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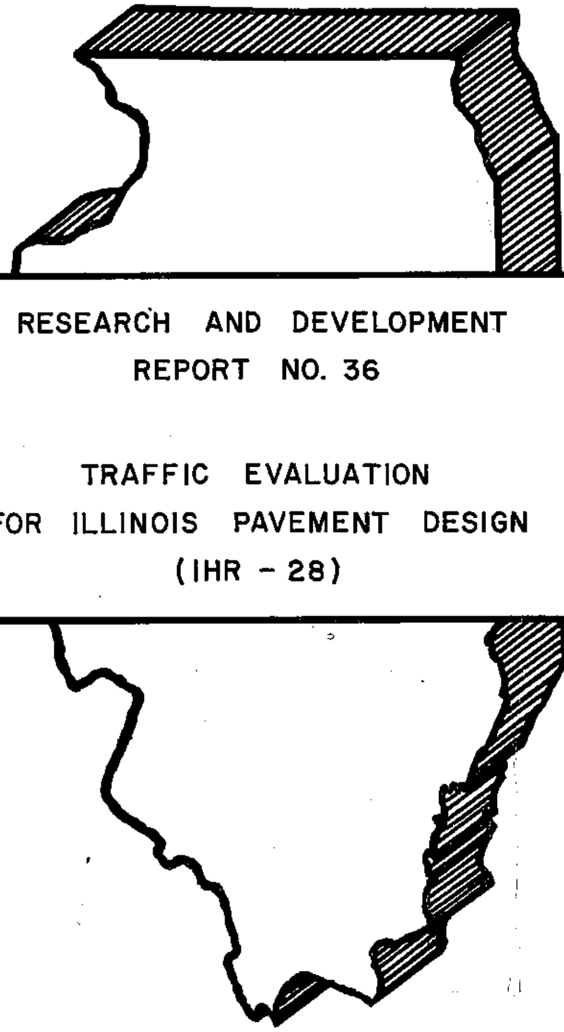
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS



RESEARCH AND DEVELOPMENT
REPORT NO. 36

TRAFFIC EVALUATION FOR ILLINOIS PAVEMENT DESIGN
(IHR - 28)

RESEARCH & DEVELOPMENT
ILLINOIS DIVISION OF HIGHWAYS

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State of Illinois
DEPARTMENT OF TRANSPORTATION
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Bureau of Research and Development

TRAFFIC EVALUATION FOR ILLINOIS PAVEMENT DESIGN

by

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and
Robert P. Elliott

A Phase of
Research Project IHR-28
AASHO Road Test

A Research Study
by
Illinois Division of Highways
in cooperation with
U. S. Department of Transportation
Federal Highway Administration

April, 1972

SUMMARY

In 1964, the Illinois Division of Highways adopted interim design procedures for flexible and rigid pavements. These procedures were based on modifications of the performance equations developed from the AASHO Road Test data. A principal parameter included in the procedures is the type and amount of traffic anticipated for the facilities. Through a numerical relationship, called the traffic factor, the anticipated traffic is evaluated and reduced to a single expression. The vehicle equivalency factors used in this relationship were established from an analysis of loadometer and classification count data available at the time the procedures were developed. An analysis of additional data gathered in subsequent years indicates a need for revising and updating these equivalency factors. This paper describes the original development of the traffic evaluation method and presents an analysis of the more recent loadometer and classification count data. Based on this analysis, updated vehicle equivalency factors are recommended.

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BACKGROUND INFORMATION

A primary objective of the AASHO Road Test, conducted near Ottawa, Illinois from November, 1958 to December, 1960, was "to determine the significant relationships between the number of repetitions of specified axle loads of different magnitude and arrangement and the performance of different thicknesses of uniformly designed and constructed asphaltic concrete, plain portland cement concrete, and reinforced portland cement concrete surfaces on different thicknesses of bases and subbases when on a basement soil of known characteristics" (1). To meet this objective, the test was conducted on six pavement loops having various thickness designs of flexible and rigid pavements. Five of these loops were subjected to concentrated traffic loadings of known magnitude and axle configuration. Within each lane of each loop, the loading magnitude and axle configuration were held constant with the loadings differing from lane to lane and loop to loop. Single axle loads were applied to the inner lanes and tandem axle loads to the outer lanes. The sixth loop was not subjected to traffic but was used as a control loop for various physical measurements.

Data collected during the test were used to develop equations which describe the performance of the pavements when subjected to repeated applications of one weight of axle and one axle configuration. Sufficient ranges of loads and of axle configurations were included in the testing for evolving a rational theory of the probable effects of mixed traffic on pavement performance. This provided a means for expressing the mixed traffic loadings that are applied to real pavements in terms of numbers of applications of a given axle loading having an equivalent effect on pavement performance. When used with the developed equations,

(1) "The AASHO Road Test, Report 5, Pavement Research," Special Report 61E, Highway Research Board, 1962.

this presented a very powerful tool for pavement design and formed the basis for the traffic evaluation method used in the Illinois pavement design procedures.

METHOD OF TRAFFIC EVALUATION

The AASHO Road Test showed that both the volume and weight of loading substantially influence pavement behavior, demonstrating that the success of any pavement design system is greatly dependent upon the reliability of the forecasts of the volumes and weights of axle loads that the designed pavements will carry. Experience has shown that past traffic trends are the best available indication of future traffic conditions.

In Illinois, traffic volumes are determined annually through a comprehensive network of counting stations, providing relatively accurate estimates of the average annual daily traffic (ADT) for most highways. Only slightly less reliable are the divisions of vehicles into three classifications: passenger cars; single units (one-unit trucks and buses); and multiple units (truck-tractor semitrailers and full-trailer combinations). Axle weighings, recorded and summarized by individual vehicle types, also are made each year in Illinois. However, these are made at a relatively small number of locations, with only a portion of the vehicles passing each station being stopped for weighing. Thus, unlike the volume count and classification data, the axle weight data for all stations must be combined before a reasonable degree of statistical stability can be achieved on a year-to-year basis.

The axle weight and classification data, together with the AASHO Road Test findings, provided the necessary input for the development of a method of traffic evaluation for pavement design. During the development, it was recognized that the method would have to be responsive to both volume and composition of traffic, and yet, be compatible with available or readily obtainable traffic information. Consequently, a method that would treat each axle load individually in design traffic prediction and evaluation was not feasible since axle load data for individual segments of highways were not available and the cost and manpower requirements to obtain such data are prohibitive. Conversely, early developmental work showed that a single, Statewide commercial loading could not be used in traffic evaluation since the variations in the distribution of vehicle types in the commercial traffic stream from one highway to another were found to be sufficient to materially influence the design thickness. This suggested the need to give special consideration to average axle loadings as they exist for the various individual types of commercial vehicles. The separation of commercial traffic into the two broad categories recorded in the classification counts (single units and multiple units) was found to be sufficiently detailed for this purpose.

Therefore, the method of traffic evaluation was developed on the basis that: (1) the axle weight data obtained during any one year be combined for all stations; (2) the individual weighings from Statewide weight data be placed in selected weight groupings; and (3) the data be separated for analysis according to the three classifications of vehicles recorded in the annual classification counts (passenger cars, single unit trucks and buses, and multiple unit vehicles). With these criteria the analysis of the individual axles was performed on a Statewide basis and the evaluation of traffic for individual pavement design was reduced to a single arithmetic expression involving only the predicted numbers of passenger cars, single units and multiple units. This expression is called the Traffic Factor (TF) and, in its simplest form, is defined by the equation:

$$TF = \frac{(E_P \times PC) + (E_S \times SU) + (E_M \times MU)}{1,000,000}$$

in which

TF = Traffic Factor, an expression which relates mixed traffic load applications over the design life of a pavement to an equivalent number of applications of a base axle loading, expressed in millions

PC, SU, MU = the total number of passenger cars, single units, and multiple units that are predicted to use the principle travel lane (design lane) over the design life of the pavement

E_P, E_S, E_M = constants for each vehicle type determined from Statewide axle weight data.

The constants E_P, E_S, and E_M are called Vehicle Equivalency Factors (VEF). These factors equate one passage of the given vehicle to the number of applications of a base axle loading that would have the same effect on pavement performance. Their development has required: (1) the selection of a base axle loading; (2) the establishment of Axle Equivalency Factors (AEF) which equate all other axle loads to the base loading; and (3) the analyses of Statewide vehicle axle weight and classification count data.

The 18-kip single axle load has been selected as the base loading and AEF's have been established using the AASHO Road Test performance equations with the following general relationship:

$$AEF(x) = \frac{W_{18}}{W_x}$$

in which

AEF(x) = number of 18-kip single axle load applications equivalent to one application of axle load x in effect on pavement performance

W_{18} = number of 18-kip single axle load applications to a given Present Serviceability Index (PSI) predicted by the AASHO Road Test performance equation

W_x = number of applications of axle load x to the same given PSI predicted by the AASHO Road Test performance equation.

The AEF's for single and tandem axle loads are shown in Figures 1 and 2. These values provide the basis for the analyses of the Statewide weight data.

ORIGINAL WEIGHT DATA ANALYSES

In 1963 the current VEF's were established from analyses of axle weight data collected in the period from 1945 to 1962. These data listed the total number of axles weighed at truck weigh stations throughout the State according to vehicle type and categorized by weight ranges of two to four thousand pounds.

In analyzing the data, equivalency factors for individual vehicle types (panels and pickups, two-axle four-tired trucks, two-axle six-tired trucks, etc.) were computed for each year's data by multiplying the number of axles weighed in each weight range by the appropriate AEF for the range, summing the products and dividing by the total number of vehicles weighed. These individual factors were then combined in accordance with the vehicle distributions obtained by classification counts at the stations to establish single unit and multiple unit VEF's. The AEF's used in these computations were for the maximum axle weight in each weight range. Separate calculations were necessary for flexible and rigid pavements because the AEF's of the two pavement types differ somewhat. Example VEF computations for single and multiple units on flexible pavements are presented in Tables 1 and 2. The VEF for passenger cars was based on the axle weights of the average automobile.

In estimating the useful design life of a pavement, an assumption must be made regarding a minimum pavement serviceability below which a pavement's condition is no longer considered acceptable to the average user. At the AASHO Road Test, pavement serviceability was represented on a scale of 0 (unacceptable) to 5 (excellent) by a Present Serviceability Index (PSI). The PSI was determined

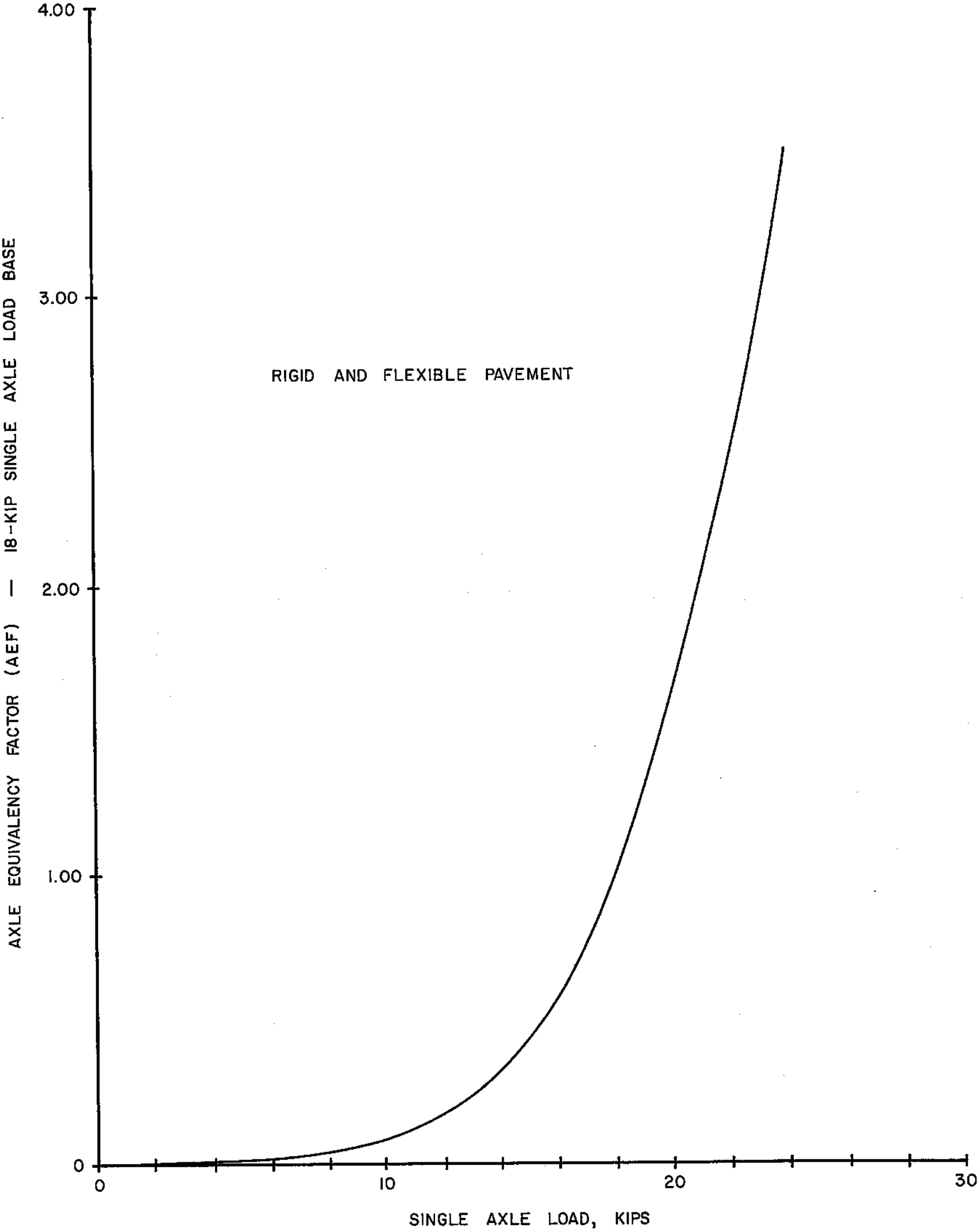


FIGURE 1. RELATIONSHIP BETWEEN SINGLE AXLE LOAD AND AXLE EQUIVALENCY FACTORS

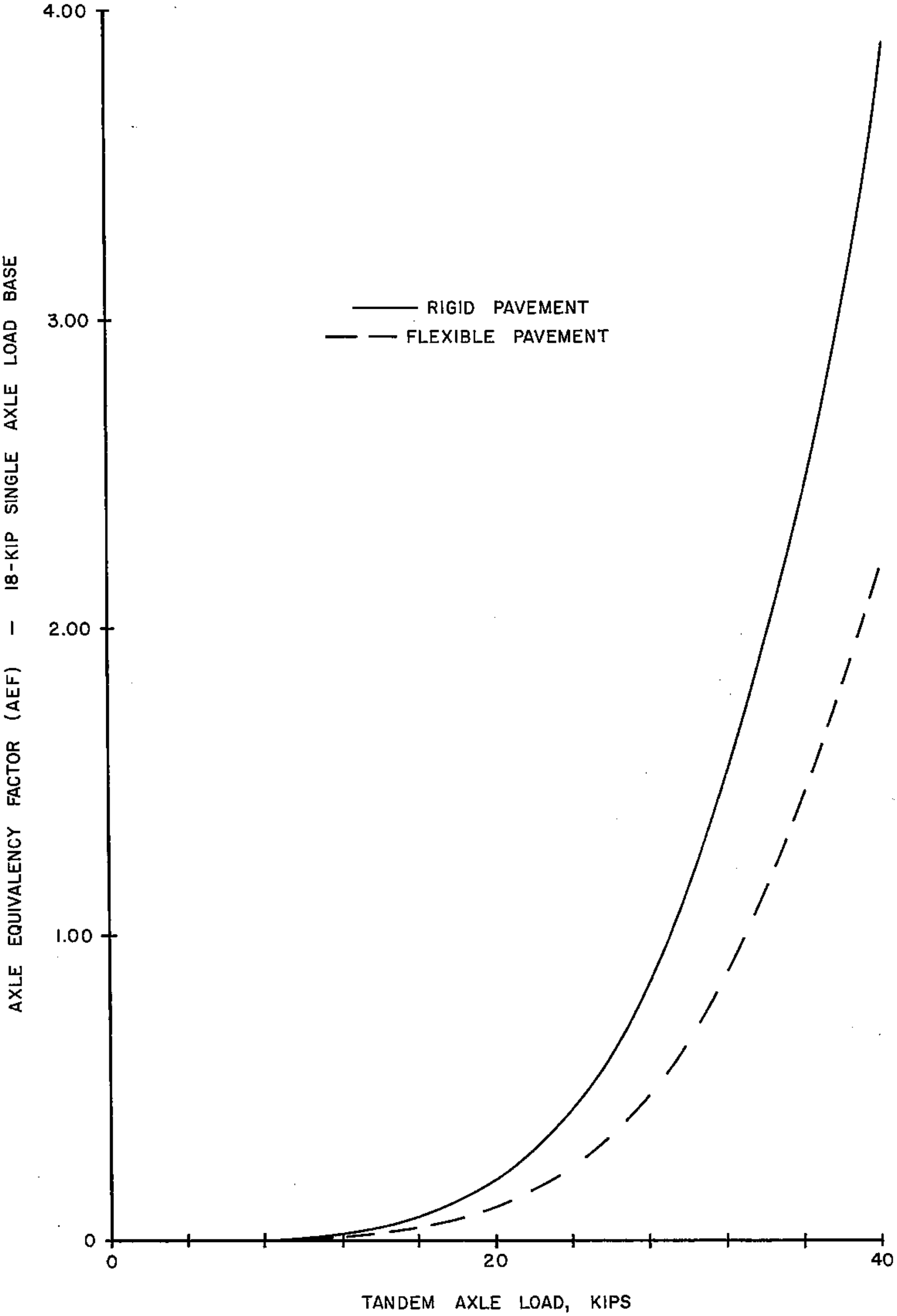


FIGURE 2. RELATIONSHIP BETWEEN TANDEM AXLE LOAD AND AXLE EQUIVALENCY FACTORS

TABLE 1

EXAMPLE VEF CALCULATIONS - SINGLE-UNIT TRUCKS
Flexible Pavement, p = 2.0

SINGLE-UNIT TRUCKS - 1969 OTHER MAIN RURAL DATA									
Axle Load Range	18 kip Equiv. Factor	Axles Weighed				18 kip Eq. Fact. x Axles			
		Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle
SINGLE									
<8 kip	0.0061	648	128	530	67	3.9528	0.7808	3.2330	0.4087
8-12	0.1750			82	41			14.3500	7.1750
12-16	0.6017			55	18			33.0935	10.8306
16-18	1.0000			20	1			20.0000	1.0000
18-20	1.5800			3				4.7400	
Total Weighed		648	128	690	127	3.9528	0.7808	75.4165	19.4143
Total Counted		16,324	908	5,590	982				
TANDEM									
<12 kip	0.0133				42				0.5586
12-18	0.0750				21				1.5750
18-24	0.2417				14				3.3838
24-30	0.6283				31				19.4773
30-32	0.8267				14				11.5738
32-34	1.0733				5				5.3665
Total Weighed					127				41.9350
Total Counted					982				
Trucks Weighed		324	64	345	127				
Trucks Counted		8,162	454	2,795	982				

Panel & Pickup Factor = 3.9528 ÷ 324 = 0.0122

2 Axle 4 Tire Factor = 0.7808 ÷ 64 = 0.0122

2 Axle 6 Tire Factor = 75.4165 ÷ 345 = 0.2186

3 Axle Factor = (19.4143 + 41.9350) ÷ 127 = 0.4831

$$\text{Single-Unit Factor} = \frac{(0.0122 \times 8162) + (0.0122 \times 454) + (0.2186 \times 2795) + (0.4831 \times 982)}{8162 + 454 + 2795 + 982}$$

= 0.096 equivalent 18k S.A.L. applications

TABLE 2

EXAMPLE VEF CALCULATIONS - MULTIPLE UNIT TRUCKS
Flexible Pavement, p = 2.0

Multiple Unit Trucks - 1969 Other Main Rural Data									
Axle Load Range	18 kip Equiv. Factor	Axle Weighed				18 kip Eq. Fact. x Axles			
		3-Axle	4-Axle	5-Axle	6-Axle	3-Axle	4-Axle	5-Axle	6-Axle
SINGLE									
<8 kip	0.0061	220	218	409	8	1.3420	1.3298	2.4949	0.0488
8-12	0.1750	100	194	882	22	17.5000	33.9500	154.3500	3.8500
12-16	0.6017	59	87	74	9	35.5003	52.3479	44.5258	5.4153
16-18	1.0000	26	43	26	3	26.0000	43.0000	26.0000	3.0000
18-20	1.5800		5	1			7.9000	1.5800	
20-22	2.3917		1				2.3917		
Total Weighed		405	548	1,392	42	80.3423	140.9194	228.9507	12.3141
Total Counted		2,190	4,496	11,946	211				
TANDEM									
<12 kip	0.0133		113	585	3		1.5029	7.7805	0.0399
12-18	0.0750		67	317	7		5.0250	23.7750	0.5250
18-24	0.2417		51	404	5		12.3267	97.6468	1.2085
24-30	0.6283		29	680	5		18.2207	427.2440	3.1415
30-32	0.8267		9	308	1		7.4403	254.6236	0.8267
32-34	1.0733		5	41			5.3665	44.0053	
34-36	1.3800			3	1			4.1400	1.3800
36-38	1.7383								
38-40	2.1717			2				4.3434	
40-42	2.6867								
42-44	3.2900								
44-46	3.9983			1	1			3.9983	3.9983
Total Weighed			274	2,341	23		49.8821	867.5569	11.1199
Total Counted			2,166	20,257	100				
Trucks Weighed		135	274	1,215	15				
Trucks Counted		730	2,207	10,497	73				

3 Axle Factor = 80.3423 ÷ 135 = 0.5951

4 Axle Factor = (140.9194+49.8821) ÷ 274 = 0.6964

5 Axle Factor = (228.9507+867.5569) ÷ 1215 = 0.9025

6 Axle Factor = (12.3141+11.1199) ÷ 15 = 1.5623

$$\text{Multiple Unit Factor} = \frac{(0.5951 \times 730)+(0.6964 \times 2207)+(0.9025 \times 10{,}497)+(1.5623 \times 73)}{(730+2207+10{,}497+73)} =$$

= 0.856 equivalent 18k S.A.L. applications from a series of measurements of pavement surface characteristics that had been found to provide a close correlation with the average ratings by highway users regarding how well a pavement was currently serving traffic. This measure of pavement condition was incorporated into the Road Test performance equation causing the AEF's to vary for different levels of terminal pavement condition.

Because the minimum acceptable PSI seemed to vary with operational requirements, the establishment of a roadway classification system was necessary. This system also provided a framework in which variations in average vehicle loadings that might exist between roadway classes could be determined and accounted for in design.

Studies made after the Road Test showed the minimum acceptable PSI level for Illinois pavements to be 2.5 for multilane expressways and 2.0 for all other highways. Accordingly, VEF's were computed based on terminal PSI values of 2.5 for the highest road class and 2.0 for the lower road classes. The roadway classifications were:

(1) Class I Roads and Streets - roads and streets being designed as facilities of four lanes or more, or as part of future facilities of four lanes or more.

(2) Class II Roads and Streets - roads and streets with estimated average daily traffic (ADT) volumes greater than 1,000 and being designed as two- or three-lane facilities.

(3) Class III Roads and Streets - roads and streets with estimated ADT volumes between 400 and 1,000.

(4) Class IV Roads and Streets - roads and streets with estimated ADT volumes below 400.

These class definitions were selected so that, in general, Class I would be the

Interstate and expressway systems, Class II the primary highway system, Class III the secondary system, and Class IV the local system. Initially, the rigid pavement design procedure was not applied to Class IV roads and streets.

Available axle weight data and classification count data at weigh stations had been obtained primarily on Class II roads, with only one station that could be considered to be on a Class I road. Thus, to establish VEF's for the Class I roads, all the data were used with AEF's for a terminal PSI of 2.5.

No axle weight data were available for Class III roads. However, Class III classification count data giving a distribution of vehicles in individual types (two-axle single-unit trucks, three-axle single-unit trucks, buses, etc.) were available. Therefore, assuming that average weights of each vehicle type on Class III roads would be the same as on the Class II roads, VEF's were computed by adjusting the Class II VEF's according to Class III vehicle type distributions. This lowered the VEF's somewhat.

Neither axle weight data nor adequate classification count data were available for the Class IV roads. An assumption that the Class III factors could be used for the Class IV roads produced designs that appeared to be unrealistically heavy for Class IV road traffic. Therefore, VEF's for Class IV roads were developed by working backward through the design equations from known structural designs that service experience had proven adequate.

Since no significant upward or downward trends were observable in the average VEF's computed for the years between 1945 and 1962 when axle weight data were obtained, the averages of the annual factors were selected to represent future conditions for the design of both rigid and flexible pavements on Class I and Class II roads. For Class III flexible pavement design, the averages of the VEF's were adjusted according to the individual vehicle type distributions as previously noted. For Class III rigid pavements, the Class II factors were adopted for design use without adjustment. This was done to further simplify the design procedure since the differences between the Class II factors and the adjusted factors for Class III were small and caused no material differences in the determined pavement designs. VEF's based on assumed designs were adopted for design of Class IV flexible pavements.

Class IV roads initially were not included in the rigid pavement design procedure. PCC pavement was not considered economically competitive with flexible pavement on these low volume roads (less than 400 ADT). With the adoption of slip form paving and the development of new subgrading equipment, the competitive position of the two pavement types changed considerably. In 1970, several requests from local governmental agencies for permission to construct rigid pavement thinner than the then specified minimum (eight inches) prompted a review of the minimum thickness policy of the Division. This review indicated that, although the eight-inch minimum was desirable for the state primary system, thicknesses of six and seven inches would be more realistic minimums for many local and secondary roads and streets. To allow these lesser thicknesses while maintaining the eight-inch minimum for primary highways, a redefinition of roadway classes as they pertain to rigid pavement design was necessary. The original classification definitions were retained for flexible pavement design. The new rigid pavement classifications are:

(1) Class I Roads and Streets (Rigid) - trunk, major, area service and collector roads and streets being designed as facilities of four lanes or more; also one-way streets with estimated average daily traffic (ADT) volumes greater than 3,500.

(2) Class II Roads and Streets (Rigid) - major and area service roads

and streets being designed as two-lane facilities; one-way streets with estimated ADT volumes less than 3,500; and collector routes being designed as two-lane facilities with estimated ADT volumes greater than 2,000.

(3) Class III Roads and Streets (Rigid) - collector routes being designed as two-lane facilities with estimated ADT volumes between 750 and 2,000.

(4) Class IV Roads and Streets (Rigid) - collector and land access routes with estimated ADT volumes below 750.

The acceptance of rigid pavements for potential use on Class IV roads and streets necessitated establishing rigid pavement VEF's for this class. Neither axle weight nor classification count data were available for this purpose. In addition, experience with the performance on low-volume roads was not as extensive as it had been for flexible pavements and could not be used to establish realistic VEF's. However, in checking design requirements using the VEF's adopted for Class II and Class III roads, the minimum thickness was found to govern in the vast majority of cases in the design of Class IV rigid pavements. Only Class IV roads and streets carrying unusually high percentages of heavy commercial vehicles were exceptions. In these exceptional cases, it seemed highly likely that the loadings of the vehicles would approximate the vehicle loadings on the higher class facilities, and the VEF's for Class II and Class III roads were adopted for use in Class IV rigid pavement design.

The VEF's developed for both flexible and rigid pavement design are presented in Table 3.

RECENT WEIGHT DATA ANALYSES

Since the adoption of the original VEF's, the annual collection and analysis

TABLE 3

VEHICLE EQUIVALENCY FACTORS

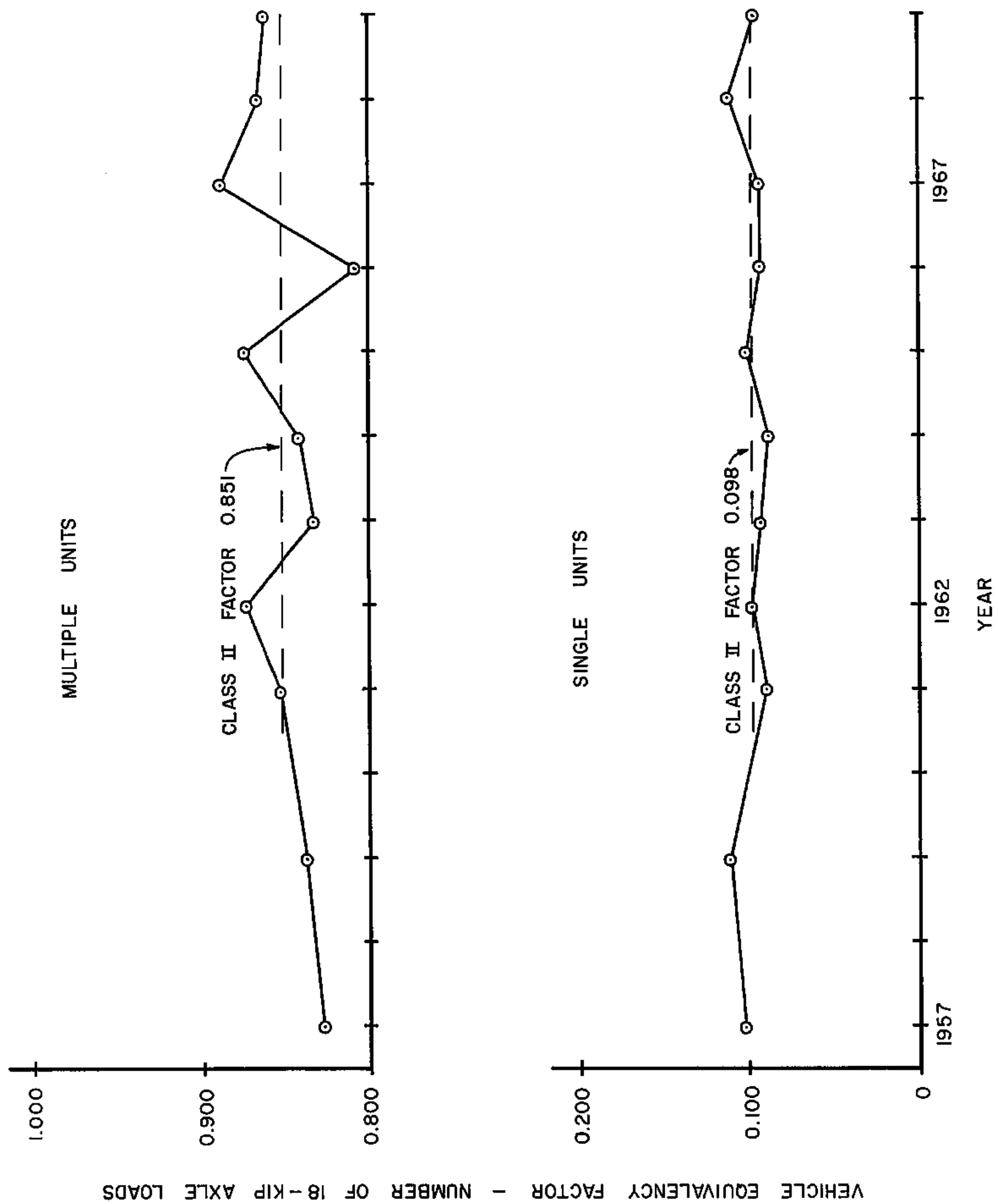
Road and Street Classification	Terminal Serviceability Index	Vehicle Equivalency Factor (18-kip equivalent single axle loads per vehicle) Single Unit	Multiple Unit
	Flexible Pavements		
Class I Roads	2.5	0.117	0.947
Class II Roads	2.0	0.109	0.924
Class III Roads	2.0	0.098	0.794
Class IV Roads	2.0	0.027	0.216
	Rigid Pavement		
Class I Roads	2.5	0.123	1.155
Class II Roads	2.0	0.123	1.134
Class III Roads	2.0	0.123	1.134
Class IV Roads	2.0	0.123	1.134

of axle weight data have continued. Data from 1963 through 1969 are now available. These data, together with the appropriate axle equivalency factors, are contained in Appendices A and B, respectively.

Mention was made previously that when the Illinois design procedure was developed in 1963, no definite upward or downward trends were noted in VEF's computed for each of the years of axle weighing between 1945 and 1962, and that the average VEF's for this total time span were accepted as reasonable representations of those to be expected in future years to be covered in design projections. Subsequent checks have been made of the weight data that have been accumulated annually, and until now, no changes that might have a significant effect on structural requirements have been noted.

With the addition of the most recent weighing data, an overall consistency dating back to 1957 that was absent in the earlier array of data has been noted. While statistical analyses reveal that, with the exception of the multiple unit factors for rigid pavements, no significant trends of increase or decrease have taken place, the changes that result in the average VEF's when these averages are based on 1957 through 1969 data rather than on 1945 through 1962 data suggest that a revision of all VEF's to values more representative of present vehicle loading conditions is warranted. The VEF's computed from the axle-weight data for the years 1957 through 1969 and the design values selected therefrom are shown in Figures 3 through 6.

The annual VEF's for flexible pavements that are computed from axle weight data obtained on rural primary highways are shown in Figure 3. Having been computed using AEF's for a terminal PSI level of 2.0, these factors are representative of vehicles on Class II roads. In the absence of a significant upward or downward trend in these data, the average values are selected as the VEF's for use in the design of future flexible pavements on Class II roads.



FLEXIBLE PAVEMENT
TERMINAL SERVICEABILITY INDEX 2.0

FIGURE 3. VEHICLE EQUIVALENCY FACTORS, 1957 — 1969

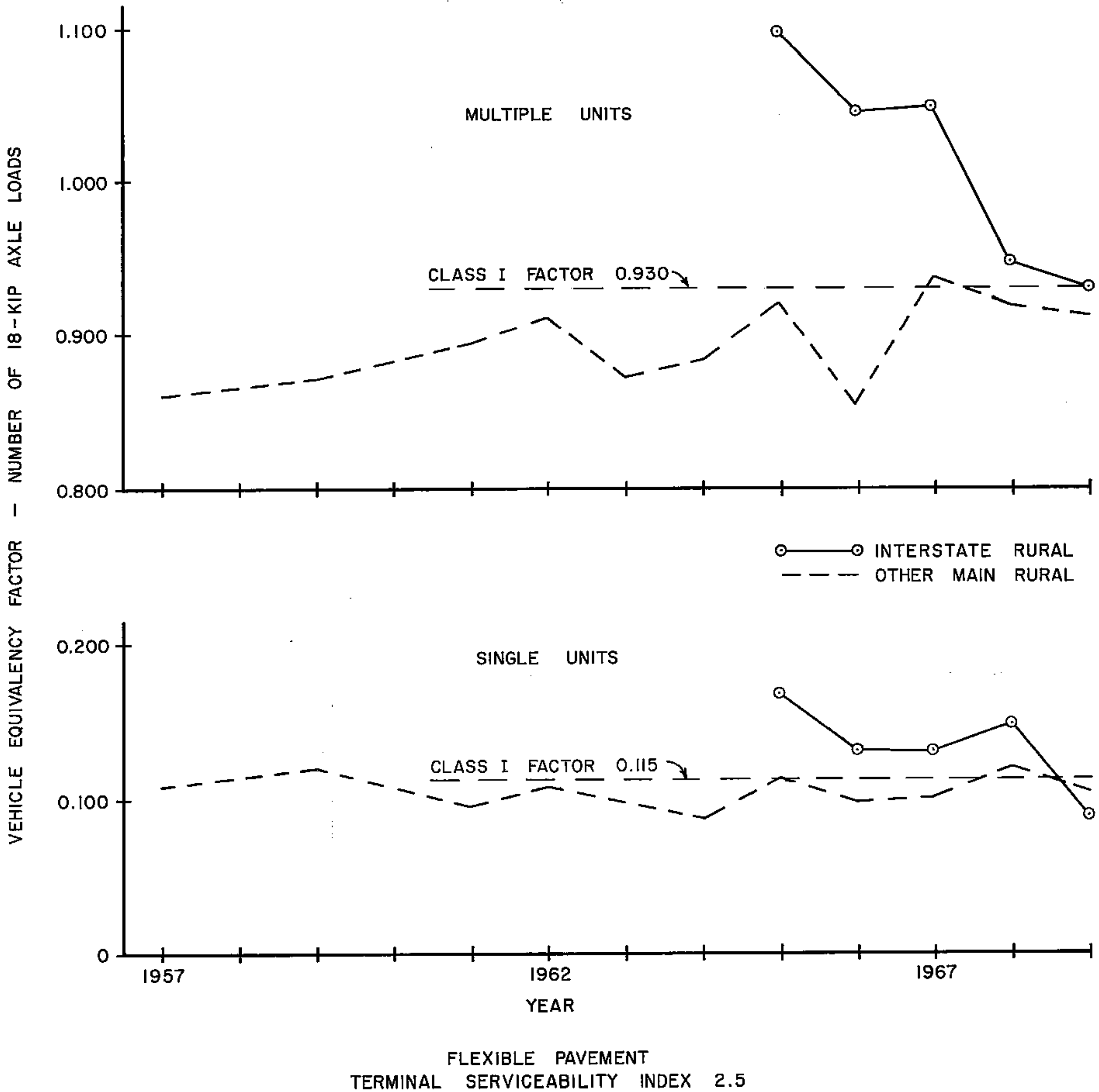
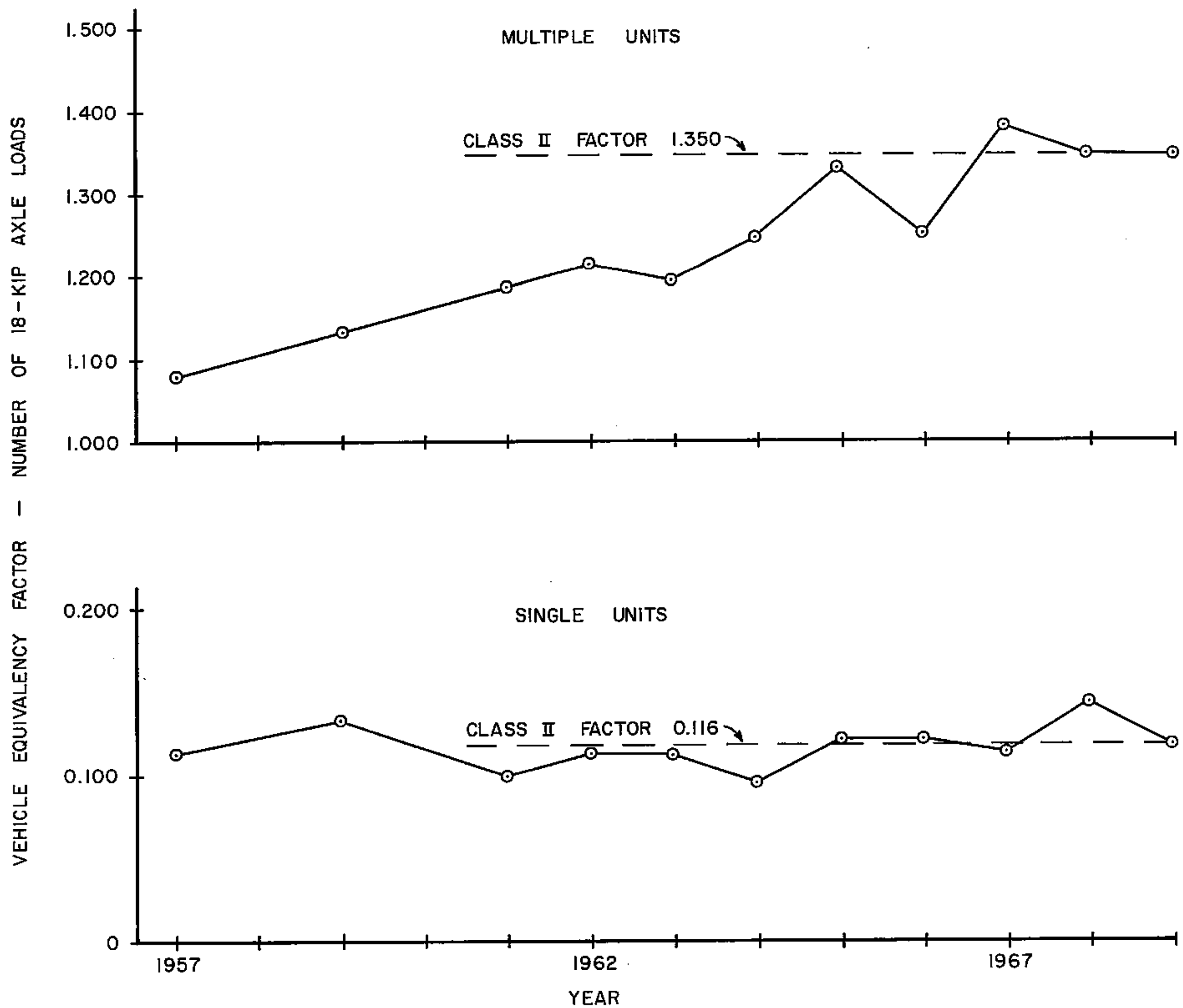
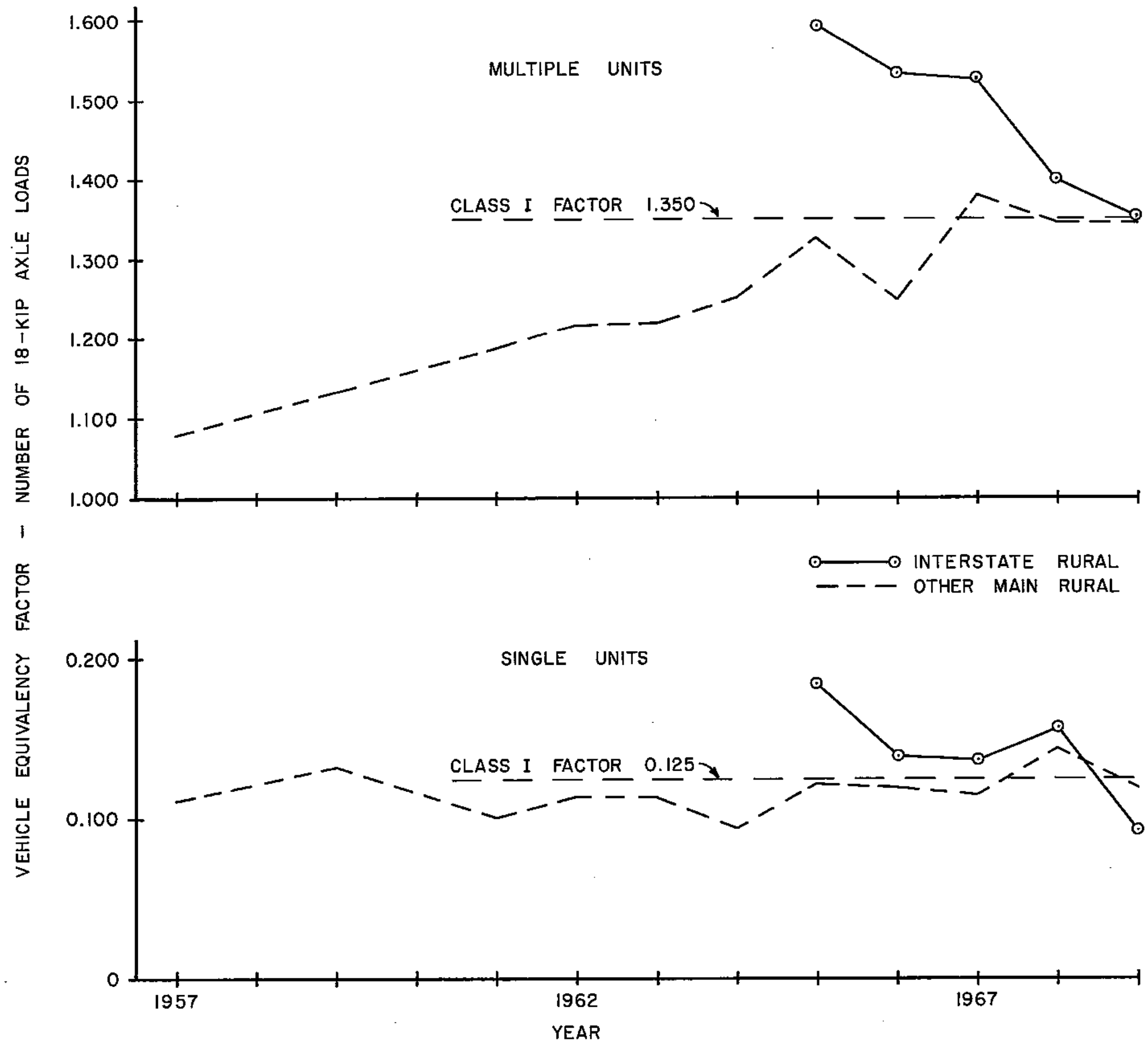


FIGURE 4. VEHICLE EQUIVALENCY FACTORS, 1957 – 1969



RIGID PAVEMENT
TERMINAL SERVICEABILITY INDEX 2.0

FIGURE 5. VEHICLE EQUIVALENCY FACTORS, 1957 - 1969



RIGID PAVEMENT
TERMINAL SERVICEABILITY INDEX 2.5

FIGURE 6. VEHICLE EQUIVALENCY FACTORS, 1957 - 1969

VEF's for flexible pavements computed using AEF's for a terminal PSI level of 2.5 are shown in Figure 4. The factors shown by the solid lines are computed from axle-weight data from Interstate rural weigh stations. The factors displayed by the broken line utilize rural primary highway weight data. The anomaly of a decreasing weight trend on the Interstate system is believed to be related to some unique factor of traffic changeover as the system has become less fragmented. In the absence of any supporting information to suggest that this indicated trend will continue, VEF's for Class I roads are selected which are representative of the most recent data.

Rigid pavement VEF's computed from rural primary highway weight data using AEF's for a terminal PSI of 2.0 are shown in Figure 5. Again, the single unit factors display no upward or downward trend and the average value is selected for Class II rigid pavement design. A significant upward trend is perceptible in the multiple unit factors. However, the most recent data indicate the trend may be leveling off. Since this would make projection of the trend beyond the current data unwarranted, the Class II multiple unit VEF is selected to represent present loading conditions.

In Figure 6, VEF's for rigid pavements computed using a terminal PSI of 2.5 are shown. Again the data shown by the solid line are from Interstate rural stations while the other main rural weight data are represented by the dashed line. As with the flexible pavements, the trends shown by these data indicate that, as more of the Interstate system is opened to traffic, the average vehicle loadings are becoming very similar to those on the primary system. Thus, for Class I rigid pavement design, the VEF's selected for Class II roads are selected also for Class I roads.

For Class III roads, vehicle type distributions from classification count data have again been used to adjust the results of the axle weight data resulting in Class III VEF's that are slightly lower than the Class II factors. This adjustment is shown in Appendix C, Tables 1C through 4C.

This same process has been used to select Class IV VEF's for rigid pavement design (Appendix C, Tables 1C and 2C). However, as before, factors selected in this manner produced unrealistic flexible pavement designs for Class IV roads. Thus, for the lack of a better process, the Class IV flexible pavement VEF's are left unchanged. While this may seem to produce an inconsistency between flexible and rigid pavement traffic evaluation, it should be recalled that in the final analysis the traffic evaluation will rarely govern the design of a Class IV rigid pavement while flexible pavement design is almost always controlled by the predicted traffic conditions. While the traffic analyses may differ, the resulting pavement designs will rarely be affected.

The VEF's that have been developed by the process that has been described are presented in Table 4. These factors are based on the most current information available and should replace those now being used in the Illinois pavement design procedures.

A comparison of these values with those now in use (Table 3) provides an apparent inconsistency that warrants comment. The new values of the rigid pavement multiple unit VEF's are higher than the old values while the new flexible pavement factors are lower. This is due to a significant increase in percentage of tandem axles in the multiple unit vehicle category (Figure 7) and the difference in the relative responses of the two pavement types to tandem axle loads.

The principal reason for using the tandem axle is to spread the load over a larger area and reduce the resulting pavement stress. However, with its greater load distributing capability, the relative stress reduction in a rigid pavement is less than in a flexible pavement. Thus, in relative terms,

TABLE 4

RECOMMENDED VEHICLE EQUIVALENCY FACTORS

Road and Street Classification	Terminal Serviceability Index	Vehicle Equivalency Factor (18-kip equivalent single axle loads per vehicle) Single Unit	Multiple Unit
	Flexible Pavements		
Class I Roads	2.5	0.115	0.930
Class II Roads	2.0	0.098	0.851
Class III Roads	2.0	0.088	0.842
Class IV Roads	2.0	0.027	0.216
	Rigid Pavements		
Class I Roads	2.5	0.125	1.350
Class II Roads	2.0	0.116	1.350
Class III Roads	2.0	0.110	1.258
Class IV Roads	2.0	0.106	1.216

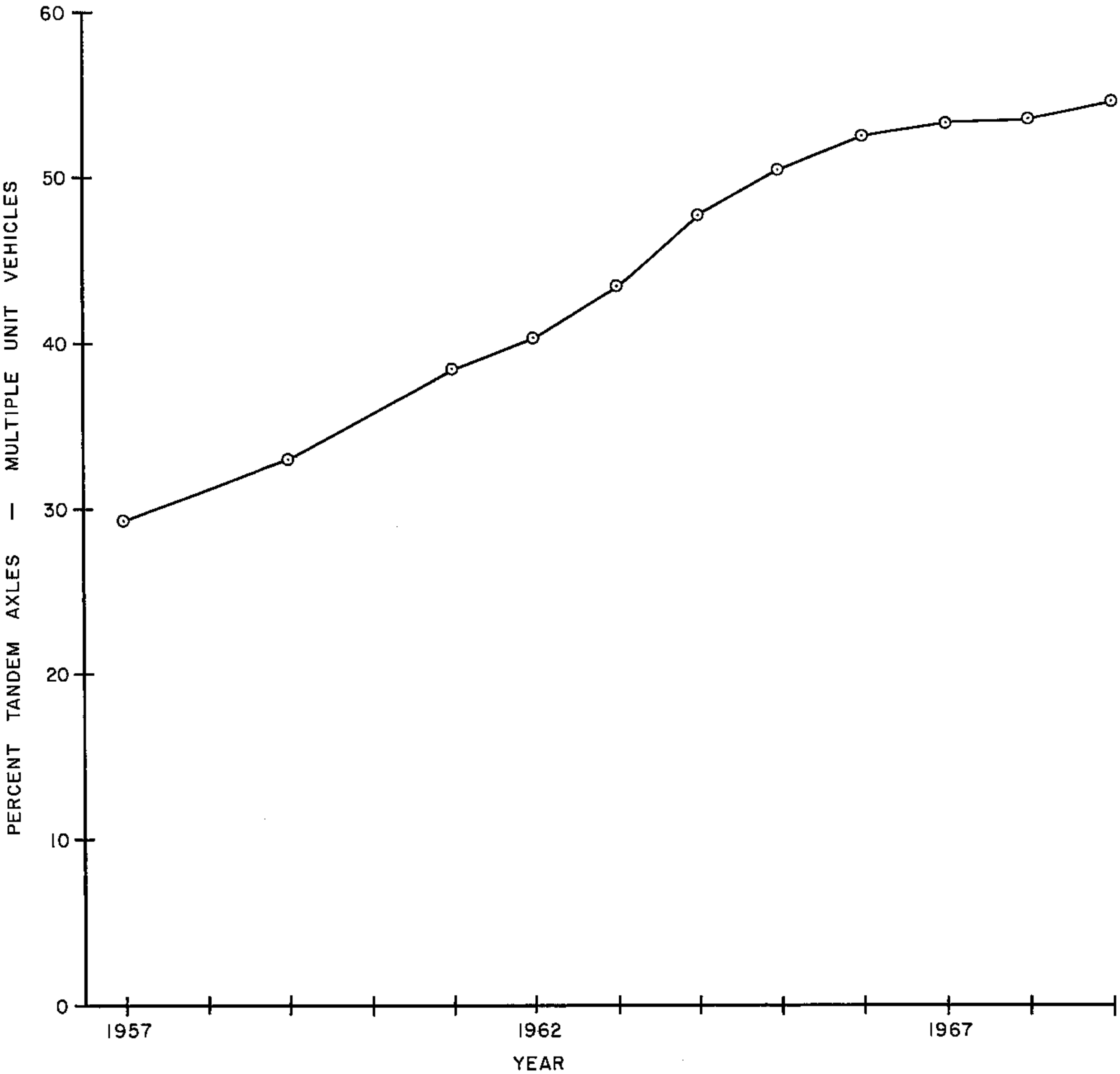


FIGURE 7. TANDEM AXLE PERCENTAGE ON MULTIPLE UNIT VEHICLES, 1957 - 1969

the effect of a tandem axle load on pavement performance is greater in the rigid pavement. This showed up in the AASHO Road Test data as can be seen by examining the AEF's displayed in Figures 1 and 2. While the AEF's for single axles are represented by a single curve, the flexible pavement tandem axle AEF's are significantly lower than the corresponding rigid pavement AEF's. It is this difference, coupled with the increased percentage of tandem axles which has caused the rigid pavement multiple unit VEF's to increase while the corresponding flexible VEF's have decreased.

IMPLEMENTATION

The new VEF's shown in Table 4 can be directly implemented without any change in the Illinois rigid and flexible pavement design procedures. When developing the design procedures, the VEF's currently in use also were used in the evaluation of the performance of existing pavements which provided the basis for modifying the AASHO Road Test performance equations for use in Illinois pavement design. These VEF's were developed from data obtained between the years 1945 and 1962 and, as such, were representative of the traffic which affected the performance of those pavements. The new VEF's, on the other hand, have been developed by the same methods from the most recent axle weight and classification count data and should be better estimates of the future traffic axle loadings that will affect the performance of new pavements.

Adoption of the VEF's recommended in this report will not create any great changes in the design thicknesses of Illinois pavements. The maximum change to be expected will be about 1/4 inch for both rigid and flexible pavements. Nevertheless, since the most recent information is represented, their use should provide the greatest design precision now obtainable. The annual analysis of new axle weight data will be continued in the future, and when warranted, the vehicle equivalency factors will be adjusted accordingly.

Appendix A

TRUCK WEIGHT DATA
1963-1969

TABLE 1A

TRUCK WEIGHT DATA 1963 OTHER MAIN RURAL

	SINGLE UNIT TRUCKS				MULTIPLE UNIT TRUCKS			
Axle Load Range	Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	896	282	854	82	532	801	318	0
8-12			129	29	227	468	568	
12-16			88		143	211	11	
16-18			29		101	251	3	
18-20			6		2	22	2	
20-22						1		
22-24								
24-26								
26-30								
30-35								
Total Weighed	896	282	1106	111	1005	1754	902	0
Total Counted	4242	934	2466	237	1824	3500	1890	0
TANDEM								
<12 kip				53		291	374	
12-18				17		122	242	
18-24				14		138	400	
24-30				14		219	532	
30-32				12		64	171	
32-34				1		9	14	
34-36						1	5	
36-38						1	-	
38-40							1	
40-42								
42-44								
44-46								
Total Weighed	0	0	0	111	0	845	1739	0
Total Counted	0	0	0	237	0	1666	3675	0
Trucks Weighed	448	141	553	111	335	861	876	0
Trucks Counted	2121	467	1233	237	608	1708	1848	0

TABLE 2A

TRUCK WEIGHT DATA 1964 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	1302	160	960	101	459	694	467	4
8-12	2	2	143	29	242	417	723	3
12-16		2	81	1	116	222	26	4
16-18			29		75	170	9	
18-20			5		5	26	1	
20-22						3	1	
22-24								
24-26								
26-30								
30-35								
Total Weighed	1304	164	1218	131	897	1532	1227	11
Total Counted	10,436	3134	6146	626	3480	8524	7604	23
TANDEM								
<12 kip				57		269	526	5
12-18				14		122	307	2
18-24				10		118	433	1
24-30				31		153	680	2
30-32				15		46	226	-
32-34				3		29	38	-
34-36				1		4	9	-
36-38						1		1
38-40								
40-42								
42-44								
44-46								
Total Weighed	0	0	0	131	0	742	2219	11 1/
Total Counted	0	0	0	626	0	4116	13,858	19 2/
Trucks Weighed	652	82	609	131	299	754	1133	6
Trucks Counted	5218	1567	3073	626	1160	4189	7064	11

1/ 3 Tridems Weighed
2/ 5 Tridems Counted

TABLE 3A

TRUCK WEIGHT DATA 1965 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	1001	258	958	92	463	613	407	8
8-12	1	1	142	20	238	382	819	7
12-16	1	-	81	3	141	180	27	1
16-18	1	1	38		93	168	9	
18-20	-		9		7	22	4	
20-22	-					2		
22-24	-					1		
24-26	2							
26-30								
30-35								
Total Weighed	1006	260	1228	115	942	1368	1266	16
Total Counted	11,538	2114	6936	606	3339	7048	8576	40
TANDEM								
<12 kip				54		235	518	8
12-18				15		109	319	3
18-24				8		119	457	2
24-30				20		117	697	4
30-32				15		74	308	1
32-34				3		11	36	
34-36						1	9	
36-38							1	
38-40							-	
40-42							1	
42-44								
44-46								
Total Weighed	0	0	0	115	0	666	2346[1]	18[3]
Total Counted	0	0	0	606	0	3408	15,893[2]	44[4]
Trucks Weighed	503	130	614	115	314	675	1192	9
Trucks Counted	5769	1057	3468	606	1113	3466	8074	22

[1] 2 Tridems Weighed
[2] 8 Tridems Counted
[3] 2 Tridems Weighed
[4] 4 Tridems Counted

TABLE 4A

TRUCK WEIGHT DATA 1966 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	1174	869	780	70	322	441	433	16
8-12		1	104	25	141	293	810	9
12-16		1	63	8	99	122	32	3
16-18		1	23		37	103	15	
18-20			3		1	9		
20-22								
22-24								
24-26								
26-30			1					
30-35								
Total Weighed	1174	872	974	103	600	968	1290	28
Total Counted	11,794	10,008	5716	678	2574	5250	8830	51
TANDEM								
<12 kip				41		195	584	14
12-18				6		80	321	4
18-24				15		85	444	2
24-30				26		82	668	5
30-32				14		31	279	1
32-34				1		2	26	1
34-36						-	1	-
36-38						1	1	-
38-40								-
40-42								-
42-44								-
44-46								1
Total Weighed	0	0	0	103	0	476	2324 1/	28
Total Counted	0	0	0	678	0	2531	15,834 2/	56 3/
Trucks Weighed	587	436	487	103	200	480	1188	14
Trucks Counted	5897	5004	2858	678	858	2578	8106	31

1/ 2 Tridems Weighed
2/ 32 Tridems Counted
3/ 23 Tridems Counted

TABLE 5A

TRUCK WEIGHT DATA 1967 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	1168	284	663	80	244	381	458	10
8-12			111	29	140	258	975	7
12-16			50	6	99	115	47	6
16-18			19		26	86	35	
18-20			7		1	15	2	
20-22						3		
22-24								
24-26								
26-30								
30-35								
Total Weighed	1168	284	850	115	510	858	1517	23
Total Counted	11,590	1736	5388	755	2253	4590	9855	64
TANDEM								
<12 kip				43		159	625	6
12-18				18		105	347	5
18-24				7		55	448	3
24-30				20		68	780	1
30-32				21		22	384	2
32-34				6		7	49	1
34-36						1	7	1
36-38							2	-
38-40							-	-
40-42							1	-
42-44							1	-
44-46								1
Total Weighed	0	0	0	115	0	417	2644	20 2/
Total Counted	0	0	0	755	0	2207	16,850 1/	51 3/
Trucks Weighed	584	142	425	115	170	423	1361	11
Trucks Counted	5795	868	2694	775	751	2251	8728	31

1/ 85 Tridems Counted
2/ 3 Tridems Weighed
3/ 20 Tridems Counted

TABLE 6A

TRUCK WEIGHT DATA 1968 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	746	162	629	84	204	322	387	3
8-12	3	6	106	51	122	263	901	4
12-16	1		67	14	68	115	44	-
16-18			19		25	68	24	1
18-20			3		4	8	1	
20-22						1	1	
22-24						-		
24-26						-		
26-30						1		
30-35								
Total Weighed	750	168	824	149	423	778	1358	8
Total Counted	14,408	2063	5508	1297	2367	5332	11,705	110
TANDEM								
<12 kip				55		154	618	1
12-18				19		84	336	2
18-24				11		66	391	-
24-30				32		61	721	-
30-32				25		9	303	-
32-34				5		1	49	2
34-36				1		2	10	
36-38				-			-	
38-40				-			-	
40-42				-			2	
42-44				1			-	
44-46							1	
Total Weighed	0	0	0	149	0	377	2431	5
Total Counted	0	0	0	1297	0	2466	20,005 1/	66 2/
Trucks Weighed	375	84	412	149	141	383	1244	3
Trucks Counted	7204	1031	2754	1297	789	2566	10,352	44

1/ 45 Tridems Counted
2/ 22 Tridems Counted

TABLE 7A

TRUCK WEIGHT DATA 1969 OTHER MAIN RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	648	128	530	67	220	218	409	8
8-12			82	41	100	194	882	22
12-16			55	18	59	87	74	9
16-18			20	1	26	43	26	3
18-20			3			5	1	
20-22						1		
22-24								
24-26								
26-30								
30-35								
Total Weighed	648	128	690	127	405	548	1392	42
Total Counted	16,324	908	5590	982	2190	4496	11,946	211
TANDEM								
<12 kip				42		113	585	3
12-18				21		67	317	7
18-24				14		51	404	5
24-30				31		29	680	5
30-32				14		9	308	1
32-34				5		5	41	-
34-36							3	1
36-38							-	-
38-40							2	-
40-42							-	-
42-44							-	-
44-46							1	1
Total Weighed	0	0	0	127	0	274	2341 1/	23 3/
Total Counted	0	0	0	982	0	2166	20,257 2/	100 4/
Trucks Weighed	324	64	345	127	135	274	1215	15
Trucks Counted	8162	454	2795	982	730	2207	10,497	73

1/ 1 Tridem Weighed
2/ 23 Tridems Counted
3/ 2 Tridems Weighed
4/ 27 Tridems Counted

TABLE 8A

TRUCK WEIGHT DATA 1965 INTERSTATE RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	12	2	53	3	65	103	60	0
8-12			6	4	20	68	103	
12-16			8		14	36	16	
16-18			2		9	18	6	
18-20			-		3	1	1	
20-22			1					
22-24								
24-26								
26-30								
30-35								
Total Weighed	12	2	70	7	111	226	186	0
Total Counted	712	136	724	81	954	1946	2499	0
TANDEM								
<12 kip				1		43	80	
12-18				2		15	30	
18-24				1		12	62	
24-30				-		29	68	
30-32				3		7	55	
32-34						1	3	
34-36							-	
36-38							-	
38-40							-	
40-42							2	
42-44							1	
44-46							1	
Total Weighed	0	0	0	7	0	107	302	0
Total Counted	0	0	0	81	0	921	4043	0
Trucks Weighed	6	1	35	7	37	110	158	0
Trucks Counted	356	68	362	81	318	947	2117	0

TABLE 9A

TRUCK WEIGHT DATA 1966 INTERSTATE RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	162	95	174	20	96	224	321	1
8-12		-	36	8	71	122	429	5
12-16		1	18		49	62	96	1
16-18			6		15	52	23	
18-20			3		3	9	2	
20-22			1			3		
22-24						2		
24-26								
26-30								
30-35								
Total Weighed	162	96	238	28	234	474	871	7
Total Counted	1580	598	1416	205	1383	3564	6743	6
TANDEM								
<12 kip				12		85	262	1
12-18				10		32	134	3
18-24				1		41	216	-
24-30				3		37	368	6
30-32				2		22	243	
32-34						3	60	
34-36						1	7	
36-38							2	
38-40								
40-42								
42-44								
44-46								
Total Weighed	0	0	0	28	0	221	1292	10 2/
Total Counted	0	0	0	205	0	1740	10,582 1/	12 3/
Trucks Weighed	81	48	119	28	78	229	691	5
Trucks Counted	790	299	708	205	461	1761	5584	6

1/ 13 Tridems Counted
2/ 3 Tridems Weighed
3/ 6 Tridems Counted

TABLE 10A

TRUCK WEIGHT DATA 1967 INTERSTATE RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	68	6	91	14	33	90	145	1
8-12			23	2	12	60	228	6
12-16			11		11	33	51	2
16-18			5		-	20	25	2
18-20			2		1	9	2	
20-22			-			1	2	
22-24			2			2	2	
24-26						1		
26-30								
30-35								
Total Weighed	68	6	134	16	57	216	455	11
Total Counted	1884	240	1208	185	1011	2650	5933	24
TANDEM								
<12 kip				12		27	118	-
12-18				-		20	82	5
18-24				2		22	78	1
24-30				1		20	177	-
30-32				1		4	103	-
32-34						5	67	-
34-36						2	25	-
36-38						1	3	-
38-40						1	1	-
40-42							-	1
42-44							-	-
44-46							1	1
Total Weighed	0	0	0	16	0	102	655	8 2/
Total Counted	0	0	0	185	0	1277	9179 1/	20 3/
Trucks Weighed	34	3	67	16	19	105	353	5
Trucks Counted	942	120	604	185	337	1301	4871	12

1/ 64 Tridems Counted
2/ 3 Tridems Weighed
3/ 8 Tridems Counted

TABLE 11A

TRUCK WEIGHT DATA 1968 INTERSTATE RURAL

Axle Load Range	SINGLE UNIT TRUCKS Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	347	102	236	35	123	151	367	6
8-12	-		58	13	47	120	574	11
12-16	1		22	-	48	43	46	3
16-18			8	1	4	33	24	
18-20			1	-		5	5	
20-22			2	-				
22-24			-	-				
24-26			1	-				
26-30				-				
30-35				1				
Total Weighed	348	102	328	50	222	352	1016	20
Total Counted	4368	604	3408	459	2217	3420	9353	107
TANDEM								
<12 kip				31		71	417	-
12-18				8		30	211	4
18-24				3		36	253	2
24-30				4		20	414	2
30-32				2		10	288	
32-34				2		1	44	
34-36							6	
36-38							5	
38-40							1	
40-42							1	
42-44							2	
44-46							2	
Total Weighed	0	0	0	50	0	168	1644 1/	8
Total Counted	0	0	0	459	0	1646	14,672 2/	39 3/
Trucks Weighed	174	51	164	50	74	172	861	6
Trucks Counted	2184	302	1204	459	739	1678	7761	32

1/ 1 Tridem Weighed
2/ 108 Tridems Counted
3/ 7 Tridems Counted

TABLE 12A

TRUCK WEIGHT DATA 1969 INTERSTATE RURAL

Axle Load Range	SINGLE UNIT TRUCKS: Panel & Pickup	2 Axle 4 Tire	2 Axle 6 Tire	3 Axle	MULTIPLE UNIT TRUCKS: 3 Axle	4 Axle	5 Axle	6 Axle
SINGLE								
<8 kip	242	45	279	24	120	137	357	10
8-12		1	56	16	83	120	602	20
12-16			32	1	48	58	79	10
16-18			6		9	28	29	
18-20			-		1	8	2	
20-22			1			-		
22-24						1		
24-26								
26-30								
30-35								
Total Weighed	242	46	374	41	261	352	1069	40
Total Counted	6360	432	2878	360	1902	3440	9948	150
TANDEM								
<12 kip				22		63	423	1
12-18				9		45	214	7
18-24				3		26	235	4
24-30				6		26	386	1
30-32				1		11	261	
32-34						2	30	
34-36						1	4	
36-38							3	
38-40							2	
40-42								
42-44								
44-46								
Total Weighed	0	0	0	41	0	174	1558	13
Total Counted	0	0	0	360	0	1656	14,955 1/	71 2/
Trucks Weighed	121	23	187	41	87	175	837	11
Trucks Counted	3180	216	1439	360	634	1688	7976	52

1/ 22 Tridems Counted
2/ 20 Tridems Counted

APPENDIX B

AXLE EQUIVALENCY FACTORS USED IN VEF CALCULATIONS

Axle Load Range	18k Single Axle Load Equivalency Factor			
	Rigid Pavement		Flexible Pavement	
	p = 2.0	p = 2.5	p = 2.0	p = 2.5
Single Axles				
<8 kip	0.0060	0.0060	0.0061	0.0083
8-12	0.1780	0.1830	0.1750	0.1967
12-16	0.6030	0.6100	0.6017	0.6217
16-18	1.0000	1.0000	1.0000	1.0000
18-20	1.5720	1.5520	1.5800	1.5333
20-22	2.3630	2.3020	2.3917	2.2667
22-24	3.4370	3.3000	3.5000	3.2433
24-26	4.8480	4.5930	4.9767	4.5183
26-30	8.9900	8.3050	9.3667	8.2317
30-35	17.5300	15.8330	18.6350	15.9750
Tandem Axles				
<12 kip	0.0300	0.0300	0.0133	0.0167
12-18	0.1330	0.1380	0.0750	0.0867
18-24	0.4430	0.4520	0.2417	0.2667
24-30	1.1370	1.1300	0.6283	0.6583
30-32	1.4900	1.4730	0.8267	0.8533
32-34	1.9370	1.8900	1.0733	1.0883
34-36	2.4670	2.3880	1.3800	1.3800
36-38	3.1030	2.9800	1.7383	1.7133
38-40	3.8580	3.6730	2.1717	2.1133
40-42	4.7500	4.4880	2.6867	2.5783
42-44	5.7970	5.4300	3.2900	3.1183
44-46	7.0100	6.5130	3.9983	3.7467

APPENDIX C

VEF ADJUSTMENTS FOR CLASS III AND IV ROADS

TABLE 1C

VEF ADJUSTMENTS FOR CLASS III AND IV ROADS

SINGLE UNITS
RIGID PAVEMENT

Year	Road Class	Percent of Single Units		Equivalency Factor		Single Unit Equivalency Factor[1/]
		2 Axle	3 Axle	2 Axle	3 Axle	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1963	III	94.4	5.6	0.080	0.470	0.102
	IV	96.2	3.8	0.080	0.470	0.095
1964	III	94.1	5.9	0.062	0.618	0.095
	IV	95.4	4.6	0.062	0.618	0.088
1965	III	94.7	5.3	0.096	0.552	0.120
	IV	95.6	4.4	0.096	0.552	0.116
1966	III	93.8	6.2	0.073	0.777	0.117
	IV	95.2	4.8	0.073	0.777	0.107
1967	III	93.2	6.8	0.066	0.712	0.110
	IV	94.0	6.0	0.066	0.712	0.105
1968	III	93.1	6.9	0.066	0.811	0.117
	IV	92.5	7.5	0.066	0.811	0.112
1969	III	93.4	6.6	0.063	0.759	0.109
	IV	93.9	6.1	0.063	0.759	0.106
Average (1963-1969)	III					0.110
	IV					0.106

1/ $$\text{S.U.E.F.} = \frac{(\text{Col. 3} \times \text{Col. 5}) + (\text{Col. 4} \times \text{Col. 6})}{100}$$

TABLE 2C

VEF ADJUSTMENTS FOR CLASS III AND IV ROADS

MULTIPLE UNITS
RIGID PAVEMENT

Year (1)	Road Class (2)	Percent of Multiple Units: 3 Axle (3)	4 Axle (4)	5 Axle (5)	Equivalency Factor: 3 Axle (6)	4 Axle (7)	5 Axle (8)	Multiple Unit Equivalency Factor 1/ (9)
1963	III	15.0	46.9	38.1	0.686	1.115	1.410	1.163
	IV	23.7	48.0	28.3	0.686	1.115	1.410	1.096
1964	III	13.0	40.8	46.2	0.677	1.105	1.425	1.197
	IV	18.8	42.0	39.2	0.677	1.105	1.425	1.150
1965	III	11.6	37.1	51.3	0.753	1.100	1.502	1.266
	IV	9.5	39.3	51.2	0.753	1.100	1.502	1.273
1966	III	9.5	29.0	61.5	0.638	0.930	1.415	1.201
	IV	11.8	31.2	56.9	0.638	0.930	1.415	1.170
1967	III	8.2	25.2	66.6	0.667	0.954	1.550	1.327
	IV	5.9	24.5	69.6	0.667	0.954	1.550	1.353
1968	III	7.7	21.2	71.1	0.672	0.900	1.505	1.313
	IV	11.6	23.2	65.2	0.672	0.900	1.505	1.269
1969	III	5.7	17.1	77.2	0.607	0.857	1.496	1.336
	IV	16.5	23.3	60.2	0.607	0.857	1.496	1.201
Average (1963-1969)	III							1.258
	IV							1.216

1/ $\text{M.U.E.F.} = \dfrac{(\text{Col. 3} \times \text{Col. 6}) + (\text{Col. 4} \times \text{Col. 7}) + (\text{Col. 5} \times \text{Col. 8})}{100}$

TABLE 3C

VEF ADJUSTMENTS FOR CLASS III ROADS

SINGLE UNITS
FLEXIBLE PAVEMENT

Year (1)	Road Class (2)	Percent of Single Units 2 Axle (3)	Percent of Single Units 3 Axle (4)	Equivalency Factor 2 Axle (5)	Equivalency Factor 3 Axle (6)	Single Unit Equivalency Factor 1/ (7)
1963	III	96.3	3.7	0.080	0.281	0.087
1964	III	94.1	5.9	0.070	0.363	0.087
1965	III	96.3	3.7	0.088	0.299	0.096
1966	III	94.3	5.7	0.066	0.474	0.089
1967	III	96.2	3.8	0.066	0.432	0.080
1968	III	93.0	7.0	0.066	0.502	0.097
1969	III	95.9	4.1	0.063	0.488	0.080
Average (1963-1969)						0.088

1/ $$\text{S.U.E.F.} = \frac{(\text{Col. 3} \times \text{Col. 5}) + (\text{Col. 4} \times \text{Col. 6})}{100}$$

TABLE 4C

VEF ADJUSTMENTS FOR CLASS III ROADS

MULTIPLE UNITS
FLEXIBLE PAVEMENT

Year	Road Class	Percent of Multiple Units			Equivalency Factor			Multiple Unit Equivalency Factor[1]
		3 Axle	4 Axle	5 Axle	3 Axle	4 Axle	5 Axle	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1963	III	19.5	48.7	31.8	0.685	0.880	0.836	0.828
1964	III	13.9	42.8	43.3	0.674	0.864	0.854	0.833
1965	III	12.8	36.9	50.3	0.749	0.873	0.893	0.867
1966	III	9.1	35.3	55.6	0.635	0.743	0.847	0.791
1967	III	7.6	21.5	70.9	0.664	0.775	0.935	0.880
1968	III	8.9	20.5	70.6	0.669	0.724	0.917	0.855
1969	III	9.1	22.3	68.6	0.605	0.707	0.913	0.839
Average (1963-1969)	III							0.842

1/ $$\text{M.U.E.F.} = \frac{(\text{Col. 3} \times \text{Col. 6}) + (\text{Col. 4} \times \text{Col. 7}) + (\text{Col. 5} \times \text{Col. 8})}{100}$$