Research Report
302

OPERATIONAL EFFECTS OF AUTO-UTILITY TRAILER COMBINATIONS ON RURAL HIGHWAYS IN KENTUCKY

KYP 16

by

Bruce S. Siria
Research Engineer Associate

January 1971

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May 21, 1971

H-3-16

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

SUBJECT: Research Report: "Operation of Auto-Utility Trailer Combinations on Rural Highways in Kentucky;" KYP - 16; HPR - 1 (6), Part III

Boat trailers, campers, rental-type trailers, etc., comprise a surprising proportion of traffic and a somewhat disproportionately high accident involvement rate. Heretofore, these appendant vehicles have been ignored in traffic classification and volume counts -- except where automatic traffic recorder (ATR) stations count axles. The report submitted herewith represents the first known attempt to evaluate, in depth, the contribution of A-UT's to traffic statistics.

Mr. Siria resigned at the end of February.

Respectfully submitted,

Jas. H. Havens
Director of Research

Attachment

cc's: Assistant State Highway Engineer, Research and Development
Assistant State Highway Engineer, Planning and Programming
Assistant State Highway Engineer, Pre-Construction
Assistant State Highway Engineer, Construction
Assistant State Highway Engineer, Operations
Assistant State Highway Engineer, Staff Services
Assistant Pre-Construction Engineer
Assistant Operations Engineer
Executive Director, Office of Computer Services
Executive Director, Office of Equipment and Properties
Director, Division of Bridges
Director, Division of Construction
Director, Division of Design
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Director, Division of Right of Way
Director, Division of Roadside Development
Director, Division of Rural Roads
Director, Division of Traffic
Division Engineer, Federal Highway Administration
Chairman, Department of Civil Engineering, University of Kentucky
Associate Dean for Continuing Education, College of Engineering, University of Kentucky
All District Engineers

JHH: sg

ABSTRACT

An analysis of accident records indicated that A-UT combinations are involved in a disproportionately high number of traffic mishaps. Locations which have a history of accidents involving A-UT vehicles indicated that differential crosswinds and unanticipated driving maneuvers contribute to driver loss of control. A-UT combinations contributed to the fatigue loss in pavement life approximately 50 percent as much as single-unit, two-axle, six-tire trucks (per vehicle). In general, this vehicle type constituted approximately three percent of the total traffic stream. Analysis of speed distributions indicated an equivalency factor for A-UT combinations equal to that for trucks for similar roadway types and topographical conditions.

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Division of Research
DEPARTMENT OF HIGHWAYS
Commonwealth of Kentucky

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INTRODUCTION

The Division of Research, Kentucky Department of Highways, has recently completed several studies concerning characterization of traffic on highway facilities within the state. The first of these studies *(1)* was the result of an attempt to establish a methodology for the prediction of the composition of the traffic stream as related to significant local variables. The methodology was needed to increase the accuracy of predictions of cumulative equivalent wheel loads (or of equivalent axleloads, depending upon the terminology used), commonly referred to as EWL's (EAL's). The report *(1)* proposed a procedure for the prediction of cumulative EAL's for rural highways in Kentucky based on a statistical evaluation of data gathered over a 17-year period (1950-1966). The validity of this procedure depends upon the accuracy of the vehicle classification and loadometer data used as inputs.

A second study *(2)* was conducted to enhance the validity of the predictive technique of the first by providing data on the lateral distribution of traffic on four- and six-lane limited access facilities. Previous design procedures *(3)* had assumed that all EAL's were accumulated in the shoulder lane. As a result of the second study, a tentative recommendation *(4)* to consider only 85 percent of the total cumulative EAL's in the design lane was vindicated.

A third study *(5)* was conducted to analyze loadometer data and classification information of traffic utilizing bridges which span the Ohio River from Kentucky. The result of this traffic analysis, complemented by a data bank of existing information *(6)*, was a proposed methodology by which the fatigue life of a bridge could be evaluated.

In conjunction with the lane distribution study and the bridge fatigue study, a considerable volume of traffic was counted, classified, coded and comprehensively analyzed. A surprisingly large number of automobiles pulling utility trailers was noted by the data collectors. Preliminary observations indicated that during peak periods of traffic flow up to ten percent of the total traffic stream was composed of auto-utility trailer (A-UT) combinations.

Present methods of classifying vehicle types *(7)* do not segregate this vehicle combination. Traffic classification counts merely denote an auto-utility trailer combination as a passenger car. If a trailer is being pulled by a pickup truck, the combination is recorded as a single unit, two-axle, four-tire truck. In compliance with this practice, previous studies of traffic characteristics *(1,2,5,6)* made no special notation of these vehicles.

The present study was conceived with the following objectives:

1. To establish the degree of usage on certain rural Kentucky highways by automobile-utility trailer combinations,

2. To ascertain the effect of A-UT combinations on capacity (level of service) for various highway types and various dissimilar highway sections (in terms of number of equivalent autos),

3. To provide a basic data bank for denoting quantitative trends for this vehicle type in the future,

4. To examine the advisability of counting A-UT combinations separately in classification studies,

5. To consider the effect A-UT axleloads have on the total equivalent axleload accumulation, and

6. To investigate accidents involving A-UT vehicles.

ACCIDENT DATA AND ANALYSIS

Preliminary comparisons of the accident involvement rate of A-UT combinations to the percentage of this vehicle type in the traffic stream revealed a glaring disproportionality as displayed in Table 1. The data were obtained from toll roads records *(8)* and from available accident reports. The percentages being compared were not amenable to statistical techniques of evaluation since they were in violation of the assumptions requisite to comparison of proportions. (A summary of statistical theory and tests utilized in the analysis of data contained herein is presented in Appendix A.) In addition, there were many variables which affect each proportion and it is perhaps wise not to attempt a strictly analytical comparison of the relative differences between the two proportions for each road-year data set. Still, a comparison between the ratios in each case offered some insights. The ratios of the proportions for each road-year data set are shown in Table 2. Since these figures were valuable for intuitive purposes primarily, it was anticipated that a detailed analysis of accident records would provide additional information.

Other researchers have observed a seemingly greater rate of accident occurence for cars pulling trailers than for standard autobmobiles *(9)*. A risk index of a vehicle was defined as the number of accidents relative to the mileage travelled by that vehicle type. A standard 3000-pound automobile was arbitrarily assigned a base value of 1.00 for its risk index. Figure 1 relates the relative risk indices of vehicles with and without trailers. It can be seen that in each case, the risk index for the vehicle with the trailer in tow is many times that of the vehicle without the trailer. An especially noticeable difference in trailer and non-trailer accident risk indices for compact and small cars can be easily seen. Furthermore, it was observed that a trailer adds to the chances of a vehicle overturning in an accident.

ACCIDENT RECORDS

Extensive accident records of limited access highways were available for analysis from several concurrent studies of the Division of Research *(10, 11)*. Table 3 shows the road-year data sets which were available for immediate analysis. It was decided to utilize these existing accident records to the fullest possible extent.

In addition to tnese accident records already available, supplemental reports were obtained coincidental with other data to be collected for this study. These data sets included a more complete listing of accidents on I 75 and accident records at several non-controlled access highway sections. Table 4 shows a listing of the supplemental accident records available.

ACCIDENT CODING SCHEME

The handling, inspection and analysis of the immense quantity of accident records to be used in the study necessitated the transfer of pertinent data to computer cards. This was no small task in itself, but the anticipated economy of time and money justified the effort. The decision to use automatic data processing compelled a selection of specific data to be gleaned from the accident report forms for transfer to computer cards.

Several accident coding schemes were extant *(12, 13)*, but none was appropriate to this study. An accident coding scheme was created especially for this study included in this scheme was that information which was believed to be relevant to the type of analysis to be performed. The first 71 columns were specifically referenced to this study. The remaining columns were relevant to other active and proposed studies.

ACCIDENT ANALYSIS

The initial step in the analysis of the characteristics of accidents involving A-UT combinations was to compare A-UT accident trends with those of accidents in general. The procedure involved examination of all single vehicle accidents, accidents involving A-UT combinations, single vehicle accidents involving A-UT combinations, and traffic volumes by means of a graphical representation of trends by hour of day, day of week, and month of year. Figure 2 shows total traffic volume distribution and the distribution of accident occurrence by hour of day as observed at the I 75 Scott County location. It can be seen that the distributions were similar. Also illustrated is the distribution of A-UT accidents as a function of hour for comparison. Although this curve was not as smooth as that for all accidents (due to a smaller sample size), the same comparative trend was evident. Figure 3 shows the same comparison for

TABLE I
PERCENT OF ACCIDENTS INVOLVING A-UT COMBINATIONS AND PERCENT OF A-UT COMBINATIONS IN TRAFFIC STREAM ON KENTUCKY TOLL ROADS

ROAD	YEAR	PERCENT ACCIDENTS INVOLVING A-UT COMBINATIONS	PERCENT A-UT COMBINATIONS IN TRAFFIC STREAM *(9)*
Bluegrass Parkway	1967	6.58	2.85
Bluegrass Parkway	1968	11.42	3.08
Kentucky Turnpike	1967	5.95	2.51
Kentucky Turnpike	1968	7.78	2.79
Mountain Parkway	1967	4.75	1.22
Mountain Parkway	1968	2.12	1.32
West Kentucky Parkway	1967	10.44	3.61
West Kentucky Parkway	1968	7.37	4.08

TABLE 2
PERCENT ACCIDENTS INVOLVING A-UT COMBINATIONS TO PERCENT OF A-UT COMBINATIONS IN TRAFFIC STREAM

ROAD	YEAR	RATIO
Bluegrass Parkway	1967	2.31
Bluegrass Parkway	1968	3.71
Kentucky Turnpike	1967	2.37
Kentucky Turnpike	1968	2.79
Mountain Parkway	1967	3.89
Mountain Parkway	1968	1.61
West Kentucky Parkway	1967	2.89
West Kentucky Parkway	1968	1.81

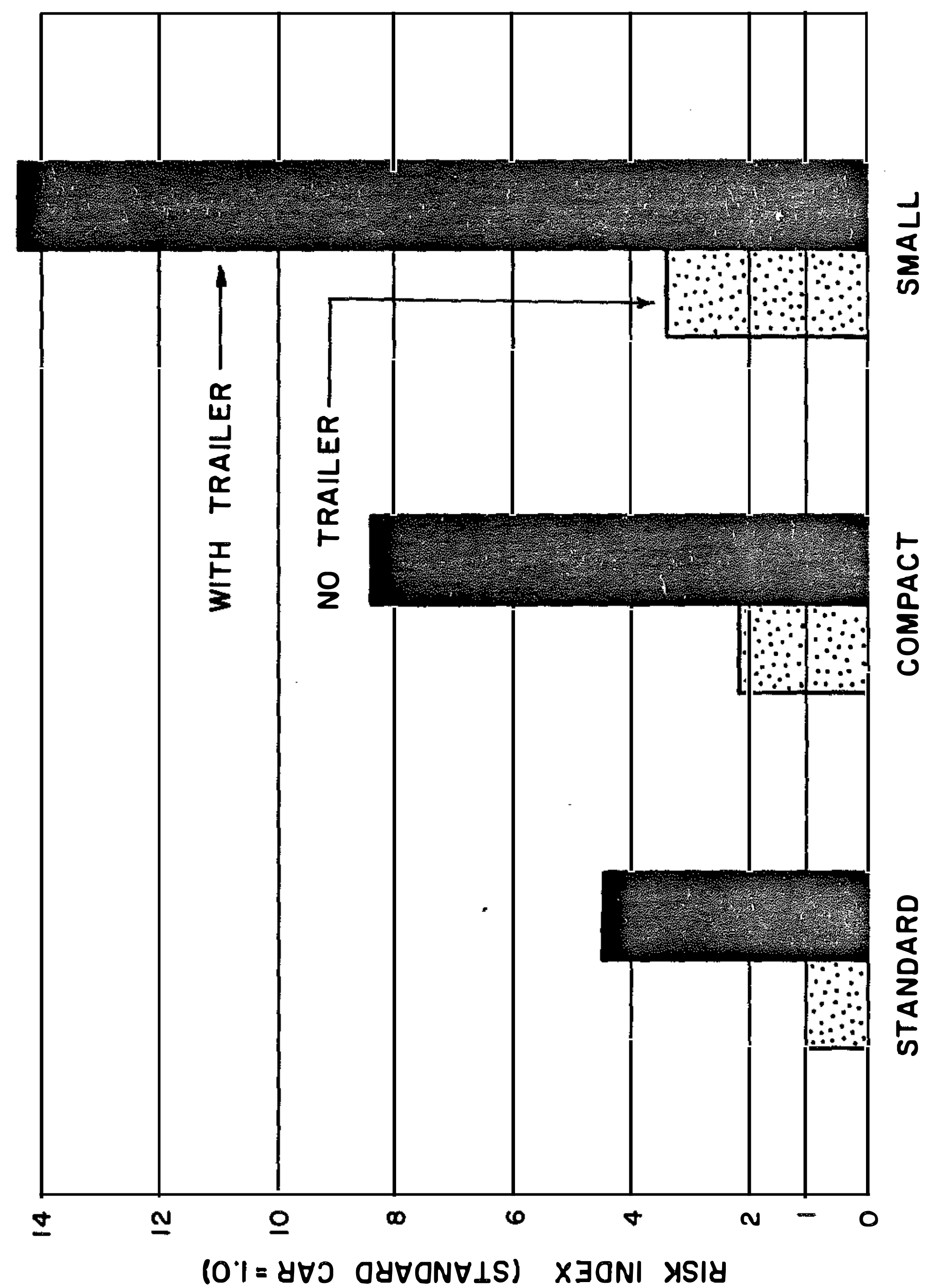
WITH TRAILER
NO TRAILER
RISK INDEX (STANDARD CAR = 1.0)
0
1
2
4
6
8
10
12
14
STANDARD
COMPACT
SMALL

TABLE 3
ACCIDENT DATA AVAILABLE AT THE
COMMENCEMENT OF STUDY

ROAD	YEAR	TYPE OF ACCIDENT RECORDS AVAILABLE
Bluegrass Parkway	1966	Median Accidents, X-Over, Fatalities
Bluegrass Parkway	1967	All Accidents
Bluegrass Parkway	1968	All Accidents
Kentucky Turnpike	1965	Median Accidents, X-Over, Fatalities
Kentucky Turnpike	1966	Median Accidents, X-Over, Fatalities
Kentucky Turnpike	1967	All Accidents
Kentucky Turnpike	1968	All Accidents
Mountain Parkway	1965	Median Accidents, X-Over, Fatalities
Mountain Parkway	1966	Median Accidents, X-Over, Fatalities
Mountain Parkway	1967	All Accidents
Mountain Parkway	1968	All Accidents
West Kentucky Parkway	1965	Median Accidents, X-Over, Fatalities
West Kentucky Parkway	1966	Median Accidents, X-Over, Fatalities
West Kentucky Parkway	1967	All Accidents
West Kentucky Parkway	1968	All Accidents
I 64*	1965	Median Accidents, X-Over, Fatalities
I 64*	1966	Median Accidents, X-Over, Fatalities
I 64*	1967	All Accidents
I 64*	1968	All Accidents
I 64**	1965	Median Accidents, X-Over, Fatalities
I 64**	1966	Median Accidents, X-Over, Fatalities
I 64**	1967	All Accidents
I 64**	1968	All Accidents
I 65***	1965	Median Accidents, X-Over, Fatalities
I 65***	1966	Median Accidents, X-Over, Fatalities
I 65****	1967	All Accidents
I 65****	1968	All Accidents
US 41*****	1965	Median Accidents, X-Over, Fatalities
US 41*****	1966	Median Accidents, X-Over, Fatalities
US 41*****	1967	All Accidents
US 41*****	1968	All Accidents
I 75******	1967	All Accidents

*Montgomery, Clark, Shelby Counties (all regular median)
**Shelby, Franklin Counties (irregular median)
***Hardin, Larue Counties
****Hardin, Larue, Hart Warren, Simpson Counties
*****Limited Access Section in Hopkins County
******Grant County

TABLE 4
SUPPLEMENTAL ACCIDENT RECORDS ACQUIRED

ROAD	YEAR	TYPE OF ACCIDENT RECORDS AVAILABLE
US 62, Marshall County	1967	All Accidents
US 62, Marshall County	1968	All Accidents
US 68, Marshall County	1967	All Accidents
US 68, Marshall County	1968	All Accidents
I 75*	1968	All Accidents
US 68, Trigg County	1967	All Accidents
US 68, Trigg County	1968	All Accidents
US 60, Woodford Coutny	1968	All Accidents
US 127, Mercer County	1968	All Accidents

*Madison, Scott, Kenton, Whitley, Grant, Boone, and Rockcastle Counties.

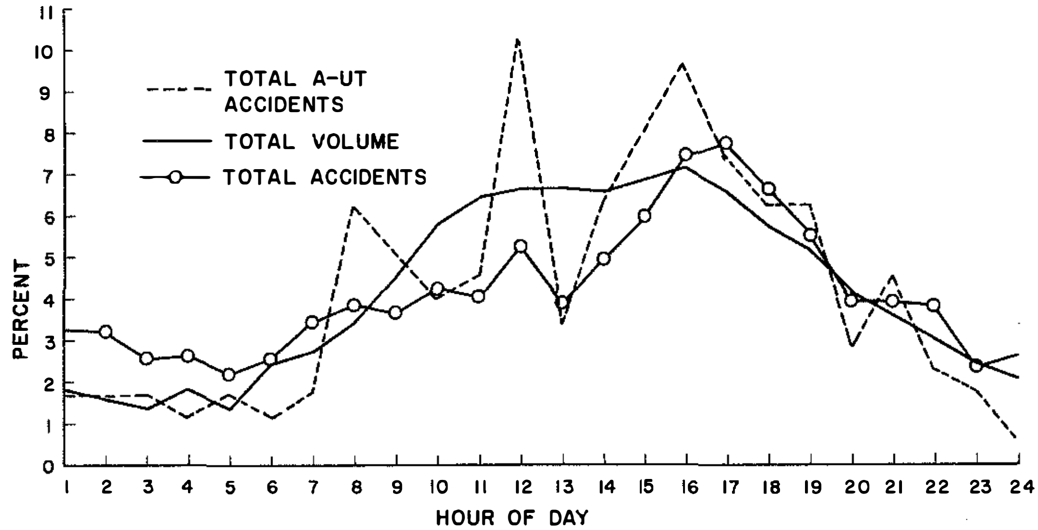

Figure 2. I 75 Total Traffic Volume, A-UT Traffic Volume, and Accident Distributions by Hour of Day

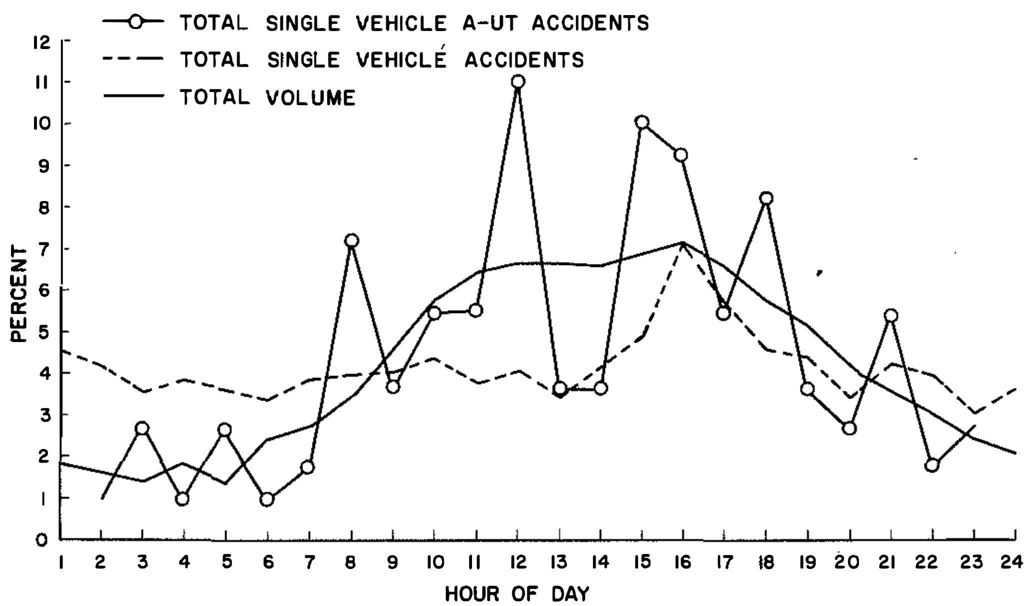

Figure 3. I 75 Single-Vehicle Accidents, Single-Vehicle A-UT
A

all single-vehicle accidents and for single-vehicle accidents involving A-UT combinations. Again, smaller sample sizes increased the jaggedness of the curve's relative maxima and minima, but the trends were still apparent. Therefore, it can be stated that there was no marked difference in the hourly distributions of A-UT accidents relative to traffic volume distribution from the hourly distribution of all accidents. The same statement can be made regarding single-vehicle accidents. Figure 4 shows a comparison of the hourly distribution of all accidents and that of A-UT accidents. The similarity was diminished only by the smoothness of the curves as a function of sample size. Figure 5, similar to Figure 4, shows that general trends in single-vehicle accidents were similar but that during the daylight hours a greater percentage of single-vehicle A-UT accidents occurred than do single-vehicle accidents -- at night the opposite trends were evident. Although no statistical evaluation of these differences is presented, it was hypothesized that these trends were caused by the low volume of A-UT traffic at night.

Figure 6 shows accident and traffic volume distributions by day of the week. Again, the similarities were apparent. Figure 7 illustrates accident and volume distributions of A-UT traffic. Here marked differences were in evidence. Tuesday was the lightest day for A-UT traffic, yet Tuesday was the third highest day for A-UT accident occurrence. A similar statement can be made concerning Friday; whereas for Saturday the opposite was true. Furthermore, similar percentage distributions of each variable were evident on Sunday, Wednesday, and Thursday. Monday was similar to Saturday, but not to such an extreme. Thus, A-UT traffic and A-UT accidents cannot be said to coincide to the degree that was exhibited for all traffic and all accidents. Figure 8 is similar to Figure 6 except that it shows single-vehicle accidents. Similarities were again evident. Figure 9 is similar to Figure 7 in the same respect, and once again the greater-accident-than-volume condition prevailed for Tuesday and Friday, the opposite held true for Monday and Saturday; and Sunday was approximately the same. In this case, however, Tuesday and Wednesday showed a greater-accident-than-volume trend. The direct comparison between accident distributions for all accidents and those for A-UT accidents, Figure 10, showed the different trends clearly -- as did Figure 11, which is a representation of single-vehicle accidents and single-vehicle A-UT accidents. It may be concluded from these observations that the distribution by day of the week of all accidents, both single-vehicle and total, was not identical to that of similarly classed A-UT accidents.

Figure 12 shows the distribution of accidents by month. Generally, A-UT accidents illustrated the same trends as all accidents. There were, however, some notable exceptions. The percentage of A-UT accidents increased markedly in April, while the percentage of all accidents dropped significantly. The trends then coincided until October, when A-UT accidents rose noticeably over a rather exaggerated September low; at the same time, all accidents decreased slightly from September to October. Again, in November, the percentage of A-UT accidents dropped perceptibly, while the percentage of accidents in general increased slightly. Figure 13 compares single-vehicle accident trends and single-vehicle A-UT accident distributions by month. Discounting exaggerations (again probably caused by small sample sizes), the trends seemed to follow similar patterns with the exception of the previously noted differences for October and November. Figure 14 compares the distribution, by month, of A-UT accidents and A-UT volume. Volume of A-UT traffic (as a monthly percentage of the yearly total) increased significantly during the summer months; a corresponding increase in accident proportions was not observed. A relatively high percentage of A-UT accident occurrence during December and January was countered by the lowest number of A-UT vehicles during these two months. This leads to the suspicion that A-UT accidents, like accidents in general, correlate rather highly with periods of inclement weather and reduced visibility. The distribution of single-vehicle A-UT accidents shows similar features to all A-UT accidents, but the increase in summer accidents corresponding to high summer volumes was more noticeable.

Another manner in which accidents involving A-UT combinations can be compared with other types of accidents is by distribution in space. It was hypothesized that any location at which A-UT accidents occurred at a much greater rate that accidents in general could be analyzed for possible contributing factors. The same analysis was also applied to severe accidents and severe A-UT accidents, although the small sample size of these latter categories limited the amount of information which could be derived from this analysis. The following sets of figures depict the distribution by location of these four types of accidents for each county and each road.

Figures 15, 16 and 17 show the distribution of accidents on the four-lane portion of the Mountain

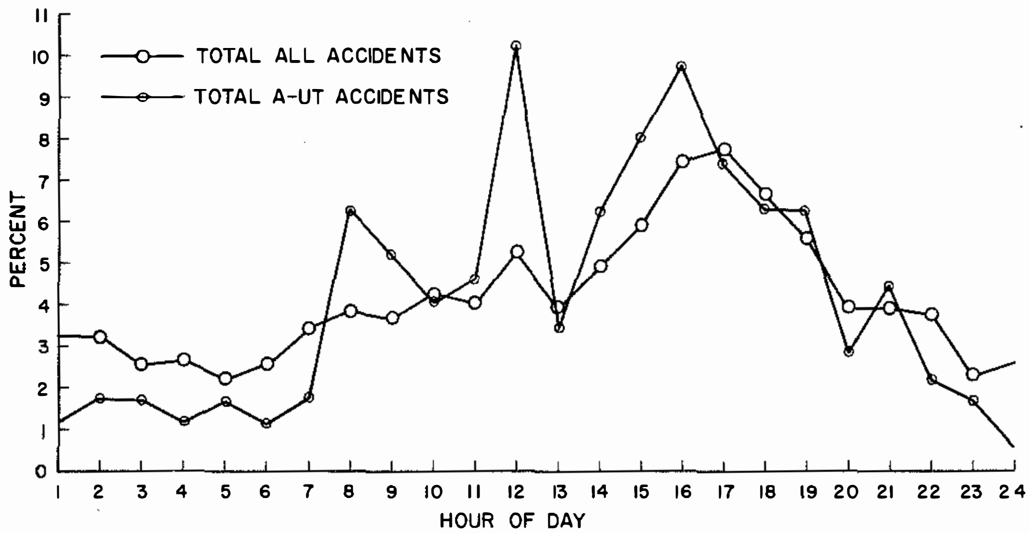

Figure 4. All Accidents and A-UT Accidents as a Function of Hour of Day on I 75

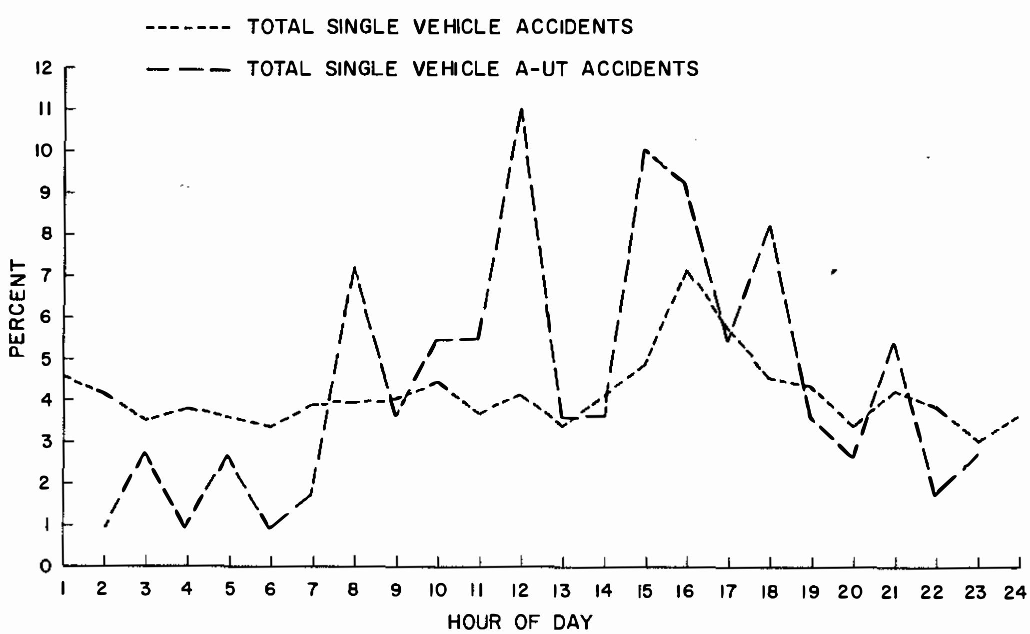

Figure 5. Single-Vehicle Accidents and Single-Vehicle A-UT Accidents as a Function of Hour of Day on I 75

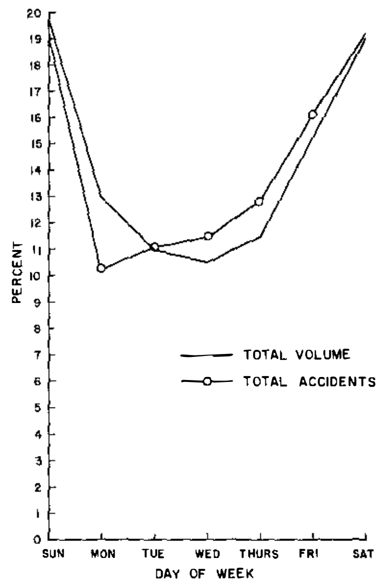

Figure 6. I 75 Traffic Volume and Accident Distributions by Day of Week

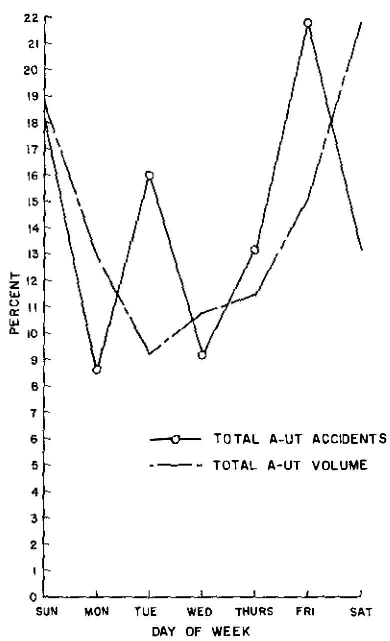

Figure 7. I 75 A-UT Traffic Volume and Accident Distributions by Day of Week

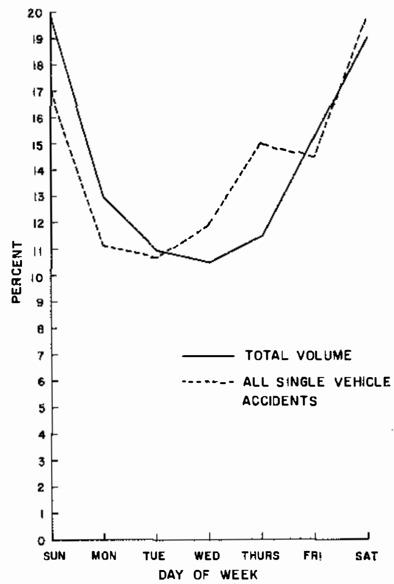

Figure 8. I 75 Single-Vehicle Accidents and Volume as a Function of Day of Week

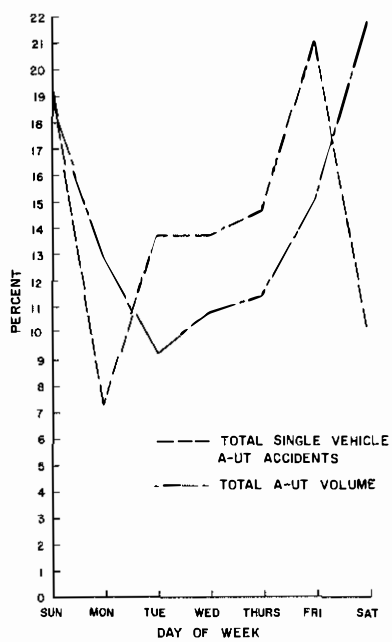

Figure 9. I 75 Single-Vehicle A-UT Accidents and A-UT Volume as a Function of Day of Week

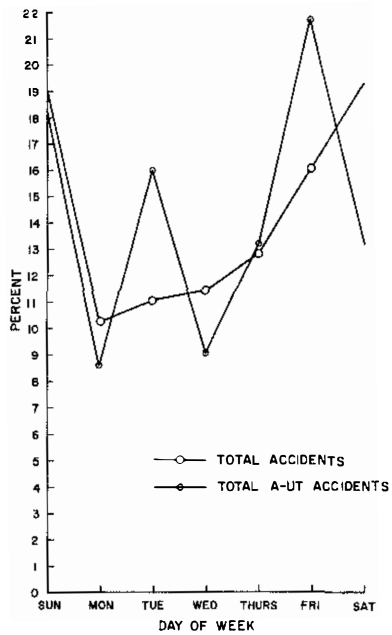

Figure 10. All Accidents and A-UT Accidents as a Function of Day of Week on I 75

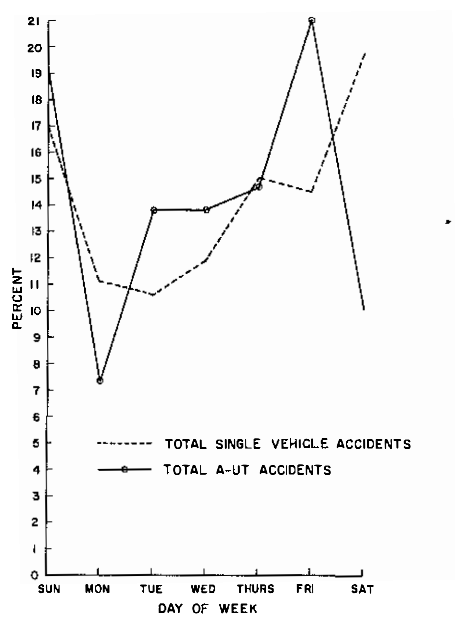

Figure 11. I 75 Single-Vehicle Accidents and Single-Vehicle A-UT Accidents as a Function of Day of Week

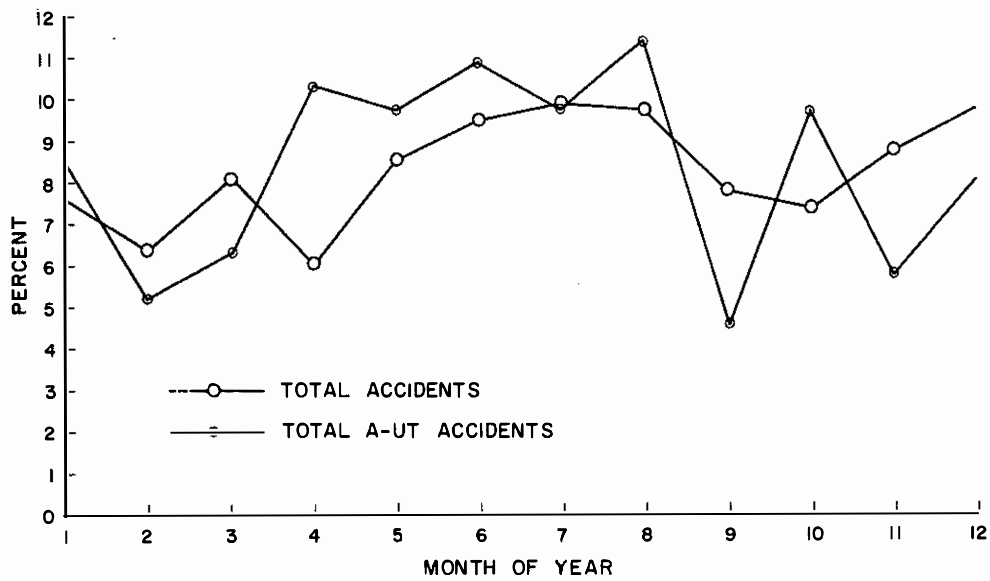

Figure 12. All Accidents and A-UT Accidents as a Function of Month of Year on I 75

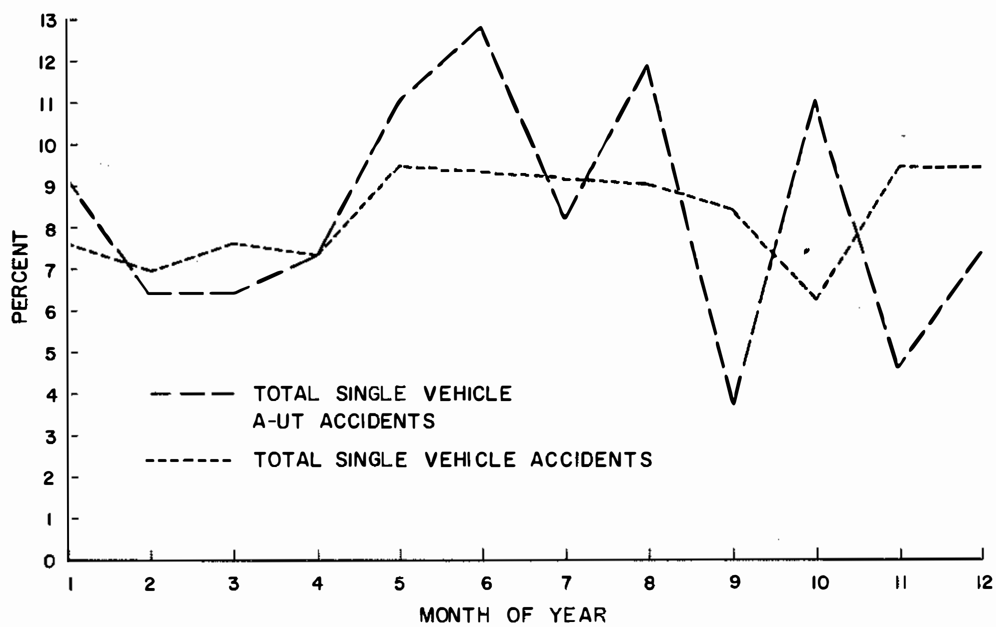

Figure 13. Single-Vehicle Accidents and Single-Vehicle A-UT Accidents as a Function of Month of Year on I 75

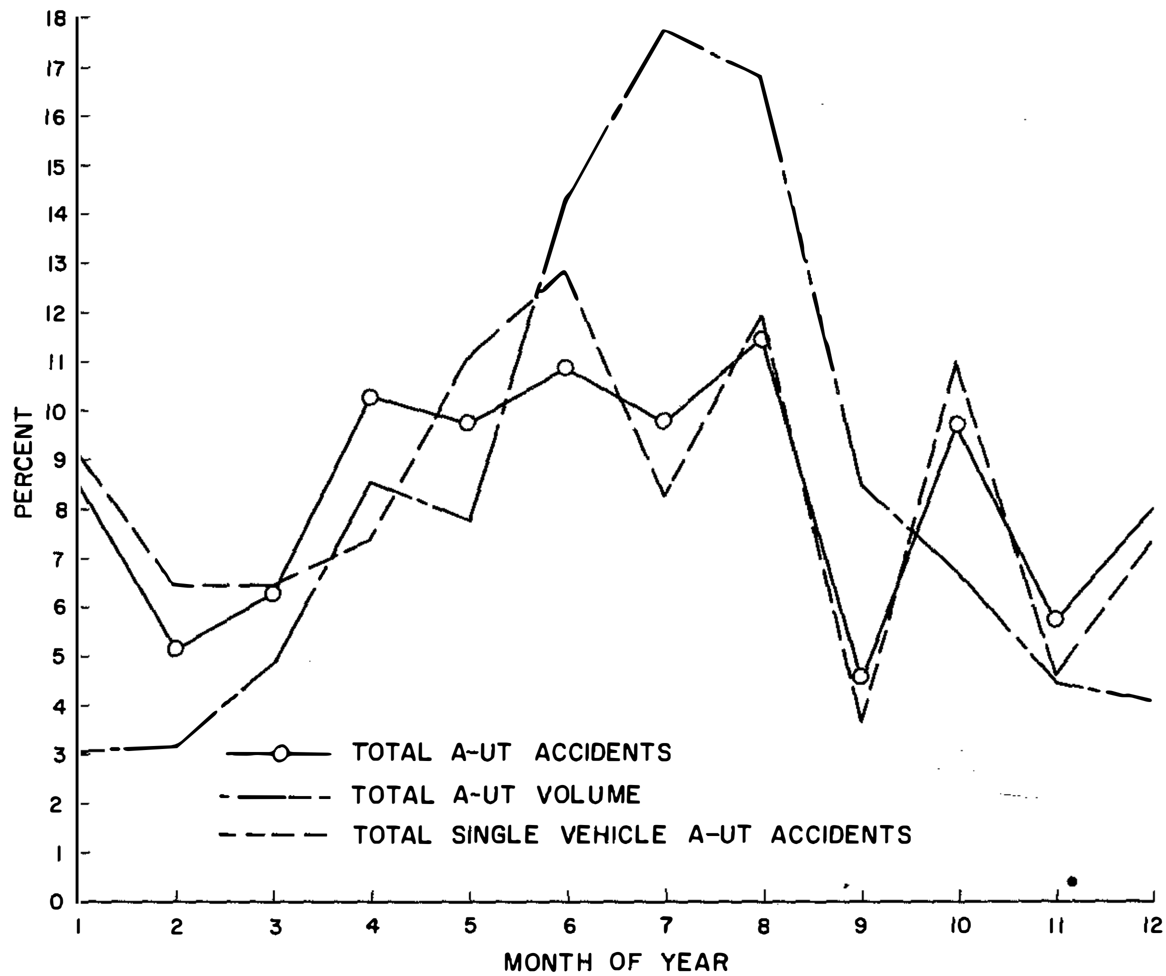

Figure 14. A-UT Traffic Volume, Single-Vehicle A-UT Accidents, and Total Accident Distributions by Day of Week on I 75

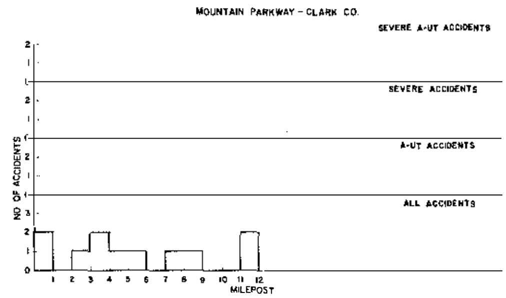

Figure 15. Spatial Distribution of Accidents - Mountain Parkway, Clark County

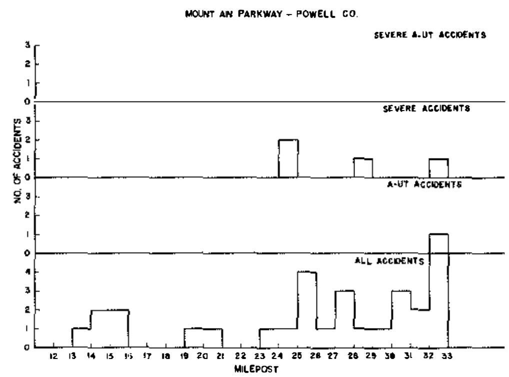

Figure 16. Spatial Distribution of Accidents - Mountain Parkway, Powell County

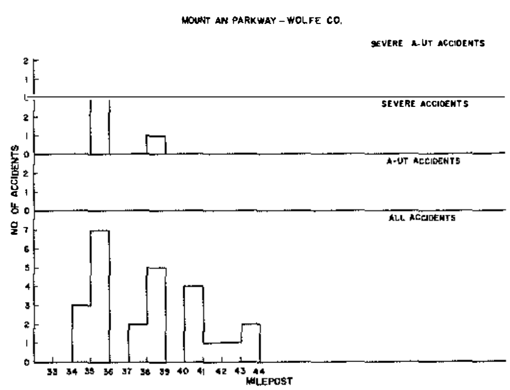

Figure 17. Spatial Distribution of Accidents - Mountain Parkway, Wolfe County

Parkway in Clark, Powell and Wolfe Counties, respectively. Although the number of A-UT and severe accidents was limited for this roadway, from those records which were available, it appeared that no particular location could be selected at which A-UT accidents and (or) severe accidents occurred at a disproportionate rate.

Figures 18, 19 and 20 illustrate the spatial occurrence of accidents on the Kentucky Turnpike in Hardin, Bullitt and Jefferson Counties, respectively. Unlike the data on the Mountain Parkway, there was a sufficient number of accident records to provide an indication of trends. On this roadway, there were four one-mile sections at which two A-UT accidents occurred and two one-mile sections at which three A-UT accidents occurred. Of the four sections where two A-UT accidents occurred, the total number of accidents at each were 16, 7, 16 and 8. Of the two sections where three A-UT accidents occurred, the total number of accidents at each were 10 and 20. It was decided that none of these locations had a sufficiently disproportionate rate of A-UT accident occurrence to warrant special investigation.

Figures 21 through 26 show the distribution of accidents on the Western Kentucky Parkway for Caldwell, Hopkins, Muhlenberg, Ohio, Grayson and Hardin Counties, respectively. No one-mile stretch on this entire roadway recorded more than one A-UT accident.

Figures 27 through 33 illustrate the spatial distribution of accidents on the Bluegrass Parkway for Hardin, Nelson, Washington, Anderson, Mercer, a second section in Anderson, and Woodford Counties, respectively. There were two sites at which two A-UT accidents have been reported, and one site at which three A-UT accidents have been recorded. The ratios of A-UT to total accidents at these sites were 2/2, 2/4 and 3/4. These three locations will be discussed subsequently.

Figures 34 through 37 show accidents by milepost for I 64 in Shelby, Franklin, Clark and Montgomery Counties, respectively. There were no locations which exhibited a disproportionate rate of A-UT accident occurrence sufficient to warrant a special investigation.

Figures 38 through 42 illustrate accident distribution on I 65 in Simpson, Warren, portions of Barren, Hart and Hardin Counties. There were four locations at which two A-UT accidents occurred; the ratios of A-UT accidents to total accidents were 2 in 11, 2 in 3, 2 in 8, and 2 in 6. It was decided to investigate in detail the location at Milepost 81-82. At Milepost 69-70, three of the five accidents were A-UT accidents, and this site was also selected for further investigation.

Figures 43, 44 and 45 show the distribution of accidents on four-lane, limited-access US 41 in Hopkins County; four-lane, non-access-controlled US 60 in Woodford County; and two-lane US 27 in Jessamine County. None of these roadway sections had more than one A-UT accident in any one-mile section.

Figures 46 through 52 illustrate the accident distribution on I 75 for Whitley, Rockcastle, Madison, Scott, Grant and portions of Kenton and Boone Counties. There were nine locations at which two A-UT accidents had been reported. These locations have, however, high accident rates in general and no special analysis was thought to be necessary. In addition, there were four locations at which three A-UT accidents had been reported. At three of these locations A-UT accidents appeared to be in line with other accident histories. At the fourth location, however, there was a total of only four accidents and three of these involved A-UT combinations. It was decided that this site was worthy of detailed investigation.

FREQUENT A-UT ACCIDENT LOCATIONS

The preceeding analysis of those locations at which the incidence of A-UT accidents deserved special investigation necessarily required subjective judgment as to what sites should be selected for analysis. The selection methodology initially identified all locations at which at least two A-UT accidents had been reported. Judgment was then employed to ascertain if the number of A-UT accidents represented a disproportionate percentage of the total number of accidents reported at that location. Thus, a site where three A-UT accidents out of a total of five accidents were reported was selected for investigation, whereas another site with corresponding figures of three and ten, respectively, was omitted from further analysis. Using this admittedly intuitive selection process, six locations were selected for further investigation. These six locations have been mentioned above in the discussion of each roadway; but in summary, it can be stated that three were near the western terminus of the Bluegrass Parkway, two were in Hart County on I 65, and one was in Boone County on I 75.

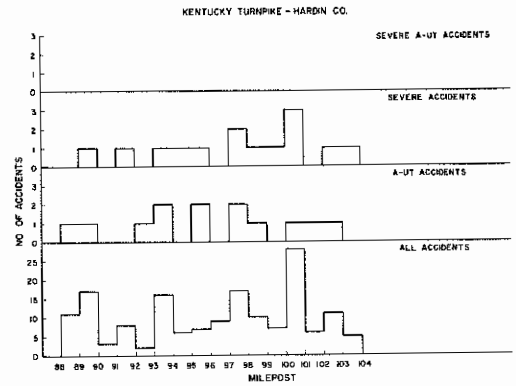

Figure 18. Spatial Distribution of Accidents - Kentucky Turnpike, Hardin County

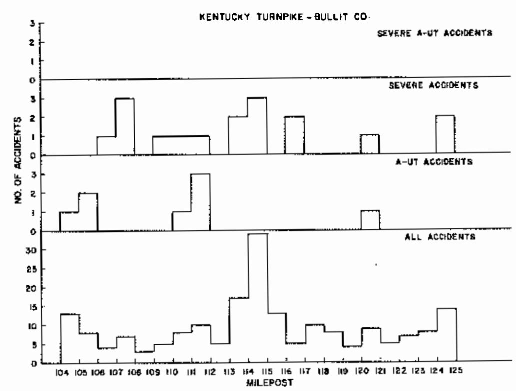

Figure 19. Spatial Distribution of Accidents - Kentucky Turnpike, Bullit County

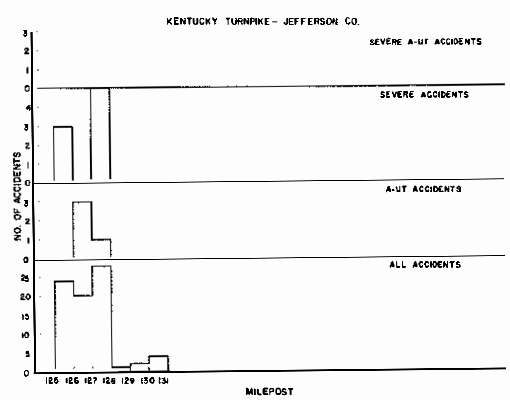

Figure 20. Spatial Distribution of Accidents - Kentucky Turnpike, Jefferson County

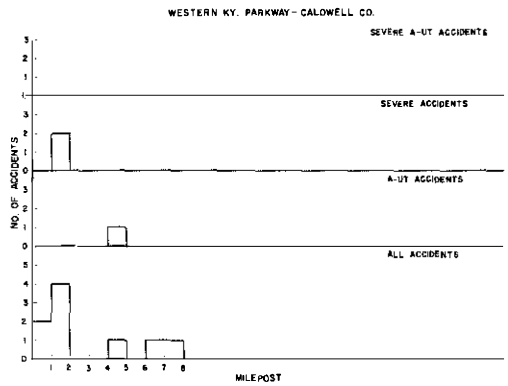

Figure 21. Spatial Distribution of Accidents - Western Kentucky Parkway, Caldwell County

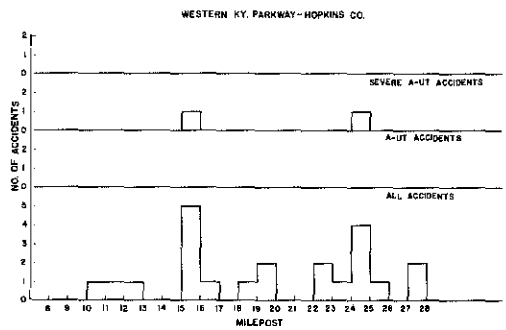

Figure 22. Spatial Distribution of Accidents - Western Kentucky Parkway, Hopkins County

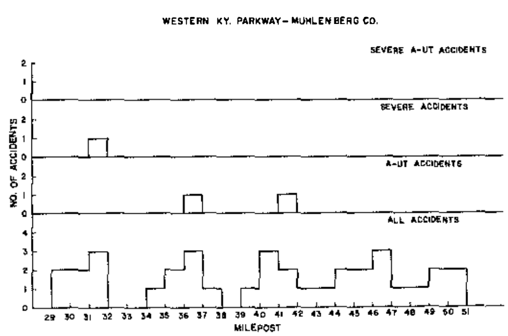

Figure 23. Spatial Distribution of Accidents - Western Kentucky Parkway, Muhlenberg County

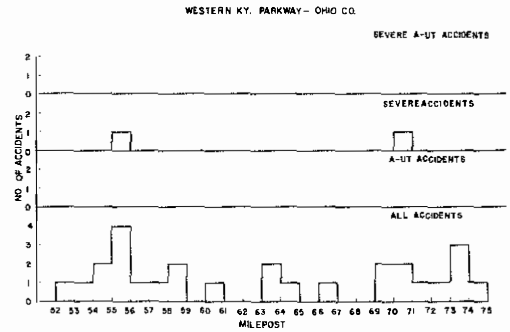

Figure 24. Spatial Distribution of Accidents - Western Kentucky Parkway, Ohio County

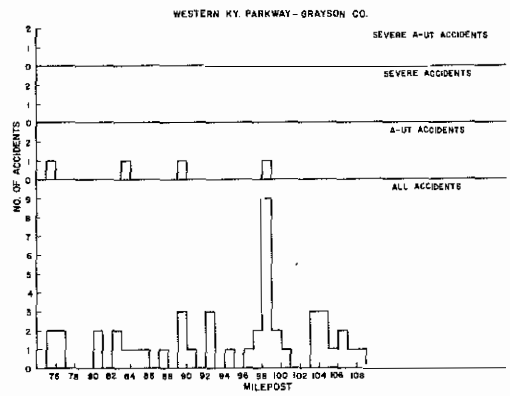

Figure 25. Spatial Distribution of Accidents - Western Kentucky Parkway, Grayson County

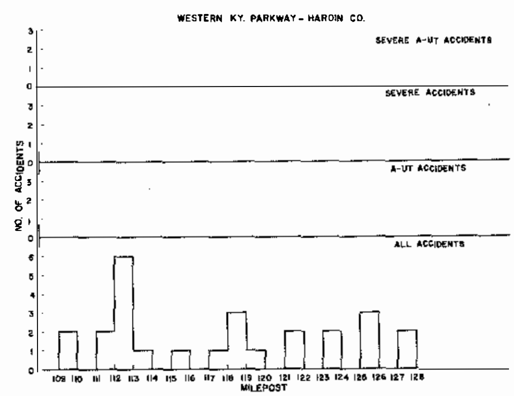

Figure 26. Spatial Distribution of Accidents - Western Kentucky Parkway, Hardin County

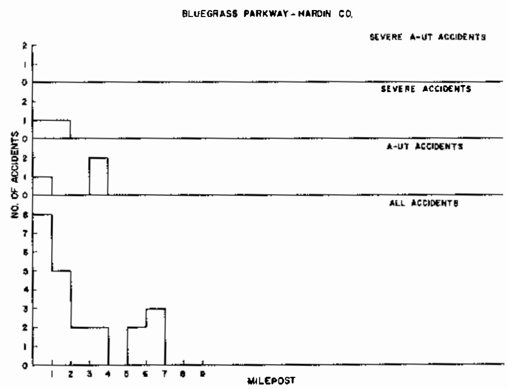

Figure 27. Spatial Distribution of Accidents - Bluegrass Parkway, Hardin County

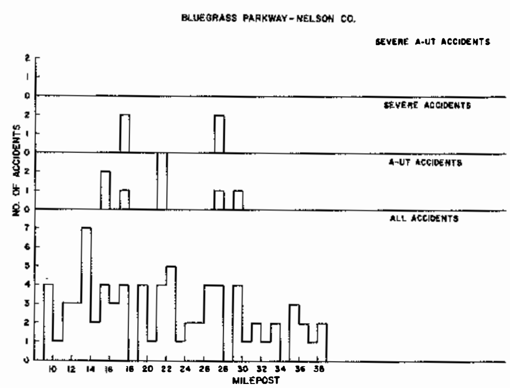

Figure 28. Spatial Distribution of Accidents - Bluegrass Parkway, Nelson County

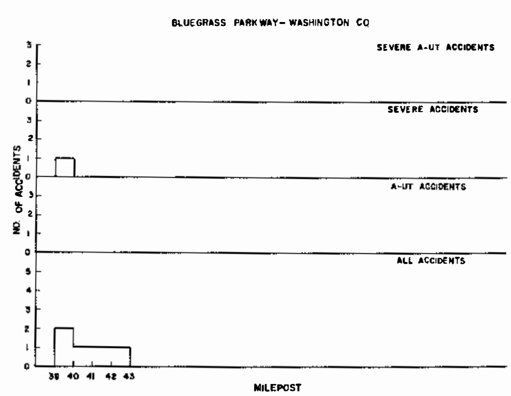

Figure 29. Spatial Distribution of Accidents - Bluegrass Parkway, Washington County

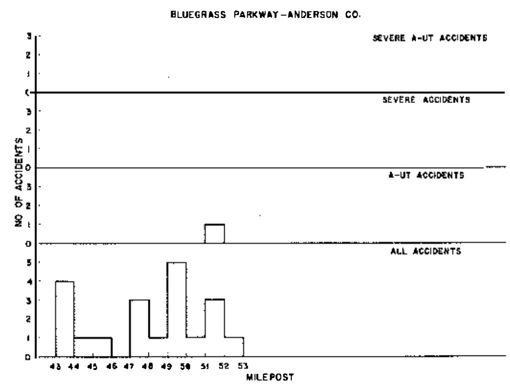

Figure 30. Spatial Distribution of Accidents - Bluegrass Parkway, Anderson County

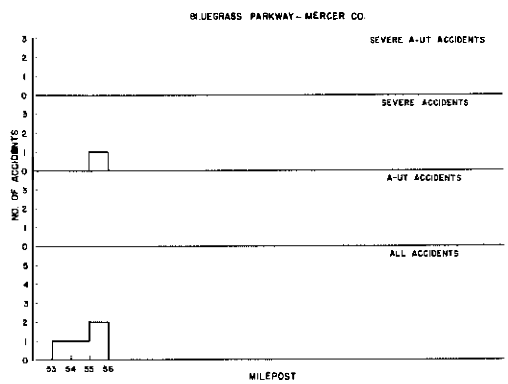

Figure 31. Spatial Distribution of Accidents - Bluegrass Parkway, Mercer County

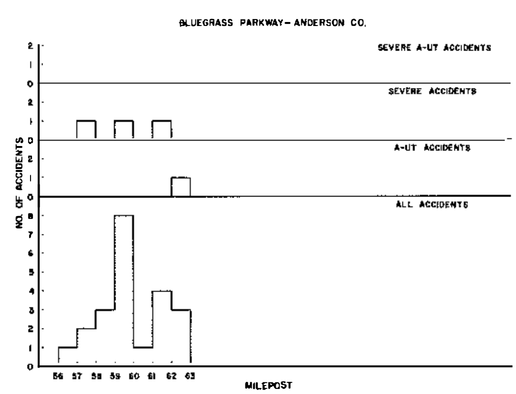

Figure 32. Spatial Distribution of Accidents - Bluegrass Parkway, Anderson County

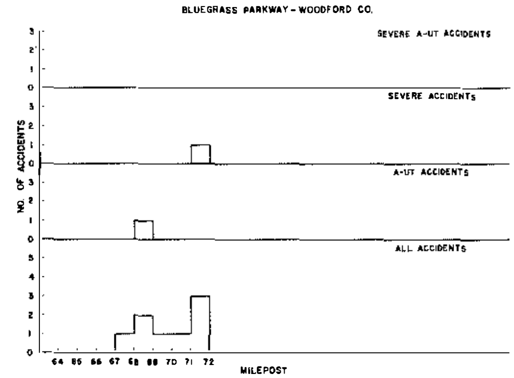

Figure 33. Spatial Distribution of Accidents - Bluegrass Parkway, Woodford County

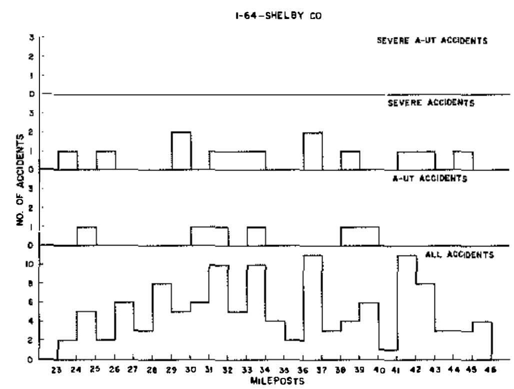

Figure 34. Spatial Distribution of Accidents - I 64, Shelby County

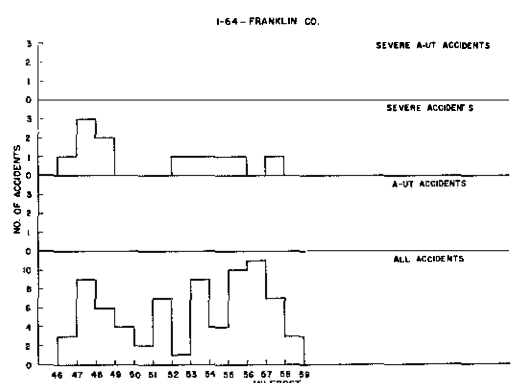

Figure 35. Spatial Distribution of Accidents - I 64, Franklin County

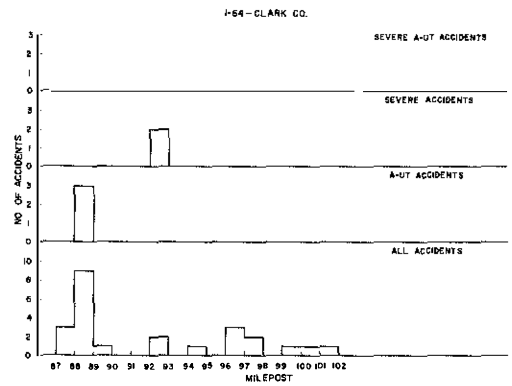

Figure 36. Spatial Distribution of Accidents - I 64, Clark County

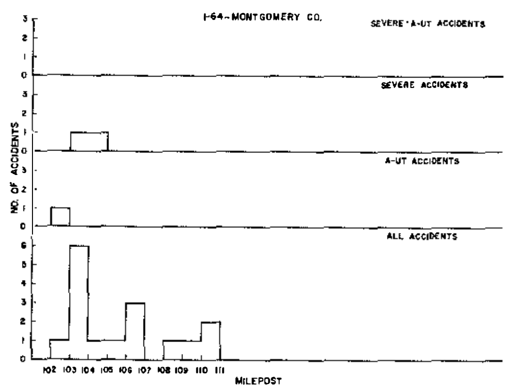

Figure 37. Spatial Distribution of Accidents - I 64, Montgomery County

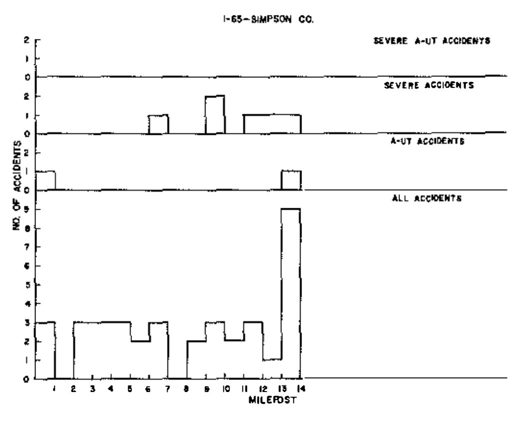

Figure 38. Spatial Distribution of Accidents - I 65, Simpson County

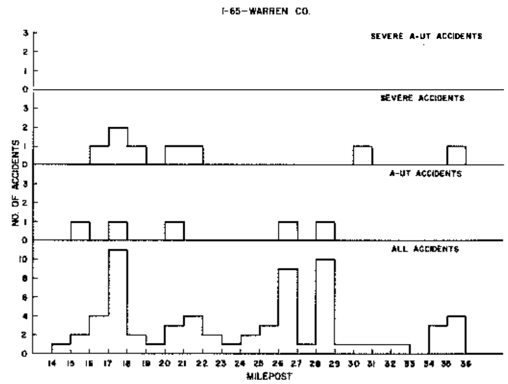

Figure 39. Spatial Distribution of Accidents - I 65, Warren County

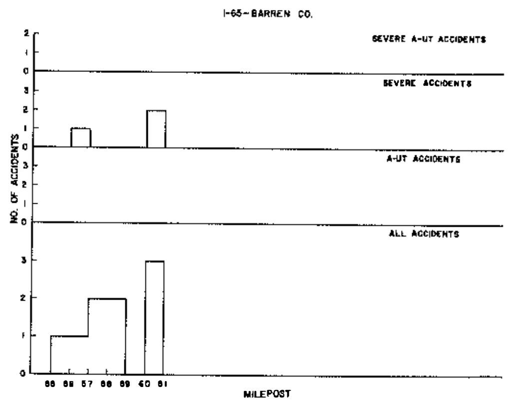

Figure 40. Spatial Distribution of Accidents - I 65, Barren County

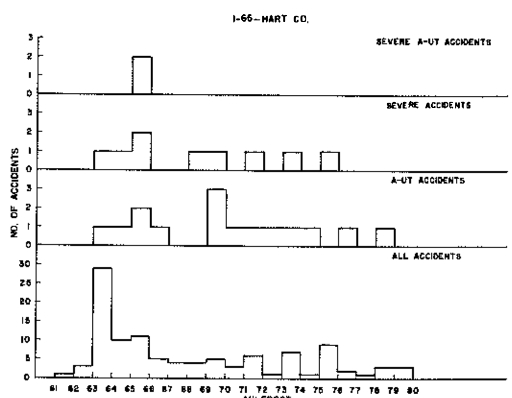

Figure 41. Spatial Distribution of Accidents - I 65, Hart County

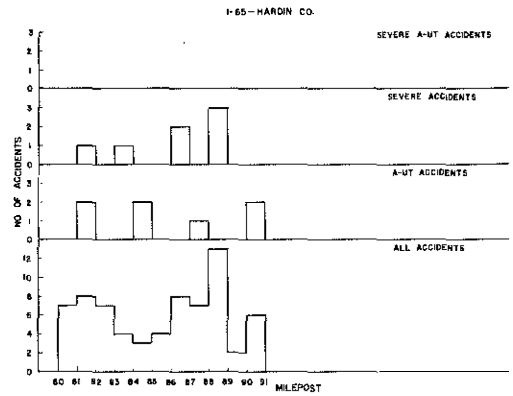

Figure 42. Spatial Distribution of Accidents - I 65, Hardin County

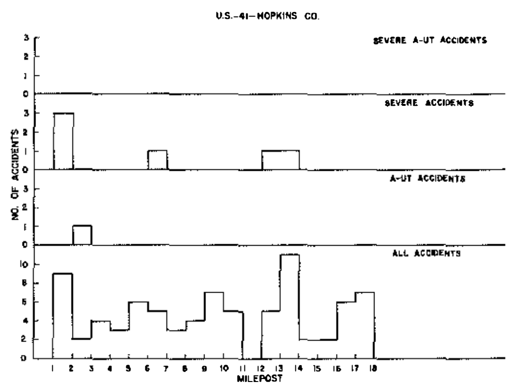

Figure 43. Spatial Distribution of Accidents - US 41, Hopkins County

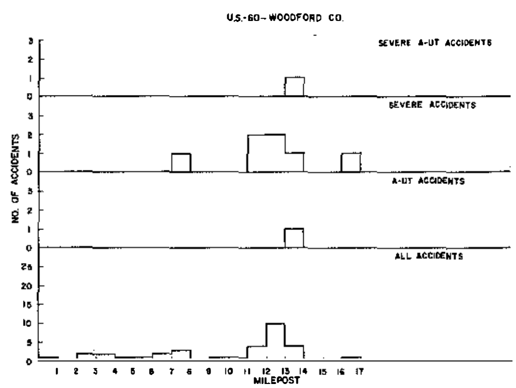

Figure 44. Spatial Distribution of Accidents - US 60, Woodford County

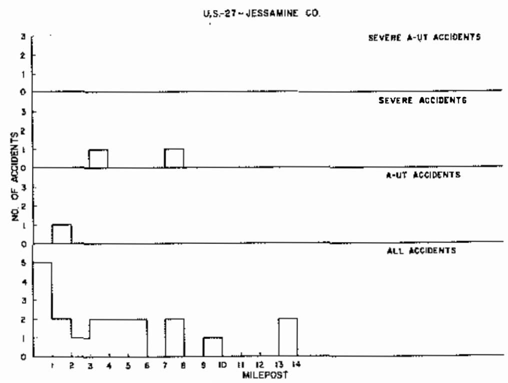

Figure 45. Spatial Distribution of Accidents - US 27, Jessamine County

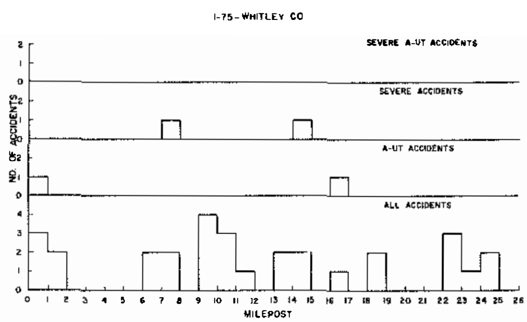

Figure 46. Spatial Distribution of Accidents - I 75, Whitley County

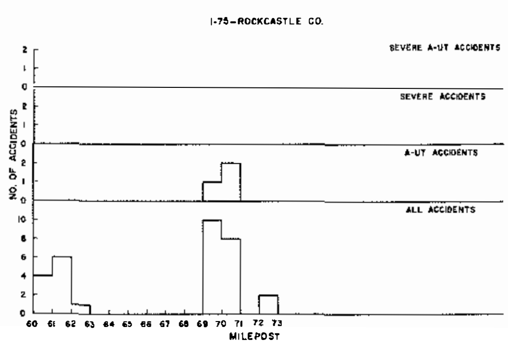

Figure 47. Spatial Distribution of Accidents - I 75, Rockcastle County

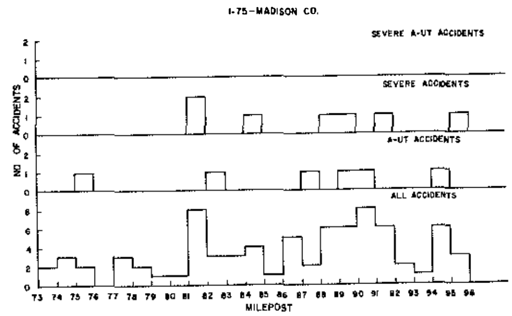

Figure 48. Spatial Distribution of Accidents - I 75, Madison County

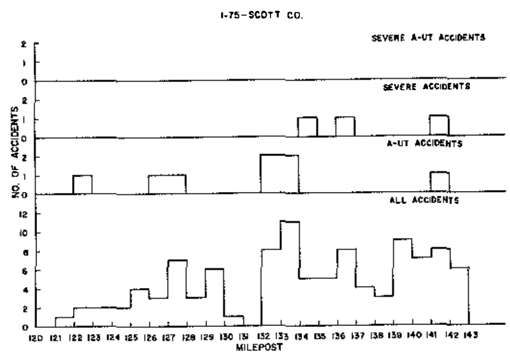

Figure 49. Spatial Distribution of Accidents - I 75, Scott County

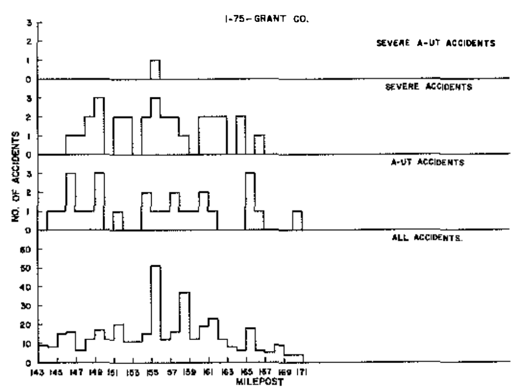

Figure 50. Spatial Distribution of Accidents - I 75, Grant County

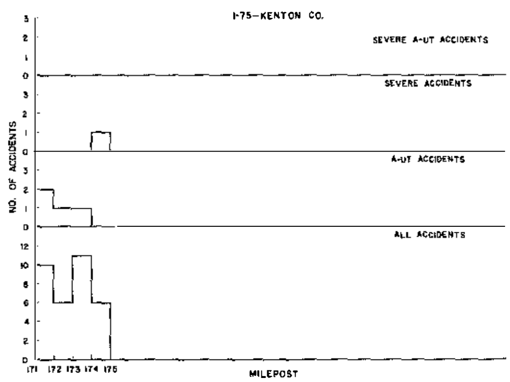

Figure 51. Spatial Distribution of Accidents - I 75, Kenton County

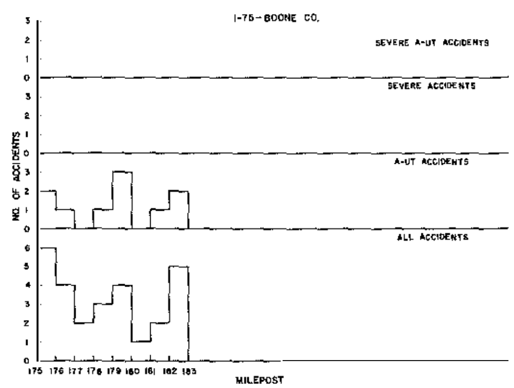

Figure 52. Spatial Distribution of Accidents - I 75, Boone County

Although accident records for the selected sites were available in the original form, it was felt that a sample size of two or three accidents was relatively small to provide an indication of trends for the particular location. The foregoing analysis of trends in A-UT accidents in general was considered a better use of the specific data listed on the accident reports. Thus, it was decided that, while specific accident records at each site could provide insight into the probable causes of the problem, the use of accident records would be best utilized as a supplement to on-the-site investigations. These investigations will be discussed below.

BLUEGRASS PARKWAY SITES

Between Mileposts 3 and 4 on the Bluegrass Parkway, only two accidents were reported over a two-year period, and both of these involved A-UT combinations. This location is situated on a relatively steep vertical grade (downgrade eastbound) and is accompanied by several relatively deep rock cuts. The crosswind conditions created by such cuts have been recognized to contribute to accidents in the past. It was hypothesized that crosswind would be more deleterious to A-UT vehicles due to the increased surface area on which the wind forces could act. The sudden steering action required when a vehicle is subjected to differential crosswind could add to the already difficult task of controlling an A-UT combination while driving. The other two locations on this roadway, i.e. Milepost 15-16 where two of four accidents involved A-UT combinations, and Milepost 21-22 where three of four accidents involved A-UT's, were similar sites to the first one. The steep grades reduce the speed of A-UT combinations, thus inducing other vehicles to overtake and pass. The passing of a vehicle also creates a wind loading on both the passing and passed vehicle. Thus, this particular set of accident sites indicated that at least some A-UT accidents occur at locations where cuts induce crosswinds and steep grades lead to wind currents from passing vehicles. These wind factors may be sufficient to affect A-UT vehicles while at the same time not necessarily affecting other traffic to such a deleterious extent.

I 75 SITES

Between Mileposts 179 and 180 in Boone County on I 75, three of the four accidents recorded during 1968 involved A-UT combinations. This particular section of interstate roadway is three lane in each direction and has relatively high traffic volumes. At Milepost 179.2, northbound, an informational sign depicting the exit ramp for US 42-127 suggested that weaving maneuvers may begin about this point. Signs advising gas, food and lodging may also precipitate weaving by all traffic and especially A-UT traffic. Although accident records have not indicated any particular history of median crossover accidents at this site, a waiting vehicle within the crossover could induce erratic maneuvers within the traffic stream, and thus indirectly create a traffic conflict and (or) a collision. Similar signing previews the southbound exit of I 71 toward Louisville and a rest area, thus indicating weaving by those vehicle operators contemplating a route change. Therefore, the high rate of A-UT accidents at this site is probably induced by weaving maneuvers performed during high traffic volume conditions.

I 65 SITES

Two sites on I 65 were investigated. The first was at Mileposts 84-85 in Hardin County at which two of the three reported accidents during 1967 and 1968 involved A-UT vehicles. The only indicative factor was a blank blue sign panel which previously was lettered *REST AREA 2 MILES*. It was not known if the sign message appeared at this site, but there is no subsequent rest area to warrant such a message. Had this sign been erected with such a message, weaving would have been induced. There does not appear to be any contributing conditions, other than some advanced directional signing and the overpass of KY 1136 with its concomitant bridge piers. The second location was at Mileposts 69-70 in Hart County. At this location, three of five reported accidents involved A-UT combinations. Nothing notable in the way of signing appeared at this site southbound, but northbound several sign panels preliminary to an exit (*EXIT 1 MILE, GAS-FOOD-LODGING*) seemed to present a situation which could induce weaving. In addition, a combination of the cut-fill profile and the tree patterns adjacent to the roadway created a situation where wind could be a problem. There was also a crossover located just south of Milepost 70. Again, the specific accident records did not indicate this crossover to be a problem. The primary problem at this site appeared to be a combination of wind and weaving.

ACCIDENT RECORDS SURVEY

A general purview of accidents involving A-UT combinations seemed to indicate that the primary sources of trouble for vehicle operators were trailer hitches becoming loosened while the vehicle was in motion, and a general loss of driver control of the A-UT combination. There was nothing to indicate that the loss of control could be solely attributed to conditions of wet weather. The situations seemed to indicate that more often loss of driver control resulted from wind gusts created by roadway topography or overtaking vehicles. Much the same trend might possibly be evidenced for lighter weight vehicles if they could be extracted from accident records for analysis. Such situations are difficult if not impossible to correct through modification of the roadway. The apparent difficulty lies with the vehicle itself and not with any roadway design disparity. Of course, the roadway situations in deep cuts and steep grades which may contribute to a wind problem are the result of a desire for economic optimality. The possible elimination of reduction of such situations are necessarily a trade-off against the economic toll of accidents induced by such features. The important factor for cognizance at this juncture is that these situations can present problems and may be genuine causes of accidents.

ACCIDENT FREQUENCY

As a final step in the accident analysis, frequency rates of A-UT accidents were compared with the rates of occurrence of all accidents. The common denominator of this analysis was the accident rate per one hundred million vehicle-miles. (A vehicle-mile is the equivalent of one vehicle travelling over one mile of roadway.) Accident rate per one hundred million vehicle-miles is a measure of the number of accidents presented as a function of both the length of roadway and volume of traffic. Thus, accident rates can be computed as follows:

$$AR = (N \times 10^8)/(V \times L) \qquad (1)$$

where

AR = accident rate per one hundred million vehicle-miles,

N = number of recorded accidents,

V = a volume measurement, such as 365.25 times ADT for an average year, and

L = length in miles of the roadway under study.

The advantage of using this type of statistic lies in the compatibility with currently stated accident statistics. This measure is in common use in accident studies and thus would be readily understandable. However, there is a disadvantage inherent in the method. The vehicle-mile concept does not consider traffic density. A total of X vehicles over Y miles is a measure of XY vehicle-miles. Likewise, 2X vehicles over Y/2 miles, a condition of quadruple density, is also XY vehicle-miles.

In order to obtain reliable measures of such rates, accident records, ADT values and roadway lengths were analyzed for all accidents. Similarly, rates were computed for A-UT frequency utilizing the number of A-UT accidents, the appropriate roadway length, and the volume of A-UT traffic. The volume of A-UT traffic was computed by using the data obtained from traffic classification counts and expanding this information by using proper expansion factors. The methodology for this procedure will be discussed subsequently in the section on **TRAFFIC COUNTS**. Using the volume of A-UT combinations was thought to be a more legitimate procedure than using total volumes and A-UT accidents.

The results of the analysis for ten sections of roadway are shown in Figure 53. The four toll roads are four-lane limited access highways with attendant toll facilities. US 41 and the three interstate roadways are four-lane limited access highways with no toll facilities. US 27 represents a two-lane rural highway, and US 60 depicts a four-lane, no-toll, no access control facility. For the toll roads, the ratio of A-UT rates to total accident rates had an unweighted mean value of 0.97. This displayed a marked discrepancy with the unweighted mean value for the four toll-free, four-lane, limited-access facilities, which was 3.32.

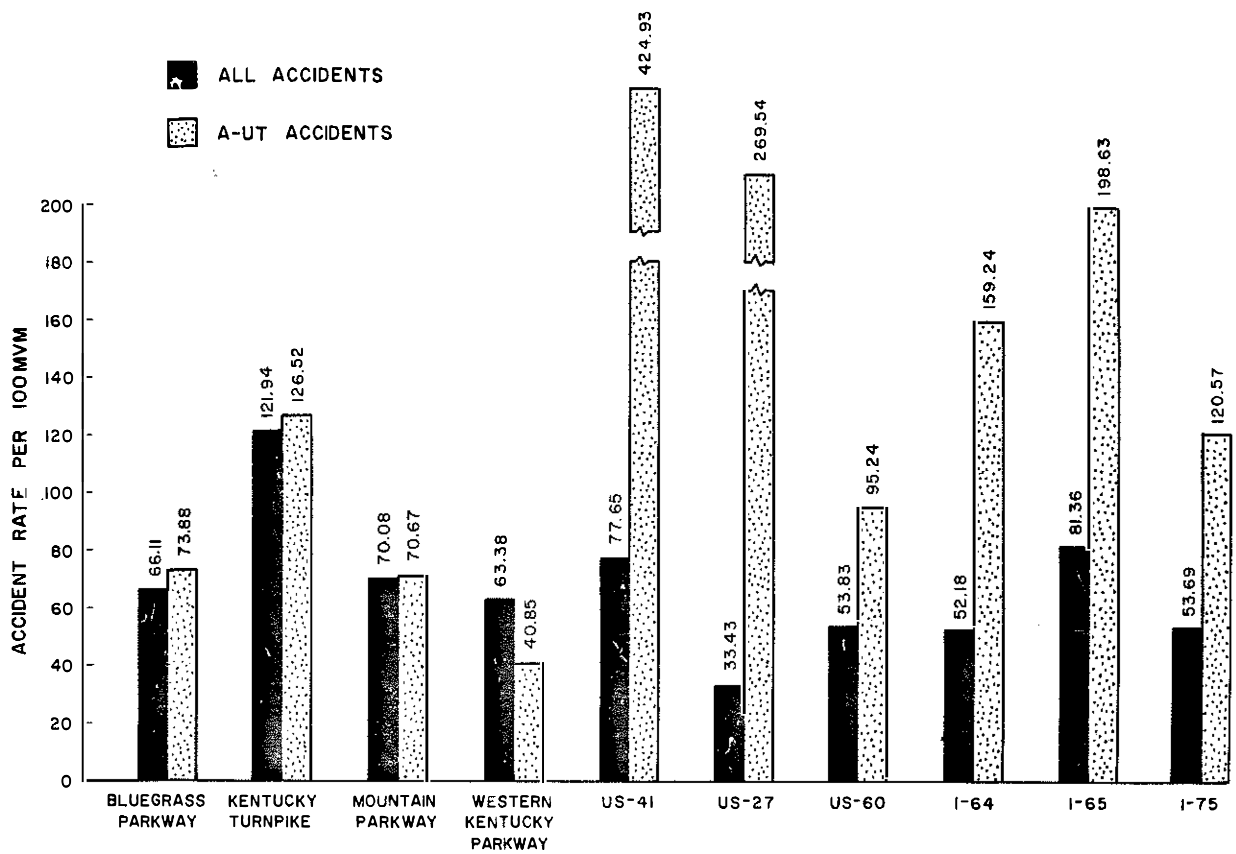

Figure 53. Accident Rates Per 20 Million Vehicle-Miles

This dissimilarity could not be related with any statistical significance to levels of volume, median design, or accidents which occurred at toll facilities. Likewise, no correlation could be established with percentage of A-UT vehicles in the traffic stream. Consideration of density did not offer a solution. Finally, this situation was judged to be the result of data sample size. Reference has been previously made to the jaggedness in curve peaking which can be directly attributed to small sample size. A closer examination of some of the numbers in Figure 53 reveals several general peculiarities which could most aptly be related to sample size. For instance, the two-lane section of US 27 had the lowest accident rate of all roads considered. This did not conform to intuitive suspicions, since US 27 carried a relatively dense traffic stream in the subject area. Furthermore, many A-UT accident rates were based on a single A-UT accident. Undoubtedly larger sample sizes of accidents would provide better indications.In general, however, it can still be said that the frequency of A-UT accidents was greater than accidents involving automobiles alone. The unweighted combination of the statistics depicted in Figure 53 indicated that A-UT accidents occur at a rate 2.35 times greater than the occurrence of all accidents. It must be concluded from all that has been previously stated that the main causative factors for this frequency of accident occurrence were wind currents caused by passing vehicles or by the profile of the ground line adjacent to the roadway and the tree pattern along the ground surface.

The final portion of the accident analysis was an attempt to compare the severity rates of A-UT accidents with those of all accidents. Here again data were very sparse, and meaningful relationships were difficult to develop. Figure 54 illustrates the values obtained in the severe accident analysis. No attempt has been made to draw any conclusions from these limited data; they are presented for informational purposes only.

WEIGHING OPERATIONS AND ANALYSIS OF WEIGHT DATA

To test the hypothesis that the auto-utility trailer combinations contribute significantly more to accumulated equivalent axleloads on a pavement structure than the standard automobiles, it was proposed as part of this study to obtain sample weights of A-UT vehicles. No records were available of any previous loadometer data on automobile-utility trailers in the State of Kentucky. Literature search did not reveal any data acquired elsewhere. These weight data would be summarized as inputs to current and proposed methodologies in Kentucky for computing EAL's.

SELECTION OF WEIGHING SITES

Several considerations contributed to the selection of the sites for weighing operations. The principal determinants were compatibility with accident data and available facilities for weighing vehicles. As has been previously mentioned, extensive accident records were available for rural, limited access facilities in the State, both toll roads and interstate highways. Permanent loadometer stations have been constructed in conjunction with several interstate facilities, and three of these installations were in operation.

These loadometer stations are normally operated for law enforcement purposes at random times by the Department of Motor Transportation. However, during the early summer of each year, the Division of Planning conducts 24-hour weighings at each of the three operating stations to collect inputs for their data banks of weight information. Since the need for weight information in this study closely coincided with weighing activities of the Division of Planning, it was decided that weight data would be taken simultaneously and in juxtaposition with the weight data collection by the Division of Planning.

The I 75 weigh station was located in Scott County, the I-64 weigh station was situated in Shelby County, and the weigh station on I 65 was located in Hardin County.

It was decided that the Division of Research would conduct its weighing operations only during the 16-hour period between 6 am and 10 pm. The amount of A-UT traffic between 10 pm and 6 am did not appear to warrant the inclusion of this time period in the weighing operations. This decision was justified by the number of A-UT vehicles finally weighed on I 65 and I 75 (114 and 202, respectively). Thus, a statistically large sample of vehicles in each direction of travel was weighed. However, only 49 vehicles were weighed on I 64. Of these 49, 21 were eastbound vehicles and 28 were westbound.

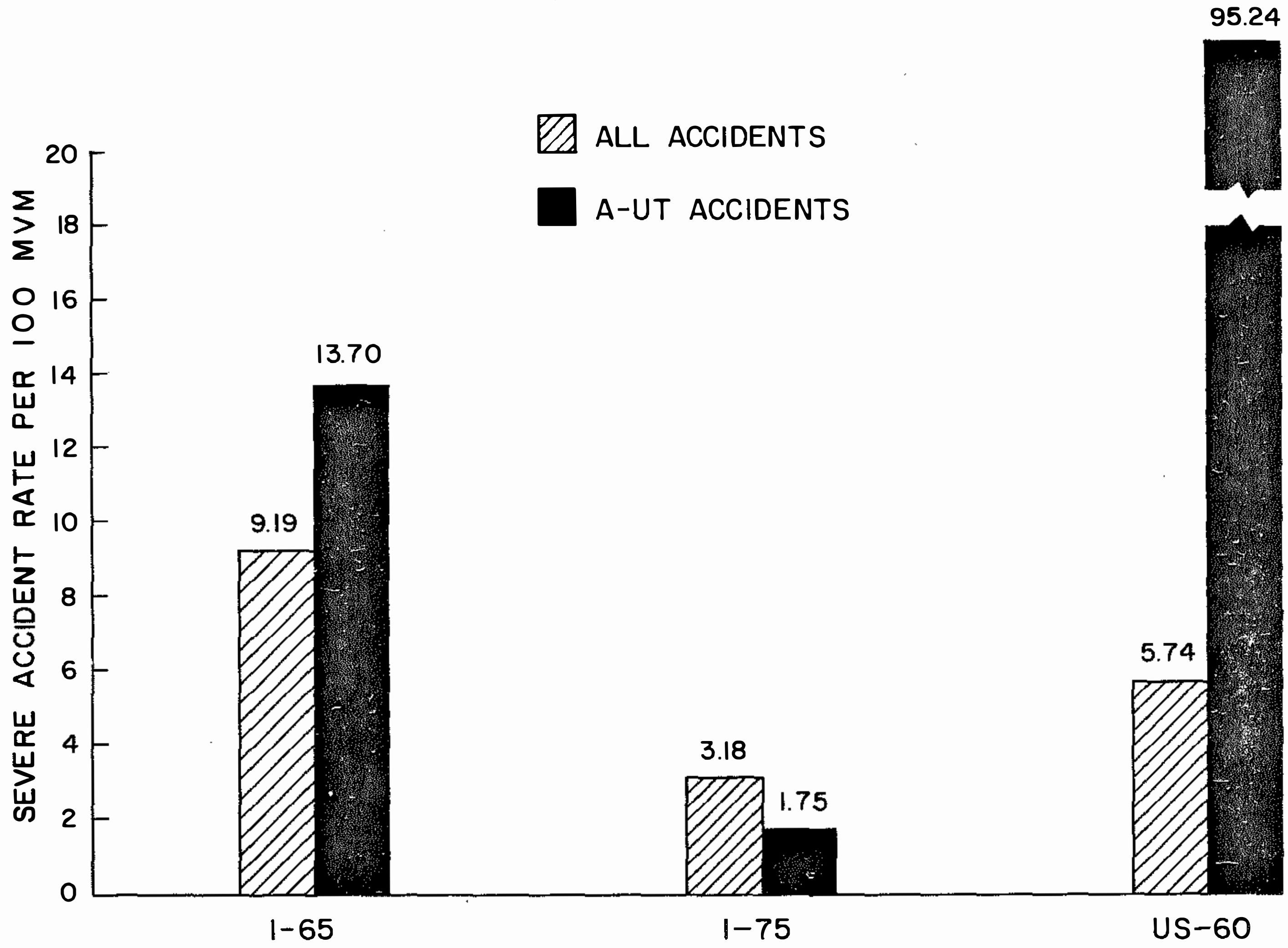

Figure 54. Severe Accident Rates Per 100 Million Vehicle-Miles

The relatively smaller number of vehicle weights was partially attributable to the small daily traffic volumes on I 64 and because of less responsiveness on the part of A-UT combination drivers to enter the weigh station area.

WEIGHT DATA ACQUIRED

Several considerations were important in determining the type of data which was desired from the weighing operations. For each set of data, representing each A-UT combination weighed, there were recorded axleloads, axle spacings, direction of travel, roadway name and type of trailer being pulled. Several comments are in order at this point regarding the classification scheme used to categorize the trailers being towed.

It was desirable to separate the trailers into distinguishable categories in order to evaluate trends which might be evident for a given trailer type. However, it was realized that in order to obtain statistically significant sample sizes, there was a certain practical limit to the number of categories which could be used. As the number of categories increased, the size of each subset of data necessarily decreased. Thus, it was decided to categorize the vehicles into three to six classes. A pilot study of vehicle classification was conducted prior to the collection of any data for use in the study for the purpose of establishing procedures and determining classification of trailers to be used in the actual data collection process.

The sample data were collected for approximately two hours on I 75. From this sample, it was decided that A-UT combinations should be classified as either house trailers, boat trailers (loaded or unloaded), or U-Haul type trailers. A fourth category was provided for other types of trailers which did not lend themselves to categorization in this manner. This classification system was utilized during the weighing operations. Later, it became apparent that the system needed revision due to the large number of trailers being recorded as miscellaneous types which could be classified as a specific trailer type. With the exception of the relatively small amount of data acquired at the I 64 station, the 16-hour weighing period provided statistically sufficient data sample sizes. At the I 64 weigh station, the gross number of vehicles weighed (49) was a significant sample size, but subdivisions of the data into smaller groupings reduced the size of the samples below that generally regarded as being statistically large (i.e. 30). However, no additional data were taken at this site. The Division of Planning had already conducted the third-shift count (10 pm - 6 am) prior to completing the two daylight counts, so any additional data would have been collected necessarily outside the phase involving joint efforts with the Division of Planning. This was judged to be inadvisable.

Additional data collected during the weighing operations were number of cylinders, horsepower, number of cubic inches in the cylinders (a common measure of engine size), and the make and model of the automobile.

ANALYSIS OF WEIGHT DATA

As has been stated in previous work *(6)*, the relationship between vehicle load and contribution to fatigue, whether the fatigue being considered involves structural metallic materials (as in bridge members) or asphaltic or cementitious concrete pavement substances, can best be analyzed by consideration of discrete loading distributions. A presentation of basic statistical values, such as the mean and the standard deviation, can provide a readily examinable basis for both illustrative purposes and for an analysis of trends within certain variable combinations and data source components. Consequently, the initial phase of the weight data analysis was to create a program to calculate the following values: average axleloads for each of the axles, average axle spacing for each such spacing position (e.g. the average space between the rear axle of the automobile and the first axle of the trailer being pulled), the mean gross load, the mean wheel base, the standard deviation of each of the axle's weights, the standard deviation of each spacing position's distance, the standard deviation of the gross loads, and the standard deviation of the wheel base. This program, as well as all programs written for the study are presented in Appendix B. The results of this analysis is shown in Figure 55. Summaries of subsets of the data are presented in Appendix C.

Before proceeding to a statistical analysis of the significance of differences among these variables, an explanation of set size discrepancies between spacing data and weight data is needed. During the

AVERAGE AXLELOADS (POUNDS)		
	FIRST	2357
	SECOND	2788
	THIRD	1530
	FOURTH	1483
STANDARD DEVIATION OF AXLELOADS (POUNDS)		
	FIRST	521
	SECOND	371
	THIRD	704
	FOURTH	418

MEAN GROSS LOAD 6992 POUNDS
STANDARD DEVIATION OF GROSS LOAD 665 POUNDS

AVERAGE AXLE SPACINGS (FEET)		
	FIRST	10.0
	SECOND	17.1
	THIRD	2.3
STANDARD DEVIATION OF AXLE SPACINGS (FEET)		
	FIRST	0.9
	SECOND	2.1
	THIRD	0.3

MEAN WHEEL BASE 23.1 FEET
STANDARD DEVIATION OF WHEEL BASE 10.7 FEET

Figure 55. Sample of Weight Data Output

collection of data at the I 75 weigh station, there was a four-hour period (6 am to 10 am) when it was not possible to obtain distance measurements between axles. However, weight values for the vehicles were recorded during this period. Since a considerable amount of data was collected during the remaining 12-hour period (certainly a statistically significant sample size), it was decided that the best procedure to follow was to take the data as it was, i.e. to accept a different sample size for weight and space data. In this manner, all the data collected was included in the data bank. The elimination of that portion of weight data which had no corresponding distance data would introduce a time bias into the weight data. Since no comparison was to be made directly between lumped statistical parameters of each of the data types, the mixed sample size method was acceptable.

Since the principal intended use of the axle weight data was its application to pavement design techniques, the decomposition of these data into subsets of vehicle type, road name and direction of travel was a necessity if trends peculiar to a certain subset were to be identified *(1)*. However, if certain subsets could be examined with extraneous variables eliminated, the analysis could pinpoint more accurately the source of these trends. For example, if northbound and southbound traffic on I 75 could be statistically combined and (or) if traffic on I 75 could be combined statistically with that on I 65 for an examination of house trailer weights, then the results could be interpreted strictly on the basis of vehicle type with the variables "road" and "direction of travel" eliminated.

In order to determine whether or not certain aspects of data subsets were combinable, appropriate statistical tests were selected to examine the equality of means and variances. Appendix D provides a listing of the results of the Smith-Satterthwaite t-test for equality of means and the F-test for equality of variances. Each of these statistical analyses were performed at the 95-percent level of confidence, with the α = .05 region divided into two tails.

From these analyses, it was found that very few of the data subsets were statistically combinable. A rather arbitrary method was necessarily chosen to evaluate the results of the statistical comparisons. Four criteria were established. The first was the acceptable statistical combination of three of the four axleloads. The second was the acceptibility of combining gross loads. The third examined the combinability of two of the three axleloadings. Statistical lumping of the wheel base was the final criterion. If three of the four criteria were satisfied, this was deemed to be sufficient evidence of the combinability of the statistical parameter under study. Table 5 illustrates the application of these criteria to several pairs of data subsets for comparisons of means; while Table 6 shows the results of analysis of the variances. As a result of these tests, the only data lumping which was deemed proper was that of I 64 eastbound with I 64 westbound and that of I 65 northbound with that of I 65 southbound.

WEIGHT VALUES AND PAVEMENT DESIGN

As discussed earlier, current highway pavement design philosophies *(3, 14, 15, 16, 17, 18, 19)* embody the theory of failure by fatigue in both flexible and rigid pavements and recognize the fatigue contributing equivalence of a certain number of passages of a standard axleload to a single passage of a certain axle weight. A thorough treatise on the theory of pavement design can be found is the referenced literature. It should be sufficient to say that the passage of a sufficiently heavy axle contributes to the reduction in the remaining fatigue life. Thus, any unanticipated increase in the number of sufficiently heavy axleloads from any traffic source could theoretically decrease the useful life of the pavement. Since A-UT combinations are categorized merely as automobiles in traffic classification studies, trailer axles are not included. If the trailer axles should prove to be relatively heavy, then the damage to the pavement fatigue strength could be significant.

Current PCC pavement design techniques *(14)* operate on the theory that an infinite number of axleloads can be supported without fatigue damage provided that the ratio between the flexural stress induced in the pavement and the modulus of rupture of the pavement is less than 0.50. Also, flexible pavement design procedures *(3, 19)* based on a value of 1.00 for a 10,000-pound axleload do not indicate fractional contributing factors for lighter axleloads. Other flexible pavement design methods *(15, 16)* based on equivalent 18,000-pound axleloads mention fractional values for axleloads less than the base value. One study *(17)* presented a theoretical equivalency value for axleload values for one through seventeen kips. Table 7, taken from this study, presents these factors. It is these latter factors which

TABLE 5
STATISTICAL ACCEPTANCE CRITERIA FOR MEANS

1. 3 out of 4 axle weights
2. gross weights
3. 2 out of 3 axle spacings
4. wheel base

DATA SUBSETS		COMPARISON CRITERIA				
1	2	1	2	3	4	VERDICT
I 75 N	I 75 S	No	No	Yes	No	Not Combinable
I 64 E	I 64 W	Yes	Yes	Yes	Yes	Combinable
I 65 N	I 65 S	Yes	No	Yes	Yes	Combinable
I 75	I 64	No	Yes	No	Yes	Not Combinable
I 65	I 75	No	No	Yes	Yes	Not Combinable
I 64	I 65	Yes	No	Yes	Yes	Combinable
One-Axle Tr.	Two-Axle Tr.	No	No	No	No	Not Combinable
House Tr.	U-Haul Tr.	No	No	No	No	Not Combinable
U-Haul Tr.	Other Tr.	No	Yes	Yes	Yes	Combinable
Boat Tr.	U-Haul Tr.	No	No	No	No	Not Combinable
Boat Tr.	Other Tr.	Yes	No	Yes	No	Not Combinable
House Tr.	Other Tr.	No	No	No	No	Not Combinable
Boat Tr.	House Tr.	No	No	No	No	Not Combinable

TABLE 6
STATISTICAL ACCEPTANCE CRITERIA FOR VARIANCES

1. 3 out of 4 axle weights
2. gross weight
3. 2 out of 3 axle spacings
4. wheel base

DATA SUBSETS		COMPARISON CRITERIA				
1	2	1	2	3	4	VERDICT
I 75 N	I 75 S	No	No	Yes	Yes	Not Combinable
I 64 E	I 64 W	No	Yes	Yes	Yes	Combinable
I 65 N	I 65 S	Yes	No	Yes	Yes	Combinable
I 75	I 64	No	No	Yes	Yes	Not Combinable
I 65	I 75	No	No	Yes	Yes	Not Combinable
I 64	I 65	No	No	Yes	Yes	Not Combinable
One-Axle Tr.	Two-Axle Tr.	No	No	No	No	Not Combinable
House Tr.	U-Haul Tr.	Yes	Yes	No	Yes	Combinable
U-Haul Tr.	Other Tr.	No	No	No	Yes	Not Combinable
Boat Tr.	U-Haul Tr.	No	No	No	Yes	Not Combinable
Boat Tr.	Other Tr.	No	No	No	Yes	Not Combinable
House Tr.	Other Tr.	No	No	No	No	Not Combinable
Boat Tr.	House Tr.	No	No	No	Yes	Not Combinable

TABLE 7
THEORETICAL LOAD EQUIVALENCY FACTORS FOR
SINGLE TIRES ON SINGLE AXLES

AXLELOAD IN KIPS	THEORETICAL EQUIVALENCY FACTOR
1	.00001
2	.00021
3	.00150
4	.00582
5	.0163
6	.0371
7	.0731
8	.128
9	.213
10	.333
11	.494
12	.699
13	.964
14	1.29
15	1.69
16	2.16
17	2.70

TABLE 8
COMPUTED LOAD EQUIVALENCY FACTORS FOR
SINGLE TIRES ON SINGLE AXLES

AXLELOAD IN KIPS	COMPUTED EQUIVALENCY FACTOR	AXLELOAD IN KIPS	COMPUTED EQUIVALENCY FACTOR
0.2	.0000000059	3.4	.0026543675
0.4	.0000001432	3.6	.0034510358
0.6	.0000009219	3.8	.0044235734
0.8	.0000034549	4.0	.0055984153
1.0	.0000096259	4.2	.0070043059
1.2	.0000222350	4.4	.0086723708
1.4	.0000451287	4.6	.0106361868
1.6	.0000833198	4.8	.0129318495
1.8	.0001430993	5.0	.0155980417
2.0	.0002321418	5.2	.0186760984
2.2	.0003596053	5.4	.0222100717
2.4	.0005362273	5.6	.0262467955
2.6	.0007744162	5.8	.0308359475
2.8	.0010883400	6.0	.0360301118
3.0	.0014940114	7.0	.0731275889
3.2	.0020093711	8.0	.1350133751
		9.0	.2318815031

have been selected for use in this study.

The factors presented in Table 7 provide a basis for an expanded listing of equivalency factors. Using the equivalency values for one kip through eight kips, a multiple regression equation was developed using the method of least squares. The points were linear when plotted on log-log graph paper, indicating an equation of the form

$$y = ax^b. \tag{2}$$

Solution of the normal equations indicated that

$$\log_e a = 43.27105 \tag{3}$$

and that

$$b = 4.59194. \tag{4}$$

Therefore, the equation for the equivalency factors was

$$\log_e y = -43.27105 + 4.59194 \log_e x \tag{5}$$

where y = equivalent fatigue consumption value and x = axleload. This equation has a correlation coeffiecint of $r = .99987$, thus indicating an exceptionally high degree of predictive capability within the range of the input data.

Using Equation 5, axleload values (x) were input for every 200 pounds up to 6000 pounds and for 7000, 8000, and 9000 pounds, and a corresponding equivalency factor (y) was computed. These values are presented in Table 8.

In order that the effects of A-UT combinations on the life of a pavement structure be given due consideration, these factors must be incorporated into current pavement design techniques. Specifically, what follows is a means by which these factors can be incorporated within Kentucky's methods of pavement design.

The load equivalency factors as developed in Table 8 from Equation 5, based on values in Table 7, are for single tires on single axles. Current design procedures *(3)* use equivalency factors based on a 10,000-pound axleload. Other methods proposed for use *(1, 15, 16)* are based on a load-damage factor having an 18,000-pound axleload base. The factors derived herein have a base ($y = 1.00$) of approximately 13,150 pounds (linear interpolation). The difference between the factors derived herein and the AASHO factors proposed for use in Kentucky is that the latter are for truck axles only and this is assumed to be a dual tire configuration. Also current procedures discount axle weights of less than 9000 pounds although AASHO recommends that a constant factor (.0002) be assigned to them. The first step in the procedure described herein was to convert the factors derived above to those used in pavement design procedures in Kentucky.

A linear regression analysis indicated an excellent correlation ($r = .93992$) between the AASHO single tire on single axle factors previously developed (Table 8) and those proposed for use in Kentucky based on an 18,000-pound axleload. When expressed in an exponential form, the equation is

$$d = 0.2213s^{0.2607} \tag{6}$$

where d is the AASHO dual tire factor for a given single tire factor s. Table 9 shows a complete listing of both sets of factors. The AASHO 18,000-pound axleload factors are based on the equation

$$f = 1.25^{(P-18)} \tag{7}$$

where f is the equivalency factor and P is the axleload in kips.

TABLE 9
COMPARISON BETWEEN DIFFERING AASHO EQUIVALENCY FACTORS

AXLELOAD	AASHO SINGLE TIRE FACTOR	AASHO DUAL TIRE FACTOR	AXLELOAD	AASHO SINGLE TIRE FACTOR	AASHO DUAL TIRE FACTOR
200	.0000000059	.0188	3400	.0026543675	.0385
400	.0000001432	.0197	3600	.0034510358	.0402
600	.0000009219	.0206	3800	.0044235734	.0421
800	.0000034549	.0215	4000	.0055984153	.0440
1000	.0000096259	.0225	4200	.0070043059	.0460
1200	.0000222350	.0235	4400	.0086723708	.0481
1400	.0000451287	.0246	4600	.0106361868	.0503
1600	.0000833198	.0257	4800	.0129318495	.0526
1800	.0001430993	.0269	5000	.0155980417	.0550
2000	.0002321418	.0218	5200	.0186760984	.0575
2200	.0003596053	.0294	5400	.0222100717	.0601
2400	.0005362273	.0308	5600	.0262467955	.0629
2600	.0007744162	.0322	5800	.0308359475	.0657
2800	.0010883400	.0337	6000	.0360301118	.0687
3000	.0014940114	.0352	7000	.0731275889	.0860
3200	.0020093711	.0368	8000	.1350133751	.1074
			9000	.2318815031	.1342

The proper application of these values to Kentucky's proposed method for pavement design requires a knowledge of the distribution of axle weight values for the A-UT combinations weighed. Weight data were analyzed in data subsets based on the previously discussed statistical validity tests for data lumping. These axleload distributions are presented in Appendix E.

The equivalency factors thus developed and the distribution of axle weight values of A-UT combinations can then be incorporated into the proposed methodology for predicting EAL's *(1)*. Appendix E presents a sample calculation of the type shown in Appendix G of the referenced report utilizing these factors and axleload distributions as well as average percent A-UT and average axles per A-UT data to be presented in the next section of this report.

ADDITIONAL IMPLICATIONS OF WEIGHT DATA

Although a detailed analysis of A-UT traffic from the capacity study viewpoint of equivalent number of automobiles will be presented in the subsequent section concerning spot speed data, certain preliminary remarks may be presented here. It has been determined that the average dual-tire vehicle (truck) has a weight-horsepower ratio of 325 pounds per horsepower *(20)*. An investigation of the weight-horsepower ratios of A-UT combinations will provide some foresight at the outset as to the automobile-equivalency factors for A-UT traffic to be anticipated.

As has been previously discussed, information gathered from interviews with A-UT operators produced some indication as to the power capabilities of the automotive engine size expressed in cubic inches. It had been hoped that this type of information could be converted to horsepower ratings; however, time limitations have proven this to be prohibitive. Of the 365 elements of the set of weight data, 34 included direct reports of vehicle horsepower. The mean value of the weight-horsepower ratio for these A-UT combinations was 36 pounds per horsepower -- with a standard deviation of 17 pounds per horsepower. Thus, preliminary data would seem to indicate a considerably lesser influence on the traffic stream by A-UT combinations than by trucks due to the lesser pounds per-horsepower ratio.

TRAFFIC COUNTS - PROCEDURE AND ANALYSIS

Prior to the initiation of this study by the Division of Research, there was virtually no information available as to the amount of A-UT traffic, either absolute or relative, which was present on Kentucky highways. The use of A-UT classification data was considered necessary when used in juxtaposition with accident records, loadometer data and speed distributions. Therefore, it was decided to obtain a variety of data from several types of classification studies directed toward the acquisition of A-UT information.

SELECTION OF COUNTING SITES

The selection of locations at which to conduct classification studies was restricted from both the aspect of compatibility with prior data (i.e. with available accident records and facilities available for loadometer studies) and of congruity with radar speed study information. A visual survey was conducted in the vicinity of the loadometer stations on each facility, and the following locations were selected at which to conduct classification studies:

1. I 65 in Harden County: At a point approximately 0.75 miles south of the loadometer stations where East Rhudes Creek Church Road is overpassed by I 65.

2. I 75 in Scott County: At a point about 0.5 mile north of the loadometer stations where KY 620 passes under the interstate.

3. I 64 in Shelby County: At a point 1.3 miles west of the interchange with KY 395 between Waddy and Petona on KY 395, where Wentworth Road passes beneath I 64. This site is 3.4 miles east of the loadometer stations on I 64, but there are no intervening exits to allow any change in the traffic stream.

These locations were all judged to satisfy the requirements for classification studies and radar speed studies.

In addition to the interstate highways, it was reasoned that several other types of facilities should be examined for numbers of A-UT vehicles. The only remaining facility for which accident information was available was the four-lane section of US 41 in Hopkins County; thus, it was decided to conduct a classification study on this highway. The site selected for this count was the point 0.6 mile south of the US 41 - US 62 interchange where US 41 overpassed the old Nortonville-White Plains Road.

Additional sites were selected in order to provide data from different classes of roads. The locations selected were the site on US 27 in Jessamine County, 0.8 mile south of the intersection with KY 981 at the roadside park, and a site on US 60 in Woodford County, 4.6 miles south of the Fayette County - Woodford County line.

It was believed that these six classification study locations combined with the information available from four toll roads would provide the necessary classification information for purposes of this project.

TYPE OF CLASSIFICATION STUDIES UTILIZED

There was a diversity of information desired from the classification studies; however, at each site there was a physical limitation as to the number of varying types of information which could be obtained for each count. Some of the types of information desired included the lane distribution of total traffic and of A-UT traffic and the information as to whether the automobiles passing had a trailer hitch. On any one count period, the distribution of traffic by lane or the separation of those vehicles having a trailer hitch could be recorded, but not both. Early in the study the notation as to the trailer hitch was the information which was recorded. It was, however, difficult to acquire this information at night or at dusk. A count of cars with trailer hitches was a relatively good indicator of the potential of A-UT combinations on the roadway. This was the count procedure utilized at sites on I 64, I 65, US 27, US 60, Us 41 and the short count on I 75. For the week-long count on I 75, where the determination of the presence of a trailer hitch during darkness was precluded, it was decided to record the lane distribution of automobiles and of A-UT combinations.

In addition to varying the type of information to be acquired, the length of the classification study was altered. A long count (a staggered, week-long study which included each hour of the week) was conducted at the I 75 location in Scott County. Personnel limitations precluded a 24-hour per day, seven-day continuous count. The remaining studies, which were short, were conducted at the locations on I 65, I 64, US 27, US 60 and US 41. In general, the short counts corresponded to the trailer hitch observations, and the long count was a lane distribution study. The short counts were of 12-hour duration, conducted from 8:00 am to 8:00 pm on the days chosen. These data were supplemented by toll receipts data from the Office of Toll Facilities.

ACQUISITION AND ORGANIZATION OF CLASSIFICATION INFORMATION

Prior to obtaining the classification information, a method to classify trailer types was chosen. An investigation of the licensing procedure in Kentucky indicated that only "house trailers' and the general class of "trailers" were licensed; a better stratification of trailer type information was needed. During initial counts, it was observed by the data collectors that an unusually large number of miscellaneous trailers were being recorded which could be classified separately as campers.

Stratification of trailers by axle configuration was included because this is the type of data which is used in the analysis of the effect of axleloads on the pavement. A systematic presentation of loadometer data would of necessity include those types of data needed for the computation of the average numbers of axles in various subsets. Distinction was made between those trailers having two axles were closely spaced in tandem and those spaced similar to standard automobiles.

In order to make the count data amenable to rapid analysis, the information from the classification data sheets was transferred to computer cards; and a program was devised to perform the desired manipulations.

RESULTS OF CLASSIFICATION DATA ANALYSIS

Table 10 indicates the average percentages of vehicle types for each of the six roadways at which classification information was obtained. This table also presents a weighted (by volume) average of all data and of data acquired at four-lane, controlled-access facilities. This classification of vehicle types was divided only into automobiles, A-UT combinations, campers and trucks. It can be seen that A-UT vehicles ranged from 1.12 percent of total traffic on US 27 to 4.24 percent on I 75; the weighted mean value was 2.47 percent on all roads and 3.00 percent on four-lane, controlled-access facilities. The percentage of campers similarly ranged from 0.59 percent on I 64 to 1.32 percent on I 75; the weighted mean was 1.01 percent for all roads and 1.11 percent for four-lane, controlled-access highways. Thus, the total weighted percentage of recreational vehicles on all roads was 3.48 percent and on all four-lane, limited-access facilities was 4.11 percent. The range was a low of 1.75 percent on I 64 and a high of 5.56 percent on I 75.

From the data on I 75, it was possible to obtain a similar distribution of vehicle types by hour of day and by day of week. Table 11 illustrates the distribution by hour of day and by day of week. Table 11 illustrates the distribution by hour of day; Table 12 shows the distribution by day of the week. An analysis of the percentage of A-UT traffic as a function of hour of day indicates a good correlation with traffic volume. Regression analysis indicated an equation of the form

$$y = 2.48 + .00148x \qquad (8)$$

where x is the hourly traffic volume and y is the percentage of A-UT traffic. The correlation coefficient of this equation (r) is .85. Table 13 illustrates the testing for significance of the slope, intercept and correlation coefficient. The boundary lines within which 95 percent of relationships fall are:

Lower: $$y = 2.05 + .00107x \qquad (9)$$

Upper: $$y = 2.91 + .00189x \qquad (10)$$

These boundaries are illustrated in Figure 56. A similar attempt to correlate percentages of A-UT vehicles to daily volumes did not produce any significant correlation. It was hypothesized that correlation with volume was significant when day of the week could be incorporated into the percentages, but when percentage as a function of volume is stratified by day of the week, no correlation was evident.

These regression models are presented for the purpose of illustrating trends rather than for the actual prediction of A-UT percentage. Correlation is high, but this does not necessarily mean that there exists a causative relationship. The regression line was derived from volumes stratified by hour of the day; the real meaning of this correlation was that the increase in A-UT traffic during certain periods of time was proportionately greater than the increase in traffic in general. It was obvious this was true for certain days of the week, and the figures presented seem to indicate that this was also true for certain hours of the day.

An analysis was also performed to test the directional equality of vehicle percentages and volume percentages. Table 14 shows that, at the 95-percent level of significance, the percentages of the four vehicle types and of volume were not significantly different by direction of travel.

Furthermore, an analysis was performed to compare the percentage of non A-UT automobiles which had a trailer hitch. Table 15 indicates that the mean percentage was 9.09 and that the standard deviation was 1.79. Testing of the largest deviation from the mean showed this extremum to be insignificantly larger than the mean. Therefore, it can be stated that there was no statistically significant difference in the percentages of non A-UT vehicles with trailer hitches. The magnitude of the percentage of this type of vehicle indicated a potential for as much as ten percent of the total traffic becoming A-UT vehicles.

Analysis of the percentage of A-UT vehicles in the shoulder lane of traffic revealed an unweighted mean percentage of 90.49 when the data were stratified by hour and 88.68 percent when categorized by day. Examination of the hourly percentages revealed that, except for the period between 4 am and 5 am, when every A-UT vehicle was travelling in the shoulder lane, no particular hour had a statistically significant percentage differential. Similar analysis of percentages by day revealed no significant deviation.

TABLE 10
AVERAGE VEHICLE TYPE PERCENTAGES

ROAD	AUTOS	A-UT	CAMPERS	TRUCKS	ADT
I 75	85.21	4.21	1.32	9.23	22988
I 64	80.90	1.16	0.59	18.53	10586
I 65	77.85	2.80	1.13	18.22	9860
US 27	90.24	1.12	0.72	7.92	9740
US 41	79.43	2.02	1.14	17.41	8510
US 60	86.29	1.26	0.83	11.62	12000
WEIGHTED AVG.	83.59	2.47	1.01	12.93	12281
FLCA WEIGHTED AVG.	81.72	3.00	1.11	14.17	12986

TABLE 11
DISTRIBUTION OF VEHICLE TYPES ON I 75 BY HOUR OF DAY

HOUR	AUTOS	A-UT	CAMPERS	TRUCKS	AVERAGE VOLUME
Midnight					
12-1	73.72	2.66	1.60	22.02	418
1-2	72.96	3.03	1.65	22.36	364
2-3	71.87	2.90	1.54	23.69	315
3-4	75.97	2.80	0.98	20.25	424
4-5	76.19	2.99	1.29	19.53	320
5-6	83.36	3.26	0.94	12.44	561
6-7	82.75	3.62	1.27	12.36	631
7-8	85.22	3.64	1.24	9.90	785
8-9	85.77	4.19	1.22	8.82	1043
9-10	86.59	4.70	0.98	7.73	1334
10-11	87.37	4.99	0.99	6.65	1481
11-12	87.12	4.95	1.22	6.71	1528
Noon					
12-1	87.64	4.68	1.12	6.56	1526
1-2	87.29	4.89	1.27	6.55	1517
2-3	87.91	4.86	1.33	5.90	1583
3-4	87.19	4.59	2.13	6.09	1639
4-5	88.10	3.93	1.44	6.53	1513
5-6	88.09	4.19	1.28	6.44	1316
6-7	87.11	3.87	1.46	7.56	1186
7-8	84.94	4.07	1.47	9.52	951
8-9	81.93	5.35	1.16	11.56	824
9-10	83.18	3.34	1.30	12.18	693
10-11	80.23	2.92	1.41	15.44	557
11-12	78.69	3.14	1.26	16.91	411

TABLE 12
DISTRIBUTION OF VEHICLE TYPES ON I 75 BY DAY OF WEEK

DAY	AUTOS	A-UT	CAMPERS	TRUCKS	VOLUME
Sunday	90.21	3.98	1.20	4.61	32080
Monday	84.99	4.23	1.26	9.52	20878
Tuesday	81.99	3.57	1.14	13.30	17589
Wednesday	79.33	4.35	1.13	15.19	16842
Thursday	80.60	4.24	1.56	13.60	18369
Friday	85.34	4.18	1.20	9.28	24589
Saturday	87.92	4.87	1.64	5.57	39569

TABLE 13
STATISTICAL SIGNIFICANCE OF REGRESSION EQUATION

PARAMETER	H_0	t	ACCEPTANCE RANGE	STATISTICAL DECISION
Slope	a = O	7.54	+2.07	Reject H_0
Intercept	c = O	11.85	+2.07	Reject H_0

PARAMETER	H_0	z	ACCEPTANCE RANGE	STATISTICAL DECISION
Correlation Coefficient	p = O	5.74	+1.96	Reject H_0

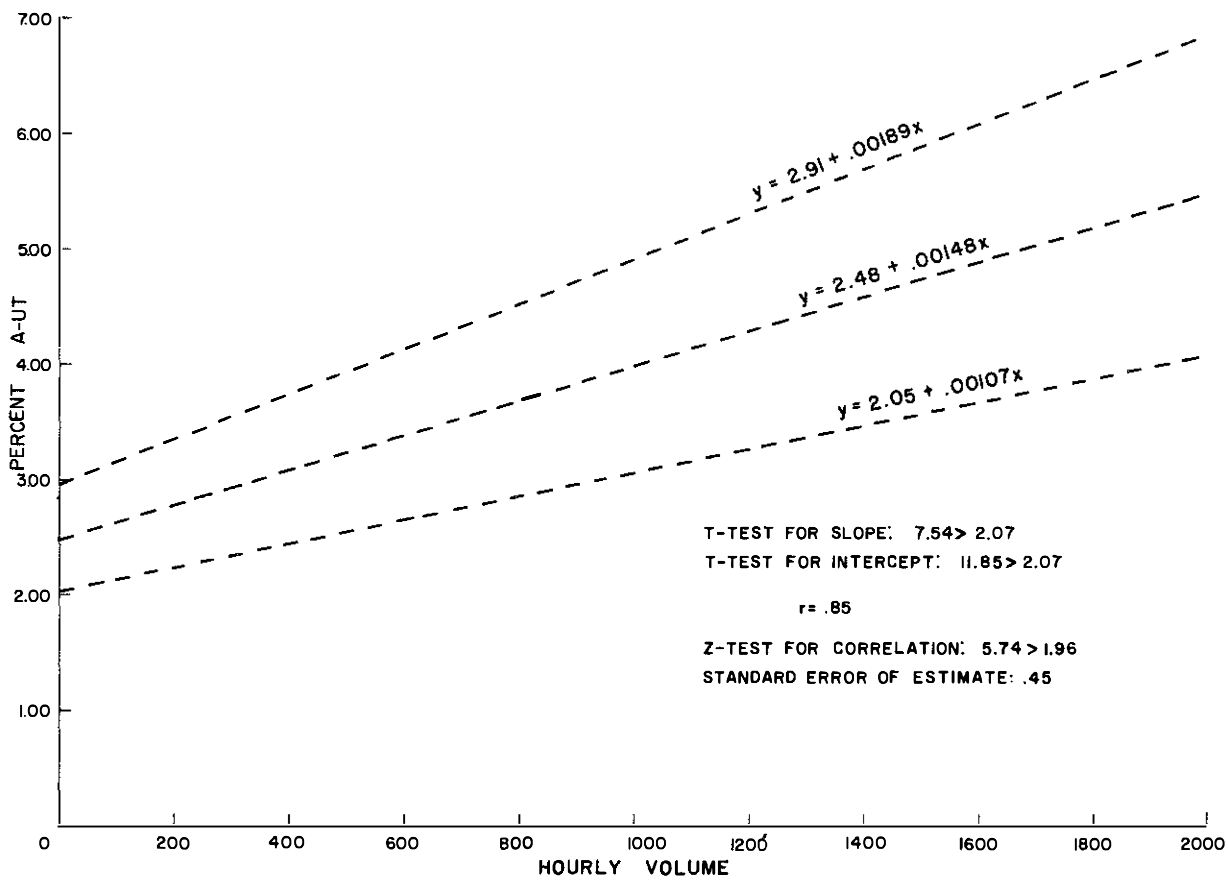

Figure 56. A-UT Traffic as a Function of Hourly Volume

TABLE 14
COMPARISON OF DIRECTIONAL VEHICLE TYPE AND TRAFFIC VOLUME PERCENTAGES

VEHICLE TYPE	d	S_d	υ	t VALUE	TEST STATISTIC	DECISION
Trucks	-.12	.89	4	.301	2.776	Accept H_o
A-UT	-.33	.35	4	2.108	2.776	Accept H_o
Campers	-.11	.21	4	1.171	2.776	Accept H_o
Autos	.56	1.19	4	1.055	2.776	Accept H_o
Volume	2.11	3.78	4	1.116	2.776	Accept H_o

TABLE 15
STATISTICAL TEST FOR PERCENT HITCH IN TOTAL TRAFFIC

ROAD	% HITCH	H-H	$(H-H)^2$
US 41	9.68	.59	.35
US 27	11.31	2.22	4.93
I 65	8.16	-.93	.86
I 64	7.22	- 1.87	3.50
Σ			9.64

$x = 9.09, \ \sigma = 1.79$

T TEST FOR LARGEST DEVIATION: $t = 2.480 < t^* = 3.182$
Largest deviation from mean is not significantly large.

For purposes of analysis, it may be concluded that approximately 90 percent of A-UT combinations travel in the shoulder lane. Hourly and daily distributions of the percentages of A-UT vehicles in the shoulder lane are shown in Tables 16 and 17.

The final analysis of traffic classification data was a summary of trailer types. A matrix of five trailer types and three axle configurations was made on each road. There were, however, three roads at which only four trailer types were used. A summary of this information is presented in Tables 18 and 19.

The summation of trailer types exceeds 100 percent because the counts in which camper trailers both were and were not included are mixed. The summation of axle configurations is less than 100 percent due simply to rounding. From these tables, the following can be deduced:

1. The distribution of trailer types is dominated by camper trailers, although each of the other four trailer types share an approximately equal percentage of the total.

2. Nearly four-fifths of all trailers had one axle and less than one percent had three axles.

3. Camper trailers were the dominant type of one-axle and three-axle trailers, but were the least dominant two-axle trailer.

4. House trailers were the least prevalent one-axle trailer. With the exception of miscellaneous trailer types, house trailers were also the most prevalent two-axle trailer.

5. There were no three-axle boat or camper trailers observed.

6. The largest single trailer type is the one-axle camper trailer.

Table 20 is the same as Table 18 except the percentages have been normalized to total 100 percent. An examination of the individual matrices for each road revealed the following observations:

1. I 65 was the dominant road for house trailers, while US 27 had the smallest percentage of this trailer type.

2. This same trend was apparent for one-axle house trailers, but US 41 had the greatest percentage of two-axle house trailers while US 60 had none.

3. I 65 was the only road with a significant percentage of three-axle house trailers.

4. US 27 had the greatest percentage of boat trailers while US 60 had the lowest.

5. The same is true for one-axle boat trailers; for two-axle boat trailers, US 27 had the greatest percentage while neither I 64 nor US 60 had any of this vehicle type.

6. There were no three-axle boat trailers observed.

7. The greatest percentage of U-Haul type trailers was on US 41 while the least was observed on US 27.

8. This same trend was observed for both one-axle and two-axle U-Haul trailers, although I 75 had only slightly more two-axle U-Hauls than did US 27.

9. There were no three-axle U-Haul trailers observed.

TABLE 16
STATISTICAL TEST OF A-UT TRAFFIC IN SHOULDER LANE BY HOUR

HOUR	P	P-P	(P-P)^2	HOUR	P	P-P	(P-P)^2
1	94.87	4.38	19.18	13	87.80	-2.62	6.86
2	98.70	8.21	67.40	14	89.21	-1.35	1.82
3	93.75	3.26	10.63	15	86.99	-3.50	12.25
4	96.39	5.90	34.81	16	86.53	-3.96	15.68
5	100.00	9.51	90.44	17	85.58	-4.91	24.11
6	95.31	4.82	23.22	18	88.60	-1.89	3.57
7	93.12	2.63	6.92	19	85.67	-4.82	23.23
8	84.50	-5.99	35.88	20	87.82	-2.67	7.13
9	92.81	2.32	5.38	21	84.47	-6.02	36.24
10	87.47	-3.02	9.12	22	89.51	- .98	.96
11	88.20	-2.29	5.24	23	93.86	3.37	11.36
12	89.22	-1.27	1.61	24	91.43	.92	.85

P = 90.49, σ = 4.44

T TEST FOR LARGEST DEVIATION: $t = 1.87 < t^* = 2.07$
Largest deviation from mean is not significantly large.

TABLE 17
STATISTICAL TEST OF A-UT TRAFFIC IN SHOULDER LANE BY DAY

DAY	P	P-P	(P-P)^2
Sun	87.39	-1.29	1.66
Mon	90.93	2.25	5.06
Tue	91.08	2.40	5.76
Wed	86.90	-1.78	3.17
Thur	88.45	- .23	.05
Fri	86.37	-2.31	5.34
Sat	89.66	.98	.96

P = 88.68, σ = 1.91

T Test indicates Monday, Tuesday, Wednesday, and Friday have significantly different percentages.

TABLE 18
MEAN TRAILER TYPE PERCENTAGES (UNADJUSTED)

	HOUSE	BOAT	U-HAUL	CAMPER	OTHER	SUMMATION
One-Axle	13.22	20.01	16.62	27.26	14.76	78.33
Two-Axle	3.60	3.30	4.95	0.98	4.00	7.99
Three-Axle	0.16	0.00	0.00	0.60	0.30	0.77
Summation	18.27	22.65	21.47	28.51	23.20	114.10/99.84

TABLE 19
STANDARD DEVIATION OF TRAILER TYPE PERCENTAGES (UNADJUSTED)

	HOUSE	BOAT	U-HAUL	CAMPER	OTHER	SUMMATION
One-Axle	6.04	12.62	8.42	15.00	6.06	8.28
Two-Axle	3.60	3.30	4.95	0.98	4.00	7.99
Three-Axle	0.40	0.00	0.00	1.03	0.73	1.43
Summation	8.80	15.54	11.82	13.07	9.25	--

TABLE 20
MEAN TRAILER TYPE PERCENTAGES (ADJUSTED)

	HOUSE	BOAT	U-HAUL	CAMPER	OTHER	SUMMATION
One-Axle	11.59	17.54	14.57	23.89	13.01	80.60
Two-Axle	4.28	2.31	4.25	0.59	7.05	18.47
Three-Axle	0.14	0.00	0.00	0.53	0.26	.93
Summation	16.01	19.85	18.82	25.00	20.32	100.00

10. Camper trailers comprised 40 percent of the trailer types on US 60 and over 30 percent on I 75.

11. The percentage of miscellaneous trailers decreased when camper trailers were included as a separate class.

12. The greatest percentage of miscellaneous trailer types on roads at which camper trailers were separated was on US 60 while the least percentage was on I 75.

13. The greatest percentage of one-axle trailers was on I 75 while the least percentage was on US 41.

14. US 27 had over three percent three-axle trailers; I 65 had nearly one percent.

COMPUTATION OF PROJECTION FACTORS

There was one roadway section, I 75, at which the classification study extended to each hour of the week. It was hypothesized that a calculation could be made to determine the percentage of daily A-UT traffic which occurs during each hour of the day, and this information could be utilized to expand a 12-hour count to a full day's count. Similar calculations could then be made for day of the week. Information available from the Office of Toll Facilities could then be used to project the data from the month in which it was taken over the entire year.

There were several assumptions implicit in this numerical manipulation. The distribution by hour of the day was lumped for all days of the week. Therefore, the assumption was that the distribution does not vary within the week. There are several obvious instances in which this assumption is not valid. However, in general, it was felt that the hypothesis was true. Similarly, the assumption was implicit that the week during which the classification study was conducted was typical of every week of the year. Finally, the assumption was also made that the years for which toll data were acquired were typical. In addition, the assumption was implicit that distributions by hour and by day on I 75 were typical of that for other roads.

Table 21 lists the percentages of daily total A-UT vehicles which occurred during each hour of the day. It can be seen that the percentage occurring between 7 pm and 8 pm exceeds that during the hour 7 am to 8 am, and that the percentage occurring between 8 am and 9 am and that occurring between 8 pm and 9 pm were not significantly different. Therefore, it can be concluded that the 8-8 shift for the 12-hour count was preferable to a 7-7 shift, equally desirable as a 9-9 shift, and superior to any other possible continuous 12-hour shift. The percentage of daily A-UT vehicles counted between 8 am and 8 pm was 77.31.

As noted before, Table 21 contains the distribution of daily A-UT vehicles by hour of the day. Similarly, Tables 22 and 23 show similar distributions by day of the week and month of the year. Appendix F illustrates the use of this type of information in the calculation of the ordinal values of A-UT traffic.

SPOT SPEED MEASUREMENT AND ANALYSIS

The final phase of the study was the determination of various spot speed parameters for different vehicle types. It was felt that this information could be used to determine auto-utility trailer combination equivalency factors to be utilized in conjunction with capacity analyses. Furthermore, since accident potential on high speed facilities increases as speed differential increases, an analysis of any speed differential trends might yield a correlation with accident records.

SELECTION OF LOCATIONS

As previously mentioned, the choice of locations at which to conduct spot speed studies was made in conjunction with the appropriate criteria for other phases of the study. The specific criteria which

TABLE 21
DAILY A-UT TRAFFIC: DISTRIBUTION BY HOUR

HOUR	PERCENT OF TOTAL	HOUR	PERCENT OF TOTAL
Midnight-1	1.14	Noon-1	7.36
1-2	1.13	1-2	7.61
2-3	.94	2-3	7.88
3-4	1.22	3-4	7.73
4-5	.98	4-5	6.10
5-6	1.88	5-6	5.66
6-7	2.35	6-7	4.71
7-8	2.93	7-8	3.98
8-9	4.49	8-9	4.53
9-10	6.44	9-10	2.38
10-11	7.59	10-11	1.67
11-12	7.76	11-12	1.54

TABLE 22
WEEKLY A-UT TRAFFIC: DISTRIBUTION BY DAY

DAY	PERCENT OF TOTAL
Sunday	18.74
Monday	12.94
Tuesday	9.21
Wednesday	10.75
Thursday	11.43
Friday	15.07
Saturday	21.86

TABLE 23
YEARLY A-UT TRAFFIC: DISTRIBUTION BY MONTH

MONTH	PERCENT OF TOTAL
January	3.08
February	3.18
March	4.87
April	8.52
May	7.76
June	14.39
July	17.74
August	16.76
September	8.43
October	6.69
November	4.50
December	4.08

were considered especially relevant to the collection of spot speed information were relatively straight and level sections of roadway and appropriate possibilities for conceahnent of testing apparatuses. The most likely spot on limited access roadways for concealment is the gap between parallel bridge structures where the major facility overpasses a minor road. The customary practice at these sites is to plant shrubbery in front of the paved fill slope which leads to the minor road. The requirement that the roadway section be relatively straight and level was derived from the fact that the most important aspect to be considered is the relative speed between A-UT combinations and autos, not the absolute speed of either.

SPOT SPEED PROCEDURES

The radar meter used for this study was a Decature Electronics Model 989. This model was designed to run on a standard, 12-volt car battery. The standard procedure for using this apparatus was to connect the power terminals into the lighter socket and to affix the radar unit to a side window so that the emissions and reflections are as closely as possible parallel to the direction of traffic. The major disadvantage of this procedure was that vehicle operators tend to alter their pattern of driving when a vehicle parked at the roadway edge is observed. This pattern is magnified when the vehicle parked is a state-owned car. For these reasons, it was felt that an alternate procedure should be employed to obtain maximum accuracy of the spot speed data. The radar meter apparatus was altered so that it would operate directly from the terminals of a 12-volt battery outside the vehicle. This allowed the apparatus to be located such that emissions and reflections to the radar antenna were properly aligned, and permitted operators to conceal themselves behind shrubbery, bridge walls, etc. Figure 57 illustrates a typical installation at a bridge railing.

At least three hours data in each direction was obtained for each road. Spot speed was recorded for as many vehicles as was deemed appropriate. However, only the first vehicle of a platoon was recorded since this vehicle was the speed determinator of the entire queue. This limited the data which could be obtained on the two-lane roadway, US 27; however, the greater volume and multi-lane aspects of the other roads eased the effects of this restriction. Speeds were obtained for automobiles, A-UT vehicles and trucks.

ANALYSIS OF SPEED DATA

A statistical analysis of speed data collected at each of the six test sites is shown in Table 24. These tests indicated a statistically significant difference between the speeds of A-UT combinations and of automobiles at each of the six test sites. Table 25 shows a parcel of the information gathered from a plot of the cumulative speed distributions of automobiles, trucks and A-UT combinations for the six roadway sections. The use of the 85th percentile is consistent with the normal practice used by traffic engineers to establish speed limits and gauge the normal running speed of the traffic stream. The 50th percentile is the median speed, a common measure of central tendency, being the speed above and below which half of the vehicles travel. The 15th percentile is used as a lower base for running speed calculations, sometimes used as the speed below which allowance should not be made in the design of speed-influenced facilities. It is also an appropriate statistical symmetry for the 85th percentile speed.

The first observation regarding the data was to compare the speed distributions against symmetry. This is to say, to compare the difference between the 85th percentile level and the 50th percentile level with the difference between the 50th percentile and the 15th percentile. It will be noted at this point that speed figures were expressed as whole numbers. This is consistent with the accuracy with which speeds can be recorded from the radar meter. Table 26 summarizes the two speed differences discussed above.

Based on this symmetry analysis, it can be said that automobiles were relatively symmetrical in their speed distribution, exhibiting a slightly greater tendency toward more dispersion among lower speeds. Trucks were not greatly skewed in their distribution, yet they exhibited a marked trend toward greater variance at lower speeds -- more so than automobiles. Speed distributions of A-UT vehicles exhibited the greatest variance in distribution in either direction, undoubtedly due to a smaller sample size. However, when the mean difference between upper and lower differentials was computed, the A-UT distribution was more heavily skewed downward than the distribution of either automobiles or trucks. By inference,

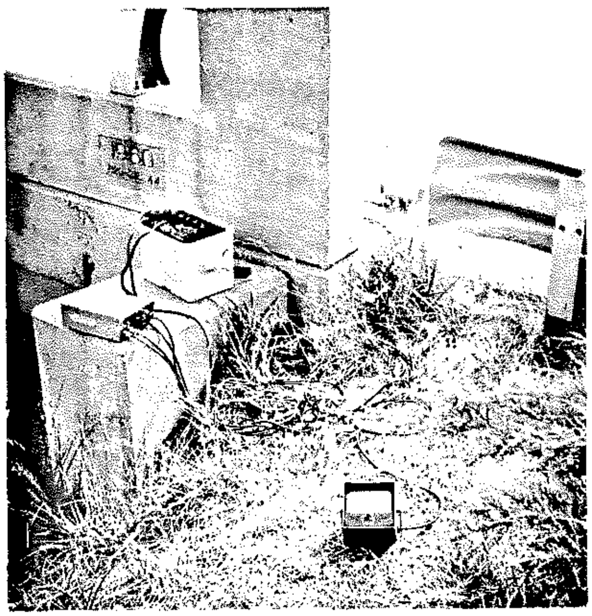

Figure 57. Radar Speed Study Instrumentation

TABLE 24
STATISTICAL ANALYSIS OF SPOT SPEED DATA

ROAD	x_{AUTO}	$x_{A\text{-}UT}$	t_{SAMPLE}	υ	t_{TEST}	STATISTICAL DECISION
US 41	63	57	3.54	9	3.25	Difference is significant
US 60	60	54	5.88	35	2.58	Difference is significant
US 27	48	44	3.14	24	2.80	Difference is significant
I 65	64	56	7.55	63	2.58	Difference is significant
I 75	66	58	9.73	119	2.58	Difference is significant
I 64	64	58	4.64	22	2.82	Difference is significant

FORMULA USED TO CALCULATE NUMBER OF DEGREES OF FREEDOM *(23)*

$$\upsilon = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$$

TABLE 25
SPEED PERCENTILES

ROAD	VEHICLE TYPE	85TH PERCENTILE SPEED	50TH PERCENTILE SPEED	15TH PERCENTILE SPEED
US 27	Autos	56	48	42
	Trucks	50	43	34
	A-UTs	49	43	38
US 60	Autos	65	59	53
	Trucks	60	54	47
	A-UTs	60	54	44
US 41	Autos	69	63	56
	Trucks	64	58	52
	A-UTs	61	57	44
I 65	Autos	70	64	58
	Trucks	63	59	54
	A-UTs	65	56	50
I 64	Autos	70	65	59
	Trucks	65	60	54
	A-UTs	64	58	54
I 75	Autos	72	66	61
	Trucks	62	58	52
	A-UTs	65	58	52

TABLE 26
SPEED PERCENTILE DIFFERENCES

ROAD	VEHICLE TYPE	UPPER DIFFERENTIAL	LOWER DIFFERENTIAL
US 27	Autos	8	6
	Trucks	7	9
	A-UTs	6	5
US 60	Autos	6	6
	Trucks	6	7
	A-UTs	6	10
US 41	Autos	6	7
	Trucks	6	6
	A-UTs	4	13
I 65	Autos	6	8
	Trucks	4	5
	A-UTs	9	6
I 64	Autos	5	6
	Trucks	5	6
	A-UTs	6	4
I 75	Autos	6	5
	Trucks	4	6
	A-UTs	7	6

the lower half of the A-UT speed distribution was more widely variant than those for automobiles or trucks, indicating that the lower half of the speed range was more extended for A-UT combinations.

Equivalency factors can be computed to a remarkable degree of accuracy from speed distributions *(21)*. The process used here to compute equivalency factors for A-UT combinations was to compare speed distributions of automobiles, trucks, and A-UT combinations; then, using established factors for trucks as a base, a related figure for A-UT combinations was calculated. This process will be illustrated for US 27, since equivalency factors are most relevant (and most easily calculated) for rural two-lane roads. Spot speeds were determined at several representative percentile levels (in this case the 10th, 30th, 50th, 70th and 90th) for each of the three vehicle types. These are listed for US 27 in Table 27. The automobile-equivalency factor for trucks for a rural, two-lane road in a terrain considered 60 percent level and 40 percent rolling and for a Level of Service B or C is 3.5. Using this figure as a base, and the mean ratio between truck-auto differences and A-UT-auto differences as a multiplier, the calculation becomes 3.5 x .99 or 3.5. Thus, the equivalency factor for A-UT combinations on US 27, calculated from spot speed distributions, was equal to the equivalency factor for trucks. The effect was not as great, however, since the percentage of A-UT vehicles was less than that of trucks.

Using the same procedure for the other roadway sections resulted in the spot speed figures listed in Table 27. Table 28 lists the speed differential ratios for the five percentile levels previously mentioned. The mean values are also listed for each road. It can be seen that the mean on each of these roads, like the mean on US 27, was close to unity. Therefore, it can be said in general that the automobile equivalency factor for A-UT combinations is the same as the factor for trucks. For US 60, this factor is 2.0 because the US 60 site was in level terrain. For US 41 and I 65, which are in level terrain and are limited access multi-lane facilities, the equivalency factor was 2.0. For I 64 and I 75, which are in moderately rolling terrain, the factor was 3.0.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The purpose of the preceeding discussion has been to consider the influence of automobile-utility trailer (A-UT) combinations with respect to several areas of highway engineering. The accident history of these vehicles, the influence of their axle weights on pavement design, the relative amount of these vehicles in the traffic stream, the relative speed distributions of these vehicles and other vehicle types are factors which have never before been considered in the field of highway design. The purpose of this discussion was not to provide an exhaustive treatise on any of these subject areas, but merely to consider all four areas from a general viewpoint and to point out any ramifications which may become apparent.

The following conclusions can be drawn from the results of the study:

1. Accidents involving A-UT combinations are disproportionately greater than the prevalence of these vehicles in the traffic stream.

2. Although the size of the data sample was small, several types of locations were pin-pointed which seemed to be problem areas for A-UT accidents.

3. Indications at these locations were that accidents are related to wind forces created either by passing maneuvers or cross sectional configurations, or to weaving.

4. Trailer axles, while generally being heavier than automobile axles, are relatively light.

5. When both car axles and trailer axles are considered in a cumulative fatigue analysis for flexible pavement design, the additional equivalent axleloads accumulated for a roadway with significant A-UT percentage is approximately five percent.

TABLE 27
SPOT SPEEDS

	US 27			US 41			US 60			I 65			I 75			I 64		
	AUTOS	TRUCKS	A-UT	AUTOS	TRUCKS	A-UT	AUTOS	TRUCKS	A-UT	AUTOS	TRUCKS	A-UT	AUTOS	TRUCKS	A-UT	AUTOS	TRUCKS	A-UT
10th Percentile	41	33	33	54	52	41	51	45	43	56	53	49	59	50	50	58	53	54
30th Percentile	44	39	41	59	55	52	57	51	50	61	56	53	64	55	55	62	58	56
50th Percentile	48	43	43	63	58	57	59	55	53	64	59	55	66	58	58	65	60	58
70th Percentile	52	45	45	66	60	59	64	58	56	67	61	60	69	60	61	66	63	60
90th Percentile	57	51	50	71	65	63	66	60	64	71	64	65	73	64	66	71	65	65

TABLE 28
SPEED DIFFERENTIALS

	US 27	US 41	US 60	I 65	I 75	I 64
10th Percentile	1.00	1.27	1.05	1.08	1.00	.98
30th Percentile	.95	1.08	1.02	1.06	1.00	1.04
50th Percentile	1.00	1.02	1.04	1.07	1.00	1.03
70th Percentile	1.00	1.02	1.04	1.02	.98	1.05
90th Percentile	1.02	1.03	.94	.98	.97	1.00
Mean	.99	1.08	1.02	1.04	.99	1.02

6. Three-fourths of the A-UT combination trailers on the road are one-axle trailers.

7. The camper trailer is the most common type of trailer.

8. The speed distribution of A-UT combinations closely resembles that of trucks.

9. The automobile equivalency factor for A-UT combinations is approximately equal to that for trucks.

As a result of this study, the following recommendations concerning consideration of A-UT combinations are made:

1. At locations where cross sectional configuration and accident records indicate cross winds to be a problem, the standard United Nations cross wind warning sign *(22)* or a similar message panel should be employed to warn motorists of a possible hazard.

2. Pavement design may involve the consideration of A-UT trailer axles.

3. When designing rural secondary roadways which have as their primary traffic constituent recreational vehicles, A-UT combinations should be considered in analysis of traffic capacity and level of service.

4. Studies of vehicle classifications should include A-UT combinations as a vehicle class, if not on a regular basis then at least periodically, to evaluate trends in the percentage of these vehicles in the traffic stream.

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APPENDIX A

STATISTICAL THEORY

STATISTICAL THEORY

INFERENCES CONCERNING PROPORTIONS

The n trials or events must satisfy the assumptions underlying the binomial distribution *(23)*:

1. There are only two possible outcomes for each trial, arbitrarily called "success" and "failure" without inferring that a success is necessarily a desirable outcome.

2. The probability of a success is constant from trial to trial; it will be denoted by the letter p and, hence, the probability of failure is denoted by (1-p).

3. There are n trials, where n is a constant.

4. The n trials are independent.

For traffic count data, the distribtuion has historically been designated as a Poisson distribution rather than a binomial distribution. For accident occurence, only the first condition above is satisfied, i.e. either an accident involves at least one A-UT combination or it does not. Conditions Two and Three are obviously violated, as is, in all probability, Condition Four. Consideration of A-UT accidents as a binomial distribution appears to have no basis; hence a statistical comparison of the two proportions is not practical.

INFERENCES CONCERNING MEANS

Test for equality of means when concerned with two independent random samples with normal populations whose variances are not necessarily equal:

$$H_O:\ x = y \qquad H_1:\ x \neq y$$

$$t = (x-y)/\,(S_x^2/n_1) + (S_y^2/n_2)$$

$$\nu = [(S_x^2/n_1) + (S_y^2/n_2)]/\left[\frac{(S_x^2/n_1)^2}{n_1 - 1} + \frac{(S_y^2/n_2)^2}{n_2 - 1}\right]$$

INFERENCES CONCERNING VARIANCES

Test for the equality of variances when concerned with independent random samples taken from normal populations:

$$H_O:\ S_x^2 = S_y^2 \qquad H_1:\ S_x^2 \neq S_y^2$$

$$F = S_x^2/S_y^2$$

METHOD OF LEAST SQUARES

A linear regression line of y on x can be computed using the technique of minimizing the squares of the distances in the "y" direction of all the points from the proposed line, commonly known as the method of least squares. If the linear relationship, $y = f(x)$, is expressed in the form $y = a + bx$, then the parameters a and b can be computed as follows:

$$a = (\Sigma x^2 \Sigma y - \Sigma x \Sigma xy)/[n(\Sigma x^2) - (\Sigma x)^2]$$

$$b = (n\Sigma xy - \Sigma x \Sigma y)/[n(\Sigma x^2) - (\Sigma x)^2]$$

INFERENCES BASED ON LEAST SQUARES ESTIMATORS

H_O: $a = \alpha$ $\qquad$ H_1: $a \neq \alpha$

$$t = [(a - \alpha)/S_e]\sqrt{nS_{xx}/[S_{xx} + (n\bar{x})^2]} \text{ and } \nu = n - 2$$

H_O: $b = \beta$ $\qquad$ H_1: $b \neq \beta$

$$t = [(b - \beta)/S_e]\sqrt{S_{xx}/n} \text{ and } \nu = n-2$$

where $S_e = \sqrt{[S_{xx}S_{yy} - (S_{xy})^2]/n(n-2)S_{xx}}$

$$S_{xx} = n\Sigma x^2 - (\Sigma x)^2$$

$$S_{yy} = n\Sigma y^2 - (\Sigma y)^2$$

$$S_{xy} = n\Sigma xy - (\Sigma x)(\Sigma y)$$

APPENDIX B

A-UT COMPUTER PROGRAMS

STATISTICAL SUMMARY
OF
LOADOMETER DATA SUBSETS

```
      REAL SP(5),TSP(5),T2SP(5),MAS(5),SAL(5),SAS(5),SPACE,MWB,TTSPAC,SW
     1B,LEO(5),HAYS(5),SAN,BSS
      INTEGER TWT(5),WT(5),W(5),S(5),T2WT(5),MAL(5),N,WEIT,MGL,TTWEIT
      DO 29 I=1,5
      TWT(I)=0
      WT(I)=0
      W(I)=0
      TSP(I)=0.0
      SP(I)=0.0
      S(I)=0
      T2WT(I)=0
      T2SP(I)=0.0
      MAL(I)=0
      MAS(I)=0.0
      SAL(I)=0.0
      SAS(I)=0.0
   29 CONTINUE
      N=0
      MGL=0
      MWB=0.0
      TTWEIT=0
      TTSPAC=0.0
      SGL=0.0
      SWB=0.0
      SPACE=0.0
      WEIT=0
   68 READ(5,100) (WT(I),I=1,5),(SP(I),I=1,4),MO
  100 FORMAT(16X,5I4,1X,4F4.1,I2)
      IF(MO.EQ.99) GO TO 81
      N=N+1
C     WEIT IS THE TOTAL SUM OF ALL THE AXLES WEIGHED
      WEIT=WT(1)+WT(2)+WT(3)+WT(4)+WEIT
      TTWEIT=(WT(1)+WT(2)+WT(3)+WT(4))*(WT(1)+WT(2)+WT(3)+WT(4))+TTWEIT
C     SPACE IS THE TOTAL SUM OF THE SPACINGS MEASURED
      SPACE=SP(1)+SP(2)+SP(3)+SP(4)+SPACE
      TTSPAC=(SP(1)+SP(2)+SP(3)+SP(4))*(SP(1)+SP(2)+SP(3)+SP(4))+TTSPAC
      DO 69 I=1,5
      TWT(I)=TWT(I)+WT(I)
      T2WT(I)=WT(I)*WT(I)+T2WT(I)
      IF(WT(I).GT.0) GO TO 30
      GO TO 60
   30 W(I)=W(I)+1
   60 CONTINUE
      TSP(I)=TSP(I)+SP(I)
      T2SP(I)=SP(I)*SP(I)+T2SP(I)
      IF(SP(I).GT.0) GO TO 31
      GO TO 61
   31 S(I)=S(I)+1
   61 CONTINUE
   69 CONTINUE
```

```
      GO TO 68
   81 CONTINUE
      DO 99 I=1,4
C     MAL=MEAN AXLE LOAD
      MAL(I)=TWT(I)/W(I)
   99 CONTINUE
      DO 999 I=1,3
C     MAS=MEAN AXLE SPACING
      MAS(I)=TSP(I)/S(I)
  999 CONTINUE
C     MGL=MEAN GROSS LOAD
      MGL=WEIT/N
C     MWB=MEAN WHEEL BASE
      MWB=SPACE/N
   76 CONTINUE
      WRITE(6,101)
  101 FORMAT(1H1)
      WRITE(6,102)
  102 FORMAT(10X,'AVG AXLE LOADS FOR EACH AXLE FOLLOW',//)
      WRITE(6,103)(MAL(I),I=1,5)
  103 FORMAT(30X,'FIRST',5X,I4,//,30X,'SECOND',5X,I4,//,30X,'THIRD',5X,I
     14,//,30X,'FOURTH',5X,I4,//,30X,'FIFTH',5X,////)
      WRITE(6,101)
      WRITE(6,104)
  104 FORMAT(10X,'AVG AXLE SPACINGS FOLLOW',/)
      WRITE(6,105)(MAS(I),I=1,4)
  105 FORMAT(30X,'FIRST',5X,F6.1,//,30X,'SECOND',5X,F6.1,//,30X,'THIRD',
     1F6.1,//30X,'FOURTH',5X,F6.1,////)
      WRITE(6,106) MGL
  106 FORMAT(15X,'MEAN GR. LOAD =',10X,I6)
      WRITE(6,107)MWB
  107 FORMAT(15X,'MAX WH. SPACING =',10X,F6.2)
      DO 93 I=1,4
      LEO(I)=((W(I)*T2WT(I))-(TWT(I)**2))
      HAYS(I)=LEO(I)/(W(I)*(W(I)-1))
C     SAL=STD DEV OF AXLE LOAD
      SAL(I)=SQRT(ABS(HAYS(I)))
   93 CONTINUE
      DO 94 I=1,3
C     SAS=STD DEV OF AXLE SPACING
      SAS(I)=SQRT((S(I)*T2SP(I)-(TSP(I)**2))/(S(I)*(S(I)-1)))
   94 CONTINUE
      SAN=(N*TTWEIT-(WEIT**2))
      BSS=SAN/(N*(N-1))
      SGL=SQRT(ABS(BSS))
      SWB=SQRT((N*TTSPAC-(SPACE**2))/(N*(N-1)))
      WRITE(6,141)
  141 FORMAT(1H1)
      WRITE(6,142)(SAL(I),I=1,5)
  142 FORMAT(15X,'STD DEV OF THE AXLES ARE THE FOLLOWING',//25X,'FIRST',
```

```
   1F7.2,//,24X,'SECOND',F5.2,//25X,'THIRD',F8.2,//,23X,'FOURTH',F8.2,
   2////)
    WRITE(6,969)
969 FORMAT(IHI)
    WRITE(6,143)(SAS(I),I=1,4)
143 FORMAT(15X,'STD DEV OF THE SPACINGS ARE AS FOLLOWS',//,25X,'FIRST'
   1,F5.2,//,24X,'SECOND',F5.2,//,25X,'THIRD',F5.2,//,23X,'FOURTH',F5.
   22,///)
    WRITE(6,969)
    WRITE(6,769) SGL
769 FORMAT(20X,'THE STD DEV OF THE GR.LOADS IS'F8.2,///)
    WRITE(6,770) SWB
770 FORMAT(20X,'THE STD DEV OF THE GR SPACINGS IS',F8.2,///)
    WRITE(6,101)
    STOP
    END
```

TRAILER TYPE DISTRIBUTION

```
      INTEGER   AUTO(40),TAUTO,TRUCK,SHTRK,AUTT,AUTTT,CAMPER,AUTSHL,CARS,C
     1ARSS,SHLCAR,DAY,BAUTT,N
      REAL PERTRK,PERSTK,PERATT,PERCAM,PERASL,PERAUT(10),PERNON,AUT(5)
      DO 1000 I=1,40
      AUTO(I)=0
 1000 CONTINUE
      N=0
      BAUTT=0
      TAUTO=0
      TRUCK=0
      SHTRK=0
      AUTT=0
      AUTTT=0
      CAMPER=0
      AUTSHL=0
      DO 1 I=1,5
      AUT(I)=0.0
    1 CONTINUE
      AHOUSE=0.0
      ABOAT=0.0
      AHAUL=0.0
      CAMTRL=0.0
      OTRAIL=0.0
      BHOUSE=0.0
      BBOAT=0.0
      BHAUL=0.0
      BCMTRL=0.0
      BOTRIL=0.0
      CHOUSE=0.0
      CBOAT=0.0
      CHAUL=0.0
      CCMTRL=0.0
      COTRIL=0.0
      WONWEL=0.0
      SUM1=0.0
      SUM2=0.0
      SUM3=0.0
      SUM4=0.0
      SUM5=0.0
      SUM6=0.0
      SUM7=0.0
      SUM8=0.0
      SUM9=0.0
      AHOUSP=0.0
      ABOATP=0.0
      AHAULP=0.0
      CAMTRP=0.0
      OTRALP=0.0
      BHOUSP=0.0
      BBOATP=0.0
```

```
      BHAULP=0.0
      BCMTRP=0.0
      CHOUSP=0.0
      CBOATP=0.0
      CHAULP=0.0
      CCMTRP=0.0
      COTRLP=0.0
      BOTRLP=0.0
      PRWNWL=0.0
      CARS=0
      CARSS=0
      SHLCAR=0
      PERTRK=0.0
      PERSTK=0.0
      PERATT=0.0
      PERCAM=0.0
      DO 2 I=1,10
      PERAUT(I)=0.0
    2 CONTINUE
      PERNON=0.0
   69 READ(5,11)(AUTO(I),I=I,38),DAY
   11 FORMAT(13X,2I3,I2,I3,10I2,10I1,2I2,12I1,2X,I1)
      DO 900 I=1,38
      TAUTO=AUTO(I)+TAUTO
  900 CONTINUE
      IF(DAY.EQ.9) GO TO 15
      N=N+1
   66 TRUCK=AUTO(3)+AUTO(4)+TRUCK
      SHTRK=AUTO(4)+SHTRK
C     AUTT STANDS FOR A-UT TRAFFIC
      DO 902 I=5,24
      AUTT=AUTO(I)+AUTT
  902 CONTINUE
   16 CONTINUE
      DO 903 I=27,38
C     AUTTT SHOULD STAND FOR TOTAL A-UT
      BAUTT=AUTO(I)+BAUTT
  903 CONTINUE
      AUTTT=AUTT+BAUTT
      CAMPER=AUTO(25)+AUTO(26)+CAMPER
      DO 601 I=5,23,2
C     AUTSHL STANDS FOR ALL A-UT IN SHOULDER LANE
      AUTSHL=AUTO(I)+AUTSHL
  601 CONTINUE
      AUT(1)=AUTO(5)+AUTO(15)+AUT(1)
      AUT(2)=AUTO(7)+AUTO(17)+AUT(2)
      AUT(3)=AUTO(9)+AUTO(19)+AUT(3)
      AUT(4)=AUTO(11)+AUTO(21)+AUT(4)
      AUT(5)=AUTO(13)+AUTO(23)+AUT(5)
      DO 702 I=1,2
```

```
      CARS=AUTO(I)+CARS
  702 CONTINUE
      CARSS=CARS
      SHLCAR=AUTO(2)+SHLCAR
      AHOUSE=AUTO(7)+AUTO(8)+AHOUSE
      ABOAT=AUTO(9)+AUTO(10)+ABOAT
      AHAUL=AUTO(5)+AUTO(6)+AHAUL
      CAMTRL=AUTO(11)+AUTO(12)+CAMTRL
      OTRAIL=AUTO(13)+AUTO(14)+OTRAIL
      BHOUSE=AUTO(17)+AUTO(18)+BHOUSE
      BBOAT=AUTO(19)+AUTO(20)+BBOAT
      BHAUL=AUTO(15)+AUTO(16)+BHAUL
      BCMTRL=AUTO(21)+AUTO(22)+BCMTRL
      BOTRIL=AUTO(23)+AUTO(24)+BOTRIL
      CHOUSE=AUTO(27)+AUTO(28)+CHOUSE
      CBOAT=AUTO(31)+AUTO(32)+CBOAT
      CHAUL=AUTO(29)+AUTO(30)+CHAUL
      CCMTRL=AUTO(33)+AUTO(34)+CCMTRL
      COTRIL=AUTO(35)+AUTO(36)+COTRIL
      WONWEL=AUTO(37)+AUTO(38)+WONWEL
      GO TO 69
   15 CONTINUE
C     PERTRK STANDS FOR PERCENTAGE OF TRUCKS IN TRAFFIC
      ATRUCK=TRUCK
      ATAUTO=TAUTO
   78 PERTRK=ATRUCK/ATAUTO
C     SHTRK STANDS FOR TRUCKS IN SHOULDER LANE
C     PERCENTAGE OF TRUCKS IN SHOULDER LANE
      ASHTRK=SHTRK
      PERSTK=ASHTRK/ATRUCK
C     PERATT STANDS FOR PERCENT OF A-UT IN TOTAL TRAFFIC
      AAUTTT=AUTTT
      PERATT=AAUTTT/ATAUTO
      ACAMP=CAMPER
      PERCAM=ACAMP/ATAUTO
C     PERACEN OF A-UT IN SHOULDER LANE FOLLOW FOR ALL DATA
      AAUTSH=AUTSHL
      PERASL=AAUTSH/AAUTTT
C     PERCENTAGE OF DIFFERENT A-UT FOLLOW FOR 5 TYPES
      DO 401 I=1,5
      PERAUT(I)=AUT(I)/AAUTSH
  401 CONTINUE
C     PERCENTAGE OF NON-AUT IN SHOULDER FOLLOWS
      ASHLCA=SHLCAR
      ACARSS=CARSS
      PERNON=ASHLCA/ACARSS
      AHOUSP=AHOUSE/AAUTTT
      ABOATP=ABOAT/AAUTTT
      AHAULP=AHAUL/AAUTTT
      CAMTRP=CAMTRL/AAUTTT
```

```
      OTRALP=OTRAIL/AAUTTT
      BHOUSP=BHOUSE/AAUTTT
      BBOATP=BBOAT/AAUTTT
      BHAULP=BHAUL/AAUTTT
      BCMTRP=BCMTRL/AAUTTT
      BOTRLP=BOTRIL/AAUTTT
      CHOUSP=CHOUSE/AAUTTT
      CBOATP=CBOAT/AAUTTT
      CHAULP=CHAUL/AAUTTT
      CCMTRP=CCMTRL/AAUTTT
      COTRLP=COTRIL/AAUTTT
      PRWNWL=WONWEL/AAUTTT
      SUM1=AHOUSP+ABOATP+AHAULP+CAMTRP+OTRALP
      SUM2=BHOUSP+BBOATP+BHAULP+BCMTRP+BOTRLP
      SUM3=CHOUSP+CBOATP+CHAULP+CCMTRP+COTRLP
      SUM4=AHOUSP+BHOUSP+CHOUSP
      SUM5=ABOATP+BBOATP+CBOATP
      SUM6=AHAULP+BHAULP+CHAULP
      SUM7=CAMTRP+BCMTRP+CCMTRP
      SUM8=OTRALP+BOTRLP+COTRLP
      SUM9=SUM4+SUM5+SUM6+SUM7+SUM8+SUM9
  777 FORMAT(35X,'I-75 THU JULY',/////)
  674 WRITE(6,800)
  800 FORMAT(1H1)
      WRITE(6,777)
      WRITE(6,801) PERTRK
  801 FORMAT(25X,'PERCENT OF TRUCKS IN TRAFFIC =',F8.5,/////)
      WRITE(6,802) PERSTK
  802 FORMAT(25X,'PERCENT OF TRUCKS IN SHOULDER LANE =',F8.5,/////)
      WRITE(6,803) PERATT
  803 FORMAT(25X,'PERCENT OF A-UT IN TOTAL TRAFFIC =',F8.5,/////)
      WRITE(6,804) PERCAM
  804 FORMAT(25X,'PERCENT OF CAMPERS IN TRAFFIC =',F8.5,/////)
      WRITE(6,805) PERASL
  805 FORMAT(25X,'PERCENT OF A-UT IN SHOULDER LANE =',F8.5,/////)
      WRITE(6,807)
  807 FORMAT(25X,'SHOULDER LANE PERCENT OF DIFFERENT A-UTS',///)
      WRITE(6,806)(PERAUT(I),I=1,5)
  806 FORMAT(25X,'FIRST',10X,F8.5,///,25X,'SECOND',9X,F8.5,///,25X,'THIR
     1D',10X,F8.5,///,25X,'FOURTH',8X,F8.5,///,25X,'FIFTH',10X,F8.5,///)
      WRITE(6,808) PERNON
  808 FORMAT(25X,'PERCENT OF NON-A-UT IN SHOULDER LANE ='F8.5,////)
      WRITE(6,800)
      WRITE(6,777)
      WRITE(6,500)AUTTT
  500 FORMAT(10X,'TOTAL NUMBER OF A-UTS COUNTED IS',I5,///)
      WRITE(6,501)ATAUTO
  501 FORMAT(10X,'TOTAL NUMBER OF VEHICLES COUNTED IS',F7.0,///)
      WRITE(6,502)ATRUCK
  502 FORMAT(10X,'TOTAL NUMBER OF TRUCKS COUNTED IS',F6.0,///)
```

```
      WRITE(6,503)ACAMP
  503 FORMAT(10X,'TOTAL  NUMBER OF CAMPERS COUNTED IS',F5.0,///)
      WRITE(6,504)N
  504 FORMAT(10X,'SETS OF DATA IN THIS CALCULATION-',I3)
      WRITE(6,800)
      WRITE(6,777)
      WRITE(6,509)
  509 FORMAT(25X,'PERCENTAGE MATRIX OF A-UT TYPES',//)
      WRITE(6,510)
  510 FORMAT(20X,'HOUSE',5X,'BOAT',6X,'U-HAUL',4X,'CAMPER',4X,'OTHER',5X
     1,'SUMMATION',/)
      WRITE(6,511)AHOUSP,ABOATP,AHAULP,CAMTRP,OTRALP,SUM1
  511 FORMAT(1X,'ONE-AXLE',10X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,6X,F
     16.4,/)
      WRITE(6,512)BHOUSP,BBOATP,BHAULP,BCMTRP,BOTRLP,SUM2
  512 FORMAT(1X,'TWO-AXLE',10X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,6X,F
     16.4,/)
      WRITE(6,513)CHOUSP,CBOATP,CHAULP,CCMTRP,COTRLP,SUM3
  513 FORMAT(1X,'THREE-AXLE',8X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,6X,
     1F6.4,/)
      WRITE(6,514)SUM4,SUM5,SUM6,SUM7,SUM8,SUM9
  514 FORMAT(1X,'SUMMATION',9X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,4X,F6.4,6X,F
     16.4,/)
      WRITE(6,515)PRWNWL
  515 FORMAT(15X,'THE PERCENT OF ONE-WHEEL TRAILERS IS',F7.4)
      WRITE(6,800)
      STOP
      END
```

DISTRIBUTION
OF
ALL ACCIDENTS AND A-UT ACCIDENTS
by
Road Surface, Traffic Control,
Driver Action, Contributing Circumstances,
and Seat Belt Use

```
      INTEGER WTHR,RDSUR,DACT,TRCON,CONTC,SBELT
      DIMENSION WTHR(2,6),RDSUR(2,5),TRCON(2,13),DACT(2,14),
     1CONTC(2,18),SBELT(2,4),ICARD(50)
      DATA WTHR,RDSUR,TRCON,DACT,CONTC,SBELT/12*0,10*0,26*0,28*0,36*0,
     18*0/
      NOW=0
      NEXT=0
   10 READ(5,101) ICARD
      IF(ICARD(1).LT.0) GOTO99
  101 FORMAT(3I2,I1,I4,I3,I7,A3,A4,2(I1,I2,I1,I1,I2),2I1,I2,3I1,3I2,2I1,
     13I2,17I1)
      NOW=NEXT
      NEXT=0
      IF(ICARD(40).EQ.2) NEXT=1
      IAUT=1
      IF(ICARD(41).NE.0) IAUT=2
      NEND=IAUT
      IF(NOW.EQ.1) GOTO50
      DO11 I=1,NEND
      K=ICARD(23)
      IF(K.EQ.0.OR.K.GT.5) K=6
      WTHR(I,K)=WTHR(I,K)+1
      K=ICARD(29)
      IF(K.EQ.0.OR.K.GT.4) K=5
      RDSUR(I,K)=RDSUR(I,K)+1
      K=ICARD(31)
      IF(K.EQ.0.OR.K.GT.12) K=13
   11 TRCON(I,K)=TRCON(I,K)+1
   50 DO12 I=1,NEND
      K=ICARD(26)
      IF(K.EQ.0.OR.K.GT.14) K=13
      DACT(I,K)=DACT(I,K)+1
      K=ICARD(27)
      IF(K.EQ. 0.OR.K.GT.14) K=13
      DACT(I,K)=DACT(I,K)+1
      DO13KK=32,33
      K=ICARD(KK)
      IF(K.EQ.0.OR.K.GT.17) K=18
   13 CONTC(I,K)=CONTC(I,K)+1
      DO14KK=37,38
      K=ICARD(KK)
      IF(K.EQ.0.OR.K.GT.3) K=4
   14 SBELT(I,K)=SBELT(I,K)+1
   12 CONTINUE
      GOTO10
   99 WRITE(6,102)
  102 FORMAT(' ',15X,'ALL     A-UT ONLY')
      WRITE(6,103) (WTHR(I,6),I=1,2)
  103 FORMAT('OWEATHER'/,' DISTRIBUTION'/,'OUNSPECIFIED',4X,I3,2X,I3)
      DO21K=1,5
```

```
 21 WRITE(6,104) K,(WTHR(I,K),I=1,2)
104 FORMAT(' ',3X,I2,10X,I3,2X,I3)
    WRITE(6,105) (RDSUR(I,5),I=1,2)
105 FORMAT('0'//,' ROAD SURFACE'/,' DISTRIBUTION'/,'OUNSPECIFIED',4X,I
   13,2X,I3)
    DO22 K=1,4
 22 WRITE(6,104) K,(RDSUR(I,K),I=1,2)
    WRITE(6,106)(TRCON(I,13),I=1,2)
106 FORMAT('0'//,' TRAFFIC CONTROL'/,' DISTRUBUTION'/,'OUNSPECIFIED',4
   1X,I3,2X,I3)
    DO23K=1,12
 23 WRITE(6,104) K,(TRCON(I,K),I=1,2)
    WRITE(6,107) (DACT(I,14),I=1,2)
107 FORMAT('0'//,' DRIVER ACTION'/,' DISTRIBUTION'/,'OUNSPECIFIED',4X,
   1I3, 2X,I3)
    DO24 K=1,14
 24 WRITE(6,104)K,(DACT(I,K),I=1,2)
    WRITE(6,108) (CONTC(I,17),I=1,2)
108 FORMAT('0'//,' CONTRIBUTING CIRCUM'/,' DISTRIBUTION'/,'OUNSPECIFIE
   1D',4X,I3,2X,I3)
    DO25 K=1,17
 25 WRITE(6,104) K,(CONTC(I,K),I=1,2)
    WRITE(6,109) (SBELT(I,4),I=1,2)
109 FORMAT('0'//,' SEATBELT USE'/,' DISTRIBUTION' ,4X,I3,2X,I3)
    DO26 K=1,3
 26 WRITE(6,104) K,(SBELT(I,K),I=1,2)
    CALL EXIT
    END
```

DISTRIBUTION
OF
ALL ACCIDENTS AND A-UT ACCIDENTS
by
Nighttime, Wet Weather,
and Road

```
      INTEGER WWA,WW
      DIMENSION IROAD(14),NT(14),NTA(14),WW(14),WWA(14),NOACC(14)
      DATA NT,NTA,WW,WWA,NOACC/14*0,14*0,14*0,14*0,14*0/
     1'U27','U60','U62','U68','U75','   '/
      DATA IROAD/'I64','I65','I75','T01','T02','T03','T04','U41',
      NOW=0
      NEXT=0
    9 READ(5,101) IK,IRDNO,IWTHR,ILIGHT,ICONT,IAUT
  101 FORMAT(I2,19X,A3,22X,I1,9X,I1,12X,I1,I1)
      IF(IK.LT.0) GOTO15
      NOW=NEXT
      NEXT=0
      IF(ICONT.EQ.2) NEXT=1
      IF(NOW.EQ.1) GOTO9
      DO10 I=1,14
      IF(IROAD(I).EQ.IRDNO) GOTO11
   10 CONTINUE
      GOTO9
   11 NOACC(I) =NOACC(I)+1
      IF(ILIGHT.NE.3.AND.ILIGHT.NE.4) GOTO12
      NT(I) =NT(I)+1
      IF(IAUT.GE.1.AND.IAUT.LE.3) NTA(I)=NTA(I)+1
   12 IF(IWTHR.NE.2.AND.IWTHR.NE.3) GOTO9
      WW(I)=WW(I)+1
      IF(IAUT.GE.1.AND.IAUT.LE.3) WWA(I)=WWA(I)+1
      GOTO9
   15 WRITE(6,102)
  102 FORMAT('1ROAD   TOTAL ACC.   NIGHT ACC.   NIGHT A-UT   WET WTHR   WET W
     1THR  A-UT')
      DO16 I=1,13
   16 WRITE(6,103) IROAD(I),NOACC(I),NT(I),NTA(I),WW(I),WWA(I)
  103 FORMAT('0',A3,5X,I5,6X,I5,8X,I5,6X,I5,7X,I5)
      CALL EXIT
      END
```

DISTRIBUTION OF DRIVER AGE, AGE OF CAR AND INJURIES

```
      IMPLICIT INTEGER(A-W)
      DIMENSION ICARD(50)
      DIMENSION AGE1(13),AGE2(13),CAR1(11),CAR2(11),INJRY1(5),INJRY2(5)
      DATAAGE1,AGE2,CAR1,CAR2,NOACC1,NOACC2,INST1,INST2/13*0,13*0,11*0,
     111*0,0,0,0,0/
      DATA INJRY1,INJRY2/5*0,5*0/
   10 READ(5,101) ICARD
  101 FORMAT(3I2,I1,I4,I3,I7,A3,A4,2(I1,I2,I1,I1,I2),2I1,I2,3I1,3I2,2I1,
     13I2,17I1)
      IF(ICARD(1).LT.0) GOTO90
C****    CARD WITH -9 TO END
      IF(ICARD(15).EQ.0.AND.ICARD(16).EQ.0.AND.ICARD(17).EQ.0.AND.
     1ICARD(18).EQ.0.AND.ICARD(19).EQ.0) GOTO11
      NOACC2=NOACC2+1
      IF(ICARD(15).EQ.1) INST2=INST2+1
      NYRS=ICARD(3)-ICARD(19)+1
      IF(NYRS.LT.1) NYRS=11
      IF(NYRS.GT.10) NYRS=11
      CAR2(NYRS)=CAR2(NYRS)+1
      IF(ICARD(16).EQ.0) GOTO12
      DAGE=ICARD(16)
      IF(DAGE.LT.16) GOTO13
      KAGE=DAGE/5-1
      IF(KAGE.GT.12) KAGE=13
      GOTO14
   13 KAGE=1
      GOTO14
   12 KAGE=13
   14 CONTINUE
C     WRITE(6,201) DAGE,KAGE
C 201 FORMAT(' DAGE2=',I3,'  KAGE2=',I3)
      AGE2(KAGE)=AGE2(KAGE)+1
      INJ=ICARD(18)+1
      IF(INJ.GT.5) GOTO15
      INJRY2(INJ)=INJRY2(INJ)+1
   15 CONTINUE
   11 NOACC1=NOACC1+1
      IF(ICARD(10).EQ.1) INST1=INST1+1
      NYRS=ICARD (3)-ICARD(14)+1
      IF(NYRS.GT.10) NYRS=11
C     IF(NYRS.GT.10) GOTO3
      IF(NYRS.LT.1) NYRS=11
C     GOTO4
C   3 WRITE(6,205) NYRS
C 205 FORMAT (' NYRS=',I3)
C     NYRS=11
C   4 CONTINUE
      CAR1(NYRS)=CAR1(NYRS)+1
      IF(ICARD(11).EQ.0) GOTO22
      DAGE=ICARD(11)
```

```
      IF(DAGE.LT.16) GOTO23
      KAGE=DAGE/5-1
      IF(KAGE.GT.12) KAGE=13
      GOTO24
   23 KAGE=1
      GOTO24
   22 KAGE=13
   24 CONTINUE
C     WRITE(6,202) DAGE,KAGE
C 202 FORMAT(' DAGE1=',I3,'  KAGE1=',I3)
      AGE1(KAGE)=AGE1(KAGE)+1
      INJ=ICARD(13)+1
      IF(INJ.GT.5) GOTO25
      INJRY1(INJ)=INJRY1(INJ)+1
   25 CONTINUE
      GOTO10
   90 WRITE(6,102)
  102 FORMAT('1       U N I T  1')
      XN=NOACC1
      YN=INST1
      XPCT=YN/XN*100
      WRITE(6,103) XPCT
  103 FORMAT('OPERCENTAGE OF DRIVERS LIVING IN STATE-',F4.1)
      WRITE(6,104)
  104 FORMAT('0   AGE DISTRIBUTION')
      WRITE(6,105) AGE1(1)
  105 FORMAT('   -16   ',I3)
      II=1
      DO31I=16,61,5
      II=II+1
      JJ=I+4
   31 WRITE(6,106)  I,JJ,AGE1(II)
  106 FORMAT(' ',I2,'-',I2,3X,I3)
      WRITE(6,107) AGE1(12),AGE1(13)
  107 FORMAT(' 66-     ',I3/,' UNKNOWN ',I3)
      WRITE(6,108)
  108 FORMAT('OINJURY DISTRIBUTION')
      DO32I=1,5
      K=I-1
   32 WRITE(6,109) K,INJRY1(I)
  109 FORMAT(' ',I1,'-',I5)
      WRITE(6,110)
  110 FORMAT('OAGE OF CAR IN YEARS')
      WRITE(6,111) CAR1(1)
  111 FORMAT(' NEW-',I3)
      DO33I=2,10
      K=I-1
   33 WRITE(6,112) K,CAR1(I)
  112 FORMAT(' ',I3,'-',I3)
      WRITE(6,113) CAR1(11)
```

```
113 FORMAT(' 10+-',I3)
    WRITE(6,114)
114 FORMAT('1    U N I T  2')
    XN=NOACC2
    YN=INST2
    XPCT=YN/XN*100.
    WRITE(6,103) XPCT
    WRITE(6,104)
    WRITE(6,105) AGE2(1)
    II=1
    DO41 I=16,61,5
    II=II+1
    JJ=I+4
 41 WRITE(6,106)  I,JJ, AGE2(II)
    WRITE(6,107) AGE2(12),AGE2(13)
    WRITE(6,108)
    DO42 I=1,5
    K=I-1
 42 WRITE(6,109) K,INJRY2(I)
    WRITE(6,110)
    WRITE(6,111) CAR2(1)
    DO43I=2,10
    K=I-1
 43 WRITE(6,112) K,CAR2(I)
    WRITE(6,113) CAR2(11)
    CALL EXIT
    END
```

DISTRIBUTION
OF
FATAL AND INJURY ACCIDENTS
by
Road

```
      DIMENSION IROAD(14),NOINJ(13),NOF(13),NOI(13),NOFA(13),NDIA(13)
      DATA IROAD/'I64','I65','I75','T01','T02','T03','T04','U41',
     1'U27','U60','U62','U68','U75','    '/
      DATA NOINJ,NOF,NOI,NCFA,NOIA/13*0,13*0,13*0,13*0,13*0/
      MOST=0
      NOW=0
      NEXT=0
      ITR=0
   10 READ(5,101) IK,IRDNO,INJ1,INJ2,ICONT,IAUT
  101 FORMAT(I2,19X,A3,8X,I1,6X,I1,29X,2I1)
      IF(IK.LT.0) GOTO90
      NOW=NEXT
      NEXT=0
      IF(ICONT.EQ.2) NEXT=1
      IF(IAUT.NE.0) ITR=1
      IF(NEXT.EQ.0) GOTO11
      IF(INJ1.LT.5.AND.INJ1.GT.MOST) MOST=INJ1
      IF(INJ2.LT.5.AND.INJ2.GT.MOST) MOST=INJ2
      GOTO10
   11 IF(INJ1.LT.5.AND.INJ1.GT.MOST) MOST=INJ1
      IF(INJ2.LT.5.AND.INJ2.GT.MOST) MOST=INJ2
      DO12I=1,13
      IF(IRDNO.EQ.IROAD(I)) GOTO13
   12 CONTINUE
      GOTO20
   13 IF(ITR.EQ.1) GOTO14
      IF( MOST.EQ.4) GOTO15
      IF( MOST.EQ.0) GOTO19
      NOI(I)=NOI(I)+1
      GOTO20
   15 NOF(I)=NOF(I)+1
      GOTO20
   14 IF(MOST.EQ.4) GOTO16
      IF(MOST.EQ.0) GOTO19
      NOIA(I)=NOIA(I)+1
      GOTO20
   16 NOFA(I)=NOFA(I)+1
      GOTO20
   19 NOINJ(I)=NOINJ(I)+1
   20 MOST=0
      ITR=0
      GOTO10
  102 FORMAT(' ',15X,'ALL',25X,'A-UT',//,' ',6X,'FATAL   INJURY  F/I RATI
     1O     FATAL  INJURY  F/I RATIO')
   90 WRITE(6,102)
      DO91I=1.13
      R1=0
      R2=0
      IF(NOF(I).EQ.0) GOTO92
      IF(NOI(I).EQ.0) GOTO93
```

```
      X1=NOF(I)
      X2=NOI (I)
      R1=X1/X2
   94 IF(NOFA(I).EQ.0) GOTO95
      IF(NOIA(I).EQ.0) GOTO96
      X1=NOFA(I)
      X2=NOIA(I)
      R2=X1/X2
      GOTO97
   92 R1=0.
      GOTO94
   93 R1=99.
      GOTO94
   95 R2=0.
      GOTO97
   96 R2=99.
   97 WRITE(6,103) IROAD(I),NOF(I),NOI(I),R1,NOFA(I),NOIA(I),R2
   91 CONTINUE
      WRITE(6,104) NOINJ
  104 FORMAT ('1NUMBER ACCIDENTS PER ROAD WITH NO INJURY-'//,' ',13I5)
  103 FORMAT('0',A3,2X,I5,3X,I5,4X,F6.3,6X,I5,3X,I5,4X,F6.3)
      CALL EXIT
      END
```

PLOTTING OF ACCIDENTS BY MILEPOST

```
      DIMENSION IROAD(14),IMP(14,200)
C*****    THIS VERSION PRODUCES A DECK WHICH CAN BE LISTED TO PLOT
C*****    ACCIDENTS. CARDS ADDED FOR THIS CHANGE ARE PRECEEDED BY
C*****    COMMENTS. JUNE 3 1970.
C*****
C*****    PUNCHING ELEMINATED-JUNE 9.
C*****
      DIMENSION IPLOT (117)
C*****    ORIGINAL VERSION HAS CAPACITY OF 117 ACCIDENTS/MILE.
C**   DIMENSION IPLOT(70)
      DATA ISTOP,IBLK,IX/'STO',' ','X'/
      DATA IMP/2800*0/
      DATA IROAD/'I64','I65','I75','T01','T02','T03','T04','U41',
     1'U27','U60','U62','U68','U75','   '/
  101 FORMAT(11X,I3,7X,A3,F4.0,4X,I1,6X,I1,29X,I1)
  102 FORMAT('1ALL ACCIDENTS'/,'0HIGHWAY',5X,13(3X,A3,2X),'UNSPECIFIED')
  104 FORMAT(' ',I3,' AND',I3,1X,14(2X,I4,2X))
C****   REQUIRES CARD WITH NEGATIVE NO. IN COLS. 25-28
C****   TO END.
  105 FORMAT(' ',A3,2X,F8.2,2X,I1)
   10 READ(5,101)ICO,IRDNO ,XMPNO,INJ1,INJ2,ICONT
      IF(XMPNO.LT.0) GOTO90
      IF(ICONT.NE.1) GOTO10
C****    CARDS WITH C*** ARE NEEDED TO GIVE SEVERE AND FATAL ONLY.
      IF(INJ1.EQ.4.OR.INJ2.EQ.4.OR.INJ1.EQ.3.OR.INJ2.EQ.3) GOTO35
      GOTO10
   35 CONTINUE
      DO11I=1,13
      IF(IRDNO.EQ.IROAD(I)) GOTO12
   11 CONTINUE
      I=13
   12 INO=XMPNO+1.
      IF(I.EQ.5) GOTO33
      IF(I.EQ.1) GOTO31
      IF(I.EQ.7) GOTO32
      IF(I.EQ.3) GOTO36
      GOTO30
   31 IF(ICO.EQ.87.OR.ICO.EQ.6.OR.ICO.EQ.103.OR.ICO.EQ.22.OR.ICO.EQ.10)
     1 INO=INO+100
      IF(ICO.EQ.25.AND.INO.LT.88) INO=INO+100
      GOTO30
   32 IF(ICO.EQ.47) INO=INO+100
      IF(ICO.EQ.43.AND.INO.LT.70) INO=INO+100
      GOTO30
   33 IF(ICO.EQ.47.AND.INO.LT.70) INO=INO+100
      IF(ICO.EQ.15.OR.ICO.EQ.56) INO=INO+100
      GOTO30
   36 IF(ICO.EQ.41) INO=INO+100
   30 IF(INO.GT.200) INO=200
  199 FORMAT(' ',2I5)
```

```
      IMP(I,INO)=IMP(I,INO)+1
      GOTO10
   90 WRITE(6,102) IROAD
      WRITE(6,115)
  115 FORMAT(' SEVERE AND FATAL ONLY')
      WRITE(6,103)
  103 FORMAT('0','NUMBER ACC.'/,' BETWEEN MPOSTS'/)
      DO15I=1,200
      J=I-1
   15 WRITE(6,104) J,I,(IMP(K,I),K=1,14)
  108 FORMAT('1FREQUENCY PLOT-HIGHWAY',1X,A3/,' MILEPOST',115X,'TOTAL'/)
  107 FORMAT(' ',I3,'-',I3,2X,'*',117A1,I5)
CC107 FORMAT(' ',I3,'-',I3,2X,'*', 70A1,47X,I5)
   20 READ(5,106)IHY
  106 FORMAT(A3)
      IF(IHY.EQ.ISTOP) GOTO 99
      DO21I=1,13
      IF(IHY.EQ.IROAD(I)) GOTO22
   21 CONTINUE
      GOTO20
   22 WRITE(6,108)IHY
C****    TO PUNCH TITLES.
C**   WRITE(7,110) IHY
  110 FORMAT(/////'FREQUENCY PLOT-HIGHWAY',1X,A3/,'MILEPOST')
      DO23II=1,200
      JJ=II-1
      LIM=IMP(I,II)
C****    CHANGE TO 117 FOR COMPLETE PLOT.
      DO24 K=1,117
   24 IPLOT(K)=IBLK
      IF(LIM.EQ.0) GOTO43
C****    REMOVE IF 117 LIMIT USED
C**   IF(LIM.GT.70) GOTO41
      DO25K=1,LIM
   25 IPLOT(K)=IX
   43 WRITE(6,107)JJ,II,IPLOT,LIM
C****    TO PUNCH PLOT
C**   WRITE(7,112) JJ,II,IPLOT
  112 FORMAT(I3,'-',I3,2X,'*',70A1)
C****    NEXT 4 CARDS FOR PUNCH PROGRAM ONLY.
C**   GOTO23
C**41 WRITE(6,111) LIM
C**   WRITE(7,111) LIM
  111 FORMAT(' MORE THAN 70 ACCIDENTS-NUMBER IS',I5)
   23 CONTINUE
      GOTO20
   99 CALL EXIT
      END
```

APPENDIX C

SUMMARIES OF DATA

	I 75		I 75 NORTH		I 75 SOUTH		I 65		I 65 NORTH		I 65 SOUTH		I 64		I 64 EAST		I 64 WEST	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
1st AXLE WEIGHT	2270	76	2233	465	2303	400	2338	341	2360	339	2325	344	2258	351	2301	94	2224	388
2nd AXLE WEIGHT	2697	112	2605	308	2778	337	2771	177	2725	588	2800	499	2579	485	2549	455	2603	515
3rd AXLE WEIGHT	1798	164	1871	214	1733	250	1893	352	1730	993	1995	524	1693	894	1742	1165	1654	820
4th AXLE WEIGHT	1730	642	2360	761	1507	419	2088	669	2028	867	2112	617	1610	750	1100	—	1695	783
GROSS LOAD	6949	222	6856	148	7032	262	7325	314	7041	934	7502	507	6756	824	6643	1571	6845	1573
1st AXLE SPACE	9.9	0.6	9.8	0.7	9.9	0.5	10.0	0.6	9.9	0.6	10.0	0.6	10.0	0.5	10.1	0.4	10.0	0.6
2nd AXLE SPACE	14.4	2.6	14.0	2.4	14.7	2.8	14.3	2.8	14.0	2.7	14.5	2.9	13.9	2.4	13.6	2.3	14.1	2.5
3rd AXLE SPACE	2.5	0.4	2.4	0.6	2.5	0.4	3.2	1.6	3.1	0.2	3.3	2.0	2.8	0.2	2.8	0.4	2.8	0.1
WHEEL BASE	24.6	3.2	23.9	3.0	25.1	3.4	24.7	3.5	24.2	3.3	25.1	3.6	24.4	3.1	24.0	2.4	24.7	3.3

	ALL DATA		ONE-AXLE TRAILERS		TWO-AXLE TRAILERS		BOAT TRAILERS		HOUSE TRAILERS		U-HAUL TYPE TRAILERS		MISC. TRAILER TYPES	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
1st AXLE WEIGHT	2290	118	2269	98	2417	337	2357	521	2459	407	2194	349	2193	334
2nd AXLE WEIGHT	2704	89	2657	136	3014	661	2788	371	2781	336	2538	505	2713	170
3rd AXLE WEIGHT	1814	117	1791	56	1878	649	1530	704	2906	394	1483	454	1366	298
4th AXLE WEIGHT	1847	681	—	–	1847	681	1483	418	2518	520	1807	647	1756	733
GROSS LOAD	7041	88	6713	123	9156	915	6992	665	8412	456	6453	464	6439	306
1st AXLE SPACE	9.9	0.6	9.9	0.6	10.3	0.4	10.0	0.9	10.1	0.4	9.8	0.6	9.9	0.5
2nd AXLE SPACE	14.3	2.7	14.0	2.4	16.1	3.5	17.1	2.1	15.7	2.4	12.6	1.4	13.0	2.0
3rd AXLE SPACE	2.9	1.1	—	–	2.9	1.1	2.3	0.3	2.9	0.1	2.9	0.1	3.3	1.9
WHEEL BASE	24.6	3.3	23.8	2.6	29.3	3.3	27.7	2.8	26.2	3.1	22.8	2.3	23.3	2.6

APPENDIX D

ANALYSIS OF DATA

STATISTICAL COMPARISON

$$H_o: \mu_1 = \mu_2 \text{ and } \sigma_1 = \sigma_2$$

DATA SETS BEING COMPARED	DATA COMPONENT	x_1	s_1	n_1	x_2	s_2	n_2	Z TEST: ACCEPTANCE RANGE	Z TEST: Z	Z TEST: DECISION FOR H_o	F TEST: ACCEPTANCE RANGE	F TEST: F	F TEST: DECISION FOR H_o
I 75 - I 64	1st AXLE	2270	76	202	2258	351	49	±1.960	+ 0.240	REJECT	1.00 - 1.36	21.33	REJECT
	2nd AXLE	2697	112	202	2579	485	49	±1.960	+ 1.710	ACCEPT	1.00 - 1.36	18.75	REJECT
	3rd AXLE	1798	164	202	1693	894	49	±1.960	+ 0.877	ACCEPT	1.00 - 1.36	29.72	REJECT
	4th AXLE	1730	642	22	1610	750	7	±2.262	+ 2.612	REJECT	1.00 - 2.57	1.365	ACCEPT
	GROSS WEIGHT	6949	222	202	6756	824	49	±1.960	+ 1.642	ACCEPT	1.00 - 1.36	13.78	REJECT
	1st SPACE	9.9	0.60	154	10.0	0.54	49	±1.960	- 2.215	REJECT	1.00 - 1.52	1.235	ACCEPT
	2nd SPACE	14.4	2.64	154	13.9	2.42	49	±1.960	+ 1.242	ACCEPT	1.00 - 1.52	1.19	ACCEPT
	3rd SPACE	2.5	0.37	17	2.8	0.16	7	±2.074	- 2.774	REJECT	1.00 - 3.93	5.35	REJECT
	WHEEL BASE	24.6	3.22	154	24.4	3.10	49	±1.960	+ 0.393	ACCEPT	1.00 - 1.52	1.08	ACCEPT
I 64 - I 65	1st AXLE	2258	351	49	2338	341	114	±1.960	- 1.360	ACCEPT	1.00 - 1.53	1.059	ACCEPT
	2nd AXLE	2579	485	49	2771	177	114	±1.960	- 2.723	REJECT	1.00 - 1.53	7.508	REJECT
	3rd AXLE	1693	894	49	1893	352	114	±1.960	- 1.532	ACCEPT	1.00 - 1.53	6.45	REJECT
	4th AXLE	1610	750	7	2088	669	17	±2.228	- 1.463	ACCEPT	1.00 - 3.93	1.257	ACCEPT
	GROSS WEIGHT	6756	824	49	7325	314	114	±1.960	- 4.738	REJECT	1.00 - 1.53	6.89	REJECT
	1st SPACE	10.0	0.54	49	10.0	0.60	114	±1.960	- 0	ACCEPT	1.00 - 1.53	1.23	ACCEPT
	2nd SPACE	13.9	2.42	49	14.3	2.80	114	±1.960	- 0.932	ACCEPT	1.00 - 1.53	1.34	ACCEPT
	3rd SPACE	2.8	0.16	7	3.2	1.64	17	±2.101	- 0.994	ACCEPT	1.00 - 3.93	105.06	REJECT
	WHEEL BASE	24.4	3.10	49	24.7	3.50	114	±1.960	- 0.551	ACCEPT	1.00 - 1.53	1.27	ACCEPT
I 65 - I 75	1st AXLE	2338	341	114	2270	76	202	±1.960	+ 2.128	REJECT	1.00 - 1.22	20.13	REJECT
	2nd AXLE	2771	177	114	2697	112	202	±1.960	+ 4.091	REJECT	1.00 - 1.22	2.49	REJECT
	3rd AXLE	1893	352	114	1798	164	202	±1.960	+ 2.758	REJECT	1.00 - 1.22	4.606	REJECT
	4th AXLE	2088	669	17	1730	642	22	±1.960	+1.7029	ACCEPT	1.00 - 2.17	1.086	ACCEPT
	GROSS WEIGHT	7325	314	114	6949	222	202	±1.960	+11.461	REJECT	1.00 - 1.22	2.00	REJECT
	1st SPACE	10.0	0.60	114	9.9	0.60	154	±1.960	+1.3622	ACCEPT	1.00 - 1.31	1.00	ACCEPT
	2nd SPACE	14.3	2.80	114	14.4	2.64	154	±1.960	- 0.299	ACCEPT	1.00 - 1.29	1.12	ACCEPT
	3rd SPACE	3.2	1.64	17	2.5	0.37	17	±2.101	+ 1.716	ACCEPT	1.00 - 2.30	19.6	REJECT
	WHEEL BASE	24.7	3.50	114	24.6	3.22	154	±1.960	+ 0.241	ACCEPT	1.00 - 1.29	1.18	ACCEPT

STATISTICAL COMPARISON

H_o: $\mu_1 = \mu_2$ and $\sigma_1 = \sigma_2$

DATA SETS BEING COMPARED	DATA COMPONENT	x_1	s_1	n_1	x_2	s_2	n_2	Z TEST: ACCEPTANCE RANGE	Z TEST: Z	Z TEST: DECISION FOR H_o	F TEST: ACCEPTANCE RANGE	F TEST: F	F TEST: DECISION FOR H_o
I 64 E - I 64 W	1st AXLE	2301	94	21	2224	388	28	±1.960	+ 1.013	ACCEPT	1.00 - 2.01	17.04	REJECT
	2nd AXLE	2549	455	21	2603	515	28	±1.960	- 0.393	ACCEPT	1.00 - 2.01	1.281	ACCEPT
	3rd AXLE	1742	1165	21	1654	820	28	±1.960	+ 0.301	ACCEPT	1.00 - 1.93	2.018	REJECT
	4th AXLE												
	GROSS WEIGHT	6643	1571	21	6854	1573	28	±1.960	- 0.451	ACCEPT	1.00 - 2.06	1.003	ACCEPT
	1st SPACE	10.1	0.41	21	10.0	0.62	28	±1.960	+ 0.686	ACCEPT	1.00 - 2.02	2.29	REJECT
	2nd SPACE	13.6	2.32	21	14.1	2.52	28	±1.960	- 0.725	ACCEPT	1.00 - 2.01	1.18	ACCEPT
	3rd SPACE												
	WHEEL BASE	24.0	2.43	21	24.7	3.32	28	±1.960	- 0.861	ACCEPT	1.00 - 2.02	1.87	ACCEPT
I 65 N - I 65 S	1st AXLE	2306	339	43	2800	344	71	±1.960	- 6.971	REJECT	1.00 - 1.64	1.03	ACCEPT
	2nd AXLE	2725	588	43	2800	499	71	±1.960	- 0.711	ACCEPT	1.00 - 1.58	1.39	ACCEPT
	3rd AXLE	1730	993	43	1995	524	71	±1.960	- 1.652	ACCEPT	1.00 - 1.58	3.59	REJECT
	4th AXLE	2028	867	5	2112	617	12	±2.447	- 0.197	ACCEPT	1.00 - 3.36	1.97	ACCEPT
	GROSS WEIGHT	7041	934	43	7502	507	71	±1.960	- 3.043	REJECT	1.00 - 1.58	3.394	REJECT
	1st SPACE	9.9	0.63	43	10.0	0.61	71	±1.960	- 0.842	ACCEPT	1.00 - 1.58	1.07	ACCEPT
	2nd SPACE	14.0	2.70	43	14.5	2.90	71	±1.960	- 0.944	ACCEPT	1.00 - 1.64	1.15	ACCEPT
	3rd SPACE	3.1	0.22	5	3.3	1.95	12	±2.179	- 3.500	REJECT	1.00 - 4.71	78.56	REJECT
	WHEEL BASE	24.2	3.26	43	25.1	3.62	71	±1.960	+ 1.393	ACCEPT	1.00 - 1.64	1.23	ACCEPT
I 75 N - I 75 S	1st AXLE	2233	465	96	2303	400	106	±1.960	+ 1.167	ACCEPT	1.00 - 1.39	1.35	ACCEPT
	2nd AXLE	2605	308	96	2778	337	106	±1.960	- 0.257	ACCEPT	1.00 - 1.41	1.197	REJECT
	3rd AXLE	1871	214	96	1733	250	106	±1.960	+ 4.318	REJECT	1.00 - 1.41	1.364	ACCEPT
	4th AXLE	2360	781	6	1507	419	16	±2.306	+ 2.723	REJECT	1.00 - 2.66	3.47	REJECT
	GROSS WEIGHT	6856	148	96	7032	262	106	±1.960	- 6.069	REJECT	1.00 - 1.43	3.134	REJECT
	1st SPACE	9.8	0.69	68	9.9	0.50	86	±1.960	- 1.001	ACCEPT	1.00 - 1.48	1.904	REJECT
	2nd SPACE	14.0	2.39	68	14.7	2.80	86	±1.960	- 1.672	ACCEPT	1.00 - 1.52	1.372	ACCEPT
	3rd SPACE	2.4	0.55	3	2.5	0.35	14	±2.074	- 0.302	ACCEPT	1.00 - 3.74	2.469	ACCEPT
	WHEEL BASE	24.0	2.96	68	25.1	3.35	86	±1.960	+ 2.158	REJECT	1.00 - 1.49	1.28	ACCEPT

STATISTICAL COMPARISON

H_o: $\mu_1 = \mu_2$ and $\sigma_1 = \sigma_2$

DATA SETS BEING COMPARED	DATA COMPONENT	x_1	s_1	n_1	x_2	s_2	n_2	Z TEST: ACCEPTANCE RANGE	Z TEST: Z	Z TEST: DECISION FOR H_o	F TEST: ACCEPTANCE RANGE	F TEST: F	F TEST: DECISION FOR H_o
HOUSE TRAILERS - MISC TRAILERS	1st AXLE	2459	407	92	2193	334	125	±1.960	+ 5.208	REJECT	1.00 - 1.39	1.48	REJECT
	2nd AXLE	2781	336	92	2713	170	125	±1.960	+ 1.809	ACCEPT	1.00 - 1.39	3.91	REJECT
	3rd AXLE	2906	394	92	1366	298	125	±1.960	+31.956	REJECT	1.00 - 1.39	1.75	REJECT
	4th AXLE	2518	520	9	1756	733	13	±2.080	+ 2.914	REJECT	1.00 - 3.07	1.99	ACCEPT
	GROSS WEIGHT	8412	456	92	6439	306	125	±1.960	+36.545	REJECT	1.00 - 1.39	2.22	REJECT
	1st SPACE	10.1	0.44	74	9.9	0.53	112	±1.960	+ 2.834	REJECT	1.00 - 1.45	1.45	ACCEPT
	2nd SPACE	15.7	2.44	74	13.0	1.98	112	±1.960	+ 3.877	REJECT	1.00 - 1.45	1.44	ACCEPT
	3rd SPACE	2.9	0.14	8	3.3	1.86	13	±2.179	- 0.772	ACCEPT	1.00 - 3.28	176.5	REJECT
	WHEEL BASE	26.2	3.14	74	23.3	2.57	112	±1.960	+6.7034	REJECT	1.00 - 1.45	1.49	REJECT
BOAT TRAILERS - U-HAUL TRAILERS	1st AXLE	2357	521	64	2194	349	84	±1.960	+ 2.185	REJECT	1.00 - 1.51	2.23	REJECT
	2nd AXLE	2788	371	64	2538	505	84	±1.960	+ 3.493	REJECT	1.00 - 1.50	1.85	REJECT
	3rd AXLE	1530	704	64	1483	454	84	±1.960	+ 0.471	ACCEPT	1.00 - 1.48	2.404	REJECT
	4th AXLE	1483	418	14	1807	647	10	±2.145	- 1.390	ACCEPT	1.00 - 2.71	2.396	ACCEPT
	GROSS WEIGHT	6992	665	64	6453	464	84	±1.960	+ 5.600	REJECT	1.00 - 1.51	2.05	REJECT
	1st SPACE	10.0	0.87	55	9.8	0.57	74	±1.960	+ 1.489	ACCEPT	1.00 - 1.51	2.33	REJECT
	2nd SPACE	17.1	2.06	55	12.6	1.45	74	±1.960	+14.210	REJECT	1.00 - 1.51	2.01	REJECT
	3rd SPACE	2.3	0.30	13	2.9	0.07	7	±2.145	+ 2.268	REJECT	1.00 - 4.00	18.37	REJECT
	WHEEL BASE	27.7	2.85	55	22.8	2.31	74	±1.960	+10.497	REJECT	1.00 - 1.53	1.52	ACCEPT
BOAT TRAILERS - MISC TRAILERS	1st AXLE	2357	521	64	2193	334	125	±1.960	+ 2.324	REJECT	1.00 - 1.43	2.43	REJECT
	2nd AXLE	2788	371	64	2713	170	125	±1.960	+ 1.561	ACCEPT	1.00 - 1.43	4.76	REJECT
	3rd AXLE	1530	704	64	1366	298	125	±1.960	+ 1.811	ACCEPT	1.00 - 1.43	5.518	REJECT
	4th AXLE	1438	418	14	1756	733	13	±2.093	- 1.176	ACCEPT	1.00 - 2.79	3.075	REJECT
	GROSS WEIGHT	6992	665	64	6439	306	125	±1.960	+ 6.417	REJECT	1.00 - 1.43	4.72	REJECT
	1st SPACE	10.0	0.87	55	9.9	0.53	112	±1.960	+ 0.785	ACCEPT	1.00 - 1.47	2.69	REJECT
	2nd SPACE	17.1	2.06	55	13.0	1.98	112	±1.960	+11.694	REJECT	1.00 - 1.47	1.08	ACCEPT
	3rd SPACE	2.3	0.30	13	3.3	1.86	13	±2.101	- 1.727	ACCEPT	1.00 - 2.60	3.84	REJECT
	WHEEL BASE	27.7	2.85	55	23.3	2.57	112	±1.960	+ 9.715	REJECT	1.00 - 1.47	1.23	ACCEPT

STATISTICAL COMPARISON

H_o: $\mu_1 = \mu_2$ and $\sigma_1 = \sigma_2$

DATA SETS BEING COMPARED	DATA COMPONENT	x_1	S_1	n_1	x_2	S_2	n_2	Z TEST			F TEST		
								ACCEPTANCE RANGE	Z	DECISION FOR H_o	ACCEPTANCE RANGE	F	DECISION FOR H_o
HOUSE TRAILERS - U-HAUL TRAILERS	1st AXLE	2495	407	92	2194	349	84	±1.960	+ 4.689	REJECT	1.00 - 1.50	1.35	ACCEPT
	2nd AXLE	2781	336	92	2538	505	84	±1.960	+ 3.739	REJECT	1.00 - 1.44	2.26	REJECT
	3rd AXLE	2906	394	92	1483	454	84	±1.960	+22.257	REJECT	1.00 - 1.44	1.32	ACCEPT
	4th AXLE	2518	520	9	1807	647	10	±2.110	+ 2.709	REJECT	1.00 - 3.18	1.55	ACCEPT
	GROSS WEIGHT	8412	456	92	6453	464	84	±1.960	+28.419	REJECT	1.00 - 1.45	1.035	ACCEPT
	1st SPACE	10.1	0.44	76	9.8	0.57	74	±1.960	+ 3.634	REJECT	1.00 - 1.51	1.68	REJECT
	2nd SPACE	15.7	2.44	76	12.6	1.45	74	±1.960	+ 9.522	REJECT	1.00 - 1.51	2.83	REJECT
	3rd SPACE	2.9	0.07	8	2.9	0.14	7	±2.201	+ 0	ACCEPT	1.00 - 3.79	4.00	REJECT
	WHEEL BASE	26.2	3.14	76	22.8	2.31	74	±1.960	+ 9.432	REJECT	1.00 - 1.48	1.85	ACCEPT
U-HAUL TRAILERS - OTHER TRAILERS	1st AXLE	2194	349	84	2193	334	125	±1.960	+ 0,021	ACCEPT	1.00 - 1.39	1.09	ACCEPT
	2nd AXLE	2538	505	84	2713	170	125	±1,960	- 3.065	REJECT	1.00 - 1.39	8.82	REJECT
	3rd AXLE	1483	454	64	1366	298	125	±1.960	+ 2.087	REJECT	1,00 - 1,39	2.32	REJECT
	4th AXLE	1807	647	10	1756	733	13	±2,080	+ 0.177	ACCEPT	1.00 - 3.07	1.28	ACCEPT
	GROSS WEIGHT	6453	464	84	6439	306	125	±1.960	+ 0,244	ACCEPT	1.00 - 1.39	2,299	REJECT
	1st SPACE	9.8	0,57	74	9.9	0.53	112	±1.960	- 1.220	ACCEPT	1.00 - 1.43	1,16	ACCEPT
	2nd SPACE	12.6	1.45	74	13.0	1.98	112	±1,960	- 1.610	ACCEPT	1.00 - 1.45	1,86	REJECT
	3rd SPACE	2.9	0.14	7	3.3	1.86	13	±2.179	- 0.774	ACCEPT	1.00 - 3.57	706.04	REJECT
	WHEEL BASE	22,8	2,31	74	23.3	2.57	112	±1.960	- 1.399	ACCEPT	1.00 - 1.45	1,24	ACCEPT
HOUSE TRAILERS - BOAT TRAILERS	1st AXLE	2459	407	92	2357	921	64	±1.960	+ 1,333	ACCEPT	1.00 - 1.48	1,64	REJECT
	2nd AXLE	2781	336	92	2788	371	64	±1.960	- 0.122	ACCEPT	1.00 - 1.48	1.21	ACCEPT
	3rd AXLE	2906	394	92	1530	704	54	±1.960	+14.390	REJECT	1.00 - 1.48	3.19	REJECT
	4th AXLE	2518	520	9	1483	418	14	±2.110	+ 5.206	REJECT	1.00 - 2.71	1,55	ACCEPT
	GROSS WEIGHT	8412	456	92	6992	655	64	±1,960	+15.061	REJECT	1.00 - 1.48	2.17	REJECT
	1st SPACE	10.1	0.44	76	10.0	0.87	55	±1.960	+ 0,783	ACCEPT	1,00 - 1.51	3,91	REJECT
	2nd SPACE	15.7	2.44	76	17.1	2,06	55	±1,960	- 3.550	REJECT	1.00 - 1.51	1.40	ACCEPT
	3rd SPACE	2.9	0,14	8	2.3	0,30	13	±2.101	+ 6.198	REJECT	1.00 - 3.57	4.59	REJECT
	WHEEL BASE	26.2	3,14	76	27.7	2.85	55	±1,960	- 2,848	REJECT	1.00 - 1.51	1,21	ACCEPT
ONE-AXLE TRAILERS - TWO-AXLE TRAILERS	1st AXLE	2417	337	319	2269	98	46	±1,960	- 6.275	REJECT	1.00 - 1.45	11.82	REJECT
	2nd AXLE	3014	661	319	2657	136	46	±1,960	- 8.606	REJECT	1.00 - 1.45	23.6	REJECT
	3rd AXLE	1878	649	319	1791	56	46	±1.960	- 2.390	REJECT	1.00 - 1.45	134.31	REJECT
	4th AXLE												
	GROSS WEIGHT	9156	915	319	6713	123	46	±1.960	-45,878	REJECT	1,00 - 1.45	55.3	REJECT
	1st SPACE	9.9	0.45	281	10.3	0.60	36	±1.960	- 5,676	REJECT	1.00 - 1.51	1.78	REJECT
	2nd SPACE	14.0	3.49	281	16.1	2.38	36	±1.960	- 3.728	REJECT	1,00 - 1,39	2,15	REJECT
	3rd SPACE												
	WHEEL BASE	23.8	3.27	281	29,3	2.59	36	±1.960	-10.308	REJECT	1,00 - 1.39	1.59	REJECT

APPENDIX E

CONSIDERATION OF A-UT AXLE WEIGHTS IN EAL COMPUTATIONS

ALL DATA SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			2		2	.0188	.0376
300-499			8		8	.0197	.1576
500-699			12		12	.0206	.2472
700-899			28		28	.0215	.6020
900-1099	1		28	5	34	.0225	.7650
1100-1299	2	1	47	6	56	.0235	1.3160
1300-1499	2	2	48	4	56	.0246	1.3776
1500-1699	6	3	40	8	57	.0257	1.4649
1700-1899	31	14	24	3	72	.0269	1.9368
1900-2099	54	23	20	4	101	.0281	2.8381
2100-2299	74	32	16	2	124	.0294	3.6456
2300-2499	80	51	17	5	153	.0308	4.7124
2500-2699	72	61	18	2	153	.0322	4.9266
2700-2899	29	65	16	3	113	.0337	3.8081
2900-3099	8	41	3	2	54	.0352	1.9008
3100-3299	5	32	5	1	43	.0368	1.5824
3300-3499	1	13	6	1	21	.0385	.8085
3500-3699		13	6		19	.0402	.7638
3700-3899		7	9		16	.0421	.6736
3900-4099			4		4	.0440	.1760
4100-4299						.0460	
4300-4499			2		2	.0481	.0962
4500-4699		3	4		7	.0503	.3521
4700-4899			1		1	.0526	.0526
4900-5099		1			1	.0550	.0550
5100-5299						.0575	
5300-5499		2	1		3	.0601	.1803
5500-5699		1			1	.0629	.0629
TOTALS	365	365	365	46	1141		34.5397

AVERAGE AXLES PER VEHICLE = 1141/365 = 3.126

UNIT EAL = 34.5397/365 = 0.0946

8000-9999 VEHICLES PER DAY (I 64 AND I 65) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			2		2	.0188	.0376
300-499			3		3	.0197	.0591
500-699			2		2	.0206	.0412
700-899			11		11	.0215	.2365
900-1099			11	1	12	.0225	.2700
1100-1299	2	1	19	4	26	.0235	.6110
1300-1499		1	29	2	32	.0246	.7872
1500-1699	1		13	1	15	.0257	.3855
1700-1899	11	4	9	1	25	.0269	.6725
1900-2099	24	13	12	3	52	.0281	1.4612
2100-2299	32	7	10	2	51	.0294	1.4994
2300-2499	35	23	9	5	72	.0308	2.2176
2500-2699	33	25	7	1	66	.0322	2.1252
2700-2899	18	36	5	1	60	.0337	2.0220
2900-3099	3	18	2	2	25	.0352	.8800
3100-3299	4	15	2		21	.0368	.7728
3300-3499		7	3	1	11	.0385	.4235
3500-3699		7	3		10	.0402	.4020
3700-3899		4	3		7	.0421	.2947
3900-4099			3		3	.0440	.1320
4100-4299						.0460	
4300-4499			1		1	.0481	.0481
4500-4699		1	2		3	.0503	.1509
4700-4899			1		1	.-526	.0526
4900-5099		1			1	.0550	.0550
5100-5299						.0575	
5300-5499			1		1	.0601	.0601
TOTALS	163	163	163	24	513		15.6977

AVERAGE AXLES PER VEHICLE = 513/163 = 3.147

UNIT EAL = 15.6977/163 = 1.0963

SOUTH CENTRAL KENTUCKY (I 65) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		1	.0188	.0188
300-499			2		2	.0197	.0394
500-699			1		1	.0206	.0206
700-899			7		7	.0215	.1505
900-1099			8	1	9	.0225	.2025
1100-1299			10		10	.0235	.2350
1300-1499			24	1	25	.0246	.6150
1500-1699	1		8	1	10	.0257	.2570
1700-1899	10	2	5	1	18	.0269	.4842
1900-2099	16	11	9	3	39	.0281	1.0959
2100-2299	16	5	6	2	29	.0294	.8526
2300-2499	26	14	5	4	49	.0308	1.5092
2500-2699	27	13	5	1	46	.0322	1.4812
2700-2899	12	24	5	1	42	.0337	1.4154
2900-3099	2	16	2	1	21	.0352	.7392
3100-3299	4	12	1		17	.0368	.6256
3300-3499		6	3	1	10	.0385	.3850
3500-3699		6	2		8	.0402	.3216
3700-3899		3	3		6	.0421	.2526
3900-4099			2		2	.0440	.0880
4100-4299						.0460	
4300-4499			1		1	.0481	.0481
4500-4699		1	2		3	.0503	.1509
4700-4899			1		1	.0526	.0526
4900-5099		1			1	.0550	.0550
5100-5299						.0575	
5300-5499			1		1	.0601	.0601
TOTALS	114	114	114	17	359		11.1560

AVERAGE AXLES PER VEHICLE = 359/114 = 3.149

UNIT EAL = 11.1560/114 = 0.0979

EAST-WEST TRAVEL (I 64) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		1	.0188	.0188
300-499			1		1	.0197	.0197
500-699			1		1	.0206	.0206
700-899			4		4	.0215	.0860
900-1099			3		3	.0225	.0675
1100-1299	2	1	9	4	16	.0235	.3760
1300-1499		1	5	1	7	.0246	.1722
1500-1699			5		5	.0257	.1285
1700-1899	1	2	4		7	.0269	.1883
1900-2099	8	2	3		13	.0281	.3653
2100-2299	16	2	4		22	.0294	.6468
2300-2499	9	9	4	1	23	.0308	.7084
2500-2699	6	12	2		20	.0322	.6440
2700-2899	6	12			18	.0337	.6066
2900-3099	1	2		1	4	.0352	.1408
3100-3299		3	1		4	.0368	.1472
3300-3499		1			1	.0385	.0385
3500-3699		1	1		2	.0402	.0804
3700-3899		1			1	.0421	.0421
3900-4099			1		1	.0440	.0440
TOTALS	49	49	49	7	154		4.5417

AVERAGE AXLES PER VEHICLE = 154/49 = 3.143

UNIT EAL = 4.5417/49 = 0.0927

NORTH-SOUTH TRAVEL (I 75 and I 65) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THRID AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		7	.0188	.0188
300-499			6		6	.0197	.1182
500-699			9		9	.0206	.1854
700-899			22		22	.0215	.4730
900-1099	1		25	5	31	.0225	.6975
1100-1299			38	2	40	.0235	.9400
1300-1499	2		43	3	48	.0246	1.1808
1500-1699	6	3	27	8	44	.0257	1.1308
1700-1899	30	12	20	3	65	.0269	1.7485
1900-2099	46	21	17	4	88	.0281	2.4728
2100-2299	58	30	12	2	102	.0294	2.9988
2300-2499	72	42	13	4	131	.0308	4.0348
2500-2699	66	49	16	2	133	.0322	4.2826
2700-2899	23	53	16	3	95	.0337	3.2015
2900-3099	7	39	8	1	55	.0352	1.9360
3100-3299	5	29	4	1	39	.0368	1.4352
3300-3499		13	6	1	20	.0385	.7700
3500-3699		12	5		17	.0402	.6834
3700-3899		6	9		15	.0421	.6315
3900-4099			3		3	.0440	.1320
4100-4299						.0460	
4300-4499			2		2	.0481	.0962
4500-4699		3	4		7	.0503	.3521
4700-4899			1		1	.0526	.0526
4900-5099		1			1	.0550	.0550
5100-5299						.0575	
5300-5499		2	1		3	.0601	.1803
5500-5699		1			1	.0629	.0629
5700-5899						.0657	
TOTALS	316	316	316	69	1017		29.8707

AVERAGE AXLES PER VEHICLE = 1017/316 = 3.218

UNIT EAL = 29.8707/316 = 0.0945

HOUSE TRAILERS SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299						.0188	
300-499						.0197	
500-699			1		1	.0206	.0206
700-899						.0215	
900-1099			1		1	.0225	.0225
1100-1299			2		2	.0235	.0470
1300-1499			4		4	.0246	.0984
1500-1699			3		3	.0257	.0771
1700-1899	3	3	6	1	13	.0269	.3497
1900-2099	7	1	7	1	16	.0281	.4496
2100-2299	15	5	3	1	24	.0294	.7056
2300-2499	19	13	7	3	42	.0308	1.2936
2500-2699	22	17	10		49	.0322	1.5778
2700-2899	19	17	10		46	.0337	1.5502
2900-3099	4	9	2	1	16	.0352	.5632
3100-3299	3	14	4	1	22	.0368	.8096
3300-3499		4	6	1	11	.0385	.4235
3500-3699		4	6		10	.0402	.4020
3700-3899		4	8		12	.0421	.5052
3900-4099			4		4	.0440	.1760
4100-4299						.0460	
4300-4499			2		2	.0481	.0962
4500-4699			4		4	.0503	.2012
4700-4899			1		1	.0526	.0526
4900-5099		1			1	.0550	.0550
5100-5299						.0575	
5300-5499			1		1	.0601	.0601
TOTALS	92	92	92	9	285		9.5367

AVERAGE AXLES PER VEHICLE = 285/92 = 3.098

UNIT EAL = 9.5367/92 = 0.1037

BOAT TRAILERS SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		1	.0188	.0188
300-499			3		3	.0197	.0591
500-699			2		2	.0206	.0421
700-899			2		2	.0251	.0430
900-1099			3	3	6	.0225	.1350
1100-1299	1	1	11	1	14	.0235	.3290
1300-1499			14	3	17	.0246	.4182
1500-1699			8	5	13	.0257	.3341
1700-1899	6	2	9	1	18	.0269	.4842
1900-2099	8	7	2		17	.0281	.4777
2100-2299	11	5	3		19	.0294	.5586
2300-2499	18	14			32	.0308	.9856
2500-2699	14	7	2	1	24	.0322	.7728
2700-2899	3	9	1		13	.0337	.4381
2900-3099	2	7	1		10	.0352	.3520
3100-3299	1	2	1		4	.0368	.1472
3300-3499		4			4	.0385	.1540
3500-3699		2			2	.0402	.0804
3700-3899		1	1		2	.0421	.0842
3900-4099						.0440	
4100-4299						.0460	
4300-4499						.0481	
4500-4699		1			1	.0503	.0503
4700-4899						.0526	
4900-5099						.0550	
5100-5299						.0575	
5300-5499		1			1	.0601	.0601
5500-5699		1			1	.0629	.0629
TOTALS	64	64	64	14	206		6.0865

AVERAGE AXLES PER VEHICLE = 206/64 = 3.219

UNIT EAL = 6.0865/64 = 0.0951

OTHER TRAILERS SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THRID AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		1	.0188	.0188
300-499			2		2	.0197	.0394
500-699			7		7	.0206	.1442
700-899			15		15	.0215	.3225
900-1099			16	1	17	.0225	.3825
1100-1299	1		20	4	25	.0235	.5875
1300-1499	1	1	20	1	23	.0246	.5658
1500-1699	3		18	2	23	.0257	.5911
1700-1899	16	2	8		26	.0269	.6994
1900-2099	27	12	5		44	.0281	1.2364
2100-2299	28	10	6	1	45	.0294	1.3230
2300-2499	22	14	3	1	40	.0308	1.2320
2500-2699	20	23	1		44	.0322	1.4168
2700-2899	4	23	3	2	32	.0337	1.0784
2900-3099	2	15		1	18	.0352	.6336
3100-3299	1	9			10	.0368	.3680
3300-3499		6			16	.0385	.2310
3500-3699		6			6	.0402	.2412
3700-3899		2			2	.0421	.0842
3900-4099						.0440	
4100-4299						.0460	
4300-4499						.0481	
4500-4699		1			1	.0503	.0503
4700-4899						.0526	
4900-5099						.0550	
5100-5299						.0575	
5300-5499		1			1	.0601	.0601
TOTALS	125	125	125	13	388		11.3062

AVERAGE AXLES PER VEHICLE = 388/125 = 3.104

UNIT EAL = 11.3062/125 = 0.0904

10000-13999 VEHICLES PER DAY (I 75) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299						.0188	
300-499			4		4	.0197	.0788
500-699			8		8	.0206	.1648
700-899			15		15	.0215	.3225
900-1099	1		17	4	22	.0225	.4950
1100-1299			28	2	30	.0235	.7050
1300-1499	2		19	2	23	.0246	.5658
1500-1699	5	3	27	7	42	.0257	1.0794
1700-1899	20	10	15	2	47	.0269	1.2643
1900-2099	30	10	8	1	49	.0281	1.3769
2100-2299	42	25	6		73	.0294	2.1462
2300-2499	46	28	8		82	.0308	2.5256
2500-2699	39	36	11	1	87	.0322	2.8014
2700-2899	11	29	11	2	53	.0337	1.7861
2900-3099	5	23	6		34	.0352	1.1968
3100-3299	1	17	3	1	22	.0368	.8096
3300-3499		7	3		10	.0385	.3850
3500-3699		6	3		9	.0402	.3618
3700-3899		3	6		9	.0421	.3789
3900-4099			1		1	.0440	.0440
4100-4299						.0460	
4300-4499			1		1	.0481	.0481
4500-4699		2	2		4	.0503	.2012
4700-4899						.0526	
4900-5099						.0550	
5100-5299						.0575	
5300-5499		2			2	.0601	.1202
5500-5699		1			1	.0629	.0629
5700-5899						.0657	
TOTALS	202	202	202	52	658		18.9391

AVERAGE AXLES PER VEHICLE = 685/202 = 3.257

UNIT EAL = 18.9391/202 = 0.0938

U-HAUL TRAILERS SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299						.0188	
300-499			3		3	.0197	.0591
500-699			2		2	.0206	.0412
700-899			11		11	.0215	.2365
900-1099			8	1	9	.0225	.2025
1100-1299			14	1	15	.0235	.3525
1300-1499	1		10		11	.0246	.2706
1500-1699	2	3	11	1	17	.0257	.4369
1700-1899	6	7	1	1	15	.0269	.4035
1900-2099	12	3	6	3	24	.0281	.6744
2100-2299	20	12	4		36	.0294	1.0584
2300-2499	24	10	7	1	42	.0308	1.2936
2500-2699	16	14	5	1	36	.0322	1.1592
2700-2899	3	16	2	1	22	.0337	.7414
2900-3099	10	10			10	.0352	.3520
3100-3299		7			7	.0368	.2576
3300-3499.						.0385	
3500-3699		1			1	.0402	.0402
3700-3899						.0421	
3900-4099						.0440	
4100-4299						.0460	
4300-4499						.0481	
4500-4699		1			1	.0503	.0503
TOTALS	84	84	84	10	262		7.6299

AVERAGE AXLES PER VEHICLE = 262/84 = 3.119

UNIT EAL = 7.6299/84 = 0.0938

NORTH CENTRAL KENTUCKY (I 75 AND I 64) SUBSET

WEIGHT GROUP	FIRST AXLE	SECOND AXLE	THIRD AXLE	FOURTH AXLE	TOTAL AXLES	DAMAGE FACTOR	EAL'S
0-299			1		1	.0188	.0188
300-499			5		5	.0197	.0985
500-699			9		9	.0206	.1854
700-899			19		19	.0215	.4085
900-1099	1		20	4	25	.0225	.5625
1100-1299	2	1	37	6	46	.0235	1.0810
1300-1499	2	1	24	3	30	.0246	.7380
1500-1699	5	3	32	7	47	.0257	1.2079
1700-1899	21	12	19	2	54	.0269	1.4526
1900-2099	38	12	11	1	62	.0281	1.7422
2100-2299	58	27	10		95	.0294	2.7930
2300-2499	55	37	12	1	105	.0308	3.2340
2500-2699	45	48	13	1	107	.0322	3.4454
2700-2899	17	41	11	2	71	.0337	2.3927
2900-3099	6	25	6	1	38	.0352	1.3376
3100-3299	1	20	4	1	26	.0368	.9568
3300-3499		8	3		11	.0385	.4235
3500-3699		7	4		11	.0402	.4422
3700-3899		4	6		10	.0421	.4210
3900-4099			2		2	.0440	.0880
4100-4299						.0460	
4300-4499			1		1	.0481	.0481
4500-4699		2	2		4	.0503	.2012
4700-4899						.0526	
4900-5099						.0550	
5100-5299						.0575	
5300-5499		2			2	.0601	.1202
5500-5699		1			1	.0629	.0629
5700-5899						.0657	
TOTALS	251	251	251	59	812		23.4620

AVERAGE AXLES PER VEHICLE = 812/251 = 3.235

UNIT EAL = 23,4620/ 51 = 0.0935

UNIT EWL'S

VEHICLE TYPE A-UT

LOCAL CONDITION	CODE	AASHO MEAN	STD DEV
ROAD TYPE	1	0.0946	
	2		
	3		
	4		
DIRECTION	1	0.0956	0.0022
	2	0.0927	
ALTERNATE ROUTE	1	0.0946	
	2		
	3		
SERVICE PROVIDED	1		
	2	0.0946	
	3		
	4		
	5		
	6		
	7		
	8		
	9		
VOLUME	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8	0.0907	
	9	0.0979	
	10	0.0938	
MAGW	1		
	2		
	3		
	4	0.0946	
AREA	1		
	2	0.0979	
	3	0.0934	0.0006
	4		
YEAR	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10	0.0946	
AVERAGES		0.0946	

The following calculations of the total design EAL's for a section of I 75 in Scott County indicate the following:

NO CONSIDERATION OF A-UT DATA:	26,412,977 EAL's
INCLUDING A-UT DATA:	27,990,127 EAL's
PERCENTAGE OF TOTAL EAL's ACCOUNTED FOR BY NOT INCLUDING DATA FOR A-UT COMBINATIONS:	94.37%

Expressed in another way, if A-UT vehicles are not included and the total design EAL's are calculated for a 20-year period, then this number is actually accumulated in 18 years and 10 months.

WITHOUT A-UT's

PREDICTION OF DESIGN EWLS (RURAL ONLY) — SHEET- 1 OF 5

DATE- 10-23-70

DESCRIPTION OF PROJECT AND COMPUTATIONS — PREPARATOR- SIRIA

DESCRIPTION OF PROJECT

ROUTE NAME-

ROUTE NUMBER- I 75

PROJECT NUMBER-

COUNTY-

PROJECT LIMITS-

LOADOMETER STATION REFERENCE (IF ANY)-

DESCRIPTION OF TRAFFIC AND DESIGN PERIOD

DESIGN PERIOD (INCLUSIVE DATES)- 1970 -1990

DESIGN PERIOD (YEARS)- 20

DESIGN OR EFFECTIVE ADT (VEHICLES PER DAY)- 56000 *

TYPE OF EWL (CIRCLE)- KY (AASHO) MODIFIED AASHO

COMPUTATIONS

VEHICLE TYPE	ADJUSTED FRACTION (FROM SHEET 4)		UNIT EWLS (FROM SHEET 5)		
CARS	86.999	X	0.0002	=	0.000174
BUSES	0.234	X	0.4000	=	0.000936
SU-2A-4T	3.845	X	0.0135	=	0.000519
SU-2A-6T	2.303	X	0.1999	=	0.004604
SU-3A	0.261	X	0.6089	=	0.001589
C-3A	0.814	X	0.4031	=	0.003281
C-4A	2.073	X	0.7546	=	0.015643
C-5A	3.471	X	1.0909	=	0.037865

AVERAGE UNIT EWL = .064611 = SUM

DESIGN EWLS = 365 X 20 (DESIGN PERIOD (YEARS)) X 56000 (ADT (VEHICLES PER DAY)) X 0.064611 (SUM) = 26,412,977 (DESIGN EWLS)

COMPARISON WITH REFERENCE STATION

*1990 ADT = 23000 x 1.07^20
= 89000

Average ADT = (23000 + 89000)/2 = 56000

WITH A-UT'S

PREDICTION OF DESIGN EWLS (RURAL ONLY)	SHEET- 1 OF 5
DESCRIPTION OF PROJECT AND COMPUTATIONS	DATE- 10-23-70
	PREPARATOR- SIRIA

DESCRIPTION OF PROJECT

ROUTE NAME- ROUTE NUMBER- I 75

PROJECT NUMBER- COUNTY-

PROJECT LIMITS-

LOADOMETER STATION REFERENCE (IF ANY)-

DESCRIPTION OF TRAFFIC AND DESIGN PERIOD

DESIGN PERIOD (INCLUSIVE DATES)- 1970-1990

DESIGN PERIOD (YEARS)- 20

DESIGN OR EFFECTIVE ADT (VEHICLES PER DAY)- 56000

TYPE OF EWL (CIRCLE)- KY (AASHO) MODIFIED AASHO

COMPUTATIONS

VEHICLE TYPE	ADJUSTED FRACTION (FROM SHEET 4)		UNIT EWLS (FROM SHEET 5)		
CARS	83.020	X	0.0002	=	0.000166
BUSES	0.234	X	0.4000	=	0.000936
A-UT'S	4.427	X	0.0926		0.004100
SU-2A-4T	3.427	X	0.0135	=	0.000463
SU-2A-6T	2.297	X	0.1999	=	0.004592
SU-3A	0.260	X	0.6089	=	0.001583
C-3A	0.811	X	0.4031	=	0.003269
C-4A	2.068	X	0.7546	=	0.015605
C-5A	3.461	X	1.0909	=	0.037756

AVERAGE UNIT EWL = .068470 = SUM

DESIGN EWLS = 365 X 20 (DESIGN PERIOD (YEARS)) X 56000 (ADT (VEHICLES PER DAY)) X 0.068470 (SUM) = 27,990,127 (DESIGN EWLS)

COMPARISON WITH REFERENCE STATION

PREDICTION OF DESIGN EWLS (RURAL ONLY) DETERMINATION OF LOCAL CONDITIONS	SHEET- 2 OF 5 DATE- 10-23-70 PREPARATOR- 51218

** FOR EACH OF THE FOLLOWING LOCAL CONDITIONS, CIRCLE THE APPROPRIATE CODE **

LOCAL CONDITION	CODE	DESCRIPTION
ROAD TYPE	(1)	INTERSTATE-NUMBERED RURAL ROUTE
	2	US-NUMBERED RURAL ROUTE
	3	KY-NUMBERED RURAL ROUTE
	4	OTHER RURAL ROUTE
DIRECTION	(1)	SERVES PREDOMINANTLY NORTH-SOUTH TRAFFIC
	2	SERVES PREDOMINANTLY EAST-WEST TRAFFIC
ALTERNATE ROUTE	(1)	ALTERNATE ROUTE PROVIDES INFERIOR SERVICE
	2	NO ALTERNATE ROUTE OR SAME QUALITY OF SERVICE
	3	ALTERNATE ROUTE PROVIDES SUPERIOR SERVICE
SERVICE PROVIDED	1	PRIMARILY PROVIDES SERVICE TO MAJOR RECREATIONAL ACTIVITIES
	(2)	PROVIDES SIGNIFICANT SERVICE TO MAJOR RECREATIONAL ACTIVITIES
	3	PROVIDES SOME SERVICE TO RECREATIONAL ACTIVITIES
	4	ORDINARY
	5	PROVIDES SOME SERVICE TO MINING ACTIVITIES
	6	PROVIDES SIGNIFICANT SERVICE TO MAJOR MINING ACTIVITIES
	7	PRIMARILY PROVIDES SERVICE TO MAJOR MINING ACTIVITIES
	8	PROVIDES MORE THAN ORDINARY SERVICE TO INDUSTRIAL ACTIVITIES
	9	PRIMARILY PROVIDES SERVICE TO MAJOR INDUSTRIAL ACTIVITIES
VOLUME	1	0-499 VEHICLES PER DAY
	2	500-999 VEHICLES PER DAY
	3	1000-1999 VEHICLES PER DAY
	4	2000-2999 VEHICLES PER DAY
	5	3000-3999 VEHICLES PER DAY
	6	4000-5999 VEHICLES PER DAY
	7	6000-7999 VEHICLES PER DAY
	8	8000-9999 VEHICLES PER DAY
	9	10000-13999 VEHICLES PER DAY
	(10)	14000 OR MORE VEHICLES PER DAY
MAXIMUM ALLOWABLE GROSS WEIGHT	1	30,000 POUNDS
	2	42,000 POUNDS
	3	59,640 POUNDS
	(4)	73,280 POUNDS
	OTHER	POUNDS
GEOGRAPHICAL AREA	1	WESTERN (HIGHWAY DISTRICTS 1 AND 2)
	2	SOUTH CENTRAL (HIGHWAY DISTRICTS 3, 4, AND 8)
	(3)	NORTH CENTRAL (HIGHWAY DISTRICTS 5, 6, AND 7)
	4	EASTERN (HIGHWAY DISTRICTS 9, 10, 11, AND 12)
SEASON	1	WINTER (JANUARY-MARCH)
	2	SPRING (APRIL-JUNE)
	3	SUMMER (JULY-SEPTEMBER)
	4	FALL (OCTOBER-DECEMBER)

Without A-UT's

PREDICTION OF DESIGN EWLS
(RURAL ONLY)
BASIC VEHICLE TYPE PERCENTAGES

SHEET- 3 OF 5
DATE- *10-23-70*
PREPARATOR- *Siria*

** SELECT BASIC PERCENTAGES FOR EACH VEHICLE TYPE AND TRANSFER TO SHEET 4 **

ROAD TYPE	MAX ALLOW GR WEIGHT	VOLUME GROUP	CARS	BUSES	SU-2A-4T	SU-2A-6T	SU-3A	C-3A	C-4A	C-5A
1	4	8		0.172		4.432	0.692	0.953	4.229	12.099
1	4	9		0.576		2.466	0.340	0.935	3.250	14.519
1	4	10	82.930	0.352	3.981	2.351	0.319	0.868	2.581	6.618

WITH A-UT's

PREDICTION OF DESIGN EWLS
(RURAL ONLY)
BASIC VEHICLE TYPE PERCENTAGES

DATE- 10-23-70
PREPARATOR- SIRIA

** SELECT BASIC PERCENTAGES FOR EACH VEHICLE TYPE AND TRANSFER TO SHEET 4 **

ROAD TYPE	MAX ALLOW GR WEIGHT	VOLUME GROUP	CARS	BUSES	A-UT	SU-2A-4T	SU-2A-6T	SU-3A	C-4A	C-5A
1	4	8	69.855	0.172	1.160	6.471	4.432	0.629	4.229	12.099
1	4	9	69.554	0.576	2.503	5.851	2.466	0.340	3.250	14.519
1	4	10	79.118	0.352	4.236	3.557	2.351	0.319	2.581	6.618

Without A-UT's

PREDICTION OF DESIGN EHLS
(RURAL ONLY)
ADJUSTED VEHICLE TYPE PERCENTAGES

SHEET- 4 OF 5
DATE- *10-23-71*
PREPARATOR- *S.A.A.*

** SELECT THE APPROPRIATE FACTORS AND PERFORM THE INDICATED CALCULATIONS **

VEHICLE TYPE	CODE	BASIC PERCENT	ALTERNATE ROUTE	SERVICE PROVIDED	DIRECTION	AREA	SEASON		UNADJUSTED PERCENT	ADJUSTMENT FACTOR	ADJUSTED PERCENT
	1		1.011	1.028	0.998	0.994	0.966				
	2		0.994	1.029	1.002	0.999	1.005				
	3		1.019	0.999		1.016	1.038				
	4	FROM		1.011		0.984	0.969				
CARS	5	SHEET		C.975							
	6	3		0.856							
	7			1.023							
	8			1.122							
	9			0.881							
		82.930 x	*1.011* x	*1.029* x	*0.998* x	*0.999* x	0.997	- 0.001 =	*85.256* x	*1.0145* =	*86.9990*
	1		0.993	0.646	1.052	0.772	1.185				
	2		1.012	0.618	0.913	1.008	1.026				
	3		0.903	1.065		1.076	0.808				
	4	FROM		0.946		1.099	1.090				
BUSES	5	SHEET		1.000							
	6	3		0.862							
	7			1.492							
	8			1.059							
	9			0.194							
		0.352 x	*0.993* x	*0.618* x	*1.052* x	*1.008* x	1.015	- 0.001 =	*0.231* x	*1.0145* =	*0.2340*
	1		0.970	0.926	0.973	1.101	0.977				
	2		1.002	1.058	1.045	0.952	1.013				
	3		1.051	0.955		0.827	0.973				
	4	FROM		1.004		1.236	1.047				
SU-2A-4T	5	SHEET		0.952							
	6	3		1.024							
	7			1.188							
	8			1.059							
	9			0.869							
		3.981 x	*0.970* x	*1.058* x	*0.973* x	*0.952* x	1.002	- 0.001 =	*3.790* x	*1.0145* =	*3.8450*
	1		0.967	0.631	0.990	0.918	1.061				
	2		1.014	1.003	1.016	0.998	0.966				
	3		0.957	0.953		0.942	0.906				
	4	FROM		1.008		1.172	1.122				
SU-2A-6T	5	SHEET		1.039							
	6	3		1.184							
	7			0.875							
	8			0.707							
	9			0.856							
		2.351 x	*0.967* x	*1.003* x	*0.990* x	*0.998* x	1.008	- 0.001 =	*2.270* x	*1.0145* =	*2.3029*
	1		0.826	0.338	0.941	1.225	1.057				
	2		1.037	1.195	1.096	0.869	0.989				
	3		1.066	0.950		1.022	0.963				
	4	FROM		0.856		0.916	1.017				
SU-3A	5	SHEET		1.081							
	6	3		5.802							
	7			1.095							
	8			0.405							
	9			0.474							
		0.319 x	*0.826* x	*1.195* x	*0.941* x	*0.869* x	1.003	- 0.001 =	*0.257* x	*1.0145* =	*0.2610*
	1		1.034	1.509	1.054	0.853	1.269				
	2		1.006	0.770	0.911	1.089	C.942				
	3		C.854	1.143		1.160	0.847				
	4	FROM		C.956		0.824	1.047				
C-3A	5	SHEET		1.118							
	6	3		0.821							
	7			0.551							
	8			0.458							
	9			1.775							
		0.868 x	*1.034* x	*0.770* x	*1.054* x	*1.089* x	1.012	- 0.001 =	*0.802* x	*1.0145* =	*0.8140*
	1		0.965	0.713	1.038	1.109	1.073				
	2		1.004	0.784	0.931	1.006	0.982				
	3		1.050	1.145		1.062	0.962				
	4	FROM		0.952		0.818	1.010				
C-4A	5	SHEET		1.145							
	6	3		0.884							
	7			0.476							
	8			0.507							
	9			5.743							
		2.581 x	*0.965* x	*0.784* x	*1.038* x	*1.006* x	1.003	- 0.001 =	*2.044* x	*1.0145* =	*2.0730*
	1		1.137	0.883	0.903	1.437	0.847				
	2		0.938	0.560	1.169	0.903	1.108				
	3		1.044	0.995		0.890	1.050				
	4	FROM		0.943		0.748	0.949				
C-5A	5	SHEET		1.065							
	6	3		3.383							
	7			0.421							
	8			1.289							
	9			4.851							
		6.618 x	*1.137* x	*0.560* x	*0.903* x	*0.903* x	0.996	- 0.001 =	*3.421* x	*1.0145* =	*3.4710*

ADJUSTMENT FACTOR = 100 DIVIDED BY THE SUM OF UNADJUSTED PERCENTAGES = 100/ *98.571* = *1.0145*

** TRANSFER ADJUSTED PERCENTAGES TO SHEET 1 IN FORM OF FRACTIONS **

With A-UT's

PREDICTION OF DESIGN EWLS
(RURAL ONLY)
ADJUSTED VEHICLE TYPE PERCENTAGES

SHEET- 4 OF 5
DATE- 10-23-70
PREPARATOR- S.R.I.A

** SELECT THE APPROPRIATE FACTORS AND PERFORM THE INDICATED CALCULATIONS **

VEHICLE TYPE	CODE	BASIC PERCENT	ALTERNATE ROUTE	SERVICE PROVIDED	DIRECTION	AREA	SEASON		UNADJUSTED PERCENT	ADJUSTMENT FACTOR	ADJUSTED PERCENT
	1		(1.011)	1.028	(0.998)	0.994	0.966				
	2		0.994	(1.029)	1.002	(0.999)	1.005				
	3		1.019	0.999		1.016	1.038				
	4	FROM		1.011		0.984	0.969				
CARS	5	SHEET		0.975							
	6	3		0.856							
	7			1.023							
	8			1.122							
	9			0.881							
		79.118 x	x	x	x	x	0.997	- 0.001 =	82.060	x 1.0117 =	83.020
	1		(0.993)	0.646	(1.052)	0.772	1.185				
	2		1.012	(0.618)	0.913	(1.008)	1.026				
	3		0.903	1.065		1.076	0.808				
	4	FROM		0.946		1.099	1.090				
BUSES	5	SHEET		1.000							
	6	3		0.862							
	7			1.492							
	8			1.059							
	9			0.194							
		0.352 x	x	x	x	x	1.015	- 0.001 =	0.231	x 1.0117 =	0.234
	1		(0.970)	0.926	(0.973)	1.101	0.977				
	2		1.002	(1.058)	1.045	(0.952)	1.013				
	3		1.051	0.955		0.827	0.973				
	4	FROM		1.004		1.236	1.047				
SU-2A-4T	5	SHEET		0.952							
	6	3		1.024							
	7			1.188							
	8			1.059							
	9			0.869							
		3.557 x	x	x	x	x	1.002	- 0.001 =	3.387	x 1.0117 =	3.427
	1		(0.967)	0.431	(0.990)	0.918	1.061				
	2		1.014	(1.003)	1.016	(0.998)	0.966				
	3		0.957	0.953		0.942	0.906				
	4	FROM		1.008		1.172	1.122				
SU-2A-6T	5	SHEET		1.039							
	6	3		1.184							
	7			0.875							
	8			0.707							
	9			0.856							
		2.351 x	x	x	x	x	1.008	- 0.001 =	2.270	x 1.0117 =	2.297
	1		(0.826)	0.338	(0.941)	1.225	1.057				
	2		1.037	(1.195)	1.096	(0.869)	0.989				
	3		1.066	0.950		1.022	0.963				
	4	FROM		0.856		0.916	1.017				
SU-3A	5	SHEET		1.081							
	6	3		5.802							
	7			1.095							
	8			0.405							
	9			0.474							
		0.319 x	x	x	x	x	1.003	- 0.001 =	0.257	x 1.0117 =	0.260
	1		(1.034)	1.508	(1.054)	0.853	1.269				
	2		1.006	(0.770)	0.911	(1.089)	0.942				
	3		0.854	1.143		1.160	0.847				
	4	FROM		0.956		0.824	1.047				
C-3A	5	SHEET		1.118							
	6	3		0.821							
	7			0.551							
	8			0.458							
	9			1.775							
		0.868 x	x	x	x	x	1.012	- 0.001 =	0.802	x 1.0117 =	0.811
	1		(0.965)	0.713	(1.038)	1.109	1.073				
	2		1.004	(0.784)	[illegible]	(1.006)	0.982				
	3		1.050	1.145		1.062	0.962				
	4	FROM		0.952		0.818	1.010				
C-4A	5	SHEET		1.145							
	6	3		0.884							
	7			0.476							
	8			0.507							
	9			5.743							
		2.581 x	x	x	x	x	1.003	- 0.001 =	2.044	x 1.0117 =	2.068
	1		(1.137)	0.893	(0.903)	1.637	0.847				
	2		0.958	(0.560)	1.169	(0.903)	1.108				
	3		1.044	0.995		0.890	1.050				
	4	FROM		0.943		0.748	0.949				
C-5A	5	SHEET		1.065							
	6	3		3.383							
	7			0.421							
	8			1.289							
	9			4.851							
		6.618 x	x	x	x	x	0.996	- 0.001 =	3.421	x 1.0117 =	3.461
A-UT		4.236 x	1.000 x	1.000 x	0.999 x	1.034 x	1.000	- 0.0 =	4.376	x 1.0117 =	4.427

ADJUSTMENT FACTOR = 100 DIVIDED BY THE SUM OF UNADJUSTED PERCENTAGES = 100/98.848 = 1.0117

** TRANSFER ADJUSTED PERCENTAGES TO SHEET 1 IN FORM OF FRACTIONS **

MAY 1968

Without A-UT's

PREDICTION OF DESIGN EALS
(RURAL ONLY)
AASHO UNIT EALS

SHEET- 59 OF 5
DATE- *10-23-70*
PREPARATOR- *51214*

** SELECT THE APPROPRIATE FACTORS AND PERFORM THE INDICATED CALCULATIONS **

VEHICLE TYPE	CODE	ROAD TYPE	DIRECTION	ALTERNATE ROUTE	VOLUME	MAX ALLOW GR WEIGHT	GEOGRAPHICAL AREA	DESIGN UNIT EALS
CARS	NO ADJUSTMENT FOR LOCAL CONDITIONS							0.0002
BUSES	NO ADJUSTMENT FOR LOCAL CONDITIONS							0.4000
	1	-0.0054	0.0067	0.0087	-0.0034	-0.0085	0.0054	
	2	0.0	0.0	-0.0076	0.0011	-0.0110	0.0033	
	3	-0.0004		0.0	0.0048	-0.0105	0.0033	
	4	-0.0004			0.0092	0.0	0.0	
SU-2A-4T	5				0.0			
	6				0.0018			
	7				0.0019			
	8				0.0041			
	9				-0.0024			
	10				-0.0040			
0.0042	+	+	+	+	+	+		= *0.0135*
	1	-0.0684	0.0101	0.0104	-0.0463	-0.0471	-0.0166	
	2	0.0	0.0	-0.0030	0.0130	-0.0622	-0.0036	
	3	0.0164		0.0	0.0300	-0.0160	-0.0075	
	4	0.0164			-0.0212	0.0	0.0	
SU-2A-6T	5				0.0			
	6				0.0120			
	7				0.0150			
	8				0.0399			
	9				0.0457			
	10				0.0500			
0.2053	+	+	+	+	+	+		= *0.1999*
	1	-0.2121	-0.0393	0.3249	-0.0227	-0.6798	-0.0533	
	2	0.0	0.0	0.3647	-0.1591	-0.1176	-0.0718	
	3	0.5827		0.0	0.1238	0.0088	-0.0059	
	4	0.5827			-0.0421	0.0	0.0	
SU-3A	5				0.0			
	6				0.0459			
	7				0.0687			
	8				0.1796			
	9				0.2304			
	10				0.5000			
0.0413	+	+	+	+	+	+		= *0.6089*
	1	-0.1476	0.0897	0.1549	0.3328	0.1924	-0.0910	
	2	0.0	0.0	0.1076	0.1140	0.0792	0.0392	
	3	-0.1686		0.0	-0.0527	0.0184	0.0949	
	4	-0.1686			-0.0137	0.0	0.0	
C-3A	5				0.0			
	6				0.0181			
	7				0.0495			
	8				0.0985			
	9				-0.0195			
	10				-0.1000			
0.3093	+	+	+	+	+	+		= *0.4031*
	1	-0.2805	0.1343	0.2687	-0.2546	-0.6893	0.2714	
	2	0.0	0.0	0.2251	0.2150	-0.5778	0.1642	
	3	0.3662		0.0	0.0238	-0.0647	0.1214	
	4	0.3662			0.0524	0.0	0.0	
C-4A	5				0.0			
	6				0.0347			
	7				0.0665			
	8				0.1726			
	9				0.1161			
	10				0.0500			
0.4607	+	+	+	+	+	+		= *0.7546*
	1	-0.2848	0.2440	0.5151	0.0	-0.1902	0.1855	
	2	0.0	0.0	0.3841	0.0219	-0.3416	0.2141	
	3	0.0649		0.0	0.0824	-0.6093	0.0771	
	4	0.0649			0.2334	0.0	0.0	
C-5A	5				-0.1448			
	6				-0.0087			
	7				0.0			
	8				0.2307			
	9				0.2305			
	10				0.3000			
0.2395	+	+	+	+	+	+		= *1.0909*

** TRANSFER DESIGN UNIT EALS TO SHEET 1. A NEGATIVE ESTIMATE SHOULD BE TRANSFERRED AS ZERO **

MAY 1968

With A-UT's

PREDICTION OF DESIGN EALS
(RURAL ONLY)
AASHO UNIT EALS

SHEET- 58 OF 5
DATE- *10-23-70*
PREPARATOR- *SIRIA*

** SELECT THE APPROPRIATE FACTORS AND PERFORM THE INDICATED CALCULATIONS **

VEHICLE TYPE	CODE	ROAD TYPE	DIRECTION	ALTERNATE ROUTE	VOLUME	MAX ALLOW GR WEIGHT	GEOGRAPHICAL AREA	DESIGN UNIT EALS
CARS	NO ADJUSTMENT FOR LOCAL CONDITIONS							0.0002
BUSES	NO ADJUSTMENT FOR LOCAL CONDITIONS							0.4000
	1	-0.0054	0.0067	0.0087	-0.0034	-0.0085	0.0054	
	2	0.0	0.0	-0.0076	0.0011	-0.0110	[illegible]	
	3	-0.0004		0.0	0.0048	-0.0105	0.0033	
	4	-0.0004			0.0092	0.0	0.0	
SU-2A-4T	5				0.0			
	6				0.0018			
	7				0.0019			
	8				0.0041			
	9				[illegible]			
	10				-0.0040			
0.0042 +		+	+	+	+	+		= *0.0135*
	1	-0.0684	0.0101	0.0104	-0.0463	-0.0471	-0.0166	
	2	0.0	0.0	-0.0030	0.0130	-0.0622	[illegible]	
	3	0.0164		0.0	0.0300	-0.0160	-0.0075	
	4	0.0164			-0.0212	0.0	[illegible]	
SU-2A-6T	5				0.0			
	6				0.0120			
	7				0.0150			
	8				0.0399			
	9				0.0457			
	10				0.0500			
0.2053 +		+	+	+	+	+		= *0.1999*
	1	-0.2121	-0.0393	0.3249	-0.0227	-0.6798	-0.0533	
	2	0.0	0.0	[illegible]	-0.1991	-0.1176	-0.0718	
	3	0.5827		0.0	0.1238	0.0088	-0.0059	
	4	0.5827			-0.0421	0.0	0.0	
SU-3A	5				0.0			
	6				0.0459			
	7				0.0687			
	8				0.1796			
	9				[illegible]			
	10				0.5000			
0.0413 +		+	+	+	+	+		= *0.6089*
	1	-0.1476	0.0897	0.1545	0.3328	0.1924	-0.0810	
	2	0.0	0.0	0.1676	0.1140	0.0792	[illegible]	
	3	-0.1686		0.0	-0.0527	0.0184	0.0948	
	4	-0.1686			-0.0137	0.0	0.0	
C-3A	5				0.0			
	6				0.0181			
	7				0.0495			
	8				0.0895			
	9				-0.0195			
	10				-0.1000			
0.3093 +		+	+	+	+	+		= *0.4031*
	1	-0.2805	0.1343	0.2687	-0.2546	-0.6893	0.2214	
	2	0.0	0.0	0.2251	0.2150	-0.5778	0.1642	
	3	0.3662		0.0	0.0238	-0.0647	0.1214	
	4	0.3662			0.0924	0.0	0.0	
C-4A	5				0.0			
	6				0.0347			
	7				0.0665			
	8				0.1726			
	9				0.1161			
	10				0.0500			
0.4607 +		+	+	+	+	+		= *0.7546*
	1	-0.2848	0.2440	0.5151	0.0	-0.1902	0.1855	
	2	0.0	0.0	0.3840	0.0219	-0.3416	[illegible]	
	3	0.0649		0.0	0.0824	-0.4093	0.0771	
	4	0.0649			0.2334	0.0	0.0	
C-5A	5				-0.1448			
	6				-0.0087			
	7				0.0			
	8				0.2307			
	9				0.2705			
	10				0.3000			
0.2395 +		+	+	+	+	+		= *1.0909*
	1	0.0	-0.0001	0.0				
	2		-0.0019			0.0033		
	3					-0.0011		
	4				0.0			
A-UT	5							
	6							
	7							
	8			-0.0019				
	9			0.0033				
	10			-0.0008				
0.0946 +		+	+	+	+	+		= *0.0926*

** TRANSFER DESIGN UNIT EALS TO SHEET 1. A NEGATIVE ESTIMATE SHOULD BE TRANSFERRED AS ZERO **

APPENDIX F

EXAMPLE OF A-UT VOLUME PROJECTION

EXAMPLE OF A-UT VOLUME PROJECTION

The purpose of the calculations in this appendix is to expand the number of A-UT combinations observed in a 12-hour count to the number of A-UT vehicles in the traffic stream in a two-year period. The expanded value can then be used in conjunction with accident statistics. The general form of the calculation is

Two-Year Total = 2A/.2308 BCD

where A = number of A-UT's observed in 12-hour count,

B = portion of daily A-UT traffic occurring during period of traffic count,

C = portion of weekly A-UT traffic occurring during day of traffic count,

D = portion of yearly A-UT traffic occurring during month of traffic count, and

.2308 = portion of monthly A-UT traffic occurring during month of traffic count.

EXAMPLE: 12-hour count 8 am to 8 pm, Friday, June 23
Number of A-UT vehicles counted = 247.

From Table 21, B = .7731, C = .1507, and D = .1439

Two-Year Total = (2 x 247)/.2308 x .7731 x .1507 x .1439 = 127,668