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AN INVESTIGATION OF TRUCK SIZE AND WEIGHT LIMITS TECHNICAL SUPPLEMENT VOLUME I

ANALYSIS OF TRUCK PAYLOADS UNDER VARIOUS LIMITS OF SIZE, WEIGHT AND CONFIGURATION

by

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16. Abstract

This volume documents the results of an analysis of the impact that various truck size and weight limits have on the carrier equipment selection process as a result of changes, in the design payload and design density of individual trucks.

An analysis of actual truck weight data confirmed the hypothesis that design payload approximates the actual payload of fully loaded trucks, and the importance of design density as a determinant of the loaded character of trucks. A relationship between the average load carried on full trucks and the average load carried on partially loaded trucks, and the relative mix of full and partially loaded trucks was developed.

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PREFACE

This is one of several technical reports prepared in support of the Secretary of Transportation's Response to Congress on the Truck Size and Weight Study mandated by Section 161 of the Surface Transportation Assistance Act of 1978. This report, Volume I, documents the conduct and results of one of the many specific areas of investigation - the effects of truck size and weight limit changes on individual vehicle capacity and average truck payloads.

This volume presents the background data and methods used to estimate effects of size and weight limits on the average payload of fully and partially loaded trucks carrying various commodities. Body type distributions are provided for various commodities so that an appropriate distribution can be estimated for each component of the total flow of freight shipments. The concepts of design payload and design density are then introduced as key determinants in the selection of a particular tractor-trailer configuration for use in modeling the transportation of a particular commodity under a given set of truck size and weight limits. Actual data on loaded trucks was utilized to confirm the hypothesis that design payload approximates the payload of fully loaded trucks. Information is also provided on the relationship between the average load carried on full trucks and the average load carried on partly loaded trucks by commodity type, and the relative split between full and partially full trucks.

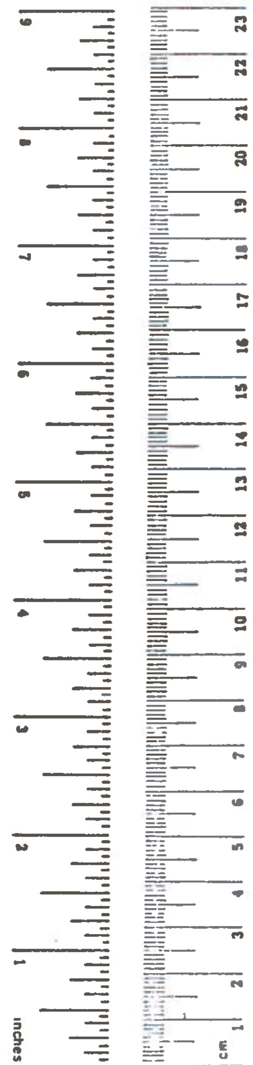
The extensive data collection and analysis and the preparation of this report have been the responsibility of the author under the technical direction of Domenic J. Maio, Manager of the TSC contribution to the DOT Truck Size and Weight Study.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

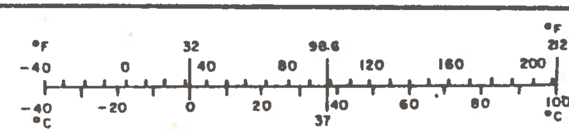
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10 286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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1. INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the results of an analysis of the impact that various truck size and weight limits have on the payloads of individual trucks. Both design, or legal, capacity and the actual average loads of specific truck types are investigated.

The majority of truck trips are made with less than the design or legal load on board. Many trucks may be loaded to their volume capacity but are far below their legal weight capacity because of low product density (pounds per cubic foot of space occupied). Still others are dispatched to meet traffic service requirements or carrier network operating requirements, even though neither the weight nor the volume capacity has been fully utilized. In such cases, two questions arise: 1) are the existing size and weight limits really constraining the productivity of trucking? and 2) how prevalent are these cases?

Analysis of available data suggests that van type tractor-trailer combinations, in the aggregate, carry only about half the average legal payload weight when traveling "loaded."* The legal payload capacity for any given trip will, of course, be determined by the lowest limits posted in the states traversed in the trip. The utilization of truck weight and volume capacity will vary depending upon the type of rig and carrier, the commodity transported, the trip length, and the actual route.

Motor carrier average operating costs and fuel intensiveness vary inversely with the average payload weight per truck-mile traveled. Vehicle trip costs are relatively insensitive to the

*Loaded usually means that the truck is not empty. It does not mean the truck volume or weight capacity is fully utilized.

actual payload weight in the average long haul tractor-trailer combination. Although fuel consumption per truck-mile is obviously greater for heavier trucks, the percentage increase in fuel is considerably less than the percentage increase in payload. Therefore, strong economic incentives exist to maximize the payload weight of every long haul truck trip. However, the data seems to suggest that carrier operating conditions and market service requirements in combination with specific state and Federal truck limits constrain the maximum utilization of truck capacity, thus increasing the average cost and possibly the fuel intensiveness above the optimum. This report attempts to isolat the effects of specific size and weight limits and of certain operating situations on average payloads. The effect of these changes in average payloads on average fuel consumption and on average operating costs may be found in other technical suppleme volumes which specifically address these two subjects.

1.2 BACKGROUND AND STUDY PREMISES

The Transportation Systems Center has been assigned a specific role in the overall Department of Transportation (DOT) Truck Size and Weight (TS&W) Study. The assignment involves the evaluation of impacts resulting from changes in the limits which control the size and weight of trucks on the Federal Aid Primary Road System. Specifically, TSC must estimate the effects of suc changes on motor carriers and rail carriers in terms of changes in their respective operations, costs, revenues, and profit levels. Such changes to carrier operations and economics could result in changes to shipper/receiver services and freight rates which in turn could induce shifts of certain markets among carrier groups. These effects also must be estimated by TSC.

Changes in the payload capacity of individual trucks result ing from TS&W limit changes will effect the net average fuel intensiveness of the effected highway freight movements. Also, an shifts of freight markets among carrier groups having different fuel intensiveness will impact the overall demand for petroleum fuel for freight transportation. TSC must estimate the changes in fuel requirements for freight transport which result from specific changes in the TS&W limits.

The following are the four major premises on which this project is founded:

1. Changes to the current state or Federal limits which control the payload weight capacity or the limits which control the payload volume capacity of individual trucks will have different cost effects and different fuel intensiveness effects on specific traffic flows depending on their respective characteristics. In general, volume controlling limits are more critical to low density shipments than to high density shipments and the reverse is true for axle and gross weight limits.

2. Any change to the payload volume or weight capacity of individual trucks which changes a carrier's operating economics or fuel intensiveness may change the competitive relationships between the competing highway and rail services in specific markets. For example, the availability of higher capacity trucks in highly competitive markets could make rail TOFC service less attractive than private trucking or even regulated for-hire carriers.

3. Many alternative sets of uniform national size and weight limits can be conceived from the myriad of limits that exist among all the states. Any one of these may prove to be economically viable and institutionally feasible. For purposes of this study, all limits are considered negotiable and the task is to find the attractive trade-offs among the following limits:

Length	Tractor-Trailer Configuration
Height	Axle Loads
Width	Gross Weight.

It may be possible to liberalize one or more of the above while holding fast or even tightening up on another.

4. The last is perhaps the most fundamental (and the most controversial) premise on which this study is founded -- that it is within the capability of analysts to model the economic inter actions of the supply of and the demand for freight transport services with sufficient accuracy to yield order of magnitude estimates of specific market shifts among the highway and rail services. It is recognized that reliable data on origin/destina tion flows by truck are thin, and that decisions of carriers abo their respective fleet mix and equipment route assignments or of decisions by shippers/receivers on mode and carrier choices may not always appear "rational." Nonetheless, TSC is familiar with the available data, and, based on previous projects in this area is at the state-of-the-art in mode share and network flow modeling. It is believed that application of these tools to estimate the changes in the competitive relationships among the pertinent carrier groups is necessary if policy makers are to be provided with a comprehensive perspective on the full impact of any Federal action with respect to truck size and weight limits.*

1.3 ANALYTICAL APPROACH

This analysis centers around a determination of two technical parameters: design payload and density, under various axle load and gross combined weight (GCW) limits. These two paramete form a key element in the equipment selection process and thus impact the basic study premises indicated above. Design payload either in terms of weight or volume, influences equipment selection since for a particular piece of equipment maximum payload usually implies minimum unit costs. Thus, carriers could be expected to choose equipment which best matches the payload characteristics of their traffic. Design density (design payloa

*For a more complete discussion of this issue and the method used by TSC in the analysis of the supply/demand interaction, refer to Technical Supplement Volume 4 and Volume 5.

on a weight basis divided by trailer volume) provides a rough indication of the dividing line between commodities which would "weigh-out" versus those that would "cube-out" for a particular rig.* It should be noted that other factors influence these two parameters in the real world and, thus, the equipment selection process. Backhaul, distance, and traffic mix influences, along with the problem of partial payloads, constitute the most important of those considerations.

Figure 1-1 illustrates the approach used for the overall TSC study. The area enclosed by the dashed lines is the primary focus of the work reported here. The details of the work performed are described in the subsequent sections and the Appendices; however, a brief overview of this effort is presented below.

The payload analysis consisted of two major efforts. Under the first of these tasks, design payload and density values were developed for single, double, and triple van trailer rigs of various lengths and axle configurations. Approximately 130 different rigs were examined under three GCW limits (73,280 pounds, 80,000 pounds, and a GCW limit based on the bridge formula**). The assumed axle load limits were 20,000 pounds per single axle and 34,000 pounds per tandem axle. However, a selected subset of vehicles of various body types was also examined at axle laod limits of 18,000 pounds/32,000 pounds and 22,400 pounds/36,000 pounds per single/tandem axle. As a byproduct of the development

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*"Weigh-out" means that the rig reaches the GCW limit before the volume of the trailer is completely filled, while "cube-out" means that the volume of the trailer is filled before the rig reaches the GCW limit. It should be noted that the current analysis deals exclusively with general purpose van trailers. In the overall analysis, the traffic under study is that which could be diverted to or from van trailers by other modes, or directed from one type of van to another, i.e., large singles to small doubles.

**See Appendix B.

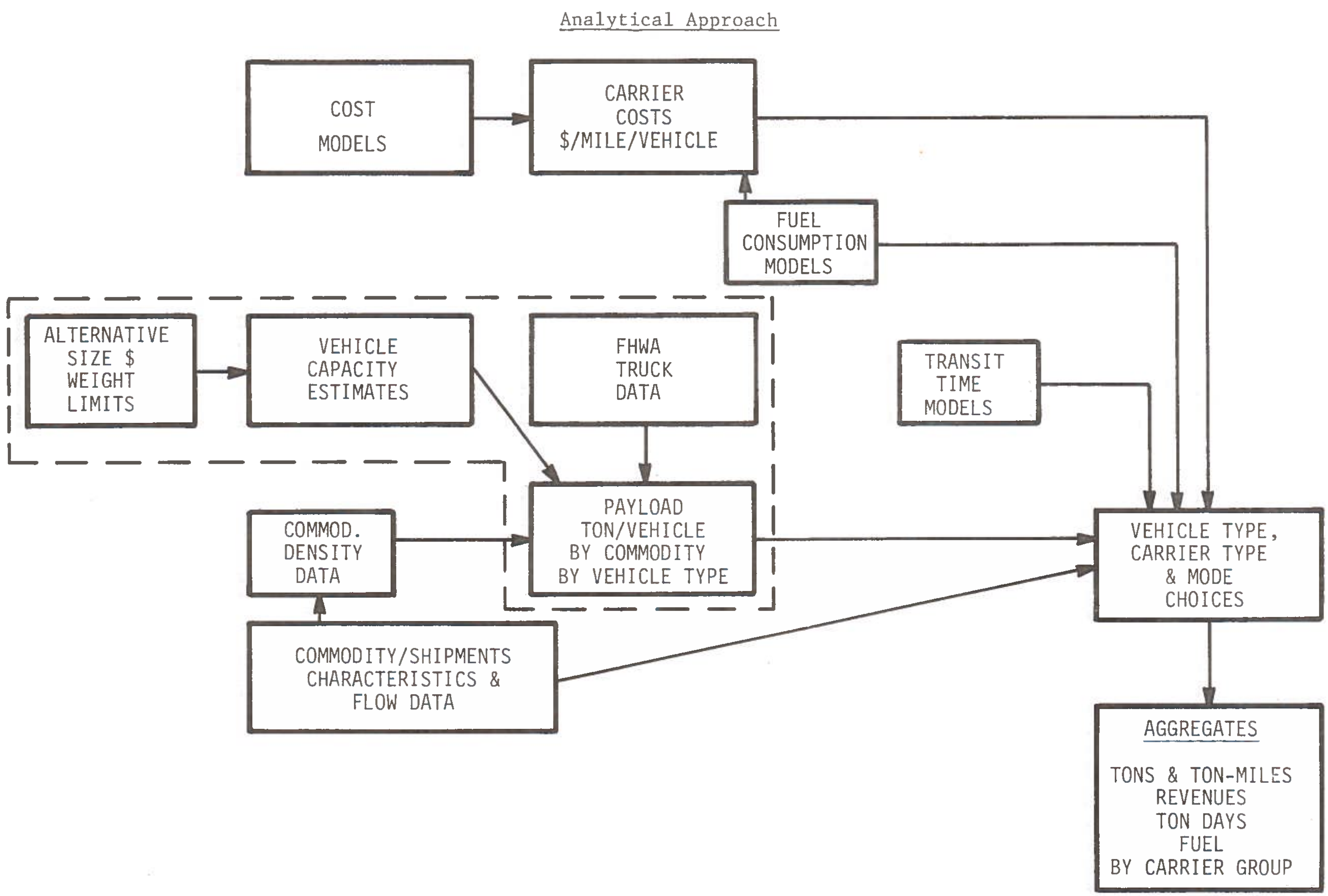


FIGURE 1-1. CARRIER GROUP IMPACTS OF TRUCK SIZE AND WEIGHT CHANGES

of data on weight payload, trailer cube and design density, information on trailing length, overall length, tare weight, and required tractor horsepower were also developed. This theoretical payload and density data formed the basis of the analysis in Section 2. There, the past behavior of the industry regarding equipment selection is explained, using the van body type as an example, and some future trends in equipment usage based on potential changes in truck size and weight regulations are postulated.

The second task involved an analysis of the Federal Highway Administration's 1977 Loadometer Study, and 1977 and 1978 data from the Truck and Waterway Information Center's (TWIC) National Motor Transport Data Base. This effort provided verification for some of the technical data developed in the first task, and provided data on actual loads by commodity and vehicle type.

The data was utilized to confirm the hypothesis that design payload approximates the actual payload of fully loaded trucks, and to confirm the importance of design density as a determinant of the loaded character of trucks. A model of the relationship between the average load carried on full trucks and the average load carried on partially loaded trucks, and the relative split between full and partially full trucks was developed. In addition, these data were used to develop the distribution of tonnage by body type for various commodity groups. This analysis is described in Section 3.

Thus, the basic technical results developed as part of these tasks provide an important input to the vehicle, carrier, and mode selection process which forms the key element of the overall TSC contribution to the DOT TS and W study.

2. ANALYSIS OF VAN TRACTOR/TRAILER CAPACITIES UNDER VARIOUS GROSS WEIGHT, AXLE LOAD, AND LENGTH LIMITATIONS

2.1 INTRODUCTION

The purpose of this analysis is to examine the impact of various assumptions regarding gross combined weight and axle load limits on the design payload and density of selected dry va trucks. (This same approach could be applied to trucks with other body types.) Design payload is the difference between the GCW limit and the empty weight of the vehicle. Design density is the design payload divided by the volume of the trailer(s). These two parameters are important because maximum payload (in terms of weight) implies minimum unit cost for some carriers. Other carriers are not weight restricted due to the characteristics of the commodities they carry, but rather desire to maximiz payload in terms of volume. Design density is important since it provides an indication of which commodities would "cube-out" and which would "weigh-out" on a particular vehicle. The former term implies that the entire volume of the cargo space is occupied before the vehicle reaches the GCW limit, while the latter term means that the weight limit is reached before the volume is completely filled. Thus, this analysis aims to identify which trucks gain or lose payload capability due to changes i GCW, axle load, and length limits, and which commodity traffic might be most economically moved in trucks of a specific type under varying size and weight limitations.

A basic premise of this study is that the current set of widely used rigs is a result of the current set of length and weight limits. A major change in these limits would probably result in a shift away from the current equipment mix. Thus, this study will attempt to provide some quantitative indication of why specific trucks are in use today, and some insights regarding future equipment usage given changes in some of the basi size and weight restrictions.

The payload and density parameters were determined for various trucks for three cases of maximum GCW limit (73,280 pounds, 80,000 pounds and a GCW limit derived from the bridge formula) and three cases of axle load limits (18,000 pounds/32,000 pounds per single/tandem axle, 20,000 pounds/34,000 pounds per single/tandem axle and 22,400 pounds/36,000 pounds per single/tandem axle). Current width and height restrictions were assumed, while overall length was unrestricted by assumption. The trucks examined included 3 and 4 axle straight trucks, single 35, 40, 45, 48, and 50-foot trailers, double 20, 23, 27, 31, 35, 40, and 45-foot trailers, and triple 23, 27 and 31-foot trailers. As part of the process of computing design density and payload, the following parameters were determined for each tractor/trailer rig: trailing and overall length, tractor horsepower and weight, empty trailing weight, and trailer cube. The data sources, assumptions, and procedures used in this process are described in more detail in Appendices A and B, while the actual results are tabulated in Appendix C.

2.2 THE IMPACT OF PAST CHANGES IN AXLE LOAD AND GROSS WEIGHT LIMITS ON EQUIPMENT SELECTION

As late as 1972, the 40-foot van trailer dominated the trucking industry; just over 50 percent of the trailers manufactured in that year were of this length. By 1978, 40-foot trailers made up only 33 percent of that year's production. Trailers ranging in length from 42 feet on up increased their share of production from about 35 percent in 1972 to almost 59 percent in 1978. (Trends in trailer lengths over this period are indicated in Table 2-1.) A survey of long haul truckers conducted in 1977 and 1978 confirms the data indicated by the production figures. These data indicate that 48 percent of the sampled vehicles were pulling trailers of lengths greater than or equal to 42 feet. (Table 2-2 gives the trailer length distribution for rigs sampled in the Truck Stop Survey.)

The underlying force influencing this shift is undoubtedly economic. Rising costs over time would probably have motivated

TABLE 2-1. PERCENTAGE VAN TRAILER PRODUCTION BY LENGTH

Length	1972	1974	1976	1978
≥45'	31.7	41.8	37.0	52.2
42' - 45'	3.1	5.3	18.5	7.2
40'	50.2	41.4	28.2	32.7
27'	10.4	5.9	8.6	4.2
Other	4.6	5.6	7.7	3.7
	100.0	100.0	100.0	100.0
Total Trailers	95,900	137,500	61,700	127,600

Source: Van Trailer Cube - 1976. Truck Trailer Manufacturers Association, Washington, D.C., September 1976.

Van Trailer Size Survey - 1978. Truck Trailer Manufacturers Association, Washington, D.C., July 1979.

TABLE 2-2. DISTRIBUTION OF TRAILER LENGTH FOR LONG HAUL TRUCK TRAFFIC ON SELECTED MAJOR ROUTES (1977 & 1978)

Length	CARRIER TYPE							
	Regular Route Common	Irregular Route Common	Private	Contract	Exempt	Agricultural Co-Op	Leased	TOTAL
≥45'	46.2%	23.3%	24.1%	24.3%	12.4%	30.9%	11.9%	23.6%
42'-45'	11.4%	26.2%	20.7%	27.1%	28.4%	27.7%	23.7%	24.4%
40'	21.3%	41.2%	43.5%	37.2%	40.7%	34.5%	52.3%	40.3%
27'	10.9%	0.2%	0.5%	0.4%	0.3%	0.0%	0.0%	0.9%
Other	10.2%	9.1%	11.2%	11.0%	18.2%	6.9%	12.1%	10.8%
	100%	100%	100%	100%	100%	100%	100%	100%
Total Trucks	1,206	11,850	4,975	1,204	1,976	237	83	21,531

Source: National Motor Transport Data Base. Truck and Waterway Information Center, Unpublished.

the trucking industry to move toward larger trailers in an attemp to match or better cost increases by gains in productivity. However, the rather rapid shift indicated above may have been brough about by two government actions arising out of the 1973 oil embargo. The first action was the imposition of the 55 mph nationa speed limit in December 1973. The industry contended that this resulted in decreased productivity due to increased trip times. An accelerated shift toward longer trailers would have been one way of recouping these productivity losses. In January 1975, increased maximum weight limits went into effect on the Interstate Highway System.* The Federal legislation which increased these weight limits was intended to compensate for industry productivity losses by allowing increased payloads; however, the new Federal weight limits may also have encouraged the shift toward longer trailers.

Figure 2-1 illustrates the payload gains possible due to increased GCW and axle load limits and increased trailer length. Note that all increases are relative to a base case which assumes a 73,280 pound GCW limit, 18,000/32,000-pound axle load limit and a rig with a single 40-foot trailer. Increased GCW limits with axle load limits held at the base level offer little payload advantage for a 40-foot trailer (1 percent increase), and little incentive to shift to a 45-foot trailer (3 percent increase). When axle load limits are increased along with GCW limits, the single 40-foot trailer realizes a potential payload increase of 5 percent over the base case. Shifting to a 45-foot trailer, however, provides a potential 13 percent payload advantage over the base case, for the five-axle 3S2 rigs considered here. Thus for rigs of this type, axle load limits are the key constraints. (It should also be noted that the arbitrary 80,000 GCW limit does

*The maximum gross combined weight limit was raised from 73,280 pounds to 80,000 pounds. Maximum axle load limits were increased from 18,000 pounds to 20,000 pounds per single axle, and from 32,000 pounds to 34,000 pounds per tandem axle.

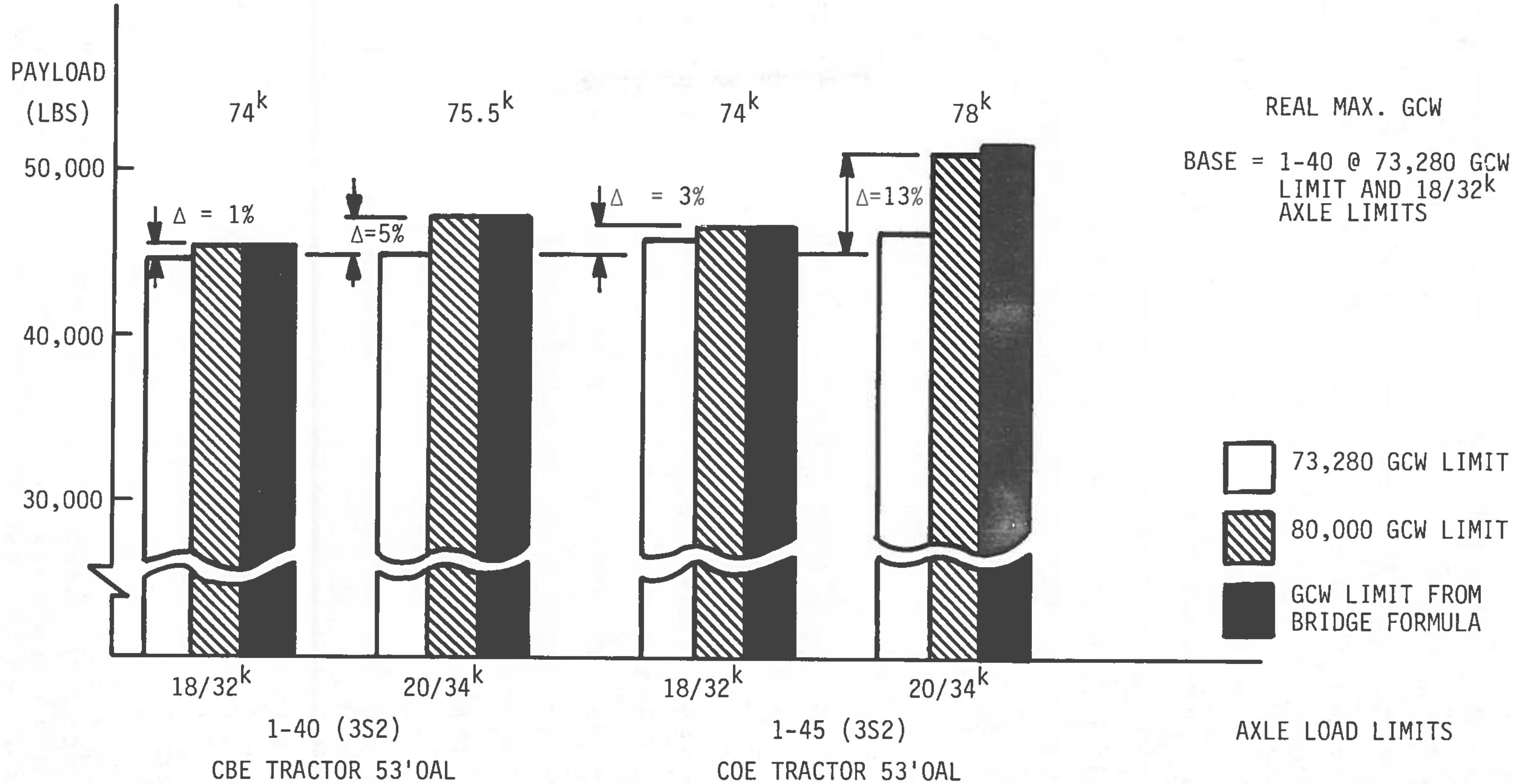


FIGURE 2-1. PAYLOAD INCREASES FOR TWO TRACTOR-TRAILER RIGS DUE TO INCREASED WEIGHT LIMITS

not really constrain these rigs, since application of the bridge formula to rigs, as configured here, results in a permissible maximum GCW slightly below 80,000 pounds, as indicated in the figures.) It seems that the increased weight limits offered an incentive to shift from a 40-foot to a 45-foot trailer, at least to certain segments of the industry.

This shift toward longer trailers may have resulted in the shift away from the conventional cab-behind-engine (CBE) tractor to the short cab-over-engine (COE) tractor.* This would have followed as a consequence of state length limits which regulate the overall length of the rig rather than trailer length. As indicated in Figure 2-1, a COE tractor pulling a 45-foot trailer is just as long as a CBE tractor pulling a 40-foot trailer. This fact is crucial since an examination of Figure 2-2 indicates that the segment of the industry that requires increased cube independent of weight considerations can achieve their end by moving toward shorter tractors and longer trailers, while still keeping within individual state length restrictions. It should also be noted that multiple trailer rigs offer advantages to this segment of the industry, where their use is permitted. Finally, Figure 2-2 indicates that the need for increased trailer width (e.g., 102") may be superfluous since a single 40-foot trailer with a 102" width has the same cubic capacity as a conventional width double 27-foot combination.

2.3 SOME IMPLICATIONS OF POTENTIAL CHANGES IN AXLE LOAD AND GROSS WEIGHT LIMITS ON THE FLEET MIX

Where their operation is permitted, five-axle double 27-foot trailer combinations are used by carriers desiring maximum cube,

*CBE tractors were utilized for the larger multiple trailer configurations in this analysis. Widespread relaxation of overall length limits to permit use of these combinations could favor the use of this cab type because of its driver comfort and safety characteristics.

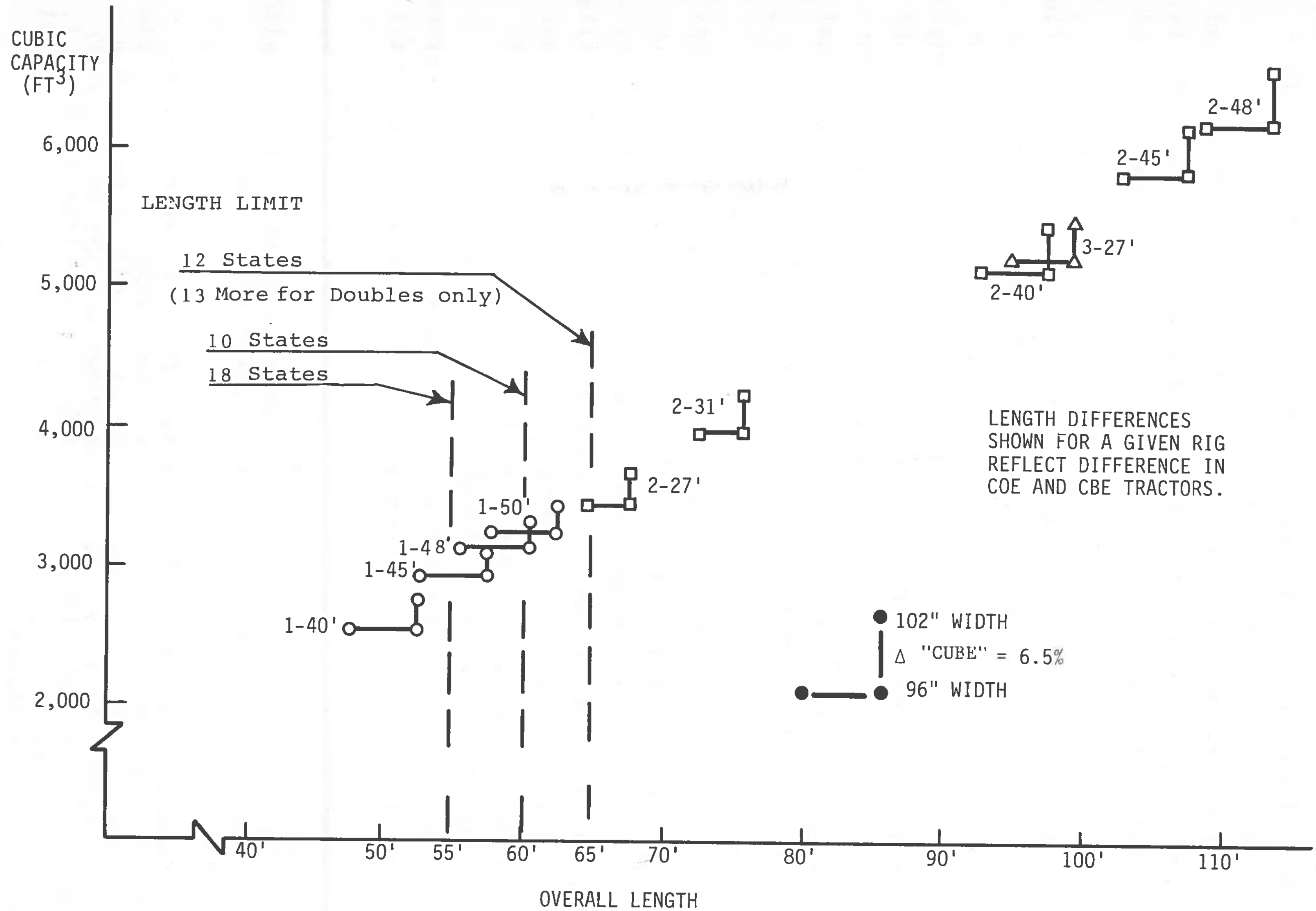


FIGURE 2-2. CUBIC CAPACITY VERSUS LENGTH, WIDTH AND TRACTOR CAB CONFIGURATION

and five-axle single 40- to 45-foot trailer combinations are used when payload considerations are more important than cube. However, it appears that the removal of arbitrary length and GCW limits (with GCW controlled instead by the bridge formula),* and a rollback of axle load limits to the 18,000/32,000-pound levels, could satisfy shippers' and carriers' needs for maximum cube and maximum payload.**

For example, Figure 2-3 shows that increasing GCW limits from 73,280 pounds to 80,000 pounds, while maintaining 18,000-pound/32,000-pound axle limits, provide doubles with a 16 percent increase in payload while the potential payload increase for singles would be insignificant. On the other hand, increasing axle load limits along with GCW limits provide singles with an 11 percent increase in payload, while doubles would not gain any additional payload capability from the increased axle limits.

A gross weight limit based on the bridge formula without arbitrary GCW limits could encourage the use of different equipment types such as a nine-axle double 27-foot rig. As shown in Figure 2-4, such a rig would have 30 percent more payload carrying capability than single 45-footers under high axle load limits Moreover, such heavy doubles could carry 22 percent more payload with 18,000-pound/32,000-pound axle load limits than single 45-footers could carry with 22,400-pound/36,000-pound axle load limits. In addition, with the bridge formula controlling, curren nine-axle turnpike doubles (double 45-footers) would have a mini-

*This analysis assumes that all bridges would be capable of handling trucks with these high GCW's. In fact, older (H 15 design standard) bridges could not accomodate these trucks without undue overstressing and would require replacement or rehabilitation.

**Axle loads, rather than the vehicle's GCW, appear to be the prime determinant of pavement wear. For example, a 20k single axle is equivalent to about 1.5 18k axle applications, and a 22.4k single axle is equivalent to about 2.5 18k axle applications. For tandem axles, a 24k axle is equivalent to about 1.3 32k axle applications, and a 36k axle is equivalent to about 1. 32k axle applications.(2)

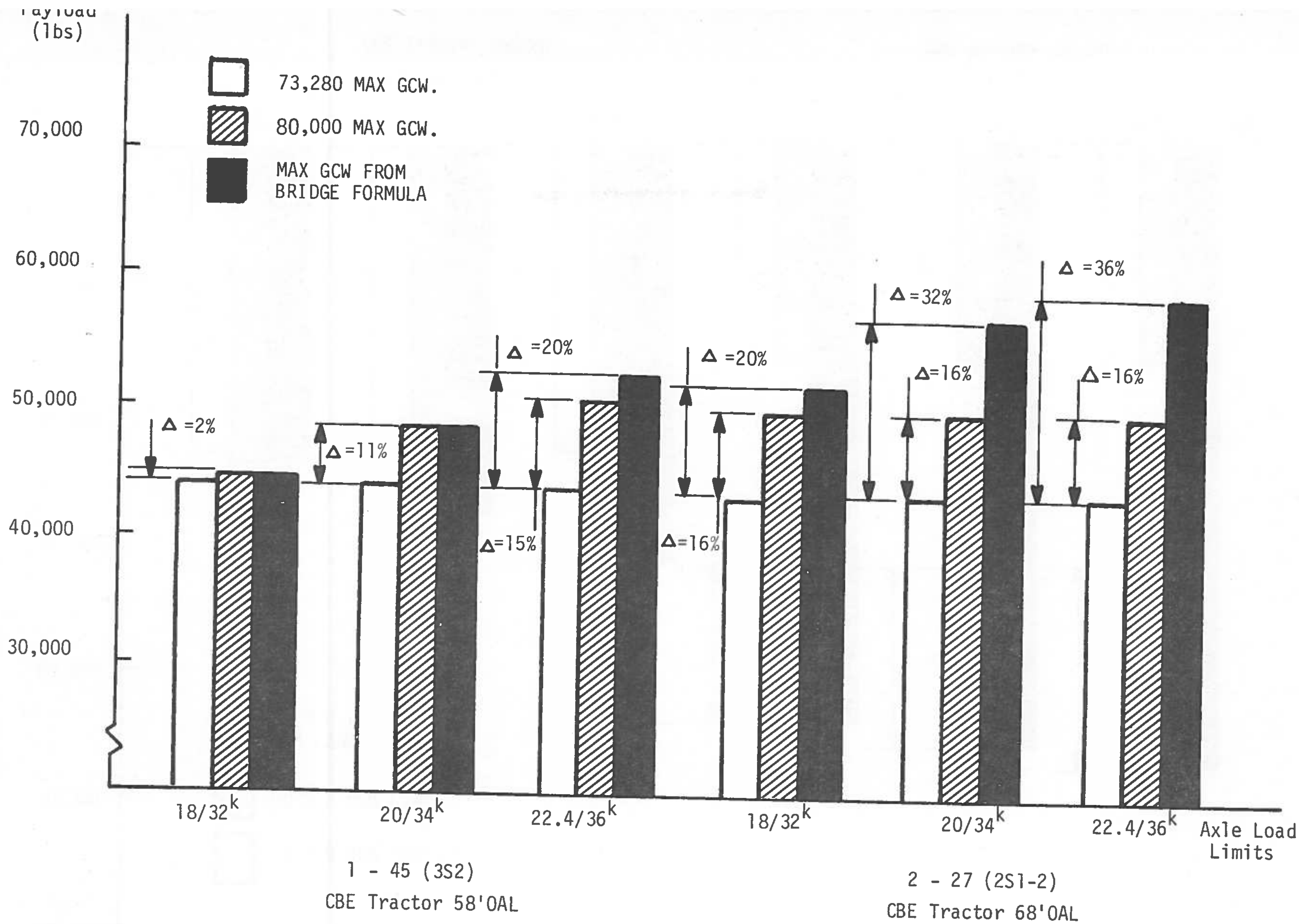
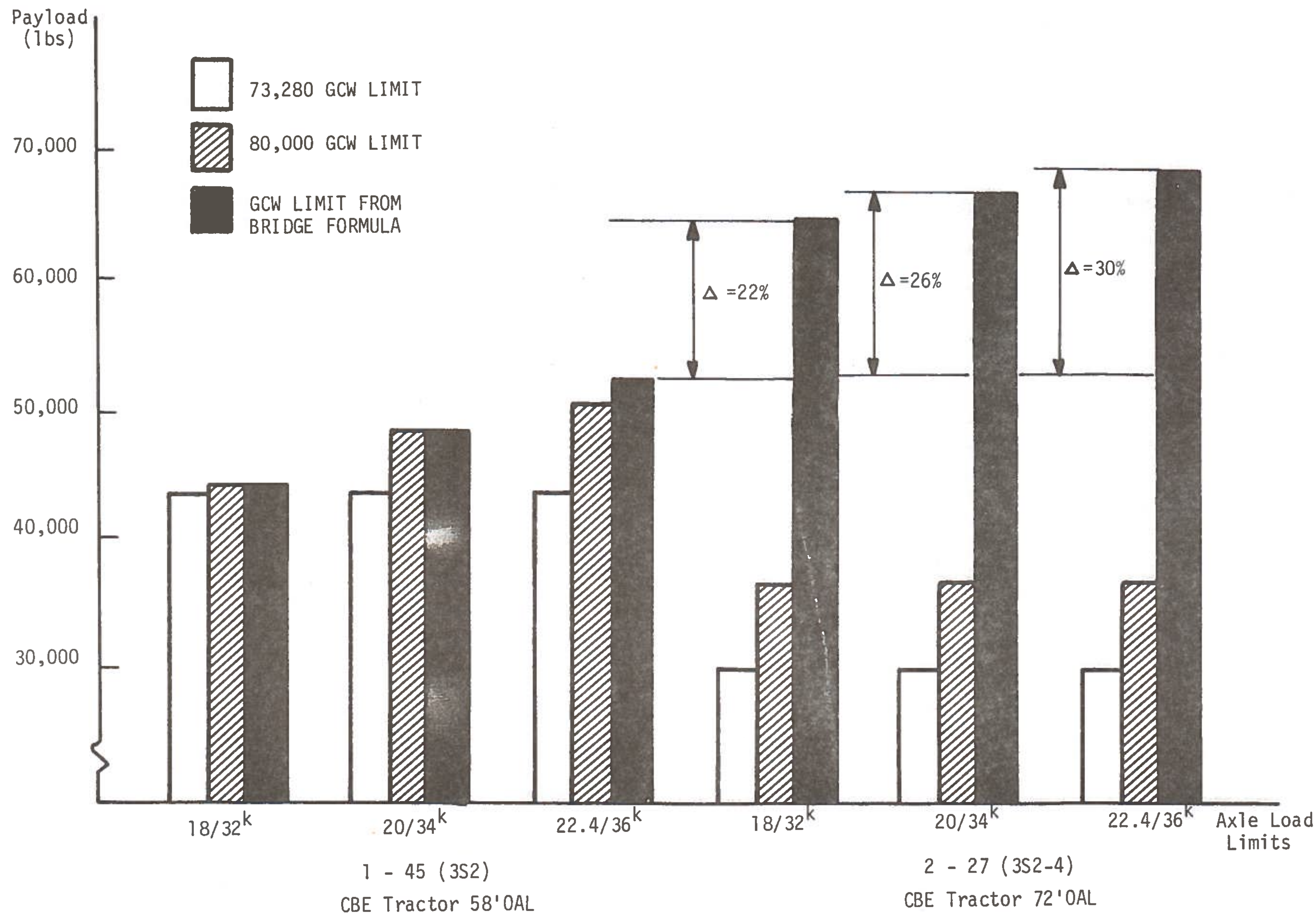


FIGURE 2-3. AXLE LOAD LIMIT INCREASES FAVOR SINGLES, GCW LIMIT INCREASES FAVOR DOUBLES


Payload (lbs)
70,000
60,000
50,000
40,000
30,000
73,280 GCW LIMIT
80,000 GCW LIMIT
GCW LIMIT FROM BRIDGE FORMULA
Δ =22%
Δ =26%
Δ =30%
18/32k
20/34k
22.4/36k
18/32k
20/34k
22.4/36k
Axle Load Limits
1 - 45 (3S2)
CBE Tractor 58'OAL
2 - 27 (3S2-4)
CBE Tractor 72'OAL

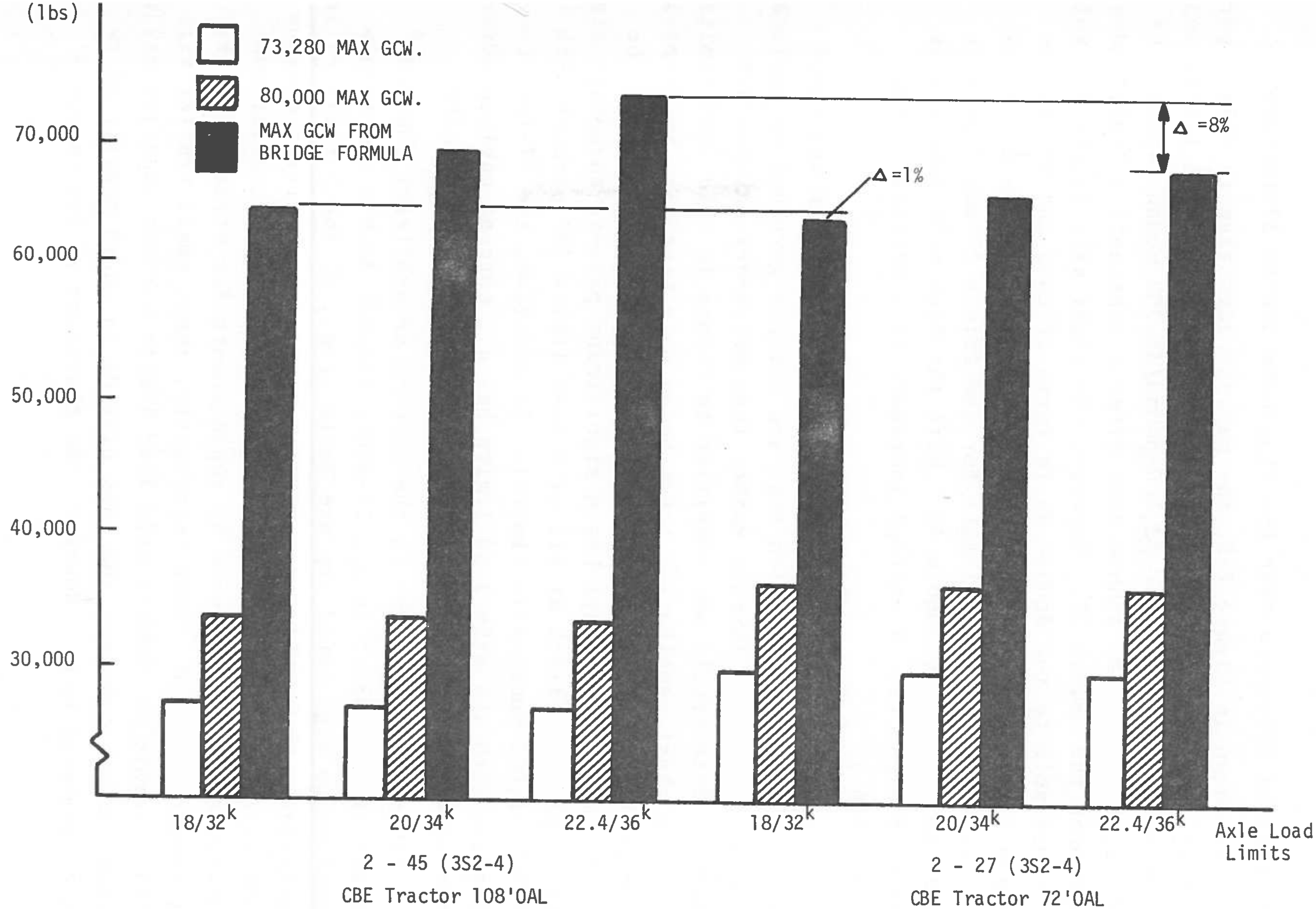


FIGURE 2-5. WITH BRIDGE FORMULA CONTROL OF GCW LIMITS, LONG DOUBLES HAVE MINIMAL ADVANTAGE OVER SHORT DOUBLES

mal payload advantage over the nine-axle double 27-footers.

As shown in Figure 2-5, the payload advantage is only 1 percent at the lower 18,000-pound/32,000-pound axle load limits and 8 percent with the higher 22,400-pound/36,000-pound limits. Of course, the turnpike double does offer a substantial "cube" advantage over the double 27. However, the eight-axle triple 27, which is comparable to the double 45 in terms of cube and shorter in length offers a 1 percent payload advantage over the double 45, even with low axle load limits for the triple 27 and high axle load limits for the double 45. With the high axle load limits for both rigs, this advantage increases to 6 percent. (See Figure 2-6.)

Figure 2-7 illustrates that single-unit trucks and short (i.e., 27-foot) combination rigs are already governed by application of the bridge formula rather than arbitrary maximum GCW limits. Both trucks are sensitive to change in axle load limits with the short combination truck being more sensitive to changes in axle load limits than the single-unit truck. Moreover, the short combination always has a significant payload advantage over the single-unit truck at all axle load limits (27 percent with 18,000/32,000-pound axle limits). In addition, the 27-foot combination with low axle load limits has a 7 percent payload advantage over the single-unit truck with high axle load limits.

Thus, it seems that in the absence of arbitrary GCW and length limits, short (e.g., 27-foot) trailer double and triple combination rigs could replace large (e.g., 45-foot) trailers in both single and double operations for carriers desiring maximum cube and/or maximum payload weight. Small single trailer combinations could also serve as replacements for straight trucks of comparable size. More importantly, these small trailer rigs could operate at reduced axle load limits without imposing payload penalties on operators and thus provide an added benefit of reduced pavement wear. However, the character of the carriers'

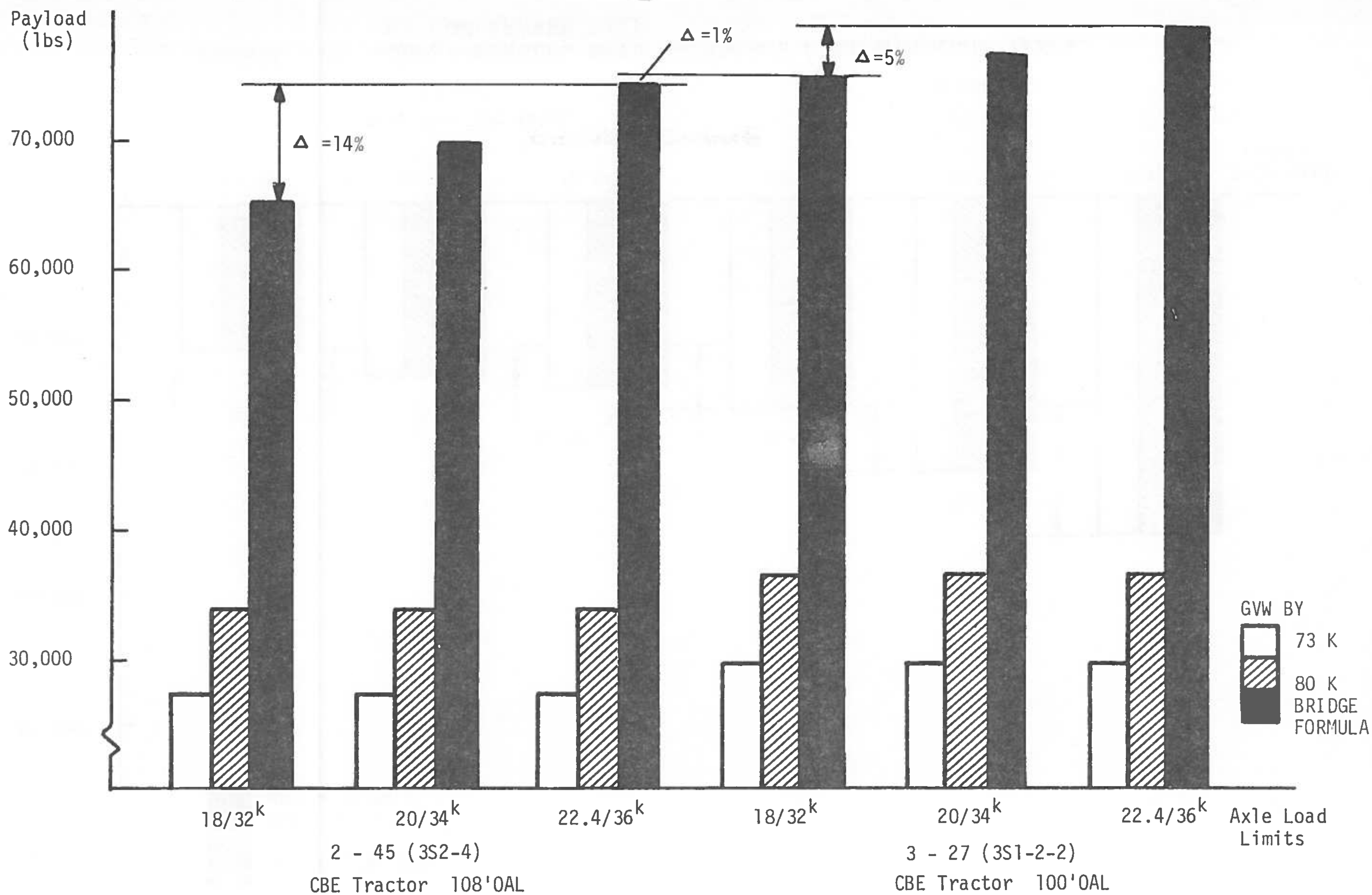


FIGURE 2-6. WITH BRIDGE FORMULA, SHORT TRIPLES HAVE ADVANTAGE OVER LONG DOUBLES

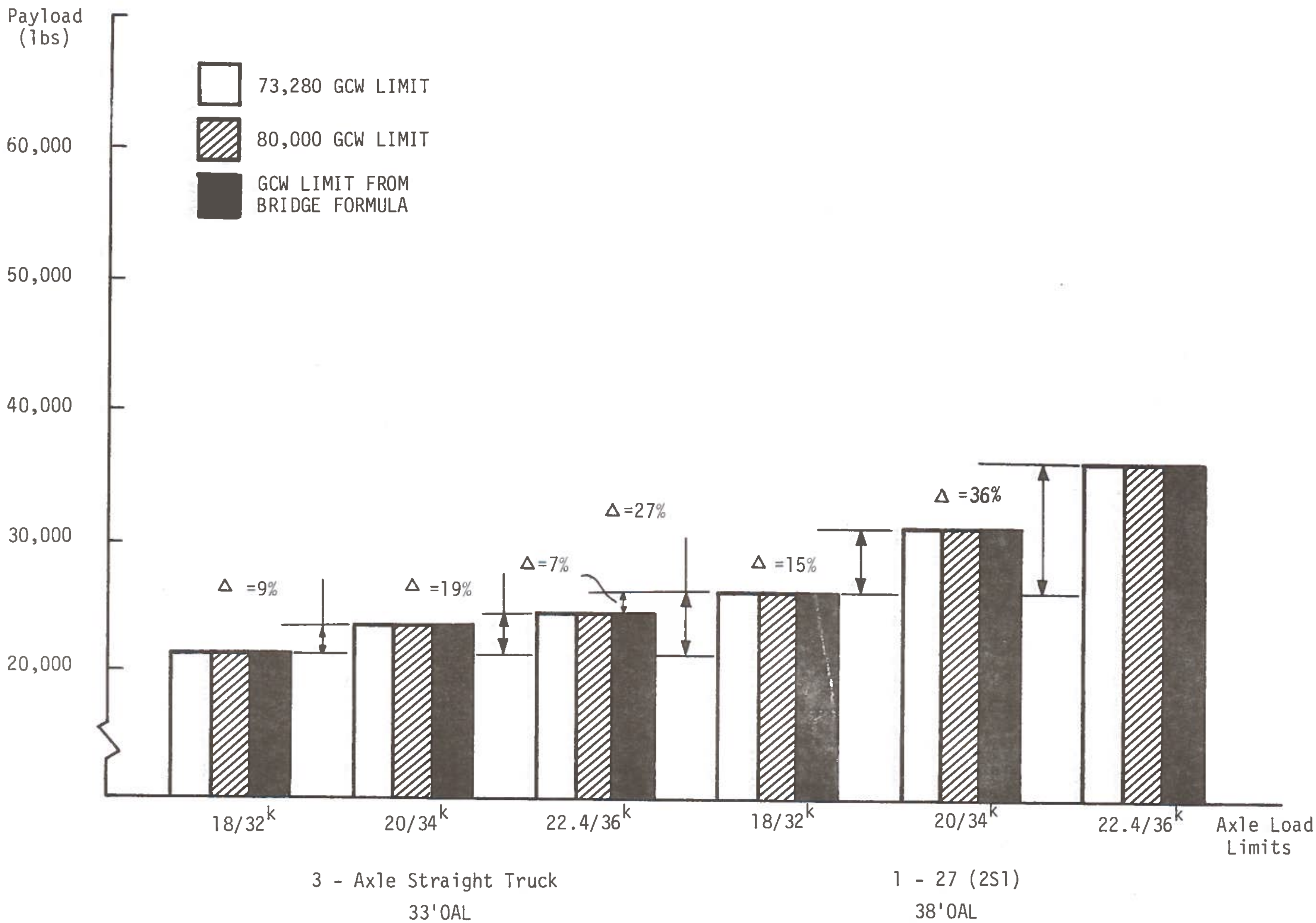


FIGURE 2-7. SHORT SINGLES HAVE ADVANTAGE OVER STRAIGHT TRUCKS OF COMPARABLE SIZE

commodity mix, back-haul loads, and trip length, and their impact on costs and overall system profits would have to be considered in making the final selection of equipment to best handle an individual carrier's traffic mix and route structure.

2.4 DENSITY -- THE LINK BETWEEN EQUIPMENT SELECTION AND COMMODITY/SHIPMENT SIZE CHOICES

As indicated, design density is a key parameter in equipment selection, since it roughly defines the dividing line between the group of commodities which weight-out and those which cube-out for any given rig. Knowing the commodity mix most likely to be hauled, the carrier can then utilize the equipment best suited to moving the traffic in question.

Conventional wisdom has it that double 27-footers are more appropriate to carry low density freight where their operation is permitted, and large singles are more appropriate to carry denser commodities. This is substantiated in Figure 2-8, which shows design densities for selected rigs. It should be noted, however, that all of these rigs compete within a rather narrow density band, with the difference between the "low density" rigs and the "high density" rigs being only about 5 pounds/cubic foot of commodity density. Thus, double 27-footers, especially under a GCW limit determined by the bridge formula, can easily compete with large single rigs for traffic in denser commodities.

The narrow range of design densities also holds true for large multiple rigs, such as triples or turnpike doubles, when the GCW limit is determined by the bridge formula and tractors are available to haul these high weights. This is indicated in Figure 2-9. The same figure also shows that under relatively low arbitrary GCW limits such rigs would be restricted to serving very low density shipments. It should be apparent that the selection of a GCW limit has a significant impact on the design density of a given tractor-trailer combination. This in turn has an influence on the selection of the specific type of rig to handle specific types of traffic in question, and could even influence

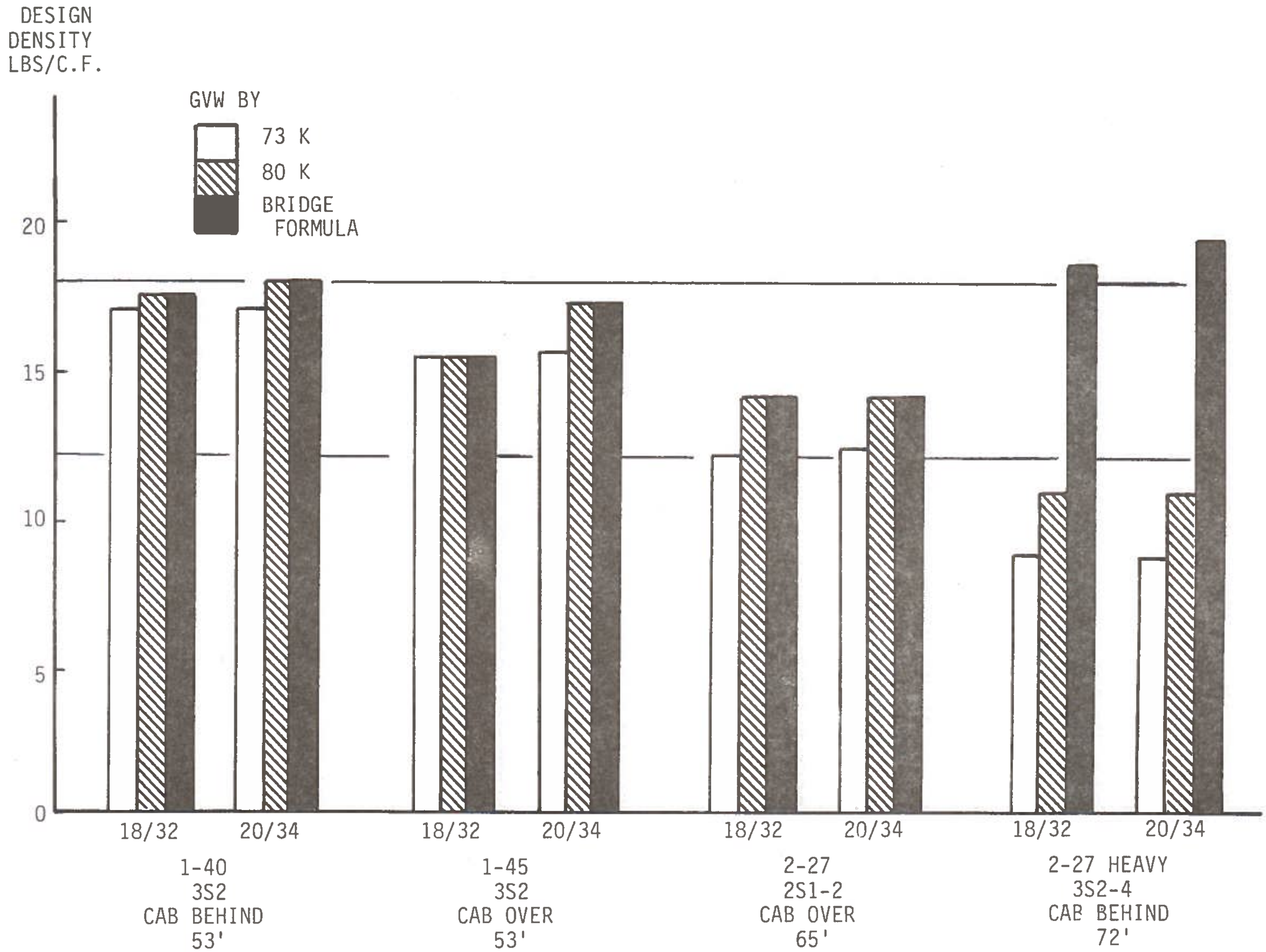


FIGURE 2-8. DESIGN DENSITIES OF SELECTED COMBINATIONS

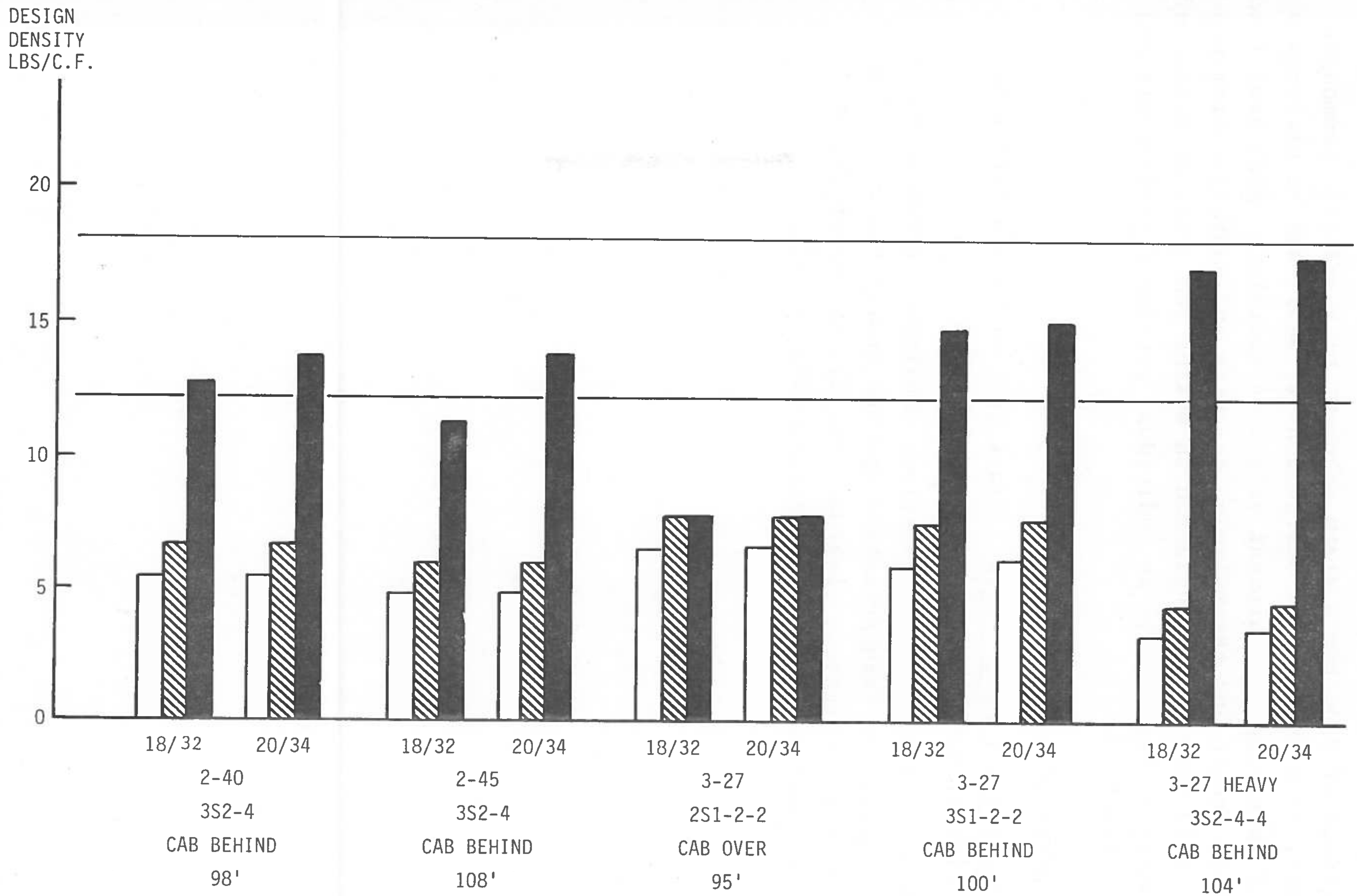


FIGURE 2-9. DESIGN DENSITIES OF SELECTED LARGE MULTIPLE TRAILER COMBINATIONS

the choice of mode for a given shipment of a specific commodity. However, this theoretical design density would not be utilized by itself in making an equipment selection decision. Back-haul loads and trip length and their impact on costs and overall system profits would have to be considered in making the final selection of equipment to best handle an individual carrier's traffic mix and route structure.

2.5 REFERENCES

1. Van Trailer Cube - 1976. Truck Trailer Manufacturers Association, Washington, DC, September 1976.

2. U.S. Senate, 43rd, 2nd Session, Committee on Public Workes, "Hearings on Transportation and New Energy Policies (Truck Sizes and Weights)," February 20, 21, and March 26, 1974, U.S. Government Printing Office, 1974, p. 72.

3. A MODEL OF THE CHARACTERISTICS OF TRUCK PAYLOADS

3.1 INTRODUCTION

This analysis was performed in order to verify some of the "theoretical" concepts developed in the design payload and density analyses of Section 2. Real world data was utilized to characterize the relationship among load factors (here defined as the average payload in pounds) and vehicle type, carrier type, and commodity, and to characterize the split among trucks which weigh-out, cube-out, and those which travel partially loaded. Thus, it is possible to estimate changes in the average payload of fully and partially loaded trucks carrying those commodities which are sensitive to changes in axle and gross weight limits, and estimate the changes in the average payloads of trucks carrying full or partial loads of those commodities which are sensitive to changes in limits that restrict trailer cubic capacity (e.g., length limits or prohibitions on the use of double trailers). This information also provides an important input to the analysis of impacts on carrier economics and market shares in that it provides a more meaningful basis for predicting loads per vehicle, and thus, average transport costs, vehicle requirements, vehicle-miles, and fuel use. In addition, a related analysis was performed to determine the distribution of a given commodity's tonnage among various truck body types.

The basic data source for this study was the Federal Highway Administration's (FHWA) 1977 Loadometer Study, which provides, among other things, data on truck weights by truck type, commodity, and class of operation. This source was supplemented by data from the Truck and Waterway Information Center's (TWIC) Truck Stop Survey (1977-78), which provides data on payload weight and volume by trailer size, commodity, and carrier type. Other data sources considered, but rejected for use here, were the Federal Highway Administration's Truck Commodity Flow Study (1972-73) and the Interstate Commerce Commission's study of empty/loaded truck miles (1976). These data sources are described in more detail in Appendix D.

Preliminary analyses of the data (performed on van tractor-trailers only) resulted in a data set disaggregated by four carrier type classes (private, I.C.C.-for-hire, other for-hire, unknown), two vehicle types (3S2 van singles, 2S1-2 van doubles), and three state GCW limits (73,280 pounds, 76,000 pounds, and 80,000 pounds), with commodities represented at the 2-digit STCC level. While it was possible to identify those trucks which were weighed-out, the commodity type data (i.e., commodity density) was too coarse to allow an identification of those trucks which were cubed-out.

This analysis did indicate that carrier type had little or no influence on average payload. It also showed that the weight of most trucks seemed to be governed by the weight limit in the states with the lower limits (73,280 pounds), and that the average payload did not differ to any great extent because of the state GCW limits.

Thus, the data base was reaggregated, eliminating carrier type and state GCW limit distinctions, but incorporating finer commodity type detail (3-digit STCC level). In this form, the data yielded a model of the average payload of fully loaded trucks, the average payload of partially loaded trucks, and the average split between fully and partially loaded trucks as a function of the relationship between commodity density and design density of a particular piece of equipment. This analysis was then extended to trucks with different body types.

3.2 MODEL RESULTS

The analysis showed that the full truck payload model hypothesized in Section 2 is supported by the data. Figure 3-1 shows a plot of commodity density at the 3-digit level against average payload on fully loaded trucks. The line indicates the payload predicted by the model. (Here, fully loaded trucks are those with more than 90 percent of the trailer volume occupied and/or a GCW greater than 70,000 pounds.) Thus, for commodities with densities greater than design density, payload equals the

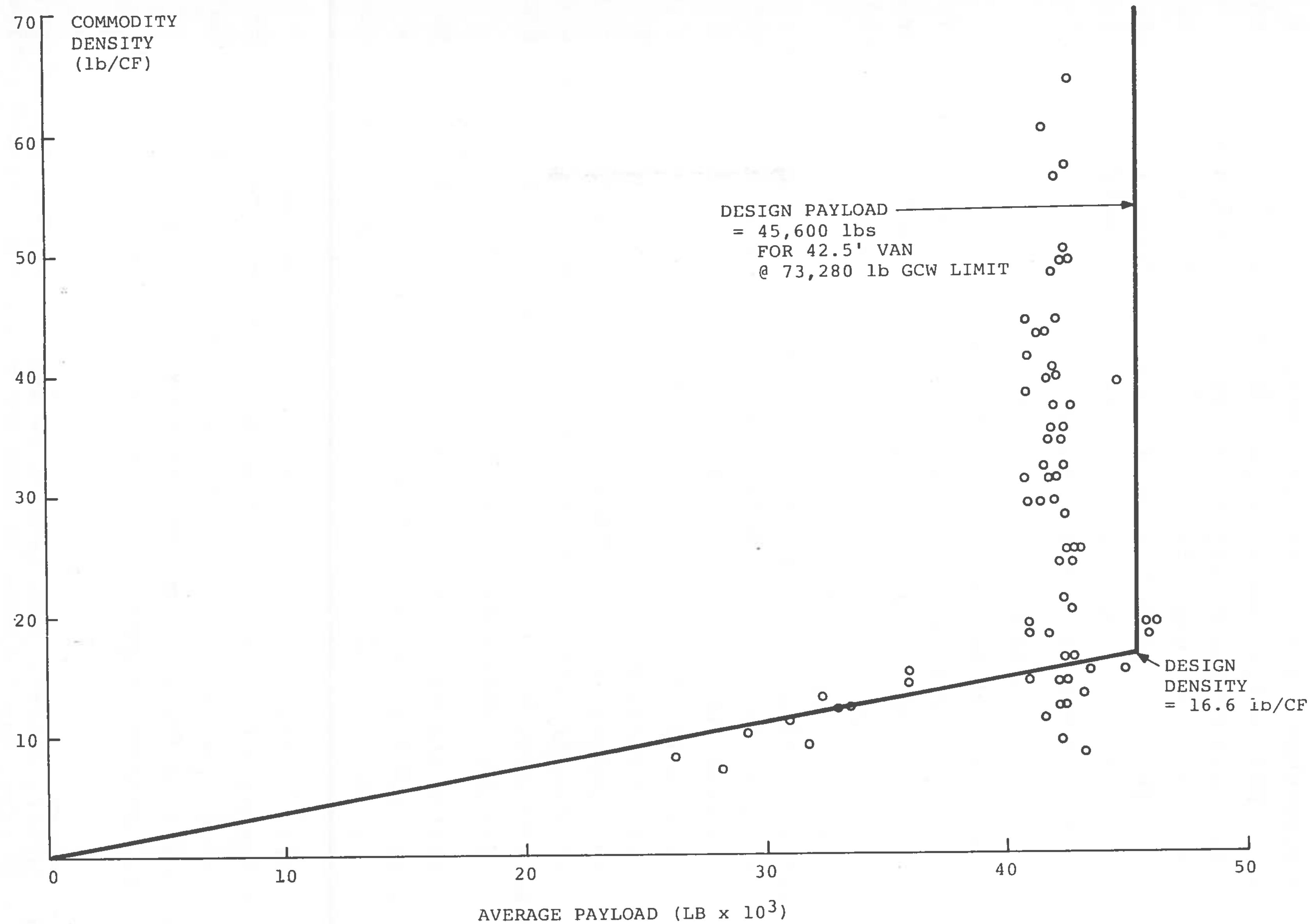


FIGURE 3-1. COMMODITY DENSITY VERSUS AVERAGE PAYLOAD OF FULLY LOADED SINGLE VANS

maximum allowable GCW minus the tare weight of the vehicle times a factor.* For commodities less than the design density, payload equals the trailer volume divided by the commodity density. It should be noted that commodity density is not an important factor per se. Whether the commodity is more or less dense than the design density of the tractor-trailer carrying that commodity seems to be the key element in determining payload.

As indicated in Appendix D, the development of a relationship between partial payloads and commodity density was more difficult since trucks are partially loaded for reasons which are generally unrelated to commodity type. A more simplistic approach was adopted in this case. For partially loaded trucks, the ratio of partial to full payload was found to provide a reasonable representation of average partial payloads as derived from the FHWA data. In the case of van tractor-trailers for example, this partial payload "model" states that for commodities denser than the maximum design density of all rigs considered (18 lbs/cf), the average partial payload would be 55 percent of the full payload. For commodities less dense than this maximum design density, the average partial payload would be 40 percent of the full payload predicted by the model. The corresponding figures, where appropriate for other body types, are given in Appendix D.

Finally, the data indicates the split between cubed-out and partially loaded trucks for commodities less dense than the maximum design density and, for commodities denser than this maximum design density, the split between partially loaded and weighed-out trucks. (This information appears in the following tables and in Appendix D.) This aspect of the study and the use of the FHWA data as the basis of the analysis were substantiated by comparison with a few reference points available from other data sources. However, a lack of a universally accepted definition

*This factor, which varies between 90 and 100 percent depending on body type, was included to make the model more representative of actual loading conditions.

of what constitutes a full and a less-than-full truck hampered the efforts of this comparison.

Thus, this portion of the study has established a method for estimating payloads of fully and partially loaded van-type tractor-trailers of any configuration as a function of commodity density under various assumed weight limits, and of estimating the split between fully and partially loaded trucks.

3.3 MODEL APPLICATIONS

The truck payload model can be utilized to estimate changes in payloads on tractor-trailer rigs due to changes in truck size and weight regulations. Tables 3-1 through 3-7 present the estimated payloads for a number of selected rigs under various weight limit scenarios. These combinations and scenarios are some of those utilized in TSC's portion of the DOT Truck Size and Weight Study described in Section 1. The rigs shown here include Western Double vans, and conventional semi vans, reefers, dumps, platforms, tanks, and auto transporters. The weight limit scenarios include both the current and former Federal weight limits, and cases based on $18^k/32^k$, $20^k/34^k$, and $22.4^k/36^k$ single/tandem axle load limits with a GCW limit determined by the appropriate bridge formula.

As stated in Section 2, some carriers are restricted by weight limits since the commodities they carry tend to be those which would cause a truck to weigh-out before completely filling the trailer's full volume. Other carriers hauling less dense commodities are restricted by regulations which limit the size and/or number of trailers that can be pulled by a tractor and thus the cubic capacity of a given tractor-trailer combination rig. These are the carriers who would tend to cube-out. However, certain commodities would cube-out or weight-out depending on the vehicle (i.e., double 27, single 40, or single 45) and weight limit scenario in question. In applying the model, three cases could be considered based on whether the commodity in question had a

*See Footnote on p. 16.

TABLE 3-1. PAYLOADS ESTIMATED BY THE MODEL FOR VAN SINGLES[1]

Load Limits[2]	Design Density (DD) (lb/cf)	Commodity Density	Full Payload[3] (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	16	≥19 ≥16, <19 <16	43,100 43,100 (4)	23,700 17,200 (5)	25% 40% 40%
Bridge Formula 18/32	16	≥19 ≥16, <19 <16	43,800 43,800 (4)	24,100 17,500 (5)	25% 40% 40%
80/20/34	17	≥19 ≥17, <19 <17	47,600 47,600 (4)	26,200 19,000 (5)	25% 40% 40%
Bridge Formula 20/34	17	≥19 ≥17, <19 <17	47,600 47,600 (4)	26,200 19,000 (5)	25% 40% 40%
80/22.4/36	18	≥19 ≥18, <19 <18	49,300 49,300 (4)	27,100 19,700 (5)	25% 40% 40%
Bridge Formula 22.4/36	18	≥19 ≥18, <19 <18	49,300 49,300 (4)	27,100 19,700 (5)	25% 40% 40%

Notes:

1. 3S2 axle pattern, 45' trailer, cab-over-engine tractor, cubic capacity - 2,910 cubic feet.
2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of <u>a</u>, single-axle limit of <u>b</u>, and a tandem-axle limit of <u>c</u>.
3. Payload = .95 X Theoretical Maximum Payload.
4. Payload = Commodity Density X 2910 Cubic Feet.
5. Partial Payload = .4 X Full Payload X .95.

   Maximum Design Density = 19 lb/cf.

TABLE 3-2. PAYLOADS ESTIMATED BY THE MODEL FOR WESTERN DOUBLES[1]

Load Limits[2]	Design Density (DD) (lb/cf)	Commodity Density	Full Payload[3] (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	12	>19	39,900	21,900	25%
		≥12, <19	39,900	16,000	40%
		<12	(4)	(5)	40%
Bridge Formula 18/32	14	>19	46,300	25,500	25%
		≥14, <19	46,300	18,500	40%
		<14	(4)	(5)	40%
80/20/34	12	>19	46,300	25,500	25%
		≥12, <19	46,300	18,500	40%
		<12	(4)	(5)	40%
Bridge Formula 20/34	14	>19	46,300	25,500	25%
		≥14, <19	46,300	18,500	40%
		<14	(4)	(5)	40%
80/22.4/36	14	>19	46,300	25,500	25%
		≥14, <19	46,300	18,500	40%
		<14	(4)	(5)	40%
Bridge Formula 22.4/36	14	>19	46,300	25,500	25%
		≥14, <19	46,300	18,500	40%
		<14	(4)	(5)	40%

Notes:

1. 2S1-2 axle pattern, two 27' van trailer, cab-over-engine tractor, cubic capacity - 3,470 cubic feet.

2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.

3. Payload = .95 X Maximum Theoretical Payload.

4. Payload = Commodity Density X 3,470 Cubic Feet X .95.

5. Partial Payload = .4 X Full Payload.

Maximum Design Density = 19 lb/cf.

TABLE 3-3. PAYLOADS ESTIMATED BY THE MODEL FOR REEFER SINGLES[1]

Load Limits[2]	Design Density (DD) (lb/cf)	Commodity Density	Full Payload[3] (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	16	>20 ≥16, <20 <16	38,200 38,200 (4)	23,700 17,200 (5)	43% 45% 45%
Bridge Formula 18/32	16	>20 ≥16,< 20 <16	38,800 38,800 (4)	24,100 17,500 (5)	43% 45% 45%
80/20/34	18	>20 ≥18,< 20 <18	42,400 42,400 (4)	26,300 19,100 (5)	43% 45% 45%
Bridge Formula 20/34	18	>20 ≥18,< 20 <18	42,400 42,400 (4)	26,300 19,100 (5)	43% 45% 45%
80/22.4/36	18	>20 ≥18, <20 <18	44,000 44,000 (4)	27,300 19,800 (5)	43% 45% 45%
Bridge Formula 22.4/36	18	>20 ≥18, <20 <18	44,000 44,000 (4)	27,300 19,800 (5)	43% 45% 45%

Notes:

1. 3S2 axle pattern, 45' trailer, cab-over-engine tractor, cubic capacity - 2,650 cubic feet.
2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.
3. Payload = .90 X Maximum Theoretical Payload.
4. Payload = Commodity Density X 2,650 Cubic Feet X .90.
5. Partial Payload = .45 X Full Payload.

Maximum Design Density = 20 lb/cf.

TABLE 3-4. PAYLOADS ESTIMATED BY THE MODEL FOR DUMP SINGLES[1]

Load Limits[(2)]	Design Density (DD) (lb/cf)	Commodity Density	Full Payload[(3)] (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	15	≥ 15 <15	38,500 NA	27,000 NA	68% NA
Bridge Formula 18/32	15	≥ 15 <15	38,500 NA	27,000 NA	68% NA
80/20/34	16	≥ 16 <16	39,500 NA	27,600 NA	68% NA
Bridge Formula 20/34	16	≥ 16 <16	39,500 NA	27,600 NA	68% NA
80/22.4/36	17	≥ 17 <17	42,700 NA	29,900 NA	68% NA
Bridge Formula 22.4/36	17	≥ 17 <17	42,700 NA	29,900 NA	68% NA

Notes:

1. 3S2 axle pattern, 40' trailer, cab-over-engine tractor, cubic capacity - 2,400 cubic feet.

2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.

3. Payload = 1.00 X Maximum Theoretical Payload.

NA (Not Applicable) - Light density commodities would not normally be transported in dump type bodies.

TABLE 3-5. PAYLOADS ESTIMATED BY THE MODEL FOR PLATFORM SINGLES[1]

Load Limits[(2)]	Design Density (DD) (lb/cf)	Commodity Density	Full Payload[(3)] (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	NA	NA	44,300	27,900	39%
Bridge Formula 18/32	NA	NA	44,900	28,300	39%
80/20/34	NA	NA	48,600	30,600	39%
Bridge Formula 20/34	NA	NA	48,600	30,600	39%
80/22.4/36	NA	NA	50,300	31,700	39%
Bridge Formula 22.4/36	NA	NA	50,300	31,700	39%

Notes:

1. 3S2 axle pattern, 45' trailer, cab-over-engine tractor, cubic capacity is meaningless.

2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.

3. Payload = .93 X Maximum Theoretical Payload.

NA (Not Applicable) - Cubic capacity and therefore design density are not meaningful parameters for platform or flatbed body types. Light density commodities would not normally be transported in platform body types.

TABLE 3-6. PAYLOADS ESTIMATED BY THE MODEL FOR TANK SINGLES[1]

Load Limits (2)	Design Density (DD) (lb/cf)	Commodity Density	Full Payload (3) (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	37	≥37 <37	45,000 NA	29,200 NA	57% NA
Bridge Formula 18/32	38	≥38 <38	45,600 NA	29,600 NA	57% NA
80/20/34	39	≥39 <39	47,500 NA	30,900 NA	57% NA
Bridge Formula 20/34	39	≥39 <39	47,500 NA	30,900 NA	57% NA
80/22.4/36	41	≥41 <41	49,400 NA	32,100 NA	57% NA
Bridge Formula 22.4/36	41	≥41 <41	49,400 NA	32,100 NA	57% NA

Notes:

1. 3S2 axle pattern, 45' trailer, cab-over-engine tractor, cubic capacity - 1,270 cubic feet.

2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.

3. Payload = .95 X Maximum Theoretical Payload.

NA (Not Applicable) - Tank bodies are generally sized to carry a specific commodity or group of commodities. Tank capacity varies as a function of commodity carried so that design density is ≤ commodity density.

TABLE 3-7. PAYLOADS ESTIMATED BY THE MODEL FOR SINGLE AUTO TRANSPORTS[1]

Load Limits(2)	Design Density (DD) (lb/cf)	Commodity Density	Full Payload(3) (pounds)	Partial Payload (pounds)	% Fully Loaded Trailers
73/18/32	NA	NA	37,300	20,900	5%
Bridge Formula 18/32	NA	NA	38,000	21,300	5%
80/20/34	NA	NA	42,000	23,500	5%
Bridge Formula 20/34	NA	NA	42,000	23,500	5%
80/22.4/36	NA	NA	43,800	24,500	5%
Bridge Formula 22.4/36	NA	NA	43,800	24,500	5%

Notes:

1. 3S2 axle pattern, 45' trailer, cab-over-engine tractor, cubic capacity is meaningless.

2. The weight limit expressions "a/b/c" mean gross vehicle weight limit of a, single-axle limit of b, and a tandem-axle limit of c.

3. Payload = 1.00 X Maximum Theoretical Payload.

NA (Not Applicable) - Cubic capacity and design density are not meaningful parameters for this body type.

density greater than or equal to the maximum design density of all substitute rigs of the same body type, less than the design density of the rig in question, or greater than or equal to the design density of the rig in question but less than the maximum design density of all substitute rigs of the same body type.*

Once a tractor-trailer combination and weight limit scenario have been defined, the design density is defined and the commodity in question can be classified as one that would tend to weigh-out or one that would cube-out on the vehicle being considered. For commodities that weigh-out, the analysis described in Appendices A and B yield a full truck payload illustrated in the tables of Appendix C. For commodities which would cube-out, the full truck payload would be determined as a product of commodity density and the trailer volume.** Partial payload, as well as the percentage of trucks partially loaded, would then be calculated as the appropriate percentage (obtained from Appendix D) of the full payload.

The method and data developed in this study allow for the easy estimation of the average full and partial payload for a given commodity movement on specified trucks under various truck size and weight limit scenarios. This information, along with the estimate of the split between fully and partially loaded trucks, can then be used to calculate the impact of equipment choices and truck size and weight limits on unit costs, vehicle requirements, vehicle-miles, and fuel use.

3.4 BODY TYPE DISTRIBUTION

This discussion implicitly assumes that a given commodity is

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*In practice, this point only applies to vans and to some extent reefers, since the other body types either carry only very dense commodities, e.g., dumps, or do not cube-out, e.g., platforms.

**These payloads could be modified to reflect actual measured payloads as done in Tables 3-1 to 3-7. This procedure is described in Appendix D.

transported in one type of truck (i.e., body type). For certain commodities this is the case. However, many commodities are transported in a number of different body types. Thus, in order to utilize the model outlined above, one would need a distribution of a specific commodity flow tonnage by body type.

This data was derived from the 1977 FHWA Loadometer Study. The distributions by body type and axle configuration for various 3-digit STCC (commodity) codes, are given in Appendix F. The distributions shown in Table 3-8 are those actually used in subsequent TSC analyses. These data represent a different aggregation of commodity groups than the 3-digit STCC groups (in some cases more aggregate, in others more disaggregate), and represent distributions for single and Western Double-type tractor-trailer combinations only. These distributions were verified, where possible, against comparable data from the Truck Inventory and Use Survey and the TWIC Truck Stop Survey.

TABLE 3-8. DISTRIBUTION OF COMMODITY TONNAGE BY TRUCK BODY TYPE

COMMODITY		BODY TYPE DISTRIBUTION						
Code	Description	Van	Reefer	Flat	Tank	Dump	Auto Transp.	Other
1	Grain	22	15	10				53
9	Forest & Fish	25	75					
10	Ore					100		
11	Coal					100		
13	Oil & Gas				100			
14	Minerals	11		12	6	66		5
F-12	Fruits & Vegetables	22	78					
20	Food Products	37	53	1	6			3
21	Tobacco	84	12		4			
22	Textiles	96	4					
23	Apparell	91	7	2				
24	Lumber	14	1	85				
26	Paper	82	7	11				
28	Chemicals	49	10	6	35			
29	Petroleum Products	8	4	12	76			
32	Stone, Clay & Glass	30	4	41	4	4		17
33	Primary Metal	21	2	75		2		
34	Fabricated Metal	36	4	60				
35	Machinery	36	1	63				
36	Electrical	71	6	23				
37	Motor Vehicle Parts	100						
G-40	Miscellaneous	86	6	8				
L-1	Motor Vehicles			15			80	5
L-2	Cans	88	8	4				
L-3	Lighting	80	5	15				
L-4	Computers	93	4	3				
L-5	Furniture	85	5	10				
L-6	Misc. Rubber	74	8	18				
L-7	Shoes	86	14					
L-8	Boxes & Tires	76	15	9				
L-9	Ignition Motors	84	5	11				
L-10	Misc. Appliances	77	7	16				
L-11	TV Sets	83	13	4				
L-12	Millwork	58	5	37				
LTL	LTL	93	5	2				

APPENDIX A

COMPILATION OF EQUIPMENT TECHNICAL DATA

A.1 INTRODUCTION

The objective of this analysis was the development of basic technical data on straight truck and tractor-trailer combination rigs with emphasis on tare weight, interior volume of trailers, where appropriate, and required horsepower. The initial analysis concentrated on van tractor-trailers. Subsequent analyses expanded the number of body types considered and also included three-axle and four-axle straight trucks. Data and basic relationships between data items were obtained from the literature and manufacturers' published information. However, gaps in the data were evident and assumptions were required to fill in these gaps and tie the available data together into a consistent package. This Appendix explains the procedures and assumptions utilized in this process.

It should be noted that the data developed here, while real, may or may not be typical. There is a wide range of options available for any equipment item connected with trucks and tractor-trailer rigs and, in a sense, most units in use today are custom made to the user's specific requirements. Thus defining specifications for the "typical" rig could be difficult. The data utilized in this study relies on standard equipment specifications or reported averages and does not attempt to account for all the variations possible.

A.2 AXLE CONFIGURATION

The various tractor-trailer axle arrangements considered in this study are illustrated in Figure A-1. (Three-axle and four-axle straight trucks were also considered but are not shown in the figure since code designations were not utilized in their descriptions.) The axle

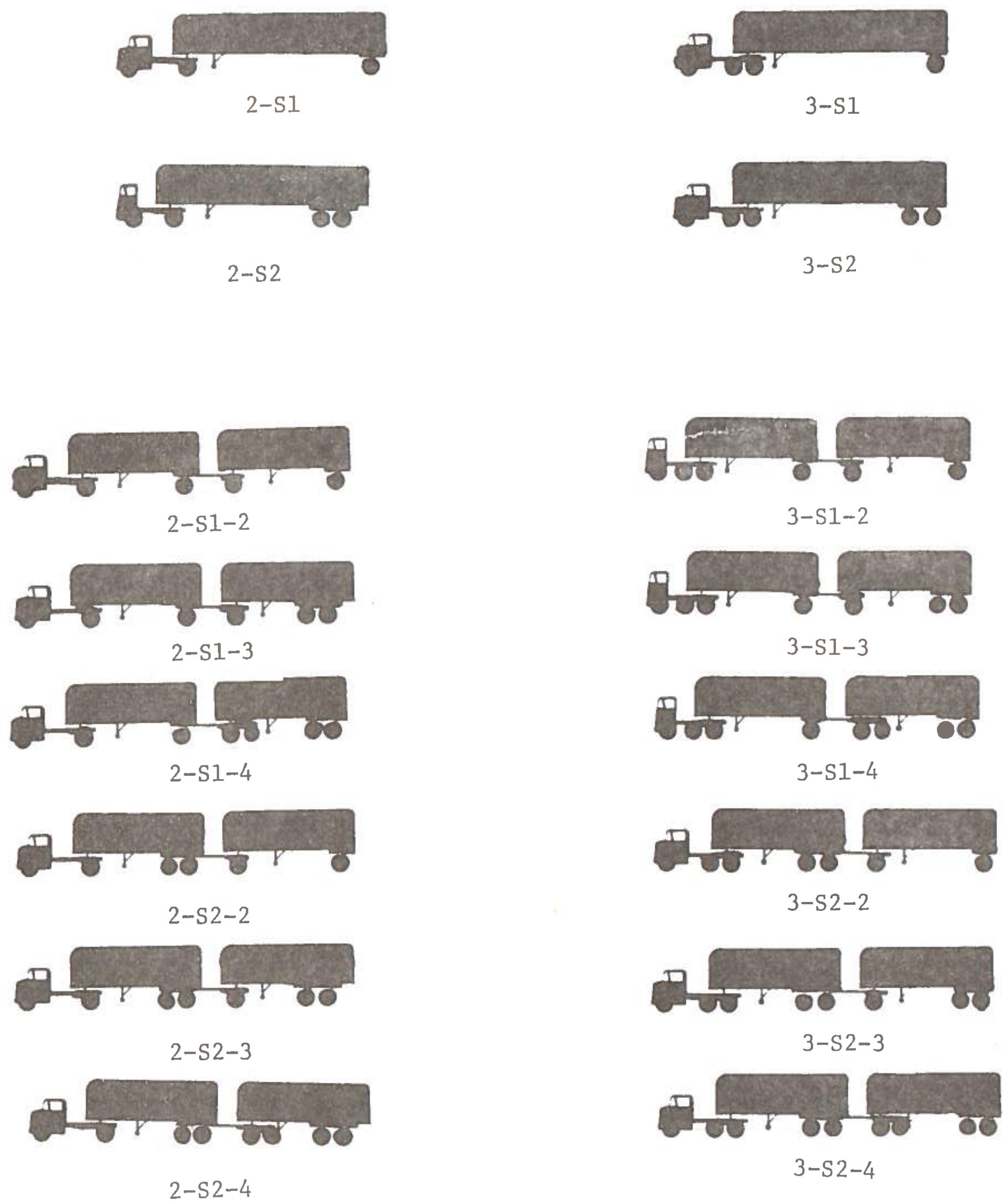
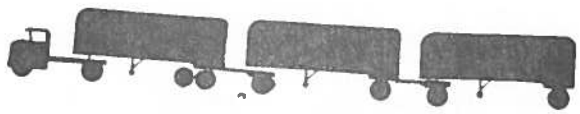


FIGURE A-1. VEHICLE AXLE ARRANGEMENTS AND CODE DESIGNATIONS

2-S1-2-2

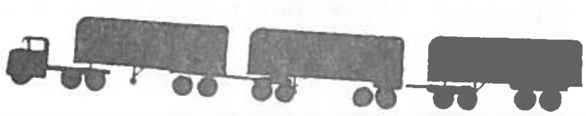


2-S2-2-2

3-S2-2-3

3-S2-2-4

3-S2-3-4



3-S2-4-4

FIGURE A-1. VEHICLE AXLE ARRANGEMENTS AND CODE DESIGNATIONS (Cont'd.)

code designations are those employed by the FHWA in their annual truck weight study (Ref. 1). The numerical designation is a simple way of indicating the number of axles under each element of a given combination rig. For example, a 3-S1-2 rig consists of a three-axle tractor pulling a single axle semi-trailer and a two-axle full trailer.

The variation in axle configurations arises from the variation in commodity attributes, primarily density. Carriers seek the rig which allows them to carry the most payload of a particular commodity for the least cost, given a set of regulations governing size and weight limits. In general, rigs with more axles in a particular class (i.e., singles, doubles or triples) would be used to haul denser commodities, while trucks with fewer axles would be used to carry less dense freight.

Many of the axle configurations considered here are not now widely used in practice. However, these rigs were examined in this study since changes in current truck size and weight regulations could foster the use of equipment with axle configurations which are not currently attractive to carriers under the existing set of regulations. It should be noted that the set of axle configurations illustrated in Figure A-1 is not all-inclusive. Many other variations, such as triple axle "tandems" or "spread tandems," are possible. However, in order to bound the limits of the analysis and keep computations at a manageable level it was decided to confine the equipment set to those rigs which represent variations of vehicles in general use today.

A.3 TRAILER LENGTH, TARE WEIGHT, AND CUBE

A wide range of van trailer lengths were considered for each of the axle configurations illustrated previously. The trailer lengths chosen for analysis were those that seem to be in general use today. For single semi-trailer rigs, trailer lengths of 35, 40, 45, 48, and 50 feet were considered. Trailers of 20, 23, 27, 31, 35, 40, and 45 feet in length were examined for double bottom rigs, while triple trailer combination with trailers of 20, 23, 27, and 31 foot lengths were studied. For non-van trailers a more limited set of lengths was studied depending on the body type.

Trailing length as well as trailer length is an important technical parameter since this impacts vehicle stability and off-tracking as well as the rig's "legality" under various overall length limits. The trailing lengths for each combination studied here are found in Appendix C. For single semi-trailer rigs, the trailing length is equal to the trailer length. For multiple trailer rigs, the trailing length is equal to the sum of the trailer lengths plus the space between trailers. In general, the space between trailers is three feet when there is a single lead axle on a following trailer and five feet when there is a tandem lead axle on a following trailer (Refs. 2, 3, 4).

Where appropriate, the interior volume of each trailer, usually referred to as its cube or cubic capacity, was determined as the product of interior width, height, and length. For vans, the interior width assumed in this analysis was

92 3/4" based on a legal maximum exterior width of 96". This was determined from manufacturers' data for Budd, Fruehauf and Trailmobile aluminum van trailers which have interior widths of 92½" to 93". Data from the Truck Trailer Manufacturers Association (TTMA) also indicates that 94.5% of van trailers manufactured in 1976 had interior widths of 92" to 93" (Ref. 5). The same manufacturers' data was used to arrive at an interior height of 101½". This is based on an overall height of 13 feet with an exterior body height of 9 feet. TTMA data indicates that 60.3% of all trailers made in 1976 had an overall height of 13 feet and that most other trailers had an overall height within ±6" of this. Interior length was found to be six to seven inches less than the overall exterior length of the trailer, according to manufacturers' specifications. For this analysis, interior length was set equal to exterior length minus six inches. The resultant cubic capacities are given in the tables in Appendix C. Volumes for refrigerated and moving vans were developed from the same basic data sources. Cubic capacities of dump and tank trailers were taken from Reference 12.

Van trailer tare weights were based on the manufacturers' data referred to previously. However, this data was available for only 40 and 45 foot tandem axle trailers and 26 and 27 foot single axle trailers. Weights of all other trailers were derived from a function of the form WEIGHT = a + b (Length). For tandem axle trailers the function used was:

Weight (lbs) = 7425 + 82.6 (Length);

and for single axle trailers the relationship was:

Weight (lbs) = 3475 + 123.0 (Length).

An early FHWA study on truck size and weight limits indicated a linear relationship between tare weight and length (Ref. 6). Such a relationship seems reasonable in light of the fact that a trailer's weight consists of a substantial "fixed" portion in the running gear and undercarriage and a variable portion, i.e., the weight of the box, which varies directly with the length of the box. Moreover, the tare weights of van tractor-trailer rigs, as determined in this study, compared reasonably well with actual tare weights reported in the FHWA Loadometer Study (Ref. 7), as indicated in Table A-1. Tare weights for rigs (tractor and trailer) of other body types, and the relationship between the tare weights of various single and multiple van tractor trailers were derived from the FHWA data directly.

A weight of 2420 pounds for single axle converter dollies and 5500 pounds for tandem axle converter dollies were assumed for multiple combination rigs. This data was derived from manufacturers' data and the Western Highway Institute (Ref. 4). Empty trailing weight, i.e., trailer(s) plus dolly, where appropriate, is also indicated in Appendix C for each rig studied.

A.4 TRACTOR LENGTH, HORSEPOWER, AND TARE WEIGHT

Four types of tractors were considered in the analysis: a two-axle cab-over-engine (COE) tractor; a two-axle cab-behind-engine (CBE) tractor; a three-axle COE tractor; and a three-axle CBE tractor. The type of cab was felt to be a relevant parameter since it impacts the overall length of the combination, and has been the focus of attention in recent Senate hearings, primarily regarding driver comfort and safety. The bumper to back of

TABLE A-1. COMPARISON OF TARE WEIGHTS USED IN THE ANALYSIS WITH REPORTED WEIGHTS

Rig	Average Tare Weight FHWA Loadometer Study[1]	Tare Weights Used in This Study[2]
2S1	22,794 lbs.	21,250 lbs. - 23,760 lbs.
3S2	30,839 lbs.	27,060 lbs. - 29,800 lbs.
2S1-2	29,919 lbs.	28,450 lbs. - 35,740 lbs.

Notes:

1 Includes all lengths and all body types.

2 Minimum weight is for the shortest trailer considered and maximum is for the longest trailer considered. Weights are for van trailer rigs only.

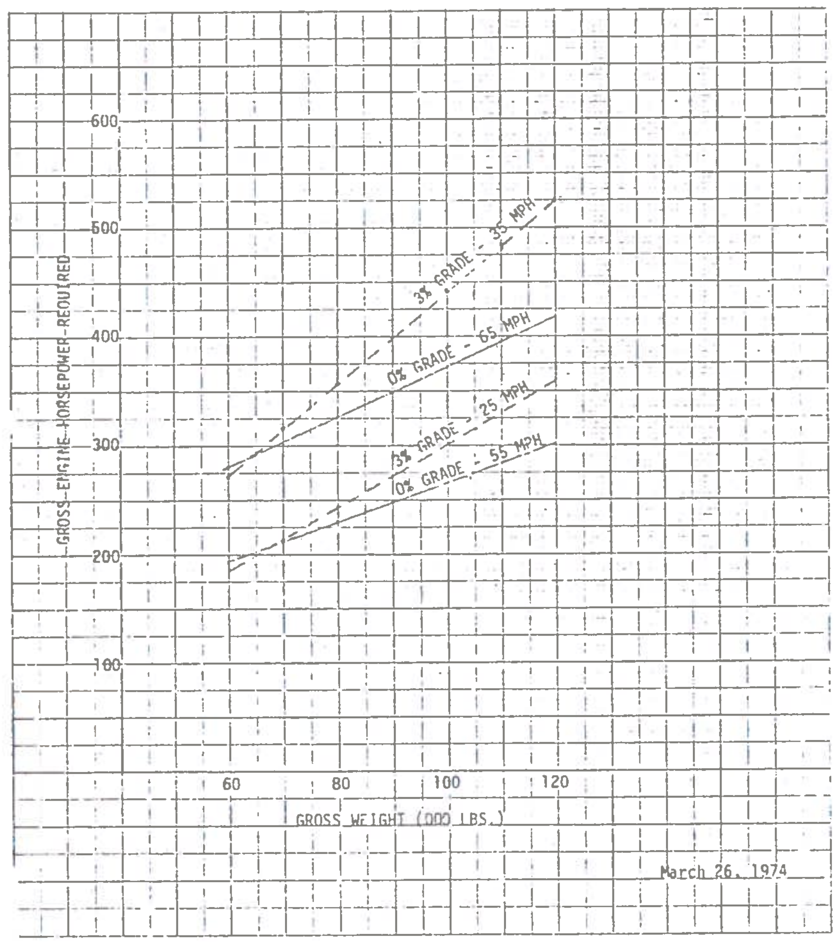
cab (BBC) dimensions for these four typical tractors are given in Appendix C. This dimension, along with the tractor-trailer spacing and the trailing length described above, make up the overall length of a given rig. This is the length dimension currently regulated by the states. The BBC dimensions were based on data from five major tractor manufacturers (Ref. 8) and are for tractors without sleeper cabs.

Tractor gross horsepower requirements were derived from an equation based on the graph shown in Figure A-2. For a 3% grade and 35 mph speed the graph yields the equation:

$$HP = 21.6 + 4.2 \text{ (gross combined weight, in lbs. x } 10^3\text{)}.$$

The horsepower requirements provided by this equation compare reasonably well with similar data provided by other truck and engine manufacturers (Refs. 9, 10). The 3% grade/35 mph speed criterion was chosen since this seems to represent one widely used informal performance standard. It should be noted that there are no formal standards, although highway design practice includes desirable limits on truck speed reduction due to grades, since this impacts highway safety and capacity (Ref. 11). The horsepower figures found in the tables in Appendix C are for the smallest engine(s) available for each typical tractor considered which meets the horsepower requirements identified by the equation.

Engine weight in each particular case was added to the chassis/cab weight indicated in the manufacturers' data (Ref. 8) to determine the tare weight of the tractor. An allowance for fuel and driver (1,000 lbs.) was added to this figure to arrive at the tare weights indicated in the tables for van trailer rigs. Tare weights for rigs (tractor and trailer) of other body types were derived from the FHWA data directly.



SOURCE: Ref. 3

FIGURE A-2. GROSS ENGINE HORSEPOWER REQUIREMENTS

A.5 STRAIGHT TRUCKS

Since such a wide variation is possible in the technical parameters relating to straight trucks, no attempt was made to construct a typical truck from manufacturers' data alone. Instead, the FHWA data (Ref. 7) was relied upon to form the basis of a statistically typical truck. Vehicle tare weight and wheelbase were taken directly from these data. Cab BBC dimensions were assumed to be the same as for tractors. Overall length was determined by adding an assumed length to the wheelbase to account for both front and rear overhangs. The length of the cargo space was then found by subtracting the BBC dimension from the overall length. Where appropriate, cube was determined as the product of length, height and width, where height and width were assumed to be the same as those of trailers of the corresponding body type. Engine horsepower was determined in the same manner as tractor horsepower requirements.

A.6 REFERENCES

1. Guide for Truck Weight Study Manual. Highway Planning Program Manual, Transmittal 107, Appendix 51, Federal Highway Administration, U.S. Department of Transportation. April 1971.

2. Maximum Desirable Dimensions and Weights of Vehicles Operated on the Federal-Aid Systems. House Document No. 354, report pursuant to Section 108(K) of the Federal-Aid Highway Act of 1956. Bureau of Public Roads, U.S. Department of Commerce. August 1964.

3. Sternberg, E. R., Director, Advanced Truck Engineering, Truck Group, White Motor Corporation. "Statement Before the Transportation Subcommittee, Committee on Public Works, U.S. Senate, on Truck Axle and Gross Weights." March 26, 1974.

4. Traction Characteristics of Trucks and Truck Combinations. Western Highway Institute, San Francisco. January 1969.

5. Van Trailer Cube - 1976. Truck Trailer Manufacturers Association, Washington, DC. September 1976.

6. Winfrey, W., et al., Economics of the Maximum Limits of Motor Vehicle Dimensions and Weights. Report No. FHWA-RD-73-64, Federal Highway Administration. U.S. Department of Transportation. September 1968.

7. 1975 National Truck Characteristics Report. Federal Highway Administration. U.S. Department of Transportation. April 1978.

8. Diesel Truck Index. Truck Index, Inc., Anaheim, CA. March 1978.

9. Cummins Engine Co., Inc. Appendix in Transportation and the New Energy Policies (Truck Sizes and Weights), Hearings Before the Subcommittee on Transportation, Committee on Public Works. U.S. Senate, 93rd. Congress 2nd. Session, Serial No. 93-H28. February 20, 21 and March 26, 1974.

10. Ford Motor Co. Appendix in Transportation and the New Energy Policies (Truck Sizes and Weights), Hearings Before the Subcommittee on Transportation, Committee on Public Works. U.S. Senate, 93rd. Congress, 2nd. Session, Serial No. 93-H28. February 20, 21 and March 26, 1974.

11. Whitside, R. E., et al., Changes in Legal Vehicle Weights and Dimensions, Some Economic Effects on Highways. NCHRP Report 141, Highway Research Board, Washington, DC. 1973.

12. Kochanowski, R. J., Trucks of Gross Vehicle Weight Greater Than 80,000 Pounds: A Preliminary Analysis of Current Use. SS-321-1-9a, U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA. June 1979.

APPENDIX B

DESIGN PAYLOAD/DENSITY ANALYSES

B.1 INTRODUCTION

Design payload and density are two important technical parameters. They determine, to a great extent, the type of rig a carrier of a particular commodity is likely to utilize. Design payload is merely the maximum allowable gross weight of a particular vehicle less the tare or empty weight of the vehicle. Design density, where appropriate, is the design payload divided by the cubic capacity of the trailer(s).

The payload of a rig is important since carriers generally seek the vehicle which minimizes costs by maximizing payload. For carriers of certain commodities, maximizing payload means maximizing the weight of the cargo carried, while for others it means maximizing the volume of the cargo carried. Design density enters the picture, since this figure provides a guide as to whether a particular commodity will be one that the carrier seeks to maximize in terms of weight or volume. Commodities with densities greater than the design density will be ones which weigh-out, i.e., the maximum weight payload of the rig is reached before the volume of the trailer(s) is completely filled. Commodities with densities less than the design density will be ones which cube-out, i.e., the maximum volume of the trailer(s) is filled before the maximum allowable payload weight is reached. This data on design payload and density for various rigs under different GCW and axle load limit scenarios can be used to explain why certain carriers utilize particular pieces of equipment to haul specific commodities. It can also be used to indicate which types of equipment carriers might choose under new GCW and axle load limits and which commodities would be carried in that equipment.

Design payload and density figures for each of the rigs considered are indicated in the tables of Appendix C. A few caveats should be kept in mind regarding these figures. First, the payload figures should not be taken as exact. As stated in Appendix A, there is a wide variability in the tare weights of tractors and trailers of any given type and thus there is a potentially wide variation in design payload. The figures given in Appendix C should be viewed as representative rather than definitive. Moreover, the design density figures must be viewed as theoretical rather than real. Due to limitations in loading and packaging, the volume occupied by a load rarely, if ever, equals the volume of the trailer even though the trailer is considered to be cubed-out. Thus, design density should be viewed as an approximate rather than exact dividing line between commodities that cube-out and those that weigh-out.

B.2 GCW/AXLE LOAD LIMIT CASES

Payload and payload density were determined for all the vans indicated in Appendix A and for selected rigs of other body types for three basic weight limit cases. These were a 73,280-pound GCW limit, an 80,000-pound GCW limit, and a GCW limit determined through application of the bridge formula. The assumed single/tandem axle load limits for these cases were 20,000 pounds per single and 34,000 pounds per tandem axle. In addition, a selected group of trucks was also studied at the three GCW limits indicated above, but with axle load limits lowered to 18,000 pounds-per-single and 32,000 pounds-per-tandem axle, and raised to 22,400 pounds per--single and 36,000 pounds-per-tandem axle.

There is currently a wide variation in weight limits among the states and within states between interstate and non-interstate roads. An attempt to study all the current variations in GCW and axle load limit combinations for all the rigs described in Appendix A would have been a monumental task. The limits chosen were those felt to be likely candidates for possible uniform nationwide application. The 73,280 and 80,000-pound GCW limits apply in almost all states on the interstate system and in most states on other Federal-Aid highways. Those states with higher non-interstate GCW limits generally apply the bridge formula or tables based on it to determine GCW limits. The axle load limits considered here are also applicable in most states.

B.3 THE BRIDGE FORMULA

In two of the cases studied the maximum GCW limit was set at an arbitrary figure. In the other case, the GCW limit was determined by the application of "the bridge formula," which deserves some further explanation. It should be noted, however, that both arbitrary weight limits, 73,280 and 80,000 pounds, are based on applications of bridge formulas to vehicles of a specific wheelbase having a specific number of axles. For example, a 3S2 rig with a 45 foot trailer would have a maximum permissible GCW of approximately 80,000 under the bridge formula with axle load limits of 20,000 lbs./34,000 lbs. per single/tandem axle. Shorter rigs with fewer axles would have smaller GCW limits according to the bridge formula. Thus, these rigs could not now legally operate at the maximum GCW limit for the state in question, but would operate at some GCW less than the maximum.

(The tables of Appendix C account for this; in those cases where the GCW limit as determined by the bridge formula is less than the arbitrary maximum, 73,280 or 80,000 pounds, the GCW limit from the bridge formula is assumed to govern in determining design payload and density.)

The bridge formula is an explicit part of Federal law regulating the maximum weight of vehicles allowed on the Interstate Highway System (Ref. 1). Maximum GCW is determined as the lesser of the following:

(A) $$W = 500 \left(\frac{LN}{N-1} + 12N + 36 \right)$$

where W = overall gross weight

N = number of axles in the group under consideration

L = distance in feet between the extreme of any group of two or more consecutive axles;

(B) the sum of the maximum permissible axle loadings of 34,000 lbs./tandem axle and 20,000 lbs./single axle,

with a maximum allowable gross weight of 80,000 pounds (or the maximum permitted in the state on July 1, 1956, whichever is greater).

The current bridge formula (bridge formula B) was developed for axle load limits of 20,000 pounds and 34,000 pounds per single and tandem axles respectively. Another version of this formula (bridge formula A) was utilized when the Federal axle load limits were 18,000 pounds and 32,000 pounds per single and tandem axles respectively. This formula is:

$$W = 500 \left(\frac{LN}{N-1} + 12N + 32 \right)$$

with all terms as defined previously (Ref. 2). With assumed axle load limits of 22,400 pounds and 36,000 pounds per single and tandem axles, respectively, another version of the bridge formula was used (Ref. 5). This version is:

$$W = 500 \left(\frac{LN}{N-1} + 12N + 40\right)$$

with all terms defined as before. Thus, a different bridge formula must be applied under different axle load limit assumptions.

It should be noted that the Federal regulations and the bridge formula do not distinguish steering axles from other single axles. In practice, the steering axle generally carries about 10,000 pounds (Refs. 2, 3, 4) and this has been the assumed steering axle loading in all the computed GCW limits indicated in Appendix C.

The bridge formulas were developed by the Bureau of Public Roads to provide simple approximations of the maximum desirable loads (in terms of gross weight and axle weights) that could be safely carried over existing bridges (Ref. 2).* These formulas were based on the premise that with the appropriate vehicle type and the resultant distribution of gross weight to the axles it would be possible to provide for the maximum in payload economy without adversely affecting the safety or economical life of bridges. The formulas give consideration to the number of axles as well as to axle spacing, and thus encourage the use of longer vehicles with a greater number of axles.

All possible groups of axles must be tested by means of the bridge formula. The gross weight permitted by application of the formula to the total wheelbase may not be permitted because of other limitations. When the bridge formula gives a greater permissible weight than the sum of the individual axle weights, the sum of the axle weights governs. Where the

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*Note that bridges designed to older standards (H15-44) would not be adequately protected under the bridge formula from the longer and heavier combinations.

maximum allowable weight determined by the application of the formula to an internal group of axles restricts the gross weight below that permitted by application of the formula to the overall wheelbase, then the internal axle limit governs. This latter restriction on the use of the bridge formulas reportedly causes the most misunderstanding among users of the formulas and tables based on the formulas (Ref. 2). However, these restrictions have been considered in this analysis, and the GCW limits shown in the tables in Appendix C include notations indicating whether the particular limit was due to the sum of the individual axle limits, the overall bridge formula, or the bridge formula applied to an internal axle grouping.

B.1 REFERENCES

1. Truck and Bus Sizes and Weights; 1977 edition. Motor Vehicle Manufacturers Association, Detroit. 1977.

2. Maximum Desirable Dimensions and Weights of Vehicles Operated on the Federal-Aid Systems. House Document No. 354, report pursuant to Section 108(K) of the Federal-Aid Highway Act of 1956, Bureau of Public Roads, U.S. Department of Commerce. August 1964.

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4. 1975 National Truck Characteristics Report. Federal Highway Administration, U.S. Department of Transportation. April 1, 1978.

5. Memorandum from D. J. Maletic and J. H. Sinnott (SYDEC) to Chief, Intermodal Studies Division, OST, dated 2/1/80.

APPENDIX C

NET PAYLOAD AND AVERAGE PAYLOAD DENSITY

TABLE C-1. NET PAYLOAD AND AVERAGE PAYLOAD DENSITY SELECTED GENERAL SERVICE AND TOFC DRY VANS[1]

TRAILER	AXLE CONFIGURATION	DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2] HP	TRACTOR[2] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT^3)	WITH GCW = 73,280 LBS PAYLOAD (LBS)	WITH GCW = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW = 80,000 LBS PAYLOAD (LBS)	WITH GCW = 80,000 LBS DENSITY (LBS/FT^3)	WITH BRIDGE FORMULA GCW[3] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT^3)
	With $18^K/32^K$ Axle Load Limit														
1-40'	3S2	4.50	40.00	47.50	350	16,750	10,730	2,584	45,020	17.4	45,020	17.4	72,500	45,020	17.4
		9.67	40.00	52.67	350	18,250	10,730	2,584	44,300	17.1	45,020	17.4	* 74,000	45,020	17.4
1-45'	3S2	4.50	45.00	52.50	350	16,750	11,140	2,911	45,390	15.6	46,110	15.8	* 74,000	46,110	15.8
		9.67	45.00	57.67	350	18,250	11,140	2,911	43,890	15.0	44,610	15.3	* 74,000	44,610	15.3
2-27'	2S1-2	4.50	57.00	64.50	350	15,300	16,020	3,468	41,960	12.1	48,680	14.0	* ●82,000	48,680	14.0
		7.73	57.00	67.73	350	14,150	16,020	3,468	43,110	12.4	49,830	14.4	* ●82,000	49,830	14.4
	3S2-4	4.50	59.00	66.50	#450	17,750	24,820	3,468	31,510	9.1	38,430	11.1	104,500	61,930	17.9
		9.67	59.00	71.67	#350	18,250	24,820	3,468	30,210	8.7	36,960	10.6	107,500	64,430	18.5
2-45	3S2-4	4.50	95.00	102.50	#450	17,750	27,780	5,822	28,560	4.9	35,480	6.1	o111,000	65,470	11.2
		9.67	95.00	107.67	#350	18,250	27,780	5,822	27,260	4.7	33,820	5.8	o111,000	64,970	11.1
3-27'	S1-2-2	4.50	87.00	94.50	350	15,300	25,240	5,202	32,750	6.3	39,460	7.6	●110,000	39,460	7.6
		7.73	87.00	97.23	350	14,150	25,240	5,202	33,890	6.5	40,610	7.8	●112,000	40,610	7.8
	3S1-2-2	4.50	87.00	94.50	#450	17,750	25,240	5,202	31,090	6.0	38,010	7.3	115,000	72,010	13.8
		9.67	87.00	96.67	#350	18,250	25,240	5,202	29,790	5.7	36,510	7.0	118,000	74,510	14.3
	With $20^K/34^K$ Axle Load Limit														
1-40'	3S2	4.50	40.00	47.50	350	16,750	10,730	2,584	45,800	17.7	46,020	17.8	o73,500	46,020	17.8
		9.67	40.00	52.67	350	18,250	10,730	2,584	44,300	17.1	46,520	18.0	o75,500	46,530	18.0
1-45'	3S2	4.50	45.00	52.50	350	16,750	11,140	2,911	45,400	15.6	50,120	17.2	78,000	50,120	17.2
		9.67	45.00	57.67	350	18,250	11,140	2,911	43,900	15.1	48,620	16.7	* 78,000	48,620	16.7
2-27'	2S1-2	4.50	57.00	64.50	350	15,300	16,020	3,468	41,960	12.3	48,680	14.0	●85,000	48,680	14.0
		7.73	57.00	67.73	350	14,150	16,020	3,468	43,110	12.4	49,830	14.4	●87,000	49,830	14.4
	3S2-4	4.50	59.00	66.50	#450	17,750	24,820	3,468	31,530	9.6	38,440	11.1	106,500	64,470	18.6
		9.67	59.00	71.67	#350	18,250	24,820	3,468	30,210	8.7	36,930	10.6	109,500	66,430	19.2
2-45'	3S2-4	4.50	95.00	102.50	#450	17,750	27,780	5,822	28,570	4.9	35,480	6.1	o115,000	69,470	11.9
		9.67	95.00	107.67	#350	18,250	27,780	5,822	27,250	4.7	33,970	5.8	o115,000	68,970	11.8
3-27'	2S1-2-2	4.50	87.00	94.50	350	15,300	25,240	5,202	32,750	6.3	39,460	7.6	●112,000	39,460	7.6
		7.73	87.00	97.73	350	14,150	25,240	5,202	33,890	6.5	40,610	7.8	●114,000	40,610	7.8
	3S1-2-2	4.50	87.00	94.50	#450	17,750	25,240	5,202	31,090	6.0	38,010	7.3	117,000	74,010	14.2
		9.67	87.00	99.67	#350	18,250	25,240	5,202	29,790	5.7	36,510	7.0	120,000	76,510	14.7
	With $18^K/32^K$ Axle Load Limit														
1-40'	3S2 (TOFC)	4.50	40.00	47.50	350	16,750	12,130	2,584	43,620	16.9	43,620	16.9	72,500	43,620	16.9
		9.67	40.00	52.67	350	18,250	12,130	2,584	42,900	16.6	43,620	16.9 *	74,000	43,620	16.9
1-45'	3S2 (TOFC)	4.50	45.00	52.50	350	16,750	12,860	2,911	43,670	15.0	44,390	16.6 *	74,000	44,390	16.6
		9.67	45.00	57.67	350	18,250	12,860	2,911	42,170	14.5	42,890	14.7 *	74,000	42,890	14.7
	With $20^K/34^K$ Axle Load Limit														
1-40'	3S2 (TOFC)	4.50	40.00	47.50	360	16,750	12,130	2,584	44,430	17.2	44,620	17.3 o	73,500	44,620	17.3
		9.67	45.00	52.67	350	18,250	12,130	2,584	42,900	16.6	45,120	17.5 o	75,500	45,120	17.5
1-45	3S2 (TOFC)	4.50	45.00	52.50	350	16,750	12,860	2,911	43,670	15.0	48,390	16.6	73,000	48,390	16.6
		9.67	45.00	57.67	350	18,250	12,860	2,911	42,170	14.5	46,890	16.1 *	78,000	46,890	16.1
	With $22.4^K/36^K$ Axle Load Limit														
1-40'	3S2 (TOFC)	4.50	40.00	47.50	350	16,750	12,130	2,584	44,400	17.2	47,820	18.5	76,700	47,820	18.5
		9.67	40.00	52.67	350	18,250	12,130	2,584	42,900	16.6	47,320	18.30	77,700	47,320	18.3
1-45"	3S2 (TOFC)	4.50	45.00	52.50	350	16,750	12,860	2,911	43,670	15.0	50,190	17.2	79,800	50,190	17.2
		9.67	45.00	57.67	350	18,250	12,860	3,511	42,170	14.5	48,890	16.8*	82,800	50,890	17.5

Information for general service dry vans with $22.4^k/36^k$ axle load limits is indicated in Table C-5.

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1]

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BCC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2.] HP	TRACTOR[2.] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT.^{3})	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMITS = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMITS = 80,000 LBS DENSITY (LBS/FT.^{3})	WITH BRIDGE FORMULA GCW[3.] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS./FT.^{3})
1-35'	2S1	4.50	35.00	42.50	270	14,130	7,780	2.257	28,090	12.4	28,090	12.4	* 50,000	28,090	12.4
		7.33	35.00	45.73	238	13,470	7,780	2,257	28,750	12.7	28,750	12.7	* 50,000	28,750	12.7
	2S2	4.50	35.00	42.50	290	14,700	10,320	2,257	38,980	17.3	38,980	17.3	* 64,000	38,980	17.3
		7.73	35.00	45.73	290	14,280	10,320	2,257	39,400	17.5	39,400	17.5	* 64,000	39,400	17.5
	3S1	4.50	35.00	42.50	290	12,720	7,780	2,257	39,500	17.5	39,500	17.5	* 64,000	39,500	17.5
		9.67	35.00	47.67	290	18,360	7,780	2,257	37,860	16.8	37,860	16.8	* 64,000	37,860	16.8
	3S2	4.50	35.00	42.50	320	16,740	10,320	2,257	42,940	19.0	42,940	19.0	o 70,000	42,940	19.0
		9.67	35.00	47.67	350	18,240	10,320	2,257	43,440	19.2	43,440	19.2	o 72,000	43,440	19.2
1-40'	2S1	4.50	40.00	47.50	270	14,130	8,400	2,584	27,470	10.6	27,470	10.6	* 50,000	27,470	10.6
		7.73	40.00	50.73	238	13,470	8,400	2,584	28,130	10.9	28,130	10.9	* 50,000	28,130	10.9
	2S2	4.50	40.00	47.50	290	14,700	10,730	2,584	38,570	14.9	38,570	14.9	* 64,000	38,570	14.9
		7.73	40.00	50.73	290	14,280	10,730	2,584	38,890	15.1	38,890	15.1	* 64,000	38,890	15.1
	3S1	4.50	40.00	47.50	290	16,720	8,400	2,584	38,880	15.1	38,880	15.1	* 64,000	38,880	15.1
		9.67	40.00	52.67	290	18,360	8,400	2,584	37,240	14.4	37,240	14.4	* 64,000	37,240	14.4
	3S2	4.50	40.00	47.50	335	16,740	10,730	2,584	45,810	17.7	46,030	17.8	o 73,500	46,030	17.8
		9.67	40.00	52.67	350	18,240	10,730	2,584	44,310	17.1	46,530	18.0	o 75,500	46,530	18.0
1-45'	2S1	4.50	45.00	52.50	270	14,130	9,010	2,911	26,860	9.2	26,860	9.2	* 50,000	26,860	9.2
		7.73	45.00	55.73	238	13,470	9,010	2,911	27,520	9.4	27,520	9.4	* 50,000	27,520	9.4
	2S2	4.50	45.00	52.50	290	14,700	11,140	2,911	38,160	13.1	38,160	13.1	* 64,000	38,160	13.1
		7.73	45.00	55.73	290	14,280	11,140	2,911	38,580	13.2	38,580	13.2	* 64,000	38,580	13.2
	3S1	4.50	45.00	52.50	290	16,720	9,010	2,911	38,270	13.2	38,270	13.2	* 64,000	38,270	13.2
		9.67	45.00	57.67	290	18,360	9,010	2,911	36,630	12.6	36,630	12.6	* 64,000	36,630	12.6
	3S2	4.50	45.00	52.50	350	16,740	11,140	2,911	45,400	15.6	50,120	17.2	78,000	50,120	17.2
		9.67	45.00	57.67	350	18,240	11,140	2,911	43,900	15.1	48,620	16.7	* 78,000	48,620	16.7
1-48'	2S1	4.50	48.00	55.50	270	14,130	9,380	3,107	26,490	8.5	26,490	8.5	* 50,000	26,490	8.5
		7.73	48.00	58.73	238	13,470	9,380	3,107	27,150	8.7	27,150	8.7	* 50,000	27,150	8.7
	2S2	4.50	48.00	55.50	290	14,700	11,390	3,107	37,910	12.2	37,910	12.2	* 64,000	37,910	12.2
		7.73	48.00	58.73	290	14,280	11,390	3,107	38,330	12.3	38,330	12.3	* 64,000	38,330	12.3
	3S1	4.50	48.00	55.50	290	16,720	9,380	3,107	37,900	12.2	37,900	12.2	* 64,000	37,900	12.2
		9.67	48.00	60.67	290	18,360	9,380	3,107	36,260	11.7	36,260	11.7	* 64,000	36,260	11.7
	3S2	4.50	48.00	55.50	350	16,740	11,390	3,107	44,950	14.5	49,870	16.1	* 78,000	49,870	16.1
		9.67	48.00	60.67	350	18,250	11,390	3,107	43,470	14.0	48,360	15.6	* 78,000	48,360	15.6
1-50'	2S1	4.50	50.00	57.50	270	14,130	9,630	3,283	26,240	8.1	26,240	8.1	* 50,000	26,240	8.1
		7.73	50.00	60.73	238	13,470	9,630	3,238	26,900	8.3	26,900	8.3	* 50,000	26,900	8.3
	2S2	4.50	50.00	57.50	290	14,700	11,560	3,238	37,740	11.7	37,740	11.7	* 64,000	37,740	11.7
		7.73	50.00	60.73	290	14,280	11,560	3,238	38,160	11.8	38,160	11.8	* 64,000	38,160	11.8
	3S1	4.50	50.00	57.50	290	16,720	9,630	3,238	37,650	11.6	37,650	11.6	* 64,000	37,650	11.6
		9.67	50.00	62.67	290	18,360	9,630	3,238	36,010	11.1	36,010	11.1	* 64,000	36,010	11.1
	3S2	4.50	50.00	57.50	350	16,740	11,560	3,238	44,980	13.9	49,700	15.3	* 78,100	49,700	15.3
		9.67	50.00	62.67	350	18,240	11,560	3,238	43,480	13.4	48,200	14.9	* 78,000	48,200	14.9

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1.] (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2.] HP	TRACTOR[2.] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT.^{3})	WITH GCW LIMIT 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMIT=80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT=80,000 LBS DENSITY (LBS/FT.^{3})	WITH BRIDGE FORMULA GCW[3.] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT.^{3})
2-23'	2S1-2	4.50	49.00	56.50	350	15,300	15,020	2,944	42,960	14.6	49,690	16.9	80,000	49,690	16.9
		7.73	49.00	59.73	350	14,150	15,020	2,944	44,110	15.0	50,830	17.3	● 82,000	50,830	17.3
	2S1-3	4.50	49.00	56.50	350	15,300	18,050	2,944	39,930	13.6	46,650	15.9	● 85,000	46,650	15.9
		7.73	49.00	59.73	350	14,150	18,050	2,944	41,080	14.0	47,800	16.2	● 87,000	47,800	16.2
	2S1-4	4.50	51.00	58.50	350	15,300	21,130	2,944	36,850	12.5	43,580	14.8	● 91,500	43,580	14.8
		7.73	51.00	61.73	350	14,150	21,130	2,944	38,000	12.9	44,720	15.2	● 93,000	44,720	15.2
	2S2-2	4.50	49.00	56.50	350	15,300	18,050	2,944	39,930	13.6	46,660	15.9	● 84,500	46,660	15.9
		7.73	49.00	59.73	350	14,150	18,050	2,944	41,080	14.0	47,800	16.2	o ● 85,000	47,800	16.2
	2S2-3	4.50	49.00	56.50	350	15,300	21,080	2,944	36,900	12.5	43,620	14.8	● 90,000	43,620	14.8
		7.73	49.00	59.73	350	14,150	21,000	2,944	38,050	12.9	44,770	15.2	● 92,000	44,770	15.2
	2S2-4	4.50	51.00	58.50	350	15,300	24,160	2,944	33,820	11.5	40,540	13.8	● 96,500	40,540	13.8
		7.73	51.00	61.73	350	14,150	24,160	2,944	34,970	11.9	41,690	14.2	● 98,500	41,690	14.2
	3S1-2	4.50	49.00	56.50	375	16,590	15,020	2,944	41,330	14.0	48,240	16.4	84,500	52,890	18.0
		9.67	49.00	61.67	#350	18,250	15,020	2,944	40,010	13.6	46,730	15.9	87,000	53,730	18.2
	3S1-3	4.50	49.00	56.50	400	16,590	18,050	2,944	38,300	13.0	45,210	15.4	90,000	55,360	18.8
		9.67	49.00	61.67	#350	18,250	18,050	2,944	36,920	12.6	43,700	14.8	92,500	56,200	19.1
	3S1-4	4.50	51.00	58.50	430	16,590	21,130	2,944	35,220	12.0	42,130	14.3	96,500	58,780	20.0
		9.67	51.00	63.67	#350	18,250	21,130	2,994	33,900	11.5	40,620	13.8	99,000	59,620	20.2
	3S2-2	4.50	49.00	56.50	400	16,590	18,050	2,944	38,300	13.0	45,210	15.4	90,000	55,360	18.8
		9.67	49.00	61.67	#350	18,250	18,050	2,944	36,980	12.6	43,700	14.8	92,500	56,200	19.1
	3S2-3	4.50	49.00	56.50	425	17,750	21,080	2,944	35,270	12.0	42,180	14.3	95,500	56,670	19.2
		9.67	49.00	61.67	#350	18,250	21,080	2,944	33,950	11.5	40,670	13.8	98,000	58,670	19.9
	3S2-4	4.50	51.00	58.50	450	17,750	24,160	2,944	32,190	10.9	39,100	13.3	102,000	60,090	20.4
		9.67	51.00	63.67	#350	18,250	24,160	2,944	30,870	10.5	37,590	12.8	104,500	62,090	21.1

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2] HP	TRACTOR[2] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPCITY ($FT.^3$)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ($LBS/FT.^3$)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY ($LBS/FT.^3$)	GCW[3] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSI (LBS/FT
2-20'	2S1-2	4.50	43.00	50.50	340	14,920	14,330	2,552	43,050	16.9	46,400	18.2	76,000	46,400	18.2
		7.73	43.00	53.73	350	14,150	14,300	2,552	44,830	17.6	49,550	19.4	78,000	49,550	19.4
	2S1-3	4.50	43.00	50.50	350	15,300	17,440	2,552	40,540	15.9	47,260	18.5	● 81,500	47,260	18.5
		7.73	43.00	53.73	350	14,150	17,440	2,552	41,690	16.3	48,410	19.0	● 83,500	48,410	19.0
	2S1-4	4.50	45.00	52.50	350	15,300	20,520	2,552	37,460	14.7	44,180	17.3	● 88,000	44,180	17.3
		7.73	45.00	55.73	350	14,150	20,520	2,552	38,610	15.1	45,330	17.8	● 89,500	45,330	17.8
	2S2-2	4.50	43.00	50.50	350	15,300	17,440	2,552	40,540	15.9	47,260	18.5	● 81,000	47,260	18.5
		7.73	43.00	53.73	350	14,150	17,440	2,552	41,690	16.3	48,410	19.0	● 83,000	48,410	19.0
	2S2-3	4.50	43.00	50.50	350	15,300	20,580	2,552	37,400	14.6	44,120	17.3	● 86,500	44,120	17.3
		7.73	43.00	53.73	350	14,150	20,580	2,552	38,550	15.1	45,270	17.8	● 88,500	45,270	17.8
	2S2-4	4.50	45.00	52.50	350	15,300	23,660	2,552	34,320	13.4	41,040	16.1	● 93,000	41,040	16.1
		7.73	45.00	55.73	350	14,150	23,660	2,552	35,470	13.9	42,190	16.5	● 95,000	42,190	16.5
	3S1-2	4.50	43.00	50.50	360	17,030	14,300	2,552	42,050	16.5	48,960	19.2	81,000	49,670	19.5
		9.67	43.00	55.67	#350	18,250	14,300	2,552	40,730	16.0	47,450	18.6	84,000	51,450	20.2
	3S1-3	4.50	43.00	50.50	400	16,590	17,440	2,552	38,910	15.2	45,820	18.0	86,500	52,470	20.6
		9.67	43.00	55.67	#350	18,250	17,440	2,552	37,590	14.7	44,310	17.4	89,500	53,810	21.1
	3S1-4	4.50	45.00	52.50	425	17,750	20,520	2,552	35,830	14.0	42,740	16.8	93,000	54,730	21.4
		9.67	45.00	57.67	#350	18,250	20,520	2,552	34,510	13.5	43,500	17.0	96,000	57,230	22.4
	3S2-2	4.50	43.00	50.50	400	16,590	17,440	2,552	38,910	15.2	45,820	18.0	86,500	52,470	20.6
		9.67	43.00	57.67	#350	18,250	17,440	2,552	37,590	14.7	44,310	17.4	89,500	53,810	21.1
	3S2-3	4.50	43.00	50.50	425	17,750	20,580	2,552	35,770	14.0	42,680	16.7	92,000	53,670	21.0
		9.67	43.00	55.67	#350	18,250	20,580	2,552	34,450	13.5	41,170	16.1	95,000	56,170	22.0
	3S2-4	4.50	45.00	52.50	430	16,590	23,660	2,552	32,690	12.8	39,600	15.5	99,000	58,750	23.0
		9.67	45.00	57.67	#350	18,250	23,660	2,552	31,370	12.3	38,090	14.9	101,500	59,597	23.4

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1] (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2] HP	TRACTOR[2] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY ($FT.^3$)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ($LBS/FT.^3$)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY ($LBS/FT.^3$)	WITH BRIDGE FORMULA GCW[3] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY ($LBS/FT.^3$)
2-27'	2S1-2	4.50	57.00	64.50	350	15,300	16,020	3,468	41,960	12.1	48,680	14.0	● 85,000	48,680	14.0
		7.73	57.00	67.73	350	14,150	16,020	3,468	43,110	12.4	49,830	14.4	● 87,000	49,830	14.4
	2S1-3	4.50	57.00	64.50	350	15,300	18,880	3,468	39,100	11.3	45,820	13.2	● 90,000	45,820	13.2
		7.73	52.00	67.73	350	14,150	18,880	3,468	40,250	11.6	46,970	13.5	● 91,500	46,970	13.5
	2S1-4	4.50	57.00	66.50	350	15,300	21,960	3,468	36,020	10.4	42,740	12.3	● 96,000	42,740	12.3
		7.73	57.00	69.73	350	14,150	21,960	3,468	37,170	10.7	43,890	12.7	● 98,000	43,890	12.7
	2S2-2	4.50	57.00	64.50	350	15,300	18,880	3,468	39,100	11.3	45,820	13.2	○● 85,000	45,820	13.2
		7.73	57.00	67.73	350	14,150	18,880	3,468	40,250	11.6	46,970	13.5	○● 85,000	46,970	13.5
	2S2-3	4.50	57.00	64.50	350	15,300	21,740	3,468	36,240	10.4	42,960	12.4	● 95,000	42,960	12.4
		7.73	57.00	67.73	350	14,150	21,740	3,468	37,390	10.8	44,110	12.7	● 96,500	44,110	12.7
	2S2-4	4.50	57.00	66.50	350	15,300	24,820	3,468	33,160	9.6	39,880	11.5	● 101,000	39,880	11.5
		7.73	57.00	69.73	350	14,150	24,820	3,468	34,310	9.9	41,030	11.8	● 103,000	41,030	11.8
	3S1-2	4.50	57.00	64.50	400	16,590	16,020	3,468	40,330	11.6	47,240	13.6	89,500	56,890	16.4
		9.67	57.00	69.67	#350	18,250	16,020	3,468	39,010	11.2	45,730	13.2	92,500	58,230	16.8
	3S1-3	4.50	57.00	64.50	425	17,750	18,880	3,468	37,470	10.8	44,380	12.8	95,000	58,370	16.8
		9.67	57.00	69.67	#350	18,250	18,880	3,468	36,150	10.4	42,870	12.4	98,000	60,870	17.6
	3S1-4	4.50	59.00	66.50	450	17,750	21,960	3,468	34,390	9.9	41,300	11.9	101,000	61,290	17.7
		9.67	57.00	71.67	#350	18,250	21,960	3,468	33,070	9.5	39,790	11.5	104,000	63,790	18.4
	3S2-2	4.50	57.00	64.50	425	17,750	18,880	3,468	37,470	10.8	44,380	12.8	94,500	57,870	16.7
		9.67	57.00	69.67	#350	18,250	18,880	3,468	36,150	10.4	42,870	12.4	97,500	60,370	17.4
	3S2-3	4.50	57.00	64.50	450	17,750	21,740	3,468	34,610	10.0	41,520	12.0	100,000	60,510	17.4
		9.67	57.00	69.67	#350	18,250	21,740	3,466	33,290	9.6	40,010	11.5	103,000	63,010	18.2
	3S2-4	4.50	57.00	66.50	#450	17,750	24,870	3,468	31,530	9.1	38,440	11.1	106,500	64,470	18.6
		9.67	57.00	71.67	#350	18,250	24,820	3,468	30,210	8.7	36,930	10.6	109,500	66,430	19.2

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2.] HP	TRACTOR[2.] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY ($FT.^3$)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ($LBS/FT.^3$)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY ($LBS/FT.^3$)	WITH BRIDGE FORMULA GCW[3.] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY ($LBS/FT.^3$)
2-31'	2S1-2	4.50	65.00	72.50	350	15,300	17,000	3,990	40,980	10.3	47,700	12.0	○● 88,000	47,700	12.0
		7.73	65.00	75.73	350	14,150	17,000	3,990	42,130	10.6	48,850	12.2	○● 88,000	48,850	12.2
	2S1-3	4.50	65.00	72.50	350	15,300	19,700	3,990	38,280	9.6	45,000	11.3	● 94,500	45,000	11.3
		7.73	65.00	75.73	350	14,150	19,700	3,990	39,430	9.9	46,150	11.6	● 96,500	46,150	11.6
	2S1-4	4.50	67.00	74.50	350	15,300	22,780	3,990	35,200	8.8	41,920	10.5	●100,500	41,920	10.5
		7.73	67.00	77.73	350	14,150	22,780	3,990	36,350	9.1	43,070	10.8	○●101,000	43,070	10.8
	2S2-2	4.50	65.00	72.50	350	15,300	19,700	3,990	38,280	9.6	45,000	11.3	○● 85,000	45,000	11.3
		7.73	65.00	75.73	350	14,150	19,700	3,990	39,430	9.9	46,150	11.6	○● 85,000	46,150	11.6
	2S2-3	4.50	65.00	72.50	350	15,300	22,400	3,990	35,580	8.9	42,300	10.6	● 99,500	42,300	10.6
		7.73	65.00	75.73	350	14,150	22,400	3,990	36,730	9.2	43,450	10.9	○●100,000	43,450	10.9
	2S2-4	4.50	67.00	74.50	350	15,300	25,480	3,990	32,500	8.2	39,220	9.8	○●104,000	39,220	9.8
		7.73	67.00	77.73	350	14,150	25,480	3,990	33,650	8.4	40,370	10.1	○●104,000	40,370	10.1
	3S1-2	4.50	65.00	72.50	425	17,750	17,000	3,990	39,350	9.7	46,260	11.6	94,500	59,750	15.0
		9.67	65.00	77.67	#350	18,250	17,000	3,990	38,030	9.5	44,750	11.2	97,500	62,250	15.6
	3S1-3	4.50	65.00	72.50	450	17,750	19,700	3,990	36,650	9.2	43,560	10.9	99,500	62,050	15.6
		9.67	65.00	77.67	#350	16,250	19,700	3,990	35,330	8.8	42,050	10.5	102,500	64,550	16.2
	3S1-4	4.50	67.00	74.50	#450	17,750	22,760	3,990	33,750	8.4	40,480	10.1	105,500	64,970	16.3
		9.67	67.00	79.67	#350	18,250	22,780	3,990	32,250	8.1	38,970	10.0	109,000	67,970	17.0
	3S2-2	4.50	65.00	72.50	430	16,590	19,700	3,990	36,650	9.2	43,560	10.9	99,000	61,550	15.4
		9.67	65.00	77.67	#350	18,250	19,700	3,990	35,330	8.8	42,050	10.5	102,000	64,050	16.0
	3S2-3	4.50	65.00	72.50	#450	17,750	22,400	3,990	33,950	8.5	40,860	10.2	104,500	64,350	16.1
		9.67	65.00	77.67	#350	18,250	22,400	3,990	32,630	8.2	39,350	9.9	107,500	66,850	16.8
	3S2-4	4.50	67.00	74.50	#450	17,750	25,480	3,990	30,870	7.7	37,780	9.5	111,000	67,770	17.0
		9.67	67.00	79.67	#350	18,250	25,480	3,990	29,550	7.4	36,270	9.0	114,000	70,270	17.6

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1] (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2] HP	TRACTOR[2] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT.³)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT³)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT.³)	WITH BRIDGE FORMULA GWC[3] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT.³)
2-35'	2S1-2	4.50	73.00	80.50	350	15,300	17,980	4,514	40,000	8.9	46,720	10.4	○● 88,000	46,720	10.4
		7.73	73.00	83.73	350	14,150	17,980	4,514	41,150	9.1	47,870	10.6	○● 88,000	47,870	10.6
	2S1-3	4.50	73.00	80.50	350	15,300	20,520	4,514	37,460	8.3	44,180	9.8	● 99,500	49,180	9.8
		7.73	73.00	83.73	350	14,150	20,520	4,514	38,610	8.5	45,330	10.0	●101,500	45,330	10.0
	2S1-4	4.50	75.00	82.50	350	15,300	23,600	4,514	34,380	7.6	41,100	9.1	○●101,000	41,100	9.1
		7.73	75.00	85.73	350	14,150	23,600	4,514	35,530	7.9	42,250	9.4	○●101,000	42,250	9.4
	2S2-2	4.50	73.00	80.50	350	15,300	20,520	4,514	37,460	8.3	44,180	9.8	○● 85,000	44,180	9.8
		7.73	73.00	83.73	350	14,150	20,520	4,514	38,610	8.5	45,330	10.0	○● 85,000	45,330	10.0
	2S2-3	4.50	73.00	80.50	350	15,300	23,060	4,514	34,420	7.7	41,640	9.2	○●100,000	41,640	9.2
		7.73	73.00	83.73	350	14,150	23,060	4,514	36,070	8.0	42,790	9.5	○●100,000	42,790	9.5
	2S2-4	4.50	75.00	82.50	350	15,300	26,140	4,514	31,840	7.0	38,560	8.5	○●104,000	38,560	8.5
		7.73	75.00	85.73	350	14,150	26,140	4,514	32,990	7.3	39,710	8.8	○●104,000	39,710	8.8
	3S1-2	4.50	73.00	80.50	430	16,590	17,980	4,514	38,370	8.5	45,280	10.0	99,000	64,430	14.3
		9.67	73.00	85.67	#350	18,250	17,980	4,514	37,050	8.2	43,770	9.7	102,000	65,770	14.6
	3S1-3	4.50	73.00	80.50	#450	17,750	20,520	4,514	35,830	7.9	42,740	9.5	104,000	65,730	14.6
		9.67	73.00	85.67	#350	18,250	20,520	4,514	34,510	7.6	41,230	9.1	107,000	68,230	15.1
	3S1-4	4.50	75.00	82.50	#450	17,750	23,600	4,514	32,750	7.3	39,660	8.8	110,000	68,250	15.2
		9.67	75.00	87.67	#350	18,250	23,600	4,514	31,430	7.0	38,150	8.4	113,500	71,650	15.9
	3S2-2	4.50	73.00	80.50	#450	17,750	20,520	4,514	35,830	7.9	42,740	9.5	104,000	65,730	14.6
		9.67	73.00	85.67	#350	18,250	20,520	4,514	34,510	7.6	41,230	9.1	107,000	68,230	15.1
	3S2-3	4.50	73.00	80.50	#450	17,750	23,060	4,514	33,290	7.4	40,200	8.9	109,000	68,190	15.1
		9.67	73.00	85.67	#350	18,250	23,060	4,514	31,970	7.1	38,690	8.6	112,000	70,690	15.7
	3S2-4	4.50	75.00	82.50	#450	17,750	26,140	4,514	30,210	6.7	37,120	8.2	○ 115,000	71,110	15.8
		9.67	75.00	87.67	#350	18,250	26,140	4,514	28,890	6.4	35,610	7.9	○ 115,000	70,610	15.6

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2]. HP	TRACTOR[2]. WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY ($FT.^3$)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ($LBS/FT.^3$)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY ($LBS/FT.^3$)	WITH BRIDGE FORMULA GCW[3]. (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY ($LBS/FT.^3$)
2-40'	2S1-2	4.50	83.00	90.50	350	15,300	19,220	5,168	38,770	7.5	45,480	8.8	o ● 88,000	45,480	8.8
		7.73	83.00	93.73	350	14,150	19,220	5,168	39,910	7.7	46,630	9.0	o ● 88,000	46,630	9.0
	2S1-3	4.50	83.00	90.50	350	15,300	21,550	5,168	36,440	7.0	43,150	8.4	* ●104,000	43,150	8.9
		7.73	83.00	93.73	350	14,150	21,550	5,168	37,580	7.3	44,300	8.6	* ●104,000	44,300	8.6
	2S1-4	4.50	85.00	92.50	350	15,300	24,630	5,168	33,360	6.5	40,070	7.8	o ●101,000	40,070	7.8
		7.73	85.00	95.73	350	14,150	24,630	5,168	34,500	6.7	41,220	8.0	o ●101,000	41,220	8.0
	2S2-2	4.50	83.00	90.50	350	15,300	21,550	5,168	36,440	7.0	43,150	8.4	o ● 85,000	43,150	8.4
		7.73	83.00	93.73	350	14,150	21,550	5,168	37,580	7.3	44,300	8.6	o ● 85,000	44,300	8.6
	2S2-3	4.50	83.00	90.50	350	15,300	23,800	5,168	34,110	6.6	40,820	7.9	o ●100,000	40,820	7.9
		7.73	83.00	93.73	350	14,150	23,880	5,168	35,250	6.8	41,970	8.1	o ●100,000	41,970	8.1
	2S2-4	4.50	85.00	92.50	350	15,300	26,960	5,168	31,030	6.0	37,740	7.3	o ●104,000	37,740	7.3
		7.73	85.00	95.73	350	14,150	26,960	5,168	32,170	6.2	38,890	7.5	o ●104,000	38,890	7.5
	3S1-2	4.50	83.00	90.50	#450	17,750	19,220	5,168	37,130	7.2	44,040	8.5	* 104,000	67,030	13.0
		9.67	83.00	95.67	#350	18,250	19,220	5,168	35,810	6.9	42,530	8.2	* 104,000	66,530	12.9
	3S1-3	4.50	83.00	90.50	#450	17,750	21,550	5,168	34,800	6.7	41,710	8.1	110,000	70,700	13.7
		9.67	83.00	95.67	#350	18,250	21,550	5,168	33,480	6.5	40,200	7.8	113,000	73,200	14.2
	3S1-4	4.50	85.00	92.50	#450	17,750	24,630	5,168	31,720	6.1	38,630	7.5	116,000	73,620	14.2
		9.67	85.00	97.67	#350	18,250	24,630	5,168	30,400	5.9	37,120	7.2	o 118,500	76,120	14.7
	3S2-2	4.50	83.00	90.50	#450	17,750	21,550	5,168	34,800	6.7	41,710	8.1	109,500	70,200	13.6
		9.67	83.00	95.67	#350	18,250	21,550	5,168	33,480	6.5	40,200	7.8	112,500	72,700	14.1
	3S2-3	4.50	83.00	90.50	#450	17,750	23,880	5,168	32,470	6.3	39,380	7.6	115,000	73,370	14.2
		9.67	83.00	95.67	#350	18,250	23,880	5,168	31,150	6.0	37,870	7.3	o 115,000	75,870	14.7
	3S2-4	4.50	85.00	92.50	#450	17,750	26,960	5,168	24,390	5.7	36,300	7.0	o 115 000	70,290	13.6
		9.67	85.00	97.67	#350	18,250	26,960	5,168	28,070	5.4	34,790	6.7	o 115,000	69,790	13.5

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1]. (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2] HP	TRACTOR[2] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY ($FT.^3$)	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ($LBS/FT.^3$)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY ($LBS/FT.^3$)	WITH BRIDGE FORMULA GCW[3] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY ($LBS/FT.^3$)
2-45'	2S1-2	4.50	93.00	100.50	350	15,300	20,440	5,822	37,550	6.4	44,260	7.6	o ● 88,000	44,260	7.6
		7.73	93.00	103.73	350	14,150	20,440	5,822	38,690	6.6	45,410	7.8	o ● 88,000	45,410	7.8
	2S1-3	4.50	93.00	100.50	350	15,300	22,570	5,822	35,420	6.1	42,130	7.2	* ●104,000	42,130	7.2
		7.73	93.00	103.73	350	14,150	22,570	5,822	36,560	6.3	43,280	7.4	* ●104,000	43,280	7.4
	2S1-4	4.50	95.00	102.50	350	15,300	25,650	5,822	32,340	5.6	39,050	6.7	o ●101,000	39,050	6.7
		7.73	95.00	105.73	350	14,150	25,650	5,822	33,480	5.7	40,200	6.9	o ●101,000	40,200	6.9
	2S2-2	4.50	93.00	100.50	350	15,300	22,570	5,822	35,420	6.1	42,130	7.2	o ● 85,000	42,130	7.2
		7.73	93.00	103.73	350	14,150	22,570	5,822	36,560	6.3	43,280	7.4	o ● 85,000	43,280	7.4
	2S2-3	4.50	93.00	100.50	350	15,300	24,700	5,822	33,290	5.7	40,000	6.9	o ●100,000	40,000	6.9
		7.73	93.00	103.73	350	14,150	24,700	5,822	34,430	5.9	41,150	7.1	o ●100,000	41,150	7.1
	2S2-4	4.50	95.00	102.50	350	15,300	27,780	5,822	30,210	5.2	36,920	6.3	o ●104,000	36,920	6.3
		7.73	95.00	105.73	#350	14,150	27,780	5,822	31,350	5.4	38,070	6.5	o ●104,000	38,070	6.5
	3S1-2	4.50	93.00	100.50	#450	17,750	20,440	5,822	35,910	6.2	42,820	7.3	* 104,000	65,810	11.3
		9.67	93.00	105.67	#350	18,250	20,440	5,822	34,590	5.9	41,310	7.1	* 104,000	65,310	11.2
	3S1-3	4.50	93.00	100.50	#450	17,750	22,570	5,822	33,780	5.8	40,690	7.0	116,000	75,680	13.0
		9.67	93.00	105.67	#350	18,250	22,570	5,822	32,460	5.6	39,180	6.7	* 118,000	67,290	11.6
	3S1-4	4.50	95.00	102.50	#450	17,750	25,650	5,822	30,700	5.3	37,610	6.5	o 118,500	78,100	13.4
		9.67	95.00	107.67	#350	18,250	25,650	5,822	29,380	5.0	36,100	6.2	o 118,500	76,100	13.1
	3S2-2	4.50	93.00	100.50	#450	17,750	22,570	5,822	33,780	5.8	40,690	7.0	o 115,000	75,180	12.9
		9.67	93.00	105.67	#350	18,280	22,570	5,822	32,460	5.6	39,180	6.7	o 115,000	77,180	13.3
	3S2-3	4.50	93.00	100.50	#450	17,750	24,700	5,822	31,650	5.4	38,560	6.6	o 115,000	72,550	12.5
		9.67	93.00	105.67	#350	18,250	24,700	5,822	30,330	5.2	37,050	6.4	o 115,000	72,050	12.4
	3S2-4	4.50	95.00	102.50	#450	17,750	27,780	5,822	28,570	4.9	35,480	6.1	o 115,000	69,470	11.9
		9.67	95.00	107.67	#350	18,250	27,780	5,822	27,250	4.7	33,970	5.8	o 115,000	68,970	11.8

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1.] (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2.] HP	TRACTOR[2.] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT.^{3})	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT.^{3})	WITH BRIDGE FORMULA GCW[3.]	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT.^{3})
3-20	2S1-2-2	4.50	66.00	73.50	350	15,300	22,660	3,828	35,330	9.2	42,040	11.0	●100,000	42,040	11.0
		7.73	66.00	76.73	350	14,150	22,660	3,828	36,470	9.5	43,190	11.3	●101,500	43,190	11.3
	2S2-2-2	4.50	66.00	73.50	350	15,300	25,800	3,828	32,190	8.4	38,900	10.2	●105,000	38,900	10.2
		7.73	66.00	76.73	350	14,150	25,800	3,828	33,330	8.7	40,050	10.5	●107,000	40,050	10.5
	3S2-2-3	4.50	66.00	73.50	#450	17,750	28,940	3,828	26,410	6.9	34,320	9.0	116,000	69,310	18.1
		9.67	66.00	78.67	#350	18,250	28,940	3,828	26,040	6.8	32,810	8.6	119,000	71,810	18.8
	3S2-2-4	4.50	68.00	75.50	#450	17,750	32,020	3,828	24,330	6.4	31,240	8.2	123,000	73,230	19.1
		9.67	68.00	80.67	#350	18,250	32,020	3,828	23,010	6.0	29,730	7.8	●125,500	67,730	18.2
	3S2-3-4	4.50	68.00	75.50	#450	17,750	35,160	3,828	21,190	5.5	28,100	7.3	128,500	75,590	19.8
		9.67	68.00	80.67	#350	18,250	35,160	3,828	19,870	5.2	26,590	7.0	●131,500	66,590	17.4
	3S2-4-4	4.50	70.00	77.50	#450	17,750	38,240	3,828	17,110	4.5	25,020	6.5	135,500	79,510	20.8
		9.67	70.00	82.67	#350	18,250	38,240	3,828	16,790	4.4	23,510	6.1	●138,000	63,510	16.6
3-23'	2S1-2-2	4.50	75.00	82.50	350	15,300	23,740	4,416	34,250	7.8	40,960	9.3	●105,000	40,960	9.3
		7.73	75.00	85.73	350	14,150	23,740	4,416	35,390	8.0	42,110	9.5	●107,000	42,110	9.5
	2S2-2-2	4.50	75.00	82.50	350	15,300	26,770	4,416	31,220	7.1	37,930	8.6	●110,000	37,930	8.6
		7.73	75.00	85.73	350	14,150	26,770	4,416	32,360	7.3	39,080	8.9	●112,000	39,080	8.9
	3S2-2-3	4.50	75.00	82.50	#450	17,750	29,800	4,416	26,550	6.0	33,460	7.6	121,000	73,450	16.6
		9.67	75.00	87.67	#350	18,250	29,800	4,416	25,230	5.7	31,950	7.2	●124,000	71,950	16.3
	3S2-2-4	4.50	77.00	84.50	#450	17,750	32,880	4,416	23,470	5.3	30,380	6.9	128,000	77,370	17.5
		9.67	77.00	89.67	#350	18,250	32,880	4,416	22,150	5.0	28,870	6.5	●130,500	68,870	15.6
	3S2-3-4	4.50	77.00	84.50	#450	17,750	35,910	4,416	19,440	4.4	27,350	6.2	133,500	79,840	18.1
		9.67	77.00	89.67	#350	18,250	35,910	4,416	19,120	4.3	25,840	5.8	●136,000	65,840	14.9
	3S2-4-4	4.50	79.00	86.50	#450	17,750	38,990	4,416	17,360	3.9	24,270	5.5	140,500	83,760	19.0
		9.67	79.00	91.67	#350	18,250	38,990	4,416	16,040	3.6	22,760	5.2	●143,000	62,760	14.2
3-27'	2S1-2-2	4.50	87.00	94.50	350	15,300	25,240	5,202	32,750	6.3	39,460	7.6	●112,000	39,460	7.6
		7.73	87.00	97.73	350	14,150	25,240	5,202	33,890	6.5	40,610	7.8	●114,000	40,610	7.8
	2S2-2-2	4.50	87.00	94.50	350	15,300	28,100	5,202	29,890	5.8	36,600	7.0	●117,000	36,600	7.0
		7.73	87.00	97.73	350	14,150	28,100	5,202	31,030	6.0	37,750	7.3	●119,000	37,750	7.3
	3S2-2-3	4.50	87.00	94.50	#450	17,750	30,960	5,202	25,390	4.9	32,300	6.2	128,000	79,290	15.2
		9.67	87.00	99.67	#350	18,250	30,960	5,202	24,070	4.6	30,790	5.9	●130,500	70,790	13.6
	3S2-2-4	4.50	89.00	96.50	#450	17,750	34,040	5,202	22,310	4.3	29,220	5.6	134,500	82,710	15.9
		9.67	89.00	101.07	#350	18,250	34,040	5,202	20,990	4.0	27,710	5.3	●137,500	67,710	13.0
	3S2-3-4	4.50	89.00	96.50	#450	17,750	36,900	5,202	19,450	3.7	26,360	5.0	140,000	85,350	16.4
		9.67	89.00	101.67	#350	18,250	36,900	5,202	18,130	3.5	24,850	4.8	●143,000	64,850	12.5
	3S2-4-4	4.50	91.00	98.50	#450	17,750	39,980	5,202	16,370	3.2	23,280	4.5	146,500	88,770	17.1
		9.67	91.00	103.67	#350	18,250	39,980	5,202	15,050	2.9	21,770	4.2	●149,500	61,770	11.9
	3S1-2-2	4.50	87.00	94.50	#450	17,750	25,240	5,202	31,090	6.0	38,010	7.3	117,000	74,010	14.2
		9.67	87.00	99.67	#350	18,250	25,240	5,202	29,790	5.7	36,510	7.0	120,000	76,510	14.7

TABLE C-2. NET PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY GENERAL SERVICE DRY VANS[1.] (CONTINUED)

TRAILER	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT.)	LENGTH (FT.) TRAILING	LENGTH (FT.) OVERALL	TRACTOR[2.] HP	TRACTOR[2.] WEIGHT (LBS)	EMPTY TRAILING WEIGHT (LBS)	CUBIC CAPACITY (FT.^{3})	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY ((LBS/FT.^{3})	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT.^{3})	WITH BRIDGE FORMULA GCW[3.] (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT.^{3})
3-31'	2S1-2-2	4.50	99.00	106.50	350	15,300	26,710	5,985	31,280	5.2	37,990	6.4	●119,000	37,990	6.4
		7.73	99.00	109.73	350	14,150	26,710	5,985	32,420	5.4	39,140	6.5	●121,000	39,140	6.5
	2S2-2-2	4.50	99.00	106.50	350	15,300	29,410	5,985	28,580	4.8	35,290	5.9	●129,000	35,290	5.9
		7.73	99.00	109.73	350	14,150	29,410	5,985	29,720	5.0	36,440	6.1	●125,500	36,440	6.1
	2S2-2-3	4.50	99.00	106.50	#450	17,750	32,110	5,985	24,240	4.0	31,150	5.2	134,500	84,640	14.1
		9.67	99.00	111.67	#350	18,250	32,110	5,985	22,920	3.8	29,640	4.9	●137,000	69,640	11.6
	2S2-2-4	4.50	101.00	108.50	#450	17,750	35,190	5,965	21,160	3.5	28,070	4.7	•141,000	88,060	14.7
		9.67	101.00	113.67	#350	18,250	35,190	5,985	19,840	3.3	26,560	4.4	●144,000	66,560	11.1
	2S2-3-4	4.50	101.00	108.50	#450	17,750	37,890	5,985	18,460	3.1	25,370	4.2	146,500	90,860	15.2
		9.67	101.00	113.67	#350	18,250	37,890	5,985	17,140	2.9	23,860	4.0	●149,500	63,860	10.7
	2S2-4-4	4.50	101.00	110.50	#450	17,750	40,970	5,985	15,380	2.6	22,290	3.7	●153,500	91,289	15.2
		9.67	101.00	115.67	#350	18,250	40,970	5,985	14,060	2.4	20,780	3.5	●156,000	60,780	10.2

TABLE C-3. PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY FOR SELECTED TRUCKS WITH $18/32^{k}$ AXLE LOAD LIMITS[1].

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBIC CAPACITY	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT^3)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT^3)
1-45	AUTO TRANSPORT	3S2	4.50	350	45.00	52.50	36,000		37,280	-	38,000	-	* 74,000	38,000	-
			9.67	350	45.00	57.67	36,000	-	37,280	-	38,000	-	* 74,000	38,000	-
1-45	MOVING VAN	3S2	4.50	350	45.00	52.50	29,600	3800	43,680	11.5	44,400	11.7	* 74,000	44,400	11.7
			9.67	350	45.00	57.67	31,200	3800	42,080	11.1	42,800	11.3	* 74,000	42,800	11.3
2-27	MOVING VAN	2S1-2	4.50	350	57.00	64.50	33,200	4620	40,080	8.7	46,800	10.1	*•82,000	46,800	10.1
			7.73	350	57.00	67.73	32,000	4620	41,280	8.9	48,000	10.4	*•82,000	48,000	10.4
2-45	MOVING VAN	3S2-4	4.50	#450	95.00	102.50	48,200	7600	25,080	3.3	31,200	4.2	o111,000	62,800	8.3
			9.67	#350	95.00	107.67	48,800	7600	24,480	3.2	31,200	4.1	o111,000	62,200	8.2
3-27	MOVING VAN	3S2-2-2	4.50	#450	87.00	94.50	45,600	6930	27,680	4.0	34,400	5.0	115,000	69,400	10.0
			9.67	#350	87.00	99.67	46,100	6930	27,180	3.9	33,900	4.9	118,000	71,900	10.4
3 AXLE	REEFER	3A	4.50	220	-	32.60	21,800	1650	20,200	12.2	20,200	12.2	* 42,000	20,200	12.2
			9.67	220	-	32.60	21,800	1340	20,200	15.1	20,200	15.1	* 42,000	20,200	15.1
1-40	REFFER	3S2	4.50	350	40.00	47.50	30,500	2350	42,000	17.9	42,000	17.9	72,500	42,000	17.9
			9.67	350	40.00	52.67	32,000	2350	41,280	17.6	42,000	17.9	* 74,000	42,000	17.9
1-45	REEFER	3S2	4.50	350	45.00	52.50	30,900	2650	42,380	16.0	43,100	16.3	* 74,000	43,100	16.3
			9.67	350	45.00	57.67	32,400	2650	40,880	15.4	41,600	15.7	* 74,000	41,600	15.7
2-27	REEFER	2S1-2	4.50	350	57.00	64.50	37,100	3140	36,180	11.5	42,900	13.7	*•82,000	42,900	13.7
			7.73	350	57.00	67.73	36,000	3140	37,280	11.9	44,000	14.0	*•82,000	44,000	14.0
2-45	REEFER	3S2-4	4.50	#450	95.00	102.50	52,100	5300	21,180	4.0	27,900	5.3	o111,000	58,900	11.1
			9.67	#350	95.00	107.67	52,600	5300	20,680	3.9	27,400	5.2	o111,000	58,400	11.0
3-27	REEFER	3S1-2-2	4.50	#450	87.00	94.50	51,400	4710	21,880	4.6	28 600	6.1	115,000	63,600	13.5
			9.67	#350	87.00	99.67	51,900	4710	21,380	4.5	28,100	6.0	118,000	66,100	14.0
3 AXLE	TANK	3A	4.50	220	-	31.30	23,400	810	18,600	23.0	18,600	23.0	* 42,000	18,600	23.0
			9.67	220	-	31.30	23,400	650	18,600	28.6	18,600	28.6	* 42,000	18,600	28.6
1-42	TANK	3S2	4.50	350	42.00	49.50	25,900	1270	47,380	37.3	48,000	39.8	73,900	48,000	37.8
			9.67	350	42.00	54.67	27,300	1270	45,980	36.2	46,700	36.8	* 74,000	46,700	36.8
2-27	TANK	2S1-2	4.50	350	57.00	64.50	29,100	1630	44,180	27.1	50,900	31.2	*•82,000	50,900	31.2
			7.73	350	57.00	67.73	28,100	1630	45,180	27.7	51,900	31.8	*•82,000	51,900	31.8
2-42	TANK	3S2-4	4.50	#450	89.00	96.50	41,600	2540	31,680	12.5	38,400	15.1	o112,000	70,400	27.7
			9.67	#350	89.00	101.67	42,000	2450	31,280	12.3	38,000	15.0	o112,000	70,000	27.6
3-27	TANK	3S1 2-2	4.50	#450	87.00	94.50	40,000	2450	33,280	13.6	40,000	16.3	115,000	74,000	30.6
			9.67	#350	87.00	99.67	40,400	2450	32,880	13.4	39,600	16.2	118,000	77,600	31.7
3 AXLE	PLATFORM/RACK	3A	4.50	220	-	32.20	18,300	-	23,700	-	23,700	-	* 42,000	23,700	-
			9.67	220	-	32.20	18,300	-	23,700	-	23,700	-	* 42,000	23,700	-
4 AXLE	PLATFORM/RACK	4A	4.50	260	-	37.40	25,100	-	31,600	-	31,600	-	56,700	31,600	-
			9.67	260	-	37.40	25,100	-	31,600	-	31,600	-	56,700	31,600	-
1-40	PLATFORM/RACK	3S2	4.50	350	40.00	47.50	25,300	-	47,200	-	47 200	-	* 72,500	47,200	-
			9.67	350	40.00	52.67	26,700	-	46,580	-	47,300	-	* 74,000	47,300	-
1-45	PLATFORM/RACK	3S2	4.50	350	45.00	52.50	25,700	-	47,580	-	48,300	-	* 74,000	48,300	-
			9.67	350	45.00	57.67	27,000	-	46,280	-	47,000	-	* 74,000	47,000	-

TABLE C-3. PAYLOAD WEIGHT AND PAYLOAD DENSITY FOR SELECTED TRUCKS WITH 18/32[k] AXLE LOAD LIMITS[1]. (CONTINUED)

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBLIC CAPACITY	WITH GCW LIMIT - 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT - 73,280 LBS DENSITY (LBS/FT³)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT³)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT³)
2-27	PLATFORM/RACK	2S1 2	4.50	350	57.00	64.50	28,800	-	44,480	-	51,200	-	*•82,000	51 200	-
			7.73	350	57.00	67.73	27,800	-	45,480	-	52,200	-	*•82,000	52,200	-
2-45	PLATFORM/RACK	3S2 -4	4.50	#450	95.00	102.50	41,900	-	31,380	-	38,100	-	o111,000	69,100	-
			9.67	#350	95.00	107.67	42,300	-	30,980	-	37,700	-	o111,000	68,700	-
3-27	PLATFORM/RACK	3S1-2-2	4.50	#450	87.00	94.50	39,600	-	33,680	-	40,400	-	115,000	75,400	-
			9.67	#350	87.00	99.67	40,000	-	33,280	-	40,000	-	118,000	78,000	-
3 AXLE	DUMP	3A	4.50	220	-	25.10	21,500	1290	20,500	15.9	20,500	15.9	* 42,000	20,500	15.9
			9.67	220	-	24.10	21,500	960	20,500	21.4	20,500	21.4	* 42,000	20,500	21.4
4 AXLE	DUMP	4A	4.50	270	-	33.90	26,600	1840	31,100	16.9	31,100	16.9	57,700	31,100	16.9
			9.67	270	-	33.90	26,600	1510	31,100	20.6	31,100	20.6	57,700	31,100	20.6
1-40	DUMP	3S2	4.50	350	40.00	47.50	34,000	2500	38,500	15.4	38,500	15.4	72,500	38,500	15.4
			9.67	350	40.00	52.67	35,500	2500	37,780	15.1	38,500	15.4	* 74,000	38,500	15.4
2-27	DUMP	2S1-2	4.50	350	57.00	64.50	39,100	3380	34,180	10.1	40,900	12.1	*•82,000	40,900	12.1
			7.73	350	57.00	67.73	38,000	3380	35,280	10.4	42,000	12.4	*•82,000	42,000	12.4
2-40	DUMP	3S2-4	4.50	#450	85.00	92.50	56,000	5000	17,280	3.5	24,000	4.8	o112,000	56,000	11.2
			9.67	#350	85.00	97.67	56,500	5000	16,780	3.4	23,500	4.7	o112,000	55,500	11.1
3-27	DUMP	3S1-2-2	4.50	#450	87.00	94.50	53,700	5060	19,580	3.9	26,300	5.2	115,000	61,300	12.1
			9.67	#350	87.00	99.67	54,200	5060	19,080	3.8	25,800	5.1	118,000	63,800	12.6
3 AXLE	MIXER/UTILITY	3A	4.50	220	-	26.10	25,900	-	16,100	-	16,100	-	* 42,000	16,100	-
			9.67	220	-	26.10	25,900	-	16,100	-	16,100	-	* 42,000	16,100	-
4 AXLE	MIXER/UTILITY	4A	4.50	280	-	44.80	37,500	-	22,500	-	22,500	-	* 60,000	22,500	-
			9.67	280	-	44.80	37,500	-	22,500	-	22,500	-	* 60,000	22,500	-
3 AXLE	VAN	3A	4.50	220	-	33.10	20,800	1840	21,200	11.5	21,200	11.5	* 42,000	21,200	11.5
			9.67	220	-	33.10	20,800	1510	21,200	14.0	21,200	14.0	* 42,000	21,200	14.0
2-45	AUTO TRANSPORT	3S2 -4	4.50	#450	95.00	102.50	57,600	-	15,600	-	22,400	-	o111,000	53,400	-
			9.67	#350	95.00	107.67	57,600	-	15,600	-	22,400	-	o111,000	53,400	-
2-27	VAN	3S2-3	4.50	#450	57.00	64.50	39,500	3470	33,780	9.7	40,500	11.7	98,100	58,600	16.9
			9.67	#350	57.00	69.67	40,000	3470	33,280	9.6	40,000	11.5	101,000	61,000	17.6

TABLE C-4. PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY FOR SELECTED TRUCKS WITH $20/34^{k}$ AXLE LOAD LIMITS[1].

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBIC CAPACITY	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT^3)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT^3)
1-45	AUTO TRANSPORT	3S2	4.50	350	45.00	52.50	36,000	-	37,280	-	42,000	-	78,000	42,000	-
			9.67	350	45.00	57.67	36,000	-	37,280	-	42,000	-	* 78,000	42,000	-
1-45	MOVING VAN	3S2	4.50	350	45.00	52.50	29,600	3800	43,680	11.5	48,400	12.7	78,000	48,400	12.7
			9.67	350	45.00	57.67	31,200	3800	42,080	11.1	48,400	12.7	* 78,000	46,800	12.7
2-27	MOVING VAN	2S1-2	4.50	350	57.00	64.50	33,200	4620	40,080	8.7	46,800	10.1	•85,000	46,800	10.1
			7.73	350	57.00	67.73	32,000	4620	41,280	8.9	48,000	10.4	•87,000	48,000	10.4
2-45	MOVING VAN	3S2-4	4.50	#450	95.00	102.50	48,200	7600	25,080	3.3	31,800	4.2	o115,000	66,800	8.8
			9.67	#350	95.00	107.67	48,800	7600	24,480	3.2	31,200	4.1	o115,000	66,200	8.7
3-27	MOVING VAN	3S1-2-2	4.50	#450	87.00	94.50	45,600	6930	27,680	4.0	34,400	5.0	117,000	71,400	10.3
			9.67	#350	87.00	99.67	46,100	6930	27,180	3.9	33,900	4.9	120,000	73,900	10.7
3 AXLE	REEFER	3A	4.50	220	-	32.50	21,800	1650	22,200	13.5	22,200	13.5	* 44,000	22,200	13.5
			9.67	220	-	32.60	21,800	1340	22,200	16.6	22,200	16.6	* 44,000	22,200	16.6
1-40	REEFER	3S2	4.50	335	40.00	47.50	30,500	2350	42,780	18.2	43,000	18.3	o73,500	43,000	18.3
			9.67	350	40.00	52.67	32,000	2350	41,280	17.6	43,500	18.5	o75,500	43,500	18.5
1-45	REEFER	3S2	4.50	350	45.00	52.50	30,900	2650	42,380	16.0	47,100	17.8	78,000	47,100	17.8
			9.67	350	45.00	57.67	32,400	2650	40,880	15.4	45,600	17.2	* 78,000	45,600	17.2
2-27	REFFER	2S1-2	4.50	350	57.00	64.50	37,100	3140	36,180	11.5	42,900	13.7	•85,000	42,900	13.7
			7.73	350	57.00	67.73	36,000	3140	37,280	11.9	44,000	14.0	•87,000	44,000	14.0
2-45	REEFER	3S2-4	4.50	#450	95.00	102.50	52,100	5300	21,180	4.0	27,900	5.3	o115,000	62,900	11.9
			9.67	#350	95.00	107.67	52,600	5300	20,680	3.9	27,400	5.2	o115,000	62,400	11.8
3-27	REEFER	3S1-2-2	4.50	#450	87.00	94.50	51,400	4710	21,880	4.6	28,600	6.1	117,000	65,600	13.9
			9.67	#350	87.00	99.67	51,900	4710	21,380	4.5	28,100	6.0	120,000	68,100	14.5
3 AXLE	TANK	3A	4.50	220	-	31.30	23,400	810	20,600	25.4	20,600	25.4	* 44,000	20,600	25.4
			9.67	220	-	31.30	23,400	650	20,600	31.7	20,600	31.7	* 44,000	20,600	31.7
1-42	TANK	3S2	4.50	350	42.00	49.50	25,900	1270	47,380	37.3	50,000	39.4	75,900	50,000	39.4
			9.67	350	42.00	54.67	27,300	1270	45,980	36.2	50,700	39.9	* 78,000	50,700	39.9
2-27	TANK	2S1-2	4.50	350	57.00	64.50	29,100	1630	44,180	27.1	50,900	31.2	•85,000	50,900	31.2
			7.73	350	57.00	67.73	28,100	1630	45,180	27.7	51,900	31.8	•87,000	51,900	31.8
2-42	TANK	3S2-4	4.50	#450	89.00	96.50	41,600	2540	31,680	12.5	38,400	15.1	o116,000	74,400	29.3
			9.67	#350	89.00	101.67	42,000	2540	31,280	12.3	38,000	15.0	o116,000	74,000	29.1
3-27	TANK	3S1-2-2	4.50	#450	87.00	94.50	40,000	2450	33,280	13.6	40,000	16.3	117,000	77,000	31.4
			9.67	#350	87.00	99.67	40,400	2450	32,880	13.4	39,600	16.2	120,000	79,600	32.5
3 AXLE	PLATFORM/RACK	3A	4.50	220	-	32.20	18,300	-	25,700	-	25,700	-	44,000	25,700	-
			9.67	220	-	32.20	18,300	-	25,700	-	25,700	-	44,000	25,700	-
4 AXLE	PLATFORM/RACK	4A	4.50	270	-	37.40	25,100	-	33,600	-	33,600	-	58,700	33,600	-
			9.67	270	-	37.40	25,100	-	33,600	-	33,600	-	58,700	33,600	-
1-40	PLATFORM/RACK	3S2	4.50	335	40.00	47.50	25,300	-	47,980	-	48,200	-	o73,500	48,200	-
			9.67	350	40.00	52.67	26,700	-	46,580	-	48,200	-	o75,500	48,800	-
1-45	PLATFORM/RACK	3S2	4.50	350	45.00	52.50	25,700	-	47,580	-	52,300	-	78,000	52,300	-
			9.67	350	45.00	57.67	27,000	-	46,280	-	51,000	-	* 78,000	51,000	-

TABLE C-4. PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY FOR SELECTED TRUCKS WITH $20/34^{k}$ AXLE LOAD LIMITS[1]. (CONTINUED)

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBIC CAPACITY	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT³)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT³)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT³)
2-27	PLATFORM/RACK	2S1-2	4.50	350	57.00	64.50	28,800	-	44,480	-	51,200	-	•85,000	51,200	-
			7.73	350	57.00	67.73	27,800	-	45,480	-	52,200	-	•87,000	52,200	-
2-45	PLATFORM/RACK	3S2-4	4.50	#450	95.00	102.50	41,900	-	31,380	-	38,100	-	o115,000	73,100	-
			9.67	#350	95.00	107.67	42,300	-	30,980	-	37,700	-	o115,000	72,700	-
3-27	PLATFORM/RACK	3S1-2-2	4.50	#450	87.00	94.50	39,600	-	33,680	-	40,400	-	117,000	77,400	-
			9.67	#350	87.00	99.67	40,000	-	33,280	-	40,000	-	120,000	80,000	-
3 AXLE	DUMP	3A	4.50	220	-	25.10	21,500	1290	22,500	17.4	22,500	17.4	* 44,000	22,500	17.4
			9.67	220	-	25.10	21,500	960	22,500	23.4	22,500	23.4	* 44,000	22,500	23.4
4 AXLE	DUMP	4A	4.50	280	-	33.90	26,600	1840	33,100	18.0	33,100	18.0	59,700	33,100	18.0
			9.67	280	-	33.90	26,600	1510	33,100	21.9	33,100	21.9	59,700	33,100	21.9
1-40	DUMP	3S2	4.50	335	40.00	47.50	34,000	2500	39,280	15.7	39,500	15.8	o73,500	39,500	15.8
			9.67	350	40.00	52.67	35,500	2500	37,780	15.1	40,000	16.0	o75,500	40,000	16.0
2-27	DUMP	2S1-2	4.50	350	57.00	64.50	39,100	3380	34,180	10.1	40,900	12.1	•85,000	40,900	12.1
			7.73	350	57.00	67.73	38,000	3380	35,280	10.4	42,000	12.4	•87,000	42,000	12.4
2-40	DUMP	3S2-4	4.50	#450	85.00	92.50	56,000	5000	17,280	3.5	24,000	4.8	o115,000	59,000	11.8
			9.67	#350	85.00	97.67	56,500	5000	16,780	3.4	23,500	4.7	o115,000	58,500	11.7
3-27	DUMP	3S1-2-2	4.50	#450	87.00	94.50	53,700	5060	19,580	3.9	26,300	5.2	117,000	63,300	12.5
			9.67	#350	87.00	99.67	54,200	5060	19,080	3.8	25,800	5.1	120,000	65,800	13.0
3 AXLE	MIXER/UTILITY	3A	4.50	220	-	26.10	25,900	-	18,100	-	18,100	-	* 44,000	18,100	-
			9.67	220	-	26.10	25,900	-	18,100	-	18,100	-	* 44,000	18,100	-
4 AXLE	MIXER/UTILITY	4A	4.50	290	-	44.80	37,500	-	26,500	-	26,500	-	* 64,000	26,500	-
			9.67	290	-	44.80	37,500	-	26,500	-	26,500	-	* 64,000	26,500	-
3 AXLE	VAN	3A	4.50	220	-	33.10	20,800	1840	23,200	12.6	23,200	12.6	* 44,000	23,200	12.6
			9.67	220	-	33.10	20,800	1510	23,200	15.4	23,200	15.4	* 44,000	23,200	15.4
2-45	AUTO TRANSPORT	3S2-4	4.50	#450	95.00	102.50	57,600	-	15,600	-	22,400	-	o115,000	57,400	-
			9.67	#350	95.00	107.67	57,600	-	15,600	-	22,400	-	o115,000	57,400	-

TABLE C-5. PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY FOR SELECTED TRUCKS WITH $22.4/36^{k}$ AXLE LOAD LIMITS[1].

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	TRACTOR HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBIC CAPACITY	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT³)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT³)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT³)
2-27	PLATFORM/RACK	2S1-2	4.50	350	57.00	64.50	28,800	-	44,480	-	51,200	-	•87,000	51,200	-
			7.73	350	57.00	67.73	27,800	-	45,480	-	52,200	-	•89,000	52,200	-
2-45	PLATFORM/RACK	3S2-4	4.50	#450	95.00	102.50	41,900	-	31,380	-	38,100	-	o120,000	78,100	-
			9.67	#350	95.00	107.67	42,300	-	30,980	-	37,700	-	o120,000	77,700	-
3-27	PLATFORM/RACK	3S1-2-2	4.50	#450	87.00	94.50	39,600	-	33,680	-	40,400	-	119,000	79,400	-
			9.67	#350	87.00	99.67	40,000	-	33,280	-	40,000	-	121,900	81,900	-
3 AXLE	DUMP	3A	4.50	220	-	25.10	21,500	1290	24,500	19.0	24,500	19.0	* 46,000	24,500	19.0
			9.67	220	-	25.10	21,500	960	24,500	25.5	24,500	25.5	* 46,000	24,500	25.5
4 AXLE	DUMP	4A	4.50	290	-	33.90	26,600	1840	35,100	19.1	35,100	19.1	61,700	35,100	19.1
			9.67	290	-	33.90	26,600	1510	35,100	23.2	35,100	23.2	61,700	35,100	23.2
1-40	DUMP	3S2	4.50	350	40.00	47.50	34,000	2400	39,280	15.7	42,700	17.1	76,700	42,700	17.1
			9.67	350	40.00	52.67	35,500	2500	37,780	15.1	42,200	16.9	o77,700	42,200	16.9
2-27	DUMP	2S1-2	4.50	350	57.00	64.50	39,100	3380	34,180	10.1	40,900	12.1	•87,000	40,900	12.1
			7.73	350	57.00	67.73	38,000	3380	35,280	10.4	42,000	12.4	•89,000	42,000	12.4
2-40	DUMP	3S2-4	4.50	#450	85.00	92.50	56,000	5000	17,280	3.5	24,000	4.8	o120,000	64,000	12.8
			9.67	#350	85.00	97.67	56,500	5000	16,780	3.4	23,500	4.7	o120,000	63,500	12.7
3-27	DUMP	3S1-2-2	4.50	#450	87.00	94.50	53,700	5060	19,580	3.9	26,300	5.2	119,000	65,300	12.9
			9.67	#350	87.00	99.67	54,200	5060	19,080	3.8	25,800	5.1	121,900	67 700	13.4
3 AXLE	MIXER/UTILITY	3A	4.50	220	-	26.10	25,900	-	20,100	-	20,100	-	* 46,000	20,100	-
			9.67	220	-	26.10	25,900	-	20,100	-	20,100	-	* 46,000	20,100	-
4 AXLE	MIXER/UTILITY	4A	4.50	315	-	44.80	37,500	-	30,900	-	30,900	-	* 68,400	30,900	-
			9.67	315	-	44.80	37,500	-	30,900	-	30,900	-	* 68,400	30,900	-
3 AXLE	VAN	3A	4.50	220	-	33.10	20,800	1840	25,200	13.7	25,200	13.7	* 46,000	25,200	13.7
			9.67	220	-	33.10	20,800	1510	25,200	16.7	24,200	16.7	* 46,000	25,200	16.7
1-40	VAN	3S2	4.50	350	40.00	47.50	27,500	2580	45,780	17.7	49 200	19.1	76,700	49,200	19.1
			9.67	350	40.00	52.67	29,000	2580	44,280	17.2	48,700	18.9	o77,700	48,700	18.9
1-45	VAN	3S2	4.50	350	45.00	52.50	27,900	2910	45,380	15.6	51,900	17.8	79,800	51,900	17.8
			9.67	350	45.00	57.67	29,400	2910	43,880	15.1	50,600	17.4	* 82,000	52,600	18.1
2-27	VAN	2S1-2	4.50	350	57.00	64.50	31,300	3470	41,980	12.1	48,700	14.0	•87,000	48,700	14.0
			7.73	350	57.00	67.73	30,200	3470	43,080	12.4	49,800	14.4	•89,000	49,800	14.4
2-45	VAN	3S2-4	4.50	#450	95.00	102,50	45,500	5820	27,780	4.8	34,500	5.9	o120,000	74,500	12.8
			9.67	#350	95.00	107.67	46,000	5820	27,280	4.7	34,000	5.8	o120 000	74,000	12.7
3-27	VAN	3S1-2-2	4.50	#450	87.00	94.50	43,000	5200	30,280	5.8	37 000	7.1	119,000	76,000	14.6
			9.67	#350	87.00	99.67	43,500	5200	29,780	5.7	36,500	7.0	121,900	78,400	15.1
2-45	AUTO TRANSPORT	3S2-4	4.50	#450	95.00	102.50	57,600	-	15,600	-	22,400	-	o120,000	62,400	-
			9.67	#350	95.00	107.67	57,600	-	15,600	-	22,400	-	o120,000	62,400	-
2-27	VAN	3S2-3	4.50	#450	57.00	64.50	39,500	3470	33,780	9.7	40,500	11.7	102,100	62,600	18.0
			9.67	#350	57.00	69.67	40,000	3470	33,280	9.6	40 000	11.5	105,000	65 000	18.7

TABLE C-5. PAYLOAD WEIGHT AND AVERAGE PAYLOAD DENSITY FOR SELECTED TRUCKS WITH 22.4/36^{k} AXLE LOAD LIMITS[1]. (CONTINUED)

TRUCK TYPE	BODY TYPE	AXLE CONFIGURATION CODE	TRACTOR BBC DIMENSION (FT)	HP	VEHICLE TRAILING	LENGTH (FT) OVERALL	VEHICLE TARE WEIGHT (LBS)	CUBIC CAPACITY	WITH GCW LIMIT = 73,280 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 73,280 LBS DENSITY (LBS/FT^3)	WITH GCW LIMIT = 80,000 LBS PAYLOAD (LBS)	WITH GCW LIMIT = 80,000 LBS DENSITY (LBS/FT^3)	WITH BRIDGE FORMULA GCW LIMIT (LBS)	WITH BRIDGE FORMULA PAYLOAD (LBS)	WITH BRIDGE FORMULA DENSITY (LBS/FT^3)
1-45	AUTO TRANSPORT	3S2	4.50	350	45.00	52.50	36,000	-	37,280	-	43,800	-	79,800	43,800	-
			9.67	350	45.00	57.67	36,000	-	37,280	-	44,000	-	* 82,000	46,000	-
1-45	MOVING VAN	3S2	4.50	350	45.00	52.50	29,600	3800	43,680	11.5	50,200	13.2	79,800	50,200	13.2
			9.67	350	45.00	57.67	31,200	3800	40,080	11.1	48,800	12.8	* 82,000	50,800	12.8
2-27	MOVING VAN	2S1-2	4.50	350	57.00	64.50	33,200	4620	40,080	8.7	46,800	10.1	•87,000	46,800	10.1
			7.73	350	57.00	67.73	32,000	4620	41,280	8.9	48,000	10.4	•89,000	48,000	10.4
2-45	MOVING VAN	3S2-4	4.50	#450	95.00	102.50	48,200	7600	25,080	3.3	31,800	4.2	o120,000	71,800	9.4
			9.67	#350	95.00	107.67	48,800	7600	24,480	3.2	31,200	4.1	o120,000	71,200	9.4
3-27	MOVING VAN	3S1-2-2	4.50	#450	87.00	94.50	45,600	6930	27,680	4.0	34,400	5.0	119,000	83,400	10.6
			9.67	#350	87.00	99.67	46,100	6930	27,180	3.9	33,900	4.9	121,900	75,800	10.9
3 AXLE	REEFER	3A	4.50	220	-	32.60	21,800	1650	24,200	14.7	24,200	14.7	* 46,000	24,200	14.7
			9.67	220	-	32.60	21,800	1340	24,200	18.1	24,200	18.1	* 46,000	24,200	18.1
1-40	REEFER	3S2	4.50	350	40.00	47.50	30,500	2350	42,780	18.2	46,200	19.7	76,700	46,200	19.7
			9.67	350	40.00	52.67	32,000	2350	41,280	17.6	45,700	19.4	77,700	45,700	19.4
1-45	REEFER	3S2	4.50	350	45.00	52.50	30,900	2650	42,380	16.0	48,900	18.5	79,800	48,900	18.5
			9.67	350	45.00	57.67	32,400	2650	40,880	15.4	47,600	18.0	* 82,000	49,600	18.7
2-27	REEFER	2S1-2	4.50	350	57.00	64.50	37,100	3140	36,180	11.5	42,900	13.7	•87,000	42,900	13.7
			7.73	350	57.00	67.73	36,000	3140	37,280	11.9	44,000	14.0	•89,000	44,000	14.0
2-45	REEFER	3S2-4	4.50	#450	95.00	102.50	52,100	5300	21,180	4.0	27,900	5.3	o120,000	67,900	12.8
			9.67	#350	95.00	107.67	52,600	5300	20,680	3.9	27,400	5.2	o120,000	67,400	12.7
3-27	REEFER	3S1-2-2	4.50	#450	87.00	94.50	51,400	4710	21,880	4.6	28,600	6.1	119,000	67,600	14.4
			9.67	#350	87.00	99.67	51,900	4710	21,380	4.5	28,100	6.0	121,900	70,000	14.9
3 AXLE	TANK	3A	4.50	220	-	31.30	23,400	810	22,600	27.9	22,600	27.9	* 46,000	22,600	27.9
			9.67	220	-	31.30	23,400	650	22,600	34.8	22,600	34.8	* 46,000	22,600	34.8
1042	TANK	3S2	4.50	350	42.00	49.50	25,900	1270	47,380	37.3	52,000	40.9	77,900	52,000	40.9
			9.67	350	42.00	54.67	27,300	1270	45,980	36.2	52 700	41.5	81,200	53,900	41.5
2-27	TANK	2S1-2	4.50	350	57.00	64.50	29,100	1630	44,180	27.1	50,900	31.2	•87,000	50,900	31.2
			7.73	350	57.00	67.73	28,100	1630	45,180	27.7	51,900	31.8	•89,000	51,900	31.8
2-42	TANK	3S2-4	4.50	#450	89.00	96.50	41,600	2540	31,680	12.5	38,400	15.1	o120,000	78,400	30.9
			9.67	#350	89.00	101.67	42,000	2540	31,280	12.3	38,000	15.0	o120,000	78,000	30.7
3-27	TANK	3S1-2-2	4.50	#450	87.00	94.50	40,000	2450	33,280	13.6	40,000	16.3	119,000	79,000	32.2
			9.67	#350	87.00	99.67	40,400	2450	32,880	13.4	39,600	16.2	121,900	81,500	33.3
3 AXLE	PLATFORM/RACK	3A	4.50	220	-	32.20	18,300	-	27,700	-	27,700	-	* 46,000	27,700	-
			9.67	220	-	32.20	18,300	-	27,700	-	27,700	-	* 46,000	27,700	-
4 AXLE	PLATFORM/RACK	4A	4.50	280	-	37.40	25,100	-	35,600	-	35,600	-	60,700	35,600	-
			9.67	280	-	37.40	25,100	-	35,600	-	35,600	-	60,700	35,600	-
1-40	PLATFORM/RACK	3S2	4.50	350	40.00	47.50	25,300	-	47,980	-	51,400	-	76,700	51,400	-
			9.67	350	40.00	52.67	26,700	-	46,580	-	51,000	-	o77,700	51,000	-
1-45	PLATFORM/RACK	3S2	4.50	350	45.00	52.50	25,700	-	47,580	-	54,100	-	79,800	54,100	-
			9.67	350	45.00	57.67	27,000	-	46,280	-	53,000	-	* 82,000	55,000	-

NOTES TO TABLES

1. Based on a standard 96-inch width limit, and axle load limits of 20,000 pounds/single axle and 34,000 pounds/double axle, unless otherwise indicated.

2. The HP and Weight indicated is that required for the GCW determined by the bridge formula (see Appendix B). The HP and Weight for tractors at a 73,280 GCW limit are as follow:

   2 axle COE - 335 HP; 15,300 lbs.
   2 axle CBE - 335 HP; 14,150 lbs.
   3 axle COE - 325 HP; 16,950 lbs.
   3 axle CBE - 350 HP; 18,250 lbs.

   For tractors at an 80,000 GCW limit the following values apply:

   2 axle COE - 350 HP; 15,300 lbs.
   2 axle CBE - 350 HP; 14,150 lbs.
   3 axle COE - 350 HP; 16,750 lbs.
   3 axle CBE - 350 HP; 18,250 lbs.

\# The indicated HP is the largest available for the tractor used in this study and is less than that necessary to meet the assumed performance standard (maintain 35 mph speed on a 3% grade). In all cases these indicated rigs should be able to maintain at least a 25 mph speed on a 3% grade.

3. The GCW limit indicated is that determined by the overall bridge formula as explained in Appendix B. However, the following should be noted:

   * - In these cases the GCW limit was determined as the sum of the axle loadings.
   o - In these cases the GCW limit was governed by the application of the bridge formula to "internal" axle groupings.
   ● - The indicated figure may not be possible in practice, at least in the short run, due to the limited availability of tractors rated for the indicated limit. In practice, the widely available 2 axle tractors have a maximum GCW rating of 80,000 pounds, while 3 axle COE tractors and CBE tractors have maximum GCW ratings of 150,000 pounds and 120,000 pounds, respectively.

APPENDIX D

DEVELOPMENT OF LOAD FACTORS FOR GENERAL PURPOSE DRY VANS AND OTHER SELECTED TRUCK TYPES

D.1 INTRODUCTION

This analysis was performed in order to verify some of the theoretical concepts developed in the design payload and density analyses. Real world data was utilized to provide a check on some of the technical data on tractor trailer rigs, e.g., tare weight. More importantly, the data was used to characterize the relationship between load factors (here defined as the average payload in pounds) and vehicle type, carrier type, and commodity, and to characterize the split between trucks which weigh-out, cube-out, and those which travel partially loaded. The original analysis concentrated on general-purpose, van-type tractor trailers. The models developed were subsequently refined and extended to other truck types. This information provides an important input to the impact analysis of TS&W limits on the different carrier groups and their respective market shares. Moreover, it provides a more meaningful basis for predicting loads per vehicle, and thus unit costs, vehicle requirements, vehicle-miles, and fuel use.

The basic data source for this study was the Federal Highway Administration's (FHWA) 1977 Loadometer Study, which provides, among other things, data on truck weights by truck type, commodity, and class of operation. This source was supplemented by data from the Truck and Waterway Information Center's (TWIC) Truck Stop Survey (1977-78), which provides data on payload weight and volume by trailer size, commodity, and carrier type. Other data sources considered were the Federal Highway Administration's Truck Commodity Flow Study (1972-73), and the Interstate Commerce Commission's study of Empty/Loaded Truck Miles (1976). These data sources are described in more detail below.

D.2 DESCRIPTION OF THE BASIC DATA SOURCES

D.2.1 FHWA Loadometer Study

The FHWA Loadometer Study is based on data collected by state agencies on an alternate year basis. Truck characteristic study data is compiled at selected collection points by about half the states each year. One-half of the states collect data in even numbered years and the other in odd numbered years. The split between the states is such that a uniform geographical distribution and proportional annual miles traveled are provided by each year's sample. Prior to 1976, the states conducted the study on an annual basis (Ref. 1). The data utilized in this study was obtained in 1976-1977, and is the latest data available in machine readible form. The latest available published data is from the year 1975 (Ref. 1).

In 1975, nearly 231,000 trucks were weighed at 690 locations, most of which were on main intercity roads. The 1976-1977 data was obtained for just over 221,000 trucks. Table D-1 provides information on the 1976-1977 sample and the subset of the overall sample actually utilized in the prototypical analysis, i.e., the 3S2 and 2S1-2 tractor trailer vans. A finer breakdown of the sample data is provided in Appendix F.

The data at each location was collected for one 8-hour daylight weekday period, generally in the summer months (Ref. 1). All vehicles in the traffic stream were counted and classified, but only a sample (about 80%) of trucks were stopped and weighed. Pertinent information collected for the purposes of this analysis included axle configuration code, body type, class of operation, commodity type, gross combined weight, axle weights, axle spacing, and overall wheelbase (Ref. 2).

The FHWA data is often criticized as having biases due to uncontrolled sampling procedures; due to avoidance of weigh stations by many trucks, especially those that are overweight or potentially overweight, and due to

TABLE D-1. FHWA LOADOMETER STUDY SAMPLE

	Number	Percent
Loaded Trucks	135,484	61%
Empty Trucks	85,848	39%
Total Trucks	221,332	100%
Loaded Van Trailer Rigs	47,678	74%
Empty Van Trailer Rigs	17,092	26%
Total Van Trailer Rigs	64,770	100%

Van Trailers As Percent of Total -- 29%

	Number	Percent
Loaded 3S-2 Van Rigs	25,372	78%
Empty 3S-2 Van Rigs	7,200	22%
Total 3S-2 Van Rigs	32,572	100%

3S-2 Van Rigs As Percent of Total Vans - 50%

	Number	Percent
Loaded 2S1-2 Van Rigs	1,780	89%
Empty 2S1-2 Van Rigs	210	11%
Total 2S1-2 Van Rigs	1,990	100%

2S1-2 Van Rigs as Percent of Total Vans - 3%

3S2 and 2S1-2 Vans as Percent of Total Trucks - 15%

he potential seasonal variation in truck movements. Despite these potential biases, the FHWA data was found to be the best data available for use in this study, since it is the only data set available providing a relatively large sample of detailed data on actual truck weights, truck types, carrier types, and commodities carried.

D.2.2 <u>TWIC Truck Stop Survey</u>

The Truck Stop Survey data was utilized as a supplement to the FHWA Loadometer Study. The survey, which began in February 1977 and is continuing at present, is being conducted by a number of sponsors primarily interested in long-haul trucking operations. The actual data utilized in this study was provided in a series of special tabulations provided by TWIC and includes data on about 24,000 trucks gathered between February 1977 and December 1978.

The survey data was gathered at twenty truck stops scattered throughout the country. With one exception, these truck stops were located on Interstate highways in relatively isolated locations away from major metropolitan areas. The survey was conducted by an employee at a truck stop who, at random, selected drivers to respond to a 15-25 minute interview involving about 100 questions related to the current haul and the previous haul. Approximately 60 interviews per month were conducted over a three-day period chosen at each truck stop. The survey data includes a great deal of information on such diverse topics as equipment age and driver characteristics (Ref. 3). However, for the purposes of this study, the most relevant subset of the data was expected to be on carrier type, commodity type, trailer size, payload weight, trailer volume occupied, body type, and trip length.

The survey data is biased in at least two respects. First, the survey captured long-haul truck trip information, since this was the area of interest to the sponsors. Secondly, the survey was biased away from regular route common carrier trucking, since most of these survey responses were expected to be less diverse than the other carrier types. However, these potential biases were not considered to be too serious for the purposes of this study. The major reason why this data was used as a supplement to the FHWA data and not a primary data source was the relatively small sample size. With only about 7,000 van trailer rigs in the sample it was not possible to disaggregate the data by carrier type or commodity type to a level required for use in the study, and retain a meaningful number of observations within any particular cell.

D.2.3 Other Data Sources Considered

Two other data sources were considered for use in this study but were rejected for reasons described below. These data sources were the I.C.C.'s Empty/Loaded Truck Mile Study (Ref. 4) and the FHWA's Nationwide Truck Commodity Flow Study (Refs. 5, 6).

The I.C.C. gathered data on over 13,000 trucks at 439 points along the Interstate Highway System in the period January 1976 through January 1977. The survey was conducted both day and night during every week and every month of the year. The main objective of the project was to determine the overall percent of empty truck miles for trucks with 3-or-more axles operating on the Interstate Highway System for various subclassifications such as carrier type and body type. The secondary objective was to measure variation in operations by season, time of day, and day of week. Other lesser objectives included determining how many trucks were loaded and the influence of commodity type on loading characteristics (Ref. 4).

The study objectives obviously influenced the survey design and the choice of data gathered. Unfortunately the objectives of the I.C.C. survey did not produce a data set useful for the present analysis. The data set was weakest in three areas that were most critical to the load factor analysis, i.e., payload data, both in terms of weight and truck space utilized, and commodity type breakdown. The payload size data was gathered in terms of floor area covered. This gives no indication of whether or not a truck is cubed-out and tends to overstate the number of full trucks, since even a truck carrying a very small load might have that load distributed over the entire floor area. The payload weight data was not highly regarded by the I.C.C. since weight data was not obtained for many trucks, and weights that were obtained usually could not be verified (Ref. 4). Finally, the commodity type information was at a level which would have been too coarse for the purposes of the current study.

A second data source considered was the FHWA Truck Commodity Flow Study (Refs. 5, 6). The study was based on a sample of vehicle registration numbers selected for each state for each of twelve months during the period July 1972 through June 1973. The owners of the selected vehicles were then provided with a questionnaire and asked to supply data on the usage of the vehicle during a specified 24-hour period. About 107,000 responses were received. However, only 17,000 of these were other than single unit trucks (Ref. 7).

The major objective of the study was to get commodity specific origin/destination data on privately owned trucks by type of place. such as truck terminal or factory building. A secondary objective was to obtain information on the characteristics of the trucks and their operations (Ref. 6).

Due to the small sample size of tractor-trailer vans and the fact that the data was somewhat dated, it was felt that this source could not be relied upon to be the primary source for the study. However, it was felt that it might provide a supplementary source of information. Unfortunately, there appears to have been serious problems on data collection and coding which casts doubts on the validity of the entire data set. Especially serious problems, from the perspective of this study's needs, were encountered in the coding or miscoding of commodity type, vehicle type, and payload weight (Ref. 6). Since it was not clear that all of these descrepancies had been successfully resolved, the extensive data processing effort required to extract a small subset of questionable data from a marginally useful data set did not seem justified.

D.3 DATA ANALYSIS

D.3.1 Initial Approach

The FHWA Loadometer File was screened and data items selected from the file were converted into the proper format for use on the System 1022 Data Base Management System. System 1022 is a data management software system designed for use on the DEC System 10 and is especially suited for sorting and manipulating large data files. The data items stored in the 1022 version of the Loadometer File included state, vehicle type code, body type code, commodity code, gross combination weight, individual axle weights, axle spacings, total wheelbase, and carrier class of operation.

Data on selected van trailer rigs (3S-2 singles and 2S1-2 doubles) was selected from the overall data set and partitioned by load status and class of operation into 16 categories. The result of this exercise is summarized in Table D-2.

The empty trailer data set was used to obtain mean tare weights for the single and double rigs under study. The average empty 5-axle, single-tractor, van trailer was found to weigh 31,500 pounds and the corresponding weight of the 5-axle double rig was 33,000 pounds. These weights are about 2,000 pounds heavier than the calculated weights for the corresponding rigs indicated in Appendix C. This would be expected since the FHWA data reflects a mix of equipment of various vintages including the older and thus heavier rigs not included in the data of Appendix C. Thus, the FHWA tare weight data was utilized in the calculation of average payloads in order to maintain consistency.

In the initial attempt to determine the split between weighed-out, cubed-out and partially loaded trucks and their corresponding average payloads, as much disaggregation as possible was maintained in the data. Thus the data on loaded 5-axle single and double vans was partitioned by four carrier types (private, I.C.C. for hire, other for hire, unknown) and by state, according to three state GCW limits (73,280 pounds; 80,000 pounds and 76,000 pounds, the GCW limit in Montana). The number of trucks in each

TABLE D-2. CLASS OF OPERATION AND LOAD STATUS SELECTED VAN TRAILER RIGS

Van Singles (3S-2)

	Empty	Loaded	Total
Private	2,586 (36%) [30%]	5,946 (23%) [70%]	8,532 (26%) [100%]
ICC for Hire	3,902 (54%) [19%]	16,521 (65%) [81%]	20,423 (63%) [100%]
Other for Hire	487 (7%) [25%]	1,457 (6%) [75%]	1,944 (6%) [100%]
Unknown	225 (3%) [13%]	1,448 (6%) [87%]	1,673 (5%) [100%]
Total	7,200 (100%) [22%]	25,372 (100%) [78%]	32,572 (100%) [100%]

Van Doubles (2S1-2)

	Empty	Loaded	Total
Private	63 (30%) [21%]	244 (14%) [79%]	307 (15%) [100%]
ICC for Hire	133 (63%) [9%]	1,344 (75%) [91%]	1,477 (74%) [100%]
Other for Hire	10 (5%) [18%]	45 (3%) [82%]	55 (3%) [100%]
Unknown	4 (2%) [3%]	147 (8%) [97%]	151 (8%) [100%]
Total	210 (100%) [11%]	1,780 (100%) [89%]	1,990 (100%) [100%]

cell after this partition of the data set is shown in Table D-3. At this point weighed-out trucks were separated from non weighed-out trucks.* Weighed out singles made up about 4% of the sample according to this definition, while only 2% of doubles weighed-out. The data was further sorted by two-digit STCC code, since a finer partition of the data by commodity would have resulted in an insufficient number of observations within each cell.

At this point the analysis reached an impasse because it was not possible to determine which trucks were cubed-out and which were partially loaded. The data set had been partitioned so much that the two-digit commodity level was the only one which yielded sufficient observations on payload information by commodity group. However, the density of commodities within a two-digit group varies so widely that it was impossible to make any statements about whether trucks carrying specific commodities were cubed-out or not.

However, the analysis did show that there is little difference in the average payload carried between private and I.C.C.-for-hire singles, a slight difference for private and I.C.C.-for-hire doubles, and little difference between trucks in states with an 80,000-pound GCW limit and those in states with a 73,280-pound GCW limit. These payload figures are presented in Table D-4. Moreover, the analysis indicated that the lower 73,280-pound GCW limit seemed to determine the maximum GCW of trucks,

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* Here, "weighed-out" was defined as being within 1,000 pounds of the applicable state GCW limit.

TABLE D-3. VAN TRAILERS BY CLASS OF OPERATION AND STATE GCW LIMIT

Singles (3S-2)

Class of Operation	States Having GCW Limits of 73,280 lbs.	76,000 lbs.	80,000 lbs	Total
Private	1,938 (19%) [33%]	36 (9%) [-]	3,972 (27%) [67%]	5,946 (23%) [100%]
ICC for Hire	6,807 (66%) [41%]	377 (91%) [2%]	9,337 (64%) [57%]	16,521 (65%) [100%]
Other for Hire	684 (7%) [47%]	-	773 (5%) [53%]	1,457 (6%) [100%]
Unknown	872 (8%) [60%]	-	576 (4%) [40%]	1,448 (6%) [100%]
Total	10,301 (100%) [40%]	413 (100%) [2%]	14,658 (100%) [58%]	25,372 (100%) [100%]

[ ] = row percentage

( ) = column percentage

TABLE D-3. VAN TRAILERS BY CLASS OF OPERATION AND STATE GCW LIMIT (CONTINUED)

Doubles (2S1-2)

Class of Operation	States Having GCW Limits of 73,280 lbs.	76,000 lbs.	80,000 lbs.	Total
Private	17 (5%) [7%]	4 (3%) [2%]	223 (17%) [91%]	244 (14%) [100%]
ICC for Hire	259 (74%) [19%]	138 (97%) [10%]	947 (74%) [71%]	1,344 (76%) [100%]
Other for Hire	2 (-) [4 %]	-	43 (3%) [96%]	45 (2%) [100%]
Unknown	74 [50%]	-	73 (6%) [50%]	147 (8%) [100%]
Total	352 (100%) [20%]	142 (100%) [8%]	1,286 (100%) [72%]	1,780 (100%) [100%]

[ ] = row percentage

( ) = column percentage

TABLE D-4. AVERAGE PAYLOAD OF SELECTED VAN TRAILER RIGS*

Single (3S2)

	73,280 lb. GCW Limit	80,000 lb. GCW Limit
Private	26,000 lbs.	25,900 lbs.
I.C.C.-for-Hire	25,800 lbs.	26,500 lbs.

Double (2S1-2)

	73,280 lb. GCW Limit	80,000 lbs. GCW Limit
Private	--**	23,800 lbs.
I.C.C.-for-Hire	28,100 lbs.	27,400 lbs.

Notes:

* Payload was calculated as gross combined weight less the average tare weight of vehicles of that type. Average is for all rigs of the type shown, carrying all commodities.

** Insufficient number of observations.

even in states where the GCW limit was 80,000 pounds. For example, 29% of the private van singles studied were within 6,000 pounds of the GCW limit in states where the limit was 73,280 pounds, while only 8% were within 6,000 pounds of the limit in states where the limit was 80,000 pounds. For I.C.C-for-hire singles the corresponding figures were 27% and 7%, while for I.C.C-for-hire doubles they were 29% and 11%.

D.3.2 Revised Approach

Another attempt was made at determining the split between cubed-out, weighed-out and partially loaded trucks and the average payload of those trucks by commodity carried. However, this time more emphasis was placed on commodity detail (3-digit STCC level) while carrier type and state weight limit differences were ignored.

The data for 3S-2 single and 2S1-2 double van trailer rigs was sorted by gross combined weight block and by 3-digit commodity code. For doubles, 1464 observations (i.e., trucks) fell into the commodity group miscellaneous mixed shipments with only an insignificant number of observations scattered among other commodity groups. For singles, however, 68 three-digit commodity groups contained enough observations to make further analysis worthwhile. A list of these is presented in Table D-5.

Distributions of the number of trucks by weight block (5,000-pound intervals in gross combined weight) were developed from the data for each of the 69 commodity groups. These were then converted to payload distributions by subtracting the appropriate equipment tare weight from the gross combined weight. The volume theoretically occupied by each payload was

TABLE D-5. MAJOR COMMODITIES CARRIED BY SINGLE (3S2) TRACTOR TRAILER VANS IN 1977 FHWA LOADOMETER STUDY

Commodity Code	Number of Trucks	Commodity Code	Number of Trucks
Farm Products		Wood Products	
011	450	241	88
012	97	242	132
013	286	243	169
019	60	244	62
Food Products		249	115
201	146	Furniture	
202	136	251	335
203	694	Pulp & Paper	
204	277	262	810
205	216	264	278
206	116	265	107
207	87	266	54
208	969	Chemicals	
209	364	281	299
Basic Textiles		282	210
221	203	283	96
227	162	284	226
228	197	284	174
229	93	287	55
Apparel		289	204
238	83	Petroleum Prod.	
239	54	291	211

TABLE D-5. MAJOR COMMODITIES CARRIED BY SINGLE (3S2) TRACTOR TRAILER VANS IN 1977 FHWA LOADOMETER STUDY (CONTINUED)

Commodity Code	Number of Trucks	Commodity Code	Number Trucks
Rubber & Plastics		Machinery	
301	206	353	90
306	55	356	56
307	268	358	53
Stone, Clay, Glass		359	68
321	183	Electrical Machinery	
322	375	361	52
325	53	362	58
327	51	363	190
329	120	364	79
Primary Metal		367	59
331	360	369	100
332	66	Transportation Equip.	
333	55	371	539
335	232	Misc. Manufacturers	
Fabricated Metal		394	80
341	100	Misc. Mixed Shipments	
342	107	41, 46, 47	8,272
343	53	TOTAL	13,384
344	98		
348	52		
349	93		

then calculated as the payload weight divided by the commodity density for each specific 3-digit commodity group.*

Thus it was now possible to develop the split among weighed-out, cubed-out and partially loaded (i.e., neither weighed-out nor cubed-out) trucks for each of the 69 commodity groups. Weighed out trucks were taken as all those having a GCW greater than or equal to 70,000 pounds. This accounts for the fact that most trucks seem to load to the lowest GCW limit they will encounter on a trip. This also includes an allowance for trucks reaching axle load limits before GCW limits, problems with indivisible loads, load lot size, etc. A truck cubed-out when the volume theoretically occupied by its cargo was greater than 90% of the trailer volume. This allows for inefficiencies in packing and loading due to container size and shape. The cubic capacity of two 27' trailers (3470 cf) was assumed for reference purposes for double rigs and the cubic capacity of a 42.5' trailer (2750 cf) was assumed as the reference for single trailers. The 42.5' trailer size was assumed since most single vans are 40' or 45' long, while a 27' trailer is common in 5-axle, double-bottom operations.

Having determined the number of trucks within each category (weighed-out, cubed-out, partially loaded) for each commodity group in question, it was then possible to determine the average payload in each case.

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* Commodity density here is the on-dock or warehouse density obtained from the TSC-developed commodity attribute file. The 3-digit density is the average of all 5-digit commodity densities within that 3-digit group.

D.4 RESULTS

D.4.1 The Fully Loaded Truck Payload Model

This is the model that was implicitly utilized in the analysis of Section 2 and is based on the concepts and data described in Appendices A, B and C. The model basically states that for commodities with densities greater than a truck's design density, the maximum payload simply equals the maximum allowable GCW* less the tare weight of the vehicle. This is a weigh-out condition. For commodities with densities less than the design density, fully loaded trucks would be cubed-out and the payload would be equal to the volume of the trailer multiplied by the commodity density.

The data support this model as shown in Figure D-1. There the average density of each of the 3-digit commodity groups, as obtained from the commodity attribute file, is plotted against the average payload for fully loaded trucks carrying that particular commodity.** The line is the theoretical maximum load line for a 42.5' van trailer rig, and a 73,280-pound GCW limit. The theoretical line fits the data rather well, especially if one remembers that the maximum load line for weighed-out trucks is based on lighter, newer equipment rather than the mix of older and heavier vehicles actually observed in the field.*** The sloped line is unaffected by tare weight assumptions.

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* Maximum allowable GCW is a function of the axle load limits, the gross combined weight limits and the size and axle configuration of the rig in question.

** With a design density of 16.6 lbs/cf, 6907 (52%) of the sampled trucks carried commodities with densities greater than design density, while 6477 (48%) of the trucks carried commodities with densities less than design density.

*** In practice, this model could be modified to more accurately reflect reported payloads by reducing the theoretical payload by the ratio of the reported to theoretical payload for any given truck type.

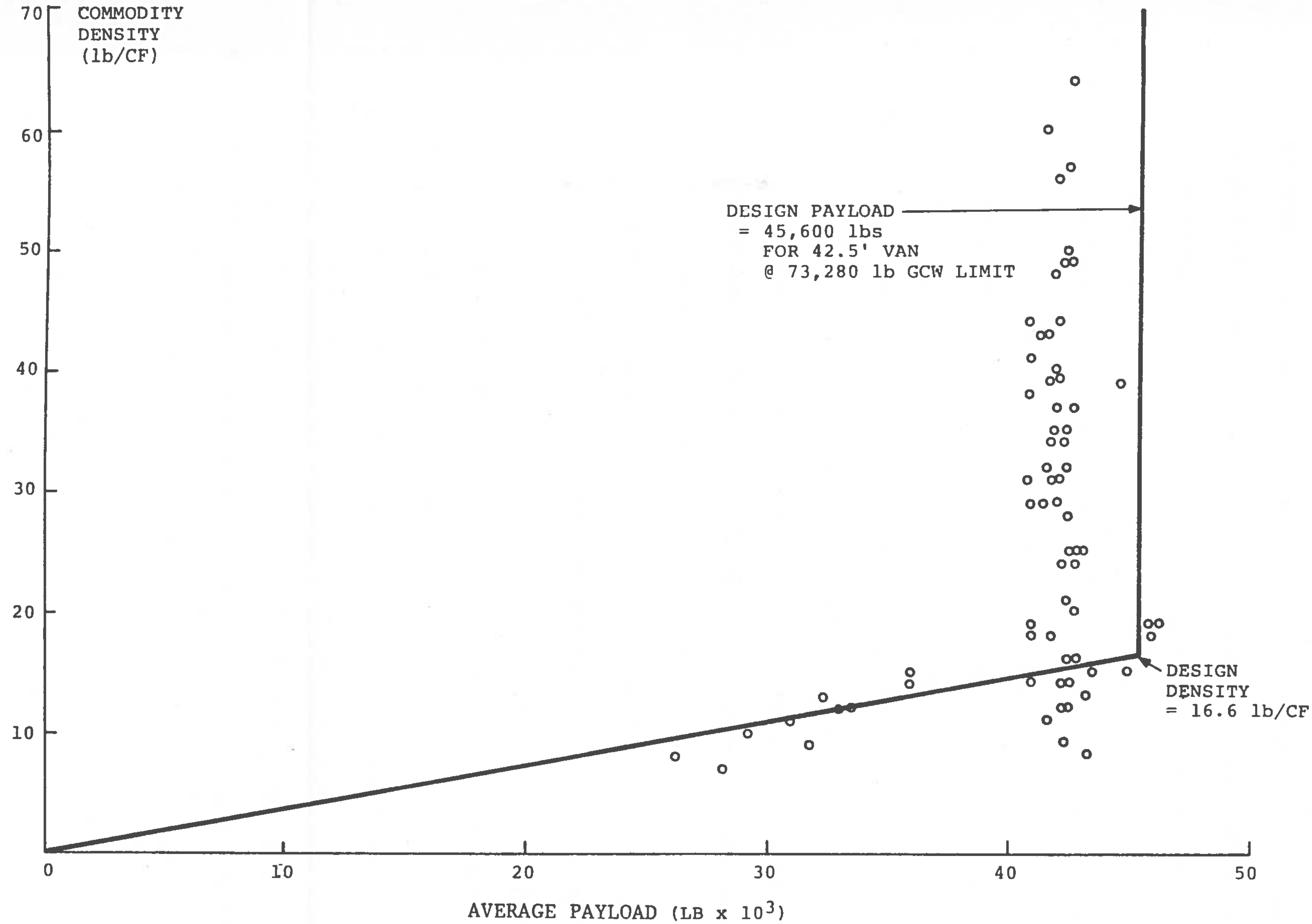


FIGURE D-1. COMMODITY DENSITY VS. AVERAGE PAYLOAD OF FULLY LOADED SINGLE VANS

For small double trailer rigs there was only one commodity specific data point (LTL traffic). In that case the average fully loaded truck carried 40,600 pounds of payload, and the theoretical fully loaded payload was calculated as 41,960 pounds. Again, the theoretical payload is greater than that from the Loadometer Study by roughly the same amount as the difference in the theoretical and measured tare weights.

D.4.2 The Partially Loaded Truck Payload Model

The fully loaded payload model indicated that while there was a relationship between commodity density and payload for less dense commodities, payload for denser commodities was independent of commodity density and depended on vehicle tare weight and the maximum allowable GCW. For partially loaded trucks, the lack of a strong relationship between commodity type, as represented by commodity density, and payload became apparent. Figure D-2 shows the plot of commodity density for each of the 3-digit commodity types studied versus the ratio of the average partial to the average full payload for trucks carrying that commodity.

This lack of a relationship in the case of partially loaded trucks could be expected since trucks are generally carrying partial loads for reasons unconnected to the commodity type. One of the questions in the I.C.C.'s Empty/Loaded Truck Survey dealt with reasons why a truck was only partially loaded. The four major responses, covering just over half of all responses were "returning from or making delivery," "lack of freight," "shipper's order size," and "destined to pick up another load."

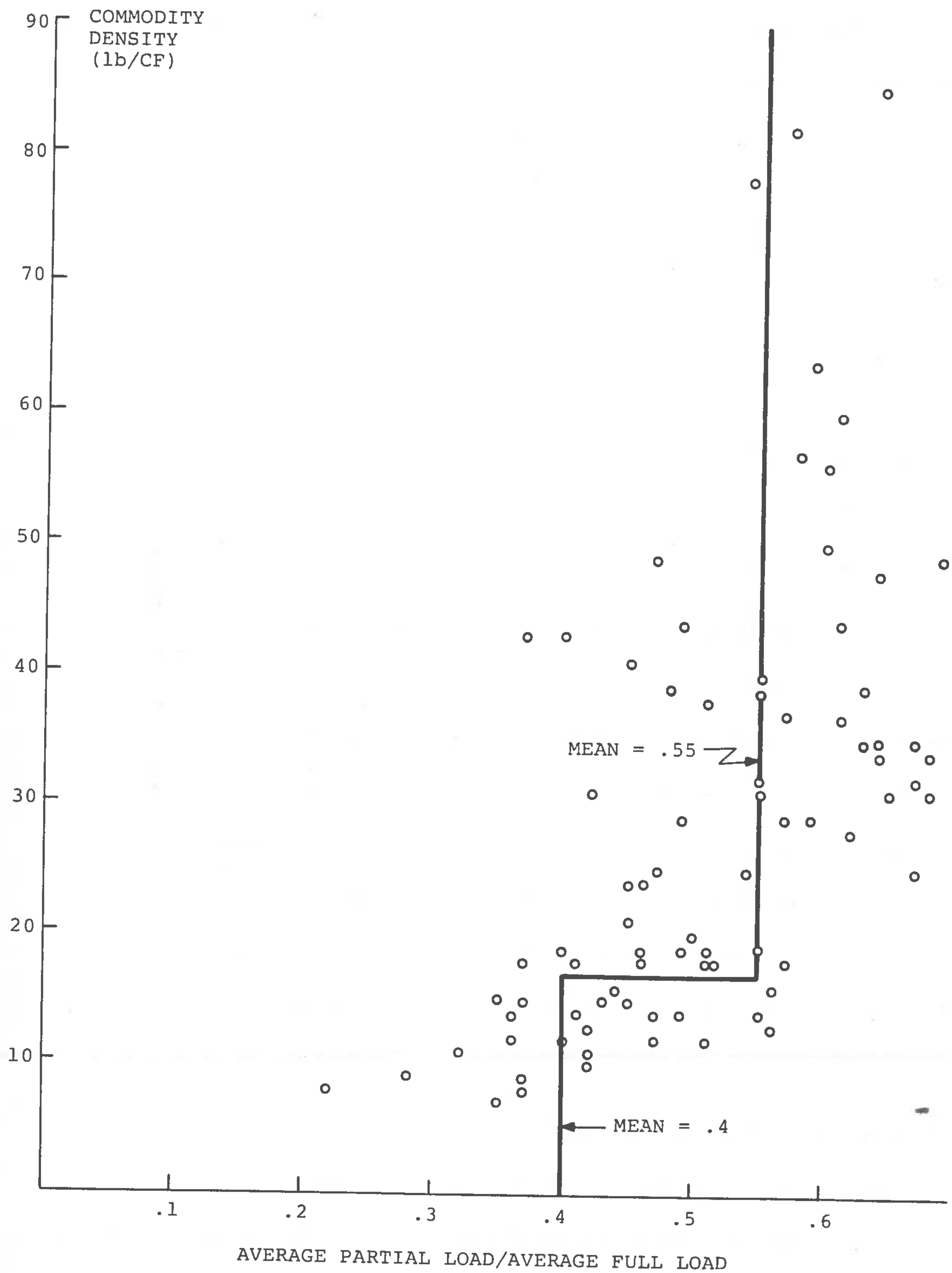


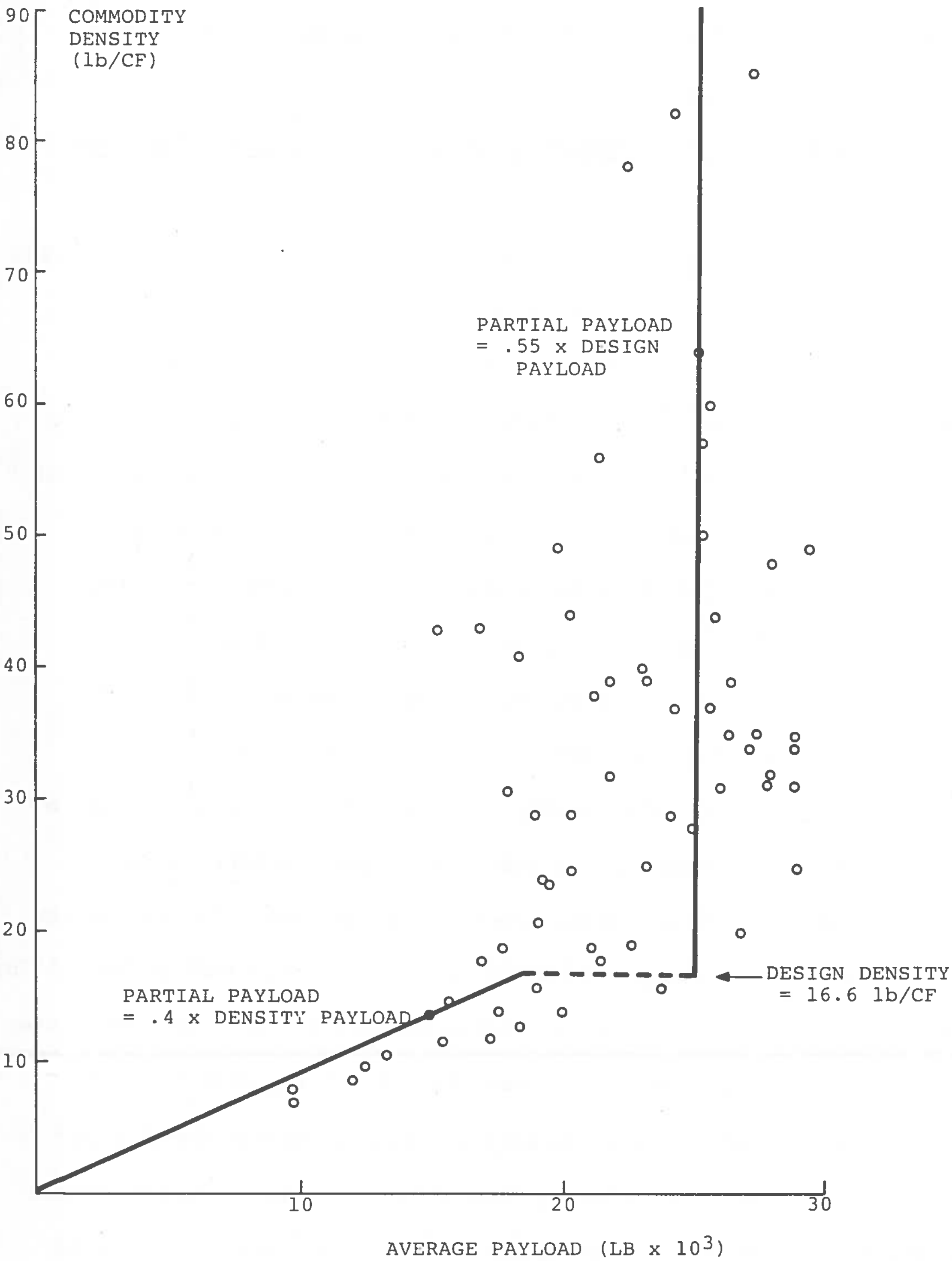
FIGURE D-2. COMMODITY DENSITY VS. PARTIAL/FULL LOAD RATIO

The two reasons given, which might be considered related to the commodity type, i.e., "shipment size/bulk" and "special handling," constituted only 3.8% of the responses (Ref. 4).

Given the lack of a clear cut functional relationship between density and partial payload, but keeping in mind the difference between dense and lighter commodities evidenced in the full truck load model, it was decided to take the mean of the partial payload ratios for both commodity groups separately. These two means, indicated in Figure D-2, would then form the basis of the partial payload model. For commodities with densities greater than the design density, the mean ratio of partial to full load was found to be 0.55. For commodities having densities less than the design density it was found to be 0.4.

However, in applying the model it was found that this model yielded some paradoxical results for commodities which would cube-out on some rigs but weigh-out on other rigs. Thus in practice the model was modified so that the transition point between partial payload factors (.4 or .55) was changed from the design density of the rig in question to the maximum design density of all rigs considered. This figure is 18 lb/cf for a single 40' tractor-trailer rig under axle load limits of 20,000/34,000 lbs. per single/tandem axle and a GCW limit of 8,000 lbs.

When these ratios are applied to the loads predicted by the full truckload model and superimposed on a plot of commodity density versus average partial payload as shown in Figure D-3, it can be seen that the rough approximation fits the data reasonably well given the nature of



GURE D-3. COMMODITY DENSITY VS. AVERAGE PAYLOAD OF PARTIALLY LOADED TRUCKS partial loads. When applied to the double trailer data the model yields an average partial payload of 23,100 pounds versus the 23,900 pounds derived from the FHWA data.

D.4.3 Estimating the Breakdown Between Partially and Fully Loaded Trucks

This exercise proved to be the most difficult element of the analysis for two major reasons. The first is the lack of a relationship between commodity attributes and reasons why trucks are partially loaded, as discussed above. The second is a lack of agreement on what constitutes a "full" truck and therefore what constitutes a truck which is "not full." The first problem is illustrated in Figure D-4, which shows commodity density at the 3-digit level versus the percent of trailers carrying partial loads of that commodity. Here a partial load is one which is on a truck with a GCW of less than 70,000 pounds and/or which would theoretically occupy less than 90% of the trailer's volume.

Since no functional relationship was apparent, the mean percentage of partial loads was chosen as the model, with the distinction kept between commodities with densities greater than and less than the design density. The mean percentage of partial loads was determined to be 75% for commodities denser than the maximum design density and 60% for commodities than the maximum design density. Given that 48% of the trucks in the sample carried commodities with densities less than design density and 60% of these were partially loaded, then 19% of the trucks in the sample would have been cubed-out according to the definition used here. Likewise, since 75% of the 52% of the trucks carrying commodities denser

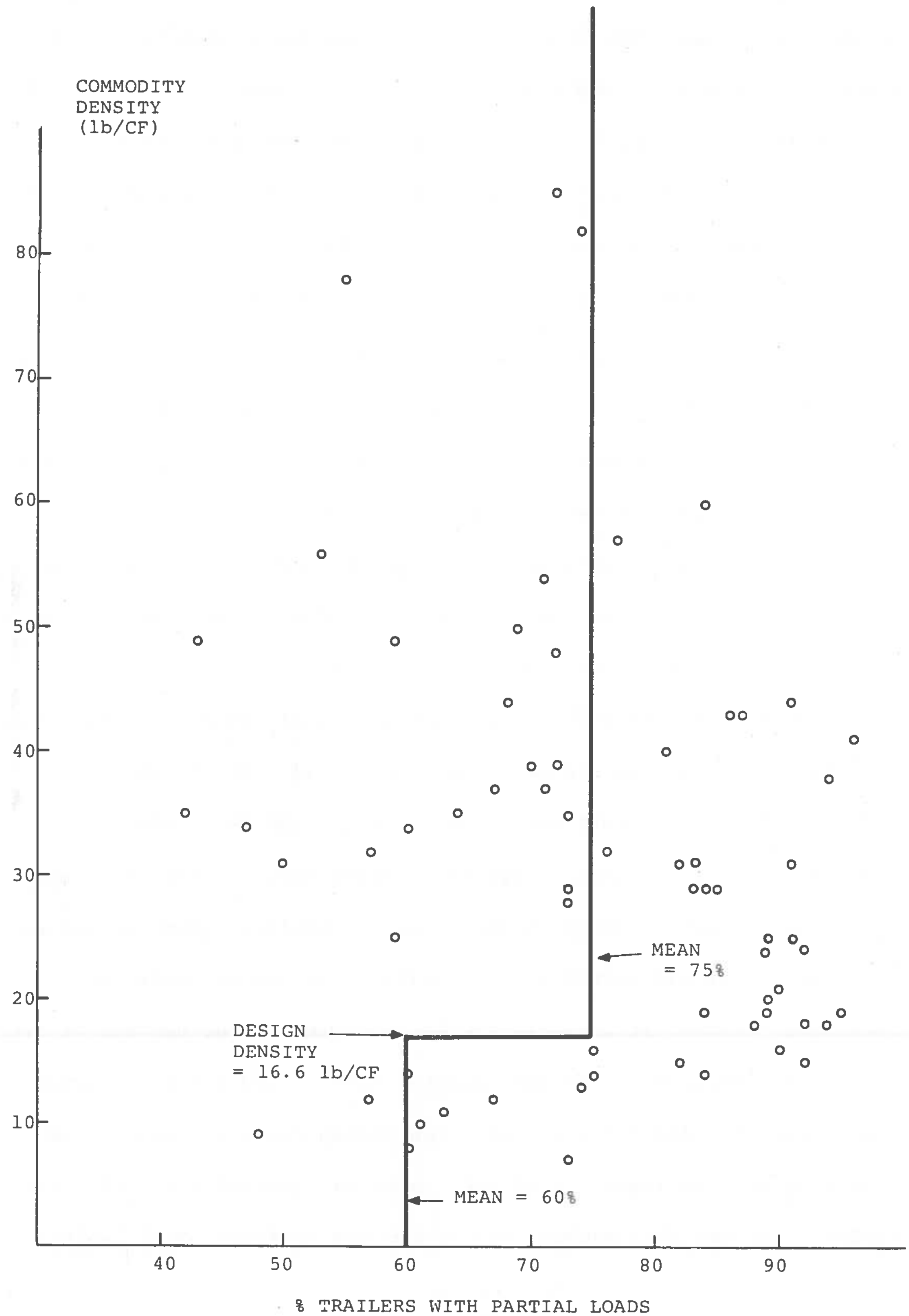


FIGURE D-4. COMMODITY DENSITY VS. PERCENT TRAILERS WITH PARTIAL LOADS than design density were partially loaded, then 13% would have been weighed out. Thus, 68% of all trucks studied would have carried partial loads. This split is based on data for single vans of all carrier types and the 68 major 3-digit commodity types indicated previously.

Two data sources were available as a check on these figures. As indicated earlier, one was rejected partly because of its unique definition of a full truck, i.e., 100% of the floor space covered (Ref. 4) and its lack of payload weight data. One analysis of this study data indicated that 76% of all van-type trucks sampled were full.

The other data source was the TWIC Truck Stop Survey. There were some comparability problems with this data in the definition of full also, and in the payload weight data that was available. The weight data available for van trailers only indicated whether or not the payload was greater than 35,000 pounds. A full trailer was one in which the trailer space was utilized to the greatest extent possible. Thus, many trailers carrying dense products, such as coil steel, would be considered full if it were not possible to get any more coils of steel in the trailer, even though the trailer would be far from cubed-out by any definition based on percentage of trailer volume occupied.

However, it was possible to establish some common basis for comparison. First, it was possible to determine the percentage of trucks in the FHWA sample with payloads greater than 35,000 pounds carrying commodities with densities greater than design density. Under this definition of full load, 56% of the trucks in question fell into this category. In the TWIC sample, 51% of the van trailers (with lengths greater than or equal to 40') carried payloads greater than 35,000 pounds. The TWIC data further indicated that 37% of this same set of trailers was classified as full and had payloads of less than 35,000 pounds. This is one group which is probably cubed-out in the sense used in this study, that is a high percentage of trailer volume occupied. The FHWA data indicated that 40% of the trucks carrying commodities with densities less than design density were cubed-out. Thus, in terms of these two reference points, the two dissimilar data sets seem to be giving similar results.

Another point of reference exists for comparison purposes, and that is the data reported by Encisco (Ref. 9). This data gives the split between trucks dispatched with maximum legal weight, those dispatched with maximum cube, and those released for service reasons. This data is presented in Table D-6, along with data from FHWA and TWIC. The Encisco data was based on a 1974 survey by the National Classification Committee of 48 regular route, general freight carriers. It thus represents primarily LTL shipments. Fortunately, data on LTL traffic by all trailer types was available in the TWIC data. Since 83% of the sampled LTL traffic moved in van trailers, it was felt that this aggregate data could be used for comparison purposes. This particular data tabulation also had the advantage of a finer weight breakdown and so it was possible to extract data on weighed-out trucks which would be directly comparable to the definition used with the FHWA data. Cubed-out or "full" trucks were taken directly from the tabulations. Two sets of figures are presented for the FHWA data, one based on the previous definition of cubed-

TABLE D-6. LOADED STATE OF EQUIPMENT CARRYING LTL-TYPE CARGO

	PERCENT OF SAMPLE			
	FHWA Data*		TWIC Data	Encisco Data
WEIGHED-OUT	15%[1]	15%[1]	18%[1]	27%
CUBED-OUT	43%[2,3]	58%[2,4]	59%[2]	45%
PARTIAL LOAD or SERVICE REASONS	57%[5]	42%[5]	41%[5]	28%

Notes:

1. Payload greater than 40,000 pounds.
2. Includes weighed-out trucks.
3. Trailers with 90% or more of volume theoretically occupied.
4. Trailers with 80% or more of volume theoretically occupied.
5. Trailers neither weighed-out and/or cubed-out.

* Two sets of figures are indicated to show the variation in the percent of trailers which cube-out as a function of the definition of "cubed-out."

out and a second based on a more liberal definition (80% volume occupied) which might be more in line with the TWIC data's definition of full. As seen in the table, the FHWA and TWIC data for LTL traffic are reasonably close, especially when the revised definition of cubed-out is applied to the FHWA data. These two data sets, however, yield somewhat different results than the data reported by Encisco. A number of differences in the data may explain the variance. First, the TWIC and FHWA data are for all carrier types, while the Encisco data would seem to be for regular route common carriers only. Secondly, there may be differences in the definition of "full" in the Encisco data which shift the figures one way or another relative to the other data. Especially noteworthy is the fact that this data makes a distinct split between weighed-out and cubed-out trucks, while in the other data sets the weighed-out trucks would also be cubed-out. Finally, there may be some variation due to the difference in the dates on which the data was gathered.

Thus, it would seem that the FHWA data provides a reasonable representation of the split between weighed-out, cubed-out, and partially loaded trucks, under current truck size and weight regulations. Further, it seems that a shift in size and weight laws would not alter this split. Rather, those trucks now weighing-out would probably continue to weigh-out, but at higher payload weights. Those trucks now cubed-out would continue to cube-out but at higher payload volumes, while partially loaded trucks would continue to be partially loaded for all the reasons reported by the I.C.C. (Ref. 4).*

D.4.4 Extension to Other Truck Types

Only three other truck types contained enough observations at the three-digit commodity level to permit an analysis analogous to that performed for 3S-2 van tractor-trailers. These were the 3S-2 reefers, tanks, and platforms. The commodities carried by these truck types are indicated in Tables D-7 to D-9. Information on the breakdown between full and partially loaded trucks and the ratio of partial to full load for these truck types is indicated in Table D-10.

In addition, this table (D-10) presents information for a number of other truck types. This data is based on a limited number of observations for a few commodity groups and should be viewed with caution. It is presented here, however, so that as much information about as many truck types as possible is made available. The commodity observation base for this latter group of truck types is presented in Table D-11.

D.4.5 Conclusions

This research has established a method for predicting payloads of fully and partially loaded trucks as a function of commodity density and of estimating the split between fully and partially loaded trucks carrying that commodity. However, the analysis indicated that commodity density is not an important factor per se. Whether or not the commodity is more or less dense than the design density of the tractor-trailer carrying that commodity seems to be the key element in determining the load factor.

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* This same study reports that only 3% of trucks with partial loads gave "weight/size law restrictions" as the reason for the partial load.

TABLE D-7. MAJOR COMMODITIES CARRIED BY SINGLE (3S2) TRACTOR TRAILER REEFERS IN 1977 FHWA LOADOMETER STUDY

Commodity Code	Number of Trucks
Farm Products	
011	374
012	676
013	1401
015	172
019	158
Fish Products	
091	102
Food Products	
201	2734
202	722
203	1134
204	88
205	122
207	126
208	179
209	260
Pulp & Paper	
262	87
Chemicals	
281	60
284	91
Petroleum Prod.	
291	64
Misc. Mixed Shipments	
41, 46, 47	537
TOTAL	9,087

TABLE D-8. MAJOR COMMODITIES CARRIED BY SINGLE (3S2) TRACTOR TRAILER TANK TRUCKS IN 1977 FHWA LOADOMETER STUDY

Commodity Code	Number of Trucks
Farm Products	
014	70
Crude Petroleum & Natural Gas	
131	61
Food Products	
202	188
204	87
206	96
209	69
Chemicals	
281	606
285	67
287	51
289	76
Petroleum Products	
291	2183
Stone, Clay & Glass Products	
324	75
TOTAL	3629

TABLE D-9. MAJOR COMMODITIES CARRIED BY SINGLE (3S2) TRACTOR TRAILER PLATFORM/RACK/LOG TRUCKS IN 1977 FHWA LOADOMETER STUDY

Commodity Code	Number of Trucks
Farm Products	
011	133
Wood Products	
241	1466
242	1399
243	379
249	153
Pulp & Paper	
266	171
Petroleum Products	
295	159
Rubber & Plastic Prod.	
307	91
Stone, Clay & Glass Prod.	
324	101
325	195
327	497
329	84
Primary Metal Products	
331	2374
332	155
335	215
344	231
348	60
349	73
Machinery	
353	350
355	51
356	82
Transportation Equip.	
371	239
Waste & Scrap	
402	130
Misc. Mixed Shipments	
41, 46	273
TOTAL	9061

TABLE D-10. LOADED STATE OF VARIOUS TRUCK TYPES

DERIVED FROM THE 1977 FHWA LOADOMETER STUDY

Truck Type	Percent[1] Weighed-Out	Mean Payload	Percent[2,3] Cubed-Out	Mean Payload	Percent[4] Partial Load	Mean Payload	Partial Full
3-Axle Dump*	68.7	30.3k	--	--	31.3	16.1k	.53
3-Axle Reefer*	3.5	26.4k	--	--	96.5	7.8k	.30
3-Axle Tank*	36.2	25.8k	--	--	63.8	9.8k	.38
" Concrete Mixer*	46.0	27.0k	--	--	54.0	8.8k	.33
3-Axle Platform*	22.4	32.9k	--	--	77.6	13.4k	.41
4-Axle Dump*	88.0	40.2k	--	--	12.0	24.6k	.61
2S1-2 Platform*	85.7	48.4k	--	--	14.3	34.3k	.71
3S2-Moving Van*	--	--	23.4	28.3k	76.6	12.5k	.44
3S2-Auto Transport*	5.3	37.0k	--	--	94.7	20.6k	.56
3S2-Dump*	67.5	43.8k	--	--	32.5	30.8k	.70
3S2-Reefer Commodities > design density	43.1	38.7k	--	--	56.9	24.1k	.62
Commodities ≤ design density	--	--	44.8	34.3k	55.2	15.6k	.45
3S2-Tank	56.7	45.7k	--	--	43.3	29.7k	.65
3S2-Platform	39.3	44.7k	--	--	60.7	28.1k	.63

Notes: 1. GVW ≥ 44,000 lbs. on 3-axle trucks, GCW ≥ 55,000 lbs. on 4-axle trucks and GCW ≥ 70,000 lbs. on combination rigs.

2. Includes rigs both weighed-out and cubed-out.

3. Moving vans with 80% or more of volume occupied. Reefers with 90% or more of volume occupied.

4. Neither weighed-out and/or cubed-out.

* Based on a limited number of observations for a few commodity groups.

TABLE D-11. MAJOR COMMODITIES CARRIED BY OTHER MAJOR TRUCK TYPES IN 1977 LOADOMETER STUDY

Truck Type	Commodity Code	Number of Trucks
3S2 Auto Transport	Transportation Equipment	
	371	995
3S2 Moving Van	Furniture	
	251	269
3-Axle Reefer	Food Products	
	201	107
	202	94
3-Axle Tanks	Food Products	
	202	58
3-Axle Platform/Rack/Log	Wood Products	
	241	109
	242	89
	Stone, Clay & Glass Products	
	327	69
	Machinery	
	353	73
2S1-2 Platform/Rack/Log	Wood Products	
	242	70
3-Axle Concrete Mixer	Stone, Clay & Glass Products	
	324	97
	327	268
3-Axle Dumps	Non-Metallic Minerals	
	142	121
	144	300
	149	78
	Petroleum Products	
	291	84
	295	72
4-Axle Dumps	Non-Metallic Minerals	
	144	100
3S2 Dumps	Coal	
	112	133
	Non-Metallic Minerals	
	142	112
	144	406
	Waste & Scrap	
	402	66
	TOTAL	717

The analysis showed that the full truck payload model hypothesized is substantiated by the FHWA data. Thus, for commodities greater than design density, payload equals the maximum allowable GCW minus the tare weight of the vehicle. For commodities less than the design density, payload equals the trailer volume divided by the commodity density.

For partially loaded trucks, the ratio of partial to full payload was found to provide a reasonable representation of average payloads as derived from the FHWA data.

The use of the FHWA data as the basis of the analysis was substantiated by comparison to a few reference points available from other data sources, although lack of a universally accepted definition of what constitutes a full, and thus a not full, truck hampered the comparison.

D.5 REFERENCES

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APPENDIX E

SELECTED CHARACTERISTICS OF THE HEAVY DUTY TRUCK FLEET

E.1 INTRODUCTION

This appendix provides data on the heavy duty truck fleet mix and average loads in 1977, the base year for the TS&W Study. These data represent truck trips and were derived from the FHWA Truck Weight Study. The 1977 Truck Inventory and Use Survey (TI&U) data will be relied upon for regional level total traffic and fleet mix information on the basis of vehicle miles traveled, and the FHWA Truck Weight Study data will be relied upon for national level distributions of loading conditions among truck categories. Both data sets will contribute toward distributions of commodity shipments among truck types.

A third data set currently being collected by FHWA via state departments of transportation will provide state level estimates of total VMT by truck category and highway class. This final data, when it becomes available, will contribute to refinement of state and regional level total traffic and distribution by truck category, but is not expected to provide new information on loading conditions of trucks.

Six tables of data are included in this appendix. The first four tables are directed toward those concerned with the mix of heavy duty truck types in the total truck traffic stream and the impact of their axle configurations and loads on pavement and bridges. The next two are directed toward those concerned with forecasting truck traffic from projected commodity flows and potential modal shifts.

E.2 DATA

Table E-1 gives the size of the FHWA Truck Weight Study sample and the breakdown of the observations selected to represent the characteristics of the truck traffic stream. These selected 121,340 trucks are the basis for all the following tables. Note that only heavy duty trucks carrying some loads are included and that trucks with six or more axles have been excluded; the latter group represents about 1% of the total. The tables which follow, therefore, represent a large national level sample of the dominant 3-5 axle truck types and focus on those trucks which move most of the intercity freight.

Table E-2 shows a distribution of the 121,340 truck observations among the nine body types and the six axle configurations. Note that the 3S2 tractor-trailer combination represents 48% of the total, while the "Other" axle configuration represents 46%. The dominant body types are vans, flats and reefers, while tanks and dumps are the only other body types with significant representation in the sample. Moving vans, auto transporters, and utility either represent an extremely small percentage of the intercity truck traffic stream or they tend to be missed by the truck weigh stations. The "Other" axle configuration category represents mostly trucks with low gross weights and payloads (as shown on subsequent tables).

Table E-3 shows the distribution of all selected vehicles with gross weights equal to or less than 80,000 pounds. Both the number of and the average gross weight for each body type and axle configuration are given.

Since 97% of all the selected trucks are under 80,000 pounds, the distribution here is the same as in Table F-2. Note that the average weights in most of the cells in the "Other" axle configuration column are less than the corresponding cell in the 3-axle single unit column. This is because most of these "Other" trucks are 2-axle units, except for the auto transporters (53% of the "Other" are 2S2s) and the miscellaneous body types (44% of the "Other" are 3S2s).

Note that the 2S1-2 axle configuration includes six body types. Vans dominate with 83% of the observations, but light doubles units are apparently used for other than LTL shipments.

Table E-4 is similar to Table E-3, except that trucks over 80,000 pounds are shown. Again, the dominant axle configuration is the 3S2 conventional tractor-semi trailer combination followed by the "Other" configuration category. In this latter case, the high gross weights of the "Others" suggest trucks with axle loadings well in excess of Federal limits. If not erroneous codings of data, then these might be legal loads in high limit states or illegal loads. Further disaggregation by state and comparison with TI&U data and the FHWA/State data will be necessary to validate these values.

Tables E-5 and E-6 show average payloads by body type and axle configuration for rigs under 80,000 pounds and those over 80,000 pounds, respectively. These are average loads for all loaded trucks within each cell of the matrix. All empty trucks have been deleted.

TABLE E-1. 1977 FHWA TRUCK WEIGHT STUDY SAMPLE

Total Trucks in Sample:	221,332
Empty Trucks	- 85,848
Code 11-15 Small Trucks	- 12,879
$\geq$ Six Axle Trucks	- 1,265
Selected Trucks:	121,340
$\leq 80^k$ Gross Weight	117,804
$> 80^k$ Gross Weight	3,536

TABLE E-2. DISTRIBUTION OF CLASS VIII TRUCKS SAMPLED BY FHWA's 1977 TRUCK WEIGHT STUDY PERCENT OF TOTAL

BODY TYPE *	AXLE CONFIGURATIONS						
	SINGLE UNITS		COMBINATIONS			OTHER	TOTAL
	3 AXLE	4 AXLE	3S2	2S1-2	3S2-4 & TRIPLES		
1 VANS	0.44 (543)		21.42 (25,998)	1.48 (1797)	N A	16.13 (19,574)	39.48 (47,912)
2 REEFERS	0.34 (424)		9.45 (11,468)	0.04 (54)	N.A	2.76 (3,350)	12.60 (15,296)
3 MOVING			.51 (625)	- (12)	N.A	2.08 (2,525)	2.60 (3,162)
4 AUTO TRANSP.			.87 (1,056)			0.39 (481)	1.26 (1,537)
5 TANK	0.18 (220)		4.35 (5,279)	0.03 (39)	N.A	1.70 (2,067)	6.26 (7,605)
6 FLAT/RACK/LOG	0.77 (940)	0.06 (76)	9.86 (11,970)	0.22 (269)	N.A	6.65 (8,075)	17.57 (21,330)
7 DUMP	0.78 (954)	0.22 (279)	1.34 (1,637)	0.01 (15)	N.A	1.18 (1,435)	3.56 (4,320)
8 UTILITY/ETC.	0.37 (450)	0.04 (59)				0.88 (1,068)	1.29 (1,577)
9 ALL OTHER	0.90 (1,103)	0.06 (81)				14.35 (17,417)	15.32 (18,601)
TOTALS	3.81 (4,634)	0.40 (495)	47.82 (58,033)	1.80 (2,186)	- N.A	46.14 (55,992)	100% (121,340)

Number Trucks Sampled in Parentheses

N.A - 1,265 Trucks with 6 or more Axles Extracted from File

TABLE E-3. MEAN GCW OF SELECTED VEHICLES (WITH GCW < 80,000 LBS) AS REPORTED IN THE FHWA's 1977 LOADOMETER STUDY

BODY TYPE *	AXLE CONFIGURATIONS						
	SINGLE UNITS		COMBINATIONS			OTHER	TOTAL
	3 AXLE	4 AXLE	3S2	2S1-2	3S2-4 & TRIPLES		
1 VANS	30,800 lbs (543)		57,000 lbs (25,372)	59,600 lbs (1,780)	N.A	26,500 lbs (19,543)	44,200 lbs (47,238)
2 REEFERS	30,600 lbs (424)		63,200 lbs (11,075)	62,400 lbs (54)	N.A	22,500 lbs (3,343)	53,100 lbs (14,896)
3 MOVING			51,100 lbs (617)	50,500 lbs (12)	N.A	32,200 lbs (2525)	36,000 lbs (3,154)
4 AUTO TRANSP.			57,400 lbs (1050)			43,600 lbs (481)	53,100 lbs (1531)
5 TANK	38,300 lbs (220)		67,400 lbs (4636)	66,600 lbs (34)	N.A	39,800 lbs (1873)	58,800 lbs (6,763)
6 FLAT/RACK/LOG	32,700 lbs (940)	58,100 lbs (74)	62,300 lbs (11,532)	67,400 lbs (246)	N.A	25,400 lbs (7,950)	46,900 lbs (20,742)
7 DUMP	45,900 lbs (943)	64,000 lbs (264)	69,600 lbs (1323)	70,800 lbs (15)	N.A	34,600 lbs (1388)	51,200 lbs (3933)
8 UTILITY/ETC.	41,200 lbs (448)	58,000 lbs (55)				15,300 lbs (1061)	24,200 lbs (1564)
9 ALL OTHER	36,300 lbs (1103)	51,100 lbs (75)				40,600 lbs (16,805)	40,400 lbs (17,983)
TOTALS	36,900 lbs (4,621)	60,300 lbs (468)	60,400 lbs (55,605)	60,700 lbs (2,141)	N.A	26,800 lbs (54,969)	45,900 lbs (117,804)

N.A. - Data not available in this data set

Sample size indicated in parentheses

TABLE E-4. MEAN GCW OF SELECTED VEHICLES (WITH GCW > 80,000 LBS) AS REPORTED IN THE FHWA's 1977 LOADOMETER STUDY

BODY TYPE *	AXLE CONFIGURATIONS						
	SINGLE UNITS		COMBINATIONS			OTHER	TOTAL
	3 AXLE	4 AXLE	3S2	2S1-2	3S2-4 & TRIPLES		
1 VANS	- (0)		85,500 lbs (626)	82,400 lbs (17)	N.A	86,400 lbs (31)	85,500 lbs (674)
2 REEFERS	- (0)		85,000 lbs (393)	- (0)	N.A	83,100 lbs (7)	85,000 lbs (400)
3 MOVING			85,400 lbs (8)	- (0)	N.A	- (0)	85,400 lbs (8)
4 AUTO TRANSP.			89,800 lbs (6)			- (0)	89,800 lbs (6)
5 TANK	- (0)		86,000 lbs (643)	83,100 lbs (5)	N.A	100,400 lbs (144)	89,300 lbs (842)
6 FLAT/RACK/LOG	- (0)	89,800 lbs (2)	85,000 lbs (438)	83,000 lbs (23)	N.A	131,800 lbs (125)	94,900 lbs (588)
7 DUMP	87,400 lbs (11)	85,100 lbs (15)	89,200 lbs (314)	- (0)	N.A	169,600 lbs (47)	98,800 lbs (387)
8 UTILITY/ETC.	81,000 lbs (2)	86,700 lbs (4)				101,500 lbs (7)	93,800 lbs (13)
9 ALL OTHER	- (0)	89,900 lbs (6)				91,700 lbs (612)	91,700 lbs (618)
TOTALS	86,400 lbs (13)	86,800 lbs (27)	86,000 lbs (2428)	82,800 lbs (45)	N.A	101,700 lbs (1023)	90,500 lbs (3536)

N.A - Data not available in this data set

Sample size indicated in parentheses

TABLE E-5. MEAN PAYLOAD OF SELECTED VEHICLES (WITH GCW ≤ 80,000 LBS) AS REPORTED IN THE FHWA 1977 LOADOMETER STUDY

BODY TYPE *	AXLE CONFIGURATIONS						
	SINGLE UNITS		COMBINATIONS			OTHER	TOTAL
	3 AXLE	4 AXLE	3S2	2S1-2	3S2-4 & TRIPLES		
1 VANS	10,000 lbs (543)		25,500 lbs (25,372)	26,600 lbs (1780)	N.A	8,900 lbs (19,543)	20,400 lbs (47,238)
2 REEFERS	8,800 lbs (424)		28,900 lbs (11,075)	21,900 lbs (54)	N.A	3,900 lbs (3,343)	23,100 lbs (14,896)
3 MOVING			17,600 lbs (617)	13,700 lbs (12)	N.A	9,100 lbs (2,525)	11,500 lbs (3,154)
4 AUTO TRANSP.			21,400 lbs (1050)			16,200 lbs (481)	20,300 lbs (1,531)
5 TANK	14,900 lbs (220)		38,100 lbs (4636)	38,400 lbs (34)	N.A	16,200 lbs (1,873)	31,000 lbs (6763)
6 FLAT/RACK/LOG	14,400 lbs (940)	33,000 lbs (74)	33,200 lbs (11,532)	39,800 lbs (246)	N.A	11,900 lbs (7,950)	25,900 lbs (20,742)
7 DUMP	24,400 lbs (943)	37,400 lbs (264)	38,800 lbs (1323)	45,000 lbs (15)	N.A	16,400 lbs (1388)	28,100 lbs (3933)
8 UTILITY/ETC.	15,300 lbs (448)	20,500 lbs (55)				3,900 lbs (1061)	6,400 lbs (1564)
9 ALL OTHER	17,100 lbs (1103)	18,200 lbs (75)				19,600 lbs (16,805)	19,600 lbs (17,983)
TOTALS	16,200 lbs (4621)	32,500 lbs (468)	29,400 lbs (55,605)	29,000 lbs (2,141)	N.A	8,400 lbs (54,969)	22,400 lbs (117,804)

N.A - Data not available in this data set

Sample size indicated in parentheses

TABLE E-6. MEAN PAYLOAD SELECTED VEHICLES (WITH GCW > 80,000 LBS) AS REPORTED IN THE FHWA 1977 LOADOMETER STUDY

BODY TYPE *	AXLE CONFIGURATIONS						
	SINGLE UNITS		COMBINATIONS			OTHER	TOTAL
	3 AXLE	4 AXLE	3S2	2S1-2	3S2-4 & TRIPLES		
1 VANS	- (0)		54,000 lbs (626)	49,400 lbs (17)	N.A	68,800 lbs (31)	61,700 lbs (674)
2 REEFERS	- (0)		50,700 lbs (393)	- (0)	N.A	64,500 lbs (7)	55,000 lbs (400)
3 MOVING			51,900 lbs (8)	- (0)	N.A	- (0)	60,900 lbs (8)
4 AUTO TRANSP.			53,800 lbs (6)			- (0)	53,800 lbs (6)
5 TANK	- (0)		56,700 lbs (643)	54,900 lbs (5)	N.A	76,800 lbs (194)	61,500 lbs (842)
6 FLAT/RACK/LOG	- (0)	64,700 lbs (2)	55,900 lbs (438)	55,400 lbs (23)	N.A	118,300 lbs (125)	73,900 lbs (588)
7 DUMP	65,900 lbs (11)	58,500 lbs (15)	58,400 lbs (314)	- (0)	N.A	151,400 lbs (47)	75,700 lbs (387)
8 UTILITY/ETC.	55,100 lbs (2)	49,200 lbs (4)				90,100 lbs (7)	76,000 lbs (13)
9 ALL OTHER	- (0)	57,000 lbs (6)				70,700 lbs (612)	70,900 lbs (618)
TOTALS	65,700 lbs (13)	59,000 lbs (27)	55,000 lbs (2428)	51,100 lbs (45)	N.A	83,300 lbs (1023)	67,000 lbs (3536)

NOTE TO TABLES
TSC TS&W STUDY
TRUCK BODY TYPE CODES

The following represents a more complete description of the body type designations utilized in the tables:

TSC TS&W Code	Description of Body
1	General Merchandise Dry Van
2	Refrigerated Van and Insulated Non-Refrig. Van
3	Household Goods and Furniture Moving Van
4	Auto and Light Truck Transporters
5	Tanks: Liquid and Dry Bulk
6	Flatbed, Platforms, Racks, Log. and Pole
7	Dumps
8	Utility Co., Concrete Mix, Crane, Wrecker
9	All Other: Not Classified Above

APPENDIX F

TRUCK TYPE DISTRIBUTIONS FOR SELECTED COMMODITY GROUPS

TABLE F-1. PERCENT DISTRIBUTION OF TONNAGE FOR SELECTED COMMODITY GROUPS BY TRUCK TYPE**

BODY TYPE/AXLE CONFIGURATION		STCC CODE 011	012	013	014	015	019	091	112	131	141	142	144	145	147	149	201	202	203	204	205	206	207	208	209	211	221
3S2	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	Auto Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
3 Axle	Van	0.1	0.2	0.4	-	1.2	0.6	0.4	-	-	-	-	-	-	-	2.3	0.1	0.5	0.1	1.1	0.7	0.3	0.1	0.4	0.5	-	-
3S2	Van	15.4	10.2	15.4	1.3	15.2	15.3	17.1	1.8	2.7	1.4	2.5	1.4	22.9	32.8	6.8	4.9	11.6	35.7	26.6	30.4	35.2	37.1	66.7	38.1	74.8	71.6
2S1-2	Van	0.3	-	0.2	-	0.7	0.2	-	-	-	-	-	-	-	-	-	-	0.2	0.5	0.2	4.9	1.8	1.4	0.7	2.7	1.0	-
Other	Van	1.1	0.2	1.1	0.2	-	-	-	0.5	0.5	-	0.4	-	1.9	5.9	1.5	0.4	1.3	3.1	3.2	45.2	4.5	0.1	5.6	12.4	8.8	18.7
Total	Van	16.9	10.6	17.1	1.5	17.1	16.1	17.5	2.3	3.2	1.4	2.9	1.4	24.8	38.7	10.6	5.4	13.6	39.4	31.1	81.2	41.8	38.7	73.4	53.7	84.6	90.3
3S2	Moving Van	0.1	0.6	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.6	-	0.3	-	0.2	-	0.4	-	0.2
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-
Other	Moving Van	-	0.2	0.1	-	-	0.2	-	-	-	0.5	-	0.1	0.1	-	-	-	-	-	-	0.9	-	-	-	0.3	-	0.6
Total	Moving Van	0.1	0.8	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.5	0.0	0.1	0.1	0.0	0.0	0.8	0.4	0.6	0.0	1.2	0.0	0.2	0.0	0.7	0.0	0.8
3 Axle	Reefer	-	0.2	0.5	0.2	2.4	0.2	5.0	-	-	-	-	-	-	-	-	0.9	2.3	0.6	0.2	0.1	0.2	-	-	0.9	-	-
3S2	Reefer	12.4	70.6	66.7	2.9	57.1	33.9	66.3	-	2.3	-	-	0.1	1.7	-	1.4	86.0	52.5	53.2	7.7	16.1	5.5	55.8	12.1	24.3	11.4	3.6
2S1-2	Reefer	-	0.2	0.2	-	-	0.4	0.7	-	-	-	-	-	-	-	-	0.2	0.4	-	-	-	-	-	-	0.1	-	-
Other	Reefer	0.3	2.1	1.9	0.2	3.5	0.6	-	-	-	-	-	-	-	0.9	-	1.6	4.8	2.7	0.2	0.8	0.1	2.2	0.3	1.5	-	-
Total	Reefer	12.7	73.1	69.3	3.3	63.0	35.1	72.0	0.0	2.3	0.0	0.0	0.1	1.7	0.9	1.4	88.7	60.0	56.5	8.1	17.0	5.8	58.0	12.4	26.8	11.4	3.6
3 Axle	Tanks	0.5	-	0.1	0.8	-	0.4	-	-	0.2	-	-	-	-	-	-	-	2.5	-	1.5	-	0.6	-	0.2	-	-	-
3S2	Tanks	-	0.1	0.1	5.4	1.7	0.4	0.9	0.7	78.6	0.7	0.5	0.7	0.9	26.6	7.3	1.2	18.7	1.0	9.3	0.3	31.3	2.4	-	9.3	3.6	-
2S1-2	Tanks	-	-	-	0.5	-	-	-	-	-	-	-	-	-	1.5	-	-	0.3	-	-	-	0.4	-	-	-	-	-
Other	Tanks	-	-	-	0.1	-	0.6	-	0.7	14.2	-	0.6	0.1	-	11.4	0.5	0.1	4.2	-	0.7	-	5.6	-	0.3	0.6	-	-
Total	Tanks	0.5	0.1	0.2	6.8	1.7	1.4	0.9	1.4	93.0	0.7	1.1	0.8	0.9	39.5	7.8	1.3	25.7	1.0	11.5	0.3	37.9	2.4	0.5	9.9	3.6	0.0
3 Axle	Platform	0.4	0.3	0.9	0.1	-	0.6	-	-	-	0.4	1.2	0.3	-	-	1.1	-	0.1	0.1	0.5	-	0.4	-	-	-	-	-
4 Axle	Platform	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	4.4
3S2	Platform	4.5	2.3	2.4	1.1	10.6	6.5	-	1.4	-	14.8	3.7	1.8	14.4	6.6	7.9	0.7	0.1	0.5	1.5	0.3	2.1	0.6	1.2	0.5	-	-
2S1-2	Platform	1.3	1.1	0.3	0.3	-	-	-	-	-	-	0.3	-	0.9	-	-	-	-	0.1	-	-	0.5	-	0.5	-	-	-
Other	Platform	2.9	3.0	0.5	0.5	2.3	8.0	0.4	-	0.5	2.5	1.5	1.0	4.0	9.4	3.9	-	-	-	0.8	-	0.1	0.1	0.4	-	0.4	-
Total	Platform	9.1	6.7	4.1	2.0	12.9	15.3	0.4	1.4	0.5	17.7	6.7	3.1	19.3	16.0	13.2	0.7	0.2	0.7	2.8	0.3	3.1	0.7	2.1	0.5	0.4	4.4
3 Axle	Dumps	-	-	0.1	-	-	0.3	1.2	0.9	-	21.5	17.8	14.8	16.5	-	20.0	-	-	-	0.2	-	-	-	-	-	-	-
4 Axle	Dumps	-	-	-	-	-	-	-	2.5	-	4.5	4.8	7.4	0.9	-	9.3	-	-	-	-	-	-	-	-	-	-	-
3S2	Dumps	1.0	0.1	0.3	-	0.5	1.0	1.8	85.3	-	19.7	23.6	31.3	2.7	3.0	5.5	0.2	-	0.1	2.5	-	-	-	0.1	0.3	-	-
2S1-2	Dumps	-	-	-	-	-	-	-	-	-	-	-	0.9	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-
Other	Dumps	0.2	-	0.1	-	-	-	-	2.2	-	15.4	17.2	21.6	0.1	1.9	7.6	-	-	-	0.1	-	-	-	-	0.3	-	-
Total	Dumps	1.2	0.1	0.5	0.0	0.5	1.3	3.0	90.9	0.0	61.1	63.4	76.0	20.2	4.9	42.4	0.2	0.0	0.1	2.9	0.0	0.0	0.0	0.1	0.6	0.0	0.0
3 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	0.6	-	-	-	-	0.1	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
Total	Concrete Mixer/Utility/Wrecker	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Miscellaneous	2.6	1.6	0.6	1.0	0.2	0.3	-	0.4	-	-	0.5	0.7	-	-	7.2	0.1	0.1	0.1	6.8	-	-	-	0.3	0.3	-	-
4 Axle	Miscellaneous	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-	-	0.1	-	-
Other	Miscellaneous	56.8	7.0	7.7	85.4	4.6	29.7	6.2	3.6	1.0	18.6	25.2	17.7	33.0	-	17.3	2.8	-	1.6	36.1	-	11.4	-	11.2	7.4	-	0.7
Total	Miscellaneous	59.5 *	8.6	8.3	86.4	4.8	30.0	6.2	4.0	1.0	18.6	25.7	18.4 *	33.0	0.0	24.5	2.9	0.1	1.7	43.6 *	0.0	11.4	0.0	11.5	7.8	0.0	0.7

TABLE F-1. PERCENT DISTRIBUTION OF TONNAGE FOR SELECTED COMMODITY GROUPS BY TRUCK TYPE** (CONTINUED)

BODY TYPE/AXLE CONFIGURATION		STCC CODE																										
		227	228	229	231	233	238	239	241	242	243	244	249	251	262	264	265	266	271	281	282	283	284	285	287	289	291
3S2	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	Auto Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Van	-	0.1	0.5	-	0.3	0.3	0.6	-	-	0.1	0.0	-	0.4	0.2	0.7	0.6	0.2	-	0.2	0.1	-	0.3	1.0	-	0.5	0.1
3S2	Van	69.4	80.0	71.6	61.0	48.5	57.4	48.4	3.4	4.4	14.1	33.6	22.2	12.6	73.4	60.6	27.9	17.6	57.3	17.3	49.6	51.4	53.0	49.4	19.5	42.2	5.0
2S1-2	Van	-	-	-	0.4	0.4	-	1.0	0.1	0.1	0.1	1.1	-	0.4	0.9	1.5	0.5	0.9	-	0.2	0.8	0.6	0.3	0.1	-	0.3	0.2
Other	Van	14.5	16.5	17.9	33.1	46.0	36.6	17.6	0.1	1.0	6.3	18.7	10.9	26.2	11.9	21.9	50.4	4.4	10.6	2.4	10.2	11.1	6.9	9.9	3.3	2.5	1.1
Total	Van	83.9	96.6	90.0	94.5	95.7	94.3	76.6	3.6	5.5	20.6	53.4	33.1	39.6	85.4	84.7	74.9	19.1	67.9	20.1	60.7	63.1	60.5	60.4	22.8	45.5	6.4
3S2	Moving Van	1.7	0.3	0.8	-	1.3	0.4	2.5	-	-	-	-	-	9.2	0.2	0.3	0.5	-	-	-	-	-	0.5	-	-	-	0.1
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Moving Van	3.0	-	1.4	1.0	-	0.4	13.5	-	-	0.6	-	0.3	46.7	0.1	0.1	-	-	0.2	-	0.1	0.3	-	-	-	0.2	-
Total	Moving Van	4.7	0.3	2.2	1.0	1.3	0.8	16.0	0.0	0.0	0.6	0.0	0.3	55.9	0.3	0.4	0.5	0.0	0.2	0.0	0.1	0.3	0.5	0.0	0.0	0.2	0.1
3 Axle	Reefer	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
3S2	Reefer	10.2	2.3	6.0	4.5	3.0	4.6	4.2	0.2	0.9	0.9	6.2	1.0	0.9	7.8	4.5	8.1	0.6	23.4	3.8	5.9	19.0	21.1	7.6	3.2	4.6	1.7
2S1-2	Reefer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Reefer	-	-	-	-	-	-	1.1	-	0.1	0.1	0.1	0.3	0.6	-	-	0.7	-	-	0.1	-	1.8	0.7	0.7	-	0.1	0.1
Total	Reefer	10.2	2.3	6.0	4.5	3.0	4.6	5.3	0.2	1.0	1.0	6.4	1.3	1.5	7.8	4.5	8.8	0.6	23.4	3.9	5.9	20.8	21.8	8.3	3.2	4.8	1.8
3 Axle	Tanks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.1	-	-	0.6	1.6	-	0.4
3S2	Tanks	-	0.6	-	-	-	-	-	0.1	0.1	0.1	-	0.6	-	0.2	-	-	-	2.6	41.7	15.5	15.4	11.3	24.4	20.4	19.3	66.3
2S1-2	Tanks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-	0.4	-	0.5	-	0.2
Other	Tanks	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	0.3	-	-	-	4.2	0.9	-	1.5	2.4	0.3	1.1	16.1
Total	Tanks	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.8	0.0	0.2	0.3	0.0	0.0	2.5	46.6	16.5	15.4	13.2	27.4	22.8	20.4	83.0
3 Axle	Platform	-	-	-	-	-	-	-	2.4	1.8	1.4	-	0.6	-	0.1	0.2	0.2	1.0	-	0.6	-	-	-	0.1	0.4	0.1	0.2
4 Axle	Platform	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	0.1	-	-	-
3S2	Platform	1.2	-	1.3	-	-	-	3.3	69.6	61.1	46.5	21.8	48.1	1.4	4.0	3.6	4.7	66.4	5.9	3.2	4.7	-	2.1	1.6	6.2	6.9	1.0
2S1-2	Platform	-	-	-	-	-	-	4.4	0.1	3.8	2.7	4.6	1.6	-	0.4	-	0.6	0.5	-	0.1	-	-	-	-	-	0.3	0.1
Other	Platform	-	0.2	-	-	-	0.3	3.4	8.5	17.4	20.3	8.4	7.5	1.5	-	2.1	2.1	6.4	-	17.3	1.2	0.4	0.1	1.2	4.0	2.6	0.4
Total	Platform	1.2	0.2	1.3	0.0	0.0	0.3	11.1	80.6	84.1	70.9	34.8	58.0	2.9	4.5	5.9	7.6	74.5	5.9	21.2	5.9	0.4	2.2	3.0	10.6	9.9	1.7
3 Axle	Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.1	-	-	-	-	-	0.1	1.6
4 Axle	Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	0.6
3S2	Dumps	-	-	-	-	-	-	-	0.3	0.5	-	0.3	0.5	-	-	-	0.5	-	-	0.4	-	-	0.3	-	5.5	1.1	0.7
2S1-2	Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Dumps	-	-	-	-	-	-	-	-	-	0.5	-	0.2	0.1	-	-	-	-	-	0.1	-	-	-	-	0.3	0.3	0.3
Total	Dumps	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.3	0.7	0.1	0.0	0.0	0.8	0.0	0.0	0.6	0.0	0.0	0.3	0.0	6.1	1.5	3.2
3 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	0.2	-	-	-	0.2	0.1	-	-
Total	Concrete Mixer/Utility/Wrecker	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.2	0.1	0.0	0.0
3 Axle	Miscellaneous	-	-	-	-	-	-	-	0.1	0.2	0.1	-	-	-	-	0.1	-	0.4	-	0.2	0.2	-	-	-	1.3	0.2	0.2
4 Axle	Miscellaneous	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Miscellaneous	-	-	0.5	-	-	-	-	15.1	8.6	6.1	5.1	5.6	-	1.8	4.1	2.4	5.3	-	7.2	10.7	-	1.5	0.7	32.9	17.5	3.6
Total	Miscellaneous	0.0	0.0	0.5	0.0	0.0	0.0	0.0	15.2	8.8	6.2	5.1	5.8	0.0	1.8	4.2	2.4	5.7	0.0	7.4	10.9	0.0	1.5	0.7	34.2	17.7	3.8

TABLE F-1. PERCENT DISTRIBUTION OF TONNAGE FOR SELECTED COMMODITY GROUPS BY TRUCK TYPE** (CONTINUED)

BODY TYPE/AXLE CONFIGURATION		STCC CODE 295	301	306	307	314	321	322	324	325	327	328	329
3S2	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-
Other	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-
Total	Auto Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Van	-	0.7	0.6	0.1	-	0.1	-	-	0.3	0.1	-	0.2
3S2	Van	8.7	59.5	46.7	47.9	50.2	57.9	64.9	1.8	9.7	3.6	2.9	24.4
2S1-2	Van	-	2.8	-	0.2	2.5	0.6	1.1	0.1	-	-	-	0.6
Other	Van	0.5	13.3	25.9	15.0	38.9	6.6	10.2	0.2	0.9	0.3	2.0	11.8
Total	Van	9.2	76.3	73.2	63.2	91.6	65.2	76.2	2.1	10.9	4.0	4.9	37.0
3S2	Moving Van	-	0.2	1.0	0.2	-	0.3	-	-	-	-	-	-
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	-
Other	Moving Van	-	0.3	0.8	-	-	0.2	-	-	-	-	-	-
Total	Moving Van	0.0	0.5	1.8	0.2	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Reefer	-	0.1	-	-	-	-	-	-	-	-	-	0.5
3S2	Reefer	3.1	6.8	-	7.8	8.4	6.2	5.4	0.2	2.2	0.2	-	4.5
2S1-2	Reefer	-	0.3	-	-	-	-	-	-	-	-	-	-
Other	Reefer	-	0.2	1.5	0.8	-	-	0.1	-	-	-	-	-
Total	Reefer	3.1	7.4	1.5	8.6	8.4	6.2	5.5	0.2	2.2	0.2	0.0	5.0
3 Axle	Tanks	0.1	-	-	-	-	-	-	0.3	-	-	-	-
3S2	Tanks	11.8	0.6	3.7	3.1	-	0.5	0.6	10.5	0.2	1.7	0.6	1.7
2S1-2	Tanks	0.3	-	-	-	-	-	-	-	-	0.2	-	-
Other	Tanks	1.4	-	-	-	-	-	-	0.7	-	0.2	-	0.2
Total	Tanks	13.6	0.6	3.7	3.1	0.0	0.5	0.6	11.5	0.2	2.1	0.6	1.9
3 Axle	Platform	0.4	1.8	-	-	-	0.2	0.1	0.8	3.7	3.5	2.0	0.7
4 Axle	Platform	-	-	-	-	-	-	-	0.2	0.2	0.6	-	-
3S2	Platform	33.5	8.0	9.2	15.1	-	9.0	3.6	13.5	42.1	40.0	15.1	33.3
2S1-2	Platform	0.5	-	-	0.2	-	1.4	-	0.2	-	0.9	-	-
Other	Platform	5.5	-	3.8	2.1	-	1.2	1.4	3.6	13.6	10.5	1.8	2.7
Total	Platform	41.9	9.8	12.0	17.4	0.0	11.8	5.1	18.3	59.6	55.5	18.9	36.7
3 Axle	Dumps	11.2	-	-	-	-	-	-	0.6	0.3	1.0	2.6	0.8
4 Axle	Dumps	1.9	-	-	-	-	-	-	-	-	0.3	8.4	-
3S2	Dumps	1.3	0.4	2.9	-	-	-	0.4	0.9	0.6	3.4	23.6	4.5
2S1-2	Dumps	-	-	-	-	-	-	-	-	-	0.1	-	-
Other	Dumps	3.6	-	-	-	-	-	-	-	-	1.4	17.3	0.7
Total	Dumps	18.0	0.4	2.9	0.0	0.0	0.0	0.4	1.5	0.9	6.2	51.9	6.0
3 Axle	Concrete Mixer/Utility/Wrecker	0.2	-	-	-	-	-	-	6.1	-	10.4	-	-
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	1.7	-	1.4	-	-
Other	Concrete Mixer/Utility/Wrecker	0.1	-	0.2	-	-	-	-	1.3	0.8	2.8	0.1	-
Total	Concrete Mixer/Utility/Wrecker	0.3	0.0	0.2	0.0	0.0	0.0	0.0	9.1	0.8	14.6	0.1	0.0
3 Axle	Miscellaneous	1.0	0.3	-	-	-	0.1	0.2	0.5	6.1	0.7	0.8	0.5
4 Axle	Miscellaneous	0.2	-	-	-	-	-	-	-	0.8	-	0.6	-
Other	Miscellaneous	12.7	4.7	3.7	7.5	-	15.7	12.0	56.8	18.5	16.7	22.2	12.9
Total	Miscellaneous	13.9	5.0	3.7	7.5	0.0	15.8	12.2	57.3*	25.4	17.4	23.6	13.4

BODY TYPE/AXLE CONFIGURATION		STCC CODE 331	332	333	335	341	342	343	344	348	349	351	352	353	354
3S2	Auto Transport	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-
Other	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
Total	Auto Transport	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
3 Axle	Van	0.1	-	-	0.2	-	1.2	0.3	0.1	-	-	0.3	-	0.1	3.8
3S2	Van	7.9	20.6	28.6	30.8	42.8	51.3	35.3	13.1	30.0	25.3	31.9	5.0	4.7	32.3
2S1-2	Van	-	-	0.7	0.3	2.5	-	1.4	-	-	-	0.8	0.1	0.1	-
Other	Van	1.5	2.3	3.2	3.2	28.3	17.5	17.2	7.2	2.5	15.2	4.5	1.7	0.6	9.1
Total	Van	9.5	22.9	32.5	34.5	73.6	70.1	54.2	20.4	32.5	40.5	37.5	6.8	5.5	45.2
3S2	Moving Van	-	-	-	0.2	0.2	0.9	-	-	-	0.1	-	-	0.1	-
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Moving Van	-	-	-	0.1	-	4.4	0.2	-	-	0.5	-	-	-	-
Total	Moving Van	0.0	0.0	0.0	0.3	0.2	5.3	0.2	0.0	0.0	0.6	0.0	0.0	0.1	0.0
3 Axle	Reefer	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Reefer	1.1	1.6	1.7	3.2	4.5	4.1	5.3	0.8	2.1	6.1	2.7	0.1	0.2	1.9
2S1-2	Reefer	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Reefer	-	-	0.2	-	0.1	1.4	-	0.3	-	-	0.7	0.1	-	-
Total	Reefer	1.1	1.6	1.9	3.2	4.6	5.5	5.3	1.1	2.1	6.1	3.4	0.2	0.2	1.9
3 Axle	Tanks	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Tanks	-	-	1.4	1.1	1.3	0.9	-	0.7	-	-	-	-	0.1	-
2S1-2	Tanks	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Tanks	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	Tanks	0.0	0.0	1.4	1.1	1.3	0.9	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.0
3 Axle	Platform	0.4	0.2	-	0.2	1.2	1.0	0.8	0.9	-	0.4	0.2	1.4	2.6	1.9
4 Axle	Platform	-	-	-	0.1	-	-	-	0.1	0.2	-	-	-	0.1	-
3S2	Platform	60.4	53.2	27.1	32.3	-	11.0	22.3	43.9	41.2	25.5	34.0	31.0	29.2	32.3
2S1-2	Platform	0.3	-	0.7	0.3	1.1	0.5	-	0.4	1.1	-	-	0.4	-	2.6
Other	Platform	12.9	10.9	2.8	7.0	2.4	-	4.6	11.2	9.7	14.7	2.3	9.8	9.9	3.0
Total	Platform	73.7	64.3	30.6	39.9	4.7	12.5	27.7	56.5	52.2	40.6	36.5	42.6	41.8	39.8
3 Axle	Dumps	-	0.2	0.5	-	-	-	0.9	-	-	-	-	0.1	0.2	-
4 Axle	Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Dumps	1.4	-	3.5	0.5	-	0.7	-	-	-	0.6	-	0.3	0.1	-
2S1-2	Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Dumps	0.2	-	0.9	-	-	-	-	-	-	1.4	-	0.3	1.3	-
Total	Dumps	1.6	0.2	4.9	0.5	0.0	0.7	0.9	0.0	0.0	2.0	0.0	0.7	1.6	0.0
3 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	0.6	-	0.1	-	-	-	0.1	0.4	-
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	3.4	-	-	0.1	0.7	-	0.2	1.7	-
Total	Concrete Mixer/Utility/Wrecker	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.1	0.1	0.7	0.0	0.3	2.1	0.0
3 Axle	Miscellaneous	0.1	0.3	0.4	-	0.6	1.0	-	0.2	-	0.2	3.5	0.3	5.9	-
4 Axle	Miscellaneous	-	-	-	-	-	-	-	-	-	-	0.5	-	0.9	-
Other	Miscellaneous	14.0	10.7	28.3	20.5	13.8	-	11.7	21.0	13.1	9.3	18.6	49.1	41.7	13.1
Total	Miscellaneous	14.1	11.0	28.7	20.5	14.4	1.0	11.7	21.2	13.1	9.5	22.6	49.4	48.5	13.1

TABLE F-1. PERCENT DISTRIBUTION OF TONNAGE FOR SELECTED COMMODITY GROUPS BY TRUCK TYPE** (CONTINUED)

BODY TYPE/AXLE CONFIGURATION		STCC CODE											
		355	356	357	358	359	361	362	363	364	365	367	369
3S2	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-
Other	Auto Transport	-	-	-	-	-	-	-	-	-	-	-	-
Total	Auto Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Van	1.1	0.7	1.6	-	0.2	-	0.7	0.1	-	-	-	0.8
3S2	Van	16.9	25.7	52.1	48.4	29.4	38.4	44.8	39.4	54.4	48.5	51.2	66.1
2S1-2	Van	-	0.6	-	-	0.8	0.5	-	0.3	0.4	2.6	-	-
Other	Van	3.6	3.7	25.4	11.9	16.0	2.6	9.8	38.2	15.3	29.1	17.2	12.2
Total	Van	21.6	30.7	79.1	60.3	46.4	41.5	55.3	78.0	70.1	80.2	68.4	79.1
3S2	Moving Van	-	-	8.6	1.2	-	2.4	0.8	2.7	-	0.5	13.3	3.5
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	-
Other	Moving Van	0.4	0.3	3.2	3.9	-	-	1.0	7.4	0.1	2.1	6.3	0.3
Total	Moving Van	0.4	0.3	11.8	5.1	0.0	2.4	1.8	10.1	0.1	2.6	19.6	3.8
3 Axle	Reefer	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Reefer	-	0.7	2.5	4.6	2.7	1.0	7.6	3.2	4.5	8.3	3.2	3.8
2S1-2	Reefer	-	-	-	-	-	-	-	-	-	-	-	-
Other	Reefer	-	-	-	-	-	-	0.4	0.3	0.7	-	-	-
Total	Reefer	0.0	0.7	2.5	4.6	2.7	1.0	8.0	3.5	5.2	8.3	3.2	3.8
3 Axle	Tanks	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Tanks	0.7	-	-	-	-	-	-	-	-	-	-	-
2S1-2	Tanks	-	-	-	-	-	-	-	-	-	-	-	-
Other	Tanks	-	-	-	-	-	-	-	-	-	-	-	-
Total	Tanks	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Axle	Platform	0.3	2.7	-	-	0.8	0.2	0.6	-	0.4	-	-	0.3
4 Axle	Platform	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Platform	31.8	36.6	1.8	15.6	17.3	19.6	20.2	5.9	10.3	2.4	5.9	9.3
2S1-2	Platform	-	-	-	-	-	-	-	-	0.8	-	-	-
Other	Platform	18.5	5.0	-	3.6	11.8	3.7	0.4	0.3	6.2	1.4	0.7	0.2
Total	Platform	50.6	44.3	1.8	19.2	29.9	23.5	21.2	6.2	17.7	3.8	6.6	9.8
3 Axle	Dumps	-	0.1	-	-	0.1	-	-	-	-	-	-	0.5
4 Axle	Dumps	-	6.1	-	-	-	-	-	-	-	-	-	-
3S2	Dumps	-	-	-	-	0.5	-	-	-	0.7	-	-	-
2S1-2	Dumps	-	-	-	-	-	-	-	-	-	-	-	-
Other	Dumps	-	0.3	-	-	0.4	-	-	-	0.1	-	-	0.3
Total	Dumps	0.0	0.5	0.0	0.0	1.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8
3 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	0.8	0.1
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-
Other	Concrete Mixer/Utility/Wrecker	1.5	0.1	-	0.5	0.5	1.4	-	-	1.9	-	-	-
Total	Concrete Mixer/Utility/Wrecker	1.5	0.1	0.0	0.5	0.5	1.4	0.0	0.0	1.9	0.0	0.8	0.1
3 Axle	Miscellaneous	-	1.7	-	-	0.3	0.3	0.4	-	-	-	-	0.2
4 Axle	Miscellaneous	-	-	-	-	-	-	-	-	-	-	-	-
Other	Miscellaneous	25.2	24.7	4.8	10.3	19.2	24.9	13.3	2.2	4.2	5.1	1.3	2.4
Total	Miscellaneous	25.2	23.4	4.8	10.3	19.5	30.2	13.7	2.2	4.2	5.1	1.3	2.6

BODY TYPE/AXLE CONFIGURATION		STCC CODE											
		371	373	379	394	398	399	401	402	411	461	462	471
3S2	Auto Transport	37.9	-	1.8	-	-	-	-	-	-	0.3	-	-
Other	Auto Transport	13.1	0.1	2.3	0.4	-	-	-	0.1	-	0.1	-	-
Total	Auto Transport	51.0	0.1	4.1	0.4	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.0
3 Axle	Van	0.1	-	-	-	-	1.2	-	0.3	0.1	-	0.2	0.1
3S2	Van	21.6	4.8	17.8	58.9	41.6	57.2	5.3	17.1	53.6	56.2	52.1	55.6
2S1-2	Van	0.2	-	-	2.7	4.5	-	-	0.4	11.2	9.8	21.9	12.9
Other	Van	-	-	6.8	25.6	21.8	14.7	-	-	20.3	12.8	16.6	16.6
Total	Van	21.9	4.8	24.6	87.2	67.9	73.1	5.3	17.8	85.2	78.8	90.8	85.2
3S2	Moving Van	-	-	-	-	-	0.7	-	-	1.0	0.2	-	0.1
2S1-2	Moving Van	-	-	-	-	-	-	-	-	-	-	-	0.1
Other	Moving Van	-	-	-	-	2.5	1.5	-	-	2.6	0.2	2.3	1.0
Total	Moving Van	0.0	0.0	0.0	0.0	2.5	2.2	0.0	0.0	3.6	0.4	2.3	1.2
3 Axle	Reefer	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Reefer	1.4	1.2	-	4.3	17.4	3.7	-	0.7	4.7	3.1	3.0	3.7
2S1-2	Reefer	-	-	-	0.2	-	-	-	-	0.2	-	-	-
Other	Reefer	-	-	-	-	0.7	2.8	-	0.1	0.5	0.3	-	0.1
Total	Reefer	1.4	1.2	0.0	4.5	18.1	6.5	0.0	0.8	5.4	3.4	3.0	3.8
3 Axle	Tanks	-	-	-	-	-	-	-	0.1	-	-	-	-
3S2	Tanks	-	-	-	-	-	-	2.1	2.6	0.2	2.8	-	0.4
2S1-2	Tanks	0.2	-	-	-	-	-	-	-	-	0.1	-	-
Other	Tanks	-	-	-	-	-	-	-	-	-	-	-	-
Total	Tanks	0.2	0.0	0.0	0.0	0.0	0.0	2.1	2.7	0.2	2.9	0.0	0.4
3 Axle	Platform	0.4	-	2.5	0.2	-	-	3.3	0.9	-	0.1	-	-
4 Axle	Platform	-	-	-	-	-	-	-	-	-	-	-	-
3S2	Platform	9.4	2.6	23.2	2.4	0.2	7.5	6.0	21.4	1.3	5.2	2.2	1.2
2S1-2	Platform	-	-	-	-	-	-	2.1	0.5	0.1	0.1	-	-
Other	Platform	3.7	13.1	43.3	5.3	2.9	1.4	-	3.7	0.4	0.8	0.3	0.1
Total	Platform	13.5	15.7	69.0	7.9	3.1	8.9	11.4	26.5	1.8	6.2	2.5	1.3
3 Axle	Dumps	-	-	-	-	8.1	-	7.0	2.4	-	0.2	-	-
4 Axle	Dumps	-	-	-	-	-	-	-	0.2	-	-	-	-
3S2	Dumps	0.1	-	-	-	-	-	16.6	11.1	0.1	0.2	-	-
2S1-2	Dumps	-	-	-	-	-	-	-	0.4	-	-	-	-
Other	Dumps	-	-	-	-	-	0.1	7.6	1.7	-	0.3	-	-
Total	Dumps	0.1	0.0	0.0	0.0	8.1	0.1	31.2	16.8	0.1	0.7	0.0	0.0
3 Axle	Concrete Mixer/Utility/Wrecker	0.1	-	-	-	-	-	-	-	-	-	-	-
4 Axle	Concrete Mixer/Utility/Wrecker	-	-	-	-	-	-	-	-	-	-	-	-
Other	Concrete Mixer/Utility/Wrecker	0.9	-	0.3	-	0.3	0.9	-	-	0.1	-	0.3	-
Total	Concrete Mixer/Utility/Wrecker	1.0	0.0	0.3	0.0	0.3	0.9	0.0	0.0	0.1	0.0	0.3	0.0
3 Axle	Miscellaneous	0.5	-	2.0	-	-	-	1.0	12.9	-	0.2	-	0.1
4 Axle	Miscellaneous	-	-	-	-	-	-	-	0.1	-	-	-	-
Other	Miscellaneous	10.4	78.2	-	-	-	8.3	49.0	23.3	3.6	7.0	1.1	8.0
Total	Miscellaneous	10.9	78.2	2.0	0.0	0.0	8.3	50.0	36.3	3.6	7.2	1.1	8.1

NOTES TO TABLE F-1.

* Two truck body types (grain carriers and dry bulk tankers or hoppers) were included in the miscellaneous category. However, these truck types do carry a significant amount of the traffic for selected commodity groups. Thus, the miscellaneous category for the selected commodity groups could be further refined as indicated below.

Body Type/Axle Code	PERCENT OF TOTAL TONNAGE			
	Commodity Group			
	011	144	204	324
3 Axle Grain	1.7	--	1.2	--
3S2 Grain	26.7	--	5.2	--
3 Axle Hopper	--	--	2.5	--
3S2 Hopper	6.8	6.8	7.6	38.0
2S1-2 Hopper	--	3.8	--	2.1
3 Axle Miscellaneous	0.9	0.7	3.1	0.5
4 Axle Miscellaneous	0.1	--	0.7	--
Other Miscellaneous	23.3	7.1	23.3	16.7
TOTAL	59.5	18.4	43.6	57.3

** Data derived from the 1977 FHWA Loadometer Study.

TABLE F-2. STCC CODE DEFINITIONS DESCRIPTION

CODE	DESCRIPTION
011	Field crops
012	Fresh fruits and tree nuts
013	Fresh vegetables
014	Livestock and livestock products
015	Poultry and poultry products
019	Miscellaneous farm products
084	Gums and barks, crude
086	Miscellaneous forest products
091	Fresh fish and other marine products
101	Iron ores
102	Copper ores
103	Lead and zinc ores
104	Gold and silver ores
105	Bauxite and other aluminum ores
106	Manganese ores
107	Tungsten ores
108	Chromium ores
109	Miscellaneous metal ores and concentrates
111	Anthracite coal
112	Bituminous coal and lignite
131	Crude petroleum and natural gas
132	Natural gasoline, except liquefied petroleum gases
141	Dimension stone, quarry
142	Crushed and broken stone
144	Sand and gravel
145	Clay, ceramic and refractory minerals
147	Chemical and fertilizer minerals
148	Water, raw, for construction or irrigation
149	Miscellaneous nonmetallic minerals, except fuels
191	Guns, howitzers, mortars, and related equipment, over 30 mm
192	Ammunition, exept for small arms (over 30 mm.)
193	Full tracked combat vehicles and parts
194	Sighting and fire control equipment
195	Small arms, 30 mm. and under
196	Small arms ammunition, 30 mm. and under
199	Miscellaneous ordnance and accessories or parts
201	Meat, fresh, chilled or frozen
202	Dairy products
203	Canned and preserved fruits, vegetables and sea foods
204	Grain mill products
205	Bakery products
206	Sugar (beet and cane)
207	Confectionery and related products, candy and other related products
208	Beverages and flavoring extracts
209	Miscellaneous food preparations and kindred products
211	Cigarettes
212	Cigars
213	Chewing or smoking tobacco, snuff
214	Stemmed and redried tobacco
221	Cotton broad woven fabrics
222	Man-made fiber and silk broad woven fabrics
223	Wool broad woven fabrics
224	Narrow fabrics
225	Knit fabrics
227	Carpets and rugs, textile

TABLE F-2. STCC CODE DEFINITIONS DESCRIPTION (CONTINUED)

CODE	DESCRIPTION
228	Yarn and thread
229	Miscellaneous basic textiles
231	Men's, youths', and boys' clothing
233	Women's, misses', girls', and infants' clothing
235	Millinery, hats and caps (mens), millinery goods n.e.c.
237	Fur goods
238	Miscellaneous apparel and accessories
239	Miscellaneous fabricated textile products
241	Primary forest products (pulpwood, piling, posts, logs, bolts, etc.)
242	Lumber and dimension stock
243	Millwork, veneer, plywood, prefabricated structural wood products
244	Wooden containers
249	Miscellaneous wood products
251	Household and office furniture (except concrete, stone, or terra cotta)
253	Public building and related furniture (except concrete, stone, or terra cotta)
254	Partitions, shelving, lockers, office and store fixtures
259	Miscellaneous furniture and fixtures (except concrete, stone, or terra cotta)
261	Pulp and pulp mill products
262	Paper, except building paper
263	Paperboard, pulpboard and fiberboard, except insulating board (bldg.)
264	Converted paper and paperboard products (except containers and boxes); coated or glazed paper, oiled, waxed or wax laminated paper (except wrapping paper), gummed products
265	Containers and boxes, paperboard, fiberboard and pulpboard
266	Building paper and building board
271	Newspapers
272	Periodicals
273	Books
274	Miscellaneous printed matter
276	Manifold business forms
277	Greeting cards, seals, labels, and tags
278	Blankbooks, looseleaf binders and devices
279	Products of service industries for the printing trades
281	Industrial inorganic and organic/chemicals
282	Plastic materials and synthetic resins, synthetic rubbers and fibers
283	Drugs (biological products, medicinal chemicals, botanical products and pharmaceutical preparations) for human and veterinary use
284	Soap, detergents, and cleaning preparations, perfumes, cosmetics, and other toilet preparations
285	Paints, varnishes, lacquers, enamels, and allied products
286	Gum and wood chemicals
287	Agricultural chemicals
289	Miscellaneous chemical products
291	Products of petroleum refining, except liquefied petroleum gases
295	Paving and roofing materials
299	Miscellaneous petroleum and coal products

TABLE F-2. STCC CODE DEFINITIONS DESCRIPTION (CONTINUED)

CODE	DESCRIPTION
301	Tires and inner tubes
302	Rubber footwear
303	Reclaimed rubber
306	Miscellaneous fabricated rubber products
307	Miscellaneous plastics products
311	Leather, tanned or finished
312	Industrial leather belting and packing
313	Boot and shoe cut stock and findings, all materials
314	Footwear, except rubber
315	Leather gloves and mittens
316	Luggage, handbags, and other personal leather goods (all materials)
319	Miscellaneous leather goods (saddlery, harness and whips, and n.e.c.)
321	Flat glass
322	Glass and glassware, pressed and blown
324	Hydraulic cement
325	Structural clay products
326	Pottery and related products
327	Concrete, gypsum, and plaster products
328	Cut stone and stone products
329	Abrasives, asbestos, and miscellaneous nonmetallic mineral products
331	Steel works and rolling mill products
332	Iron and steel castings
333	Nonferrous metals primary smelter products (slab, ingot, pig, etc. and residues), miscellaneous primary nonferros and nonferrous base alloy basic metal products (anodes, cathodes, billets, blooms, pig, slab or ingot, etcs; pig, slab or ingot
335	Nonferrous metal basic shapes, and misc. nonferrous metal basic shapes
336	Nonferrous and nonferrous base alloy castings
339	Miscellaneous primary metal products
341	Metal cans
342	Cutlery, hand tools, and general hardware
343	Plumbing fixtures and heating apparatus, except electric
344	Fabricated structural metal products
345	Bolts, nuts, screws, rivets, washers, and other industrial fasteners (dowels, cotter pins, toggle or expansion bolts, etc.)
346	Metal stampings
348	Miscellaneous fabricated wire products (except steel)
349	Miscellaneous fabricated metal products
351	Engines and turbines
352	Farm machinery and equipment
353	Construction, mining and materials handling equipment
354	Metalworking machinery and equipment
355	Special industry machinery, except metalworking machinery
356	General industrial machinery and equipment
357	Office, computing and accounting machines
358	Service industry machines
359	Miscellaneous machinery and parts, except electrical
361	Electrical transmission and distribution equipment
362	Electrical industrial apparatus
363	Household appliances
364	Electric lighting and wiring equipment
365	Radio and TV receiving sets, except communication types
366	Communication equipment
367	Electronic components and accessories
369	Miscellaneous electrical machinery, equipment, and supplies

TABLE F-2. STCC CODE DEFINITIONS DESCRIPTION (CONTINUED)

CODE	DESCRIPTION
371	Motor vehicles and motor vehicle equipment
372	Aircraft and parts
373	Ships and boats
374	Railroad equipment
375	Motorcycles, bicycles, and parts, except velocipedes, tricycles, or parts
379	Miscellaneous transportation equipment
381	Engineering, laboratory, and scientific instruments
382	Measuring, controlling, and indicating instruments
383	Optical instruments and lenses
384	Surgical, medical, and dental instruments and supplies, also apparatus
385	Ophthalmic or opticians' goods
386	Photographic equipment and supplies
387	Watches, clocks, clockwork operated devices, and parts
391	Jewelry, silverware, and plated ware
393	Musical instruments and parts
394	Toys, amusement
395	Pens, pencils, and other office and artists' materials
396	Costume jewelty, novelties, buttons, and other notions
398	Miscellaneous manufactured products-A
399	Miscellaneous manufactures products-B
401	Ashes
402	Waste and scrap, except ashes
411	Miscellaneous freight shipments
412	Miscellaneous commodities not taken in regular freight service
421	Containers, shipping, returned empty
422	Trailers, semitrailers, returned empty (only when carried as a load by another vehicle)
461	All freight rate shipments, n.e.c.
462	Mixed shipments on one factor rates consistency of commodities representing two or more major industry groups where it is impossible to determine the predominant industry
471	Small packaged freight shipments.

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