

DRISI

CALTRANS DIVISION OF RESEARCH,
INNOVATION AND SYSTEM INFORMATION

Research Notes

Traffic Operations

SEPTEMBER 2023

Project Title:
Ramp Metering and HOV Lane
Degradation Mitigation

Task Number: 3903

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Ramp Metering and HOV Lane Degradation Mitigation

Select several sites in California with different types of HOV lane, ramp, and traffic, where data are available and conduct analysis of the relationship between ramp metering and HOV lane operation.

WHAT IS THE NEED?

The average speeds of vehicles in the High-Occupancy Vehicle (HOV) lane must be at or above 45 miles per hour during the morning or afternoon peak period at least 90 percent of the time over a 180-day period. An HOV lane that does not meet federal performance standards is considered "degraded". HOV lane performance must be reported annually to the Federal Highway Administration (FHWA) and states must develop a plan to bring degraded HOV lanes into compliance. Failure to comply with the performance standard may result in federal sanctions and jeopardize states from receiving federal funds or project approvals.

Ramp metering is often proposed by the California Department of Transportation (Caltrans) districts as a strategy for addressing degradation. FHWA requested to quantify the impact of ramp metering on the HOV lane performance.

WHAT ARE WE DOING?

We start by studying Caltrans 2017, 2018 and 2019 HOV degradation reports to identify freeways with HOV facilities, where HOV performance was degraded. These will be candidate sites for our study. Then, we will narrow down this list by selecting 4 sites with diverse characteristics.

We then conduct empirical and theoretical analyses of the relationship between ramp metering and HOV lane operation. The goal is to explore different freeway configurations (e.g., full access HOV lane vs. controlled access) and to quantify the nexus between ramp metering and HOV lane performance.



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Theoretical analysis will be conducted using simulation in Operations Planning Toolbox (OPT) recently developed by PATH for Caltrans. OPT is an open-source, multi-modal traffic modeling software for quantitative assessment of operational scenarios.

WHAT IS OUR GOAL?

The project goal is: find out which types of ramp metering (e.g., local, coordinated, on HOV preferential lanes, etc.) can improve the performance of the HOV lanes with various features (full vs limited access, density of on-ramps, bottleneck cause, severity of degradation) and to what extent, which will be quantified. If for certain HOV facilities the mitigating effect of ramp metering is negligible or nonexistent, we will investigate why, and what other mitigation techniques can be in order.

WHAT IS THE BENEFIT?

The main result of the proposed project will be a quantitative assessment of the ramp metering impact on the HOV lane performance at the selected sites in terms of the metrics listed above. It will help Caltrans to develop legally defensible HOV lane degradation reports.

A byproduct of this project will be the calibrated OPT simulation models for the selected sites. These can be later re-used by Caltrans in other studies. This will demonstrate an efficient way of evaluating operational scenarios.

WHAT IS THE PROGRESS TO DATE?

The researcher finished the project and is preparing the final report. There will a presentation in 10/12/2023.

During the last quarter, the researcher finished analyzing the theoretical analysis with simulation modeling. They will be using simulation in OPT

support for various managed lane policies and ramp metering schemes enables construction of multiple operational scenarios, for each of which the above listed performance measures will be computed. This will allow describing the nexus between ramp metering and HOV lane performance in quantitative terms

IMAGES

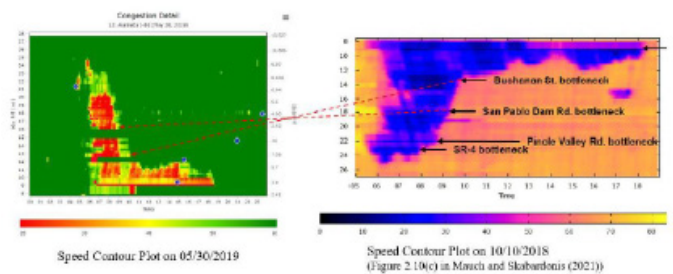


Image 1: Typical weekday speed contour plots and identified traffic bottlenecks.

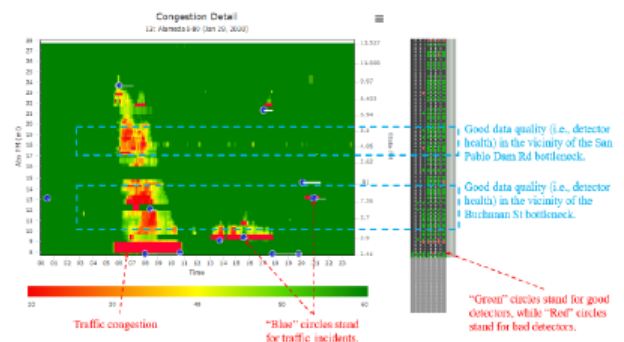


Image 2: Figure 2. Speed contour plot, traffic, incidents, and detector health in the study site on 2020-01-29.