NCHRP Report 672
Roundabouts: An Informational Guide, 2nd Edition

An Overview of Key Changes

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Caltrans Webinar
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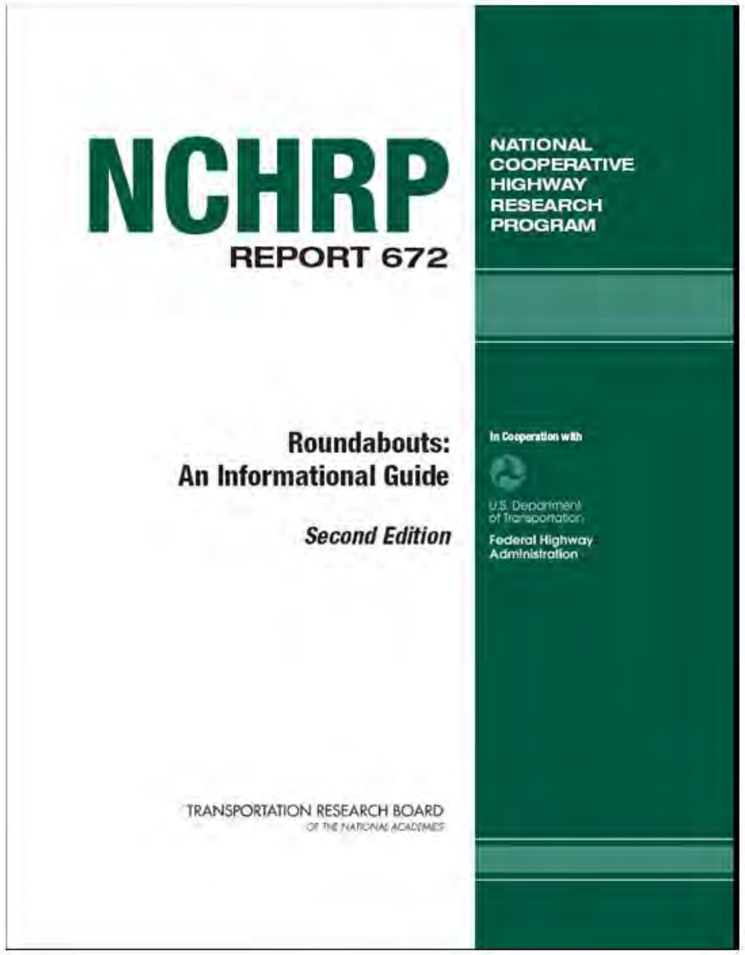
Roundabouts: An Informational Guide, 2nd ed.

- Overview & Philosophy of NCHRP Report 672
- Chapter-by-Chapter Discussion

Overview

- Work conducted under NCHRP Project 3-65A
- Work published as NCHRP Report 672
- Co-branded by FHWA



Overview (cont.)

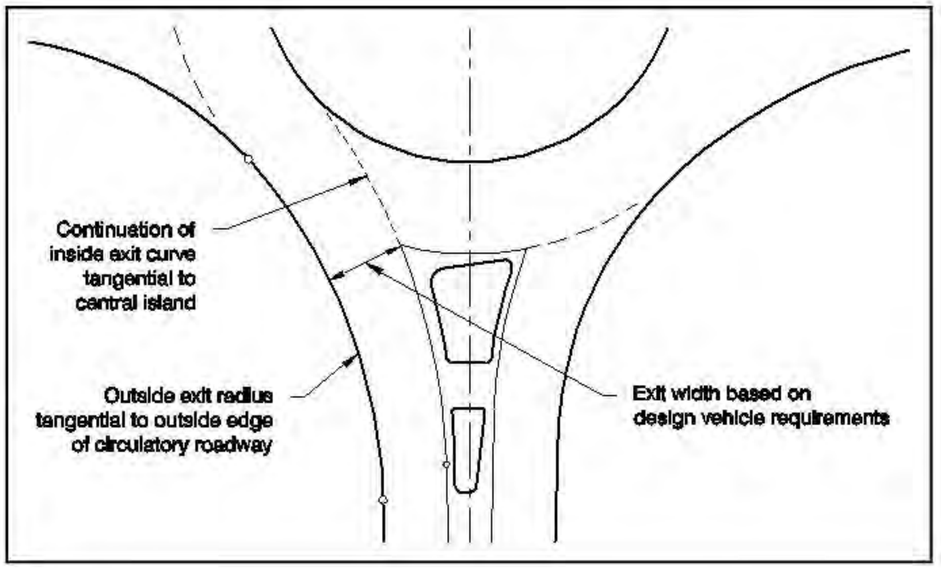
- Builds extensively on the first edition (2000)
- Based on established and emerging U.S. practices and recent research
  - *Less exclusive reliance on international practice*
  - *More US empirical experience and examples*
- Alignment with other documents
  - *Highway Capacity Manual 2010*
  - *Highway Safety Manual, 1st Edition*
  - *2009 Manual on Uniform Traffic Control Devices*
  - *IESNA Roundabout Lighting Design Guide*

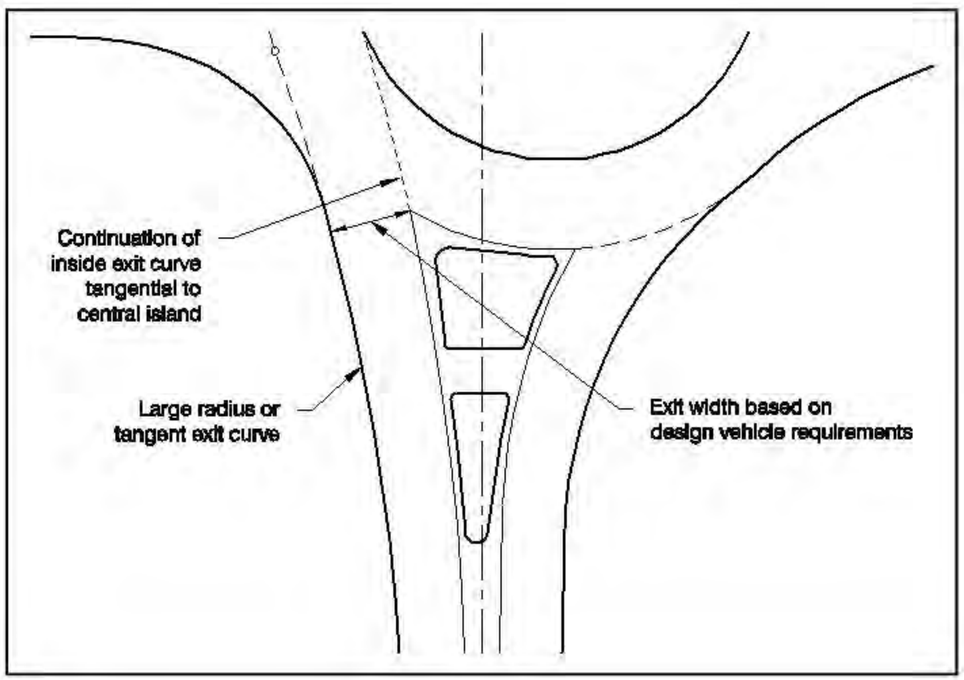
Philosophy

- Principle-based approach (performance-based design)
- Recognizes roundabouts, as with any intersection treatment, requires the balancing of competing objectives
- Flexibility is provided to encourage independent designs and techniques
  - *Tailored to particular situations*
  - *Emphasizes performance-based evaluation of designs*
  - *Allows development of new techniques*
- More than one way to achieve an acceptable design

Example of Principles: Alignment

- Offset left, radial, and offset right each have their place
- Each circumstance requires its own solution, with principles determining tradeoffs
- Words "preferred", "acceptable", and "avoid" have been removed





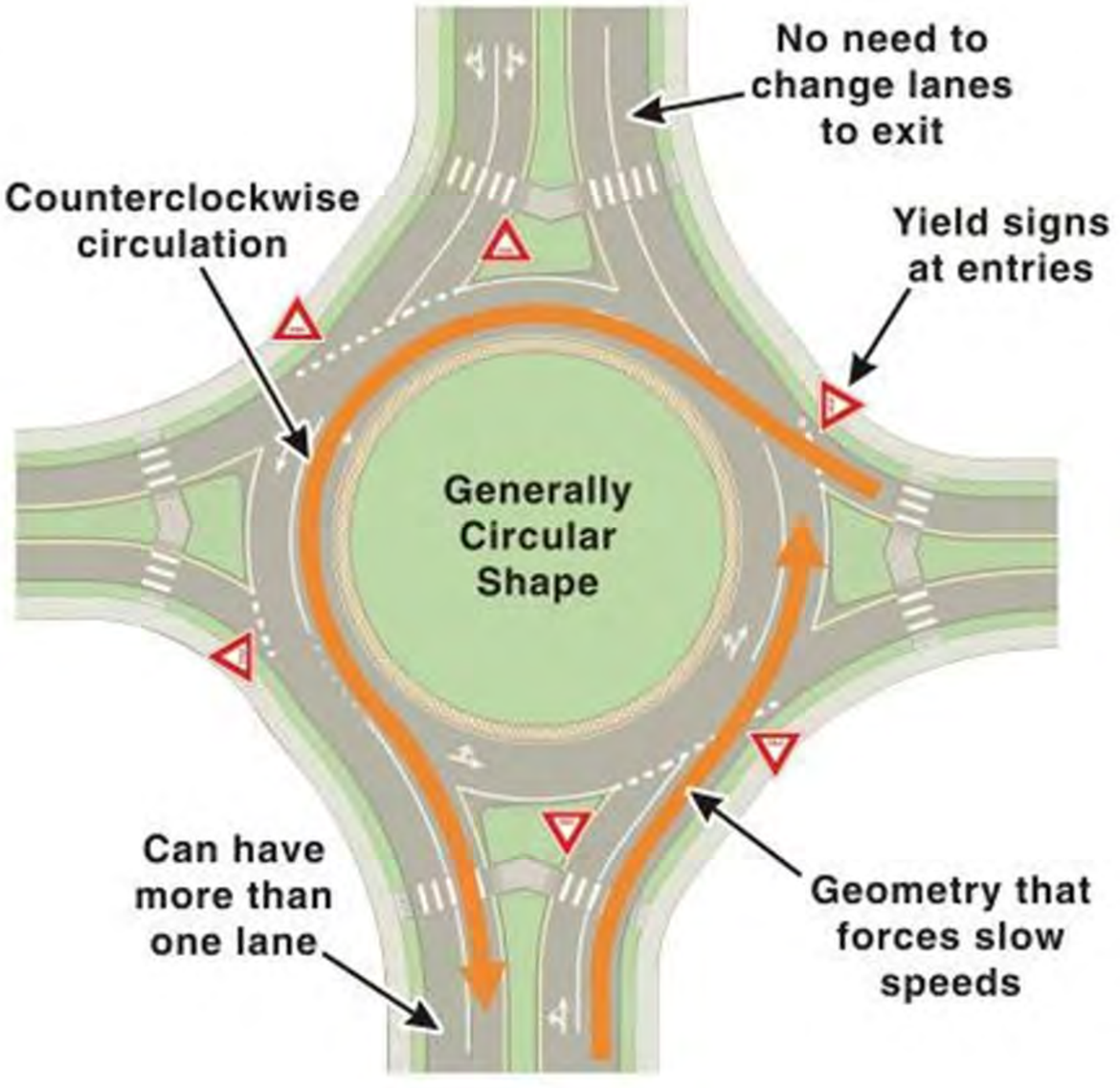
Roundabout Guide Outline

1. Introduction
2. Roundabout Considerations
3. Planning
4. Operations
5. Safety
6. Geometric Design
7. Application of Traffic Control Devices
8. Illumination
9. Landscaping
10. Construction and Maintenance

Appendices

Chapter 1: Introduction

- What is a roundabout?
- How are they different from other circular intersections?
- Scope and purpose of the guide



Ch 1 (cont.): Features that Distinguish Roundabouts Compared to Other Circular Intersections

- Priority to circulating vehicles
- Yield control
- Etc.

Traffic Circle –
Paris, France

Neighborhood Traffic Circle – Portland, Oregon

Photos: Lee Rodegerdts

Basics in Size and Context

- Three major categories of roundabouts
  - *Mini-roundabout*
  - *Single-lane*
  - *Multilane*
- Variety of potential contexts
  - *Urban versus rural*
  - *Low-speed versus high-speed environment*
  - *Auto-oriented versus multimodal*
  - *First roundabout in community versus previous history*

Basic Comparison of Roundabout Categories

Design Element	Mini-Roundabout	Single-Lane Roundabout	Multilane Roundabout
Desirable maximum entry design speed	15 to 20 mph (25 to 30 km/h)	20 to 25 mph (30 to 40 km/h)	25 to 30 mph (40 to 50 km/h)
Maximum number of entering lanes per approach	1	1	2+
Typical inscribed circle diameter	45 to 90 ft (13 to 27 m)	90 to 180 ft (27 to 55 m)	150 to 300 ft (46 to 91 m)
Central island treatment	Fully traversable	Raised*	Raised*
Typical maximum service volumes	≤15,000 veh/day	≤25,000 veh/day	≤45,000 veh/day

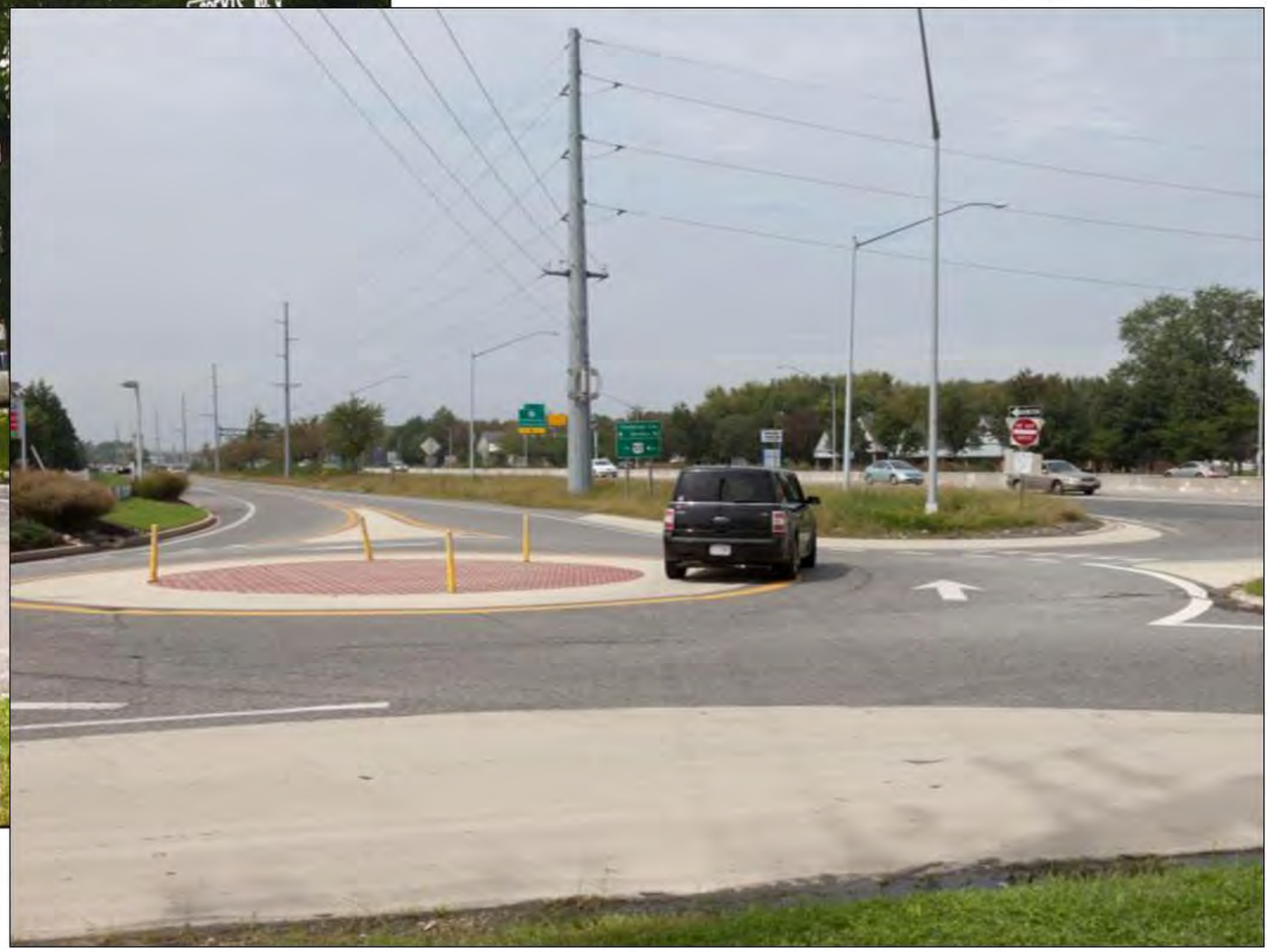
* (may have traversable apron)

NCHRP Report 672, Exhibit 1-9

Mini-Roundabout Examples – U.S.

Dimondale, MI

Stevensville, MD



Photos: Lee Rodegerdts

Single-Lane Roundabout Examples

Photo: Joe Sullivan

Dublin, OH

Photo: Oregon DOT

Bend, OR

Multilane Roundabout Examples

Photo: Casey Bergh

Bend, OR

Photo: American Structurepoint Inc.

Carmel, IN

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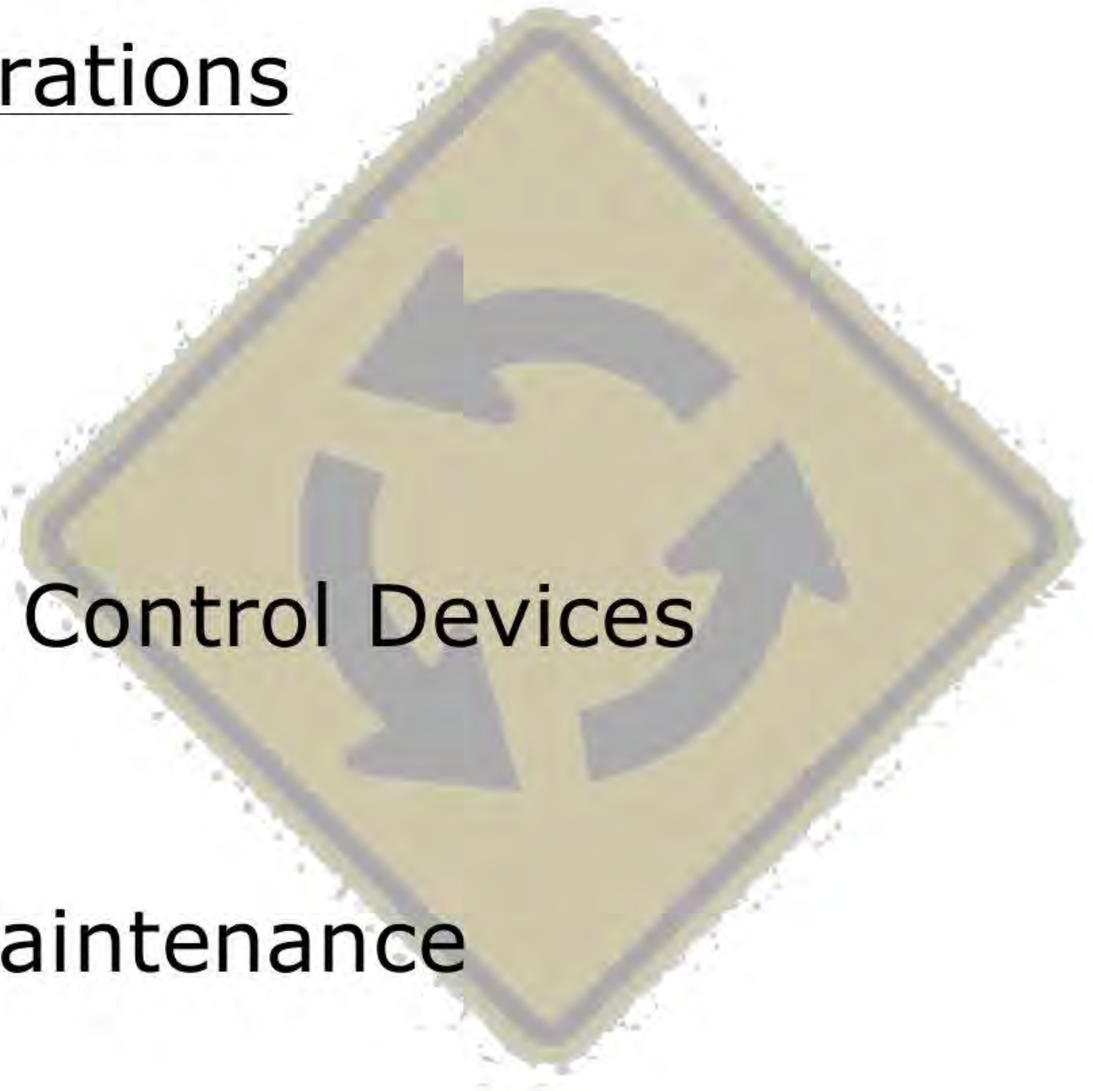


Chapter 2: Roundabout Considerations

- General characteristics
- Advantages and disadvantages
  - *Safety*
  - *User decisions*
  - *Operations*
  - *Spatial considerations*
  - *Access management*
  - *Environmental factors*
  - *Operations and maintenance costs*
  - *Traffic calming*
  - *Aesthetics*
- User considerations
- Policy and legal issues

Why Roundabouts?

- Roundabouts are being considered as viable or even preferred alternatives due to a number of potential benefits:
  - *Safety performance*
  - *Operational performance*
  - *Environmental benefits*
  - *Land use*
  - *Access management*
  - *Operations and maintenance costs*
  - *Aesthetics*

- Roundabouts are often, but not always, the best choice – make a case-by-case evaluation

Safety Performance

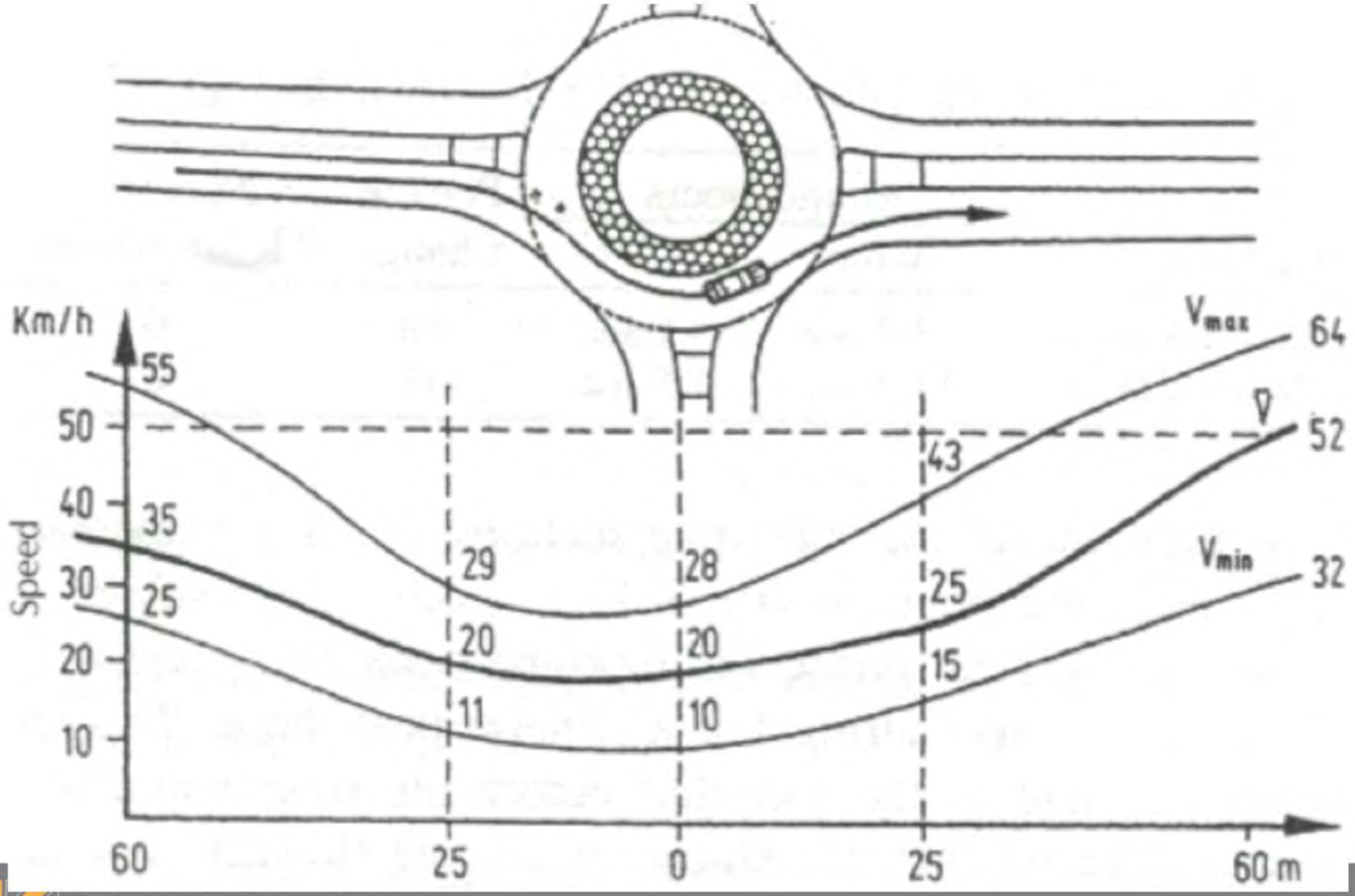
- Roundabouts have a proven safety record for reducing motor vehicle crashes, particularly injury crashes
- Experience is due to basic contributing factors:
  - *Reduced vehicle speeds*
  - *Reduced driver decisions*
  - *Reduced conflict points*
  - *Reduced conflict severity*

U.S. Experience
NCHRP Report 572 Results (May 2006)

Group Characteristic before Conversion (sample size)	% Reduction in All Crashes	% Reduction in Injury Crashes
All sites (55)	35	76
Signalized (9)	48	78
All-way stop (10)	No significant change	No significant change
Two-way stop (36)	44	82

NCHRP Report 572, Table 28

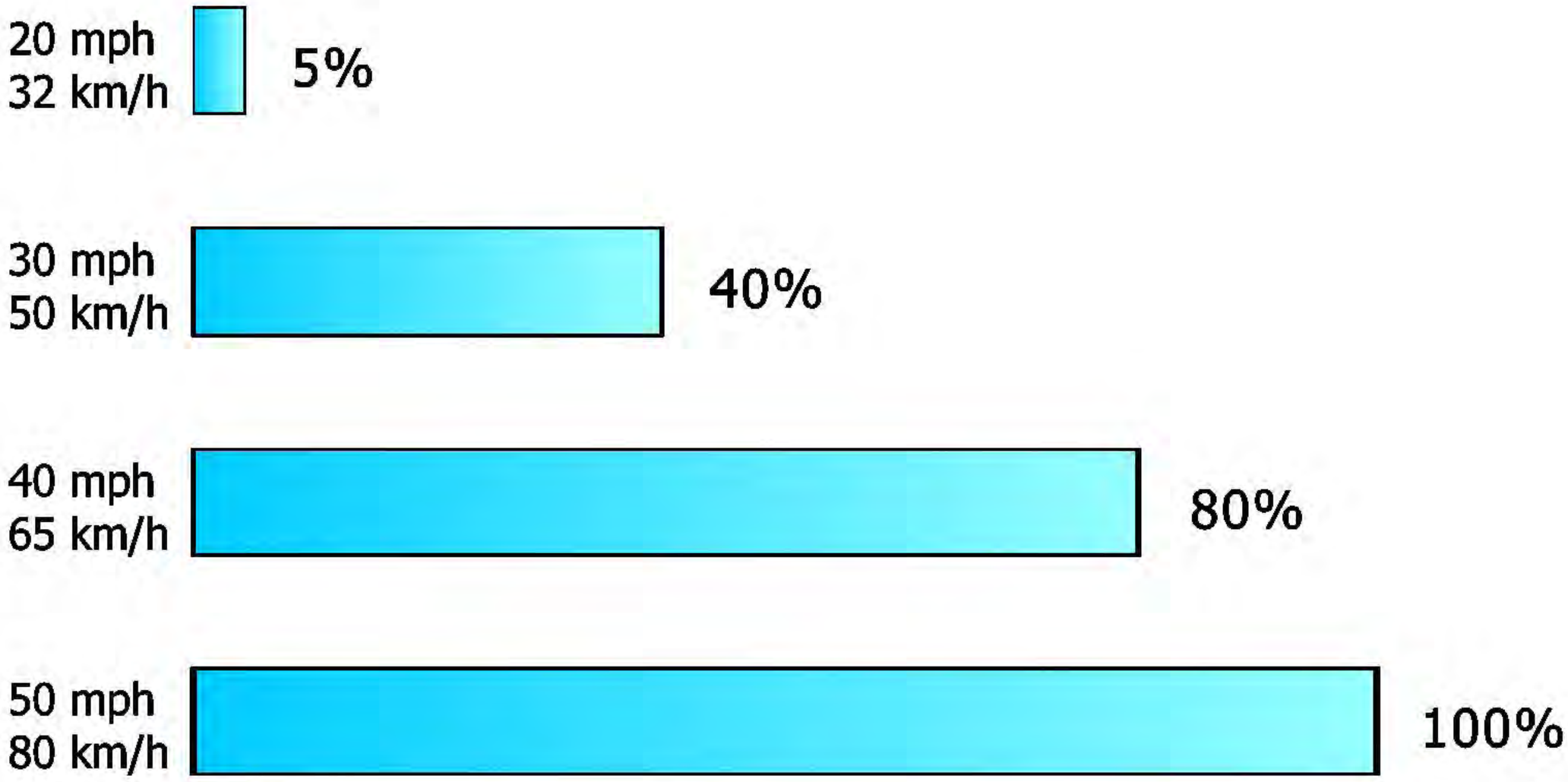
Vehicle Speeds: REDUCED



Source: Werner Brilon

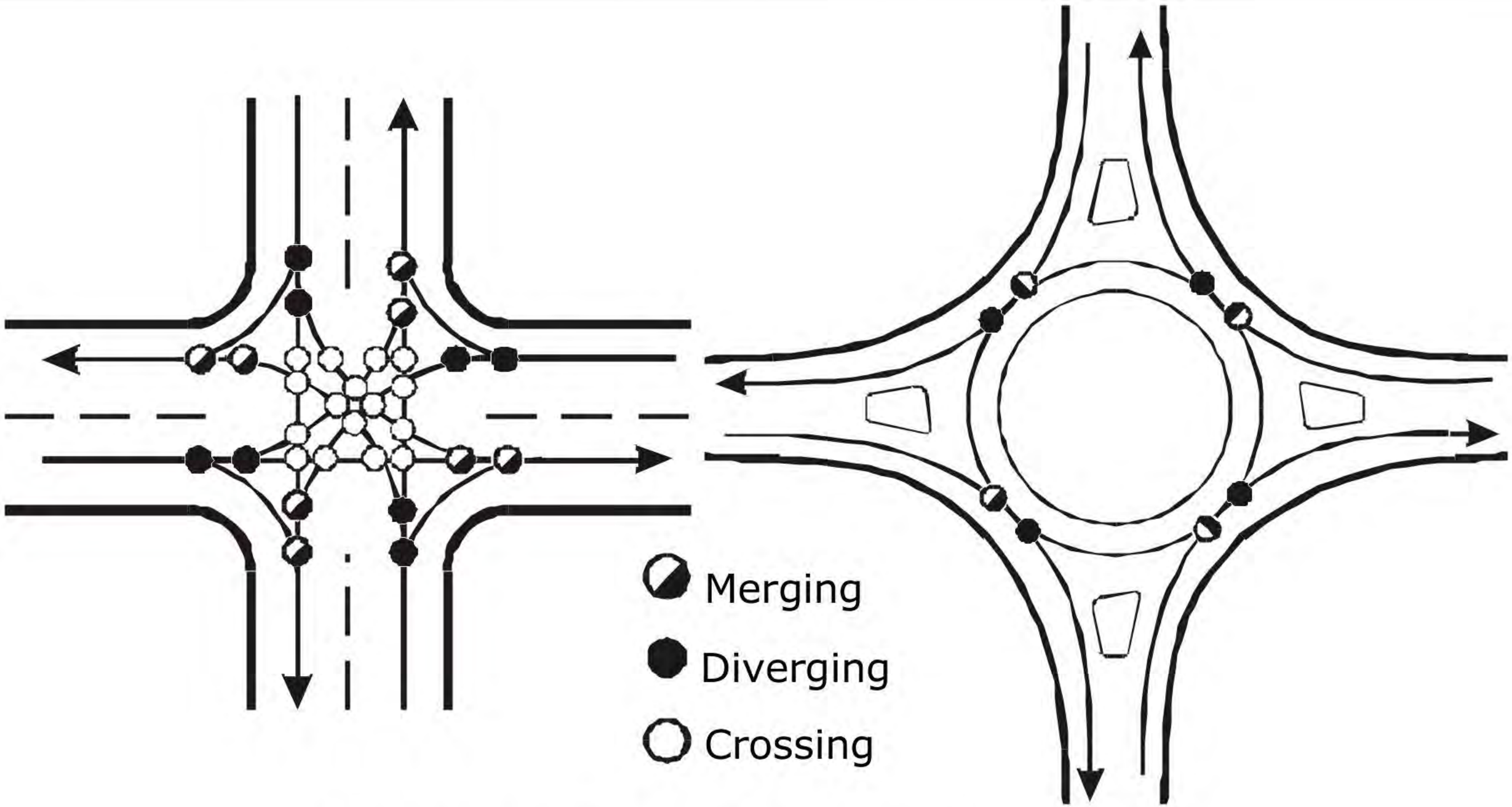
Lower speed is safer for pedestrians

Chance of pedestrian death if hit by a motor vehicle



NCHRP Report 672, Exhibit 5-15

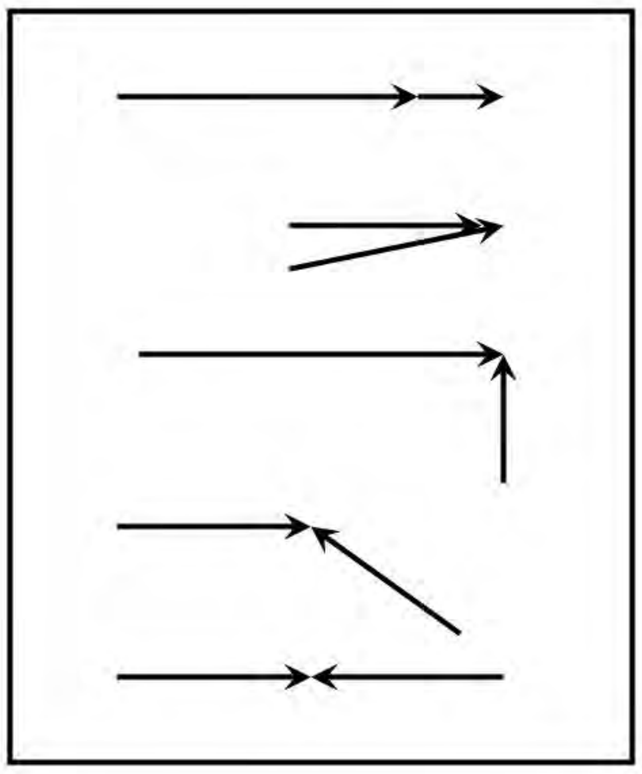
Vehicle Conflict Points: REDUCED



Crossing conflicts eliminated at roundabout

Severity of Vehicular Conflicts: REDUCED

- Severity related to relative velocities of conflicting streams



Rear-end

Sideswipe

Angle

Angle

Head-on

Least severe

Most severe

Example of Land Use Opportunity: Clearwater, FL

Photo: City of Clearwater, FL

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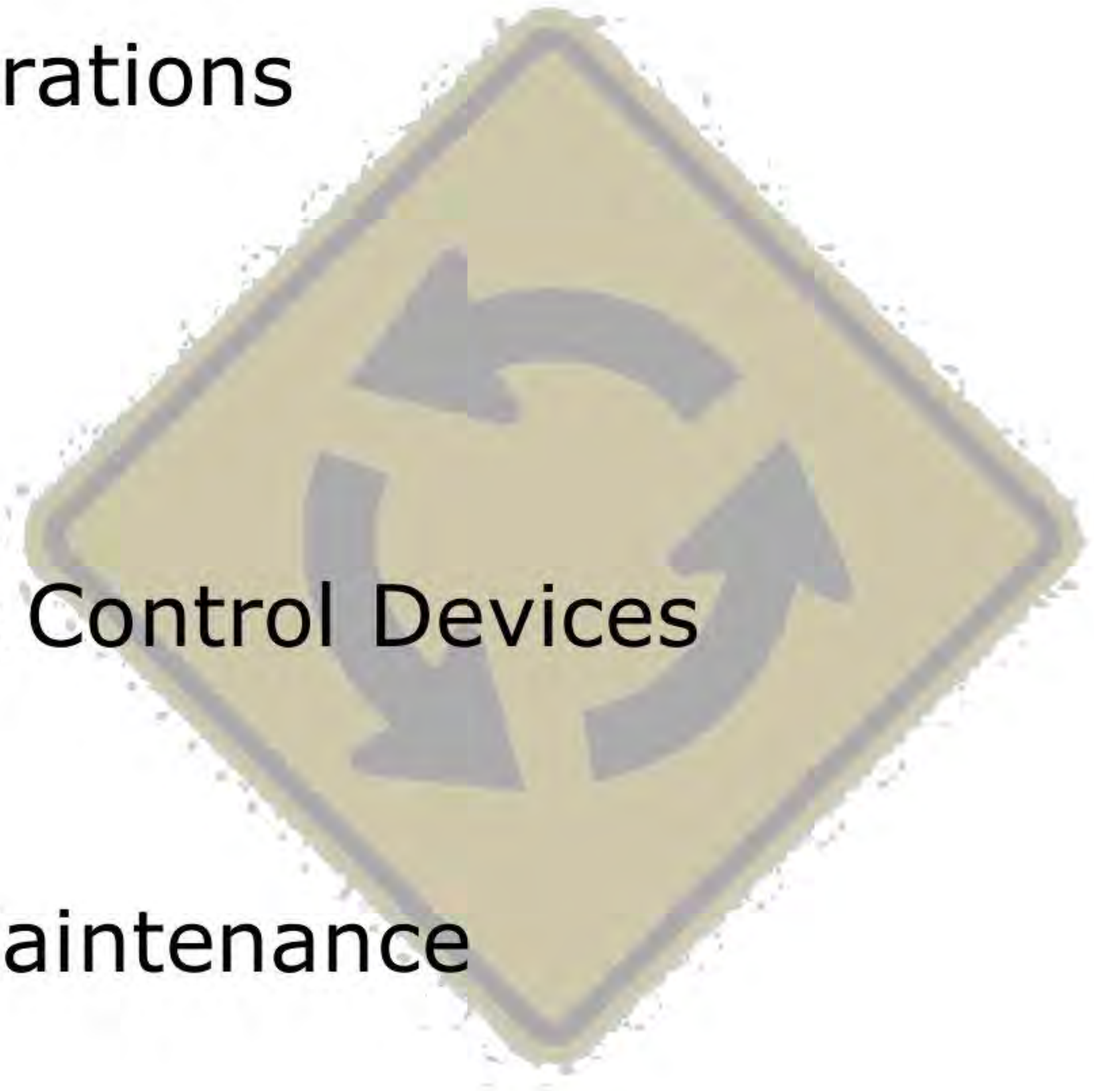


Chapter 3: Planning

- New information on range of potential applications

  - *Intended to demonstrate breadth of feasibility*
  - *Discussion of considerations for each typical application*
- Updated user education materials
- Examples of applications

Photos: Lee Rodegerdts

Variety of Roundabout Uses

Residential Subdivisions - Modesto, California

Small Towns - Howard, Wisconsin

Urban Centers - Towson, Maryland

High-Speed Rural Roadways - Paola, Kansas

Photos: Lee Rodegerdts

Variety of Roundabout Uses (cont.)

Tourist Routes -
Astoria, Oregon

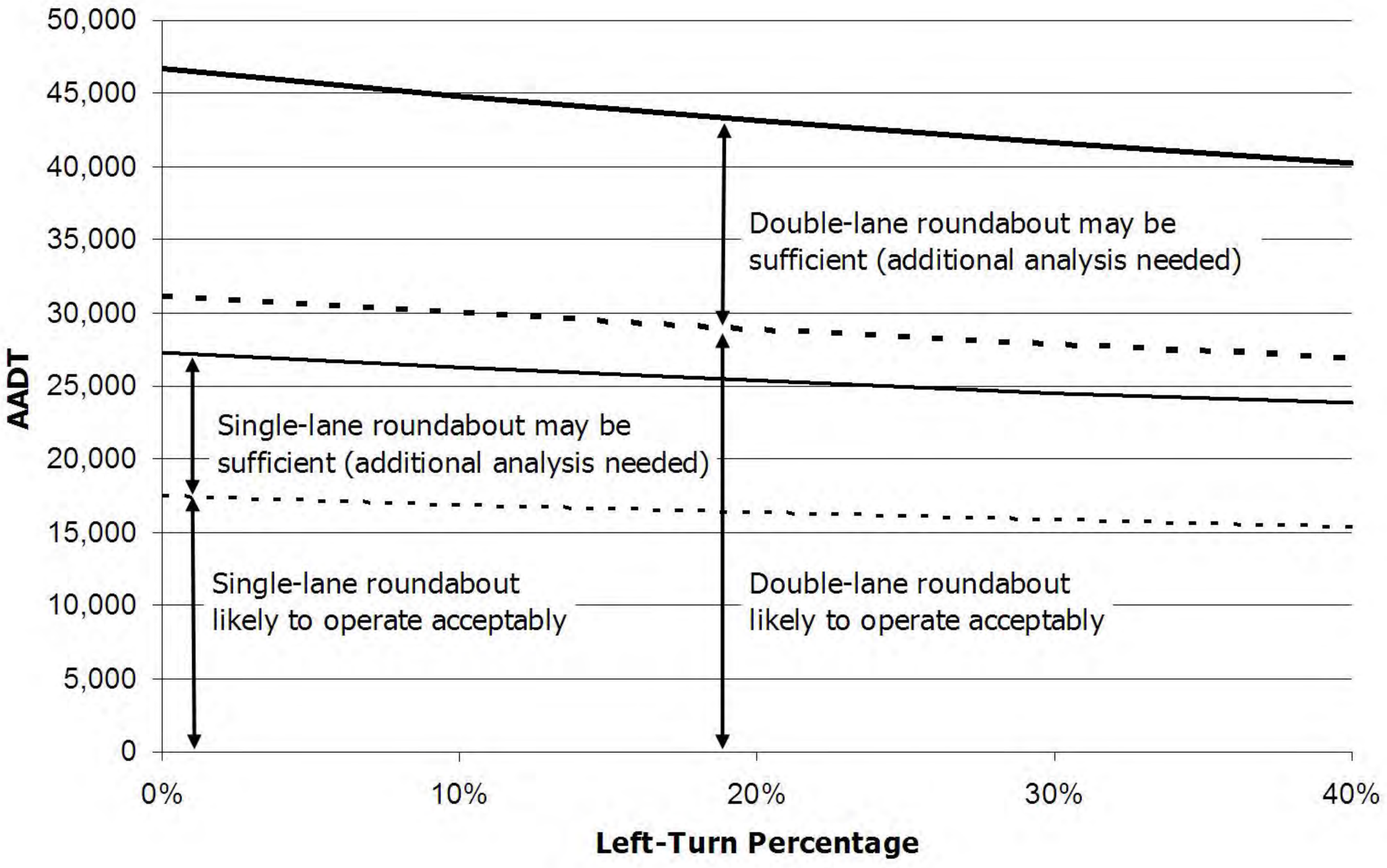
Large Developments - South Jordan, Utah

Northern Climates - North Pole, Alaska

Near Schools -
Clearwater, Florida

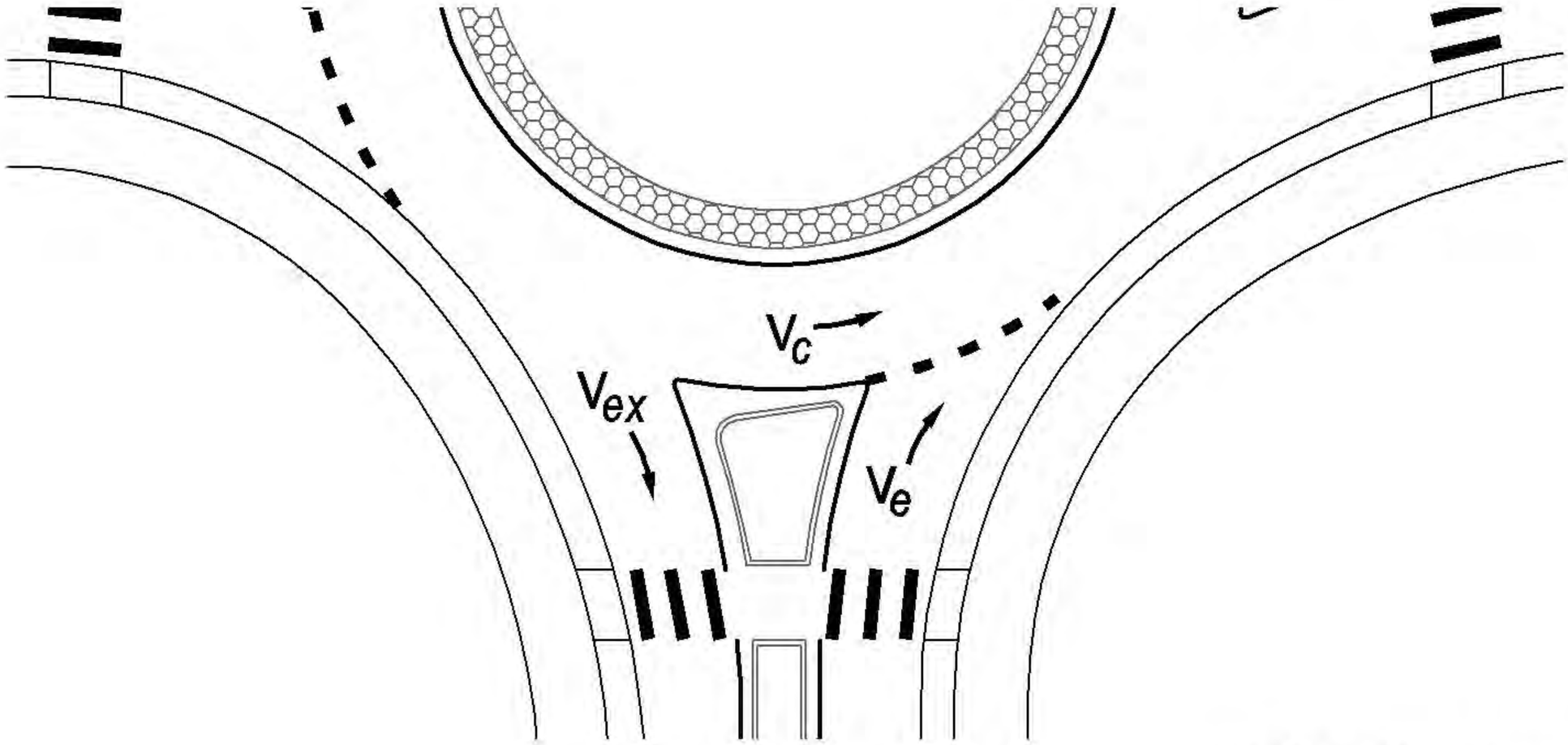
Photos: Lee Rodegerdts

Chapter 3 (cont.):
Updated planning-level capacity figure



Flow Types at a Roundabout: Aggregations of Turning Movements

- Entering flow (v_e)
- Circulating flow (v_c)
- Exiting flow (v_{ex})



HCM 2010 Exhibit 21-2

Planning-Level Volume Thresholds

Sum of Entering Plus Conflicting Flows (veh/h)	Number of Lanes Required
0 – 1,000	1 lane likely ok
1,000 – 1,300	1 lane might be ok 2 lane may be needed
1,300 – 1,800	2 lane likely ok
> 1,800	More than 2 lanes may be needed

NCHRP Report 672 Exhibit 3-14 (from New York State DOT)

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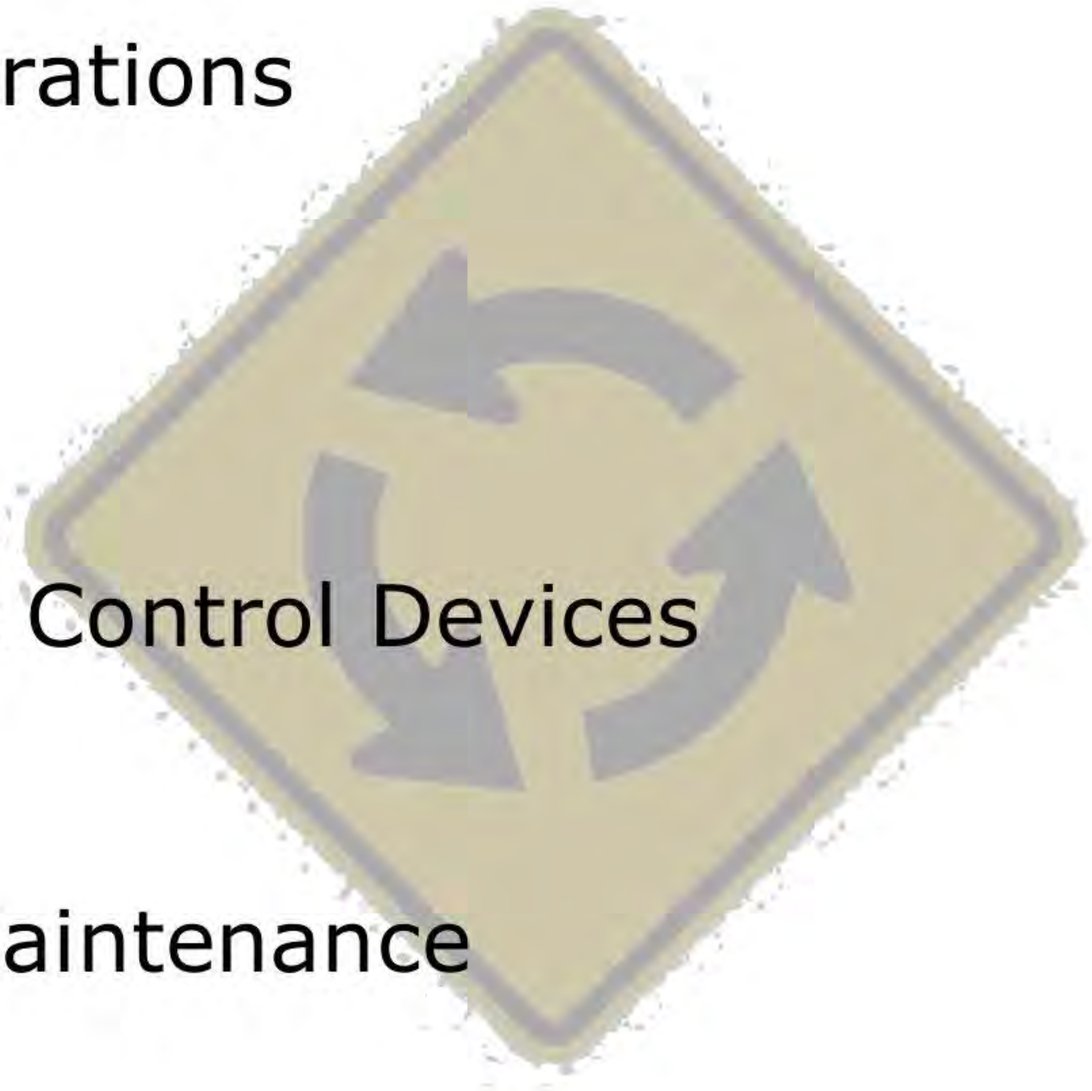
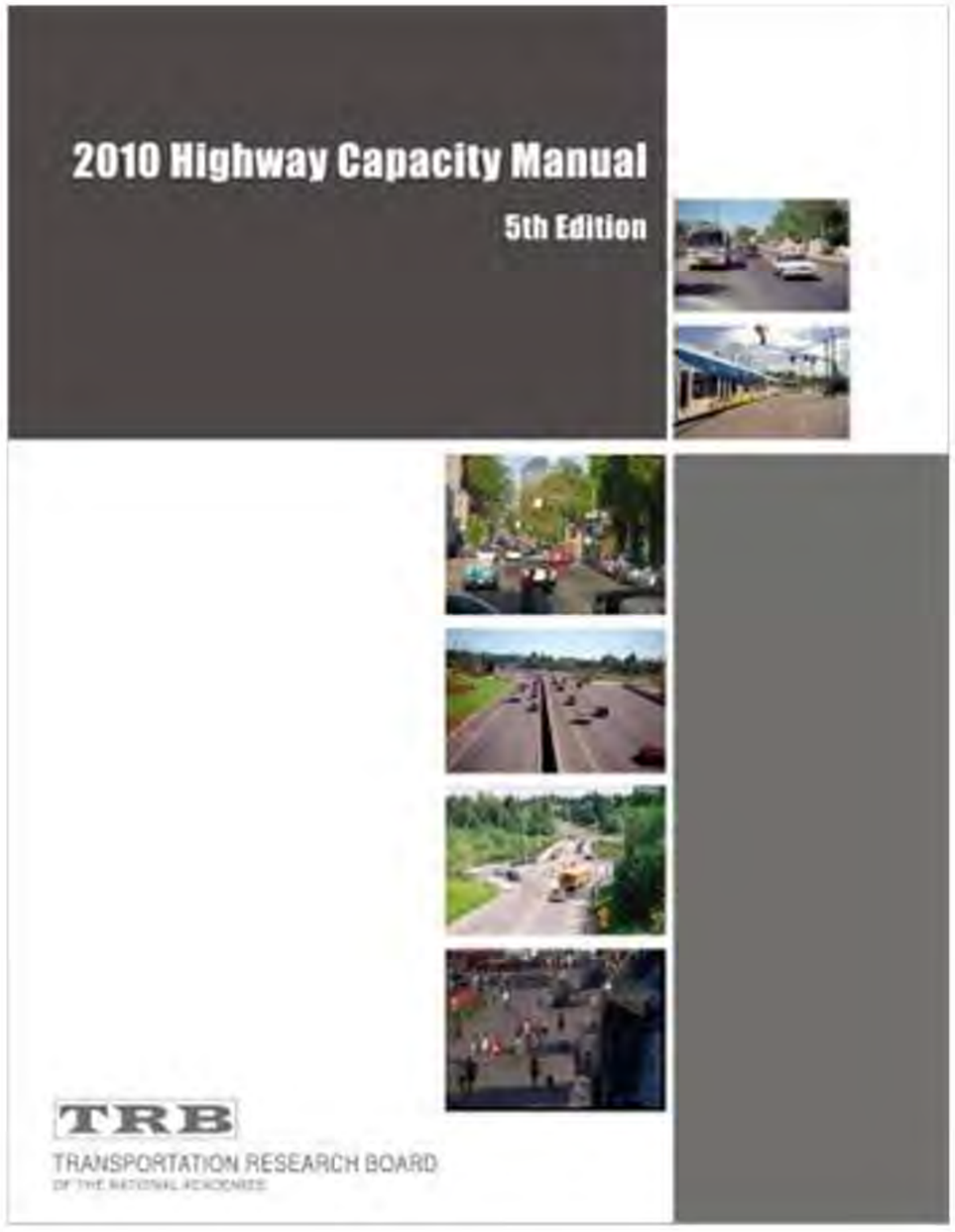
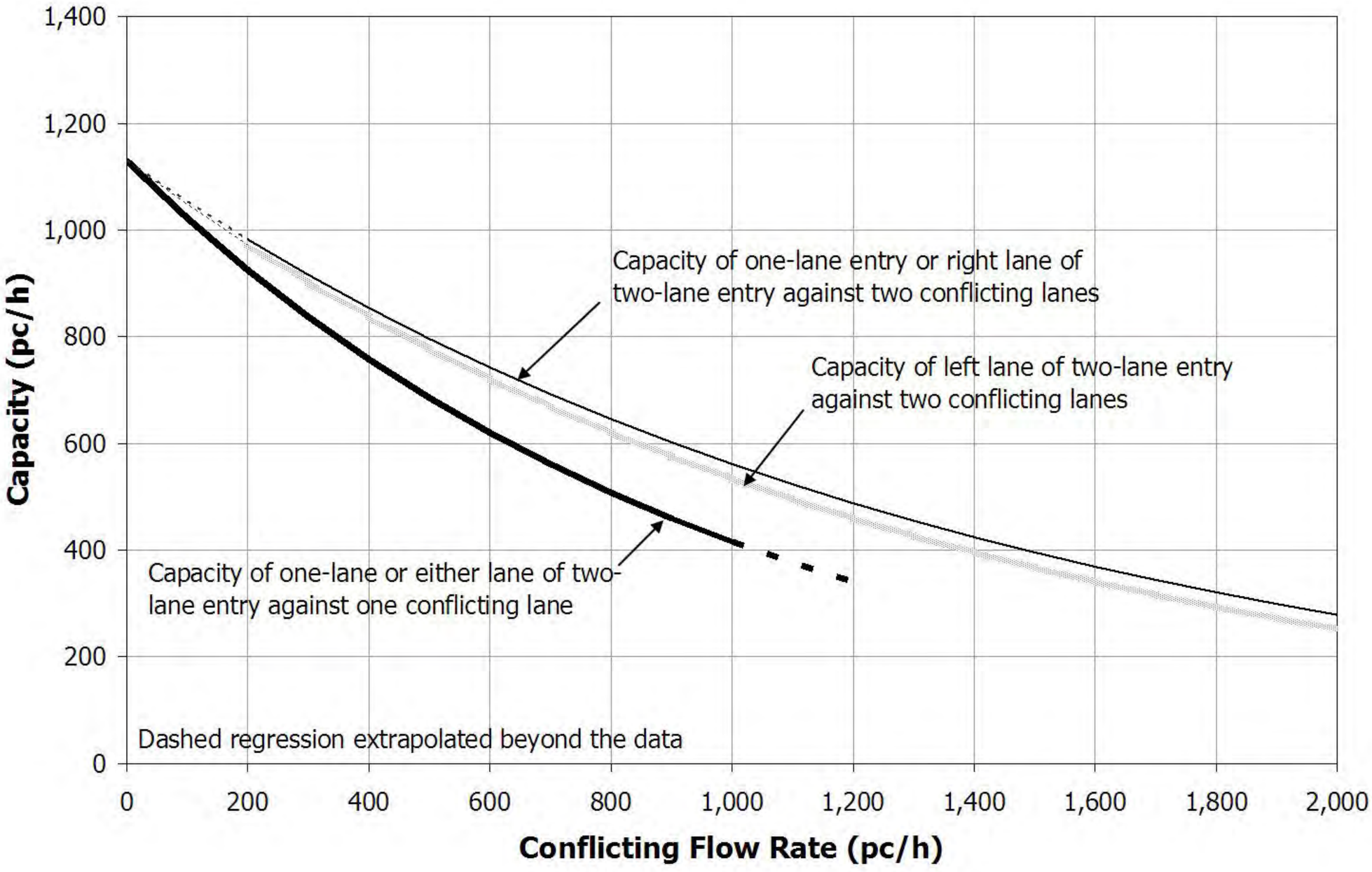


Chapter 4: Operations

- Based on 2010 edition of the Highway Capacity Manual NEW!
- Chapter presents subset of HCM procedure (incomplete without HCM 2010)
- Explicit recognition of use of calibrated alternative tools to analyze situations not covered by HCM models



Capacity Models in HCM 2010



Other Elements of Procedure

- Lane use assignment
- Level of Service
  - *Based on control delay*
  - *LOS assigned to each lane, approach, and intersection*
  - *Delay thresholds same as for TWSC due to similar delay formulation and driver decision process*
- Explicit recognition that HCM procedures are not the only way to analyze roundabouts (or other facilities)
- Applicability to roundabouts
  - *Geometric configurations not included in HCM model*
  - *Oversaturated conditions requiring multiple-period analysis*
  - *Interaction effects with other intersections*
- Need for calibration

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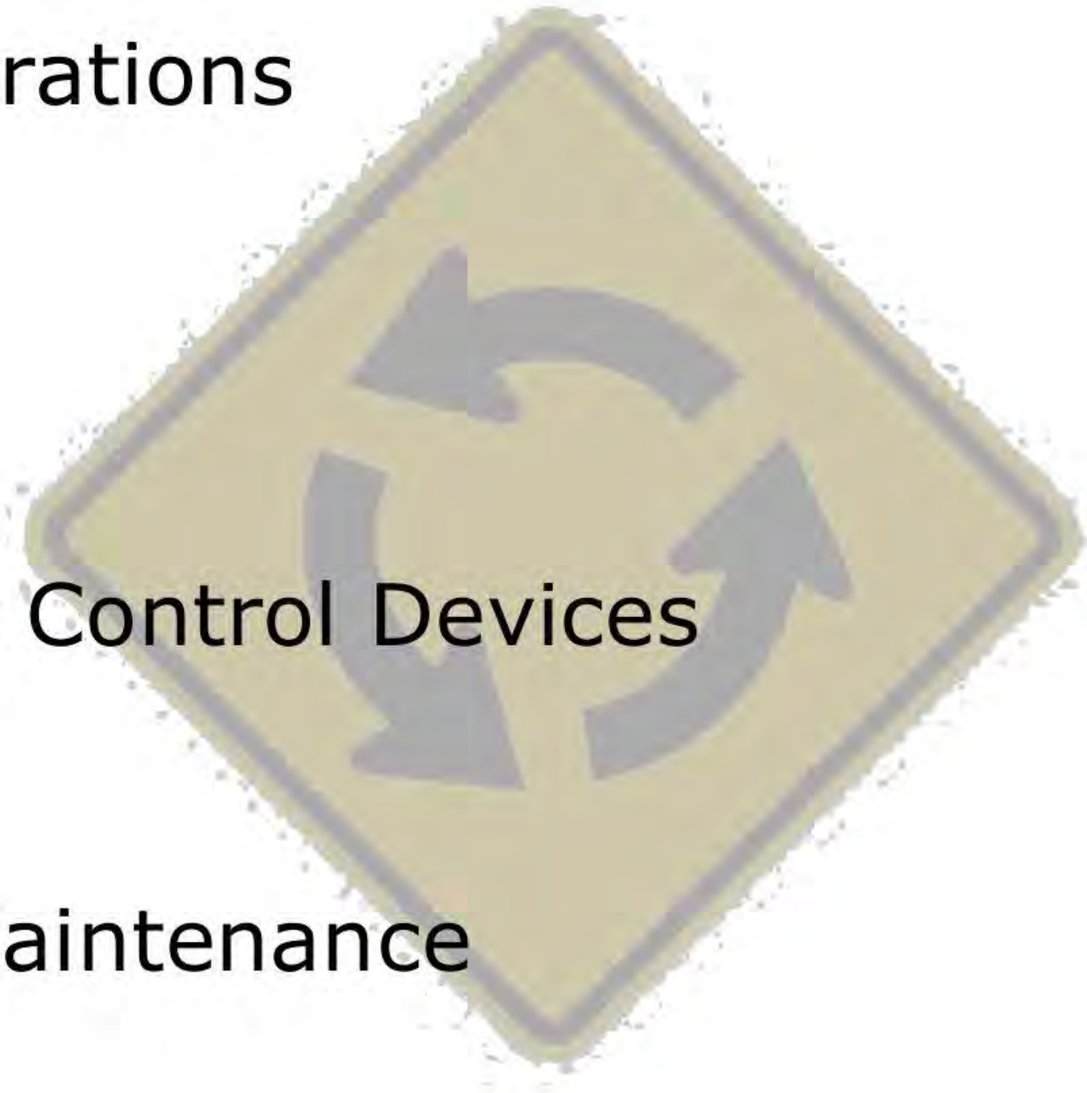
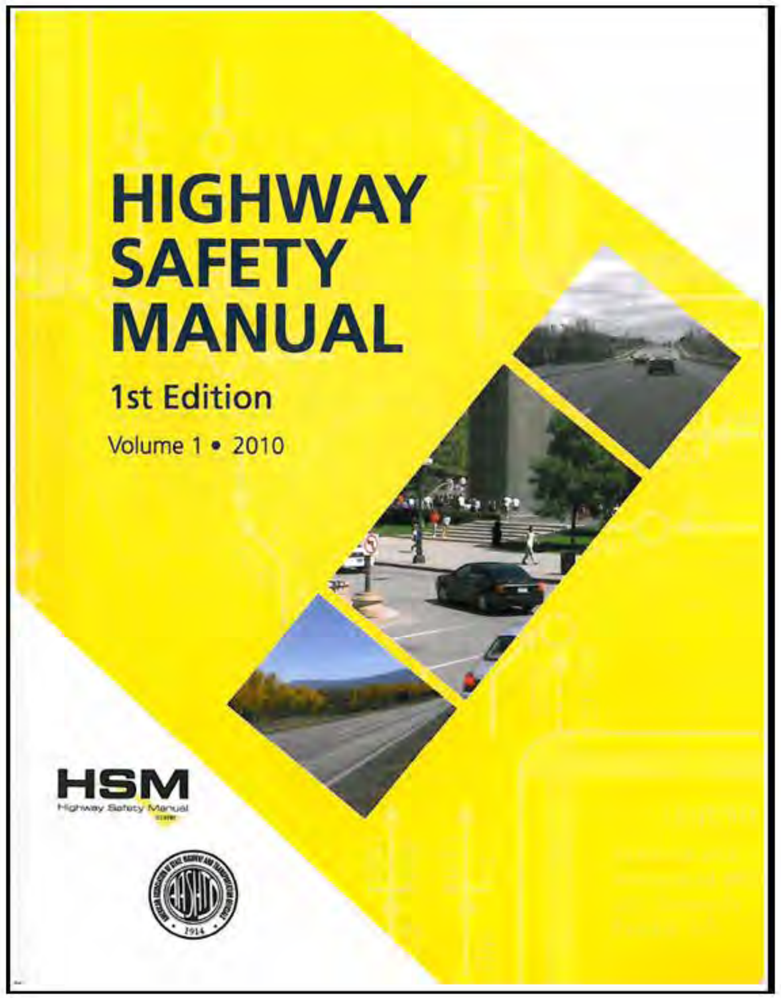


Chapter 5: Safety

- Principles
- Observed safety performance
- Crash prediction methodologies NEW!
  - *Intersection level*
  - *Approach level*

- Builds on NCHRP Report 572 research incorporated into the Highway Safety Manual



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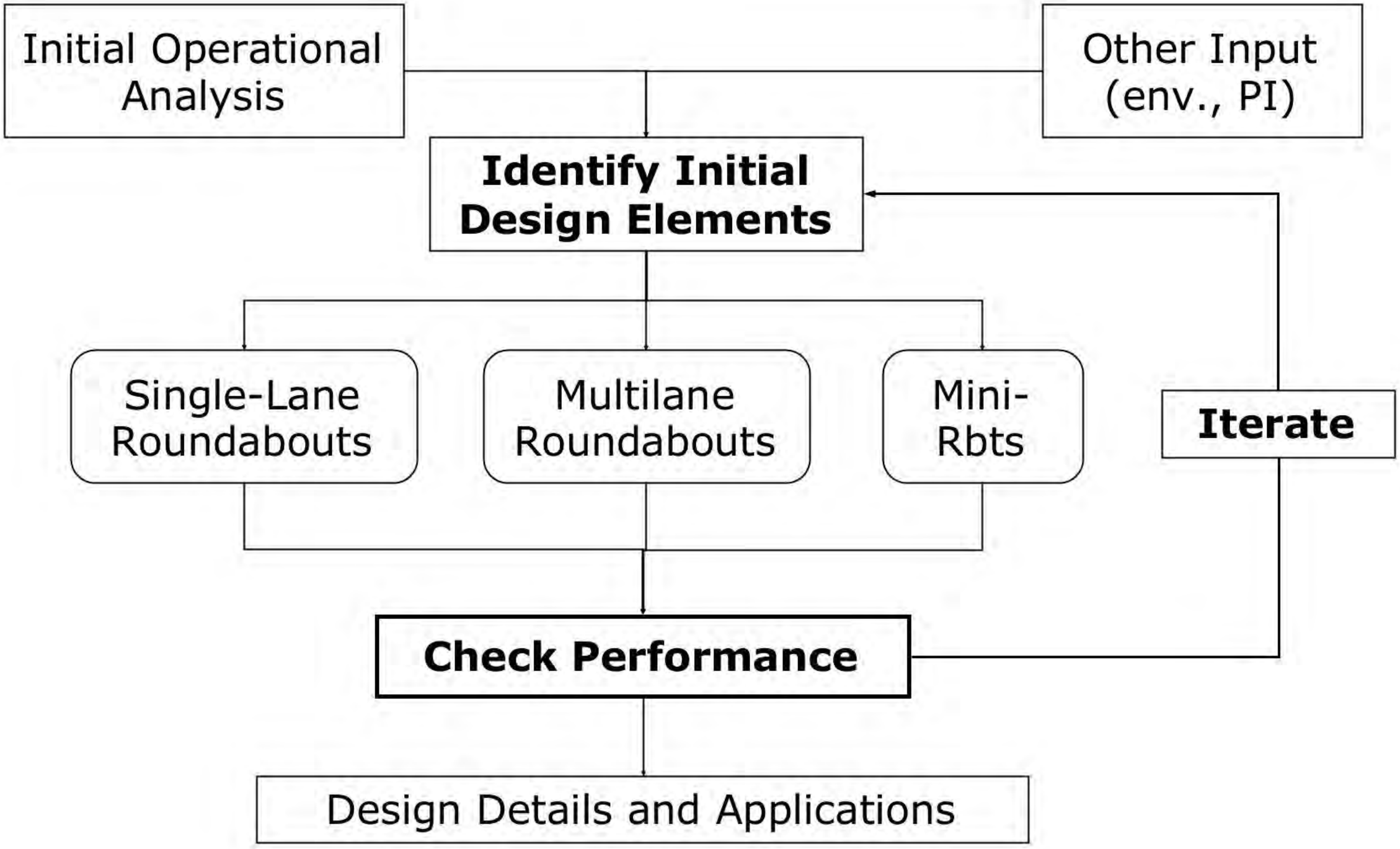
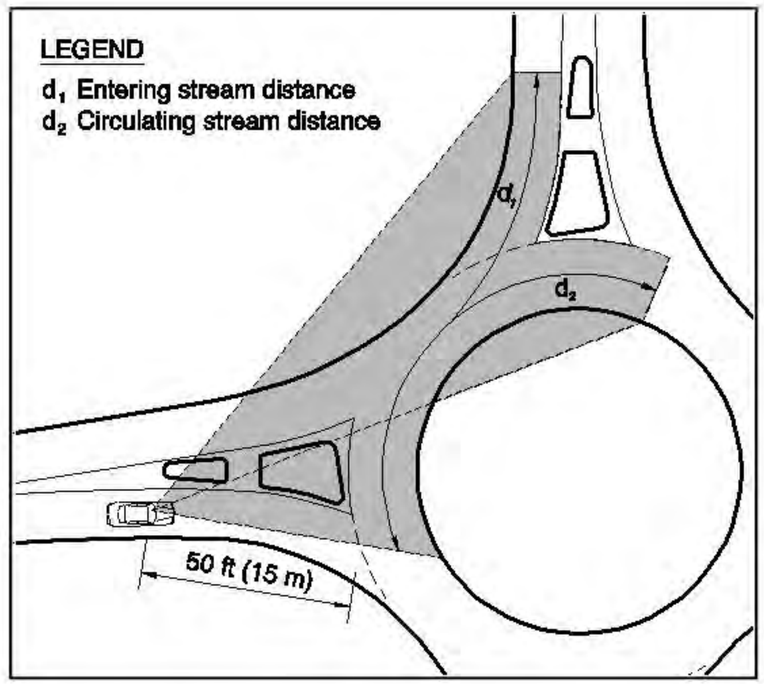
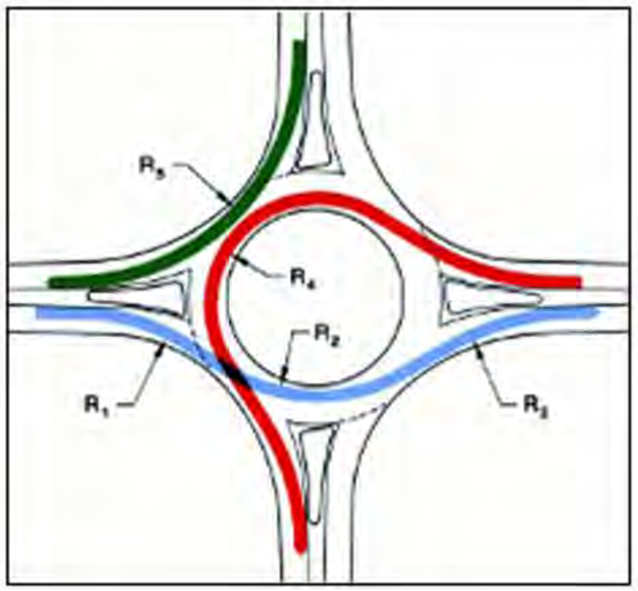
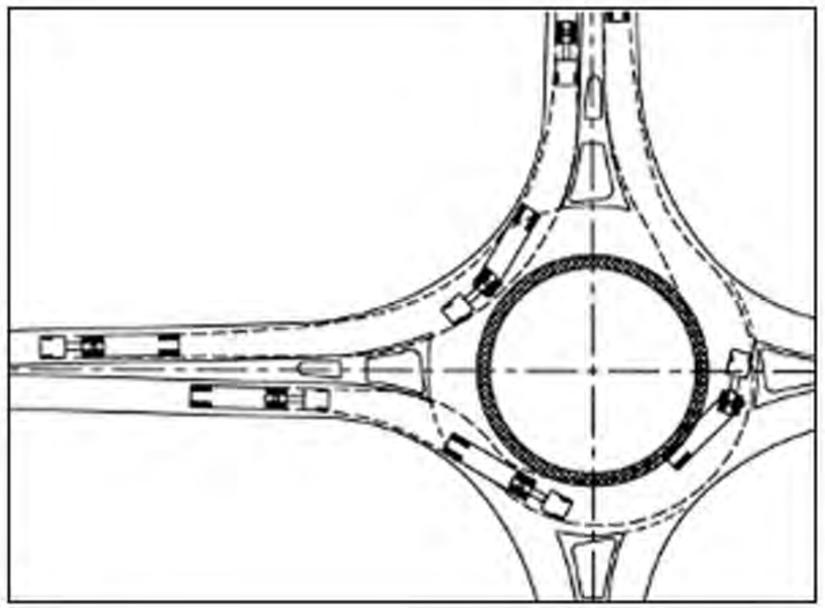

Initial Operational Analysis
Other Input (env., PI)
Identify Initial Design Elements
Single-Lane Roundabouts
Multilane Roundabouts
Mini-Rbts
Iterate
Check Performance
Design Details and Applications

Chapter 6 (cont.): Principles

- Fastest path
- Path alignment
- Design vehicle
- Non-motorized design users
- Sight distance and visibility
- Visibility/view angles





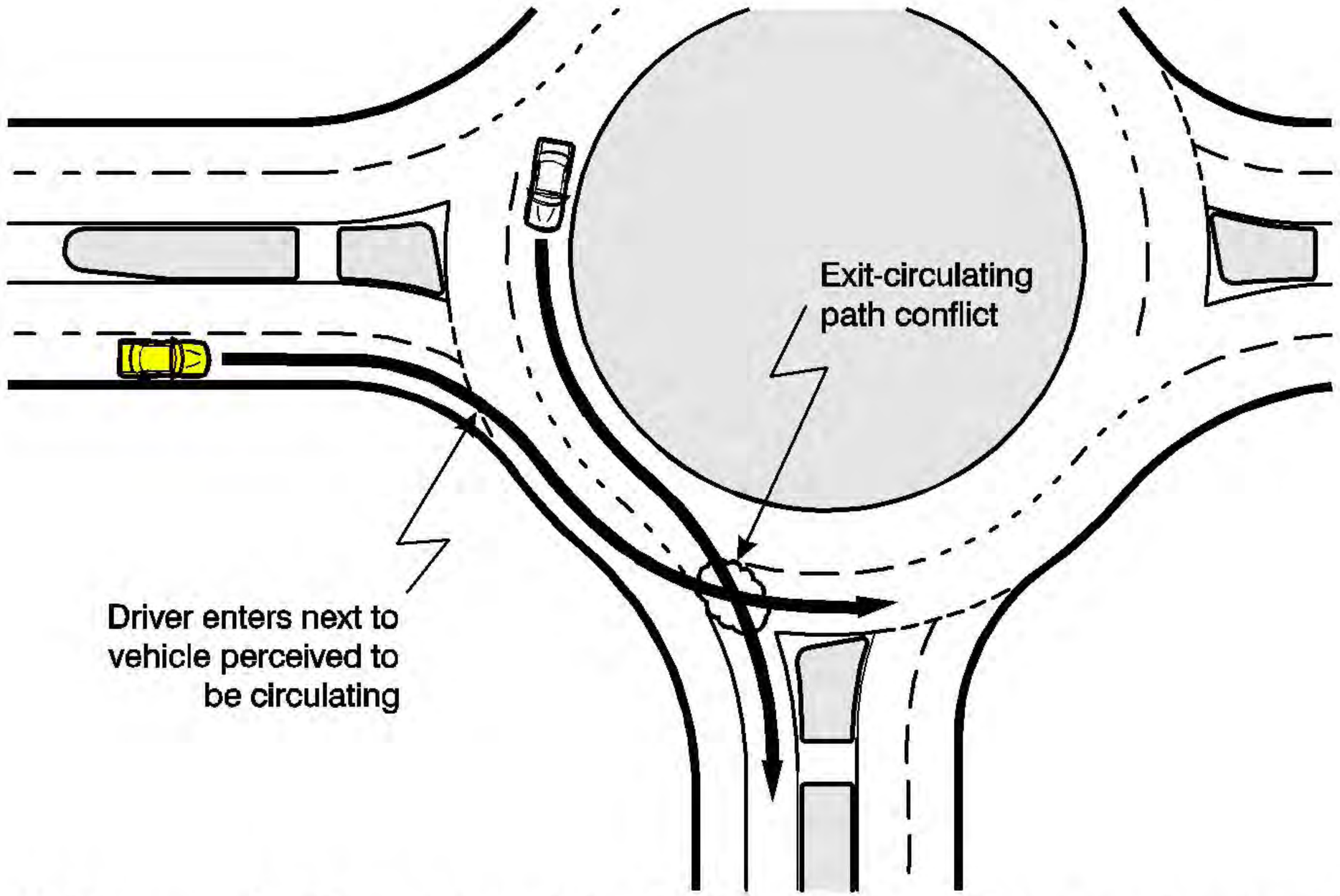


Chapter 6 (cont.): Horizontal Design

- Three fundamental components:
  - *Size*
  - *Location*
  - *Alignment of approaches*

- No one combination is appropriate for every circumstance
- Principles and design checks used to determine suitability of given design

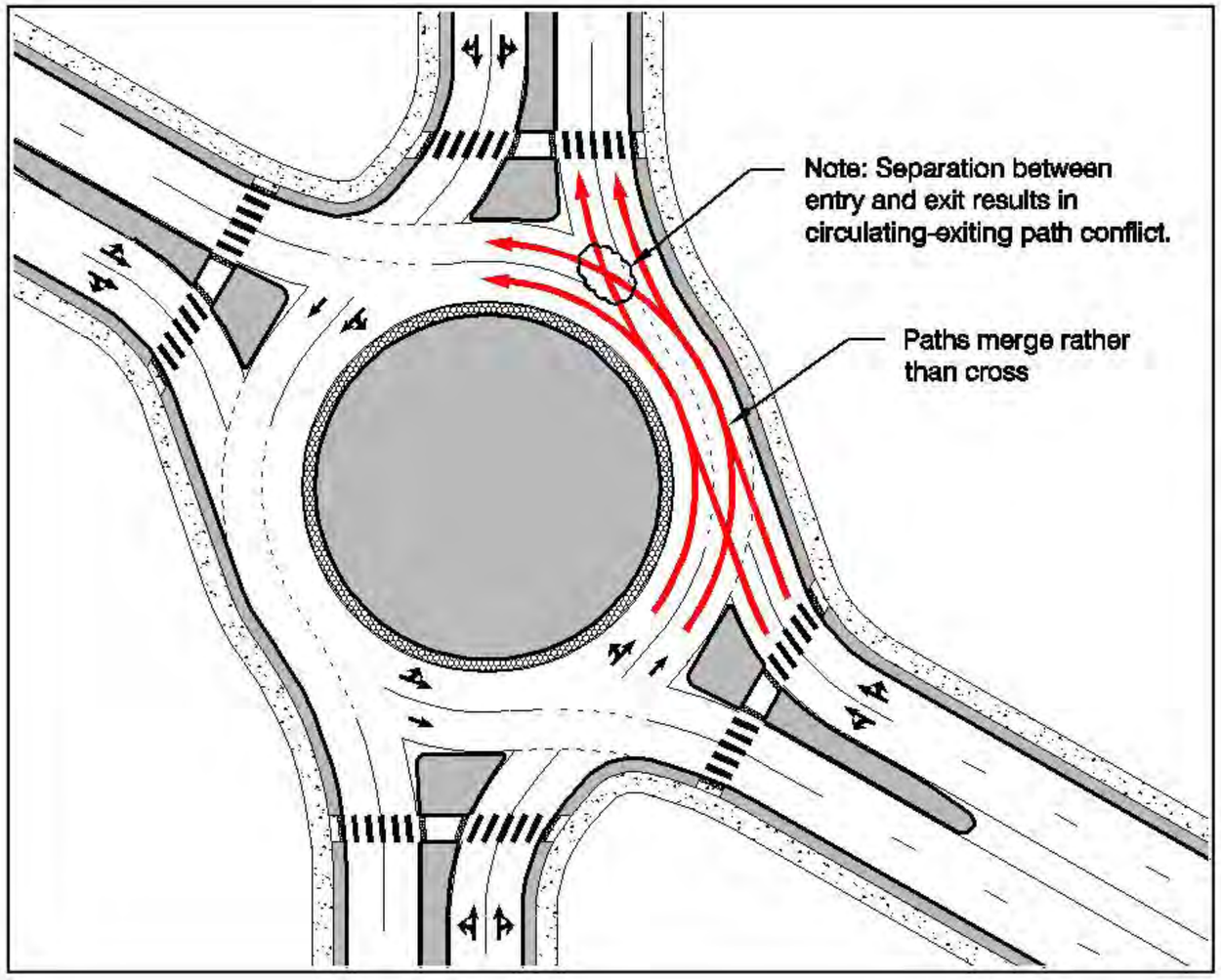
Multilane Roundabout: Managing Conflicts

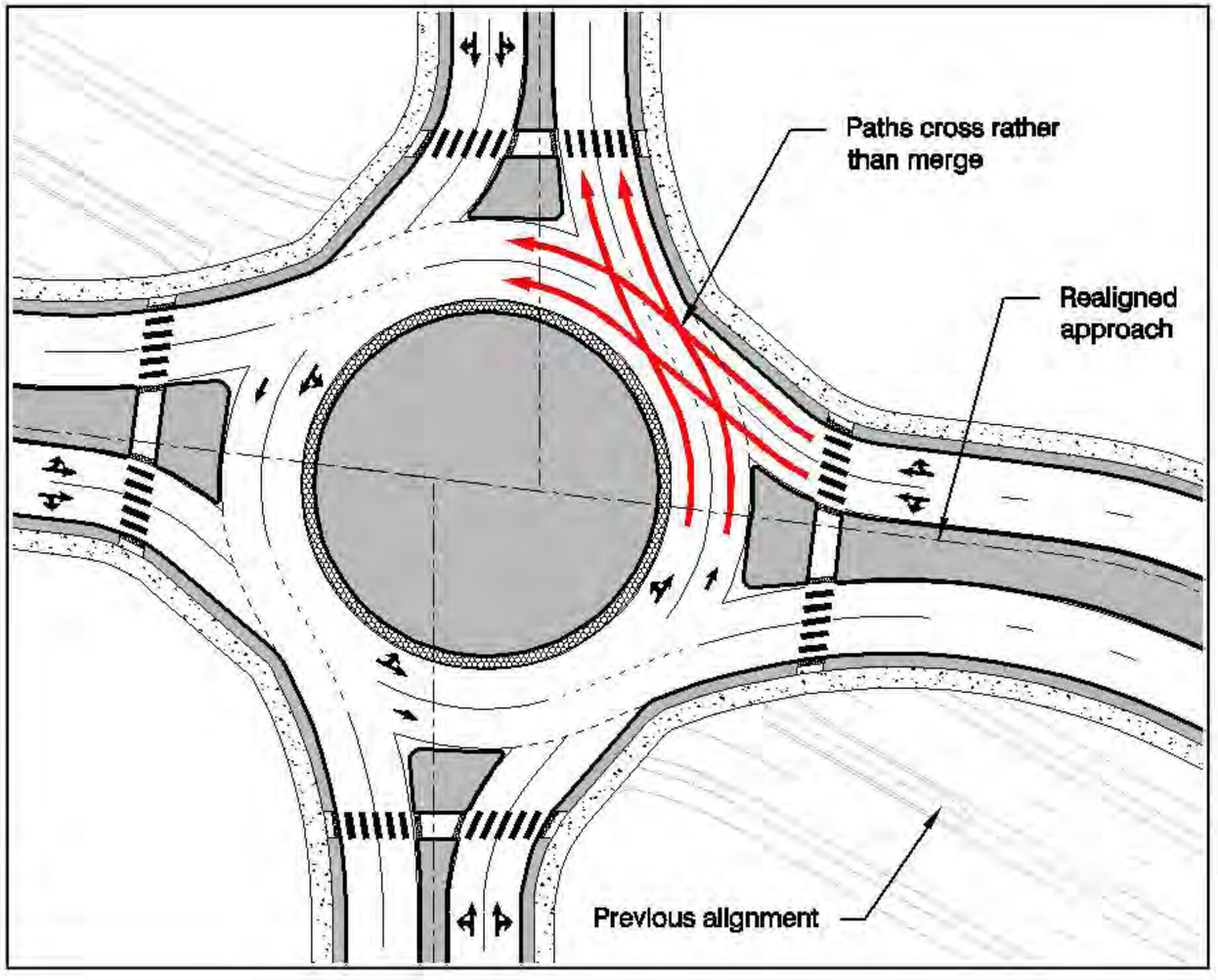


Addressed with geometric design and/or lane assignments

Managing Conflict Areas at Multilane Roundabouts

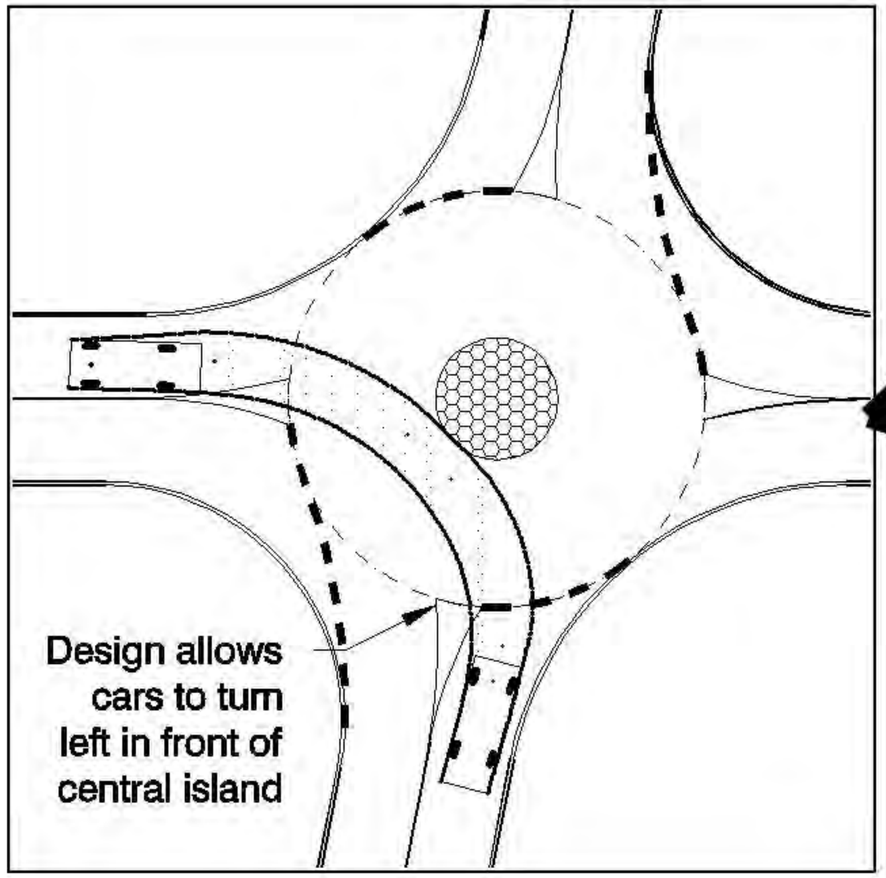
- Desire to minimize likelihood of vehicles entering next to exiting vehicles

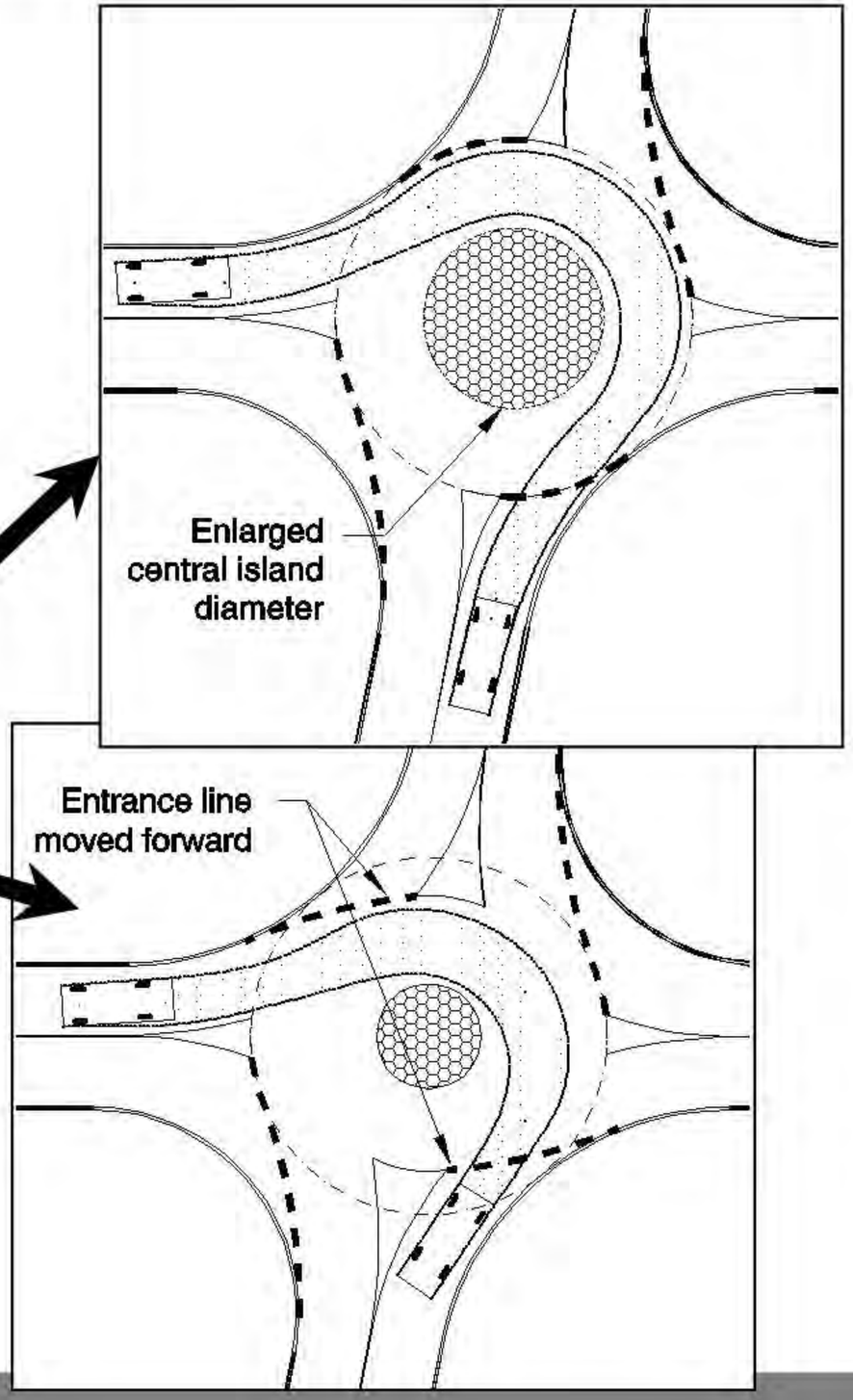




Chapter 6 (cont.): Mini-Roundabouts

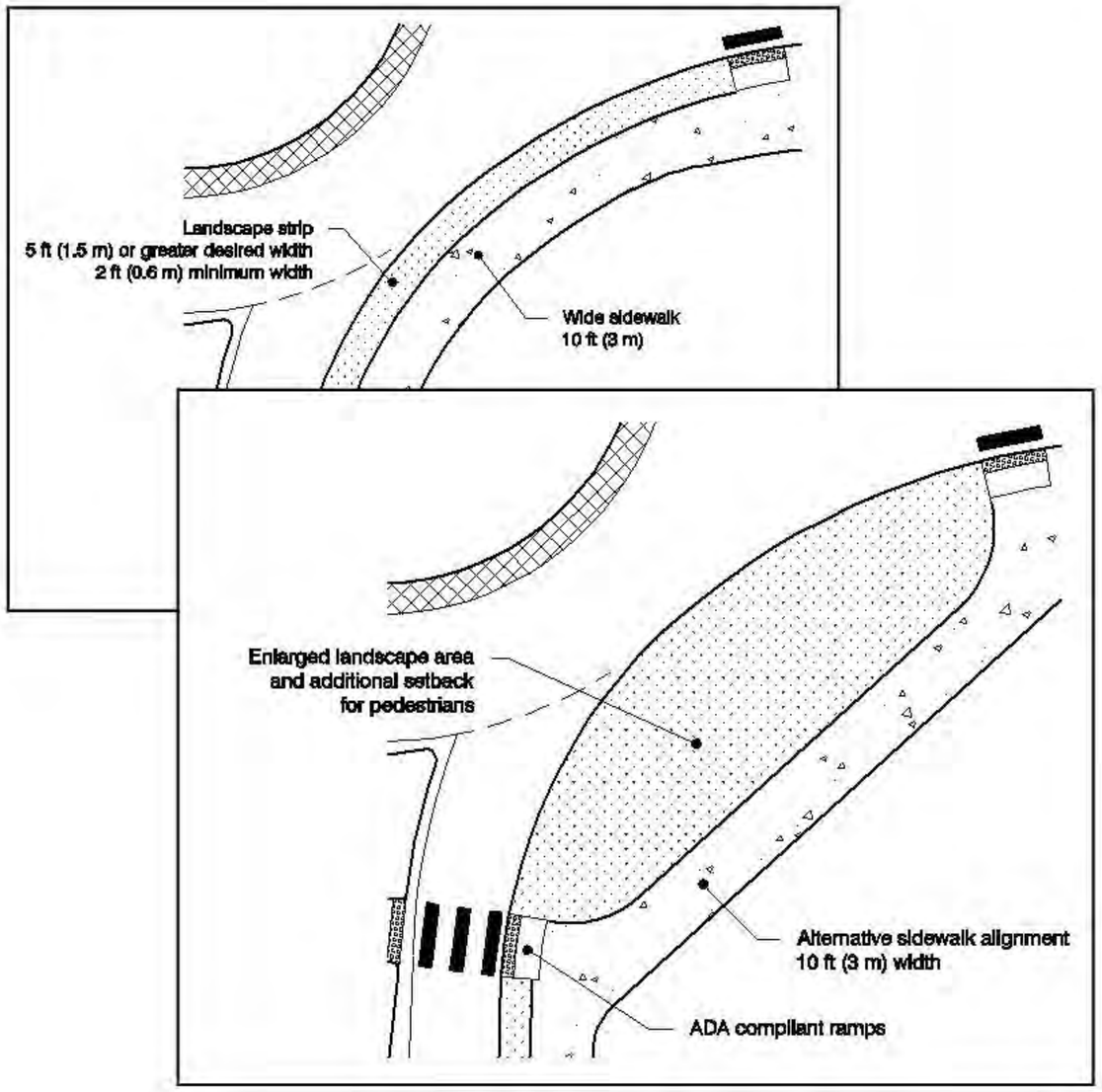
- New material based on latest practices

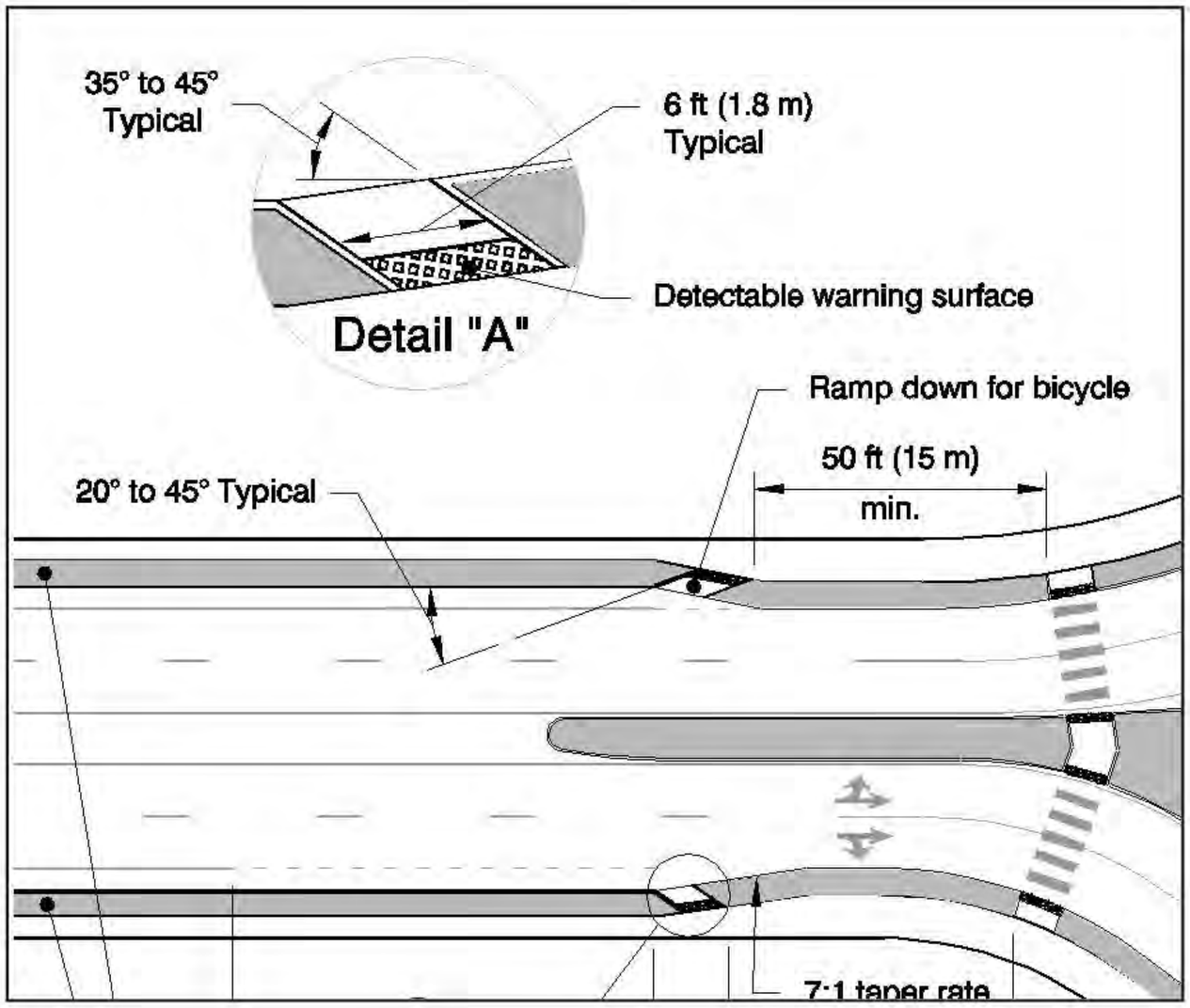




Chapter 6 (cont.): Pedestrian and Bicycle Treatments

- Updated to reflect latest research, practices, and policies





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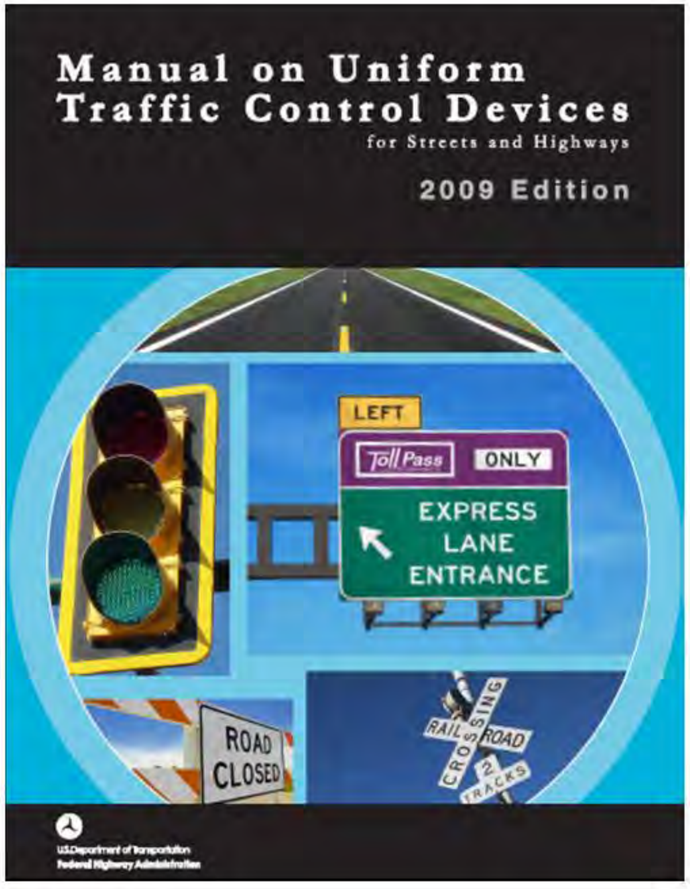
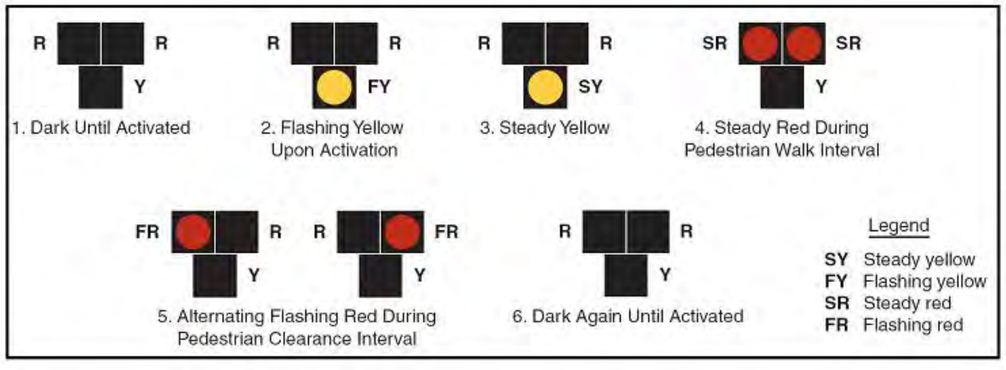
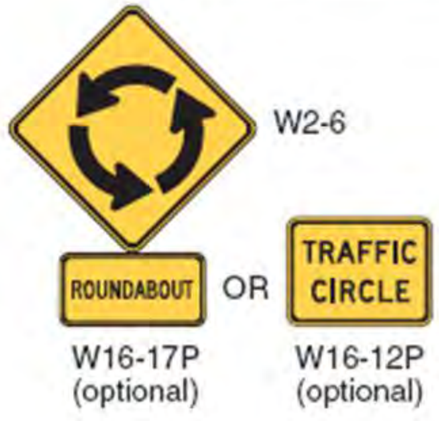
Chapter 7: Application of Traffic Control Devices

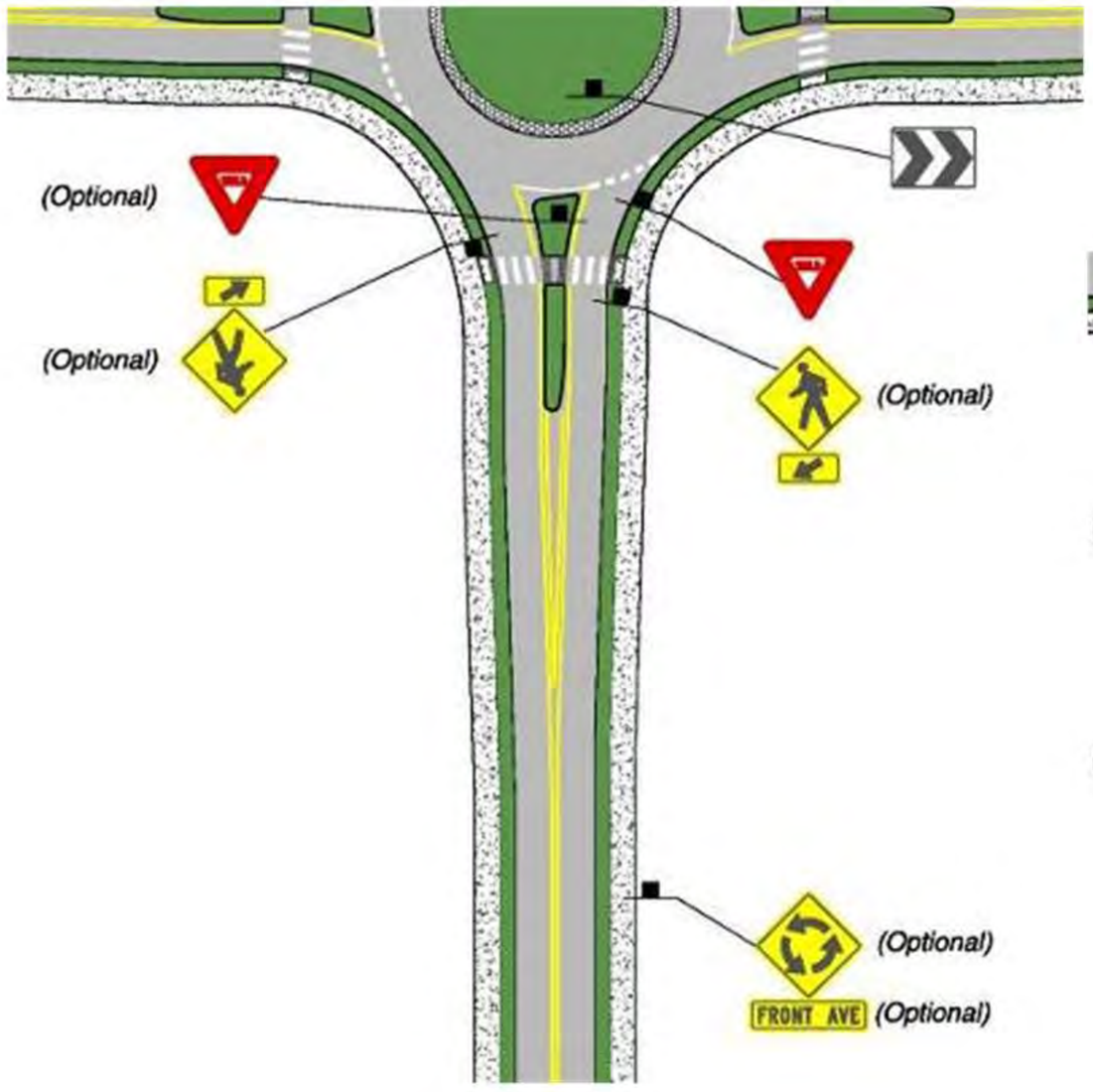
- Complements 2009 MUTCD NEW!
- Discusses applications of signs, markings, and signals/beacons

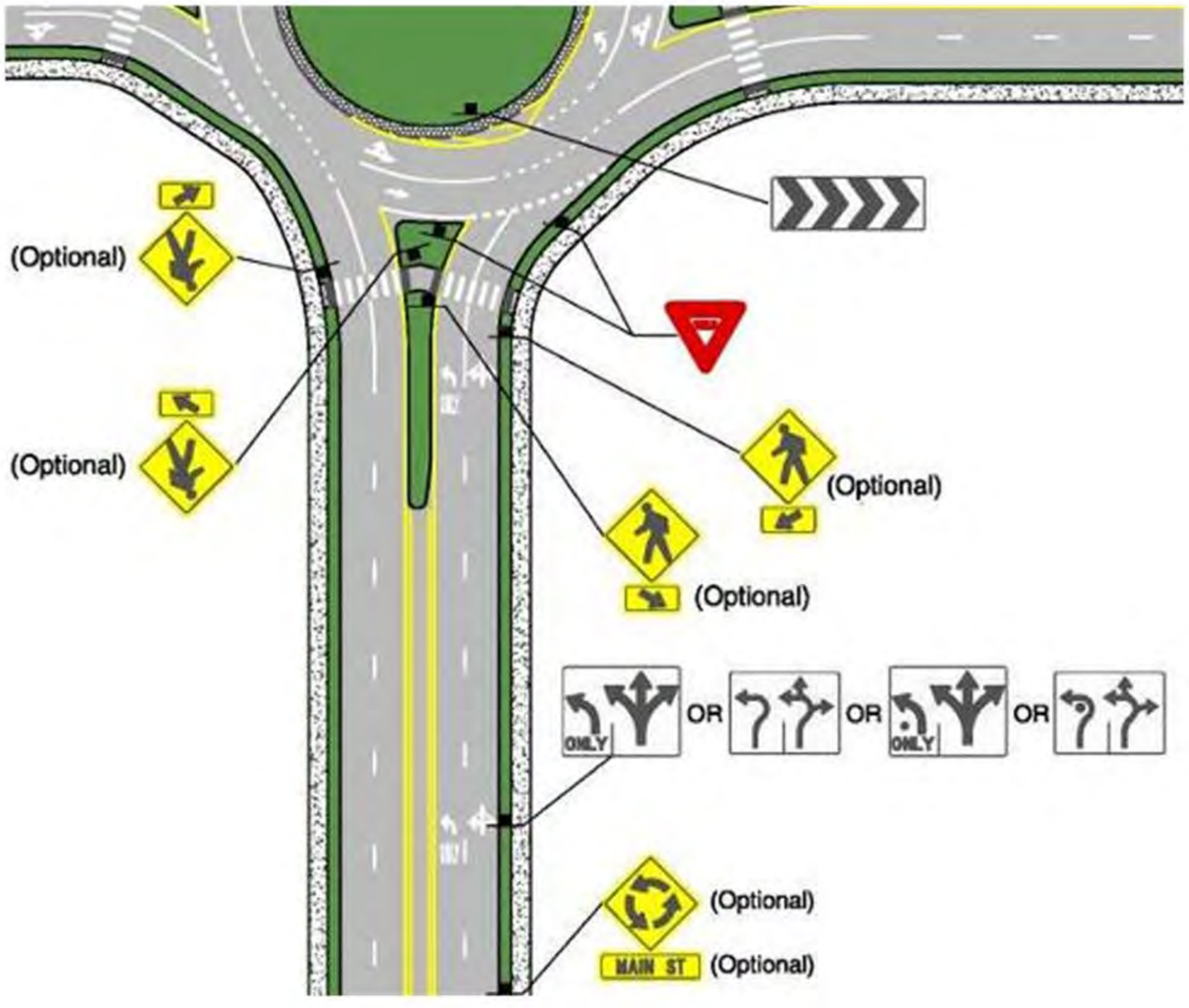




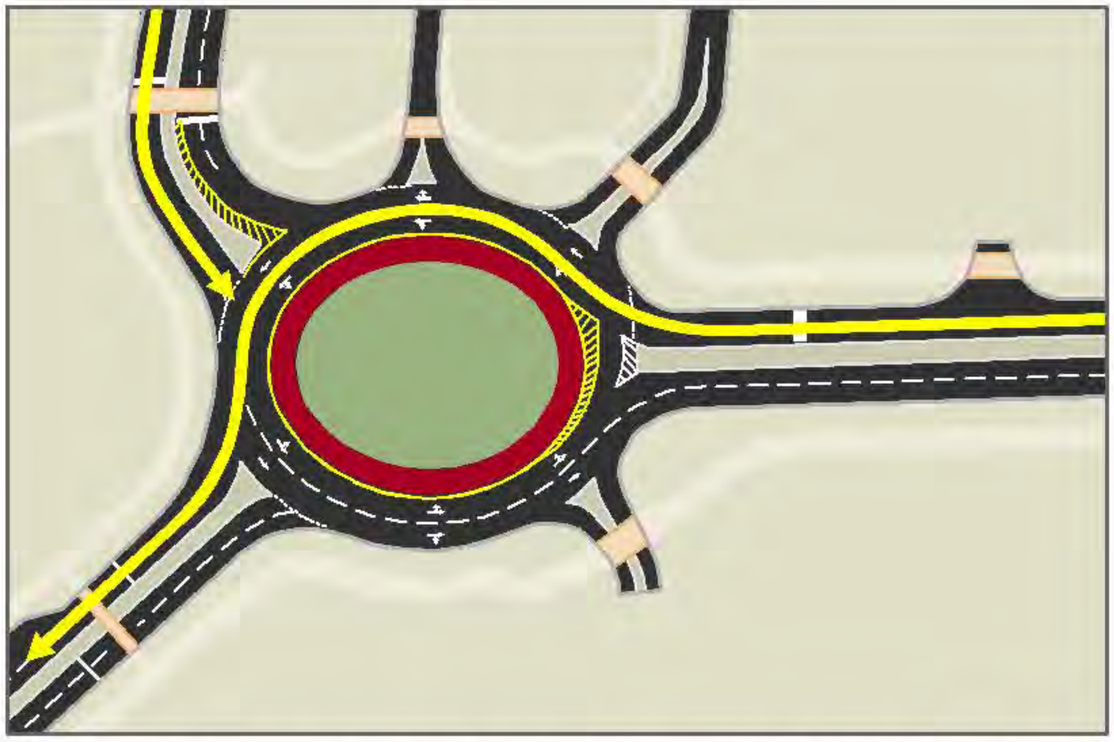


Signing and Markings: Typical Layouts

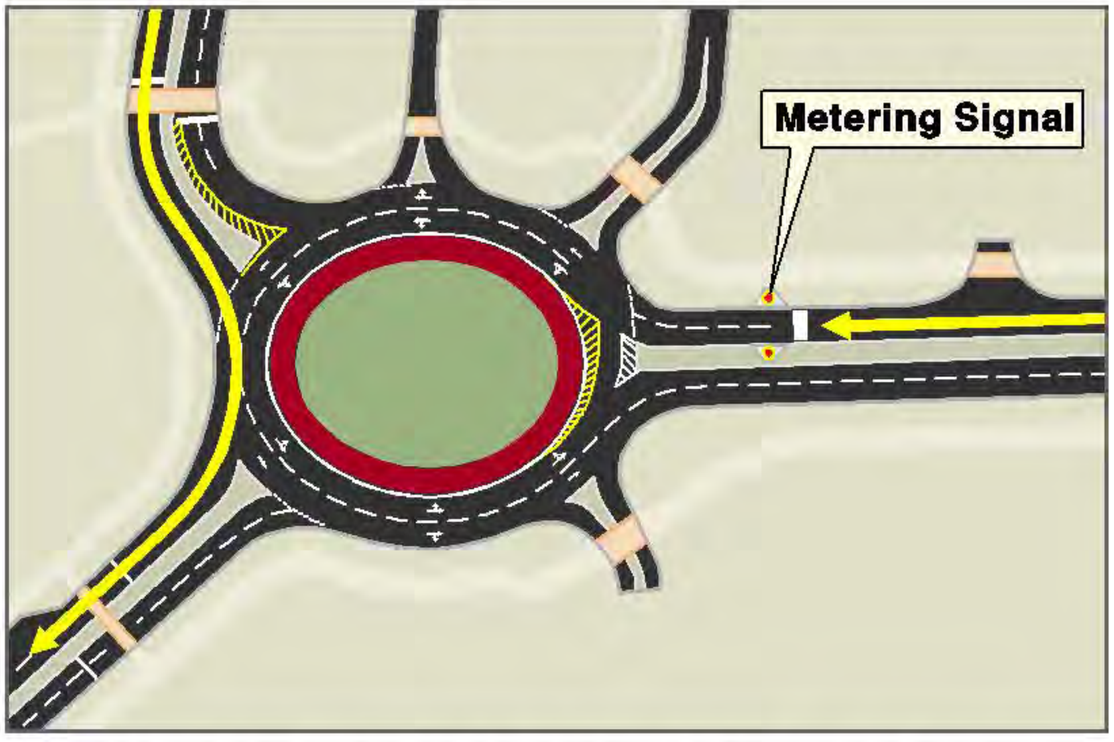




Applications of Signals and Beacons



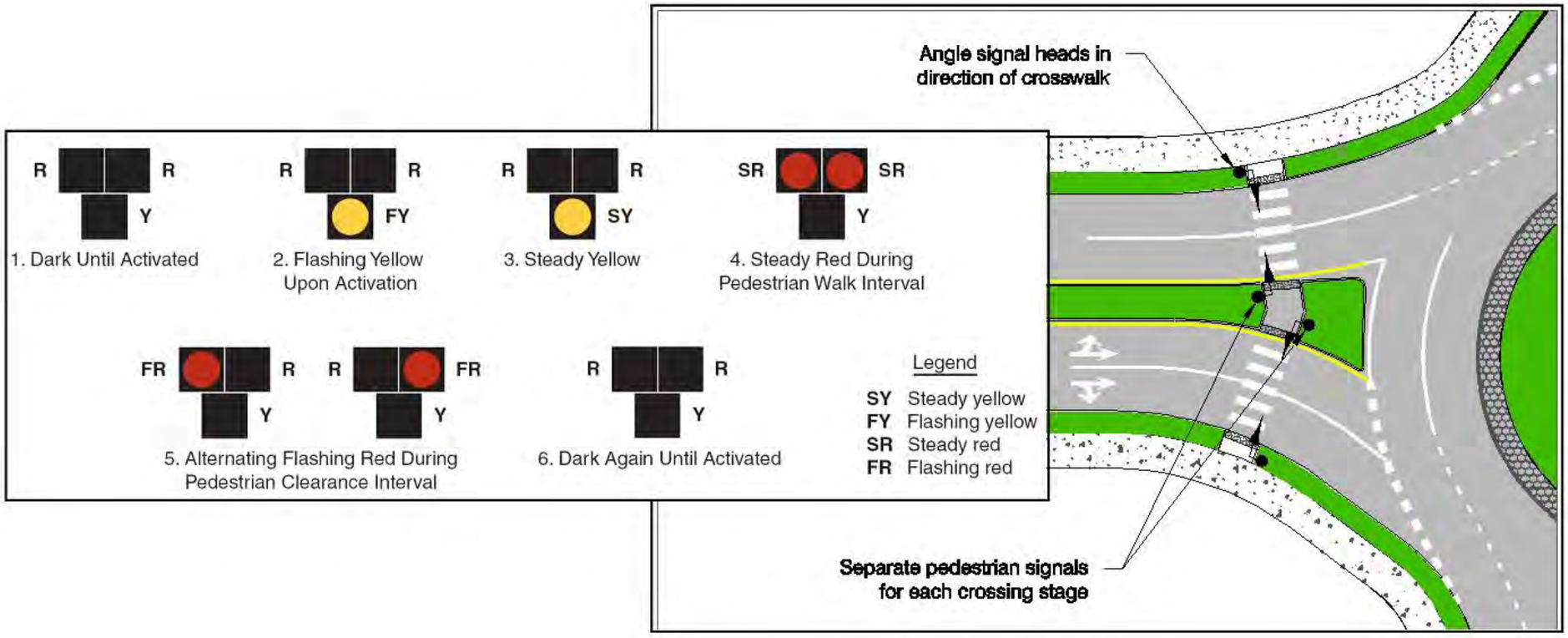
Without metering signal: At peak times traffic from the east flows continuously, blocking traffic entering from the north.



Metering signal briefly stops traffic from the east, which allows traffic from the north to enter the roundabout.

Applications of Signals and Beacons (cont.)

- Pedestrian Hybrid Beacon (HAWK)
- Rectangular Rapid Flashing Beacon



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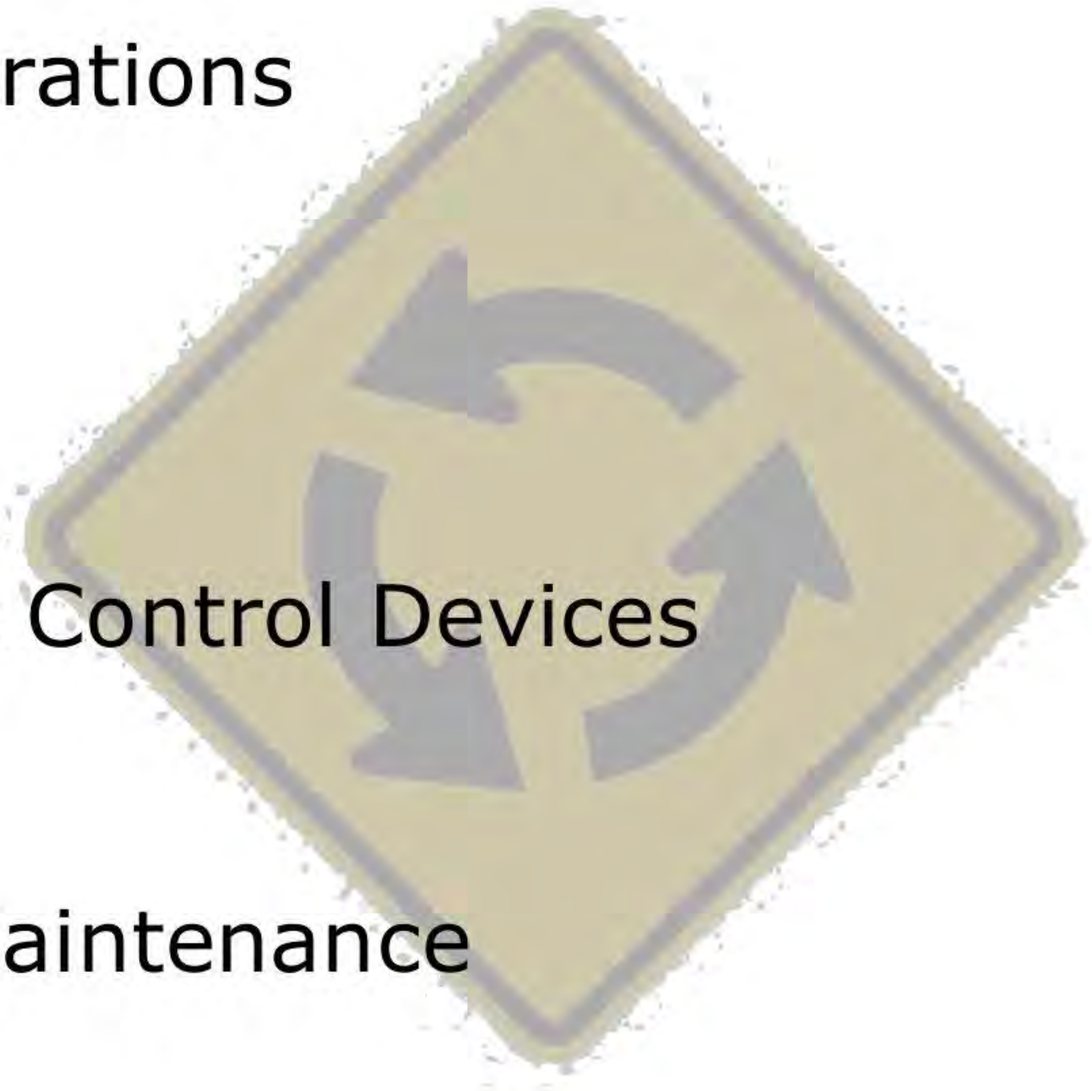
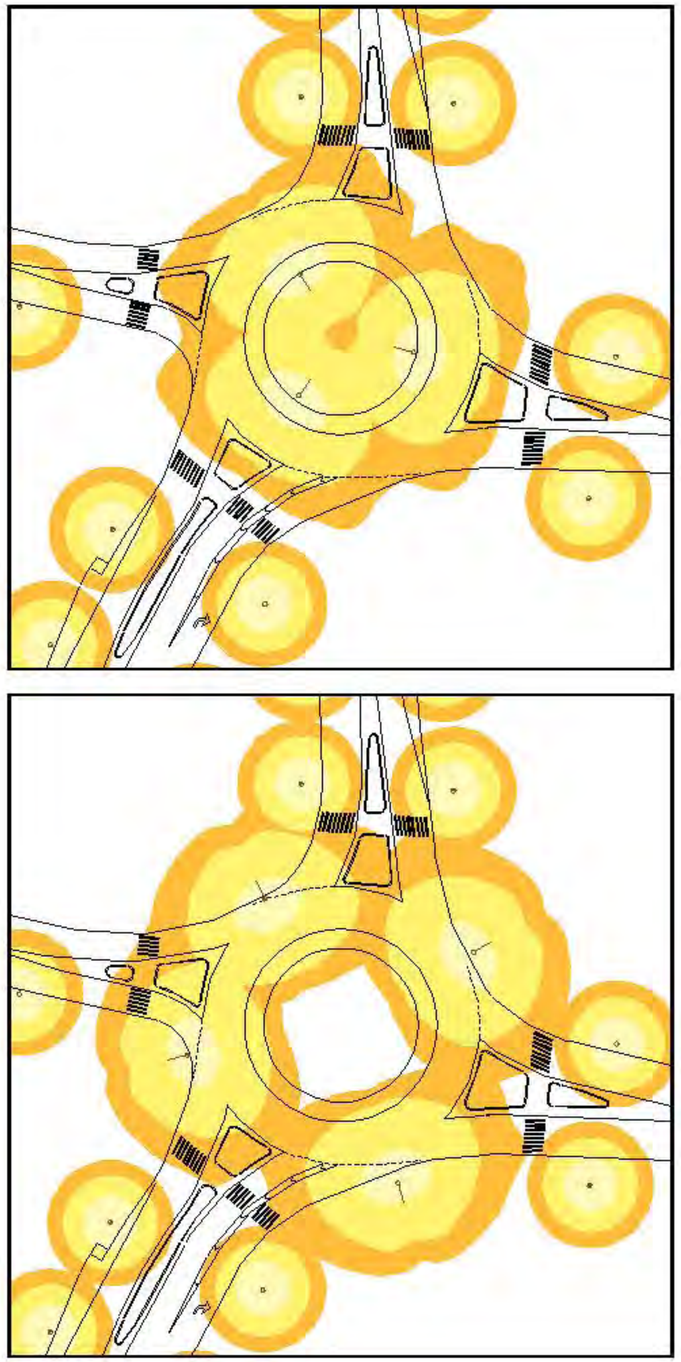


Chapter 8: Illumination

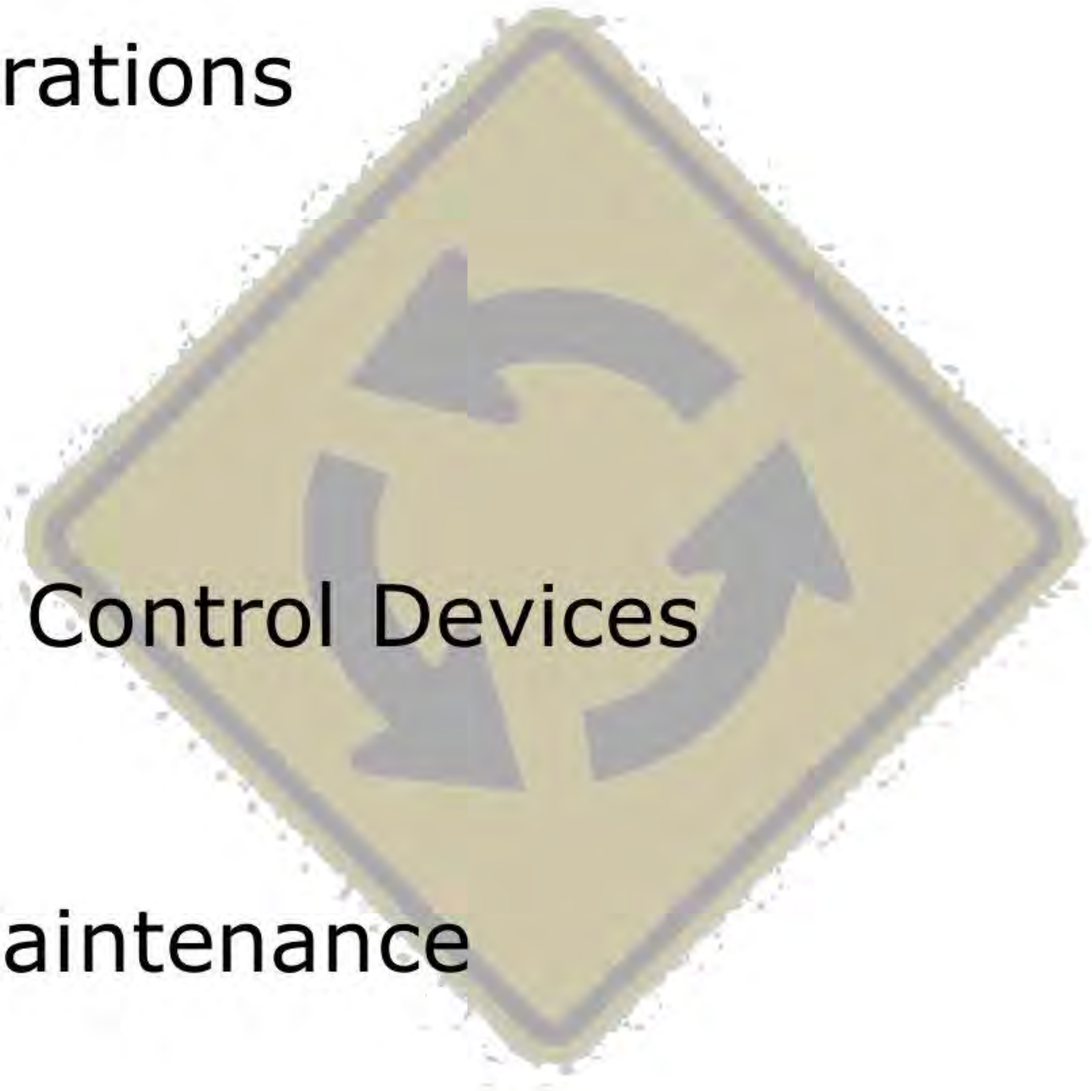
- Provides several useful resources for roundabout lighting
- Discuss principles
  - *Visibility from a distance*
  - *Visibility of key conflict areas*
- Lighting levels
- Equipment type/location
- Pole location
- Example illumination layouts



Roundabout Guide Outline

1. Introduction
2. Roundabout Considerations
3. Planning
4. Operations
5. Safety
6. Geometric Design
7. Application of Traffic Control Devices
8. Illumination
9. Landscaping
10. Construction and Maintenance

Appendices



Chapter 9: Landscaping

- Emphasis on visibility and focus of driver attention
- Expanded discussion of landscaping context
  - *Lower speed urban environments typically provide more flexibility than higher speed suburban or rural environments*
- Discussion of tradeoffs with art and other features

Photo: Lee Rodegerdts

Coralville, Iowa

Photo: Brian Walsh

Federal Way, Washington

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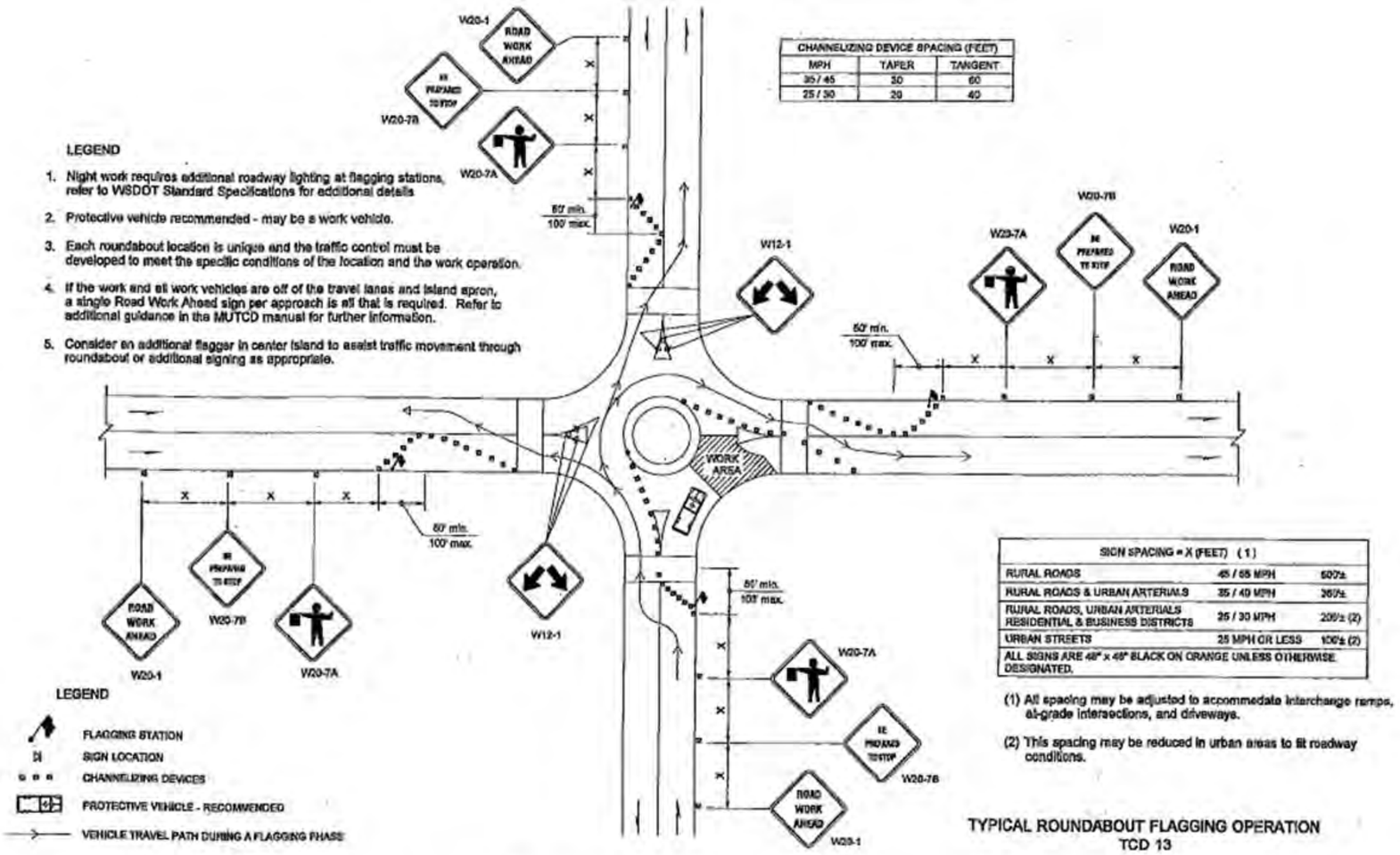
Appendices

Chapter 10: Construction & Maintenance

NEW!

- Construction staging scenarios
- Public information techniques
- Maintenance considerations



CHANNELIZING DEVICE SPACING (FEET)		
MPH	TAPER	TANGENT
35 / 45	50	60
25 / 30	20	40

SIGN SPACING = X (FEET) (1)		
RURAL ROADS	45 / 55 MPH	500±
RURAL ROADS & URBAN ARTERIALS	35 / 40 MPH	350±
RURAL ROADS, URBAN ARTERIALS RESIDENTIAL & BUSINESS DISTRICTS	25 / 30 MPH	200± (2)
URBAN STREETS	25 MPH OR LESS	100± (2)
ALL SIGNS ARE 48" x 48" BLACK ON ORANGE UNLESS OTHERWISE DESIGNATED.		

(1) All spacing may be adjusted to accommodate interchange ramps, at-grade intersections, and driveways.

(2) This spacing may be reduced in urban areas to fit roadway conditions.

TYPICAL ROUNDABOUT FLAGGING OPERATION
TCD 13

Washington State Department of Transportation

Conclusion

- The 2nd Edition presents a significant update and expansion over the 1st edition
- It incorporates US-based research and experience and many more US-based examples and photographs
- Reorganization of key sections is intended to clarify the emphasis on principles and balancing trade-offs

Thank you!

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