

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

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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



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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 making 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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New Roundabout:
Avenida Bermudas and
Eisenhower Drive

42 28 Comments 12 Shares

Like Comment Share

Rebecca Corinn Foltz Santos
I'm curious why so many roundabouts in such a small area too, when there were hardly any accidents before, yet since the gang of them have been put, there's twice as many accidents. How does this make sense? And it's not the locals not knowing how to drive them, it's out-of-towners, 2nd-homer's aka snowbirds etc.

Just wait til season starts 😊.
The Bermuda's & 52 lane merge is ridiculous! It should merge back from Palmers. And oval, really?! 🤔🤔. What was wrong with the light before and the crosswalks there?
Might as well throw one in front of the fire station light too.

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CASE STUDIES

6

Long Beach, CA

7

7

Daisy Avenue and 4th Street in Long Beach

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



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

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8

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



9

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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

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

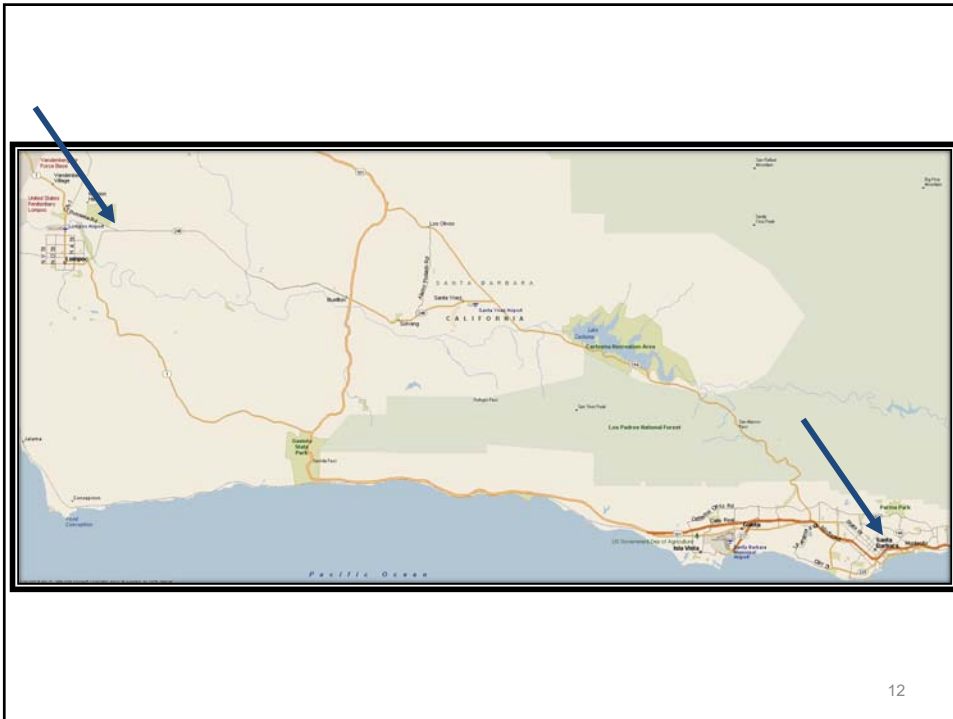


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Lompoc, CA

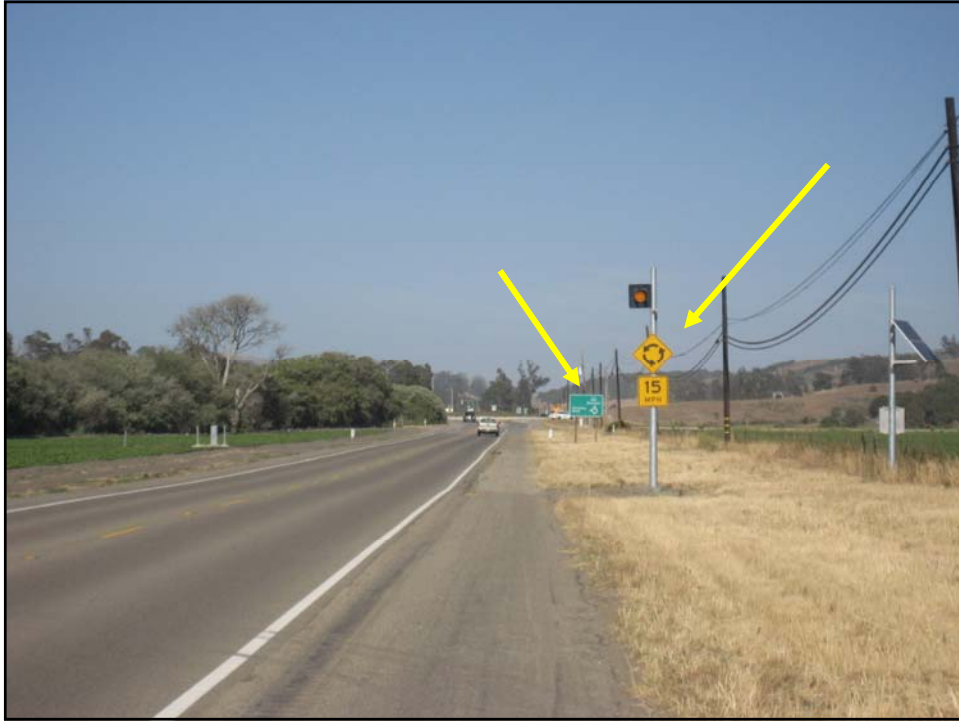
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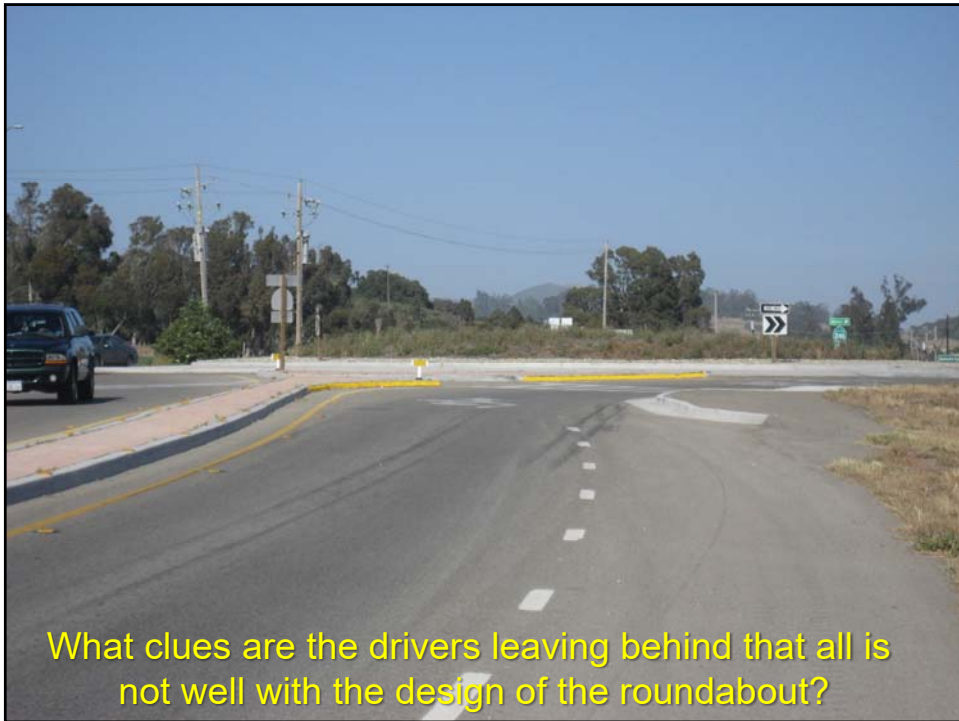


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VIDEO: Ventura firefighter dies in roundabout crash

Sep 21, 2016

f t e b q



http://lompocrecord.com/news/local/video-ventura-firefighter-dies-in-roundabout-crash/youtube_ff9f457-c5c6-5ecf-9f29-6c0003bc7748.html 15

RECOM

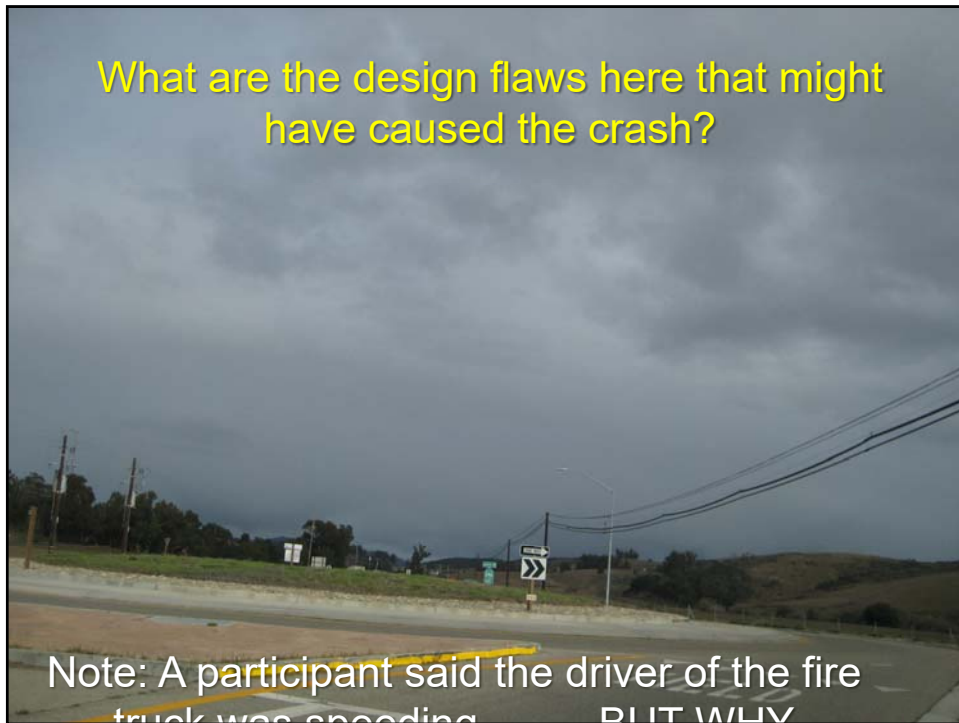


LOCAL NEWS
Shop Lompoc promotion put focus on local business



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What are the design flaws here that might have caused the crash?



Note: A participant said the driver of the fire truck was speeding. BUT WHY

16

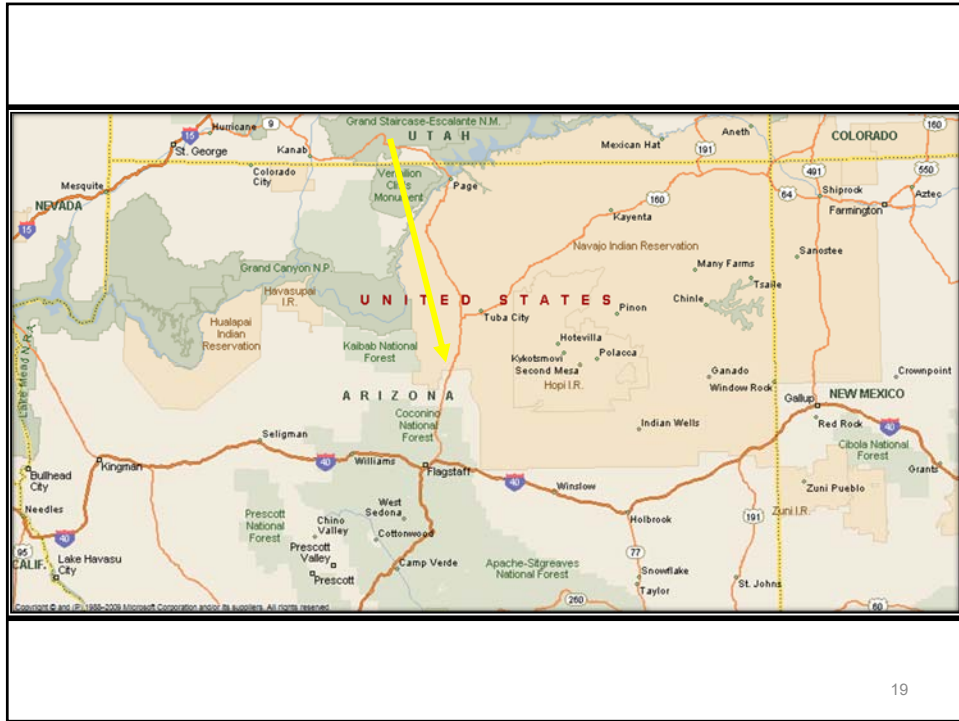


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Observation During Site Visit

- 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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Strategies for Effective Roundabout Approach Speed Reduction

Susan Chrysler, Principal Investigator
Texas A&M Transportation Institute

May 2017

Research Project
Final Report 2017-14



RESEARCH SERVICES & LIBRARY • [mntrp.org/research](#)




Exhibit 7-17. Examples of speed reduction treatments

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CROSSROADS

Minnesota's transportation research blog

ABOUT

COMMENT POLICY

CONTACTS



RESEARCH TOPICS

- Aviation
- Bicycling
- Bridges and Structures
- Education
- Environment
- Maintenance Operations
- Materials and Construction
- Mode
- Multimodal
- Pedestrian
- Policy and Planning
- Public transit
- Rail
- Research
- Traffic and Safety
- Trucking
- Uncategorized
- Water transportation

SIGN UP FOR EMAIL UPDATES!



TRAFFIC AND SAFETY

CHOOSING EFFECTIVE SPEED REDUCTION STRATEGIES FOR ROUNDABOUTS

MOST POPULAR

-  GFRP Rebar Shows Promise for Use in Bridge Decks
-  Pavement Preservation Techniques for Local Agencies
-  Roadside Turf That Tolerates Salt, Heat and Ice
-  Choosing Effective Speed Reduction Strategies for Roundabouts
-  Methods to Mitigate Bridge Corrosion Show Mixed Results 20 Years Later
-  Rumble Strips vs. Mumble Strips: Noise Comparison (Video)
-  Using Chemical Adhesives to Post-Install Epoxy-Coated Rebar in Concrete

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

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U.S. Department of Transportation
Federal Highway Administration

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Safety

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FHWA Home / Safety / Intersection / Intersection Safety

Intersection Safety **Roundabouts & Rural Highways**

Crash Facts [Download PDF \(0.79 MB\)](#)

Human Factors

Pedestrians & Bicycles

Intersection Control Evaluation

Innovative Intersection **Slate Hwy 55 at County Hwy KK**

Conventional Intersections **Calumet County, Wisconsin**

Rural & Local

Other Topics

Program Contact

Jeffrey Shaw
jeffrey.shaw@dot.gov

The intersection of State Trunk Highway 55 (STH 55) and County Trunk Highway KK (CTH KK) was originally a two-way stopcontrolled intersection with a 55 mph posted speed limit on each approach. In a five-year period (2001–2005), 39 crashes occurred at the intersection resulting in 17 people injured and one person killed.

The Wisconsin Department of Transportation (WisDOT) added intersection warning signs along STH 55 in advance of CTH KK and lowered the approach posted speed limits to 45 mph, but crashes continued to occur.

In 2006, WisDOT decided to reconstruct the intersection as a roundabout. They modified the design to account for the high-speed approaches by providing longer splitter islands and pavement markings, along with enhanced signing. These features help drivers recognize the roundabout well in advance, and to reduce their speed accordingly.

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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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/article/235258957.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.

State	City	Date	Month	Intersection
Alabama	Irvington	10/13/2017	October	Irvington Bayou La Balle highway and rd 101a Rd
Arizona	Chino Valley	12/1/2012	December	State Route 89 and E 4 Rd N
Arizona	Prescott	8/4/2017	September	Prescott Lake Parkway and Sunning Ranch Road
Arkansas	Little Rock	7/20/2019	July	Woodmont Drive and Reservoir Park Road
California	Orland	7/21/2013	July	Jamison Road at Interchange 700

Fatal crashes at roundabouts spreadsheet – available on request

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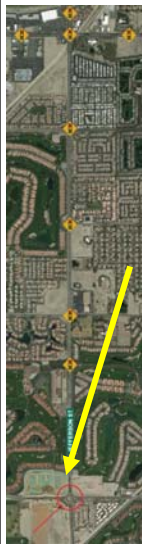
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La Quinta, CA

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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](http://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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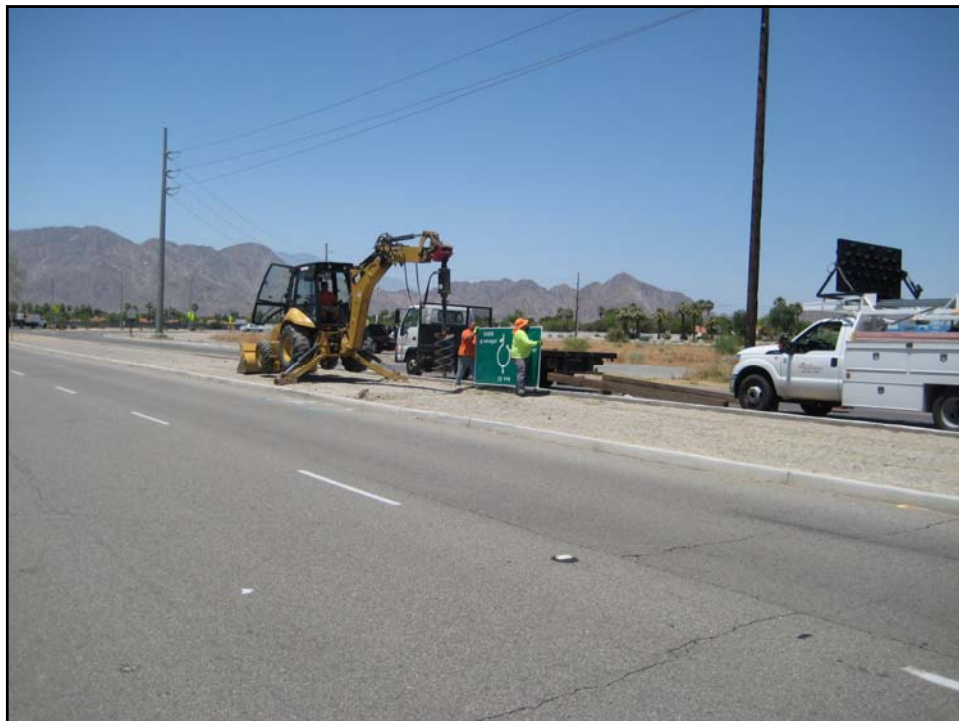
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Diagrammatic Sign for Two Lane Roundabout



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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?



49

Yield sign is too far to the right

Chevron is too small

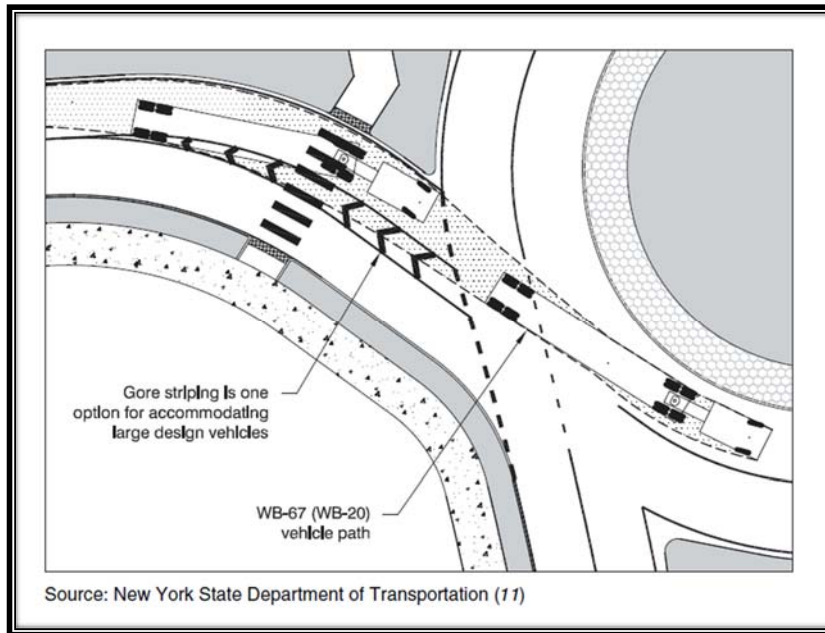
Sign in splitter island is best option in FYG



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Truck Path With Gore Striping (NCHRP 672)



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SOURCES OF OTHER COMMON DESIGN PROBLEMS

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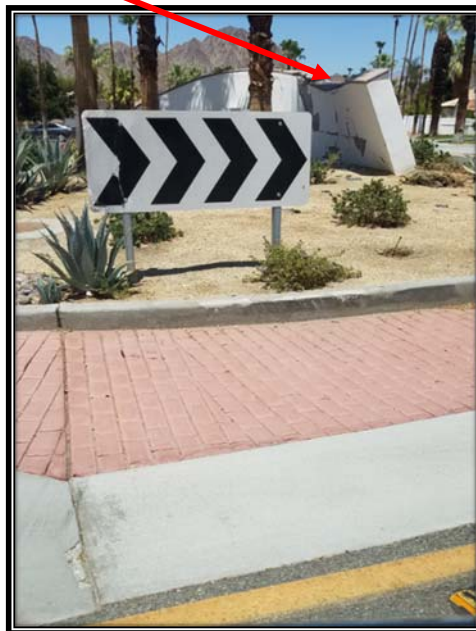
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Avoid Fixed Objects in the Center Island

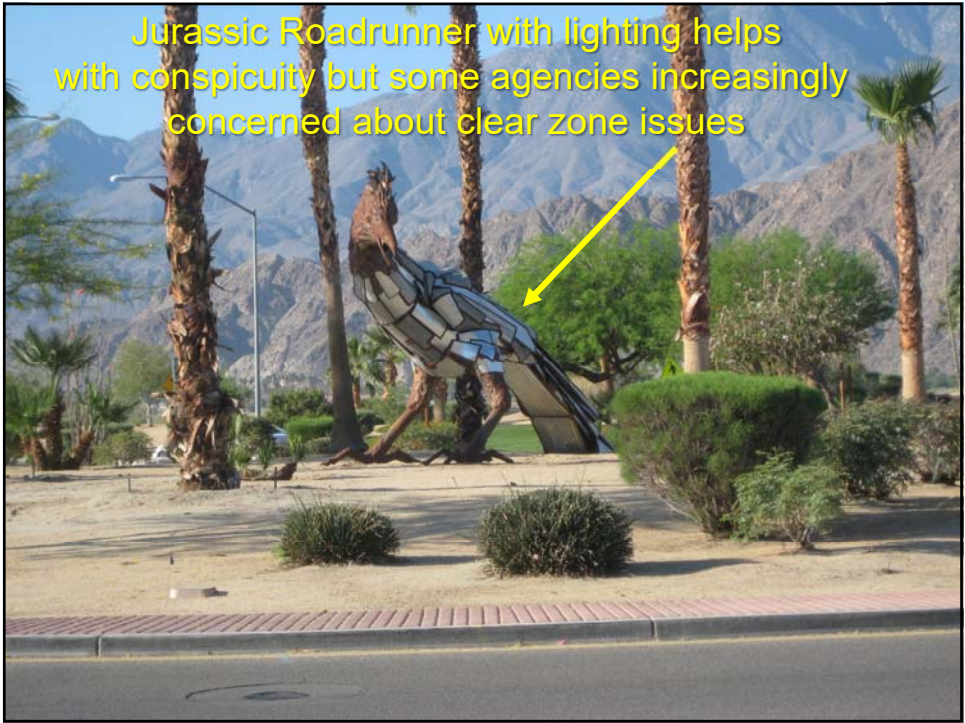
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Landscaping
and Aesthetics
(Can help but
be careful!)



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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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City of La Quinta - Government
3h · 🌐

Please find the press release below from the Riverside County Sheriff's Department:

On July 31, 2020, at 7:38 AM, La Quinta deputies responded to Avenue 52 and Avenida Bermudas reference a single vehicle traffic collision. Investigation revealed driver, Roberto Ruelas, 20yrs of Lake Elsinore was traveling eastbound on Avenue 52 when he drove his vehicle into the raised wall within the round-about. Ruelas was subsequently arrested for driving under the influence of alcohol and booked into the John Benoit Detention Center.

The Riverside County Sheriff's Department encourages all drivers not to drink and drive and encourages everyone wear their seatbelt. To report drunk drivers, please call 911. Anyone with any information about this incident is urged to contact the Riverside County Sheriff's Department, at (760) 863-8990, or they can call anonymous tips at (760) 341-STOP (7867).



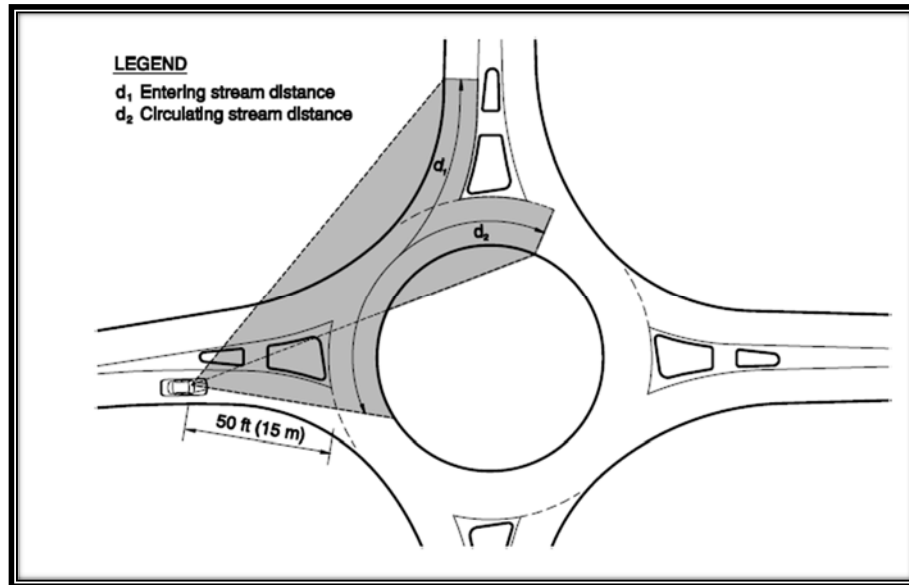
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Sight Distance

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Entering Stream Distance and Circulation Stream Distance



Source: NCHRP 672

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What is happening to the red car?

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New Roundabout at NB Off Ramp on I 5



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What clues are there that something 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*



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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



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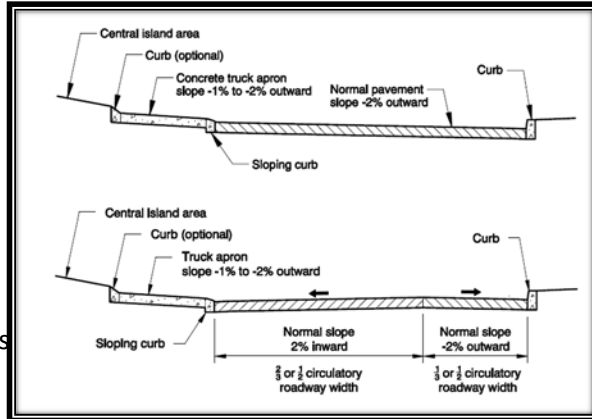
Badly Designed Truck Aprons Cause Problems

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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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What is wrong here?



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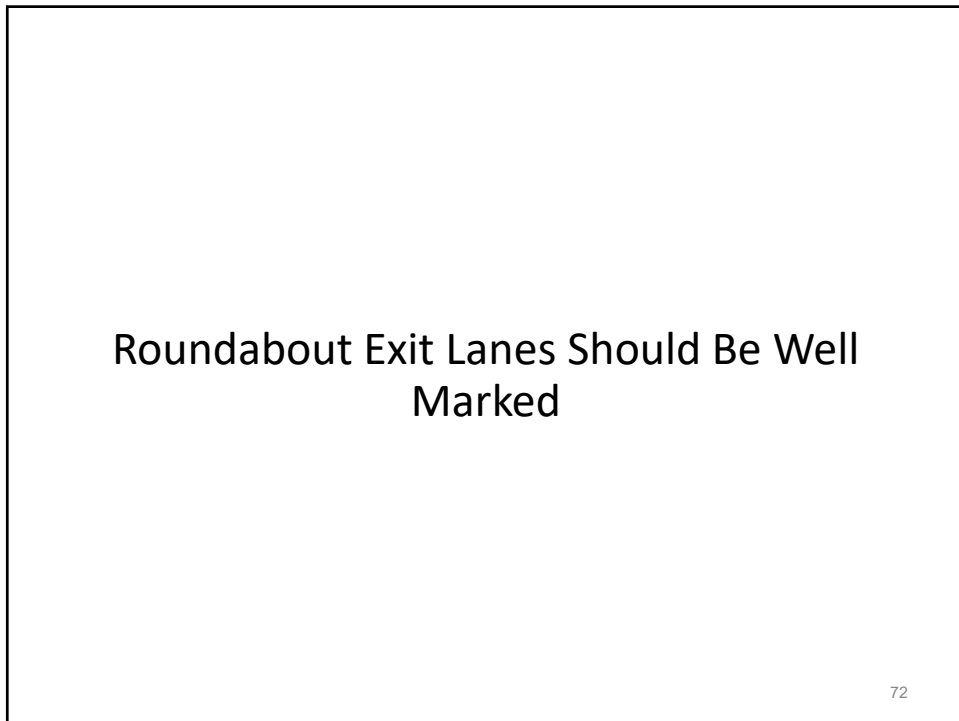
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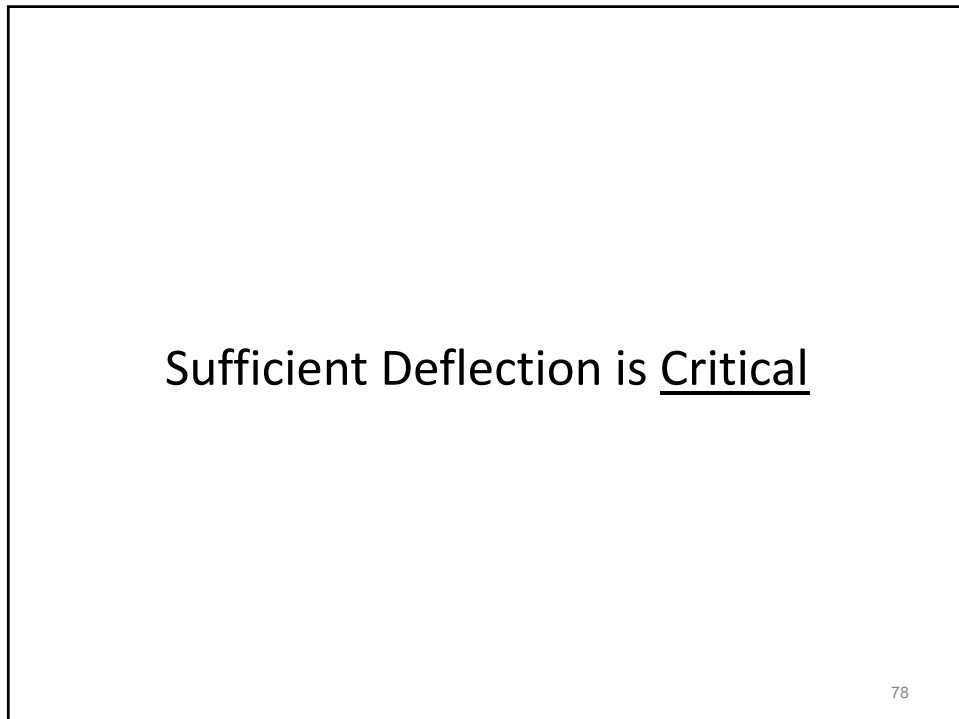
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Steepening the Curve
Roundabouts on Grade
Heather Anderson | Project Manager
June 29, 2020



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Signing and Striping

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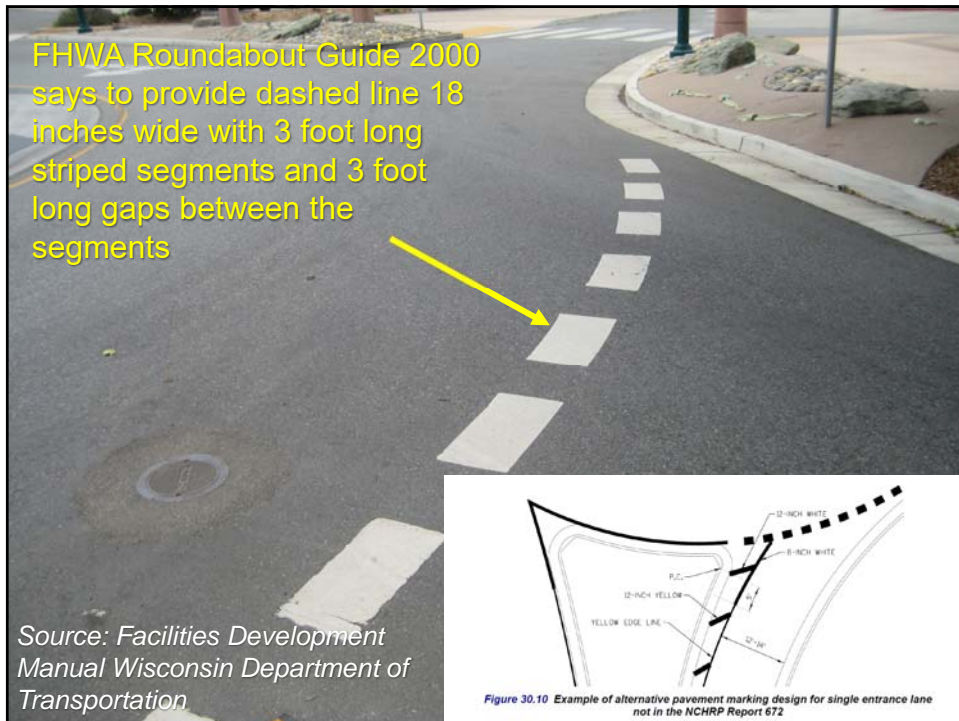
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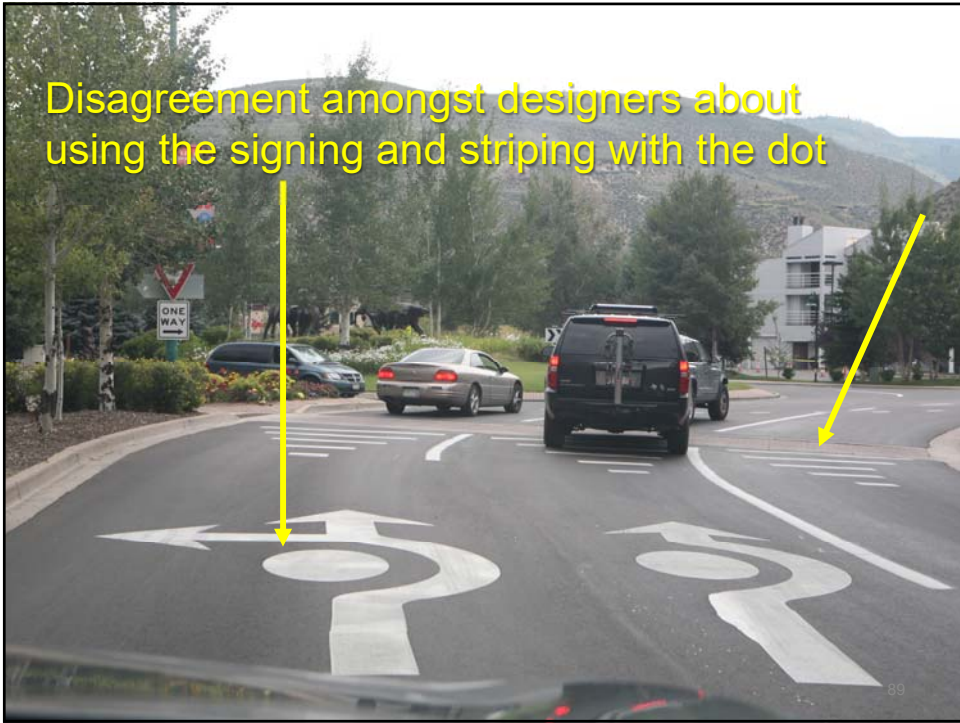
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Webinar Quiz

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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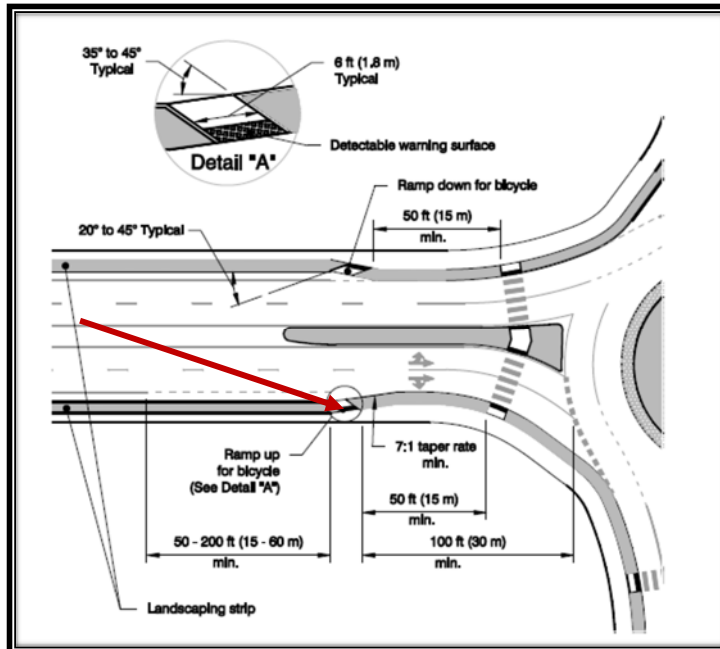


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Ramp With ODOT Design



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Source: NCHRP 672

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What could be a concern here for pedestrians and bicyclists?

99



What is the problem here?

100

100



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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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IMPORTANT NOTICE
The FHWA issued a new Interim Approval for the RRFB in March 2018. For more information, please consult:
• Interim Approval 21 memorandum at [\[HTML\]](#) or [\[PDF\]](#)
• Frequently Asked Questions at [\[HTML\]](#)
• Informational Brief on Alternative Treatments at [\[HTML\]](#) or [\[PDF\]](#)

**Accelerating Roundabout Implementation
in the United States - Volume I of VII**

**Evaluation of Rectangular Rapid-Flashing
Beacons (RRFB) at Multilane Roundabouts**

PUBLICATION NO. FHWA-SA-15-069 SEPTEMBER 2015



U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives

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Lighting Levels and Patterns

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What is wrong here?

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And Here?

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Check Visibility at Night



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Check Visibility at Night LEDs Retrofits Better!



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Blocked Railroad Crossings

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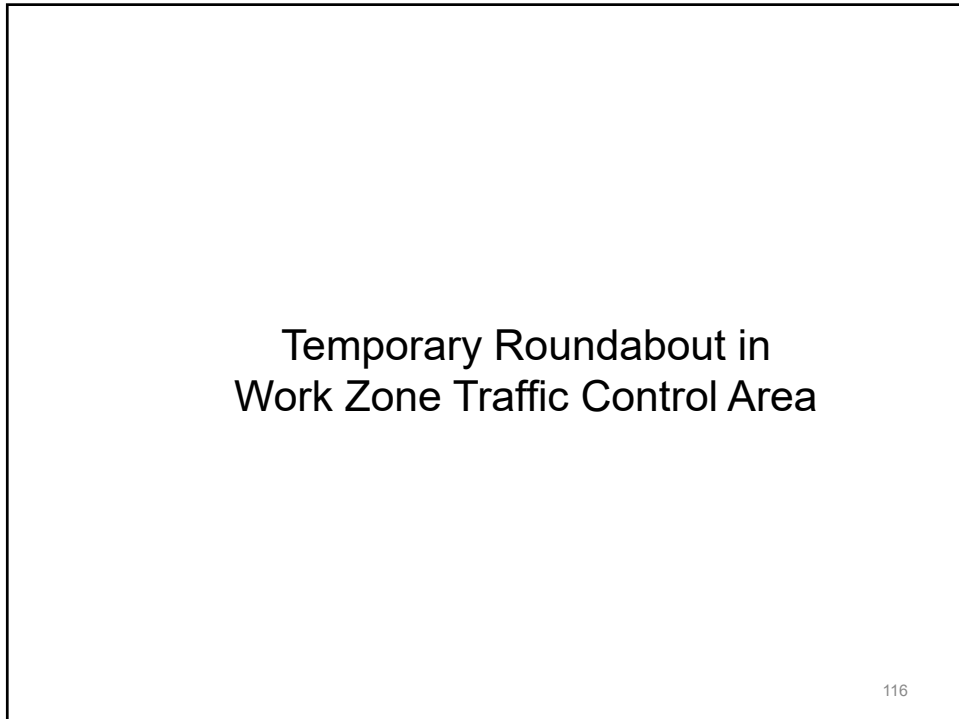
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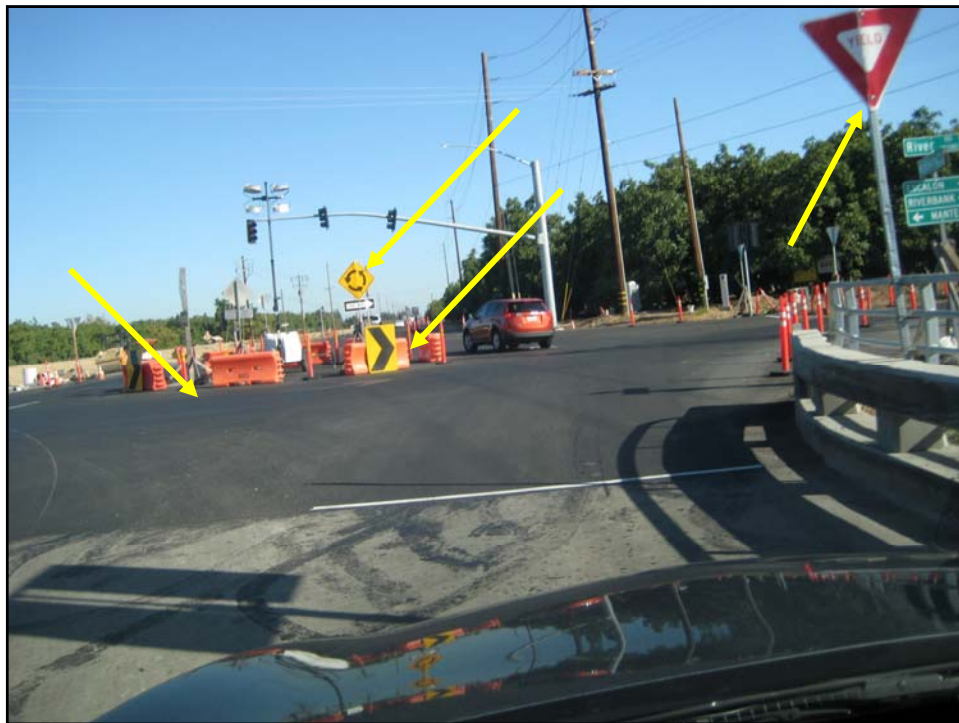
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Mini Roundabouts v. Traffic Circles

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Intersection Safety

- Crash Facts
- Human Factors
- Pedestrians & Bicycles
- Intersection Control Evaluation
- Innovative Intersections
- Conventional Intersections
- Rural & Local
- Other Topics

Program Contact

Jeffrey Shaw
jeffrey.shaw@dot.gov

Roundabouts and Mini Roundabouts

Outreach & Education
Technical Materials
Other Resources
State & Federal Research
National Partners

A roundabout is a type of circular intersection, but is quite unlike a neighborhood traffic circle or large rotary. Roundabouts have been proven safer and more efficient than other types of circular intersections.

Roundabouts have certain distinguishing features and characteristics (as shown in the adjacent diagram). While these noted features are common to many roundabouts, they are not always present, as roundabouts are adapted to the context of the location. In fact, roundabouts don't even need to be perfectly circular! Successful roundabouts come in all shapes and sizes. Some are oval-, teardrop-, peanut- and dogbone-shaped. Some have as few as three legs and others as many as six. There are small, simple mini roundabouts, and larger, more complex multilane roundabouts. However, regardless of size, circular shape, or number of legs, the fundamental and essential characteristics of all roundabouts include:

- Counterclockwise Flow. Traffic travels counterclockwise around a center island.
- Entry Yield Control. Vehicles entering the roundabout yield to traffic already circulating.

Diagram labels: Bicycle lane treatment, Pavement, Markings at Entry, Counterclockwise circulation, Circulatory roadway, Splitter island, Accessible pedestrian crossing, Sidewalk or shared use path, Central island, Apron, Landscape buffer.

Source: FHWA Roundabout and Mini Roundabout Guide

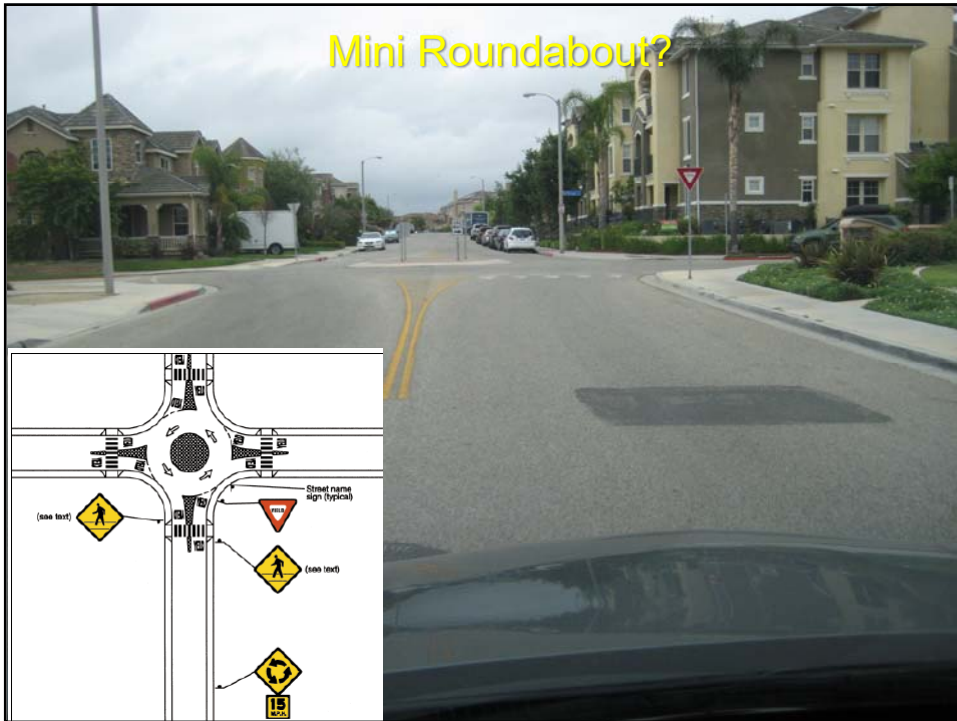
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What could be done better?



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Mini Roundabout?



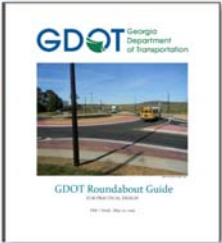
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Additional Guidance

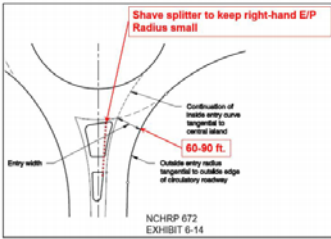
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127

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



Entry Curves – kept tight by design



NCHRP 672
EXHIBIT 6-14
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 Jurisch, TES Ltd, Auckland
D Campbell, Auckland Transport, Auckland
R Dunn, University of Auckland, Auckland

NZ Transport Agency research report 510

WESTERNPIECE
Est 2018

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: Waf Dreir, PE, Omar J. Peters, ACP, Ray Sparraguirre, 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 these growth, Valley Metro continues to pursue innovative and resilient technologies to create a more safe and reliable system. The Agency will soon have four roundabouts, with a 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 includes several roundabouts, the decision to install them must be evaluated on a site-specific basis.

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 2013, 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).

3.0 RESEARCH OF EXISTING RAIL ROUNDABOUTS

Given the context of the new roundabouts being constructed...

Figure 1: Primary causes of automobile collisions with Valley Metro Light Rail. Figure 2: Comparison of conventional intersection and a left-turning motorist in a light rail roundabout.

www.westernpiece.com Page 9

ITE International Roundabout Committee 2020/2021 Vision

Presented By:

Lindsey Van Parys, PE
Committee Chair

Presented to:

ITE Central Coast Section

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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