HEAVY AXLE LOAD FREQUENCY

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SYNOPSIS

The Highway Planning Surveys have gathered much data concerning the composition of traffic in the various States Using this information, an investigation was made to determine variations in the frequency of heavy axles on the main rural highways of the country in comparison with the average density of truck traffic.

The findings are based on data collected in 1943 and 1944 in all States except Florida, Oregon, and Virginia where weight surveys were not made during this period. The data were analyzed to obtain the average rate of axles weighing 18,000 lb or more, 16,000 lb or more, and 14,000 lb. or more in the entire country, in each of the census regions and in each of the main geographical sections of the country.

The investigation indicated that, in general, the frequency of heavy axles on roads carrying 1,000 or more trucks daily is roughly between two and six times the frequency on the lightly traveled portions and that the variation in the frequency is in direct proportion to the average daily truck traffic. As an example, on roads carrying up to 250 trucks daily, the average frequency of axles weighing 16,000 lb or more was found to be 3 for each 100 passing trucks, while on highways carrying 2,000 or more such vehicles, the frequency was 32 axles of that weight for every 100 commercial vehicles It further indicated that there is a wide difference between the ratio of heavy axles to total truck traffic in various parts of the country For instance the rate of heavy axles on routes carrying 1,000 or more trucks daily in the eastern coastal area is about double that in the western States and in the central regions, and the frequency in the Middle Atlantic States is about 25 per cent more than that in the entire east coastal section

Persons interested in traffic have observed that apparently there is a direct relationship between the density of truck traffic and the portion of this traffic that consists of the heavier types of vehicles. It might be reasonable to assume that the gross weights and the percentages of all axle weights in the heavier groups would likewise vary in proportion to the number of units using the road. In this study the available data concerning the variation of the heavier axle loads were investigated and the average relationship, between traffic and the loads, was determined for several main geographic regions and for the country as a whole.

FREQUENCY IN EARLY SURVEYS

During the highway planning surveys conducted in each State between 1936 and 1941, a large amount of valuable data was collected concerning axle loads. This information, which is representative of the prewar years, is still available to the States, but unfortunately, frequency tables were prepared from the data by the planning surveys in only six scattered States: Florida, Maryland, Nevada, Oklahoma, South Dakota, and Virginia. The series of tables prepared by Maryland showed a relationship between the amount of traffic and the frequency of the heavy axle loads that was approximately typical of that furnished by the other five States In this early survey it was found upon analyzing data collected at 54 stations that on low traffic roads carrying up to 250 commercial vehicles daily, the average rate of axles weighing 18,000 lb or more was six for each 1,000 trucks and combinations passing the survey stations, while on roads carrying between 1,000 and 2,000 trucks daily the number of these heavy axles per 1,000 trucks and combinations was 35. A like comparison of axles weighing 16,000 lb. and over showed a frequency of 21 per 1,000 trucks on the lightly

[1] Data compiled and analyzed by Miss Mary E. Kipp, Statistician and Mrs Mary S Austin, Highway Economist

traveled routes and 122 on the heavily traveled highways; and a distribution of those weighing 14,000 lb. or over, shows 48 on the light traffic sections compared to 288 on the heavy traffic portions. Frequency of heavy axles on the high traffic sections is roughly six times the frequency of such axles on the lower traffic routes.

Subsequent to the original survey in Maryland, the axle load restrictions were raised from 18,000 to 22,400 lb. With the higher limit in force, a survey made at 10 stations in 1944 indicated that the frequency of 18,000-, 16,000-, and 14,000-lb. axles had increased at high traffic stations from 35 to 237, from 122 to 405, and from 288 to 634 axles, respectively, for each 1,000 vehicles The frequency of the 18,000-lb. axles had increased almost seven times, of the 16,000-lb. axles three times, and of the 14,000-lb. axles two times. This comparison is only approximate, inasmuch as the earlier data covered the entire year at a large number of stations, whereas the later data were collected at a smaller number of locations in the summer season only. It is not inconsistent, however, with similar data for all stations used in the later survey, which show, when compared with information collected at the same stations in the earlier period, that the axles weighing 18,000 lb. or more had increased seven times, the 16,000-lb. axles four times, and the frequency of those weighing 14,000-lb. or more had increased two and one-half times

In addition to the reports from the six States referred to, a special report was received from California listing the percentage of axle loads by weight groups for each of 231 weight stations. Truck traffic density at each station was furnished in another report, the data from the two separate reports giving complete information for calculating the heavy-axle load ratio in this important trucking area Briefly, this information indicated a variation in frequency that was approximately the same as that found in Maryland for the 1936–1937 period, although the actual frequency in California was about one-half as large as the Maryland occurrences for similar traffic volume groups For instance, the low traffic roads were found to have carried four axles weighing 18,000 lb. or more while the high traffic roads carried 13, a frequency of 14 weighing 16,000 lb. or more on the low traffic routes compared to 48 on the high traffic highways, and 42 axles weighing 14,000 lb. or more on the low traffic routes to 146 on the high traffic routes for each 1,000 vehicles passing the stations The percentage frequencies of the heavier axles were, therefore, approximately four times as great on the high traffic routes as on those carrying small volumes. A comparison cannot be made between the 1936–1937 information collected in California and the frequency data collected in a 1944 survey in that area, for the stations used in the later survey were located, in most cases, at new points not previously used for weighing purposes.

WARTIME FREQUENCY

In the summer of 1942, at the request of the Public Roads Administration, the States collected weight data at a few representative loadometer stations, mainly for the purpose of determining trucking trends. These surveys were continued in succeeding years and while they are single counts, taken for one 8-hr. day at each location, in the summer only, they are a source of much valuable information obtained in a common period for all sections of the country. From three portions of the reports, which were submitted on a uniform basis by each State making these summer weight surveys, information can be obtained concerning the frequency of heavy axle loads. Data collected in 1944 were selected because they were the latest on which complete reports had been made. To augment the 1944 figures, 1943 data obtained in North Carolina, South Carolina, and Iowa (in which no surveys were conducted in 1944) were added to the later information Thus a sample was obtained which omits information from only Florida, Oregon, and Virginia, in which surveys were made in neither year

In the 1944 survey, traffic was generally counted for 8 hr. either from 6 a m to 2 p m or 2 p m to 10 p m. All counts were converted to a 24-hr. basis by correlation with available density counts and grouped in several significant average daily truck-traffic classification groups.

The axle frequency data are analyzed in this report for the United States as a whole, and for each census region. The census regions were grouped into three main geographical divisions, the Western States, Central States and the Eastern Seaboard. The two census regions where the heaviest axle loads were permitted, the Middle Atlantic and the New England regions, are discussed specifically. The coverage on this short survey was not sufficient to justify presentation of the data separately for each State.

weights allowed in the heavy trucking area of California and surrounding States, it is noteworthy that the frequency of heavy axles in this section is consistently low in all weight groups. Larger gross weights in this area are generally distributed over a larger number of axles and, therefore, the load on an individual axle is not necessarily large.

As was done in the analysis of the earlier data, the frequencies of axle loads for each

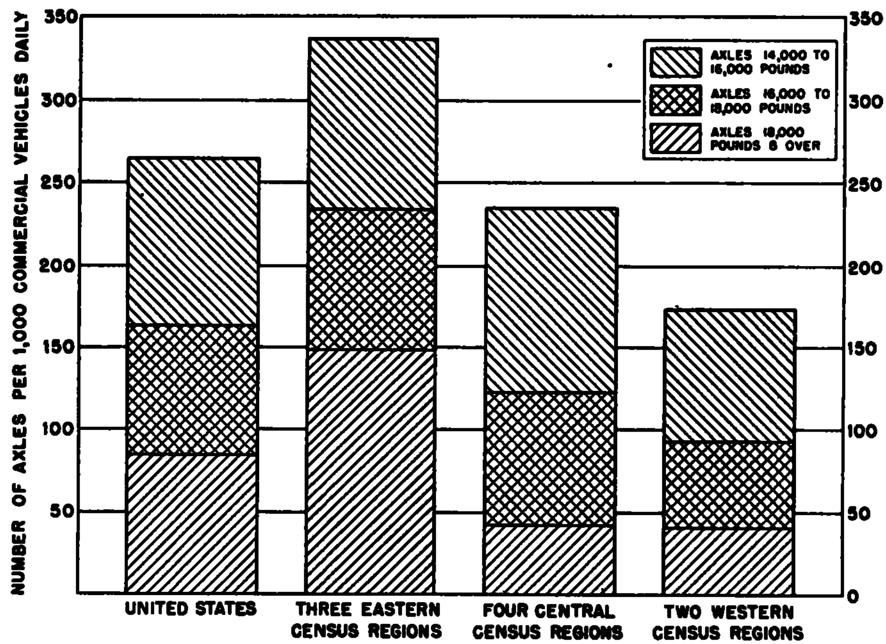

Figure 1. Frequency of Heavy Axles per 1,000 Commercial Vehicles by Axle Weight Groups

FREQUENCY IN MAIN GEOGRAPHICAL AREAS

The differences in axle load frequencies per 1,000 commercial vehicles in the three main geographical sections of the United States and their comparison to the country as a whole is illustrated by Figure 1. From this chart it is apparent that the average highway in the Eastern Seaboard States carries a far higher percentage of heavy axles than those in the other two sections. The frequency of axle loads of 18,000 lb. and over, in this eastern area, runs 76 per cent above the rate in the United States as a whole. Axle weights of 16,000 lb. and over and of 14,000 lb. and over are likewise more frequently found on highways in the east than in other sections of the country. Despite the high maximum gross 1,000 trucks and combinations passing the weight stations were determined for three weight groups, axles weighing 18,000 lb. and over, those weighing 16,000 lb. and over, and those weighing in excess of 14,000 lb. One chart has been prepared showing the variation of the rate of heavy axles per 1,000 passing trucks to illustrate the relationship between axle load frequency on roads carrying a low volume of trucks and combinations, and those carrying a larger volume. The others show the absolute relationship between the number of axles and the volume of commercial traffic, as this generally will be the relationship most useful for design purposes.

The frequency of axles for each 1,000 commercial vehicles in the three axle weight groups at all weight stations in the entire country, is shown in Figure 2 The curves given on this chart indicate that the estimated rate of axles weighing 18,000 lb. and over varies from less than one on low traffic roads to 155 axles at an average station carrying between 1,500 and 2,000 commercial vehicles daily. Similarly the axles weighing 16,000 lb or more varied from 31 to 275 and the 14,000-lb. axles varied from 162 on the low traffic sections to 382 on those sections carrying the higher traffic. For the comparatively few road sections carrying over 2,000 commercial

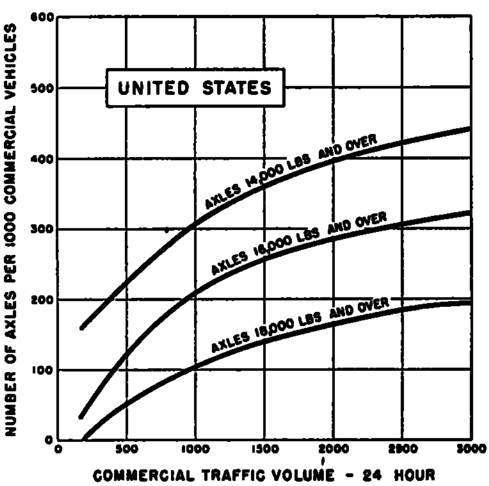

Figure 2. Estimated Frequency of Heavy Axles per 1,000 Commercial Vehicles.

vehicles daily, the data indicate a still greater frequency of heavy axle loads The average commercial traffic at all stations was 500 trucks and combinations and the axle frequency (average) was 50 axles of 18,000 lb or more, 127 axles of 16,000 lb. or more, and 220 axles of 14,000 lb or more for each 1,000 vehicles passing the survey stations

The absolute relationship between the number of heavy-axle loads and the volume of commercial traffic is shown in Figure 3 for the United States. While Figure 2 showed the change in the rate per 1,000 vehicles of axle weights in the three groups according to the volume of traffic, Figure 3 shows the estimated number of axles, of the three weight groups being discussed, which may be expected on the average road section for any given commercial traffic volume.

Inasmuch as there are wide variations between traffic in various sections of the country, such a relationship as that illustrated by Figures 1 and 2 is not particularly significant but it is interesting as an over-all picture of the frequency throughout the country and

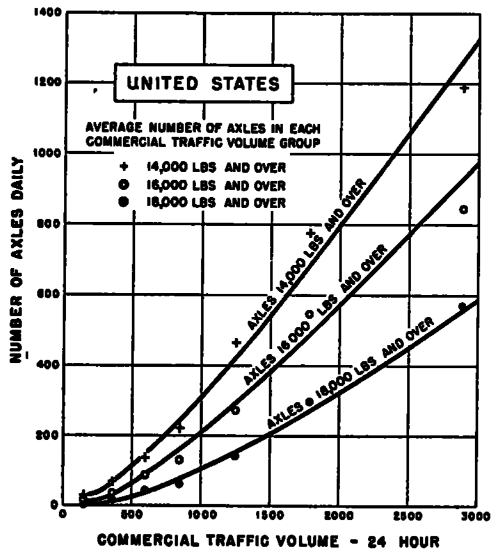

Figure 3

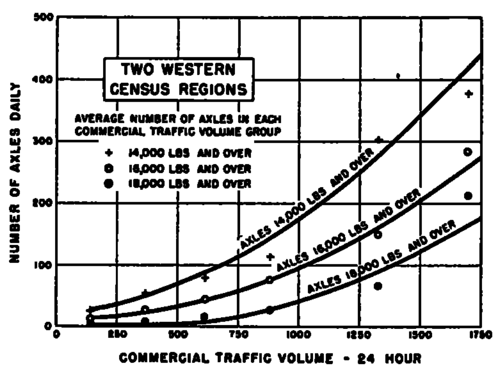

Figure 4

useful as a check on the variations to be found in any one area Each region exhibited different characteristics in truck traffic, which sometimes varied widely from those in other regions. Obviously, then, the characteristics of heavy-axle load frequencies are local in type, are influenced by factors and conditions peculiar to the particular region, and must be analyzed separately.

Figure 4 shows the variation of the frequency of axles in the three weight groups in the 11 Western States which comprise the Pacific and Mountain census regions. In this area axle loads in excess of 18,000 lb. are not generally permitted except in Nevada

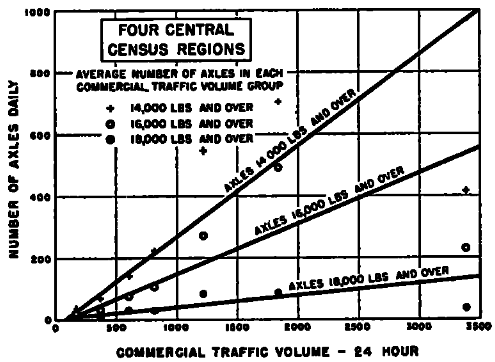

Figure 5

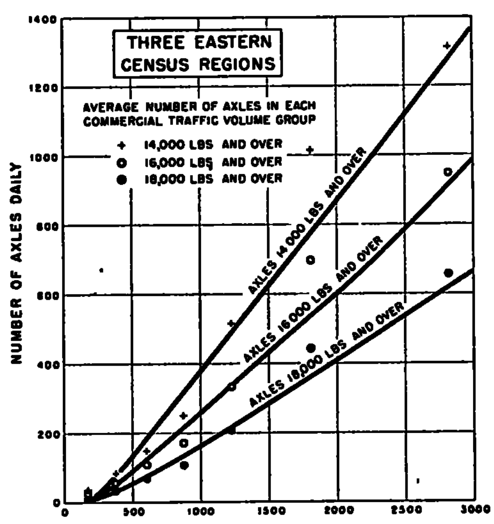

Figure 6

Notwithstanding these restrictions, a frequency for 18,000-lb. axles of 9 for each 1,000 passing trucks was indicated at the average station. The estimated frequency of 16,000- and 14,000-lb. axles was 62 and 134 axles, respectively. Table 3 shows that, for the highest traffic volume group found in the Western States, that is, 1,500 to 2,000 trucks daily, an estimated frequency for each 1,000 commercial vehicles of 97, 153, and 247 axles was found for the three axle load groups described.

Figure 5 indicates the variations which were found in the load frequencies in the Central States In this area axles over 18,000 lb were not permitted except in Wisconsin, where 19,000 lb. were allowed on a single axle, and in Oklahoma and South Dakota, where no restrictions on axle loads were in effect. In this area, with an average traffic of 441 trucks daily, the 18,000-lb. axles averaged 41 for each 1,000 commercial vehicles on all sections of highway. The number of axles of 16,000 lb. or more on all main roads averaged 122 for each 1,000 trucks, while the rate of such axles on the highest commercial traffic routes was 155, as shown in Table 3. Likewise the rate of axles weighing 14,000 lb or more was 234 on the average road and increased in direct proportion to the daily commercial traffic volume to 280 axles in the high traffic volume group.

The variation in frequencies in the three eastern regions is shown in Figure 6. The States in which there was no legal restriction on axle weights in 1944 or in which the legal maximum exceeded 18,000 lb. were mainly those on the Eastern Seaboard. Consistent with this fact, Table 3 shows that the greatest number of axle loads 18,000 lb. and over for each 1,000 passing trucks was found in this area. Here, too, was found a wider range of daily commercial traffic and an average daily commercial volume 58 per cent greater than that in the central regions and 87 per cent greater than that in the western regions.

In the eastern area, with an average truck traffic of 697 commercial vehicles daily, the estimated frequency of axles weighing 18,000 lb. or more was 148 for each 1,000 vehicles at the average station and increased to a rate of 219 such axles on roads carrying 2,000 or more trucks and combinations daily. The number of axles weighing 16,000 lb. or more for each 1,000 trucks was 222 on the average road and 321 at the highest commercial traffic volume stations. At the same time the number of axles weighing 14,000 lb or more for each 1,000 trucks was 330 on the average road and 452 on the high traffic routes

The rate of axles of 18,000 lb. and over on all sections carrying 1,000 or more trucks daily in the East Coast area is four times the ratio occurring in the central regions and three times greater than that in the western regions The rate of other heavy axle weights in this area was correspondingly higher than those in the other two sections of the country

heavy axles at an average station was 191, 272, and 390 for the three weight groups, respectively.

As indicated by a high index of correlation, the curves fitted the actual data in a highly satisfactory manner At some points, however, the frequencies in the higher traffic volume groups were somewhat erratic. This variation from the normal trend was caused by the data from a few high traffic stations in or near urban centers, as for instance the one on U S 9 in Jersey City, north of Tonnelle Circle. At this one location the frequency of 18,000-lb. axles was surprisingly low being 133 for each 1,000 passing trucks while the average of all others in this high

TABLE 1

NUMBER OF AXLES EXCEEDING SPECIFIED WEIGHTS IN EACH COMMERCIAL TRAFFIC VOLUME GROUP BY GEOGRAPHICAL AREAS, BASED ON DATA AS REPORTED[1]

Average daily commercial traffic	Number of weight stations	Average daily commercial traffic	Axles 18,000 lb and over		Axles 16,000 lb and over		Axles 14,000 lb and over	
			Number of axles in group	Number per 100 commercial vehicles	Number of axles in group	Number per 100 commercial vehicles	Number of axles in group	Number per 100 commercial vehicles
East Coastal Area								
0- 249	19	175	11	6 20	25	14 29	37	21 14
250- 499	49	377	35	9 28	58	15 38	82	21 75
500- 749	37	602	67	11 13	107	17 77	147	24 42
750- 999	19	878	107	12 19	172	19 59	250	28 47
1,000-1,499	16	1,233	206	16 71	333	27 01	515	41 77
1,500-1,999	4	1,806	443	24 53	698	38 65	1,014	56 15
2,000 and over	6	2,817	657	23 32	944	33 51	1,314	46 64
Central Area								
0- 249	65	175	6	3 43	20	11 43	35	20 00
250- 499	102	369	13	3 52	34	9 21	67	18 16
500- 749	39	602	30	4 98	75	12 46	140	23 26
750- 999	19	814	29	3 56	109	13 39	221	27 15
1,000-1,499	7	1,218	84	6 90	273	22 41	544	44 66
1,500-1,999	2	1,834	86	4 69	490	26 72	703	38 33
2,000 and over	1	3,377	37	1 10	227	6 72	416	12 32
Western Area								
0- 249	65	144	4	2 78	13	9 03	25	17 36
250- 499	34	373	9	2 41	27	7 24	54	14 48
500- 749	8	613	16	2 61	44	7 18	79	12 89
750- 999	5	884	27	3 05	75	8 48	115	13 01
1,000-1,499	8	1,326	67	5 05	151	11 39	303	22 85
1,500-1,999	2	1,690	214	12 66	284	16 80	378	22 37
2,000 and over								
Total—United States								
0- 249	149	161	6	3 73	18	11 18	31	19 25
250- 499	185	372	18	4 84	39	10 48	69	18 55
500- 749	84	603	45	7 46	86	14 26	137	22 72
750- 999	43	850	63	7 41	133	15 65	221	26 00
1,000-1,499	31	1,254	143	11 40	272	21 69	466	37 16
1,500-1,999	8	1,784	297	16 65	543	30 44	777	43 55
2,000 and over	7	2,897	568	19 61	842	29 06	1,186	40 94

[1] Based on 1944 loadometer data except in North Carolina, South Carolina, and Louisiana, where 1943 data were used Data not available from Florida, Oregon, and Virginia

In view of the greater frequency of high traffic volumes and the general absence of stringent restrictions on heavy axle loads, the Eastern census regions were analyzed separately. The relation between traffic and heavy axle frequency in the Middle Atlantic region are shown in Figure 7 and Table 4. In this area the average truck traffic was 841 vehicles and the estimated frequency of

TABLE 2

NUMBER OF AXLES EXCEEDING SPECIFIED WEIGHTS IN EACH COMMERCIAL TRAFFIC VOLUME GROUP BY CENSUS REGIONS, BASED ON DATA AS REPORTED[1]

Average daily commercial traffic	Number of weight stations	Average daily commercial traffic	Axles 18,000 lb and over		Axles 16,000 lb and over		Axles 14,000 lb and over	
			Number of axles in group	Number per 100 commercial vehicles	Number of axles in group	Number per 100 commercial vehicles	Number of axles in group	Number per 100 commercial vehicles
New England Region								
0- 249	8	172	12	6 98	27	15 70	37	21 51
250- 499	10	379	36	9 50	40	10 55	55	14 51
500- 749	15	637	64	10 05	105	16 48	145	22 76
750- 999	5	911	119	13 06	182	19 98	266	29 20
1,000-1,499	4	1,219	184	15 09	293	24 04	402	32 98
1,500-1,999								
2,000 and over	1	2,332	451	19 34	660	28 30	891	38 21
Middle Atlantic Region								
0- 249	3	141	1	0 71	3	2 13	3	2 13
250- 499	19	370	41	11 08	60	16 22	70	18.92
500- 749	9	592	114	19 26	170	28 72	202	34 12
750- 999	10	884	130	14 71	192	21 72	262	29 64
1,000-1,499	8	1,301	237	18 22	353	27 13	554	42 58
1,500-1,999	1	1,664	398	23 92	434	26 08	478	28 72
2,000 and over	4	2,927	694	23 71	881	30 10	1,226	41 89
South Atlantic Region								
0- 249	8	190	14	7 37	32	16 84	51	26 84
250- 499	20	382	30	7.85	66	17 28	107	28 01
500- 749	13	570	36	6 32	64	11 23	110	19 30
750- 999	4	821	35	4 26	108	13 15	200	24 36
1,000-1,499	4	1,111	167	15 03	335	30 15	549	49 41
1,500-1,999	3	1,854	446	24 06	798	43 04	1,193	64 35
2,000 and over	1	2,854	715	35 04	1,478	51 79	2,090	73 23
East North Central Region								
0- 249	11	196	9	4 59	40	20 41	68	34 69
250- 499	27	393	20	5 09	53	13 49	106	26 97
500- 749	13	583	42	7 20	115	19 73	219	37 56
750- 999	9	811	37	4 56	132	16 28	282	34 77
1,000-1,499	6	1,242	98	7 89	312	25 12	622	50.08
1,500-1,999	2	1,834	86	4 69	490	26 72	703	38 33
2,000 and over								
West North Central Region								
0- 249	35	160	4	2 50	17	10 63	28	17 50
250- 499	27	352	13	3 69	39	11 08	74	21 02
500- 749	5	564	25	4 43	94	16 67	174	30 85
750- 999	6	821	27	3 29	126	15 35	236	28 75
1,000-1,499								
1,500-1,999								
2,000 and over	1	3,377	37	1 10	227	6 72	416	12 32
East South Central Region								
0- 249	15	186	5	2 69	13	6 98	26	13 98
250- 499	21	363	7	1 93	17	4 68	40	11 02
500- 749	6	612	34	5 56	58	9 48	108	17 65
750- 999	2	834	10	1 20	24	2 88	53	6 35
1,000-1,499	1	1,077	0		39	3 62	78	7 24
1,500-1,999								
2,000 and over								
West South Central Region								
0- 249	4	212	7	3 30	19	8 96	33	15 57
250- 499	27	326	8	2 45	23	6 25	42	11 41
500- 749	15	625	19	3 03	40	6 37	74	11 78
750- 999	2	786	16	2 04	36	4 58	69	8 77
1,000-1,499								
1,500-1,999								
2,000 and over								

TABLE 2—*Concluded*

Average daily commercial traffic	Number of weight stations	Average daily commercial traffic	Axles 18,000 lb and over		Axles 16,000 lb. and over		Axles 14,000 lb and over	
			Number of axles in group	Number per 100 commercial vehicles	Number of axles of group	Number per 100 commercial vehicles	Number of axles in group	Number per 100 commercial vehicles
Mountain Region								
0- 249	57	140	3	2 14	11	7 86	23	16 43
250- 499	26	363	8	2 20	24	6 61	49	13 50
500- 749	6	606	13	2 15	34	5 61	66	10 89
750- 999	3	885	25	2 82	84	9 49	137	15 48
1,000-1,499	1	1,165	49	4 21	108	9 27	142	12 19
1,500-1,999								
2,000 and over								
Pacific Region								
0- 249	8	170	14	8 24	25	14 71	43	25 29
250- 499	8	406	11	2 46	36	8 87	69	17 00
500- 749	2	632	25	3 96	72	11 39	118	18 67
750- 999	2	883	30	3 40	62	7 02	81	9 17
1,000-1,499	7	1,349	70	5 19	157	11 64	326	24 17
1,500-1,999	2	1,690	214	12 66	284	16 80	378	22 37
2,000 and over								

[1] Based on 1944 loadometer data except in North Carolina, South Carolina, and Lousiana, where 1943 data were used Data not available from Florida, Oregon, and Virginia

TABLE 3

PROBABLE NUMBER OF AXLES EXCEEDING SPECIFIED WEIGHTS IN EACH COMMERCIAL TRAFFIC VOLUME GROUP BY GEOGRAPHICAL AREAS, BASED ON TREND CURVES[1]

Average daily commercial traffic	Average daily commercial traffic volume	Number per 100 commercial vehicles			Average daily commercial traffic volume	Number per 100 commercial vehicles		
		Axles 18,000 lb and over	Axles 16,000 lb and over	Axles 14,000 lb and over		Axles 18,000 lb and over	Axles 16,000 lb and over	Axles 14,000 lb and over
	East Coastal Area				**Central Area**			
0- 249	175				175	4 13	5 63	13 94
250- 499	377	8 22	14 32	20 95	369	4 06	11 36	22 07
500- 749	602	12 46	20 60	30 73	602	4 03	13 36	24 90
750- 999	878	15 38	24 49	36 22	814	4 02	14 19	26 07
1,000-1,499	1,233	17 60	27 25	39 74	1,218	4 01	14 96	27 17
1,500-1,999	1,806	19 77	29 80	42 69	1,834	4 01	15 49	27 92
2,000 and over	2,817	21 87	32 13	45 19	3,377	4 00	15 96	28 59
	Western Area				**Total—United States**			
0- 249	144		9 72	18 06	161		3 11	16 15
250- 499	373	0.86	6 17	13 40	372	3 49	9 41	18 82
500- 749	613	1 60	7 18	14 36	603	6 30	14 93	24 38
750- 999	884	3 34	8 71	16 63	850	9 18	19 18	28 82
1,000-1,499	1,326	6 74	12 22	20 89	1,254	12 52	23.76	33 89
1,500-1,999	1,690	9 74	15 32	24 73	1,784	15 47	27 47	38.23
2,000 and over					2,897	19 23	32 03	43 56

[1] Estimations based on 1944 loadometer data except in North Carolina, South Carolina, and Lousiana, where 1943 data were used Data not available from Florida, Oregon, and Virginia

traffic group was 288 axles. The heavy vehicles at this location were relatively less prominent in a traffic that involved many delivery trucks and similar city-type vehicles.

The least variation of axle-load frequencies from the trend curve was found in the New England area, Figure 8. Here only small variations from a smooth curve were found for practically all traffic groups. Association as measured by the indices of correlation was high, being around 90 per cent for each axle weight group, with 100 per cent indicating a perfect relationship The average traffic at all stations was 616 trucks and combinations daily. Table 4 shows that the rate of axles weighing 18,000 lb. or more for each 1,000

TABLE 4

PROBABLE NUMBER OF AXLES EXCEEDING SPECIFIED WEIGHTS IN EACH COMMERCIAL TRAFFIC VOLUME GROUP BY CENSUS REGION, BASED ON TREND CURVES[1]

Average daily commercial traffic	Average daily commercial traffic volume	Number per 100 commercial vehicles: Axles 18,000 lb and over	Axles 16,000 lb and over	Axles 14,000 lb and over
	New England Region			
0- 249	172	6 40	9 88	12 79
250- 499	379	7 39	11 87	16 62
500- 749	637	10 68	16 64	23 23
750- 999	911	13 06	20 09	27 88
1,000-1,499	1,219	15 01	22 97	31 75
1,500-1,999				
2,000 and over	2,332	19 43	28 82	39 45
	South Atlantic Region			
0- 249	190	7 37	18 42	24 21
250- 499	382	4 97	10 73	19 63
500- 749	570	7 54	15 09	26 84
750- 999	821	11 33	22 17	36 54
1,000-1,499	1,111	15 03	29 25	45 81
1,500-1,999	1,854	21 09	40 94	60 73
2,000 and over	2,854	26 00	50 42	72 70
	East South Central Region			
0- 249	186	3 76	8 06	17 74
250- 499	363	2 75	6 06	12 67
500- 749	612	2 12	5 23	10 78
750- 999	834	1 92	5 04	10 07
1,000-1,499	1,077	1 86	4 83	9 56
1,500-1,999				
2,000 and over				
	West South Central Region			
0- 249	212	1 89	5 66	10 38
250- 499	368	2 45	6 25	11 41
500- 749	628	2 87	6 53	11 78
750- 999	786	2 93	6 62	11 96
1,000-1,499				
1,500-1,999				
2,000 and over				
	Pacific Region			
0- 249	170		5 91	16 91
250- 499	406	3 99	10 44	20 11
500- 749	632	5 66	11 60	20 94
750- 990	883	6 52	12 20	21 36
1,000-1,499	1,349	7 26	12 72	21 73
1,500-1,999	1,690	7 55	12 92	21 87
2,000 and over				

Average daily commercial traffic	Average daily commercial traffic volume	Number per 100 commercial vehicles: Axles 18,000 lb and over	Axles 16,000 lb and over	Axles 14,000 lb and over
	Middle Atlantic Region			
0- 249	141			
250- 499	370	10 54	16 76	19 73
500- 749	592	16 65	24 49	34 12
750- 999	884	19 34	27 38	39 25
1,000-1,499	1,301	20 60	28 29	40 66
1,500-1,999	1,664	21 03	28 24	40 26
2,000 and over	2,927	21 18	27 09	37 58
	East North Central Region			
0- 249	196	5 61		13 27
250- 499	393	5 85	14 50	30 28
500- 749	583	6 00	18 70	35 85
750- 999	811	6 17	21 21	38 96
1,000-1,499	1,242	6 20	23 43	41 79
1,500-1,999	1,834	6 22	24 81	43 57
2,000 and over				
	West North Central Region			
0- 249	160	5 00	15 00	28 13
250- 499	352	3 13	11 65	21 59
500- 749	564	2 66	10 64	19 68
750- 999	821	2 31	10 11	18 64
1,000-1,499				
1,500-1,999				
2,000 and over	3,377	1 84	9 12	16 94
	Mountain Region			
0- 249	140	2 15	7 05	16 16
250- 499	363	2.55	7 33	13 46
500- 749	606	2 65	7 40	12 78
750- 999	885	2 70	7 44	12 46
1,000-1,499	1,165	2 72	7 45	12 30
1,500-1,999				
2,000 and over				
	Total—United States			
0- 249	161		3 11	16 15
250- 499	372	3 49	9 41	18 82
500- 749	603	6 30	14 93	24 38
750- 999	850	9 18	19 18	28 82
1,000-1,499	1,254	12 52	23 76	33 89
1,500-1,999	1,784	15 47	27 47	38 23
2,000 and over	2,997	19 23	32 03	43 56

[1] Estimations based on 1944 loadometer data except in North Carolina, South Carolina, and Louisiana, where 1943 data were used. Data not available from Florida, Oregon, and Virginia.

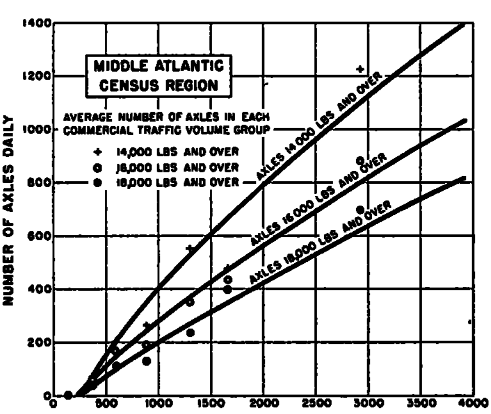

Figure 7

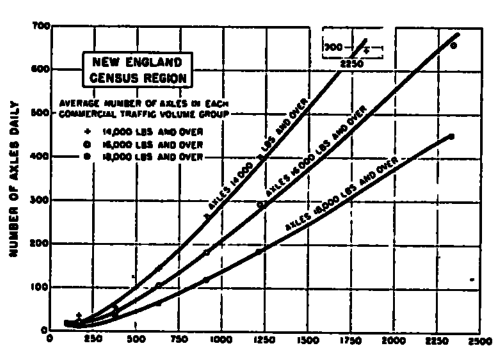

Figure 8

such vehicles varied from 64 axles at low traffic stations to 194 at stations carrying 2,000 or more trucks daily, with an average rate of 120 at all stations The rate of axles weighing 16,000 lb or more varied in like manner from 99 at the low-count stations to 288 at the high traffic stations with an average rate of 187 Likewise the rate of axles weighing 14,000 lb or more increased from 128 at the low count stations to 395 at stations carrying the larger commercial traffic, the average at all stations being 258 axles per 1,000 commercial vehicles

CONCLUSIONS

The study of the information in all regions indicates a consistent trend for all three axle weight groups Although there were some inconsistencies between actual and estimated numbers of axles in the lower volume section of the curves for some regions, the trend curve appear to be satisfactory in the middle volume and higher volume sections Tables accompanying this study present the complete variations as reported and as based on trend curves

The investigation of the data indicates need for a study concerning the variation in the frequencies of heavy axle loads in relation to traffic in the proximity of urban areas Such a study is not practicable at present due to the limited data available, but regular or special surveys in the future must be so designed as to obtain this information fully. The indices of correlation computed for the trends in each region indicate, however, that for rural areas, a sufficient degree of reliability was attained to justify the use of this information for design purposes

PLANNING PUBLIC TRANSPORTATION ON URBAN EXPRESSWAYS

By Leslie Williams, *City Planning Engineer,*
American Transit Association

SYNOPSIS

The author sets forth in this paper the broad public interests which would be served and the types of public transportation service which could be rendered by operating public transportation vehicles—motor buses, trolley coaches and electric cars—on urban expressways.

He also indicates the facilities necessary to permit public transportation to provide an adequate and safe service and advocates the incorporation of turnouts, off the travelled roadways, for free-wheel rubber-tired transit vehicles and rails and transfer stations in the central malls where traffic volume warrants. He suggests that these improvements be financed, as are highways, through taxation because such provisions are essential features of the highway, built for the convenience and safety of the public, and persons using public transportation, presumably, pay their fair share of the taxes used for highway improvements

The author points out that by combining expressway design features, including turnouts and transfer stations, a highway is produced, which, on a passenger miles basis, is safer and generates more capacity per construction dollar spent

The paper contains a warning to the effect that opportunities for reducing urban traffic congestion and for promoting sound community development will be lost if urban expressways are not located so that public transportation can make full use of them

The Federal aid act of 1944 which provides $125,000,000 a year for 3 years for highways within urban areas, has brought to the fore many questions in the design of urban expressways Before detailed design can be undertaken some far-reaching questions of