DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Field Experiment of Variable Speed Advisory (VSA)

PATH/Caltrans conducted Variable Speed Advisory (VSA)field test on State Route 78 in District 11 in San Diego to help manage vehicle speeds in areas well known for congestion or traffic incidents.

Transportation Safety and Mobility

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Project Title:
Field Experiment of Variable Speed Advisory (VSA)

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WHAT IS THE NEED?

Typically, driver behavior is the main cause of traffic on the freeways. To better control this, Local Responsive Ramp Metering was introduced onto US freeway corridors years ago, but Variable Speed Advisory was still missing. Ramp Metering controls the demand into the freeway, and Variable Speed Advisory attempts to control driver behavior. Since then, and partly due to over-simplified algorithms, there has only been limited testing to improve mobility. Through simulation, the PATH project team developed a simple, practical algorithm that can improve bottleneck flow and reduce shockwaves along the freeway. This generated promising results but still needed to be field tested to determine its success.

WHAT WAS OUR GOAL?

The goal of this test was to evaluate the effectiveness of a newly designed VSA algorithm to mitigate the impact of construction on freeway mainline traffic along State Route 78 (SR78) eastbound from Civic Center Drive in the City of Vista to I-15 interchange in Caltrans District 11 in San Diego. The VSA algorithm is designed for bottleneck flow maximization for shockwave reduction along the freeway corridor.

WHAT DID WE DO?

PATH/Caltrans conducted the Variable Speed Advisory field test on State Route 78 in District 11 to help manage vehicle speeds in areas well known for congestion or traffic incidents. The VSA

algorithm used data from traffic sensors and radar in the signs to advise drivers of the optimum speed to improve traffic flow; reduce travel time; minimize traffic delays caused by incidents, work zone lane closures and recurrent congestion; improve roadway safety; and reduce emissions and energy consumption. The VSA field test ran from April 9 until May 4, 2018. The Research team worked closely with District 11 traffic engineers on system tuning (hardware/software and VSA algorithm tuning). Three main freeway performance indices, VMT (Vehicle-Miles-Travelled), VHT (Vehicle-Hours-Travelled), and Q (=VMT/VHT, defined as average speed) have been used as performance evaluation parameters. PeMS data has been used for evaluation for objectiveness since it is independent from the VSA system used data.

WHAT WAS THE OUTCOME?

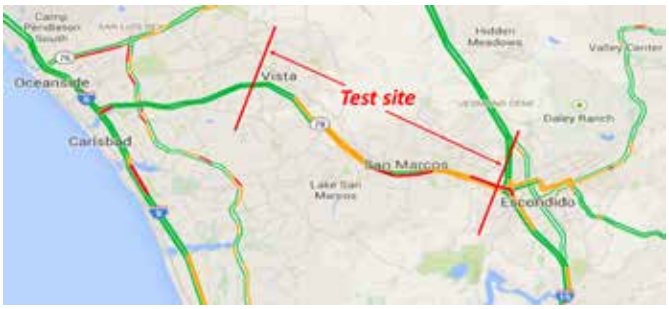
The outcome is summarized as follows:

- VSA displayed in the field were reasonable based on extensive observation from the project website, which was very useful.
- VSA roadside signs should be larger in size or could be mounted on overhead gantries. In future, this information can be transmitted by using automated and connected vehicle technologies.
- The average system performance in AM Peak Hours (6:00am – 9:00am) during the 4 weeks:
  - VMT increased by 2.72% on average.
  - VHT decreased by 6.28% on average.
  - Improved the traffic speed by 8.71% on average.
- The average system performance in PM Peak Hours (2:00pm – 7:00pm) during the 4 weeks:
  - VMT decreased by 0.096% on average.
  - VHT decreased by 1.47% on average.
  - Improved the traffic speed by 2.80% on average.
- Driver compliance rate was improving as the test was progressing;
- VSA sign with radar detection was very useful: for better estimation of mainline traffic and to evaluate the driver compliance by comparing the traffic speed and displayed speed.

WHAT IS THE BENEFIT?

It is generally recognized that traffic throughput along a freeway corridor is mainly determined by its bottleneck flow. The field-test of the VSA strategy for freeway corridor traffic confirmed that bottleneck flow is maximized by reducing shockwave upstream. When the traffic flow at the bottleneck is maximized, the freeway throughput will be improved, Total Travel Time will be reduced, and Total Travel Distance will be increased since the average speed and/or the number of vehicles accommodated will be increased for a given time interval - making freeway traffic operation run more smoothly. This will significantly improve the travel quality of the drivers who use the freeway. Freeway traffic improvement also positively impacts other travel modes such as an increased feeding flow of air travelers to the airport and freight container flows from/into the seaport. Total Travel Time reduction also directly benefits the environment by reducing emission and energy consumption caused by freeway traffic congestion. The speed harmonization effect of VSA reduce/remove shockwaves which occupy a large percent of collisions/accidents on freeways. In turn, driver injuries are reduced. The expected improvement in all aspects strongly supports Caltrans Strategic Goal on mobility and safety.

IMAGES



Test site from Vista to Escondido