



TECHNICAL SUMMARY

Technical Liaison:

David Engstrom, Mn/DOT
david.engstrom@dot.state.mn.us

Administrative Liaison:

Dan Warzala, Mn/DOT
dan.warzala@dot.state.mn.us

Principal Investigator:

David Noyce, University of
Wisconsin-Madison

PROJECT COST:

\$51,546



This section of Fairview Avenue in St. Paul is shown after its conversion to a three-lane roadway with a TWLTL.



RESEARCH
SERVICES SECTION

Improving Road Safety with Two-Way Left-Turn Lanes

What Was the Need?

There is a widespread and growing network of four-lane undivided and median-divided highways in the United States, and increasing traffic volumes on these roadways have led to escalating congestion and safety problems. Traditional methods of addressing these problems include the addition of travel lanes, raised medians and center two-way left-turn lanes. However, because these improvements require an increase in roadway cross-section width, it is not possible to implement them when no additional cross-sectional space is available.

To address this problem, engineers have explored improving the safety of traditional four-lane undivided highways by converting them to three-lane highways with two-way left-turn lanes, or TWLTLs, which require no increase in cross-section width.

Because of documented successes in other states, Minnesota has been increasingly interested in using TWLTLs, but while Minnesota has implemented several four-lane to three-lane conversions, no Minnesota-based research had evaluated the safety and operational effects of these conversions. It was unclear if cross-sections with TWLTLs were safer and more operationally efficient than the traditional four-lane roadways that they replaced.

What Was Our Goal?

The objective of this research was to compare the safety and operational characteristics of three-lane roadways with TWLTLs to the four-lane undivided roadways they replace.

What Did We Do?

Researchers first performed a comprehensive literature review of published and unpublished research findings concerning four-lane to three-lane with TWLTL conversions in several different states.

With the assistance of Mn/DOT and local officials, researchers then selected nine study sites from across Minnesota featuring conversions of this sort and collected operational and crash data from these sites before and after the conversion. Sites were selected based on the availability of this data and the timing of the conversion. Researchers used site visits, pneumatic traffic counters, LIDAR speed guns, photographs and videotaping to measure changes in the:

- Number of crashes
- Severity of crashes
- Type of crashes
- Operating speed (the mean speed and 85th percentile)
- Average daily traffic

Researchers divided crash data into several levels of severity, including total crashes, injury, and property damage only. They also identified crashes as either rear-end or right angle. Because no fatal crashes occurred during the study, this category was not a part of the analysis.

Finally, two forms of analysis were used to compare data before and after conversions: a yoked/group comparison and the Empirical Bayes statistical approach.

“We recommend these conversions for applicable roads in Minnesota—but only if they have existing safety problems, and if traffic volumes are not projected to increase beyond that of the roads examined in this study.”

—David Noyce,
Associate Professor,
University of Wisconsin-
Madison

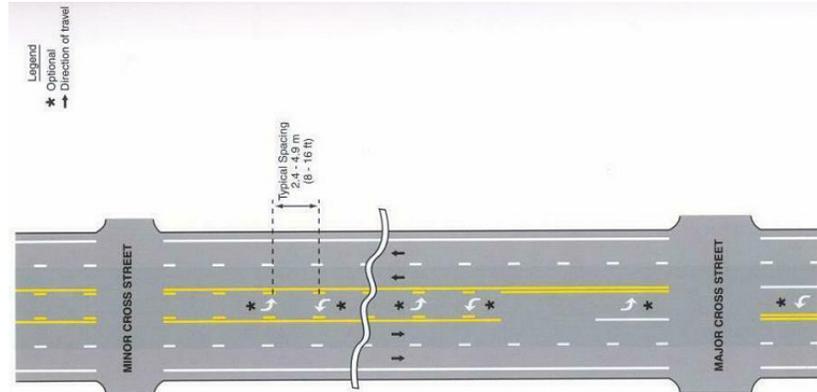
“This study confirmed the findings of other states – that converting four-lane undivided highways to three-lane highways with left-turn lanes can increase safety without negatively impacting operations.”

—David Engstrom,
State Traffic Safety Engineer, Mn/DOT Traffic,
Safety and Technology,
University of Minnesota

Produced by CTC & Associates for:

Minnesota Department
of Transportation
Research Services Section
MS 330, First Floor
395 John Ireland Blvd.
St. Paul, MN 55155-1899
(651) 366-3780

www.research.dot.state.mn.us



Pavement markings on each side of the two-way left-turn lane consist of a normal broken yellow line and a normal solid yellow line to delineate the edges of a lane that can be used by traffic in either direction for a left-turn.

What Did We Learn?

Results of this study showed that safety can be improved by converting a four-lane roadway to a three-lane roadway with a TWLTL, with little impact on capacity and other operational conditions. This accords with the results of the literature search: nearly all of the published research studies found positive improvements in safety and negligible impact on traffic operations.

The current study found statistically significant reductions in total crashes for the sites evaluated, which had traffic volumes ranging from approximately 8,900 to 17,400 vehicles per day. According to the yoked/group comparison, the percentage reductions in total crashes, property-damage-only crashes and left-turn crashes after conversions were approximately 37 percent, 46 percent and 24 percent, respectively. The reductions in crash rates per vehicle mile traveled for total and property-damage crashes were 46 percent and 45 percent, respectively. The Empirical Bayes statistical analysis, as well as other more traditional approaches, yielded similar results.

Operationally, researchers found that although a roadway cross-section change is not a countermeasure for speeding problems, it may lead to some speed reduction benefits. The change in average daily traffic after cross-section conversions was not statistically significant, and traffic volumes remained consistent or grew slightly at most study sites. The change in the mean speed and 85th percentile speed before and after conversion was statistically significant but not large in magnitude. The average reduction in the mean and 85th percentile speed after conversion was 1.88 mph and 1.66 mph, respectively.

What's Next?

This study successfully confirmed results in other states; researchers recommend using TWLTLs along roadways with safety problems and a projected average daily traffic of less than 17,500 vehicles per day. For higher daily traffic volumes, additional analysis should be completed before considering a four-lane to three-lane conversion.

While no follow up research is currently planned, Minnesota will continue to consider changing four-lane cross-sections to three-lanes with TWLTLs. Other states may also benefit from using this research in their decision-making processes concerning such conversions.

This Technical Summary pertains to the LRRB-produced Report 2006-25, “Safety and Operational Characteristics of Two-Way Left-Turn Lanes,” published June 2006. The full report can be accessed at <http://www.lrrb.org/PDF/200625.pdf>.