Avoiding Roundabout Design Failures - An Interactive Approach to Identifying Errors and Finding Solutions

Presented by
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ASCE | KNOWLEDGE & LEARNING

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Meet Your Instructor

- Course instructor for UC Berkeley on classes concerning on roundabouts
- Reviewer of many roundabout projects for five public agencies
- Responsible for implementing many mini-roundabouts in London
- Reviewed many roundabout locations both before and after construction of the roundabouts
- Provided peer review of roundabout designs by other transportation professionals
- Specialized expertise on designing roundabouts for all road users

2

What You Will Learn

- What can go wrong at roundabouts?
- What are the most common mistakes?
- Identifying crash patterns and what they tell us
- Identifying conflict patterns and what messages they convey
- Identifying the most effective ways to avoid makings similar mistakes
- Case study results
- Best sources of additional information

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Webinar Format

- Duration: 90 minutes ON LESSON LEARNED FROM CASE STUDIES
- Follow along with pdf of slides
- Create a folder of slide pdfs and all technical report free downloads
- Feel free to ask questions
- Instructor may ask audience a question at a specific slide
- **Webinar Quiz Questions**

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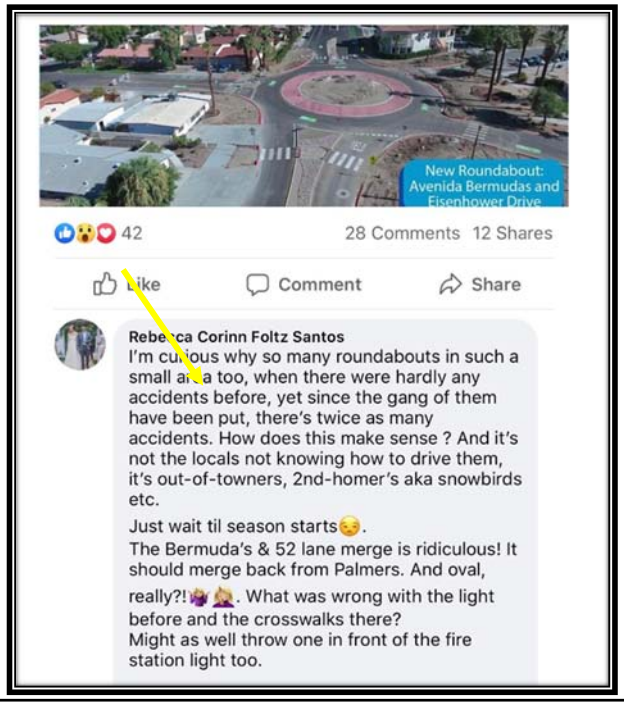

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CASE STUDIES

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Long Beach, CA

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Daisy Avenue and 4th Street in Long Beach

https://abc7.com/car-goes-airborne-in-crash-caught-on-camera-in-long-beach/5927454/

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VIDEO: Car goes airborne after crashing into roundabout in Long Beach

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Webinar Quiz

Why Was the Driver Surprised by the roundabout?

a) Incorrect markings
b) Inadequate advance warning and at roundabout
c) Center island sign not per MUTCD
d) In appropriate four way stop operation
e) All of the above

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Lompoc, CA

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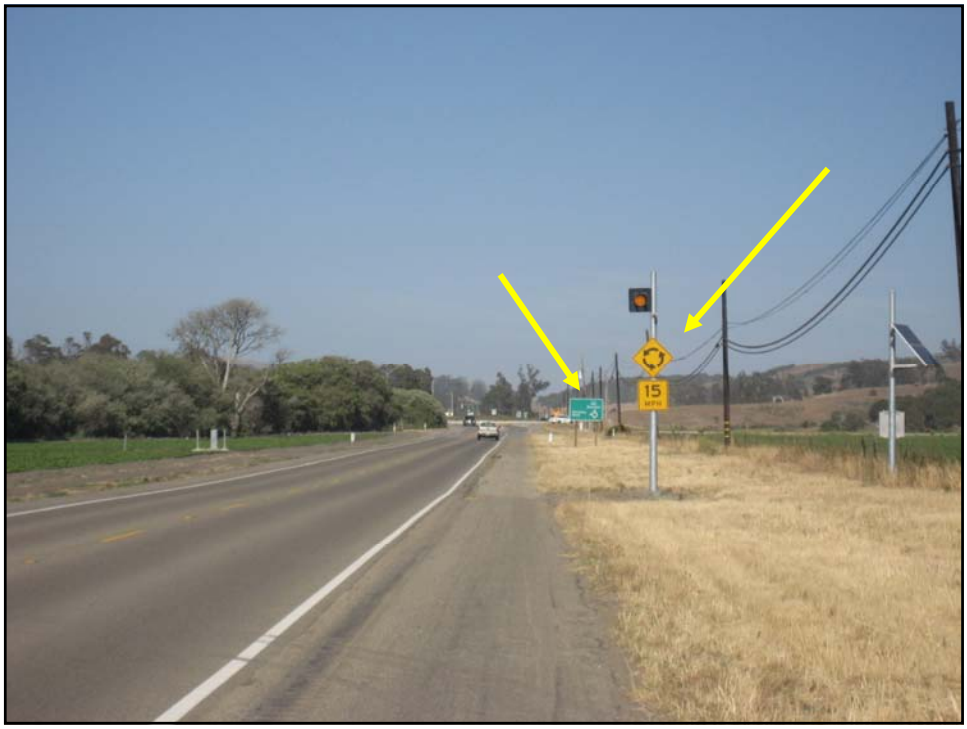
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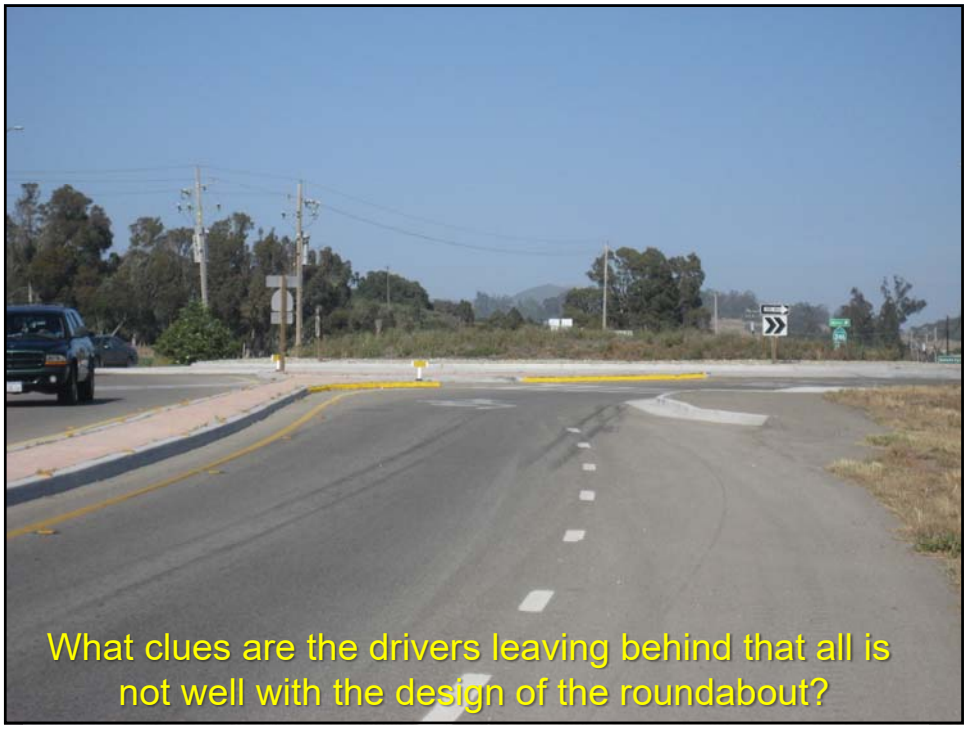
What clues are the drivers leaving behind that all is not well with the design of the roundabout?

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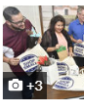
VIDEO: Ventura firefighter dies in roundabout crash

Sep 21, 2016

RECOM



LOCAL NEWS

Shop Lomp promotion put focus l local busir

http://lompocrecord.com/news/local/video-ventura-firefighter-dies-in-roundabout-crash/youtube_fff9f457-c5c6-5ecf-9f29-6c0003bc7748.html

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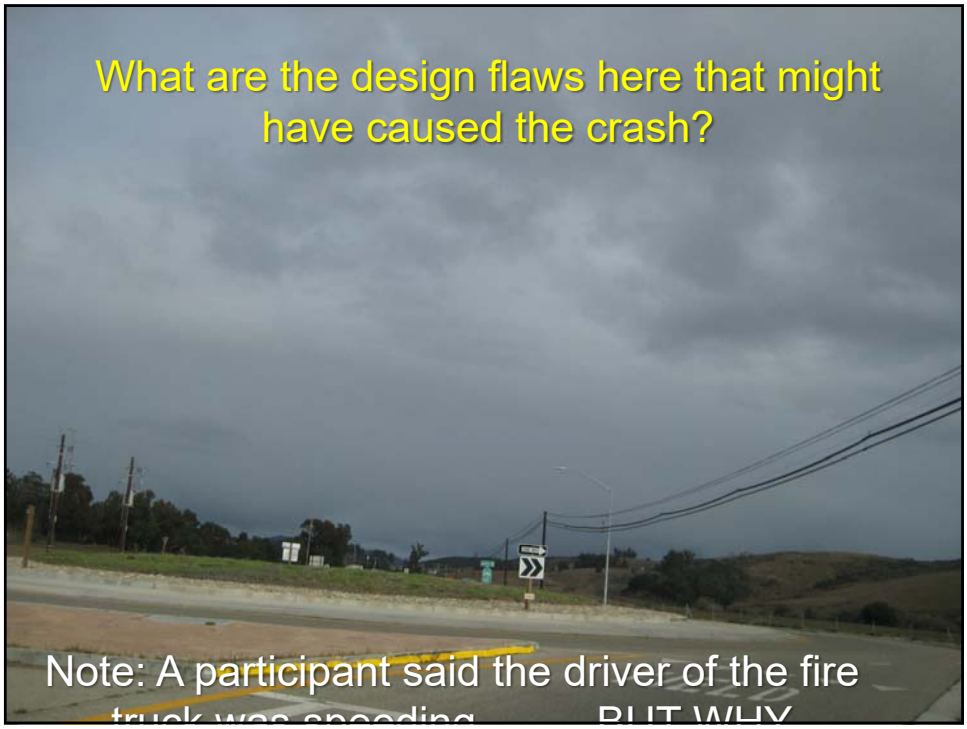

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State Highway in Arizona

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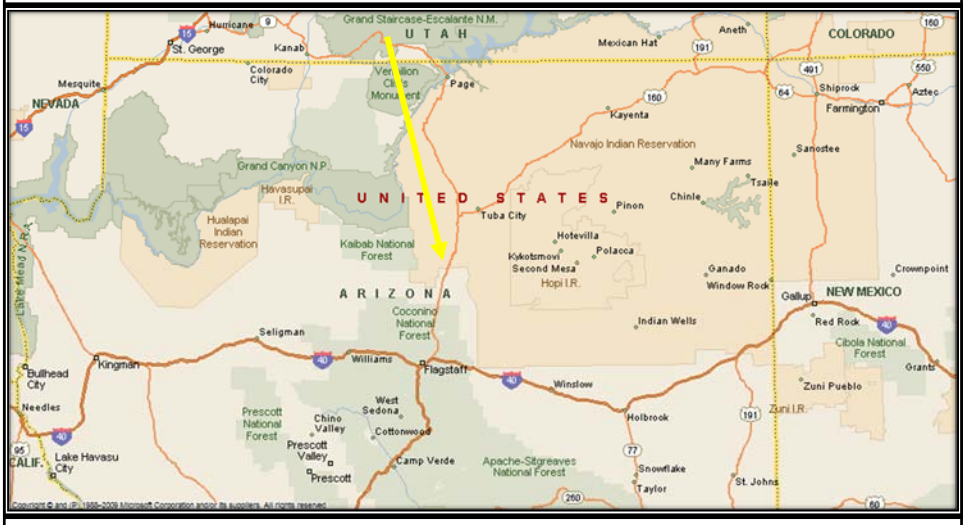

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Observation During Site Visit

- The roundabout curb has severely damaged curb and skid mark
- Roundabout appears out of nowhere after driving for 40 miles at 65 miles per hour without any interruptions on US 89 from Flagstaff.
- Advance warning appears minimal – no flashers, diagrammatic signs, or rumble strips
- Roundabout warning signs that are present appear small

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Webinar Quiz

Why Would Roundabout Damage be Expected?

a) Isolated roundabout
b) Minimal advance warning/Yield signs not clearly visible
c) Center island conspicuity/Signs on the island too high
d) No grooved rumble strips
e) All of the above

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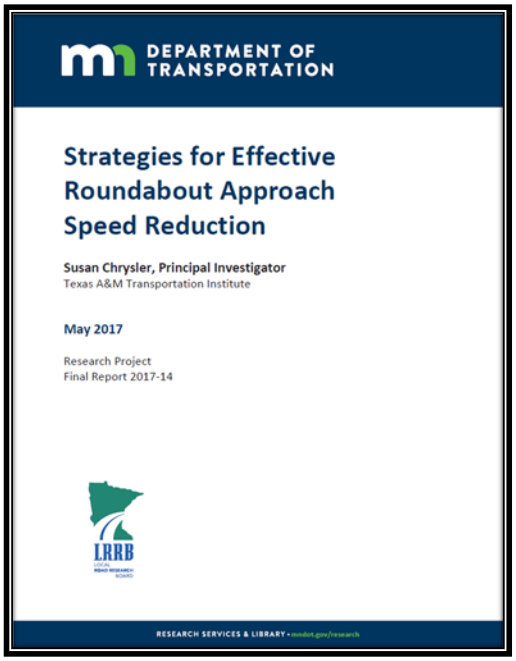

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https://mntransportationresearch.org/2017/08/02/choosing-effective-speed-reduction-strategies-for-roundabouts/

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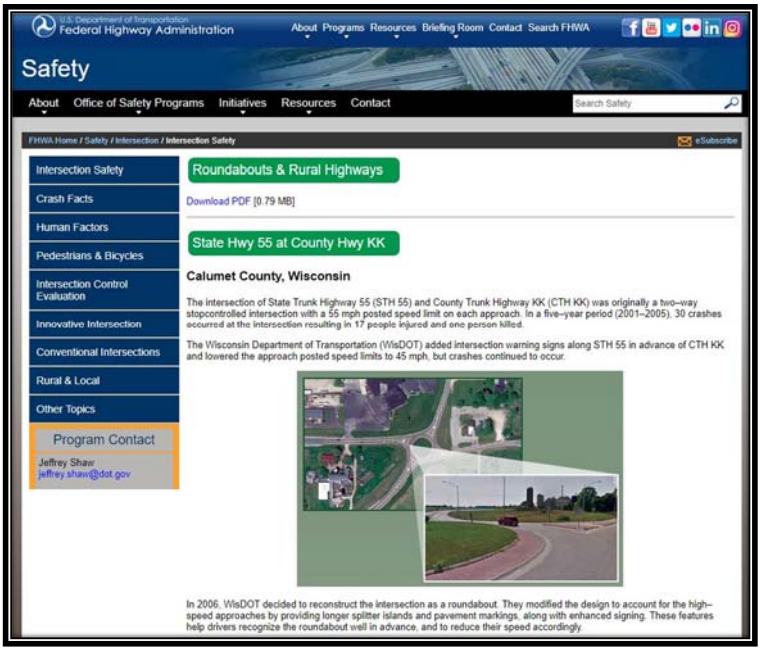

https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/rural_roundabouts/

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Double Fatality in California

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Crash Facts

- Two motorcyclists killed at two new roundabouts
- Design compliant with current guidance
- Crash occurred when it was getting dark (dusk)
- East west street with a center raised median/splitter and posted speed of 45 mph
- Construction work was still being completed
- Roundabouts had been recently open to traffic (1-2 days)
- Motorcyclists appeared to be unaware of new roundabouts

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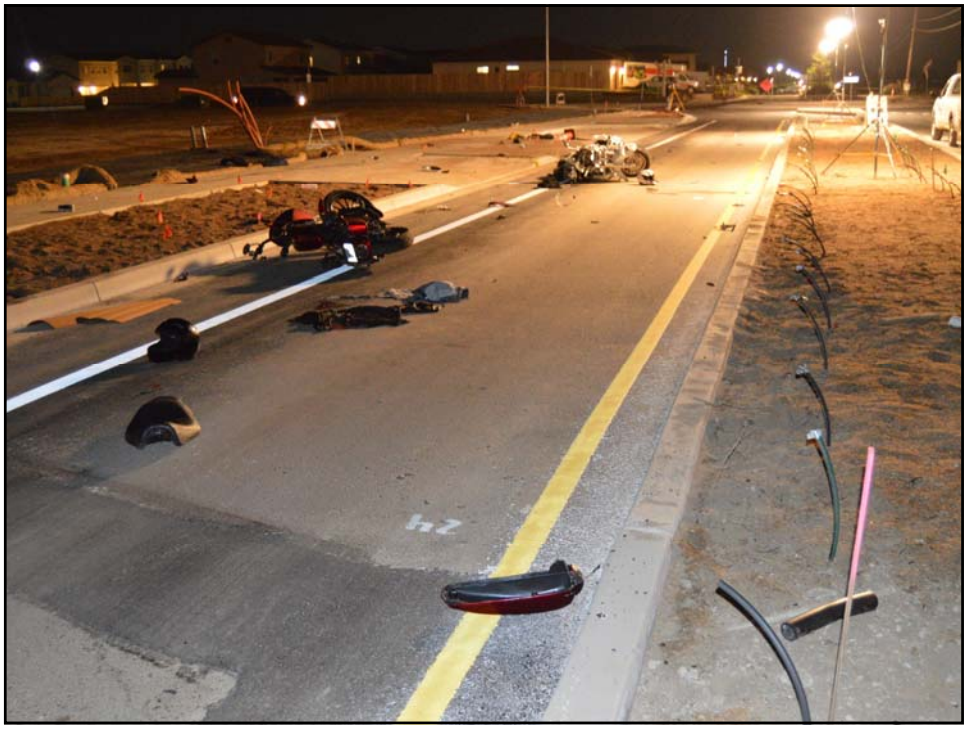

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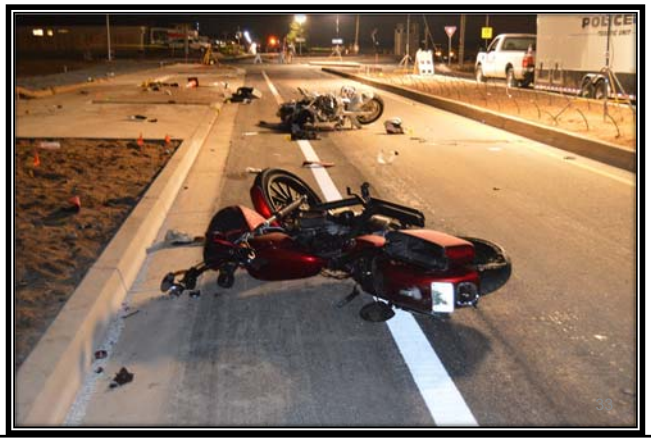
Webinar Quiz

What Could Have Been Done?

a) Wait until all landscaping construction was completed to open street to traffic
b) Add more advance signs than required
c) Provide orange flags on approach signs
d) Provide CMS announcing new roundabouts
e) All of the above



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More Crash Facts on SR 12/13

One person died in a crash Wednesday night in unincorporated Solano County west of Rio Vista, according to the California Highway Patrol.

https://www.sacbee.com/news/local/article235258957.html

The solo-vehicle crash was reported at about 10:40 p.m. at state Highway 12 and state Highway 113.

A vehicle crashed into a **concrete roundabout**, CHP Officer James Evans said. Reported at sfgate.com.

Two elderly people were killed in a crash Wednesday night when their vehicle collided with a **highway roundabout being constructed** west of Rio Vista, according to the California Highway Patrol.

Fatal crashes at roundabouts spreadsheet – available on request

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La Quinta, CA

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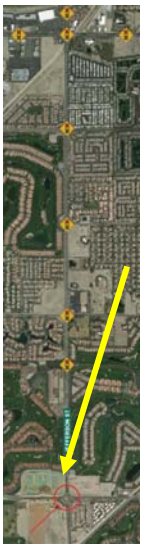
Problems with Roundabout



- Constructed in 2002
- Many citizen complaints of side swipe conflicts
- 105 crashes in 10 years – more than 70% were drivers running into roundabout
- Signing changes by designer did not work
- Pedestrians and bicyclists hate it!
- City discusses many options - improvements in 2015

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What are the design flaws here?

37


And here?
Video at www.traffexengineers.com

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Proposed Changes Considered

- Dual lane striping on circulatory road with one lane sections (Per 2009 MUTCD)
- Signs to tell truck drivers to take both lanes (Unsure this will work)
- Restriping exits to make them only one lane wide
- Advance speed reduction markings to reduce entry speeds closer to the circulatory design speed of 19mph
- **What design changes should be implemented?**

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Avenue 52
Jefferson St SOUTH
Jefferson St NORTH
10 -14 collisions per year before – only 1- 3 per year after improvements completed

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Diagrammatic Sign for Two Lane Roundabout

45

Union Gap (Yakima), WA

46

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Comments Made During Site Visit

- Waste of time
- Dangerous
- Waste of money
- Put it back the way it was
- Who is going to pay for the repairs for the damaged curbs
- Can you get this project stopped?

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What is broken here?
SHOPKO

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Yield sign is too far to the right
Chevron is too small
Sign in splitter island is best option in FYG
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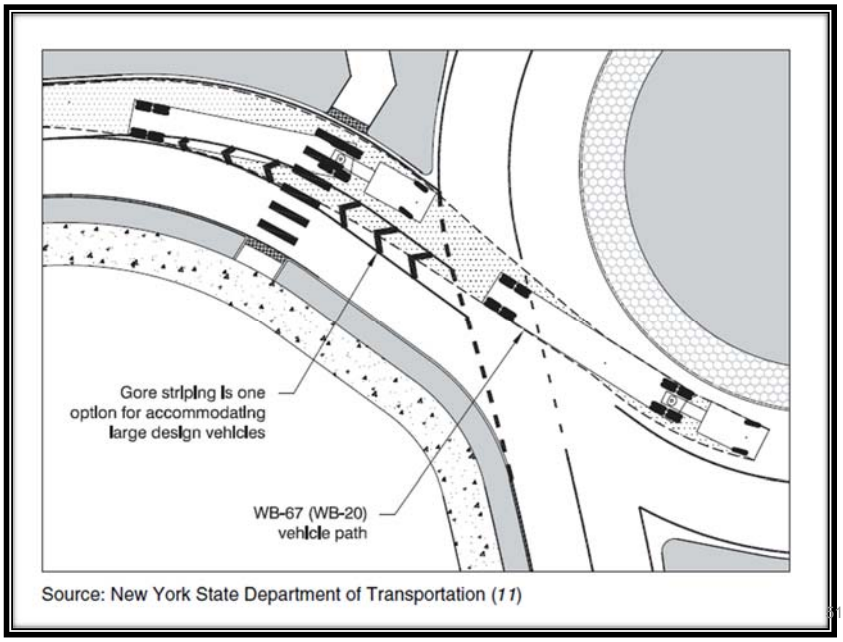
Truck Path With Gore Striping (NCHRP 672)



Source: New York State Department of Transportation (*11*)

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SOURCES OF OTHER COMMON DESIGN PROBLEMS

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Avoid Fixed Objects in the Center Island

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Landscaping and Aesthetics

(Can help but be careful!)

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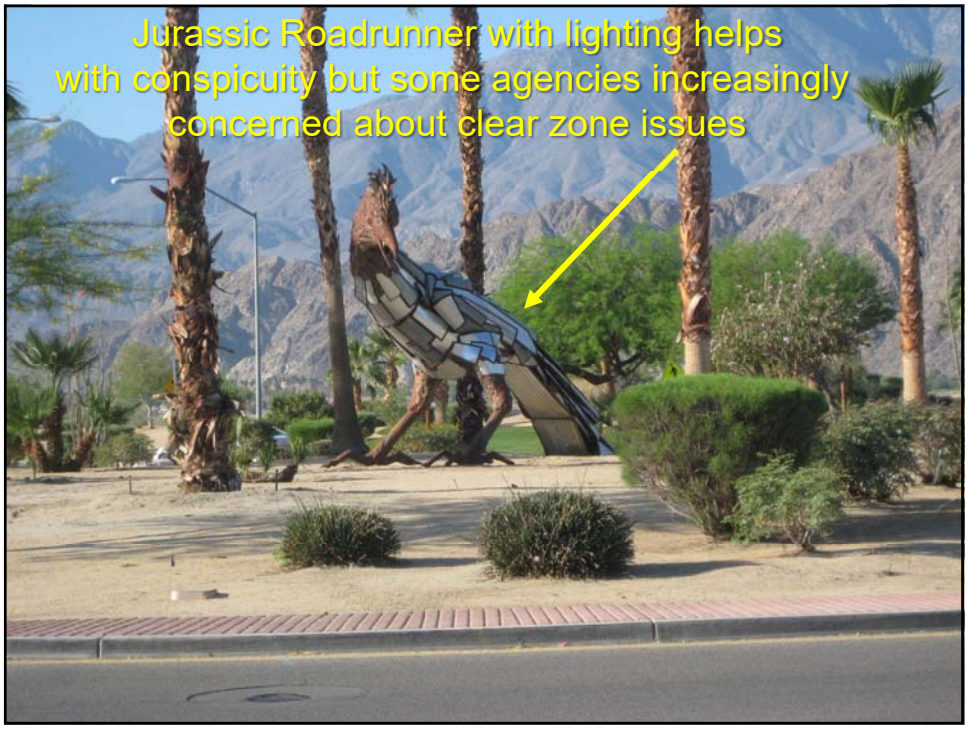
Jurassic Roadrunner with lighting helps
with conspicuity but some agencies increasingly
concerned about clear zone issues

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Palm Tree in Roundabout

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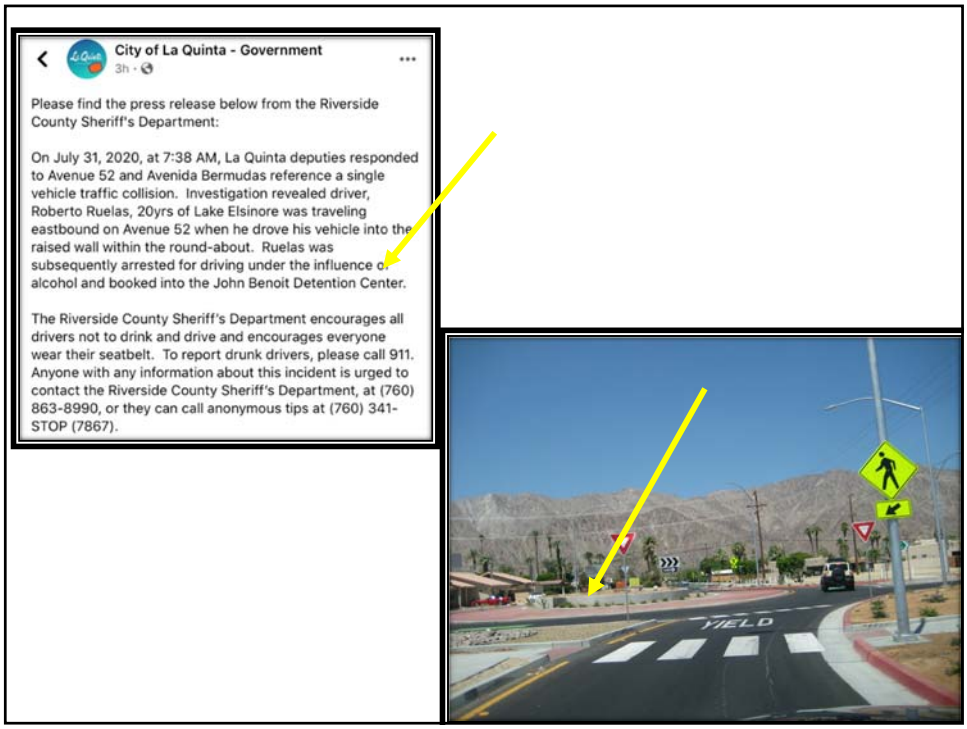

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Sight Distance

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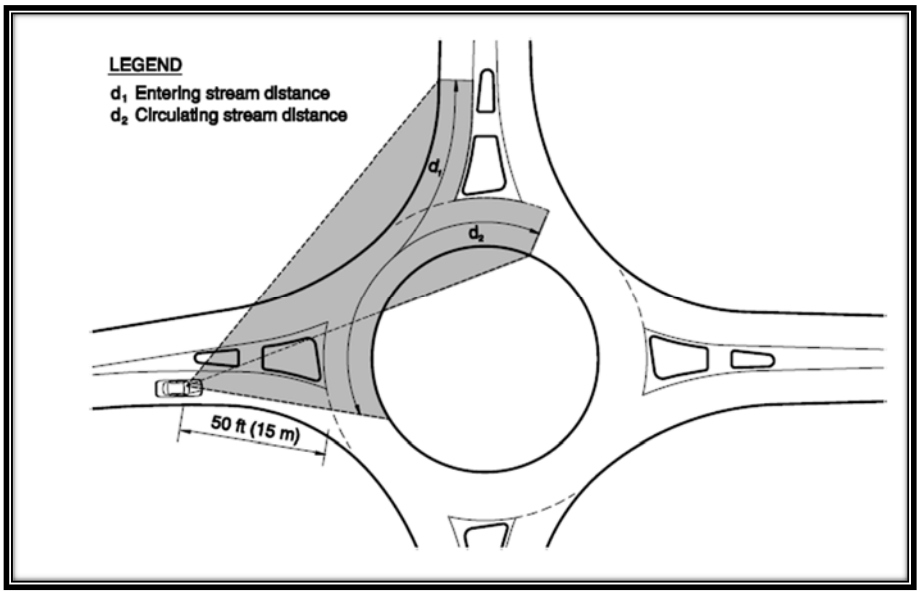
Entering Stream Distance and Circulation Stream Distance



Source: NCHRP 672

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New Roundabout at NB Off Ramp on I 5
LEFT LANE
RIGHT LANE

61


What clues are there that somethings are not quite right here?

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Fire Departments uneasy about Roundabouts –why is that?

Source: Omni Means for City of La Quinta

63

Fire fighters need to be visible

64

Webinar Quiz

How many collisions happened at the Jefferson and Avenue 52 roundabout over a 10 year period before changes were made?

a) 75
b) 100
c) 105
d) 85

65

Badly Designed Truck Aprons Cause Problems

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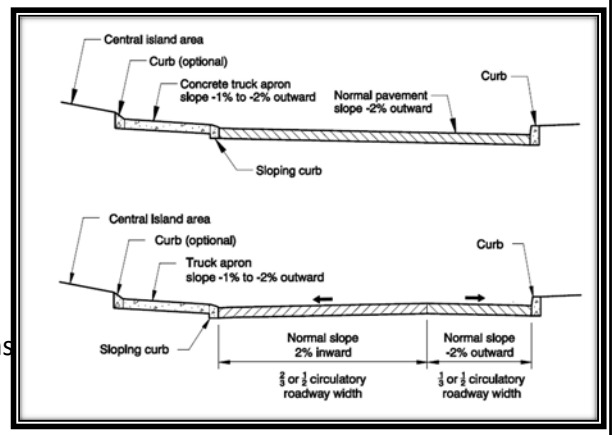
City Requested Review

- Something is wrong with the roundabout
- Bus driver is complaining
- Bus passengers are complaining
- Skid marks show problems
- What went wrong?
- What should be changed?



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Rear Wheels Mount the 2" High Truck Apron

Video at www.traffexengineers.com

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Roundabout Exit Lanes Should Be Well Marked

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What would be a major design concern here?
View video at www.traffexengineers.com
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What critical signage is missing here considering this is a freeway interchange?
74

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DO NOT ENTER
WRONG WAY

75


Destination Signing
89A
NORTH
MILE
349

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Sufficient Deflection is Critical

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Contra flow by pass lane
STOP
How many design flaw are there here?
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Contra Flow Lane

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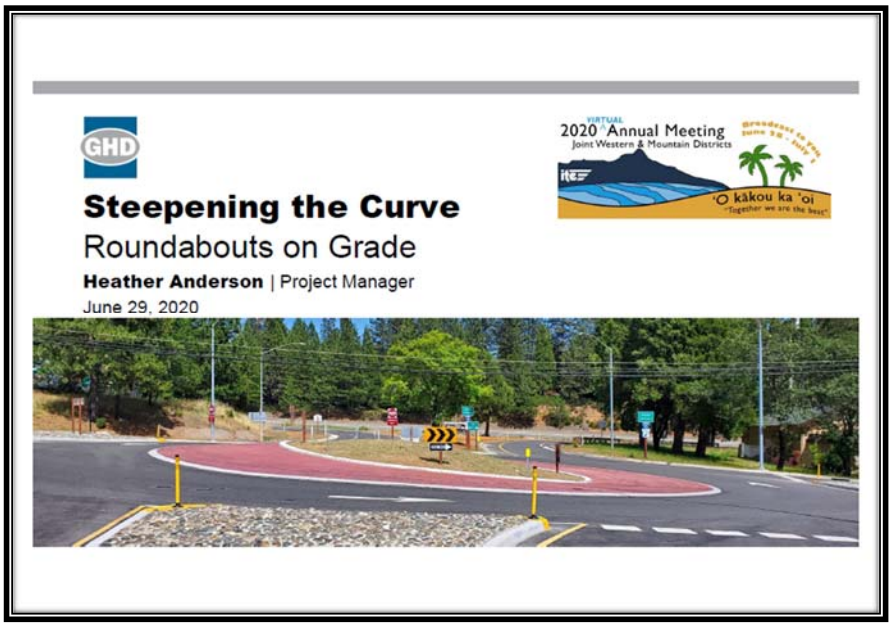

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Signing and Striping

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STOP
What is WRONG Here?

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N. Ripon
STOP
What are the design flaws here?

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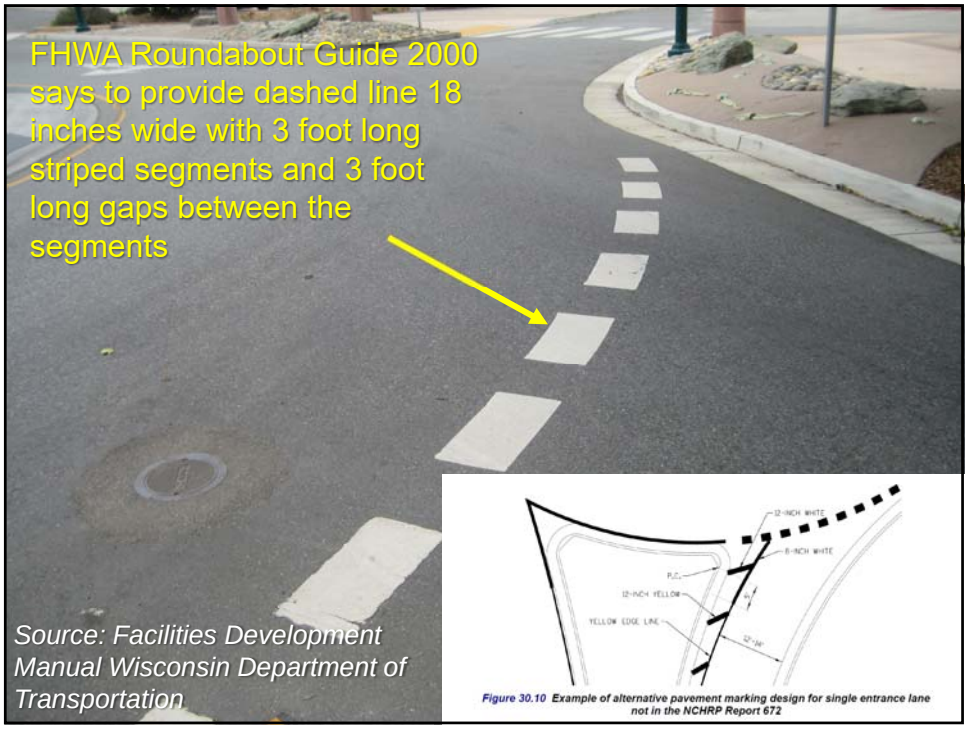
FHWA Roundabout Guide 2000 says to provide dashed line 18 inches wide with 3 foot long striped segments and 3 foot long gaps between the segments
Source: Facilities Development Manual Wisconsin Department of Transportation
Figure 30.10 Example of alternative pavement marking design for single entrance lane not in the NCHRP Report 672

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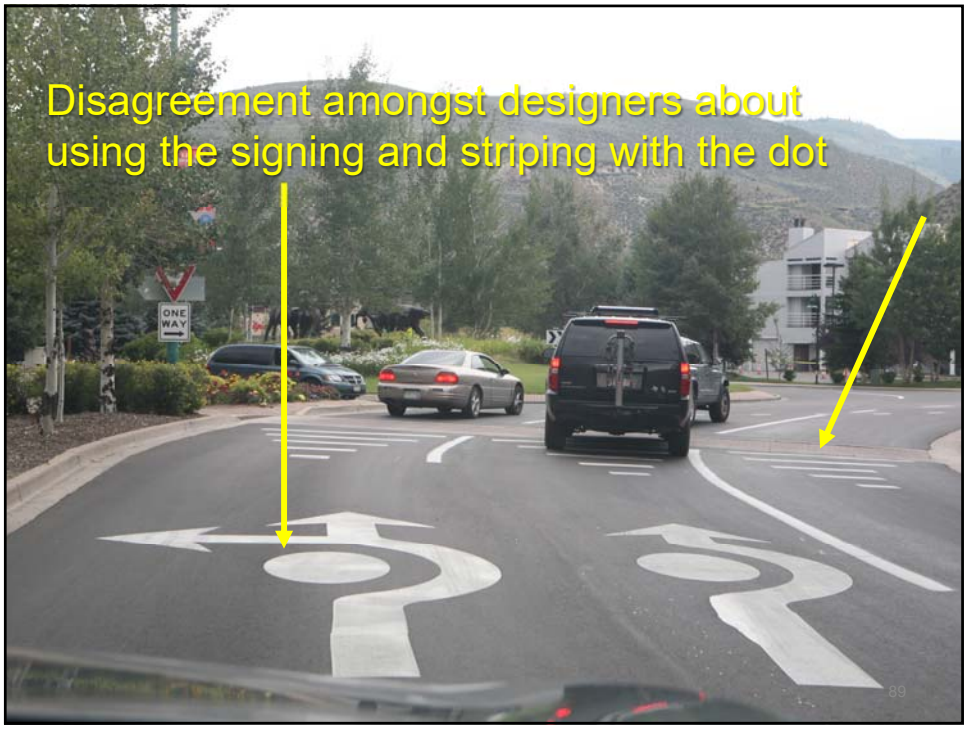
Disagreement amongst designers about
using the signing and striping with the dot
ONE WAY
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What's wrong with the signing here ?
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Webinar Quiz

What are the most common design errors made by roundabout designers?

a) Inadequate deflection
b) Lack of sufficient sight distance
c) Inadequate/inconsistent signage on center island and entrance
d) Lack of sufficient advance warning
e) All of the above

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Bicycles and Pedestrians

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Ramp With ODOT Design

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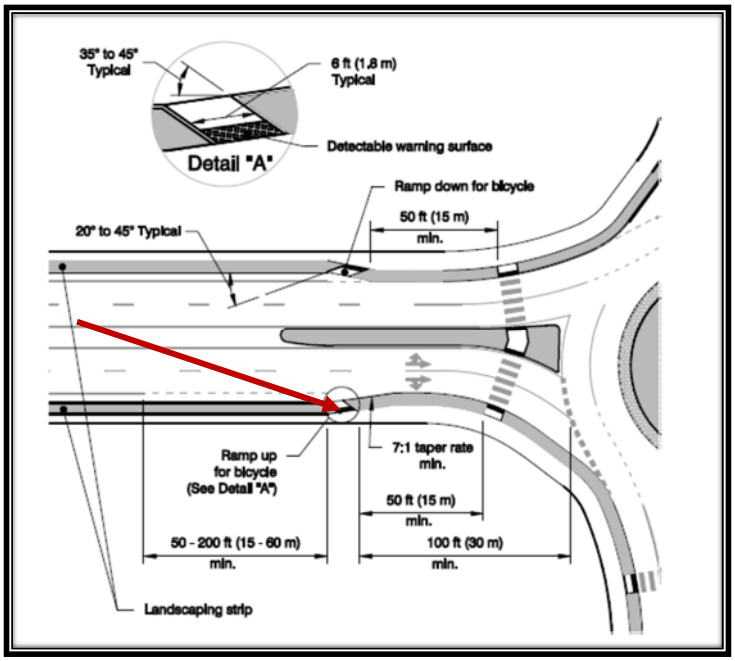

Source: NCHRP 672

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Separated bike lane at a roundabout

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Access ramp can serve peds and bikes
What is missing here?

98


Producers
What could be a concern here for pedestrians and bicyclists?

99


What is the problem here?
100

100

101

Jonathan French:
The tables for the roundabout under design in Orono, Maine are 10' in length and have a 3" rise and the approach ramps are at a 15:1 slope and the trailing ramps are sloped at 2%.

Raised crosswalk at roundabout in the UK

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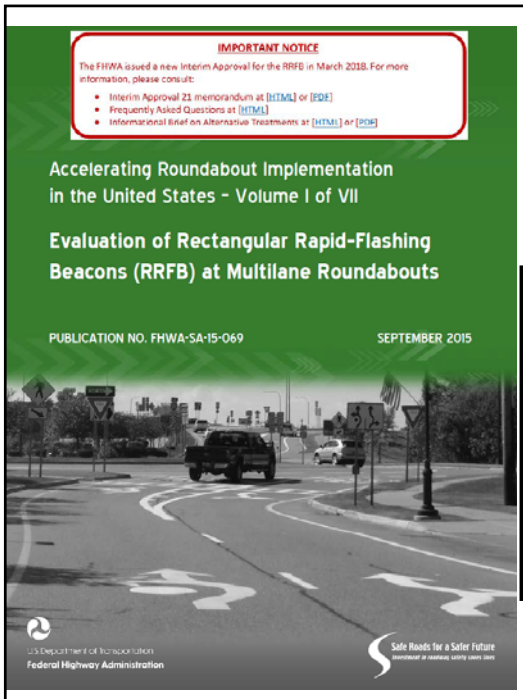

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Lighting Levels and Patterns

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Pedestrian Oriented Lighting at Crosswalks – Slightly Ahead of the Crosswalk is Preferred

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Check Visibility at Night
02 02 2016

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Check Visibility at Night
LEDs Retrofits Better!
02 02 2016

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Blocked Railroad Crossings

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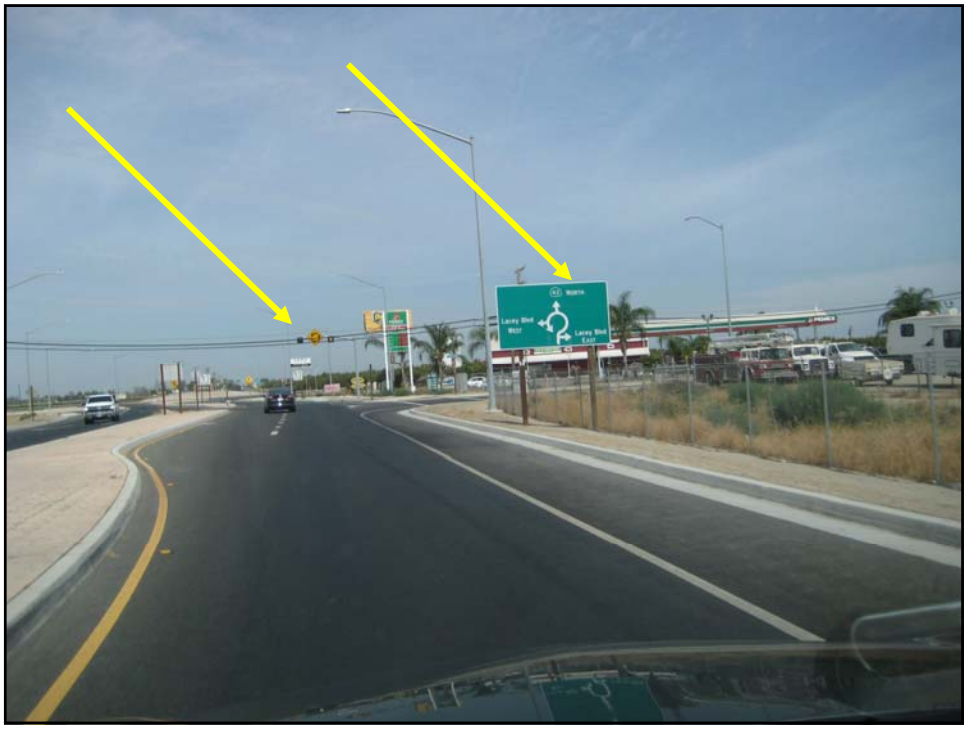

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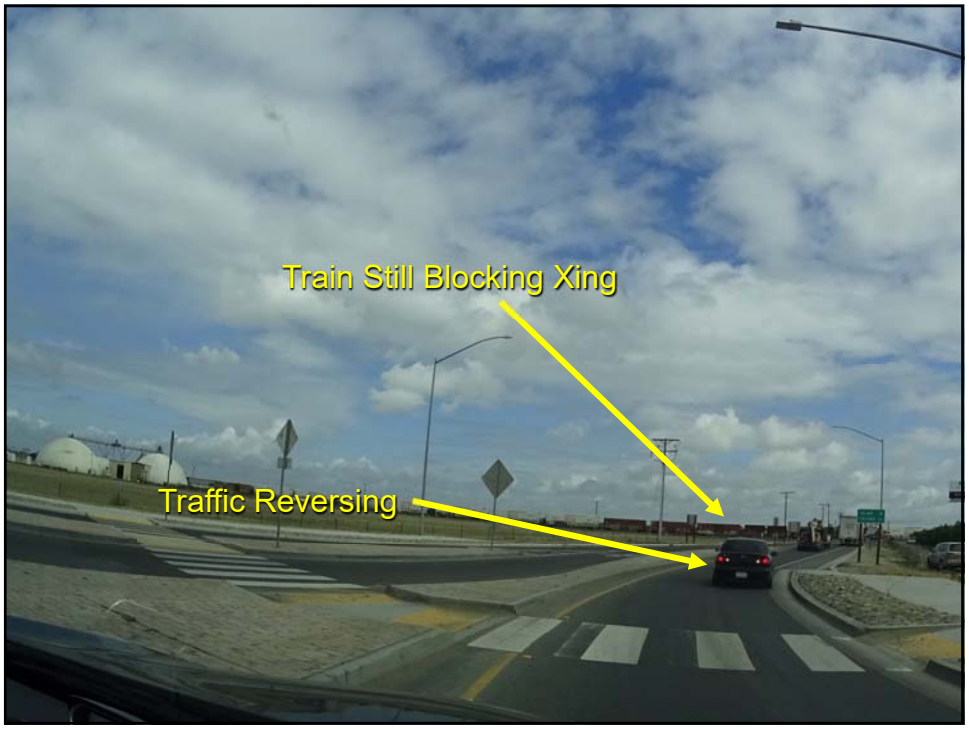

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Temporary Roundabout in
Work Zone Traffic Control Area

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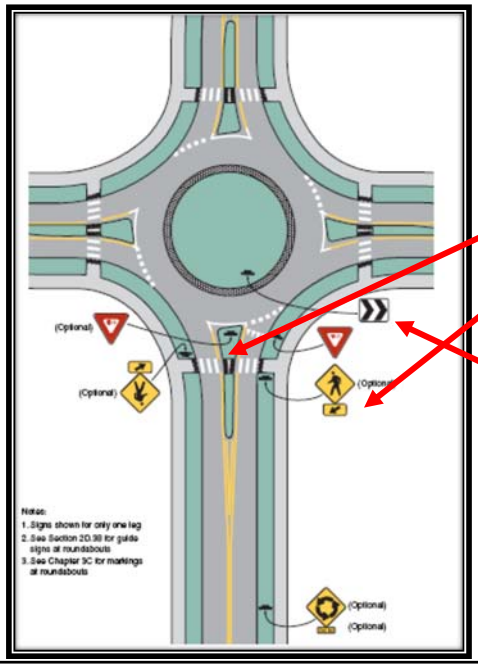
Regulatory and Warning Signs for a One -lane Roundabout



Suggest Pedestrian Warning signs be located in splitter to improve Yield sign compliance

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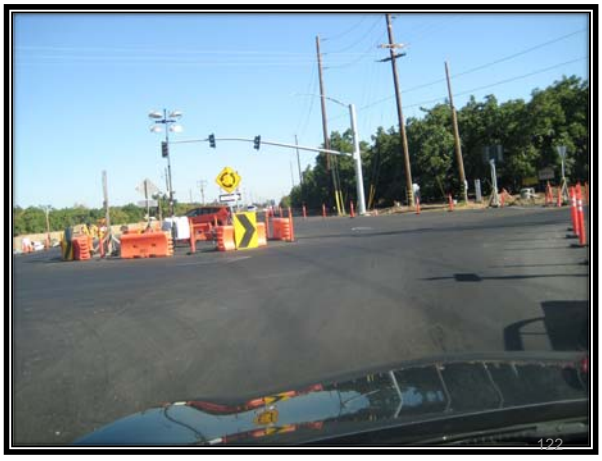
Webinar Quiz

What one thing did the contractor do <u>better</u>?

a) The Signing
b) The Striping
c) The Overhead Lighting
d) The Splitter Island



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Mini Roundabouts v. Traffic Circles

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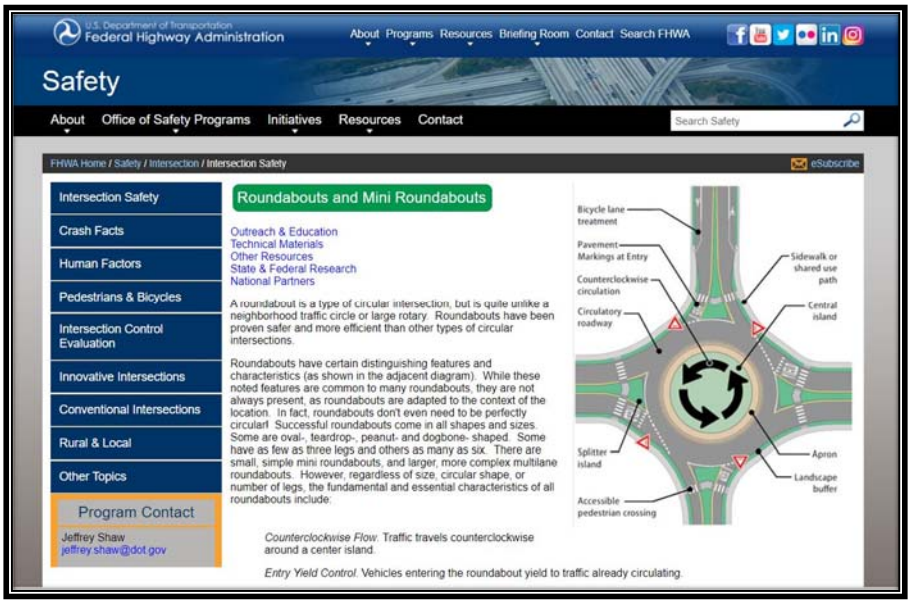

Source: FHWA Roundabout and Mini Roundabout Guide

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What could be done better?

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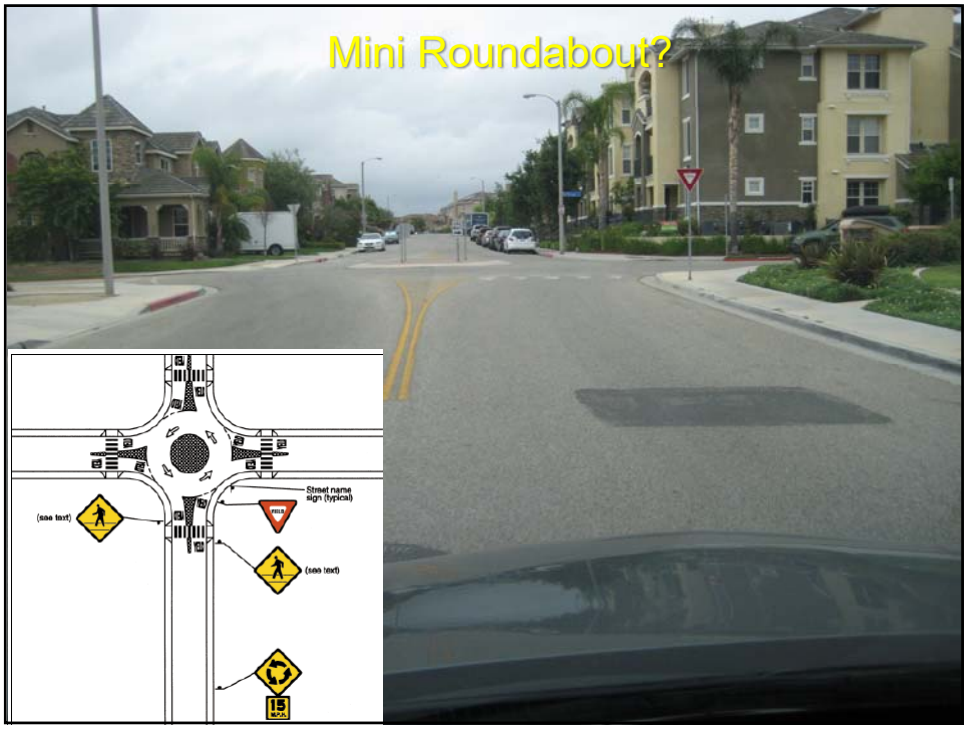

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Additional Guidance

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Roundabouts@dot.ga.gov

www.dot.ga.gov/DS/SafetyOperation/Roundabouts

Entry Curves – kept tight by design

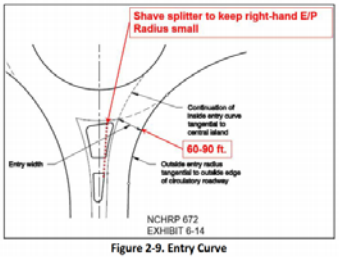

Figure 2-9. Entry Curve

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Evaluation of the C-roundabout – an improved multi-lane roundabout design for cyclists

December 2012

D Asmus, I Jurisich, TES Ltd, Auckland
D Campbell, Auckland Transport, Auckland
R Dunn, University of Auckland, Auckland

NZ Transport Agency research report 510

WESTERNITE

2019 Best Paper

The District's Best Paper Award is one of the most prestigious presented each year. The winning paper is presented here.

Rail Roundabouts: The Valley Metro Experience

Authors: Wulf Grote, PE, Omar J. Peters, AICP, Ray Tparrsguirre, PE, PTOE, Nathaniel Chadwick

1.0 INTRODUCTION

Valley Metro has operated light rail in the Phoenix metro area since 2008, and continues to improve its services to connect communities and enhance lives. The current 26-mile system is positioned to grow with several expansions planned through 2034. In concert with this growth, Valley Metro continues to pursue innovative and efficient technologies to create a more safe and reliable system. The Agency will soon have four roundabouts, with light rail or streetcar running through them. This paper identifies the safety benefits that roundabouts provide, discusses international examples of rail roundabouts and shares Valley Metro's plans to integrate rail roundabouts. It is important to note that, although Valley Metro's light rail system will include several roundabouts, the decision to install them must be evaluated on a site specific basis.

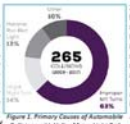

Figure 1. Primary Causes of Automobile Collisions with Valley Metro Light Rail

2.0 SAFETY AND ROUNDABOUTS

The existing 26-mile light rail system primarily operates in a semi-exclusive guideway usually at-grade with surface streets. Since the first full year of light rail operations in 2009 through 2017, there were 265 automobile collisions with a light rail vehicle. Figure 1 charts the primary causes of those collisions. The most frequent cause (63%) was motorists making improper left-turns.

Recent studies have consistently concluded that roundabouts, when compared to traditional four-way intersections, create more safe and efficient environments for vehicular traffic. Studies looking at the safety impacts of converting conventional intersections to roundabouts have found that roundabouts reduce the number of overall collisions by 37% and, moreover, substantially reduces their severity. Collisions with injuries decrease by 75% and those with fatalities decrease by 90%. These numbers are based on data from the Federal Highway Administration (FHWA) and Insurance Institute for Highway Safety (Washington State Department of Transportation, 2018). Similar research by Arizona State University (Souliman, 2018) found that by converting conventional intersections to single-lane roundabout there was an 18 percent reduction in overall collisions, and a 44 percent reduction in injuries.

The geometric design of roundabouts with rail provides additional safety benefits because it reduces the blind spot areas for left-turning motorists. Figure 2 compares the blind spot area for a left-turning motorist in a conventional intersection to that of a left-turning motorist in a light rail roundabout. The motorist in the roundabout has a smaller blind spot and better visibility to see vehicles approaching from behind. This will decrease the likelihood of improper left-turning motorists.

3.0 RESEARCH OF EXISTING RAIL ROUNDABOUTS

Given the context of the new roundabouts being construct-

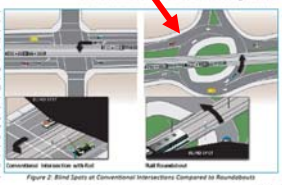

Figure 2: Blind Spots at Conventional Intersections Compared to Roundabouts

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ite
A Community of Transportation Professionals

ITE International Roundabout Committee 2020/2021 Vision

Presented By:

Lindsey Van Parys, PE
Committee Chair

GHD

Presented to:

ITE Central Coast Section

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Recap of Key Concepts

- Adequate deflection to slow entering speeds
- MUTCD/NCHRP 672 compliant signing and striping
- Provide additional warning during first days of roundabout operation
- A void large center island fixed objects
- Make center island sufficiently conspicuous
- Provide sufficient approach sight distance
- Provide sight distance across roundabout
- Avoid railroad crossings within 1,000 feet
- Provide additional advance warning at isolated roundabouts
- Make truck aprons large enough for design vehicles
- Provide raised splitter islands for pedestrian safety
- Provide bicycle ramps on approaches

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