Main accident types

• Head-on crashes
  ➢ Median barrier, centerline rumble strips … …

• Roadside crashes, rollover accidents
  ➢ Safety zone, roadside barrier, slopes … …

• Intersections
  ➢

• Vulnerable roadusers
  ➢ Separation, traffic islands, speed reduction … …
Head-on crashes

Typical accident: Blue car has by some reason crossed the median.

(In Sweden 10-15% during overtaking but in e.g. Germany 50-60% during overtaking)
Head-on crashes

Result: Not enough space to survive
Head-on crashes

Result: Less damages on the truck, but it can loose steering ability
Head-on crashes

What to do with:

Wide roads?

Normal or narrow roads?
Wide roads (13 m) (*42ft 8in*)

2+1 with median separation??

Feasibility study in 1996:

400 fatalities/year on
100 000 km (*62500 mi*) public roads

On ~ 4 000 km (*2500 mi*) wide two-lane roads around 60 people were killed every year in head-on crashes.

Those 60 should probably have survived --

if there had been a median barrier.
Cross section 2+1 road

- Low speed: 70 m (22 ft 12 in)
- Width: 13.0 m (42 ft 8 in)
- Stopped vehicle: 3.25 m (9 ft 10 in)
- 50 m (16 ft 5 in)
- 80 m (22 ft 12 in)
- 0 m (0 ft)
Experiences - safety

2+1 roads 1999 to 2016:
- ~ 400 km semi-motorway
- ~ 2500 km two-lane roads
- ~ 1800 mi

Experiences so far:
- ~ 50 people less killed every year
- 70-75 % less killed/severe injured (80% less killed)
- Increased average speeds !
- No severe maintenance problems (except repairing barriers)
Experiences - costs

Average construction costs:
(From an existing road in good shape)

Semi-motorway: 300-350 000 £ / km (200 000 £/mi)

Normal 2+1: 325-500 000 £ / km (250 000 £/mi)

Average increased maintenance costs:

About 1500 £ / km /year (940 £/mi)

- Barrier crashes
- Winter maintenance
- Road works (safety for road workers more expensive)
Median barrier - cable
Median barrier – steel beam
Median barrier - cable

10 tons 70 kph (44 mph) 15 degrees (H1)
Median barrier - cable

Motor cycles?
Median barrier - cable

Motor cycles?

Evaluation of 2+1-roads with cable barrier
Final report
Arne Carlsson

The Swedish National Road and Transport Research Institute
The fatality risk for motorcyclists related to other vehicles is ........

> 18 Times higher.

The fatality risk or FSI-risk for motorcyclists on collision-free roads have not increased.

On the contrary, it can be stated that FSI and fatality risks for motorcyclists have been reduced by 40-50% on 2+1 roads (with cable barrier).
The new Road design Guideline (2015) requires “softer” barriers.

No sharp edges, no posts above horizontal beam etc
Barrier – Motorcyclist crash

All crash tests follows European standard EN1317. Pre-standard for Motor cycle drivers.
Normal roads (7-10 m)
Normal roads (7-10 m)

Milled center line rumble strip (~5000 km so far)

Effects?
• Accident reduction up to 15 % in all
Normal roads (7-10 m)

Guard rail with passing lane
Roadside

Alternative measures

- Less run-offs (e.g. rumble strips)
- Safety zone
- Guard rails
- Smooth slopes

Swedish experience most safe!!
Roadside safety

Which car are you using?
Intersections

Roundabout:
Large (R 25-30m)
Two lanes
Lighting
Intersections

Effect:
Average speed reduction ~ 5 km/h

Radar detected speed limit warning
Pedestrians

Vulnerable road users passes through a wide central island. They are protected by barriers.
Pedestrians

"Hour-glass" with a bus stop

Result:
- Average speed: 51 km/h → 40 km/h
- Speed 85%: 59 km/h → 51 km/h
Questions ?
Questions?

Today?