

Turbo-Roundabout

- an Experience
from Netherlands and Germany

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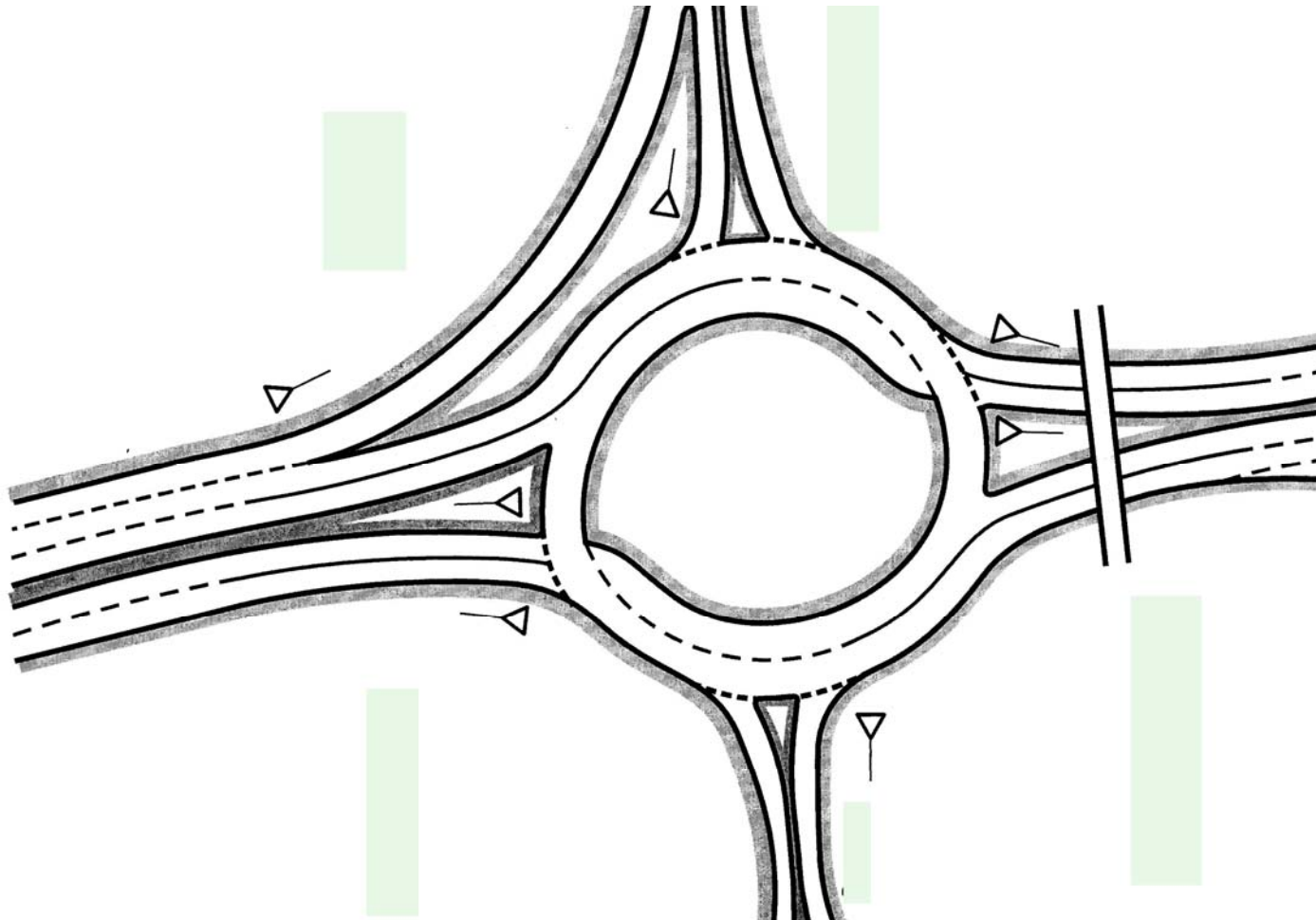


What is a Turbo-Roundabout ?



Roundabout with

- a variable number of lanes
- without lane changes on the circle



What is a Turbo-Roundabout ?



Entries

Type	Sketch	Characterisation
IN1		„Turbo-Entry“ (2 → 1)
IN2		(1 → 1)
IN3		(1 → 2) The entering driver must select his lane on the circle.
IN4		(2 → 2)



What is a Turbo-Roundabout ?



Exits



Type	Sketch	Characterisation
EX1		„Turbo-Exit“ With lane separation
EX2		
EX3		
EX4		Lane reduction

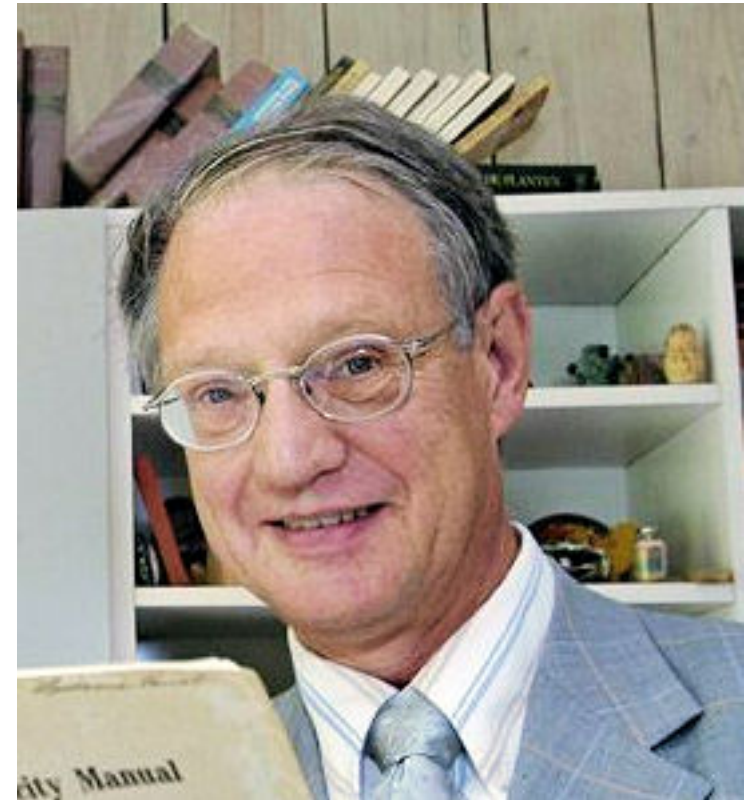
What is a Turbo-Roundabout ?



Typical:

no driver must or should change lanes within the circle
(except for turning, which is not encouraged)





Bertus Fortuijn



Maasdijk: Reconstruction of a diamond interchange

Netherlands



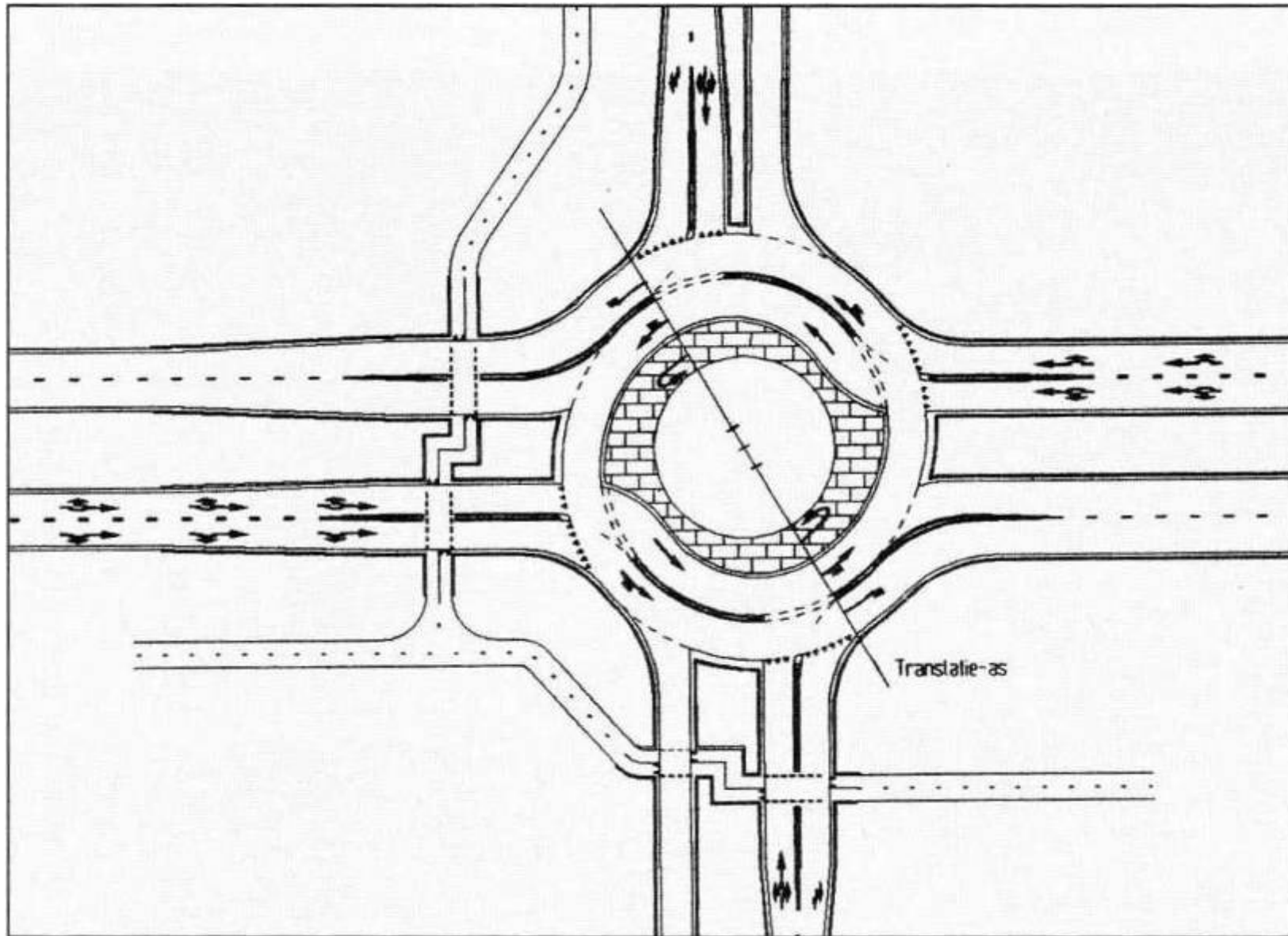
Turbo-roundabout Netherlands

Netherlands



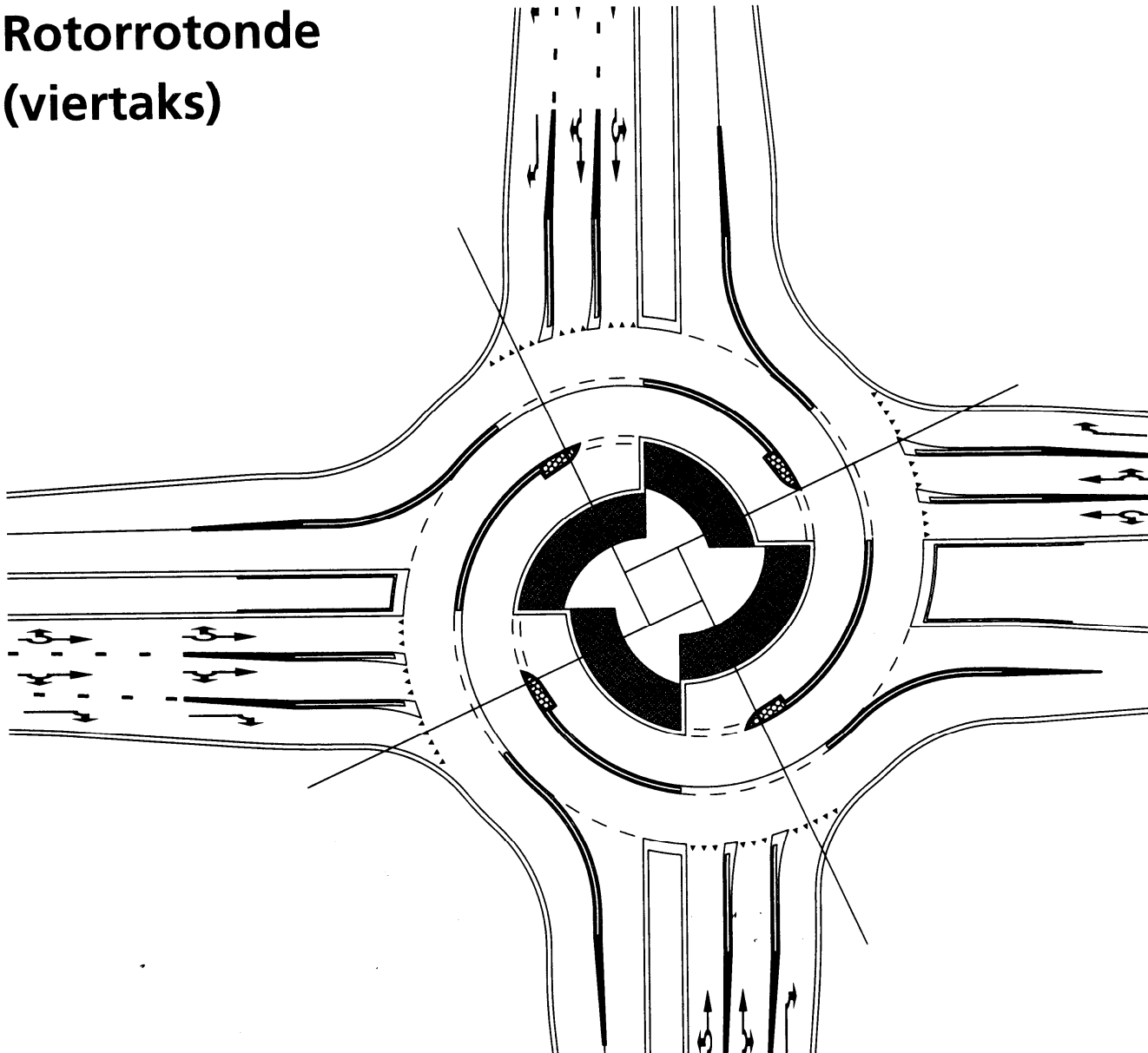
Turbo-roundabout Netherlands

Netherlands





Rotorrotonde (viertaks)



up to 3 lanes
on the circle

-

mentioned in
the guideline
but not existing
in reality

Netherlands



Source: CROW



Guideline:

Turborotondes. CROW 2008

in Dutch language, 71 €

<http://www.crow.nl/nl/Publicaties/publicatiedetail?code=257>





Characteristics:

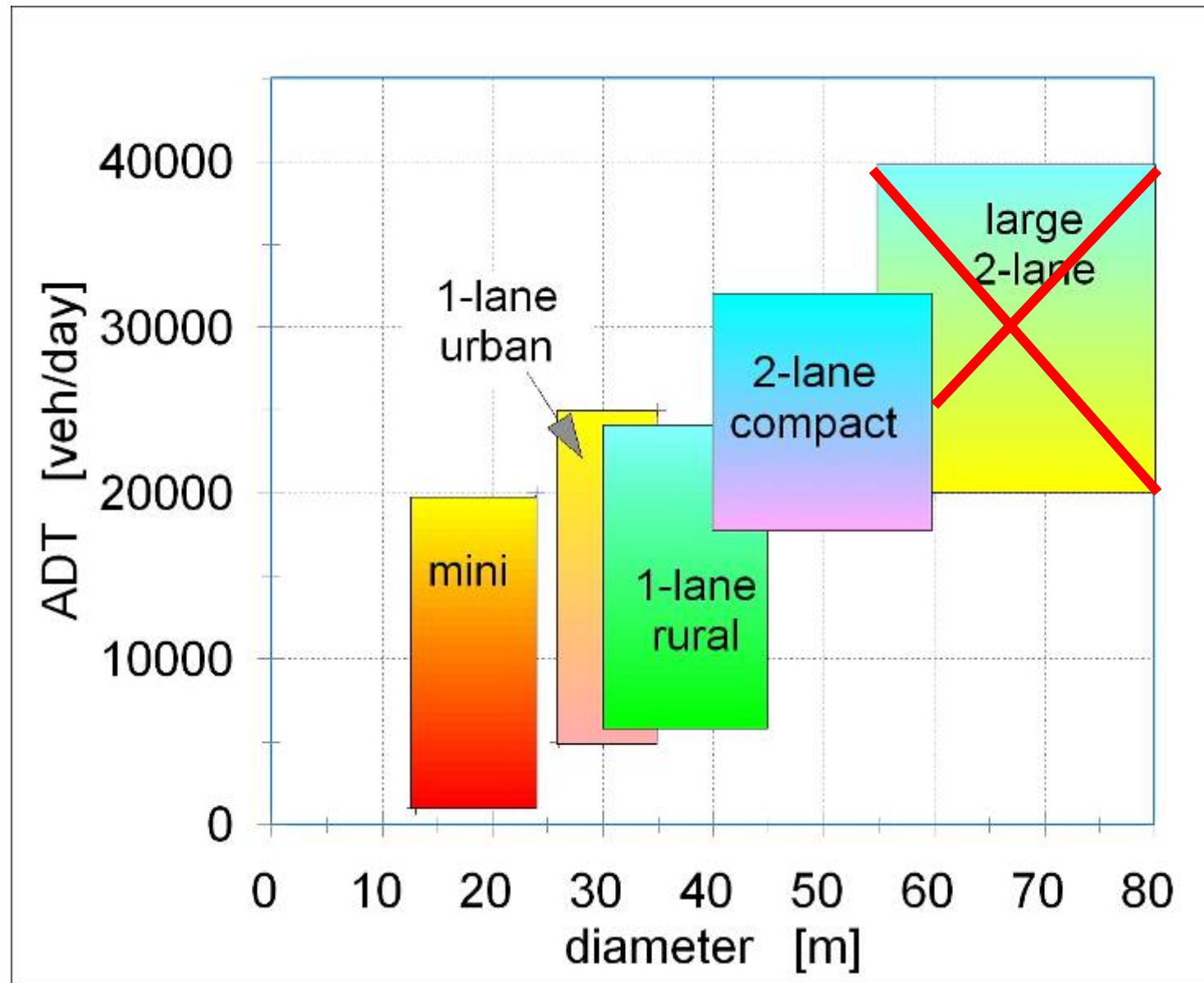
- narrow curvature
- curbs on the circle and in the approaches

Problems with application in Germany:

- curbs impede snow removal for winter service
- risk for motor cyclists
- → no curbs on the roadway in Germany



Germany: Typology of roundabouts



Types
according
to

• ADT ↑

• size →

Germany: Starting Point



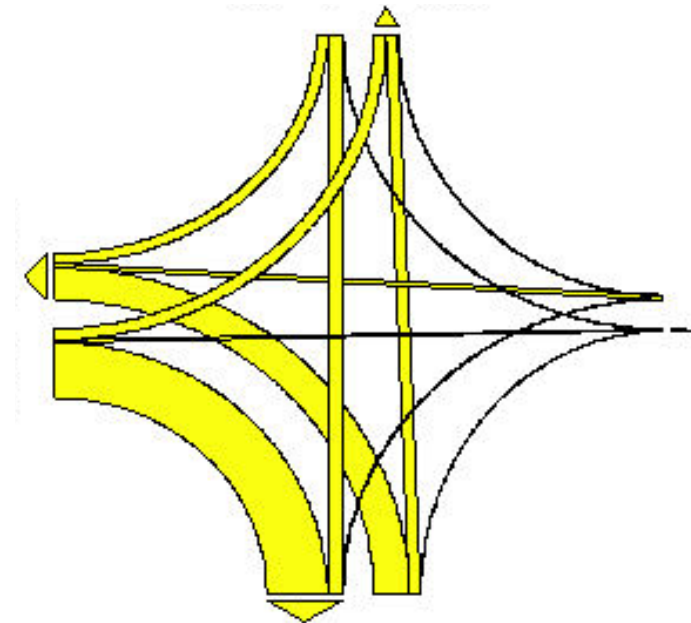
- Germany: Restrictive view on larger roundabouts (larger than single-lane)
- Large total capacities require balanced distribution of traffic volumes over the approaches and exits
- What to do, if traffic is concentrated on specific movements?

Germany: Starting Point



- What to do if traffic is concentrated on specific movements?

large right turn movements : Bypass

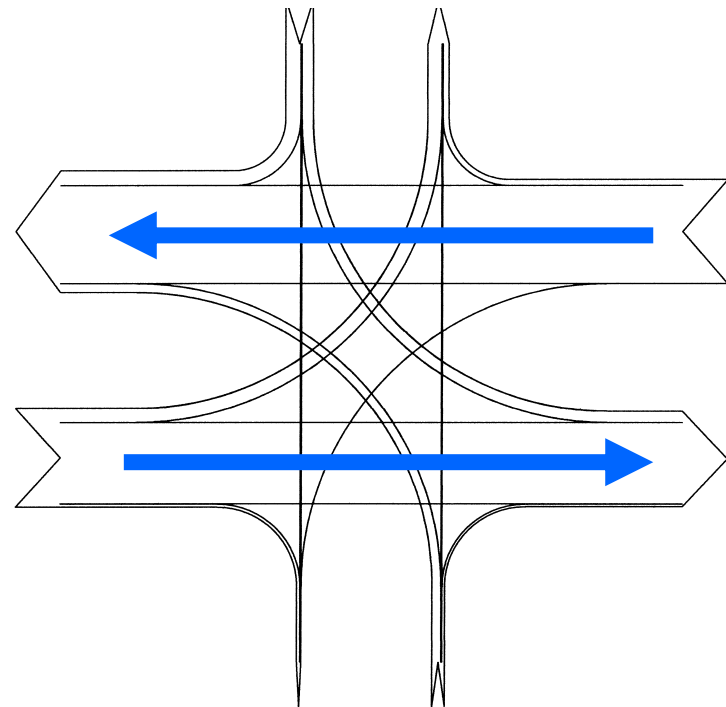


Germany: Starting Point

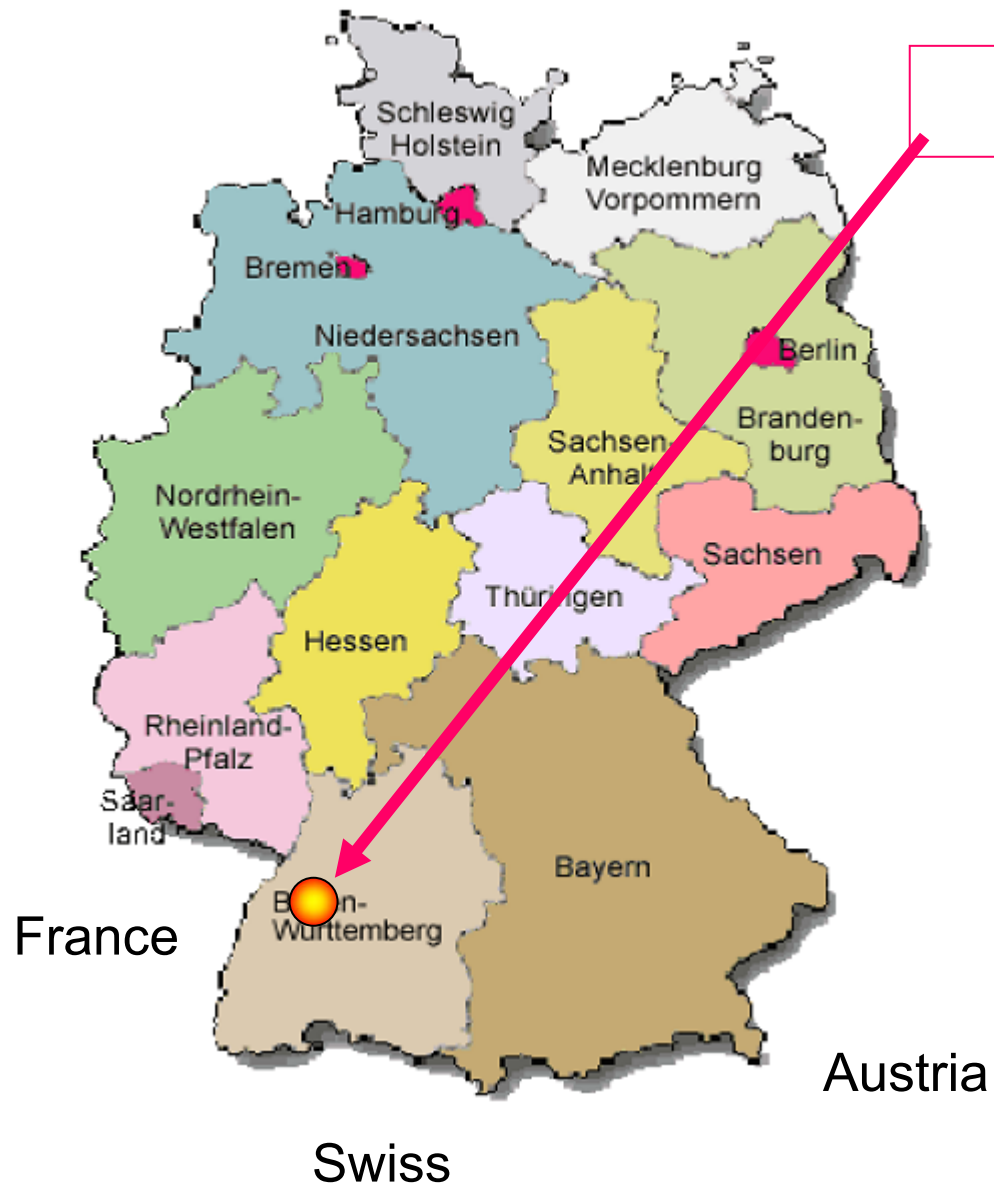


- What to do if traffic is concentrated on specific movements?

large through movements :



Germany: 1st Turbo in Baden-Baden



Baden-Baden

State:
Baden-Württemberg
80 000 Inhabitants
Spa (hot springs)
Black Forest

Baden-baden : local situation



to city of Baden-Baden ⇒

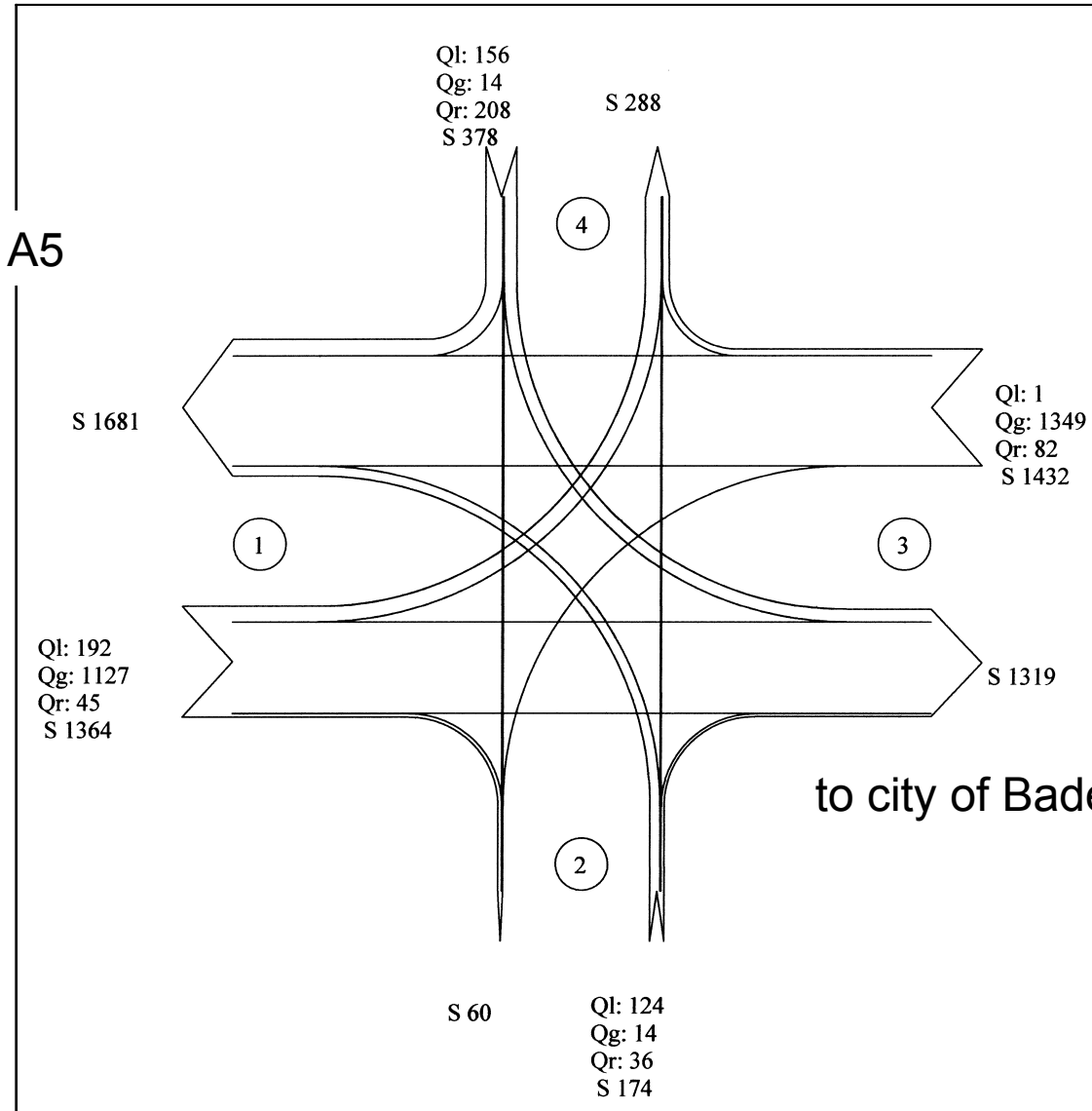


to motorway A5

Starting Point : traffic volumes



to motorway A5

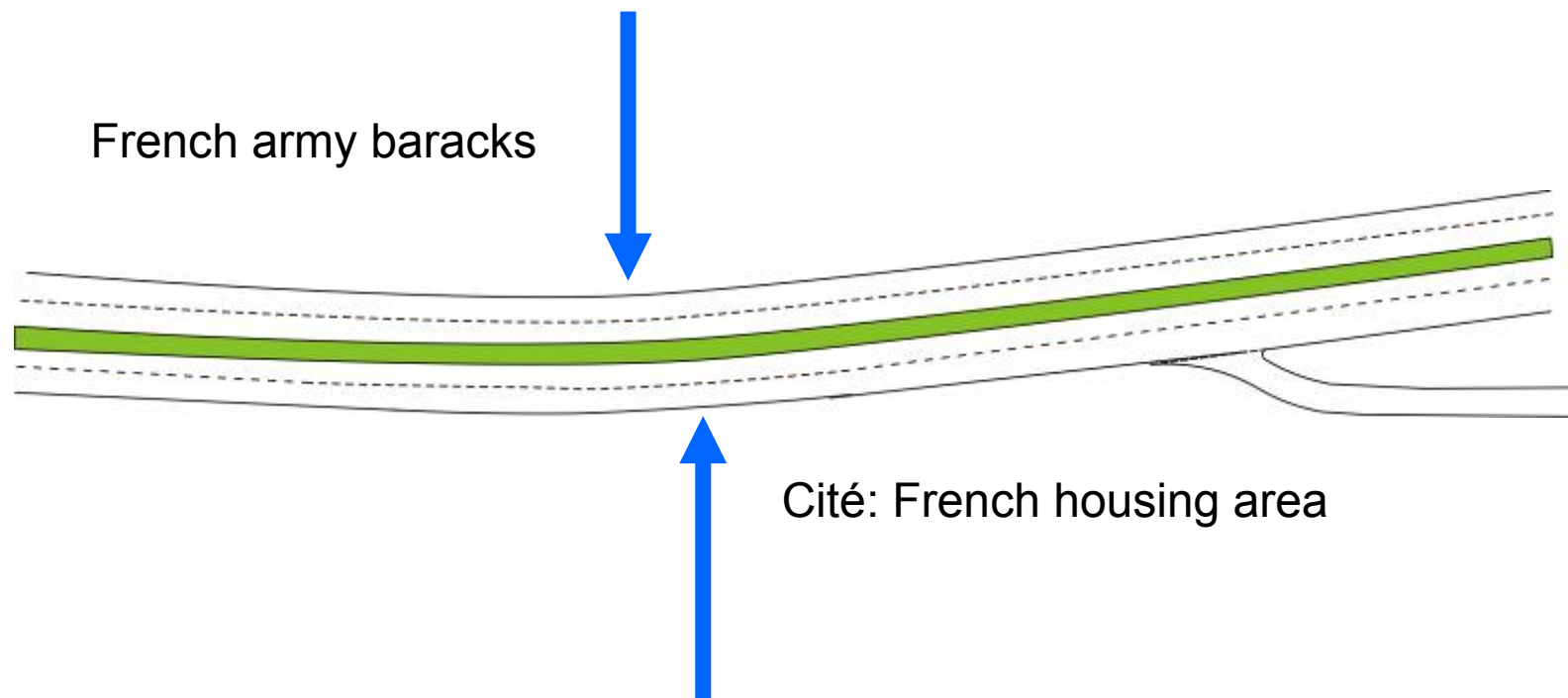


ADT:
31000 veh/d

to city of Baden-Baden

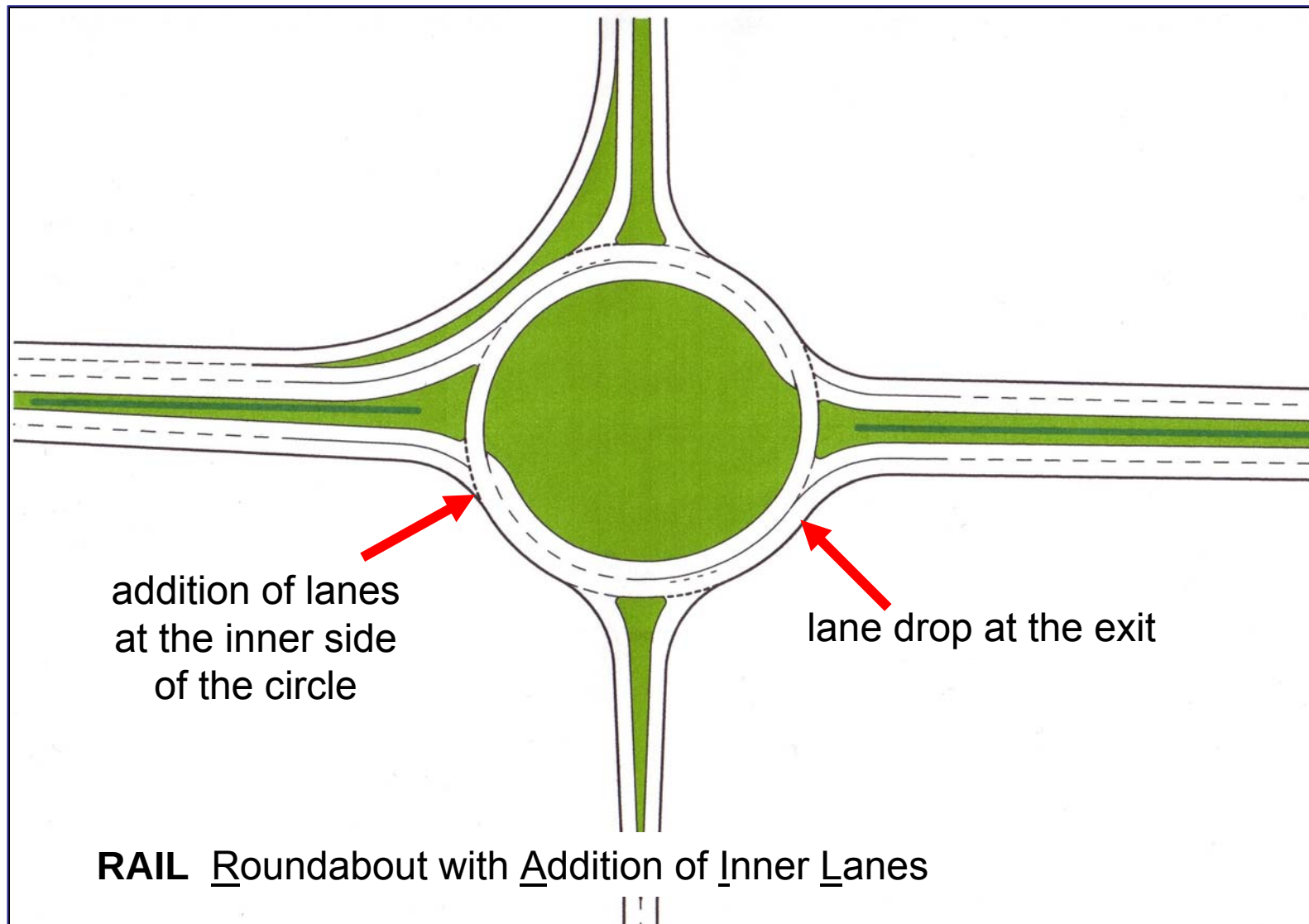


Problem : new interchange

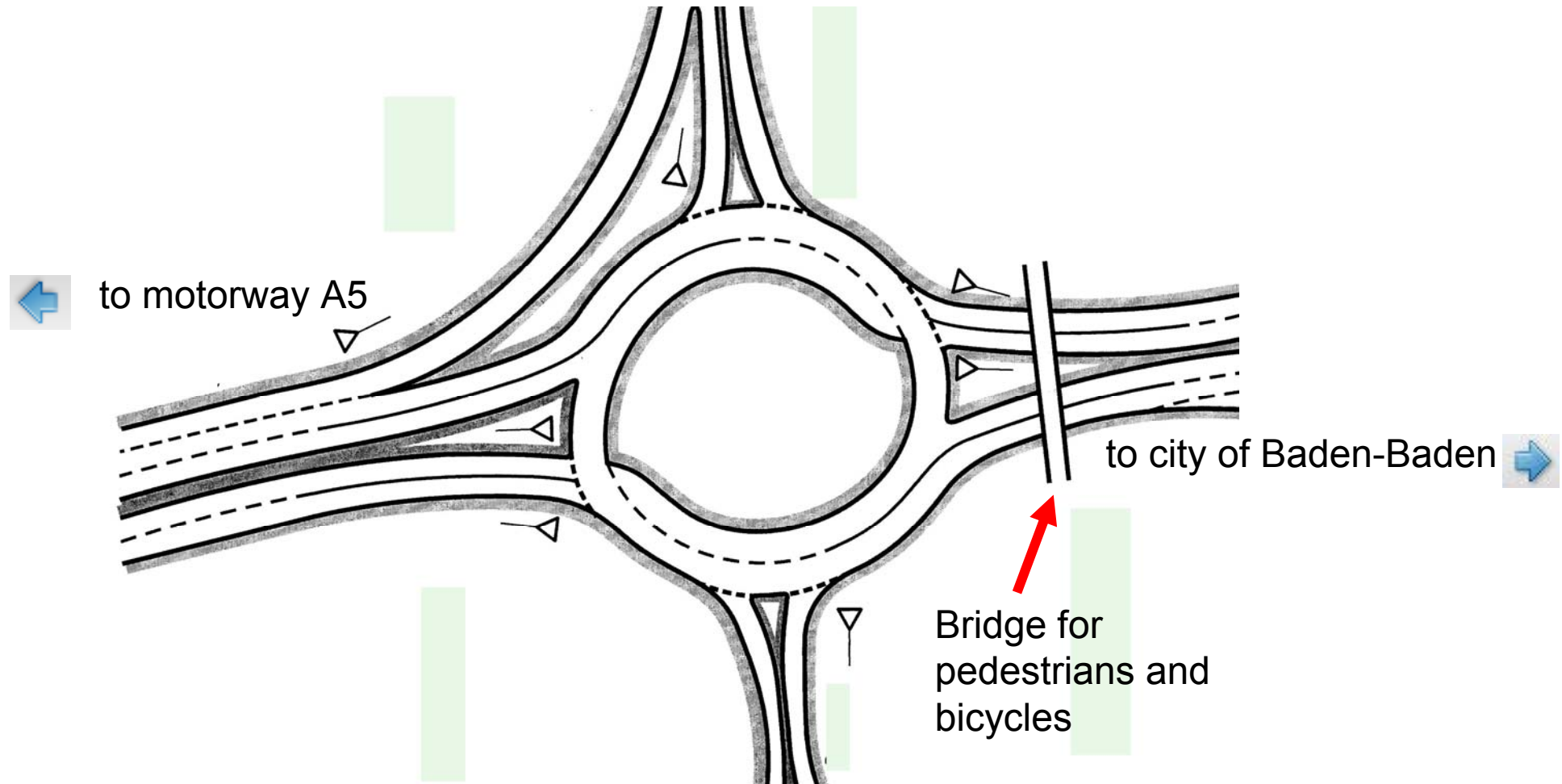


**Architects: best solution:
Roundabout**

Solution : Turbo-roundabout



Turbo-roundabout Baden-Baden



Turbo-roundabout Baden-Baden



Turbo-roundabout Baden-Baden



Baden-Baden
opened May 2006
 $\approx 30\,000$ veh/d



- no kerbs within the circle
- no pedestrians or cyclists (are on a bridge)



- no kerbs within the circle
- no pedestrians or cyclists (are on a bridge)

Turbo-Roundabout

Baden-Baden



- no kerbs within the circle
- no pedestrians or cyclists (are on a bridge)

Turbo-Roundabout Baden-Baden



Turbo-Roundabout

Baden-Baden



Kamera 1



Kamera 2



Kamera 3



Kamera 4

4 periods of observation,
each 2 * 3 hours

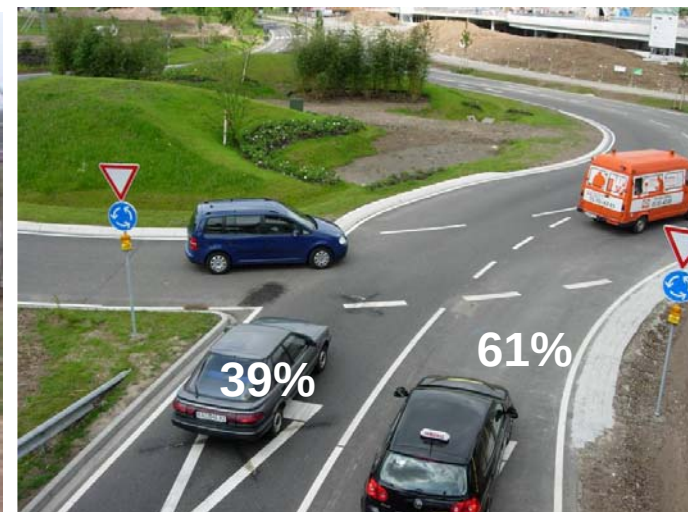
Utilisation of lanes



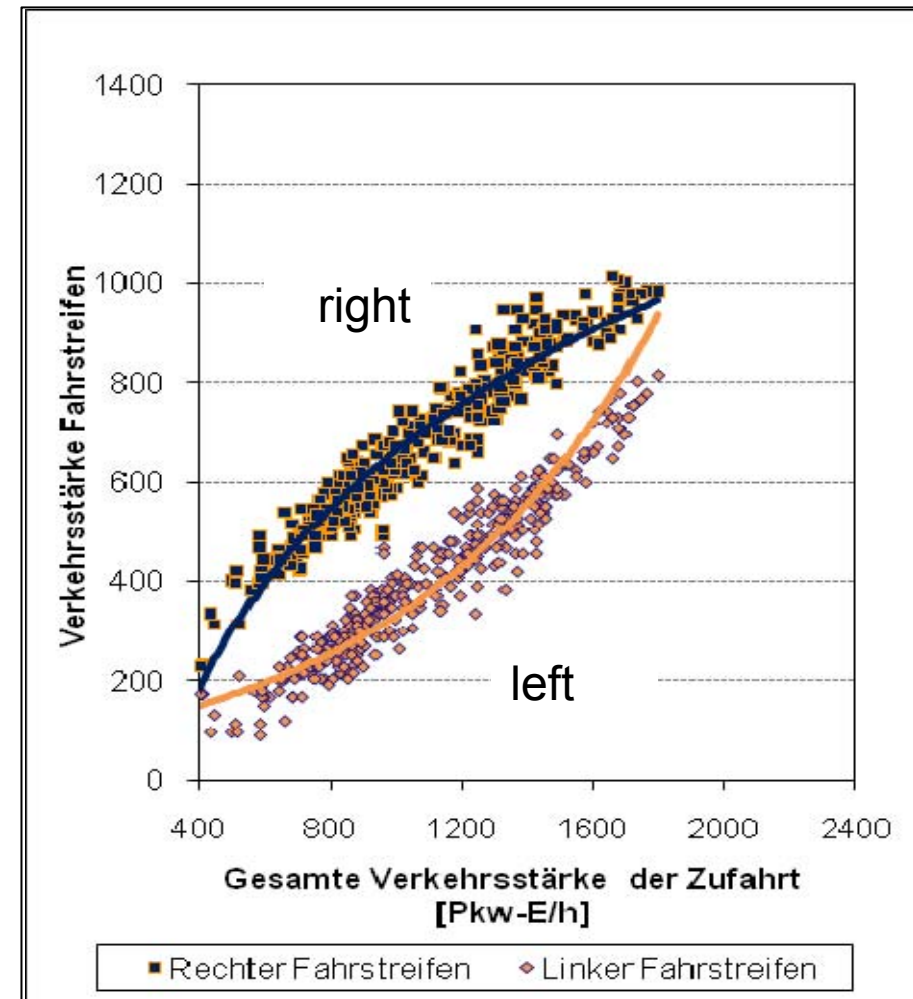
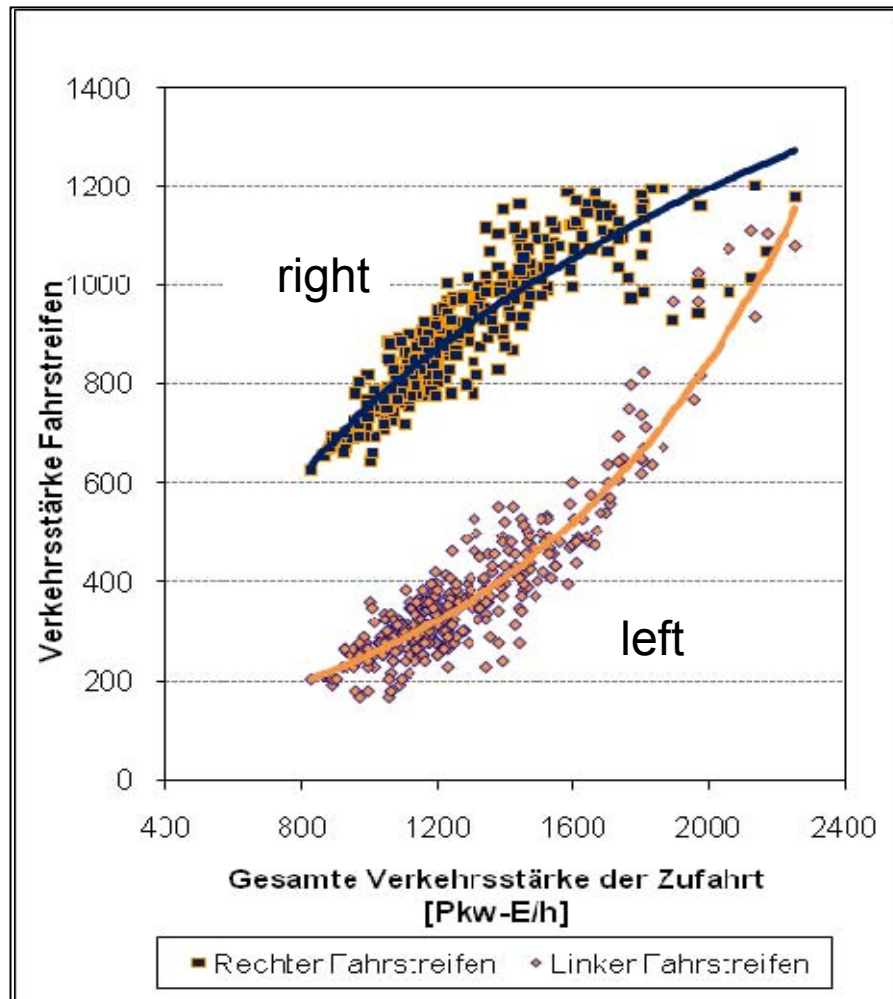
	B 500 from West to East (coming from freeway A 5 heading to city centre) →		B 500 from East to West (from city centre heading to freeway A 5) ←	
	left lane	right lane	left lane	right lane
Entry	24 %	76 %	39 %	61 %
Exit	23 %	77 %	40 %	60 %

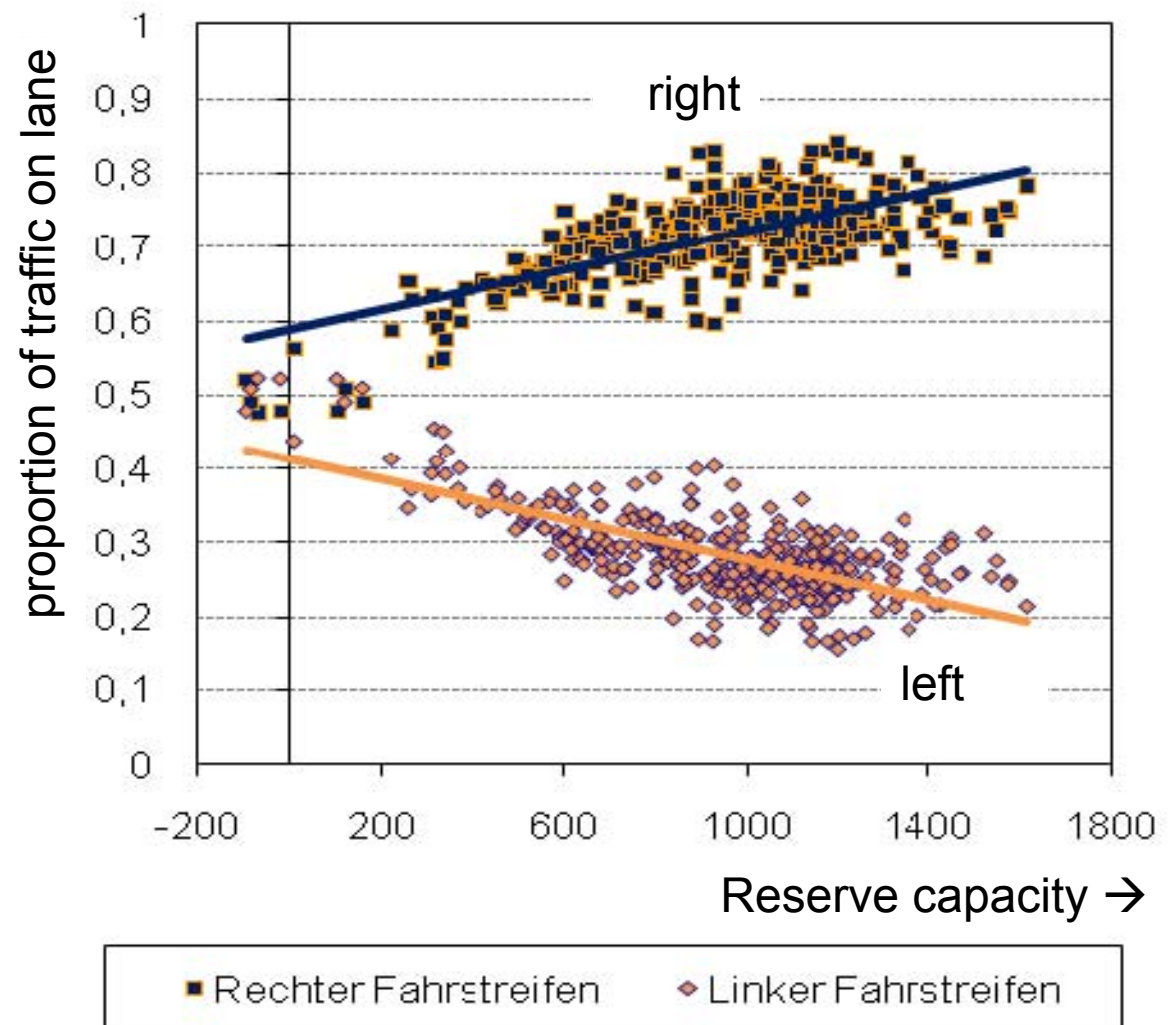
24%

76%



Utilisation of lanes





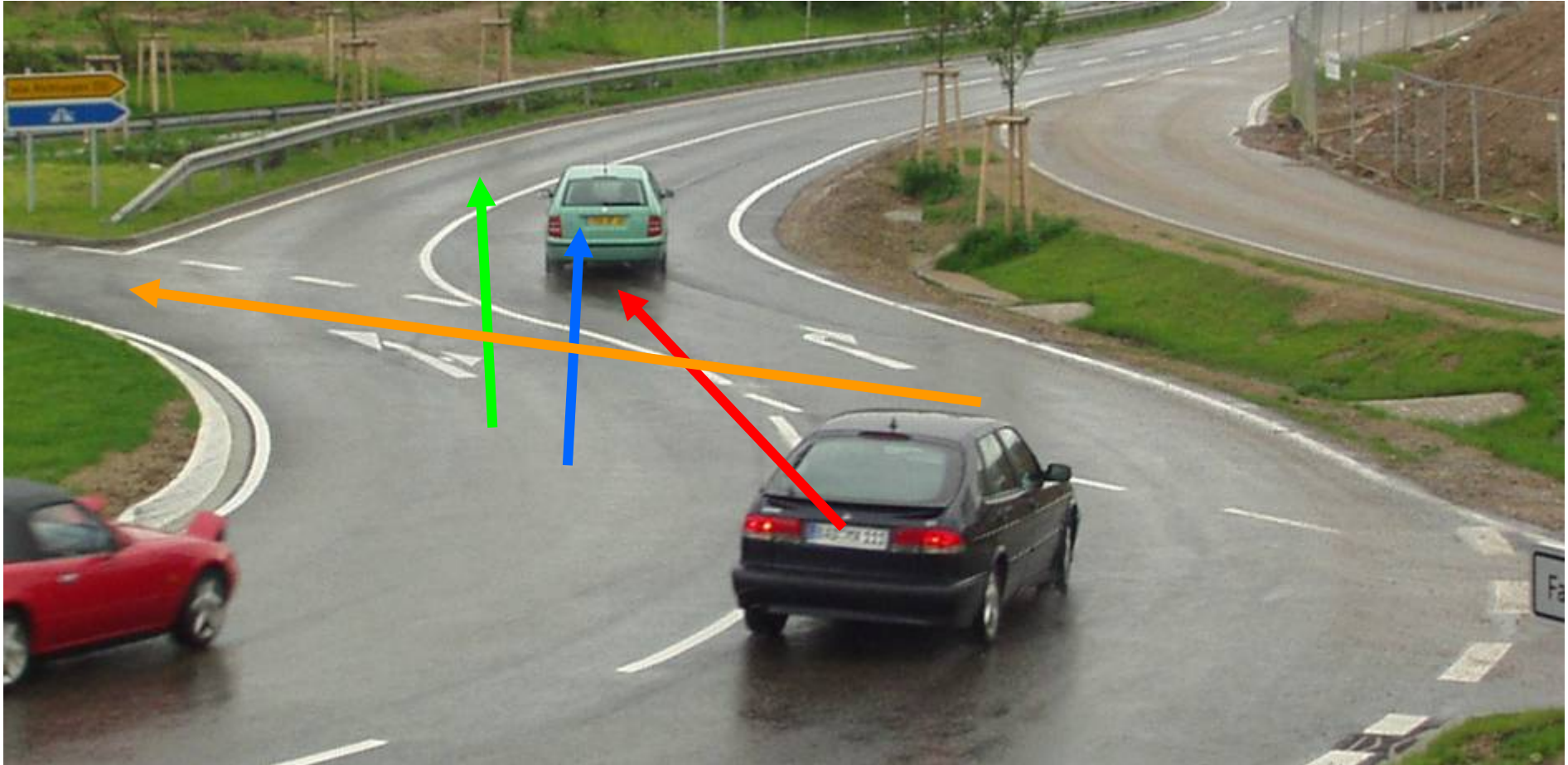
Illegal crossing of lane markings



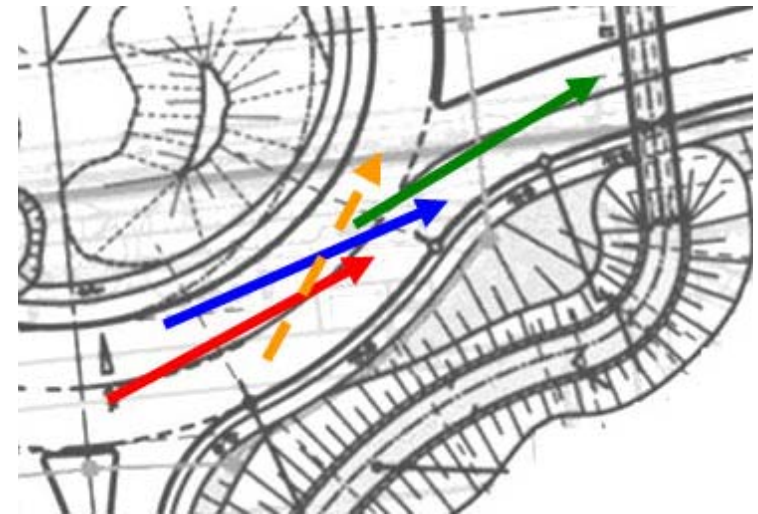
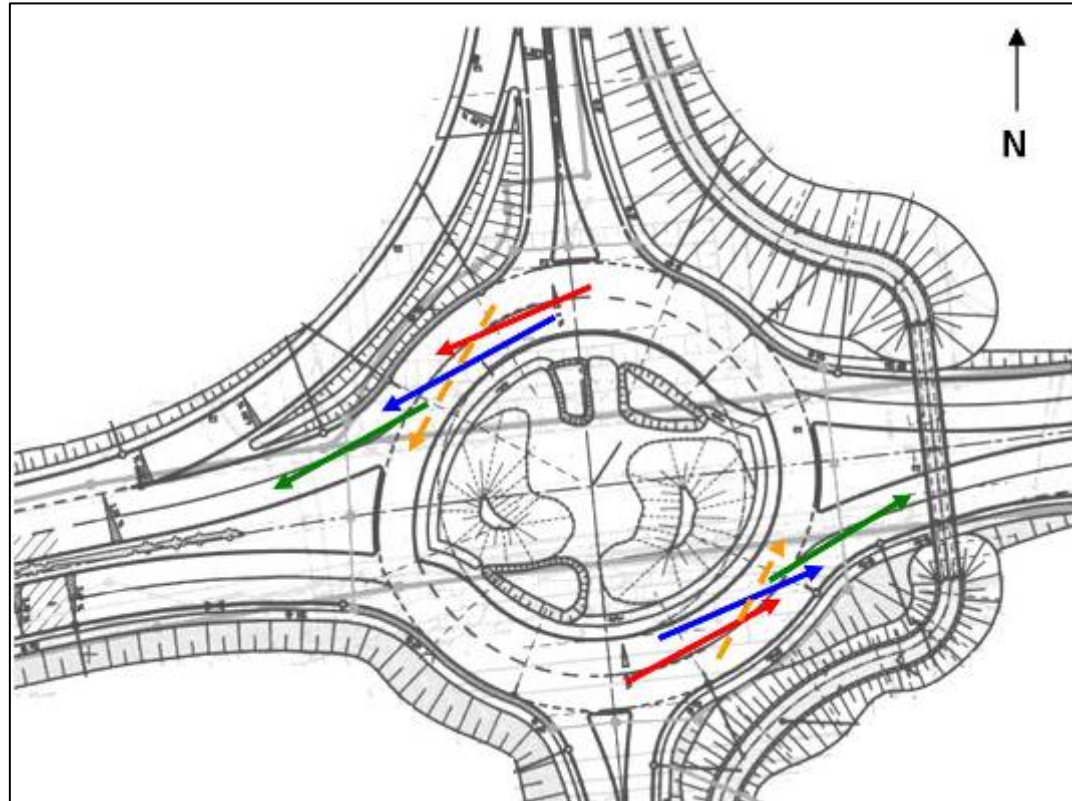
Illegal crossing of lane markings



Illegal crossing of lane markings

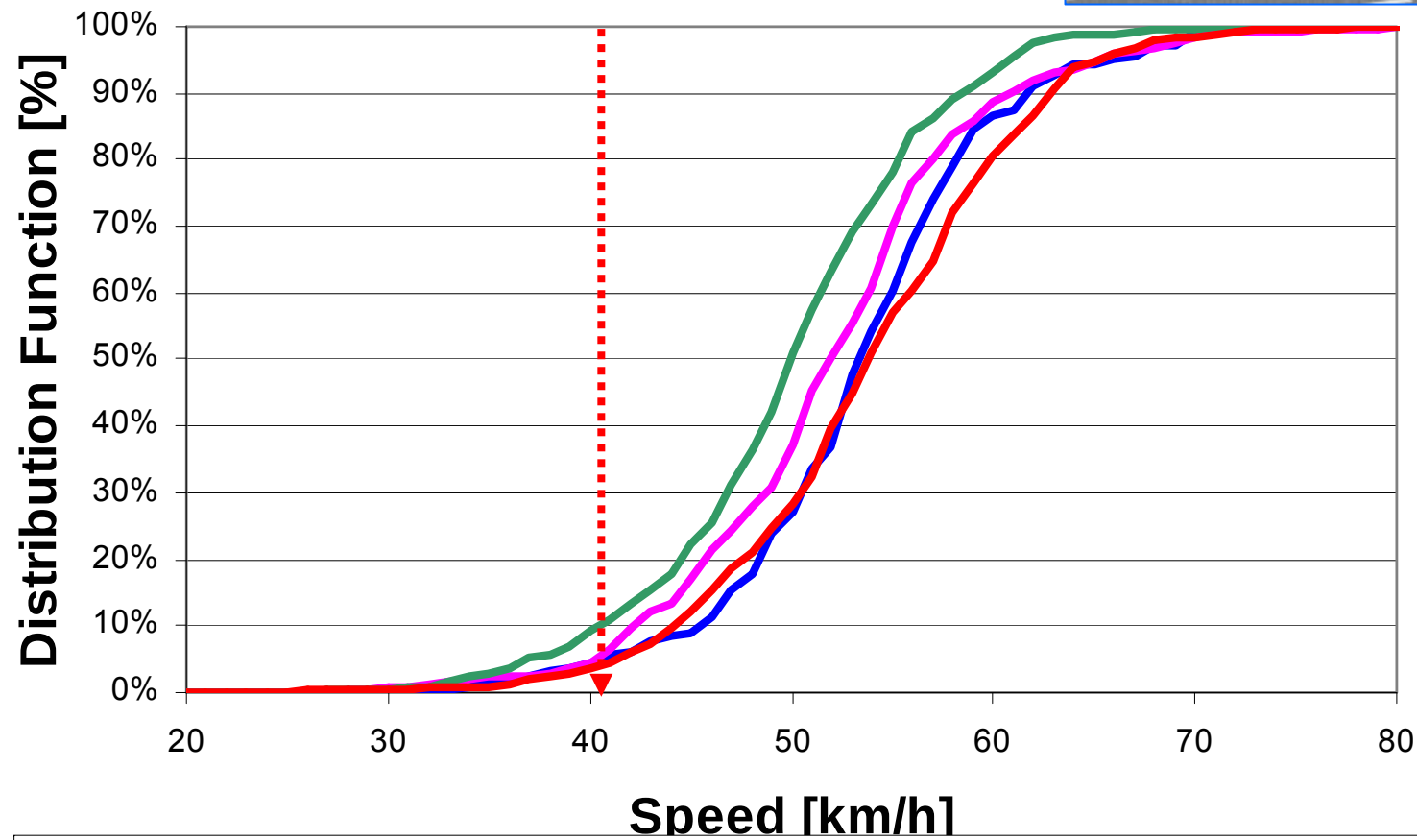


Illegal crossing of lane markings at the 2-lane exits



	violators [%]	
	Eastbound traffic →	Westbound traffic ←
red →	8 - 12	6 - 18
green →	1 - 7	1 - 20
blue →	1 - 5	3
yellow →	0 - 3	0

Speeds on the western approach



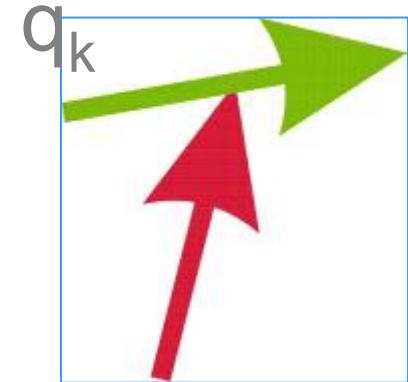
— June 2006 (Morning)	— June 2006 (Afternoon)
— Jan. 2007 (Morning - Rain)	— Jan. 2007 (Afternoon)

Turbo-roundabout entry capacity



- Turbo-Roundabout: Capacity for each entry-lane

$$G = \left(1 - \frac{t_{min} \cdot q_k}{n \cdot 3600} \right)^n \cdot \frac{3600}{t_f} \cdot e^{-\frac{q_k}{3600} \cdot \left(t_g - \frac{t_f}{2} - t_{min} \right)}$$

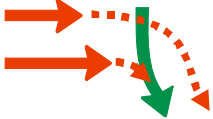
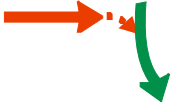
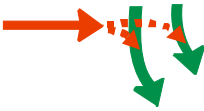
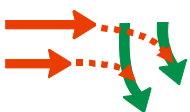


$$G = q_{e,max}$$

G	= capacity for one entry lane	[pcu/h]
q_k	= circulating traffic	[pcu/h]
q_e	= Verkehrsstärke in der Zufahrt	[pcu/h]
t_c	= critical headway	[s]
t_f	= follow-up time	[s]
t_{min}	= minimum gap on the circle	[s]
n	= number of circulating lanes to be crossed or entered	[-]

Critical headways and follow-up times



	entry type	critical headway t_c [s]	follow-up time t_f [s]	Min. gap on the circle t_0 [s]
	 IN1	4,5	2,5	1,9
1	left and right lane			
	 IN2	4,5	2,5	1,9
2	single lane			
	 IN3	4,3	2,8	2,0
3	single lane			
	 IN4	4,0	2,6	1,9
4	left lane			
5	right lane	4,5	2,7	2,0

Calculation of capacity and quality of service



Capacity, average delay, and queue length - only motorized traffic

Turbo-Kreisverkehr an der B 600
Turbo_Beispiel_KREISEL
B 600 / Grünweg
Nachmittagsspitzenstunde

File: Turbo_b600.krs

	Name	Type of	q-e-l pcu/h	q-e-r pcu/h	q-c-l pcu/h	q-c-r pcu/h	q-e-dema. pcu/h	q-e-max pcu/h	x	Reserve pcu/h	av. dly s	L pcu	L-95 pcu	L-99 pcu	LOS
1	B 600 West (Richtung BAB)		657	986	0	359	1643	2040	0,81	397	9	2,8	12	18	A
2	Grünweg		177	43	666	1090	220	308	0,71	88	39	1,7	7	9	D
3	B600 Ost (Richtung City)		632	948	0	494	1580	1799	0,88	219	15	4,8	18	27	B
4	Gewerbering		178	0	640	1016	178	314	0,57	136	26	0,9	4	6	C
4	Bypass	-	-	-	-	-	784	1400	0,56	616	6	-	-	-	A

Result:

Overall performance level: **D**

Calculation settings

Delay: Kimber, Hollis (1979) with $F_{kh} = 0,8$ / $T = 3600$

Capacity: Germany: Turbo-Roundabout

Queue-length: Wu, 1997

Definition: Geometry of the Turbo-Roundabout

Entry: 1 B 600 West (Richtung BAB)

Exit:

Entry:

Exit:

Entry:

Exit:

Entry:

Exit:

Entry:

Exit:

Entry:

Exit:

Entry:

KREISEL

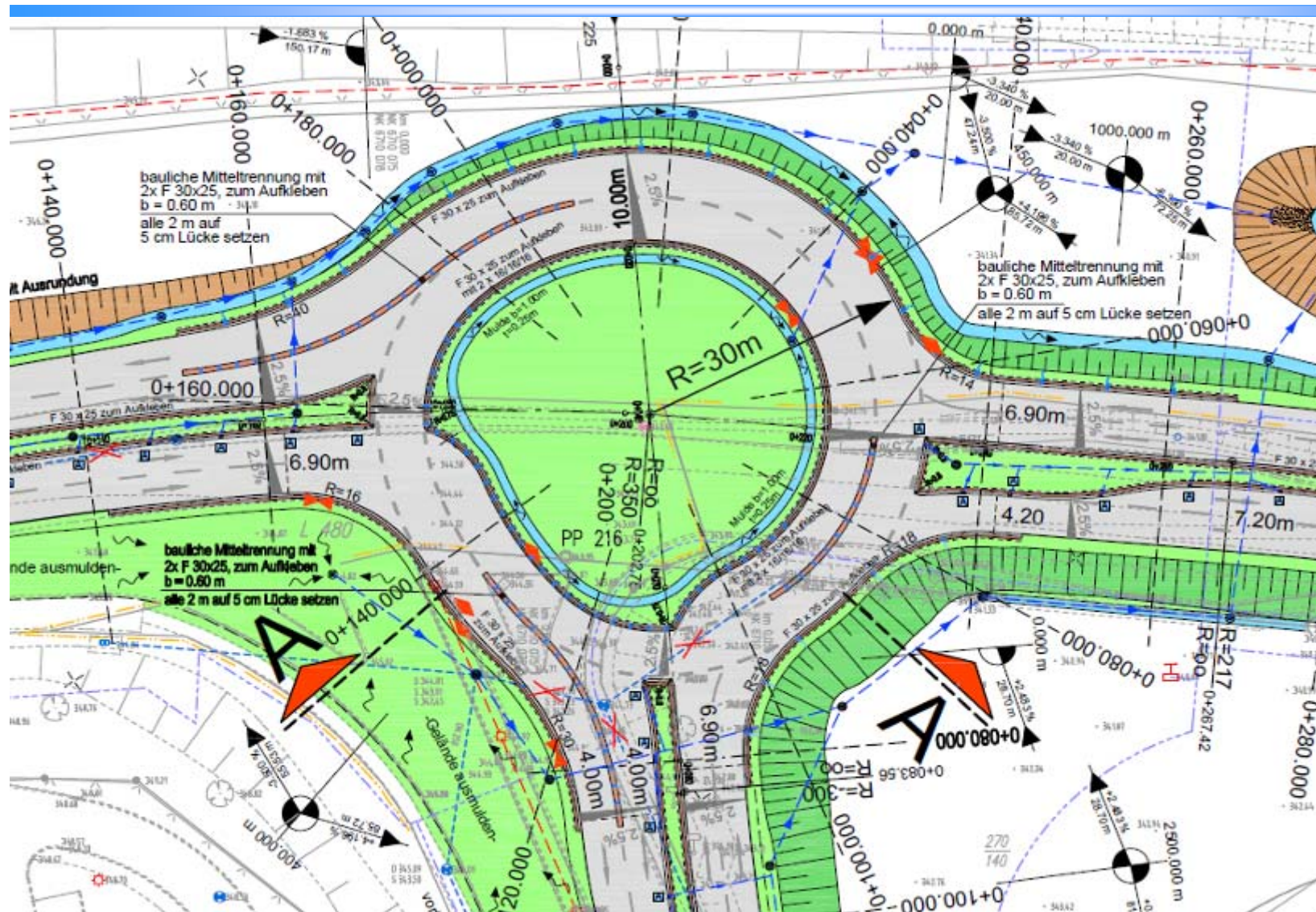
<http://www.bps-verkehr.de/html/kreisel.html>

More Turbo-roundabouts in Germany



Markdorf

More Turbo-roundabouts in Germany



Zweibruecken

More Turbo-roundabouts in Germany



Zweibruecken

More Turbo-roundabouts in Germany



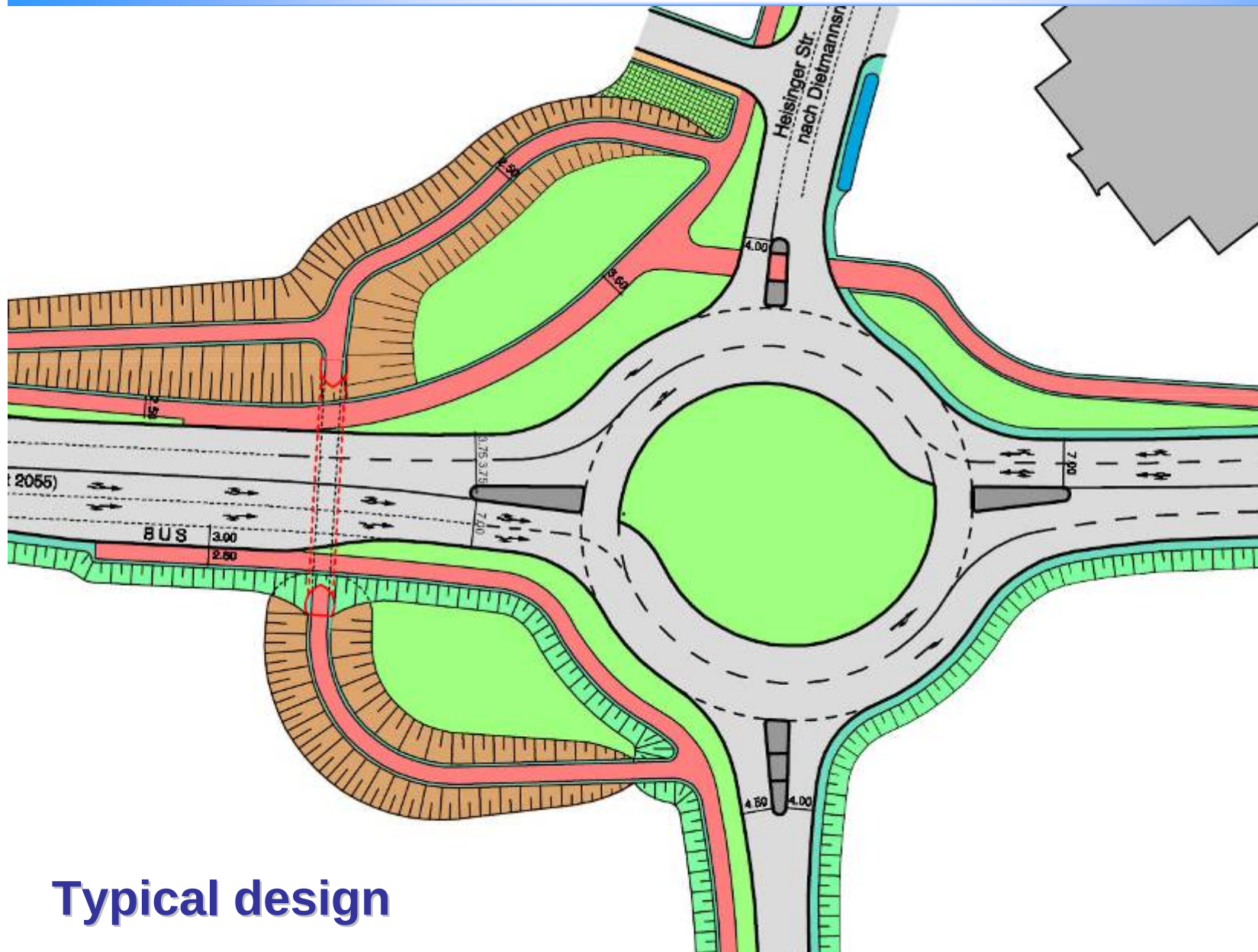
Zweibruecken

More Turbo-roundabouts in Germany

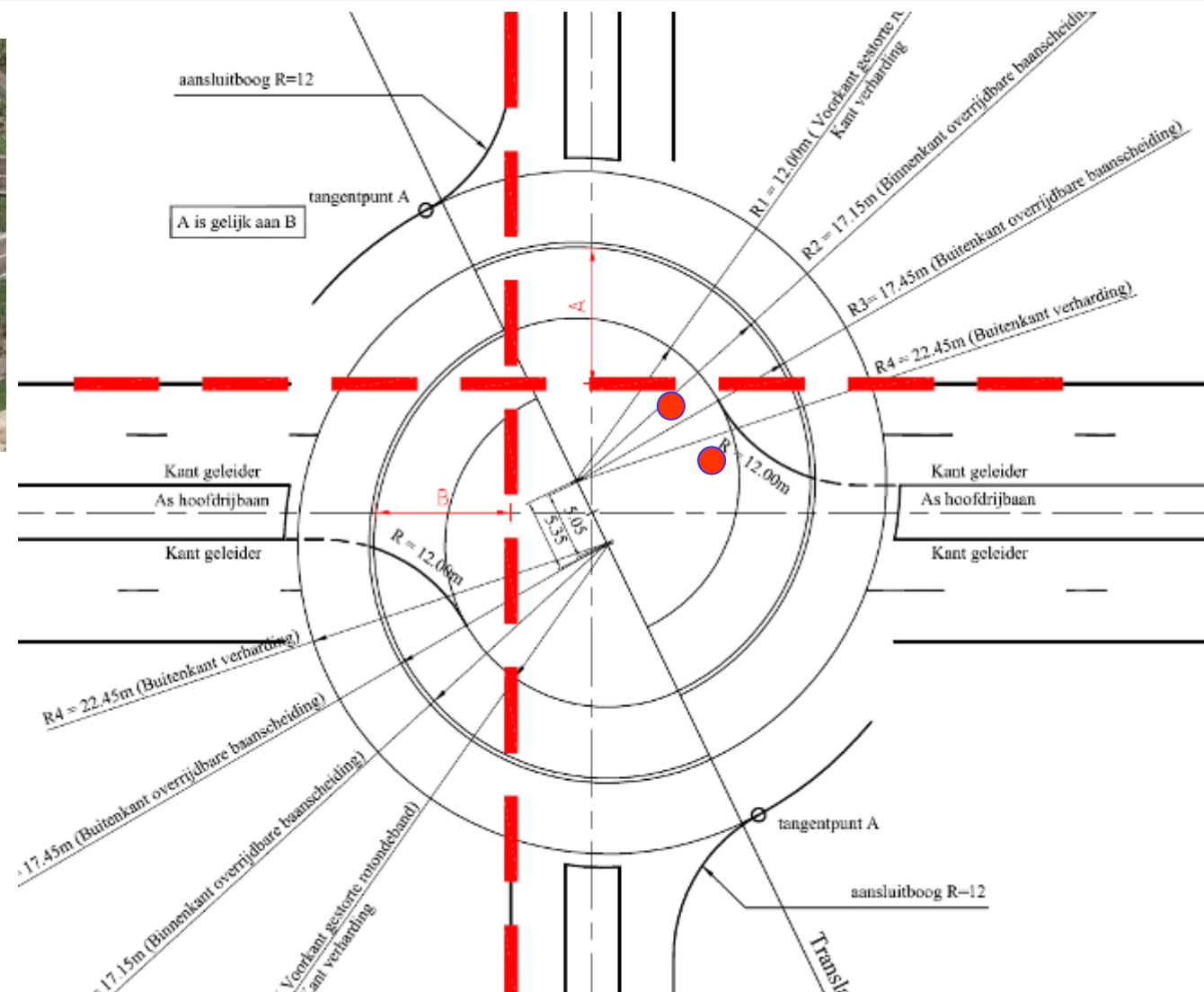


Zweibruecken

More Turbo-roundabouts in Germany

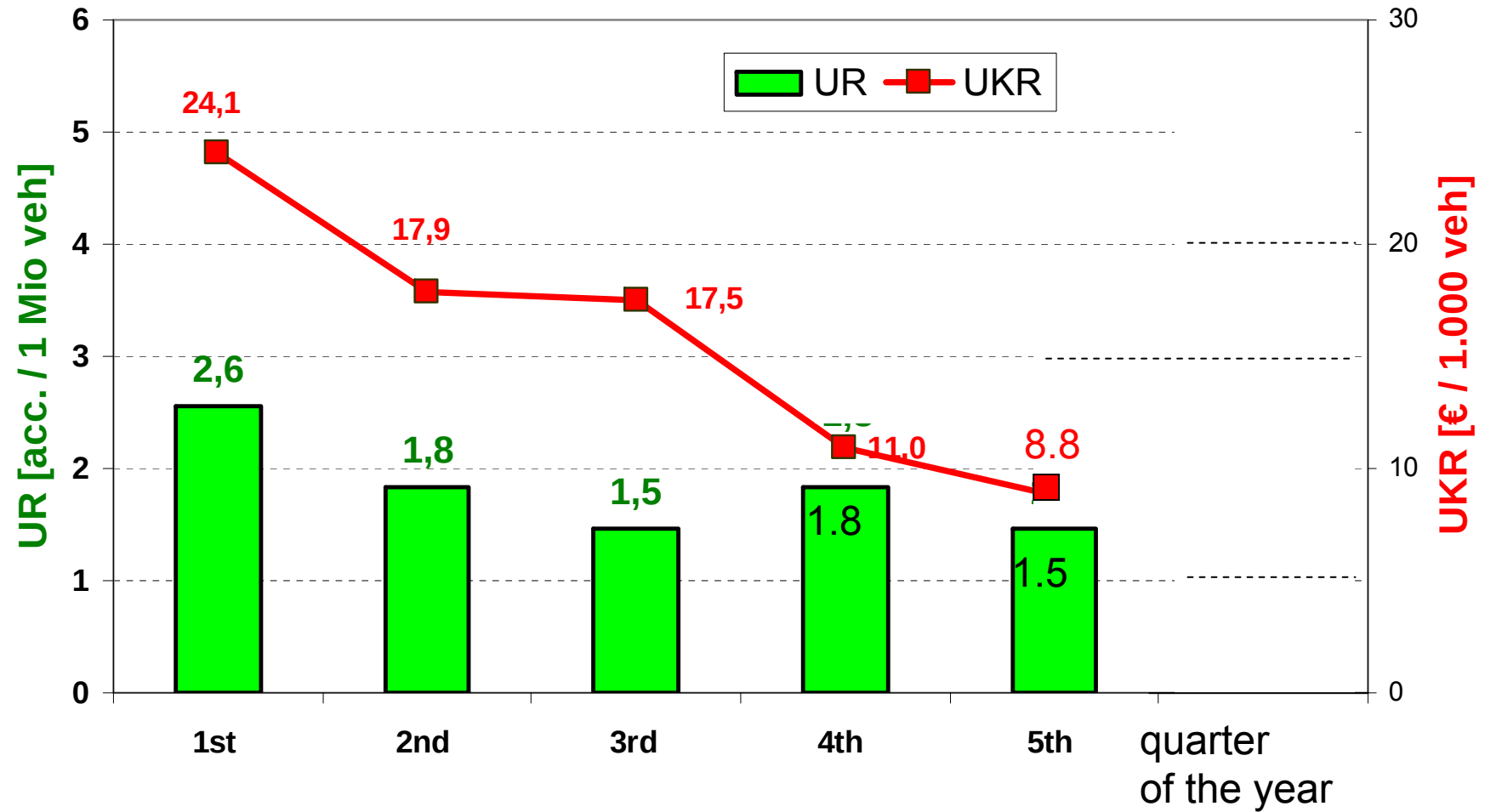


Typical design

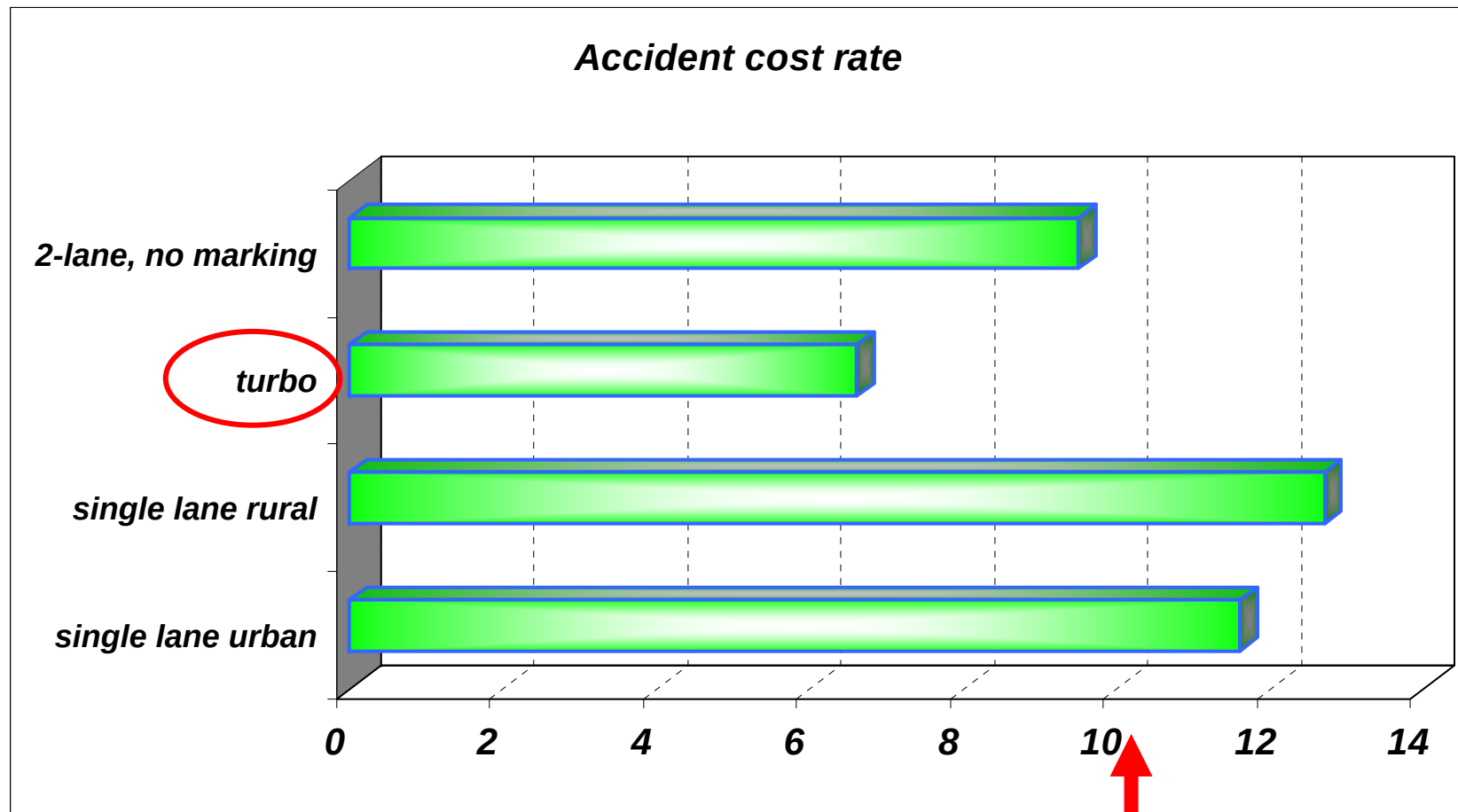


48

Accident rates (UR) + acc. cost rates (UKR) Baden-Baden



Accident cost rates (UKR in €/1000 veh)



Conclusions



- Idea is based on the policy to avoid large roundabouts
- Turbo-roundabout works
- is capable to treat large volumes of through-traffic
under lower demand on the side approaches
- no cyclists not pedestrians should be allowed
- no severe accidents – low accident-cost-rates
- Turbo-roundabouts offer the potential
to combine high safety with larger capacities
- Turbo will, however, not compete above 40 000 veh/day.

some impressions from Baden-Baden



Thank you for your attention



