



Roundabout designs and cycling safety

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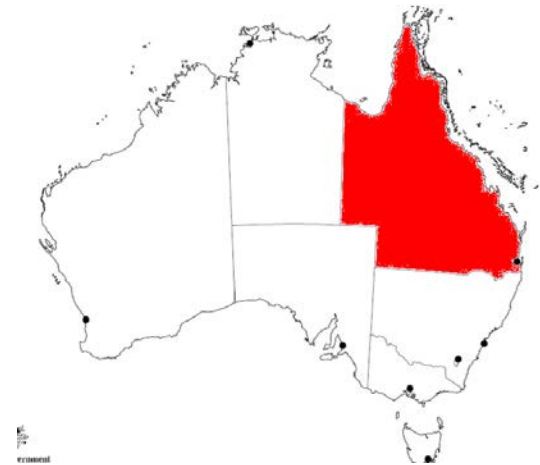
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Presentation Outline

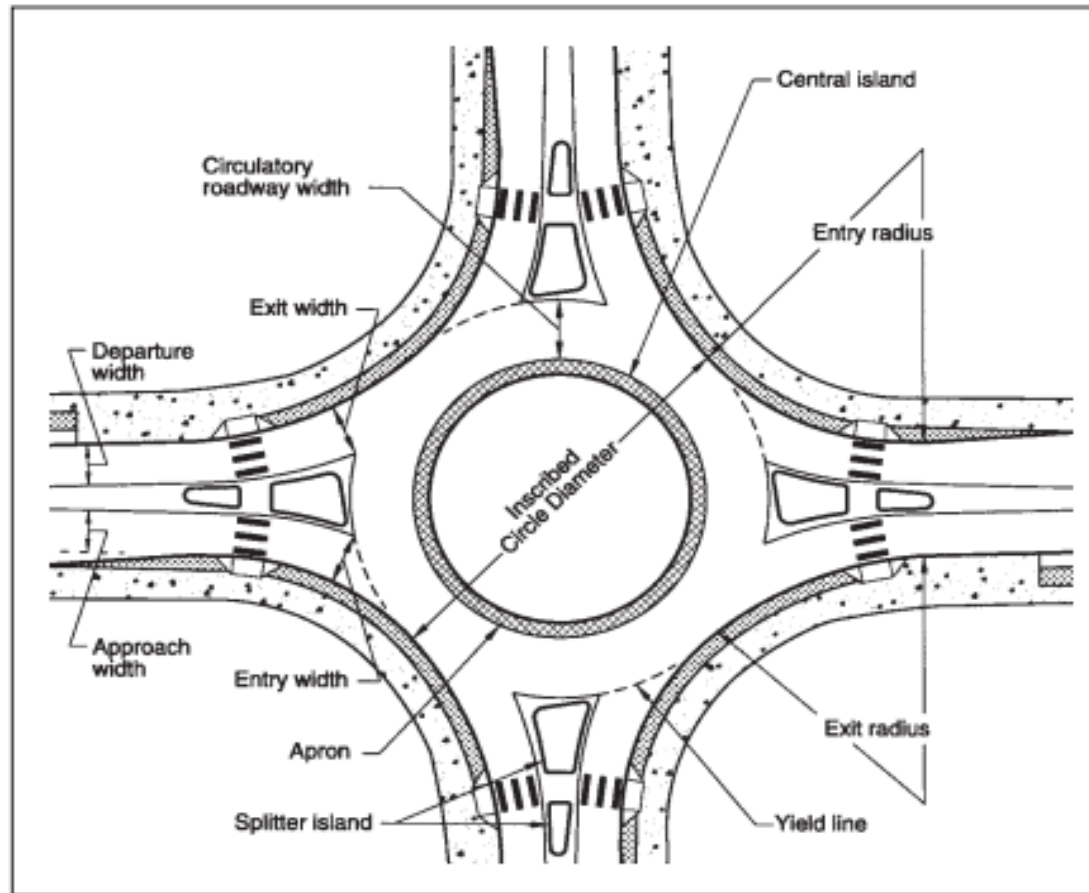
- Project context
- Roundabout geometry
- Roundabout design guidelines
- Provisions for cyclists at roundabouts
- Overall safety
- Safety of cyclists at roundabouts
- Features that influence safety
- Cyclist perceptions of safety, behaviour
- Discussion

Context

- Review conducted as part of a Queensland Department of Transport and Main Roads funded project 'Roundabout design review
- Literature review
 - Design guidelines
 - Factors that affect safety



Roundabout Geometric Features

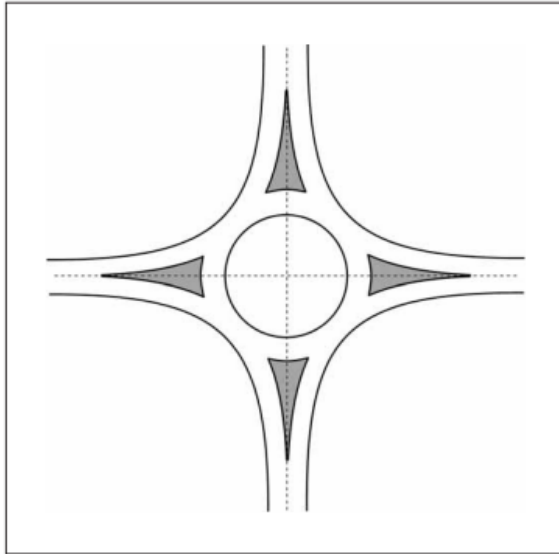


Robinson, B.W., Rodegerts, L., Scarborough, W., & Kittelson, W. (2000). *Roundabouts: An Informational Guide*. Federal Highway Administration, Virginia

Roundabout designs

- Approaches to roundabout designs differ
 - Motorist expectations
 - Cycling culture
 - Legislative frameworks
- Approach to roundabout designs can be condensed to 2
 - Tangential entries
 - Radial entries

Tangential vs Radial



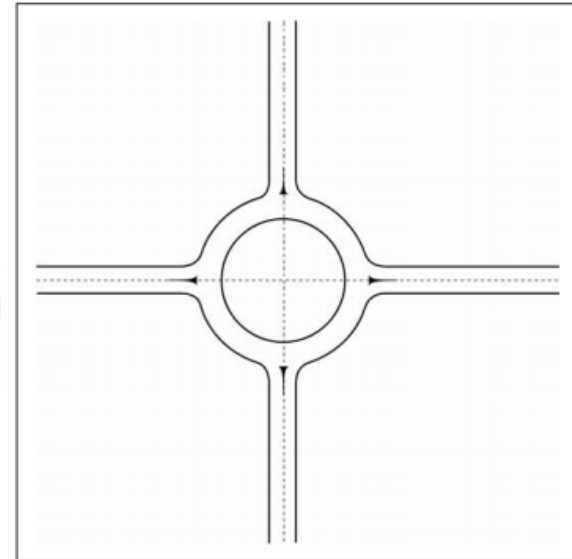
Tangential

Increased visibility on approach

Greater vehicle speeds

Increased traffic capacity

US, UK, Australia, NZ



Radial

Decreased vehicle speeds

Decreased traffic capacity

Germany, Sweden, Belgium, etc.

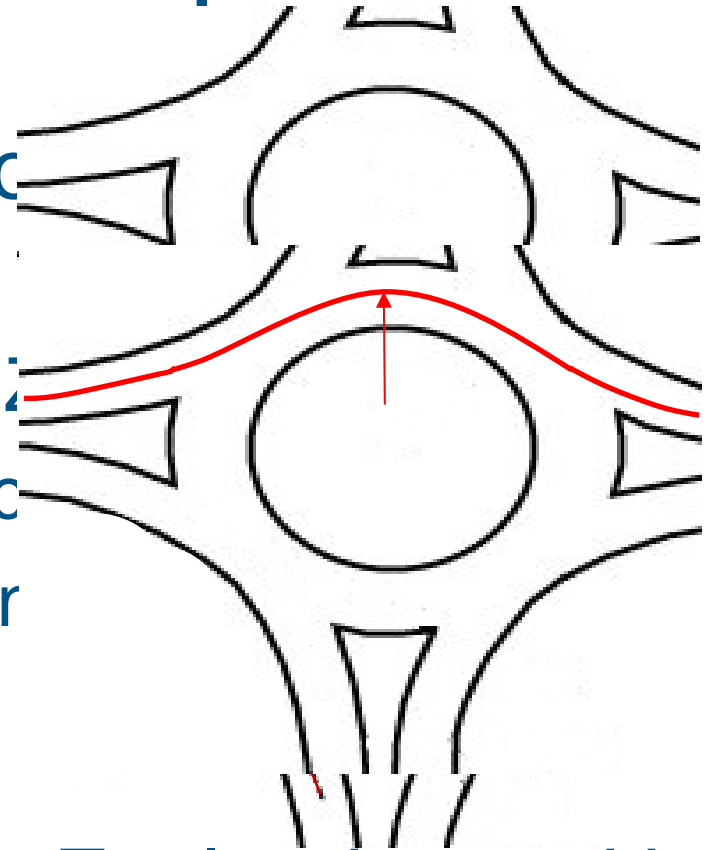
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Types of roundabouts

Vehicle entry speeds	Designs
Low [25 km/h]	Mini-roundabouts Compact Urban (European design)
Moderate [35-40 km/h]	Urban single lane (Australian design) Urban double lane Rural single lane
High [50 km/h]	Rural double lane

Controlling vehicle speeds

- Vehicle speeds through roundabouts controlled by:
 - Entry path radius: Aust., Nz
 - Radius of deflection: France
 - Deviation angle: Switzerland
- In US, Australia and New Zealand speed is reduced by increasing inscribed circle diameters



Comparison of single-lane designs ^[1]

Country	Operating speed	ICD	Central is. treatment	Splitter is.
Australia	≤ 80 km/h*	26m – 54m	Non-traversable†	Provisions
US	—	27m – 55m	Non-traversable†	Provisions
UK	—	28m – 36m	Non-traversable†	No provisions
France	—	30m – 50m	Non-traversable	Provisions
Switzerland	—	26m – 40m	Non-traversable†	Provisions
Italy (Lombardia)	—	26m – 50m	Non-traversable†	Provisions
Italy (national)	Speed ↓ measures	25m – 50m	Non-traversable	No provisions

† Truck aprons provided if required

Comparison of multi-lane designs ^[1]

Country	# circ. Lanes	ICD	Central is. treatment	Splitter is.
Australia	≥ # entry	34m – 62m	Non-traversable†	Provisions
US	≥ # entry	46m – 91m	Non-traversable†	Provisions
UK	≥ # entry	36m – 100m	Non-traversable†	No provisions
France	1 (no lane markings)	30m – 50m	Non-traversable†	Provisions
Switzerland	—	—	Non-traversable†	Provisions
Italy (Lombardia)	1-2	50m – 70m	Non-traversable†	Provisions
Italy (national)	1 (no lane markings)	25m – 50m	Non-traversable†	No provisions

† Truck aprons provided if required

Provisions for cyclists

- Generally no special facilities for low-speed, single-lane roundabouts
- Bicycle lanes (on circulating roadway) permitted in:
 - UK, Australia [2]
- Greater off-road provisions at roundabouts for cyclists in continental Europe
- Bicycles prohibited from multi-lane roundabouts in Germany [3]

Safety for all users

- Overall ↓ crashes by 36% [4]
- Fatal crashes ↓ 66% and injury crashes ↓ 46% [4]
- Modelling (UK and US) suggests replacing intersections with roundabout ↓ crashes [5-8]
- Less effective as black spot treatments [9]
- Roundabout complexity influences safety
 - Regardless of design approach, ↑ entry arms ↓ safety [5]

Safety for cyclists

- Cyclists are less safe at roundabouts than signalised intersections [10]
- Are less safe for all vulnerable road users
- The impact of roundabouts on safety differs across jurisdictions [11]
- Greatest risk from entering vehicles [Sakshaug]
- Difficult to make direct comparison
 - Traffic regulations (drivers yielding on exit)
 - Roundabout design approach

Design features that improve safety

- Small traffic calming roundabouts ^[12]
 - Also improved yielding behaviours at pedestrian crossings
- Single-lane roundabouts ^[13]
 - Where the central island radius $\geq 10\text{m}$
- Presence of bypass facilities ^[13]
 - Safest for all road users

Design features that reduce safety

- Older roundabouts (reflects design standard) [14]
- Large drive curve [14]
- Narrow aprons [14]
- Multi-lane roundabouts [13]
- Roundabouts with marked cycle lanes [15]
- High traffic volumes [14]
- High cyclist volumes [14]

Cyclist perceptions of roundabouts

- Perceptions differ between countries
- Riders in the UK and USA report feeling uncomfortable/unsafe riding through roundabouts [16, 17]
- Cyclists in Denmark more likely to only perceive risk at specific locations [18]
- Riders most apprehensive when vehicles enter [18]

Cyclist behaviours at roundabouts

- Cyclist positioning may influence safety
- Drivers' gave more visual attention on cyclists when no bicycle facility was present ^[19]
- Majority “straight-line” when negotiating a roundabout, approximately 40% ride on the outer edge ^[20]
- Less than half travelled in circulating bicycle lanes ^[21]

Discussion

- Bicycle riders are not homogeneous
 - Ride for different reasons
 - Perception of risk is personal
- Roundabouts have overall benefit to road safety
- Cyclists do not receive same safety benefit
- On-road bicycle lanes appear to be more hazardous, for all road user groups

Acknowledgement

- Review conducted as part of a TMR-funded project 'Roundabout design review'

Questions?

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