



TECHSUMMARY *January 2021*

State Project No. DOTLT1000211 / LTRC Project No. 18-3SS

Evaluation of DOTD's Existing Queue Estimation Procedures

INTRODUCTION

The United States has extensive transportation infrastructure connecting different parts of the country. With this widespread transportation system comes the need for periodic maintenance and repairs with as many as 3,000 active work zones across state-maintained highways at any given time, resulting in lane closures or detours often causing mobility and safety issues. Lane drops and merges arising from work zones account for nearly 24 percent of non-recurring congestion or 482 million vehicle hours lost in a year due to traffic delays at work zones.



Figure 1. Traffic queue at work zones

Queue analysis at work zones is vital from both operation and safety perspective. In the past, the Louisiana Department of Transportation and Development (DOTD) utilized an HCM-based spreadsheet tool to estimate queuing for proposed projects, but more recently has been using a flat reduced construction zone capacity of 1,309 pcphpl (passenger car per hour per lane) for its freeways, which also approximates to 30 minutes of queuing. It is not known how accurate the estimation is when compared to actual queuing related to real world work zones in Louisiana.

This study sought to document work zone lane closure policies practiced within the various DOTD districts as well as what other state DOTs practice. Additionally, the study aimed to validate the flat capacity of 1,309 pcphpl currently being used. Since lane closures on interstates for construction, maintenance, and permit projects impact stakeholder travel time, economic competitiveness, safety, and expense of road works, results of this study provide DOTD with a robust justification of its current practices of queue analysis or a basis to revise it thereof.

OBJECTIVE

The primary purpose of this study was to evaluate the effectiveness of DOTD's existing queue estimation procedures. Specifically, tasks performed to meet the objectives were:

1. Provide a review of the state of practice of work zone lane closure analysis nationally and statewide.
2. Identify work zones and collect data on traffic flows.
3. Analyze traffic flow to determine breakdown capacities, queue duration, and queue lengths.
4. Determine if the flat construction work zone capacity of 1,309 pcphpl is a valid assumption.
5. Replicate HCM 2016 model using Louisiana data.
6. Compare field values with HCM 2016 recommended values.

SCOPE

Sites were selected for data collection using the Louisiana 511 System and Content Manager of DOTD's Project and Highway Information. Future and current work zone projects, along with their percentage of work complete, were retrieved. However, the percentage of work complete did not always reflect actual work

LTRC Report 642

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SPR: TT-Fed/TT-Reg - 5

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zone conditions, which meant that a site selected could actually have no work zone at the time it was scheduled for data collection. Existing DOTD cameras were also found insufficient for the data collection effort due to inadequate range of the cameras at the specific work zone sites. Subsequently, a contractor was appointed to collect data through Remote Traffic Microwave Sensors. Overall, speed and volume data were collected for 10 sites across Louisiana. It was impossible to observe queue lengths from the data collected, hence data from the National Performance Management Research Data Set (NPMRDS) was used to estimate queue lengths.

METHODOLOGY

Two approaches were used to meet the objectives. First, the study conducted a nationwide and Louisiana statewide survey to determine work zone lane closure procedures practiced by other state departments of transportation and to also find out the work zone lane closure procedures administered by the various DOTD districts. Second, field data was collected from 10 different work zone locations in Louisiana and work zone capacity at each location was estimated. Field-observed capacities were compared to the work zone capacity from Highway Capacity Manual 2016 (HCM 2016). The new adjusted field capacity was compared to the currently used work zone capacity threshold value of 1,309 pcphpl. Queue length was estimated using data from NPMRDS.

CONCLUSIONS

- From the nationwide study, it was determined that approximately half of the states (15 out of 31 states) require a minimum capacity (threshold), ranging from 1,100 – 2,000 pcphpl to be maintained when determining when to allow work zone closures. Seven out of the 15 states reported a higher threshold than Louisiana's current threshold of 1,309 pcphpl.
- The statewide survey revealed that majority of DOTD districts regularly performed queue analysis. There was a general perception that the current DOTD threshold of 1,309 vphpl was too high, based on local knowledge of site conditions.
- The study determined the capacity of Louisiana work zones based on observations of 136 traffic breakdowns across 10 work zone sites spread around the state. Accordingly, average field-observed work zone capacities of 1,310 pcphpl and 1,575 pcphpl corresponding to heavy vehicle equivalent factor (ET) = 1.5 and ET = 2.0, respectively, were obtained with an average queue duration of 120 minutes and average queue length of 1.30 miles.
- Field-observed work zone capacity of 1,310 pcphpl was adjusted by ET and percentage of truck to 1,035 pcphpl. This observation may justify the perceived notion that the current 1,309 pcphpl (estimated based on ET = 1.5) threshold was too high.
- The HCM 2016 capacity model slightly overestimated the capacities of Louisiana work zones at 6%. Using the model, an average capacity of 1,670 pcphpl was obtained versus the field observed average of 1,575 pcphpl.
- The study determined a new threshold for lane closures that will result in queues of less than 30 minutes as 1,052 pcphpl for ET = 1.5 and 1,242 pcphpl for ET = 2.0. Since the current threshold is based on ET = 1.5, the corresponding revised threshold determined by this study is 1,052 pcphpl—an approximate 20% reduction of the current threshold.

RECOMMENDATIONS

- The results of this study show that traffic flow breakdown occurs at lower capacities than the current threshold being used, resulting in approximately 120 minutes of queuing. The study recommends a new threshold of 1,052 pcphpl, which will result in approximately 30 minutes of queuing.
- The suggested new threshold may offer an opportunity to implement a consistent practice statewide within all districts. However, it was outside the scope of this study to evaluate how enforcing this reduced threshold will impact on stakeholder travel times and economic competitiveness of the region.
- The study compared the field-observed capacities with the HCM 2016 work zone capacity model and found out that the HCM 2016 model slightly overestimated the capacity at seven out of 10 sites, and underestimated at the remaining three sites. However, overall, HCM 2016 only overestimated slightly by an average 6%. In the absence of local data, the HCM 2016 work zone capacity model may be used to determine capacity for Louisiana work zones.