

WARTIME CHANGES IN VOLUME AND COMPOSITION OF TRAFFIC ON RURAL ROADS IN THE UNITED STATES

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SYNOPSIS

During the summer of 1942, the highway departments of 46 states, in cooperation with the Public Roads Administration, conducted a special survey to aid in determining wartime changes in the volume and composition of traffic. In this survey, more than 500,000 vehicles were counted and classified and more than 50,000 trucks were weighed at 486 stations operated for eight hours each. Data from this special survey were combined with data from the original highway planning survey, made in the 1936-1940 period, and from subsequent continuing operations including the records of over 500 automatic traffic recorders now operating continuously throughout the United States, in order to determine the traffic trends on rural roads.

The ratio of 1942 traffic to 1941 traffic declined month by month from February through August, but increased in September. This is true for the United States as a whole and, with minor exceptions, for all U. S. census regions. Declines were of course greatest in the eastern States in which gasoline rationing has been in effect.

Traffic by all vehicles increased each year from 1936 through 1941, but dropped sharply in 1942. Truck traffic increased at a greater rate in the 1936-1941 period and decreased less from 1941 to 1942. Traffic by truck combinations has increased steadily since 1936, except for a slight 1941 peak and subsequent slight recession, and the increase has been at a more rapid rate than that for truck traffic as a whole.

Since 1940, there has been an increase in the vehicle-miles of empty vehicles, and a decrease in the vehicle-miles of loaded vehicles. This is true for all U. S. census regions except the Pacific region. In two regions, the vehicle-miles of empty vehicles in 1942 equal or exceed the vehicle-miles of loaded vehicles. On a vehicle-mile basis, the per cent loaded has decreased both for single-unit trucks and for combinations, but the decrease has been greater in the case of single-unit trucks.

The average weight of the load carried by loaded vehicles has increased materially in all regions. This increase has been nearly sufficient to offset the loss in vehicle-miles of loaded vehicles, so that the ton-miles of load being carried by truck, for the United States as a whole, is almost as great in 1942 as in 1940. In the Pacific region it is about 22 per cent greater, in the other regions it is about the same as, or smaller than, in 1940.

Since the original loadometer operations in the 1936-1940 period, the frequency of heavy gross weights has increased materially in all regions. The same is true of the frequency of heavy axle loads. In the Pacific region, the frequency of gross weights over 25 tons is much higher than in any other region, but the frequency of heavy axle loads is below the average. In New England, on the other hand, the frequency of heavy gross weights is about average, but the frequency of heavy axle loads is much higher than in any other region.

Since our entrance into the war, a number of things have happened which have had important effects upon the volume and composition of the traffic on rural highways. Restrictions have been placed on the purchase of automobiles, tires and gasoline; legal restrictions on sizes and weights have been lifted or relaxed in

some States, and regulations have been issued by the Office of Defense Transportation. Changes from a peacetime economy to a wartime economy have involved changes in the kind of materials hauled and in their origins and destinations. Hauling to cantonments and war plants during and after construction has

increased to large proportions, while hauling in many other categories has decreased. The net results of these diverse factors are not readily apparent.

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To determine these trends, data from the special 1942 survey were combined with data from the original highway planning survey, and from subsequent continuing operations, including the records of over 500 automatic traffic recorders

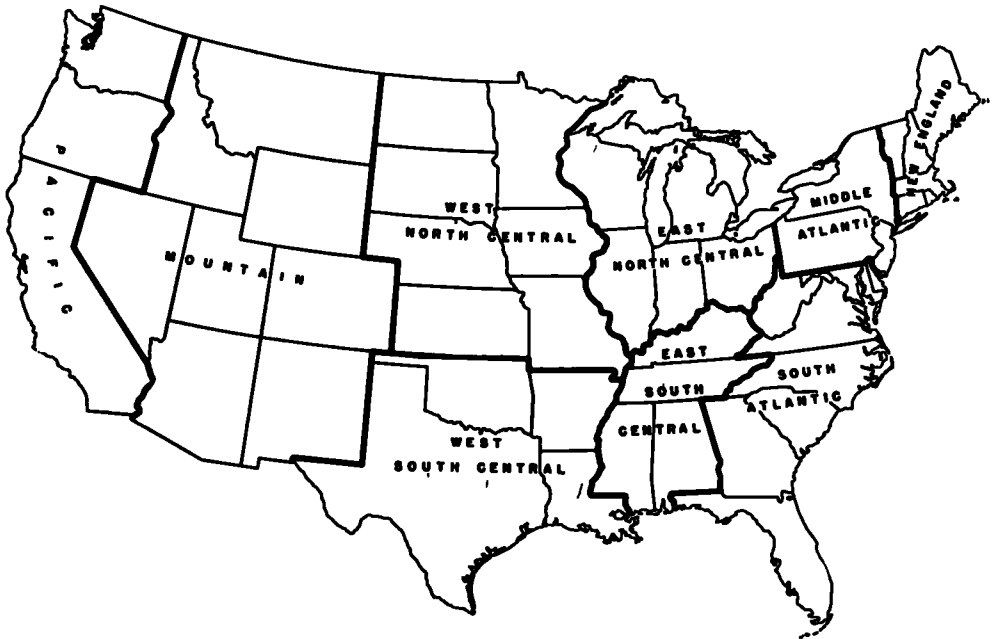


Figure 1. Census Regions of the United States

and classified and more than 50,000 trucks were weighed at 486 stations, operated for eight hours each on weekdays between 6 a m and 10 p m These operations were so scheduled as regards time and place that the data would be strictly comparable with data obtained in the original highway planning survey, made before the war. While short operations of this kind, conducted at a limited number of points, would not yield data representative of traffic at all times of the day, week, and year, on all rural roads, the trends estab-

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tirely wartime trends, as the changes in traffic composition and weights between 1936 and 1940 were by no means negligible. However, trends from the survey year to 1940 had previously been estimated for each State, on the basis of the best available data. The trends from the survey year to 1942, established from the special survey, were combined with the estimated trends from the survey year to 1940 in such a manner as to give estimated trends from 1940 to 1942. Vehicle-miles and ton-miles for 1942 were estimated on the assumption that the trends thus established would be representative of the en-

versal in this trend, probably due mainly to the fact that the normal vacation season had passed and there was therefore less opportunity to eliminate nonessential driving. In both years the traffic volume in September was less than in August, in keeping with the seasonal trend. The decline from August to September was 13 per cent in 1941 and only 5 per cent in 1942, reflecting a smoothing out of the summer peak normally caused by recreational travel.

The ratio of 1942 traffic to 1941 traffic declined month by month from March through August in each general section of

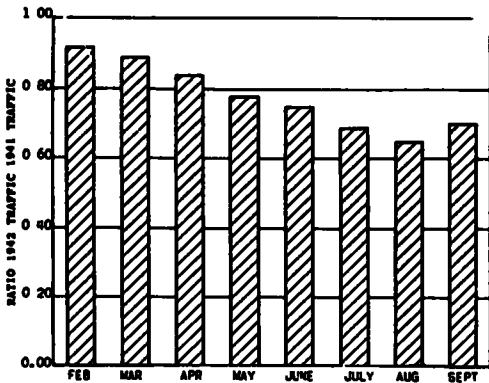


Figure 2. Ratio of Traffic Volume in Months of 1942 to that in Corresponding Months of 1941, on Rural Roads Throughout the United States.

tire year 1942. This is intended more as an aid in visualizing the effect on a year's traffic of the trends observed, than as a prediction.

Automatic traffic recorder data show that, on rural roads in the United States as a whole, the ratio of 1942 traffic to 1941 traffic declined month by month from February through August. Figure 2, in which these records are presented, shows that traffic in February, 1942, was about 92 per cent of that in February, 1941, while that in August, 1942, was only about 65 per cent of that in August, 1941. In September, however, there was a re-

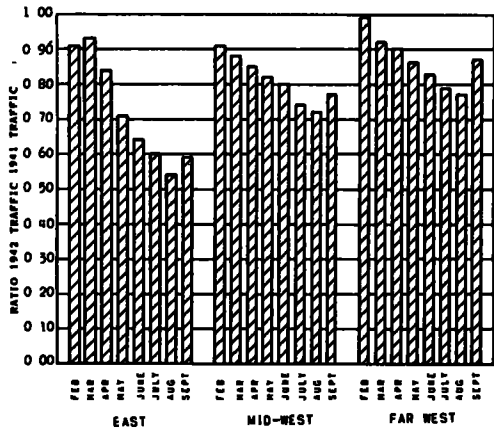


Figure 3. Ratio of Traffic Volume in Months of 1942 to that in Corresponding Months of 1941, on Rural Roads in Each of Three Sections of the United States.

the United States. Figure 3 shows the comparison separately for the East, composed of the three census regions bordering the Atlantic; for the Midwest, composed of the four central regions, and for the Far West, composed of the Mountain and Pacific regions. The decline was naturally greatest in the East, where gasoline rationing was effective. In this region the traffic in August, 1942, was only about 54 per cent of that in August, 1941. The absence of any abrupt decline because of gasoline rationing is undoubtedly due to

the fact that rationing came about gradually. First there was voluntary curtailment of driving; then on March 19, dealer rationing began; on May 15, card rationing was instituted; and on July 22, complete coupon rationing became effective. The decline in the traffic ratio was next greatest in the Midwest, where traffic in August, 1942 was 72 per cent of that in August, 1941; and least in the Pacific region where the corresponding figure was 77 per cent. The September reversal took

Figure 5 shows that traffic by all vehicles increased each year from 1936 through 1941, but dropped sharply in 1942. Truck traffic increased at a slightly greater rate in the 1936-1941 period, and declined less in 1942. Traffic by all vehicles is less in 1942 than in any year of the 1936-1941 period, while truck traffic is greater this year than in 1936, 1937 and 1938, but less than in 1939, 1940 and 1941.

Some typical truck combinations are shown in Figure 6 In Figure 7, the tops

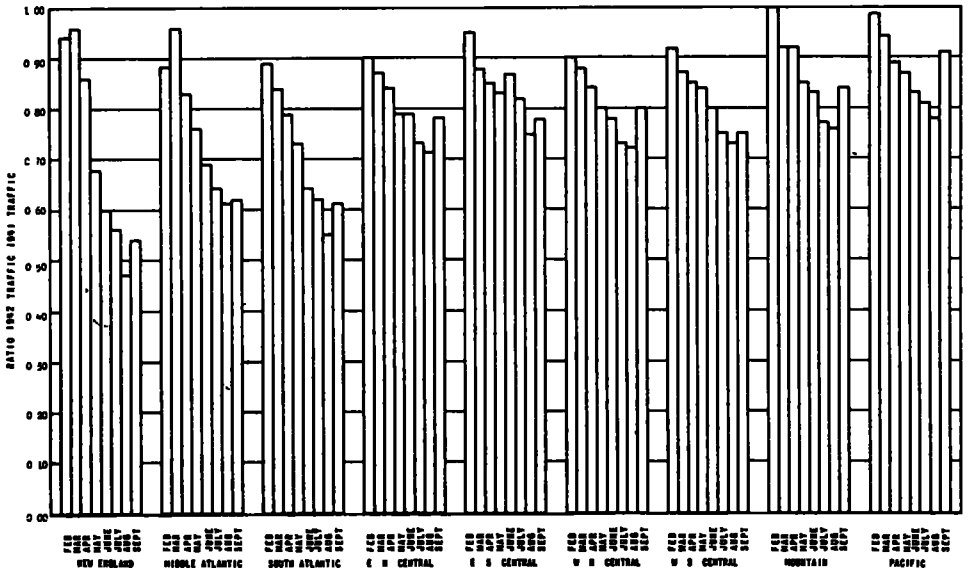


Figure 4. Ratios of Traffic Volume in Months of 1942 to that in Corresponding Months of 1941, on Rural Roads in Each United States Census Region

place in all sections, and was greatest in the Far West.

Figure 4 gives the same information for each census region separately. The trend in the ratio of 1942 traffic to 1941 traffic in each census region corresponds fairly closely with that in the general section of which it is a part. The greatest traffic declines have been in New England which is entirely within the rationed area, and the next greatest declines have been in the Middle Atlantic and South Atlantic regions, which are mostly in the rationed but partly in the nonrationed area

of the bars represent total truck traffic, and the tops of the shaded portions represent traffic by combinations. Traffic by combinations has increased steadily since 1936 except for a slight peak above the trend line in 1941.

Since the special survey made this year was confined to main roads, most of the subsequent discussions will relate to roads of this class. Figure 8 shows that roads classified as "main" constitute only about 12 per cent of the total road mileage, but carry about 72 per cent of the total vehicle-miles, about 69 per cent of the

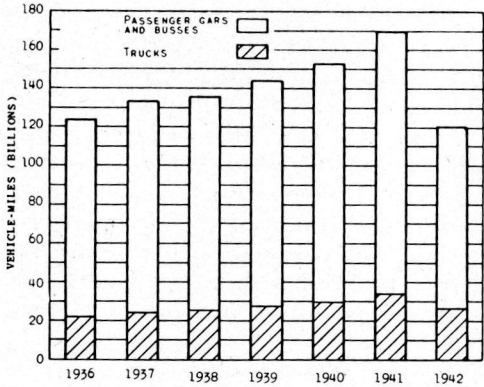


Figure 5. Estimated Vehicle-Miles of All Traffic and of Truck Traffic on All Rural Roads in the United States in Each Year from 1936 to 1942, Inclusive.

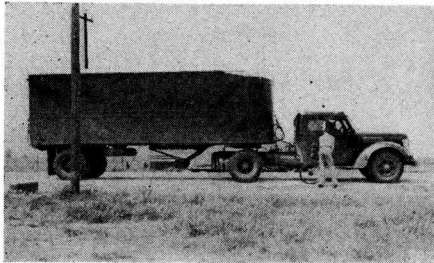


Figure 6. Some Truck Combinations

truck vehicle-miles, and about 79 per cent of the total ton-miles.

Figure 9 shows that, on main rural roads, a larger percentage of both single-

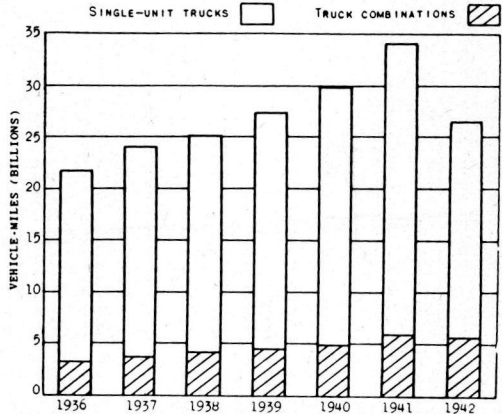


Figure 7. Estimated Vehicle-Miles of Single-Unit Trucks and of Combinations on All Rural Roads in the United States in Each Year from 1936-1942, Inclusive.

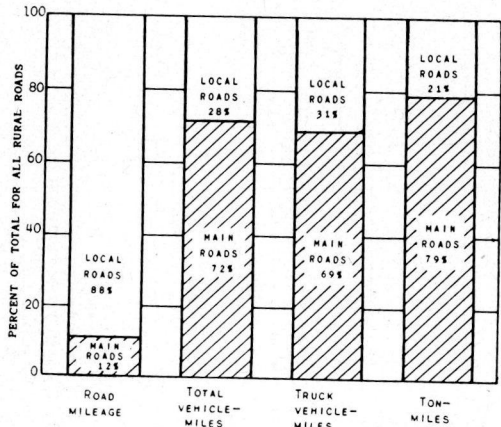


Figure 8. Comparison of Road Mileage, Total Vehicle-Miles, Truck Vehicle-Miles and Ton-Miles of Carried Load on Main Rural Roads with Those on Local Rural Roads, in the Year 1940.

unit trucks and combinations are running empty in 1942 than in 1940. In the case of single-unit trucks, this may be due largely to the use of trucks in lieu of passenger cars; in the case of combina-

tions it is probably due principally to inability to obtain return loads from construction jobs, military establishments, etc

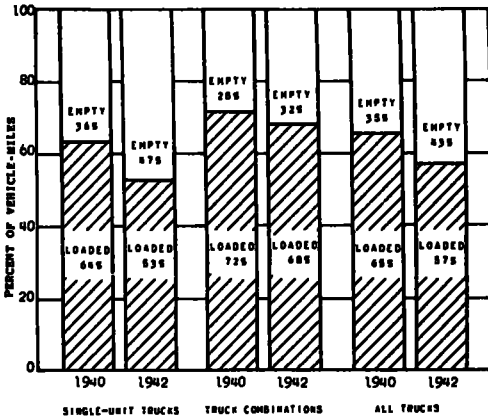


Figure 9. Comparison of Per Cent of Vehicle-Miles Loaded in 1942 with that in 1940, for Single-Unit Trucks and Combinations on Main Rural Roads Throughout the United States.

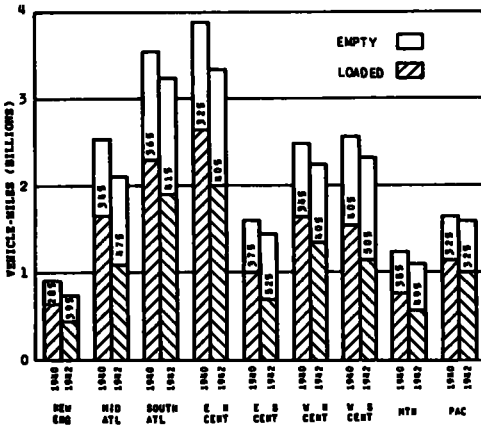


Figure 10. Comparison of Estimated Vehicle-Miles of Empty Trucks and of Loaded Trucks on Main Rural Roads in 1942, with Those in 1940, in Each United States Census Region.

In all regions, total truck traffic and loaded truck traffic are both less this year than in 1940, as shown in Figure 10. In all except the Pacific region, empty truck traffic has increased while loaded truck

traffic has decreased. In the East South Central region and the West South Central region empty truck traffic actually equals or exceeds loaded truck traffic.

Figure 11 shows that the average carried load was higher in 1942 than in 1940 for both single-unit trucks and for combinations. Because of the increased proportion of combinations, the average carried load of all trucks has increased by a greater percentage than that of either type.

Figure 12 shows that, in all regions, the average carried load of all trucks is

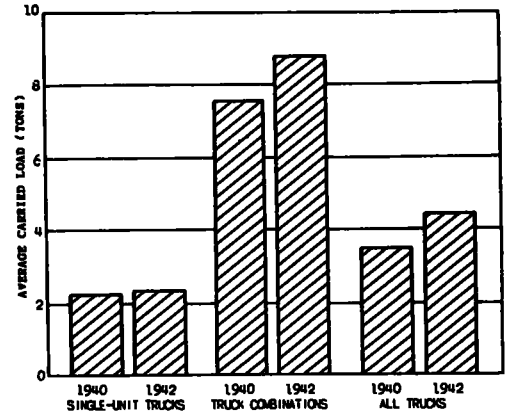


Figure 11. Comparison of Estimated Average Carried Load of Loaded Single-Unit Trucks and Combinations in 1942 with that in 1940, on main rural roads throughout the United States.

greater in 1942 than in 1940. Loads are heaviest in the Pacific region and next heaviest in the East North Central region which includes most of the industrial Midwest.

In the United States as a whole, the decrease in loaded vehicle-miles has been nearly offset by the increase in carried load so that the ton-miles of carried load, represented by area in Figure 13, is almost as great in 1942 as in 1940.

Figure 14 shows these relationships by vehicle type. The vehicle-mileage of loaded single-unit trucks has decreased

considerably, and the average carried load has increased only slightly with a resultant large loss in ton-miles of load carried by vehicles of this type. On the other hand,

unit trucks, while in 1942 the combinations carry about 74 per cent more than the single-unit trucks

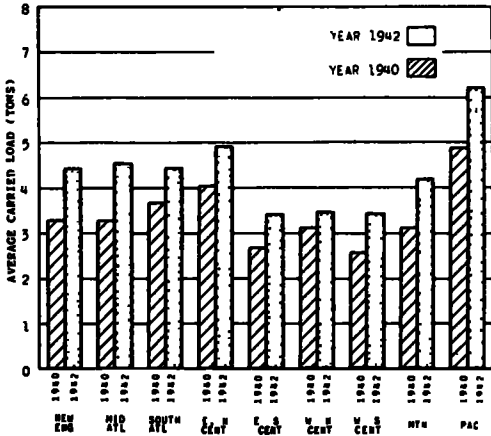


Figure 12. Comparison of Estimated Average Carried Load of Loaded Trucks in 1942 with that in 1940, on Main Rural Roads in Each United States Census Region.

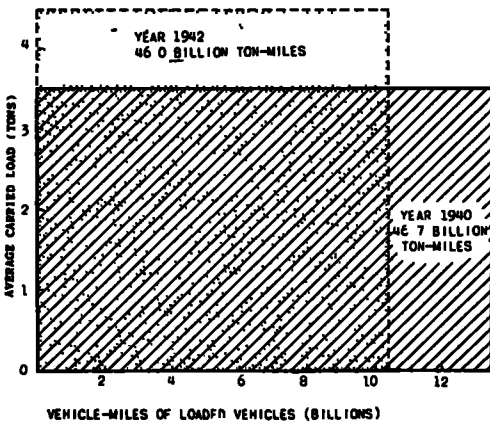


Figure 13. Comparison of Estimated Ton-Miles in 1942 with Those in 1940, on Main Rural Roads in the United States.

both the loaded vehicle-mileage and the average carried load of combinations have increased and the ton-miles of load carried has increased correspondingly. In 1940, the ton-miles carried by combinations was about the same as that carried by single-

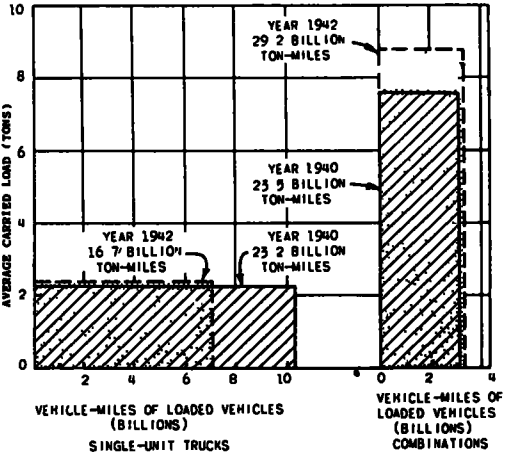


Figure 14. Comparison of Estimated Ton-Miles Carried by Single-Unit Trucks and by Combinations in 1942 with Those in 1940, on Main Rural Roads in the United States.

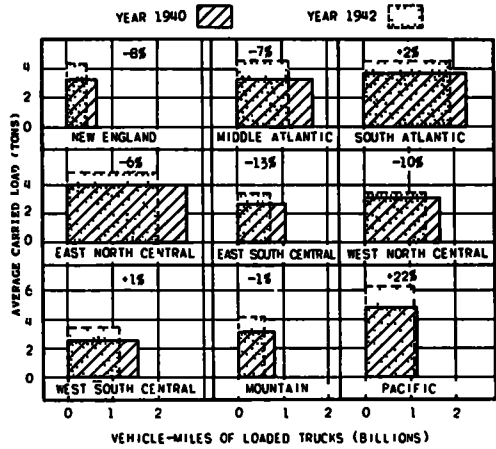


Figure 15. Comparison of Estimated Ton-Miles in 1942 with Those in 1940 on Main Rural Roads in Each United States Census Region.

Figure 15 shows, for 1940 and 1942, the relationships between loaded vehicle-miles, average carried load and ton-miles for all trucks and combinations by regions. Only in the Pacific region is the total ton-

miles of load being carried substantially greater in 1942 than in 1940. In all but two other regions it is less.

Figure 16 shows that the frequency of

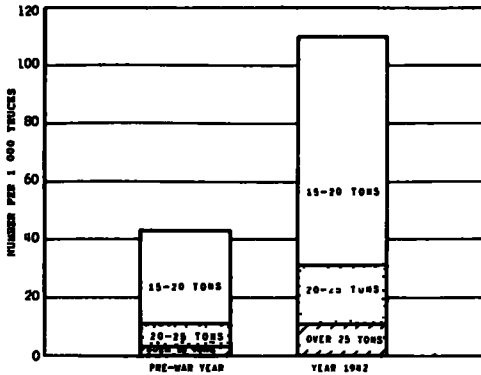


Figure 16. Number of Heavy Gross Loads Per 1,000 Loaded and Empty Trucks in the Summer of 1942 and in a Corresponding Period of a Pre-War Year Between 1936 and 1940 on Main Rural Roads Throughout the United States.

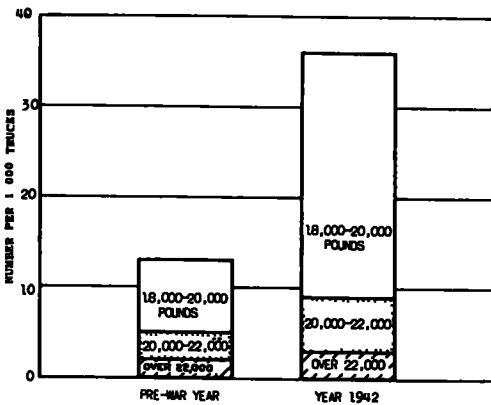


Figure 17. Number of Heavy Axle Loads Per 1,000 Loaded and Empty Trucks in the Summer of 1942 and in a Corresponding Period of a Pre-War Year Between 1936 and 1940 on Main Rural Roads Throughout the United States.

heavy gross loads has increased substantially since the original survey in the 1936-1940 period, and Figure 17 shows that the frequency of heavy axle loads has also increased substantially. As can be seen

from Figure 18, the frequency of heavy gross loads has increased in all regions. Gross loads over 15 tons are most frequent in the East North Central region, but nearly all of these are between 15 and 25 tons. The frequency of gross loads over 25 tons is by far the greatest in the Pacific region. Heavy gross loads are of about average frequency in New England.

Figure 19 shows that the frequency of heavy axle loads also has increased in all regions. Heavy axle loads are most fre-

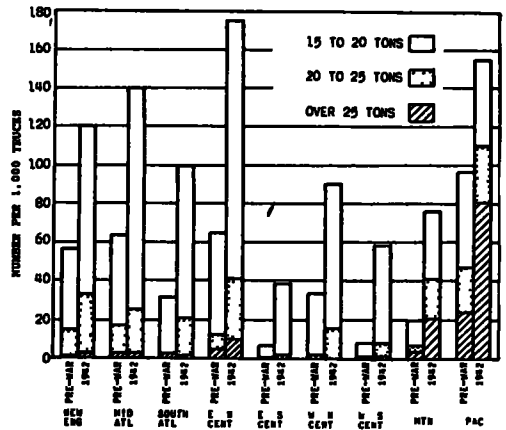


Figure 18. Number of Heavy Gross Loads Per 1,000 Loaded and Empty Trucks in the Summer of 1942 and in a Corresponding Period of a Pre-War Year Between 1936 and 1940, on Main Rural Roads in Each United States Census Region.

quent in New England, and are less frequent than average in the Pacific region in spite of the high frequency of gross loads over 25 tons in that region. The State laws in the two regions are such as to encourage these conditions.

The three-axle tractor-truck with a triple-axle semitrailer in the upper picture of Figure 20 weighed 64,430 lb., but no axle weighed more than 12,020 lb. The tractor-truck, semitrailer and trailer combination with seven axles, in the lower picture of Figure 20 weighed 72,255 lb., but no axle weighed more than 14,010 lb. These types of vehicles are especially

prevalent in California and surrounding States. They are illegal in many States because they do not comply with statutory limitations, particularly as regards length.

It is easy to see that most of the weight of the single-unit truck in the upper pic-

ture of Figure 21 is on one axle. The one in the lower picture of this figure has better load distribution, but even in this case the rear axle carries most of the weight.

While the gross load frequencies give an indication of the extent to which our bridges are being overloaded, they are less significant from the point of view of bridge stress than the frequencies of heavy load concentrations. It makes considerable difference in bridge stresses whether

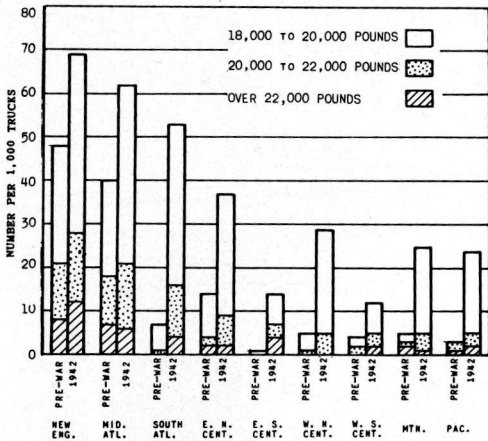


Figure 19. Number of Heavy Axle Loads Per 1,000 Loaded and Empty Trucks in the Summer of 1942 and in a Corresponding Period of a Pre-War Year, Between 1936 and 1940, on Main Rural Roads in Each United States Census Region.

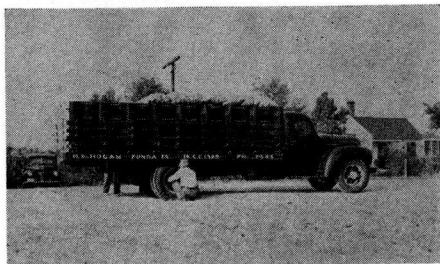


Figure 21. Single-Unit Trucks, with Most of Weight on One Axle

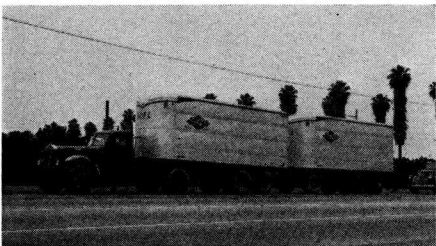
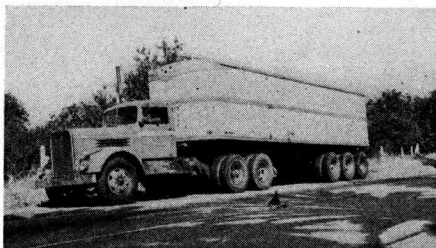


Figure 20. Combinations with the Load Well Distributed

a heavy load is concentrated in a relatively short length, or spread over a longer length. The gross load formula

$$C = \frac{W}{L + 40}$$

has been designed to give an indication of the degree of load concentration. In this formula "L" is the distance in feet between the first and last axle of the vehicle, or of any interior group of axles. "W" is the total weight of the vehicle or of the interior group of axles, and "C" is a measure of

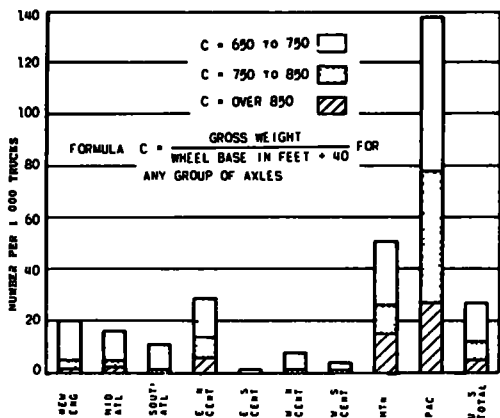


Figure 22. Number of Trucks Per 1,000 Loaded and Empty Trucks with High Values of "C" in the Gross-Weight Formula, in the Summer of 1942, on Main Rural Roads in Each United States Census Region.

in values of "C," but Figure 22 shows the frequencies of various values as found in the summer of 1942. It will be noted that values in excess of 750 are very frequent in the Mountain and Pacific regions and are not uncommon throughout the United States.

It is not the over-all wheel base, but some interior group of axles that generally has the highest value of "C" for a given truck with more than two axles. This fact is especially significant, since the laws of some States provide for considering only the over-all wheel base in calculating "C."

Table 1 shows the number of trucks observed with values of "C" greater than 750, classified in accordance with the axle group having the highest value of "C."

TABLE 1

Type of vehicle	Axle group with highest value of "C"			
	Over-all wheel base	Second to last axle	Other group	Total
Single-unit (2-axle)	1			1
Single-unit (3-axle)	1	31		32
Combination	13	437	59	509
Total	15	468	59	542

the load concentration. Numerous States have laws limiting the maximum permissible value of "C" for any load to a value which is different in different States, and sometimes depends upon axle spacing but ordinarily is 750, 700 or 650.

Since complete information on axle spacing was not obtained in the original survey, it is not possible to establish trends

In other words, for the 542 vehicles weighed with a value of "C" greater than 750, in only 15 cases was the highest value of "C" obtained by considering the over-all wheel base as the group of axles. In 468 cases, or 86 per cent of the total, it was the group including all axles other than the front axle that had the highest value.