

Ramp Management & Control Handbook

Questions and Answers

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1) What is Ramp Management?

Ramp management is the “application of control devices, such as traffic signals, signing, and gates to regulate the number of vehicles entering or leaving the freeway, in order to achieve operational objectives”. Most ramp management strategies are employed to balance freeway demand and capacity, maintain optimum freeway operation by reducing incidents that produce traffic delays, improve safety on the adjacent freeway or surface street, or give special treatment to a specific class of vehicles.

2) Why is Ramp Management Important?

Managing and controlling traffic on ramps is important because freeway entrance and exit ramps are the only facilities motorists may use to legally make connections to and from limited access facilities and as such represent the only locations where traffic entering and exiting a limited access facility can be controlled. Often, ramps are too closely spaced, do not offer adequate acceleration distances for posted speeds, or are simply overwhelmed by the increasing number of motorists that use them on a daily basis. When conditions like these exist, impacts may develop that affect the efficient and safe operation of traffic on ramps and the facilities to which they are connected (i.e., freeways and arterials). Ramp management offsets problems like these to obtain desired benefits or to satisfy pre-determined goals and objectives.

Ramp management also serves as an effective medium through which different agencies can collaborate to address needs more effectively. Since ramps often join facilities that are operated by different agencies, ramp management can break down barriers that exist between agencies, allowing agencies to work together more effectively to address issues.

3) What are the Benefits of Ramp Management?

Ramp management strategies may be used to improve safety and mobility by improving the flow of vehicles that enter and exit a freeway facility. Other in direct benefits of ramp management include environmental improvements such as reduced fuel consumption and vehicle emissions, as well as improved public perception and use of the transportation system, and the individuals responsible for it.

4) How do Ramp Management Strategies Improve Safety?

The manner in which safety is improved depends on the type of ramp management strategy selected. Ramp metering improves safety by breaking up platoons of vehicles entering the freeway, thereby allowing more orderly and safe interactions between merging vehicles and freeway mainline vehicles. Ramp closure improves safety by preventing vehicles from using ramps, where nearby events or activities pose a safety threat to vehicles. Other strategies improve safety by alerting motorists of conditions that motorists do not expect, while others reduce conflicts between through traffic and vehicles that intend to use the ramp.

5) How do Ramp Management Strategies Improve Mobility?

Ramp management strategies aim to improve conditions on the adjacent freeway and surface streets, resulting in benefits to mobility. By managing how vehicles use ramps, practitioners can set limits based on downstream capacity to maintain a pre-determined operational objective. For instance, ramp metering is often used to balance capacity and demand. Even in an uncongested state, a platoon of vehicles merging onto a freeway can cause enough turbulence (stop-and-go conditions as freeway vehicles slow down or quickly change lanes to accommodate the merging vehicles) to cause localized congestion around the ramp merge area. Metering can minimize these impacts by releasing vehicles in a controlled manner depending on the freeway mainline's ability to accept traffic. Operational characteristics that may be improved through the application of ramp management strategies include; speed, travel time, and delay.

6) How do Ramp Management Strategies Improve the Environment?

Ramp management strategies improve the environment by improving traffic flow on ramps and the facilities which they connect. This reduces the total amount of time vehicles are delayed, which results in less fuel consumption and emissions released into the environment. In some cases, strategies promote the use of transit which not only improves traffic flow, but also reduces the number of single-occupant vehicles on the roadway.

7) How do Ramp Management Strategies Promote Transit and Carpooling?

Special use ramp management strategies such as High Occupancy Vehicle (HOV) bypass lanes and exclusive HOV ramps provide travel time incentives to multi-occupant vehicles. HOV bypass lanes on metered on-ramps allow multi-occupant vehicles to bypass vehicles queued at the meter when entering freeway. Exclusive HOV ramps, on the other hand, provide vehicles with quick access to and from freeways, allowing these vehicles to avoid congestion on arterials and freeways.

8) Are There any Drawbacks or Impacts Associated with Ramp Management?

Typically, impacts associated with ramp management are positive; however, those responsible for the implementation of ramp management strategies should be cognizant of the fact that ramp management strategies may adversely affect specific groups of individuals, or push problems from one location to another, if not implemented correctly. Potential impacts of ramp management include:

- ▶ Trip diversion - From freeways to surface streets.
- ▶ Equity issues – Favoring longer trips suburban trips over shorter trips that occur closer to urbanized areas.
- ▶ Public opposition – Complaints from the general public, neighborhood groups and local businesses.
- ▶ Queue spillback – Queues that form on ramps that spill back onto freeways and/or surface streets.
- ▶ Emissions on ramps – Emissions from vehicles that are subject to delays caused by ramp meters. Although sometimes considered an impact, increases in emissions are typically offset by mainline improvements.





9) What Strategies are Used to Manage Ramp-based Traffic?

There are four general categories of ramp management strategies:

- ▶ Ramp metering – Controlling vehicles entering a freeway facility through the use of traffic signal(s) deployed on freeway entrance ramps.
- ▶ Ramp closure – Controlling vehicles entering or exiting a freeway facility by restricting vehicles access to a ramp on a temporary, intermittent, or permanent basis.
- ▶ Special use treatments – Controlling traffic and promoting the use of multi-occupant vehicles through preferential treatments given to a specific class of vehicle.
- ▶ Ramp terminal treatments – Controlling traffic through improvements (e.g., signal timing, widening lanes, pavement markings, adding turn lanes, etc.) made at the ramp terminal. Ramp terminal strategies are often lower cost solutions that either seek to improve existing conditions, and/or maximize the benefits of other ramp management strategies like ramp metering.

10) What is Ramp Metering?

Ramp metering is the use of a traffic signal(s) deployed on a ramp to control the rate at which vehicles enter a freeway facility. By controlling the rate at which vehicles are allowed to enter a freeway, the flow of traffic onto the freeway facility becomes more consistent, smoothing the flow of traffic on the mainline and allowing more efficient use of existing freeway capacity. Ramp metering can be an effective tool to address congestion and safety concerns that occur at a specific point or along a stretch of freeway. Ramp metering can also improve overall system performance by increasing average freeway throughput and travel speed, and decreasing travel delay. Finally, ramp metering can lead to a reduction in fuel consumption and vehicle emissions. Specific benefits documented in past literature are described in Chapter 5 of the Ramp Management and Control Handbook.

11) Ramp Metering Seems Complex - What do I Need to Consider before Implementing Meters?

Ramp metering is perhaps the most complex ramp management strategy and likely the most difficult to understand. However, once the basic components of a ramp metering system are identified and their functions understood, implementation becomes much easier. There are at least seven aspects that affect implementation of ramp meters. These aspects, which are listed below and described in detail in the Ramp Management and Control Handbook, include:

- ▶ Selecting a metering strategy.
- ▶ Determining the geographic coverage of metering.
- ▶ Selecting a metering approach.
- ▶ Selecting metering algorithms.
- ▶ Managing queues.
- ▶ Selecting a flow control scheme.
- ▶ Determining signing needs.

Before considering the above aspects of ramp meter implementation, practitioners should coordinate with upper management and department managers within their respective agencies to determine if agency directives support ramp metering.

12) What is Ramp Closure?

Ramp closure often involves the use of automatic or manual gates, and barriers to restrict vehicles from entering and exiting a freeway. In cases where ramps need to be closed quickly (e.g., severe weather or emergencies), ramps may be closed by enforcement personnel stationed in vehicles positioned in front of a ramp. If ramps will be permanently closed, more extreme methods such as physically removing the ramp pavement may be used. Regardless of the method used to close a ramp, closures will have a significant impact on existing traffic patterns. Closures will result in traffic diverting to upstream and downstream ramps. As a result, traffic volumes and congestion will likely increase on nearby ramps and adjacent arterials. Similarly, traffic problems that had once occurred at the closed ramp may shift to other locations. Considering these impacts, ramp closures should only be considered for severe safety problems that cannot be addressed through any other ramp management technique.

13) What are Special Use Treatments?

Special use ramp management treatments include strategies that give “special” consideration to a vehicle class or classes to improve safety, improve traffic conditions, and/or encourage specific types of driving behavior. The most popular special use ramp management application is the designation of HOV bypass lanes or ramps. Designation of HOV bypass lanes and ramps limit use of these facilities to only those vehicles with multiple occupants in an effort to reduce overall freeway delay.

HOV bypass lanes allow HOVs (i.e., public transit vehicles, carpools, vanpools) and emergency vehicles to bypass metered vehicles without having to stop. When ramps are not metered, HOV lanes offer a means for HOV and transit traffic to bypass queues built up from traffic entering the freeway. However, HOV bypass lanes should be designed properly to reduce the potential safety hazard posed by single-occupant violators who attempt to jump metered queues by using the bypass lane.

Transit and other HOVs, construction vehicles, delivery vehicles, and trucks are classes that may be targeted for special use ramp treatments. In regard to construction vehicles, delivery vehicles, and trucks, special use applications are focused on reducing conflicts between these vehicles and other vehicles that typically use ramps. In addition, special use applications for these types of vehicles may reduce the impact these vehicles have on neighborhoods. In regard to transit and HOV vehicles, special use applications include freeway ramps that link directly to park-and-ride lots or transit stations. These ramps provide travel time incentives for vehicles designated as HOV by allowing them to bypass congested arterials leading to and from the freeway, park-and-ride, and/or transit station.





14) What are Ramp Terminal Treatments?

Ramp terminal treatments include signal timing improvements, ramp widening, additional storage or new turn lanes on arterials, improved signing, and pavement markings on or adjacent to ramps. These treatments are geared to improving localized problems at either entrance or exit ramp terminals. Treatments focus on providing solutions to problems at the ramp/arterial intersection, on the freeway (e.g., exit ramp traffic queuing onto the freeway mainline), or on freeway ramps. At exit ramp terminals, the strategies are aimed at reducing queue spillback on the freeway, but may also be aimed at improved arterial flow by limiting the amount of freeway traffic that can access certain areas in the arterial network. At entrance ramps, the strategies generally are aimed at:

- ▶ Better coordination of ramp terminal signal timing and ramp metering timing.
- ▶ Sufficient storage space, either on the ramp or in turn lanes on the arterial, to contain queues from ramp meters or from a congested roadway.
- ▶ Signing to inform motorists approaching a ramp what to expect at the ramp. The types of signing range from information on the status of ramp meters (on or off), freeway congestion, or ramp closure.

15) Where have Ramp Management Strategies been Implemented?

Ramp management strategies have been used and routinely proven effective in cities all across the U.S, stemming back as far as the 1960s. For instance, the first ramp meter was deployed in Chicago in 1963, and as of 2002 the number of ramp meters, in cities across the U.S. has grown to roughly 2,160. Ramp meters have been deployed in metropolitan areas including Chicago, Minneapolis, Los Angeles and Detroit. Similarly, at least six agencies have indicated they have temporarily closed ramps that enter or exit freeway facilities. Special use strategies such as HOV flyover ramps and HOV bypass lanes have been implemented in cities such as Seattle and San Francisco.

16) Is it Expensive to Deploy Ramp Management Strategies?

In comparison to traditional highway improvements like adding lanes, and constructing new roads, ramp management strategies are relatively inexpensive. The true cost of implementing ramp management strategies depends on several criteria such as; the type(s) of strategy being considered, and the geographic extent each strategy will be deployed.

17) How Do I Choose the Best Ramp Management Strategies for My Area?

Selecting the “best” strategy or set of strategies is a difficult decision to make. The selection of a “best” strategy or set of strategies depends on the several factors, including; the type of problems being experienced, location of problems, geographic extent of problems, agency directives, and magnitude of benefits and impacts of strategies on existing operations. The Ramp Management and Control Handbook provides several decision making processes that guide readers through the process of 1) narrowing down acceptable strategies, and 2) deciding on which, if any, acceptable strategies are applicable for specific problems or conditions in the field.

18) More than One Ramp Management Strategy Seems Appropriate for Conditions I'm Looking at - Are There Any Tools I Can Use to Select a "Best" Strategy?

Depending on the conditions or problems being addressed and the strategies being considered, two or more strategies may be implemented together to deliver maximum benefits. A number of tools and models are available to determine a "best" strategy or set of strategies for existing conditions or problems. These tools range from very simplistic spreadsheet-based tools to much more complex microsimulation models. Traffic analysis tools can be grouped into the following categories:

- ▶ Sketch-Planning Tools.
- ▶ Travel Demand Models.
- ▶ Analytical/Deterministic Tools (HCM-based).
- ▶ Traffic Signal Optimization Tools.
- ▶ Macroscopic Simulation Models.
- ▶ Mesoscopic Simulation Models.
- ▶ Microscopic Simulation Models.

A description of each of these tool categories above can be found in the Ramp Management and Control Handbook.

19) How Should I Handle Public Outreach for My Ramp Management Project?

Agencies responsible for the implementation of ramp management strategies should be proactive in their public information and outreach efforts, and they should actively market the reasons for and benefits of proposed ramp strategies. Information released to the public, local agencies, and the media should be fair and accurate, to reduce the chance that the reliability of released information will be called into question at a later date. Preparations should also be made to accommodate questions and concerns likely to be posed by the public after strategies are set in place and become operational.

For some strategies such as ramp metering, public information campaigns may need to be set in place anywhere from one to five years before ramp meters are turned on (timing depends on the scale and scope of the project). The size and scope of the public outreach effort should be commensurate with the size and scope of the ramp management strategy that is selected. At a minimum, agencies should seek to inform the public, local agencies and the media at various points during the planning, design, and implementation phases of projects to keep these groups abreast of project progress and to solicit information needed to support subsequent project activities.

20) How Can I Make Sure My Ramp Management Strategies are Properly Operating and Well Maintained?

Successfully operating and maintaining ramp management strategies depends on the availability of funding, number of staff, staff training, and inter- and intra-agency coordination. All these variables must come together before they are needed to ensure continuity of operations. Maintaining strategies also requires thorough documentation of systems and equipment that needs to be maintained, and prioritizing these based on their impacts to safety.





21) What is the Purpose of the Ramp Management and Control Handbook?

The Ramp Management and Control Handbook provides guidance and recommended practices on managing and controlling traffic on freeway entrance and exit ramps. The primary purpose of this handbook is to improve the operation of freeways and their associated ramps by providing support, information, guidance, and recommended practice to practitioners responsible for freeway management and operations.

22) Who is the Target Audience for the Ramp Management and Control Handbook?

The Ramp Management and Control Handbook was developed taking into account the typical needs of transportation professionals charged with the responsibility of implementing, operating, and maintaining ramp management strategies. Although these individuals comprise this handbook's primary audience, consultants, contractors and researchers that have an interest in ramp management will find this handbook, or parts of it, beneficial.

23) What Topics are Discussed in the Ramp Management and Control Handbook?

The Ramp Management and Control Handbook provides specific information and guidance on the following:

- ▶ Strategies and treatments used for ramp management.
- ▶ Operating and maintaining ramp management strategies.
- ▶ Public information and outreach.
- ▶ Planning and design considerations.
- ▶ Inter- and intra-agency coordination.
- ▶ Enforcement.
- ▶ Performance evaluation, monitoring, and reporting.
- ▶ Selecting and implementing strategies.

24) Where Can I Get the Ramp Management and Control Handbook and more Information about Ramp Management?

More information on ramp management can be found at the FHWA Freeway Management Program website. This website can be accessed using the following URL:

<http://ops.fhwa.dot.gov/freewaymgmt/index.htm>

At this site, the Ramp Management and Control Handbook may be downloaded. Additionally, the site contains links to several other resources used to develop this handbook, including a link to the Freeway Management and Operations Handbook.