Vejdirektoratet

DANISH GEOMETRIC GUIDELINES FOR RURAL ROADS

5TH MEETING IN THE RURAL ROADS DESIGN GROUP, 3-4 APRIL 2014

KENNETH KJEMTRUP

THE GUIDELINES FOR RURAL ROADS DESIGN, 2013

- Road planning in rural areas
- Premises for the geometric design
- Alignment
- Cross-sections
- Road junctions
  - Planning
  - Priority intersections
  - Signalised intersektions
  - Roundabouts
  - Grade seperated intersections
- Rest areas
- Visual conditions
- Speed-reducing measures

The road classification

Road Directorate
Ministry of Transport - Denmark

Functional classification

- **Through roads**
- **Distributor roads**
- **Local roads**

Speed

Road Directorate
Ministry of Transport - Denmark

- Planning speed, Vp . Political design speed based on passability.

- Design speed, Vd. Traffic safety.

  Vp+(0-20km/h)

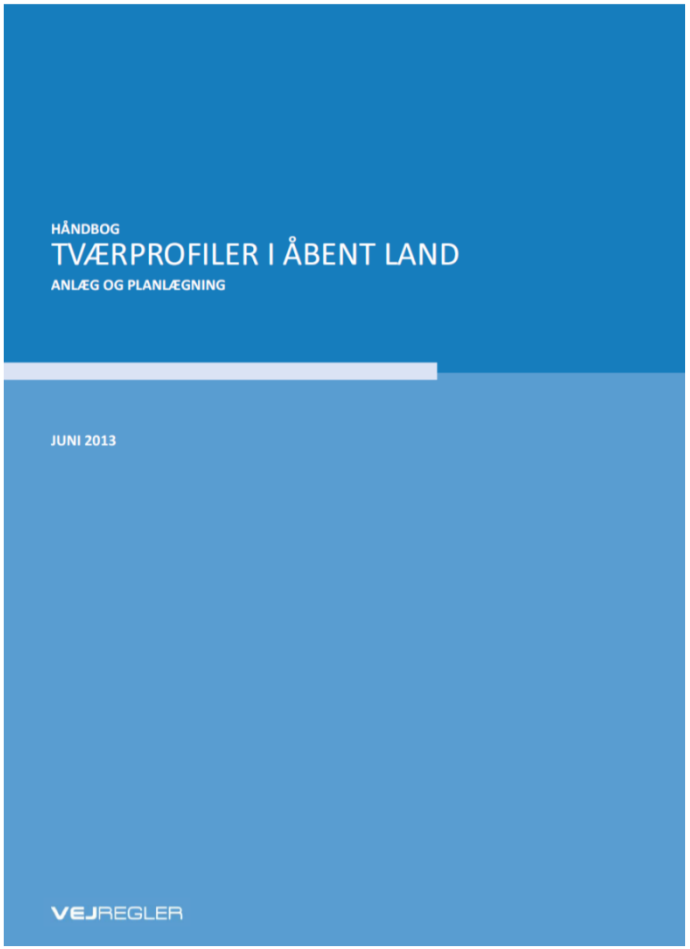
- Sight at intersections
- Sight at sections

The Speed classification

Road Directorate
Ministry of Transport - Denmark

Hastighedsklasse	Planlægningshastighed	Trafikveje		Lokalveje
		Gennemfartsveje	Fordelingsveje	
Meget høj+	120-130 km/h	X		
Meget høj	90-110 km/h	X		
Høj+	80 km/h	X	X	(X)
Høj	60-70 km/h	X	X	X
Middel	50 km/h		X	X
Lav	30-40 km/h			X

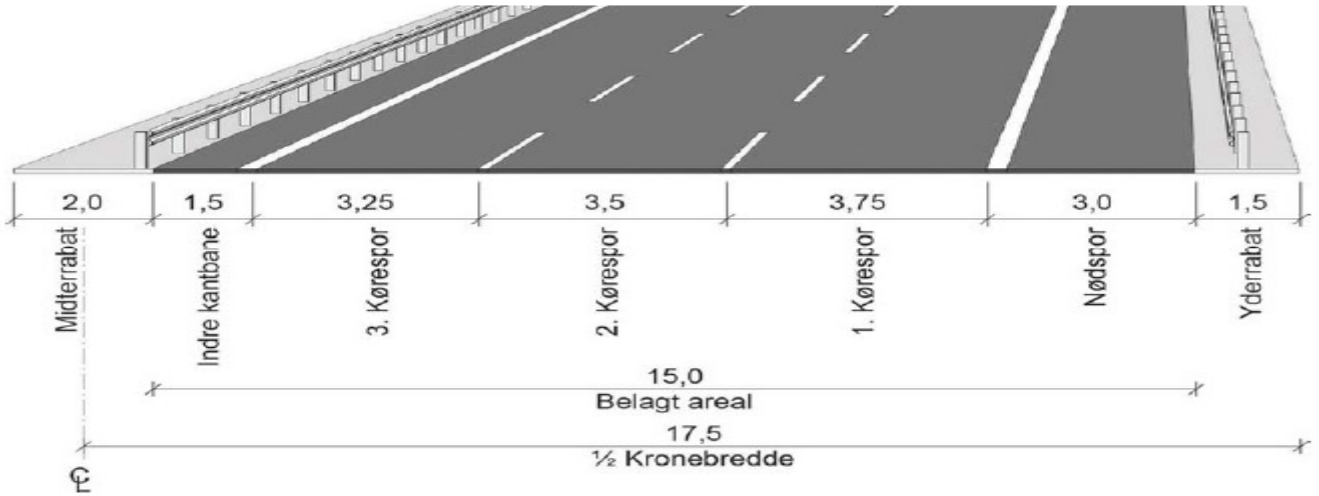
CROSS SECTIONS

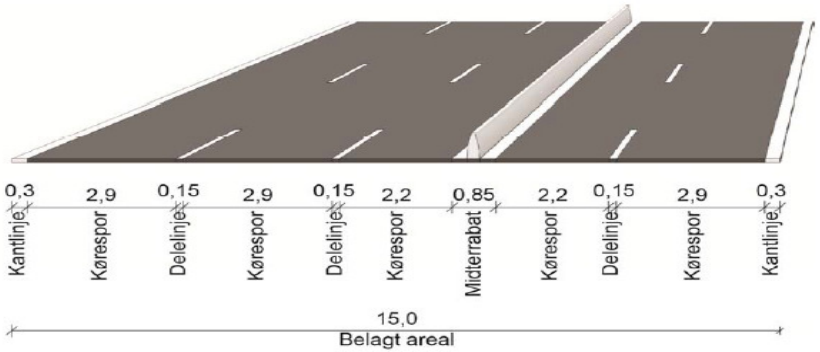


NEW BASIC ROAD TYPES

- 6-lane Motorways
- 4-lane Motorways
- 4-lane Roads
- 2+1 Roads
- 2-lane Roads
- 2-1 Roads

6-LANE MOTORWAY, 130KM/H





Road work

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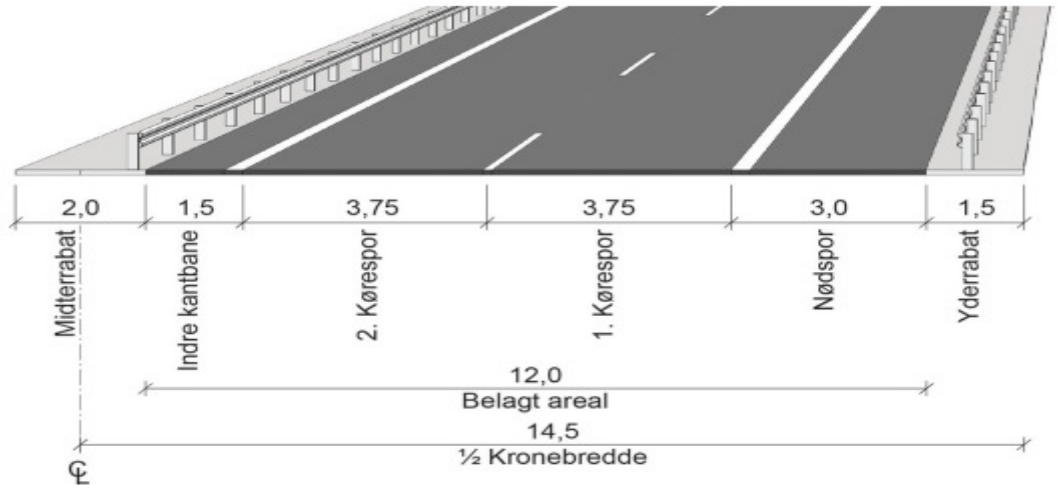
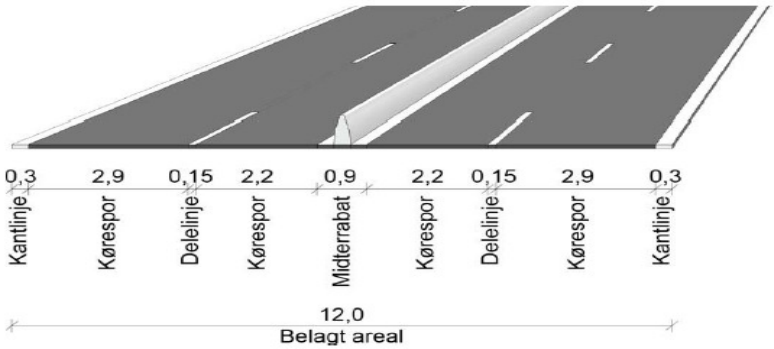
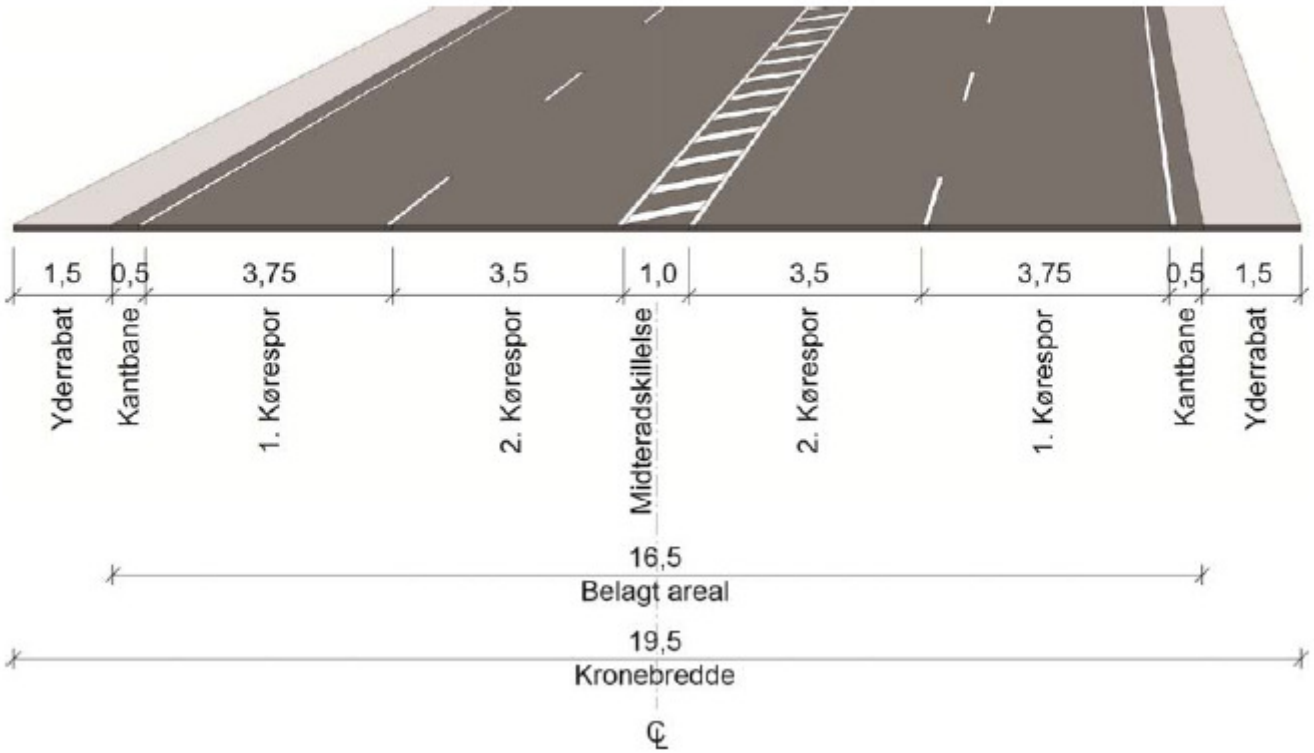
4-LANE MOTORWAY, 130KM/H



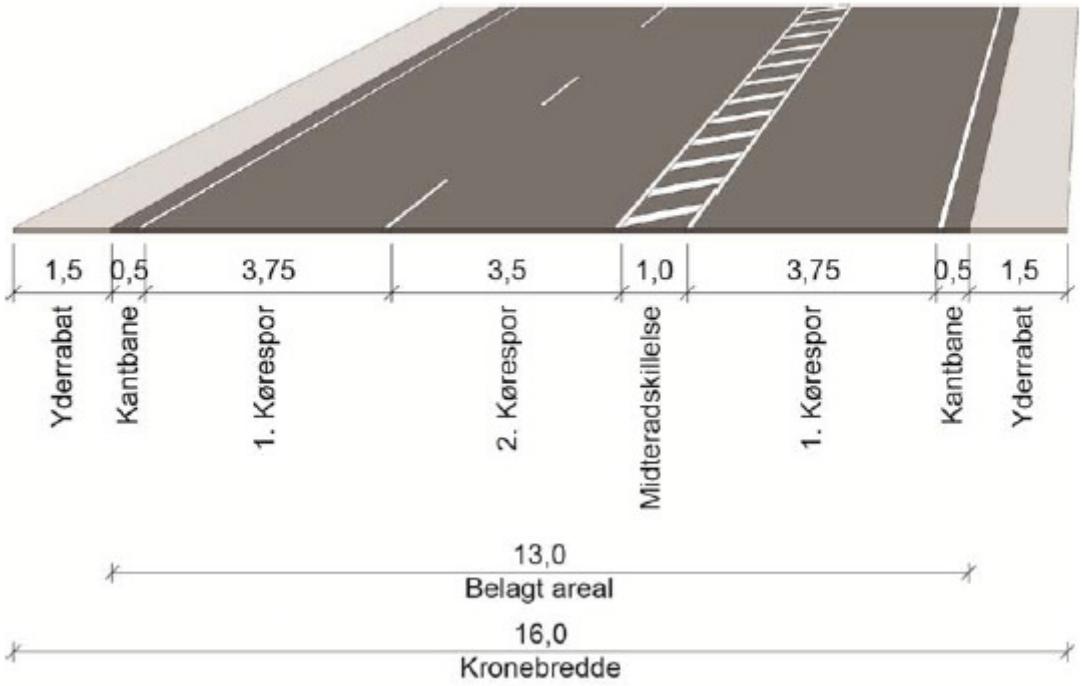


Road work

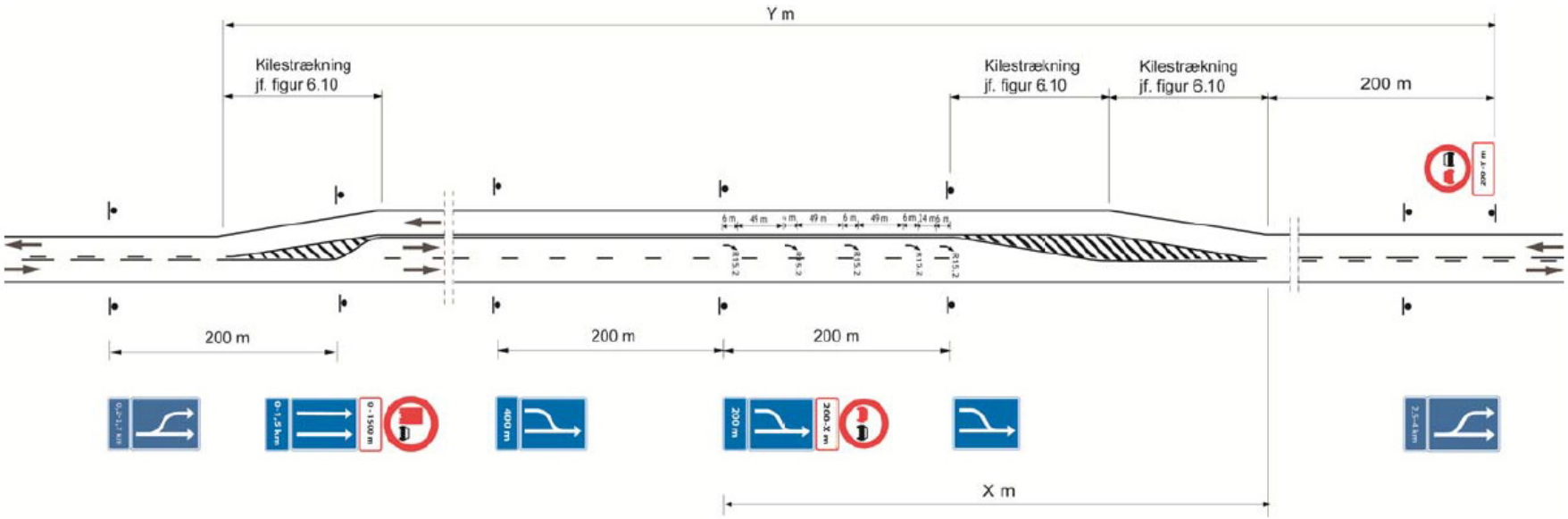
4-LANE ROAD, 90KM/H



2+1 ROAD, 90KM/H



2+1 ROADS, SIGNING AND MARKING



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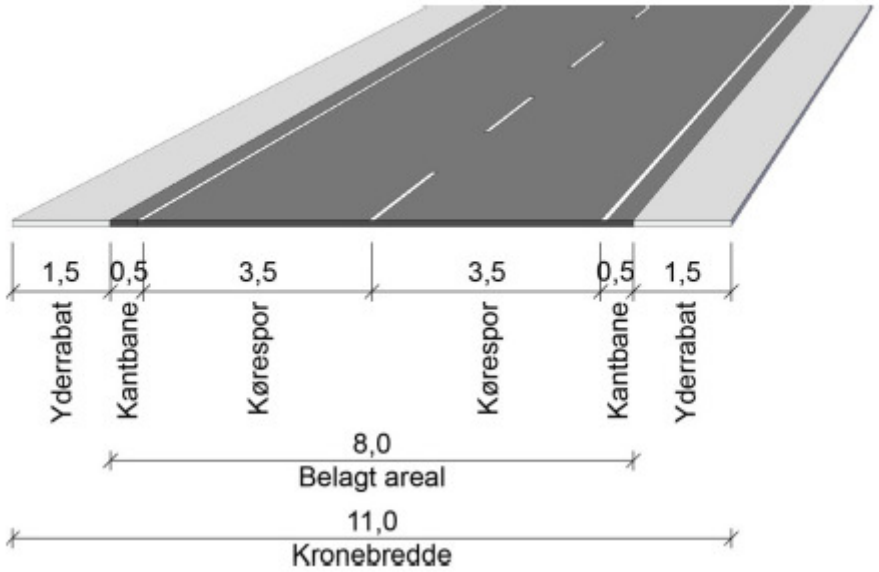
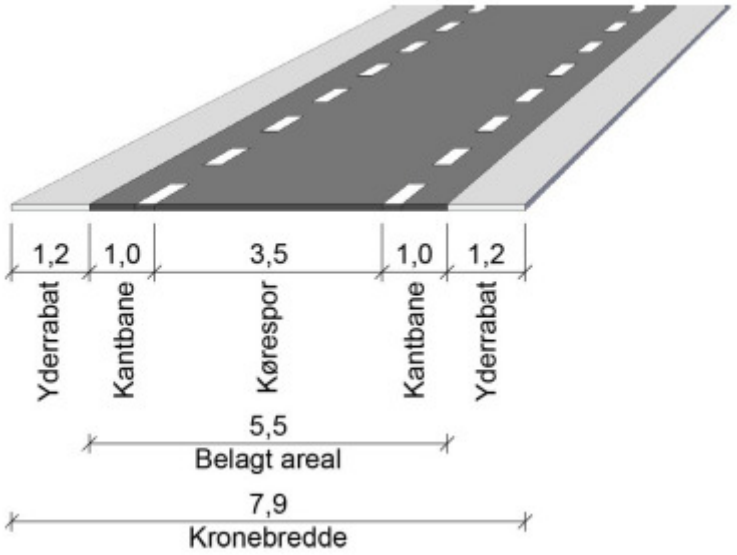
2-LANE ROAD, 80KM/H

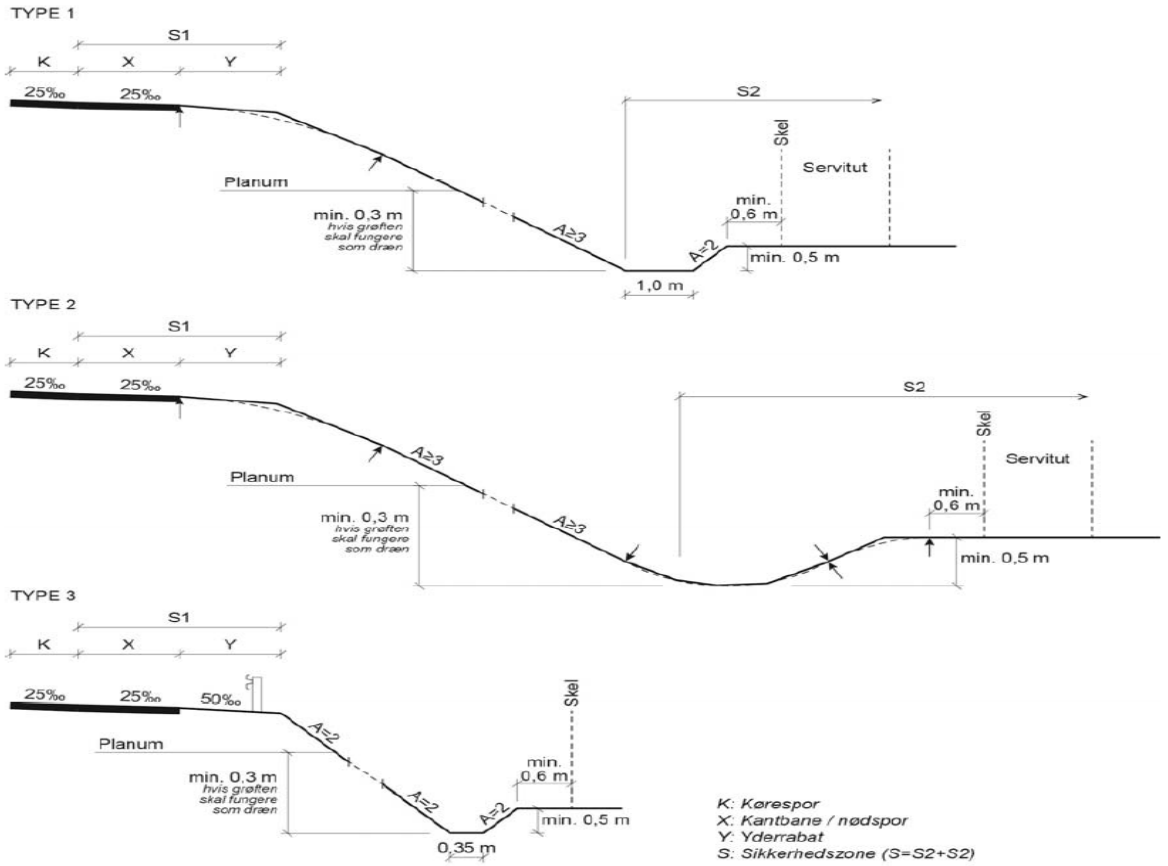


2-1 ROAD, 60KM/H



2-1 ROADS

SLOPE AND DITCH, DESIGN



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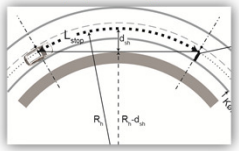
CALCULATION TOOL

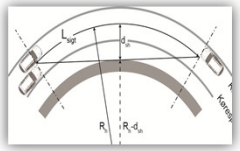
Beregninger for lang kurve benyttes, når kurven er længere end sigtlængden og benyttes normalt til fastlæggelse af kurveradier før linjeføringsberegning
Beregninger for kort kurve benyttes, når kurven er kortere end sigtlængden og benyttes normalt når linjeføringen er fastlagt

Horisontalkurver

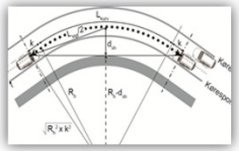
Stopsigt ved lang kurve



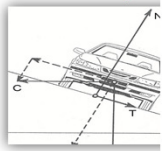
Mødesigt og overhalingssigt, lang kurve



Stop-, møde- og overhalingssigt, kort kurve

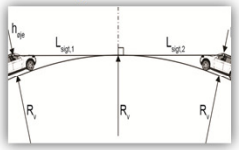


Tværfald og radius

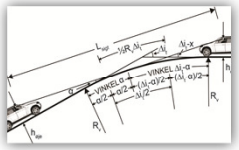


Vertikalkurver

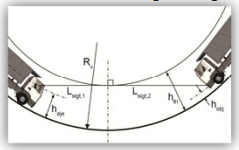
Stop-, møde- og overhalingssigt, lang konveks kurve



Stop-, møde- og overhalingssigt, kort konveks kurve

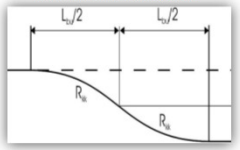


Stop-, møde- og overhalingssigt, konkav kurve ved sigthindring

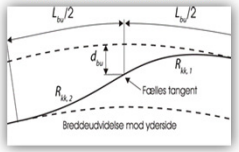


Breddeudvidelse i kryds

Breddeudvidelse, lige vej



Breddeudvidelse, kurvet vej



Vælg beregningsfunktion ved at trykke på billedet

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SPEED ADAPTATION, REVISION 2014

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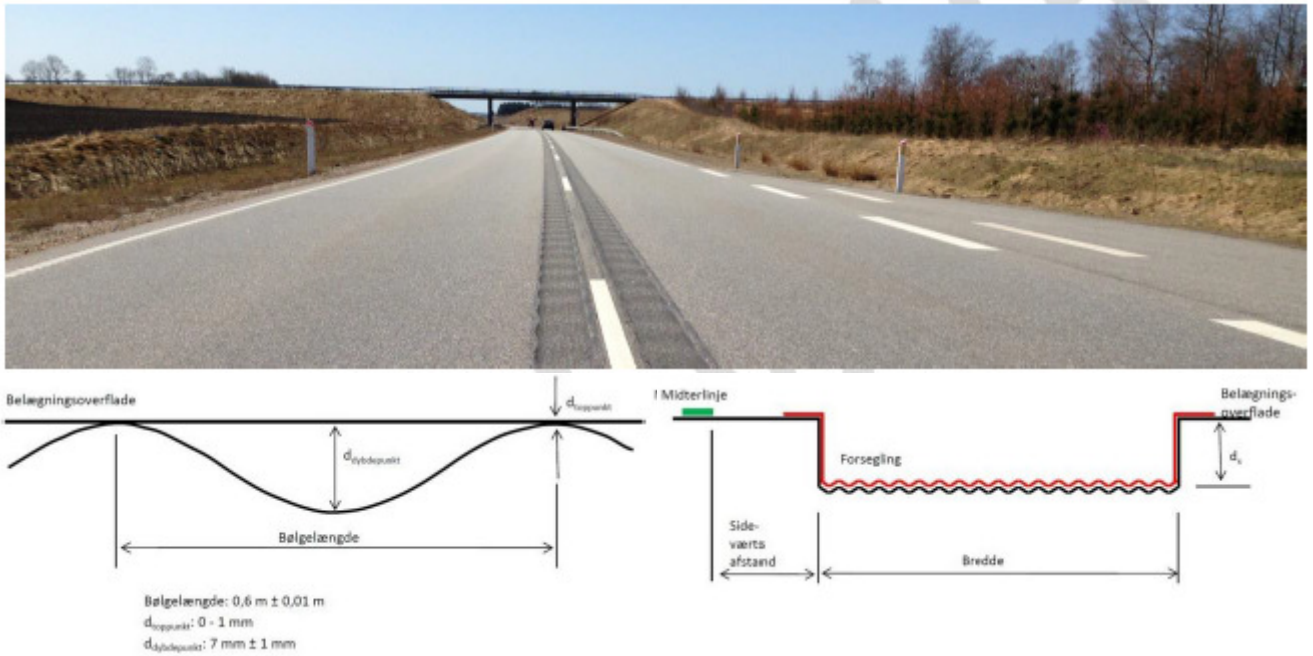
RUMBLE STRIPS



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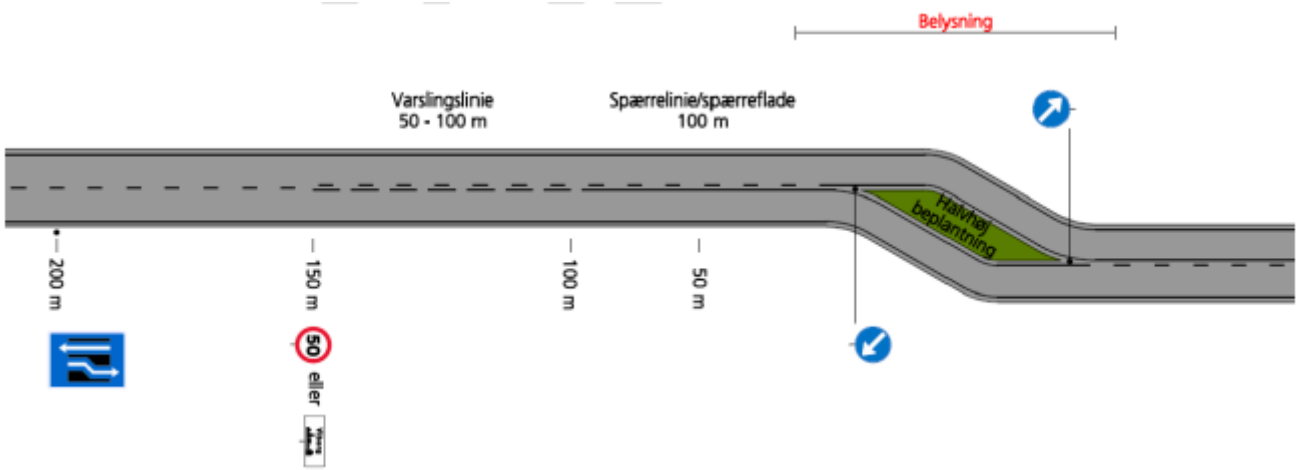
TRANSITION ZONE BETWEEN RURAL ROAD AND URBAN ROAD



Søren Underlien Jensen

Trafitec

Safety effects of converting intersections to roundabouts - and safe roundabout design

- Systematic literature study and meta-analyses
- Before-after safety evaluation of 332 conversions in DK
- Accident models and safety effects models

Reports available at:

www.trafitec.dk

Main safety effects

Type of accident/injury	Safety effects	
	Literature study	Danish before-after safety evaluation
Fatal accidents	-65 %	-88 %
Injury accidents	-60 %	-47 %
Property-damage-only accidents	-25 %	-16 %
All accidents	-44 %	-27 %
Fatalities	-87 %	-87 %
Severe injuries	-75 %	-58 %
Slight injuries	-66 %	-59 %
All injuries	-72 %	-60 %

Speed limit and safety effects

Maximum speed limit	Safety effects		
	Accidents	Injuries	Accident costs
40-50 km/h	+1 %	-1 %	-12 %
60 km/h	-14 %	-55 %	-38 %
70 km/h	-33 %	-63 %	-64 %
80 km/h	-43 %	-81 %	-78 %
90-130 km/h	-67 %	-81 %	-69 %
Total	-27 %	-60 %	-58 %

Safety effects of converting intersections to roundabouts split by the maximum speed limit on roundabouts arms (100 m away from yield line).

Height of central island

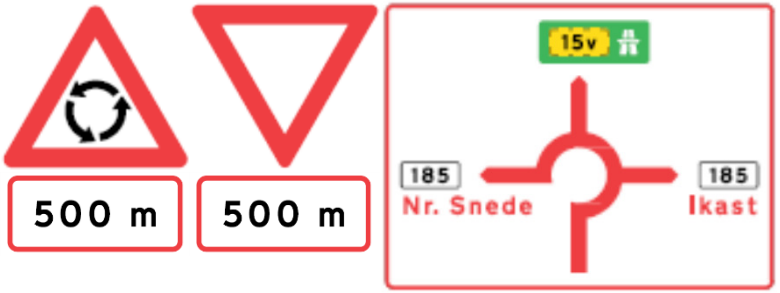
Roundabout design - height

Height of central island	Type of accident	Safety effects (accidents)	
		Short term effect first-second year	**Long term effect** third-ninth year
0.0 – 1.4 m	Single-vehicle	+229 %	+82 %
	Multi-element	-36 %	-37 %
	Total	-6 %	-24 %
1.5 – 10.0 m	Single-vehicle	+278 %	+223 %
	Multi-element	-66 %	-64 %
	Total	-38 %	-39 %

Safety effects of converting intersections to roundabouts split by the height of the central island, the type of accident and short- and long-term effects.

Roundabout design

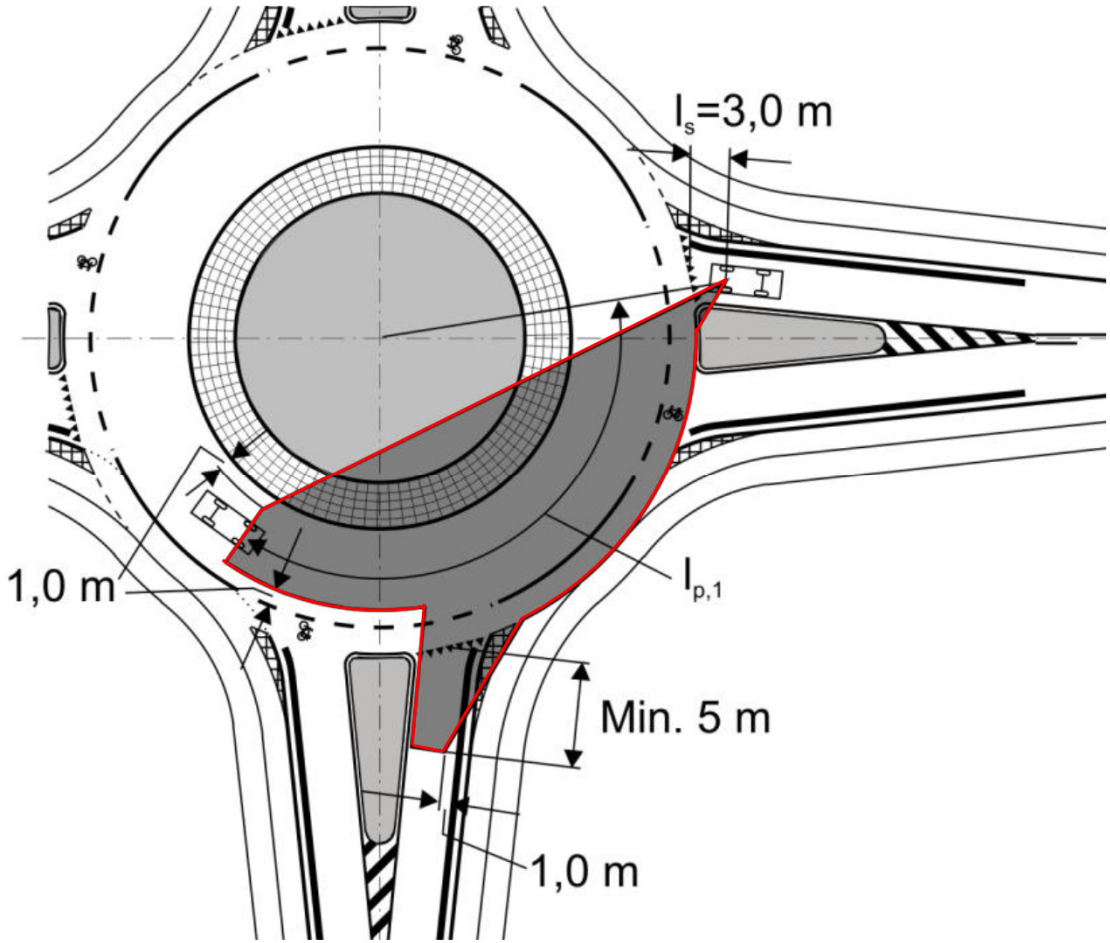
Pre-warning & direction signs 20-500 m behind yield line - Safety effects on accidents



Zone	Number of signs and markings per entry	Mini-roundabouts			Single lane roundabouts		
		Expected after	Observed after	Effect	Expected after	Observed after	Effect
Urban	0	15	21	+42 %	22	38	+70 %
	0.25 – 0.75	10	9	-9 %	67	73	+10 %
	1	26	20	-24 %	107	99	-7 %
	1.25 – 2	16	27	+65 %	101	62	-39 %
	2.25 – 7	5	17	+236 %	3	0	-100 %
Rural	0.25 – 0.75	-	-	-	10	8	-24 %
	1	-	-	-	103	56	-45 %
	1.25 – 2	-	-	-	324	171	-47 %
	2.25 – 7	-	-	-	88	38	-57 %

Roundabout design

Sight distance. How far from the yield line are you able to see the marked area?



Relative risk in Denmark:

Distance	Urban	Rural
0 m	2,19	NA
5-17 m	0,96	(1,67)
17-40 m	1,48	1,39
40- m	1,00	1,00

Mini-roundabout design

Recommended design:

Central island diameter: 4-9 m

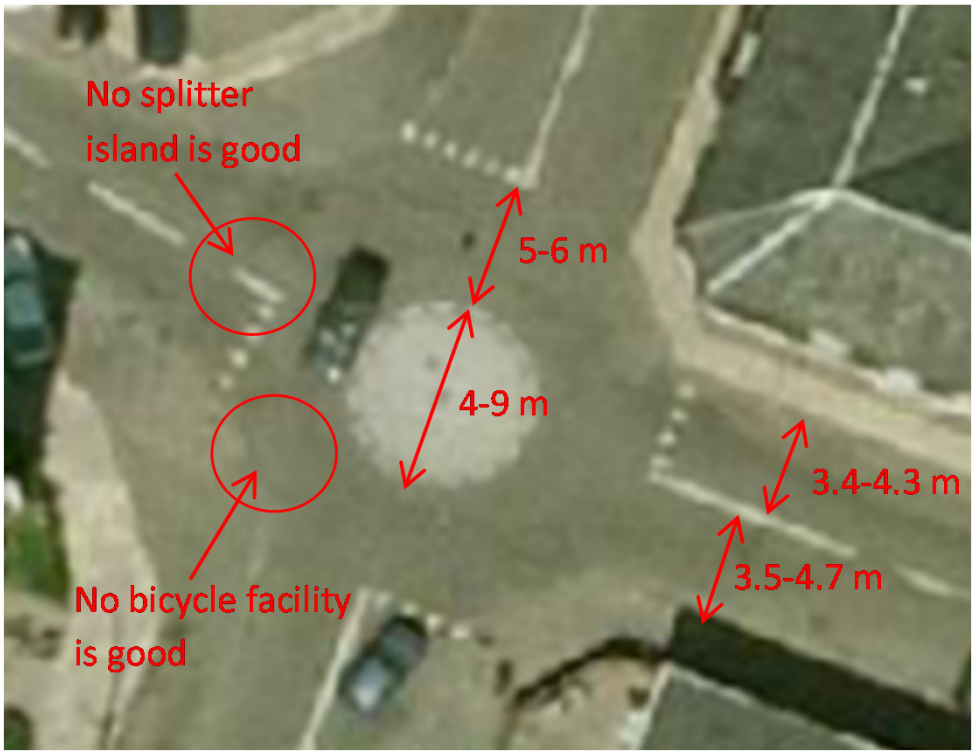
Circulation lane width: 5-6 m

Entry lane width: 3.4-4.3 m

Exit lane width: 3.5-4.3 m

Splitter island: None

Bicycle facility: None



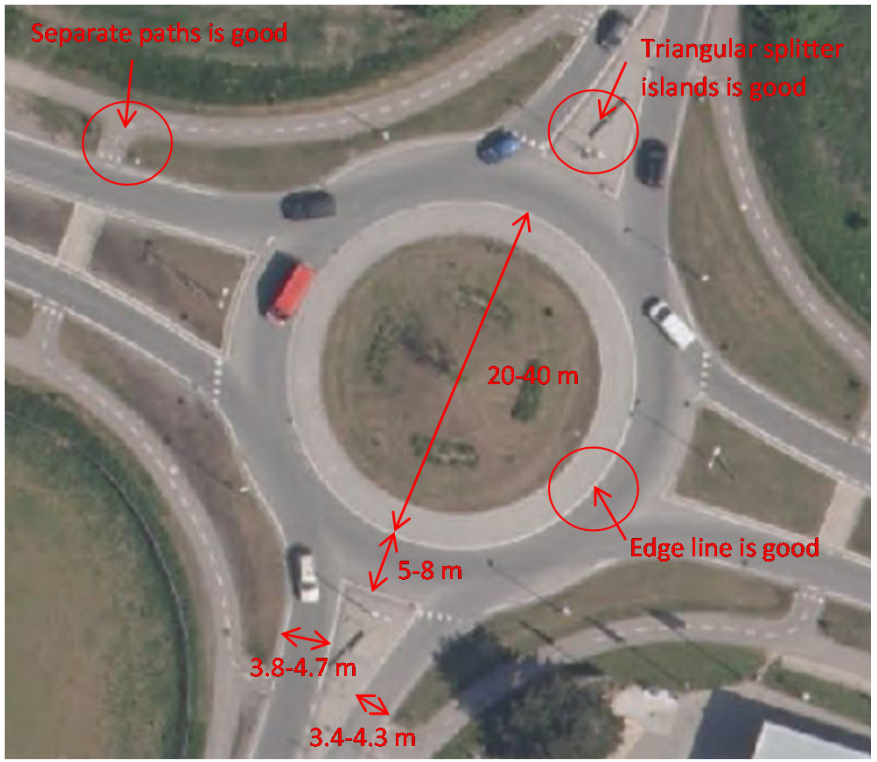
Pre-warning/direction signage: 1 sign 20-50 m before every entry

Sight distance: 5-15 m or more than 40 m before entry

Traffic: Less than 5,000 incoming motor vehicles per day

Single-lane roundabouts

Recommended design:



Central island diameter: 20-40 m

Central island height: 2 m or more

Edge line at central island

Circulation lane width: 5-8 m

Entry lane width: 3.4-4.3 m

Exit lane width: 3.8-4.7 m

Splitter islands: Triangular or trumpet (not in urban roundabout)

Bicycle facility: No bicycle lane, no colored markings

Pre-warning/direction signage: One or more before every entry starting at least 100 m before yield line

Sight distance: 5-15 m or preferably more than 40 m before entry

Recommended design:

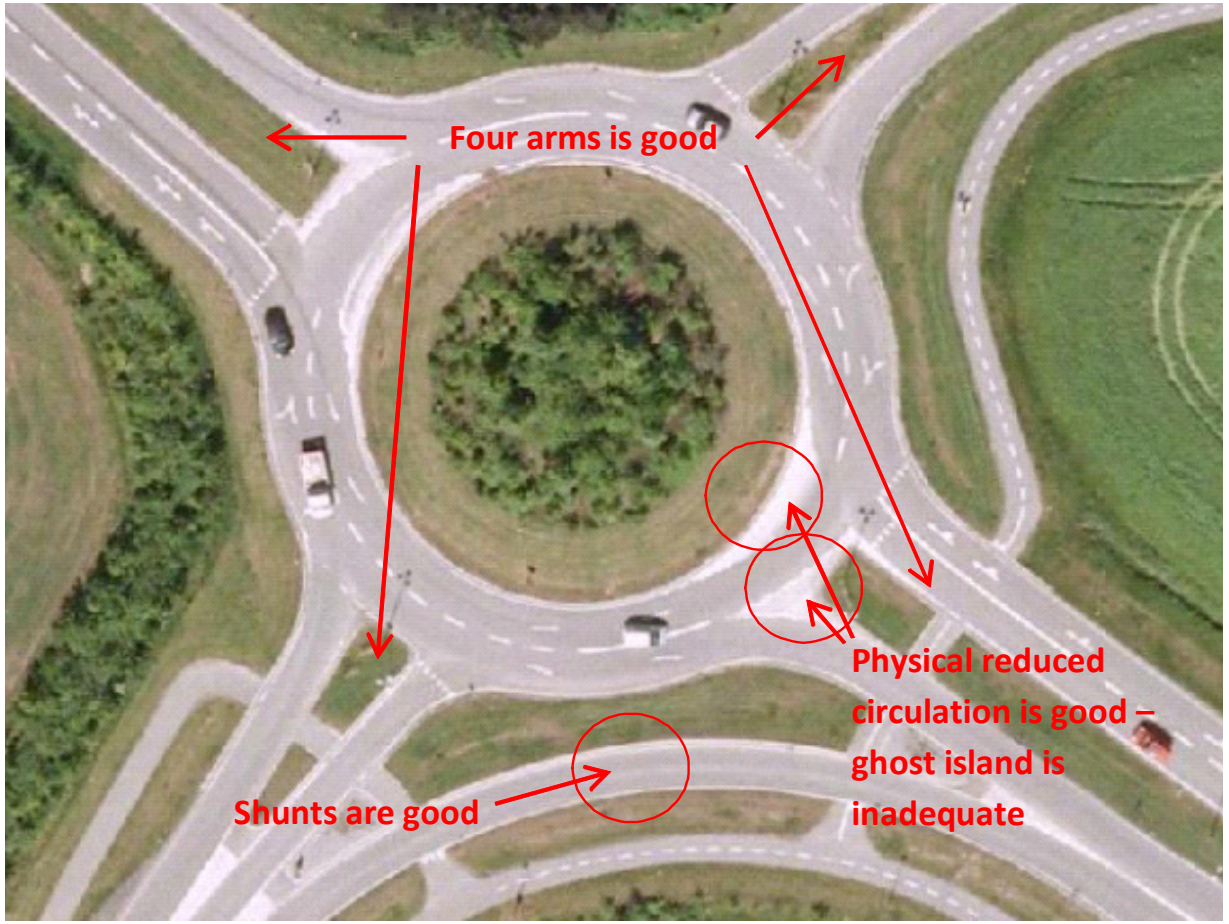
Physically reduced width of circulation at splitter island: Yes

Forced exit lane: Yes

Shunts: Yes

Bicyclists: None

Number of arms: 4



Experienced Level of Service - Pedestrians and cyclists

- Road segments
- Signalized intersections
- Roundabouts
- Non-signalized crossings

Reports available at: www.trafitec.dk

Methodology

How satisfied were you as a pedestrian/cyclist on the shown road / crossing?

	Very satisfied ☺ **A**	Moderately satisfied **B**	A little satisfied **C**	A little dissatisfied **D**	Moderately dissatisfied **E**	Very dissatisfied ☹ **F**
Road 1						
Road …						

Roadway segments

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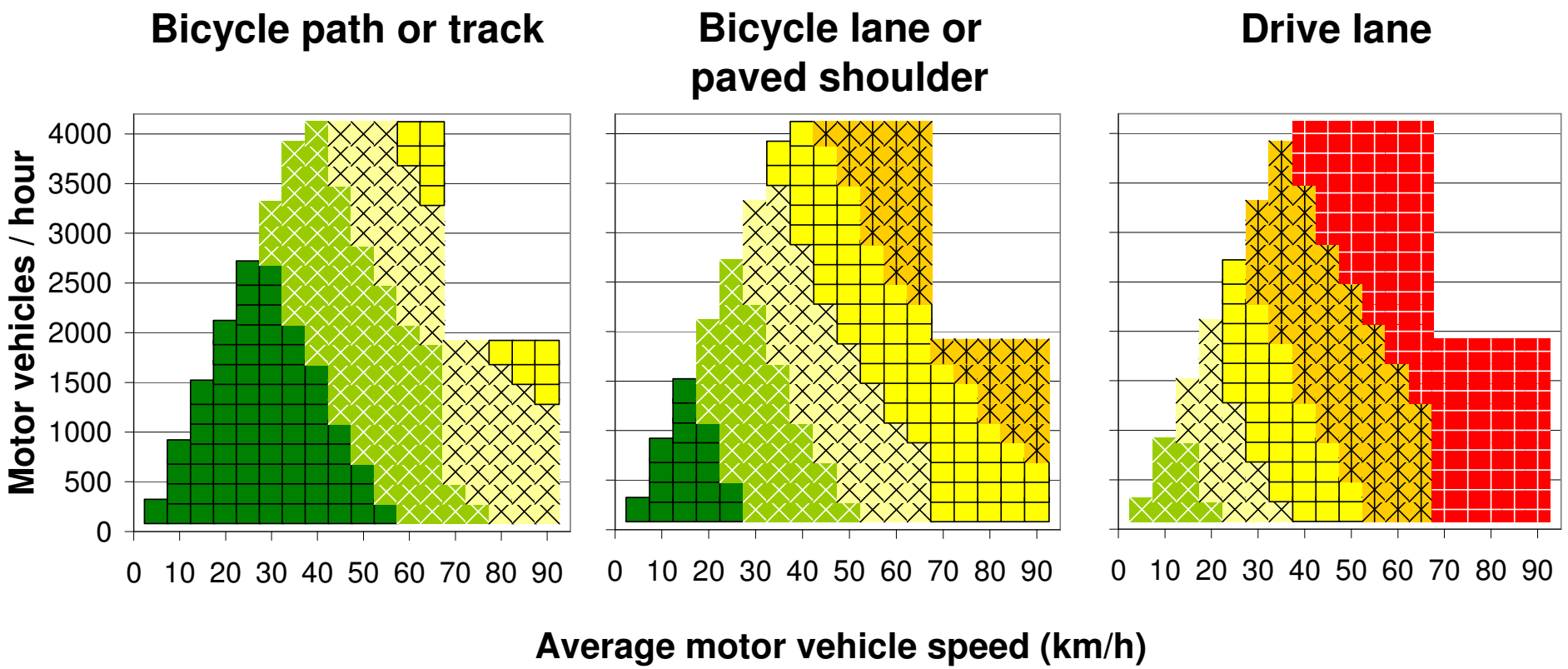
Variables included in roadway segment models:

Pedestrian LOS model	Bicycle LOS model
Type and width of walking area	Type and width of bicycle facility
Width of buffer between walking area and drive lane	Widths of buffers between cyclists and sidewalk and drive lane
Trees (dummy)	Sidewalk (dummy)
Number of drive lanes (dummy)	Number of drive lanes (dummy)
Central reserve (dummy)	Width of nearest drive lane
Number of motor vehicles	Number of motor vehicles
Average motor vehicle speed	Average motor vehicle speed
Number of parked motor vehicles	Number of parked motor vehicles
Number of pedestrians	Number of pedestrians
Number of cyclists and mopedists	Bus stop (dummy)
Type of roadside development / landscape	Type of roadside development / landscape

Type of cyclists' area and LOS



Signalized intersections

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Variables in signalized intersection models:

Pedestrian LOS model (crossing one road)	**Bicycle LOS model** (straight on going)
Sidewalk (dummy)	Width of bicycle facility at stop line
Zebra stribes (dummy)	Type of bicycle facility in intersection
Crossing time	Type of bicycle facility before stop line
Motor vehicles on crossed road	
	Bicycle LOS model (left-turning)
	Type of bicycle facility in intersection
	Zebra stribes (dummy)
	Cyclist signal (dummy)
	Waiting time between the two stages of the left-turn

Trafitec

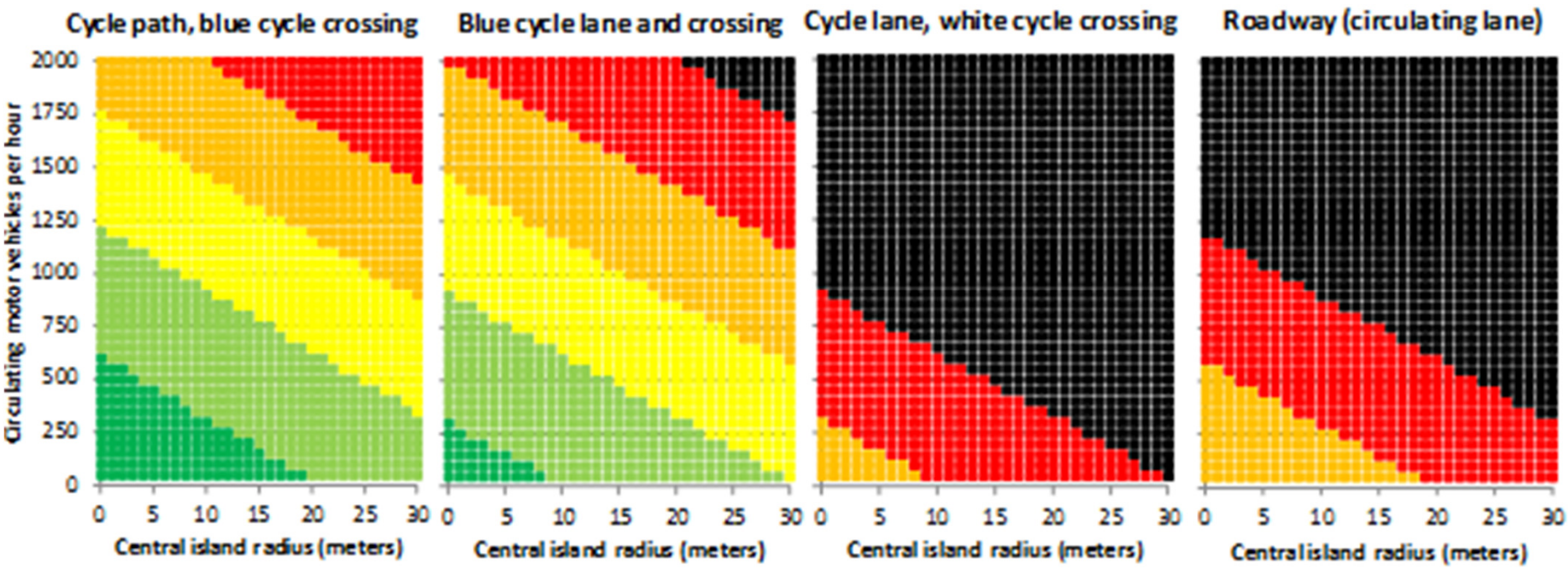
Variables in roundabout models:

Pedestrian LOS model (crossing one road/arm)	**Bicycle LOS model** (crossing one road/arm)
Zebra stribes (dummy)	Type of bicycle facility between arms
Type of walking area before crossing	Type of bicycle facility across arm
Circulating motor vehicles before the arm being crossed	Circulating motor vehicles before the arm being crossed
	Central island radii
	Outer radii (center of roundabout to outer side of bicycle facility)

Roundabouts

Bicycle LOS at roundabouts => Type of bicycle facility, circulating traffic and central island radii

A B C D E F



Non-signalized crossings

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Variables in various models:

Pedestrian LOS model (crossing main road)	**Bicycle LOS model** (crossing main road)
Motor vehicles on main road	Motor vehicles on main road
Zebra stribes (dummy)	Speed limit on main road
Type of walking area before crossing	Width of side road (total of all drive lanes) if any
Pedestrian LOS model (pedestrian bridge/tunnel)	
Type - tunnel or bridge (dummy)	
Height from top to bottom of staircase	