Traffic Signals in Roundabouts

”Signalreglering i Cirkulationsplatser”

Client: Road Administration - Vägverket
(Traffic Administration – Trafikverket)

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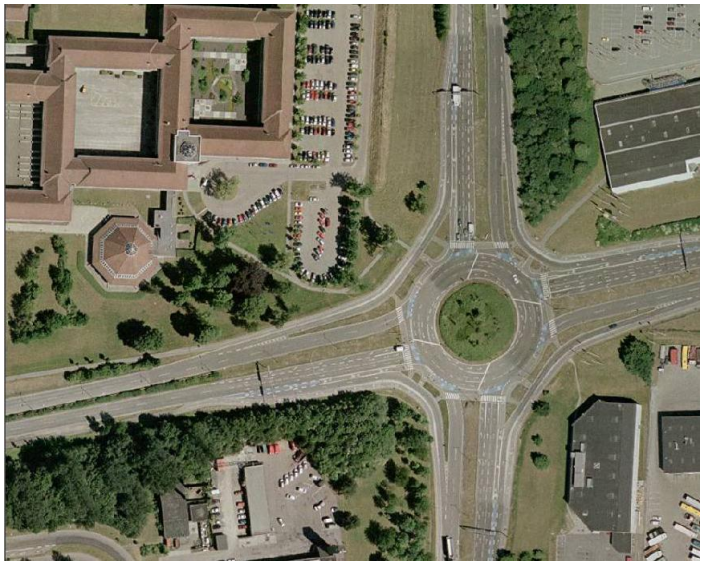
Background to project

- State of the art, little knowledge in Sweden
- Need for better understanding and design of Signal control of Roundabouts



SCOPE AND METHODOLOGY

- Inventory of available knowledge about traffic signals in roundabouts with focus on geometry, traffic flow, type of signal control, and the results of empirical impact studies.
- Determination of criteria and composite measures for evaluation of traffic signals in roundabouts with and without pedestrians.
- Selection of roundabouts for field study and data reduction of traffic behaviour and impacts (non presented in this paper).
- Analysis and synthesis of the results compared with practical experiences and accident statistics.

SCOPE AND METHODOLOGY

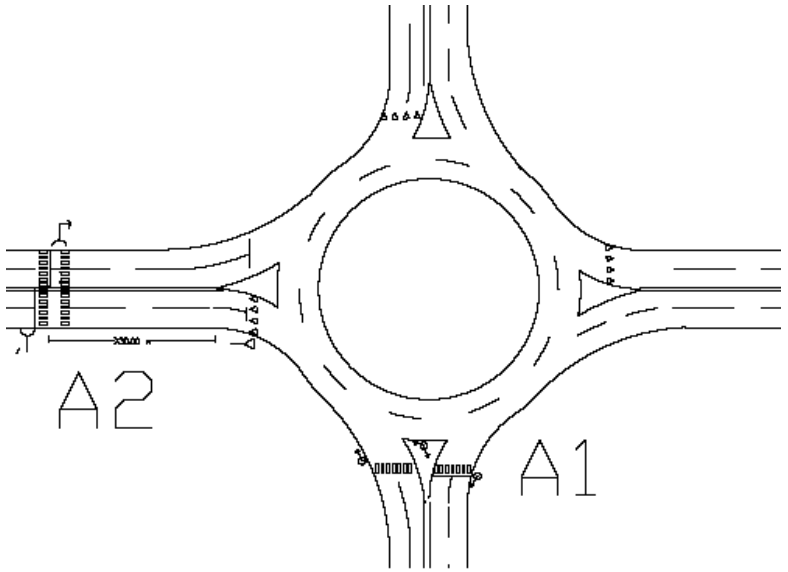
- Using TRANSYT 13 to evaluate and optimise coordinated signal timing,
- Using VISSIM 5 to evaluate and compare the impacts of different types of signal controlled roundabouts including crossings,
- Recommendations for Road Design Manual (VGU) about application of traffic signals in roundabout, as well as need for further studies.

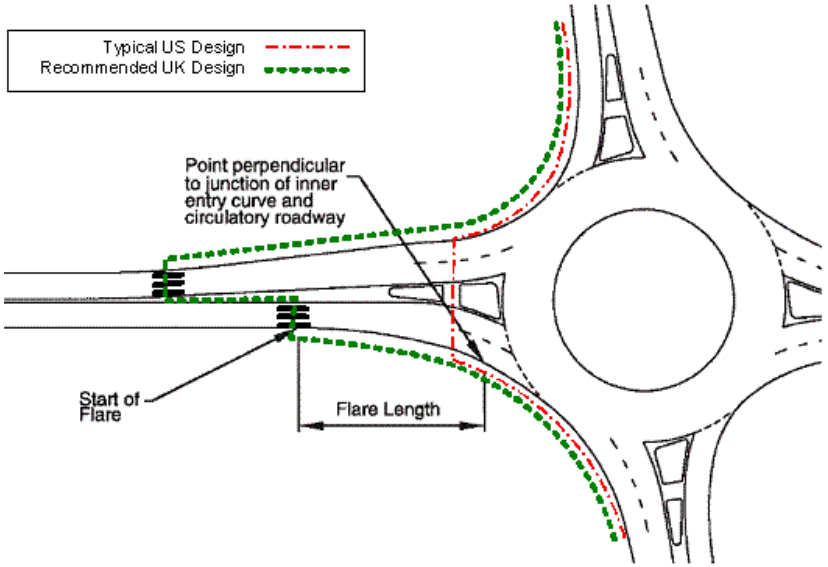
The projects classification of signalized roundabouts

Many alternative forms of signal control in roundabouts:

A1: Signal controlled crosswalks at the approach and in the direct vicinity of the gyratory (off signal).

A2: Signal control of crosswalks at the approach up- and downstream.



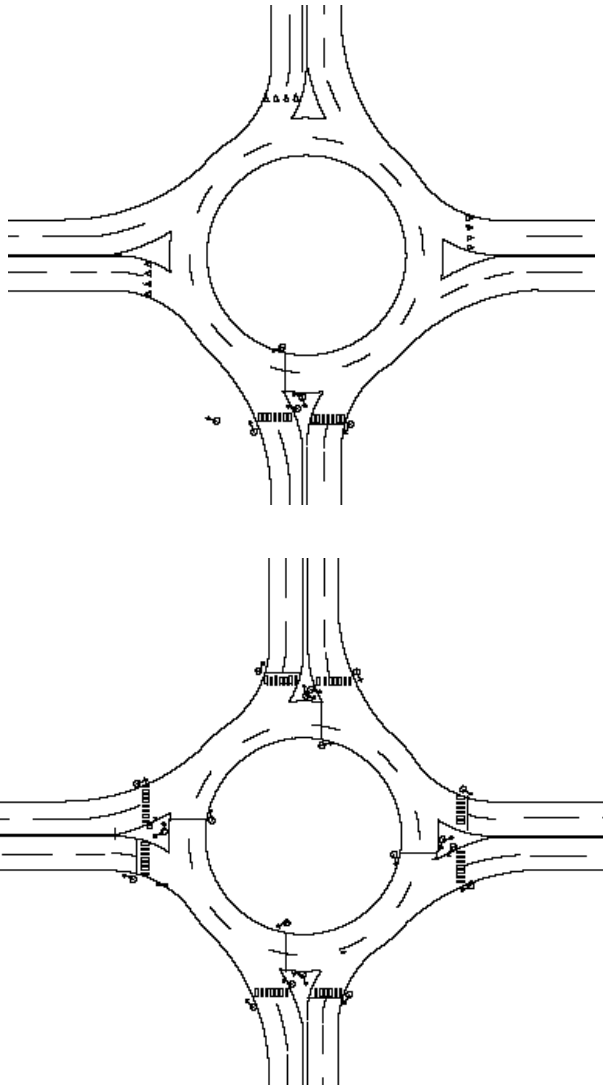


Many alternative forms of signal control in roundabouts:

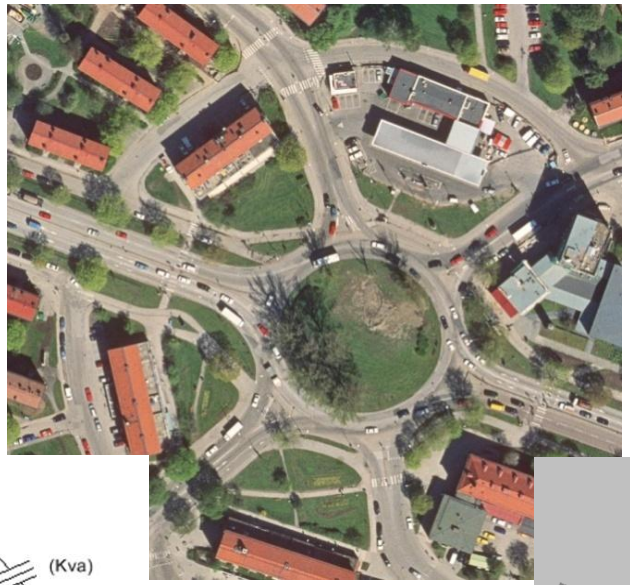
B1: Complete signal control of an approach. The crosswalks on both directions are passed in a single movement.

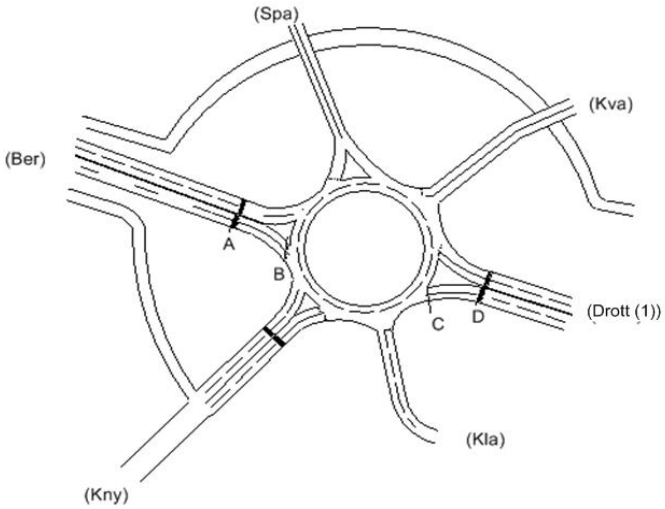
B2: As B1 passing the crosswalk in two movements (with intermediate stops).

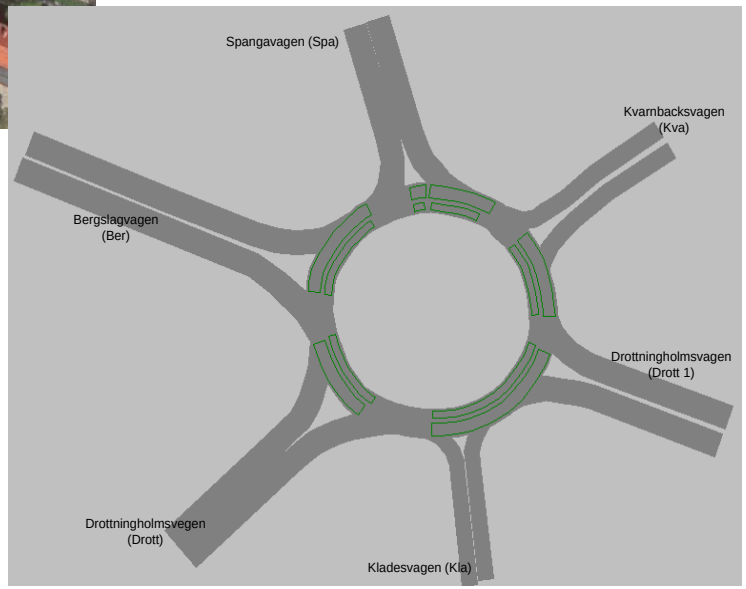
C: Coordinated, fully signal control.



FIELDSTUDIES BROMMAPLAN: CALIBRATION VISSIM





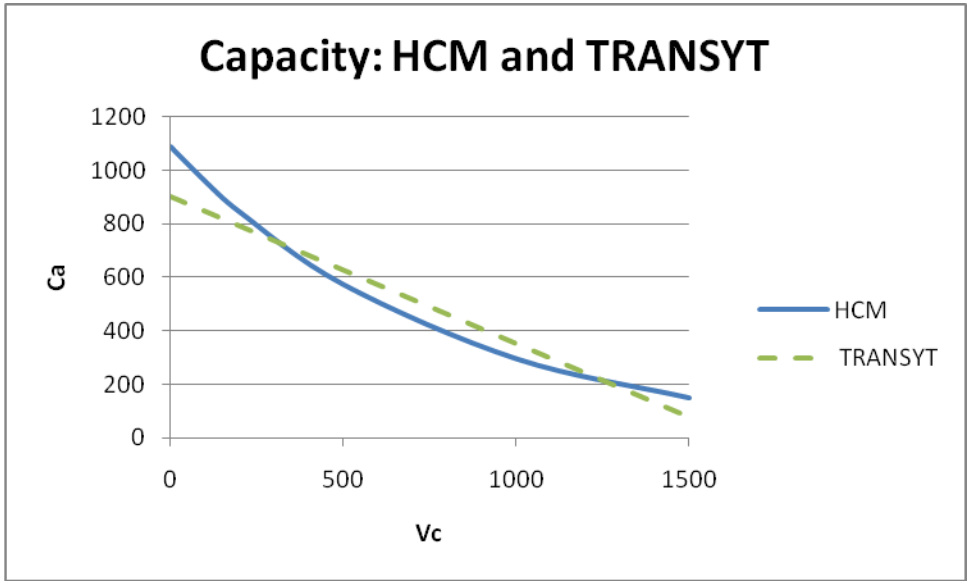


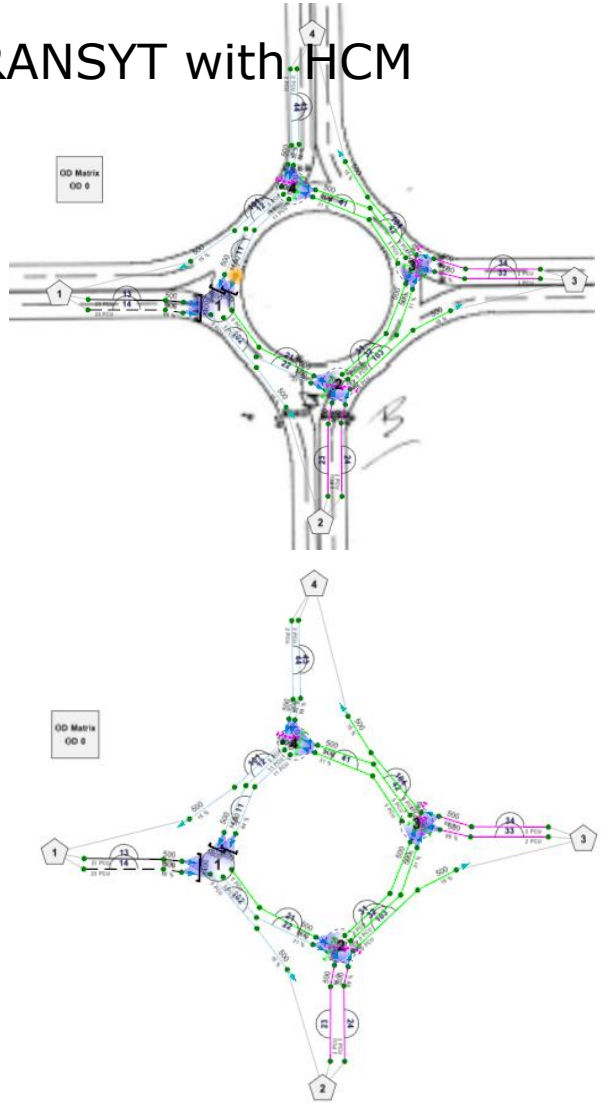
Analyses have been carried out with the following assumptions of design and traffic volumes:

- Design: 4 legs roundabout, 20 m inner radius, two lanes everywhere.
- Traffic flow: 800-3200 pcu, the optimization was elected at 2400 pcu
- Traffic distribution: 60% in the main road and 40% in the secondary road.
- Traffic movements: 70% straight, 15% right and 15% left.
- Pedestrians: 100 p/h for all crosswalks

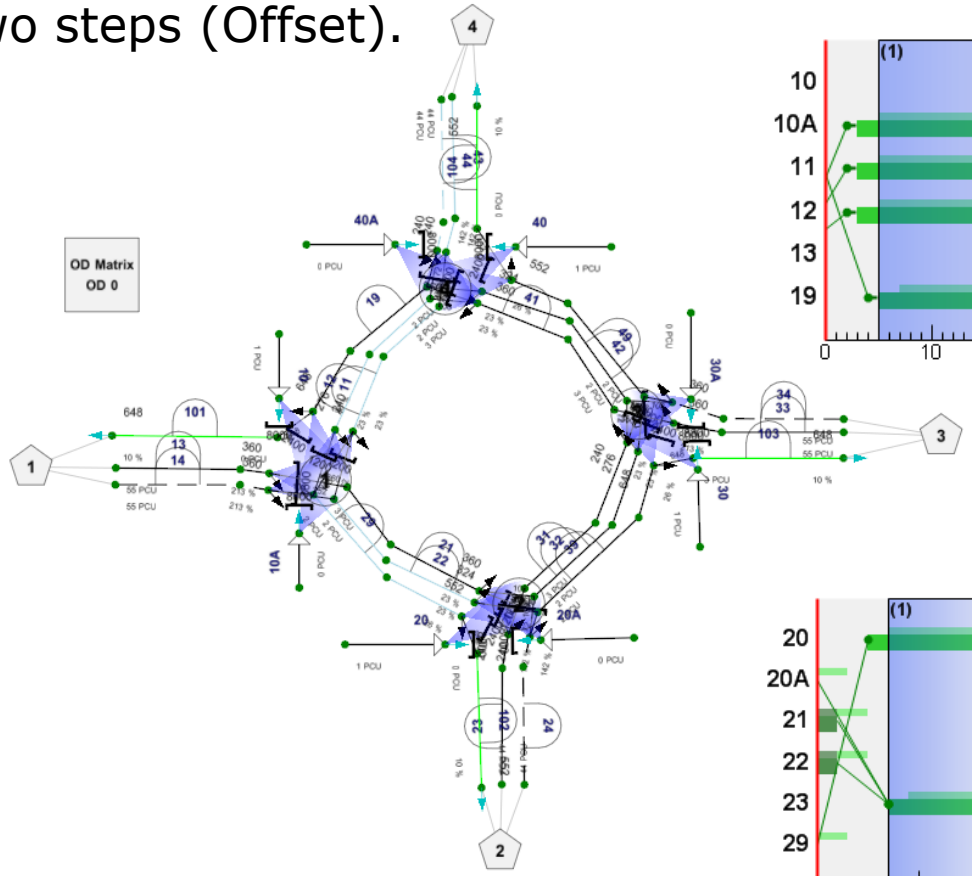
TRANSYT

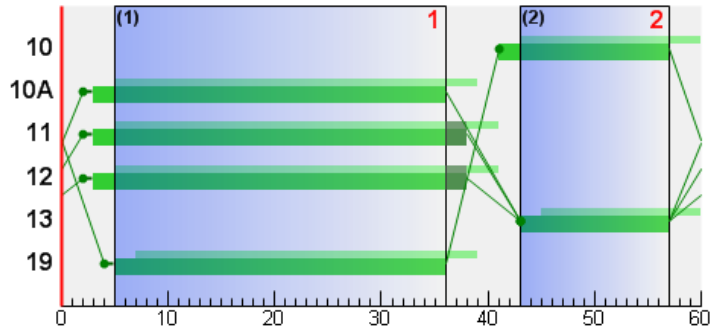
Adjustment of the approach capacity in TRANSYT with HCM

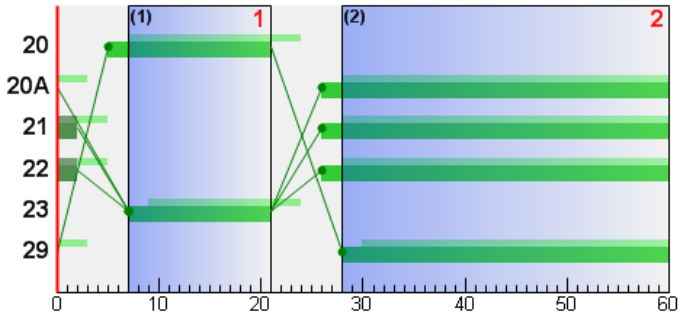




Optimized cycle time resulted by TRANSYT was about 60 s for all types of signalized roundabouts. Example of the signal timing of type C. 14 s green time allocated to the approaches and the rest to the exits. Pedestrians passes in two steps (Offset).



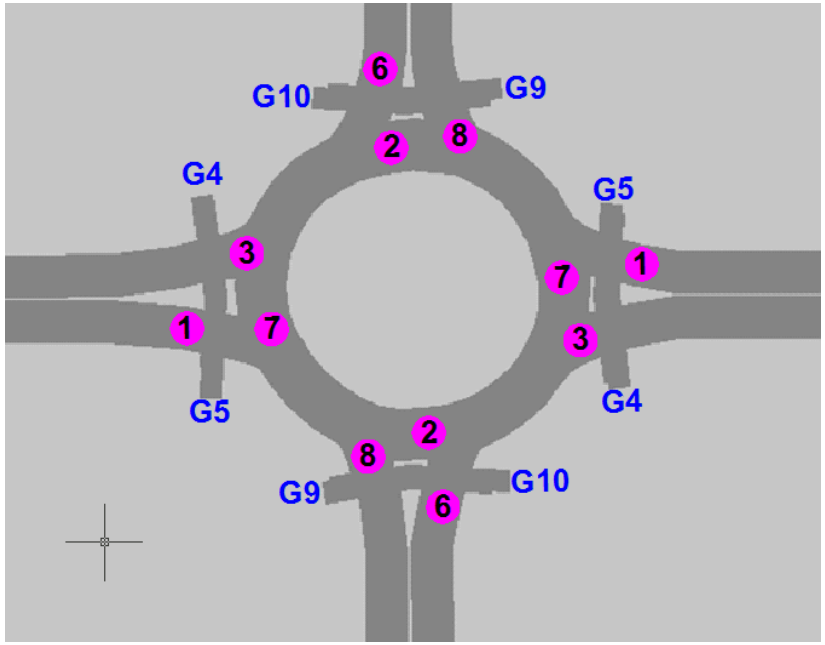


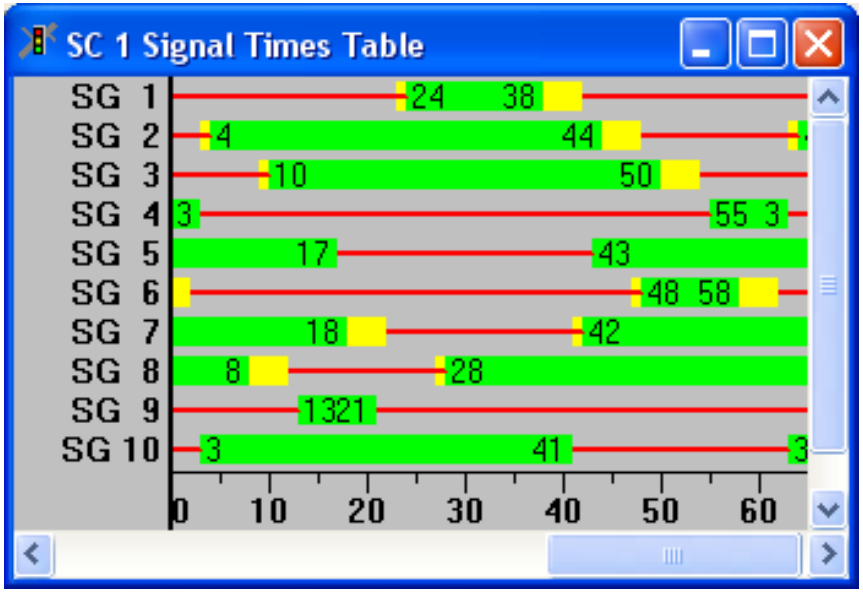


VISSIM

Basic data are the same as was used in TRANSYT. Signal options that have been studied in VISSIM are:

- Reference case is: unsignalized roundabout;
- Fixed time signal controlled crosswalks;
- Push-button activation for pedestrians;
- Coordination (applies to Type C).

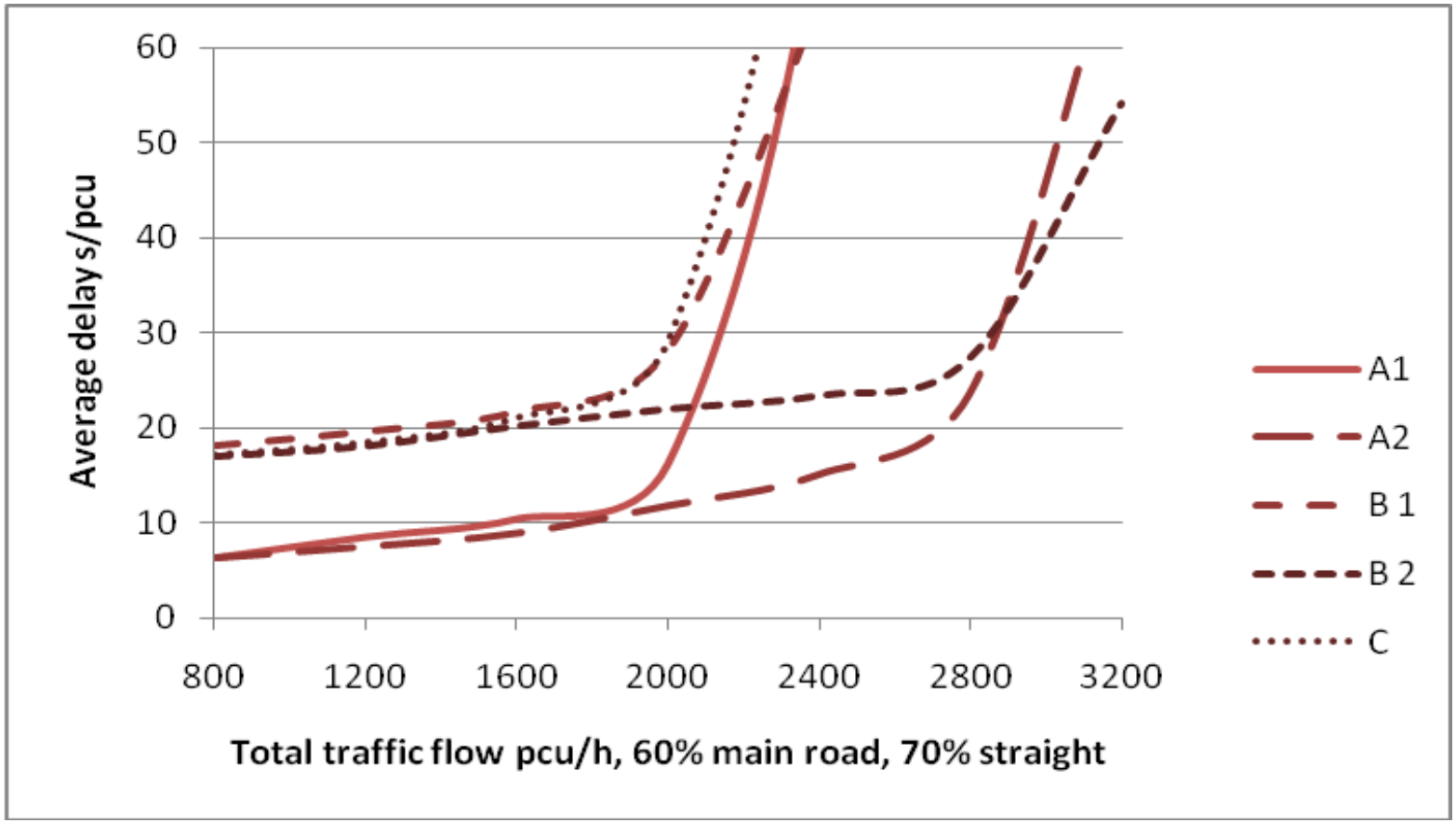




RESULTS

Roundabout type	Capacity pcu/h (V/C=1)	Pedestrian average delay s/p -main road	Pedestrian average delay s/p −second road
A1	2000	13.5	
A2	2800	14	
B1	2000	15	
B2	2800	28	
C	2000	21.5	24.5

Relationship between traffic volume and average delay time for signal-controlled main approach for all types of signal control



Where are they in Sweden?

- 20 councils/kommuner said they have
- Stockholm (23), Göteborg (6), Malmö (1), Haninge (3), Ekerö (1), Falun (1), Högsby (1), Jönköping (3), Kalmar (1), Ludvika (1), Mölndal (1), Nacka (3), Solna (2), Täby (1), Umeå (1), Uppsala (2), Öckerö (1), Örebro (1), Linköping (2) och Sundbyberg (2).
- Total of 57
- Council/kommun with most is Stockholm (23)

Why?

- Stockholm and Göteborg said capacity and prio.
- Stockholm for cars and Göteborg prio for spårvagn/trams.
- Others: traffic safety for pedestrians and prio for buses.

Field study of 2 signalized roundabouts

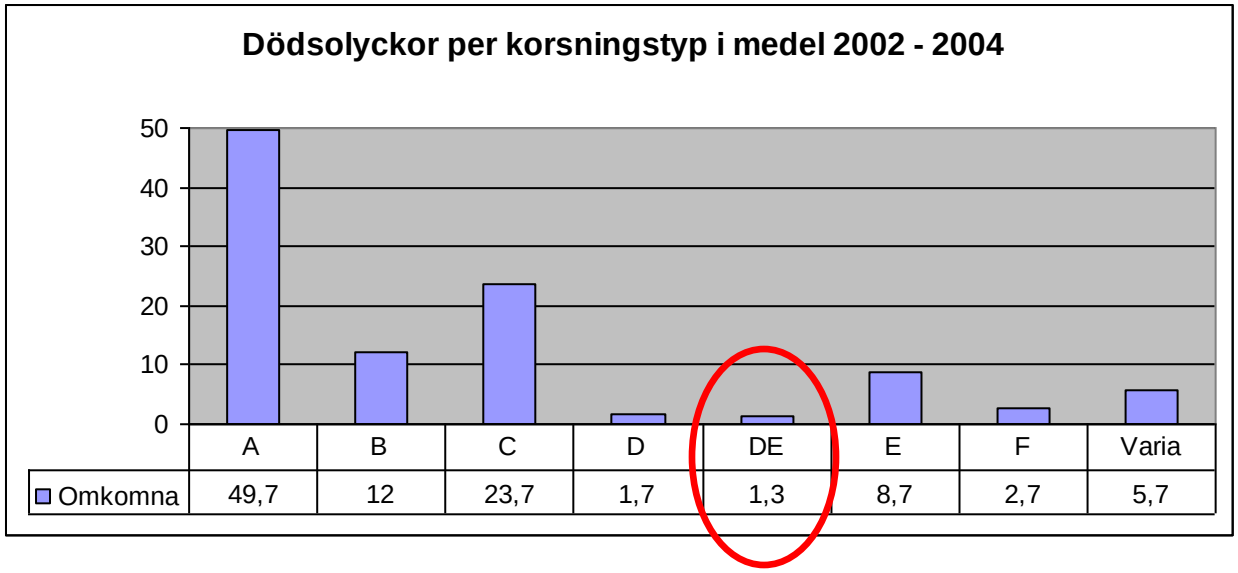
- Falun Gruvrondellen, 5 legs.
  1 Signal controlled crosswalk at the approach and in the direct vicinity of the gyratory (off signal). A1

- Stockholm Brommaplan, 6 legs.
  4 Signal controlled crosswalks at the approach up- and downstream. A2

SAMMANFATTNING

- The signalization of roundabouts with pedestrian activation shows many different and potentially dangerous behaviour
- When the signal is not lit (off) and “normal” giveaway rules apply, the vehicles show little acceptance for giveaway to pedestrians. This shows a big difference between normal signalization a “not lit” (off) signal.
- The two field studies shows that signals that are not lit (off) and has to be activated by pedestrians should be avoided.

Safety

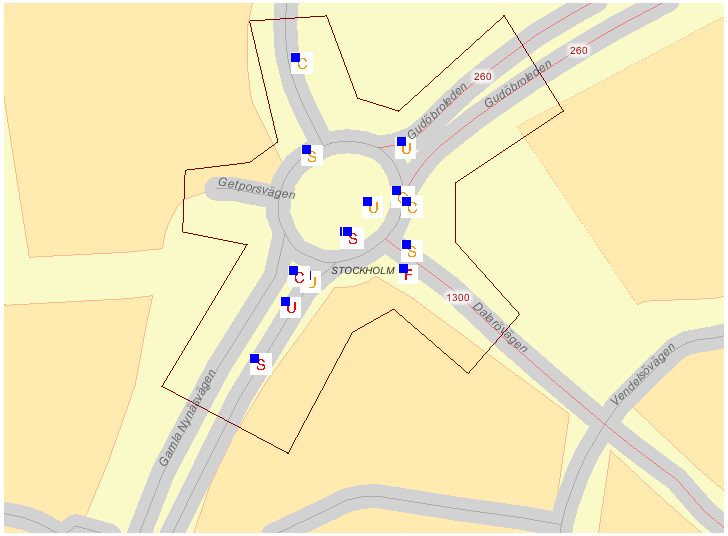

Dödsolyckor per korsningstyp i medel 2002 - 2004
50
40
30
20
10
0
A
B
C
D
DE
E
F
Varia
Omkomna
49,7
12
23,7
1,7
1,3
8,7
2,7
5,7

”Typical” fatal accidents in roundabouts

- High speed cars, ”doesnt see”, ”single” accidents
- Pedestrian, high age, signalized roundabout

Accident data from STRADA

- STRADA 2000-01-01 tom 2009-01-31.
- Total 57 ”places”
- 35 in Stockholms county
- All 57 mapped via GIS.
- Data from STRADA every signalized roundabout.
- 50% of accidents not relevant for signalized roundabout. (outside, falling accident, non signalized leg etc.)



Total accidents and relevant

Degree of Injury	All Roundabouts	Signalised Roundabouts
Death	7	3
Severe Injured	138	62
Injured	764	371
No Injury	473	257
Not Available	104	55
Total	1486	748

Accidents (relevant)

- Most ”common” is car and minor accident (72%).
  - Overtaking/upphinnande (50%).
- Most accidents about 15.00
- Of pededstrian (all accidensts) collision with vehicle (73%).
- Of 3 dead, 2 ped and 1 cyclist.
- Severe accidents
  - 45% ped and cyclists
  - 80% in Stockholm.

A comparative analyze between accidents from STRADA with anticipated from EVA

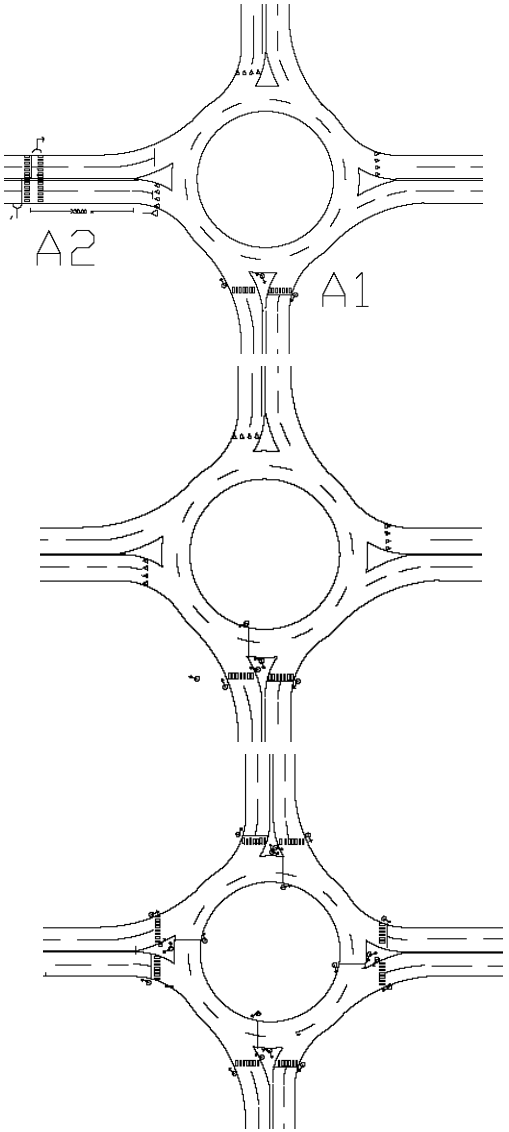
	STRADA						EVA	
	Total Sweden	Total Sthlm	Total Others	Acc/Sig Rd Sweden	Acc/Sig Rd Sthlm	Acc/Sig Rd Others	Rd	Sig
Death	7	5	2	0.015	0,018	0,007	0.004	0.009
Severe Injured	122	110	12	0.27	0,39	0,043	0.08	0.133
Injured	588	474	114	1,29	1,69	0,41	0.35	0.57

Problem?

- Severe accidents with pedestrians
- Traffic safety comparable or better then roundabouts ”outside” Stockholm.
- Stockholms higher rate then anticipated compared to roundabout and traffic signal.
    - ”Explantation” The high volume of ped?

Recommendations regarding accessibility and road safety

- Alternative (A1) should be avoided from both a capacity and a traffic safety aspect. Use B.
- Alternative (A2) should be placed a minimum of 22 m from the roundabout due to both capacity and a traffic safety aspects.
- Alternative (B2), which has higher capacity than (B1) can be applied if there is a need for signalized crosswalks.
- Alternative (C) can be considered due to capacity constraints at high pedestrians' flow of several approaches.



THANK YOU, TACK, KIITOS, TAK, TAKK