Single Lane Roundabouts
Geometric Design in Context
-Urban versus Rural
GEOMETRIC PARAMETERS Affecting Capacity
Effective Geometry

\[ V = \text{Approach Road half width} \]
\[ E = \text{Entry Width} \]
\[ L' = \text{Effective Flare Length} \]
\[ D = \text{Inscribed Circle Diameter} \]
\[ R = \text{Entry Radius} \]
\[ \phi = \text{Entry Angle} \]

FIGURE 16 Capacity/geometry relationships according to RODEL (48).
Empirical Evidence

![Graph showing the relationship between Entry Angle (°) and Capacity (PCE's)](image)

- **Y-axis:** Capacity (PCE's)
- **X-axis:** Entry Angle (°)

The graph illustrates a decreasing trend in capacity as the entry angle increases.
Empirical Evidence

Entry angle (phi)
Gap models do not include phi, blind to effect
If designs uses large phi
- Like R, the large loss in capacity not predicted
- Large phi increase crashes into central island
- Uncomfortable for drivers, additional capacity reduction

Phi best between 20° – 35° on MLRs
Entry Angle & Entry Radius

Tangent approaches:
- Small entry angle
- Large entry radius
- Not much deflection

This can result in:
- High capacity
- Poor observance of yield and potential for high speeds and entry-circulating crashes

LEGEND
Ø In this case the entry angle is defined as $2\theta \div 2$. 
Entry Angle & Entry Radius

Perpendicular approaches:

- Large entry angle
- Small entry radius
- Lots of deflection

Combined Net Effect:

- Low capacity
- Abrupt braking at entries and potential for rear-end crashes (especially in high-speed locations)
Geometric Parameters Affecting Safety

Geometric Parameters in the Predictive Relationship:

• **Entry Path Curvature** ($\text{Ce}$)
• **Entry Width** ($E$)
• **Approach lane(s) width** ($v$)
• **Angle between arms** ($\phi$)
• **Inscribed Circle** ($\text{IC}$)
• **Diameter/Central Island Diameter** ($\text{CI}$)

• (19 Others less significant e.g. sight distance to the left)

**Figure 1 - Definition of Geometric Parameters in the Predictive Relationship**

$C_e = 1/R_e$
Safety Explicit in Design:

UK Graph of crashes versus EPC for Entry Deflection

EPC is a surrogate for entry angle and other speed related parameters

Optimum 100’< EPC < 300’
Vehicle Entry Path

- Determines the design speed of a roundabout
- Fastest path allowed based on geometry is drawn
- Fastest path possible for a single vehicle
  - Absence of other traffic,
  - Ignore all lane markings
  - Traverse thru entry, around central island, out the exit
  - Fastest path is the thru movement
  - Check Right turns for skewed intersections
Fastest Path Through a Single Lane Rdbt

Page 134
FHWA

5 ft off curbs
1.5 m (5 ft)
1.5 m (5 ft)
1.5 m (5 ft)
1.0 m (6 ft)

5 ft off curbs
(3 ft)
1.5 m (5 ft)
1.5 m (5 ft)
Application of EPC requires assessment of traffic flows…

Optimum entry safety depends on this combination.
Matching the design to the context

- Same intersection
- Different design
- Very different operations

- Focus was peds./bikes
- Required outside truck apron
Controlling entry speed

• R1 should be used to control speed - Not entry angle

• PHI amongst other geometrics is simply a means to an end NOT the end itself – an outcome not a criteria.

• With a small PHI for improved capacity you can use other geometrics to compensate and get a small R1 so that speed is controlled.
Entry Deflection Urban Case

Simple to draw – poor composition = POOR performance
Entry Deflection with Roundabout

Complex to draw but expect optimal safety and efficiency

30 km/h

35 km/h

Ourston Roundabout Engineering
DESIGN EXAMPLE
Original – Re-design

Flatter exit

More entry curvature
Rural Context Design Elements

• Provide a minimum SSD to the entry.

• Align approach roadways

• Set vertical profiles to make the central island conspicuous.

• Splitter islands should extend to initiate deceleration.
Rural Context Design Elements

• Use landscaping on extended splitter islands and roadside to create a tunnel effect.

• Provide illumination in transition to the roundabout.

• Use signs and marking effectively to advise of the appropriate speed and path for drivers.
Central Island Delineation
Australian Researched Method of Achieving Speed Reduction

Figure 37.
Figure 36. Extended splitter island treatment
Speed Differential Alternatives for Rural Design

Long medians
• Safety:
  - Transition between high-speed rural and low-speed urban environments
Proof: Predicted Vs. Measured Speeds - Data Collection
Speed Studies

Wilson Street West

- Entering Speed
- Exiting Speed

85th Percentile Speed = 39 km/h
85th Percentile Speed = 45 km/h
Additional Treatment of High Speed Entry
Empirically Based Re-Design
Entry Path Curvature

Entry Curvature = 
Slow entry 
(R1 & R2)

Entry curvature = 
tangential entry
Components (geometric elements) vs. Composition (functionality)

• The design isn’t functional unless it passes the test of the driver interface

• It’s not enough to have knowledge of the components

• Composition based on principles is what determines the functionality

• If you only focus on the components the final assembly may be totally overlooked

• Adhering to the manual using data, figures and tables does not guarantee a sound design.