

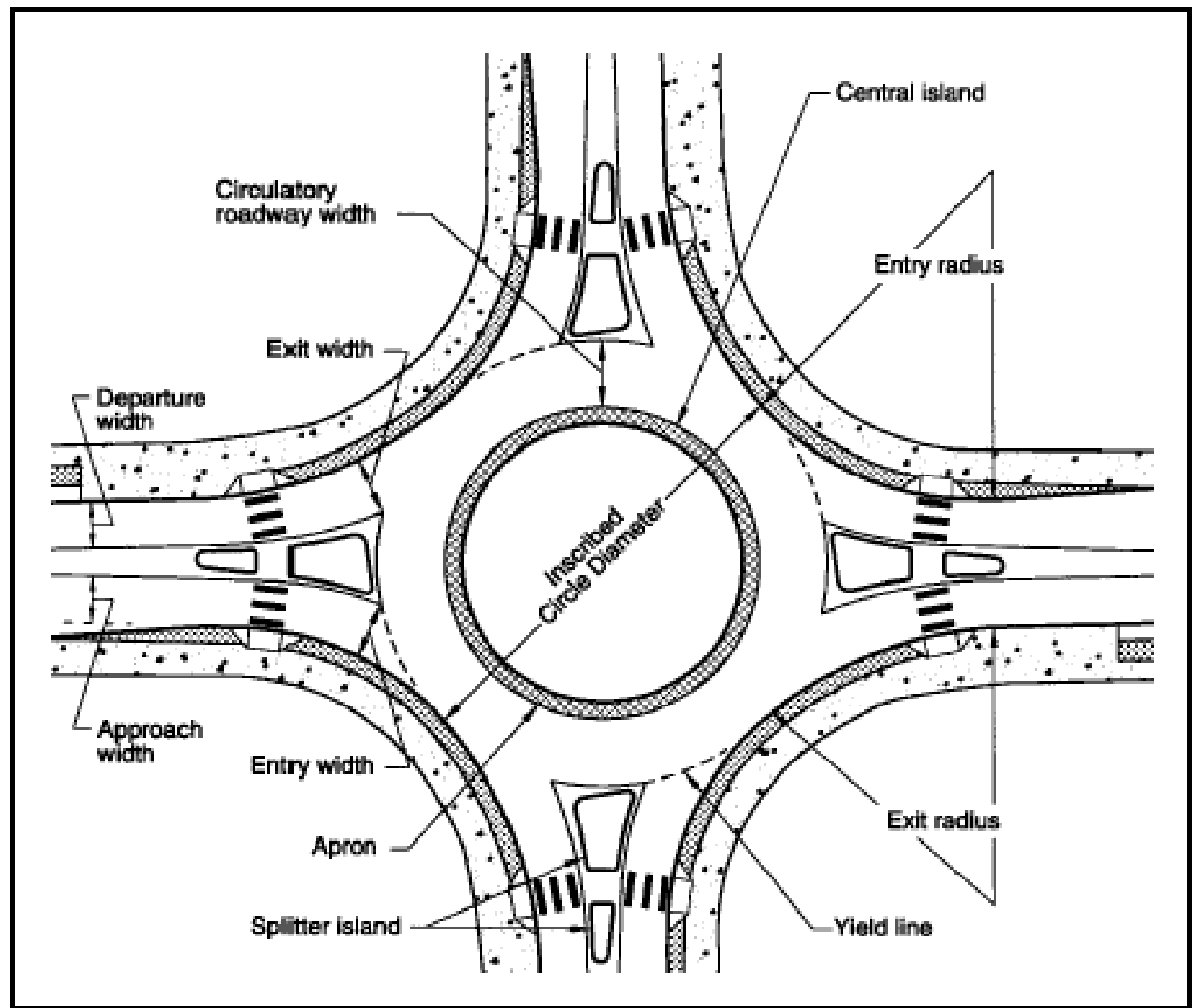
Roundabout Workshop

Module 5

Geometric Design

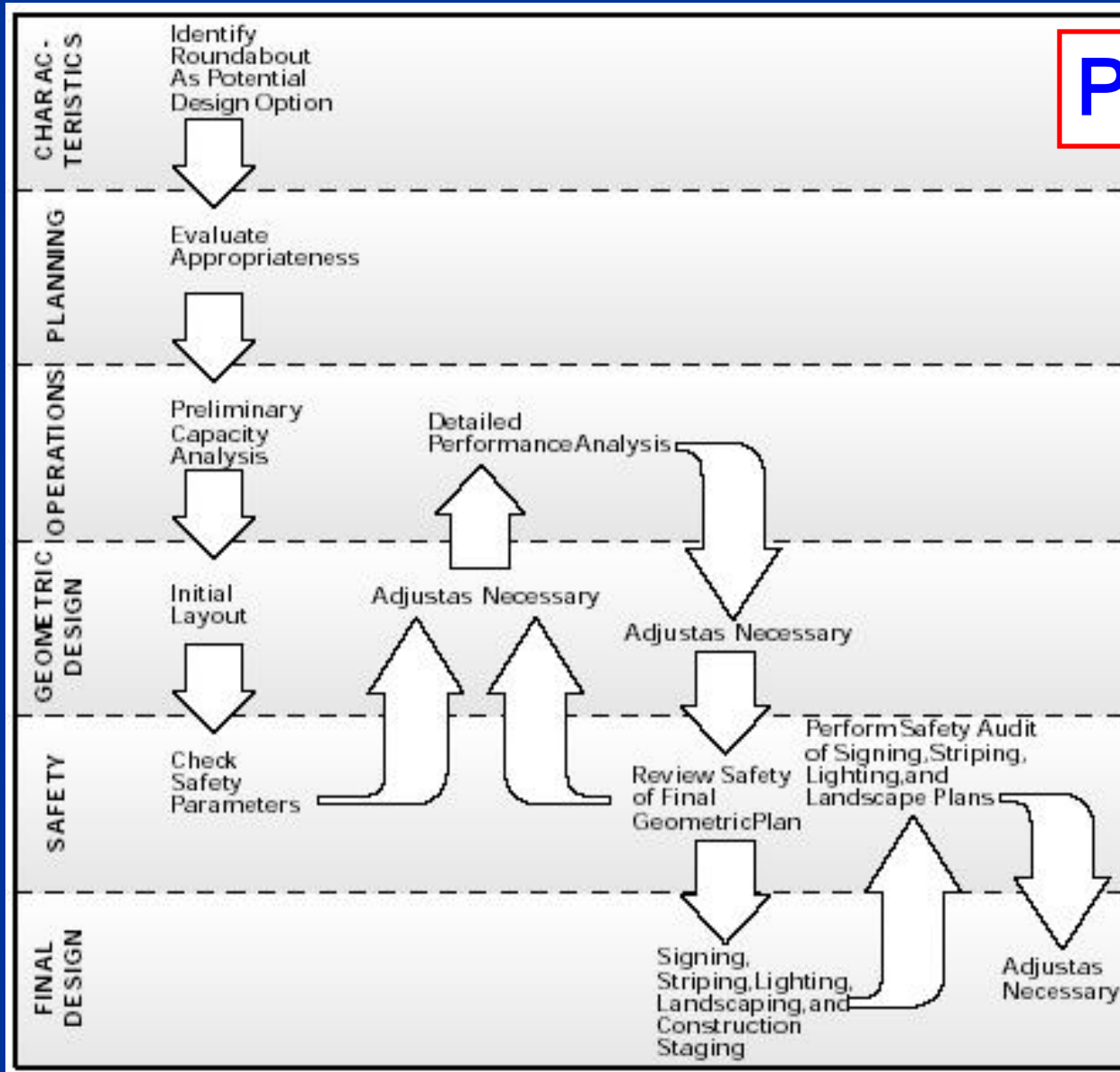
Basic Geometric Elements of a Roundabout

Exhibit 6-1. Basic geometric elements of a roundabout.



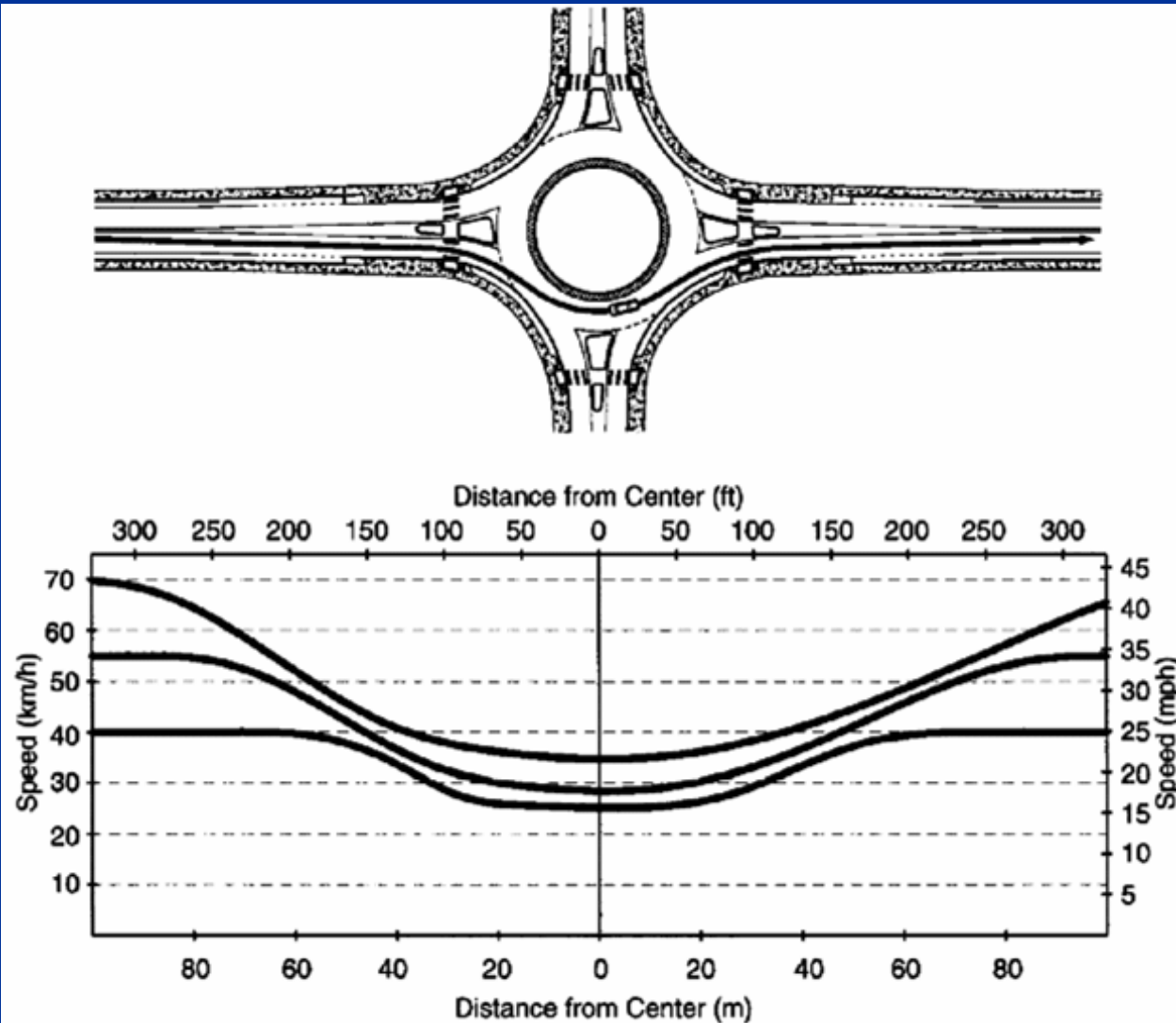
Iterative Roundabout Design Process

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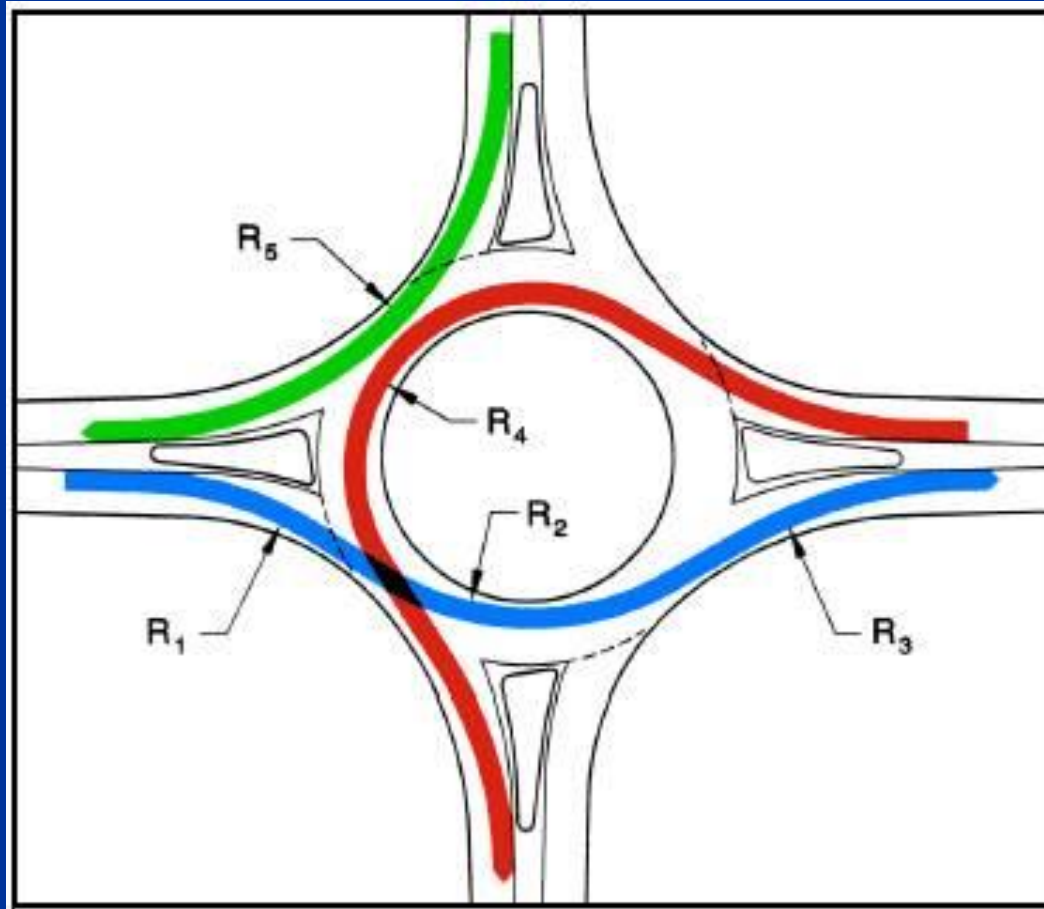


Speed Profile Through a Roundabout

Achieving appropriate vehicular speeds through the roundabout is critical



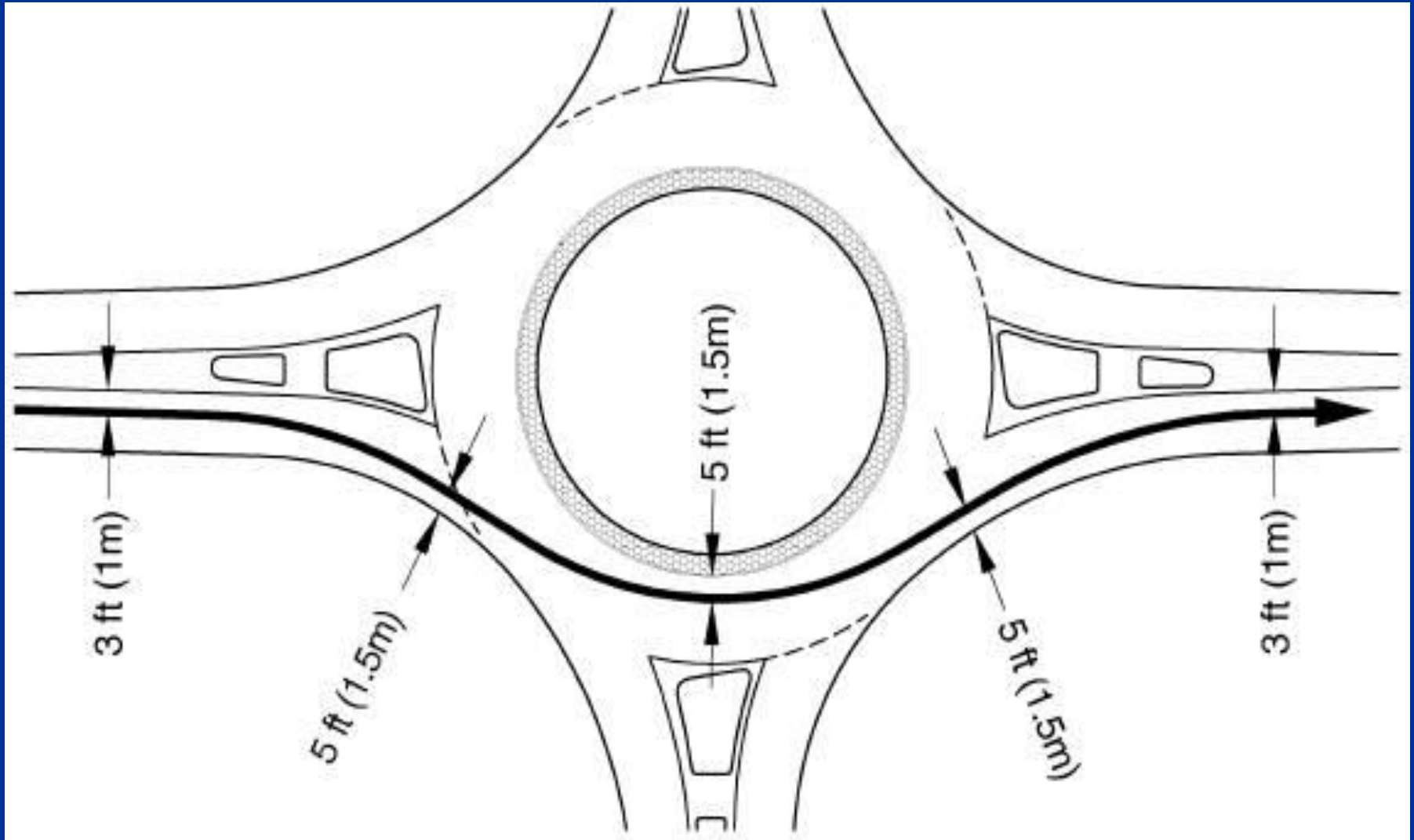
Vehicle Path Radii



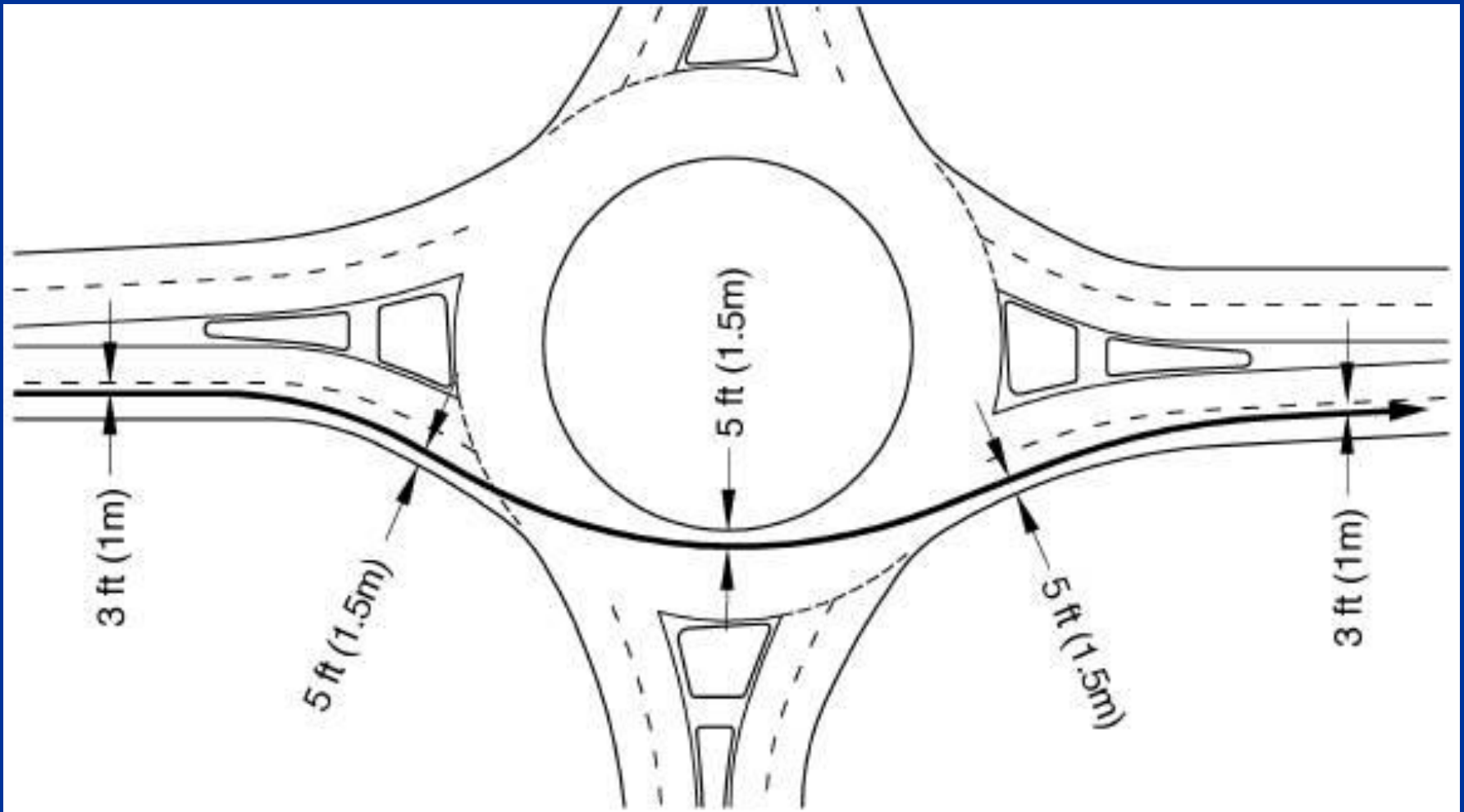
Five critical
path radii

Note: Vehicular path radii $\neq$ Curb radii

Fastest Path at a Single Lane Roundabout



Fastest Path at a Double Lane Roundabout

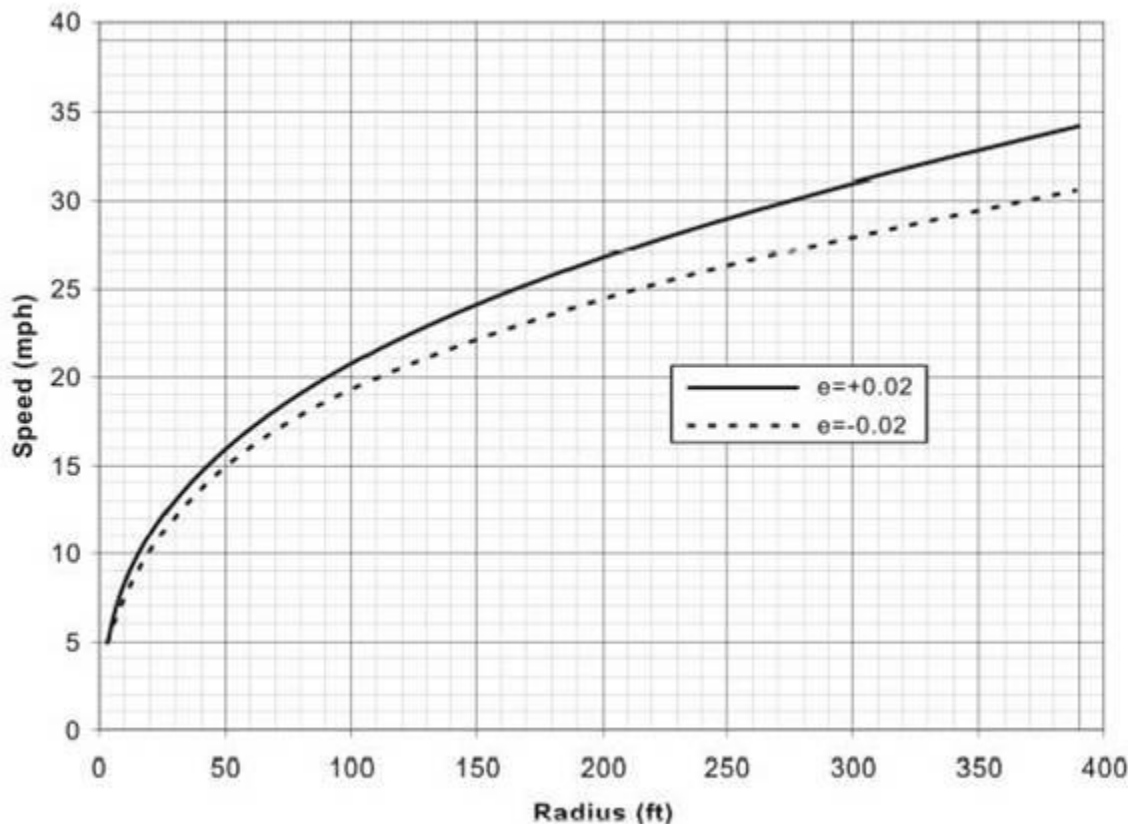


Speed - Radius Relationship

Speed-Radius Relationship:

$$V = \sqrt{15R(e + f)}$$

where: V = Design speed, mph
R = Radius, ft
e = superelevation, ft/ft
f = side friction factor



Superelevation

Assumptions

+ 0.02 for entry
and exit curves
(R1, R3, R5)

- 0.02 for curves
around central
island (R2, R4)

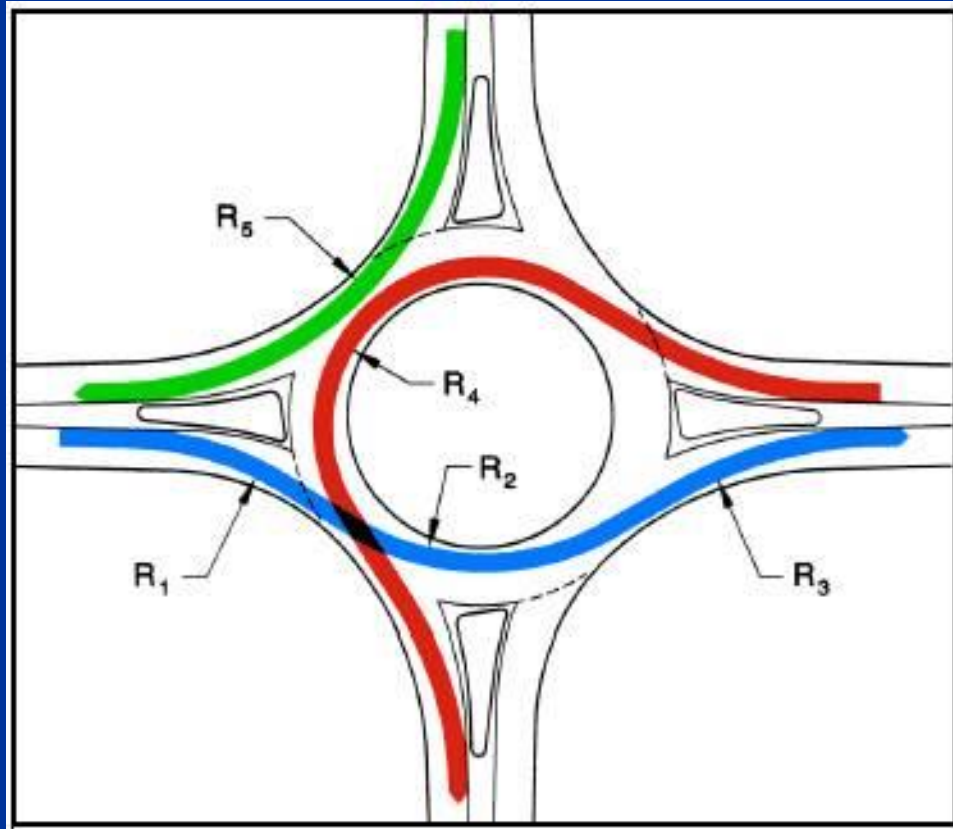
Recommended Maximum Entry (R1) Design Speeds

Roundabout Design Speeds

Site Category	Maximum Entry (R_1) Design Speed
Mini Roundabout	20 mph (32 km/h)
Urban Compact Roundabout	20 mph (32 km/h)
Urban Single-Lane Roundabout	25 mph (40 km/h)
Rural Single-Lane Roundabout	25 mph (40 km/h)
Urban Double-Lane Roundabout	25 mph (40 km/h)
Rural Double-Lane Roundabout	30 mph (48 km/h)

Source: Kansas Roundabout Guide

Speed Consistency



Consistency in speeds of all movements is desired (preferably less than 6 mph relative difference)

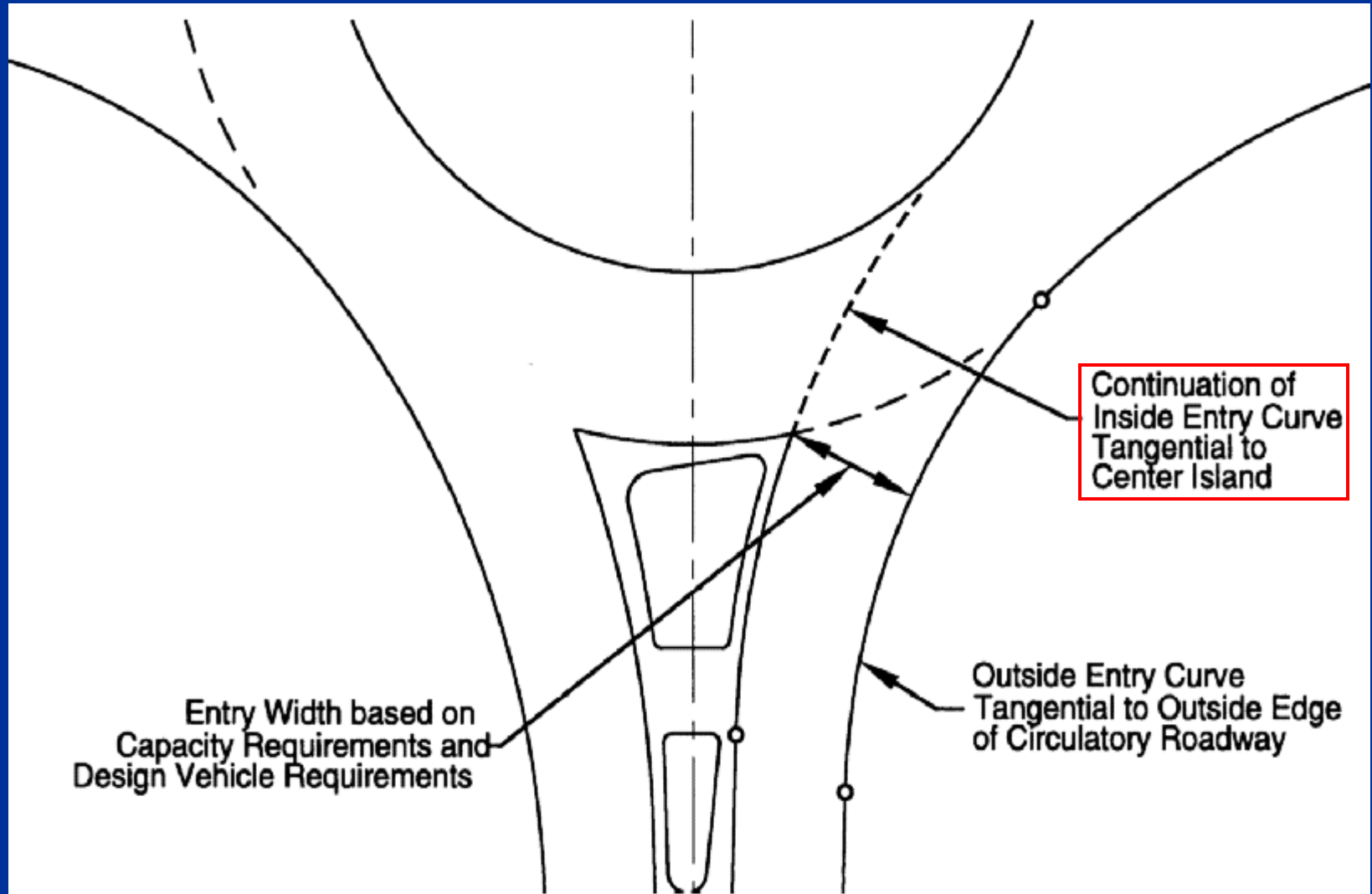
Desirable for $R_1 < R_2 < R_3$ (speeds lowest at entrance)

Example of Good Speed Consistency

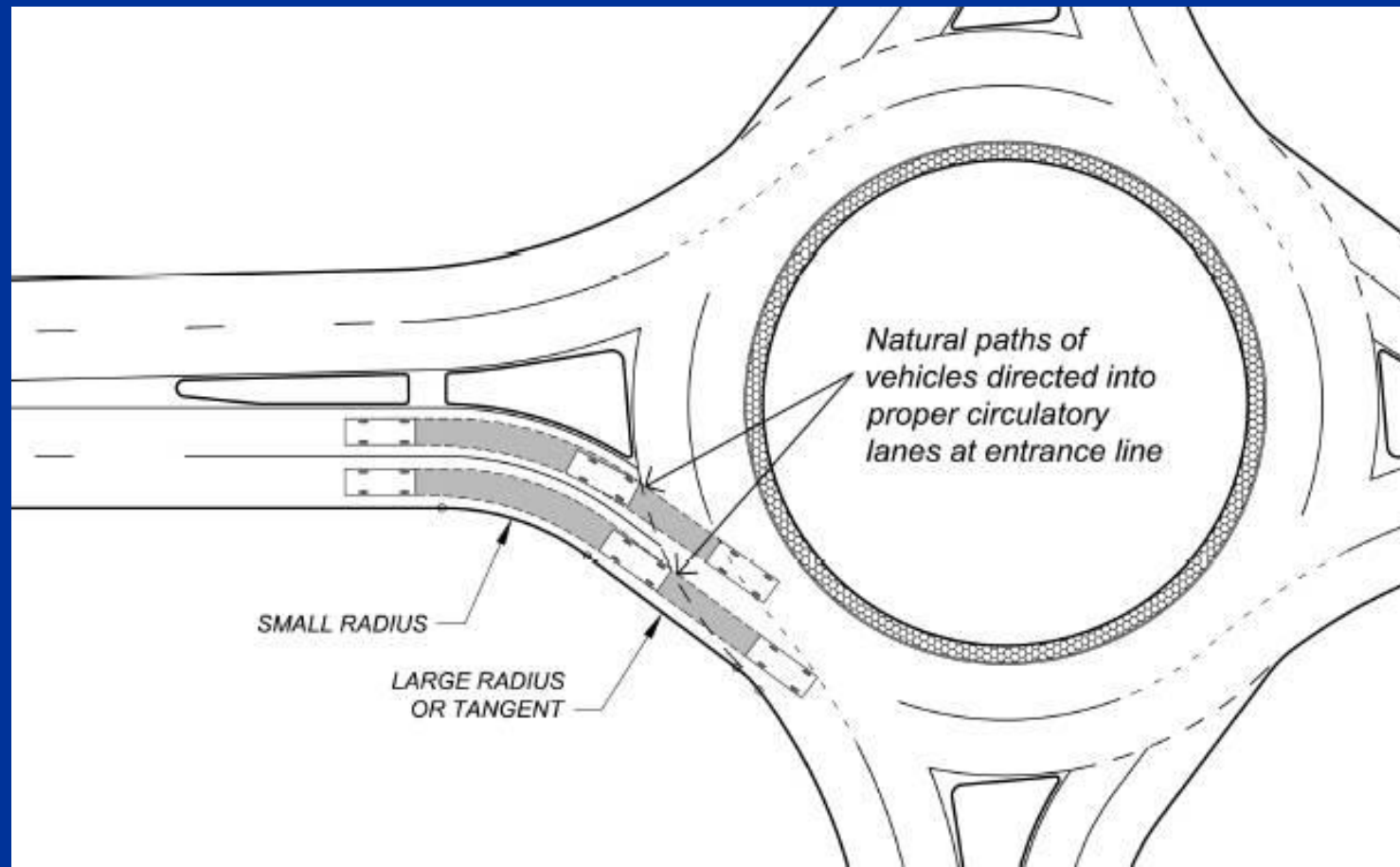
Entry Path Curvature (Deflection)

- Good Entry Path Curvature:
 - Provides speed reduction
 - Promotes speed consistency
 - Reduces entry/circulating crashes
 - Improves safety for pedestrians
- Entry path curvature must be applied prior to the YIELD line

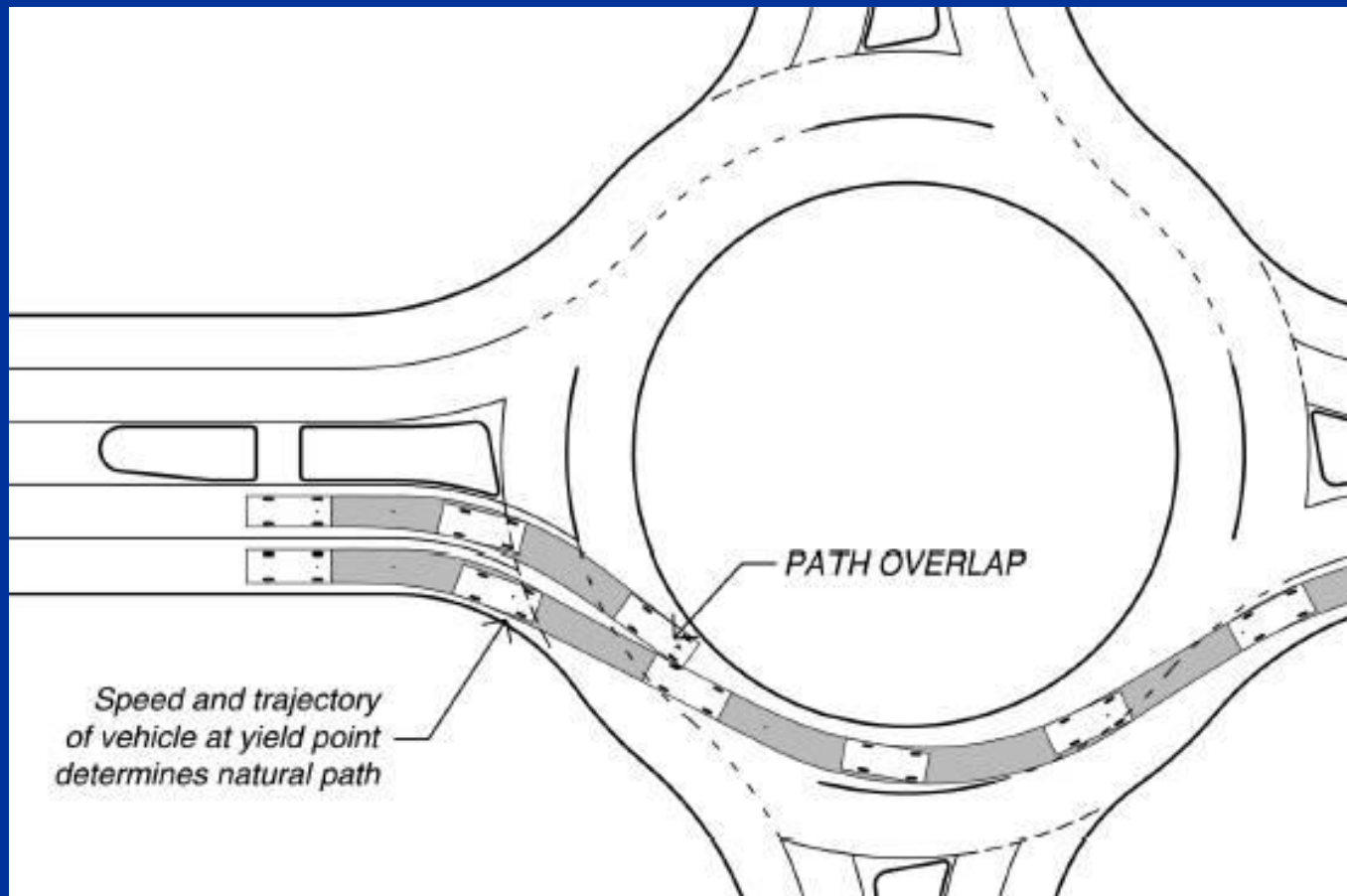
Entry Path Curvature



Critical Design Issue for Multilane Roundabouts – Minimize Entry Path Overlap



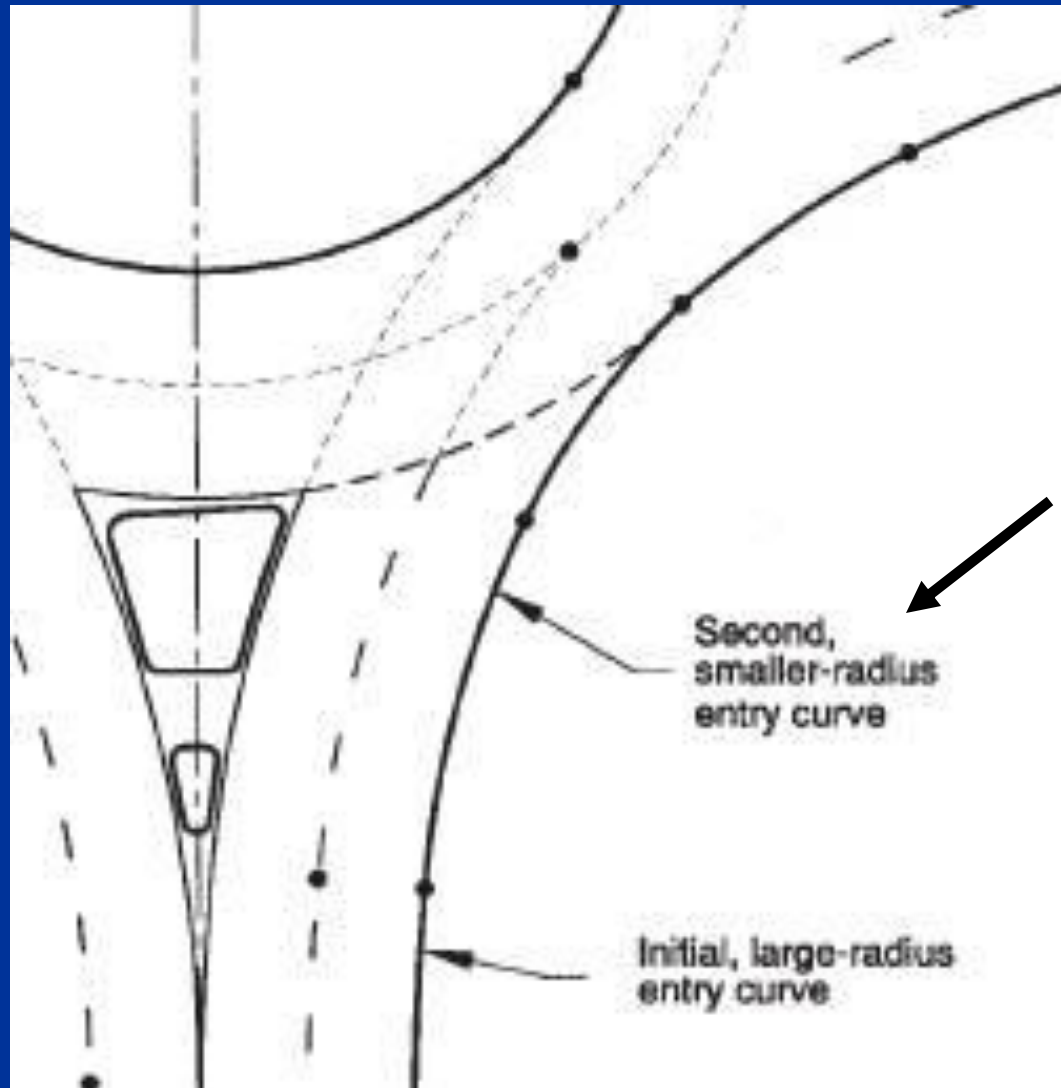
Common Design Error for Multilane Roundabouts – Entry Path Overlap



Poor entry deflection can lead to vehicle path overlap on multi-lane roundabouts

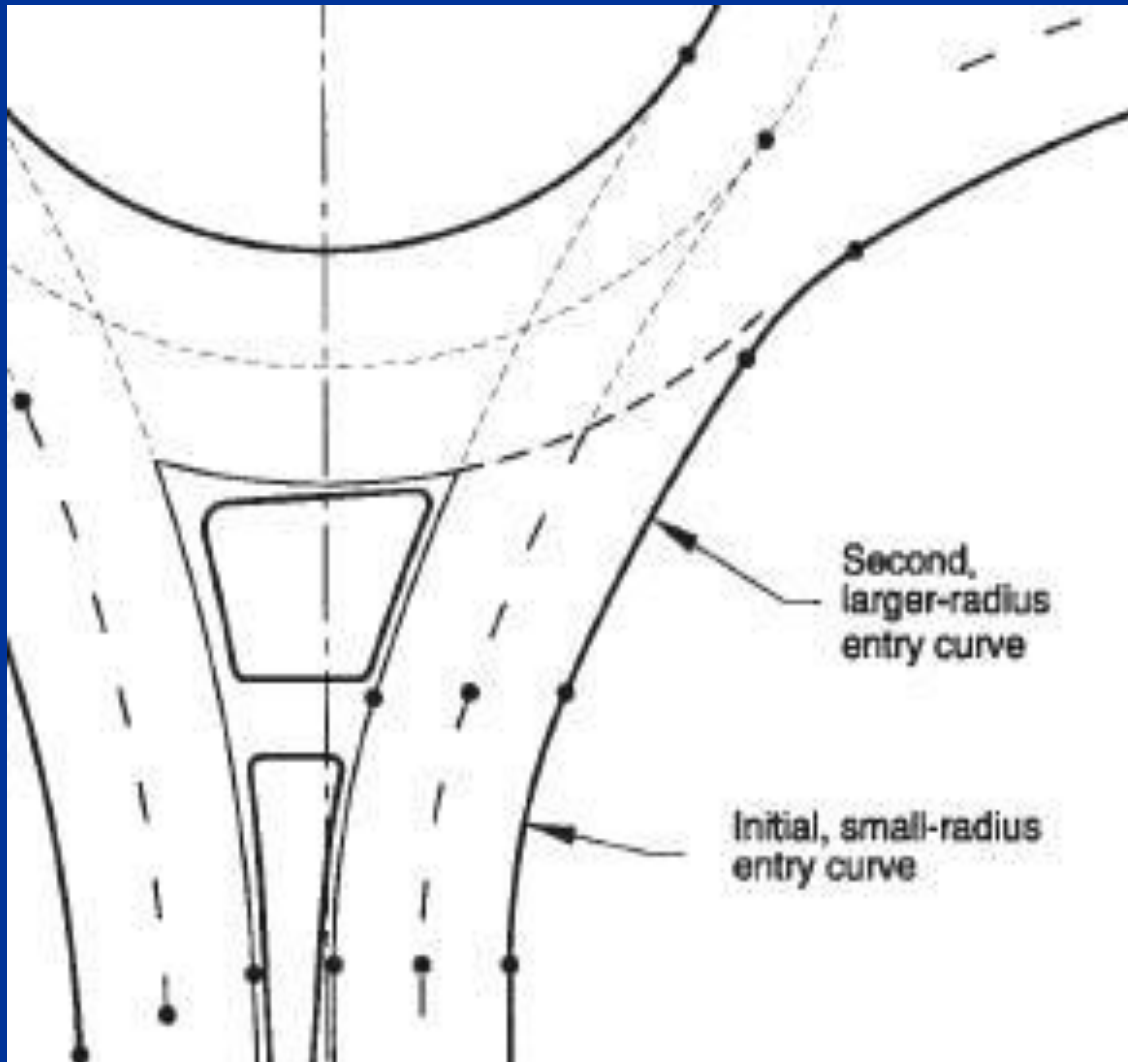
Note that vehicle entry paths are not properly “aligned” at the Yield Bar

Entry Curves of Two-Lane Rdbts



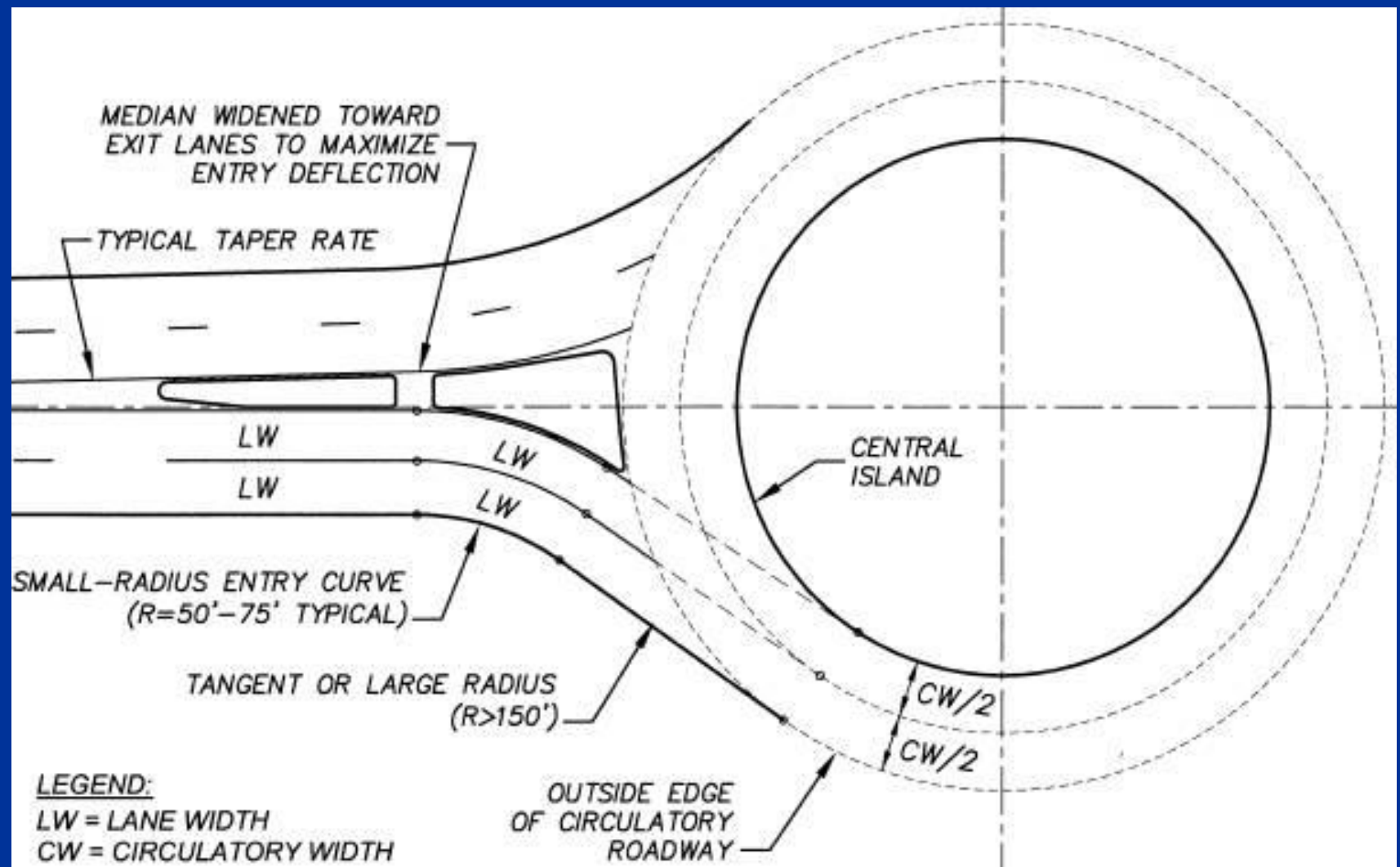
Typical
100-200' urban
130-260' rural

Entry Curves of Two-Lane Rdbts



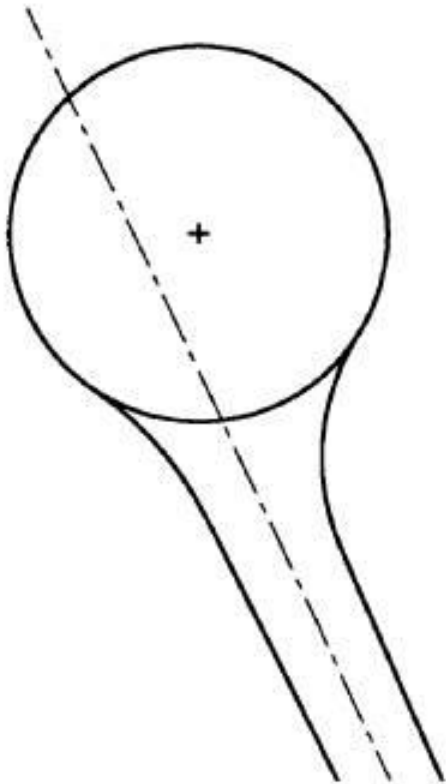
Typical
50-100'

Multilane Entry Design Details



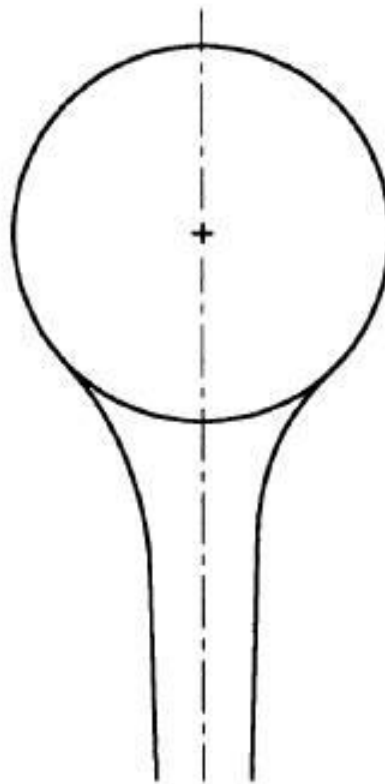
Alignment at Entries

Alignment Offset Left



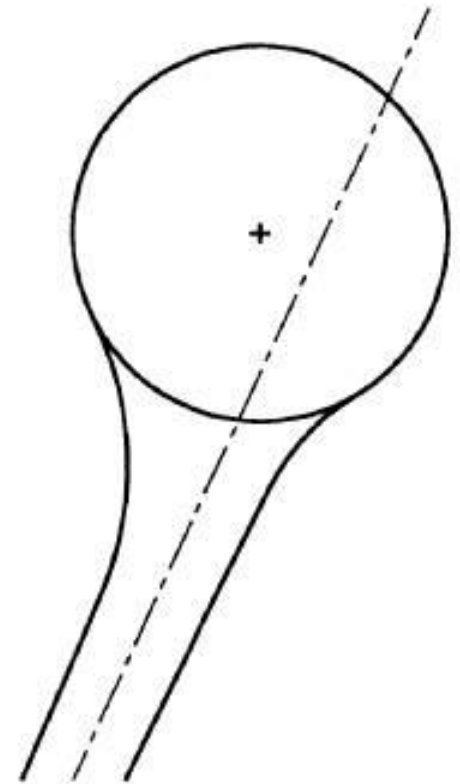
ACCEPTABLE

Radial Alignment



PREFERRED

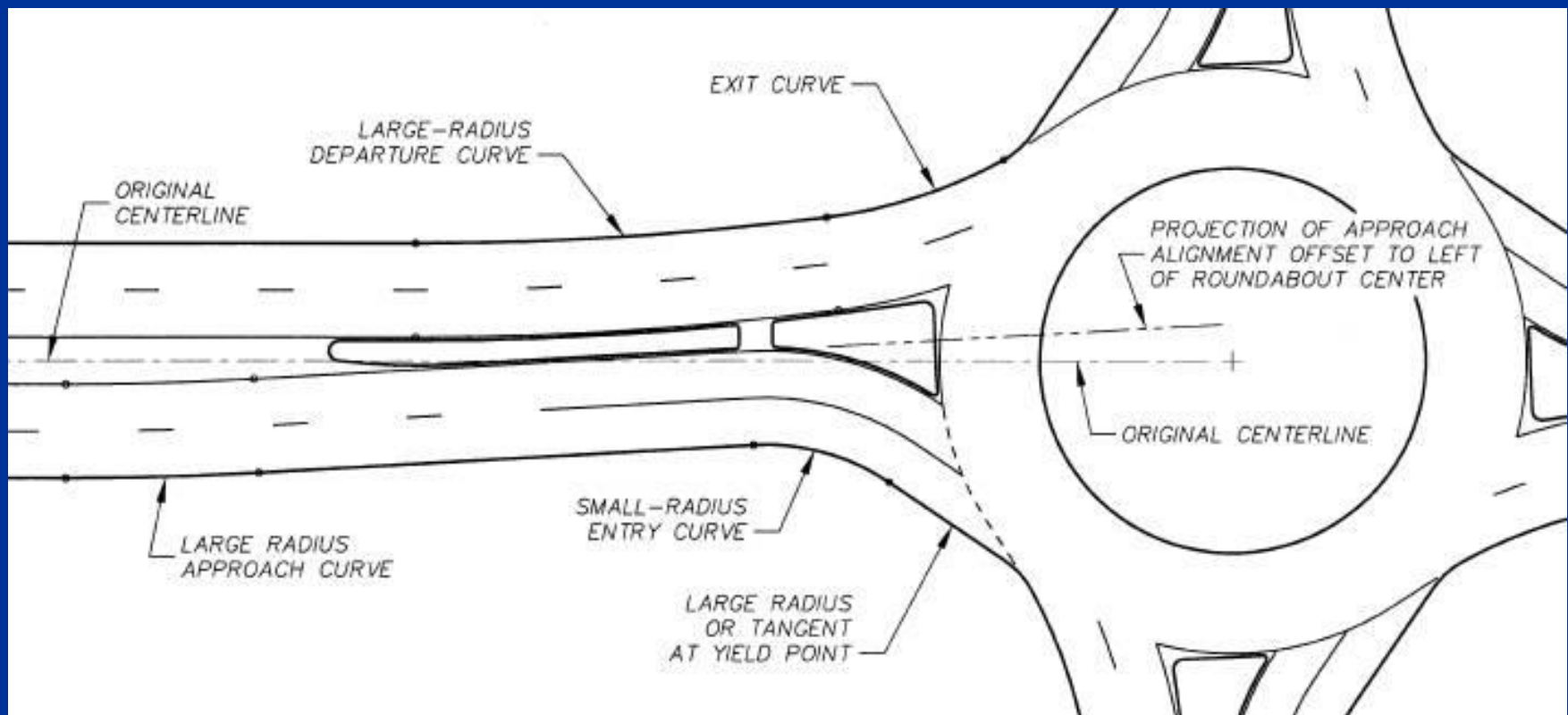
Alignment Offset Right



UNACCEPTABLE

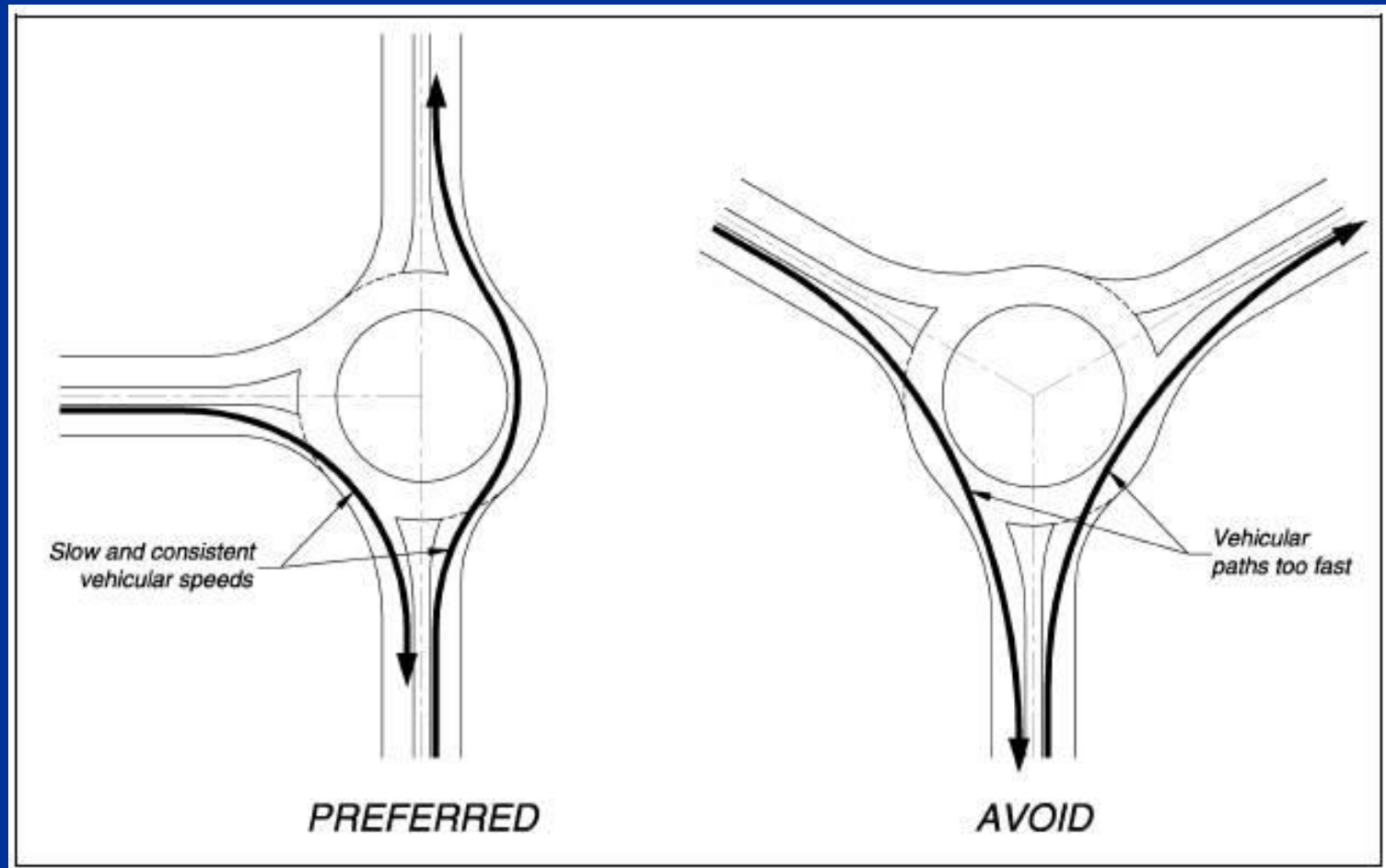


Approach Offset to Increase Entry Deflection



Approach Angles

Perpendicular Preferred Over Obtuse



Source: Kansas Roundabout Guide

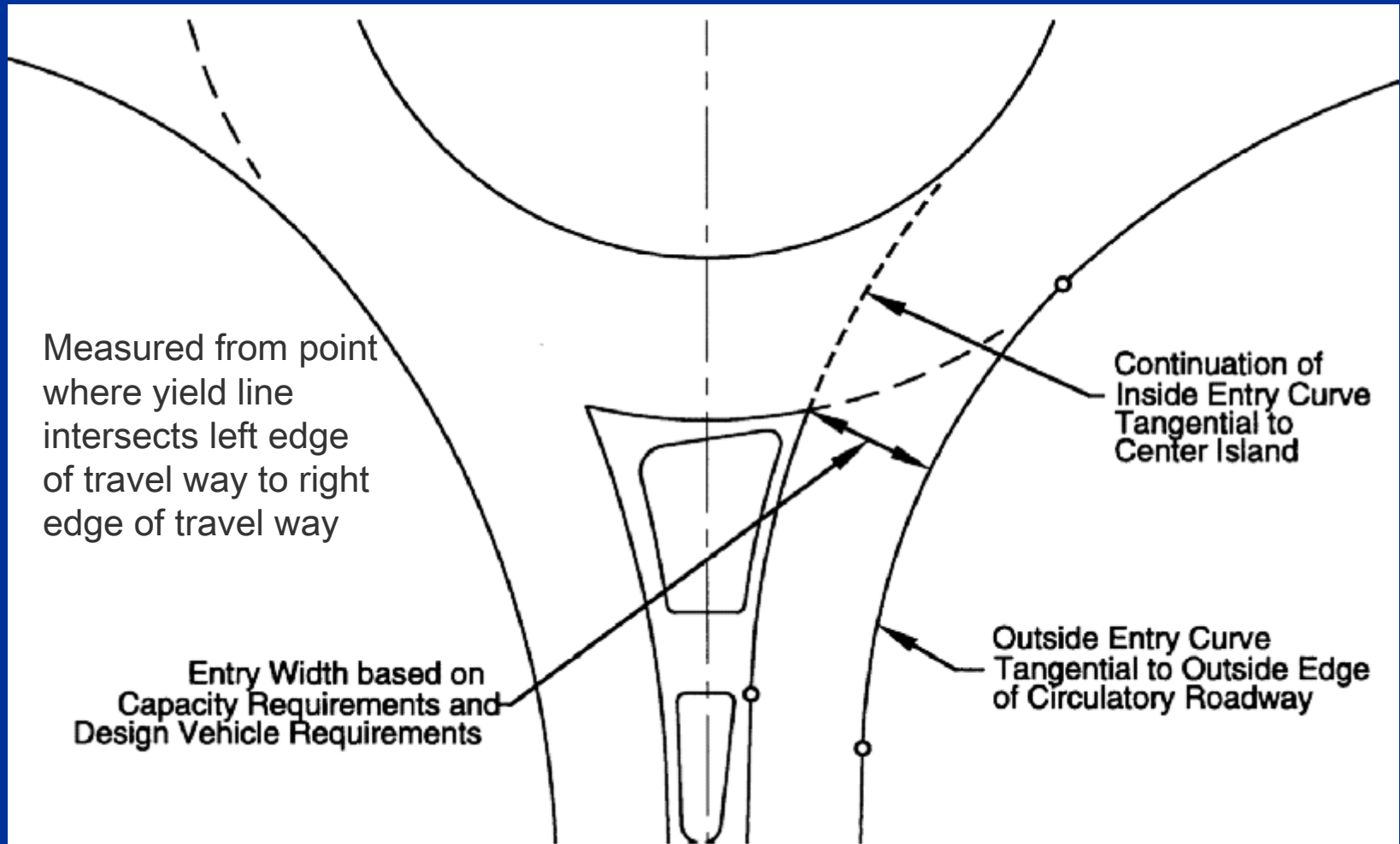
Three-Leg Roundabout



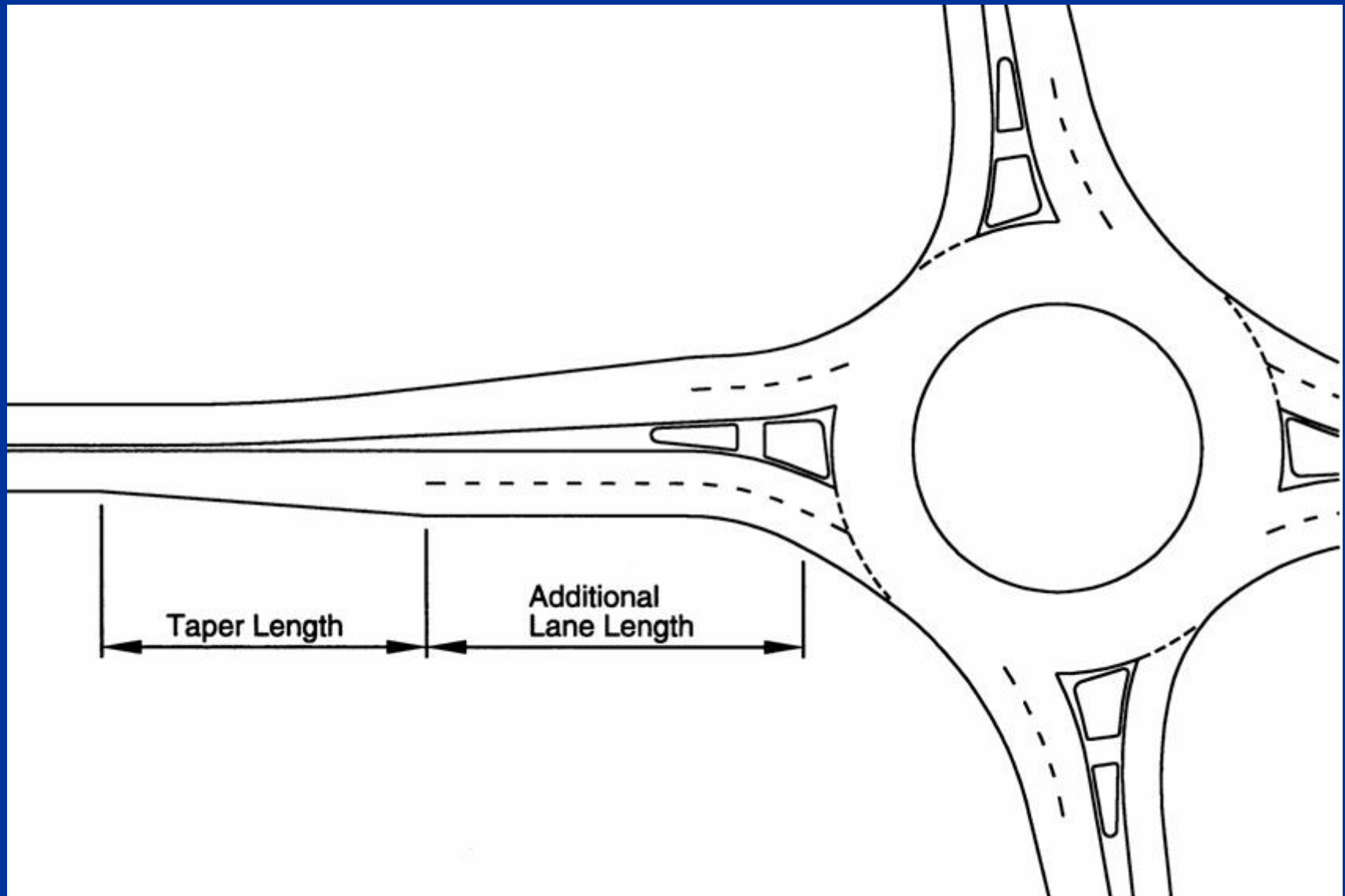
Okemos, MI

Entry Width

Typical 14-16 ft for single-lane entrance



Additional Flared Entry Lane



Flared Two Lane Entry

Flared two lane entry



The diagram illustrates a 'Flared Two Lane Entry' configuration. It features a black rectangular box at the top left containing the text 'Flared two lane entry'. From the bottom right corner of this box, two black arrows originate. One arrow points diagonally down and to the right, ending near the 'Single lane entries' box. The other arrow points diagonally down and to the left, ending near the 'Varying circulatory width' box. The 'Single lane entries' box is located on the right side of the slide, and the 'Varying circulatory width' box is located at the bottom center. The entire diagram is set against a solid blue background.

Single lane entries

Varying circulatory width

Mount Horeb, WI

Typical Inscribed Circular Diameter Range

Site Category	Typical Design Vehicle	Inscribed Circle Diameter Range*
Mini-Roundabout	Single-Unit Truck	13–25m (45–80 ft)
Urban Compact	Single-Unit Truck/Bus	25–30m (80–100 ft)
Urban Single Lane	WB-15 (WB-50)	30–40m (100–130 ft)
Urban Double Lane	WB-15 (WB-50)	45–55m (150–180 ft)
Rural Single Lane	WB-20 (WB-67)	35–40m (115–130 ft)
Rural Double Lane	WB-20 (WB-67)	55–60m (180–200 ft)

* Assumes 90-degree angles between entries and no more than four legs.

Circulatory Roadway Width

- At least as wide as the maximum entry width (up to 120% of maximum entry width)

Minimum Circulatory Lane Widths for Two-Lane Roundabouts

Inscribed Circle Diameter	Minimum Circulatory Lane Width*	Central Island Diameter
150 ft (45 m)	32 ft (9.8 m)	86 ft (25.4 m)
165 ft (50 m)	31 ft (9.3 m)	103 ft (31.4 m)
180 ft (55 m)	30 ft (9.1 m)	120 ft (36.8 m)
200 ft (60 m)	30 ft (9.1 m)	140 ft (41.8 m)
215 ft (65 m)	29 ft (8.7 m)	157 ft (47.6 m)
230 ft (70 m)	29 ft (8.7 m)	172 ft (52.6 m)

* Based on 2001 AASHTO Exhibit 3-55, Case III(A). Assumes infrequent semi-trailer use.

Typical Cross Section



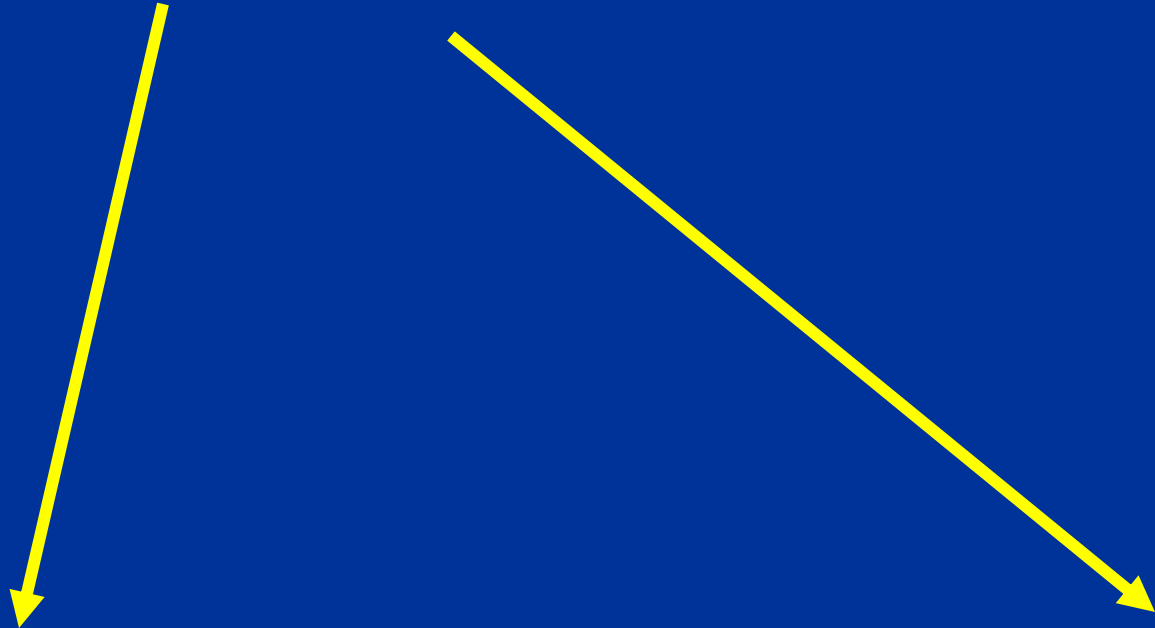
-4%

Source: CALTRANS
Design Bulletin 80-01

Design Vehicle

Swept Paths of WB-50 Vehicles

Truck Apron



Traversable Surface

Improper Truck Apron Designs



**Flush
Apron**



**Painted
Apron**

Oversized Truck Movements

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Diagnostic clue for an undersized
truck apron

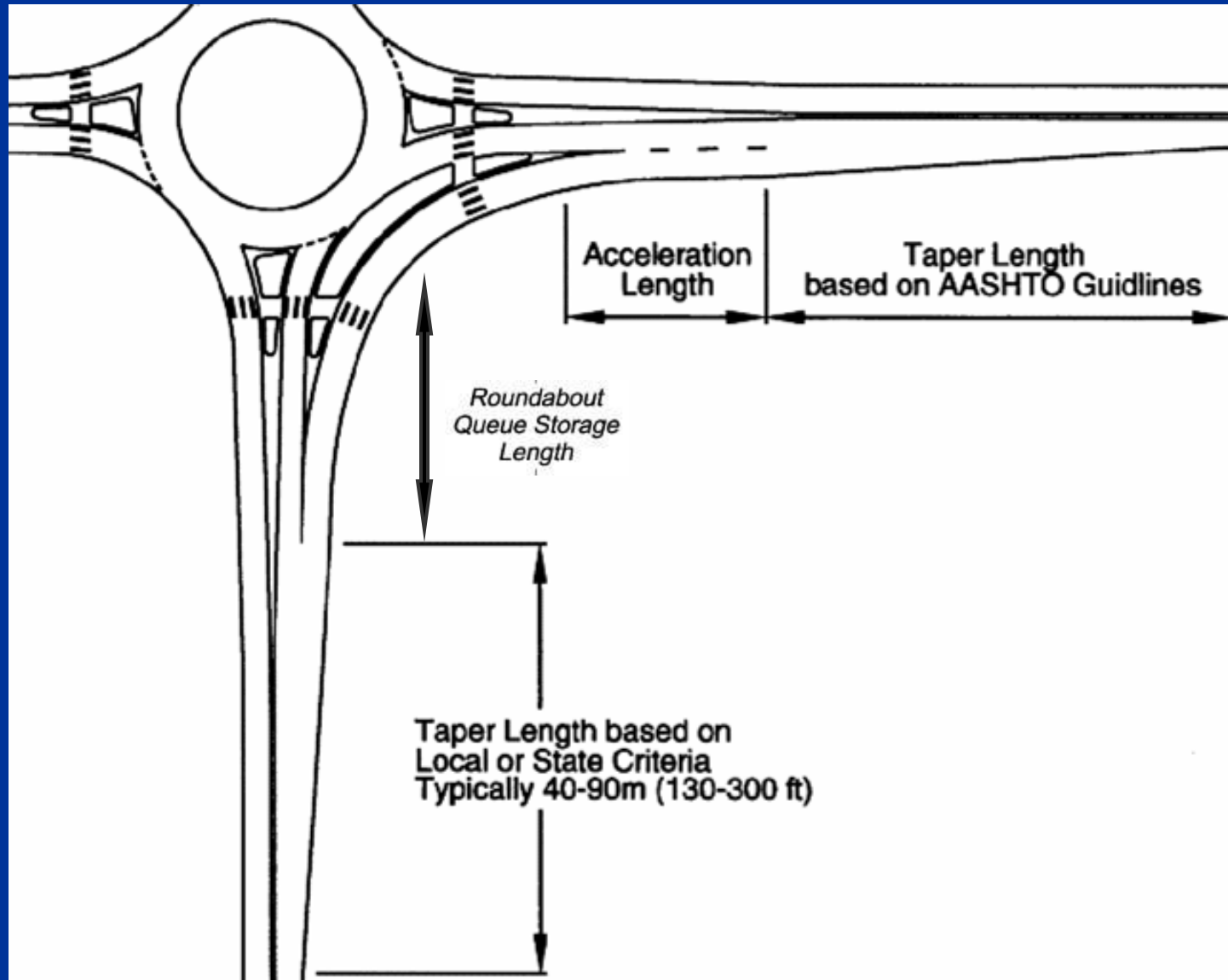
What's wrong with this truck apron?



Right Turn Bypass Lane



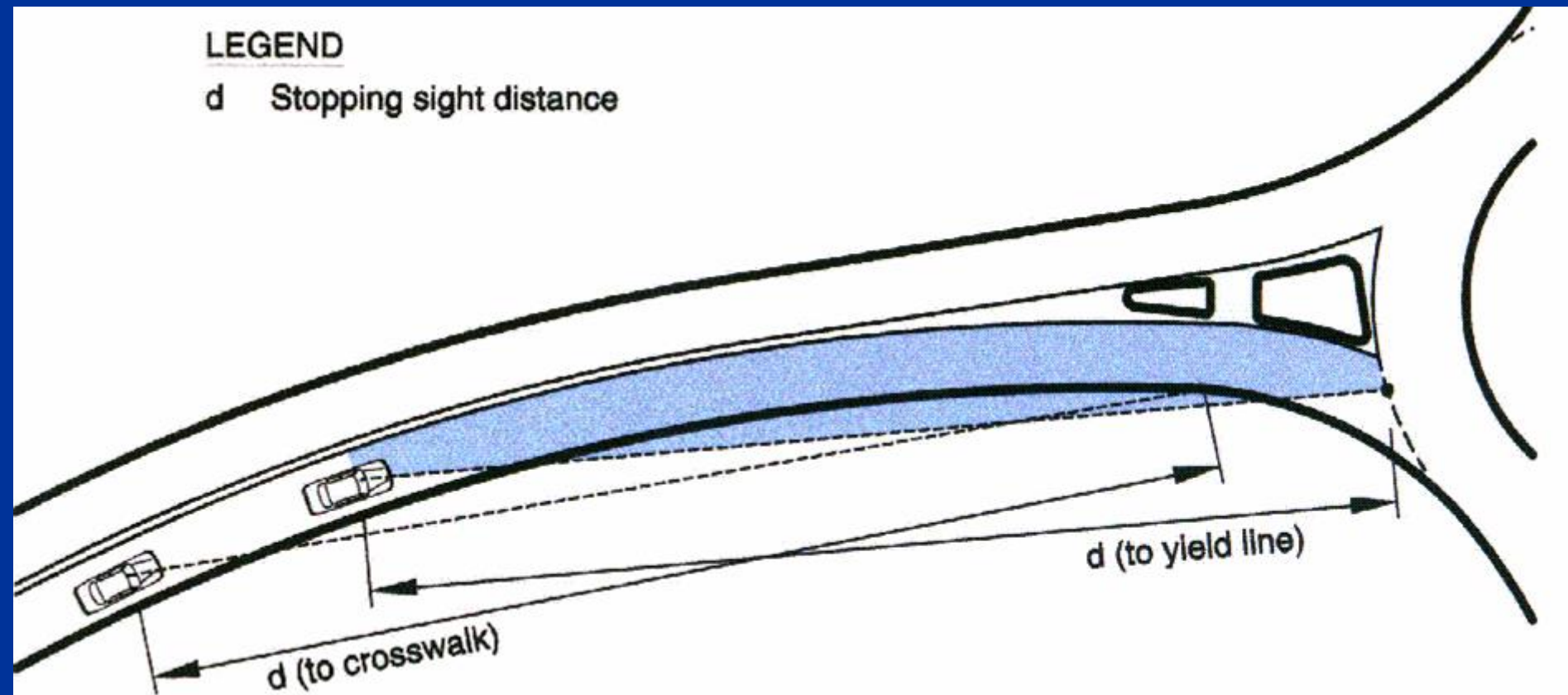
Right-Turn Bypass Lane



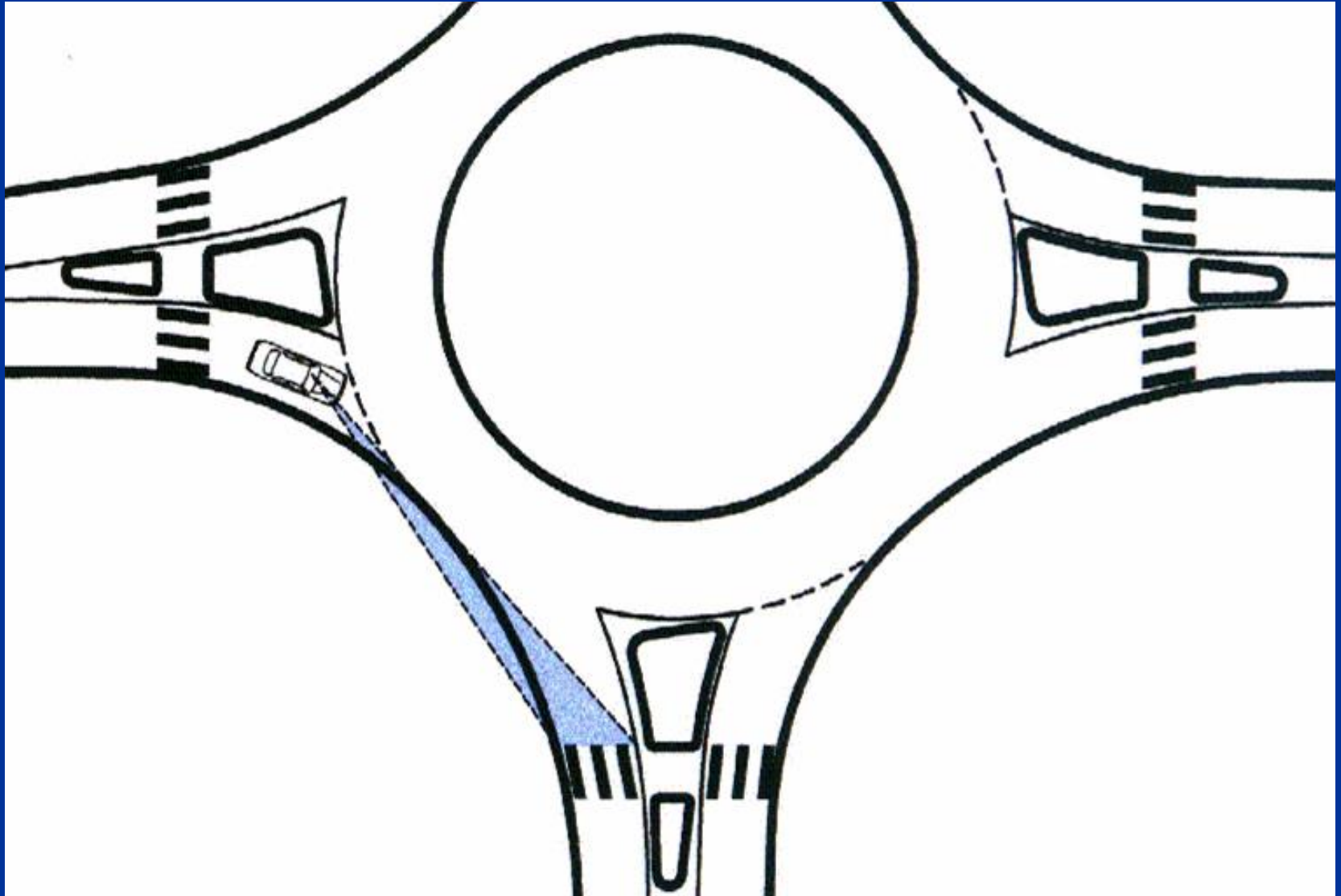
Required Stopping Sight Distance at Entries

LEGEND

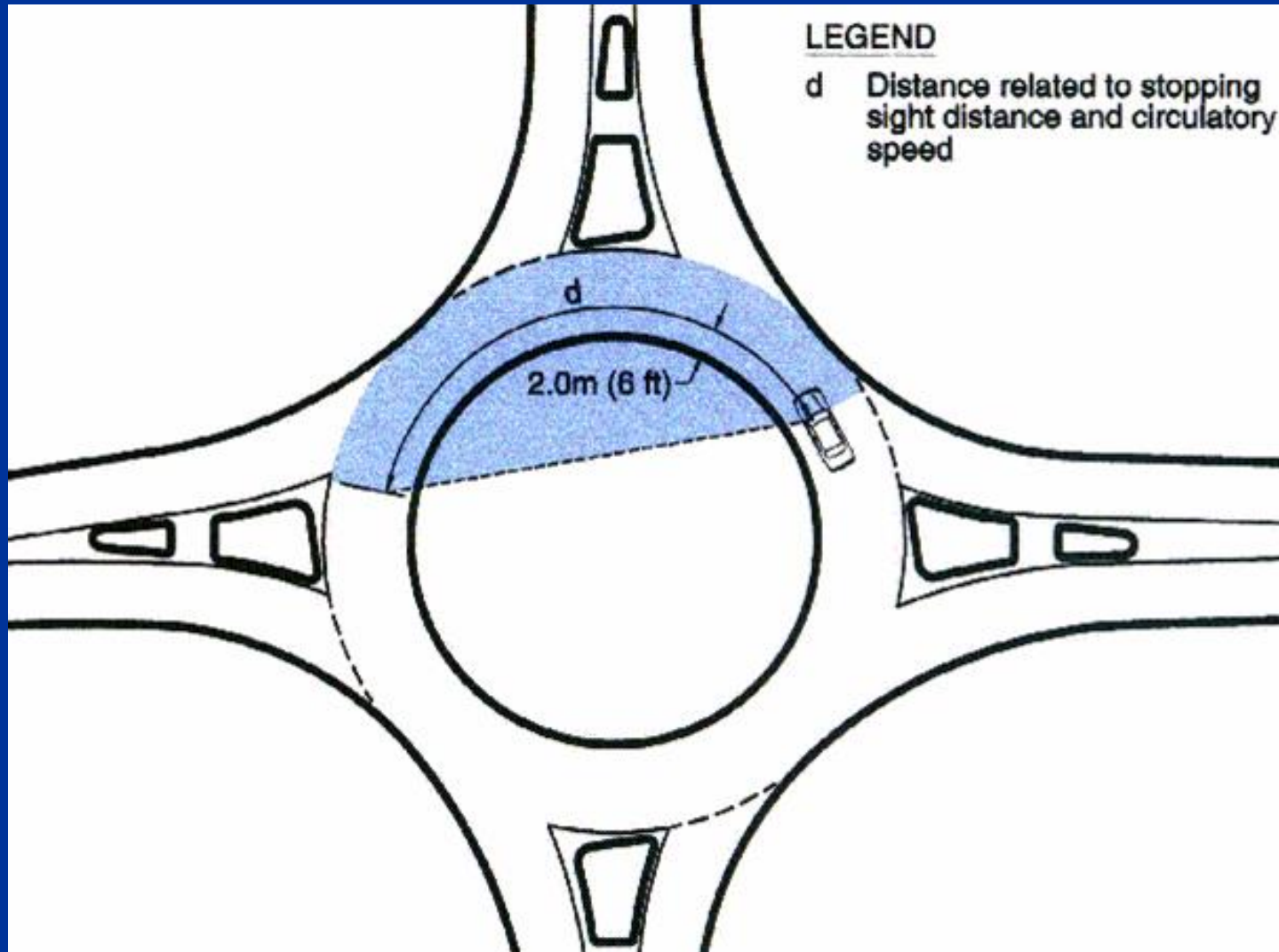
d Stopping sight distance



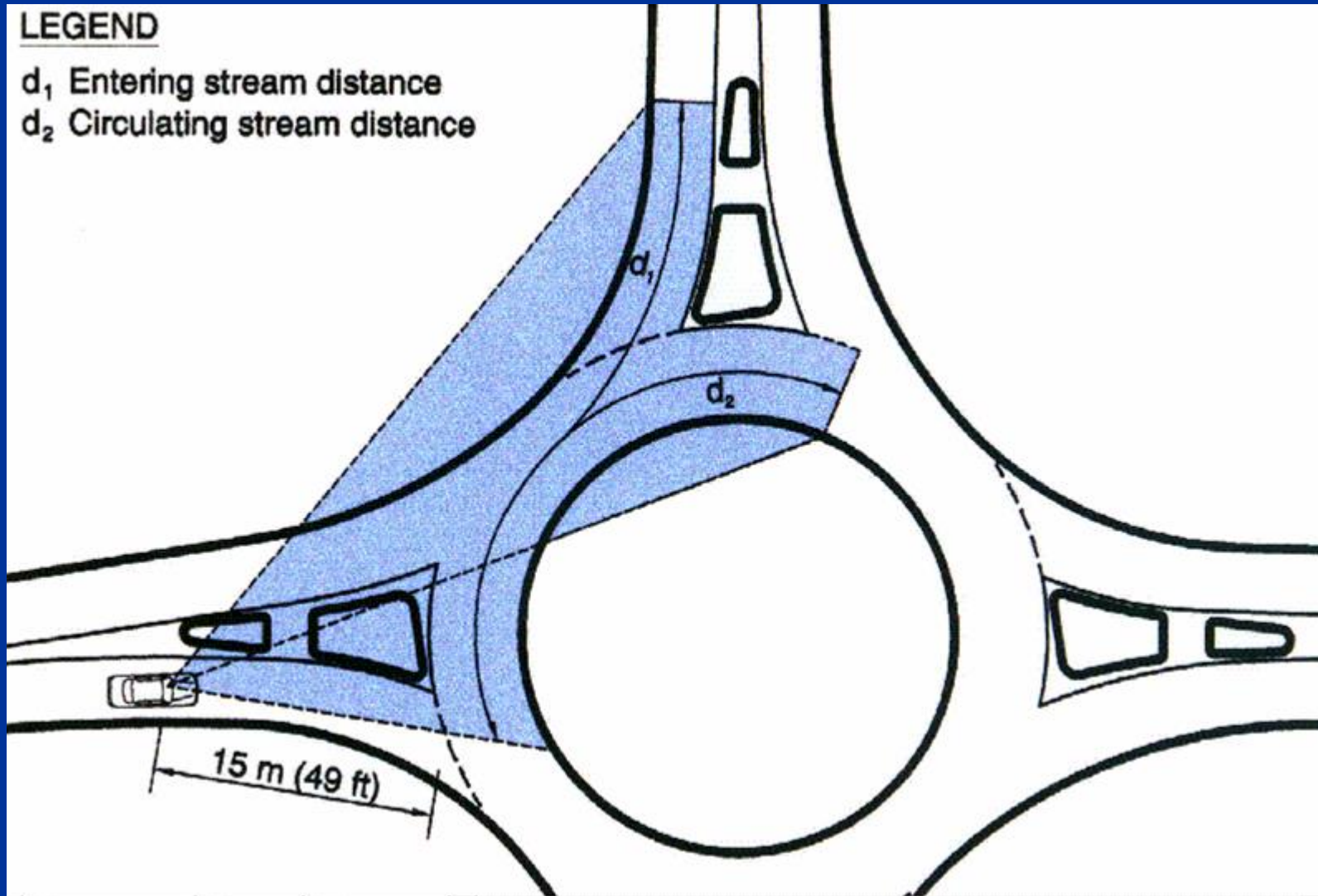
Stopping Sight Distance to Pedestrian Crosswalk



Stopping Sight Distance in the Circulatory Rdwy



Required Intersection Sight Distance



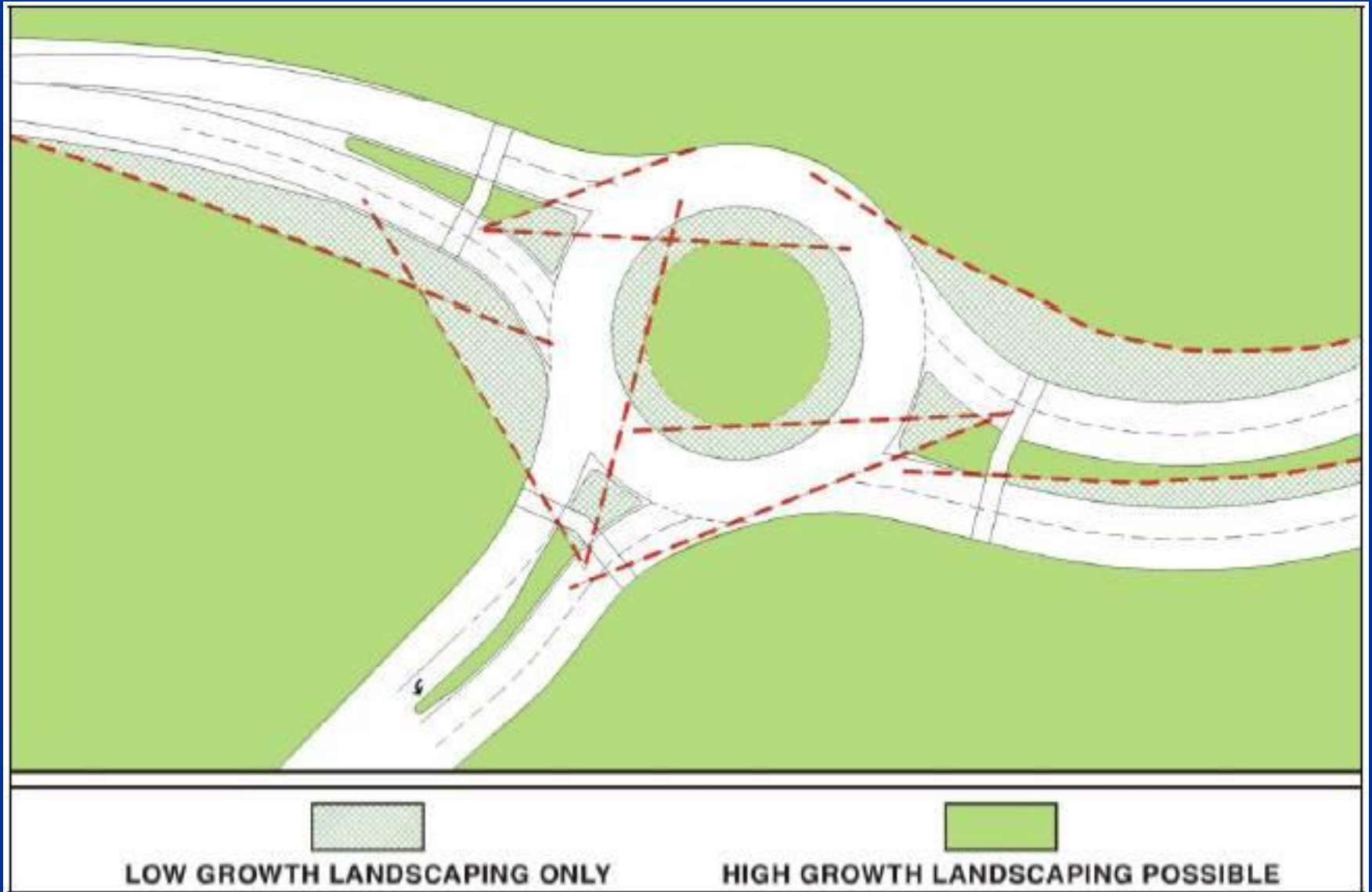
SSD

Speed (mph)	Computed Distance* (ft)
10	46.4
15	77.0
20	112.4
25	152.7
30	197.8
35	247.8
40	302.7
45	362.

ISD

Conflicting Approach Speed (mph)	Computed Distance (ft)
10	95.4
15	143.0
20	190.1
25	238.6
30	286.3

Example Sight Distance Diagram



Sight Distance Case Study: Clearwater, FL

Before



After



Clearwater, FL Roundabout

Before



Sideswipe crashes
improper left turns

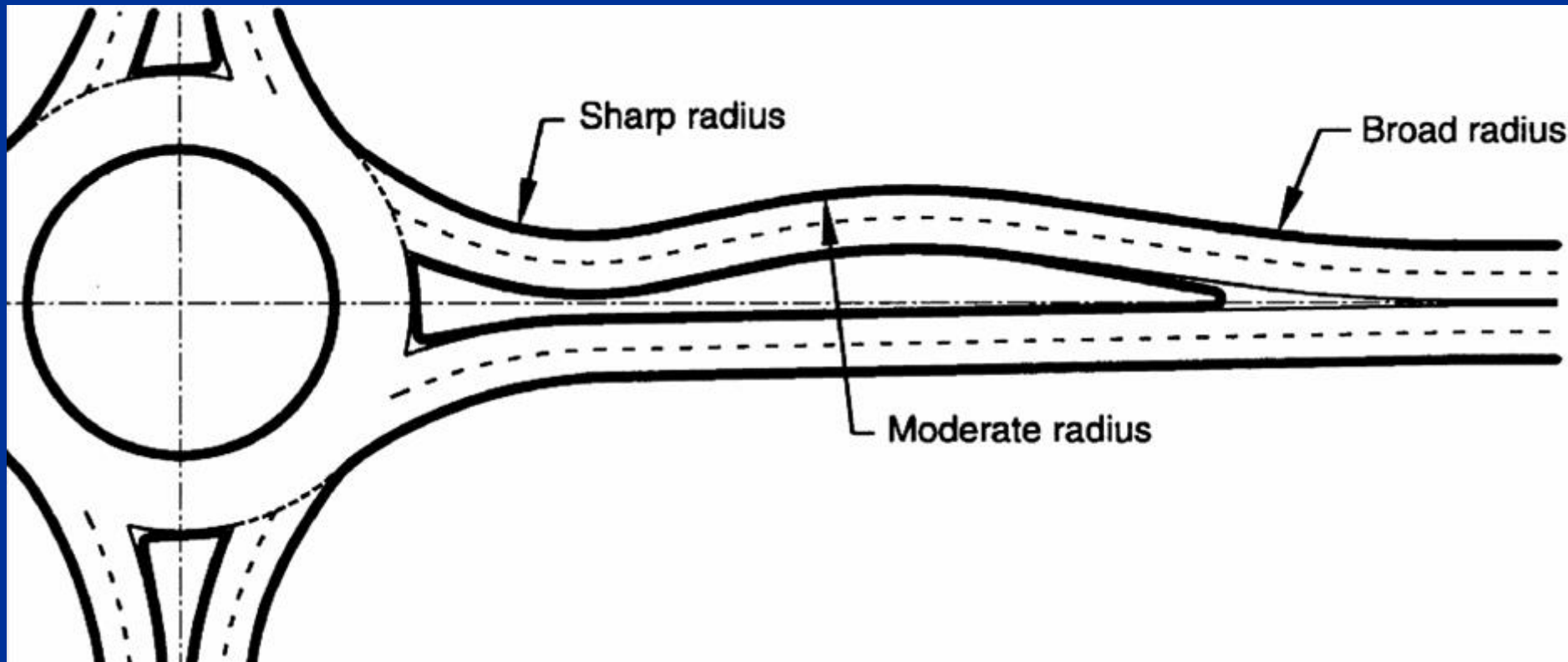
After



Eliminate ability for
improper lefts

Use of Successive Curves on High Speed Approaches

Page 179



Approach Curves

Curvature in Advance of Rural High Speed Approach

Topography Considerations

Brighton, CO

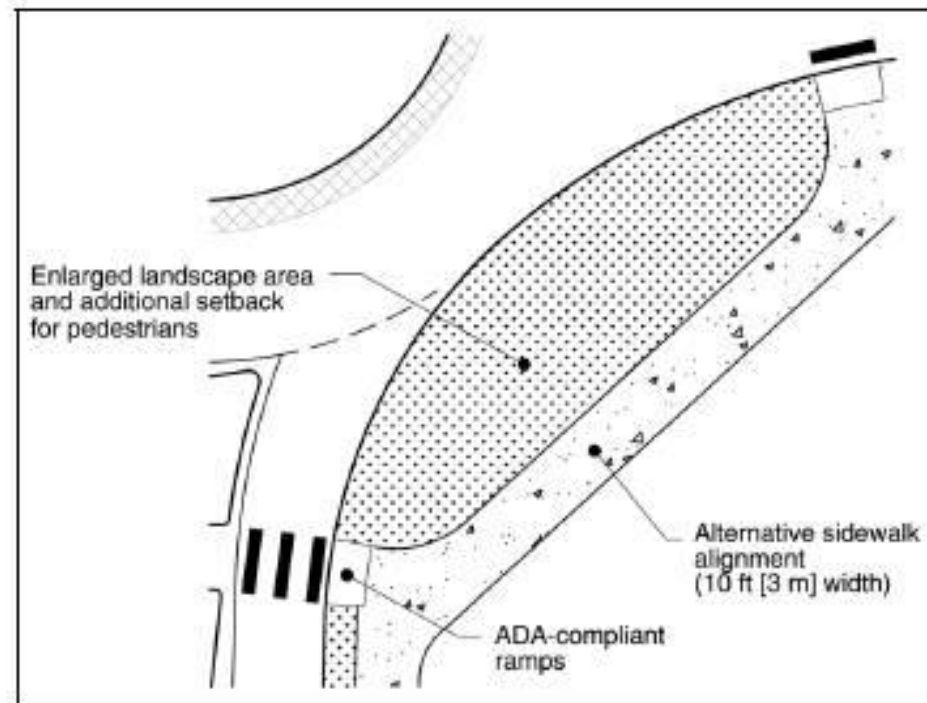
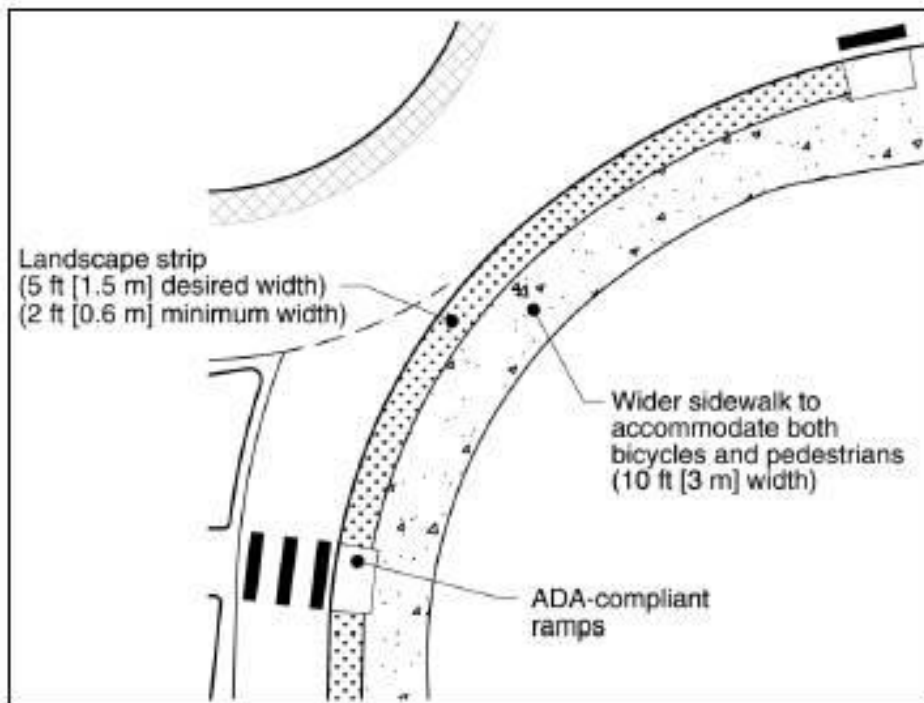
Relatively flat plateau desired
(some grade for drainage)

Max suggested grade 4%

Pedestrians Treatments

- Pedestrian crossing locations need to consider the balance among pedestrian convenience, safety, and roundabout operations
- Current suggested practice for pedestrian crossing location:
 - Single-lane roundabouts: one vehicle length (25 ft) from the yield line
 - Multi-lane: at least one vehicle length or greater in 25 ft increments
- Minimum width of pedestrian refuge: 6 feet
- Provide ramps (with detectable warning surface) at curbs and keep the refuge at street level
- Possible other experimental treatments (speed table, pedestrian signal, active crosswalk flashing light system)

Sidewalk Treatments



Bicyclists Treatment

- Bicyclists have a choice to proceed either as a vehicle or a pedestrian
- Bicycle lane should be terminated about 100 feet ahead of the yield line
- Never design a bicycle lane in the circle
- For heavy bicycle volumes consider providing a separate bicycle path

Bicycle Operations



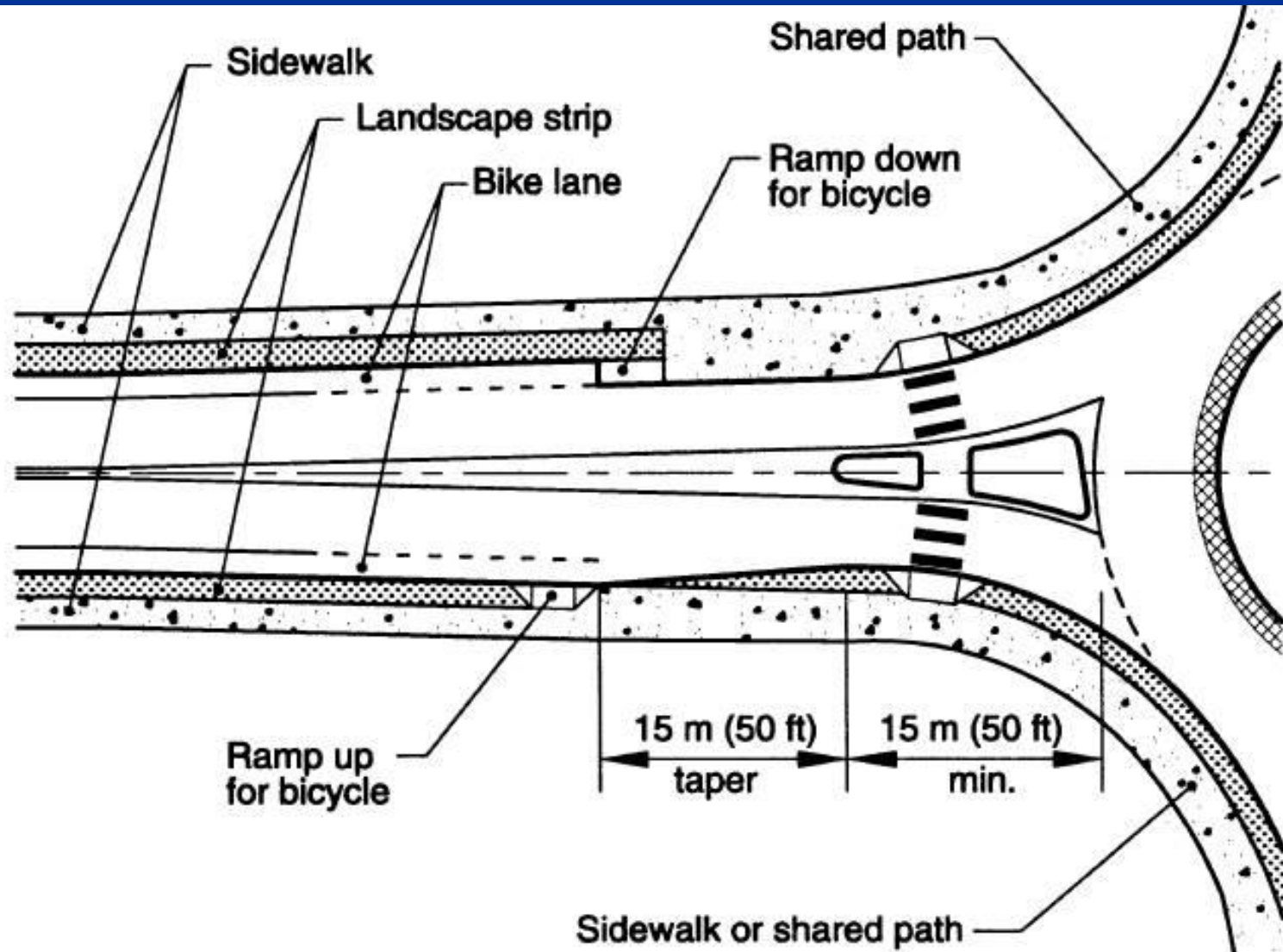
Bicycle Operations

Separate Bicycle Path

Separate Bicycle Path



Treatment for Bicycles



Treatment for Bicycles

Source: CALTRANS Design Bulletin 80-01

Questions ???