Ramp Metering: A Proven Effective Strategy

WHAT IS RAMP METERING?

Ramp metering is a strategy used to regulate the volume of vehicles entering a freeway at a given time thereby seeking optimal freeway operations. Access to the freeway is controlled using a traffic signal that is powered by an algorithm that uses real-time system traffic data to determine the rate at which vehicles should enter the freeway. This breaks up the platoons of vehicles attempting to merge onto the mainline. Vehicles already on the mainline will not need to reduce their speed as much due to the spacing of the entering vehicles.

Rather than acting in isolation, ramp metering is an integral part of an agency’s overall corridor management and operations program. Agencies can align ramp metering programs with programs or efforts, such as arterial management, incident management, work zone management, integrated corridor management or with others, to optimize the combined effect of their tools and strategies. Coordinating these programs and deploying ramp metering will likely depend on the capabilities of the agencies involved.

RAMP METERING IN THE TOP U.S. METROPOLITAN AREAS

BenEFITs OF RAMP METERING

Ramp metering is a widely proven, cost-effective strategy to increase the efficiency of a freeway system. Metro areas that deployed ramp meters touted benefits such as increases in freeway mainline throughput, decreases in overall travel delays, increases in travel time reliability, reductions in freeway crashes and their severity, and even benefits to the environment through reductions in fuel consumption and emissions.

LEGEND

Traffic Speed Increase
Travel Time Reduction
Collision Reduction
Emission Reduction

Note: 1. According to the 2010 United States Census, metro areas have a population greater than one million people.
2. Ramp metering information is current as of 2014.
FEASIBILITY STUDIES & BENEFIT/COST ANALYSIS

Agencies should conduct feasibility studies and benefit/cost analysis on proposed ramp metering locations. Benefit/cost analysis monetizes the estimated benefits of ramp metering associated with travel time, crash reduction, and emissions reduction savings and compare against estimated capital and operations costs.

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<th>BENEFIT/COST ANALYSIS TOOLS</th>
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<td>U.S. Department of Transportation Research &amp; Innovative Technology Administration ITS Joint Programs Office Knowledge Resources: Users can browse benefits and costs of various projects.</td>
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<tr>
<td>FHWA Tool for Operations Benefit Cost Analysis (TOPS-BC): Users can select different project aspects and parameters to test the affect on total cost.</td>
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CASE STUDIES

Miami faced public opposition during their efforts to deploy ramp metering. Through outreach and educational efforts, the agency was able to shift public opinion and raise the support required to start metering.

New York City ran a public relations campaign to re-brand ramp meters as “merge lights” as a means of circumventing pre-existing negative perceptions about ramp metering.

IDENTIFY COST & SECURE FUNDING SOURCES

Agencies can utilize FHWA resources and tools to identify capital and operating costs related to the installation of new systems. Agencies can strengthen their case for deploying ramp metering by itemizing specific costs, thus increasing transparency. Providing benefit/cost information can help strengthen the case for ramp meter expansion by showcasing the benefits and providing leverage for requesting funds. In order to secure funding, agencies must also communicate the high priority of ramp metering to authorities.

CASE STUDY

The Twin Cities evaluated the costs and benefits of their ramp metering system, which provided the agency with empirical basis for the expenses associated with ramp metering. The evaluation yielded a benefit/cost ratio of 15 to 1, thus the benefits of ramp metering dramatically outweighed its costs.
Our region first installed ramp metering in our state’s largest urban area in the 1980’s and we have steadily expanded the system since then. Other, smaller cities in our state have seen the benefits and are planning ramp meter systems.

– Pete Briglia, former WSDOT and TRB Freeway Operations Committee Chair
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GOING ABOVE AND BEYOND
One of the key attitudes that agencies with successful ramp metering programs embrace is the desire for continued improvement in ramp metering operations. Through ongoing performance monitoring and internal agency assessment, enhanced ramp metering strategies can be identified and planned for in future regional planning efforts. Even agencies that already have ramp meters should assess both suitability and feasibility prior to expanding and improving their program. These approaches tend to require high organizational capability and are not necessarily suitable for all ramp metering locations.

Operational enhancements can include:

- **Extended Hours of Operation**
  Policies that extend ramp meter operations outside the peak hours and for special events and construction activities offer further flexibility and control.

- **Special Ramp Treatments**
  This encompasses strategies that can improve traffic conditions, improve safety at the merge point, and provide driver incentives for specific modes of travel. For instance, an agency could designate a bypass lane accessible only to HOVs or transit vehicles.

- **Adaptive Ramp Metering**
  Adaptive ramp metering utilizes algorithms that can optimize either local or system-wide conditions. Adaptive ramp metering can also utilize advanced metering technologies such as dynamic bottleneck identification, automated incident detection, and integration with adjacent arterial traffic signal operations. This technique is effective for recurring and non-recurring congestion.

- **Integrated Freeway and Arterial Corridor**
  When operating independently of the ramp meter signals, the arterial signals may release too many cars onto the ramp, causing backup onto the arterial. If the two systems are integrated, backup could be reduced leading to safer and more efficient conditions.

RESOURCES FOR MORE INFORMATION

- **FHWA Ramp Management web site**
  http://www.ops.fhwa.dot.gov/freewaymgmt/ramp_mgmnt.htm

- **FHWA Office of Operations web site**
  http://www.ops.fhwa.dot.gov/

- **FHWA Operations Benefit/Cost Analysis Desk Reference web site**
  http://ops.fhwa.dot.gov/publications/fhwahop13004/

- **U.S. Department of Transportation Research & Innovative Technology Administration ITS Joint Programs Office Knowledge Resources web site (including benefit and cost databases)**
  http://www.itsknowledgeresources.its.dot.gov/

- **FHWA Ramp Management and Control Handbook**

- **Ramp Metering Public Outreach videos**
  - Maximizing the Flow (Source: Kansas City Scout)
    http://www.kcscout.net/RMWatchTheVideo.aspx
  - Ramp Metering: Signal for Success (Source: FHWA)
    https://www.youtube.com/watch?v=rsvaGXW6moA
  - Ramp Meters: How-to (Source: RTC of Southern Nevada)
    https://www.youtube.com/watch?v=Lv3CHhsPN-Y

To obtain more information on ramp metering, please contact:

- **FHWA Office of Operations**
  operationsfeedback@dot.gov

“Ramp meters are the most effective traffic management strategy available. They have consistently shown high levels of benefits across numerous deployments throughout the U.S.”

– Brian Kary
Freeway Operations Engineer,
Minnesota DOT