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Truck Traffic Analysis using Weigh-In-Motion (WIM) Data in California

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report is based on truck traffic data collected during 1991 to early 2001 from all the data Weight in Motion (WIM) stations on the California State highway network. The entire set of data was obtained, sampled, and cleaned before subsequent analysis.

The objectives of the studies reported herein were as follows:

- develop axle load spectra for various axle groups of each truck type and compare these load spectra among various locations and time periods;
- determine truck traffic volume and load growth trends using regression methods;
- characterize past truck traffic loading patterns, including truck speeds, gross weights, and side wheel load differences;
- check the possibility of extrapolation of available truck traffic data to sites where WIM stations are not installed.

Chapter 2 provides a summary of data preparation and analysis techniques. Chapter 2 also includes a brief introduction to WIM systems, description of the WIM data structure, data sampling and cleaning methods, and assumptions used in the analysis.

The data were sampled and cleaned in such a way that all the data used in the analysis were those that passed the Caltrans routine validation checks and did not include identifiable erroneous records.

Chapter 3 reports the results of analysis of combined data from all the WIM stations across the entire analysis period. It shows that the generalized load spectra of all four axle groups became heavier at night than in the daytime, but had little seasonal variation. It also shows that the axle load spectra in Central Valley were heavier than those in the Bay Area and

Southern California, and that the axle load spectra in rural areas were heavier than those in urban areas.

Chapter 4 contains the results of analysis of data from six representative WIM sites. It includes the comparison of axle load spectra for various directions, lanes, years, and day versus night. Chapter 4 also contains the comparison of truck traffic volume for day versus night, among seasons, and among lanes. The growth trends of truck traffic volumes were estimated using linear and non-linear regression methods. Side wheel load variation, truck speed distribution, truck gross weight distribution, and yearly variation also included in this chapter.

The results show that the axle load spectra were similar for both directions of travel, but varied among lanes. The load spectra at night were generally heavier than those in the daytime. The load spectra didn't show much yearly variation, but the load spectra coefficients changed with time, especially for tandem and tridem axle groups. An increasing trend of truck volumes was observed from each WIM station, and can be fitted with linear regression modeling. The load difference between wheels on each end of the same axle(s) was very small and can possibly be ignored in pavement design. The speed of each truck type had a narrow distribution, ranging mainly from 80 km/h to 112 km/h. The gross weight of each truck type did not show appreciable yearly change.

Chapter 5 includes the comparison of axle load spectra and truck traffic volume among some WIM stations grouped by their close proximity to each other. The results show that it is possible to extend axle load spectra at available WIM stations to adjacent sites, if the extrapolation is made judiciously. The truck traffic volume, however, usually changes significantly from site to site, and can not be extrapolated.

Chapter 6 includes the conclusions and recommendations of the study. It is recommended that adequate resources be provided to perform regular quality assurance checks at all WIM stations. This is essential if the tremendously valuable WIM data will continue to be accurately collected in the future.

1.0 INTRODUCTION

1.1 Background

Pavements are damaged by the environment and by traffic, and by the interaction of the two. Highway pavements sustain nearly all the traffic-related damage from trucks and nearly none from automobiles. Until relatively recently, truck traffic data have typically been aggregated into equivalent repetitions of a standard axle load (ESAL) for pavement design for two reasons:

- Pavement design methods required relatively simple computations in order to be widely implemented in the absence of high-speed computers, axle load database storage capacity, and low-cost methods of collecting detailed truck traffic load data, and
- Empirical pavement design methods did not analyze pavement damage in terms of specific distress models, therefore, it was not necessary to calculate the different damage rates for each distress mode caused by a given axle load.

The increasing sophistication of pavement distress models used in mechanistic pavement design methods requires more detailed truck traffic information in order to take full advantage of their increased predictive capability. At the same time, computing speed, database storage, and access to databases have improved to the point that highly detailed truck traffic information can be easily stored, organized, and readily used for pavement design.

The Portland Cement Association (PCA) method of rigid pavement design recognized the need for detailed data early, and has used detailed axle load spectrum data since 1966.(*1*) The AASHTO 2002 methods for rigid and flexible design use axle load spectra.(*2*) Mechanistic pavement design procedures being developed for the California Department of Transportation

(Caltrans) by the University of California Pavement Research Center (UCPRC) (which will make use of some AASHTO 2002 models) will also make use of axle load spectra in cases for which that level of detail is required.

With its data Weigh-In-Motion (WIM) systems, Caltrans collects all the data needed for axle load spectra, but currently only uses it to calculate the Traffic Index (TI) used in the current Caltrans pavement design procedures. This quick and readily understood number provides a good general indication of traffic loading. The Traffic Index is calculated using the following formula:

$$TI = 9.0 \times (ESAL/10^{6})^{0.119} \quad \textbf{(1)}$$

where:

T = Traffic Index,
ESAL = Equivalent 80-kN Single Axle Loads, calculated by:

$$ESAL = \sum \left(n \times \left(\frac{axle\_group\_load(KN)}{n \times 80(KN)} \right)^{4.2} \right) \quad \textbf{(2)}$$

where:

n = 1 for steering and single axle group, 2 for tandem axle group, 3 for tridem axle group.
$\sum$ = summation on all axle group loads expected in the design life of the pavement.

An axle load spectrum is the load distribution of an axle group during a period of time. The equation for converting spectra into ESALs is based on an average across all pavement types, (i.e., rigid and flexible), and all distress mechanisms, (i.e., faulting and cracking in rigid pavements and cracking and rutting in flexible pavements), and ride quality across all pavements. It is well known that different pavement types and different distress mechanisms are affected at different rates by the same axle load, information that is lost by converting to ESALs. For example, transverse cracking in rigid pavements is mostly determined by the few heaviest single axle loads, and is little damaged by other loads. Therefore, the 4.2 exponent in Equation 2 underestimates the damage caused by those loads, particularly during the day when curling stresses compound the damage caused by the trucks at the edge of the slab.

For another example, consider base and subgrade rutting in flexible pavements. The 4.2 exponent greatly overestimates the damage caused by heavy loads for thick flexible pavements. This is particularly true at night, when the asphalt concrete is stiff and protects the underlying layers.

These two examples also illustrate the extra information obtained from examining data showing how axle load spectra may vary from day to night and season to season.

WIM systems can continuously measure and store loads and axle spacing data for each truck that passes through the WIM station. Additionally, they also record supplementary data such as the date, time, speed, lane of travel, vehicle type, and station identification. With the information provided by WIM systems, it is possible to get detailed truck traffic data, such as axle load spectra, required in modern pavement design methods.

In the late 1980s, Caltrans began to install data WIM systems on its highways to record truck traffic information. Currently, over 100 data WIM stations are installed on the California highway system. These data WIM stations are producing massive amounts of traffic data every day. Figure 1 and Table 1 show data WIM station locations throughout California as of March 2001.

1.2 Objectives of This Study

The objectives of this study are:

1. Take the binary database of available Caltrans WIM data, clean it, and convert it into a relational database to provide easy access to facilitate pavement design and management.
2. Examine the axle load spectra for the total data set by:
   a. axle type (steering single, single, tandem, tridem)
   b. day versus night, and across the three typical California seasons (wet, spring, dry)
   c. by region (Bay Area, Central Valley, Southern California)
   d. by rural versus urban locations, and
   e. the distribution of truck types
3. Examine the axle load spectra and axle load spectra coefficients for six WIM sites representative of the three regions and rural versus urban by:
   a. day versus night
   b. direction (Northbound versus Southbound)
   c. axle type
   d. lane
   e. year (growth rates)
4. Examine truck traffic volume and ESALs for the 6 stations by:
   a. truck type
   b. day versus night
   c. direction
   d. season
   e. lane

   f. year (growth rate)
   g. differential load between axle ends
5. Examine truck speeds for the 6 stations by truck type and location
6. Examine gross vehicle weights (GVW) by truck type, location, and year (growth rate)
7. Evaluate the feasibility of estimating truck traffic information for adjacent locations from a given WIM station, including:
   a. Average Annual Daily Truck Traffic (AADTT), equivalent single axle loads (ESALs)

1.3 Scope of This Report

This report analyzes the data collected from all data WIM stations in California from January 1991 to March 2001, explores axle load frequency distributions for the various axle groups within all truck types, and compares frequency distributions among sites, years, seasons, day/night, and various regions. Also reported are analyses of truck volume distributions among lanes, directions, years, and truck types, right/left side wheel load difference distribution, and truck speed distribution.

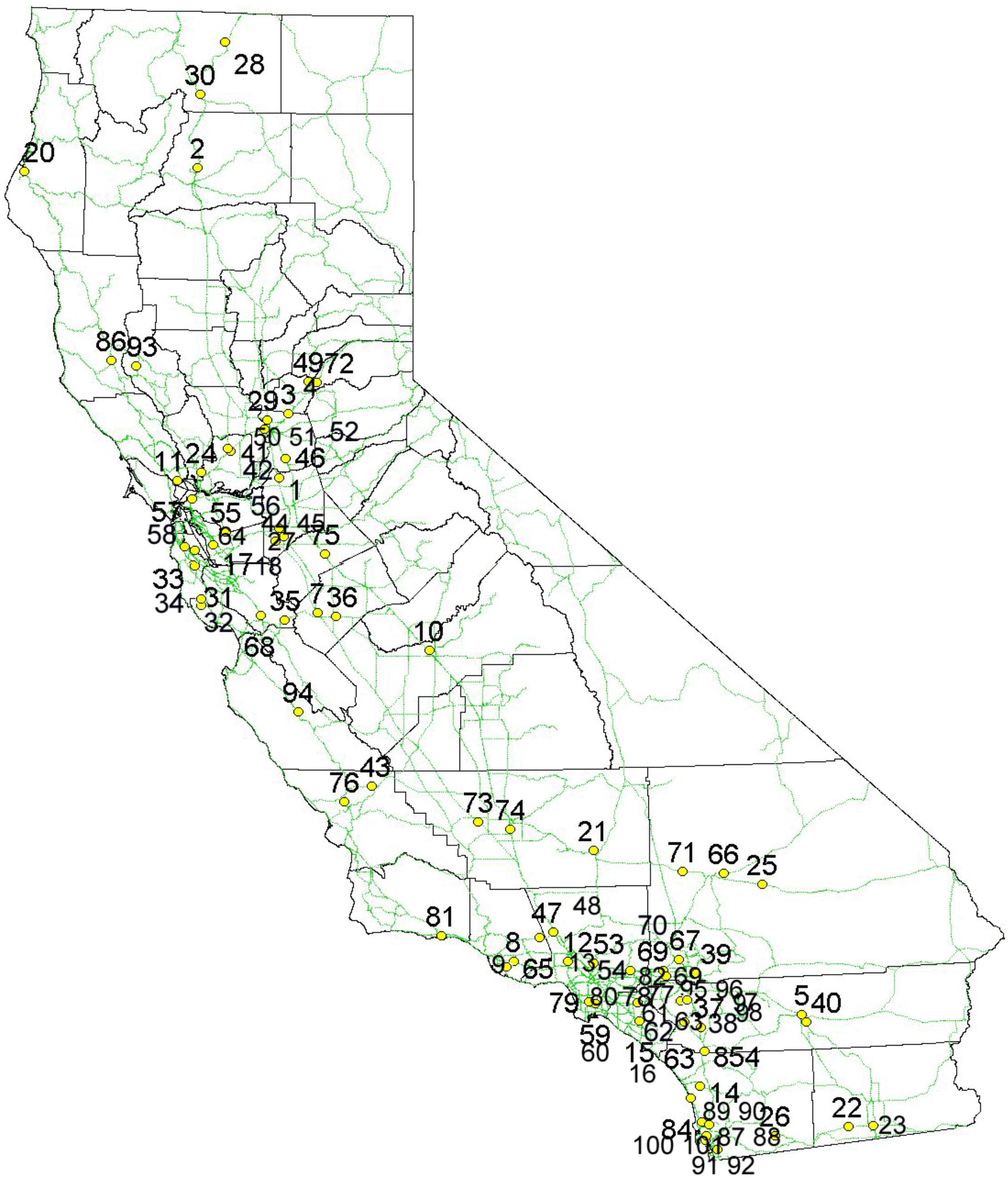


Figure 1. Distribution of WIM stations on California state highway network in March 2001.

Table 1 Summary of Basic Information for Each WIM Station in California

Station No.	Location Information					Data System (Vendor)	Lane Configuration	
	Name	District	County	Route	Postmile		No. of Lanes	Direction[1]
1	Lodi	10	San Joaquin	5	43.7	DAW 200	4	1234(N2N1S1S2)
2	Redding	2	Shasta	5	R24.9	DAW 200 (7/99)	4	1234(S2S1N1N2)
						IRD (7/99-Pres)	4	1234(N2N1S1S2)
3	Antelope	3	Sacramento	80	15	DAW 200 (8/95)	4	1234(W4W3W2W1)
	Antelope (EB)-After 95					IRD (8/95-Pres)	4	1234(E4E3E2E1)
4	Antelope (WB)-After 98	3	Sacramento	80	17.2	IRD	4	1234(W4W3W2W1)
5	Indio	8	Riverside	10	R59.4	DAW 200 (4/00)	4	1234(E2E1W1W2)
						IRD (4/00-Pres)	4	1234(W2W1E1E2)
6	Newhall-Before 98	7	Los Angeles	5	44.6	DAW 200	2	14(N1N2)
	Palmdale	7	Los Angeles	14	R57.8	*SITE INSTALLATION PENDING		
7	Santa Nella	10	Merced	5	20.2	DAW 200	4	1234(S2S1N1N2)
8	Ventura(SB)	7	Los Angeles	101	37.8	DAW 200 (8/99)	5	12345(S4S3S5S1S2)
	Conejo (SB)		Ventura		12	DAW 190 (8/99-Pres)	5	12345(S4S3S5S1S2)
9	Ventura(NB)	7	Los Angeles	101	37.8	DAW 200 (8/99)	5	12345(N4N3N5N1N2)
	Conejo (NB)		Ventura		7.7	DAW 190 (8/99-Pres)	5	12345(N4N3N5N1N2)
10	Fresno	6	Fresno	99	25	DAW 200	6	123456(S3S2S1N1N2N3)
11	Sonoma	4	Sonoma	37	2.7	DAW 200	4	1234(W2W1E1E2)
12	Van Nuys (SB)	7	Los Angeles	405	42.9	DAW 200 (6/94)	4	1235(S4S3S1S2)
						DAW 190 (6/94-Pres)	4	1235(S4S3S1S2)
13	Van Nuys (NB)	7	Los Angeles	405	42.9	DAW 200 (6/94)	4	1235(N4N3N1N2)
						DAW 190 (6/94-Pres)	4	1235(N4N3N1N2)
14	San Marcos	11	San Diego	78	10.7	DAW 200	6	123456(E3E2E1W1W2W3)
15	Irvine (SB)	12	Orange	5	25.8	DAW 200 (1/98)	6	123456(S6S5S2S1S4S3)
						DAW 190 (1/98-Pres)	6	123456(S6S5S4S3S2S1)
16	Irvine (NB)	12	Orange	5	25.8	DAW 200 (1/98)	6	123456(N6N5N2N1N4N3)
						DAW 190 (1/98-Pres)	6	123456(N6N5N4N3N2N1)
17	Hayward (SB)	4	Alameda	880	14.7	DAW 200	4	1235(S4S3S1S2)
18	Hayward (NB)	4	Alameda	880	14.7	DAW 200	4	1235(N4N3N1N2)
19	Martinez	4	Contra Costa	4	11.2	*SITE INSTALLATION PENDING		
20	Loleta	1	Humboldt	101	65.6	DAW 200	4	1234(N2N1S1S2)
21	Mojave	6	Kern	58	108.1	DAW 200	4	1234(E2E1W1W2)

Station No.	Location Information					Data System (Vendor)	Lane Configuration	
	Name	District	County	Route	Postmile		No. of Lanes	Direction[1]
22	Jeffrey	11	Imperial	8	25.8	DAW 200	4	1234(E2E1W1W2)
23	El Centro	11	Imperial	8	40	DAW 200	4	1234(E2E1W1W2)
24	Napa	4	Napa	12	2.3	DAW 200	2	14(W1E1)
25	Newberry	8	San Bernardino	40	28.9	DAW 200	4	1234(E2E1W1W2)
26	Cameron	11	San Diego	8	51.5	DAW 200	4	1234(E2E1W1W2)
27	Tracy	10	San Joaquin	5	7.4	DAW 200	4	1234(S2S1N1N2)
28	Macdoel	2	Siskiyou	97	34.5	IRD	2	12(S1N1)
29	Arco (SB)	3	Sacramento	5	28.9	IRD	3	123(S1S2S3)
30	Mt Shasta	2	Siskiyou	5	11.4	DAW 200	4	1234(S2S1N1N2)
31	Woodside (SB)	4	San Mateo	280	5.6	DAW 200	4	1235(S4S3S1S2)
32	Woodside (NB)	4	San Mateo	280	5.6	DAW 200	4	1235(N4N3N1N2)
33	Burlingame (SB)	4	San Mateo	101	17.5	DAW 200	4	1235(S4S3S1S2)
34	Burlingame (NB)	4	San Mateo	101	17.5	DAW 200	4	1235(N4N3N1N2)
35	Pacheco	4	Santa Clara	152	26.9	DAW 200	4	1234(W2W1E1E2)
36	Los Banos	10	Merced	152	23	DAW 200	4	1234(W2W1E1E2)
37	Elsinore (SB)	8	Riverside	15	21.6	DAW 200(11/99)	4	1235(S4S3S1S2)
						DAW 190(11/99-Pres)	4	1235(S4S3S1S2)
38	Elsinore (NB)	8	Riverside	15	21.6	DAW 200(11/99)	4	1235(N4N3N1N2)
						DAW 190(11/99-Pres)	4	1235(N4N3N1N2)
39	Redlands	8	San Bernardino	30	31.7	DAW 200	4	1234(E2E1W1W2)
40	Coachella	8	Riverside	86	R16	DAW 200	4	1234(N2N1S1S2)
41	Vacaville (EB)	4	Solano	80	30.6	IRD	4	1234(E4E3E2E1)
42	Vacaville (WB)	4	Solano	80	30.6	IRD	4	1234(W4W3W2W1)
43	Cholame	5	San Luis Obispo	46	44.7	IRD	2	12(E1W1)
44	Banta	10	San Joaquin	205	R9.5	DAW 200 (8/00)	4	1234(W2W1E1E2)
						DAW 190 (8/00-Pres)	4	1234(W2W1E1E2)
45	Carbona	10	San Joaquin	580	6.4	DAW 200	4	1234(E2E1W1W2)
46	Galt	3	Sacramento	99	6.9	IRD	4	1234(S2S1N1N2)
47	Castaic (SB)	7	Los Angeles	5	R56.1	DAW 200	4	1235(S4S3S1S2)
48	Castaic (NB)	7	Los Angeles	5	R56.1	DAW 200	4	1235(N4N3N1N2)
49	Auburn	3	Placer	49	9	DAW 200	4	1234(N2N1S1S2)
50	Elmira	4	Solano	505	2.2	IRD	4	1234(N2N1S1S2)
51	West Sac (EB)	3	Yolo	50	0.6	IRD	4	1234(E4E3E2E1)

Station No.	Location Information					Data System (Vendor)	Lane Configuration	
	Name	District	County	Route	Postmile		No. of Lanes	Direction[1]
52	West Sac (WB)	3	Yolo	50	0.6	IRD	4	1234(W4W3W2W1)
53	Montrose (EB)	7	Los Angeles	2	21.9	*SITE ABANDONED		
54	Montrose (WB)	7	Los Angeles	2	21.9	*SITE ABANDONED		
55	Dublin (SB)	4	Contra Costa	680	R0.1	DAW 100	4	1234(S4S3S2S1)
56	Dublin (NB)	4	Contra Costa	680	R0.1	DAW 100	4	1234(N4N3N2N1)
57	Pinole (EB)	4	Contra Costa	80	7.5	DAW 200	4	1235(E4E3E1E2)
58	Pinole (WB)	4	Contra Costa	80	7.5	DAW 200	4	1235(W4W3W1W2)
59	LA - 710 (SB)	7	Los Angeles	710	11.5	IRD	4	1234(S4S3S2S1)
60	LA - 710 (NB)	7	Los Angeles	710	11.5	IRD	4	1234(N4N3N2N1)
61	Peralta (EB)	12	Orange	91	11.9	IRD	4	1234(E4E3E2E1)
62	Peralta (WB)	12	Orange	91	11.9	IRD	4	1234(W4W3W2W1)
63	Murrieta	8	Riverside	215	R15	DAW 100	4	1234(N2N1S1S2)
64	Foster City	4	San Mateo	92	14.1	IRD	6	123456(W3W2W1E1E2E3)
65	Piru	7	Ventura	126	30.8	DAW 100	4	1234(W2W1E1E2)
66	Calico	8	San Bernardino	15	R81.4	IRD	4	1234(N2N1S1S2)
67	Devore	8	San Bernardino	215	14.8	DAW 100	4	1234(N2N1S1S2)
68	Gilroy	4	Santa Clara	101	R9.8	IRD	6	123456(S3S2S1N1N2N3)
69	Fontana (SB)	8	San Bernardino	15	6.1	DAW 100	4	1234(S4S3S2S1)
70	Fontana (NB)	8	San Bernardino	15	6.1	DAW 100	4	1234(N4N3N2N1)
71	Hinkley	8	San Bernardino	58	19.7	DAW 100	4	1234(W2W1E1E2)
72	Bowman	3	Placer	80	23.4	IRD	6	123456(W3W2W1E1E2E3)
73	Stockdale	6	Kern	5	48.7	IRD	4	1234(N2N1S1S2)
74	Bakersfield	6	Kern	99	20.2	IRD	6	123456(N3N2N1S1S2S3)
75	Keyes	10	Stanislaus	99	R8.4	IRD	6	123456(N3N2N1S1S2S3)
76	Templeton	5	San Luis Obispo	101	49.5	IRD	4	1234(S2S1N1N2)
77	Colton (EB)	8	San Bernardino	10	12.4	IRD	4	1234(E4E3E2E1)
78	Colton (WB)	8	San Bernardino	10	12.4	IRD	4	1234(W4W3W2W1)
79	Artesia (EB)	7	Los Angeles	91	7.5	IRD	5	12345(E4E3E2E1,E(HOV))
80	Artesia (WB)	7	Los Angeles	91	7.5	IRD	5	12345(W4W3W2W1,W(HOV))
81	Positas	5	San Benito	101	16.2	IRD	6	123456(N3N2N1S1S2S3)
82	Glendora (EB)	7	Los Angeles	210	42.6	IRD	5	12345(E4E3E2E1,E(HOV))
83	Glendora (WB)	7	Los Angeles	210	42.6	IRD	5	12345(W4W3W2W1,W(HOV))
84	Leucadia (SB)	11	San Diego	5	42.2	IRD	4	1234(S4S3S2S1)

Station No.	Location Information					Data System (Vendor)	Lane Configuration	
	Name	District	County	Route	Postmile		No. of Lanes	Direction[1]
85	Leucadia (NB)	11	San Diego	5	42.2	IRD	4	1234(N4N3N2N1)
86	Ukiah	1	Mendocino	101	21.9	DAW 190	4	1234(S2S1N1N2)
87	Balboa (SB)	11	San Diego	15	10	IRD	4	1234(S4S3S2S1)
88	Balboa (NB)	11	San Diego	15	10	IRD	4	1234(N4N3N2N1)
89	Dekema (SB)	11	San Diego	805	24.5	IRD	4	1234(S4S3S2S1)
90	Dekema (NB)	11	San Diego	805	24.5	IRD	4	1234(N4N3N2N1)
91	Poggi (SB)	11	San Diego	805	5.6	IRD	4	1234(S4S3S2S1)
92	Poggi (NB)	11	San Diego	805	5.6	IRD	4	1234(N4N3N2N1)
93	Lakeport	1	Lake	29	44.4	IRD	4	1234(N2N1S1S2)
94	Greenfield	5	Monterey	101	47.9	IRD	4	1234(S2S1N1N2)
95	Ontario (EB)	8	San Bernardino	60	R7.9	IRD	3	123(E3E2E1)
96	Ontario (WB)	8	San Bernardino	60	R7.9	IRD	3	123(W3W2W1)
97	Chino	8	San Bernardino	83	5.7	IRD	4	1234(N2N1S1S2)
98	Prado	8	San Bernardino	71	R5.8	IRD	4	1256(S3S2N2N3)
99	Tulloch	10	Tuolumne	120	6.4	IRD	4	1234(E2E1W1W2)
100	Miramar (SB)	11	San Diego	163	10.4	DAW 190	5	12345(S5S4S3S2S1)
101	Miramar (NB)	11	San Diego	163	10.4	DAW 190	4	1235(N4N3N2N1)

[1] The lane numbers in the parentheses are Caltrans lane number designation. (e.g.,W2 represents westbound second lane from the centerline)

2.0 DISCUSSION OF DATA HANDLING

The methods used in the analysis to process the traffic data are presented in this chapter.

2.1 WIM systems

Weigh-in-Motion (WIM) is a state-of-the-art system to collect, store, process and transmit vehicular data from key locations on California State highways. Currently two categories of WIM systems are used in California: data collection and weigh station bypass. The former is used to collect traffic data in California while the latter is used in the PrePass™ operation to enable registered heavy vehicles to legally bypass open weigh stations after electronic verification. In the bypass WIM system, no data is stored except for the purpose of performance check on the WIM, therefore, all the data analyzed in this report came from the data WIM system.

The typical vehicle presence sensors employed in the data WIM system are bending plate scales and inductive loop detectors. Bending plates are steel plates, typically 2 inches by 6 inches, which are secured in frames anchored and epoxy bonded into the pavement. Two bending plates are installed side by side in each lane, one bending plate for each wheeltrack, as shown in Figure 2. WIM systems record instantaneous dynamic axle loads and spacings, number of axles, speed of vehicle, lane and direction of travel, and the date and time as a vehicle is passing over the sensors. The accuracy of these systems is primarily dependent on the vehicle dynamics and the inherent variance of the technology used within the WIM system. The data WIM station systems used by Caltrans were provided by two different vendors: PAT Traffic Control Corporation and International Road Dynamics Inc.. PAT Traffic Control Corporation provided three slightly different systems: DAW 100, DAW 190 and DAW 200, while International Road Dynamics Inc. provided one system called the IRD system. These two companies have different data handling software and data format. The ASCII truck information files used in this analysis also differ slightly from one another.

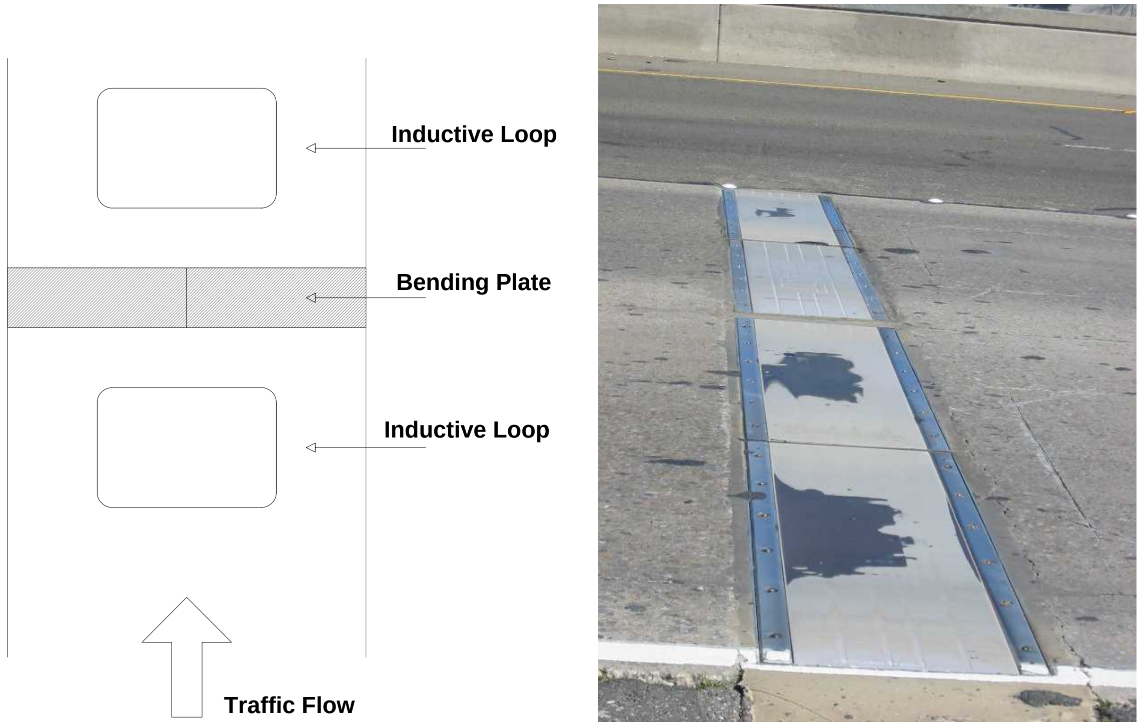


Figure 2. Common configuration of WIM system.

2.2 Data Sampling Method

Ideally, the Caltrans WIM stations collected and stored truck traffic information continuously once they were installed. Only on abnormal occasions would the data collection action be interrupted. These occasions included power failures, communication interruptions, pavement maintenance and rehabilitation activities, etc. Typically, a huge amount of data has been collected for each WIM station and included in the database developed by UCPRC. However, because traffic patterns generally do not change much over short periods such as a few days, it is not necessary to analyze the whole data set, and the results for the full set would be too difficult to report.

Based on the results of preliminary analysis of traffic data from six Caltrans WIM stations, which show a significant difference in traffic from weekdays to weekends and less significant differences across months, it was decided that the data in one week out of each month be used in the analysis. In this way, the variation in traffic patterns from weekdays to weekends and across months can be included in the sampled data set.

The data to be sampled were primarily determined according to the WIM File Download Record maintained by the WIM office of Caltrans. The WIM office of Caltrans has checked one to two weeks' WIM data in each month for validity and has kept the results in the WIM File Download Record. Two kinds of data were chosen to be candidates for sampling: *D* and *M*. *D* denotes data collected from a system that was working well and the provided good data; *M* denotes data collected from a system that had some minor errors but was generally considered acceptable.

As the data checked by Caltrans were continuous for one- to two-week periods, most of the data sampled for this research also came from continuous one-week periods. When a continuous week of good data was not available, two sampling strategies were used. First, if good data on the same day of the week in the same month was available, that day's data was selected (e.g., if the data from the first Monday of the month was bad but was good for the second Monday, then the data from the second Monday of the month was selected to combine with good data from the rest of the first week.) The second strategy was as follows: if less than 7 days of good data were available for a given month, then the data from three weekdays and one weekend were selected to keep the ratio of weekdays to weekends in the sampled data set close to 2.5:1.

Due to breakdown of WIM stations, system errors lasting several months, communication interruptions between WIM station and the WIM office, and other reasons, a complete one-week-out-of-one-month data set sample for the entire analysis period (up to 10 years) was not obtained for a few WIM stations. This may have introduced some errors in the analysis results, but they were believed to be small because of the large sample size of the remaining data sets analyzed.

2.3 Computer Programs

The raw data obtained from the WIM office of Caltrans were compressed and in a binary format that couldn't be analyzed directly. After sampling and extraction, these data files were converted into ASCII files using software provided by the two WIM vendors.

The program used to convert PAT system data files is called REPORTER, which uses different switches to convert DAW 100/190 and DAW 200 data files. This program obtains lane and direction information from a file called RESTAT.LST, which also contained other basic information from each WIM station.

The program used to convert IRD system data files is called OFFICE. This program provides the lane, direction, and other basic information of each station.

Both programs can also provide detailed truck weight, truck traffic volume, speed distribution analysis, summaries, and other analyses for each day's traffic data.

2.4 ASCII format

The ASCII truck information files created by REPORTER and OFFICE have similar format. They are both text files, in which each line of record represents one truck that has passed through the WIM systems. Each record is composed of a certain number of fields, which are delimited with commas.

The name of the PAT system ASCII file has the format of “A###MMDD.YY”, where ### is the WIM station number, MM is month, DD is day in a month, and YY is year. For example, A0100112.98 means the data in the file was collected from WIM Station 10 on January 12, 1998.

Each record in the PAT system ASCII file has 41 fields, as shown in Table 2.

The filename of the IRD system ASCII file has the format of “YYMMDDTR.###”, where ### is the WIM station number, MM is month, DD is day in a month, and YY is year.

Each record in the IRD system ASCII file has 40 fields, as shown in Table 2. The first 39 fields are identical to those of the PAT system ASCII files except for Field No. 13. PAT’s Field No. 13 code designates weight violations as well as “warnings” (such as right/left wheel “imbalance”). IRD’s Field No. 13 code designates only weight violations. IRD’s Field No. 40 code designates “warnings” and “system errors”.

The lane number used in the ASCII files is determined by the order in which the WIM storage hardware is installed, not by the Caltrans lane number designation system.

Because the WIM storage hardware was installed in arbitrary order, the lane number designation varies from station to station. In this report, however, the lane number has been converted into the Caltrans designation, which starts with the innermost lane as lane 1 and increases sequentially outward. The relationship between WIM lane numbers and Caltrans lane numbers is shown in Table 1.

Table 2 Fields in ASCII Data Files

Field	PAT Data Type by Field	IRD Data Type by Field
1	Lane	Lane
2	Month	Month

3	Day	Day
4	Year	Year
5	Hour	Hour
6	Minute	Minute
7	Second	Second
8	Vehicle Number	Vehicle Number
9	Type	Type
10	Gross weight (kips)	Gross weight (kips)
11	Overall length (feet)	Overall length (feet)
12	Speed (mph)	Speed (mph)
13	Weight violation and warning code	Weight violation code
14	Axle 1 Right Side weight (kips)	Axle 1 Right Side weight (kips)
15	Axle 1 Left Side weight (kips)	Axle 1 Left Side weight (kips)
16	Axle 2 Right Side weight (kips)	Axle 2 Right Side weight (kips)
17	Axle 2 Left Side weight (kips)	Axle 2 Left Side weight (kips)
18	Spacing between Axles 1 & 2 (feet)	Spacing between Axles 1 & 2 (feet)
19	Axle 3 Right Side weight (kips)	Axle 3 Right Side weight (kips)
20	Axle 3 Left Side weight (kips)	Axle 3 Left Side weight (kips)
21	Spacing between Axles 2 & 3 (feet)	Spacing between Axles 2 & 3 (feet)
22	Axle 4 Right Side weight (kips)	Axle 4 Right Side weight (kips)
23	Axle 4 Left Side weight (kips)	Axle 4 Left Side weight (kips)
24	Spacing between Axles 3 & 4 (feet)	Spacing between Axles 3 & 4 (feet)
25	Axle 5 Right Side weight (kips)	Axle 5 Right Side weight (kips)
26	Axle 5 Left Side weight (kips)	Axle 5 Left Side weight (kips)
27	Spacing between Axles 4 & 5 (feet)	Spacing between Axles 4 & 5 (feet)
28	Axle 6 Right Side weight (kips)	Axle 6 Right Side weight (kips)
29	Axle 6 Left Side weight (kips)	Axle 6 Left Side weight (kips)
30	Spacing between Axles 5 & 6 (feet)	Spacing between Axles 5 & 6 (feet)
31	Axle 7 Right Side weight (kips)	Axle 7 Right Side weight (kips)
32	Axle 7 Left Side weight (kips)	Axle 7 Left Side weight (kips)
33	Spacing between Axles 6 & 7 (feet)	Spacing between Axles 6 & 7 (feet)
34	Axle 8 Right Side weight (kips)	Axle 8 Right Side weight (kips)
35	Axle 8 Left Side weight (kips)	Axle 8 Left Side weight (kips)
36	Spacing between Axles 7 & 8 (feet)	Spacing between Axles 7 & 8 (feet)
37	Axle 9 Right Side weight (kips)	Axle 9 Right Side weight (kips)
38	Axle 9 Left Side weight (kips)	Axle 9 Left Side weight (kips)
39	Spacing between Axles 8 & 9 (feet)	Spacing between Axles 8 &9(feet)
40	Direction	Warning and system error code
41	Number of axles	<does not exist>

The vehicle classification method used by Caltrans was primarily based on axle spacing and vehicle weight, as shown in Table 3. The typical profiles for each truck type are sketched in Figure 3.

As Caltrans WIM stations are programmed to collect individual vehicle records for only the heavy vehicles, vehicle Types 1 to 3 are not included in the ASCII truck information file.

Vehicle Type 4 (Bus) is regarded as a truck and is included in the WIM ASCII truck information file.

2.5 Erroneous Data

Although all the data to be analyzed were sampled from the data set that had passed the Caltrans routine validation checks, there still remained a variety of erroneous records in the sampled data set. The following sections explain these errors.

2.5.1 <u>Records with Non-zero Violation, Warning, and System Error Codes</u>

Each truck record in the data set has one or two codes used to denote weight violation, warning or system error. Such codes with non-zero values represent some kind of system errors or violations, such as axle weight violation, tandem weight violation, bridge weight violation, speed violation, off scale violation, imbalance, etc. The meanings of these codes differ for the PAT and IRD systems.

After discussion with the WIM office of Caltrans, the following methods were used to deal with those truck records with non-zero violation and warning codes: For PAT stations, codes 1-15 are weight violations and do not require any special treatment. Records with codes larger than 15 were exempted from analysis. For IRD stations, all violation and warning codes had already been taken into account and the corresponding records were kept in the analysis.

However, in the analysis of annual average daily truck traffic, all truck records were included.

2.5.2 Records with Zero Violation Codes

During the analysis, a small percentage of truck records with zero violation codes from the PAT system were found to contain other types of erroneous data, such as negative load values or lane numbers, erroneous (impossibly large) spacing between two axles, or zero or extremely large axle load values. Because these records only account for a very small percentage of the data sample size, they were deleted from the analysis.

Table 3 WIM Vehicle Classification Parameters

Type	Vehicle Description	# of Axles	Spacing (ft.)								Weight (kips)
			1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	Min.-Max.
1	Motorcycle	2	0.10-5.99								0.10-3.00
2	Auto, Pickup	2	6.00-9.99								1.00-7.99
3	Other (Limo, Van, RV)	2	10.00-22.99								1.00-7.99
4	Bus	2	23.00-40.00								12.00->
5	2D	2	6.00-22.99								8.00->
2	Auto W/ 1 Axle trailer	3	6.00-9.99	6.00-25.00							1.00-11.99
3	Other W/ 1 Axle trailer	3	10.00-16.00	6.00-25.00							1.00-11.99
4	Bus	3	23.10-40.00	3.00-5.99							20.00->
5	2D W/ 1 Axle trailer	3	6.00-23.09	6.00-25.00							12.00-19.99
6	3 Axle	3	6.00-23.09	3.00-5.99							12.00->
8	2S1,21	3	6.00-23.00	11.00-40.00							20.00->
2	Auto W/ 2 Axle trailer	4	6.00-9.99	6.00-25.00	1.00-11.99						1.00-11.99
3	Other W/ 2 Axle trailer	4	10.00-16.00	6.00-25.00	1.00-11.99						1.00-11.99
5	2D W/ 2 Axle trailer	4	6.00-23.09	6.00-25.00	1.00-11.99						12.00-19.99
7	4 Axle	4	6.00-23.09	3.00-5.99	3.00-12.99						12.00->
8	3S1, 31	4	6.00-23.00	3.00-5.99	13.00-44.00						12.00->
8	2S2	4	6.00-23.00	11.00-44.00	3.00-11.99						20.00->
3	Other W/ 3 Axle trailer	5	10.00-16.00	6.00-25.00	1.00-3.49	1.00-3.49					1.00-11.99
9	3S2	5	6.00-26.00	3.00-5.99	6.00-46.00	3.00-10.99					12.00->
11	2S12	5	6.00-26.00	11.00-26.00	6.00-20.00	11.00-26.00					12.00->
14	32	5	6.00-26.00	3.00-5.99	6.00-23.00	11.00-27.00					12.00->
10	3S2, 33	6	6.00-26.00	3.00-5.99	6.00-46.00	3.00-11.99	3.00-10.99				12.00->
12	3S12	6	6.00-26.00	3.00-5.99	11.00-26.00	6.00-24.00	11.00-26.00				12.00->
13	2S23, 3S22, 3S13	7	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00			12.00->
13	3S23	8	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00		12.00->
13	Permit	9	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	12.00->
15	Error and/or unclassified vehicles not meeting axle configurations set for classifications 1 through 14										

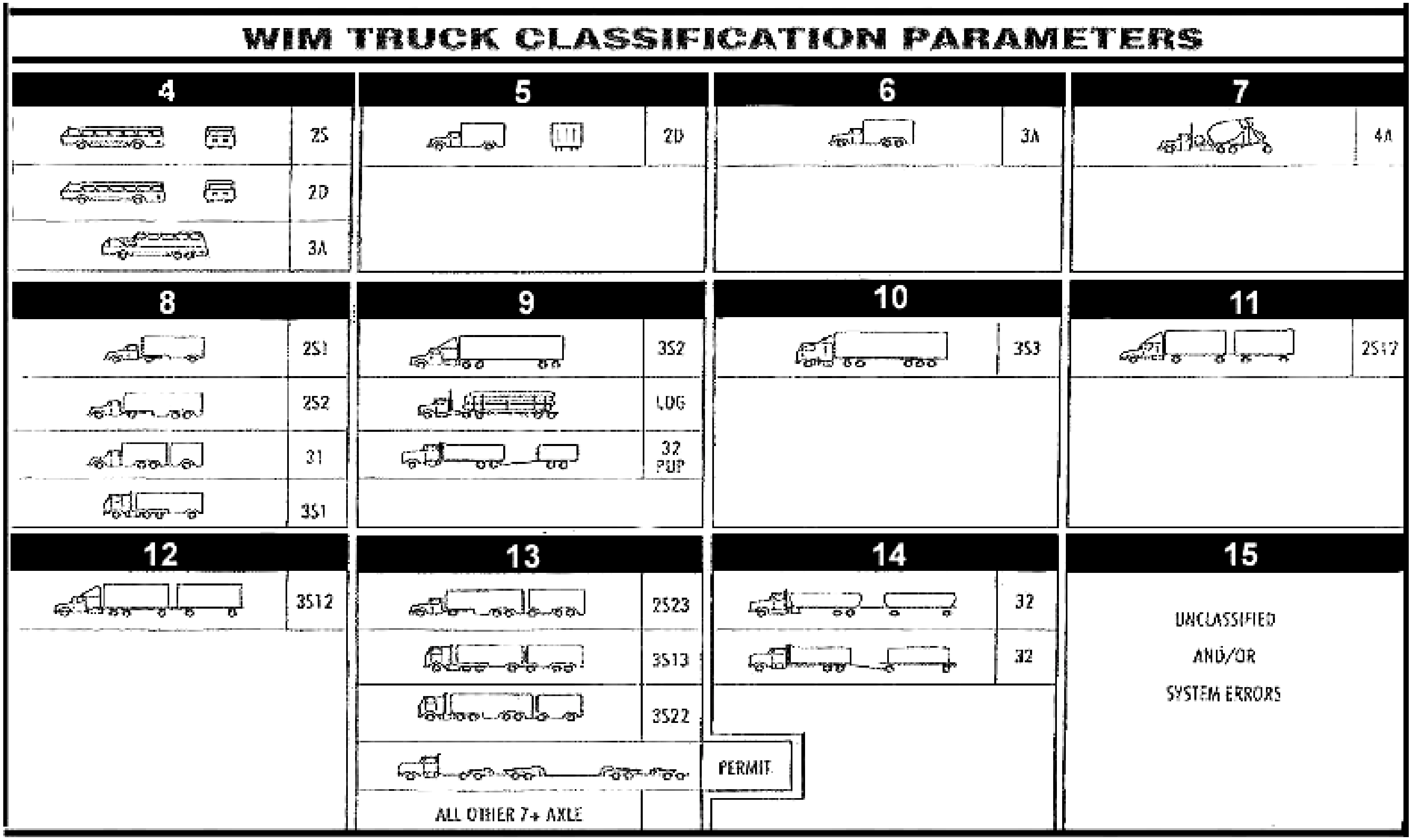


Figure 3. Typical vehicle profiles for Caltrans truck type.

2.6 Assumptions Used in Analysis

Several assumptions have been used in the analysis. These assumptions include:

- Axle grouping assumption. The first axle of each truck type was regarded as a steering axle. The spacing used to distinguish between single axles, tandem axles and tridem axles is 1.8 m (6 ft.). That is, if the spacing between one axle and its adjacent axles is larger than 1.8 m (6 ft.), this axle is regarded as a single axle; if the spacing between two adjacent axles is less than 1.8 m (6 ft.) and the spacing between these two axles and their adjacent axles is larger than 1.8 m (6 ft.), these two axles were regarded as a tandem; if the spacing between three adjacent axles is both less than 1.8 m (6 ft.)and the spacing between these three axles and their adjacent axles is larger than 1.8 m (6 ft.), these three axles were regarded as a tridem.
- Daytime assumption. Daytime was assumed to be between 6 AM and 6 PM. Night was assumed to be between 6 PM and 6 AM.
- Season assumption. Three seasons were used to characterize the weather in California: wet season (from November to February), spring season (from March to June) and dry season (from July to October).
- Axle load ranges assumption. The load interval for steering axles and single axles is in 5-kN increments from 0 to 220 kN. The load interval for tandem axles is in 10-kN increments from 0 to 440 kN. The load interval for tridem axles is in 10-kN increments from 0 to 500 kN. Analysis showed that almost all the axle weights were in the load ranges above. The very few exceptions were believed to be erroneous data that had not been deleted from the sample data set.

2.7 Data Analysis

After sampling and conversion of the binary data files, the cleaned ASCII files were run by a FORTRAN program (WIMANA.FOR developed by the UC Pavement Research Center) to compute the load spectra of the four axle groups (steering, single, tandem, and tridem) of different truck types at different times (day/night, season, year) and different locations (site, direction, and lane), and to compute the traffic volume distribution among different locations (site, direction, and lane) and at different times (day/night, season, and year). Truck traffic growth trends, side wheel load differences, and truck speed distributions were also analyzed.

The comparison and evaluation of axle load spectra are necessary in the analysis of truck traffic data. Several comparison and evaluation methods have been proposed, such as plotting the load distributions and using non-parametric statistical tests (e.g., Kruskal-Wallis test, Kolmogorov-Smirnov test).

Because the effect of traffic loads on pavement damage increases exponentially with the size of the load, statistical tests are not appropriate to evaluate axle load spectra, as they do not reflect the influence of axle load on pavement damage.

According to the discussion in FHWA-RD-00-054 report,(*3*) Load Spectrum Coefficient (LSC) is a better statistical measure that is related to the concept of pavement damage and is independent of pavement-related variables. The LSC for normalized load spectra was defined by Equation (3):

$$LSC = \sum_{i=1}^{l} \left(\frac{\left(\frac{mid - load\_range_i}{L} \right)}{80} \right)^m \times \frac{load - range\_count_i}{total\_count} \times L \qquad \textbf{(3)}$$

where:

LSC = Load spectrum coefficient used to compare normalized load spectra
l = Number of load ranges
mid-load_range = Average load range (kN) for load range *i*
$Load\_range\_count_i$ = Number of axles in load range *i*
L = 1 for steering axle and single axle, 2 for tandem, and 3 for tridem
m = exponent, 3.8

As Equation (3) is similar to Equation (2) used by Caltrans to compute ESALs, with the difference being the exponent, the exponent 4.2 was used instead of 3.8 to compute the LSC in this report. With this change, ESALs as defined by Caltrans can be easily calculated from LSCs for different axle groups and truck types.

In this report, different load spectra were compared using load spectra diagrams as well as LSCs.

3.0 ANALYSIS OF OBSERVED DATA

3.1 Generalized Axle Load Spectra and Truck Composition in California

In this section, the data files sampled from all the WIM sites across the entire analysis period were combined to give the general load spectra of steering axle, single axle, tandem axles and tridem axles, and general truck traffic composition. Furthermore, these load spectra and truck traffic compositions were examined for day/night and seasonal variation. Load spectra are shown in Figures 4 through 11. Truck traffic compositions are shown in Figures 12 and 13. (Refer to Figure 3 for the truck type designations referred to in this section.) The legal load limit for single axles in California is 89 kN; for tandem axles it is 151 kN.

Figure 4 shows that the majority of steering axles come from Truck Types 5 and 9, and most of the steering axle loads are less than 90 kN.

Figure 5 shows that the majority of single axles come from Truck Types 5, 8, and 11, and most of the single axle loads are less than 110 kN.

Figure 6 shows that the majority of tandem axles come from Truck Type 9, and most of the tandem axle loads are less than 210 kN.

Figure 7 shows that the majority of tridem axles come from Truck Types 10 and 15, and most of the tridem axle loads are less than 260 kN.

Figures 8-11 show that at night, the load spectra of all four axle groups shift to the right of corresponding load spectra in the daytime, meaning that trucks running at night generally carry heavier loads than those running in the daytime. On the other hand, there is little seasonal variation in all load spectra.

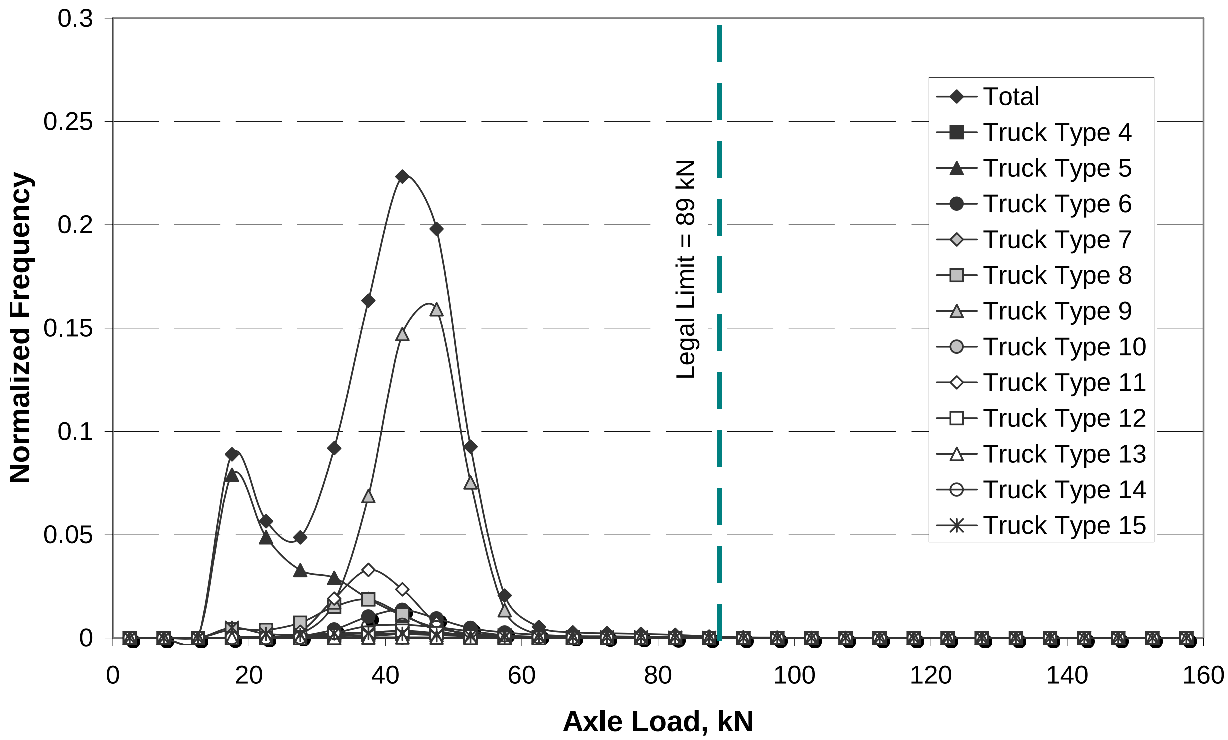


Figure 4. General steering axle load spectra across all dates and locations.

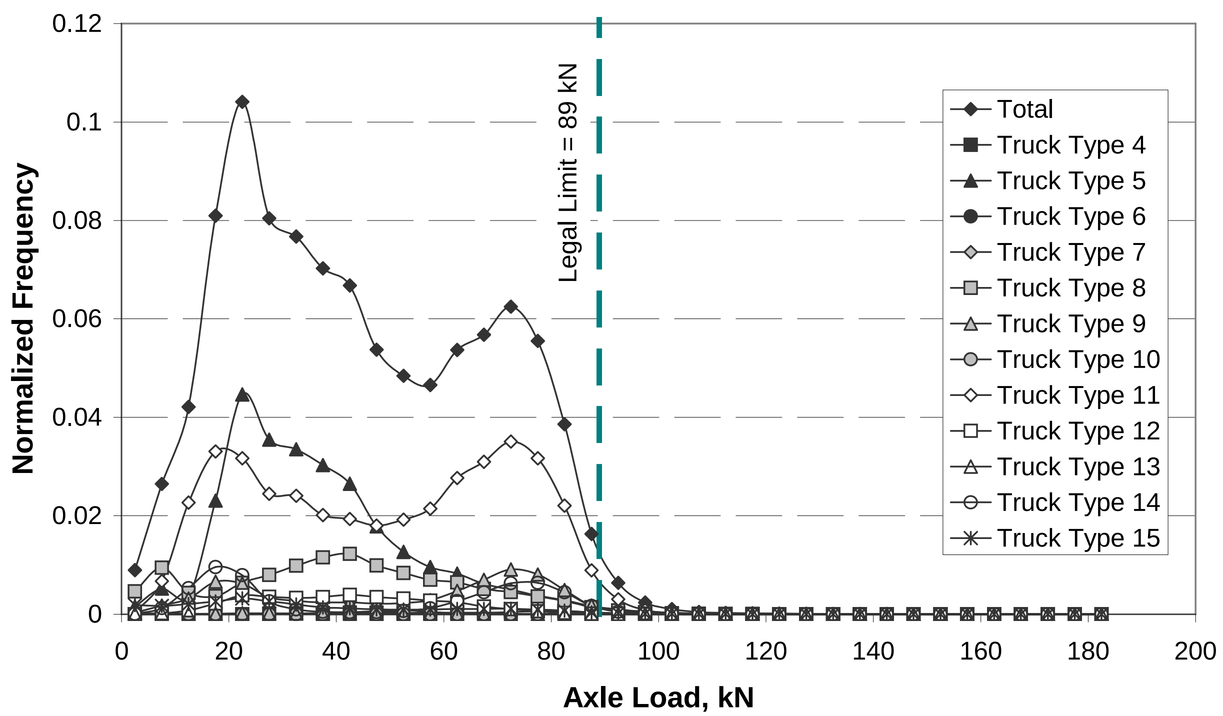


Figure 5. General single axle load spectra across all dates and locations.

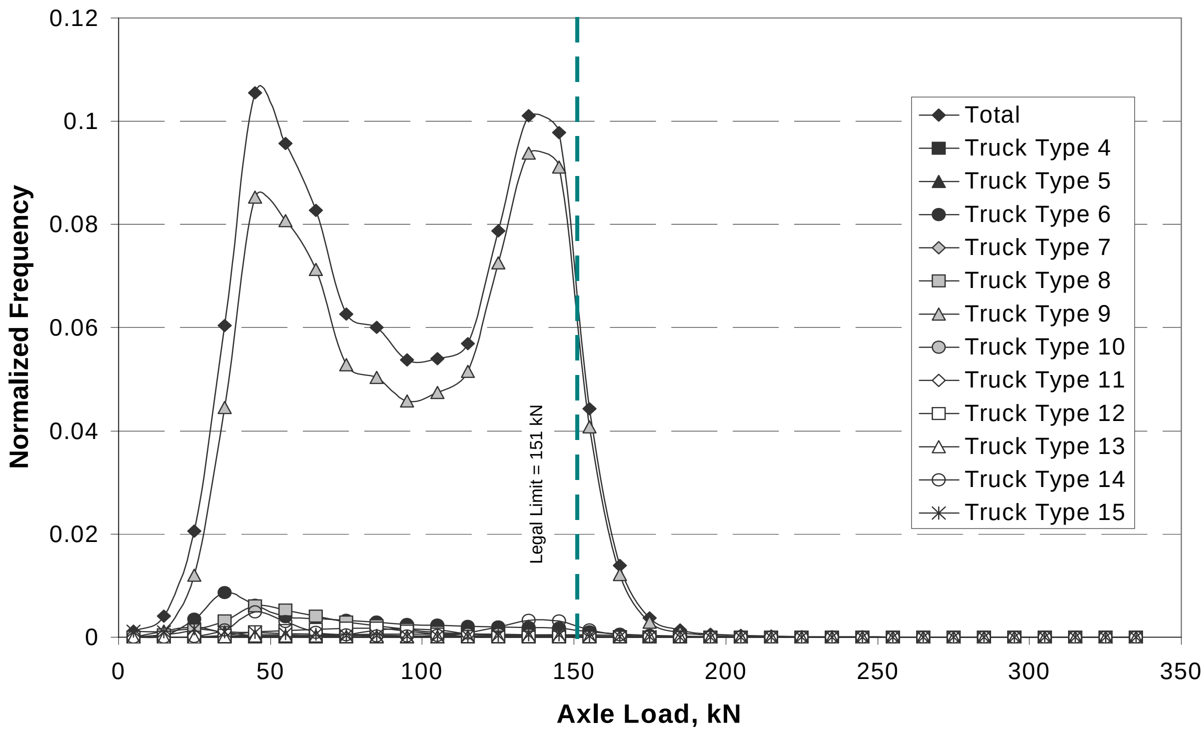


Figure 6. General tandem axle load spectra across all dates and locations.

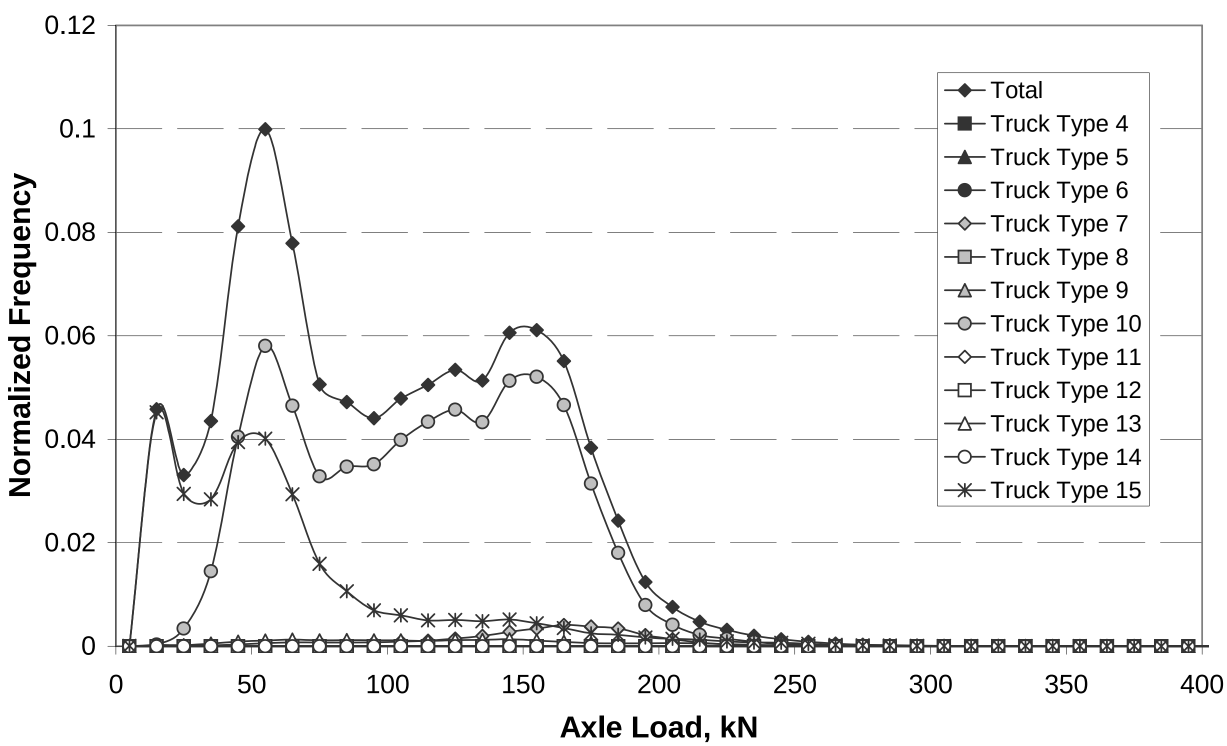


Figure 7. General tridem axle load spectra across all dates and locations.

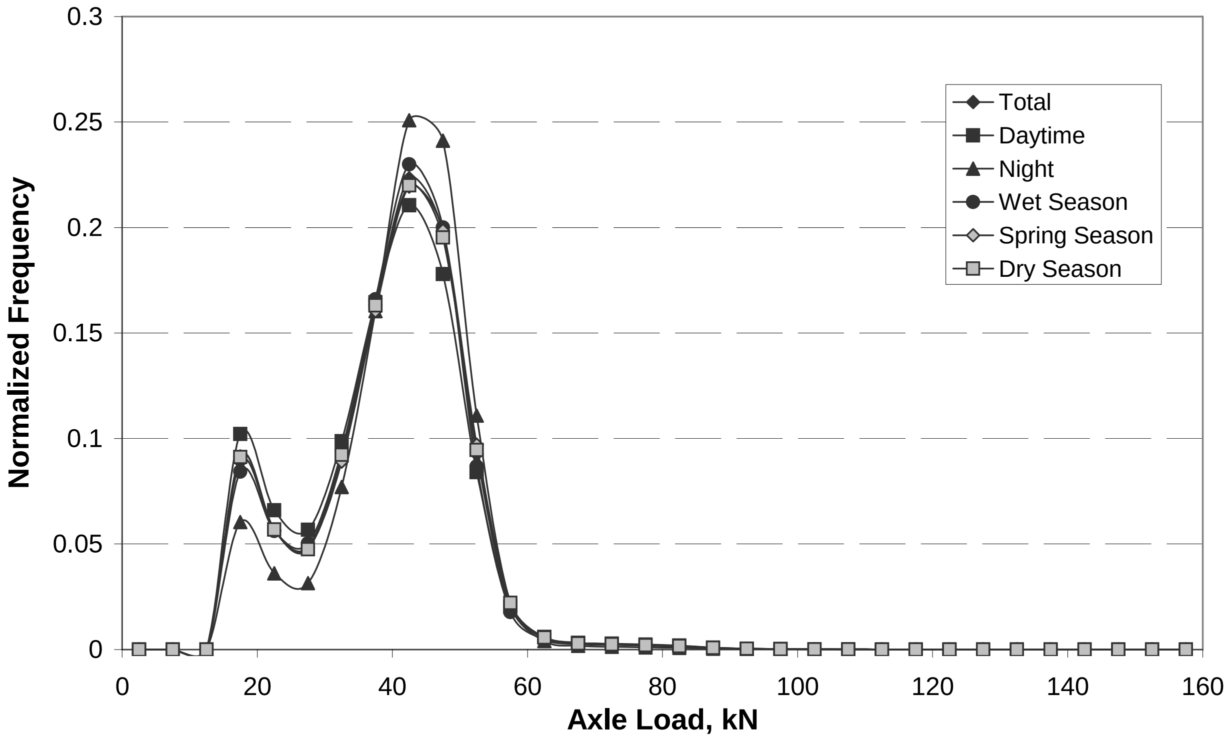


Figure 8. General steering axle load spectra at different times.

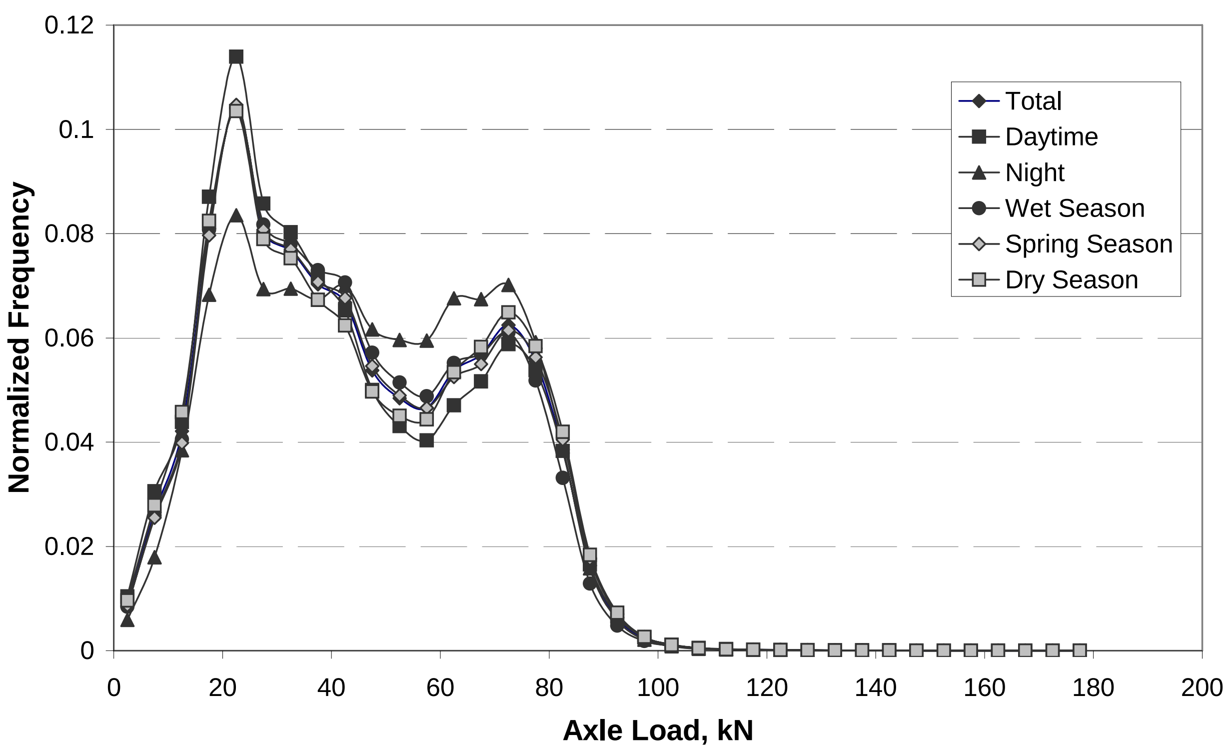


Figure 9. General single axle load spectra at different times.

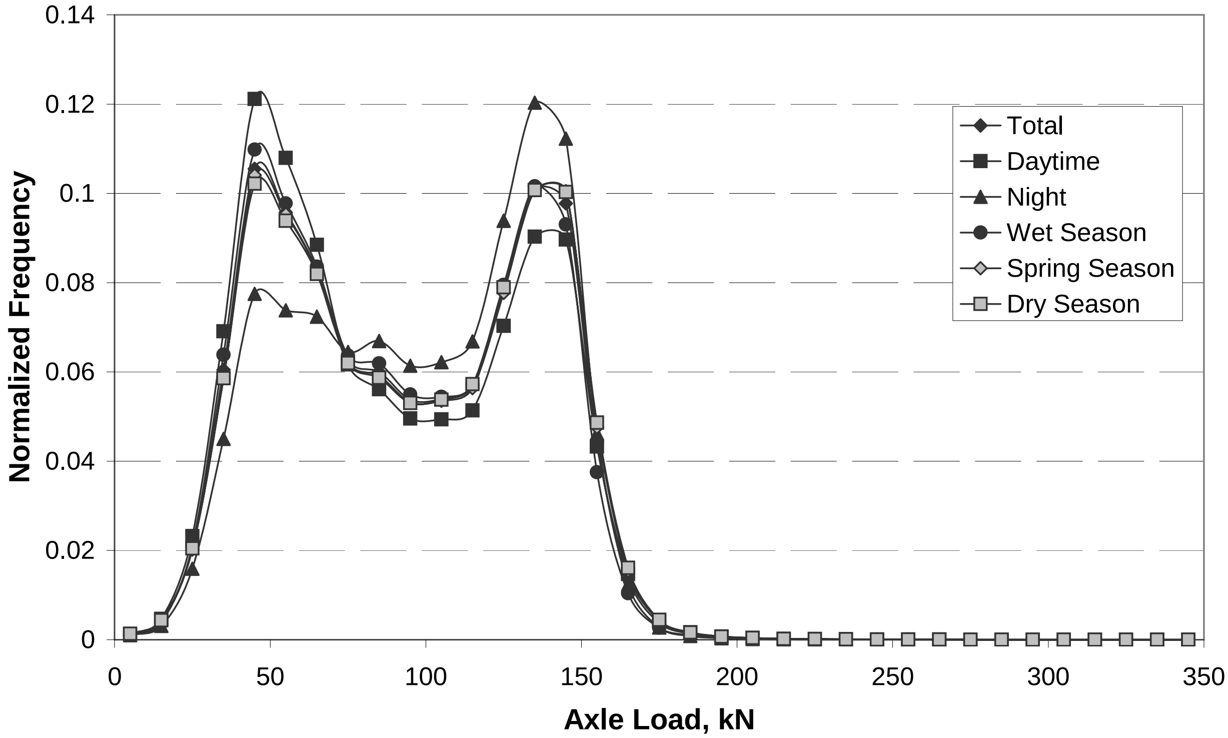


Figure 10. General tandem axle load spectra at different times.

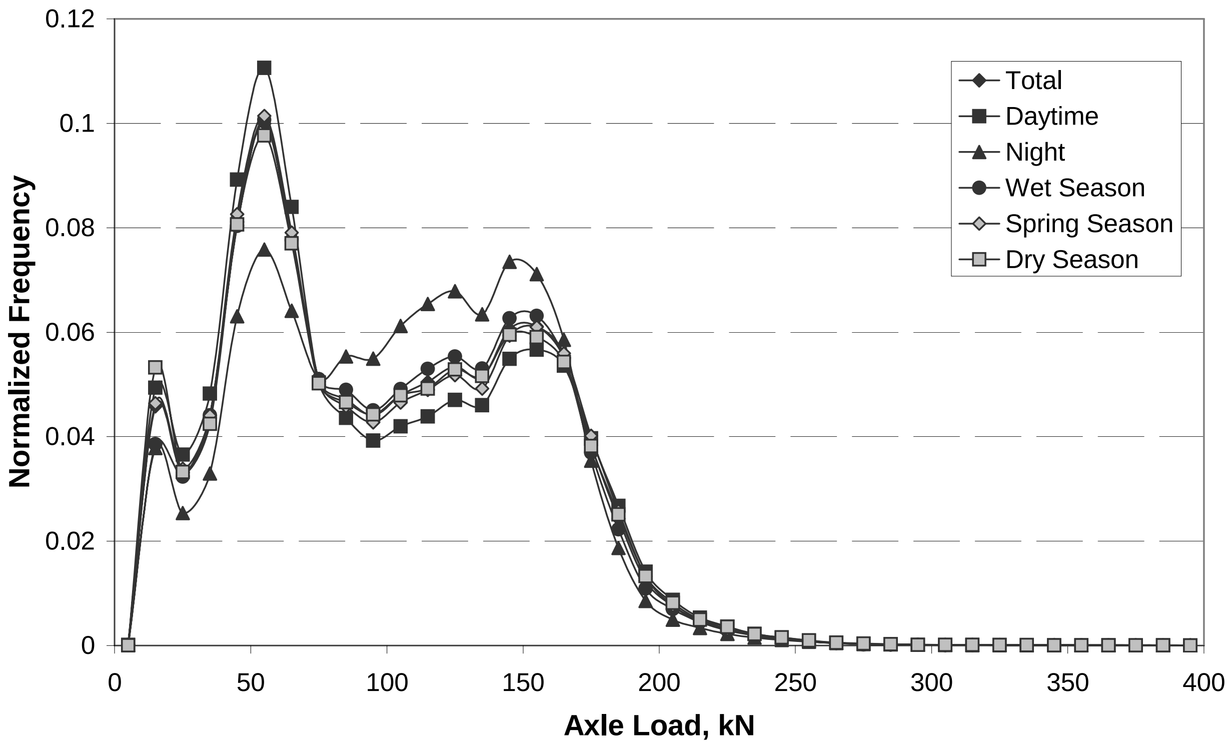


Figure 11. General tridem axle load spectra at different times. Figures 12 and 13 show that Truck Types 5, 6, 8, 9, and 11 account for an average of 90 percent of all the truck traffic. Their frequency in decreasing order is Type 9, Type 5, Type 11, Type 8, and Type 6.

The percentages of Types 9 and 11 (semi tractor trailers typically used for long-hauls) increase and those of Type 5, 6 and 8 (typically used for local hauls) decrease at night. Moreover, the truck traffic composition shows little seasonal variation.

3.2 Generalized Axle Load Spectra in Different Regions

Because pavements in a specific region are designed according to the specific environmental and traffic conditions in that region, it is useful to perform regional comparisons of the axle load spectra. In this report the WIM stations are grouped in two ways. The first is to group them by geographical region: Central Valley, Bay Area and Southern California. The second way is to group them by type of area: Rural and Urban. Here an urban area is defined as a place and the adjacent densely-settled surrounding territory that together have a minimum population of 50,000 people. The densely-settled surrounding territory generally consists of an area with continuous residential development and an overall population density of at least 1,000 people per square mile. Table 4 shows both groupings of stations by both criteria.

The load spectra of the four axle groups (steering, single, tandem, and tridem) are shown by geographical region in Figures 14 through 17. The load spectra of the four axle groups by type of area are shown in Figures 18 through 21.

Figures 14-17 show that the load spectra in Central Valley shift to the right (heavier) of those in the Southern California, while the load spectra in the Southern California shift to the right (heavier) of those in the Bay Area.

Figures 18-21 show that the load spectra in rural areas shift to the right (heavier) of those in urban areas. A few urban links that likely carry very heavy short-haul traffic do not have WIM stations. These include the link between the Port of Oakland and the Richmond container

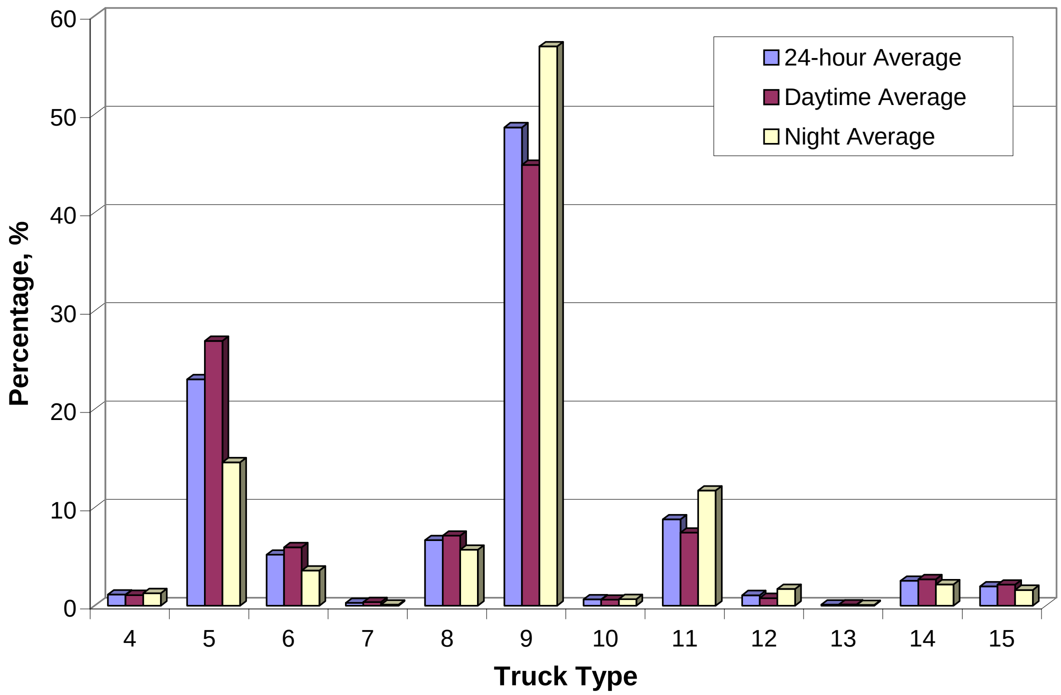


Figure 12. General truck traffic compositions (day, night, and 24-hour).

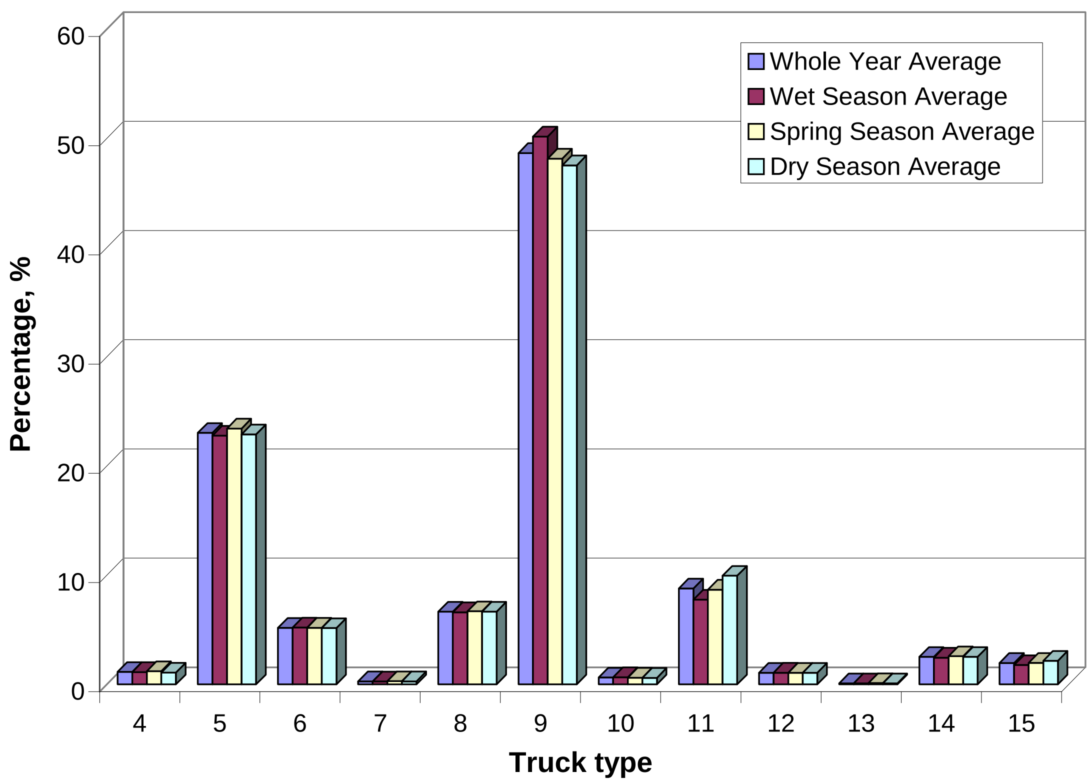


Figure 13. General truck traffic compositions (yearly, wet season, spring season, and wet season averages).

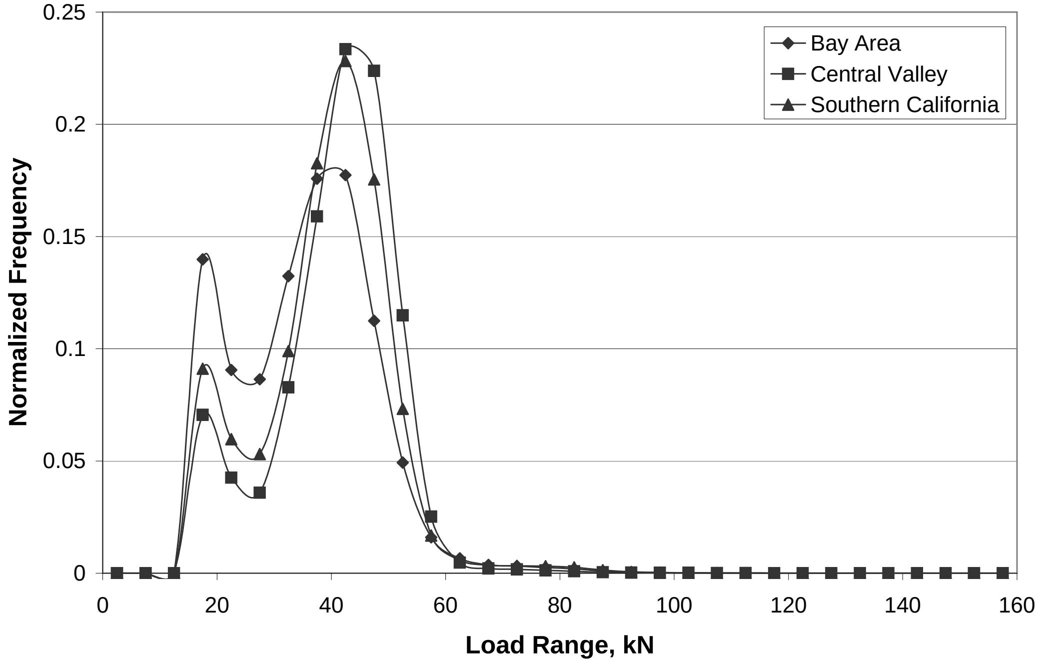


Figure 14. Steering axle load spectra in three regions.

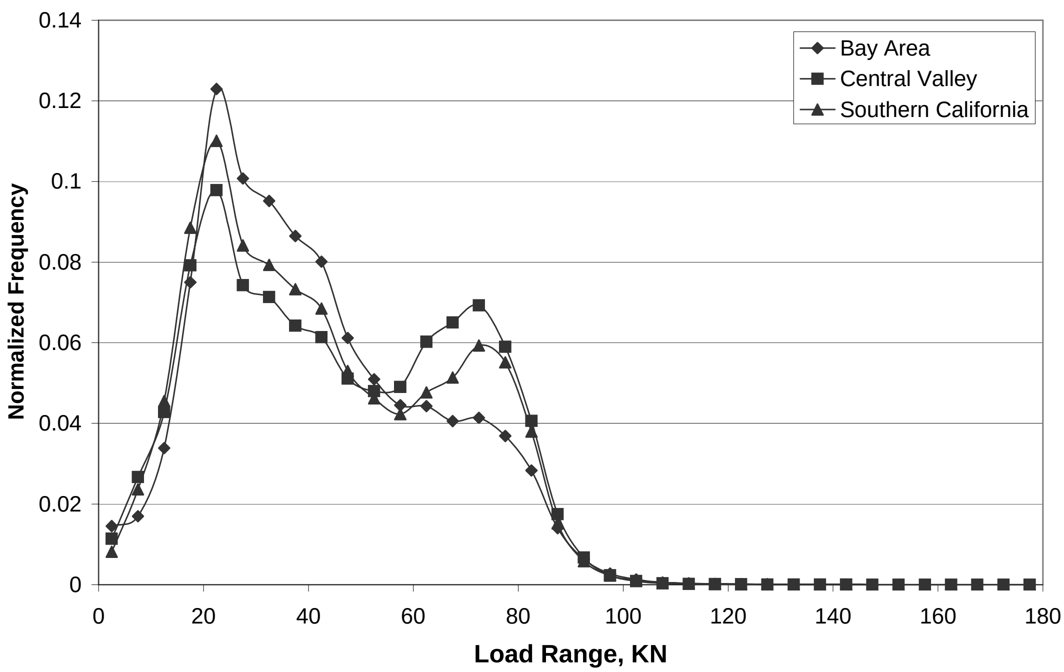


Figure 15. Single axle load spectra in three regions.

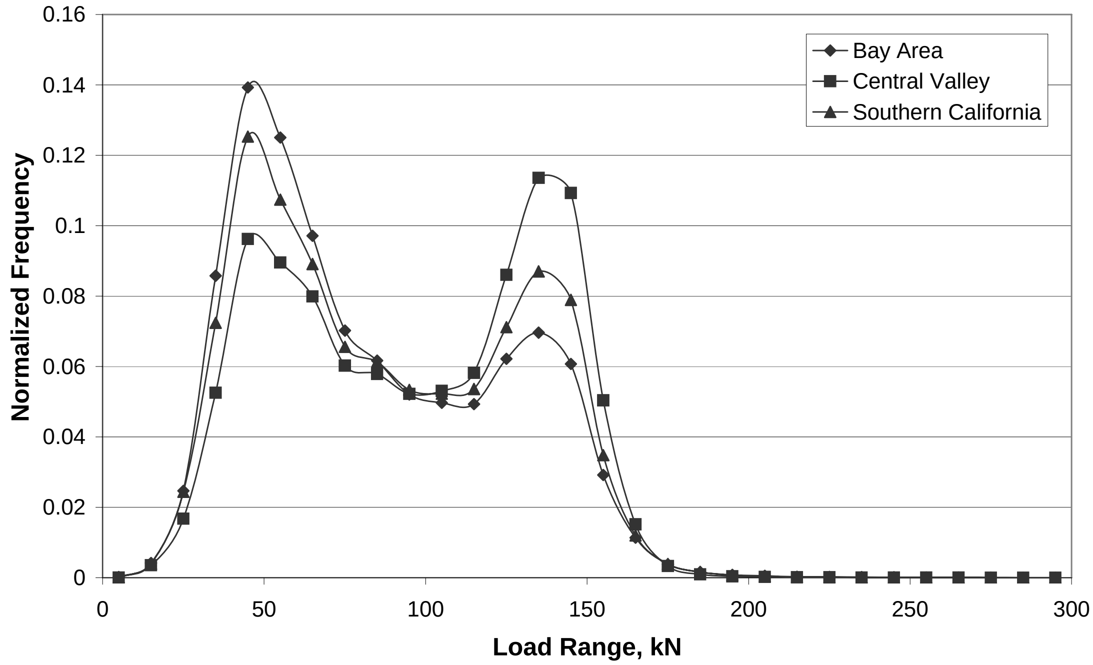


Figure 16. Tandem load spectra in three regions.

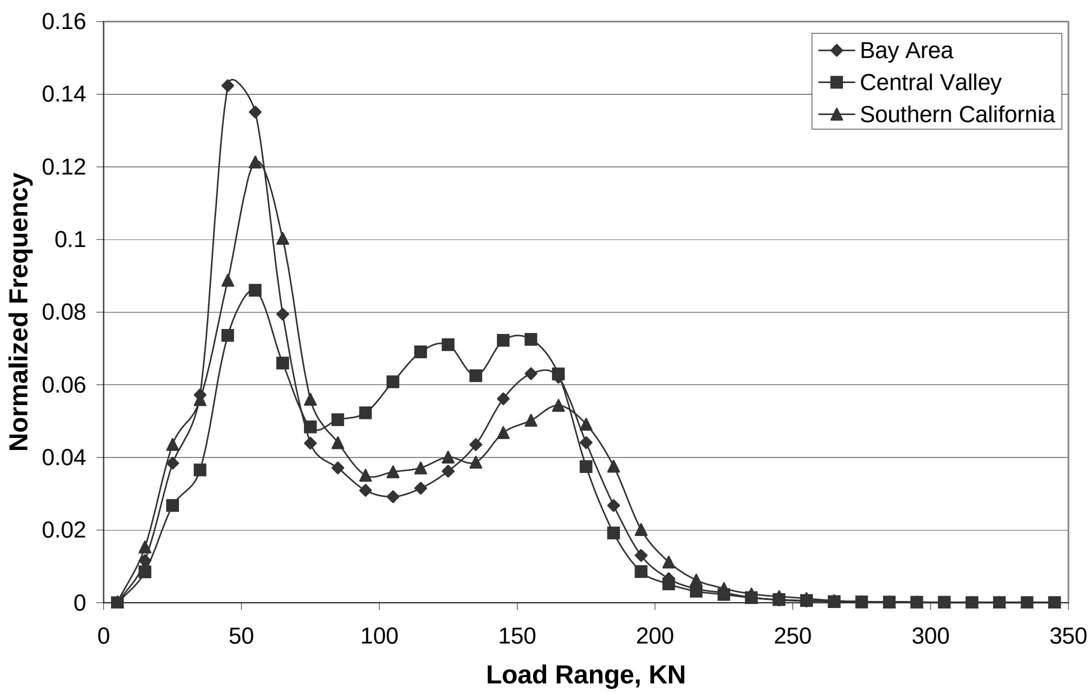


Figure 17. Tridem load spectra in three regions.

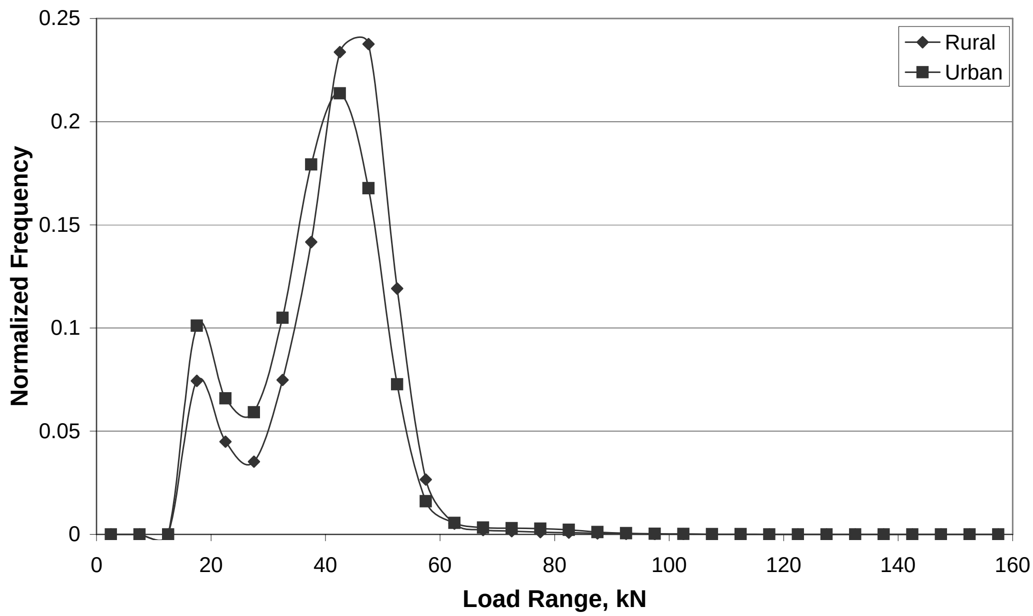


Figure 18. Steering axle load spectra in two areas.

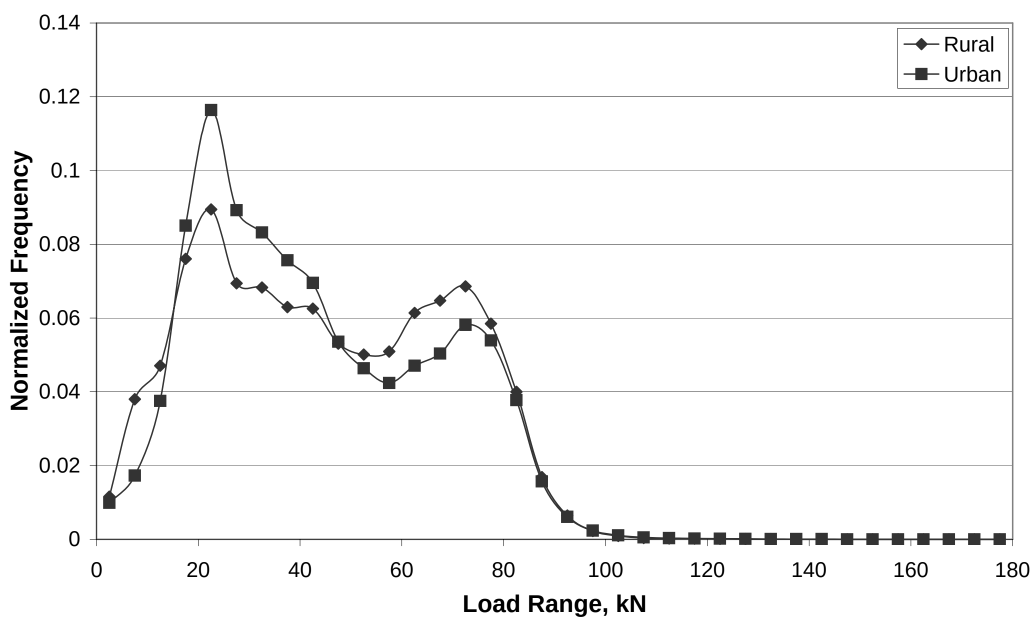


Figure 19. Single axle load spectra in two areas.

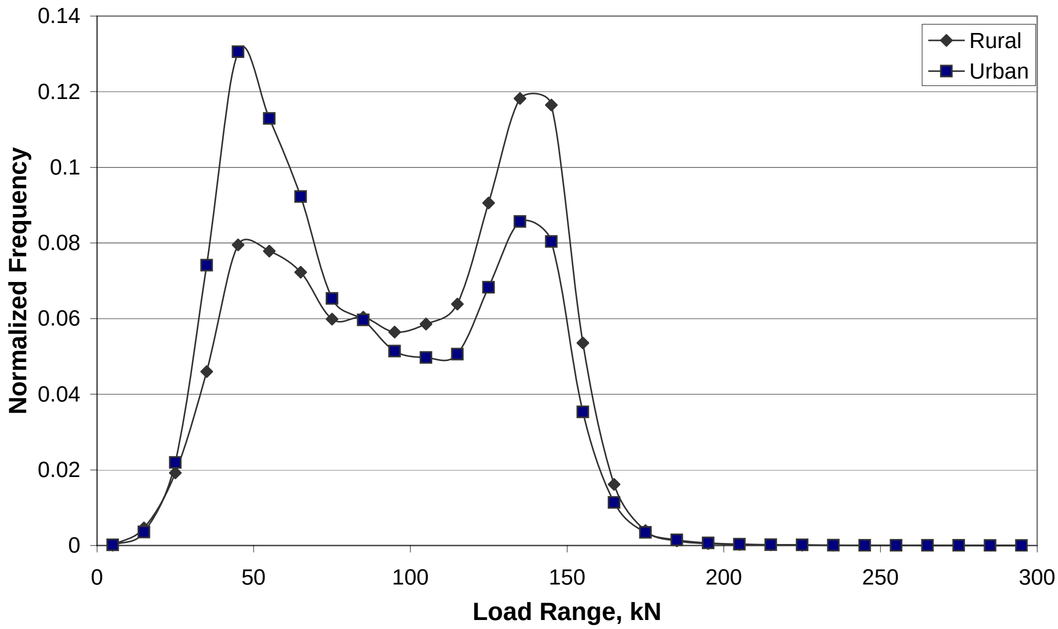


Figure 20. Tandem load spectra in two areas.

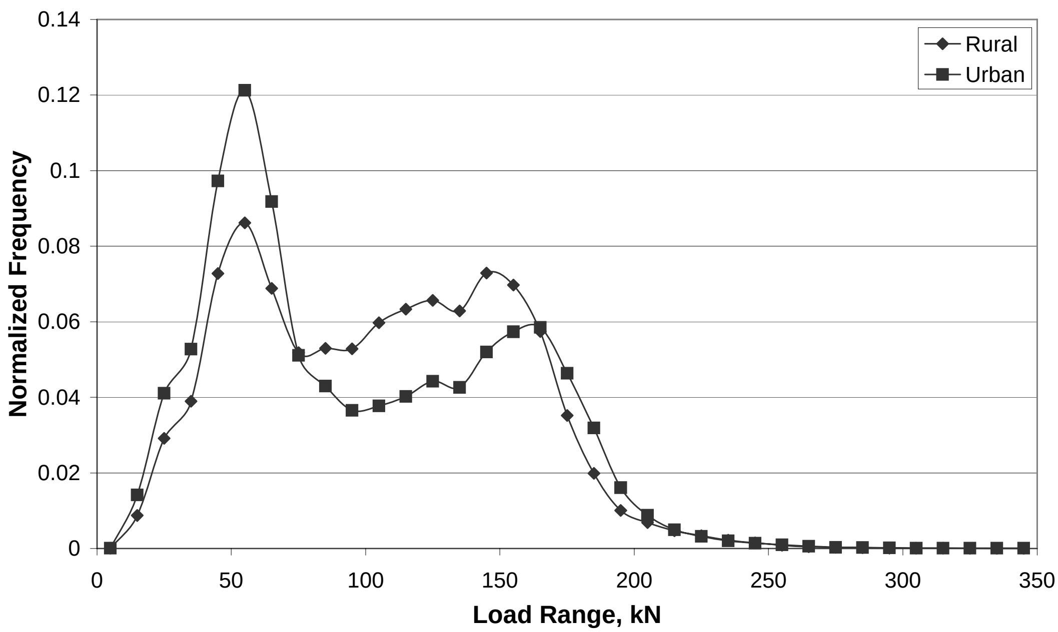


Figure 21. Tridem load spectra in two areas.

Table 4 WIM Station Location Groupings

Geographical Region	WIM Station No.
Central Valley	1, 2, 3, 4, 7, 10, 27 ,36, 44, 45, 46, 49, 51,52, 72, 73, 74, 75, 99
Bay Area	11, 17, 18, 24, 31, 32, 33, 34, 41, 42, 55, 56, 57, 58, 64
Southern California	8, 9, 12, 13, 14, 15, 16, 21, 37, 38, 39, 47, 48, 53, 54, 59, 60, 61, 62, 63, 65, 67, 69, 70, 77, 78, 79, 80, 82, 83, 84, 85, 87, 88, 89, 90, 91, 92, 95, 96, 97, 98
Type of Area	**WIM Station No.**
Rural	1, 2, 5, 7, 11, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 35, 39, 41, 42, 43, 44, 45, 46, 49, 63, 65, 66, 68, 71, 72, 73, 77, 78, 86, 93, 94, 99
Urban	3, 4, 8, 10, 12, 13, 14, 15, 16, 17, 18, 29, 31, 32, 33, 34, 36, 37, 38, 40, 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 64, 67, 69, 70, 74, 75, 76, 79, 80, 81, 82, 83, 84, 85, 87, 88, 89, 90, 91, 92, 95, 96, 97, 98

rail yard on I-880 and I-580; and the link between the Ports of Long Beach and Los Angeles and State Route 1 on I-710.

4.0 TRUCK TRAFFIC DATA ANALYSIS OF SIX WIM SITES

In this chapter, six WIM sites (listed in Table 5) were selected to illustrate the analysis results. These six sites are located in three regions (Bay Area, Central Valley and Southern California) and two areas (rural area and urban area), and in two different freight distribution directions (westbound/eastbound and southbound/northbound).

Table 5 Descriptions of Six WIM Sites Selected as Representative Examples

Site No.	WIM Station No.	Location Information					Direction	Area [1]
		Name	District	County	Route	Postmile		
1	2	Redding	2	Shasta	5	R24.9	SB/NB	CV/R
2	17,18	Hayward	4	Alameda	880	14.7	SB/NB	BA/U
3	21	Mojave	6	Kern	58	108.1	WB/EB	SC/R
4	47,48	Castaic	7	Los Angeles	5	R56.1	SB/NB	SC/U
5	57,58	Pinole	4	Contra Costa	80	7.5	WB/EB	BA/U
6	72	Bowman	3	Placer	80	23.4	WB/EB	CV/R

[1] CV-Central Valley; BA-Bay Area; SC-Southern California; U-Urban; R-Rural.

4.1 Axle Load Spectra Analysis

4.1.1 Axle Load Spectra on All Lanes

The axle load spectra of both traveled directions combined for various times of the day (whole day, day, and night), and each direction for the whole day at Site 1 (Station 2) are shown in Figures 22–25. Spectra at the other five sites are shown in Appendix A.

It can be observed that steering axle load spectra are similar among all the six sites, but single axle, tandem and tridem load spectra are quite different among these sites. For all the sites, the load spectra of all the four axle groups at night shift slightly to the right (heavier) of those in the daytime. Furthermore, the load spectra are also a little different between the two directions. Similar results can also be observed from the load spectra coefficient (LSC) table (Tables 6 through 11).

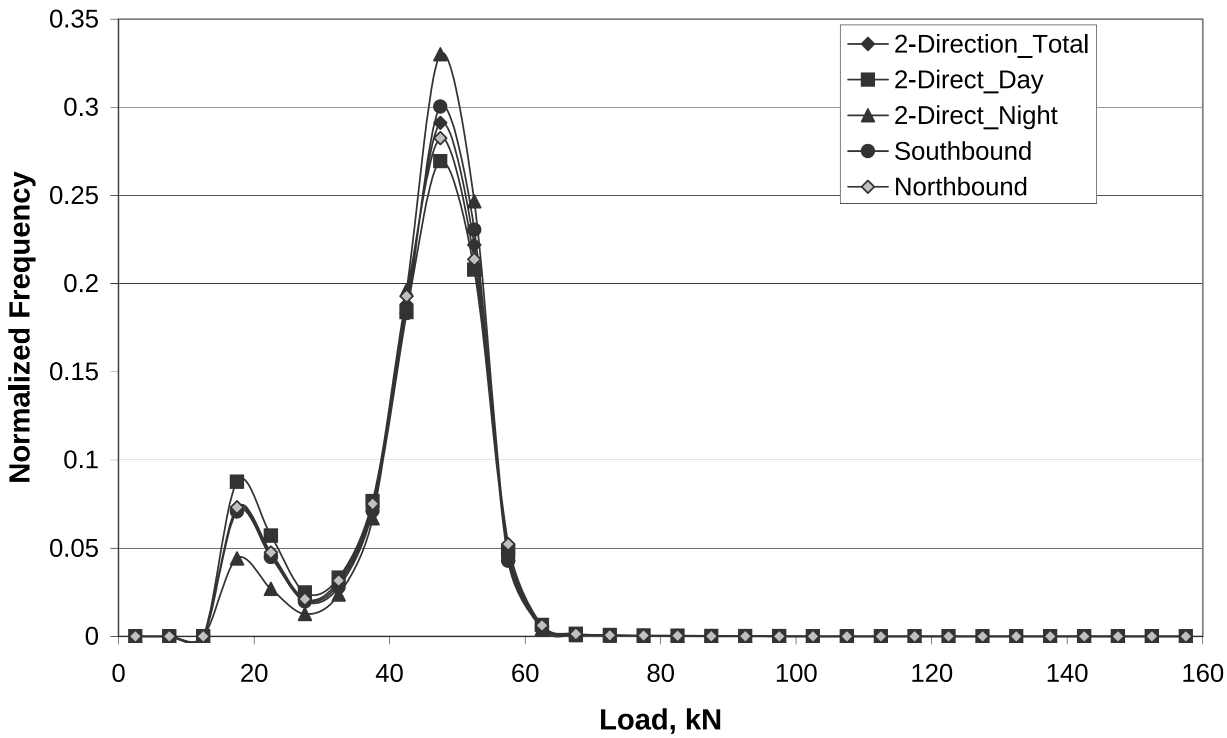


Figure 22. Axle load spectra, Station 2 (Redding), steering axle.

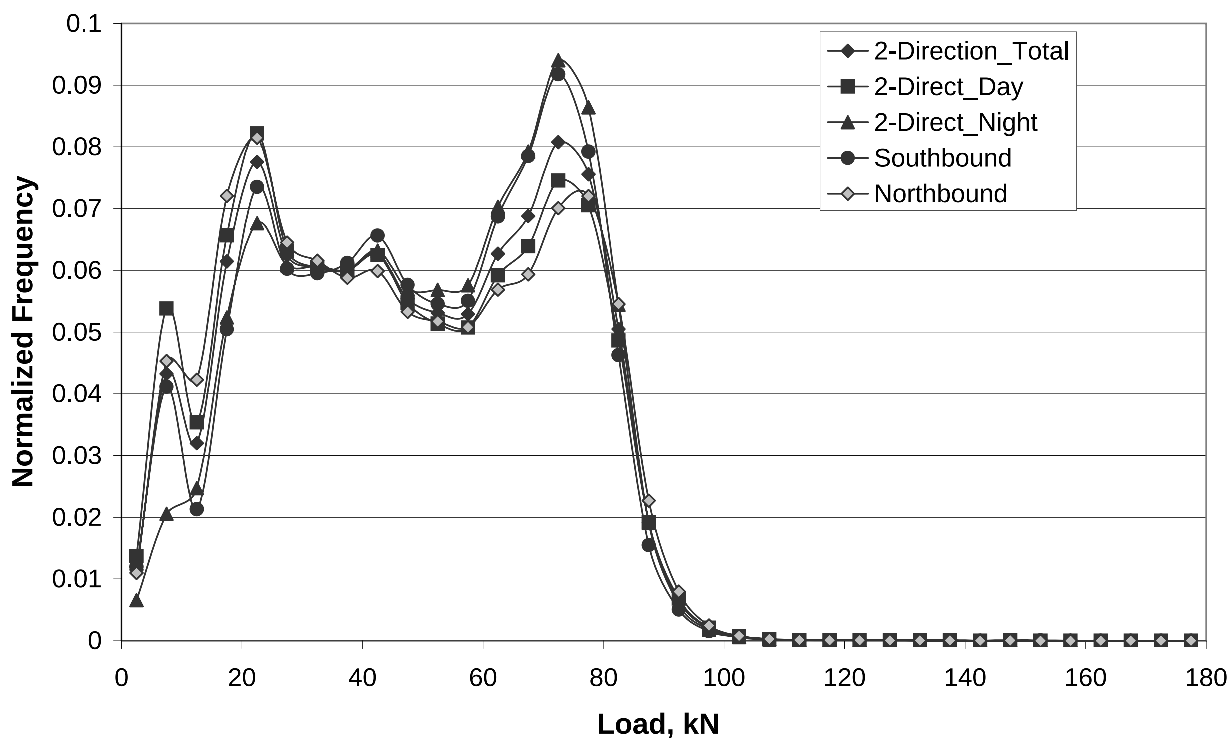


Figure 23. Axle load spectra, Station 2 (Redding), single axle.

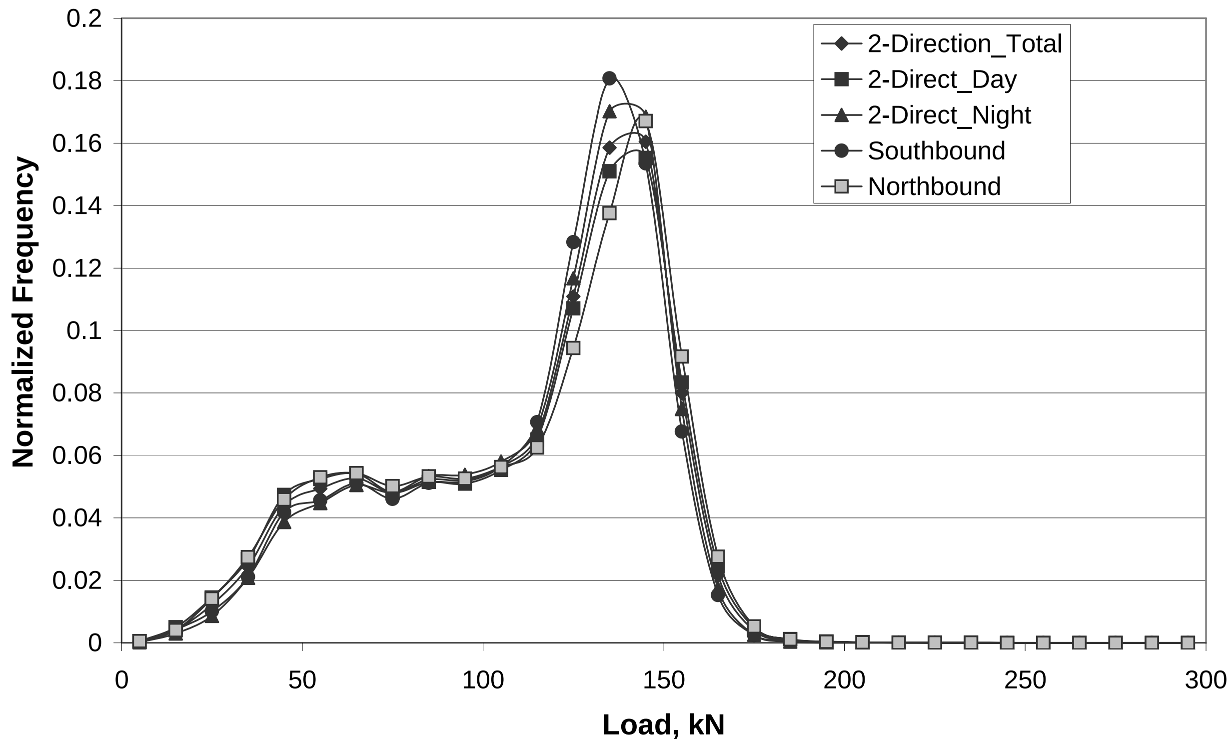


Figure 24. Axle load spectra, Station 2 (Redding), tandem axle.

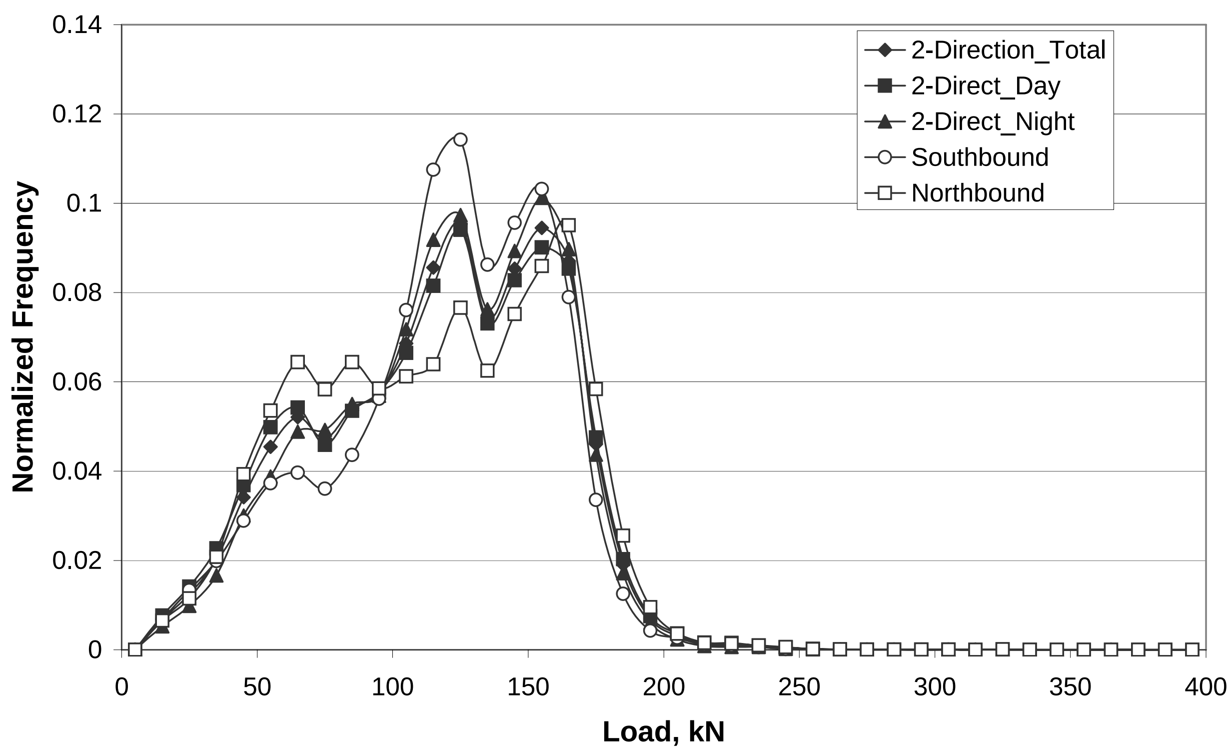


Figure 25. Axle load spectra, Station 2 (Redding), tridem axle.

Table 6 Load Spectra Coefficients for Site 1 (Station 2, Redding)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Southbound	Northbound
Steering	0.108	0.113	0.116	0.113	0.114
Single	0.322	0.309	0.351	0.326	0.319
Tandem	0.739	0.740	0.738	0.724	0.754
Tridem	0.279	0.282	0.274	0.267	0.291

Table 7 Load Spectra Coefficients for Site 2 (Stations 17 and 18, Hayward)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Southbound	Northbound
Steering	0.062	0.074	0.068	0.073	0.071
Single	0.193	0.182	0.225	0.195	0.190
Tandem	0.328	0.311	0.379	0.333	0.323
Tridem	0.226	0.215	0.269	0.272	0.174

Table 8 Load Spectra Coefficients for Site 3 (Station 21, Mojave)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Westbound	Eastbound
Steering	0.078	0.079	0.081	0.067	0.089
Single	0.295	0.281	0.316	0.337	0.259
Tandem	0.615	0.595	0.637	0.567	0.649
Tridem	0.267	0.273	0.257	0.277	0.257

Table 9 Load Spectra Coefficients for Site 4 (Stations 47 and 48, Castaic)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Southbound	Northbound
Steering	0.088	0.097	0.090	0.095	0.093
Single	0.253	0.248	0.259	0.252	0.255
Tandem	0.469	0.450	0.492	0.516	0.428
Tridem	0.240	0.224	0.260	0.257	0.222

Table 10 Load Spectra Coefficients for Site 5 (Stations 57 and 58, Pinole)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Westbound	Eastbound
Steering	0.083	0.094	0.091	0.089	0.097
Single	0.211	0.203	0.225	0.205	0.217
Tandem	0.398	0.393	0.411	0.432	0.356
Tridem	0.271	0.272	0.268	0.269	0.273

Table 11 Load Spectra Coefficients of Site 6 (Station 72, Bowman)

Axle Group	Both Directions	Both Directions, Day	Both Directions, Night	Westbound	Eastbound
Steering	0.105	0.102	0.111	0.109	0.102
Single	0.275	0.259	0.297	0.292	0.259
Tandem	0.636	0.620	0.657	0.614	0.659
Tridem	0.330	0.337	0.316	0.305	0.353

4.1.2 Axle Load Spectra for Each Lane

The axle load spectra vary among lanes. Figures 26–29 show the load spectra of the four axle groups on four lanes of Site 1. The load spectra of the other five sites are shown in Appendix B. The corresponding load spectra coefficients are listed in Tables 12 through 17. For each site, it can be observed that the load spectra for the lanes with the same lane number but different directions of travel are similar, and that load spectra on the outside lanes are mostly located to the right (heavier) side of the load spectra on the inside lanes. This difference shows that heavier trucks run more frequently on the outside lanes than on the inside lanes. At Sites 2, 4 and 5, each of which have 3 lanes in one direction, the load spectra on the outside two lanes are similar.

4.1.3 Axle Load Spectra by Year

The axle load spectra at Site 1 (Station 2) in each year from 1991 through 2000 are shown in Figures 30–33. Figure 34 presents load spectra coefficients (LSCs) for Site 1 over the same period for all four axle groups. It can be seen that the load spectra are similar in shape for each year while the LSCs change with time. The LSCs of tandem and tridem axles decreased from 1991 to 1994 and increased after 1995, which means that these two axle groups showed a trend of becoming lighter from 1991 to 1994 and a trend of becoming heavier after 1995. The

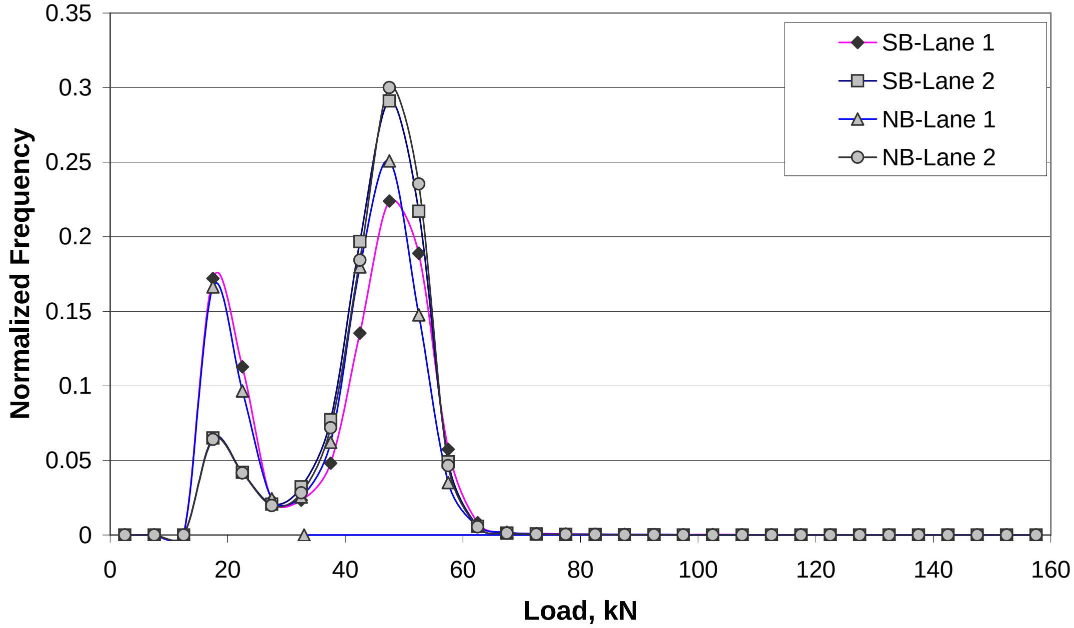


Figure 26. Axle load spectra by lane, Station 2 (Redding), steering axle.

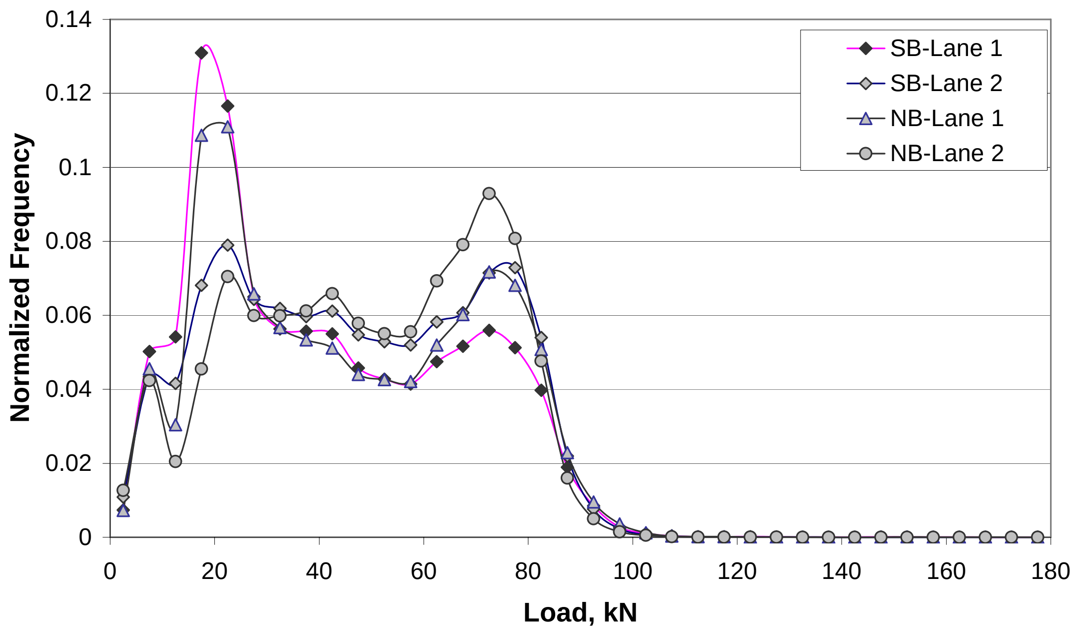


Figure 27. Axle load spectra by lane, Station 2 (Redding), single axle.

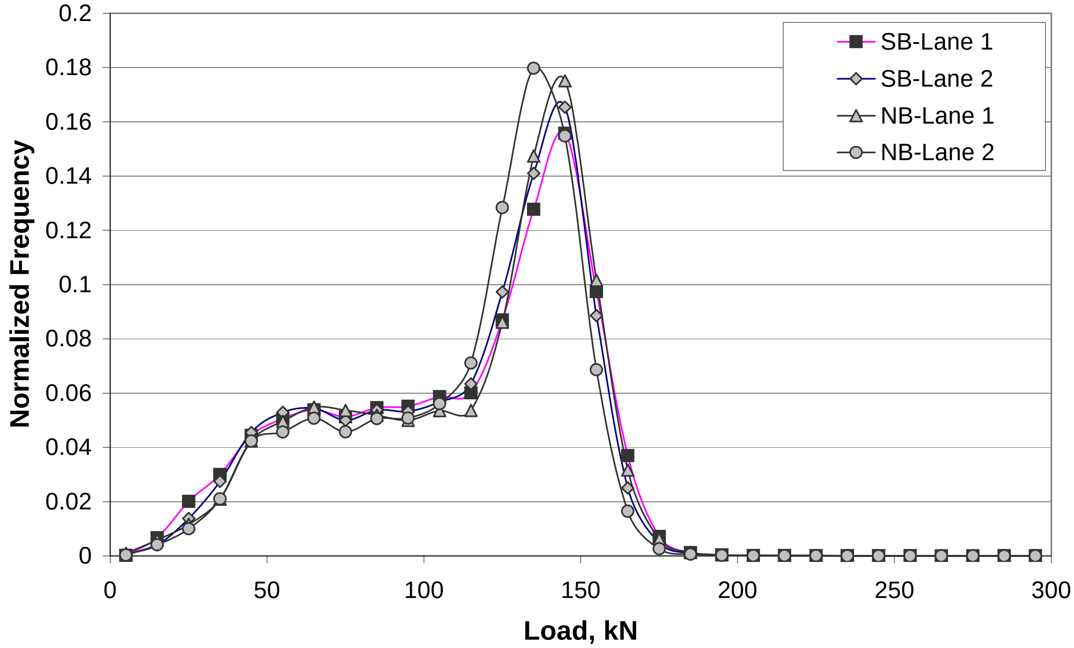


Figure 28. Axle load spectra by lane, Station 2 (Redding), tandem axle.

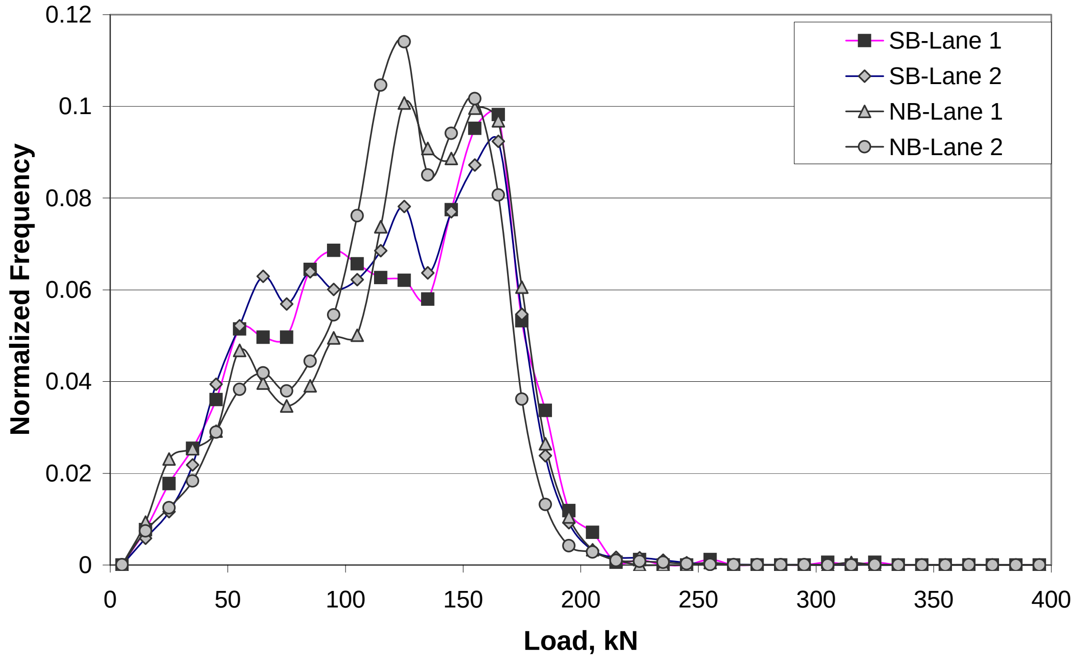


Figure 29. Axle load spectra by lane, Station 2 (Redding), tridem axle.

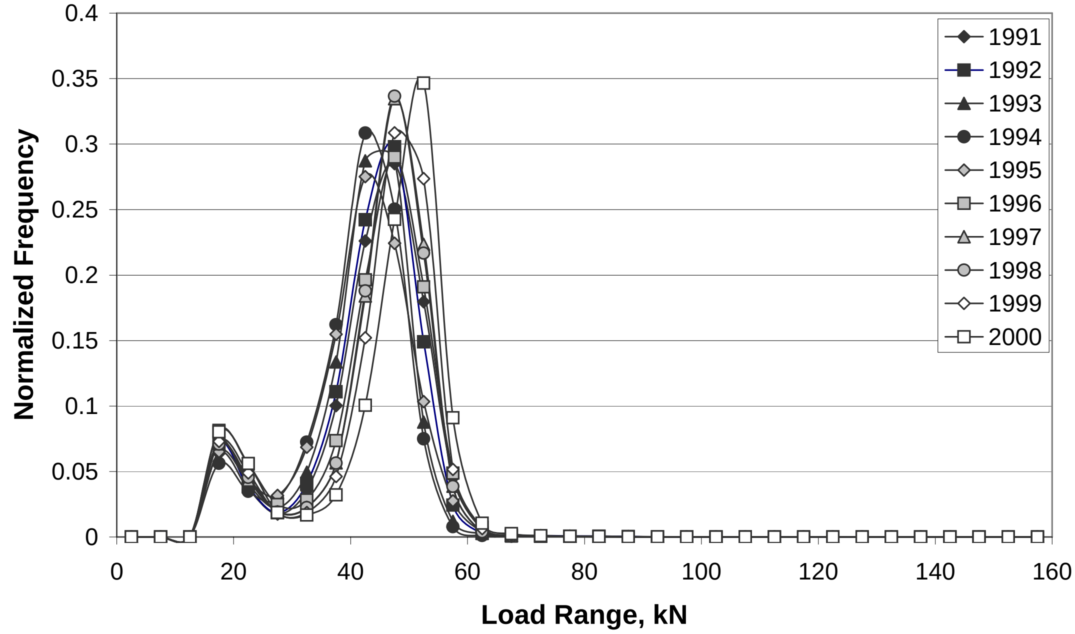


Figure 30. Axle load spectra by year, Station 2 (Redding), steering axle.

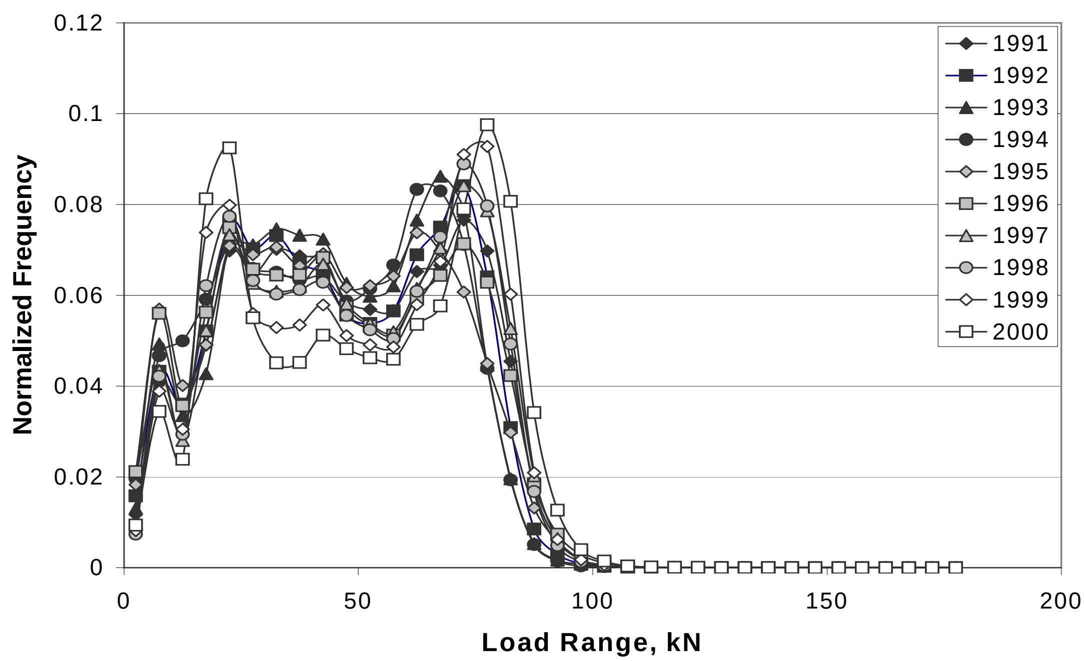


Figure 31. Axle load spectra by year, Station 2 (Redding), single axle.

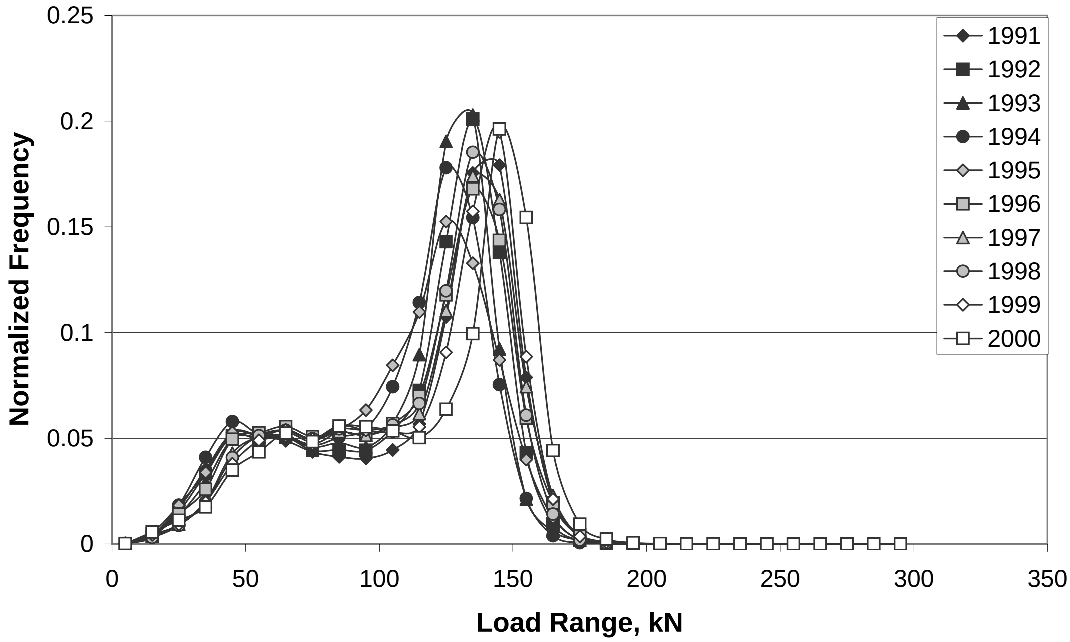


Figure 32. Axle load spectra by year, Station 2 (Redding), tandem axle.

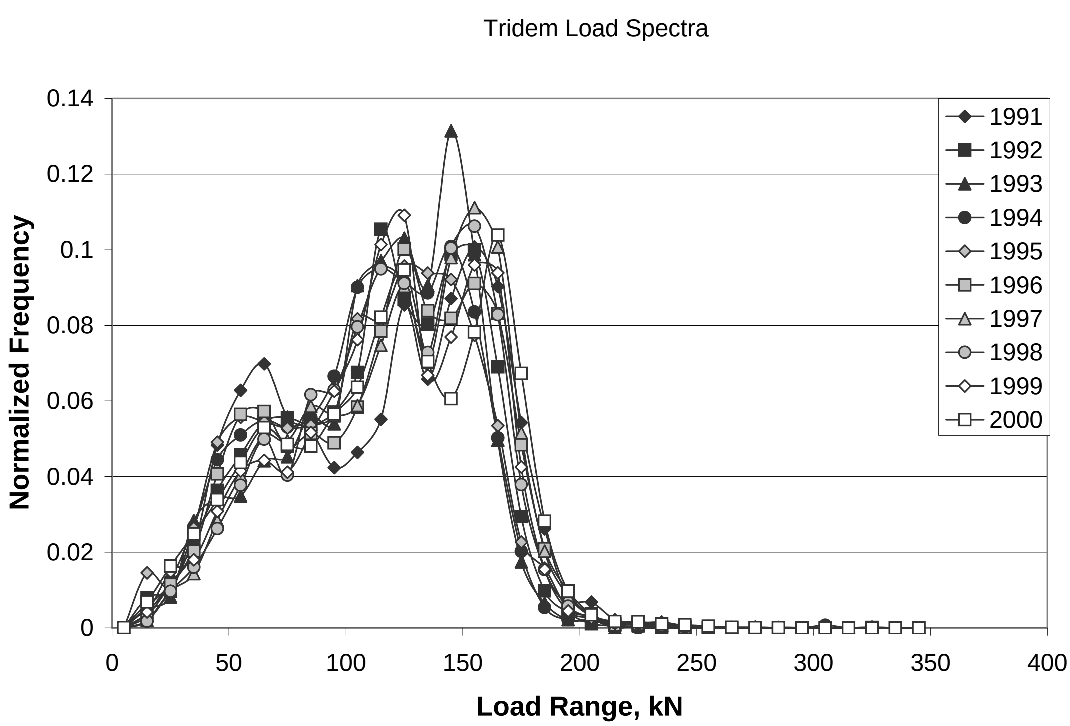


Figure 33. Axle load spectra by year, Station 2 (Redding), tridem axle.

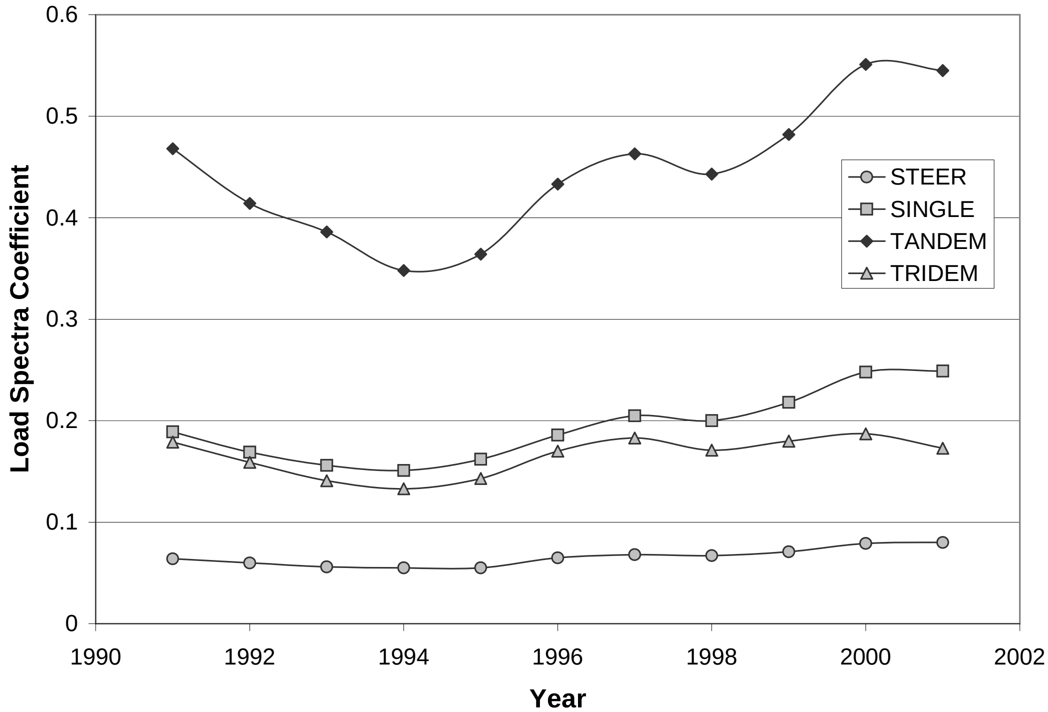


Figure 34. Load spectra coefficients at Station 2 (Redding) by year for all four axle groups.

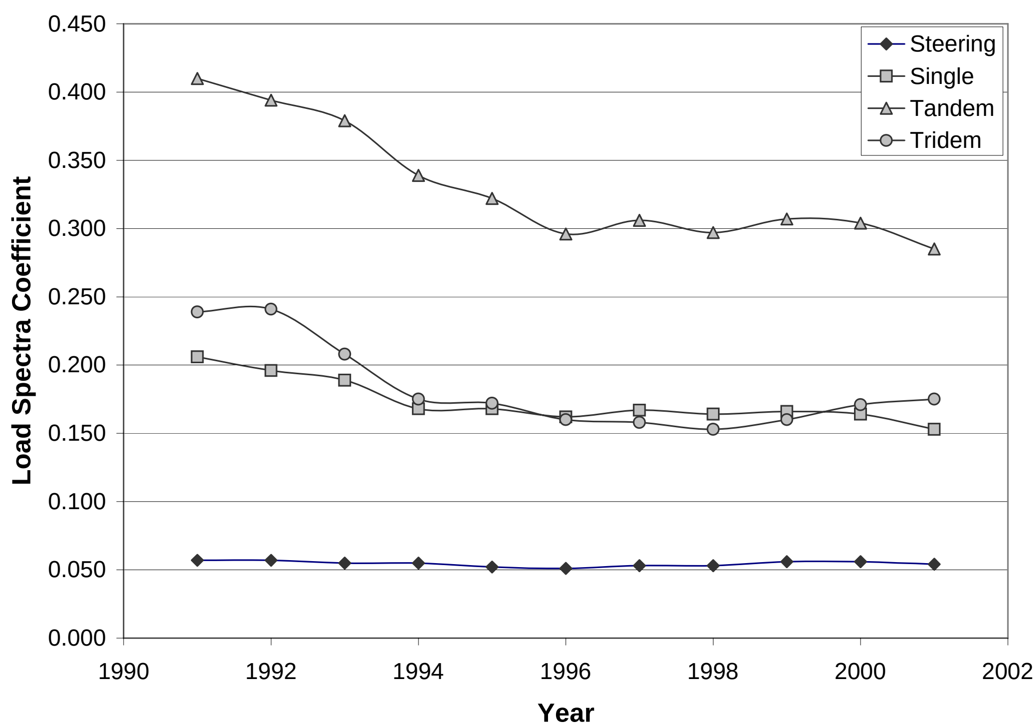


Figure 35. General load spectra coefficients across all stations in California in each year 1991 through 2000.

Table 12 Load Spectra Coefficients of Site 1 (Station 2, Redding) by Lane

Axle Group	Southbound Lane 1	Southbound Lane 2	Northbound Lane 1	Northbound Lane 2
Steering	0.135	0.112	0.117	0.114
Single	0.271	0.319	0.321	0.330
Tandem	0.782	0.743	0.818	0.727
Tridem	0.308	0.284	0.307	0.271

Table 13 Load Spectra Coefficients of Site 2 (Stations 17 and 18, Hayward) by Lane

Axle Group	Southbound Lane 2	Southbound Lane 3	Southbound Lane 4	Northbound Lane 2	Northbound Lane 3	Northbound Lane 4
Steering	0.052	0.079	0.069	0.035	0.067	0.079
Single	0.139	0.229	0.163	0.081	0.173	0.220
Tandem	0.320	0.333	0.334	0.279	0.295	0.357
Tridem	0.315	0.310	0.225	0.118	0.167	0.181

Table 14 Load Spectra Coefficients of Site 3 (Station 21, Mojave) by Lane

Axle Group	Westbound Lane 1	Westbound Lane 2	Eastbound Lane 1	Eastbound Lane 2
Steering	0.068	0.067	0.078	0.090
Single	0.160	0.348	0.217	0.261
Tandem	0.335	0.583	0.692	0.645
Tridem	0.151	0.284	0.223	0.259

Table 15 Load Spectra Coefficients of Site 4 (Stations 47 and 48, Castaic) by Lane

Axle Group	Southbound Lane 2	Southbound Lane 3	Southbound Lane 4	Northbound Lane 2	Northbound Lane 3	Northbound Lane 4
Steering	0.050	0.098	0.094	0.051	0.086	0.097
Single	0.088	0.286	0.235	0.081	0.206	0.278
Tandem	0.296	0.560	0.492	0.271	0.339	0.461
Tridem	0.190	0.352	0.212	0.125	0.171	0.238

Table 16 Load Spectra Coefficients of Site 5 (Stations 57 and 58, Pinole) by Lane

Axle Group	Westbound Lane 2	Westbound Lane 3	Westbound Lane 4	Eastbound Lane 2	Eastbound Lane 3	Eastbound Lane 4
Steering	0.064	0.085	0.093	0.056	0.091	0.109
Single	0.114	0.189	0.218	0.116	0.171	0.268
Tandem	0.425	0.360	0.472	0.364	0.245	0.480
Tridem	0.065	0.217	0.309	0.039	0.194	0.380

Table 17 Load Spectra Coefficients of Site 6 (Station 72, Bowman) by Lane

Axle Group	Westbound Lane 2	Westbound Lane 3	Eastbound Lane 2	Eastbound Lane 3
Steering	0.095	0.114	0.091	0.105
Single	0.193	0.322	0.140	0.303
Tandem	0.623	0.612	0.638	0.662
Tridem	0.241	0.316	0.158	0.376

LSCs of steering and single axles did not show much yearly change. The LSCs of the other five sites (shown in Appendix C) also show that the LSCs of steering and single axles are similar among years, while the LSCs of tandem and tridem axles vary from year to year.

Figure 35 shows the general load spectra coefficients across all stations in California for each year. It shows that the LSC of the steering axle group is stable across all years, while the LSCs of single, tandem, and tridem axles decreased from 1991 to 1995 and then remained stable after 1996.

4.2 Truck Traffic Volume Analysis

4.2.1 Traffic distribution between day and night

Traffic distribution between day and night is an important factor in pavement design because the environmental factors (e.g., temperature) vary greatly between day and night, which leads to corresponding changes in pavement material properties.

The percentage of trucks operating in the daytime for each direction for each truck type and total and total truck types for the six sites are shown in Figures 36 through 41. It can be observed that the daytime percentages are similar for both directions at a given WIM site. In general, the daytime truck percentage for total truck types ranges from 55 to 75 percent, and is close to the corresponding values of Truck Type 9.

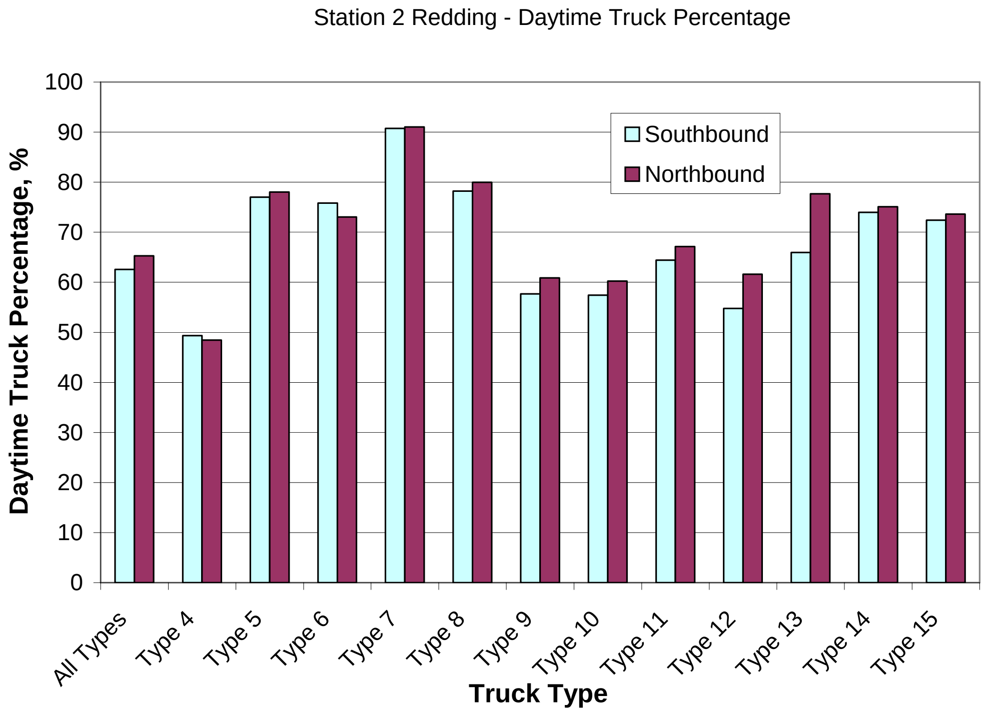


Figure 36. Percentage of trucks operating in the daytime, Station 2 (Redding).

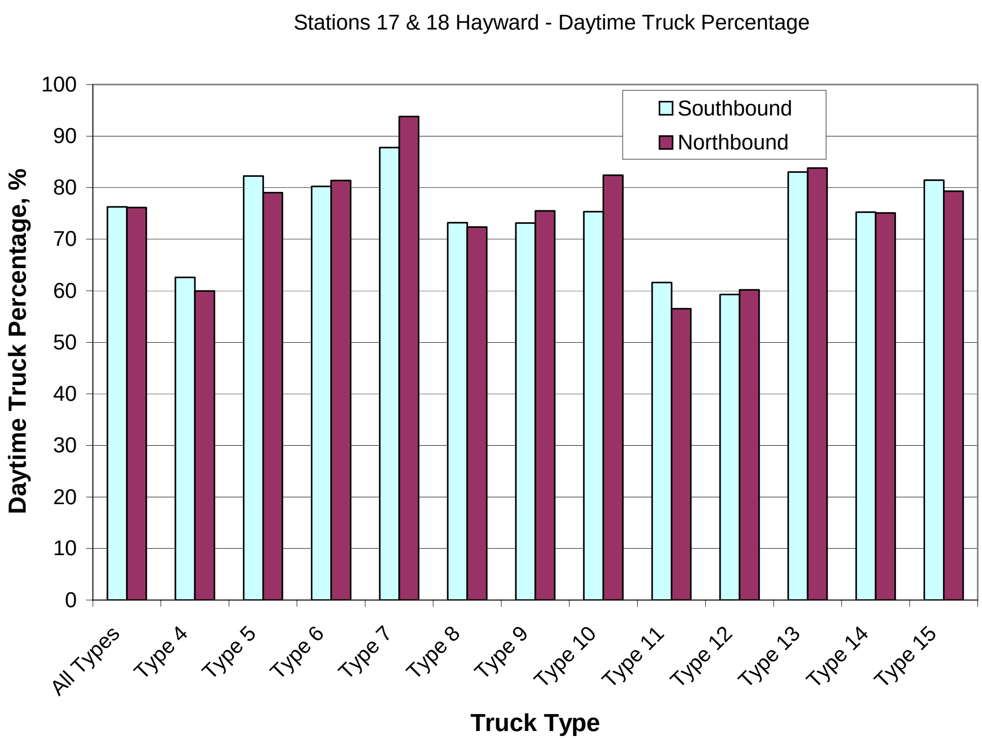


Figure 37. Percentage of trucks operating in the daytime, Stations 17 and 18 (Hayward).

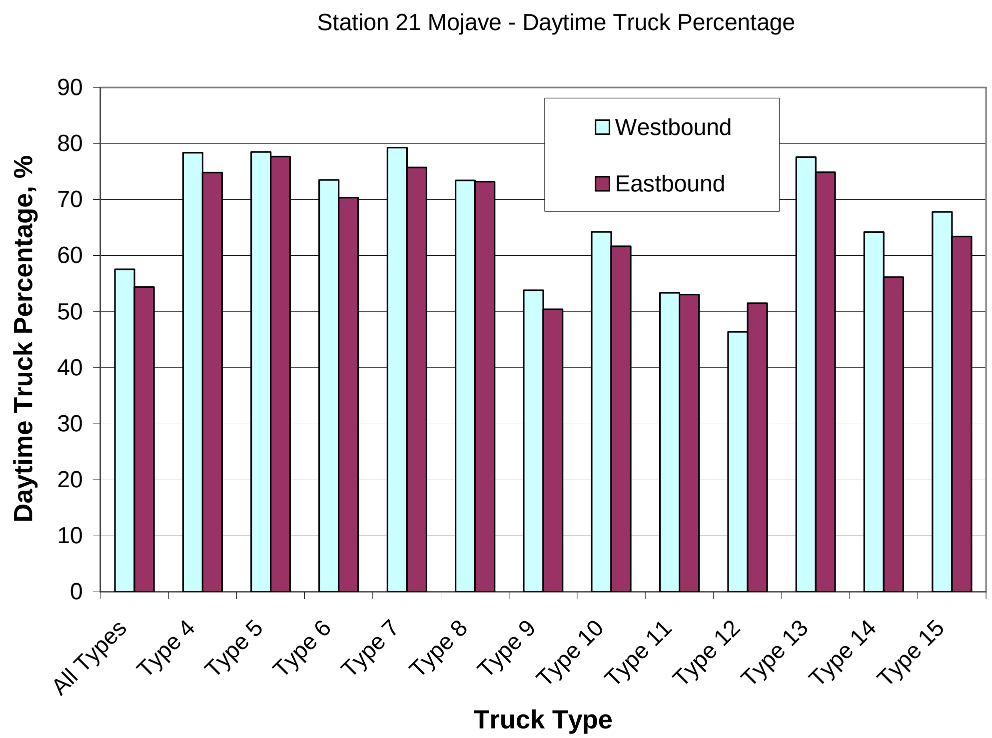


Figure 38. Percentage of trucks operating in the daytime, Station 21 (Mojave).

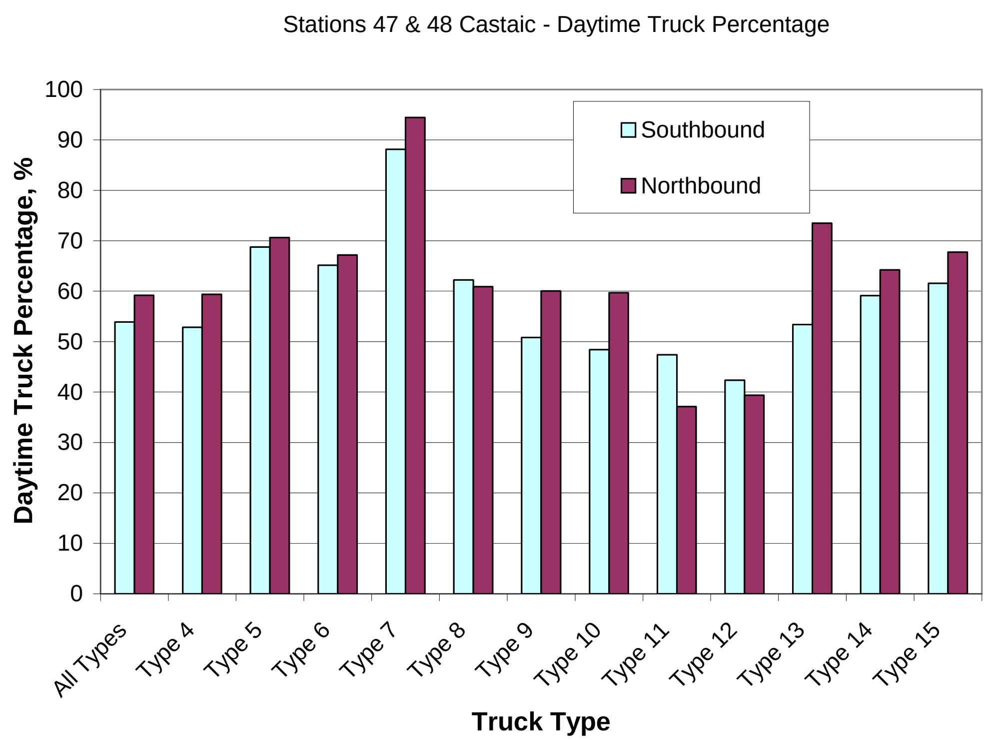


Figure 39. Percentage of trucks operating in the daytime, 47 and 48 (Castaic).

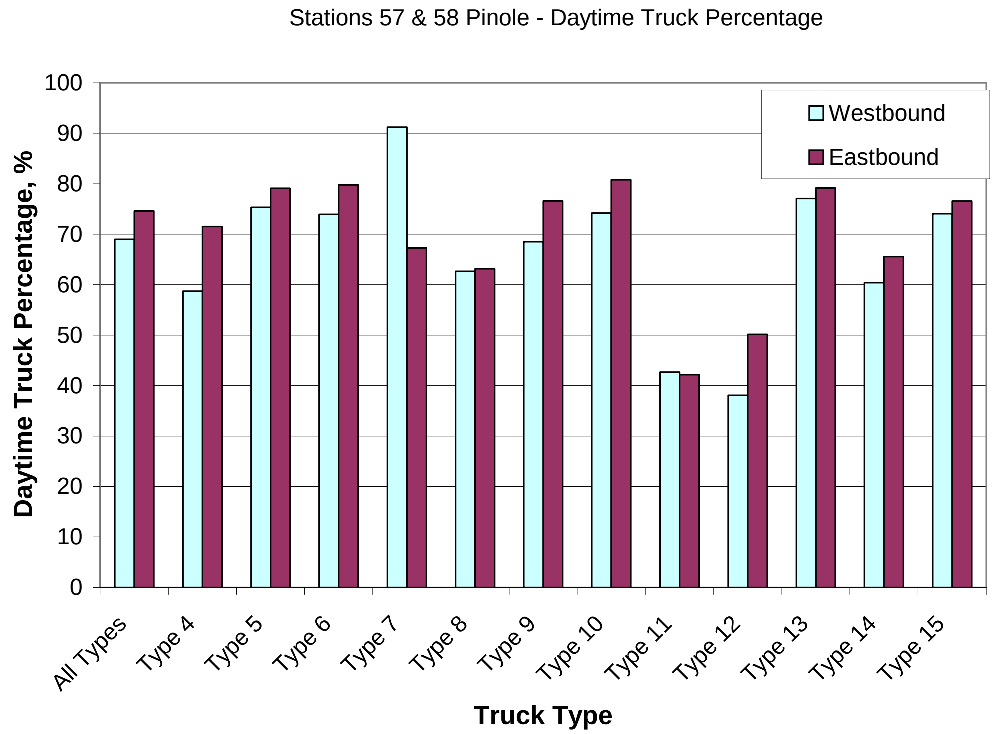


Figure 40. Percentage of trucks operating in the daytime, Stations 57 and 58 (Pinole).

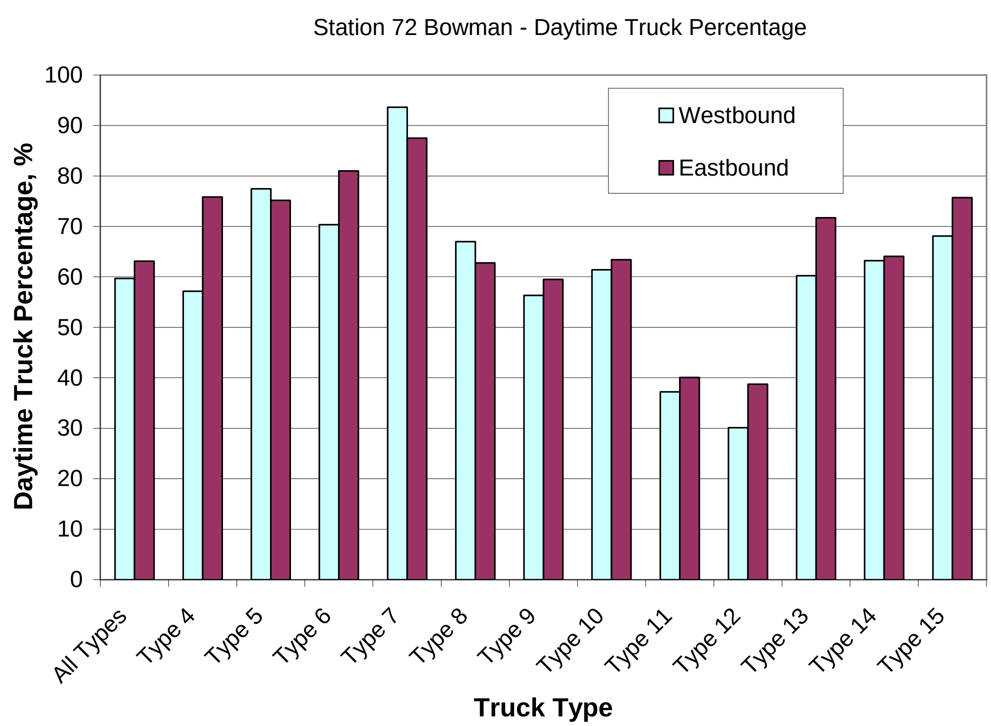


Figure 41. Percentage of trucks operating in the daytime, (Bowman).

Figure 42 shows each sampled day's daytime percentage for total truck types at Station 2. The higher points in the figure are for weekdays and the lower points are for weekends. This figure shows that the daytime percentage is quite stable across the whole analysis period. Similar conclusions can be made from other sites' daytime truck percentage diagrams, which are shown in Appendix D.

4.2.2 Traffic Seasonal Distribution

Traffic seasonal distribution is also an important factor in pavement design because the same traffic loading will have different effects on pavement damage during different seasons.

The seasonal average daily truck traffic volume for Site 1 (Station 2) and Site 2 (Stations 17 and 18) are shown in Figures 43 and 44, respectively. The figures show that the truck traffic volume is higher in the dry season (July to November) than in the wet or spring season, while no significant difference between the wet and spring seasons. Analysis on the other four sites shows the same conclusions. The diagrams of the daily truck traffic volume give a better view, as shown in figures 49 through 54. A seasonal component in the sinusoidal wave pattern is observed from the daily traffic volume series on all the figures. In each year, the traffic volume reaches the highest between August and November and then decreases and reaches the lowest between January and April.

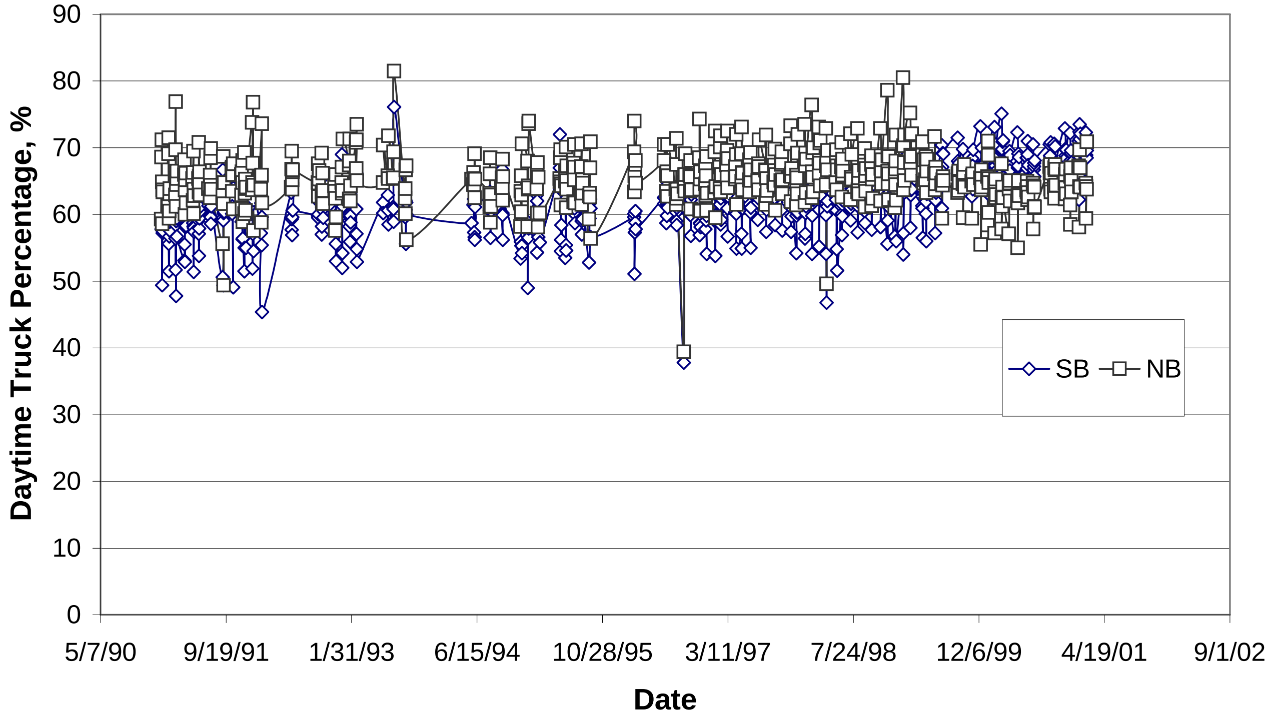


Figure 42. Percentage of trucks operating in the daytime, (Redding).

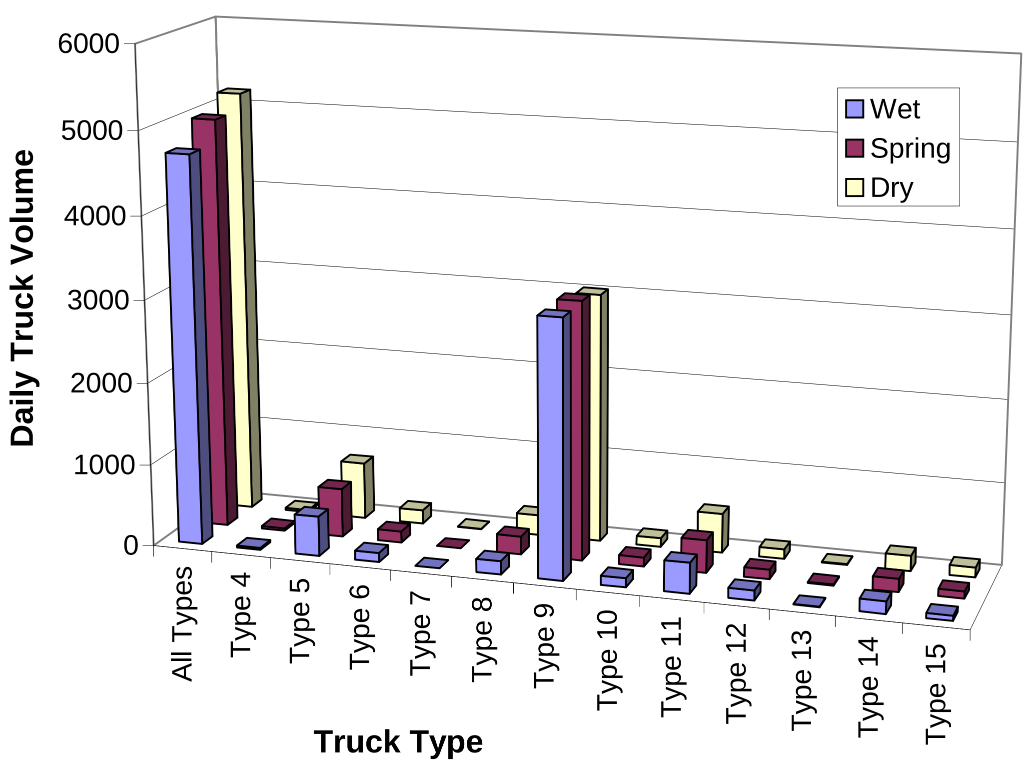


Figure 43. Seasonal average daily truck volume (both directions), Site 1 (Station 2, Redding).

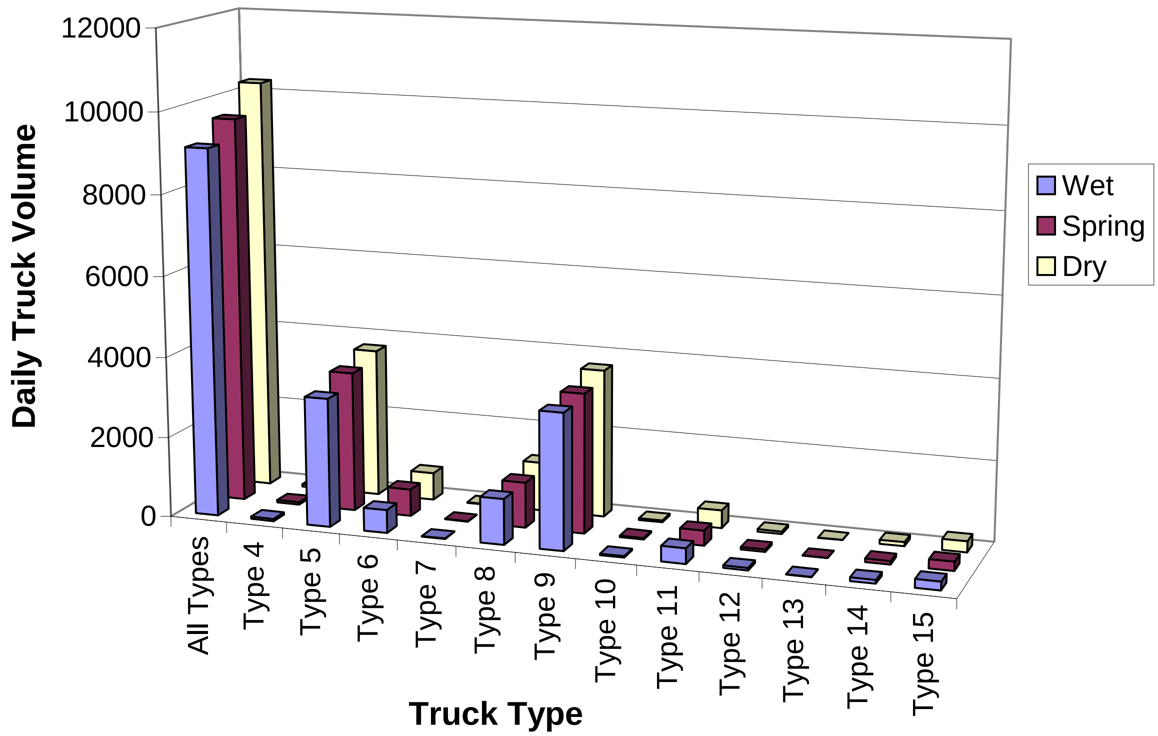


Figure 44. Seasonal averaged daily truck volume (both directions), Site 2 (Stations 17 and 18, Hayward).

4.2.3 <u>Traffic Distribution by Lane</u>

The knowledge of traffic distribution by lane is important in determining the expected traffic volume that will travel on the designed pavement. Table 18 summarizes the distribution of each truck type at the six WIM sites by lane.

Table 18 shows that when there are two lanes in one driving direction, over 90 percent of the truck traffic will travel on the outside lane, and when there three or more lanes in one driving direction, over 90 percent of the truck traffic will travel on the outermost two lanes. In the latter situation, the truck traffic distribution between the outermost two lanes differs across sites. For example, at Stations 17 and 18, the right-hand lane has a slightly smaller percentage than the left-hand lane, while at Stations 47 and 48, the right-hand lane has a much larger percentage than the left-hand lane.

Figures 45 through 48 show the averaged daily truck traffic volume distributions by lane at Site 1 (Station 2) and Site 2 (Stations 17 and 18). The figures show that the truck traffic distributions by lane are similar in both directions for a given WIM site.

4.2.4 Traffic Growth Trend Analysis

One of the main goals of truck traffic analysis is to produce a long-term forecast of traffic loading on the pavement being considered. Two parameters are currently used by Caltrans to estimate the traffic growth trend: annual average daily truck traffic (AADTT) and equivalent single axle loads (ESALs). Figures 49 through 54 show truck volume and ESALs of the six WIM sites for each sampled day. In each series, the higher points occur on weekdays and the lower points occur on weekends. The figures show that the traffic volume reaches its maximum value during August through November of each year.

Table 18 Truck Traffic Distribution by Lane

Station	Lane No.	Truck Traffic Distribution for Each Truck Type (percent)												
		All Types	Type 4	Type 5	Type 6	Type 7	Type 8	Type 9	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15
Station 2 Southbound	**1**	7	18	18	8	4	7	6	4	5	5	8	4	8
	2	93	82	82	92	96	93	94	96	95	95	92	96	92
Station 2 Northbound	**1**	7	19	17	9	0	8	6	5	5	6	5	5	10
	2	93	81	83	91	100	92	94	95	95	94	95	95	90
Stations 17 & 18 Southbound	**2**	7	27	15	3	1	2	2	1	2	1	1	3	16
	3	53	46	47	55	46	52	59	55	57	47	45	71	44
	4	40	27	39	42	54	46	39	44	40	52	54	26	40
Stations 17&18 Northbound	**2**	5	23	12	1	0	0	0	0	0	0	0	0	7
	3	49	45	43	51	29	47	56	58	44	42	35	60	51
	4	46	32	45	48	71	53	44	42	56	58	65	40	42
Station 21 Westbound	**1**	7	24	11	10	2	6	6	5	5	5	5	9	6
	2	93	76	89	90	30	94	94	95	95	95	96	91	94
Station 21 Eastbound	**1**	7	18	11	9	1	5	7	6	6	5	5	5	5
	2	93	82	89	91	28	95	93	94	94	95	95	95	95
Stations 47 & 48 Southbound	**2**	2	46	10	4	0	1	0	0	0	0	0	0	2
	3	38	44	43	40	19	37	37	33	37	38	19	34	34
	4	60	11	47	56	81	62	62	66	63	62	81	66	64
Stations 47 & 48 Northbound	**2**	3	49	10	4	0	1	0	0	0	0	0	0	5
	3	27	37	42	30	5	30	26	22	22	22	12	26	32
	4	70	14	48	66	95	69	74	77	78	77	88	74	63
Stations 57 & 58 Westbound	**2**	3	24	8	2	0	0	0	0	0	0	0	0	6
	3	36	52	39	30	8	29	37	45	24	27	24	20	29
	4	61	24	53	68	72	70	63	55	76	73	76	80	65
Stations 57 & 58 Eastbound	**2**	6	31	14	4	0	0	0	0	0	0	0	0	5
	3	48	53	46	41	14	44	55	59	35	45	37	29	41
	4	46	16	40	55	86	56	45	41	65	55	63	71	54
Station 72 Westbound	**2**	24	61	50	35	6	14	17	13	12	13	7	7	21
	3	76	39	50	65	94	86	83	87	88	87	93	93	79
Station 72 Eastbound	**2**	25	56	60	31	0	17	12	13	8	10	1	11	18
	3	75	44	40	69	100	83	88	87	92	90	99	89	82

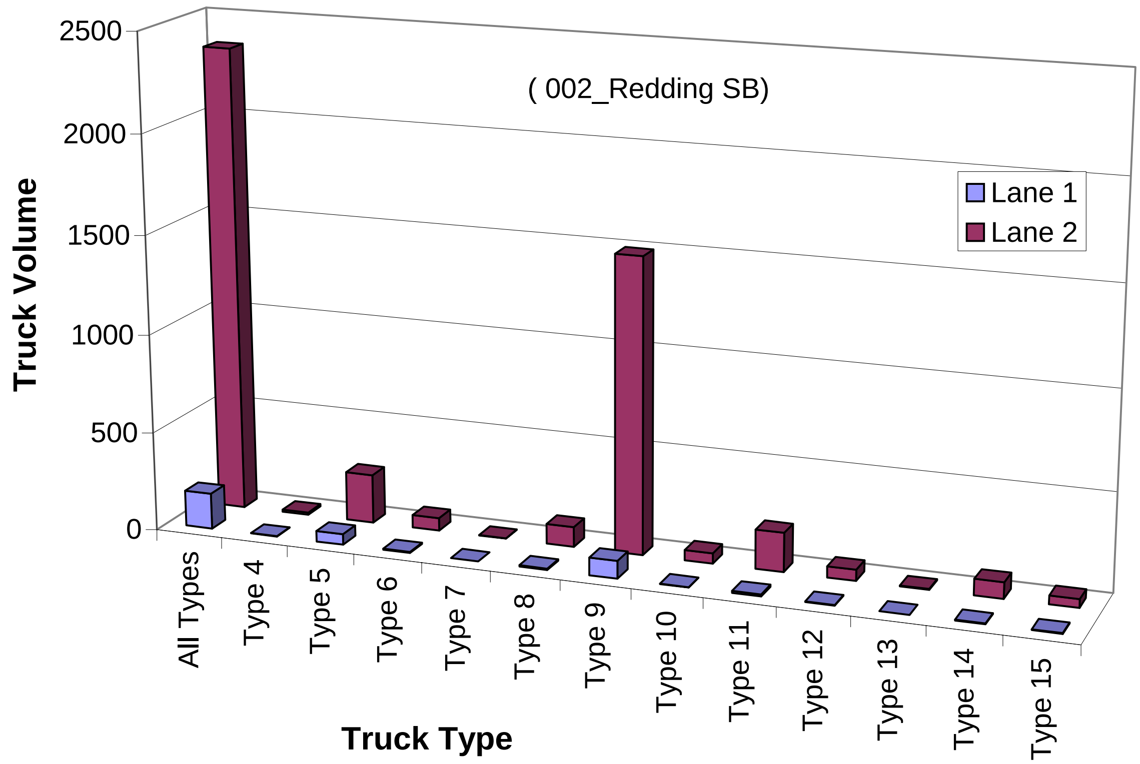


Figure 45. Truck traffic distribution by lane, Site 1 (Station 2, Redding), Southbound.

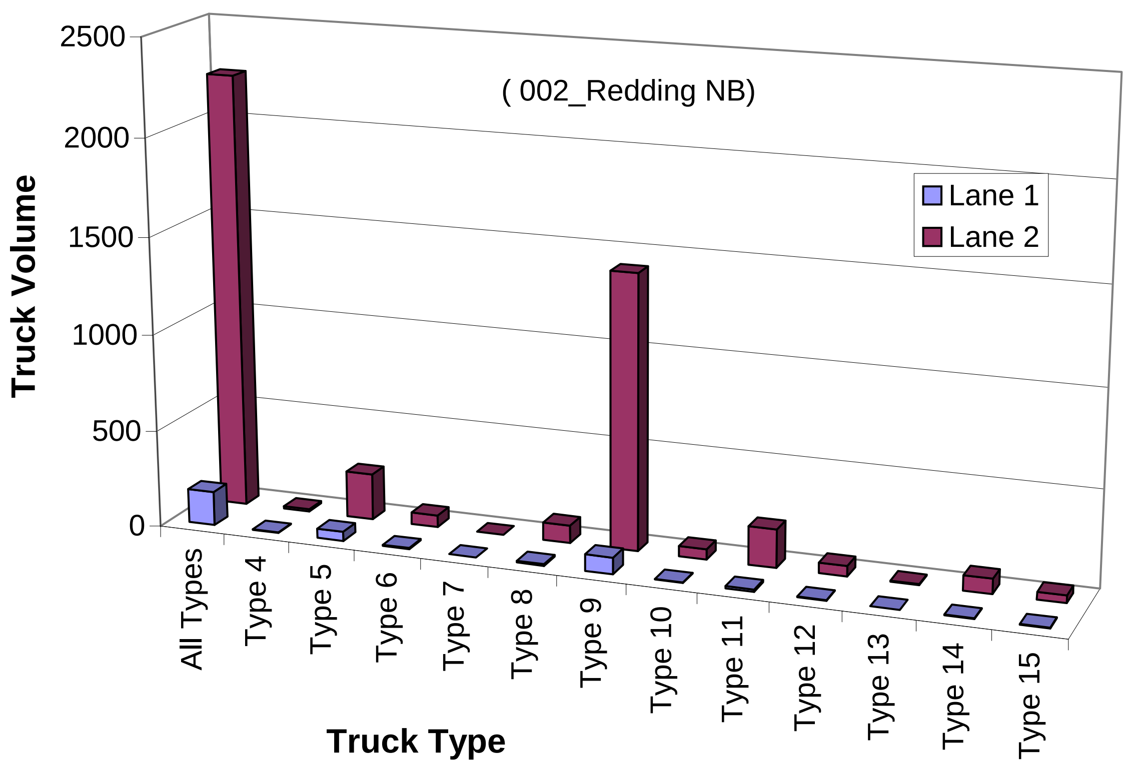


Figure 46. Truck traffic distribution by lane, Site 1 (Station 2, Redding), Northbound.

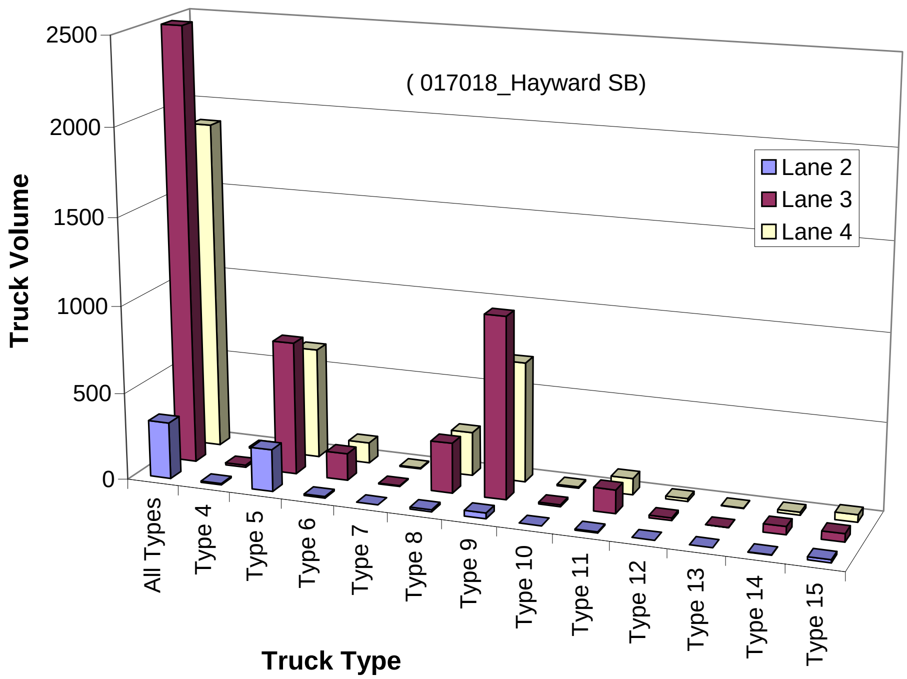


Figure 47. Truck traffic distribution by lane, Site 2 (Stations 17 and 18, Hayward), Southbound.

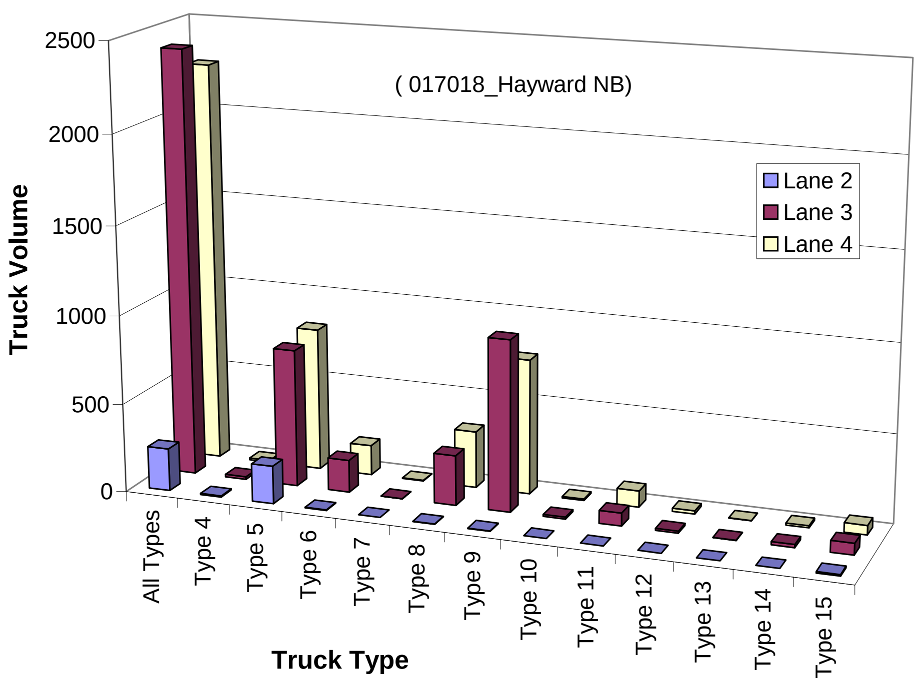


Figure 48. Truck traffic distribution by lane, Site 2 (Stations 17 and 18, Hayward), Northbound.

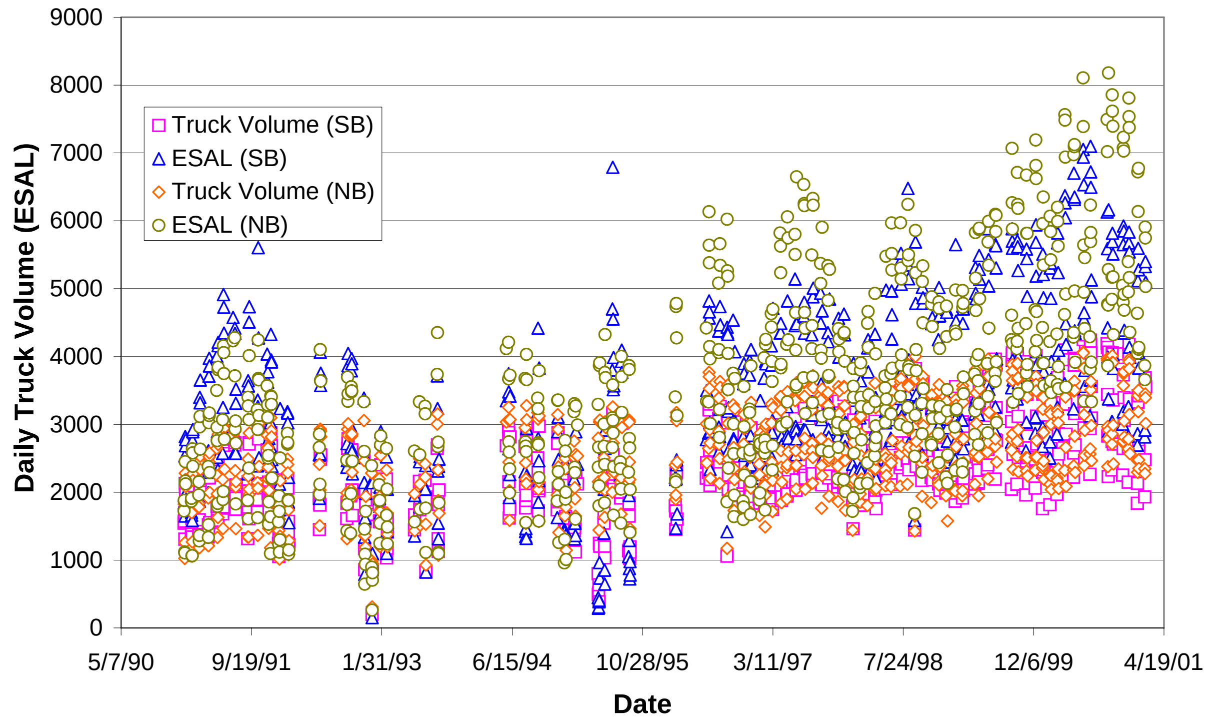


Figure 49. Daily truck volume and ESALs at Site 1 (Station 2, Redding).

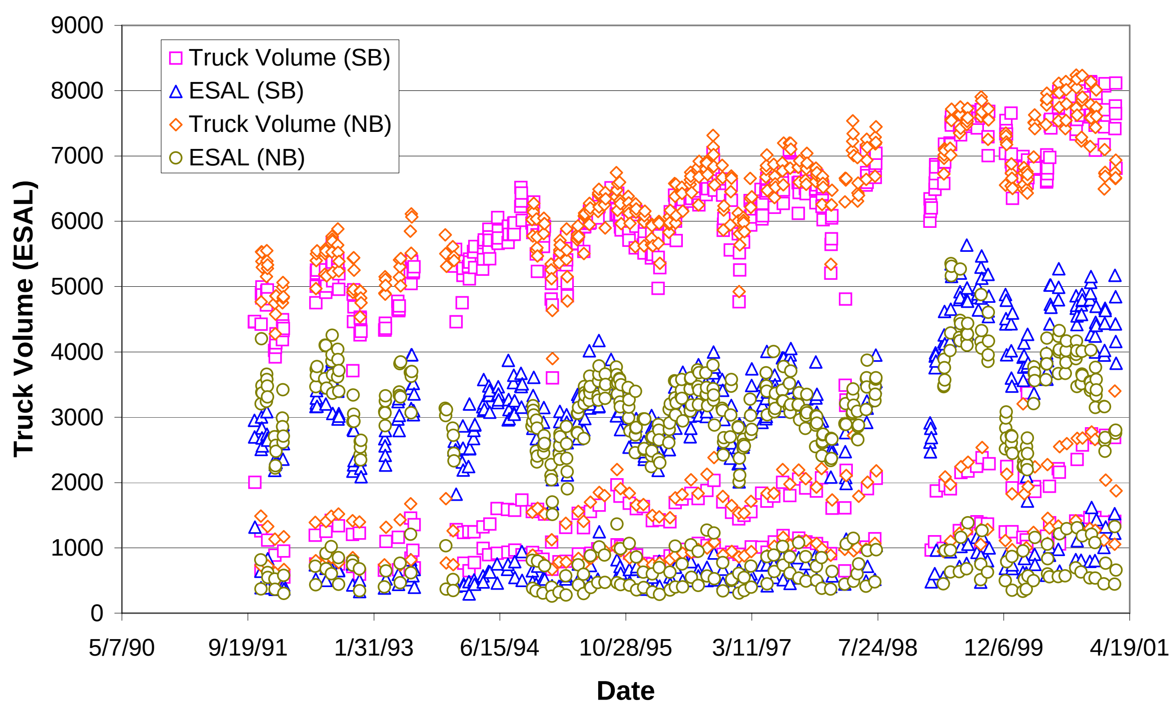


Figure 50. Daily truck volume and ESALs at Site 2 (Stations 17 and 18, Hayward).

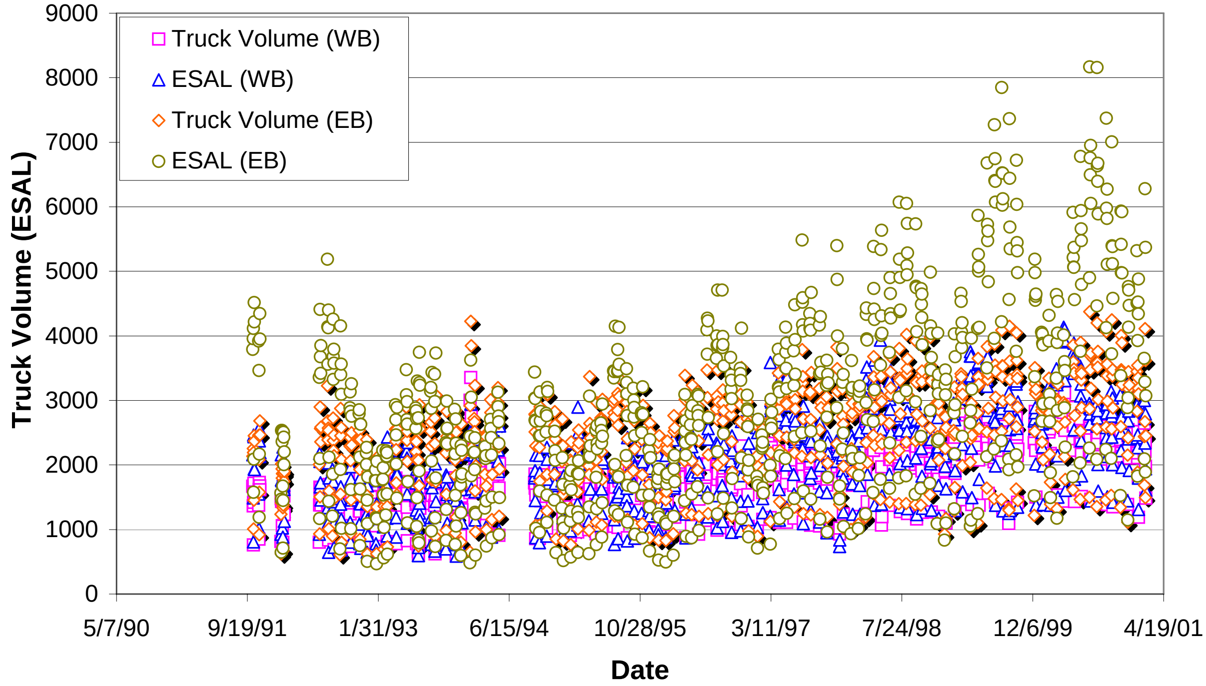


Figure 51. Daily truck volume and ESALs at Site 3 (Station 21, Mojave).

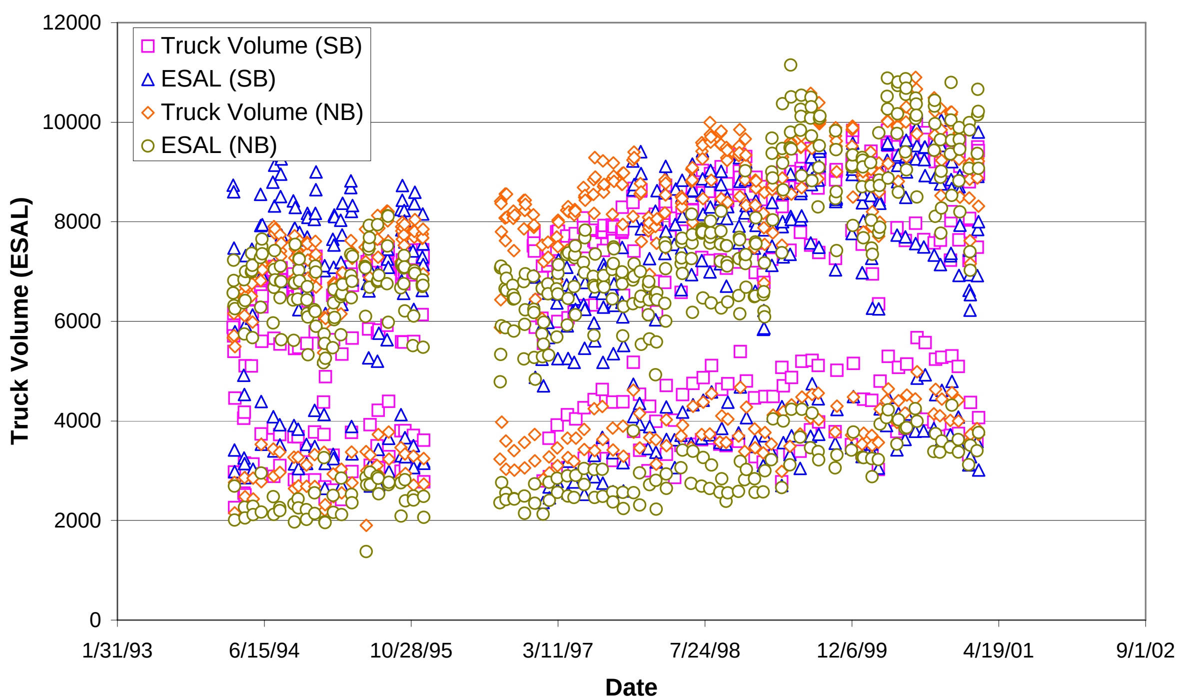


Figure 52. Daily truck volume and ESALs at Site 4 (Stations 47 and 48, Castaic).

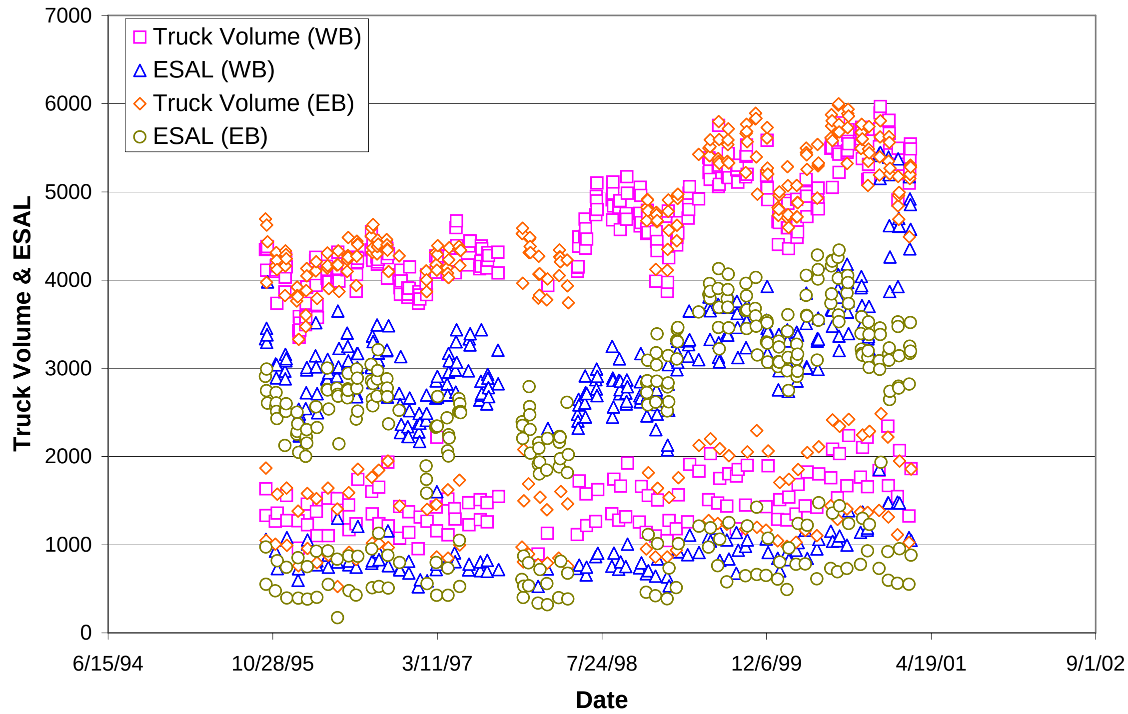


Figure 53. Daily truck volume and ESALs at Site 5 (Stations 57 and 58, Pinole).

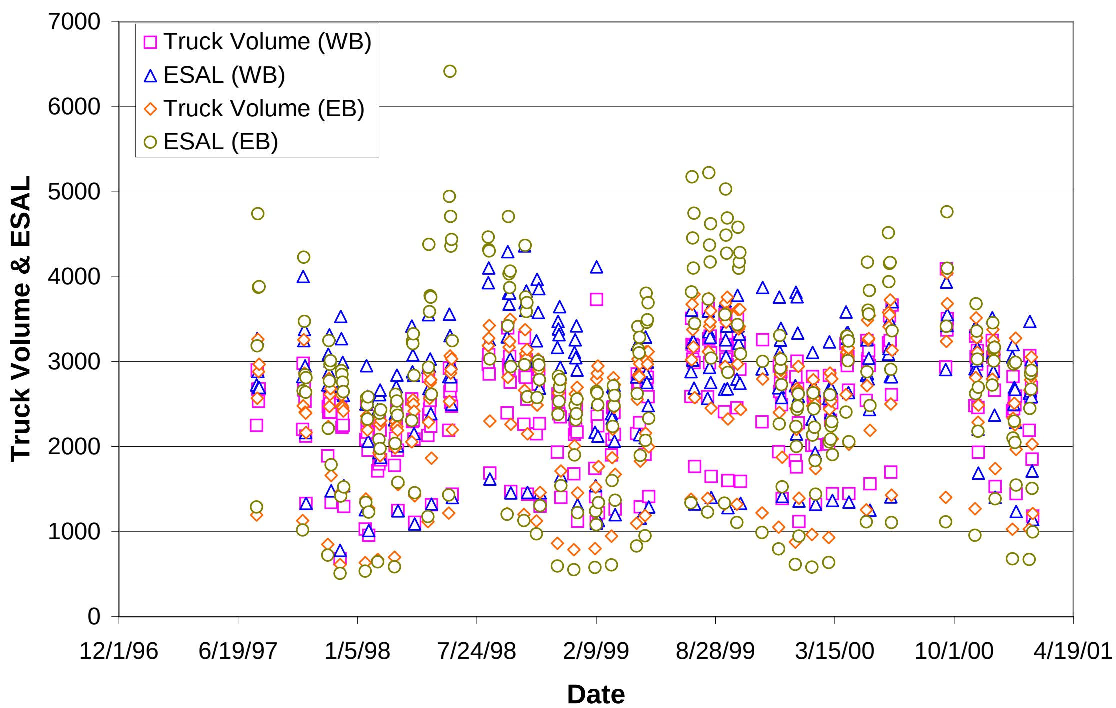


Figure 54. Daily truck volume and ESALs at Site 6 (Station 72, Bowman).

It can also be observed from Figures 49–54 that the traffic volume growth trends are identical for both directions. Moreover, both traffic volume and ESALs show similar growth trends over the time period studied.

However, traffic volume is the better choice to measure trends in truck traffic growth for the following two reasons:

- ESALs have a larger variance than traffic volume. One of the reasons for this is that there are still some erroneous records (e.g., extremely heavy axle load records) in the raw data. Although their percentage is small, they generate erroneously large ESAL numbers due to their heavy loads.
- In the analysis of load spectra, all the identifiable erroneous records were deleted. These records, however, usually represent some real trucks. These records cannot be used to calculate ESALs, but they should be included in the truck volume.

Based on these two reasons, it is more appropriate to use traffic volume to reflect truck traffic growth trend.

Figure 55 shows the AADTT of Site 1 (Station 2), including the volume for each direction of travel individually and both directions combined. Figure 56 shows the AADTT of each truck type at this site.

From Figure 55, it can be observed that the southbound AADTT and the northbound AADTT are almost identical and have the same growth trend.

Using simple linear regression modeling, a linear function was fitted to the AADTT for both directions combined, which is given by:

$$AADTT = -416653 + 211.29 \times year \qquad \textbf{(4)}$$

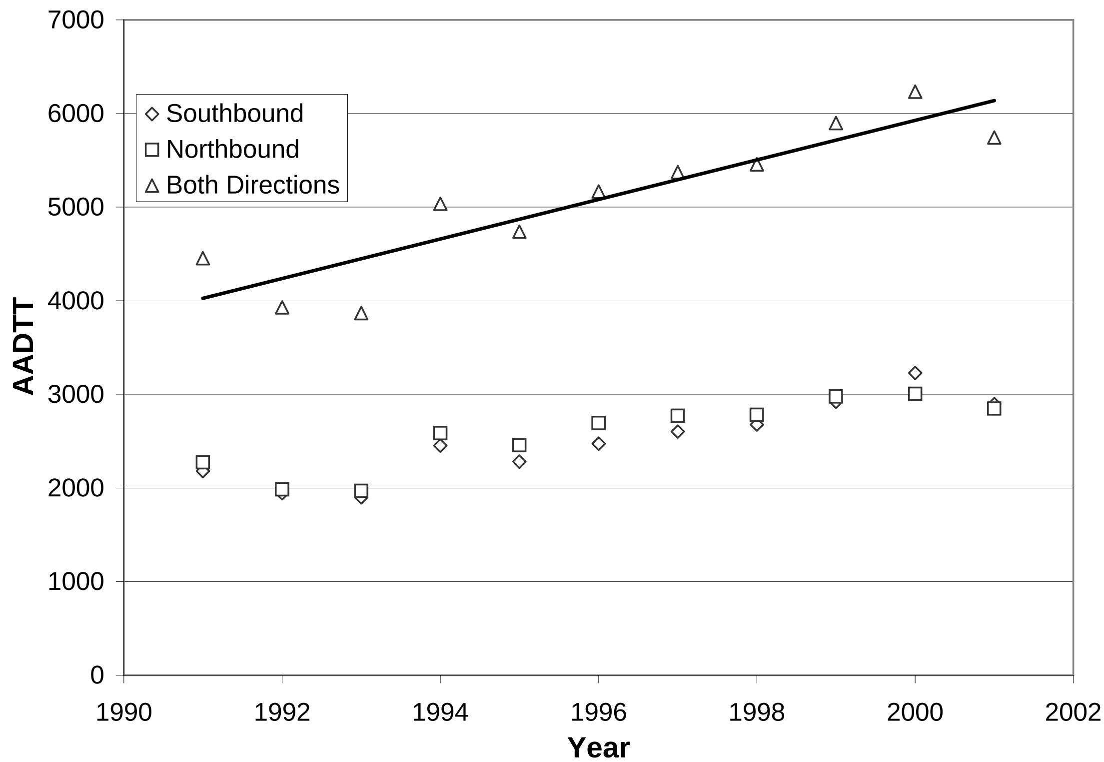


Figure 55. Annual average daily truck traffic (AADTT) at Site 1 (Station 2, Redding).

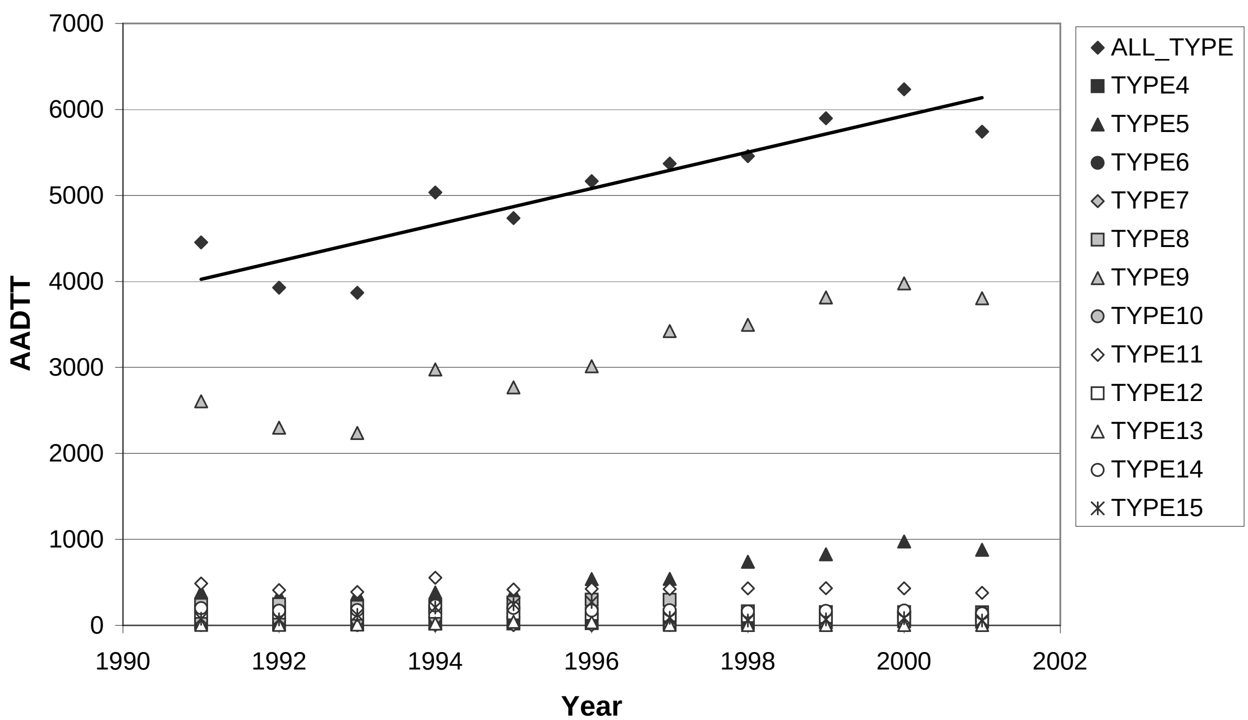


Figure 56. Annual average daily truck traffic of each truck type at Site 1 (Station 2, Redding).

The multiple R-Squared is 0.82, which indicates that the linear relationship between AADTT and year is good.

Using annual growth rate can also be estimated using non-linear regression modeling. The function used in the non-linear regression analysis has the following form:

$$AADTT = b_0 \times (1 + b_1)^{(year-1990)} \quad \textbf{(5)}$$

Where:

b_0 = Coefficient.
b_1 = Annual Growth Rate.

For Site 1, the estimated annual growth rate b_1 of truck traffic volume (both directions combined) is 4.2 percent.

Figure 56 shows that the increase in the total traffic volume was mainly caused by the increase in the volumes of Truck Types 5 and 9 — especially Truck Type 9. Therefore, the growth trend of total traffic volume can be roughly estimated from the growth trend of Truck Type 9. This conclusion is valid with the qualification that if these truck types fall out of favor due to legislation or other causes, then their use as an estimate will no longer be valid.

Similar conclusions for the other 5 sites can be obtained from their AADTT diagrams, which are shown in the appendices, and the estimated annual growth rates listed in Table 19.

Table 19 Estimated Annual Growth Rate of Truck Traffic Volume at 6 WIM sites

Station No.	Annual Growth Rate of Total Truck Traffic (%)	Annual Growth Rate of Type 9 Truck Traffic (%)
2 (Redding)	4.2	5.7
17 & 18 (Hayward)	3.0	2.5
21 (Mojave)	3.9	3.6
47 & 48 (Castaic)	2.4	4.4
57 & 58 (Pinole)	4.9	5.1
72 (Bowman)	2.0	1.3

4.3 Side Wheel Load Difference Analysis

In pavement mechanical analysis, axle load is generally assumed to be distributed equally on the wheels at each end of the axle. The validity of this assumption, however, directly affects pavement performance. Large unequal distribution of axle load will accelerate pavement damage and shorten pavement service life on the side where the heavier wheel travels.

Side wheel load difference can be represented by Side Wheel Load Difference Ratio (SWLDR), which is calculated with the following equation:

$$SWLDR = \left(L_{right} - L_{left}\right) / \left(L_{right} + L_{left}\right) \times 100\% \qquad \textbf{(2)}$$

Where:

L_{right} = Right side wheel load (kN)
L_{left} = Left side wheel load (kN)

The side wheel load difference ratio distributions of the four axle groups at Station 2 are shown in Figures 57 and 58. It can be observed that SWLDR has a normal distribution shape, with most of its values in the range of –20 to +20 percent. The expectations of this distribution are greater than zero and smaller than 3 percent, which means that right-side wheel loads are a little heavier than the left-side loads. This result can be attributed to the transverse slope of the pavement. The SWLDR distributions at the other 5 sites are shown in Appendix E, which gives similar results. These results suggest that the side wheel load difference can probably be ignored in pavement analysis.

4.4 Truck Speed Analysis

Truck speed information is also useful in pavement design. Figures 59 and 60 show the speed distribution of each truck type at Station 2. It can be observed from these figures that the speed of each truck type has a narrow distribution, mainly between 80 km/h (50 mph) and 112

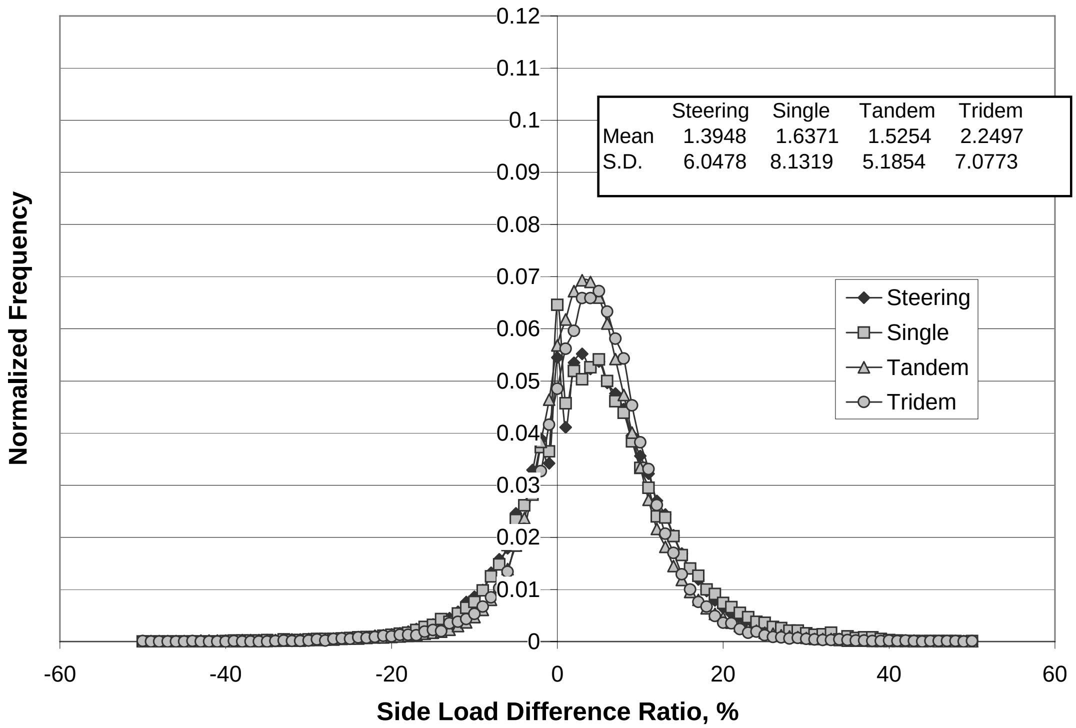


Figure 57. Side wheel load difference ratio distribution, Site 1 (Station 2, Redding), Southbound.

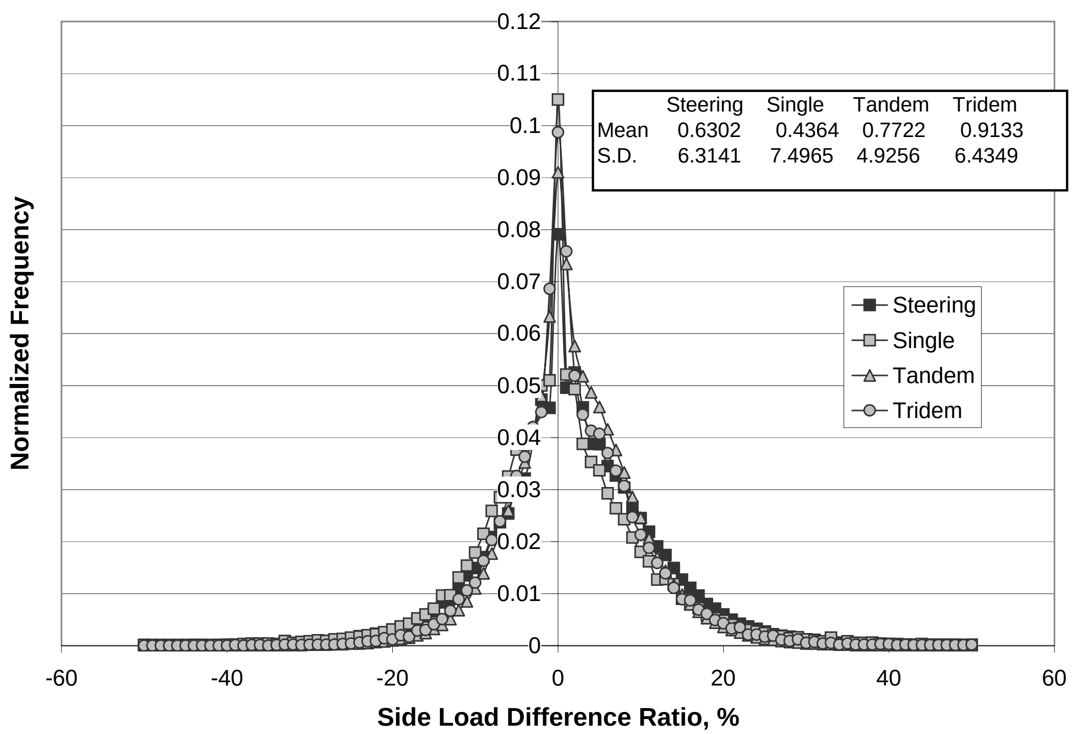


Figure 58. Side wheel load difference ratio distribution, Site 1 (Station 2, Redding), Northbound.

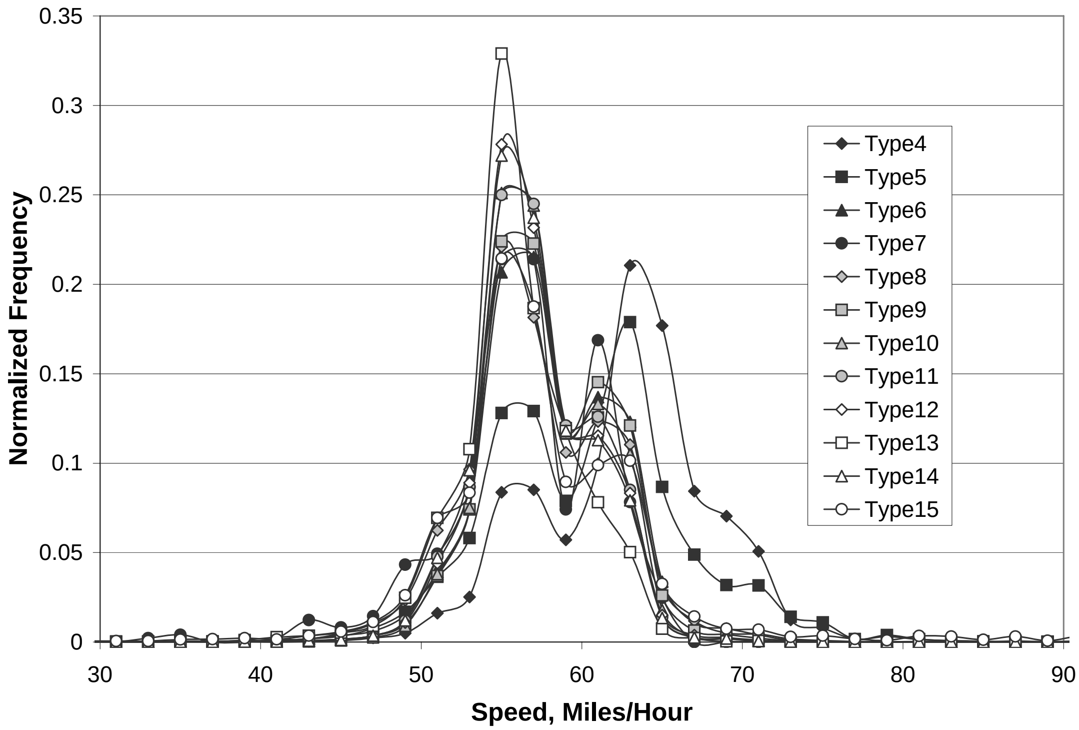


Figure 59. Speed distribution of each truck type at Site 1 (Station 2, Redding), Southbound.

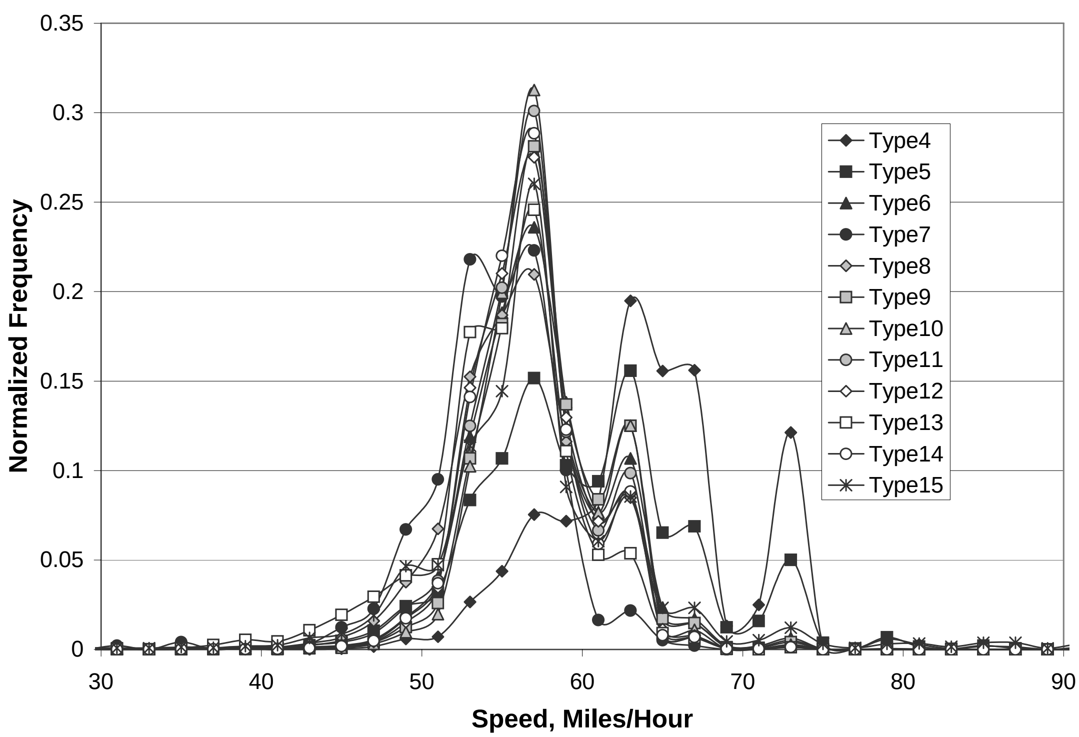


Figure 60. Speed distribution of each truck type at Site 1 (Station 2, Redding), Northbound.

km/h (70 mph), except for the speed distributions of Truck Types 4 and 5, which fall between 80 km/h (50 mph) and 120 km/h (75 mph).

Table 20 gives the average speed of each truck type at the six WIM sites. This table shows that the average speed of each truck is similar between two directions, but different between sites. The table also shows that the average speeds of Truck Type 5 through Truck Type 15 are quite similar at the same site, most of which vary between 80 km/h (50 mile/h) and 96 km/h (60 mile/h).

Table 20 Average Speed Of Each Truck Type at 6 WIM Sites

Station No.	Location	Direction	Speed by Truck Type (km/h)											
			4	5	6	7	8	9	10	11	12	13	14	15
2	Redding	Southbound	103	97	93	90	92	93	92	92	92	90	92	92
		Northbound	103	97	92	87	90	93	92	92	92	89	92	92
17 & 18	Hayward	Southbound	92	87	85	84	85	85	85	85	87	77	87	76
		Northbound	89	84	82	80	82	82	80	84	82	79	84	77
21	Mojave	Westbound	92	87	87	76	84	84	82	76	79	66	84	84
		Eastbound	97	92	93	89	90	92	90	92	92	85	90	90
47 & 48	Castaic	Southbound	101	93	92	85	90	90	90	92	92	85	90	89
		Northbound	100	93	90	84	90	90	90	90	90	84	90	90
57 & 58	Pinole	Westbound	89	85	80	74	80	80	80	79	79	71	77	77
		Eastbound	95	90	87	85	89	89	87	89	89	84	87	84
72	Bowman	Westbound	109	106	101	97	100	101	101	103	103	98	98	95
		Eastbound	105	105	100	95	97	95	95	93	95	93	93	92

4.5 Truck Gross Weight Analysis

The changes in truck gross weight are directly related to the effect that truck traffic has on pavement damage. They can also reflect the economic development of an area. Changes in truck gross weights were analyzed for this report for the period 1991–2000. The legal maximum gross vehicle weight in California is 355 kN (80,000 lbs.).

Because the gross weight of one truck type running on a certain highway has a distribution pattern instead of a single value, it's somewhat difficult to describe its variation trend. One direct method is to draw the gross weight distribution curve of each year in the same diagram and make a visual comparison.

Figures 61–72 show the gross weight distribution of each truck type at Station 2 (Redding) northbound from 1991 to 2000. It can be observed that the gross weight distribution shifts slightly to the right (heavier) over time for Truck Types 6, 8 and 9, and shows no significant change for other truck types except Truck Types 7 and 13, which came from small sample sizes. As Truck Types 5, 6, 8, 9, and 11 make up the majority of total truck traffic volume, it can be concluded that in general, there is a slight increase in the truck gross weight at Station 2. To quantify this increase, the mean value of truck gross weight distribution was computed and fitted with non-linear regression functions. The maximum legal truck gross weight for Truck Type 9 is 356 kN (80,000 lbs.)

Figure 73 shows the yearly averaged truck gross weight at Station 2 northbound.

The fitted annual growth rates at the six sites are shown in Table 21 and Figure 74. The apparent large values of Truck Type 13 were caused by a small sample size and do not have much meaning.

It can be observed that the growth rates of truck gross weight are different between sites and between truck types. Generally the value is between –1 and +2 percent.

Table 21 Annual Growth Rate of Truck Gross Weight at Six WIM Sites.

Station No.	Growth Rate by Truck Type (percent)											
	4	5	6	7	8	9	10	11	12	13	14	15
2	1.54	-0.13	0.75	3.05	3.41	0.95	0.76	1.57	1.81	4.93	0.49	-0.74
17 & 18	0.45	0.07	0.29	0.47	0.78	-0.43	1.04	-0.24	-0.67	3.46	-0.27	3.51
21	0.76	0.89	1.57	-0.17	2.47	0.12	0.44	0.67	0.51	2.59	0.89	-1.80
47 & 48	0.17	0.54	0.69	0.96	1.65	-0.37	-0.88	-0.39	-1.45	0.25	-0.72	1.71
57 & 58	-0.20	-0.10	0.25	-0.49	2.34	0.05	0.61	0.06	0.45	3.36	0.81	0.42
72	-0.06	-2.86	0.99	1.65	0.68	-1.35	0.62	-0.16	-0.15	4.41	-0.41	-6.27

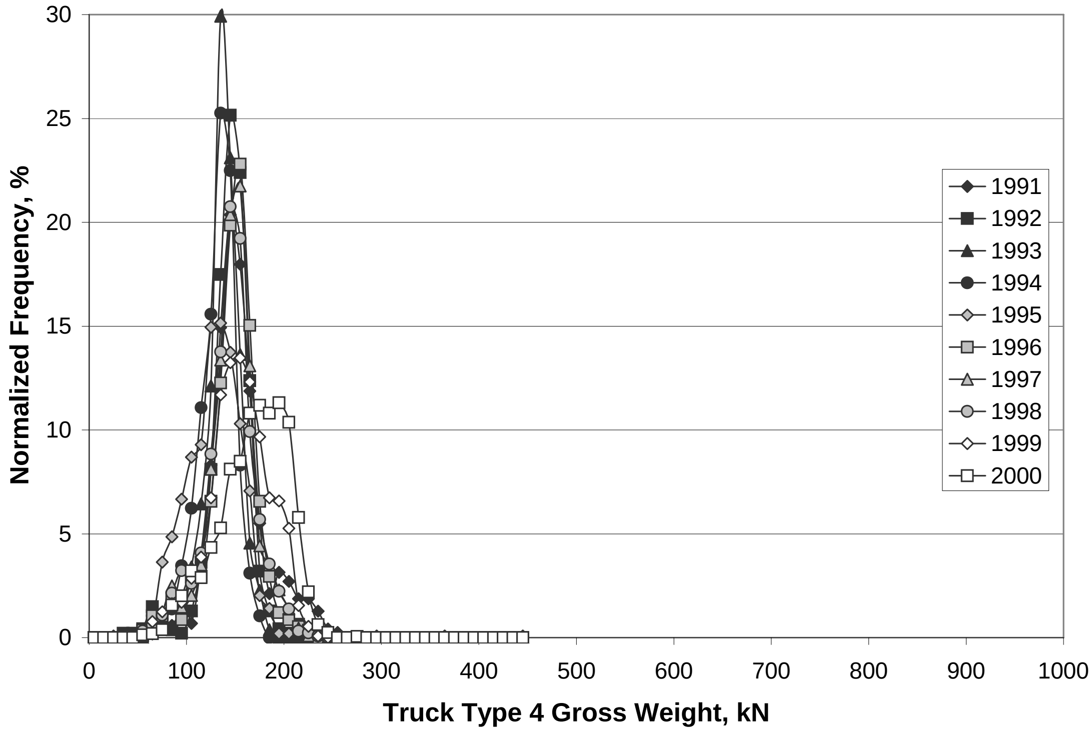


Figure 61. Truck gross weight distribution for Truck Type 4 at Site 1 (Station 2, Redding), Northbound.

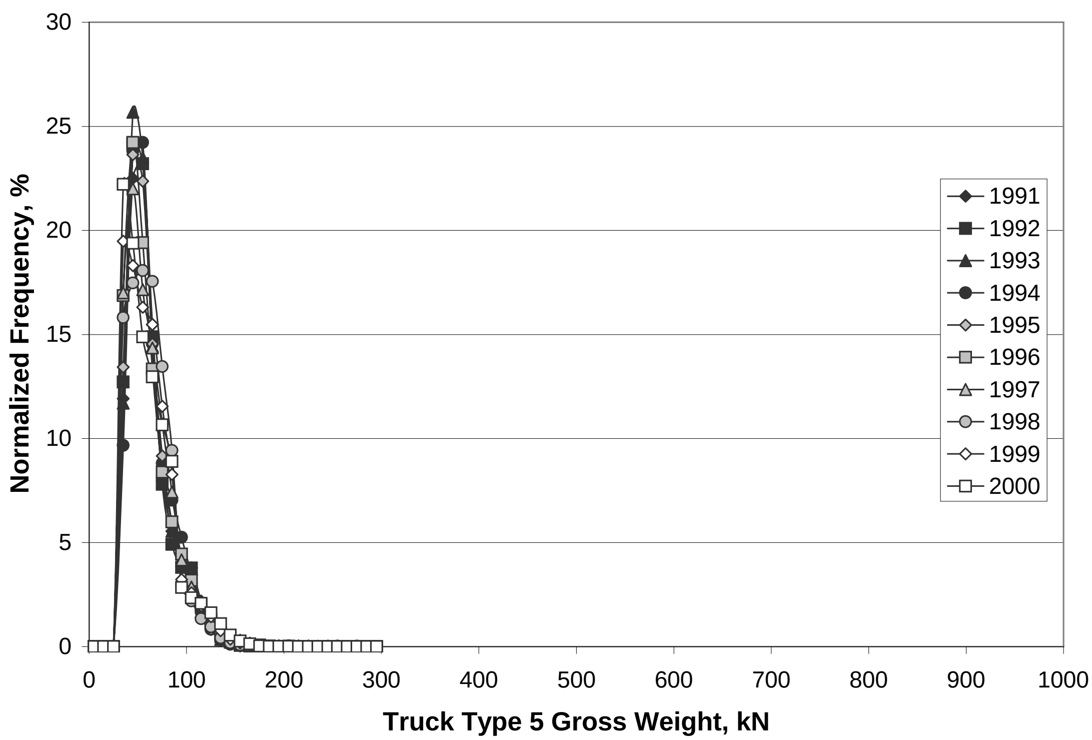


Figure 62. Truck gross weight distribution for Truck Type 5 at Site 1 (Station 2, Redding), Northbound.

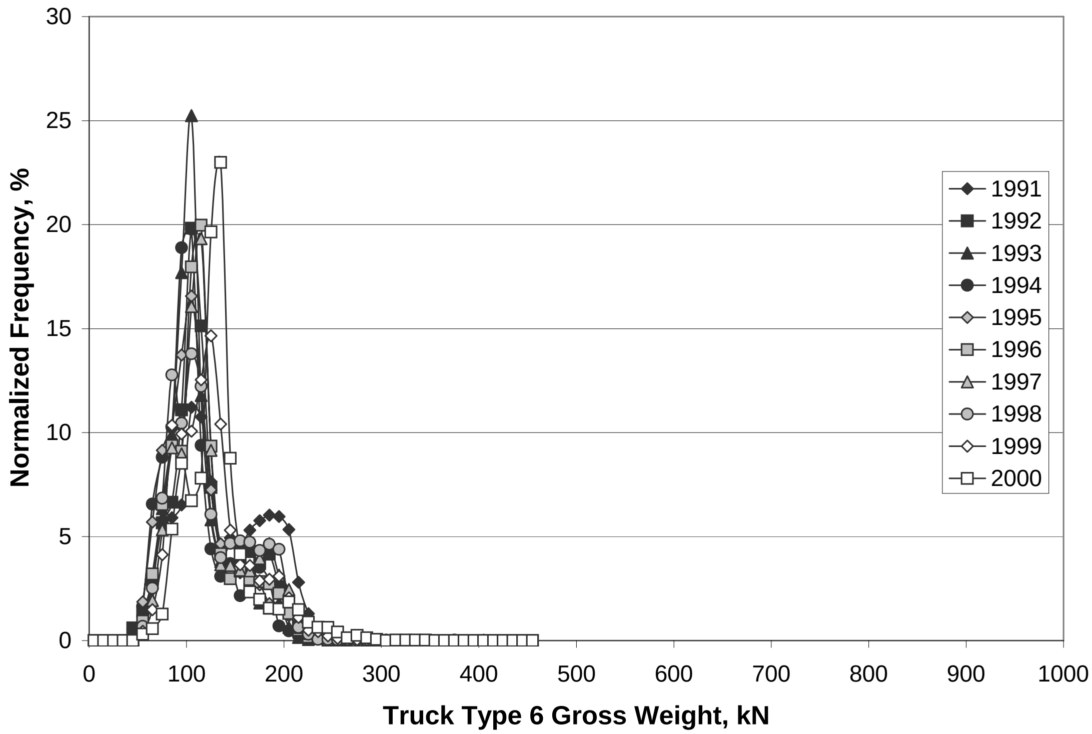


Figure 63. Truck gross weight distribution for Truck Type 6 at Site 1 (Station 2, Redding), Northbound.

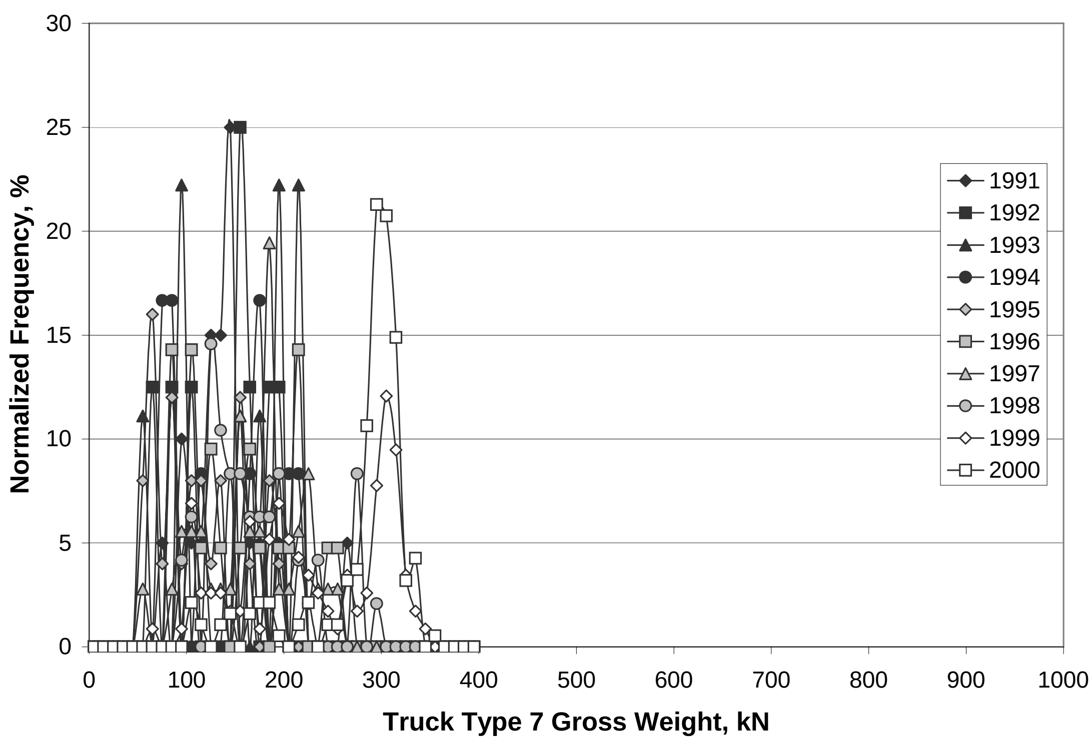


Figure 64. Truck gross weight distribution for Truck Type 7 at Site 1 (Station 2, Redding), Northbound.

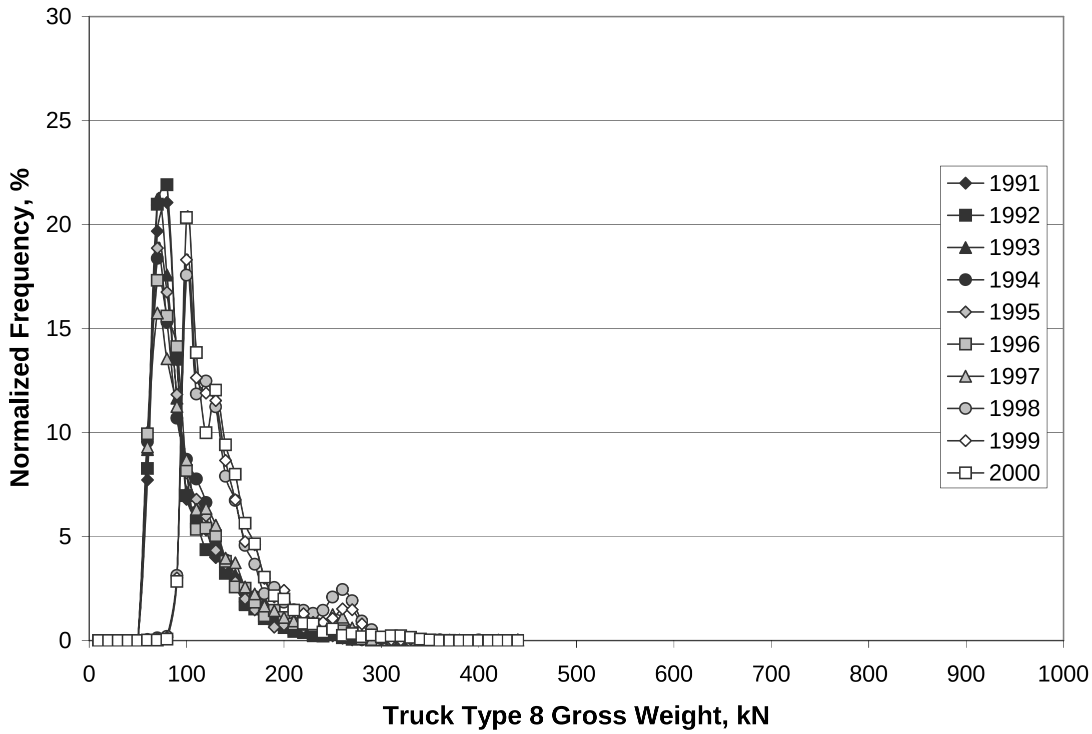


Figure 65. Truck gross weight distribution for Truck Type 8 at Site 1 (Station 2, Redding), Northbound.

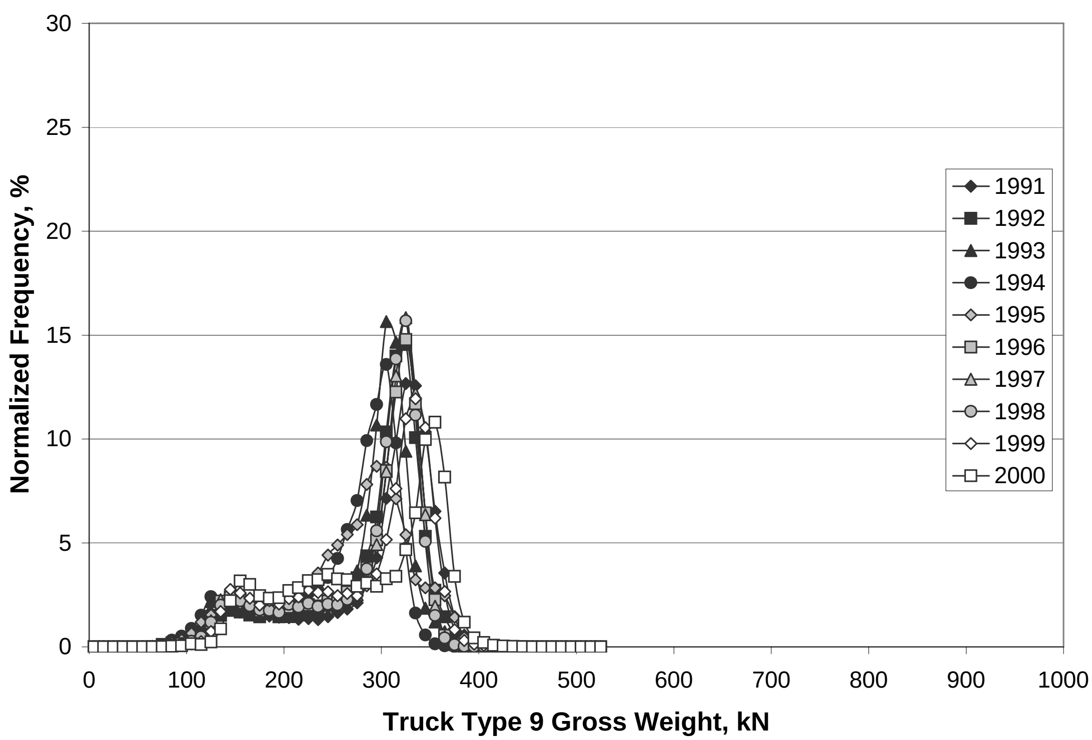


Figure 66. Truck gross weight distribution for Truck Type 9 at Site 1 (Station 2, Redding), Northbound.

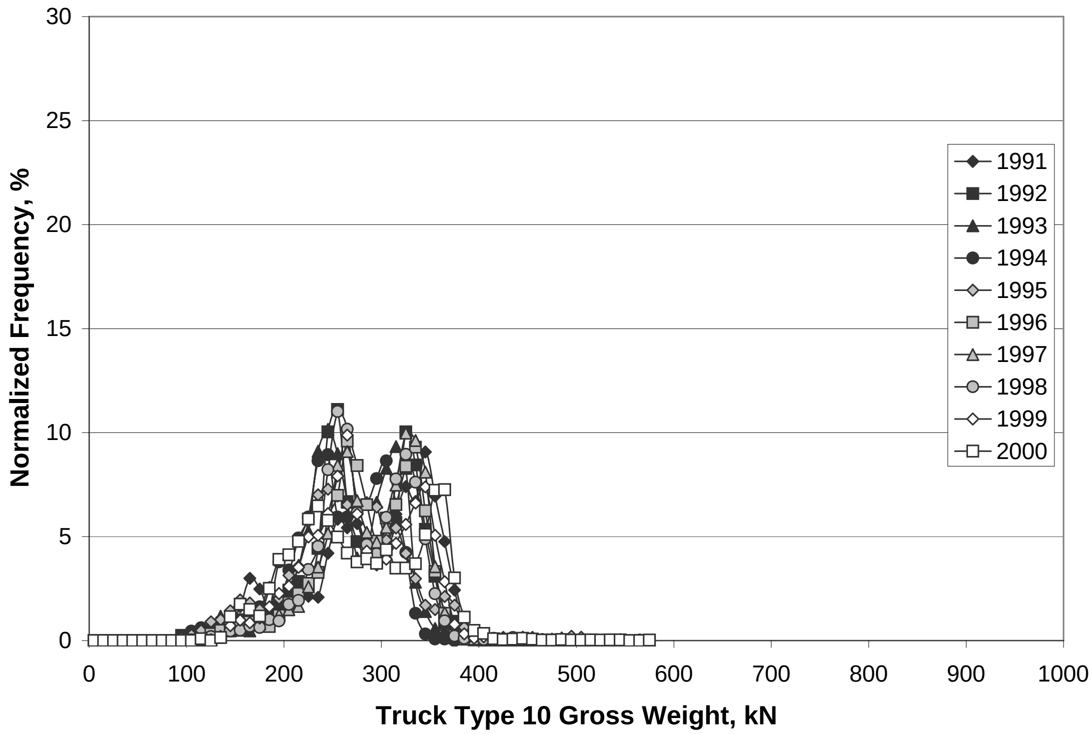


Figure 67. Truck gross weight distribution for Truck Type 10 at Site 1 (Station 2, Redding), Northbound.

Figure 68. Truck gross weight distribution for Truck Type 11 at Site 1 (Station 2, Redding), Northbound.

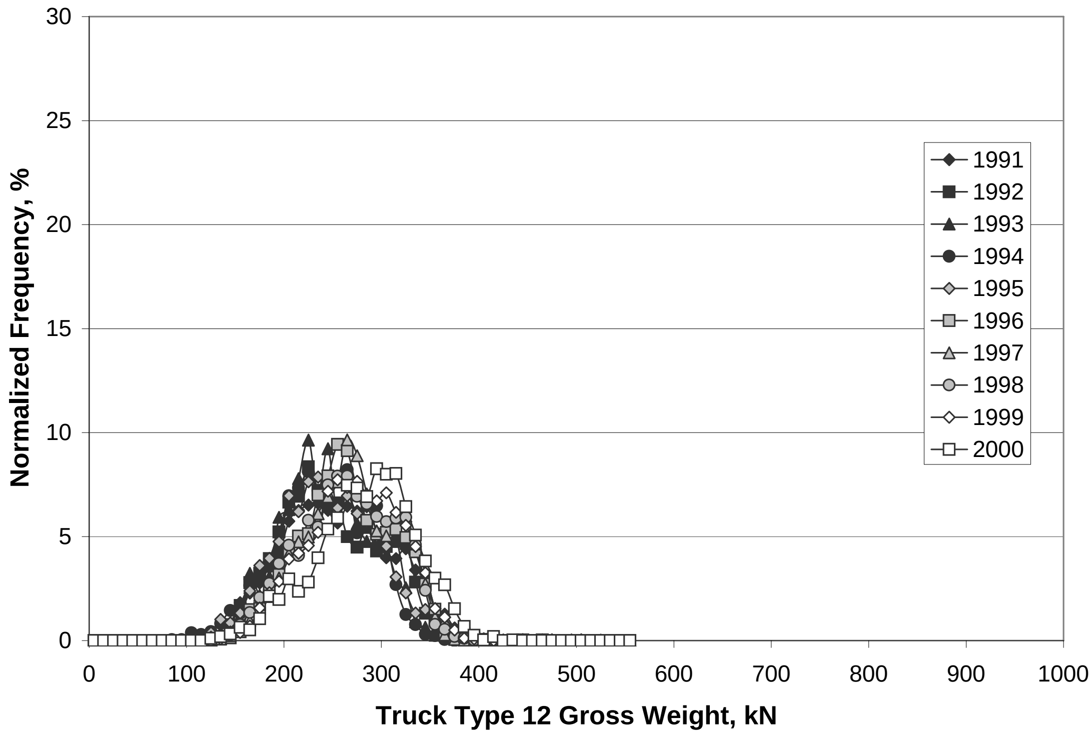


Figure 69. Truck gross weight distribution for Truck Type 12 at Site 1 (Station 2, Redding), Northbound.

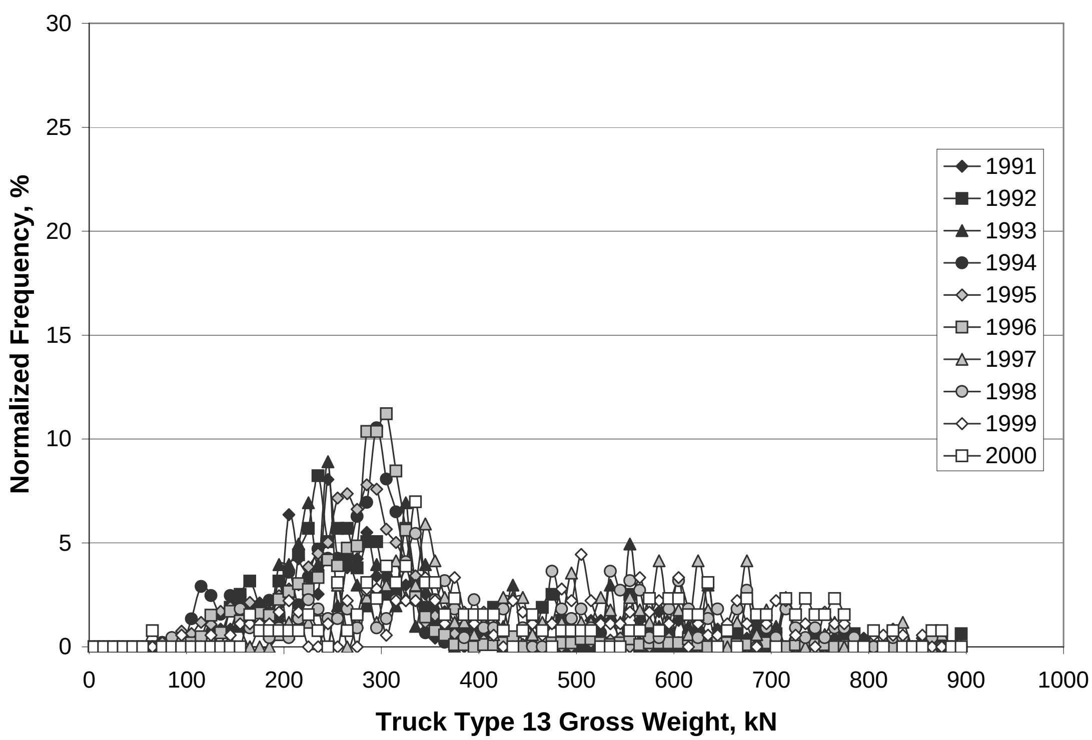


Figure 70. Truck gross weight distribution for Truck Type 13 at Site 1 (Station 2, Redding), Northbound.

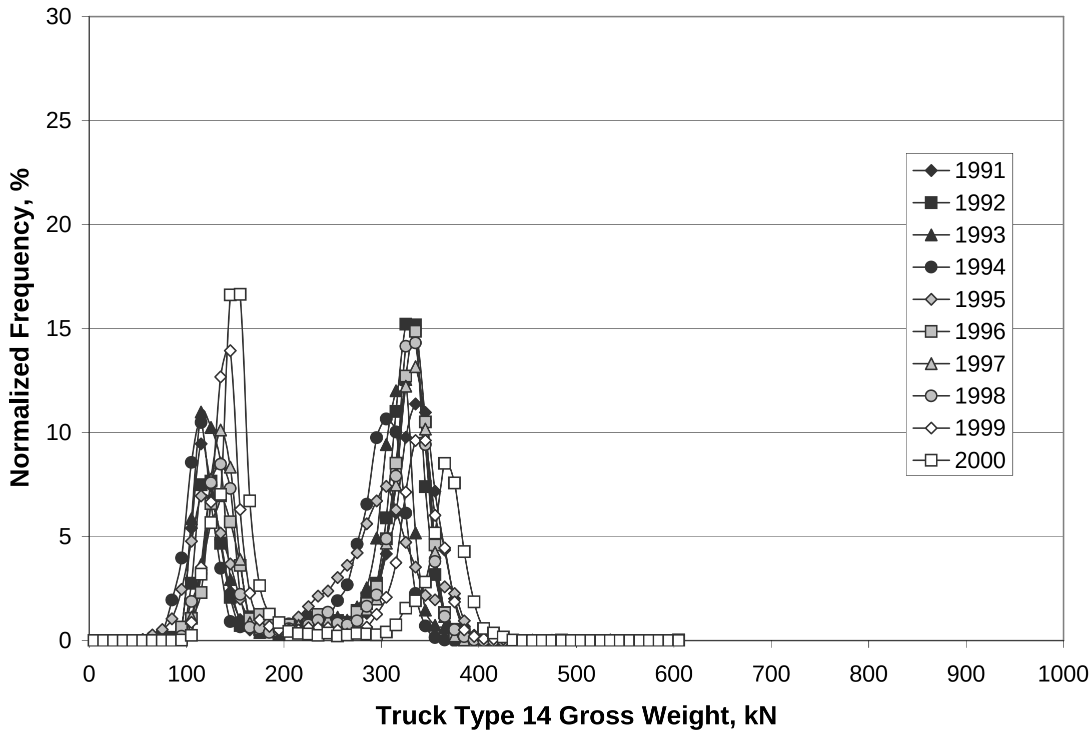


Figure 71. Truck gross weight distribution for Truck Type 14 at Site 1 (Station 2, Redding), Northbound.

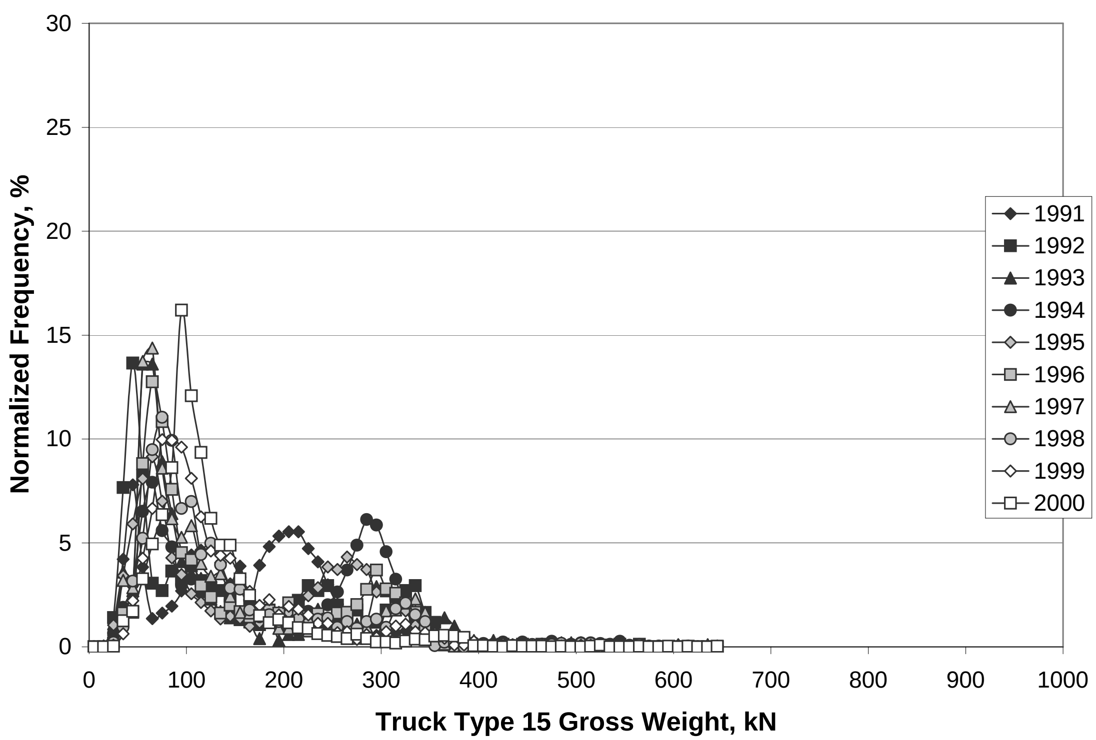


Figure 72. Truck gross weight distribution for Truck Type 15 at Site 1 (Station 2, Redding), Northbound.

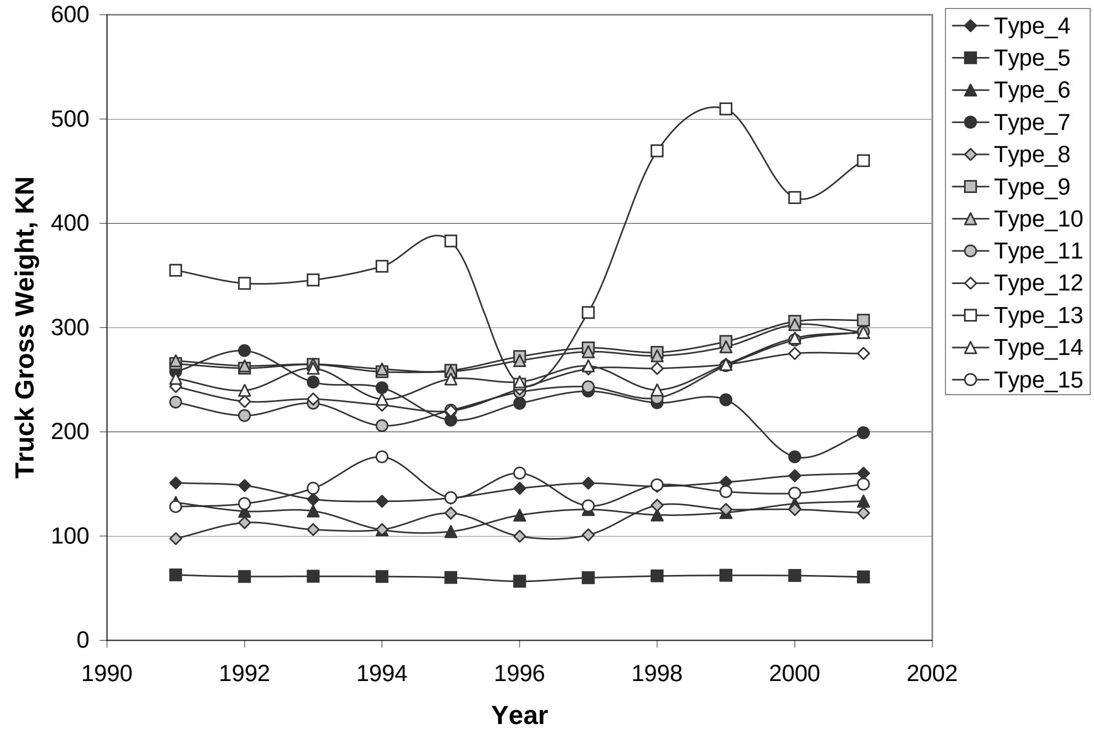


Figure 73. Average yearly truck gross weight at Site 1 (Station 2, Redding), Northbound.

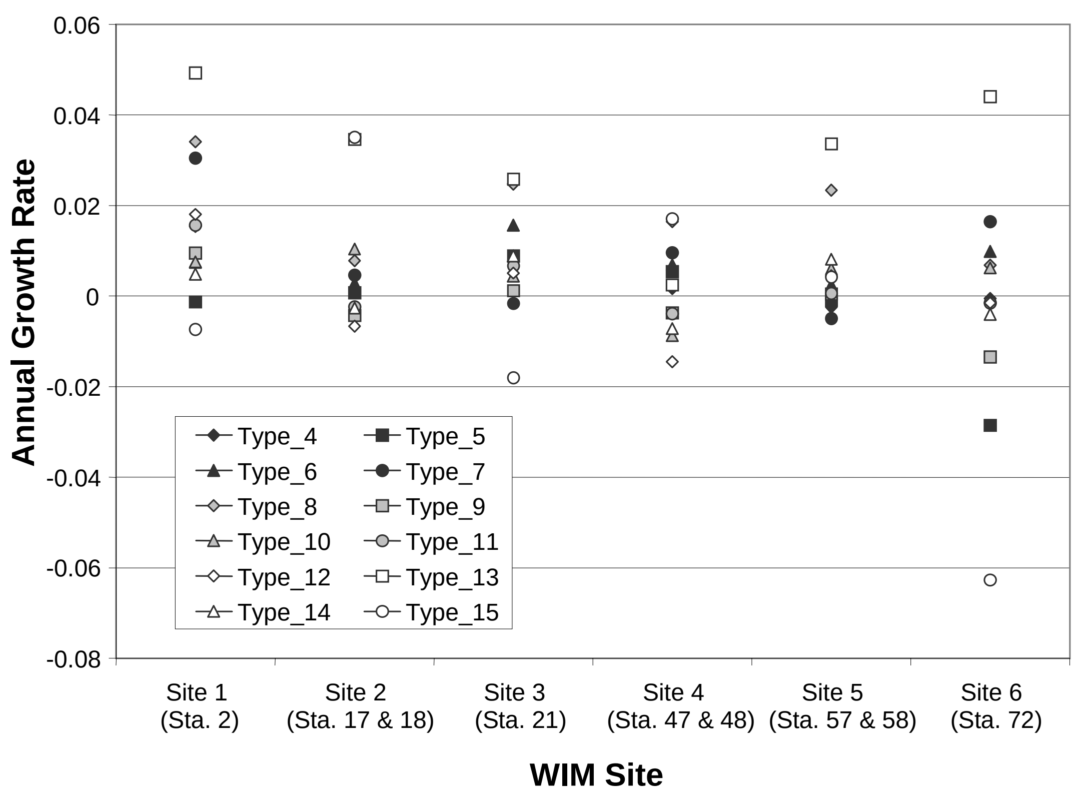


Figure 74. Annual growth rate of truck gross weight at six WIM sites.

5.0 COMPARISON OF TRUCK TRAFFIC AMONG SITES

Although there are more than 100 WIM stations across the state highway system in California and more stations will be installed in the future, there still remain many highway links from which traffic data are not available. It would be useful if the truck traffic characteristics on these links can be inferred from the traffic data from adjacent WIM stations.

The two most important traffic characteristics are axle load spectra and truck traffic volume. In this section, these two factors are compared for selected adjacent WIM sites.

Six WIM station groups were selected according to their geographic distribution, which is shown in Table 22 and Figure 75. All these station groups are located in areas with low WIM station density, and all WIM stations in one group are close to each other geographically.

Table 22 Six WIM Station Groups Compared

Group No.	WIM Stations Included
1	20, 86, 93
2	2, 28, 30
3	21, 73, 74
4	25, 66, 71
5	43, 76, 94
6	22, 23, 26

Load spectra coefficient (LSC) was used to compare the load spectra of each axle group, and AADTT (both directions combined) from year 2000 was used to compare truck traffic volume of each site. Their values are presented in Table 23. Load spectra coefficients are also shown in Figures 76 through 81.

It can be observed from the data presented in Table 23 that for Groups 2, 5, and 6, the LSCs are close to one another for all four axle groups. For Groups 1, 3, and 4, the LSCs of tandem and tridem axles are significantly across the stations in the group, but the LSCs of the

Table 23 Load Spectra Coefficient and AADTT of Six WIM Station Groups

Group	WIM Station	Load Spectra Coefficient				AADTT
		Steering	Single	Tandem	Tridem	
1	Station 20	0.083	0.300	0.863	0.190	1446
	Station 86	0.079	0.303	0.739	1.912	2057
	Station 93	0.050	0.185	0.446	0.161	561
2	Station 2	0.108	0.322	0.739	0.279	6234
	Station 28	0.094	0.357	0.751	0.258	1054
	Station 30	0.098	0.301	0.737	0.229	5689
3	Station 21	0.078	0.295	0.615	0.267	5443
	Station 73	0.111	0.300	0.532	0.214	7604
	Station 74	0.087	0.288	0.405	0.172	8529
4	Station 25	0.101	0.340	0.738	0.339	5824
	Station 66	0.107	0.342	0.589	0.238	6584
	Station 71	0.114	0.334	0.746	0.222	3784
5	Station 43	0.070	0.271	0.545	0.200	1782
	Station 76	0.068	0.242	0.465	0.202	3616
	Station 94	0.085	0.208	0.487	0.215	3123
6	Station 22	0.067	0.213	0.405	0.279	1666
	Station 23	0.072	0.241	0.429	0.270	3217
	Station 26	0.079	0.175	0.394	0.289	1811

steering and single axles are similar. This means that it is possible to extend the axle load spectra of available WIM stations to adjacent sites where WIM stations are not installed, especially for the load spectra of steering axle and single axle. But this interpolation should be made judiciously according to results from these adjacent WIM stations. These LSCs/Truck Factors can probably be improved by inclusion of additional information such as area economic factors, local population, and highway direction.

Table 23 shows that AADTT varies widely in each group and therefore the interpolation of AADTT is not useful. However, this value can be obtained from the *Annual Average Daily Truck Traffic on the California State Highway System* compiled by Traffic and Vehicle Data Systems, which can be obtained from Caltrans *(6)*.

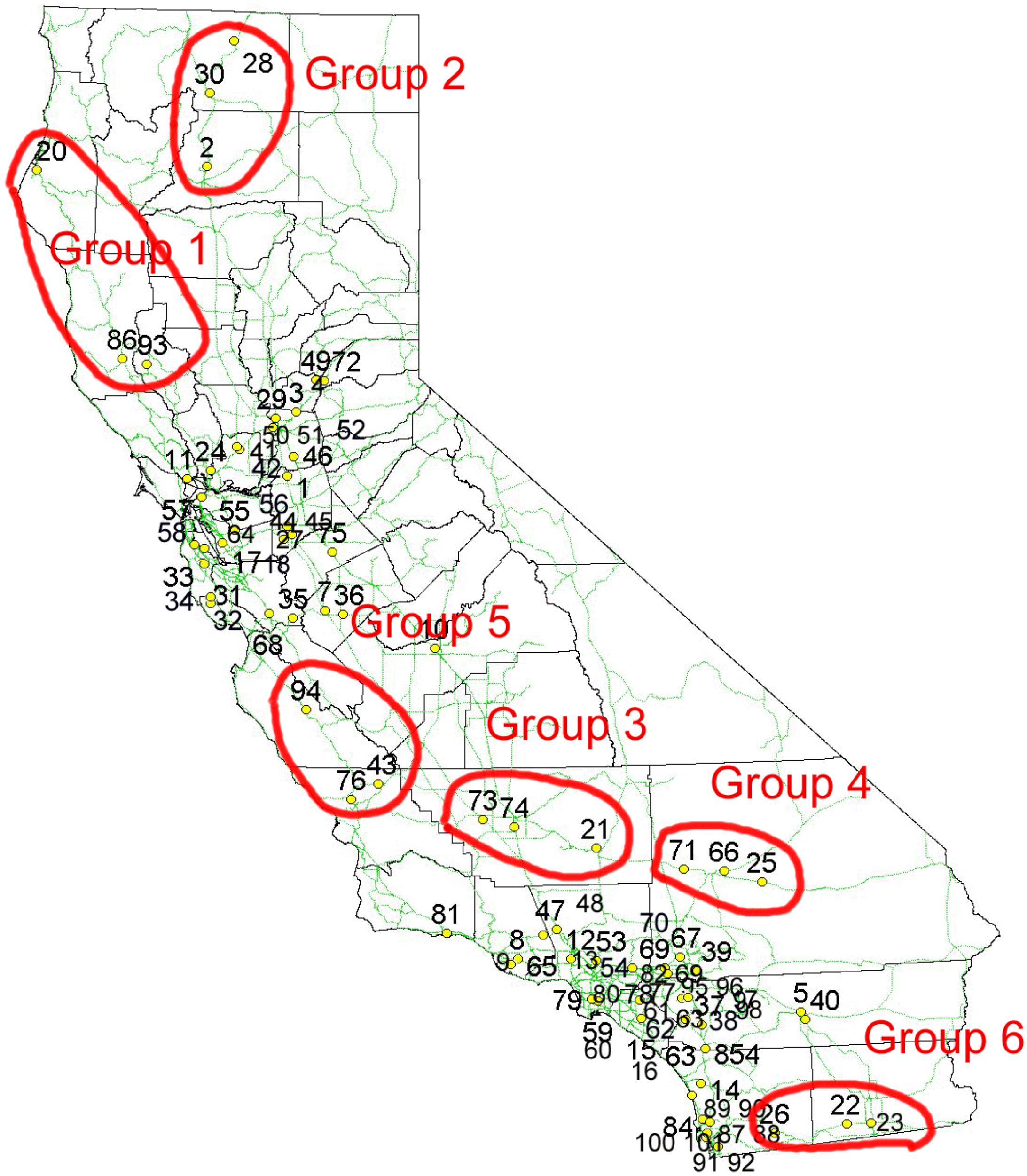


Figure 75. The six WIM station groups used in comparison.

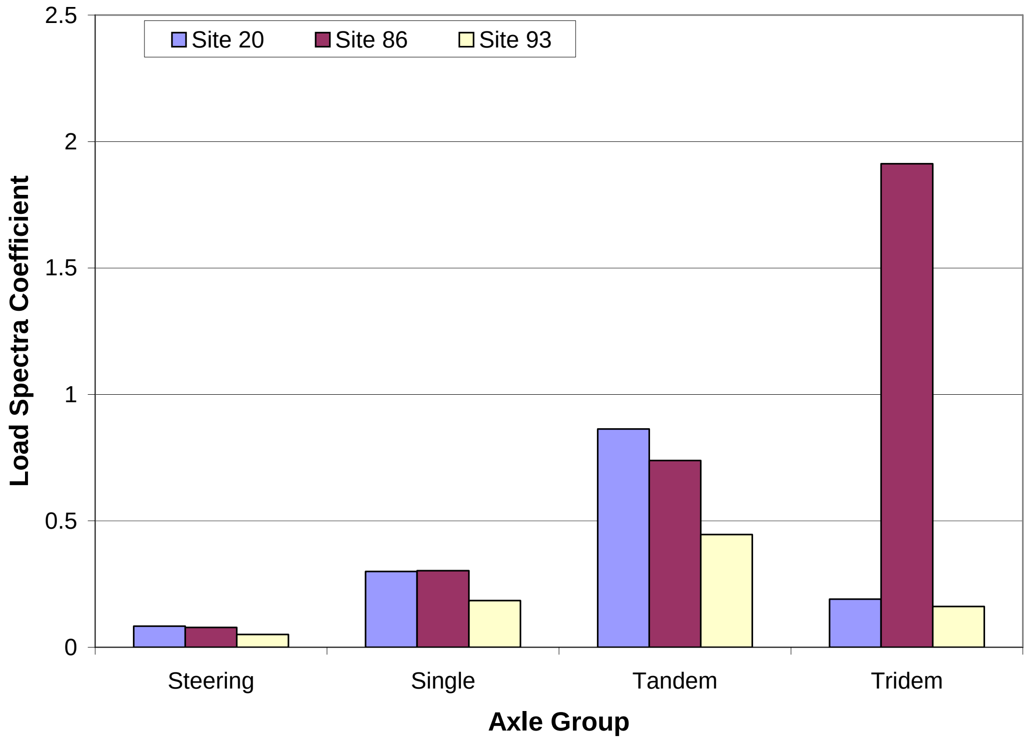


Figure 76. Comparison of load spectra coefficients from Group 1.

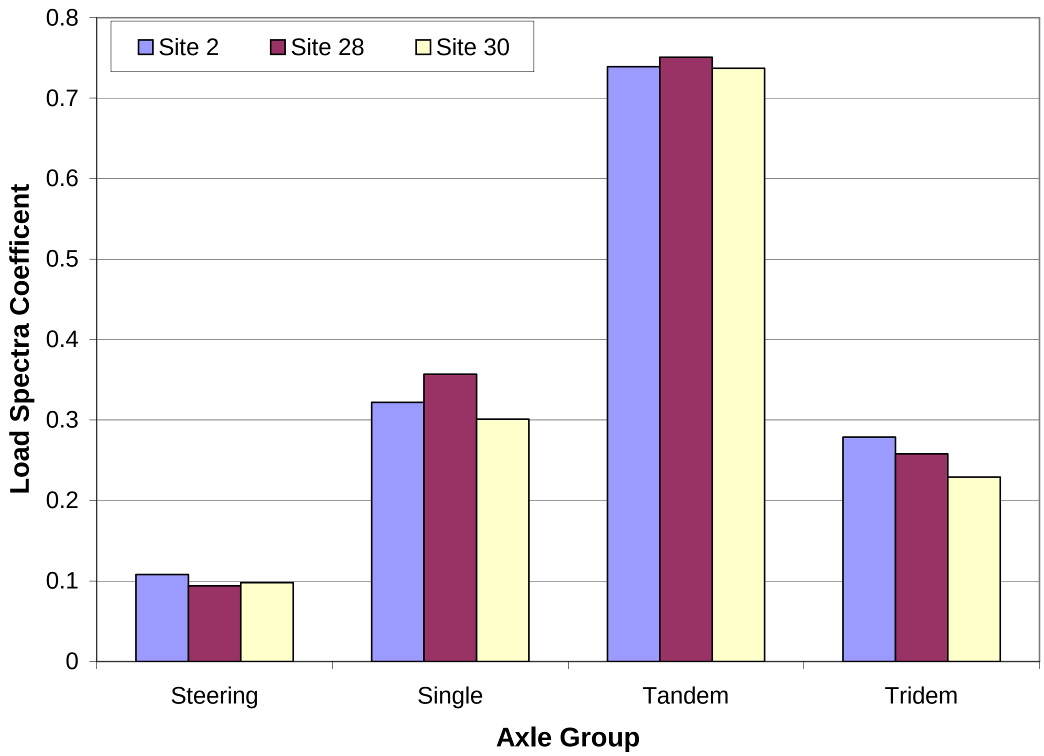


Figure 77. Comparison of load spectra coefficients from Group 2.

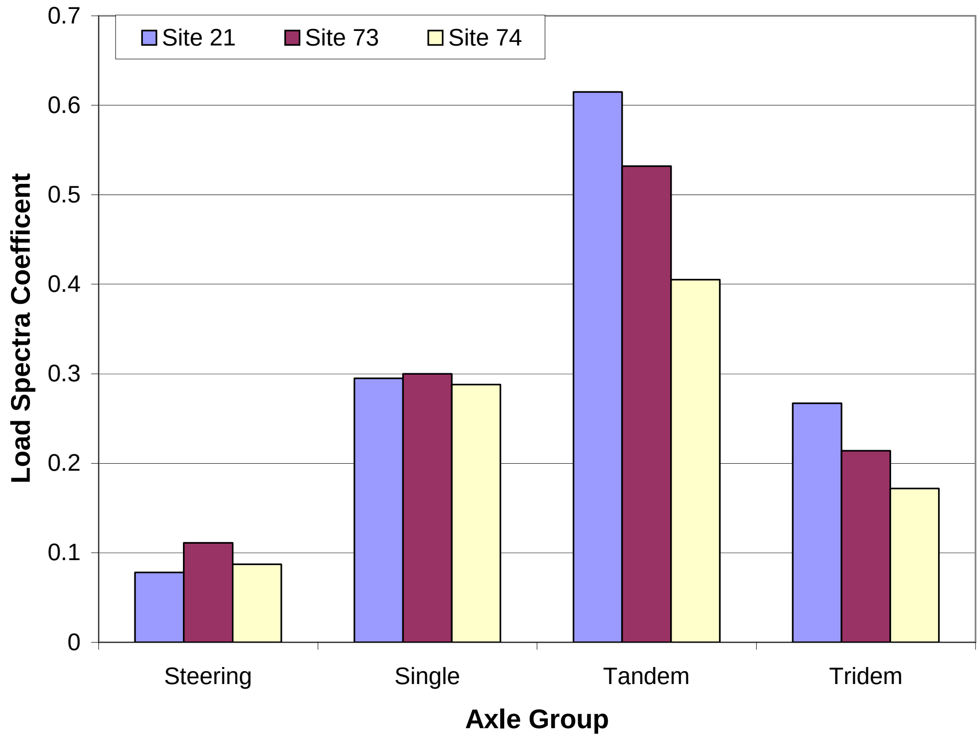


Figure 78. Comparison of load spectra coefficients from Group 3.

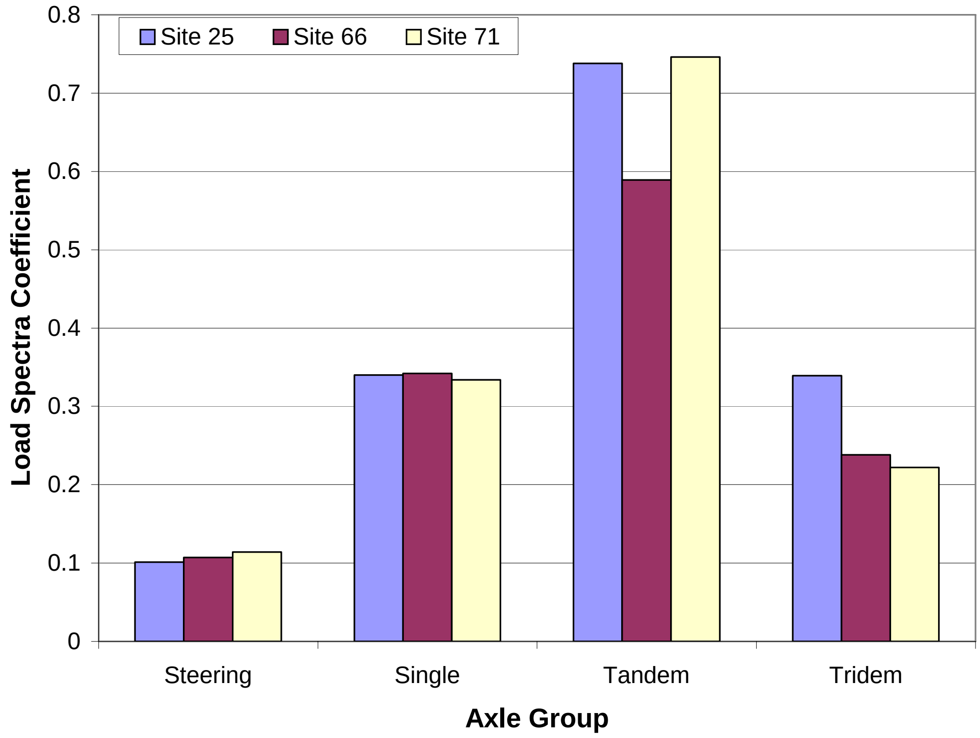


Figure 79. Comparison of load spectra coefficients from Group 4.

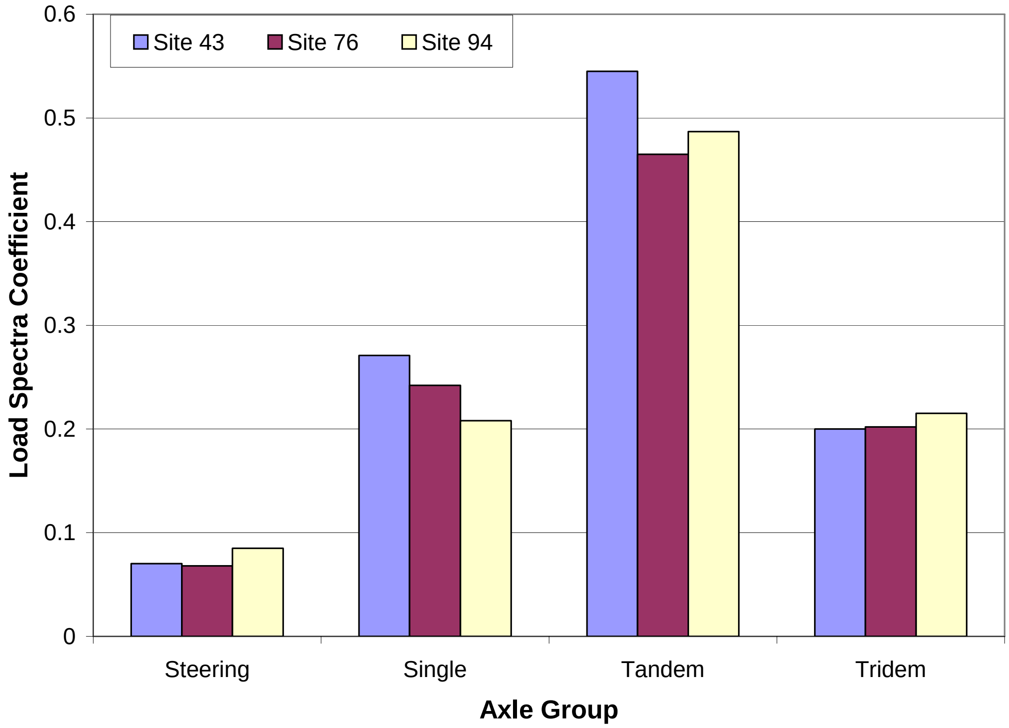


Figure 80. Comparison of load spectra coefficients from Group 5.

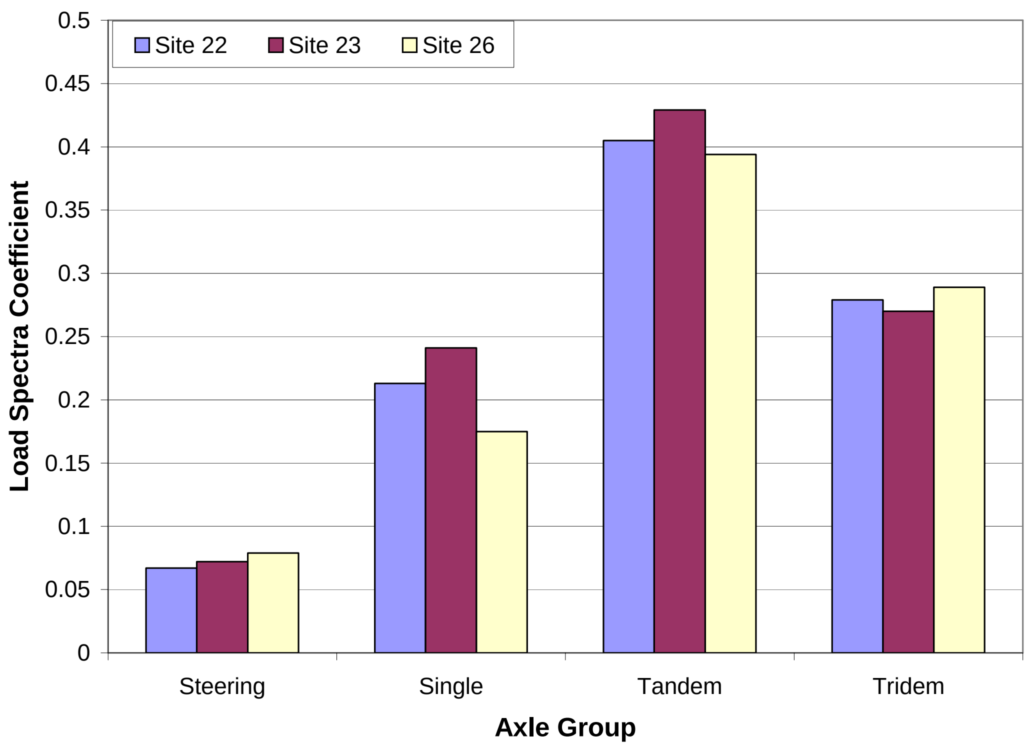


Figure 81. Comparison of load spectra coefficients from Group 6.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The complete truck traffic data collected from more than 100 WIM stations on the California state highway network since 1991 were sampled and used in this analysis. For sites where WIM stations were installed in the late 1990s, conclusions on truck traffic growth trend may not be reliable because of the small sample size. The computer program developed in this project to perform the analyses included in this report can accommodate more data collected in the future, which will make future analysis results more accurate.

6.1 Summary

The database of Weigh-In-Motion (WIM) axle load and truck traffic count measurements collected by the Caltrans from early 1991 through 2001 was converted from binary format, cleaned, and organized into an accessible relational database. This database includes data from more than 100 stations that were installed during that time.

Once the database was set up, a research-grade computer program was developed to analyze the massive amount of data with the goal of answering specific questions of interest for pavement design and management. Some questions were analyzed using the full data set from all WIM stations, although only data from one week per month were analyzed because of the time required to perform the analyses on the complete data set. Other questions were analyzed using only data from six representative WIM stations, again because of the time required to perform the analyses on the huge database.

The analyses performed for this study and included in this report are by no means exhaustive, and were intended to answer a few important questions as well as to demonstrate the quality and potential uses of the data included in the database. For sites where WIM stations were installed in the late 1990s, conclusions regarding truck traffic growth trends may not be reliable because of the small sample size. The computer program developed for this project can accommodate more data collected in the future.

6.2 Conclusions Regarding Axle Load Spectra

6.2.1 Analysis of the Full Data Set

The following conclusions were drawn from analysis of the full data set of all WIM stations across the time they were in operation:

1. A very small number of extremely high axle loads in the database are probably due to error in the equipment and were not included in the analyses. A very few of these loads may be real, and may represent permitted as well as illegal overloads.
2. Across all truck types operating in California:
   a. nearly all steering axle loads are less than 90 kN,
   b. nearly all of the single axle loads are less than 110 kN,
   c. nearly all of the tandem axle loads are less than 210 kN, and
   d. nearly all of the tridem axle loads are less than 260 kN.

   The legal load limit for single axle loads is 89 kN, and the legal limit for tandem axle loads is 151 kN. It is clear that there is a small, but significant portion of the axle loads that are over the legal limit.
3. All four axle types had a bimodal pattern of load spectra. The reasons for these bimodal patterns varied. For tandem axles, the bimodal pattern is due to the empty and full loading status of Truck Type 9 (the predominant truck type, consisting of a tractor with a tandem axle and a single semi-trailer with a tandem axle [3S2]). For

the other three axle types, the bimodal pattern is caused by the different loading levels associated with the various truck types.

4. Axle load spectra are heavier at night than in the daytime. Two possible reasons for this are that it is more efficient to operate when car traffic is lighter, and that heavier and potentially overloaded trucks operate more at night when more Highway Patrol load enforcement stations are closed.
5. Axle load spectra show very little seasonal variation. This contradicts the assumption that truck loads are significantly influenced by agricultural hauling during the harvest season (fall).
6. Axle load spectra are much higher in the Central Valley than in the Bay Area and Southern California, particularly for tandem axles. Axle load spectra in the Southern California are higher than those in the Bay Area.
7. Axle load spectra are much higher at rural WIM stations compared to urban WIM stations. This is likely due to the presence of more long-haul trucking at rural WIM stations, and more short-haul, less-than-full-load trucking in urban areas.
8. The predominant truck types across the state are Truck Type 9, accounting for 49 percent of all trucks, and Truck Type 5 (two-axle truck with dual tires at the back [2D]), accounting for 23 percent of all trucks. Truck Type 11 (tractor with single axle, one semi-trailer with a single axle and another trailer with single axles [2S12]) accounted for 8 percent of all trucks, and the rest of the truck types together accounted for the remaining 20 percent of all trucks.
9. The proportion of larger truck types, which would more typically be used for long-haul trucking, increases at night, with Truck Type 9 accounting for 56 percent of all

trucks at night. The proportion of smaller truck types, such as Truck Type 5, that would more typically be used for shorter deliveries decreases at night.

10. Truck type distribution does not change much across the seasons.

6.2.2 Conclusions from Analysis of the Six Representative WIM Sites: Axle Load Spectra, Truck Traffic Volumes, and Equivalent Single Axle Loads (ESALs)

The following conclusions were drawn from a set of six WIM sites selected to represent different combinations of direction (east/westbound versus north/southbound), region (Bay Area, Central Valley and Southern California), and urban versus rural:

11. Steering axle load spectra were similar across all six stations.
12. Axle load spectra for other axle types varied considerably across the six stations.
13. Axle load spectra were similar for both directions.
14. Axle load spectra were much heavier in the outside lanes.
15. Axle load spectra for steering and single axles remained fairly constant across the years. Axle load spectra for tandem and tridem axles exhibited yearly variation.
16. The right-side (outside) ends of each axle were heavier on average than the left-side ends, which can probably be attributed to the transverse slope of most facilities. The difference was typically less than 3 percent on average, which indicates that it is probably not significant enough to include in pavement design calculations.
17. For facilities with two lanes in each direction, more than 90 of the truck traffic traveled in the outside lane. For facilities with three or more lanes in each direction, more than 90 percent of the truck traffic traveled in the two outside lanes. The distribution of trucks across those two outside lanes varied across the six sites.

18. All six sites showed growth of Average Annual Daily Truck Traffic (AADTT), with growth rates ranging between 2 and 5 percent.
19. The daily truck traffic volume varies in a sinusoidal waveform, reaching the highest between August and November, and the lowest between January and April.
20. The growth rates for different truck types varied considerably.
21. Equivalent Single Axle Loads (ESAL) were calculated for each site and growth trends were estimated for ESALs. Equivalent single axle loads were calculated using the Caltrans exponential function with a 4.2 exponent. However, the growth trends were erratic, primarily because a few very heavy and possibly erroneously measured loads significantly influenced the ESAL calculations.

6.2.3 Conclusions from Analysis of the Six Representative WIM Sites: Truck Speeds and Gross Vehicle Weights

22. Truck speeds typically fall within the range of 80 to 120 km/h (50 to 75 mph).
23. Truck speeds vary by truck type.
24. Examination of the truck speed distributions at Station 2 on Interstate 5 in Redding indicated that many truck types have a bimodal speed distribution, which may reflect loaded trucks traveling more slowly than unloaded trucks.
25. Gross Vehicle Weights (GVW) generally did not grow across the six sites. Annual growth rates of GVW typically ranged between –1 and +2 percent. This conclusion combined with conclusion 18, indicates that there were increasing numbers of trucks using California highways in the 1990s, but the trucks were generally not carrying heavier loads.

6.3 Conclusions Regarding Extrapolation of WIM Data to Adjacent Sites

The following conclusions are drawn from comparison of data from adjacent WIM sites:

26. Truck traffic volumes (AADTT) cannot be extrapolated from one site to another, and must be measured for each site.
27. Axle load spectra, as characterized by Load Spectra Coefficients ([LSC] similar to truck factors) can generally be extrapolated for steering and single axles to adjacent sites. Differences in LSC for tandem and tridem axles are larger and more common among adjacent sites, which means that extrapolation to adjacent sites for design is more risky. The effect of extrapolation of axle load spectra to adjacent sites was not quantified for different pavement types.

6.4 Recommendations for the Use of the WIM Database

1. It is recommended that Caltrans begin to use the WIM database for pavement design and management. Caltrans does not currently use its WIM data for pavement design and management. Traffic indices (summations of ESALs in the design period) for pavement designs are currently estimated by a variety of means, and are often considered to include gross over- and under-estimates. Anecdotal checks performed by Caltrans Traffic Operations between WIM truck traffic counts and Traffic Index calculations, and design estimates used in the districts have shown some large discrepancies.

   Truck volume estimates and ESAL estimates in the Caltrans Pavement Management System database (*7*) are also suspected of containing significant numbers of errors or poor relation to actual traffic, based on comparison of pavement performance and traffic levels.

The data in the WIM database appears to be of much higher quality than the data currently being used for pavement design and management. The primary problem will be estimation of truck traffic volumes and load spectra coefficients for locations that are not equipped with WIMs. A standard method needs to be developed for filtering out the few super-heavy overloads that are probably errors, and that can skew Traffic Index estimates using the WIM data.

2. It is recommended that further research be conducted to improve methods of estimation for locations that are not equipped with WIMs. This research should develop improved, statistically based estimation methods for truck traffic volumes (AADTT) and Load Spectra Coefficients (LSC). The results should include procedures for short-term measurements on non-WIM equipped locations, and verification of the risk associated with errors in these estimation methods for different pavement types.

6.5 Recommendations for Improving the Capability of the WIM Data Collection System

3. It is recommended that the two WIM vendors that Caltrans uses, IRD Inc. and PAT Traffic Control Corporation, be contacted to find an improved method for identifying and modifying erroneous records that appear as super-heavy overloads.
4. It is recommended that Caltrans continue to collect WIM data, and that Caltrans Traffic Operations assume responsibility for expanding and maintaining the WIM database that the University of California has created. This database can be of great value to Design, Maintenance, and Materials for the design and maintenance of pavements. The WIM database can also be used by Traffic Operations for the development of Traffic Management Plans, because it provides very good estimates

of truck traffic volume that can augment loop detector data. If this recommendation is implemented, the University of California and Caltrans Design, Maintenance, and Materials can work with Traffic Operations in the future to increase the accessibility of the WIM database to Caltrans engineers, and the ability to use it for analysis.

5. It is recommended that adequate resources be provided to perform quality assurance checks at all WIM stations and to maintain them as needed. The high quality of the WIM data is dependent upon the WIM devices being routinely checked, calibrated, and maintained.

7.0 REFERENCES

1. Portland Cement Association. *Thickness Design for Concrete Pavement*. Portland Cement Association, Illinois, 1966.

2. Personal conversation with developers of 2002 AASHTO Test Methods, currently in process of writing.

3. Lee, C. E. and N. Souny-Slitine. *Final Research Findings on Traffic-Load Forecasting Using Weigh-in-Motion Data.* Research Report 987-7, Center for Transportation Research, Bureau of Engineering Research, the University of Texas at Austin, September 1998.

4. Hajek, J. J. and O. I. Selezneva. *Estimating Cumulative Traffic Loads, Final Report for Phase 1*. FHWA-RD-00-054, Federal Highway Administration, July 2000.

5. Hajek, J. .J. "General Axle Load Equivalency Factors." *Transportation Research Board Record 1482*, Transportation Research Board, National Research Council, Washington, DC, 1995, pp. 57-68.

6. California Department of Transportation. *Annual Average Daily Truck Traffic on the California State Highway System.* State of California, Business, Transportation and Housing Agency, Department of Transportation, 1998.

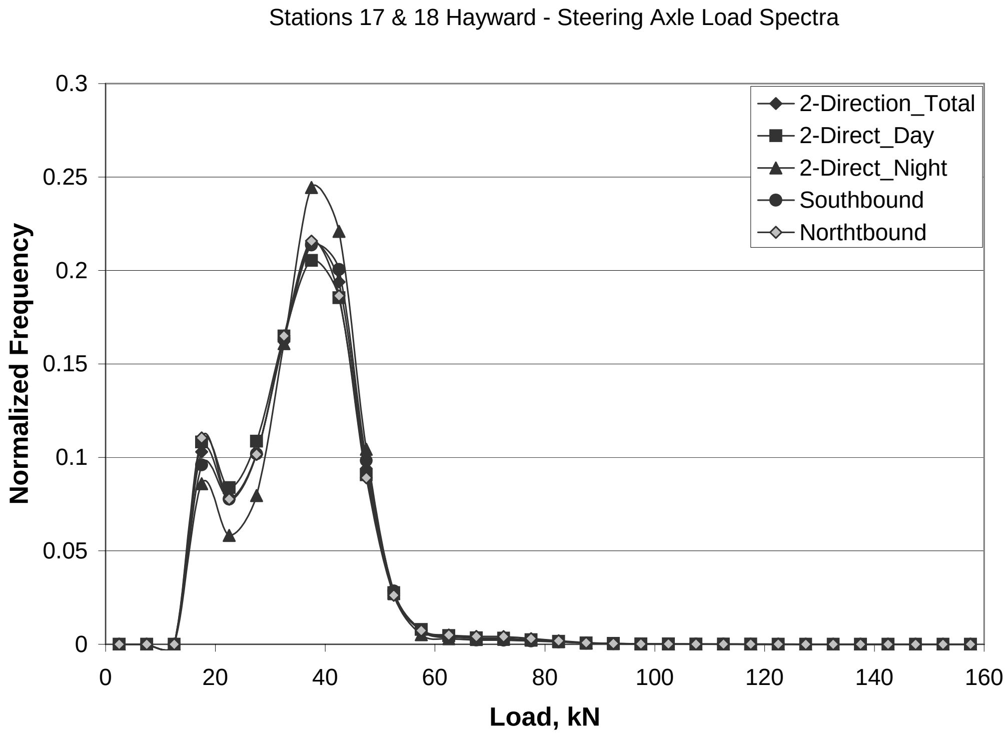
7. Lea, J. et al. *Datamining of the Caltrans PMS Database.* Draft report delivered to California Department of Transportation. Pavement Research Center, University of California. June 2002.

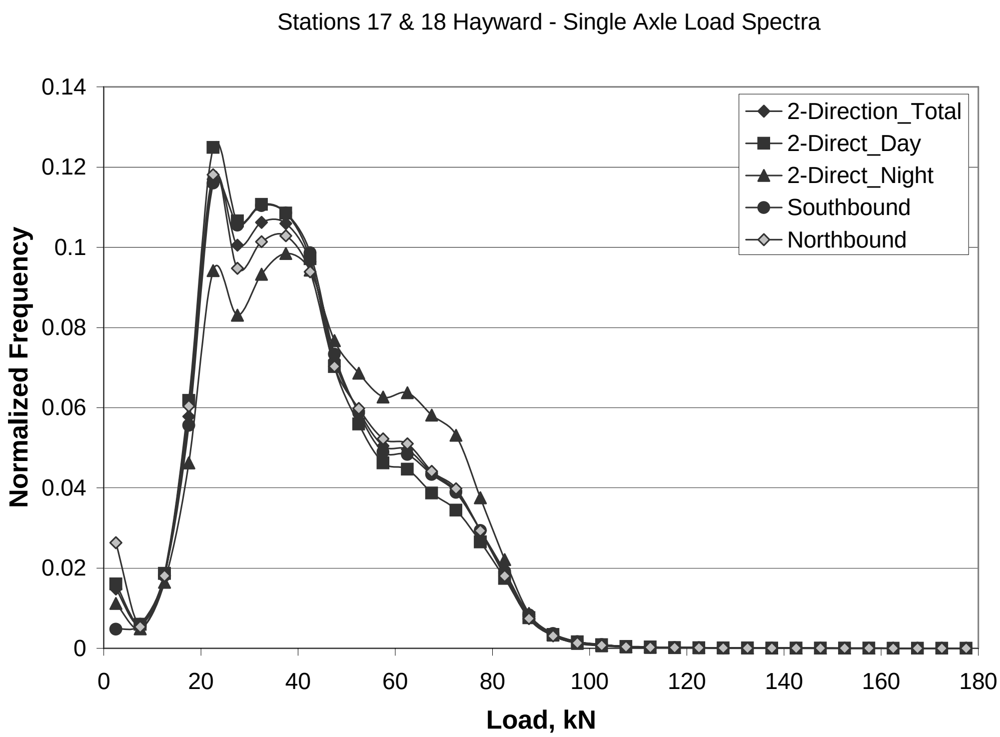
8. *Weigh in Motion Program*, Office Truck Services, Division of Traffic Operations, California Department of Transportation, September, 2002.

9. http://www.gis.ca.gov/meta.epl?data_title=Urban/Rural&catalog=casil&name=urbrura

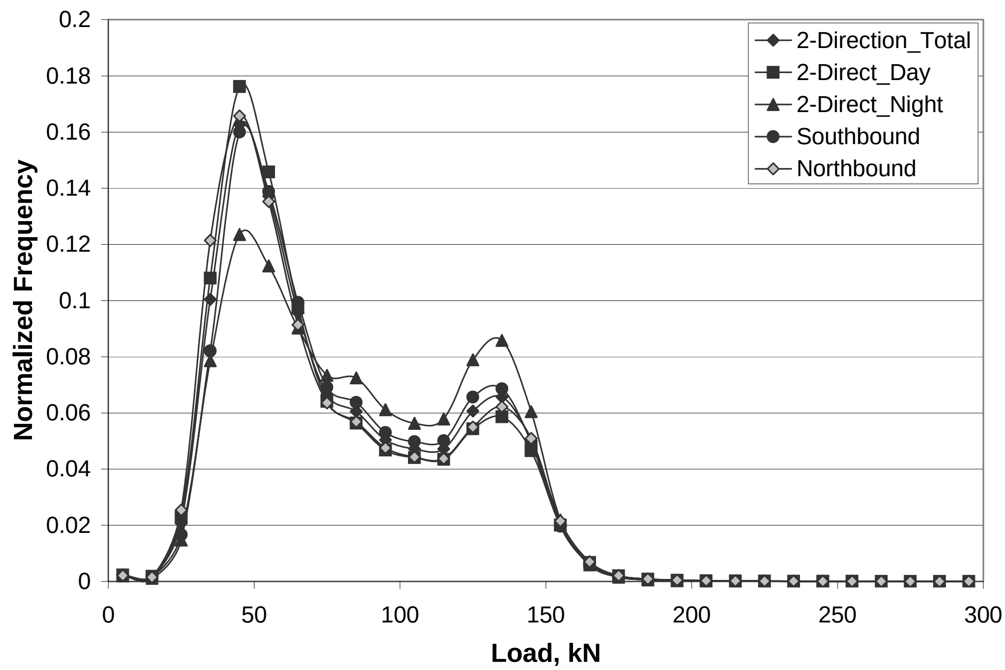
APPENDIX A:

AXLE LOAD SPECTRA IN TWO DIRECTIONS (WHOLE DAY, DAYTIME AND NIGHT) AND EACH DIRECTION AT 5 WIM SITES

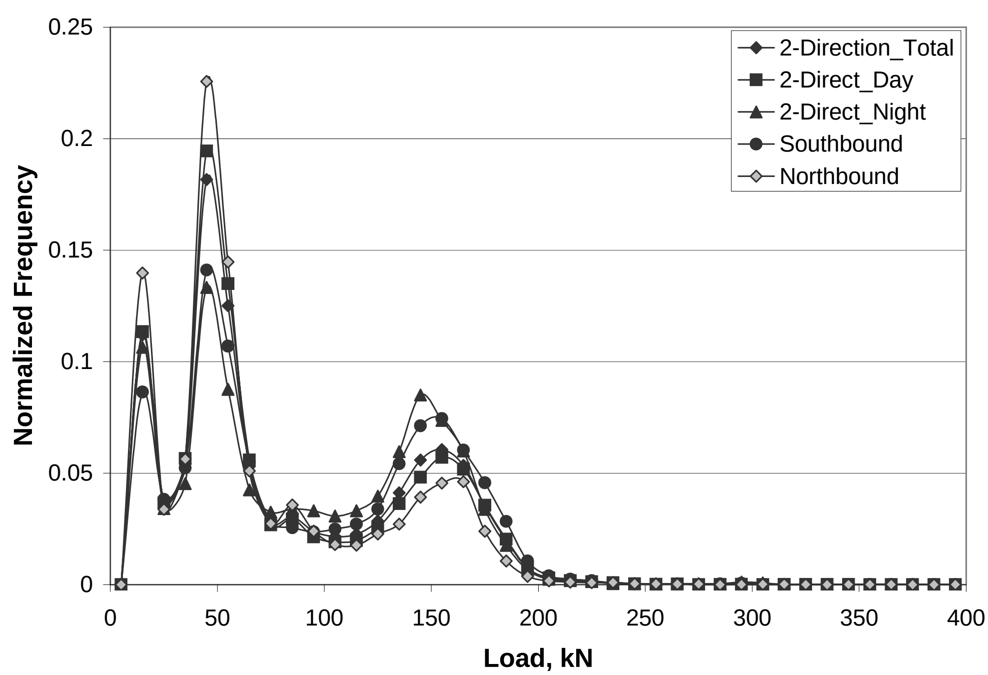

Stations 17 & 18 Hayward - Steering Axle Load Spectra
Normalized Frequency
Load, kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Southbound
Northtbound
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160


Stations 17 & 18 Hayward - Single Axle Load Spectra
Normalized Frequency
Load, kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Southbound
Northbound
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
20
40
60
80
100
120
140
160
180

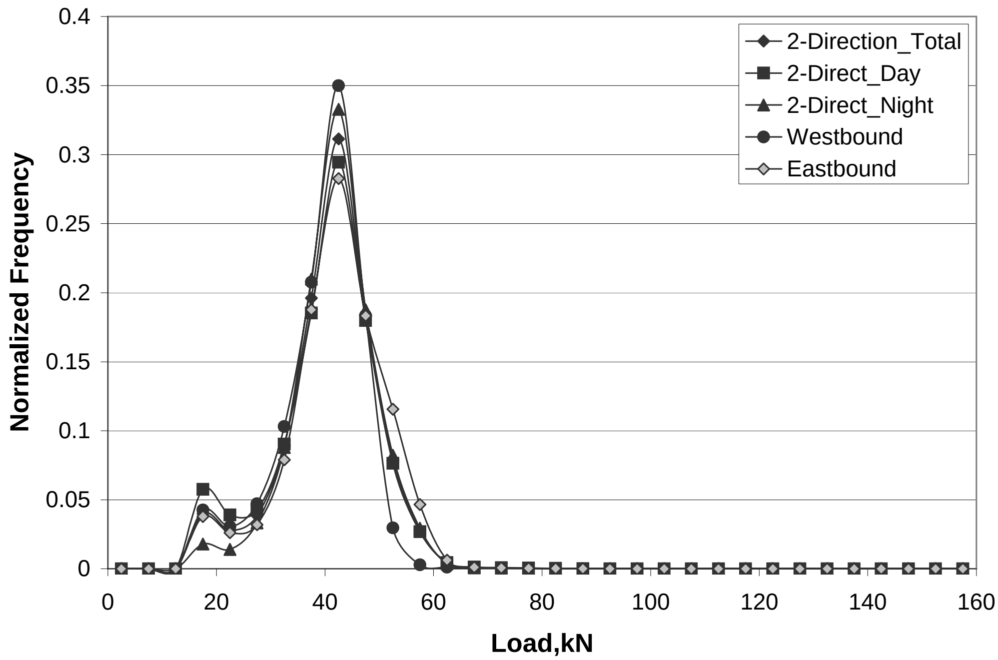
Stations 17 & 18 Hayward - Tandem Axle Load Spectra



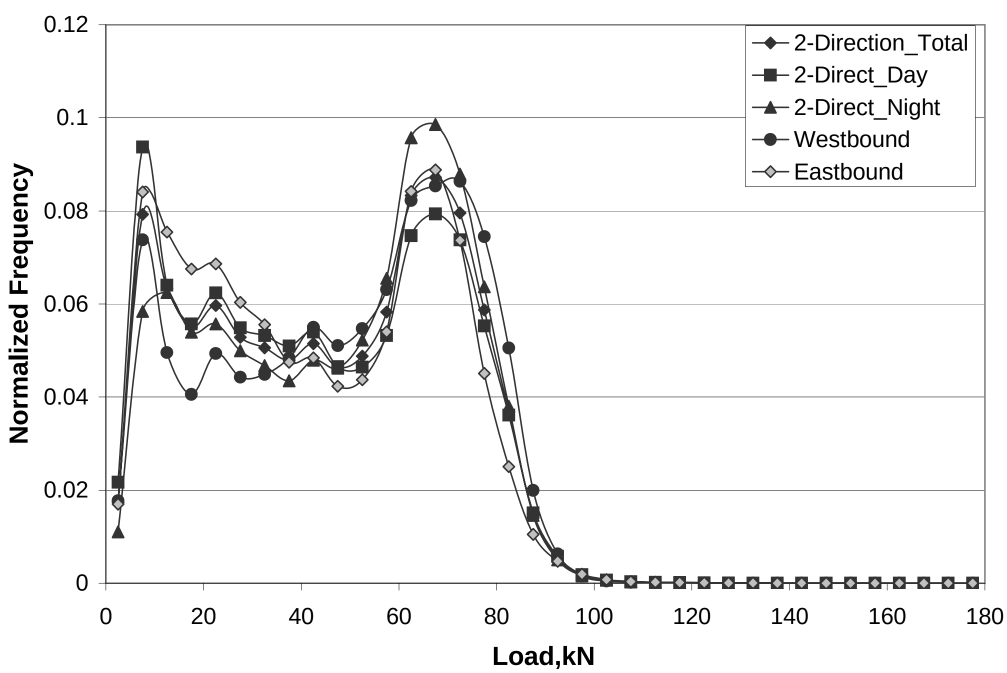
Stations 17 & 18 Hayward - Tridem Axle Load Spectra



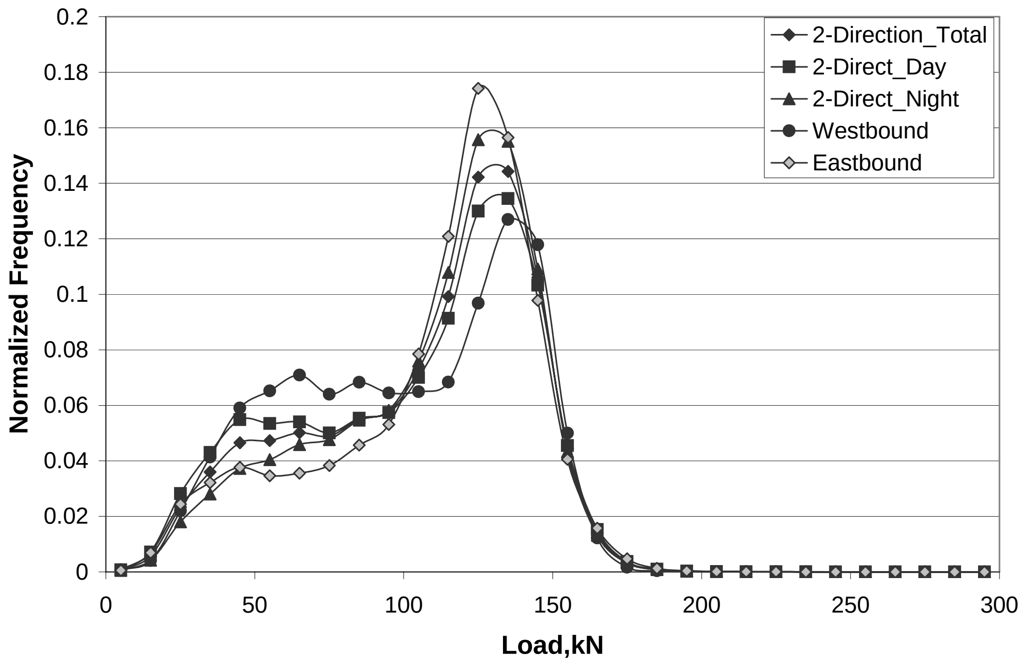
Station 21 Mojave - Steering Axle Load Spectra



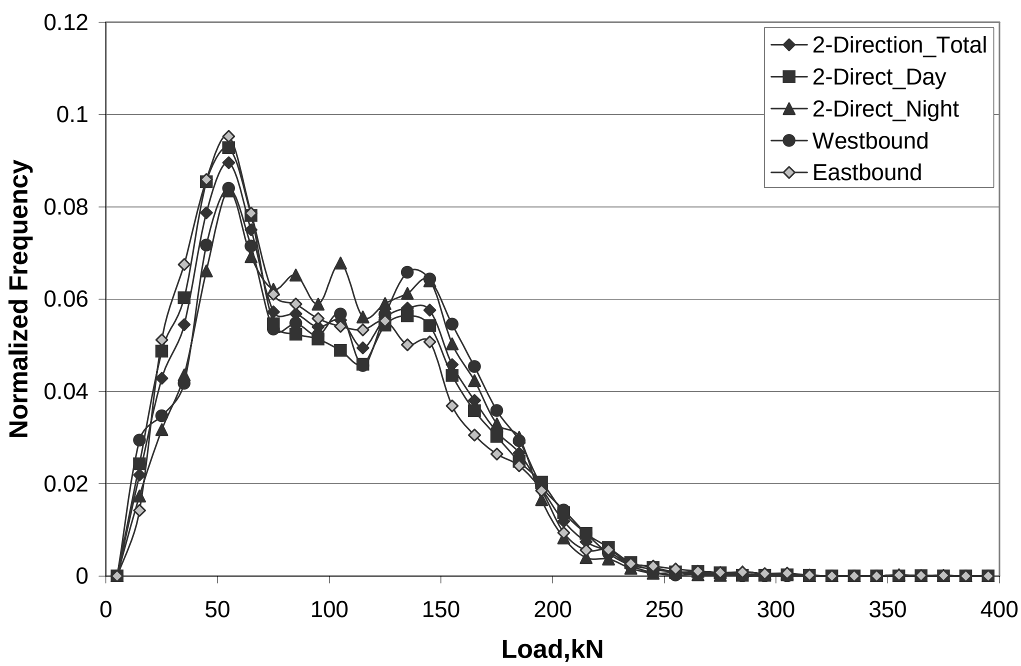
Station 21 Mojave - Single Axle Load Spectra



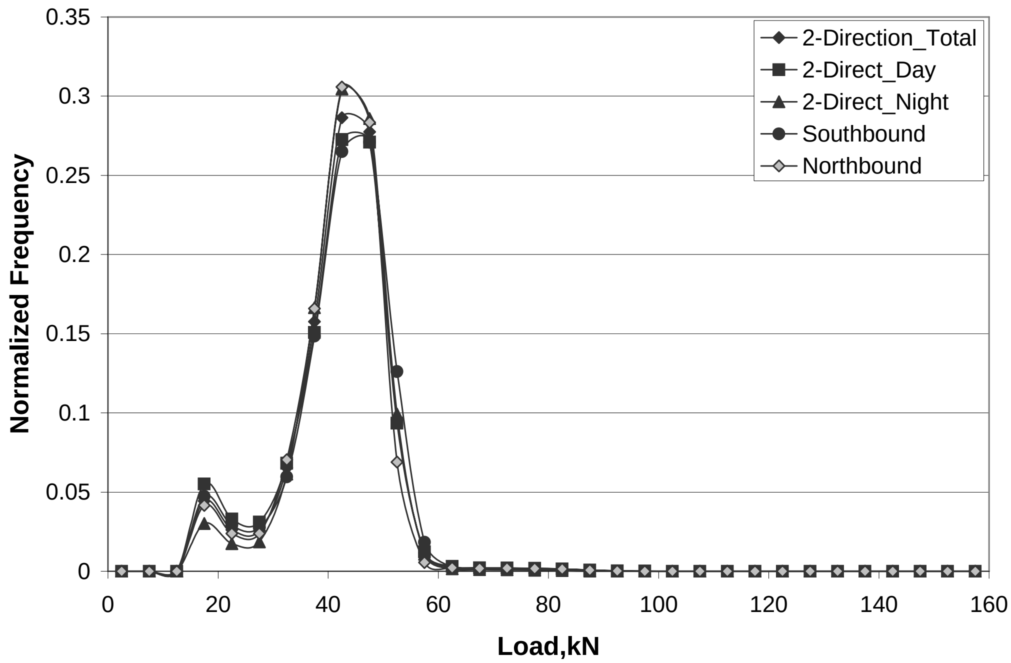
Station 21 Mojave - Tandem Axle Load Spectra



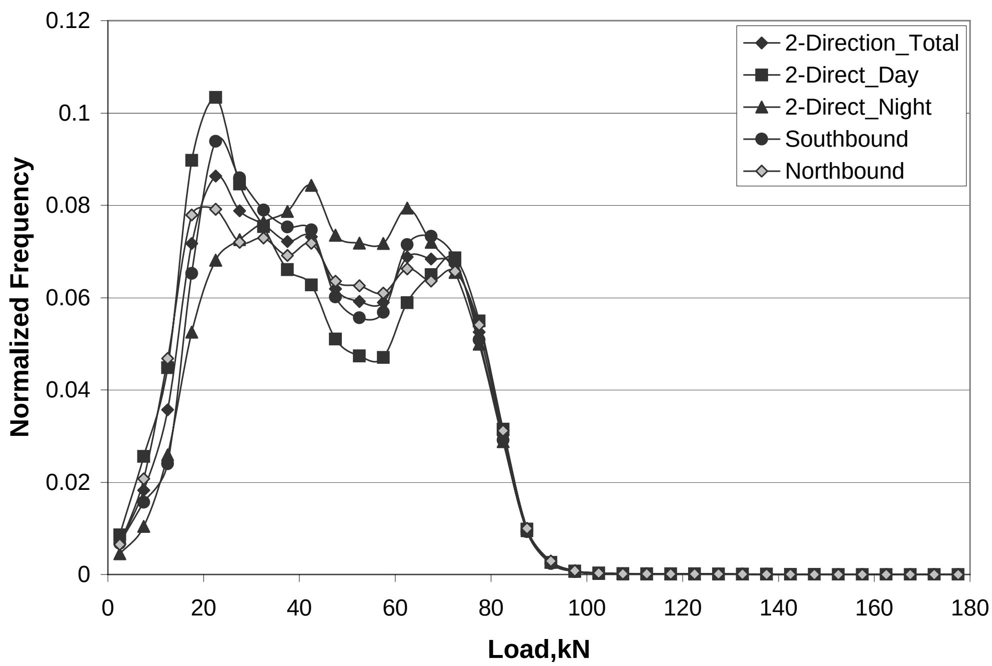
Station 21 Mojave - Tridem Axle Load Spectra

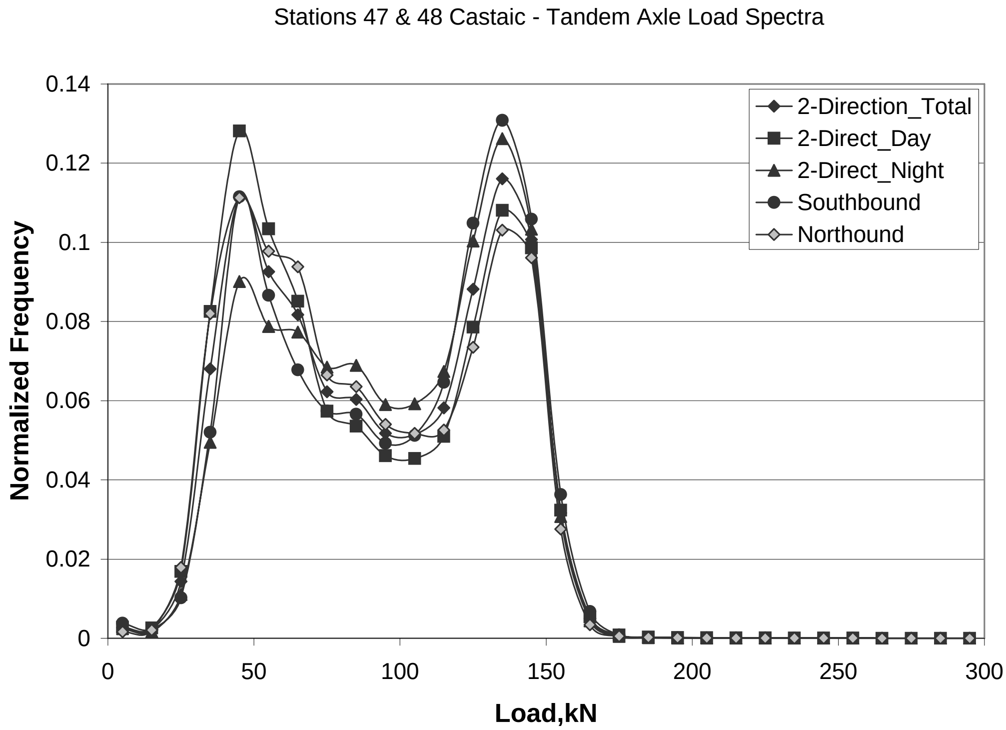


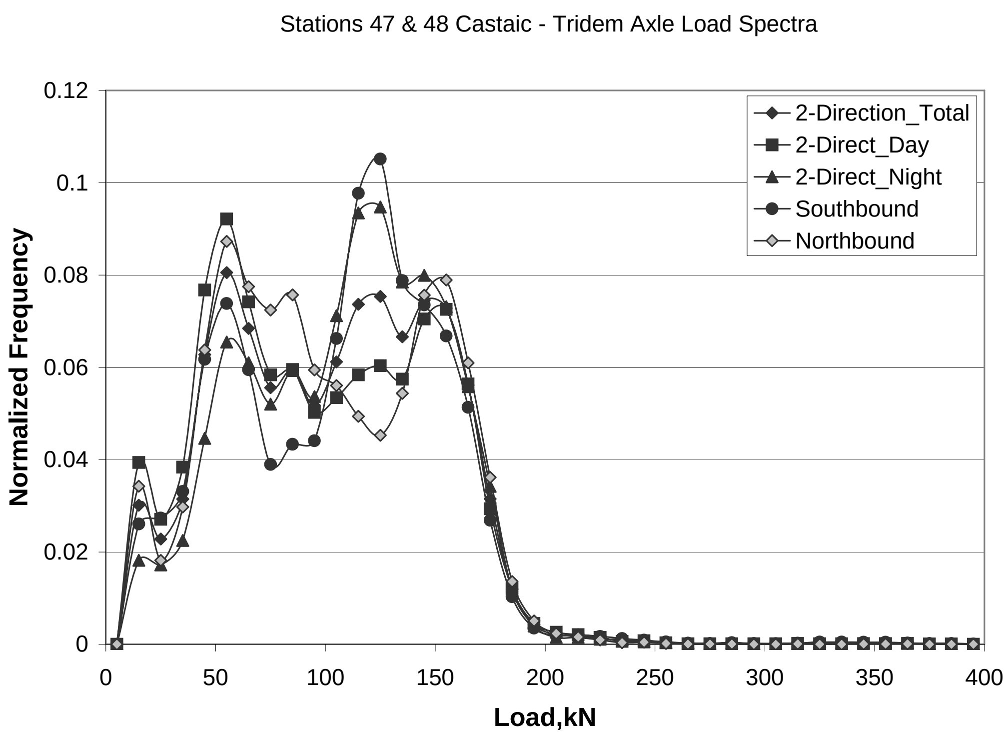
Stations 47 & 48 Castaic - Steering Axle Load Spectra

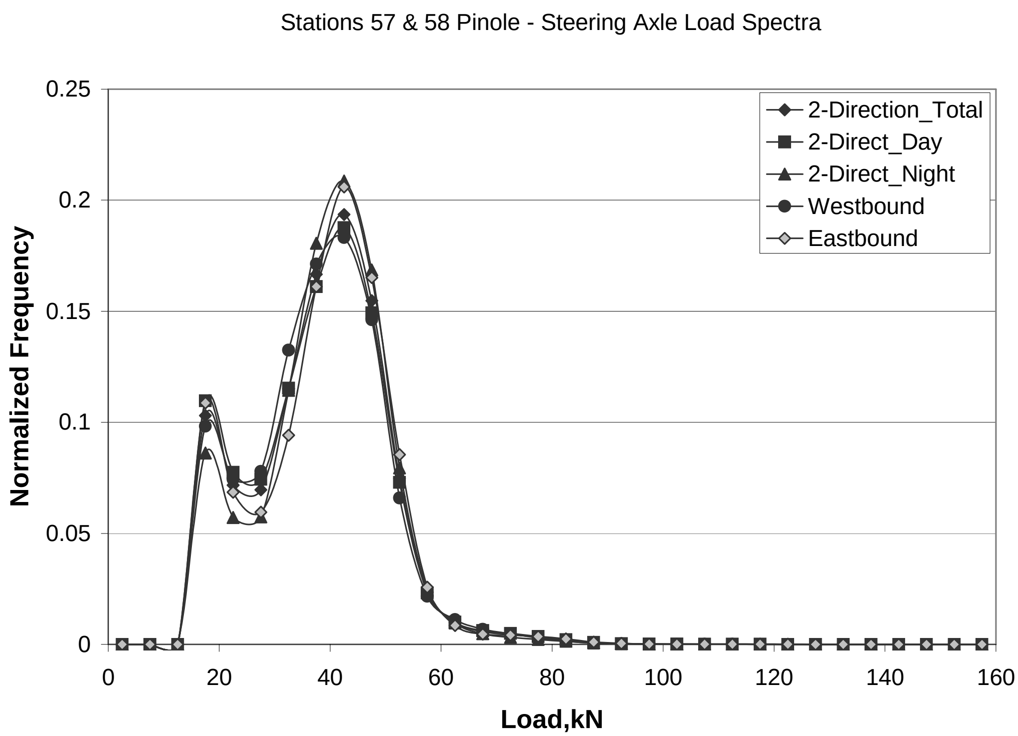


Stations 47 & 48 Castaic - Single Axle Load Spectra

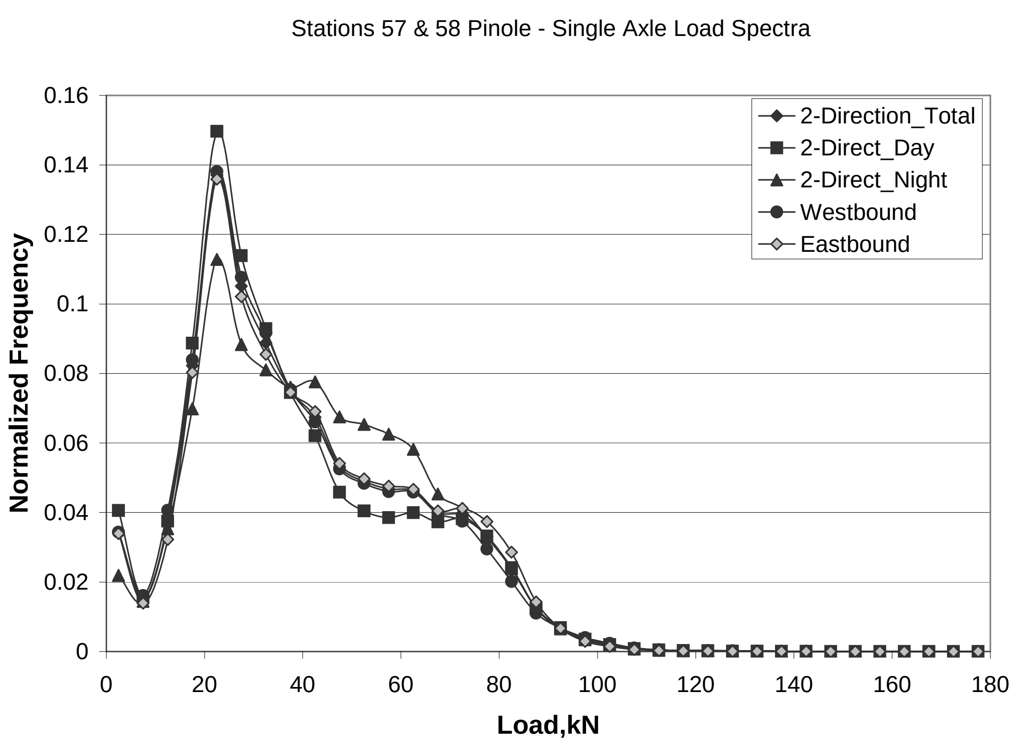



Stations 47 & 48 Castaic - Tandem Axle Load Spectra
Normalized Frequency
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
Load,kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Southbound
Northound


Stations 47 & 48 Castaic - Tridem Axle Load Spectra
Normalized Frequency
0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
Load,kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Southbound
Northbound



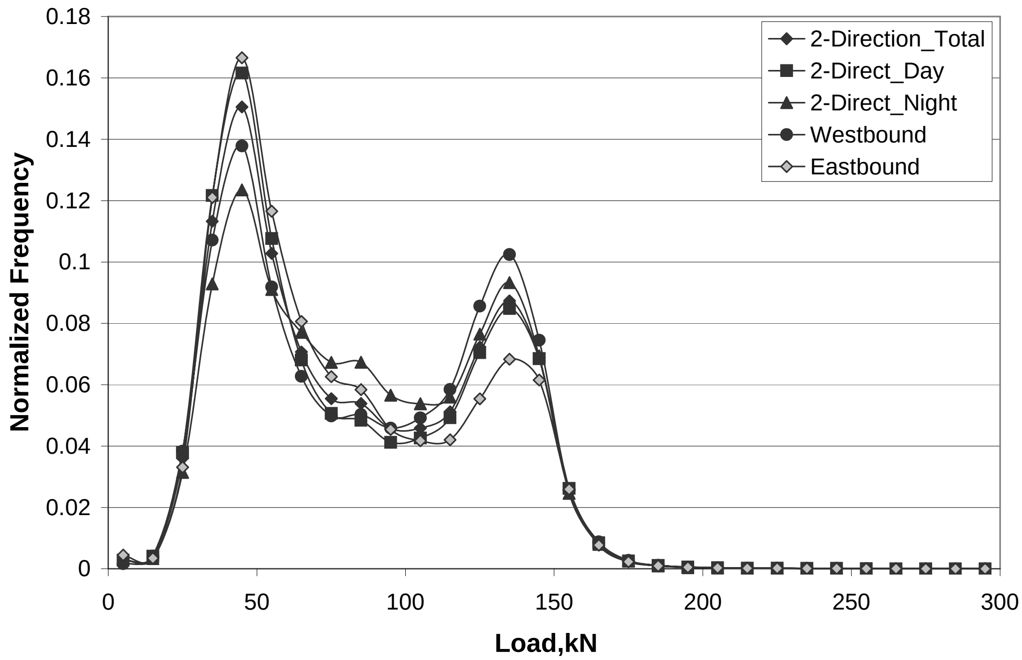
Stations 57 & 58 Pinole - Steering Axle Load Spectra
Normalized Frequency
Load,kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Westbound
Eastbound
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160



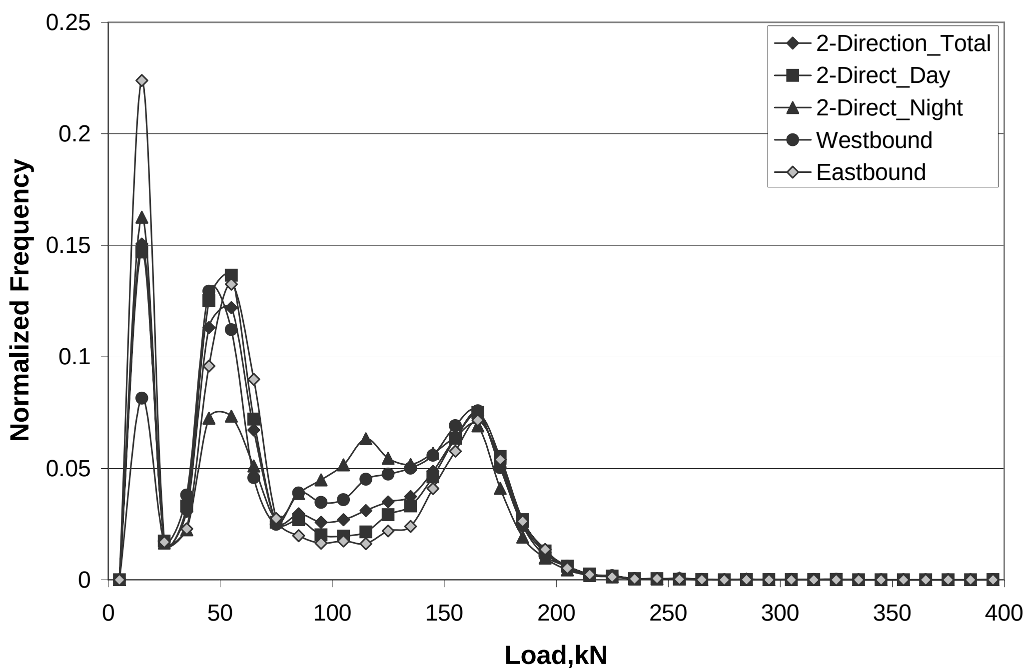
Stations 57 & 58 Pinole - Single Axle Load Spectra
Normalized Frequency
Load,kN
2-Direction_Total
2-Direct_Day
2-Direct_Night
Westbound
Eastbound
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
20
40
60
80
100
120
140
160
180

\

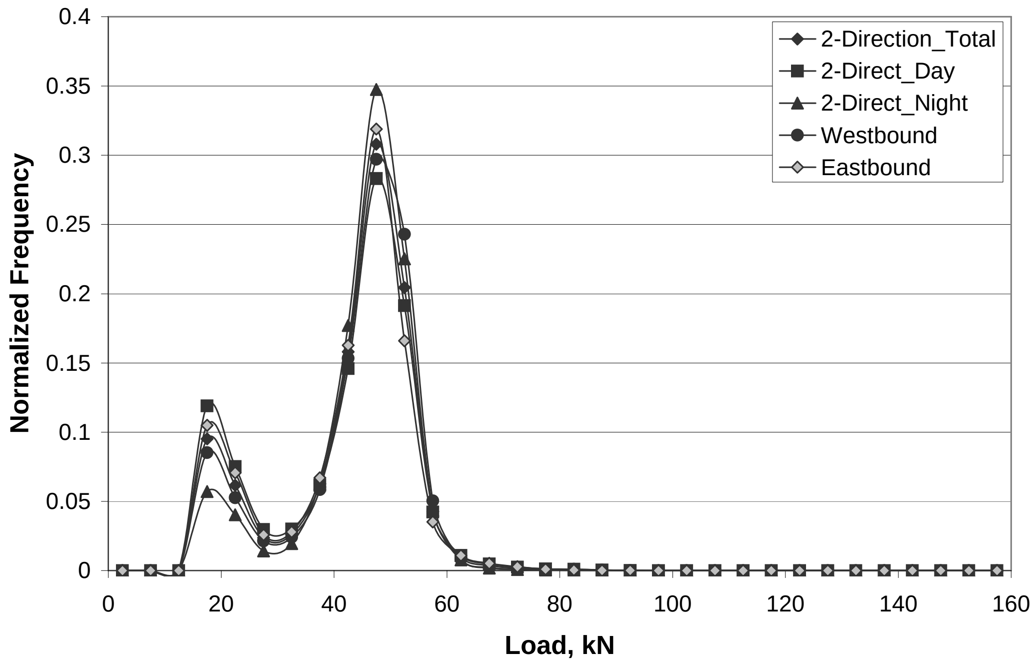
Stations 57 & 58 Pinole - Tandem Axle Load Spectra



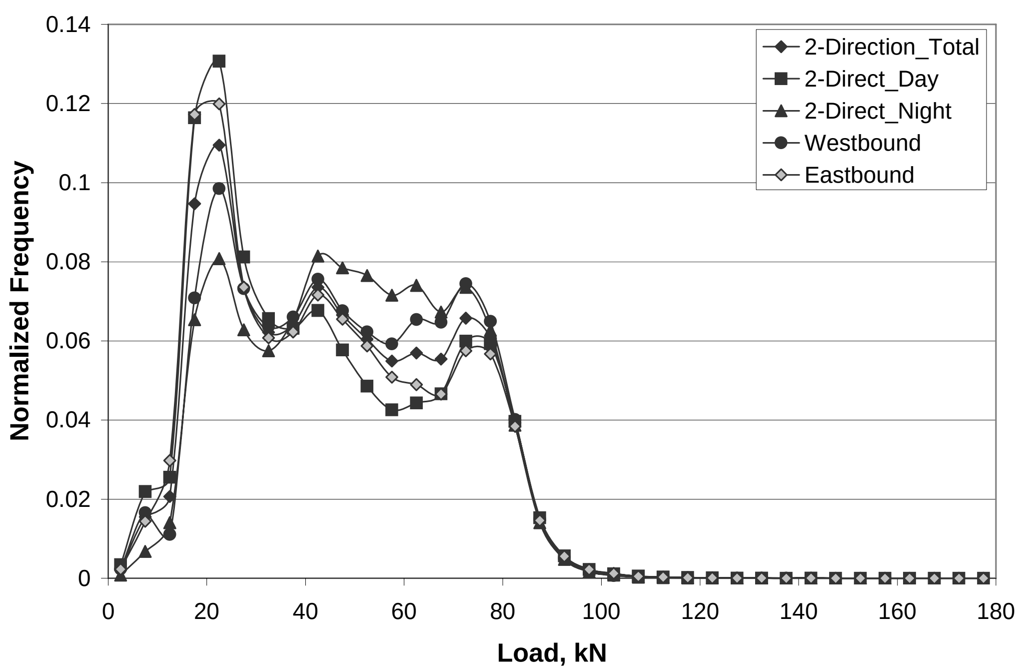
Stations 57 & 58 Pinole - Tridem Axle Load Spectra



Station 72 Bowman - Steering Axle Load Spectra



Station 72 Bowman - Single Axle Load Spectra



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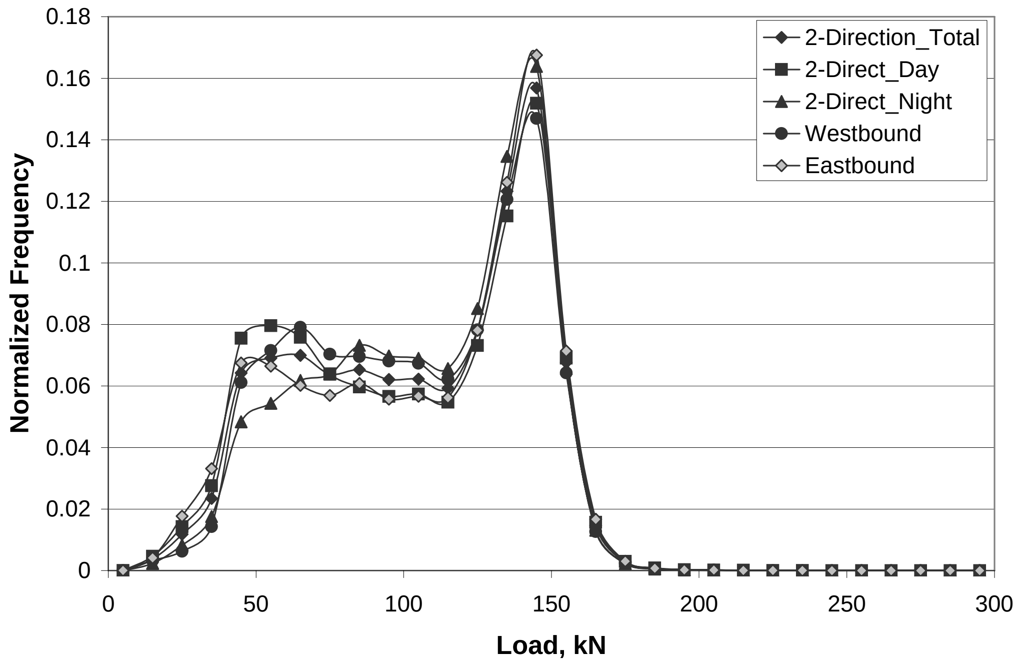

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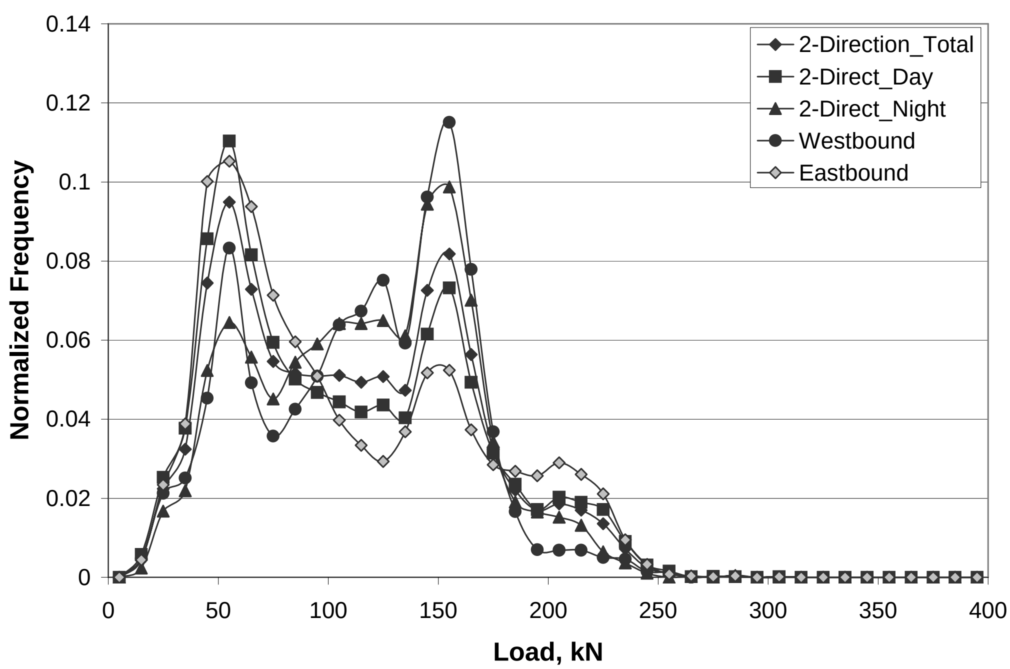
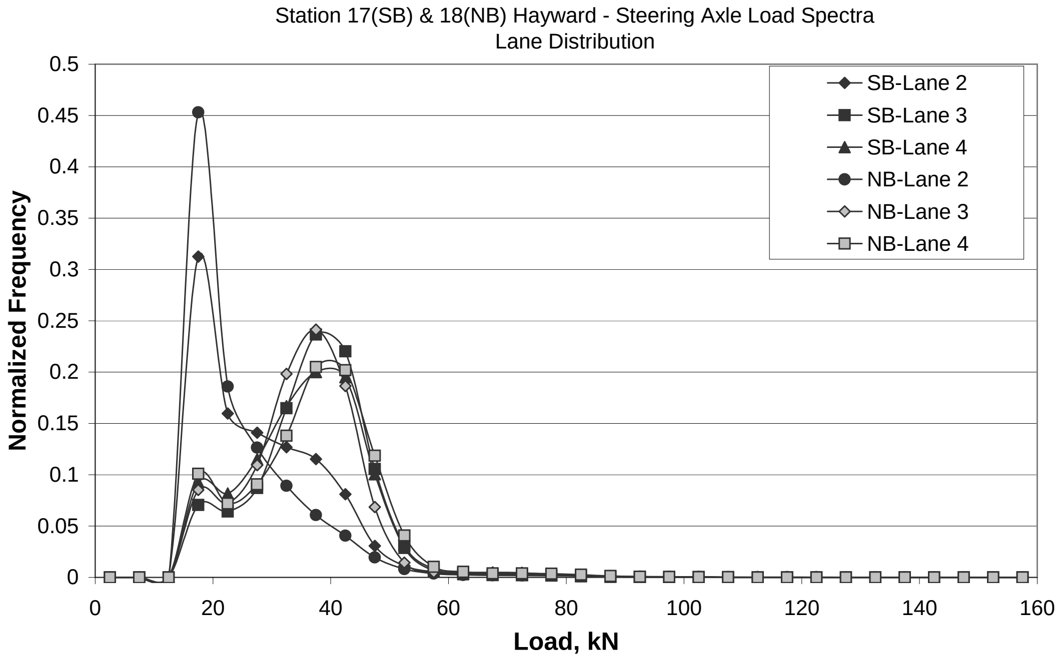
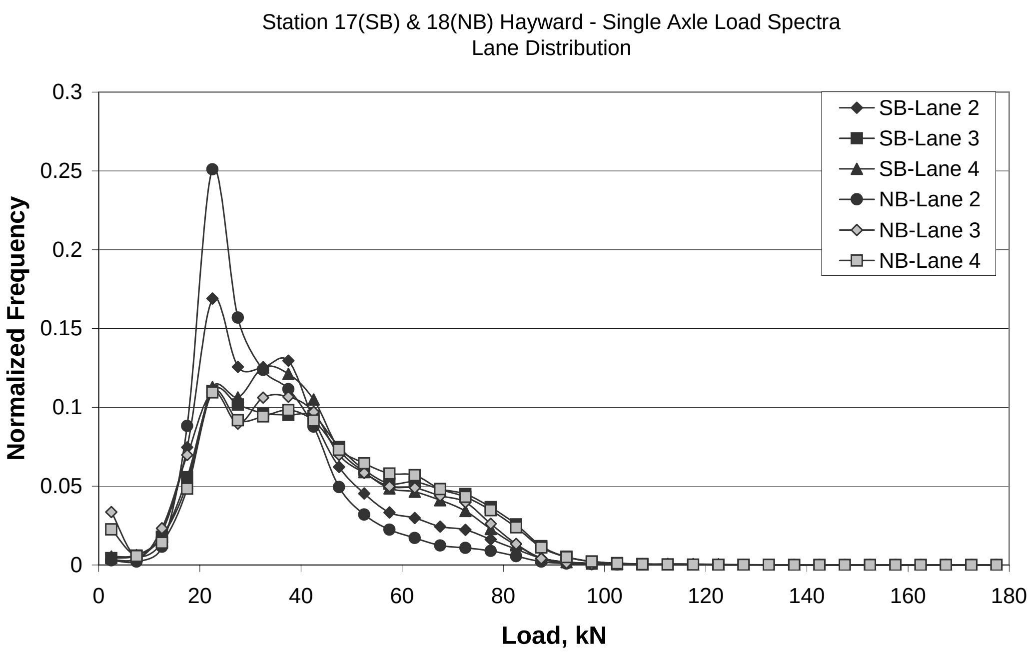
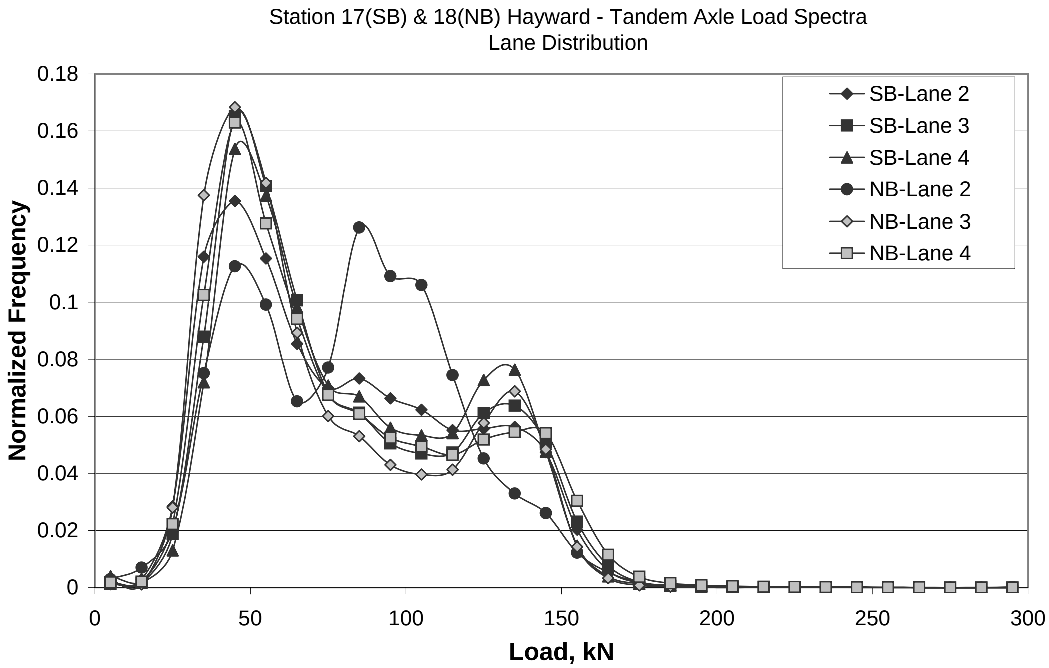


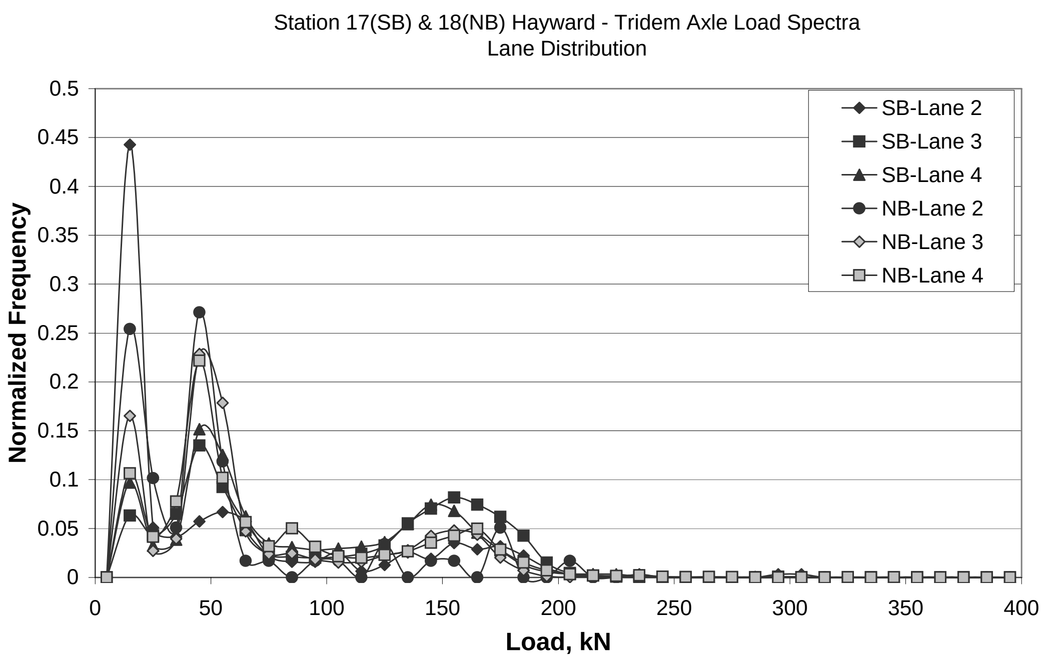
APPENDIX B:

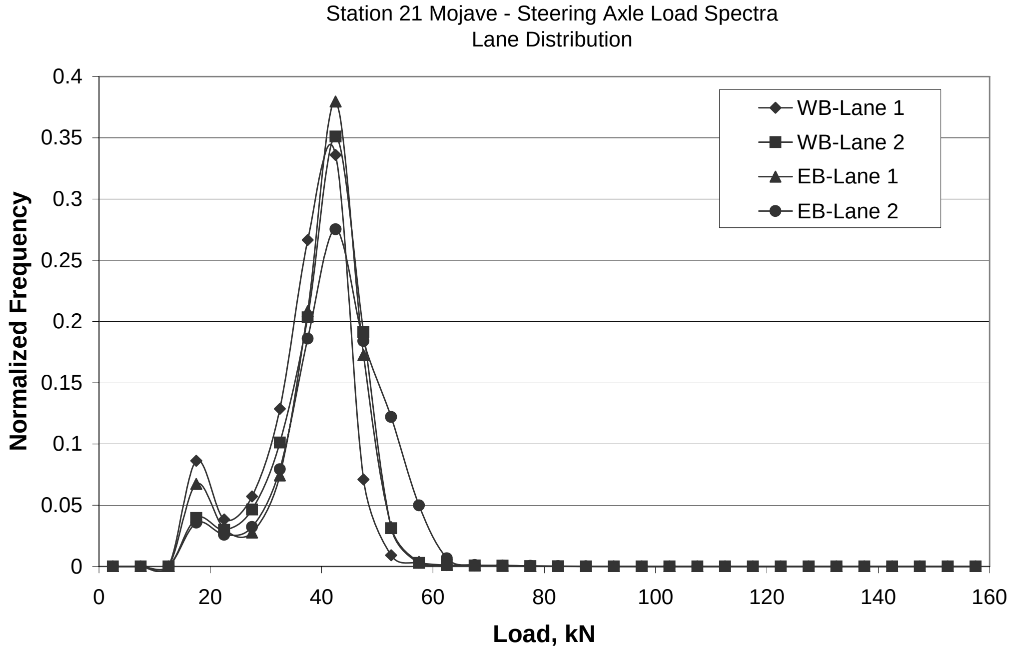
LANEWISE AXLE LOAD SPECTRA AT 5 WIM SITES

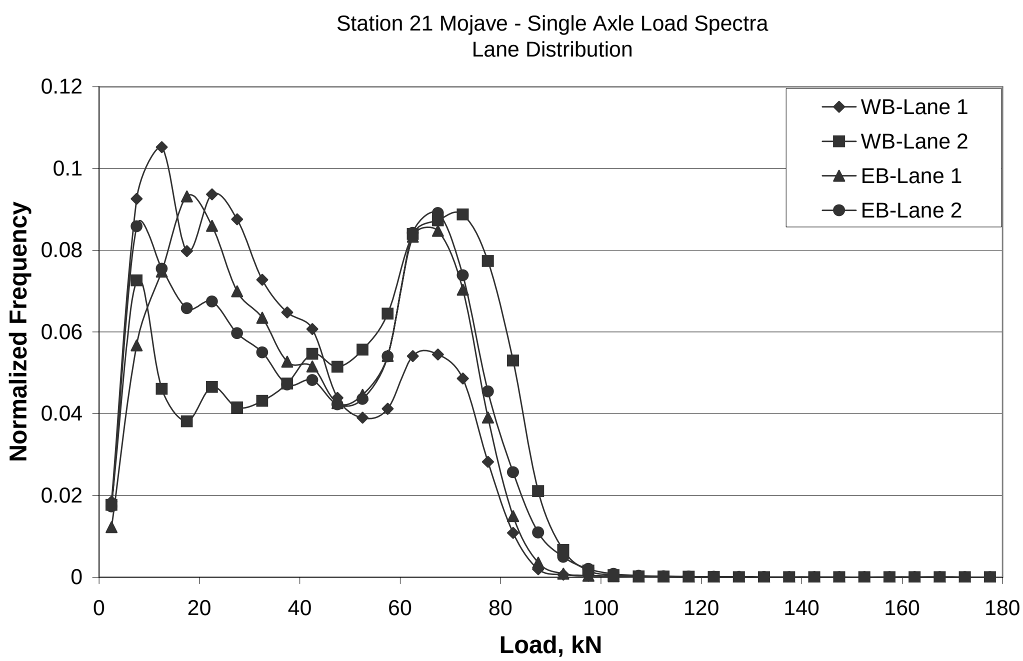

Station 17(SB) & 18(NB) Hayward - Steering Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0
20
40
60
80
100
120
140
160

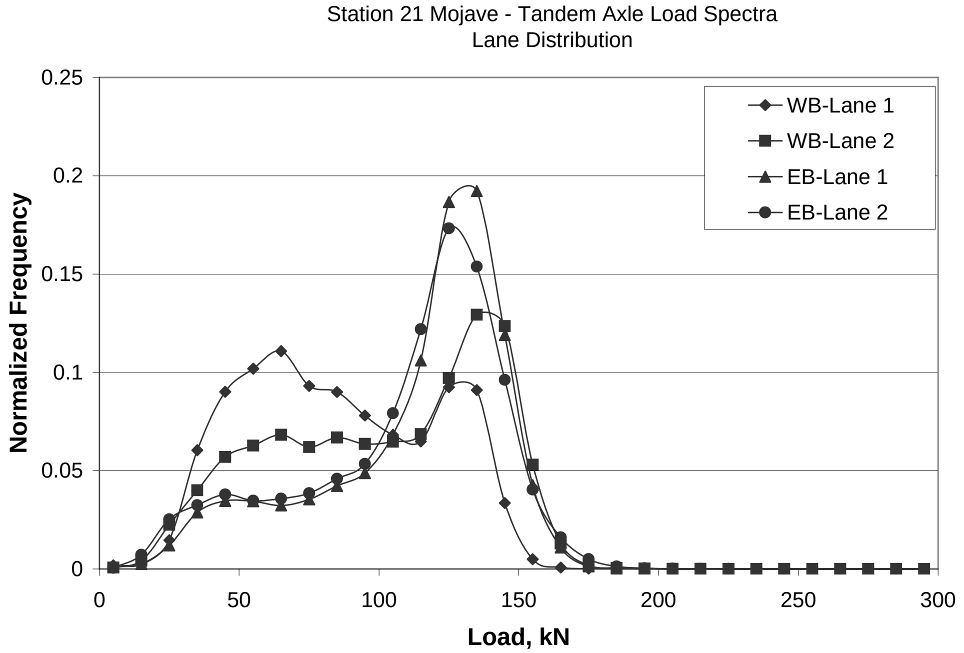

Station 17(SB) & 18(NB) Hayward - Single Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4
0
0.05
0.1
0.15
0.2
0.25
0.3
0
20
40
60
80
100
120
140
160
180

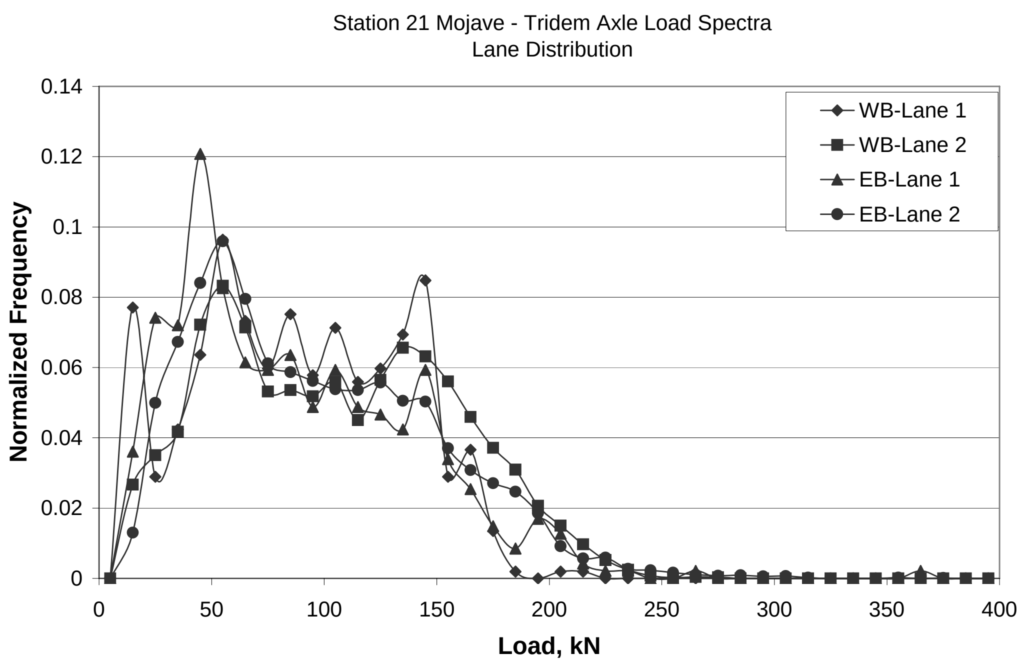

Station 17(SB) & 18(NB) Hayward - Tandem Axle Load Spectra
Lane Distribution
Normalized Frequency
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4

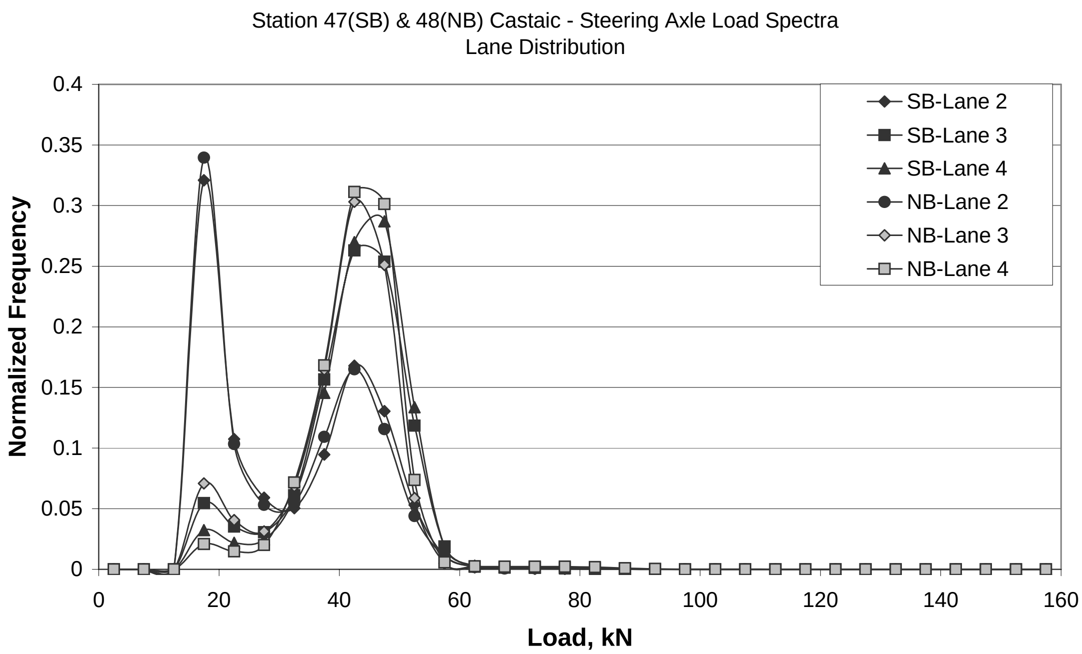

Station 17(SB) & 18(NB) Hayward - Tridem Axle Load Spectra
Lane Distribution
Normalized Frequency
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
200
250
300
350
400
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4

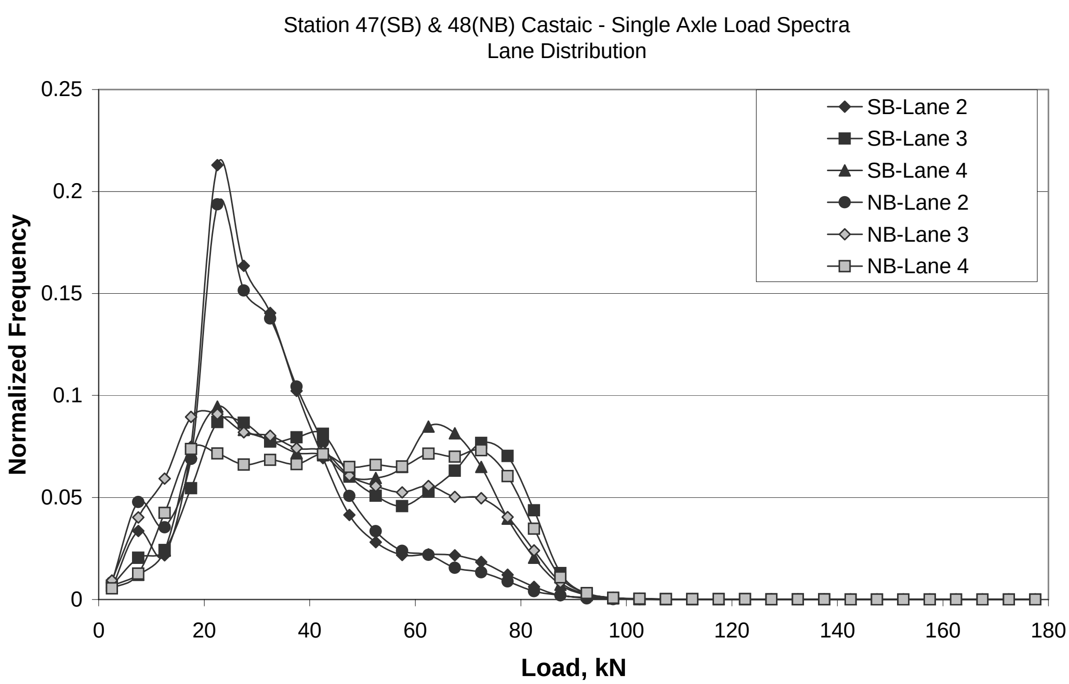

Station 21 Mojave - Steering Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 1
WB-Lane 2
EB-Lane 1
EB-Lane 2
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
20
40
60
80
100
120
140
160


Station 21 Mojave - Single Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 1
WB-Lane 2
EB-Lane 1
EB-Lane 2
0
0.02
0.04
0.06
0.08
0.1
0.12
0
20
40
60
80
100
120
140
160
180

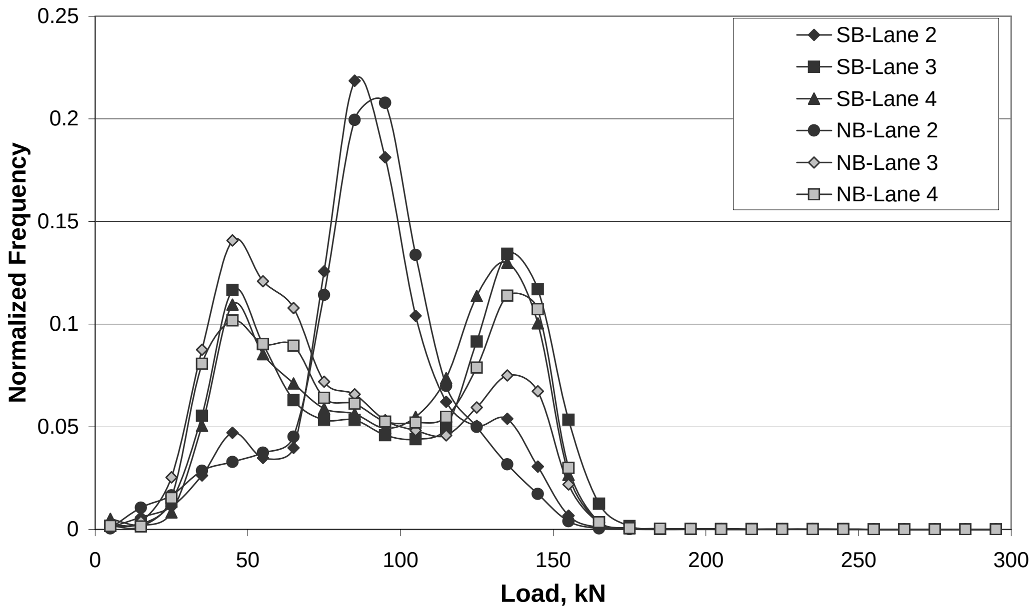

Station 21 Mojave - Tandem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 1
WB-Lane 2
EB-Lane 1
EB-Lane 2
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
200
250
300


Station 21 Mojave - Tridem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 1
WB-Lane 2
EB-Lane 1
EB-Lane 2
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400

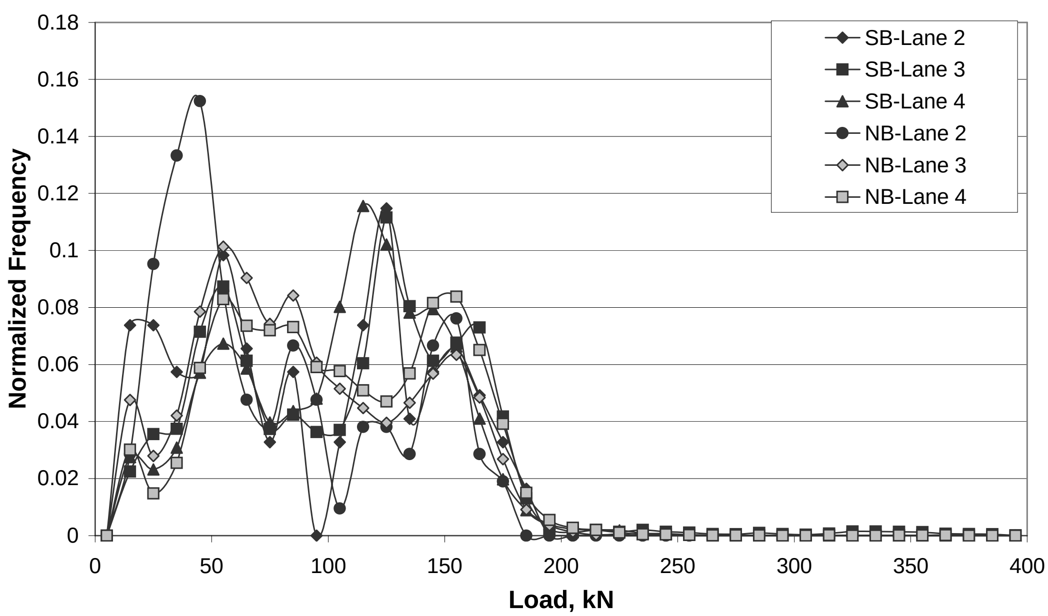

Station 47(SB) & 48(NB) Castaic - Steering Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
20
40
60
80
100
120
140
160

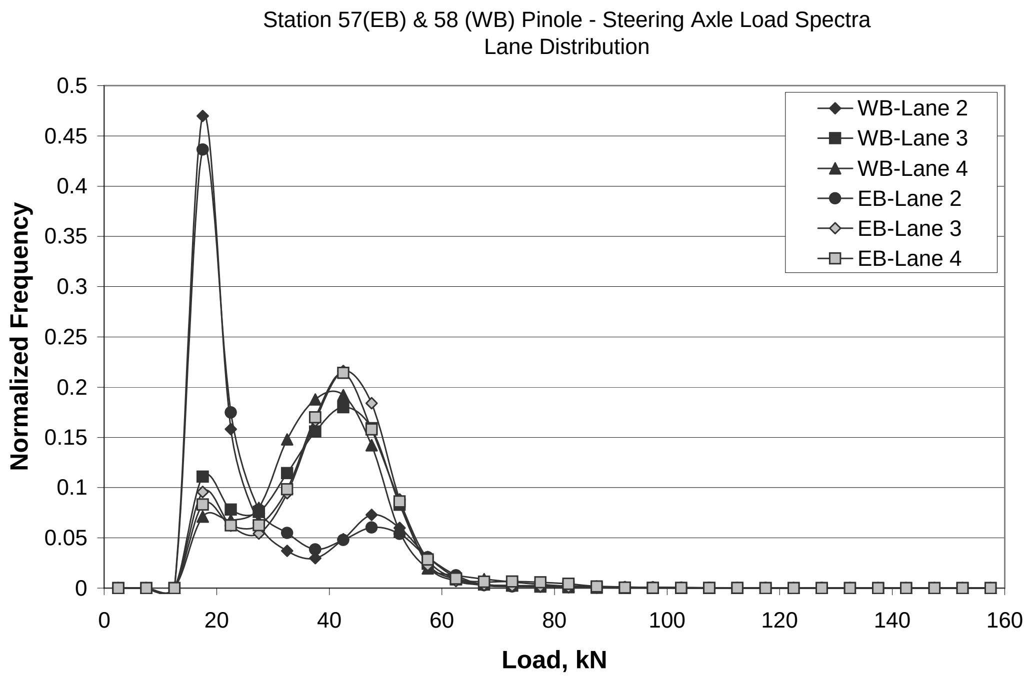

Station 47(SB) & 48(NB) Castaic - Single Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
SB-Lane 2
SB-Lane 3
SB-Lane 4
NB-Lane 2
NB-Lane 3
NB-Lane 4
0
0.05
0.1
0.15
0.2
0.25
20
40
60
80
100
120
140
160
180

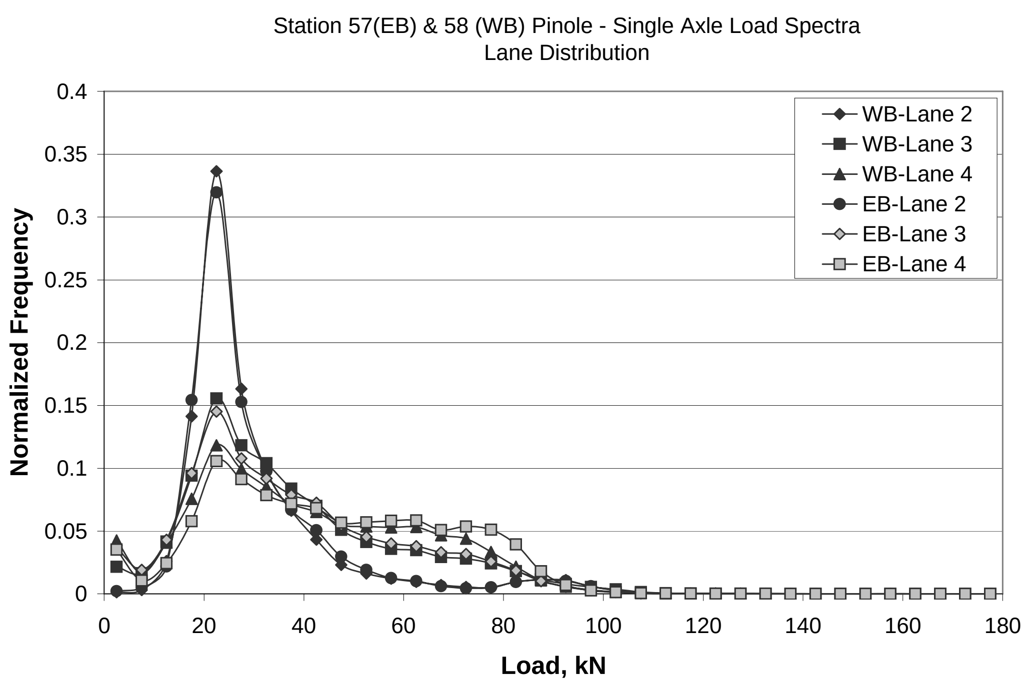
Station 47(SB) & 48(NB) Castaic - Tandem Axle Load Spectra
Lane Distribution

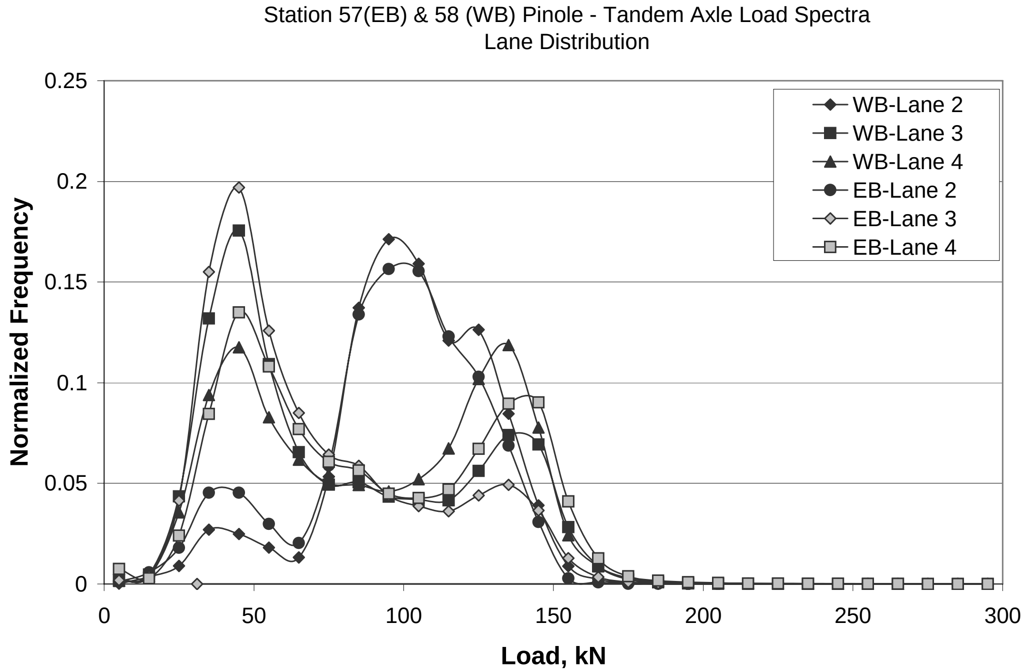


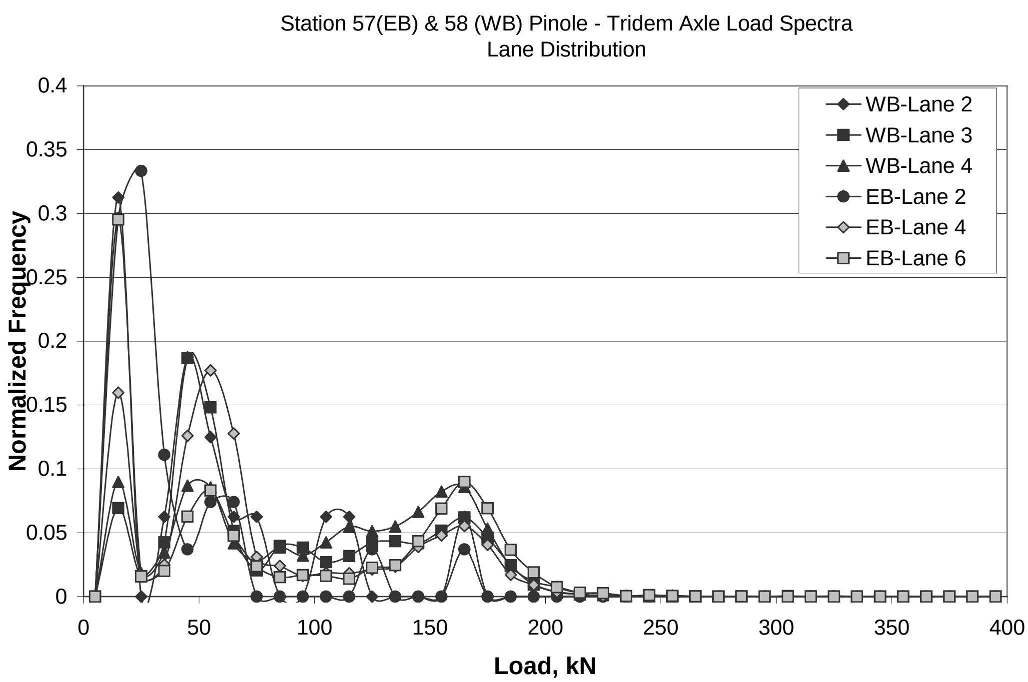
Station 47(SB) & 48(NB) Castaic - Tridem Axle Load Spectra
Lane Distribution

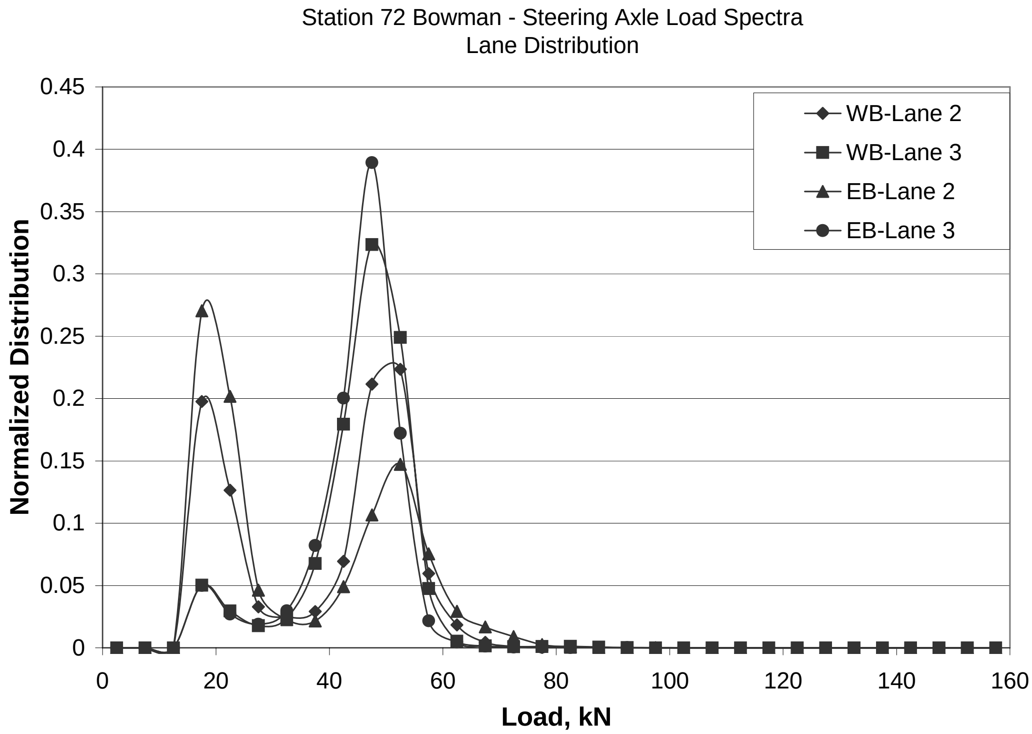


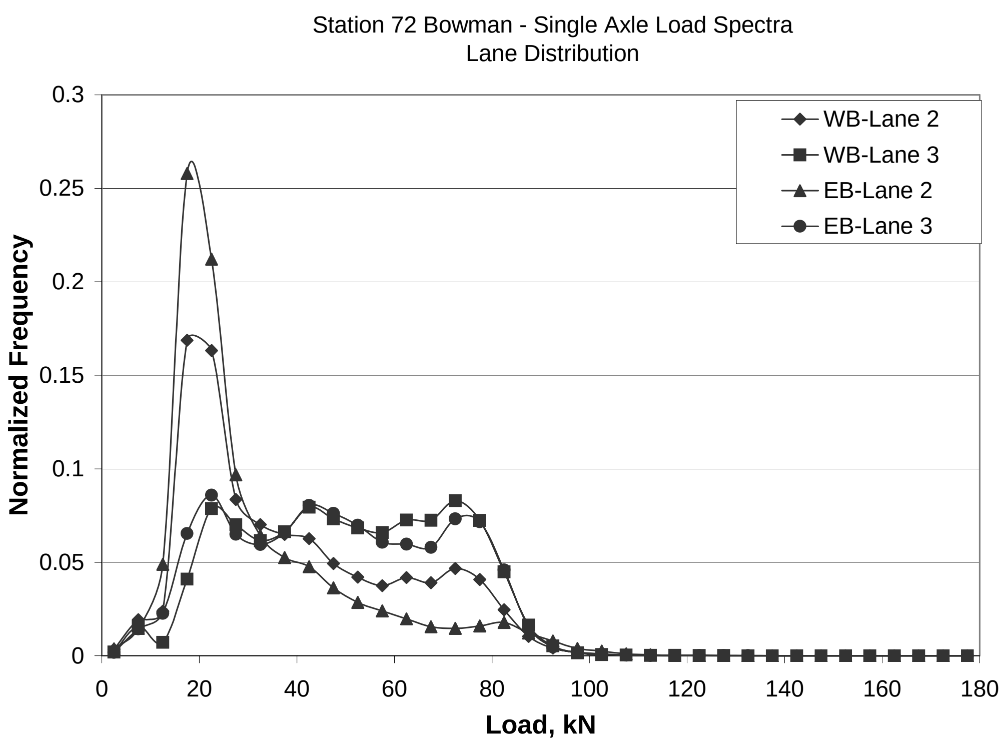

Station 57(EB) & 58 (WB) Pinole - Steering Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
WB-Lane 4
EB-Lane 2
EB-Lane 3
EB-Lane 4

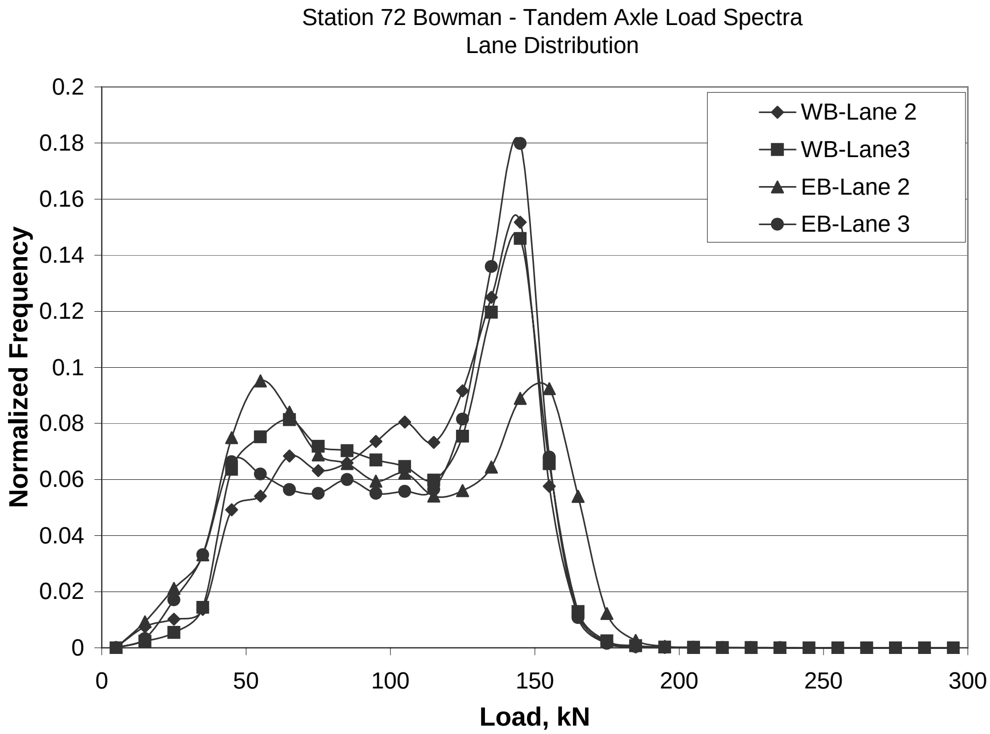

Station 57(EB) & 58 (WB) Pinole - Single Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
WB-Lane 4
EB-Lane 2
EB-Lane 3
EB-Lane 4

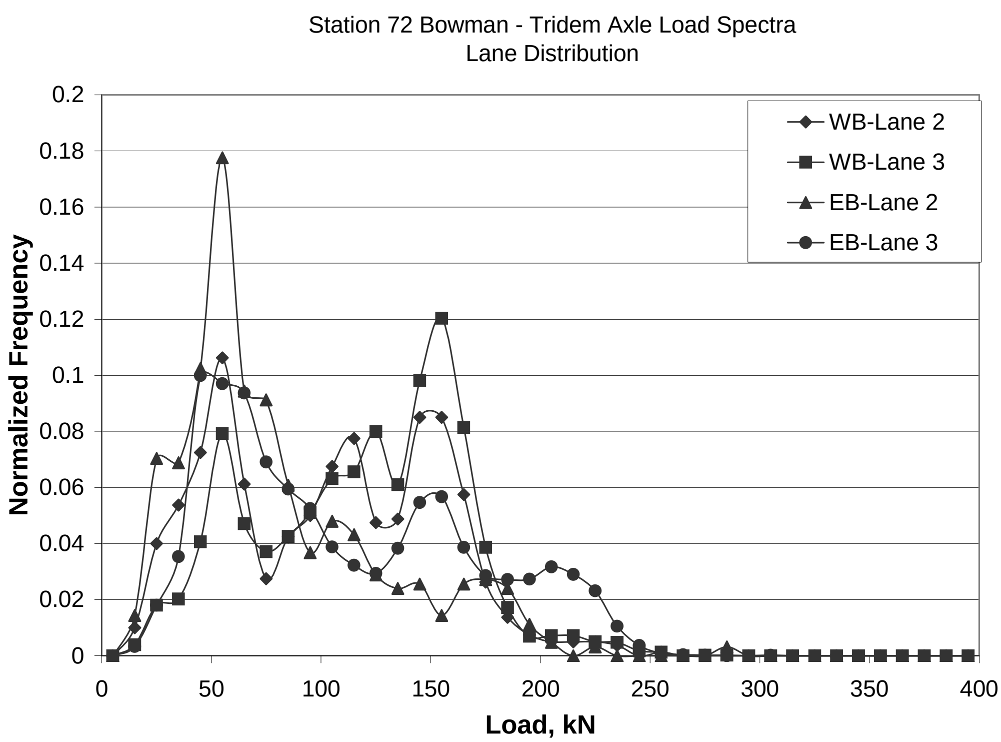

Station 57(EB) & 58 (WB) Pinole - Tandem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
WB-Lane 4
EB-Lane 2
EB-Lane 3
EB-Lane 4
0
0.05
0.1
0.15
0.2
0.25
0
50
100
150
200
250
300


Station 57(EB) & 58 (WB) Pinole - Tridem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
WB-Lane 4
EB-Lane 2
EB-Lane 4
EB-Lane 6
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
50
100
150
200
250
300
350
400


Station 72 Bowman - Steering Axle Load Spectra
Lane Distribution
Normalized Distribution
Load, kN
WB-Lane 2
WB-Lane 3
EB-Lane 2
EB-Lane 3
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160


Station 72 Bowman - Single Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
EB-Lane 2
EB-Lane 3
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160
180

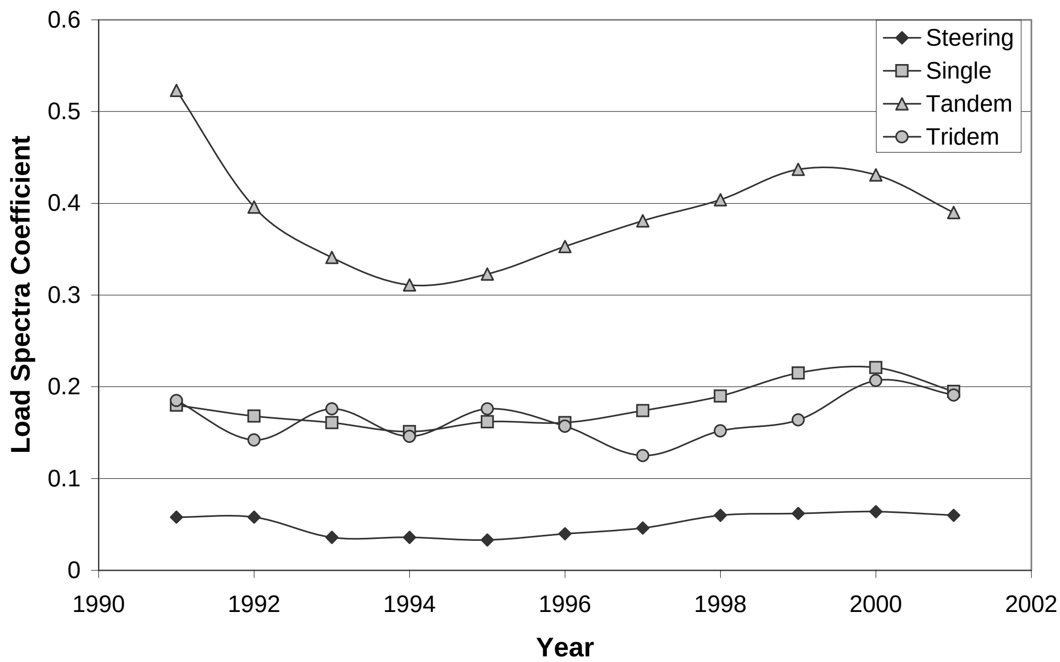

Station 72 Bowman - Tandem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane3
EB-Lane 2
EB-Lane 3
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0
50
100
150
200
250
300


Station 72 Bowman - Tridem Axle Load Spectra
Lane Distribution
Normalized Frequency
Load, kN
WB-Lane 2
WB-Lane 3
EB-Lane 2
EB-Lane 3
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0
50
100
150
200
250
300
350
400

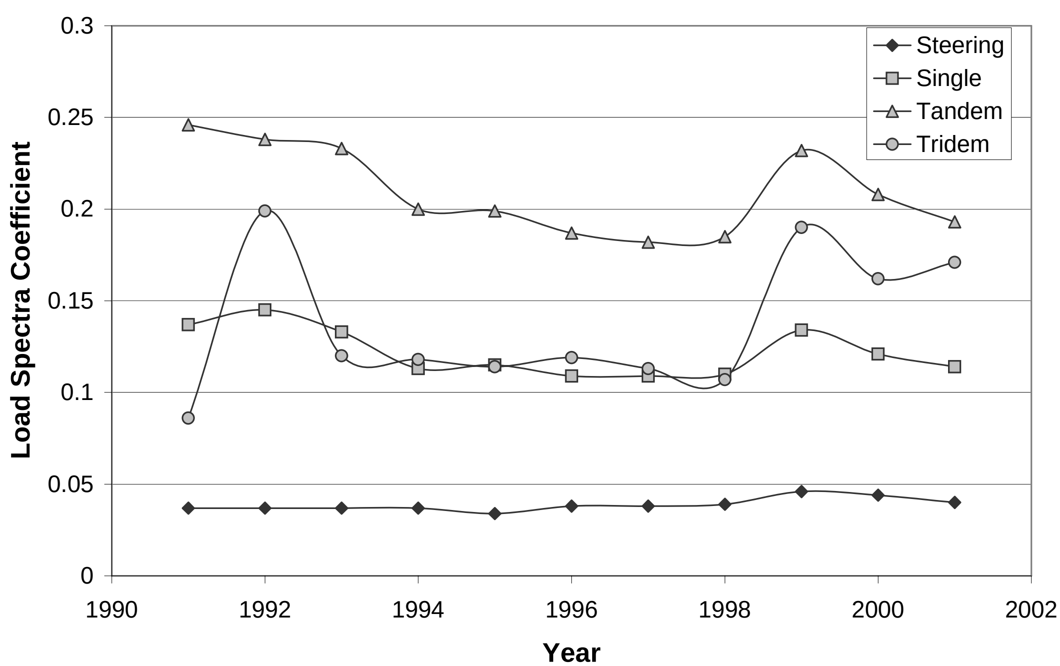
APPENDIX C:

LOAD SPECTRA COEFFICIENTS IN EACH YEAR AT 5 WIM SITES

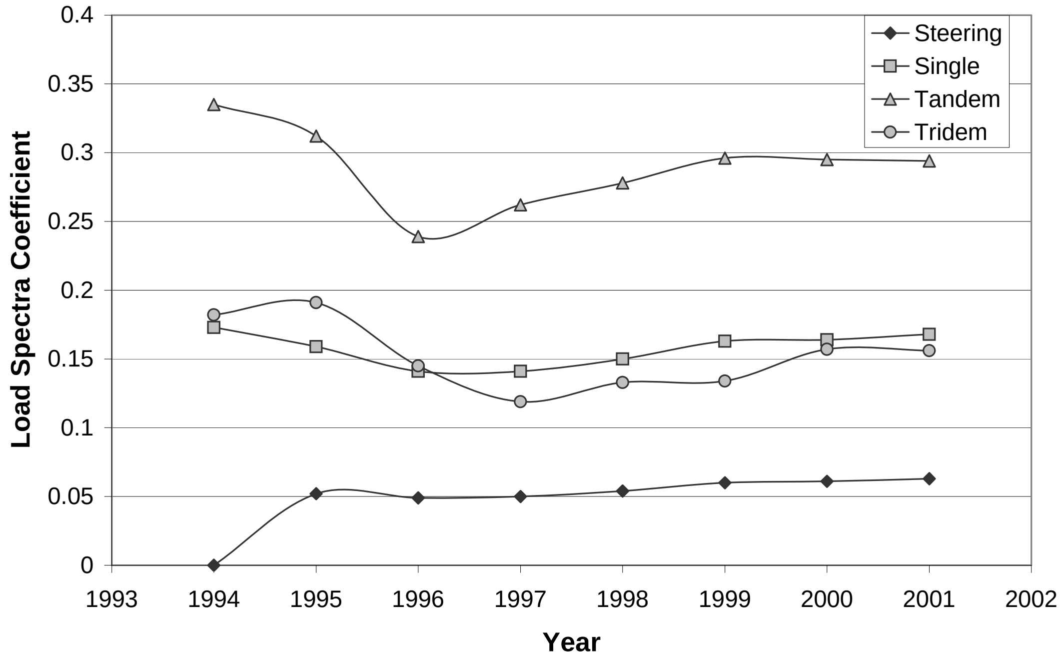
Load Spectra Coefficients in Each Year at Station 21



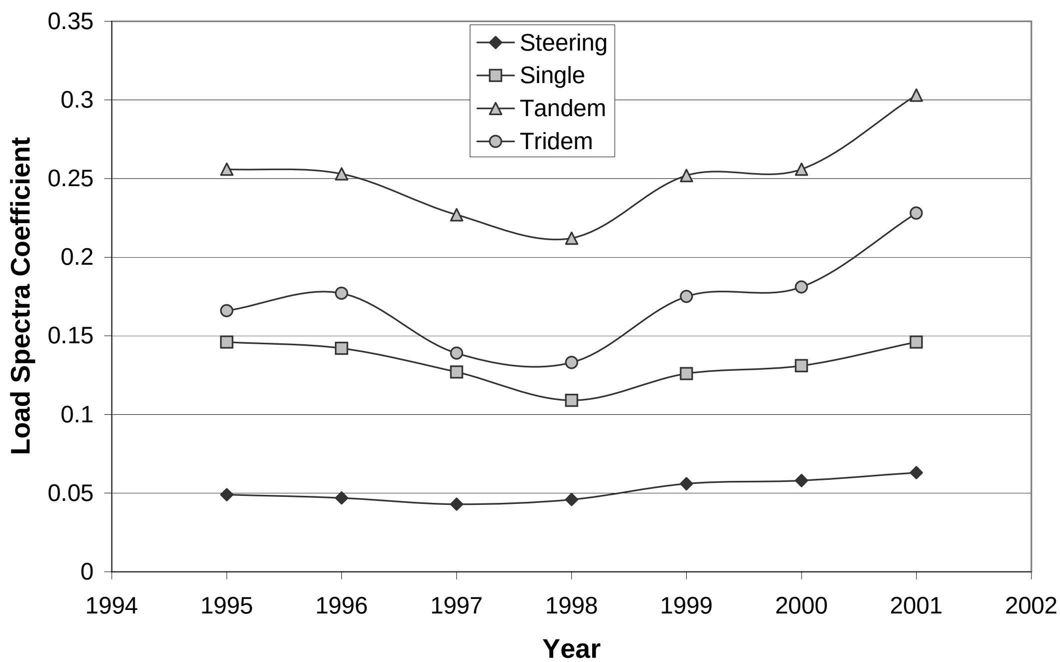
Load Spectra Coefficients in Each Year at Stations 17&18



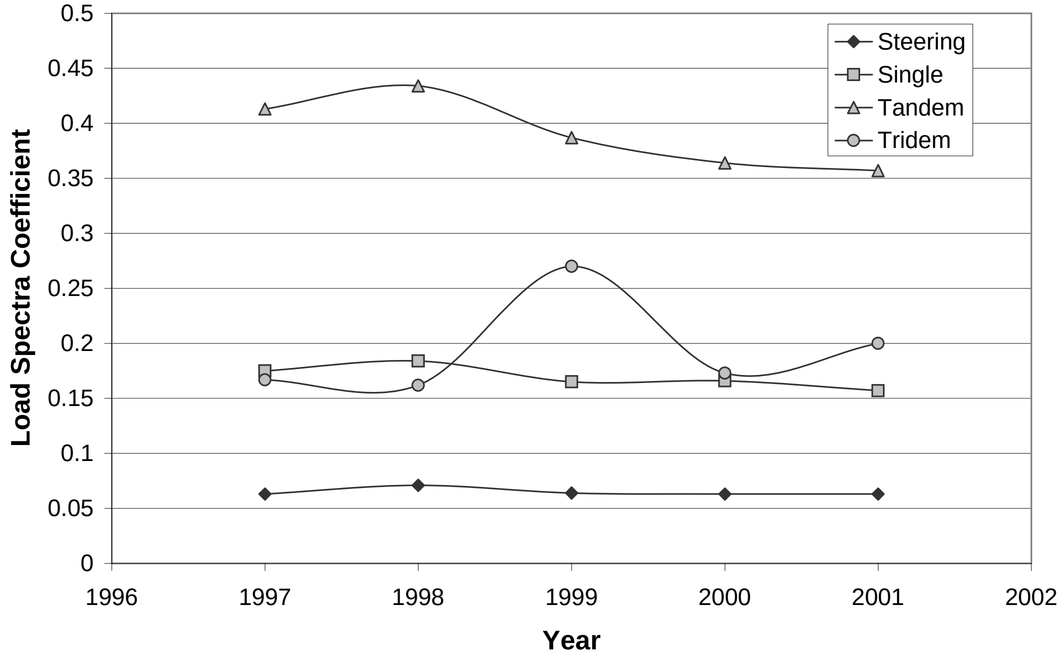
Load Spectra Coefficients in Each Year at Stations 47&48



Load Spectra Coefficients in Each Year at Stations 57&58

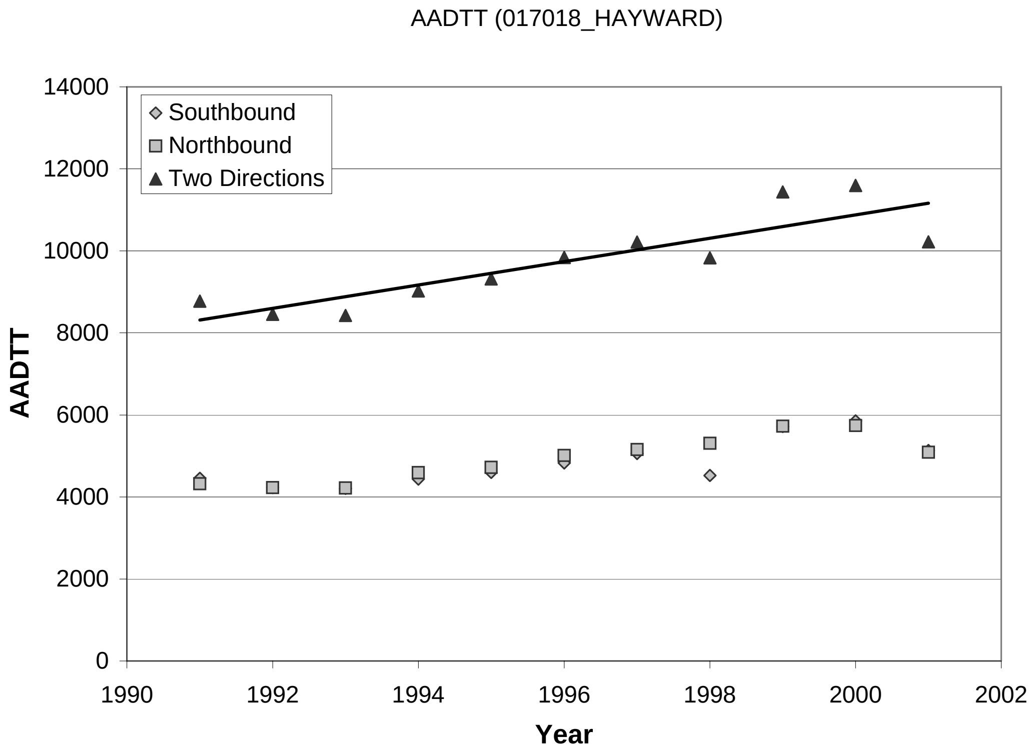


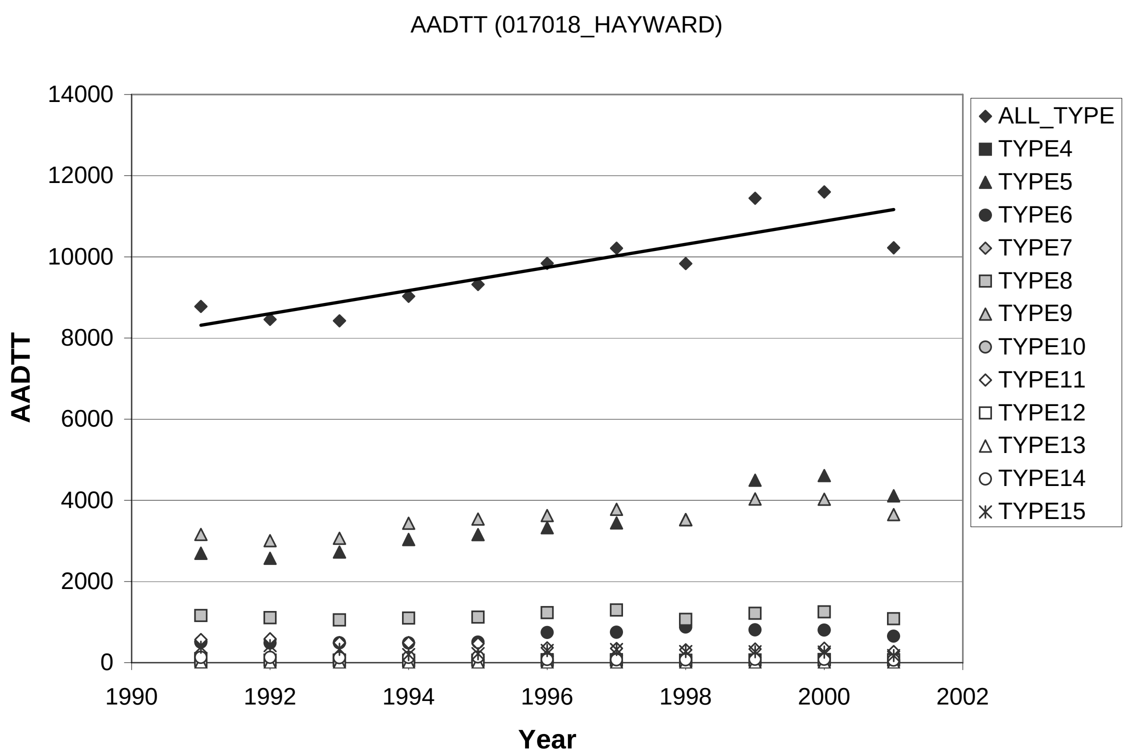
Load Spectra Coefficients in Each Year at Station 72

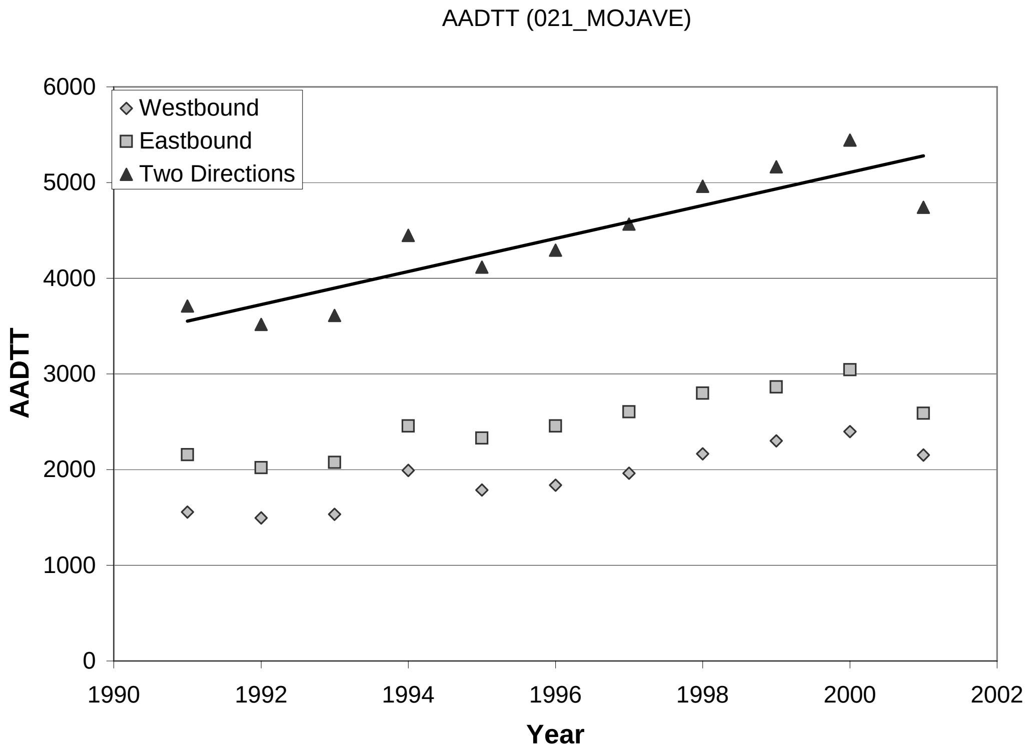


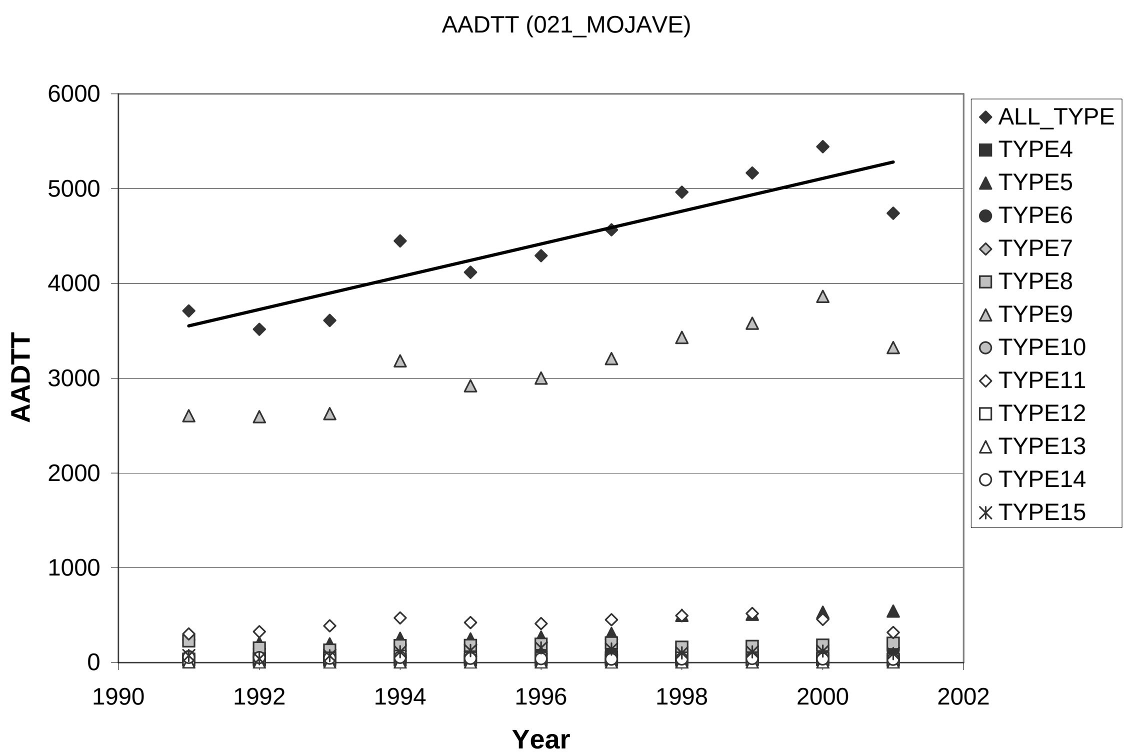
APPENDIX D:

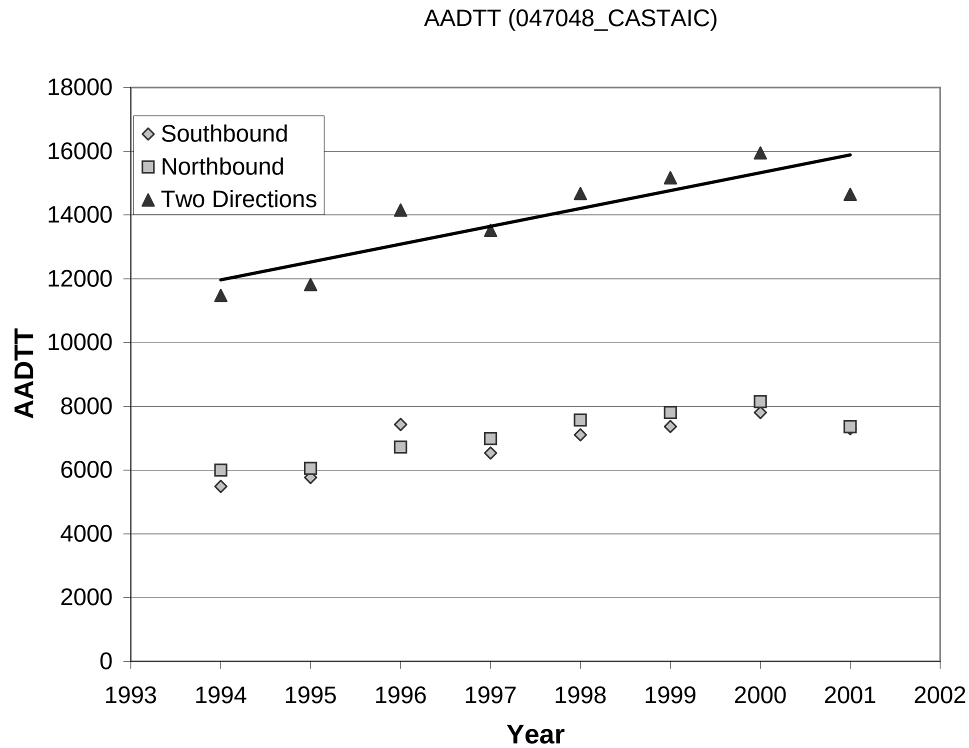
AADTT OF 5 WIM SITES

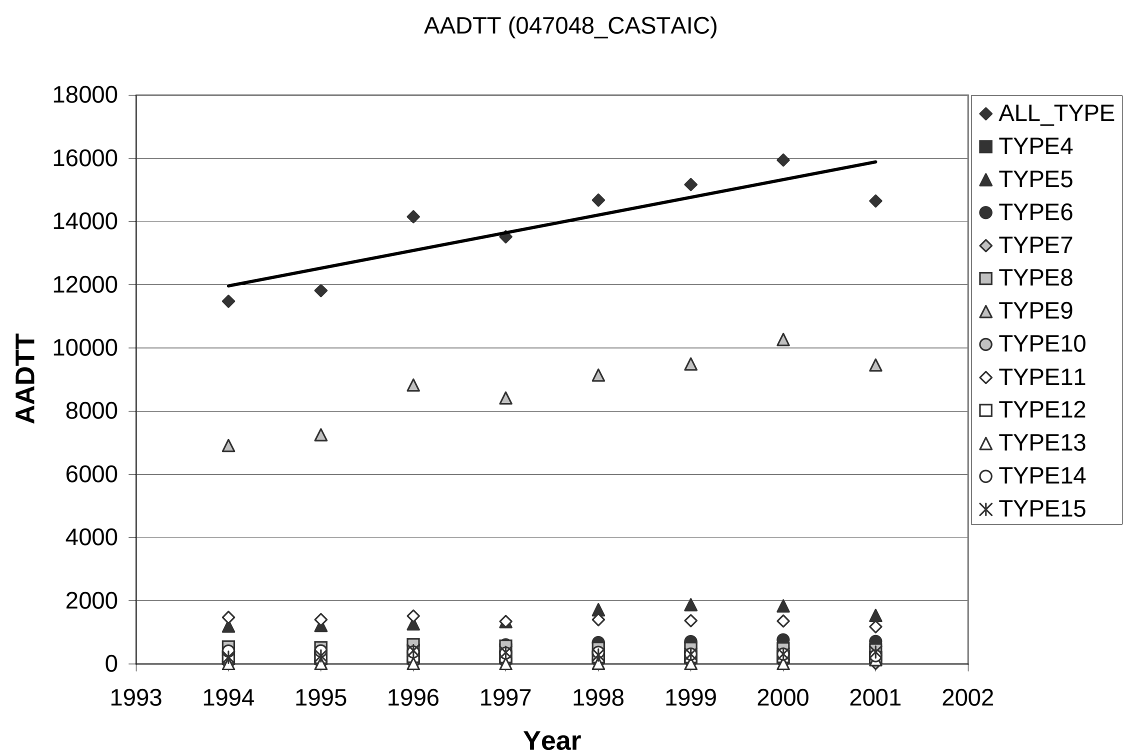

AADTT (017018_HAYWARD)
Southbound
Northbound
Two Directions
AADTT
Year
14000
12000
10000
8000
6000
4000
2000
0
1990
1992
1994
1996
1998
2000
2002


AADTT (017018_HAYWARD)
ALL_TYPE
TYPE4
TYPE5
TYPE6
TYPE7
TYPE8
TYPE9
TYPE10
TYPE11
TYPE12
TYPE13
TYPE14
TYPE15
AADTT
Year
14000
12000
10000
8000
6000
4000
2000
0
1990
1992
1994
1996
1998
2000
2002

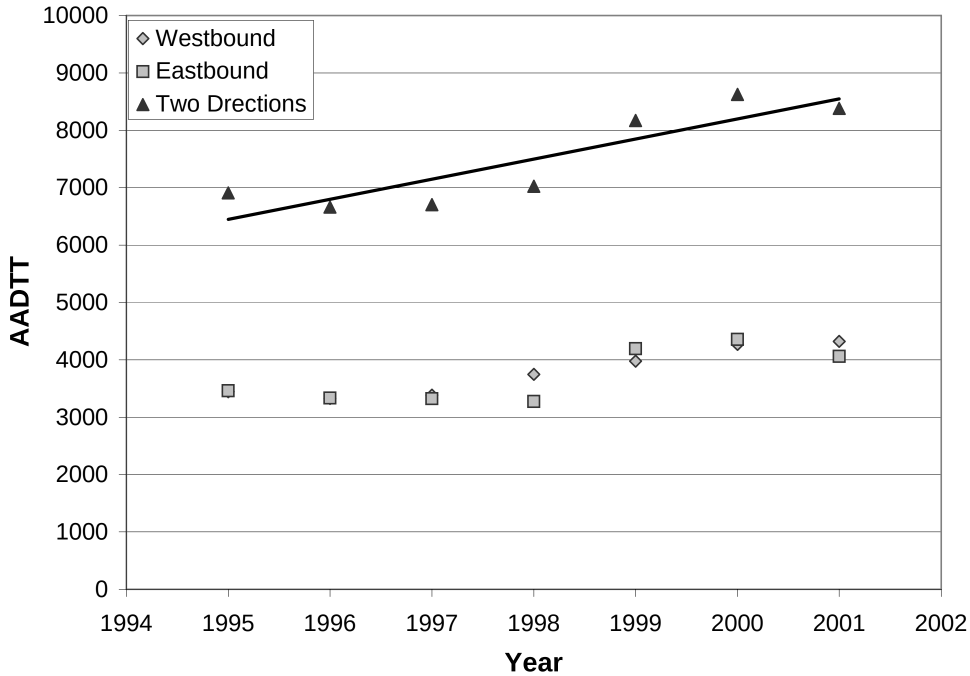

AADTT (021_MOJAVE)
Westbound
Eastbound
Two Directions
AADTT
Year
0
1000
2000
3000
4000
5000
6000
1990
1992
1994
1996
1998
2000
2002


AADTT (021_MOJAVE)
ALL_TYPE
TYPE4
TYPE5
TYPE6
TYPE7
TYPE8
TYPE9
TYPE10
TYPE11
TYPE12
TYPE13
TYPE14
TYPE15
AADTT
Year
0
1000
2000
3000
4000
5000
6000
1990
1992
1994
1996
1998
2000
2002

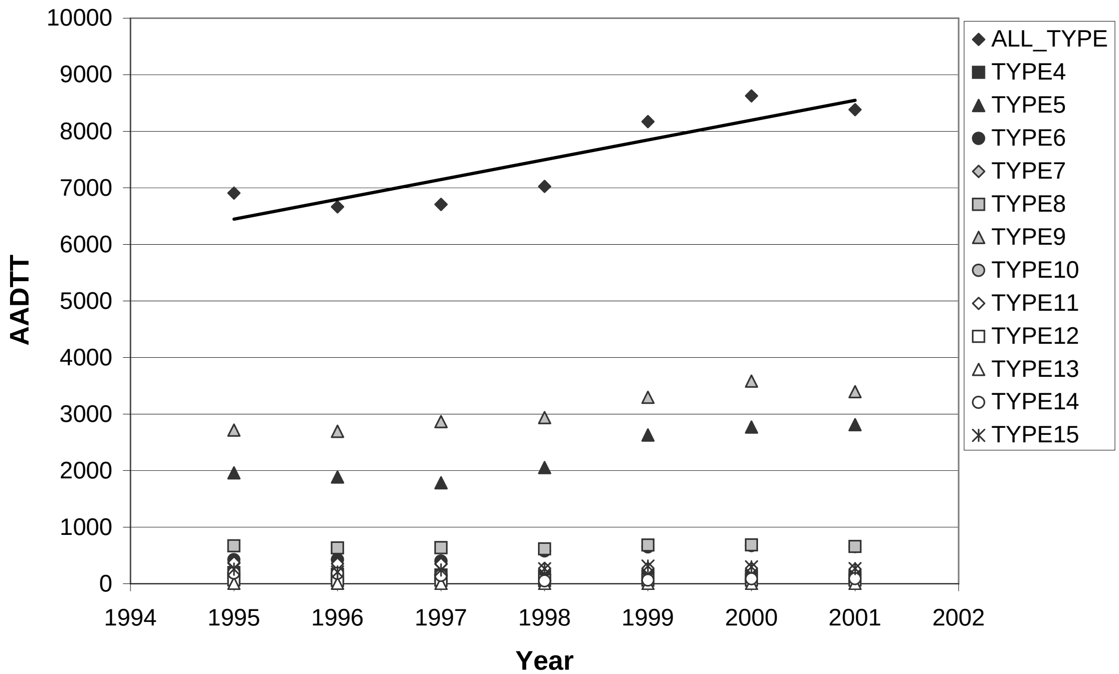

AADTT (047048_CASTAIC)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
AADTT
Southbound
Northbound
Two Directions
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year

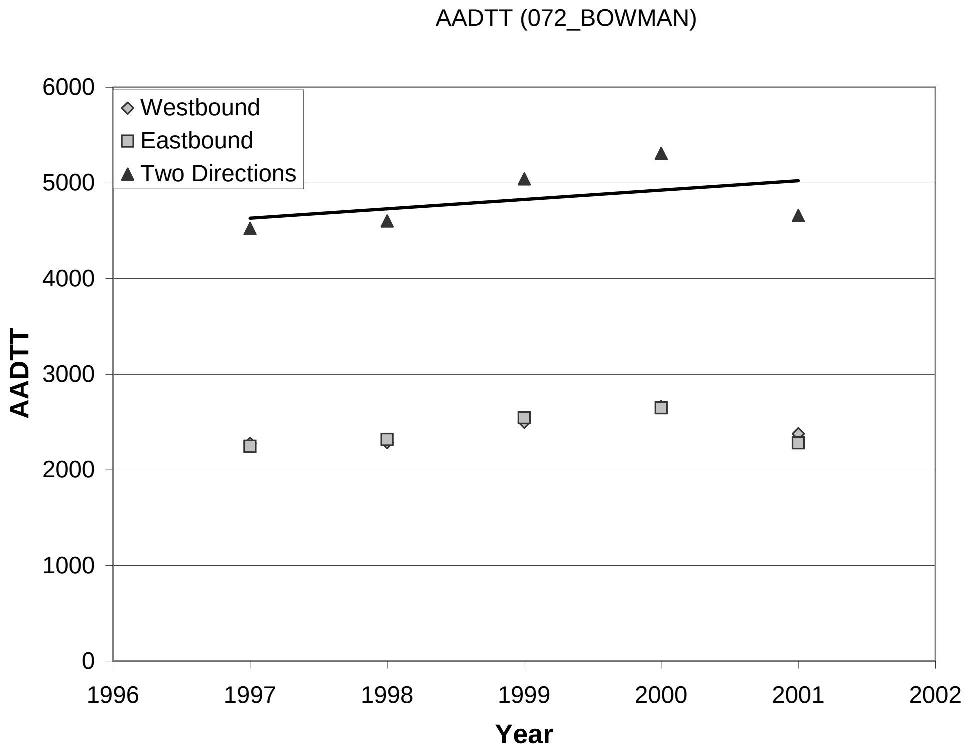

AADTT (047048_CASTAIC)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
AADTT
ALL_TYPE
TYPE4
TYPE5
TYPE6
TYPE7
TYPE8
TYPE9
TYPE10
TYPE11
TYPE12
TYPE13
TYPE14
TYPE15
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year

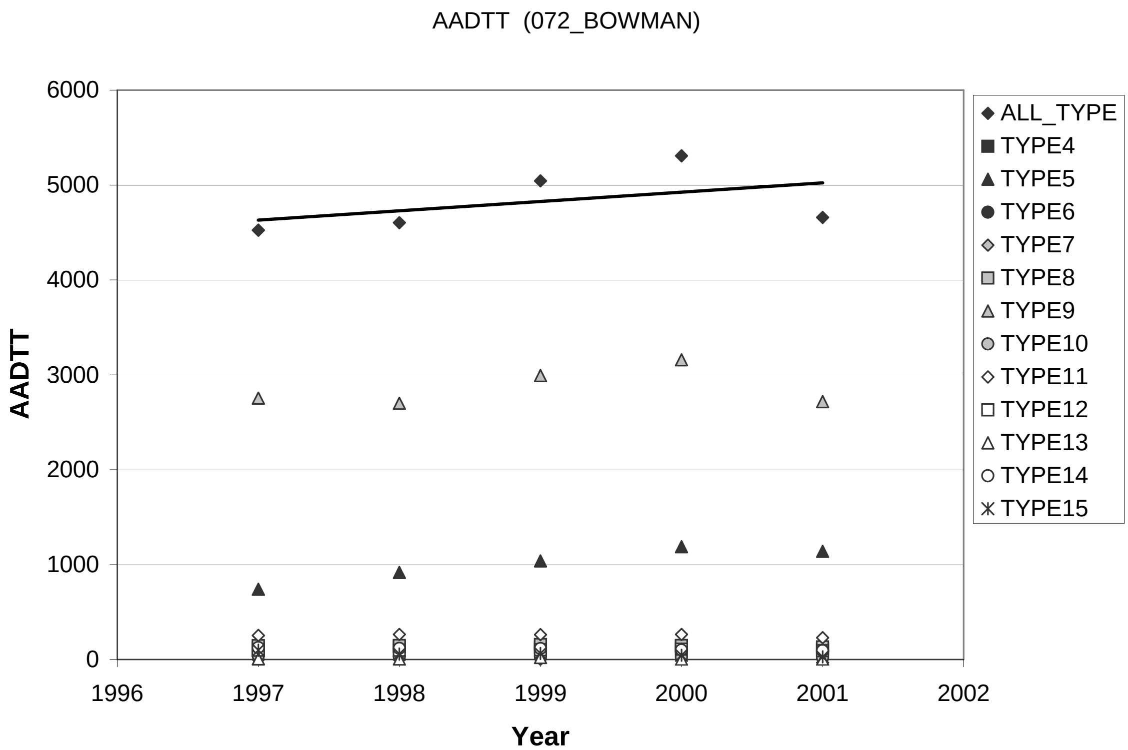
AADTT (057058_PINOLE)



AADTT (057058_PINOLE)




AADTT (072_BOWMAN)
Westbound
Eastbound
Two Directions
AADTT
Year
0
1000
2000
3000
4000
5000
6000
1996
1997
1998
1999
2000
2001
2002

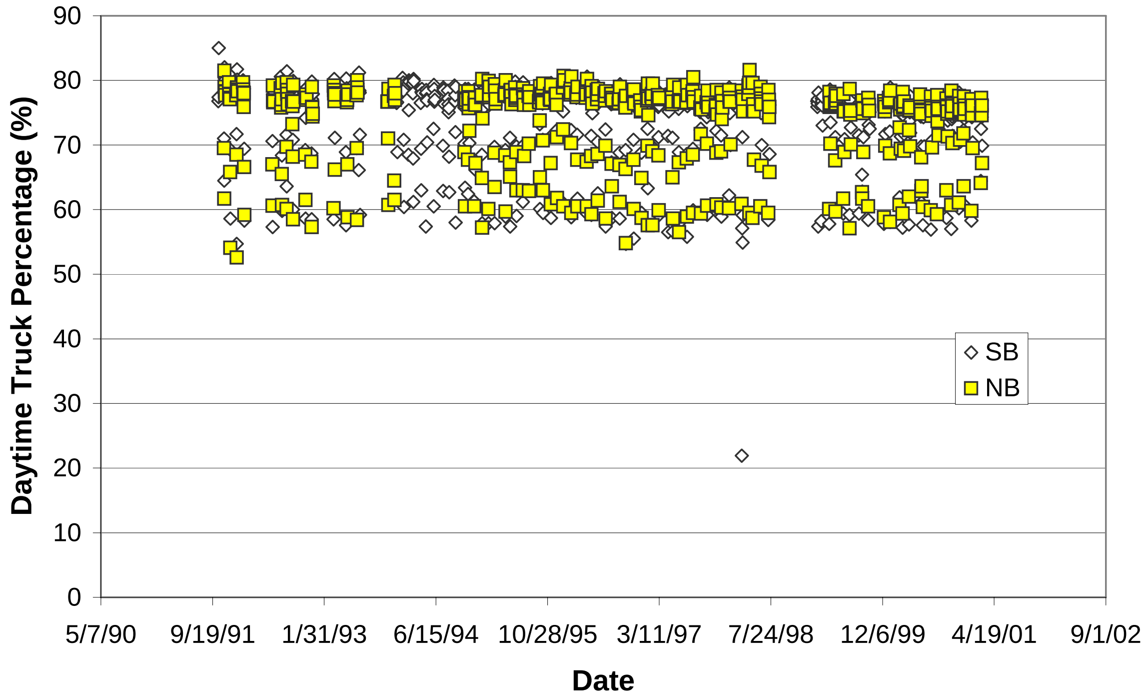

AADTT (072_BOWMAN)
ALL_TYPE
TYPE4
TYPE5
TYPE6
TYPE7
TYPE8
TYPE9
TYPE10
TYPE11
TYPE12
TYPE13
TYPE14
TYPE15
AADTT
Year
0
1000
2000
3000
4000
5000
6000
1996
1997
1998
1999
2000
2001
2002

APPENDIX E:

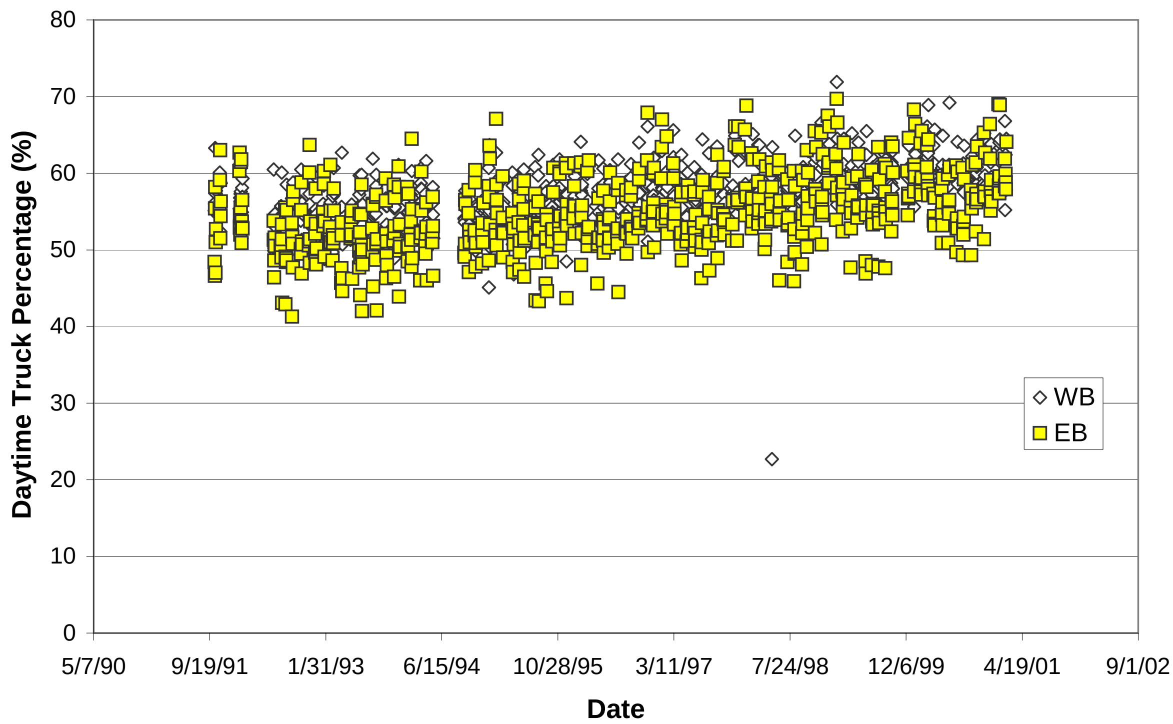
DAYTIME TRUCK PERCENTAGE OF

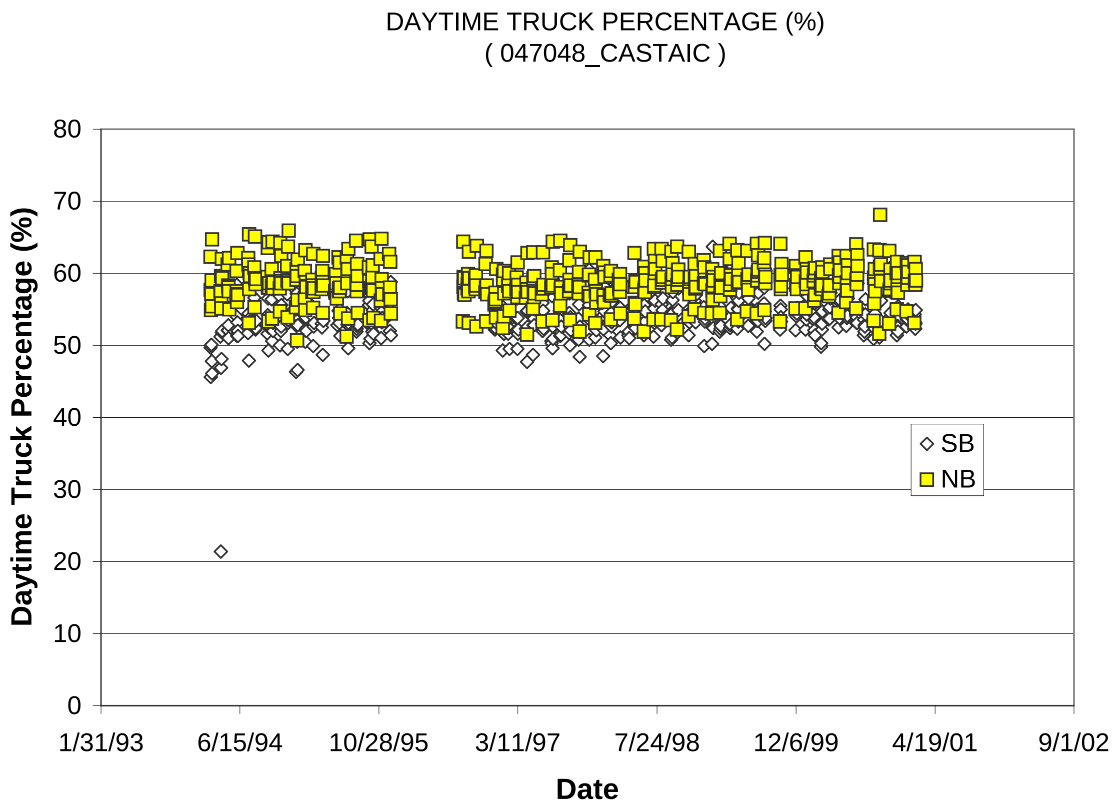
EACH SAMPLED DAY AT 5 WIM SITES

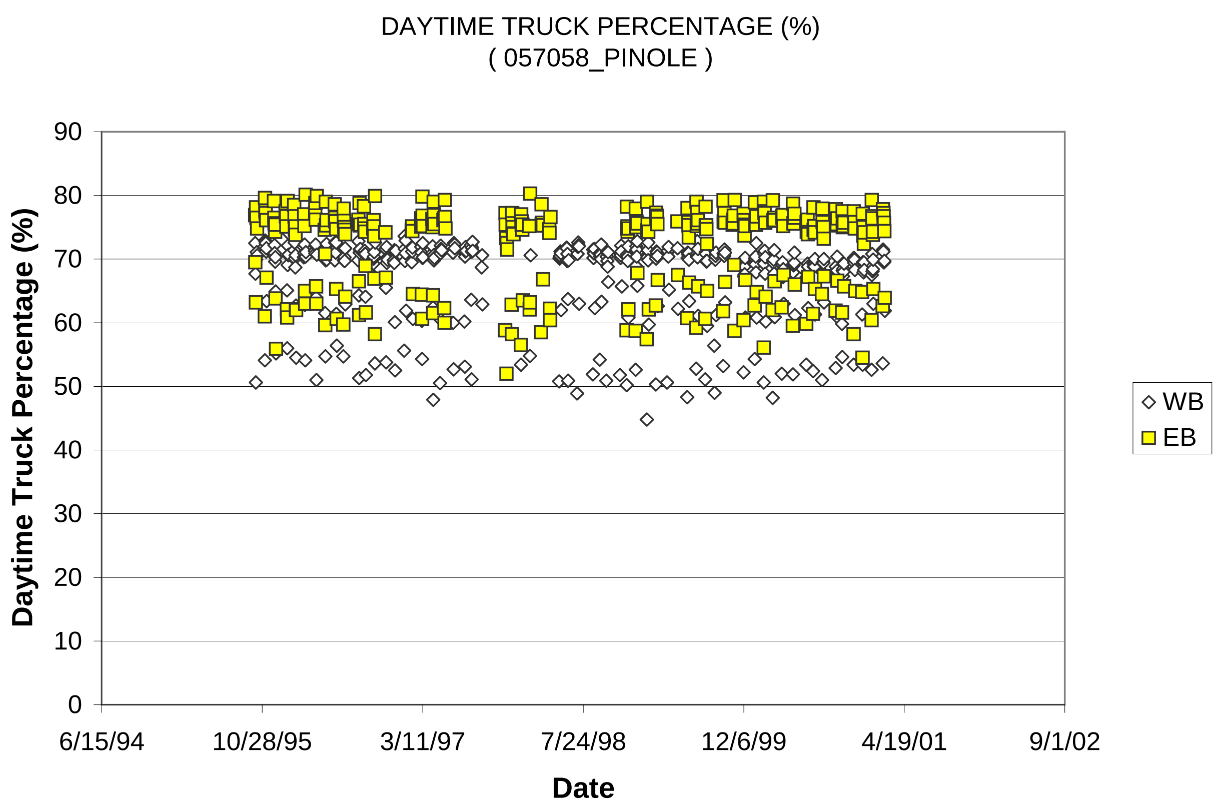
DAYTIME TRUCK PERCENTAGE (%)
(017018_HAYWARD)

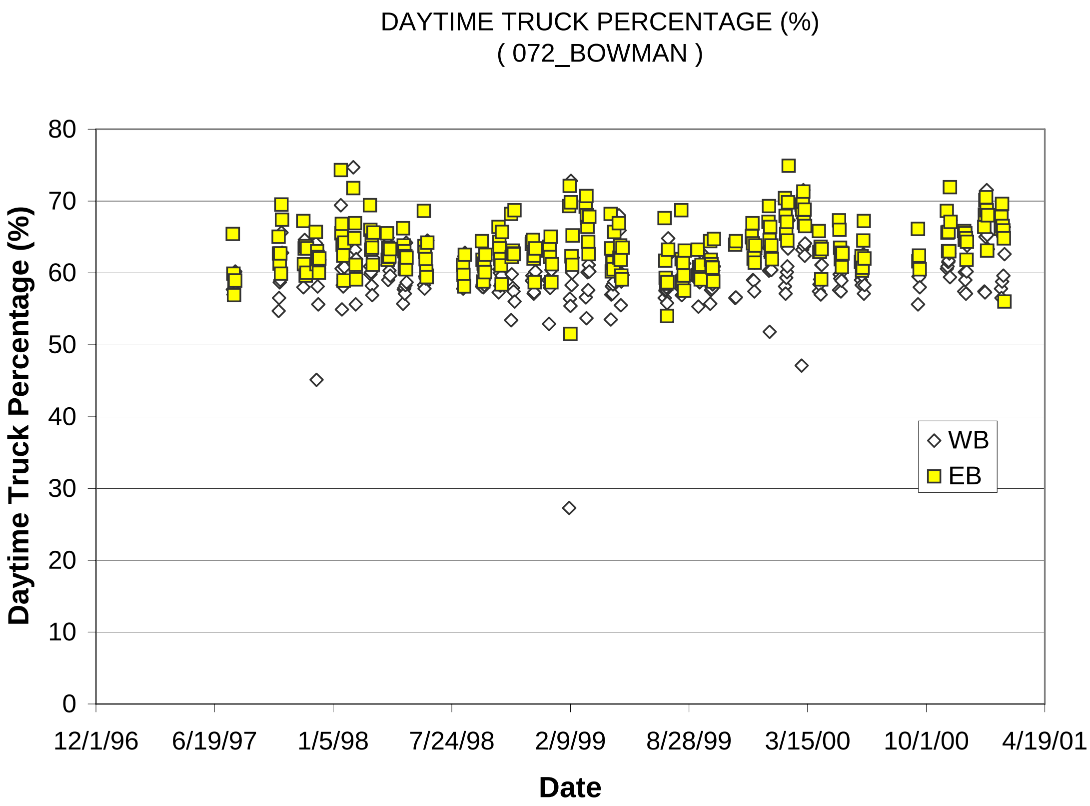


DAYTIME TRUCK PERCENTAGE (%)
(021_MOJAVE)



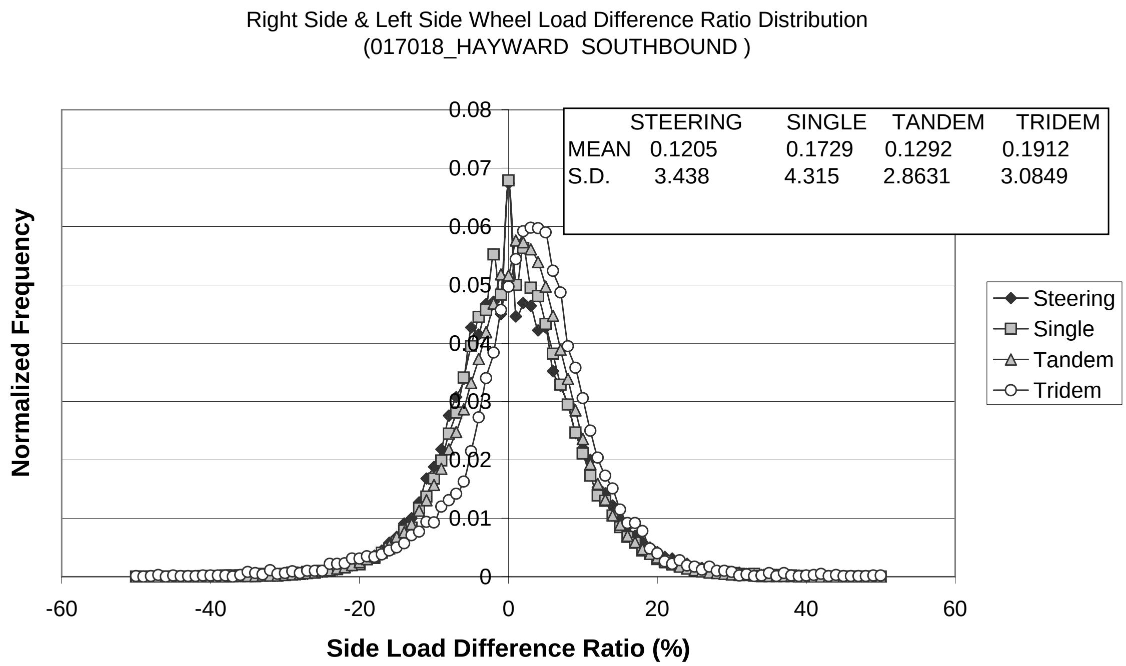

DAYTIME TRUCK PERCENTAGE (%)
(047048_CASTAIC)
Daytime Truck Percentage (%)
80
70
60
50
40
30
20
10
0
1/31/93
6/15/94
10/28/95
3/11/97
7/24/98
12/6/99
4/19/01
9/1/02
Date
SB
NB

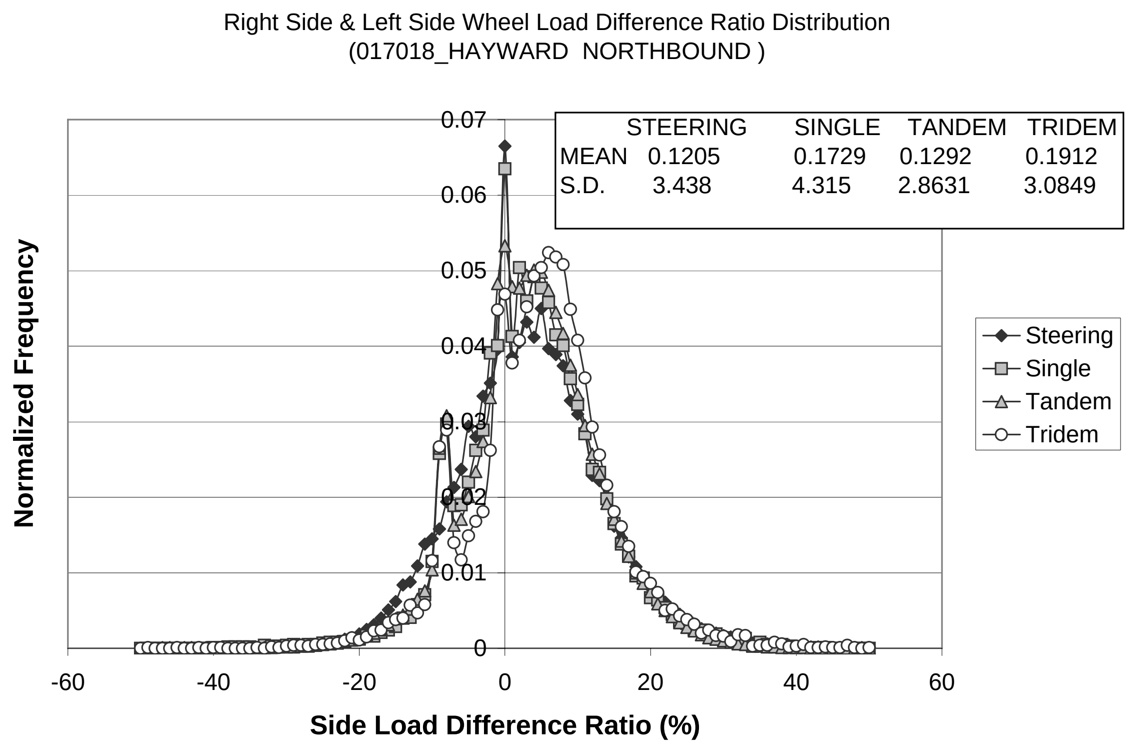

DAYTIME TRUCK PERCENTAGE (%)
(057058_PINOLE)
Daytime Truck Percentage (%)
90
80
70
60
50
40
30
20
10
0
6/15/94
10/28/95
3/11/97
7/24/98
12/6/99
4/19/01
9/1/02
Date
WB
EB


DAYTIME TRUCK PERCENTAGE (%)
(072_BOWMAN)
Daytime Truck Percentage (%)
80
70
60
50
40
30
20
10
0
12/1/96
6/19/97
1/5/98
7/24/98
2/9/99
8/28/99
3/15/00
10/1/00
4/19/01
Date
WB
EB

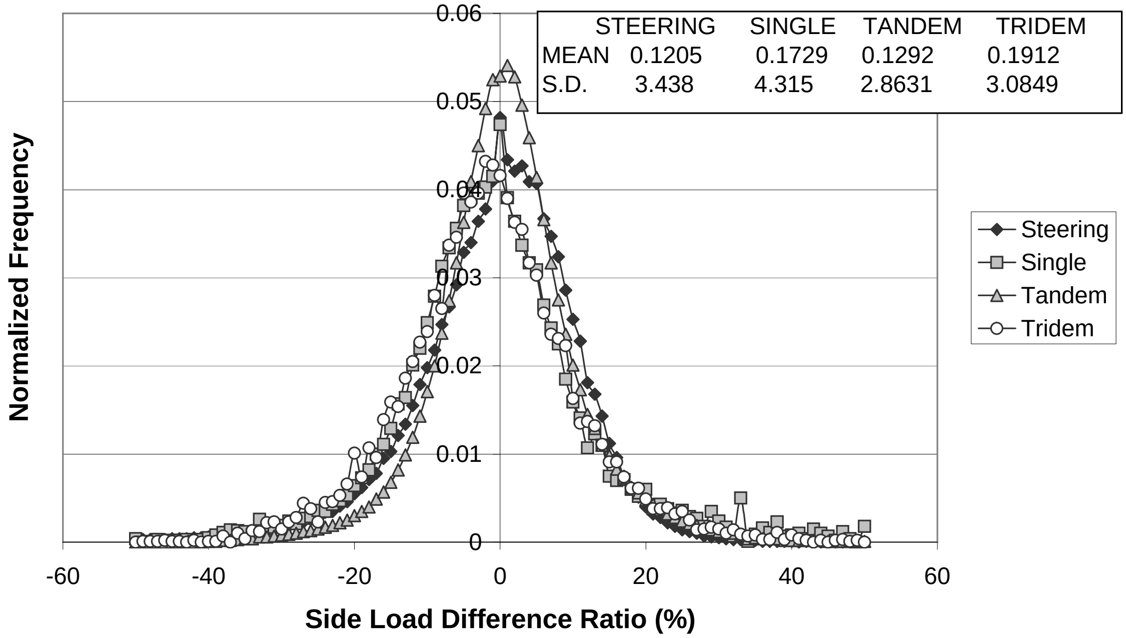
APPENDIX F:

SIDE WHEEL LOAD DIFFERENCE RATIO DISTRIBUTION AT 5 WIM SITES

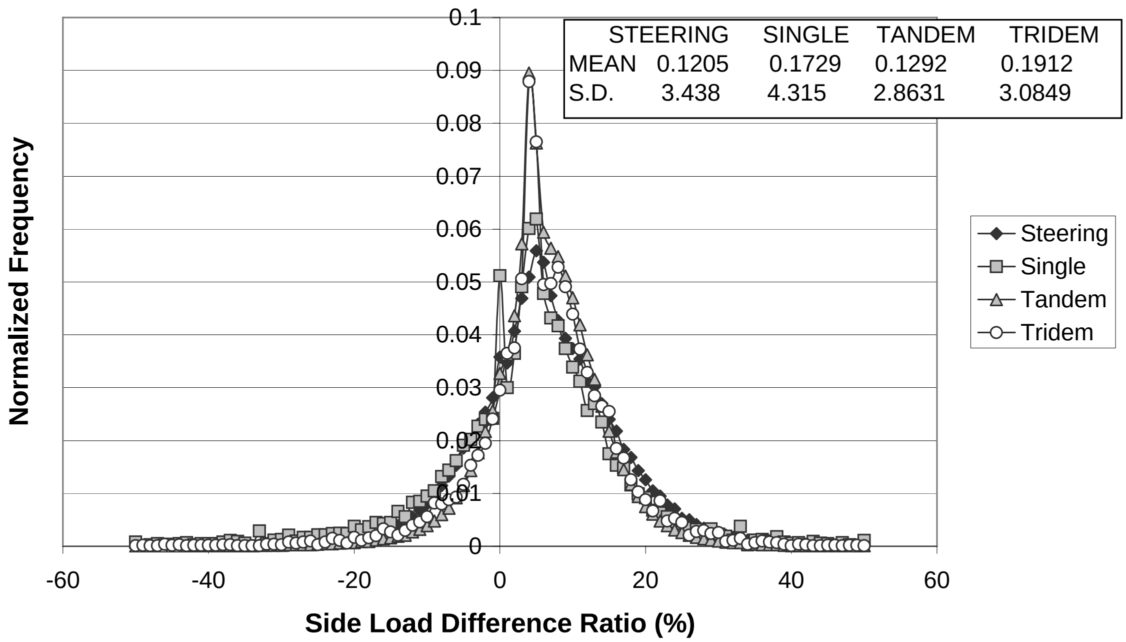

Right Side & Left Side Wheel Load Difference Ratio Distribution
(017018_HAYWARD SOUTHBOUND)
STEERING SINGLE TANDEM TRIDEM
MEAN 0.1205 0.1729 0.1292 0.1912
S.D. 3.438 4.315 2.8631 3.0849
Steering
Single
Tandem
Tridem
Normalized Frequency
Side Load Difference Ratio (%)


Right Side & Left Side Wheel Load Difference Ratio Distribution
(017018_HAYWARD NORTHBOUND)
STEERING SINGLE TANDEM TRIDEM
MEAN 0.1205 0.1729 0.1292 0.1912
S.D. 3.438 4.315 2.8631 3.0849
Steering
Single
Tandem
Tridem
Normalized Frequency
Side Load Difference Ratio (%)

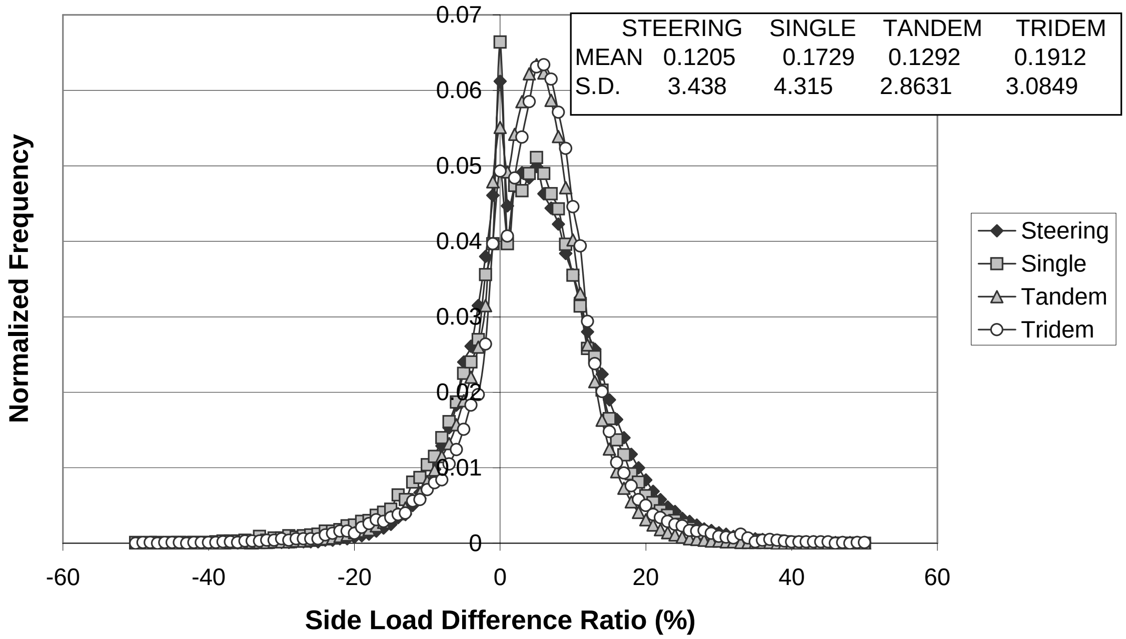
Right Side & Left Side Wheel Load Difference Ratio Distribution
(021_MOJAVE WESTBOUND)



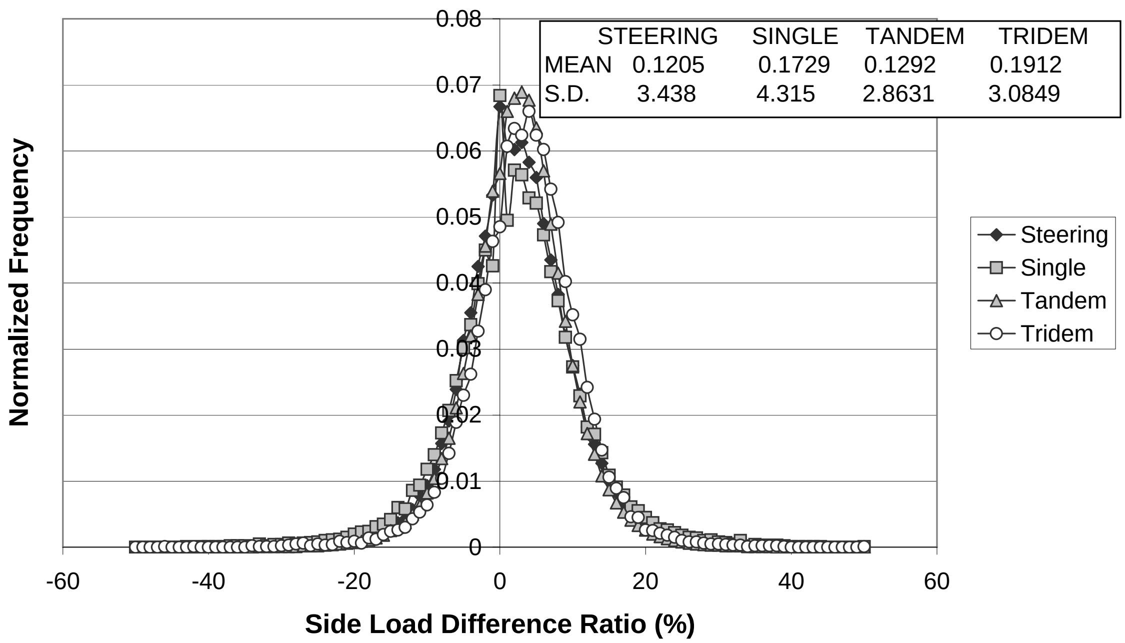
Right Side & Left Side Wheel Load Difference Ratio Distribution
(021_MOJAVE EASTBOUND)



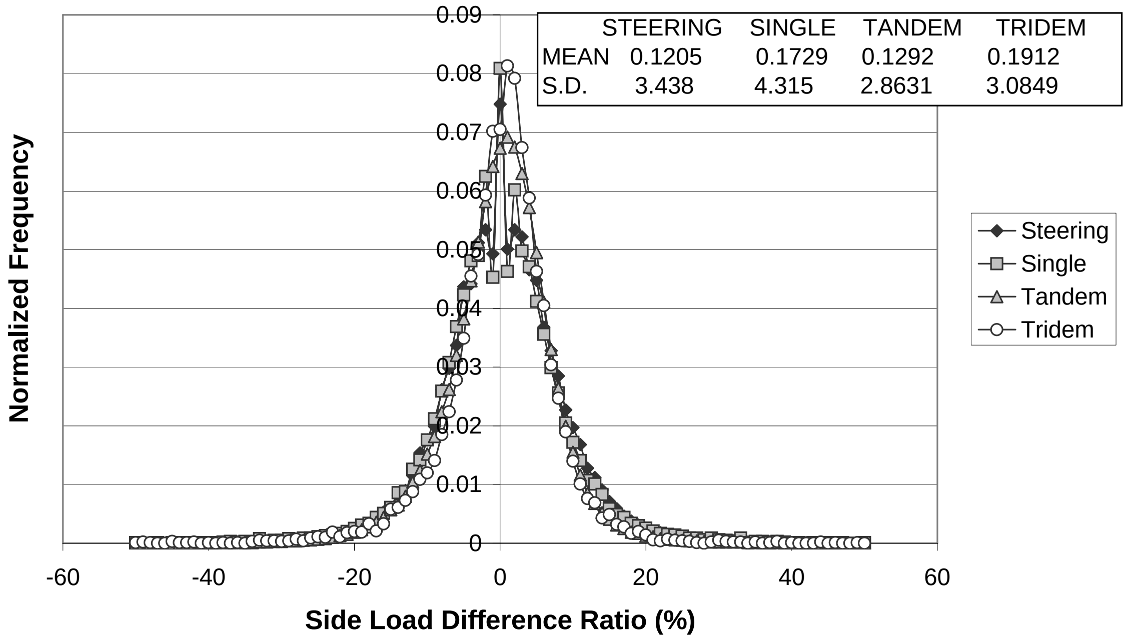
Right Side & Left Side Wheel Load Difference Ratio Distribution
(047048_CASTAIC SOUTHBOUND)



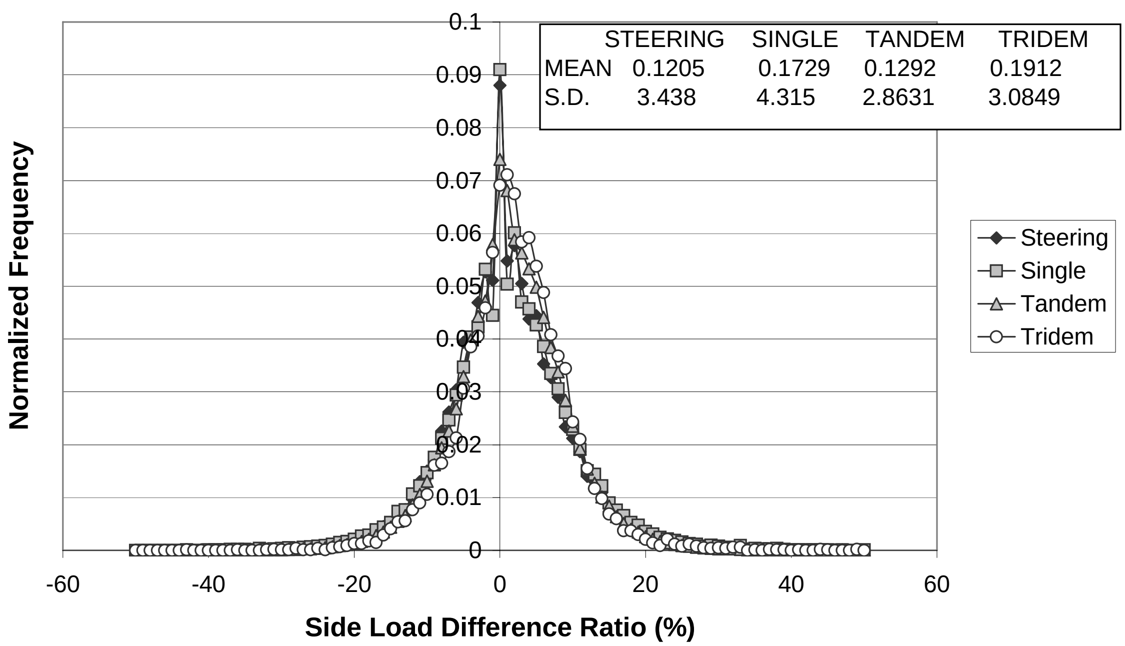
Right Side & Left Side Wheel Load Difference Ratio Distribution
(047048_CASTAIC NORTHBOUND)

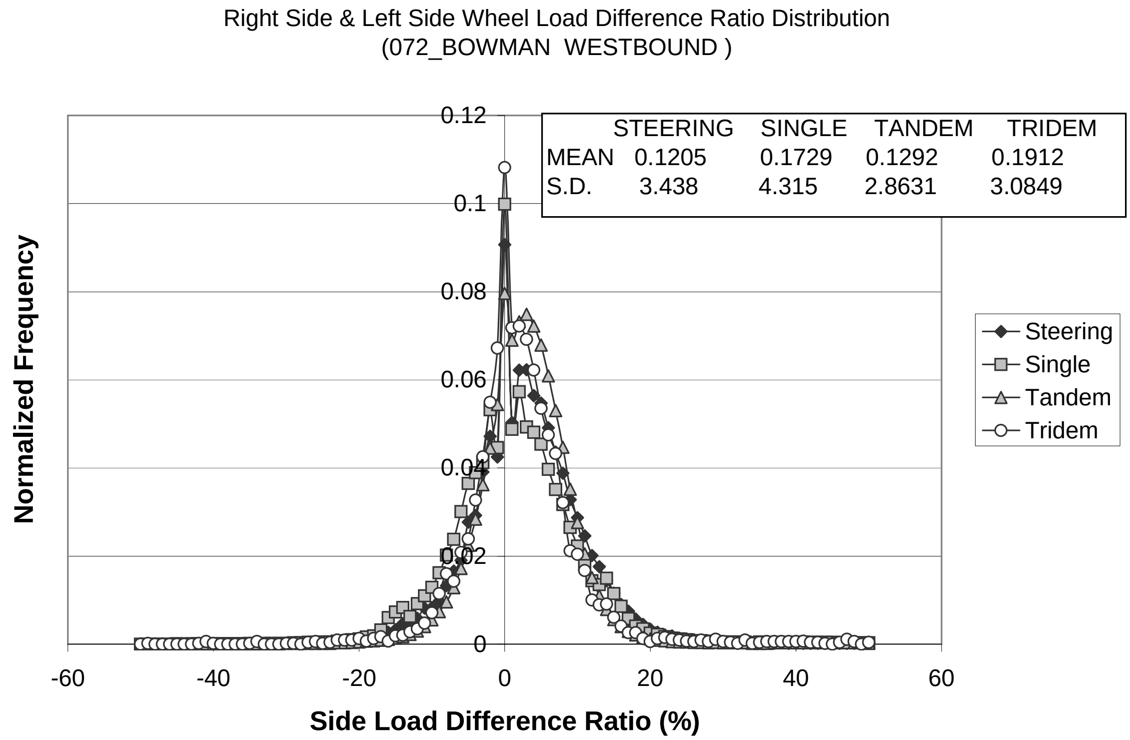


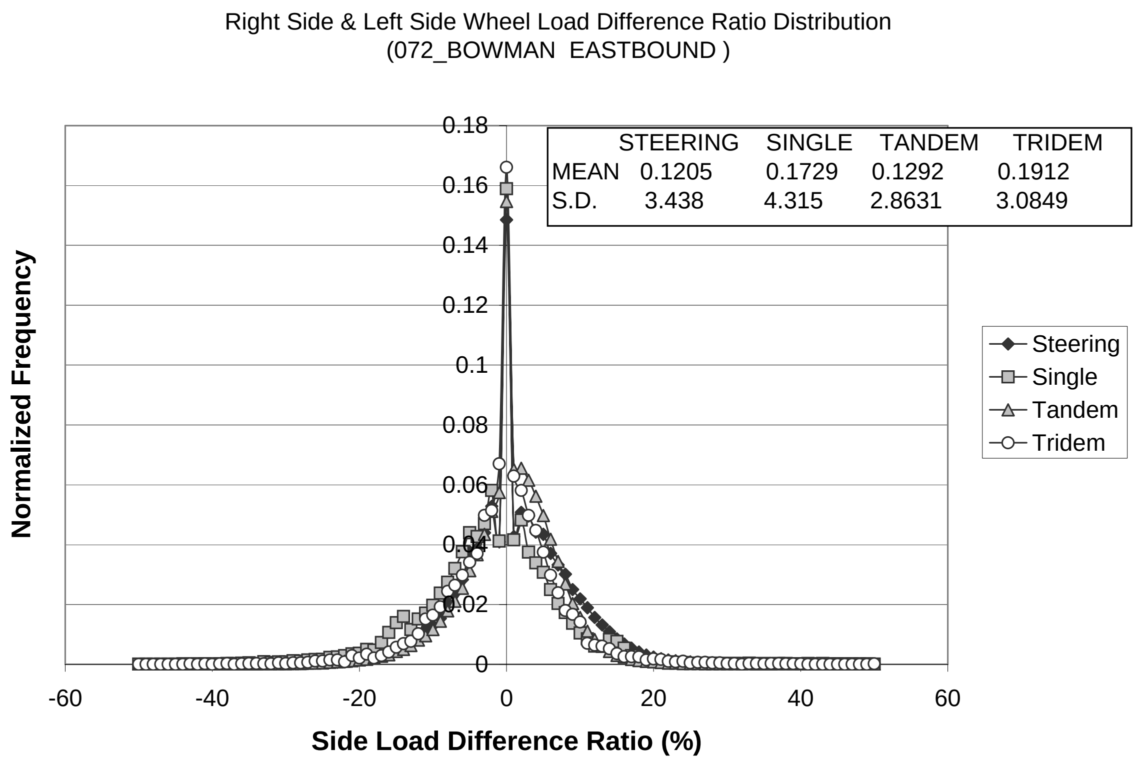
Right Side & Left Side Wheel Load Difference Ratio Distribution
(057058_PINOLE WESTBOUND)



Right Side & Left Side Wheel Load Difference Ratio Distribution
(057058_PINOLE EASTBOUND)




Right Side & Left Side Wheel Load Difference Ratio Distribution
(072_BOWMAN WESTBOUND)
STEERING SINGLE TANDEM TRIDEM
MEAN 0.1205 0.1729 0.1292 0.1912
S.D. 3.438 4.315 2.8631 3.0849
Normalized Frequency
Side Load Difference Ratio (%)
Steering
Single
Tandem
Tridem


Right Side & Left Side Wheel Load Difference Ratio Distribution
(072_BOWMAN EASTBOUND)
STEERING SINGLE TANDEM TRIDEM
MEAN 0.1205 0.1729 0.1292 0.1912
S.D. 3.438 4.315 2.8631 3.0849
Normalized Frequency
Side Load Difference Ratio (%)
Steering
Single
Tandem
Tridem

APPENDIX G:

TRUCK AXLE RELATIONSHIP (PER 1000 TRUCKS)

(AVERAGED OVER ALL THE WIM STATIONS IN CA FROM 1991 TO 2001)

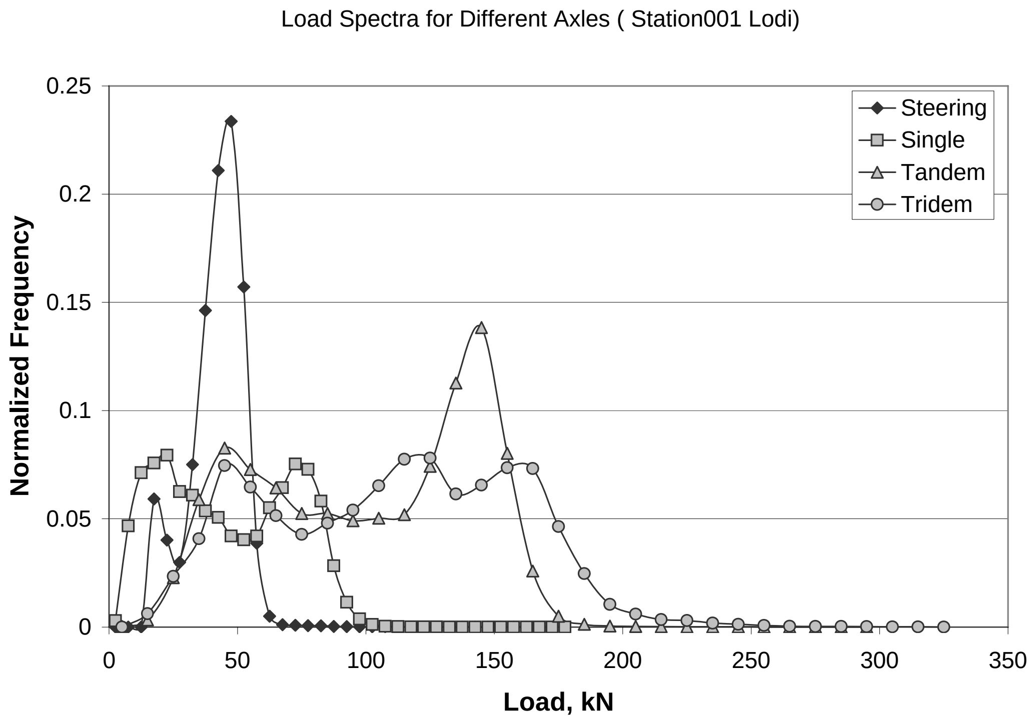
Axle Number per 1000 Trucks

Axle Group	Truck Type											
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Steering	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Single	342	1000	0	893	1583	0	0	4000	3000	1600	2000	1214
Tandem	649	0	1000	893	494	2000	1000	0	1000	2400	1000	577
Tridem	0	0	0	107	0	0	1000	0	0	200	0	143

APPENDIX H:

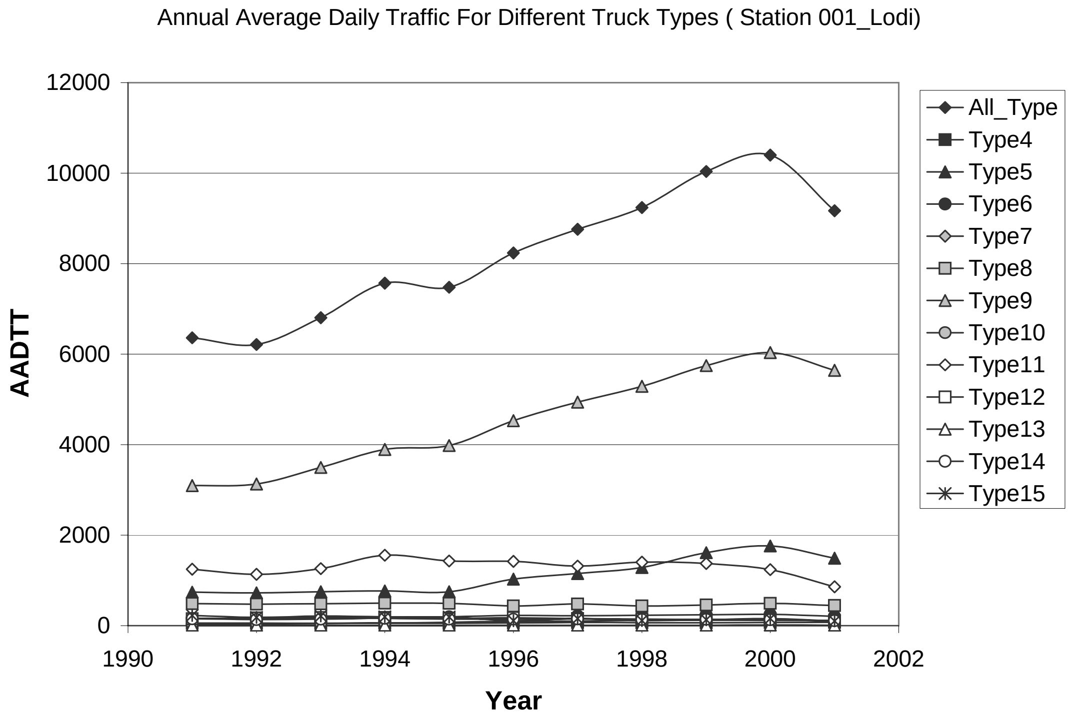
LOAD SPECTRA AND AADT FOR EACH STATION

STATION 1 LODI

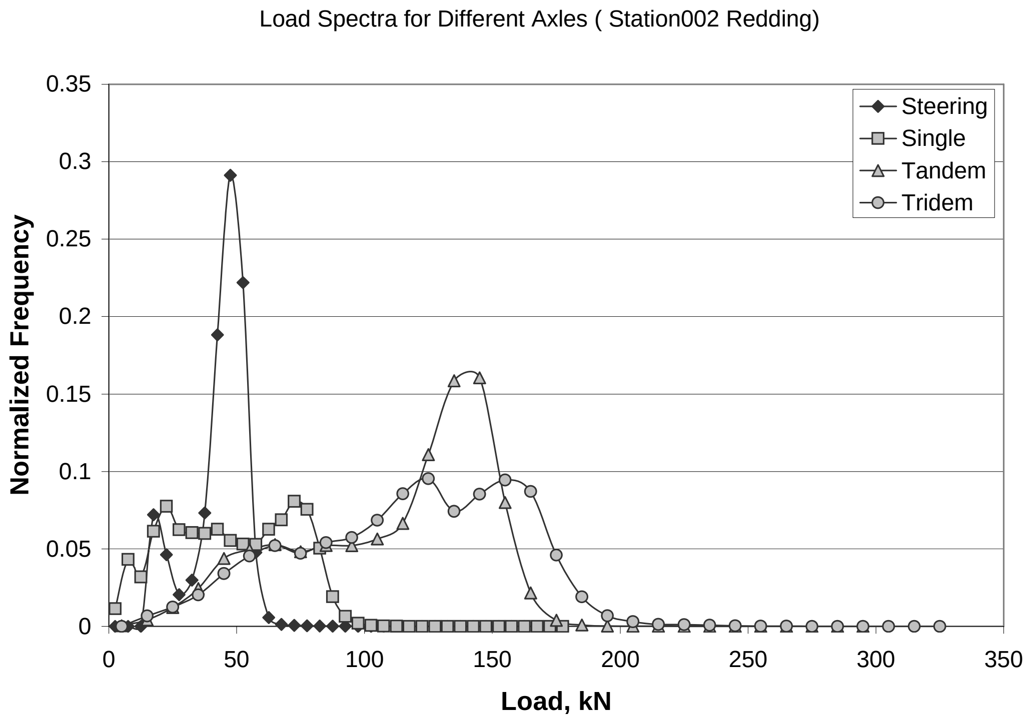


Average Annual Daily Truck Traffic (AADTT) for Different Truck Types

Year	**Truck Type**												
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	6364	55	741	160	2	490	3098	30	1249	154	8	152	225
1992	6214	56	724	157	1	474	3132	39	1135	170	7	137	181
1993	6807	51	748	173	1	482	3499	48	1262	177	8	145	214
1994	7568	58	766	179	1	499	3896	62	1558	183	8	161	198
1995	7480	54	748	197	2	491	3979	72	1431	163	8	145	190
1996	8235	59	1030	225	3	435	4530	95	1421	176	8	144	110
1997	8762	70	1151	220	4	479	4942	101	1319	158	8	150	159
1998	9238	66	1286	232	4	434	5290	118	1405	145	10	136	112
1999	10037	65	1612	239	4	460	5747	121	1375	137	9	138	130
2000	10400	70	1763	251	3	491	6035	119	1237	130	12	131	156
2001	9172	76	1493	205	2	443	5643	113	859	111	9	111	106

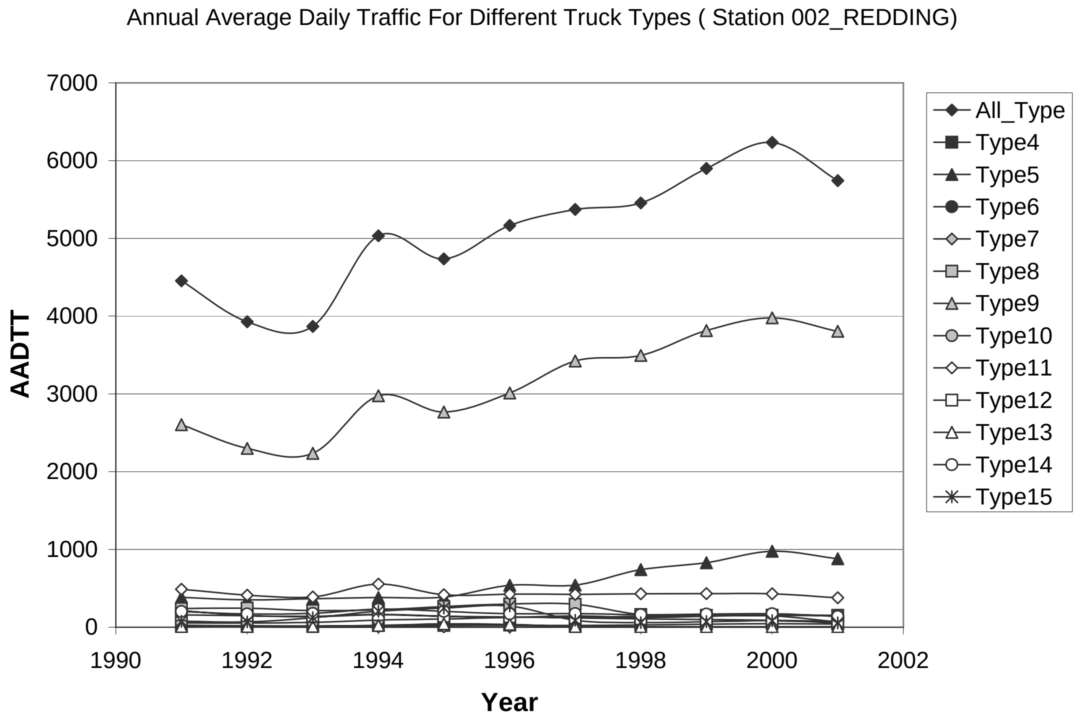

Annual Average Daily Traffic For Different Truck Types (Station 001_Lodi)
AADTT
12000
10000
8000
6000
4000
2000
0
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 2 REDDING

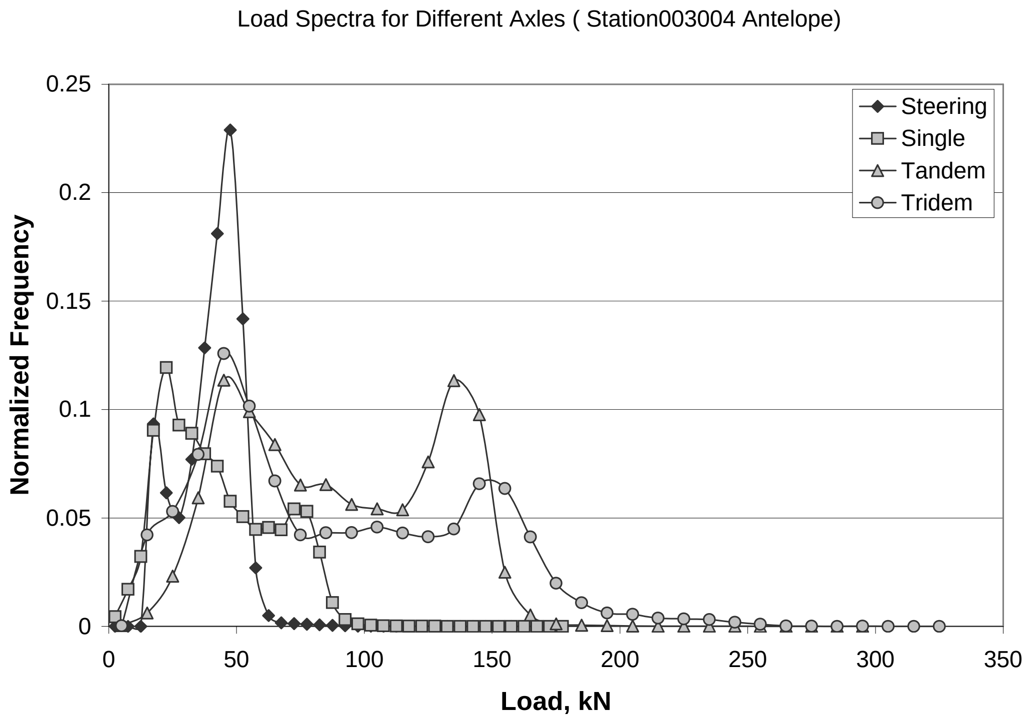


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
1991	4454	26	385	214	2	238	2605	55	488	157	7	201	76
1992	3928	18	350	151	4	244	2299	54	411	148	7	171	69
1993	3868	16	366	141	1	214	2237	61	389	136	9	178	121
1994	5035	20	382	165	3	223	2977	91	554	159	23	231	207
1995	4737	23	387	140	2	265	2768	104	417	141	43	203	246
1996	5166	25	539	126	3	298	3012	126	425	133	36	173	272
1997	5372	24	542	146	2	296	3423	125	422	119	8	175	89
1998	5457	29	740	125	2	162	3495	141	431	108	6	160	58
1999	5898	37	828	139	3	153	3815	147	433	100	5	169	70
2000	6234	47	977	145	3	154	3978	153	429	88	5	172	84
2001	5743	41	881	68	1	152	3805	148	379	71	4	138	56


Annual Average Daily Traffic For Different Truck Types (Station 002_REDDING)
AADTT
7000
6000
5000
4000
3000
2000
1000
0
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

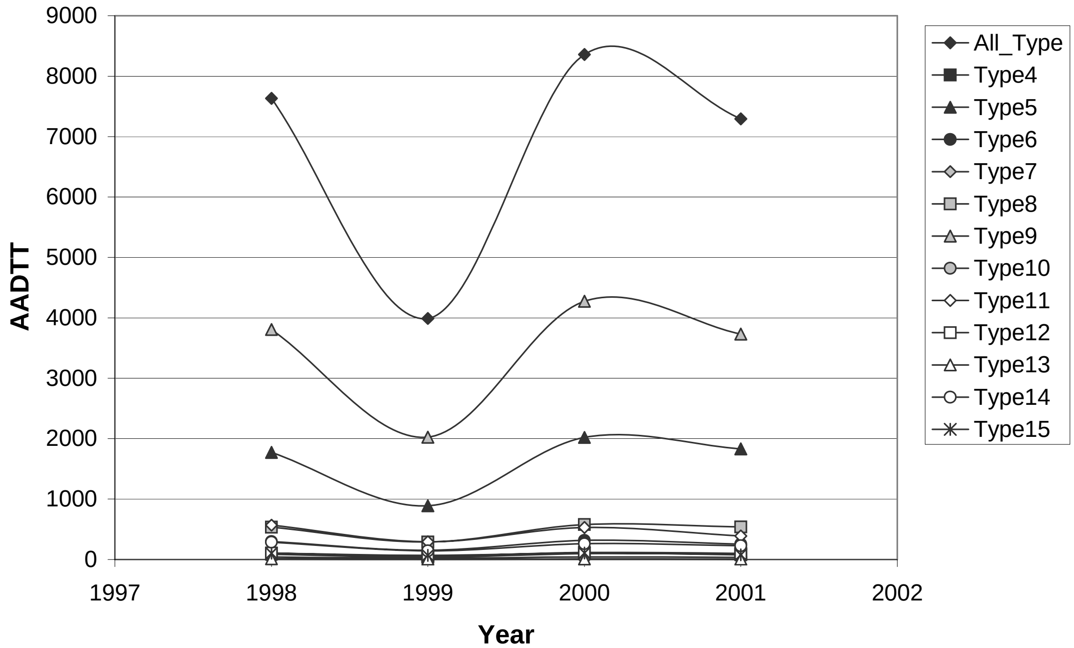
STATIONS 3&4 ANTELOPE



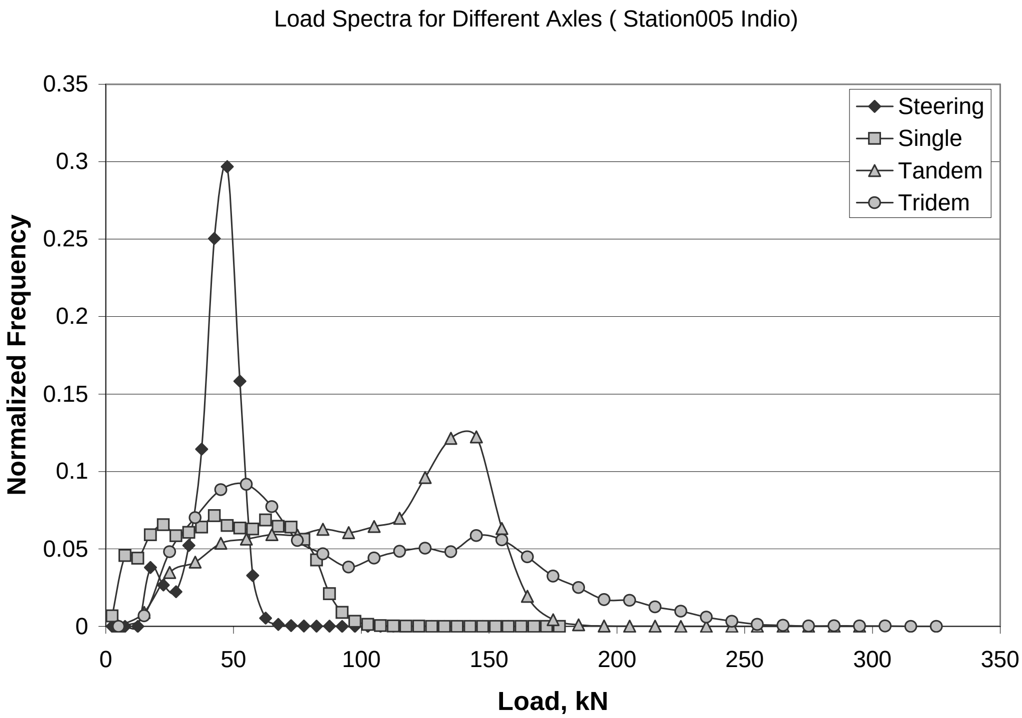
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1998	7634	89	1774	297	7	537	3807	42	569	108	12	288	104
1999	3989	40	889	155	4	290	2023	20	295	54	5	144	68
2000	8359	99	2020	317	6	579	4273	41	530	118	9	260	107
2001	7292	93	1830	255	3	541	3730	35	389	103	6	229	79

Annual Average Daily Traffic For Different Truck Types (Station 003004_ANTELOPE)

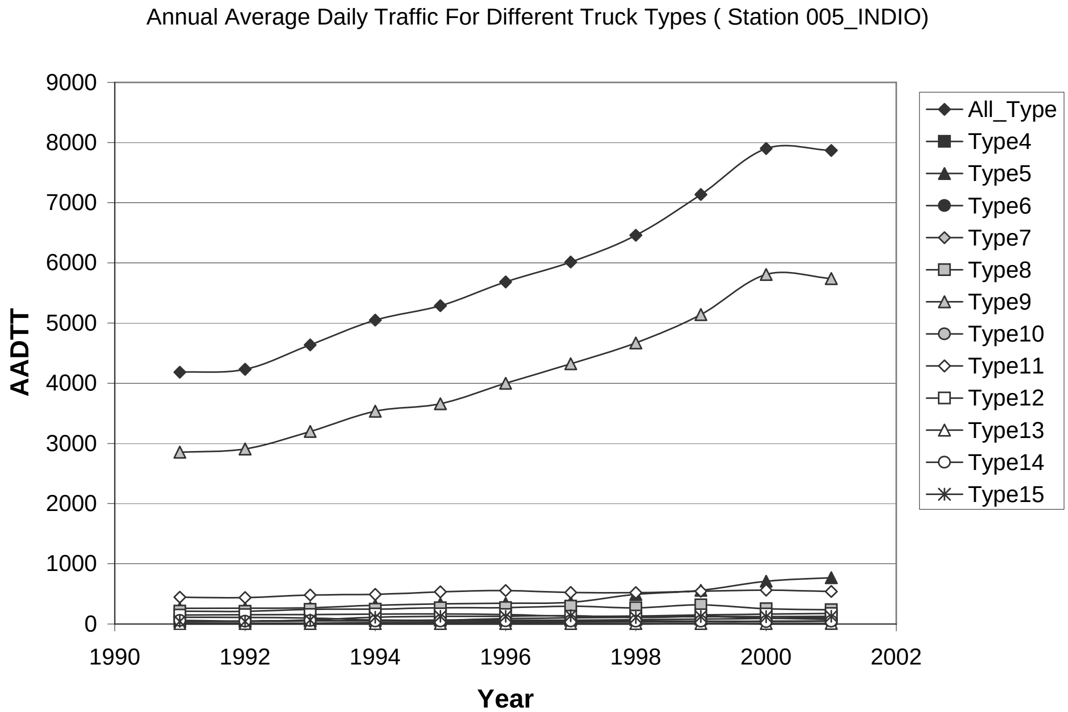


STATION 5 INDIO

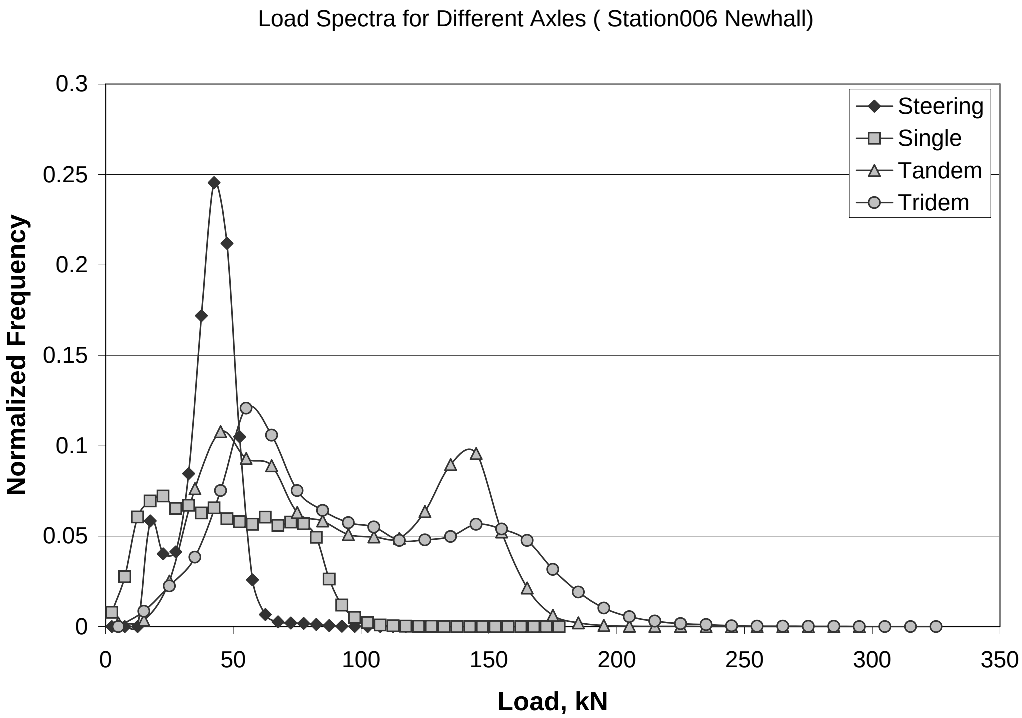


Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	4182	41	258	111	1	213	2855	10	444	146	4	59	41
1992	4232	45	263	108	0	210	2908	12	438	153	5	45	44
1993	4636	48	269	98	1	241	3200	13	482	158	6	55	65
1994	5049	57	310	65	0	245	3534	19	490	165	5	50	110
1995	5289	63	332	63	1	269	3658	23	533	166	5	48	129
1996	5685	60	342	87	1	271	4000	28	556	158	5	51	127
1997	6013	62	359	100	1	295	4323	32	524	127	6	48	137
1998	6458	71	491	110	1	268	4669	36	520	132	7	46	107
1999	7137	83	560	125	2	318	5140	40	542	149	7	46	125
2000	7900	92	709	99	1	253	5808	45	564	163	7	39	120
2001	7869	105	768	75	1	235	5740	49	539	174	9	46	128

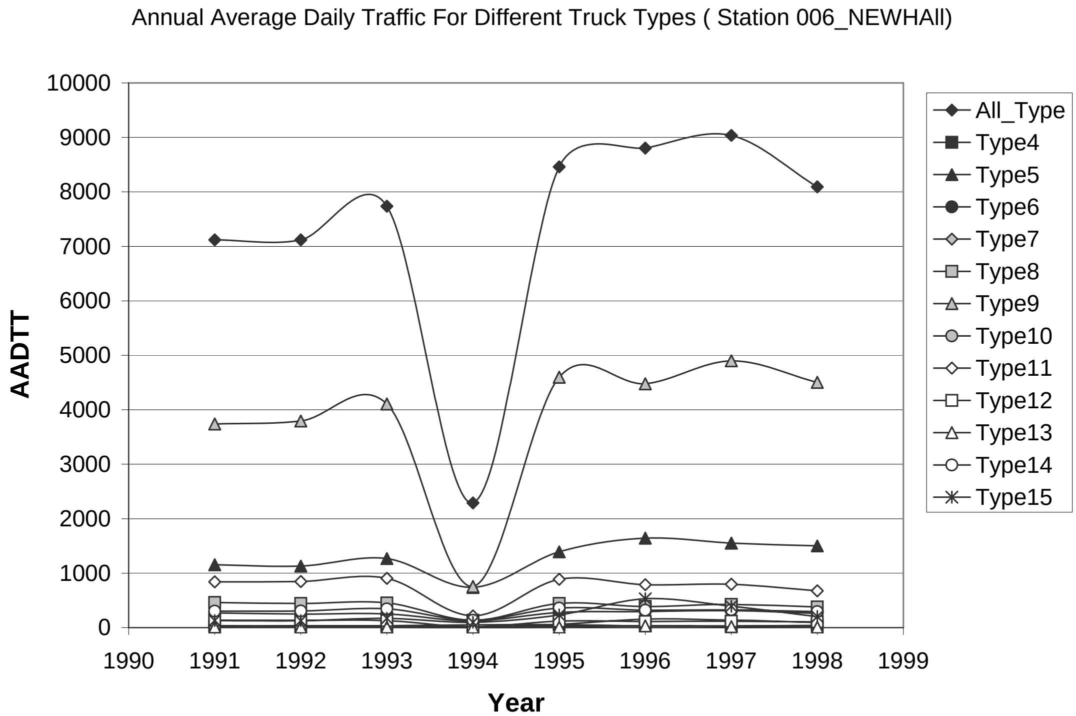

Annual Average Daily Traffic For Different Truck Types (Station 005_INDIO)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
AADTT
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 6 NEWHALL

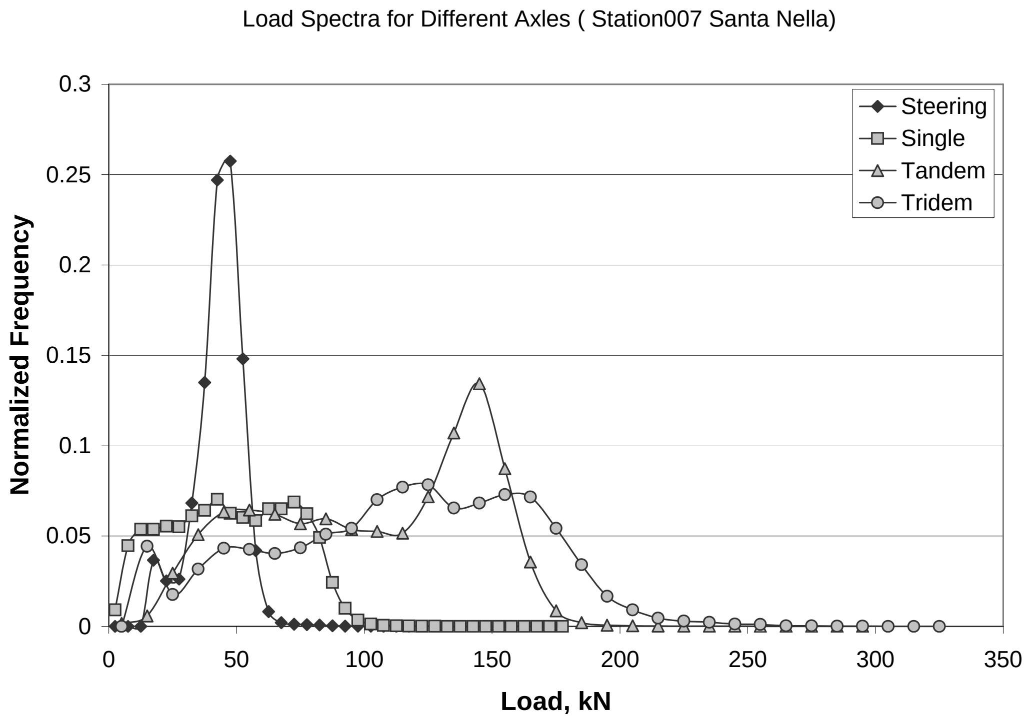


Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	7120	37	1157	270	21	460	3738	26	838	133	10	302	130
1992	7117	32	1129	251	20	444	3794	28	845	133	9	305	127
1993	7737	36	1269	250	24	456	4106	38	906	127	8	346	172
1994	2291	51	738	122	10	135	755	8	216	16	4	136	99
1995	8459	53	1392	280	26	443	4598	59	885	121	8	359	234
1996	8806	34	1642	295	28	389	4477	156	789	112	31	321	532
1997	9037	34	1551	313	27	424	4900	138	795	117	19	328	392
1998	8094	39	1499	261	32	377	4503	94	677	104	9	296	203


Annual Average Daily Traffic For Different Truck Types (Station 006_NEWHAll)
AADTT
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

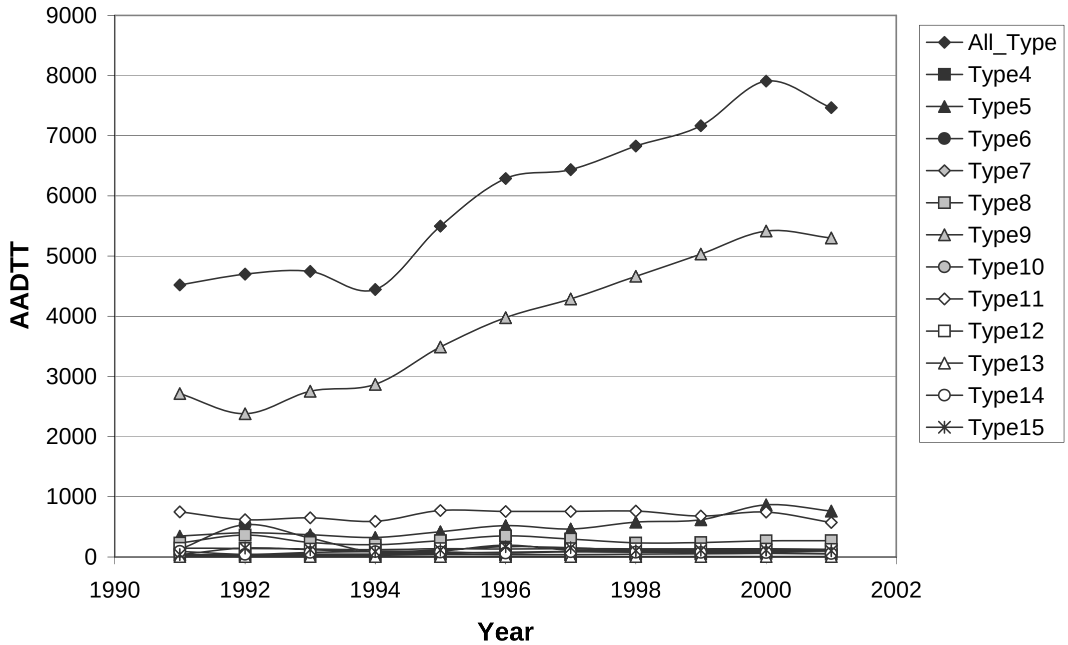
STATION 7 SANTA NELLA



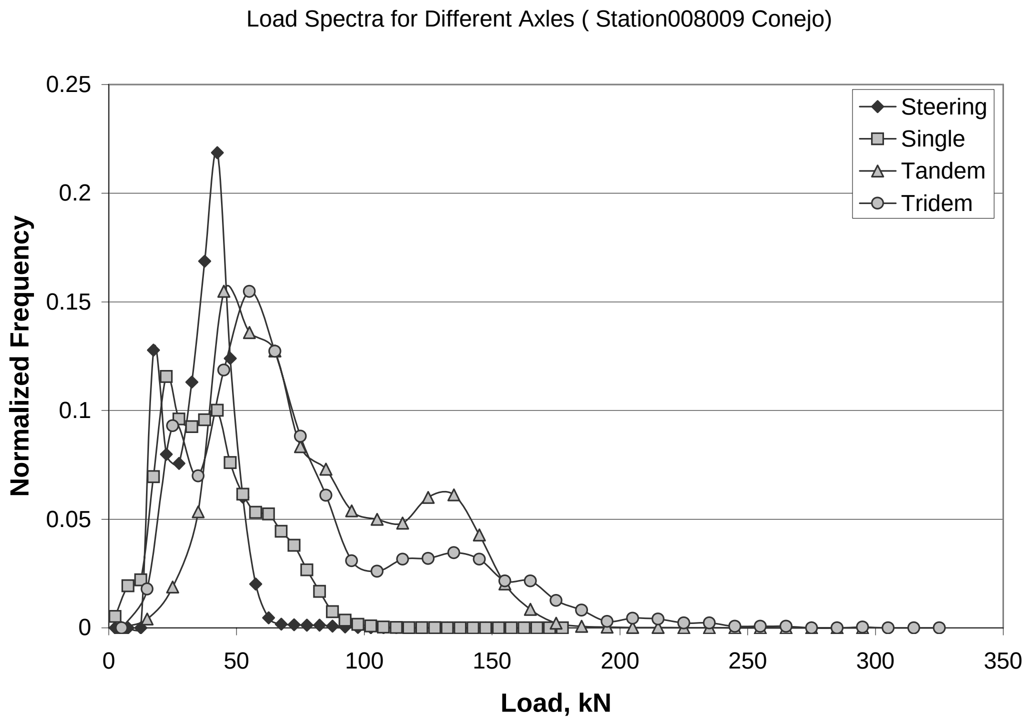
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	4518	33	346	126	1	231	2715	33	750	145	7	93	39
1992	4701	29	403	535	1	362	2381	38	618	140	7	41	146
1993	4744	31	370	315	1	243	2755	45	652	132	6	74	121
1994	4444	29	325	74	1	204	2869	47	591	120	5	89	89
1995	5496	41	419	98	1	270	3491	63	772	137	7	82	115
1996	6288	38	519	195	1	351	3976	78	755	131	6	67	170
1997	6437	40	465	116	1	296	4289	90	755	138	6	86	154
1998	6827	46	578	126	1	231	4662	98	761	135	7	77	106
1999	7164	51	618	127	1	239	5032	90	681	133	7	74	111
2000	7907	58	866	132	1	268	5416	92	746	131	8	72	116
2001	7465	50	762	126	1	273	5300	98	572	123	6	56	100

Annual Average Daily Traffic For Different Truck Types (Station 007_SANTA_NELLA)



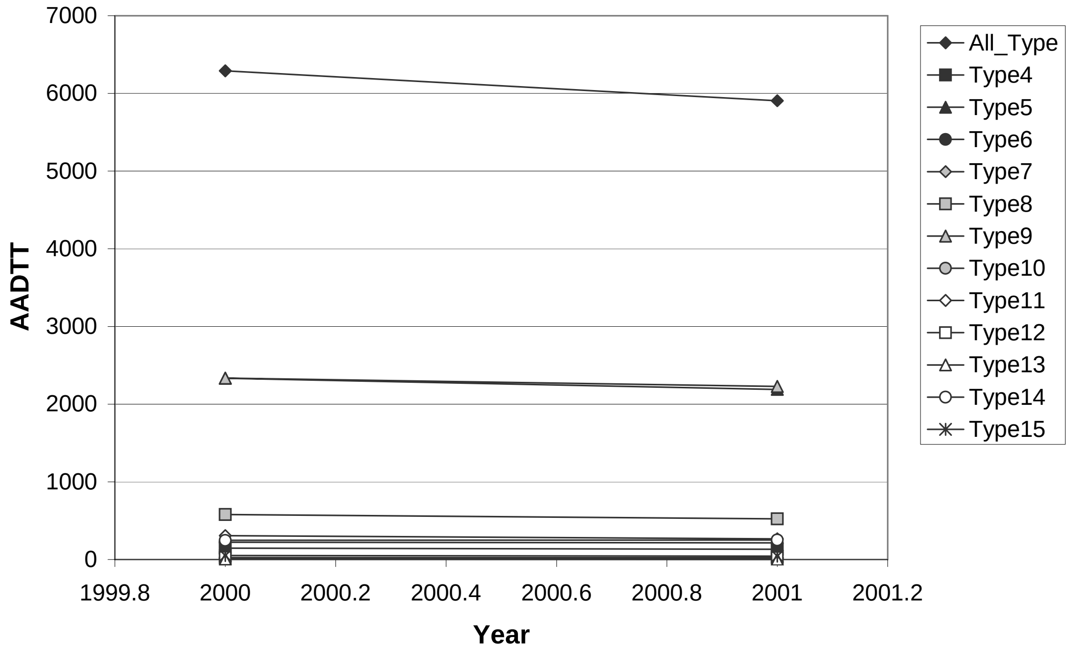
STATIONS 8&9 CONEJO



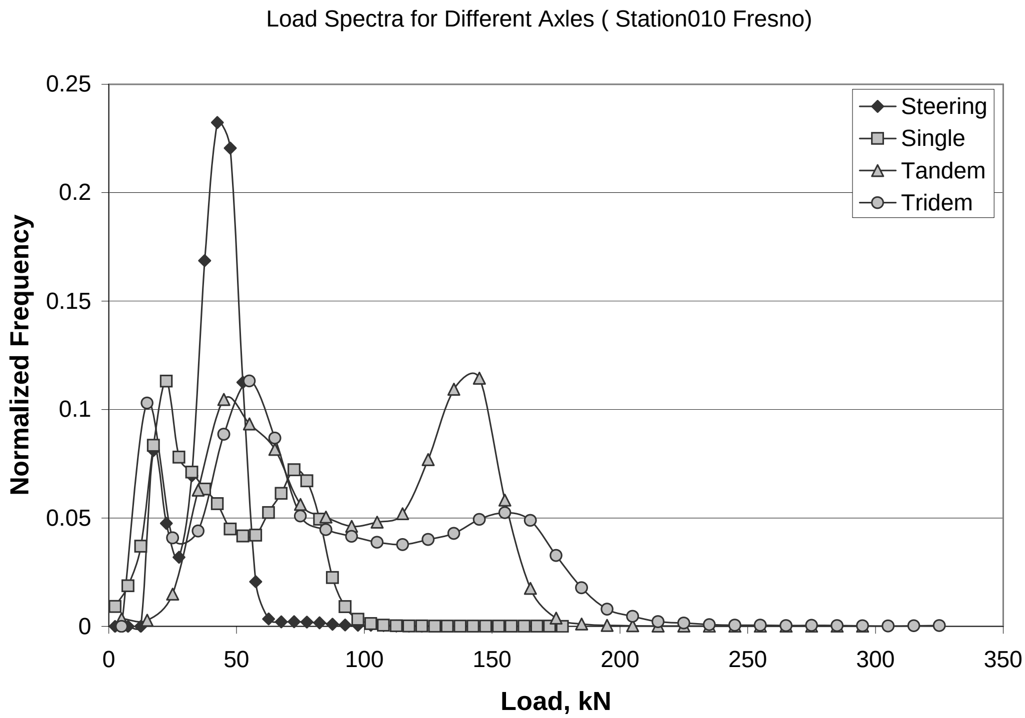
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	6291	147	2333	225	17	580	2335	13	309	26	6	248	52
2001	5905	132	2189	214	20	524	2228	10	266	23	3	253	44

Annual Average Daily Traffic For Different Truck Types (Station 008009_CONEJO)

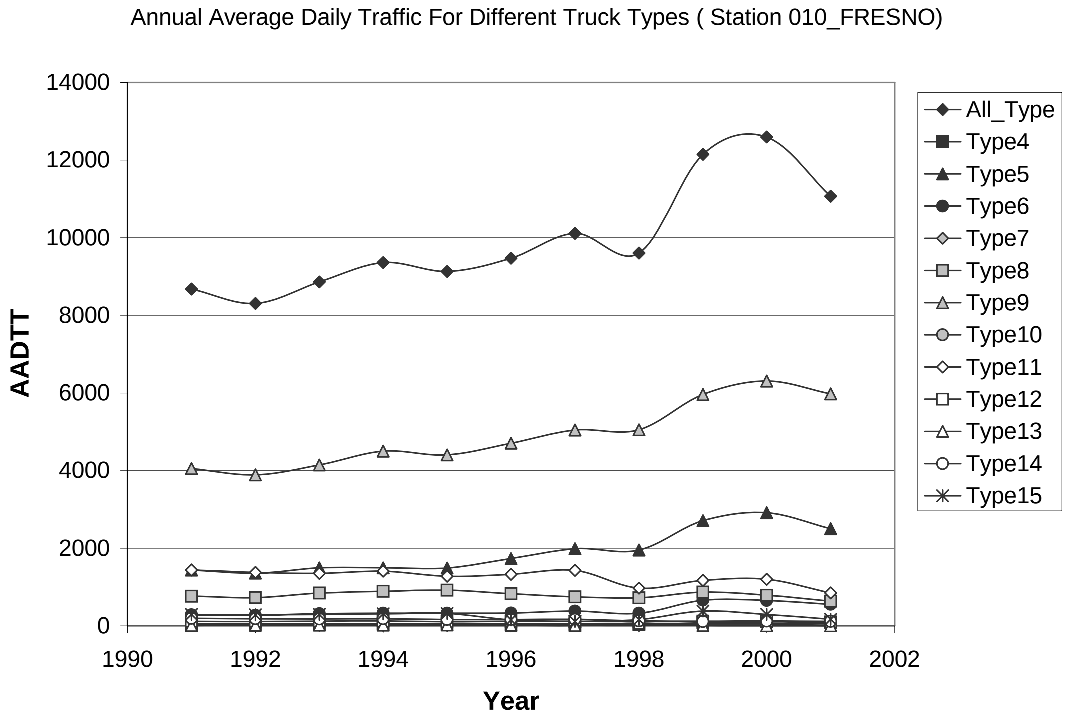


STATION 10 FRESNO

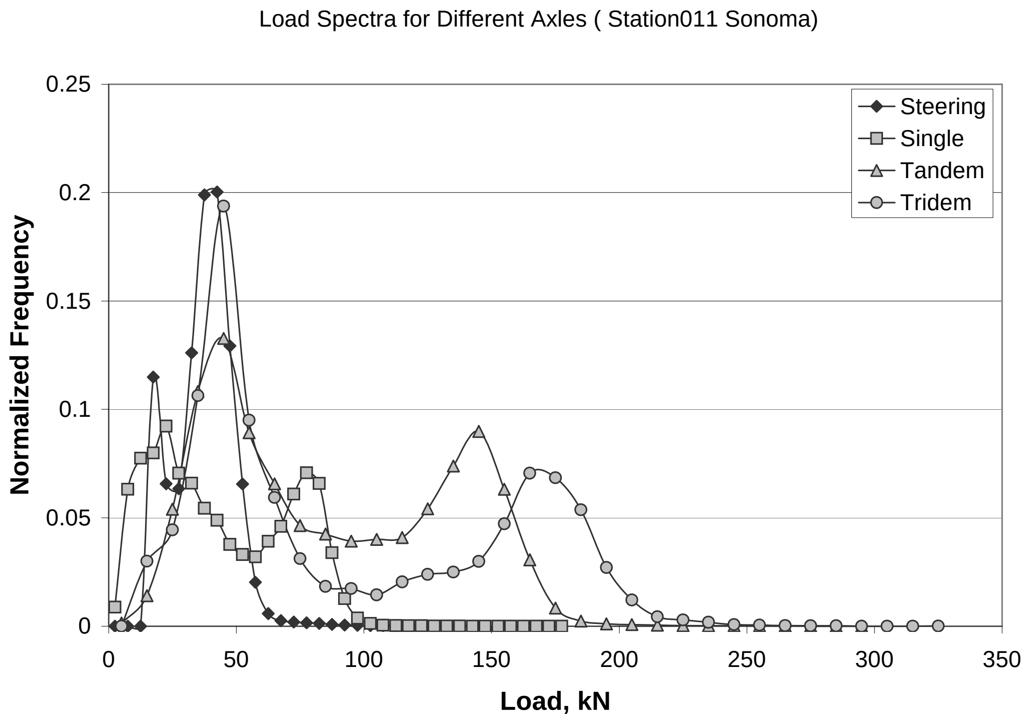


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	8679	53	1440	287	8	764	4055	17	1440	118	8	191	296
1992	8308	49	1358	273	16	726	3891	18	1379	114	16	181	286
1993	8860	50	1498	316	17	844	4147	23	1353	120	19	179	294
1994	9358	56	1495	327	12	888	4501	30	1411	127	20	181	311
1995	9131	53	1491	326	8	923	4406	32	1277	108	23	163	321
1996	9474	43	1737	331	8	831	4706	41	1328	116	14	165	153
1997	10113	43	1988	383	13	748	5047	47	1427	117	12	170	119
1998	9604	36	1956	328	10	721	5051	61	973	112	64	129	163
1999	12150	74	2713	661	21	870	5963	62	1168	120	8	110	380
2000	12594	104	2914	654	20	791	6307	60	1199	123	5	120	297
2001	11071	93	2504	557	4	638	5975	53	852	102	5	119	169

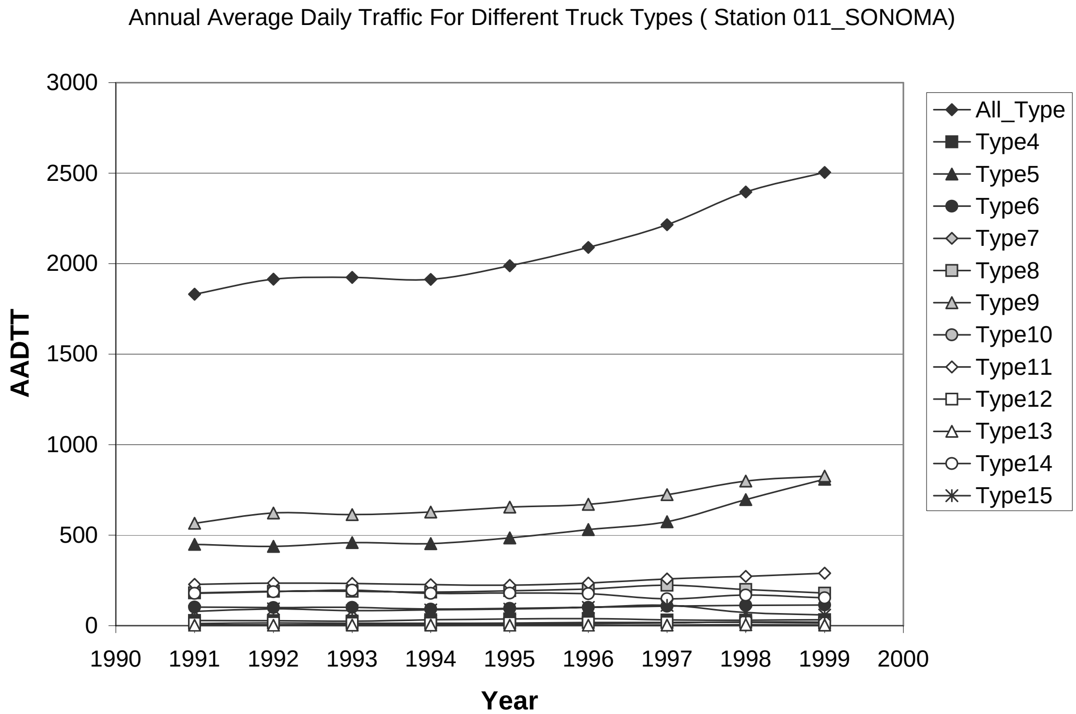

Annual Average Daily Traffic For Different Truck Types (Station 010_FRESNO)
AADTT
14000
12000
10000
8000
6000
4000
2000
0
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 11 SONOMA



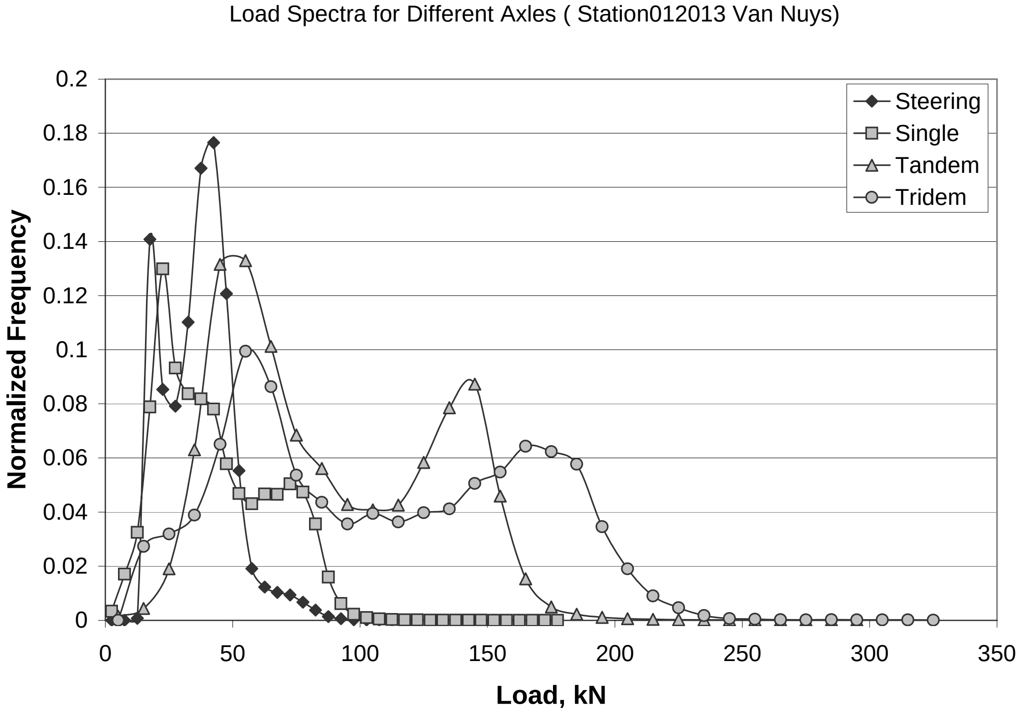
Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	1831	28	449	102	2	181	566	5	228	12	2	179	78
1992	1914	27	438	100	2	190	622	4	235	15	2	187	93
1993	1924	25	459	101	1	190	614	7	233	13	3	196	83
1994	1913	33	454	92	1	185	628	11	227	13	3	179	87
1995	1988	37	485	96	2	193	655	10	223	14	2	180	92
1996	2090	39	531	101	2	203	670	11	236	17	2	177	101
1997	2215	32	574	108	1	223	724	15	258	17	3	148	112
1998	2396	31	697	112	1	199	799	21	272	18	5	169	73
1999	2504	33	809	114	1	180	826	20	290	14	3	154	59



Annual Average Daily Traffic For Different Truck Types (Station 011_SONOMA)
AADTT
3000
2500
2000
1500
1000
500
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

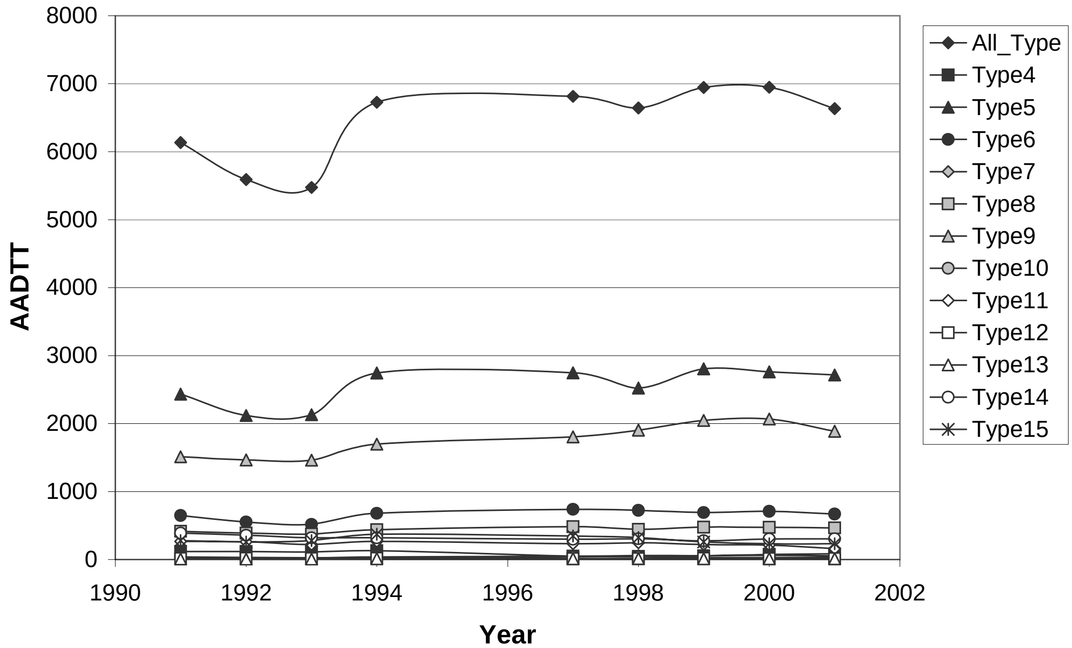
STATIONS 12&13 VAN NUYS



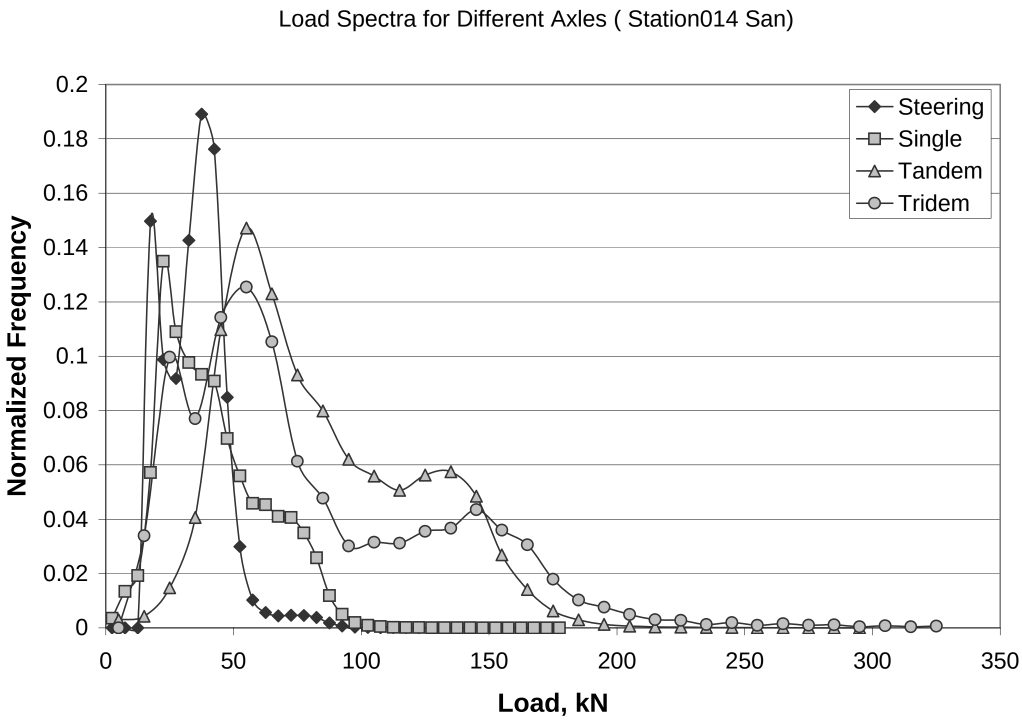
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type												
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	6134	120	2432	647	39	416	1512	8	267	15	10	389	280
1992	5591	120	2120	553	31	390	1466	9	261	16	7	357	260
1993	5473	111	2132	516	26	376	1461	10	222	14	7	321	279
1994	6727	130	2745	681	37	440	1699	11	267	16	12	319	371
1997	6813	48	2747	739	50	484	1804	39	234	11	13	299	346
1998	6643	47	2522	723	59	444	1903	42	246	13	14	304	324
1999	6944	54	2806	691	54	477	2047	29	221	16	12	277	260
2000	6948	76	2761	710	60	473	2067	30	213	13	13	302	232
2001	6635	84	2714	670	55	465	1888	36	161	11	12	305	233

Annual Average Daily Traffic For Different Truck Types (Station 012013_VAN_NUYS)



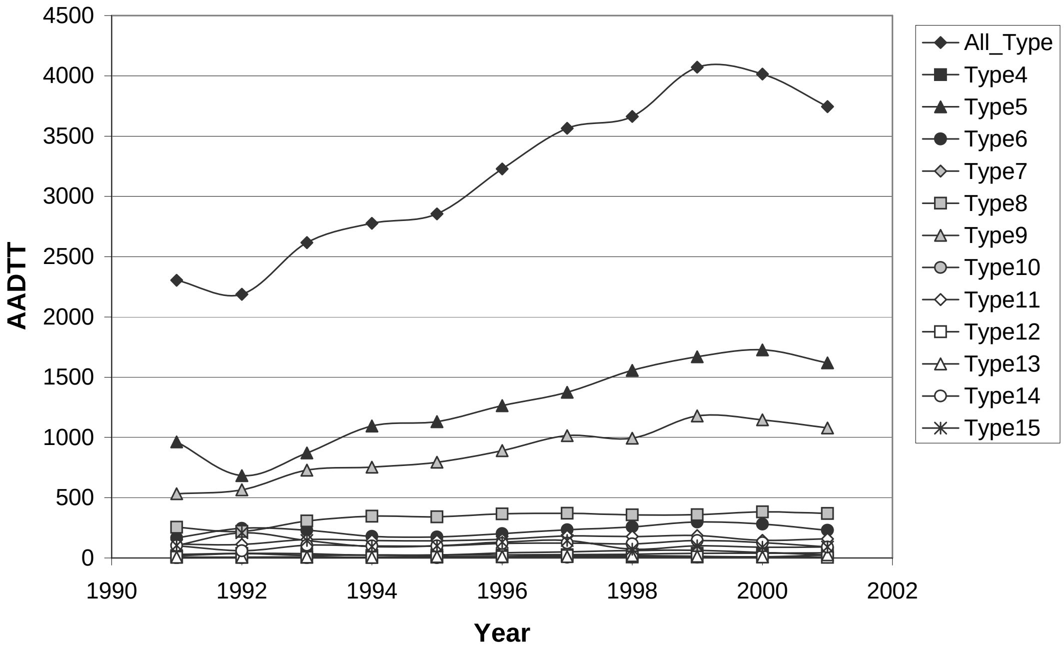
STATION 14 SAN MARCOS



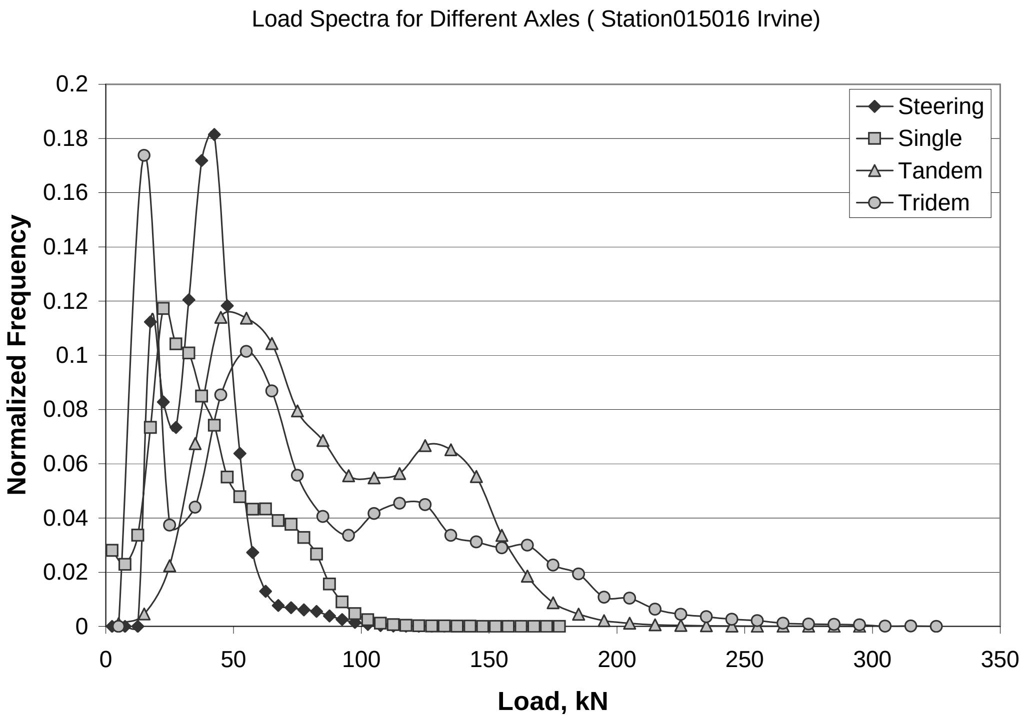
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	2304	20	963	167	29	255	533	2	114	6	6	103	105
1992	2188	38	684	247	37	221	565	4	113	5	7	60	209
1993	2616	36	871	230	22	307	730	3	153	5	8	107	145
1994	2777	22	1095	180	26	347	754	3	145	5	5	100	95
1995	2855	24	1131	175	25	341	794	4	142	6	11	100	101
1996	3228	26	1264	203	43	366	891	6	155	9	11	121	133
1997	3565	28	1375	234	50	372	1015	6	183	19	12	124	146
1998	3662	31	1557	258	62	358	995	6	178	8	19	117	74
1999	4071	39	1670	299	64	360	1179	7	187	8	14	145	101
2000	4015	41	1727	281	45	383	1147	8	147	8	10	127	90
2001	3745	42	1619	231	25	370	1079	7	158	5	26	91	92

Annual Average Daily Traffic For Different Truck Types (Station 014_SAN_MARCOS)



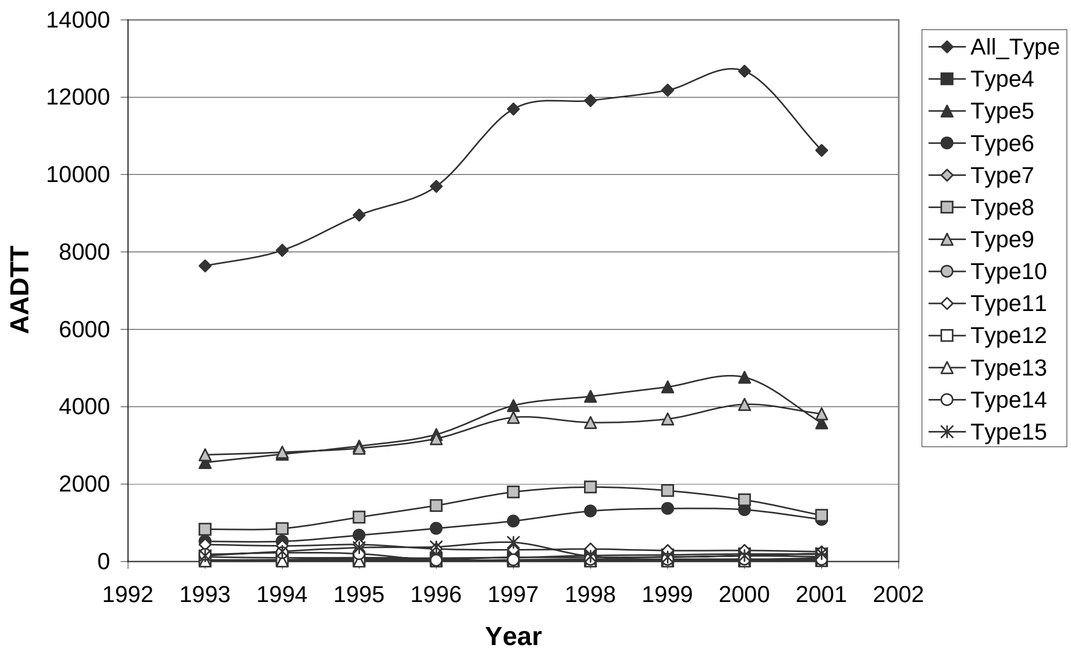
STATIONS 15&16 IRVINE



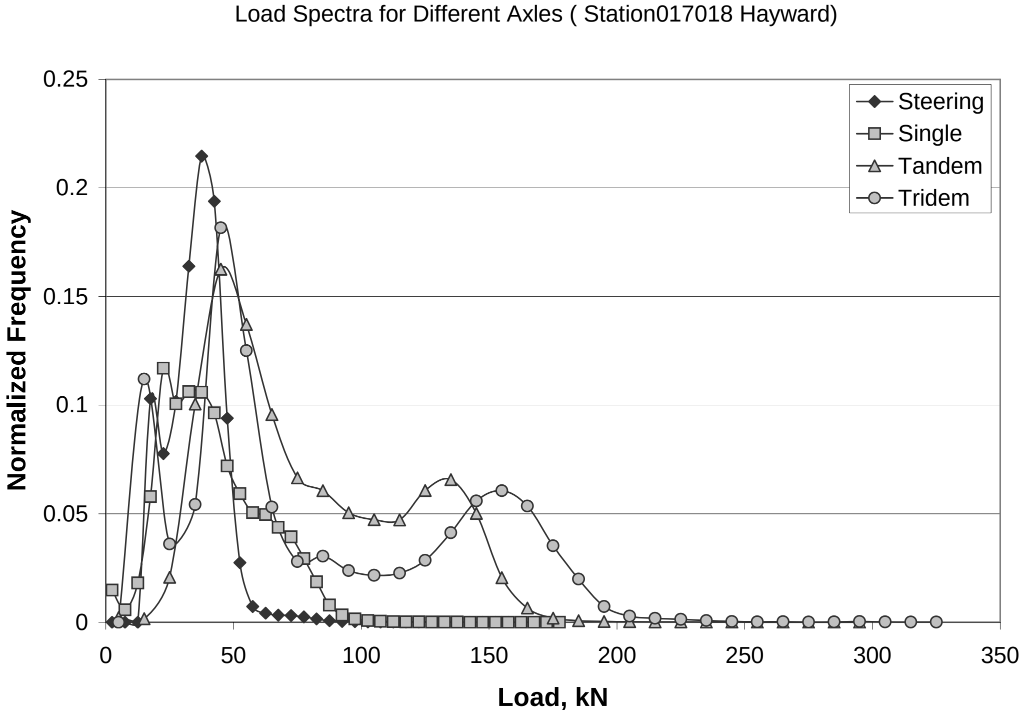
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	7640	118	2559	520	23	828	2758	13	435	42	13	182	150
1994	8045	94	2770	519	43	848	2824	15	400	35	13	225	257
1995	8952	98	2979	675	78	1144	2925	18	440	34	11	196	355
1996	9696	89	3283	857	53	1443	3176	19	328	27	13	33	376
1997	11695	100	4028	1041	108	1794	3723	20	302	27	17	43	491
1998	11914	151	4270	1300	102	1922	3594	24	319	26	17	58	131
1999	12185	166	4512	1369	116	1830	3681	24	281	23	14	56	114
2000	12674	191	4764	1338	144	1594	4059	44	286	25	14	63	152
2001	10627	190	3579	1086	120	1190	3816	91	249	23	22	58	203

Annual Average Daily Traffic For Different Truck Types (Station 015016_IRVINE)



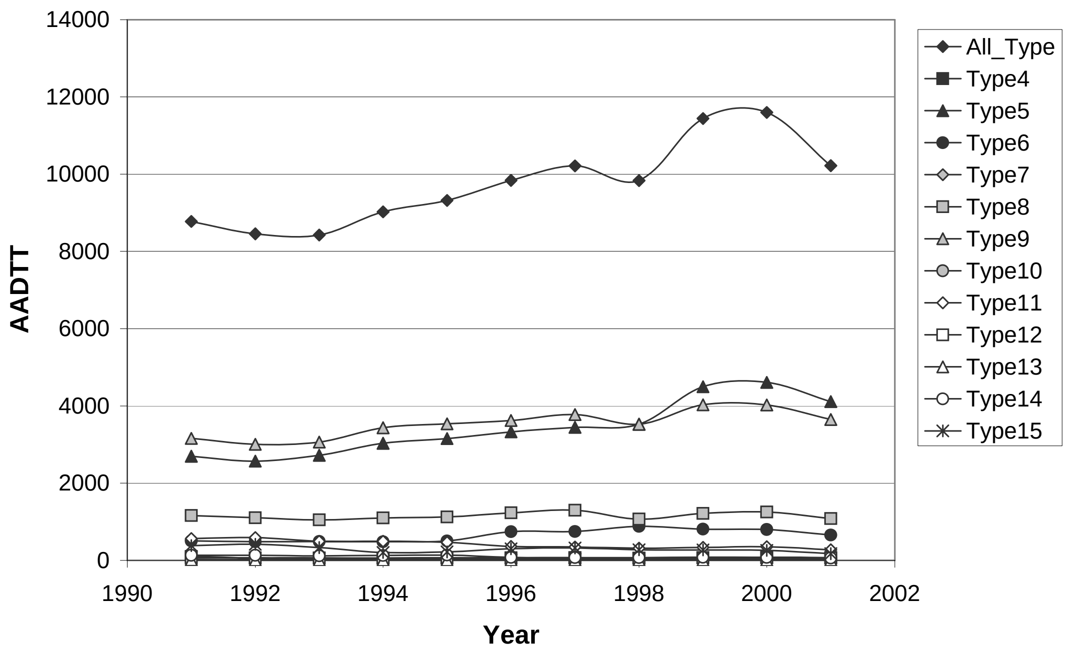
STATIONS 17&18 HAYWARD



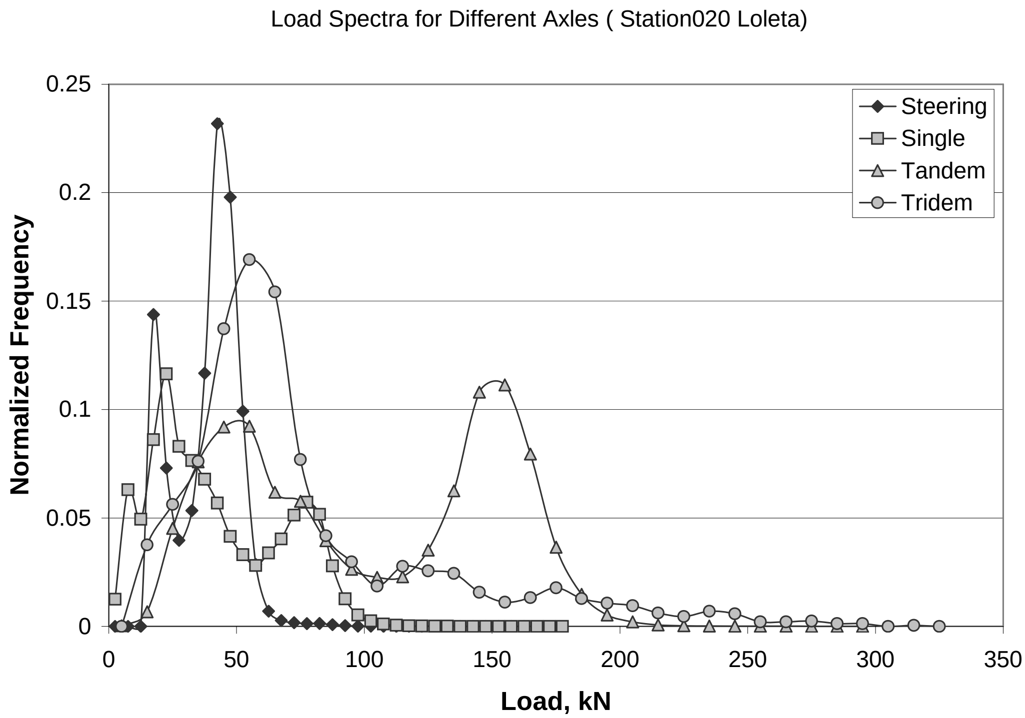
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	8776	100	2697	504	7	1160	3158	10	566	57	8	130	379
1992	8457	61	2571	483	9	1105	3004	18	590	60	6	132	418
1993	8424	63	2724	489	11	1050	3064	18	495	56	5	119	330
1994	9025	56	3033	482	11	1097	3433	25	494	57	5	129	201
1995	9318	62	3155	505	11	1122	3538	33	467	61	5	138	219
1996	9840	57	3326	742	18	1231	3622	37	363	68	5	75	298
1997	10214	60	3442	749	21	1298	3776	51	347	71	6	69	322
1998	9833	56	3523	878	22	1067	3523	45	313	56	7	70	274
1999	11442	64	4495	808	17	1217	4030	56	334	65	7	79	270
2000	11598	75	4608	800	21	1249	4026	56	352	65	7	78	260
2001	10221	72	4113	655	13	1083	3650	55	275	63	5	61	175

Annual Average Daily Traffic For Different Truck Types (Station 017018_HAYWARD)



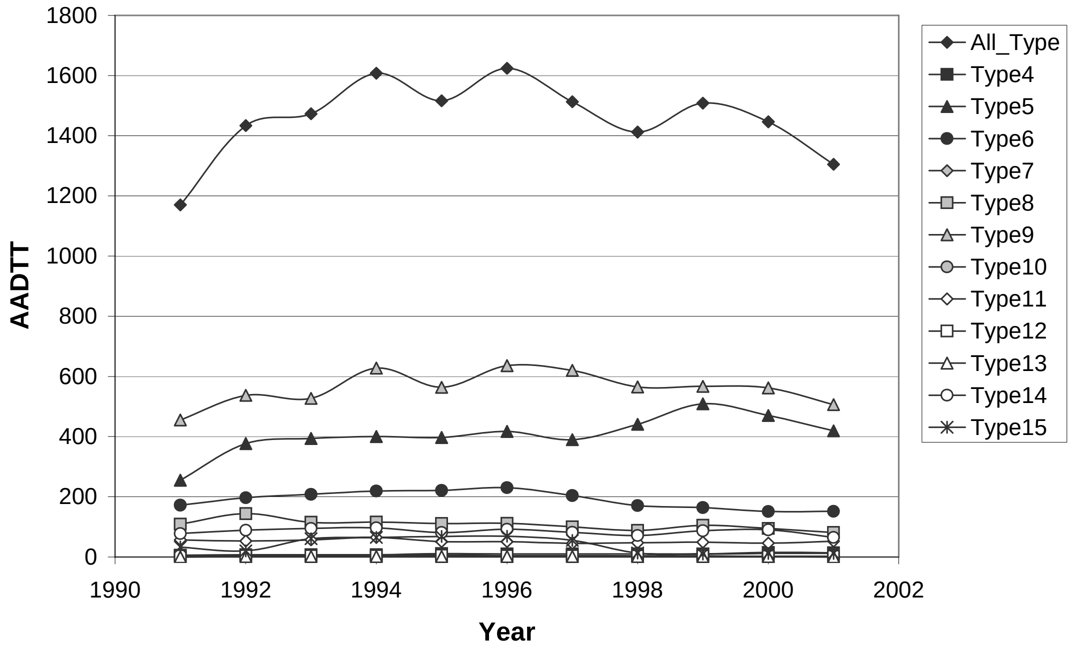
STATION 20 LOLETA



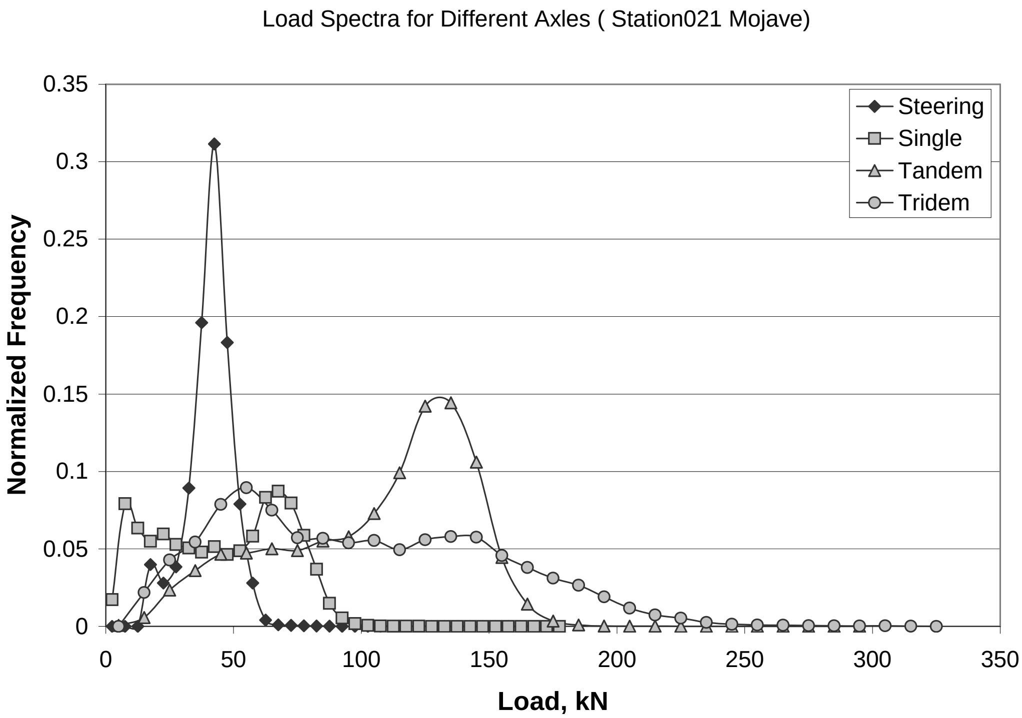
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	1170	6	255	172	1	109	455	1	57	3	0	78	33
1992	1434	7	377	197	3	144	537	1	53	4	1	89	20
1993	1473	7	394	208	4	115	527	1	57	4	1	95	61
1994	1608	7	400	219	5	116	628	1	65	4	1	97	65
1995	1516	11	397	221	5	111	564	1	51	5	1	81	68
1996	1624	10	417	230	3	112	636	1	51	4	1	92	69
1997	1513	10	390	204	1	100	620	1	45	4	1	82	55
1998	1412	10	441	171	2	88	565	1	47	3	1	71	13
1999	1508	10	509	164	2	105	567	1	49	3	1	87	10
2000	1446	15	470	151	1	95	562	1	46	2	1	90	12
2001	1305	14	419	152	1	81	506	1	52	2	0	65	12

Annual Average Daily Traffic For Different Truck Types (Station 020_LOLETA)

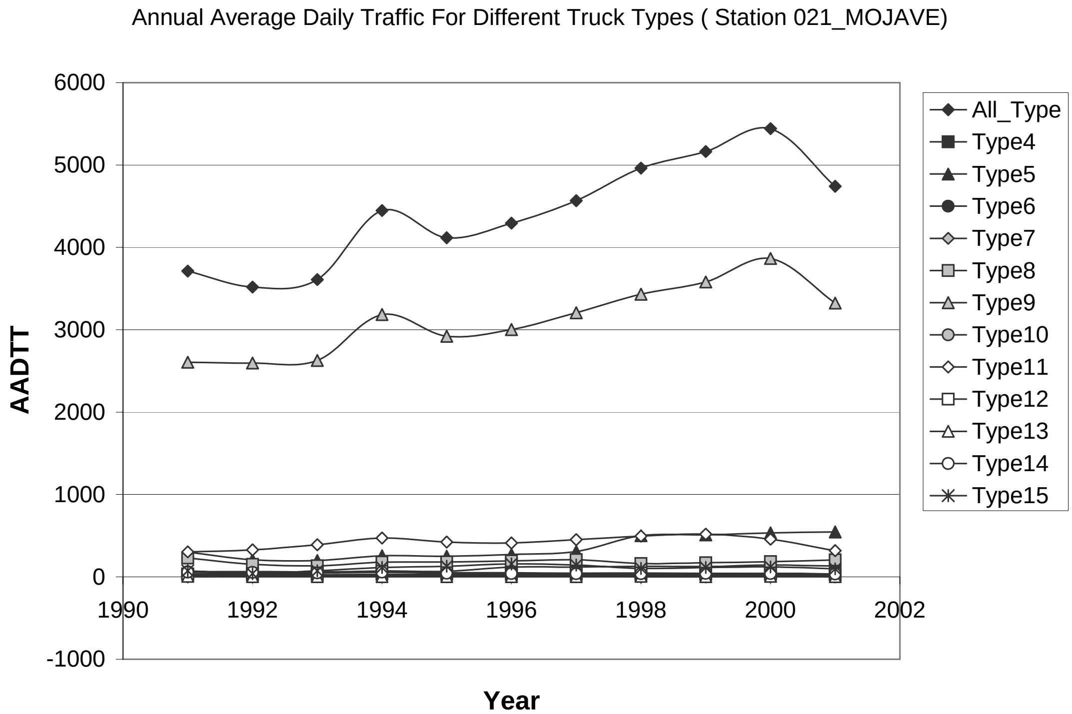


STATION 21 MOJAVE

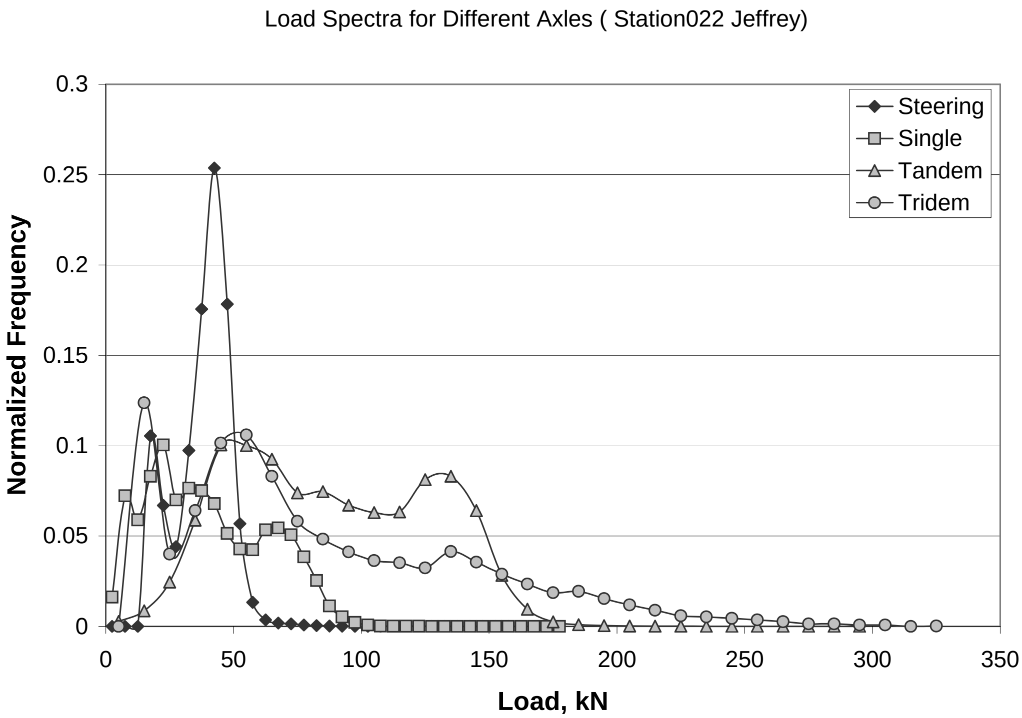


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	3711	27	301	62	0	229	2605	11	304	36	6	56	74
1992	3517	25	208	64	1	153	2595	8	327	39	4	54	40
1993	3610	25	198	59	1	133	2627	8	389	47	3	47	73
1994	4448	29	256	72	1	179	3184	15	471	66	4	56	115
1995	4117	29	250	69	1	182	2921	19	422	49	3	44	128
1996	4294	27	272	118	1	194	3003	19	411	49	4	40	156
1997	4567	28	308	118	1	207	3207	18	452	45	3	37	142
1998	4963	28	499	129	0	163	3432	23	496	46	5	38	103
1999	5165	31	509	127	0	171	3581	24	518	43	4	43	114
2000	5443	31	532	142	1	183	3865	25	457	43	5	39	121
2001	4742	25	545	131	0	204	3324	24	318	35	4	34	97


Annual Average Daily Traffic For Different Truck Types (Station 021_MOJAVE)
AADTT
6000
5000
4000
3000
2000
1000
0
-1000
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

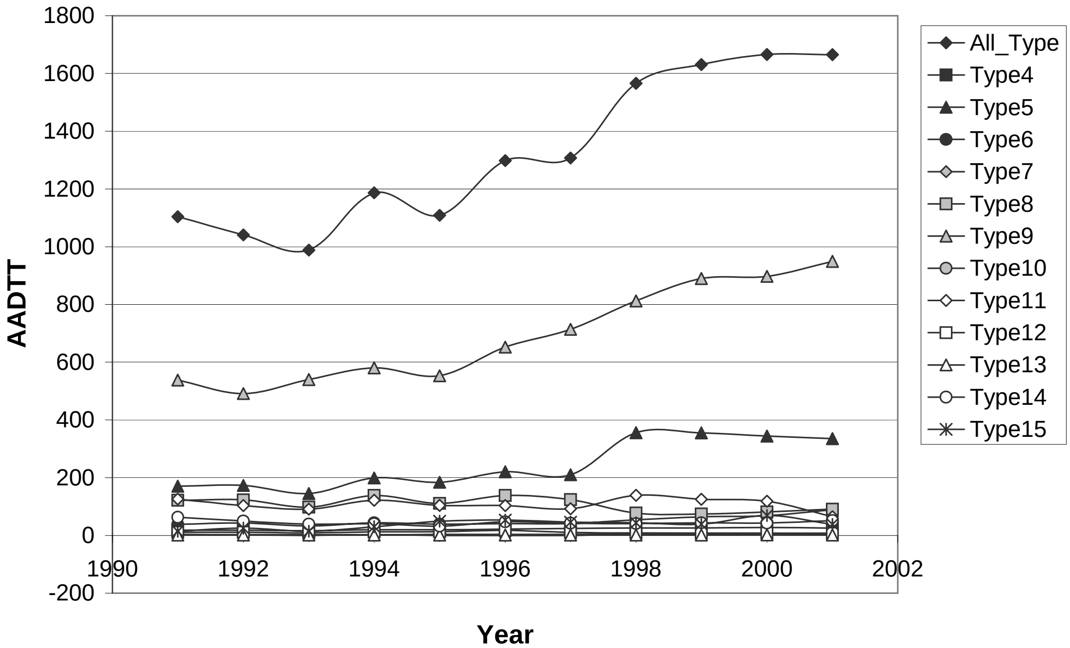
STATION 22 JEFFREY



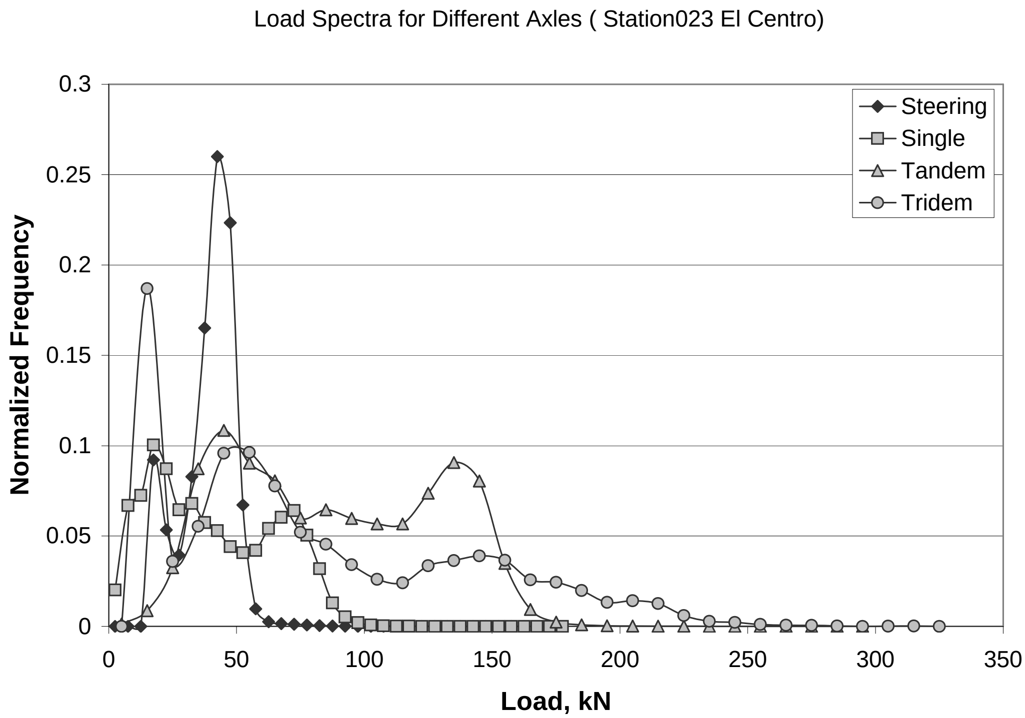
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	1104	18	170	38	1	122	538	3	126	11	1	63	14
1992	1041	18	173	43	1	123	491	2	103	11	1	50	25
1993	988	16	145	33	0	98	540	2	91	9	1	39	14
1994	1187	20	199	44	2	138	580	2	122	12	1	40	30
1995	1109	20	184	39	0	111	553	3	104	13	1	32	49
1996	1298	22	220	41	0	138	652	3	103	18	1	47	53
1997	1307	24	210	41	0	124	714	3	92	10	1	42	46
1998	1566	26	356	54	3	77	812	4	139	9	1	41	44
1999	1631	26	355	64	1	74	890	4	125	8	1	44	39
2000	1666	27	344	68	3	81	897	6	118	8	2	43	69
2001	1665	25	335	89	8	91	949	6	65	7	1	51	38

Annual Average Daily Traffic For Different Truck Types (Station 022_JEFFREY)



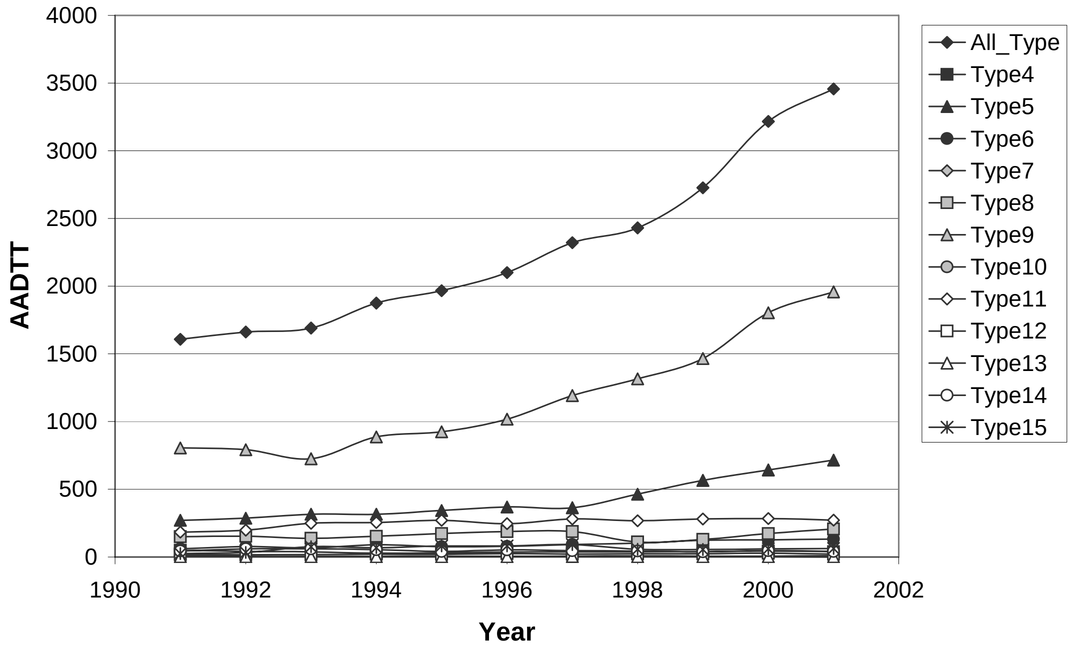
STATION 23 EL CENTRO



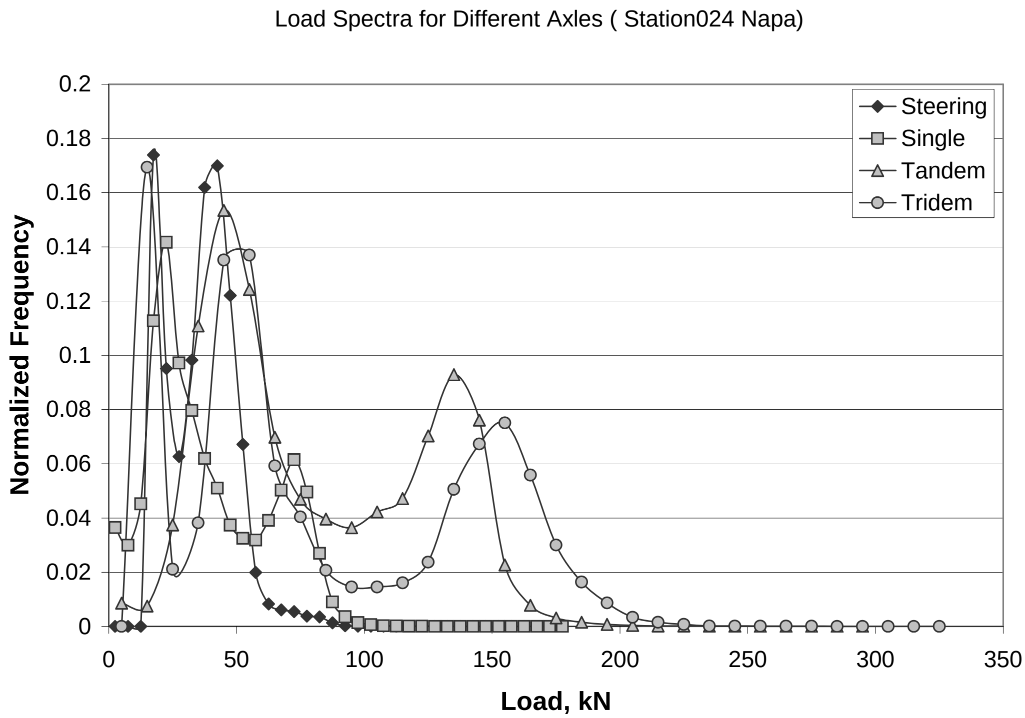
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1991	1608	49	270	59	4	150	805	3	183	16	1	44	24
1992	1662	41	287	77	3	153	792	2	197	16	1	59	34
1993	1690	38	315	67	2	138	725	3	248	18	2	60	75
1994	1875	28	316	90	2	152	886	3	255	20	1	54	69
1995	1967	31	343	75	2	173	924	4	271	19	2	41	82
1996	2100	37	369	78	1	188	1017	5	246	24	2	52	82
1997	2321	38	364	92	2	187	1192	6	280	21	3	47	91
1998	2430	38	463	102	2	111	1315	7	268	23	2	43	56
1999	2727	39	566	124	1	130	1465	6	280	23	1	38	55
2000	3217	43	643	127	1	173	1804	6	284	27	2	46	60
2001	3456	39	715	132	0	206	1958	9	272	20	2	41	62

Annual Average Daily Traffic For Different Truck Types (Station 023_EL_CENTRO)

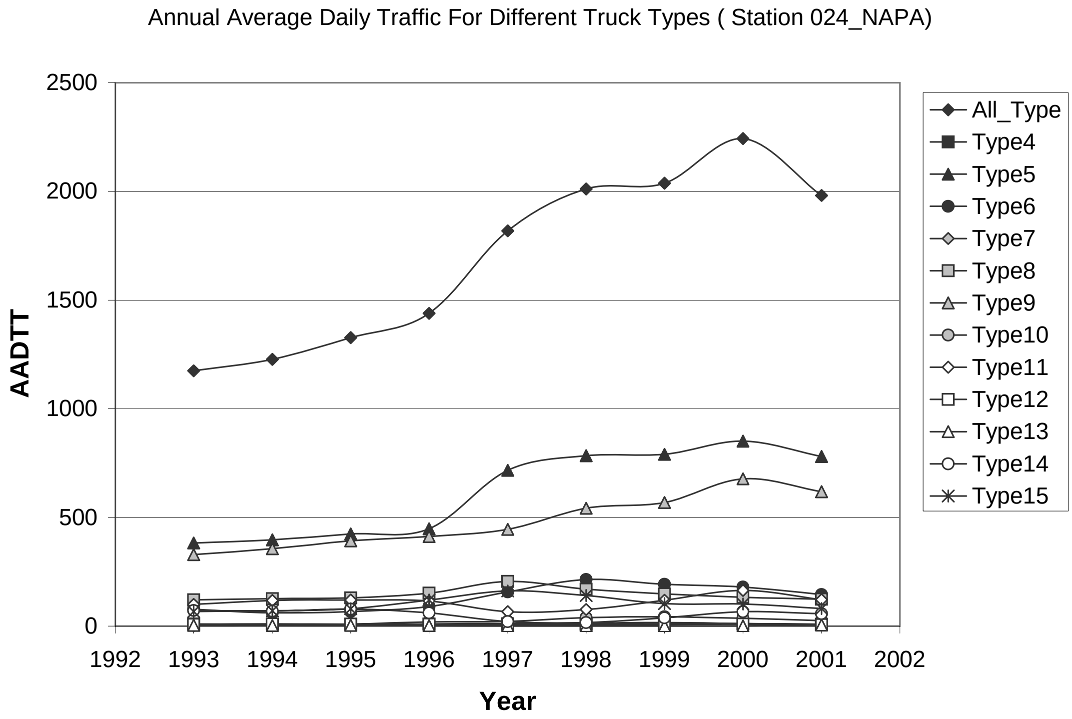


STATION 24 NAPA

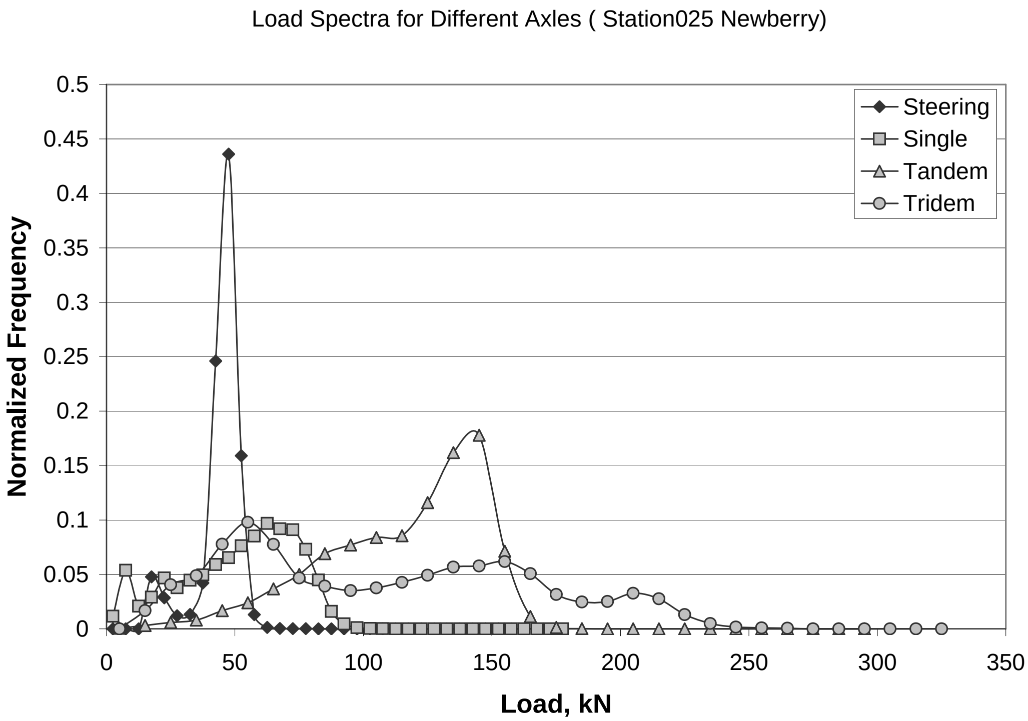


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	1175	10	382	77	2	121	329	4	100	7	4	72	67
1994	1227	9	397	61	3	126	356	5	118	10	3	69	71
1995	1327	8	424	67	5	130	392	9	120	9	4	78	80
1996	1439	10	448	90	4	152	412	19	115	8	2	61	120
1997	1819	11	717	157	6	205	445	22	66	7	1	21	162
1998	2011	10	784	214	13	170	542	39	76	6	1	16	141
1999	2038	9	790	193	16	148	569	43	119	8	1	38	104
2000	2243	11	851	180	12	133	678	36	164	9	1	66	102
2001	1981	8	780	145	9	124	619	25	122	6	5	57	81


Annual Average Daily Traffic For Different Truck Types (Station 024_NAPA)
AADTT
2500
2000
1500
1000
500
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

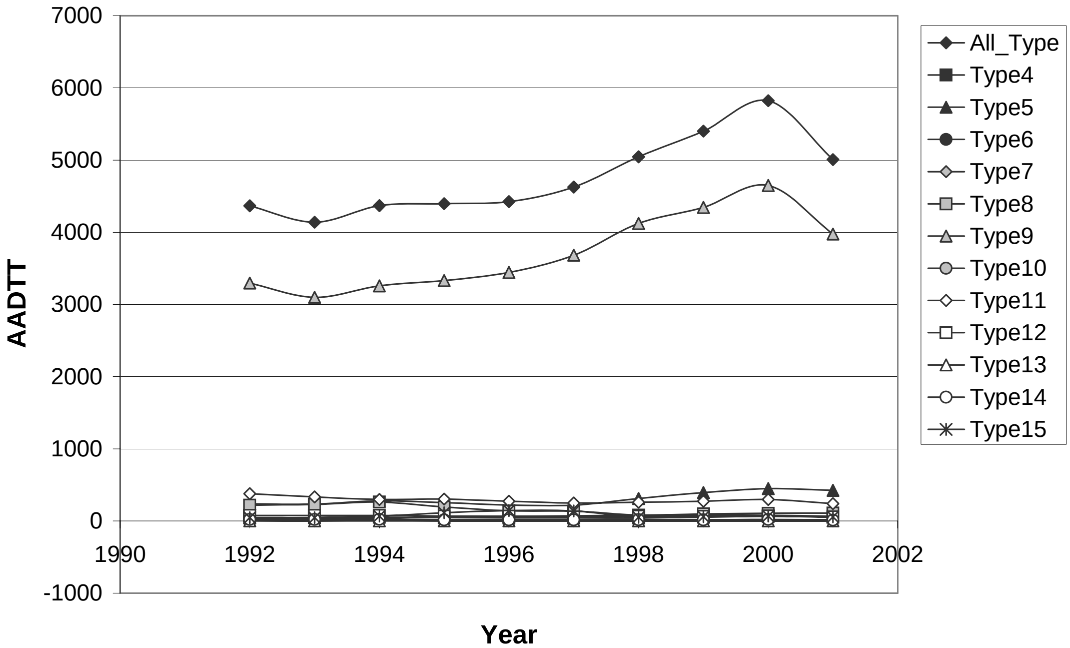
STATION 25 NEWBERRY



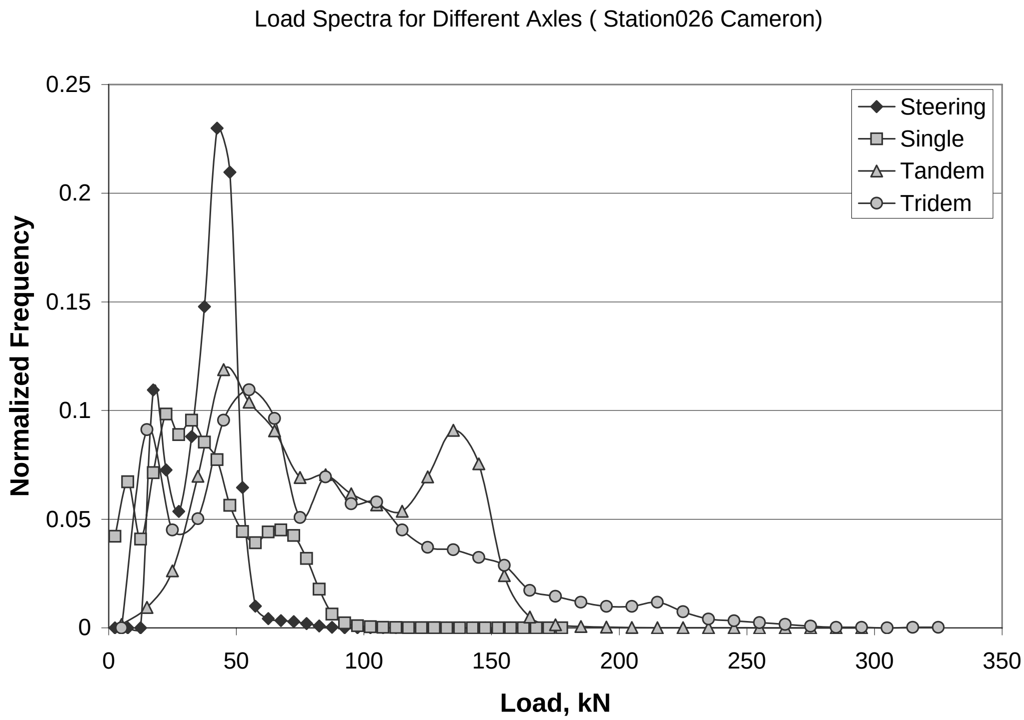
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	1175	10	382	77	2	121	329	4	100	7	4	72	67
1994	1227	9	397	61	3	126	356	5	118	10	3	69	71
1995	1327	8	424	67	5	130	392	9	120	9	4	78	80
1996	1439	10	448	90	4	152	412	19	115	8	2	61	120
1997	1819	11	717	157	6	205	445	22	66	7	1	21	162
1998	2011	10	784	214	13	170	542	39	76	6	1	16	141
1999	2038	9	790	193	16	148	569	43	119	8	1	38	104
2000	2243	11	851	180	12	133	678	36	164	9	1	66	102
2001	1981	8	780	145	9	124	619	25	122	6	5	57	81

Annual Average Daily Traffic For Different Truck Types (Station 025_NEWBERRY)

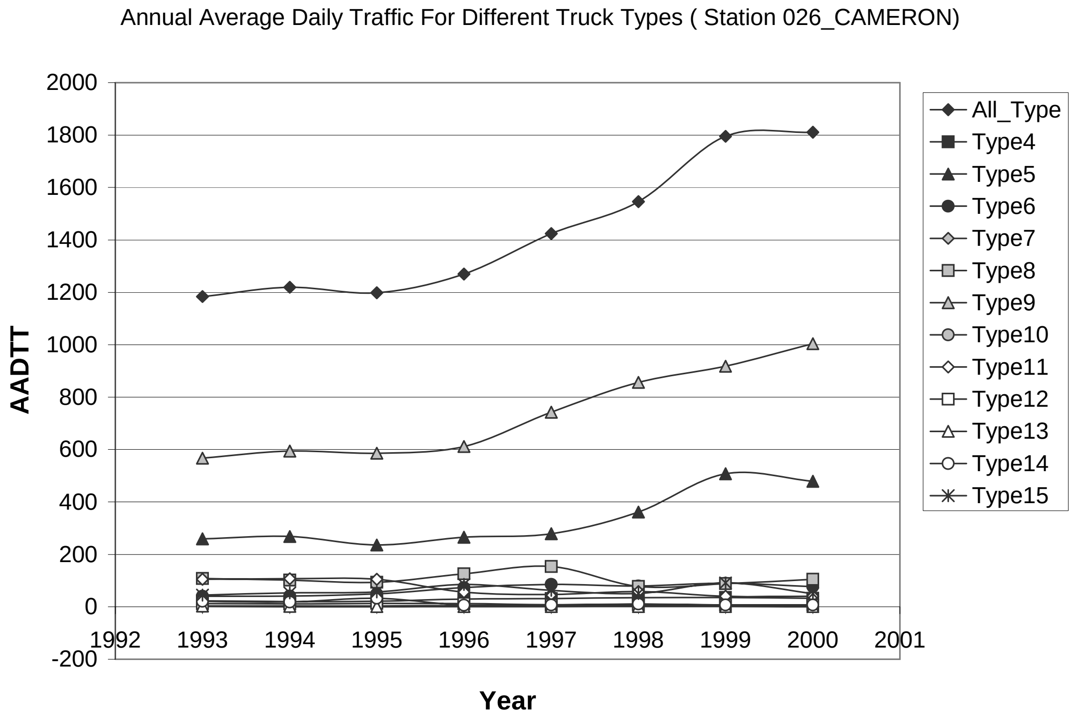


STATION 26 CAMERON

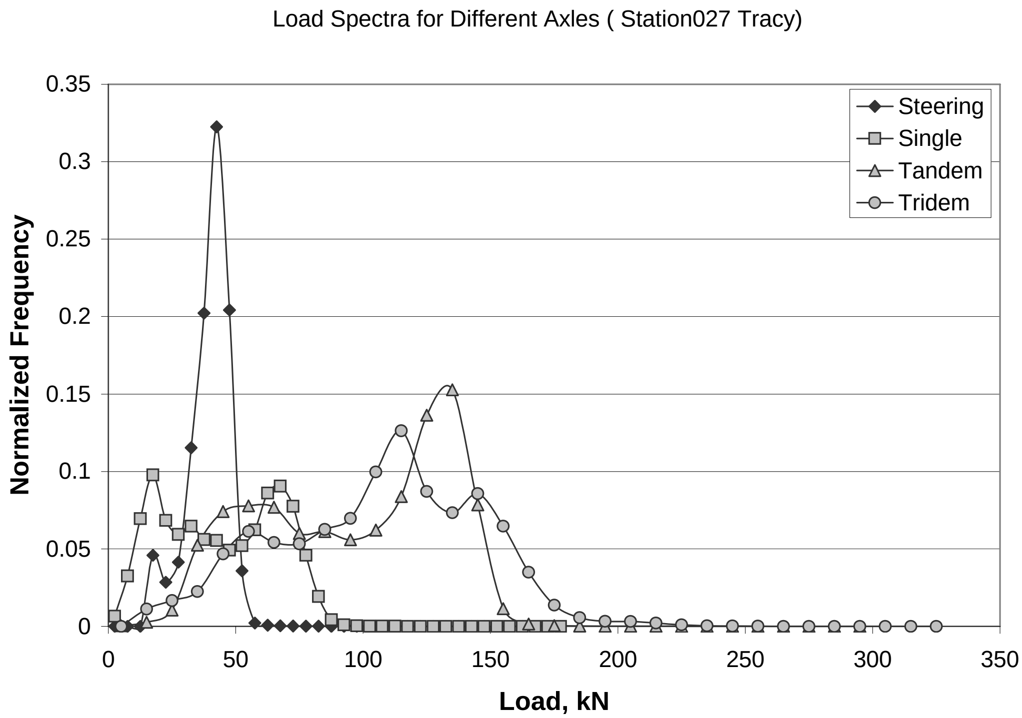


Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	1184	23	259	40	1	108	567	2	105	12	3	21	45
1994	1219	20	268	41	0	102	594	3	107	11	2	18	53
1995	1198	21	236	49	0	94	586	3	105	13	1	33	57
1996	1270	30	265	73	1	126	612	4	56	12	1	6	85
1997	1424	31	279	85	1	154	743	4	47	8	1	7	63
1998	1546	35	362	79	2	78	856	5	58	8	1	11	51
1999	1795	36	508	90	2	88	918	6	40	7	1	7	91
2000	1811	33	479	77	0	105	1004	7	40	7	1	7	50


Annual Average Daily Traffic For Different Truck Types (Station 026_CAMERON)
AADTT
Year
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

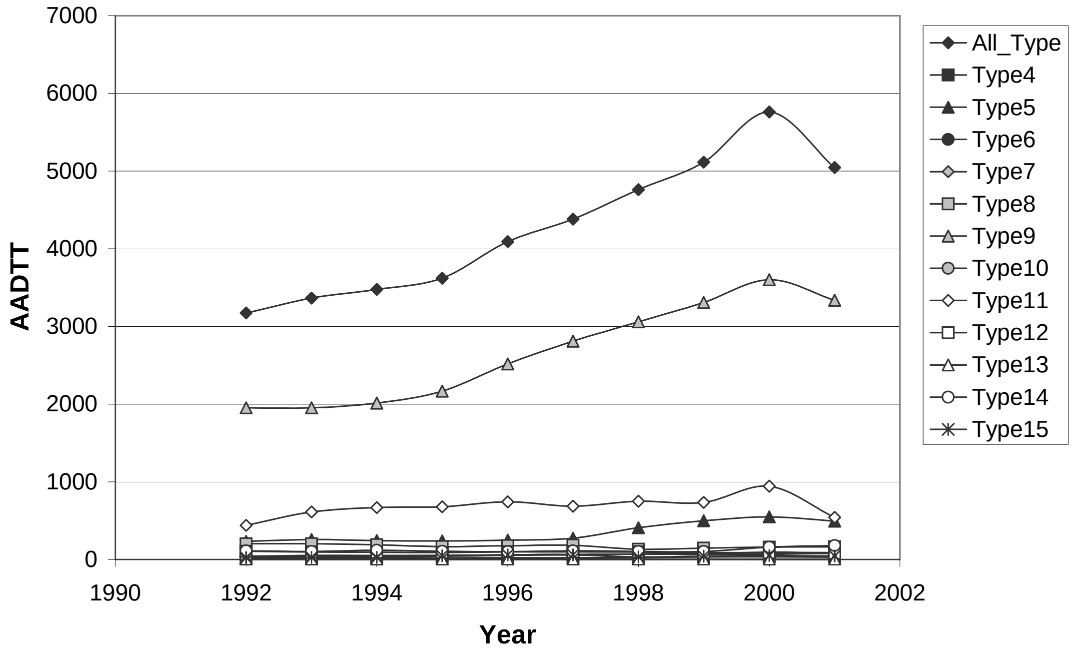
STATION 27 TRACY



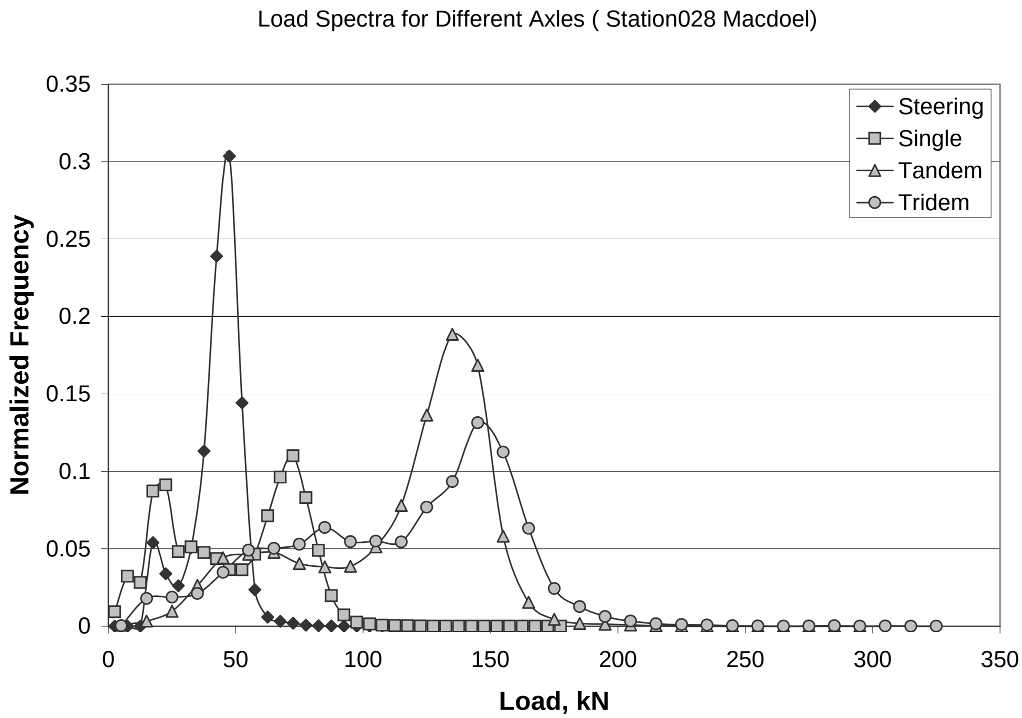
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1992	3175	16	235	44	0	204	1954	31	441	107	5	113	25
1993	3366	19	256	53	1	203	1954	34	612	97	4	105	28
1994	3477	20	245	50	0	192	2015	40	669	93	4	120	29
1995	3622	20	239	54	1	166	2167	44	680	91	4	108	49
1996	4092	22	249	59	1	177	2519	55	744	99	4	103	62
1997	4383	23	274	67	1	183	2811	61	688	99	4	111	62
1998	4762	27	409	70	1	133	3060	72	751	96	5	105	34
1999	5114	32	499	80	2	147	3310	69	735	90	5	105	42
2000	5760	35	550	95	1	161	3601	69	943	90	5	159	50
2001	5047	30	493	90	1	162	3338	79	543	82	5	180	45

Annual Average Daily Traffic For Different Truck Types (Station 027_TRACY)



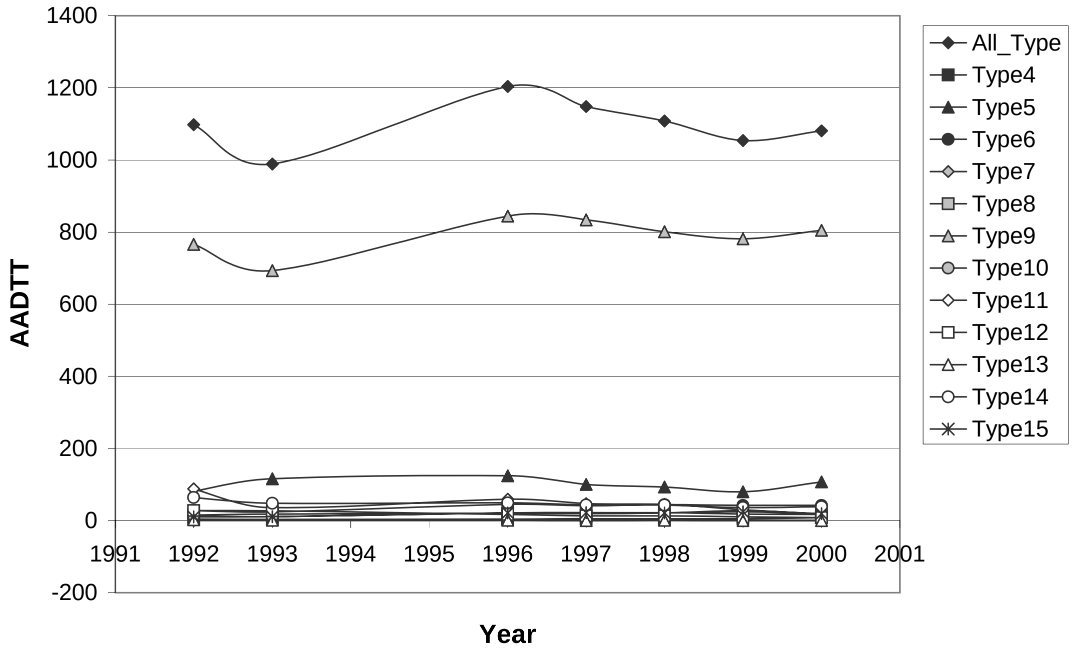
STATION 28 MACDOEL



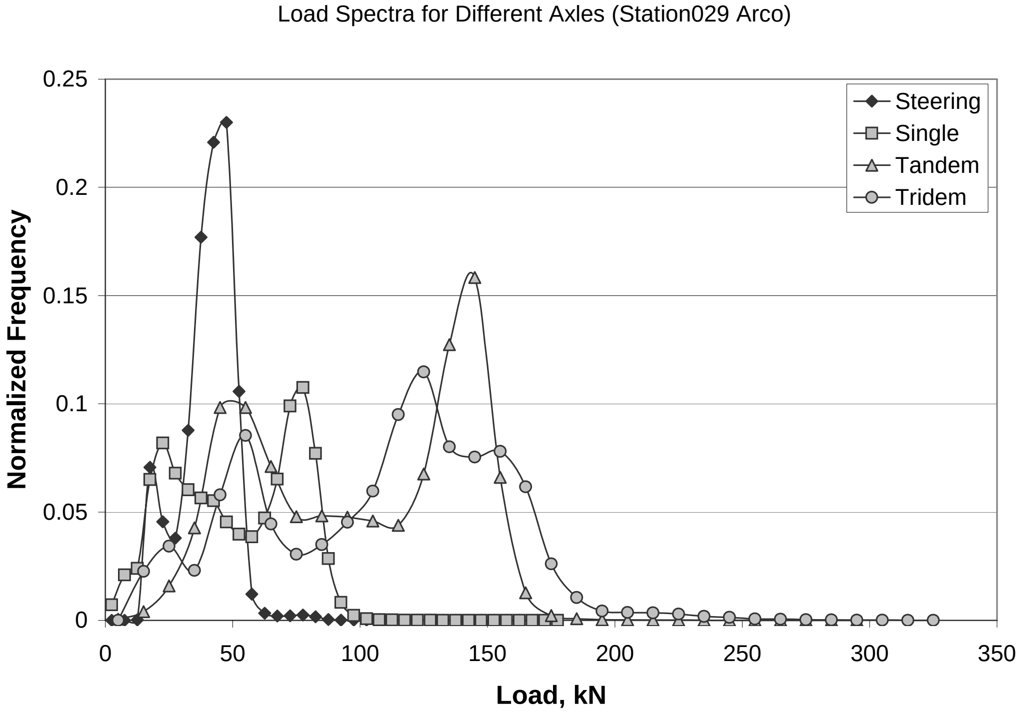
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1992	1098	4	81	28	0	15	766	13	88	28	2	64	10
1993	989	3	116	24	0	18	693	11	36	27	1	48	11
1996	1204	4	124	45	0	20	844	21	59	17	1	49	21
1997	1148	5	100	41	0	19	834	22	47	13	0	43	22
1998	1108	5	93	44	0	21	801	22	45	13	1	43	21
1999	1054	5	80	42	0	27	781	18	30	10	0	36	24
2000	1081	8	107	42	0	19	805	17	18	8	0	38	19

Annual Average Daily Traffic For Different Truck Types (Station 028_MACDOEL)

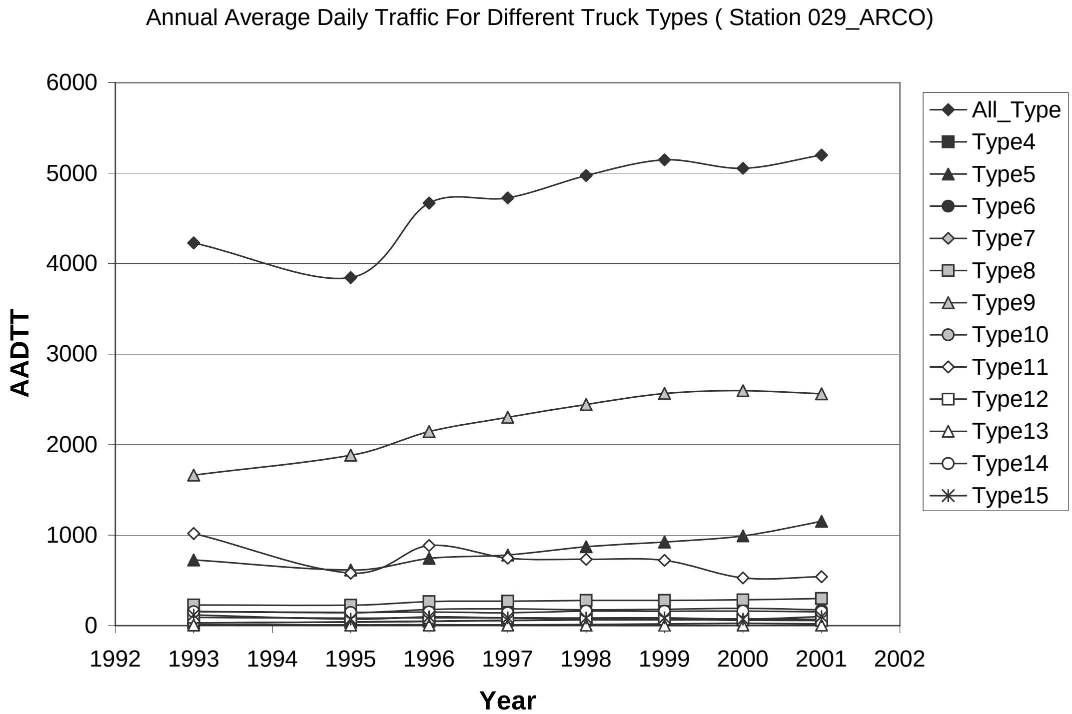


STATION 29 ARCO

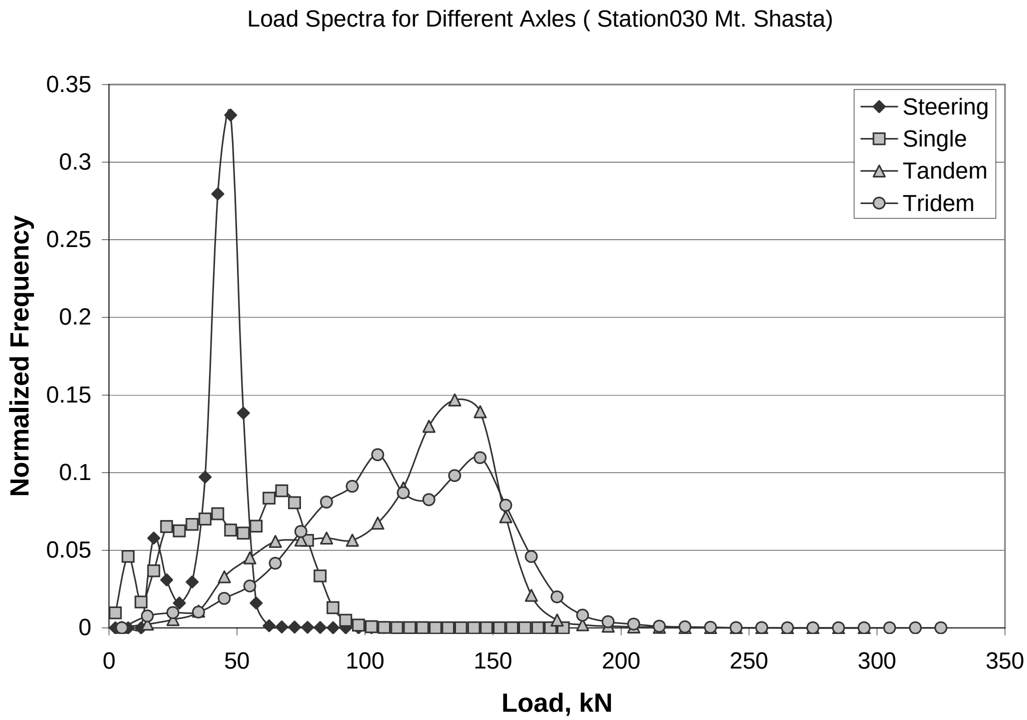


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	4230	31	725	157	9	229	1664	28	1019	92	6	154	118
1995	3845	39	615	143	9	227	1883	42	581	83	5	145	73
1996	4671	46	743	179	10	267	2146	50	886	88	5	151	99
1997	4727	59	781	185	9	270	2302	56	745	84	4	142	88
1998	4973	67	872	175	13	279	2443	64	732	77	4	161	86
1999	5147	72	924	180	19	280	2566	63	721	71	3	159	87
2000	5054	77	992	191	27	285	2597	61	528	60	4	161	72
2001	5199	70	1154	175	20	301	2562	60	541	57	5	153	101


Annual Average Daily Traffic For Different Truck Types (Station 029_ARCO)
AADTT
6000
5000
4000
3000
2000
1000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

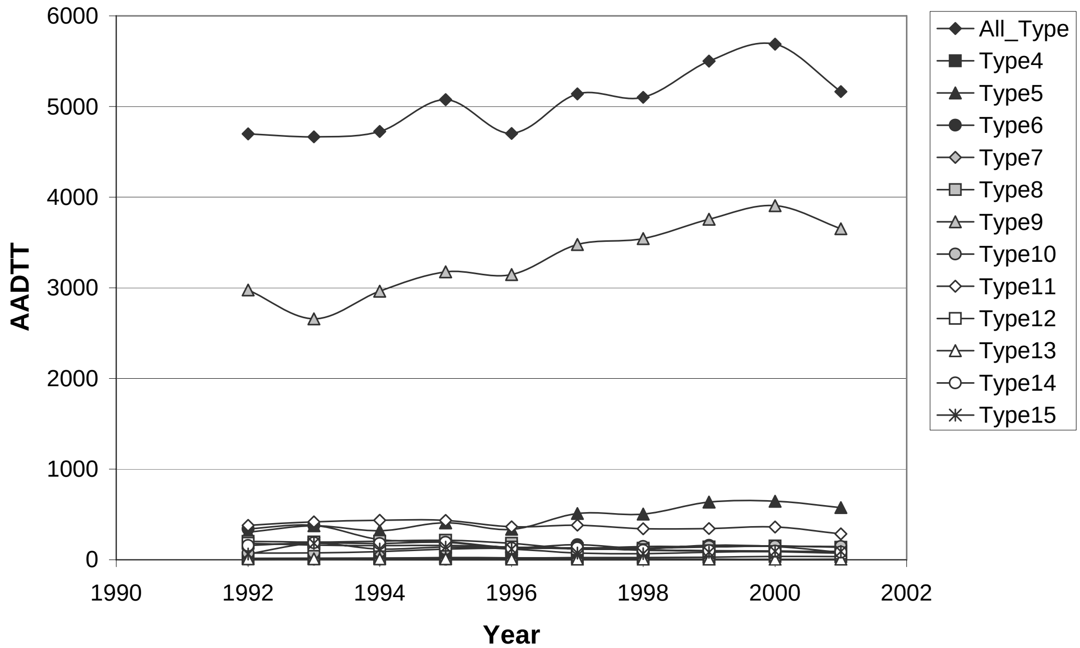
STATION 30 MT. SHASTA



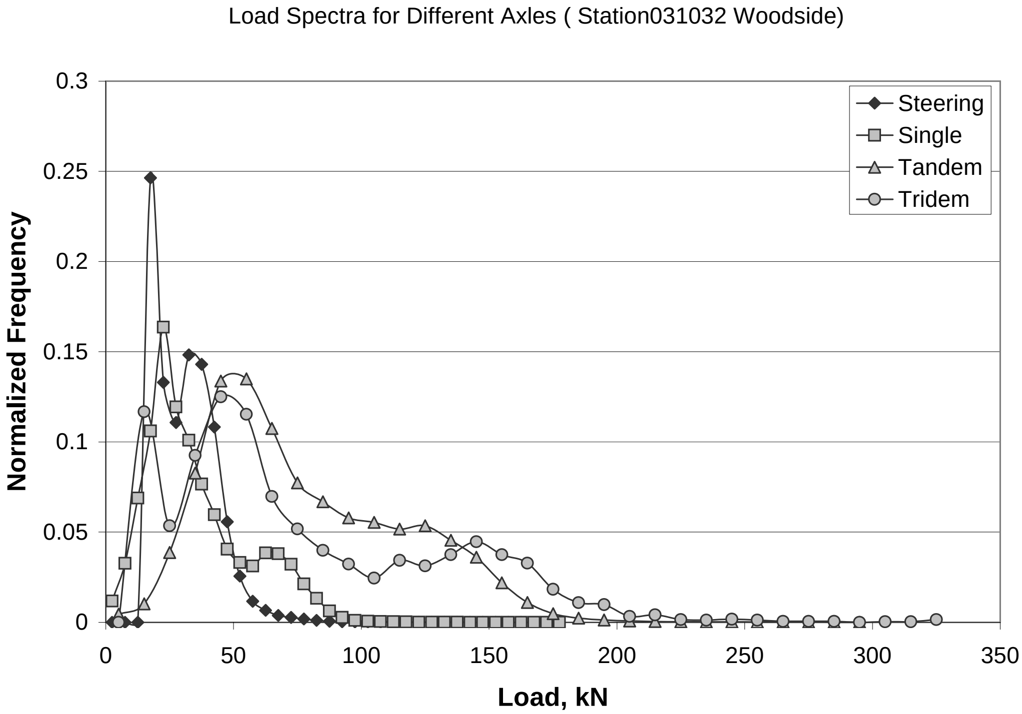
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1992	4699	15	302	340	0	203	2975	74	379	181	10	156	64
1993	4666	17	374	380	3	196	2657	77	419	161	11	188	182
1994	4725	20	321	223	0	206	2964	89	437	158	10	179	117
1995	5076	24	407	201	0	216	3176	118	434	159	10	191	140
1996	4703	21	335	136	1	181	3145	128	365	140	6	126	118
1997	5139	24	511	166	0	121	3478	126	381	119	7	130	75
1998	5101	23	504	124	0	127	3543	145	343	112	6	104	68
1999	5501	29	637	160	1	141	3756	147	345	98	6	101	82
2000	5689	38	645	147	0	153	3908	150	361	90	5	97	94
2001	5166	35	575	81	1	137	3651	146	285	73	6	85	91

Annual Average Daily Traffic For Different Truck Types (Station 030_MT._SHASTA)

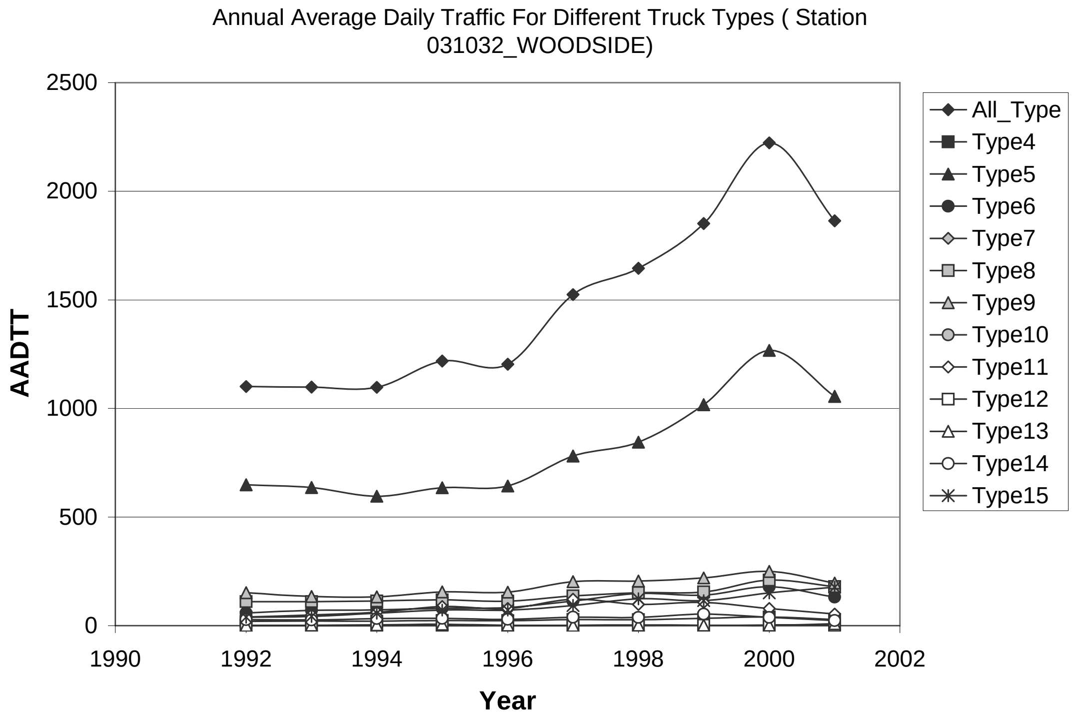


STATIONS 31&32 WOODSIDE



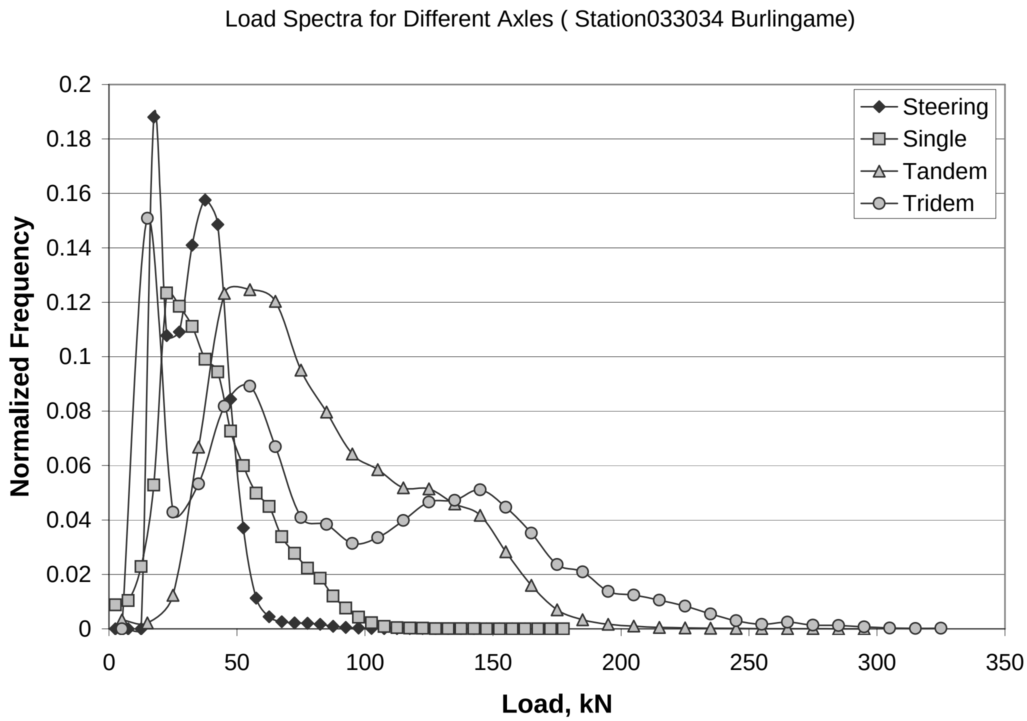
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1992	1101	20	649	58	0	111	152	0	40	2	1	28	39
1993	1098	22	636	71	1	111	134	1	49	2	2	26	43
1994	1097	21	596	73	1	114	133	1	62	2	4	33	57
1995	1218	24	635	80	1	119	155	2	88	2	6	34	72
1996	1204	23	643	84	1	113	154	1	79	1	2	29	72
1997	1524	28	781	114	1	137	203	2	122	2	1	39	93
1998	1645	27	845	148	2	152	205	3	98	1	2	38	124
1999	1851	34	1017	141	2	155	220	2	107	2	2	54	115
2000	2223	40	1267	179	2	210	250	3	79	1	2	38	151
2001	1864	28	1056	132	3	180	196	4	54	1	9	24	177



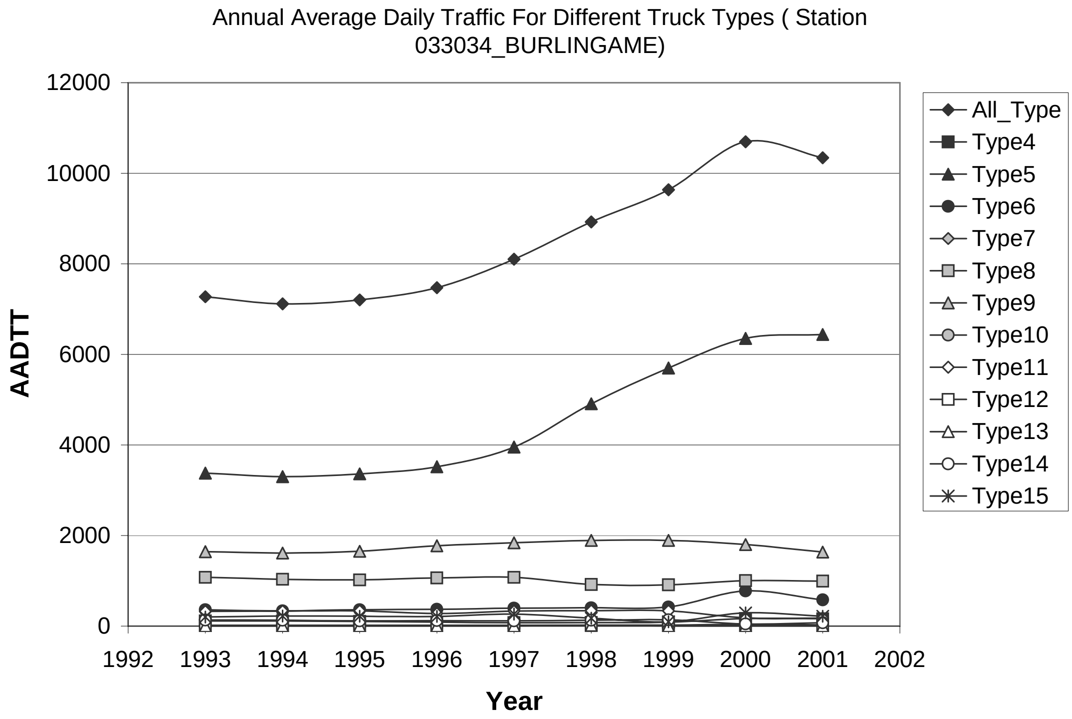
Annual Average Daily Traffic For Different Truck Types (Station 031032_WOODSIDE)
2500
2000
1500
1000
500
0
AADTT
1990
1992
1994
1996
1998
2000
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 33&34 BURLINGAME



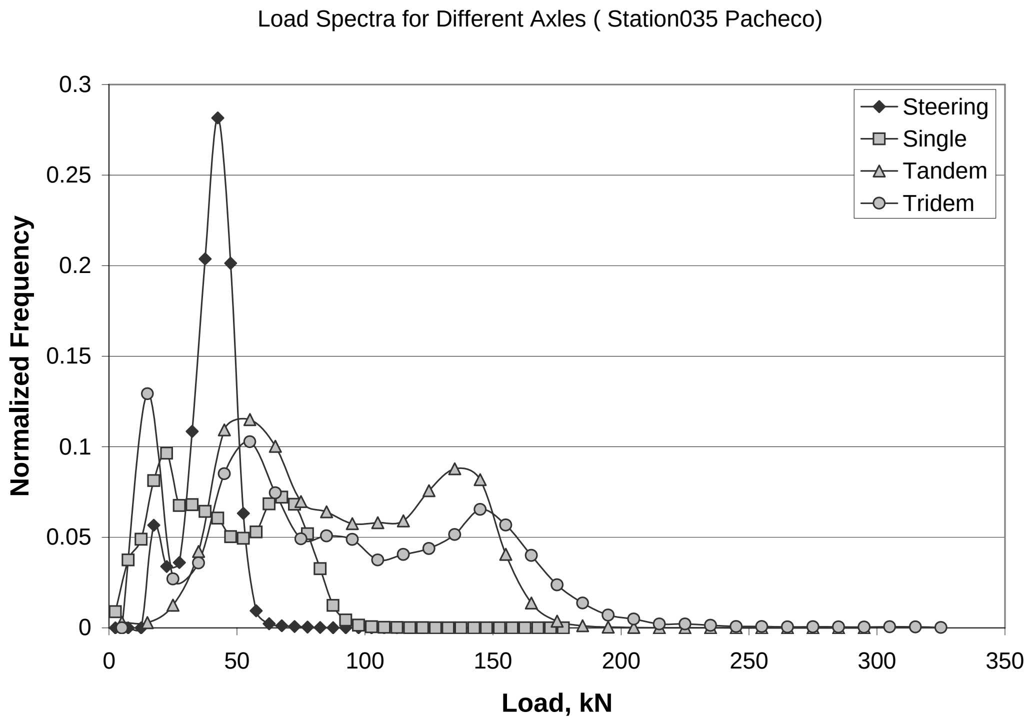
Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	7273	112	3381	361	12	1075	1643	9	325	19	4	133	199
1994	7116	113	3302	337	11	1034	1612	7	330	17	3	129	222
1995	7205	104	3363	360	13	1019	1651	9	334	15	3	117	219
1996	7474	86	3520	370	15	1062	1776	11	280	14	4	121	215
1997	8100	72	3953	396	17	1078	1841	12	332	16	5	116	264
1998	8925	78	4912	406	23	919	1894	18	339	15	17	131	173
1999	9638	87	5698	422	22	911	1893	16	336	14	4	140	95
2000	10696	167	6353	778	40	1004	1801	14	185	12	3	48	290
2001	10342	162	6440	582	27	994	1637	14	180	12	4	72	219



Annual Average Daily Traffic For Different Truck Types (Station 033034_BURLINGAME)
12000
10000
8000
6000
4000
2000
0
AADTT
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

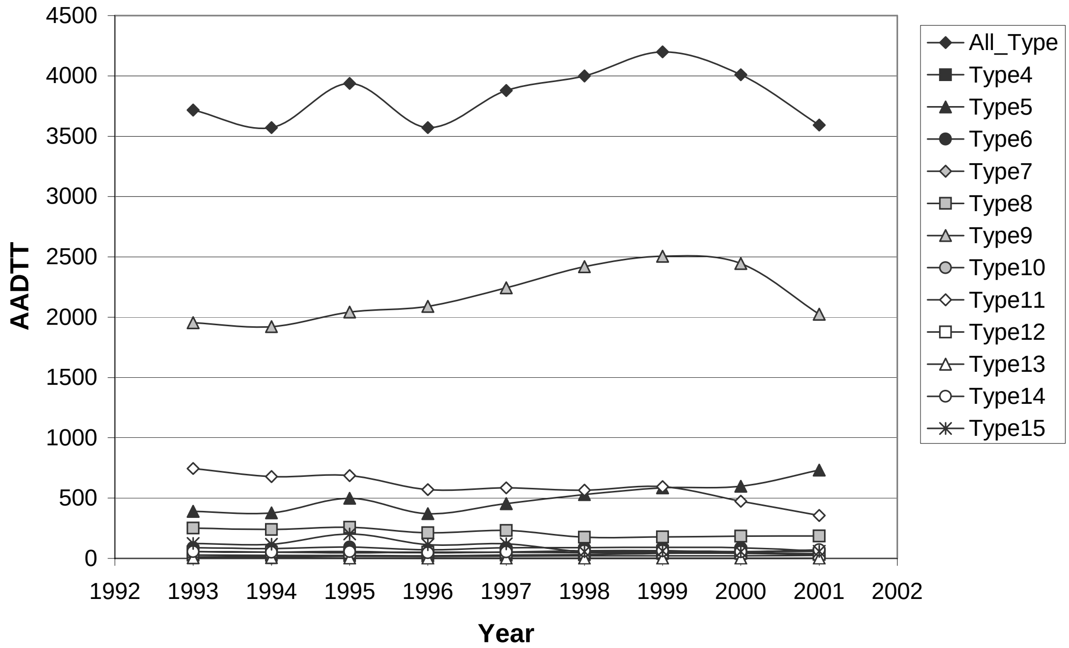
STATION 35 PACHECO



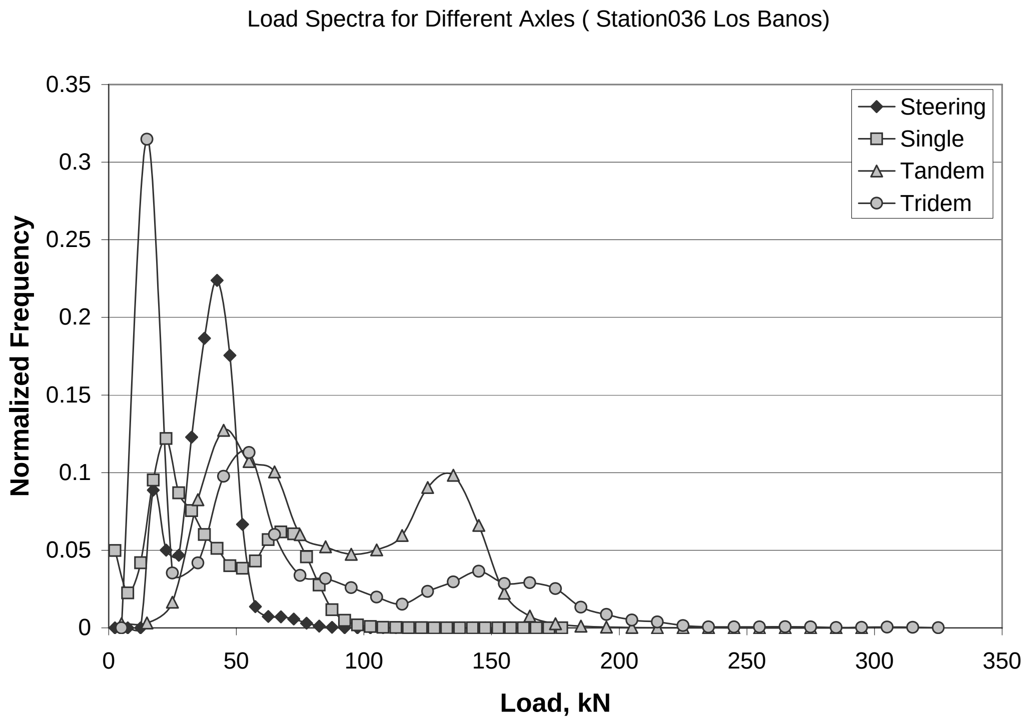
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	3716	27	391	90	2	252	1954	13	746	56	5	58	124
1994	3571	26	377	81	1	241	1921	16	678	53	6	53	118
1995	3937	25	499	95	1	258	2043	19	686	48	3	57	203
1996	3571	22	371	72	1	213	2090	17	570	52	2	47	115
1997	3879	28	454	88	1	232	2244	19	586	51	2	54	121
1998	3999	31	529	90	1	176	2418	21	565	48	2	63	55
1999	4199	43	586	92	1	178	2505	22	595	49	2	63	62
2000	4009	45	598	88	1	184	2444	21	474	42	2	56	55
2001	3592	39	732	62	1	186	2024	26	356	33	2	72	59

Annual Average Daily Traffic For Different Truck Types (Station 035_PACHECO)



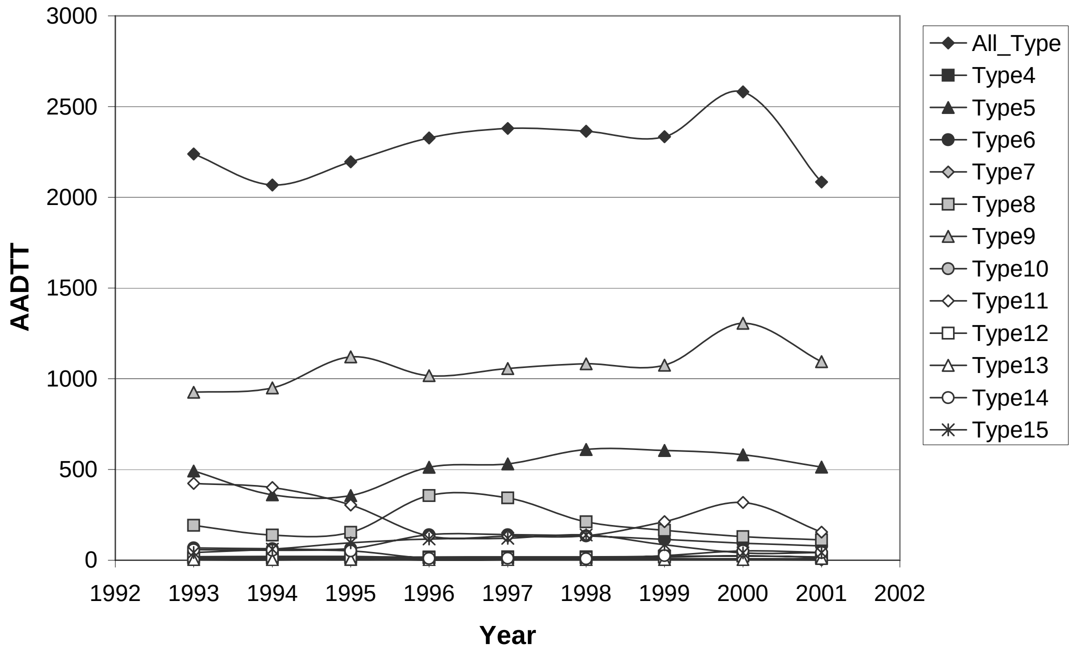
STATION 36 LOS BANOS



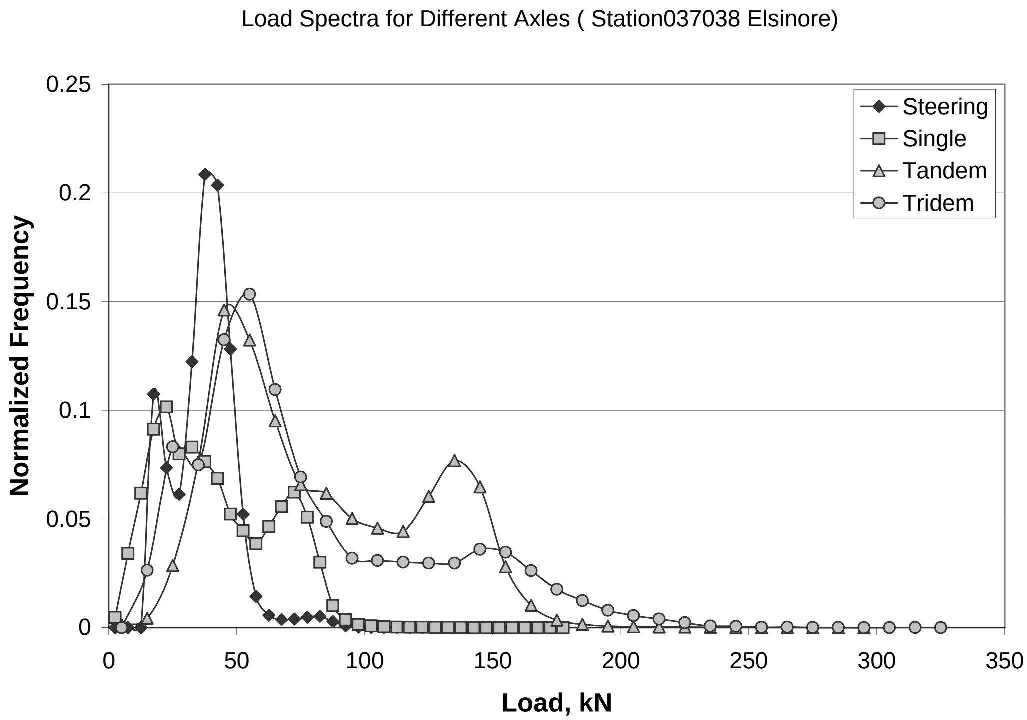
Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	2239	12	492	68	2	192	926	2	423	20	3	58	42
1994	2068	12	361	63	1	138	950	4	400	21	2	55	61
1995	2196	14	356	64	4	154	1121	8	304	21	4	51	96
1996	2327	17	512	141	1	357	1017	8	133	13	1	10	117
1997	2380	19	531	141	2	343	1056	9	132	13	2	11	121
1998	2364	19	610	134	2	211	1082	8	135	13	2	8	140
1999	2334	22	605	115	2	165	1075	8	213	16	3	25	85
2000	2581	23	581	94	3	130	1306	8	318	24	3	51	40
2001	2084	17	513	78	1	112	1094	7	155	14	10	43	41

Annual Average Daily Traffic For Different Truck Types (Station 036_LOS_BANOS)

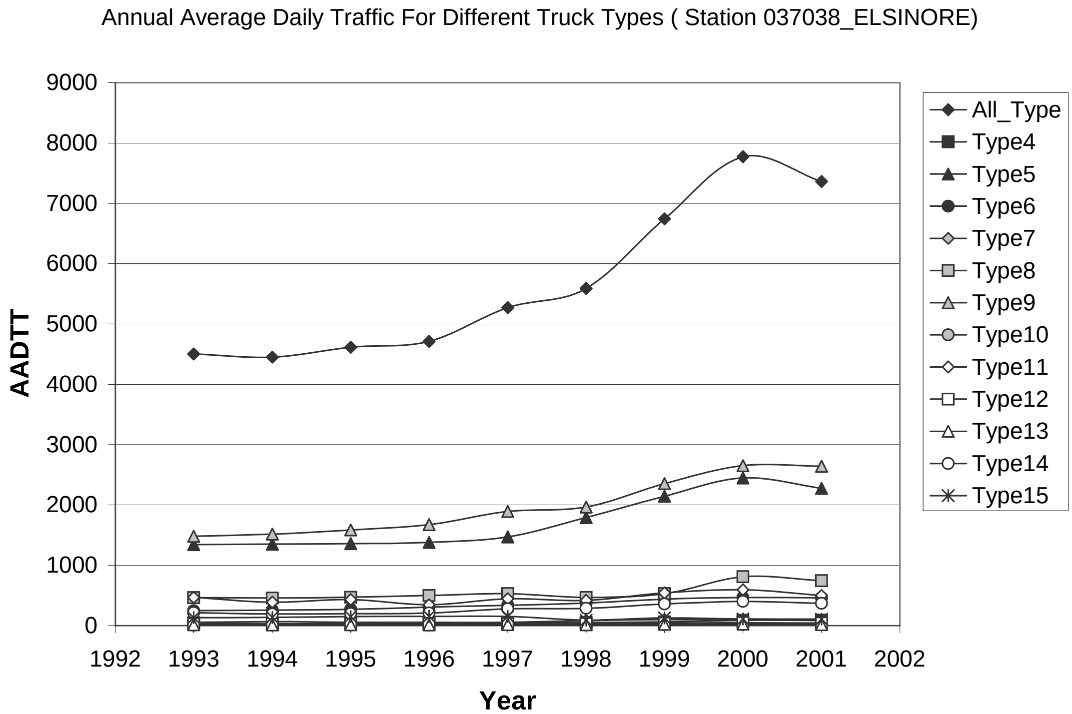


STATIONS 37&38 ELSINORE

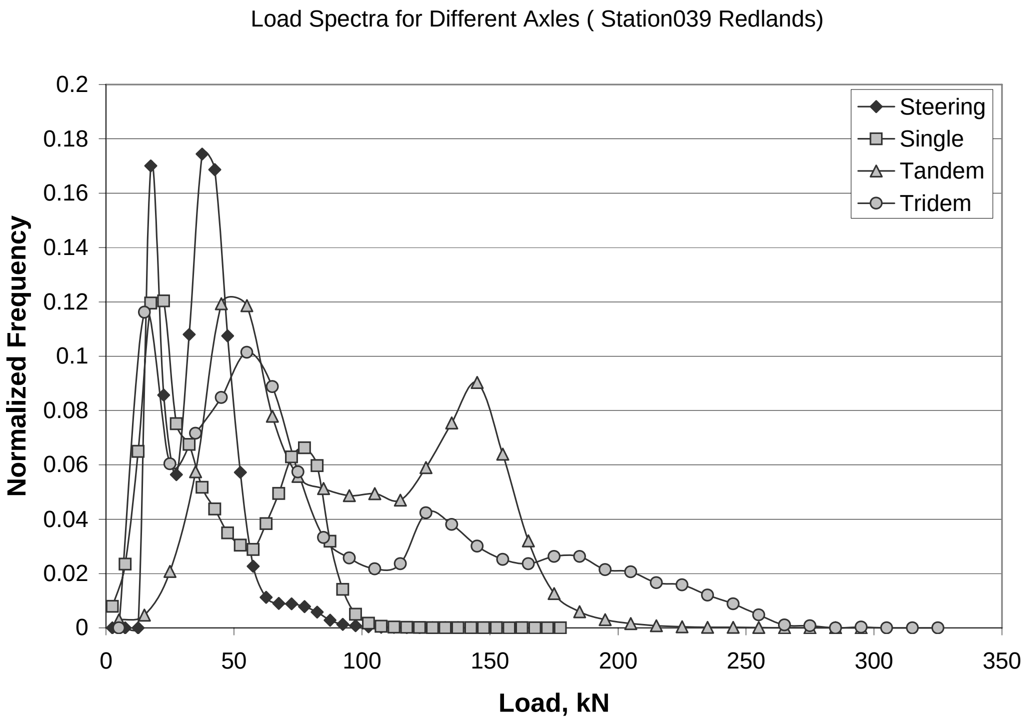


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	4502	50	1344	247	54	464	1481	5	467	26	16	215	133
1994	4450	30	1350	259	64	457	1519	10	390	30	13	194	136
1995	4615	35	1359	270	56	470	1586	11	433	31	15	198	150
1996	4712	33	1379	306	54	501	1674	10	346	31	14	208	155
1997	5271	41	1471	336	57	531	1895	12	444	32	18	277	155
1998	5588	51	1791	374	84	468	1966	11	417	30	17	287	93
1999	6742	61	2144	441	103	531	2355	16	544	39	22	361	127
2000	7774	88	2450	469	97	812	2653	20	594	49	27	403	112
2001	7363	90	2276	460	86	746	2641	22	499	44	21	369	109


Annual Average Daily Traffic For Different Truck Types (Station 037038_ELSINORE)
AADTT
Year
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

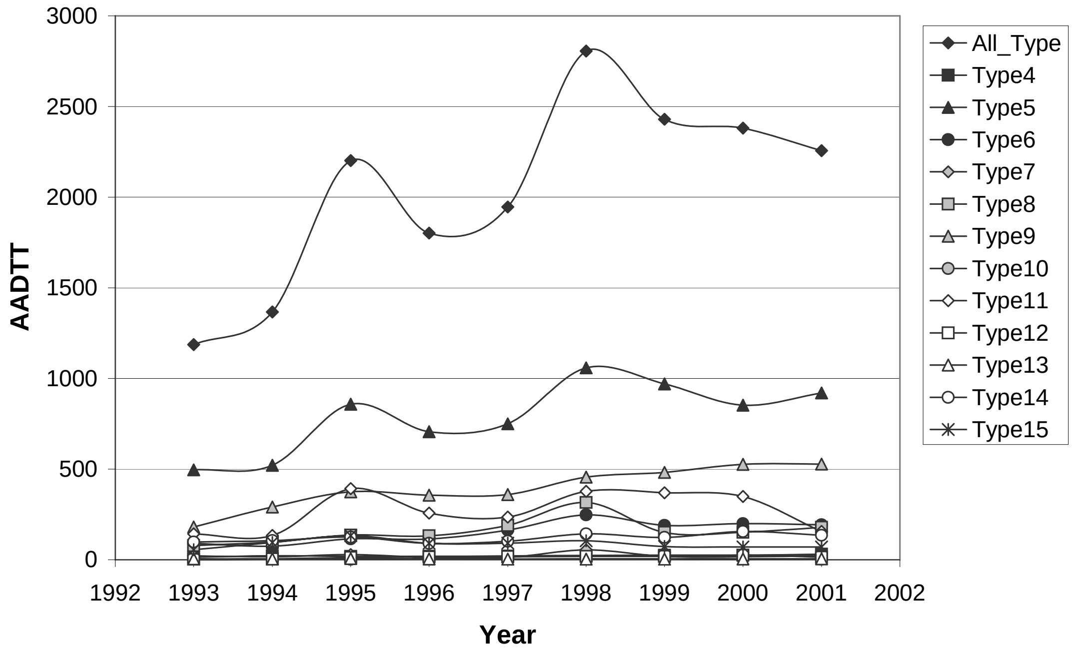
STATION 39 REDLANDS



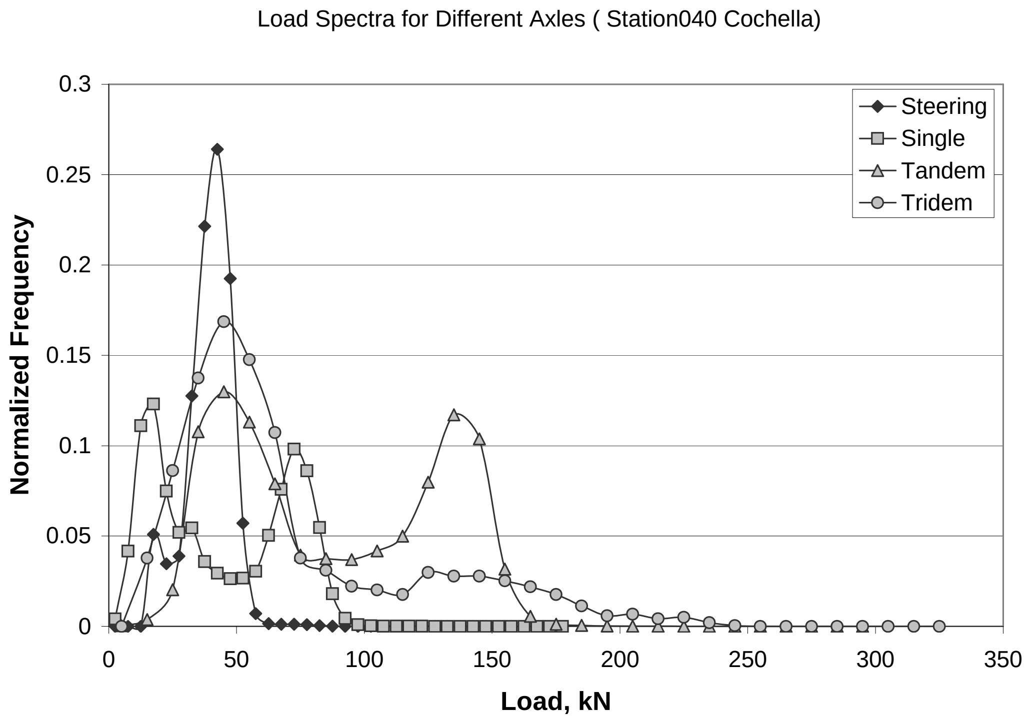
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	1187	14	496	91	22	79	181	0	143	1	5	98	56
1994	1367	22	521	75	16	98	291	2	134	4	4	106	95
1995	2202	18	858	116	28	136	375	2	392	12	6	125	133
1996	1802	20	706	115	13	132	357	3	257	15	4	91	90
1997	1946	21	750	163	13	190	360	2	236	16	3	102	92
1998	2806	24	1059	248	55	316	456	4	377	18	3	143	105
1999	2430	25	970	190	19	150	482	5	370	19	3	123	73
2000	2381	25	853	199	16	152	527	5	349	25	4	156	71
2001	2257	31	920	193	22	179	528	3	156	14	5	135	71

Annual Average Daily Traffic For Different Truck Types (Station 039_REDLANDS)

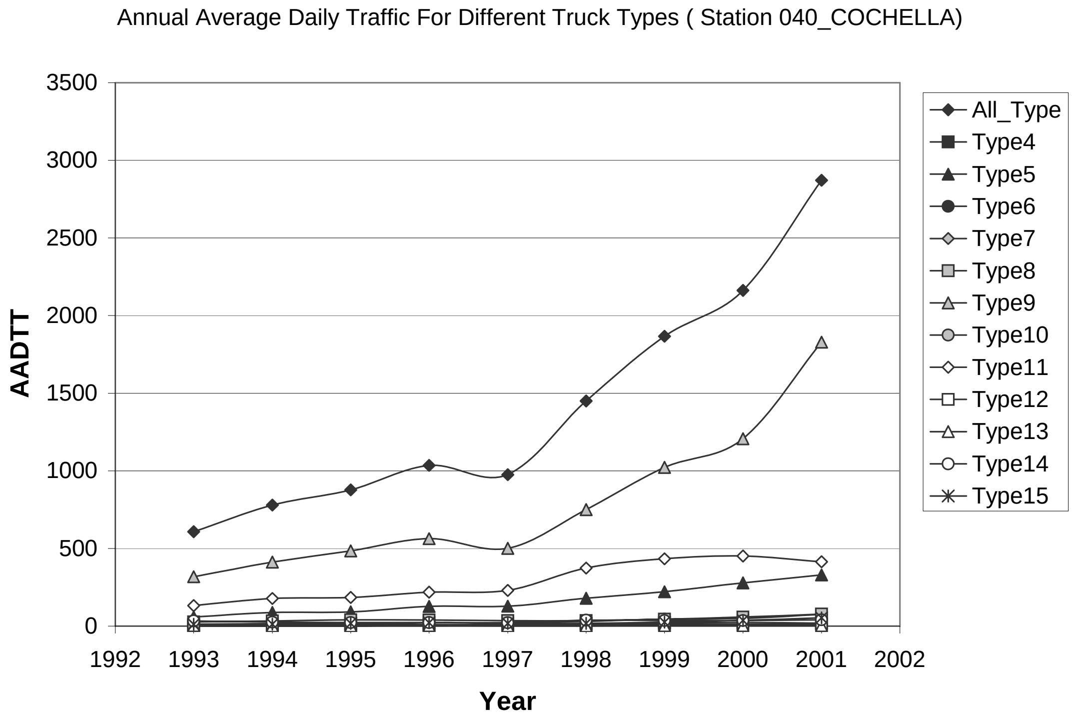


STATION 40 COCHELLA

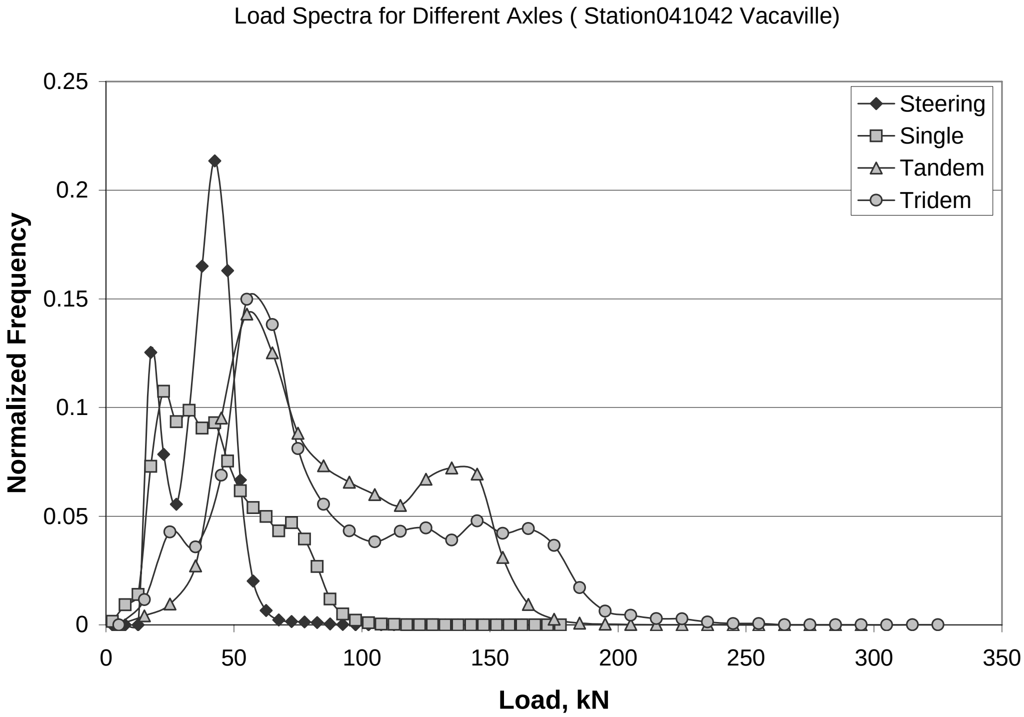


Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	608	3	59	13	1	27	318	1	132	8	3	33	11
1994	779	2	88	15	2	33	412	1	178	9	1	25	13
1995	877	3	91	17	1	41	484	1	184	11	1	23	18
1996	1035	4	127	22	5	39	563	1	219	9	2	23	22
1997	976	3	128	23	3	36	501	2	230	9	1	22	18
1998	1450	6	179	30	3	36	750	2	374	14	1	38	18
1999	1867	10	221	45	4	45	1023	2	434	19	2	35	26
2000	2162	11	278	49	5	59	1207	3	452	23	3	35	37
2001	2872	13	330	75	13	77	1829	3	415	19	3	41	54

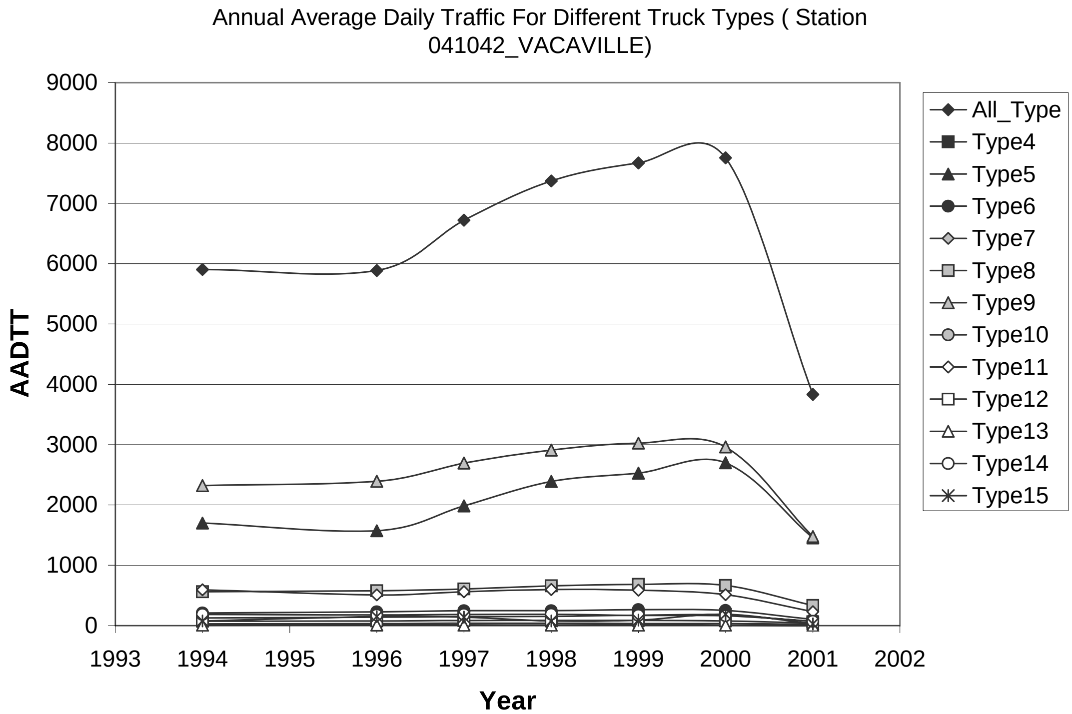

Annual Average Daily Traffic For Different Truck Types (Station 040_COCHELLA)
AADTT
3500
3000
2500
2000
1500
1000
500
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 41&42 VACAVILLE



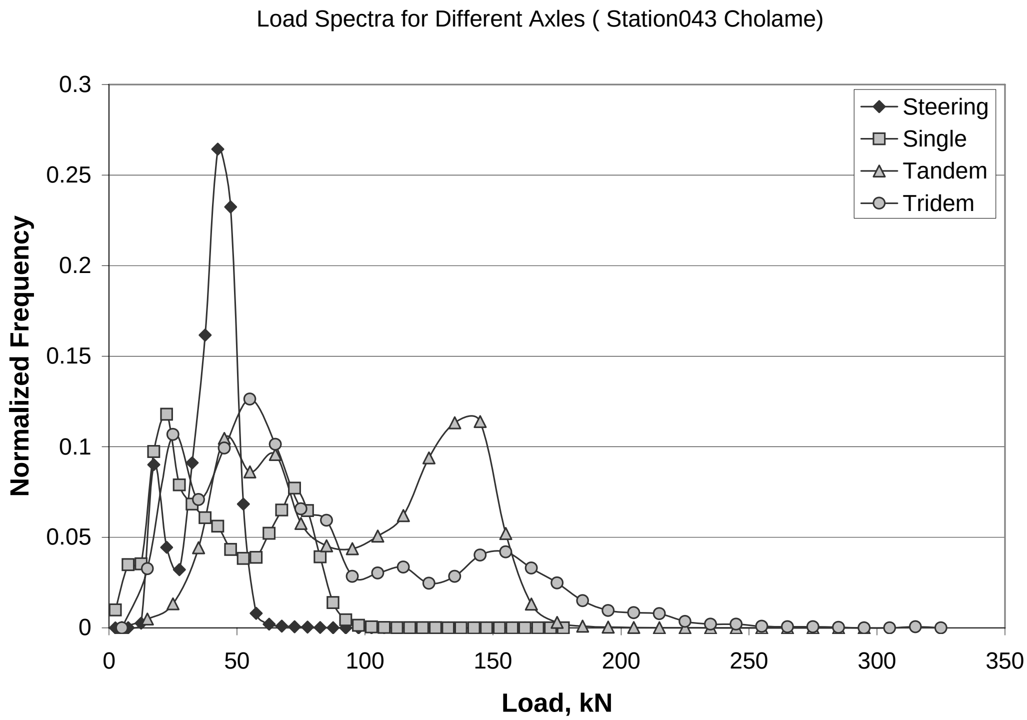
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	5904	129	1702	209	6	563	2323	28	596	75	6	187	80
1996	5887	139	1573	230	14	578	2394	37	510	78	9	176	150
1997	6719	151	1985	248	14	608	2696	38	564	85	7	185	139
1998	7371	155	2390	250	10	661	2909	38	598	88	5	190	77
1999	7669	172	2528	264	13	685	3026	35	589	87	6	170	93
2000	7754	178	2701	251	7	668	2962	36	513	80	5	164	190
2001	3833	66	1454	106	0	333	1477	19	232	41	2	71	31



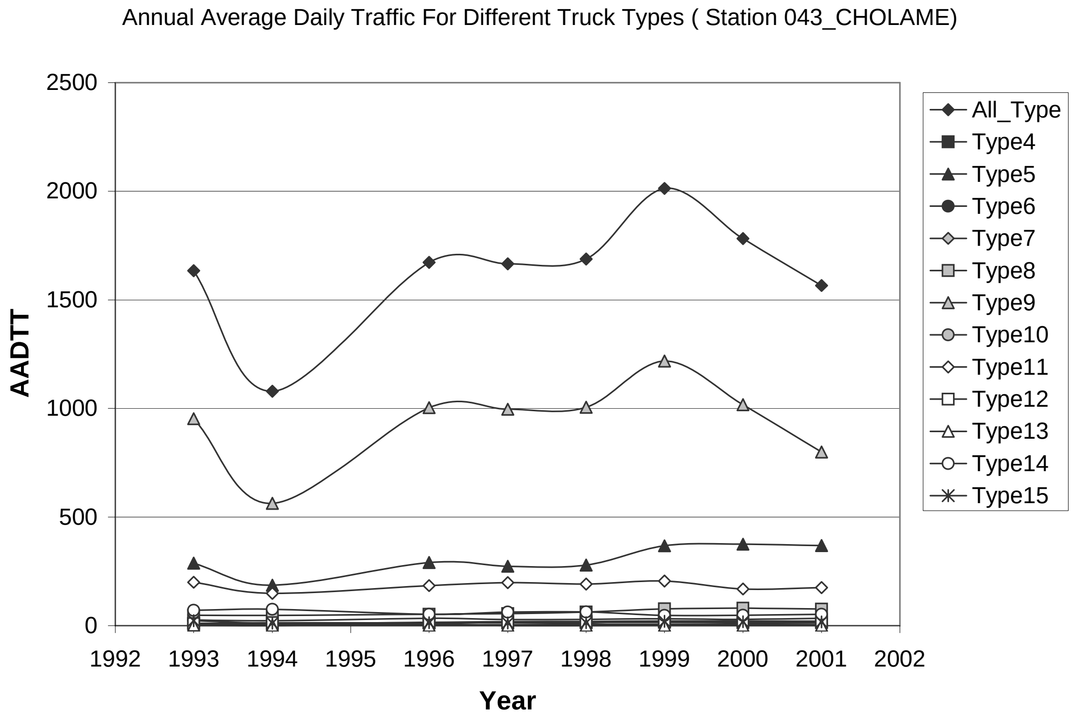
Annual Average Daily Traffic For Different Truck Types (Station 041042_VACAVILLE)
AADTT
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 43 CHOLAME

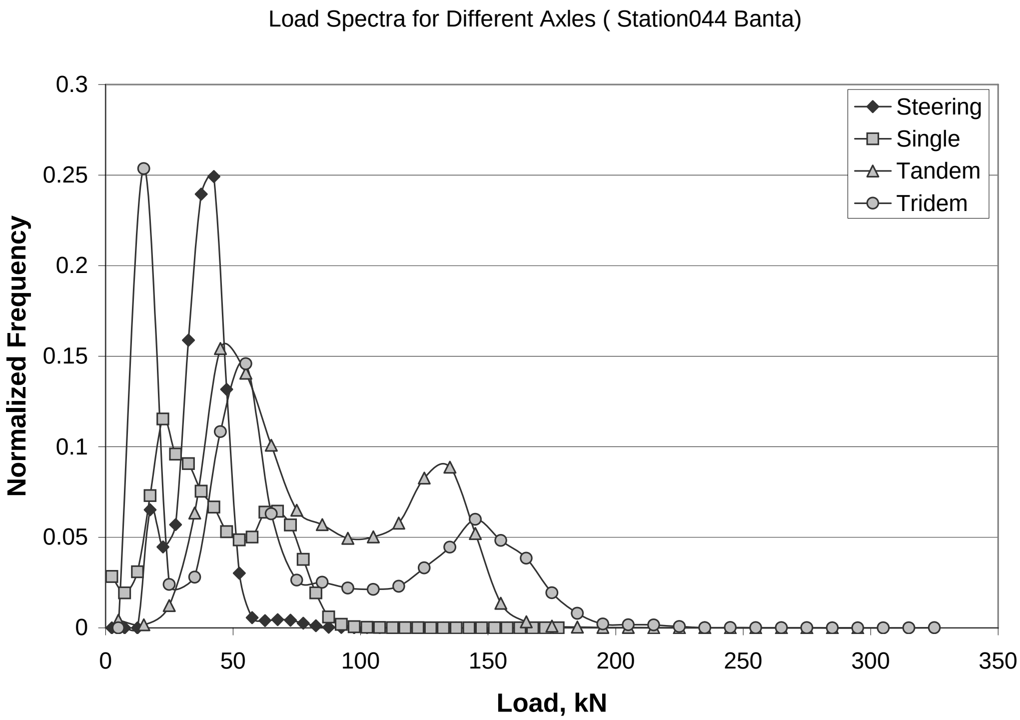


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1993	1634	11	288	26	1	48	953	3	200	9	2	71	23
1994	1079	8	186	23	1	47	563	2	149	14	1	75	12
1996	1672	15	291	34	7	53	1004	4	184	13	1	53	14
1997	1666	18	273	28	1	55	997	4	198	15	1	63	13
1998	1688	19	279	29	1	63	1006	6	192	15	1	64	14
1999	2013	22	368	32	2	77	1218	6	205	15	1	47	20
2000	1782	22	375	29	2	81	1017	6	169	14	1	48	18
2001	1566	21	369	34	2	76	799	5	175	14	1	53	17

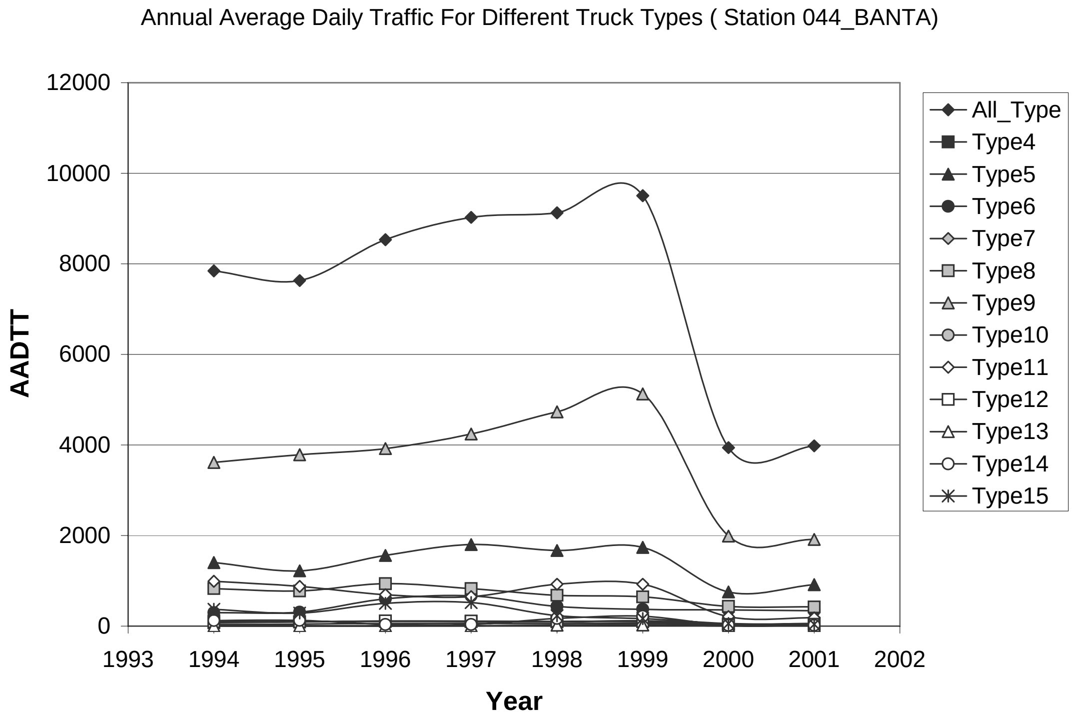

Annual Average Daily Traffic For Different Truck Types (Station 043_CHOLAME)
2500
2000
1500
1000
500
0
AADTT
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 44 BANTA



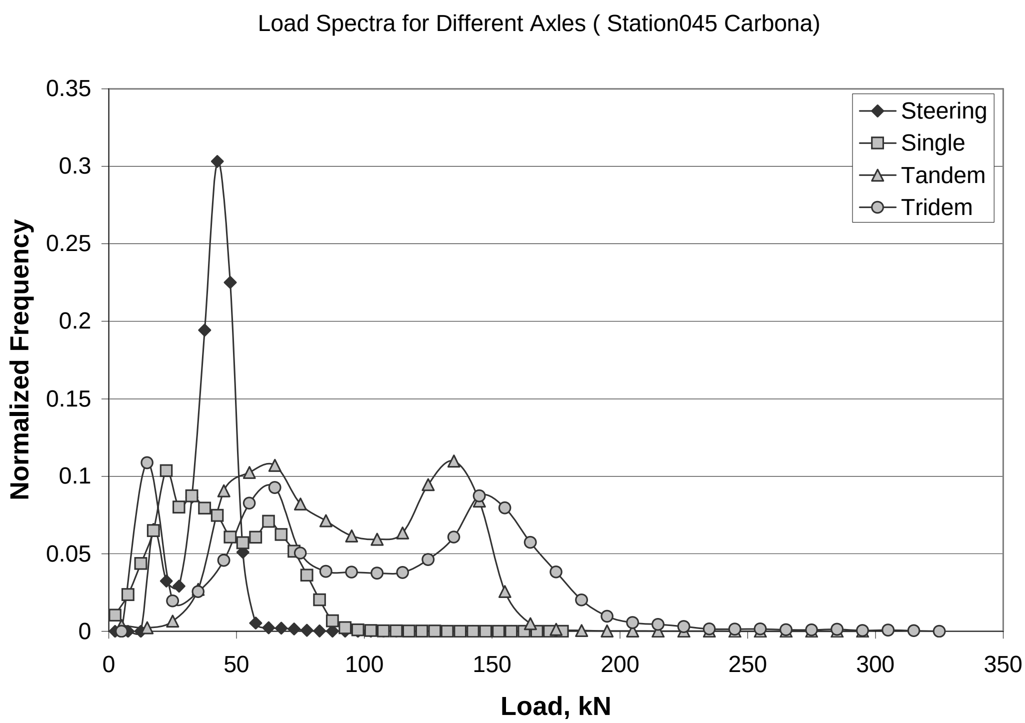
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	7845	74	1405	296	4	830	3616	35	989	97	6	123	369
1995	7631	93	1221	310	5	778	3786	45	876	97	6	126	287
1996	8535	104	1562	601	6	938	3920	56	693	113	6	34	503
1997	9028	100	1803	668	8	828	4241	59	650	108	6	35	520
1998	9128	98	1670	434	10	679	4731	56	924	105	20	170	229
1999	9506	116	1738	369	20	644	5126	65	924	100	24	216	164
2000	3940	41	753	359	7	437	1987	29	210	37	5	17	58
2001	3979	60	914	338	25	425	1916	19	185	39	4	16	41



Annual Average Daily Traffic For Different Truck Types (Station 044_BANTA)
AADTT
Year
0
2000
4000
6000
8000
10000
12000
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

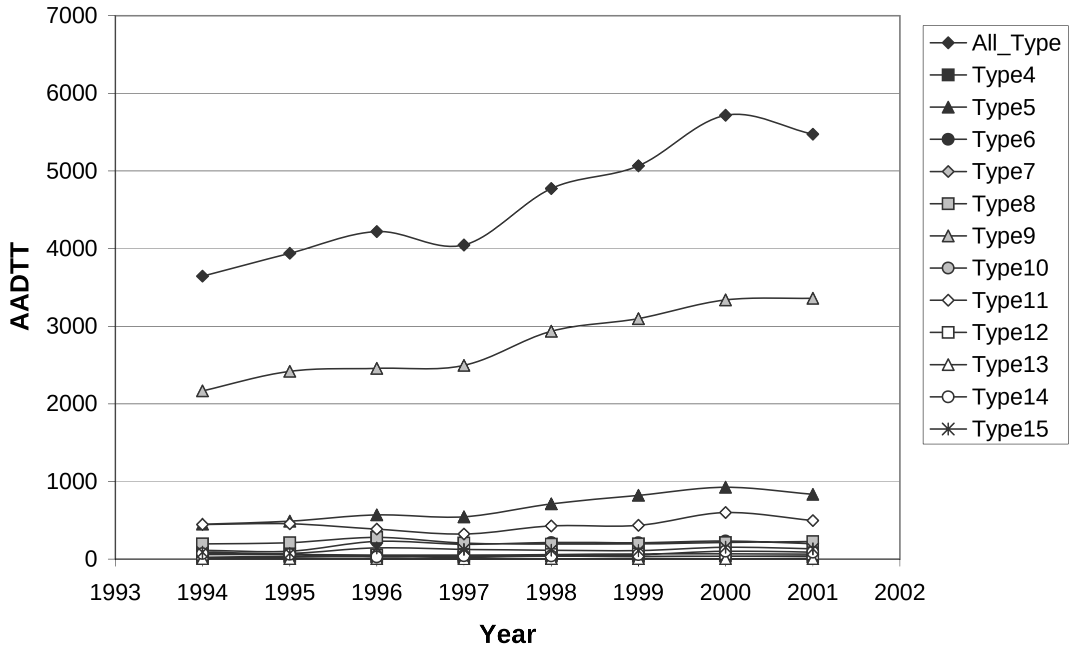
STATION 45 CARBONA



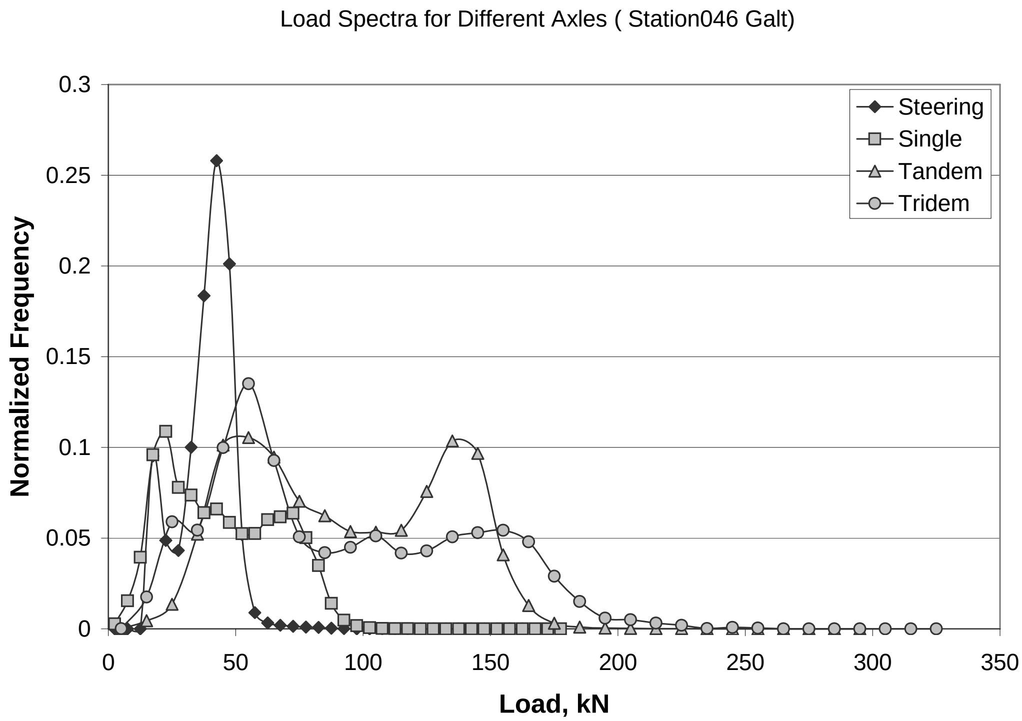
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	3646	23	451	114	1	197	2168	23	446	58	4	72	89
1995	3939	36	489	102	1	211	2420	26	456	60	4	62	73
1996	4220	34	571	228	1	281	2458	35	386	51	4	29	144
1997	4046	22	544	191	1	207	2495	42	322	51	3	44	124
1998	4774	37	712	213	0	193	2936	40	427	58	5	40	114
1999	5066	35	821	210	1	197	3097	32	434	67	4	58	110
2000	5718	39	926	233	1	213	3339	37	601	68	4	103	153
2001	5475	31	835	199	1	226	3360	40	496	63	4	89	131

Annual Average Daily Traffic For Different Truck Types (Station 045_CARBONA)



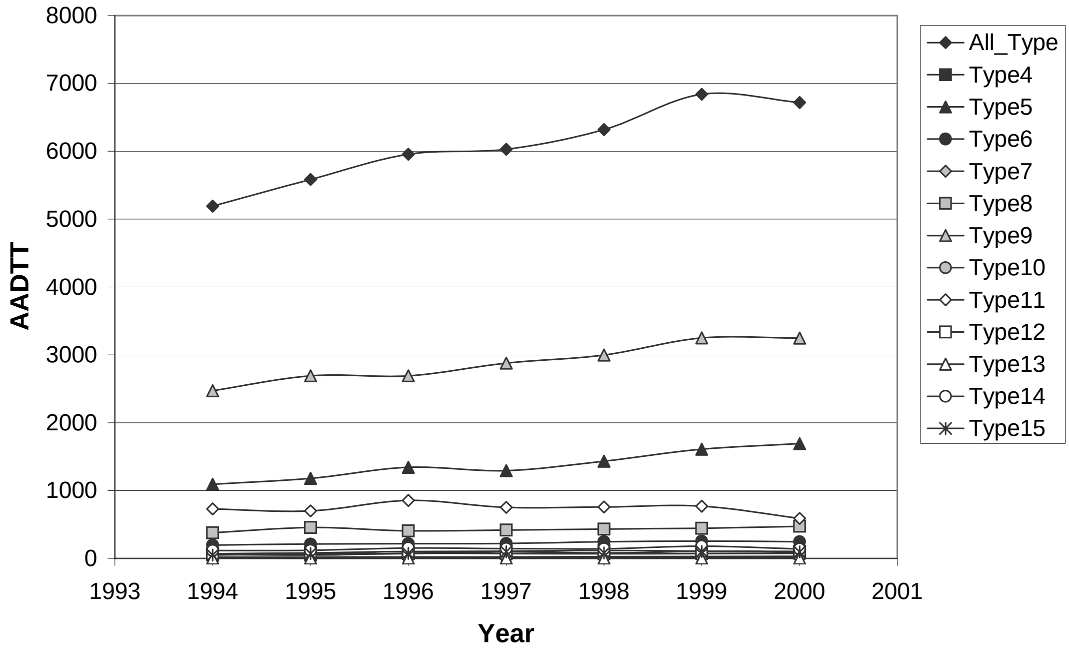
STATION 46 GALT



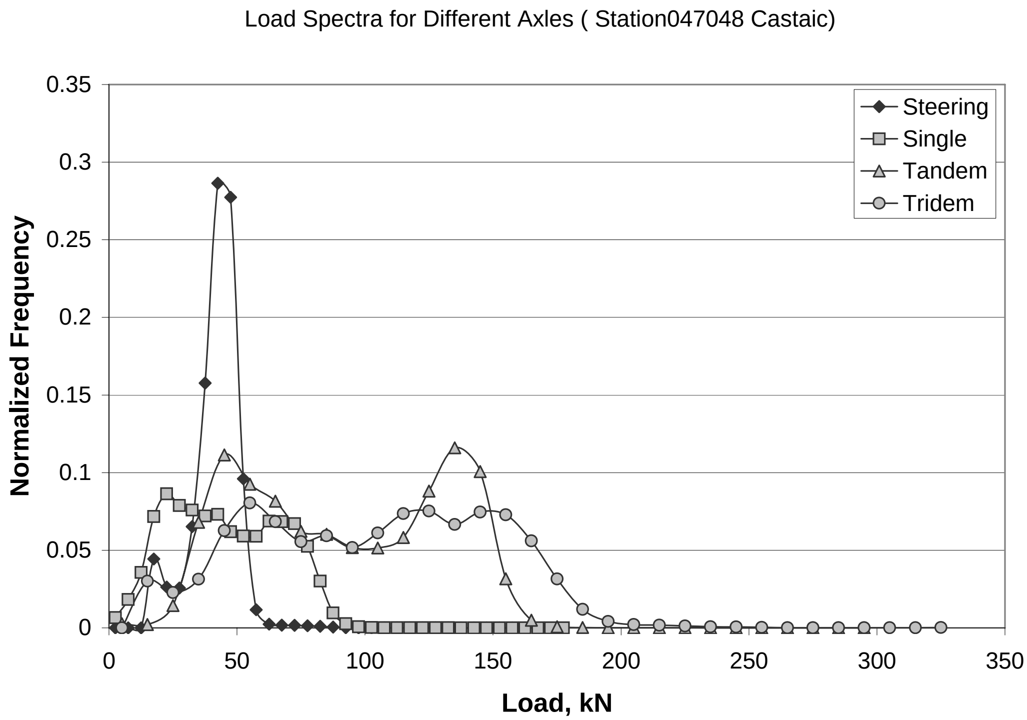
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	5191	59	1092	197	11	377	2471	19	729	69	3	115	50
1995	5583	48	1179	212	4	457	2693	19	700	80	3	118	72
1996	5955	72	1343	217	8	407	2693	24	856	101	3	154	76
1997	6030	73	1293	222	9	420	2879	24	753	108	3	145	99
1998	6319	69	1432	246	13	432	2997	26	760	117	4	141	81
1999	6839	74	1611	255	14	445	3250	29	770	108	4	179	101
2000	6717	77	1691	247	13	473	3248	33	591	105	4	140	97

Annual Average Daily Traffic For Different Truck Types (Station 046_GALT)



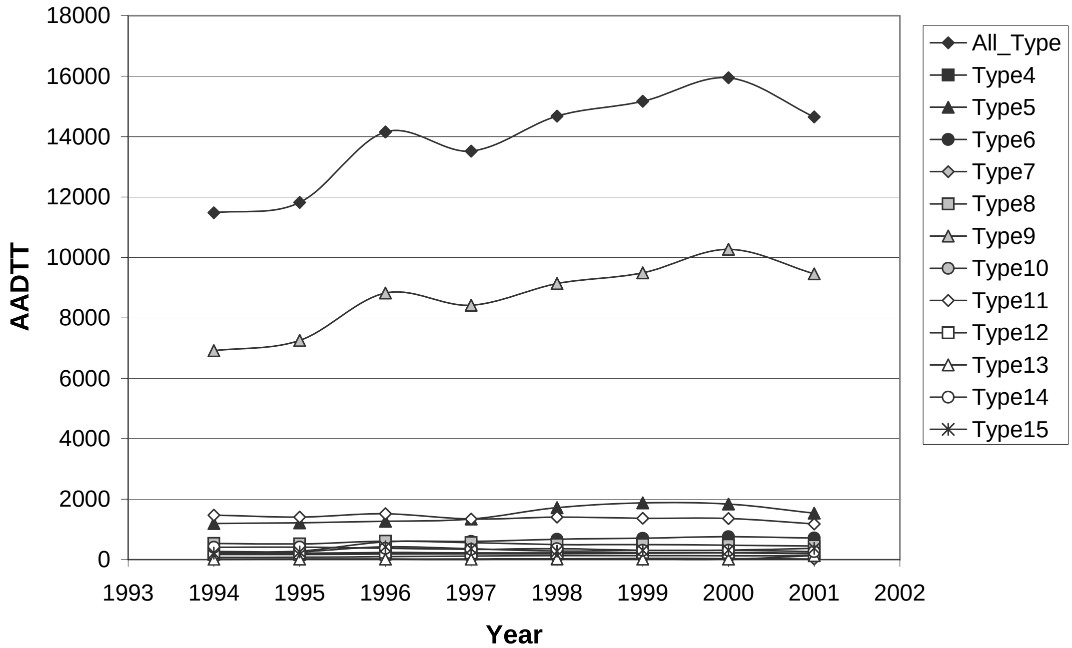
STATIONS 47&48 CASTAIC



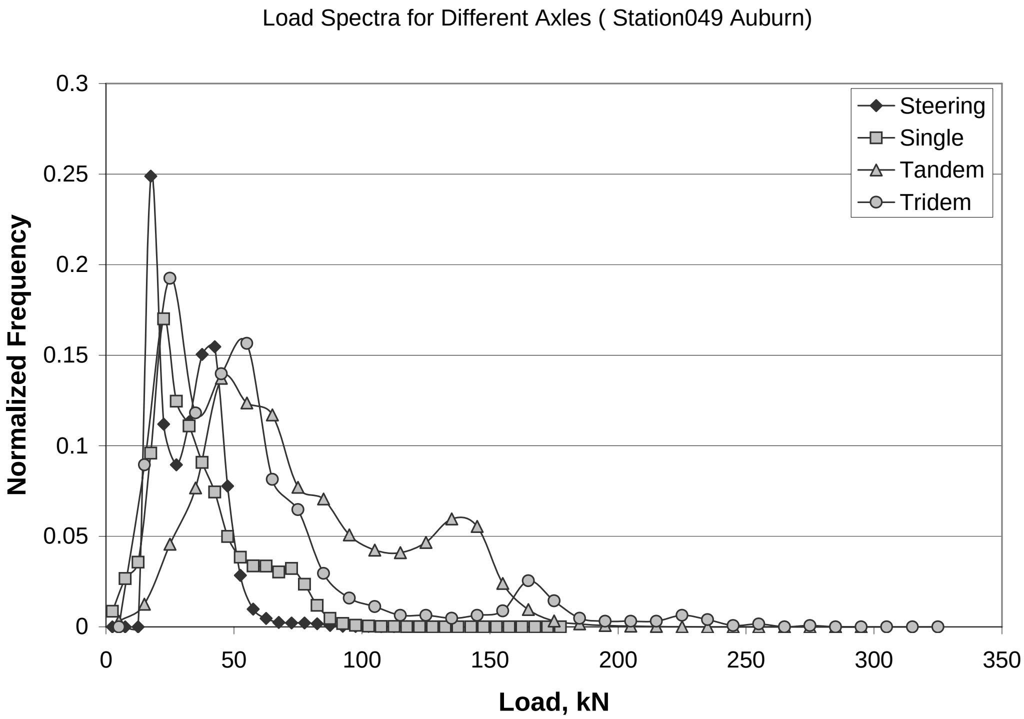
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	11480	172	1196	270	13	536	6914	71	1472	213	8	403	213
1995	11818	170	1215	283	13	514	7255	81	1403	208	12	412	253
1996	14153	183	1268	591	11	607	8824	101	1519	236	12	375	425
1997	13521	190	1338	602	21	563	8416	115	1343	223	9	339	362
1998	14677	199	1718	674	29	497	9138	132	1405	222	19	363	281
1999	15171	211	1876	704	41	496	9493	129	1368	227	10	306	309
2000	15948	222	1838	759	31	480	10270	126	1360	228	12	310	314
2001	14652	189	1538	712	22	451	9459	127	1180	208	132	259	375

Annual Average Daily Traffic For Different Truck Types (Station 047048_CASTAIC)



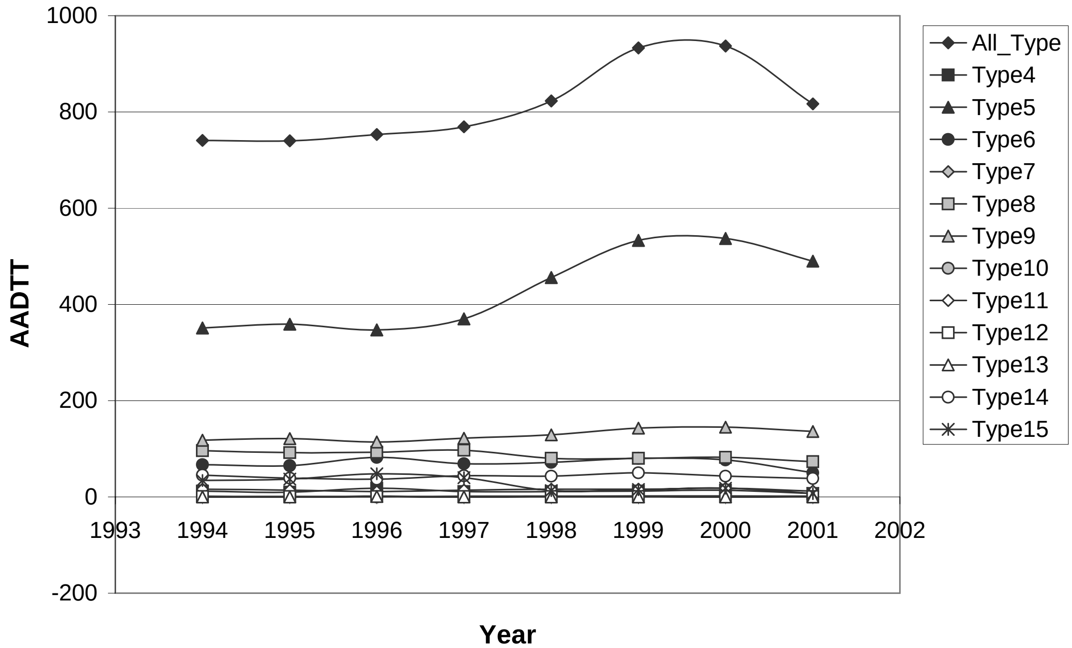
STATION 49 AUBURN



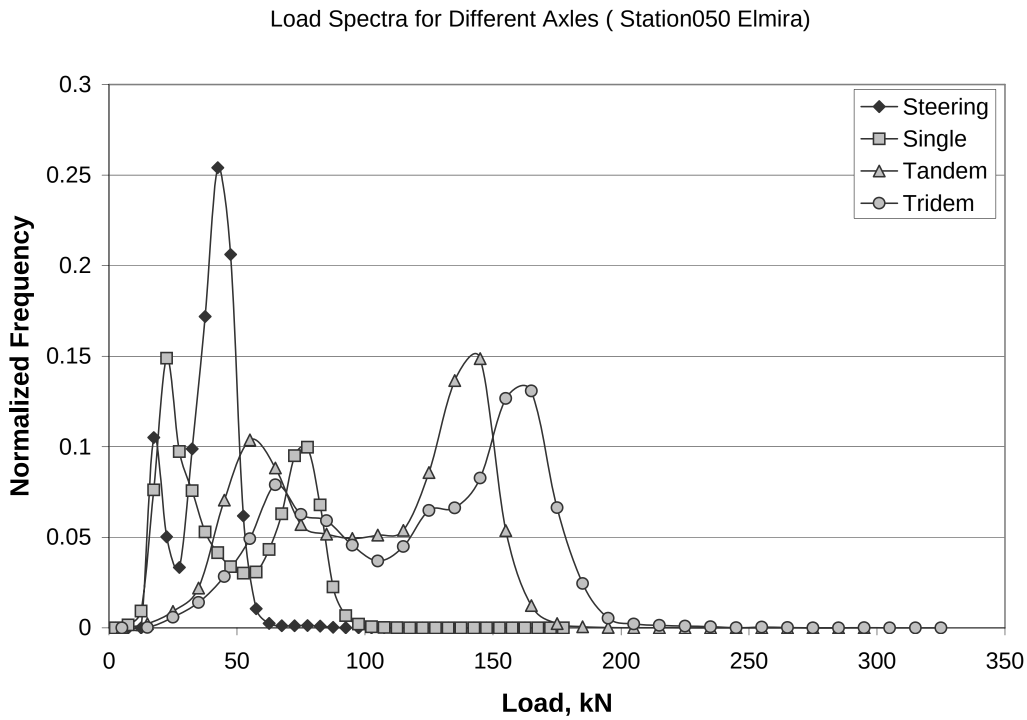
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1994	741	12	351	67	0	96	118	1	16	1	0	45	34
1995	740	10	359	65	0	92	121	0	14	1	0	39	37
1996	753	18	347	82	1	93	114	0	11	1	1	37	48
1997	769	11	370	69	0	97	122	1	14	1	0	44	40
1998	823	11	456	72	1	80	129	1	16	1	0	43	13
1999	933	12	533	80	2	80	143	1	16	1	0	50	15
2000	937	14	537	77	2	82	145	0	18	1	0	43	18
2001	817	7	490	50	1	73	136	1	12	1	0	38	7

Annual Average Daily Traffic For Different Truck Types (Station 049_AUBURN)



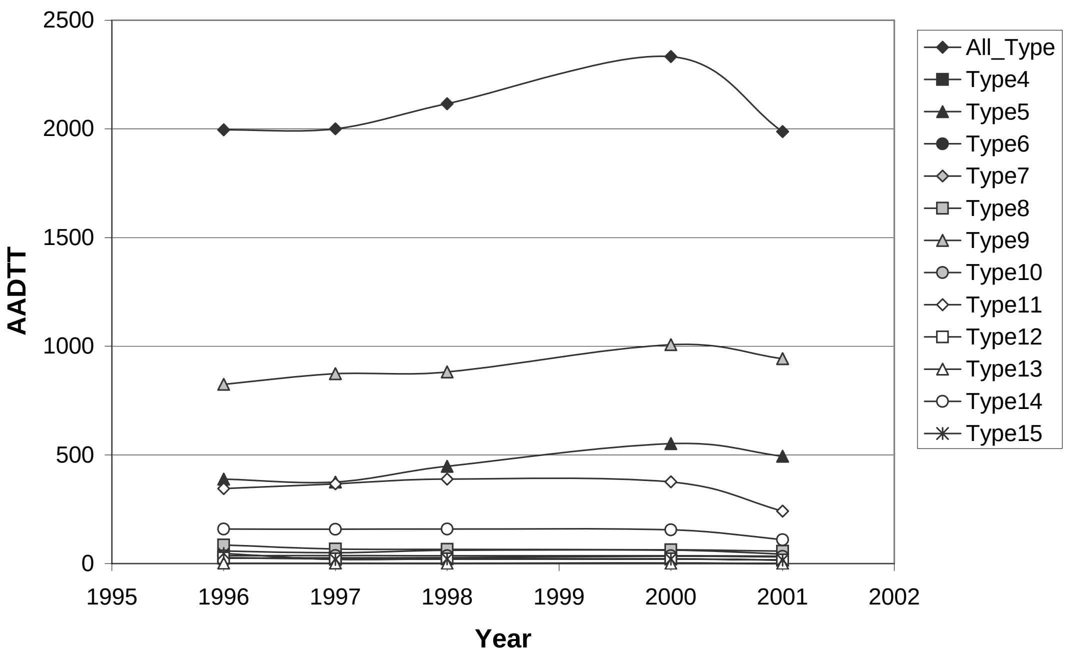
STATION 50 ELMIRA



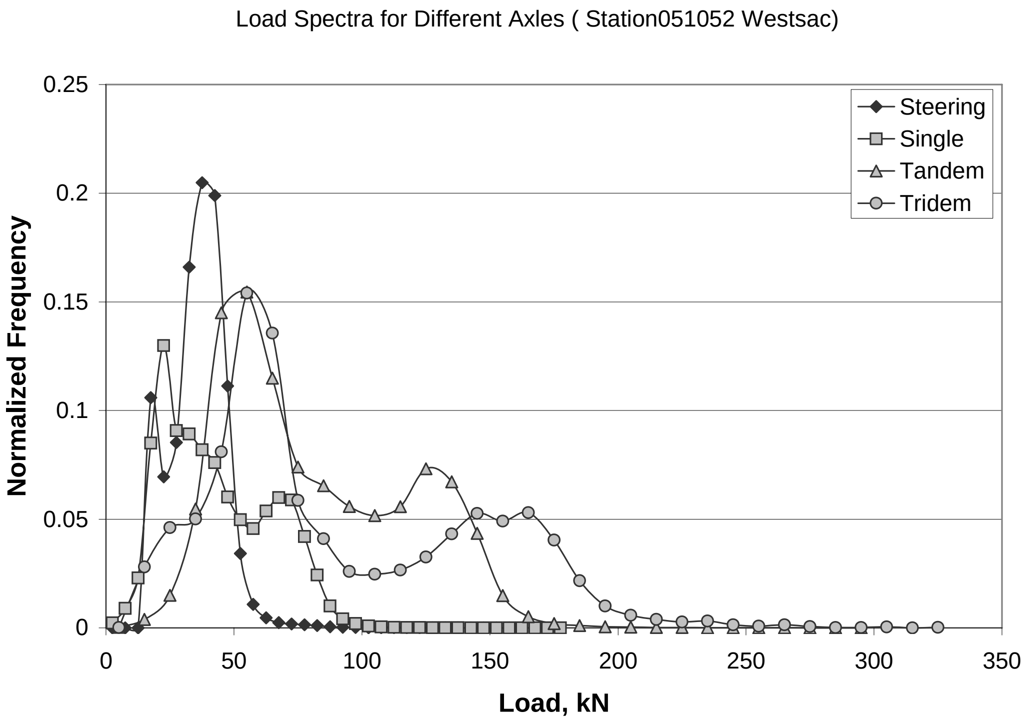
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1996	1996	25	389	58	2	85	825	36	345	26	2	159	46
1997	2000	26	375	50	2	67	874	37	367	22	2	158	19
1998	2116	27	448	61	2	65	882	36	389	22	1	159	22
2000	2333	34	552	62	3	64	1007	36	376	22	1	155	21
2001	1988	31	494	44	0	57	943	34	242	16	1	110	16

Annual Average Daily Traffic For Different Truck Types (Station 050_ELMIRA)



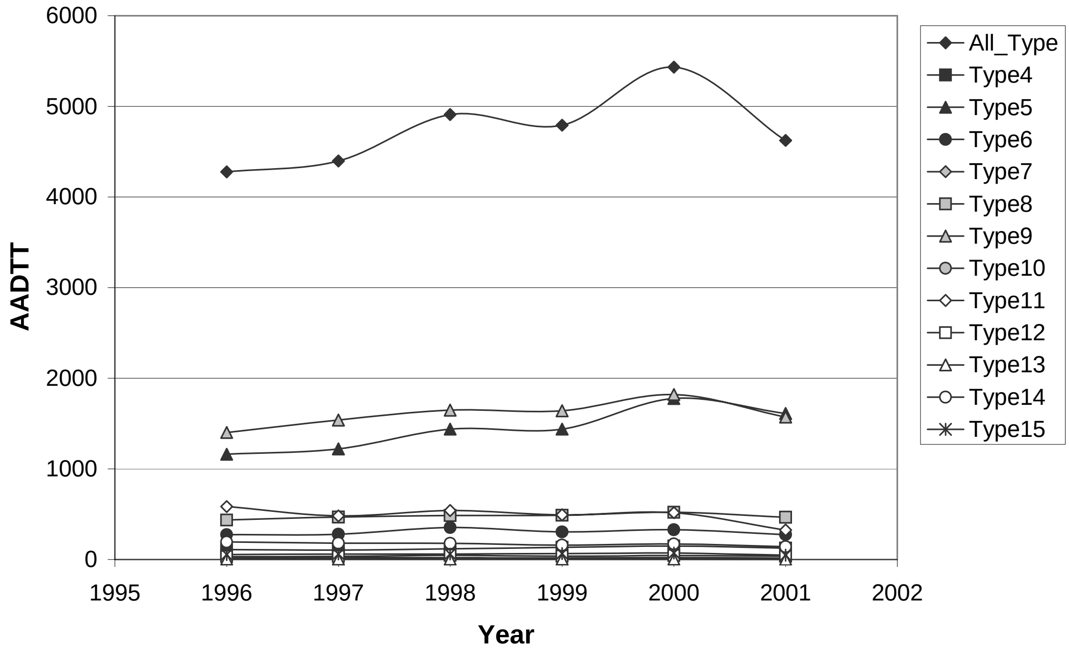
STATIONS 51&52 WESTSAC



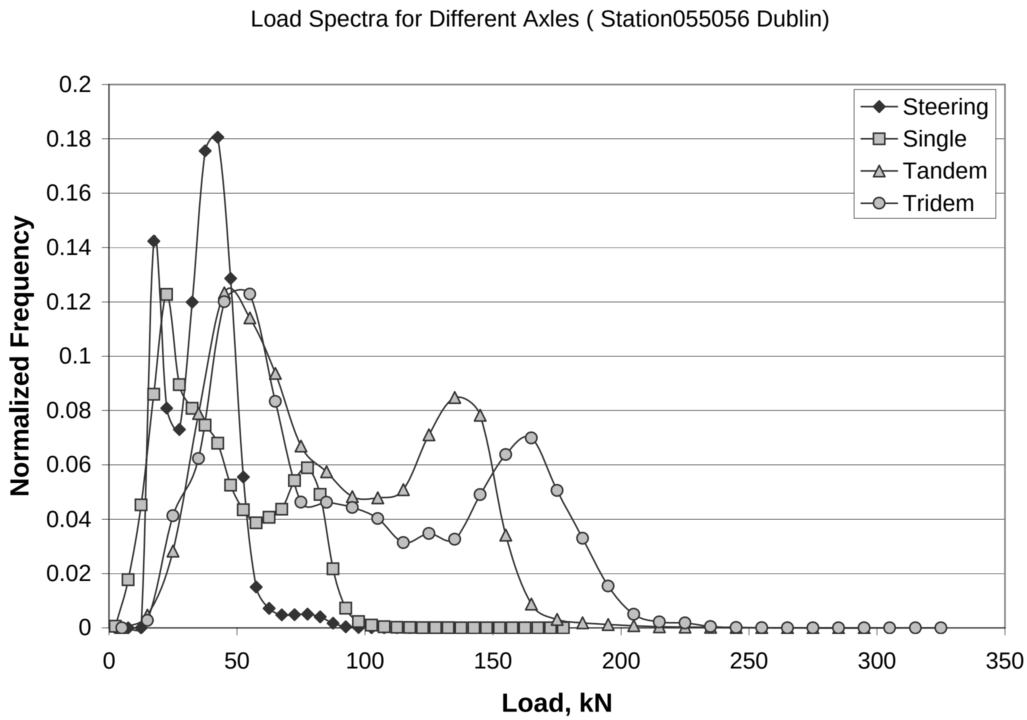
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1996	4278	108	1163	275	10	436	1402	16	584	33	4	194	54
1997	4398	104	1222	278	7	468	1539	21	481	34	4	180	61
1998	4910	117	1439	354	15	486	1648	20	540	46	4	179	61
1999	4793	135	1439	305	10	488	1641	18	493	37	4	159	65
2000	5433	148	1776	329	9	520	1821	21	517	43	4	173	71

Annual Average Daily Traffic For Different Truck Types (Station 051052_WESTSAC)

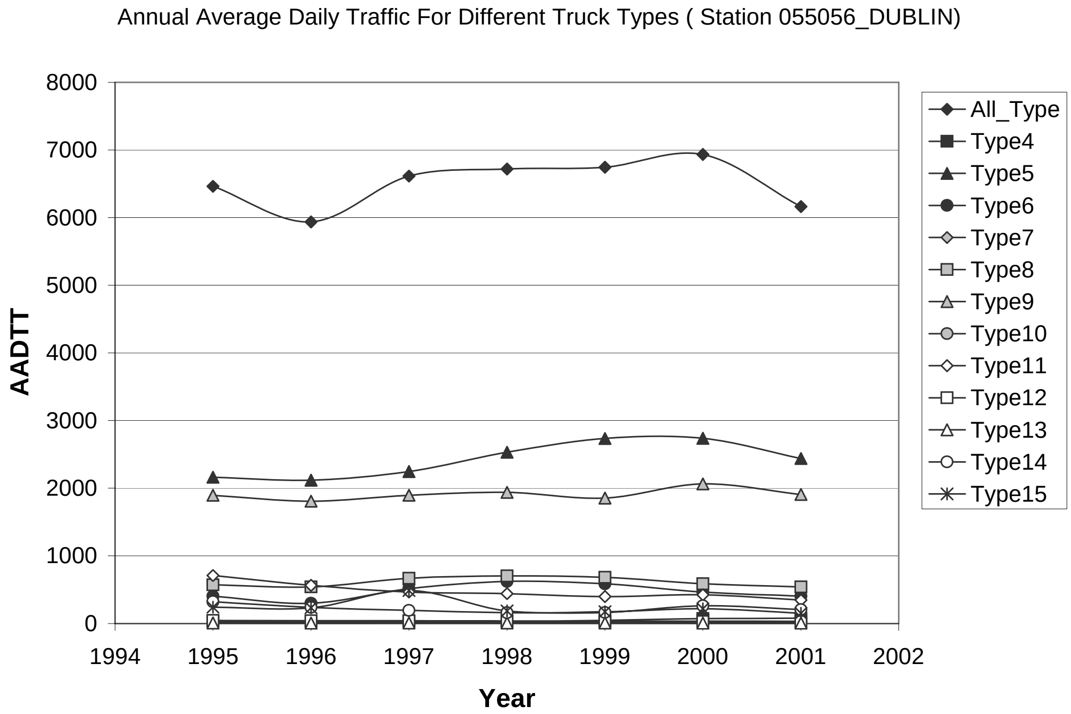


STATIONS 55&56 DUBLIN

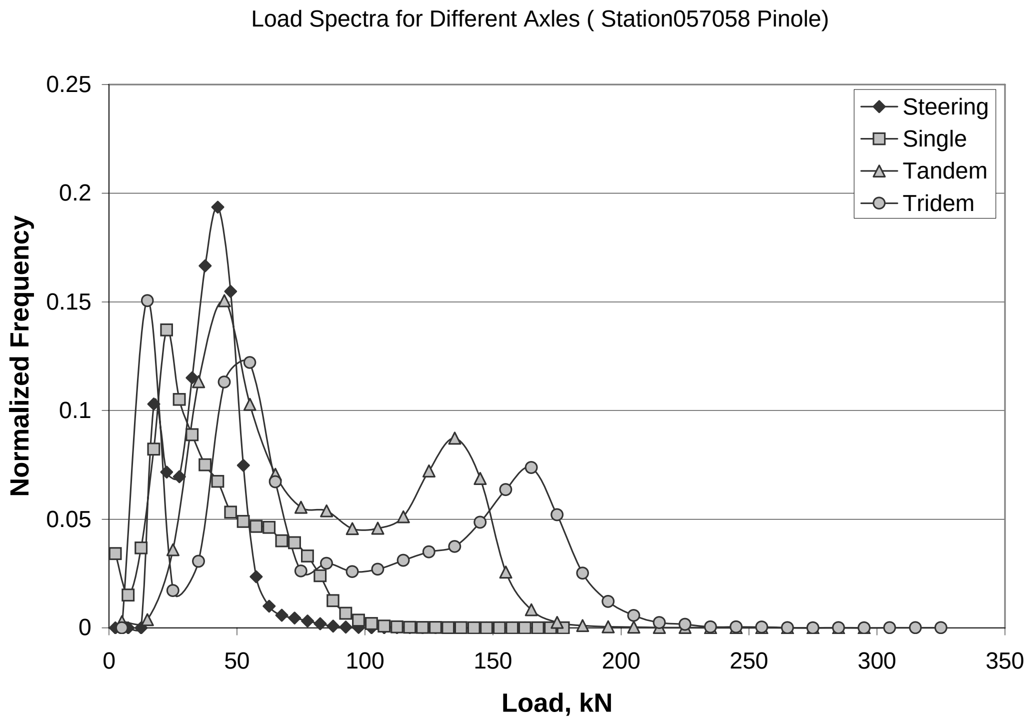


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1995	6462	34	2163	403	40	573	1896	26	709	44	9	323	240
1996	5937	33	2120	298	26	540	1808	29	565	42	6	237	232
1997	6614	36	2246	514	23	668	1895	37	464	40	8	195	489
1998	6719	35	2531	623	23	704	1940	35	441	31	8	161	187
1999	6743	46	2736	588	32	683	1856	32	397	28	9	163	174
2000	6932	72	2739	465	32	588	2065	36	424	28	5	261	217
2001	6162	78	2439	405	29	541	1907	32	345	26	5	205	151


Annual Average Daily Traffic For Different Truck Types (Station 055056_DUBLIN)
AADTT
8000
7000
6000
5000
4000
3000
2000
1000
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

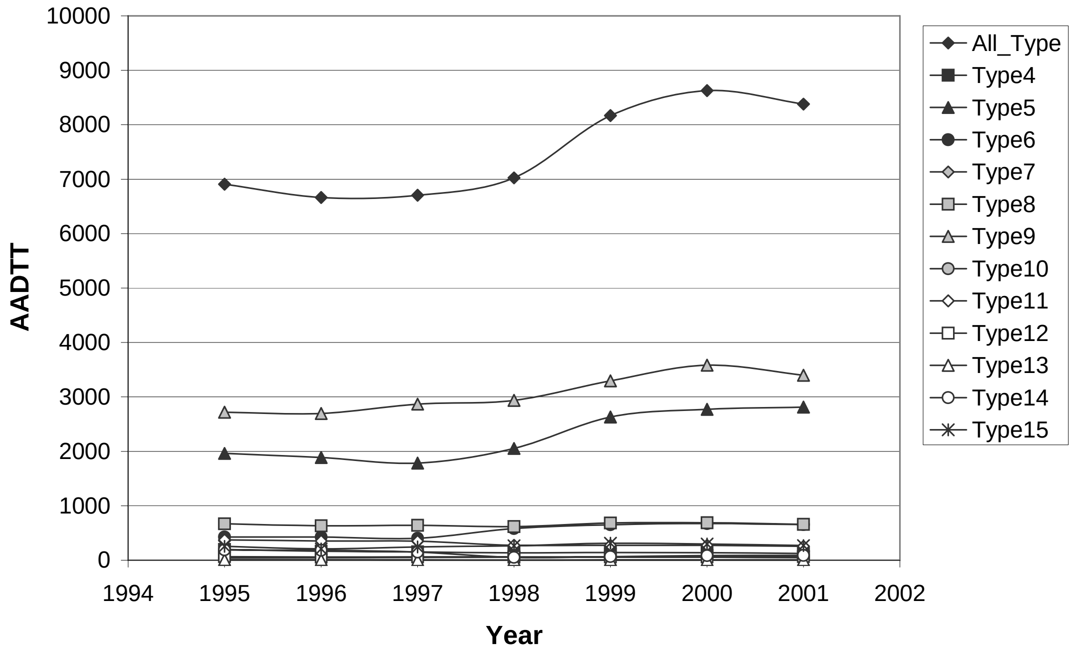
STATIONS 57&58 PINOLE



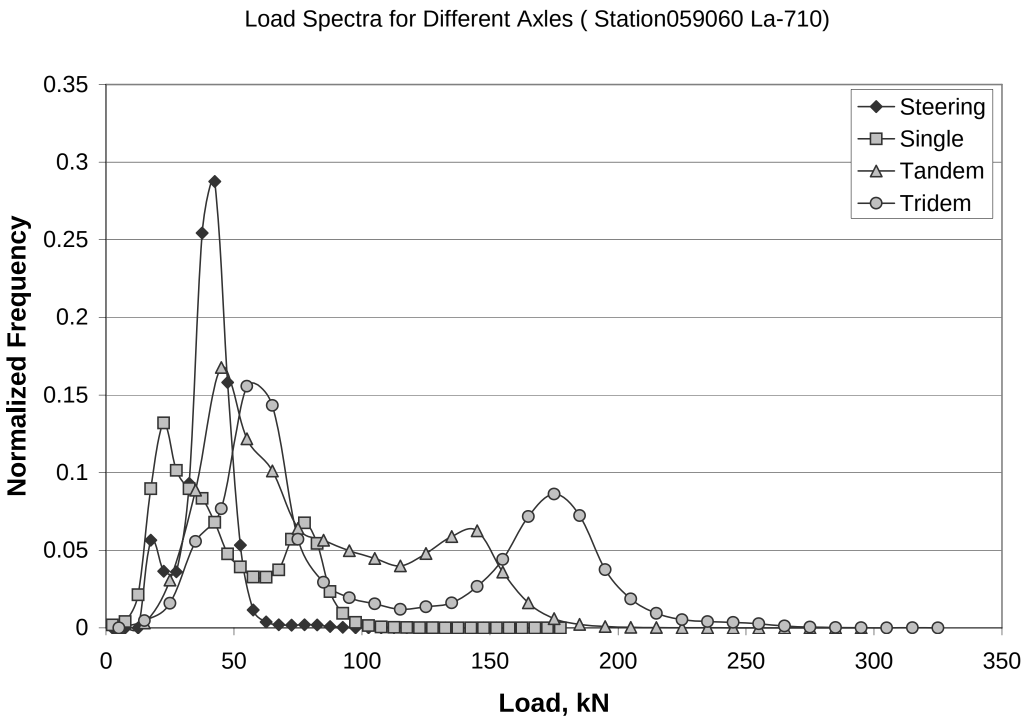
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
1995	6909	196	1962	426	5	669	2718	40	375	67	6	188	256
1996	6663	163	1887	425	4	633	2696	45	354	59	7	183	207
1997	6706	153	1785	402	5	638	2866	50	350	62	5	148	242
1998	7024	135	2053	580	1	616	2937	54	273	58	4	50	264
1999	8170	140	2629	650	2	683	3296	54	273	63	4	66	311
2000	8626	137	2771	672	2	687	3582	53	271	63	4	85	297
2001	8381	124	2813	655	2	659	3397	48	256	65	4	89	269

Annual Average Daily Traffic For Different Truck Types (Station 057058_PINOLE)

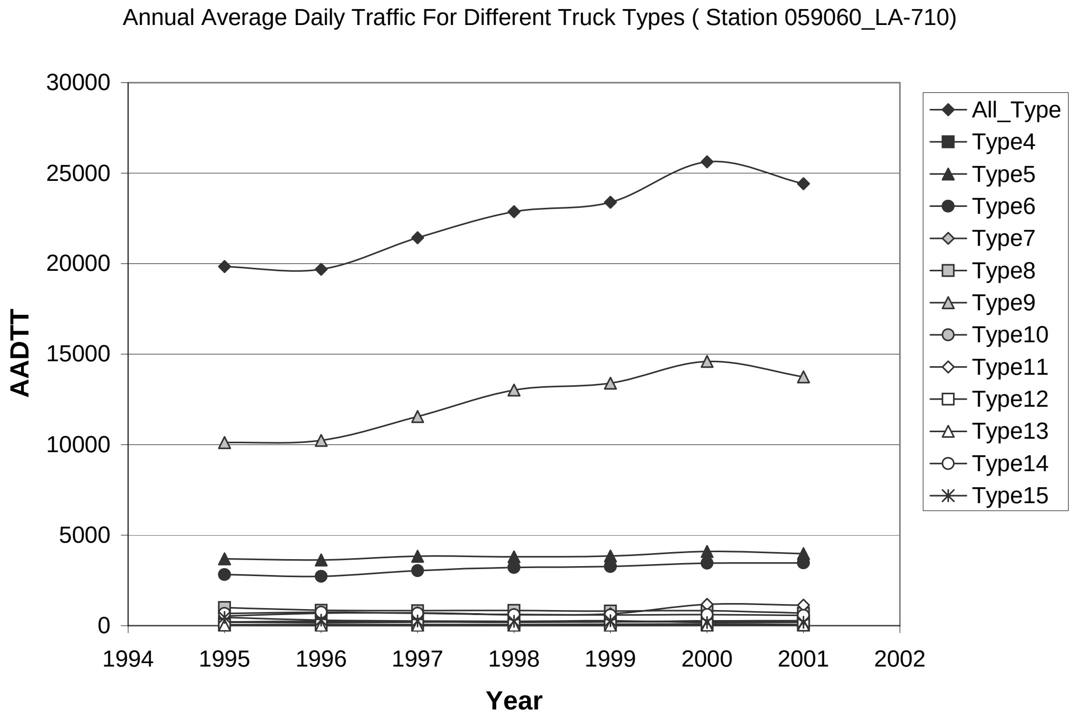


STATIONS 59&60 LA-710



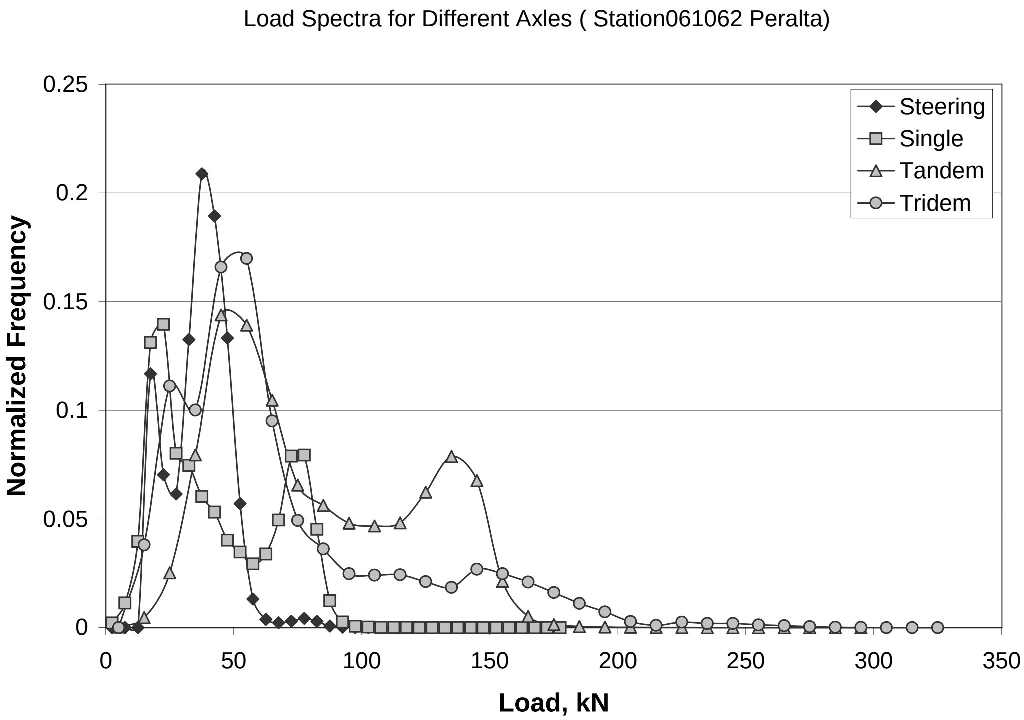
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1995	19841	212	3696	2819	57	1008	10113	201	537	39	23	674	463
1996	19684	237	3628	2727	67	847	10232	167	689	34	15	739	302
1997	21431	215	3832	3038	64	826	11560	191	710	37	16	683	260
1998	22868	190	3800	3220	64	841	13019	230	619	35	16	596	238
1999	23394	223	3843	3272	78	808	13397	211	654	33	15	584	277
2000	25626	267	4104	3458	89	827	14595	258	1182	42	21	613	171
2001	24419	263	3975	3463	63	682	13744	276	1130	39	36	562	186



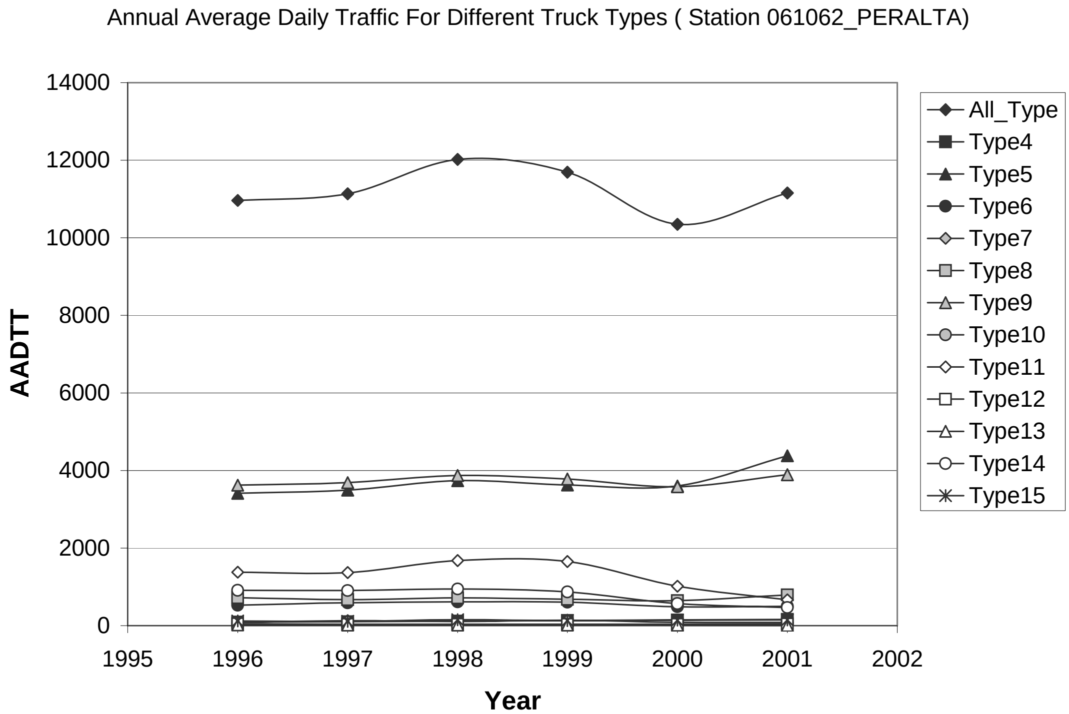
Annual Average Daily Traffic For Different Truck Types (Station 059060_LA-710)
30000
25000
20000
15000
10000
5000
0
AADTT
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 61&62 PERALTA

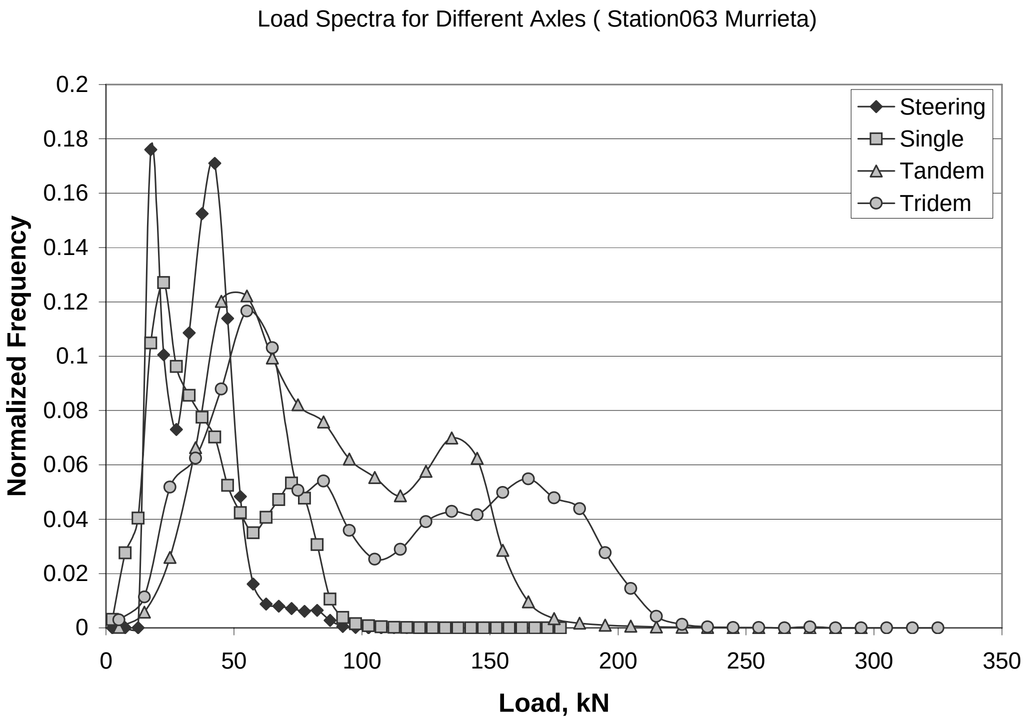


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1996	10962	93	3415	527	87	722	3620	26	1379	46	18	910	120
1997	11137	100	3496	590	129	672	3689	21	1367	37	17	905	114
1998	12019	115	3739	616	108	719	3873	20	1679	38	17	944	152
1999	11692	131	3628	607	141	683	3778	17	1652	37	14	871	133
2000	10348	150	3604	490	86	647	3579	17	1017	38	8	570	141
2001	11157	163	4381	499	81	792	3893	20	665	42	4	468	149

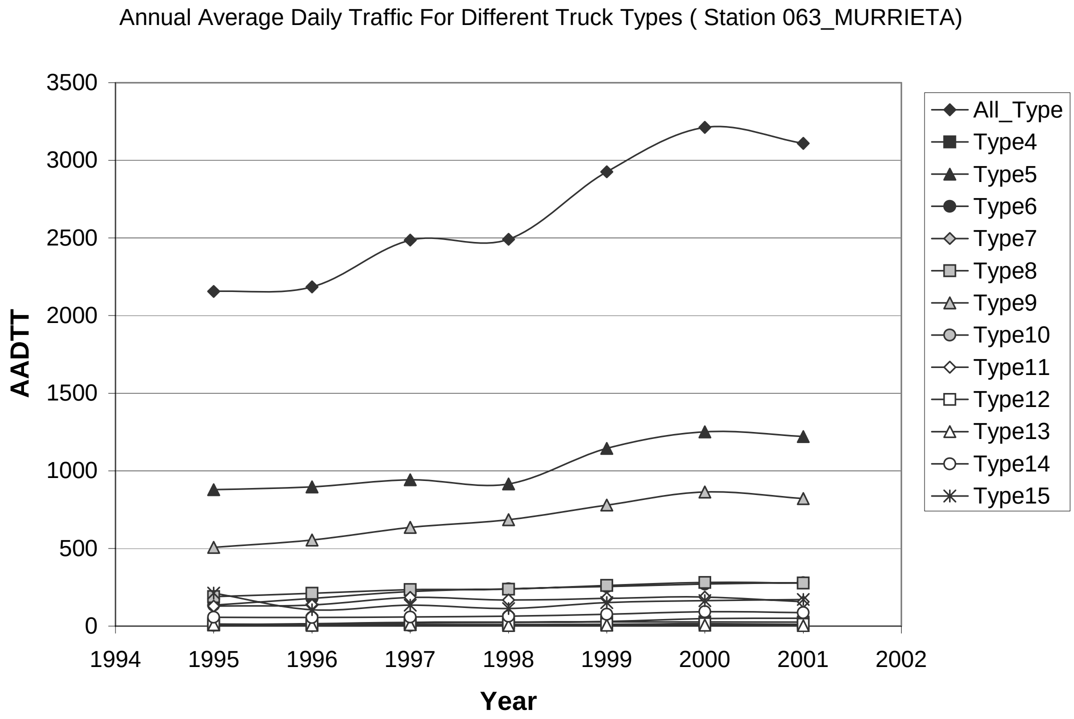

Annual Average Daily Traffic For Different Truck Types (Station 061062_PERALTA)
AADTT
14000
12000
10000
8000
6000
4000
2000
0
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 63 MURRIETA

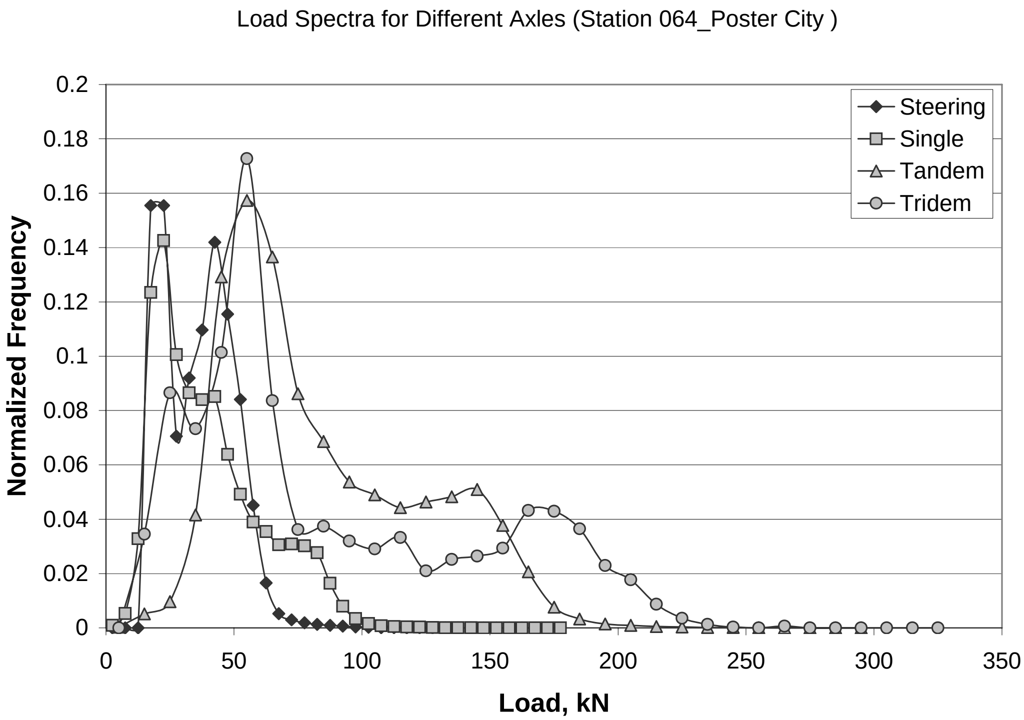


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1995	2156	14	879	135	12	189	507	5	128	8	9	57	212
1996	2185	12	897	178	15	211	555	3	136	13	5	56	105
1997	2486	22	942	222	24	235	636	4	184	12	9	59	135
1998	2492	24	916	240	26	238	686	4	168	10	4	63	113
1999	2927	27	1144	254	31	262	779	5	179	12	6	76	151
2000	3212	27	1252	271	48	281	863	6	187	15	6	93	164
2001	3110	26	1221	280	51	277	822	4	156	11	3	87	172


Annual Average Daily Traffic For Different Truck Types (Station 063_MURRIETA)
AADTT
3500
3000
2500
2000
1500
1000
500
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

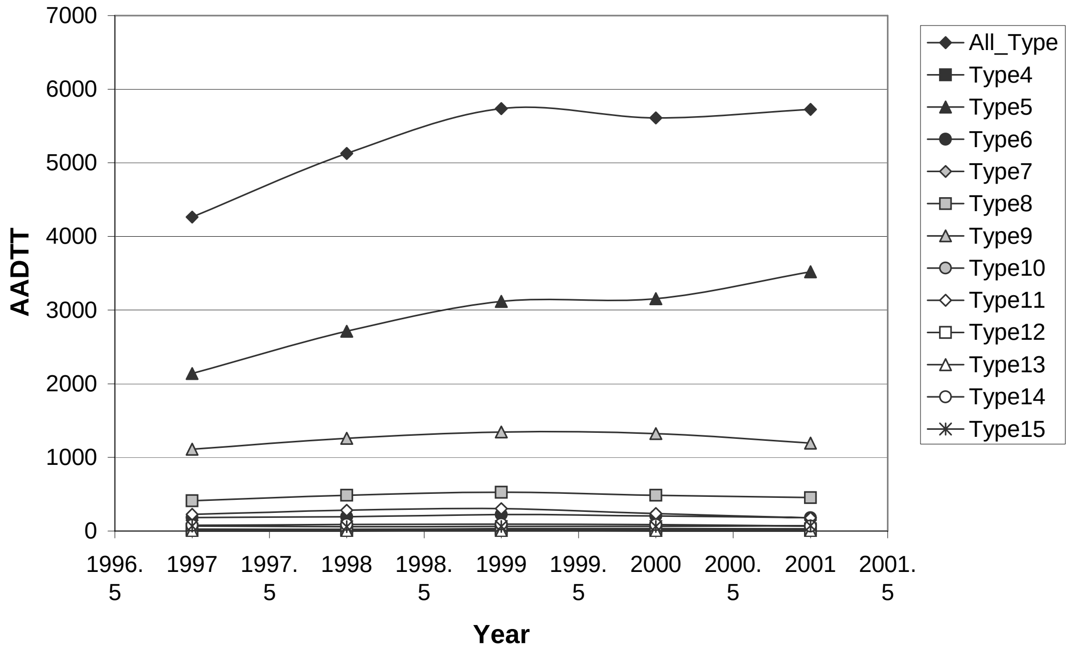
STATION 64 FOSTER CITY



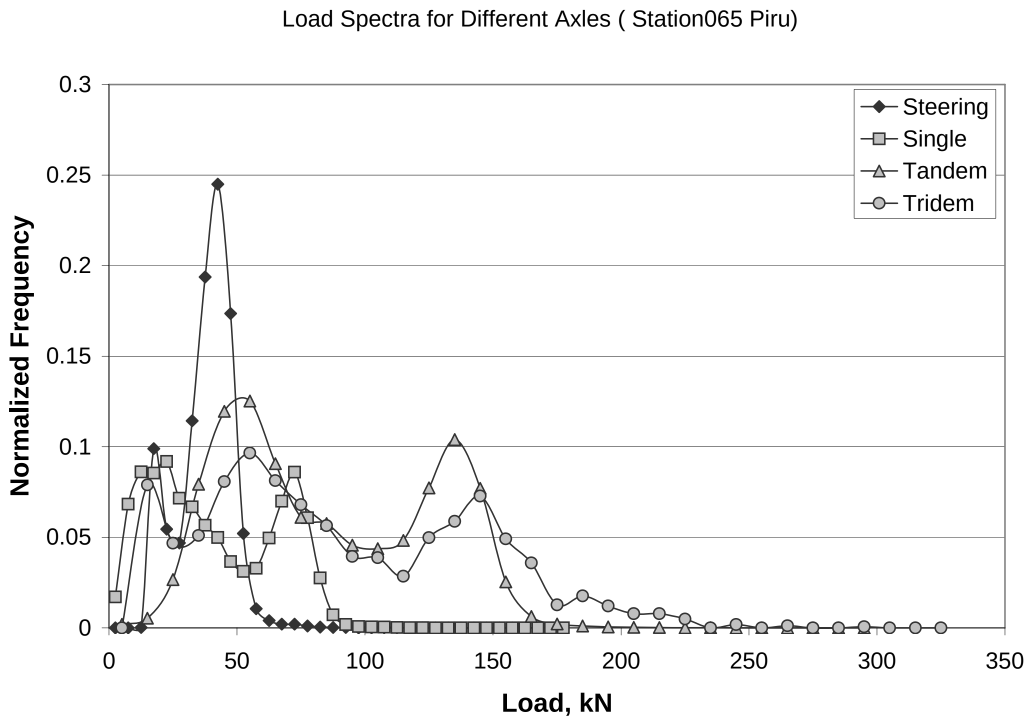
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	4262	27	2139	182	1	410	1110	8	225	13	2	77	68
1998	5127	25	2713	193	2	485	1257	9	281	13	2	88	58
1999	5735	32	3119	224	5	526	1343	11	302	14	3	94	61
2000	5611	33	3156	205	2	486	1322	10	235	12	3	85	61
2001	5725	30	3521	181	1	453	1194	9	177	14	2	68	73

Annual Average Daily Traffic For Different Truck Types (Station 064_POSTER_CITY)

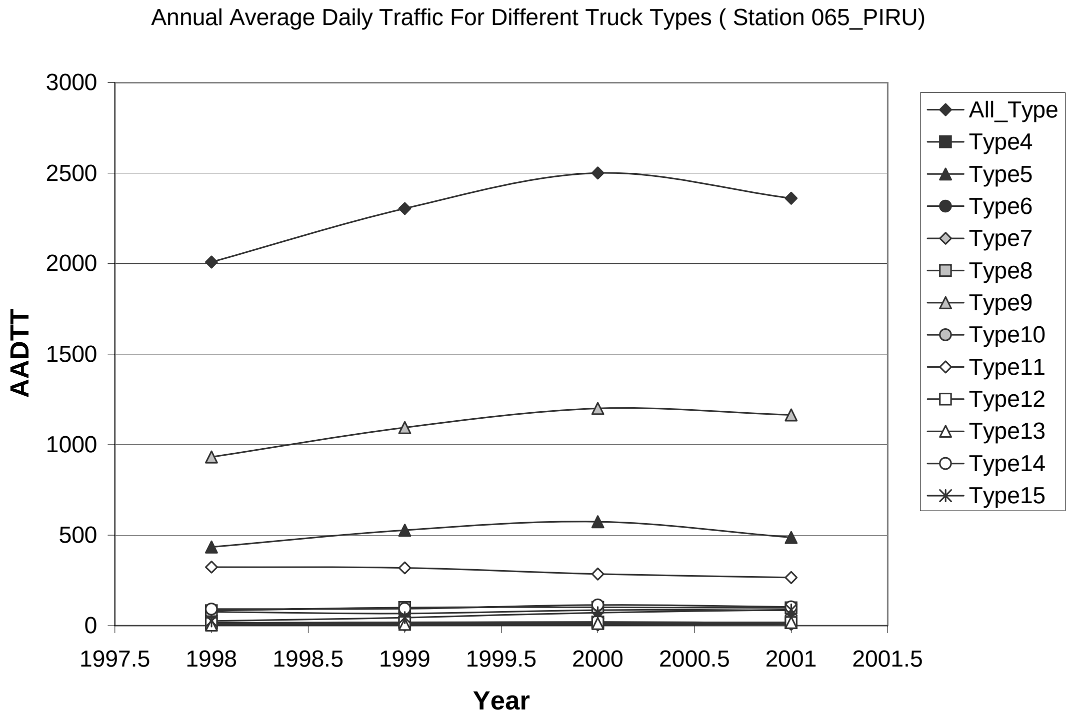


STATION 65 PIRU

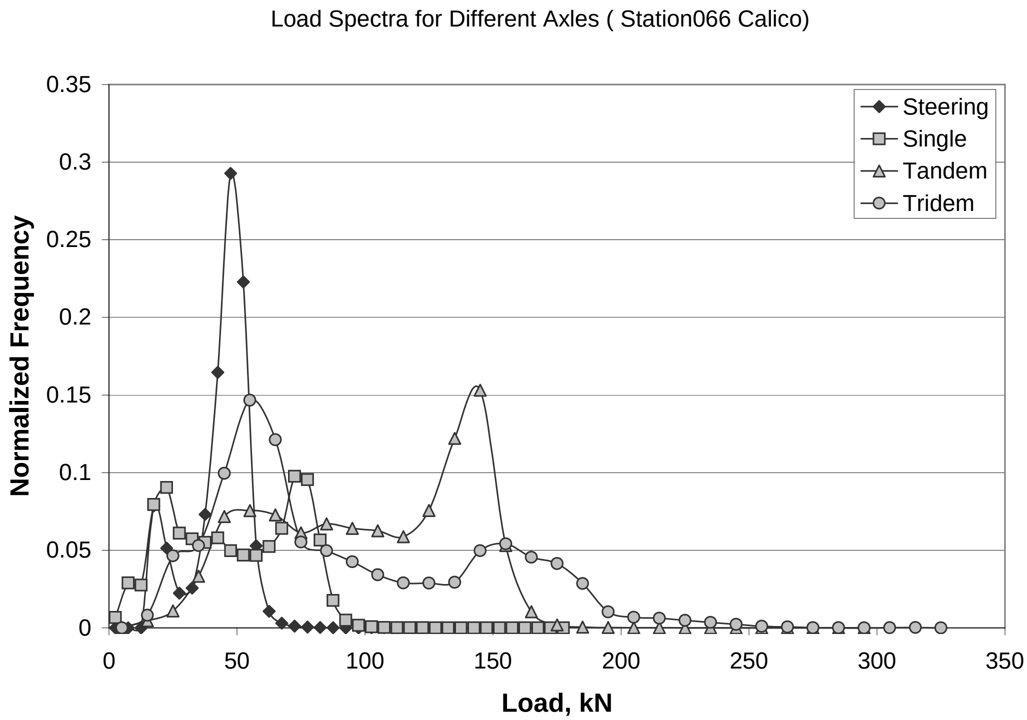


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1998	2009	16	435	76	4	83	932	6	324	12	3	92	26
1999	2304	18	528	68	2	100	1095	9	319	17	8	94	45
2000	2501	20	575	86	4	101	1200	13	286	20	12	114	72
2001	2361	16	487	85	8	98	1164	13	266	16	17	104	87


Annual Average Daily Traffic For Different Truck Types (Station 065_PIRU)
AADTT
Year
3000
2500
2000
1500
1000
500
0
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

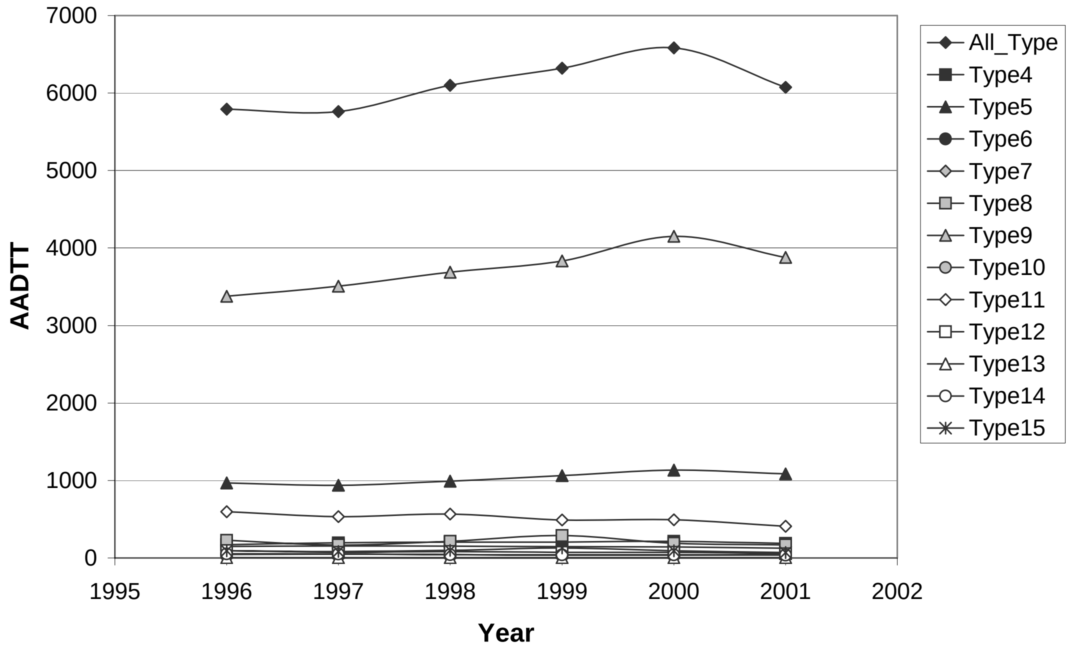
STATION 66 CALICO



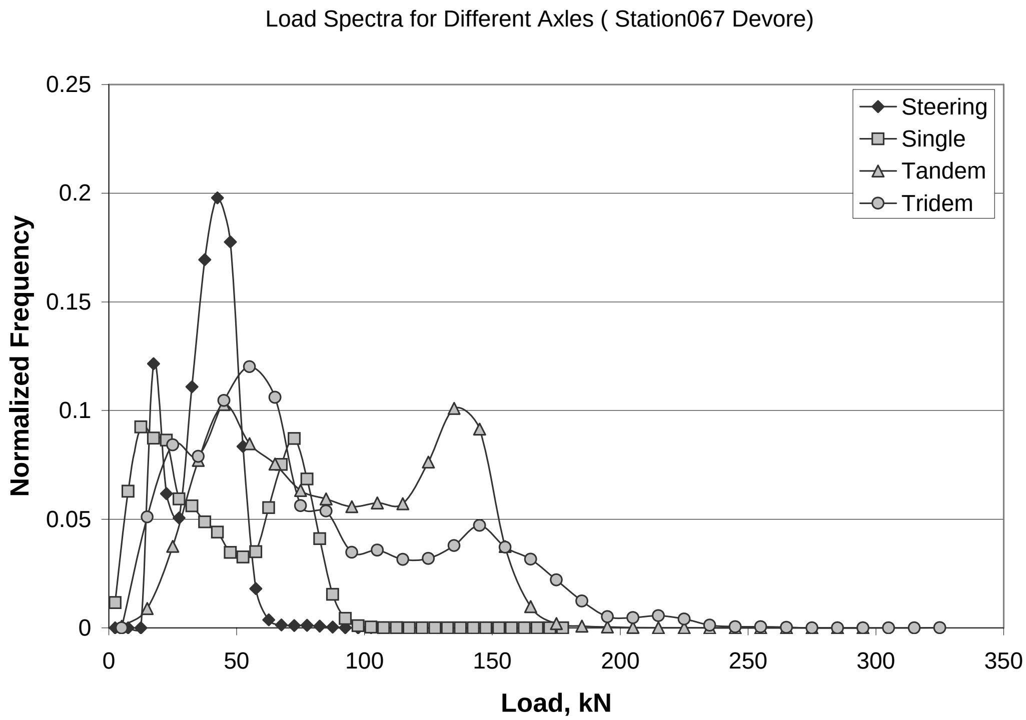
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1996	5792	174	968	149	2	230	3378	47	598	97	4	54	93
1997	5762	195	938	155	1	167	3508	51	533	74	4	52	83
1998	6100	207	992	152	1	216	3689	44	567	83	5	44	100
1999	6321	207	1064	147	1	289	3832	41	490	75	5	40	129
2000	6584	216	1134	143	1	190	4152	41	493	73	5	41	95
2001	6073	188	1086	128	1	168	3879	43	410	56	6	38	70

Annual Average Daily Traffic For Different Truck Types (Station 066_CALICO)



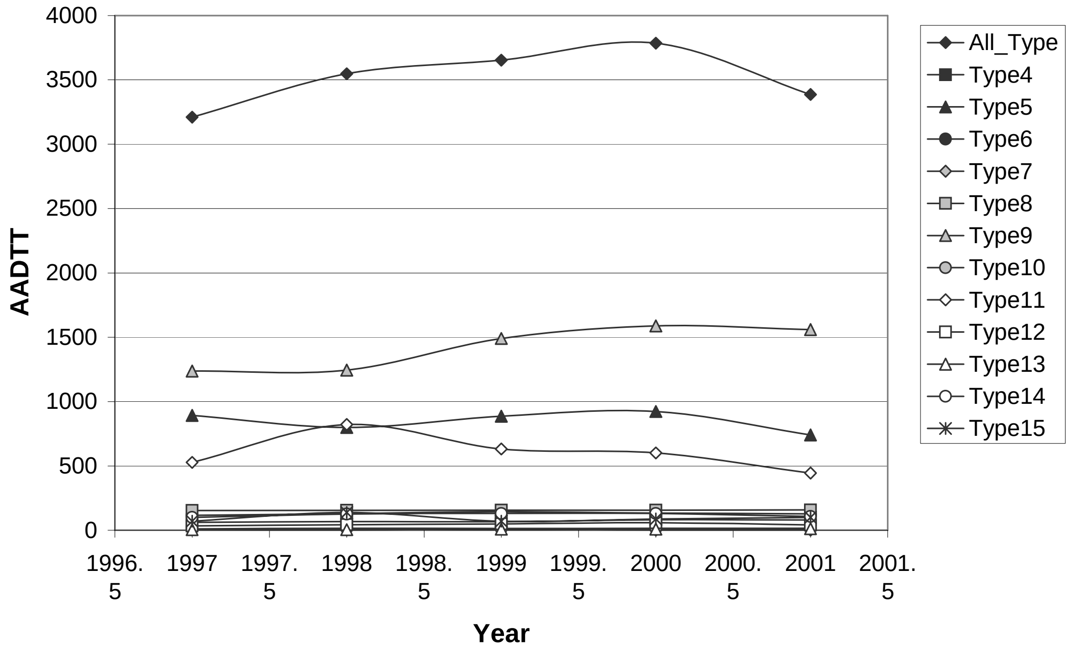
STATION 67 DEVORE



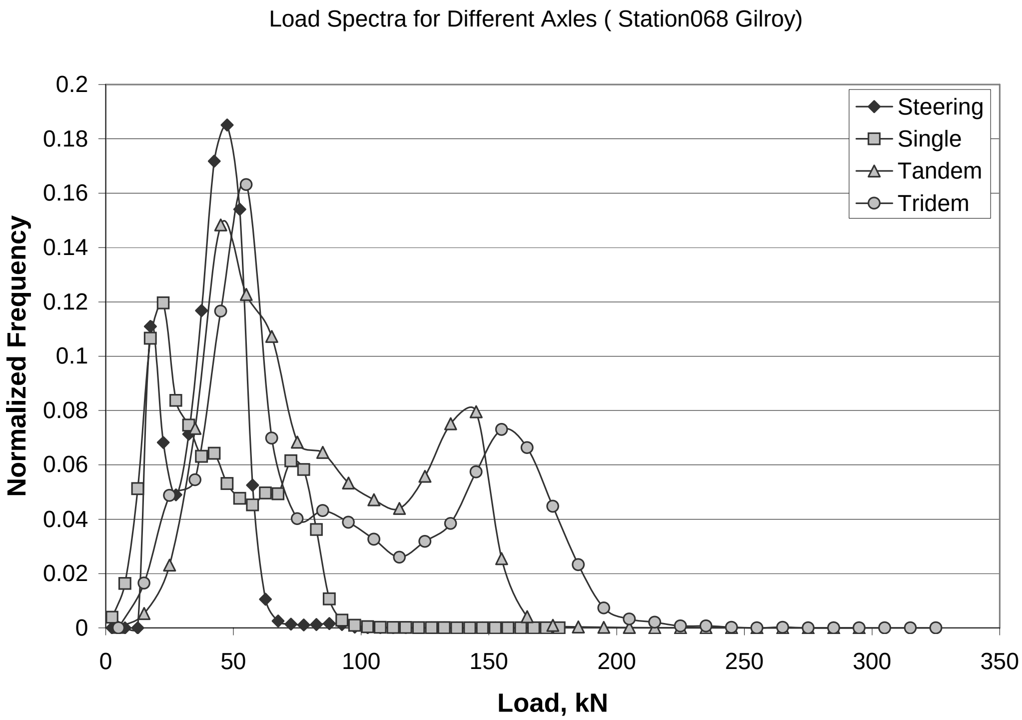
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	3210	61	892	117	3	153	1238	11	527	33	4	99	71
1998	3547	68	799	129	2	155	1245	16	822	43	5	125	138
1999	3654	66	886	144	10	156	1490	14	631	49	9	130	70
2000	3785	81	923	133	2	156	1589	16	601	59	9	130	87
2001	3387	79	741	128	2	158	1559	15	444	41	13	107	100

Annual Average Daily Traffic For Different Truck Types (Station 067_DEVORE)

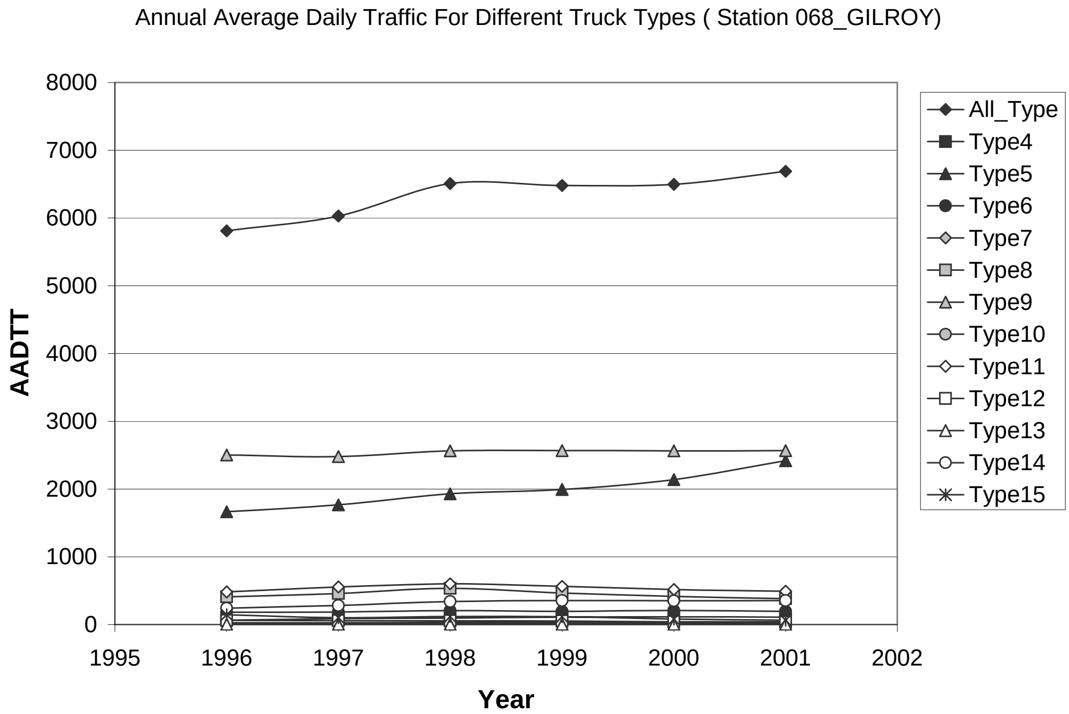


STATION 68 GILROY

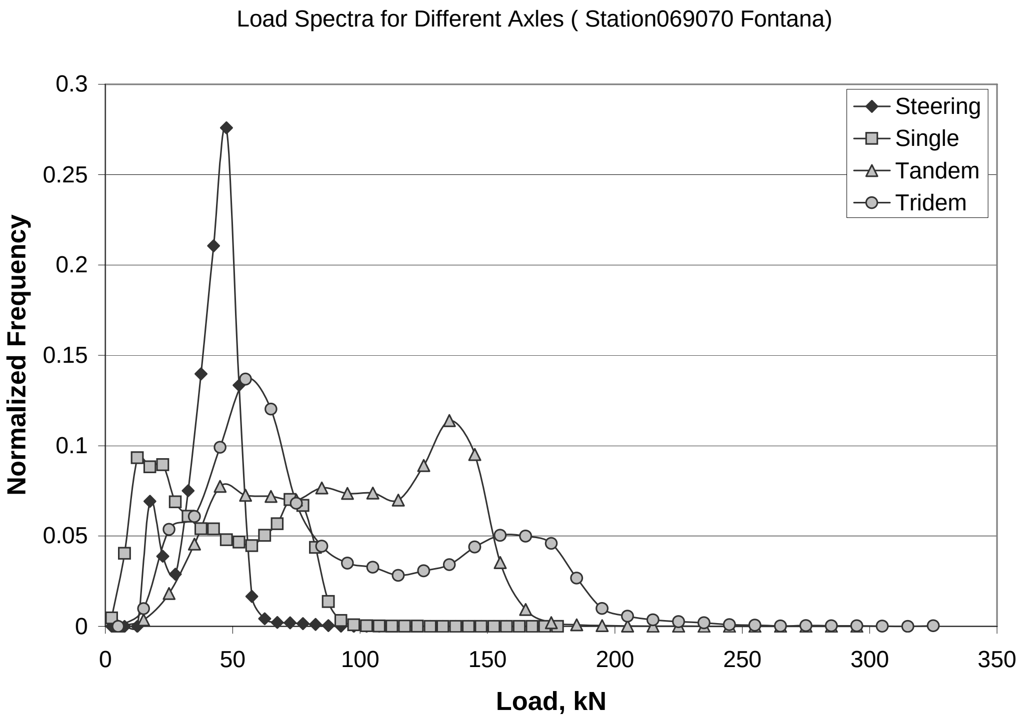


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1996	5812	65	1667	182	26	410	2504	24	482	62	2	242	146
1997	6029	88	1767	187	19	460	2480	27	556	59	3	281	102
1998	6509	97	1930	206	23	535	2564	34	602	54	4	341	120
1999	6479	111	1995	194	18	465	2568	40	563	53	4	355	115
2000	6496	112	2139	210	19	417	2564	40	518	42	3	351	80
2001	6690	111	2419	196	22	384	2567	40	491	39	3	355	63


Annual Average Daily Traffic For Different Truck Types (Station 068_GILROY)
AADTT
8000
7000
6000
5000
4000
3000
2000
1000
0
1995
1996
1997
1998
1999
2000
2001
2002
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

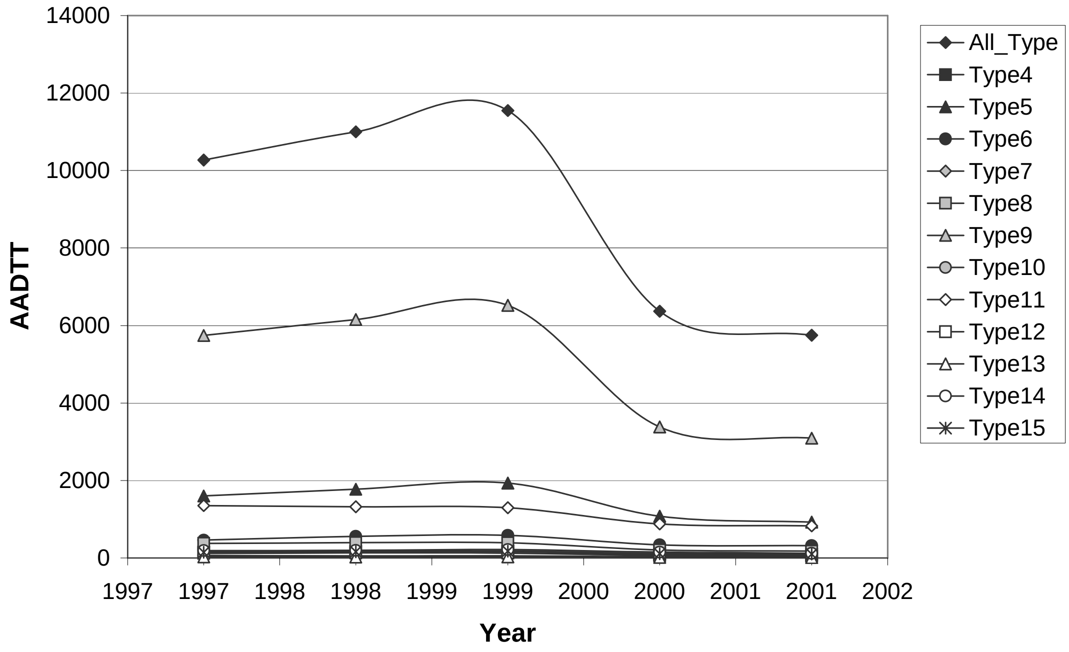
STATION 69&70 FONTANA



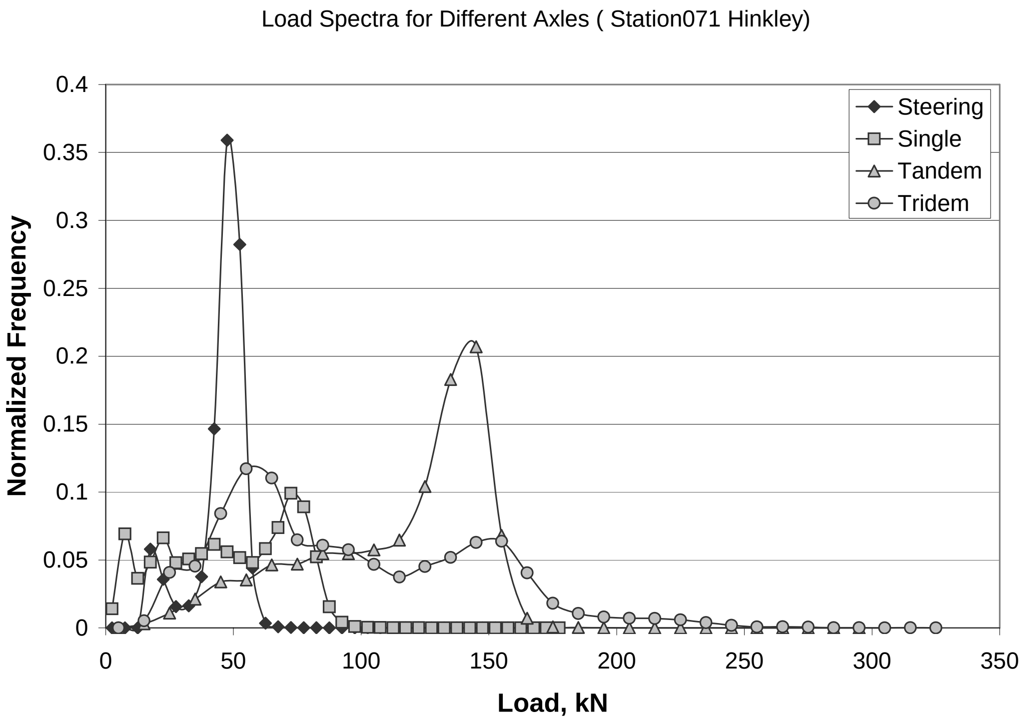
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	10273	151	1603	462	26	374	5744	66	1354	120	31	191	150
1998	11000	167	1777	561	43	397	6158	58	1321	134	24	199	163
1999	11548	166	1933	587	47	391	6522	55	1298	125	31	219	176
2000	6367	87	1076	340	26	207	3382	28	878	62	16	153	113
2001	5747	76	928	320	12	180	3091	26	830	49	9	122	103

Annual Average Daily Traffic For Different Truck Types (Station 069070_FONTANA)

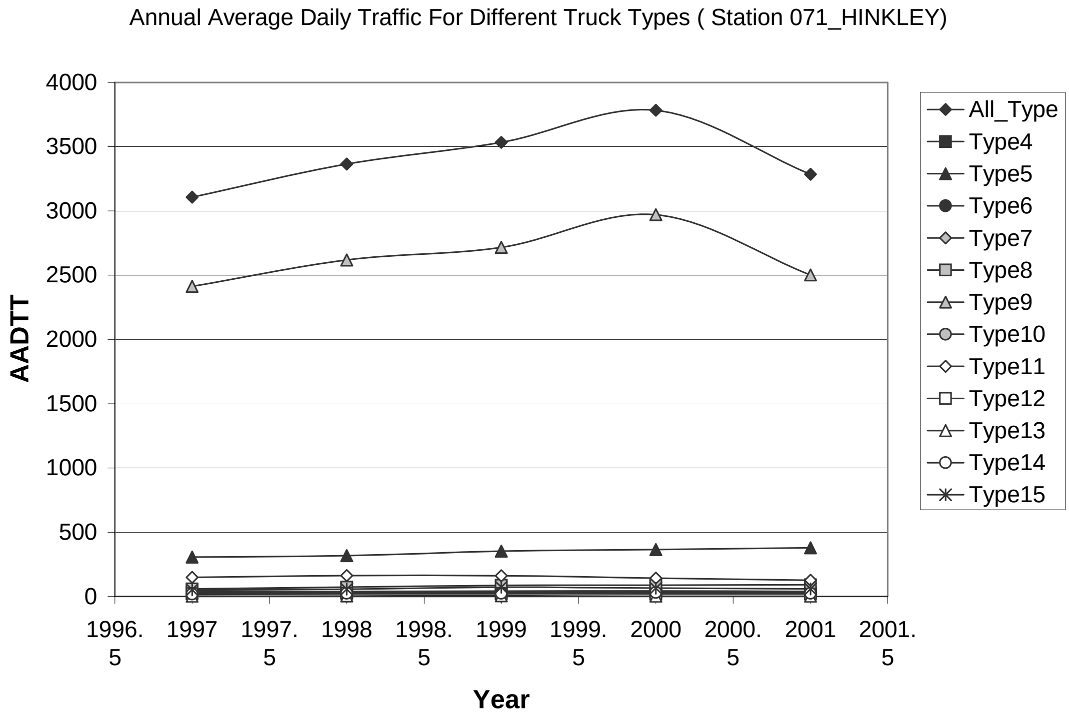


STATION 71 HINKLEY



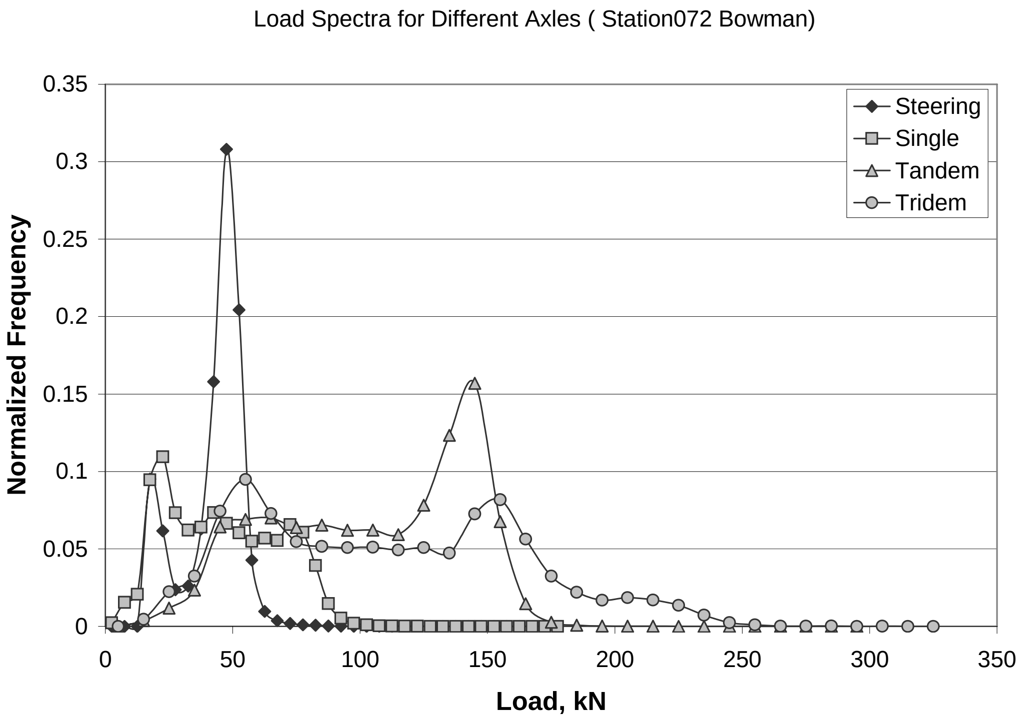
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	3108	31	306	41	0	59	2413	16	148	22	2	18	52
1998	3365	31	317	39	0	72	2618	19	162	24	3	24	56
1999	3534	33	352	42	0	86	2716	22	161	22	4	25	72
2000	3784	35	365	43	0	87	2972	21	143	19	2	30	65
2001	3286	28	378	39	0	91	2502	22	125	19	1	24	59



Annual Average Daily Traffic For Different Truck Types (Station 071_HINKLEY)
AADTT
4000
3500
3000
2500
2000
1500
1000
500
0
1996.5
1997
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

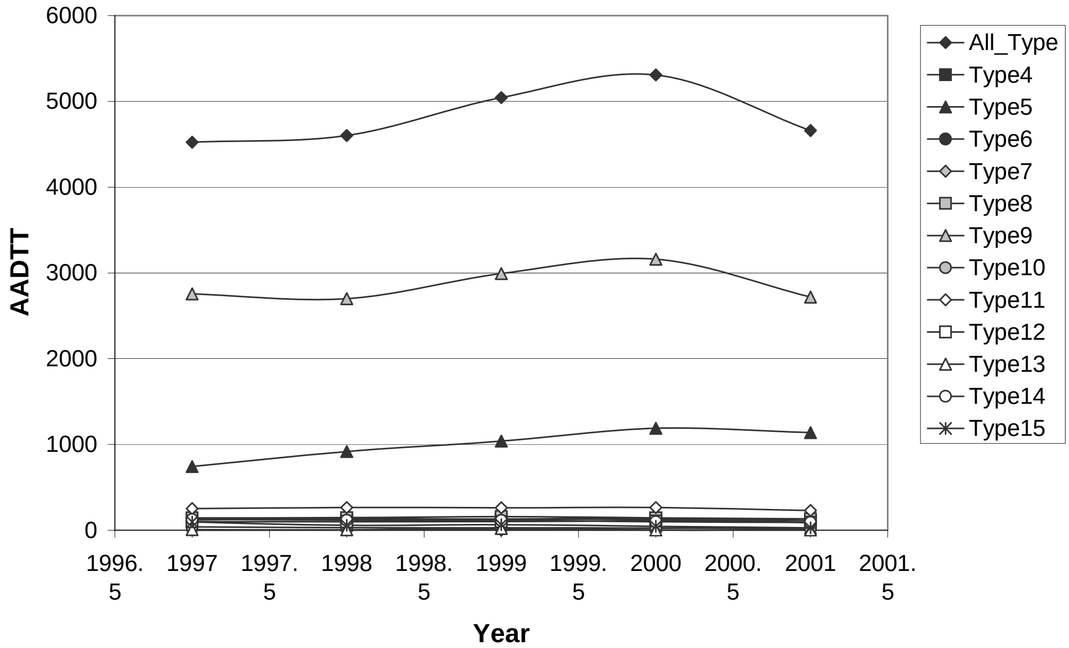
STATION 72 BOWMAN



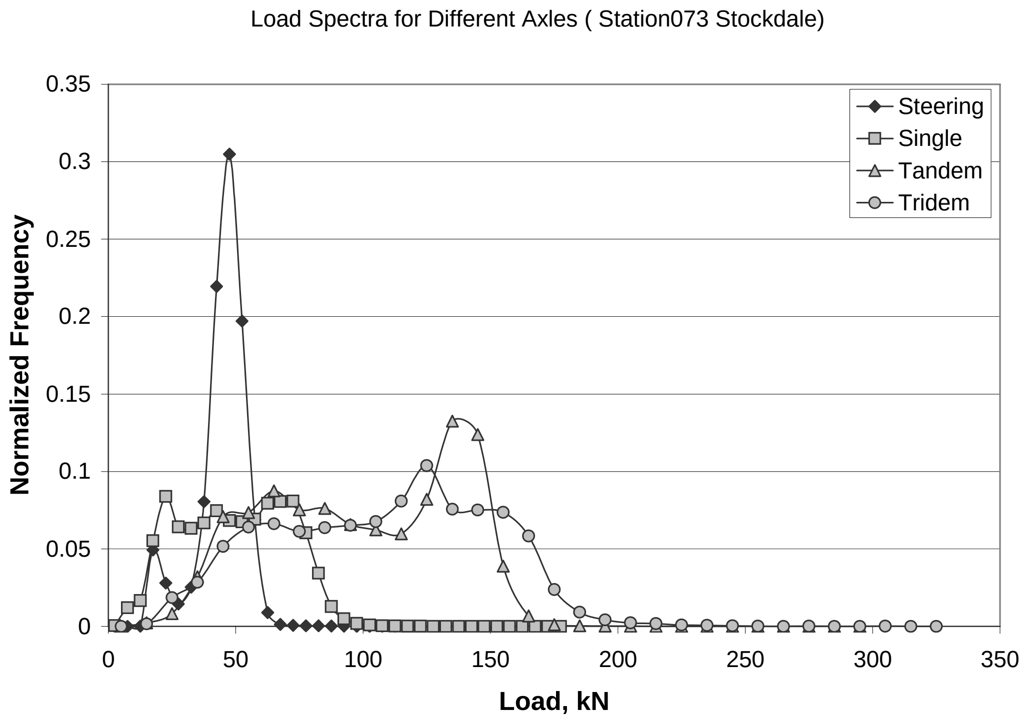
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	4523	119	742	139	1	144	2755	40	254	98	7	126	97
1998	4602	136	918	126	2	147	2700	30	265	98	5	117	58
1999	5043	130	1039	129	3	158	2992	28	262	102	21	115	64
2000	5308	140	1189	124	2	146	3159	26	265	109	3	100	45
2001	4659	112	1139	91	2	133	2718	19	231	91	2	93	28

Annual Average Daily Traffic For Different Truck Types (Station 072_BOWMAN)



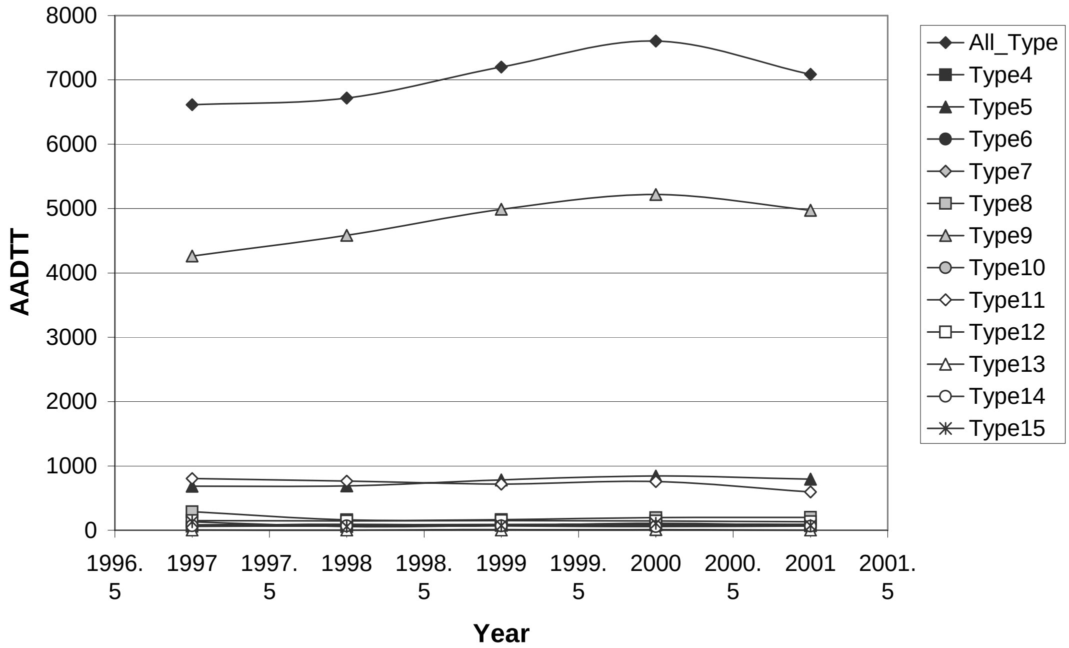
STATION 73 STOCKDALE



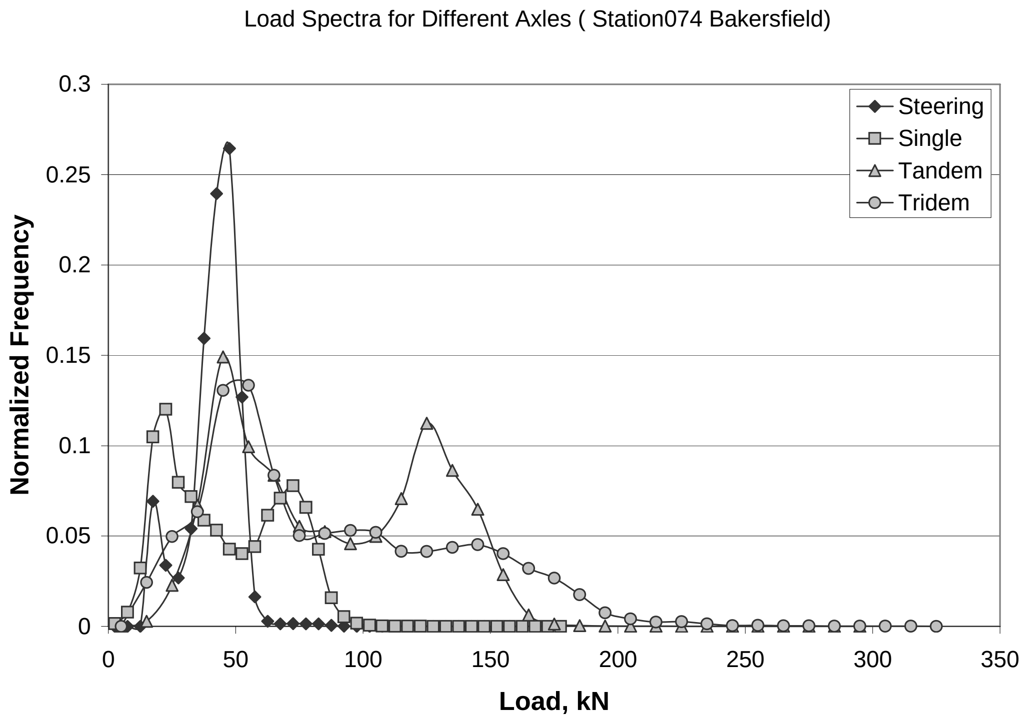
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	6614	60	684	83	2	288	4263	80	803	149	4	69	131
1998	6719	70	689	85	1	163	4585	92	763	143	4	68	58
1999	7200	79	783	88	8	165	4988	81	717	149	4	66	73
2000	7604	83	844	91	4	196	5218	92	758	145	8	58	108
2001	7085	71	794	87	1	199	4975	91	594	131	4	63	75

Annual Average Daily Traffic For Different Truck Types (Station 073_STOCKDALE)

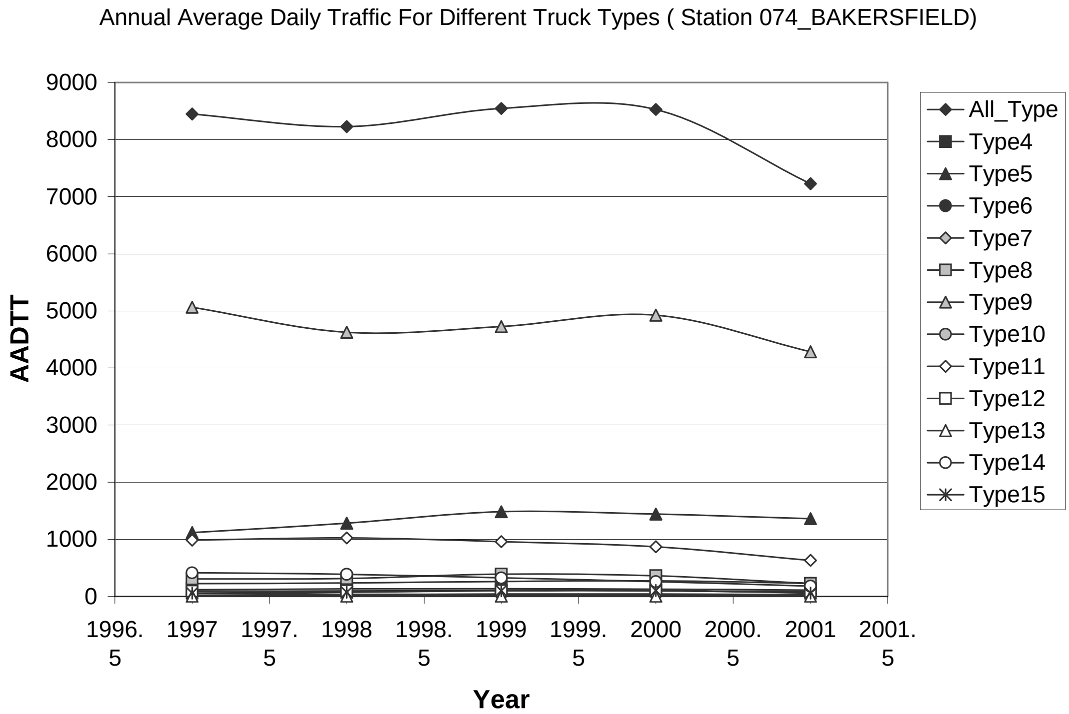


STATION 74 BAKERSFIELD



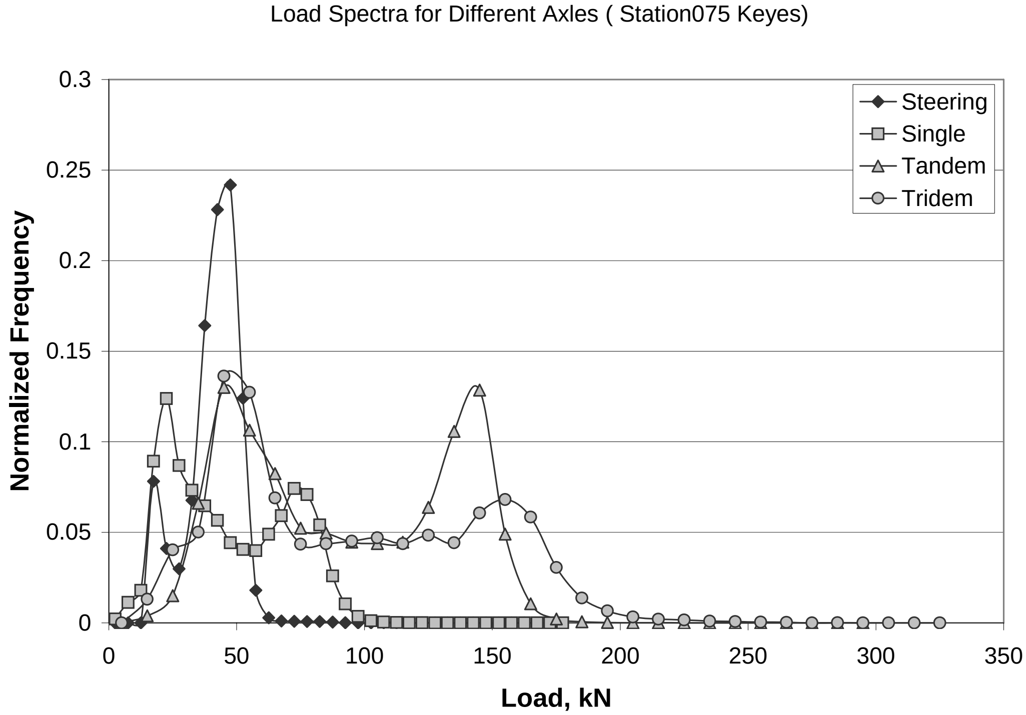
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	8449	118	1116	223	16	307	5063	51	986	90	4	415	60
1998	8229	131	1282	236	20	315	4626	39	1023	96	4	385	72
1999	8546	133	1485	262	21	390	4725	43	960	99	3	324	100
2000	8529	129	1441	271	27	362	4927	40	869	98	4	260	103
2001	7226	111	1363	228	30	227	4285	31	630	82	3	178	57



Annual Average Daily Traffic For Different Truck Types (Station 074_BAKERSFIELD)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
AADTT
1996.5
1997
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

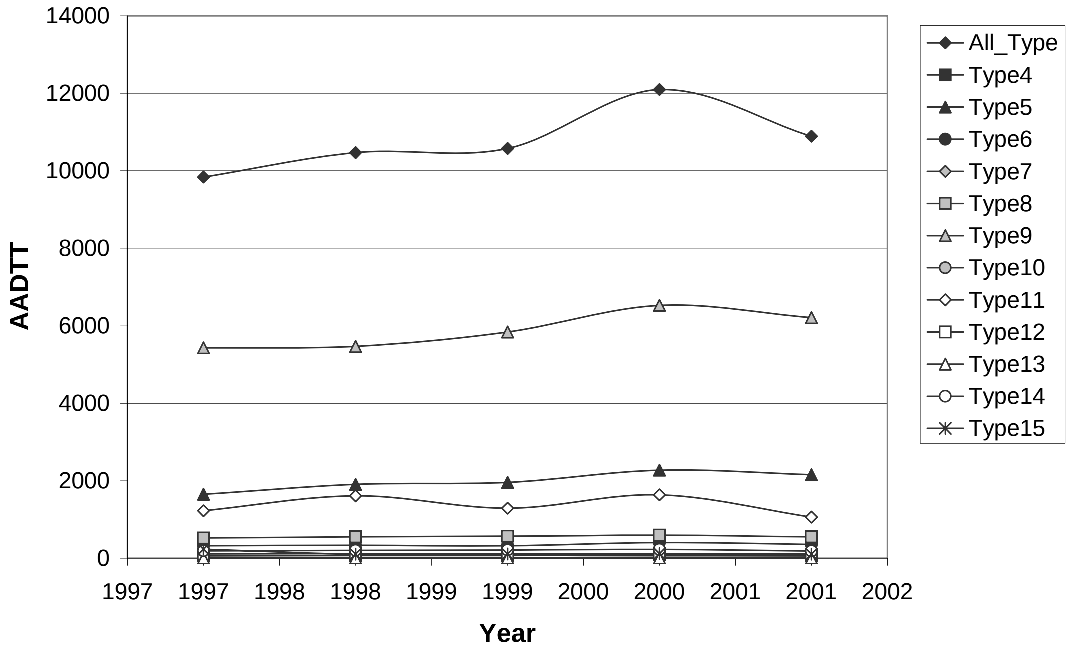
STATION 75 KEYES



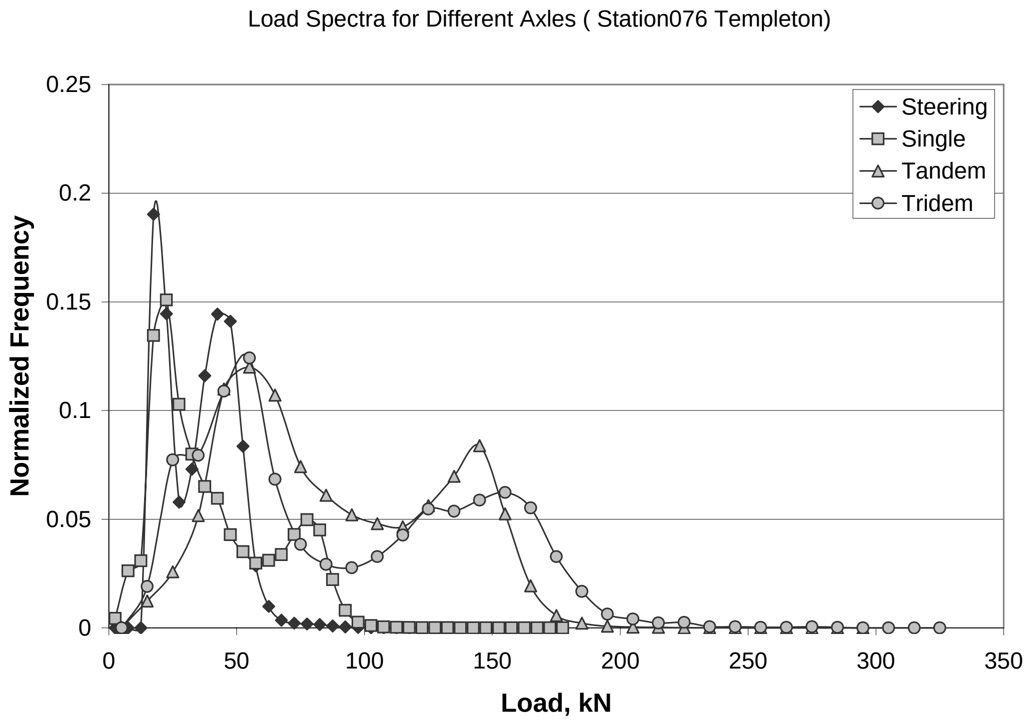
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1997	9839	64	1654	328	7	523	5432	65	1224	113	3	193	233
1998	10471	69	1906	338	10	556	5469	70	1614	122	5	204	109
1999	10578	73	1961	325	11	568	5838	69	1290	117	4	213	110
2000	12097	89	2272	407	26	595	6526	75	1636	118	4	227	120
2001	10890	69	2156	356	24	555	6212	65	1062	97	2	188	105

Annual Average Daily Traffic For Different Truck Types (Station 075_KEYES)

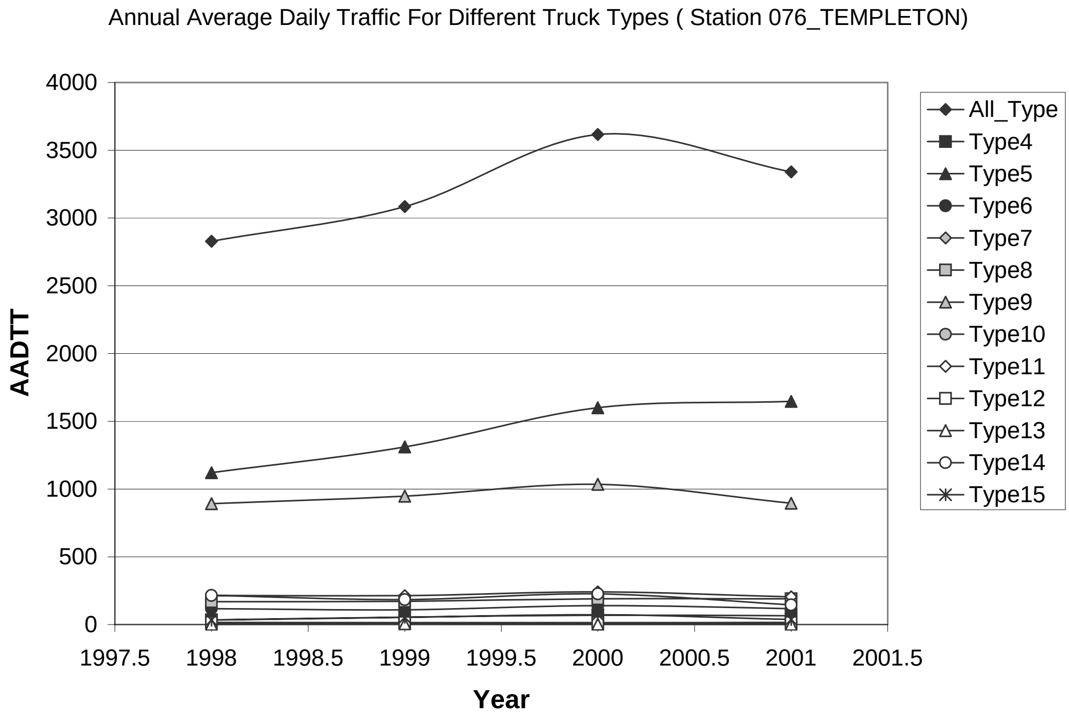


STATION 76 TEMPLETON



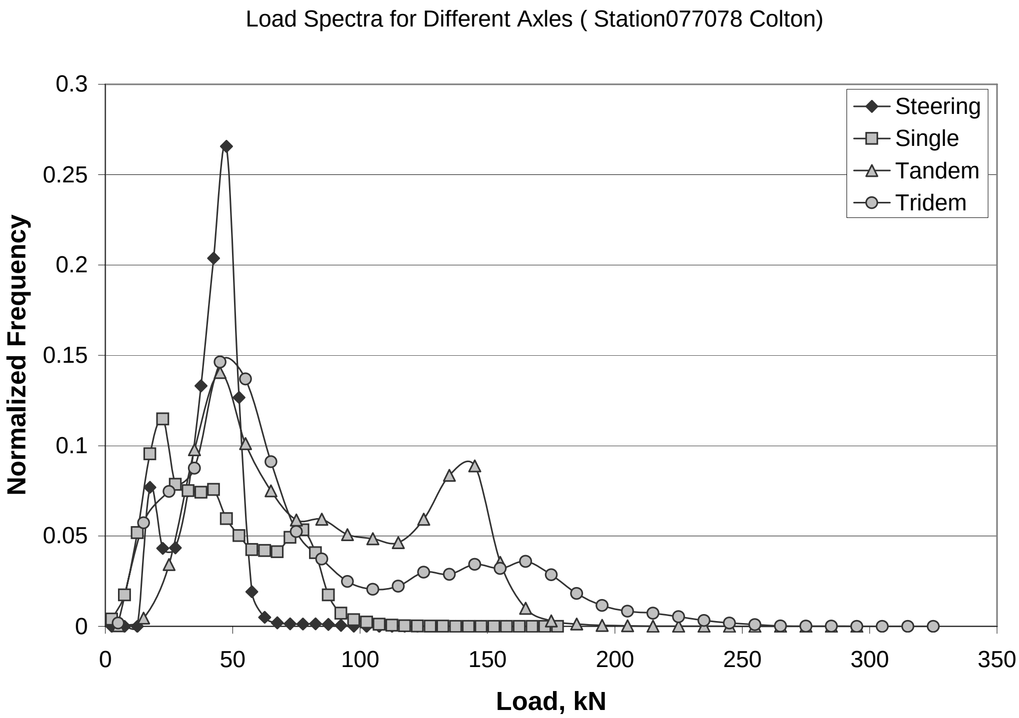
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
1998	2828	35	1121	118	9	168	892	6	215	16	2	215	33
1999	3085	55	1311	109	8	172	948	10	213	14	6	184	54
2000	3616	69	1601	140	11	191	1035	11	241	14	3	227	72
2001	3340	65	1647	118	14	191	895	7	205	14	2	146	38



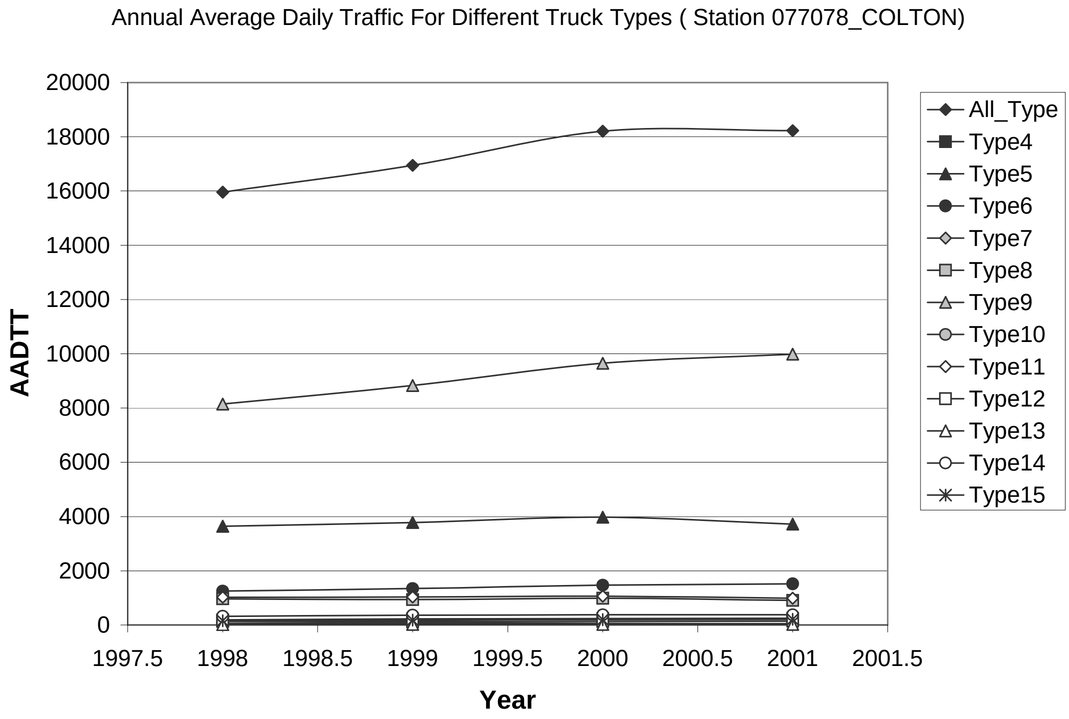
Annual Average Daily Traffic For Different Truck Types (Station 076_TEMPLETON)
AADTT
4000
3500
3000
2500
2000
1500
1000
500
0
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 77&78 COLTON



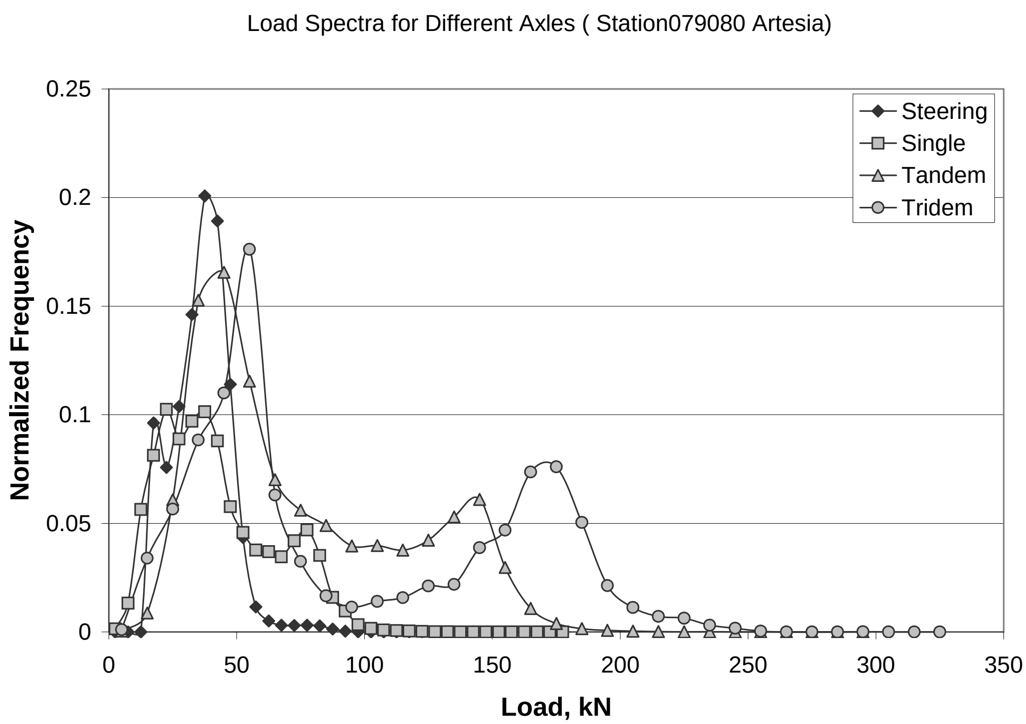
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1998	15961	189	3644	1250	53	967	8146	58	1024	132	17	322	159
1999	16946	222	3778	1348	48	941	8828	64	1035	124	20	360	179
2000	18208	239	3972	1465	51	987	9652	60	1062	130	20	375	194
2001	18225	250	3724	1520	44	909	9986	54	985	144	22	380	209



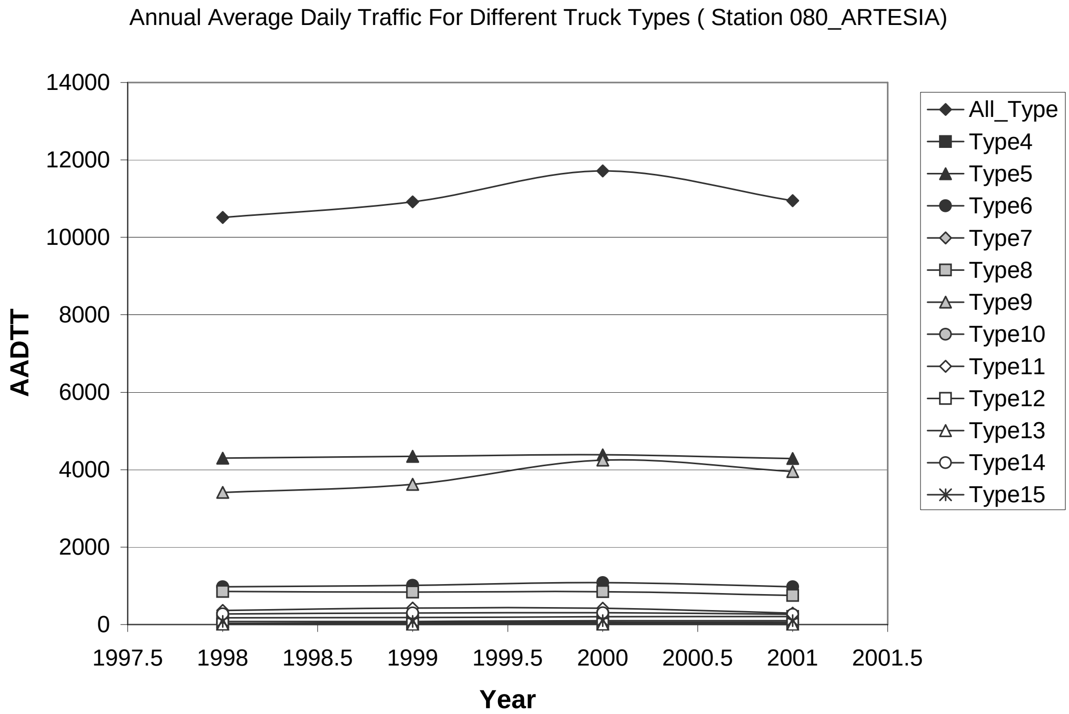
Annual Average Daily Traffic For Different Truck Types (Station 077078_COLTON)
AADTT
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 79&80 ARTESIA

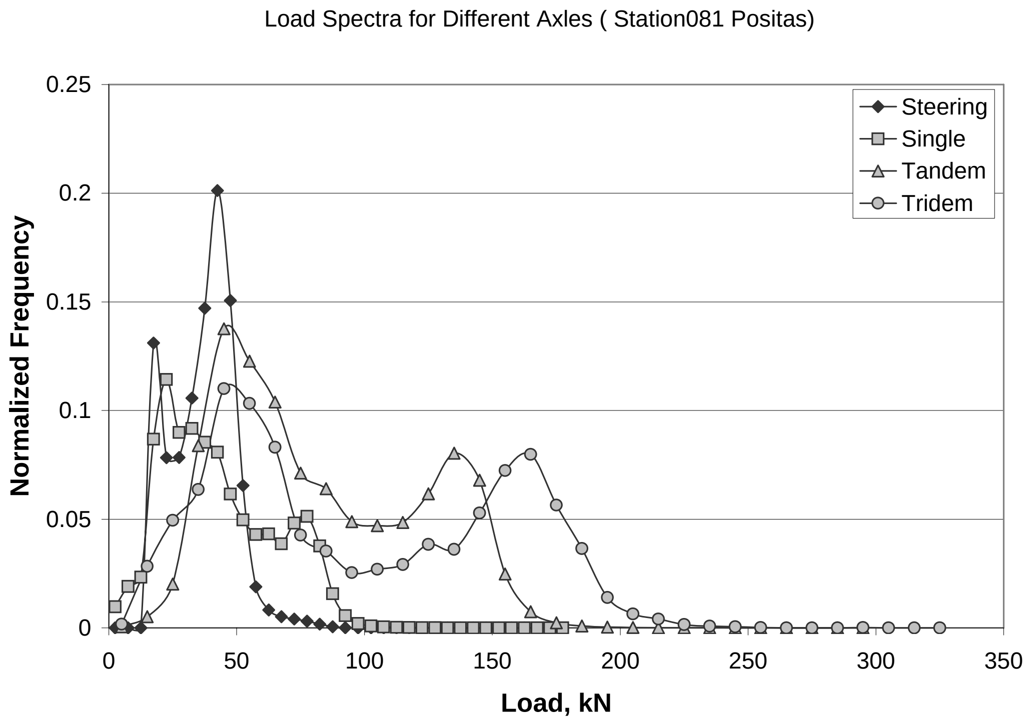


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1998	10514	173	4298	975	28	853	3416	30	368	11	8	277	79
1999	10915	185	4346	1014	53	839	3620	36	425	9	6	299	82
2000	11717	201	4385	1083	62	849	4247	46	424	9	8	303	100
2001	10949	209	4286	976	48	755	3951	55	296	5	5	262	102

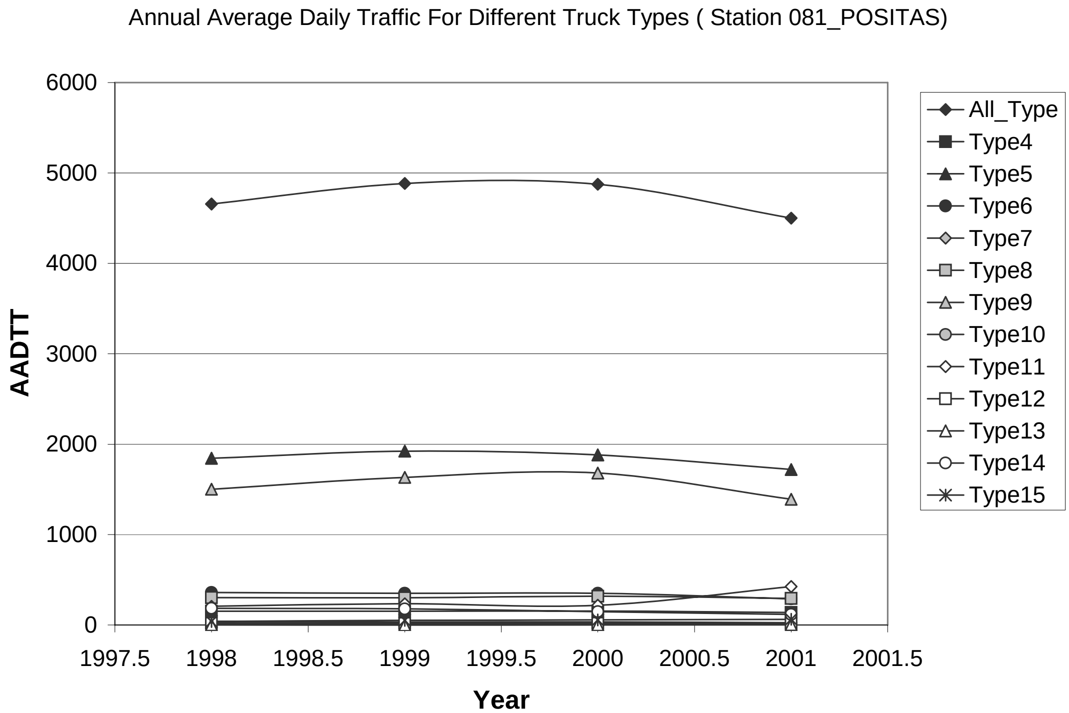

Annual Average Daily Traffic For Different Truck Types (Station 080_ARTESIA)
AADTT
14000
12000
10000
8000
6000
4000
2000
0
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 81 POSITAS

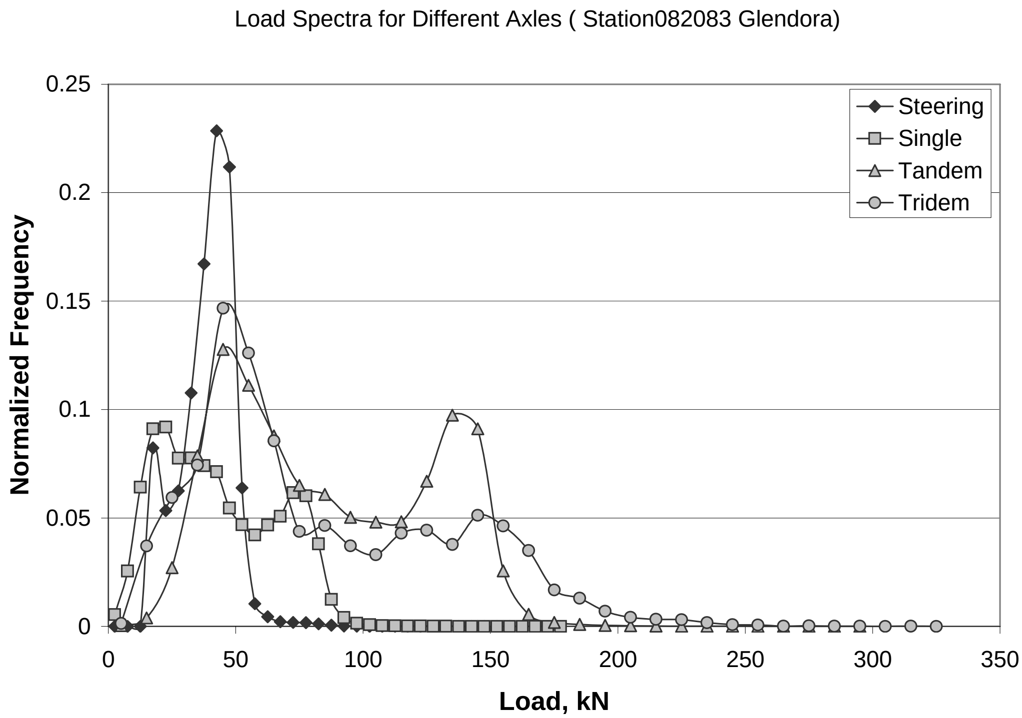


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
1998	4658	152	1844	360	38	302	1503	5	208	19	2	186	40
1999	4883	152	1922	350	33	300	1634	6	236	18	1	178	52
2000	4875	155	1882	351	35	318	1682	7	217	19	3	148	57
2001	4501	140	1721	289	27	294	1392	8	425	18	5	118	64

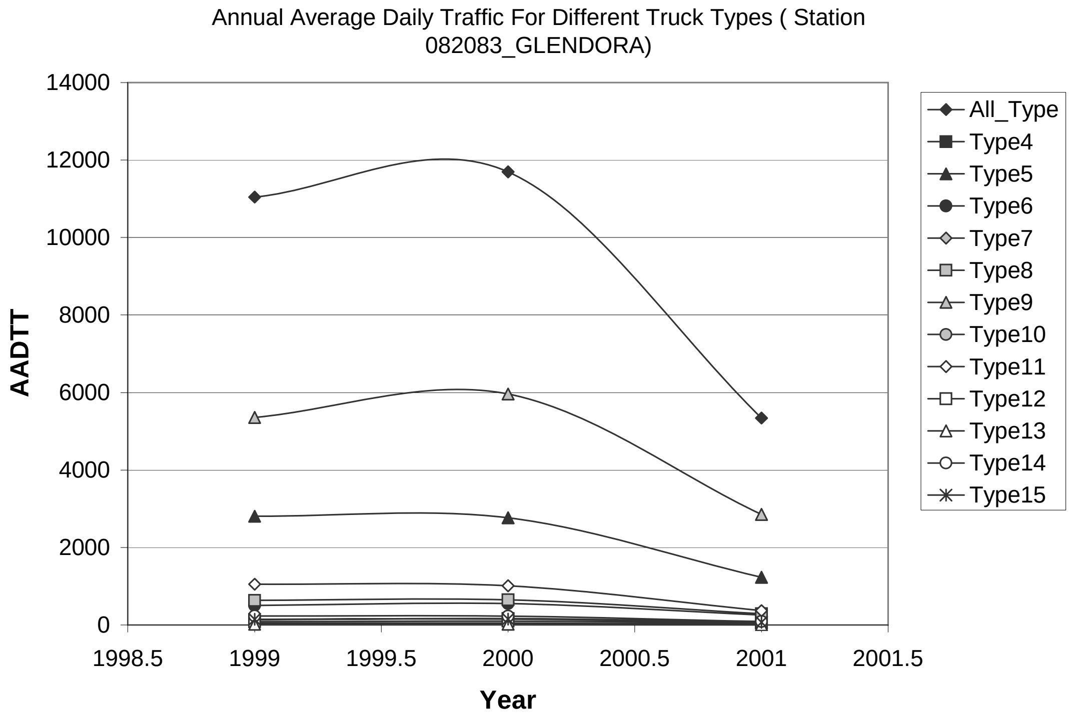

Annual Average Daily Traffic For Different Truck Types (Station 081_POSITAS)
6000
5000
4000
3000
2000
1000
0
AADTT
1997.5
1998
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATIONS 82&83 GLENDORA

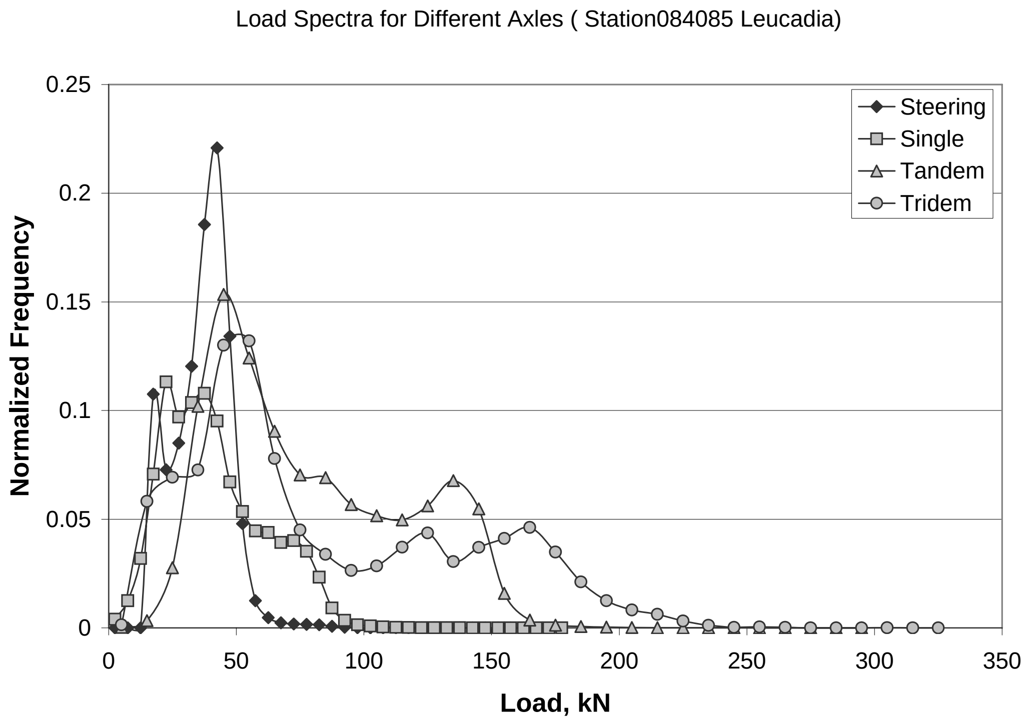


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1999	11042	137	2806	503	22	636	5355	48	1052	87	18	233	145
2000	11693	167	2765	554	25	652	5964	51	1014	101	18	230	153
2001	5340	71	1232	258	10	292	2853	29	371	52	7	93	72


Annual Average Daily Traffic For Different Truck Types (Station 082083_GLENDORA)
AADTT
Year
14000
12000
10000
8000
6000
4000
2000
0
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

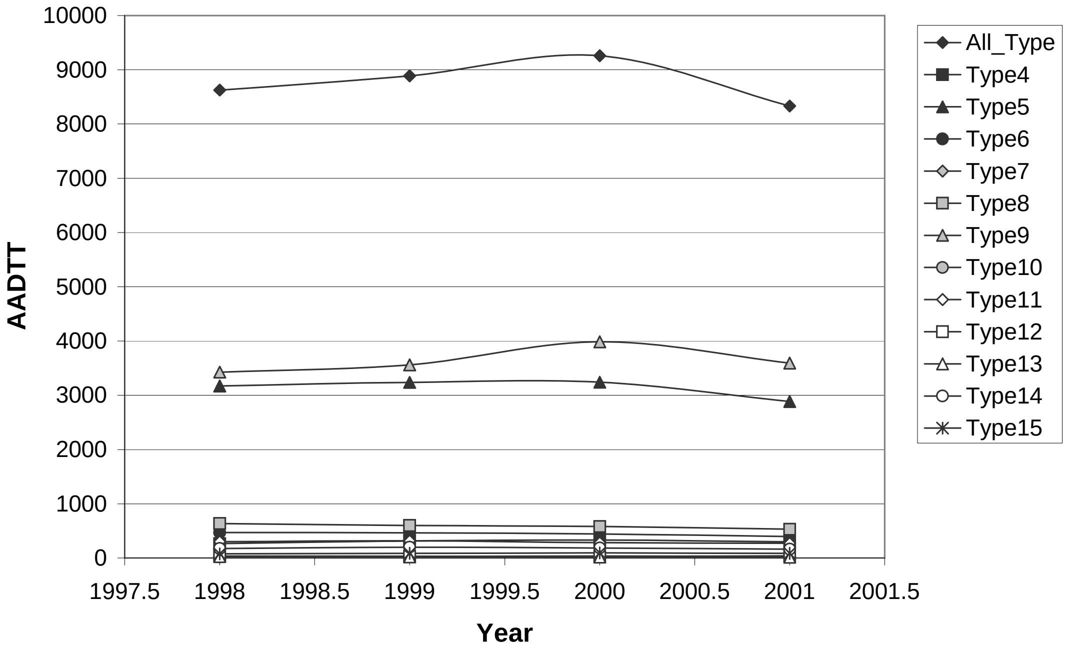
STATIONS 84&85 LEUCADIA



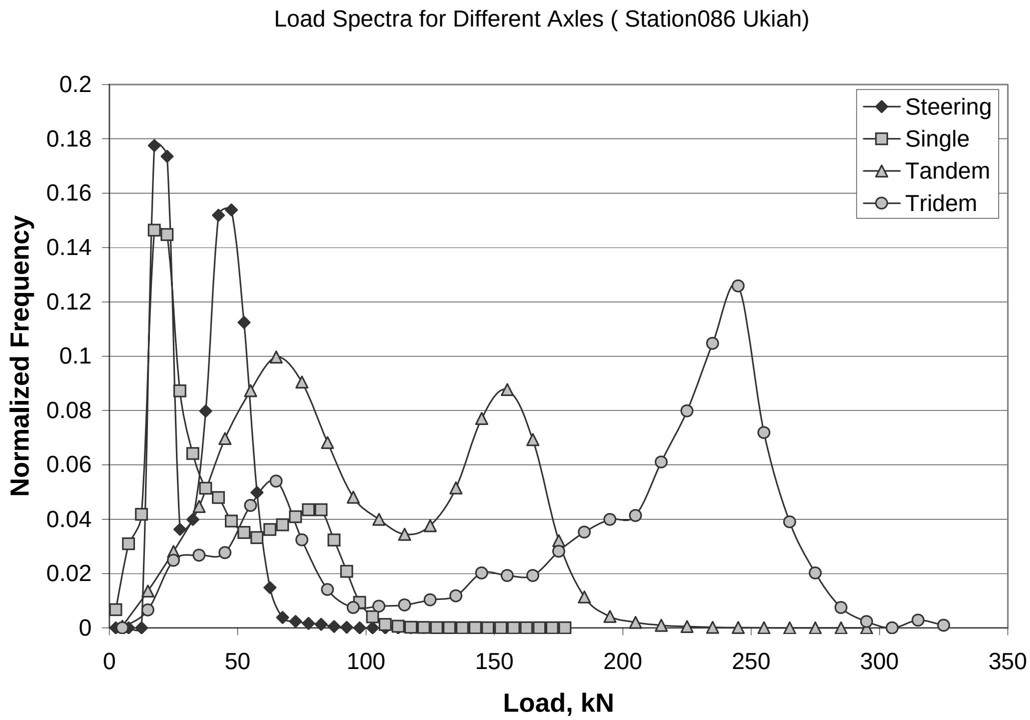
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1998	8627	265	3174	468	28	635	3427	20	301	36	24	174	76
1999	8888	316	3238	465	29	601	3561	25	315	33	21	199	86
2000	9259	332	3240	442	37	582	3986	28	285	29	17	186	95
2001	8332	298	2886	396	25	531	3592	28	273	40	14	162	86

Annual Average Daily Traffic For Different Truck Types (Station 084085_LEUCADIA)



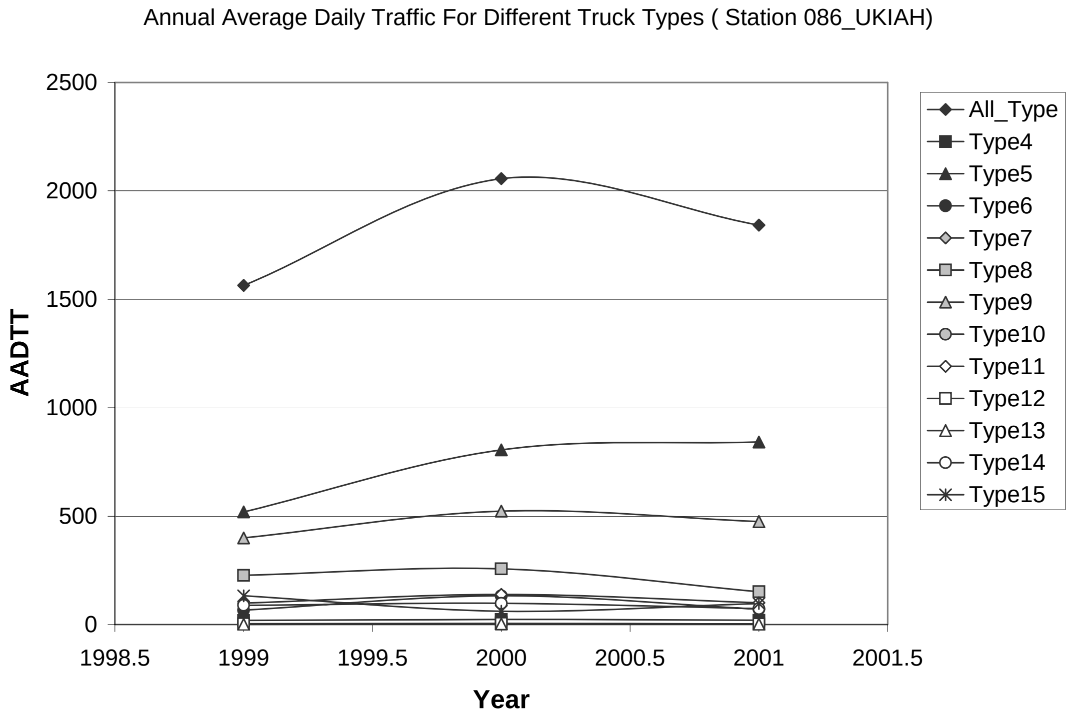
STATION 86 UKIAH



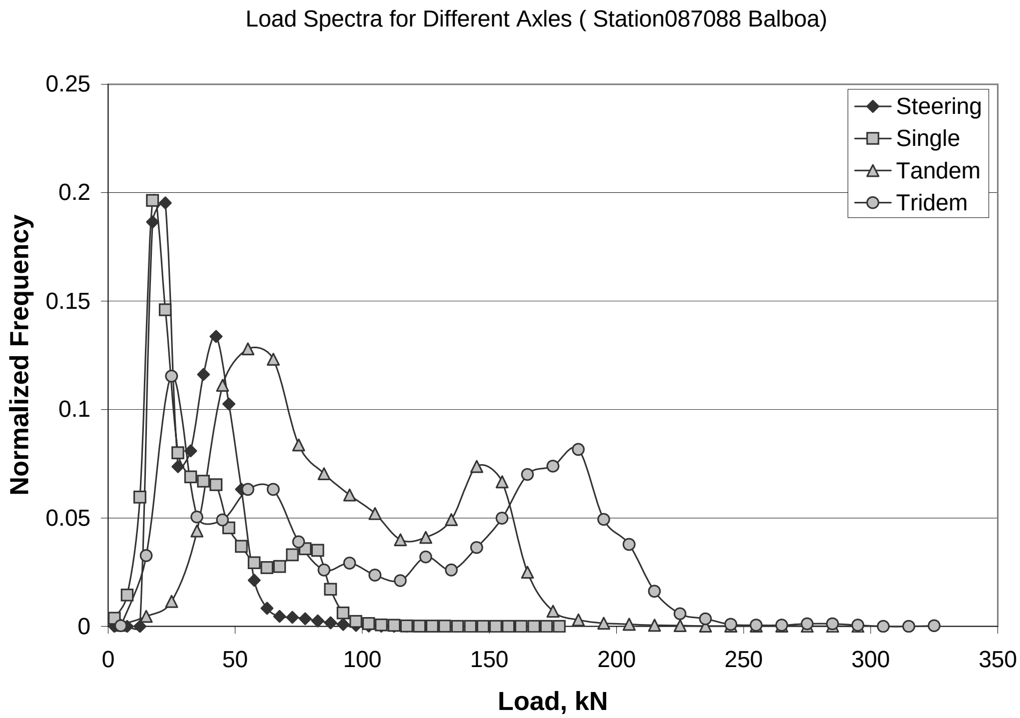
Note: Truck data from this WIM site contain "ghost" axles that cannot be corrected, so the load spectra in the above figure may contain large errors.

Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
1999	1564	19	520	66	3	227	400	2	99	4	1	89	133
2000	2057	24	806	133	3	257	523	3	139	5	3	98	62
2001	1842	20	842	71	2	152	475	3	101	3	2	74	97


Annual Average Daily Traffic For Different Truck Types (Station 086_UKIAH)
AADTT
2500
2000
1500
1000
500
0
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

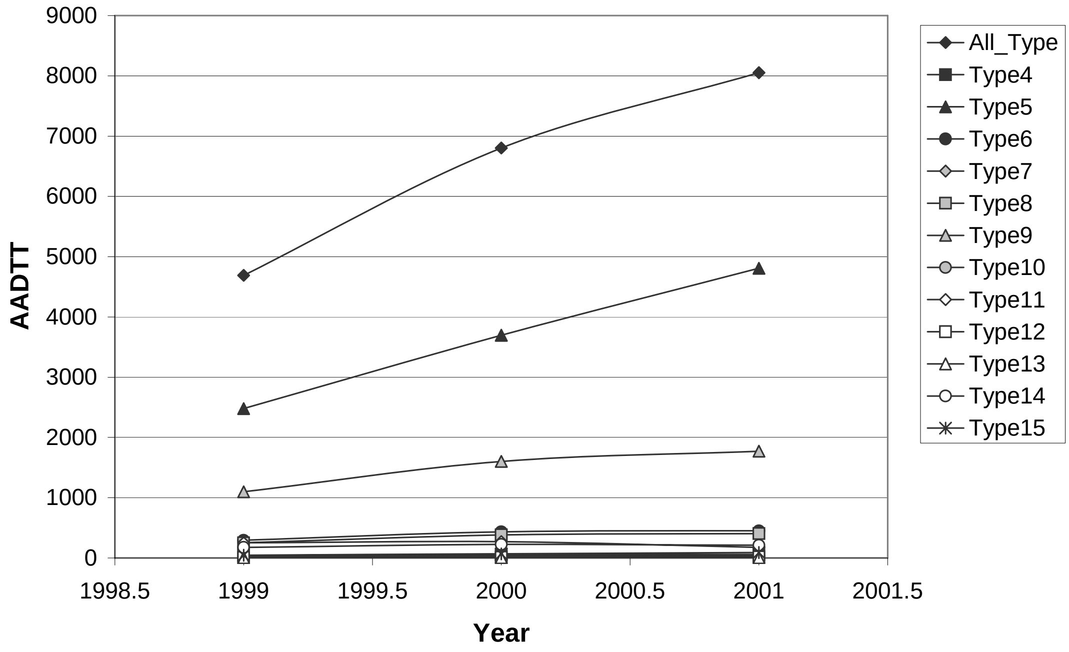
STATIONS 87&88 BALBOA



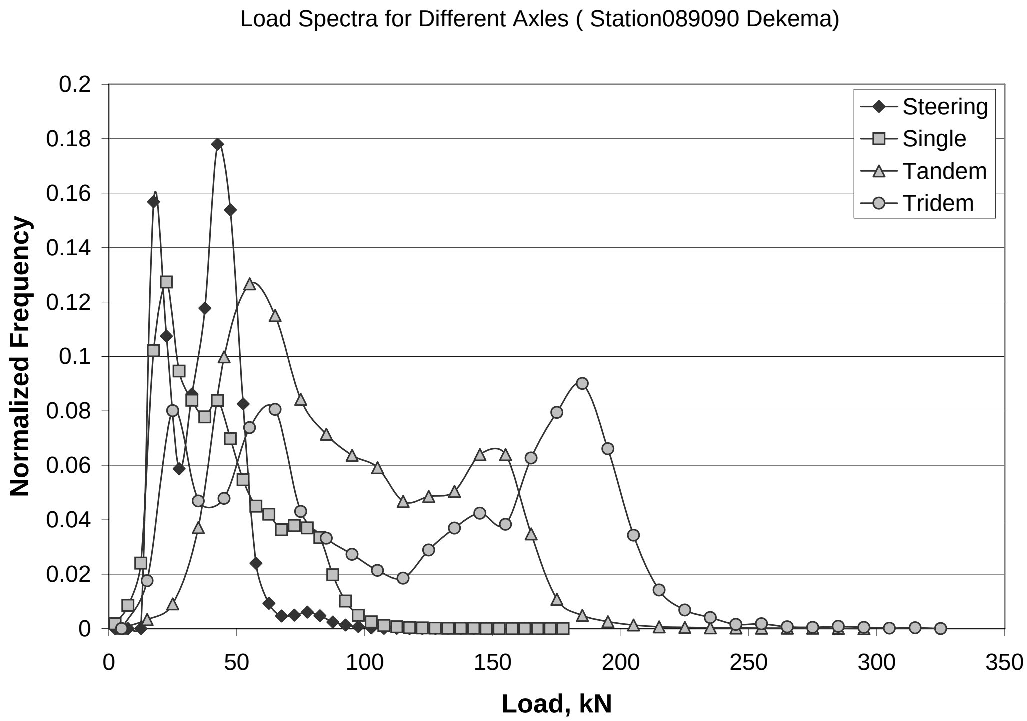
Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1999	4690	41	2479	294	26	253	1099	8	253	9	5	178	45
2000	6802	57	3697	435	34	384	1601	11	271	14	5	225	69
2001	8053	60	4808	451	36	404	1773	14	177	17	5	213	93

Annual Average Daily Traffic For Different Truck Types (Station 087088_BALBOA)



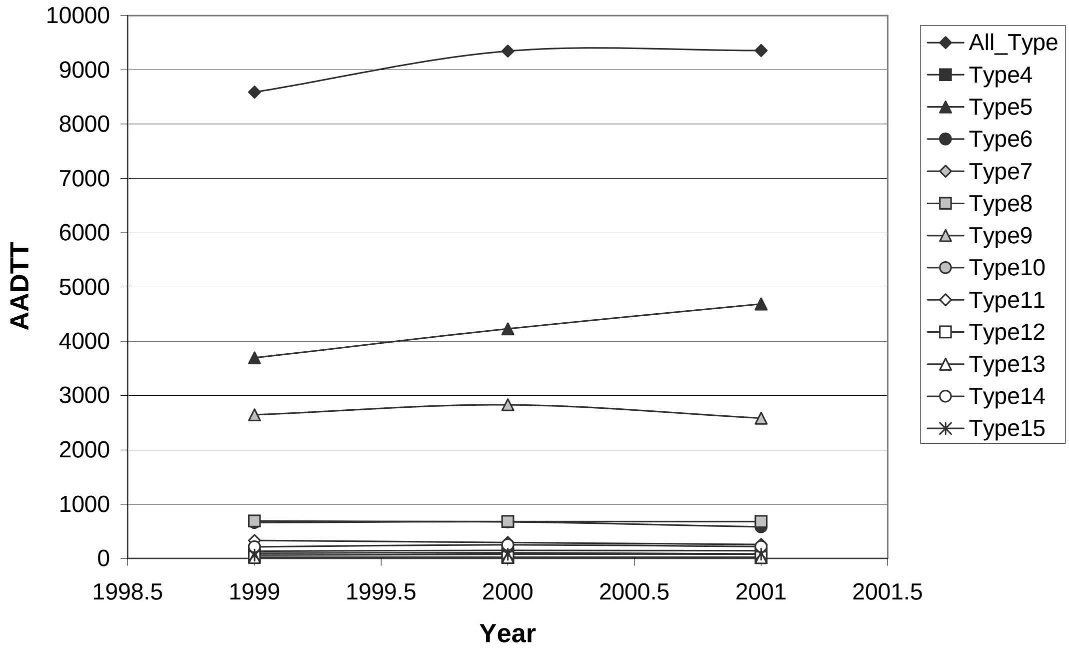
STATIONS 89&90 DEKEMA



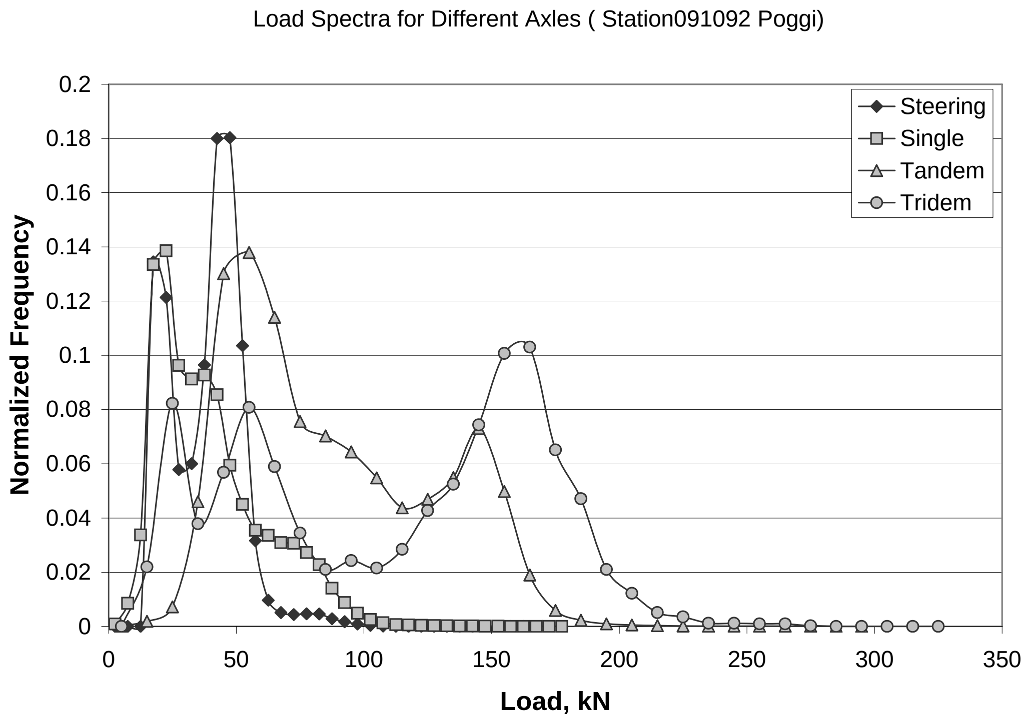
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1999	8591	134	3697	662	98	689	2644	14	331	27	18	214	62
2000	9347	149	4231	673	107	680	2832	21	293	17	18	249	76
2001	9358	141	4686	582	79	678	2585	21	257	17	16	217	79

Annual Average Daily Traffic For Different Truck Types (Station 089090_DEKEMA)

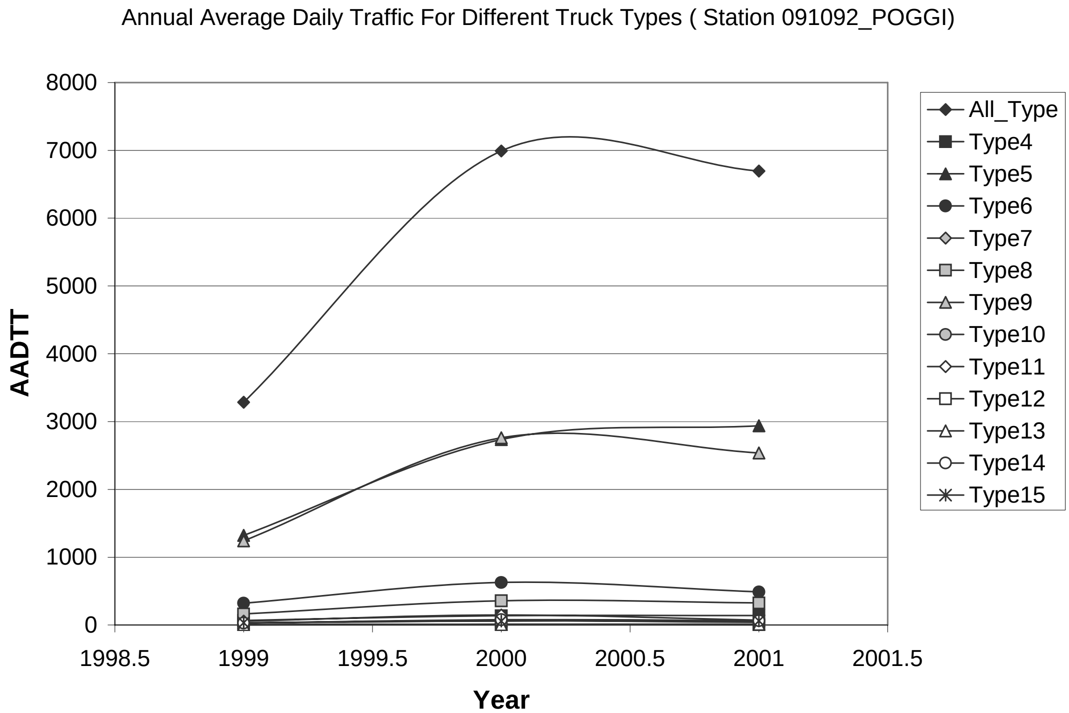


STATIONS 91&92 POGGI

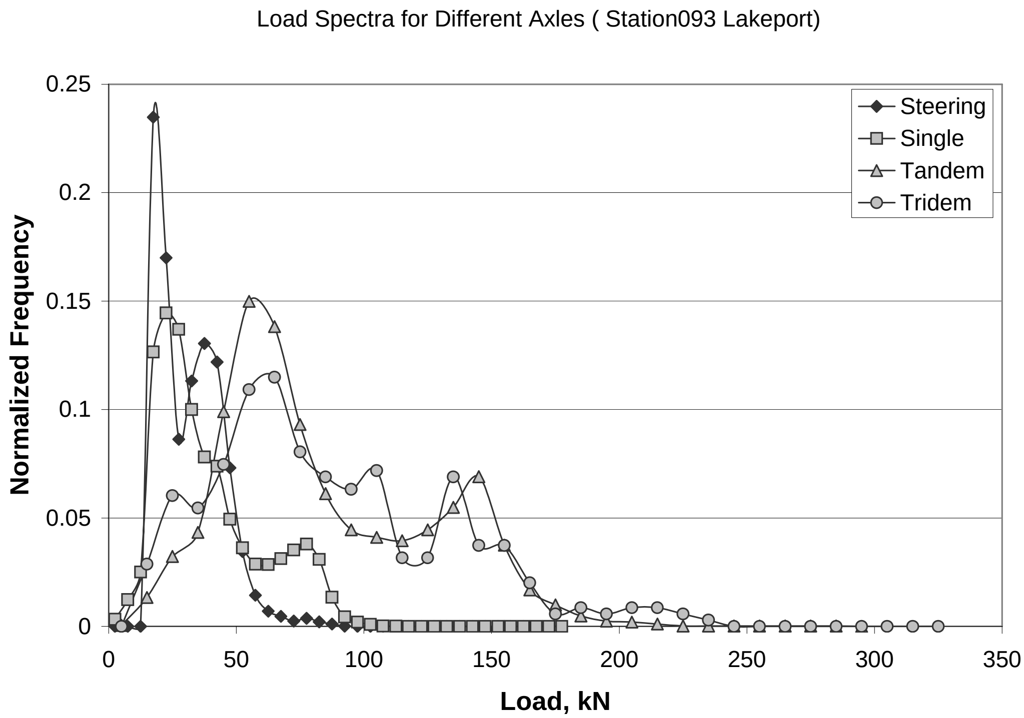


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1999	3286	68	1323	322	31	163	1240	4	57	10	3	28	34
2000	6992	137	2736	627	64	359	2762	11	147	8	7	79	57
2001	6695	139	2940	489	41	327	2537	12	73	4	8	63	62


Annual Average Daily Traffic For Different Truck Types (Station 091092_POGGI)
AADTT
8000
7000
6000
5000
4000
3000
2000
1000
0
1998.5
1999
1999.5
2000
2000.5
2001
2001.5
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

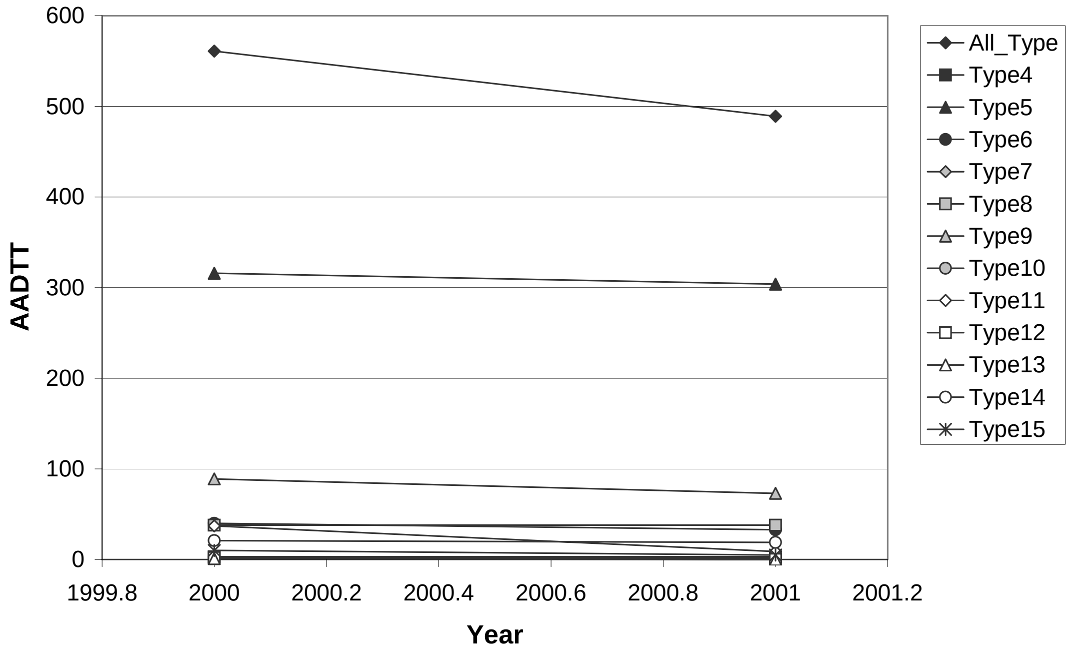
STATION 93 LAKEPORT



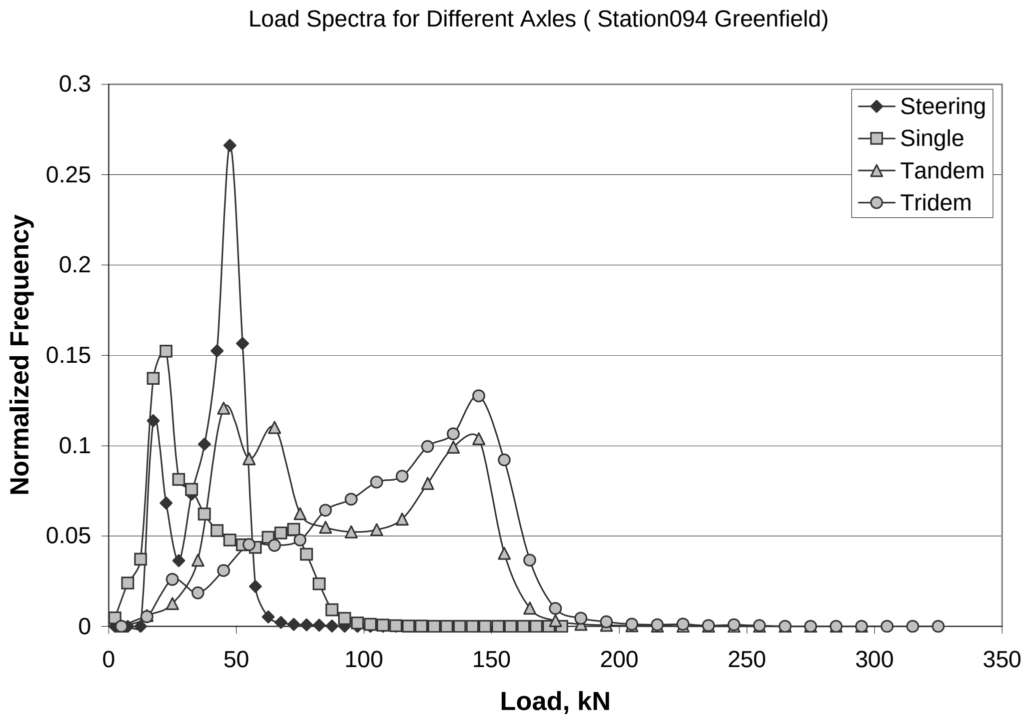
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	561	3	316	40	3	38	89	2	37	2	1	21	10
2001	489	3	304	33	3	38	73	2	9	0	0	19	5

Annual Average Daily Traffic For Different Truck Types (Station 093_LAKEPORT)



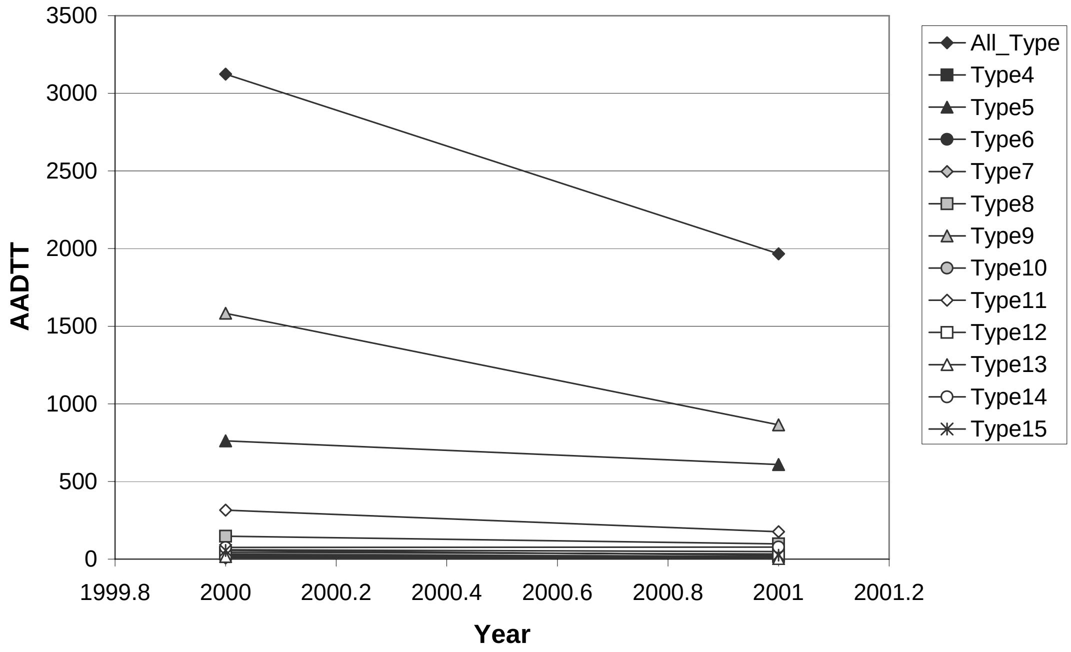
STATION 94 GREENFIELD



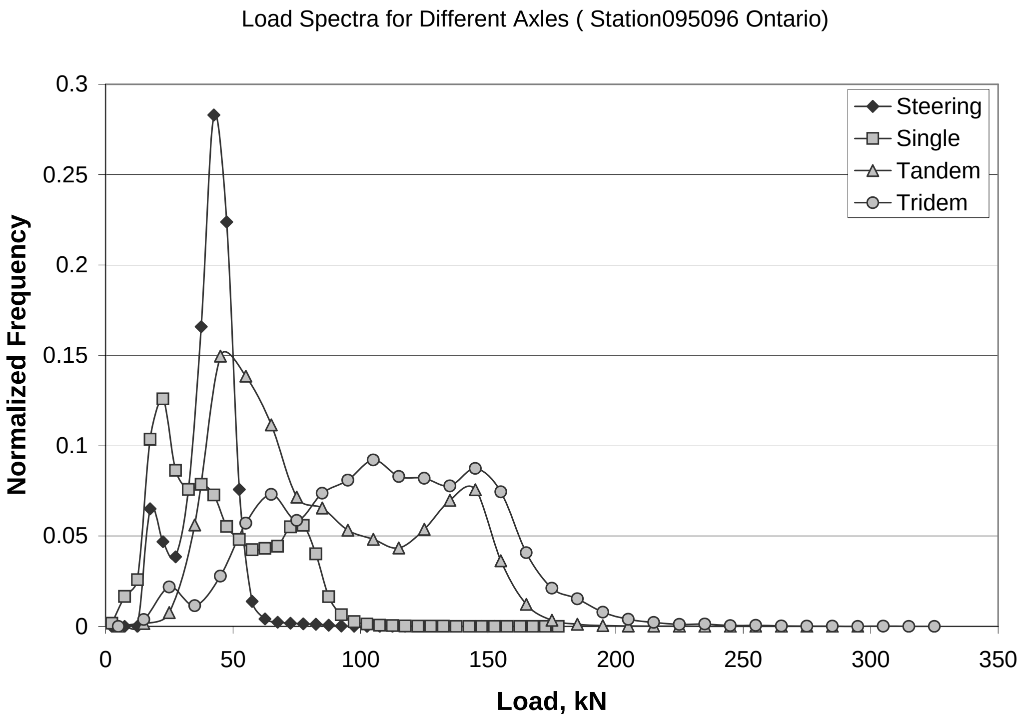
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	3123	43	762	60	7	147	1584	24	316	32	17	75	56
2001	1966	33	609	48	5	98	865	8	177	17	2	77	26

Annual Average Daily Traffic For Different Truck Types (Station 094_GREENFIELD)

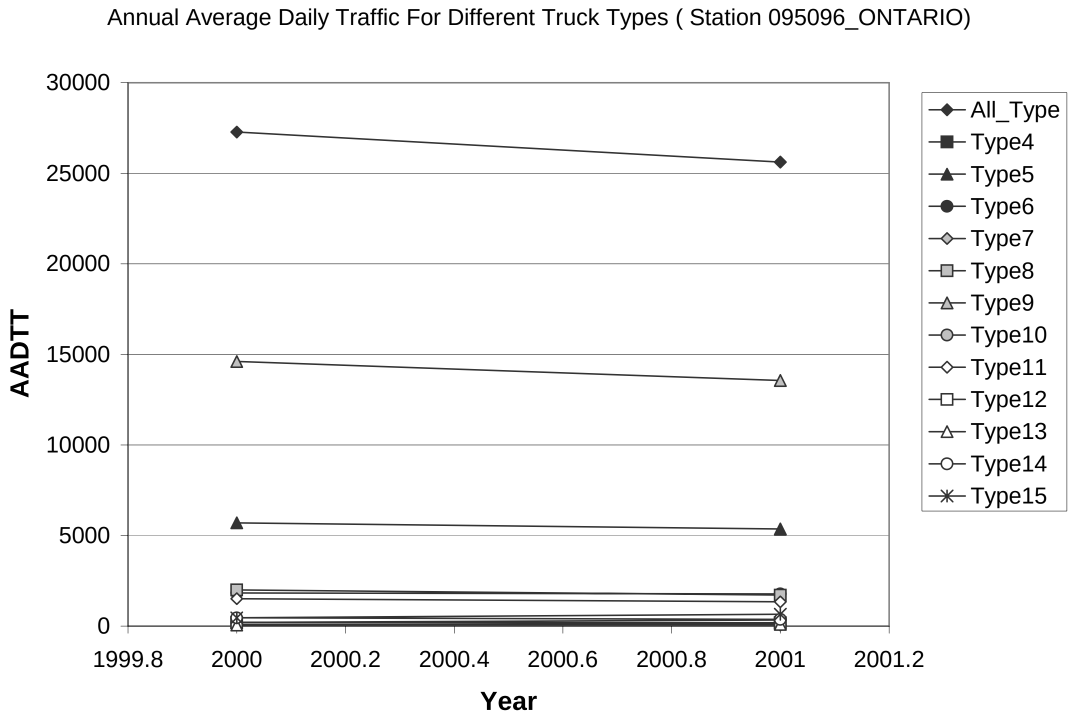


STATIONS 95&96 ONTARIO

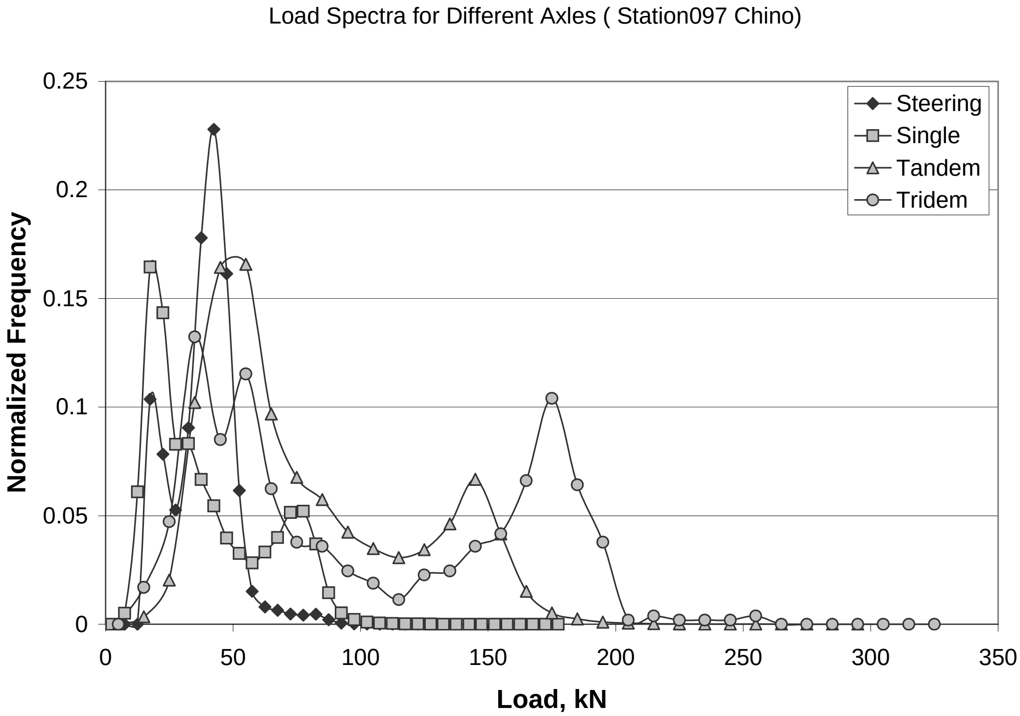


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	4	5	6	7	8	9	10	11	12	13	14	15
2000	27279	194	5704	1833	61	1996	14609	211	1510	185	64	455	456
2001	25615	190	5359	1773	61	1716	13565	338	1337	150	100	368	659

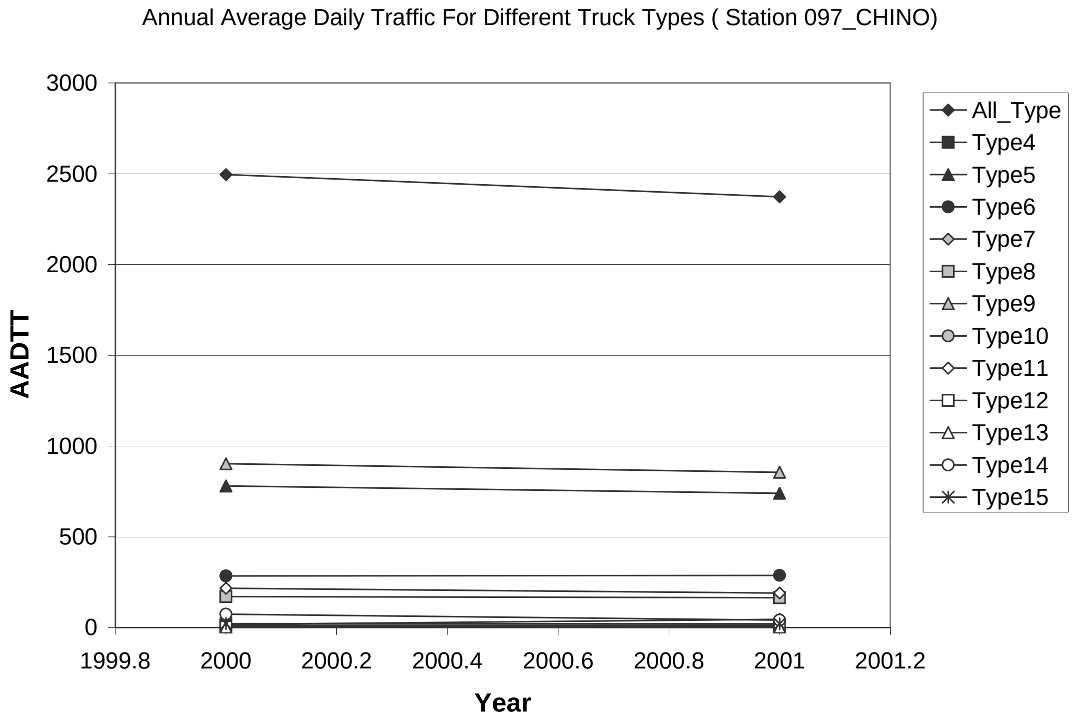

Annual Average Daily Traffic For Different Truck Types (Station 095096_ONTARIO)
AADTT
30000
25000
20000
15000
10000
5000
0
1999.8
2000
2000.2
2000.4
2000.6
2000.8
2001
2001.2
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 97 CHINO



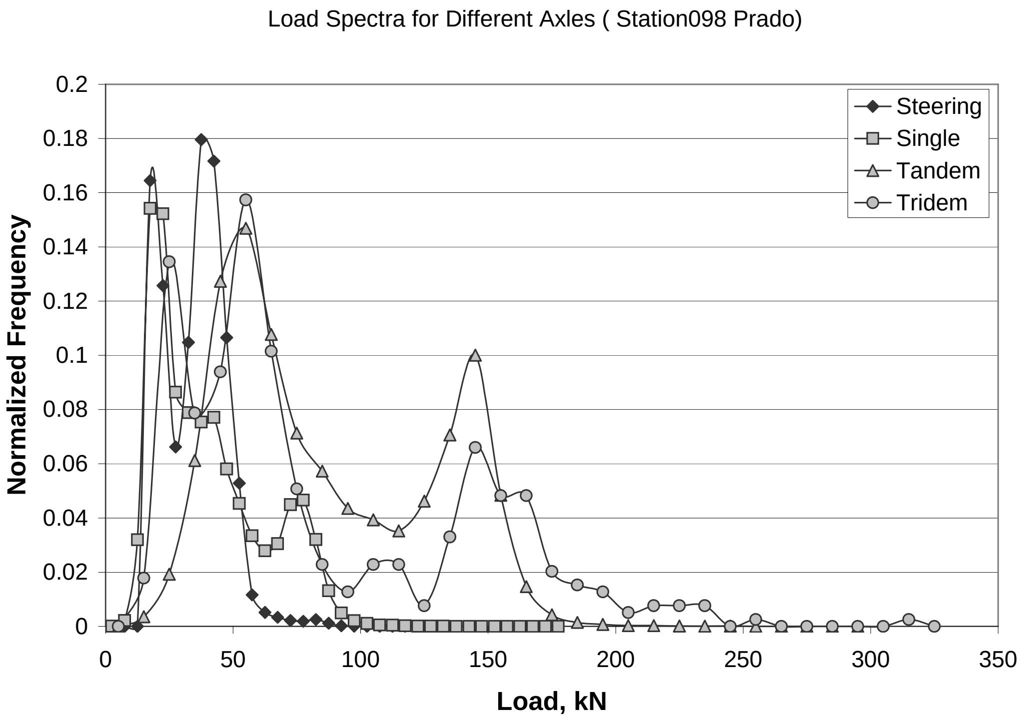
Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	2495	12	781	285	17	171	903	6	217	4	2	74	22
2001	2373	12	740	288	46	165	856	6	191	4	2	41	21



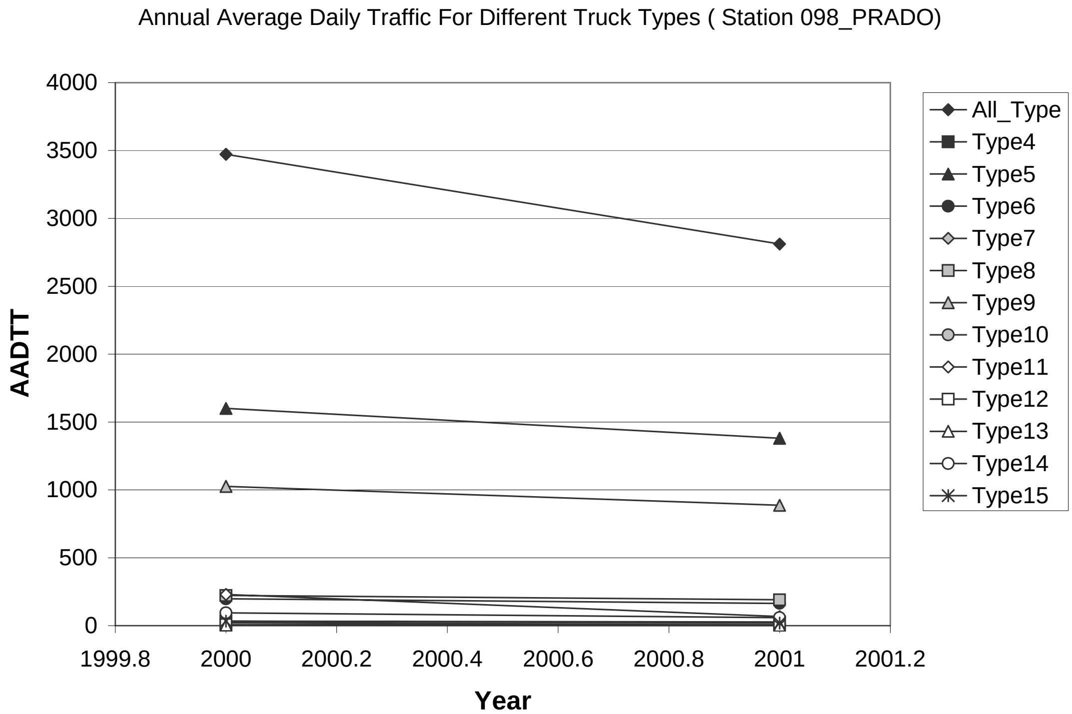
Annual Average Daily Traffic For Different Truck Types (Station 097_CHINO)
3000
2500
2000
1500
1000
500
0
AADTT
1999.8
2000
2000.2
2000.4
2000.6
2000.8
2001
2001.2
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

STATION 98 PRADO

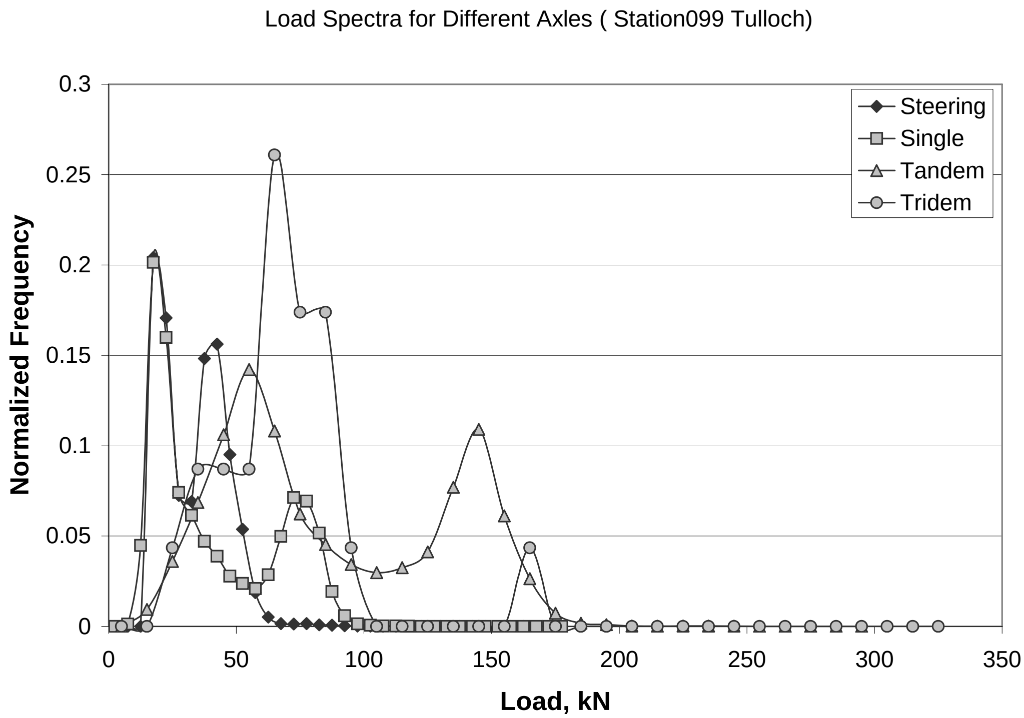


Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	3472	34	1600	197	22	223	1026	5	229	7	3	94	33
2001	2811	28	1381	164	6	191	886	5	67	4	2	59	19


Annual Average Daily Traffic For Different Truck Types (Station 098_PRADO)
AADTT
4000
3500
3000
2500
2000
1500
1000
500
0
1999.8
2000
2000.2
2000.4
2000.6
2000.8
2001
2001.2
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

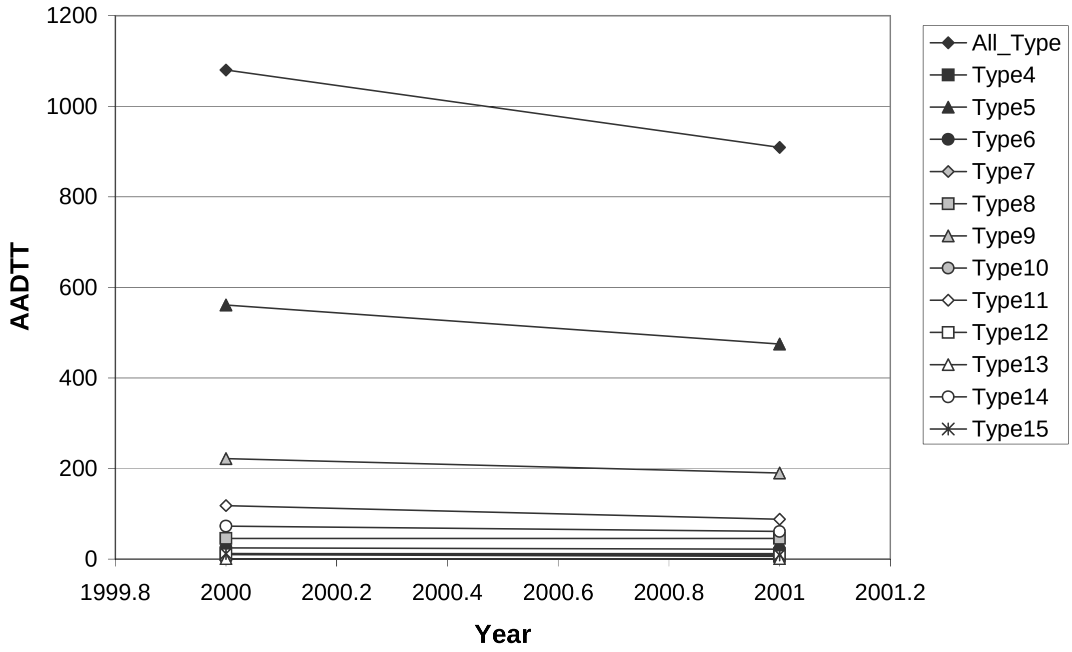
STATION 99 TULLOCH



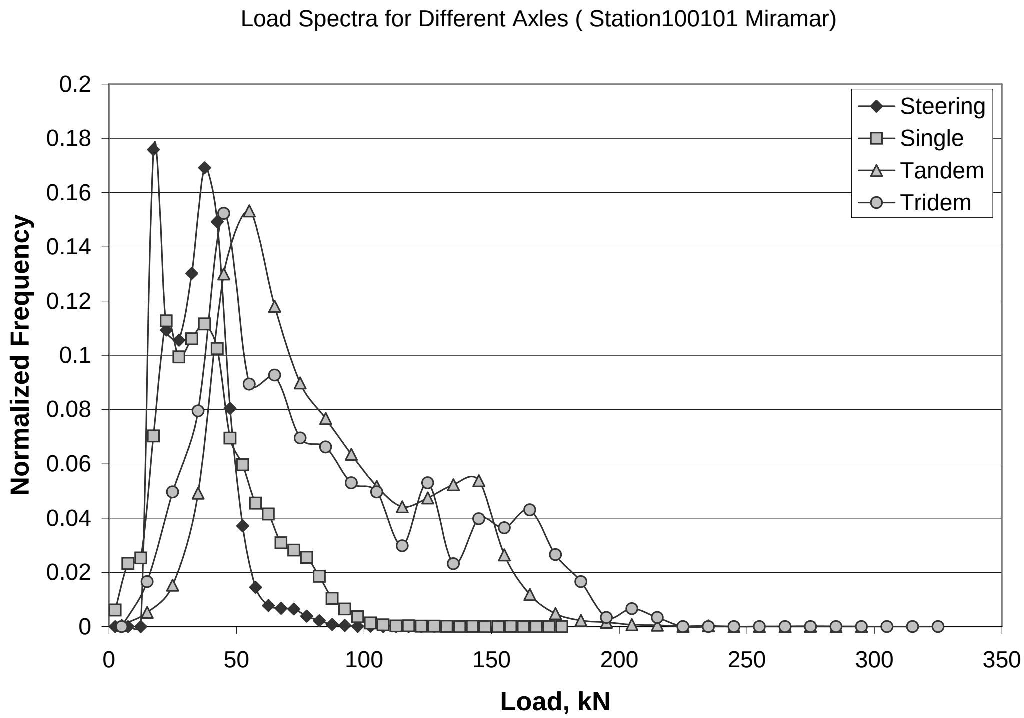
Average Annual Daily Traffic for Different Truck Types

Year	**Truck Type**											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2000	1080	12	561	25	1	46	222	0	118	10	1	73	12
2001	909	12	475	22	0	46	190	0	88	6	1	61	9

Annual Average Daily Traffic For Different Truck Types (Station 099_TULLOCH)

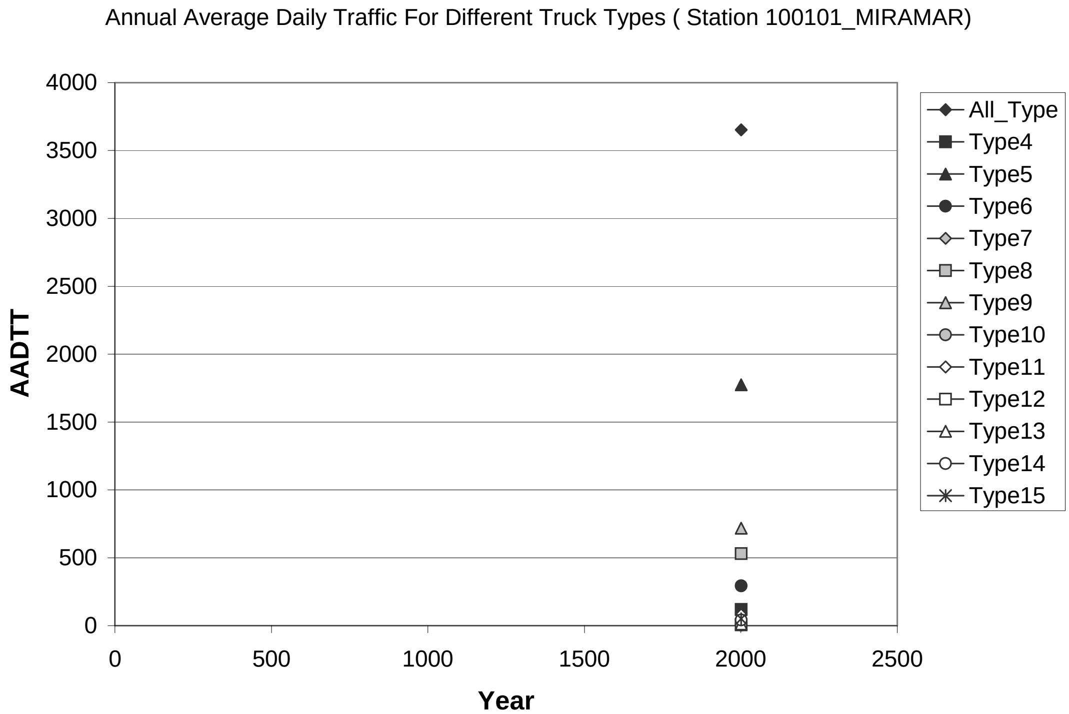


STATIONS 100&101 MIRAMAR



Average Annual Daily Traffic for Different Truck Types

Year	Truck Type											
	All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2001	3653	119	1775	293	20	530	718	5	81	6	13	42	51


Annual Average Daily Traffic For Different Truck Types (Station 100101_MIRAMAR)
AADTT
4000
3500
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
Year
All_Type
Type4
Type5
Type6
Type7
Type8
Type9
Type10
Type11
Type12
Type13
Type14
Type15

APPENDIX I:

TRUCK LANEWISE DISTRIBUTION FACTOR AND

ESALs PER TRUCK TYPE FOR ALL STATIONS

Truck Lanewise Distribution Factor

Station	Location	Southbound						Northbound					
		Lane1	**Lane2**	**Lane3**	**Lane4**	**Lane5**	**Lane6**	**Lane1**	**Lane2**	**Lane3**	**Lane4**	**Lane5**	**Lane6**
1	Lodi	0.0938	0.9062	-	-	-	-	0.1004	0.8996	-	-	-	-
2	Redding	0.0716	0.9284	-	-	-	-	0.0723	0.9277	-	-	-	-
6	Newhall	-	-	-	-	-	-	0.5798	0.4202	-	-	-	-
7	Santa Nella	0.0795	0.9205	-	-	-	-	0.0781	0.9219	-	-	-	-
8&9	Conejo	-	-	0.2653	0.7347	-	-	-	-	0.1594	0.8406	-	-
10	Fresno	-	0.3533	0.6467	-	-	-	-	0.3506	0.6494	-	-	-
12&13	Van Nuys	-	-	0.5669	0.4331	-	-	-	-	0.5815	0.4185	-	-
15&16	Irvine	-	-	-	0.125	0.5036	0.3714	-	-	-	0.2021	0.4874	0.3105
17&18	Hayward	-	0.0688	0.532	0.3992	-	-	-	0.0489	0.4897	0.4613	-	-
20	Loleta	0.0552	0.9448	-	-	-	-	0.0493	0.9507	-	-	-	-
27	Tracy	0.0543	0.9457	-	-	-	-	0.0595	0.9405	-	-	-	-
28	Macdoel	1		-	-	-	-	1	-	-	-	-	-
29	Arco		0.4645	0.5355	-	-	-	-	-	-	-	-	-
30	Mt. Shasta	0.0612	0.9388	-	-	-	-	0.0696	0.9304	-	-	-	-
31&32	Woodside	-	0.0653	0.3282	0.6065	-	-	-	0.0856	0.3032	0.6113	-	-
33&34	Burlingame	-	0.1035	0.5001	0.3964	-	-	-	0.0812	0.5326	0.3862	-	-
37&38	Elsinore	-	0.1586	0.8407	0.0007	-	-	-	0.1614	0.838	0.0006	-	-
40	Cochella	0.0763	0.9237	-	-	-	-	0.0415	0.9585	-	-	-	-
46	Galt	0.102	0.898	-	-	-	-	0.1226	0.8774	-	-	-	-
47&48	Castaic	-	0.0229	0.3789	0.5982	-	-	-	0.0224	0.2741	0.7035	-	-
49	Auburn	0.1226	0.8774	-	-	-	-	0.1476	0.8524	-	-	-	-
50	Elmira	0.0853	0.9147	-	-	-	-	0.0507	0.9493	-	-	-	-
55&56	Dublin	-	0.0734	0.3779	0.5487	-	-	-	0.019	0.2135	0.7675	-	-
59&60	LA-710	-	0.0423	0.6461	0.3116	-	-	0.0569	0.5259	0.2946	0.1227	-	-
63	Murrieta	0.1196	0.8804	-	-	-	-	0.0773	0.9227	-	-	-	-
66	Calico	0.1301	0.8699	-	-	-	-	0.0901	0.9099	-	-	-	-
67	Devore	0.0695	0.9305	-	-	-	-	0.1028	0.8972	-	-	-	-
68	Gilroy	-	0.1437	0.8563	-	-	-	-	0.206	0.794	-	-	-
69&70	Fontana	-	0.0448	0.4013	0.5538	-	-	-	0.0456	0.4638	0.4906	-	-
73	Stockdale	0.0913	0.9087	-	-	-	-	0.0788	0.9212	-	-	-	-
74	Bakersfield	-	0.3039	0.6961	-	-	-	-	0.3146	0.6854	-	-	-
75	Keyes	-	0.2436	0.7564	-	-	-	-	0.2697	0.7303	-	-	-
76	Templeton	0.157	0.843	-	-	-	-	0.1532	0.8468	-	-	-	-
81	Positas	-	0.4666	0.5334	-	-	-	-	0.5066	0.4934	-	-	-
84&85	Leucadia	-	0.0705	0.484	0.4454	-	-	-	0.0794	0.4869	0.4336	-	-
86	Ukiah	0.0563	0.9437			-	-	0.0565	0.9435	-	-	-	-
87&88	Balboa	-	0.1011	0.2836	0.6154	-	-	-	0.0628	0.4164	0.5209	-	-
89&90	Dekema	-	0.0696	0.4174	0.513	-	-	-	0.0653	0.3957	0.539	-	-
91&92	Poggi	-	0.0708	0.449	0.4802	-	-	-	0.0588	0.4629	0.4782	-	-
93	Lakeport	0.0803	0.9197	-	-	-	-	0.0797	0.9203	-	-	-	-
94	Greenfield	0.0663	0.9337	-	-	-	-	0.0694	0.9306	-	-	-	-

97	Chino	0.1927	0.8073	-	-	-	-	0.1736	0.8264	-	-	-	-
98	Prado	-	0.1201	0.8799	-	-	-	-	0.1328	0.8672	-	-	-
100&101	Miramar	-	-	0.2316	0.518	0.2504	-	-	0.0513	0.2985	0.6503	-	-

Station	**Location**	**Westbound**						**Eastbound**					
		Lane1	**Lane2**	**Lane3**	**Lane4**	**Lane5**	**Lane6**	**Lane1**	**Lane2**	**Lane3**	**Lane4**	**Lane5**	**Lane6**
3&4	Antelope	-	-	0.4843	0.5157	-	-	-	-	0.3265	0.6735	-	-
5	Indio	0.085	0.915	-	-	-	-	0.107	0.893	-	-	-	-
11	Sonoma	0.077	0.923	-	-	-	-	0.15	0.85	-	-	-	-
14	San Marcos	-	0.3068	0.6932	-	-	-	-	0.3264	0.6736	-	-	-
21	Mojave	0.0659	0.9341	-	-	-	-	0.0708	0.9292	-	-	-	-
22	Jeffrey	0.0305	0.9695	-	-	-	-	0.0297	0.9703	-	-	-	-
23	El Centro	0.1075	0.8925	-	-	-	-	0.0765	0.9235	-	-	-	-
24	Napa	1	-	-	-	-	-	1	-	-	-	-	-
25	Newberry	0.0709	0.9291	-	-	-	-	0.0946	0.9054	-	-	-	-
26	Cameron	0.0454	0.9546	-	-	-	-	0.0739	0.9261	-	-	-	-
35	Pacheco	0.0522	0.9478	-	-	-	-	0.0631	0.9369	-	-	-	-
36	Los Banos	0.0623	0.9377	-	-	-	-	0.1289	0.8711	-	-	-	-
39	Redlands	0.1154	0.8846	-	-	-	-	0.1824	0.8176	-	-	-	-
41&42	Vacaville	0.047	0.213	0.5176	0.2224	-	-	0.04	0.2537	0.7001	0.0062	-	-
43	Cholame	1	-	-	-	-	-	1	-	-	-	-	-
44	Banta	0.0956	0.9044	-	-	-	-	0.103	0.897	-	-	-	-
45	Carbona	0.0654	0.9346	-	-	-	-	0.0638	0.9362	-	-	-	-
51&52	WestSac	-	0.1117	0.5587	0.3296	-	-	-	0.1049	0.5212	0.3739	-	-
57&58	Pinole	-	0.0322	0.3566	0.6113	-	-	-	0.0551	0.4816	0.4634	-	-
61&62	Peralta	-	0.0628	0.3644	0.5728	-	-	-	0.0354	0.3284	0.6362	-	-
64	Foster City	-	0.3195	0.6805	-	-	-	-	0.4889	0.5111	-	-	-
65	Piru	0.0732	0.9268	-	-	-	-	0.0858	0.9142	-	-	-	-
71	Hinkley	0.0726	0.9274	-	-	-	-	0.0599	0.9401	-	-	-	-
72	Bowman	-	0.2373	0.7627	-	-	-	-	0.2492	0.7508	-	-	-
77&78	Colton	-	0.036	0.3807	0.5833	-	-	-	0.0426	0.3666	0.5909	-	-
79&80	Artesia	-	0.0388	0.3631	0.5981	-	-	-	0.0356	0.3637	0.6007	-	-
82&83	Glendora	-	0.0354	0.3683	0.5963	-	-	-	0.0273	0.3366	0.6361	-	-
95&96	Ontario	0.0542	0.5047	0.4411	-	-	-	0.0608	0.5249	0.4143	-	-	-
99	Tulloch	0.1097	0.8903	-	-	-	-	0.0912	0.9088	-	-	-	-

ESAL/1000 Trucks

Station	Location	Truck Type												
		All	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	Lodi	1238.4	611.9	150.4	388.6	999.5	423.7	1520.1	920.4	1672.1	701.8	6032	1691.7	648.9
2	Redding	1374	745	128.8	410.6	2066	354.4	1750.6	956.3	1501.8	712	2383.1	1704.7	641.8
3&4	Antelope	778.7	611.1	110.4	381.7	2313.3	336	1100.7	769.1	1194.9	612.7	3569.2	1143.7	654.3
5	Indio	1229.6	821.4	148.9	460.2	1384.2	331.7	1408.3	940.8	1495.7	612.4	6920.4	1838.3	486.3
6	Newhall	983.2	472.4	240.5	597.4	2363.1	482.6	1186.2	770.8	1469.9	860.9	2360.2	1751.8	643.7
7	Santa Nella	1339.3	924.5	217.3	1179.9	1981.7	526.4	1573	933.9	1412.9	563.3	8973.1	1749.5	729.9
8&9	Conejo	497.4	356.2	154.1	433.2	2731.9	310.9	721.1	572.5	938.3	513.8	3799	1367	610.9
10	Fresno	1061.2	1239.7	210.6	1194.4	3074	723.2	1282.9	782	1539.5	759.8	2276.7	1620.1	983.6
11	Sonoma	920.6	637.7	192.5	550.2	2435	309.7	1234.5	887.1	1841.1	653.4	6629.4	1798.9	506
12&13	Van Nuys	665.7	774.5	192.5	846.9	1915.4	391.4	1008.3	720.2	1445.8	610.4	1992.2	1513.6	684.1
14	San Marcos	545.6	949.7	161	730.1	2433.7	437.3	751.3	543.8	1384.3	697.6	1775.7	1354.8	586.2
15&16	Irvine	648.7	955	181.6	883.4	3266.3	583.3	941.3	702.3	1040	519.3	2460.9	1757.8	577
17&18	Hayward	506.5	581.5	182.6	451.7	2029.6	412.6	766.3	612.8	971.2	453.6	3746.7	1418	615.4
20	Loleta	1171.8	851.5	191.8	454.2	2888.7	461.2	2087.7	897.3	1731.3	669.1	6077.9	2354.2	389.4
21	Mojave	1197	413.7	139	444.2	705	297	1385.8	876.2	1414.3	544.9	5423.4	1266.2	443.1
22	Jeffrey	725.7	428.8	111.9	347.8	2119.6	301.8	933.5	835.9	1273	495.8	4894	1326.2	482.1
23	El Centro	787.3	370.1	164	321.8	2422	322.5	994.7	920	1295.2	685.6	4497.3	1607.1	355.7
24	Napa	584.5	627.1	145.5	529.8	2965	375.6	958.5	699.5	1410.6	449.4	2217.6	1359.7	324.6
25	Newberry	1464.4	675	112.4	641.9	1553.9	275.3	1632.4	1114.4	1940.8	1068.5	4503.5	1492.8	479.4
26	Cameron	656.8	460.1	174.8	641.7	1189.3	343.8	906.9	896.5	1061.2	480.3	5157.5	1215.7	305.7
27	Tracy	942.3	461.4	113.7	401	1111.4	271.1	1084.4	662.6	1069.9	504.4	5527	1191.3	497.6
28	Macdoel	1447	495.3	162.2	401.6	577.5	604.9	1688.9	909.2	1754	926.8	2559.6	1710.2	1045.2
29	Arco	1189.9	694.2	145.7	424.9	2492.3	428.3	1449.8	808.1	2090.6	839.4	4571.2	1281.8	992.7
30	Mt. Shasta	1374.4	552.4	174.4	338.5	699.3	435.9	1694.6	950.4	1290.7	722.4	2754.2	1608.7	882.1
31&32	Woodside	335.4	631.7	111.4	597.5	1815.6	292.5	676.4	683.1	974.1	450.8	8024.6	1129.3	300.4
33&34	Burlingame	456.9	696	171.6	603	3373.3	500.3	866.2	793.8	1097.3	469.8	4019.5	1509.7	629.9
35	Pacheco	907	557.9	152.5	777.3	302.6	418.1	1048.7	791.7	1240.1	545.9	3869.2	1222.9	537
36	Los Banos	726.2	549.1	200	818.5	1992.6	418.4	936.7	668.2	1214.2	437	6919.2	1288.4	354.7
37&38	Elsinore	683.6	521.5	178.3	466.8	2721.4	362.9	858.3	623.7	1338.9	602.3	4605.1	1414.6	521.5
39	Redlands	887.4	690.9	210.9	662.8	2917.8	633.4	1336.5	1462.6	1978.2	1093.5	5859.7	1665.3	600.8
40	Cochella	991.2	399	171.5	382	2510.8	375.3	1027.7	791.5	1488.3	840.4	3142.7	1391.2	372.8
41&42	Vacaville	650.1	729.2	125.1	459.2	2438.4	454.9	941.2	639.1	1227.8	590.5	3156.5	1251.5	959.4
43	Cholame	998	559	118.7	449.2	942.6	423.3	1227.5	806.1	1396.1	630.7	8526.6	1488.4	400
44	Banta	651.6	660.3	173.8	433.4	1491.7	412.7	822.3	652.2	1046.5	488.8	3267.8	1073.1	441.3
45	Carbona	836.4	575.4	147.9	531.1	1251.1	395.4	1041.1	793	934	426.9	8743.7	1211.3	707.1
46	Galt	838.9	566.7	145.1	468.5	1726.4	475.9	1132.6	726.3	1271.8	732.2	1266.3	1327.7	695
47&48	Castaic	924.9	389.1	158.8	503.5	2111.2	417.4	1092.2	707.5	1116.2	501.6	4210.6	1375	625.5
49	Auburn	358.4	317.8	128.8	485.1	2945.3	284.5	734	916.3	836.9	416.3	3280.4	1243.7	349.5
50	Elmira	1118	771.3	120.8	474.3	2445	458.7	1394.9	975.9	1702.9	734.7	3872.1	1669.9	1211.2
51&52	WestSac	581.4	601.1	135.1	340.6	2082.5	375.5	770.5	551.9	1196.3	498.1	5203.6	1024	1640.9

55&56	Dublin	678.8	712.4	163.6	616.3	2838.7	557.6	977.6	765.9	1616.3	556.8	7862.2	1528.6	918.1
57&58	Pinole	633.9	933.6	194.3	677	1777.3	435.9	931.1	738.9	897.2	453.7	3257.1	1391	505.8
59&60	LA-710	713.8	649	153	212.8	2754.8	482.7	902.1	792.2	1789.8	716.8	2433.4	1559.1	920.6
61&62	Peralta	664.9	510.2	127.9	317.5	2677.3	419.5	762.2	524.7	1456.3	742.3	1508.1	1290.7	669.5
63	Murrieta	569.4	469.2	155.2	630.8	2566	332.6	843.5	609	1435	687.9	5125.7	1436.4	296.6
64	Foster City	506.6	718.3	138.6	685	2955.4	468.2	977.4	994.8	1586.2	534.1	1009.1	1589	1619.9
65	Piru	760	562.8	112	425.6	1136.6	422.8	942.4	882.8	1321.2	794	1798.2	1131.1	605.3
66	Calico	1136	770	117.9	567	1216.4	724.3	1400.8	921.4	1803.1	684.3	6406.2	1528	615.5
67	Devore	848.6	514.1	104.2	387.6	2068.3	417.7	1113	919.6	1504.7	699.7	2397.9	1383.8	479.9
68	Gilroy	668	614	135.7	409.7	2615.6	567.5	860.9	716.8	1257.1	542.9	5694.5	1435.1	973.6
69&70	Fontana	973	664	122.3	472.5	2799.4	438.3	1154	774.4	1572.2	715.8	3505.5	1360.5	622.5
71	Hinkley	1467	740.8	100.7	469.2	1441.4	444.8	1698.2	1018.8	1779.5	695.9	6223.1	1612.4	532.6
72	Bowman	1111.4	1037.3	110.5	650	2543.8	485.3	1484.9	1042.3	1427.5	669.7	3332.4	1468	949
73	Stockdale	1099.1	739.4	143.7	388.3	2564.5	543.3	1250.2	808.1	1422.7	636.8	7032.9	1766.8	704.2
74	Bakersfield	843.5	564.4	168.8	378.4	2608.9	662.9	948.3	541	1398.5	613.8	3282	1180	849.4
75	Keyes	992.3	617.9	164.7	345.6	2437	494.5	1207.2	685.8	1605.1	694.5	1954.4	1443.5	677.9
76	Templeton	671	1000.6	110.3	600.8	2649.2	508.1	1059.7	1038.8	1653.4	704.6	2749.2	1635.6	622
77&78	Colton	774.2	656.9	189.6	280.9	2662.6	497.1	1010.4	824.9	1374	650.4	6066.8	1503.1	567
79&80	Artesia	529.8	615.5	187.2	361.9	2353.4	451.3	768.5	660.8	1482.4	595	4048.1	1431.1	724.8
81	Positas	579.2	644.4	229.1	563.5	1907.1	351	823.5	535.9	1167.3	556.9	3147.4	1459.9	447.5
82&83	Glendora	745.1	549.9	149.6	443.2	2128.2	404.6	979.2	683.3	1299.2	526.6	6572	1171.7	451
84&85	Leucadia	501.2	529.5	152.4	445.8	2427.6	399	695.1	546.9	1091.1	530	3008.4	1439.6	588.7
86	Ukiah	936	1170	130.4	789	3201.5	487.5	1763.9	1233.2	1797.3	887.6	3719.1	1974.5	2498.9
87&88	Balboa	546	690.5	103	755.3	2820.1	498.2	1068	872.9	1807.5	626	9987	1618.6	944.7
89&90	Dekema	702.5	830.4	179.6	758.4	3591.5	614.5	1123.6	888.8	1590.5	1004.6	5825.6	1930.6	1526.5
91&92	Poggi	635.5	709.6	158.3	539.9	3075	528.9	1005.8	758.3	1330.1	1014.5	9908	1750.4	566.3
93	Lakeport	459.4	744	129.2	524	1870.7	410	1052.8	973.3	1293.1	785.2	4268.1	1335.1	506.9
94	Greenfield	810.6	725.9	108.7	417.3	2266.7	617.7	1148.1	1137.9	1060.5	511.9	1027.1	1219.3	556.1
95&96	Ontario	735.2	541.3	165	325.5	1906.6	569.1	931.1	1051.4	1337.4	686.2	1770.5	1488.4	871.5
97	Chino	615.9	480.1	130.7	403.7	2896.4	398.3	846.1	595.9	1330.1	599.2	8281.1	1308.6	374.2
98	Prado	572.1	787.1	133.3	526.4	2456.8	394.2	1023.4	816.7	1573.9	536.1	5330.2	1480.4	730.1
99	Tulloch	666.2	1124	81.8	584.8	2176.4	395.8	1224.9	425.7	1958	1222.8	3359.8	1459.3	1034.8
100&101	Miramar	438.7	655.5	150.4	727.5	2299.3	394.4	803.2	565.7	1059.3	347	4122.6	1086.7	459.7