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PROJECT SUMMARY REPORT

Changeable Lane Assignment System Improves Incident Management

Traditional lane use signs reflect average conditions and do not change with changing traffic needs. Changeable Lane Assignments Signs (CLAS) offer a potentially effective solution to changing traffic conditions. Maintaining acceptable traffic operations at frontage road intersections can be a significant challenge to transportation agencies in the Houston area and other Texas cities.

When these interchanges experience high turning movement demands, permitted double turns are often used to maximize traffic throughput. However, turning demands can have entirely different characteristics between AM, mid-day, and PM peak operations. This variation leads to the need for different lane use controls on a recurring time-of-day basis. In addition to the recurring daily traffic patterns that may need some type of differing lane use control, freeway incidents often impact frontage roads by creating high frontage road traffic demands as freeway mainlane traffic diverts. Lane use information at intersections is typically communicated with pavement markings and static signing.

The use of CLAS on frontage roads can mitigate the lane imbalances seen on a time-of-day recurring basis and during freeway incidents. As traffic signals have long been used as a time management technique for optimizing traffic operations, CLAS is used as a space management technique to add an additional dimension to optimization.

The Texas Department of Transportation (TxDOT) deployed CLAS at ten outbound frontage road interchanges on U.S. 290 as part of the Houston ITS Priority Corridor Program. These CLAS installations replaced static signs and markings for permitted double turns. The CLAS deployment provided the capability for Houston TranStar operators to alter the use of permissive double turns on a recurring basis. It also served as a tool for freeway incident management.

The purpose of this project was to evaluate the operational effectiveness of CLAS as a space management tool to optimize operations for time-of-day (TOD) and incident management conditions. Separate evaluation studies were conducted for the two applications of CLAS.

Changeable Lane Assignments Signs (CLAS) offer a potentially effective solution to changing traffic conditions

What We Did . . .

The TOD study evaluated operational measures for CLAS under typical recurring conditions. Multiple before and after studies were conducted at each of the three locations where TOD operation was employed. Primary measures of effectiveness were queuing, lane balance, approach delay, and lane use violations. Data collection for before and after conditions was undertaken during several periods from October 1995 to June 1998. The data collected included automatic vehicle counts, manual turning movement counts, manual and video recorded demand, saturation flow, and queuing.

The other part of the project evaluated the effectiveness of CLAS as a Houston TranStar incident management tool. During incident management, CLAS eliminates permitted double turn operation at affected intersections to enable through movement in all three lanes of the frontage road. Incident management plans, including signal timing and CLAS operation, were developed for the number of incident scenarios in the study section on U.S. 290.

Incidents were documented by a video data collection system and reviewed to assess the impact of incidents on freeway and frontage road operations. Seven incidents (one AM, three mid-day, and three PM) were evaluated using simulation models of freeway and frontage road operations. Comparisons were made between results for the actual incident conditions with simulated CLAS incident management conditions.

Researchers identified combined freeway and frontage road network total delay and delay per vehicle as the primary measures of effectiveness for making comparisons between actual conditions observed during incidents and simulated incident management conditions. Frontage road intersection approach level of service (LOS), throughput, and lane use violations were also identified as additional measures of effectiveness.

What We Found . . .

Results of the TOD evaluations at the three studied intersections were mixed. Although some reductions in delay and queuing were experienced, statistically significant reductions in approach delay and queuing were not indicated. Improvements in lane balance in some cases were accompanied by increased vehicle delays, especially at right turn CLAS intersections. However, this result is considered a function of location and operational characteristics of the intersections studied and not necessarily the effectiveness of CLAS use at other locations. For example, an earlier Texas Transportation Institute (TTI) study of the prototype CLAS installation at IH 10/Voss Road in Houston found significant operational improvements resulted from use of CLAS for TOD operations. Findings of this study on U.S. 290 indicate the need for a detailed operational analysis prior to deploying CLAS solely for TOD operation to assure that significant turning demand variations exist.

CLAS was found to be an effective incident management tool when deployed in concert with a freeway management system. Reductions in

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total delay were found for the three mid-day and three PM peak period incidents studied. However, an increase in total delay was found during the one AM peak period (off-peak flow direction) incident studied, indicating that rarely should CLAS be used for peak period incidents in the off-peak flow direction (e.g., for incidents blocking two or more lanes). Corridor throughput increased with implementation of CLAS, while frontage road level of service generally increased and lane use violations decreased. The accompanying table summarizes the study results for the seven incidents.

A unique network technology, which transmitted sign control data over the signs power lines, was incorporated in the design of CLAS. This design feature created deployment and maintenance problems. Both TxDOT and its contractor recommend that this technology not be designed into future CLAS projects and that conventional data communications methods be used instead.

Researchers Recommend . . .

CLAS is considered to be a traffic control tool which is ready for implementation in urban freeway management systems for management of incidents. Operation from a central control facility is necessary for use of CLAS in incident management since incident detection and observation are important elements of incident management and CLAS activation. Detailed operational analyses should be conducted to identify frontage road intersections where CLAS is to be implemented for TOD needs. Additional evaluation on frontage roads at other locations is needed to assess demand characteristics and threshold conditions for implementation of CLAS for TOD operations.

CLAS Effectiveness with Seven Incidents Studied

Date	Analysis Period	Description of Blockage	CLAS Activated at	Increase in Throughput (veh/hr)	Delays Savings from Use of CLAS (veh-hr)	Percent Change
AM PEAK PERIOD						
5/27/98	8:00-8:45	1 lane 30 minutes	West 34th, Antoine	49	-35.4	-8.2%
MID-DAY PERIOD						
4/13/98	12:00-13:00	2 lanes 15 minutes	West 34th, Antoine	574	317.7	26.2%
6/1/99	11:45-13:00	2 lanes 45 minutes	Mangum, West 34th, Antoine	1170	196.5	12.7%
6/18/99	11:00-11:45	2 lanes 30 minutes	Mangum	307	82.8	12.8%
PM PEAK PERIOD						
6/9/98	18:45-19:30	1 lane 30 minutes	Mangum, West 34th, Antoine	53	108.7	11.1%
10/5/98	17:15-18:15	1 lane 30 minutes	Mangum, West 34th, Antoine	63	4.7	0.4%
5/19/98	18:00-18:45	1 lane 30 minutes	Mangum, West 34th, Antoine	306	23.0	2.2%

TxDOT Implementation Status
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John Gaynor, TxDOT Project Director for this project, has indicated the following implementation status for this research project.

The research results for the intersections studied show that:
- significant improvements were noted during incidents,
- less improvement was noted when changing from a double right turn to a shared right turn than when changing from a double left turn to a shared left turn, and
- no significant improvements were noted for recurrent time-of-day operations.

CLAS may be an effective traffic management center tool for freeway incidents. However, the number of applications may be limited, and each potential site considered should be studied in detail. A limited implementation may be justified to study the TOD effects for a different application (e.g., an arterial). There were significant problems with the communication system. A modification of the communication system design is essential before further implementation.

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