

Project Summary Report 8202

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Montana Rest Area Use: *Data Acquisition and Usage Estimation*

http://www.mdt.mt.gov/research/projects/planning/rest_area.shtml

Introduction

Rest areas perform a critical role in the highway network. They provide vehicle occupants and heavy vehicle operators with an opportunity to use a restroom, walk around, stop for a meal, sleep for a period of time, or even pause to use a cellular phone. Many of these activities aid in reducing driver distraction and fatigue, with the potential for consequently reducing distracted and fatigue-related crashes. These various activities also have a direct impact on a number of aspects of rest area design, from parking stall demand to facility sizing, water needs, and wastewater generation and handling.

For decision-making related to rest area usage, many states, including Montana, consult the American Association of State Highway and Transportation Officials (AASHTO), *A Guide for the Development of Rest Areas on Major Arterials and Freeways*. This reference provides guidance related to rest area design, including water and sewer system capacity, as well as parking lot size and layout. The Montana Department of Transportation (MDT)

questioned the use of this document for various rest area design aspects as the data are based on national averages, which may not represent usage patterns in a rural state like Montana. As a result of these concerns, research was undertaken to refine the methods employed in the estimation of Montana rest area usage, including water flow, effluent flow, pedestrian traffic, vehicle traffic counts and classifications, and vehicle dwell times for commercial and passenger vehicles. This information is intended to provide MDT with methods and guidelines based on Montana data that may be employed in usage estimation for rest area design and rehabilitation activities.

What we did

Data was collected at 44 state-maintained rest areas throughout the state. These rest areas represent a wide range of design layouts, facility condition, highway type served, and proximity to developed areas. Thirty of these rest areas are located on interstate facilities, leaving 14 rest areas on non-interstate principal/minor arterials. Due to the large number of study

sites, it was necessary for a sampling technique to be employed. The methodology called for collecting traffic data at representative rest areas (control stations) for the total duration of the study, not including the winter months, while collecting short-term traffic data at all other locations (coverage stations). Control stations were selected to represent different highway classifications and traffic levels. Interstate highways and other major/minor arterial routes (mainly rural arterials) were used for highway class. Two levels of AADT were used to classify sites by traffic level on the two categories of highway classes. This resulted in four different categories of study sites. One rest area was selected from each of these categories to be a control station. The four categories of rest areas along with the selected control stations are listed in Table 1.

Portable traffic counters were installed at the entrance of the rest area at each study site to obtain traffic count and classification of vehicles entering the rest areas. When setting up the traffic counters, attention was paid to making sure they were set up in a way that ensured all vehicles

Table 1. Control Stations

Highway Group	Average Annual Daily Traffic (AADT)	Study Site Selected
Interstate high-volume	AADT ≥ 5000	Greycliff Eastbound
Interstate low-volume	AADT < 5000	Divide Southbound
Major/minor route high-volume	AADT ≥ 3000	Bridger
Major/minor route low-volume	AADT < 3000	Emigrant

entering the rest area would be counted. When MDT had automatic traffic recorders (ATR) located on the same mainline facility and no “branching” facilities were located between the location of the ATR and the rest area, hourly mainline counts from the permanent ATRs were used during the period in which rest area traffic data was collected. Daily and monthly factors were derived using trends observed from ATRs selected to represent all other sample count stations. Directional splits of traffic for each ATR were obtained from MDT data. The proportion of vehicles exiting the mainline and entering the rest area was estimated by dividing the number of vehicles entering the rest area by the mainline traffic count every hour. For sites with multiple mainlines, such as those located at T-intersections of highways, the mainline traffic counts from all three directions were added together and the resulting traffic count divided by two based on the assumption that each vehicle would enter and leave the intersection once. All hourly mainline counts and AADT values at these sites were rounded up to the next highest integer.

Dwell time data was collected at three rest areas (two on the interstate and one on a state highway) for approximately one week at each site using surveillance cameras on mobile trailers. Dwell time is defined as the time elapsed from the moment a vehicle occupies a parking stall to the moment it leaves the parking stall and is important in estimating parking needs at a rest area. The field

dwell time video data was processed manually. As a vehicle entered the parking lot, the time was noted (the video data included a timestamp) along with the coded parking space it entered. When observed to leave, the time was once again noted for the specific vehicle. Vehicles that entered the rest area parking lot(s) were also identified by their type. While video data processing utilized the Federal Highway Administration (FHWA) vehicle classification, only three vehicle classes were used in the analysis of results: (1) passenger vehicles, which includes automobiles, minivans, and pickup trucks; (2) commercial vehicles and buses; and (3) recreational vehicles (RVs), which includes motor homes, truck campers, and cars towing camping trailers.

Water usage and door counts were collected on a daily basis throughout the duration of the project at all sites. Automatic door counters and water meters were installed by MDT Maintenance personnel at all of the state-maintained rest areas investigated. In conjunction with water usage data, data from the door counters will help MDT better design and maintain rest areas in the future, primarily in terms of designing water and wastewater treatment systems and determining the required number of stalls for a specific restroom. This will be accomplished through an understanding of the relationship between the number of persons entering a restroom and the amount of wastewater generated. The counters provided counts for patrons both entering and exiting, the counts

recorded were divided by two to obtain the number of persons using the restroom facilities. Water meter readings were recorded by gallons per day at each site. This data was employed in estimating the amount of water used and wastewater being produced at each rest area. The estimation of the latter is based on the assumption that the amount of water used is approximately equal to the amount of wastewater produced, as justified by previous research.

What we found

Traffic data analysis of descriptive statistics indicated the mean usage at rest areas in the high volume interstate category was approximately 10% of mainline traffic. The average percent mainline traffic entering for the low volume interstate category was approximately 8.7%. This value was 10.96% for the high volume arterial category (excluding the control station) and 13.39% for low volume arterials. Linear regression was employed to develop models that could be used by MDT in estimating rest area usage based on the expected mainline traffic. The models developed did not exhibit strong R square values; consequently, no model was viewed to be strong enough to warrant being employed by MDT to estimate rest area usage in the future. In light of the modeling results, an alternative, empirical observation approach regarding future usage guidance was employed.

A total of 5,521 dwell time observations were gathered at the three study sites using 19 total days of video. The overall mean dwell time at the three study sites, among all vehicle types, varied roughly between 14 and 24 minutes, which were similar to the guidance provided by AASHTO. When examined by vehicle type, commercial vehicles had the greatest mean dwell time followed by RVs and cars, respectively. It was evident from the data and analysis that the mean dwell times at the two rest areas on interstate highways were notably greater than their counterpart rest area located on the state highway. Examination of

dwelling time by parking duration found that mean dwelling times varied roughly between 8 and 11 minutes for short-term parking (at or below 1 hour) and between 4.5 and 5.5 hours for long-term parking (above 1 hour). When data were separated by day and night, average dwelling time during the day was found to be significantly shorter than that during the night.

Water usage data was analyzed on a per patron basis for each site. Patron data was obtained via the door counts collected at each site, with those counts divided by two (entry and exit each counted) to obtain the number of patrons. With a figure of daily patrons visiting each rest area, a calculation of the amount of water used and wastewater generated per patron could be made. This was accomplished by dividing a specific day's water meter reading by the number of patrons at the rest area for that day. Potential counter errors and malfunctions were first identified by examining a range of data three standard deviations above and below the average for each site. Any values outside of this range were deemed outliers and removed from further analyses. Mean water usage and wastewater generated at Montana rest area sites was approximately 1.5 gallons per person. At interstate rest areas, mean water usage was approximately 1.45 gallons per person, while arterial rest areas saw mean water usage of 1.46 gallons per person. Regardless of the category employed (interstate, arterial, overall), water usage was found to be significantly lower than the value of 3.5 gallons per person recommended by AASHTO.

The data analyses performed throughout the course of this project indicated the selected aspects of usage varied in a broad range and only explained some of the variation in rest area usage. Specifically, additional variables such as trip length, trip purpose, and traffic composition (local versus non-local drivers) may affect the percentage of traffic using a rest area.

These variables were not investigated by this project, primarily for reasons related to data availability and required resources. However, given the extensive amount of data collected in this project, this research offered valuable guidance to rest area usage in rural areas supported by extensive empirical observations.

What the researchers recommend

The major research results found in the course of this project offer some practical guidelines for rest area usage estimation in Montana. While the guidance developed is primarily related to Montana, it may prove to be useful in assisting other rural states in the planning and design of their rest area facilities as well.

- **Guideline #1:** In rest area design, a baseline rest area usage of 16% and 25% of mainline peak traffic may be used at rest areas on interstate highways and rural arterials, respectively. This roughly corresponds to the 85th percentile rest area traffic usage. A more conservative design may adopt a higher percentile value.
- **Guideline #2:** There is no need to adjust the baseline rest area usage (percent of mainline traffic) for the peak daytime period based on the overall percentage of buses and commercial vehicles in the mainline served by the rest area.
- **Guideline #3:** For planning and design purposes, it is reasonable to assume the percentage of buses and commercial vehicles during the daytime design peak period and the nighttime off-peak period as equivalent to 70% and 200%, respectively, of the overall bus and commercial vehicle percentage for the mainline served by the rest area. In this research, the former period corresponds to the period between 9:00 a.m. and 4:00 p.m. while the latter period corresponds to the period between midnight and 6:00 a.m.
- **Guideline #4:** Passenger vehicle traffic counts and average dwelling time during the daytime peak period should be used in the determination of passenger car parking needs at the rest area.
- **Guideline #5:** Both commercial vehicle counts and dwelling times during the daytime peak period and the nighttime off-peak period should be used in determining truck parking needs at the rest area.
- **Guideline #6:** A weigh station sharing the site with a rest area will most likely increase the commercial truck demand on the rest area when the weigh station is in operation. The amount of the induced heavy vehicle demand needs to be estimated on a case-by-case basis.
- **Guideline #7:** While rest area condition may affect traffic usage, it is recommended not to adjust the baseline usage for rest area condition due to lack of consistent empirical evidence.
- **Guideline #8:** For rest area planning and design purposes, it is important to use mainline traffic counts that reflect the peak summer season.
- **Guideline #9:** For rest area planning and design purposes, a rate of 1.5 may be used in estimating the number of patrons using the rest area building based on the number of vehicles stopping at the rest area facility.
- **Guideline #10:** It is recommended MDT use an average water usage of 2.0 gallons per patron in planning water and wastewater systems at current rest area projects. The ultimate value employed will also need to conform to the requirements set forth by the Montana Department of Environmental Quality (DEQ) for the design of such systems, specifically wastewater treatment systems at sites where city sewer access is not available.

References

American Association of State Highway and Transportation Officials, Task Force on Geometric Design, "A Guide for the Development of Rest Areas on Major Arterials and Freeways, 3rd Edition." Washington D.C., (2001).

For More Details . . .

The research is documented in Report FHWA/MT-10-009/8202, *Montana Rest Area Use: Data Acquisition and Usage Estimation*.

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MDT Implementation Status

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Implementation activities related to the rest area research will include: (1) conveyance of the new Montana rest area guidelines to current and future rest area design consultants for consideration in rest area facility and site development or improvement; (2) on-going tracking and data warehousing of rest area usage data initiated in this study for utility in generation of the design guidelines; (3) periodic and regular design review of substantive rest area research pertinent to national, regional and rural rest area usage estimation. These efforts will be primarily managed by the MDT Rail, Transit, and Planning Division in coordination with the affected stakeholders, as represented in the Rest Area Prioritization Plan Committee. The ten guidelines presented will be considered, as appropriate, communicated to peers who might help refine these ideas and support them as research efforts at the regional or national levels.

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