REPORT OF THE
TWIN TRAILER STUDY COMMISSION
To
THE GOVERNOR
And
THE GENERAL ASSEMBLY OF VIRGINIA

COMMONWEALTH OF VIRGINIA
Department of Purchases and Supply
Richmond
1970

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Richmond, Virginia
January, 1970

To: Honorable Mills E. Godwin, Jr., *Governor of Virginia*
and
The General Assembly of Virginia

Pursuant to the provisions of Senate Resolution 464, enacted by the 1968 Session of the Virginia General Assembly, the Twin Trailer Study Commission hereby transmits its report to you. This report was adopted unanimously by the Commission at a meeting held on November 12, 1969. The report is presented in summary form. The principal findings of the Commission are set forth. Attached to the report are copies of the research reports which the Commission had prepared during the course of its study.

Over the last 16 months this Commission has assembled a great deal of information about twin trailer operations in other states. In addition, a complete set of the minutes of the meetings of the Commission as well as minutes of our public hearings are also available. All of these materials are in the custody of the Division of Statutory Research and Drafting.

If you care to discuss this report with the Commission, we would be more than happy to do so at your convenience.

This has been a most interesting assignment. Few public questions have evoked as much emotion as the question of whether twin trailers should be allowed on the highways of Virginia. We hope that the results of our study will be of benefit to you as you consider this very difficult and complex question.

Sincerely,

Alan F. Kiepper
Chairman of the Commission

I. INTRODUCTION

The question of whether to allow twin trailer vehicles, not to exceed 65 feet in length, to operate on the highways of the Commonwealth was clearly posed for the first time in the 1968 General Assembly by Senate Bill No. 11. Senate Bill No. 11 would have added language to §§ 46.1-330 and 46.1-335 designed to allow the operation of combinations of three vehicles of up to sixty-five feet in length on the four-lane highways of the Commonwealth, and other highways when in transit, by the most direct route, between permitted highways. The Bill died in the Senate Roads and Internal Navigation Committee, but led to Senate Resolution No. 464, the directive for this study, which reads as follows:

Be it enacted by the General Assembly of Virginia:

1. § 1. There is hereby created a Commission to conduct a study of the uses and operational safety of combinations of three vehicles, to be known as the Twin Trailer Study Commission.

§ 2. The Commission shall study the following: (a) The economic aspects of permitting the operation in the Commonwealth of combinations of three vehicles of an actual length not to exceed 65 feet, including such advantages as may be derived therefrom by industry, agriculture, communities and ports.

(b) The safety and operational characteristics of this combination on the highways of the Commonwealth.

(c) Whether or not the public convenience and necessity will be served by such a combination.

§ 3. The Commission shall consist of nine members to be appointed by the Governor, who shall also designate the chairman. Members of the Commission shall receive no compensation for their services, but shall be paid their necessary expenses.

§ 4. For the purposes of the study, and notwithstanding any limitation imposed by § 46.1-330 and § 46.1-335 of the Code of Virginia, the State Highway Department, at the request of the Commission, shall issue a permit for the operation of one test combination of vehicles not to exceed 65 feet in length over such routes in the Commonwealth as the Commission, with the concurrence of the State Highway Department and the Department of State Police, shall from time to time designate on the conditions that such records as the Commission may specify at any time concerning the operation of the test combination will be maintained and supplied to the Commission without cost.

§ 5. The Commission may employ such secretarial, technical, clerical, professional and other assistance as may be required to assist in the performance of its duties.

§ 6. All agencies of the Commonwealth shall cooperate with and assist the Commission upon its request.

§ 7. The Commission shall conclude its study and make its report to the Governor and General Assembly not later than November one, nineteen hundred sixty-nine.

Pursuant to this directive, the Governor appointed a Commission to conduct a study and report to him. The nine member Commission, selected by the Governor, includes Alan F. Kiepper, Chairman, Richmond; Felix E. Edmunds, Vice-Chairman, Waynesboro; Harold W. Burgess, Richmond; Robert G. Clifford, Portsmouth; Richard C. Emrey, Glasgow; Douglas B. Fugate, Richmond; Miss Anne Dobie Peebles,

Carson; C. G. Pembroke, Kilmarnock; and John W. Roberts, Richmond.

The Commission began its study of the effects of permitting twin trailers in Virginia with an organizational meeting in Richmond on August 16, 1968. At that meeting a tentative study outline was adopted which called for independent studies in three basic areas:

1. What impact would twin trailers have on the economy of Virginia?

2. How would Virginia roads and bridges be affected by twin trailer vehicles?

3. What are the safety and operational characteristics of the twin trailer vehicles, as compared to single trailer vehicles?

It was also decided to actually operate a specially licensed twin trailer on the highway, as per Chapter 186 to implement the study of area number three.

In subsequent meetings on September 30 and November 7, the members selected Dr. Harmon Haymes, Chairman of the Department of Economics at Virginia Commonwealth University, to furnish a report on the probable effect of twin trailers on the economy of Virginia.

Major J. S. Pearson of the Department of State Police, J. P. Mills, Jr. of the Department of Highways, and John T. Hanna, Director of the Division of Highway Safety, were appointed to serve as a steering Committee to supervise and report on the testing of the twin trailer.

Mr. Douglas Fugate, Director of the Department of Highways, agreed to research the effect twin trailers would have on State roads and bridges.

Mr. E. H. Williams, Vice-President of the Highway Users Association, volunteered to supply a twin trailer from Overnite Transportation Company to be used in the testing.

After several more meetings and much study throughout the winter, which included a February visit to Wallops Station on Eastern Shore to observe the testing, all three reports were sent to the Commission. The reports were reviewed by the Commission which decided to print a number of copies of each and make them available to the public. While the Commission made the reports available to the public, it stressed that the reports in no way reflected the attitude of the members of the Commission but were the result of independent study by three commissioned groups. The reports were, therefore, released without comment by the Commission, and are incorporated into this report as appendices A, B and C, found at the end of this report.

The Commission conducted two well-attended and informative public hearings in August and then held several executive meetings.

We now submit the following findings.

II. FINDINGS

For the purposes of this study, twin trailer combinations are defined as a combination of vehicles consisting of a truck tractor drawing two semi-trailers. The rearmost of these semi-trailers moves over the highway as a full trailer through the use of a converter axle or "dolly" which is equipped with an approved coupling device.

A. From a strictly economic point of view, the preponderance of the evidence gathered by this Commission indicates that the economic progress of Virginia would be benefited by allowing twin trailer combinations to operate over the highways.

B. Twin trailer combinations, not exceeding 65 feet in length and conforming to existing width and weight limitations, may be operated safely and efficiently on four-lane divided highways without interfering with the safety and convenience of motorists.

Because of the complexity of the economic aspects of the use of twin trailers and the limitations of time and resources of this Commission, we feel that further study of the economic impact of twin trailers would be beneficial.

III. REASONS FOR FINDINGS

1. Evidence presented to the Commission indicates that increased flexibility and improved ability to handle low density cargo are advantages inherent in twin trailer operations. These advantages would cause definite and substantial benefits to accrue to many segments of Virginia's economy.

2. The independent study reports initiated by the Commission and testimony received at the public hearings reveal that use of twin trailer units, not exceeding 65 feet in length and conforming to existing width and weight limitations, on four-lane divided highways would not be in conflict with the convenience and safety of motorists.

3. The independent study reports reveal that the use of twin trailer units, not exceeding 65 feet in length and conforming to existing width and weight limitations, on four-lane divided highways would not materially increase the cost of highway and bridge construction and maintenance.

We offer the above findings for the consideration of the General Assembly.

Respectfully submitted,

ALAN F. KIEPPER, *Chairman*
*FELIX E. EDMUNDS, *Vice-Chairman*
HAROLD W. BURGESS
*ROBERT G. CLIFFORD
*RICHARD C. EMREY
DOUGLAS B. FUGATE
*MISS ANNE DOBIE PEEBLES
*C. G. PEMBROKE
*JOHN W. ROBERTS

* See attached statements.

STATEMENT OF FELIX E. EDMUNDS

In the deliberations of the Twin Trailer Study Commission, it was my position that any member of the Commission should be entitled to file a minority report or a supplemental statement as he or she might determine to be reflective of his or her opinion concerning the study.

While I agree in part with the statement of Mr. John W. Roberts and the statement of Miss Anne Dobie Peebles, I cannot concur with these statements for the reason that in my opinion the statements are not entirely responsive to the directive issued the Commission by the General Assembly of Virginia. Both of these statements go beyond the directive and bring in extraneous and irrelevant matter to the study resolution.

I do agree, however, that further and additional study of the complex problem of twin trailer operation on the highways of Virginia is desirable; but the General Assembly of Virginia in its wisdom may and should determine whether further study is necessary or whether legislation can be enacted on the basis of the study report.

I concur and subscribe to the statement of Mr. Robert G. Clifford.

STATEMENT OF ROBERT G. CLIFFORD,

FELIX E. EDMUNDS, RICHARD C. EMREY and C. G. PEMBROKE concurring therein.

The purpose of this statement is to enlarge upon the (a) findings, (b) reasons for findings, and (c) conclusions, in the Twin Trailer Study Report as presented to the Governor and General Assembly of Virginia.

This member agrees with the unanimous conclusion of the Commission; a conclusion, that was reached with the splendid cooperation and good will of all the members, working with an able staff over a period of eighteen months.

The Commission formed into three sub-committees, had an over-the-road test vehicle in commercial use, extensive vehicle testing at Wallops Island, permanent film record of the testing, documented experience records and laws of other states, two public hearings, and volumes of information all pertinent to this study. This statement hopes to emphasize that even with limited funds and time, a thorough study was made quite sufficient to justify the General Assembly to make a decision at this session.

Pursuant to the Commission's purpose the Virginia State Highway Department, and the Department of State Police combined to make a most professional and quality study of twin trailers. Summaries of the conclusions reached in these reports are attached to the end of my statement. The full text of these reports may be found at the end of the Commission's report. They are identified as appendices B and C.

1. The sub-committee report "The Operational And Safety Characteristic of Twin Trailer Combinations" combined study from the following sources:

(a) Film of the Wallops Island testing of twin trailers.

(b) Film of the over-the-road operation of the test vehicle.

(c) An excellent experience study of twin trailers in other states, conducted by the Virginia State Police in 1967 and updated in 1968. This study is titled "Twin Trailer Study—Department of State Police, 1968". This study is a survey of thirty-one (31) states and five toll road authorities with twin trailer experience. Included are some vehicle laws of other states.

(d) Provides a thorough list of twin trailer literature.

2. "Effects of Twin Trailer Trucks on Highway Pavements and Bridges in Virginia" is a report by the Virginia Department of Highways. This report is a part of the Commission's Report. The report's conclusion is attached to this statement.

3. The Study Commissions Report titled "The Economic Impact of Twin Trailer Operations in Virginia" did not offer a conclusion, but it does provide a considerable amount of material, and did stimulate other studies. It is urged this report be read as well as the additional economic studies here listed. These can be obtained from the Division of Statutory Research or the authors.

(a) "Analysis of the Economic Impact of Twin Trailer Operations in Virginia" by Charles F. Phillips, Jr., Professor of Economics, Washington and Lee University, Lexington, Virginia.

(b) "Evaluation of the Statistical and Research Methods of the Economic Impact of Twin Trailers in Virginia" by Paul E. Ambalang.

(c) "The Economics of Twin Trailers" by Clarence R. Jung, Jr., Professor and Chairman, Department of Economics, University of Richmond.

(d) "Research Briefs" by Bureau of Business Research, College of Business Economics, University of Kentucky.

NOTE: (a), (b), and (c) were prepared for the Virginia Highway Users Association.

This Commission Member concludes that:

(a) Twin trailers with no dimensional or weight change other than the ten-foot total length increase, and when restricted to specified highways such as four-lane and direct feeder roads to terminals are as safe or safer than the tractor-trailer combinations now allowed in Virginia.

(b) From studies of other states there would be no additional policing problems, nor would any additional Virginia highway funds be needed because of limitations to specified highways and terminal feeder roads.

(c) Twin trailers will provide some traffic relief to the suburbs and cities. The combinations would be split at the terminals and the shorter single units delivered through the city.

(d) The arterial highway is sufficiently complete in Virginia to justify twin trailer legislation now. No one would expect a great industry rush for twin trailer combinations, but legislation is needed now so that trucking and industrial users can plan capitalization schedules, termi-

nal locations, etc. Virginia's highway program, industrial expansion and the transportation industry can grow and plan together.

(e) The economy of Virginia would, without question, benefit from the authorization of twin trailers. This state's effort to be no. 2 in the east coast port struggle justifies combinations from an economic view. The state of Virginia has spent, and is committed to continue to spend, millions of dollars for port development. The entire state economy will benefit from success in this containerized port development. Twin trailer legislation would be a forward step and helpful in the port development program at this critical time.

Summary of Conclusions reached by the Report on the Operational and Safety Characteristics of Twin Trailer Combinations:

1. Statistical data concerning accident involvement of twin trailers in states permitting twin trailer operations were not available, because the accident reporting forms and procedures do not differentiate between types of tractor-trailer combinations.

2. The majority of officials in states permitting twin trailer operations felt that accident involvement of twin trailers was not any greater than that of standard tractor-trailers; some were of the opinion the involvement rate was less for twin trailers. (Of the twenty-seven states responding to a study questionnaire, sixteen permitted operation of twin trailers on all highways; nine did not; and two did not answer the query on this particular subject. Generally, where restrictions were imposed, operations were limited to inter-state highways, freeways, and four-lane highways with limited egress and ingress.)

3. The capabiliy of the twin trailer combination to be driven in reverse is limited.

4. The twin trailer combination having a total length of sixty-five feet can be turned in a shorter radius than that required by the fifty-five foot conventional tractor-trailer combination.

5. Generally, to an average motorist following or meeting a twin trailer combination on a straight highway, the combination presents an appearance similar to that of a standard tractor-trailer combination.

6. Of all motorists observed passing the twin trailer during the Driver Reaction Survey, 93.5% stated there was nothing different nor unusual about the passing maneuver.

7. During the Driver Reaction Survey, all observed passing maneuvers on four-lane highways were made in a normal manner; 95% of the observed passing maneuvers on two-lane highways were made in a proper manner.

8. During the highway operations, the twin trailer combination tracked accurately without noticeable sway of either trailer.

9. There was relatively little difference in the stopping distances required by the conventional trailer and the twin trailer combination.

10. Apparently, at normal road speeds, tractor-trailers, both conventional and twin, require a much greater stopping distance on wet pavements when they are empty than when loaded.

11. With regard to stability, visual observation indicated that the two units performed equally. However a closer study can be made of the stability of the two vehicles through the use of the motion pictures taken by the State Police.

12. In all maneuvering tests the twin trailer performed as well as, if not better than, the conventional trailer.

(NOTE: The entire report is attached to and part of the Twin Trailer Study Commission Report to the Governor and General Assembly.)

Summary of Conclusions Reached in the Report on the Effect of Twin Trailer Trucks on Pavements and Bridges in Virginia:

1. Pavement thickness and strength would not have to be increased if twin-trailers were permitted in Virginia, provided the present legal limits of 18,000 pounds for single axles, 32,000 pounds for tandem axles, and 70,000 pounds for gross weights remained unchanged.

All axle weights for a given road are equated in terms of an equivalent number of repetitions of an 18,000-pound single axle, the legal limit in most states.

While the study indicated that, because of redistribution of loads to a different axle pattern, twin-trailer operations would result in an increase of approximately 6 per cent in the number of 18,000-pound axle loads, or the equivalent, this would not be sufficient to require a higher design.

2. A slight rise in the cost of maintaining existing pavements in order to assure satisfactory service might be expected because of the increased frequency of axle loads.

3. There would be no appreciable effect on bridges from loads on twin-trailer vehicles as long as present weight limits were retained.

4. Should the safety and traffic studies indicate increased hazard or congestion on existing highways, this study should be extended to determine the effects of such increases on highway financing.

(NOTE: The entire report is a part of the Twin Trailer Study Commission Report to the Governor and General Assembly.)

STATEMENT OF ANNE DOBIE PEEBLES

I cannot affirm too strongly my feeling that certain factors beyond the limitations of time, staff and the financial resources of the Twin Trailers Study Commission require further analysis and study of the impact of Twin Trailers on the highways of Virginia. In no way do I wish to negate or criticize the efforts of the Commission, which has worked long and diligently against many odds on a complex and many-faceted problem; I was a part of that effort and I have signed the Commission's report. Because of the complexity of the problem, the emotional public reaction to the question of twin trailers, and because the enabling legislation creating the Commission somewhat restricted its considerations to specific questions, I wish to outline certain areas of concern to which I hope further exploration can be directed.

The Commission on the Industry of Agriculture and the Commission on the Virginia Ports were conducting their own studies simultaneous to the Twin Trailers Study and no exchange of findings or recommendations was possible. It is further noted that no representative of the Ports or the Industry of Agriculture Commissions appeared at the public hearings of the Twin Trailers Study Commission.

While the Twin Trailers Study Commission received information on the effects of Twin Trailers on bridges and pavements and the insuing costs, the question of the costs of marshalling yards, access roads, etc. for enabling these trucks to use four-lane divided highways was not a part of our study. This has economic bearing on the costs to taxpayers and should be clarified before legislation is considered.

No study was made, due to limited staff, of the projected impact on Virginia highways and on traffic patterns should Twin Trailer rigs be permitted on four-lane divided highways. By this, I mean whether *through traffic* trucking would clog and crowd the North-South Interstates—or the future East-West routes—to the harassment of the average motorist and leading to increased road costs without contributing economic advantages to Virginia industry.

Another area of consideration which demands study beyond the efforts of the present Commission, is that of orderly growth and economic development over the Commonwealth as a whole. Permitting twin trailers on four-lane divided highways may exert artificial stimulation resulting in a concentation of industrial growth through narrow corridors of the State. Safeguards are necessary to insure that this growth is in the interest of our Commonwealth. More funds and staff than the present Commission had at its disposal are required for such exploration.

In my humble opinion, Virginia would profit in the years ahead from further study and planning in so complex a problem in which so many of its citizens have such concern and interest.

STATEMENT OF JOHN W. ROBERTS

I feel that further study of the economic impact of twin trailers would be beneficial in order to bring into focus sufficient information on which to ascertain if and under what conditions twin trailer combinations would be in the public interest. The commission literally ran out of time necessary to study this many-faceted problem.

There is no reason from an operational viewpoint to restrict twin trailers from using two-lane roads, but there is sufficient question as to their safety on two-lane roads that further study should be made in order to ascertain on which of such roads they might be allowed.

The study relating to the economic aspects did not adequately address itself to the point of whether or not the Commonwealth would derive an overall net economic benefit if twin trailers were permitted *only* on four-lane divided highways; so if they were to be limited to such roads, additional study is needed to ascertain if the advantages of such limited use are greater than the disadvantages.

A restriction as to where twin trailers may be used will add economic obstacles, in addition to those already brought out in the study, to the net benefits that would accrue if there were no such limit and will add a number of aspects to the questions which have not been studied. These include an unnatural forcing influence on the location of industry in the future, on the types of truck transportation that will be used (private or common carrier), and on the provision of marshalling yards for making up the trailer combinations and storage of trailer units (with the need for a decision on public policy as to who would pay for them, where they would be permitted, and what type they would be). Channeling of twin trailers onto the four-lane highway system would in-

tensify the adverse effect on the railroads, with the resultant lowering of tax revenues that they contribute to the general funds of the Commonwealth.

Since the common carrier trucking companies make the point that twin-trailer combinations should be permitted "if the trucking industry is not subsidized", the further study should include a study as to the relative contributions to the highway funds made by private and by for-hire carriers, and by Virginia-registered trucks and by out-of-state trucks. It should also include a study as to what the contribution of the for-hire trucks is to the general funds of the state and the relationship of that contribution to that made by the railroads.

The incomplete status of the four-lane interstate and arterial system is such that it will be several years before there could be a substantial use of twin trailers, and, in the meantime, the benefits to segments of the Virginia economy would be minimal. We are fortunate in having time so that a definite conclusion may be made as to (1) whether there are sufficient net economic benefits if twin trailers are permitted only on four-lane roads or (2) whether they are safe when operated on certain two-lane roads.

APPENDICES

APPENDIX A

THE ECONOMIC IMPACT OF TWIN TRAILER OPERATIONS IN VIRGINIA

A Research Study Prepared for the Twin Trailer Study Commission by The Bureau of Business and Economic Research of Virginia Commonwealth University under the direction of HARMON H. HAYMES, B. A., Ph.D.

May 18, 1969

PREFACE

This study was undertaken to estimate what effect the introduction of twin trailers onto Virginia highways would have on the economy of the state. It is impossible to specify in dollars and cents just what effects this relatively small change in transportation technology would have on the economy of Virginia. All we can hope to accomplish in a study such as this one is to set forth the major economic costs and benefits in such a way that they may be compared.

The most difficult aspect of the task lies in the fact that the change being contemplated is a very subtle one, involving only the use of twin trailers in place of or in addition to existing semitrailers of the same maximum gross weight, height, and width. It would be far easier to specify the effects of the use of twin trailers as compared with no freight trucks at all, or to compare the effects of twin trailers carrying larger and heavier loads than existing semitrailers. But the limits of the study were narrowly specified. It was to deal *only* with the use of twin trailer combinations not exceeding 65 feet in length, in place of or in addition to semitrailers of up to 55 feet in length, operating under the same width, height, and weight regulations.

Changes of this nature, however slight, obviously will have economic effects in the realm of highway safety, construction, and maintenance, but these matters are being dealt with by other agencies, and are outside the scope of this study. This study concentrates entirely on how the transportation of freight in twin trailers would affect the economic welfare of the people of Virginia.

In our investigation, we were offered help by the Virginia Highway Users Association and the Virginia Railway Association. They supplied us with much useful material, with a great deal of background information, and with their own views on the subject. We consulted dozens of periodicals, books, and government publications. We wrote to a number of business firms and trade associations in Virginia who had not previously expressed their views, sent out questionnaires to a randomly selected sample of all business firms in the state, and contacted a sizeable sample of all trucking firms in the state. We also wrote to the offices of Governors, to Industrial Development Commissions, and to State Chambers of Commerce in those states where twin trailers are now permitted. We contacted the Virginia State Chamber of Commerce and a number of local chambers in the state. We talked with port authorities about containerization. We also solicited the views of economists in the State Planning Commission and the State Industrial Development Commission. We would like to thank all of the hundreds of busy people who answered our many questions.

THE ECONOMIC IMPACT OF TWIN TRAILER OPERATIONS IN VIRGINIA

I

The Rapid Rise of Trucks

The growth of highway freight transportation in the United States since World War II has been phenomenal. Trucks offer stiff competition to other carriers in long distance hauling, and they are the major means of transporting goods over short distances. Almost all farm produce moves by truck, and within cities, trucks are the only feasible means of moving freight. With the rapid growth in their use, trucks have come to play a major role in the economy. Shippers now pay more in freight charges to trucking companies than to railroads, and a great many ship-

pers own and operate their own trucks. Table I shows that in 1940, motor carriers collected only 17.74 percent of the total revenue of all regulated freight carriers and 75.43 percent went to railroads. By 1966, the American Truckers Association estimated that the share going to motor carriers had increased to 48.50 percent, while the portion received by railroads had fallen to 43.58 percent.

The rapid pace of expansion of highway freight is due in part to the relatively small investment required to start a trucking business. Some trucking companies have been started with a minimum of capital, using very little equipment of their own. They either lease tractors and trailers, or hire drivers who provide their own tractors. A number of giant truck fleets have developed out of such shoe-string beginnings. But truck

TABLE I

REVENUE DISTRIBUTION AMONG REGULATED FREIGHT CARRIERS

Gross Operating Revenue[1] from Transportation of Goods

	Railroads Classes I and II		Motor Carriers Class I, II, and III		Water Carriers Class A, B, C, and Maritime[2]	
	Thousands of Dollars	Percent of Total	Thousands of Dollars	Percent of Total	Thousands of Dollars	Percent of Total
1940	$3,686,375	75.43	$ 867,000	17.74	$ 85,394	1.75
1942	6,166,896	79.86	1,212,700	15.70	65,640	0.85
1944	7,228,979	80.21	1,351,900	15.00	77,835	0.86
1946	5,982,524	74.42	1,654,500	20.58	70,929	0.88
1948	8,271,158	71.14	2,698,100	23.21	190,396	1.64
1950	8,134,568	64.09	3,737,052	29.44	259,	
1952	9,142,896	62.93	4,417,478	30.40	275,570	1.90
1954	8,109,577	58.37	4,737,120	34.10	282,176	2.03
1956	9,320,230	56.81	5,828,877	35.54	335,351	2.04
1958	8,411,737	53.19	6,131,217	38.77	325,548	2.06
1959	8,678,519	50.54	7,144,950	41.61	330,902	1.93
1960	8,390,026	49.39	7,213,911	42.47	335,257	1.97
1961	8,085,468	47.72	7,462,668	44.05	295,887	1.75
1962r	8,343,757	46.48	8,131,117	45.30	292,687	1.63
1963r	8,507,630	45.82	8,458,257	46.04	301,092	1.62
1964r	8,817,090	45.12	9,154,776	46.85	296,766	1.52
1965r	9,286,628	47.86	10,068,243	47.86	314,070	1.49
1966e	9,750,959	43.58	10,853,300	48.50	328,200	1.47

[1] Included are revenues of Federally regulated carriers only; a major portion of the traffic handled by motor and water carriers is not subject to this regulation—for example, not reflected are the revenues or value of service generated by intrastate, local, and exempt for-hire and private motor carriers. The total value of all motor carrier services would approximately triple the 10.9 billion shown in 1966; consequently, this table does not compare the economic significance of different modes of transportation.

[2] Includes only regulated water carriers, and excludes domestic traffic of regulated maritime carriers in coastal and intercoastal service for the years 1939-1947 (data not available for period). Because of changes of various kinds in regulation, reporting requirements, and statistical publication procedures, comparison of early data with 1951 and later years is not strictly valid.

[3] Scheduled domestic service, including mail and subsidy, express, freight, and excess baggage. Comparability of early data with 1950 and later years is limited because of the inclusion since that time of additional domestic air carrier services.

[4] Components may not add to total due to rounding.
r—Revised e—Estimated

Pipelines (Oil)		Airways[3]		Total[4]
Thousands of Dollars	Percent of Total	Thousands of Dollars	Percent of Total	Thousands of Dollars
$225,760	4.62	$ 22,719	0.46	$ 4,887,248
245,061	3.17	31,708	0.41	7,722,005
310,194	3.44	43,654	0.48	9,012,562
293,723	3.65	37,595	0.47	8,039,271
377,034	3.24	89,765	0.77	11,626,453
441,627	3.48	119,984	0.95	12,692,342
562,268	3.87	130,723	0.90	14,528,935
617,463	4.44	146,579	1.06	13,892,915
737,386	4.50	180,508	1.10	16,402,352
720,670	4.56	225,812	1.43	15,814,984
765,232	4.46	252,183	1.47	17,171,786
770,417	4.54	278,118	1.64	16,987,729
786,718	4.64	312,293	1.84	16,943,034
810,605	4.52	372,596	2.08	17,950,762
840,260	4.53	371,384	2.00	18,568,623
865,079	4.43	406,144	2.08	19,539,855
903,817	4.30	463,327	2.20	21,036,085
941,100	4.21	502,616	2.25	22,376,175

SOURCES: Interstate Commerce Commission, Bureau of Transport Economics—Transport Economics, ICC Annual Reports; Federal Aviation Agency—Statistical Handbook of Aviation; Air Transport Association of America—Facts & Figures about Air Transportation; Civil Aeronautics Board—Handbook of Airline Statistics. Estimates for 1966 assembled, in part, by American Truckers Association.

freight is also expanding rapidly due to the flexibility and prompt service it permits. Railroad trains can haul freight only where rail lines and terminals are present; water carriers require navigable waterways and port facilities; and airlines require airports. But freight trucks may pick up and deliver goods wherever public roads and streets are available.

Responsibility for Regulation

It was widely realized years ago that highway freight transportation is such an important element in the economy that whatever affects the trucking industry affects everyone, and regulatory laws have been based on that realization. Like other public carriers, the trucking industry is regulated by local and state governments as well as by the Federal Government. There are regulations concerning weight, height, length, and width of equipment; speed limits; numbers of hours drivers may drive continuously; safety devices required; and rates which may be charged; among other things. Many of these regulations are difficult to enforce, but the laws are sufficiently effective that the trucking industry from its infancy has sought legislative changes to ease restrictions and to make them consistent with new developments in equipment and highway construction.

The limits on freight truck operations are set primarily by state laws, with an occasional restriction on the use of city streets or bridges set by local governments, but the Federal-Aid Highway Act of 1956

places a ceiling on the size and weight of trucks the states may allow to use the National System of Interstate and Defense Highways. That Federal legislation only sets limits, however. It does not require the states to allow vehicles of the size and weight permitted by the law to use the system. The Federal-Aid Highway Act of 1956 provides:

> That any state which accepts Federal-Aid Highway money for construction of the Interstate system agrees not to permit the Interstate system to be used by vehicles having a width in excess of 96 inches, a single axle weight greater than 18,000 pounds, a tandem axle weight greater than 32,000 pounds, and a gross vehicle weight greater than 73,280 pounds except where the existing State law of July 1, 1956, permitted dimensions or weights greater than those four specified limits.
>
> It is to be noted that this provision of Federal law represents a contract between the State and Federal government rather than a Federal law regulating the size and weight of vehicles on the Interstate system. Further, these four provisions apply only to the Interstate system. Therefore, except on this 41,000-mile system (as completed), the use of the National total of 3,500,000 miles of streets, roads, and highways is *wholly controlled by State and local laws.* (Italics added.)[1]

In 1967, the trucking industry attempted to get the limits spelled out in Federal law revised upward, and a bill providing for such revisions (S. 2658) was passed by the Senate, but not by the House of Representatives. In considering the new legislation, however, Congress continued to emphasize the responsibility of the states for setting appropriate size and weight limits to meet their individual requirements.

> The proposed legislation continues the congressional policy of providing limits regarding maximum permissible use of weights and dimensions on the Interstate System in order to adequately protect the Federal investment. This determination is based on and enforced by the States, which continued to bear the ultimate responsibility for permitting vehicles to operate within these weights and width ranges. *The committee most emphatically reaffirms that the responsibility for legal maximum allowable limits and control of sizes and weights of vehicles operating on the Interstate System, as well as on all the other road systems in the United States, rests with the individual States.* The legislation is not intended as a Federal determination that such weights should be permitted, nor does it imply that roads other than those on the Interstate System are capable of carrying loads.[2]

Larger Units—Higher Speeds

The number and size of freight trucks, as well as their gross weight, have become factors in highway capacity utilization in recent years. The available space on highways is not unlimited, and in some areas congestion is already a serious problem. For the carrier, the tractor-trailer units now being used in Virginia and in most other states are far below the optimum size. Except for short-haul deliveries, efficiency continues

[1] Winfrey Robley (Highway Research Engineer, U. S. Bureau of Public Roads), "Some Implications of Motor Vehicle Size and Weight Regulations," SHORT RANGE TRENDS AND THEIR EFFECTS ON TRUCK TRANSPORTATION, American Trucking Association, Department of Research and Transport Economics, 1967, p. 71.

[2] VEHICLE AND WEIGHT AND WIDTH LIMITATIONS—INTERSTATE SYSTEM, 90th Congress, 2nd Session, House of Representatives, Report No. 1636, July 3, 1968, p. 2.

to increase with size up to some point not yet reached. The chart and table below, the results of an extensive trucking cost study by the Highway Research Board, illustrate this point. (See Chart I, Table II)

CHART I

Gross Operating Costs for All Trailer Combinations, Showing Gross Ten-Mile Costs, Payload Ton-Mile Costs for Operations Loaded Both Ways, a Payload Ton-Mile Costs When Loaded One Way with Empty Return Trips.

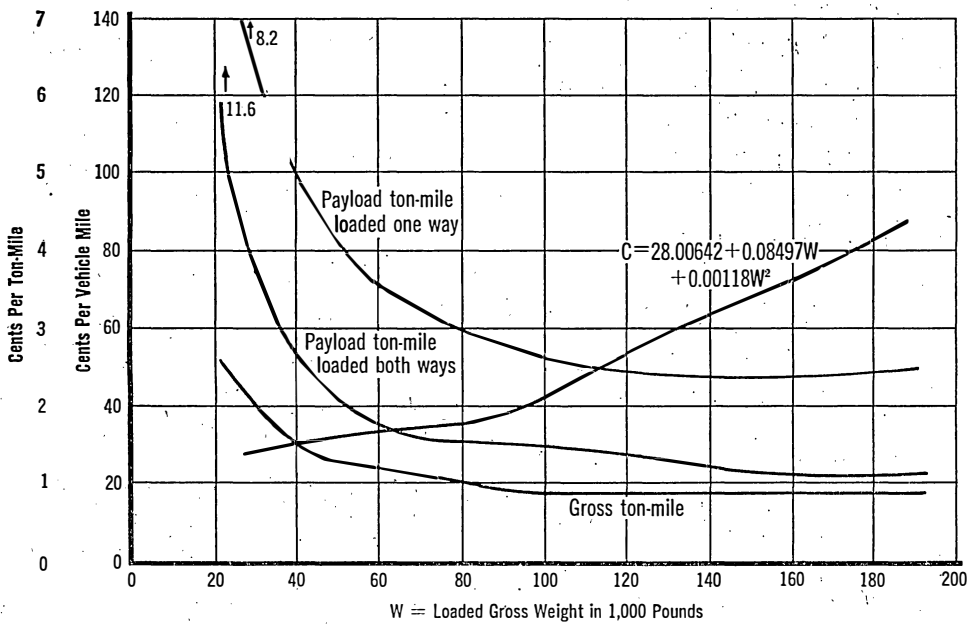

TABLE II

PAYLOAD TON-MILE AND GROSS TON-MILE COSTS BY LOADED GROSS WEIGHT—ALL TRAILER COMBINATIONS

Loaded Gross Weight (Lb.)	Payload Ton-Mile Costs		
	Loaded in Both Directions	Loaded in One Direction With Empty Return	Gross Ton-Mile Costs
27,500	$0.0410	$0.0820	$0.0227
44,000	0.0230	0.0460	0.0155
58,000	0.0183	0.0366	0.0127
65,000	0.0170	0.0340	0,0118
73,000	0.0160	0.0320	0.0111
82,000	0.0152	0.0304	0.0105
91,000	0.0147	0.0294	0.0100
100,600	0.0142	0.0284	0.0096
123,000	0.0133	0.0266	0.0091
137,000	0.0129	0.0258	0.0090
171,000	0.0124	0.0248	0.0090

SOURCE: National Academy of Sciences—National Research Council.

These . . . charts show how gross operating costs of trailer combinations increase with increases in loaded gross weight; show the extent to which payload ton-mile costs and gross ton-mile costs decrease with increases in gross weight; and indicate the region of maximum gross weight above which further increases in loaded gross weight do not produce significant reductions in payload ton-mile costs with vehicles and power plants available in 1956.[3]

The development of more powerful power plants and more efficient equipment since 1956 has no doubt changed the shape of the curves shown considerably, but the principal remains the same. As the loaded gross weight of a vehicle increases, the cost per ton of moving it decreases. The per ton cost of drivers' salaries obviously would fall, but other costs such as fuel and maintenance also are affected.

Reductions in cost per ton-mile with increases in size apparently occur in all forms of transportation. Railroads recently have sought and received permission to use larger cars for certain purposes, ocean shipping companies are building giant freighters and super-tankers, and airlines are developing larger and larger cargo planes. But even before studies were made showing the greater efficiency of larger carrying units, truck operators recognized the advantages of size.

The major objective of much of the legislation sought by the trucking industry over the years has been to take advantage of technological improvements through the operation of larger, heavier units at higher speeds, and over the years, the states periodically have revised their laws to increase legal limits on dimensions, weights, and speeds.

. . . As highway use by motor vehicles has increased year by year since about 1920 and as highway construction and design have produced highways of higher vehicular and structural capacities, States have increased the legal limits of dimensions and weights . . .

Gross vehicle weight limits . . . have been increased to 73,280 pounds—or near to this limit—by 15 to 20 states since 1956.

In 1965 the State of Maine raised its tandem axle limit from 32,000 to 36,000 pounds with the provision that the change applies only to non-Interstate highway systems. South Carolina has the same dual limits on tandem axles adopted in 1963.

Ohio in 1965 raised its tandem axle weight from 31,500 to 32,000 pounds.

Vermont adopted a single-axle weight limit of 22,400 pounds in 1964. Before this year, it had no specific limit on the single axle, but use of the Interstate system continues to be governed by the State law in effect prior to the 1964 change in law.

Two or three other States have modified their laws with respect to weights on special axle arrangement but did not change their basic single or tandem axle limit.

In 1962, about 15 States had basic gross vehicle weight limits materially less than 73,000 pounds. As of October, 1966 only 5 States had basic limits of less than 73,000 pounds and none of less than 70,000 pounds. Approximately 15 States in 1963 raised their gross weight limits to 73,280 pounds or to approximately this figure.

[3] Highway Research Board, Bulletin 301, LINE-HAUL TRUCKING COSTS IN RELATION TO VEHICLE GROSS WEIGHTS, National Academy of Sciences—National Research Council, Washington, D. C., 1961, p. 82.

Several States have raised the limit on vehicle height to 13.5 feet or slightly greater. Only three States had a limit of less than 13.5 feet at the end of 1966.

The most recent trend (1964 to 1967) in legislation has been to make legal the 60- or 65-foot truck with full trailer and the tractor-semitrailer with full trailer (known as double bottoms in the transport trade and also as 3-unit combinations.)

As of the end of March, 1967 legislation in the several States had progressed far enough to indicate the trend in motor vehicle size and weight legislation for 1967. *Provision for combination of 65-foot length was the most active item in the legislative process.* (Italics added.)

The 65-foot double was authorized in Arkansas and Maryland. The same provision was included in bills in Connecticut, Iowa (passed both houses) Maine, Nevada, and Ohio (passed Senate). Idaho approved a law permitting up to four units (triples) of 98-foot length on designated highways. Wyoming has authorized for test purposes a combination of more than three units and lengths exceeding 65 feet.

Wyoming has provided a 68-foot length for auto transport combinations—Minnesota, Ohio, and Wyoming have proposals to increase the length of single units or tractor semitrailers.[4]

In 1967, sixteen states passed legislation increasing the length limit for trailer trucks or other combinations of vehicles, two raised the maximum height, fifteen passed laws affecting the number of units to be hooked together, five altered the weight limits, and four passed laws affecting axle loads. Table III shows the size and weight limits in effect in early 1969.

In Virginia, as in other states, the trucking industry has been active for many years in its attempts to gain beneficial concessions. In at least 13 of the past 23 years, proposals were made for higher size, weight, or speed limits. (See Table IV)

The two bills introduced in 1968, S.B. 11 and S.B. 303, sought higher limits on length and weight as well as the introduction of "Double Bottoms," or twin trailers. This investigation, however, is limited to the probable economic effects of the introduction of twin trailers.

Twin trailers, i.e., a semi-trailer and a full trailer pulled by a single tractor, have been in use in several western states for many years. Where there were no restrictions to prevent it, truckers have found it beneficial to pull two and sometimes three or four trailer units with a single tractor in order to save on both equipment and labor expense. A number of midwestern states also permit twin trailers, but in the East, which is generally more congested, only Delaware permits such combinations up to 65′ without restriction. Several other Eastern states allow shorter combinations, or 65′ combinations on designated roads.

[4] Winfrey, Robley, *op. cit.*, pp. 72, 73.

TABLE III FEBRUARY 1, 1968

(This Chart is Designed Only as a Quick Reference -- State Laws Should Be Examined for Specifics)

STATE	HEIGHT FT. - IN.	WIDTH IN.	LENGTH LIMITS (FT.) Semi or Full Trailer	Tractor & Semi	Truck & Full	Tractor & Semi & Full	AXLE LOAD LIMITS(lbs.) SINGLE	TANDEM 4-Ft. Apart	GROSS WEIGHT LIMITS (lbs.) Tractor & Semi-Axle Calculation Basis 3-Axle	4-Axle	5-Axle	MAXIMUM POSSIBLE GVW	USE FORMULA OR TABLE
Alabama	13-6	96	NS	55	NP	NP	18,000 E4	36,000 E4	45,000	63,000	73,280	73,280	T
Alaska	13-6	96	40	60	60	65	20,000 D1	34,000	60,000	71,500	75,500	100,000	T
Arizona	13-6	96	NR	65	65	65	18,000	32,000	45,000	59,000	73,000	76,800	T
Arkansas	13-6	96	NR	55	65	65	18,000	32,000	45,000	59,000	73,280	73,280	...
California	14	96 B1	40	60	65	65	18,000	32,000	45,000	73,280	73,280	76,800	T
Colorado	13-6 A1	96	NR	65 A1	65 A1	65 A1	18,000	36,000	45,000	63,000	67,200	80,000	F2
Connecticut	13-6	102	40 C2	55	55	NP	22,400D3;E1	36,000 E1	53,800	67,400	73,000	73,000	...
Delaware	13-6	96	40	55	65	65	20,000 D5	36,000	48,000	60,000	73,280	73,280	T
District of Columbia	12-6	96	NR	50	50	NP	22,000	38,000	53,000	69,000	70,000	70,000	T
Florida	13-6	96	NR C5	55	55	NP	20,000 E4	40,000 E4	49,000 E4	66,610 E4	66,610 E4	66,610 E4	T
Georgia	13-6	96	NR	55	55	55	20,340	40,680	61,020	63,280	73,280	73,280	...
Hawaii	13	108	NR	55	65	65	24,000 D7	32,000	54,000	65,000	73,280	73,280	T
Idaho	14	96	NR	60	65	65	18,000 D6	32,000	45,000	59,000	73,280	76,800	...
Illinois	13-6	96	42	55	60	65 A1	18,000	32,000	45,000	64,000	73,280	73,280	T
Indiana	13-6	96	NR	55	55	65	18,000 D6	32,000	45,000	59,000	72,000	72,000 E7	...
Iowa	13-6	96	NR C4	55	55	60	18,000 E2	32,000 E2	45,000 E2	59,000 E2	72,634	73,280	T
Kansas	13-6	96 B2	42.5	55	65	65	18,000	32,000	45,000	59,000	73,280	73,280	T
Kentucky	13-6 A1	96	NR	55 A1	65 A3	65 A3	18,000 D3; E3	32,000	42,000 A1	59,640 A1	73,280 A1	73,280 A1	...
Louisiana	13-6	96	NR	60	65	NP	18,000	32,000	45,000 E6	59,000 E6	73,000 E6	73,280	...
Maine	13-6	102 A2	NR	55	55	NP	22,000 D3	36,000 A1	51,800 E3	66,300 E3	73,280	73,280	T
Maryland	13-6	96	NR	55	55	65	22,400	40,000	55,000	65,000	73,280	73,280	T
Massachusetts	NS	96	NR	55	NP	NP	22,400 D6	36,000	53,800	67,400	73,000	73,000	T
Michigan	13-6	96	40	55	55	65 A1	18,000 D5	26,000 G4	45,000	59,000 A1	73,000 A1	155,000 A1	...
Minnesota	13-6	96	40	55	55	NP	18,000	32,000	45,000	59,000	73,280	73,280	T
Mississippi	13-6	96	NR	55	55	NP	18,000 D8	32,000 A1	45,000	59,000	73,280 A1	73,280 A1	T
Missouri	13-6	96	NR	55	55	65	18,000	32,000	45,000	59,000	73,280	73,280	T
Montana	13-6	96	NR	60	60	60	18,000 G3	32,000 G3	45,000	59,000	73,280 G3	76,800 G3	T
Nebraska	13-6	96	NR C6	60	60	65	18,000 E3	32,000 E3	45,000 E2	59,000 E2	70,500 E2	71,146 E2	T
Nevada	NS	96 B2	NR	70	70	70	18,000	32,000	45,000	59,000	73,280	76,800	T
New Hampshire	13-6	96	NR	55	55	55	22,400 D3	36,000	52,800	66,400	73,280	73,280	T
New Jersey	13-6	96	NR	55	55	55	22,400 D6 E3	32,000 E3	53,800 E3	63,400 E3	73,280	73,280	T
New Mexico	13-6	96 B3	NR	65	65	65	21,600 D3	34,320	52,200	64,920	75,600	86,400	T
New York	13-6	96	NR C4	55	55	NP	22,400 D6	36,000	53,800	67,400	71,000	71,000	F3
North Carolina	13-6	96	NR	55	55	NP	18,000 D3;E5	36,000 E5	47,500	64,000 E3	70,000 E3	73,280	...
North Dakota	13-6	96	NR	60	60	65 A1	18,000 D2	32,000	45,000	59,000	73,280 A3	73,280 A3	F1
Ohio	13-6	96	NR	55	65	65	19,500 D4	24,000 G1	47,000	60,000 G1	73,000 G1	78,000	F4
Oklahoma	13-6	96	NR	55	55	65	18,000 D4	32,000	45,000	59,000	73,280	73,280	T
Oregon	13-6	96 A1	40 A3	60 A1	65 A1	75 A1	18,000 D2G2	34,000 G2	49,000	63,000	76,000 A3;A1	76,000 A3;A1	T
Pennsylvania	13-6	96	40	55	55	NP	22,400 D6	36,000	50,000 E2	60,000 E2	71,145 E2	71,145	...
Rhode Island	13-6	102	40 C2	55	55	NP	22,400	NS	53,800 D9	67,400 D9	73,280 D9	73,280	...
South Carolina	13-6	96	NR	55	55	NP	20,000 E4	36,000 A3;E4	50,000 E4	65,000 E4	73,280	73,280	...
South Dakota	13-6	96	NR	65 A1	65 A1	65 A1	18,000 D3	32,000	45,000	59,000	72,110	73,280	T
Tennessee	13-6	96	NR C5	55	55	NP	18,000	32,000	45,000	59,000	73,280	73,280	...
Texas	13-6	96	40	55	55	65	18,000 D4	32,000	45,000	58,420	72,000	72,000	T
Utah	14	96	45	60	60	60	18,000	33,000	45,000	60,000	76,500	79,900	T
Vermont	13-6	96	NR	55	55	NP	22,400 E3	36,000	50,000 A1	60,000 A1	73,280	73,280	T
Virginia	13-6	96	NR	55	55	NP	16,000 D4	32,000	45,000	59,000	70,000	70,000	T
Washington	13-6	96	40	60	65	65	18,000 D2	32,000	45,000	59,000	73,280 A2	78,000 A3	T
West Virginia	13-6 A1	96	NR	55 A1	55 A1	NP	18,000 E3	32,000 E3	45,000 E3	59,000 E3	60,800 E3	73,280 A2	T
Wisconsin	13-6	96	35 C3	55	55	NP	19,500	32,000	48,000	67,500	73,000	73,000	T
Wyoming	13-6	96	NR	65	65	65	18,000	36,000	45,000	63,000	72,110	73,950	T

FOOTNOTES

GENERAL:
- A1 - On Designated Highways
- A2 - Except on Interstate System
- A3 - With Permit
- NP - Not Permitted
- NR - Not Restricted
- NS - Not Specified
- T - Tables may be obtained from State Motor Vehicle Administrators

WIDTH:
- B1 - 100" acrosstires
- B2 - 102" across tires
- B3 - 102" on Designated Highways

LENGTH:
- C2 - No restriction on semitrailer if total length does not exceed 55-ft.
- C3 - Semitrailer measured from the extreme rear of tractor chassis to rear of trailer.
- C4 - Full trailer 35-ft.
- C5 - Full trailer 35-ft. unless 3-Axle, then 40-ft.
- C6 - Full trailer 40-ft.

TIRE SIZE OR LOAD LIMITATIONS:
- D1 - Subject to weight limitation of 500 lbs. per inch of tirewidth.
- D2 - Subject to weight limitation of 550 lbs. per inch of tire width.
- D3 - Subject to weight limitation of 600 lbs. per inch of tire width.
- D4 - Subject to weight limitation of 650 lbs. per inch of tire width.
- D5 - Subject to weight limitation of 700 lbs. per inch of tire width.
- D6 - Subject to weight limitation of 800 lbs. per inch of tire width.
- D7 - Subject to weight limitation of 60 lbs. per square inch of tire contact area.
- D8 - On Tires 9:75 and larger.
- D9 - On Tires 10:00 x 20 and larger; not less than 27' between extreme axles.

WEIGHT TOLERANCE:
- E1 - Plus 2% Tolerance
- E2 - Plus 3% Tolerance
- E3 - Plus 5% Tolerance
- E4 - Plus 10% Tolerance
- E5 - Plus 1,000 lbs. Tolerance on each axle.
- E6 - Including 9,000 lbs. on Front Axle.
- E7 - Overload of 1,000 lbs. gross weight or less not subject to fine or penalty.

FORMULAS:
- F1 - Formula 750 (L + 40)
- F2 - Formula 800 (L + 40)
- F3 - Formula 34,000 + (L x 1000)
- F4 - Formula 38,000 + (L x 900)

WEIGHT EXCEPTIONS:
- G1 - 32,000 lbs. with tandem axles spaced more than 45 inches apart.
- G2 - 20,000 lbs. on single axle and 34,000 lbs. on tandem on State Highways only.
- G3 - 20,000 lbs. on single axle; 34,000 lbs. on tandem axle; 105,500 lbs. total gross with permit except on Interstate System
- G4 - 32,000 lbs. on one tandem per combination on Designated Highways, or 32,000 lbs. on two tandems if total gross is not over 73,280 lbs.

SCHEDULE OF CHARGES

1 - 10	@	10¢ each	100 - 499	@ $4.00 per hundred.
11 - 49	@	8¢ each	500 - 999	@ $3.00 per hundred.
50 - 99	@	6¢ each	1,000 & Over	@ $1.50 per hundred.

SOURCE: TRUCK TRAILER MANUFACTURERS ASSOCIATION Telephone: Area Code 202
1413 K Street, N. W., Washington, D. C. 20005------ 393-2979

22068

TABLE IV

Notes relating to increase in size and weight of motor vehicle carriers of property—Virginia General Assembly.

1946—H.B. 209—increasing gross loads from 40,000 lbs. to 50,000 lbs. Defeated.

1948—S.B. 252 (Ch. 510)—increased gross loads from 40,000 lbs. to 50,000 lbs.

1950—S.B. 113 & H.B. 175—increasing gross loads to 56,800 lbs. on certain highways. Defeated.

H.B. 401—increasing weight from 35,000 to 40,000 lbs. for trucks operating over those highways on which the Highway Department does not permit the maximum loads permitted under § 46-336. Defeated.

H.B. 502 (Ch. 382)—increased length of single trucks from 33′ to 35′.

H.B. 506—would have permitted increase in basic law covering maximum loads to 50,000 lbs. Defeated.

1952—S.B. 203 & H.B. 315—increasing maximum permitted weight on certain highways from 50,000 to 56,800 lbs.; increasing maximum length of trucks from 45′ to 50′. Defeated.

1954—Marr Commission bills before legislature. Legislation provided, among other things, for weight distance tax; length increase from 45 to 50 feet and weight increase from 50,000 to 56,800 lbs. This legislation was killed, together with most of the recommendations of the Commission, including a surcharge on diesel fuel.

1956—Trucking industry—"Package bills" before legislature. S.B. 201 (Ch. 476)—increased permitted length of any combination of vehicles coupled together to 50 feet from 45 feet. Bill prohibited any tolerance on length. Increased maximum gross weight to 56,800 lbs.; provided for special permits for excessive weight for certain ready mix concrete haulers and haulers of construction materials.

SIZE & WEIGHT:

1958—S.B. 10 (Ch. 72)—provided special permits may be issued for increased axle weights under certain conditions for coal haulers.

1960—S.B. 38—increasing maximum permissive weight from 56,800 to 64,650 lbs. Dropped by patrons.

S.B. 39—increasing maximum height from 12′6″ to 13′6″. Dropped by patrons.

H.B. 659—would have permitted excessive size and weight for pulpwood haulers. Defeated.

1962—S.B. 91 (Ch. 84)—increased maximum gross weight from 56,800 to 70,000 lbs. and abandoned the AASHO weight formula.

S.B. 92 (Ch. 85)—increased maximum height from 12′6″ to 13′6″.

S.B. 39 (Ch. 35)—provides for increased axle weights for ready mix concrete haulers.

S.B. 40—would have permitted addition of 10′ to length of semitrailers designed to transport motor vehicles, making total length of such vehicles 60′. Defeated.

H.B. 92 (Ch. 162)—increasing gross weight limits for coal hauling vehicles under special permits.

H.B. 391 (Ch. 192)—provides for permits for excessive size and weights for motor vehicles hauling Virginia grown farm products from Eastern Shore.

1964—(Stone Commission Bills before legislature.)

S.B. 261—sought to amend §46.1-343 to provide that vehicles hauling forestry and agricultural products may increase axle weight to 20,000 lbs. and tandem axle weight to 35,000 lbs. Defeated.

1966—H.B. 23 (Ch. 59)—increased length of a combination of motor vehicles to 55′.

S.B. 449—sought to allow owners or operators of vehicles hauling forestry and agricultural products by permit to increase single axle weight to 20,000 lbs. and tandem axle weights to 36,000 lbs. Defeated.

H.B. 192—sought to amend law relating to permits for three axle trucks of excessive weight and size by increasing tandem axle weight from 32,000 to 36,000 lbs. and broaden types of material to be hauled. Defeated.

H.B. 669—sought to add trucks hauling gypsum or land plaster to groups eligible for special permits for overweight vehicles. Defeated.

1968—S.B. 11—Double Bottoms—increase length from 55′ to 65′ for three vehicle combinations on Interstate System. Defeated.

S.B. 303—increase single axle loads on roads other than Interstate from 18,000 lbs. to 20,000 lbs.; would have written into Virginia law the formula of the Magnuson bill (S.2658) in Congress so that if the Magnuson Bill were to be enacted, weight limits and lengths in Virginia would automatically rise to the level permitted in the Magnuson Bill. Defeated.

Advantages of Twin Trailers

The proponents of twin trailers in Virginia have cited four advantages in their use:

1) Greater cubic capacity than can be achieved with a single trailer or semitrailer.
2) The possibility of hauling two types of freight, requiring different types of trailers, behind the same tractor.
3) Greater convenience in spotting at loading docks, loading and unloading, etc.
4) Simplified handling of containerized freight.

The advantage most frequently cited is the ability to carry a load of greater cubic footage within a given weight limitation. It has been pointed out that two 27′ twin trailers, which could be used within the proposed length limit of 65′, have almost one-third more cubic capacity than a 40′ trailer. In both cases, it is assumed that the trailers are eight feet wide and 13½ feet high, with a load 7½ feet wide and nine feet deep. The current overall length limit of 55′ does not restrict trucks to the use of 40′ trailers, however. With a tractor of the same size used to pull the two 27′ twins, a semi-trailer of 47′ could be used, with a cubic capacity less than 14 percent below that of two 27′ twins.

Trucking interests feel that the added cubic capacity permitted by twin trailers is especially important because they believe that on the average, freight hauled by trucks is becoming lighter per cubic foot and the total weight that can be loaded in semi-trailers at present is limited by space.

> The tractor semitrailer unit has, in terms of cubic capacity, just about reached its limit. Freight is becoming bulkier, but lighter, as a result of improved manufacturing techniques and packaging. This is evident in the increased use of plastics, resins, and aluminum. Items such as household appliances and plastic pipe occupy a great deal of space in a trailer, but weigh relatively little.[5]

Available empirical data suggest that the situation may be somewhat different in Virginia. A questionnaire sent to a randomly selected sample of Virginia business firms revealed that among 83 respondents answering the question in a manner indicating they understood the question, "What would you estimate to be the average weight per cubic foot for your firm's shipment?", the average weight specified was 37.8 pounds, which would be far above the density necessary to achieve the legal maximum weight within current cubic capacity limitations. In addition, 30 of the respondents indicated that the weight per cubic foot of their freight has increased over the past five years, 44 said that it has remained unchanged, and only 9 felt that it has been decreasing. And in 1967, in a spot check made during July and August, of 1516 trucks with five axles or more weighed by the State Highway Department, 224 or over 17 percent were overweight. This indicates that the weight limitation, as well as the space limitation, is still a significant factor.[6]

Flexibility

The flexibility of twin trailers often is cited as one of their advantages.

> In addition to their greater carrying capacity in terms of cubic content, these vehicles may have many other advantages. One lies in the nature of the equipment itself. The use of two, relatively short, semitrailers permits efficiencies not possible with single types of semitrailers in twin operations. One unit may be for dry freight, while the other is refrigerated. A flat bed trailer may be coupled with an open top.[7]

While important to some truckers, for the general public, the overall economic impact of such flexibility is likely to be rather small. As indicated in Table V, general freight made up 39.5 percent of all truck freight in 1967, and liquid petroleum, which is too heavy to benefit from the greater cubic capacity of twin trailers, made up another 25 percent. Refrigerated solids and liquids totalled only 1.6 percent of all freight hauled. And flat bed trailers can be used only for certain limited purposes in most states.

Convenience at Loading Docks

Convenience in spotting trailers at loading docks is likely to be somewhat more significant than the ability to pull two types of trailers with the same tractor, but here, too, there are drawbacks. Unless a carrier has a reserve supply of trailers of all sizes, it would be necessary at times to use two twin trailers for loads which otherwise could

[5] DOUBLES EQUIPMENT A WAY TO MODERN TRANSPORTATION, Research and Transport Economics, American Trucking Association, Inc., Washington, D. C., p. 11.

[6] Traffic and Planning Division, TRUCK WEIGHT STUDY, 1967, Virginia State Highway Department.

[7] TWIN TRAILERS, Press Relations, Public Relations Department, American Trucking Association, Inc., 1616 P Street, N. W., Washington, D. C., p. 2.

TABLE V

COMPARISON OF INTERCITY TRUCK TONNAGE FULL YEAR 1967 ALL CARRIERS BY COMMODITY CLASS AND TYPE OF CARRIAGE

Commodity Class	Number of Carriers	Tonnage 1967	Percent of All Tonnage 1967
All	2,634	560,087,719	100.0
General Freight	1,120	221,226,528	39.5
Household Goods	147	3,259,125	0.6
Heavy Machinery	74	5,192,269	0.9
Liquid Petroleum	171	139,967,157	25.0
Refrigerated Liquids	13	1,854,793	0.3
Refrigerated Solids	85	7,204,552	1.3
Agricultural Comm	69	9,029,770	1.6
Motor Vehicles	49	17,176,998	3.1
Building Materials	92	22,017,851	3.9
All Other Intercity Classes	814	133,158,676	23.8

SOURCE: Association of American Railroads

be hauled on one larger trailer. Under those circumstances it would be necessary to spot two trailers instead of one, which would take additional time. It should be noted that railroads, which are not prohibited from linking together as many cars as they wish to make up a train of a given length, have generally preferred longer rather than shorter freight cars. If there were advantages in flexibility to be gained by using more cars of smaller size, the railroads presumably would have discovered them by now. The true flexibility in twin trailers seems to be that they can be attached to tractors in pairs and used as substitutes for full sized semi-trailer units, or they can be attached to tractors separately and used as substitutes for straight trucks. Thus the trucking company may standardize and buy only one type of equipment instead of buying straight trucks for some purposes and semi-trailers for others.

Containerization

In recent years ship operators have achieved savings and other benefits through the use of containerization. Containerization consists of packing freight bound for a common destination in large box-like containers of standard size, which may then be hauled by truck, train, or ship. Its greatest advantage has been in the labor it saves at dockside. Ships may be loaded with a full cargo of prepackaged containers in a fraction of the time necessary to load the same freight when packed in cartons, barrels, crates, etc.

Containers in a wide variety of lengths are now being used, but the American Standards Association, Inc., has adopted four standard lengths—10, 20, 30 and 40 feet. One of the frequently cited advantages of twin trailers is that they facilitate the use of containerization. The 40 foot containers now may be equipped with a chassis and used as semi-trailers, but the shorter lengths must be linked together as twins or in some other way. One device which is sometimes used is to lock two 20 foot containers together into one 40 foot length for use as a

semitrailer. With the present standard sizes of containers, the advantage in hauling these on twin trailers is that the use of twins makes possible two separate 20 foot units on two separate chasses, obviating the necessity for loading the two units onto a single 40 foot bed. This advantage is largely offset, however, by the loss of payloads when two 20 foot units are used in place of one 40 foot unit. There would perhaps be some advantage in using twins to haul containers if a container of 26½ feet should be adopted as standard. There is no evidence at present, however, that twin trailers are being used to haul standard size containers on the East coast.

Truckers in general appear to feel that these four advantages in the use of twin trailers far outweigh any disadvantages which they may have, but they recognize that there are some disadvantages for the operations of such equipment. The two disadvantages generally cited are the higher cost of twin trailer equipment and the lower net weight its use permits.

Higher Cost of Equipment

A tractor plus a pair of twin trailers costs considerably more than a semi-trailer unit of comparable size. Not only is it necessary to have two trailers instead of one, but if full use of the twins is to be made for in-city deliveries, as has been suggested, it might even be necessary to have more tractors in the fleet as a whole. Also, the tractors used with twin trailers should be more powerful, with more braking power than those used with the lighter and shorter semi-trailer. The acquisition of more expensive equipment may be of little concern to the large trucking company, assuming it will pay for itself in the long run. If twin trailers were permitted, many large firms would immediately add new trailers and tractors to their fleets. The small operator, however, who is finding it increasingly difficult to compete with the trucking giants, probably would find that the use of twin trailers would add to the competitive edge the large firm now has over him. He would not be able to re-equip immediately, perhaps, and even if he could, he perhaps could not afford the variety of equipment which would be necessary to make the best use of twin trailer flexibility. Thus the small trucking company conceivably could suffer rather than benefit from the use of twin trailers.

Lower Net Weight

Since two trailers obviously weigh more than one, as long as the gross weight limit remains the same, the use of twin trailers would reduce the net weight which a single combination could haul. For light shipments, where cubic capacity limitations are reached before weight limitations are reached, this would pose a problem, but on heavier shipments, with a weight per cubic foot appoaching the 42.9 pounds which the questionnaire respondents averaged the reduction in net weight would be costly. The number of overweight trucks detected each year in Virginia indicates that gross weight limitations are still of prime importance to trucks, and use of heavier equipment would provide even more incentive for the industry to strive for higher weight limits.

Opposition to Twin Trailers

The trucking industry in Virginia, including those nontrucking firms which operate their own fleets as well as common carriers, ap-

pear to be firmly convinced that the operation of twin trailers would be beneficial to them, but Virginia railroads are just as firmly opposed to their use. They base their opposition not so much on any immediate effects of the use of twin trailers as such, but on the opinion that to permit twin trailers would be taking a major step in a series of moves which have steadily improved the competitive position of highway freight hauling vis-a-vis rail freight hauling over the years. They feel that the trucking interests may be over optimistic concerning the gains to be derived from twin trailers with no increase in weight limits, but that if this step is permitted, the next step attempted by the truckers will be to obtain higher gross weight limits, based on the argument that with more axles to carry the load, a higher gross weight limit would be no more damaging to highways than the present weight limits with existing length restrictions. They view the present proposed change in the trucking statutes as only one step, but a very important step, in a long series of measures which have eroded the preeminence of the railroads in hauling freight.

The sample survey questionnaire revealed somewhat less clearcut attitudes among the business firms surveyed, but with the result substantially weighted toward opposition to twin trailers. Of the firms which operate tractor trailers answering the questionnaire, 20 said they felt that twin trailers would be beneficial to their firms, while 18 felt that they would not be. This group of firms included common carriers as well as other firms operating their own tractor trucks. In a telephone survey of eigth trucking companies, six said they would use twin trailers if they were permitted to do so, while two said they would not. Among the firms in the questionnaire sample survey which did not own tractor trailers, 95 said that twin trailers would not assist them in their operations, while 18 felt that they would, usually because they felt that they would bring about lower freight rates.

When asked, "would your firm benefit from increased trailer capacity (i.e., increased cubic footage) without an increase in the gross weight limit?", only 28.4 percent of those answering the questionnaires answered "Yes", a proportion slightly larger than the percentage owning tractor trailers.

On balance, it appears that although most trucking interest are enthusiastic about the advantages of twin trailers, the majority of the business community in the sample survey feel that they would not be beneficial, and some of them, including the railroads, are very strongly opposed to twin trailers, although perhaps not altogether for economic reasons.

The Basis for Decision

The history of trucking legislation, and the way the Virginia proposal to permit twin trailers was tied in with almost identical proposals in a number of other states, and with Federal legislation which passed the Senate and was defeated in the House, suggests that trucking interests regard this proposal as only one step in their continuing campaign to ease restrictions on trucking.

Such restrictions should always be set realistically. When highways can economically be constructed to carry heavier loads, heavier loads should be permitted, and when better engineering makes higher speeds safer, there is no reason to maintain outdated speed limits. It is essential, however, that restrictions designed to protect the general public and to insure the most economical use of the public domain not

be cast aside while they are still serving a useful purpose. And so the effects of legislation which would permit twin trailers on Virginia highways should be examined in the broadest possible context.

From the point of view of society as a whole, and the citizens of Virginia, the only reason for having freight trucks running through the State is to move freight. There may be other benefits to be derived, such as employment of drivers, the sale of gasoline and diesel fuel, etc., but none of those subsidiary benefits would be considered sufficient reasons for choosing trucks instead of some other means for moving freight unless they can do it better. How well the job is done must be measured in a number of ways—the dollars and cents cost to society, the relative convenience and speed, the extent of undesirable side effects, such as air pollution, noise, traffic congestion, etc. Unfortunately there are so many factors entering into transportation costs that they cannot be compared in a brief period of time. The total cost involves not only the price the shipper pays, but also the cost of highways for trucks, in excess of their tax payments, the cost of terminals and other facilities for railroads, the cost of terminals for airlines, etc. And unfortunately, means of transportation chosen by the shipper is not a sufficient guide in most instances, because the shipper may be expected to choose that method of transportation which costs him least, other things being equal, and that is not necessarily the method which is least expensive to the state, or to society as a whole. A shipper may ship by mail instead of some other means, for example, because postage charges are less than some private means of delivery; but then the Post Office Department must be heavily subsidized from tax payments. Or he may ship by truck at rates more favorable than air or rail rates, but only at great expense to the public in the construction and maintenance of highways and bridges.

If there were no subsidization of the various means of transportation, and no regulation, the public would very quickly choose the most efficient on the basis of cost. But subsidization and regulation have muddied the waters to such an extent that each shipper can only act in his own best interest.

Governments and regulatory agencies, however, are charged with the protection of the interests of all the public, and not just the shippers. Indeed, if they were not, regulation would be much simpler. Since bigger, heavier, wider, and longer trucks obviously are beneficial to trucking companies, those companies could be given permission to expand the size of their units without limit. But in the interests of the public, some effort must be made to determine at what point the benefits to trucking companies are offset by social costs. Safety and the construction and maintenance of highways are important variables in such a consideration; probably the most important variables. But in the absence of any consideration of those variables, there is still a sound economic basis for making a decision concerning the use of twin trailers.

The decision should be based on the marginal rate of substitution between alternative ways of moving freight. For relatively short hauls, most freight is more efficiently moved by truck than by any other means. There are no reasonable substitutes except in rare instances. But twin trailers are not designed for the short haul. The time and expense involved in coupling two units together would not justify their use. And in longer hauls, for which twin trailers were designed, there are alternatives to truck transportation. These alternatives are rail, air, and water transportation. Water transportation is competitive

only where there are navigable waterways, and air freight is competitive only for relatively light products. This means that the major competition for trucks is rail transportation.

As long-haul freight trucks have increased in importance in recent years, railroad trains have decreased. In some cases, such as hauling coal, their competitive advantages have been great enough that they have lost little if any business to the trucking industry; but in the hauling of general freight, the trucking companies have enjoyed a competitive advantage which has allowed them to overcome more than a century of railroad development and in recent years to carry more than the trains. (See Table I) To the extent that the competitive advantage derives from greater efficiency, this is highly desirable. Efficiency is sometimes difficult to define, however, and it is up to the states and to the regulatory agencies to decide whether is is more efficient, from the social as well as from the purely economic point of view to haul freight by highway rather than by rail.

Twin trailers represent merely a step in the movement toward combinations involving more than two trailers. Triple trailers are now operating on a trial basis on a number of highways in one state in the West and are also being tested on the New York Thruway. If trailer combinations are the best way to haul freight, they should be encouraged, but in considering legislation which would speed up the move out of rail freight and into highway freight in Virginia, the question of capacity utilization should be considered in addition to the efficiency factors previously discussed, and safety and highway costs. In Virginia, total Interstate miles of road increased from 106.94 in 1963 to 587.01 in 1967, but vehicle miles traveled on interstate roads went from 759,927 to 8,147,866. This resulted in an increase in average traffic per mile of road from 7,106 to 13,880. (See Table VI) And although the Interstate System comprises only 7.17 percent of the total mileage, it carried 25.01 percent of the total traffic in 1967. Over 19 percent of that traffic was trucks and buses. These statistics suggest that Virginia highways, particularly the through routes used most for long-haul trucking, are already heavily loaded. Capacity may be impossible to define, but it is obvious that many sizable stretches of highway, such as Route 95 near Washington, Route 95-64 through Richmond, and Route 495 around Washington are approaching or already reached full capacity utilization. There are other arterial routes on which bottlenecks cause extensive traffic backups on a regular basis, as for example, Route 60 through Richmond.

The heavy and increasing use of highways is in sharp contrast with the declining use of many railroads and the large amount of excess capacity in existence on most of them.

> The railroad industry in Virginia, as well as in other parts of the country, has a tremendous amount of unutilized capacity. It is understood that the term capacity has a number of varying meanings and can refer either to the additional traffic which would be handled with the existing number of locomotives and freight cars or to the additional traffic which could be handled over the existing system of tracks and yards if more cars and locomotives were placed in service.
>
> The most restrictive measure of additional capacity is in terms of how much more traffic can be handled in terms of locomotives and cars . . . Even on this extremely limited concept of what constitutes capacity, it is estimated that the railroad industry in Vir-

ginia could increase its output by at least 50% without buying any more locomotives or any more cars. All that is required is a more efficient use of the equipment which is now in existence.

The basis for the estimate of a 50% increase in capacity with existing equipment is the fact that if traffic demands it the railroads have demonstrated they are capable of handling tremendous volumes of additional traffic with virtually no increase in equipment. Thus, between 1940 and 1944, the tonnage handled by railroads which operate in Virginia increased from 450,000,000 to 695,000,000, an increase of 55% during a period when the supply of locomotives increased only 5% and the supply of freight cars only 8%.

Another way of looking at capacity in terms of existing equipment is to note how many loads per car per year are currently made and to give some indication of the degree of improvement which should be possible. Thus, in 1967, freight cars were loaded an average of between 18 and 19 times per year which means there were about 18 days between loads. As far back as 1947, freight cars were loaded some 24 times a year and a reversion to even this degree of utilization would represent an effective increase in capacity of some 25%. This, of course, is far from the maximum which could be achieved and there are services currently performed in this country where cars are loaded as frequently as every five days. Freight cars now average in loaded and empty service only about 50 miles per day in this country. It is perfectly feasible to increase this performance by at least 50% as is evidenced by the fact that cars that are used in piggyback service are actually averaging well over 100 miles per day. Accordingly, an estimate of 50% increase in capacity *with existing equipment* is conservative.

A better measure of capacity is what the railroads could do with their existing track and yard facilities provided that traffic increased to the point where it was desirable to add new locomotives and cars just as truckers have constantly been enlarging their trucking fleets. Measured from this standpoint, the potential increase in capacity on the railroads is tremendous. Cars and locomotives occupy less than 1% of the available tract space and the additional number of trains which can be operated over any segment of track is accordingly very large indeed. As a specific illustration, traffic between Roanoke and Norfolk on the Norfolk and Western is far from the saturation point since many more trains could be operated than are now moving. Yet, traffic on this segment of track is about five times as heavy as the average which prevails throughout the country. Accordingly, at a minimum, it would appear that if traffic justified it the Virginia railroads could enlarge their carrying capacity by at least 500% merely through additional locomotives and freight cars. In short, tremendous reserve capacity now exists in the railroad plant and actual utilization of this capacity would, of course, eliminate congestion on the highways.[8]

It seems quite clear that if trucking companies are allowed to use twin trailers, the proportion of long-distance freight transported by highway ultimately will be greater than would otherwise be the case. And in view of the overcrowded condition of the highways, while railroads are being forced to reduce their services due to lack of sufficient

[8] John B. Boatwright, Jr., Virginia Railway Association, Letter of January 22, 1969.

business, this would appear to be a strange goal to seek. Our total transportation system has become seriously unbalanced.

When he was Secretary of Transportation, Alan S. Boyd commented that:

> Everybody talks about a balanced transportation system. We've got about $4.5 billion a year going into the Highway Trust Fund. On the other side of the scale, we have $175 million going into mass transit (both rail and bus) and $65 million of airports. We've got a bucketful of money for highways and only a medicine dropperful for the rest.[9]

Virginia's transportation budget is more unbalanced than the Federal budget, and even so, the "bucketful of money for highways" is far from adequate to provide for highway needs for which there is no logical alternative. This suggests that steps should not be taken to shift more long-haul freight to the highways, but on the contrary, anything which would direct additional freight to the railroads or waterways would be in the public interest.

It may be argued that the general public wants its freight hauled in such a way that only trucks—larger trucks than we now have—can do the job. A very quick way to find out would be to hold a statewide referendum on whether or not to permit twin trailers.

SAMPLE DESIGN

In order to measure the probable impact of the use of Twin Trailers upon the economy of the state of Virginia, the business sector of the enonomy was defined as all of those businesses which employed 4 or more employees and which reported to the Virginia Employment Commission during the fourth quarter of 1968. The sample design used to collect the information was a combination of the Judgment Sampling technique and the Random Sampling technique. Judgment Sampling techniques were employed to eliminate from the population those types of businesses which probably would have little information concerning shipments by tractor-trailers. Those industries that were eliminated in the Judgment Sampling were: services, medical services, real estate, insurance and finance.

The Virginia Employment Commission supplied a list of all businesses in Virginia which reported to them. Of these 24,800 were classified as follows: (1) Agriculture, Forestry, and Fisheries, (2) Manufacturing (3) Transportation, and (4) Wholesale and Retail Trade.

Random Sampling techniques were used to select 450 business firms in the state of Virginia, selecting only from the main classifications immediately above.

In addition to Judgment and Random Sampling techniques, Proportional Sampling techniques were then used to select the same proportion of firms to the sample as that which existed within the population. (See Table I)

The following table shows trends in miles of road, average daily vehicle miles of travel and average traffic per mile of road for the Interstate Rural, Interstate Urban, Arterial and Primary Systems for the years indicated.

[9] "The U. S. 'Lopsided Transportation Budget'," FORBES, October 1, 1968.

TABLE VI

	1963	1964	1965	1966	1967
INTERSTATE RURAL					
Miles of Road	93.56	315.04	399.73	476.12	519.80
Vehicle Miles	600,881	3,841,331	5,151,149	6,115,751	6,851,323
Average Traffic per mile of road	6,422	12,193	12,887	12,845	13,180
INTERSTATE URBAN					
Miles of Road	13.38	19.33	30.70	38.19	67.21
Vehicle Miles	159,046	236,282	366,215	565,819	1,296,543
Average Traffic per mile of road	11,887	12,195	11,929	14,812	19,290
INTERSTATE TOTAL					
Miles of Road	106.94	334.37	430.43	514.31	587.01
Vehicle Miles	759,927	4,077,613	5,517,364	6,681,570	8,147,866
Average Traffic per mile of road	7,106	12,195	12,818	12,990	13,880
PRIMARY					
Miles of Road	7,463.39	7,323.75	7,324.66	5,797.24	6,015.35
Vehicle Miles	23,449,750	20,959,199	22,126,303	15,517,016	16,686,438
Average Traffic per mile of road	3,142	2,862	3,021	2,677	2,774
ARTERIAL					
Miles of Road				1,522.77	1,585.85
Vehicle Miles				7,158,545	7,738,846
Average Traffic per mile of road				4,701	4,880
PRIMARY AND ARTERIAL					
Miles of Road				7,320.01	7,601.20
Vehicle Miles				22,675,561	24,425,284
Average Traffic per mile of road				3,098	3,213
TOTAL					
Miles of Road	7,570.33	7,658.12	7,755.09	7,834.32	8,188.21
Vehicle Miles	24,209,677	25,036,812	27,643,667	29,357,131	32,573,150
Average Traffic per mile of road	3,198	3,269	3,565	3,747	3,978

SOURCE: Virginia State Highway Department

TABLE I SAMPLE DESIGN

POPULATION PROPORTION	PERCENTAGE (Rounded)	SAMPLE PROPORTION
309	1.2%	5
5,620	24.0%	106
2,552	11.0%	49
862	3.5%	16
1,409	5.3%	24
14,044	56.0%	250
24,800	100.0%	450

TWIN TRAILER QUESTIONNAIRE

165 Returns

INSTRUCTIONS:

Please check the appropriate response and/or supply the necessary information in the space provided.

1. Does your firm require the services of tractor-trailer shipping?

   Yes 133
   No 29
   N/A 3

2. What would you estimate to be the percentage of your firm's shipments via:

(a) tractor-trailer	73.1%	(Avg. of 128 responses)	
(b) railroad	27.9%	(Avg. of 75 responses)	(Most respondents left one or more categories blank
(c) air freight	6.8%	(Avg. of 26 responses)	
(d) steamship	5.0%	(Avg. of 12 responses)	

3. Does your firm own any tractor-trailers?

   Yes 41
   No 124

4. Does your firm operate any tractor-trailers?

   Yes 40
   No 118
   N/A 7

5. What do you estimate the total weight of annual shipping to be into as well as out of your firm?
   Tons Avg. 308,641

6. What would you estimate to be the average weight per cubic foot for your firm's shipments? Avg. 37.8 for all under 500 lbs.

   This figure has:

   30 a. increased in the last 5 years
   40 b. remained unchanged in the last 5 years
   9 c. decreased in the last 5 years

7. Would the use of "twin-trailers" assist your firm in its operations? How?

   Yes 38
   No 113
   N/A 14

8. Would your firm benefit from increased trailer capacity (i.e., increased cubic footage) without an increase in the gross weight limit?

Yes 46 (Avg. annual weight = 546,708)
No 103 (Avg. annual weight = 172,041)
N/A 16

9. Does your firm make use of containerized shipping?

Yes 25
No 132
N/A 8

10. What size containers do you use? _____

11. The majority of your firm's over-land shipments involve distances of:

38 a. less than 100 miles
22 b. 100 miles but less than 200
21 c. 200 miles but less than 300
24 d. 300 miles but less than 400
46 e. 400 miles or more

12. You would generally classify your firm as:

11 Agricultural	33 Wholesaling
10 Mining	70 Retail Sales
1 Forestry	26 Services
40 Manufacturing	4 Other (specify)

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APPENDIX B

REPORT ON THE OPERATIONAL AND SAFETY CHARACTERISTICS OF TWIN TRAILER COMBINATIONS

(A report to the Twin Trailer Study Commission)

May 1969

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REPORT ON THE OPERATIONAL AND SAFETY CHARACTERISTICS OF TWIN TRAILER COMBINATIONS

PURPOSE

The 1968 Virginia General Assembly created a commission to study the uses and operational safety of combinations of three vehicles, such commission to be known as the Twin Trailer Study Commission. In charting the course of the study, the Commission felt that some State regulatory body should devise, conduct and report on the operational and safety tests of the twin trailer combination. Since it appeared that the facilities of the Highway Safety Division, the Department of Highways, and the Department of State Police would all logically be involved in some aspects of the tests, the Commission established a Steering Committee comprised of Major J. S. Pearson, Field Supervisor, Department of State Police, Chairman; Mr. J. P. Mills, Jr., Traffic and Planning Engineer, Department of Highways; and Mr. J. T. Hanna, Director, Highway Safety Division; to carry out and report on the tests. This work was performed under the overall supervision of the three State agencies involved.

SCOPE

Virginia law presently permits the operation of a combination of two vehicles up to a length not exceeding *55* feet on the highway. The scope of the subcommittee's assignment was limited to the study of a combination of *three* vehicles of an actual length not exceeding *65* feet, as provided in Chapter 186, Acts of the 1968 General Assembly. Further, the maximum gross weight of 70,000 pounds and the height and width limitations presently provided under Virginia law were assumed for the study.

In the operational safety aspects of the testing, primary attention was given to the differences between the 55-foot two-vehicle combination now permitted by law and the 65-foot three-vehicle combination.

PROCEDURE

Chapter 186, Acts of the 1968 General Assembly, provided for the issuance of a permit by the State Highway Department for the operation of one test twin trailer combination of vehicles. For the purpose of this study, it was deemed essential to place this combination into normal revenue load-carrying service over State highways and to make observations as to its operation, maneuverability, performance and effect on other motorists. Also, it was deemed advisable to conduct certain off-the-road tests, and to determine the experience with twin trailer operations in other states. Readily available literature relating to twin trailers was surveyed to compile a listing of references. The study was divided into individual projects, and responsibility for each project was assigned as follows:

I. *Over-the-road Operation of Test Vehicle*—Department of State Police

II. *Driver Reaction Survey*—Virginia Highway Research Council and Department of Highways

III. *Off-road Stopping Distance, Stability and Maneuverability Tests* —Virginia Highway Research Council

IV. *Experience in Other States*

a. Summary of information received from states permitting twin trailer operation—Department of State Police

b. Personal investigation in nearby states permitting twin trailer operations—Highway Safety Division

V. *Twin Trailer Reference Listing*—Virginia Highway Research Council.

CONCLUSIONS

1. Statistical data concerning accident involvement of twin trailers in states permitting twin trailer operations were not available, because the accident reporting forms and procedures do not differentiate between types of tractor-trailer combinations.

2. The majority of officials in states permitting twin trailer operations felt that accident involvement of twin trailers was not any greater than that of standard tractor-trailers; some were of the opinion the involvement rate was less for twin trailers. (Of the twenty-seven states reponding to a study questionnaire, sixteen permitted operation of twin trailers on all highways; nine did not; and two did not answer the query on this particular subject. Generally, where restrictions were imposed, operations were limited to inter-state highways, freeways, and four-lane highways with limited egress and ingress.)

3. The capability of the twin trailer combination to be driven in reverse is limited.

4. The twin trailer combination having a total length of sixty-five feet can be turned in a shorter radius than that required by the fifty-five foot conventional tractor-trailer combination.

5. Generally, to an average motorist following or meeting a twin trailer combination on a straight highway, the combination presents an appearance similar to that of a standard tractor-trailer combination.

6. Of all motorists observed passing the twin trailer during the Driver Reaction Survey, 93.5% stated there was nothing different nor unusual about the passing maneuver.

7. During the Driver Reaction Survey, all observed passing maneuvers on four-lane highways were made in a normal manner; 95% of the observed passing maneuvers on two-lane highways were made in a proper manner.

8. During the highway operations, the twin trailer combination tracked accurately without noticeable sway of either trailer.

9. There was relatively little difference in the stopping distances required by the conventional trailer and the twin trailer combination.

10. Apparently, at normal road speeds, tractor-trailers, both conventional and twin, require a much greater stopping distance on wet pavements when they are empty than when loaded.

11. With regard to stability, visual observation indicated that the two units performed equally. However a closer study can be made of the stability of the two vehicles through the use of the motion pictures taken by the State Police.

12. In all maneuvering tests the twin trailer performed as well as, if not better than, the conventional trailer.

FINDINGS

Over-the-road Operation of Test Vehicle

The Subcommittee deemed it essential to place what would be a typical twin trailer into normal over-the-road operations carrying revenue producing loads. From Mr. E. H. Williams, Jr., Executive Vice President, Virginia Highway Users Association, it was learned that equipment of this type was owned by the Overnite Transportation Company, Richmond, Virginia. Arrangements were made to place one of the Company's twin trailer combinations into typical operation. In keeping with Chapter 186, Acts of the 1968 General Assembly, the Department of Highways issued Permit No. M56311 on October 31, 1968, to the Overnite Transportation Company to allow the operation of a twin trailer combination not exceeding an overall length of 65 feet. Gross weight, overall height, and overall width were not to exceed the legal limits currently permitted by the Code of Virginia.

Mr. J. P. Mills, Jr. contacted Mr. Julian F. Hirst, Roanoke City Manager, for assistance in securing permits from the cities through which the Overnite twin trailer would operate. Mr. Hirst was contacted because of his involvement with the Street and Highway Committee of the Virginia League of Municipalities. He, in turn, solicited the cooperation of the town and city managers of Abingdon, Bedford, Bristol, Danville, Farmville, Lynchburg, Marion, Pulaski, Radford, Richmond, Salem, South Boston, and Wytheville in issuing permits from their respective jurisdictions.

The Overnite Transportation Company was requested by the Subcommittee to maintain a record of each operation of the test combination to provide information concerning the operator, origin and destination of movements, routes and dates of travel, and the weight of payloads. A recording tachograph was installed in the tractor and the graph charts from this instrument were made available to the Subcommittee. A summary of the records for the period of operation, from November 11, 1968 to February 7, 1969, is included in Appendix I.

Typical over-the-road operation of the Overnite twin trailer carrying revenue loads was scheduled for routes between Richmond and Danville and between Richmond and Bristol, routes for which the Overnite Transportation Company is franchised. Prior to the operations, the tractor and trailers were inspected under Virginia's motor vehicle inspection program and found to meet all its requirements. The combination was inspected by personnel of the Virginia State Police and found to be in compliance with Virginia law.

Members of the Department of State Police observed the twin trailer combination during its freight hauling operations and were instructed to investigate and submit reports on any accidents in which it might be involved. Reports were received of two involvements in which it was concluded that the type of vehicle was not a contributing factor. Details of these accidents, as well as reports and a summarization of State Police surveillance, are included in Appendix I.

While the Overnite twin trailer was engaged in normal freight hauling operations between Richmond and Bristol, members of the Department of State Police took motion pictures of the vehicle. These

16mm silent pictures are available for viewing as directed by the Twin Trailer Study Commission.

Driver Reaction Survey

The Virginia Highway Research Council and the Division of Traffic and Planning, Department of Highways, designed and conducted the Driver Reaction Survey.

The survey was designed to determine the reactions of motorists to the presence of twin trailers in the traffic stream. This involved the manning of two roadside interview stations 15 to 20 miles apart and the operation of the twin trailer between the stations. The twin trailer began a trip at one station and completed it upon passing through the other; the direction of travel was then reversed and the process repeated.

Radio communication was maintained between the twin trailer and each interview station. An observer in the cab of the twin trailer recorded data on each passing maneuver involving this vehicle, and transmitted data to the interview stations. At the stations the passing vehicles were culled out and the drivers interviewed. Drivers of vehicles trailing the twin trailer were also interviewed.

Observance and interview operations were conducted on two-lane and four-lane divided and undivided highways for a period of over 165 hours. Conclusions are based upon the observance of the 603 vehicles which passed or were passed by the twin trailer, and the analyses of the interview data obtained from the drivers of these vehicles and the 260 vehicles that trailed the twin trailer.

The survey revealed that seven and one-half percent of the motorists observed passing the twin trailer did not realize they had passed any vehicles in the test sections. Of all motorists observed passing the twin trailer, six and one-half percent stated that there was something different or unusual about the passing maneuver. Forty percent of the motorists that passed or were passed by the twin trailer noticed something different about the vehicle and ninety-four percent of these motorists correctly identified the twin trailer.

Thirty-one percent of the motorists observed trailing the twin trailer noticed a vehicle on the highway that was different, and nearly all of these motorists correctly identified the twin trailer.

The observer in the cab of the twin trailer noted that ninety-five percent of the passing maneuvers on two-lane highways and all on four-lane highways were made in a proper manner.

A detailed report of this survey is incorporated in this report as Appendix II.

Off-road Stopping Distance, Stability and Maneuverability Tests

The major part of the stopping distance, stability, and maneuverability tests were conducted on an airstrip at Wallops Station, Virginia, made available through the courtesy of the National Aeronautics and Space Administration. It was planned that all tests would be performed there, but because of the flat grade and limtied acceleration distance on the airstrip, the 55 mph stopping distance tests were moved to an unopened section of I-85 near Petersburg.

The stability of the vehicles was evaluated through observations made during the stopping distance tests.

The maneuverability demonstration was conducted through a course simulating left and right turns in an intersection, an "S" curve, and a full 180° turn. Tracking of the trailer was also observed.

All stopping distance tests were limited in that the trailer combination was compared to a conventional trailer during panic stops under the following conditions:

1. Only two pavements were tested; both had excellent skid resistant characteristics.
2. The vehicles were new, as were the brakes and tires.
3. The brakes were adjusted throughout the tests to ensure excellent performance.
4. The brakes were applied in more of a panic manner than the drivers are trained to apply brakes.
5. The drivers were handpicked.
6. The tractors and trailers, and the drivers and mechanics were supplied by the trucking industry.

A point of interest noted during the wet pavement tests with the trailers empty was that the units required about equal stopping distances for the 20, 30, and 55 mph speeds, but at the 40 and 45 mph speeds the distances for the twin trailer were larger.

The testing program was under the supervision of Mr. David C. Mahone of the Virginia Highway Research Council and his full report on the project is attached as Appendix III.

Experience in Other States

Accident Record Data Survey—In 1967, the Department of State Police made a survey of three insurance companies, the United States Department of Transportation, and 15 states which permitted the operation of twin trailer combinations, to determine their experience with the operation of these vehicles. Following the formation of the Twin Trailer Study Commission, the 1967 data were updated with a survey of four toll road authorities and 27 states permitted twin trailers. The replies to the 1967 and 1968 inquiries were placed in two binders and a copy of each was furnished each member of the Twin Trailer Commission on November 7, 1968.

The information in these two volumes has been summarized and is made a part of this report in Appendix IV.

Personal Investigation—Mr. R. W. DuVal, Assistant Director, Virginia Highway Safety Division, and Mr. J. M. Harris, Jr., Traffic Engineer, Virginia Department of Highways, went to Maryland, Delaware and Pennsylvania to make a personal investigation of twin trailer operations.

This study was conducted primarily in the State of Maryland; however, some interviews were made in Pennsylvania and Delaware. Most people interviewed were police officers, traffic records clerks, and trucking officials. Some citizens in Maryland were also questioned as to their observations and opinions regarding twin trailer operations.

A demonstration of the combination was conducted by the Preston Trucking Company, Preston, Maryland. This demonstration consisted of connecting and disconnecting, and operating on two-lane and dual highway facilities. The test vehicle was observed making several maneu-

vers, including passing, making right and left turns across dual roadways and backing.

On the basis of personal observations the following conclusions were made:

1. The capability of the vehicle to be driven in reverse was limited to the point that this maneuver was virtually impossible.
2. Citizens in the vicinity of Preston have no particular reaction towards the vehicle.
3. The vehicle can be turned in a much shorter radius than can the conventional tractor-trailer.
4. Accident records are kept in such a manner that no information pertaining to this type of vehicle could be retrieved.
5. The physical characteristics of this vehicle are such that it would not be readily identified as a twin trailer vehicle by the average motorist.
6. The operation of twin trailers on a dual facility would create no more problems from a safety standpoint than those c eated by conventional tractor-trailers.

The details of this study by Messrs. DuVal and Harris may be found in Appendix IV.

Twin Trailer Reference Listing

At the request of this Subcommittee, the Virginia Highway Research Council compiled a listing of available literature regarding twin trailers. The listing is made a part of this report as Appendix V.

APPENDIX I

OVER-THE-ROAD OBSERVATION OF THE TWIN TRAILER VEHICLE

OVERNITE TRANSPORTATION COMPANY RECORDS of the TWIN TRAILER VEHICLE

The Overnite Transportation Company was requested by Major J. S. Pearson, Chairman of the Twin Trailer Committee, to keep a written record of pertinent facts concerning each twin trailer operation.

These records cover the period of time between November 11, 1968, and ending February 7, 1969, and a total of 65 operations. They have been very carefully reviewed.

The summary is as follows:

Operator

Mr. Charles W. Newsome was the prevalent driver a d operated the vehicle for 55 of the 65 operations.

Mr. Ray Shields was the operator for 6 trips and Mr. J. D. Nix for 4 trips.

Destination

The usual route traveled was between Richmond and Danville and accounted for 63 of the 65 operations. The routes traveled were 58, 304, and 360. The remaining two operations were between Richmond and Bristol.

Weight of Vehicle

The empty weight of the tractor pulling the trailers was 12,050 pounds. The empty weight of both trailers was 15,900 pounds. The total empty weight of the combined tractor and trailer was 27,950 pounds. The lightest payload was 8,221 pounds and the heaviest 45,881 pounds. Eight payloads were in excess of 40,000 pounds. Twenty-one payloads exceeded 30,000 pounds and were not more than 40,000 pounds. Twelve payloads exceeded 20,000 pounds and were not more than 30,000 pounds. Twenty payloads exceeded 10,000 pounds and were not more than 20,000 pounds. Three payloads were less than 10,000 pounds. The average payload was 26,436 pounds. The average gross weight of the combination and load was 54,386 pounds.

Tachograph

A Servis Recorder Tachograph was installed in the tractor. The graph indicates the speed, miles traveled, time of day, and number of stops. A written record on the chart listed the driver, date, destination, and identified the operator.

The graph indicated the normal speed to range between 45 and 55 MPH for the operations between Richmond and Danville, except for the first trip on November 11, 1969, and this speed generally ranged between 20 MPH and 40 MPH.

The graphs of the Richmond-Bristol operation indicated a greater variation in speed and it was not uncommon for the graph to show 30 to 35 MPH. The gross weight was approximately the same as that of the Danville-Richmond operation. The graph indicated the gross weight had little effect on the average speed.

Miles Traveled

The twin trailer vehicle was operated approximately 1,284 miles between Richmond and Bristol; 11,400 miles between Richmond and Danville; and approximately 3,000 for other test purposes.

The total operation from November 11, 1968, through February 7, 1969, is 15,688 miles.

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

RICHMOND, VIRGINIA 23210

February 7, 1969

To: MAJOR J. S. PEARSON

SUBJECT: State Police Twin Trailer Observation

I am attaching a summary of our members observations of the twin trailer vehicle that were made during the normal pay-load operation in this State.

R. M. TERRY
Safety Officer

RMT/jw
Enclosure

STATE POLICE OVER-THE-ROAD OBSERVATION OF THE TWIN TRAILER VEHICLE

PURPOSE

Observe the vehicle during routine operation and report its road worthiness.

OBSERVERS

The following members of the Department of State Police observed the twin trailer during its operation on the public highway:

Trooper L. E. Strickland	Division I	Richmond
Trooper J. T. Lee	Division I	Richmond
Investigator C. R. Deavers, Jr.	Division III	Appomattox
Trooper T. R. Sexton	Division III	Appomattox
Trooper R. W. Litton	Division IV	Wytheville
Trooper D. R. Jessup	Division IV	Wytheville
Investigator G. A. Farthing, Jr.	Division IV	Wytherville
Trooper J. G. Dula	Division VI	Salem
Investigator H. C. Lucas	Division VI	Salem
Sergeant G. S. Cooper	Division VI	Salem
Lieutenant R. L. Suthard	Administrative Hdqts.	Richmond
Major J. S. Pearson	Administrative Hdqts.	Richmond

TWIN TRAILER OPERATION

The trailer was operated by Mr. Charles W. Newsome. Mr. Newsome has 26 years of driving experience and is 48 years of age. (Born 2-26-21) The trailer was loaded and the route was similar to other normal operations of the Overnite Trucking Company.

CONDITIONS

The twin trailer was observed during both daylight and darkness. It was under observation while the highway was wet and dry, and also when it was covered with ice and snow. The trailer was observed while operating on two-lane, three-lane, four-lane and interstate highways. State Policemen followed the trailer through cities and towns, and also on the open highway. It was under constant direct vigilance for several hundred miles between Richmond and Bristol and intermittent observation at numerous other intervals.

ACCIDENTS

The vehicle was involved in two minor accidents—

1. The second trailer scraped an overpass abutment (13'3" clearance height) with its top right front. The damage was estimated at less than $50.00.
2. A passenger vehicle backed into the highway and struck the right rear of the second trailer. No damage to trailer. Approximately $100.00 damage to the passenger vehicle.

RESULTS

1. Passing—

   Passing maneuvers by both the twin trailer and the public appeared normal. Observers passed the trailer and also had the twin trailer pass the vehicle occupied by the observers.

2. Following—

   When following the twin trailer on a straight highway, the average person cannot differentiate between the standard tractor trailer and the twin trailer. There is no noticeable sway and the rear trailer tracks with the front.

3. Turning—

   The vehicle made U-turns, 90° left and right intersection turns and other normal intersection and cross-over turns. Here, as a singular exception, the twin trailer appeared to make a 90° turn and track better than the one long trailer.

4. Braking—

   The normal braking appeared the same as other semi-trailer vehicles. Emergency braking was not observed.

5. Acceleration—

   The acceleration appeared to be the same as the standard semi-trailer.

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

RICHMOND, VIRGINIA

January 8, 1969

To: MAJOR J. S. PEARSON

SUBJECT: Twin Trailers

On January 7, 1969 Trooper J. T. Lee and I observed the twin trailers owned by Overnite Transportation Company from Commerce Road in Richmond to Farmville, Virginia.

The vehicle traveled Routes 360 and 307. The vehicle was operated by Charles W. Newsom and had a gross weight of 57,000 pounds. The trailers were pulled by a Mack Tractor bearing Virginia license YH 1-070. The first trailer was bearing Overnite no. 27204 and the second trailer was no. 27102.

During the time we observed this unit, we did not notice any unusual situations. Traffic passed the unit on Routes 360 and 307 and did not seem to pay any attention to the double trailer.

We do not see any reason that units similar to this could not be used on four-lane and two-lane highways.

L. E. STRICKLAND, *Trooper*

J. T. LEE, *Trooper*

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

APPOMATTOX

January 8, 1969

To: CAPTAIN W. W. BLYTHE

SUBJECT: Operation of Twin Trailer Through Third Division

Investigator C. R. Deavers and Trooper T. R. Sexton were assigned to observe this twin trailer unit, operated by Overnite Transportation Company, while traveling highways in the Third Division. The tractor-trailer entered the Third Division on Route 307 at the Nottoway and Prince Edward County line at 9:50 A. M., January 7, 1969. This vehicle was involved in a slight accident in the Town of Farmville. The tractor-trailer was preparing to stop at a red light at the intersection of U. S. Route 460 and Saint George Street at 10:00 A. M. when a 1956 four-door Dodge backed out of a garage entrance of the Planter's Warehouse and struck the right rear tire of the twin trailer. Mr. Charles Wilson Newsome, driver of the tractor-trailer, stated he never saw the Dodge prior to the accident, but felt the bump when the car struck the trailer tire. Mr. James Monroe Watkins, operator of the Dodge, apparently never looked back while backing. Sergeant Carl H. Kelsey, Farmville Police Department, investigated this accident and placed no charges. Sergeant Kelsey stated several accidents had occurred at this location. An accident report (SR-300) is attached.

This tractor-trailer was observed on two-lane roads, Route 307 and Route 460 and four-lane highway on Route 460. There was no noticeable difference in the operation of this unit and the common tractor-trailer units now pulling one trailer.

There was such little sway in the rear trailer that on straight road, it appeared there was only one trailer. Both automobiles and tractor-trailers passed the twin trailer unit without difficulty and traffic was not impeded. The twin unit passed another tractor-trailer on four lane U. S. Route 460 without difficulty and no sway was evident.

This twin unit traveled U. S. Route 460 through the City of Lynchburg and maneuvered very well. When required to stop on quick notice, the unit stopped in a short distance and without any sliding or sway.

The twin unit executed tight right-angle turns in Lynchburg with less trouble and tracked better than shorter tractor-trailers pulling one long trailer, now legal in Virginia.

This twin unit left the Third Division at 1:30 P. M. westbound on U. S. Route 460. During operation in the Third Division, it operated completely within the law and caused no traffic problems. The weather was clear and road conditions were dry, with occasional wet spots. It is felt this twin unit tractor-trailer would be safe and cause no additional traffic problems than the legal tractor-trailer units now operating in this State. It was not necessary for this unit to back during operation in the Third Division, but Mr. Charles W. Newsome, the driver, states this is difficult with this twin combination.

CARL R. DEAVERS, *Jr., Investigator*

T. R. SEXTON, *Trooper*

CRDjr:jns

Forwarded

W. W. Blythe
Division Commander

S. R. 3C; POLICE REV. 7-21-66 — MAIL TO: DIVISION OF MOTOR VEHICLES, BOX 1258, RICHMOND (16), VIRGINIA

TIME — DATE OF ACCIDENT (MONTH / DATE / YEAR): January 7, 1969 — DAY OF WEEK: Tuesday — HOUR: 10:00 A.M. / P.M.

DO NOT WRITE IN THIS SPACE

RO.....
CA.....
LET.....
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(1-2-3-4-5)
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T.T. R.V.S. NSP OFF

LOCATION

COUNTY: Prince Edward — CITY OR TOWN: Farmville

IF ACCIDENT OCCURRED IN RURAL AREA INDICATE DISTANCE IN MILES AND TENTHS OF MILE FROM NEAREST TOWN. USE TWO DISTANCES AND TWO DIRECTIONS IF NECESSARY.
.....MILES NORTH
.....MILES SOUTH
.....MILES EAST
.....MILES WEST
OF ☐ LIMITS OF ..... CITY OR TOWN

ACCIDENT HAPPENED ON (18-19-20): U. S. Route 460
GIVE NAME OF STREET OR HIGHWAY NUMBER (U.S. OR STATE). IF NO HIGHWAY NUMBER, IDENTIFY BY BLOCK

CHECK AND COMPLETE ONE
☐ AT ITS INTERSECTION WITH: ..... OR IF
☒ NOT AT INTERSECTION

.....FEET NORTH OF Saint George Street
.....FEET SOUTH
120 FEET EAST
.....FEET WEST
NAME OF INTERSECTING STREET OR HIGHWAY NUMBER

URBAN - LOCATE TO NEAREST INTERSECTING STREET. HOUSE NUMBER. BRIDGE, RAILROAD CROSSING, ALLEY, DRIVEWAY, UNDERPASS, NUMBERED TELEPHONE POLE, OR OTHER IDENTIFYING LANDMARK.
RURAL - LOCATE TO NEAREST INTERSECTION. SHOW EXACT DISTANCE, USING TWO DIRECTIONS AND TWO DISTANCES IF NECESSARY.

SUPPLEMENTARY REPORT ☐

ROAD

ALIGNMENT (CHECK ONE) (23)
1 ☒ STRAIGHT-LEVEL
2 ___ CURVE-LEVEL
3 ___ GRADE-STRAIGHT
4 ___ GRADE-CURVE
5 ___ HILLCREST-STRAIGHT
6 ___ HILLCREST-CURVE
7 ___ DIP-STRAIGHT
8 ___ DIP-CURVE

SURFACE CONDITION (CHECK ONE) (24)
4 ☒ DRY
5 ___ WET
6 ___ SNOWY
7 ___ ICY
8 ___ MUDDY
9 ___ OILY

DEFECTS (CHECK ONE)
12 ___ UNDER REPAIR
0 ___ LOOSE MATERIAL
1 ___ HOLES, RUTS, BUMPS
2 ___ SOFT OR LOW SHOULDER
3 ☒ NO DEFECTS

TRAFFIC CONTROL (CHECK ONE) (25)
4 ___ OFFICER OR WATCHMAN
1 ___ STOP AND GO LIGHT
2 ___ STOP SIGN
3 ___ SLOW OR WARNING SIGN
7 ___ RAILROAD GATES OR SIGNALS
12 ☒ TRAFFIC LANES MARKED
5 ___ NO PASSING LINES
0 ___ YIELD SIGN
9 ___ ONE WAY ROAD OR STREET
6 ___ RAILROAD WATCHMAN
8 ___ NO TRAFFIC CONTROL

KIND OF LOCALITY (CHECK ONE) (26)
12 ☒ BUSINESS OR INDUSTRIAL
0 ___ RESIDENTIAL DISTRICT
1 ___ SCHOOL, CHURCH OR PLAYGROUND ZONE
2 ___ OPEN COUNTRY

LIGHT (CHECK ONE)
4 ☒ DAYLIGHT
5 ___ DUSK
6 ___ DAWN
7 ___ DARKNESS-STREET OR HIGHWAY LIGHTED
8 ___ DARKNESS-STREET OR HIGHWAY NOT LIGHTED

WEATHER (CHECK ONE) (27)
1 ☒ CLEAR
2 ___ CLOUDY
3 ___ FOG
4 ___ MIST
5 ___ RAINING
6 ___ SNOWING
7 ___ SLEETING
8 ___ SMOKE-DUST

SURFACE
___ CONCRETE
☒ BLACKTOP
___ BRICK
___ GRAVEL
___ DIRT
SPECIFY OTHER

VEHICLE

YOUR VEHICLE-NO. 1 (28) — (29) — (30)
Mack Tractor-Trailer — 1968 — WAS VEHICLE INSURED? Yes — VEHICLE LICENSE PLATE YEAR 1968 (31) STATE Va. NUMBER YH1-070 — I.C.C. PLATE NO. Unk. (33)
MAKE — TYPE (SEDAN, TRUCK, TAXI, BUS, ETC.) — YEAR — YES OR NO
OWNER: Charles Wilson Newsome, 103 Apollo St., Petersburg, Va. — BORN (MO. DAY YR) 2-26-21 — SEX M — RACE W
NAME — STREET OR R.F.D. — CITY AND STATE
OWNER'S OCCUPATION: Truck Dr. — DRIVING EXPERIENCE: 30 — DRIVER'S LICENSE: Va. N05851-78789-191787 — (34) CARPENTER, CLERK, ETC. — YEARS — STATE — NUMBER
☒ CHAUFFER ☐ OPERATOR ☐ BEGINNER
(35) ESTIMATED SPEED BEFORE ACCIDENT: 45 M.P.H. — (36-37) SPEED LIMIT: 25 M.P.H.
DAMAGED: Overnite Transportation Company, 1100 Commerce Rd., Richmond, Va. — MAXIMUM SAFE SPEED: 20 M.P.H.
NAME — STREET OR R.F.D. — CITY AND STATE
PARTS OF VEHICLE DAMAGED: None
WAS SAFETY BELT INSTALLED? YES ___ NO ☒ — WAS BELT IN USE? YES ___ NO ___ — APPROXIMATE COST TO REPAIR VEHICLE $: None

OTHER VEHICLE-NO. 2 (38) — (39) — (40)
Dodge 4-Dr. Sedan — 1956 — WAS VEHICLE INSURED? Yes — VEHICLE LICENSE PLATE YEAR 1968 (41) STATE Va. NUMBER 744-067 — I.C.C. PLATE NO. — (42) SEX M — RACE N (43)
MAKE — TYPE (SEDAN, TRUCK, TAXI, BUS, ETC.) — YEAR — YES OR NO
OWNER: James Monroe Watkins, P. O. Box 38, Prospect, Va. — BORN (MO. DAY YR) 9-24-05
NAME — STREET OR R.F.D. — CITY AND STATE
OWNER'S OCCUPATION: Farmer — DRIVING EXPERIENCE: 43 — DRIVER'S LICENSE: Va. W01721-90643-046155 — (44) CARPENTER, CLERK, ETC. — YEARS — STATE — NUMBER
☐ CHAUFFER ☒ OPERATOR ☐ BEGINNER
(45) ESTIMATED SPEED BEFORE ACCIDENT: 5 M.P.H. — (46-47) SPEED LIMIT: 25 M.P.H.
DAMAGED: Elizabeth Hill Watkins, Same — MAXIMUM SAFE SPEED: 0 M.P.H.
NAME — STREET OR R.F.D. — CITY AND STATE
PARTS OF VEHICLE DAMAGED: Right rear fender, rear taillight and rear bumper.
WAS SAFETY BELT INSTALLED? YES ___ NO ☒ — WAS BELT IN USE? YES ___ NO ___ — APPROXIMATE COST TO REPAIR VEHICLE $: 100.00

TOTAL VEHICLES INVOLVED: 2

DAMAGE TO PROPERTY OTHER THAN VEHICLES: None (48)
NAME OBJECT, SHOW OWNERSHIP, AND STATE NATURE OF DAMAGE
APPROXIMATE COST TO REPAIR $:

INJURED

NAME ..... ADDRESS .....
AGE ..... (49) SEX ..... (50) NATURE AND EXTENT OF INJURY .....
RACE ..... WAS PERSON KILLED .....
☐ DRIVER ☐ PASSENGER ☐ PEDESTRIAN ☐ BICYCLIST — IN VEHICLE NO. (51)

NAME ..... ADDRESS .....
AGE ..... (52) SEX ..... (53) NATURE AND EXTENT OF INJURY .....
RACE ..... WAS PERSON KILLED .....
☐ DRIVER ☐ PASSENGER ☐ PEDESTRIAN ☐ BICYCLIST — IN VEHICLE NO. (54)

TOTAL KILLED: 0

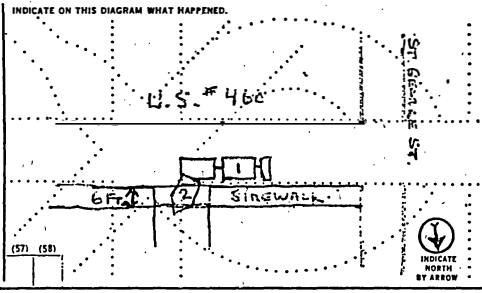
NOTE: DO NOT WRITE IN BOXES.

IMPORTANT IF YOU HAD AN AUTOMOBILE LIABILITY POLICY AT THE TIME OF THE ACCIDENT, SECURE FROM YOUR AGENT OR INSURANCE COMPANY A NOTICE OF INSURANCE (FORM SR-21) AND SEND IT WITH THIS REPORT TO THE DIVISION OF MOTOR VEHICLES OR HAVE YOUR AGENT SEND IT AT ONCE.

LOCATION IN VEHICLE OF PERSONS KILLED AND INJURED.
(CHECK ONE FOR EACH PERSON KILLED AND INJURED)

	VEHICLE 1 (55) KILLED	VEHICLE 1 (56) INJURED	VEHICLE 2 (55) KILLED	VEHICLE 2 (56) INJURED
1 FRONT LEFT				
2 FRONT CENTER				
3 FRONT RIGHT				
4 REAR LEFT				
5 REAR CENTER				
6 REAR RIGHT				

INDICATE ON THIS DIAGRAM WHAT HAPPENED.



(57) (58)

INSTRUCTIONS

1. FOLLOW DOTTED LINES TO DRAW OUTLINE OF ROADWAY AT PLACE OF ACCIDENT.
2. NUMBER EACH VEHICLE AND SHOW DIRECTION OF TRAVEL BY ARROW.
3. USE SOLID LINE TO SHOW PATH BEFORE ACCIDENT. DOTTED LINE AFTER ACCIDENT.
4. SHOW PEDESTRIAN BY
5. SHOW RAILROAD BY
6. SHOW DISTANCE AND DIRECTIONS TO LANDMARKS; IDENTIFY LANDMARKS BY NAME OR NUMBER.

DESCRIBE WHAT HAPPENED (REFER TO VEHICLES BY NUMBER)

Vehicle #2 backed into right most rear trailer tire of vehicle #1, which was proceeding west. Vehicle #2 occupied by man and wife, both in front seat. Necessary for vehicle #2 to back into street before driver could tell if any vehicle was coming.

INJURED PERSONS. ALSO EXPLAIN QUESTIONS NOT FULLY ANSWERED BY CHECKING IN THE SPACES PROVIDED AND REASON FOR SUBMITTING IF SUPPLEMENTARY.

IF MORE SPACE IS NEEDED USE ANOTHER FORM OR A SHEET OF PAPER THE SAME SIZE.

(59) OFFENSES CHARGED DRIVER?

No charges.

DRIVERS' ACTIONS INDICATED (CHECK ONE FOR EACH DRIVER)

	DRIVER 1 (60)	DRIVER 2 (63)
1 EXCEEDED SPEED LIMIT		
2 EXCEEDED SAFE SPEED BUT NOT SPEED LIMIT		
3 OVERTAKING ON HILL		
4 OVERTAKING ON CURVE		
5 OVERTAKING AT INTERSECTION		
6 IMPROPER PASSING OF SCHOOL BUS		
7 CUTTING IN		
8 OTHER IMPROPER PASSING		
9 WRONG SIDE OF ROAD-NOT OVERTAKING		
	(61)	(64)
12 DID NOT HAVE RIGHT-OF-WAY		
0 FOLLOWING TOO CLOSE		
1 FAILED TO SIGNAL OR IMPROPER SIGNAL		
2 IMPROPER TURN-WIDE RIGHT TURN		
3 IMPROPER TURN-CUT CORNER ON LEFT TURN		
4 IMPROPER TURN FROM WRONG LANE		
5 OTHER IMPROPER TURNING		
6 X IMPROPER BACKING		
7 IMPROPER START FROM PARKED POSITION		
8 DISREGARDED OFFICER OR WATCHMAN		
9 DISREGARDED STOP-GO-LIGHT		
	(62)	(65)
12 DISREGARDED STOP OR YIELD SIGN		
0 .0 DISREGARDED SLOW SIGN		
1 FAILED TO STOP AT THROUGH HIGHWAY-NO SIGN		
2 DROVE THROUGH SAFETY ZONE		
3 FAILED TO SET OUT FLARES OR FLAGS		
4 FAILED TO DIM HEADLIGHTS		
5 DRIVING WITHOUT LIGHT		
6 IMPROPER PARKING LOCATION		
7 OTHER VIOLATIONS		
8 X NO VIOLATIONS		

MISCELLANEOUS (CHECK ONE ITEM FOR EACH DRIVER, IF APPLICABLE)

	DRIVER 1 (66)	DRIVER 2
12 AVOIDING PEDESTRIAN		
0 AVOIDING OTHER VEHICLE		
1 AVOIDING ANIMAL		
2 SKIDDING-BEFORE APPLYING BRAKES		
3 SKIDDING-AFTER APPLYING BRAKES		
4 CROWDED OFF ROADWAY		
5 HIT AND RUN		
6 CAR RAN AWAY-NO DRIVER		
7 BLINDED BY LIGHTS		

PEDESTRIAN ACTIONS (CHECK ONE)

(67-68)

01 CROSSING AT INTERSECTION-WITH SIGNAL
02 CROSSING AT INTERSECTION-AGAINST SIGNAL
03 CROSSING AT INTERSECTION-NO SIGNAL
04 CROSSING AT INTERSECTION-DIAGONALLY
05 CROSSING NOT AT INTERSECTION-RURAL
06 CROSSING NOT AT INTERSECTION-URBAN
07 COMING FROM BEHIND PARKED CARS
08 GETTING OFF OR ON SCHOOL BUS
09 PLAYING IN ROADWAY
10 GETTING OFF OR ON OTHER VEHICLE
11 INTENING ON VEHICLE
12 WALKING IN ROADWAY WITH TRAFFIC-SIDEWALKS AVAILABLE
13 WALKING IN ROADWAY WITH TRAFFIC-SIDEWALKS NOT AVAILABLE.
14 WALKING IN ROADWAY AGAINST TRAFFIC-SIDEWALKS AVAILABLE
15 WALKING IN ROADWAY AGAINST TRAFFIC-SIDEWALKS NOT AVAILABLE
16 WORKING IN ROADWAY
17 STANDING IN ROADWAY
18 LYING IN ROADWAY
19 NOT IN ROADWAY

CONDITION OF DRIVERS AND PEDESTRIAN (CHECK ONE FOR EACH DRIVER AND PEDESTRIAN)

	DRIVER 1 (69)	DRIVER 2 (71)	PED (73)
8 X NO DEFECTS			
0 EYESIGHT DEFECTIVE			
1 HEARING DEFECTIVE			
2 X OTHER BODY DEFECT legs crippled			
3 ILL			
4 PATHYED			
5 APPARENTLY ASLEEP			
6 OTHER HANDICAP			

(CHECK ONE FOR EACH DRIVER AND PEDESTRIAN)

	DRIVER 1 (70)	DRIVER 2 (72)	PED (74)
12 X X HAD NOT BEEN DRINKING			
0 DRINKING-APPARENTLY DRUNK			
1 DRINKING-ABILITY IMPAIRED			
2 DRINKING-ABILITY NOT IMPAIRED			
3 DRINKING-NOT KNOWN WHETHER IMPAIRED			

VEHICLE CONDITION (CHECK ONE FOR EACH VEHICLE)

	VEHICLE 1 (75)	VEHICLE 2 (76)
8 X X NO DEFECTS		
1 LIGHTS DEFECTIVE		
2 BRAKES DEFECTIVE		
3 STEERING DEFECTIVE		
4 PUNCTURE OR BLOWOUT		
5 WORN OR SLICK TIRES		
6 MOTOR TROUBLE		
7 OTHER DEFECTS		

WHAT DRIVERS WERE DOING (CHECK ONE FOR EACH DRIVER)

	DRIVER 1	DRIVER 2
X GOING STRAIGHT AHEAD		
MAKING RIGHT TURN		
MAKING LEFT TURN		
MAKING U TURN		
SLOWING OR STOPPING		
STARTING IN TRAFFIC LANE		
STARTING FROM PARKED POSITION		
STOPPED IN TRAFFIC LANE		
PARKED		
X BACKING		
PASSING		

DRIVER VISION OBSCURED (CHECK ONE FOR EACH DRIVER)

	DRIVER 1	DRIVER 2
RAIN, SNOW, ETC. ON WINDSHIELD		
WINDSHIELD OTHERWISE OBSCURED		
VISION OBSCURED BY LOAD OR VEHICLE		
TREES, CROPS, ETC.		
X BUILDING		
EMBANKMENT		
SIGNBOARD		
HILLCREST		
PARKED VEHICLES		
MOVING VEHICLES		
SPECIFY OTHER		
X NOT OBSCURED		

SIGNATURE Carl R. Deavers Jr.
(SIGNATURE OF PERSON SUBMITTING REPORT IS REQUIRED)

WITNESS
OCCUPANT
DRIVER

IF FILED BY POLICE Carl R. Deavers, Jr. BADGE NO. 617 DEPT. of State Police

DATE FILED (77) 1-8-69

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

SALEM, VIRGINIA 24153

January 8, 1969

To: CAPTAIN J. W. BURROW

SUBJECT: Twin Trailer Study

Trooper J. G. Dula and I conducted surveillance of the Overnite Twin Trailer operation through Division Six on January 7, 1969. We intercepted this operation at the Third Division line on U. S. 460 and conducted surveillance to the Fourth Division line, on Interstate 81. The weather was clear and windy, and the road surface was dry. Our observations were as follows:

1:35 P.M. Intercepted Study Unit at Third Division line—going west on Route 460—two-lane highway. Travelling approximately 45 miles per hour. Made good time going up hills until we caught up with a regular tractor-trailer that was dragging down on the hills. The second trailer of the Twin Trailer Unit tracked in almost perfect line with the first trailer. There was no swaying or other unusual movement on this stretch of two-lane highway. Except in curves where both trailer units were visible, we could not distinguish this unit from a regular tractor-trailer unit. Other traffic on this stretch of highway was light, and only four automobiles passed this unit. Neither the passing traffic nor the traffic we met showed any particular signs of recognition.

2:05 P.M. Arrived in the City of Bedford, proceeding South on Bridge Street to make a ninety degree turn west onto West Main and west out of the City on U. S. 460. There was no unusual incident or problem in going through Bedford except for the right turn from Bridge Street onto West Main. This Unit began his right turn from the right lane of Bridge Street and extended his turn into the eastbound lane of Main Street. Eastbound vehicles on Main that were stopped for the traffic light had to clear the intersection before the Twin Trailer Unit could complete his turn. In making the right turn, the rear wheels of the second trailer ran onto the corner of the sidewalk, tracking approximately two feet inside the rear wheel track of the first unit. Investigator Lucas obtained photographic coverage of this movement with a movie camera from the top of a building at the northwest corner of this intersection.

This was not an unusual problem for this intersection with regular tractor-trailer units. It is a frequent occurrence for tractor-trailers going either direction, and the northwest corner of the sidewalk has sloped curbs to accommodate these incidents.

2:15 P.M. Left Bedford on U. S. 460 west, a divided highway. From 40 to 50 vehicles passed this Unit between Bedford and Roanoke. One automobile drove beside this Unit for a short distance while the driver appeared to be looking the Unit over. None of the other vehicles, automobile or tractor-trailer units, showed any special sign of recognition or appeared to experience any problem in passing.

This Study Unit operated about five miles under the posted speed limits on open highways. On a long upgrade just East of Villamont he slowed from about 45 miles per hour to 26 miles per hour before making the crest of the hill. This was the only noticeable incident of dragging down on this stretch of travel.

2:47 P.M. Arrived in Roanoke on Orange Avenue and left by Interstate 581 and 81. Construction on Orange Avenue presented no problems. Entered 581 ramp from Orange Avenue in nomal manner and appeared to track in almost perfect fashion. It did not appear that the operator of this Study Unit had to make any special allowances in negotiating normal curves and turns. There was no unusual incident associated with our trip through Roanoke. His speed ranged from 45 to 50 miles per hour on the Interstate system, and the operator appears extremely careful to observe all highway rules and courtesies.

3:15 P.M. Left Interstate 81 at Big Hill, enroute South on U. S. 11. This is a dual highway west to Christiansburg mountain where it becomes three lane. The character of this highway is generally hilly with some curves. The Study Unit's movement on this leg was routine until we arrived at Christiansburg mountain. He began this ascent at 35 miles per hour and slowed to 12 miles per hour by the time we reached a point half way to the crest. He maintained 12 miles per hour, the remainder of the way up the mountain, preceded by a straight truck loaded with gas cylinders. Upon clearing the crest of this mountain, he increased his speed to 45 miles per hour, without unusual delay and made Christiansburg without incident.

3:45 P.M. We entered Interstate 81 south of Christiansburg and proceeded to the Fourth Division line without a reportable incident.

We passed this Study Unit several times during the course of this surveillance, and let him pass us several times. The unusual length of this Unit was not very noticeable to us while we were passing, however, as it was passing us at a slower rate of passing, his length became considerably more noticeable. At no time during this surveillance did the Study Unit pass any vehicle other than ours. The surface condition and crown of the highways on this trip had no unusual effect on this Study Unit. This Unit's movement with the general flow of traffic on the open road and in town appeared normal for tractor-trailers. It did not run

off the pavement or show any unusual sway movement, even though the wind became quite strong toward the end of our surveillance. It departed our Division at 4:05 P.M. under surveillance by the Fourth Division team.

Trooper Dula and I have concluded that this Unit should be able to operate as safely on multiple lane roads as regular tractor-trailer units, insofar as maneuverbility is concerned. We had no occasion to witness a demonstration of his stopping ability, or his recovery from any emergency operation. It is our observation that this unit's operation on the two-lane stretch of highway during this study appeared no more hazardous than any other routine tractor-trailer operation.

G. S. COOPER, *Sergeant*

GSC:msb

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

WYTHEVILLE

January 8, 1969

To: CAPTAIN C. M. BOLDIN

SUBJECT: Operation of Twin Trailers

On January 7, 1969 Trooper D. R. Jessup and I accompanied the twin trailer from the Montgomery County line to the Bristol terminal. The total travel time was approximately two hours and thirty minutes for the 104 miles. We encountered snow and ice on the highway through Smyth and Washington Counties for a distance of about 50 miles. We observed the operation of this vehicle from the front and rear and did not see anything unusual about the operation. It traveled at about the same speed as other truck traffic. There was no swaying of the trailers, and from the rear it appeared to be a single unit truck.

The driver passed several vehicles and was passed by numerous cars and trucks, and if any of them noticed this vehicle was any different from any other vehicle, it was not obvious.

The driver appeared to have been well trained in the operation of this vehicle and was very cautious.

On January 8, 1969 Investigator G. A. Farthing and Trooper D. R. Jessup accompanied the twin trailer from the Bristol terminal to the Montgomery County line. The total travel time for the 104 miles was two hours and twenty minutes. The vehicle did not have any difficulties during the trip and was able to travel at about the same speed as other truck traffic. It did not exceed the speed limit at any time and did not impede traffic.

Investigator Farthing made moving pictures of the truck as it left the Bristol terminal and through parts of the City of Bristol. He also took other pictures of this vehicle as it passed traffic and when traffic was passing it. The road had some snow and ice on the surface, but the vehicle did not skid nor stall. The vehicle did not encounter any emergency situations on the trip to Bristol or back.

We are of the opinion that it would be safe to operate the twin trailer on any type of highway that is suitable for any other tractor-trailer. Due to the fact that the twin trailer cannot be backed, it might create more of a hazard on an icy road in a mountainous or steep terrain.

R. W. LITTON, *Trooper*
D. R. JESSUP, *Trooper*

RWL/mjf
DRJ/

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

SALEM, VIRGINIA 24153

January 10, 1969

To: CAPTAIN J. W. BURROW

SUBJECT: Twin Trailer Study

Investigator H. C. Lucas and I conducted surveillance of the Overnite Twin Trailer operation through Division Six on January 8, 1969. During this surveillance, Investigator Lucas took several rolls of movie films of this operation. This vehicle was intercepted near the Fourth Division line on Interstate 81 and surveillance conducted to the Third Division line on U. S. 460. The weather was cloudy and the road surface was dry.

We intercepted the Study Unit at Fourth Division line at 11:45 A.M. and continued east on Interstate 81. Speed of this vehicle ranged around 50 miles per hour during the Interstate operation. Upon leaving the Interstate ramp and entering U. S. 11 near Christiansburg, the study vehicle was able to negotiate these movements without any difficulty. While proceeding east on U. S. 11 which at some locations is a dual divided highway and at other locations, a three-lane highway, this vehicle was able to maneuver without any difficulties. Other traffic, which included tractor trailers, showed no particular sign of recognition while passing or meeting this vehicle.

The study vehicle while traveling east on U. S. 460 (Orange Avenue) within the City of Roanoke at approximately 600 feet west of Ninth Street, encountered difficulty at the Norfolk and Western Railway overpasses. At this location, there are two adjacent railroad overpasses spanning U. S. 460 with a posted height of 13 feet and 3 inches clearance.

At approximately 2:05 P.M., this vehicle approached the overpasses and stopped. After checking his trailer clearance, the operator proceeded with caution. The vehicle was proceeding close to and parallel to the curb line. The vehicle cleared the first overpass without any difficulty, but as the unit was passing under the second overpass, he appeared to be closer to the curb. When the second trailer entered the overpass, the right front corner made contact with the abutment which supports the bridge. As we observed this operation from the rear, it appeared the second trailer leaned to the right causing the top portion of the trailer to come in contact with the concrete abutment. After examining the study vehicle, it was learned that the tractor and first unit had cleared the abutment, however, the second unit made contact

beginning at the right front corner and extending a short distance to the rear. Examination of the abutment indicated the unit was in contact with the abutment for its entire width. Damage to the trailer was minor which was contained to the right front corner, front clearance lamp and roof rail. Damage to the trailer was estimated to be less than $50.00. Damage to the abutment was considered nil.

The crash incident of this vehicle will be covered in a separate report.

The operation was continued on to the Third Division line without further incident and surveillance was completed at 3:35 P.M.

J. G. DULA, *Trooper*

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

SALEM, VIRGINIA 24153

January 10, 1969

To: CAPTAIN J. W. BURROW

SUBJECT: Vehicle Crash Involving Twin Trailer Unit
Overnite Transportation Company
Richmond, Virginia
January 8, 1969

On January 8, 1969, at approximately 2:05 P.M., Investigator H. C. Lucas and I were following the above vehicle. While this vehicle was being operated east on U. S. 460 (Orange Avenue) within the City of Roanoke it became involved in a cash by a fixed object, bridge abutment.

This vehicle is described as a Twin Tailer Study Unit consisting of a 1968 Mack tractor, Virginia License YH1-070 and two identical trailers, first trailer bearing Virginia License TR/H 4031 connected to the tractor in the usual manner by a fifth wheel. The second trailer Virginia License TR/H63 connected to the first trailer by a tongue fifth wheel apparatus. This combination of vehicles is owned by the Overnite Transportation Company, Richmond, Virginia and operated by Charles Wilson Newsome, 103 Apollo Street, Petersburg, Virginia. The fixed object was a railway bridge support abutment, owned by the Norfolk and Western Railway, Roanoke, Virginia.

At approximately 600 feet west of Ninth Street N.E., and Orange Avenue, U.S. 460; the operator of this vehicle stopped to observe the clearance of two overpasses which spanned the route of travel. The operator proceeded in a cautious manner keeping close to and parallel to the curb. The first overpass was cleared without incident. As the vehicle proceeded under the second overpass, it was noted, that the rear wheels of the second trailer was closer to the curb. As the second trailer entered the overpass, we heard a thud and observed dust and sparks appear. At the same time, it appeared the top of the trailer was leaning to the right in the direction of the abutment. After clearing the highway, an examination of the vehicles revealed no contact was made by the tractor and the first trailer, however, the second trailer received minor damage to its right front corner and extending to the rear for a short distance along the roof railing. This damaged area included the front clearance lamp. The estimated damage to the trailer is believed to be less than $50.00. However, a closer examination by a qualified person may prove to be more or less.

Damage to the bridge abutment consisted of a scratch on the concrete, which appeared to be nil. Examination of the abutment indicated that

part of the trailer was in contact with the abutment's entire width. This abutment bore numerous scars and incisions caused by other vehicles in the past.

The above incident occurred on U.S. 460 (Orange Avenue) within the City of Roanoke near Ninth Street, N.E. The highway at this point is a four-lane undivided, straight, asphalt pavement. The weather was cloudy and pavement was dry. Overpasses which span this route are posted at a 13 foot, 4 inch clearance for east bound traffic using the right lane. The contour of the pavement reveals a slope from the crown to near the curb lines. The curb and gutter lines extend approximately eighteen inches from edge of pavement to curb wall. From the edge of asphalt to the curb wall, the surface again decends approximately two inches. It appears the contour of the pavement and bridge clearance at this point tends to cause drivers to use the extreme right portion of the roadway. The curb wall showed numerous tire marks from other vehicles.

This incident was witnessed by Investigator Lucas and I while following close to the rear of this vehicle. It is our undivided opinion that this crash was caused by the leaning or tilting of the second trailer, due to the contour of the roadway, or some unexplained movement of the tractor and first trailer.

Mr. Newsome, operator, could offer no explanation how the first trailer cleared the abutment and the second did not, other than he could have been too close to the curb.

The overpass clearance or other traffic had no bearing in any way with this crash.

We feel Mr. Newsome was not negligent in the operation of this vehicle as its purpose is at present a study matter and we may well profit or learn from this incident.

J. G. DULA, *Trooper*

APPENDIX II

TWIN TRAILER

DRIVER REACTION SURVEY

Submitted to

The Subcommittee on Traffic and Safety
Virginia Twin Trailer Study Commission

by

VIRGINIA DEPARTMENT OF HIGHWAYS
DIVISION OF TRAFFIC AND PLANNING

March 1969

CONTENTS

PREFACE

The Subcommittee on Traffic and Safety of the Virginia Twin Trailer Study Commission required a study of motorist reactions to twin trailer combinations operating on highways of the Commonwealth.

The Division of Traffic and Planning, and Highway Research Council of the Virginia Department of Highways cooperated in developing the procedure of study, design of questionnaire forms, the conduct of the study and the analyses.

This report presents the results of the driver reaction study and furnishes the background information and survey procedures.

BACKGROUND

The Twin Trailer Study Commission was created in 1968 by the Virginia General Assembly to conduct a study of the uses and operational safety of combinations of three vehicles. The Twin Trailer Study Commission appointed a subcommittee on Traffic and Safety and assigned certain areas of responsibility. Among these areas of responsibility was determining driver reaction to twin trailers on Virginia highways.

The subcommittee requested the assistance of the Virginia Department of Highways in planing and conducting the driver reaction phase of their study since that agency is experienced in similar surveys. The Division of Traffic and Planning, and the Highway Research Council of the Department of Highways coordinated their efforts in planning and conducting the survey.

The survey was designed to determine the reactions of motorists to the presence of twin trailers in the traffic stream. These reactions could be an indicator of the highway user's acceptance or rejection of twin trailers operating on Virginia highways. For this reason, considerable thought was given to eliminating the possibility of bias in developing the procedure to be followed and in designing the questionnaires to be used.

CONCLUSIONS

The twin trailer was operated between interview stations for over one hundred sixty-five hours: eighty-one hours on two-lane roads and eighty-six and one-half hours on four-lane divided and undivided highways. Conclusions that can be drawn from the survey of driver reactions follow:

1. Six hundred vehicles passed the twin trailer and the twin trailer passed three vehicles. The three vehicles passed by the twin trailer were on the four-lane divided highway.

2. Seven and one-half percent of the motorists observed passing the twin trailer did not realize they passed any vehicles in the test sections.

3. Of all the motorists observed passing the twin trailer six and one-half percent stated that *there was something different or unusual about the passing maneuver.* Motorists reporting differences were 14.9 percent on two-lane, 2.4 percent on four-lane undivided and 2.5 percent on four-lane divided highways.

4. The motorists observances of what appeared to be different or unusual about the passing maneuver (6.5%) when they passed other vehicles were the length of time it took to pass and having to wait longer for a passing opportunity on two-lane highways and greater wind velocity in passing on four-lane divided highways.

5. Forty percent of the motorists that passed or were passed by the twin trailer noticed *something different about the vehicle* and ninety-four percent of these motorists correctly identified the vehicle. Motorists passing or being passed on the two-lane highways were more observant of the twin trailer and a larger percentage of these motorists identified it.

6. During the 165 hour survey, two hundred sixty vehicles were observed trailing the twin trailer. Thirty-one percent of these motorists noticed a vehicle on the highway that was different and nearly all (97.5%) of these motorists correctly identified the twin trailer. A smaller percentage of the motorists on two-lane highways noticed the twin trailer and all were not able to identify it as was the case on the four-lane highways.

7. A state trooper riding in the cab of the twin trailer observed 603 passing maneuvers on the two-lane and four-lane highways. The 408 passing maneuvers on four-lane highways were all made in a normal manner. Of the passing maneuvers on the two-lane highways, 186 or ninety-five percent were normal, 8 did not re-enter lane before solid yellow line and 1 passed on a double yellow line.

SURVEY PROCEDURES

Questionnaires

The roadside interview questionnaire was designed to solicit specific information from drivers of vehicles that had been in the presence of a twin trailer. The drivers interviewed were those that had passed or been passed by a twin trailer and those that were following the twin trailer when it passed through an interview station. This questionnaire is shown in Figure 1.

An additional form was prepared for use of an observed in the cab of the twin trailer. This form identified the vehicle passing or being passed by the twin trailer and describes the manner in which the passing maneuver was made. This form is shown in Figure 2.

Field Operation

The procedure in conducting the survey involved the manning of two roadside interview stations and the operation of the twin trailer between the stations. Radio communication was maintained between the twin trailer and each interview station.

The interview stations were set up on a selected highway and spaced fifteen to twenty miles apart. The twin trailer would begin a trip at one station and complete the trip upon passing through the other interview station. The direction of travel would then be reversed for another trip between stations.

During the twin trailer operation between stations, a state trooper in the cab of the twin trailer would observe each passing maneuver. He would

FIGURE 1

VIRGINIA DEPARTMENT OF HIGHWAYS
SURVEY OF MOTORIST REACTIONS TO TWIN TRAILERS

(**Behind the Wheel Interview**) ☐☐☐☐☐

Interviewer_____Serial No._____Date__/__/__Weather_____ ☐☐☐☐☐

Hour____District_____City or County_____Station_____ ☐☐☐☐☐☐☐

Station Location: City_____Suburb_____Town_____Rural_____ ☐

Type of Roadway: Interstate___Primary 4 Lane Divided___Primary 4 Lane___
Primary 3 Lane___Primary 2 Lane___Secondary___ ☐

Type of Vehicle: American Standard Pass. Car___American Compact Pass. Car___
Foreign Car___P. & P.___Truck or Tractor___Bus___
With Trailer___ ☐☐

Approximate Age of Vehicle: New to 4 Years___5 to 8 Years___8 Years & Older___ ☐

Vehicle Registration: Virginia_____ Out of State_____ ☐

License No._____ ☐☐☐☐☐☐☐

No. of Passengers (Exclude Driver)____ Sex of Driver: Male___Female___ ☐☐☐

Approximate Age of Driver: 15-25____26-50____51-65____66 & Above____ ☐

How many Years have you Operated a Motor Vehicle?_____ ☐☐

Have you passed any Vehicles on the Highway within the last twenty miles?
Yes_____No_____ ☐

If yes: Was there anything different or unusual about any passing maneuver?
(a) No___ (b) Yes, but can't describe___ (c) Took longer___
d) Had to wait longer for opportunity___ (e) Greater wind velocity
to contend with___ (f) Had to accelerate faster than usual___
(g) Other_____ ☐

Have any Vehicles passed you within the last twenty miles? Yes___No___ ☐

If yes: Was there anything different or unusual about any passing maneuver?
(a) No___ (b) Yes, but can't describer___ (c) Took longer___
(d) Greater wind velocity to contend with___ (e) Had to slow down___
(f) Other_____ ☐

What was the highway alignment when the passing maneuver was made?
Level___ Upgrade___ Downgrade___ Curve___ ☐

Did you notice any vehicle on the highway today that was different, in any way, from vehicles you usually see on Virginia roads? Yes___ No___
If yes: Could you describe or identify that Vehicle? Yes___ No___ ☐
(The truck you saw is commonly called a twin trailer or doubled bottom trailer)

record data on the type of vehicle, state of registration, license number, whether the vehicle passed or was passed by the twin trailer, and the manner in which the passing maneuver was made. The trooper would then radio identification data to a state trooper at the interview station ahead.

The state trooper at the advanced interview station would make note of each vehicle that had been observed in a passing maneuver. Upon the arrival of each vehicle at the interview station he would divert the vehicle to the shoulder of the roadway. The state trooper would also divert to the shoulder of the roadway those vehicles he observed trailing the twin trailer through the interview station. The driver of each stopped vehicle was then interviewed. All other vehicles that were not observed in a passing maneuver or trailing the twin trailer were allowed to proceed through the station without being stopped.

FIGURE 2

VIRGINIA DEPARTMENT OF HIGHWAYS
SURVEY OF MOTORIST REACTIONS TO TWIN TRAILERS

(Cab Observer Data Sheet)

Observer_____Observation No._____Date__/__/__
Station ☐☐☐☐☐☐☐☐☐☐
Type of Vehicle: American Standard Pass. Car___American Compact Pass. Car___
Foreign Car___P & P___Truck or Tractor___Bus___.
With Trailer___ ☐☐
State of Registration: Virginia Out of State ☐
License No._____Make Mode___ Color_____ ☐☐☐☐☐☐☐
Vehicle pass Twin Trailer_____Twin Trailer pass Vehicle_____
Vehicle trailed Twin Trailer_____ ☐
Observations on the pass: Passing manuever norma._____
Did not re-enter lane before beginning yellow line_____
Approaching vehicle had to slow down or leave lane_____
Driver partially lost contro Could not complete pass_____
Other (Describe)_____ ☐

Survey Sites

It was initially determined that interviews should be obtained on all types of highways over which twin trailers may be allowed to operate. These highways would include Interstate routes, four-lane divided and undivided routes and three-lane and two-lane highways.

In locating test section sites, it was found that three-lane highways comprise very little of the total highway mileage and there are no continous sections ten miles or more in length. For these reasons, three-lane highways were eliminated as survey sites. It was also concluded that there is not sufficient difference between Interstate and other four-lane divided routes to treat them individually. Although survey sites were determined and interviews obtained on both Interstate and other four-lane divided section, they have been grouped for the analyses.

Five survey sites were selected which would provide reasonably adequate opportunity for passing and appeared to be representative of road and driving conditions. These site locations and dates of operation follow:

TWO LANE HIGHWAYS
SURVEY STATION LOCATIONS
(FIFTEEN MILE SURVEY SECTIONS)

Station	Route	Location	Date	Hours of Operation
1	250	Louisa County	December 4, 1968	11:00 AM-4:30 PM
2	250	Goochland County	December 4, 1968	11:00 AM-4:30 PM
1	250	Louisa County	December 10, 1968	7:00 AM-4:00 PM
2	250	Goochland County	December 10, 1968	7:00 AM-4:00 PM
7	60	Powhatan County	December 12, 1968	7:30 AM-4:30 PM
8	60	Powhatan County	December 12, 1968	7:30 AM-4:30 PM
7	60	Powhatan County	December 16, 1968	7:30 AM-4:00 PM
8	60	Powhatan County	December 16, 1968	7:30 AM-4:00 PM
1	250	Louisa County	December 19, 1968	7:30 AM-4:00 PM
2	250	Goochland County	December 19, 1968	7:30 AM-4:00 PM

FOUR-LANE UNDIVIDED HIGHWAYS
SURVEY STATION LOCATIONS
(TWENTY MILE SURVEY SECTIONS)

Station	Route	Location	Date	Hours of Operation
9	460	Prince George County	December 13, 1968	7:30 AM-4:30 PM
10	460	Sussex County	December 13, 1968	7:30 AM-4:30 PM
9	460	Prince George County	December 17, 1968	7:30 AM-4:30 PM
10	460	Sussex County	December 17, 1968	7:30 AM-4:30 PM

FOUR-LANE DIVIDED HIGHWAYS
SURVEY STATION LOCATIONS
(EIGHTEEN MILE SURVEY SECTIONS)

Station	Route	Location		Hours of Operation
3	60	New Kent County	December 9, 1968	7:30 AM-3:00 PM
4	60	New Kent County	December 9, 1968	7:30 AM-3:00 PM
5	81	Augusta County	December 11, 1968	10:30 AM-5:15 PM
6	81	Rockbridge County	December 11, 1968	10:30 AM-5:15 PM
3	60	New Kent County	December 18, 1968	7:30 AM-4:30 PM
4	60	New Kent County	December 18, 1968	7:30 AM-4:30 PM

Analyses

The date secured through the roadside interviews and recorded by the twin trailer cab observer were coded for IBM analyses. The roadside interview data and cab observer data were matched through license numbers, and the information for each vehicle observed in a passing maneuver involving the twin trailer was placed on the same IBM card. The data on vehicles trailing the twin trailer secured through roadside interviews only, formed another set of cards.

The analyses are based upon the actual number of observances.

In the roadside interview questionnaire there are two key questions: "Have you passed any vehicles on the Highway within the last twenty miles?" and "Have any vehicles passed you within the last twenty miles?" To eliminate the passing maneuvers that did not involve the twin trailer, it was necessary to control the data through the twin trailer cab observance. In doing so, differences were noted in the answers obtained in the roadside interviews and that obtained through observance of the passing maneuvers. Tables I and IA in the RESULTS OF THE SURVEY reveals tese differences.

In addition to the information used in the analyses, the interviewers obtained data such as Type of Vehicle, Approximate age of Vehicle, Number of Passengers, Sex of Driver, Approximate age of Driver and Number of Years each has driven a Motor Vehicle. These data did not appear to be pertinent to the driver reaction survey and no analyses were made. However, the data is coded into the IBM cards and is available if there is a need.

RESULTS OF THE SURVEY

The driver reaction survey was conducted on two-lane and four-lane divided and undivided highways. Table I reveals all vehicles passing and being passed by the twin trailer.

TABLE I

VEHICLE OBSERVED PASSING AND BEING PASSED BY THE TWIN TRAILER

Passing Maneuver	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Passing the twin trailer			320
Passed by the twin trailer			3
Totals	195		323

There were differences in the passing maneuvers observed and the answers obtained from the drivers in the roadside interviews. Table IA is a tabulation of all vehicles observed passing or being passed by the twin trailer but revealing the answers of the drivers when interviewed.

TABLE IA

VEHICLES OBSERVED PASSING THE TWIN TRAILER

Roadside Interview Answers	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Motorists stated they passed and were passed by vehicles	67	42	218
Motorists stated they passed vehicles	115	32	81
Motorists stated they were passed by vehicles	3	5	12
Motorists stated they neither passed or were passed by vehicles	10	6	9
Sub-Total	195	85	320

VEHICLES OBSERVED BEING PASSED BY THE TWIN TRAILER

Roadside Interview Answers	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Motorists stated they passed and were passed by vehicles	0	0	2
Motorists stated they passed vehicles	0	0	0
Motorists stated they were passed by vehicles	0	0	1
Motorists stated they neither passed or were passed by vehicles	0	0	0
Sub-Total	0	0	3
Total All Passing or Being passed Interviews	195	85	323

FINDINGS: Forty-five or 7.5 percent of the 603 motorists interviewed were observed passing the twin trailer but evidently did not realize it because upon being interviewed they answered the question "Have you passed any vehicles on the Highway within the last twenty miles?" in the negative.

TABLE II

REACTION OF ALL MOTORISTS WHO STATED THEY PASSED OTHER VEHICLES

Question: Was there anything different or unusual about passing maneuver with vehicles you have passed?

Type Highway	Total[1] Interviews	Answers[1] Yes	No	Motorists Stating a Difference
Two-lane Highway	195	29	166	14.9%
Four-lane undivided Highway	85	2	83	2.4%
Four-lane divided Highway	320	8	312	2.5%
Totals	600	39	561	6.5%

[1] Includes the forty-five vehicles that passed other vehicles (including the twin trailer) without realizing it.

REACTION OF ALL MOTORISTS WHO STATED THEY WERE PASSED BY OTHER VEHICLES

Question: Was there anything different or unusual about passing maneuver with vehicles that passed you?

Type Highway	Total[1] Interviews	Answers[1] Yes	No	Motorists Stating a Difference
Two-lane Highway	0	0	0	0.0%
Four-lane undivided Highway	0	0	0	0.0%
Four-lane divided Highway	3	0		0.0%
Totals	3	0	3	0.0%

[1] Eliminates the vehicles that were passed by other than the twin trailer.

FINDINGS: A Significant fact from these data is that on two-lane highways the reaction of nearly fifteen percent of the motorists that passed other vehicles (including the twin trailer) was that something was different or unusual about the passing maneuver. Less than two and one-half percent of the motorists reported something different or unusual on the four-lane highways.

There was nothing different or unusual about the passing maneuver when the twin trailer passed other vehicles.

TABLE III

MOTORISTS OBSERVANCE OF WHAT APPEARED TO BE DIFFERENT OR UNUSUAL ABOUT PASSING MANEUVER WHEN THEY PASSED OTHER VEHICLES

What Appeared to Be Different or Unusual[1]	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Nothing different or unusual	166	83	312
Took longer	15	1	1
Had to wait longer for opportunity	11		
Greater wind velocity	1		4
Had to accelerate faster	1		
Could not describe	1	1	
Other			3
Totals	195	85	320

[1] Includes the forty-five vehicles that passed other vehicles (including the twin trailer) without realizing it.

MOTORISTS OBSERVANCE OF WHAT APPEARED TO BE DIFFERENT OR UNUSUAL ABOUT PASSING MANEUVER WHEN THEY WERE PASSED BY OTHER VEHICLES

What Appeared to Be Different or Unusual[1]	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Nothing different or unusual			3

[1] Eliminates the vehicles that were passed by other than the twin trailer.

FINDINGS: (1) In passing other vehicles, the length of time it took to pass and having to wait longer for a passing opportunity were the main differences having occurred on two-lane highways.

(2) In passing other vehicles, greater wind velocity created by the passing maneuver was reported as the main difference on four-lane divided highways.

(3) In being passed by other vehicles, comments were available on four-lane divided highways only and there appeared to be nothing different or unusual about the passing maneuvers.

TABLE IV

MOTORISTS OBSERVANCE OF OTHER VEHICLES AFTER HAVING PASSED OR BEEN PASSED BY THE TWIN TRAILER

Question: Did you notice any vehicle on the highway today that was different, in any way, from vehicles you usually see on Virginia roads?

Type Highway	Answers Yes	No	Total	Percent "Yes"
Two-lane Highway	102	93	195	52.3
Four-lane undivided Highway	27	58	85	31.8
Four-lane divided Highway	117	206	323	36.2
Totals	246	357	603	40.8

Question: Of those who noticed a different vehicle, could you describe or identify that vehicle?

Type Highway	Answers Yes	No	Total	Percent "Yes"
Two-lane Highway	99	3	102	97.1
Four-lane undivided Highway	24	3	27	88.9
Four-lane divided Highway	109	8	117	93.2
Totals	232	14	246	94.3

FINDINGS: (1) Over forty percent of the motorists that passed or were passed by the twin trailer noticed something different about the vehicle and ninety-four percent of these motorists correctly identified the vehicle.

(2) Motorists on the two-lane highways were more observant of the twin trailer and a larger percentage of these motorists identified it.

TABLE V

MOTORISTS OBSERVANCE OF OTHER VEHICLES AFTER HAVING TRAILED THE TWIN TRAILER

Question: Did you notice any vehicle on the highway today that was different, in any way, from vehicles you usually see on Virginia roads?

Type Highway	Answers: Yes	No	Total	Percent "Yes"
Two-lane Highway	33	92	125	26.4
Four-lane undivided Highway	14	18	32	43.8
Four-lane divided Highway	33	70	103	32.0
Totals	80	180	260	30.8

Question: Of those who noticed a different vehicle, could you describe or identify that vehicle?

Type Highway	Answers: Yes	No	Total	Percent "Yes"
Two-lane Highway	31	2	33	93.9
Four-lane undivided Highway	14	0	14	100.0
Four-lane divided Highway	33	0	33	100.0
Totals	78	2	80	97.5

FINDINGS:

(1) Approximately thirty-one percent of the motorists that trailed the twin trailer noticed a vehicle on the highway that was different from vehicles usually seen and nearly all (97.5%) of these motorists correctly identified the twin trailer.

(2) Motorists on the two-lane highways were either less observant or their vision more restricted than those on the four-lane routes as a smaller percentage noticed the twin trailer and all of these motorists were unable to identify it.

TABLE VI

STATE TROOPER OBSERVANCE OF PASSING MANEUVERS FROM THE CAB OF THE TWIN TRAILER

VEHICLES THAT PASSED TWIN TRAILER

Observation	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Passing Maneuver Normal	186	85	320
Did not re-enter lane before solid yellow line	8		
Passed on a double yellow line	1		
Sub-Total	195	85	320

VEHICLES THAT WERE PASSED BY TWIN TRAILER

Observation	Two-Lane Highway	Four-Lane Undivided Highway	Four-Lane Divided Highway
Passing Maneuver Normal			3
Totals	195	85	323

FINDINGS: The passing maneuver was normal ninety-five percent of the time on the two-lane highways and all the time on the four-lane highways.

APPENDIX III

OFF-ROAD STOPPING DISTANCE, STABILITY AND MANEUVERABILITY TESTS

OFF-ROAD STOPPING DISTANCE, STABILITY AND MANEUVERABILITY TESTS FOR TWIN TRAILER COMBINATION

by

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PURPOSE

Because of its long experience in the field of pavement skid resistance, the Virginia Highway Research Council was requested to advise the study steering committee in the planning, conducting, and reporting of tests designed to evaluate the stopping ability, stability, and maneuverability of the twin trailer combination. In developing and executing the testing program, the Council received the cooperation of the Steering Committee, the Virginia State Police, the National Aeronautics and Space Administration, the Virginia Highway Users Association, the American Trucking Association, and the Virginia Department of Highways.

SCOPE

The scope of the tests was limited in that the twin trailer combination was compared to a canventional trailer during panic stops under the following conditions:

1. Only two pavements were tested; both had excellent skid resistant characteristics.
2. The trucks were new, as were the brakes and tires.
3. The brakes were adjusted throughout the tests to ensure that they were performing excellently.
4. The brakes were applied in more of a panic manner than the drivers are trained to apply brakes, and
5. The drivers were handpicked.
6. The tractors and trailers, and the drivers and mechanics were supplied by the trucking industry.

The stability of the vehicles was observed during the tests, and a maneuverability demonstration was staged.

Stopping distances were conducted with the regular Council stopping distance car in order to rate the test pavement.

TESTING VARIABLES

The intent of the tests was to compare the stopping ability of the twin and conventional tractor-trailers during panic stops from normal operating speeds. It was also hoped that the vehicles would use the same

braking system; that is, if one vehicle used nonlocked front wheels or, in fact, did not lock any of the other wheels for a series of tests, then the other vehicle would perform likewise.

The normal operating test speeds were planned to be 20, 40, and 55 miles per hour for wet tests and 20 and 55 mph for dry tests. The trailers were to be tested at each of these speeds while loaded to capacity, half capacity, and empty.

The tests were to be conducted on the airstrip at Wallops Station, Virginia, which was made available through the courtesy of the National Aeronautics and Space Administration. It was anticipated that the tests should be completed in four days. In actuality, tests were performed at the Wallops Station for approximately two weeks; and even then, because of flat grades and a limited acceleration distance, the 55 miles per hour tests had to be performed on as unopened portion of Interstate 85 in the Petersburg Highway Residency.

It was also originally planned that tests would be performed on both bituminous concrete and portland cement concrete for all test conditions; but, due to the time required for testing, it was decided that the portland cement concrete pavement would be eliminated. However, when the test site was moved from Wallops Station, the available pavement sites on Interstate 85 were portland cement concrete; so all tests other than those at 55 mph were performed on bituminous concrete, while the 55 miles per hour test was performed on portland cement concrete. Although the regular wet test speeds were planned to be 20, 40, and 55 mph and the dry 20 and 55 mph, tests were performed on both wet and dry pavements at 20, 30, 40, 45, and 55 mph because of the desire of the trucking people to approach the higher test speeds cautiously. For the most part, five repeat tests were conducted for all wet pavement conditions, and three repeat tests for dry pavement conditions.

One reason that the tests required so much time was that the twin trailer stopping distances had to be measured by tape in all tests performed, and the single trailer was measured by tape during the Wallops Station tests and with a self-contained odometer on Interstate 85. Prior to use, the odometer was tested against the regular chalk to gun method on the same unit during the same panic stops and was found to provide like readings.

Trailer Variables

Both the conventional and twin trailers were towed with a new Mack F700 tactor. Table I provides pertinent information concerning the two tractors as well as the trailer.

The tires were provided by Goodyear and Firestone and were to be returned upon completion of the tests. The brakes were adjusted so that the steering wheels on the tractors and all the wheels on the twin trailers except the rearmost were not supposed to lock. The drive wheels on the tractors and the rearmost wheels on the conventional trailer and the rear wheels on the back twin trailer did lock. However, due to mechanical imperfections and the lack of technical development in the braking industry, the wheels did not always retard or lock the same way; i.e. sometimes the wheels which were not supposed to lock did, and at other times the wheels which were supposed to lock did not. Information concerning the brakes is given in Table II.

TABLE I

DESCRIPTION OF TEST VEHICLES

	Conventional Trailer	Twin Trailer
Make	Mack F700-Fruehauf FG9-F2-45	Mack F700-Fruehauf FGG9-Wi-27
Horsepower	240 at 1700-1800 RPM	240 at 17-1800 RPM 225 at 2100 RPM
Total Length	56′5″	65′
Length between Cab and Trailer	4′4″	3′11″
Length between Trailers		3′2″
Length 1st Trailer	45′	27′
Length 2nd Trailer		27′
Length Cab	6′7″	4′3″
Length Tractor	18′10″	14′5″
Tires	Goodyear 12 ply rating 10.00-20 Tube Type	Firestone Transport 200 12 ply rating 10.00-20 Tube Type

TABLE II

WALLOPS ISLAND BRAKE TESTS
(Axles and Brake Lining)

	Tractor No. 1—3 Axle	Tractor No. 2—2 Axle
Chassis	F785ST3680	F785T4656
Front Axle	FA535	FA535
Brake Size	16½ x 4 (brake chamber 16″, slack adj. 5½)	16½ x 4
Brake Lining	3QD2123A	3QD2123A
F. M. S. No.	4316	4316
Forward Shoe	J-M 1385	J-M 1385
Reverse Shoe	J-M 1112	J-M 1112
Rear Axle	SWDL56	RADL5281
Brake Size	16½ x 6	16½ x 7
Brake Lining	3QD2116A	3QD2139
Forward Shoe	J-M 1385	Raybestos MA417A
Reverse Shoe	J-M 1112	Raybestos MA417A
F. M. S. No.	4317C	4311B
Slack Adj. Length	7″	7″
Brake Chamber Size	28 sq. in.	24 sq. in.

Test Surfaces

Two test surfaces were used; the first was a bituminous concrete at Wallops, and the second a portland cement concrete on I-85 south of Petersburg. The bituminous surface was a coarse aggregate mix which had been in place for approximately one year but had received very little wear since it is on a seldom used runway. The portland cement

concrete had a silica sand mortar and a longitudinal burlap drag finish, and had not been open to traffic. Both surfaces had excellent friction coefficients; 40 mph stopping distance tests with the Virginia stopping distance car yielded a coeffiicent of 0.61 on the bituminous pavement and 0.59 on the portland cement concrete pavement.

Testing Procedure

Prior to each wet test the pavement was wetted down with a water truck. The vehicle being tested was then accelerated to the desired test speed and, while the tractor was still in gear, the brakes were applied vigorously as in a panic stop. Upon brake application a chalk gun attached to the front bumper was discharged so that the stopping distance could be taped from the chalk mark on the pavement to the gun on the front bumper. However, as mentioned earlier, the measurements with the conventional trailer unit were taken with a self-contained odometer on Interstate 85, where the 55 mph tests were performed. The dry tests were performed in the same manner as were the wet tests except, of course, the pavement was dry.

The Virginia stopping distance car performed five repeat tests at Wallops Station at test speeds of 20, 30, 40, 45, and 55 mph, and three repeat tests at 30 and 40 mph and five repeat tests at 55 mph on wet pavement on Interstate 85. The Virginia car employed a self-contained odometer attached to a fifth wheel.

TEST RESULTS

Stopping Distance

The average test results and standard deviations for all conditions tested and an indication as to whether there are significant differences between the conventional and twin trailer stopping ability are given in Table III. With the inclusion of the different test speeds, wet and dry conditions, and variance in load, the trailers were compared twenty-six times and found to have significantly different stopping ability at the 95% level on seven occasions, or one fourth of the time. In six of the seven cases where significant differences were shown, the twin trailer had greater stopping distances; while under one set of conditions, the conventional trailer had the greater stopping distance. Also of interest is the fact that in five of the seven cases where a significant difference is shown the test section was dry. The significant difference at the 95% level means that one can be 95% confident that the trailers performed differently under a specific set of test conditions. Further, if the same two units were retested under the same conditions, including brake adjustment and applications, like results would be expected. However, it should be noted here that a significant difference does not necessarily mean that a critical difference exists in the performance of the units; delineation of a "critical difference" is a judgment or decision factor. Likewise, the figures do not mean that real or critical differences do not exist where significant differences are not shown, since real and critical differences could exist and yet the data be so scattered or variable that a significant difference could not be shown statistically.

The test data are depicted graphically in Figures 1, 2 and 3. Items of interest which can be noted from these figures are:

1. There is relatively little difference between the conventional and twin trailers tested with regard to stopping ability.

2. The greatest difference between the two units is found for the 55 mph half loaded tests, where the conventional trailer has a greater stopping distance than does the twin trailer.
3. Each of the units stop as well on wet as they do on dry roads at low speeds; however, it requires a great deal more distance to stop each of the units on wet than it does on dry pavements at the higher speeds.
4. Under every condition the car could stop in a shorter distance on a wet pavement than either of the trailer units could stop on a dry pavement.
5. For a given speed other than 55 mph the size of the load did not greatly affect either unit's stopping ability, but for the 55 mph wet test the stopping distance for the conventional trailer jumped from 253′ to 273′ and the twin trailer jumped from 227′ to 271′ when the trailer was changed from half loaded to empty.
6. The stopping distance improved by about 25 to 30 feet for the dry test at 55 mph with the change from the loaded to half loaded condition. The writer cannot account for this unless there was an adjustment in the braking system.

Stability

With regard to stability, the two units were about equal. During the 55 mph wet test both units experienced some difficulty in maintaining a straight line stop; however, they did not have to abort for stability reasons since the drivers were able to adjust for the side movement. In addition to the deviation from a straight line stop during the 55 mph test, the conventional unit's two rear axles chattered (vibrated up and down) rather severely during a number of stops from 40 mph and greater. The State Police took motion pictures which show both the chatter of the conventional unit at several test speeds and the deviation of both units from a straight line during the 55 mph wet tests.

Maneuverability Demonstration

To demonstrate the maneuverability of the two units, a course was laid out which required left and right turns in an intersection, an "S" curve type maneuver, a full 180° radius turn, and a tracking capacity demonstration. A layout of the demonstration course is shown in Figure 4.

Figure 5 is a blown up insert of the intersection which shows the path that each of the units followed while negotiating the left and right 90° turns. The 12′6″ lane widths provided a street width of 25′, which, of course, is quite a narrow street. As can be seen, the twin trailer performed better than the conventional trailer. While negotiating the right turn, the conventional unit required 20′8″ more width of street than was provided, or it could have made the turn if the streets were 46′ wide rather than 25′ wide. The twin unit, making the same turn, required 15′4″ more space than was provided, or could have made the turn if the street had been 41′ wide.

For the left turn the conventional unit required 5′3″ additional street width, or a street about 31′ wide, whereas the twin unit made the same turn in the space provided with about a foot left over.

Neither unit had any trouble with the "S" type curve, and Figure 6 shows that the double unit demonstrated that it could make a "U" turn in a shorter diameter than could the conventional unit. As can be seen, the conventional unit required from a diameter of 62′5″ inside of cab to inside of cab while the twin unit required 43′7″.

Part of the maneuvering demonstration was a tracking test in which small balls were placed 3′ apart for a distance of 52′ as shown in Figure 7. The units pulled the wheels on one side of their tractor-trailers through the lane made by the balls. Neither unit disturbed the balls.

A demonstration was also conducted whereby the driver of the twin trailers backed the unit a distance of 50′ and then shifted the front trailer to the back and vice versa. In all maneuvering tests the twin trailer performed as well as, if not better than, the conventional trailers.

CONCLUSIONS

In summary it should be reiterated that under the very limited scope of these stopping distance and stability tests, the trailers performed about equally.

The major findings which should be restated here are:

1. There is relatively little difference between the conventional and twin trailers tested with regard to stopping ability.
2. Based on the test results it would seem safe to conclude that at road speeds both units require a much greater stopping distance when they are empty than they do when they are loaded.
3. Each of the units stop as well on wet as they do on dry roads at low speeds; however, it requires a great deal more distance to stop each of the units on wet than it does on dry pavements at the higher speeds.
4. With regards to stability, visual observation indicated that the two units performed equally. However a closer study can be made of the stability of the two vehicles through the use of the motion pictures taken by the State Police.
5. In all maneuversing tests the twin trailer performed as well as, if not better than, the conventional trailers.

A point of interest noted during the wet pavement tests with the trailers empty was that the units required about equal stopping distances for the 20, 30, and 55 mph speeds, but at the 40 and 45 mph speeds the distances for the twin trailer were larger.

Finally, since both the conventional and twin trailers performed so poorly with regard to stopping ability when compared to an automobile, if is hoped that the trucking industry, in conjunction with the trailer and tire industries, will continue to work toward improved equipment for these vehicles.

TABLE III

AVERAGE STOPPING DISTANCE VALUES IN FEET,
WITH STANDARD DEVIATIONS AND SIGNIFICANT DIFFERENCE

		Car			Conv. Trailer / Twin Trailer — Loaded							Conv. Trailer / Twin Trailer — Half Loaded							Conv. Trailer / Twin Trailer — Empty						
Test Speed	Surface Condition	No. Tests	SD*	STD**	No. Tests	SD	STD	No. Tests	SD	STD	Sig. Diff.	No. Tests	SD	STD	No. Tests	SD	STD	Sig. Diff.	No. Tests	SD	STD	No. Tests	SD	STD	Sig. Diff.
20	Wet	5	21.8	1.3	5	33.8	0.8	6	35.2	2.2	No	5	30.7	1.4	5	30.8	2.5	No	5	33.2	1.3	5	33.2	1.3	No.
20	Dry				6	30.7	0.9	3	33.0	1.0	Yes 5%	3	30.3	0.6	3	31.0	1.4	No.	3	31.0	0.0	3	33.3	0.6	Yes 5%
30	Wet	5	48.4	1.5	5	65.2	1.9	5	63.8	1.8	No	5	64.4	1.9	5	67.6	3.4	No.	3	63.0	0.0	3	68.7	3.1	No
30	Dry				3	64.1	2.0	3	64.7	0.6	No.	3	61.0	1.0	3	62.8	0.9	No.	3	73.0	1.0	3	69.3	2.5	No.
40	Wet	5	87.0	2.4	5	119.8	4.2	5	119.9	6.2	No.	5	128.0	5.6	5	125.2	6.3	No.	5	122.8	3.0	5	134.4	4.2	Yes 5%
40	Dry				3	109.2	1.5	5	116.1	3.6	Yes 5%	3	102.7	2.5	3	110.0	2.0	Yes 5%	3	117.3	9.1	3	125.0	6.2	No.
45	Wet	5	106.8	1.5	5	147.2	4.3	5	151.4	8.1	No.	5	163.1	6.8	5	154.8	9.3	No.	3	159.3	6.1	3	168.0	5.3	No.
45	Dry											3	128.7	1.2	5	135.6	6.2	No.	3	135.0	4.0	3	149.7	3.8	Yes 5%
55	Wet	5	175.0	4.4	5	237.0	7.7	5	247.2	9.9	No.	5	252.6	12.4	5	227.4	6.8	Yes 5%	5	273.4	10.3	5	271.2	17.4	No.
55	Dry							2	217.5						1	181.0						2	193.0		

* Stopping distance
** Standard deviation

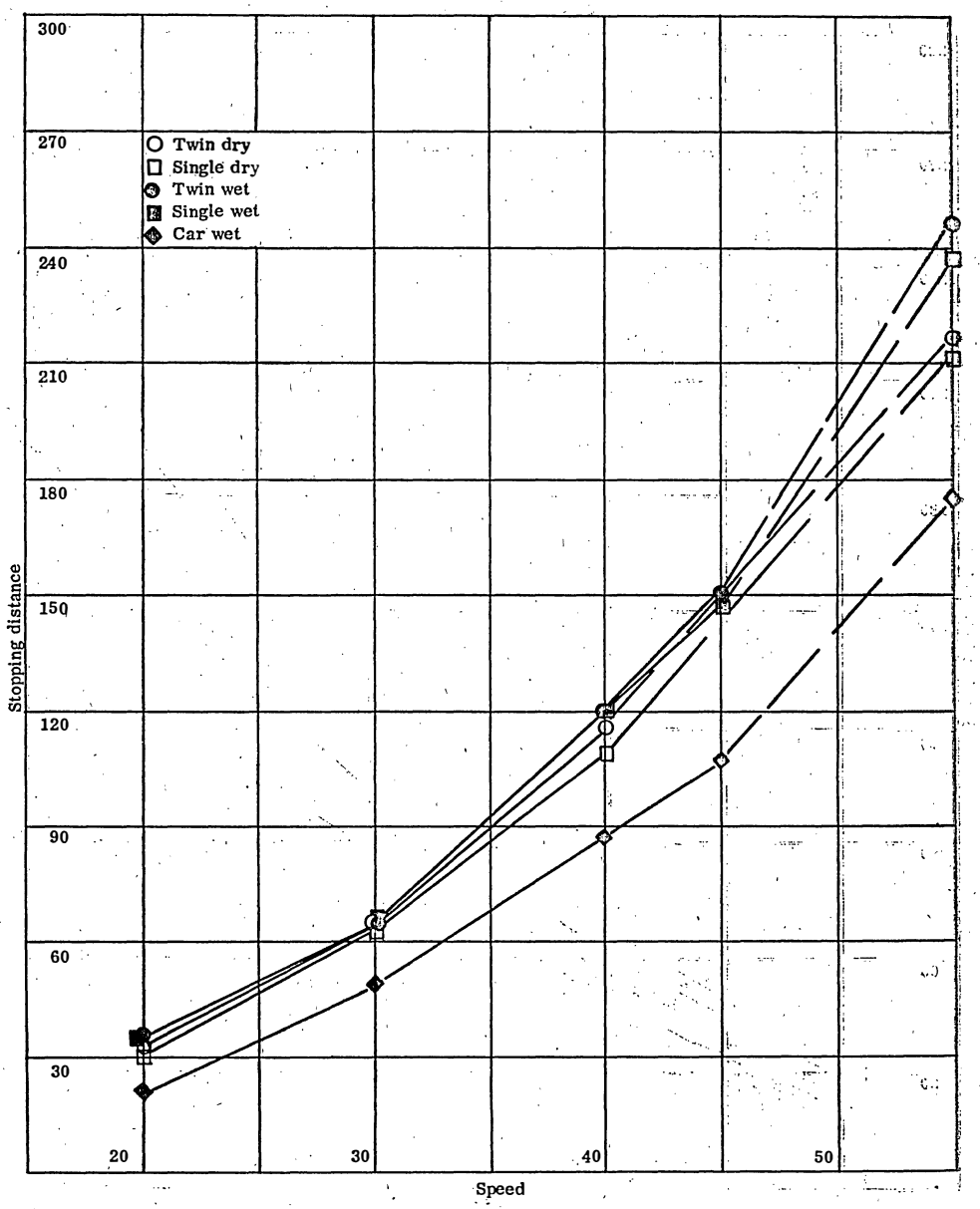


Figure 1. Full load condition.

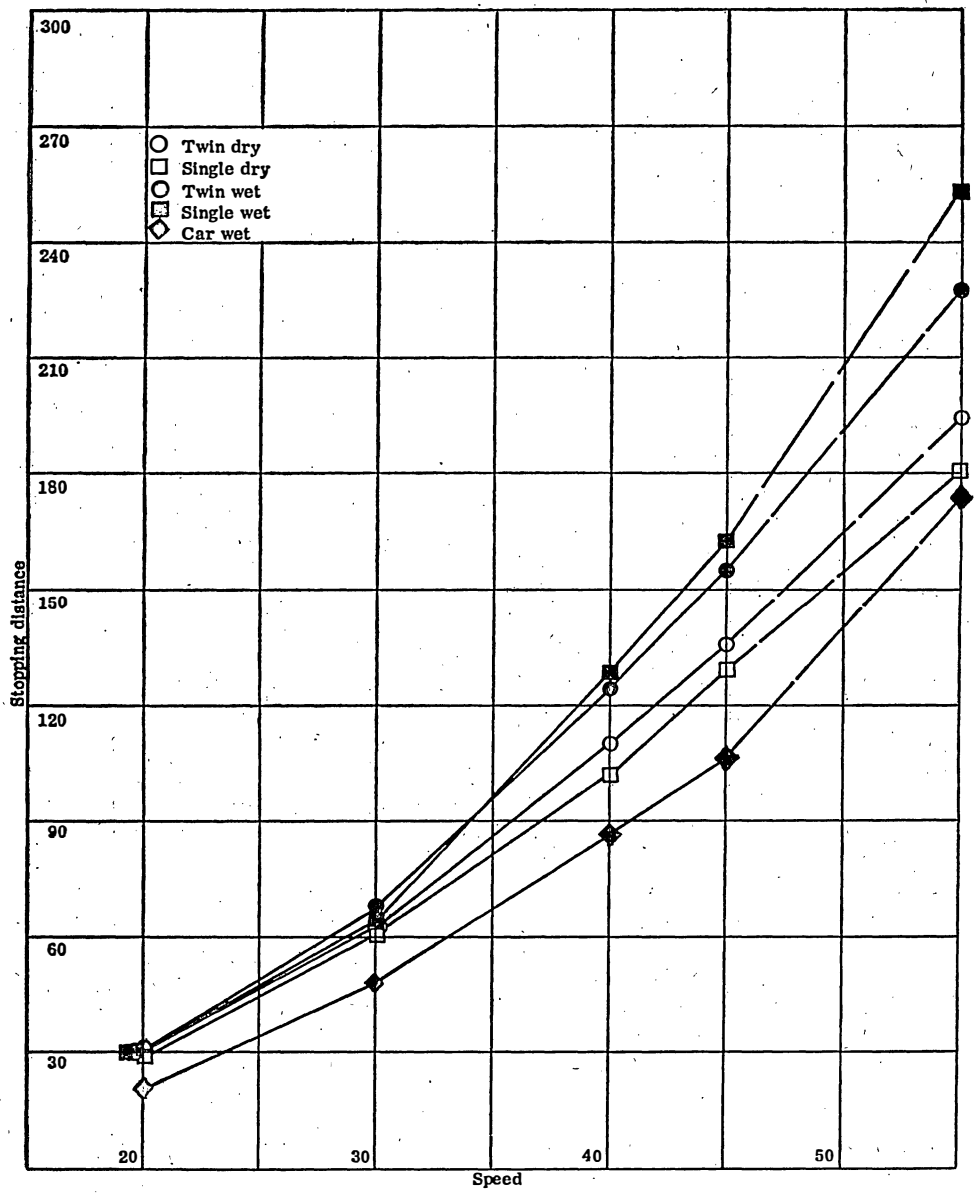


Figure 2. Half load condition.

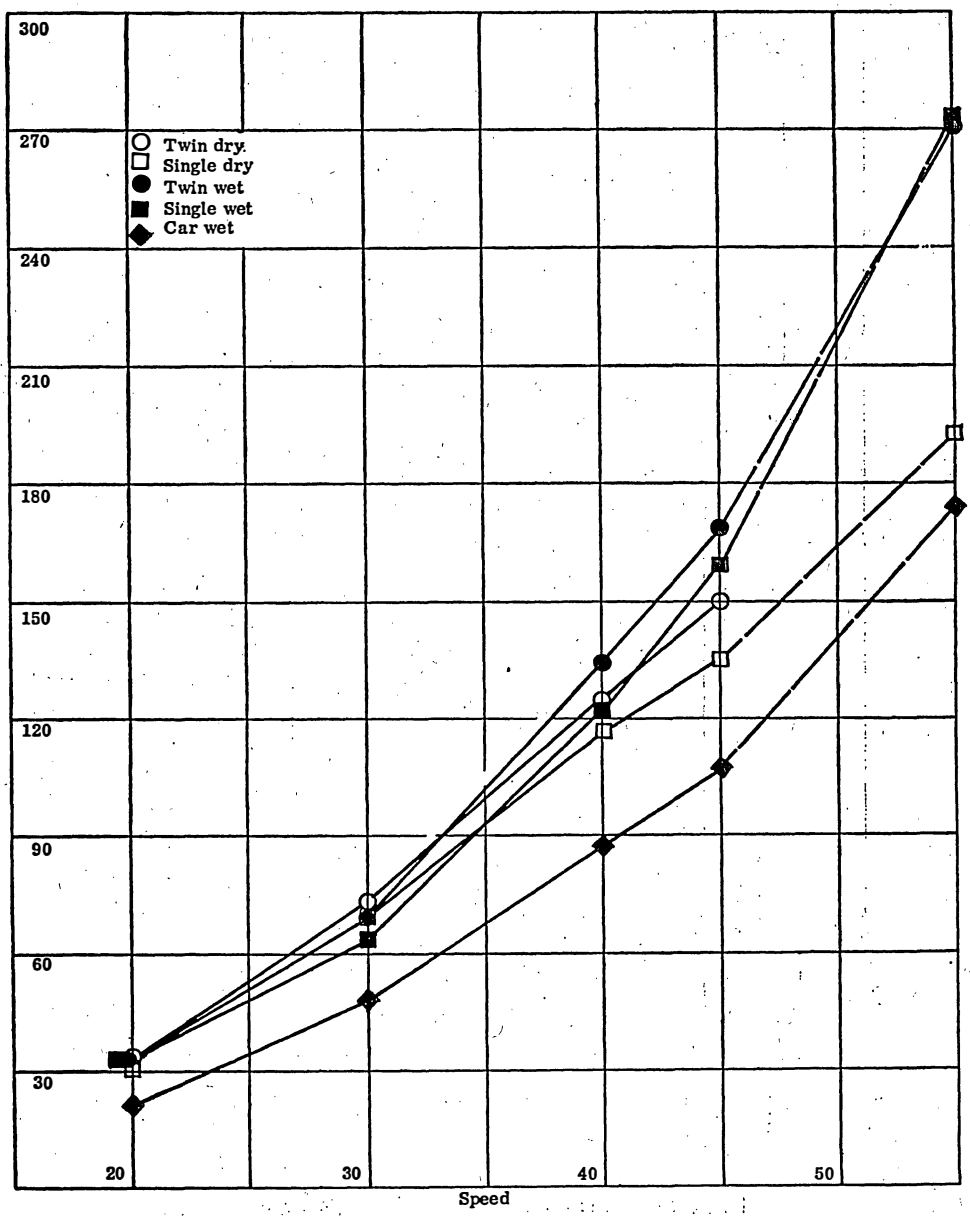


Figure 3. Empty condition.

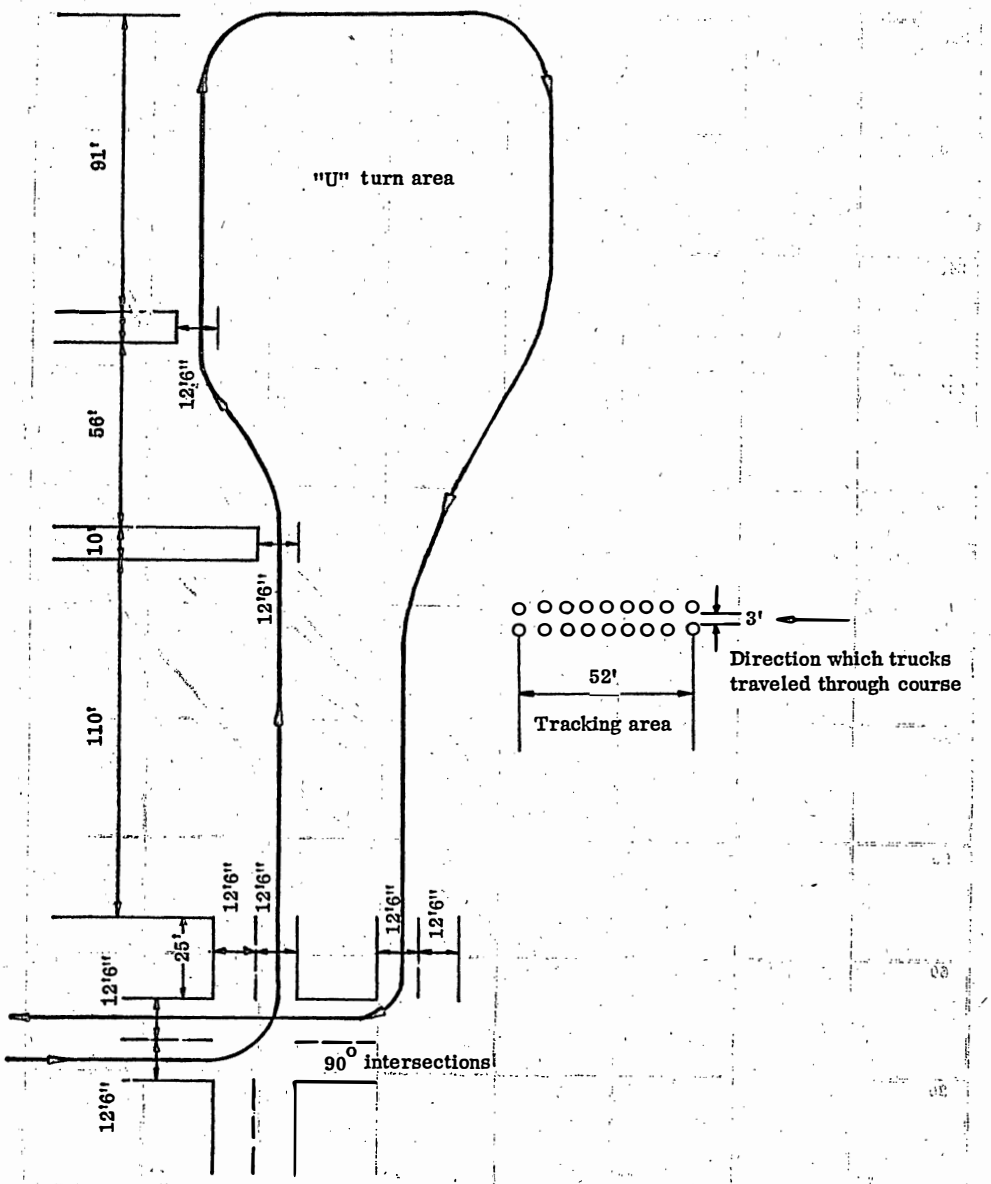


Figure 4. Tracking course for trailers.

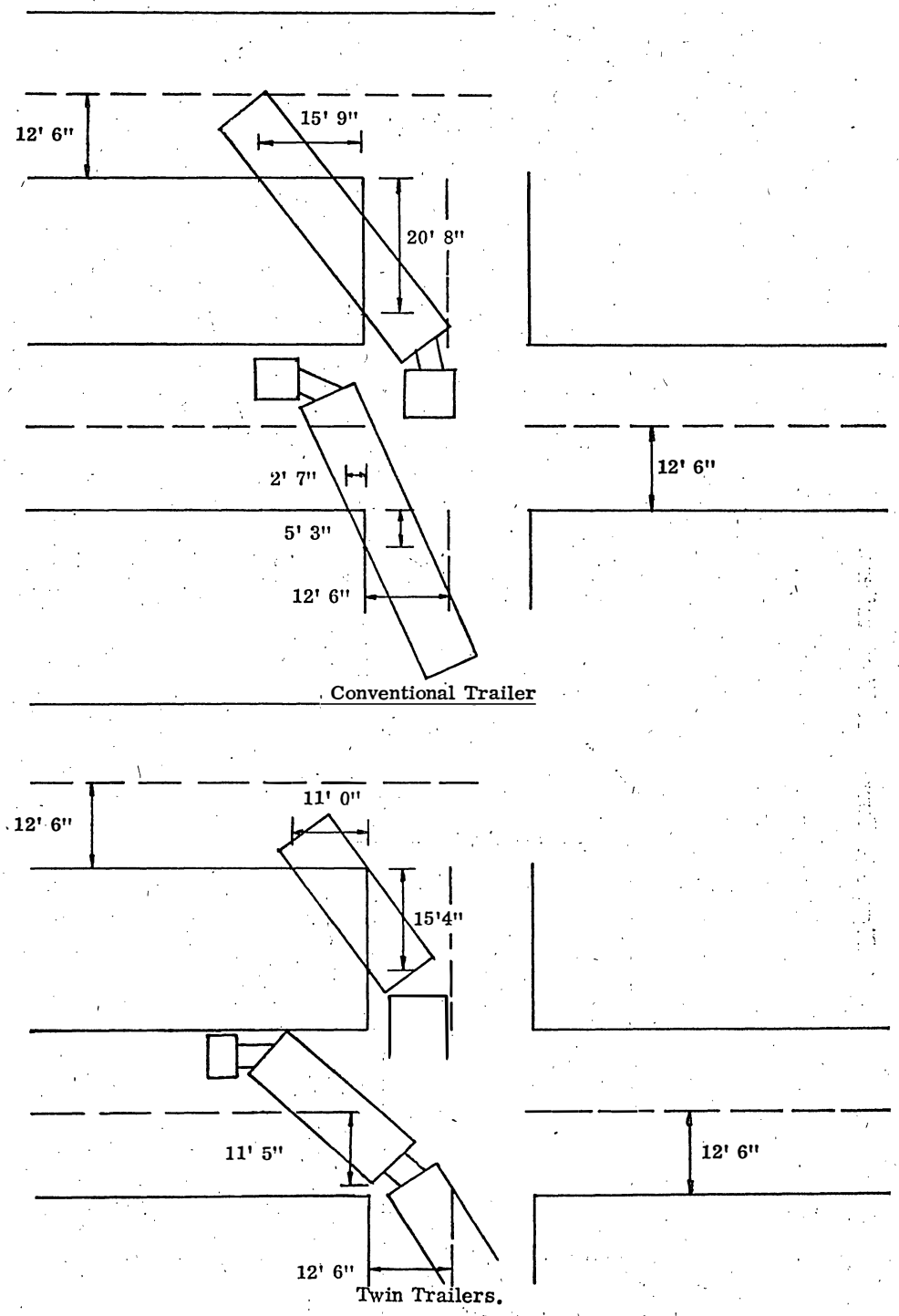


Figure 5. Schematics of conventional and twin trailers at 90° intersections.

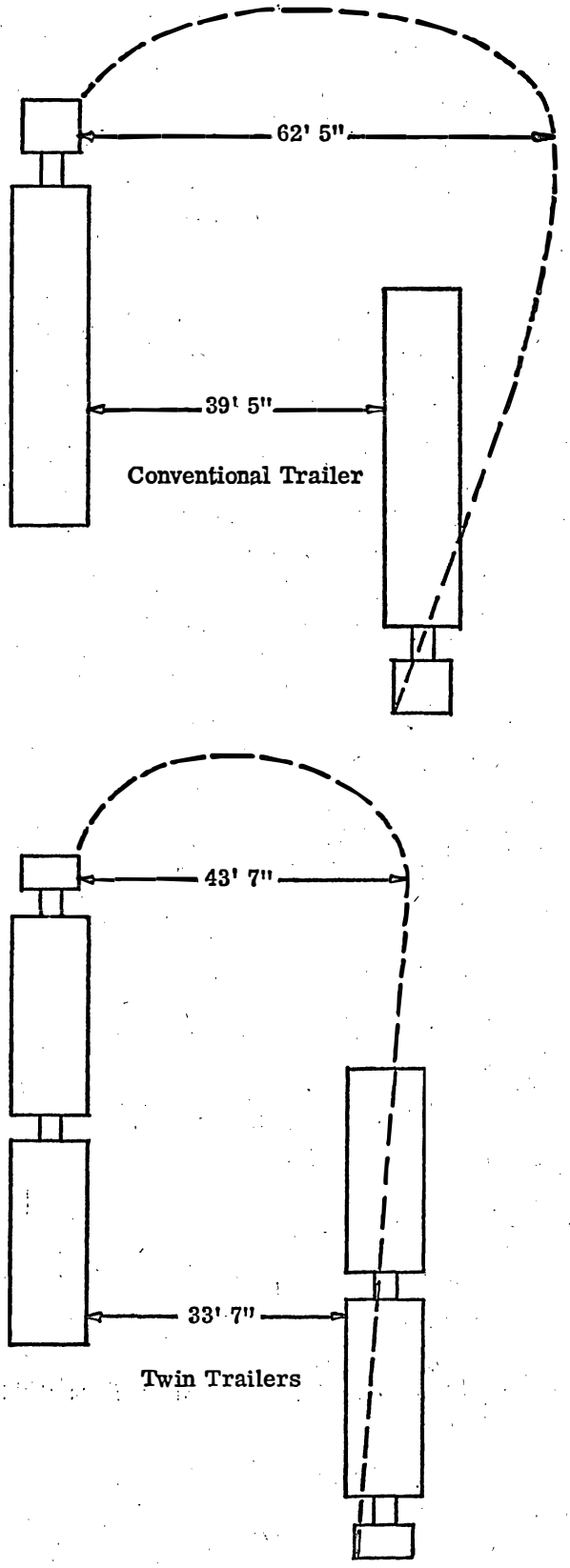


Figure 6. Turning radii of trailers.

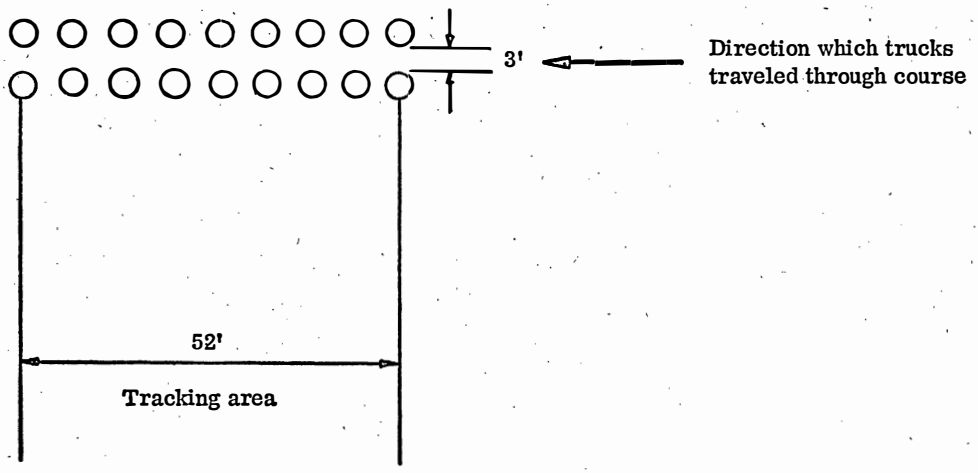


Figure 7. Tracking test.

APPENDIX IV

EXPERIENCE IN OTHER STATES

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE

RICHMOND, VIRGINIA 23210

March 21, 1969

Major J. S. Pearson

SUBJECT: Twin Trailer Study

During 1968 information was received from 27 states and 4 toll road authorities regarding their experience involving the operation of twin trailer combinations in their jurisdictions. This information has been summarized and is included in the attached report.

R. M. TERRY
Safety Officer

RMT: cc
Enclosure

March 21, 1969

TWIN TRAILER STUDY

THIRTY-ONE STATES AND FIVE TOLL ROAD AUTHORITIES

In 1967, in order to have the availability of the experience of some of the states which permitted the operation of twin trailer combinations, letters were written to 15 states, 3 insurance companies, and the Bureau of Motor Carrier Safety, U. S. Department of Transportation.

Replies were received from each of the inquiries and were used to furnish information to the 1968 Legislature.

After the Twin Trailer Study Commission had its initial meeting, Colonel H. W. Burgess directed Captain R. M. Terry, State Police Safety Officer, to update the 1967 data by writing to each of the states and toll road authorities in the United States which permitted the operation of twin trailer combinations.

On August 15, 1968, after conducting a survey as to what states permitted the operation of twin trailer combinations, a survey questionnaire was forwarded to the following 31 states and 5 toll road authorities:

Alaska	Nevada
Arizona	New Hampshire
Arkansas	New Jersey
California	New Mexico
Colorado	North Dakota
Delaware	Ohio
Georgia	Oklahoma
Idaho	Oregon
Illinois	South Dakota
Indiana	Texas
Iowa	Utah
Kansas	Washington
Kentucky	Wyoming
Maryland	Indiana Toll Road Commission
Michigan	Kansas Turnpike Authority
Missouri	Massachusetts Turnpike Authority
Montana	New York State Thruway Authority
Nebraska	Ohio Turnpike Commission

Replies were received from 29 states and 4 toll road authorities. The states of New Hampshire and Iowa and the Indiana Toll Road Authority did not reply. The States of Georgia and New Jersey stated their laws did not permit the operation of twin trailers.

Therefore, we have data from 27 states and 4 toll road authorities.

The four toll road authorities which replied permit the operation of twin trailer combinations, ranging in overall length from 98 feet to 108 feet. They stated that the accident experience involving these combinations is good. They also stated that this experience is less than the semi-trailer combination operation.

In order to summarize the answers received from the states relating to the questions contained in the questionnaire, each equestion is listed below in chronological order and a summary answer to each question is listed below the question.

Q. When did your state law permitting the operation of twin trailers become effective?

A.

Laws in effect less than 5 years	—11 states.
Laws in effect 5 to 10 years	— 2 states.
Laws in effect more than 10 years	—12 states.
Not stated	— 2 states.

Q. 1) What was your state's death rate for the year immediately prior to the legalization of twin tailers? For what year?
2) What was your state's death rate for the first year after the legalization of twin trailers? For what year?
3) What was your state's death rate for 1967?

A. 3 states reported an increase in fatalities for the first year after legalization of twin trailers.

3 states reported a decrease in fatalities for the first year after the legalization of twin trailers.

4 states reported an increase in the state's death rate for the first year after the legalization of twin trailers.

6 states reported a decrease in state's death rate the first year after the legalization of twin trailers.

8 states failed to supply an answer to this question.

3 states reported that this question was not applicable in their states.

Q. What is your state's accident experience involving twin trailer operation?

A. 26 states reported they did not have available data to answer this question.

Kansas reported its accident experience involving trailer operation was greater but made no further comment.

Q. Is this experience greater or less than regular semitrailer operation?

A. 9 states reported their accident experience involving twin trailer operation was less than regular semitrailer operation.

1 state reported its accident experience involving twin trailer operation was greater than regular semitrailer operation.

16 states reported they did not have the available data to answer this question.

1 state did not supply any answer.

Q. Does the operation of twin trailers in your state present any problems concerning the following?

1) Turning of corners?

12 states reported no problem.
9 states reported some problems.
6 states did not supply answers.
2 states reported they are experiencing more problems in the metropolitan area.

2) Passing other vehicles?

13 states reported they are experiencing no problem.
8 states reported they are experiencing some problems.
6 states did not supply answers.
2 states reported more problems are being experienced on two-lane highways.

3) Being passed by automobiles?

13 states reported no problems.
8 states reported problems.
6 states did not supply answers.
2 states reported problems being experienced on two-lane highways.

Q. 4) Being passed by trucks and semitrailer combinations?

A. 13 states reported no problem.
7 states reported problems.
7 states did not supply answers.
2 states reported problems on two-lane highways.

Q. 5) Jackknifing?

A. 12 states reported no problems.
6 states reported problems.
9 states did not supply answers.

Q. 6) Becoming stalled on slick, icy, and snow covered highways?

A. 11 states reported no problems.
8 states reported problems.
8 states did not supply answers.

Q. Does your state permit the operation of twin trailers on all highways?

A. 16 states stated they permit the operation of twin trailers on all highways.
9 states stated they do not permit operation on all highways.
2 states did not supply answer to this question.

Q. 1) If not, on what highways are they permitted to operate?

A. Some states stated that twin trailers are limited to Inter-state highways, freeways, and four-lane highways with limited egress and ingress.

Early in 1960 the State of Kansas authorized the use of twin trailers on all the state's highways without any specific limitations. Since that time the accident involvement of this type of equipment has tripled.

Q. If your law restricts the twin trailer operation to certain highways with access to and from the terminal of origin or destination by the most direct route, is there any difficulty being encountered in the enforcement of this regulation?

A. No problems reported.

Q. What is the maximum overall length permitted in your state?

A. 21 states permit the overall length of a twin trailer combination to be 65 feet.
2 states permit the overall length of a twin trailer combination to be 70 feet.
1 state permits the overall length to be 75 feet.
3 states did not supply answers to this question.

Q. Has your state encountered any difficulty with coupling devices on twin trailer combinations becoming disengaged or disconnected?

A. 20 states stated they had not encountered any difficulty.
2 states reported they had encountered difficulties.
5 states did not supply answers to this question.

Q. If difficulty has been encountered, is it greater or less than in the regular semitrailer operations?

A. Reports indicate the problems are not greater than with regular semitrailer operations and also indicate there is little or no comparable data available.

Q. Does your state require any special operator's or chauffeur's license for the operator of a twin trailer combination?

A. The operator's and chauffeur's license requirements for semitrailer combination operators are applicable to twin trailer combination operators.

Q. If so, what is required?

A. The regular classified chauffeur's license is required in the states that have a law requiring a chauffeur's license for semitrailer operators.

Q. What is the public reaction in your state to twin trailer combination operation?

A. 20 states reported they have received no complaints from the public.
2 states reported they have received numerous complaints.
2 states reported they have received some complaints.
3 states did not supply answers to this question.

Q. Would you please furnish us with any other appropriate comments which you feel might be useful to our study commission and Legislature?

A. The states of Arkansas and New Mexico recommended that the twin trailer combination be limited to 4-lanes and limited access highways with egress and ingress to and from terminals.

The states of Kansas, Colorado, Oklahoma and Wyoming stated that the power unit of the combination should be adequate to handle heavy gross loads.

Q. Comments concerning ability to accelerate, decelerate, or brake would be helpful.

A. The states did not supply any beneficial answers to this question.

The studies made in 1967 and 1968 have been placed in binders and each member of the Twin Trailer Study Commission has been furnished a copy of each. These binders are labeled as follows: *TWIN TRAILER STUDY DEPARTMENT OF STATE POLICE 1967* and *TWIN TRAILER STUDY DEPARTMENT OF STATE POLICE SUPPLEMENT #1 1968.*

COMMONWEALTH OF VIRGINIA

GOVERNOR'S OFFICE

JOHN T. HANNA
DIRECTOR

OFFICE OF ADMINISTRATION
HIGHWAY SAFETY DIVISION TELEPHONE 272-1431
BOX 1299
RICHMOND, VIRGINIA 23210

November 19, 1968

TO: John T. Hanna, Director, Highway Safety Division

FROM: J. M. H. Harris, Jr., Traffic Engineer, Department of Highways

R. W. Duval, Assistant Director, Highway Safety Division

SUBJECT: Twin Trailer Study
November 12 and 13, 1968

A trip was made to the States of Maryland, Delaware and Pennsylvania for the purpose of studying the operation of double bottom trailers. An effort was made to distinguish, from accident records kept by the State Police and Divisions of Motor Vehicles, the differences in accident frequency of conventional tractor-trailers and double trailers. Interviews were made to determine citizen reaction and personal observations were made of a demonstration by Preston Trucking Company, Preston, Maryland.

We contacted Mr. Paul Jawoski, Traffic Division, Maryland State Roads Commission by telephone on November 12, 1968. Mr. Jawoski advised that all accident reports are filed at Pikesville, but there was no way of distinguishing between twin trailer trucks and semi-trailer trucks. In addition, he received copies of all serious accident reports and no reports involving twin-trailers had been received.

Interviews were conducted with Trooper First Class Robert Crawford of the Maryland State Police. Trooper Crawford is assigned to the truck weighing station on the North side of the Susquahanna River on Route 40. Trooper Crawford was familiar with double bottom trailers. He advised that the Maryland statute limited the overall length to 65 feet, gross weight was limited to 73,280 pounds with 22,400 pounds maximum axle weight. He further advised that their enforcement policy allowed a 1,000 pound tolerance. Trooper Crawford stated that, to his knowledge, no double bottom trailer units had ever been involved in a traffic crash in the state of Maryland. He said he had no personal feelings about their operation one way or the other. In his estimation, they created no particular problem since they were restricted in operation to dual highway systems. Trooper Crawford indicated that the double bottom trailers were relatively scarce and he estimated that one, operated by Montgomery Ward, would pass through his weighing station on Route 40 about once every two weeks.

Sgt./Maj. P. Kosirowsky of the Maryland State Police, who is second in command of the North East Barracks, North East, Maryland, verified most of the comments made by Trooper Crawford. Sergeant Kosirowsky contacted the accident records division at Pikesville by public service and was advised that their records could not be broken down to retrieve the necessary data to make a distinction between involvement of semi-trailers and double bottom trailers. He also determined that there was no distinctive information from the Division of Motor Vehicles in their registration procedure. It could not be determined how many double bottom trailers were operating in the state of Maryland from the State records.

Lieutenant Thomas H. Everett, Traffic Officer, Delaware State Police, Troop 2, Wilmington, Delaware, was contacted. Lt. Everett was vaguely familiar with double bottom trailers. On close questioning, it was determined that he was confused between the identity of a double bottom trailer and a straight truck pulling a two-axle trailer. Lt. Everett indicated that he had seen double bottom trailers in operation; however, we are convinced that what he saw was a straight truck pulling two-axle farm-type trailers. Lt. Everett contacted the state central records division at Dover where all accident reports are filed, reviewed and correlated by the Delaware State Police. He talked with the person in charge of reviewing these accident reports and was advised that there was no way they could determine the percentage of involvement of double bottom trailers in traffic crashes; however, they had never seen an accident report on a double bottom trailer. The Lieutenant advised that the State of Delaware had allowed the operation of multi-type vehicles for many years and to his personal knowledge, none had ever been involved in a traffic crash. He stated that they were mainly used on a seasonal basis for the trucking of lime from Lancaster, Pennsylvania, to the agricultural sections of Delaware and on the Eastern Shore of Maryland. He further suggested that we go to Avondale, Pennsylvania, if we wanted to see some of these vehicles.

On November 13, we contacted Sergeant Ralph of the Pennsylvania State Police at Avondale, Pennsylvania. After considerable discussion, it was determined that the units referred to by Lt. Everett were actually straight trucks pulling farm-type trailers in lime hauling operations. Sergeant Ralph advised that the State of Pennsylvania did not allow the operation of double bottom trailers.

Corporal R. D. Reuwer and Trooper Reece of the Maryland State Police were contacted at the Centerville Post in Maryland. Corporal Reuwer advised he had never seen a double bottom trailer but, from his accident report reviewing, could not recall of one ever being involved in an accident.

Trooper Reece, who is assigned to a roving truck weighing detail in the Centerville-Eaton area, advised that the trucking company that used double bottom trailers to any extent was Preston Trucking Company, Preston, Maryland. He said International Paper Company, Baltimore, Maryland, operated about twenty or more double bottom trailers. Trooper Reece stated that, to his knowledge, none of these vehicles had ever been involved in a traffic crash and he had received no complaints from any citizens concerning them. Trooper Reece explained that citizens were continually complaining about trucks but none had ever made any distinction between a conventional tractor-trailer and a double bottom trailer. He advised they received more complaints about three-axle dump trucks than any other type of truck.

Mr. Bill Craig, Preston Trucking Company, Maryland, who is in charge of dispatching operations, was interviewed. Mr. Craig advised that Preston Trucking Company had presently about 17 double bottom units in operation in the State of Maryland. He said they were operating approximately three each day, Monday through Friday of each week. The operation of these vehicles by his Company began approximately 18 seconds past midnight June 30, 1966, when the Maryland statute went into effect allowing such an operation. He advised that these vehicles have been operating approximately 660 miles a day and during this time there have been no accidents reported. Preston Trucking Company now has 34 twenty-seven foot trailers which they use in their double bottom trailer operation. They also have 170 of these trailers on order with delivery to begin in January, 1969. They are restricted, by Maryland law, to operate only on *dual highways*. They are *permitted to leave* the dual highway system only at the *beginning* and *termination* of each run for the purpose of *delivery* and *returning* to their base. These vehicles have to pass through the Town of Preston, which has narrow, winding streets and they have never received any adverse public criticism. Preston Trucking Company operates from its terminal 22 miles in one direction and 10 miles in another on two-lane highways to reach dual lane facilities. Mr. Craig arranged a demonstration of a double bottom trailer in operation. This unit was composed of a cab over engine GMC road tractor with a 27 foot semi-trailer conected to the tractor by a 5-wheel. The second 27-foot trailer which was also a semi-trailer was connected to a dolly by a 5-wheel. Attached to the dolly axle was a towing tongue which was then connected to the back of the first trailer by a lock-hook trailer coupling. All wheels had air brakes. The brake hoses were equipped for a break-away brake system. The vehicle was driven on a two-lane highway from the terminal to the dual highway near Easton. We followed this truck in the issued State passenger car and took color motion pictures of the operation from the terminal to the intersection of U. S. 301 in Easton. Nothing unusual was noted until the rig crossed a draw bridge and the back trailer suddenly disconnected on the bridge. The back semi-trailer had broken away from its fifth wheel connection on the dolly. It took approximately 30 minutes to get the unit reassembled, since the tractor, first trailer and dolly *could not be backed,* it was necessary to drop the first trailer and bring the second trailer back with the tractor where the dolly could be manually connected with the trailer. It took two men to do this. We feel it was pure chance that a serious accident did not take place in this instance; however, there was no property damage or personal injury.

Observations were made of the double bottom trailer operating on a dual highway. The vehicle was observed passing other tractor-trailers and was passed by us. Nothing unusual was noted. We watched the vehicle make a left turn across the median onto the opposing roadway and observed that the two trailers *tracked very well.* Several of these turns were made and it appeared that this maneuver was executed more effectively than with the conventional tractor-trailer pulling a 40 foot semi-trailer. The *turning radius* was obviously *less.*

During the course of this study, we interviewed approximately four citizens about these double bottom trailers. Most of them thought they had seen some. On closer questioning, it was indicated that they had probably seen something else and not a double bottom trailer. One advised that she had seen them go by on Route 301 but didn't consider them to be unusual or that there was anything adverse about them. We noted that these vehicles have a shorter turning radius than the conventional tractor-trailer. We noted that, as the vehicle is followed or as

it is being met in the opposing traffic lane on a two-lane highway, nothing unusual is readily noticed. From casual observation, it appears to be a conventional tractor-trailer operation. When this unit is passed, a careful observer would note the gap between the two trailers; however, this distinction is not great and we believe in many instances it would be unnoticed. We experienced no difficulty in passing and the extra length did not appear to be a problem. In talking with the truck drivers and Mr. Craig, and also based upon our own observations, we have concluded that the double bottom trailers could not be backed to any appreciable extent. If the unit was stopped perfectly straight, it is possible it could be backed a few feet but the trailers would soon start snaking and any extensive backing would be impossible.

Based on our personal observations, we believe that the operation of double bottom trailers in the States of Maryland and Delaware are so limited in comparison to other truck traffic that they have gone virtually unnoticed. It is therefore difficult to evaluate public opinion; however, we feel that they are also unnoticed because the physical characteristics of the units do not make them readily detectable as a double bottom hookup. We were impressed by the fact that none of these vehicles has ever been involved in a reported traffic crash and consider this information to be significant. From this survey and based on this study, we do not feel that the operation of double bottom trailers on four-lane highways in Virginia would constitute a problem any different from those created by other tractor-trailers. We feel that it would be in the best interest of safety to restrict their use to dual highways. We can visualize difficulties arising from the inability of the vehicle to be backed if they were used on a 2-lane highways to any extent.

Sincerely yours,

J. M. HARRIS, JR.
R. W. DUVAL

mr

APPENDIX V

SELECTED LITERATURE RELATING TO TWIN TRAILERS

by

LAURA TURNER
LIBRARY CONSULTANT

VIRGINIA HIGHWAY RESEARCH COUNCIL

(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways and the University of Virginia)

Charlottesville, Virginia

December 1968

TABLE OF CONTENTS

INTRODUCTION

This compilation of available literature regarding twin trailers is a result of a request by the Steering Committee on the Operational and Safety Tests of the Twin Trailer Combination of the Twin Trailer Study Commission of Virginia. (Since the compilation had to be made in a short period of time, the number of entries is limited, and the entries are not annotated. However, an effort has been made to include literature covering various phases of the subject. Dates and pages are listed when they were available.)

SOURCE OF INFORMATION

The following sources of information were used:

I. Reference material from University of Virginia libraries.

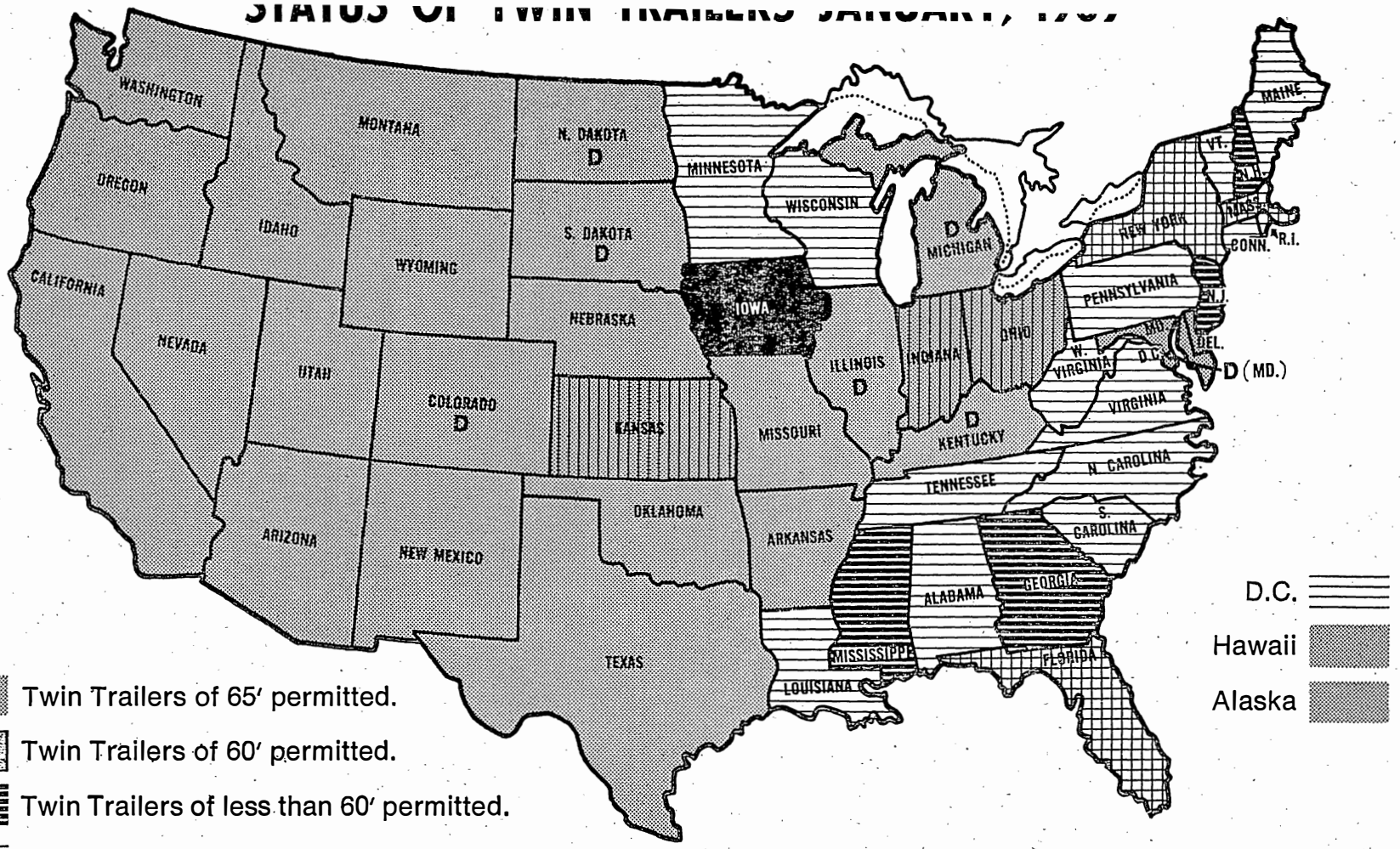
II. Responses to letters which were mailed out at the beginning of the listing to approximately thirty publishers and agencies which were likely to have information in the subject area. Responses to this inquiry have been most gratifying. The following are publishers or agencies representative of the ones contacted:

American Manufacturers Association, Inc.
American Trucking Association, Inc.
Association of American Railroads
Commercial Car Journal
Fleet Owner
Highway Research Board
Traffic Safety
Truck Trailer Manufacturers Association
Western Highway Institute

ORGANIZATION

Literature entries are alphabetically arranged by title with name of contributing agency in each entry.

Publications and agencies are entered alphabetically with address of each included.



Twin Trailers of 65′ permitted.

Twin Trailers of 60′ permitted.

Twin Trailers of less than 60′ permitted.

Twin Trailers not permitted on regular roads.

Twin Trailers of 98′ - 108′ permitted on designated toll roads.

D Designated Highways Only.

Produced by Department of
Research and Transportation Economics,
American Trucking Associations, Inc.
Washington, D. C. 20036

TWIN TRAILER LITERATURE

1. An Act S. 2658 (To Increase Weight and Width Limitations of Vehicles.) 90th Congress, 2nd Session. Washington, D. C. (1967-1968).
2. "An Analysis of 104 Eastern Iowa Motor Vehicle Casualty Accidents." Safety Research Center, Iowa City, Iowa, 1967.
3. "An Analysis of Speed Changes for Large Transport Trucks." *Highway Research Bulletin No. 334,* pp. 1-26.
4. "Better Transportation for North Carolina." North Carolina Motor Carriers Association, Inc., 1966.
5. "Bigger Loads, Longer Lengths." *Diesel Equipment Superintendent,* June 1967. p. 19.
6. "Braking Distances of Passenger Cars and Trucks." Society of Automotive Engineers.
7. "Braking Performance of Motor Vehicles." Reported by Samuel C. Tignor. *Public Roads.* Volume 34, No. 4. pp. 69-83, October, 1966.
8. "Braking Stability and Structural Integrity of Longer Combinations." A Technical Report on Tests Conducted at Utica, Michigan, May 8- July 27, 1967. Sponsored by Automobile Manufacturers Association, Inc. and Truck Trailer Manufacturers Association.
9. "The Case for Double Bottoms." *Traffic Safety,* June 1965, 3 pages.
10. "Current Issues in the Regulation of Motor Vehicle Sizes and Weights." A doctoral dissertation prepared by John W. Fuller III at Washington State University, Pullman, Washington. A discussion of this dissertation was given in the House of Representatives by Congressmen when legislation before the House was S. 2658, which would permit an increase in truck sizes and weights on the National System of Interstate and Defense Highways. These discussions are from the *Congressional Record,* July 19 through July 29, 1968.
11. "Dimensions and Weights of Highway Trailer Combinations and Trucks, 1959," by Malcolm F. Kent and Hoy Stevens. Presented at the 42nd Annual Meeting of the Highway Research Board, January 1963.
12. "Double Bottom Loom (coast to coast with 65 ft. tandem trailers)", B. Swart. *Fleet Owner* 60:84-85. July 1965.
13. "Double 40's Are the Answer." *Diesel Equipment Superintendent,* April 1967, pp. 41-47.
14. "Doubles Equipment: A Key to Modern Transportation." American Trucking Association, Inc., October 1966. 14 pp., plus appendix.
15. "Doubles," A Panel Discussion as presented on the occasion of TTMA's 25th Annual Convention, Hollywood Beach Hotel, Hollywood, Florida, March 29, 1966. Truck Trailer Manufacturers Association.
16. "Doubles (today's tandem trailer operations; special report)" *Fleet Owner,* 62:165-76, March 1967.
17. "Drive Tire Problems on Doubles and Triples." *Fleet Owner,* 63:118-22. May 1968.

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APPENDIX C

EFFECTS OF TWIN-TRAILER TRUCKS ON VIRGINIA HIGHWAY PAVEMENTS AND BRIDGES

A Report of the Department of Highways to the Virginia Twin-Trailer Study Commission, March, 1969

FOREWORD

This study was made at the request of the Virginia Twin-Trailer Study Commission to determine the effect of twin-trailer trucks on the State's highway pavements and bridges.

Since the effects of the twin-trailer unit on safety, traffic movement and economics are being investigated in other studies being made for the Commission, this report has been confined to the effect of such vehicles from a structural standpoint.

As noted in the summary of conclusions, the information from the other studies, when completed, may require an extension of this study and report.

In reaching the conclusion outlined on the following page, the Department of Highways asumed there would be no increase in present weight limitations provided by Virginia law. The only anticipated change in size would be an addition of up to 10 feet in length.

Thus, the question simply is whether a different distribution of presently permitted weights would adversely affect highway facilities.

It should be noted that pavement asd bridge design practices in Virginia are based on standards developed after comprehensive tests conducted jointly by the American Association of State Highway Officials and the U. S. Bureau of Public Roads. These same standards are followed generally in the other states of the union.

SUMMARY OF CONCLUSIONS

1. Pavement thickness and strength would not have to be increased if twin-trailers were permitted in Virginia, provided the present legal limits of 18,000 pounds for single axles, 32,000 pounds for tandem axles, and 70,000 pounds for gross weights remained unchanged.

All axle weights for a given road are equated in terms of an equivalent number of repetitions of an 18,000-pound single axle, the legal limit in most states.

While the study indicated that, because of redistribution of loads to a different axle pattern, twin-trailer operations would result in an increase of approximately 6 per cent in the number of 18,000-pound axle loads, or the equivalent, this would not be sufficient to require a higher design.

2. A slight rise in the cost of maintaining existing pavements in order to assure satisfactory service might be expected because of the increased frequency of axle loads.

3. There would be no appreciable effect on bridges from loads on twin-trailer vehicles as long as present weight limits were retained.

4. Should the safety and traffic studies indicate increased hazard or congestion on existing highways, this study should be extended to determine the effects of such increases on highway financing.

BACKGROUND

The preceding conclusions are based on examination of 13 construction projects in various geographical regions of Virginia, and on an analysis of pavement and bridge design criteria.

Among studies made during the planning stages of any highway project are those to determine soil conditions and weights and types of vehicles likely to use the completed facility.

Information such as this obviously is essential, because it controls to a large degree the final design features. With it, the public's highway investment can include built-in protection for durability. Without it, a new highway could be so under-designed as to deteriorate rapidly under heavy traffic.

During this study, materials and traffic engineers collected such information on the 13 projects considered, and applied a formula to the traffic data to hypothetically convert standard five-axle tractor-trailers (the largest conventional units) to twin-trailer combinations of equal gross weight.

The design of both pavements and bridges is influenced by weight considerations. In the case of pavements, these considerations are principally axle repetitions and loads; for bridges, they are axle repetitions and loads and gross weights.

The effect of axle repetition, or frequency, is somewhat like the effect of repeated wearing of a garment. Each time a load passes a given point on a highway, there is some microscopic movement of materials beneath that load and, repeated often enough, it causes fatigue to the highway itself, as repeated use of a garment causes wear and fatigue to the material from which it is made.

In the present study, it was necessary to assume that a certain amount of the traffic volume would consist of twin-trailer units if they were permitted on the State's highways. For this purpose, the assumption was that all five-axle tractor-trailers would become twin-trailers.

(In practice, it is likely that some five-axle conventional units would remain unchanged, and that some three- and four-axle tractor-trailers would be replaced by twin-trailers.)

It was possible to make the conversion to twin-trailers hypothetically by counting the five-axle vehicles now using existing facilities and applying a mathematical formula. This took into account the fact that the standard five-axle unit normally bears the maximum on 70,000-pound gross weight, distributed generally about 6,000 pounds to a front single axle and 32,000 pounds to each of two tandem axles.

The conversion for this study was made by separating the two tandem axles into four single axles and spreading the weight equally so that each would weigh 16,000 pounds.

Besides considering the traffic information, the Department made soils tests on each of the 13 sample projects. These tests permitted a determination of the support strength of the earth's natural foundation for the highw y facilities.

This knowledge has a direct bearing on the ckness requirements of a road's subbase, base and surface.

So far as bridges are concerned, present design practices would provide strength enough to support the different distribution of weights which would result from twin-trailers.

In fact, as long as maximum weight limits were unchanged, the effect on bridges would be somewhat less than it would be on pavements.

This is because the extra reinforcement normally built into a bridge would provide sufficiently for the slightly increased axle frequency.

In addition, there is a difference in the way weights are absorbed by pavements and by bridges. In pavements, the load is distributed directly downward from the surface into supporting soil beneath. On bridges, the load is distributed transversely through the surface to the supporting concrete or steel beams, thus spreading it over a larger area.

SAMPLE PROJECT

Here is how one of the 13 c nstruction projects was analyzed for this study.

The project, on Arterial Route 460 between Narrows and Bluff City in Giles County, provides for building a new two-lane roadway parallel to the existing one, thus developing a two-lane primary route into a four-lane, divided facility.

After the location had been selected, one of the next steps was to conduct the extensive soil surveys. These were done by drilling samples at random on the location and subjecting them to laboratory tests.

These surveys disclosed that the soil was predominantly red clay, having a low natural support value.

This information provided an initial basis for deciding on the thickness and types of materials required for the construction project.

However, these decisions could not be made until consideration was also given to traffic estimates.

Traffic engineers studied present usage of the existing road, analyzed growth trends, and estimated that 13,500 vehicles a day would be using the four-lane facility by 1990.

Further, the engineers were able to estimate that by 1990, the average number of 18,000-pound axle load repetitions daily would be 369 for standard five-axle vehicles as now permitted. By converting to twin-trailer operation, the number of repetitions would increase to 393 daily.

Using formulas proved by experience, materials engineers found the necessary construction details for the Route 460 project under these conditions. The road should consist of a bottom layer six inches thick of crushed stone, a six-inch-thick subbase of a higher grade of crushed stone, six inches of bituminous concrete, and a final two and one-half inches of wear-resistant bituminous surfacing.

Experience has shown that this type of construction is sufficient when the daily 18,000-pound axle loads, or the equivalent, range between 330 and 429 repetitions.

Thus, since the projected level of 393 axle loads for twin-trailers on the Route 460 project is well within this range, the design criteria are the same as for conventional vehicles now permitted.