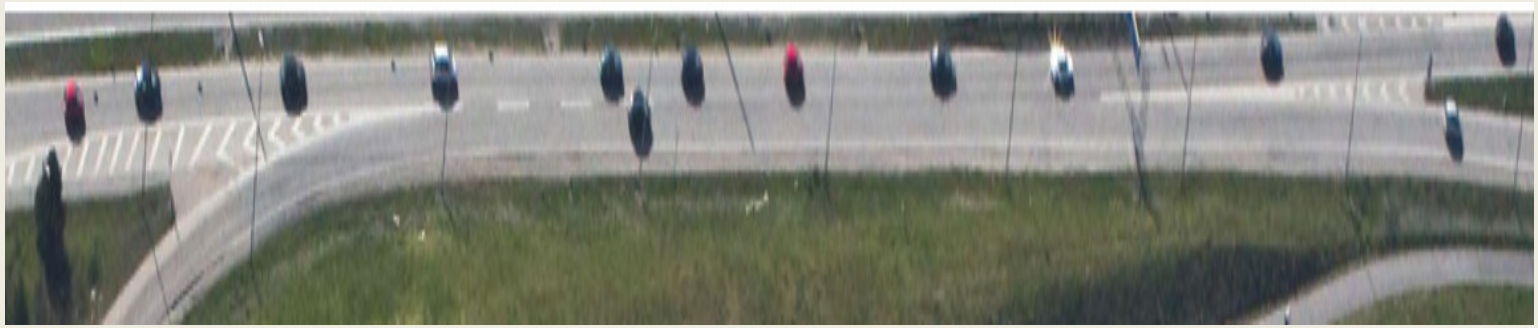
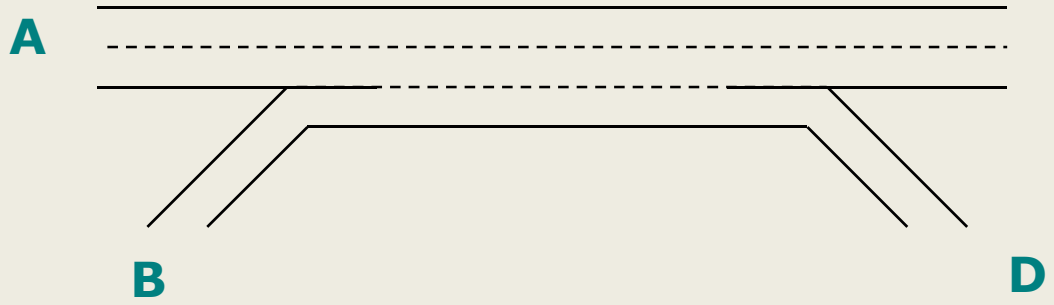
Motorway Weaving Sections (study completed in 2013)

Main purpose:
To analyse the capacity of weaving sections in DK

- Collect existing knowledge, HCM 2010
- Literature review
- Locate weaving sections in DK
- Find method for traffic data collection
- Collect data
- Analysis
- Model development

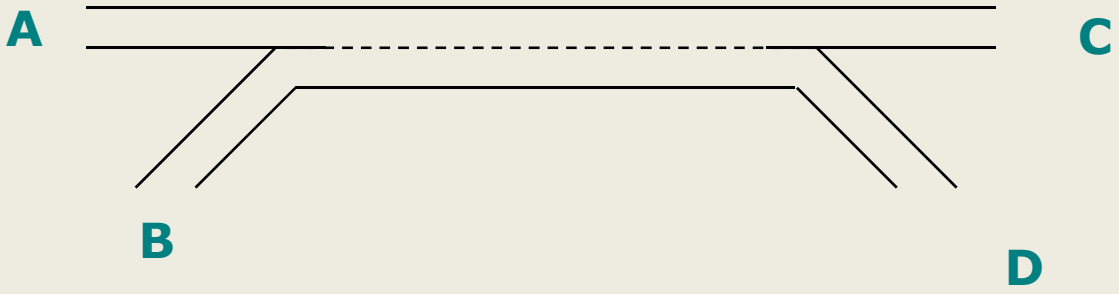


Type A

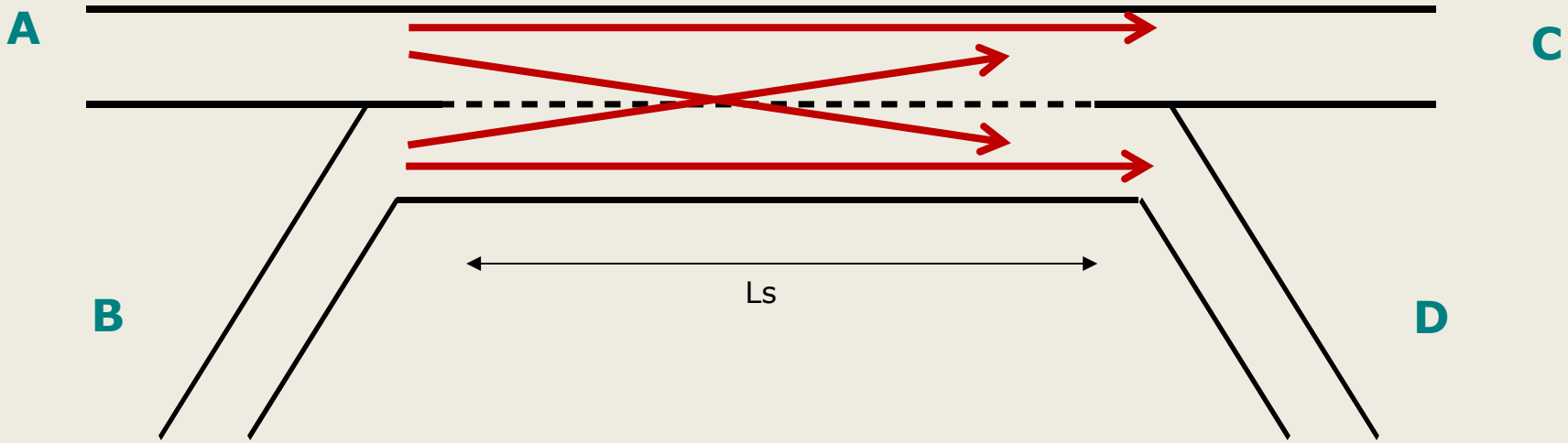


Total: 4
Length: 280 – 330 m

Type B



Total: 14
Length: 100 – 125 m

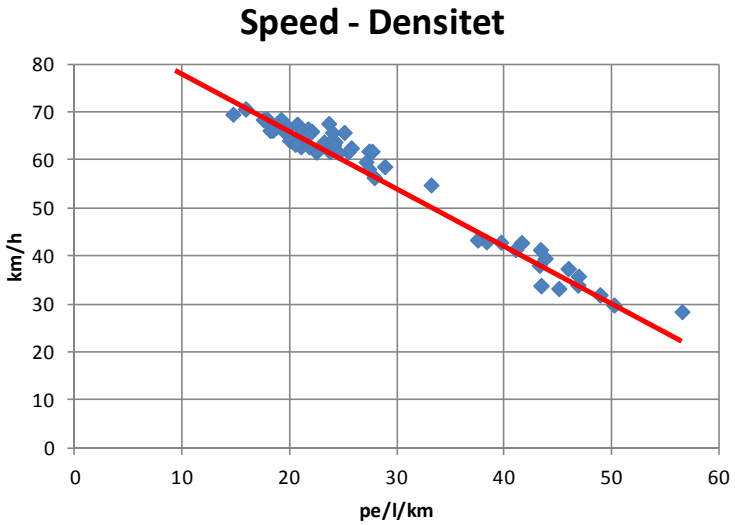


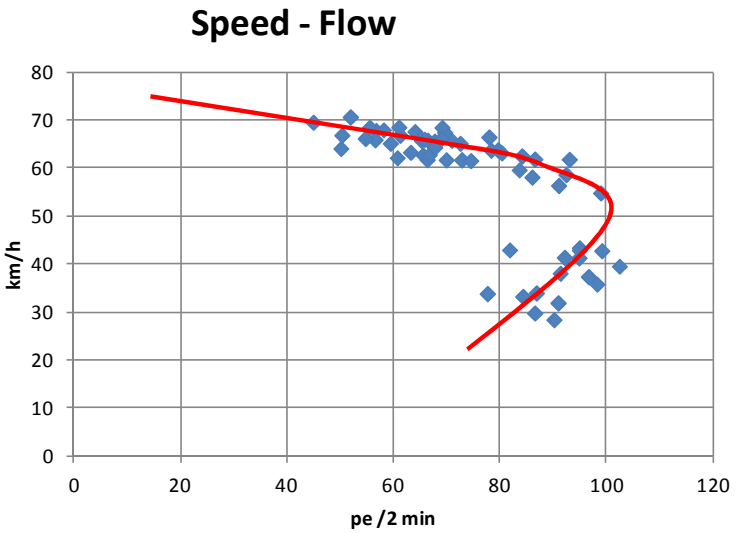
Data collection by use of video (3-4h recording)

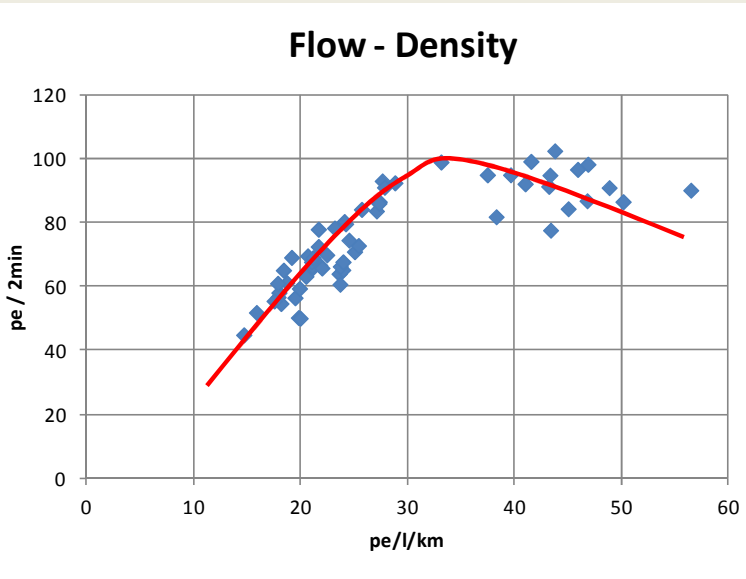
Vehicle by vehicle data !!

Data aggregated to 1, 2, 5 and 10 min intervals

Type B - 2 min data



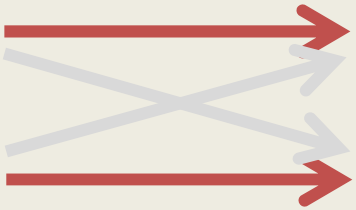




Type B

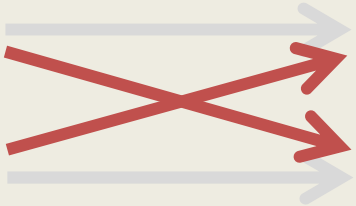
Type B

0 % weaving



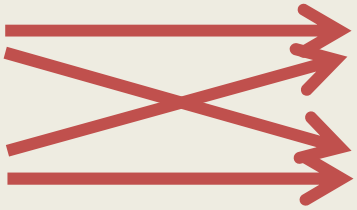
Capacity: 4200 pc/h

100 % weaving



Capacity: 1000- 1500 pc/h

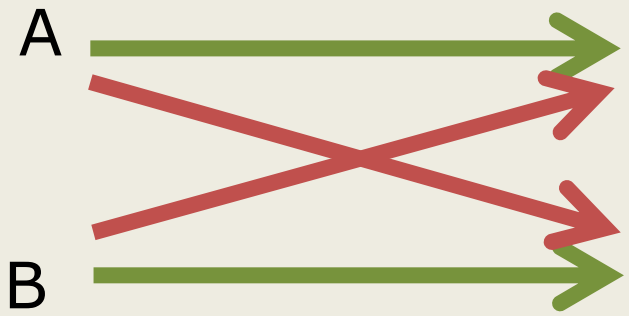
10-90 % weaving



Capacity: 1200 – 4000 pc/h

Simple approach:
1 weaving pc = non weaving pc x Fve

Type B



Weaving vehicles have greater impact on weaving section speed than non-weaving vehicles

Factor 1.3 – 1.8

Weaving flow Vad + Vbc (pc/1min)	Non weaving flow Vac +Vbd (pc/1min)				
	10-15	15-20	20-25	25-30	30-35
0-5	71	70	68	67	65
5-10	70	68	66	65	63
10-15	68	66	65	63	62
15-20	66	64	63	61	60
20-25	64	62	61	59	58

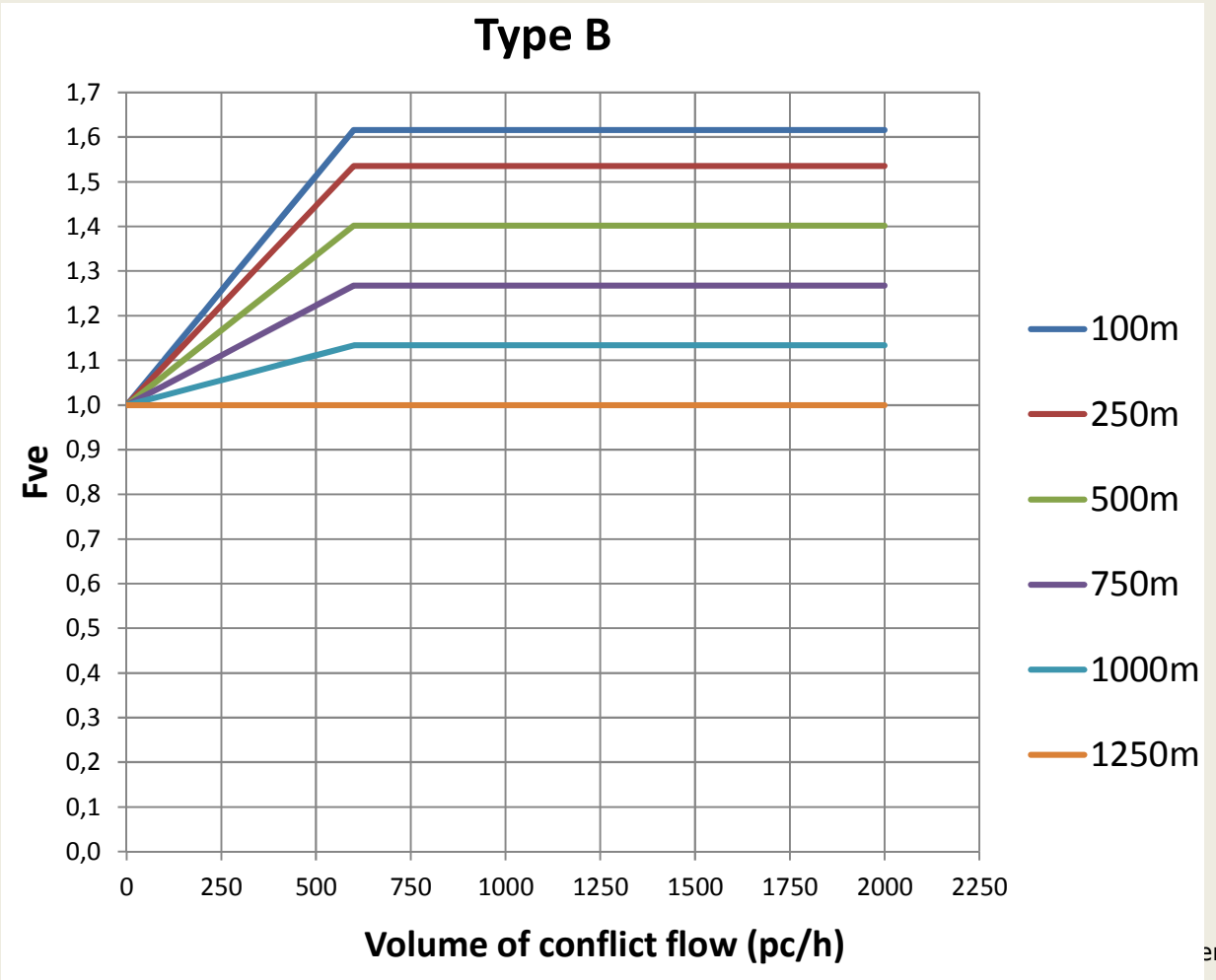
Table: Speed of weaving section at different weaving / non-weaving flow rates

Simpel Model

Fve: Flow modification factor for weaving flow

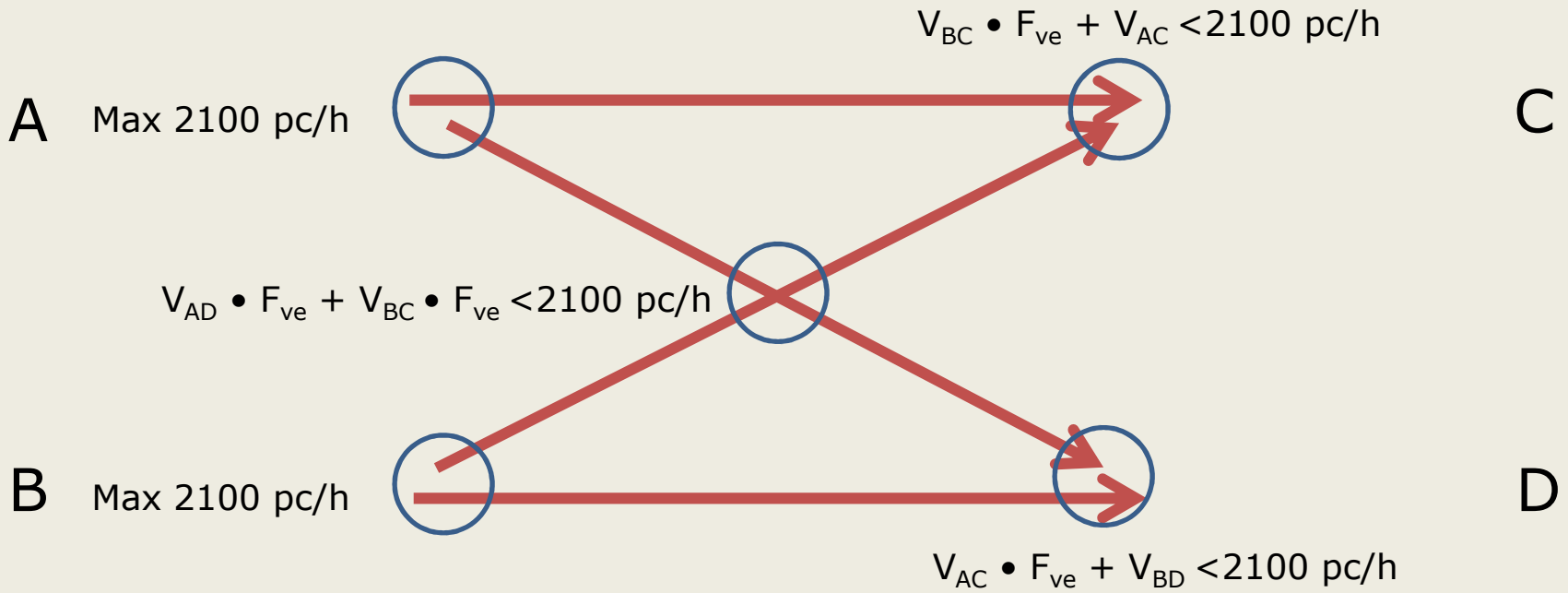
Depends on:

- Length of weaving section
- Volume of crossing/merging flow

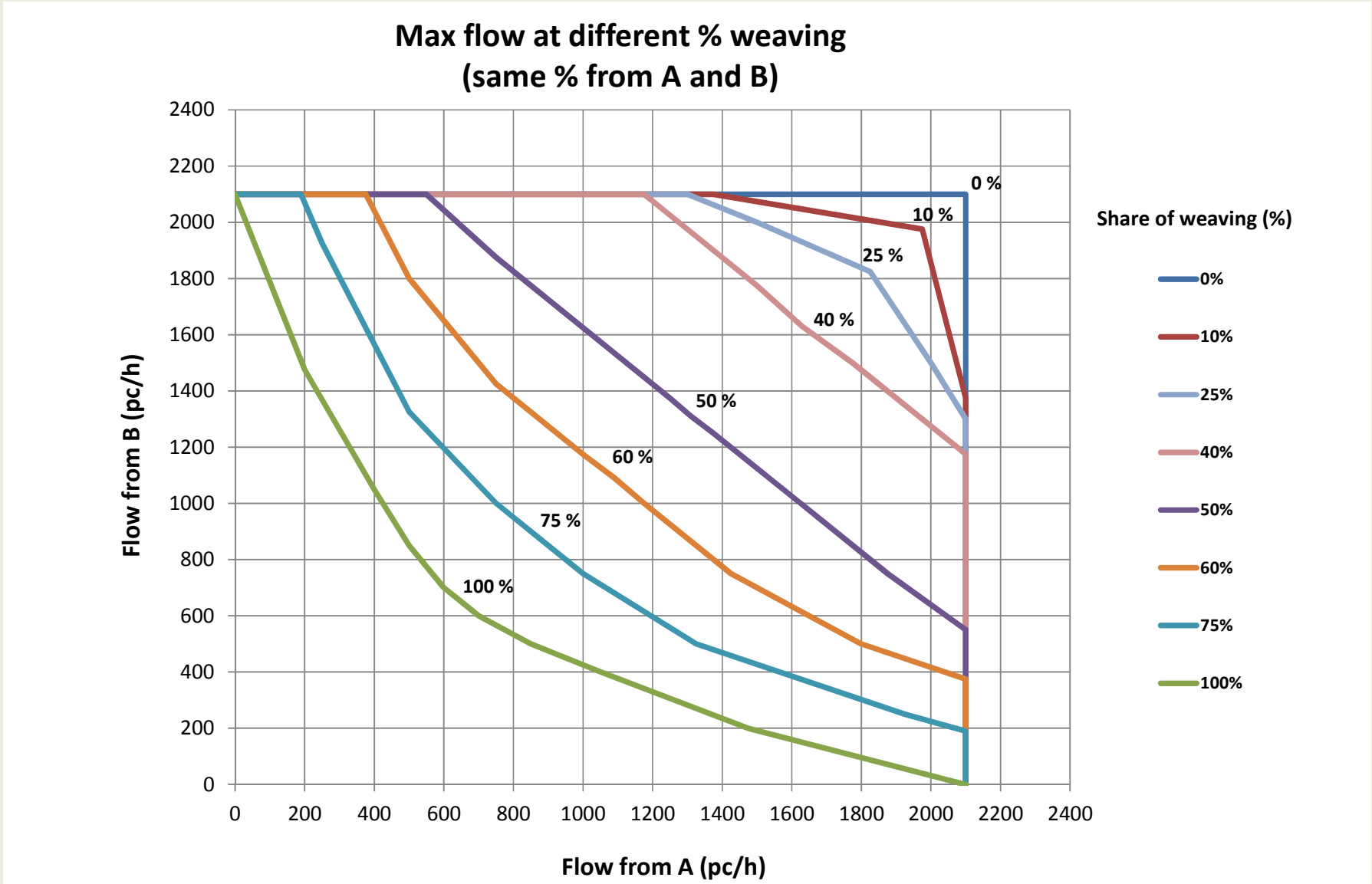


Simpel Model

Type B



Type B

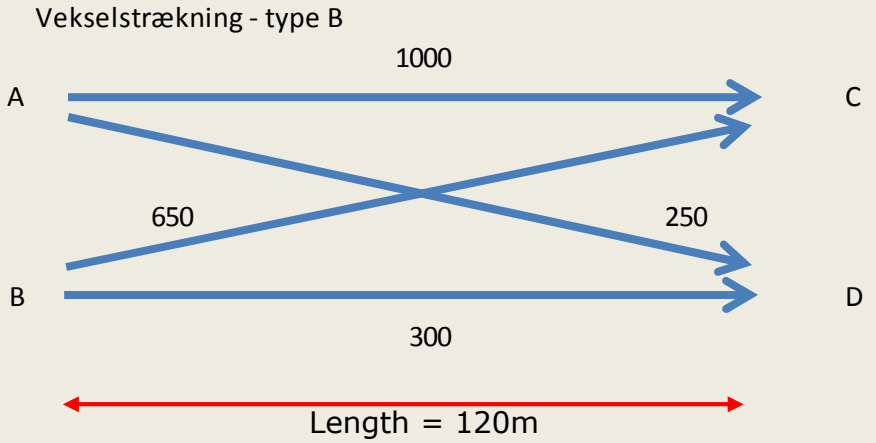

Max flow at different % weaving
(same % from A and B)
Flow from B (pc/h)
Flow from A (pc/h)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
0 %
10 %
25 %
40 %
50 %
60 %
75 %
100 %
Share of weaving (%)
0%
10%
25%
40%
50%
60%
75%
100%

Type B

Model implemented in spreadsheet

Input:

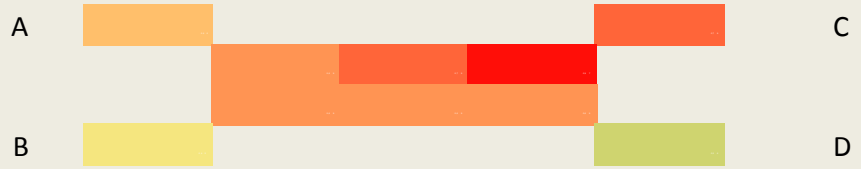
- Flow AC, AD, BC, BD
- Length



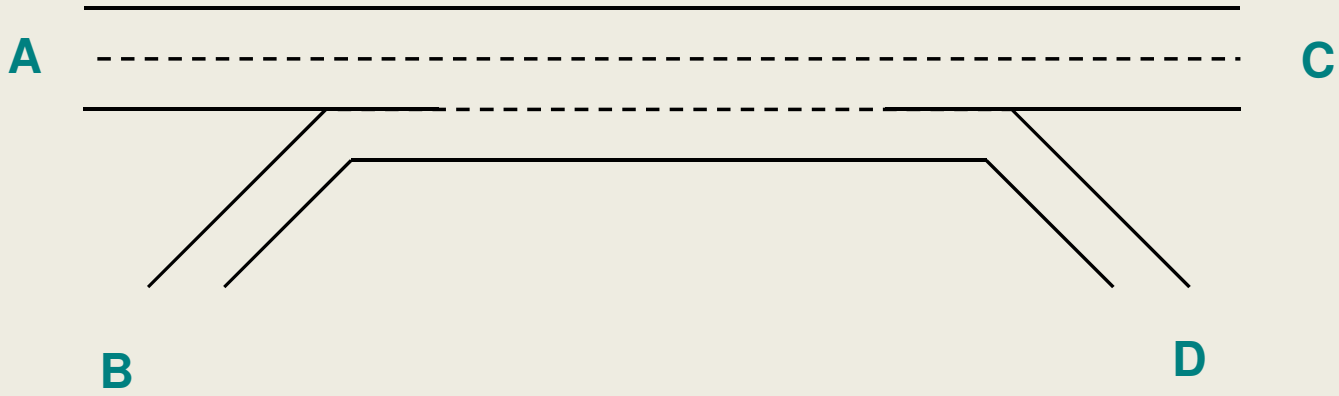
Output:

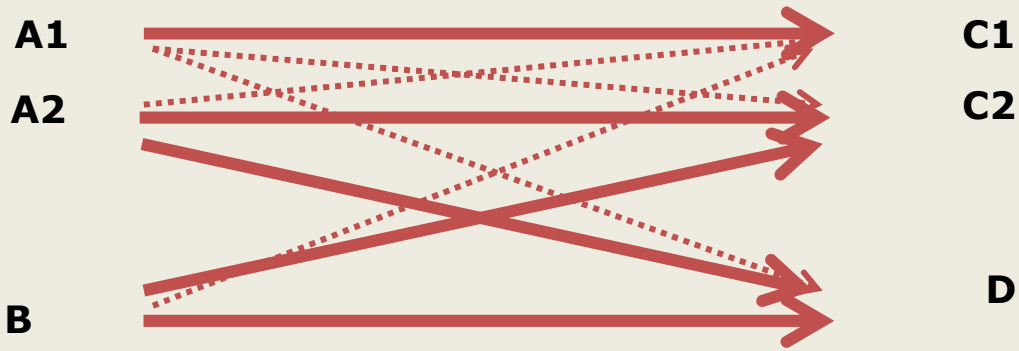
- V/C ratio

	Belastning (d/c)
A	0,60
B	0,45
C	0,79
D	0,26
AD + BC Kryds	0,69
AC + BC - Flet	0,97
BD + AD - Flet	0,33
Samlet	0,65



Type A



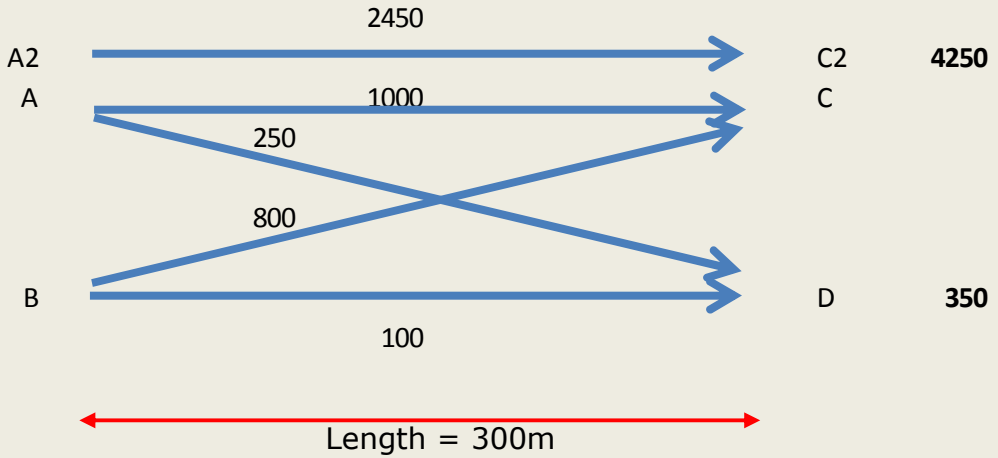


Type A

Model implemented in spreadsheet

Input:

- Flow AC, AD, BC, BD
- Length
- Share of AC in left lane



Output:

V/C ratio

	Belastning (d/c)
A2C2	0,98
A	0,50
B	0,41
C	0,72
D	0,16
AD + BC Kryds	0,58
AC + BC - Flet	0,87
BD + AD - Flet	0,18
Samlet	0,52

Capacity at non signalised intersections (study completed in 2010)

Capacity at non signalised intersections

- Capacity model based on gap acceptance theory (Tanners gap acceptance formula)
- Update values for critical gap and follow up times
- Driver behaviour observed by use of video recordings

Data from:

- Five rural 3-arm intersections (give way)
- One rural 4-arm intersection (stop controlled)
- Five urban 3-arm intersections (give way)

Rural areas

3-arm rural

Passenger cars

	Critical gap	Follow up time
Right turn from minor	7.0 sec	3.3 sec
Left turn from minor	6.9 sec	3.7 sec
Left turn from major	5.6 sec	2.4 sec

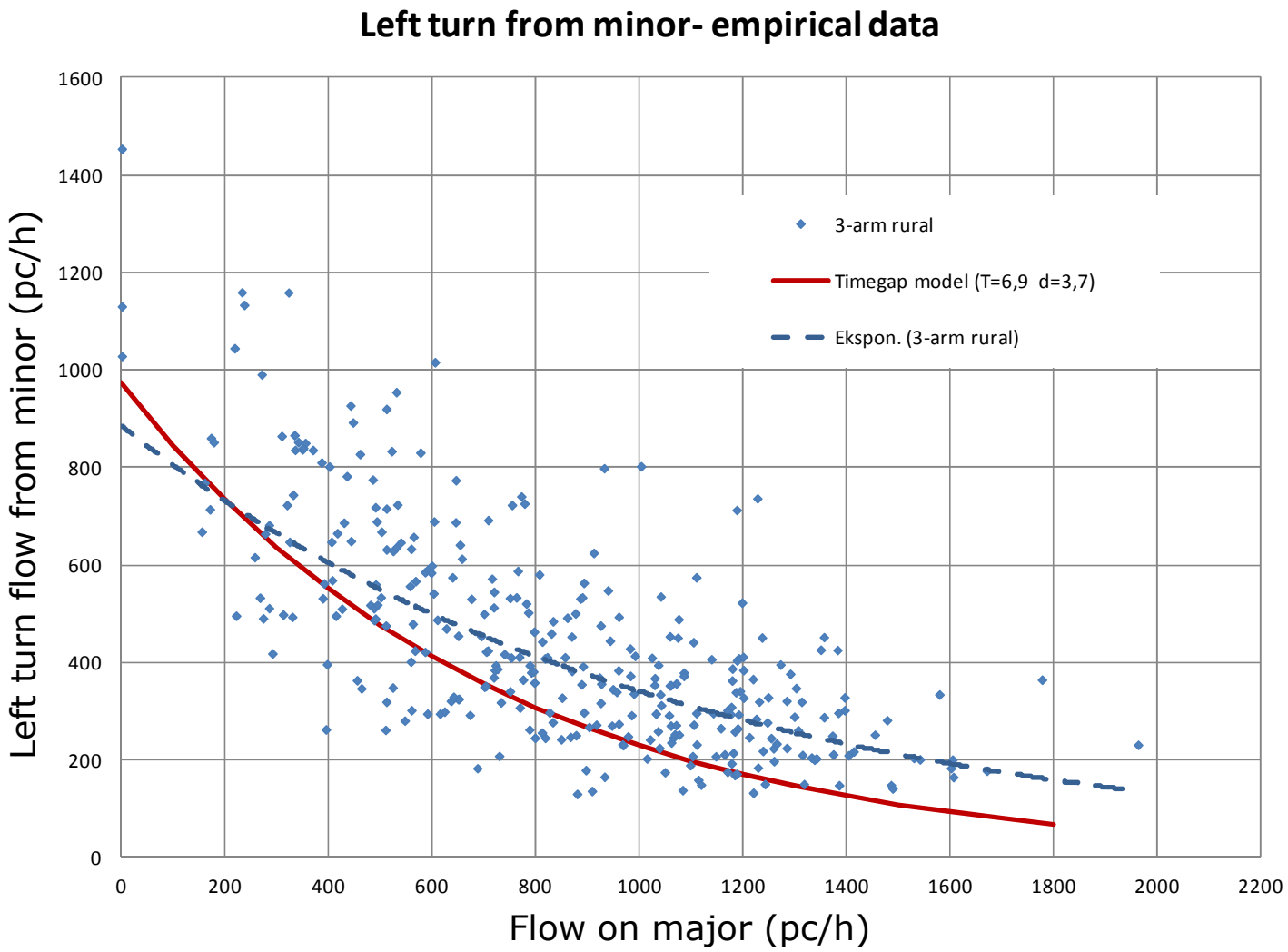
Heavy vehicles

	Critical gap		Follow up time	
	Truck/bus	Semitrailer/ truck w. trailer	Truck/bus	Semitrailer/ truck w. trailer
Right turn from minor	7.2 sec	(8.7 sec)	5.4 sec	6.7 sec
Left turn from minor	8.0 sec	9.8 sec	5.8 sec	8.1 sec
Left turn from major	7.3 sec	(8.8 sec)	4.6 sec	6.5 sec

PCU – values for heavy vehicles

	Truck/bus		Semitrailer/ truck w. trailer	
Right turn from minor	1.4	(1.3-1.6)	2.2	(2.0-2.6)
Left turn from minor	1.7	(1.6-1.9)	3.1	(2.2-4.4)
Left turn from major	2.3	(1.8-2.8)	4.1	(2.6-5.8)

Empirical data



Signalised intersections
Follow-up times and pcu-values
(study completed in 2013)

Main purpose:

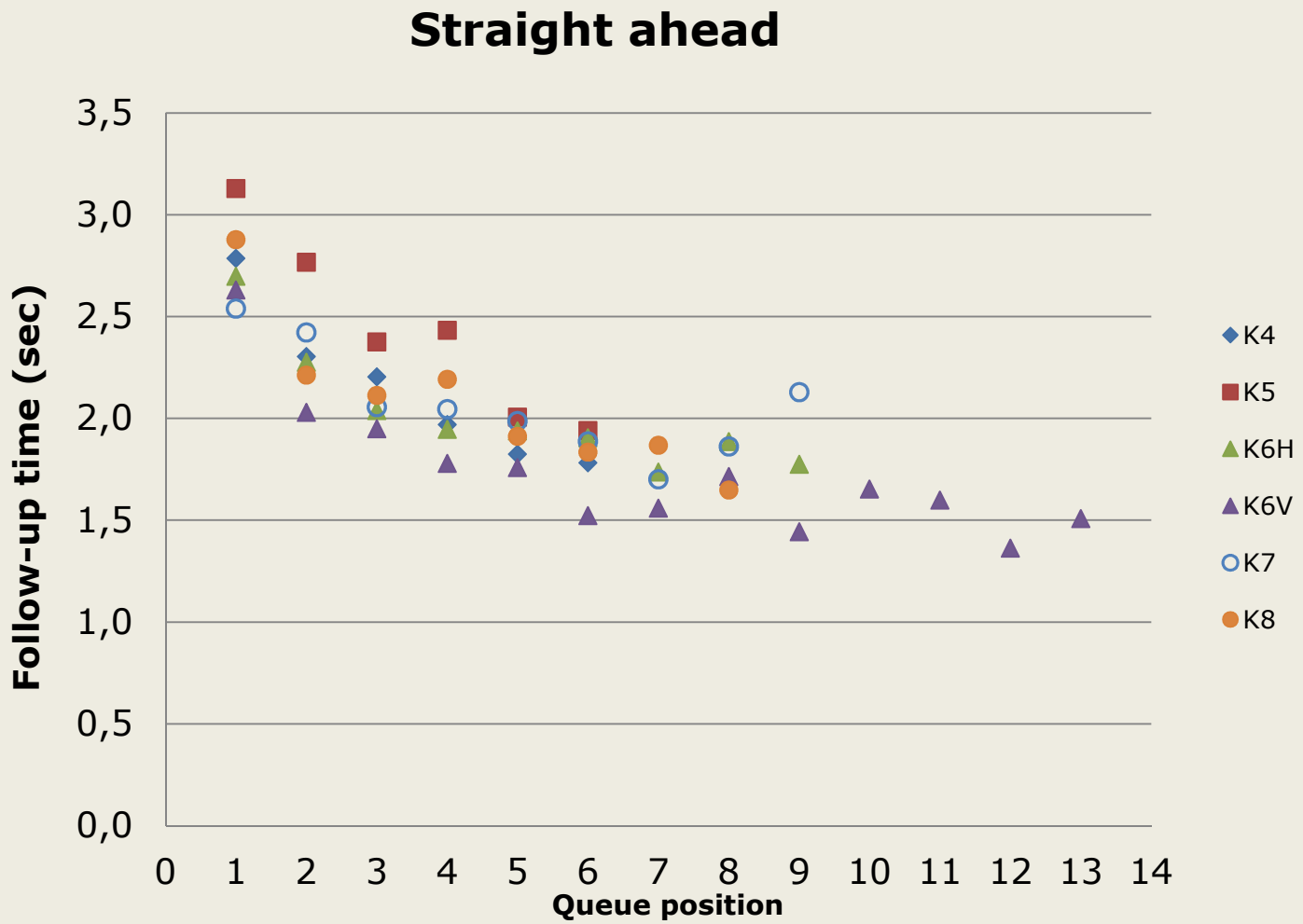
To study follow-up times and PCU-values for signal-controlled intersections

Studied flows:

- Separate right/left turn (right of way)
- Straight going (left/right lane)
- Right turn and left turn
  (with give way for cyclists/pedestrians/motor vehicles)

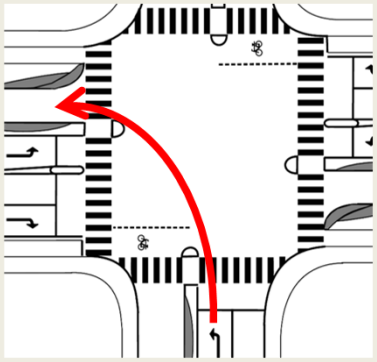
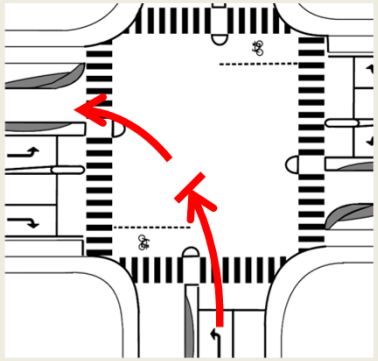
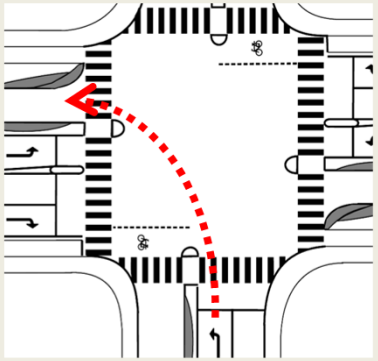
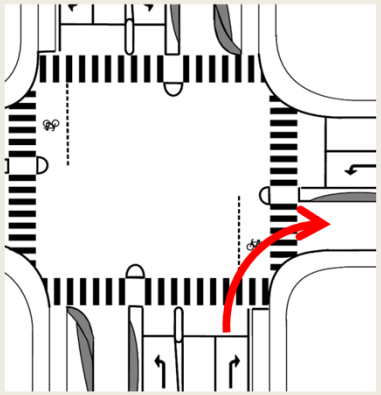
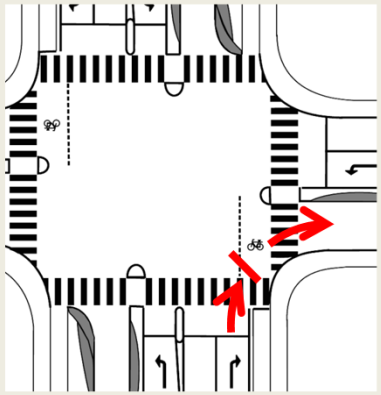
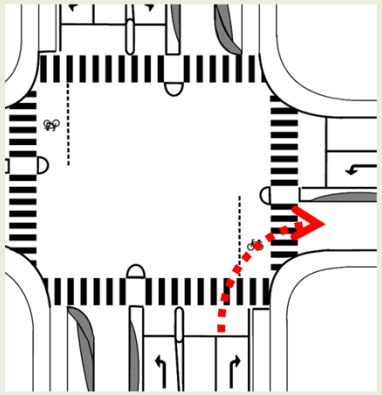
10 signalized intersections – in total 15 traffic flows (rural / urban)

Follow-up times for passenger cars (example)



Driver behavior in streams that should give way for other road users

Trafitec

A	B	C
		
53 obs	408 obs	578 obs
		
109 obs	143 obs	698 obs

Traffic stream	Follow-up time (sec)
Right turn - right of way (>4. queue pos.)	2.3 – 2.4 sec
Left turn – right of way (>4. queue pos.)	1.7 – 2.0 sec
Straight ahead (>4. queue pos.)	1.6 – 2.0 sec
Right turn – give way	2.6 – 3.0 sec
Left turn – give way	2.1 – 2.2 sec

PCU-values
Based on follow-up times

Traffic stream	PCU-value	
	Truck/bus	Road trains / semi-trailers
Right turn - right of way	1.5	-
Left turn – right of way	1.5	1.9
Straight ahead	1.5	2.0
Right turn – give way	1.5	2.1
Left turn – give way	1.7	(2.2)
In average – approx.:	**1.5**	**2.0**