INTERSECTION TURN LANES

Description

Intersection turn-lane improvements could include designated left-turn and right-turn lanes, deceleration and acceleration lanes, and space to handle turning traffic away from the through traffic. Turn movements at intersections—especially movements that are made from lanes that are shared with high-speed through traffic—cause delays and negatively affect safety. Common reasons for considering turn lanes to improve an intersection include:

- Through street speeds are too high to turn safely to or from a particular roadway.
- There is a trend or pattern of turning, rear-end or sideswipe/weaving crashes when through vehicles interact with queued vehicles.
- Drivers have to wait a long time to make a turn.
- There are a high number of turning vehicles.

Target Market

Major Street Intersections and Driveways

Major streets and access roads without turn lanes or acceleration/deceleration lanes have congestion from either traffic slowing to turn from the main lanes of traffic accelerating to join the main lanes. The differences in speed between through traffic and entering/exiting traffic can significantly slow all traffic, cause stop-and-go main lane traffic, and increase the number of collisions.

How Will This Help?

Turn lanes at intersections substantially reduce crashes by removing stopped vehicles from through traffic as shown in Table 1. Research[1] has shown that adding a left-turn lane on one approach of a three-leg stop controlled intersection is predicted to reduce total crashes by 44 percent. The developers of the *Highway Safety Manual*[2] used the findings from the FHWA study[1] along with data from other studies and developed crash modification factors for use in predicting changes in number of crashes due to the installation of a turn lane. The crash modification factors are included in the *Highway Safety Manual*.

Cost:	●●●○○
Time:	**Short**
Impact:	**Spot**
Who:	**City/State**
Hurdles:	**Right-of-Way**

Left-turn lanes also substantially increase the capacity of many roadways. A shared left turn and through lane has about 40 to 60 percent of the capacity of a standard through lane.[3] A synthesis of research on this topic found a 25 percent increase in capacity, on average, for roadways that added a left-turn lane.[4] Right-turn lanes typically have a less substantial impact on roadway capacity than other types of turn strategies, because there are fewer limitations on right turns. Though there are fewer studies of these impacts, there is a clear relationship between the number of vehicles attempting a right turn in a through traffic lane and its delay to through traffic. This relationship is exponential—each additional car that must wait

Table 1. Expected Percent Reduction for Adding Turn Lane Identified in FHWA Study[1]

Treatment/Area/Intersection Type	Expected Reduction of Total Crashes			
	One Approach		Both Approach	
	Stop	Signal	Stop	Signal
Add Left-Turn Lane				
Rural				
3-Leg	44%	15%	NA	NA
4-Leg	28%	18%	48%	33%
Urban				
3-Leg	33%	7%	NA	NA
4-Leg	27%	10%	47%	19%
Add Right-Turn Lane				
Rural/Urban				
All	14%	4%	26%	8%

for a right turn will increase the delay more than the previous car (see Table 2). At intersections with substantial right-turn movements, a dedicated right-turn lane segregates these cars from through traffic and increases the capacity of the road.

Table 2. Impacts of Right-Turning

Right-Turning Vehicles Per Hour	Through Vehicles Affected
Under 30	2.4%
31-60	7.5%
61-90	12.2%
91 and Up	21.8%

Implementation Examples

In a rapidly growing area of College Station, Texas, an intersection was experiencing a large number of cars using the shoulder to pass slow-moving left-turning vehicles (examples shown in figures on the next page). The area is currently considered rural; however, the anticipated development within the next five years will change the performance of the roadway. Ultimately, the roadway will provide more access and less mobility. It has already started evolving into a suburban high-speed major street. TxDOT recently widened the intersection at SH 60 and Copperfield Drive to accommodate left-turn lanes on both major approaches.

Application Principles and Techniques

Table 2-3 of the TxDOT *Access Management Manual* (Auxiliary Lane Thresholds) provides thresholds for auxiliary lanes. For example, left turn lane "may be required if it would provide a benefit to the safety and operation of the roadway." The TxDOT *Roadway Design Manual* chapter three has acceleration and deceleration lengths.

NCHRP project 3-91[5] recently used a benefit-cost approach to determine when a left-turn lane would be justified. The steps included simulation to determine delay savings from installing a left-turn lane, crash costs and crash reduction savings determined from safety calculations available in the *Highway Safety Manual,* and construction costs. Left-turn lane warrants were developed for rural two-lane highways, rural four-lane highways, and urban and suburban roadways.

NCHRP Project 3-72[6] used an economic-analysis procedure to identify where installation of right-turn lanes at unsignalized intersections and major driveways would be cost-effective. The procedure was used to develop graphs that indicate combinations of through-traffic volumes and right-turn volumes for which provision of a right-turn lane would be recommended.

Issues

Right-of-way is the primary issue with adding turn lanes or providing space for acceleration and deceleration lanes. Increased crossing distance for pedestrians can be another concern.

SH 60 Before – Vehicle using shoulder to pass left-turning vehicle

Converting the existing shoulders to useable lanes may require adding width and pavement structural strength. If the shoulder cannot be used, the road will need to be widened, possibly requiring acquisition of additional right-of-way and higher costs due to construction. Complex, dated, or elevated designs make it more difficult and costly to add these lanes. Right-of-way constraints at intersections may ultimately require a complete rebuild or alternative design.

Who Is Responsible?

States and cities bear the primary responsibility of installing and maintaining turn lanes. On state designated roads, the local office of the department of transportation may take responsibility. On city roads, however, the local government controls the construction and management of turn lanes and acceleration/ deceleration lanes. In either case, the improvements should be coordinated with local citizens and businesses to ensure that the road serves the adjacent property.

Project Timeframe

The timeline for adding turn and/or acceleration/deceleration lanes will differ based upon which method is used, the current road geometry, and the roadway class. A typical surface road can be converted in a shorter timeframe than an elevated section.

SH 60 After – Left-turn lane installed

Cost

The cost of incorporating a turn lane into a road depends on many factors. A review of the TxDOT Expressway Detailed Letting website[7] showed a range of $120,000 to $400,000 in construction costs for left-turn lane projects with an average of $250,000.

Data Needs

The basic information that should be used when considering the implementation of a turn lane includes the development at that location, the number of lanes on the major roadway (e.g., two, four, or more), and the number of approaches (e.g., three streets or four streets). The data should also include the peak-hour major roadway volume per lane, peak-hour speed, the number of crashes, and, for selected locations, the delay and/or gap acceptance.

Useful information might also include the access to any adjacent developments, access management consideration, available right-of-way, existing roadway width, crash history, and consistency with nearby intersections. Sight distance restrictions, speed differential concerns, pedestrian traffic, the existing or proposed medians in the area, and the available budget can be useful when implementing this technique.

Intersection Turn Lanes Best Practice

- Type of Location: Major street intersections.
- Agency Practices: Coordination between planning, design, safety, and operations.
- Frequency of Reanalysis: Annually, during safety reviews.
- Supporting Policies or Actions Needed: Capability to fund improvements.
- Complementary Strategies: Intersection improvements – pedestrian treatments.

For More Information

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7. TxDOT Expressway. Detailed Letting. 2010 [June 22, 2010] http://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/let/2010/bastrop.htm#032103017.