Project Summary

Texas Department of Transportation

0-6112: Development of Guidelines for Triple Left and Dual Right-Turn Lanes

Background

Left- or right-turn lanes at intersections improve safety and operations by separating turning and through vehicles. At intersections with heavy turning demand, it may be necessary to provide multiple turn lanes. Triple left-turn (TLT) and dual right-turn (DRT) lanes are still considered as relatively new designs that many agencies are reluctant to use, so they are somewhat limited in Texas. Guidelines for TLT or DRT lanes are almost nonexistent, leaving traffic engineers to rely on judgment for their designs. Therefore, this research was needed to develop consistent guidance. The project achieved two primary project goals:

1. Develop geometric and signal design guidelines for TLT and DRT lanes.
2. Evaluate safety and operational performance of TLT and DRT sites in Texas.

What the Researchers Did

The research team performed five primary tasks to fulfill the project goals:

- reviewed existing guidelines and practices regarding TLT and DRT lanes,
- identified important factors that affect the design, operation, and safety of TLT and DRT lanes through a survey of transportation professionals,
- completed studies of existing TLT and DRT sites to document design issues and concerns, operational performance, and safety performance,
- developed geometric and signal design criteria (e.g., lane/throat widths, pavement markings, storage bay length, positioning/placement of signal faces, traffic signs), and
- synthesized criteria for determining when TLT or DRT lanes can be installed.

What They Found

Researchers found that published studies are very limited regarding the design and operation of TLT lanes and almost nonexistent for DRT lanes. There is a lack of detailed guidance for multiple turn lanes. Researchers received a good response from national and state agencies to determine which factors are important to TLT and DRT performance. Of 66 completed surveys, less than 25 percent indicated formal guidance on either type of multiple turn lane and only 4 respondents had done evaluations. The respondents indicated that the most important installation criteria were turn lane volumes, intersection capacity, adjacent development, and safety.

The field studies in Texas collected both static (e.g., lane widths, grades, pavement markings, traffic signs, upstream and downstream conditions, signal timing) and dynamic (e.g., volumes by lane, saturation flow, critical events) data in order to evaluate design and operational performance.

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Project Completed: 8-31-10

Researchers collected these data at 5 TLT and 20 DRT lane sites, primarily in the Dallas-Fort Worth and Houston urban areas. Some key findings for TLT lanes were:

- Lane utilization patterns were varied for each of the 5 sites studied.
- All sites were T-intersections with peak-hour volumes from 646 to 2,846 vehicles.
- Lighted pavement markers that were used to delineate the lane lines between the TLT lanes were effective at reducing violations and well received by the public at one site.
- Saturation flow rates in Texas were consistent with earlier published national values.

Some key findings of the operational analysis for DRT lanes were:

- Most vehicles use the outside lane (closest to the curb) to make their right turns.
- Peak-hour volumes ranged from a low of 200 to a high of almost 1,000 vehicles.
- Lane utilization (inside vs. outside) is comparable when the right-turn volumes are high.
- Saturation flow rates are higher in the inside lane (an average of 1,717 vehicles per hour (vph) versus the outside lane at an average of 1,668 vph) and also generally lower than those at TLT sites.
- Impact of trucks in the inside lane is greater than when in the outside lane.

Researchers evaluated safety performance by investigating the crash history of the 25 sites using 3 techniques: collision diagrams, field conflict study, and comparison study. The results revealed that TLT lanes do not experience any major safety issues and also concluded that, in general, a well designed DRT lane does not cause significantly higher crash frequency or severity compared to single right-turn lanes.

What This Means

Based on this research, TxDOT and other agencies should be confident that well-designed TLT and DRT lanes can be implemented to address heavy turning demand at key intersections. The evaluation of these multiple turn lanes revealed that they perform well from both operational and safety standpoints. Some of the key recommendations based on the research include:

- TLT lanes should be considered when turning volumes exceed 600 vph.
- DRT lanes should be considered when turning volumes exceed 300 vph.
- Clear turning guide lines (a.k.a. “puppy tracks”) are highly recommended for both sides of the inside right-turn lane when the intersection has a turning angle greater than 90 degrees.
- Narrow DRT lanes (turning roadway ≤ 30 feet) with channelization should not be used.
- Right-turn on red is not advised for the inside lane when there are more than two receiving lanes.
- Designers should avoid installing DRT lanes near access points (e.g., corner gas stations).
- If an auxiliary receiving/acceleration lane is provided for the curb right-turn lane at channelized dual turn lanes, its length should not be less than 150 feet.
- For closely spaced intersections, if a downstream intersection uses dual right-turn lanes, the outside (curb) lane should not be aligned with any through lane at the upstream intersection.

TLT and DRT lanes are not appropriate for all situations, and their use should be supported by an operational analysis. Other techniques (grade separation, signal timing) might be better solutions for a particular site, especially when considering the effects of adjacent intersections, pedestrian/bicycle movements, and other key factors. Researchers developed *Keys to Successful Public Outreach*, which may be useful for implementing multiple turn lane projects.

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