The Ohio Department of Transportation
Office of Research & Development
Executive Summary Report

Improved Work Zone Design Guidelines and Enhanced Model of Travel Delays in Work Zones

Phase I: Portability and Scalability of Interarrival and Service Time Probability Distribution Functions for Different Locations in Ohio and the Establishment of Improved Work Zone Design Guidelines

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Problem

Work zones on heavily traveled divided highways present problems to motorists in the form of traffic delays and increased accident risks due to sometimes reduced motorist guidance, dense traffic, and other driving difficulties. To minimize the delays encountered in traveling through a work zone, there are two areas in which we can look for improvement. First the modeling of traffic through the work zone and designing the work zone in such a way that we keep traffic delays within acceptable limits and second, providing optimal guidance for drivers through the work zone.

Objectives

The first objective of this study is to improve driver guidance and delineation cues for drivers in work zones to minimize delays and improve safety in the work zones. The secondary objective of the study is to thoroughly measure all traffic before and through the work zone including entrance and exit ramps to initiate a data library that will be used to understand the dynamics of work zone traffic flow and to analyze interarrival time (IAT) and service time (ST) distributions in the work zones. The analysis of the IAT distributions provide the information on the evaluation of the scalability (IAT distributions can be generated with reasonable accuracy from hourly traffic volumes) and portability (IAT distributions are similar in different geographical locations in Ohio) of the distributions.

Description

The project focuses on two major issues - the improvement of current work zone design practices and an analysis of IAT and ST distributions for the development of a digital

computer simulation model for travel delays in work zones. Important considerations in the development of work zone design guidelines include the safety of workers, drivers, and driver comfort. A nationwide survey of current best work zone practices was conducted. Based on the review of the existing ODOT guidelines, superior practices available in other states, relevant research, and professional judgment of personnel involved in work zone activities, a set of guidelines for work zone design are proposed.

A comprehensive data collection effort was made to record traffic data in a total of six work zone sites, with different types of lane configurations in different areas of Ohio. A method to generate IAT distributions from hourly traffic counts was developed and then it was used to investigate portability of IAT distributions in this project. A statewide ODOT district survey in selected districts was conducted for assessment of the current and future estimates of traffic, vehicle queues and delay times in work zones.

Recommendations

Based on the evaluation of ODOT work zone guidelines contained in the OMUTCD, TEM, CMS, and SCD and the comparison of these specifications with the practices of other state DOTs, literature and product reviews, and anecdotal evidence, it was found that it would be more convenient for practitioners to have all guidelines and specifications gathered into a single work zone practices handbook. The main areas for improvement were found as signing materials, portable changeable message signs (variable message signs), arrow panels, drums, rumble strips, regulatory, warning, and guide signs, speed control, worker safety and clothing, flaggers, glare and visibility screens, illumination, materials and hardware, ramp closures and metering, entrance ramp configurations, pavement markings, acceleration lane lengths, curve radii, and public education sections of the guidelines.

A trailer using two Wavetronix microwave radar units in side-fire mode was developed to nonintrusively measure traffic. Traffic data collected in six different Ohio work zones and IAT data of successive vehicles in free-flowing traffic ahead of work zones were analyzed and IAT distributions were generated as a function of the traffic volume for each lane and relationships between traffic volumes and cumulative IAT distributions were established allowing a direct conversion from hourly traffic counts to corresponding cumulative IAT distributions. This conversion method produces fairly accurate cumulative IAT distributions for selected hourly traffic volumes. Total of 9 universal IAT distributions tables were generated, for 2-lane, 3-lane, and 4-lane freeways and for different lanes. It was also found that the same cumulative IAT distribution can be used to model the free-flowing traffic at other freeway locations in Ohio, which means that the IAT distributions are portable and scalable and a microscopic digital computer simulation model based on queueing theory may be developed to investigate traffic delays in work zones.

It should be noted that some of these recommendations may eventually be modified depending on the results of the computer simulations performed in Phase II of this research project. Also, some of these recommendations may require evaluation in future research studies prior to implementation to verify their effectiveness.

Implementation Potential

Most of the implementation of the work zone design guidelines consists of revisions to the standards contained in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), Traffic Engineering Manual, and the Standard Construction Drawings. The recommendations were originally proposed while the 1999 OMUTCD was being revised and many of the recommendations have already been incorporated into the 2003 OMUTCD and other official documents. Other recommendations may be further evaluated and incorporated at a later date.

The spreadsheets, which provide the cumulative IAT distributions based on hourly traffic counts, developed in this study may be used with simulation programs in modeling traffic. Hourly traffic volume information will be sufficient to simply generate the IAT distributions of the vehicles arriving to the work zones. The use of IAT distributions in traffic modeling programs will provide better vehicle arrival information and increase the quality of the traffic modeling program results. The Cumulative IAT Distribution spreadsheets for freeways with different number of lanes may be downloaded at http://webce.ent.ohiou.edu/orite/CumulativeIAT Distributions.html.