National Center for Rural Road Safety

Est. Dec. 2014

Rural Roundabouts are Saving Lives

Presented by: Hillary Isebrands, FHWA Resource Center
Safety & Design Team

Webinar Logistics

- Duration is 11:00 AM - 12:30 PM Mountain
- Webinar – recorded and archived on website. For quality of recording, phone will be muted during presentation
- If listening on the phone, please mute your computer
- To maximize the presentation on your screen click the 4 arrows in the top right of the presentation
- At the end of each section, there will be time for Q&A
- There is a handout pod at the bottom of the screen
- Send group lists to info@ruralsafetycenter.org
- Please complete follow-up surveys; they are vital to assessing the webinar quality

Certificates of Completion/CEUs

- Survey Link –

http://survey.constantcontact.com/survey/a07efjxeflyjjq5hxor/start

  - Survey closes 2 weeks after webinar
  - Expect certificate/CEU form 3-4 weeks after webinar
  - Return CEU form to ContinuingEd@montana.edu **NOT** Safety Center
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Course *cex 280717 Pedestrian Treatments for Uncontrolled Locations - Live* Location *Online*

Date *01/18/18 - 01/18/18* REGISTRATION FEE *$0.00* # OF CEU's *0.150* GENDER: M / F

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VERIFICATION OF COMPLETION

February 2, 2018

REGISTRANT: First Last
123 Main St
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ID #:		CEU	Hours
18SCEX280717	Pedestrian Treatments for Uncontrolled Locations - Live January 18, 2018	0.150	1.50
18SCEX280720	Primer on the Joint Use of the HSM and the HFG for February 13, 2018 - February 13, 2019	0.150	1.50
TOTAL:		**0.300** CEU's	**9.00** Hours

Today's Presenter

Hillary Isebrands
FHWA Resource Center Safety & Design Team

Goals of this Webinar

Once you have completed this webinar, you will:

- have an overview of the safety and design of rural roundabouts in the United States including case studies of rural roundabouts on local and state highways as well as the safety experience.

Learning Outcomes

To achieve the webinar goal, you will learn to:

- State the risks of rural intersections
- Summarize the benefits of roundabouts on rural roadways
- Name examples of rural roundabouts in the U.S.
- List some of the characteristics of rural roundabouts with high speed approaches

Hillary Isebrands,
FHWA

National Center for Rural Road Safety

State the risks of rural intersections

Summarize the benefits of roundabouts on rural roadways

Name examples of rural roundabouts in the U.S.

List some of the characteristics of rural roundabouts with high speed approaches

Defining Rural Roadways

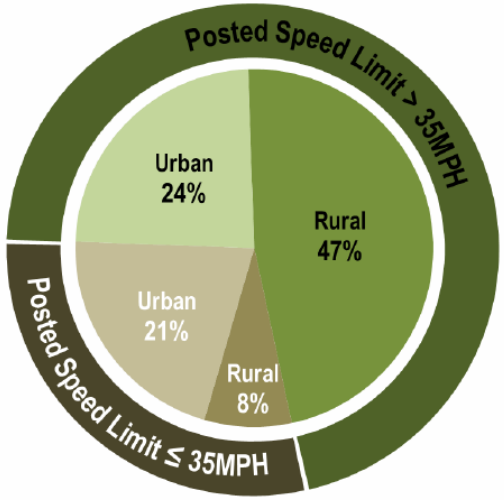
- Posted speeds typically between 35mph - 75mph
- Diverse Road Users
  - Pedestrians, Bicyclists, Trucks, Farming Equipment, Wildlife
- Land Use
  - Agriculture, Recreation, Forests, Prairie Lands

Rural Roadway Risks

- High Speeds (>35mph)
- Speed Differentials
- Isolated Intersections
- At-grade Intersections
- Two Lane Roadways
- Roadway Lighting Sparse

Intersection Safety Facts

- Over 10,000 deaths at intersections in 2016
  - Nearly 7,000 deaths were at unsignalized intersection
    - 3,850 deaths were in rural areas
      - 85% of those deaths were on roadways with the posted speed limit >35mph



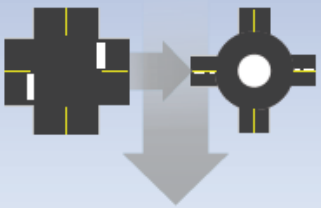
Unsignalized Intersection Fatalities

U.S. Department of Transportation
Federal Highway Administration

PROVEN SAFETY COUNTERMEASURES

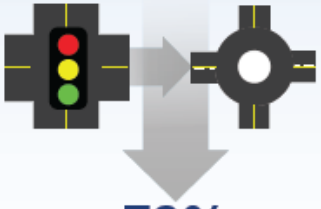
Roundabouts

TWO-WAY STOP-CONTROLLED INTERSECTION TO A ROUNDABOUT



82%
Reduction in severe crashes

SIGNALIZED INTERSECTION TO A ROUNDABOUT



78%
Reduction in severe crashes

Source: *Highway Safety Manual*

The modern roundabout is a type of circular intersection configuration that safely and efficiently moves traffic through an intersection. Roundabouts feature channelized approaches and a center island that results in lower speeds and fewer conflict points. At roundabouts, entering traffic yields to vehicles already circulating, leading to improved operational performance.

Example of a single-lane roundabout.

Source: FHWA

Roundabouts provide substantial safety and operational benefits compared to other intersection types, most notably a reduction in severe crashes.

Roundabouts can be implemented in both urban and rural areas under a wide range of traffic conditions. They can replace signals, two-way stop controls, and all-way stop controls. Roundabouts are an effective option for managing speed and transitioning traffic from high-speed to low-speed environments, such as freeway interchange ramp terminals, and rural intersections along high-speed roads.

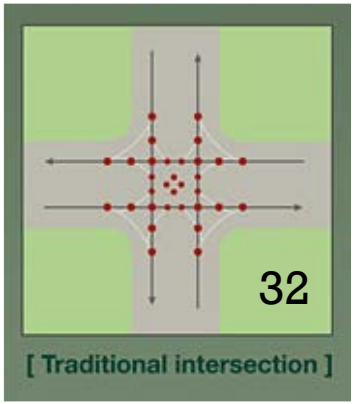
Example of a multi-lane roundabout.

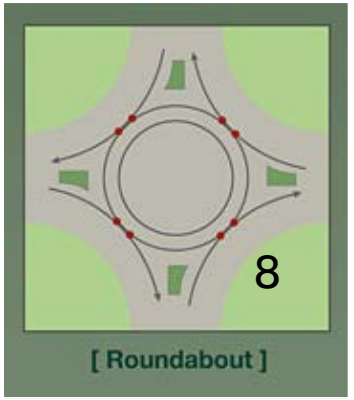
Source: FHWA

FHWA encourages agencies to consider roundabouts during new construction and reconstruction projects as well as for existing intersections that have been identified as needing safety or operational improvements.

Roundabout Facts

- Over 4,500 modern roundabouts in the US
- Before and After Crash data
  - 90% reduction in fatalities
  - 76% reduction in injuries
  - 35% reduction in all crashes
- Slow speeds for all vehicles
- Reduced conflict points
- Diameter ranges from 45ft to 300ft



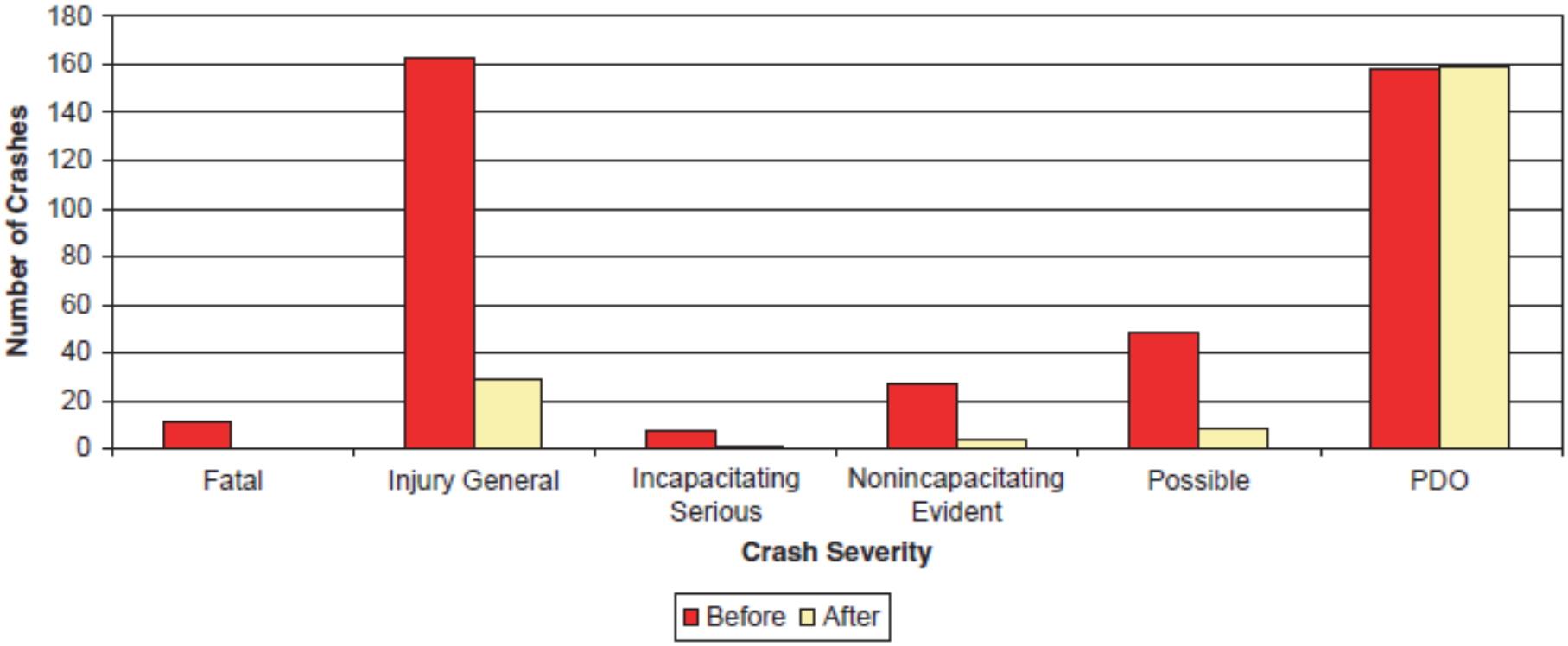


Rural Roundabouts by the Numbers

- Estimated over 200* in rural areas
- Posted speed limits on approaches 35mph to 65mph
- Before and After crashes
  - 88% reduction in injury crashes
  - 68% reduction in all crashes
- Diameters range from 90ft to 210ft

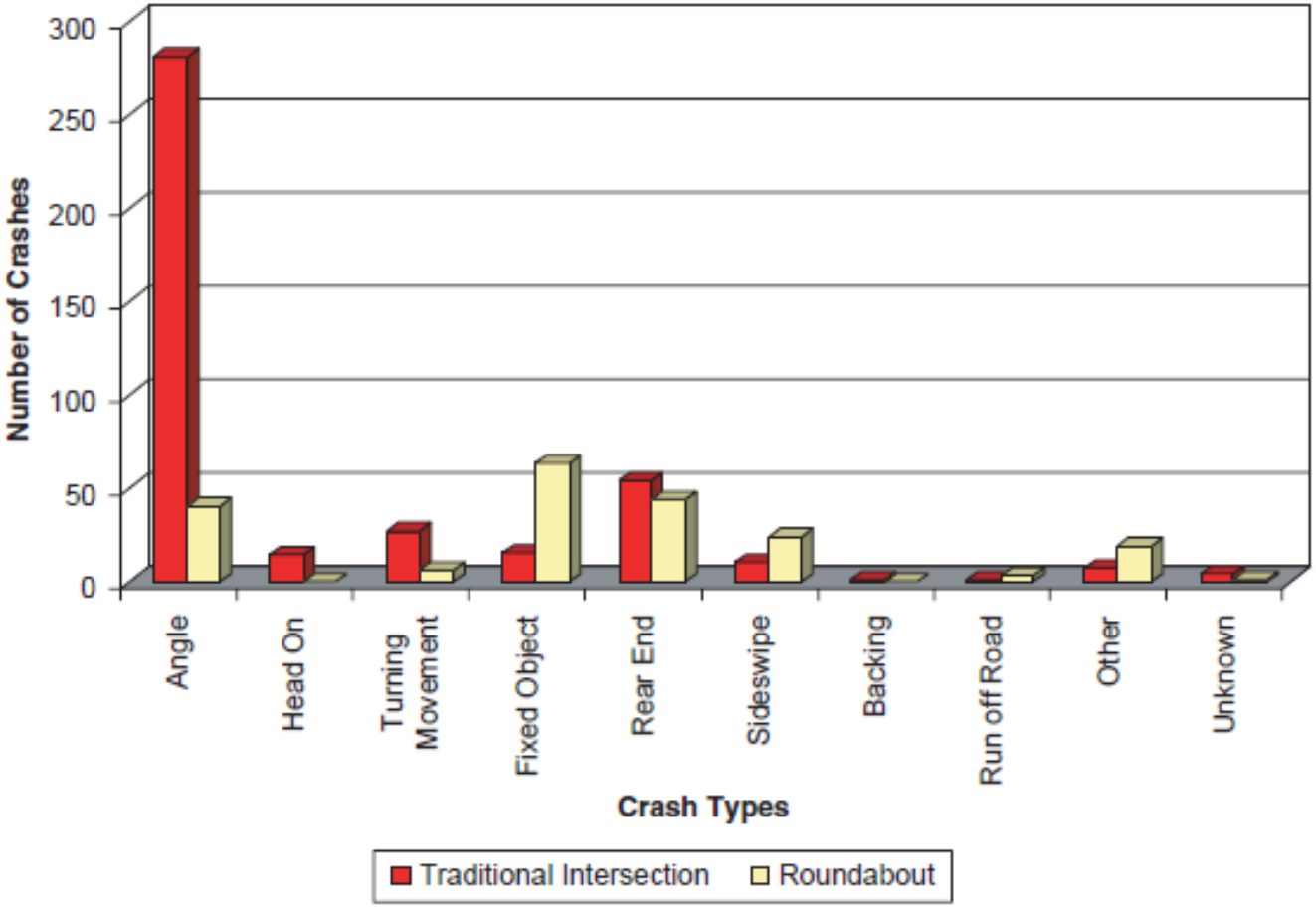
Photo sources: Isebrands and CH2MHill (aerial with permission)

Sample Crash Data from Rural Roundabouts (17 locations)



Source: Transportation Research Record 2096, Isebrands 2009

Sample Crash Data from Rural Roundabouts (17 locations)



Source: Transportation Research Record 2096, Isebrands 2009

CONNECTICUT DOT CONVERTED
5 INTERSECTIONS TO ROUNDABOUTS

Reductions:

81%
SEVERE CRASHES

49%
OVERALL CRASHES

As of 2017, 150 crashes and 100 injuries have been prevented.

Directing Your Questions via the Chat Pod

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Hillary Isebrands,
FHWA

National Center for Rural Road Safety

State the risks of rural intersections

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Name examples of rural roundabouts in the U.S.

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Washington State

- Before Crashes (5.5 years)
  - 32 total
  - 20 injury
  - 1 fatal
- After Crashes (12 years)
  - 10 total
  - 5 injury

Photo source: WSDOT

California

Aerial Source: Caltrans
Photo Source: Isebrands


Photo Source: Placer County

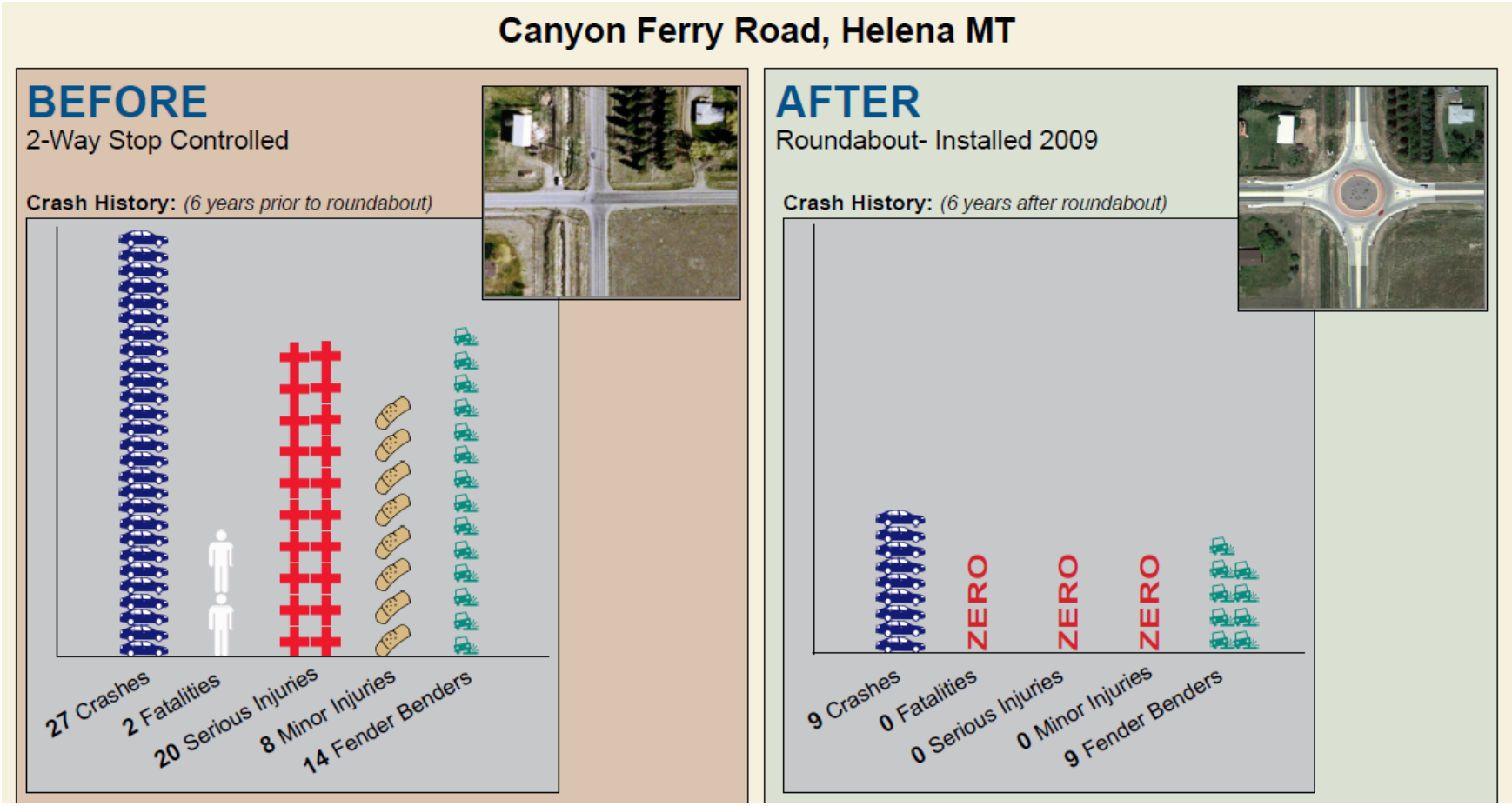

Kings Beach
© 2016 Google
Google earth
Tour Guide
1969
Imagery Date: 4/16/2015 39°14'13.67" N 120°01'38.95" W elev 6248 ft eye alt 8257 ft


4/2014
Google Earth

Nevada

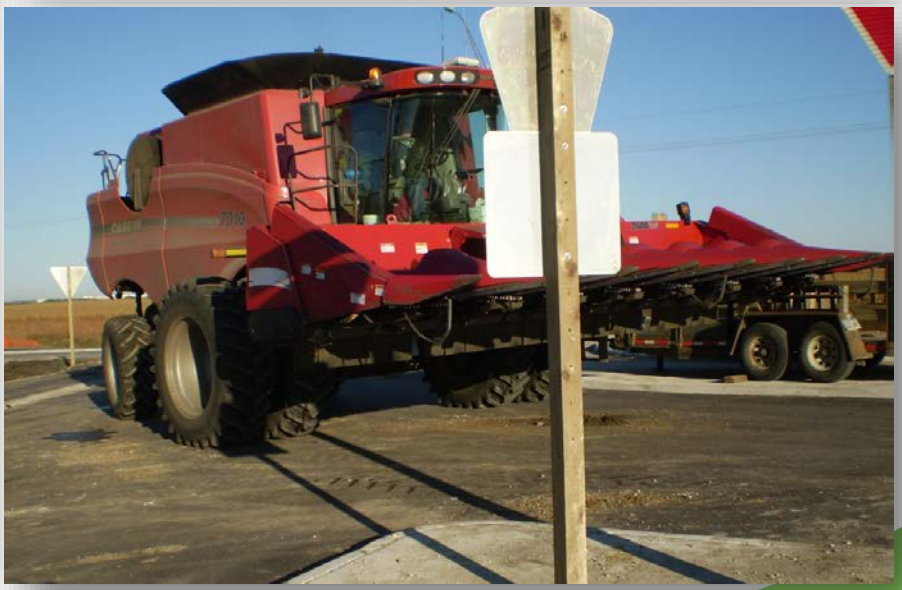
Aerial Source: Google Earth
Photo Source: Isebrands

Montana



Source: Montana DOT

Iowa



Aerial Source: GoogleEarth; Photo Sources: Roche, Iowa DOT

Kansas

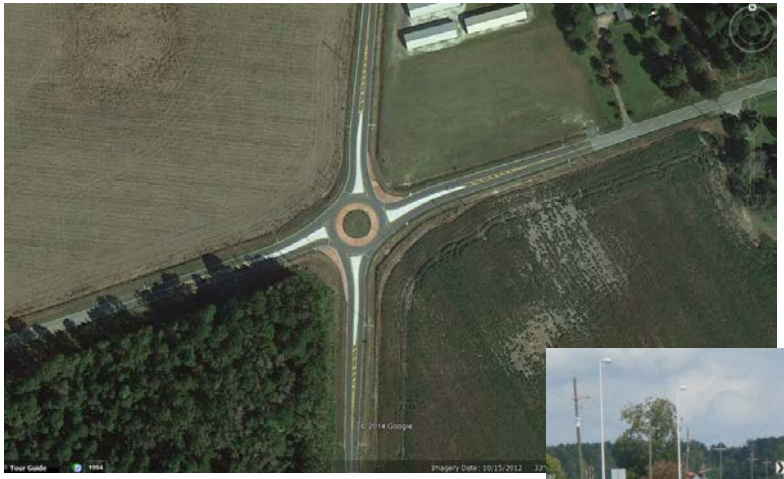
Photo Source: Isebrands

Georgia

Photo Source: Georgia DOT

South Carolina

- Before Crashes (3 yrs)
  - 17 total
  - 12 injury
- After Crashes (5 yrs)
  - 13 total
  - 0 injury



Aerial Source: GoogleEarth; Photo Source: Isebrands

Maryland

Photo Source: Isebrands

Tribal Lands

Photo sources: Isebrands and GoogleEarth (aerials)

Federal Lands

Photo Source: Isebrands, FHWA CFLHD

Grand Teton National Park

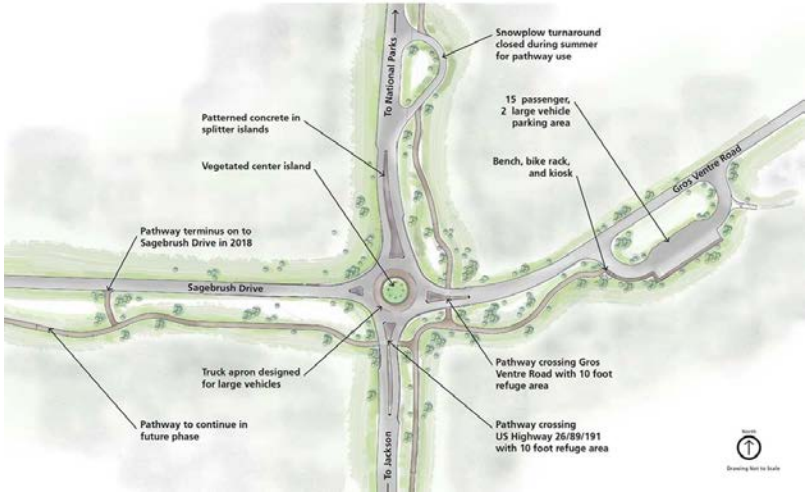


Figure Source: Grand Teton NPS
Photo Source: Isebrands

Directing Your Questions via the Chat Pod

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Hillary Isebrands,
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National Center for Rural Road Safety

State the risks of rural intersections

Summarize the benefits of roundabouts on rural roadways

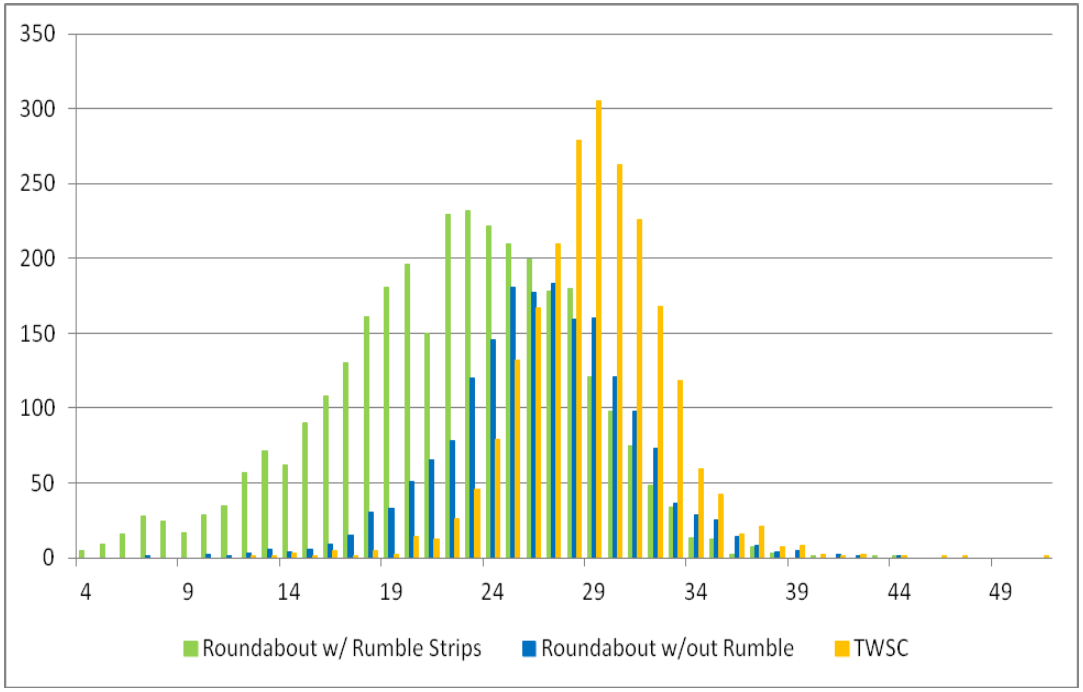
Name examples of rural roundabouts in the U.S.

List some of the characteristics of rural roundabouts with high speed approaches

Features of Rural Roundabouts

- Approach Geometry
- Visibility & Conspicuity
  - Signing
  - Curbing
  - Lighting

But How do Drivers Slow Down to Navigate a Rural Roundabout?



Source: Transportation Research Record 2096, Isebrands 2009

Approach Geometry & Splitter Islands

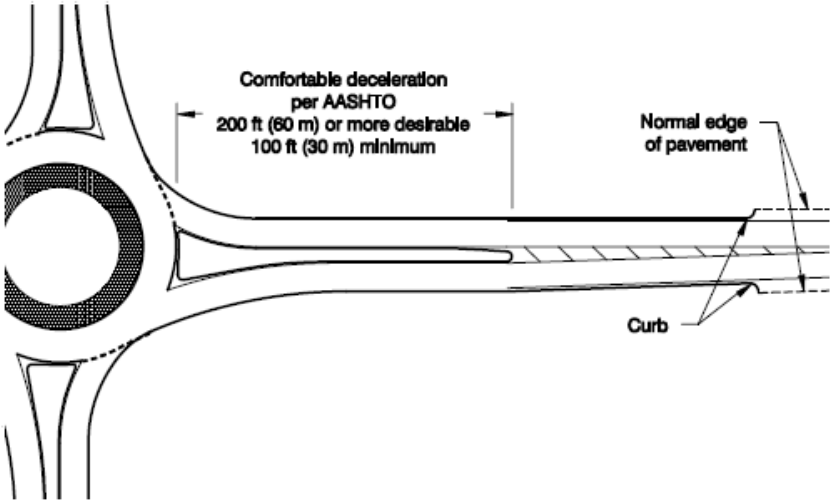
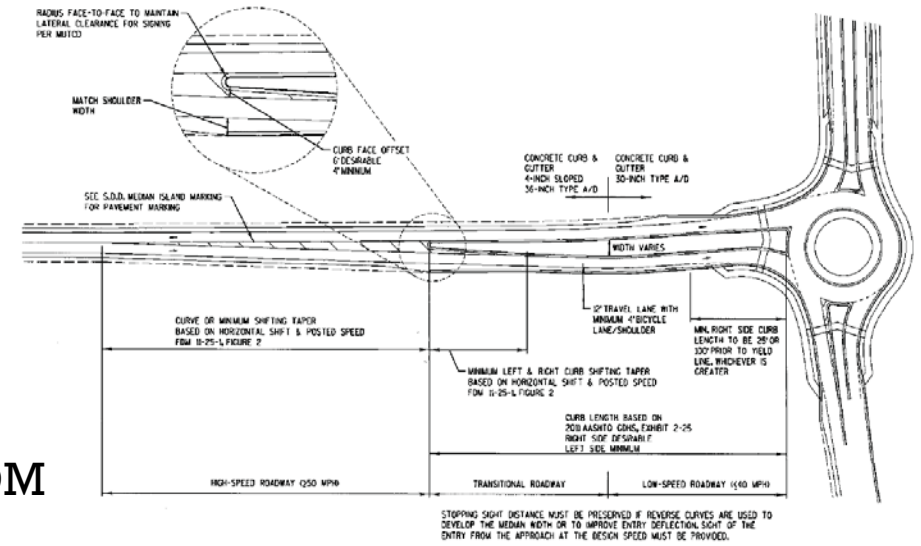
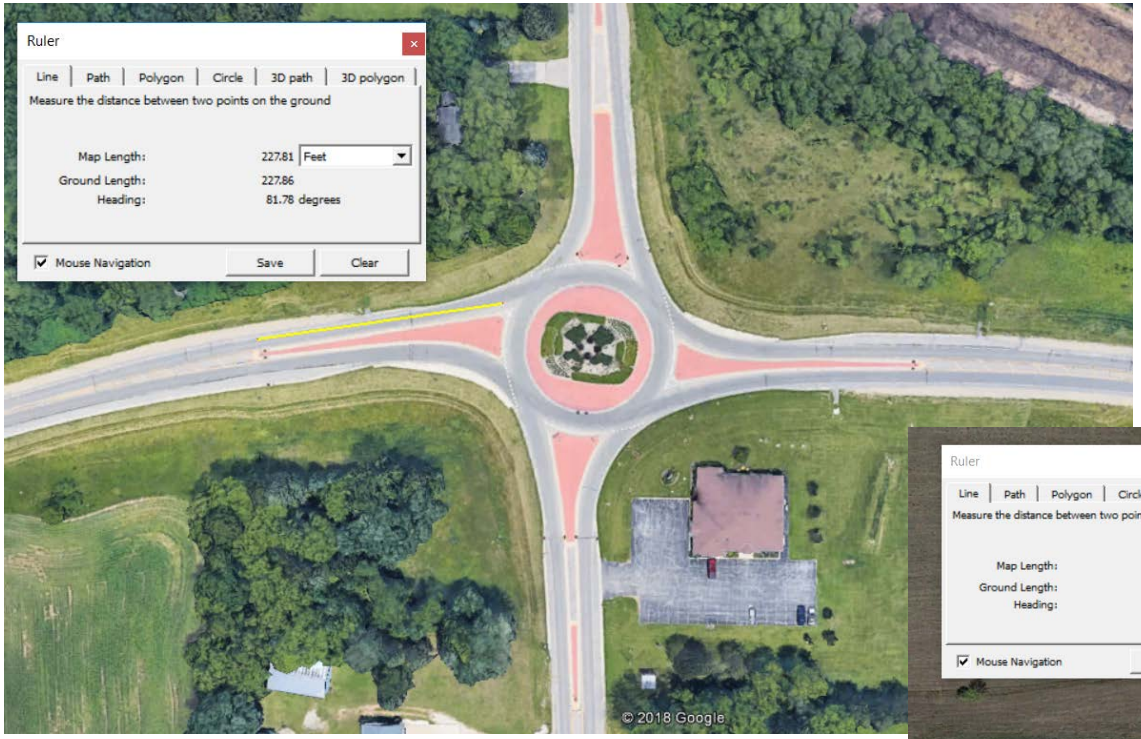


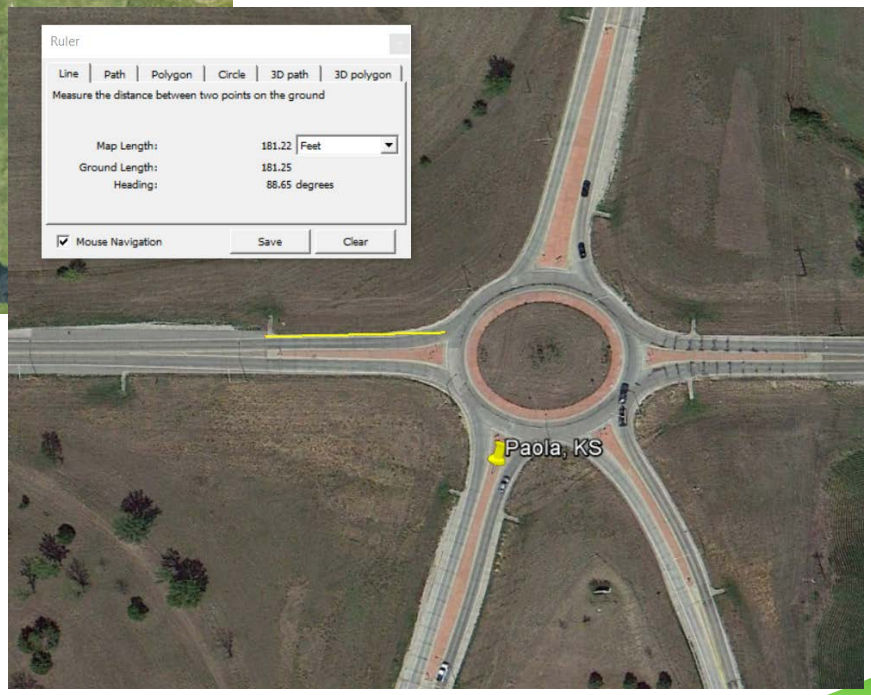
Exhibit 6-69
Extended Splitter
Island Treatment



Source: NCHRP 672 and WisDOT FDM

Approach Geometry & Splitter Islands

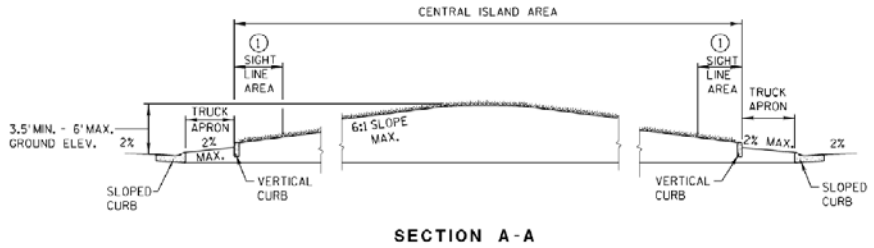




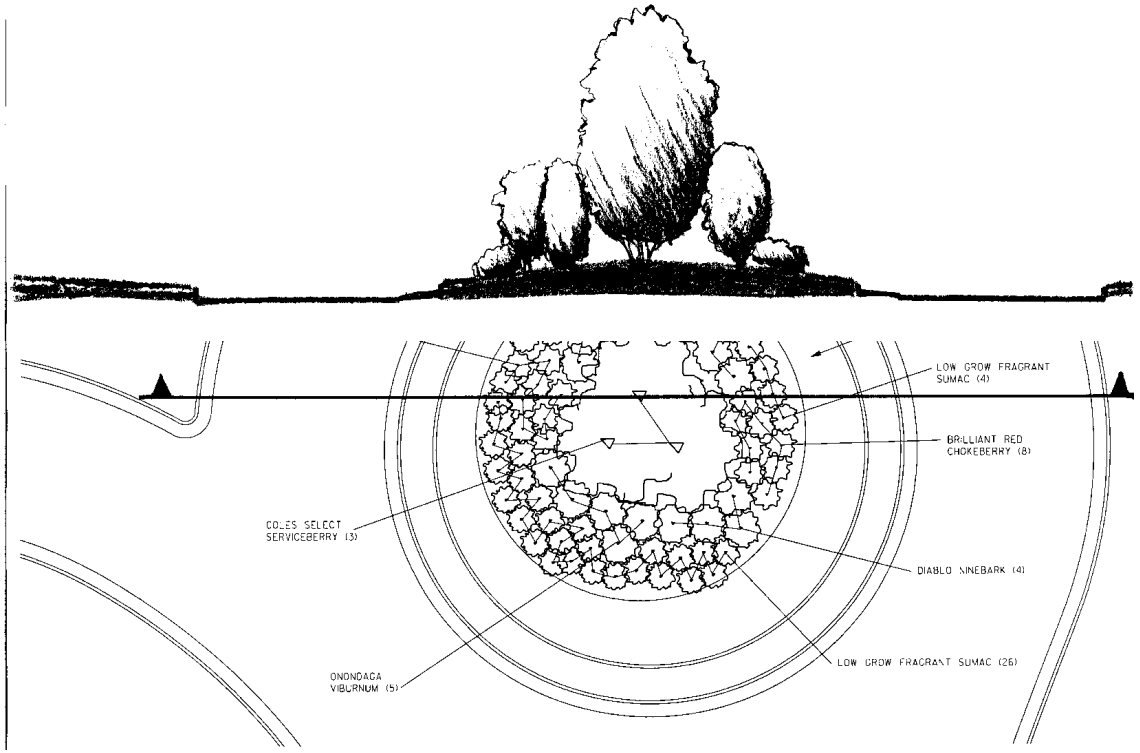
Aerial Source: GoogleEarth

Visibility and Conspicuity

- Splitter Island
- Center Island
- Geometry
- Curbing
- Lighting
- Signing



SECTION A-A



Signing

R1-2

Standard: A YIELD (R1-2) sign shall be used to assign right-of-way at the entrance to a roundabout.

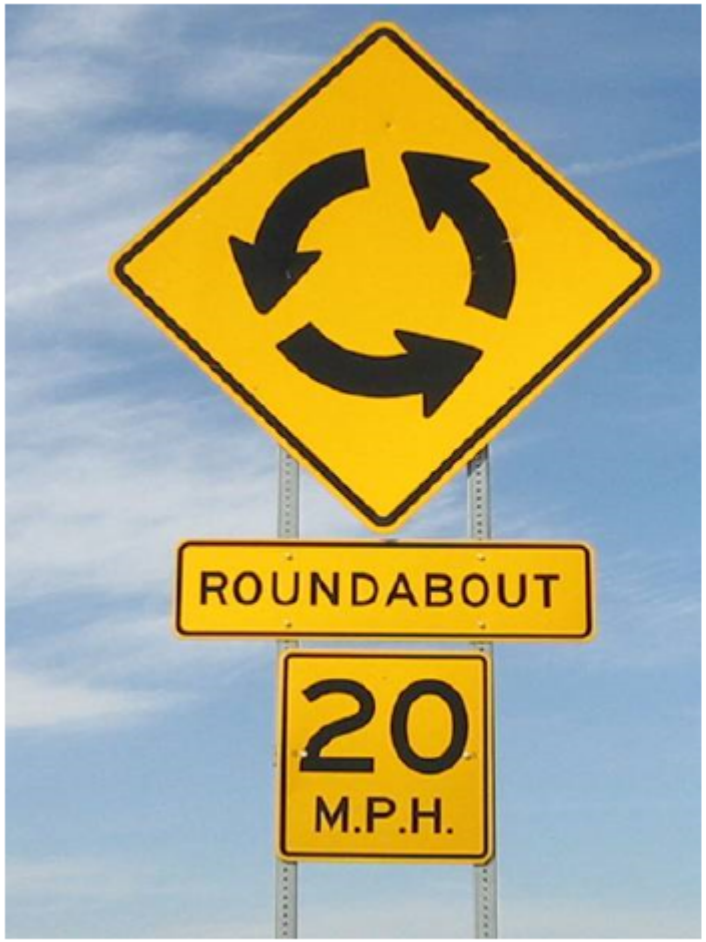
Option: Where the central island of a roundabout allows for the installation of signs, ONE WAY signs may be used instead of or in addition to Roundabout Directional Arrow (R6-4 series) signs to direct traffic counter-clockwise around the central island.


R6-4b

Guidance: Where the central island of a roundabout allows for the installation of signs, Roundabout Directional Arrow (R6-4 series) signs should be used in the central island

Source: MUTCD

Signing



Option: The Circular Intersection (W2-6) symbol sign may be installed in advance of a circular intersection.

Guidance: If an approach to a roundabout has a statutory or posted speed limit of 40 mph or higher, the Circular Intersection (W2-6) symbol sign should be installed in advance of the circular intersection.

Option: An educational plaque with a legend such as ROUNDABOUT (W16-17P) may be mounted below a Circular Intersection symbol sign.

Option: The Advisory Speed (W13-1P) plaque may be used to supplement any warning sign to indicate the advisory speed for a condition.

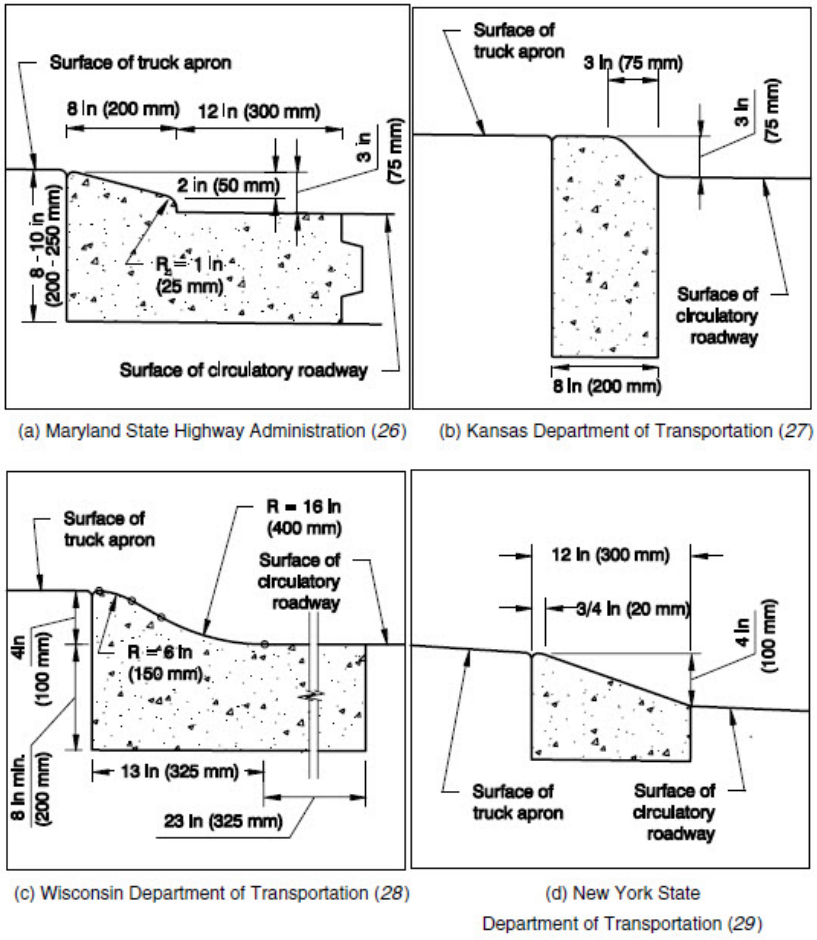
Source: MUTCD

Signing

Source: Isebrands, Google Street View (upper right)

Curbing

	NCHRP 672
Width	3 to 15 ft
Cross slope	1% to 2% (away)
Curb height	2 to 3 in



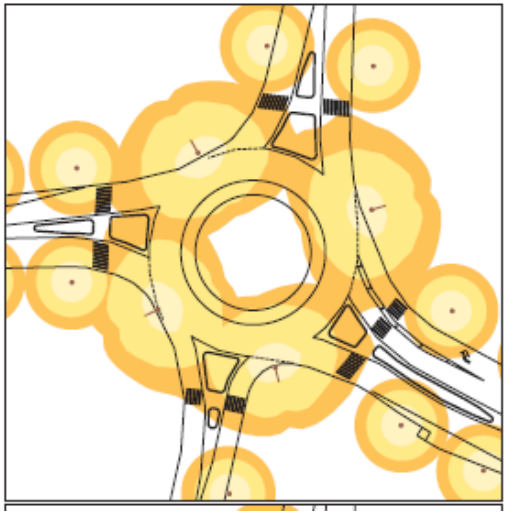
(a) Maryland State Highway Administration (*26*) (b) Kansas Department of Transportation (*27*)

(c) Wisconsin Department of Transportation (*28*) (d) New York State Department of Transportation (*29*)

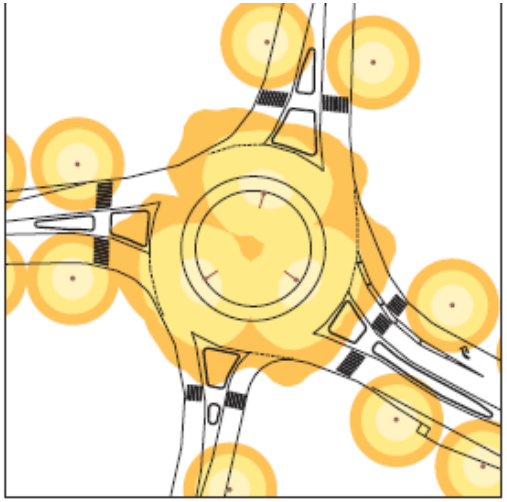
Source: NCHRP 672

Lighting

Illumination Type	Advantages	Disadvantages
Perimeter illumination	• Illumination can be strongest around critical bicycle and pedestrian areas. • Continuity of poles and luminaires is maintained for the illumination of the lanes, as well as good visual guidance on the circulatory roadway. • Approach signs typically appear in positive contrast and thus are clearly visible. • Maintenance of luminaires is easier due to curbside location.	• Illumination is weakest in central island, which may limit visibility of roundabout from a distance. • More poles are required to achieve the same illumination level. • Poles may need to be located in critical conflict areas to achieve illumination levels and uniformity.



Perimeter Illumination Design



Central Illumination Design

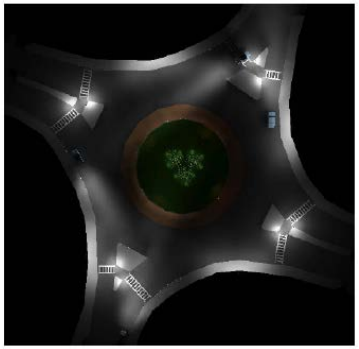


Figure 25. Plan view of the lighting layout.

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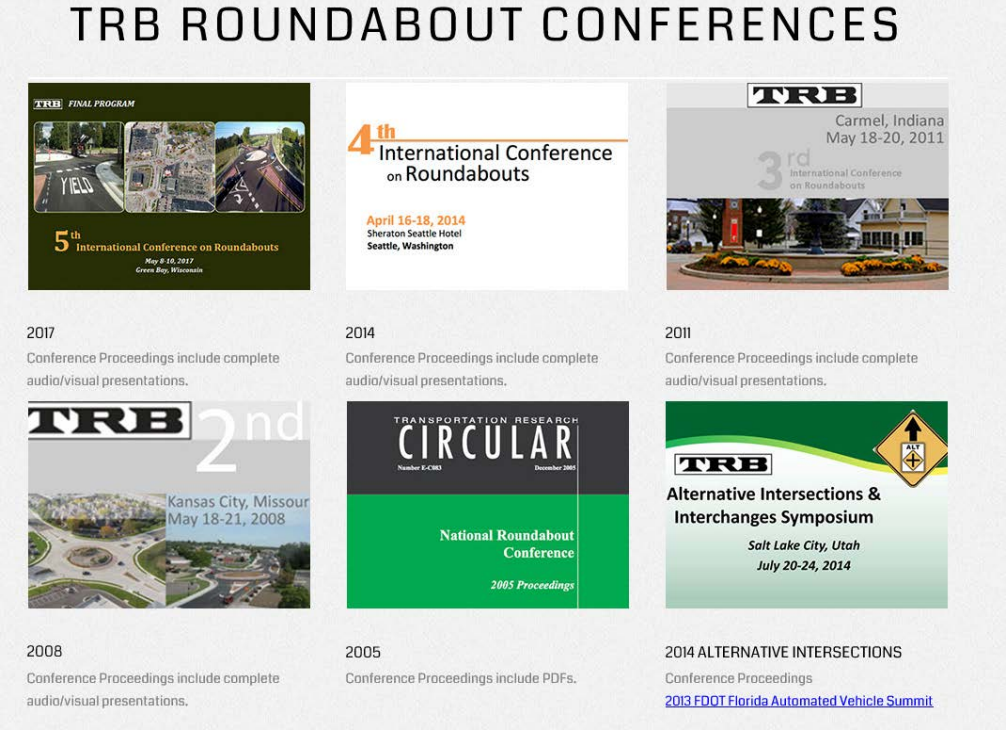
Learning Outcomes

In this webinar, you have learned to:

- State the risks of rural intersections
- Summarize the benefits of roundabouts on rural roadways
- Name examples of rural roundabouts in the U.S.
- List some of the characteristics of rural roundabouts with high speed approaches

Resources

- NCHRP 17-70 Development of Roundabout Crash Prediction Models (forthcoming)
- Teachamercia.com



Resources

Crash Analysis of Roundabouts at High-Speed Rural Intersections

2012 PATRICIA F. WALLER AWARD: Outstanding Paper on Safety and System Users

Statistical Analysis and Development of Crash Prediction Model for Roundabouts on High-Speed Rural Roadways

Effects of Approach Speed at Rural High-Speed Intersections

Roundabouts Versus Two-Way-Stop Control

Hillary Isebrands, Shauna Hallmark, and Neal Hawkins

Speed can increase the risk of injury-producing crashes, especially at intersections where vehicles may be approaching and entering the intersection with high speed differentials. It is known that roundabouts force all drivers to reduce their speed in the intersection; however, speed data in advance of the roundabout approach were not available for roundabouts with high-speed approaches to verify this phenomenon. In this research, a comparative evaluation of the difference in the average approach speeds between rural roundabouts and rural two-way-stop-controlled intersections and between rural roundabouts with and without rumble strips on the intersection approaches was performed. Approach speed data proved that drivers could slow down in advance of roundabouts on rural roadways. The mean speed 100 ft from the yield line of the roundabouts was 2.5 mph lower than the mean speed 100 ft from the stop bar at stop-controlled approaches. Additionally, a comparison of roundabout approaches with and without rumble strips showed mean speeds 4.3 and 3.3 mph lower 100 and 250 ft from the yield line, respectively, for approaches with rumble strips; however, the variation in speeds increased with the introduction of rumble strips.

"Drivers, vehicles, and roadways are complicated co-contributors in traffic accidents" (*1*). This statement made in 1968 holds true more than 40 years later, despite the advancements in vehicle safety and improvements in roadway guidelines and designs that have been made. Regardless of the engineering advances that have been made, driver error continues to be a major contributor to motor vehicle crashes, so roadway and intersection designs should be forgiving to allow roadway users an opportunity to recover. Design can reduce the incidence of human error, the chance that human error will result in a crash, and the severity of the consequences of crashes (*2*).

Fatal crashes still occur in abundance on U.S. roadways and are overrepresented on rural roadways. National statistics show that the fatality rate on rural non-Interstate roads is 2.35 per 100 million vehicle miles traveled. That rate is nearly three times higher than the fatality rate on urban non-Interstate roadways (*3*), and 40% of those fatalities ($n = 2,830$) are at rural intersections.

Speed is often a factor contributing to intersection crashes (*4*); however, only a modest number of studies have evaluated speeds at intersections and its relationship to safety (*5*). Speed, speed variances, and deceleration rate have been identified as surrogates for crash risk (*6–12*). Additionally, surrogate events for crashes, such as speed, may provide complementary information to decision makers (*13*) when they determine an appropriate intersection countermeasure that yields the greatest benefits.

The geometric features of a roundabout slow all vehicles approaching and entering an intersection. This aspect of roundabouts reduces the speed variances between vehicles on the same approach as well as those on the other approaches and significantly reduces the probability of right-angle crashes prone to cause injuries. Although little published research has focused on the overall safety effectiveness of roundabouts on high-speed roadways, two studies have shown substantial reductions in injury crashes at roundabouts (*14, 15*). Isebrands reported that the average frequency of injury crashes was reduced by 84%, the average rate of injury crashes was reduced by 89%, the rate of angle crashes was reduced by 86%, and fatal crashes were eliminated at 17 rural roundabouts with high-speed approaches (*15*).

This research used field data from six rural intersections (four roundabouts and two two-way-stop-controlled intersections) to evaluate the differences in the approach speeds at roundabouts and two-way-stop-controlled intersections with different types of traffic control in advance of the intersection (advance traffic control).

STUDY DESCRIPTION

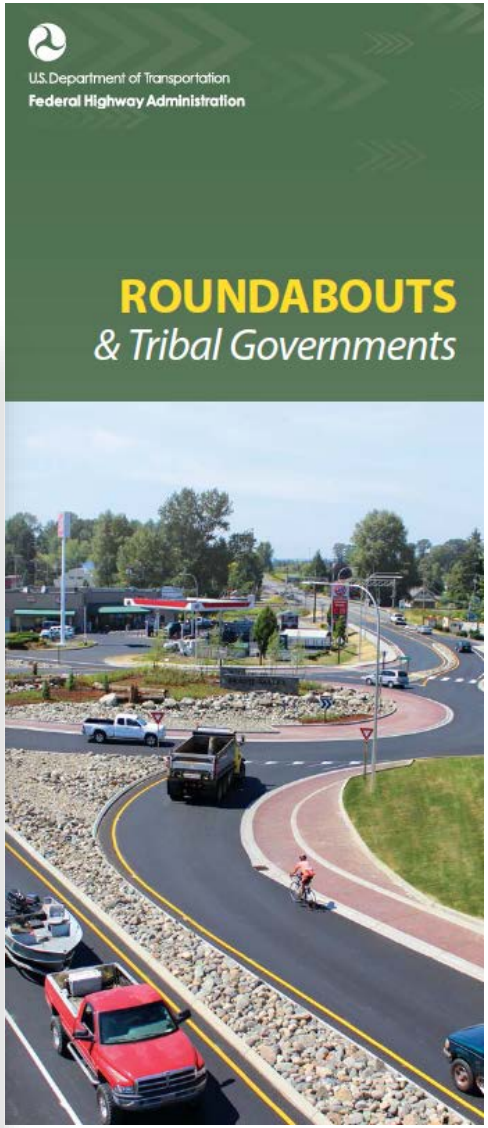
Need for Research

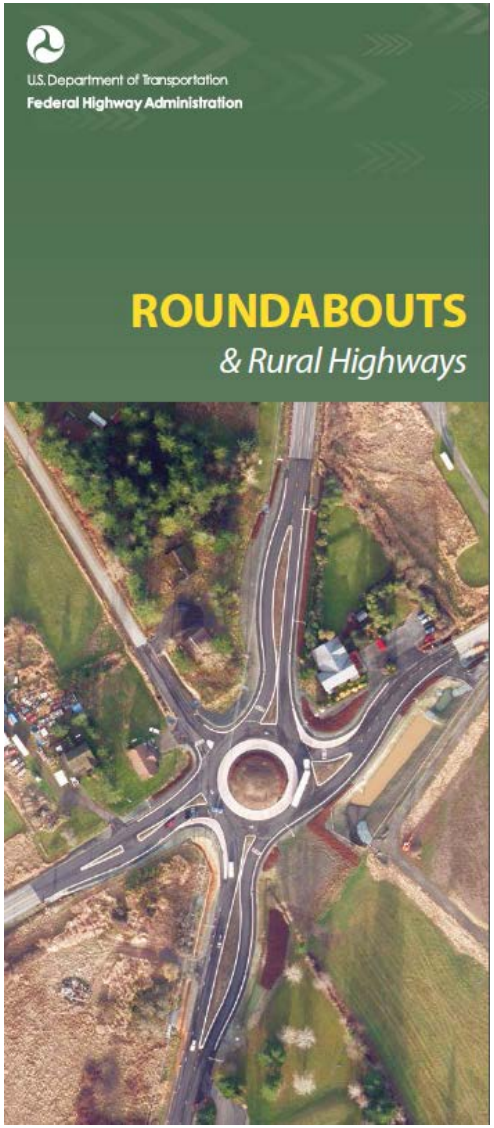
Although modern roundabouts have gained recognition as a viable intersection alternative that improves intersection safety and operations, many transportation agencies are still reluctant to construct roundabouts in rural locations on high-speed roadways (speeds greater than 40 mph). Numerous government agencies and citizens argue that roundabouts are for urban and suburban environments and are not appropriate on rural roadways.

The before-and-after safety data that are available for rural roundabouts on high-speed roadways in the United States indicate reductions in injury crashes of between 84% and 87% (*14, 15*), but concerns about the ability of drivers to slow down in advance of a roundabout to navigate it safely remain. The only speed data that have been collected at roundabouts were a part of *NCHRP Report 572: Roundabouts in the United States* (*14*). Although speed-based prediction models for roundabouts from this research showed promise, the data set was not robust enough to be used to recommend a specific safety prediction model. In addition, the number of roundabouts and approaches at rural locations was limited, and approach speed data were calculated only at locations 200 ft from the yield line and at the yield line.

H. Isebrands, FHWA, 12300 West Dakota Avenue, Lakewood, CO 80228. S. Hallmark, Iowa State University, 402 Town Engineering, Ames, IA 50011. N. Hawkins, Center for Transportation Research and Education, Iowa State University, 2711 South Loop Drive, Suite 4700, Ames, IA 50010. Corresponding author: H. Isebrands, hillary.isebrands@dot.gov.

Transportation Research Record: Journal of the Transportation Research Board, No. 2402, Transportation Research Board of the National Academies, Washington, D.C., 2014, pp. 67–77.
DOI: 10.3141/2402-08





https://trrjournalonline.trb.org/loi/trr
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SC Upcoming 2018 Webinars

- Local Safety Funding Options

  Wed. Aug. 1, 9:00-10:30 AM Mountain

- Designing for Rural Bike Safety

  Thurs. Aug. 16, 11:00 AM – 12:30 PM Mountain

Archived Webinars

Access the webinar archives

Contact Information

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