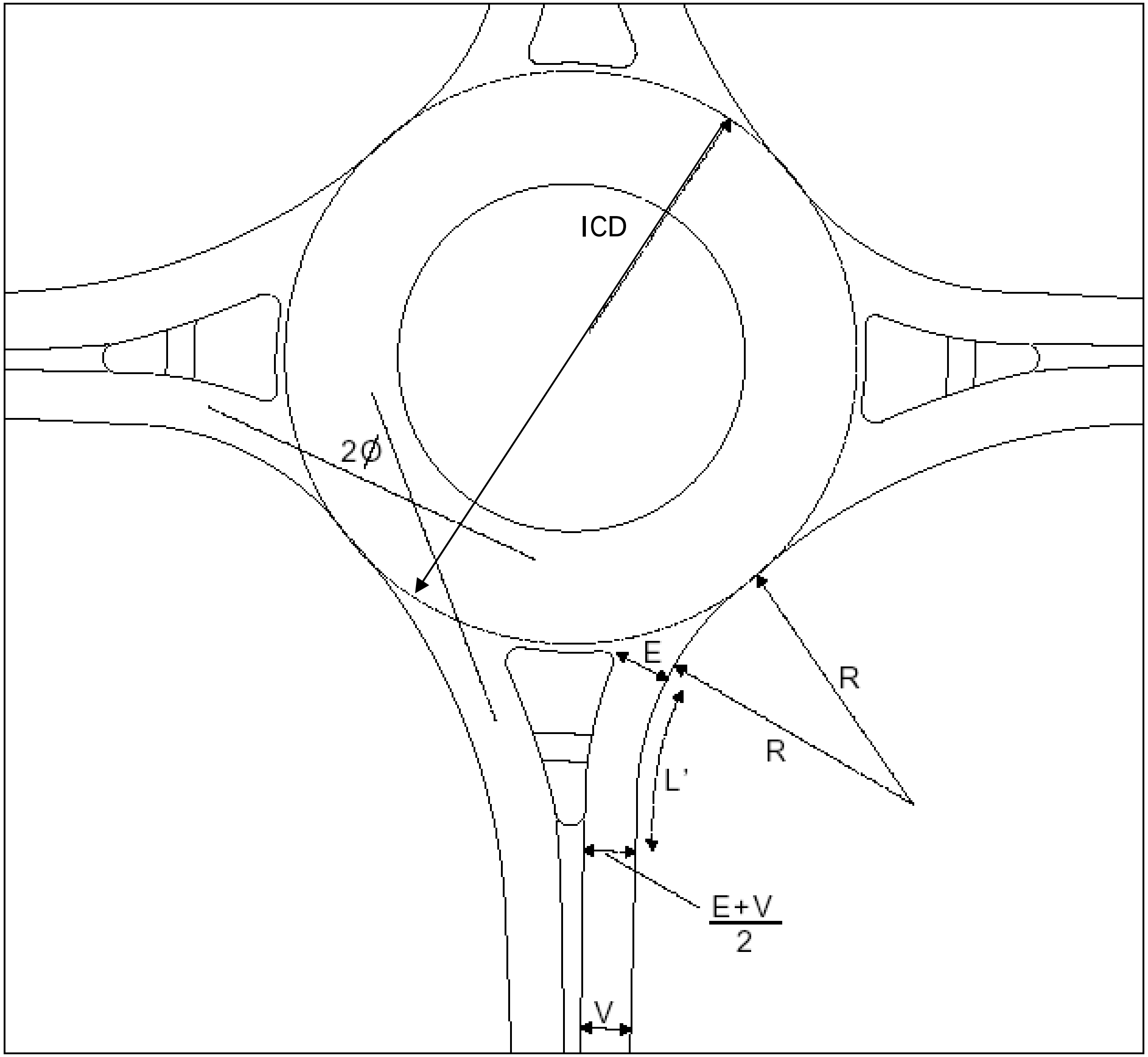
Single Lane Roundabouts Geometric Design in Context -Urban versus Rural

GEOMETRIC PARAMETERS Affecting Capacity



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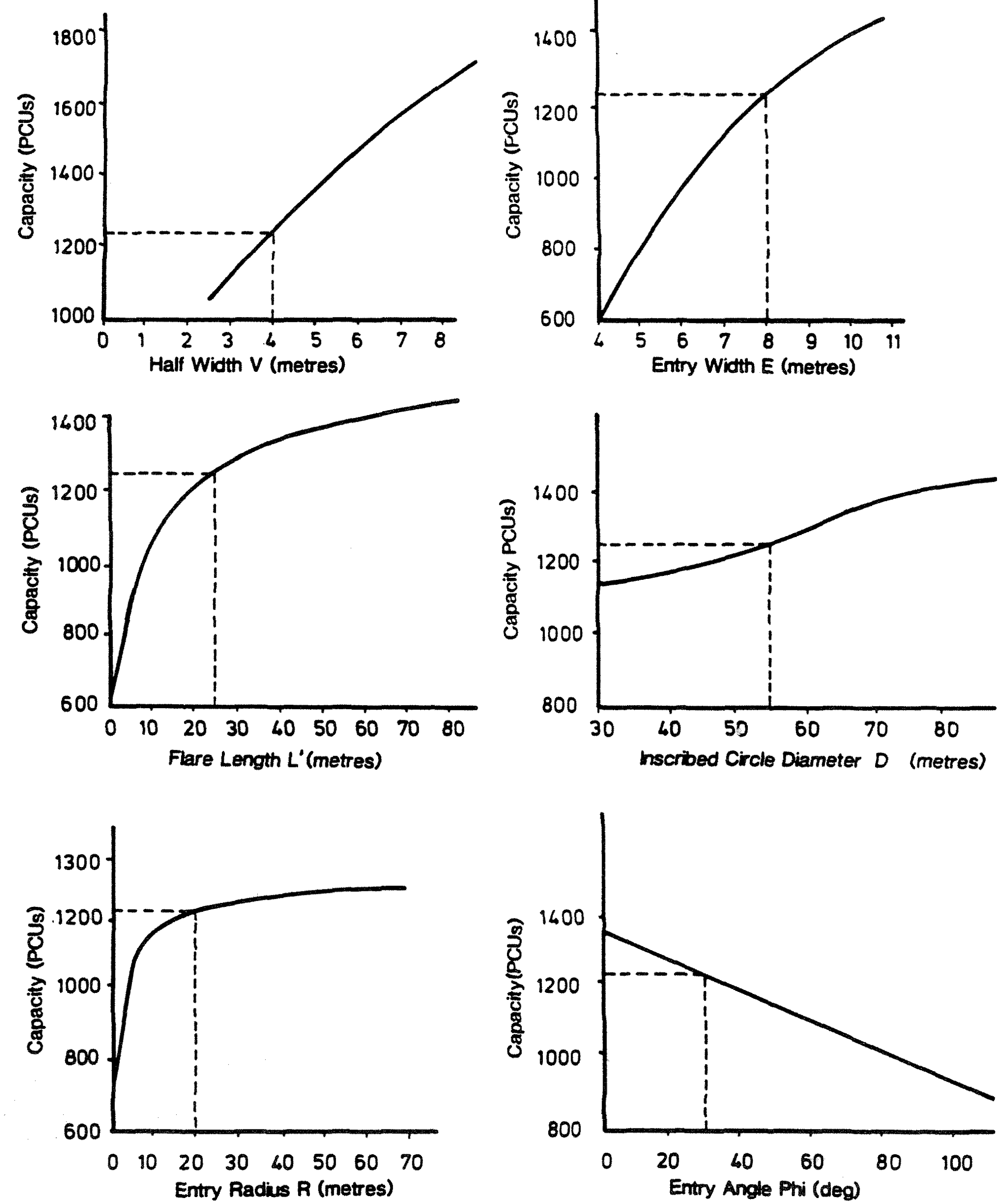


FIGURE 16 Capacity/geometry relationships according to RODEL *(48)*.

Effective Geometry

V = Approach Road half width

E = Entry Width

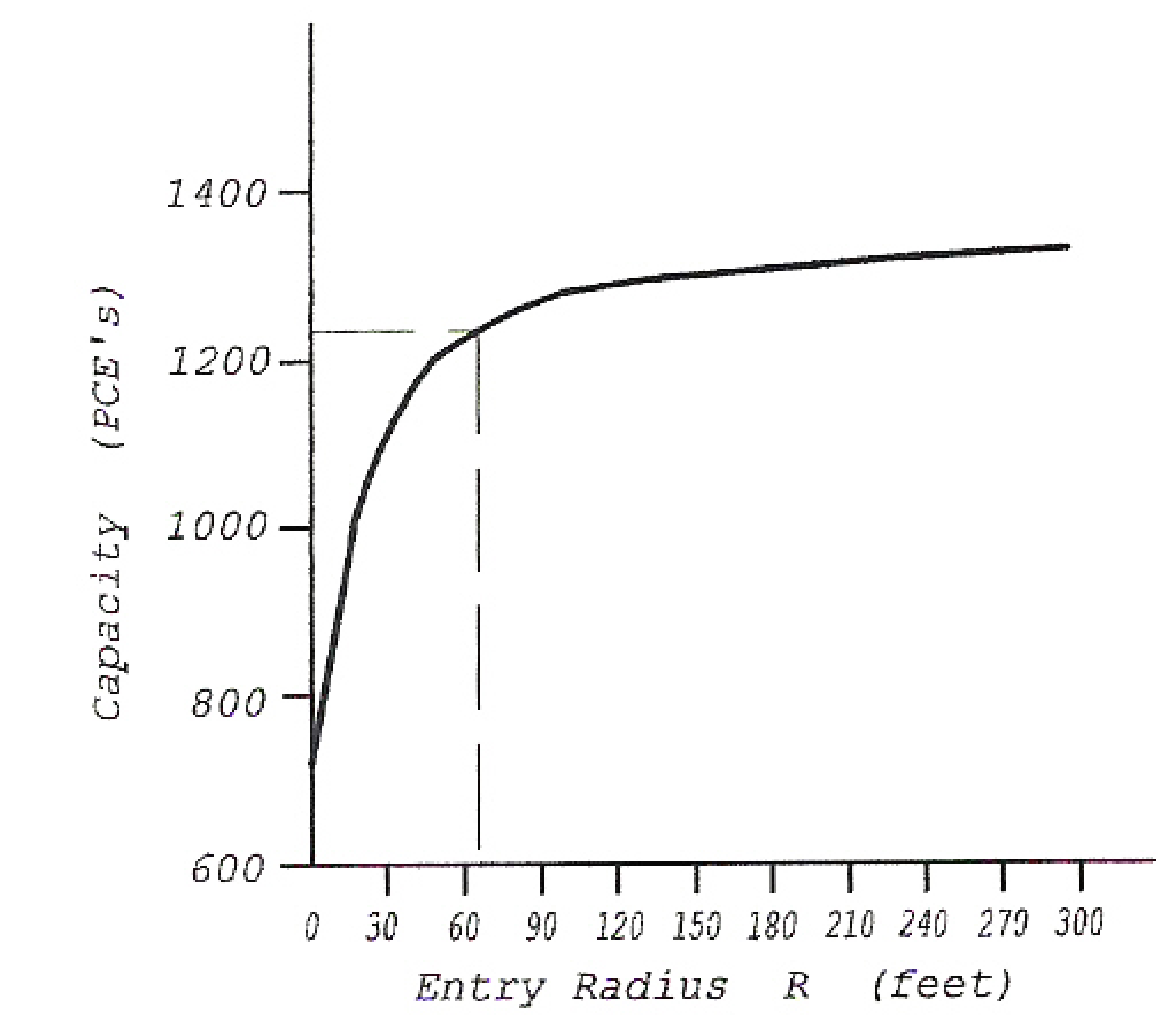
L’ = Effective Flare Length

D = Inscribed Circle Diameter

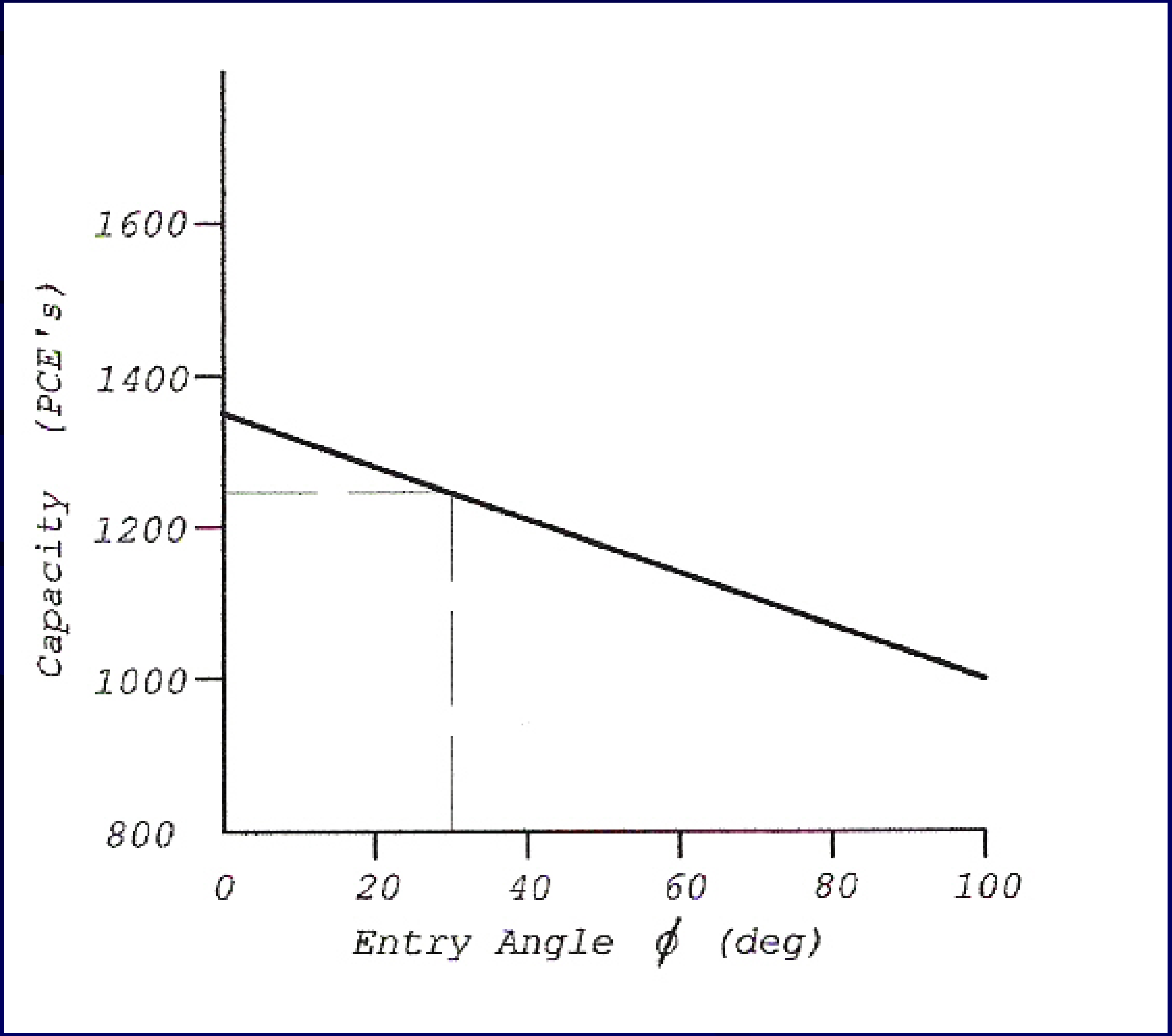
R = Entry Radius

Phi = Entry Angle

Empirical Evidence



Empirical Evidence



Empirical Evidence

Entry angle (phi)

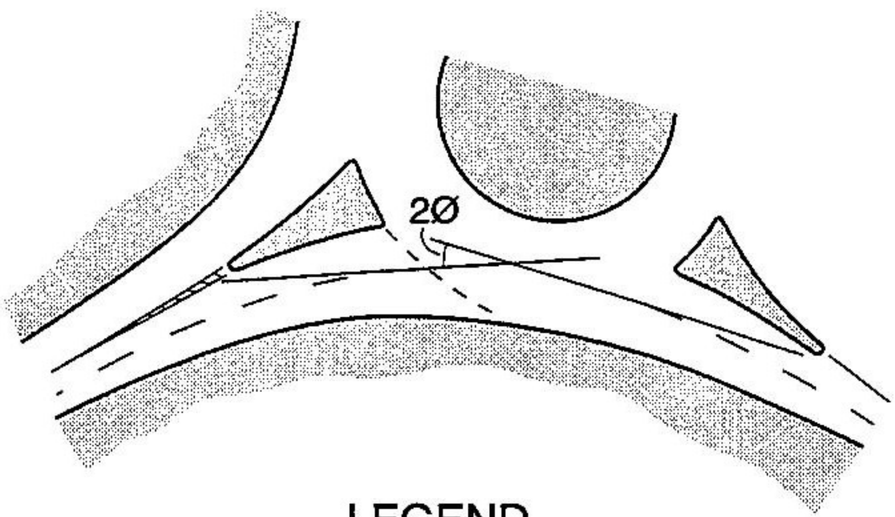
Gap models do not include phi, blind to effect

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 20^0 – 35^0 on MLRs

Entry Angle & Entry Radius



LEGEND

Ø In this case the entry angle is defined as 2Ø ÷ 2.

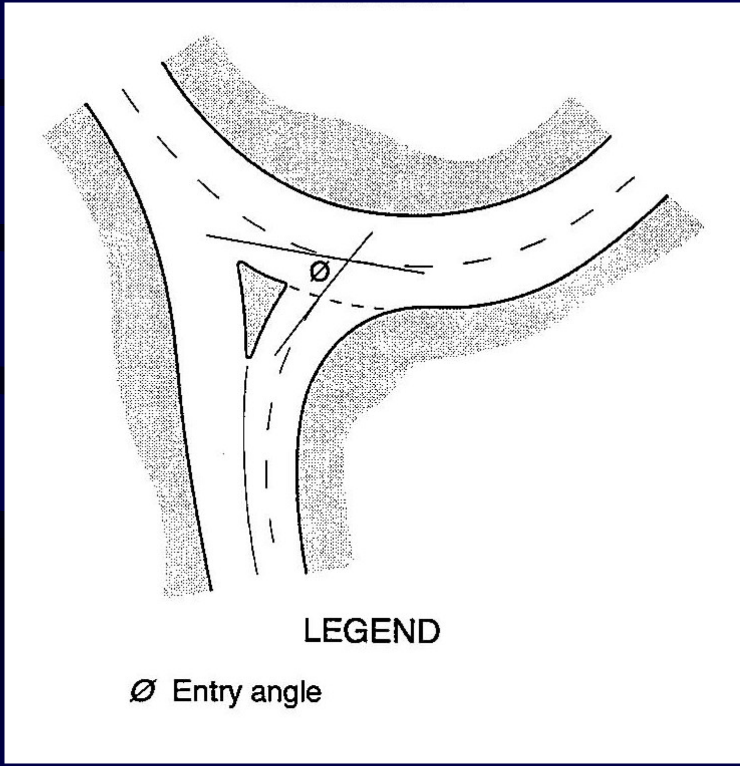
Tangent approaches:

- 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

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(Ce)**
- Entry Width (E)
- Approach lane(s) width (v)
- Angle between arms (phi)
- Inscribed Circle (IC)
- Diameter/Central Island Diameter (CI)

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

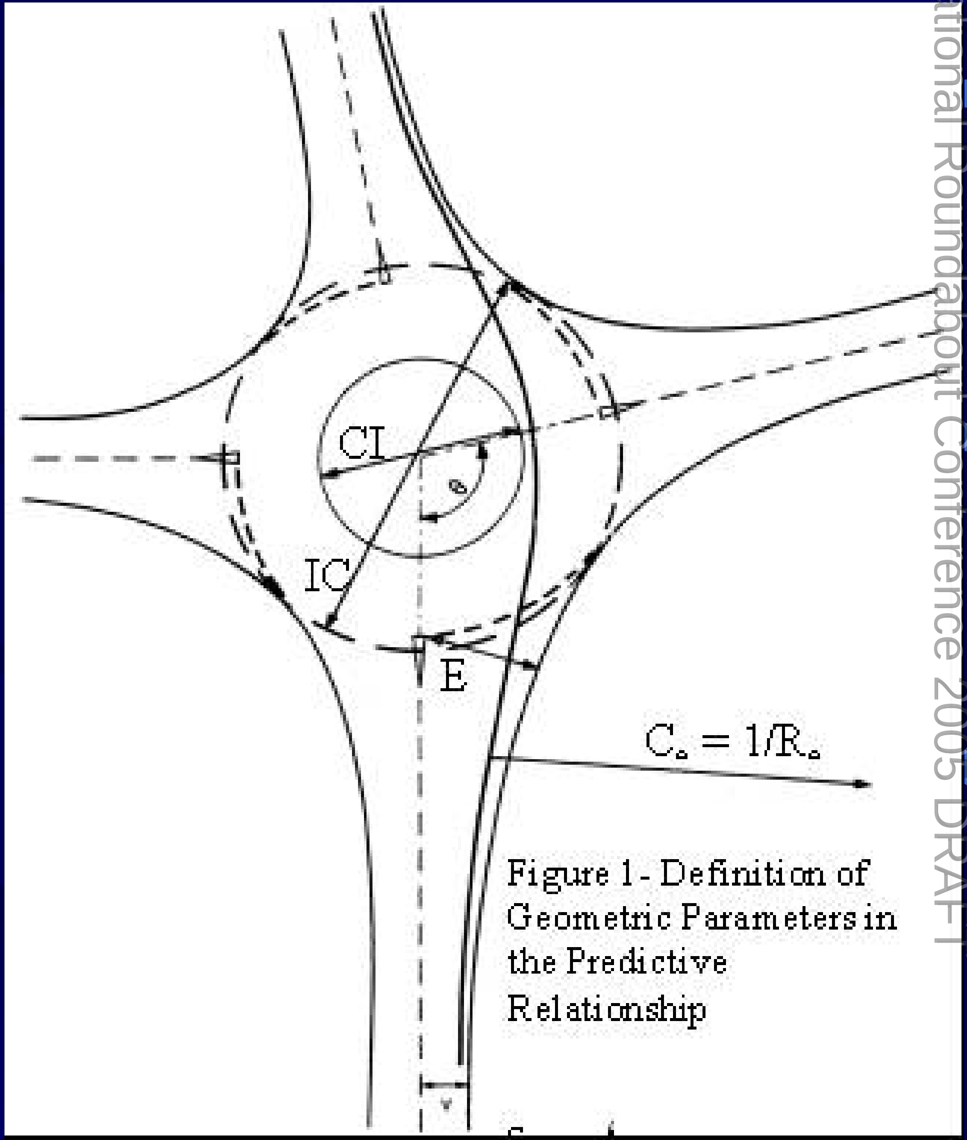
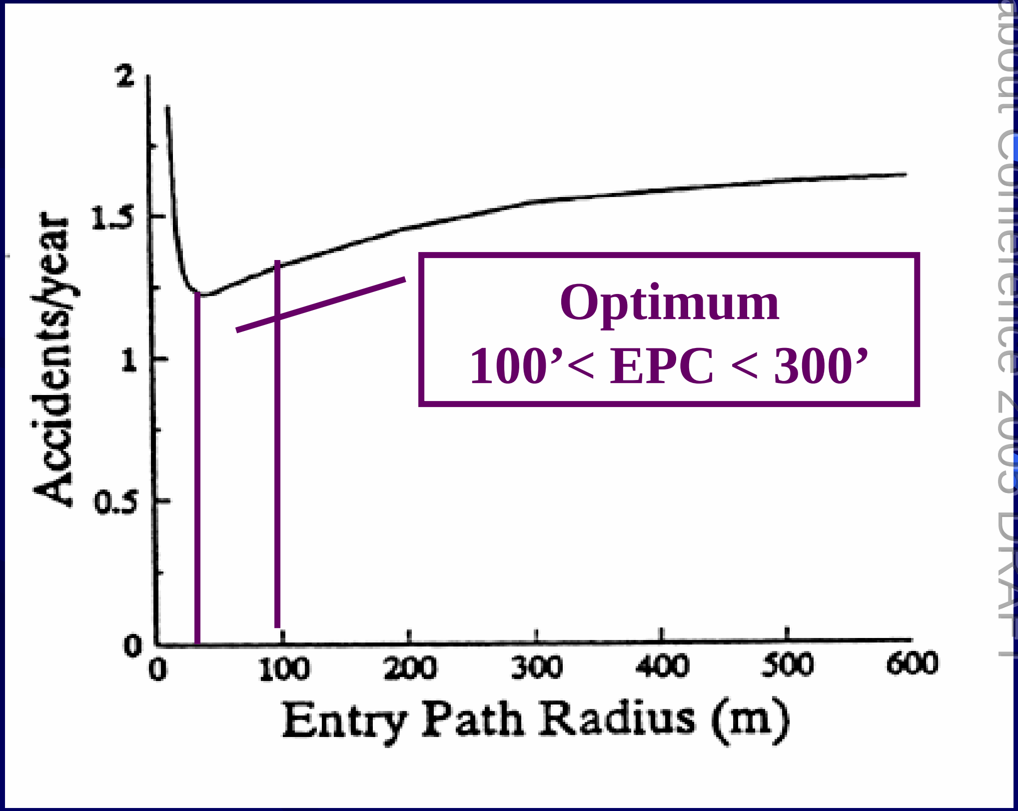


Figure 1 - Definition of Geometric Parameters in the Predictive Relationship

Safety Explicit in Design:

UK Graph of crashes versus EPC for Entry Deflection

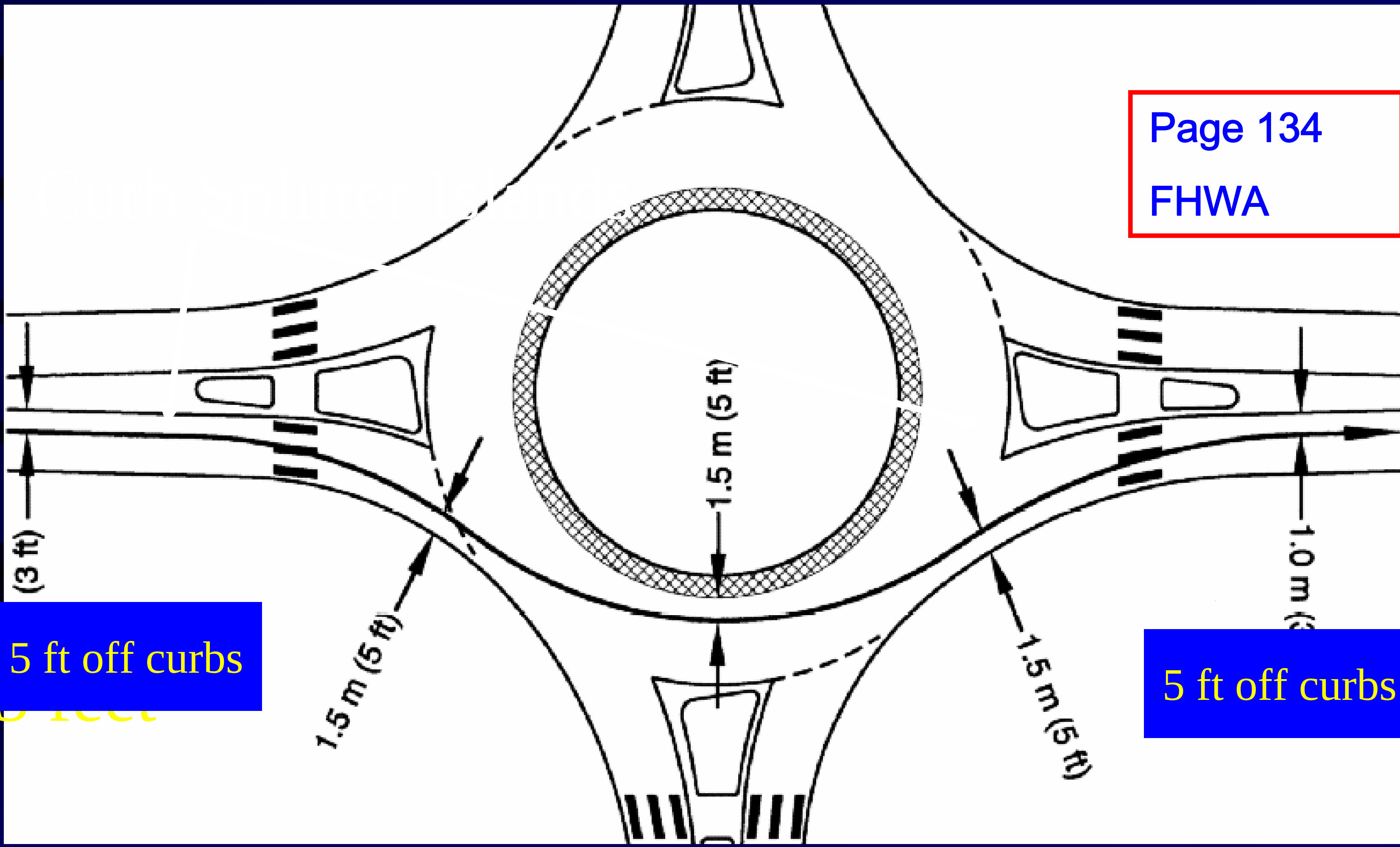
EPC is a surrogate for entry angle and other speed related parameters



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



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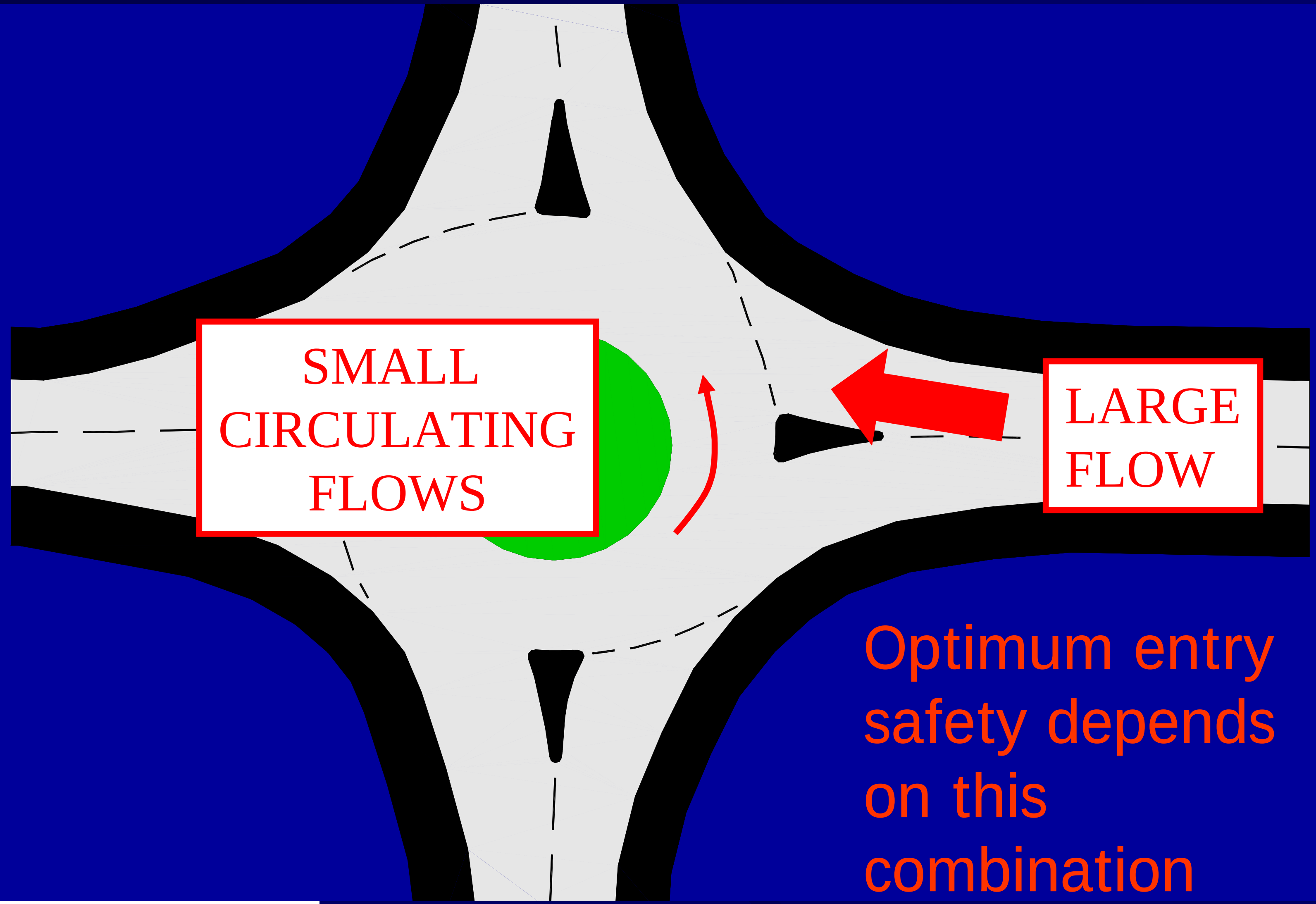
FHWA

5 ft off curbs

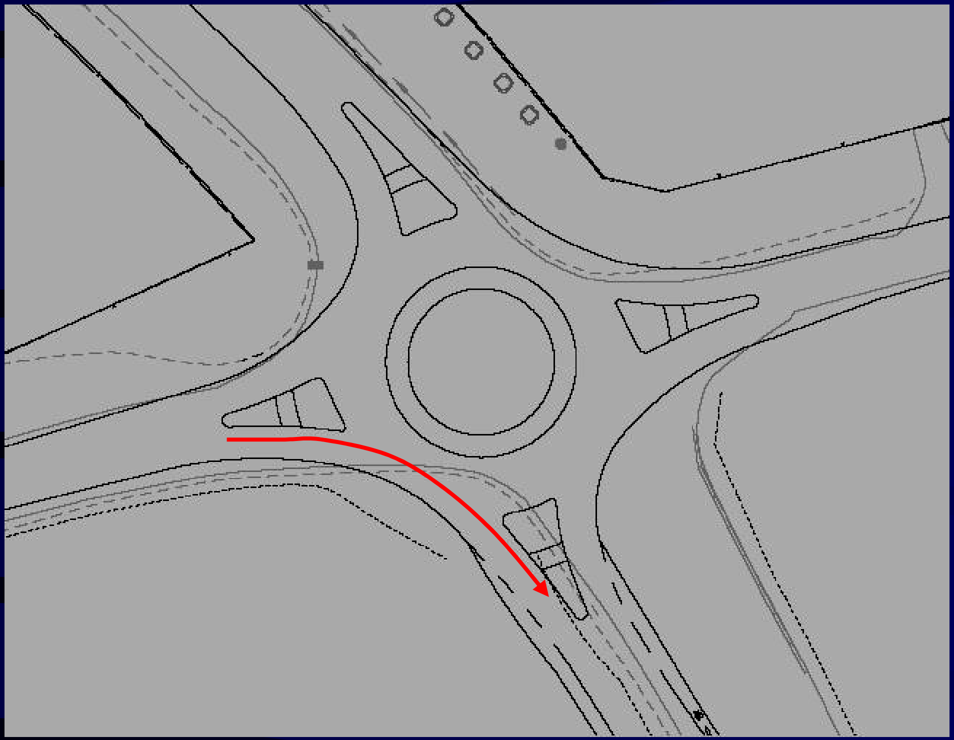
5 ft off curbs

Application of EPC requires assessment of traffic flows...

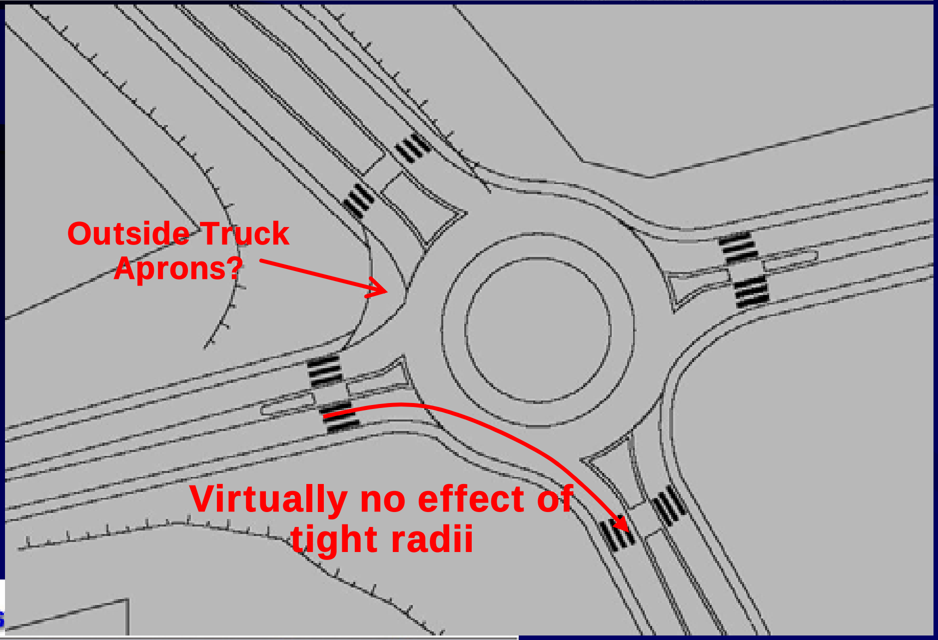


Optimum entry safety depends on this combination

Matching the design to the context



- Same intersection
- Different design
- Very different operations



- Focus was peds./bikes
- Required outside truck apron

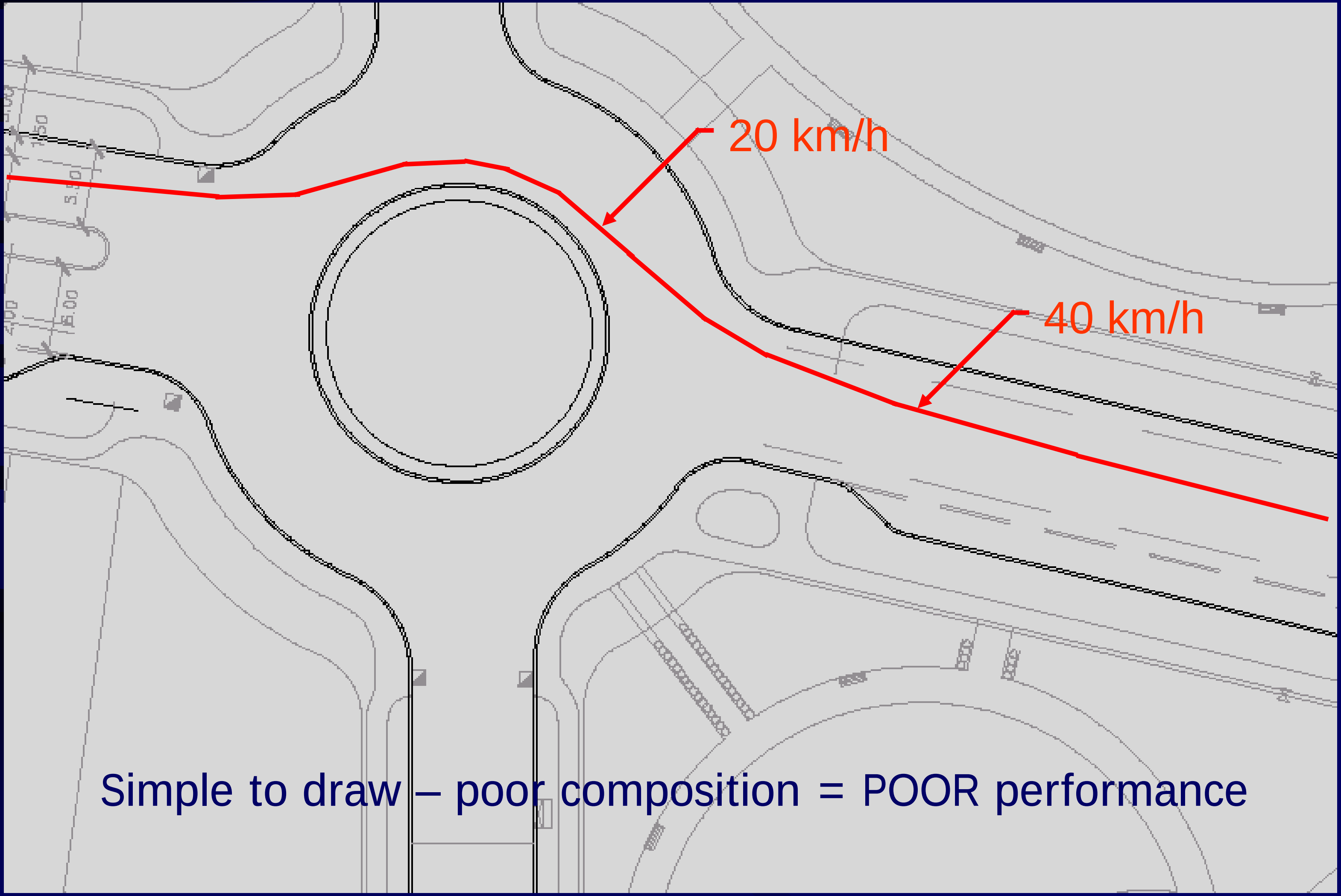
Controlling entry speed

- 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.

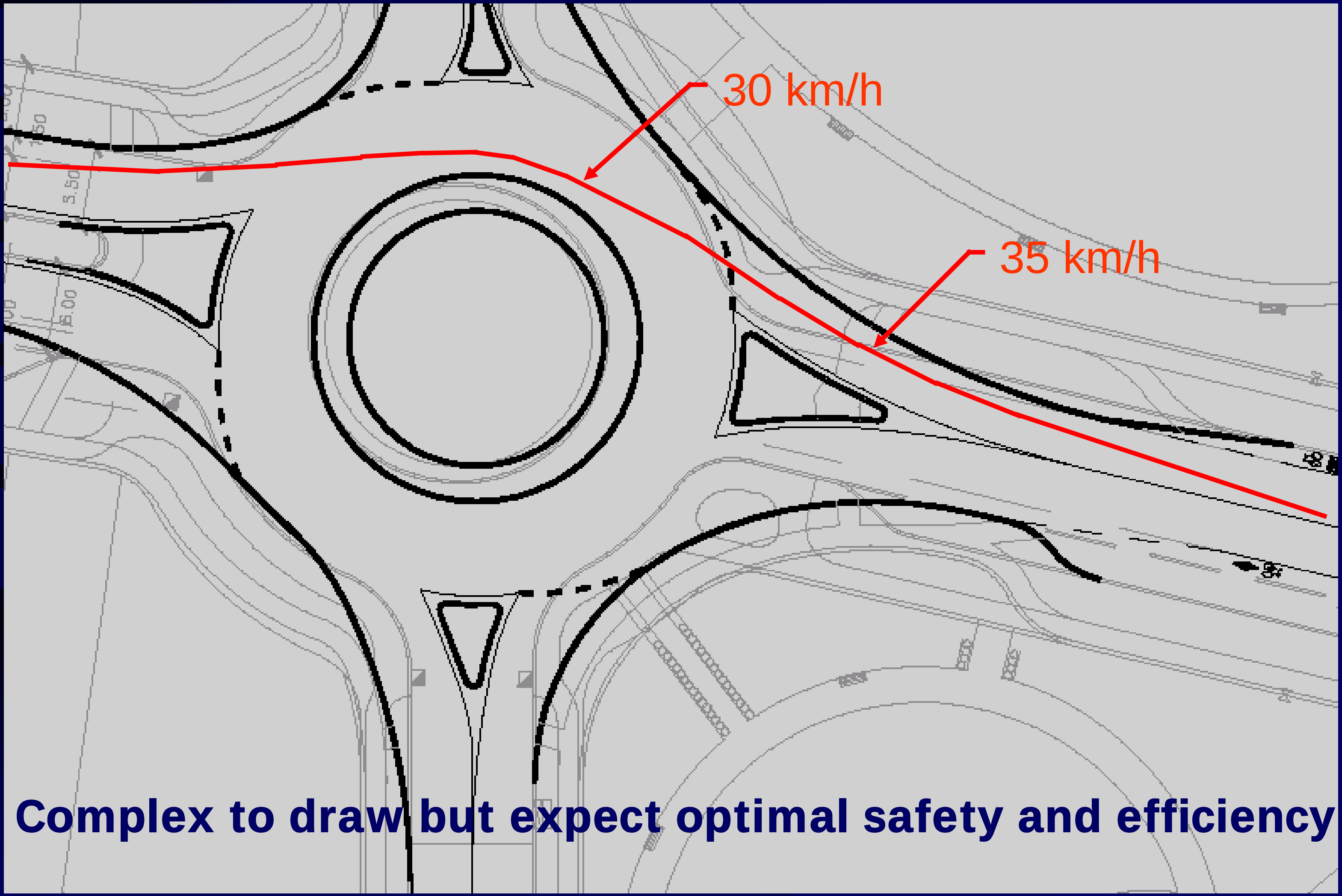
- With a small PHI for improved capacity you can use other geometrics to compensate and get a small R1 so that speed is controlled.

Entry Deflection Urban Case



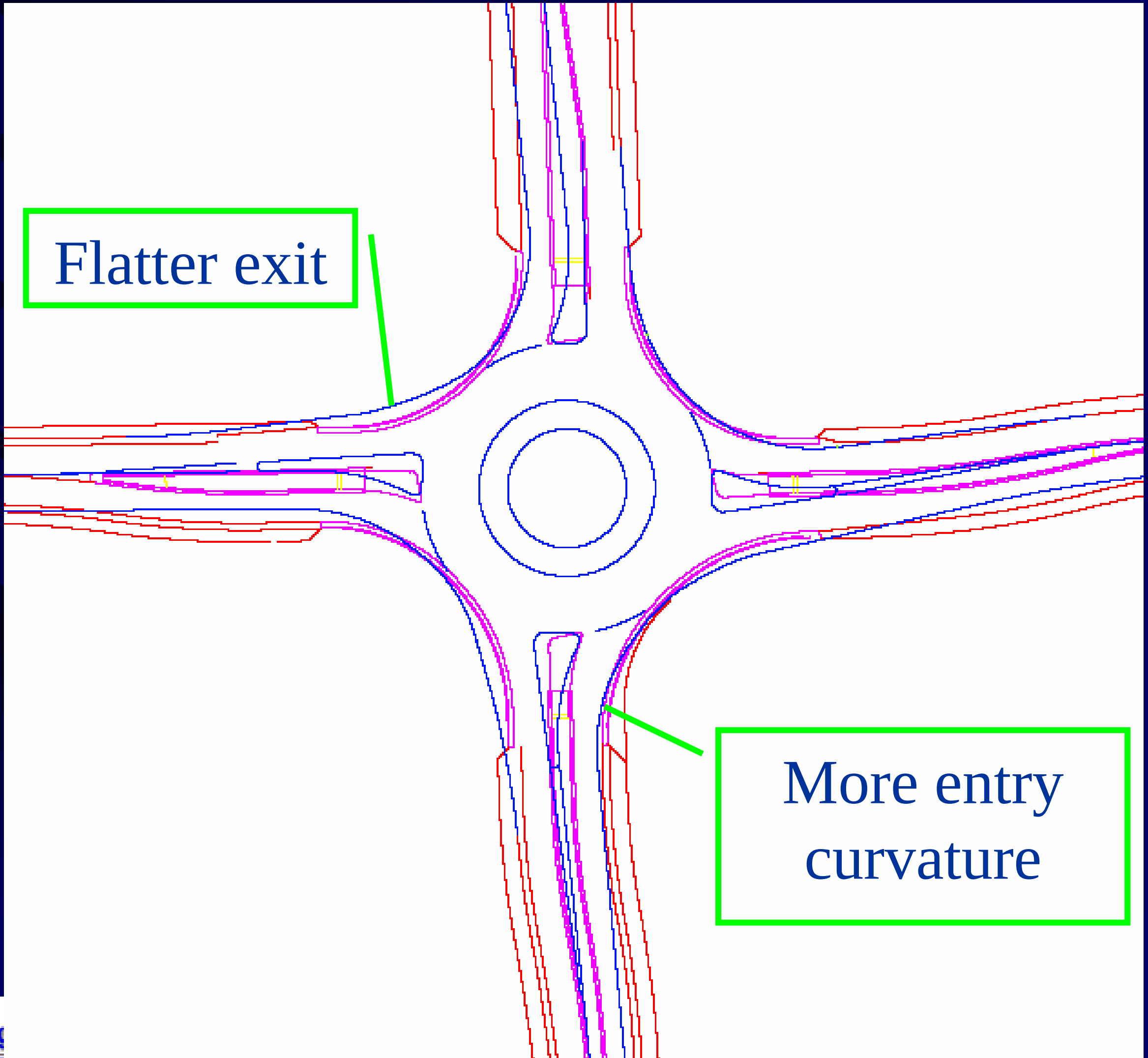
Simple to draw – poor composition = POOR performance

Entry Deflection with Roundabout



Complex to draw but expect optimal safety and efficiency

DESIGN EXAMPLE
Original – Re-design



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

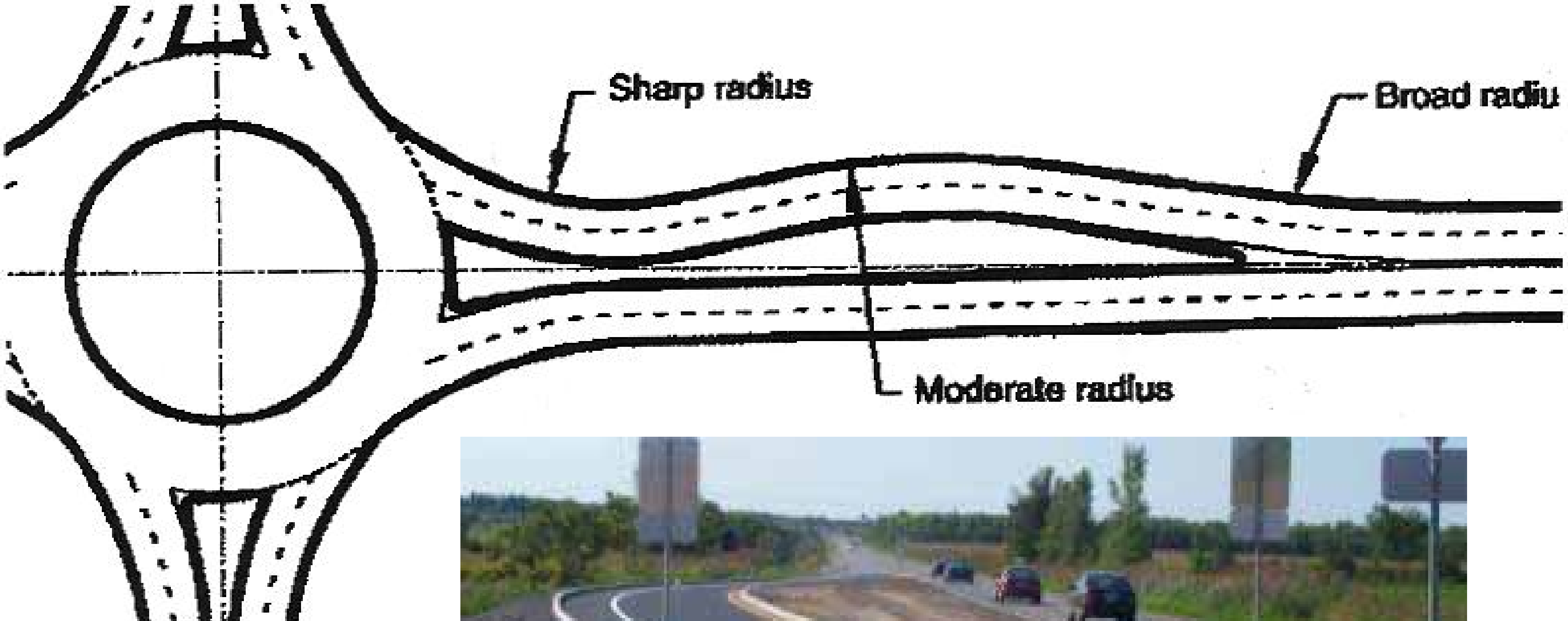
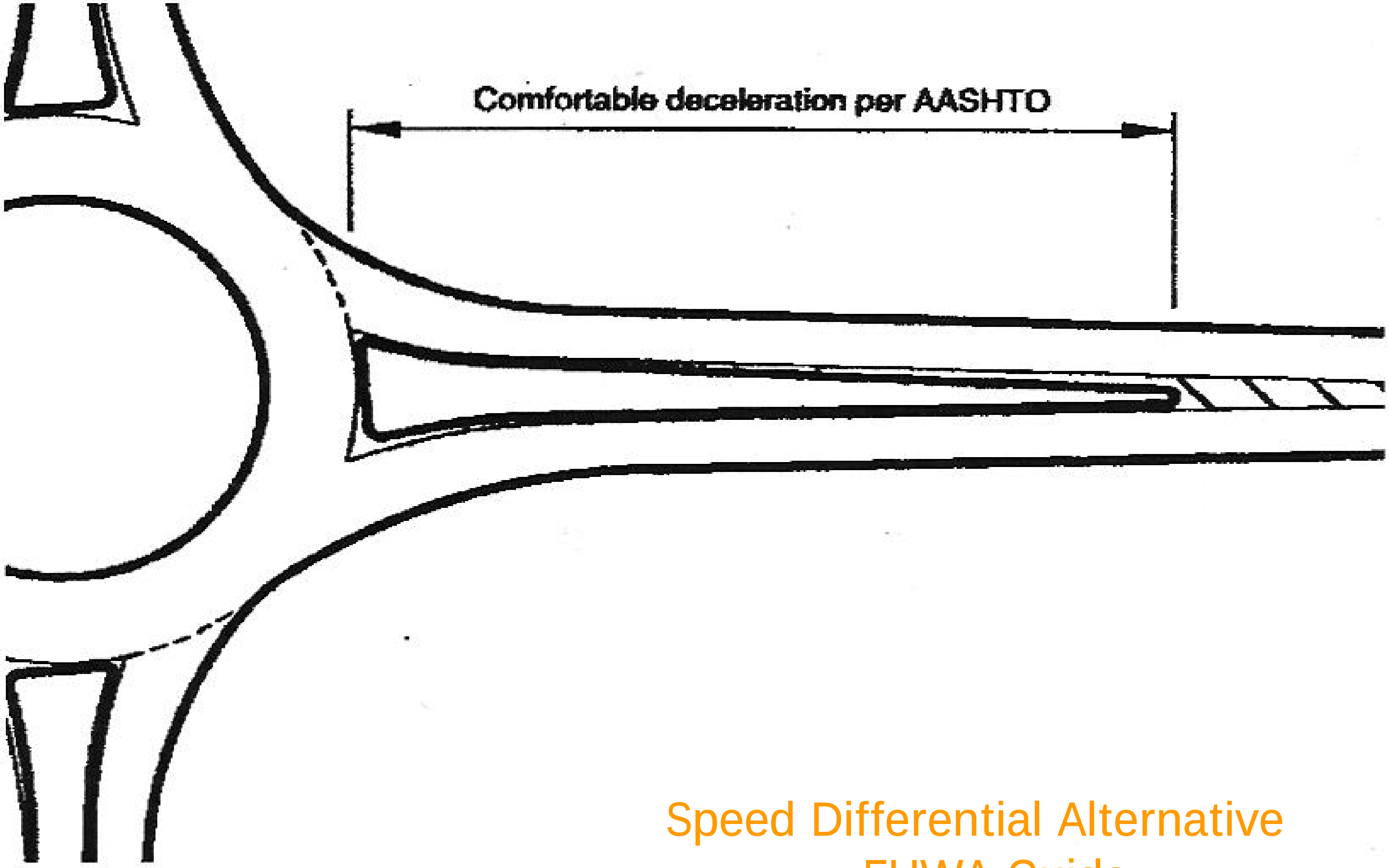


Figure 37.



Speed Differential Alternative – FHWA Guide

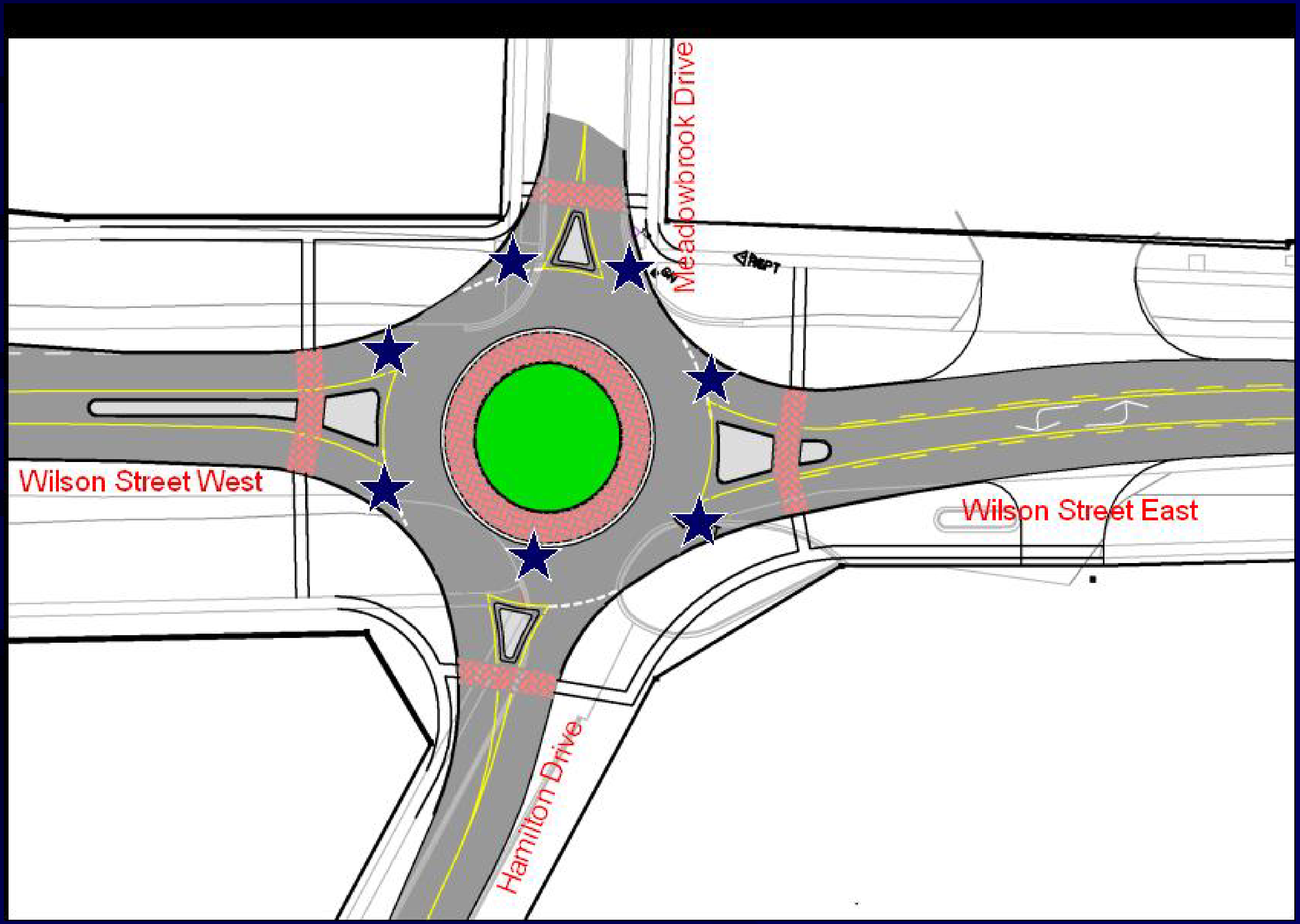
Figure 36. Extended splitter island treatment

Speed Differential Alternatives for Rural Design

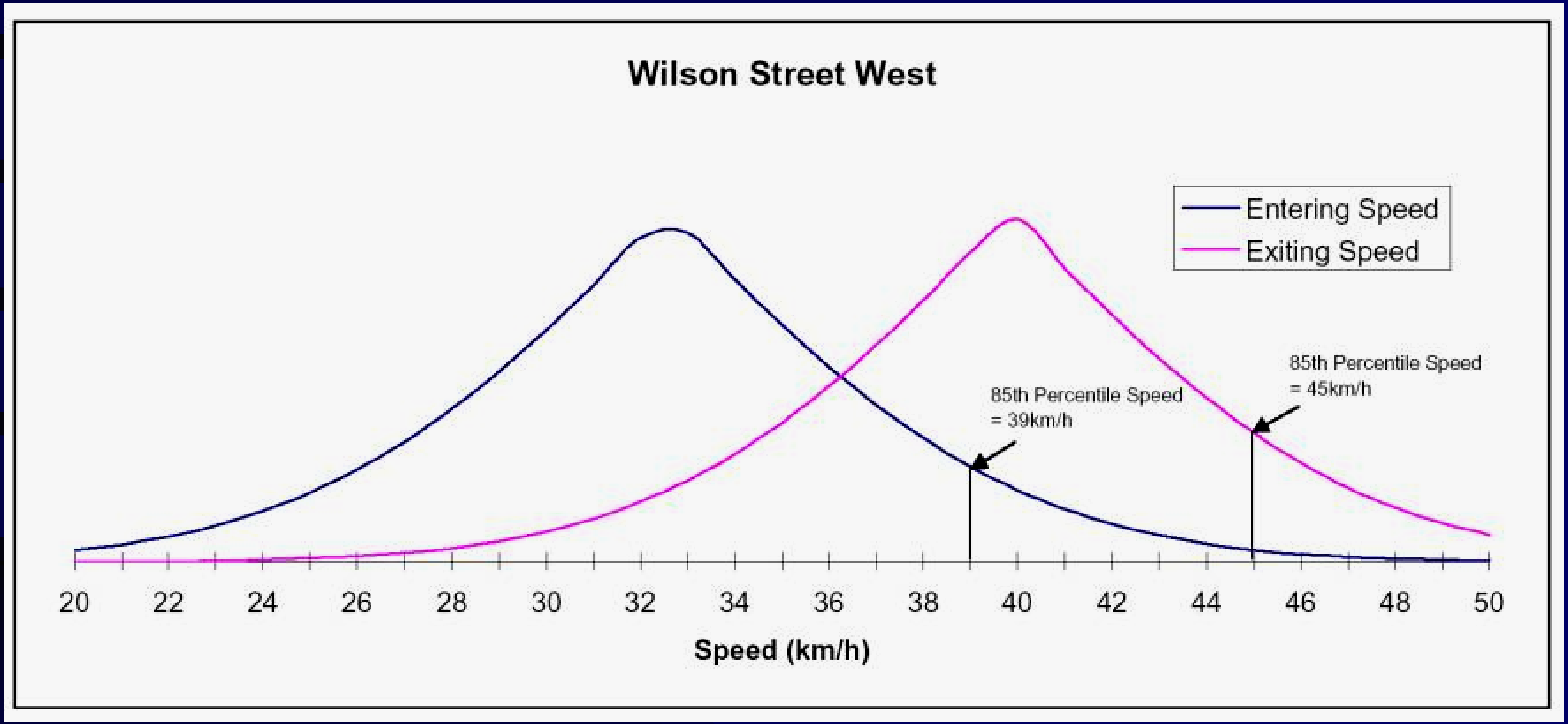
Long medians

- Safety:
  - Transition between high-speed rural and low-speed urban environments

Proof: Predicted Vs. Measured Speeds - Data Collection

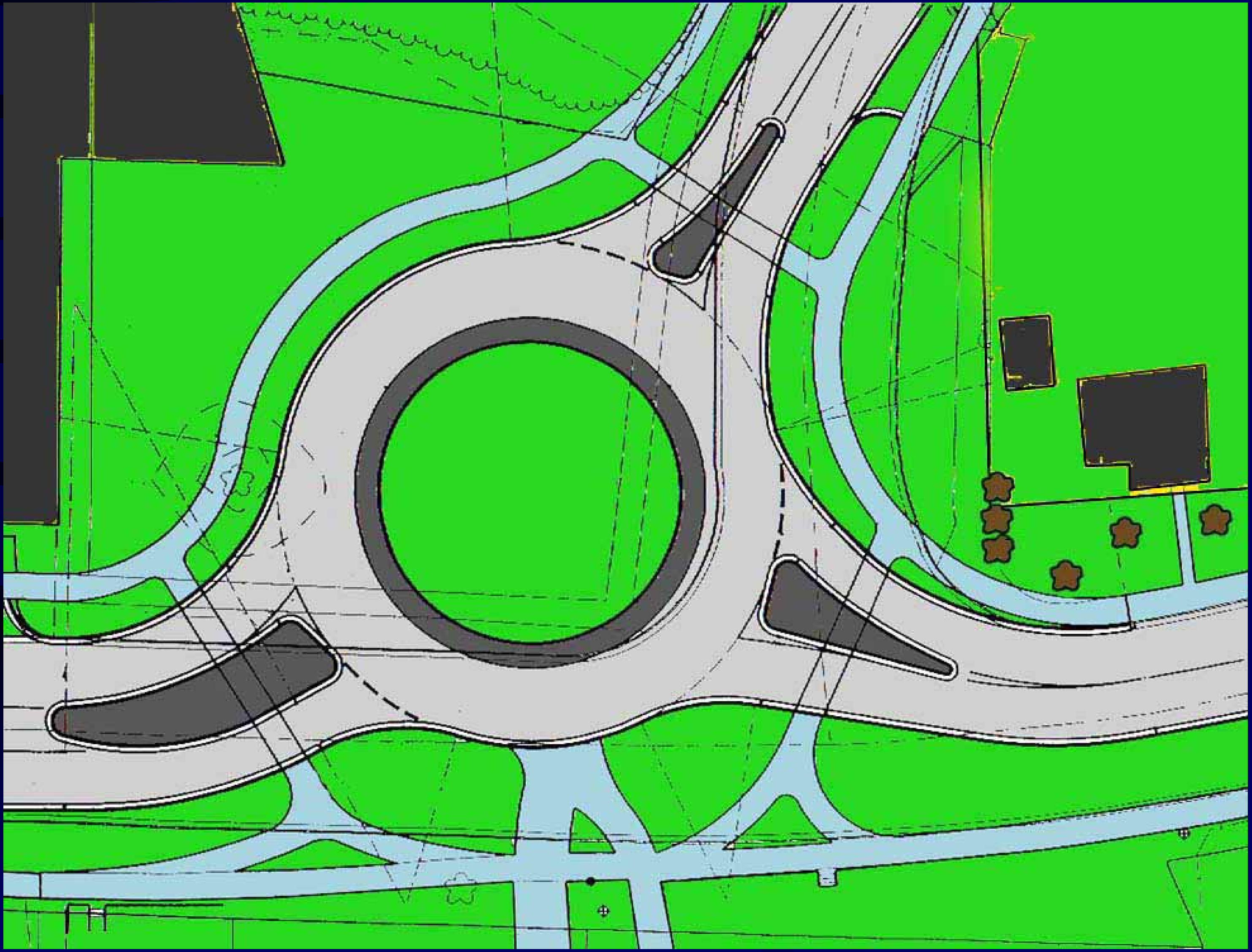


Speed Studies



Additional Treatment of High Speed Entry

Original SLR



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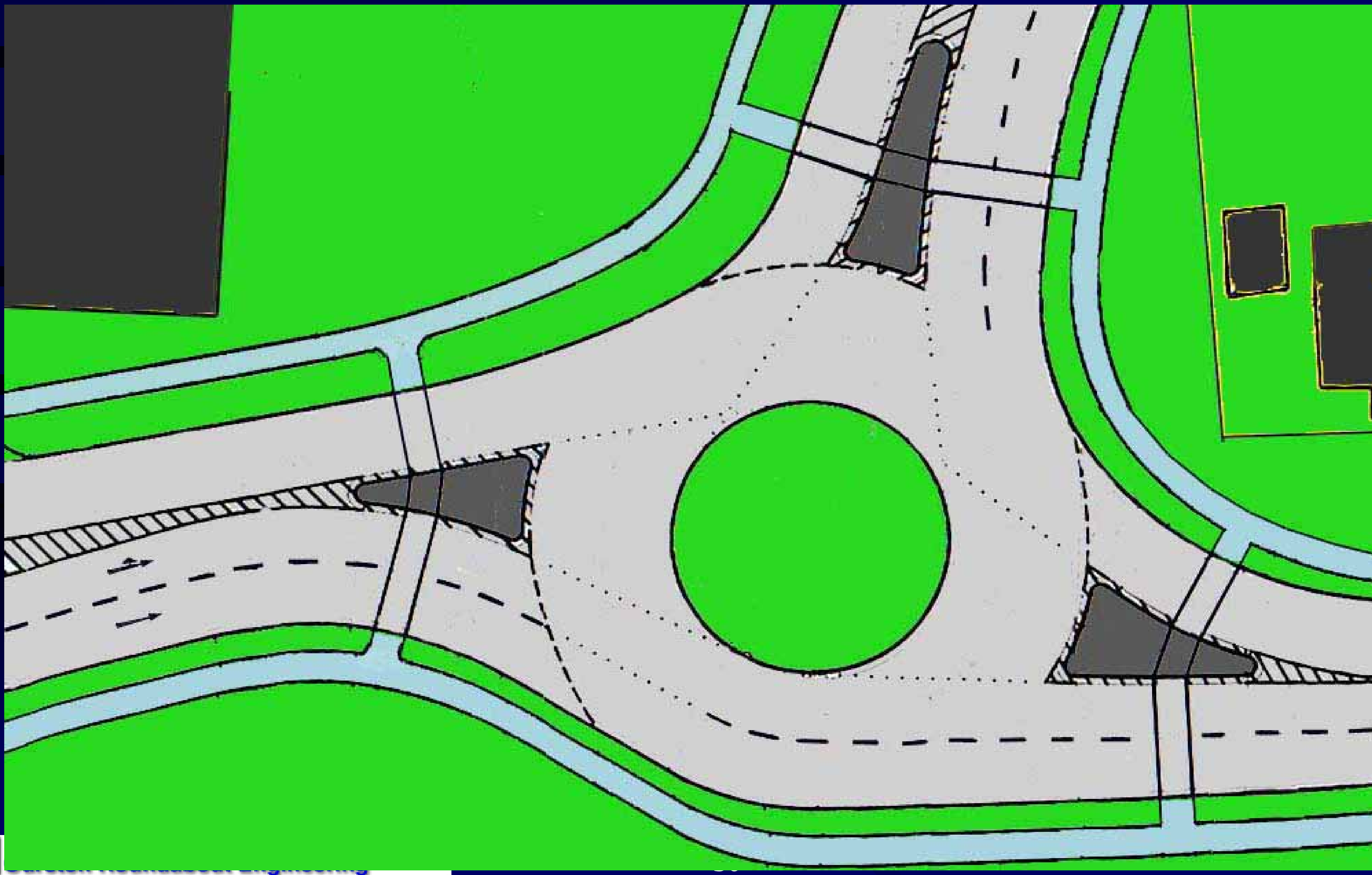
Empirically Based Re-Design



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.