Roundabouts in the 2010 HCM and Updated FHWA Roundabout Guide

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Presentation Topics

- Overview of FHWA Roundabout Guide
- Ch 4: Operations (2010 HCM)
- Ch 6: Geometric Design
- Ch 7: Applications of Traffic Control Devices
Disclaimer

• Contents of this presentation is based on current drafts
• Review groups:
  – TRB Committee on Highway Capacity and Quality of Service
  – NCHRP 3-65A Project Panel
• Both documents MAY CHANGE prior to publication
FHWA Roundabout Guide Update

- FHWA Roundabout Guide has become a popular and standard reference
- Guide has become out of date with rapid increase in U.S.-based experience and research
- Prepare update in a timely manner to get new material to the profession
Outline Reorganization

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

Old Chapter 8 (Systems Considerations)

- e.g. Wide Nodes/Narrow Roads
- e.g. Simulation
- e.g. Interchanges, Access
- e.g. Signals, RR
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Need for Improved HCM Procedure

- Anchor to **empirical** U.S. performance
- Able to analyze multilane roundabouts
- Able to be calibrated
Basis for HCM

• Largely based on NCHRP research funded by states and FHWA
• Procedures can be based on international methods, but they must be calibrated to U.S. users
• Procedures thus must be calibrated to the performance of existing facilities
• Implications for roundabouts:
  – Existing performance
  – Existing facility types for which useful data can be collected
NCHRP 3-65/NCHRP Report 572

- Most comprehensive study of U.S. roundabout performance to date
NCHRP Report 572

- U.S. capacities lower than observed in other countries
- Capacity clearly sensitive to geometry in the aggregate (number of lanes)
- Secondary effects of geometry on capacity (e.g., lane width, diameter) masked by variations in driver behavior
- Lane-by-lane analysis needed
Possible Reasons for Lower Capacities

- Driver unfamiliarity with roundabouts
- Larger vehicles
- Prevalence of stop control
- Lack of use of turn signals on exits

- Trends may change over time or by region
- Suboptimal geometry affects lane use at multilanes

- **Ability to calibrate** is key element of procedure
Key Elements of Model Testing

• Empirical model based only on periods of continuous queuing
  – Frequently had queuing extending beyond field of view

• Calibration process explicitly included “effective geometry”
  – Needed for proper analysis of wide single-lane entries for width-based models

• Calibration process included field-measured gap acceptance parameters for applicable models
Data Supports Use of Simple Models

RMSE (root mean square error) of 140-160 vph
2010 HCM

• Production under NCHRP 3-92
• Four volumes
  – Volume 1: Concepts
  – Volume 2: Uninterrupted Flow
  – Volume 3: Interrupted Flow
    • Chapter 21: Roundabouts
  – Volume 4 (electronic)
    • Chapter 33: Supplemental Material on Roundabouts
Capacity

Capacity of one-lane entry or right lane of two-lane entry against two conflicting lanes

Capacity of left lane of two-lane entry against two conflicting lanes

Capacity of one-lane or either lane of two-lane entry against one conflicting lane

Dashed regression extrapolated beyond the data
Other Elements of HCM Procedure

- Calibration to locally measured conditions using critical headway and follow-up headway
- Lane use assignment
- Right-turn bypass lanes
  - Type 1: Yielding
  - Type 2: Non-yielding (acceleration or add lane)
- PCE adjustment for heavy vehicles
- Use of 15-minute flows or PHF adjustments
- Delay and queue estimates
Level of Service

- Considerable discussion on this topic
- Current proposal:
  - Based on control delay
  - LOS assigned to each lane, approach, and intersection
  - Delay thresholds same as for TWSC and AWSC intersections
- Committee recognizes that roundabouts are unique and may ultimately need their own thresholds (as may AWSC)
- Research to support new thresholds needed
Alternative Tools

• 2010 HCM will explicitly recognize that HCM procedures are not the only way to analyze problems

• Applicability of alternative tools
  – Geometric configurations not included in model
  – Oversaturated conditions requiring multiple-period analysis
  – Interaction effects with other intersections

• Overview of characteristics of applicable alternative tools for roundabouts
  – Deterministic tools (e.g., SIDRA, RODEL)
  – Simulation (e.g., VISSIM)

• Need for calibration
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Emphasis on Principles

- Fastest path
- Path alignment
- Design vehicle
- Non-motorized design users
- Sight distance and visibility
Emphasis on Principles (cont.)

Angle of intersection too severe. Angle should be no less than 75 degrees.

* ISD = Intersection Sight Distance

Improved angle

* ISD = Intersection Sight Distance
Emphasis on Design Tradeoffs

- Different circumstances require different solutions
- Use of principles in determining tradeoffs
Emphasis on Design Tradeoffs (cont.)

- Discussion of issues and techniques that are in use

Gore striping is one option for accommodating large design vehicles

WB-67 (WB-20) vehicle path
Emphasis on Solving Key Challenges

Note: Separation between entry and exit results in circulating-exiting path conflict.

Paths merge rather than cross
Emphasis on Solving Key Challenges (cont.)

Outside lane must exit

Right turn only lane

Paths cross rather than merge

Realigned approach

Previous alignment
Emphasis on Solving Key Challenges (cont.)

• Techniques to minimize wrong-way movements

Design allows cars to turn left in front of central island

Enlarged central island diameter

Entrance line moved forward
Emphasis on Non-Motorized Modes

- Landscape strip 5 ft (1.5 m) or greater desired width
- 2 ft (0.6 m) minimum width
- Wide sidewalk 10 ft (3 m)
- ADA compliant ramps
- Enlarged landscape area and additional setback for pedestrians
- Alternative sidewalk alignment 10 ft (3 m) width
- ADA compliant ramps
Emphasis on Non-Motorized Modes (cont.)

Diagram details:
- 35° to 45° Typical
- 6 ft (1.8 m) Typical
- Detectable warning surface
- 20° to 45° Typical
- Ramp down for bicycle
- 50 ft (15 m) min.
- 7:1 taper rate min.
- 50 ft (15 m) min.
- 100 ft (30 m) min.
- 50 - 200 ft (15 - 60 m) min.
- Ramp up for bicycle (See Detail "A")
- Landscaping strip
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Signing and Marking Principles

• Chapter is complementary to MUTCD
• Signing and pavement markings are integral to the design of a roundabout
• Geometric design does most of the work
  – Speed control
  – Vehicle alignment
  – Conflict point elimination
• Signing and pavement markings help with lane use decisions and legal definitions
• They cannot completely fix geometric design problems
  – Overly large diameters
  – Large separation between adjacent legs
Sign Changes

• **Roundabout Chevron Directional sign (new)**
  - Black on white, not black on yellow

• **Roundabout Circulation sign**
  - Supplements yield at minis
Signing: Single-Lane Roundabout
Signing: Multilane Roundabout
Advance Guide Signs

- Roundabout Destination signs
- Curved stem arrow
- Advance Street Name sign
Signing: Mini-Roundabout
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

![Diagram of pedestrian hybrid beacon (HAWK) and rectangular rapid flashing beacon]

Legend:
- SY: Steady yellow
- FY: Flashing yellow
- SR: Steady red
- FR: Flashing red

Angle signal heads in direction of crosswalk

Separate pedestrian signals for each crossing stage
Next Steps

- Publication of both documents expected 2010
- Ongoing research and experience will continue to add to profession beyond these documents
Thank You!

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