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Project Summary Report 0-4266-S
Project 0-4266: Improving Urban Intersection and Arterial Traffic Control Plans
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PROJECT SUMMARY REPORT

Traffic Control Improvements for Urban Arterial Work Zones: A Summary

Review of the design standard documents shows that the majority of the guidelines for work-zone traffic control plan (TCP) design do not adequately reflect specifics of urban arterial streets. In turn, TCP development is greatly affected by the designers' background and experience.

Beginning in 2001, the Center for Transportation Research (CTR) in collaboration with the Texas Department of Transportation (TxDOT) conducted a study to identify opportunities for improving traffic control plans for urban arterial street work zones, develop and test innovative alternatives and provide guidelines for better work-zone TCP design.

What We Did...

The first task was to identify opportunities for improving traffic control plans, their frequency, and the conditions under which they typically occur. The identification process was based on accident statistical analysis, work-zone field observations, and a survey of TxDOT personnel involved in work-zone design and inspection.

The objectives of the accident statistical analyses were to determine major accident types and factors contributing, as well as other characteristics that can support development of traffic control improvement solutions. For this purpose, an extensive literature review, as well as analysis of accidents that occurred during work-zone presence in selected arterial streets in Houston, was conducted.

The field observations included detailed investigations of twenty-three work zones in Austin, Houston, and San Antonio. In addition, inspection reports of the TxDOT Traffic Control Review Team, representing around 100 ongoing construction projects were analyzed.

For the TxDOT personnel survey, a special questionnaire was developed and distributed in the Austin, Houston, and San Antonio districts. TCP designers were asked to rate different problems experienced in TCP design. The questionnaire for inspectors was focused on estimation of problem frequencies. Seventy-one TCP designers and 137 work-zone inspectors participated in the survey.

Based on the joint analysis of the identified problems, common traffic control schemes, and principles of human perception, improvement solutions for urban arterial work-zone signing and traffic control device location better suited to human abilities and behavior were developed.

The effectiveness of the recommended solutions was tested in the laboratory and during field application. First, the solutions were modeled in computer animations, and then around 100 people including students, CTR and TxDOT staff, and others evaluated the proposed solutions. Those solutions which

Figure 1: Road sign in a visually noisy environment

showed good performance were implemented in a real work zone and their impact on driver behavior was investigated by a series of test-drives in a specially equipped vehicle.

Finally, guidelines for traffic control plan design that better address urban arterial street work-zone traffic situations were developed.

What We Found...

Based on the analysis of the data collected by the field observations and the TxDOT personnel survey, information insufficiency due to specifics of urban environment such as frequent intersections and visual noise caused by commercial displays, as well as presence of frequent local access roadways, were identified as major improvement opportunities.

The analysis of accident statistics showed two major groups of contributing factors. The first group that contributed to around 34% of crashes includes conscious violations by drivers, such as driving while intoxicated and speeding. From the traffic engineering perspective, the factors of the second group, which contributed to around 64% of investigated crashes, are of major importance. Disregarding signs, failure to yield right-of-way (ROW), and improper maneuvering belong to this group. While drivers can commit such violations consciously, violations can also be due to inadequate perception of traffic situations, caused by insufficient or missing information. An example supporting this hypothesis represented in Figure 1 shows a road sign installed in an area with many commercial signs.

The probability of a driver missing the road sign is very high in such situations. Also, the presence of a work zone may cause a situation where street signs will be out of the driver's cone of clear vision, due to increased distance of the sign from the temporary roadway. Another example is related to human optical illusions (Figure 2), when channelizing devices on the edge of the roadway create a confusing visual image of discontinuities in the work-zone boundaries and cause last moment maneuvering.

The need for better consideration of local access roadways in work-zone traffic control plan design was evident from the large number of accidents (around 35%) between intersections observed in situations where vehicles improperly entered or exited a driveway.

The Researchers Recommend...

The traffic control plan improvements can be described as three major groups: advance information, active roadwork area, and road signs dominance.

Advance Information: In advance of a work zone, information indicating work-zone location will help drivers choose an alternative route or prepare for the complicated traffic conditions ahead.

To reduce interaction of traffic flow approaching the work zone from the main and crossing streets, any lane closure should start a block upstream of the actual roadwork location.

Active Roadwork Area: There are four countermeasures proposed under this group, considering the impact of intersections and local access on traffic operation and safety.

- To provide drivers with information regarding intersecting streets, considering possible driver perception constraints due to work-zone presence, street name signs should be enlarged and/or relocated so that drivers can clearly see them.
- To increase awareness of drivers approaching the work zone, Stop signs should be added to driveways within the work zone.
- A sign grouping businesses' names or logos (Figure 3) should be placed to help drivers easily identify potential destinations, and in turn minimize frequency of last-moment maneuvering.
- To avoid human optical illusions of discontinuities in the work-zone boundaries and to assist drivers to easily recognize intersections and driveways, the work space boundaries at intersections with other streets and major local access roadways should ensure a minimum radius of 8 meters (25 feet.)

Figure 2: Optical illusion of discontinuities of work-zone boundaries

Figure 3: Business sign

Figure 4: Roadway corner treatment by cones

- To help drivers recognize adjacent roadways in a timely manner, cones on 1 meter (3-foot) centers should be placed on the edges of curves as shown in Figure 4.
- To avoid human optical illusions of discontinuities in the work-zone boundaries and to assist drivers to easily recognize downstream adjacent roadway and safely approach it, the work space boundaries at intersections with other streets and major local access roadways should ensure a corner radius of 3 to 4.5 meters.
- To help drivers recognize adjacent roadways in a timely manner, cones in close distance from each other should be placed on the edges of curves as shown in Figure 4.

Road Signs Dominance: Based on the developed methodology for determination of interacting signs, to ensure dominance in the driver field of vision, the distance between work-zone signs and the nearest other road signs or commercial boards should be at least 10 meters (30 feet) laterally and 20 meters (60 feet) longitudinally on urban arterial work zones. A sample is shown in Figure 5.

Both the computer and field experiments showed that the proposed treatments improved the driver way-finding process and destination identification, and that they significantly increased advance recognition time. Thus the recommended solutions have good potential for improvements in traffic operation and safety in urban arterial work zones.

Figure 5: Road sign dominance by reducing visual noise

For More Details...

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The research is documented in the following reports:

0-4266-1 *Identification of Traffic Control Problems on Urban Arterial Work Zones*, March 2004
0-4266-2 *Traffic Control Improvements for Urban Arterial Work Zones*, May 2004

To obtain copies of a report: CTR Library, Center for Transportation Research,
(512) 232-3126, email: ctrlib@uts.cc.utexas.edu

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The objective of this research project was to identify current traffic control problems on urban arterial work zones and to develop countermeasures for improving these problems. Four products were required for this project: (1) recommendations for urban arterial work zone traffic control plans; (2) traffic control plan standard sheets for urban arterial work zones; (3) training material for TxDOT personnel; and (4) traffic control improvements for urban arterial work zones. The products developed in this research serve as a basis for standardizing traffic controls in urban work zones. The TxDOT Traffic Operations Division is currently developing a Work Zone Handbook, and it will include a chapter dealing with urban arterial work zone traffic control. TxDOT also intends to tie the findings of this research to training for Part VI of the future Texas Manual on Traffic Control Devices after it is published.

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Your Involvement Is Welcome!

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