

# IMPACT ASSESSMENT OF THE REGULATION OF HEAVY TRUCK OPERATIONS

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## EXECUTIVE SUMMARY

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**Study Objectives.** The main objective of this project was to evaluate the impact of the New York State divisible-load permit system for heavy trucks in terms of benefits and costs to society. The costs result primarily from increased pavement damage; the benefits accrue to the trucking industry (primary economic benefits) and also to New York State's economy (secondary economic benefits). The present study is a follow-up of an earlier investigation (1987, Meyburg, Richardson, Schuler) that was commissioned by the New York State Permanent Advisory Committee on Truck Weights to investigate benefits of the divisible-load permit system. Research objectives for this project have been expanded and modified, based on findings from the surveys. Seasonal benefits and costs for several levels of departure from the federal weight regime were evaluated in order to assess the "optimum" weight limit under a simplified weight system, based on ratios of the federal limits.

A significant and unanticipated finding from these surveys was widespread and voluntarily reported non-compliance with permit weight limits. Therefore, a careful analysis of truck loadings was conducted, with special emphasis on the behavioral reaction of permit operators to the legislated changes in weight limits that were enacted between the 1987 study referenced earlier and this investigation.

**Background.** Since 1985 New York State has allowed a fleet of approximately 12,800 power units to operate above the federal limits on gross vehicle weight and axle loads. A permit system comprising eleven permit categories was instituted, corresponding to different truck configurations (number of axles), weight limits (either a ratio of federal limits or fixed limits), and geographic area of operation (statewide or downstate). The New York State Permanent Advisory Committee on Truck Weights commissioned the 1987 study referenced above, followed by this study, to evaluate the economic benefits and costs of this divisible-load permit system.

However, questions about truck weight regulations are not unique to New York State. Many state legislatures and transportation departments are concerned about the costs of increasing weight limits. Economic benefits of alternative weight policies are, in general, poorly understood. Despite the issues at stake, there have been few published studies addressing these concerns. To our knowledge, the predecessor to this study (Meyburg, Richardson, Schuler, et al., 1987) was the first one to be based on actual field data.

**Methodology.** In order to collect the information necessary to assess pavement damage and primary economic benefits, a 7.1% sample representing 916 vehicles was drawn from the New York State Department of Transportation permit application file. Operators of the trucks sampled were then surveyed three times over a one-year period in order to try to capture seasonal variations; one survey was conducted

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in the summer of 1990, another one in the winter of 1991, and the last one in the fall of 1991. No survey was conducted in the spring and it was assumed that vehicle usage information collected for the fall was representative of spring usage as well. Each survey questionnaire asked the operator of a specific truck to provide information for a randomly selected day of the week about mileage driven on three different road classes; driving and waiting times; changes in axle loadings; and general information about the truck itself and the trucking company operating it. The response rates for the summer, winter, and fall surveys were 33%, 36.7%, and 29%, respectively. These response rates underscore the difficulty of collecting primary information about truck usage. After extensive checks of the nature of the respondents against several criteria, including known characteristics of the entire divisible-load permit fleet, the research team considers that these response rates are sufficient to estimate the order of magnitude of both the costs and benefits described above.

**Findings.** One result that was surprising initially was the fact that up to about forty percent of the voluntarily reported trips were not in compliance with the load limits in force at the time of the surveys. This finding led the investigators to check whether the lowering of load limits had the anticipated effect of lowering the actual loads carried. The data do not support this anticipated effect.

Since the exceedences were reported voluntarily, and, therefore, the non-compliance with load limits may not have been known, one may conclude from this finding that the divisible-load permit system, as legislated, is poorly understood by the permit holders. Due to the complexity and the multitude of permit types, it can further be concluded that enforcement of the lowered load limits is, at the very least difficult, at worst nearly impossible.

Given the realities of the compliance situation for these permits, the research team concluded that the only meaningful approach for accomplishing the stated objective of this research, namely the analysis of the benefits and costs of the divisible-load permit system under alternative load limits, was to perform this assessment by analyzing benefits and costs for the following two fundamental scenarios: (i) under actual loads reported, and (ii) under the assumption of full compliance for operating under the various weight limit scenarios. Forming conjectures about the degree of compliance with alternative future regulations is outside the scope of this analysis, and available data do not permit accurate projections of future compliance. The weight limit scenarios considered were:

- a. Federal limits
- b. 125% of federal limits
- c. 135% of federal limits:
- d. 145% of federal limits
- e. Actual reported weights

**Pavement Damage.** Estimates of pavement damage were calculated from the data collected, using the ASSHTO formula (which gives equivalent single-axle loading based on a fourth power law). Damage to other parts of the infrastructure such as bridges, could not be estimated because it would require specific information about each bridge.

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Extrapolating the pavement damage from the sample results to the whole fleet of permitted vehicles yields the following estimates of annual pavement damage (in 1987 dollars):

Federal limits:	\$45 million per annum	
125% of federal limits:	\$64	
135% of federal limits:	\$73	
145% of federal limits:	\$80	✓
Actual reported weights:	\$96.	← > 20% more damage

It is important to note that these results assume full compliance with the corresponding weight limits. Pavement damage estimates are discussed in Chapter 4.

Primary Benefits. Primary economic benefits, (i.e. the savings to the transportation industry due to reduced transportation costs under limits higher than the federal limits), are evaluated for 125%, 135%, and 145% of the federal limits. The methodology employed relies on average statewide labor and operating costs. It assumes that the load transported by each truck on the survey day under the divisible load permit would, under the federal regime, be transported by the same truck, along the same route, but with more trips, if necessary, so that federal weight limits would be respected. In addition, the load distribution on each axle was scaled down from the data reported in the survey. It should be noted that a number of small operators surveyed indicated that they did not have scales to weigh their trucks. Therefore, their loads may be misrepresented.

Extrapolations of sample results to the whole fleet of permit vehicles give annual estimates of primary economic benefits (in 1987 dollars) of:

125% of federal limits:	\$457 million per annum	<del>7.14</del> 7.14
135% of federal limits:	\$544	7.15
145% of federal limits:	\$590	7.38
Actual reported weights:	\$740 :-	7-71

The operating cost savings were greatest for the "Construction (including Ready-Mix Concrete) Industry", "For-Hire Transportation", "Mining & Quarrying", and "Utilities & Sanitation". Much of the variation in seasonal costs and benefits reflect seasonal economic activities. Superimposed on this seasonal variation are the effects of the national and regional economic recessions. Nevertheless, strong seasonal patterns of usage for some industries do emerge. Therefore, consideration of alternative regulatory treatment for some industries may be warranted.

As expected intuitively, the primary economic benefits of the permit system substantially exceed its costs, although not all costs could be quantified in this study. As an example, differential impacts on traffic safety in NYS are not included, although the use of permitted vehicles is shown to reduce the volume of truck traffic and, therefore, the exposure to accidents. However, the question remains whether or not there is an increased frequency of accidents involving permitted vehicles. Unfortunately, NYS accident data do not contain information on the (weight) status of vehicles involved in accidents.

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Within the limited perspective of direct economic costs and benefits, the proper way to optimize the level of user-benefits, net of pavement costs, is to set the permit limit where marginal benefits equal incremental pavement damage costs (net marginal benefits approach zero). As shown at the end of Chapter 5, this study finds that a weight limit at 145% of the federal limits is close to the optimum, and lower weight limits reduce the net benefits to society.

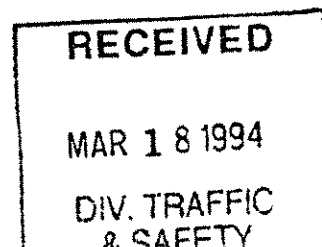
**Secondary Benefits.** Finally, the analysis of secondary economic impacts illustrates how the cost decreases in trucking, resulting from the divisible-load permit system, will work their way through the economy, primarily because in the long run, nearly every sector of the State's economy utilizes the goods and services provided by the initial beneficiaries of trucking cost savings (construction, mining and quarrying, for hire transportation, and sanitation and utilities). Thus these cost decreases have a beneficial impact, ultimately, on nearly everyone in NYS, including manufacturing, finance and services. While available economic data are not adequate to report precise estimates of the level of increase in values of output, earnings, and employment in various sectors of the economy as a result of trucking cost decreases, the illustrations presented herein suggest that these benefits are significant and pervasive throughout the State's economy in the long run. Secondary economic benefits are examined in Chapter 6.

**Policy Implications.** Results of this study strongly support the continuation of the NYS divisible-load permit system, and the State would benefit if the permit limits were based upon 145% of the federal limits. However, several modifications could be considered in order to improve on the existing system. First, given the significant degree of apparently unintentional and voluntarily reported non-compliance with the weight limits, it appears that the current permit system is too complex, both for the truck operators and for the enforcement agencies. Therefore, we recommend that the current system be simplified. This would also mean less paperwork for the operators and it might increase the degree of compliance. It does not appear to be in the State's interest to attempt to enforce widespread compliance with the current permit system limits.

With a simplified permit system of even greater value to the industries using it, NYSDOT could try to facilitate the exchange of permits among operators by providing, at a minimum, an information exchange, or by acting as a broker. This would allow NYSDOT to acquire additional evidence about the value of the permits to the industry, which is of primary importance if the permit system is to be opened to new users.

To increase the flexibility of the permit system, seasonal and/or temporary divisible-load permits could be considered, since certain businesses in agriculture and in fuel delivery appear to have a use for the permits only during certain times of the year. Thirdly, if taxes do not charge divisible-load permit vehicles for the added pavement damage they cause, it seems fair to consider increasing the permit fees to collect at least partial compensation to the State for incremental pavement damage. Finally, more data could be gathered on a routine basis by NYSDOT and other state agencies to help answer these and other questions.

Policy implications are detailed in Chapter 9.



### Permit Gross Vehicle Weight Exceedence Analysis

The following describes the procedure used to analyze the gross vehicle weights of the survey respondents. Each questionnaire asked the truck operator to describe the configuration of the truck surveyed and to give the distance between the front axle and each subsequent axle. Based on this information and the Bridge formula, it was then possible to calculate the maximum weight that could be carried by each truck axle and also, by summing truck axle maxima, to calculate the maximum truck Gross Vehicle Weight (GVW) under the Federal Weight Regime. The bridge formula is given by:

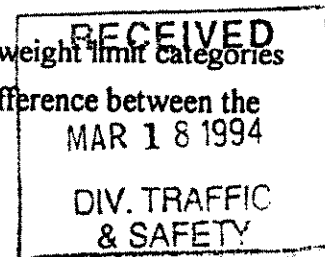
$$W = 500 * \left( \frac{L * N}{N - 1} + 12 * N + 36 \right)$$

In addition, for each loaded trip performed on the survey day, truck operators were asked to provide the loading of each axle and the GVW, each time this information changed. However, operators were not asked to identify the permits held for each permitted truck. This information was made available to us from the PAF file that New York State D.O.T. provided for the sample of 916 trucks. For each loaded trip, it was thus possible to compare the gross vehicle weight and the weight limit under the permit system, given the configuration of the truck.

The following possible preliminary conclusions can be drawn about the load exceedence analysis:

1) from Table X, we see that more weight was transported by the permit vehicles in the summer of 1990 than in the summer of 1987. Figure X.1 also illustrates this point clearly. Moreover, holders of permits 7 and 7A did not adapt to the reduction in permitted GVW, quite the contrary. Indeed, Figure X.2 shows that the group of vehicles that hold these permits transported as much weight in 1990 as they did in 1987. We can even notice a break in the 1990 empirical distribution of GVW for this group of vehicles: the upper 20% of trips for the 1990 survey were used to carry significantly more weight than in 1987. This finding supports the argument that, since no weight reduction was observed following the lowering of limits in 1990, the only reasonable method for estimating the "optimal" limit of the permit system based on the 125%, 135%, and 145% weight limits was to assume perfect compliance with the revised load limits.

2) A look at Table Y shows consistency for the distribution of permitted weight limit categories between surveys. A chi-square test could be used to test the statistical difference between the



different seasons. One problem was the fairly sizable percentage of trucks for which the permit held was not known. Assuming that the unknown category is just like the rest of the sample in terms of permit composition, it is possible to estimate the distribution of permitted weight limits for the entire population, given the configuration of the trucks on the survey day.

3) The next two tables (Z and Z') provide useful information about the extent and level of the load non-compliance. At first glance, we can see a striking difference between the two summers, with a large jump in the number and the severity of non-compliances. However, we notice a good consistency between the last three surveys conducted between 1990 and 1991, both for the statistics at the truck level and also at the trip level. Therefore, we may conclude that the operator response to the revised limits did not change in that period. It should be noted that an arbitrary "grace weight" of 500 lbs was subtracted from the gross vehicle weights for all seasons to account for uncertainties in measuring weight, reporting axle spacing, and so on.

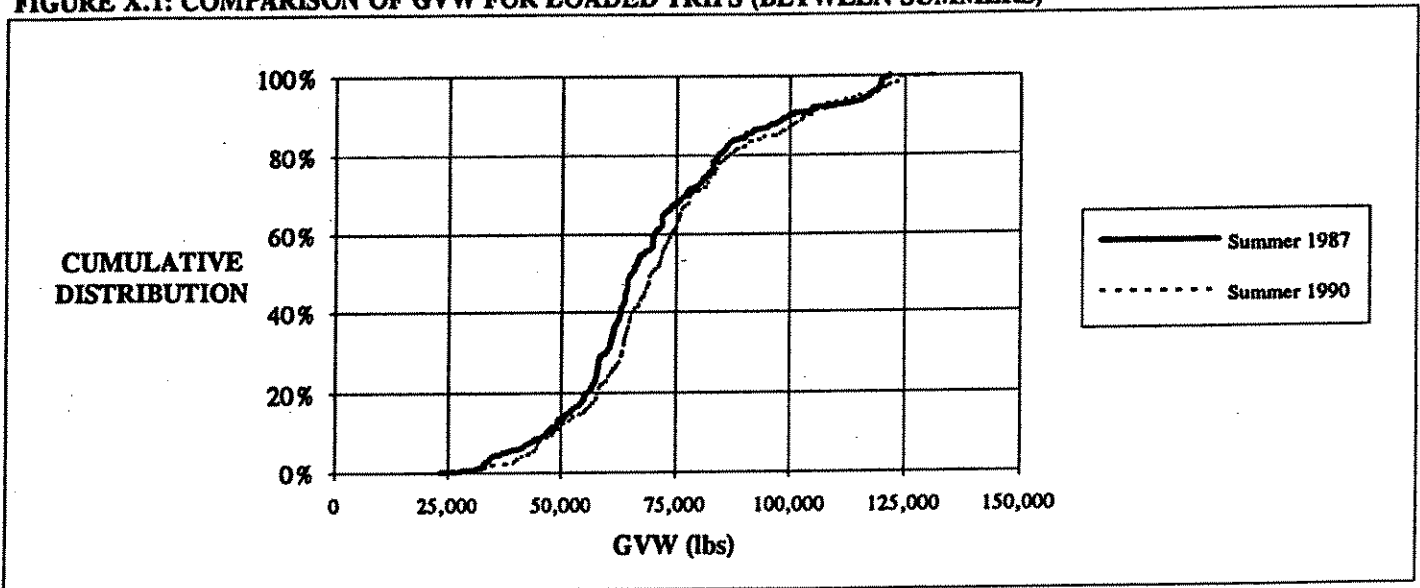


**TABLE X: COMPARISON OF REPORTED GVW BETWEEN SUMMERS**

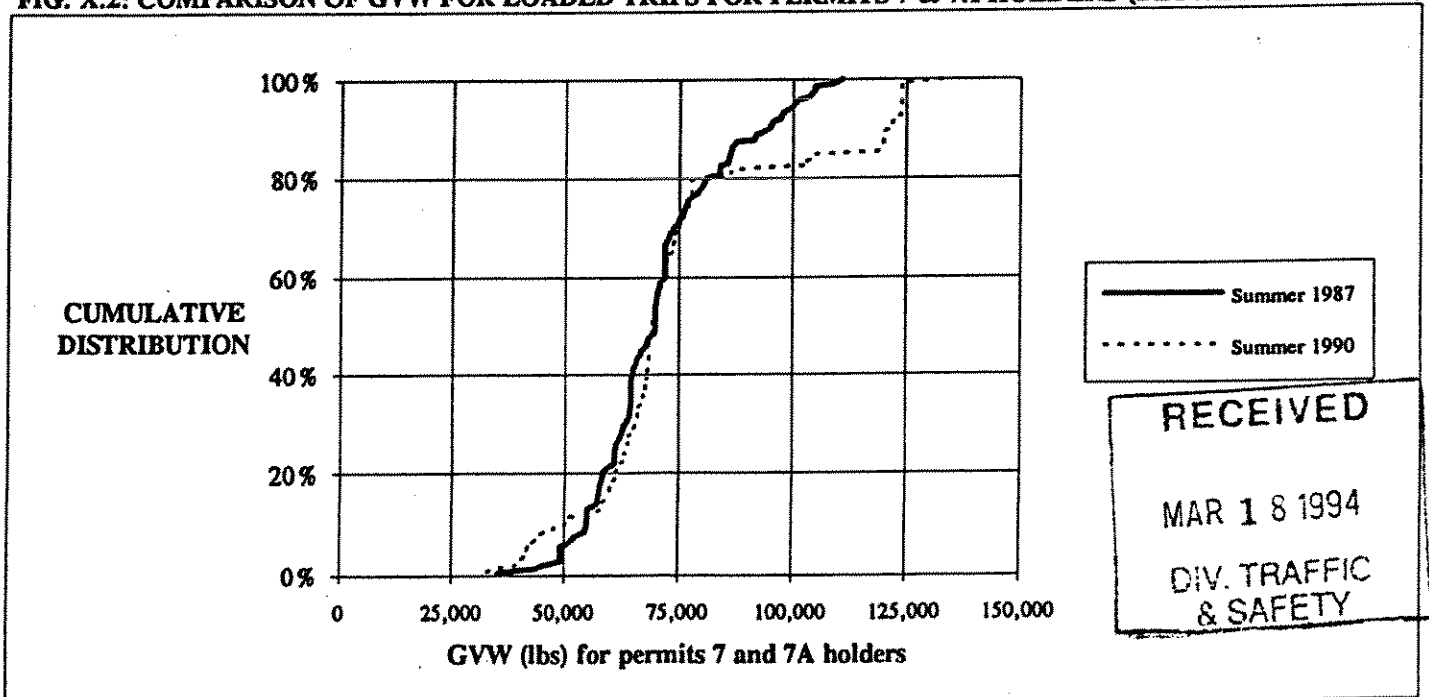
GVW Statistics	All Permit Categories		Permits 7 and 7A only	
	Summer 1987	Summer 1990	Summer 1987	Summer 1990
Average	70,100 lbs	73,000 lbs	70,800 lbs	75,300 lbs
Median	65,500 lbs	69,800 lbs	69,900 lbs	69,200 lbs
Minimum	23,600 lbs	23,700 lbs	35,300 lbs	33,100 lbs
Maximum	121,700 lbs	133,000 lbs	111,000 lbs	133,000 lbs
Stdev	20,710 lbs	20,430 lbs	14,680 lbs	23,460 lbs
Number of Trips	602	631	212	138

NOTE: The number of trips reflects only the number of points on which the distributions below are based, not the fraction of trips corresponding to permits 7 and 7A. Less complete information was available for the Summer of 1990 survey.

**FIGURE X.1: COMPARISON OF GVW FOR LOADED TRIPS (BETWEEN SUMMERS)**



**FIG. X.2: COMPARISON OF GVW FOR LOADED TRIPS FOR PERMITS 7 & 7A HOLDERS (BETWEEN SUMMERS)**

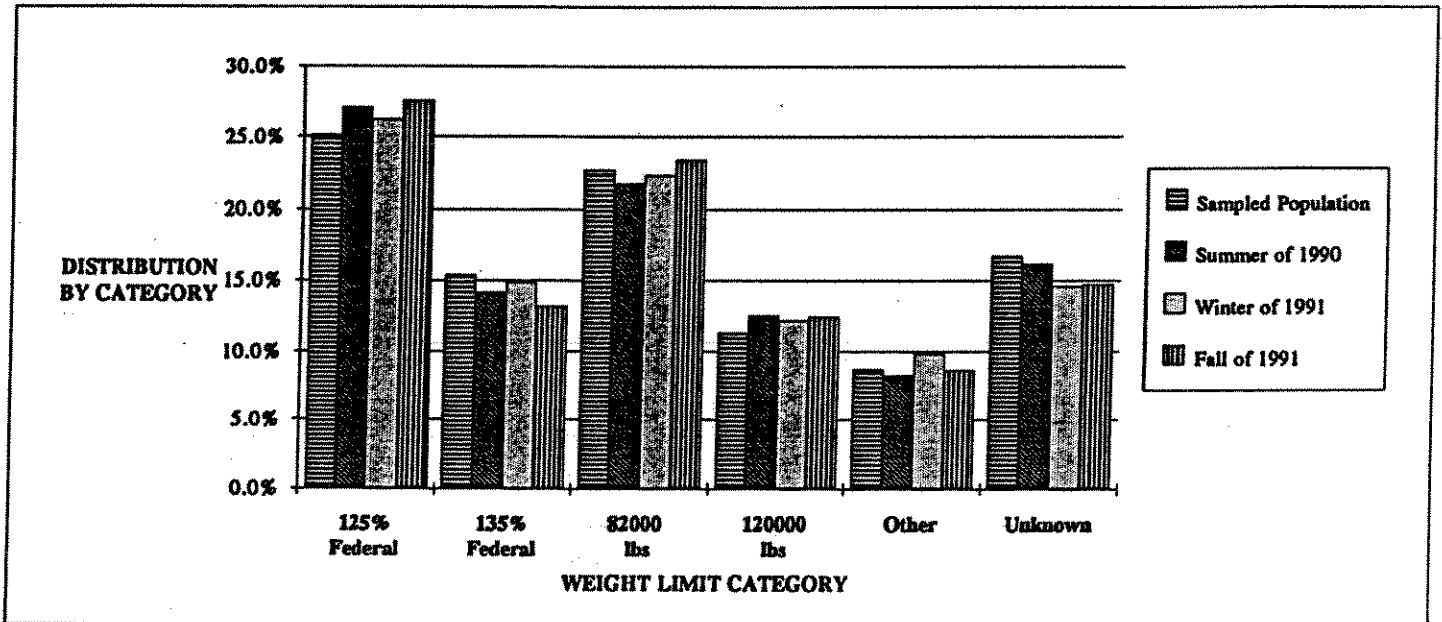


NOTE: Max. GVW for permits 7 and 7A was reduced from 145% to 135% of the Federal GVW between 1987 and 1990.

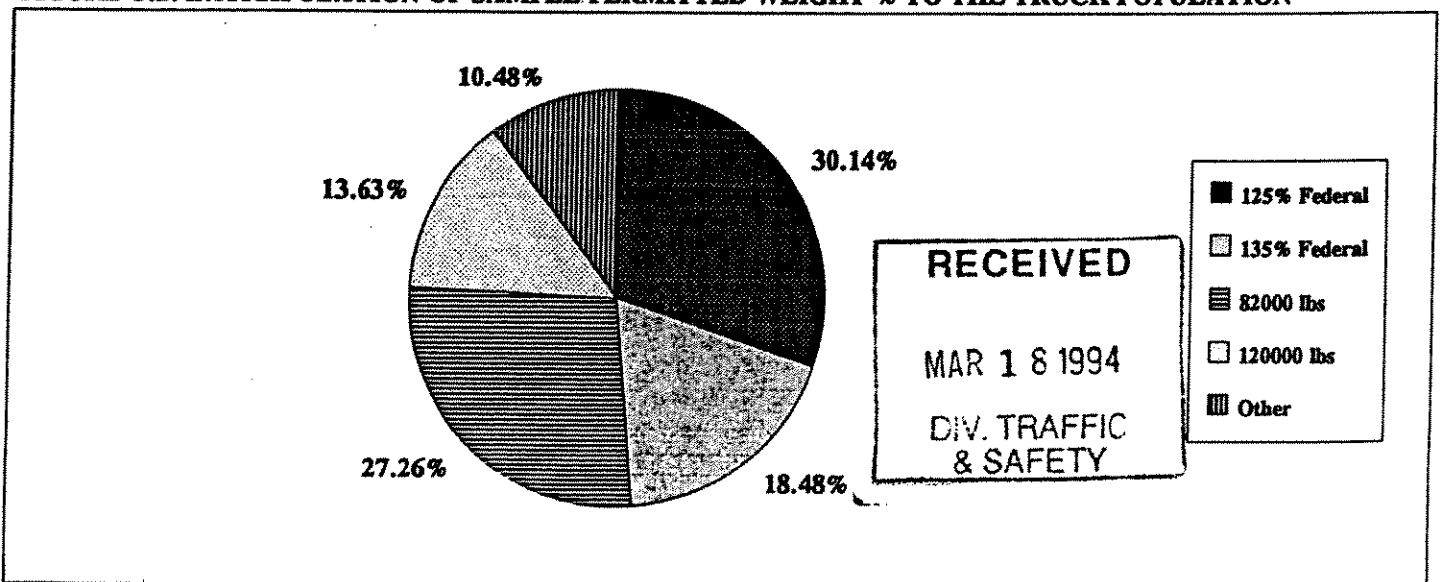
**TABLE Y: DISTRIBUTION OF RESPONDENTS BY PERMIT WEIGHT LIMIT**

Highest Weight Limit Permit Held	Weight Limit (lbs)	Sampled Population		Summer of 1990		Winter of 1991		Fall of 1991	
		Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
1 and/or 1A	125% FED	230	25.1%	82	27.1%	88	26.2%	73	27.5%
1&7 and/or 1A&7A	135% FED	141	15.4%	43	14.2%	50	14.9%	35	13.2%
2	82000 lbs	208	22.7%	66	21.8%	75	22.3%	62	23.4%
6	120000 lbs	104	11.4%	38	12.5%	41	12.2%	33	12.5%
	Other	80	8.7%	25	8.3%	33	9.8%	23	8.7%
	Unknown	153	16.7%	49	16.2%	49	14.6%	39	14.7%
	TOTAL	916	100.0%	303	100.0%	336	100.0%	265	100.0%

**FIGURE Y.1: DISTRIBUTION OF PERMITTED WEIGHT LIMIT CATEGORIES BY SURVEY**



**FIGURE Y.2: EXTRAPOLATION OF SAMPLE PERMITTED WEIGHT % TO THE TRUCK POPULATION**



NOTE: To calculate extrapolated percentages for each weight limit category, it was assumed that the composition of permits in the unknown category was similar to that of the known rest of the sample.

**TABLE Z: STATISTICS ON TRUCK WEIGHT NON-COMPLIANCE BY PERMIT CATEGORY**

CATEGORY	Summer 87	Summer 90	Winter 91	Fall 91
Number of trucks that made loaded trips on survey day	154	120	59	76
Number of trucks in exceedence of permit weight limits	23	53	26	38
Percentage of trucks in exceedence of permit limits	15%	44%	44%	50%
Number of exceedences due to incorrect # of axles	3	23	12	16
% of exceedences due to incorrect # of axles	13%	43%	46%	42%

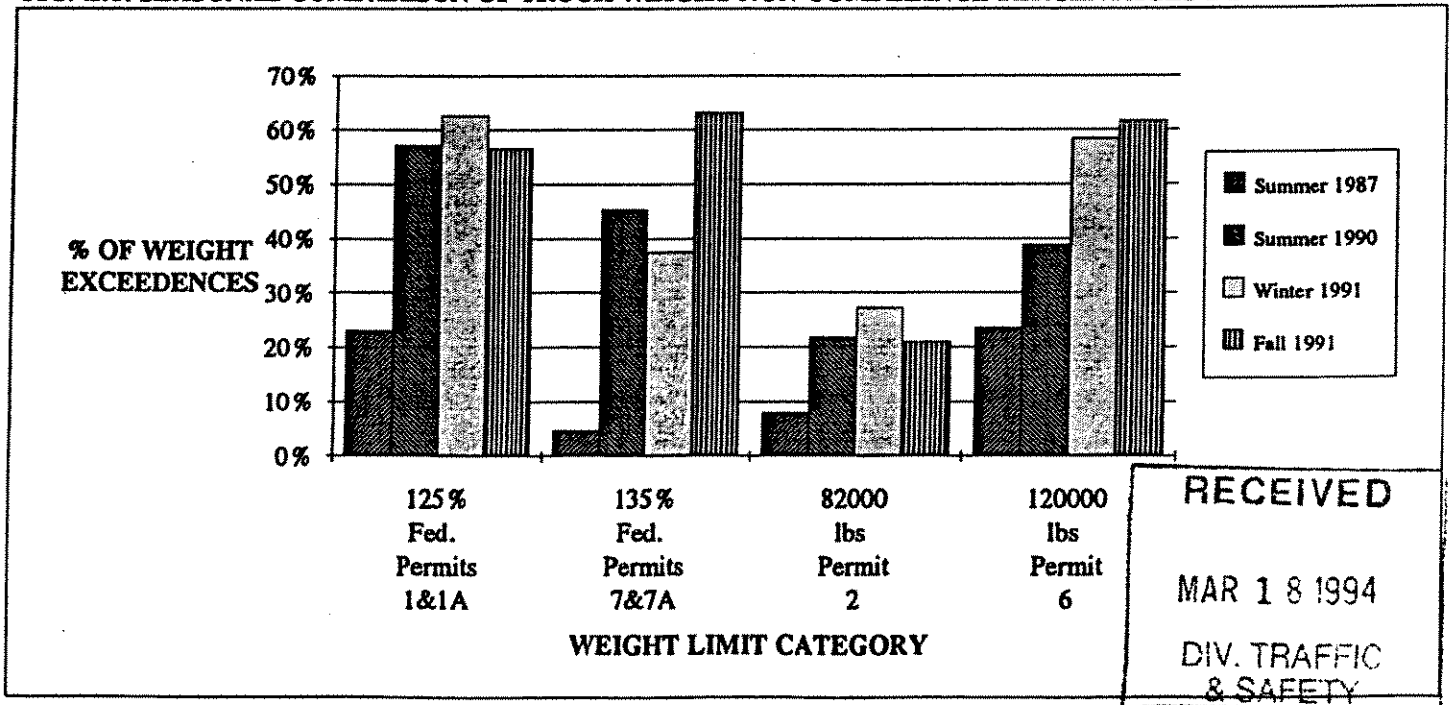
Season	Permit Type	1	7	1A	7A	2	6	3, 5, 5A	Total
	Permit Weight Limit	125% Fed.	135% Fed.	125% Fed.	135% Fed.	82000lbs	120000lbs	(*)	
	# of Axles Required	2 to 4	2 to 4	> 4	> 4	>2	>4	(**)	
Summer of 1987	Number of Trucks	48	32	17	11	25	17	4	154
	Number of Exceedences	12	2	3	0	2	4	0	23
	% of Exceedences	25%	6%	18%	0%	8%	24%	0%	15%
Summer of 1990	Number of Trucks	37	18	5	4	32	18	6	120
	Number of Exceedences	20	6	4	4	7	7	5	53
	% of Exceedences	54%	33%	80%	100%	22%	39%	83%	44%
Winter of 1991	Number of Trucks	14	7	2	1	22	12	1	59
	Number of Exceedences	8	3	2	0	6	7	0	26
	% of Exceedences	57%	43%	100%	0%	27%	58%	0%	44%
Fall of 1991	Number of Trucks	21	15	2	4	19	13	2	76
	Number of Exceedences	12	9	1	3	4	8	1	38
	% of Exceedences	57%	60%	50%	75%	21%	62%	50%	50%

NOTES: Shading of the results for a category indicates that the number of sampled trucks in this category may be too small to give statistically reliable results.

(\*): The weight limit for permit 3 is 73280 lbs; permits 5 and 5A allow up to 105,000 lbs.

(\*\*): Permit 3 applies only to trucks with 3 axles or more. At least 5 axles are needed for permits 5 and 5A.

**FIG. Z.1: SEASONAL COMPARISON OF TRUCK WEIGHT NON-COMPLIANCE PERCENTAGES BY WEIGHT LIMIT**



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**TABLE Z': STATISTICS ON TRIP WEIGHT NON-COMPLIANCE BY PERMIT CATEGORY**

CATEGORY	Summer 87	Summer 90	Winter 91	Fall 91
Number of loaded trips on survey day	602	528	181	330
Number of trips in exceedence of permit weight limits	58	245	75	164
Percentage of trips in exceedence of permit limits	10%	46%	41%	50%
Number of exceedences due to incorrect # of axles	4	101	28	79
% of exceedences due to incorrect # of axles	7%	41%	37%	48%

NOTE: During a trip, a truck can exceed the weight limits for several reasons: it may simply be over the limit stipulated by the permit or the permit may not apply because the configuration of the truck does not match the permit requirements or because the truck is outside the geographic area of validity of the permit.

Season	Permit type Weight limit # of axles	1 125% Fed. 2 to 4	7 135% Fed. 2 to 4	1A 125% Fed. > 4	7A 135% Fed. > 4	2 82000lbs >2	6 120000lbs >4	3, 5, 5A (* (**))	Total
Summer of 1987	Number of trips	40	2	5	0	7	4	0	58
	Average non-compliance	3,702 lbs	2,098 lbs	7,670 lbs		1,057 lbs	850 lbs		3,473 lbs
	Median	2,218 lbs	2,098 lbs	10,895 lbs		1,100 lbs	940 lbs		2,095 lbs
	Maximum	19,500 lbs	3,565 lbs	12,075 lbs		2,700 lbs	1,160 lbs		19,500 lbs
	Stdev	4,410 lbs	2,075 lbs	5,506 lbs		794 lbs	380 lbs		4,294 lbs
Summer of 1990	Number of trips	100	35	16	22	24	26	22	245
	Average non-compliance	7,224 lbs	24,275 lbs	16,856 lbs	14,970 lbs	17,266 lbs	16,747 lbs	13,916 lbs	13,580 lbs
	Median	4,435 lbs	24,500 lbs	14,000 lbs	16,890 lbs	20,500 lbs	15,000 lbs	10,740 lbs	11,500 lbs
	Maximum	23,700 lbs	54,500 lbs	27,000 lbs	23,020 lbs	36,480 lbs	25,500 lbs	41,460 lbs	54,500 lbs
	Stdev	7,485 lbs	19,985 lbs	5,780 lbs	5,852 lbs	9,608 lbs	6,348 lbs	11,755 lbs	12,020 lbs
Winter of 1991	Number of trips	25	15	5	0	14	16	0	75
	Average non-compliance	4,390 lbs	3,310 lbs	17,936 lbs		22,547 lbs	11,589 lbs		10,000 lbs
	Median	4,020 lbs	2,340 lbs	20,100 lbs		22,000 lbs	9,950 lbs		6,060 lbs
	Maximum	6,780 lbs	8,415 lbs	24,220 lbs		38,180 lbs	20,180 lbs		38,180 lbs
	Stdev	1,700 lbs	2,553 lbs	7,120 lbs		12,808 lbs	5,640 lbs		9,720 lbs
Fall of 1991	Number of trips	47	37	2	13	23	40	2	164
	Average non-compliance	6,316 lbs	17,546 lbs	9,020 lbs	10,088 lbs	15,778 lbs	14,801 lbs	21,500 lbs	12,760 lbs
	Median	5,450 lbs	8,515 lbs	9,020 lbs	9,000 lbs	13,725 lbs	16,690 lbs	21,500 lbs	11,370 lbs
	Maximum	17,625 lbs	45,500 lbs	12,100 lbs	18,800 lbs	34,840 lbs	20,000 lbs	21,800 lbs	45,500 lbs
	Stdev	4,463 lbs	17,459 lbs	4,356 lbs	5,651 lbs	9,792 lbs	4,897 lbs	424 lbs	10,735 lbs

NOTES: Shading of the results for a category indicates that the number of sampled trucks in this category may be too small to give statistically reliable results

(\*): The weight limit for permit 3 is 73280 lbs; permits 5 and 5A allow up to 105,000 lbs.

(\*\*): Permit 3 applies only to trucks with 3 axles or more. At least 5 axles are needed for permits 5 and 5A.

