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Caltrans Division of Research, Innovation and System Information

Research Results

Alternative High Occupancy Vehicle (HOV) Lane Operational Strategies for Congestion Mitigation in California

Evaluate HOV lane operational strategies to mitigate congestion and meet the Federal requirement of maintaining the average operating speed above 45 miles per hour (mph)

Traffic Operations

FEBRUARY 2022

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

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WHAT WAS THE NEED?

With the increase in travel demand and the introduction of more clean air vehicles, some High Occupancy Vehicle (HOV) facilities have become congested and fail to meet the Federal degradation requirement of maintaining the average operating speed above 45 miles per hour (mph). Therefore, there is a need to research and evaluate alternative operational strategies that can be used to mitigate both recurrent and non-recurrent congestion to ensure that they will provide satisfactory performance and will meet the Federal minimum average operating speed requirement. Several strategies will be researched, such as increasing the minimum occupancy requirement in HOV lanes (e.g., from HOV2+ to HOV3+), dual HOV lanes, conversion of HOV lanes to High Occupancy Toll (HOT) lanes, and reassessment of HOV lane usage by clean air vehicles.

WHAT WAS OUR GOAL?

The project goal was to evaluate the operational strategies on HOV lanes that can be used to meet the Federal degradation requirement of maintaining the average operating speed above 45 miles per hour (mph).

WHAT DID WE DO?

The research team at the University of California at Riverside (UCR) initially performed thorough literature review of alternative HOV lane operational strategies across the U.S. and summarized the findings in a task report. Researchers, in consultation with the

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Caltrans Project Panel, identified HOV facilities in California for use as case studies in this research.

The research team collected data about the selected HOV facilities from a variety of sources (such as satellite images, Google Street View, Caltrans' Performance Measurement System (PeMS), etc.). Researchers used the Highway Safety Information System (HSIS) and records from the California Highway Patrol (CHP) to retrieve incident data such as type, location, and duration. Using the collected data, researchers analyzed HOV lane performance with a focus on average operating speed. Researchers diagnosed the reason(s) for those lanes with degraded speeds and attributed the degraded performance to recurrent and non-recurrent congestion.

Researchers employed travel demand models to assess the effectiveness of five alternative HOV lane operational strategies:

1. Increasing the minimum occupancy requirement to HOV3+
2. Quantify the effectiveness of deploying dual HOV lanes
3. Estimate the short-term and long-term impacts of reducing or eliminating the HOV lane usage by clean air vehicles
4. Determine criteria that could be used to assist deciding on conversion from HOV lanes to HOT lanes
5. Develop a model to approximate the statewide impact of non-recurrent congestion on HOV lane degradation in California. All the alternative HOV operational strategies were evaluated under both recurrent and non-recurrent congestion conditions. The modeling results were compared with those of the existing operational strategy to determine the best alternative.

For a more comprehensive assessment of the alternative HOV lane operational strategies, researchers also modeled the performance of the alternative HOV lane operational strategies using traffic simulation tools. First, they created simulation networks of the case study HOV facilities and calibrated them against real-world traffic data. Then, they implemented the alternative HOV lane operational strategies in the simulation networks. After that, they simulated the networks under both recurrent and non-recurrent congestion conditions. The simulation of non-recurrent congestion was performed for a selected number of scenarios that are the most prevalent.

WHAT WAS THE OUTCOME?

Impacts of Variations in Analysis Method:

The results of this study imply that some of the degraded HOV segments could benefit from incident management strategies. It is recommended that the impacts of traffic incidents on HOV lane performance degradation be monitored over time to identify HOV segments that are consistently affected by incidents for possible investment in traffic incident management program.

Alternative Approach for Determining HOV Lane Performance Degradation:

It is recommended that the 'speed differential' measure be calculated and reported in the future in order to provide a comprehensive picture of the performance of HOV facilities in California.

Assessment of Alternative HOV Lane Operational Strategies:

- Increasing Minimum Occupancy Requirement from HOV2+ to HOV3+:
  - For this specific case study, it was also found that the increase in minimum occupancy requirement from HOV2+ to HOV3+ would not impact the speed in the Mixed Flow lanes.

- Deploying Dual HOV Lanes:
  - The modeling results show that the average HOV lane speed in both directions would improve significantly after deploying dual HOV lanes.

- The traffic flow improvements as a result of deploying dual HOV lanes would also eliminate the bottlenecks on the case study section in both directions as well.

• Reducing HOV Lane Usage by Clean Air Vehicles:
  - The modeling results show that doubling the number of CAV decals from the baseline would decrease the average operating speed in the HOV lanes by 2.1% on average. On the other hand, halving the number of CAV decals from the baseline would increase the speed in the HOV lanes by 2.2% on average. Lastly, eliminating all the CAV decals (i.e., ending the CAV decal program) would increase the speed in the HOV lanes by 5.7% on average.

• Conversion of HOV Lane to HOT Lane:
  - The comparison results show that the degradation level for a majority of these segments remained the same after the conversion to HOT lane. The degradation level for three segments actually increased during the morning peak period whereas the degradation level for one segment decreased during the afternoon peak period.

• Adding Contraflow HOV Lane:
  - The simulation results show that the addition of the contraflow HOV lane would increase the average speed in the southbound HOV facility from 38 mph to 55 mph, which is enough to lift this HOV facility out of the degradation status. Although not simulated, it is expected that this strategy would also result in an improvement in average speed in the northbound HOV facility during the morning peak period.

WHAT IS THE BENEFIT?

Implementing managed lanes, including HOV lane, represents one approach being used in metropolitan areas throughout California to respond to growing traffic congestion, declining mobility, as well as air quality and environmental concerns. The results from this research could enable Caltrans to improve the performance of HOV facilities in the state through innovative design of the facilities.

Anticipated benefits of this research include the ability for Caltrans to set appropriate HOV operation policies that could improve the freeway system's overall performance based on scientific research findings and could help Caltrans meet the Federal degradation requirement of maintaining the average operating speed above 45 miles per hour (mph).

LEARN MORE

The final report will be posted to this website when available:

https://dot.ca.gov/programs/research-innovation-system-information/research-final-reports

IMAGES

Image 1: State Route 91 Express Lane Sign – Used to show example of Increasing Occupancy from HOV2+ to HOV3+

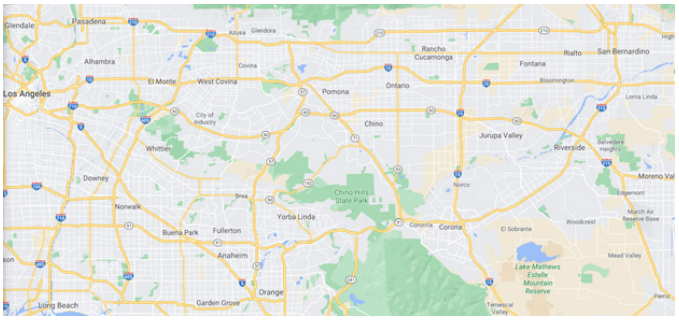

Image 2: Case study section of HOV lane on SR-91 for increasing minimum occupancy requirement to HOV3+

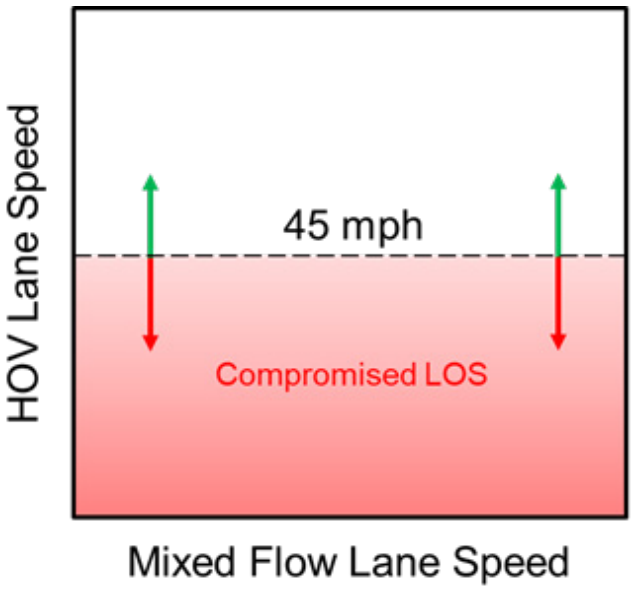

Image 3: Existing Method for Determining a Fixed Speed Threshold to determine compromised LOS

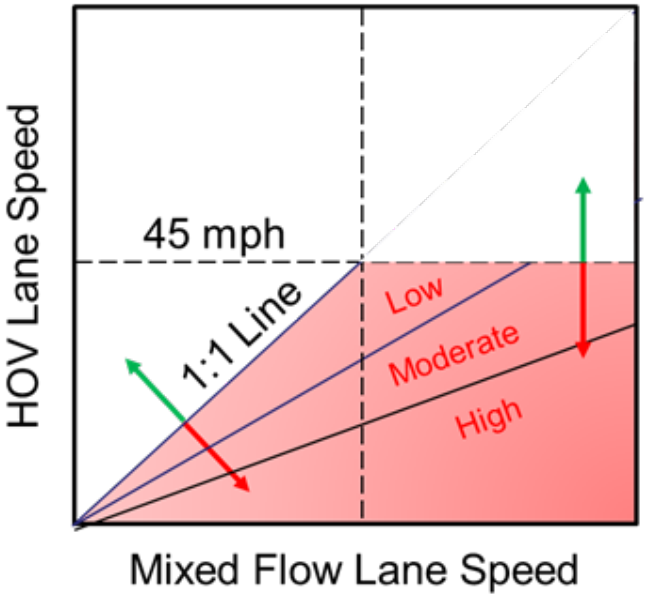

Image 4: Contrast between the speed differential approach and the fixed speed threshold approach