



Caltrans Division of Research,  
Innovation and System Information

# Research

# Notes

Transportation  
Safety and  
Mobility

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Project Title:  
Design Guidelines for Metered  
On-ramps in California

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## Queue Storage and Acceleration Lane Length Design at Metered On-ramps in California

Develop queue storage design and acceleration lane length standards for metered entrance ramps for new or reconstructed interchanges.

### WHAT IS THE NEED?

Across California, most of the freeway on-ramps at urban interchanges are either currently being metered, or proposed to be metered in the near future. The current Caltrans Highway Design Manual (HDM) does not contain specific standards on queue storage design for metered entrance ramps. Also, at metered on-ramps, approaching vehicles have to stop before picking up speeds in order to merge with mainline traffic. The standards prescribed in the current Caltrans Highway Design Manual (HDM) for acceleration lane length design are found to be insufficient at times. Vehicles, especially buses and trucks, departing the limit line may not have sufficient acceleration lane length to reach safe merging speeds with mainline traffic in the existing on-ramps.

### WHAT ARE WE DOING?

Under this task, researchers are collecting data at several on-ramp locations in California and will utilize the data collected to investigate and develop models/methodologies for sizing queue storage length and acceleration length at metered on-ramps. Researchers will develop a comprehensive design guidance for metered on-ramps that helps both designers and operators with ramp metering applications. The guideline will also help alleviate the potential in terms of queue overspill and insufficient acceleration length at metered on-ramps. Ultimately, the conclusions and recommendations from this proposed research will be of critical importance for the update of the Caltrans Ramp Metering Design Manual and Highway Design Manual (HDM) for new or reconstructed interchanges.

### WHAT IS OUR GOAL?

The goal is to investigate and develop standards on queue storage design and acceleration lane lengths for incorporating into Caltrans' design manuals.



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## WHAT IS THE BENEFIT?

The benefits of this task are expected to be the elimination or reduction of on-ramp queue overspill onto local streets, which cause congestion, and help address insufficient acceleration lane lengths at metered on-ramps.

## WHAT IS THE PROGRESS TO DATE?

Researchers completed the first set of data collection at four Sacramento sites and conducted data extraction and analysis. They are working on the development and refinement of the queue length estimation model.

So far, researchers have determined the following:

- Acceleration rate is not constant; it increase then decrease and consequently kinematic equations cannot be directly used to calculate acceleration distance.
- Merging speed and existing acceleration length seem to affect acceleration rate; sites with higher merging speed and/or shorter existing acceleration tends to give rise to higher acceleration rates.
- Trucks achieve the highest acceleration rate at a later distance and with lower acceleration rate as compared to passenger cars, as expected.