LOUISIANA TRANSPORTATION RESEARCH CENTER

Technical Summary

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Estimating HCM Default Parameters for Louisiana

Introduction

Intersection capacity, defined as the maximum number of vehicles that can pass through an intersection within a given time, directly influences traffic flow, congestion levels, and overall network efficiency. Accurate estimation of intersection capacity is essential for effective roadway planning, design, operation, and management. Intersection capacity is influenced by multiple factors, including geometric design, traffic control methods, environmental conditions, and driver behavior. To estimate intersection capacity, specific parameters must be determined based on the type of intersection. For signalized intersections, the key parameter is the saturation flow rate (SFR), while for stop-controlled intersections, the critical headway (CH) and follow-up headway (FH) are the primary parameters.

The Highway Capacity Manual (HCM) provides methodologies and default values for estimating these parameters; however, research has indicated that default values may not represent local conditions, highlighting the need for region-specific data to improve capacity computations. HCM also acknowledges that intersection capacity parameters at locations can differ from national averages due to regional or site-specific characteristics. The development of localized intersection capacity parameters is necessary to enhance traffic analysis accuracy and reflect Louisiana's unique conditions. Incorporating these local values will enhance the effectiveness of short-term and long-term transportation planning efforts, including Transportation Systems Management and Operations (TSMO) initiatives that emphasize the coordinated management of multimodal transportation systems to improve overall system reliability and performance.

Objective

The primary objectives of this research project were to:

- Estimate saturation flow rate for selected signalized intersections, and
- Analyze critical headway and follow-up headway on stop-controlled intersections.

Scope

Statewide intersection traffic flow data were collected from 511 video data and intersections chosen by DOTD District Engineers. Data analysis combined these sources, focusing on intersections with adequate sample sizes, yielding 51 signalized and 26 TWSC four-leg intersections across eight Louisiana districts.

Methodology

A multi-step methodology was used to fulfill the research objectives. A literature review identified suitable methods for estimating intersection capacity parameters, considering their advantages, limitations, and fit for Louisiana's traffic conditions. Selected methods were used to develop parameter estimation worksheets. Selection

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criteria for signalized and stop-controlled intersections were established. Qualifying intersections were identified using 511la.org, the DOTD crash database, and DOTD district consultations. Traffic video data were collected from 511la.org cameras or countCAM4 cameras where needed. Intersection geometry was categorized using Google Earth Street View and DOTD's iVision pavement management data. Comprehensive databases were created for both intersection types. For capacity parameter estimation, the HCM Saturation Headway Method was applied to determine local base saturation flow rates (BSFR) at signalized intersections. At stop-controlled intersections, CH and FH were estimated via Maximum Likelihood Estimation and Direct Measurement, respectively. LASSO regression method was utilized to analyze factors influencing SFR and CH.

Conclusions

This study estimated Louisiana-specific intersection capacity parameters and identified factors influencing SFR and CH. Data from 77 intersections (51 signalized and 26 TWSC) across eight DOTD districts were analyzed. The local BSFR for signalized intersections was 1,655 pc/h/ln, below the HCM default of 1,900 pc/h/ln, with district-level SFRs ranging from 1,537 pc/h/ln (District 03, Lafayette) to 1,773 pc/h/ln (District 61, Baton Rouge). Regression models showed SFR increased with lane width, number of lanes, exclusive turning lanes, approach grade, speed limit, and peak-hour conditions, but decreased with heavy vehicles and off-peak periods. For TWSC intersections, CH values (7.1–10.1 sec.) exceeded the HCM range (4.1–7.3 sec.), increasing with heavy vehicles and higher speed limits but decreasing with higher AADT, more rejected gaps, and additional major street lanes. FH values (5.9–6.5 sec.) surpassed the HCM range (2.2–4.0 sec.), reflecting local driving behavior at TWSC intersections with low-volume minor roads.

Recommendations

In alignment with HCM guidance, this study recommended using locally estimated intersection capacity parameters for signalized and TWSC intersections in Louisiana to reduce potential uncertainty in analysis outcomes. The statewide BSFR averaged 1,655 pc/h/ln, and district-level BSFR values provide a planning-level baseline and should be adjusted using HCM 7th Edition Equation 19-8 for project-specific applications. Additional BSFR values can be recommended by functional class, with Principal Arterials averaging 1,684 pc/h/ln and lower functional classes averaging 1,579 pc/h/ln. For TWSC intersections, locally observed CH and FH values more accurately capture regional driving behavior, particularly at low-volume minor street approaches.

When these newly estimated parameters (BSFR, CH, and FH) are applied in traffic simulation or analysis software, they should be adjusted for interconnected input variables as required, particularly in statewide or district-wide applications. In small-scale studies, validation of these values using local observations or historical data may be necessary. Caution should be exercised when average values are applied to individual intersections, with context-specific adjustments made to account for site conditions, infrastructure upgrades, or operational changes.

This study was focused on four-leg intersections with signalized or TWSC controls. Exploration of other configurations, such as roundabouts, is recommended for future research. Further refinement may be needed to reflect ongoing changes in post-pandemic traffic patterns. Investigation of real-time estimation techniques using advanced technologies is also recommended for future efforts. Integration of Vehicle-to-Everything (V2X) systems and consideration of Connected and Automated Vehicle (CAV) penetration rates in HCM methodologies are recommended to support evolving TSMO strategies in Louisiana.