ENERGY-SECTOR BRIEF

Maintenance Division, Roadway Asset Management

16-07 TRUCK AXLE WEIGHT DISTRIBUTIONS

Quantifying the number of truck trips and resulting 18-kip equivalent single axle loads (ESALs) associated with the development and operation of oil and gas wells is a critical requirement for designing and maintaining pavement structures on energy sector roads. This energy sector brief describes a methodology to characterize axle weight distributions for estimating ESALs based on data obtained from the network of permanent weigh-in-motion (WIM) stations. The analysis used 54,249 sample trucks that were captured via video screenshots and their corresponding WIM readings to develop aggregated axle weight distributions at 1,000-lb intervals. This report and related documents are available on the TxDOT Maintenance Division (MNT) SharePoint site at https://txdot.sharepoint.com/sites/division-MNT/SitePages/Home.aspx.

VIDEO DATA COLLECTION AND WIM DATA MATCHING

Axle weight data from four WIM stations located in energy sector areas (PZ-502, W-531, W-533, and W-535), as shown in Figure 1, were matched to video screenshots gathered at those stations. The focus of the analysis was the following truck types that are commonly used in the energy sector: dump trucks, drilling rig trucks, flatbed trucks, equipment trucks, water trucks, sand trucks, and crude oil trucks, gasoline trucks, and liquefied natural gas trucks.

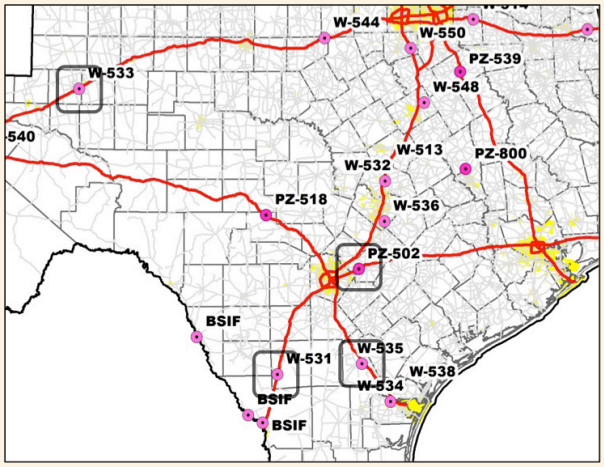

Figure 1. Locations of 4 WIM Stations for Video Data Collection.

TRUCK AXLE WEIGHT DISTRIBUTIONS

For each truck type, the data collected enabled the production of charts documenting the distribution of gross vehicle weights and axle group weights. As an illustration, Figure 2 shows the distribution of axle group weights in 1,000-lb intervals for single and tandem axles for all WIM data records in the sample. Charts for every truck type and axle configuration are provided in Research Report RR-15-01.

A high-level analysis of weight distribution trends was conducted, including an evaluation of overweight trucks. Table 1 shows the percentage of 5-axle trucks with a gross vehicle weight heavier than 80,000 lb (legal limit for 5-axle trucks) or 84,000 lb (assuming a permit allowing a five percent gross vehicle weight overload is in place). In most cases, 12 to 17 percent of trucks were heavier than 80,000 lb. Flatbed trucks showed the lowest percentage of trucks heavier than 80,000 lb (eight percent), while equipment trucks had the highest percentage of trucks heavier than 80,000 lb (31 percent). The percentage of trucks heavier than 80,000 lb was higher for rig trucks, but the sample size was very small. The trends were similar for the percentage of trucks heavier than 84,000 lb.

Table 2 shows the percentage of loads that exceed thresholds that are normally used to identify overweight loads, i.e., 20,000 lb for single axle loads, 34,000 to 38,000 lb for tandem axle loads, 45,000 lb for tridem axle loads, and 51,667 lb for quadrem axle loads. For tandem axles, the maximum legal weight varies from 34,000 lb 38,000 lb based on the axle configuration. For completeness, Table 2 also shows the corresponding percentages for all the trucks that were weighed at each of the four WIM stations in 2013.

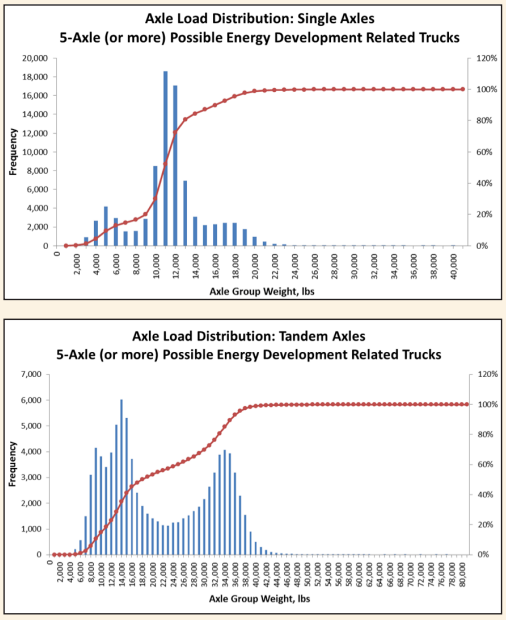

Figure 2. Distribution of Single and Tandem Axle Loads for All Trucks in the Sample.

TRUCK AXLE WEIGHT DISTRIBUTIONS (continued)

Table 1. Percentage of Trucks Heavier than 80,000 lb and 84,000 lb.

Truck Type	No. of Records in Sample	Trucks with Gross Vehicle Weight >80,000 lb	Trucks with Gross Vehicle Weight >84,000 lb
5-axle dump truck	3,496	17%	5%
5-axle rig truck	59	67%	64%
5-axle flatbed truck	17,391	8%	2%
5-axle equipment truck	1,293	31%	17%
5-axle water truck	3,771	12%	5%
5-axle sand truck	9,447	14%	3%
5-axle crude oil truck	2,102	17%	8%
5-axle gasoline truck	3,692	21%	6%
5-axle LNG truck	369	17%	6%

Table 2. Axle Group Weight Comparison at Four WIM Stations: Trucks in Table 1 versus All Trucks Measured at the WIM Stations.

WIM Data Group	Percentage of Overweight Axle Groups				
	Single Axles (>20,000 lb)	Tandem Axles (>Weight Limit*)		Tridem Axles (>45,000 lb)	Quadrem Axles (>51,667 lb)
Trucks in Table 1	1.20%	13.76%		27.46%	35.47%
All Trucks					
	Single Axles (>20,000 lb)	Tandem Axles (>34,000 lb)	(>38,000 lb)	Tridem Axles (>45,000 lb)	Quadrem Axles (>51,667 lb)
Station 502	0.75%	10.09%	1.51%	20.49%	37.35%
Station 531	0.60%	6.35%	0.63%	16.42%	19.31%
Station 533	0.48%	9.78%	1.11%	25.2%	28.59%
Station 535	0.51%	16.19%	2.77%	23.17%	29.9%

** The weight limit was determined based on the specific axle configuration of each tandem axle group.*

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HOW TO USE THE RESULTS

Truck axle weight distributions can be used in a number of applications, including the determination of ESALs on energy sector roads. An Excel spreadsheet template enables users to calculate the following for each oil or gas well:

- Total number of trucks needed by phase activity and analysis period.
- Total amount of ESALs for trips to the well by phase activity and analysis period.
- Total amount of ESALs for trips leaving the well by phase activity and analysis period.

The spreadsheet calculates these values based on inputs the user provides in various places of the spreadsheet. Input data include the number of trucks used for various oil or gas well development, operation, and maintenance activities, as well as axle weight distributions for each truck type used to support those activities. Once all the input data are populated, the spreadsheet calculates the number of trucks and ESALs per well for the selected analysis period, both for trips to the well and trips leaving the well. For each type of truck listed, the spreadsheet uses the truck axle weight distributions described in the previous section. Separate tabs in the spreadsheet document the calculations for each truck type. Implementation Report IR-16-03 provides additional information and instructions on how to use the Excel template.

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