



Truck Parking Inventory and Utilization Appendixes

WA 3 Task 2.3/2.4/2.7

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Appendix A: FHWA Methodology Details

This section provides an overview of the inputs and calculations used to derive truck parking demand in Texas utilizing the FHWA approach. As described in the report, this information provides a baseline for truck parking demand at the corridor level but has a number of limitations. Information generated from this approach will be used to cross-check data provided by the American Transportation Research Institute (ATRI) that is the main source of analysis used in this study.

This approach is based on three related studies:

- FHWA—Study of Adequacy of Commercial Truck Parking Facilities—Technical Report (2002). Referenced as “FHWA.”
- Pennsylvania State Transportation Advisory Committee—Truck Parking in Pennsylvania (2007). Referenced as “Pennsylvania STAC.”
- Virginia DOT—Virginia Truck Parking Study (2015). Referenced as “Virginia DOT.”

The Pennsylvania STAC and Virginia DOT models are based on the original FHWA approach but update some of the variables based on changes in FMCSA hours of service (HOS) regulations since 2002.

The model used to calculate truck parking demand requires 5 key user inputs. These inputs were all included in the original FHWA study:

- Truck AADT (AADTT) or Commercial AADT (AADTT).
- Corridor Length (L).
- Corridor Speed Limit or Average Speed (S).
- Percent of Trucks making short-haul trips.
- Percent of Trucks making long-haul trips.

The core equation for estimating truck parking demand (D) is shown below.

$$D = THT \times P_{avg}$$

Where:

D = Truck parking demand

THT = Truck hours traveled

P_{avg} = Average truck parking duration

Truck Hours Traveled (THT) is calculated based on:

$$THT = AADTT \times (L/S)$$

Where:

THT = Truck hours traveled

AADTT = Annual average daily truck traffic

L = Corridor length (in miles)

S = Average speed

The more time trucks require to traverse a corridor (L/S) and the more trucks in the corridor (AADTT), the higher the probability that they will need to stop at some point during that trip.

The average truck parking duration (P_{avg}) was expanded in the original FHWA study to include a number of additional parameters including:

- Hours of Service limitations (updated by the Pennsylvania STAC and Virginia DOT studies).
- Variation in truck parking characteristics for long-haul and short-haul trips. Short-haul trips can be made within a single day under hours-of-service regulations in place in 2002.
- Ratio of short-haul trips to long-haul trips. Truck parking duration is used as a surrogate. Based on observations and estimates of the percent of trucks that are parked for less than three hours (short-haul) versus those parked for more than three hours (long-haul), the original FHWA study used a 36% short-haul to 64% long-haul split for urban segments (defined as within 200 miles of a city with a population of 200,000 or more) and a 7% short-haul to 93% long-haul split for rural segments. The Pennsylvania STAC model used a 79% short-haul to 21% long-haul split while Virginia DOT used a 65% short-haul to 35% long-haul split.
- Time required for loading/unloading, staging, and other activities that occur while the driver is “on-duty” but off the roadway network.
- Demand for truck parking at public vs. private rest areas. This study does not differentiate between the types of parking available.
- Peak parking factors for long-haul and short-haul trucks. This determines the percent of daily truck parking demand that occurs during peak hours. Pennsylvania STAC and Virginia DOT both used 3 A.M to 4 a.m. as the peak truck parking hour. This study uses the same periods as the peak truck parking hour.

These parameters are further discussed in the sections below.

Short-Term Truck Parking Demand

To calculate short-term truck parking demand, the following steps were used for each corridor:

1. **Calculate AADTT.** TxDOT publishes roadway inventory data, including annual average truck counts each year. This study used 2018 data and combined the reported single- and combination-unit truck counts into an overall AADTT. Since this analysis focused on statewide Interstate corridors, the AADTT from urban areas (defined as within an MPO boundary) were not included in the overall corridor average to avoid skewing the average volume across the entire corridor.
2. **Calculate buffer AADTT.** The average AADTT value was multiplied by a 15% “buffer” to account for variances in the average daily truck traffic. This approach was used in the original FHWA study but not in the Pennsylvania STAC and Virginia DOT studies.

For the short-term truck parking demand calculation, the total daily truck volume is used instead of the short-haul percent because both short-haul and long-haul trucks need to stop for short periods of time (bathroom, fuel, etc.).

3. **Calculate segment length (L).** Obtained from GIS segment lengths for entire corridor.
4. **Calculate speed (S).** The average speed in a corridor can vary significantly based on time of year, time of day, traffic volumes, weather conditions, geography, and location (urban/rural) and speeds for commercial vehicles can be different than those for automobiles. For this analysis, statewide average speed of 65 miles per hour was used across all corridors.¹

Using equation 2, multiplying the buffer AADTT by the corridor length divided by corridor speed produces a truck-hours-traveled for the corridor.

5. **Calculate truck hours parked.** Using a truck parking/operating ratio of 5 minutes parked to 55 minutes of travel per hour, taken from the original FHWA study, the truck-hours-traveled is multiplied by 0.083.
6. **Calculate daily short-term truck stops.** All three studies used a value of 0.367 hours (22 minutes per hour) for the median short-term truck parking duration. This means that a driver would theoretically make a short-term truck parking stop once every 4 hours for 22 minutes. The total truck hours parked is multiplied by 0.367.

¹ This is consistent with the national average speed used by the National Highway Traffic Safety Administration “FMVSS No. 140. Speed Limiting Devices” (August 2016). Online at: <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/speed-limiter-pria-082016.pdf>

7. **Calculate peak truck parking demand (short-haul).** The utilization rate for trucks parked for less than 3 hours during the peak period of truck parking demand (between 3 a.m. and 4 a.m.) was estimated as 2.11% in the Pennsylvania STAC model. This value was used in the Virginia DOT model as well. Multiplying the daily truck stops by this value produces a peak truck parking demand for short-haul trips. This is the maximum demand for short-term truck parking in each corridor.

Long-Term Truck Parking Demand

To calculate long-term truck parking demand, the following steps were used for each segment:

1. **Calculate AADTT.** This study uses published TxDOT AADTT from 2018 highway inventory datasets. Since this analysis focused on statewide Interstate corridors, the AADTT from urban areas (defined as within an MPO boundary) were not included in the overall corridor average to avoid skewing the average volume across the entire corridor. However, only some trips in each corridor will require trucks to stop for long periods of rest. The average AADTT was multiplied by the percent of trucks making long-haul trips. For this analysis, since urban area AADTT was not utilized, the assumption was that 93% of trucks are making long-haul trips, consistent with the original FHWA study assumption for rural areas.
2. **Calculate buffer AADTT.** The AADTT provided in step 1 was then multiplied by a 15% “buffer” to account for variances in the average daily truck traffic. This approach was used in the original FHWA study but not in the Pennsylvania STAC and Virginia DOT studies.
3. **Calculate segment length (L).** Obtained from GIS segment lengths for the entire corridor.
4. **Calculate speed (S).** The average speed in a corridor can vary significantly based on time of year, time of day, traffic volumes, weather conditions, geography, and location (urban/rural) and speeds for commercial vehicles can be different than those for automobiles. For this analysis, statewide average speed of 65 miles per hour was used across all corridors.

Using equation 2, multiplying the buffer AADTT by the corridor length divided by corridor speed produces a truck-hours-traveled for each segment.

To derive long-term truck parking activity, a number of additional factors were considered. All three studies use a similar approach, though the Pennsylvania STAC and Virginia DOT approaches are updated to account for changes in FMCSA HOS restrictions since the 2002 FHWA study. Exhibit 1 is taken from the Pennsylvania STAC model.

Exhibit 1: Long-Haul Truck Parking Demand—HOS Related Variables

| Variable | Description | Derivation/Source |
|----------|--|--|
| F_D | Driving hours permitted in a daily on-duty window | 11 out of 14, or 0.786 (FMCSA Regulations) |
| OD_8 | Maximum on-duty hours permitted 8 over consecutive days | 70 (FMCSA) |
| DR_8 | Maximum driving hours permitted over 8 consecutive days | 55 ($OD_8 \times F_D$) |
| H_T | Total hours in 8-day period | 192 (24×8) |
| H_H | Avg. hours at home (off-duty and away from truck) for long-haul truckers in 8-day period | 42 (2002 FHWA Study) |
| H_R | Average hours with truck (on-duty or off-duty) for long-haul truckers in 8-day period | 150 ($H_T - H_H$) |
| $D\%$ | Fraction of time on the road (on-duty and driving) for long-haul truckers in 8-day period | 0.367 (DR_8 / H_R) |
| $P\%$ | Fraction of time long-haul truckers must be off-duty and/or parked under FMCSA regulations | 0.633 ($1 - D\%$) |
| P | Parking Ratio (hours parked for FMCSA regulations for every hour driving) | 1.725 ($P\% / D\%$) |

Source: Pennsylvania STAC. Truck Parking in Pennsylvania.

5. **Calculate truck hours parked.** This is found by multiplying the truck hours traveled by the parking ratio.
6. **Calculate daily long-term truck parking stops.** All three studies adopted a median long-term parking value of 435 minutes or 7.25 hours. This represents the estimated typical parking duration for trucks that park for extended periods of time to meet FMCSA requirements. The value is calculated by multiplying the truck hours parked by 7.25 hours.
7. **Calculate the peak truck parking demand (long-haul).** Similar to the peak truck parking demand (short-haul), the daily truck parking stops is multiplied by a utilization rate for trucks parked for more than 3 hours during the peak period of truck parking demand (between 3 a.m. and 4 a.m.). A value of 45.33% was used in Pennsylvania STAC and Virginia DOT models. Multiplying the Daily Truck Stops by this value produces a peak truck parking demand for long-haul trips.

Finally, to calculate total truck parking demand, the peak truck parking demand for short-haul and long-haul trips are summed.

One final note is that the FHWA methodology included a differentiation between public and private truck parking facilities and the desirability of each option. However, trying to differentiate between demand for a public truck parking space and demand for a private truck parking space with the level of specificity available in the model is of limited use. Although surveys indicate truck drivers prefer private truck parking facilities with amenities such as showers, food, and fuel, they will use any safe truck parking location they can find when necessary. Neither the Pennsylvania STAC nor the Virginia DOT models used this variable and this study also declined to make the distinction.