TECHBRIEF

Understanding Traffic Variations by Vehicle Classifications

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Introduction

Truck volume estimates are important in the design of roadways. The calculation of appropriate pavement depths and the design of many geometric features require truck volume estimates as inputs. States, however, traditionally collect only a limited number of short-duration truck volume counts. To provide a better understanding of how short-duration truck volume counts can be used to accurately estimate the key variables needed for design, planning, and operational analyses, the Long-Term Pavement Performance (LTPP) program recently completed a study entitled "Vehicle Volume Distributions by Classification." The purpose of this TechBrief is to present key findings from the study.

Key Findings

LTPP research showed that truck volumes[1] vary dramatically, both over time and from site to site by:

- Time of day.
- Day of week.
- Season of the year.
- Type of roadway.

The size and type of variation changed from site to site, but some consistent patterns emerged across the Nation. Local freight generation patterns, however, have an enormous impact on the truck volume patterns that occur at any given site. Hence, local conditions can have significant effects on the time-of-day and day-of-week patterns, as well as the vehicle mix on a given roadway. Therefore, the patterns discussed here are only average conditions.

[1]Four vehicle classifications are used in this report: cars (which includes light-duty pick-up trucks), single-unit trucks, combination trucks, and multi-trailer trucks. These are aggregations of the standard 13 categories normally reported to FHWA.

The Long-Term Pavement Performance (LTPP) program is a 20-year study of inservice pavements across North America. Its goal is to extend the life of highway pavements through various designs of new and rehabilitated pavement structures, using different materials and under different loads, environments, subgrade soil, and maintenance practices. LTPP was established under the Strategic Highway Research Program, and is now managed by the Federal Highway Administration

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Time-of-Day Patterns

The study identified four basic time-of-day patterns:

- Rural Automobile: A single-mode distribution pattern, commonly found in rural areas that are not affected by urban commuter traffic and also found on weekends in urban areas.

- Urban Automobile: A bimodal distribution that reflects morning and evening commuter traffic.

- Through-Trucks: A flat, time-of-day distribution that reflects long-haul truck traffic in areas outside of the cargo's origin or destination.

- Business-Day Trucking: A single-mode distribution that reflects the fact that most truck traffic starts and ends during the normal extended business day.

Figure 1 presents time-of-day patterns by the vehicle types listed above. Each of these patterns exhibits a large degree of variation. For example, the peak period in any of these distributions is affected by the proximity and nature of nearby activity centers. These activity centers can also affect the directional distribution of the time-of-day patterns. That is, time-of-day traffic patterns at many sites are different in each direction.

Volumes by Day of Week

The following general observations can be made about day-of-week traffic volumes based on data in the LTPP data base:

- Sunday traffic volumes are the lowest of the week for trucks at most sites, but average car volumes on Sundays can be fairly high at many rural sites.

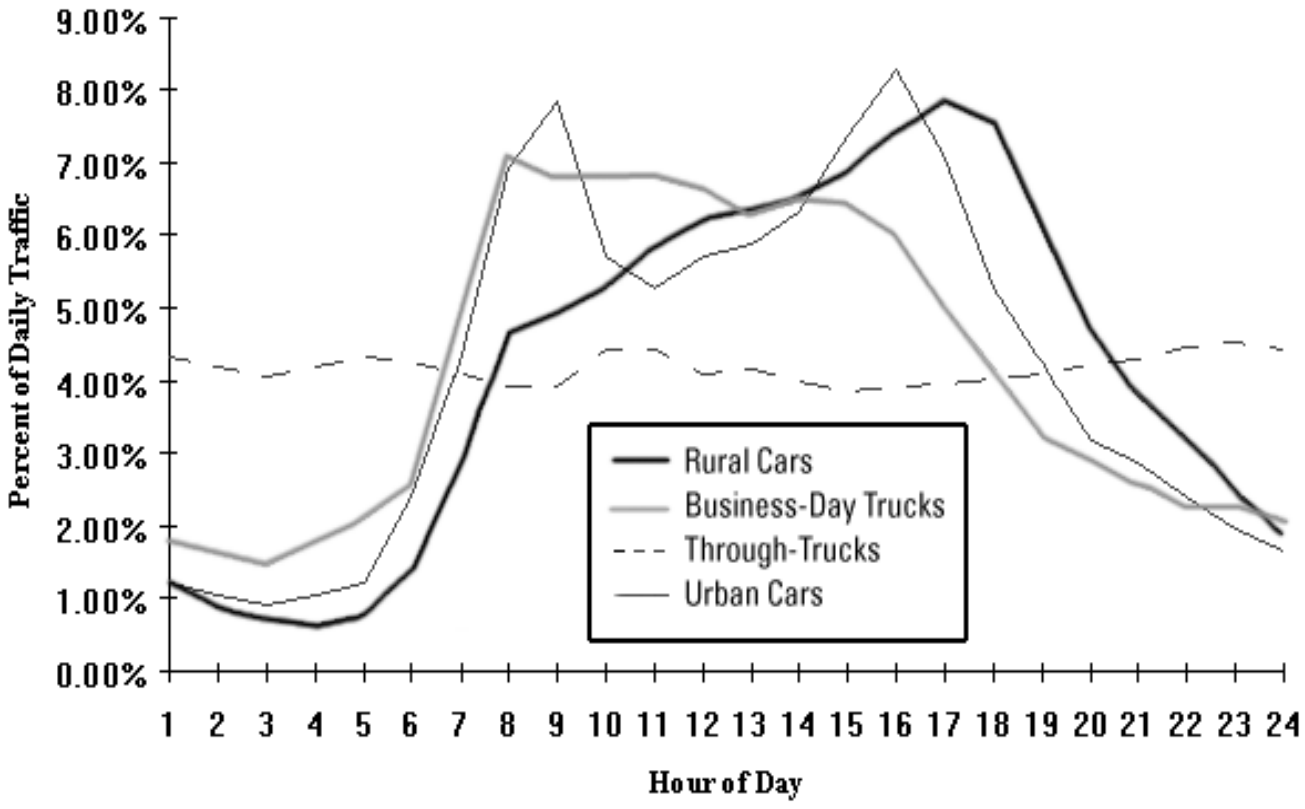
- Tuesday-through-Thursday volumes are similar for all truck classes.

- Friday is the highest volume day of the week for cars, but is similar to other weekdays for truck travel.

- Saturday volumes tend to be low for trucks, but like Sundays, they can be either high or low for cars, depending on the location.

There are many exceptions to

Figure 1. Basic time-of-day traffic patterns.



these general findings. The most significant difference is that many sites in the Great Plains and some Rocky Mountain States have different day-of-week patterns. These differences are illustrated in figure 2, which includes the day-of-week pattern from a Nebraska site on Interstate 80. The Nebraska patterns are caused by large through-movements of both cars and trucks traveling to and from the western States. A second common difference nationwide appears to be caused by recreational travel. For all urban sites in the LTPP data set, Sunday automobile volumes are lower than those on other days of the week. Some rural sites experience this same pattern; however, many rural sites experience very high Sunday volumes as a result of weekend recreational traffic.

Seasonal (Monthly) Patterns

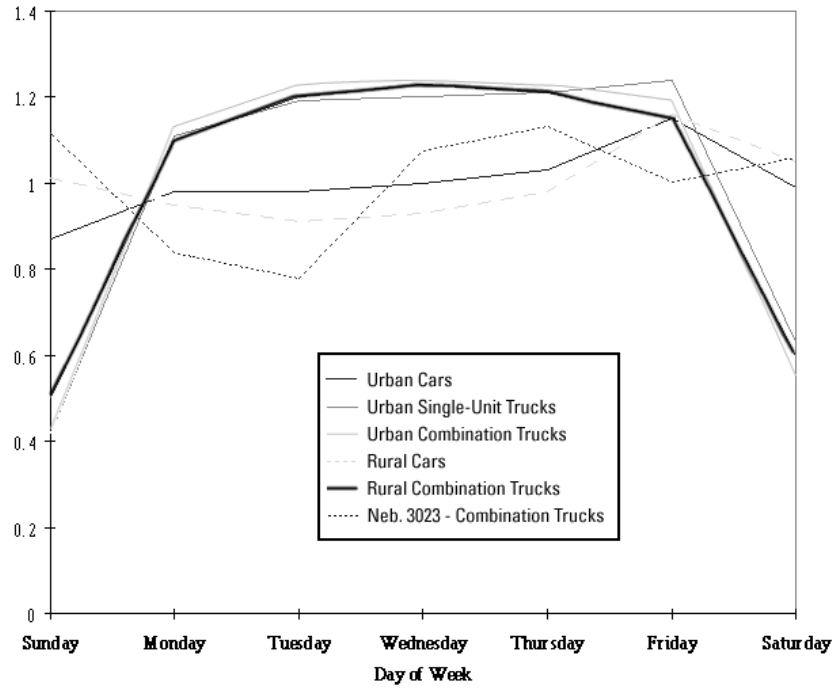
Generally, as with cars, truck volumes are lower in the winter than in the summer and fall. In addition, seasonal differences in truck volumes (as with cars) tend to be smaller in urban areas than in rural areas. However, the size and timing of truck volume changes are normally different from those of cars. In some States, truck classifications have unusual seasonal increases or decreases that relate to specific commodity movements (e.g., harvest hauls). In other States, truck movements show almost no seasonal change. One of the most interesting features of truck seasonality is that in many cases, truck volumes do not rise and fall gradually as cars volumes tend to do. In particular, single-unit and multi-trailer-unit vehicle truck volumes are subject to fairly dramatic changes in volume from month to month. These changes are often caused by intense commercial activity over a limited period. For example, the need to haul dirt to or from a major construction site can generate a large increase in the number of trucks that travel a road for an entire month, but those trips will disappear the next month when that need no longer exists.

Consequently, using patterns determined for cars to adjust short-duration truck volumes creates bias in the annual estimates. This can lead to serious errors in pavement-depth computations and other analyses that depend on the accuracy of these estimates.

Geographic Variation

In many States, there are also significant differences in truck patterns from one part of the State to another. This is partially due to major differences in the economic activity of these regions (agricultural land, heavy industry, mineral extraction, heavily populated areas, recreational areas), and partially due to the nature of the roads serving these areas. (Are the roads carrying through-traffic to and from activity centers outside of that region, or are the trucks bound to or from activity centers within the region?) Geography also affects the mix of trucks. Generally, western States are much more likely to have significant numbers of large multi-trailer trucks than eastern States.

Figure 2. Basic time-of-day traffic patterns.



Even within a State, some vehicles are prevalent in some parts of the State, but not in others (e.g., coal trucks in Kentucky), because of changes in the type of economic activity taking place.

A large amount of through-truck traffic is likely to generate higher weekend and night travel, whereas a preponderance of locally destined traffic is likely to generate truck traffic during regular business hours. These differences in through and local traffic, as well as the types of commodities being hauled, generally have a much greater impact on the types of volume patterns observed than the functional classification of the roadway. Therefore, States that wish to describe consistent truck traffic patterns need to review commodity-hauling patterns to begin to determine where truck-counting efforts are needed.

Summary

Truck volumes vary considerably by time of day, day of week, season, and from location to location. States need to develop mechanisms that can adjust short-duration truck volume counts to account for these changes. These mechanisms must be sensitive to differences in the amount of through-truck traffic on specific roads, as well as differences in trucking patterns that occur as economic activity changes from one region to another. Technical assistance in creating these mechanisms will be included in the revised Traffic Monitoring Guide, due for release in 1999.

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Availability: The publication on which this TechBrief is based, *Vehicle Volume Distributions by Classification* (Report No. FHWA-PL-97-025), was published in June 1997 by the Federal Highway Administration. Copies are available from Chaparral Systems Corporation's home page at http://www.chapsys.com/ltpp_web/ltpp7.htm.

Key Words: Vehicle classification.