



Project Summary

Texas Department of Transportation

0-5294: Warrants for Installing and Operating Ramp Metering

Background

Ramp control signals (also called ramp meters or flow signals) are used by the Texas Department of Transportation (TxDOT) to control the rate at which vehicles enter the freeway. By doing this, TxDOT can: 1) promote a more consistent and uniform flow of traffic entering the freeway, and 2) promote a more efficient use of the existing freeway capacity. Ramp control signals achieve these objectives by limiting the demand allowed to enter the freeway, breaking up platoons released from frontage road traffic signals, and smoothing traffic flow in the merge area of the freeway. Ramp control signals can also improve safety on the freeway by reducing the potential for crashes and erratic maneuvers in the merge area. The purpose of this project was to develop guidelines and criteria to assist TxDOT decision-makers on determining when and where to install new ramp control signals and to remove existing ramp control signals when they no longer provide a benefit to freeway traffic.

What the Researchers Did

We first used the results of a literature review to identify traffic volume and geometric conditions that impact the operations of ramp control signals. Simulation experiments were conducted to examine what impacts installing a ramp control signal had on freeway operations under different traffic volume and geometric conditions. We used the results of these simulation studies to develop a draft set of criteria for installing and removing ramp control signals. Field studies were then conducted at two ramp locations identified by the TxDOT Houston District as potential locations for ramp meters. Before and after traffic performance data were collected to examine the effects of ramp control signals on freeway and ramp operations. Using the results of these field studies, we reviewed the installation criteria and ramp control signal authorization form, modeled after TxDOT's current traffic signal authorization form. We also developed guidelines for installing, removing, and operating ramp control signals. The guidelines were developed in the form of a chapter to be inserted into TxDOT's current *Traffic Signals Manual*.

What They Found

We recommend that TxDOT consider installing a ramp control signal when all of the following conditions are met:

- The freeway regularly operates at speeds less than 50 mph for at least a half-hour period.
- Traffic flow rate on the entrance ramp during peak periods exceeds 300 vehicles per hour (vph).

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- The average traffic flow rate of the two right-most lanes during peak periods exceeds 1600 vehicles per hour per lane (vphpl) for entrance ramps with acceleration lanes of 500 feet or less. This threshold level increases as the length of the acceleration lane on the ramp increases.
- The combined traffic flow rate in the right-most freeway lane plus the flow rate on the entrance ramp during peak periods exceeds a minimum of 2300 vphpl for entrance ramps with acceleration lanes of 500 feet or less. This threshold level increases as the length of the acceleration lane on the ramp increases.

From a safety perspective, we recommend TxDOT consider installation of a ramp control signal when one or more of the following conditions exist:

- The rate of crashes in the immediate vicinity of the ramp exceeds the mean crash rate for comparable sections of freeway in a metropolitan area.
- The ramp length permits a vehicle starting from a stop at the signal to reach the prevailing speed of the freeway traffic in the merge area so as to prevent an unacceptable speed differential in the merge area.
- Sufficient storage length exists upstream of the ramp control signal to prevent queues from impeding operations on the frontage road or surface street intersection.

The following criteria are recommended for use by TxDOT to identify when a ramp control signal may no longer be necessary and could be removed:

- The freeway is reconstructed so that the ramp is the beginning of a new freeway lane.
- Traffic demand on the ramp no longer exceeds the minimum volume threshold for installing a ramp meter (300 vph).
- The rate of crashes in the merge area exceeds the mean crash rate of other ramps that use ramp control signals.
- A substantial increase in rear-end crash rates is observed for vehicles on the frontage road.
- The meter availability during the peak operating hours is less than 70 percent.
- The prevailing speed of the freeway exceeds 50 mph throughout the entire day (result of reconstruction of the freeway).
- The annual cost of operating and maintaining a ramp control signal exceeds the estimated benefits.
- Delays to the ramp traffic exceed the threshold established by the district engineer.
- Driver noncompliance reaches an unacceptable level and increased enforcement activities have failed to correct noncompliance issues.

What This Means

Ramp control signals are often TxDOT's only means of directly influencing operations on a freeway. The guidelines and criteria developed as part of this research will assist TxDOT in producing a more consistent application of ramp control signals throughout the state. The operational guidelines developed will assist TxDOT in maximizing the effectiveness of ramp control signals when they are installed. The removal criteria developed will assist TxDOT operations engineers in determining when ramp control signals no longer provide a benefit to the traveling public and should be removed.

For More Information:

0-5294-1 Development of Criteria and Guidelines for Installing, Operating, and Removing TxDOT Ramp Control Signals

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