

STRIDE

Southeastern Transportation Research,
Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE B2

*Evaluation of Work Zone Mobility by Utilizing Naturalistic Driving
Study Data*

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1. Project Description

As the National Highway System grows older, an increasing number of work zones have been implemented to address the growing needs of maintenance and construction. However, the reduced operating speed, narrowed lane width and shoulder clearance, and other construction activities, have not only resulted in crashes but also caused excessive delays.

Although the freeway work zone capacity methodology proposed in the latest edition of the Highway Capacity Manual (HCM) has been substantially improved over previous editions, it is still limited by the fact of the macroscopic model, which cannot account for various work zone configurations.

In order to understand how actual work zone layouts, traffic conditions, and driver behaviors affect work zone capacity, a one-year proof-of-concept study evaluated if existing Naturalistic Driving Study (NDS) work zone data collected by the second Strategic Highway Research Program (SHRP2) could be reused to develop new (or update existing) capacity and traffic flow models for work zones.

Results suggested that the capacities predicted by HCM are lower than that by NDS regression models, which implies the HCM might underestimate the work zone capacity or additional parameters (such as population factor), which should be included in HCM models. The results on headway selections by different types of drivers can also be applied to improve or calibrate work zone planning and simulation tools. More complete work zone NDS data that cover the entire work zone area should be collected to develop car-following models at work zones in the next phase.

The results offer a unique opportunity to observe actual driver behaviors negotiating different work zone configurations, which can be utilized by Department of Transportations (DOTs) and transportation agencies to improve the existing work zone planning and capacity analysis tools.

2. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	1
Technical Report: Number of client-based technical reports published	1 (STRIDE Final Report)
OUTCOMES	
Body of Knowledge: Number of trainings for transportation professionals	2
Professionals Trained: Number of professionals participating in trainings	81 (46 participants, 35 views of recording)
IMPACTS	
Stakeholders: Number of stakeholders met with to encourage adoption or implementation of product(s)	3
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	One possible adoption is the headway table for traffic simulation software after Phase II.

3. Product

Preliminary Headway Table for Traffic Simulation Software

a) Non-Technical Description

Preliminary Headway Table for Traffic Simulation Software – Naturalistic Driving Study (NDS) work zone data was reused to develop new (or update existing) capacity and traffic flow models for work zones. As the NDS data offer a unique opportunity to different drivers negotiating freeway work zones areas, this research can improve the existing work zone capacity analysis methods by developing models to measure the speed-flow-density relationship at specific work zone configurations. DOTs and transportation agencies will have better understanding of work zone traffic flow distribution to better plan construction with least traffic impact accordingly.

b) Technical Description

The speed-flow-density relationship models from NDS data can be applied for connected vehicle studies in the future, as the NDS data contain the kinematics of participant vehicle and the front vehicle, which can be treated as a small moving segment. This is similar to the connected vehicle environment, which is one of the reasons of overestimated capacities that can be achieved by connected vehicles.

The free-flow speeds predicted from NDS models for specific work zone configurations can be used to improve or calibrate the planning and simulation tools. In addition, time and space headway and their relations with driver characteristics is useful to estimate the work zone capacity at the planning level. For example, free-flow speeds and headway distribution by different driver composition can be calibrated in VISSIM to provide better prediction of work zone capacity.

4. Body of Knowledge & Professionals Trained

- 1) Presented "Application of Naturalistic Driving Study Data to Study Work Zone Mobility" at the Technical Program of the Joint ALSITE/DSITE 2019 Annual Meeting in Gulf Shores, AL. (6/6/2019, 30 participants)
- 2) STRIDE webinar - Huaguo Hugo Zhou, PhD and Dan Xu, Auburn University "The Impact of Driver Characteristics on Headway Selection and Free-Flow Speed at Work Zones by Utilizing Naturalistic Driving Study Data" (10/2/2019, 16 participants; 35 views of recording)

5. Stakeholder Engagement

MEETING DETAILS		NARRATIVE DESCRIPTION
STRIDE representative	Dan Xu	Presented the poster "The Impact of Driver Characteristics on Headway Selection and Free-Flow Speed at Work Zones by Utilizing Naturalistic Driving Study Data" at the Transportation Research Board 99th Annual Meeting in Washington DC.
Date of Activity	1/13/2020	
Type of Activity	in-person meeting	
Location	Washington DC	
Stakeholder(s)	Larry Shannon, Roadway Geometrics Specialist, Michael Baker International.	
STRIDE representative	Dr. Huaguo Zhou	Presented "Application of Naturalistic Driving Study Data to Study Work Zone
Date of Activity	9/25/2019	

Type of Activity	in-person meeting	Mobility" at Alabama Roadway Safety Conference.
Location	Point Clear, AL	
Stakeholder(s)	John Michael Walker, State Safety Operations Engineer, ALDOT	
STRIDE representative	Dr. Huaguo Zhou	Discussed the potential use of the results of this study for simulation model, as current headway table was outdated at Automated Vehicle Symposium in Orlando, FL.
Date of Activity	July 15-18, 2019	
Type of Activity	in-person meeting	
Location	Orlando, FL	
Stakeholder(s)	Dr. Jiaqi Ma, Director of Advanced Transportation Collaborative, University of Cincinnati	

6. Adoption/Implementation

This is a one-year proof-of-concept study. We are working on the phase II that will develop products for direct implementation.

7. Broader Impacts

Although the freeway work zone capacity methodology proposed in the latest edition of the Highway Capacity Manual has been substantially improved over previous editions, it is still limited by the fact of the macroscopic model, which cannot account for various work zone configurations. The results from the NDS data offering a unique opportunity to observe actual driver behaviors negotiating different work zone configurations, which can be utilized to improve the work zone capacity method defined by HCM.

The comprehensive review of available literature conducted in the Phase I indicated that this is the first project that used NDS data to study car following and traffic flow modeling at work zones. Phase II of the project will be able to collect more NDS data for developing new methods for work zone capacity analysis and calibrating some work zone planning and simulation tools, for instance, new FFS table, new headway selection tables, distance traveled during speed change cycle, and average speed in queue for the work zone planning software (QUEWZ). The headway selection table by different driver types can be applied to develop driver population factors in estimating work zone capacity based on local population conditions. In addition, the NDS data contain the kinematics of participant vehicle and the front vehicle, which can be used to develop or calibrate simulation models to evaluate the performance of connected vehicles at work zone environment.