

2+1 Roads, Geometric Design

Experiences from Germany

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- Functional Relationship of the Road Network

Link function level + Category group = Road Category

Category group		Motorways	Rural roads	Trunk roads in non built-up areas	Trunk roads in built-up areas	Local roads
		AS	LS	VS	HS	ES
continental	0	AS 0	problematic	-	-	-
sub-continental	I	AS I	LS I	problematic	-	-
inter-regional	II	AS II	LS II	VS II	problematic	-
regional	III	-	LS III	VS III	HS III	problematic
sub-regional	IV	-	LS IV	-	HS IV	ES IV
local	V	-	LS V	-	-	ES V

Legende:

AS I	Designation of the category as it occurs
problematic	problematic
-	does not occur or is not justifiable



EKL 1 = 2+1 road

- Road Design Guideline principle:

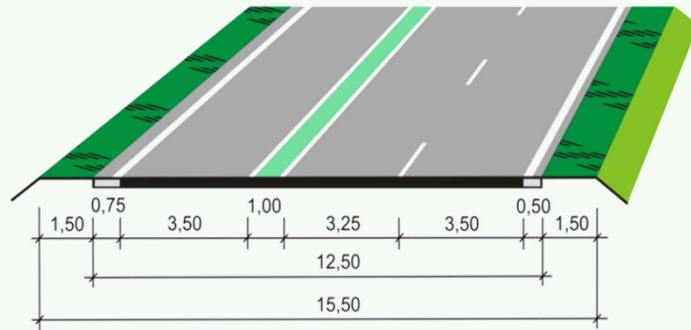
“**standardization**” and “**recognizability**”

- only a **few road types** (design classes) for motorways and rural roads
- as **uniform** as possible within the same design class
- **noticeable difference** to other design classes
- **tight specifications** for different road types (cross-sections, values and design elements, forms of junctions, etc.)

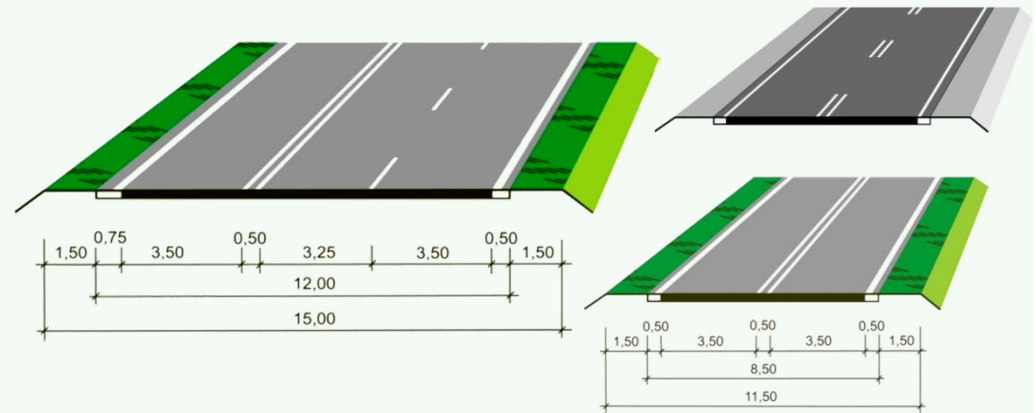
Rural Road Cross-Sections



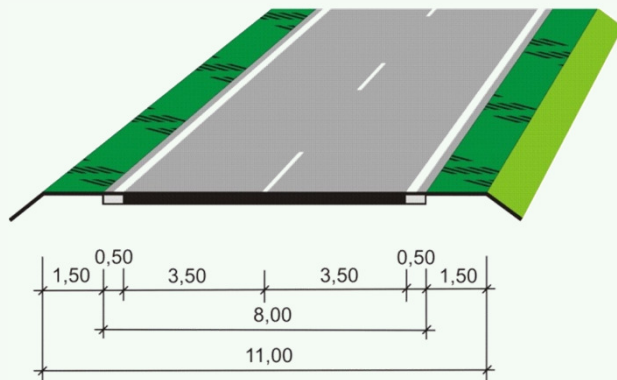
Design Class 1



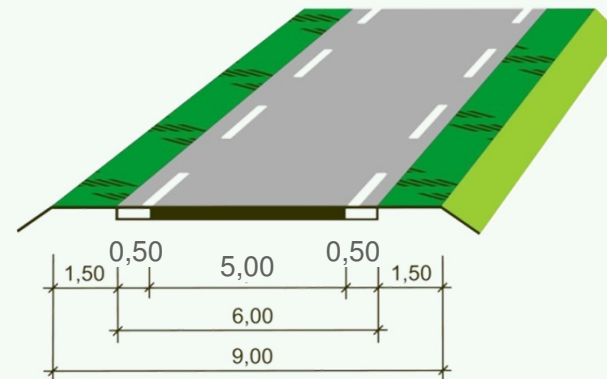
Design Class 2



Design Class 3

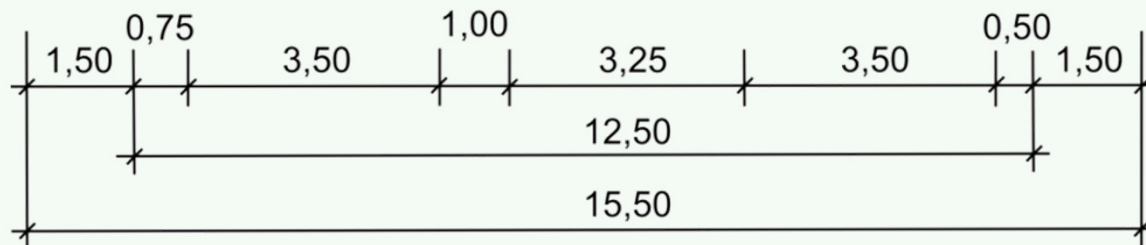
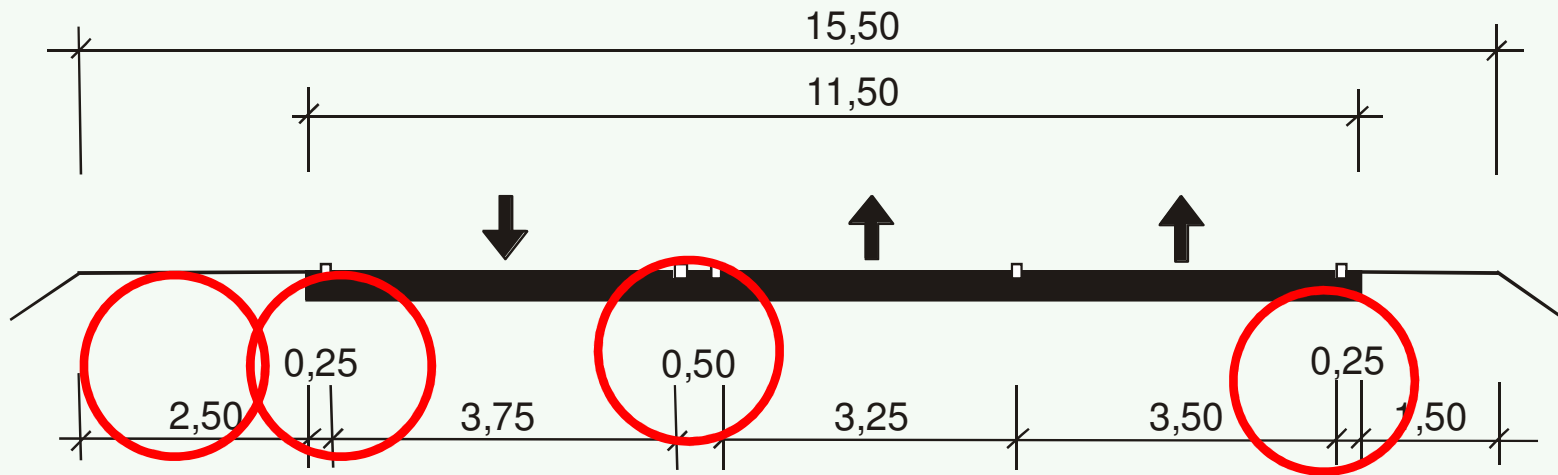


Design Class 4



road marking as the only recognizable road element

RAS-Q vs. RAL



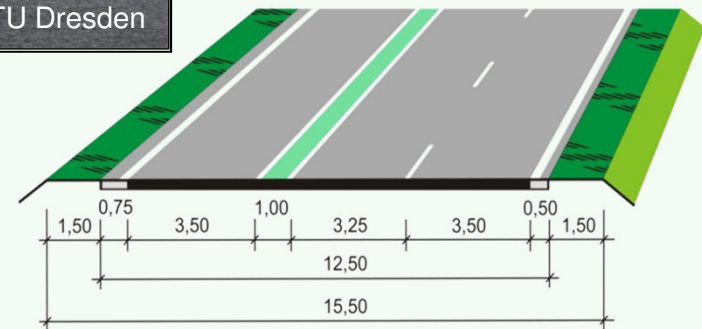
2+1

Design Class 1



long distance traffic
(40-160 km)

AADT:
up to 22.000 veh/d

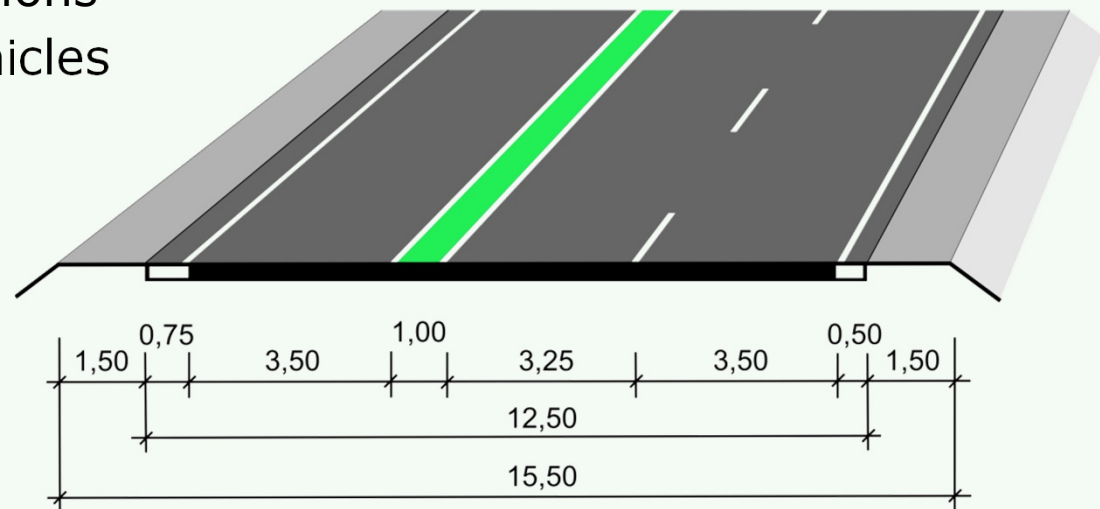


Principles of "2+1"

- continuous alternating passing lane
- 40% safe overtaking opportunities in each direction
- passing lane length 1.000 m to 2.000 m
- directions are separated by a median reserve (green colour)
- emergency lay-by's in the one lane direction (each 1.000 m)
- along a longer distance
- AADT from ~ 12.000 veh/day up to ~ 22.000 veh/day
- only level free intersections
- restriction to motor vehicles

Alignment

- radii: ≥ 500 m
- slope: ≤ 4 %
- crest: ≥ 8.000 m
- sag: ≥ 4.000 m

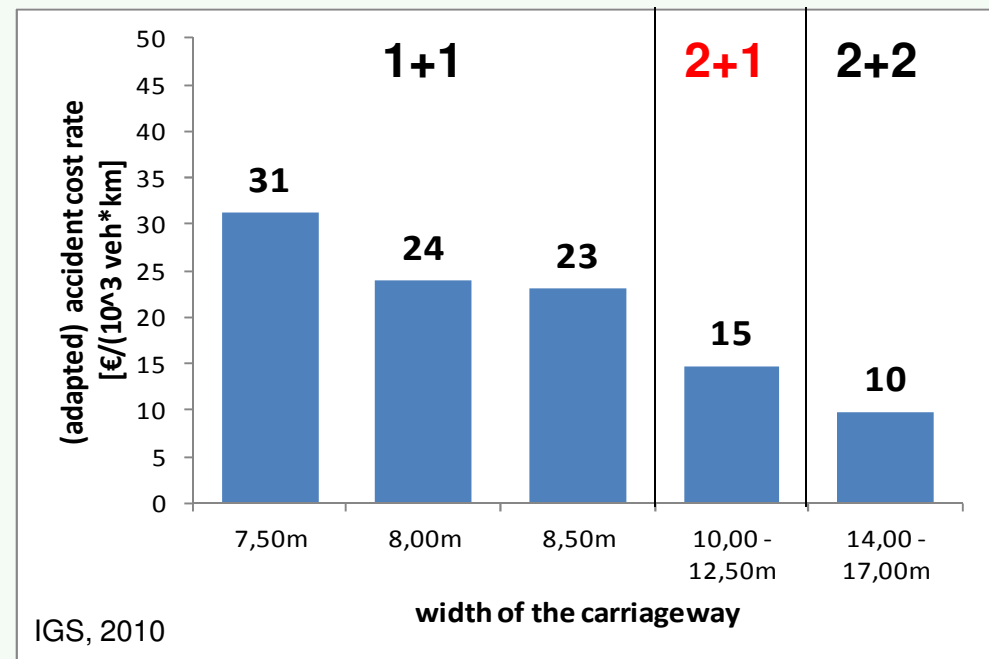


2+1 road safety in general (Meewes, 1984; Brannolte, 1992; GDV, 2002; Weber, 2005)

- high level of safety
- lowest accident cost rate of all single carriageway roads
- low number of accidents (especially head-on crashes)
- most accidents in lateral direction while merging in front of the ghost island

Most accidents caused by:

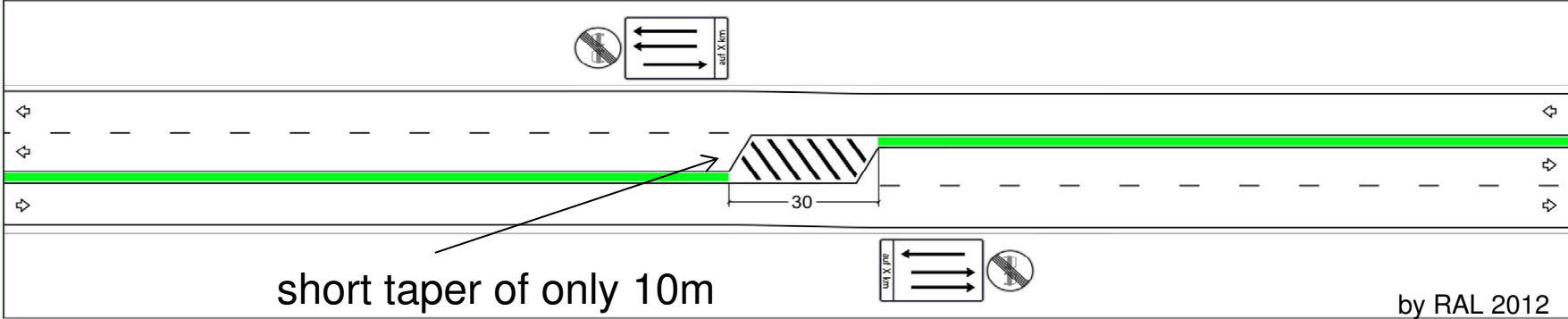
- excessive speed
- bad weather conditions
- crossing animals (game)
- overtaking even if it is prohibited (rarely)



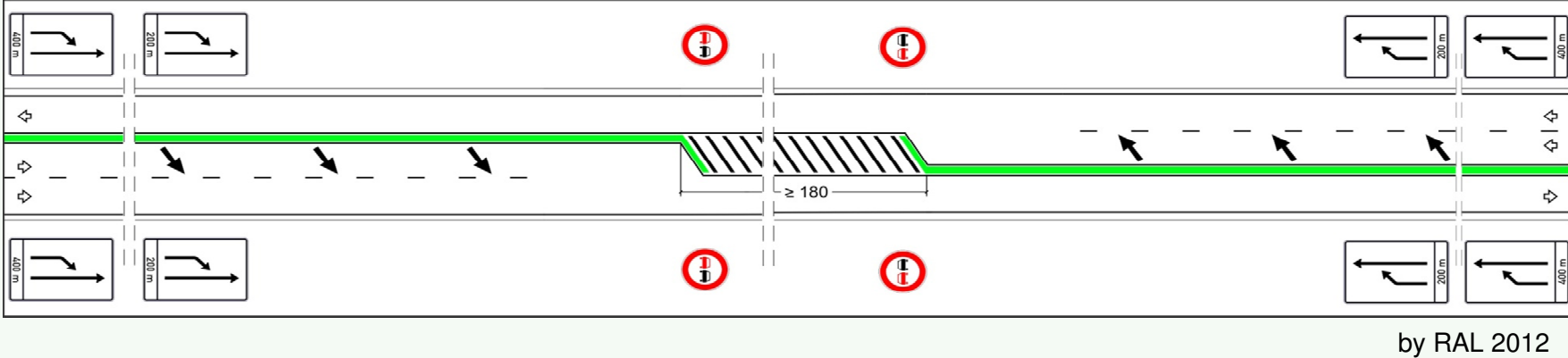
Changeovers - Marking and Signage



- non-critical changeover (vehicles are not heading towards one another)

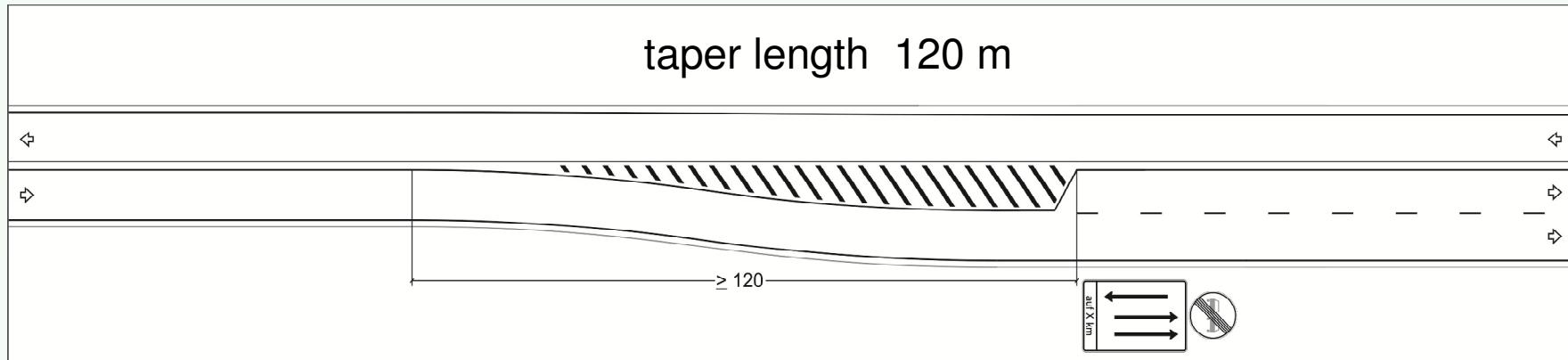


- critical changeover (vehicles in the middle lane are heading towards one another)

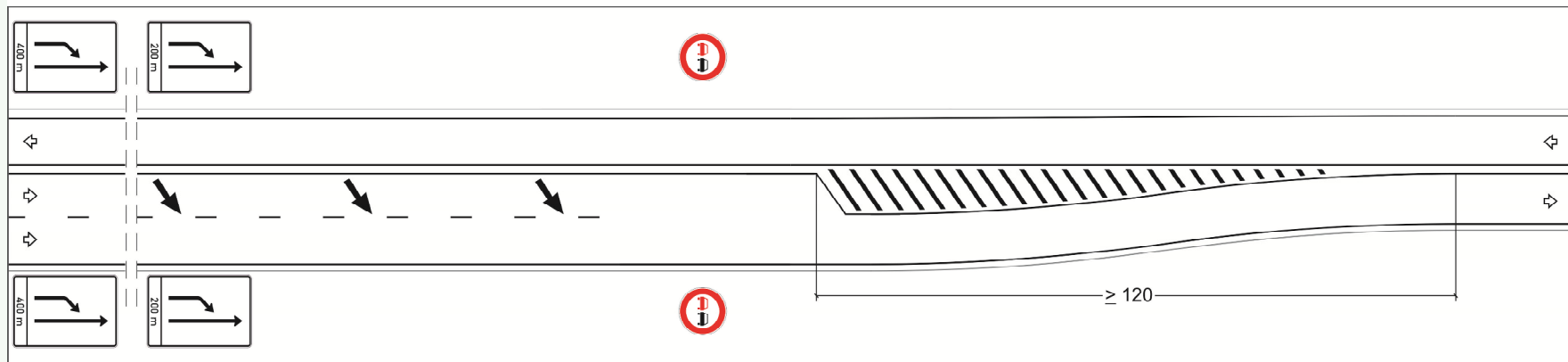


Marking and Signage

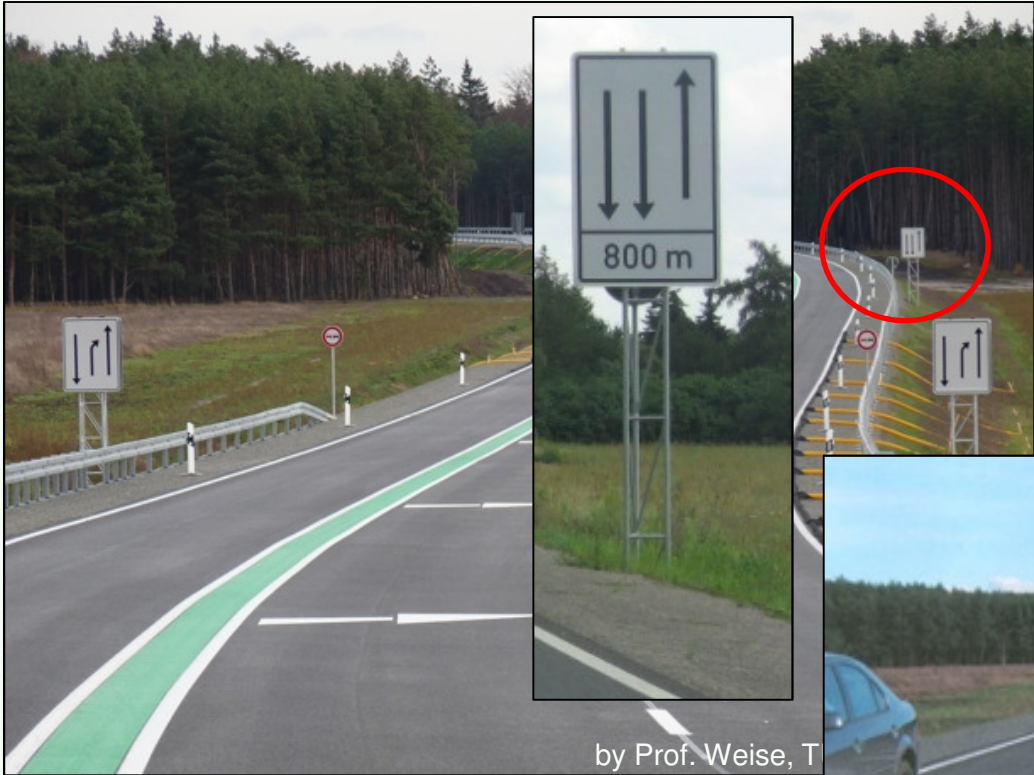
- begin of a 2+1 Section



- end of a 2+1 section



Changeover - Marking and Signage



signs are showing the distance to the next passing lane

“barrier effect” to reduce driving over critical island





large arrow marking:

- indicates passing lane end
- better visibility
- supports correct driving behaviour

emergency lay-by



by ivh, 2009

Junction Design

- only level free or grade separated junctions
 - better road safety
 - meet the standards for average travel time

