PROJECT BRIEF

UF Transportation Institute UNIVERSITY of FLORIDA STRIDE

Framework for the Operational Analysis of Ramp Weaves

(STRIDE Project K2: Assessing and Addressing Deficiencies in the HCM Weaving Segment Analyses)

PROJECT OVERVIEW

The Highway Capacity Manual (HCM) is one of the most widely used references in transportation engineering, both for planning and operational analyses. The 6th edition of the HCM (HCM6) offers a wide spectrum of analyses ranging from freeway segments to facility travel time reliability. Weaving segments are often critical components of freeway facilities, as they can act as bottlenecks. Any bias or errors within the HCM weave procedure can significantly impact facility-wide or reliability analyses, and in the process bring into question the validity of the entire facility analysis methodology.

The research project identified deficiencies in the current Highway Capacity Manual (HCM6) weaving method and developed a new, simpler framework for evaluating operations at freeway ramp weaves.

RESEARCH GOALS

The main research goals pursued were to

1. Conduct a critical review of the HCM6 weaving method and identify deficiencies that this research can address for a subset of weaving segments;
2. Create a new framework for freeway segment analyses that can ensure consistency across segment type namely basic, merge, diverge and weaving segments; and
3. Apply the proposed framework to ramp weave sites in the field and generate a simplified operational method for LOS estimation that is transferable to other segment configurations.

FINDINGS

This new framework uses the basic freeway model and a speed impedance factor that represents the weaving turbulence, which proved to be simpler and more accurate than the models in the HCM6. Speed and capacity models were developed for Type A weaves, which directly predicts the overall segment speed in the weaving segment. The team concluded that the HCM6 model tended to underestimate speed within the weaving section compared to field data. A sensitivity analysis showed that the proposed model behaves reasonably well when varying the segment length, lanes and weaving volumes.

PRODUCTS

1) A new **Capacity Analysis Method** for ramp weave segments
2) **Method** for extracting high resolution video data
3) **Computational Engine** to exercise the method

IMPACTS

The products can improve mobility on the nation's freeway by producing more accurate measures for estimating the quality of service on weaving segments, which are likely to become network bottlenecks.

WHO BENEFITS?

- State Departments of Transportation
- Consultants who use the HCM methods on a regular basis
- Researchers involved in HCM development (e.g. NCHRP 07-26)
- International researchers who use the US HCM for operational analyses

RESEARCH TEAM

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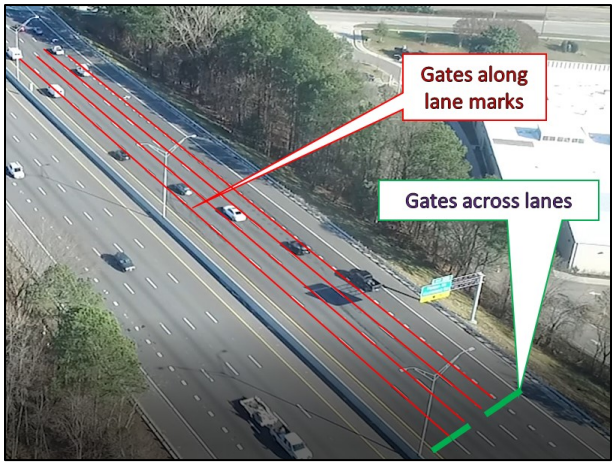
PRODUCT DESCRIPTIONS

1) A new Capacity Analysis Method for ramp weave segments

A new method was developed for evaluating operations at freeway weaves. This new method uses the basic freeway model and a speed impedance factor that represents the weaving turbulence. The model predicts the average speed of the weaving segment directly without using intermediate models to predict the number of lane changes. The new method provides an approach that is **simpler** than the current HCM6 method, **consistent** across all freeway segment analyses, and **adaptable** to other types of weaves (B & C) and merge and diverge segments when recalibrated.

2) Method for extracting high resolution video data

An unmanned aircraft system (UAS), or drone, was used to collect video 400 feet above the highway, capturing a length of up to 3,000 feet of roadway. The video was analyzed using a third party video imaging processor (VIP). Additionally, longitudinal and lateral "gates" were generated by the research team and superimposed on the processed video to capture the volume of weaving and non-weaving traffic. This enabled the team to track where vehicles started, when and where they entered, lane changed and exited at the approach.



3) Computational Engine to exercise the method

To enable end users to test and verify the methodology, a computational engine on an Excel platform has been developed that exercises the computations for the method. The data the method requires is similar to – and in some instances fewer than-- the current HCM method requires. The engine is available upon request from the project PI at rouphail@ncsu.edu.

These products will provide state agencies with a reliable tool for estimating capacity and quality of service at ramp weaves, and will enable them to improve their decision making for the design and operations of planned freeway improvements aimed at congestion mitigation.

About STRIDE

The Southeastern Transportation Research, Innovation, Development & Education Center (STRIDE) is the 2016 Region 4 (Southeast) U.S. Department of Transportation University Transportation Center headquartered at the University of Florida Transportation Institute (UFTI).

For more information on Project K2 (Assessing and Addressing Deficiencies in the HSM Weaving Segment Analyses), visit the STRIDE project page.