



Creating the future of transport



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Accidents at roundabouts

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Project for UK Highways Agency on geometric design of roundabouts

- **International review of design**
- **Review of Standard**
- **Consultation with practitioners**
- **Accident study**
- **Consider provision for non-motorised users**
- **Develop a hierarchical approach**
- **Revise Standard**

A typical four-arm roundabout in the UK



A typical three-arm roundabout in the UK



Review of design in other countries

- **Emphasis on safety rather than capacity**
- **Roundabouts smaller than in UK**
- **Single or double lane designs**
- **Limited flaring**
- **Outward-sloping crossfall on circulatory carriageway**

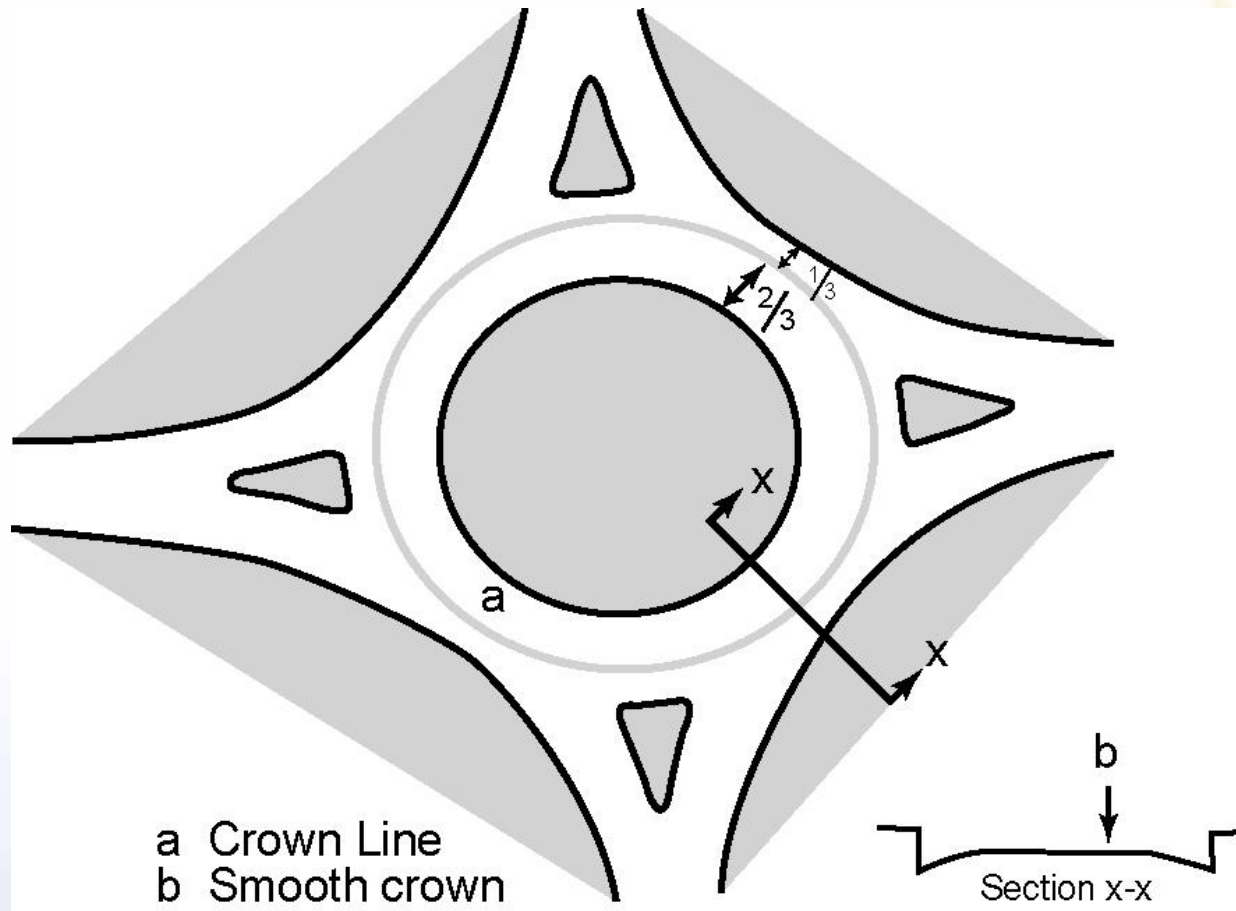
Easier to construct

Drainage

More conspicuous central island

No crown line

Typical crossfall in the UK



Personal injury accidents in 2003

	No. of accidents	% fatal and serious	Average accident cost
All roads	214,000	15%	£61,100
Roundabouts	18,700	8%	£34,600
Other junctions	111,000	14%	£52,000
Non-junction	85,000	15%	£78,800

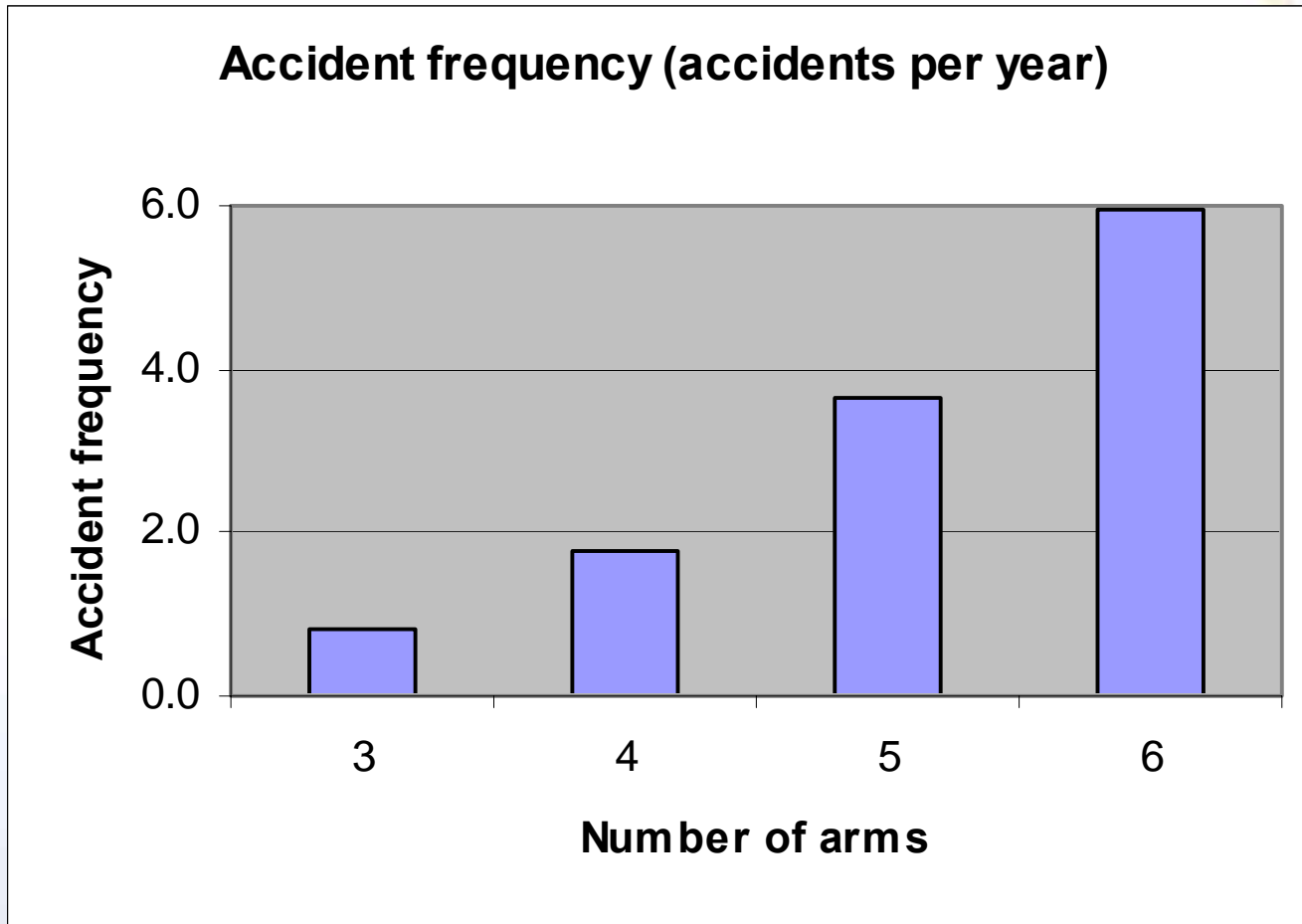
Differences between countries when comparing accidents at roundabouts

- **Higher flows / multiple lanes in the UK**
- **Difference in definition of:**
 - junction accident**
 - injury accident**
- **Cultural differences**
- **Main UK study is old (1984)**
- **Accident rates from current UK study are for high flow roundabouts only**

Comparison of accident frequencies (injury accidents per year)

Country	Number of roundabouts	Accident frequency
Australia	290	0.6
France	12,000	0.1
New Zealand	95	0.51
UK (old – 4-arm only)	84	2.36 to 4.38
UK (current)	1162	1.77
The Netherlands	46	0.23
US	11	1.5

Accident frequency as a function of number of arms at the roundabout



Accident frequency (injury accidents per year) by type of road

No. of arms	No. of sites	Single cway roads	Dual cway roads	Severity
3	326	0.63	1.28	9.3%
4	649	1.08	2.65	7.1%

Comparison of accident rates (injury accidents per 100 million vehicle-km)

Country	Number of roundabouts	Rate
Australia	-	4-8
France	179	4
Germany (includes damage only)	-	53-162
UK (old)	84	21-37
UK (current – high flow)	44	36
Sweden	182	2-16
US	11	8

Accident models

Accident frequency on each arm related to flow

$$A = kQ^\alpha$$

or

$$A = k Q_1^\alpha Q_2^\beta$$

These models were extended to include geometric and layout variables:

$$A = k Q_1^\alpha Q_2^\beta \exp(\sum g_i G_i)$$

Variables affecting safety

- **Entry path curvature (deflection)**
- **Entry width and approach width**
- **Inscribed circle diameter**
- **Central island diameter**
- **Proportion of motorcycles**
- **Angle with next arm**
- **Approach curvature**
- **(Visibility)**

Percentage of injury accidents by type at 4-arm UK roundabouts

	Small	'Conventional'
Single vehicle	8	30
Approaching	7	25
Entering-circulating	71	20
Other vehicle	10	19
Pedestrian	4	6
Total	100	100

Roundabout with single vehicle accident problem

- Approach is downhill
- Problem with vehicles overshooting
- Danger of vehicle reaching motorway below



North Lincolnshire roundabout

Roundabout with single vehicle accident problem



- **Circulatory carriageway cannot be seen**
- **Chevrons appear to be on splitter island**
- **People mark possible delineation effect of reflective marker posts**

% involvement by vehicle type

Vehicle type	% of accidents	Severity
Pedal cycles	8.0	9.5
Motorcycles	14.4	19.3
Large goods vehicles	9.3	8.0
Cars	76.7	7.1
Pedestrians	2.8	22.6

Pedal cyclists at roundabouts

- **Relative involvement rate high**
- **Move against new roundabouts?**
- **Experienced v novice cyclists**
- **Cycles mix with other vehicles**
 - Low flow, compact design
- **Cycle facilities**
 - Underpass
 - Cycle lane on roundabout
 - Cycle path with crossings

Roundabout in Calais with outer cycle path



- **Novice / cautious cyclist on outer cycle path**
- **Experienced cyclist**
 - mixes with traffic
 - rides in centre of lane

Cycle lane on circulatory carriageway



UK roundabout in York with cycle lane



Eye-level view of UK roundabout in York with cycle lane



Pedestrians at roundabouts

- **Small proportion of accidents (but high severity)**
- **Pedestrian facility**
 - Splitter island
 - Uncontrolled crossing (zebra)
 - Signal controlled crossing
 - Subway / overbridge
- **Optimum location of crossing from roundabout**
 - Zebra crossing at 5 to 20m
 - Signal controlled crossing at 20m or >60m
- **Flaring and geometric delay**

Pedestrian crossings at roundabouts



Brent / Harrow



Basingstoke

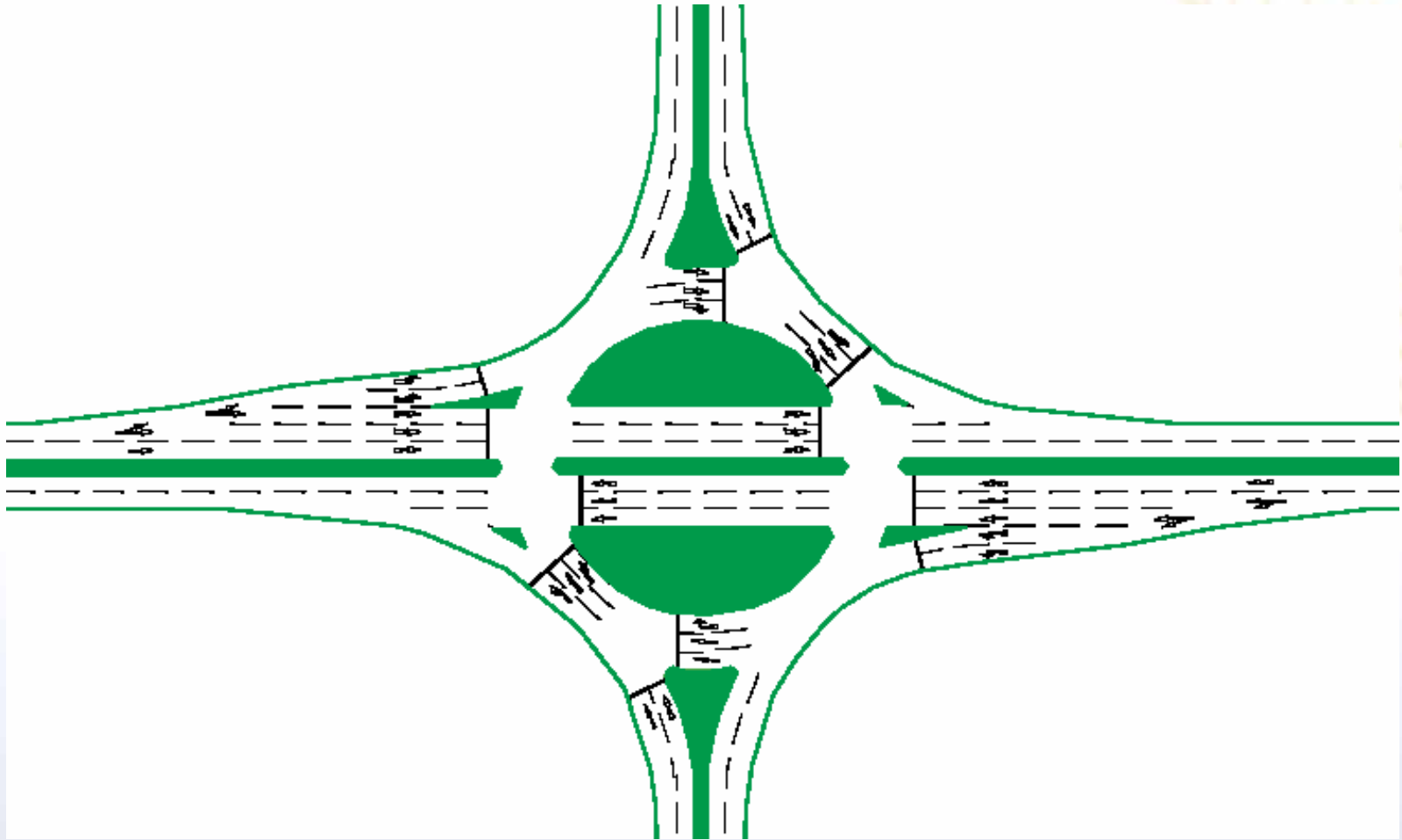
Overturning of large goods vehicles

- **Long straight high speed approach**
- **Inadequate entry deflection**
- **Low circulating flow past an entry**
- **Excessive visibility to the right**
- **Significant tightening of turn radius partway round the roundabout**
- **Crown lines**

Possible changes to UK Standard

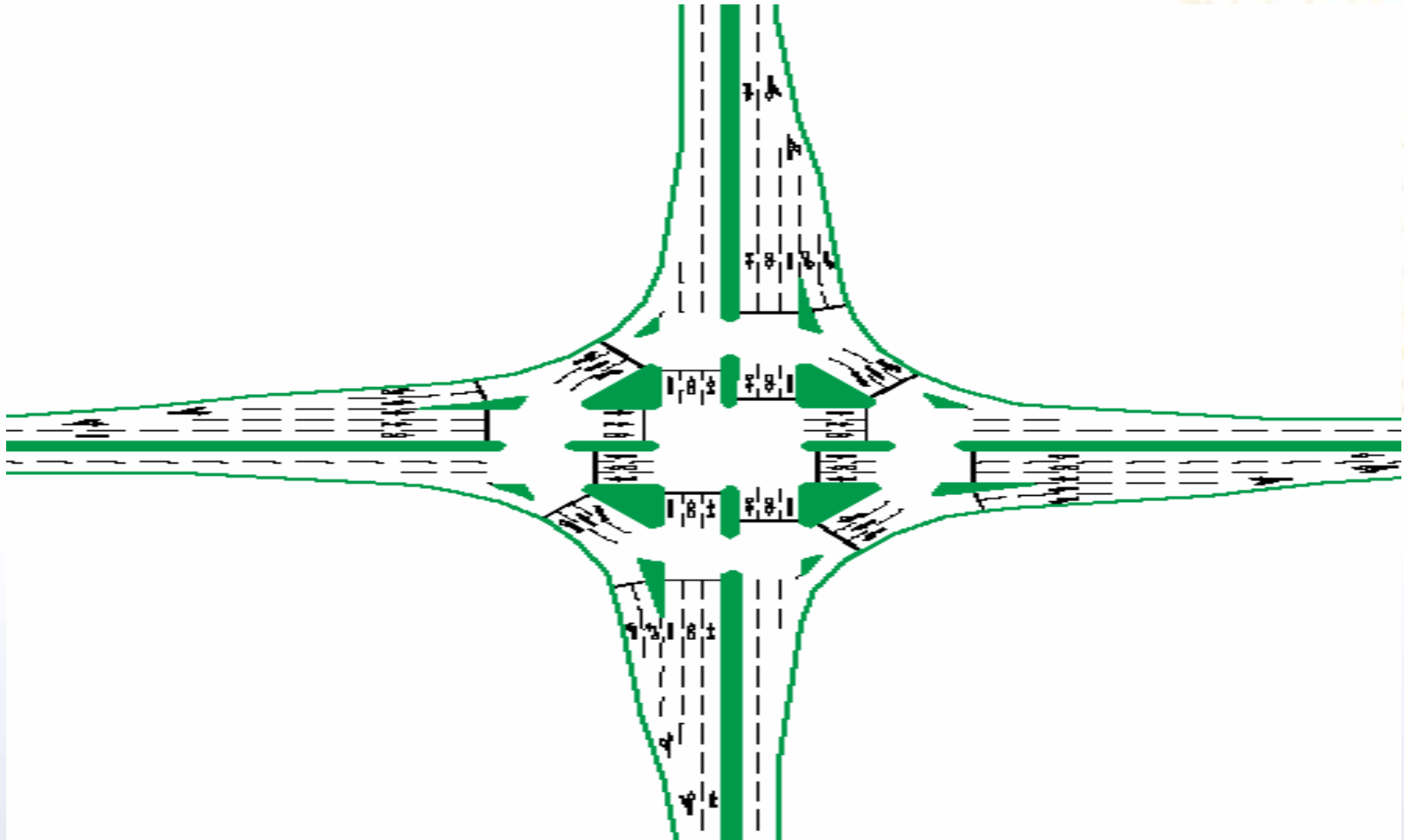
- **New design hierarchy**
- **New compact design with single lane entry**
- **Greater emphasis on provision for non-motorised**
- **Allow outward-sloping crossfall at urban roundabouts on single-carriageway roads**
- **At dual-carriageway roundabouts limit visibility to right until vehicles within 15m of give way line**

Hamburger ('through-about')



Signalised roundabout with through traffic on main road across central island

Hot cross bun ('double-through-about')



Signalised roundabout with through traffic on both roads across central island

A look back in time!





End of Presentation

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