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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE 82

CRITERIA FOR EVALUATION OF TRUCK WEIGHT ENFORCEMENT PROGRAMS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE 82

CRITERIA FOR EVALUATION OF TRUCK WEIGHT ENFORCEMENT PROGRAMS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the Academy and its Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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PREFACE

There exists a vast storehouse of information relating to nearly every subject of concern to highway administrators and engineers. Much of it resulted from research and much from successful application of the engineering ideas of men faced with problems in their day-to-day work. Because there has been a lack of systematic means for bringing such useful information together and making it available to the entire highway fraternity, the American Association of State Highway and Transportation officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize the useful knowledge from all possible sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series attempts to report on the various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which they are utilized in this fashion will quite logically be tempered by the breadth of the user's knowledge in the particular problem area.

FOREWORD

By Staff
Transportation
Research Board

This synthesis report will be useful to highway administrators, traffic engineers, and others concerned with enforcement of truck weight limits. Detailed information is presented on operations, organization, and equipment used in programs to enforce legal load limits.

Administrators, engineers, and researchers are faced continually with many highway problems on which much information already exists either in documented form or in terms of undocumented experience and practice. Unfortunately, this information often is fragmented, scattered and unevaluated. As a consequence, full information on what has been learned about a problem frequently is not assembled in seeking a solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of synthesizing and reporting on common highway problems. Syntheses from this endeavor constitute an NCHRP report series that collects and assembles the various forms of information into single concise documents pertaining to specific highway problems or sets of closely related problems.

Programs for enforcement of legal load limits vary from state to state, and their effectiveness must be evaluated periodically. This report of the Transportation Research Board includes information on various programs and on methods for measuring effectiveness.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the researcher in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

Criteria for Evaluation of Truck Weight Enforcement Programs

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Abstract: The purpose of a truck weighing program is to enforce legal load limits and thus prevent trucks from damaging highways and bridges. Although all states have truck weight enforcement programs, none has established criteria for evaluating these programs. Programs for enforcement of legal load limits vary from state to state, and their effectiveness must be evaluated periodically. This report includes information on various programs and on methods for measuring effectiveness.

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Thomas H. Myers, Jr., Rail Transport Specialist, Transportation Research Board, assisted the Project 20-5 Staff and the Topic Panel.

Information on current practice was provided by the highway and transportation agencies of the following states: Arkansas, California, Florida, Georgia, Iowa, Louisiana, North Carolina, Virginia, and Washington. In addition, Connecticut, Maryland, and New York supplied information on the use of semiportable scales. The state highway police of the following states also provided information: Arkansas, California, Florida, Louisiana, and Washington. Their cooperation and assistance were most helpful.

CRITERIA FOR EVALUATION OF TRUCK WEIGHT ENFORCEMENT PROGRAMS

SUMMARY

The purpose of a truck weighing program is to enforce legal load limits and thus prevent trucks from damaging highways and bridges. Although all states have truck weight enforcement programs, none has established criteria for evaluating these programs. However, each state periodically reviews operations, evaluates and purchases equipment, requests revisions to laws, and adjusts its organization in an effort to improve enforcement.

Comparing truck population with the number of vehicles being weighed is part of determining the effectiveness of a truck weighing program. Also needed are data on the overloaded truck, truck routes and volumes, types of movements (interstate or intrastate), vehicle classifications, types of cargo, and distances traveled.

Essential to truck weight enforcement is the effective combination and deployment of the various types of scales (permanent, portable, and semiportable). Through the use of data collected in truck traffic studies, permanent scales can be located where there are many overloaded trucks, and these scales can be supported by roving portable-scale crews. Greater use of the semiportable scales should be carefully considered and may eliminate the need for a new permanent weigh station. Improved instrumentation for weigh stations and semiportable stations is needed.

In most states overweight violations are misdemeanors and are processed through the courts. In several states an overweight violation is a civil offense, and penalties are collected at the weigh site or within 15 days after the citation is issued unless a hearing is requested. Most states have unloading requirements for an overload violation. Many enforcement officers believe that the off-loading requirement is the most effective deterrent in a truck weight enforcement program.

Some of the problems in truck weight enforcement can be attributed to insufficient personnel, usually the result of an insufficient number of budgeted positions for proper operation of permanent and portable scales. The hours of operation of scales are related to the available personnel. Most permanent stations are operated continuously only on routes with large volumes of truck traffic.

Each state needs to evaluate its truck weight enforcement program, beginning with cooperation within and among the agencies involved. The state needs to determine the most effective enforcement procedures possible under the law in light of the existing facilities and available personnel and with minimal expenditures for additional facilities and equipment. Long-range goals for changing state laws and improving site operations also are necessary, as are methods for measur-

ing the effectiveness of state truck weight enforcement programs. Some of the possible methods are simple and can be implemented with little more than an evaluation of existing data. Other methods require a different use of existing equipment, additional equipment, or a change in operations.

Weight law enforcement is similar to speed enforcement; violators will be deterred as long as the enforcement agency effectively uses the available tools. No enforcement program can entirely eliminate overweight trucks from the highways, of course; the driver of an overweight truck will always attempt to evade detection. Without dedicated, persistent truck weight enforcement officers, the highway system would have deteriorated long ago.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Before 1914 pavements and highway bridges were constructed to carry anticipated loads. However, highway engineers began to recognize that pavement failure was associated with highway loads, and the American Association of State Highway Officials (AASHO) established design criteria for bridges and pavements. In the 1950s AASHO and the Highway Research Board conducted full-scale road tests to determine the effect of repeated heavy truck loads on highway pavements and bridges. These and additional tests conducted by many states in later years produced the design guides in use today.

As highway design practices progressed, so did the development of trucks and load-carrying capacity. The capability of the truck to serve any community, the improved highway system, and the construction of the Interstate highway system served to make the truck a prime carrier of freight. To protect public investment in the highway system, states enacted laws setting legal load limits for various types of trucks. With the growth of the trucking industry came the demand to increase the legal loads, and the energy crisis of the 1970s caused the trucking industry to bring great pressure on the federal and state governments for higher legal loads.

Many states realized long ago that truck weighing was necessary and implemented a truck weight enforcement program. It is not uncommon to find permanent weigh stations that were constructed 40 to 50 yr ago still in use. The use of truck weighing programs increased after road tests were conducted to document the extent of damage to pavements by repeated heavy loads. The results of the AASHO Road Test, published in 1961 and 1962 (*1*), left no doubt that heavy truck loads cause pavement deterioration and structural damage.

NEED FOR ENFORCEMENT AND CRITERIA

Many states have evaluated the damage, the effects of truck traffic in terms of maintenance cost, and loss of serviceability on highways. For example, Arkansas (*2*) determined that a gross truck weight of 73,280 lb (33 240 kg) would require an overlay every 16.4 yr on a highway designed for an average daily traffic (ADT) volume of 450 trucks. Increasing the legal limit to 80,000 lb (36 300 kg) gross weight would require an overlay every 10.6 yr. Louisiana has determined that on its primary highways the cost of highway use is about $0.36 per ton-mile ($0.25/Mg-km). On the Interstate System an 80,000-lb truck traveling 1,000 miles (1600 km) in 1 yr costs $12,000 in terms of use and deterioration of the highway. However, if the allowed weight were 100,000 lb (45 400 kg) the deterioration cost would increase to $33,000. On Louisiana's farm-to-market roads, increasing the weight from 80,000 lb to 100,000 lb would increase the use cost from $49,000 to $145,000.

The Massachusetts Department of Public Works, in response to legislation that permitted increased use of annual special overload permits, reported concern with the damage caused by overloaded vehicles to the more than 2,400 bridges under the department's control (*3*). The report indicated that allowing overloaded vehicles to operate under special permit would decrease safety in steel bridges because of stress.

Kentucky recently published a research report (*4*) that substantiates the damage done to pavements by increased payloads. This study also suggested that some changes in the design of the truck could lessen the damage factor. In a 1978 Texas research report (*5*), the effects on roads of 80,000-lb (36 300-kg) and possible 120,000-lb (54 000-kg) truck weights were compared. It was concluded that additional highway costs (using 1977 constant dollars in a 20-yr analysis period) would be $3.50 billion, as compared with savings in truck operating costs of $9.12 billion, of which $2.42 billion is fuel. The study recommended that higher gross loads should be allowed only on selected routes. It is significant that Texas would need $3.5 billion additional revenue over a 20-yr period to maintain a system of highways that could carry 120,000-lb trucks. In Minnesota the damage to pavements caused by double-bottom trucks, compared with that caused by the more popular five-axle trucks, was studied (*6*). It was reported that an increase from 18,000 to 20,000 lb (80 to 89 kN) on a single axle caused a 50 percent increase in pavement damage and that an increase from 32,000 to 34,000 lb (142 to 151 kN) on a tandem axle caused a 25 percent increase in pavement damage. Although most of the research reported by the states has been directed to specific loads, it can be concluded that, whatever the legal load, any overload will increase the damage to highways and reduce the riding quality and the serviceability. Thus an effective enforcement program is necessary.

States use the *AASHTO Interim Guide for Design of Pavement Structures* (*7*), published by the American Association of State Highway and Transportation Officials (AASHTO), or a modified version of this guide.

To design a specific highway pavement, 20-yr traffic projections are converted into 18,000-lb (80-kN) loads. In the past traffic projections have been lower than actual growth, and many highways have reached their designed life in less than 20 yr. Large numbers of overloaded trucks or an increase in the legal loading requirements shorten the life of a highway.

The secondary highways of many states were not designed; they evolved from dirt to stone to tar and chips to bituminous concrete. This type of highway comprises the bulk of the rural county system of highways. Budgets for these subdivisions are small, and few funds are allotted to construction or overlay programs. Today many miles of these highways are subject to severe overloads because of the development of new industries or the increased productivity of old ones. Even a small amount of overloading can cause damage to the older highways.

The highway administrator at every level of government is faced with the problem of excessive truck weight. When Congress established the 80,000-lb (36 300-kg) gross weight as the legal truck weight limit on the Interstate System, many states found it impossible to hold the limit to a 73,280-lb (33 240-kg) gross load on state roads. The trucking industry has repeatedly indicated its desire for uniform loading in every state and has often played one state against another in attempting to achieve this goal. Many state officials believe that the increased limit of 80,000 lb will solve the overweight problem; however, Florida reported that the overweight problem increased when the legal limit went to 80,000 lb. It can be concluded that, regardless of the legal limit that is established, a certain percentage of trucks will run overloaded.

A report by the General Accounting Office (GAO) (*9*) suggests that the FHWA has the capacity to establish criteria for truck weight enforcement. A 1979 FHWA report to Congress (*10*) recommends that a guide be prepared by AASHTO or the Transportation Research Board (TRB) to assist the states in the evaluation of truck weight enforcement.

Along with the reports cited above, *NCHRP Synthesis of Highway Practice 68* (*11*), published in 1980, clearly indicates the vast differences in the state laws, enforcement operations, permit operations, and penalties or fine structures. In this synthesis reference is made to these publications to avoid duplication, and the conclusions drawn by these reports are accepted where applicable.

PURPOSE OF SYNTHESIS

The purpose of this synthesis is to assist states in establishing criteria for the evaluation of truck weight enforcement programs. Information is presented on current practices in the enforcement of truck weight regulations by state highway agencies. Effective procedures are highlighted; the problems encountered in truck weight enforcement programs are identified; and solutions to these problems are discussed.

In the preparation of this synthesis personal interviews using questionnaires were conducted in 10 states: Arkansas, California, Florida, Georgia, Iowa, Louisiana, North Carolina, Utah, Virginia, and Washington. Persons responsible for the enforcement of the state weight and size laws provided information on successful enforcement operations and discussed areas that needed improvement. Connecticut, Maryland, and New York were also contacted. New York officials responded to the questionnaire and provided data on the use of the semiportable scale. The primary purpose of the Maryland interview and field trip was to discuss and observe the semiportable scales. Connecticut officials were interviewed by telephone to review the use of semiportable scales in rest areas and plans for the conversion of the rest-area sites into permanent stations. In addition, 17 states (Connecticut, Delaware, Indiana, Kentucky, Massachusetts, Minnesota, Mississippi, Missouri, Nevada, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Vermont, and West Virginia) provided research reports and programs to supplement the agency interviews.

None of the states interviewed has established criteria for the evaluation of truck weight enforcement programs. However, each state agency periodically reviews operations, evaluates new hardware, requests adjustments to existing laws, seeks additional manpower, adjusts organization, and acquires new equipment within the budgetary restraints, in an ongoing effort to improve enforcement operation. Certain state operations and organizations appear to conduct effective truck weight enforcement programs; the purpose of this synthesis is to report those practices that can significantly improve a state's truck weight enforcement program.

CHAPTER TWO

TRUCK POPULATION

It is essential for states to compare truck population with the number of vehicles being weighed in order to determine the effectiveness of a truck weighing program. Discussions with the several state agencies and with FHWA officials have led to the conclusion that states also need to know the major truck routes and the probable truck volumes on these routes, the nature of the truck movement (interstate or intrastate), the classifications of the vehicles using the routes, the types of cargo and tonnage, and the distances traveled.

COLLECTION OF DATA

Annual ADT reports are prepared by the states in cooperation with the FHWA. The state traffic engineering division generally compiles the data for the report, using accepted traffic engineering collection methods.

The preface to Washington's 1978 annual traffic report (*12*) describes the methods used by most states to collect and process the data for the preparation of these reports. (See Figure 1.) The preface states:

> A traffic count is the number of vehicles that passes a given point during a specific period of time. These vehicles may be recorded by either manual tally or a mechanical counting apparatus. In this report the volumes shown represent an estimate of the average day of the year. (Average Daily Traffic Volume.)
>
> There are 45 locations throughout the State that are counted continuously throughout the year. The data collected at these locations provide traffic variation patterns.
>
> The patterns consist of monthly factors which represent seasonal variations of vehicular movement. The application of these factors to 48 and 72 hour counts averaged to a 24-hour volume results in the modifications of such counts to an estimate of the annual average daily traffic volume (ADT). Weekdays, rather than weekends, are used because the traffic does not fluctuate as erratically during weekdays as it frequently does during weekends.

California prepares an annual average daily truck traffic report each year (*13*). The preface of the report explains the methods of data collecting and processing. (See Figure 2.) The preface states:

> The annual average daily truck traffic is shown for selected locations on the State Highway System. Truck traffic is classified by number of axles. The two-axle class includes trucks with dual rear tires and excludes pickups and vans with only four tires. Total vehicle AADT for the same year is taken from the Traffic Volumes on California State Highways booklet also published by the California Department of Transportation.
>
> Annual average daily truck traffic is the total truck traffic volume divided by 365 days. There are no locations in California where trucks are counted continuously. Truck counting is done throughout the state in a program of continuous truck count sampling. The resulting counts are adjusted to an estimate of annual average daily truck traffic by compensating for seasonal influence, weekly variation and other variables which may be present. Annual average daily truck traffic is necessary for presenting a statewide picture of truck flow, evaluating truck trends, planning and designing highways and for other purposes.

The report prepared by Virginia (*14*) presents ADT for single-unit trucks and trailer trucks by route segment and compares the relative density of traffic by counties, the vehicle-miles of travel by route, and the vehicle-miles of travel by counties and cities. Figure 3 shows data for vehicle-miles of travel by route; trailer trucks travel almost 4,000,000 miles (6400000 km) on the 8,616 miles (13900 km) of Interstate, arterial, and primary roads every 24 hr.

Data are collected by the state traffic engineering divisions of California and Washington. An excellent source of data, but rarely used by traffic engineering personnel, is the permanent weigh station. In Iowa, for example, the enforcing officer is required to count and classify the trucks as they are being weighed (Figure 4 shows a form used for this purpose.) State traffic engineers overlook a valuable source of data by not using available information and not working with the enforcement agency to collect the data from permanent weigh stations. Weigh-in-motion (WIM) equipment has been used for traffic collection and planning; these data can also be obtained if the WIM equipment is part of the enforcement program at permanent weigh stations.

TONNAGE SURVEYS

Some state agencies have studied the scope of truck transportation within the state to determine the role trucking plays in the state's economy. In 1977 the Washington Department of Transportation (DOT) (*15*) conducted truck weighing at the four ports of entry into the state and at a location south of the Canadian border to determine the types of commodities being trucked into the state and their disposition within the state. Operations were conducted for a composite 24-hr period at each location. It was estimated that a total annual tonnage of 10,000,000 (9000000 Mg) entered the state through the five locations. Although this estimate was based on traffic counts and state DOT and Washington State Patrol weighing activities, it may be possible through special studies to identify all commodities that are trucked into a state or moved intrastate. Studies of this nature can shed considerable light on the tonnage that is being moved on the major truck routes. Figure 5 shows the tonnage and distribution of the tonnage at the port of entry at Ridgefield, Washington (on Interstate Route 5).

STATE ROUTE	STATE ROUTE MILE POST	LOCATION	LEG OF INTERSECTION	FA or FAS NUMBER	CONTROL SECTION NUMBER	FUNC. CLASS	TRUCK & BUS PERCENT		AVERAGE DAILY TRAFFIC VOLUME			
							SINGLE UNITS	TRUCK COMBS.	1975	1976	1977	1978
		STATE ROUTE NO 8										
8	.16	JCT CN RAMP FROM SR 12	NE	008	1408	1	05	06	8300	9200	10100	11200
8	.48	ELMA ECL		008	1408	1	05	06	8300	9200	10100	11200
8	2.42	JCT HEISE ROAD	SW	008	1408	1	05	06	8000	8700	9500	10500
8	2.42	JCT HEISE ROAD	NE	008	1408	1	05	06	7400	8100	8900	9900
8	6.03	JCT SR 108/COUNTY ROAD	W	008	1408	1	05	06	8000	8700	9500	10600
8	6.03	JCT SR 108/COUNTY ROAD	E	008	1408	1	04	07	6600	7200	7800	8700
8	6.26	MCCLEARY WCL		008	1408	1	04	07	6600	7200	7800	8700
8	7.07	MCCLEARY ECL		008	1408	1	04	07	6600	7200	7800	8700
8	7.39	JCT SINE ROAD	NW	008	1408	1	04	07	6600	7200	7800	8700
8	7.42	JCT SINE ROAD WYE CONN	SE	008	1408	1	04	07	7300	7900	8600	9500
8	9.00	JCT MOX CHEHALIS ROAD	W	008	1408	1	04	07	7300	7900	8600	9500
8	9.00	JCT MOX CHEHALIS ROAD	E	008	1408	1	04	07	7400	8100	8900	9900
8	10.54	THURSTON COUNTY LINE		008	1408	1	04	07	7400	8100	8900	9900
8	16.12	JCT SUMMIT LAKE/ROCK CANDY RDS	SW	008	3404	1	04	07	7400	8100	8900	9900
8	16.12	JCT SUMMIT LAKE/ROCK CANDY RDS	NE	008	3404	1	04	07	7900	8600	9400	10400
8	19.91	JCT PERRY CREEK ROAD	SW	008	3404	1	04	07	7800	8500	9300	10300
8	19.91	JCT PERRY CREEK ROAD	NE	008	3404	1	04	07	7562	8239	9030	10110
8	20.67	SR 101 OXING E PAVT S 8/104	W	008	3404	1	04	07	7562	8239	9030	10110
		STATE ROUTE NO 9										
9	.09	JCT ON/OFF RAMPS FR/TO SR 522	NE	009	3132	2	05	03	5100	5900	5800	6200
9	1.57	JCT 212TH STREET SE	S	009	3132	2	05	03	4100	5100	5400	5800

FIGURE 1 Data from Washington's annual traffic report (*12*).

VOL042 CALTRANS - TRAFFIC VOLUMES COUNT YEAR 1979
06/20/80 TRUCK ANNUAL AVG DAILY TRAFFIC (AADT)
10:57 ANNUAL REPORT TWO WAY TRAFFIC

RTE	SEQ	DIST	CNTY		POST MILE	LEG	DESCRIPTION	VEHICLE AADT TOTAL	TRUCK AADT TOTAL	TRUCK % TOT VEH	TRUCK AADT TOTAL BY AXLE 2	3	4	5+	% TRUCK AADT BY AXLE 2	3	4	5+	EAL 1-WAY (1000)	YEAR VER/ EST
	--->		BEGIN ROUTE																	
805	0020	11	SD		.49	A	JCT RTE 5	21700	824	3.8	560	103	26	135	68.0	12.5	3.1	16.4	72	
805	0060	11	SD		1.81	B	JCT RTE 117	22000	836	3.8	568	105	26	137	68.0	12.5	3.1	16.4	73	
805	0065	11	SD		1.81	A	JCT RTE 117	28000	938	3.8	588	153	45	152	62.7	16.3	4.8	16.2	85	76E
805	0075	11	SD	O	3.67	B	OTAY VALLEY RD	39000	1292	3.8	810	211	62	209	62.7	16.3	4.8	16.2	117	76E
805	0080	11	SD	O	3.67	A	OTAY VALLEY RD	43000	1444	3.8	905	236	69	234	62.7	16.3	4.8	16.2	130	76E
805	0160	11	SD		6.09	B	TELEGRAPH CANYON	48000	1710	3.8	1072	279	82	277	62.7	16.3	4.8	16.2	154	76E
805	0190	11	SD		8.85	B	SWEETWATER RD IC	79000	2923	3.7	1833	476	140	474	62.7	16.3	4.8	16.2	264	76V
805	0230	11	SD		14.64	B	JR 15, SAN DIEGO	88000	3520	4.0	2506	384	172	458	71.2	10.9	4.9	13.0	272	74V
805	0240	11	SD		14.64	A	JR 15, SAN DIEGO	102000	5406	5.3	3536	718	271	881	65.4	13.3	5.0	16.3	482	
805	0340	11	SD		17.65	B	JCT RTE 8	120000	5640	4.7	3615	722	198	1105	64.1	12.8	3.5	19.6	554	74V
805	0350	11	SD		17.65	A	JCT RTE 8	127000	5842	4.6	3447	736	321	1338	59.0	12.6	5.5	22.9	645	76V
805	0380	11	SD		20.60	B	JCT RTE 163	108000	4968	4.6	2867	561	288	1252	57.7	11.3	5.8	25.2	582	
805	0390	11	SD		20.60	A	JCT RTE 163	105000	4200	4.0	2646	538	201	815	63.0	12.8	4.8	19.4	414	74V
805	0420	11	SD		23.65	B	JCT RTE 52	92000	5428	5.9	2719	863	321	1525	50.1	15.9	5.9	28.1	700	74V
805	0430	11	SD		23.65	A	JCT RTE 52	74000	4662	6.3	2256	690	336	1380	48.4	14.8	7.2	29.6	626	76V
805	0450	11	SD		28.50	B	JCT RTE 5	48000	3840	8.0	1678	388	269	1505	43.7	10.1	7.0	39.2	623	
	--->		END ROUTE																	

FIGURE 2 Data from California's annual average daily truck traffic report (*13*).

INTERSTATE, ARTERIAL AND PRIMARY VEHICLE MILES BY ROUTES PER 24-HOURS
1978

ROUTE NUMBER	VIRGINIA PASSENGER CARS	OUT-OF STATE PASSENGER CARS	SINGLE UNIT TRUCKS			TRAILER TRUCKS	BUSES	TOTAL VEHICLE MILES	MILEAGE
			2 AXLE 4 TIRES	2 AXLE 6 TIRES	3 AXLE 6-10 TIRES				
419	115,886	2,934	19,171	3,247	777	1,923	451	144,389	7.07
421	25,046	5,918	12,318	2,543	2,234	374	162	48,595	13.03
460	1,337,190	125,842	397,640	75,966	53,657	189,598	7,758	2,187,651	269.85
460 BY-PASS	99,314	11,317	27,129	6,040	3,442	12,855	365	160,462	18.46
460 BUSINESS	55,292	3,449	15,410	2,433	911	2,314	505	80,314	16.83
464	3,432	460	897	250	62	468	20	5,589	0.78
495	850,197	420,664	156,297	48,956	9,868	62,347	4,297	1,552,626	14.50
501	243,691	15,089	63,467	13,141	4,038	11,358	2,034	352,818	92.65
522	210,386	42,708	77,074	14,851	3,992	12,961	1,846	363,818	140.46
564	104,983	21,606	13,573	1,884	582	2,244	249	145,121	2.77
581	197,245	12,903	33,993	5,902	1,411	15,875	920	268,249	6.75
TOTALS	33,985,391	8,405,865	8,809,229	1,884,813	596,478	3,976,455	267,959	57,926,190	8,616.60

FIGURE 3 Data for vehicle-miles of travel (Virginia) (*14*).

PARTY _____

OFFICE OF MOTOR VEHICLE ENFORCEMENT

WEIGHT SCALE TRUCK TRAFFIC COUNT

Scale Location _____ Scale Number _____ Hour Period _____ to _____ Date _____

TRUCK TYPE	COUNT	TOTAL	VIOL
TRK			
TK			
TK 2			
TT - ST			
TT - ST 2			
TT2 - ST2			
TT2 - ST3			
TK - Pup			
Double Bottoms			
All Others			
All Busses			

TRK - Pickups, Campers, Etc.

TK - 2 Axle Truck

TK2 - 3 Axle Truck

TT-ST - 2 Axle Tractor 1 Axle Trailer

TT-ST2 - 2 Axle Tractor 2 Axle Trailer

TT2-ST2 - 3 Axle Tractor 2 Axle Trailer

TT2-ST3 - 3 Axle Tractor 3 Axle Trailer

TK-Pup - TK and any Pup Trailer

NAME _____

FIGURE 4 Form used in Iowa to count and classify trucks.

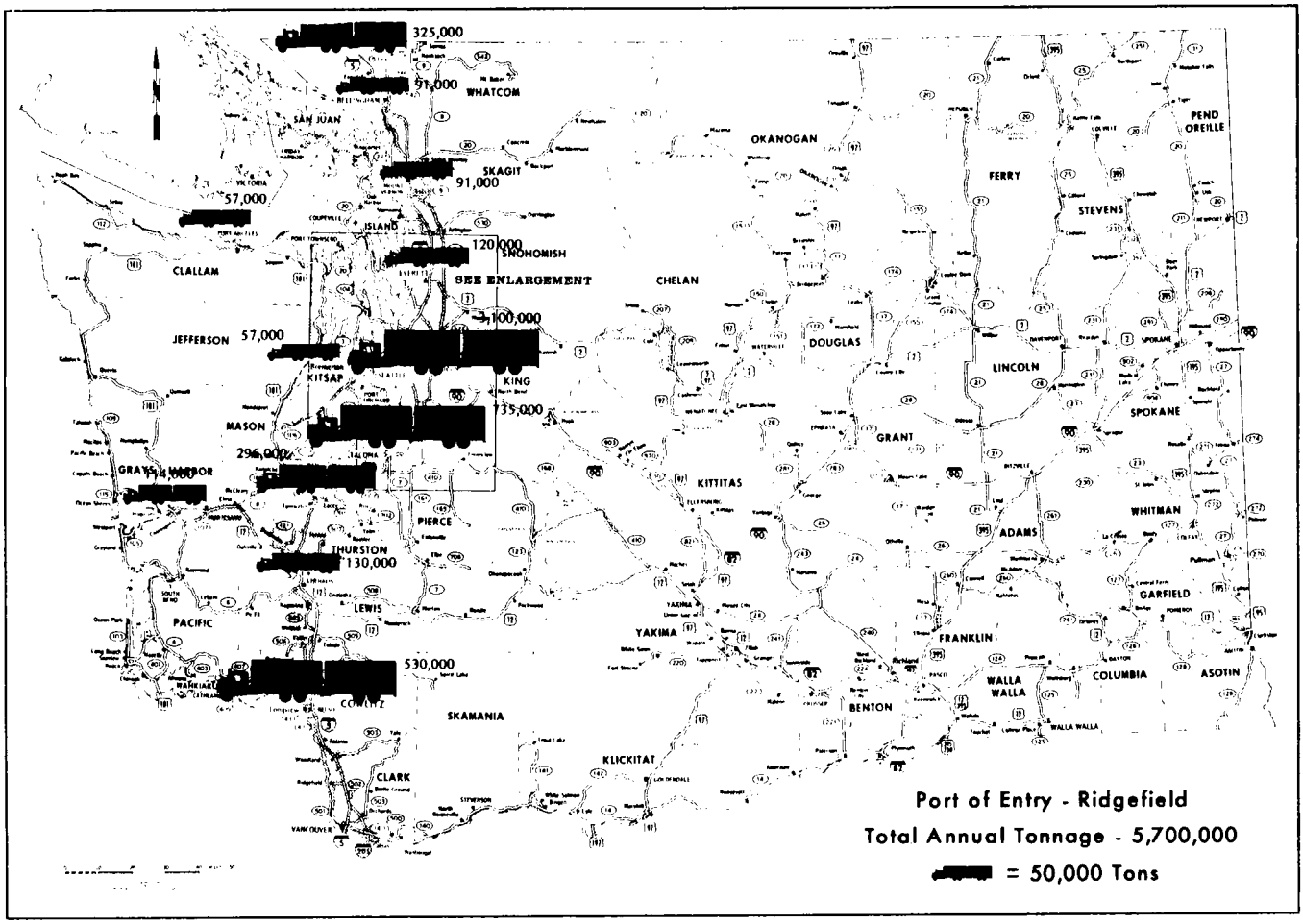


FIGURE 5 Tonnage and distribution of tonnage at the port of entry at Ridgefield, Washington.

Data from tonnage surveys are invaluable in the selection of sites for permanent weigh stations (see Chapter 3 for detailed discussion). This type of study also identifies the commodities being transported. When data are collected at a permanent weigh station, either the truck driver can identify the general cargo being transported or the enforcement officer can request to see the bill of lading.

The origin and destination (O & D) survey is another method of obtaining tonnage data for intrastate movement. Weights can be obtained with WIM equipment or from the bills of lading carried by drivers. However, the latter type of survey can be time-consuming and may result in traffic congestion.

Based on the responses from state agencies, the general assumption appears to be that the highways with the highest total truck traffic volume also carry the greatest number of overweight trucks. However, this assumption may not always be true. Although in some states enforcement efforts are concentrated on the high traffic routes, collected data (see Table 5, Chapter 5) indicate that, in 16 states where more than 1 million trucks per year are weighed, recorded overweight violations amount to less than 1 percent of the total trucks weighed. Even in California, where only loaded trucks are weighed, recorded overweight violations amount to only 1.3 percent. The goal has been to increase the number of trucks weighed each year, but it appears that there has been little attempt to determine the overweight truck population.

Using WIM equipment to make an overweight truck survey (see Chapter 3) may be one way to determine the percentage of the population that is overweight. For the survey to be valid, it must not be detected by the truck drivers. By means of this survey a state could better evaluate the effectiveness of the truck weight enforcement program, the type and location of weighing equipment needed to improve the effectiveness of the program, and the manpower and budget required to support the program. The overweight truck survey should be updated periodically to stay current with ever-changing truck routes.

USE OF DATA FOR EVALUATION

No state agencies indicated that the collected data are being used by either the states or the FHWA to evaluate the effectiveness of a truck weighing program. The general effectiveness of a continuously operating weigh station could be evaluated by comparing the total of trucks actually weighed with the total estimated in the annual ADT report. For exam-

ple, in Arkansas the truck volumes at weigh stations were calculated for the year on the basis of the ADT obtained from the traffic map and the percentage of trucks obtained from the truck percentage map. Table 1 summarizes the results of this comparison for five permanent weigh stations.

The data in Table 1 reveal that two of the permanent stations are weighing an amount approximately equal to that estimated. However, even allowing for the possibility that traffic estimates could be high, the other three stations are weighing considerably fewer trucks than the estimated number. This could mean that trucks can easily bypass stations and that perhaps a greater concentration of mobile crews on the bypass routes should be considered. This simple comparison could be helpful to the enforcement agency in assigning and placing portable weigh units. It could be that in some instances trucks are allowed to bypass stations because volumes are too great to store on the existing ramps; in this case WIM equipment, an additional set of scales, or a longer storage area should be considered.

This same type of comparison could be made for stations that do not operate continuously. A comparison could be done on a daily basis and an adjustment made for the hours the station is not open, which would reveal how many trucks are not being weighed when the station is closed.

TABLE 1
COMPARISON OF ESTIMATED TRUCK VOLUME AND NUMBER OF TRUCKS WEIGHED (ARKANSAS, 1978)

Station	Route	Est. Truck Volume	Trucks Weighed
Alma	I-40	677,440	431,619
Lehi	I-40	928,560	924,356
Marion	I-55	1,747,620	661,988
Blytheville	I-55	438,000	345,728
Corning	Hwy. 67	183,960	189,076

Information on truck population in the vicinity of permanent weigh stations and on bypass routes is essential for the evaluation of the effectiveness of the permanent weigh station operation and the supporting portable weigh units.

CHAPTER THREE

SITE SELECTION AND EQUIPMENT

Basic to good truck weight enforcement is the location of weighing sites for permanent weigh stations, semiportable stations, and supporting portable weigh units. The equipment used must be accurate and durable in all types of climatic conditions. Truck traffic studies, site selection for permanent weigh stations, types and uses of portable and semiportable scales, WIM equipment, and other weighing facilities available to the enforcement agency are discussed in this chapter.

Many states have conducted studies to determine the factors that should be considered in site selection. Two studies conducted in Georgia (*16,17*) identified these items: road systems and functional classifications, geographic location, traffic volume, season of the year, direction of route, service provided, products being transported, economic status of the transportation zone, and truck traffic patterns.

TRUCK TRAFFIC FLOW STUDIES

The state agencies interviewed for this synthesis consider a broad comprehensive survey of truck traffic flow essential to selecting effective sites for permanent weigh stations. The annual traffic report prepared by each state provides the volumes and the percentages of truck traffic broken down into the number of axles on various segments of highway routes. A comprehensive truck flow study can be based on this report. Some states, including Arkansas, prepare a truck percentage map (Figure 6). This map, in conjunction with the total ADT traffic map, provides information on the major truck corridors and may be easier to use for truck flow data than the annual traffic study. The data from these maps provide basic traffic information for all state highway routes.

Several states conduct O & D studies to supplement the annual traffic report. The O & D study, generally performed after an area is selected for the permanent weigh site, is time-consuming, but it provides valuable information that can be used not only for site selection but also for operation after the station is constructed. The times of truck movement are important; the O & D study reveals hourly and daily peaks, and perhaps seasonal peaks if the studies are continued over a long period. The study may also indicate types of cargo transported and may give some indication of tonnage.

Truck traffic studies must be updated and reevaluated periodically to keep abreast of changing truck routes. The construction of the Interstate System of highways significantly changed truck traffic routes. States with permanent

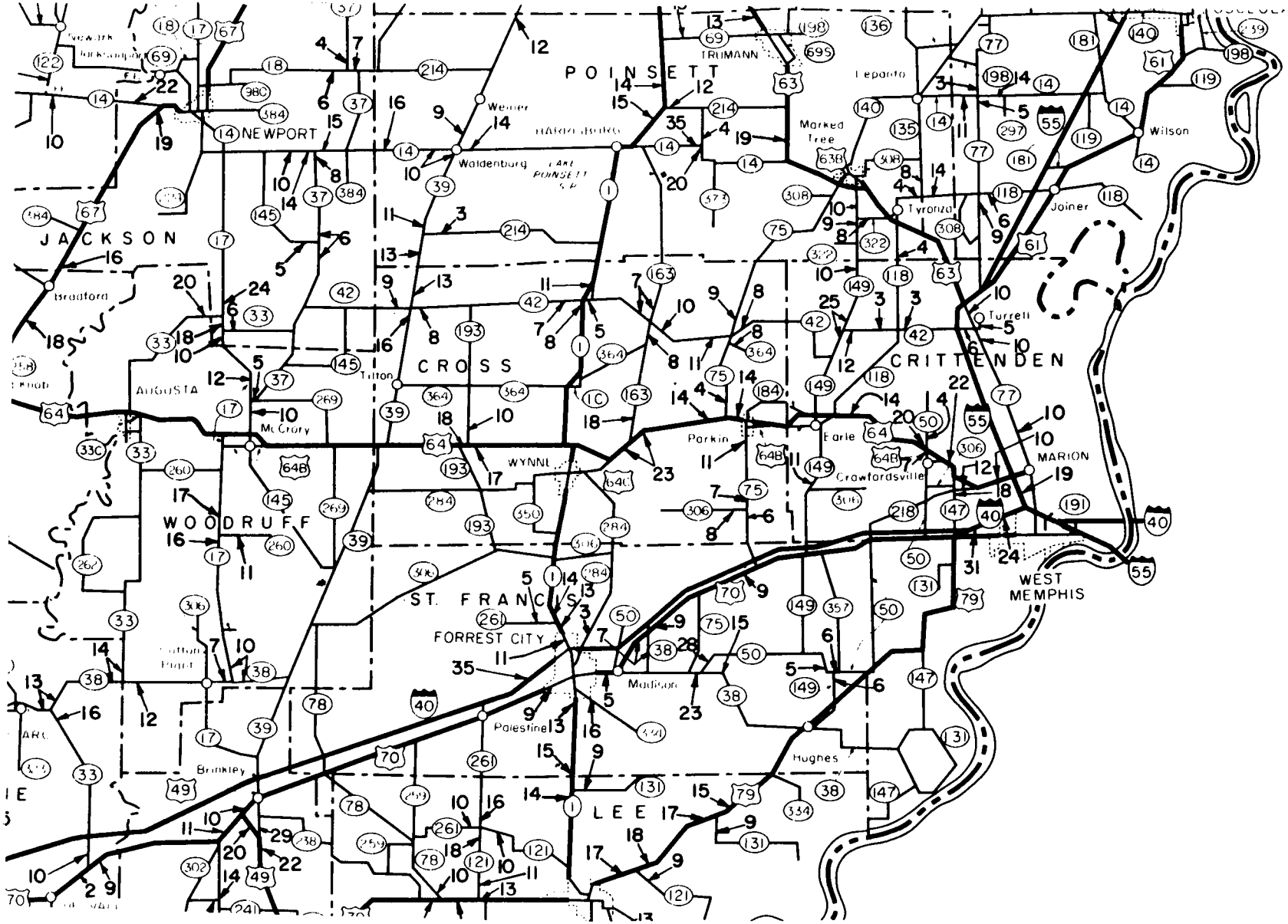


FIGURE 6 Portion of a truck percentage map (Arkansas).

weigh stations along old U.S. highway routes experienced a substantial loss in truck traffic once the Interstate System was completed; this can happen when there is major highway construction.

Factors Affecting Truck Traffic Flow

State and local economic development departments are expending much effort to attract new industries. The possibility that these new industries may generate major traffic should be considered in the site selection process. In some states, particularly those in the coal-producing regions, old industries are being revived. Fifty years ago, when coal was in general use for energy, the railroads provided the service to transport the coal. Today many of the old railroad spurs are in decay, and the truck has become the prime transporter. Strip mining is almost totally dependent on the truck for transportation service. The coal-producing states report that the coal truck is a habitual violator of the weight laws. In many states environmental constraints have limited if not completely eliminated the opening of new quarries. Existing quarries are producing more and transporting their product greater distances in larger trucks.

The agriculture industry is generally stable in location and type of product. This industry has been given great latitude by state legislatures, either being exempted from legal weight limits or provided with annual permits to allow overloads. The change in location of a grain elevator should be considered in the evaluation of truck traffic flow. The lumber industry also has special exemptions in some states. Locations of landfills change, and new landfills open each year. The refuse truck has the highest single-axle load and presents a problem to enforcement agencies.

A comprehensive truck traffic study includes communication with the city, county, and state departments of development, zoning commissions, and public works departments to ensure consideration in the study of future regional planning.

Continuing Study

Studies of truck traffic flow must continue after the permanent stations are operative in order to detect major changes in flow. The Washington DOT conducted a planning study at the four ports of entry. Data on truck weight, collected annually, are used (a) to estimate annual travel by each type of truck, ton-miles of cargo hauled on the highways, and year-to-year changes in axle and gross weights and (b) to compare the characteristics of actual highway use by trucks with administrative policies. Figure 5 shows annual tonnage and distribution of tonnage within the state for the port of entry at Ridgefield. Data on the distribution of the tonnage transported into a state, as well as on intrastate transportation, are helpful in the selection of weigh station sites.

SITE SELECTION CRITERIA

The state agencies interviewed in the preparation of this synthesis identified criteria to be used in selecting and evaluating a site after the route and general location are established by a truck traffic flow study. All the state agencies recommended that the site be on a segment of highway that trucks cannot bypass. Finding such a site is difficult, because most areas of the United States are interlaced with other state and county roads. Many of the Interstate routes parallel old U.S. numbered routes, which complicates the selection of a site on the Interstate route. In some instances a weigh station can be located on the Interstate route in the same area as that of an existing permanent weigh station on the U.S. numbered route.

The best location for a weigh station (permanent or semiportable) is adjacent to a natural obstacle, such as a large river or a swamp with few crossings. The bayous in Louisiana and the swamps in Florida are used for this purpose. Several states have been able to locate a port-of-entry station near a large river that forms the border between two states. Washington uses the Columbia River, and the Mississippi River is used by Arkansas, Mississippi, Louisiana, and other states. The use of rivers and bays for locating weigh stations within a state should also be considered; Maryland uses the Chesapeake Bay and the Susquehanna River.

Geometric considerations are important in the site selection. Grades on the main highway should be gentle or slightly rising. The enforcing officer in the weighing house should have good visibility along both the main line and the ramps into the station. Distance between the weigh stations and interchange ramps should be sufficient to prevent any traffic conflict. Signing and visibility should allow the driver sufficient reaction time to maneuver the truck onto the weigh station ramps. The ramps should meet AASHTO design criteria for deceleration, acceleration, and roadway widths. On high-volume truck routes the storage provided on the ramps must be sufficient to prevent trucks from queuing onto the main highway. An internal traffic pattern is necessary to control the truck movements to parking areas, redirection to the scales, and reentry to the ramps. Figure 7 is a geometric layout used by California for a typical platform-scale installation.

Another consideration in selecting a site is the availability of utilities. Access to electricity and telephone lines is necessary for the operation of the permanent weigh station. Of equal importance is water and sewage. Before land is purchased for a permanent weigh station, tests should be made to ensure that water will be available and that the soil will pass the local percolation test for sewage disposal. The use of sewage systems that use a minimum of water should be investigated, particularly in the arid parts of the country. The location of the wells in the station area and the need to drill additional wells must be determined. The hauling of water for the station operation should be avoided if possible.

Personnel needs must be evaluated. Utah reported that a proposed permanent weigh station has not been constructed because the area does not have adequate housing for the enforcing personnel.

Table 2 presents California's criteria for the selection of sites for permanent weigh stations.

PORT OF ENTRY

As reported in *NCHRP Synthesis 68* (*11*, Table 5, p. 9), 14 states are operating port-of-entry permit weigh stations. In

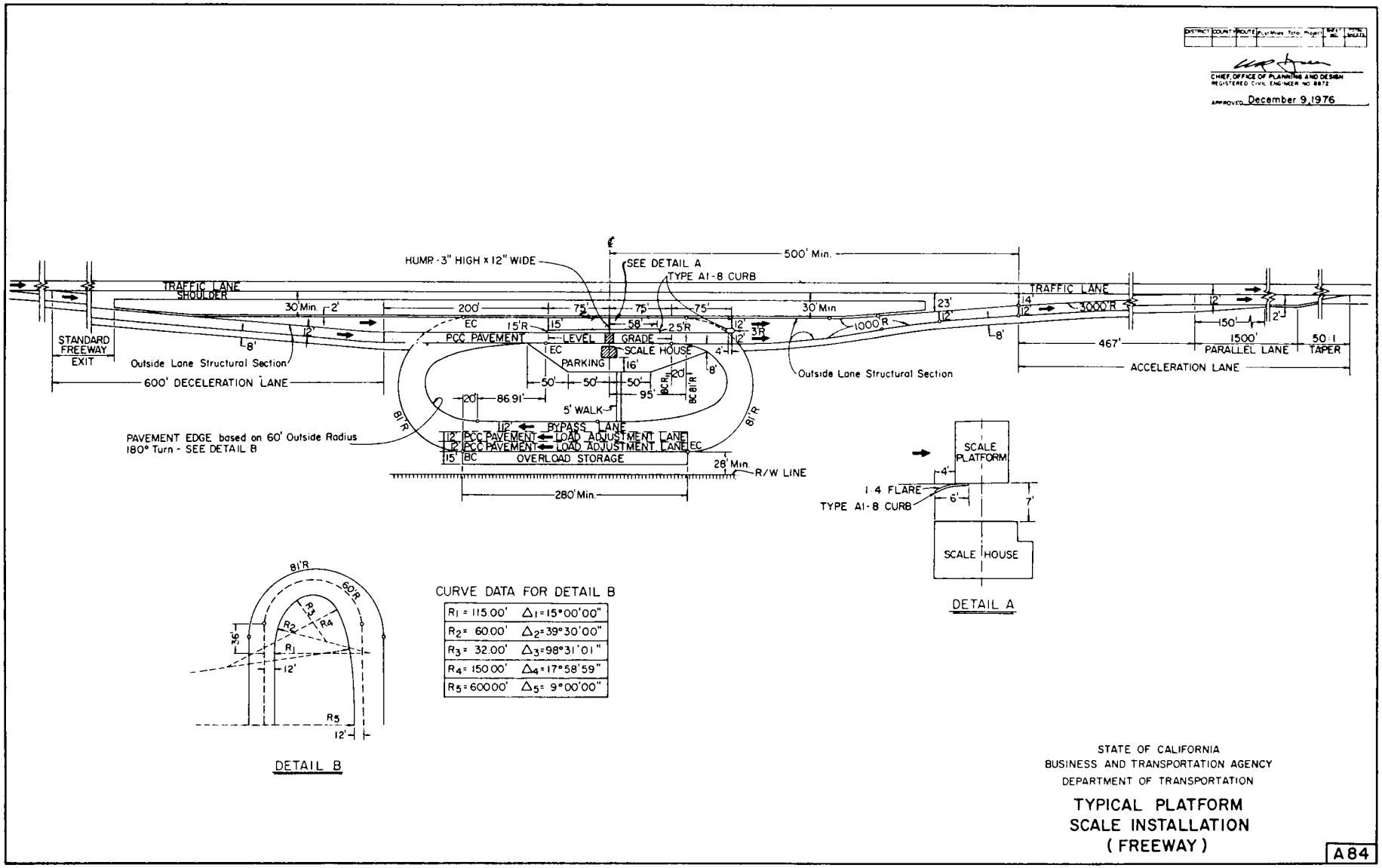


FIGURE 7 Geometric layout for a typical platform-scale installation (California).

TABLE 2
CRITERIA FOR SELECTION OF WEIGH STATION SITES (CALIFORNIA)

CRITERIA

The primary consideration of selecting locations for permanent installations is commercial vehicle traffic volume. The traffic volume must be adequate to support the level of operation recommended in this plan for the particular type of facility that is being considered. Minimum traffic volume and other factors requiring appropriate consideration are as follows.

A. Minimum Average Daily Traffic

Minimum average daily commercial vehicle count, exclusive of two-axle trucks, should not be less than the figures indicated for the particular type of installation as indicated below.

1. Commercial Vehicle Inspection Facilities
   2,000 - based on 2-way, 24-hour counts
2. Platform Scales
   600 - based on 2-way, 24-hour counts
3. Loadometer Pits
   Any location not qualifying for a platform scale which has sufficient commercial vehicle activity to warrant regular or seasonal weight control.
   These facilities are usually installed for seasonal operations such as logging, construction, etc.

B. Location of Other Facilities

Appropriate consideration must be given to the location of existing and planned facilities on existing and planned highway routes.

C. Origin and Destination Count

To sustain continued operation and maintenance, O & D data must indicate that a sufficient percentage of the commercial vehicle traffic will not be subject to identical attention and control at some other location.

D. Dual Inspection Facilities

Inspection facilities should not be constructed on each side of the highway at any location where O & D data indicates 80% or more of the trucks would be available for inspection at a facility on one side of the highway only.

E. Bypass Potential

Locations which can be bypassed easily must be avoided. While it is not possible to select locations which cannot be bypassed, it is important to minimize the problem by eliminating those locations which have built-in bypass routes.

F. Availability of Land

Sufficient land must be available on which to construct the particular facility, including turning area for reweighing, vehicle inspections, load adjustment, and vehicle storage.

G. Compatibility of Land for Construction

The geographical terrain must be such that excessive fill or grading is not necessary and the soil composition must meet established engineering standards for construction.

H. Water Supply and Utilities

Water supply and utilities needed for efficient operation of the facility must be reasonably available.

I. Proximity to Area Command Office

Locations of inspection facilities and platform scales should not be more than 30 minutes travel time at the very most from the Area office. The location of CALTRANS maintenance station should also be considered.

J. Proximity of Acceptable Living Quarters for Operating Personnel

Adequate housing and community services such as schools, hospitals, power, water, etc., must be available for personnel assigned to inspection facilities and platform scales.

K. Cost of Construction, Maintenance, and Operation

No facility should be provided at any location if it could be built more economically and operated with the same degree of efficiency and effectiveness at an alternate location with a lower expenditure of funds.

L. Climate

Facilities should not be located where adverse weather conditions can reasonably be expected to disrupt operations.

M. Outside Interest

Appearance of facility, noise level from operational activities, community support, e.g., comments from county supervisor or local legislators or other community leaders, for or against the facility, should be considered. Residential areas should be avoided if at all possible.

N. Coordination

Site selection, design, staffing, and operational plans should be closely coordinated with appropriate Field Commanders.

addition to weighing trucks, these stations are also major inspection points. Truck registration, fuel tax payments, vehicle safety, and drivers are checked for compliance with the state laws. In Washington, enforcement officers turn back a truck and send it out of the state in the event of noncompliance with state laws.

Port-of-entry operation is effective in those states that have major rivers as boundaries. However, although port-of-entry weigh stations may be effective in the control of interstate truck movements, they have no effect on intrastate routes. Thus other permanent weigh stations must be used to control the intrastate truck routes. Most state agencies select locations for permanent weigh stations to control both interstate and intrastate haulers; these stations usually meet the requirements of current truck traffic. Sites must be carefully chosen, and all factors of planned development must be considered so that the funds, which are substantial for a modern, fully equipped station, will not be expended for a station that may soon become obsolete.

California operates 49 single permanent weigh stations, with proposals for 12 additional stations to be constructed when funds become available. The state operates two types of permanent weigh stations: platform scales, which are used to check only truck weight and size; and the inspection facility, in which full safety inspections are conducted in addition to truck weighing. Permanent weigh stations are generally

constructed around large metropolitan areas and along major truck movements, which in California are north and south. The California Highway Patrol emphasized the need for 12 additional stations to improve enforcement capabilities.

Many states have permanent weigh stations that were built before construction of the Interstate System. Some stations were bypassed by the Interstate route, and others are no longer on major truck routes because of changing truck traffic patterns. In some states permanent stations have been constructed on the Interstate route in the vicinity of older scales. Of the states visited, most are using the older stations for random operation by the portable-scale crews or on a reduced hourly operation. A station is phased out if it becomes ineffective in the enforcement program. In several instances older scales have been converted from lever beam scales to electronic load cell scales (see Figure 8). The design of the ramps has also been improved when warranted by traffic volumes. Most state budgets provide maintenance funds to be used for routine maintenance of the scales and the scale house; major repairs or upgrading of the facilities are separate budget items.

TYPES OF PERMANENT SCALES

Many permanent weigh stations have been in operation 40 to 50 yr. Although some have been modernized, many of the old static platform lever scales are still in use today. Electronic scales are usually specified for new permanent weigh stations. Several enforcement officials expressed a preference for the beam (mechanical) scales, primarily because of the scales' durability in all climatic conditions. Other enforcement officials prefer the quick readouts of the electronic scales. *NCHRP Synthesis 68* (*11*, p. 8) contains an excellent discussion on the types of fixed scales.

Scales are purchased by means of competitive bidding using standard specifications; thus many states operate several different brand-name scales. The Scale Manufacturers' Association (*18*) proposed and the National Conference on Weights and Measures adopted recommendations for requirements of pit-type highway vehicle scales. The Scale Manufacturers' Association also publishes a directory of manufacturers and the types of scales manufactured; specifications for scales are established on the basis of this information and the past experience of the enforcing agency.

With the older, single-platform beam scale, the scale is read and the weight of each axle noted as the truck moves across the platform (Figure 9). Newer electronic scales have three to five platforms supported on load-cell rocker-bearing assemblies (Figure 10).

Some states have used the semiportable scales at permanent weigh stations. Two 12-ft (3.7-m) weigh bridges are placed perpendicular to the travel lanes (Figure 11). The standard manufactured weigh bridge requires reinforcement for the transverse loading because the original design was for longitudinal loading.

Maryland is in the process of reconstructing its three permanent weigh stations and, in addition to a three-platform scale with electronic load cells and digital readouts, the most important addition to the new instrumentation is the printer. The contract, unfortunately, provides the contractor the option of furnishing either a manual or an automatic printer. Both printers provide a print cycle that will automatically sequence and control the recording of the three individual scale weights and the total weight. The printer is to be designed to accept the Maryland State Police Weigh Record Form, which is the citation form used in Maryland. Appendix A contains the specifications used by the State Highway Administration of the Maryland DOT for the instrumentation of the three permanent scales.

What is important is that printers are available to the enforcement program so that management can have a continuous record of the weighing activities at each weigh station. An automatic printer should be specified so that the weight recording is not at the discretion of the enforcement officer.

The printer should be made a part of the semiportable instrumentation. Perhaps providing the weigh crew with a van for housing all instrumentation could make the printer a reality.

WEIGH-IN-MOTION (WIM) EQUIPMENT

WIM equipment has been used in Florida and New Mexico for planning and research for more than 6 yr. Indiana, Nevada, and Georgia pioneered the use of WIM equipment for truck weight enforcement. In 1980 the FHWA prepared a report (*19*) that summarized the state of the art for the use of WIM techniques and equipment. With WIM scales, trucks are weighed electronically as the wheels pass, without stopping, over the scales in or on the pavement surface. The weights obtained from these scales cannot, because of accuracy limitations, be used in writing citations. WIM equipment is used to screen potentially overweight trucks, which are then directed to a permanent static scale station or to a portable scale for accurate weighing. The WIM scales are not certified as accurate by official state weight-certifying agencies, so WIM weights are not accepted by the courts.

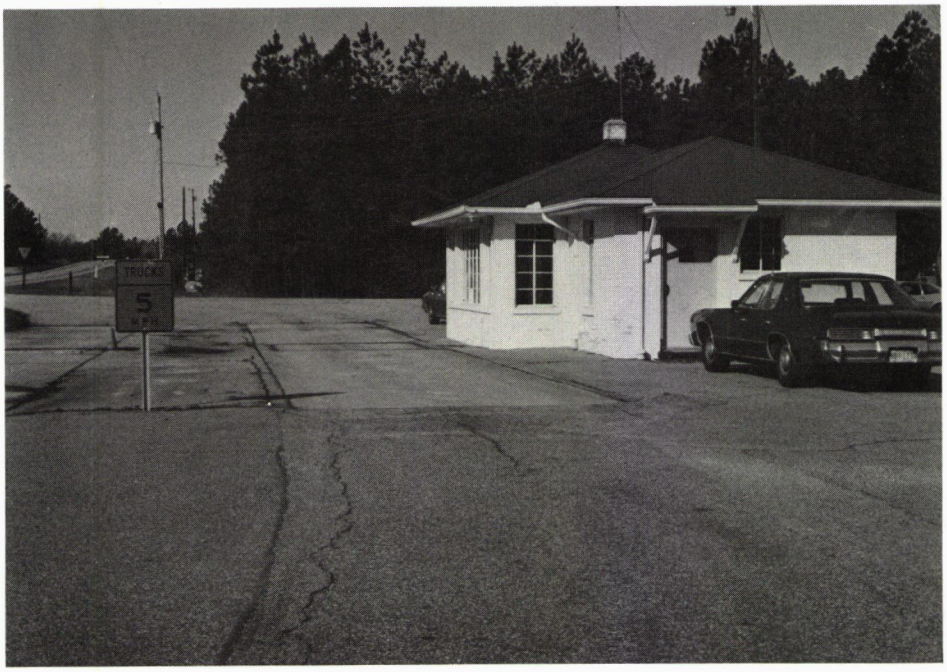
Operations

The FHWA report (*19*) classifies WIM operations for enforcement into three general categories:

1. High speed WIM, where vehicles are weighed at prevailing highway speeds on scales placed in preconstructed pits in the through traffic lanes. Possible overweight vehicles are screened by the equipment for a more accurate weighing downstream on portable scales.
2. Low to moderate speed WIM where vehicles pass over WIM equipment located in the ramp as they enter a permanent weigh station site. Traffic signals then direct the vehicles to either a bypass lane leading back to the through traffic lanes or to be weighed again on more accurate static scales.
3. In low-speed WIM operation, the scales are mounted on a level grid with ramps and are used in a portable mode similar to conventional roadside static weigh operations. The scales can also be placed in preconstructed pits to minimize the load shift that can occur when vehicles are driven onto the ramps.

High-Speed WIM

The FHWA report (*19*) describes mobile site operations. A motor home containing the operator's console with cathode



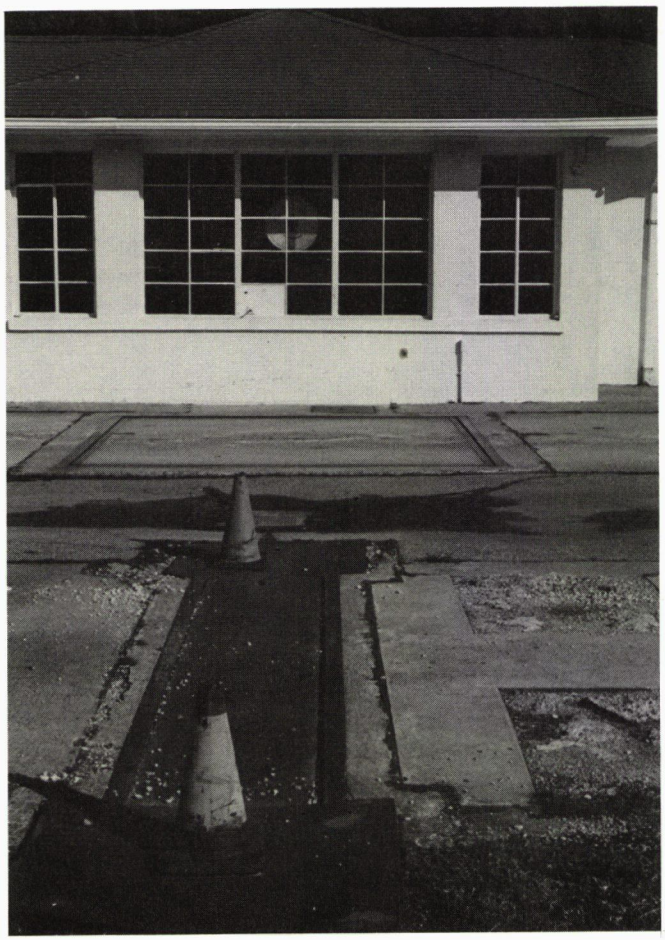


FIGURE 8 The Apex weigh station in North Carolina is being equipped with a new electronic axle scale. The older platform scale with the visible dial is shown at bottom.

FIGURE 9 Single-platform beam scale. The dial is visible to both the enforcing officer and the truck driver (see Figure 8, *bottom*).

ray tube (CRT) display, keyboard, data storage medium, and printer is positioned at the roadside opposite one or more preconstructed scale pits with embedded loop detectors. Scales are positioned in the pits only during hours of operation and weigh each axle at prevailing highway speeds with an accuracy of about 10 percent. The WIM processor classifies axles by configuration (single or tandem) and compares the weights to the legal limits for axle configuration and gross weight. The console operator, observing each approaching truck, scans the CRT display for potential overweight vehicles. When a truck appears to be overweight, either by axle configuration or gross weight, its description and potential violation is relayed by radio to an enforcement officer located downstream. The potentially overweight vehicle is then stopped and weighed on portable scales for possible citation.

Although vehicle speed is also detected by WIM equipment, speed enforcement is not yet being attempted in the states where trucks are weighed under high-speed conditions.

New Mexico uses high-speed WIM with installations for weighing trucks on four lanes on two roadways at one time. High-speed WIM is also used in Nevada, but operation is confined to a single lane. The efficiency of the Nevada system depends on the ability of scale operators to relay sufficient details of the possible violator by radio to the portable crews downstream. The enforcement officer must then safely stop the possible violator. Thus the operation of high-speed WIM is more effective on low-traffic-volume highways.

Low- to Moderate-Speed WIM

Indiana and Georgia use WIM as a sorter on weigh station ramps (Figure 12). The truck is directed by signs to reduce speed anywhere from 10 to 30 mph (16 to 48 km/h) and to maintain a 110-ft (30-m) gap. The WIM processor weighs and classifies axles by configurations (single or tandem) and compares the weights to values slightly below the legal limits for axle configurations and gross weights. Overhead directional signals then direct legal loads to a bypass lane, past the scale house for other inspections, and then back onto the highway. Possible overweight vehicles are directed by the signal to the static scales for certified weighing. This type of WIM installation is effective at locations with high volumes of truck traffic. A large number of trucks can be weighed in a short time, thus providing less delay for the legal vehicle and conserving fuel in the process.

Low-Speed WIM

This type of operation is characterized by the use of a minimum amount of equipment (usually only the scale and a digital display unit) and is intended as a hit-and-run activity. Trucks are weighed for citation at speeds of 3 to 5 mph (5 to 8 km/h). Because low-speed WIM is generally used in low-traffic-volume conditions and in a variety of locations, traffic-control strategies similarly employed in construction maintenance zones are desirable.

Low-speed WIM equipment is not currently in use in this country. In Kentucky, however, semiportable static scales are used at vehicle speeds of 3 to 5 mph (5 to 8 km/h). If a potential overweight axle is detected, the vehicle is weighed statically. Low-speed WIM is recommended for temporary use on low-volume routes until permanent operating conditions can be constructed.

Equipment

The California Department of Transportation (Caltrans), in cooperation with the California Highway Patrol, is conducting research on the WIM equipment manufactured by the three suppliers. Research has not progressed to the point where trends can be identified or conclusions drawn. However, it is clear that directing legal loads onto a bypass lane saves wear on the static scale. The frequency of overload should be estimated; if low, it would be economical to use the semiportable scale, as is done in Georgia.

Several of the state agencies interviewed are not convinced that WIM operation is cost-effective. Other agencies reported that new stations will include WIM equipment.

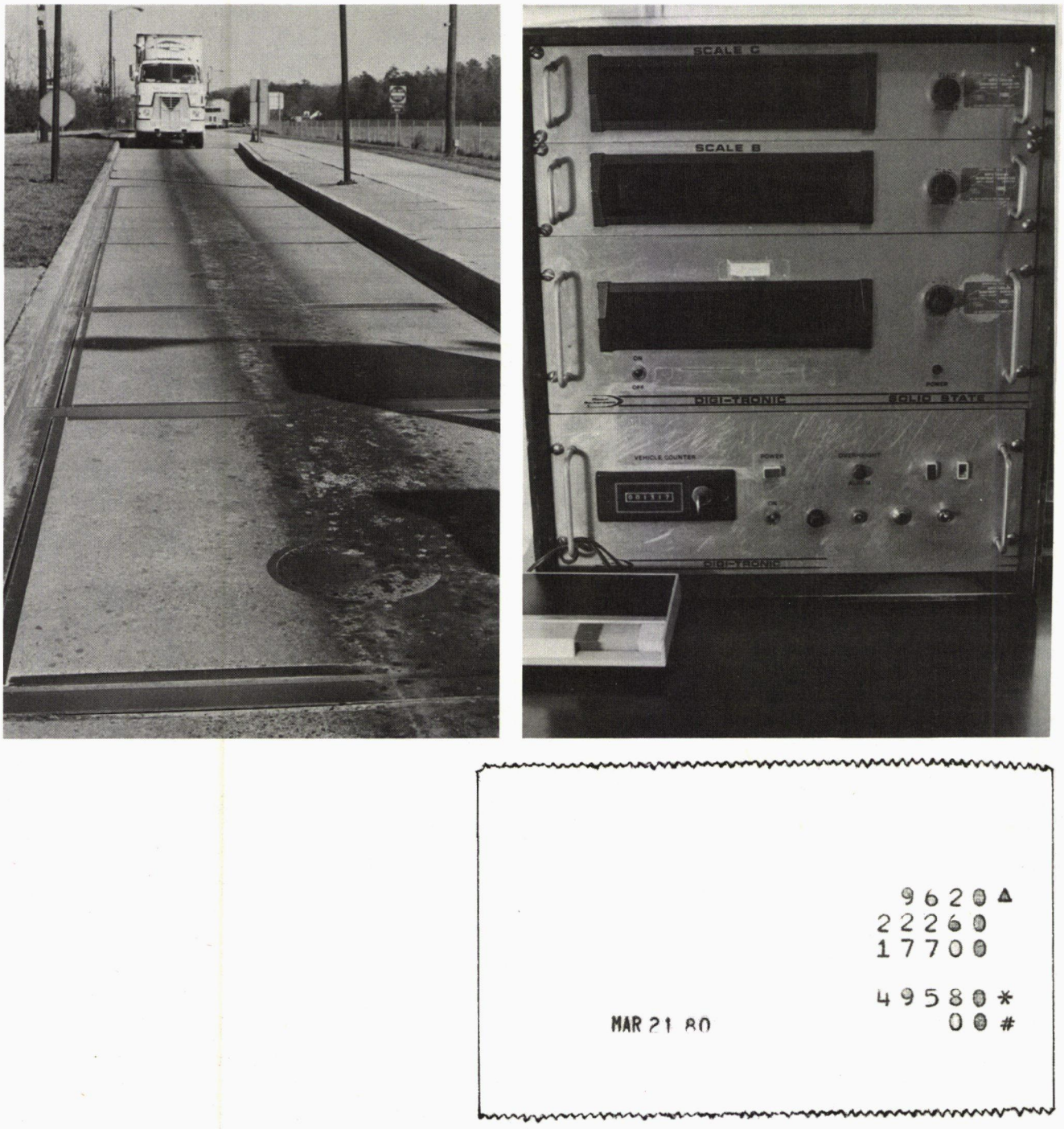


FIGURE 10 Permanent weigh station located on Interstate Route I-85 near Hillsboro, North Carolina. This is a five-platform electronic scale with a digital readout that is transferred to an adding machine.

Some agencies feel that WIM operation is not feasible because the additional functions of the enforcing agency require the enforcing official to inspect each truck personally. However, this problem can be overcome if the bypass lane is constructed to pass the scale house, as is done in Georgia. As more states use WIM techniques and ongoing research of equipment is completed, the operational problems will be resolved so that WIM equipment can be used effectively.

New WIM Concepts

In November 1980 Case Western Reserve University reported on research conducted for the Ohio Department of Transportation (ODOT) on a new economical concept for weighing trucks in motion using highway bridges as equivalent to static scales. At more than 10 sites, without disrupting traffic, researchers and members of the ODOT Bureau of

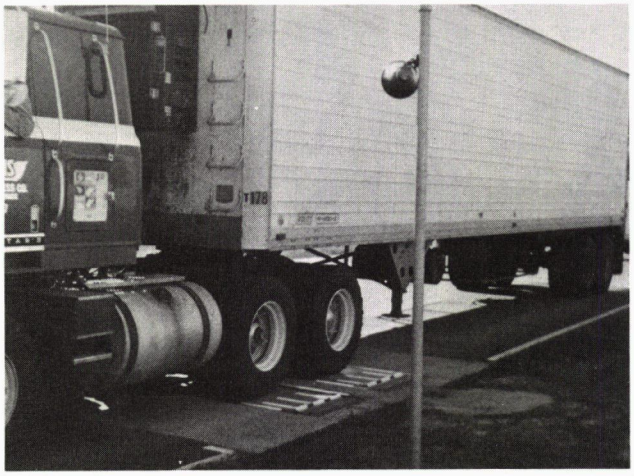


FIGURE 11 Semiportable scales used at a permanent weigh station on Interstate Route I-75 near Macon, Georgia. The digital readout is transferred to the adding machine by the enforcement officer and totaled for gross weight.

Transportation Services weighed trucks traveling at normal speeds across instrumented highway bridges (*20*).

In this type of operation weighing usually takes place without detection by the truckers. A two-person crew can set up the mobile equipment, which does not require permanent, fixed installation. The equipment includes tapes with axle detectors, a key-pad to record truck type and other visible hauling information, specially designed strain transducers clamped to the bridge girders (steel or concrete), and electronic circuitry located in a mobile instrument van usually parked under the bridge. Figure 13 shows a typical layout of field instrumentation. Either the button box can be operated manually by a member of the weigh crew or the computer can be activated by the truck passing over a tape switch, loop detector, or other signal. Details of fabrication, installation, and data processing are contained in the project reports (documentation manuals are available from the ODOT).

To date the system has weighed thousands of trucks at more than 10 sites in Ohio with weighting rates that exceed 100 trucks per hour. The accuracy of the weighing has been

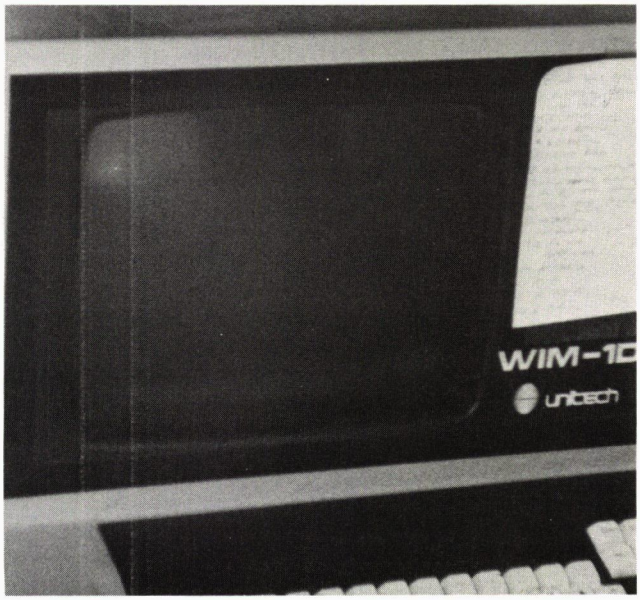


FIGURE 12 A truck approaching the WIM scales (*top*). The overhead signals are used to direct the truck to the bypass lane in front of the scale house or to the static scales in the rear of the scale house (*center*). The WIM console is used by the enforcement officer to obtain complete data from the WIM scale (*bottom*).

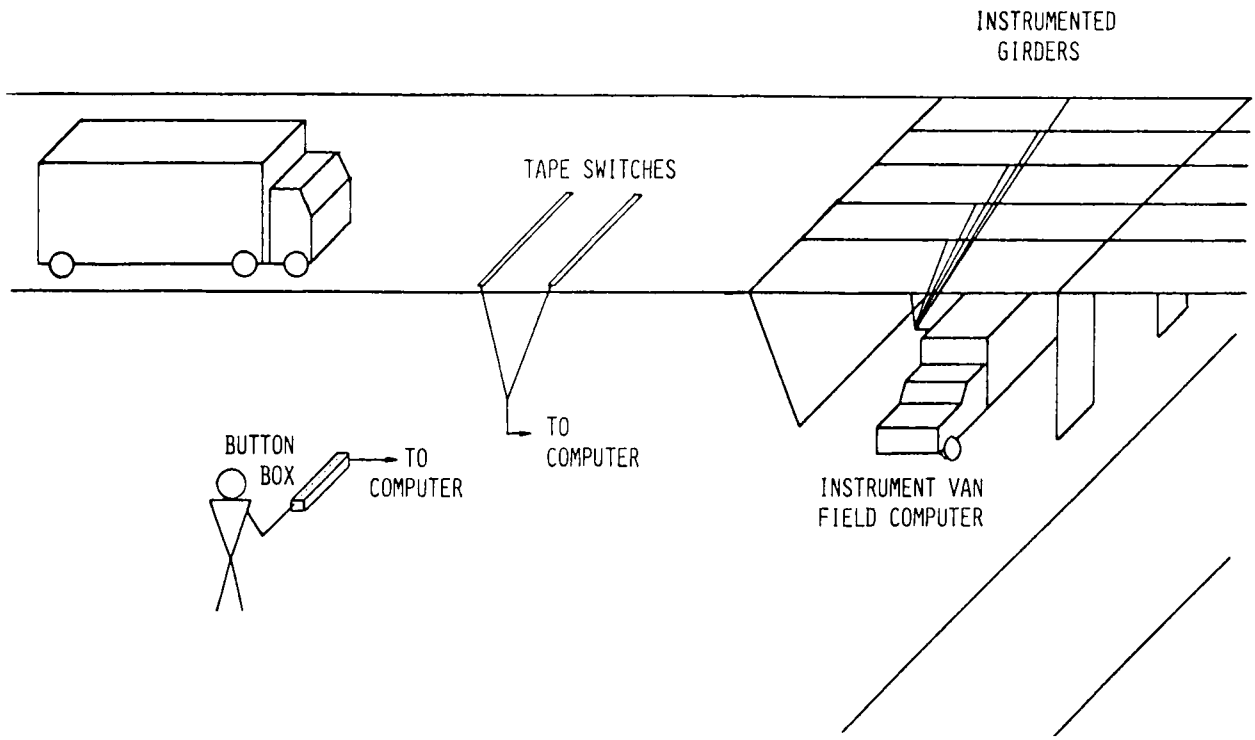


FIGURE 13 Layout of field instrumentation for weighing trucks using a highway bridge (Ohio).

established by comparison with weights from nearby static scales. The system has been operated satisfactorily both in subfreezing temperatures and on hot summer days.

This innovation in weighing trucks in motion—using bridges as scales—can provide numerous locations for weighing sites, inasmuch as no permanent installations are necessary. This system can also be used for loadometer studies for pavement design and unbiased evaluation of truck weight enforcement.

SCALE HOUSES

The location and design of scale houses are essential factors in effective truck weight enforcement. In the past designers of scale houses were unaware of the enforcement official's problems. There must be communication between enforcement agencies and designers of permanent sites in order to produce more efficient structures for truck weight enforcement. Information for this synthesis concerning the size of the scale and necessary facilities was obtained from field personnel.

The truck should be visible to the enforcement official as it approaches the scale, while it is on the scale, and as it leaves the scale. For proper visibility horizontal and vertical alignment of the ramps approaching and leaving the scale house is also necessary. The type of modular structure used by Georgia as a temporary scale house does not provide sufficient visibility for the enforcement officials and should be used only temporarily until a permanent station can be opened. In Georgia and Louisiana the static scales are located so that the scale house is on the driver's side of the vehicle. Enforcement officials believe they should be able to make eye contact with the driver to observe driver condition and improve communications between driver and enforcement official. In North Carolina a "guard house" is situated on the driver's side of the truck to facilitate observation of the driver (Figure 14) and assist in the safety inspection of the vehicle. Although several other states are considering locating scales as in Georgia and Louisiana, at the present time the scale houses in most states are situated on the opposite side of the driver. The driver and the enforcement officer communicate by signals controlled by the enforcement officer and by a PA system. Figures 15–17 show scale houses in three states.

Most states provide a scale house for each side of a dual highway; however, two-story scale houses are used for weighing trucks on both roadways of a dual highway in Virginia. The operator occupies the top floor, and the bottom level is used by state police enforcement officers. A tunnel under the highway connects to the opposite roadway scale and parking area. Probable violators are advised over the PA system to park their trucks and bring their logs and other papers to the scale house by way of the tunnel (see Figure 18).

The interior layout of the scale house is an important consideration. Sufficient space is necessary for the scale equipment. The type of scale to be used should be determined before designing the scale house. The scale equipment and the enforcement official operating the scale should be in a separate room or should be partitioned off from the public by a counter. An area should be provided to check the truck papers and to issue any citations. A separate room is needed for accounting purposes in those states that collect the cita-

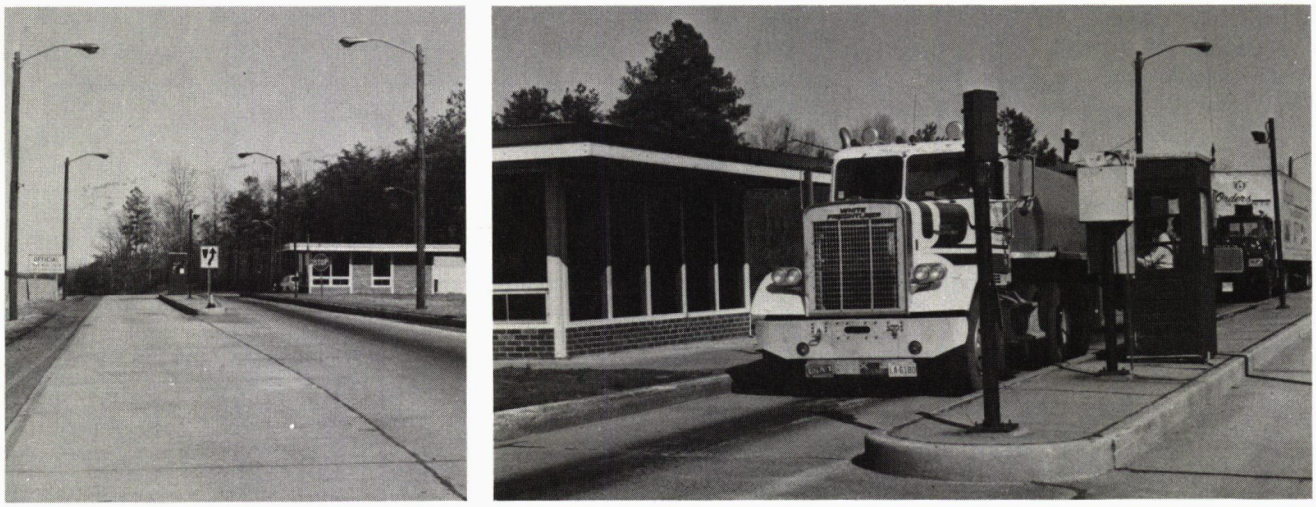


FIGURE 14 Scale house on I-85 in North Carolina. Note the visibility provided from the sides and the front of the scale house. Also note the "guard house" building that allows for eye contact between the enforcement officer and the truck driver.

tion assessments. Some states use the permanent weigh station as a headquarters for the portable crews; thus space is required for their assembly as well as for the officer in charge. Enforcement crews need rest rooms as well as space for relaxing during lunch breaks. Some states provide separate rest areas for the truck drivers. Other states are considering the construction of a basement that would give ready access under the platform scales for repair and replacement of electronic load cells. If the weigh crew has the responsibility for maintenance of the grounds, then space should be allotted in the building area for equipment needed to keep the grounds in order. The building should provide ample space for the total operation of the station, which may differ from state to state. Enforcement officials who operate and maintain the building should make known their needs for efficient operation.

STATION DESIGNS

For the station to function efficiently, the components must be properly situated. Figure 7 shows the design of a permanent weigh station without WIM equipment, which would be applicable for truck routes that have moderately heavy to low volume. This layout works in California because only loaded trucks are weighed and reported to the FHWA. The data in Table 5 in Chapter 5 indicate that a greater number of citations are issued in California than in

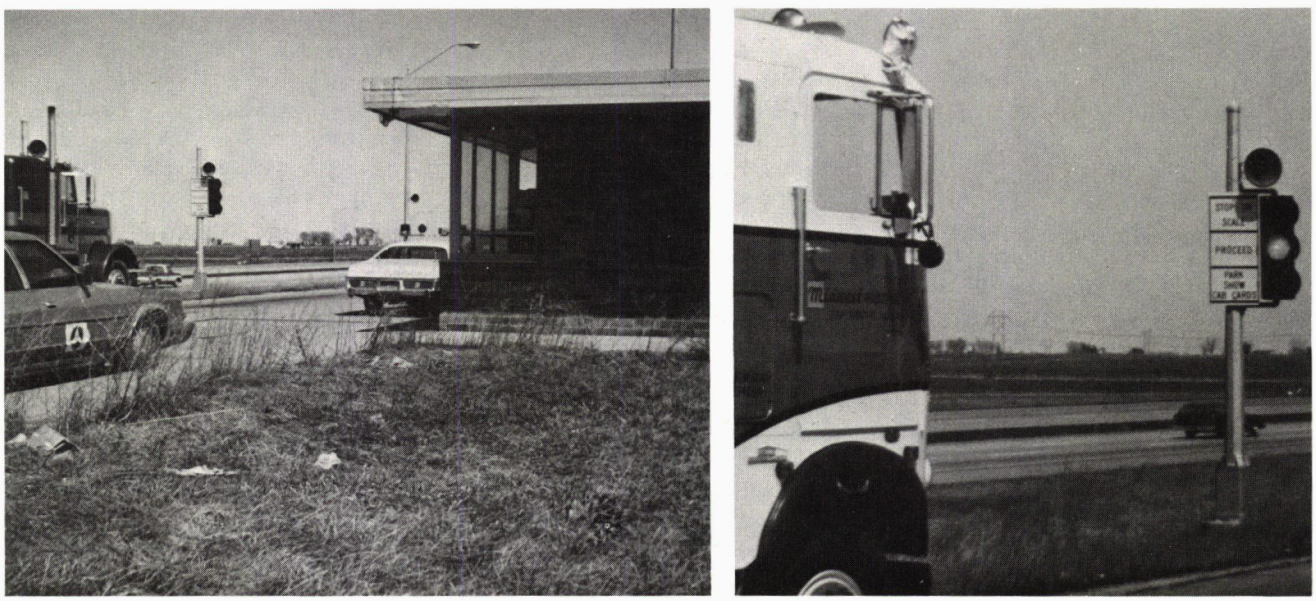


FIGURE 15 A typical scale house used in Iowa. The signal and the PA speaker used for communication are shown (*right*).

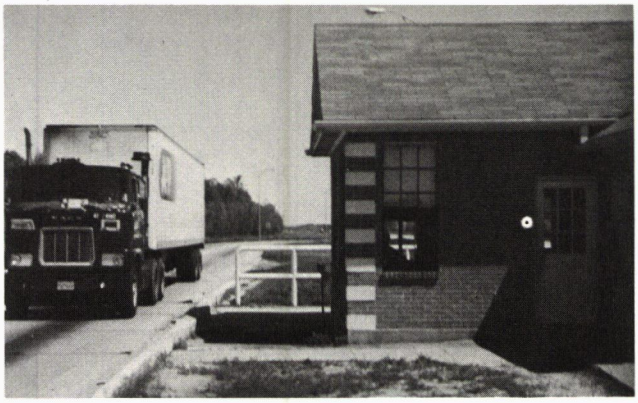


FIGURE 16 A scale house in Louisiana (the front of the house faces the truck driver).

other states that weigh about the same number of trucks. Upstream from the station is a variable message sign that directs loaded trucks only to enter the station for weighing. The difference between WIM equipment used as a sorter and the variable message sign is that the variable message sign is based on the honor system. The sign is effective when truck volumes are high and should be considered by those states not wanting to purchase expensive WIM equipment. The use of this system reduces the total number of trucks weighed.

A permanent weigh station using WIM equipment must provide a long approach ramp for the installation of the WIM scales. Figure 19 shows a typical permanent truck weigh station layout with a WIM system. This layout is different from that shown in *NCHRP Synthesis 68 (11)* in that all trucks must pass the scale house for visual inspection by the enforcement official. As previously discussed, WIM is a relatively new procedure, and those states using the system are still experimenting with some of the layout features. For example, the distance between the WIM sorting scales and the loop detector that controls the directional signal is critical and must ensure that each truck receives the proper signal. The spacing of the trucks as they pass over the sorting scales must be maintained by the directional signal. The FHWA, in a review of several WIM installations, recommends the locations of the various component parts as shown in Figure 20 (*8*). The spacing of the component parts of WIM is critical. The FHWA did not report any data on the spacing in its 1980 report, but the revised report of 1981 contains this information, along with the known manufacturers of WIM equipment. It is a state-of-the-art report, and data may change as more states use WIM and ongoing research is completed.

The typical traffic control operation needed for the high-speed WIM is shown in Figure 21. A distance of 2 to 3 miles (3 to 5 km) is required, and either the area should be free of horizontal curves or the curvature should be in one direction.

WIM was originally used as a planning tool, but it could also be used to check the effectiveness of enforcement. Several locations could be used on critical truck routes or even on bypass routes to evaluate the effectiveness of the enforcement operations. Positive thinking and experimentation with available equipment may produce the hardware needed to make an overweight truck check similar to that performed by the portable traffic counter. A survey for overweight trucks can be made with manned WIM equipment; however, the goal should be an unmanned survey. None of the states visited is using WIM in this manner, nor has the FHWA reported such use in any state.

CERTIFIED PRIVATE SCALES

Certified private scales provide an additional method for weighing trucks in many states. Iowa reports extensive use of private scales because of the many grain elevators in the rural areas of the state. The laws of Iowa impose no limit on the distance an enforcement officer can require the truck to travel to the private scale. A portable crew in Iowa consists of one enforcement officer, so it normally takes less time to travel to the nearest private scale than to weigh with the portable scales. A majority of state agencies that are allowed by law to use private scales impose a 2- to 10-mile (3- to 16-km) limit of travel for the truck unless the truck driver insists on being weighed on a platform scale. Prudent use of certified private scales is generally an asset to the truck weight enforcement program.

PORTABLE SCALES

The types and uses of portable scales are discussed in *NCHRP Synthesis 68 (11)*. The most popular portable scale is the wheel loader, which weighs between 40 and 50 lb (18 and 23 kg), depending on the model. This scale can be carried in the trunk of a standard car or station wagon, pickup truck, or van. One pair of scales can weigh one axle of a truck; and portable crews are usually equipped with 2 to 10 scales. The greater the number of scales, the less time it takes for weighing.

In this weighing procedure the truck is stopped on a level area of the highway; a portable scale is placed in front of each outside tire; the truck pulls up on the scales, which are about 3 in. (75 mm) high; the enforcement officer reads the weight on each scale; and the truck pulls off the scales. If the portable crew does not have sufficient scales to weigh all the axles of the truck simultaneously, the process is repeated. Because

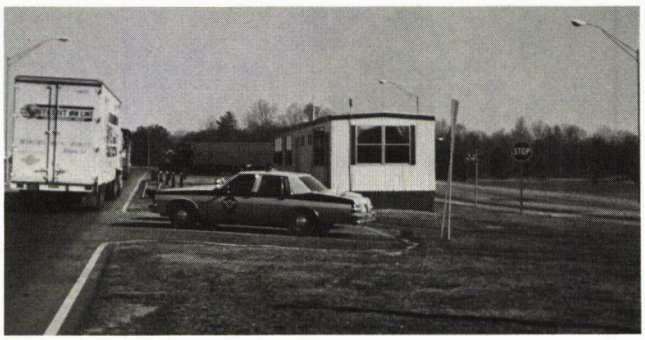


FIGURE 17 The temporary mobile house used in the Georgia station equipped with WIM. The bypass lane is to the left of the scale house, and the static scale is to the right.

FIGURE 18 A two-story scale house used in Virginia. Note the overhanging roof and the slanted glass. *Bottom left:* View of the weighing of the truck passing under the window. Numbers along the pavement are used for visual checking of the vehicle length. *Bottom right:* View of the trucks being weighed on the opposite roadway. The operator in the scale house controls the movement of the trucks with the toggle switch. The PA system is used for communication with drivers. Field glasses are used to check the length of the vehicle on the far scale.

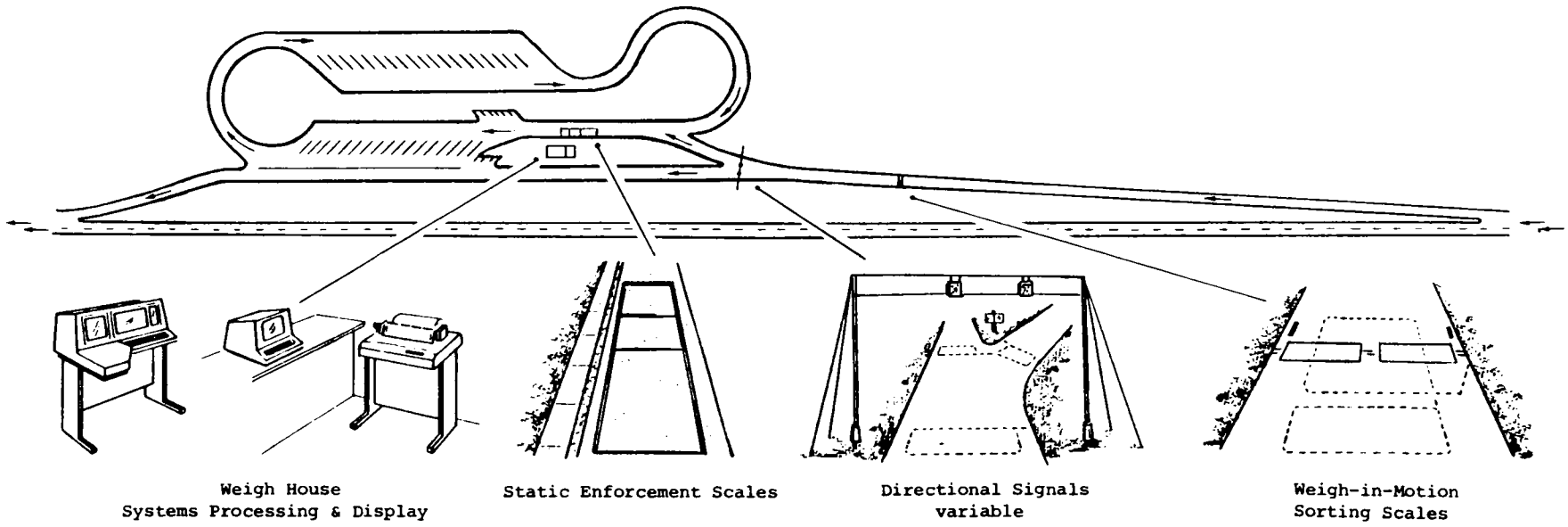


FIGURE 19 Typical permanent truck weigh station layout with a WIM system.

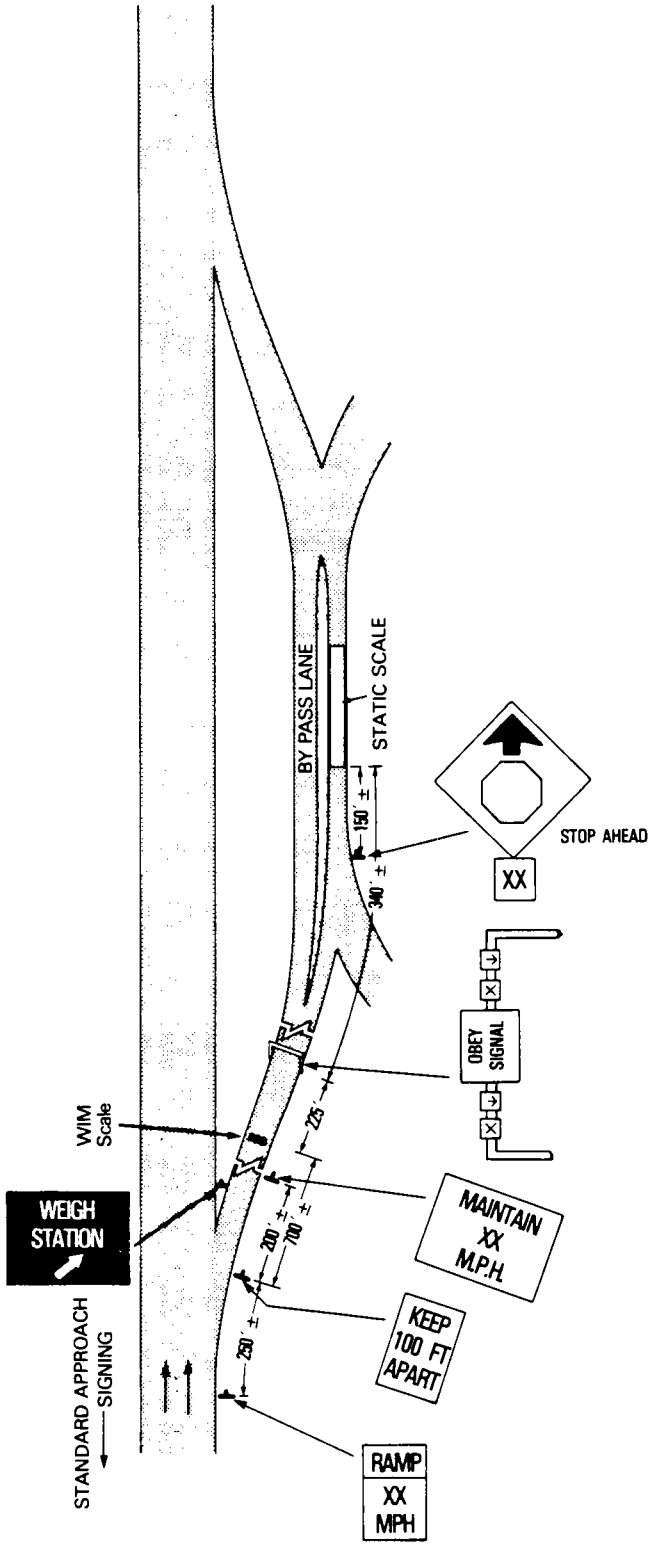


FIGURE 20 Typical traffic control application with moderate-speed WIM operation (*8*). Note: Minimum distances are shown. To prevent operational problems, ramp distances will have to be lengthened as volumes increase.

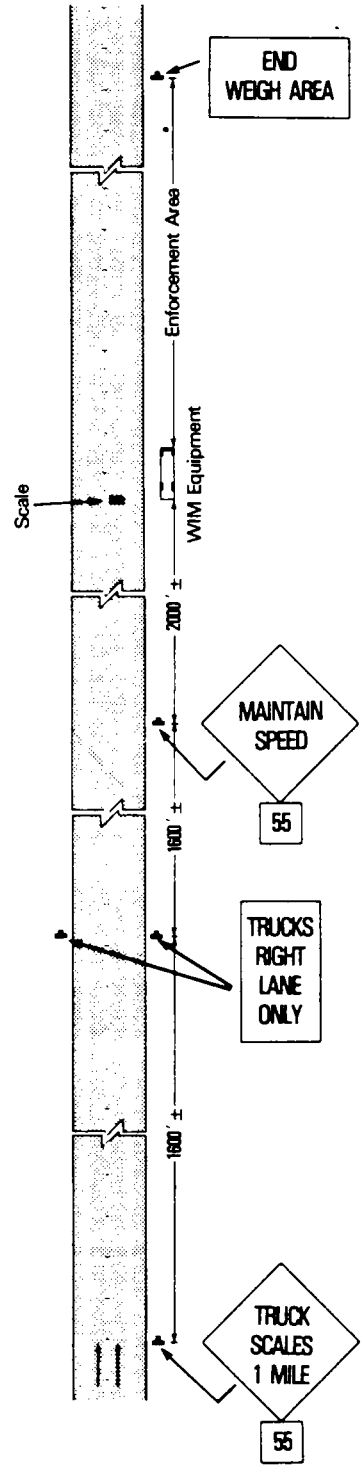


FIGURE 21 Typical traffic control application with high-speed WIM operation. Note: Enforcement area should be 2 to 3 miles (3 to 5 km) in length. It is desirable to have turnout, rest area, or other location at downstream end of enforcement area so that a truck suspected of being overweight can be pulled over for enforcement weighing.

it is essential that tandem wheels are at the same elevation, most portable crews are equipped with four to six scales. Arkansas uses only two scales with wooden ramps to provide the level area for the tandem wheels. Figure 22 shows portable scale equipment. Figure 23 shows methods of transporting the scales.

A few states are using the original loadometer wheel loader scales. In Virginia the laws use the word *loadometer*, and most of the courts will not accept weights unless the wheel loader scale is a loadometer. The loadometer is heavier and harder to maneuver, makes weighing take longer, and is easy for truckers to damage, which accounts for its lack of use in most states.

SEMIPORTABLE SCALES

The semiportable axle scale is a cross between the portable wheel loader scale and the permanent platform scale. This scale is portable but requires a trailer or pickup truck for transport. It can be used in a roving operation or set in pits in a permanent operation. Once the scales are set up, trucks can be weighed faster than they can by the wheel loader portable scales. The enforcement officer is provided with a digital readout of the weight, and the equipment can be operated from the cigarette lighter of any vehicle. The scales are available in 7- and 12-ft (2.1- and 3.7-m) lengths. Several scales can be connected to provide for a longer platform weighing area.

At the present time 14 states are using the semiportable scales (see Figure 24) at toll plazas, information centers, rest areas, frontage roads, and diamond interchange ramps, in addition to the normal roadside operation. Figure 25 shows some suggested locations for semiportable scales. With a minimum of grading and pavement construction, the semiportable scales can be used at a variety of locations; with minimal expense one semiportable-scale crew can be assigned to several locations.

COMBINED WEIGHING EFFORT

For a state to have an effective truck weighing program, there must be a proper balance of the several types of scales available and a coordinated operation by the enforcement crews. Table 3 summarizes the 1979 state certifications to the FHWA regarding the number of fixed scales, portable scales, and semiportable scales in use as of October 1, 1979. Several

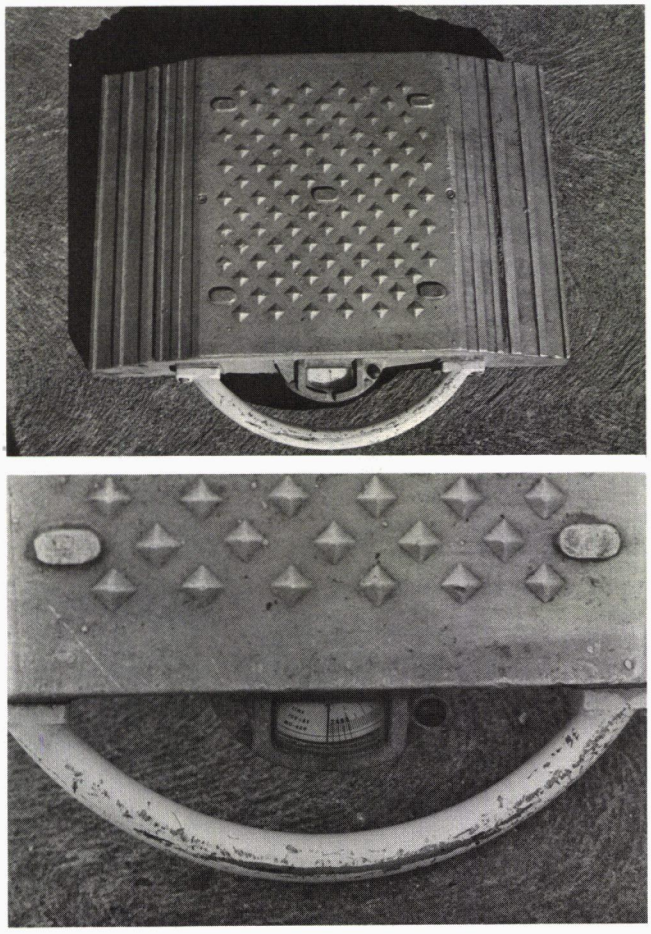


FIGURE 22 One model of the wheel loader portable scale. The dial is shown (*bottom*).

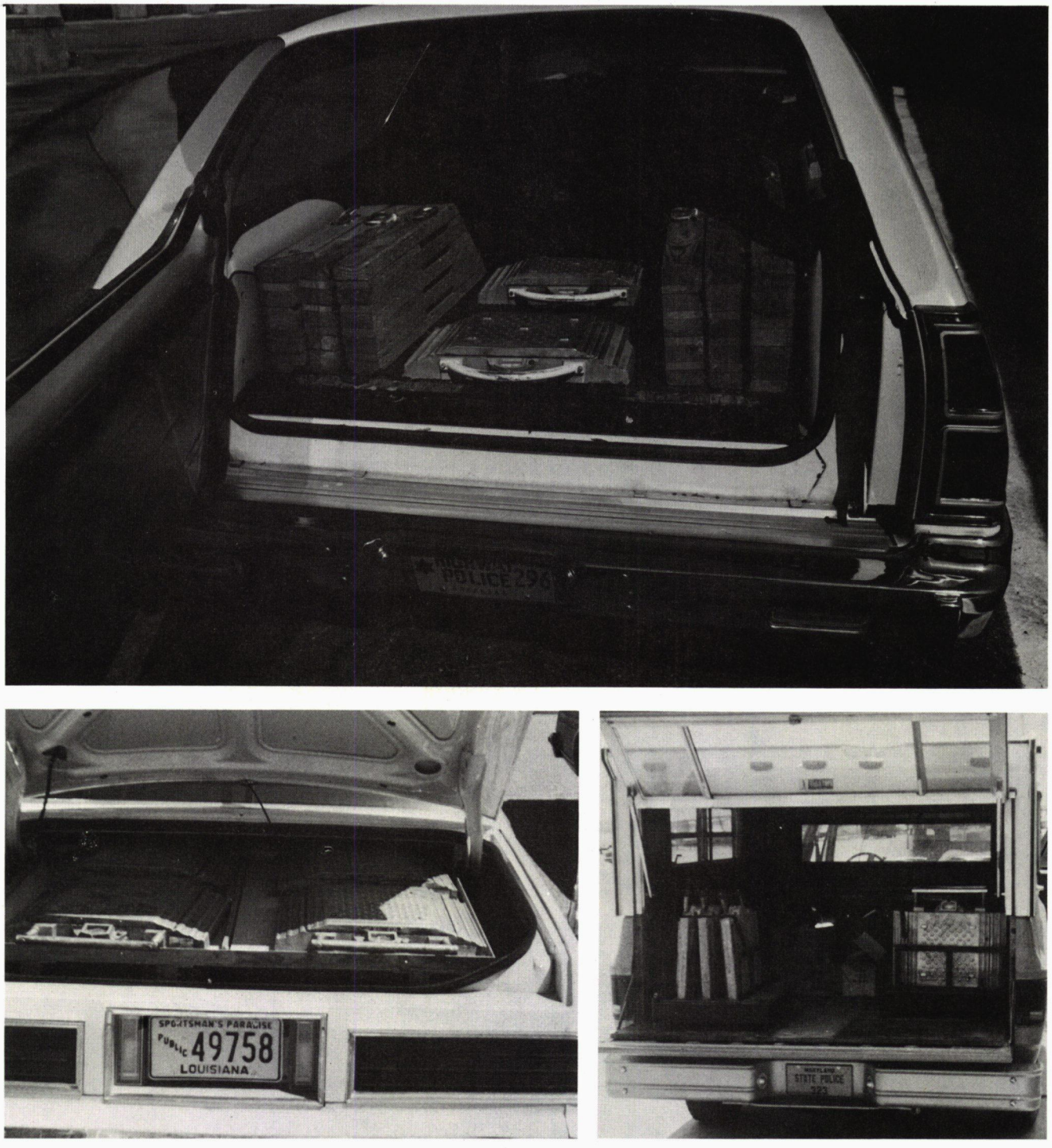


FIGURE 23 Methods of transporting portable scales. *Top*: Two portable scales and six wooden ramps transported by a station wagon in Arkansas. *Bottom left:* In Louisiana six scales (two scales are under the four visible scales) are carried in the truck of a patrol car. *Bottom right:* In Maryland portable scales are transported in a pickup truck. Note that the left rack is turned over the tailgate for easy handling. The rack on the right is in the transport position.

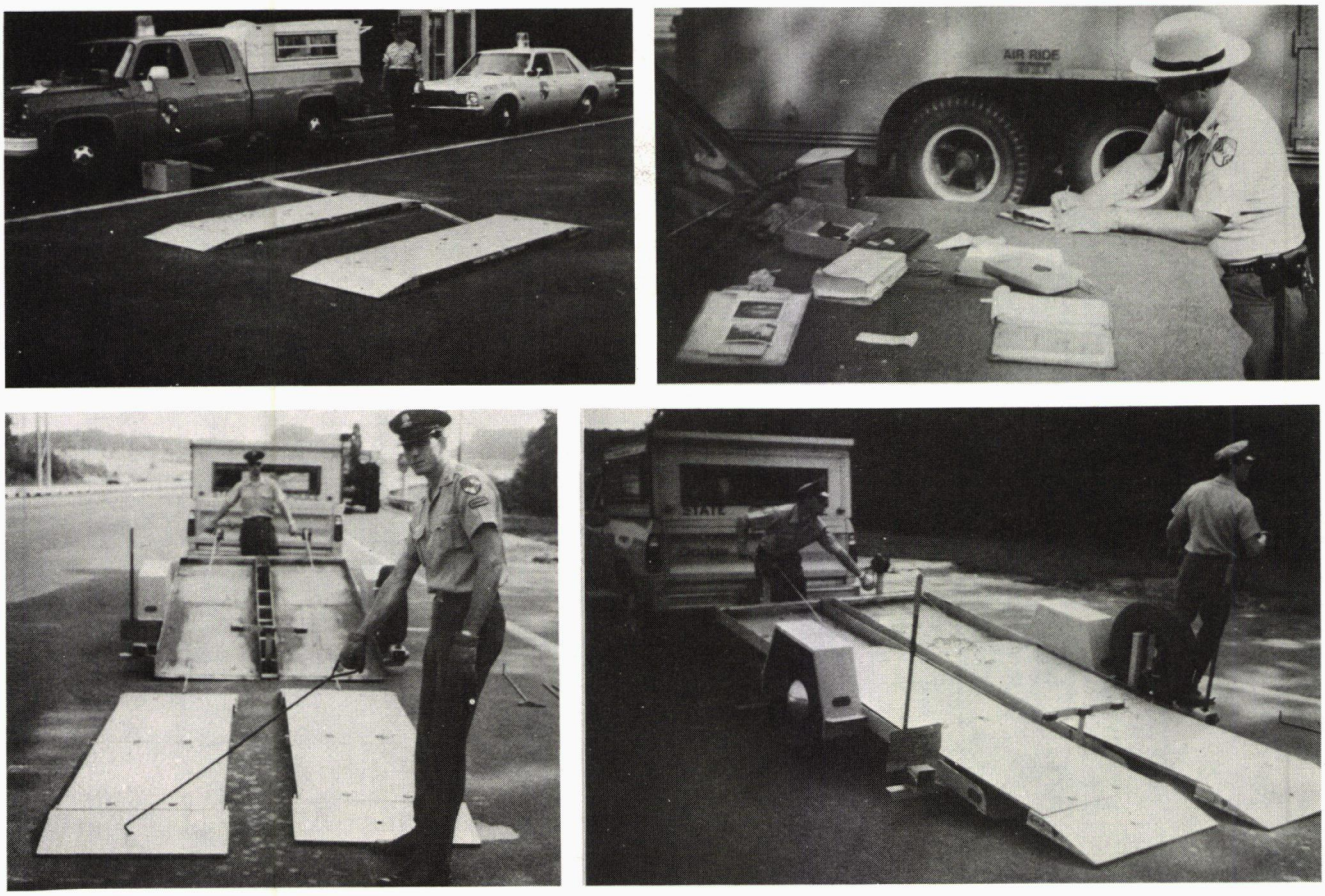


FIGURE 24 *Top left:* A 7-ft (2.1-m) semiportable scale set up for operation. Note the steel channels used to protect the cables. *Top right:* The enforcement officer reads the weight on the digital readout using the hood of the pickup truck. *Bottom:* The tilt trailer used in Maryland to transport the semiportable scales differs from the trailer suggested by the manufacturer. The two boat winches pull the scales onto the trailer.

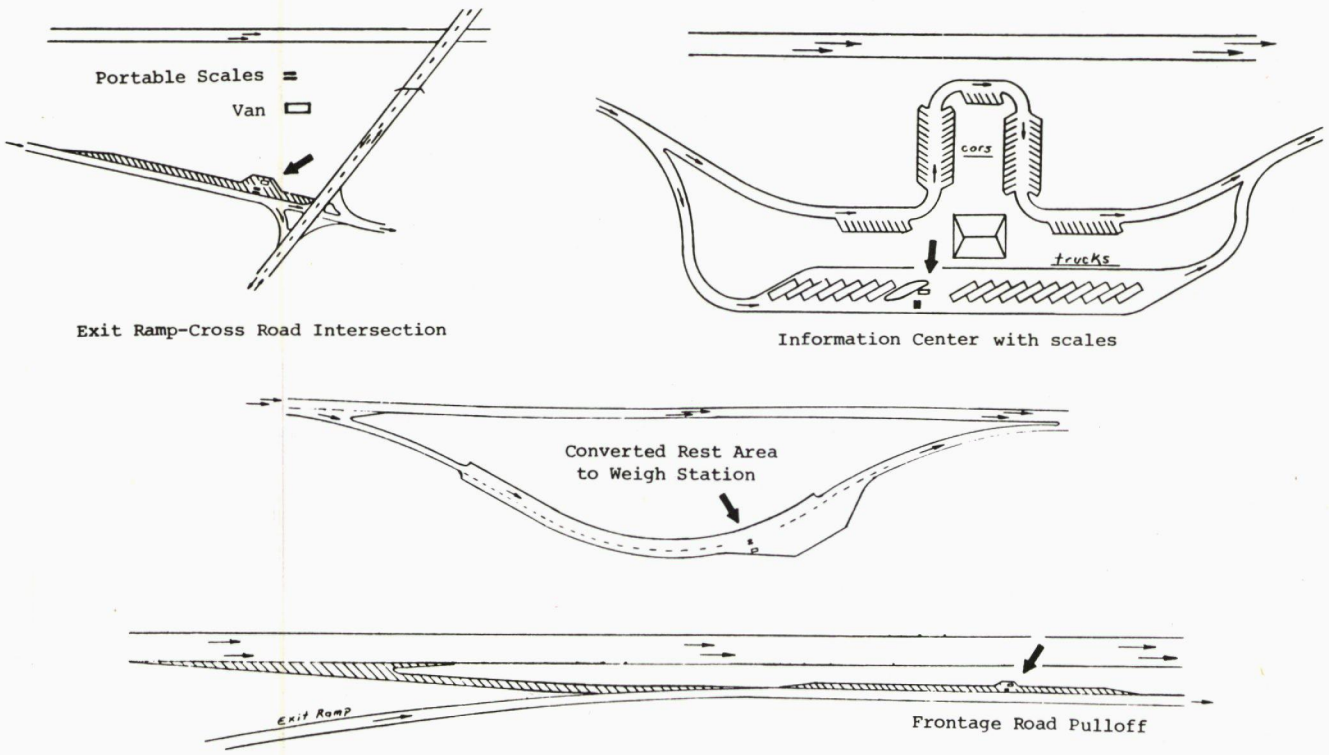


FIGURE 25 Typical semiportable weigh stations.

TABLE 3
INVENTORY OF SCALES

STATE	PORTABLE SCALES				
	Fixed Scales	Wheel Weighers	Number Per Set	Axle Weighers	Number Per Set
ALABAMA	0	88	8		
ALASKA	10	48	8		
ARIZONA	13	8	4		
ARKANSAS	18	70	2		
CALIFORNIA	49	321	4		
COLORADO	26	20	10	2	2
CONNECTICUT	7	20	10	8	2
DELAWARE	1	0	0	4	2
DIST. OF COL.	2	12	4		
FLORIDA	21	138	7@2/31@4	4	2
GEORGIA	12	290	6		
HAWAII	0	10	2		
IDAHO	23	28	4		
ILLINOIS	33	0	0	8	2
INDIANA	23	151	4, 6 or 8		
IOWA	37	75	4		
KANSAS	7	62	6	18	2
KENTUCKY	15	316	4		
LOUISIANA	12	192	6		
MAINE	0	68	2		
MARYLAND	3	90	6	4	2
MASSACHUSETTS	0	48	4		
MICHIGAN	17	162	2		
MINNESOTA	8	36	4		
MISSISSIPPI	40	60	4		
MISSOURI	39	64	4		
MONTANA	37	34	2	6	2
NEBRASKA	15	9	6		
NEVADA	10	20	4		
NEW HAMPSHIRE	4	220	4 or 6		
NEW JERSEY	4	46	2		
NEW MEXICO	17	16	2	2	2
NEW YORK	0	172	2	20	2
NORTH CAROLINA	19	348	2		
NORTH DAKOTA	12	84	4		
OHIO	23	190	12		
OKLAHOMA	9	98	2 or 4		
OREGON	66	78	2		
PENNSYLVANIA	3	117	9		
RHODE ISLAND	0	12	4		
SOUTH CAROLINA	9	76	6	8	2
SOUTH DAKOTA	8	0	0	20	2
TENNESSEE	13	191	4		
TEXAS	6	528	4	4	2
UTAH	10	16	4		
VERMONT	4	62	6		
VIRGINIA	28	156	2, 4, or 6		
WASHINGTON	63	126	2		
WEST VIRGINIA	3	90	6		
WISCONSIN	24	110	2		
WYOMING	27	0	-		
PUERTO RICO	0	43	1		

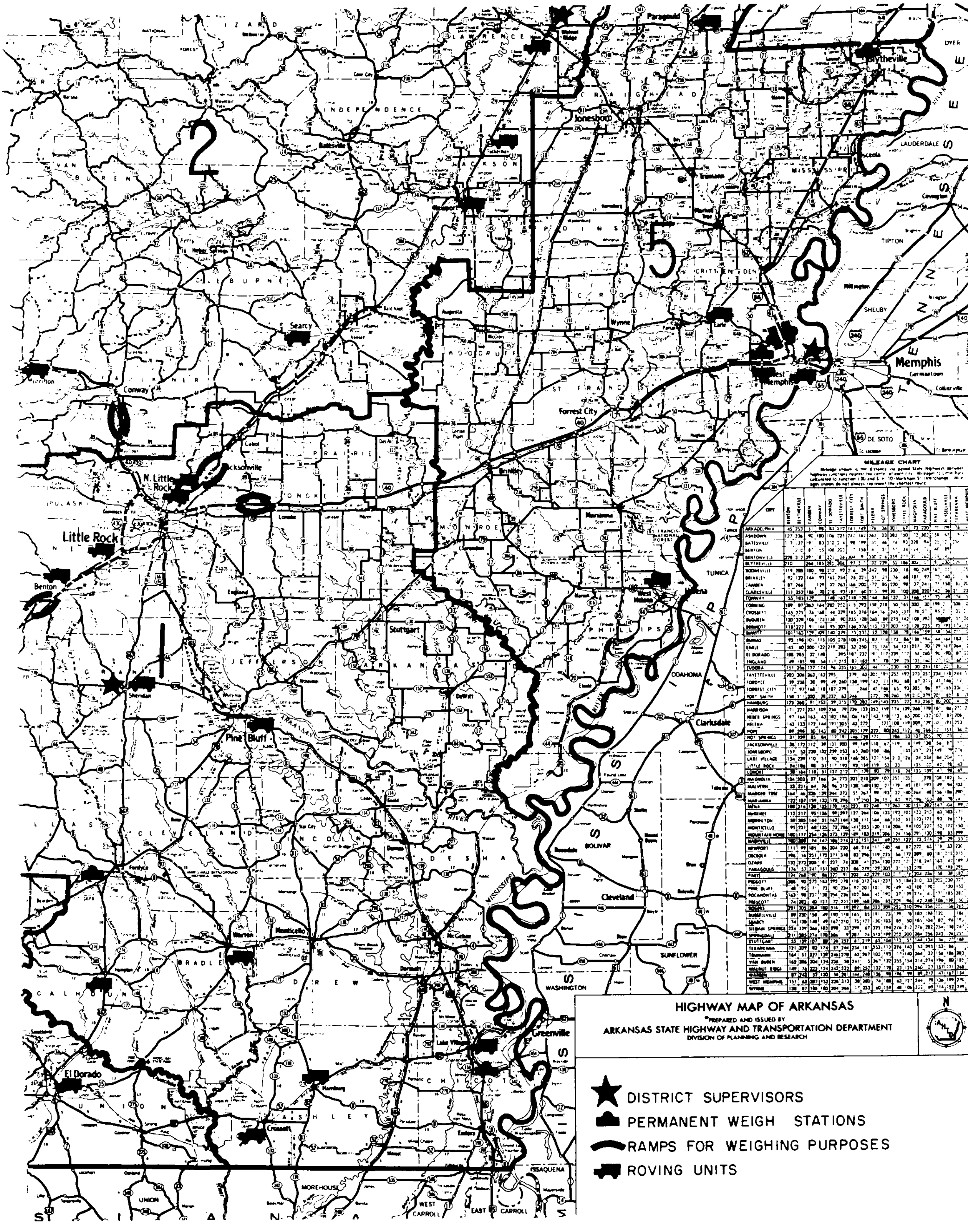


FIGURE 26 Locations of permanent weigh stations, ramps for weighing purposes, and roving units (Arkansas).

states that have either no or relatively few permanent weigh stations have acquired the newer semiportable scales.

For the permanent weigh station to be most effective, it must be supported by the roving portable crews in order to reduce the chance of bypassing trucks. If the semiportable scale is used instead of the permanent scale, the backup of a portable weigh crew is also advisable; the two operations should work together. The portable weigh crew must also cover those areas of the state that do not have permanent weigh stations. In order to provide an effective truck weighing program, all operations must be coordinated through the district headquarters or the central office. Figure 26 shows the locations of the permanent weigh stations, ramps for weighing purposes, and roving units in Arkansas. This map and Figure 6 cover the major truck routes in that state. Note the cluster of permanent and roving scales at the port of entry and at natural obstacles. The roving units operate on a radius from the base locations depicted. Areas of light truck traffic need not and cannot be completely covered. Figure 26 also shows ramps that were constructed for weighing purposes and that could be locations for semiportable scales.

Careful selection of the sites for permanent weigh stations and for semiportable scales and proper deployment of portable weigh crews are essential to effective truck weight enforcement. In addition to being committed to permanent locations, it is essential that state agencies use portable and semiportable weigh crews to seal off bypass routes to the extent practicable. State DOTs and enforcement agencies must constantly review enforcement operations and truck movements to ensure a continued effective truck weighing program.

CHAPTER FOUR

WEIGHT LAWS

In November 1979 the FHWA published *Overweight Vehicles, Penalties, and Permits—An Inventory of State Practices (21)*. This inventory revealed the variations in state laws that govern weight limits, fine structure, and overweight permits. These differences are also summarized in *NCHRP Synthesis 68 (11)*. In 1980 several state legislatures changed weight limits and fine structures. The trend appears to be toward a limit of an 80,000-lb (36 300-kg) gross weight, as allowed by federal law on the Interstate System. The administration of the laws in the several states visited is discussed in the following sections.

WEIGHT LIMITS

About one-fourth of the states have retained a legal gross weight limit of under 80,000 lb (36 300 kg), and another one-fourth have a legal gross weight limit that exceeds 80,000 lb on highways other than the Interstates. Many states have lesser load limits on county or secondary highways. Of the states interviewed, eight have a gross weight limit of 80,000 lb; Virginia and North Carolina have a limit of 76,000 lb (34 500 kg); and Arkansas has retained a limit of 73,280 lb (33 240 kg). Iowa and Maryland changed to the legal gross weight limit of 80,000 lb during the 1980 legislative session. When Florida raised the legal limit to 80,000 lb, it was anticipated that the overloaded truck problem would decrease; instead the number of overweight violations increased. Many enforcement officials believe that, whatever the legal limit, there will always be a percentage of overloaded trucks.

Table 1 in *NCHRP Synthesis 68 (11)* shows that 27 states determine gross weight limits by using either the bridge formula or the table for allowable gross vehicle weights, which was derived from the bridge formula. The other 23 states use either axle limits, specified maximum limits, or a formula other than the bridge formula. Even though other methods of establishing tables for maximum limits may be as effective as the bridge formula, the bridge formula has been the standard for many years. Damage to bridges by overweight vehicles is critical; all states must be satisfied that the legal weight limits established will not overly stress their bridges. It should be noted that, although the agency enforces the legal limit as set by statute, it is the responsibility of the state highway and transportation departments to ensure that the statutes establish the legal limit in order to best preserve the highways and bridges while allowing normal transportation of commodities.

The types of vehicles that are classified as legal vary from state to state. Washington allows vehicles of two to nine axles of 15 different truck, semitrailer, and trailer configurations. (Appendix B is a reprint of the Washington State Patrol's size, weight, and load requirements used in the administration of the state laws. The appendix contains a vehicle weight table provided by the state; all states provide similar tables for truckers.) Eastern and southern states generally do not allow the full trailer pulled by a truck and semitrailer. The state laws of California and Washington require that such trailers be counted as separate vehicles. Federal regulations count the trailer and truck as a single vehicle. This has caused some confusion in the reporting of vehicles weighed.

The variations in legal weight limits may evolve into a standard uniform gross weight. Standardization is desirable, but this should not be taken to mean that states should raise legal load limits to a very high level. The 80,000-lb (36 300-kg) gross weight limit, established as a standard for the Interstate System by Congress, has made it difficult for states to maintain lower limits. It is also difficult to envision any future reduction of legal limits in the 12 states that allow loads above 80,000 lb on non-Interstate highways.

ENFORCEMENT AGENCY

The weight laws of the state establish the enforcement agency and its responsibility to enforce the weight and size laws regardless of the gross load. The organization of several enforcement agencies and the advantages of each type of operation are discussed in Chapter 5.

The states in which both the enforcing agency and the permit section are under the same responsibility center of the state DOT appear to have a better-coordinated truck weight enforcement program. Enforcement on county roads and city streets is minimal. Most states allow the state enforcement agency to enforce the weight and size laws on any road in the state, which includes county and city roads.

FINE STRUCTURE

The executive summary in *Overweight Vehicles, Penalties, and Permits—An Inventory of State Practices (21)* states:

> The inventory of the overweight penalty systems revealed a wide variation in approach to deterring violations. Monetary fines are widely applied but the fines range from minimal to severe, from a flat assessment to one graduated by amount of the overweight violation, and from posted bonds to court-administered assessments. Some of the court-imposed fines were outside the boundaries of both the minimum and maximum fines specified in State law or regulation. Many State statutes provide for increasing the severity of the penalty for subsequent offenses, yet inadequate record systems reduce the likelihood of applying this provision.

The effects of truck weight laws on enforcement programs vary from state to state because of differences in state statutes. Statutes of several states establish the overweight violation as either a civil offense, administered by an enforcement agency or its parent organization, or a misdemeanor, which is processed through the court system.

Of the states interviewed, Arkansas, California, Iowa, Maryland, Utah, Virginia, and Washington use the court system to determine and collect penalties. Most of these state agencies report satisfaction with the courts and have about a 90 to 95 percent conviction rate. The court dockets in some counties are often crowded, and several violations from the same trucking firm foster plea bargaining and settlements of penalties for considerably less than the minimum. The county prosecutor or the state attorney's office usually handles the prosecution of the cases. The vigor of the prosecution depends on the individual prosecutor; often cases are handled by young assistants with little court experience. Virginia reported that the defense of truck weight violations is the main practice of some private attorneys. Large trucking firms often retain legal counsel on a full-time basis to handle, among other legal matters, the overweight violations.

At the issuing of a citation, a date is set for posting bond or, in some states, a plea date is set. If bond is posted or the violator does not appear on the plea date, an automatic guilty plea is entered. If the trucker pleads guilty on the plea date, the arresting officer is not required to appear in court. In Maryland the officer must appear in court regardless of the plea. Many courts require not only proof that the law was violated but also the appearance of the person who certified the accuracy of the scales. Court appearance by the enforcement officer reduces the time spent in enforcement and may eliminate the operation of a portable weigh crew during the time of the trial. Thus the court procedure is time-consuming not only for the trucker but for the enforcement agency as well.

Many courts do not adhere to the mandatory penalties, and the fines, which are established at the discretion of the court, may be less than the minimal penalties established by statute. Cases are dismissed if the arresting officer or a representative of the department responsible for the certification of the scales does not appear in court. The violator is often allowed to postpone the trial date at the last minute with little notice to the enforcing agency. These situations are all hindrances to effective truck weight enforcement. However, several states (Arkansas, California, Utah, and Washington) report that the courts in their states do levy the maximum allowable fine and that the conviction rate is high. California reported that the fine structure is too low to act as a deterrent to overweight trucks.

The fines collected are used for a variety of purposes, including education, health, welfare, and in some cases the general fund of the state or support of the court system. In a few states the fines go to the department of transportation to be used for highway maintenance.

In Florida, Georgia, Louisiana, and North Carolina, the offense is civil and handled administratively by the enforcement agency. In Florida and Louisiana, the penalty must be paid and the load adjusted before the vehicle is moved. The fine collection is handled by the enforcement officer and can be paid by credit card, posting of a bond, or deferred payment by the trucking firms that have established credit with the department. Georgia gives the offenders 15 days to post bond or request a hearing. In North Carolina the procedure is slightly different: the penalty is a tax assessment against the owner of the vehicle, and either it must be paid within 10 days or a hearing must be requested. Failure to make payment or request a hearing may result in a lien being placed on the truck. North Carolina is one of the few states in which the owner of the truck is penalized, although trucking companies normally pay the fines imposed on their drivers. In addition to the tax assessment, the driver can also be cited fo a traffic violation in North Carolina.

Appeals go through the hearing process in Florida, Georgia, Louisiana, and North Carolina. The composition of the hearing board varies among these four states; however, the board usually consists of one to three members—from the department of transportation, from the enforcement agency, and from the legal staff or another interested state agency. If the violator is not satisfied with the decision of the

hearing board or officer, appeal can be made to the commissioner or the secretary of transportation. If that fails to produce satisfaction, the violator can sue the state in a civil court. Penalties collected are used to support the weight enforcement program or the state highway maintenance program. If the violation occurs on a county road, the county may receive a portion of the penalty.

Florida, Georgia, Louisana, and North Carolina all report success with the civil procedures and are able to provide the aggrieved party with timely hearings without the expense of court costs. Usually, for the hearing board or officer to render any relief, the aggrieved party must prove that the enforcement agency made an error. The arresting officer's presence is not required at the hearing unless the board or the aggrieved party so requests. In the case of extenuating circumstances, the board may allow the owner to make monthly payments for large fines. The use of administrative procedures is very effective, resulting in immediate payment of the penalty or payment within a 15-day period, prompt hearings for the violator, relief of crowded court dockets, and use of the penalties collected for maintenance of the highway system and support of the enforcement program. The truckers support the administrative handling of violations because everyone is treated fairly and the assessments are standard.

UNLOADING REQUIREMENTS

By far the greatest deterrent to overweight trucks is the requirement to make the load legal before proceeding. This provision is part of the weight laws for all but a few states. The disposition of overweight vehicles for all states is summarized in *NCHRP Synthesis 68 (11)*. Statutes in 13 states provide for mandatory unloading; in 29 states the enforcement officer is given discretionary authority regarding unloading. Thus existing state laws in 42 states provide enforcement agencies with the most effective weapons for enforcing truck weight limits. Of the states interviewed, only Virginia does not have an unloading requirement.

The unloading requirement costs the trucker time and money. The vehicle is either impounded at the site of the violation or directed to a convenient, safe location for the unloading process. As provided in the statutory laws of the state, making arrangements for the unloading is the responsibility of the trucking company or the driver, as is the security of the cargo. All expenses of unloading must be borne by the owner, who thus incurs financial penalties in addition to a delay in delivery of the shipment. The California Highway Patrol believes, as do many other enforcement agencies, that the off-loading requirement of an overloaded vehicle is the most effective deterrent in a truck weight enforcement program.

REPEATED VIOLATIONS

Those states that use the assessment procedures report that it is virtually impossible to maintain current files for use by the enforcement officer when assessing the fine for on-the-site payment and that therefore the penalties are structured to be high. The courts are able to consider second and subsequent offenses, which is most likely to result in a reduction for the first offense and the full assessment for the second and subsequent offenses. It is sometimes difficult to identify owners because of the ease of changing truck registrations and titles. Thus the driver is sometimes the only person who can be held responsible. In many cases the driver denies knowing that the vehicle is overweight and claims just to be driving the load assigned by the dispatcher. To involve the owner or the dispatcher in the violation, many states require that intent must be proven, which is difficult unless the owner is the driver. The imposing of stiffer penalties for repeated offenses appears to be simple, but in practice it is difficult to administer. Those state agencies that collect the same stiff fine or assessment for each violation may more effectively deter the repeat offender.

Several states are using motor-vehicle laws to revoke the driver's license of those drivers with five or more truck weight violations. This is not as effective a deterrent as it might appear, because most interstate truck drivers have a driver's license for several states. Revoking a driver's license has a greater effect on the intrastate driver, but the drver's association generally fights this vigorously, using the strong argument that the loss of the license prevents drivers from pursuing their work and supporting their families. Probably the more effective deterrent, and one that has more effect on the owner, is revoking permits and refusing to issue future permits.

Many states use the point system for traffic violations, revocation of a license being the ultimate penalty. Making overweight loads a traffic violation would allow its inclusion in the point system. And because most insurance companies compute insurance rates based on the point system, an additional deterrent to overweight vehicles could be increased insurance rates for the trucking firms.

PERMIT OPERATIONS

NCHRP Synthesis 68 (11) contains an up-to-date report on the permit operations in several states, supplemented with conclusions and recommendations. Discussions with the enforcement officers of the 10 states visited in the preparation of this synthesis reinforce the findings of Synthesis 68, even though these discussions were related to the enforcement of laws and did not include the details of permit operations.

All state agencies voiced the need for uniformity of practices; several states are cooperating with neighboring states to accomplish this goal. Washington is working on a tri-state agreement with Idaho and Oregon; representatives of trucking associations are included in the working conferences. Florida, Georgia, and North Carolina are also working together with other East Coast states to simplify permit issuing and establish reciprocal agreements for permits. It is recommended that all states work together to improve the permit operations with their neighbors.

AASHTO is updating *A Recommended Policy on Maximum Dimensions and Weights of Highway Vehicles to Operate Over the Highways of the United States*. Chapter 3,

"Issuance of Truck Permits and Restrictions," will provide the states with a guide, including forms, types of permits, and all pertinent data, that could form the basis for greater uniformity in permit operations. This publication also covers the marking and flagging of oversized vehicles, another concern of many states. It is recommended that all state agencies conform with the AASHTO suggestions in order to reduce the great variance in current practice.

Types of Permits

States issue permits for vehicles carrying special cargoes that weigh more than the established weight limits. Of the existing types of permits, the annual permit presents the best opportunity for the trucker to circumvent the weight laws. Many state agencies are required by law to issue this type of permit for special cargoes. The annual permit can be used 365 days of the year and as many times as desired in 1 day. Some states issue 30-, 60-, or 90-day permits, also allowing the vehicle to make as many trips as desired in the time period. The state agencies have no knowledge of the number of trips made by truckers with these permits. The annual permit is a convenience to the trucker and also may reduce paperwork for the permit-issuing agency.

All states issue the single-trip permit; this is the only type of permit that gives the state full knowledge and control of its use. Louisiana is one of the few states that primarily issue the single-trip permit, although Lousiana also issues waste disposal truck and steering axle permits. Louisiana also issues a Harvest Season permit, which allows the hauling of farm and forest products in their natural state. One condition to these exceptions to the single permits is that weight limits are set lower for the Interstate highways. State agencies may be criticized for establishing special exceptions for farm products or other natural resource material; but the overall economy of the state is often at stake, and legislative bodies respond to economic pressures within their states.

Some states have been able to set permit fees that are high enough to cover the costs of pavement damage. In Louisiana fees are based on the distance of travel and the gross weight. For example, if the gross weight is between 90,001 and 100,000 lb (40 800 and 45 400 kg) and the distance traveled is less than 50 miles (80 km), the fee would be $20. The fee would be $65 for the same gross weight traveling over 200 miles (320 km).

Louisiana's *Weight Enforcement Policy and Procedure Manual (22)* is suggested reading for a state agency that is considering proposing changes in permit laws.

Relationship Between Permit-Issuing Agency and Enforcement Agency

In Georgia and Louisiana both permit issuing and enforcement are administered by the same department. This ideal situation appears to be the exception among the states. In most states in which the state highway patrol or state police has the responsibility for enforcement, permits are issued by the highway department or the DOT. In these states the enforcement agency must depend on liaison with the organization issuing the permit. Generally the relationship between the two agencies is good, but in some states the relationship is strained and better communication is needed to improve the enforcement program. Cooperation under a divided control is only as good as the attitudes of the personalities involved. Supervisors must be able to prevent conflicts. Conferences are needed on a regular basis to seek solutions to problems that affect the overall enforcement.

Enforcement Responsibilities

The enforcement agency determines trucker compliance with the conditions of the issued permit. Violators are cited by the enforcement agency for the amount over the weight allowed in the permit. The violator must either unload or, if possible, purchase another permit before moving the vehicle. Citations in North Carolina are based on the amount over the legal load because it is contended that any violation of the conditions of the permit voids the permit. The permit may also designate a route to be followed; if the vehicle is found to be disregarding the designated route, the permit is void and a citation is issued.

AASHTO

AASHTO recognizes that many highway transport problems, both intrastate and interstate, can be traced to variations in state laws. This concern is being pursued by the Subcommittee on Highway Transport; Chairman Billy K. Cooper of Arkansas has formed a joint task force with the Legal Affairs Subcommittee to investigate vehicle size and weight. At the time this synthesis was being prepared, the task force was drafting a model truck weight and size law to provide the states with a guide for improving truck weight enforcement programs. It is suggested that the states analyze the model weight law carefully and employ those features that will strengthen enforcement. Uniformity is desirable and should be pursued, but not at the expense of strong existing state laws.

CHAPTER FIVE

ENFORCEMENT

ORGANIZATION OF ENFORCEMENT AGENCIES

Effective enforcement begins with an organization that is properly equipped, manned, and controlled. The organization of the various state agencies that enforce size and weight laws is described in the GAO report to Congress (*9*) and *NCHRP Synthesis 68 (11)*. The 10 states interviewed confirmed the findings of these reports in regard to enforcement organization. However, each state indicated an ability to work efficiently within its organization, manpower, and budget constraints; all reported that effectiveness could be improved with additional personnel.

The organization of enforcement agencies varies among the states. The basic difference appears to be that some enforcement agencies are under the direct control of the state's DOT or highway department. The state DOTs that can exercise direct control appear to be able to administer, equip, and man the enforcement agency to better meet the needs of their enforcement programs; there also appears to be better coordination of the enforcement agency and the permit department. In Louisiana both the commander of the enforcement agency and the head of the permit section report to the enforcement and truck permits administrator. Figure 27 illustrates the organization of the enforcement agency in Louisiana. In Georgia the enforcement agency and the permit section also report to the same official; in Arkansas the enforcement agency and the permit section are 2 of 11 sections that report to the same official.

In Iowa and North Carolina the enforcement agency reports to the motor-vehicle division, which is under the state

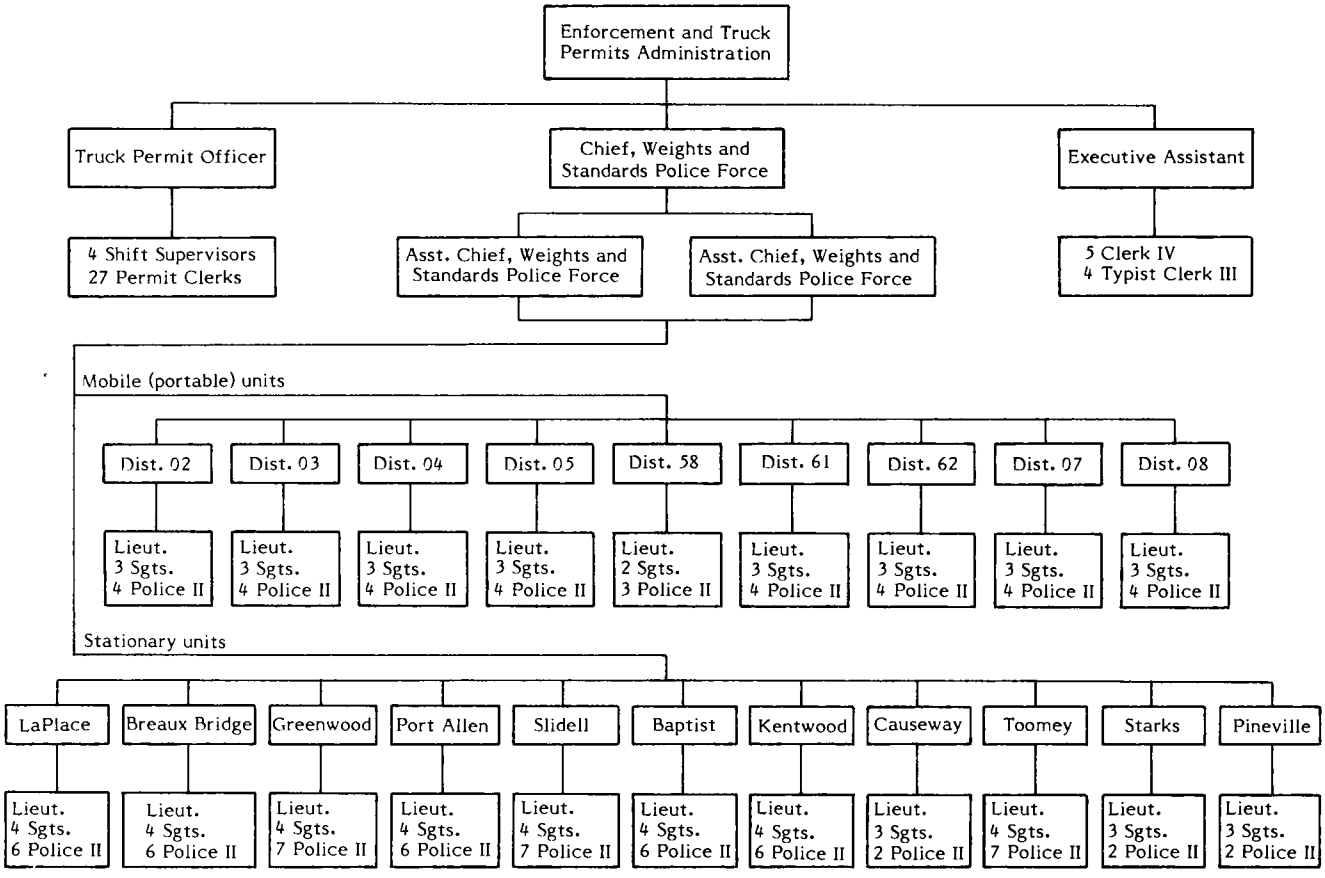


FIGURE 27 Enforcement agency organization (Louisiana).

DOT. This is an advantage in that the enforcement agency can perform certain administrative actions, such as revoking a truck driver's license after a fixed number of violations within a 1-yr period. Current permits of habitual violators can be revoked and future requests for permits denied. In Iowa the permit section is also under the motor-vehicle division. In North Carolina permits are issued by the division of highways. Although there is good liaison between the two offices, their operations are administered by different officials and they are located in separate buildings.

In Utah and Washington the state highway patrol enforces the size and weight laws; the highway patrol can enforce only highway laws. In California both the highway patrol and Caltrans report to the secretary of business and transportation. Permits are issued by the highway division in California, Utah, and Washington. In Utah the highway patrol (Figure 28) is divided into two operations: (a) enforcement of the size, weight, and safety laws under the motor carrier division and (b) enforcement of the traffic laws under the field commander. In the California highway patrol and the Washington state patrol, the division of weight and traffic enforcement responsibilities is at the district level. The district commander has both responsibilities but does not have the authority to transfer personnel from one function to another. Until recently the highway patrol in Florida was responsible for truck weight enforcement, but during the 1980 legislative session a new bureau was established in the DOT that assumed the responsibility.

Weight enforcement in Virginia is the dual responsibility of the traffic weighing operation division of the Virginia Department of Highways and Transportation and the Virginia State Police. The actual weighing is done by the former, and citations for violations are issued by the latter. At permanent weigh stations a trooper and a weigh technician work together. Portable units are accompanied by a state police officer, who issues the citations.

MANPOWER

All the states interviewed expressed the need for trained law enforcement officers to issue citations and make arrests. In these states, with the exception of Virginia, a uniformed officer performs the actual weighing. Most of the states require that the officer be a graduate of the state police academy. In Washington the officer is given a year to attain academy certification. Size and weight laws are a part of the academy curriculum.

In Louisiana the state DOT conducts its own course, which concentrates on size, weight, and safety-inspection laws; police academy subjects are also included. Both the state police academy instructors and DOT legal staff assist in the training. By concentrating on weight and inspection laws and using practical case situations, the state DOT can train an officer to deal with the day-to-day truck weight enforcement situation.

The states interviewed reported little difficulty in recruiting properly trained personnel for enforcement agencies. One state indicated that the pay scales, which are above those of the local law enforcement agencies, attract qualified officers. In other states potential officers must pass a civil examination and then are selected for enforcement officer training from the approved list; they receive on-the-job training while awaiting the start of a new class. Louisiana reports hiring problems in the metropolitan area of New Orleans; however, a slightly higher salary for officers that live and work in the metropolitan area has helped to retain personnel.

Some of the states employ personnel who live near the base of operation. Retention and morale of enforcement officers were reported to be high, even in the states that have lower salaries for officers that enforce the size and weight laws than for other law enforcement officers in the state system.

The biggest problem associated with manpower requirements appears to be that of obtaining sufficient budgeted positions, particularly in those states in which the enforcement agency is separate from the DOT. During the last session of the legislature the Washington Highway Patrol requested 28 new positions but received only 6. The enforcement agency in Florida is able to obtain new positions for new scale installation but not additional officers for existing weight enforcement facilities. In most of the states in which the enforcement agency is under the DOT, there appears to be less of a problem in obtaining additional personnel as long as the requested positions do not exceed the total budgeted positions for the department. Louisiana apparently has few problems because the fines and the permit fees become dedicated funds used to support the weight enforcement and permit operations; if the money is available, there is no difficulty in obtaining additional positions.

In 1968 Iowa conducted a study on the benefits and costs of the enforcement of truck weight and size regulations (*23*). The cost of maintaining a given number of weighing officers in the field and the cost of the administration required to support the operations were examined. Benefits included additional registration and other fees and prevention of uncompensated pavement wear. In a second study, conducted in 1975 (*24*), the optimal enforcement level was determined by structuring key parameters and relationships associated with traffic weight operations. The model predicted the outcome of various enforcement levels. The 1968 study concluded that the optimal staff size was 79; the 1975 study recommended 93.

In 1980 a third study was conducted to determine if the econometric model used in the 1975 study was still valid (*25*). Although the model was found to be still valid, it could not be updated to include current enforcement responsibilities. Two recommendations were made: (a) to establish a minimal staffing level of 99 uniformed officers for enforcement, subject to the completion of the second recommendation; and (b) to establish a research project for studying methods of increasing the productivity and effectiveness of the Office of Motor Vehicle Enforcement, based on statistical and systems analysis of enforcement activities. Appendix C contains the project proposal, which reflects many of the findings of this synthesis. States should consider conducting a similar study to assist in maintaining the existing staff or to provide the justification for additional staffing and equipment.

Utah reported a mandatory 4 percent cutback of expenditures in all state agencies. The North Carolina enforcement agency has been exempted from the expense reduction im-

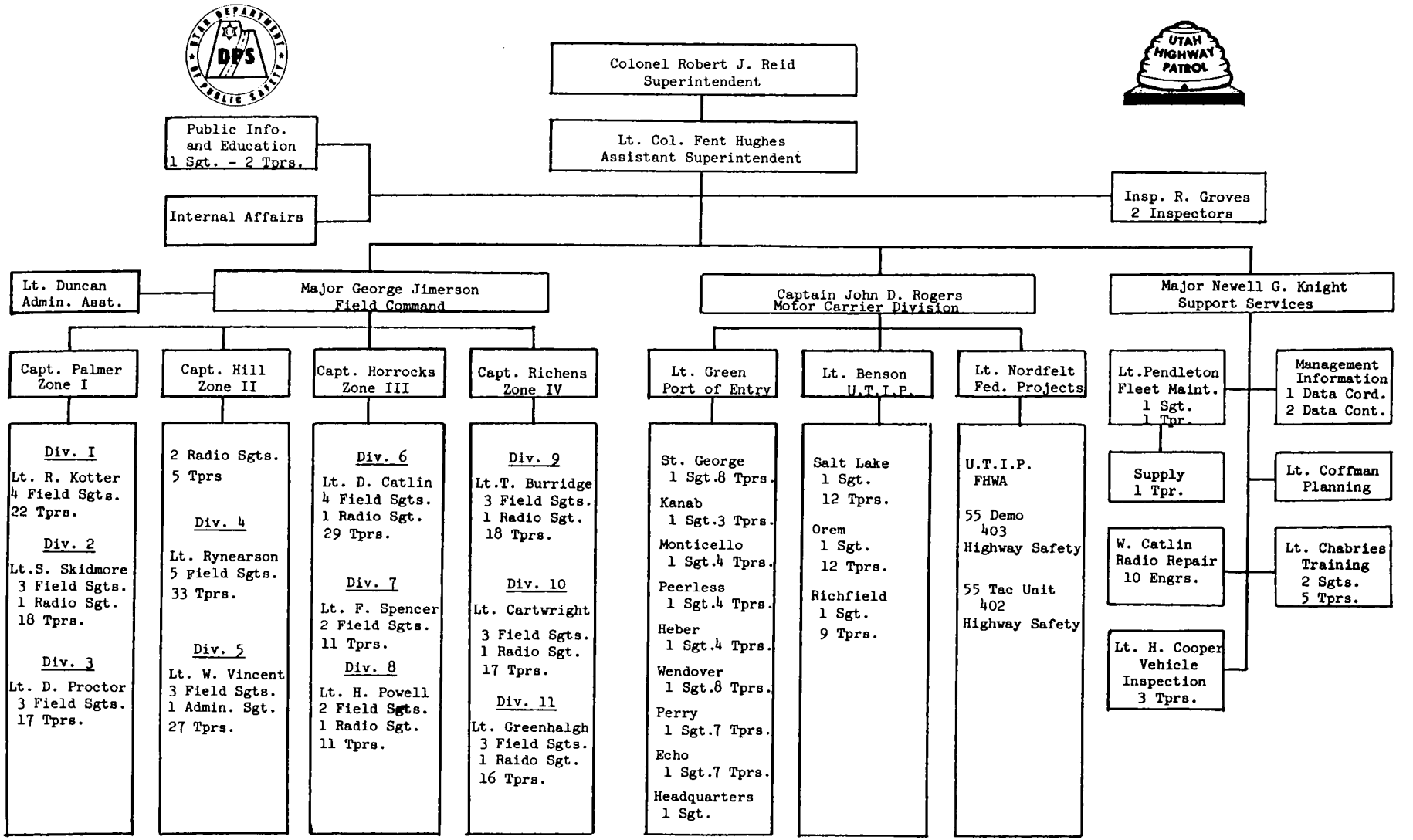


FIGURE 28 Utah Highway Patrol organization chart.

posed by the governor. It is reasonable to assume that, with current economic conditions, the agencies will have to fight to retain existing enforcement personnel with little hope of additional manpower. Even those enforcement agencies under DOT control may find the total department positions reduced and may have to compete with other divisions for the budgeted positions.

EQUIPMENT

All states interviewed reported that permanent weigh stations are in competition with other highway construction projects for available funds. The high costs of these facilities, particularly those with the WIM feature, are dealt with in *NCHRP Synthesis 68 (11)*. Many enforcement agencies are being required to prove the need for an additional permanent weigh station, even on the Interstate System, when seeking budget approval. Several agencies have resorted to the installation of permanent scales in existing rest areas. This possibility has been studied in Connecticut, and the program is being implemented at the start with semiportable scales. Agencies with an insufficient number of permanent scales may be forced to look at other alternatives.

Vehicles used for portable-scale operations vary and include standard cars, vans, station wagons, and pickup trucks. Trailers are also used for the transportation of semiportable scales. Although the number of vehicles used by weight enforcement agencies has not yet been reduced, several states did report limitations imposed on the number of miles of travel.

Many of the recent reports on truck weight enforcement emphasize the negative effects of CB radio on the random operation of fixed stations and portable operations. These reports imply that the CB radio works only for the trucker. However, many state enforcement agencies equip portable weigh crews with CB radios and have found the monitoring of trucker broadcasts invaluable in enforcement operation. A trucker reports not only where the portable crews are and whether the permanent stations are operating but also the trucker's own location and the route planned as a bypass. Enforcement agencies can use this information to track down the probable violator. Thus CB radio can be beneficial to the enforcement officer. In Lousiana, as in many other states, enforcement vehicles are equipped with state DOT, state police, and CB radio equipment, as shown in Figure 29. Several states report that the CB pays for itself in 3 months.

OPERATIONS

The enforcement agency usually has responsibilities in addition to the enforcement of the truck weight laws. The responsibilities of uniformed field enforcement personnel in Iowa, where the enforcement agency is part of the motor-vehicle division, are outlined in Figure 30. In Louisiana, where the enforcement agency is under the DOT, the responsibilities of field enforcement officers include (a) enforcing weight and size limitations, (b) enforcing vehicle regulation and licensing laws, (c) enforcing fuel-tax laws, (d) performing vehicle safety inspections, (e) citing violators, and (f) collecting cash and credit-card payments.

In California a separate team is used for safety inspection. Two types of permanent weigh stations have been constructed in the state: one is used for weight and size enforcement, and the other is a larger station where safety

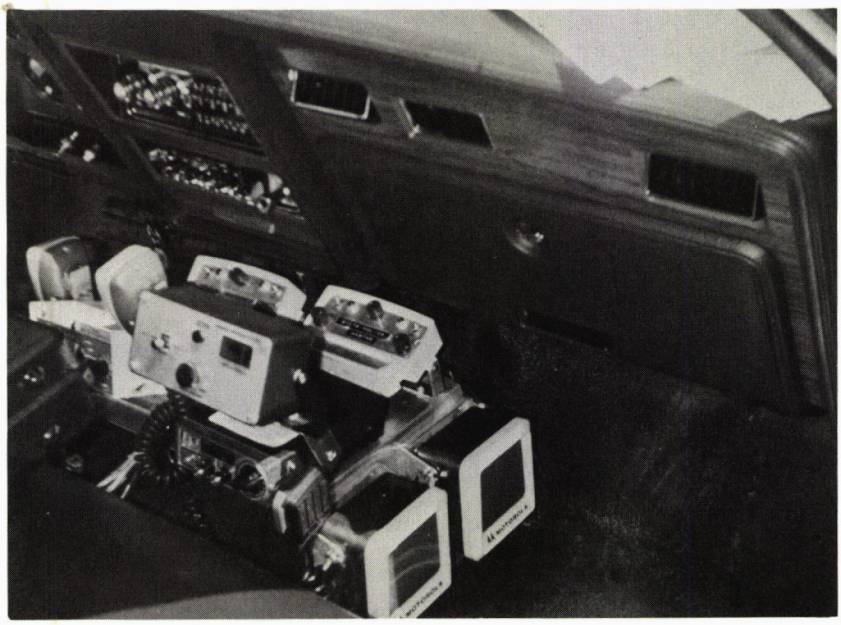


FIGURE 29 Portable crew vehicles in Louisiana are equipped with three radios: state DOT, state police, and CB.

IOWA DEPARTMENT OF TRANSPORTATION
MOTOR VEHICLE DIVISION
OFFICE OF ENFORCEMENT

SCOPE OF RESPONSIBILITIES

I. Purpose

To provide the state enforcement of the laws and rules applicable to vehicular operations on the highways and the proper licensing, titling and inspection of all vehicles registered in Iowa. The office provides assistance to county treasurers on the licensing and titling of all vehicles and assists other enforcement agencies in the enforcement of stolen vehicles.

II. Responsibilities

The Office of Motor Vehicle Enforcement shall perform the following duties and responsibilities:

A. Uniform Field Enforcement

1. Purpose

To enforce laws and rules applicable to the operation of vehicles, primarily commercial vehicles, on Iowa's highways.

2. Responsibilities

a. Inspect commercial vehicles for compliance with the size and weight laws.

b. Inspect motor carriers for proper commerce authority and compliance with established tariffs.

c. Check commercial vehicles for proper vehicle registration and other appropriate permits.

d. Check commercial vehicle operators for compliance with driver license, log book, health certificates and other driver qualifications.

e. Observe all vehicles for compliance with established vehicle safety equipment requirements and traffic laws.

f. Advise and aid permit holders and commercial motor carriers by informing them of violations detected and proper methods of obtaining compliance with applicable laws and regulations.

g. Maintain liaison and cooperation with other state and local enforcement agencies to obtain compliance with applicable laws and regulations.

FIGURE 30 Responsibilities of field enforcement personnel (Iowa).

inspections are performed in addition to vehicle weighing. In North Carolina truck thefts are the responsibility of the enforcement officers. Permits for overweight and oversized vehicles are also issued at permanent weigh stations in some states. Enforcement personnel at port-of-entry stations also make a major check of licensing and fuel taxes.

Observations indicate that, at permanent stations, truck weight enforcement receives higher priority than these additional responsibilities of the enforcement agency. Trucks are weighed and measured simultaneously. Safety inspections are made when the truck is on the scales. If the officer suspects any irregularity other than weight, the truck is held for further inspection. The portable-scale team checks all items when a truck is stopped. The truck is not stopped by the portable crew unless the enforcing officer observes or suspects violation. Figure 31 gives a summary of weight enforcement by portable and permanent weigh teams in Maryland and a breakdown of trucks checked from January to June 1980. Approximately 44 percent of the trucks checked were weighed.

ARRESTS

MARYLAND STATE POLICE WEIGHT ENFORCEMENT SUMMARY

MSP Form #24-9A (3/80) — SCALE HOUSE — PERIOD JANUARY - JUNE 198[illegible]

LOCATION	OVERWEIGHT										OTHER							GRAND TOTAL	TRUCKS CHECKED MEASURED	TRUCKS WEIGHED	HAZARDOUS MATERIALS
	AXLE	REGISTRATION	GROSS	FORMULA	BRIDGE	PERMIT	REFUSED	TOTAL	UNLOADED	RESIDENT	LENGTH	WIDTH	HEIGHT	ROAD FUEL	EQUIP.	MISC.	TOTAL				
FOY HILL																					
SALISBURY	32	40	126	4		1		203	30	51	330	1	1	318	29	134	813	1016	28553	11796	25
MARLBORO	23	132	503	5		1		644	30	148	735	3	2	497	109	448	1794	2458	46459	35902	77
TOTAL	55	172	629	9		2		867	60	199	1065	4	3	815	138	582	2607	3474	75062	47698	102
ROV. TOTAL	261	1186	1167	257	54	32	34	2991	643	1445	3710	131	9	3523	653	3362	11388	14379	44918	5483	525
SUBTOTAL	316	1358	1796	266	54	34	34	3858	703	1648	4775	135	12	4338	791	3944	13995	17853	119930	53181	627
DUNDALK MARI.																					
TERMINAL	3	14	11					28		19	10			7	11	12	40	68	373	270	1
GRAND TOTAL	319	1372	1807	266	54	34	34	3886	703	1667	4785	135	12	4345	802	3956	14035	17921	120303	53451	628

FIGURE 31 State police weight enforcement summary (arrests and warnings) for roving patrol and scale house (Maryland).

It is logical and economical for states to use the weight enforcement agencies to enforce all laws that apply to trucks and truck drivers, including checking safety and vehicle registration, driver condition, and fuel taxes at the same time weight and size are checked. All contribute to the overall safety of the highway. The permanent weigh station is the ideal place for these inspections, which should be done, if possible, by personnel from other departments or by police, inasmuch as the primary function of weight enforcement crews is enforcement of weight and size limits.

Permanent Weigh Stations

The number of enforcement officers assigned to a permanent weigh station and the hours of station operation vary from state to state. As discussed previously, a problem exists in getting adequate manpower through the state budgeting process. This is critical in assigning enforcement officers to permanent weigh stations. Louisiana appears to have ideal permanent weigh station operations: 11 or 12 officers are assigned to 8 of 11stations, providing 24-hr operation with 3 or 4 officers per shift. The other three stations have smaller truck volumes, and six officers (two per shift) are sufficient for 24-hr operation. The agency in Washington, which has had problems obtaining additional budgeted positions, has 63 permanent weigh stations and an enforcement force of 71, which permits 24-hr operation only at the port-of-entry stations. This force is not sufficient to operate all the stations, so roving crews must operate several permanent weigh stations within their assigned zone of operation.

Several states reported that only one officer is assigned to operate a permanent weigh station. If it becomes necessary to issue a citation, the station is closed for the time it takes to issue the citation. Florida reported that one officer operates both sides of a divided highway and the station is closed while a citation is being issued. Virginia uses three weigh technicians and one state police officer per shift at permanent weigh stations. The two-story weigh house with a tunnel leading to the other roadway allows one person to control the weighing of both roadways of a divided highway. The state police issue the citation so that the weigh technician does not have to leave his post.

Iowa uses a roving assignment technique, which is best suited to the state highway system. With a grid pattern of both state and county highways, trucks can easily bypass permanent weigh stations. Often a permanent weigh station is open for only 2 hr, during which a reduction in loaded-truck volume usually occurs. All the enforcement officers carry portable scales, so weighing operations can easily be operated on the bypass routes.

Many enforcement agencies establish the hours of operation and assign personnel for permanent weigh stations based on the truck traffic volumes. The routes with the highest volumes of truck traffic are covered 24 hr per day, 7 days per week. Many states on the East Coast report that, as truckers increasingly move to a 5-day workweek, station operations are also being reduced to 5 days. Most states have 16- or 8-hr staggered operations. Truck volumes may be heavy, directional, or almost nonexistent, as can be seen in Figure 32. For effective weight enforcement, operations should be tailored to the truck traffic and the available manpower.

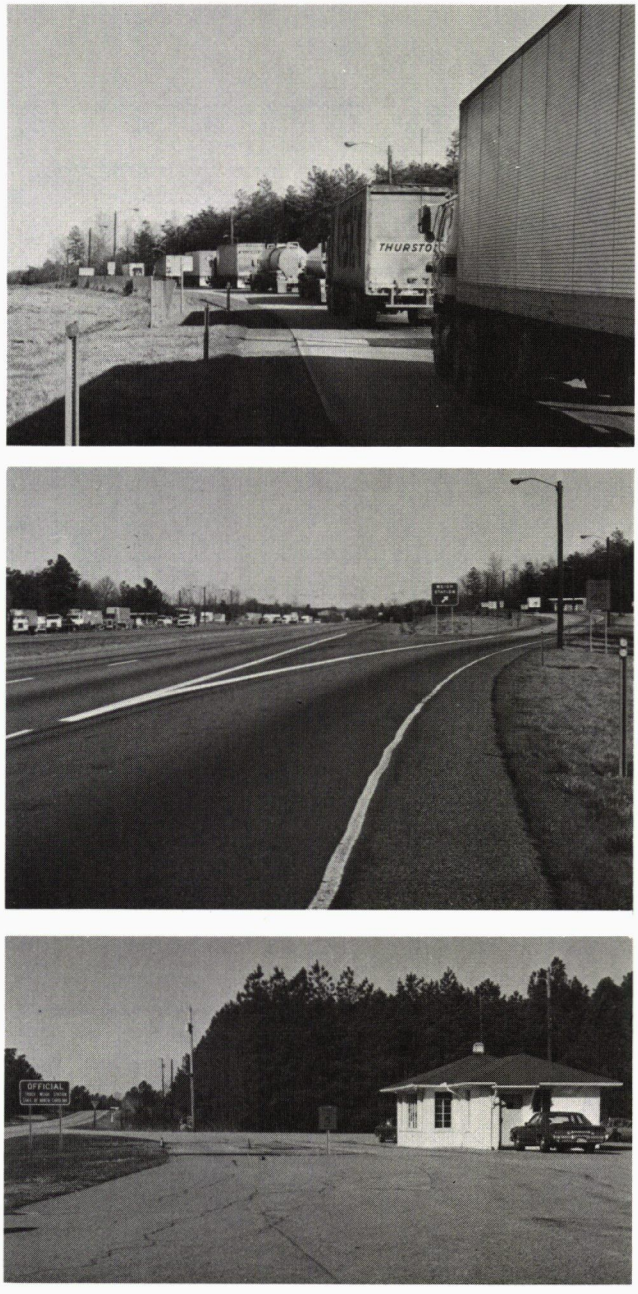


FIGURE 32 Truck volumes at various stations: heavy (*top*), directional (*center*), and nonexistent (*bottom*).

NCHRP Synthesis 68 (11) contains information on the number of scales in operation in each state and their hours of operation. In Arkansas, Nebraska, New Mexico, North Carolina, Pennsylvania, and Utah, all permanent weigh stations operate continuously. In 13 other states, some stations operate continuously—three in California and five port-of-entry stations in Washington, for example. Thus about half of the states operate stations around the clock. Eleven states operate weigh stations daily but at reduced hours (8 or 16), and 21 states randomly operate permanent weigh stations. It should be noted that many states may be using random operations because of the lack of manpower. The data in Table 4 indicate the manpower problem in many states. Those states with around-the-clock operations use

considerably fewer portable weigh crews. Arkansas and Louisiana use 35 and 32 portable crews, respectively. For permanent weigh stations to be properly staffed, the truck traffic flow must be considered.

Portable-Scale Operations

The number of portable scales operated by state enforcement agencies generally refers to the total number of portable wheel scales (*9, 11*). The operations for both the permanent and portable scales are discussed in *NCHRP Synthesis 68 (11)*. Table 4 shows the number of crews used by each state in 1979.

Portable weigh crews are usually composed of either one or two enforcement officers. In Virginia the crew consists of a weigh technician and a state police officer. Maryland portable weigh crews consist of one state police officer from the truck weight enforcement division and two cadets. The cadets work with the weighing operation, usually for less

TABLE 4
NUMBER OF POSITIONS COMPARED TO WEIGH OPERATIONS

	Positions[a]	Permanent[b] Scales	Portable[b] Crews	Semiportable[b] Crews
Alabama	55	0	11	0
Alaska	--	10	6	0
Arizona	14	13	2	0
Arkansas	181	18	35	0
California	166	49	80	0
Colorado	127	26	2	1
Connecticut	16	7	2	4
Delaware	6	1	0	2
District of Columbia	--	2	3	0
Florida	84	21	38	2
Georgia	101	12	48	0
Hawaii	0	0	5	0
Idaho	81	23	7	0
Illinois	132	33	0	4
Indiana	110	23	25	0
Iowa	95	37	18	0
Kansas	63	7	10	9
Kentucky	88	15	79	0
Louisiana	184	12	32	0
Miane	7	0	34	0
Maryland	73	3	15	2
Massachusetts	16	0	12	0
Michigan	88	17	81	0
Minnesota	49	8	9	0
Mississippi	184	40	15	0
Missouri	195	39	16	0
Montana	57	37	17	3
Nebraska	68	15	1	0
Nevada	--	10	15	0
New Hampshire	--	4	44	0
New Jersey	29	4	23	0
New Mexico	158	17	8	1
New York	156	0	40	10
North Carolina	173	19	174	0
North Dakota	93	12	21	0
Ohio	73	23	15	0
Oklahoma	21	9	33	0
Oregon	85	66	39	0
Pennsylvania	26	3	13	0
Rhode Island	--	0	3	0
South Carolina	23	9	12	0
South Dakota	20	8	0	10
Tennessee	125	13	47	0
Texas	156	6	132	2
Utah	60	10	4	0
Vermont	6	4	10	0
Virginia	121	28	20	0
Washington	71	63	63	0
West Virginia	55	3	15	0
Wisconsin	36	24	55	0
Wyoming	--	27	0	0

[a]Data from Page 43, GAO Supplement to Ref. 9.

[b]Data from 1979 Certifications to FHWA.

than 1 year, before attending the state policy academy. Each crew is equipped with 2 to 10 wheel loader scales. In Arkansas two portable scales and wooden ramps are used. Georgia, Louisiana, Maryland, North Carolina, and Virginia equip portable crews with six scales (see Figure 33). In Florida, Iowa, and Washington, the weigh crew consists of one enforcement officer. In Iowa and Washington the officer also operates fixed scales. In many cases the crews use unmarked vehicles and weigh only those trucks that are identified by an experienced officer as potentially overweight, which probably accounts for the fact that the citation rate is considerably higher in the portable crew operation (see Table 5).

In most states the enforcement force is divided into districts and the district supervisor assigns the crew to an area of operation. In North Carolina the portable weigh crews operate from the permanent weigh station under the supervision of the lieutenant, who is also responsible for the permanent weigh station. Most states employ enforcement personnel from the area of operation because enforcement officers are more familiar with the road system and the truck operations of their own areas. However, some state agencies claim that if enforcement officers are too familiar with local truckers, enforcement effectiveness may decrease. In Louisiana, to improve the effectiveness of enforcement, all areas of portable operation are assigned by the central office. Enforcement officers are assigned, on a rotating schedule, to all parts of the state, and assignments are kept confidential until the day of operation. This method of operation, although effective in small states, may be difficult to administer in large states.

The area that a crew is expected to cover is generally determined by the truck volumes on roads. Thus, in the less populated areas of a state, a crew may operate in as many as five counties. Several portable weigh crews may be assigned to counties with high volumes of truck traffic. Often many portable weigh crews will be temporarily concentrated in a small area of the state in order to prevent their being bypassed by trucks. This procedure is primarily used in the enforcement of seasonal trucking operations or in areas of habitual violations. The number of crews available influences the size of their areas of operation. Portable weigh crews in Iowa and Washington operate several permanent weigh stations on a roving basis in the assigned area.

Highway mileage within the assigned areas varies in accordance with the size and population. Generally the greater the population, the more highways and truck traffic. Most rural secondary highways have low volumes of truck traffic; if there is a shortage of manpower, weight enforcement may be insignificant. The efforts of portable weigh crews should not be wasted on highways (Interstate, state, county, or city) that have few or no problems related to overweight trucks. Truck classification traffic studies are extremely helpful to the enforcement supervisor in establishing and adjusting the size of the portable crew areas of operation. In an effective enforcement program, the daily operations of the trucking industry, as well as of large construction sites and seasonal industries (e.g., agriculture, timber, and coal), are taken into consideration.

The use of the portable weigh crews at night varies from state to state. Some agencies do not weigh at night, claiming that the operation is too hazardous. Other agencies contend that night operation is effective if a weighing site is carefully selected; their crews are equipped with lights for regularly scheduled night operations. A portable weigh crew often uses a safety rest area for night weighing. Close observation of truck movement is essential for effective night operations. It is recommended that all states consider the possibility of establishing night weighing operations, even if they are random.

Semiportable-Scale Operations

Use of the semiportable scale has become more popular in recent years. Although the time required for setting up semiportable scales is greater than that required for setting up a portable wheel loader, trucks can be weighed at a more rapid rate once the scales are in place. Semiportable scales require more space for operation because the vehicle that is used to supply the power for scale operation must be near the scale. If the scale is set up in the shoulder area of the highway, space beyond the shoulder is necessary for the power vehicle. Power cables can be plugged into the cigarette lighter of any vehicle. Figure 34 shows the procedure for weighing a truck on a semiportable scale.

The semiportable scale is being used predominantly in those states that operate few permanent scales. Currently 12 states are using these scales, and other states are considering their use. The scales are easily adaptable for use in rest areas. In New York, one of the states that uses semiportable scales instead of permanent weigh stations, eight five-person crews weigh about 114,000 trucks per year. Because of the great number of alternative routes in the state, it is believed that fixed location scales weigh only legally loaded trucks or those trucks whose drivers are unaware that they are overloaded and that a trucker who intentionally overloads the vehicle can avoid the permanently located scales.

Semiportable scales are being used in rest areas in Connecticut until construction of permanent scales can be funded. In Maryland semiportable scales are used at natural obstacles, such as the Chesapeake Bay Bridge and the Susquehanna River Bridge. Some states are providing recesses in the shoulder area for the placement of the scales during operation to avoid poor readings and cable damage by trucks. Iowa is considering the construction of pits in maintenance yards to supplement fixed scales.

Semiportable scales are manned by two to five people, which is about the same number used for the portable scales in many states. Setup time is about 20 min; weighing is continuous, as it is with a permanent scale. A crew can operate at several locations during one shift. The scales are transported on the trailer and can be vertically lowered or raised with a winch. A trailer that has been developed in Maryland tilts so that the scales slide off and on the trailer bed with a boat winch (see Figure 24).

When properly deployed, the semiportable scale is an excellent addition to the enforcement program. Unfortunately, semiportable scales have not been accepted for use in several states because of the problem in obtaining certification of the scales. The Maryland State Police reported that the semiportable scales were put into operation only after about

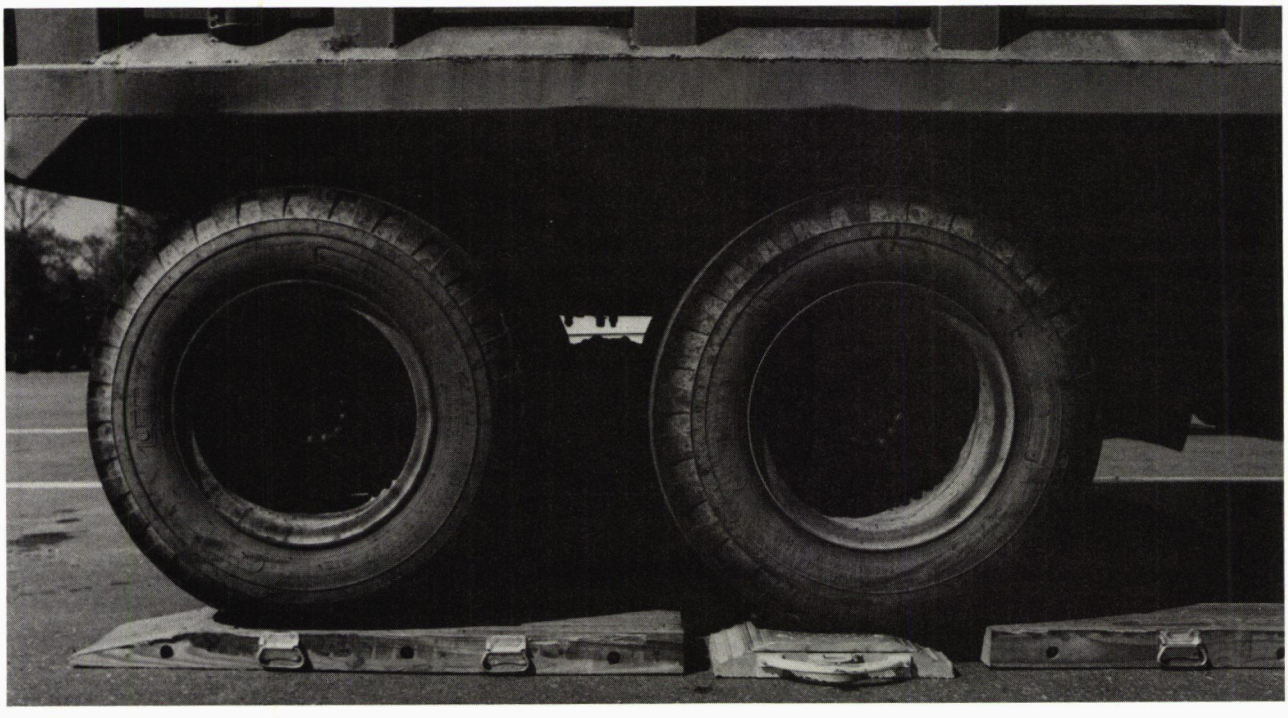


FIGURE 33 Portable wheel weighing. *Top*: Use of six wheel-load scales. The truck is stopped, the scales are placed in front of the outside tires, the truck pulls onto the scales, the enforcing officer reads all six scales, and the truck pulls off the scales and stops. The scales are then removed and placed in front of the rear axles, and the procedure is repeated. Total time for weighing one truck can vary from 4 to 10 min. *Bottom:* The use of two wheel-load scales and ramps. The truck must stop to have each axle weighed, but weigh time may be less because the scales do not have to be moved after each weight is recorded. Once set up, the scales can remain for as long as the crew operates at the location.

TABLE 5
SUMMARY OF PERMANENT AND PORTABLE SCALE OPERATIONS

State	1977 Permanent[a]			1977 Portable[a,b]			1979 Total[c]		
	Trucks Weighed (1000s)	Trucks Cited (1000s)	C/W[d] (%)	Trucks Weighed (1000s)	Trucks Cited (1000s)	C/W (%)	Trucks Weighed (1000s)	Trucks Cited (1000s)	C/W (%)
Alabama				11.0	4.6	41.82	30	5.4	18.00
Alaska	26	0.4	1.54	*	*	*	28	0.9	3.21
Arizona	20	0.2	1.00	*	*	*	484	5.6	1.16
Arkansas	4131	2.3	0.05	35.0	4.8	13.71	3857	8.1	0.21
California[e]	4491	45.7	1.02	79.0	7.6	9.62	4438	59.1	1.33
Colorado	1725	4.0	0.23	0.4	0.1	25.00	2010	6.6	0.33
Connecticut[f]	1	1.0		0.3	0.3		134	5.2	3.88
Delaware							21	0.4	1.90
District of Columbia	2	1.6	90.90	*	*	*	2	1.8	85.70
Florida	3434	24.5	0.71	*	*	*	3700	28.6	0.77
Georgia	263	4.5	1.71	*	*	*	803	13.2	1.65
Hawaii							15	0.3	0.01
Idaho	250	1.0	0.40	17.0	1.0	5.90	177	2.1	1.19
Illinois	5176	30.1	0.58				6337	45.3	0.71
Indiana	813	11.1	1.37	126.0	6.9	5.48	938	11.5	1.23
Iowa	804	15.1	1.88	*	*	*	703	21.9	3.12
Kansas	612	2.2	0.36	20.0	0.7	3.50	466	5.4	1.15
Kentucky	189	5.0	2.65	8.0	1.3	16.50	648	7.6	1.17
Louisiana	1678	6.6	0.39	30.0	5.0	16.67	4675	10.2	0.22
Maine	4	0.1	2.50	4.0	1.5	3.75	12	1.5	1.25
Maryland	310	1.9	0.61	0.8	4.2	52.50	160	7.0	4.38
Massachusetts	11	1.5		*	*	*	13	1.7	13.08
Michigan	1765	3.3	0.19	*	*	*	2042	2.8	0.14
Minnesota	424	5.6	1.32	*	*	*	344	6.1	1.77
Mississippi	8964	7.1	0.08	48.0	2.2	4.58	5107	12.6	0.25
Missouri	3800	9.5	0.25	104.0	0.9	0.87	2765	16.3	0.59
Montana	509	4.2	0.83	22.0	0.9	4.09	458	4.5	0.98
Nebraska	1188	19.8	1.67	14.0	4.6	32.85	1232	16.5	1.34
Nevada			19.27			92.52	17	0.5	2.94
New Hampshire	20	0.5	2.50				11	1.4	12.73
New Jersey	22	4.4	20.00	*	*	*	67	8.5	12.69
New Mexico	3200	1.9	0.06	*	*	*	3215	2.5	0.08
New York	0	0	0	40.0	10.0	25.00	165	15.6	9.45
North Carolina	3680	15.0	0.41	10.0	4.3	43.00	4269	15.3	0.36
North Dakota	937	0.1	0.01	3.0	0.1	4.86	1022	1.9	0.19
Ohio	4851	9.5	0.19	*	*	*	4120	10.9	2.65
Oklahoma	490	4.7	1.00	*	*	*	539	16.3	3.02
Oregon	1066	43.0	4.03	10.0	1.1	11.00	1370	60.2	4.39
Pennsylvania	13	0.4	3.08	*	*	*	43	2.8	6.51
Rhode Island							2	0.1	2.49
South Carolina	314	7.8	2.48	*	*	*	417	9.8	2.35
South Dakota	20	0.3	1.50	*	*	*	60	1.5	0.25
Tennessee	2772	18.0	0.65	693.0	5.0	0.72	3260	28.7	0.88
Texas	436	39.1	8.97	*	*	*	514	45.1	8.77
Utah	1727	3.1	0.18	16.0	1.1	6.88	871	6.4	0.73
Vermont	8	0.2	2.95	2.0	0.1	6.67	22	1.6	7.27
Virginia	6881	11.7	0.17	10.0	1.9	19.00	7607	20.1	0.27
Washington	4047	23.4	0.58	*	*	*	1801	16.2	0.90
West Virginia	76	0.2	0.26	9.0	2.2	24.44	216	3.5	1.62
Wisconsin	1107	11.9	1.07	*	*	*	1004	5.1	0.51
Wyoming	27	0.4	1.48	*	*	*	23	0.8	3.48
Puerto Rico							3	0.6	20.00

[a]Data from Ref. 9.

[b]Asterisks indicate that breakdown between permanent and portable was not available.

[c]Data from state certifications to FHWA.

[d]C/W = cited to weighed.

[e]Represents only loaded vehicles.

[f]Numbers under 1000.

6 months of experimenting, comparing weights with permanent scales, and working with the supplier. The adjustment time currently required should decrease as the scales are improved. It is recommended that state agencies continue their attempts to obtain certification of the scales.

Effectiveness of Three Types of Scales

Because WIM equipment is currently being used as a sorter for the fixed or portable scale, discussion here is limited to the three types of scales used to weigh trucks and issue citations: the permanent platform scales, the portable wheel loader scales, and the semiportable scales. Data for this comparison were drawn from the questionnaire summary of the GAO report (*9*), FHWA certifications, and information supplied by the state of New York.

Of the three types of scales, the permanent platform scale can weigh trucks at the greatest rate. When operated with a WIM for sorting the legally loaded truck from the probable overload, the capacity of the permanent platform scale increases. The portable wheel loader scale takes longer to set up and weighs the least number of trucks per set of scales, but the citation rate is high, primarily because an experienced enforcement crew can detect the potentially overloaded trucks to be weighed. The GAO questionnaire summary contains a breakdown of vehicles weighed and citations issued for both permanent scales and portable crews. Table 5 summarizes the data and shows the citation rate for both types of scales. Also included in the table are data from the 1979 certifications to the FHWA.

The portable crews weigh only trucks suspected of being overloaded. All state enforcement agencies report that an experienced enforcement officer can spot an overloaded truck by the way the load rides on the springs, tire inflation, acceleration, reaction on a grade, etc. The weighing, other vehicle checks, and the issuing of the citation can take as much as 45 min. Crews assigned to large rural areas and on a roving assignment may spot only one or two probable overloaded trucks during an 8-hr shift. Each state should review the records of portable crews to ensure that maximum effort is being expended by each crew.

Data from New York supply the only comparison for portable scale and semiportable scale operations (see Table 6). The semiportable-scale crew weighs about 14,245 vehicles per year, which is about 7 times that weighed by the portable wheel loader crew.

Rates of citations issued by the three different operations vary greatly. The portable wheel loader weighs the fewest number of trucks but has the highest citation rate. The rate of citations issued at permanent weigh stations drops as the number of trucks weighed increases. The only data obtained on the rate of citations issued at the semiportable scales reveal that these rates are well above those of most permanent stations and about equal to those of the portable wheel loader.

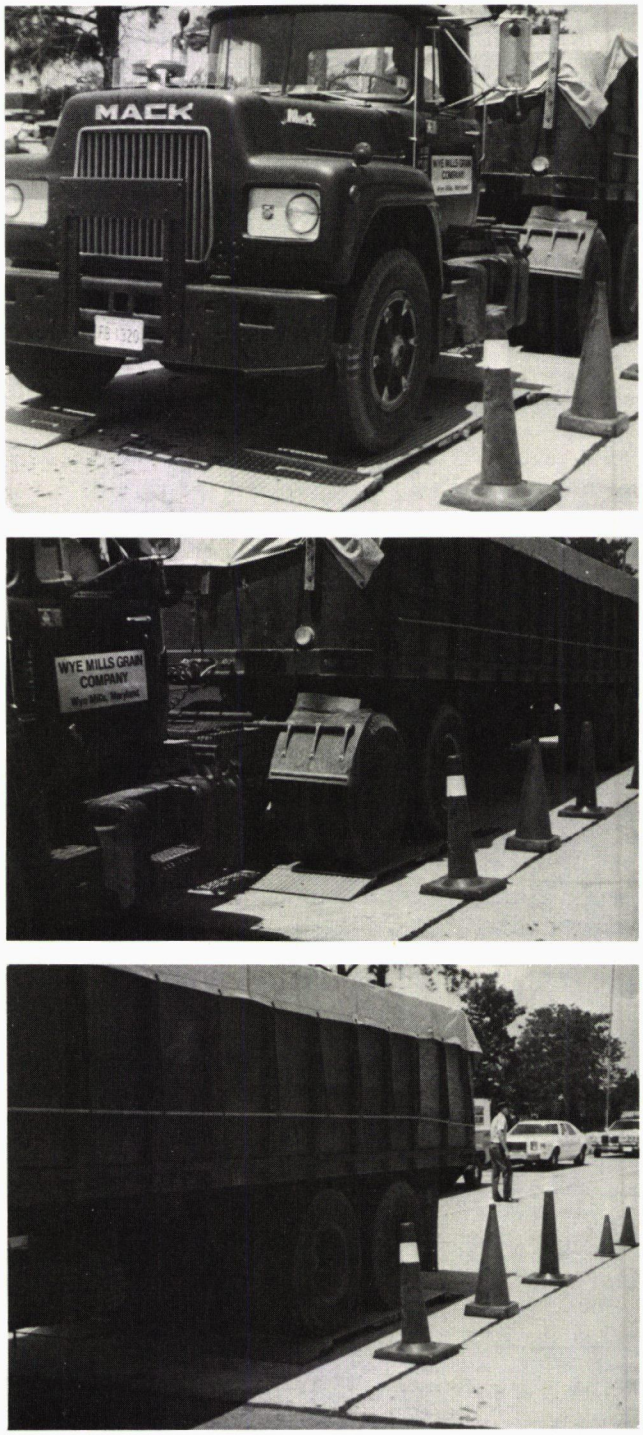


FIGURE 34 Three-step procedure for weighing trucks on semiportable scales.

COUNTY AND CITY WEIGHING

Of the states interviewed, North Carolina is the only one in which trucks on county and city roads are consistently weighed. The state constructs and maintains all the roads within the state; thus trucks are also weighed on the secondary and county road systems. All other state enforcement agencies surveyed reported that, although they have the authority to weigh on any highway in the state, manpower is insufficient for routine weighing on the county or city systems. Most states respond to requests from counties and cities for portable crews on a short-term basis. In Arkansas

TABLE 6
COMPARISON OF PORTABLE AND SEMIPORTABLE SCALES (NEW YORK, APRIL 1979–MARCH 1980)

Type	Vehicles Weighed	No. Crews	Overweight Citations	Cited to Weighed (%)
Portable	52,078	26	10,063	19.32
Semiportable	113,975	8	6,368	5.59

the state crews weigh on request, but the local sheriff's office must make the arrest and issue the citation. Weighing on parish roads in Louisiana is not performed by the state because of lack of manpower; however, some parishes and cities have been aided in training weighing personnel. Local police in Georgia have the authority to detain a suspected violator and call a mobile weigh crew or take the violator to the nearest weigh station.

Few counties and cities have facilities for weighing. Some states report that even counties and cities that have portable scales rarely use them. New York, however, operates portable units on all highways in the state, including county and some city roads. Two counties in the state and New York City have weighing capabilities; this is typical of those states interviewed. At the request of the city of New York, the state has assisted in revamping the city's enforcement program.

Most cities and some counties have enacted local ordinances restricting truck traffic to designated routes. The designated truck routes confine traffic, and the local jurisdiction can provide heavier pavement sections and better maintenance on them.

On many rural county roads the number of overloaded trucks is so small that it may be a waste of manpower to provide even routine enforcement. However, in metropolitan counties the frequency of overloaded trucks can be as great as on any state highway system. The truck traffic on county and city roads should be analyzed as part of a state's comprehensive truck traffic study. State highway departments and state DOTs have a responsibility to advise and assist the counties and cities in their efforts to establish and maintain an adequate truck weighing program.

County personnel do not always cooperate with state agencies in the enforcement of the truck weight laws. Some counties that are permitted to establish their own permit systems will, in order to support a local industry, issue permits that are not consistent with state regulations. Many counties, in an attempt to attract new industries, discourage enforcement. Other state agencies, such as those operating a seaport or a toll road, may also discourage truck weight enforcement.

PUBLIC INFORMATION AND INVOLVEMENT

Most communities are aware that heavily loaded trucks damage their streets and highways. In North Carolina the paving of rural roads was an issue during a gubernatorial campaign several years ago. People in rural areas who use the farm-to-market roads are concerned about heavy-truck damage to the roads and are quick to report suspected overloaded trucks. Many states indicate that citizens report probable overloads; there is much concern if a rated highway bridge is involved. The enforcement agencies have responded to concerned citizens and thus have enhanced their public image.

Because of the actions of a few, truckers are not as well accepted by the public as they have been in the past. There was a time when the trucker was considered the safest driver on the road and trucking firms advertised their safety record on their trucks. However, since the introduction of the 55-mph (88.5-km/h) speed limit, passenger-car drivers observe many violations of the speed limit by trucks. Trucks are getting larger and more powerful, whereas passenger cars are becoming smaller and less powerful. Some truck drivers can be heard on the CB radio downgrading the driver of a small four-wheeler, and some trucks have even intimidated small cars on the highways. Some of the states report that these actions have provided an impetus for automobile drivers to report probable weight and traffic violations to the enforcement agencies.

Not all communities encourage truck weight enforcement. If the economy of a community depends on the movement of natural resources or agricultural products, an enforcement officer can expect harassment from the citizens. The contracting industry also resists enforcement. Many contractors working on federal and state projects believe that they should not be bound by the laws regarding size and weight. The armed services also resist state regulations, expecting wartime privileges on the highways.

Several states report that many private citizens make a living assisting truckers. Some track portable weigh crews; others use electronic equipment to cause electronically operated scales to malfunction. Legal assistance to truckers is the sole practice of many lawyers.

OFF LOADING

The enforcement officer's responsibility does not end with the issuing of a citation. In most states if a vehicle is overweight on an axle or a set of axles but not over the legal gross weight, the load must be shifted and made legal before the vehicle may proceed. In some states the trucker is allowed to proceed at this point without a citation, and in other states a citation is issued. In 42 states, if a vehicle is over the gross weight, enforcement agencies have the authority to require the trucker to reduce the load before proceeding. The California Highway Patrol reports that the off-loading requirement is an effective deterrent to overweight vehicles. Off loading is costly to the owner of the truck in terms of both time and money. Some state agencies report concern for the security of the cargo or personal safety if hazardous or volatile cargoes are involved. Many state laws relieve the enforcement agency of any responsibility for the security of the cargo; if the vehicle is in violation of the weight laws, the cargo is solely the responsibility of the owner and driver.

Although most state enforcement agencies have the authority to require off loading, it is usually performed at the discretion of the arresting officer (*7,9*). Of the 10 states inter-

viewed, 9 require the vehicle to have a legal weight before proceeding. Discretion is used by enforcement officers in the case of livestock and perishable or hazardous cargoes; the trucker is permitted to move this type of cargo to a safer or more convenient location for off loading. Although many portable weighing crews can also exercise discretion and do not require off loading for purposes of highway safety at the portable weighing site, other portable crews do require the truck to proceed to a safer place for off loading. In Virginia the violator is cited and allowed to proceed, delayed only by the time it takes to write the citation. Not using this most effective weapon in truck weight enforcement only weakens enforcement of weight laws.

ADMINISTRATIVE DETERRENTS

Other deterrents have proven effective in the enforcement of weight laws. In Iowa the administrative procedure of motor-vehicle licensing is used as a deterrent to the driver. If a driver is issued five overweight or oversized citations within 1 yr, a hearing will be held to determine possible driver's license suspension. Truck registration and existing permits can also be revoked and future permits denied. These procedures cause problems for the truck owner, the person most difficult to hold responsible in an overweight violation. In Utah permits of habitual offenders are also revoked after a hearing, and requests for future permits are denied.

All states should investigate the use of administrative procedures that affect drivers, vehicles, and owners. If enforcement is to be effective, every legal and administrative procedure should be used to diminish the profit to be gained from running overweight trucks.

ENFORCEMENT TACTICS

Enforcement agencies use subterfuge tactics to catch violators. Unmarked cars are used, particularly in those states that equip the enforcement officer with standard-sized vehicles capable of transporting portable scales. Decoy vehicles are used to divert probable violators to a route on which a portable weighing crew is located. Officers may leave a permanent or semipermanent scale site for a short time and return to catch those trucks that have been waiting upstream for the weighing operation to close down. Some states allow portable crews to set their own hours in order to operate at hours of maximum truck movement. Enforcement officers may set up portable scales near entrances to state highways to catch such vehicles as logging, grain, or coal trucks. CB monitoring can often locate the hideouts of violators. An enforcement officer on a portable weighing crew must be resourceful and knowledgeable about the habits of truckers in order to be effective. This is why some state agencies staff their portable crews with personnel who live in their area of responsibility.

Many truckers who habitually run overloaded use all kinds of tactics to avoid being weighed. One vehicle may be sent to a portable scale or permanent station known to be manned by a single officer. While the officer is citing the decoy and the scales are closed, a convoy of overweight vehicles will pass by the weighing site, later meeting to split the fine assessed on the first truck. On routes close to a state line, overloaded trucks may form a convoy and travel past a scale station at high speeds, inasmuch as there is little chance that a chase car can catch the entire convoy before the state line.

Electronic equipment can cause radios and other electronic equipment to malfunction. Overloaded truckers may use equipment that affects the operation of an electronic scale. They can also pull onto a semiportable scale in a manner that will result in poor readings, and they can run over cables to put the scales out of order. In some states where the use of the loadometer is required, an overloaded trucker may pull onto the scale in such a manner as to break

FIGURE 35 *Top*: The truck driver is out of the cab, attempting to convince the enforcement officer that he cannot back onto the semiportable scale because of clutch problems. *Bottom*: After the enforcement officer advises the driver that he will be issued a citation for failure to be weighed at the weighing site (a mandatory $500 fine), the driver has little difficulty negotiating the 3-in. (75-mm) rise. (The drive axles of this truck were overweight, and the truck was 61 ft [18.6 m] long—6 ft [1.8 m] over the legal length.)

the vertical arm of the scale. If permanent stations are not manned 24 hr per day, an overloaded trucker may wait upstream until the station closes. Some may say they have a bad clutch, claiming that they cannot pull or back onto the portable scales; even drivers with powerful rigs may try to convince the enforcement officer that the truck is not able to pull onto the 2- to 3-in. (50- to 75-mm) rise to get onto the scales (see Figure 35).

Some states reported that scale houses have been shot at and that shields have been installed to protect the officers and equipment. One state reported that a portable crew car was run off the road by a truck. Scale houses are often protected by concrete barriers to prevent truckers from running into them. For these reasons many states have armed their enforcement officers, who must anticipate not only the movements of overweight trucks but also the actions of drivers during the weighing process.

CHAPTER SIX

RECOMMENDATIONS FOR EVALUATION OF ENFORCEMENT PROGRAMS

As there are vast differences among the state truck weight enforcement programs, enforcement agencies need a method for self-evaluation of enforcement programs under current laws. Several methods are discussed in this chapter.

It appears that there is little if any self-evaluation of truck weight enforcement programs by state enforcement agencies, except for reviews of the number of trucks weighed and the number of overweight citations issued. If the trucks weighed and the number of overweight citations increase from year to year, the state enforcement agencies are generally satisfied that their programs are effective. As discussed in Chapter 5, manpower requirements have been evaluated in Iowa since 1968, and the enforcement program has been developed based on research findings for the past 12 yr. Although other states may have research studies for evaluating the effectiveness of truck weight enforcement programs, no information on current research has been available.

Self-evaluation must begin with cooperation within or among the agencies involved: the state DOT, state police, state highway patrol, and other state agencies. An understanding of the physical plant and manpower requirements is necessary if overweight truck violations are to be reduced. The FHWA (*Federal Register*, Vol. 45, No. 154, August 7, 1980) requires each state to develop a program for truck weight enforcement and submit it to the FHWA for approval; state agencies will then be judged on how well they meet their own programs. All state agencies involved must have input and must be included in establishing goals for the program. Because of the great differences among the states, the FHWA's decision to require each state to develop its own truck weight enforcement program appears to be sound. Each state can develop the best program for enforcement based on existing state laws and manpower and budget constraints and can set its own pace for future adjustments for a more effective program.

SHORT-RANGE EVALUATION

The effectiveness of a state's truck weight enforcement program can be evaluated by preparing a checklist to determine if all deterrent procedures available under the existing laws are being administered to the fullest and if the manpower and the physical plant are being used effectively. The checklist could also be used to determine future budget adjustments and changes in the laws. The possibility of minor capital improvements to increase effectiveness could also be evaluated. It is suggested that the checklist include the items listed below.

1. *Fines.* Are violators receiving the maximum allowable fine under the existing statutes? If not, has the department requested assistance through the attorney general's office?
2. *Repeat Offenders.* Are the laws in those states that provide for greater penalties for repeat offenders being administered to the fullest, or is the record-keeping too archaic for an up-to-date list of prior violations and/or convictions? Has the department investigated changes needed to keep records current and taken steps for implementation? Many states use computers to maintain current records for traffic violations; can this equipment be used to record truck weight violations?
3. *Off Loading.* This procedure may be the strongest deterrent available and should be used to the maximum. If off loading is mandatory, is it being used? If off loading is discretionary, what department controls are put on the enforcement officer? What improvements are needed to increase the use of off loading (e.g., space at existing weighing stations or at strategic locations for use by the portable weighing crew)? A careful review of existing rights-of-way may identify space that could be made available to the truck weight enforcement agency.

4. *Motor-Vehicle Laws.* Carefully review existing motor-vehicle laws for provisions to suspend driver's licenses and to revoke truck registrations for repeat overweight violators. Is an overweight citation a traffic violation, and are points assigned in those states that use the point system for traffic violations?

5. *Permits.* Are existing permits revoked for repeated violations of the overweight laws and are future permits withheld?

6. *Permanent Weighing Stations.* Compare the number of trucks weighed with the estimated truck volumes. Prorate estimated volumes for stations that do not operate continuously. Comparisons should be made monthly; if stations are weighing fewer vehicles than the estimated volumes, investigate the possible reasons (e.g., stations that can be easily bypassed). Are sufficient portable or semiportable weigh crews available to deter bypassing? What adjustments can be made within existing manpower constraints? Is the station closed for too long a time when a citation is issued? Can a variable-message sign be used upstream from the station to sort the loaded trucks for weighing on high-volume routes?

7. *Portable Weigh Crews.* The number of vehicles weighed by portable crews varies from state to state. The size of the assigned area and the distance traveled could account for the differences. Assigned areas should be reviewed and adjusted to provide coverage of the major truck routes, limiting the area so that it can be reasonably covered by a portable crew. The list of daily assigned locations should be carefully guarded. Are portable weigh crews operating at night? If not, why not? The problems with safety in night operations have been overcome in many states. If truckers are aware that vehicles are not being weighed at night, they are more likely to move overloaded trucks at this time. Are the crews properly equipped for ease of setup and speedy weighing? Time studies of setup and weighing operations could provide valuable support when requests are made for additional manpower and/or additional scales for the crew. Do the portable weigh crews adequately support the permanent weigh stations and the semiportable weigh crews?

8. *Semiportable Weigh Crews.* Although the semiportable scale has been in operation for only a short time, the assigned areas should be investigated to ensure that enough locations are available for safe operations. For a small capital expense the number of semiportable crews and sites of operation could be increased. Investigate the use of semiportable scales in rest areas, on collector distributor roads, on diamond interchanges, and on arterial highways using existing rights-of-way or acquisition of additional land. Do the assigned areas support the permanent stations, or are they used in lieu of permanent scales? Have they been made an integral part of the total truck weighing program? Are the semiportable scales operated at night? This is a must for an effective program.

9. *Citations.* The time consumed in issuing a citation is significant, particularly in those states in which a permanent station is operated by a single officer. Issuing handwritten citations is time-consuming. Printers are available, and their use would reduce citation-issuing time. The weights for each axle, the date and time of day, and the station location can be automatically printed on a citation form. Truck registration and driver license information would be filled in by the issuing officer. The same printed form could be used by the semiportable crews.

10. *Deployment.* The deployment of the truck weight enforcement plant and force should be reviewed. Are major truck routes covered by permanent stations that are fully supported with portable or semiportable units? Should stations at locations with low-volume truck traffic be phased out or used by portable crews for random operations? How well are the seasonal truck volumes covered? Can the semiportable scales handle seasonal operations? Night operation of all types of scales, even if random, is needed for effective deterrence of overweight trucks.

11. *Manpower.* Semiportable and portable operations require at least two enforcement officers per shift. The permanent weigh stations require two enforcement officers per scale unless the operation is handled by a single scale house. The personnel should be bona fide peace officers who are uniformed, armed, and empowered to make arrests. Training of officers should include a police academy curriculum with emphasis on truck weight enforcement. Two officers are needed to ensure that the station or crew can operate every day; however, additional personnel such as weigh technicians would improve the capability of the crew or station. Supervisory personnel should make frequent field visits to determine the effectiveness of their crews.

In some states it may be difficult to budget positions for additional enforcement officers. The agencies involved must cooperate to convince budget analysts and legislators of the need to preserve the highways and bridges through an effective truck weighing program. An all-out campaign may be required, including a professional presentation of the deterioration of the roads and bridges.

12. *Coordination Among States.* Periodic meetings of agency personnel from neighboring states will greatly enhance the effectiveness of truck weight enforcement programs. These conferences may provide long-range goals for uniformity of state weighing procedures; however, the short-range daily operations should be the first order of business. Placing permanent weigh stations in both directions of a highway at the border of adjoining states is a waste of manpower and facilities. If states cooperate, it may be possible to eliminate the weighing operation on the outbound roadway. Discussions on permit handling, flagging, and marking could also lead to more uniformity of weighing procedures. The meetings should also include discussions on increased uniformity of existing state weight laws.

LONG-RANGE GOALS

When a state prepares its annual enforcement program for FHWA review, some long-range goals should be included. The following list of such goals also contains some suggestions that are based on observations made in the preparation of this synthesis.

Weight Enforcement Laws

1. Provide for centralization of the weight enforcement programs under the state DOT or separate division of state police or state highway patrol.

2. Use the assessment system, and collect stiff penalties at the site of the violations, thus eliminating court proceedings and appearances.
3. Use the collected fines to maintain the transportation program.
4. Establish and use mandatory off loading.
5. Revoke driver's licenses and truck registrations.
6. Consider an overload violation a traffic violation and assess points.
7. Establish reciprocal arrangements for permits with neighboring states.
8. Use the maximum weight set by Congress for the legal weight limit, and establish uniformity with neighboring states on size, length, and truck-trailer configurations.
9. Provide for vehicle marking to comply with the ASSHTO guidelines.
10. Reduce or eliminate the annual and 90-, 60-, and 30-day permits.
11. Eliminate permits for divisible loads (especially annual permits).

Site Operation

1. Establish the truck routes; review the truck patterns annually.
2. Design the permanent weigh site for the loaded truck volumes. (California is one of the few states that has prepared criteria for site selection.) It is necessary for a state to forecast for the permanent station a truck volume that is reasonable in the foreseeable future. Volumes should be established for sites both with and without WIM equipment. For site selection, use natural barriers (e.g., rivers and swamps) to the fullest extent possible.
3. For improved estimates of truck population and the tonnage passing through a permanent weigh station, equipment should be installed to provide a continuous printout of the vehicles weighed and the total weight of each vehicle. It is essential that a complete record of scale operation be maintained. (A recent Minnesota state law requires a record of all vehicles weighed.)
4. When scales are closed for the issuing of a citation at stations manned by one enforcement officer, a record should be made of the length of time the station is closed. A time clock could be attached to the sign or signal that allows trucks to pass unweighed.
5. Carefully study expanded use of the semiportable scale, and consider sites for safe operation. When planning location of sites, queuing areas for trucks waiting to move onto the scales should be considered. Trucks could be sorted visually by an enforcement officer or with the use of a variable-message sign; it is essential to weigh all loaded trucks, not just a random sample. For a relatively small capital expenditure, a van could be used to house the scale equipment and a printer and provide space for the officer to write the citation and examine other documents. This would improve the effectiveness of the crew and also permit operation in inclement weather.
6. WIM scales represent a major capital expenditure and should be considered at stations that have a high volume of truck traffic. The use of WIM equipment will preserve the platform scales, reduce maintenance and/or replacement, and increase the weighing capacity of the station. If acceptable accuracy can be obtained, low-speed WIM could be used for enforcement and citation purposes. Investigate the use of WIM equipment at semiportable-scales sites.
7. Those states currently using WIM equipment as a planning tool should investigate using it for self-evaluation. When WIM is used in traffic planning, the truck population can be sampled at the same time to determine the effectiveness of the enforcement.
8. Investigate the weighing of trucks in motion by using highway bridges as scales. This new method can provide an excellent method for self-evaluation. If set upstream from a permanent weigh station, it can also detect the number and weights of trucks that bypass the permanent weigh station.

Budget

What budget increases for manpower are needed to improve the effectiveness of the enforcement—in other words, to ensure that there is sufficient staff in both existing facilities and new facilities that are planned to be in operation within the budget period? If additional positions are not budgeted, the new facility should be postponed. Many states have existing facilities that are not properly staffed; thus a new facility that may be scheduled to operate only on a random schedule should not be opened. One alternative for improving enforcement may be for the federal government to assist the states with funds for personnel needed to operate the enforcement facilities. There should be a separate fund for weight enforcement; these programs should not be financed by existing federal highway funds. The FHWA is currently engaged in a demonstration program involving four states in which federal aid funds are used to pay the salaries of personnel needed to operate weigh stations continuously. When the program is complete, the results should be carefully examined with the purpose of providing future federal aid funds to all states for truck weight enforcement.

Weighing on county and city roads is minimal at the present time. Even though most states have difficulty providing the manpower and facilities needed to enforce the truck weight laws on the state highway system, state agencies should conduct studies to address the problem of truck weight enforcement on county and city streets. The goal of each state should be to include all truck weight enforcement procedures under a single agency that operates on the total highway system of the state. This would ensure uniform application of a state's size and weight laws. Here again federal funding may be required; many cities are on the verge of bankruptcy, and rural counties cannot afford to fund a normal highway maintenance program.

OTHER EVALUATION METHODS

Several other methods can be used to evaluate the effectiveness of a truck weight enforcement program. Although several of them have not yet been tested in the field, they may be useful for experimentation by some state agencies.

Agencies should determine the loads that are causing damage to highways and bridges. In most states the number of trucks that are being weighed has been emphasized, and truck traffic counts and projections have concentrated on the total truck population. However, concentrating on loaded trucks, as is done by the weight enforcement agency in California, may be the solution. As discussed in Chapter 2, overweight truck surveys should be conducted to determine the heaviest overloaded trucks; these are the ones doing the damage and the ones that need to be stopped. The data from the surveys would provide the information for determining which type of weighing facility is most effective. The survey data can be used to compare the probable with the actual number of overloaded trucks cited during a given time period and to compare the probable with the actual locations. Many states that have permanent weigh stations committed to weighing large volumes of trucks may want to use this comparison over a given period of time. The overall effectiveness of the permanent weigh stations can be measured by reviewing the comparison data from all the stations.

It has previously been noted that a printer can be put on-line with the digital scale readouts to provide a complete record of the number of trucks and the weight of each truck that pulls onto the scales. With some modification, this equipment could be used with semiportable scales. Portable crews could use punch cards that would be recorded on the computer for a complete record of weight enforcement operations. This record could provide a measure of the effectiveness of the penalty structure and the off-loading requirements.

Independent truck weighing surveys should be conducted without truckers' knowledge by those state agencies using high-speed WIM equipment or using highway bridges for weighing in motion. Some experimentation may be needed to perfect hardware that can operate without manpower. The data from the survey would provide an excellent method to determine (a) if the enforcement program is controlling the overweight trucks, (b) if the enforcement facilities are being deployed efficiently, and (c) if a state is using the most effective mix of the several types of scales available.

For budget planning purposes a state could evaluate the effectiveness of the enforcement manpower by conducting a study to determine the optimal staff needed for a predetermined level of enforcement. A study of how to increase the productivity and effectiveness of the enforcement officer could also be done; it would be valuable in determining the number of personnel actually needed.

The above methods can provide state agencies with better insight into the effectiveness of their truck weight enforcement programs and can aid in increasing the number of loaded trucks weighed and the number of citations issued. The goal of enforcement should be to deter the overloaded truck.

CONCLUDING REMARKS

Some of the recommendations for improving truck weight programs depend on the ability of state DOTs and enforcement agencies to convince the state legislatures that truck weight enforcement is essential to the maintenance of highways and bridges. However, a healthy state economy includes the transport of products and commodities within and among states, and legislatures will react to issues that aid the overall economy of the state, which may not always favor truck weight enforcement.

Without the dedicated, persistent truck weight enforcement officers, as observed in the states visited during the preparation of this synthesis, the highway system would have deteriorated long ago. A strong truck weight enforcement program will keep the honest trucker honest, although the habitual offender will always attempt to evade detection. Size and weight enforcement is similar to speed enforcement; oversized and overweight trucks will not be entirely eliminated but will be deterred if the enforcement agency effectively uses the available tools.

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APPENDIX A

MARYLAND DOT SPECIFICATIONS FOR INSTRUMENTATION

Instrumentation:

The instrumentation shall be completely solid state incorporating a continuously integrating logic system and housed in an approved console enclosure. All reference to instrumentation in the following sections pertain to those assemblies or sub-assemblies which are necessary to provide all weighing functions associated with a three (3) scale configuration. (Axle, gross, etc.)

All instrumentation, excluding the printer shall be packaged in an instrument console. The console shall consist of an upright cabinet which will contain the three (3) individual readout module mounts (scale drawer) and the control readout module mount (drawer.) The cabinet shall be mounted on an assembly, designed to position the cabinet ten (10) degrees from vertical. If operating temperature limitations require forced ventilation, the fan or blower must be mounted in the base. Where fan or blower assemblies are required, air filter units with changeable filter elements will be supplied.

The individual readout module mounts (scale drawer assemblies) will be the lower three elements in the instrument console. They will be identified as instruments one through three corresponding to respective platform identification. Each identical readout module mount (scale drawer) shall be a rack mounted assembly which can be pulled from its normal position to facilitate service and calibration.

All electronic components shall be circuit board mounted. Each individual circuit board must be a plug in type sub-assembly identified by the manufacturer's assembly number. Interconnecting wiring shall be kept to a minimum by use of a master circuit board. Each circuit board shall contain clearly identified test points which are easily accessible.

The readout module mount (scale drawer) shall incorporate the following:

A. Digital Automatic Zero Maintenance
B. Pushbutton Zero
C. Digital Automatic Motion Detection
D. Pushbutton Calibration Check
E. Pounds/Kilograms Selection and Indication
F. Overcapacity/Behind Zero Indication
G. Momentary Loss of Power Indication
H. Weight Display
I. A Master On-Off Power Switch, with indicator
J. Reset Switch, for reset of system in event of failure

Gradual accumulation of foreign material on the scale platform will be automatically compensated for by instrument circuitry. The range or sensitivity of this feature will be internally adjustable. A cutoff switch shall be provided on the chassis to disable the circuit for testing and calibration purposes. There shall be a clear indication when this mechanism is in operation.

The readout module mount (scale drawer) front panel shall contain a pushbutton zero switch. Actuation of same will update instrument zero memory.

Each individual read out module (scale drawer) shall contain an automatic motion detector. If the instrument (scale) is not within + - three divisions, a separate output signal to the control drawer will inhibit initiation of print cycle. The digital motion detector shall be a separate plug in circuit board.

The front panel of each readout module (scale drawer) shall be equipped with a pushbutton calibration check switch. Depressing the switch will provide an offset voltage to derive a digital readout which will be approximately thirty percent of the scale capacity. This check value will maintain tolerance to within + - 0.25%.

Each readout module (scale drawer) shall be equipped with a selector switch which permits direct readout of weight in both the avoirdupois and metric system. This shall be a direct conversion with no other adjustments being necessary. The selector switch shall not be accessible from the front of the readout module (scale drawer.) The readout module (scale drawer) shall include a visual indication of which mode has been selected.

Individual readout modules (scale drawers) shall include visual indication of overcapacity and behind zero conditions. Overcapacity shall inhibit display of readout (blackout) and inhibit printer at 105% of capacity. Behind zero conditions shall have a sufficient number of indications that are clear, definite, accurate, and easily read.

In the event of momentary loss of power a visual indication on the readout module (scale drawer) front panel shall be provided to indicate that the above condition has occurred.

Each readout module (scale drawer) shall include a digital weight display. The display shall have an indicating capacity of five active digits with one fixed zero. Each digit will be no less than .5 inches high and shall indicate numbers that are clear, definite, accurate, and easily read.

Integration of the three readout modules (scale drawers) into a working system shall be as follows: The weigh periods or cycles of each readout module (scale drawer) shall be synchronized to provide display update periods not to exceed 1.5 seconds. In addition, all three readout modules (scales drawers) displays shall update together + - 250 milliseconds.

The Control Readout Module (drawer) shall be the top assembly in the instrument Console. As with the readout module mounts (scale drawers), this unit must be a rack mount. The control readout module (drawer) will provide the following controls and indication:

A. Display of total weight (all scales in use - combined)
B. Selection of automatic and manual print modes
C. Master zero set switch
D. Out of motion indication
E. Overcapacity/behind zero indication

The control readout module (drawer) shall be a microprocessor based assembly to reduce hardware requirements and increase reliability. In addition to normal software requirements, the unit will be equipped with software diagnostics to facilitate fault location. The control package shall include an accumulator and necessary sequencing to accumulate total weight.

The control module (drawer) front panel will include a digital display which continually updates to reflect total weight applied to all three associated platform scales. The display assembly shall be identical to those used in the individual readout modules (scale drawers) to reduce spare parts requirements.

Controls shall be provided on the front panel of the readout module (drawer) to provide for selection of two print modes (manual or automatic).

A. Automatic mode: In this mode, initiation of a print cycle will automatically sequence and control the recording of the three individual scale weights and the total weight.

B. Manual mode: When the manual mode is selected, individual scale weights will be recorded on command by the scale operator. This mode will accomodate any number of entries in any sequence. The recording device shall automatically advance the ticket to the next print line.

The front panel of the control readout module (drawer) includes a pushbutton switch which will zero all three individual readout modules (scale drawers). Or it may contain a pushbutton switch for each readout module.

Automatic print mode - Initiation of an automatic print cycle shall be inhibited if any one or more of the three associated scales is not within motion limitations established by National Bureau of Standards Handbook 44. The print switch will be illuminated and active only when motion conditions are within specifications.

Manual print mode - A manual print cycle shall be inhibited if the selected scale is not within motion limitations as established by Handbook 44. The motion condition of the remaining two scales shall not affect this interlock. The print switch will be active and illuminated when the selected scale is within motions specifications.

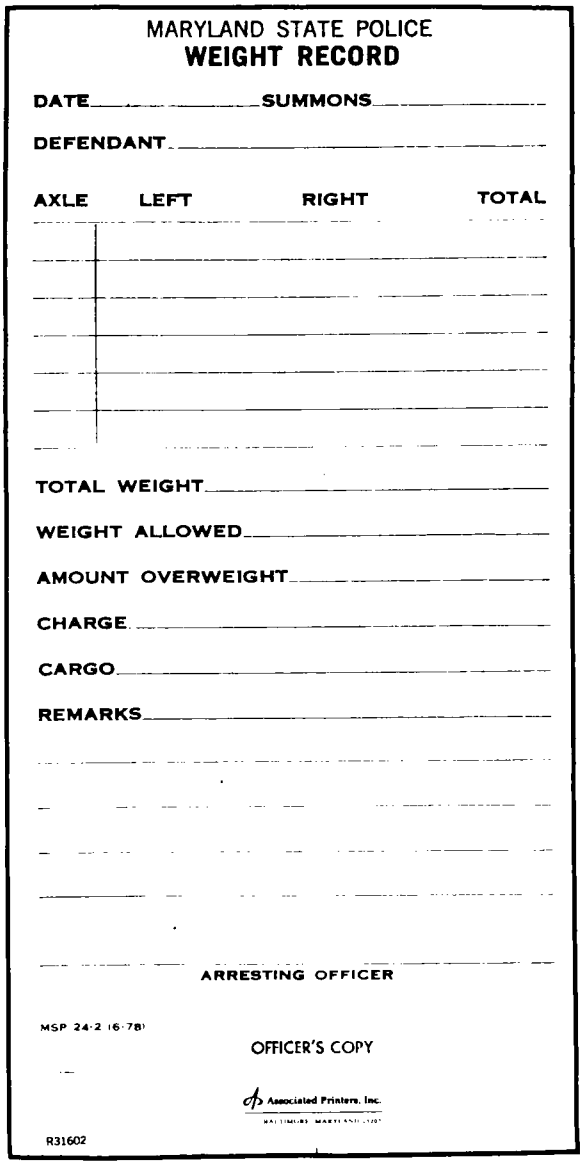
Overcapacity/behind zero indications for control module (drawer) shall be the same as for the individual readout modules (scale drawers). The print interlock, which inhibits printer, shall apply when scales are overcapacity or behind zero.

The printer shall be of solid state design with print size no less than 0.15 inches high and 0.1 inches wide and must accept Maryland State Police Weight Record Form. (Three copies - action paper 4 1/4 x 8 1/4 inches. Copy attached.)

The printer shall always print the same format when the print control switch is in the automatic position. When the all print switch is pressed, the printer shall first print the time and date, followed by the weight from platforms 1, 2, and 3 and their I.D. numbers. The printer shall end the cycle by performing a grand total function to print the total weight of the truck.

All displays shall lock during the print cycle, and the displays shall agree with the printout. In addition, the displays shall automatically unlock when the print cycle is over.

In the manual mode the printer shall be controlled by a platform print pushbutton for each platform, a subtotal print pushbutton for each platform, a grand total pushbutton, and a print release switch.



MARYLAND STATE POLICE
WEIGHT RECORD

DATE _____ SUMMONS _____

DEFENDANT _____

AXLE	LEFT	RIGHT	TOTAL

TOTAL WEIGHT _____

WEIGHT ALLOWED _____

AMOUNT OVERWEIGHT _____

CHARGE _____

CARGO _____

REMARKS _____

ARRESTING OFFICER

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Associated Printers, Inc.

R31602

The individual platform print pushbuttons shall be used to print weights from each of the three platforms. Activation of the first platform print button at the beginning of a new print cycle shall cause the printer to print the time and date as well as that particular platform weight. The circuitry shall be designed such that these buttons shall allow the printer to print only the platform weight once no matter how many times the button is pushed.

The individual platform subtotal pushbuttons will cause the total of all axle weights on the associated platform to be added into the total weight calculations. This weight will not print out on the ticket unless the print pushbutton is also activated. The circuitry shall be designed such that these buttons shall allow the weight on the platform to be subtotaled once no matter how many times the button is pushed.

The grand total print pushbutton shall cause the printer to print the total of all subtotals accumulated during that print cycle and reset all of the platform pushbuttons.

When the print release switch is actuated, platform print pushbuttons and platform subtotal pushbuttons for all three (3) platforms are allowed to be pressed more than once.

Printer must be capable of receiving and performing all automatic or manual functions as directed from the main control module.

Printer shall be furnished with sufficient length of interface cable with a plug in connection to the control module.

Each load cell junction box and instrument shall be provided with the maximum protection available against line voltage spikes, from power company sources, and from near hit lightning strikes.

Load cells shall be protected against permanent damage caused by high transient voltages, by active electronic components. These protective devices shall be placed in the load cells cable connections and in close proximity to the load cell. These devices shall provide conductive paths to protect the strain gauge circuits from permanent damage from any transient high voltages induced in the load cell cable.

A ground rod system shall be provided at the scale location to provide an adequate, low impedance electrical path to true ground and allow proper functioning of the surge voltage equipment placed at the scale location. The ground rod system shall consist of multiple grounding points to provide long term efficiency. The various mechanical structural components comprising the scale shall be grounded to the ground rod system.

Each weighing instrument shall be protected by active protection devices placed in close proximity to the signal input of the instrument. The protection devices shall provide a conductive path for any transient high voltages that appear at the input to the instrument and protect the instrument from permanent damage. The active devices shall also provide a low electrical impedance to ground should the input voltage to the instrument rise to a damaging high level. Each weighing system shall be provided with protective devices placed in the power line to protect the instrument and any auxiliary components from momentarily high voltage surges in the power line that would otherwise cause damage to the instrumentation. Standard power outlets shall be provided on the protected AC line for the operation of any other scale accessories that require surge protection such as solid state printers, etc.

The indicating elements, load cells, load receiving elements, readout modules, and printers shall be adequately protected from environmental factors such as wind, weather, radio frequency interference, and electro magnetic interference which may adversely affect the operation or performance of the device. This protection shall be provided by electronic filtering and instrument shielding.

In operation, the scale after installations must be capable of repetitive weighing of individual rubber-tired truck axles or tandem axles when placed on the platforms. The actual weighing and retention of indication must be accomplished without the aid of an operator or mechanisms dependent upon an operator's presence at the time of the actual placement of the wheels on the scale platform.

The equipment shall be ruggedly designed to function around the clock - 365 days a year and shall be capable of withstanding heavy truck volumes and the year round climatic conditons in the State of Maryland.

All replacement parts needed to make necessary repairs must be available for a period of not less than ten (10) years from delivery date. The successful bidder must notify the Commander of the Truck Enforcement Division, Maryland State Police, in writing, three (3) years prior to the proposed discontinuance of parts.

All materials and equipment shall conform to these specifications.

All materials and equipment furnished under these specifications shall be new.

The weighing equipment and any accessory items must meet all applicable specifications, tolerances and technical requirements of National Bureau of Standards Handbook 44.

The weighing equipment and all accessory items must be compatible with any and all weighing equipment that would be installed at some future date in a stationary platform scale by any of the major manufacturers of scale equipment.

Equipment shall be suitable for the environment in which it is used including but not limited to the effects of wind, weather and radio frequency interference.

All wire and cable used in the installation shall conform to applicable sections of the Insultated Power Cable Engineers Association for the various types required. Electrical wiring shall be in accordance with the National Electrical Code and applicable state and local electrical codes.

Successful bidder shall furnish five (5) standard operating manuals for the scales and each accessory item.

APPENDIX B

WASHINGTON STATE PATROL: SIZE, WEIGHT, AND LOAD LAWS

Washington State Patrol
SIZE, WEIGHT, AND LOAD--CHAPTER 46.44

Outside Width (46.44.010)
Eight Feet (96 inches) inclusive of load for all vehicles

Tolerances:

1. Rear View Mirror - five (5) inches
2. Rubber fenders - two (2) inches
3. Tires (due to expansion) - two (2) inches
4. Safety appliances (clearance lights, rub rails, binder chains) - two (2) inches
5. Appurtenances (door handles, door hinges, and turning signal brackets) - two (2) inches

Maximum Length (46.44.030)
Single vehicle - forty (40) feet with or without load

Except:

1. The permanent structure of a single vehicle in combination not to exceed forty-five (45) feet; forty-seven (47) feet with monthly, quarterly, or annual special motor vehicle permit.

   Exception: Refrigeration units placed on the front of van trailers

Combination of vehicles:

1. The overall length of any combination consisting of a *nonstinger steered tractor and semitrailer shall not exceed sixty-five (65) feet. A *stinger steered tractor and semitrailer shall not exceed sixty-five (65) feet without load and seventy (70) feet with load.

2. The overall length of combination of vehicles consisting of a truck and trailer or any lawful combination of three vehicles shall not exceed sixty-five (65) feet with or without load; seventy-five (75) feet with monthly, quarterly, or annual special motor vehicle permit.

   *Stinger steered shall mean a tractor and semitrailer combination, which has the coupling connecting the semi-trailer to the tractor located to the rear of the center line of the rear axle of the tractor.

3. These length limitations shall not apply to vehicles transporting poles, pipes, machinery, or other objects of a structural nature that cannot be dismembered, and operated by a public utility when required for emergency repairs of public service facilities or properties.

Maximum Length of Protrusions (46.44.034)

1. Front - Three (3) feet
2. Rear - Fifteen (15) feet beyond last axle

Combination Limits - Two vehicles (46.44.036)

1. Exceptions: (46.44.037)

   a. Truck tractor, semitrailer, and trailer in combination.

   b. Truck tractor, semitrailer, and semitrailer in combination (B train)

      (1) The converter gear (dolly) may be pulled behind a tractor and semitrailer in lieu of a full trailer.

   c. Three trucks or three truck tractors in double saddle-mount position.

Gross Weights - Tire

1. 550 pounds per inch width (46.44.042)

   a. Tire having a width of twelve inches or more shall be allowed a twenty percent tolerance above 550 pounds per inch. (Tire size chart on Page 7 of this pamphlet.)

Excess Weight - logging trucks operating on a permit (46.44.047)

1. Only the three-axle tractor and two-axle pole trailer are allowed to have the permit and are valid only on State primary and secondary highways authorized by the State Department of Transportation.

   a. A map is issued showing the approved routes.

2. An additional six feet of wheelbase is given if the combination is thirty-seven feet or more between the first and last axles.

3. 1,600 pounds tolerance on dual axles.

4. 6,800 pounds tolerance on the combination.

5. Permit may be transferred ($5 fee).

6. Cities and counties may issue a "County Log Tolerance" permit for county roads.

   a. May charge a $5 fee.

   b. Shall designate the routes to be used.

c. Issued on a yearly basis, expiring March 31 of each year.

d. Any person, firm, or corporation using any city street or county road for the purpose of transporting logs with weights authorized by the State highway log tolerance permits, to reach a State highway route, without first obtaining a city or county log tolerance permit when required by the city or county shall be subject to the excess weight penalties.

Special Permits for Oversize or Overweight Vehicles (46.44.090)

1. Issued by Department of Transportation for State highways--by local authorities with respect to the public highways under their jurisdiction.

Gross Weight Limits of Special Permits (46.44.091)

1. 22,000 pounds on a single axle.

2. 43,000 pounds on any group of axles more than 3 feet 6 inches apart and less than 7 feet apart.

3. Weight limits may be exceeded on highways designated for greater weight.

4. Construction equipment may exceed the above with large pneumatic tires.

Special Permit Width Limits (46.44.092)

1. 14 feet on a two-lane highway

2. 32 feet on a multiple-lane highway: Except multiple-lane highways with physical barrier serving as a median divider not in excess of 20 feet.

3. Exceptions:

   a. May be exceeded on highways designed and constructed for greater widths.

   b. May be rescinded during an emergency.

   c. 16 feet on a two-lane highway during daylight hours when the weight does not exceed 45,000 pounds.

   d. Buildings in excess of 14 feet may be moved not to exceed five miles.

Oversize Permits - Fees (46.44.0941)

1. Annual permit for 75 feet in length - $60.

   a. Permits are not restricted to hours or days.

Gross Weights (46.44.041)

1. Single axle - 20,000 pounds

2. Single drive axle garbage trucks - 22,000 pounds with additional tonnage permit

   a. Not valid on interstate system

3. Tandem axles - 34,000 pounds

   a. Axles spaced less than 7 feet must oscillate

4. Three-axle vehicle - 40,000 pounds

   a. Weight in excess of 40,000 pounds, allowed by additional tonnage permit, determined by tire size and wheelbase table.

5. Vehicle combinations - 80,000 pounds

   a. Weight in excess of 80,000 pounds, allowed by additional tonnage permit, determined by tire size and wheelbase table, using overall and internal spacing.

Wheelbase Table (46.44.041)

1. Overall measurement is from the center of the front axle on a vehicle or combination of vehicles to the center of the last axle on vehicles or combinations of vehicles.

2. Internal measurement will include groups of axles, and groups of two consecutive sets of tandem axles.

   a. Tandem axles will not be split when measuring internal spacing.

3. Minimum wheelbase - three feet, six inches, except axles spaced less than three feet, six inches may not exceed the maximum weight allowed for a single axle (46.44.050).

4. When inches are involved in wheelbase measurements, under six (6) take lower, six (6) inches or over, take the higher weight.

5. Steering axle weights are determined by tire size (46.44.042).

6. No enforcement tolerance will be allowed.

7. To determine license gross weight and additional tonnage weight, follow the examples of overall and internal measurements. Apply the total number of axles in the overall or internal measurement and apply this to the appropriate columns on the table for gross weights.

8. Establishes a grandfather provision for vehicle or combination of vehicles in operation on January 4, 1975, to operate with weights on two consecutive sets of dual axles in effect by law on that date. This provision will allow 32,000 pounds on a tandem axle and a combined gross weight of 73,280 pounds for certain combinations.

Combinations operating under the grandfather provision will be required to purchase a license gross weight tonnage of 74,000 pounds. A five axle combination with a minimum overall wheelbase measurement of 44' 6" would be allowed 73,280 pounds. Combinations with less than 44' 6" wheelbase, their weights will be determined by the enclosed vehicle loading chart. As in the past, we will not measure internal wheelbase on vehicles operating within the weights allowed by the grandfather provision. No tolerance will be allowed over these weights.

Additional Tonnage Permits (46.44.095)

1. Issued by the Department of Transportation.

2. Permits are issued annually with fees reduced by 1/12 or monthly instead of quarterly ($37.50 per thousand pounds).

   a. Permits may be transferred - fee $5.

   b. Seasonal vehicles may purchase permits quarterly. Must purchase a minimum of 6,000 pounds.

3. Temporary additional tonnage permits may be purchased for a minimum of five days at $1 per day for each 2,000 pounds.

4. Violated permits to be sent to the Department of Transportation upon third conviction.

Additional Tonnage Permits - Cities and Counties (46.44.0941)

1. Cities and counties may issue permits for operation on roads or streets under their jurisdiction.

2. Allowed on state roads by endorsement.

Mandatory Fines for Overloading (New Section--Chapter 46.44)

1. Penalties apply to tires (46.44.042), log tolerance permits (46.44.047), special motor vehicle permits (46.44.090 and 46.44.091), additional tonnage permits, axles, wheelbase, vehicles and combinations of vehicles (46.44.095), failure to obtain, display, or misrepresentation of permits (46.44.090 and 46.44.095).

2. Violation is a misdemeanor and is punishable as follows:

   a. Basic fine:

      (1) First violation - not less than $50.

      (2) Second violation - not less than $75. In addition, the court may suspend the license registration.

      (3) Third violation - not less than $100. In addition, the court shall suspend the license registration.

      (4) For license registration suspension purposes, first, second, and third violations are within any twelve-month period.

(5) In no case may the basic fine be suspended.

b. Poundage penalty (in addition to basic fine)

(1) Three cents per pound, provided that upon the first violation within a calendar year, the court may suspend 500 pounds on each axle, up to a maximum of 2,000 pounds on any combination of vehicles.

c. For license suspension purposes, bail forfeitures are given the same effect as convictions.

d. Convictions are figured on a calendar year and must be on the same vehicle or combination of vehicles.

e. Penalties for violation of a posted limitation (winter restrictions)

(1) First violation - not less than $150

(2) Second and subsequent violations - not less than $150 and, in addition, the court shall suspend the license registration for not less than 30 days.

f. Vehicles or combinations of vehicles of which the owner or operator represent as being disabled or otherwise unable to submit to immediate weighing will be sealed or marked. Removal of the seals, markings, or any part of the load prior to weighing will be punishable by a fine of not less than $500 and suspension of the license registration for not less than 30 days.

Weighing and Lightening

1. May require the operator to stop and submit to being weighed by portable scales or directed to the nearest public scales.

2. May require the load to be reduced to legal limits.

Liability for Overloading (46.44.120)

1. Owner, operator, and any person knowingly and intentionally participating in creating any unlawful condition of use shall also be subject to the penalties provided in this chapter.

Overloading Licensed Capacity - Additional License (46.16.140)

1. It is a misdemeanor to operate a vehicle in excess of the licensed gross weight.

a. Any person who operates a vehicle with a gross weight in excess of the licensed gross weight shall be deemed to have established a new gross weight and in addition to any other penalties shall be required to purchase a new tonnage license covering the new maximum gross weight.

(1) Failure to secure such new license shall be a misdemeanor.

(2) No such person shall be permitted or required to purchase additional gross weight which would exceed the gross weight allowed by law--increasing beyond the legal limits of tires or axles or vehicles.

Overloading Licensed Capacity--Penalties (46.16.145)

1. Establishes statutory fines and penalties for operating vehicles in excess of the licensed gross weight.

   a. First conviction $25 to $50 fine.

   b. Second conviction $50 to $100 fine and the court may suspend the registration.

   c. Third conviction $100 to $200 fine and the court shall suspend the registration for not less than thirty days.

Movement of Farm Implements (46.44.130)

Farm implements of less than 45,000 pounds gross weight and a total outside width of less than 20 feet may move over State highways while patrolled, flagged, lighted, signed, and at a time of day in accordance to rules to be adopted by the Department of Transportation under terms of a special permit to be issued by the Department of Transportation for a quarterly or annual period.

TIRE SIZE TABLE

Subject to the maximum gross weight for axle, axles, and vehicles.

Tire Size	Single Tire	2 Tires (1 Axle)	4 Tires (1 Axle)	8 Tires (2-Axle Duals)	10 Tires (3-Axle Veh.)
8:25	4537.5	9075	18150	36300	45375
9:00	4950	9900	19800	39600	49500
10:00	5500	11000	22000	44000	55000
11:00	6050	12100	24200	48400	60500
12:00	7920	15840	31680	63360	79200
18:00	11880	23760	47520	(Flotation Type - Used Singly on Drive Axles)	

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

VEHICLE WEIGHT TABLE

Drawn in accordance with Chapter 189, Session Laws of 1937
as last amended by Chapter 46 44 Session Laws of 1977
MARCH 1977

No vehicle or combination of vehicles shall operate upon the public highways of this state with a gross load on any single axle in excess of twenty thousand pounds, or upon any group of axles in excess of that set forth in the following table, except that two consecutive sets of tandem axles may carry a gross load of thirty-four thousand pounds each if the overall distance between the first and last axles of such consecutive sets of tandem axles is thirty- six ft or more

Distance in feet between the extremes of any group of 2 or more consecutive axles	Maximum load in pounds carried on any group of 2 or more consecutive axles								
	2 axles	3 axles	4 axles	(Maximum load in lbs. carried on any group of 2 consecutive sets of tandem axles)	5 axles	6 axles	7 axles	8 axles	9 axles
4	34,000								
5	34,000								
6	34,000								
7	34,000								
8	34,000	36,500							
9	39,000	38,000							
10	40,000	39,500							
11		S 41,000							
12		E 42,500	42,500						
13		E 44,000	44,000						
14		45,500	45,500						
15		N 47,000	47,000						
16		O 48,000	48,000		48,000				
17		T 48,500	48,500		49,000				
18		E 49,500	49,500		50,000				
19		50,000	50,000		51,000				
20		B 51,000	51,000	(55,500)	52,000	52,000			
21		E 51,500	52,500	(56,000)	53,000	53,000			
22		L 52,500	52,500	(56,500)	54,000	54,000			
23		O 53,000	53,000	(57,500)	55,000	55,000			
24		W 54,000	54,000	(58,000)	55,500	56,000	56,000		
25		54,500	55,000	(58,500)	56,500	57,000	57,000		
26		55,500	56,000	(59,500)	57,500	58,000	58,000		
27		56,000	57,000	(60,000)	58,500	59,000	59,000		
28		57,000	58,000	(60,500)	60,000	60,000	60,000	60,000	
29		57,500	59,000	(61,500)	60,500	61,000	61,000	61,000	
30		58,500	59,000	(62,000)	61,500	62,000	62,000	62,000	
31		59,000	60,500	(62,500)	62,500	63,000	63,000	63,000	
32		60,000	61,500	(63,500)	63,500	64,000	64,000	64,000	64,000
33			62,500	(64,000)	64,500	65,000	65,000	65,000	65,000
34			63,500	(64,500)	65,000	66,500	66,500	66,500	66,500
35			64,500	(65,500)	65,500	67,500	67,500	67,500	67,500
36			65,500	(68,000)	67,500	68,500	68,500	68,500	68,500
37			66,500		68,500	69,500	69,500	69,500	69,500
38			67,500		69,000	70,500	70,500	70,500	70,500
39			68,000		70,000	71,500	71,500	71,500	71,500
40			68,500		71,000	72,500	72,500	72,500	72,500
41			69,500		72,000	73,500	73,500	73,500	73,500
42			70,000		73,000	74,500	74,500	74,500	74,500
43			70,500		74,000	75,500	75,500	75,500	75,500
44			71,500		75,000	76,500	76,500	76,500	76,500
45			72,000		76,000	78,000	78,000	78,000	78,000
46			72,500		76,500	79,000	79,000	79,000	79,000
47			73,500		77,500	80,000	80,000	80,000	80,000
48			74,000		78,000	81,000	81,000	81,000	81,000
49			74,500		78,500	82,000	82,000	82,000	82,000
50			75,500		79,000	83,000	83,000	83,000	83,000
51			76,000		80,000	84,000	84,000	84,000	84,000
52			76,500		80,500	85,000	85,000	85,000	85,000
53			77,500		81,000	86,000	86,000	87,000	87,000
54			78,000		81,500	86,500	87,500	89,000	89,000
55			78,500		82,500	87,000	88,000	91,000	91,000
56			79,500		83,000	87,500	90,000	93,000	93,000
57			80,000		83,500	88,000	91,000	95,000	95,000
58					84,000	89,000	92,500	97,000	97,000
59					85,000	89,500	93,500	99,000	99,000
60					85,500	90,000	95,000	100,500	100,500
61					86,000	90,500	95,500	101,000	102,500
62					86,500	91,000	96,000	101,500	104,000
63					87,500	92,000	96,500	102,000	105,000
64					88,000	92,500	97,000	102,500	105,500
65					88,500	93,000	98,000	103,000	105,500
66					89,000	93,500	98,500	103,500	105,500
67					90,000	94,000	99,000	104,000	105,500
68					90,500	94,500	99,500	104,500	105,500
69					91,000	95,500	100,000	105,500	105,500
70					91,500	96,000	101,000	105,500	105,500

The Gross Weight of vehicle and load shall not exceed 550 lbs. per inch width of tire. (660 lbs. 12:00 or larger)

The Overall Width of vehicle and load shall not exceed 8 feet.

The Overall Height of vehicle and load shall not exceed 14 feet.

The Overall Length of any single vehicle shall not exceed 40 feet with or without load. The overall length of any combination of vehicle, with or without load, shall not exceed 65 feet. Semi trailers shall not exceed 45 feet.

(Combination of vehicles allowed 75 feet which may contain a 47 foot semi trailer by special permit—RCW 46.44. 0941.)

NOTE It is unlawful to operate upon the public highways any single unit vehicle supported upon 3-axles or more with a gross weight including load in excess of 40,000 lbs or any combination of vehicles having a gross weight in excess of 80,000 lbs without first obtaining an additional tonnage permit as provided for in RCW 46 44 095 PROVIDED That when a combination of vehicles has purchased license tonnage in excess of 72,000 lbs as provided by RCW 46 16 070, such excess license tonnage may be applied to the power unit subject to limitations of RCW 46 44 042 and this table when such vehicle is operated without a trailer

WHEN INCHES ARE INVOLVED Under six inches take lower Six inches or over take higher

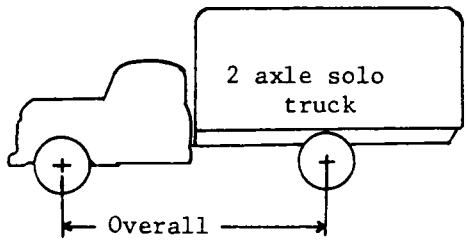
The maximum load on any axle in any group of axles shall not exceed 1 2 times the load given in the above table divided by the number of axles in that group, and shall not exceed the single axle or tandem axle allowance as set forth elsewhere For considering the number of axles in a group the front axle of a unit supplying motive power need not be included in the axle group

The maximum axle and gross weights specified in this table are subject to the braking requirements set up for the service brakes upon any motor vehicles as provided by law

It is unlawful to operate any vehicle upon the public highways equipped with two axles spaced less than seven feet apart unless the two axles are so constructed and mounted in such a manner as to provide oscillation between the two axles and that either one of the two axles will not at any one time carry more than the maximum gross weight allowed for one axle specified in this table

EXAMPLES OF OVERALL AND INTERNAL MEASUREMENTS TO DETERMINE GROSS WEIGHTS

1.



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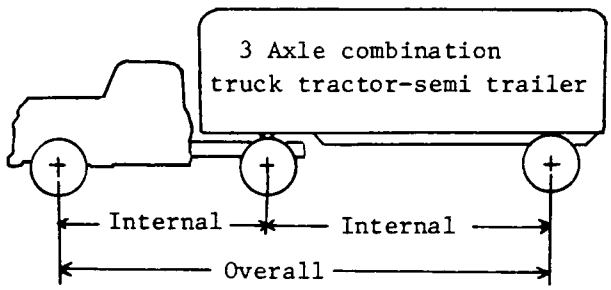

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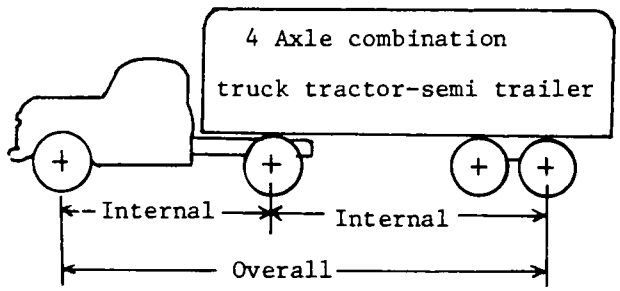

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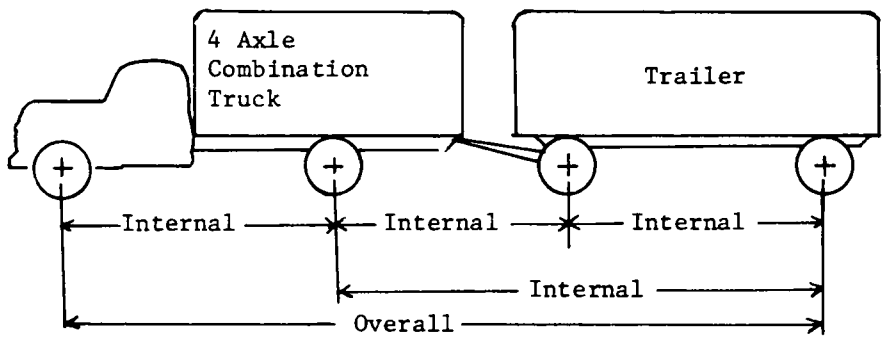

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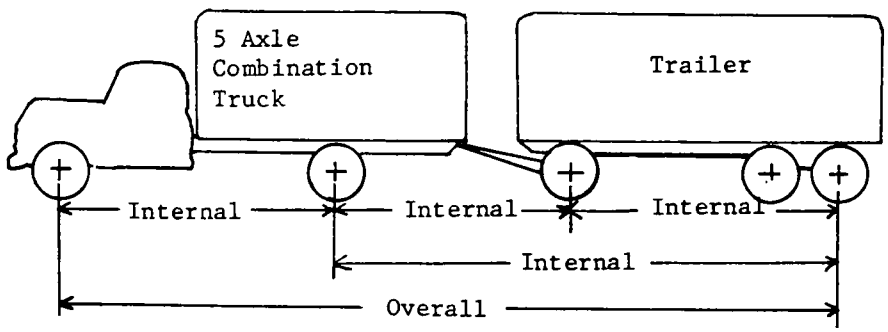

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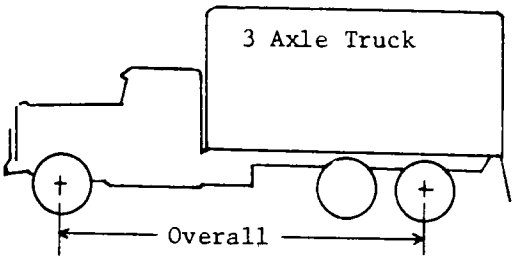

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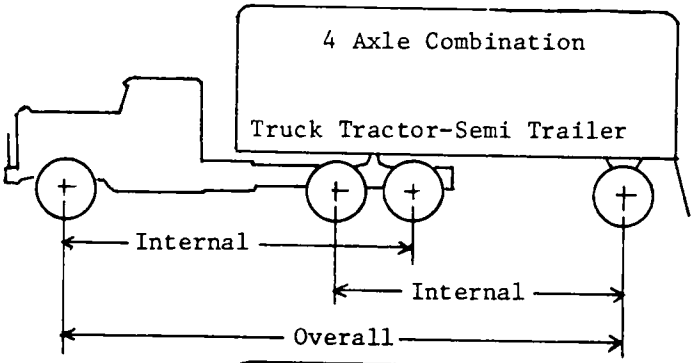
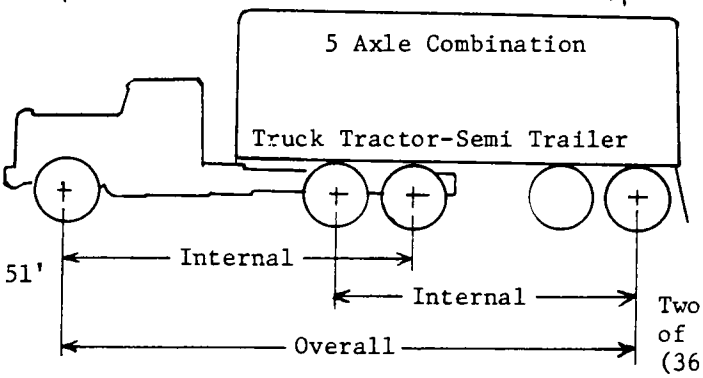


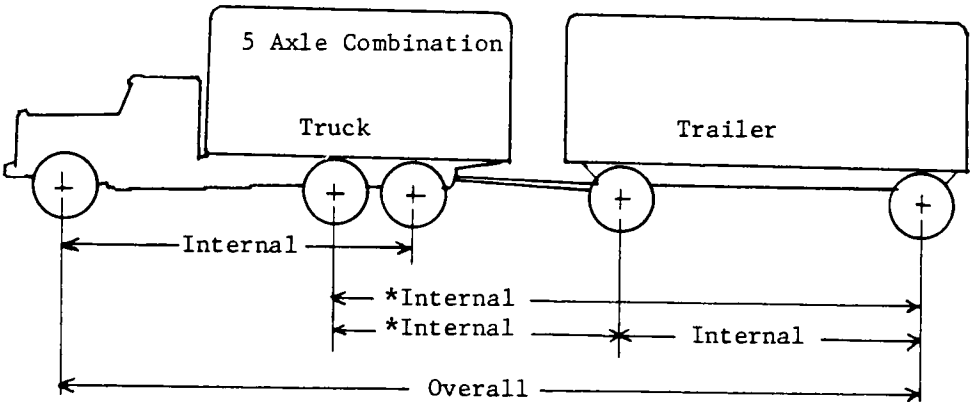
8.



Overall wheelbase of 51' allows 80,000 lbs determined by tire size steering axle

Two consecutive groups of tandem axles (36' allows 68,000 lbs)

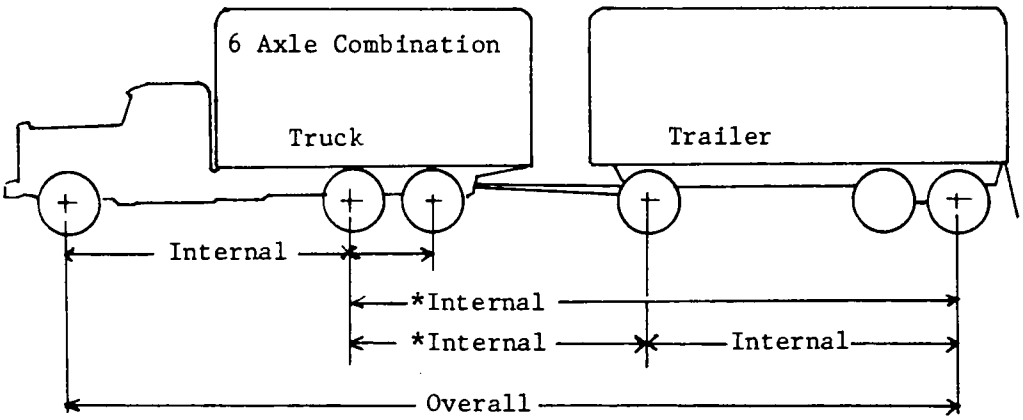
9.



*Indicates the critical measurements

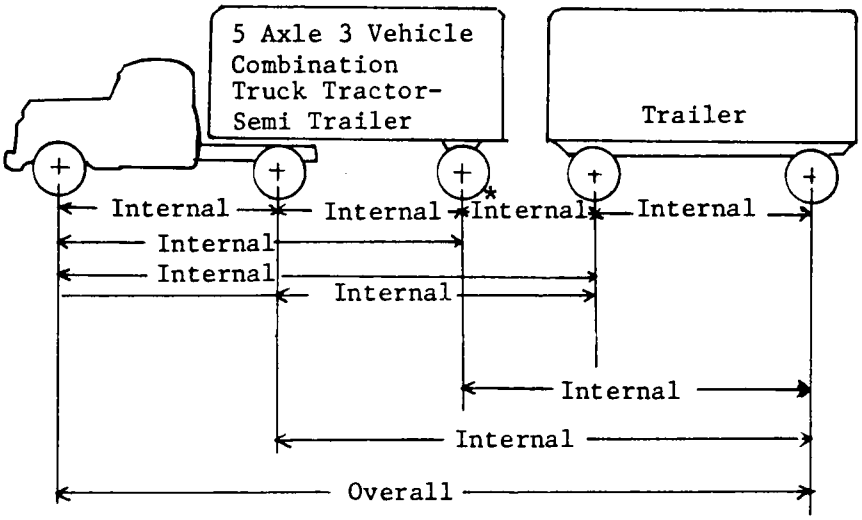
Example: 24' wheelbase from axle 2 to 4 allows by table (3 axle column) 54,000 lbs. 10' wheelbase from axle 4 to 5 allows 40,000 lbs. These two examples for gross weight purposes would be determined by the internal wheelbase from axle 2 to 5. Take the total wheelbase measurement from axle 2 to 5. This would be the critical measurement as 34' from axle 2 to 5 applied to the 4 axle column would allow a gross weight of 63,500 lbs.

10.



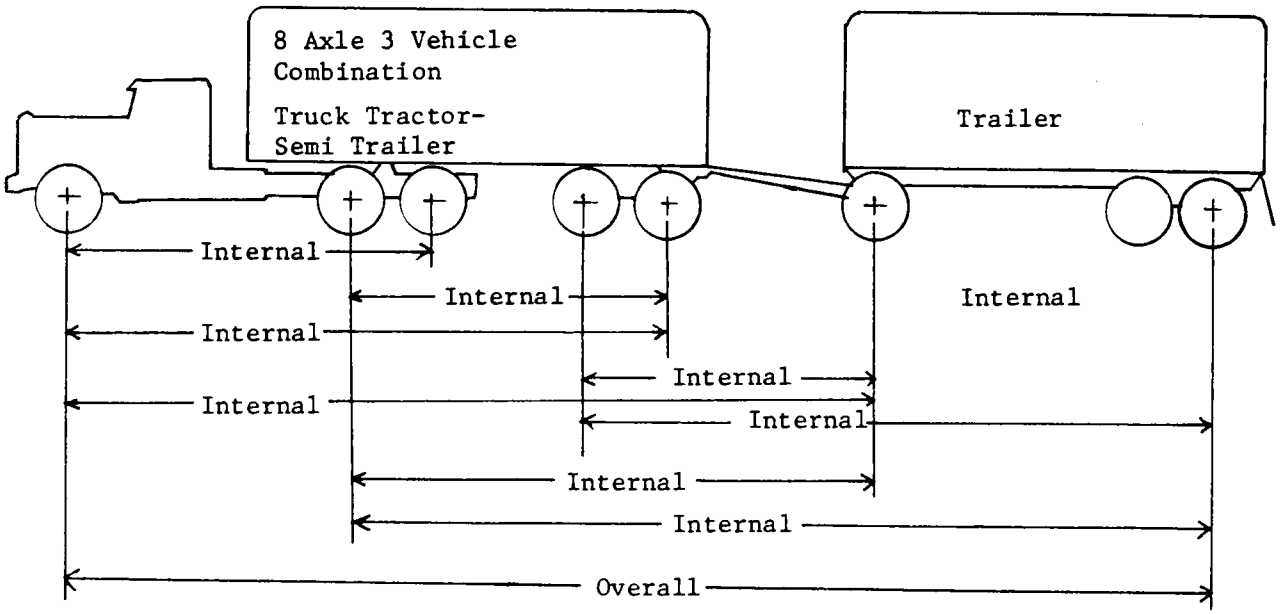
*Indicates the critical measurements

11.

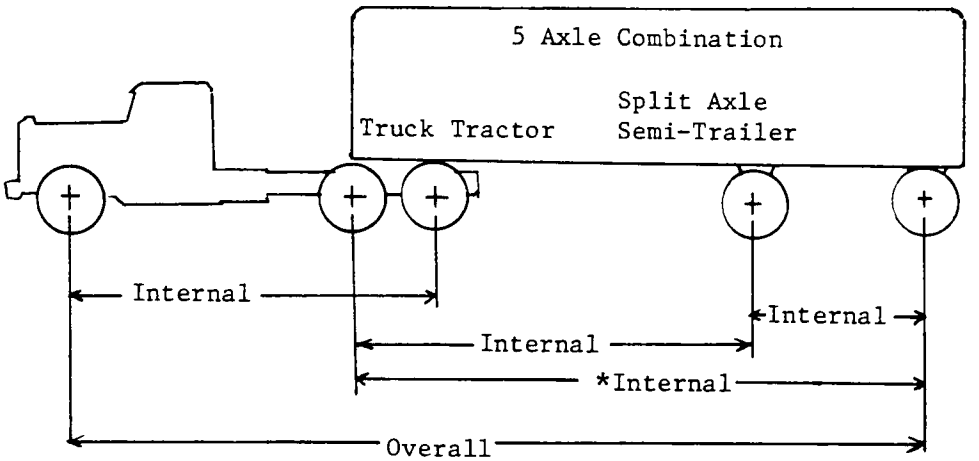


*Indicates the critical measurement

12.



13.



* Indicates the critical measurement

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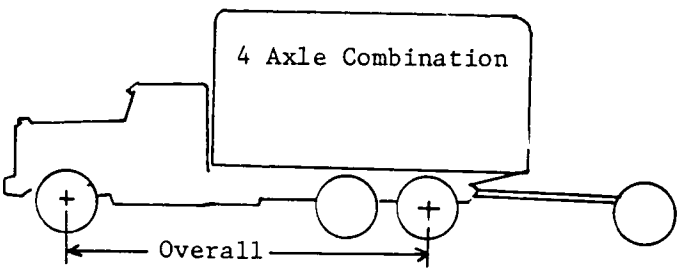

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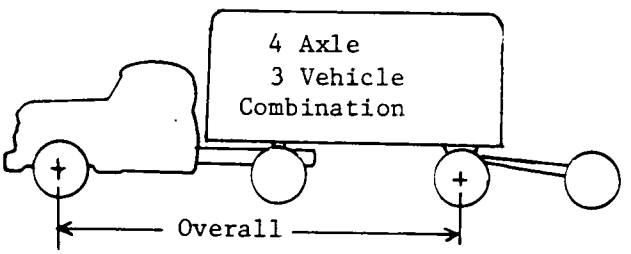

Vehicles towing a dolly axle not designed to support an appreciable part of the load will not be included in the wheelbase measurement for gross combination weight purposes.

APPENDIX C

IOWA DOT PRODUCTIVITY-EFFECTIVENESS STUDY, MOTOR VEHICLE ENFORCEMENT OFFICE

Project Proposal

October, 1980

Office Objectives:

- Enforce Iowa's laws pertaining to the movement of motor vehicles.
- Direct enforcement activity toward achieving a maximum level of compliance with the law.
- Maximize productivity and effectiveness of enforcement activity using available resources.
- Develop an enforcement plan that can be updated and certified annually by the FHWA in accordance with Regulation 23 CFR Part 657 and 658 effective October 1, 1980.

Project Objectives:

- Assist the Office of Motor Vehicle Enforcement in defining productivity and effectiveness measures.
- Assist the Office of Motor Vehicle Enforcement in using these measures to develop operational planning concepts directed toward improving existing productivity and effectiveness and identifying long-range needs.
- Assist the Office of Motor Vehicle Enforcement in utilizing these concepts to facilitate development of an enforcement plan for annual certification by the FHWA in accordance with Regulation 23 CFR part 657 and 658 effective October 1, 1980.

Study Method

- Identify and analyze existing enforcement operations for fixed stations and roving patrols.
- Identify and analyze existing commercial vehicle movement on Iowa's highways.

- Develop productivity and effectiveness indexes for enforcement operations:

  Current suggestions:

  - Productivity Index = $\frac{\text{Number Trucks Checked}}{\text{Number Trucks Available}}$

  - Effectiveness Index = $\frac{\text{Number of Trucks in Compliance}}{\text{Number of Trucks Checked}}$

- Use these productivity and effectiveness indexes to evaluate existing enforcement operations and identify enforcement needs.

Results:

- Recommendation of an operational plan, method of evaluation and maintenance that will maximize existing enforcement operations with present resources.
- Above recommendation will facilitate the annual certification of Iowa's enforcement program by FHWA in accordance with Regulation 23 CFR Part 657 and 658 effective October 1, 1980.
- Recommendation of an enforcement plan that will identify long-range needs sensitive to maintaining a dynamic productive and effective enforcement operation.

Limitations:

- An initial review of the available truck movement data and comparable Motor Vehicle Enforcement Data during weigh scale operations indicates a dynamic change in the character of truck movements.
- This change may indicate the need for an operational plan that is based on generalized truck movements and identifiable bypass activity.
- Resulting plan would necessitate a high degree of vertical communication in enforcement operations.
- Resulting plan would maximize productivity and effectiveness through operational flexibility within acceptable guidelines.

Schedule:

- Approximately 300 mandays of work will be required to conduct this study.
- Estimated cost is approximately $20,000.
- Initial draft of study should be available by April, 1981.

Cooperation, participation and consistent communication between the personnel in Offices of Motor Vehicle Enforcement and Transportation Research is essential for a successful study and a usable plan.

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