DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Evaluating Alternative Design of Geometric Configuration for High-Occupancy Vehicle (HOV) Facilities in California

Researchers used simulation models to evaluate the partially limited access lane configuration for possible improvements in operational performance of HOV facilities.

Transportation Safety and Mobility

SEPTEMBER 2018

Project Title:
Statewide Managed Lanes (HOV/HOT) System Analysis Tools

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WHAT WAS THE NEED?

The results of a recent study by the University of California, Riverside, revealed that: a) limited access high occupancy vehicle (HOV) - facilities are good at regulating traffic flows, which results in higher freeway throughput; while b) continuous access HOV facilities have potential to spread out lane changes, which allows traffic to maintain higher travel speed. Based on these results, there was a need to explore alternative designs of geometric configuration for HOV facilities that combine the advantages of the two existing configurations to determine if there could be further improvement in performance of HOV facilities.

One such alternative design is called "partially limited access" configuration where continuous access is generally provided along a freeway to achieve higher travel speed while buffers are strategically placed on selected freeway segments (e.g., bottlenecks, ramp merges) to accommodate higher throughput on those segments. Thus, there was a need to evaluate the operational performance of HOV facilities with the partially limited access configuration, via simulation, and determine if there was further improvement in performance of HOV facilities with this configuration.

WHAT WAS OUR GOAL?

Our primary goal was to evaluate the operational performance of HOV facilities with the partially limited access configuration via simulation, compare the results to those with the existing

configurations (limited access and continuous access), and determine if there was improvement in performance of the HOV facility.

Our goal also included having researchers conduct a field operational test on a freeway segment on California State Route 210 (SR-210) in California Department of Transportation (Caltrans) District 8. The field operational test included having researchers collect after modification field data (after the HOV lanes were re-striped by Caltrans with the partially limited access configuration) and compare it to the before modification field data. However, since Caltrans District 8 was not able to do the re-striping at certain sections of the High Occupancy Vehicle (HOV) lane and the researchers had already completed all the work they were able to do in accordance with the scope of work, this contract was terminated effective September 9, 2018.

WHAT DID WE DO?

Researchers first analyzed the HOV cross-weave effect upstream of off-ramps. Afterwards, a method for determining the location and length of buffers in the partially limited access control was developed and applied to the study site on California State Route 210 (SR-210) in Southern California (Caltrans District 8). The research team then created and calibrated a simulation network of the freeway segment on SR-210. Researchers then implemented an HOV lane in the simulation network with three different configurations: 1) limited access, 2) continuous access, and 3) partially limited access and ran the simulation network with these three different HOV configurations. Afterwards the researchers compared the results to determine any improvements in operational performance of the partially limited access configuration.

WHAT WAS THE OUTCOME?

The traffic microsimulation results for the case study of the freeway segment on SR-210 indicate that the partially limited access control increased the throughput and decreased the delay of the freeway as compared to the existing limited access and continuous access controls. The results show the overall network efficiency of the freeway with partially limited access HOV facility was 21% and 6% higher than that of the freeway with limited access and continuous access HOV facilities, respectively. Results also show that the buffers designed with a weaving distance per lane change of 600 ft. (instead of the existing 800 ft. guidelines) had the best operational performance in terms of average travel speed.

The results also revealed that HOV cross-weave flow had a tangible effect on the capacity of mixed-flow (MF) lanes upstream of off-ramps. Three influential factors, i.e., HOV cross-weave flow, number of MF lanes, and length of buffer were analyzed, and it was determined that placing a buffer (with appropriate length) before an off-ramp could reduce the HOV cross-weave effect, keeping the capacity of MF lanes at a high level.

WHAT IS THE BENEFIT?

The results of this study show that the partially limited access configuration has the potential to improve the overall network efficiency of the HOV lanes by 21% and 6% as compared to that of the existing freeway with limited access and continuous access HOV configurations, respectively. This improvement in efficiency could benefit Caltrans in mitigating congestion and improving lane operational speeds to meet the Federal requirement of maintaining average operating speeds above 45 miles per hour (mph).

LEARN MORE

View the Final Report
https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca18-2304-finalreport-a11y.pdf

IMAGES

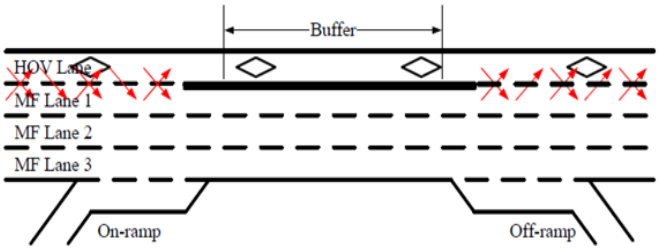
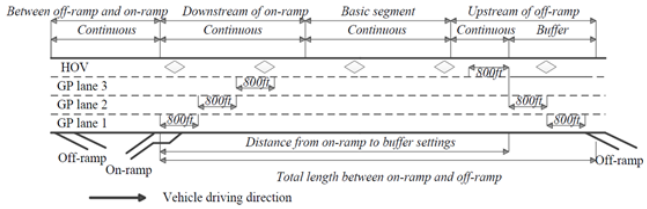


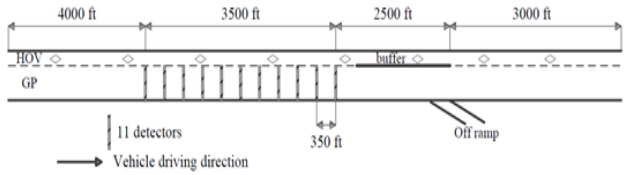
Figure 1. Partially limited access HOV facilities

Image 1: Partially limited access HOV facilities



Partially limited access design for freeway HOV facilities

Image 2: Partially limited access design for freeway HOV facilities

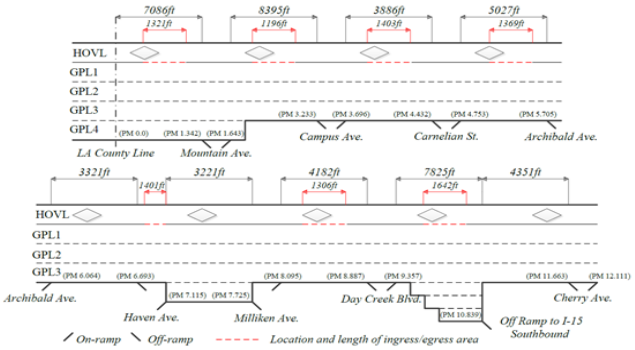


Simulation test scenario for HOV cross-weave effect

Image 3: Simulation test scenario for HOV cross-weave effect

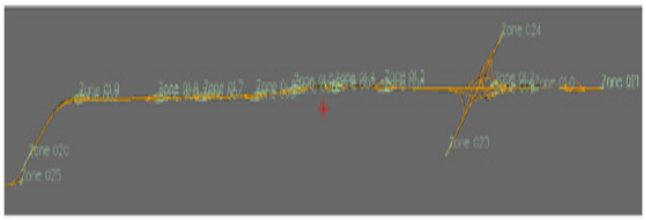
Map of the study site, SR-210 E from Los Angeles County line to I-15 interchange

Image 4: Map of the study site, SR-210 E from Los Angeles County line I-15 interchange



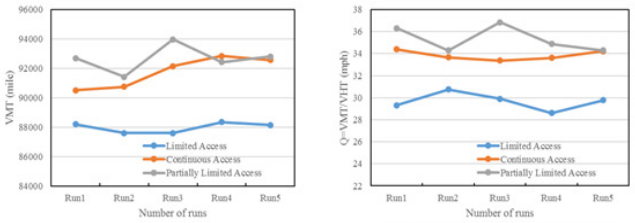
Geometric diagram of the study site

Image 5: Geometric diagram of the study site



Overview of the entire simulation network

Image 6: Overview of the entire simulation network



Vehicle Miles Traveled (VMT) for different simulation runs

Average Travel Speed (Q) for different simulation runs

$$Q = \frac{\text{Vehicle Miles Traveled (VMT)}}{\text{Vehicle Hours Traveled (VHT)}}$$

Operational performance of different HOV access designs from multiple simulation runs

Image 7: Operational performance of different HOV access designs from multiple simulation runs