

Safer Intersections for Rural Highways

Right-angle crashes are a problem on median-separated highways, but the most typical solutions for this problem—constructing an interchange or installing traffic signals—are not always the most effective. NCHRP managed research on safer median intersections that led to the expanded use of innovative designs by state transportation agencies. The effects on safety have been dramatic.

Intersections on Rural Highways: A Serious Safety Risk

Median-separated highways provide distinct advantages over undivided roadways by separating traffic, providing a recovery or stopping area for vehicles, and providing space for left-turn vehicles. In many cases, they also provide the same safety and travel time benefits as rural interstates at a lower cost. However, these safety benefits can be diminished by an increase in the frequency and severity of intersection crashes, especially right-angle crashes that occur while a vehicle from a minor road is making a left turn through the median and onto the highway.



J-turns significantly improve rural highway intersection safety by preventing drivers from directly crossing medians and requiring them instead to make a right turn followed by a U-turn.

Because interchanges and traffic lights are not always the most effective or cost-efficient solutions to these problems, transportation agencies are in need of innovative, low-cost designs that can be used to improve the safety of such intersections. To help establish design guidance and safety data for

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these treatments, NCHRP Project 15-30 was undertaken, resulting in *NCHRP Report 650: Median Intersection Design for Rural High-*

Speed Divided Highways (www.trb.org/main/blurbs/163452.aspx).

The report includes 10 case studies illustrating how various intersection designs have been applied in the field and includes recommendations for updating guidance in the FHWA *Manual on Uniform Traffic Control Devices* and AASHTO’s *A Policy on Geometric Design of Highways and Streets*, or “Green Book.”

Paths to Practice

An expanded toolbox for state DOTs

NCHRP Report 650 showed that many of the intersection designs examined can significantly

improve safety at a lower cost than constructing an interchange. In doing so, the report gives states an expanded set of options for dealing with problem intersections.

“In the past, options for improving safety at high-speed rural intersections were limited,” says Tom Welch, panel chair for NCHRP

15-30 and formerly a highway safety engineer for the Iowa DOT. “Options included a new interchange, which involves major new spending, or installing a traffic signal, which is not guaranteed to improve safety and may even worsen it.”

According to Welch, *NCHRP Report 650* provides engineers with everything they need to make an informed decision about how to handle a problem intersection and how to approach the task of design. “With this

report, we have a good toolbox,” Welch says. “There is no missing information.”

J-turns: States adopt a safer intersection design

One of the median treatments examined in *NCHRP Report 650* is the J-turn intersection, which prevents a driver on a minor road from directly crossing the median. Instead, drivers are forced to make a right turn and subsequently a U-turn at some distance from the intersection. Because the J-turn reduces drivers’ exposure to oncoming traffic in the opposing lane, the distance of which can be difficult to judge, the safety benefits can be significant.

“The J-turn is the main tool we consider when we need to address right-angle crashes.”

“Our case study showed that J-turns produced a 48 to 92 percent reduction in

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Implementation Strategies AT A GLANCE

- **Cost-Efficient Solutions:** *NCHRP Report 650* spells out rural intersection solutions that increase safety benefits and lower costs. This offers DOTs a fast track to implementation.
- **Addressing a High-Profile Research Need:** DOTs have expressed keen interest in these solutions, and research-based guidance supports field trials and implementation.
- **Proof for the Public and Elected Officials:** Research data and supporting materials help satisfy members of the public and lawmakers who need evidence that these new designs work.

NCHRP—Transportation research that works

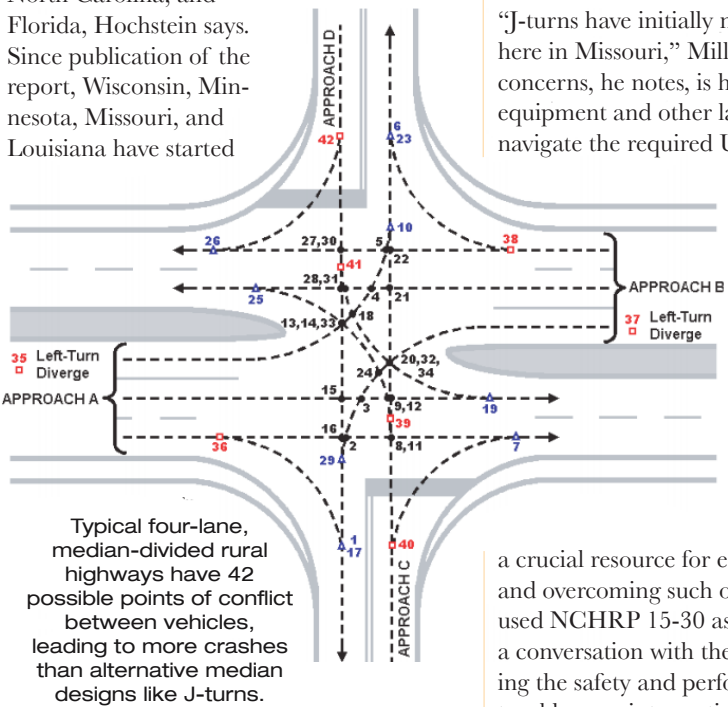
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crashes, and as much as a 100 percent reduction in more severe right-angle crashes,” says Joshua Hochstein, study co-investigator and Ph.D. candidate at Iowa State University.

“With objective safety data, the report lessens the burden of explaining to the public why these treatments are necessary.”

By the end of the study, state transportation agencies’ interest in J-turns was high. After sharing case studies with agencies during a multistate video conference, researchers had transportation agencies vote on how to prioritize further research into countermeasures. “They voted J-turns to be the highest priority,” Hochstein says.

The only states using J-turns when *NCHRP Report 650* was written were Maryland, North Carolina, and Florida, Hochstein says. Since publication of the report, Wisconsin, Minnesota, Missouri, and Louisiana have started



using J-turns, and Iowa is considering their use. Minnesota and Missouri are leaders in implementing the treatments, Welch says.

According to Missouri DOT traffic engineer John Miller, Missouri has already installed 12 J-turns with four more in the works. “The J-turn is the main tool we consider when we need to address right-angle crashes,” he says.

Minnesota has constructed about six J-turns and is planning six more, according to Brad

Estochen, traffic engineer at Minnesota DOT. “For problem intersections with high-speed angle crashes, J-turns are something we can implement to improve the situation far more quickly and cost-effectively than overpasses,” Estochen says.

A tool for educating the public

However, implementation of J-turns can be a difficult task, often facing fierce public opposition. Minnesota, Missouri, and Iowa have all reported similar problems.

“Drivers want to know why they can’t make a left turn,” Estochen says. “This is something new and nontraditional, and the public can be reluctant to embrace change.”

“J-turns have initially not been well-received here in Missouri,” Miller says. One of the concerns, he notes, is how well agricultural equipment and other large vehicles can navigate the required U-turns. According to

Welch, Iowa also encountered early resistance to its consideration of J-turns.

However, Estochen, Miller, and Welch agree that the safety data and case studies in *NCHRP Report 650* can be

a crucial resource for educating the public and overcoming such opposition. “We’ve used NCHRP 15-30 as a basis to start having a conversation with the locals about improving the safety and performance of potentially troublesome intersections,” Estochen says. “With objective safety data, the report lessens the burden of explaining to the public why these treatments are necessary. It shows that these treatments, while unfamiliar, have been successfully implemented before.”

“We’ve seen a 90 percent reduction in angle crashes where we’ve installed J-turns.”



Some J-turn treatment U-turn designs involve bulb-outs to accommodate larger vehicles.

“Because of the public reaction, the NCHRP results are handy,” Miller says. “We can point to the large reduction in collisions—and it really helps us sell J-turns.”

Implementation Success

Once installed, the safety benefits of J-turns sell themselves. “We’ve seen a 90 percent reduction in angle crashes where we’ve installed J-turns,” Estochen says. Missouri has had similarly impressive safety results.

“This is one of the most successful NCHRP projects I’ve been involved with. I’m proud to be a part of something that has saved lives.”

Estochen notes that *NCHRP Report 650* is a tool not just for educating the public, but also engineers—both new and seasoned—about alternatives to interchanges.

Miller and Welch agree. “This is a really important report,” Miller says. “It’s one I actively share with other staff.”

“This is one of the most successful NCHRP projects I’ve been involved with,” Welch says. “It really identified a need that states had, and I’m proud to be a part of something that has saved lives.” Ultimately the results will be incorporated into AASHTO’s Green Book and the FHWA *Manual on Uniform Traffic Control Devices*, he says.

ACKNOWLEDGEMENT OF SPONSORSHIP Work was sponsored by the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program, which is administered by the Transportation Research Board of the National Academies.

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