DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Improving Freeway Weaving Conditions

New matrix helps calculate which designs are most effective for safety and performance

Transportation Safety and Mobility

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Project Title:
Weave Analysis Matrix and Microsimulation Methodology Refinement

Task Number: 1934

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WHAT IS THE NEED?

Weaving sections are common freeway design elements often near ramps and freeway-to-freeway connectors where vehicles must cross paths. When traffic exceeds capacity at a weaving area, congestion occurs, which can affect performance of the entire freeway section. A weaving area can also experience problems even when traffic is less than capacity due to the design and complexity of the vehicle interactions, resulting in poor traffic flow and potential safety issues.

Most of the existing weaving analysis methods are based on limited data that does not represent the entire range of geometric configurations, traffic volumes, and patterns in weaving areas. In 2010, a new weaving analysis method was included in the Highway Capacity Manual (HCM). Caltrans needed to evaluate the new methodology and upgrade its Weave Analysis Performance Matrix to better analyze conditions and recommend best use cases for weaving sections.

WHAT WAS OUR GOAL?

TThe goal was to upgrade and enhance the Weave Analysis Performance Matrix as a tool to more accurately analyze freeway weaving sections and improve the design and performance of new and existing facilities.

WHAT DID WE DO?

Caltrans, in partnership with the University of California, Berkeley Partners for Advanced Transportation Technology (PATH), conducted a comprehensive literature review on modern weaving analysis methods. The researchers then collected field data from a number of sites, with emphasis on the types of configurations lacking data in the performance matrix. The team evaluated the accuracy of the HCM2010 capacity

predictions and methodology by comparing the calculated flow rates to observed flow rates at weaving sites that are consistent bottlenecks. Researchers applied the proposed Performance Matrix on selected real-world weaving sections to assess the toolâ€™s accuracy. They performed additional analyses by applying the selected methods to synthetic datasets for design and operating conditions for which field data was not available.

WHAT WAS THE OUTCOME?

Although the HCM2010 method provides reliable estimates for balanced major weaving sections, it can overestimate the traffic densities and associated traffic flow for ramp and un-balanced weaving sections. On average, the difference between the observed and predicted densities was 8% for balanced weaving sections and 24% for ramp and unbalanced weaving sections.

For the enhanced Weave Analysis Performance Matrix, researchers identified each method's strengths and limitations in predicting a weaving section's performance for a range of operating conditions, helping Caltrans staff to choose the best method for the weaving section under study. Each cell of the matrix represents a distinct design and operating condition, covering 144 typical weaving sections of two, three, four, and five lanes wide. Based on the comparison of the model prediction with field and synthetic data, each combination's performance is rated as good, partially good, inconsistent, or poor.

WHAT IS THE BENEFIT?

The new Weave Analysis Performance Matrix enables Caltrans to more accurately and consistently perform design analysis on freeway weaving sections, leading to better designed new facilities and improvements to existing interchanges. Improved weaving sections reduce bottlenecks, facilitate traffic flow, and create safer driving conditions.

LEARN MORE

To view the complete report:
www.dot.ca.gov/research/researchreports/reports/2014/final_report_task_1934.pdf

IMAGES

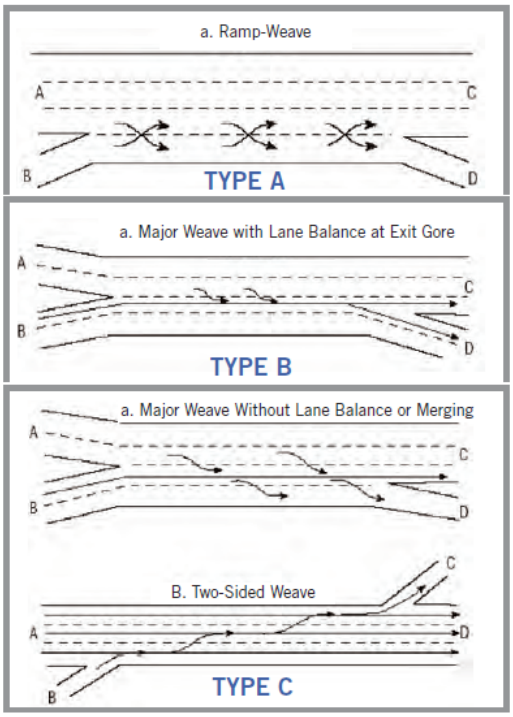

Figure 1: Configurations of freeway weaving sections

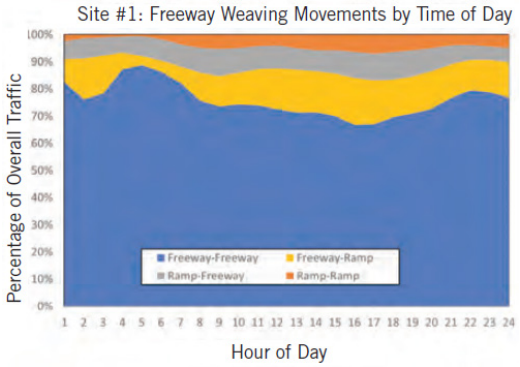

Figure 2: Weaving movements captured from Bluetooth data