PROVEN SAFETY COUNTERMEASURE:

Reduced Left-Turn Conflict Intersections

FHWA Safety Program

U.S. Department of Transportation
Federal Highway Administration

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

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Cover photo sources: Left - Bolton & Menk, Inc., Top right - FHWA, Right bottom - FHWA

Reduced Left-Turn Conflict Intersections

What is it?

Generally, reduced left-turn conflict intersections are geometric designs that lessen the number or severity of potential vehicle-to-vehicle conflicts associated with left-turn movements. Two of these highly effective intersection designs are included in this FHWA Proven Safety Countermeasure—the **restricted crossing U-turn (RCUT)** and the **median U-turn (MUT)**. In addition to modifying conflict points, these designs simplify driver decisions, reduce intersection congestion and delay, and minimize the potential for related crashes. For the RCUT and the MUT, the main intersection and the designated U-turn locations may be signalized or unsignalized.

Restricted Crossing U-turn

(Also known as: J-Turn, Synchronized Street, Superstreet)

The RCUT intersection design modifies the direct left-turn and through movements that drivers make from cross-street approaches. In an RCUT design, cross-street vehicles make a right turn followed by a U-turn at a designated location before continuing in the desired direction.

Source: Bolton & Menk, Inc.

Median U-turn

(Also known as: Michigan Left, Express Left, ThrU-Turn, Boulevard Left)

Source: FHWA

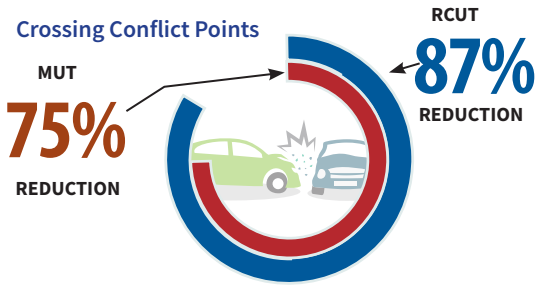
The MUT intersection design modifies direct left turns from either (or both) the major and minor approaches. Vehicles proceed through the targeted main intersection, make a U-turn a short distance down the road, then make a right turn at the targeted main intersection. Left-turning traffic on the minor approach can also be directed to make a right turn at the main intersection followed by a U-turn at a designated location.

> *"It is estimated that* **10 to 20** *reduced-conflict intersections can be* **built for the cost of ONE interchange.** *We are treating as many intersections as possible, being effective with taxpayer dollars and, most important,* **saving lives with every installation.**"
>
> Minnesota DOT

What are the Benefits?

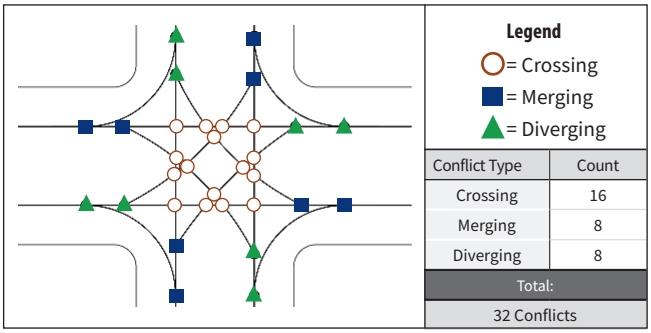
Safety

The underlying reason for the proven safety of the RCUT and MUT intersection designs is the reduction of conflict points—in particular, crossing conflict points. Each *crossing* conflict point increases the opportunity for right-angle crashes (also called T-bone crashes) to occur, which often result in severe injuries or fatalities. Compared to traditional intersection designs, the RCUT and MUT intersection designs reduce the number of *crossing* conflict points by 87 percent and 75 percent, respectively.



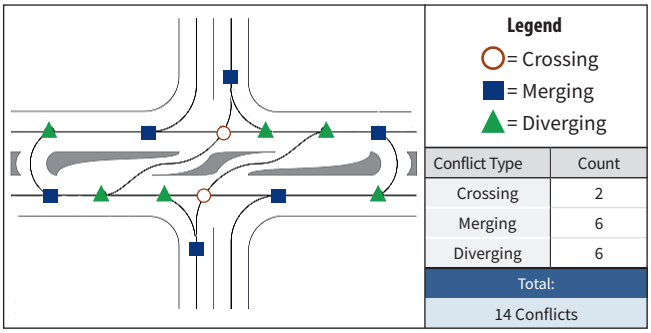
With this dramatic lessening in potential conflict points, the reduced left-turn conflict intersection strategy is proving its worth as States are increasingly implementing—and realizing the safety benefits of—RCUT and MUT designs.

Conventional Intersection: Conflict Points



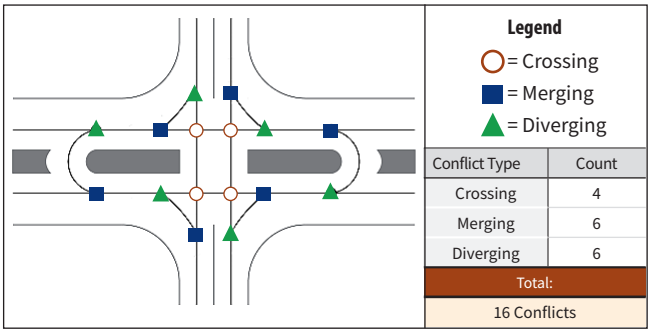
Conflict Type	Count
Crossing	16
Merging	8
Diverging	8
Total:	
32 Conflicts	

RCUT Intersection: Conflict Points



Conflict Type	Count
Crossing	2
Merging	6
Diverging	6
Total:	
14 Conflicts	

MUT Intersection: Conflict Points



Conflict Type	Count
Crossing	4
Merging	6
Diverging	6
Total:	
16 Conflicts	

The following table highlights several RCUT implementations and study results.

MARYLAND	MINNESOTA	MISSOURI	NORTH CAROLINA
9 RCUT intersections along US 15 and US 201[1] ■ 44% reduction in total crashes **RCUT at US 301 and MD-313[2]** ■ 92% crash reduction over a 10-year period ■ 100% reduction in right-angle collisions and fatal and injury crashes	**8 RCUT intersections[3]** ■ 100% reduction in fatal and serious injury right-angle crashes ■ 77% reduction in all severity right-angle crashes ■ 50% reduction in injury crashes	**5 RCUT intersections along US 63[4]** ■ 35% reduction in total crashes ■ 54% reduction in fatal and injury crashes	**93 RCUT intersections[5,6]** ■ 59% reduction in total crashes ■ 71% reduction in fatal and injury crashes ■ The study also showed that these crash reductions remained consistent over a range of intersection volumes

1 USDOT, FHWA, Field Evaluation of a Restricted Crossing U-Turn Intersection, FHWA-HRT-11-067 (June 2012). Available at: https://www.fhwa.dot.gov/publications/research/safety/hsis/11067/11067.pdf.

2 Hochstein, J., T. Maze, T. Welch, "The J-turn Intersection Design Concept Basics," September, 2008. Available at: https://transportation.ky.gov/Congestion-Toolbox/Documents/J-Turn%20101.pdf.

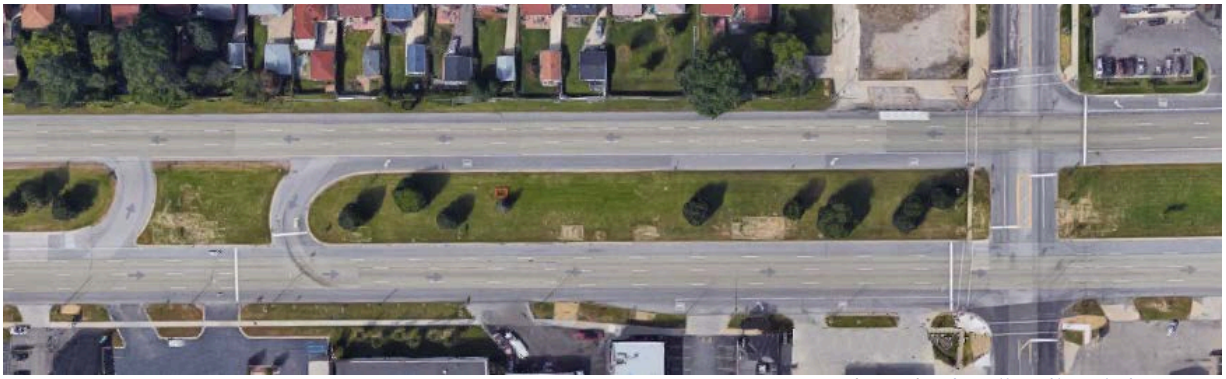
3 Minnesota Department of Transportation, A Study of the Traffic Safety at Reduced Conflict Intersections in Minnesota (May 2017). Available at: http://www.dot.state.mn.us/roadwork/rci/docs/trafficsafetyatrcistudy.pdf.

4 Edara, P., C. Sun, and S. Breslow. "Evaluation of J-turn Intersection Design Performance in Missouri." Missouri Department of Transportation, December 2013.

5 Simpson, C., Safety Effectiveness of Un-Signalized Synchronized Street Intersections. North Carolina: North Carolina Department of Transportation, July 2016. Available at: https://connect.ncdot.gov/resources/safety/Safety%20Evaluation%20Completed%20Projects/Unsignalized%20Synchronized%20Street%20Presentation%202016.pdf.

6 North Carolina Department of Transportation, NCDOT Traffic Safety Unit Programs, Synchronized Streets Evaluation. Available at: https://connect.ncdot.gov/resources/safety/TrafficSafetyResources/Unsignalized%20Synchronized%20Streets.pdf.

Michigan Department of Transportation (MDOT) is a pioneer on MUT installations. The MDOT website reports that, on roadways where Michigan Lefts were implemented, overall crashes were reduced by 30 to 60 percent. The greatest reductions are rear-end and head-on crashes during left turns (a 60 to 90 percent reduction), and in right-angle crashes (60 percent reduction).[1]



Source: @2018 Google Map data, https://goo.gl/maps/DnhC4PJpu4L2

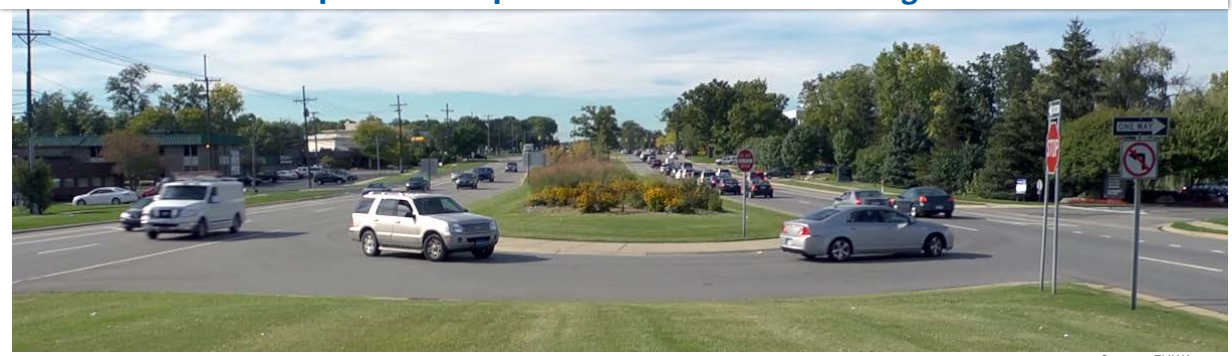
MUT intersection at US 24 and W. Warren Avenue in Dearborn Heights, Michigan.

1 Michigan Department of Transportation, "Michigan Lefts." last modified n.d., Available at https://www.michigan.gov/mdot/0,4616,7-151-9615_44557-161777—,00.html. Last accessed October 2, 2018.

Traffic Flow

The RCUT and MUT designs can reduce travel times and congestion as well as improve overall traffic flow.

Implementation of an MUT design can improve intersection throughput by 20 to 50 percent compared to direct left-turn configurations.*



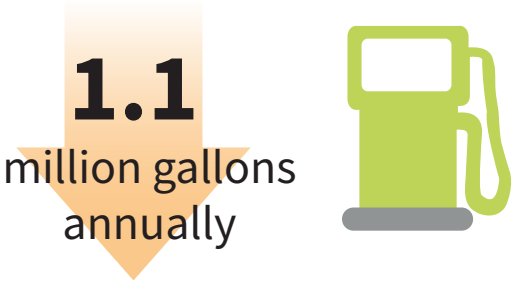
*FHWA, Median U-turn Intersection, FHWA-SA-14-042, (Washington, DC: 2014)

Source: FHWA

Texas used the RCUT design (called Superstreet in Texas) on US 281 North and Loop 1604 West. Each corridor has yielded travel time reductions in both the morning and evening peak times.[2]

Travel Time Savings	Morning Rush Hour	Evening Rush Hour
US 281	19%	34%
Loop 1604	14%	35%

According to the US 281 traffic study completed for the Alamo Regional Mobility Authority, **the RCUT design can reduce fuel consumption by 1.1 million gallons annually for the corridor**.[3]



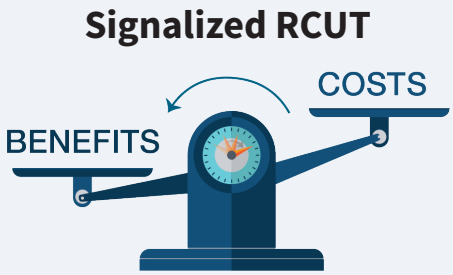
[2] Texas A&M Transportation Institute, Mobility Investment Priorities, Strategies, Superstreets. Available at: https://mobility.tamu.edu/mip/strategies-pdfs/system-modification/technical-summary/superstreets-4-pg.pdf.

[3] Alamo Regional Mobility Authority, Proposed U.S. Highway 281 Superstreet Traffic Study (June 2009).

Many agencies use the unsignalized RCUT design for their rural four-lane divided highways to improve safety. But in areas with higher volumes, signalized RCUTs and MUTs can also increase capacity and improve traffic efficiency.

- A signalized RCUT provides great flexibility in traffic signal timing to accommodate unbalanced traffic flow, because it allows for unique cycle lengths in each major street direction.
- A signalized MUT intersection can particularly improve traffic flow for the through movements on the major street by reducing the number of signal phases (from four to two) and shortening the overall signal cycle length. This can provide more "walk" time for pedestrians to cross the intersection, as well as more frequent crossing opportunities on an hourly basis.

Overall, reduced left-turn conflict intersections are often comparable in cost to an equivalent conventional design. When compared to a full, grade-separated interchange, RCUTs and MUTs cost much less while still meeting traffic demand, having fewer right-of-way impacts, and being faster to construct.



3:1 When considering safety only

4:1 When considering both safety and operations

Source: Safety Evaluation of Signalized Restricted Crossing U-Turn Intersections, FHWA-HRT-17-082.

Source: @2018 Google Map Data, https://goo.gl/maps/8sML3WGT3v12

RCUT intersection at US 169 and Dodd Road in Traverse Township, Minnesota.

What Do I Need To Know To Implement RCUTs and MUTs?

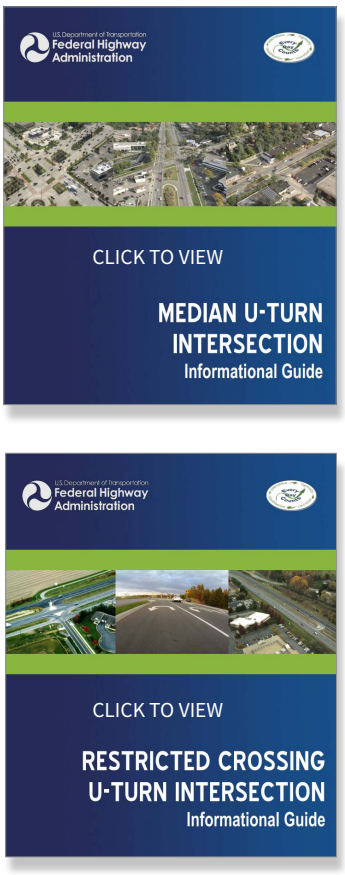
Design and User Considerations

Some of the basic elements agencies will need to consider when implementing RCUT and MUT intersections include acceleration/ auxiliary lanes, crossover spacing, median width, signing and pavement marking, and accommodations for large trucks, pedestrians, bicycles, emergency vehicles, and transit.

Signing, pavement marking, and geometric design are especially important for the success of RCUTs and MUTs. Providing sufficient guidance and direction to motorists reduces the chance of driver error and discourages prohibited turns.

The RCUT and MUT designs are adaptable and useful not only as a corridor treatment, but also as a treatment for single intersections. In addition, the designs can support community mobility and safety goals for both pedestrians and bicyclists.

FHWA has developed comprehensive informational guides for both RCUTs and MUTs. The guides provide multiple design options for accommodating pedestrians, bicyclists, and transit. Transportation practitioners looking to learn more about detailed design elements and overall guidance should refer to these publications.



Source: FHWA.

FHWA Informational Guides for RCUT and MUT Intersections.

Source: MoDOT, https://flic.kr/p/8YT2t5.

Extra pavement or loons may be necessary at the U-turn location to accommodate large vehicles where narrow medians are present.

Source: North Carolina DOT.

Providing sufficient guidance and direction to motorists reduces the chance of driver error.

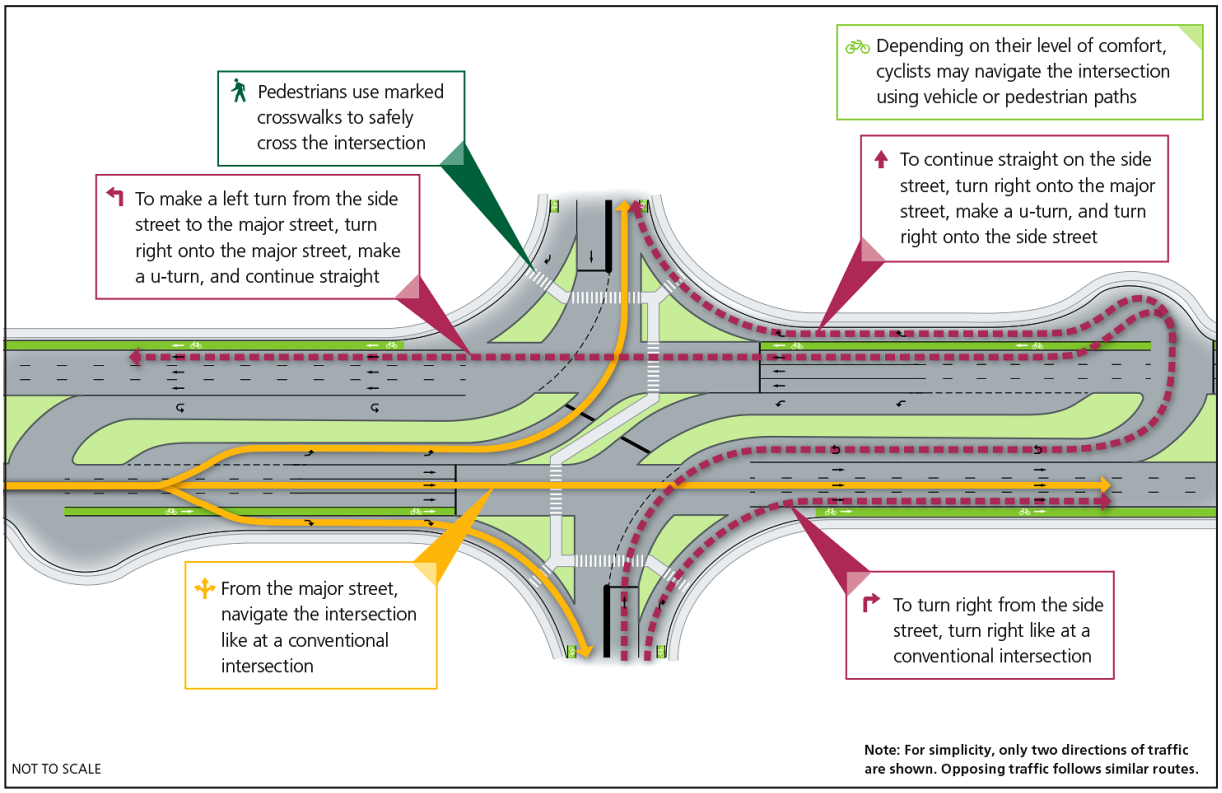
Public Outreach and Education

Public meetings are now commonplace for most transportation projects, but outreach becomes more important when implementing an unconventional intersection, especially in an area that has not experienced an RCUT or MUT design.

> *"In Missouri, converting from two-way stop-controlled intersections to RCUT intersections* ***cut the average wait time in half****."*
>
> Source: Evaluation of J-turn Intersection Design Performance in Missouri

One common concern from the public is often related to the "perceived" extra travel time they think will occur by using the u-turn designs. Most implementations have demonstrated that travel time actually improves, and the resulting safety benefits that the RCUT and MUT intersections offer are substantial.

To help address public concerns and explain the benefits of the designs, FHWA provides multiple case studies, fact sheets, brochures, and videos to help support State and local transportation agencies in their communication and education efforts. Many State DOTs have also developed their own materials; for example, Virginia DOT developed an Innovative Intersections and Interchanges website that features valuable information for the public on RCUTs and MUTs, as well as other designs.



Source: Virginia DOT.

Graphic that shows how to navigate an RCUT (available on Virginia DOT's website): http://www.virginiadot.org/info/innovative_intersections_and_interchanges/rcut.asp.

What Else Can I Learn from Others?

Exceptional Outreach and Education in Utah

When Utah DOT (UDOT) decided to implement the ThrU Turn—the first MUT in the western United States—the agency knew that public education and outreach needed to be a priority. UDOT developed numerous materials to help stakeholders understand the reduced left-turn conflict concept and how it will improve safety, reduce congestion, and support the economy. UDOT representatives visited businesses along the targeted corridors multiple times to explain the new design, provide information, and answer questions. The agency also hosted public meetings to provide opportunities to learn about the project, express concerns, and ask questions. To reach even more people, UDOT arranged for the ThrU Turn design informational videos to show at local theaters prior to the main feature. UDOT's ThrU Turn Intersection videos are available on UDOT's YouTube channel.

Source: UDOT

Reducing Left Turns in Orange Beach, Alabama

From 2012 to 2014, Highway 182 in Orange Beach experienced 227 total crashes, 49 injury crashes, and 4 fatalities – 50 percent of the fatalities were pedestrians. Alabama DOT (ALDOT) found that more than 70 percent of the crashes in this area involved left-turning traffic. To address these safety concerns, in 2016, ALDOT started a phased-construction roadway project on Highway 182 that included adding signalized median u-turns, redesigning intersections to restrict left-turn movements, and installing additional pedestrian crosswalks. With this reduced left-turn conflict intersection project, ALDOT sought to balance the needs of pedestrians, bicyclists, and motorists. While safety is the primary benefit, the project also allowed the City of Orange Beach to add landscaping to the medians, improving the overall aesthetics of the corridor, which is important for this vacation-destination city.

Source: Alabama DOT

Reduced left-turn conflict intersections can be designed to safely accommodate pedestrians and bicyclists, as shown in this preliminary concept graphic from Alabama DOT.

For More Information:

- FHWA's Office of Safety U-Turn-based Intersections Website

For More Information:

https://safety.fhwa.dot.gov/provencountermeasures/

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