# Project Summary

Texas Department of Transportation

# 0-6176: Consistent Signal Timing Strategies at Intersections with Wide Medians to Improve Efficiency and Safety

## Background

Texas Department of Transportation (TxDOT) engineers currently do not have formal guidelines to design and operate intersections with wide medians. A wide median is defined as wider than 60 feet. Lack of formal guidelines results in inconsistent design and operation of such intersections, which has sometimes resulted in an operation that did not meet driver expectation. Usually strategies are developed for peak conditions, but such strategies may not be very efficient for off-peak conditions. Inefficient operations that do not meet driver expectancy can result in an increase in motorists' non-compliance at traffic signals, which is unsafe. The Texas Transportation Institute (TTI) conducted a one-year research project to evaluate operations at intersections with wide medians and provide guidelines to operate such intersections in a consistent manner.

## What the Researchers Did

Researchers received input from 18 districts on problems and strategies with wide median intersections. Factors that affect the operations of intersections with wide medians include:

1. Median width: Median width has an impact on the storage capacity in the interior. At intersections with medians of 100 feet or less, appropriate strategies should be selected to keep the interior clear.
2. Number of lanes in the interior: This factor has an impact on the number of phases that can be used for the interior movement. In cases where an intersection has a single lane in each direction in the interior, only a single phase can be applied for all traffic in the interior. If however the interior has an exclusive left-turn lane in the interior, two separate phases can be used to give more flexibility in the operations.
3. Approach speed: High approach speeds require an appropriate strategy that provides dilemma zone protection and the appropriate detection configuration. Low approach speeds only require stop bar detection to provide safe operations.
4. Available right of way on a major street: One of the strategies uses an exclusive arterial left-turn phase to control vehicles entering the median. However in urban or suburban areas, major street approaches may not have enough right of way to have an exclusive left-turn lane. This has an impact on the strategy that the operator can choose.
5. Volumes on major movements as well as minor movements: The strategies to be used depend on the volume levels at the intersections. High volumes on major movements require a strategy that does not create long queues on a major street. Similarly high volume levels on minor movements, which include minor street movement as well as major street left-turn movement, can block a median and back up traffic into its upstream intersection.

## Research Performed by:

Texas Transportation Institute (TTI),
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**Project Completed:** 8-31-09

Based on the interviews with the districts and factors identified, eight strategies were identified to be evaluated in this project. a) Diamond phasing - Three phase, Four phase, and Two phase, and b) Non-Diamond phasing - Two phase, Split phase (with and without trailing overlap), and Major street phase (with and without arterial left-turn phase).

VISSIM simulation modeling was used to simulate the strategies. A library of volume scenarios was created. Major movement volumes were increased from 250 vehicles/hour to 1250 vehicles/hour. Minor movements, which included minor street volumes and arterial left-turn movements, were modified as a percentage of the major movement ranging from 10 to 30 percent. A total of 45 sets of volume scenarios was created. This library of volume scenarios was applied to all the strategies. Each volume scenario was repeated six times with different random seed numbers. A total of almost 10,000 simulation runs was made in this project to evaluate these strategies.

## What They Found

The observations made by TTI researchers were similar to the experiences of TxDOT engineers across the state. However some findings from the simulation runs were unique:

- Trailing green overlaps, which have been used at most intersections with wide medians, tend to increase overall delay. TTI researchers recommend that these overlaps should be used sparingly.
- The Two-phase strategy appeared to be more efficient than any other strategy. This was particularly the case during low-volume conditions. However two-phase operations at intersections with a median width of 100 feet or less tended to fill up the median with turning traffic. For such intersections, use a four-phase operation or use the strategy with an arterial left-turn phase.
- When the arterial left-turn phase is used, it is recommended to use lead-lag phasing and to lag the heavier left-turn phase.

Based on the findings of the simulation study, TTI researchers made recommendations about strategies to operate intersections with wide medians. These recommendations are in a tabular format and are based on local geometry and volume conditions. The table recommends a combination of compatible strategies to use at a certain location for differing volume conditions.

## What This Means

This research project provides recommendations regarding the operational strategy to use at intersections with wide medians. These recommendations are based on geometric as well as traffic patterns at an intersection. Researchers recommend that more than one strategy be used at a particular intersection if there is a significant change in volume patterns from peak periods to off-peak periods. Such an operational philosophy will result in the implementation of a proper strategy that will be appropriate for traffic conditions and will meet motorists' expectations, improving intersection efficiency and safety.

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