Confused about Signing and Marking at Multi-Lane Roundabouts?

LEARNING OBJECTIVES:

1) UNDERSTAND ISSUES AND CHALLENGES

2) APPLY LESSONS LEARNED

3) ACHIEVE OPTIMAL RESULTS

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MTJ Roundabout Engineering

OTECE October 2nd 2018
A. INTRODUCTION - EXAMPLES
B. MUTCD & BEST PRACTICE
C. CASE STUDIES – LESSONS LEARNED
D. DESIGN OPTIMIZATION EXAMPLE
INTRODUCTION

ROUNDABOUT DESIGN

Multi - Lanners

➢ More traffic
➢ More Lanes
➢ More Conflicts Pts.

INTEGRAL TO THE DESIGN

Pavement
Markings
Signing
Geometrics
Three-Lane Entry:

15 crashes per year (5 years)
~45k ADT

9 Conflicts

Design by: MTJ Roundabout Engineering
Flared- Two Lane Entries 2x2:

Ave. 20 PDO/yr
3 yrs of data,
~30K ADT
16 Conflicts
Success Stories

5 PDO/yr
2yrs of data, ~25K ADT

8 Conflicts

MTJ Roundabout Engineering Design
INTRODUCTION

HUMAN FACTORS RESEARCH
“Negotiating intersections involves the absorption and processing of visual information presented to the driver, primarily by the signs and pavement markings”
“Design should reduce demand made on drivers, to improve comprehension”
“Adhere to Drivers Expectations/Experiences”
INTRODUCTION

DESIGN OBJECTIVES:

- Minimize detection, reading and processing time
- Maximize comprehension

INTRODUCTION - EXAMPLES

Katie Clark, 23, of Brighton says the roundabout is a little frustrating because there are too many signs to read in a period of time. See full image.
INTRODUCTION - EXAMPLES

Multi-Lane = High Risk of Information Overload
Multi-Lane = High Risk of Information Overload
Maximize comprehension
INTRODUCTION – UK (GOOD) EXAMPLE

- Place signs according to the importance of their information
- Organize information into larger units with Color and Shape
• “Cookbook approach not advised”

• “Principles should be basis”

Professor Gene Hawkins, Texas A&M
Past Chair of NUTCD Committee
INTRODUCTION - EXAMPLES

Exit Sign Confirms exit leg choice

‘Tilt’ Arrow borrowed from Off-Ramps,
INTRODUCTION - EXAMPLES

HUMAN FACTORS RESEARCH

chevron end minimizes detection and improves advance recognition of leg choice
B. MUTCD
1. Lane Use Assignment
   - Fish Hook or
   - Standard

2. Circulatory Roadway Markings
   - Solid/Skip vs
   - Consistent Line

3. Yield/Entry Markings
   - Edge Line Extended, and Sharks Teeth
   - vs Singular Heavy Demarcation
• MUTCD is consensus based approach
  ■ Many voting on content had little or no practical RAB experience

Professor Gene Hawkins, Texas A&M
Past Chair of NUTCD Committee
1. Lane-Use Assignment

- Diagrammatical (Fish Hook) vs Standard
#1. MUTCD Lane Use Assignment

Fish Hook New Convention

Standard= Familiar Driver Convention
#1. MUTCD Lane Use Assignment

Driver Expectancy
#1. MUTCD Lane Use Assignment

Fish Hook on Approach,

Standard within circulating roadway

Inconsistent – Driver Expectancy?
#1. MUTCD Lane Use Assignment

Driver Perspective View
#1. MUTCD Lane Use Assignment

Standard Circulating

Consistent – Meets Driver Expectancy...
#1. MUTCD Lane Use Assignment
#2 Circulating Roadway Markings

- Solid and Skip
- Consistent Line Type
- Lane Widths (equal or un-equal)
Solid / Skip
Drivers behave/react based on learned expectations
Consistent = Adherence to Driver Expectancy
#2. MUTCD Circulatory Roadway Markings

Circulatory Markings:
- Consistent Line Type
- 10-12’ Inside
- 16-19’ Outside
3. Entry Markings / Yield Line
3. **MUTCD** Entry Markings - Yield Lines

"Edge line extended" from Highway Markings

- **Priority Message**
  - Confused
- **Body Language of a Merge**

Edge Line Extended, and Sharks Teeth
3. MUTCD Entry Markings - Yield Lines

Simplifies Messaging

Singular Bold Priority Line
3. MUTCD Entry Markings - Yield Lines

Singular Bold Priority Line
C. Safety Audit - Case Studies
Case Study #1

Crash Pattern Attributed to Lane Discipline Issues and FTY

FHWA P2P Program: Data Courtesy of SCDOT
Case Study #1

Entry Alignment and Natural Path Principles

Existing Confusing Messaging

Before

Singular Bold Priority Line = Priority Messaging

After
Case Study #1

Circulating Marking Type and Alignment

Existing Confusing Messaging

Clarity in Messaging & Improved Alignment

Before

AFTER

11’
crash rate reduced 50% - a good win in my book.

I’m sure pavement markings may need refreshing after 5 years but was pleased with the results considering the geometry remains the same.

...the crash reductions we achieved are strong evidence of the importance of optimized markings.

Thanks for all your assistance!

Joey Riddle, PE
Safety Program Engineer
SCDOT
SPECIAL RECOGNITION
RESEARCH PARTNERSHIP 2014

To recognize research projects within the CTS program that result in significant impacts on transportation, and to reward teams of individuals who draw on the strengths of their diverse partnerships to achieve those results.

Effect of Signing and Striping on the Safety of a Two-Lane Roundabout

Minnesota Traffic Observatory,
University of Minnesota
John Hourdos

City of Richfield
Kristin Asker

MTJ Engineering
Mark Johnson

Hennepin County
Jon Kreig

MnDOT
Shirlee Sherkow

UNIVERSITY OF MINNESOTA
Case Study #2
Solid then skip circulating markings
Case Study #2

- Comprehensive Approach- Effect Driver Behavior Change
- Researchers wanted an incremental approach (isolate each variable)
- Practice/Experience taught me that wouldn’t be effective
Case Study #2

85% Reduction of wrong movements from outside lane

Standard Lane-Use Markings and Signs

Consistent circulating markings
Standard Oversized Lane-Use
Case Study #2

Problem

Alternative Solution
~30% Increase in Yield Rates

Source: John Hourdos
Minnesota Traffic Observatory, University of MN
D. Design Process Example
D. Design Process Example
D. Design Process Example

SIGNAGE OPTIONS

SINGLE SIGN ALTERNATIVE

EAST BOUND 1A
D. Design Process Example

SIGNAGE OPTIONS

DOUBLE SIGN ALTERNATIVE

EB 2a
North
1
South
17 Mile Dr

EB 2a-1
Monterey
Carmel
Pebble Beach

EAST ROUND 2A
D. Design Process Example
D. Design Process Example

04

Signage Options

Left  Right
South

Pebble Beach
17 Mile Dr

YIELD
Summary
Multi - Lanners

- More traffic
- More Lanes
- More Conflicts Pts.

Geometrics, Markings & Signs – All Integral to Design
Multi-Lane Roundabouts

- More Traffic
- More Lanes
- More Conflicts

Greater sensitivity to imperfections

SUMMARY
SUMMARY

Multi-Lane Roundabouts

- Design Incongruences have an un-expected & Disproportionate effect on Driver Behavior
SUMMARY

- Simplify Decision-Making
- Intuitive & Easy to Understand
- Adhere to Driver Expectations
The End/
Questions

Mark T. Johnson, P.E.
MTJ Roundabout Engineering
- Key Contributor to WIDOT Roundabout Design Program 2001 - 2005
- Co-Author of FHWA 2010 Roundabout Guide
- FHWA Authorized P2P Reviewer

Resources Available:
http://www.mtjengineering.com/

Trending Operational Analysis, Design and Safety Issue Summaries by Mark T. Johnson of MTJ Roundabout Engineering
Please see these technical publications from our recently published papers/posters.

| Traffic Planning Implications of the Operational Characteristics of Roundabouts | Solving Complex Traffic Issues with Unique Roundabout Applications |
| Synthesis of Roundabout Design and Operations with Multi-Lane Flared Entries | Roundabout Geometric Capacity Measurement: Calibration and Validation of U.S. Field Measurements |
| Application of Safety Design Principles for Urban Multi-lane Roundabouts | Public Outreach and Roundabout Implementation: Overcoming Challenges |

Featured Roundabout
Holman Highway 68/Highway 1 Roundabout
Monterey, CA

Featured Video
Flared Entry Roundabout