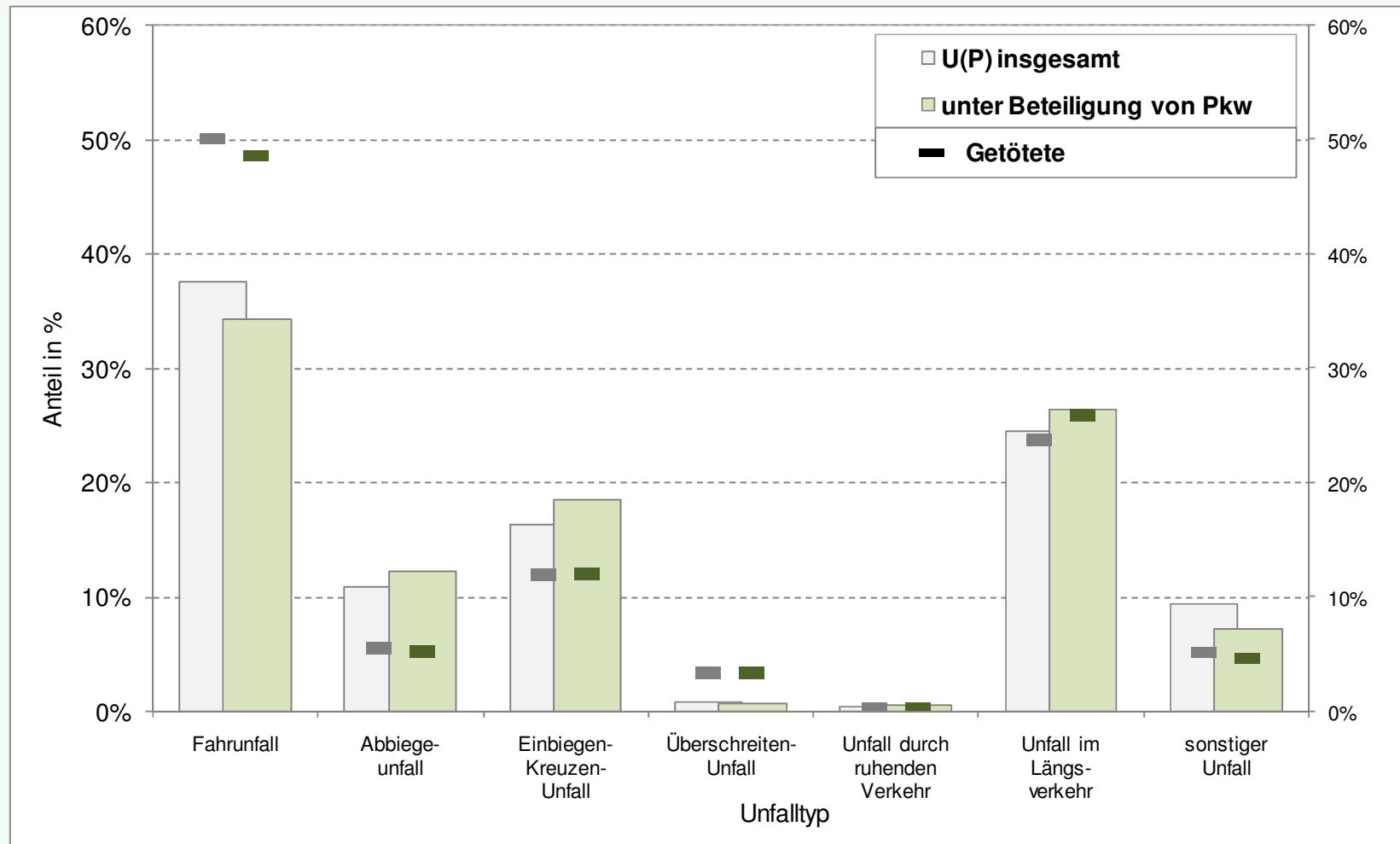


Travel Time Estimation



2-1 roads

Accident Types on Rural Roads

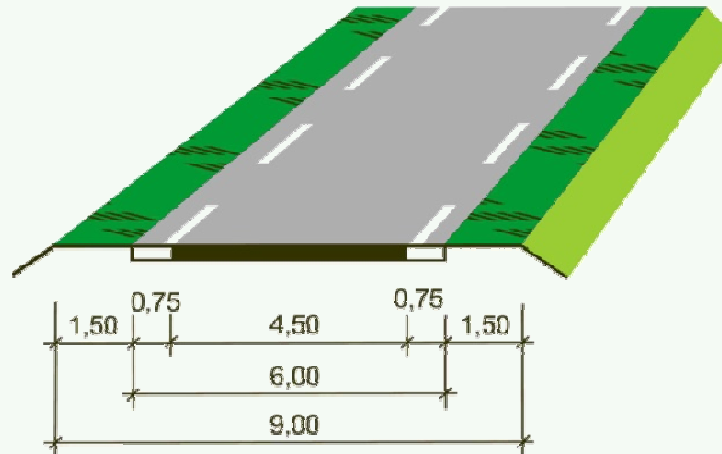


Quelle: Unfallgeschehen auf Landstraßen – Eine Auswertung der amtlichen Straßenverkehrsunfallstatistik (Heinrich et al., 2009)

Effects of road markings on driving behavior

AIM:

To develop traffic safety-enhancing recommendations for the cross-section layout and the marking of 2-1-roads



Effects of road markings on driving behavior

METHOD:

- Analysis of various layouts in a simulator
- Analysis of this layout under real conditions

RESEARCH INSTITUTES:

Technical University Dresden

→ B. Schlag, C. Lippold

→ J. Voigt, K. Enzfelder



Analysis of various layouts in a simulator



Analysis of various layouts in a simulator

1	6.00 m total width	Ø V₈₅ (km/h)	Ø distance (m)
Before	ES=0.25m DS=5.50m (separated lanes)	97,0	0,47
After	ES=0.75m DS=4.50m	+ 2,6	+ 0,31
	ES=1.00m DS=4.00m	+ 1,0	+ 0,40

ES...Edge Strip, DS...Driving Strip

Analysis of various layouts in a simulator

2	5.50 m total width	Ø V₈₅ (km/h)	Ø distance (m)
Before	ES=0.25m DS=5.00m (separated lanes)	107,0	0,35
After	ES=0.75m DS=4.00m	- 5,0	+ 0,30
	ES=1.00m DS=3.50m	- 8,0	+ 0,36

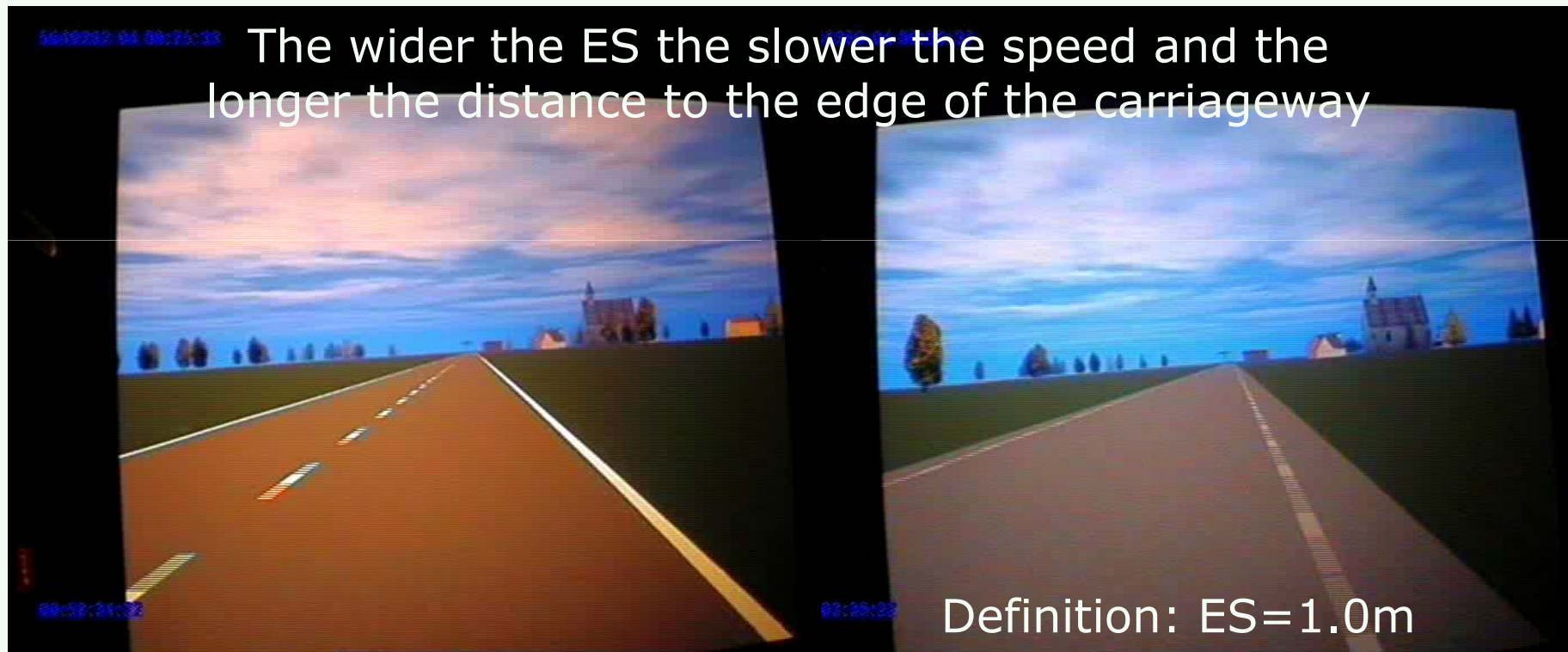
ES...Edge Strip, DS...Driving Strip

Analysis of various layouts in a simulator

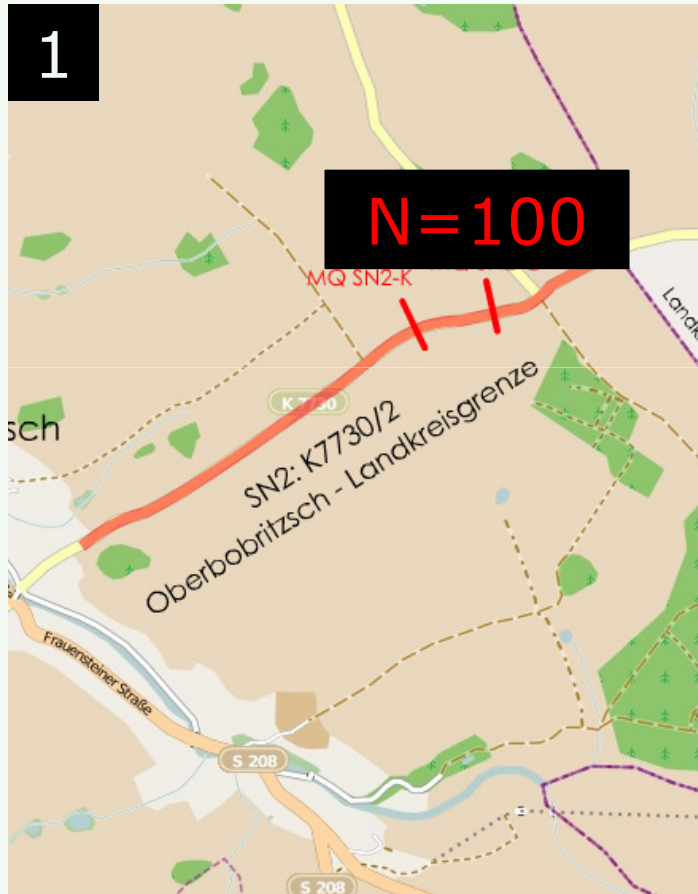
3	5.00 m total width	Ø V₈₅ (km/h)	Ø distance (m)
Before	ES=0.25m DS=4.50m (lanes not separated)	97,0	0,35
After	ES=0.75m DS=3.50m	- 1,5	+ 0,18
	ES=1.00m DS=3.00m	- 2,0	+ 0,22

ES...Edge Strip, DS...Driving Strip

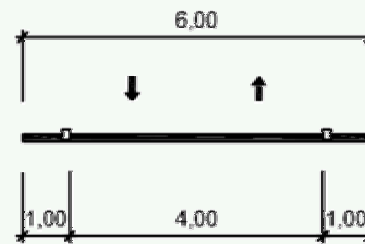
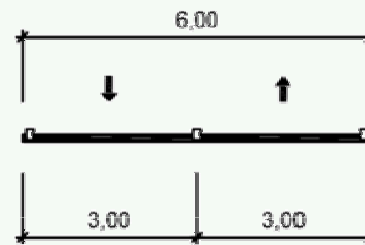
Analysis of various layouts in a simulator



Analysis of this layout under real conditions



(1) **(2)**

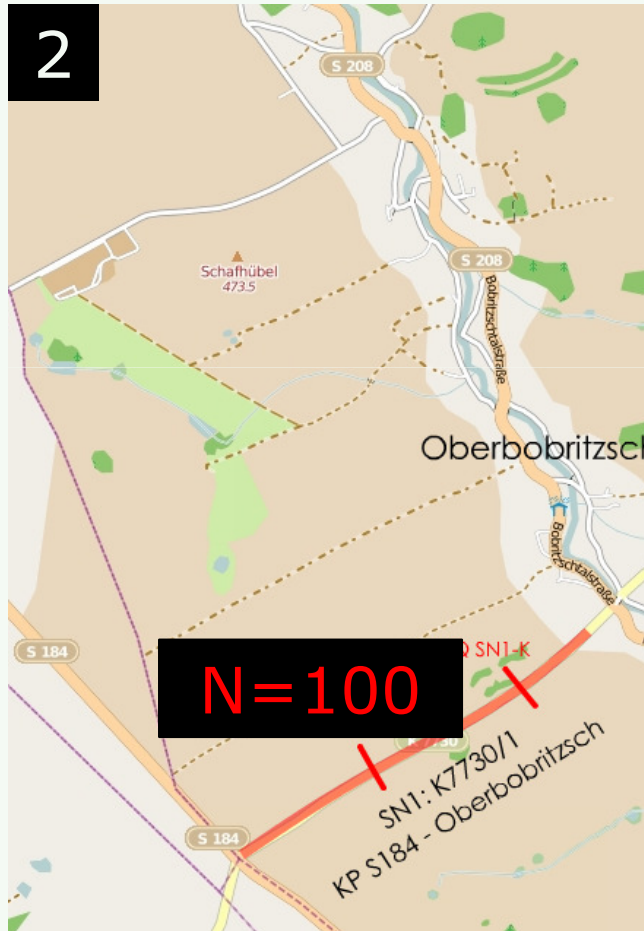


(1) $V_{85} = 91 \text{ km/h}$
(2) $V_{85} = 97 \text{ km/h}$

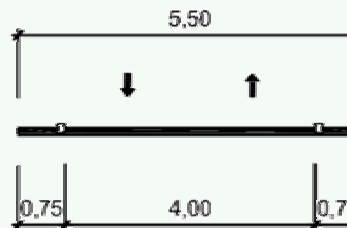
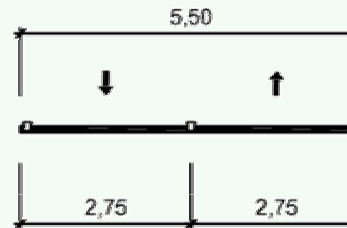


(1) $V_{85} = 89 \text{ km/h}$
(2) $V_{85} = 90 \text{ km/h}$

Analysis of this layout under real conditions



(1) (2)



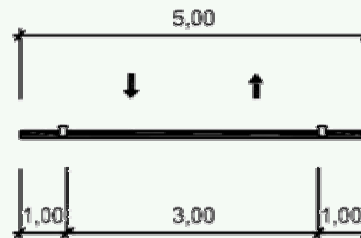
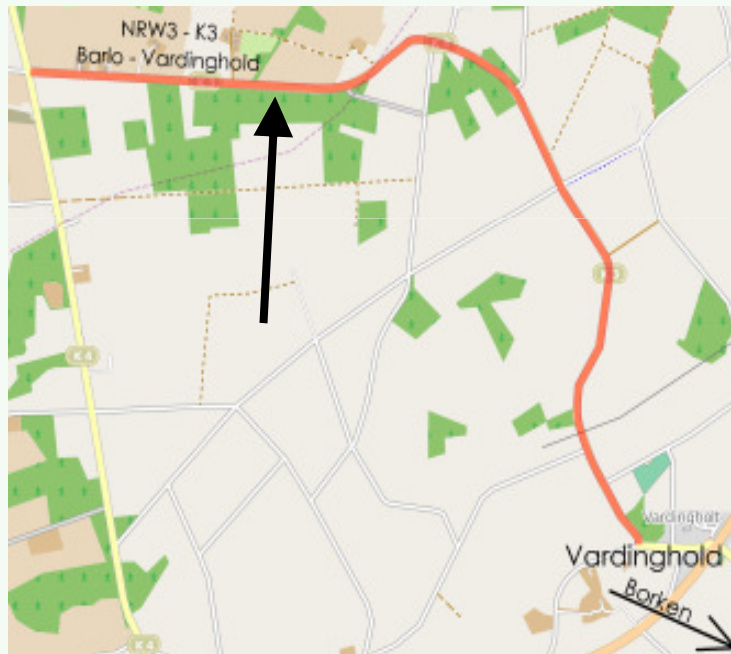
(1) $V_{85} = 86 \text{ km/h}$
 (2) $V_{85} = 99 \text{ km/h}$



(1) $V_{85} = 82 \text{ km/h}$
 (2) $V_{85} = 97 \text{ km/h}$

Analysis of this layout under real conditions

3



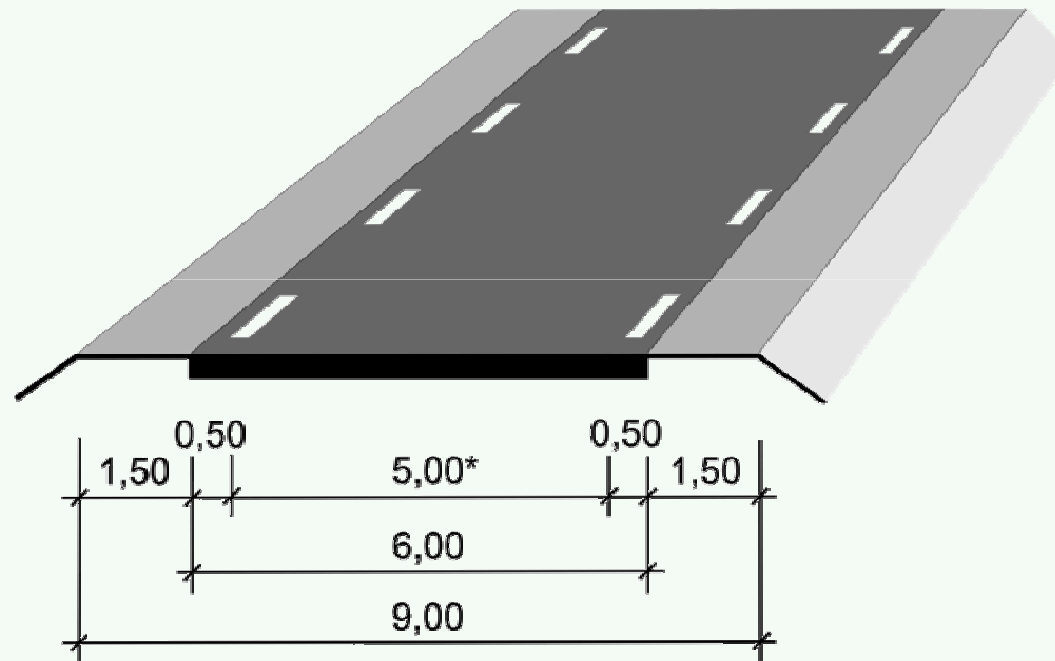
Conclusion

- A 2-1 road is an appropriate way to increase the distance of road users from the edge of the road
→ less run off the road crashes?
- A 2-1 road is not a measure to reduce speeds
→ even in situation with oncoming traffic a speed reduction could not observed

Question

- What will be the safety effect of the new cross section?

Present status in the draft rural design guideline



Road Traffic Regulations

Current Regulation:

Interrupted line marking on the edge of the road = protection strip, protection strips are only permitted inside urban areas

⇒ Make edge strip too small for bicycles

Our suggestion for road traffic regulations:

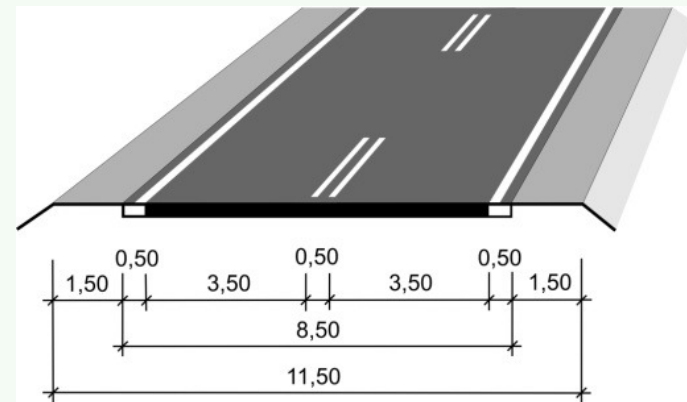
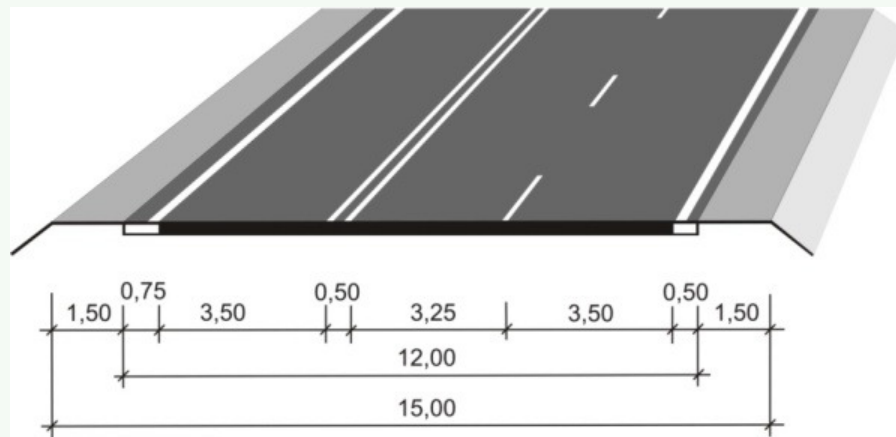
Outside urban areas cross section up to 6 m width may be marked with an interrupted edge line (max. 0,50 m). Then middle markings are not permitted.

Distinction between bicycle lanes and edge strips

Road Traffic Regulations

German Regulation:

Overtaking can only be prohibited when special risk was documented



Road Traffic Regulations

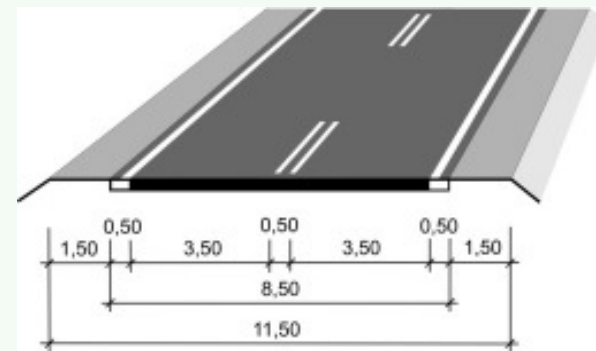
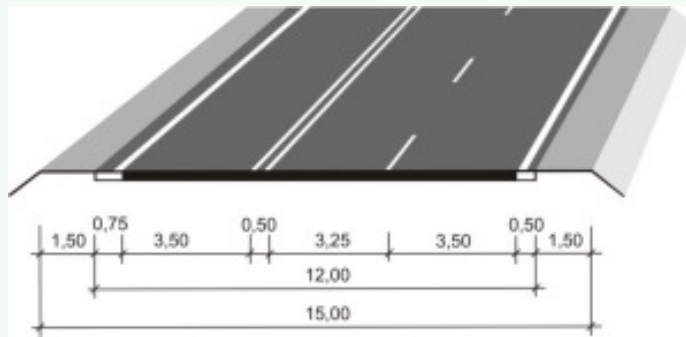
Current Regulation:

Uninterrupted line also as double line

Interrupted double lane does not exist

Our suggestion for road traffic regulations:

Interrupted double lines may be used in 2-lane sections of 2+1 roads



Thanks.