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RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS, RESEARCH & INNOVATION

TECHNICAL SUMMARY

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PROJECT COST:
$37,512

Variables such as uphill grades of more than 3 percent can shorten deceleration distances by 10 percent to 20 percent.

Putting Research into Practice: Guidelines for Designing Turn Lanes

Investigators assembled a guide that identifies and analyzes the primary factors influencing turn lane design. The guide includes a step-by-step process to calculate safe and effective turn lane lengths based on the specific characteristics of each intersection.

What Was the Need?

Turn lanes need to be designed so that vehicles will have adequate time to decelerate and sufficient storage room while waiting to make a turn. Minnesota's "Road Design Manual" suggests that a typical full-width turn lane be 300 feet long, with an additional 180-foot taper section leading into the lane.

Higher traffic speeds and volumes along with an increase in the percentage of commercial vehicles throughout the system led to safety concerns and complaints from motorists that turn lanes were not providing adequate distance for deceleration. Some district design engineers in recent years consequently began using longer turn lane lengths, resulting in inconsistency across the Mn/DOT system. Recent Mn/DOT research has identified a variety of factors—speed, volume, intersection control and percentage of heavy commercial vehicles—to evaluate in determining appropriate turn lane design. These and other recently established best practices needed to be codified into new design documentation for Mn/DOT use.

What Was Our Goal?

The primary goals of this project were to document best practices in determining appropriate turn lane lengths, prepare guidelines detailing a recommended design process and develop new turn lane length guidelines for Mn/DOT.

What Did We Implement?

Investigators leveraged information from the Mn/DOT Research Report 2008-14, "Turn Lane Lengths for Various Speed Roads and Evaluation of Determining Criteria," the "AASHTO 2004 Green Book: A Policy on Geometric Design of Highways and Streets" and "NCHRP Report 650: Median Intersection Design for Rural High-Speed Divided Highways" to create a new design process for determining turn lane lengths.

How Did We Do It?

Investigators reviewed existing research to identify how variables such as turn lane location, vehicle speeds, volume, type of intersection control, fraction of heavy commercial vehicles and roadway geometry affect turn lane storage capacity and room for deceleration. Working with a technical advisory committee composed of staff from Mn/DOT's Office of Traffic Safety and Technology, Metro District Design and the Office of Technical Support, investigators developed a process to determine optimal turn lane lengths that considered all of these factors.

Investigators then created a turn lane design checklist and provided example calculations for each of eight Mn/DOT facility types and locations: conventional or expressway, signalized and unsignalized in both rural and urban settings.

What Was the Impact?

The resulting guide provides design engineers with step-by-step guideline worksheets for determining safe and functional turn lane lengths based on the specific characteris-

continued

"Longer turn lanes, based on the new design process, will allow motorists to get out of thru lanes earlier, have greater opportunity for deceleration and have more storage room, which will lead to safer intersections with fewer crashes."

–Glen Ellis,
Senior Project Engineer, Mn/DOT Metro District Design

"These guidelines provide a resource for designers that will allow greater consistency between the length of turn lanes and traffic and roadway characteristics."

–Howard Preston,
Senior Transportation Engineer, CH2M HILL, Inc.

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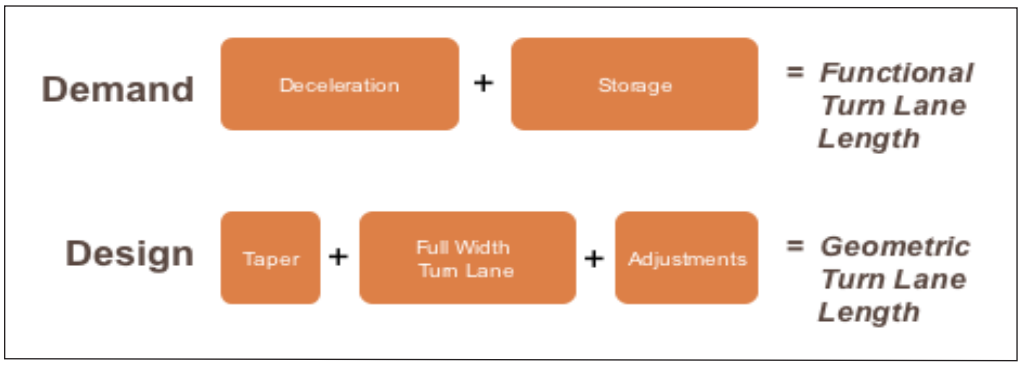

Turn lane length is ultimately calculated by combining the functional turn lane length with the geometric length.

tics of each intersection. The guide includes detailed descriptions and illustrations of the five-step process, including:

- Collect data: Identify design speed, forecasted traffic volumes, percentage of heavy commercial vehicles, grade, seasonal variations in traffic volume, roadway geometry and corridor characteristics.
- Determine facility type and intersection control: Categorize each roadway as rural or urban and as conventional or expressway. Intersection control is either signalized or unsignalized.
- Calculate turn lane demand: Combine deceleration distance (determined by speed and facility type) with storage distance (based on intersection control) to equal the basic turn lane demand length.
- Calculate turn lane design: Determine taper length based on facility type and subtract from turn lane demand to identify length of the full-width turn lane.
- Make adjustments and create final turn lane design: Adjust taper length if the intersection is located on a horizontal curve. Calculate adjustments for grade, commercial vehicle volume, use of dual turn lanes, local constraints and corridor consistency.

Sample calculations using the new design process demonstrate that there is no standard turn lane length applicable to all facility types and locations. Many intersections now require much more than the previously recommended 300 feet of turn lane length to be safe and effective. Analyzing individual characteristics of each intersection will result in turn lanes that provide appropriate distances for safe deceleration and storage, which are tailored for each intersection.

What's Next?

The guide produced by this project has been distributed to Mn/DOT design engineers and will be presented by Glen Ellis, Senior Project Engineer for Mn/DOT Metro District Design, at the Statewide Design Engineers Meeting in November 2010. The next step is for Mn/DOT's Design Advisory Committee to review the guide and determine how to incorporate it into Minnesota's "Road Design Manual."

This Technical Summary pertains to Report 2010-25 "Design of Turn Lane Guidelines," published July 2010. The guide can be accessed at http://www.lrrb.org/PDF/201025.pdf.

The research cited as source material for this guide includes "Turn Lane Lengths for Various Speed Roads and Evaluation of Determining Criteria," "NCHRP Report 650 Median Intersection Design for Rural High-Speed Divided Highways" and "AASHTO 2004 Green Book: A Policy on Geometric Design of Highways and Streets."