COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS
FRANKFORT, KENTUCKY 40601

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COMMISSIONER OF HIGHWAYS

November 22, 1972

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H.2.24

MEMORANDUM TO: J. R. Harbison
State Highway Engineer
Chairman, Research Committee

FROM: Jas. H. Havens
Director
Division of Research

SUBJECT: Research Report 339; "Accidents on Rural Interstate and Parkway Roads and Their Relation to Pavement Friction"; KYHPR-64-24; HPR-1(8), Part II.

Our recent report on the "Skid Resistance of Pavements" related the performance of types of surfaces from the standpoint of time and traffic. During 1971, we purposefully made close-interval skid tests over the entire interstate and parkway systems. These measurements, together with computerized, accident reporting and retrieval procedures now provided by the Department of Public Safety and traffic counts provided by the Division of Planning, made it possible for the first time to determine relationships between accident frequencies and skid resistance -- on a grand scale. The fact that accidents increase as pavements become slippery is a priori; but the question, How slippery can a pavement become before it is considered unsafe? has been a matter of contention for many years. We have studied many so-called high-accident sites and associated them with skid measurements. Somewhat intuitively, we have advocated coefficients of friction of 0.40 (40-mph value) and have considered values in the order of 0.40 as being critical. Speeds have increased, and it seemed necessary to test at high speeds, also.

On the basis of the analyses made, it appears that disproportionate increases in accident rates should be expected when the 70-mph skid resistance, SN_{70}, falls below 26. This is equivalent to a PSN_{70} of about 50 and an SN_{40} of about 40.

The use of 1970 accident data with 1971 friction measurements and 1969 traffic volumes was expedient to the analysis. The analysis is being checked against later statistics.

It is somewhat reassuring to know that the results obtained here are in close agreement with findings from studies in Virginia and Tennessee -- although the methods differed.

The FHWA has recently advanced a proposal to establish minimum levels of skid resistance as a requirement of compliance (in the form of a PPM). Surely our report will have direct bearing on pending decisions -- whether minimums are to be considered as advisory or as requirements. The challenge, of course, is to achieve a due margin of safety.

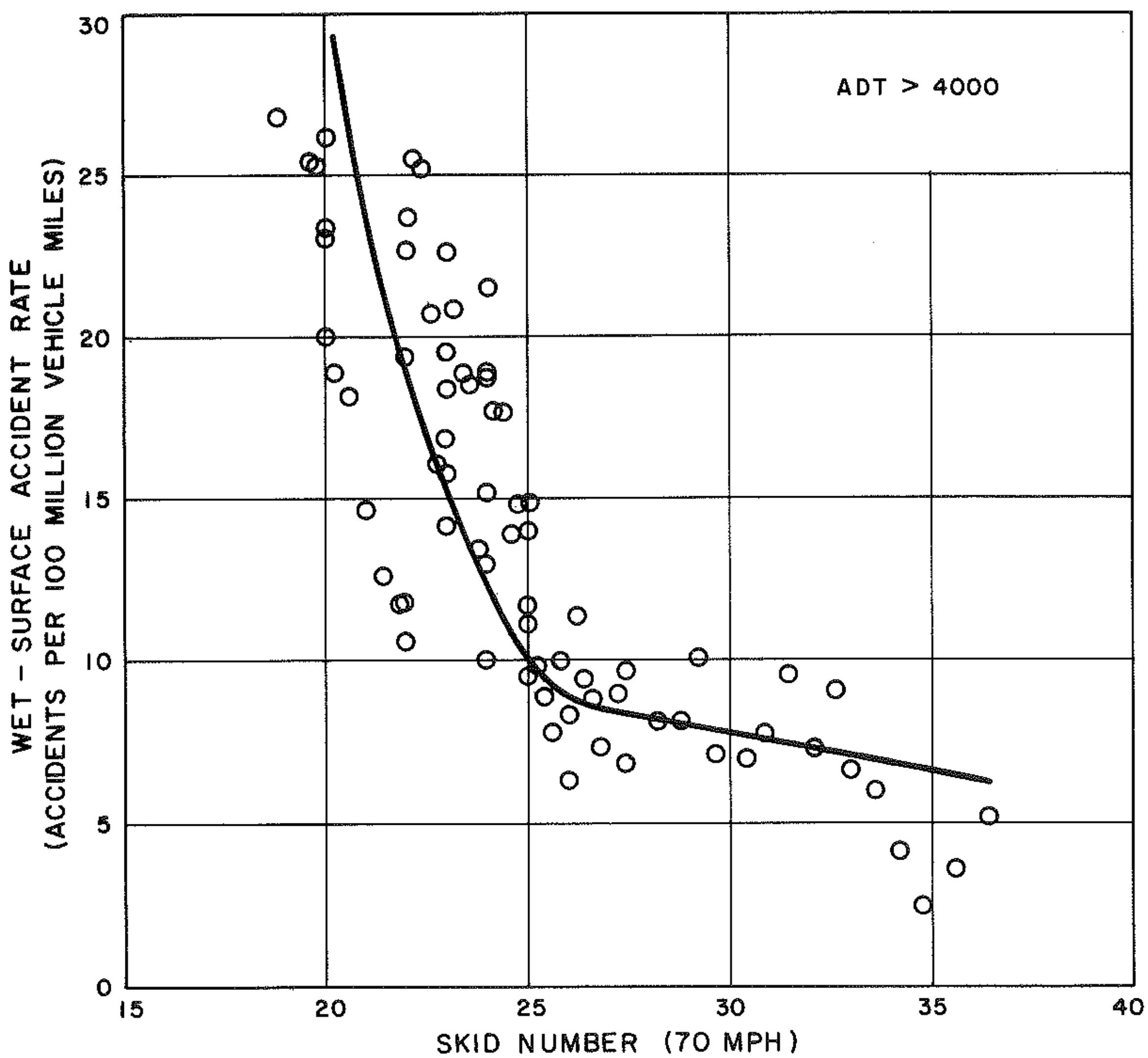
Respectfully submitted,

Jas. H. Havens
Director of Research

JHH:dw
Attachments
cc's: Research Committee

ADDENDUM

After this report was being reproduced, preliminary results from analyses using accident rates calculated for the two-year period 1970-1971 became available. The graph appended hereto shows a confirming relationship between wet-weather accident rates and 70-mph Skid Numbers. The graph is specific for ADT's greater than 4000 vehicles per day; it may be compared directly with Figure 19 in the report. Eventually, 1972 accident data will be added; and attempts will be made to explain variances by inspection of the sites.



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16. Abstract

Friction measurements were made with a skid trailer at 70 mph on 820 miles of rural, four-lane, controlled-access routes on the interstate and parkway systems in Kentucky. These facilities were subdivided into test sections and half-mile sites. Accident experience, friction measurements and traffic volumes were obtained for each subdivision.

The expression of accident occurrence which correlated best with skid resistance was wet-surface accidents per 100 million vehicle miles. There was a definite trend exhibiting a rapid decrease of accidents with increasing Skid Number (70 mph) to 26 ± 1; thereafter, with increasing Skid Numbers, the rate of decrease was considerably lessened. This trend was developed using test-section data and verified using half-mile sites. Analysis of Peak Slip Numbers and accident occurrences indicated similar trends to those developed with Skid Numbers.

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Research Report
339

ACCIDENTS ON RURAL INTERSTATE AND PARKWAY ROADS AND THEIR RELATION TO PAVEMENT FRICTION

INTERIM REPORT
KYHPR-64-24, HPR 1(8), Part II

by

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DEPARTMENT OF HIGHWAYS
Commonwealth of Kentucky

in cooperation with the
U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

September 1972

INTRODUCTION

To assure safety of highway travel in wet weather, pavements must be designed, constructed, and maintained with sufficiently high skid resistance to enable drivers to perform "normal" driving tasks and maneuvers without risk of skidding and/or loss of vehicle control. In emergency situations, a driver may be compelled to brake hard and, with conventional braking systems, may experience skidding regardless of how skid resistant the pavement may be. Anti-locking brake systems minimize the risks of skidding and permit the driver to retain directional control of the vehicle. With or without such systems, a vehicle will slip, with potential loss of control, when the demand for braking force exceeds the tractive force. As friction (traction) is increased, maximum permissable deceleration is also increased, thereby increasing a driver's chances of avoiding collision or skidding off the road. Wet pavements ideally should have the highest possible friction, preferably equal to that of dry pavements. In a practical and realistic sense, however, the question remains as to what minimum level of friction a pavement should provide to safeguard the public from undue hazards associated with driving on wet pavements. Surely, excellence is to be sought; little satisfaction derives from maintaining a friction level at the established minimum. The minimum requirement, however, may serve as an indicator of slippery roadways and may provide criteria for design of surface courses and for posting speed restrictions, etc.

Investigators elsewhere have not been altogether successful in establishing minimum friction requirements. Efforts to do so generally fall into two categories: 1) studies of driver behavior and, therefore, frictional demands attending driving tasks, and 2) analysis of accident data and accident experience as related to pavement friction. Studies in the first category represent a logical approach but involve extensive monitoring of representative driver populations under realistic roadway conditions and situations. Interpretations as to what constitutes "normal" as opposed to "emergency" reactions or situations present a problem. Friction factors thus derived cannot easily be related to skid resistance measured with conventional testers (such as trailers) operated under prescribed procedures and conditions of test.

Accident rates have been recognized as being higher on wet than on dry surfaces; many statistics are available to support this intuitive conclusion. Furthermore, research has shown that accident rates tend to increase as wet skid resistance diminishes. This relationship is now considered to be intuitive and *a priori*. However, the interaction of many contributing factors such as roadway geometrics, traffic characteristics, driver behavior, etc. together with uncertainties concerning reliability and availability of accident data, type of friction measurements, and type of analysis have heretofore obscured relationships between accident rates and wet skid-resistance measurements.

The primary objective of this study was to discern a relationship between accident experience and pavement friction for rural, four-lane, controlled access roads on the interstate and parkway systems in Kentucky. These highways were purposely chosen for this initial analysis because many of the usually confounding variables could be assumed to have minimal influence. A similar study of other rural routes is planned. Subsequent evaluations of such a relationship in conjunction with economical and technical considerations will assist in the establishment of acceptable minimum levels of friction.

To define a relationship between accidents and skid resistance, the effect of all other parameters must be known or held constant insofar as possible. By limiting the study to rural, four-lane, interstate and parkway facilities, some of the parameters, such as road geometrics, access control and speed, may be assumed to remain reasonably constant. Traffic characteristics (volume and density) and pavement surface conditions (wet or dry, and available friction when wet) could be rather readily considered as variables.

Data were accumulated in three categories. Annual average daily traffic volumes were obtained for 1969. Accident data were those reported during the calendar year 1970. Pavement friction measurements were made between June and October 1971 on 814 miles of the interstate and parkway systems. Measurements were obtained for both locked-wheel skid resistance and peak slip resistance. Skid resistance reaches a maximum somewhere between 10 and 20 percent of tire slip (apparent, may not be true slip) on the pavement. This peak resistance is often referred to as incipient friction and exceeds the resistance measured by the locked-wheel method. Therefore, both locked-wheel skid resistance and peak slip resistance at various speeds -- or some other type of measurement -- may be needed to fully characterize pavements. The measurement(s) which best correlate(s) with accidents remains to be established.

PAST STUDIES

In Great Britain, Giles *(1)* and Sabey *(2)* noted that the percentage of wet-road accidents involving skidding correlated linearily with skid-resistance (Figure 1) as measured with the British Portable Tester. Minimum acceptable friction levels, based in part on this correlation, were recommended. Those recommendations of minimim skid resistance were: 1) 55 for tangent, level roads and 2) 65 for curves, intersections, grades, and roundabouts.

Minimum friction requirements (Table 1), as measured with the skid trailer (locked-wheel) for different mean traffic speeds, were proposed by Kummer and Meyer *(3)*. In that study, driver behavior and skidding accidents were correlated with pavement friction. However, recommended minimum Skid Numbers (SN) were based on driver behavior only and were intended to satisfy tractional demands for normal vehicle maneuvers, encompassing all driving, cornering, and braking maneuvers performed by a

TABLE 1

RECOMMENDED MINIMUM INTERIM SKID NUMBERS[a]
(From Reference 3)

MEAN TRAFFIC SPEED, V(MPH)	SKID NUMBER	
	SN[b]	SN[c]
0	60	--
10	50	--
20	40	--
30	36	31
40	33	33
50	32	37
60	31	41
70	31	46
80	31	51

a Skid Number measured in accordance with ASTM E-274 Method of test.

b SN - Skid Number measured at mean traffic speed.

c SN_{40} - Skid Number, measured at 40 mph, including allowances for Skid Number reduction with speed using a mean gradient of G = 0.5 SN/mph.

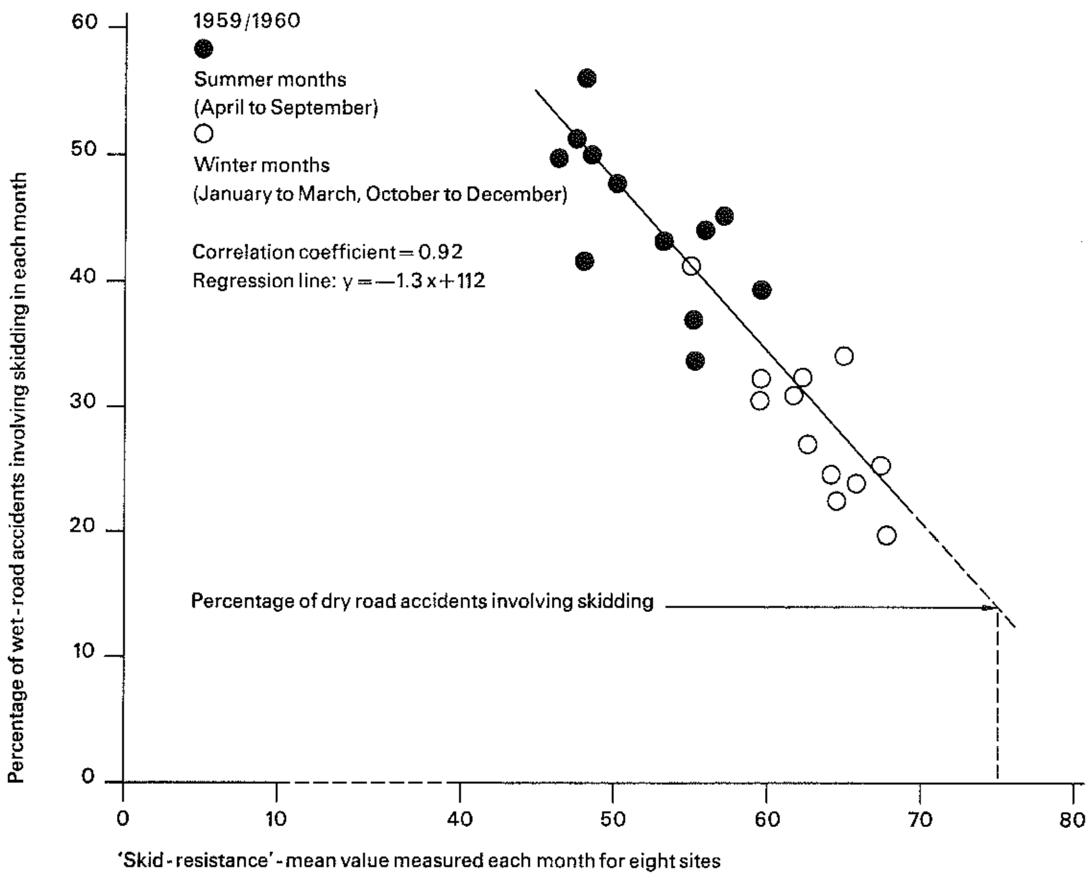

Figure 1. Relationship Found in Great Britain between Monthly Frequency of Wet-Road Accidents Involving Skidding and the Mean Skidding Resistance in the Month Concerned (from **Skidding Accidents**, Institute for Road Safety Research SWOV, The Netherlands, 1970).

majority of drivers under normal traffic conditions. Kummer and Meyer also recommended that friction measurements be made at the mean traffic speed, thus eliminating uncertainties of using predetermined skid resistance-speed gradients to extrapolate skid resistance values to other speeds.

McCullough and Hankins *(4)* studied skid resistance and accidents to set guidelines for surface improvements on Texas highways. They investigated 517 road sections and measured skid resistance with a trailer at speeds of 20 and 50 mph. Accidents were expressed in terms of both fatal and injury accidents per 100 million vehicle miles as well as total accidents (including property damage accidents) per 100 million vehicle miles. McCullough and Hankins also considered measures of accidents in other terms but indicated three reasons for choosing the final expressions:

1. Virtually no differences were observed in the preliminary investigation using the different measures of accidents - i.e. total accidents, wet-road accidents, or skidding accidents.
2. Classification of accident data so as to obtain the other measures of accidents was time consuming, and the number of skidding accidents was unreliable because it was difficult to determine a skidding accident from available accident statistics.
3. Fatal and injury accidents were selected to avoid incomplete reporting of accidents since these were virtually always reported.

From graphs of accidents per 100 million vehicle miles versus coefficient of friction (such as Figures 2 and 3), McCullough and Hankins concluded that, even though there was a wide scatter of points, the data indicated accidents were, in general terms, inversely proportional to the coefficient of friction. Similar trends and observations were determined by comparing both fatal and injury accident rates with coefficient of friction. Based on these findings, McCullough and Hankins recommended minimum friction levels of 0.40 at a speed of 20 mph and 0.30 at 50 mph.

Mahone and Runkle *(5)* studied 521 road sections and 2,727 accidents on 313 miles of interstate highways in Virginia to determine relationships between the percentage of wet accidents and Predicted Stopping Distance Number (PSDN). Friction measurements were made with a skid trailer (locked-wheel) at 40 mph and were converted to PSDN by correlation. Accidents were expressed as a ratio of wet-surface accidents to total accidents (including property damage accidents) (Figure 4). Two reasons were cited in justification of the choice of this ratio as a measure of accidents:

1. It was undesirable to be limited to the use of skidding accident statistics, since inadequate friction could promote accidents not involving skidding.
2. It is sometimes impossible to determine from accident reports if skidding was a major contributing factor.

Mahone and Runkle observed that, in most cases, the percent of wet accidents decreased as the

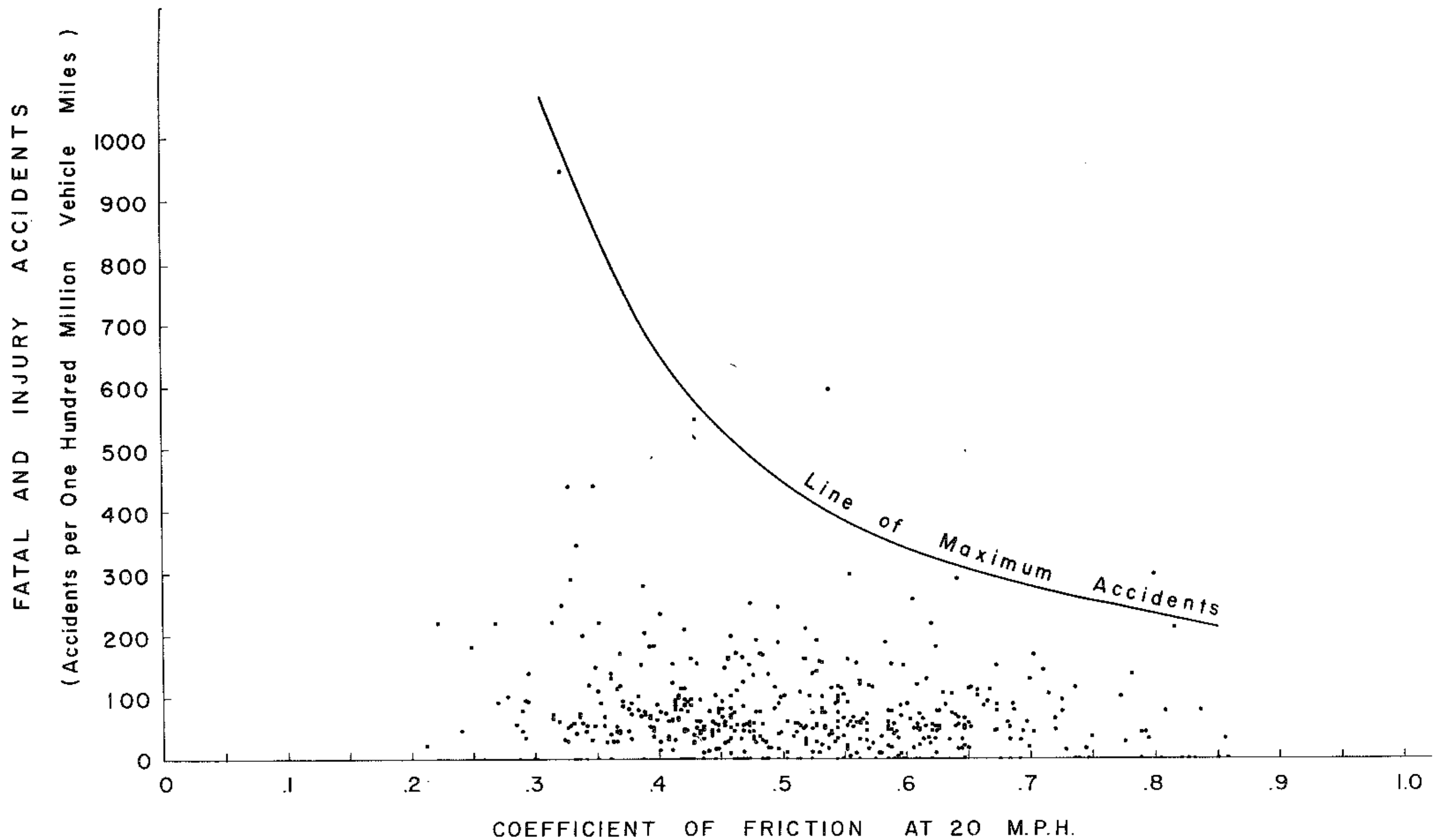

Figure 2. Comparison of Total Accidents and Coefficient of Friction at 20 mph (from Reference 4).

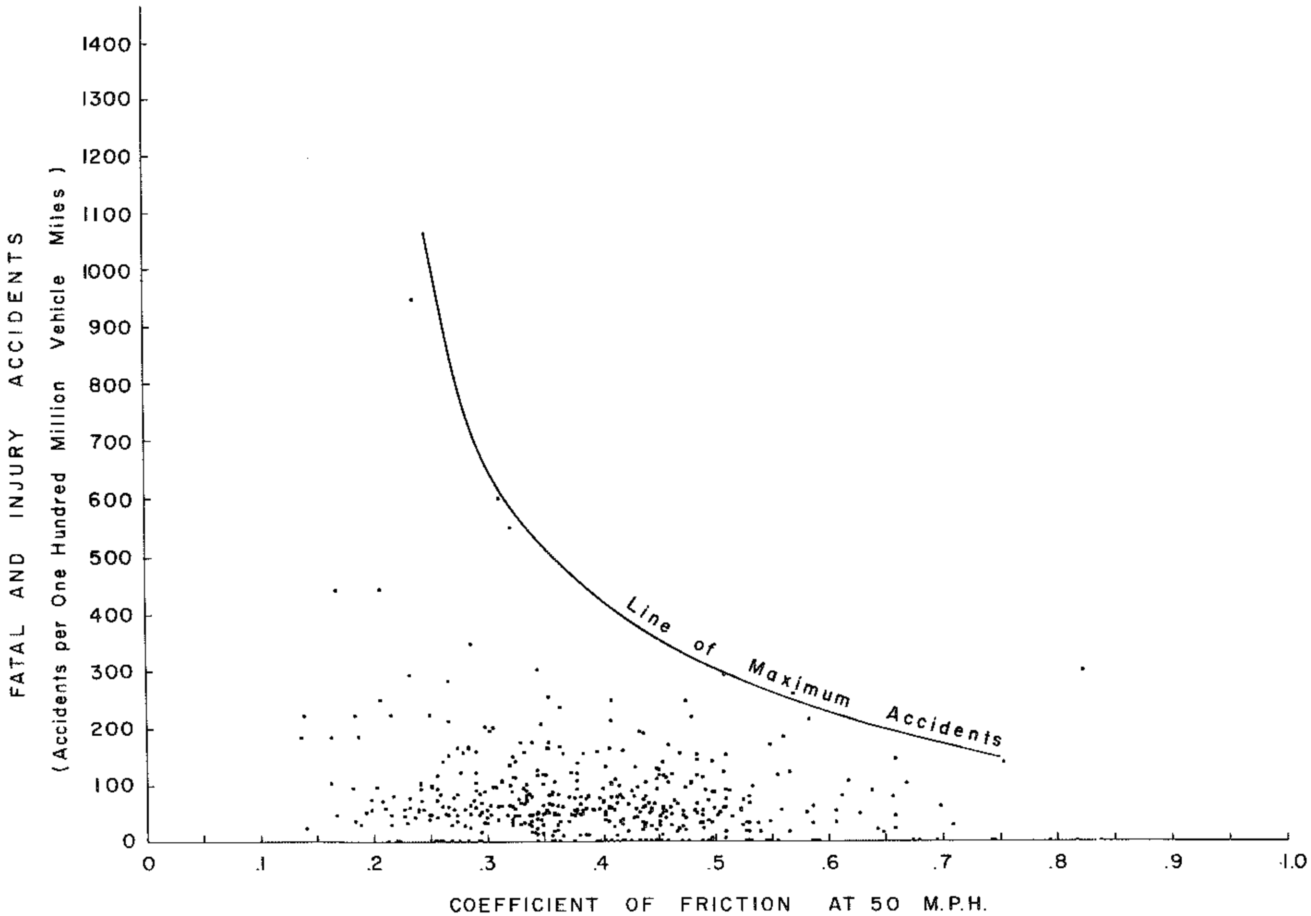

Figure 3. Comparison of Total Accidents and Coefficient of Friction at 50 mph (from Reference 4).

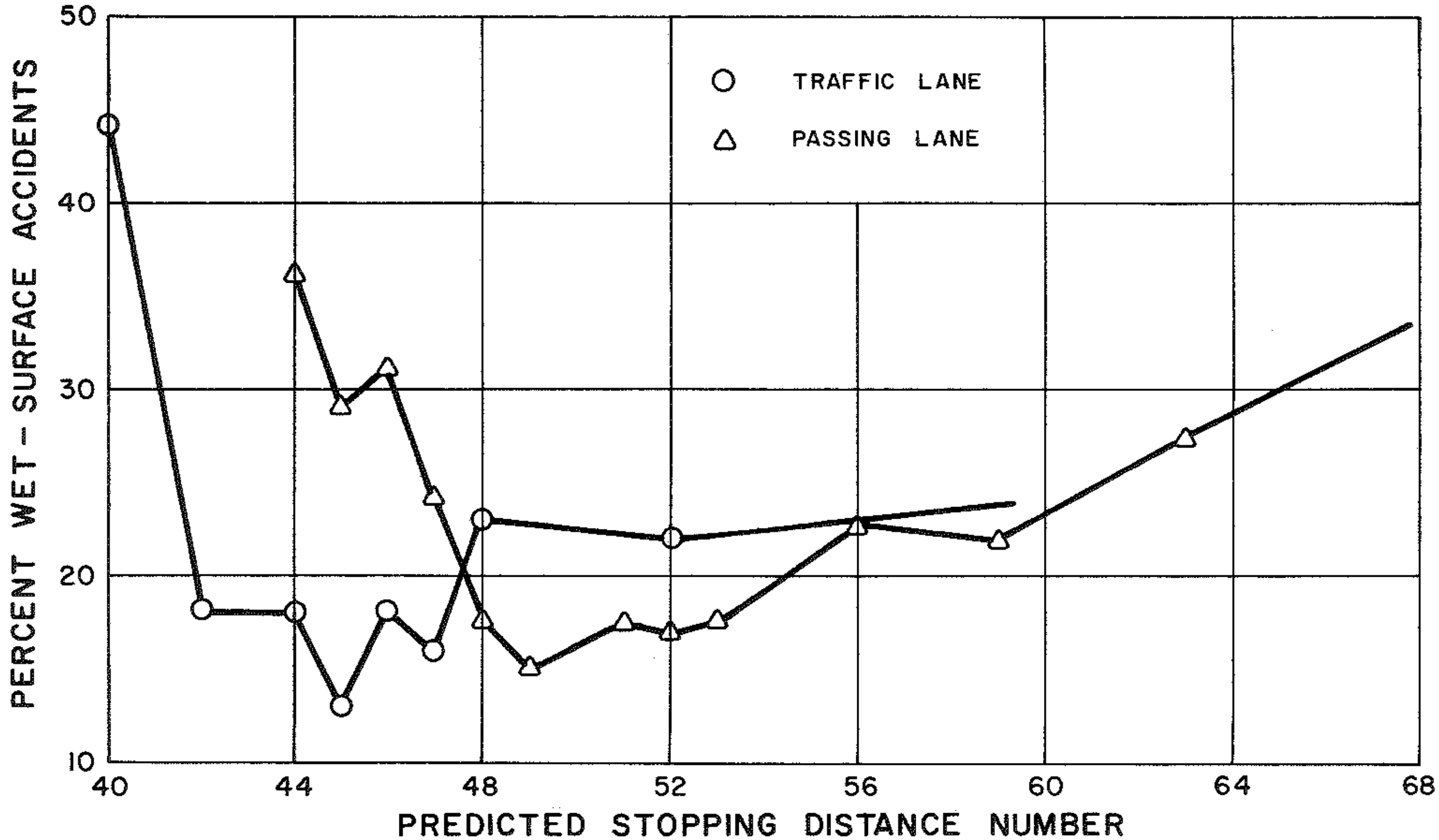

Figure 4. Comparison of Percent Wet-Surface Accidents with Predicted Stopping Distance Number for Traffic and Passing Lanes (from Reference 5).

PSDN increased and that, if volume was a factor, apparently the percent of wet accidents was lower with increased volumes, on the average. From these data, they concluded that for interstate roadways with a mean traffic speed of 65 to 70 mph the minimum PSDN should be 42 for the through lane and 48 for the passing lane.

Moore and Humphreys *(6)* studied 75 high-accident sites (each one-half mile long) in Tennessee. The sites involved 450 accidents in 1967. Skid-test (trailer) measurements were made in 1969, 1970 and 1971, and the analysis was based on 40-mph test data. Percentages of wet-pavement accidents were related to coefficient of friction. They concluded that accident reports do not adequately indicate whether skid resistance is a significant factor in a particular accident. However, pavements with coefficients of friction of 0.41 and less have almost twice as many wet-pavement accidents than surfaces with higher skid resistances. It was recommended that the minimum acceptable level of skid resistance should be a coefficient of friction of 0.40, as measured by the locked-wheel skid tester at 40 mph.

In instances where speeds and/or highway facilities were comparable, minimum levels of friction recommended by different investigators have been in general agreement. For a mean traffic speed of 70 mph, Kummer and Meyer *(3)* recommended a Skid Number of 46 at 40 mph. Mahone and Runkle *(5)* provided a means of converting measured PSDN to SN at 40 mph. Using an assumed speed gradient of 0.5 SN per mph, they recommended 40-mph SN test values of 40 for traffic lanes and 47 for passing lanes on facilities to be traveled at speeds of 65 or 70 mph. Moore and Humphreys *(6)* suggested a minimum coefficient of friction of 0.40 (SN = 40) when measured at 40 mph for highways with posted speeds of 50 mph and higher. McCullough and Hankins *(4)* recommended a minimum coefficient of friction of 0.30 (SN = 30) at test speeds of 50 mph, and this is approximately equivalent to a Skid Number of 35 at 40 mph (speed gradient of 0.5 SN per mph). Unfortunately, McCullough and Hankins did not measure mean traffic speeds. If mean speeds were 50 mph, their Skid Number agrees closely with the recommendation by Kummer and Meyer, i.e., a Skid Number of 37.

In normal driving, the vehicle operates in the non-slip and cornering modes. Slip resistance reaches a maximum somewhere between 10 and 20 percent of tire slip (apparent, may not be a true slip) on the pavement. This peak resistance is referred to as incipient friction. It exceeds the resistance measured by the locked-wheel method. Therefore, both locked-wheel skid resistance and peak-slip resistance at various speeds -- or some other type of measurement -- may be needed to fully characterize the skid resistance of pavements. Measurements which best correlate with accidents remain to be established.

Efforts to determine minimum frictional demands based on driver behavior studies are being pursued by the Franklin Institute. The study is being sponsored by the National Cooperative Highway Research

Program, Highway Research Board, under NCHRP Project 1-12(1) entitled "Pavement Friction Coefficients in Driving Tasks". A final report on the study is under review by NCHRP. Findings should greatly enhance the understanding of minimum frictional requirements for normal driving tasks under various roadway geometrics, speeds, etc.

DATA AQUISITION AND COLLATION

Traffic Volumes

Since traffic volumes vary with time, any measurement of volume not obtained at the time and location of an accident would not precisely represent the volume associated with the accident. In studies such as this, which cover a system throughout a state, that type of volume measurement is highly impractical. The measurement of traffic volume which is generally available is an annual average daily traffic (ADT). The latest ADT data available at the time of this study was for 1969; these were used in these analyses.

Friction Measurements

Friction measurements were obtained using a Surface Dynamics Pavement Friction Tester (Model II) developed by the General Motors Proving Ground and manufactured by K. J. Law Engineers, Inc., Detroit, Michigan. This skid trailer complies with ASTM E 274-70 *(7)*. The measurements represent friction developed between a standard test tire (ASTM E249-66 *(8)*) and a wetted pavement. The locked-wheel measurements are expressed as Skid Numbers (SN); incipient or peak friction is expressed as Peak Slip Number (PSN). A description of the skid trailer and procedures applicable to the method of test were presented in a previous report *(9)*.

Measurements were obtained during the summer of 1971 on all rural, four-lane, interstate and parkway routes in Kentucky having a posted speed limit of 70 mph. Tests were made in the left wheel path only and at one-mile intervals in each lane; no less than five tests per lane were made on each construction project. The basic test speed was 70 mph. Additional tests were conducted on selected pavements at 40 mph. Comparison between the Skid Numbers obtained at the two speeds are presented in Figure 5.

Accident Information

Accident data were obtained from computerized records maintained by the Department of Public Safety. The source for these files were State Police records. All accidents reported during the calendar year 1970 were analyzed. Information available from the computer files for each accident is detailed in APPENDIX A. A summary of all accidents on rural, interstate and parkway routes is presented in Table 2. Accidents totaled 2825 -- of which 2803 occurred on four-lane roadways. The accident rate for rural, four-lane routes averaged 98 accidents per 100 million vehicle miles. This was comparable to a nationwide average of 94 accidents per 100 million vehicle miles on the same type of facility during the same year *(10)*.

From these accident records, many expressions of accident occurrence may be calculated. Rates of wet-surface accidents, dry-surface accidents, fatal and injury accidents, and total (including property damage accidents) are commonly calculated. Expressions used in other investigations have included 1) ratio of wet- to dry-surface accidents, 2) ratio of wet-surface to total accidents, 3) wet-surface accidents per 100 million vehicle miles, 4) total accidents per 100 million vehicle miles, and 5) fatal and injury accidents per 100 million vehicle miles.

Test Sections

A test section is defined as "a section of pavement of uniform age and uniform composition which has been subjected to essentially uniform wear along its length" *(7)*. Almost all construction projects fit this definition. In a few cases, the projects were subdivided so that the "test sections" reflected uniform traffic and skid resistance throughout their lengths. Inasmuch as the direction of travel for a vehicle involved in an accident was not given in the accident reports, sections included both directions of travel. There were 122 test sections. These are presented in APPENDIX B along with 1969 ADT's and other relevant data.

On four-lane roadways, most traffic travels in the outer lanes (approximately 80-85 percent), and a large percentage of maneuvers begin or terminate there. The outer lane, left wheel-path Skid Numbers were selected, therefore, to characterize the skid resistance of the test sections. Distributions of these values, SN and PSN, for the 122 test sections are exhibited in Figures 6 and 7, respectively. The relationship between SN and PSN is shown in Figure 8. Minimum, average, and maximum values for each test section are presented in APPENDIX B.

Milepoints were used to describe the location of accidents to the nearest tenth of a mile. Each accident was thereby positioned within a section. The number of wet-surface accidents, dry-surface accidents, total accidents, and the ratios of wet- to dry-surface accidents and wet-surface to total accidents for each test section are presented in APPENDIX B. Rates of wet-surface accidents and total accidents, in terms of 100 million vehicle miles (total vehicle miles traveled under all pavement conditions), were calculated for each test section. These rates were based upon the lengths of sections and the 1969 ADT's. These values are also presented in APPENDIX B.

TABLE 2

SUMMARY OF 1970 RURAL ACCIDENT OCCURRENCE BY ROUTE

ROUTE	ACCIDENTS	FATALITIES
Interstate 64	231	23
Interstate 65	414	18
Interstate 71	285	8
Interstate 75	1111	51
Ky. Turnpike	443	18
Mountain Parkway	85	4
Blue Grass Parkway	76	6
Western Ky. Parkway	107	5
Pennyrile Parkway	56	2
Purchase Parkway	17	0
Total	2825	135

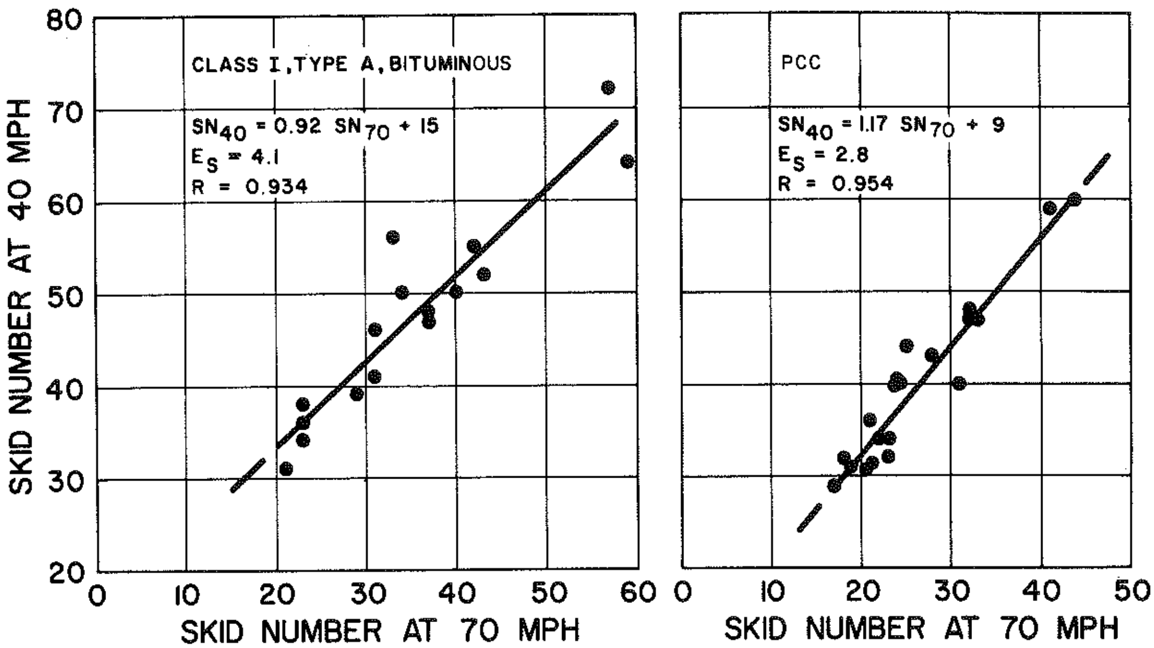

Figure 5. Correlation of Trailer Tests Conducted at 40 mph and 70 mph on Bituminous and Portland Cement Concrete Pavements on Interstate and Parkway Routes.

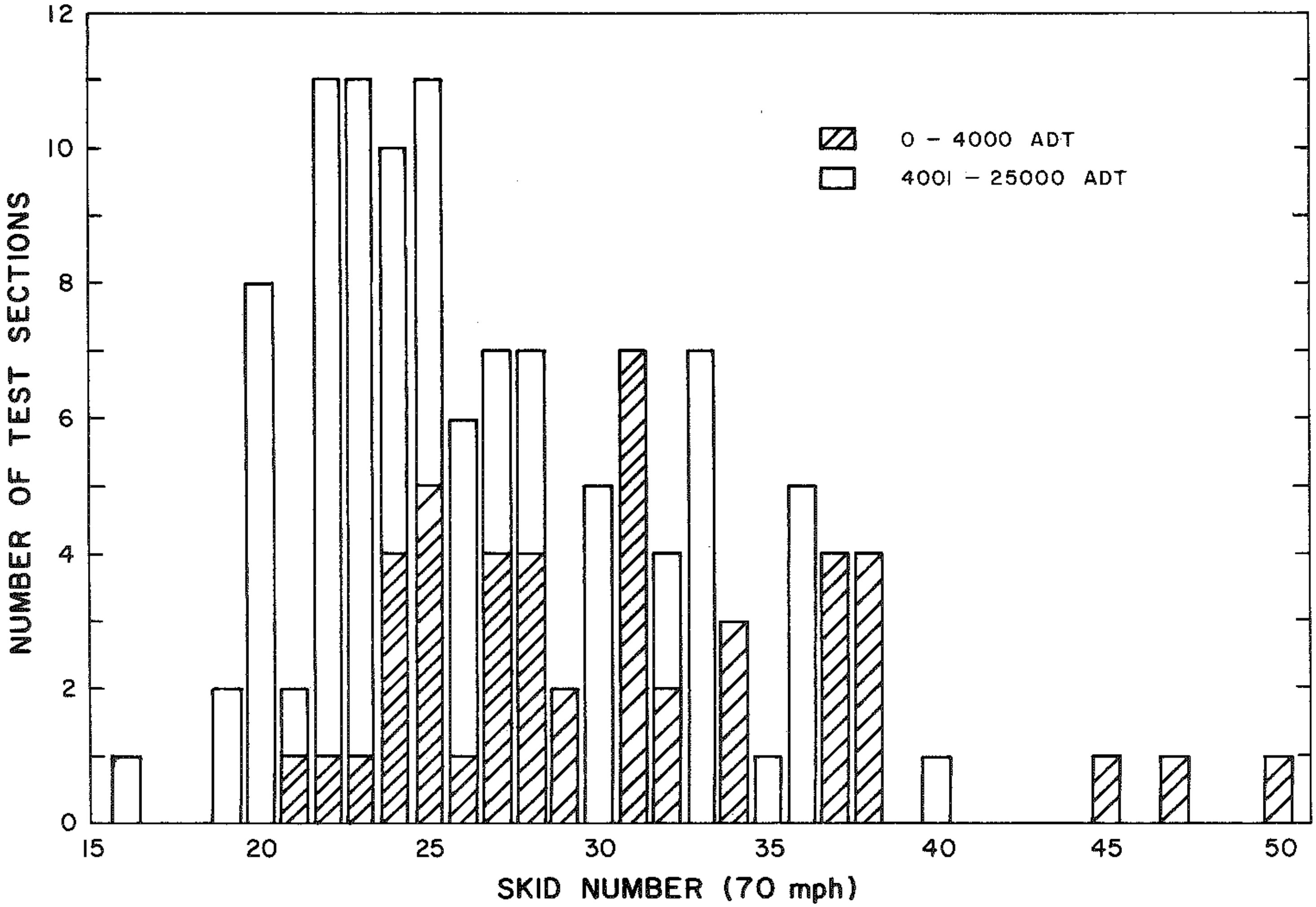

Figure 6. Skid Number Distribution for 122 Test Sections on Rural Interstate and Parkway Routes.

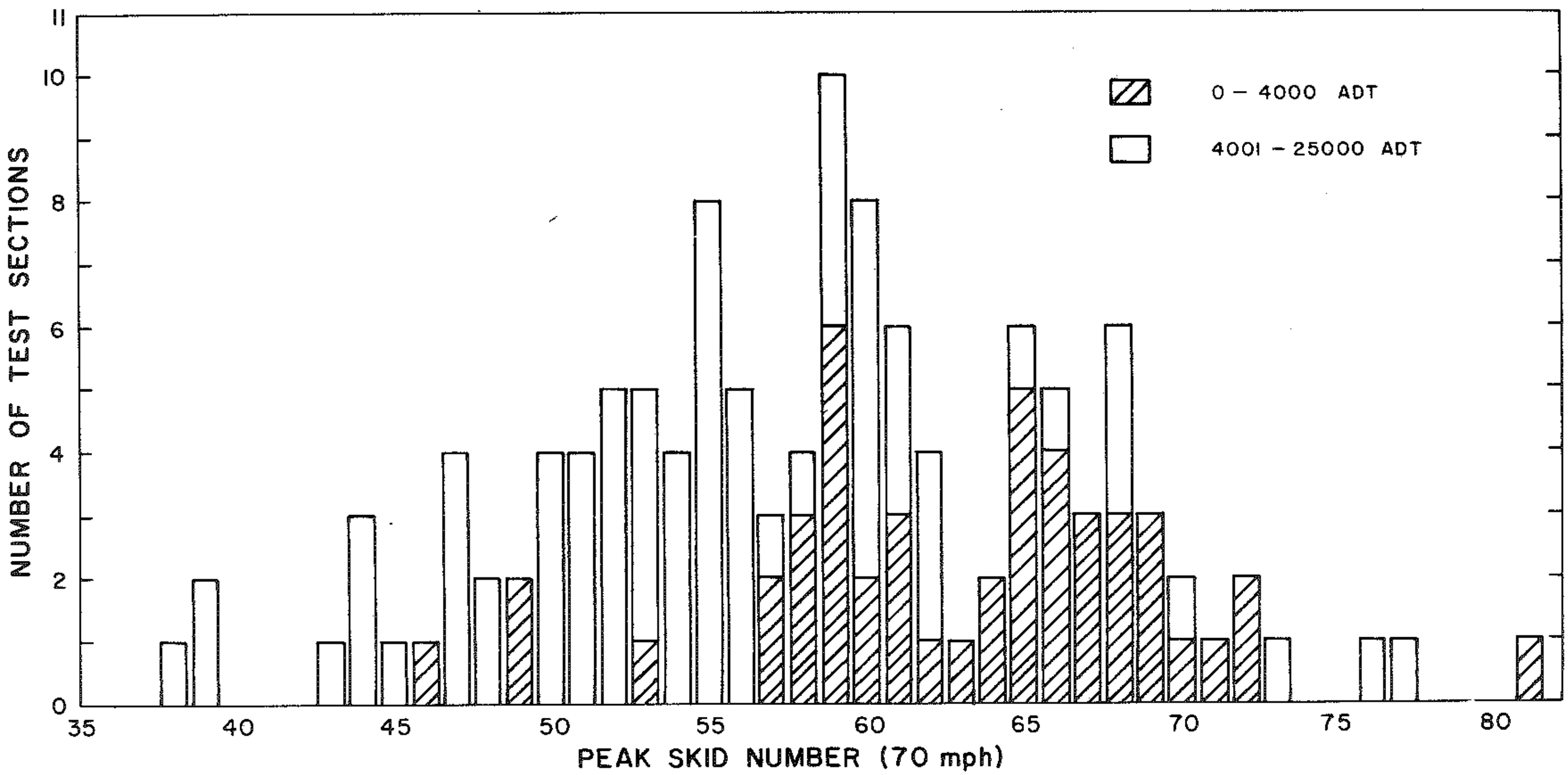

Figure 7. Peak Slip Number Distribution for 122 Test Sections on Rural Interstate and Parkway Routes.

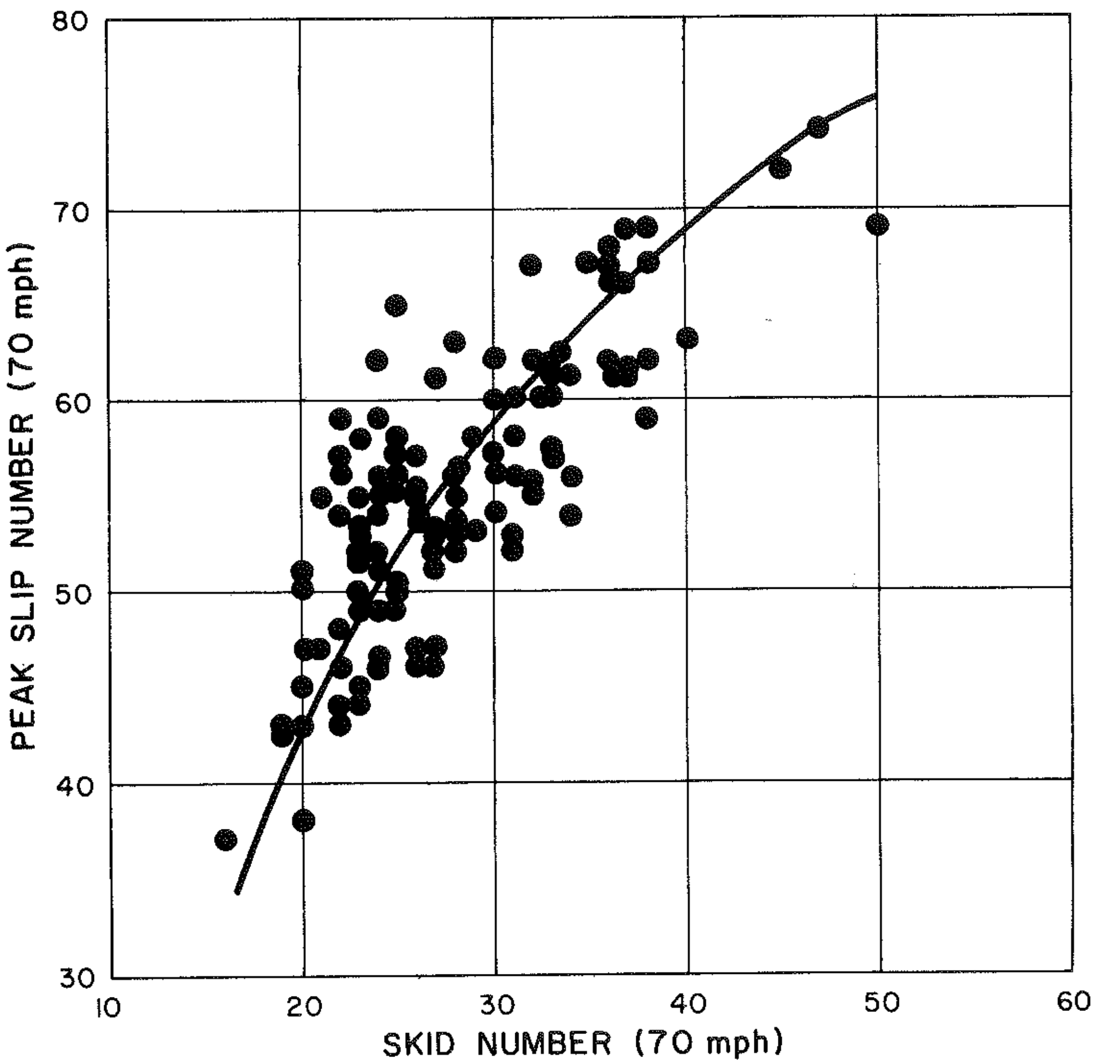

Figure 8. Relationship between Skid Number and Peak Slip Number at 70 mph on Interstate and Parkway Routes.

Half-Mile Sites

Because of bias that might result from averaging data over a test section, another basis of relating skid resistance to accident history was sought. Half-mile sites were selected on the basis of accident experience, and friction levels for the sites were related to the wet-surface accident rates. Accident records for each route were searched to locate the half-mile segment which contained the largest number of wet-surface accidents. Records were again searched to determine the half-mile segment having the second largest number of wet-surface accidents. The search was repeated in this manner until 257 half-mile sites with one or more wet-surface accidents and 1302 half-mile sites with no wet-surface accidents (Table 3) were identified. Traffic volume and skid resistance were determined for each site. Data on the 257 wet-pavement accident sites are presented in APPENDIX C.

SKID NUMBERS AND ACCIDENTS

Analysis of Test Sections by Cross Classification

To aid in determining the relationship between different combinations of traffic volume, Skid Numbers and accidents, data for test sections were arrayed as shown in Table 4. Elements of the array are average wet-surface accident rates for all test sections within Skid Number and traffic volume categories. Similar arrays were prepared for other expressions of accident occurrence, including: 1) ratio of wet- to dry-surface accidents, 2) ratio of wet-surface to total accidents, and 3) total accident rate.

Analysis of the arrays led to the conclusion that the data needed to be stratified with respect to ADT to better define the relationships between accidents and pavement friction. Separation of the data arbitrarily into two data sets (0-4,000 vehicles per day and 4,001-25,000 vehicles per day) proved best for this analysis. For other years, however, analysis might indicate that stratifications should occur at some other levels. This separation was complemented by a plot of wet accident rate versus Skid Number for each test section (Figure 9) which illustrates the need for separation of the data. The resulting relationship between accidents and pavement friction with the data stratified at 4,000 vehicles per day are presented in Figures 10, 11, 12 and 13. Although a trend was indicated for the test sections with ADT's less than 4,000 vehicles per day, there was not sufficient data to justify continued analysis. However, it is interesting to note that accident rates were higher on the lower volume than on higher volume roads. Fee, et al, *(10)* and Hutchinson and Kennedy *(11)* also found a higher rate of accidents for lower-volume, rural, four-lane roads. Some of Fee's data are shown in Table 5. Fee had postulated from an earlier report by Solomon *(12)* that higher accident rates for roads with low ADT's were not intuitively expected. However, the increase in accident rate was slight and may be due to a more relaxed attitude

TABLE 3

NUMBER OF HALF-MILE SITES WITH NO WET-SURFACE ACCIDENTS

70-MPH SKID NUMBER	ADT (VEHICLES PER DAY)	
	0-4000	>4000
16	--	11
17	--	--
18	--	1
19	--	15
20	--	97
21	6	15
22	12	83
23	5	77
24	--	87
25	7	94
26	1	64
27	40	28
28	51	54
29	51	1
30	31	40
31	89	--
32	32	28
33	75	9
34	15	--
35	--	7
36	25	22
37	27	--
38	21	38
39	--	--
40	--	--
41	--	--
42	--	--
43	1	--
44	--	--
45	31	--
46	--	--
47	11	--

TABLE 4

WET-SURFACE ACCIDENT RATES*

70-MPH SKID NUMBER	ADT (VEHICLES PER DAY) 0 4000	4001 8000	8001 12000	12001 16000	16001 20000	20001 25000	0 25000	4001 25000
18	----	----	55.3	----	----	---	55.3	55.3
19-23	61.9	----	21.9	17.0	42.7	---	25.7	25.3
24-27	----	12.3	9.8	18.0	32.7	0.0	16.4	16.4
28-33	17.5	0.0	----	12.0	6.8	6.0	11.6	9.2
34-40	18.5	5.8	0.0	0.0	----	---	10.0	3.6
41-50	15.2	----	----	----	----	---	15.2	----

*Accidents per 100 million vehicle miles

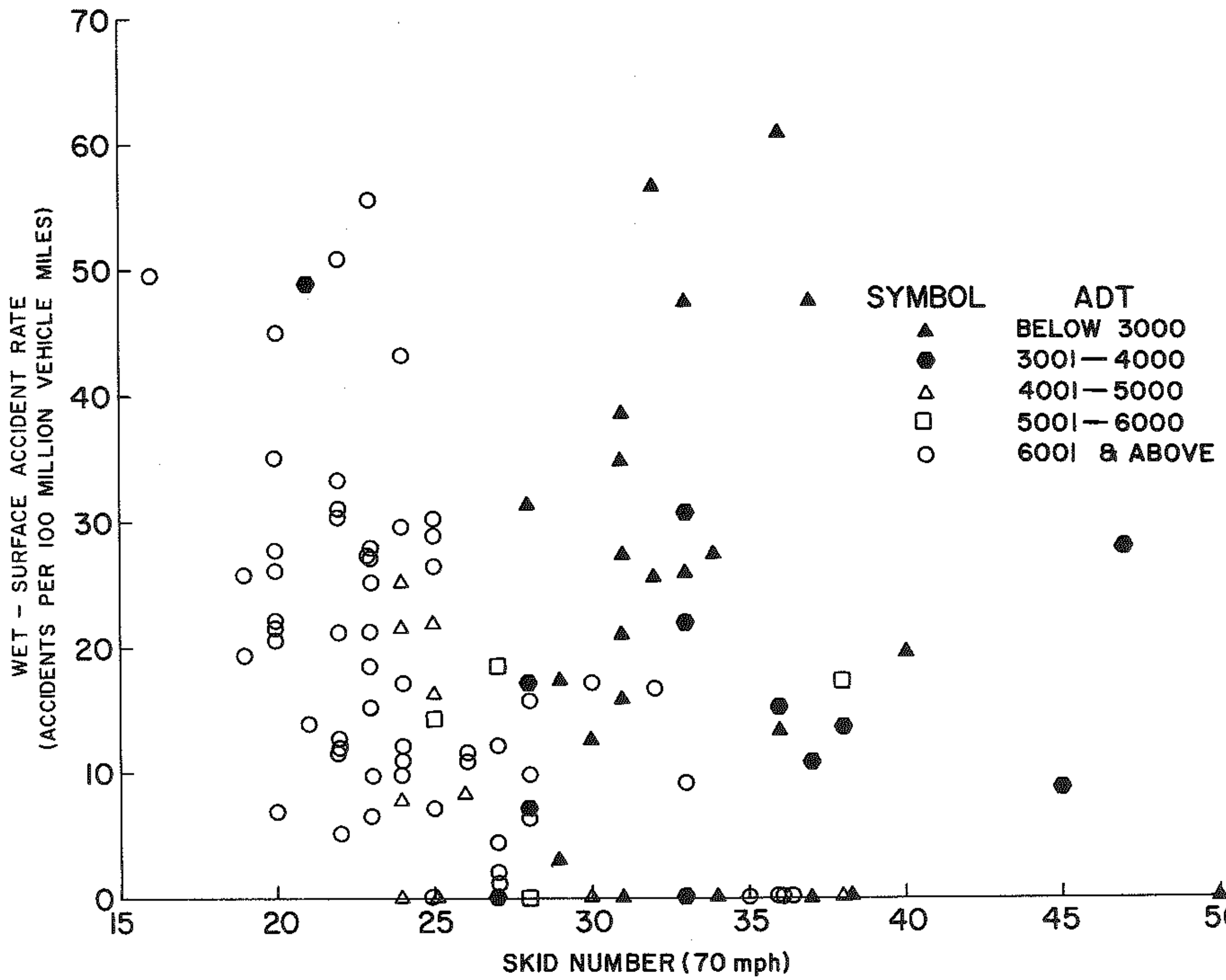

Figure 9. Test Section Averages: Wet Accident Rate versus Skid Number with ADT Stratification.

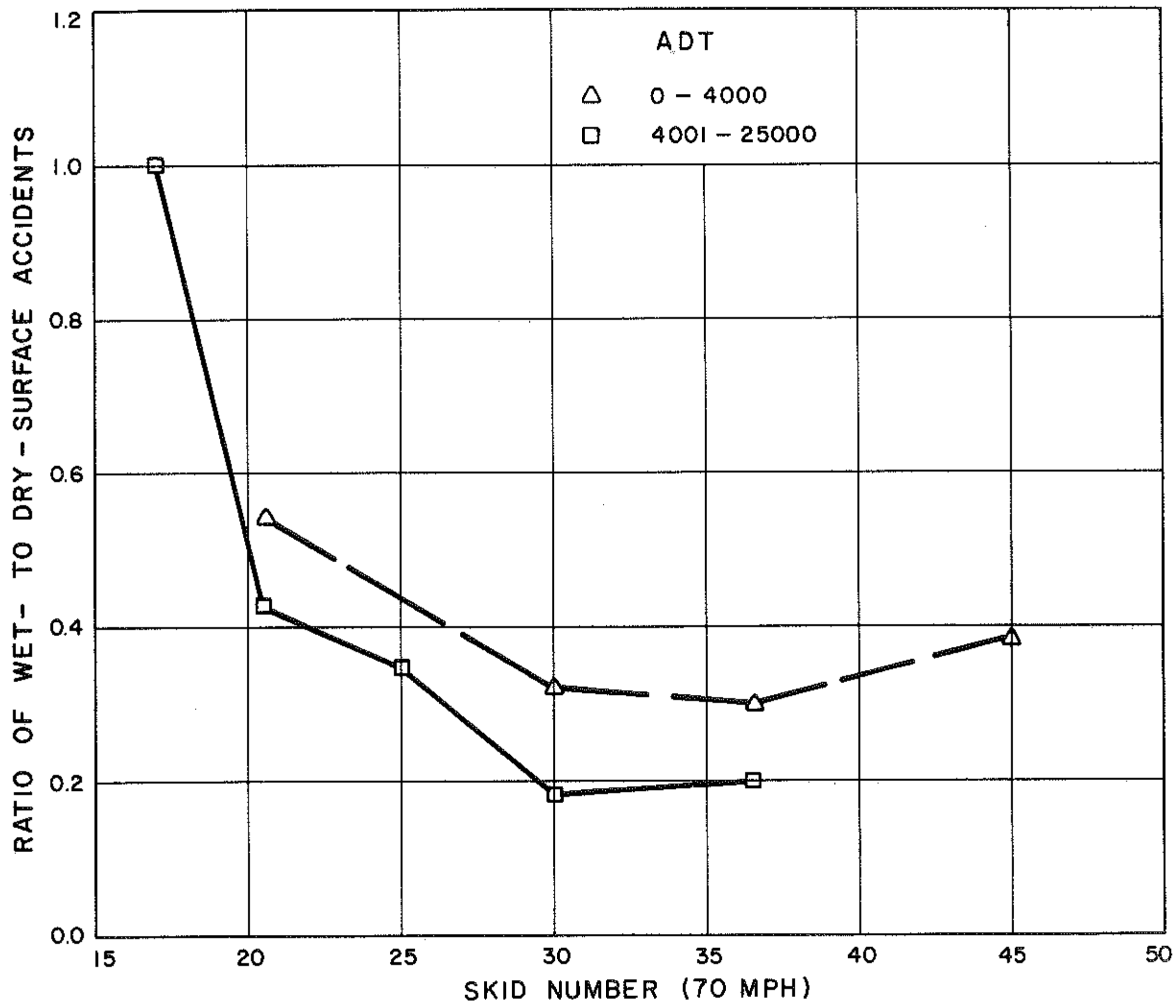

Figure 10. Comparison of Wet-Surface Accidents/Dry-Surface Accidents Ratio to Skid Number with Volume Stratification at ADT of 4000 Vehicles per Day.

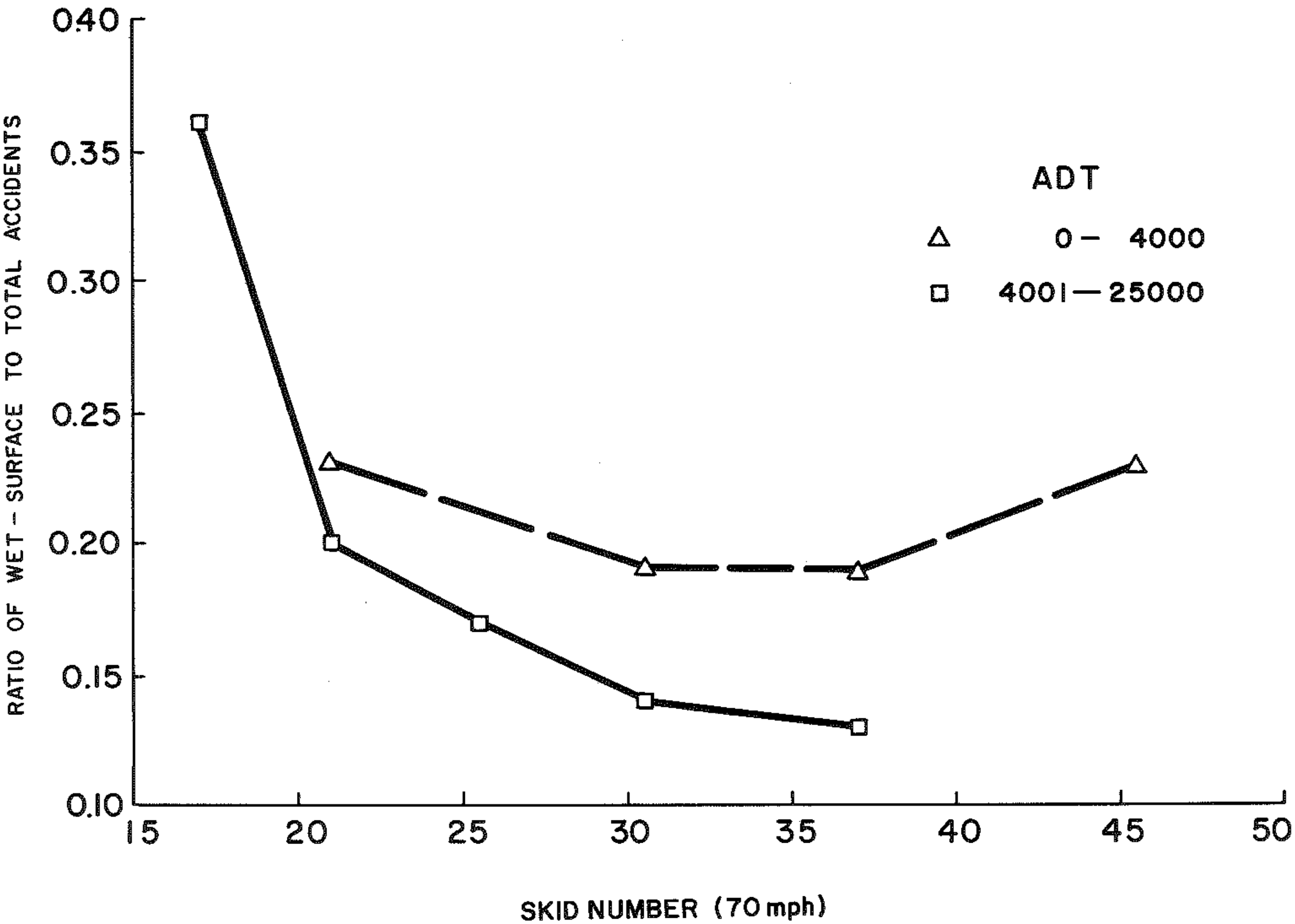

Figure 11. Comparison of Wet-Surface Accidents/Total Accidents Ratio to Skid Number with Volume Stratification at ADT of 4000 Vehicles per Day.

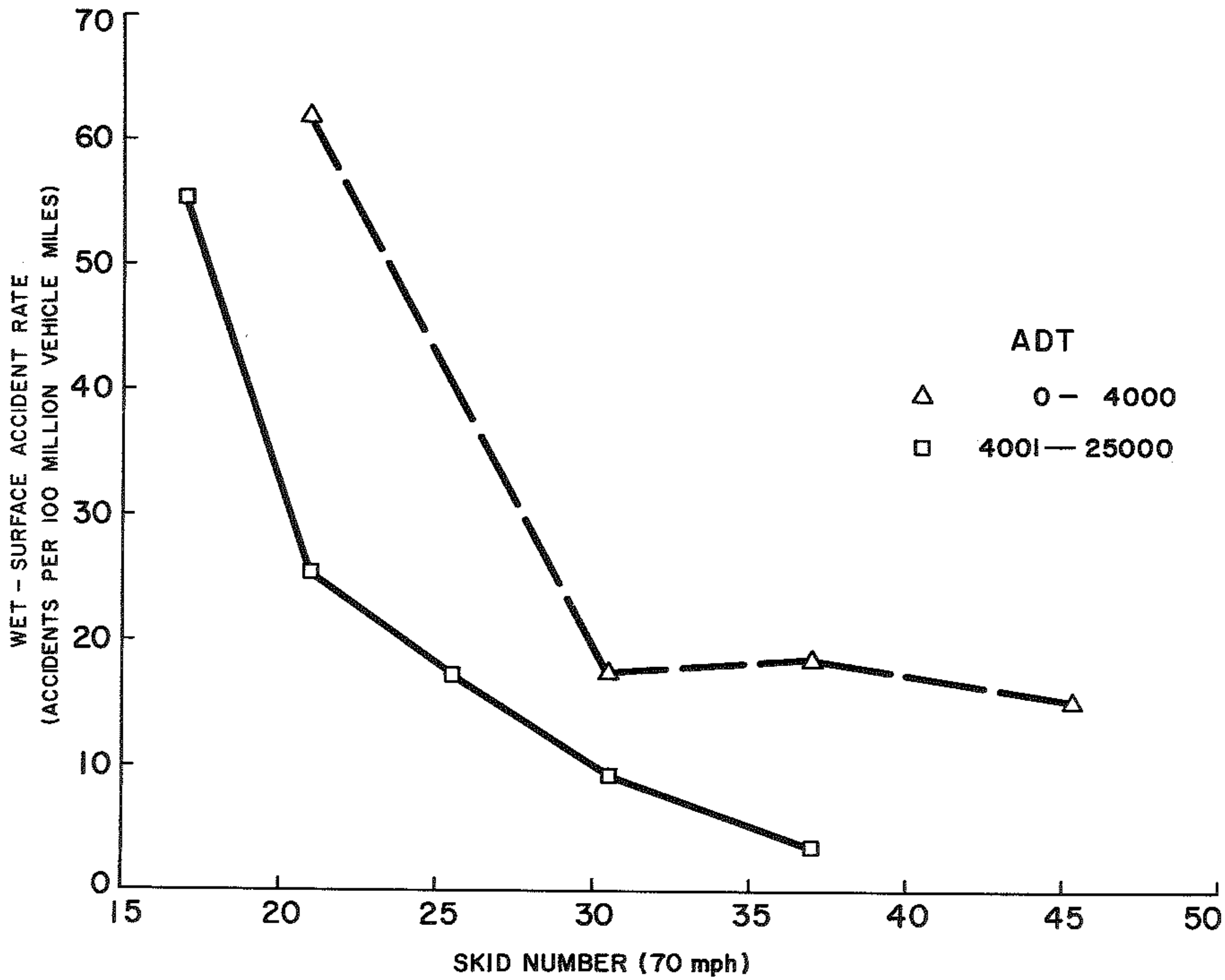

Figure 12. Comparison of Wet-Surface Accident Rate to Skid Number with Volume Stratification at ADT of 4000 Vehicles per Day.

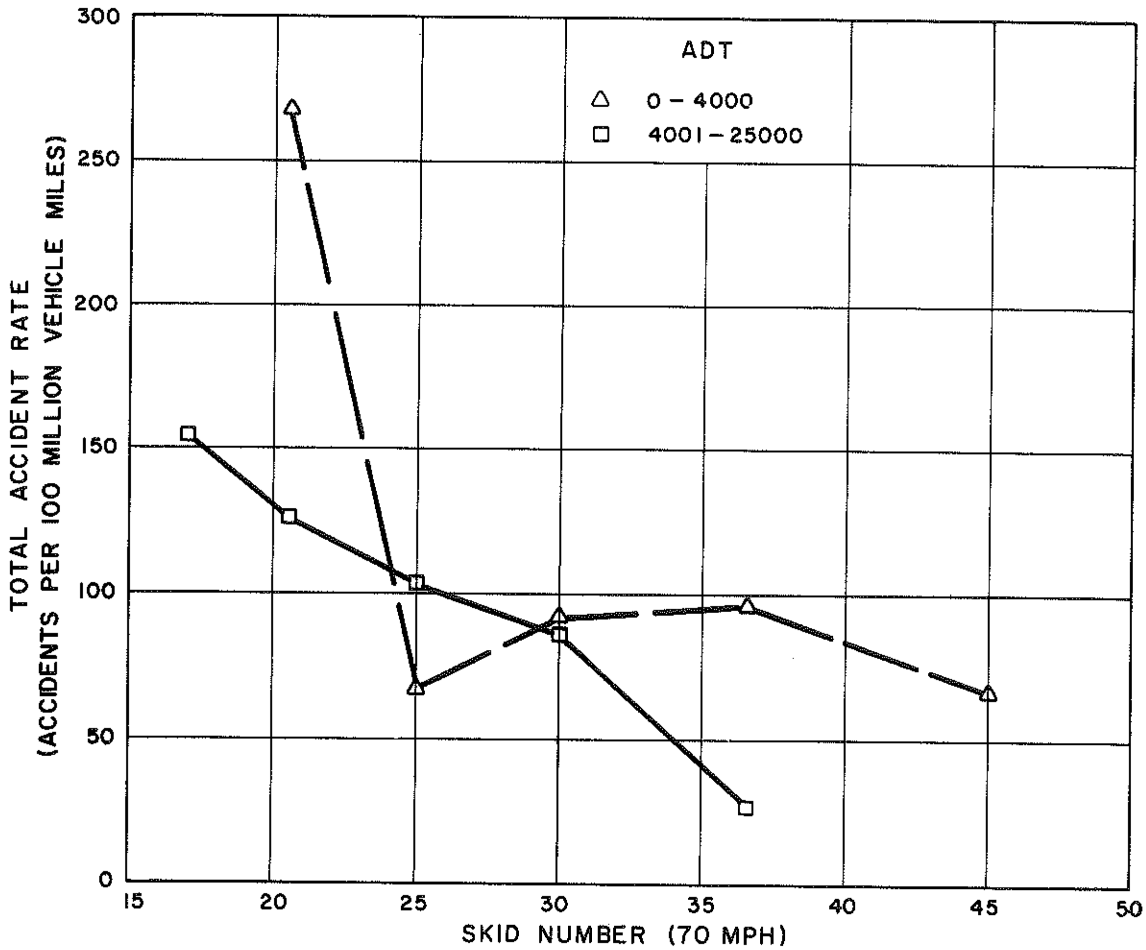

Figure 13. Comparison of Total Accident Rate to Skid Number with Volume Stratification at ADT of 4000 Vehicles per Day.

on the part of the driver on traffic-free roadways or may be attributed to larger speed variances under such low-volume conditions. There is reason to believe that either of the above situations might lead to this higher accident rate. Fee's data for rural, four-lane roads, presented in Table 5, also indicated that accident rates on roadway sections with higher ADT's were not related to traffic volume. Kentucky data presented in Table 6 indicated a slight increase in accidents with increasing ADT. Considerable variability in the data, indicated in Figure 9, remained after elimination of test sections having ADT's less than 4,000. But a definite trend of decreasing wet-surface accident rate with increased Skid Numbers was apparent.

Analysis of test section data continued, seeking that expression of accident occurrence relating best with pavement friction. This was accomplished by taking elements in the arrays as predicted values. Actual accident occurrence calculations for each test section were then compared to this "predicted" value to obtain deviations. This enabled computation of a coefficient of correlation for each accident expression. The correlation coefficients ranked the expressions in the following order:

1. Wet-surface accidents per 100 million vehicle miles
2. Ratio of wet- to dry-surface accidents
3. Total accidents per 100 million vehicle miles
4. Ratio of wet-surface to total accidents.

The degree of correlation was not sufficiently encouraging to enable a final selection of the best expression. Analysis to determine the relationship between accident occurrence and pavement friction was therefore continued using all four expressions. However, further analysis was confined to ADT's over 4,000 vehicles per day.

Analysis of Test Sections by Averaging Techniques

Three averaging methods were used to reduce variability and, thereby, to more clearly demonstrate general relationships already apparent in the data set for test sections having volumes above 4,000 vehicles per day. A discussion of these methods and the resulting trends follow.

Cumulative Averages: Two techniques were used to calculate cumulative averages. The first involved calculating the average of each expression for accident occurrence for all test sections having a Skid Number less than or equal to a given value. The second procedure involved calculating average accident occurrence -- for each method of expression -- of all test sections having a Skid Number greater than a given value. These average values are plotted in Figures 14, 15, 16, and 17.

In the first procedure of calculating averages, accident rates for low Skid Numbers had the greater influence upon the average value obtained. Extreme values of the expressions for accident occurrence

TABLE 5

ACCIDENT RATES* BY ADT GROUPINGS
(From Reference 10)

TYPE OF ROAD	ADT (VEHICLES PER DAY)							
	100 1900	2000 3900	4000 7900	8000 15900	16000 23900	24000 35900	36000 51900	52000 75900
Urban (4 Lane)		141	134	124	128	158	244	387
Rural (4 Lane)	122	92	94	93	91	93	---	---

*Accidents per 100 million vehicle miles

TABLE 6

ACCIDENT RATES* BY ADT GROUPINGS

TYPE OF ACCIDENT	ADT (VEHICLES PER DAY)				
	0 2000	2001 4000	4001 6000	8001 16000	16001 25000
Total	208	80	71	94	103
Wet-surface	32	14	11	17	19

*Accidents per 100 million vehicle miles

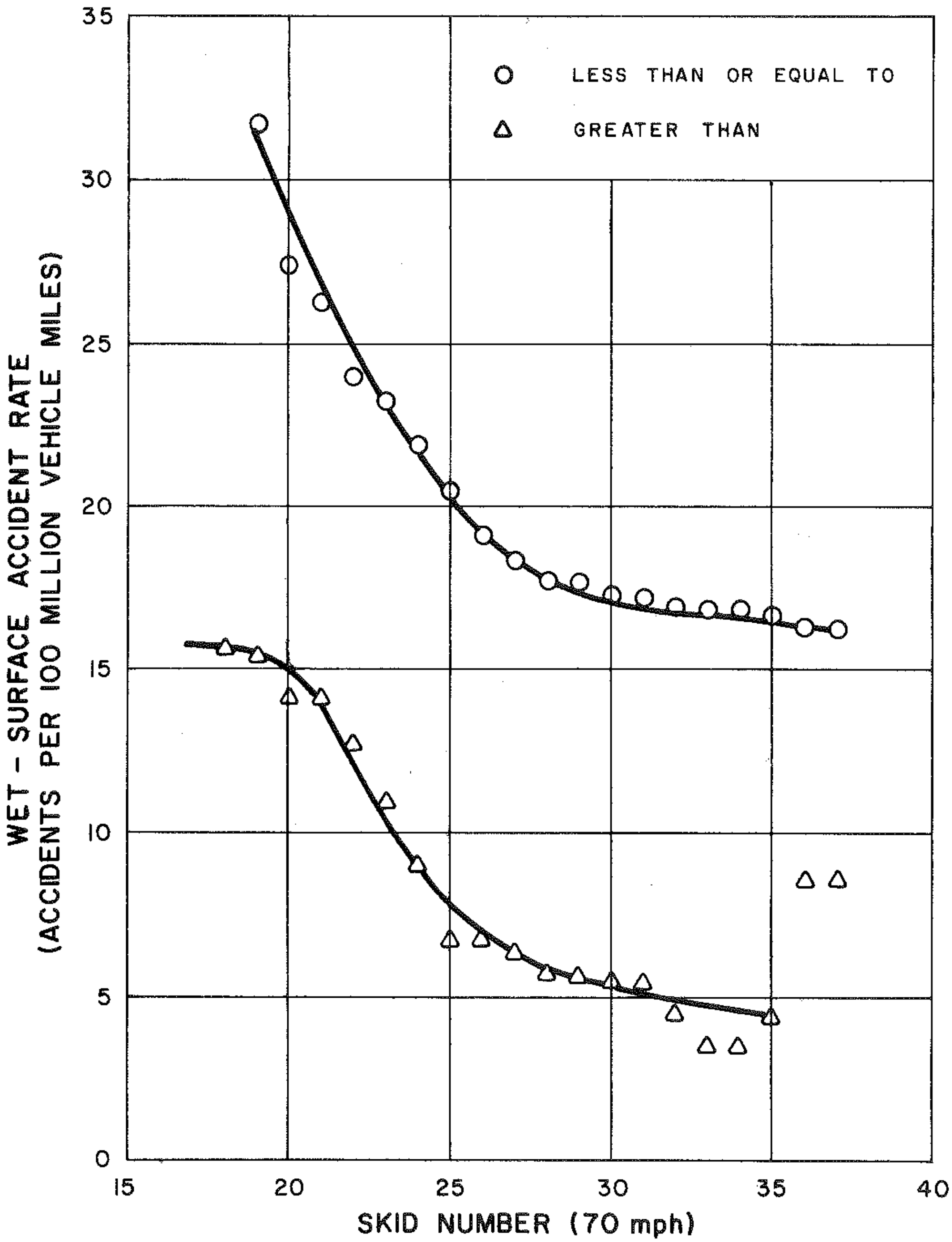

Figure 14. Cumulative Averages of Wet-Surface Accident Rate versus Skid Number.

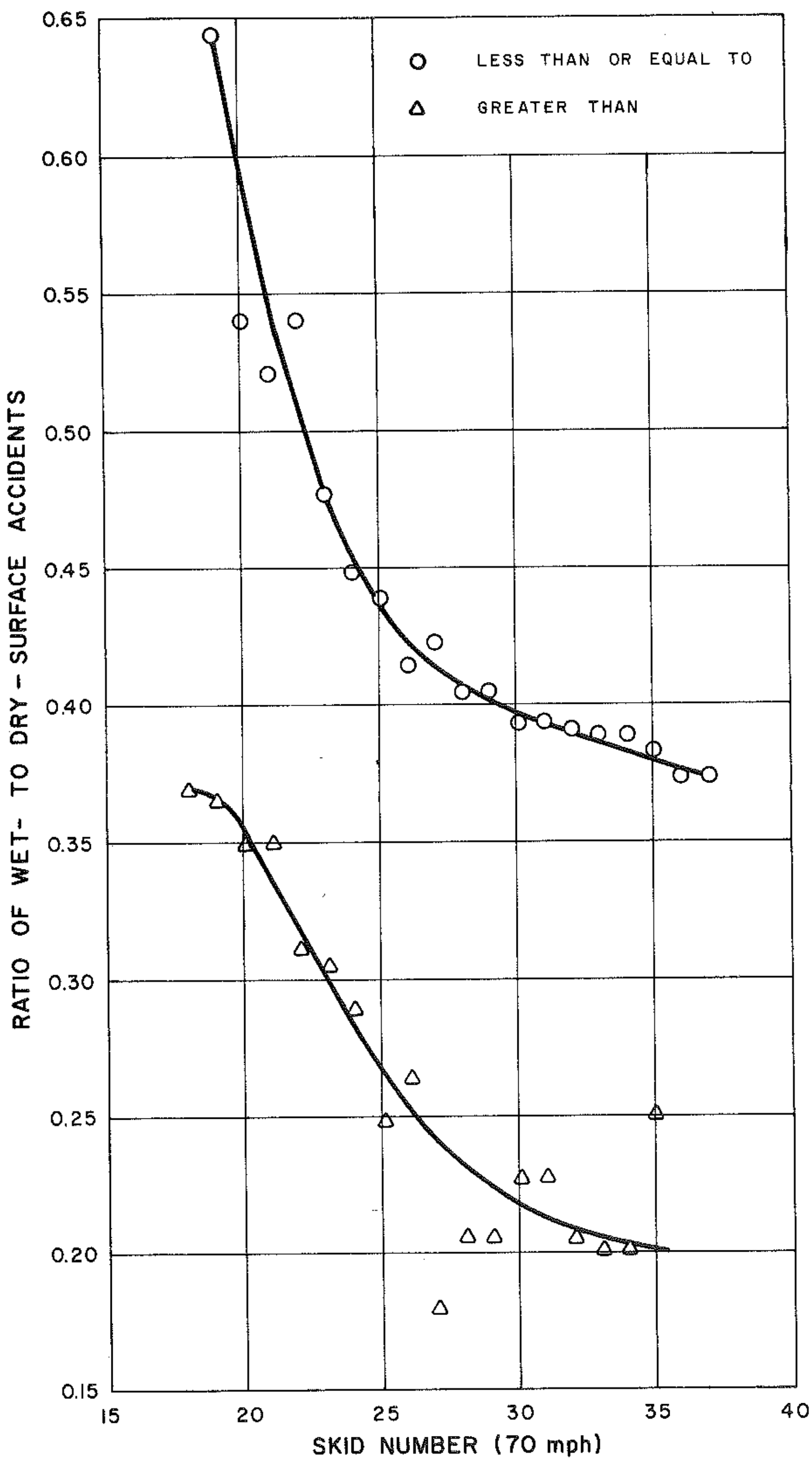

Figure 15. Cumulative Averages of Wet-Surface Accidents/Dry-Surface Accidents Ratio versus Skid Number.

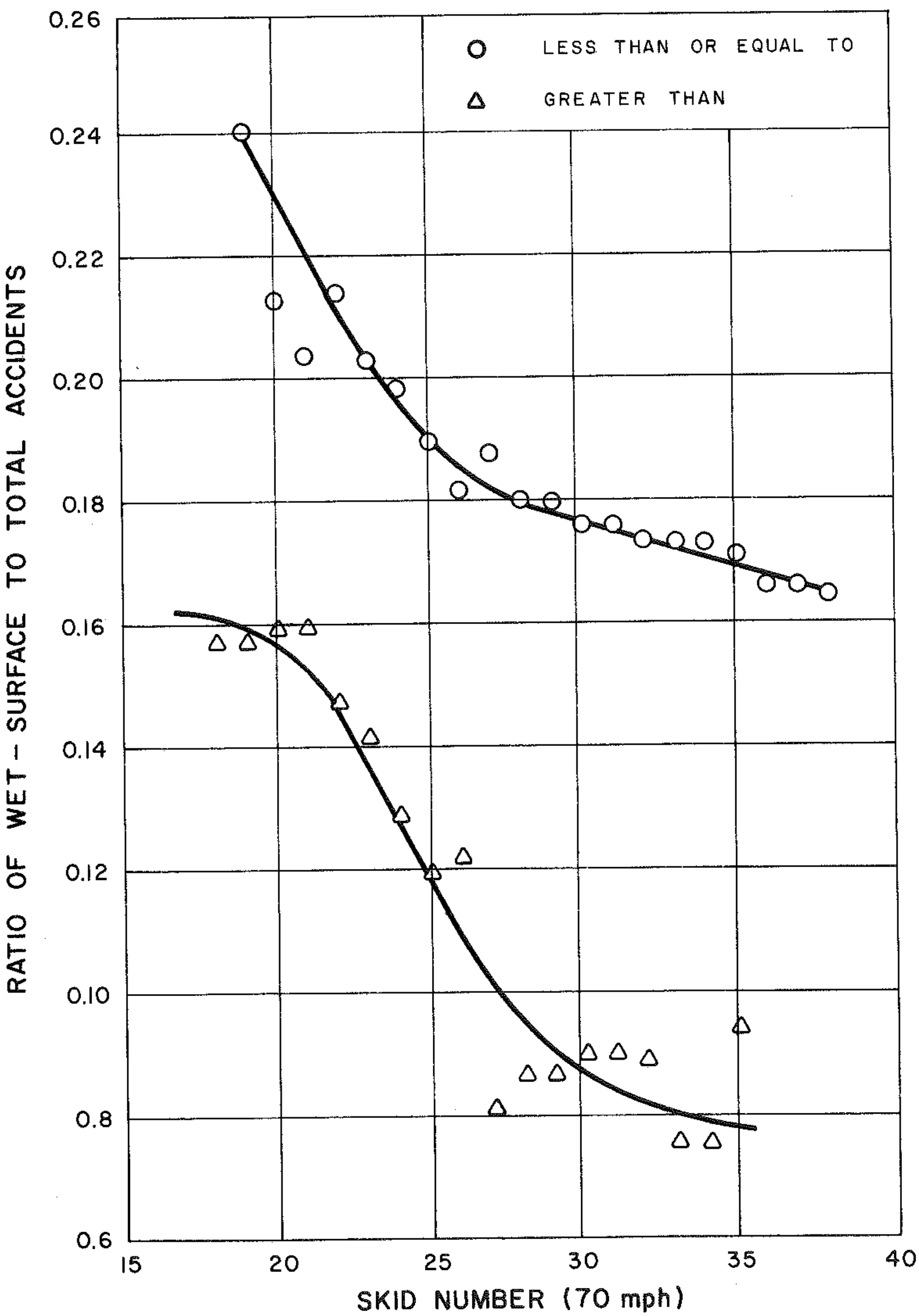

Figure 16. Cumulative Averages of Wet-Surface Accidents/Total Accidents Ratio versus Skid Number.

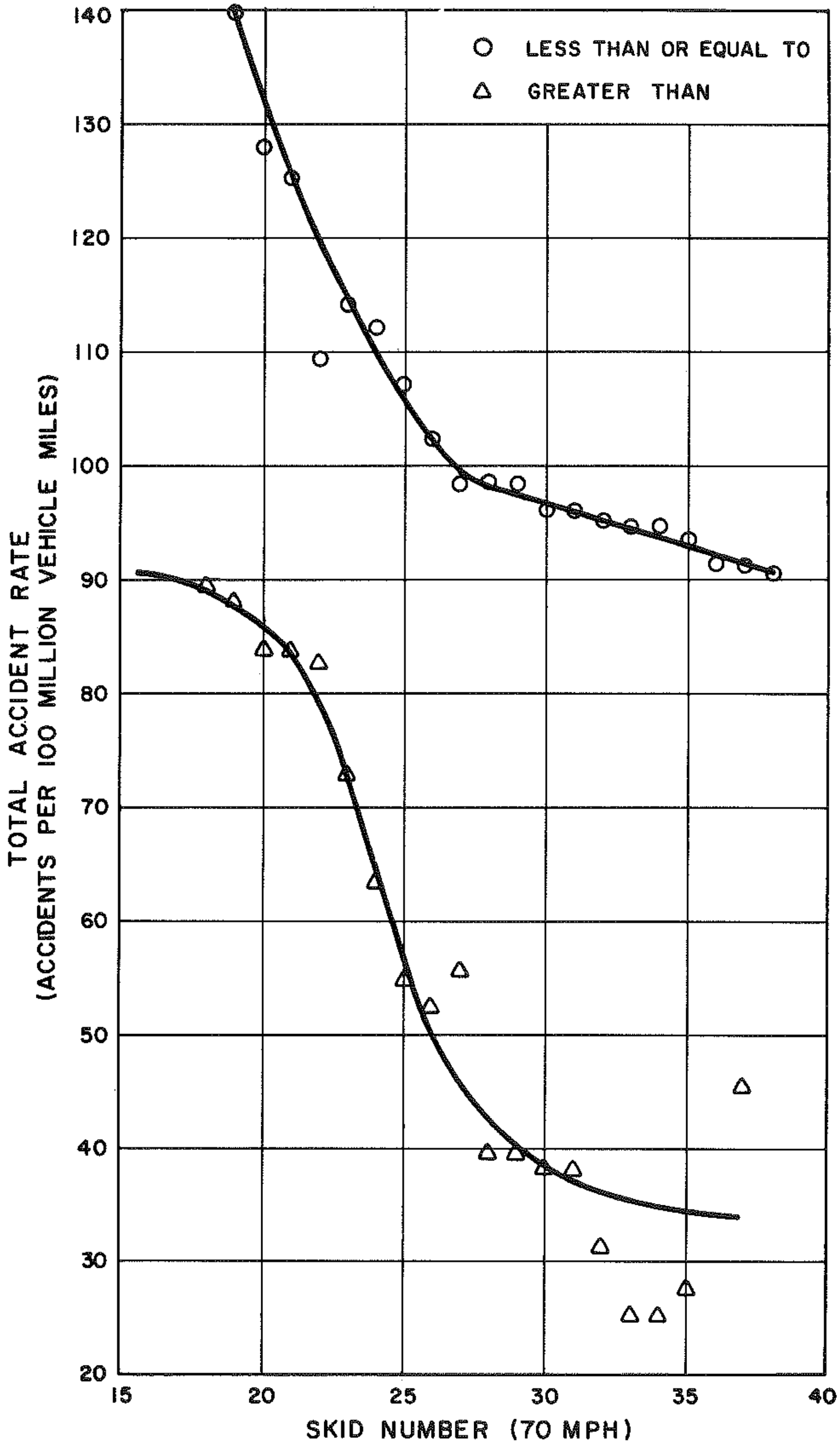

Figure 17. Cumulative Averages of Total Accident Rate versus Skid Number.

for a test section at high Skid Numbers were attenuated through division by the large number of test sections with lower Skid Numbers. Thus, the second procedure, which yielded opposite weightings, was necessary to verify the trends and to insure that large deviations at high Skid Numbers were not being masked by the averaging process. Fortunately, the resulting trends were all similar. Average accident rates and proportions of wet-surface accidents decreased significantly as the Skid Numbers increased to approximately 27; further increase in Skid Numbers resulted in only a slight reduction in accidents.

Since all trends were similar, and because of the ranking of accident expressions discussed previously, subsequent analyses were restricted to wet-surface accidents per 100 million vehicle miles as the method of expressing accident occurrences.

Average Wet-Surface Accident Rates Grouped by Skid Number: In the second method, test sections were grouped by Skid Number. The average wet-surface accident rate was calculated for each group. These averages are tabulated in Table 7 and plotted in Figure 18. Again the trend indicated a rapidly decreasing accident rate with increasing Skid Numbers up to about 25. The variability was greater than that obtained by the first method because several groups included only one or two test sections, each having equal weighting as groups containing a larger number of test sections. Still, the trends by the two methods were very similar.

Moving Averages: The third method involved calculation of an average wet-surface accident rate and an average Skid Number for progressively-ordered sets of five test sections. The first average was of the five test sections with the lowest Skid Numbers. The test section with the lowest Skid Number was then dropped, and a test section with the next highest Skid Number added. This was repeated until all test sections had been averaged in a group of five. In cases where more than one test section had the next highest Skid Number, one of these was randomly added each time. Test sections were dropped in the same sequence as they were added. Resulting averages are plotted in Figure 19.

The trend was similar to those developed by the previous two methods. However, this method indicated a more distinct change in the slopes of the two branches of the curve. At a Skid Number below 26, the wet-surface accident rate increased by about five per Skid Number, whereas above 26 the wet-surface accident rate decreased by less than one-half per Skid Number.

Analysis of Half-Mile Sites by Averaging Techniques

To verify trends developed for the test section data, average wet-surface accident rates for half-mile sites were analyzed. The averaging of sites grouped by Skid Number was tested first. This method had shown the greatest variability (poorest correlation) in the analysis of test sections. It gives equal weighting to each group regardless of the number of sites in each group. Data were not stratified initially by

TABLE 7

WET-SURFACE ACCIDENT RATES*
FOR TEST SECTIONS GROUPED
BY SKID NUMBER

70-MPH SKID NUMBER	NUMBER OF TEST SECTIONS	WET ACCIDENT RATE
16	1	49.5
17	0	
18	0	
19	2	22.7
20	8	25.6
21	1	13.9
22	10	21.4
23	10	21.3
24	9	22.3
25	10	14.5
26	6	6.5
27	4	8.5
28	4	8.1
29	0	
30	3	5.8
31	0	
32	2	8.5
33	1	9.5
34	0	
35	1	0.0
36	2	0.0
37	0	
38	2	8.6

*Accidents per 100 million vehicle miles

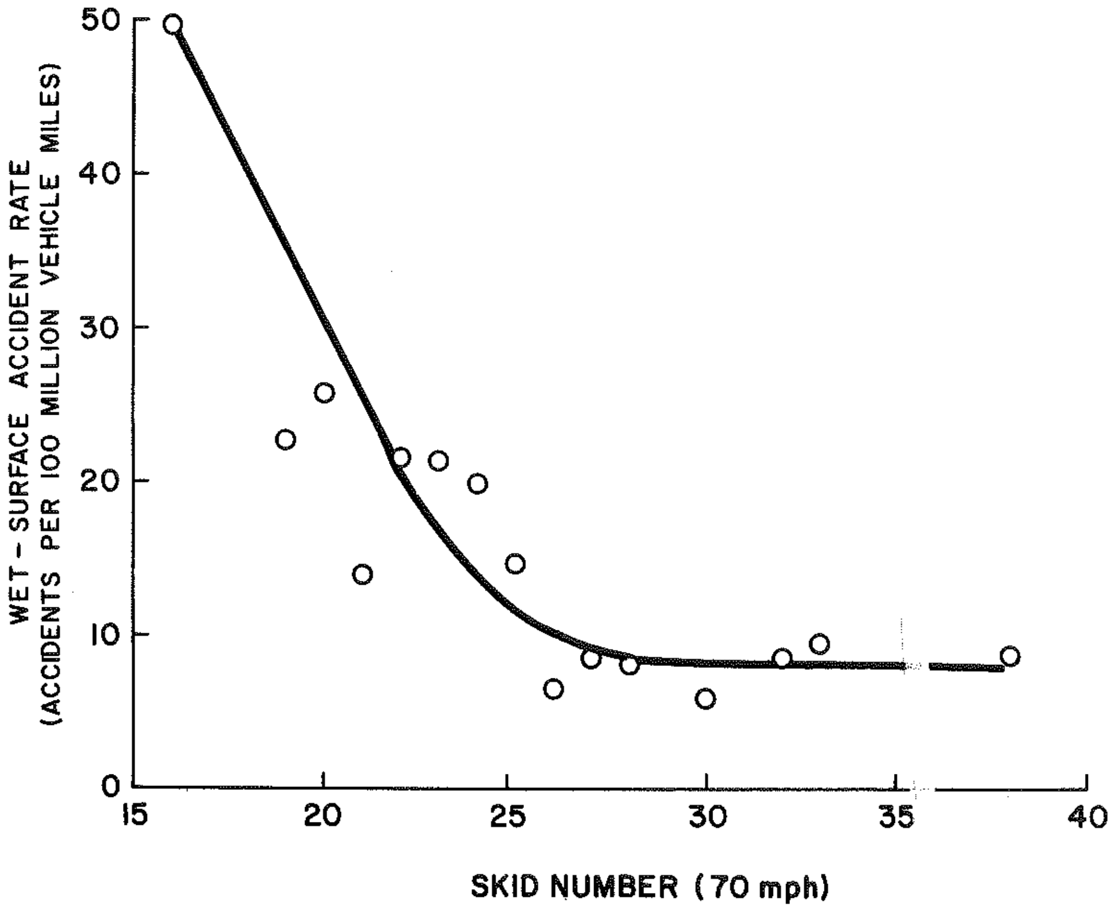

Figure 18. Average Wet-Surface Accident Rate of Test Sections -- Grouped by Skid Number -- versus Skid Number.

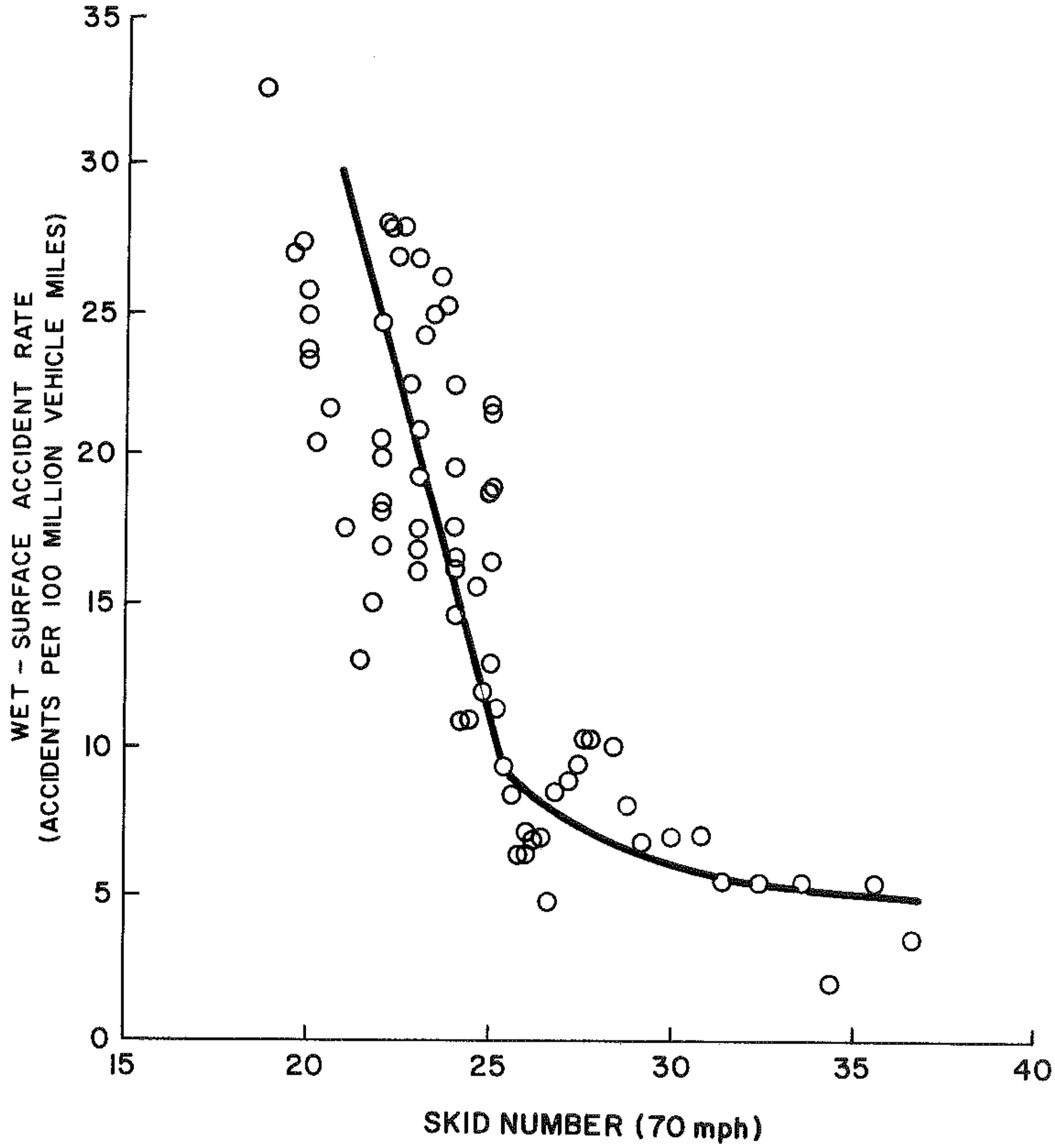

Figure 19. Five-Point Moving Averages: Wet-Surface Accident Rate versus Skid Number.

ADT in this analysis since there might be a different level for separation for the half-mile sites.

Plots of unstratified, site averages again indicated considerable variability; no definite trend was evident. Consequently, sites having ADT's less than 4,000 vehicles per day were eliminated and accident-rate averages were recalculated for the remaining sites (Table 8 and Figure 20). The resultant trend was similar to that obtained from the test sections after sorting (Figure 18), that is, a large rate of decrease in wet-surface accident rate with increasing Skid Numbers up to about 25 and a lesser rate of decrease above 25. Site averages showed greater variability (scatter) than the longer test sections (test sections averaged about seven miles in length). Also, half-mile sites were defined on the basis of accident occurrence; test sections were defined by similar traffic and construction characteristics. Even so, the similarity of results was significant.

To define a trend specifically for locations which seemed to be susceptible to wet-pavement accidents, half-mile sites which had experienced at least one wet-surface accident were grouped by Skid Number; the average wet-surface accident rate was calculated for each group (Table 9, Figure 21). The trend there indicated that increasing the skid resistance of high-accident locations would decrease the accidents proportionally. Development of trends similar to those obtained with test section averages was not possible because there was an insufficient number of high-accident sites having a Skid Number greater than 28.

PEAK SLIP NUMBERS AND ACCIDENTS

As discussed previously, there is a need to analyse different measurements of pavement friction to determine which correlates the best with accident experience. The peak friction force was measured routinely during all tests; thus this data was available for analysis. Its relevance as an index to accident potential was not fully explored here mainly because measurements of peak frictional forces yielded somewhat less consistent results than the locked-wheel measurements (SN).

The test section averages were arrayed as shown before. Peak Slip Number (PSN) was substituted for Skid Number. The arrays again indicated the necessity for sorting the data by ADT into two groups (0-4,000 and 4,001-25,000 vehicles per day). Wet-surface accident rates again appeared to be the best expression for accident occurrence. The wet-surface accident rates, for each of the two ADT groups, were plotted against the Peak Slip Numbers, as shown in Figure 22. As before, the test sections having ADT's less than 4,000 vehicles per day had accident rates which were high compared to those with ADT's above 4,000 vehicles per day. There was not sufficient data in this set to justify further analysis. Therefore, analysis was continued only for sections having ADT's greater than 4,000 vehicles per day.

The test sections with over 4,000 ADT were grouped by Peak Slip Number and average wet-surface

TABLE 8

WET-SURFACE ACCIDENT RATES*
FOR HALF-MILE SITES GROUPED
BY SKID NUMBER

70-MPH SKID NUMBER	NUMBER OF SITES	WET ACCIDENT RATE
16	14	42.6
17	0	----
18	0	----
19	22	27.6
20	142	26.8
21	17	12.4
22	118	21.4
23	113	27.1
24	109	21.1
25	121	17.7
26	71	6.5
27	33	6.2
28	69	11.7
29	0	----
30	43	3.5
31	0	----
32	30	6.5
33	15	13.1
34	0	----
35	7	0.0
36	22	0.0
37	0	----
38	39	8.3

*Accidents per 100 million vehicle miles

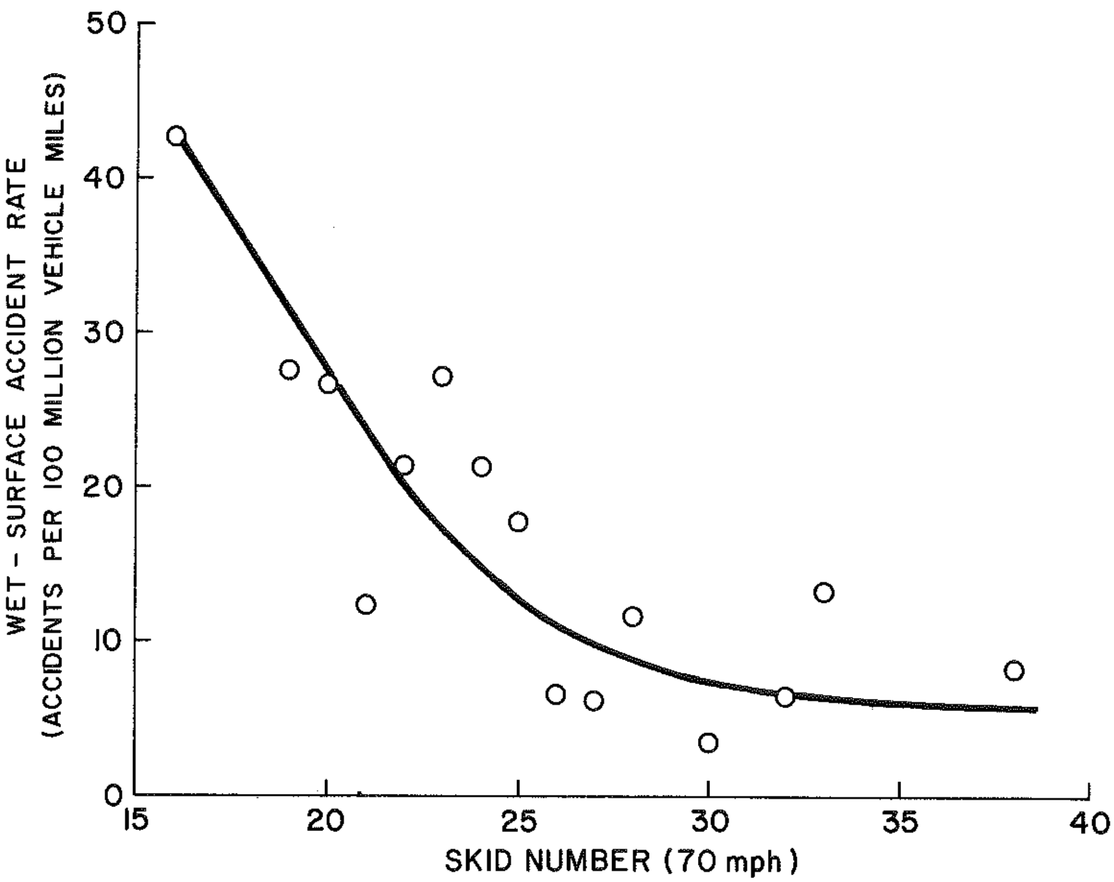

Figure 20. Average Wet-Surface Accident Rate of Half-Mile Sites -- Grouped by Skid Number -- versus Skid Number.

TABLE 9

WET-SURFACE ACCIDENT RATES*
FOR HALF-MILE SITES (WITH ONE OR MORE WET-SURFACE ACCIDENTS) GROUPED BY SKID NUMBER

70-MPH SKID NUMBER	NUMBER OF SITES	WET-SURFACE ACCIDENT RATE
16	3	199
17	0	
18	0	
19	7	87
20	45	85
21	2	115
22	35	64
23	37	75
24	22	75
25	26	69
26	7	73
27	5	67
28	15	49
29	0	
30	3	59
31	0	
32	2	104
33	3	31
34	0	
35	0	
36	0	
37	0	
38	1	289

*Accidents per 100 million vehicle miles

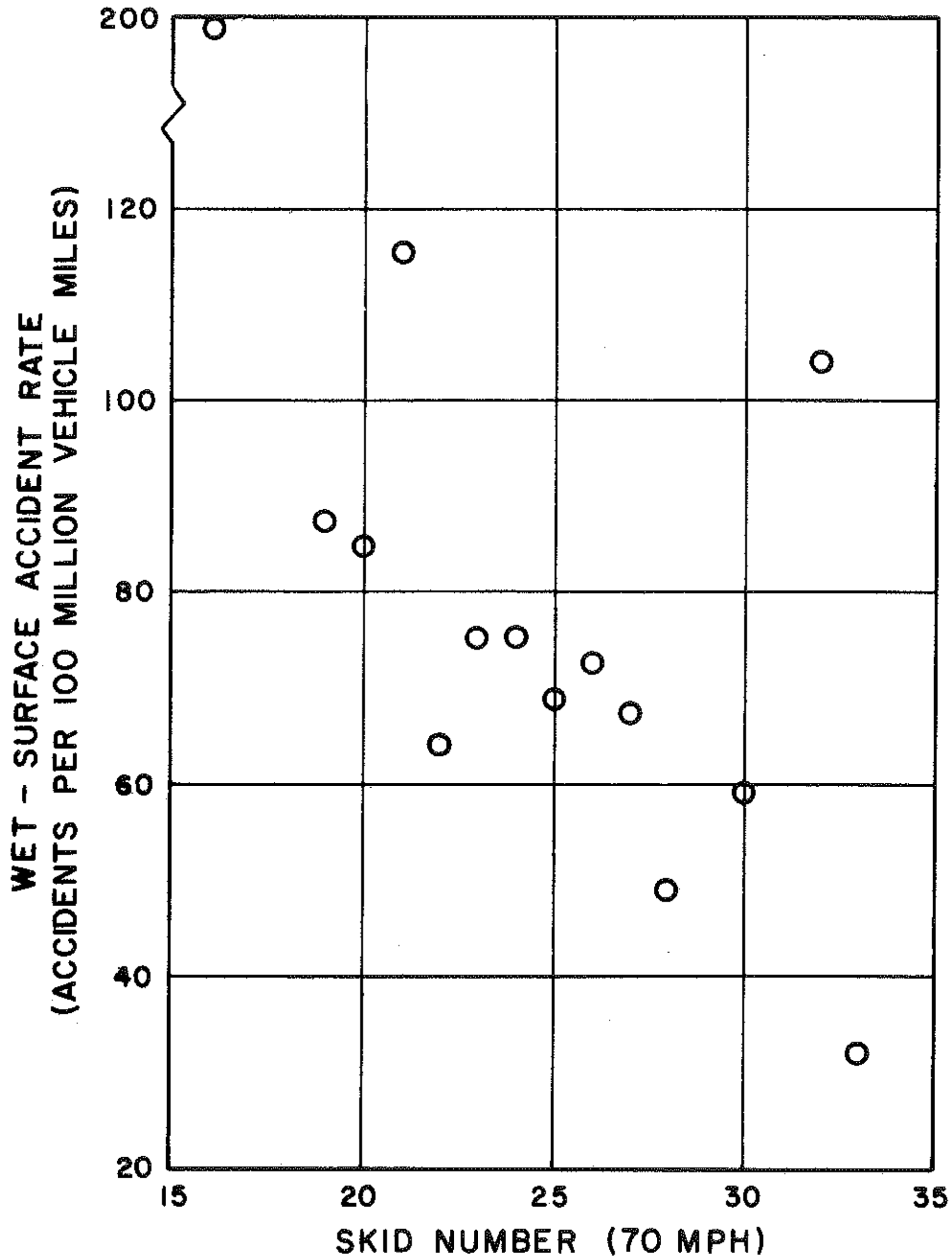

Figure 21. Average Wet-Surface Accident Rate of Half-Mile Sites with One or More Wet-Surface Accidents -- Grouped by Skid Number -- versus Skid Number.

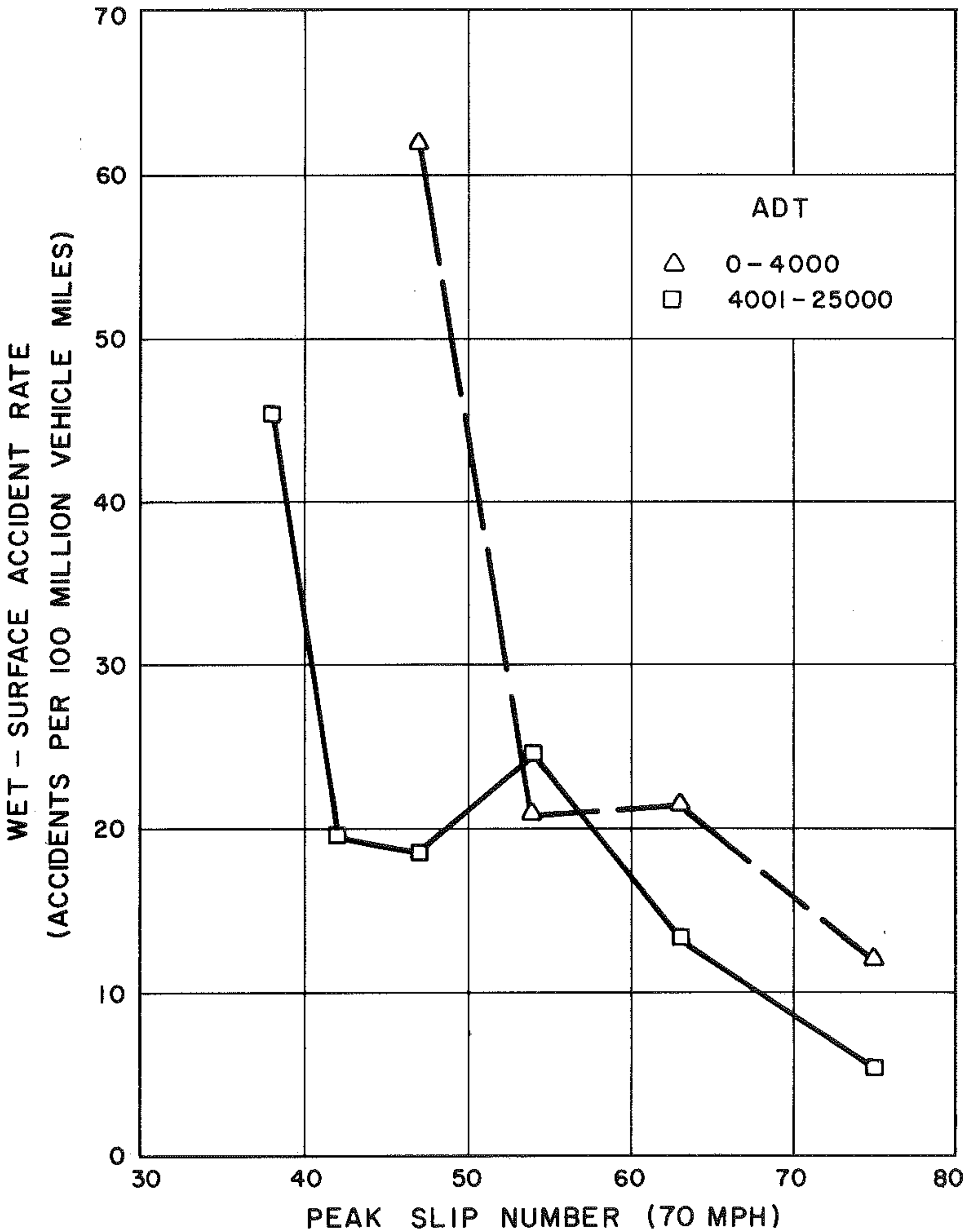

Figure 22. Comparison of Wet-Surface Accident Rate to Peak Slip Number with Volume Stratification at ADT of 4000 Vehicles Per Day.

accident rates were calculated for each Peak Slip Number (Table 10 and Figure 23). The plot indicates considerably more scatter than was obtained with Skid Numbers (Figure 18). The greatest change of slope occurred at a Peak Slip Number of about 50.

DISCUSSION AND CONCLUSIONS

On rural, four-lane, interstate and parkway facilities, accidents were found to be related to traffic volume. Accident rates on low volume sections decreased with increased ADT. Above 4,000 vehicles per day, accident rate appeared to be insensitive to variations in traffic volume. No data were available to indicate trends for highways with volumes in excess of 25,000 vehicles per day.

All four expressions of accident occurrences, when related with pavement friction, exhibited similar trends yet with different variability. Of the four expressions analyzed, wet-surface accidents per 100 million vehicle miles correlated best with skid resistance. Even using the best accident expression, scatter and spurious variability in data seem inevitable. Averaging methods are a means of developing trends and removing variability between the variables in the study. Of the averaging methods investigated, the "moving average method" yielded the better results. Definite trends were established in regard to the relationship between wet-surface accident rates and Skid Numbers. Wet-surface accident rate decreased rapidly as the Skid Number increased to 26; further increases in Skid Number beyond this point resulted in only a slight reduction in accidents.

In respect to friction measurements other than Skid Number, either the incipient friction measurement (Peak Slip Number) yielded less reliable data (measurement and chart analysis errors) or else the locked-wheel skid resistance (Skid Number) provided a better index of accident potential. A Peak Slip Number of 50 (the point of greatest change in the slope of the curve in Figure 23) is equivalent to a Skid Number of approximately 24 (Figure 8); analysis relating Skid Numbers and accidents yielded as Skid Number of 26 as the point of greatest slope change (Figure 19). This indicates that if friction requirements for locked-wheel conditions are met, peak friction needs are also satisfied.

Findings cited here should be viewed as preliminary because 1) data was for only one year and the sample size may be too small to adequately define relationships, 2) sampling one year's data may be influenced by climatic conditions, and 3) data types used (accident, friction and volume measurements) were obtained for different time periods. The analysis described herein should be repeated with all data, i.e. accidents, skid resistance and traffic volumes, applicable to the same year.

It should be pointed out, however, that repeat analyses (using all data for one year) still may not be sufficient to provide a proper indication as to minimum friction needs based on accident analysis alone. First, no consideration was given to the geometrics of roadways nor to points of traffic conflicts.

TABLE 10

WET-SURFACE ACCIDENT RATES* FOR TEST SECTIONS GROUPED BY PEAK SLIP NUMBER

PEAK SLIP NUMBER*	NUMBER OF TEST SECTIONS	WET-SURFACE ACCIDENT RATE**
38	1	35.1
39	2	47.4
40	0	
41	0	
42	0	
43	1	26.1
44	3	20.1
45	1	12.3
46	0	
47	4	22.2
48	2	14.7
49	0	
50	4	16.9
51	4	29.4
52	5	26.2
53	4	14.2
54	4	6.7
55	8	14.7
56	5	22.4
57	1	21.5
58	1	6.3
59	4	10.0
60	6	10.2
61	3	17.7
62	3	6.6
63	0	
64	0	
65	1	0.0
66	1	0.0
67	0	
68	3	7.8
69	0	
70	1	0.0
71	0	
72	0	
73	1	0.0
74	0	
75	0	
76	1	17.3
77	1	0.0

*PSN for 70-mph tests
**Accidents per 100 million vehicle miles

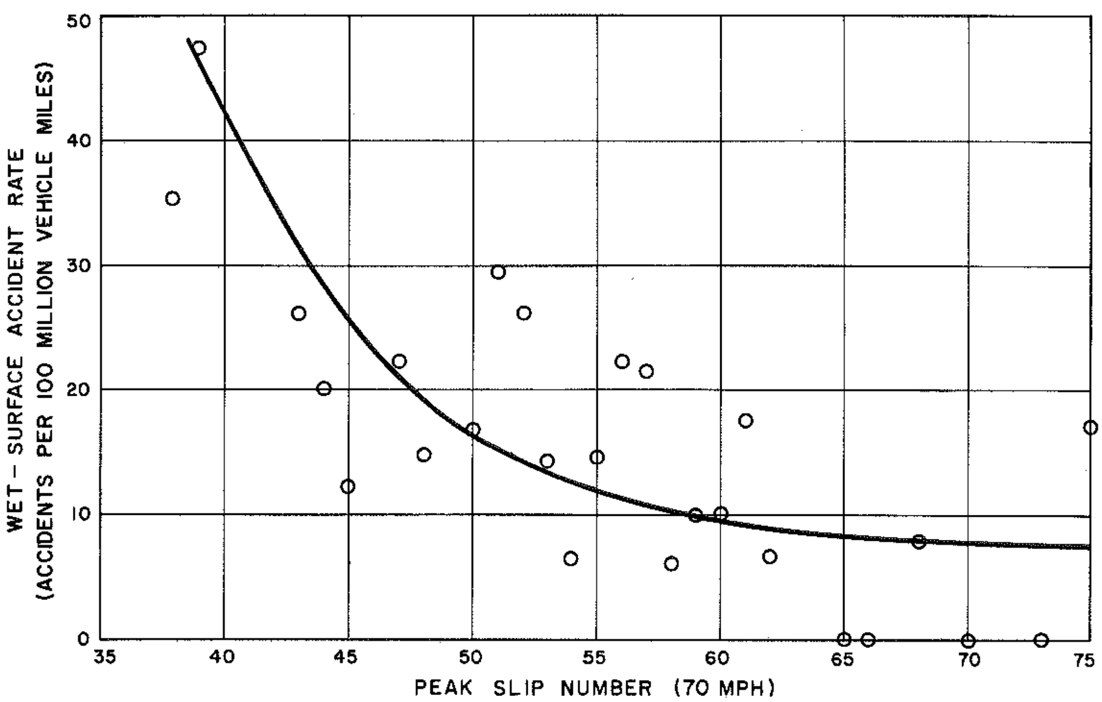

Figure 23. Average Wet-Surface Accident Rate of Test Sections -- Grouped by Peak Slip Number -- versus Peak Slip Number.

In dividing the roadways into half-mile sites according to a highest accident experience, it was found that 1302 sites out of 1559 experienced no wet-surface accidents at all. A cursory inspection of the 257 wet-surface accident sites revealed that many accidents occurred either at interchanges or on curved sections. However, a large number of accident sites were in tangent sections. Wet-surface accident locations need to be investigated in detail to determine what variable or combination of variables may be the causative factors.

The analysis herein involved accident data for the entire year while skid resistances were measured in the summer and fall when pavements exhibit lower friction values. The measured values, however, may not be assumed to represent the lowest friction during the year for a particular pavement or site nor for the road system as a whole. The rapid change in the slope of the curve in Figure 19, for instance, may occur at some higher or lower Skid Number value depending on when friction measurements are obtained. Wet-pavement accidents were more frequent during the period from June to November (shown in Table 11) even though the roads were wet during a lesser proportion of time. Lower friction during this period obviously contributed to increased wet-pavement accidents. Therefore, separation of accident data into subsets for two periods of the year may indicate somewhat different minimum friction needs for pavements.

The findings cited here, even though preliminary, are nevertheless significant. It was demonstrated that there is a relationship between accident experience and pavement friction; this relationship could be utilized in helping to establish minimum friction requirements for pavements. The established trends, relating wet-surface accident rates with skid resistance, indicated a definite value of skid resistance below which the accident rate increased rapidly. The methods described herein should be employed in future analyses involving accident histories and pavement skid resistance.

TABLE 11

SEMIANNUAL ACCIDENT SUMMARY

PERIOD (1970)	TOTAL ACCIDENTS	WET-SURFACE ACCIDENTS	WET/TOTAL (PERCENT)	PRECIPITATION (PERCENT)*
Jan - May, Dec	1,473	213	14.5	21
June - Nov	1,352	277	20.5	11

*Percent of total time of precipitation (trace or more) in the Lexington area for the six-month period.

REFERENCES

1. Giles C. G., *The Skidding Resistance of Roads and the Requirements of Modern Traffic*, **Proceedings**, Institution of Civil Engineers, Vol 6, February 1957.
2. Sabey, B. E., *Road Surface Characteristics and Skidding Resistance*, **Journal of British Granite and Whintone Federation**, Vol 5, No 2, Autumn 1965.
3. Kummer, H. W., and Meyer, W. E., *Tentative Skid Resistance Requirements for Main Rural Highways*, **National Cooperative Highway Research Program Report No. 37**, Highway Research Board, 1967.
4. McCullough, B. F., and Hankins, K. D., *Skid Resistance Guidelines for Surface Improvements on Texas Highways*, **Departmental Research Report No. 45-2**, Texas Highway Department, May 1965.
5. Mahone, D. C., and Runkle, S. N., *Pavement Friction Needs*, Virginia Highway Research Council, August 1971 (Draft).
6. Moore, A. B., and Humphreys, J. B., *A Study of Pavement Skid Resistance at High Speed and at Locations Shown to be Focal Points of Accidents*, The University of Tennessee, Department of Civil Engineering, April 1972.
7. *Skid Resistance of Paved Surfaces Using a Full-Scale Tire, E 274-70*, **Annual ASTM Standards**, Part II, 1971.
8. *Standard Tire for Pavement Tests, E 249-66*, **Annual ASTM Standards**, Part II, 1971.
9. Rizenbergs, R. L., Burchett, J. L., and Napier, C. T., *Skid Test Trailer: Description, Evaulation and Adaptation*, Division of Research, Kentucky Department of Highways, August 1972.
10. Fee, J. A., Beatty, R. L., Dietz, S. K., Kaurman, S. T., and Yates, J. G., *Interstate System Accident Research Study*, Federal Highway Administration, October 1970.
11. Hutchinson, J. W., and Kennedy, T. W., *Safety Considerations in Medians Design*, **Highway Research Record No. 162**, Highway Research Board, 1967.
12. Solomon, David, *Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle*, Government Printing Office, July 1964.

APPENDIX A

ACCIDENT RECORD FORMAT AND CODING

ACCIDENT CODE GUIDE

Col. 1-5 — Code the case number as given on the accident report.

Col. 6 — TYPE OF HIGHWAY
1. State and Federal Highway
3. County and Local Roads

Col. 7 — INVESTIGATED
5. Investigated by other than State Police
7. Investigated by State Police
9. Not Investigated

Col. 8 — TYPE OF ACCIDENT
0. Pedestrian
1. Other motor vehicle
2. Railroad train
3. Animal-drawn vehicle
4. Bicycle
5. Animal
6. Fixed Object
7. Overturned in roadway
8. Ran off roadway
9. Other non-collision

This column shows the type of accident. For example, two motor vehicles that collide would be coded as No. 1, one car that ran off roadway would be coded as No. 8, etc.

Col. 9-12 — ROUTE NO.
Record the exact numerical designation of the highway making sure that the last digit of the highway number goes in Col. 12. When the highway has a direction designation, i.e. 31 W the direction should be coded in Col. No. 9 as follows:

1 - North
2 - East
3 - South
4 - West

Highway No. 31E would be coded as follows:
In Column #9, a code number for East, (2), then put an (0) in Column #10, a (3) in Column #11, and a (1) in Column #12. In cases where the numerical designation of the highway does not fill the given columns, the ones not used will have an 0 in them.

CODE	INTERSTATES
9064	I-64
9065	I-65
9264	I-264 - Waterson Expressway
9071	I-71
9075	I-75

CODE	TURNPIKES AND/OR TOLL RDS.
0000	Kentucky Turnpike
9000	Eastern Ky. Turnpike - Mountain Pkwy.
9001	Western Ky. Turnpike
9002	Central Ky. Turnpike - Blue Grass Pkwy.
9003	Pennyrile Parkway
9004	Jackson Purchase Parkway

CODE	U. S. HIGHWAYS
0025	US 25 - Dixie Highway, Kenton Co.
0025	US 25 - Winchester, Madison Co.
0025	US 25 - Richmond Road
2025	US 25E
4025	US 25W
0027	US 27 - Nicholasville Road
2031	US 31E - Bardstown Road
4031	US 31W - Dixie Highway
5041	US 41A
0060	US 60 - Fayette Co.
0061	US 61 - Preston Highway

CODE	KENTUCKY HIGHWAYS
0001	Highways #1, etc.
0017	Ky 17 LLL
0004	Ky 4, Beltline in Lexington, Ky.
0155	Ky 155, Taylorsville Road
0008	Mary Ingles Highway

Col. 13-14 — MILES

Col. 15 — TENTHS OF MILES

Col. 16 — RECORD DIRECTION
1. North
2. East
3. South
4. West

Col. 17-20 — CITY CODE
City code is found in code index.

Col. 21-23 — COUNTY CODE
County Code is found in code index.

Col. 24

RURAL - URBAN

Code the population of the city

1. 2,500 10,000
2. 10,000 25,000
3. 25,000 50,000
4. 50,000 100,000
5. 100,000 250,000
6. 250,000 and over
8. All rural accidents
   This includes all accidents happening in cities of less than 2500 population.

Col. 25-26

CODE TIME OF DAY

00. Midnight to 12:59 a.m. (0001-0059)
01. 1:00 a.m. to 1:59 a.m.
02. 2:00 a.m. to 2:59 a.m.
03. 3:00 a.m. to 3:59 a.m.
04. 4:00 a.m. to 4:59 a.m.
05. 5:00 a.m. to 5:59 a.m.
06. 6:00 a.m. to 6:59 a.m.
07. 7:00 a.m. to 7:59 a.m.
08. 8:00 a.m. to 8:59 a.m.
09. 9:00 a.m. to 9:59 a.m.
10. 10:00 a.m. to 10:59 a.m.
11. 11:00 a.m. to 11:59 a.m.
12. 12:00 noon to 12:59 p.m.
13. 1:00 p.m. to 1:59 p.m.
14. 2:00 p.m. to 2:59 p.m.
15. 3:00 p.m. to 3:59 p.m.
16. 4:00 p.m. to 4:59 p.m.
17. 5:00 p.m. to 5:59 p.m.
18. 6:00 p.m. to 6:59 p.m.
19. 7:00 p.m. to 7:59 p.m.
20. 8:00 p.m. to 8:59 p.m.
21. 9:00 p.m. to 9:59 p.m.
22. 10:00 p.m. to 10:59 p.m.
23. 11:00 p.m. to 11:59 p.m.
24. 12:00 midnight

00 or 24 is exactly midnight

Col. 27

DAY OF WEEK

1. Sunday
2. Monday
3. Tuesday
4. Wednesday
5. Thursday
6. Friday
7. Saturday

Col. 28-29

DAY OF MONTH

Code the exact day of month.

Example:

Accident on 22nd day of month - 22

Accident on 7th day of month -- 07

Col. 30-31

MONTH

01. January
02. February
03. March
04. April
05. May
06. June
07. July
08. August
09. September
10. October
11. November
12. December

Col. 32

YEAR

Code the last digit of the year.

Col. 33

SEVERITY

0. Fatal Accident
1. Non-Fatal (Injury)
3. Property Damage

Col. 34

KIND OF ROAD

1. 1 driving lane
2. 2 driving lanes
3. 3 driving lanes
4. Four lanes or more
5. Divided Roadway
6. Expressway, toll road Parkway
7. Unpaved, any width
8. Not Stated

Col. 35

KIND OF LOCATION

1. Built Up
2. Not Built Up
3. Not Stated

Col. 36-37 & 71-72

VEHICLE ACTION

01. Go straight ahead
02. Overtake
03. Make right turn
04. Make left turn
05. Make U turn
06. Slow or stop
07. Start in traffic lane
08. Start from parked
09. Backing up
11. Remain parked
12. Other
13. Not Stated
14. Car in motion (Driverless)

Col. 38-39 PEDESTRIAN ACTION

01. Crossing or entering at an intersection
02. Crossing or entering not at intersection
03. Getting on or off vehicle
04. Walking with traffic
05. Walking against traffic
06. Standing
07. Push, work on vehicle
08. Other working
09. Playing
10. Other
11. Not in roadway
12. Not stated

Col. 40 ROAD CHARACTER

1. Level
2. On grade
3. On hill crest
4. Not stated

Col. 41

1. Straight road
2. Curve
4. Not stated

Col. 42

1. Intersection
2. Alley or driveway
3. Railroad
4. Other or not stated

Col. 43 ROAD SURFACE

1. Dry
2. Wet
3. Snowy or icy
4. Other and not stated

Col. 44 LIGHT

1. Daylight
2. Dawn or dusk
3. Darkness
4. Not stated

Col. 45-46 TRAFFIC CONTROL

01. Stop sign
02. Stop and go signal
03. Officer or watchman
04. Railroad gates or signals
05. Yield sign
06. Flash becaon
07. Center line
08. No passing zone
09. Curve sign
10. Speed zone
11. Advisory speed sign
12. Other

Col. 47 ROAD DEFECTS

1. Defective shoulders
2. Holes, deep ruts, bumps
3. Loose materials on surface
4. Road under construction
5. Specify other
6. No defects
7. Not stated

Col. 48-49 DIRECTIONAL ANALYSIS

PEDESTRIAN ACCIDENTS

01. Car going straight
02. Car turning right
03. Car turning left
04. Car backing
05. All others
06. Not stated

INTERSECTION, TWO VEHICLES

07. Entering at angle
08. From same direction - both going straight
09. From same direction - one turn, one straight
10. From same direction - one stopped
11. From same direction - all others
12. From opposite direction - both going straight
13. From opposite direction - one left turn, one straight
14. From opposite direction - all others
15. From opposite direction - not stated

NON-INTERSECTION, TWO VEHICLES

16. Going opposite direction both moving
17. Going same direction - both moving
18. One car parked
19. One car stopped in traffic
20. One car entering parked position
21. One car leaving parked position
22. One car entering alley or driveway
23. One car leaving alley or driveway
24. All others
25. Not stated

ALL OTHER ACCIDENTS
26. Collision with non-motor vehicle, train, streetcar, bicycle, etc., at intersection
30. Same - not at intersection
27. Collision with fixed object in roadway at intersection
31. Same - not at intersection
28. Overturned in roadway at intersection
32. Overturned in roadway not at intersection
29. Left roadway at intersection
33. Left roadway at curve - not at intersection
34. Left roadway on straight road not at intersection
35. Fell from moving vehicle
36. All others
37. Not stated

Col. 50&73

DRIVER RESIDENCE
1. Local Resident
2. Residing elsewhere in state
3. Non-resident of state
4. Not stated

Col. 51-52 & 74-75

VIOLATION
01. Speeding
02. Under influence or ability impaired
22. Not impaired
03. Passing on hill
04. Ran stop sign
05. Other improper passing
06. Passing on curve
07. On wrong side of road
08. Following too closely
09. Failure to yield right of way
10. Inattentive
11. Failure to signal
12. Other - Public Drunks
13. No operator license
14. Not stated
15. Hit and run
16. Racing
17. Reckless driving

Col. 53&76

DRIVER CITED
If driver is cited - code "0"

Col. 54-55 & 77-78

AGE OF DRIVER
01. 15 and under
02. 16
03. 17
04. 18-19
05. 20-24
06. 25-34
07. 35-44
08. 45-54
09. 55-64
10. 65-74
11. 75 and over
12. Not stated

Col. 56 & 79 & 68 & 91 & 98

SEX
0. Male
1. Female

Col. 57 & 80 & 69 & 92

SAFETY BELTS
5. No safety belt in vehicle
7. Safety belt in vehicle in use
9. Safety belt in vehicle not in use

Col. 58 & 70 & 81 & 93 & 99

INJURY
1. K - Death
2. A - Bleeding wound, distorted member, or had to be carried from scene.
3. B - Other visible injury as bruises, abrasions, swelling, limping and etc.
4. C - No visible injury, but complaint of pain.

Col. 59 & 82

LICENSE TYPE
0. Licensed in state - operator
1. Licensed in state - beginner
2. Licensed in state - chauffeur
3. Resident - No license
4. Non-resident - License in other state
5. Non-resident - No license
6. Resident - Licensed in other state
7. Not stated

Col. 60 & 83

LICENSE STATE
0. Kentucky
1. Illinois
2. Indiana
3. Ohio
4. West Virginia
5. Tennessee
6. Virginia
7. Missouri
9. Other states and not stated

Col. 61-62 & 84-85

VEHICLE TYPE
01. Passenger car
02. Passenger car and trailer
03. Truck or truck-tractor
04. Truck-tractor and semi-trailer
05. Other truck combination

06. Farm tractor and/or farm equipment
07. Taxicab
08. Bus
09. School Bus
10. Motorcycle
11. Motor-scooter or motor-bike
12. Other and not stated
13. Emergency vehicle (including privately owned)
14. Military vehicle
15. Other publicly owned vehicle
16. Go cart
17. Bicycle
When a bicyclist is involved in an accident, injured or killed, code in (Inj. #2) Column 89 through 93. Do not code as a driver or vehicle but code vehicle type (Col. 84-84) as a 17.
Always code as passenger number two.

Col. 63 & 86 — VEHICLE STATE REGISTRATION
Same code as license state, Column 60.

Col. 64 & 87 — VEHICLE DEFECTS
0. Defective brakes
1. Improper lights
2. Defective steering
3. Defective tires
4. Puncture or blow out
5. No trailer brakes
6. No defects
7. Not stated

Col. 64 & 88 — INJURY - LOCATION IN CAR
0. Driver
1. Passenger - front seat
2. Passenger - back seat
3. Passenger outside
4. Pedestrian
5. All others - not stated

Col. 66-67 & 89-90 & 96-97 — AGE OF INJURED
01. 0-4 years old
02. 5-9 years old
03. 10-14 years
04. 15-19 years
05. 20-24 years
06. 25-34 years
07. 35-44 years
08. 45-54 years
09. 55-64 years
10. 65-74 years
11. 75 and over
12. Not stated

Col. 94 — PEDESTRIAN VIOLATION
If pedestrian arrested, code "0"

Col. 95 — 1. Public drunk

Col. 100-101 — Post - Blank

Col. 102-105 — MILEPOST MARKER

Example:

Col.	102	103	104	105
.1 miles	0	0	0	1
1.1 miles	0	0	1	1
11.1 miles	0	1	1	1
111.1 miles	1	1	1	1

Col. 106 — AID
Must be Alpha

Col. 107-108 — TRAILERS
Show number of cards on each accident using No. 01, 02, 03, 04, etc., using No. 01 on first card in case there is a trailer.

APPENDIX B

ACCIDENT AND FRICTION DATA FOR 122 TEST SECTIONS

ROUTE CODE	LENGTH (MILES)	ADT	ACCIDENTS			ACCIDENT RATIO		ACCIDENT RATE*		70-MPH SKID NUMBER**			70-MPH PEAK SLIP NUMBER**		
			TOTAL	WET	DRY	WET/DRY	WET/TOTAL	WET	TOTAL	Min	Avg	Max	Min	Avg	Max
I 64	6.5	12480	4	0	1	0.00	0.00	0.0	13.5	24	25	31	53	62	74
	6.1	11670	4	1	3	0.33	0.25	3.8	15.4	21	26	40	51	60	69
	6.9	12970	36	7	17	0.41	0.19	21.4	110.2	22	23	26	47	55	65
	5.3	12970	20	2	8	0.25	0.10	6.7	67.1	17	23	26	53	60	66
	5.2	9780	28	5	14	0.36	0.18	26.9	150.8	19	23	25	48	62	63
	4.4	10650	9	1	7	0.14	0.11	5.8	52.6	16	23	26	56	60	67
	5.3	8240	11	3	5	0.60	0.27	18.8	69.0	21	23	29	50	56	64
	4.7	11610	30	5	14	0.36	0.17	25.1	150.6	19	23	29	34	55	60
	4.9	24170	1	0	1	0.00	0.00	0.0	2.3	21	25	28	50	56	58
	7.2	11850	2	1	1	1.00	0.50	3.2	6.4	22	27	29	44	51	54
	4.9	13640	2	0	2	0.00	0.00	0.0	8.2	32	36	40	61	70	73
	3.0	11610	2	0	1	0.00	0.00	0.0	15.7	33	35	38	74	77	82
	6.6	7500	2	0	2	0.00	0.00	0.0	11.1	31	36	41	64	73	80
	8.4	5670	8	3	3	1.00	0.38	17.3	46.0	34	38	44	71	76	83
	10.2	5670	16	3	7	0.43	0.19	14.2	75.8	20	25	31	53	59	62
	7.1	4930	7	0	3	0.00	0.00	0.0	54.8	20	24	29	60	65	69
	8.0	4360	13	1	7	0.14	0.08	7.9	102.1	20	24	31	47	58	64
	8.8	3320	5	0	3	0.00	0.00	0.0	56.3	25	30	35	44	59	64
	8.1	3320	11	3	5	0.60	0.27	30.6	112.1	27	33	41	54	64	69
	7.3	3490	4	1	2	0.50	0.25	10.8	43.0	32	37	41	60	67	79
	6.8	4240	4	0	3	0.00	0.00	0.0	38.0	26	30	33	49	59	67
	3.3	3540	3	1	2	0.50	0.33	22.8	68.4	28	33	36	57	64	74
	4.1	5110	3	0	3	0.00	0.00	0.0	39.2	25	28	31	47	55	59
	5.8	5110	5	2	2	1.00	0.40	18.5	46.2	22	27	37	41	47	67
I 65	11.0	10300	33	5	19	0.26	0.15	12.1	79.8	15	22	27	31	50	53
	9.4	10950	13	2	6	0.33	0.15	5.3	34.6	18	22	26	35	50	53
	5.7	11690	24	3	11	0.27	0.12	12.3	98.7	19	24	26	25	45	56
	7.1	15600	24	5	15	0.33	0.21	12.4	59.4	18	22	28	31	51	63
	12.2	11290	58	11	33	0.33	0.19	21.9	115.4	16	20	28	31	47	65
	9.6	11360	74	18	29	0.62	0.24	45.2	185.9	15	20	32	31	39	50
	3.4	11830	15	4	10	0.40	0.27	27.2	102.2	18	23	26	44	51	59
	3.9	11830	17	5	6	0.83	0.29	29.7	101.0	17	24	26	49	50	62
	6.8	14640	35	11	16	0.69	0.31	30.3	96.3	21	25	33	49	56	66
	5.1	12340	17	4	9	0.44	0.23	17.4	74.0	25	30	35	51	59	71
	2.6	12090	14	2	2	1.00	0.14	17.4	122.0	13	24	29	31	47	64
	13.3	14440	63	7	53	0.13	0.08	10.0	118.4	16	28	36	34	62	64
I 71	12.7	11730	46	12	24	0.60	0.26	22.0	84.5	17	20	28	37	51	68
	8.1	8830	24	6	11	0.54	0.25	30.5	122.1	19	22	28	35	44	64
	8.5	8890	53	7	21	0.33	0.13	26.0	196.5	17	19	22	32	44	58
	7.9	8750	31	7	16	0.44	0.23	27.7	122.9	16	20	28	36	44	72
	12.1	10520	30	3	18	0.17	0.10	6.5	64.8	14	20	26	35	44	59
	6.3	9920	21	5	8	0.62	0.24	26.1	108.4	18	20	22	34	43	52
	8.1	10610	52	11	11	1.00	0.21	35.1	165.8	15	20	20	28	38	49
	6.7	8260	28	10	10	1.00	0.36	48.5	138.6	14	16	19	32	39	45
I 75	3.8	9360	8	4	2	2.00	0.50	30.8	61.6	18	22	26	42	47	52
	5.7	9360	11	1	5	0.20	0.09	5.1	56.5	20	22	24	48	54	65
	4.4	9580	13	3	5	0.60	0.23	19.5	84.6	15	19	24	44	46	55
	8.3	9480	27	4	13	0.31	0.15	13.9	94.0	17	21	26	48	52	62
	3.6	10220	13	1	9	0.11	0.08	7.1	91.7	22	25	28	50	58	72
	5.4	10220	40	2	21	0.09	0.05	9.9	198.6	18	23	26	38	48	52
	5.2	11410	17	1	9	0.11	0.06	4.6	78.5	19	26	28	48	54	58
	6.2	14700	18	4	11	0.36	0.21	12.0	57.1	19	22	24	40	57	52
	9.8	14700	8	2	5	0.40	0.22	9.8	44.1	22	24	26	54	64	69
	7.4	14700	45	6	26	0.23	0.13	15.1	115.9	22	23	28	38	53	78
	6.8	13170	35	7	12	0.58	0.18	16.9	91.9	26	32	35	57	66	70
	3.3	14800	15	2	9	0.22	0.13	11.5	85.9	20	26	29	59	61	61
	3.1	14800	10	2	6	0.33	0.20	12.2	61.0	25	27	30	46	58	67
	6.9	14800	30	4	11	0.36	0.13	11.0	82.2	23	26	30	45	58	61
	11.4	18380	85	14	43	0.33	0.16	20.5	180.4	18	20	22	40	55	61
	2.7	18080	18	4	11	0.36	0.22	21.8	98.7	10	22	27	46	55	62
	7.4	25500	38	6	26	0.23	0.16	8.5	58.8	30	33	38	48	62	67
	3.6	22480	13	0	6	0.00	0.00	0.0	44.0	24	27	33	49	65	80
	3.4	21580	4	0	4	0.00	0.00	0.0	15.0	22	28	28	48	58	60
	5.7	21780	8	0	2	0.00	0.00	0.0	17.7	25	30	35	51	66	67
	7.0	15860	11	0	9	0.00	0.00	0.0	27.1	27	32	35	58	69	72
	10.5	16170	62	4	37	0.11	0.06	6.5	100.0	26	28	33	62	68	78
	6.0	14190	83	11	38	0.29	0.12	26.5	224.4	21	25	30	44	53	58
	9.7	14190	72	8	46	0.18	0.11	15.9	143.3	21	28	35	50	60	65
	4.4	14970	37	8	19	0.42	0.22	33.3	153.9	18	22	27	48	55	69
	7.4	18230	91	25	31	0.81	0.28	50.8	184.8	23	22	30	45	56	61
	5.4	18230	33	4	14	0.29	0.12	11.1	64.0	21	24	26	54	61	68
KY TURN-PIKE	12.3	16100	101	21	46	0.46	0.21	28.1	138.7	23	26	30	54	60	67
	12.8	16100	178	32	87	0.37	0.18	42.5	241.7	21	24	28	44	52	72
	12.5	16100	169	41	78	0.52	0.24	55.8	230.1	20	23	29	42	51	60
MOUNTAIN PARKWAY	4.1	4120	3	1	1	1.00	0.33	16.2	48.7	24	25	28	53	55	58
	6.1	4120	7	2	2	1.00	0.29	21.8	76.3	22	25	28	48	52	58
	5.9	4120	15	2	7	0.29	0.13	25.1	168.2	21	24	27	47	52	60
	3.1	4120	2	1	0	0.00	0.50	21.6	42.0	21	24	29	46	57	59
	6.5	4120	7	0	3	0.00	0.00	0.0	84.6	21	25	31	42	55	63
	3.5	3120	4	0	4	0.00	0.00	0.0	100.4	24	25	27	46	59	61
	3.6	3120	5	2	2	1.00	0.40	48.8	122.0	20	21	28	43	49	62
	4.4	1720	14	4	5	0.80	0.29	144.8	506.6	19	23	26	40	48	61
	6.0	1720	7	0	4	0.00	0.00	0.0	185.8	20	22	24	39	46	55
WESTERN KENTUCKY PARKWAY	5.8	2830	6	0	6	0.00	0.00	0.0	121.8	35	38	44	63	69	71
	7.9	2810	8	1	7	0.14	0.12	13.3	106.3	31	38	41	48	66	74
	2.7	2810	2	0	2	0.00	0.00	0.0	77.6	28	34	48	40	65	76
	13.3	2810	10	2	4	0.50	0.20	15.8	78.9	24	31	41	51	59	69
	4.6	2860	3	1	2	0.50	0.33	20.8	62.5	23	31	38	46	60	84
	5.5	2860	5	1	4	0.25	0.20	17.4	87.1	24	28	35	53	59	67
	5.4	2860	3	0	3	0.00	0.00	0.0	53.2	22	27	32	53	57	61
	3.5	2860	3	1	2	0.50	0.33	27.4	82.1	24	31	37	55	66	74
	8.1	2860	11	4	4	1.00	0.36	47.3	130.1	28	33	38	52	69	70
	5.9	2860	1	0	1	0.00	0.00	0.0	13.8	28	33	42	53	57	69
	11.1	2860	10	3	4	0.75	0.30	25.8	86.3	28	33	40	50	62	68
	7.6	2860	9	1	7	0.14	0.11	12.6	113.4	25	30	34	57	61	68
	7.5	2860	6	2	0	0.00	0.33	25.5	76.6	24	32	36	46	61	70
	6.1	2860	7	4	3	1.33	0.57	47.3	82.8	30	37	43	45	68	78
	6.7	3270	5	0	4	0.00	0.00	0.0	43.2	18	27	34	45	53	68
	6.1	3270	1	1	0	0.00	1.00	13.7	13.7	30	38	44	60	66	72
	7.3	3270	5	0	3	0.00	0.00	0.0	53.7	32	33	38	57	66	72
	5.5	3270	12	1	4	0.25	0.08	15.2	182.8	31	36	40	55	65	72
BLUEGRASS PARKWAY	16.4	3820	11	2	9	0.22	0.18	8.7	48.1	40	45	51	56	72	87
	7.7	3820	11	3	4	0.75	0.27	27.9	102.5	49	47	56	68	81	86
	10.0	4000	7	1	5	0.20	0.14	6.8	47.9	25	28	31	47	56	74
	8.0	4000	7	2	5	0.40	0.28	17.1	59.9	29	28	33	48	59	73
	6.1	4000	7	0	3	0.00	0.00	0.0	78.6	22	27	35	49	59	70
	14.1	4700	24	2	17	0.12	0.08	8.3	99.2	23	26	31	48	60	70
	11.8	4700	8	0	7	0.00	0.00	0.0	45.2	32	38	46	57	65	79
PENNYRILE PARKWAY	5.0	2000	6	1	5	0.20	0.17	27.4	164.4	30	34	37	63	67	77
	5.0	2130	2	0	2	0.00	0.00	0.0	51.4	22	31	38	62	66	72
	6.3	2130	3	0	3	0.00	0.00	0.0	61.2	25	31	38	54	69	74
	6.8	2130	8	1	5	0.20	0.12	19.0	151.4	24	29	33	59	65	72
	8.8	1000	7	1	6	0.17	0.14	31.1	217.9	20	28	36	51	61	69
	7.1	1000	16	1	10	0.10	0.06	38.6	617.4	27	31	38	55	59	65
	7.9	1000	8	1	6	0.17	0.12	34.7	277.4	25	31	33	55	60	64
	9.7	1000	6	2	4	0.50	0.33	56.5	169.5	24	32	41	52	63	69
JACKSON PURCHASE PARKWAY	2.0	1100	0	0	0	0.00	0.00	0.0	0.0	46	50	56	53	68	77
	6.4	1100	5	0	3	0.00	0.00	0.0	194.6	28	37	45	55	70	80
	5.4	1100	0	0	0	0.00	0.00	0.0	0.0	28	37	41	62	71	74
	6.2	1100	8	2	5	0.40	0.25	80.7	243.0	33	36	41	61	67	76
	14.4	1100	0	0	0	0.00	0.00	0.0	0.0	28	34	40	52	66	77
	12.8	1100	4	1	3	0.33	0.25	19.5	77.8	37	40	47	57	72	80

*Accidents per 100 million vehicle miles
**Minimum, average and maximum values in outer lanes independent of direction of travel

APPENDIX C

ACCIDENT AND FRICTION DATA FOR 257 HALF-MILE SITES

ROUTE	WET-SURFACE ACCIDENT RATE*	70-MPH SKID NUMBER	MIDPOINT MILE MARKER
I 64	2.89	38	103.4
	1.65	33	149.3
	1.65	33	145.3
	1.61	34	151.7
	1.57	37	158.5
	1.50	33	168.4
	1.25	24	130.5
	1.12	23	38.9
	1.07	27	189.4
	1.07	27	186.8
	0.96	25	115.6
	0.96	25	114.2
	0.96	25	111.0
	0.94	23	55.1
	0.84	23	26.1
	0.66	23	52.2
	0.56	23	42.9
	0.56	23	42.2
	0.56	23	40.4
	0.50	23	53.2
	0.47	23	56.3
	0.47	23	54.3
	0.46	27	79.8
	0.46	26	23.8
	0.42	23	36.9
	0.42	23	31.8
	0.42	23	30.1
	0.42	23	29.5
	0.42	23	28.1
	0.42	23	27.1
I 65	2.41	20	54.0
	1.94	20	47.7
	1.44	20	55.2
	1.17	22	28.2
	1.13	28	92.2
	1.12	25	70.7
	1.12	25	69.2
	1.12	25	66.6
	1.06	22	8.7
	0.97	20	42.5
	0.96	20	57.3
	0.96	20	56.1
	0.96	20	53.2
	0.92	24	64.1
	0.92	23	57.8
	0.88	30	73.4
	0.75	28	91.1
	0.70	22	35.2
	0.53	22	12.2
	0.53	22	8.2
	0.53	22	2.2
	0.50	22	19.3
	0.50	22	13.8
	0.48	20	52.7
	0.48	20	50.4
	0.48	20	49.9
	0.48	20	44.3
I 65	0.48	20	43.6
	0.48	20	42.0
	0.48	20	37.9
	0.48	20	36.5
	0.46	24	63.0
	0.46	24	61.5
	0.46	23	60.3
	0.46	23	58.7
	0.45	24	79.1
	0.45	24	77.0
	0.44	30	75.8
	0.44	30	74.5
	0.38	24	65.0
	0.37	28	90.2
	0.37	28	84.8
	0.37	25	67.7
	0.35	22	32.6
	0.35	22	30.3
	0.35	22	29.0
I 71	4.64	16	77.2
	2.58	20	63.3
	1.86	22	23.9
	1.26	19	35.8
	1.26	19	32.6
	1.25	20	44.2
	1.25	20	41.1
	1.10	20	59.0
	1.10	20	57.9
	1.04	20	53.5
	1.03	20	62.8
	1.03	20	62.2
	0.93	20	18.5
	0.93	20	18.0
	0.93	20	16.5
	0.93	20	11.7
	0.66	16	73.9
	0.66	16	70.9
	0.63	19	34.9
	0.63	19	34.2
	0.63	19	28.7
	0.62	20	42.9
	0.62	20	40.0
	0.62	20	38.8
	0.62	20	28.0
	0.62	22	26.7
	0.62	22	25.2
	0.55	20	58.5
	0.52	20	45.1
	0.51	20	67.2
	0.46	20	21.2
	0.46	20	16.0
	0.46	20	14.1
	0.46	20	9.5
I 75	1.66	32	59.4
	1.33	20	82.1
	1.20	22	158.8

ROUTE	WET-SURFACE ACCIDENT RATE*	70-MPH SKID NUMBER	MIDPOINT MILE MARKER
I 75	1.20	22	155.6
	1.17	28	62.7
	1.17	22	3.3
	1.15	21	21.6
	1.15	21	15.8
	1.14	19	13.4
	1.07	23	30.8
	0.90	22	162.2
	0.90	22	156.8
	0.90	22	155.1
	0.77	25	140.3
	0.77	25	136.6
	0.77	25	133.4
	0.75	26	74.0
	0.74	23	53.6
	0.74	23	52.7
	0.73	22	154.4
	0.73	22	153.3
	0.73	22	152.0
	0.66	20	85.5
	0.66	20	83.7
	0.66	20	83.2
	0.66	20	79.6
	0.60	24	165.5
	0.60	22	158.1
	0.58	22	2.1
	0.57	19	9.7
	0.53	25	24.4
	0.48	26	35.5
	0.46	33	94.0
	0.41	32	62.2
	0.38	28	149.7
	0.38	28	148.8
	0.38	28	148.0
	0.38	28	144.5
	0.38	28	143.9
	0.38	28	141.2
	0.38	25	138.7
	0.38	25	137.7
	0.38	25	136.1
	0.38	25	135.6
	0.38	25	134.9
	0.37	26	73.3
	0.37	26	72.7
	0.37	27	67.9
	0.37	27	67.4
	0.37	26	65.0
	0.37	23	52.2
	0.37	23	48.1
	0.37	24	44.5
	0.37	22	42.2
	0.37	22	39.3
	0.36	22	153.9
	0.33	28	128.8
	0.33	28	127.8
	0.33	28	127.0
	0.33	28	125.5
I 75	0.33	20	86.3
	0.33	20	77.6
	0.30	24	165.0
	0.30	22	161.5
	0.30	22	160.3
	0.30	22	159.8
	0.30	22	157.6
	0.30	22	156.3
	0.28	22	89.9
	0.28	22	87.9
	0.23	33	95.5
	0.23	33	90.6
KENTUCKY TURNPIKE	2.38	23	130.1
	2.04	24	114.2
	1.70	23	118.0
	1.70	24	109.0
	1.36	23	128.0
	1.36	23	122.0
	1.36	23	119.4
	1.36	24	116.9
	1.36	24	115.8
	1.36	25	94.4
	1.02	23	129.6
	1.02	23	127.4
	1.02	24	110.2
	1.02	24	107.7
	1.02	25	103.9
	1.02	25	95.8
	0.68	23	128.7
	0.68	23	120.8
	0.68	23	120.1
	0.68	24	116.3
	0.68	25	101.2
	0.68	25	100.1
	0.34	23	126.8
	0.34	23	126.2
	0.34	23	124.7
	0.34	24	111.2
	0.34	24	108.5
	0.34	24	107.2
	0.34	24	106.7
	0.34	24	105.0
	0.34	25	103.4
	0.34	25	102.0
	0.34	25	100.7
	0.34	25	97.3
	0.34	25	96.4
	0.34	25	95.3
MOUNTAIN PARKWAY	6.37	23	34.1
	3.18	22	36.0
	3.18	23	35.5
	1.75	21	31.1
	1.32	24	14.8
	1.32	25	10.2
	1.32	25	6.3

ROUTE	WET-SURFACE ACCIDENT RATE*	70-MPH SKID NUMBER	MIDPOINT MILE MARKER
WESTERN KENTUCKY PARKWAY	3.83	37	92.1
	3.83	33	49.2
	3.43	29	98.2
	2.09	31	26.2
	2.09	31	19.4
	2.09	35	13.6
	1.91	33	89.8
	1.91	32	82.7
	1.91	30	76.8
	1.91	33	72.2
	1.91	33	71.4
	1.91	33	68.2
	1.91	33	55.3
	1.91	33	52.7
	1.91	31	46.7
	1.91	29	36.0
	1.91	31	33.5
	1.67	36	124.2
	1.67	38	112.0
BLUEGRASS PARKWAY	2.88	45	0.7
	2.33	26	49.9
	1.43	47	21.0
	1.43	47	20.0
	1.43	47	18.4
	1.38	28	41.9
	1.36	28	39.8
	1.36	28	32.5
PENNYRILE PARKWAY	5.47	32	74.6
	5.47	32	72.6
	5.47	31	62.8
	2.73	34	7.0
	2.57	29	29.5

*Accidents per million vehicle miles