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May 16, 1975

MEMO TO: J. R. Harbison
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Chairman, Research Committee

SUBJECT: Research Report No. 428; "First-Year Effects of the Energy Crisis on Traffic in Kentucky (Rural Highways);" KYP-72-32; HPR-PL-1(10), Part III.

Report No. 404 (October 1974) had the same basic title as the one submitted herewith. This report includes observations extending into the latter part of April of this year and, in effect, supplants the previous report.

Respectfully submitted,

Jas. H. Havens
Director of Research

JHH:gd
Attachment
cc's: Research Committee

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16. Abstract

The Arab oil embargo in mid-October 1973 curtailed availability of gasoline. Fuel conservation measures resulted in reduced travel and decreased traffic speeds. On March 1, 1974, posted speed was set at 55 mph (24.6 m/s) on rural highways in Kentucky. Traffic volumes, speeds, and accidents for the rural highway during the period known as the "energy crisis" and its after effects were compared to the corresponding period a year earlier.

Traffic volumes began to decline in December 1973 and continued through September 1974. Total travel in the 12 months through November 1974 decreased by 2.3 percent; traffic increased by five percent in 1973. Accident rates during this period decreased by 13.5 percent; and the largest decreases were associated with the highways experiencing the greatest reductions in travel speed. The relationship between traffic speed and accident rate showed a great decrease in accident rate as traffic speeds decreased. Differences between wet-surface and dry-surface accident rates were especially significant and were more so for interstate than for two-lane highways. Improved wet-pavement skid resistance at the lower speeds obviously contributed to a reduction in accident rates. Continuation of the 55-mph (24.6 m/s) speed limit on all rural highways would seem advisable.

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Research Report
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FIRST-YEAR EFFECTS OF THE ENERGY CRISIS ON TRAFFIC IN KENTUCKY (Rural Highways)

KYP-72-32, HPR-PL-1(10), Part III

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Commonwealth of Kentucky

May 1975

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by

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EXECUTIVE SUMMARY

The "energy crisis" became a reality to motorists during the latter months of 1973. Several major events that were factors during this period are listed in chronological order:

1. Mid-October 1973 - Arab oil embargo began
2. November 7, 1973 - President's energy message
3. December 1, 1973 - gasoline allocation
4. December 1973 - Sunday gas station closing
5. February 1974 - truckers' strike
6. March 1, 1974 - 55-mph speed limit
7. Mid-March 1974 - Arab oil embargo ended

The gasoline shortage became critical after the oil embargo began. The President urged the nation to voluntarily limit travel and to lower driving speeds. Mandatory gasoline allocation to service stations was initiated. With December came "gasless Sundays". Most service stations were closed from 9 p.m. Saturday until Monday morning. The truckers' strike further intensified gasoline shortages. Kentucky speed limits were reduced to 55 mph on March 1. Gasoline again became plentiful upon lifting of the oil embargo, but at a much higher price.

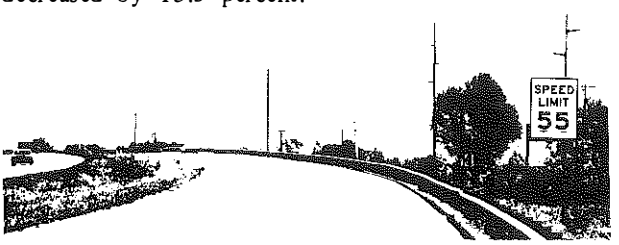
Traffic volumes, speeds, and accidents for the rural highway system (approximately 23,000 miles of roads) in Kentucky were studied. Monthly volumes and accidents, during the period characterized as the "energy crisis" and its after effects, were compared to the data of the corresponding months in the preceding year. The method best illustrated changes occurring during otherwise comparable periods of time.

Traffic volumes first showed a decrease in December 1973 and has continued through September 1974 -- reaching approximately a six-percent reduction in March 1974. In October and November 1974, traffic volumes increased compared to the previous year. The effect of the energy crisis on traffic volumes appears to have diminished to a large extent. Total travel on rural highways in 12 months (December 1973 through November 1974) decreased by 2.3 percent and must be viewed as highly significant in light of the five-percent increase during 1973. Interstates had the largest decreases in traffic (six percent).

Imposition of the 55-mph speed limit placed a definite restraint on traffic speed. Even before then, appeals for conservation started a trend toward reduced speeds. In June 1973, the median speed on interstate highways (previously posted 70 mph) was 69.1 mph for automobiles and 62.0 mph for trucks. Some speed reductions occurred as early as November 1973. In March 1974, after the speed limit was changed, automobile speeds reduced by 14.2 mph and truck speeds reduced 8.5 mph compared with June 1973. By April 1975, automobiles were being operated 11.0 mph and trucks 7.0 mph slower than in June 1973. In April 1975, however, it was discovered that truck drivers were relaying messages by radio to other drivers that speeds were being monitored. Therefore, an additional set of speed measurements were obtained from a completely concealed site. The data indicated that trucks were actually traveling 4.0 mph faster. Speeds on four-lane divided (no access control) highways dropped when the 55-mph limit went into effect but now have risen to the 1972 levels. On two-lane highways, previously posted 60 mph for daytime and 50 mph for nighttime, speeds have increased since the reduction which occurred immediately after the imposition of the 55-mph speed limit.

The decreases in traffic speed have been accompanied by greater uniformity in driving speeds. A larger percentage of vehicles were found to be operating within the 10-mph pace, particularly on interstate highways, as compared to the before time.

As shown in Figure S1, the decrease in traffic volume corresponds to a reduced accident rate. Volumes decreased in 1974, reaching a low in February and March and rising in April and May; the accident rate reached a low in April. The greatest decrease in accident rate occurred in March 1974 while the volume was fairly steady. Also, volumes increased in October and November 1974 over the previous year, but the accident rate remained lower. The large accident rate decrease, therefore, corresponded with lowering the speed limit to 55 mph on March 1, 1974. Total travel during the 12 months (December 1973 through November 1974) decreased by 2.3 percent while the accident rate decreased by 13.5 percent.



All major highway types experienced a decrease in accident rates for almost every month in 1974. January 1974 was an exception for the multilane facilities because of the unusually severe weather (snow and ice conditions). Interstate and four-lane divided (no access control) highways had the largest drop in accident rates. A summary of accident experience for various highways is presented in Table S1. Fatality and injury rates decreased more than the accident rate (total rural highway system). The most dramatic impact, of course, must be the 277 lives saved between December 1973 and November 1974 (number of fatalities in this period less the number in the same period a year earlier).

The relationship between traffic speed and accident rate for interstate highways is shown in Figure S2 and for two-lane highways in Figure S3. Very limited data points were available in preparing the plots. The plots do, however, illustrate a great decrease in accident rates as traffic speed decreases. The difference between wet-surface and dry-surface accident rates is significant but is more so on interstate highways than on two-lane highways. Improved wet-pavement skid resistance (traction) at the lower speeds obviously contributed to a reduction in accident rates. Decreased speed, therefore, has a greater effect upon accident rates during wet-surface than during dry-surface conditions.

Although traffic volume and other contributing factors may account for some of the decrease in accident rates since the beginning of the energy crisis, lower traffic speed certainly stands out as the single, most important reason why accident, fatality, and injury rates decreased.

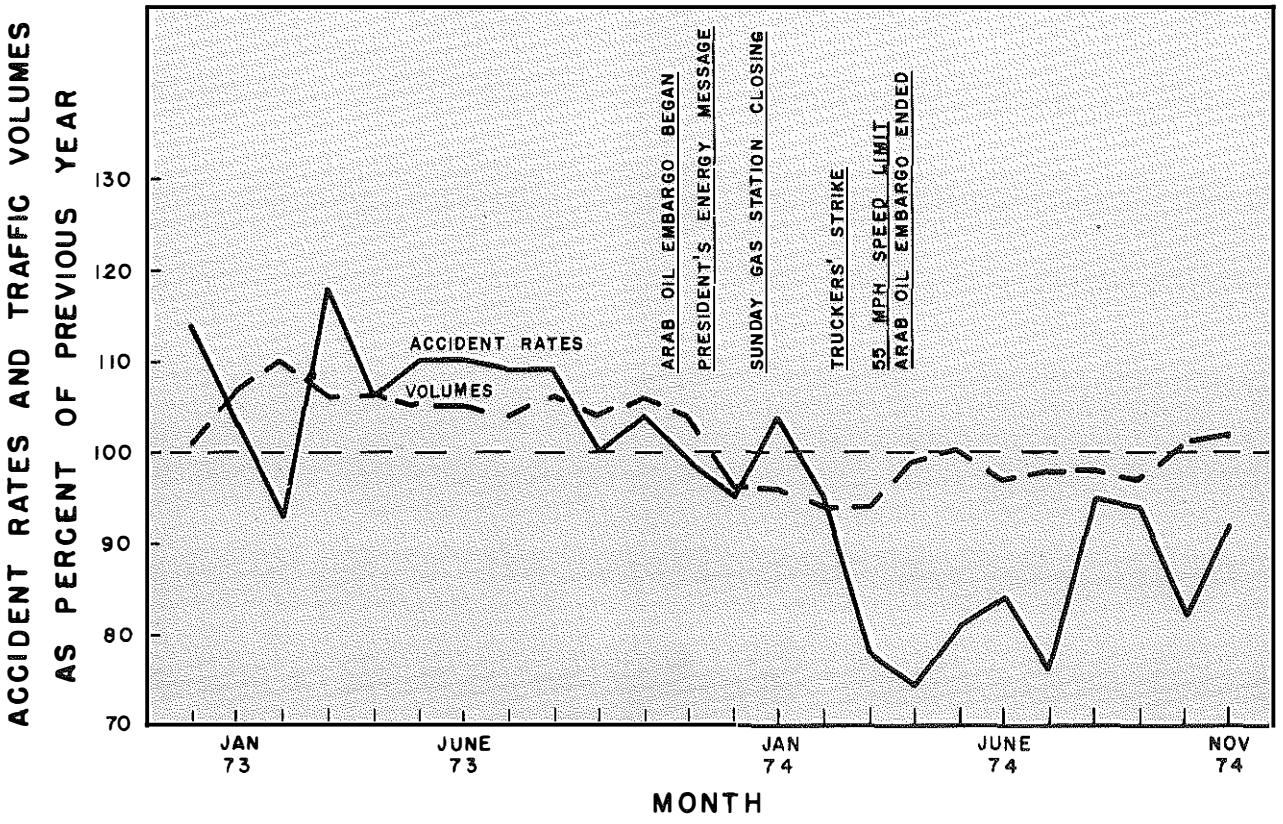


Figure S-1. Comparison of Monthly Accident Rates and Volumes to Corresponding Month in Preceding Year (Total Rural Highway System).

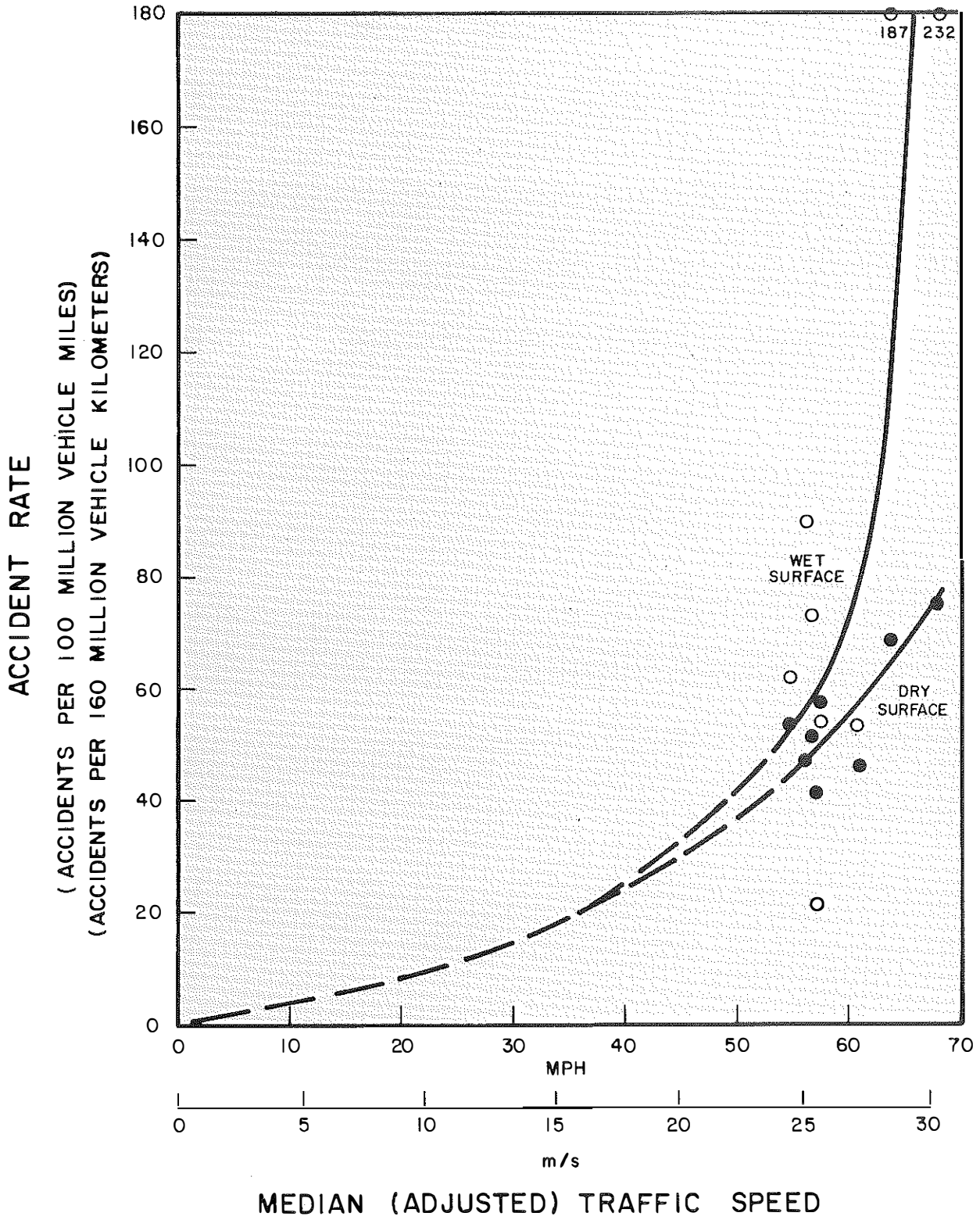


Figure S-2. Relationship between Median Traffic Speed (Adjusted between Automobiles and Trucks) and Accident Rate (Interstate Highways).

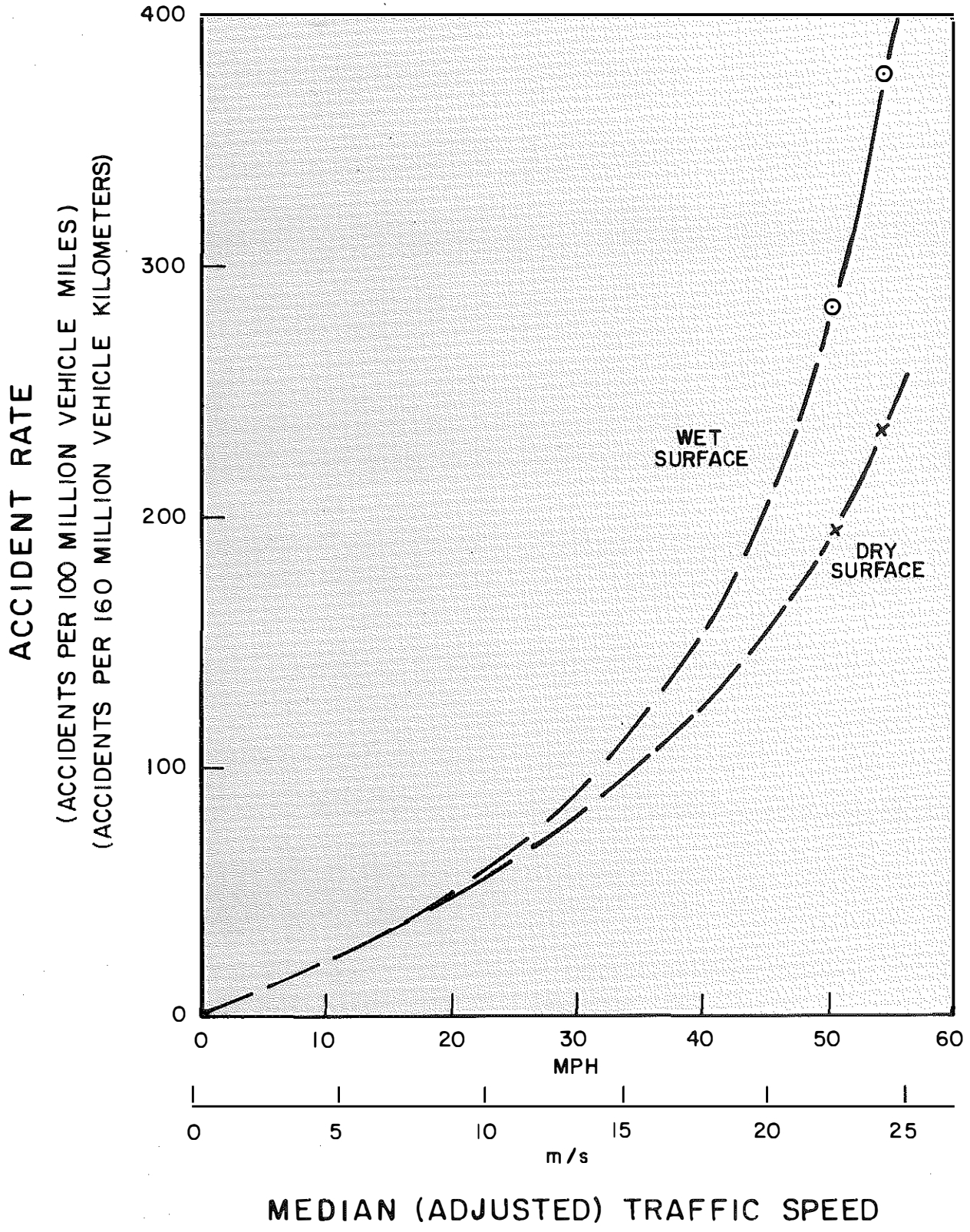


Figure S-3. Relationship between Median Traffic Speed (Adjusted between Automobiles and Trucks) and Accident Rate (Two-Lane Highways).

TABLE S-1 SUMMARY OF ACCIDENT DATA FOR VARIOUS HIGHWAY TYPES

TYPE OF HIGHWAY	PERIOD[a]	ACCIDENTS			FATALITIES			INJURIES			SEVERITY INDEX
		NUMBER	RATE[b]	RATE DECREASE (percent)	NUMBER	RATE[b]	RATE DECREASE (percent)	NUMBER	RATE[b]	RATE DECREASE (percent)	
Two-Lane	1973	23,276	259		715	8.0		15,132	169		2.78
	1974	20,209	228	12.0	486	5.5	31.2	12,256	138	18.3	2.66
Four-Lane Divided	1973	1,054	160		17	2.6		650	98		2.50
(No Access Control)	1974	815	126	21.2	21	3.2	23.1[d]	506	78	20.4	2.51
Interstate	1973	2,078	92		65	2.9		1,456	64		2.64
	1974	1,395	65	29.3	41	1.9	34.5	865	41	35.9	2.65
Parkway	1973	369	64		21	3.6		268	46		3.21
	1974	288	52	18.8	4	0.7	80.6	167	30	34.8	2.70
Total System[c]	1973	27,183	215		832	6.6		17,768	140		2.77
	1974	23,043	186	13.5	555	4.5	31.8	14,016	113	19.3	2.65

[a]1973 - Dec 1972 through Nov 1973
1974 - Dec 1973 through Nov 1974

[b]Accidents per 100 million vehicle miles (161 million vehicle kilometers)

[c]Also includes three-lane and four-lane undivided (no access control) highways

[d]Increase

INTRODUCTION

The "energy crisis" became a reality to motorists during the latter months of 1973. Theretofore, the public ignored warnings of fossil fuel shortages. Events, however, demonstrated the seriousness of the problem. Gasoline availability became critical. Voluntary (later mandatory) adherence to lower speed limits reduced traffic speed. Traffic volumes decreased. The public's rush to purchase smaller cars exhausted inventories. Driving habits and lifestyles changed. Speculation concerning effects upon accident experience abounded in the press and in the professional community. Clearly significant and perhaps lasting changes in highway transporation were being shaped.

The gasoline shortage became critical soon after the Arab oil embargo began. The Arab oil-producing nations began withholding oil from the United States in mid-October 1973. The President delivered an important energy message to the nation November 7, 1973. He discussed the criticalness of the situation and requested voluntary energy conservation measures such as reducing travel and lowering travel speeds. Gasoline allocation to service stations was initiated. With December 1973 came "gasless Sundays". Most service stations were closed from 9 p.m. Saturday until Monday morning. The truckers' strike in February 1974 intensified the awareness of the gasoline shortage. On March 1, 1974, Kentucky's speed limits were reduced to 55 mph (24.6 m/s). The oil embargo ended in mid-March. Gasoline again became plentiful but at a much higher price.

This report presents data and analysis of traffic volumes, speeds, and accidents on rural highways in Kentucky as affected by the energy crisis.

PROCEDURE

Accident and traffic volume data were collected for each month between December 1971 and November 1974. The accident data were obtained from computer tapes containing all state police reported accidents for rural areas. Therefore, only rural accidents (including cities with less than 2500 population) were considered. Jefferson, Fayette, Campbell, Kenton, and Boone Counties were excluded inasmuch as local police investigate most accidents within those counties.

The report deals with the total rural system as well as the various highway types comprising the total system. The highway system was divided into the following highway types:

(1) two-lane,
(2) three-lane,
(3) four-lane, undivided,
(4) four-lane, divided (no access control),
(5) interstate, and
(6) parkway (toll road).

Volume data for each month were obtained from the automatic traffic recording (ATR) stations located throughout the state. Volumes were converted into vehicle miles (kilometers) of travel for each type of highway. The total vehicle miles (kilometers) of travel for 1972 *(1)* was used as the base or reference. Data from the ATR stations were summarized by month. The percentage of the total traffic counted in 1972 was calculated for each month. The total vehicle miles (kilometers) of travel on a particular highway type from 1972 was then multiplied by the adjustment factor for each month to obtain the monthly volumes. These volumes were also adjusted for new highway openings. There were 29 ATR stations on two-lane highways but none on three-lane highways. The factors obtained for the two-lane highways were used for three-lane highways. There was only one usable ATR station for rural, four-lane highways. The factors obtained from this station were used for both four-lane divided and undivided highways. Five ATR stations were located on rural interstate highways. The monthly factors for parkways were obtained from monthly counts of total traffic on the toll road system made available by the Kentucky Toll Road Authority. Annual growth factors from 1971 to 1972, from 1972 to 1973, and from 1973 to 1974 were then calculated for each month and used to find the monthly traffic volumes in 1971, 1973, and 1974. Volumes from the ATR stations were used in the analysis of traffic volumes. Inasmuch as sections of new highways were added during the study period, vehicle miles (kilometers) of travel used for rate calculations reflect changing lengths of roads. The total vehicle miles (kilometers) of travel for a given type of roadway, therefore, may not be directly comparable from one year to the next.

From the accident and volume data, monthly accident rates (accidents per 100 million vehicle miles) (accidents per 160 million vehicle kilometers) were calculated for each highway type.

Severity of the accidents was studied. The number of fatalities and injuries for each month were obtained. The monthly severity index *(2)* was calculated.

Traffic speed data were obtained at two interstate

(I 65 in Hardin County and I 75 in Scott County) locations, one four-lane highway location, and two two-lane highway sites before and after initiation of the 55-mph (24.6-m/s) speed limit. The average, median, and 85th percentile speeds and speed distributions were determined as well as the 10-mph (4.6-m/s) pace and the percentage of vehicles in the 10-mph (4.6-m/s) pace. The pace is the increment of speed including the greatest number of vehicles.

Safety belt usage was also determined. The percentage of vehicle occupants involved in accidents who were using safety belts was obtained as well as the number of occupants riding in vehicles not equipped with safety belts.

RESULTS

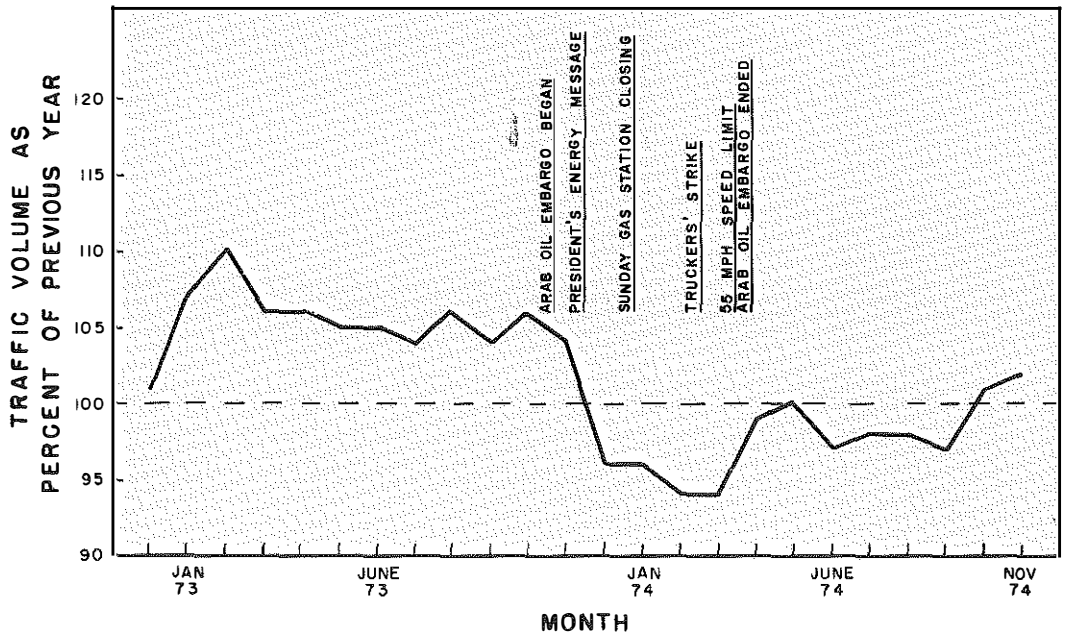
The findings presented here pertain to the total rural highway system (approximately 23,000 miles (37,000 kilometers) of roads) and its major components in Kentucky. Detailed accident and volume data may be found in the APPENDIX. Monthly data of 1 year were compared to the data of the corresponding month in the preceding year. This method best illustrated changes occurring during otherwise comparable periods of time. Three-lane and four-lane undivided highways, however, will not be discussed here because of their limited mileage.

Traffic Volume

An evident effect of the energy crisis has been the reduction in traffic volume. Monthly volumes for the total rural system are compared in Figure 1. December 1973 was the first month in which volume dropped below the corresponding month of the previous year. In the past, volumes increased by about five percent annually as exhibited by the months preceding December 1973. The decrease in traffic volume beyond December 1973 continued through September 1974 -- reaching a maximum in March 1974. In October and November 1974, traffic volumes increased compared to the previous year. The effect of the energy crisis on traffic volumes appeared to have lessened. For a 12-month period (December 1973 through November 1974), the total vehicle miles (kilometers) driven decreased by 2.3 percent compared to the same period a year earlier. The decrease was surely significant in light of a five percent increase experienced theretofore.

Major events surrounding the energy crisis are also shown in Figure 1. The traffic volumes began dropping shortly after the start of the oil embargo in October 1973 and continued to drop until the end of the oil embargo in March 1974. Reduction in traffic volumes gradually lessened. By October and November 1974, volumes exceeded those of the same months of the previous year.

Figure 1. Comparison of Monthly Volumes to Corresponding Month in Preceding Year (Total Rural Highway System).



Trends in volume changes for the various highway types were similar (Figure 2). In all cases, December 1973 was the first month which showed a large decrease compared with the preceeding year. The maximum reductions occurred in February and March 1974. Interstate highways and parkways showed the largest reduction in volume. This would be expected because minimizing long distance travel by the public would be considered foremost. The increase in parkway volume in 1973 was partially due to the opening of a new parkway in December 1972. The volume on the parkway, however, was minimal compared to the whole highway system. Two-lane and four-lane divided (no access control) highways had a smaller decrease in volume due to the local traffic on these types of highways. The decrease in volumes for the 12-month period (December 1973 through November 1974) compared to the same period a year earlier are given in Table 1. There was a large reduction in interstate and parkway volumes compared with two-lane and four-lane divided (no access control) highways. Data in this table includes some new sections of highways opened during the study period.

Speed

Imposition of the 55-mph (24.6-m/s) speed limit placed a definite constraint on traffic speed. Even before then, conservation efforts by the highway user resulted in reduced travel speeds. Table 2 summarizes the average, median, and 85th percentile automobile and truck speeds on interstate highways. In June 1973, the median speed was 69.1 mph (30.9 m/s) for cars and 62.0 mph (27.7 m/s) for trucks. Some speed reduction occurred by November and again in February for all vehicles. In March 1974, after the speed limit was changed, median speeds reduced by 14.2 mph (6.3 m/s) for cars and 8.5 mph (3.8 m/s) for trucks compared with June 1973. There were slight increases in car and truck speeds since the initiation of the lower speed limit. A comparison of April 1975 speeds with March 1974 speeds shows that the median speed has increased by 3.2 mph (1.4 m/s) for cars and 1.5 mph (0.7 m/s) for trucks. However, the 85th percentile speed has remained around 60 mph (26.8 m/s) for both cars and trucks.

Figure 2. Comparison of Monthly Volumes to Corresponding Month in Preceding Year (Various Highway Types).

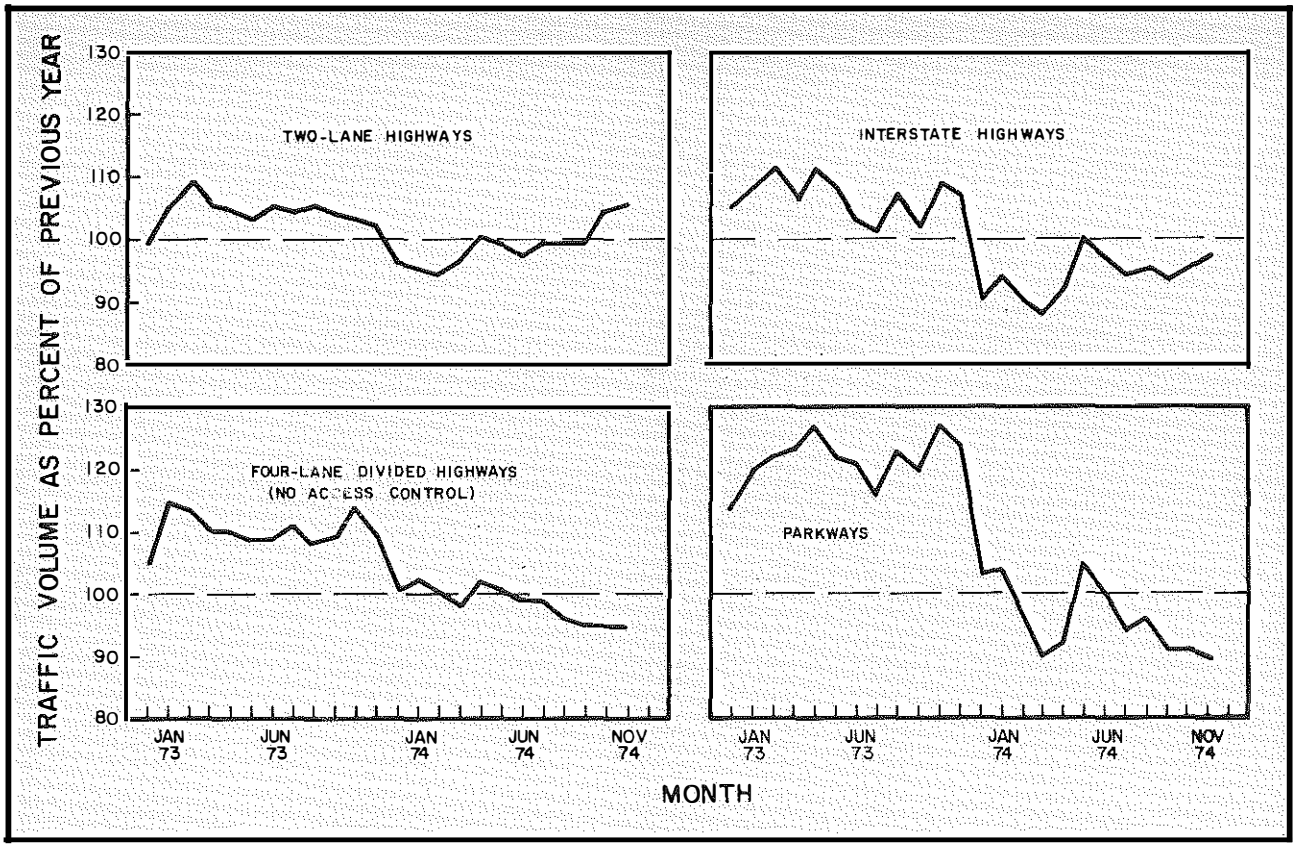


TABLE 1. SUMMARY OF VOLUME DATA FOR VARIOUS HIGHWAY TYPES

TYPE OF HIGHWAY	PERIOD[a]	VOLUME (MVM)[b]	VOLUME DECREASE (percent)
Two-Lane	1973	8979	
	1974	8864	1.3
Four-Lane Divided	1973	659.9	
(No Access Control)	1974	649.4	1.6
Interstate	1973	2267	
	1974	2131	6.0
Parkway	1973	579.0	
	1974	555.0	4.1
Four-Lane Undivided	1973	113.6	
	1974	109.6	3.5
Three-Lane	1973	52.1	
	1974	51.6	0.8
Total System	1973	12650	
	1974	12361	2.3

[a]1973 - Dec 1972 through Nov 1973
1974 - Dec 1973 through Nov 1974

[b]Million vehicle miles (1.61 million vehicle kilometers)

TABLE 2. AVERAGE, MEDIAN, AND 85th PERCENTILE SPEEDS FOR INTERSTATE HIGHWAYS (COMBINED HARDIN AND SCOTT COUNTY LOCATIONS)

MONTH	AUTOMOBILES						TRUCKS					
	AVERAGE		MEDIAN		85th PERCENTILE		AVERAGE		MEDIAN		85th PERCENTILE	
	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)
Jun 1973	68.4	30.6	69.1	30.9	75.4	33.7	62.6	28.0	62.0	27.7	67.6	30.2
Nov 1973	64.3	28.7	64.4	28.8	69.5	31.1	60.7	27.1	60.7	27.1	65.2	29.1
Feb 1974	62.5	27.9	61.3	27.4	67.4	30.1	59.9	26.8	58.8	26.3	64.3	28.7
Mar 1974	55.9	25.0	54.9	24.5	59.1	26.4	53.8	24.0	53.5	23.9	57.1	25.5
May 1974	59.0	26.4	57.8	25.8	62.8	28.1	57.4	25.7	56.2	25.1	60.3	27.0
Jul 1974	58.8	26.3	57.2	25.6	61.8	27.6	59.1	26.4	57.5	25.7	62.6	28.0
Sep 1974	58.1	26.0	56.9	25.4	61.8	27.6	54.2	24.2	53.7	24.0	57.7	25.8
Nov 1974	56.9	25.4	55.9	25.0	60.3	27.0	56.3	25.2	55.4	24.8	59.1	26.4
Dec 1974	55.9	25.0	54.5	24.4	59.8	26.7	56.5	25.3	55.4	24.8	59.6	26.6
Jan 1975	56.2	25.1	54.9	24.5	58.8	26.3	54.7	24.5	53.7	24.0	56.5	25.3
Feb 1975	55.2	24.7	54.2	24.2	58.9	26.3	52.9	23.6	52.1	23.3	55.6	24.9
Mar 1975	57.9	25.9	57.3	25.6	62.2	27.8	54.8	24.5	54.6	24.4	58.5	26.1
Apr 1975	59.6	26.6	58.1	26.0	64.0	28.6	55.9	25.0	55.0	24.6	59.5	26.6

An important aspect of traffic speed is uniformity. An index to uniformity is the 10-mph (4.5-m/s) pace which indicates the 10-mph (4.5-m/s) speed range in which the greatest percentage of vehicles operate. Data in Table 3 show that the percentage of vehicles on interstate routes in the pace increased as traffic speed diminished. This increased percentage means that the average variance in speeds between vehicles has decreased. This may contribute to a reduction in accidents *(3)*.

Speed data were collected with a radar meter installed in a marked state car. Care was exercised to collect data at locations where the oncoming traffic would not be aware of the speed measurement. But the radar gun could be sighted once vehicles were alongside the car. A problem in obtaining representative truck speeds was discovered. The first few trucks registered higher speeds than subsequently approaching trucks. Communication between truck drivers was suspected. A CB radio was taken to a test location during April 1975 data collection to monitor conversations between truck drivers. It was learned that the radar gun had been spotted and messages that speeds were being checked relayed to other drivers by radio. It was felt that this was the major reason for the lower speeds of trucks compared to automobiles.

To determine by how much speed data were being affected, a set of data was collected with the radar unit outside of the car. The radar gun was sufficiently hidden to prevent detection. This was confirmed by monitoring conversations between drivers. A summary of the data is presented in Table 4 along with the earlier April 1975 data. Automobile speeds increased by approximately 1 mph (0.4 m/s) when the radar gun was concealed. Truck speeds, however, were about 4 mph (1.8 m/s) higher. This increase brought trucks speeds almost equal to automobile speeds. The speed range in the pace was the same for automobiles and trucks.

Average driving speeds and 10-mph (4.5-m/s) paces for four-lane divided (no access control) and two-lane highways are summarized in Tables 5 and 6, respectively, which include data for before and after the speed limit reduction. On four-lane divided (no access control) highways, there was a decrease in both automobile and truck speeds. By April 1975, however, speeds have increased to the same level as before the speed limit reduction. Although speeds have increased, the percentage of vehicles in the 10 mph (4.5 m/s) pace have continued to increase. At the two-lane site, automobile speeds were still below the 1972 level in April 1975. Truck speeds had not changed. Since the speed data for two-lane highways represent a single location, it would not be entirely representative of all two-lane locations. An additional site was selected in a very isolated location. Summary of speed data collected there from January through April 1975 is also given in Table 6. Speeds at this site, especially truck speeds, were higher than at the other two-lane location.

TABLE 3. 10-MPH (4.5-M/S) PACE FOR INTERSTATE HIGHWAYS (COMBINED HARDIN AND SCOTT COUNTY LOCATIONS)

MONTH	AUTOMOBILES			TRUCKS		
		RANGE			RANGE	
	(percent)	(mph)	(m/s)	(percent)	(mph)	(m/s)
Jun 1973	50	64 - 73	28.6 - 32.6	68	59 - 68	26.4 - 30.4
Nov 1973	64	61 - 70	27.3 - 31.3	70	57 - 66	25.5 - 29.5
Feb 1974	64	57 - 66	25.5 - 29.5	66	55 - 64	24.6 - 28.6
Mar 1974	79	51 - 60	22.8 - 26.8	76	49 - 58	21.9 - 25.9
May 1974	74	55 - 64	24.6 - 28.6	79	53 - 62	23.7 - 27.7
Jul 1974	82	53 - 62	23.7 - 27.7	79	53 - 62	23.7 - 27.7
Sep 1974	75	53 - 62	23.7 - 27.7	74	49 - 58	21.9 - 25.9
Nov 1974	72	51 - 60	22.8 - 26.8	82	51 - 60	22.8 - 26.8
Dec 1974	73	51 - 60	22.8 - 26.8	79	51 - 60	22.8 - 26.8
Jan 1975	83	51 - 60	22.8 - 26.8	95	49 - 58	21.9 - 25.9
Feb 1975	73	49 - 58	21.9 - 25.9	84	47 - 56	21.0 - 25.0
Mar 1975	71	53 - 62	23.7 - 27.7	75	49 - 58	21.9 - 25.9
Apr 1975	69	55 - 64	24.6 - 28.6	72	51 - 60	22.8 - 26.8

TABLE 7. SUMMARY OF ACCIDENT DATA FOR VARIOUS PAVEMENT SURFACE CONDITIONS

TYPE OF HIGHWAY	PERIOD[a]	ALL ACCIDENTS			DRY-SURFACE ACCIDENTS			WET-SURFACE ACCIDENTS			SNOW OR ICE ACCIDENTS		
		NUMBER[b]	RATE[c]	RATE DECREASE (percent)	NUMBER	RATE[c]	RATE DECREASE (percent)	NUMBER	RATE[c]	RATE DECREASE (percent)	NUMBER	RATE[c]	RATE DECREASE (percent)
Two-Lane	1973	23,197	258		17,138	229		5,468	414		591	313	
	1974	20,106	227	12.0	14,805	202	11.8	4,370	371	10.4	931	250	20.1
Four-Lane Divided (No Access Control)	1973	1,051	159		736	134		271	279		44	317	
	1974	809	125	21.4	585	109	18.7	175	203	27.2	49	179	43.5
Interstate	1973	2,082	92		1,361	72		554	166		167	348	
	1974	1,390	65	29.3	908	52	27.8	211	74	55.4	271	301	13.5
Parkway	1973	373	64		260	54		82	96		31	254	
	1974	288	52	18.8	196	43	20.4	41	56	41.7	51	219	13.8
Total System (for above types)	1973	26,703	214		19,495	185		6,375	343		833	318	
	1974	22,593	185	13.6	16,494	164	11.4	4,797	296	13.7	1,302	254	20.1

[a]1973 - Dec 1972 through Nov 1973
1974 - Dec 1973 through Nov 1974

[b]Does not include accidents where surface condition was not stated

[c]Accidents per 100 million vehicle miles (161 million vehicle kilometers)

Speed distribution curves for automobiles and trucks are presented in Figure 3 through Figure 8. Before the concern for gas conservation materialized (June 1973), 40 percent of the automobiles on the interstate roads traveled above the 70-mph (31.3-m/s) posted speed. Approximately two years later (April 1975 (revised data)), 85 percent exceeded the posted speed of 55 mph (24.6 m/s). These percentages drop to 16 percent (June 1973) and 45 percent (April 1975) when a 5-mph (2.2-m/s) tolerance above posted speed was considered. On two-lane roads, the previous 60-mph (26.9-m/s) posted speed (daytime) was exceeded by 19 percent of the automobiles; the percentage remained about the same after the speed limit was changed to 55 mph (24.6 m/s). At the new site, 33 percent of the automobiles exceeded 55 mph (24.6 m/s). On four-lane divided (no access control) highways, the earlier 60-mph (26.9-m/s) limit was exceeded by 28 percent of the automobiles. In April 1975, 68 percent of the automobiles exceeded the 55-mph (24.6-m/s) limit.

Before the reduction of posted speed from 70 mph (31.3 m/s) to 55 mph (24.6 m/s) on interstate roads, six percent of the trucks exceeded the speed limit and one percent exceeded 75 mph (33.6 m/s) (June 1973). After the reduction, 85 percent exceeded the speed limit and 38 percent surpassed 60 mph (26.9 m/s) (April 1975 (revised data)) -- these percentages after the speed reduction are similar to those for automobiles. On two-lane highways, the truck speed limit was raised from 50 mph (22.4 m/s) to 55 mph (24.6 m/s). The increased speed limit has reduced the 32 percent of trucks traveling above 50 mph (22.4 m/s) (before) to near zero at 55 mph (24.6. m/s) (original site). At the additional site, 21 percent of the trucks exceeded 55 mph (24.6 m/s).

Accidents

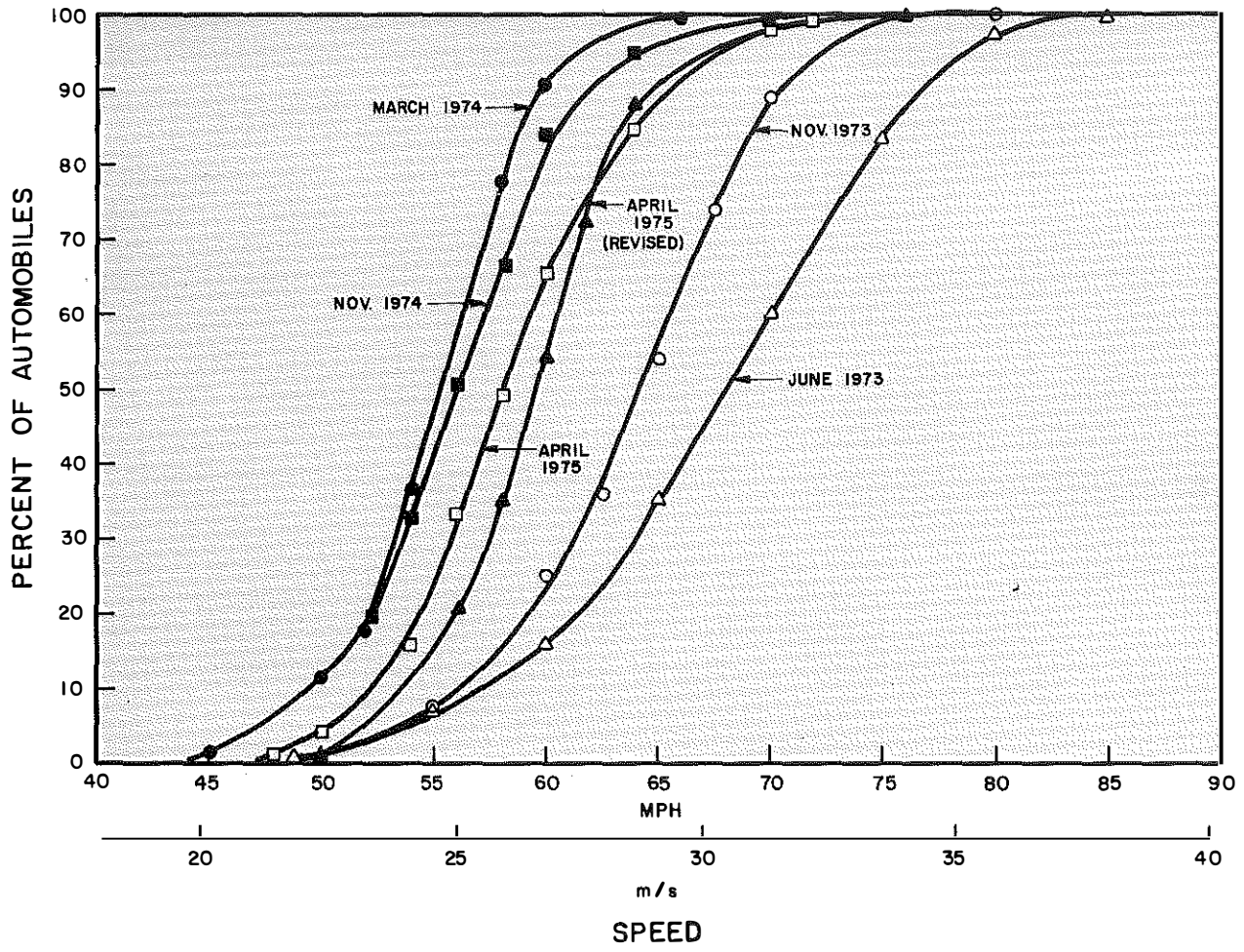
The effect of the energy crisis on the number of accidents on the entire rural system is shown in Figure 9. Similar to traffic volumes, December 1973 was the first month which exhibited decreased accidents compared to the year before. Except for January 1974, the number of accidents in the first months of 1974 was considerably less than for the corresponding months in 1973. During the months preceding December 1973, accidents had increased by an average of more than ten percent over the year before. The largest decrease in accidents occurred in March and April 1974. There were also decreases in volume during these months, and it should be noted that these low accident months followed the lowering of the speed limit on March 1, 1974. The number of accidents in the later months of 1974 remained below 1973 levels, but the reductions in numbers of accidents lessened.

All four major highway types experienced a decrease in accidents for almost every month in 1974 (Figure 10). March and April 1974 showed the largest decreases. Interstate and four-lane divided (no access control) highways had the most dramatic drop in accidents. The number of accidents on parkways has fluctuated widely, but the largest decrease occurred in March 1974. The decrease in accidents continued through November 1974. On two-lane highways, the monthly percentage in the number of accidents first dropped below the previous year in December 1973. This decrease continued through November 1974 -- reaching a minimum of 76 percent in April. The decrease lessened in the later months of 1974. On four-lane divided (no access control) highways, the number of accidents remained below the previous year since August 1973, except for January and June of 1974.

Monthly accident rates on the total rural system first showed a significant decrease from the year before in March 1974, although there were indications of the accident rate lowering prior to then (Figure 11). In November and December 1973, the accident rate dipped slightly below the same periods in 1972. In January 1974, there was an increase, but the rate again decreased in February. After the speed limit reduction on March 1, 1974, the accident rate reduced sharply compared to the year before. The reduced accident rate has continued through November 1974 -- reaching a minimum during April. The accident rate for the period between December 1973 and November 1974 was 186 accidents per 100 million vehicles miles (160 million vehicle kilometers) but was 215 during the same period a year earlier. Between 1970 and 1972, the rate was 204 *(1)*.

The monthly variation in accident rates for the various highway types is given in Figure 12. Except for two-lane highways, there was a large variation in the monthly accident rates. March 1974 showed the largest decrease in accident rates for all highway types. The reduction in accident rates was greater for interstate than for two-lane highways. This might be related to the fact that speeds decreased more on interstate than on two-lane highways.

Figure 3. Automobile Speed Distribution Curves (Interstate Highways).



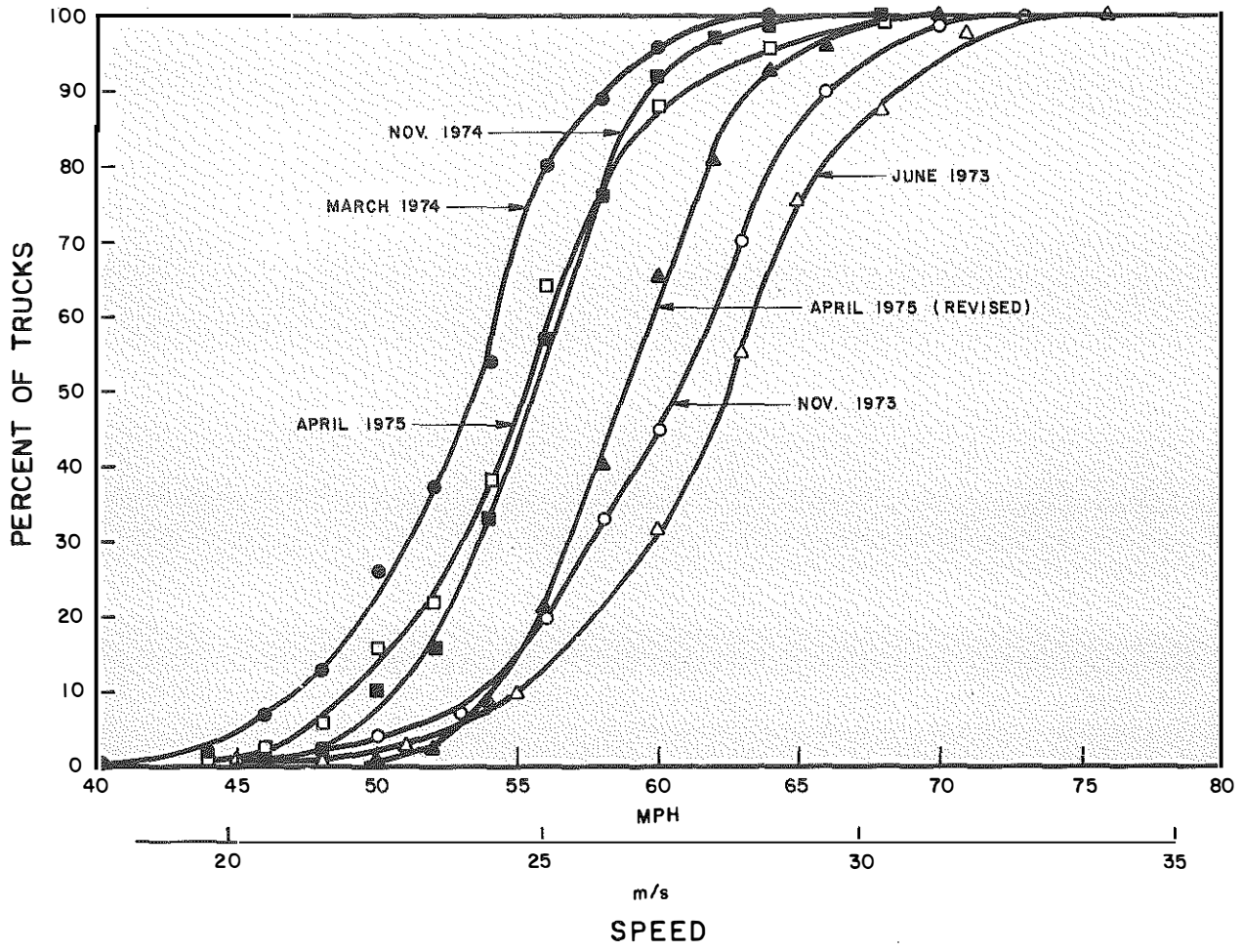
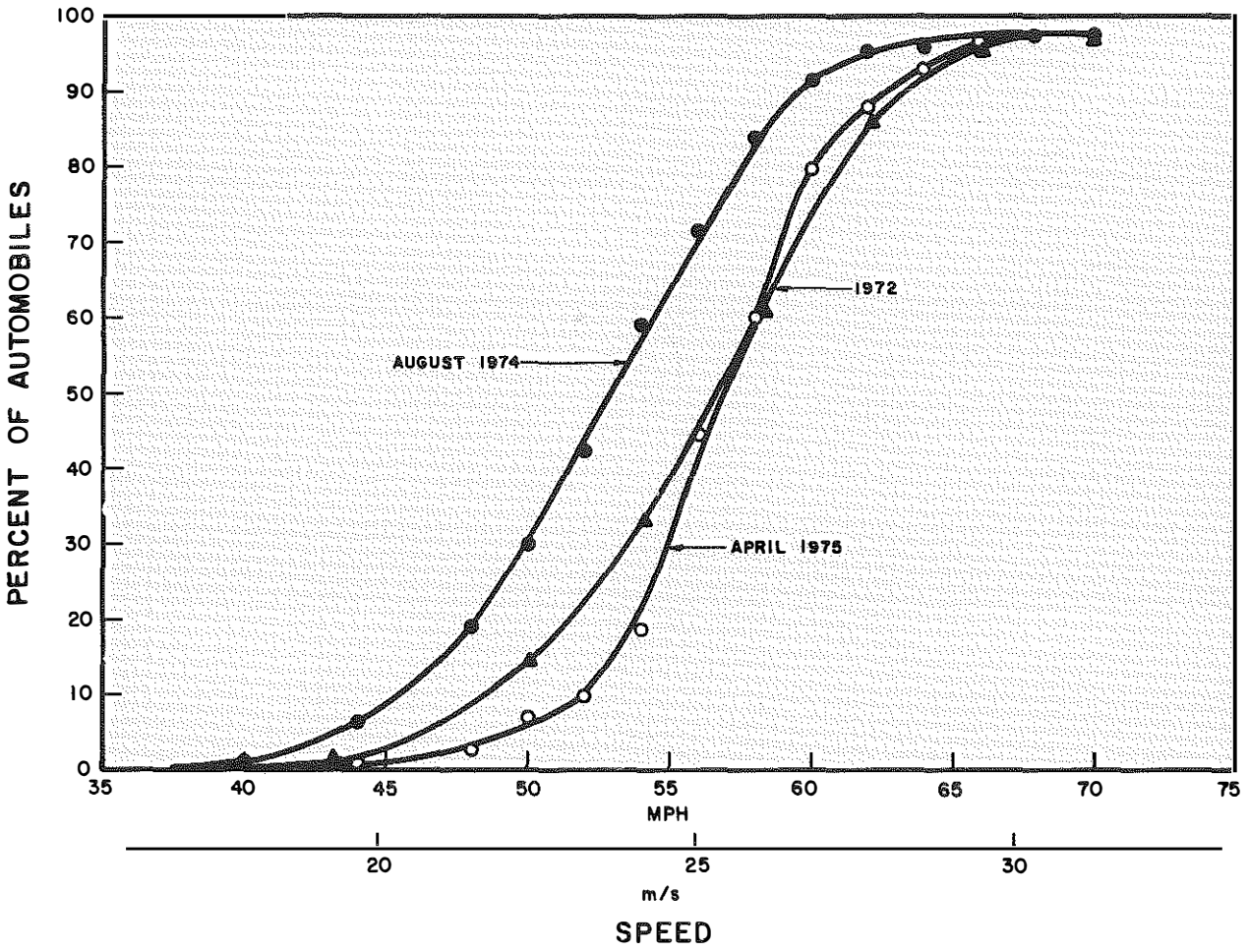


Figure 4. **Truck Speed Distribution Curves (Interstate Highways).**

Figure 5. Automobile Speed Distribution Curves (Four-Lane (No Access Control) Highways).



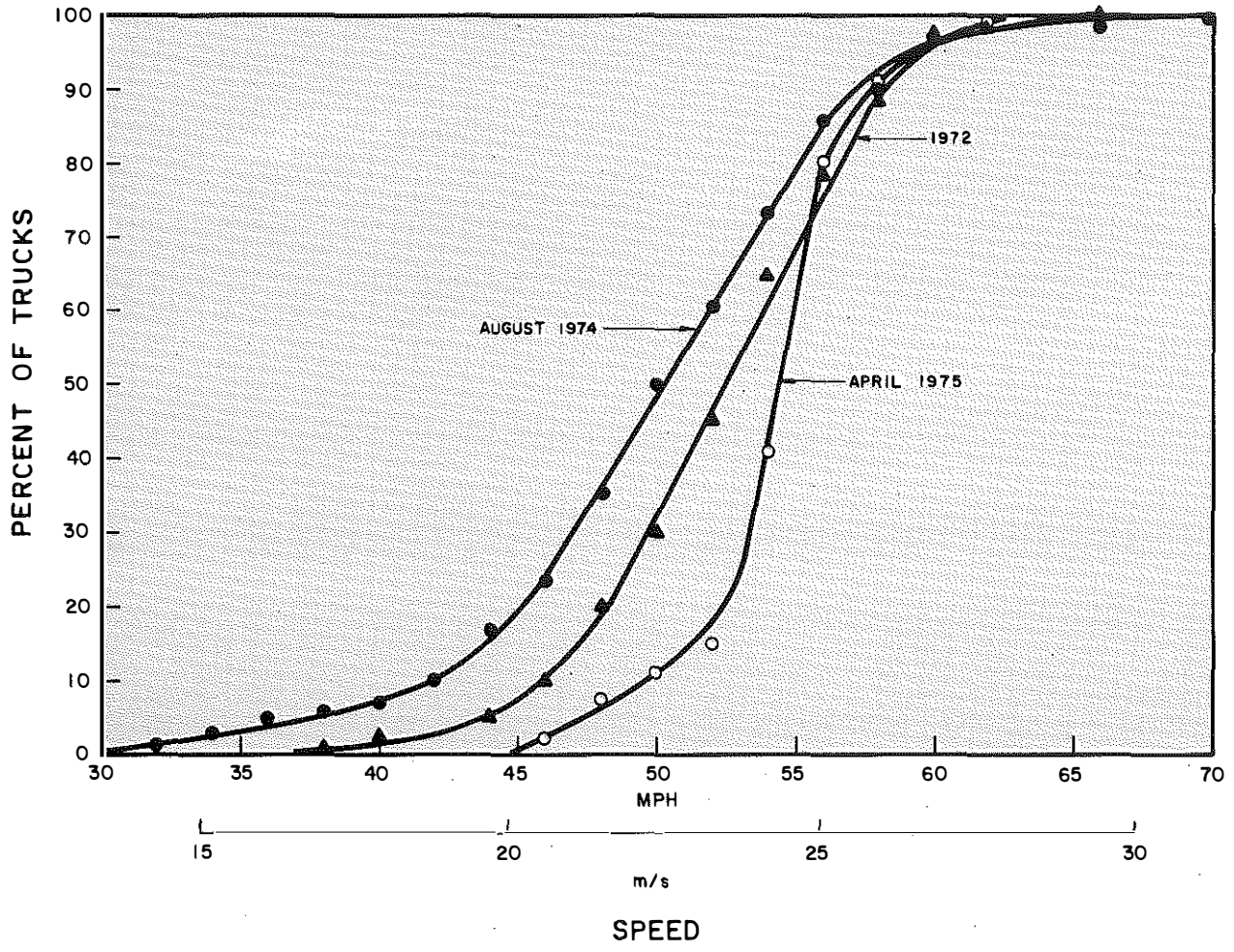
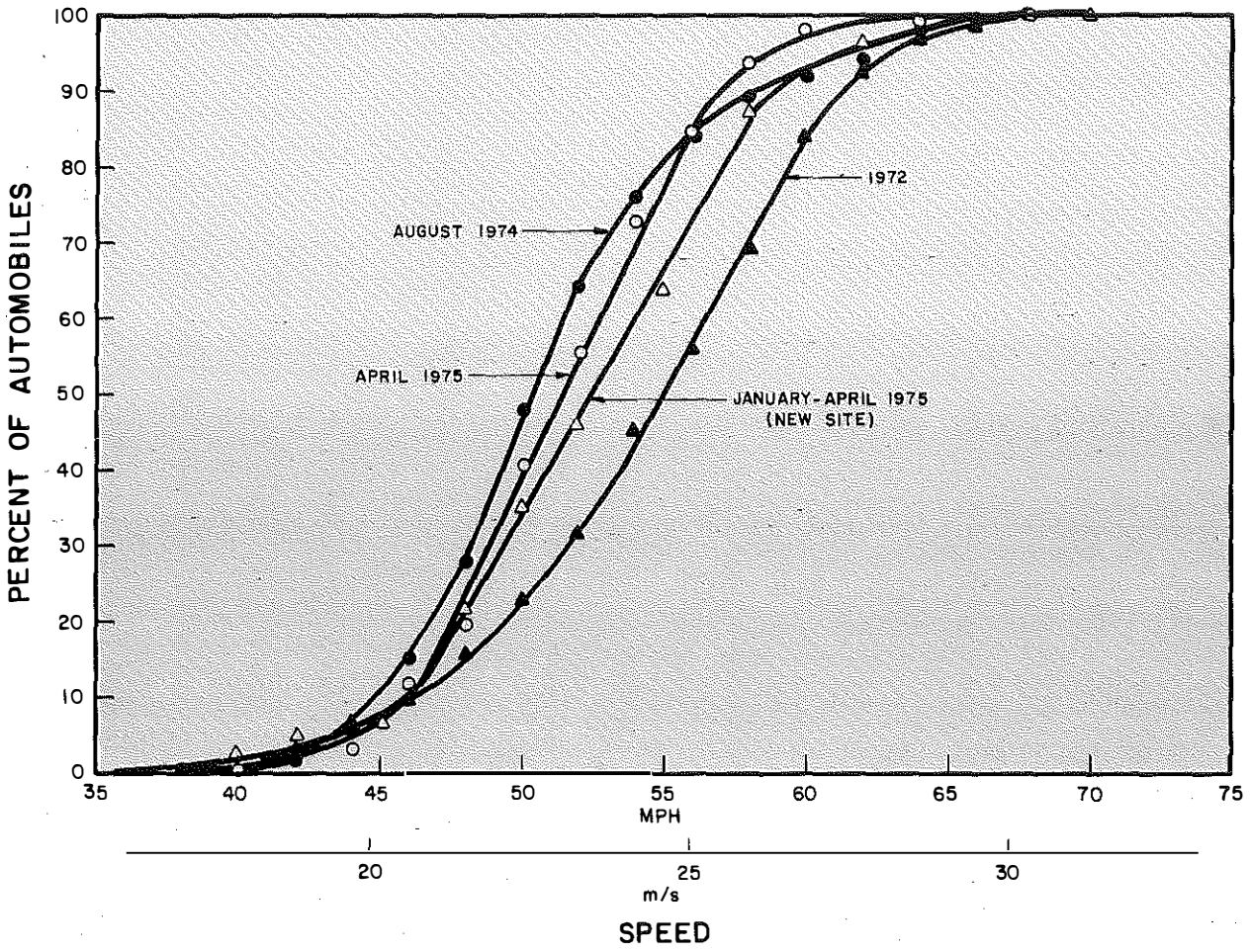


Figure 6. Truck Speed Distribution Curves (Four-Lane (No Access Control) Highways).

Figure 7. Automobile Speed Distribution Curves (Two-Lane Highways).



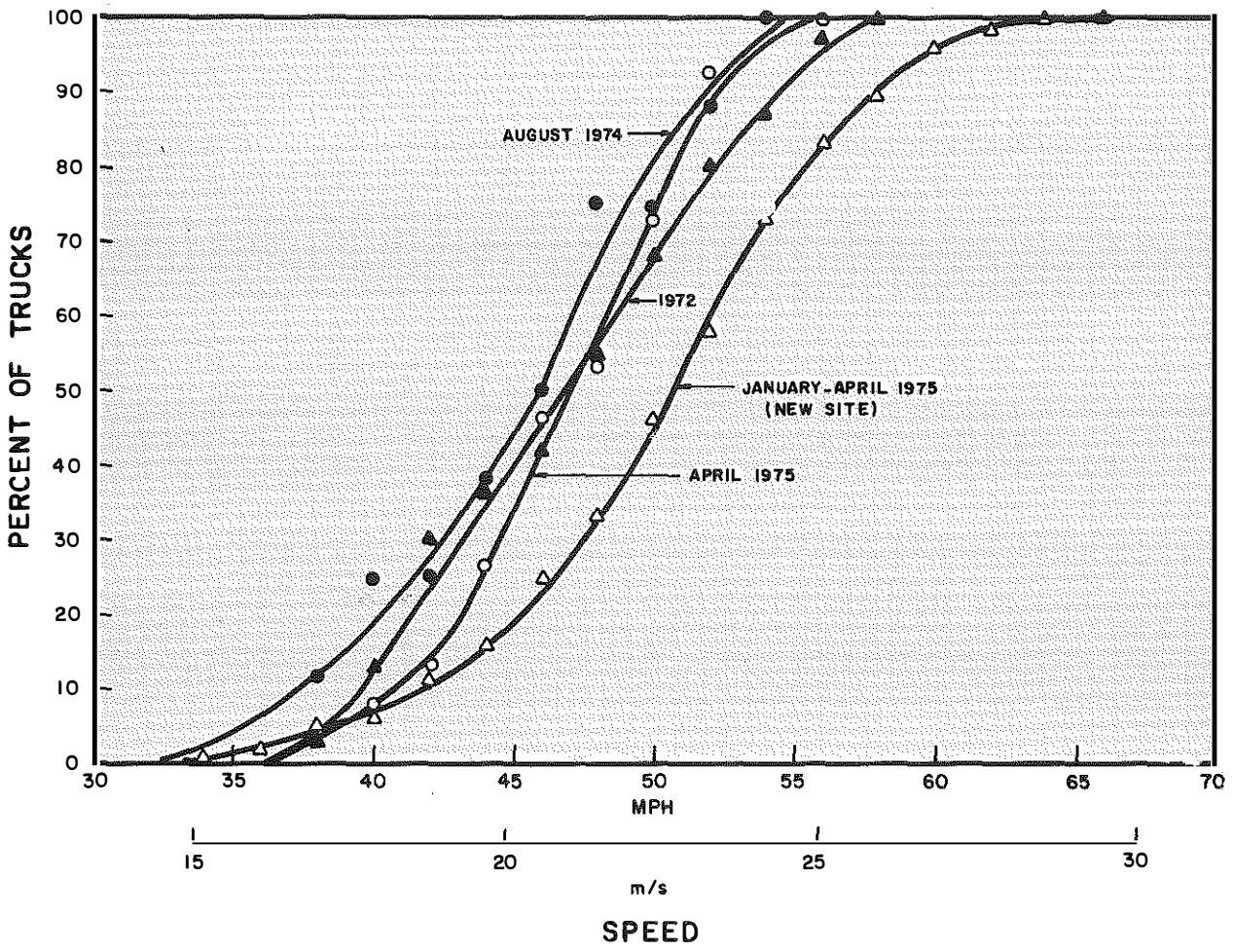
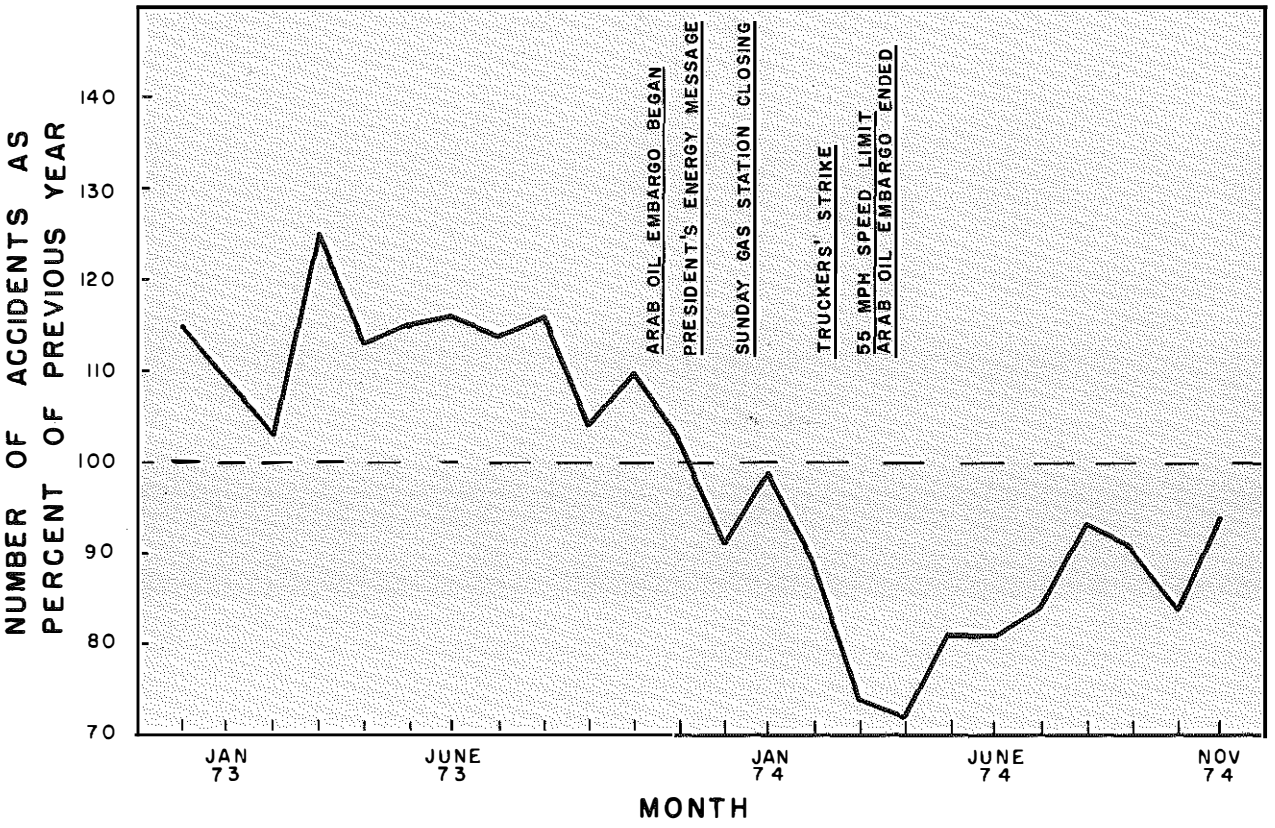


Figure 8. **Truck Speed Distribution Curves (Two-Lane Highways).**

Figure 9. Comparison of Number of Monthly Accidents to Corresponding Month in Preceding Year (Total Rural Highway System).



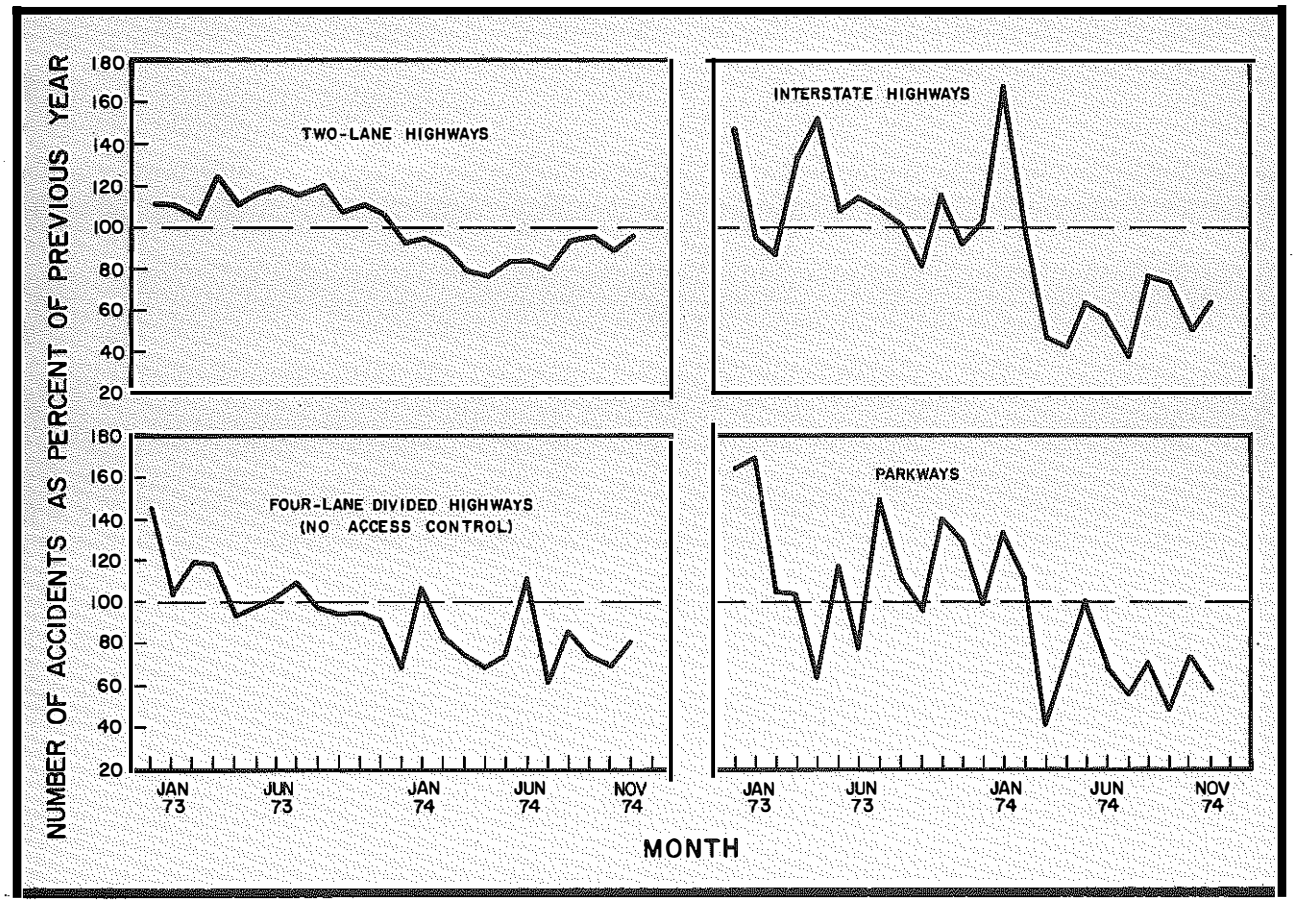
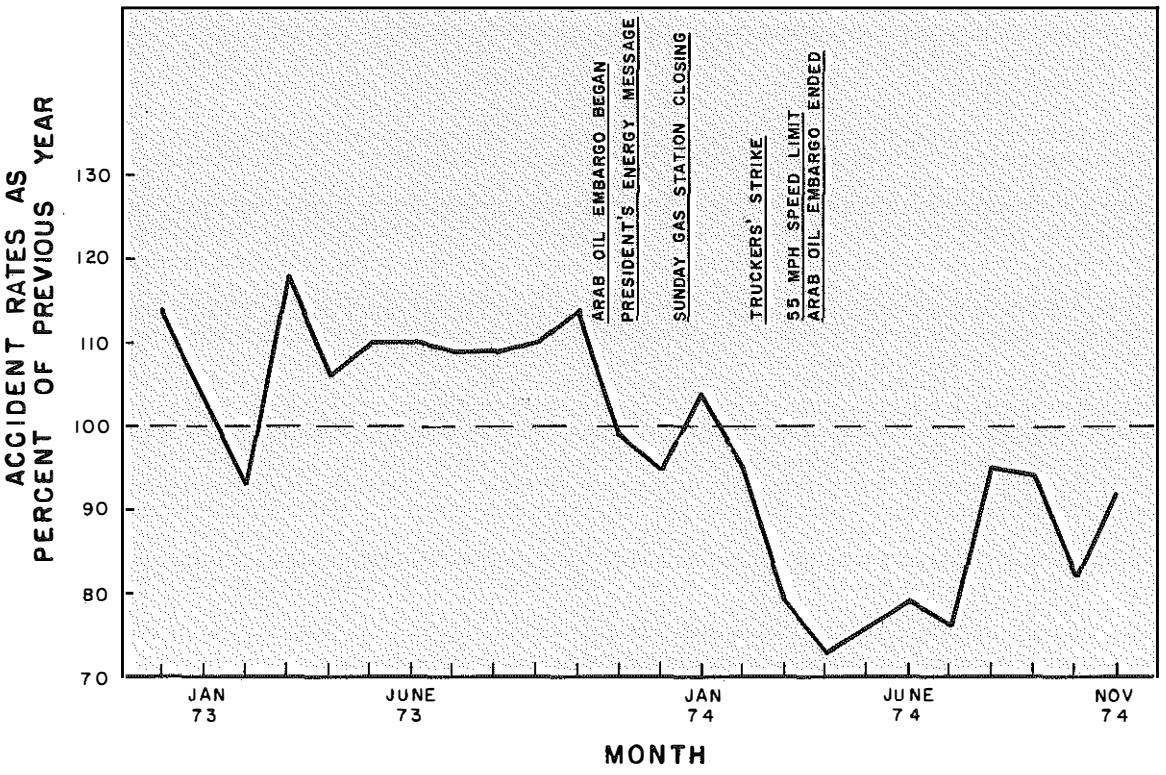


Figure 10. **Comparison of Number of Monthly Accidents to Corresponding Month in Preceding Year (Various Highway Types).**

Figure 11. **Comparsion of Monthly Accident Rates to Corresponding Month in Preceding Year (Total Rural Highway System).**



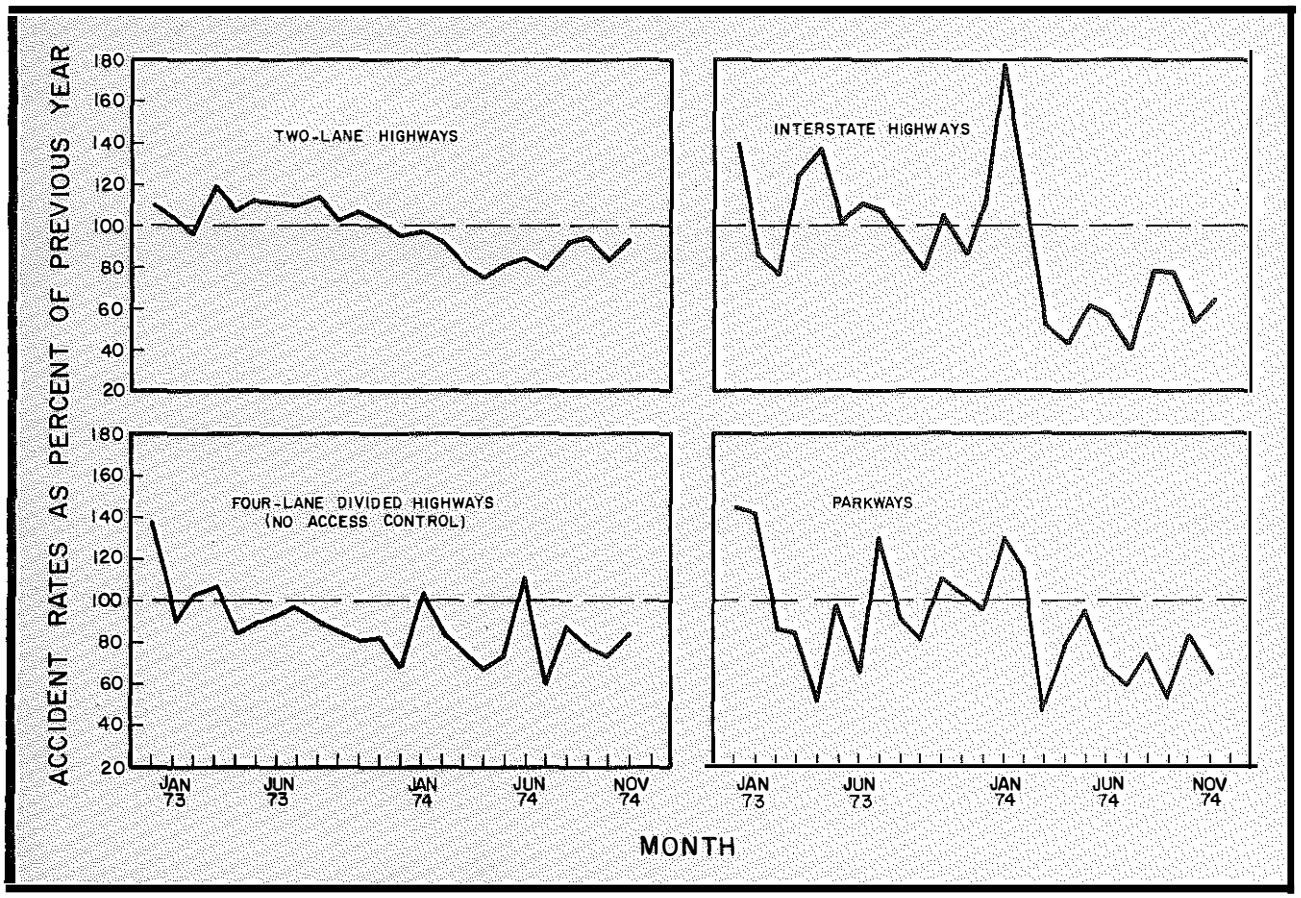


Figure 12. Comparison of Monthly Accident Rates to Corresponding Month in Preceding Year (Various Highway Types).

Pavement surface conditions (dry, wet, snow, or ice) should be considered whenever accident occurrences are compared. Weather conditions for the months of December 1973 through November 1974 were, therefore, compared to the corresponding month in the preceding year. Large differences were found for several months. An approximate doubling of the hours of snow and ice in January 1974 compared to January 1973 may partially account for the increased accident rates, especially on interstate highways. In April and July 1974, the hours of inclement weather decreased by about 50 percent compared to the same months a year earlier; this may have contributed to reduced accident rates for those months. There was also a 35-percent reduction in inclement weather in October 1974 and may explain the large accident rate decrease that month. In August and September 1974, hours of inclement weather more than doubled and corresponded to an increase in accidents. However, when the 12 month periods were compared, there was a difference of only four percent in incremental weather (1974 was slightly higher). Weather, therefore, should not have affected the total accident experience significantly.

Fatalities

The monthly variation in fatalities has fluctuated considerably as shown in Figure 13. The number of fatalities has remained below the preceding year from December 1973 through November 1974. The total number of fatalities from December 1973 (when the energy crisis seemed to have an impact) through November 1974 were compared to the same time periods two years earlier (Figure 14). The number of fatalities dropped from 832 (1973) to 555 (1974), a reduction of 32 percent. At the same time, vehicle miles (kilometers) driven dropped by only 2.3 percent.

Figure 15 presents the number of fatalities for several highway types. The average change in fatalities, using the average of the two previous years, was a 32-percent decrease for two-lane highways, a 76-percent decrease for parkways, a 14-percent increase for four-lane divided highways, and a 40-percent decrease for interstates.

A very wide fluctuation in fatality rate was also observed for the total rural system during the study period (Figure 16). As with fatalities, the fatality rate has remained below the rate of the preceding year (December 1973 through November 1974) except for two months. The lowest fatality rate occurred in December 1973. The fatality rate for the period December 1973 through November 1974 was 4.5 fatalities per 100 million vehicle miles (160 million vehicle kilometers); the rate was 6.6 fatalities per 100 million vehicle miles (160 million vehicle kilometers) for the same period a year earlier. The drop in fatality rate, therefore, was considerable (32 percent).

The fatality rate decreased on all major highway types except on four-lane divided (no access control) highways where the rate increased by 23 percent. The decreases in fatality rate were 81 percent on parkways, 34 percent on interstates, and 31 percent on two-lane highways. The largest decreases, therefore, were on those highways types where the previous speed limit was 70 mph (31.3 m/s).

Injuries

The change in injuries for the total rural system is shown in Figure 17. There was a pronounced change in the number of injuries since December 1973. In the months preceding December 1973, the number of injuries increased on an average of more than ten percent from the previous year. In April 1974, the injuries reached a minimum of only 66 percent compared to April 1973. The reduction in injuries lessened in the later months of 1974.

The reduction in injuries for the various highway types is shown in Figure 18. All highway types had a reduced number of injuries in 1974; the greatest decreases occurred in March, April, and May. Interstates and parkways had the largest decrease -- a 40-percent reduction for the 12-month period. The number of injuries on two-lane highways first dropped below the previous year in December 1973 and has remained below the previous year through November 1974. For four-lane divided (no access control) highways, the number of injuries has fluctuated widely.

The change in the injury rate for the total rural system (Figure 19) since the beginning of the energy crisis was very similar to the change in the number of injuries. With the exception of January 1974, every month since November 1973 has been below the corresponding month in the preceding year. The large drop in the injury rate occurred in March 1974 and has continued through November 1974, although the reductions lessened.

The variation in injury rates by highway type is given in Figure 20. For interstate, parkway, and four-lane divided (no access control) highways, injury rates have fluctuated above and below the rates for the previous year since the first months of 1973, but the injury rate did decrease in 1974. The injury rate on two-lane highways first dropped below the previous year in December 1973 and reduced to 70 percent in April and May 1974.

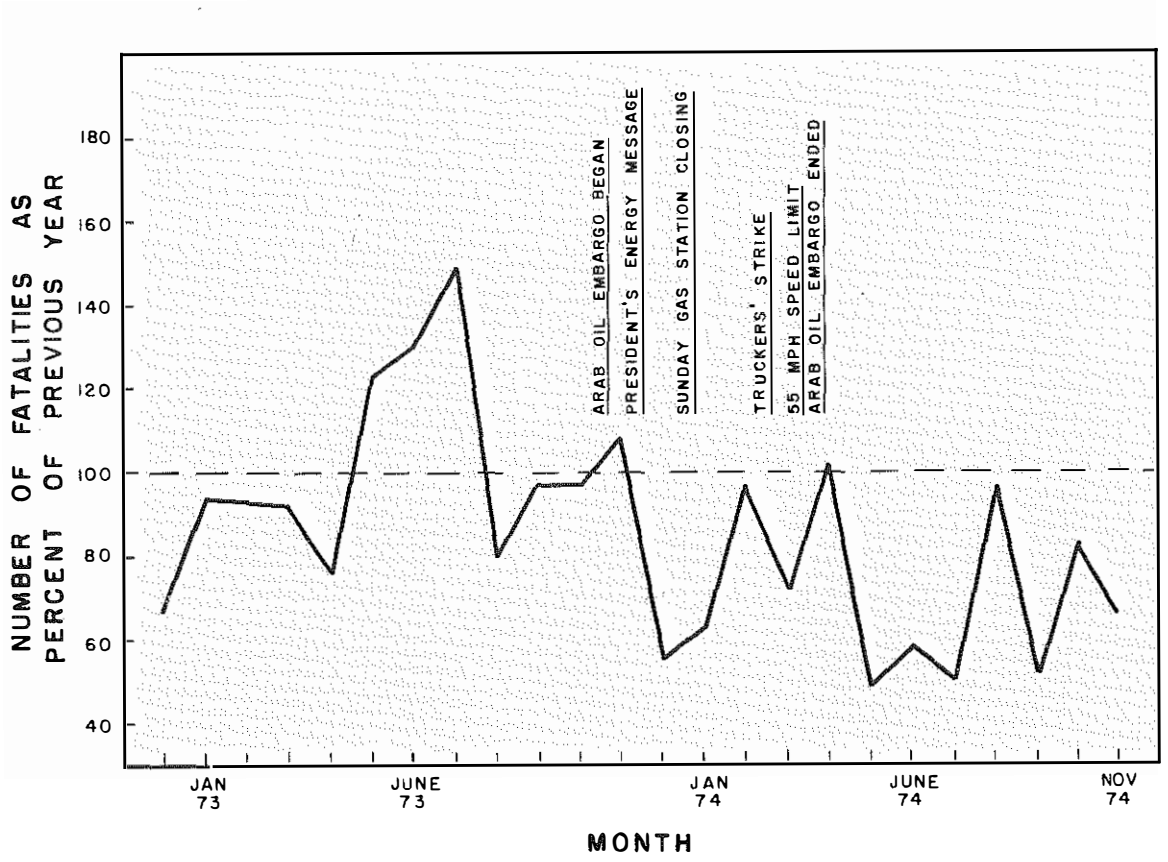


Figure 13. Comparison of Monthly Fatalities to Corresponding Month in Preceding Year (Total Rural Highway System).

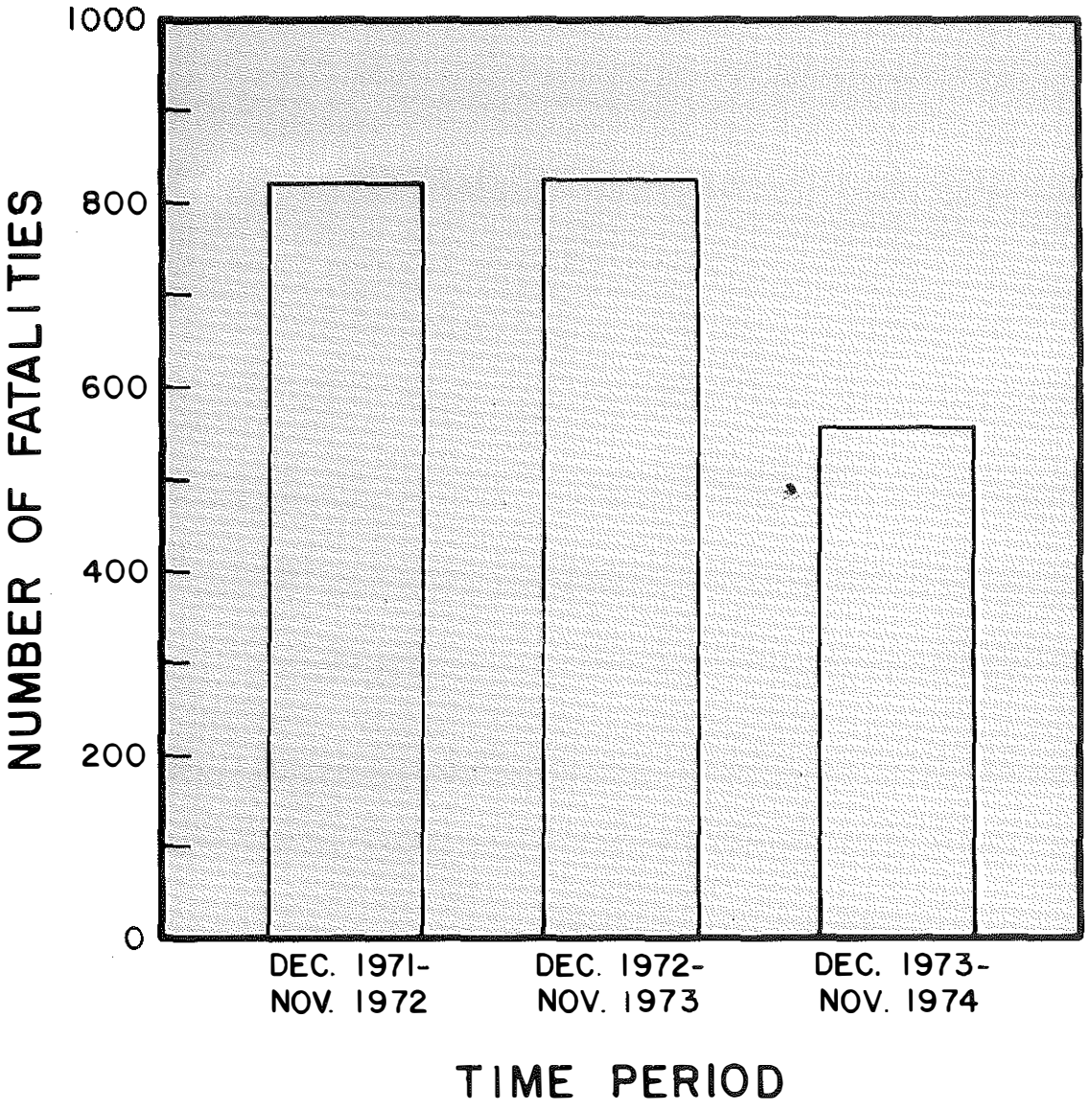
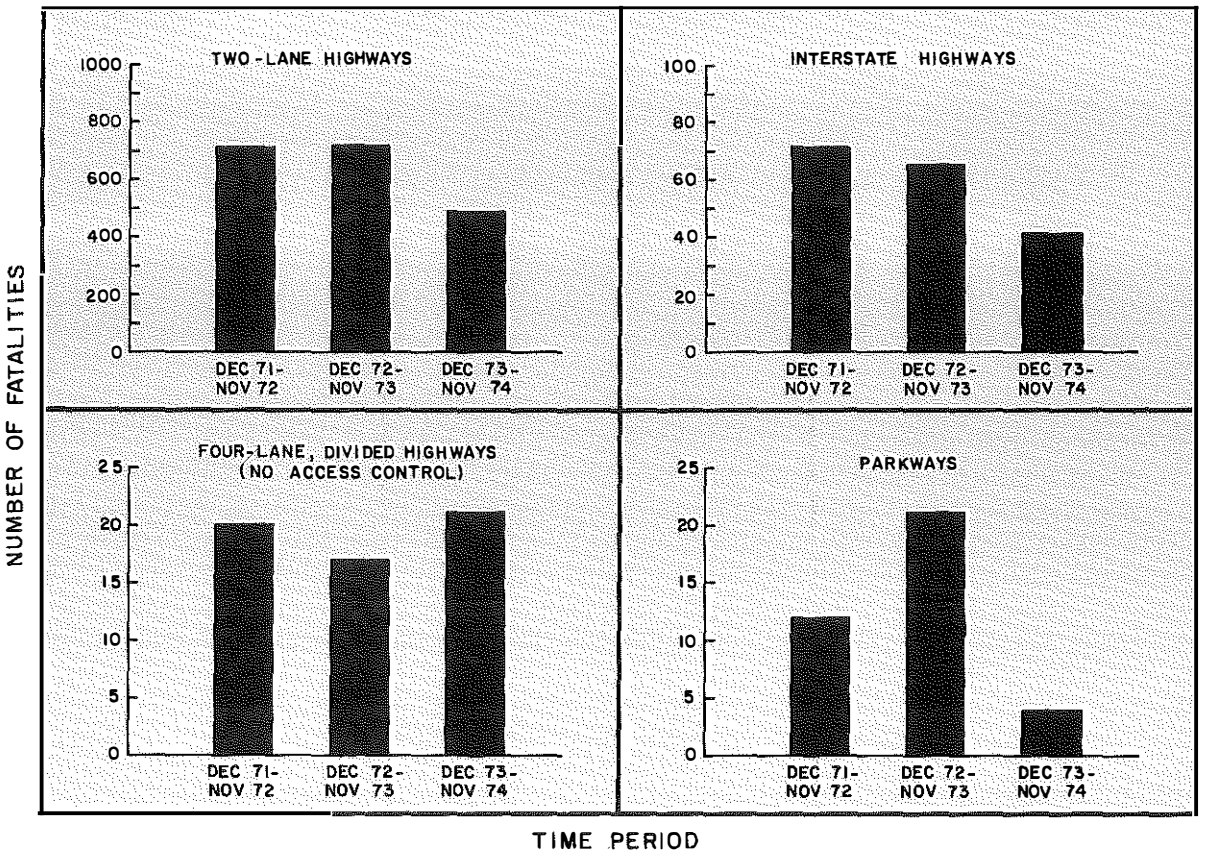


Figure 14 Comparison of Fatalities Before and During the Energy Crisis (Total Rural Highway System)

Figure 15. Comparison of Fatalities Before and During the Energy Crisis (Various Highway Types).



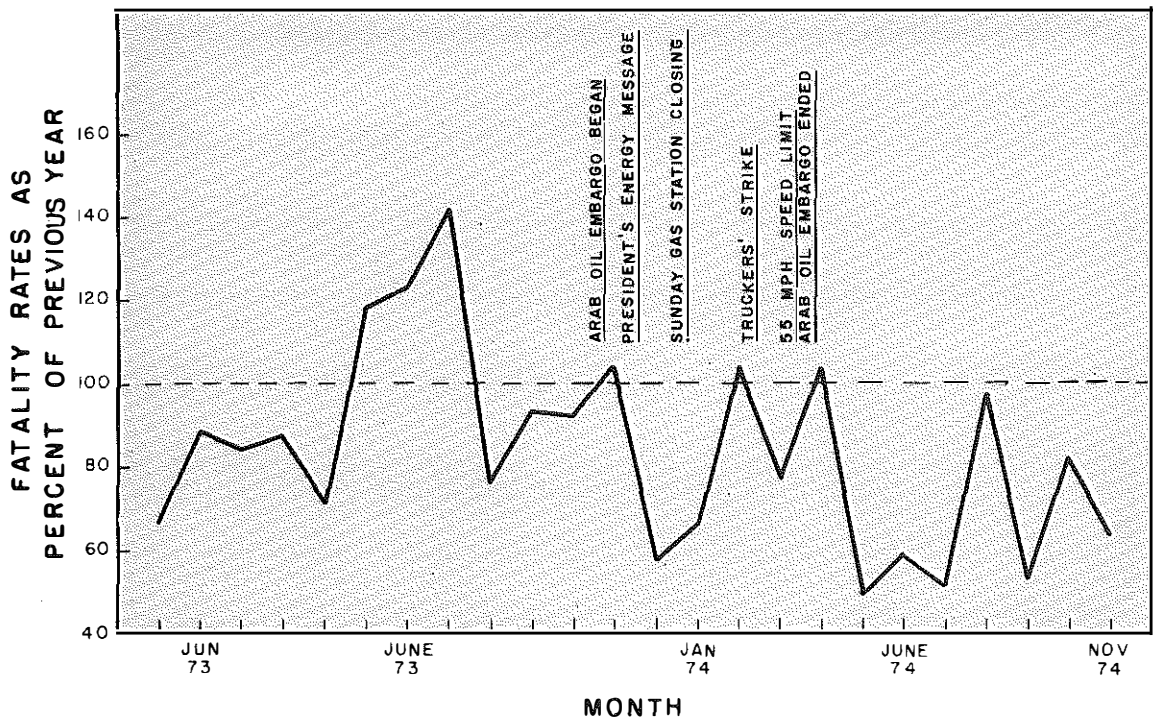
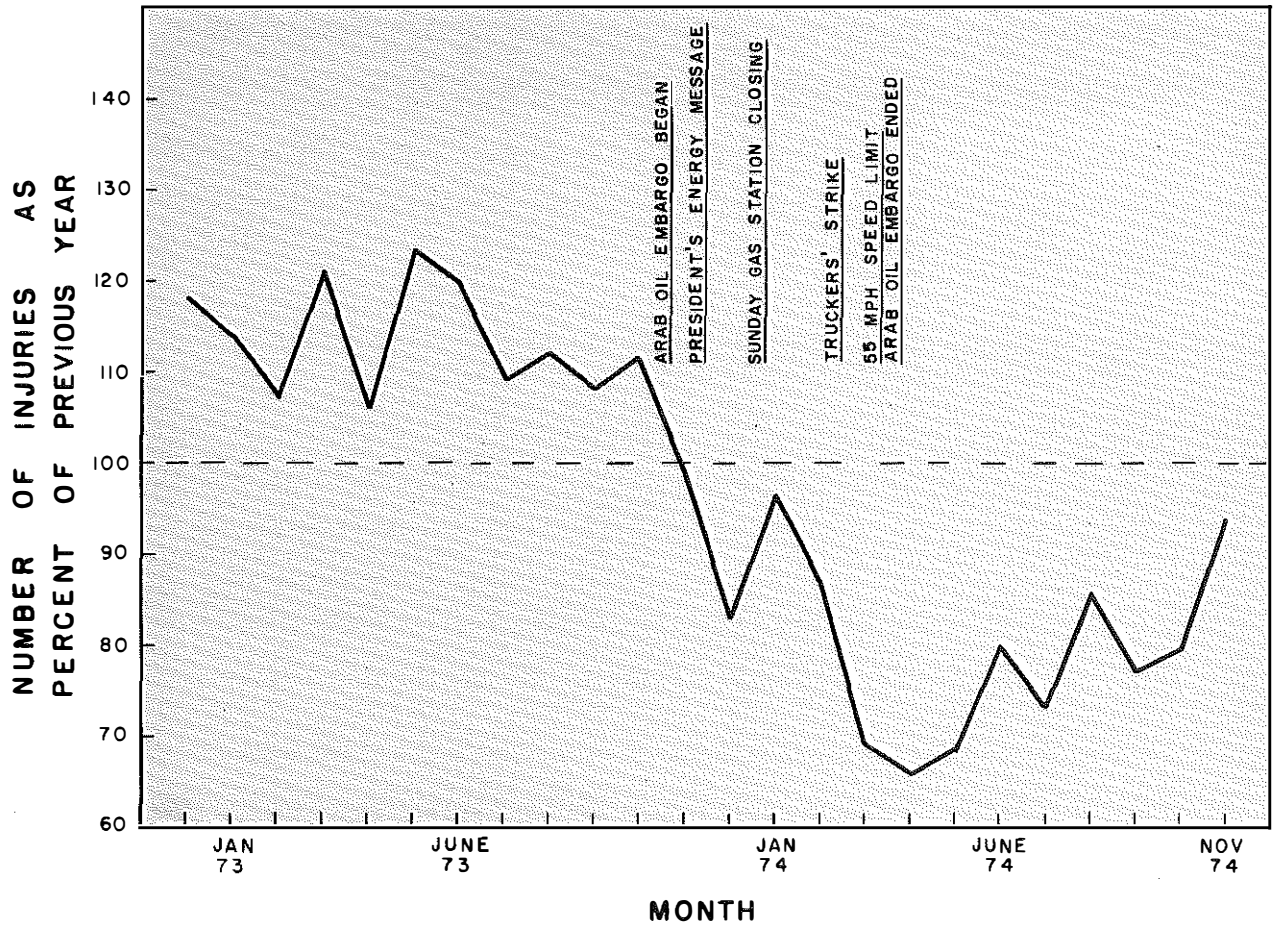


Figure 16. Comparison of Monthly Fatality Rates to Corresponding Month in Preceding Year (Total Rural Highway System).

Figure 17. Comparison of Number of Injuries to Corresponding Month in Preceding Year (Total Rural Highway System).



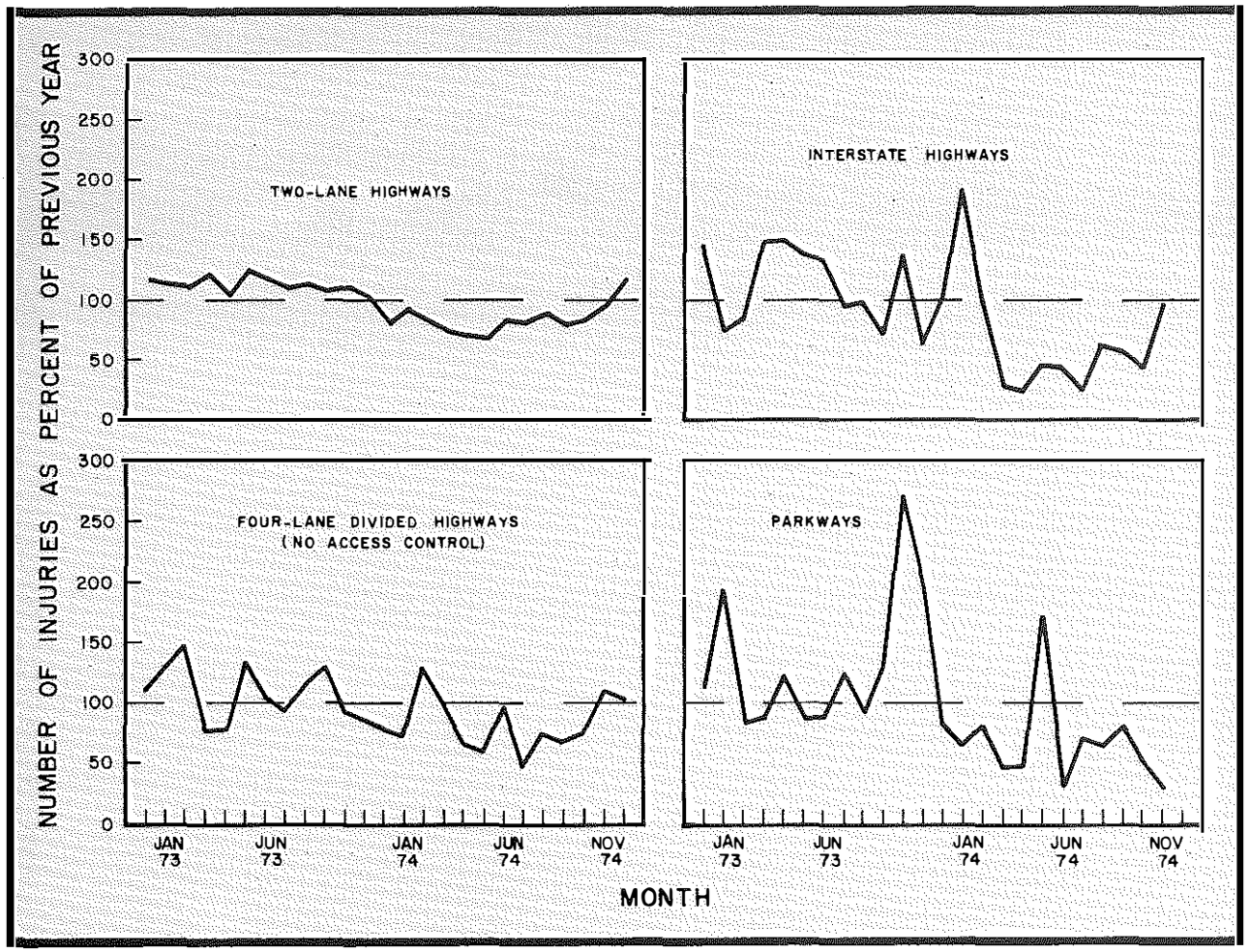


Figure 18. Comparison of Number of Injuries to Corresponding Month in Preceding Year (Various Highway Types).

Figure 19. Comparison of Monthly Injury Rates to Corresponding Month in Preceding Year (Total Rural Highway System).

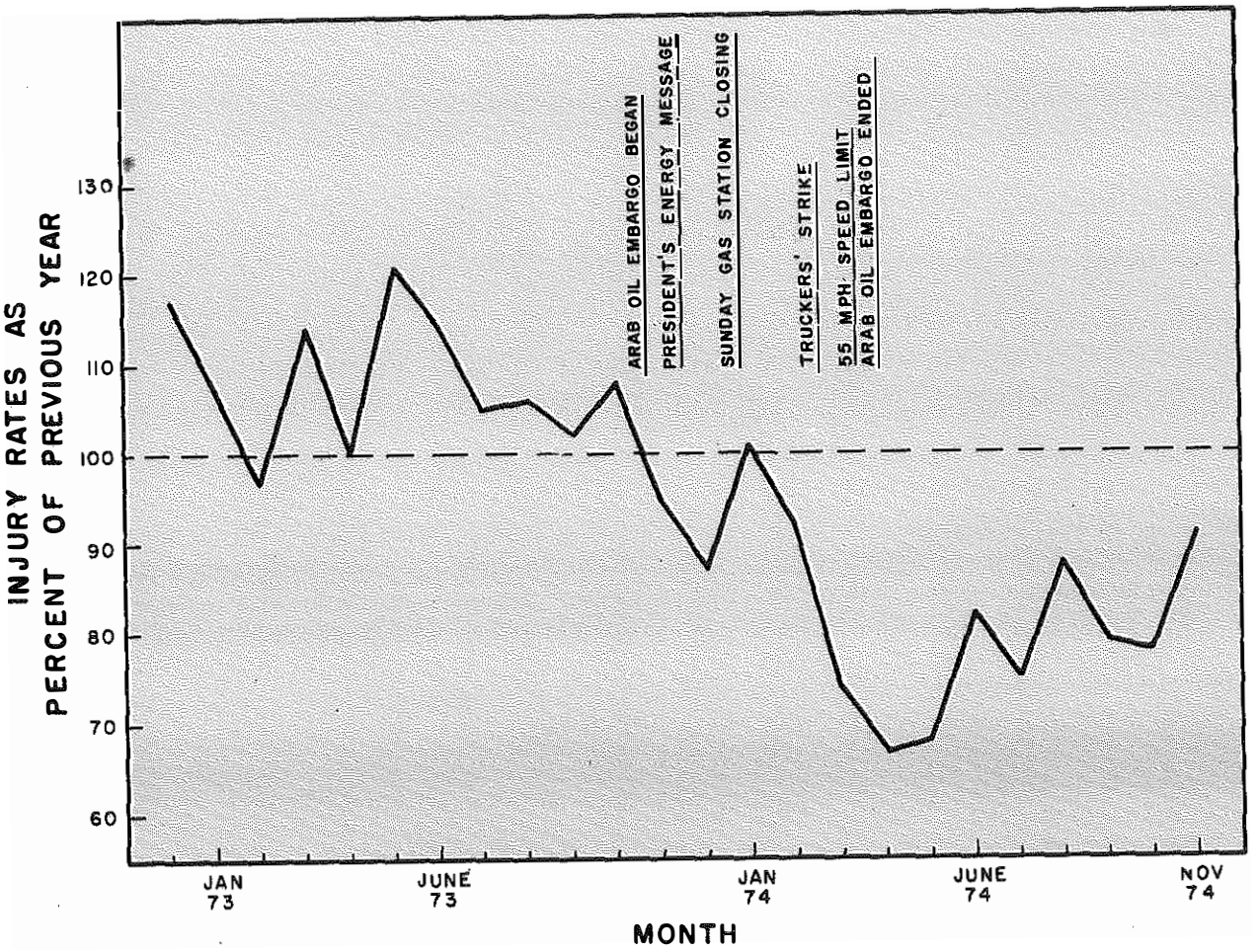


Figure 20. Comparison of Monthly Injury Rates to Corresponding Month in Preceding Year (Various Highway Types).

Severity Index

The severity index (SI) attempts to place a value on the average severity of accidents. The severity index increases as the damage and injuries increase. The weighting factors used in the formula *(2)* were calculated by considering the cost of each type of accident or injury and the number of accidents or injuries. Fatal accidents and A-injury accidents were grouped together; although fatalities are much more costly, they are also rarer. Accidents classified as B-injury or C-injury were also grouped together.

No definite trends could be discerned in the monthly severity index for the total rural system when compared to the corresponding month in the preceding year (Figure 21). However, from December 1973 through November 1974, the severity index had decreased to 2.65 compared to 2.77 a year earlier.

Accident severity has decreased slightly each year since 1970 *(1)*. This decrease may be attributable to safer vehicles, safety belt usage, safety improvements to the highway system, etc. The severity index for two-lane highways and parkways has decreased since the beginning of the energy crisis in December 1973; for interstate and four-lane divided (no access control) highways, the index has remained essentially unchanged.

Safety Belt Usage

Accident severity has decreased slightly over the past few years. One reason may be the safety features incorporated into newer vehicles. A past study *(1)* showed that persons not wearing safety belts had approximately twice the probability of being injured and four times the probability of being killed compared to persons who do wear safety belts. Surprisingly, there has not been any significant changes in the percentage of motorists involved in accidents who were wearing safety belts. This percentage has changed from an average of 6.0 percent for 1970 through 1972 to 6.7 percent in 1973 and 6.0 percent in 1974. It is interesting to note that this percentage is much lower than the 20 to 25 percent of all occupants of cars on the road today who are wearing safety belts *(4)*. This may suggest that wearing a safety belt may decrease the probability of being involved in an accident; it could also mean that drivers who use seat belts are more cautious and attentive. Another possible reason for reduced accident severity is that the percentage of older cars not equipped with safety belts, or other safety features, is constantly being reduced. The percentage of vehicle occupants in a car not equipped with safety belts has dropped from an average of 44.2 percent for 1970 through 1972 to 35.0 percent in 1973 and to 30.6 percent in 1974.

Surface Conditions

Accident rates have been recognized as being higher on wet pavements than on dry pavements. Furthermore, research has shown that accident rates tend to increase as wet skid resistance diminishes *(5)*. Table 7 shows accident rates for dry, wet, and snow or ice surface conditions for two periods of time (1973 and 1974). Accident rates were calculated from adjusted vehicle miles (kilometers) of travel under each surface condition using precipitation data for the Lexington area (Table 8). The assumption was made that Lexington weather data applied statewide and that traffic volumes did not differ between dry, wet, and ice or snow surface conditions. The latter assumption in particular is not entirely true. Some reduction in travel probably occurs in wet weather, and travel would certainly diminish during snow or ice conditions. The accident rates in contrast to those cited in Table 7, therefore, would be lower for dry surfaces, somewhat higher for wet surfaces, and substantially higher for ice or snow surfaces.

Under dry conditions, the greatest accident rate decrease occurred on interstates (27.8 percent) and parkways (20.4 percent). As shown earlier, the speed decreases were much larger on these highway types. It is important to note the very substantial decrease in wet-weather accident rates on interstates (55.4 percent) and parkways (41.7 percent). The reductions were far in excess of the corresponding decreases during dry conditions. Obviously, improved skid resistance at the lower travel speeds provided an added margin of safety and, therefore, contributed to a reduction in accidents. A similar decrease was found for four-lane divided (no access control) highways -- 27.2 percent when wet and 18.7 percent when dry.

The wet-weather accident decrease (10.4 percent) on two-lane highways was somewhat similar to dry-surface conditions (11.8 percent). It must be pointed out, however, that even a modest error in the precipitation data used in one of the periods could substantially influence the results.

During snow- or ice-surface conditions, decreases in accident rates are evident on all highways as a result of lower posted speeds. The decreases were below those shown for dry and wet conditions for interstates and parkways and above those for two-lane and four-lane divided (no access control) highways. No data were available to compare travel speeds under these conditions. It may be reasonable to assume, however, that traffic normally responds to severely hazardous driving conditions and reduces speeds accordingly. Changes in posted speeds, therefore, may not affect driving speeds to the same extent as during favorable weather. Again, assumed applicability of weather data may introduce errors.

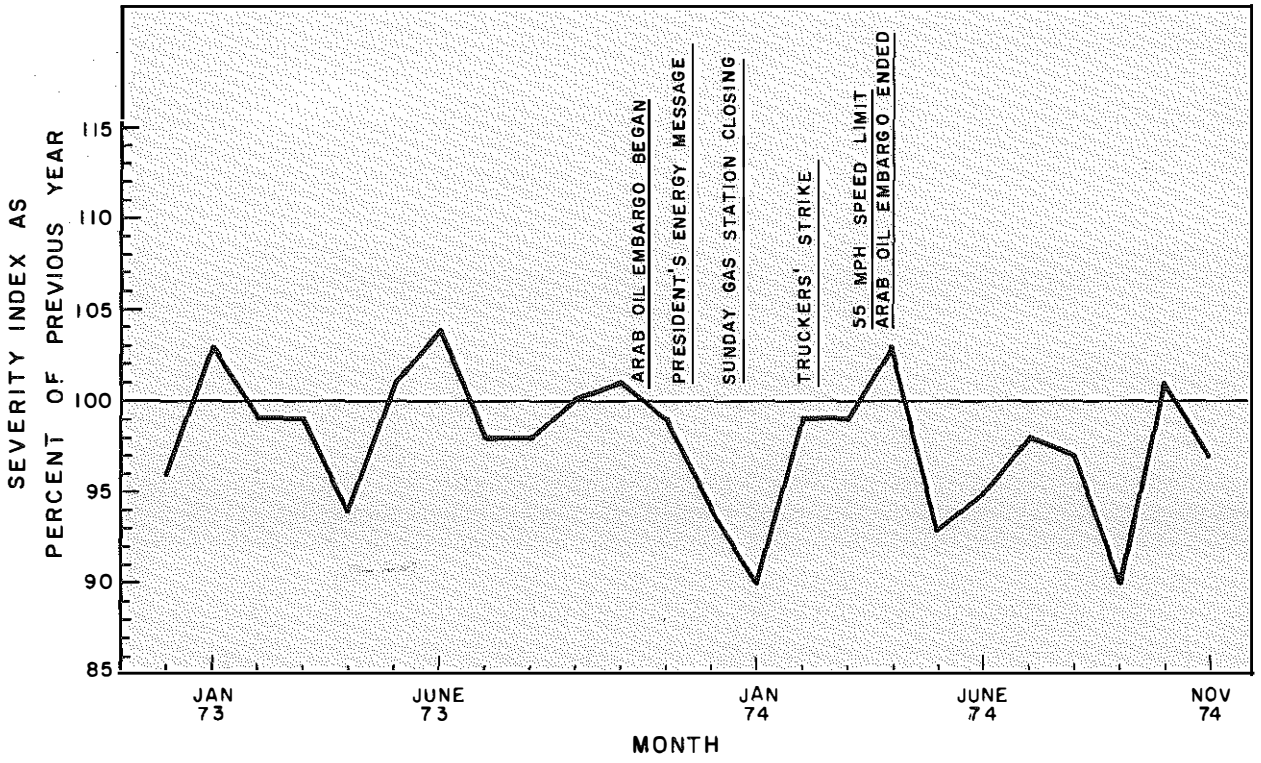


Figure 21. **Comparison of Monthly Severity Index to Corresponding Month in Preceding Year (Total Rural Highway System).**

TABLE 4. COMPARISON OF APRIL 1975 SPEED DATA FOR INTERSTATE HIGHWAYS

SITE	SPEEDS						10-MPH (4.5-M/S) PACE		
	AVERAGE		MEDIAN		85th PERCENTILE			RANGE	
	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(percent)	(mph)	(m/s)
AUTOMOBILES									
●riginal Completely Concealed	59.6	26.6	58.1	26.0	64.0	28.6	69	55 - 64	24.6 - 28.6
	60.6	27.1	59.6	26.6	63.6	28.4	79	55 - 64	24.6 - 28.6
TRUCKS									
Original Completely Concealed	55.9	25.0	55.0	24.6	59.5	26.6	72	51 - 60	22.8 - 26.8
	59.9	26.8	58.8	26.3	62.7	28.0	85	55 - 64	24.6 - 28.6

TABLE 5. DRIVING SPEEDS AND 10-MPH (4.5-M/S) PACE FOR FOUR-LANE DIVIDED (NO ACCESS CONTROL) HIGHWAYS

DATE	SPEEDS						10-MPH (4.5-M/S) PACE		
	AVERAGE		MEDIAN		85th PERCENTILE			RANGE	
	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(percent)	(mph)	(m/s)
AUTOMOBILES									
1972	57.2	25.6	56.5	25.3	61.6	27.5	66	53 - 62	23.7 - 27.7
Aug 1974	53.7	24.0	52.9	23.6	58.3	26.1	65	49 - 58	21.9 - 25.9
Apr 1975	57.9	25.9	56.8	25.4	61.2	27.4	78	53 - 62	23.7 - 27.7
TRUCKS									
1972	53.2	23.8	53.0	23.7	57.3	25.6	69	47 - 56	21.0 - 25.0
Aug 1974	50.9	22.8	50.1	22.4	55.9	25.0	62	47 - 56	21.0 - 25.0
Apr 1975	55.2	24.7	54.5	24.4	56.9	25.4	85	51 - 60	22.8 - 26.8

TABLE 6. DRIVING SPEEDS AND 10-MPH (4.5-M/S) PACE FOR TWO-LANE HIGHWAYS

DATE	SPEEDS						10-MPH (4.5-M/S) PACE		
	AVERAGE		MEDIAN		85th PERCENTILE			RANGE	
	(mph)	(m/s)	(mph)	(m/s)	(mph)	(m/s)	(percent)	(mph)	(m/s)
AUTOMOBILES									
1972	56.0	25.0	54.9	24.5	60.2	26.9	61	53 - 62	23.7 - 27.7
Aug 1974	52.0	23.2	50.3	22.5	56.4	25.2	70	45 - 54	20.1 - 24.1
Apr 1975	52.4	23.4	51.1	22.8	56.0	25.0	74	49 - 58	21.9 - 25.9
Jan - Apr 1975 (New Site)	52.9	23.6	53.3	23.8	57.8	25.8	65	49 - 58	21.9 - 25.9
TRUCKS									
1972	47.7	21.3	47.3	21.1	53.4	23.9	55	41 - 50	18.3 - 22.3
Aug 1974	46.2	20.7	46.0	20.6	51.3	22.9	63	43 - 52	19.2 - 23.2
Apr 1975	47.9	21.4	47.0	21.0	51.2	22.9	80	43 - 52	19.2 - 23.2
Jan - Apr 1975 (New Site)	50.4	22.5	51.0	22.8	57.2	25.6	58	47 - 56	21.0 - 25.0

TABLE 8. PRECIPITATION DATA

PERIOD	SURFACE CONDITION[a]		
	DRY	WET[b]	ICE OR SNOW
Dec 1972 through Nov 1973	83.2	14.7	2.1
Dec 1973 through Nov 1974	82.5	13.3	4.2

[a]Percent of time in the Lexington area

[b]Trace or more of rainfall

DISCUSSION

It was shown that fatalities, accidents, and injuries, as well as fatality rates, accident rates, and injury rates decreased since the beginning of the energy crisis. The question remains whether these decreases resulted from changes in traffic volumes, speeds, etc. or as a result of any combination of contributing factors. As shown in Figure 22, the decrease in volume, which began in December 1973, corresponds to a reduced accident rate; but volume reductions lessened in April and May while the accident rate reached its lowest percentage in April. The dramatic decrease in accident rate occurred in March 1974 while the reduction in volume remained the same. Also, traffic volumes in October and November 1974 increased above those of the previous year while the accident rate remained lower. The large accident rate decrease, therefore, corresponded with the lowering of the speed limit to 55 mph (24.6 m/s) on March 1, 1974. Total travel during the 12-month period decreased by 2.3 percent while the accident rate decreased by 13.5 percent compared to the same period a year earlier.

The relationship between traffic speed and accident rate for interstate highways is shown in Figure 23 and for two-lane highways in Figure 24. Very limited (but precious) data points were available in preparing the plots. The data points, of course, are subject to errors due to uncertainties as to traffic speeds and volumes associated with various weather conditions. The plots do, however, bring to attention a disproportionate increase in accident rates as speed increases. The differences between wet-surface and dry-surface accident rates are especially significant and more so for interstate highways (previously posted speed -- 70 mph (31.3 m/s)) than for two-lane highways (previously daytime posted speed -- 60 mph (26.9 m/s)). Improved wet-pavement skid resistance at the lower speeds obviously contributed to a reduction in accident rates. Reduced speed, therefore, has a greater effect upon accident rates during wet-surface than during dry-surface conditions.

A summary of accident experience for various highways is presented in Table 9. Fatality and injury rates decreased more than accident rates. The most dramatic impact, of course, must be the 277 lives saved between December 1973 and November 1974 when compared to the same period a year earlier. Whereas traffic volume and other contributing factors may account for some of the decrease in accident rates since the beginning of the energy crisis, lower travel speeds certainly stand out as the single most important reason why accident, fatality, and injury rates have decreased.

CONCLUSION

Decreases in accident rates associated with reducing the speed limit to 55 mph (24.6 m/s) (from previous 70 mph (31.3 m/s) on interstates and parkways and 60 mph (26.9 m/s) on two-lane roads) have been dramatic. To safeguard the public from undue hazards associated with higher-speed driving, continuation of maximum speed limit at 55 mph (24.6 m/s) on all rural highways seems advisable.

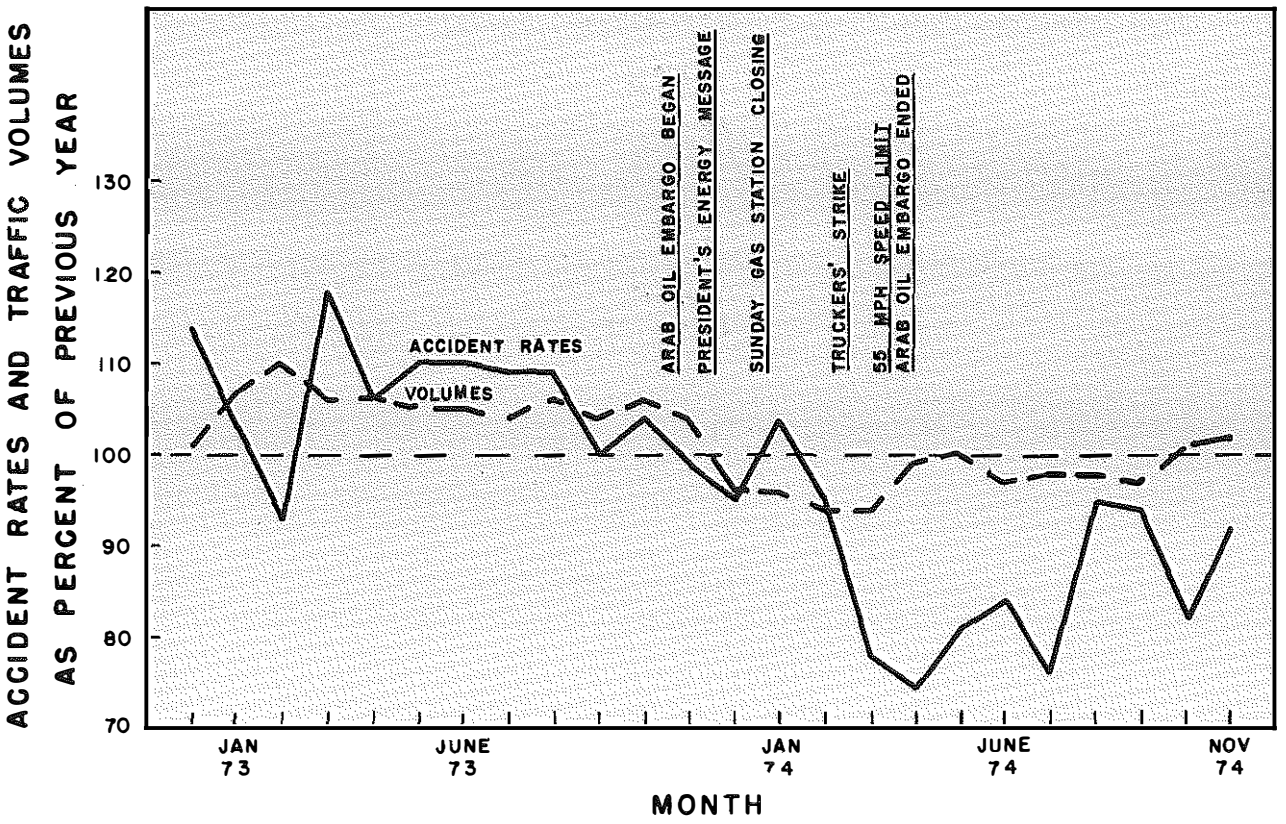


Figure 22. **Comparison of Monthly Accident Rates and Volumes to Corresponding Month in Preceding Year (Total Rural Highway System).**

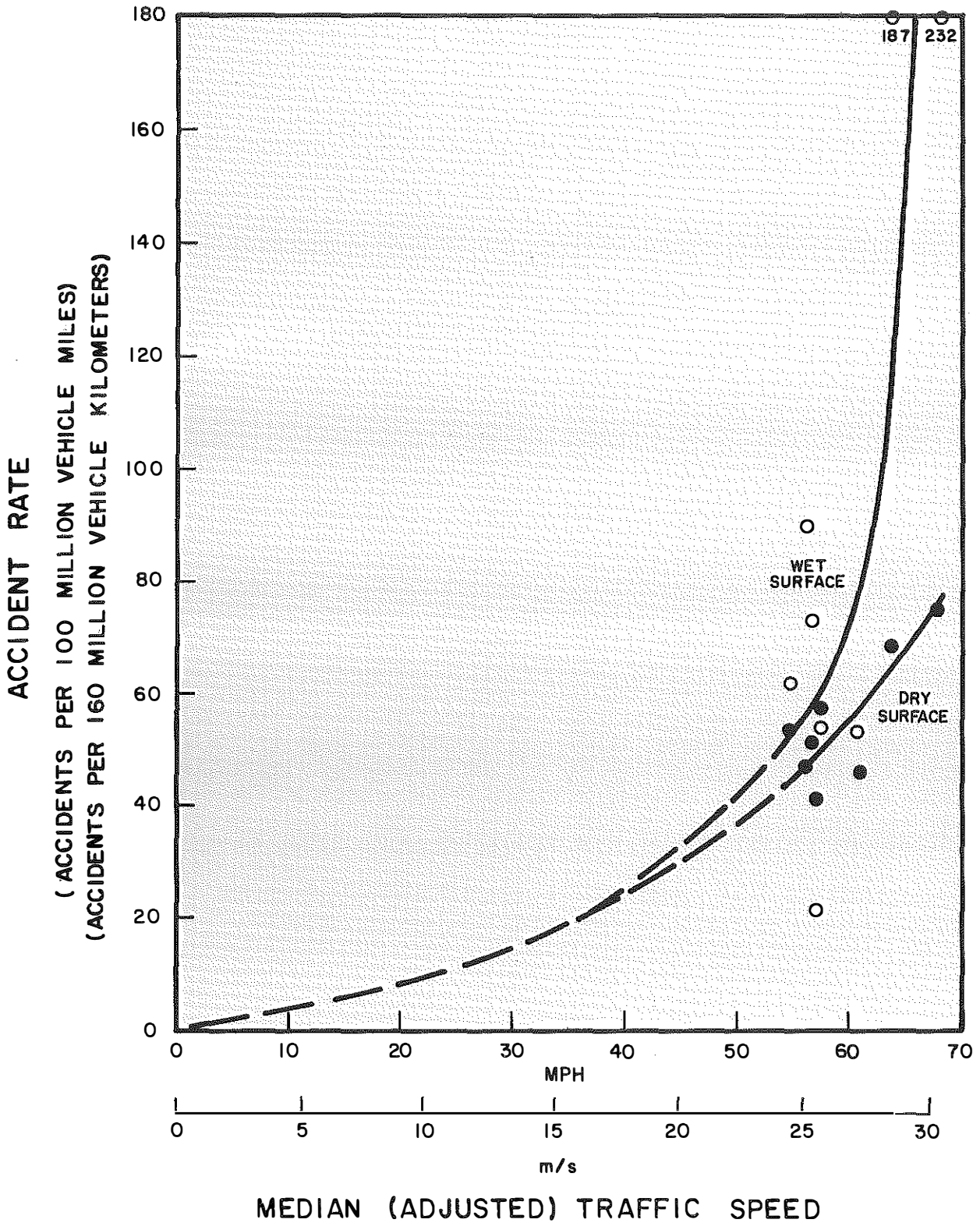


Figure 23. **Relationship between Median Traffic Speed (Adjusted between Automobiles and Trucks) and Accident Rate (Interstate Highways).**

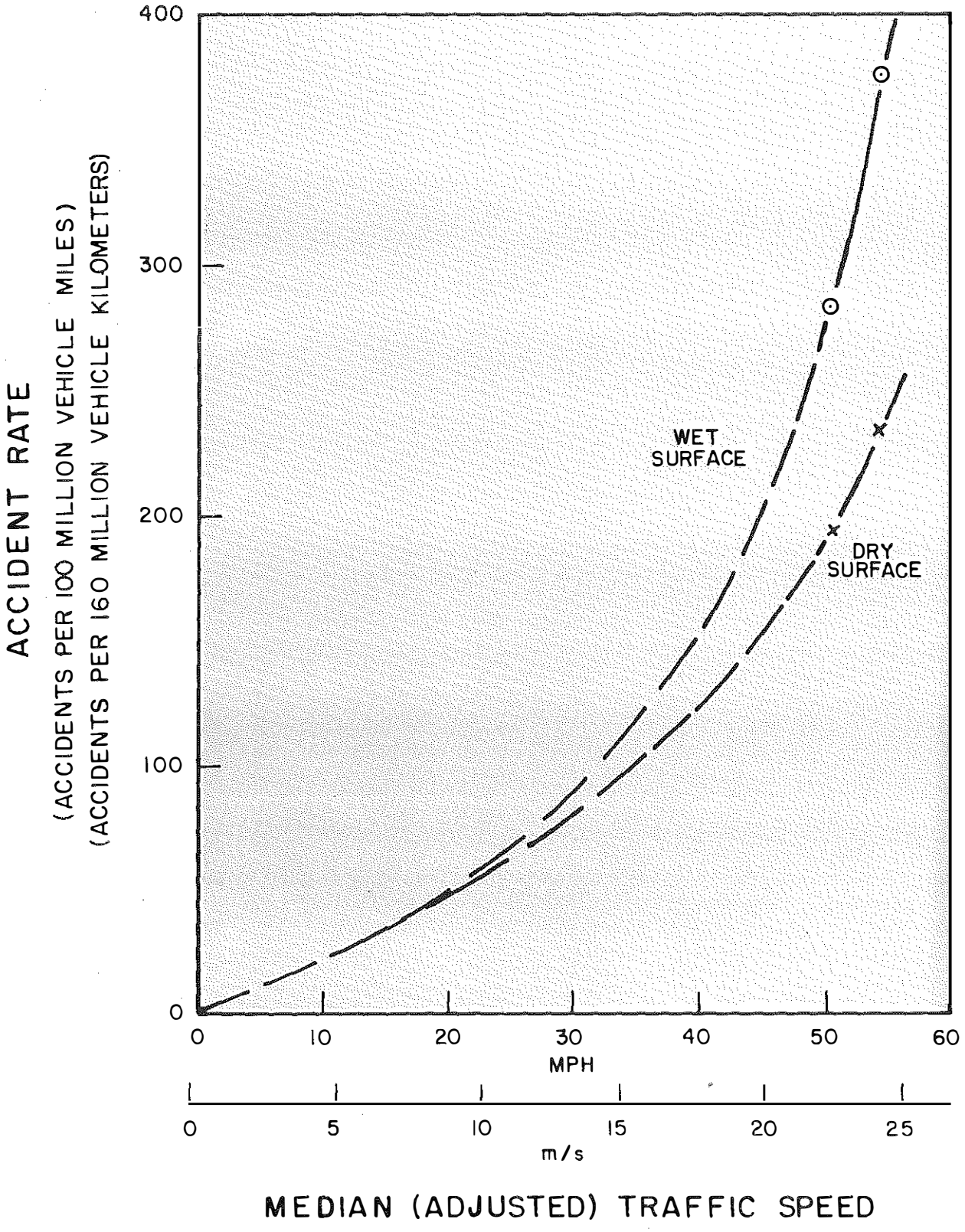


Figure 24 Relationship between Median Traffic Speed (Adjusted between Automobiles and Trucks) and Accident Rate (Two-Lane Highways).

TABLE 9. SUMMARY OF ACCIDENT DATA FOR VARIOUS HIGHWAY TYPES

TYPE OF HIGHWAY	PERIOD[a]	ACCIDENTS			FATALITIES			INJURIES			SEVERITY INDEX
		NUMBER	RATE[b]	RATE DECREASE (percent)	NUMBER	RATE[b]	RATE DECREASE (percent)	NUMBER	RATE[b]	RATE DECREASE (percent)	
Two-Lane	1973	23,276	259		715	8.0		15,132	169		2.78
	1974	20,209	228	12.0	486	5.5	31.2	12,256	138	18.3	2.66
Four-Lane Divided	1973	1,054	160		17	2.6		650	98		2.50
(No Access Control)	1974	815	126	21.2	21	3.2	23.1[d]	506	78	20.4	2.51
Interstate	1973	2,078	92		65	2.9		1,456	64		2.64
	1974	1,395	65	29.3	41	1.9	34.5	865	41	35.9	2.65
Parkway	1973	369	64		21	3.6		268	46		3.21
	1974	288	52	18.8	4	0.7	80.6	167	30	34.8	2.70
Total System[c]	1973	27,183	215		832	6.6		17,768	140		2.77
	1974	23,043	186	13.5	555	4.5	31.8	14,016	113	19.3	2.65

[a]1973 - Dec 1972 through Nov 1973
1974 - Dec 1973 through Nov 1974

[b]Accidents per 100 million vehicle miles (161 million vehicle kilometers)

[c]Also includes three-lane and four-lane undivided (no access control) highways

[d]Increase

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APPENDIX

DETAILED ACCIDENT AND TRAFFIC VOLUME DATA

TABLE A1. DATA FOR TWO LANE HIGHWAYS (21836 MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	658.00	1707	259.4	64	9.7	1006	152.7	2.71
JAN. 1972	576.00	1447	251.2	59	10.2	757	131.4	2.57
FEB. 1972	583.00	1336	229.2	36	6.2	745	127.8	2.63
MAR. 1972	673.00	1407	209.1	62	9.2	917	136.3	2.84
APR. 1972	722.00	1649	228.4	58	8.0	1167	161.6	2.92
MAY 1972	780.00	1872	240.0	64	8.2	1264	162.1	2.82
JUNE 1972	814.00	1841	226.2	59	7.2	1187	145.8	2.76
JUL. 1972	856.00	1948	227.6	57	6.7	1314	153.5	2.92
AUG. 1972	831.00	1794	215.9	61	7.3	1247	150.1	2.88
SEP. 1972	755.00	1912	253.2	78	10.3	1302	172.5	2.92
OCT. 1972	726.00	1940	267.2	64	8.8	1253	172.6	2.74
NOV. 1972	676.00	1816	268.6	50	7.4	1128	166.9	2.69
DEC. 1972	653.00	1887	289.0	47	7.2	1172	179.5	2.66
JAN. 1973	604.00	1587	262.7	54	8.9	864	143.0	2.63
FEB. 1973	634.00	1393	219.7	36	5.7	833	131.4	2.62
MAR. 1973	705.00	1764	250.2	45	6.4	1122	159.1	2.76
APR. 1973	749.00	1835	245.0	44	5.9	1225	163.6	2.73
MAY 1973	801.00	2176	271.7	79	9.9	1588	198.3	2.91
JUNE 1973	853.00	2170	254.4	81	9.5	1409	165.2	2.82
JUL. 1973	887.00	2235	252.0	74	8.3	1468	165.5	2.85
AUG. 1973	870.00	2136	245.5	52	6.0	1438	165.3	2.82
SEP. 1973	782.00	2041	261.0	80	10.2	1431	183.0	2.95
OCT. 1973	750.00	2135	284.7	64	8.5	1404	187.2	2.76
NOV. 1973	691.00	1917	277.4	59	8.5	1178	170.5	2.68
DEC. 1973	627.00	1732	276.2	24	3.8	954	152.2	2.45
JAN. 1974	574.00	1484	258.5	32	5.6	797	138.9	2.41
FEB. 1974	597.00	1237	207.2	30	5.0	693	116.1	2.52
MAR. 1974	671.00	1379	205.5	38	5.7	825	123.0	2.67
APR. 1974	751.00	1400	186.4	48	6.4	864	115.0	2.83
MAY 1974	795.00	1780	223.9	38	4.8	1101	138.5	2.67
JUNE 1974	830.00	1787	215.3	47	5.7	1175	141.6	2.75
JUL. 1974	878.00	1773	201.9	47	5.4	1187	135.2	2.81
AUG. 1974	861.00	1991	231.2	47	5.5	1266	147.0	2.69
SEP. 1974	774.00	1913	247.2	42	5.4	1128	145.7	2.63
OCT. 1974	780.00	1860	238.5	53	6.8	1158	148.5	2.80
NOV. 1974	726.00	1873	258.0	40	5.5	1108	152.6	2.59

TABLE A2. DATA FOR INTERSTATE HIGHWAYS (472 MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	159.00	119	74.8	7	4.4	72	45.3	2.65
JAN. 1972	131.00	137	104.6	4	3.1	83	63.4	2.78
FEB. 1972	135.00	139	103.0	4	3.0	106	78.5	2.83
MAR. 1972	167.00	149	89.2	2	1.2	89	53.3	2.45
APR. 1972	180.00	140	77.8	4	2.2	98	54.4	2.61
MAY 1972	173.00	157	90.8	5	2.9	101	58.4	2.93
JUNE 1972	203.00	169	83.3	4	2.0	119	58.6	2.62
JUL. 1972	231.00	230	99.6	10	4.3	208	90.0	2.97
AUG. 1972	225.00	180	80.0	9	4.0	132	58.7	2.62
SEP. 1972	184.00	163	88.6	9	4.9	135	73.4	2.98
OCT. 1972	178.00	144	80.9	6	3.4	93	52.2	2.75
NOV. 1972	167.00	172	103.0	7	4.2	128	76.6	2.74
DEC. 1972	167.00	175	104.8	1	0.6	103	61.7	2.38
JAN. 1973	142.00	128	90.1	0	0.0	62	43.7	2.25
FEB. 1973	150.00	118	78.7	1	0.7	89	59.3	2.60
MAR. 1973	177.00	198	111.9	11	6.2	133	75.1	2.78
APR. 1973	200.00	214	107.0	3	1.5	146	73.0	2.50
MAY 1973	186.00	170	91.4	6	3.2	138	74.2	2.65
JUNE 1973	210.00	192	91.4	5	2.4	158	75.2	2.86
JUL. 1973	234.00	250	106.8	19	8.1	196	83.8	2.87
AUG. 1973	241.00	182	75.5	6	2.5	130	53.9	2.52
SEP. 1973	188.00	130	69.1	4	2.1	95	50.5	2.69
OCT. 1973	194.00	165	85.1	4	2.1	127	65.5	2.85
NOV. 1973	178.00	156	87.6	5	2.8	79	44.4	2.61
DEC. 1973	151.00	178	117.9	4	2.6	106	70.2	2.57
JAN. 1974	133.00	215	161.7	6	4.5	119	89.5	2.36
FEB. 1974	135.00	114	84.4	3	2.2	87	64.4	3.34
MAR. 1974	156.00	90	57.7	1	0.6	51	32.7	2.96
APR. 1974	185.00	87	47.0	1	0.5	49	26.5	2.32
MAY 1974	186.00	105	56.5	6	3.2	65	34.9	2.94
JUNE 1974	204.00	108	52.9	3	1.5	69	33.8	2.36
JUL. 1974	220.00	90	40.9	3	1.4	50	22.7	2.66
AUG. 1974	229.00	136	59.4	9	3.9	81	35.4	2.72
SEP. 1974	175.00	94	53.7	2	1.1	54	30.9	2.61
OCT. 1974	184.00	81	44.0	1	0.5	57	31.0	2.56
NOV. 1974	173.00	97	56.1	2	1.2	77	44.5	2.68

TABLE A3. DATA FOR FOUR LANE, DIVIDED (NO ACCESS CONTROL) HIGHWAYS(195 MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	46.20	83	179.7	0	0.0	55	119.0	2.76
JAN. 1972	39.70	70	176.3	0	0.0	27	68.0	1.76
FEB. 1972	40.90	59	144.3	0	0.0	21	51.3	2.25
MAR. 1972	46.90	71	151.4	1	2.1	55	117.3	2.68
APR. 1972	49.90	91	182.4	2	4.0	66	132.3	2.73
MAY 1972	52.90	92	173.9	1	1.9	52	98.3	2.67
JUNE 1972	55.30	72	130.2	5	9.0	62	112.1	2.96
JUL. 1972	56.50	96	169.9	0	0.0	64	113.3	2.53
AUG. 1972	58.30	100	171.5	3	5.1	66	113.2	2.83
SEP. 1972	52.90	86	162.6	3	5.7	47	88.8	2.71
OCT. 1972	50.50	110	217.8	2	4.0	64	126.7	2.40
NOV. 1972	48.70	86	176.6	3	6.2	48	98.6	2.48
DEC. 1972	48.70	120	246.4	1	2.1	61	125.3	2.02
JAN. 1973	45.50	72	158.2	2	4.4	35	76.9	2.42
FEB. 1973	46.80	70	149.6	1	2.1	31	66.2	2.54
MAR. 1973	51.70	84	162.5	1	1.9	42	81.2	2.29
APR. 1973	55.00	84	152.7	1	1.8	51	92.7	2.48
MAY 1973	57.80	89	154.0	2	3.5	69	119.4	2.82
JUNE 1973	60.40	73	120.9	2	3.3	64	106.0	3.08
JUL. 1973	62.80	104	165.6	3	4.8	60	95.5	2.37
AUG. 1973	62.80	97	154.5	0	0.0	76	121.0	2.34
SEP. 1973	57.70	81	140.4	3	5.2	61	105.7	2.90
OCT. 1973	57.70	103	178.5	1	1.7	59	102.3	2.74
NOV. 1973	53.00	77	145.3	0	0.0	41	77.4	2.29
DEC. 1973	48.70	82	168.4	0	0.0	47	96.5	2.18
JAN. 1974	46.60	76	163.1	0	0.0	25	53.6	1.76
FEB. 1974	47.00	58	123.4	4	8.5	40	85.1	2.69
MAR. 1974	50.70	62	122.3	3	5.9	41	80.9	3.14
APR. 1974	55.90	57	102.0	2	3.6	33	59.0	2.55
MAY 1974	58.10	65	111.9	0	0.0	40	68.8	1.92
JUNE 1974	59.90	80	133.6	2	3.3	63	105.2	2.78
JUL. 1974	62.20	62	99.7	1	1.6	28	45.0	2.11
AUG. 1974	60.30	82	136.0	1	1.7	57	94.5	2.85
SEP. 1974	54.80	59	107.7	2	3.6	42	76.6	2.64
OCT. 1974	54.80	71	129.6	4	7.3	45	82.1	2.82
NOV. 1974	50.40	61	121.0	2	4.0	45	89.3	2.71

TABLE A4. DATA FOR PARKWAYS (565 MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	36.10	25	69.3	2	5.5	14	38.8	2.68
JAN. 1972	29.80	20	67.1	1	3.4	14	47.0	3.25
FEB. 1972	28.90	20	69.2	0	0.0	12	41.5	3.32
MAR. 1972	37.20	28	75.3	0	0.0	30	80.6	3.11
APR. 1972	39.60	38	96.0	0	0.0	20	50.5	2.33
MAY 1972	40.50	28	69.1	1	2.5	20	49.4	4.14
JUNE 1972	45.10	37	82.0	3	6.7	32	71.0	3.35
JUL. 1972	51.60	28	54.3	1	1.9	26	50.4	3.11
AUG. 1972	50.20	28	55.8	2	4.0	27	53.8	3.96
SEP. 1972	40.50	26	64.2	1	2.5	11	27.2	3.06
OCT. 1972	39.10	20	51.2	0	0.0	10	25.6	2.35
NOV. 1972	38.60	25	64.8	1	2.6	12	31.1	2.96
DEC. 1972	41.00	41	100.0	1	2.4	16	39.0	1.84
JAN. 1973	35.70	34	95.2	2	5.6	27	75.6	3.71
FEB. 1973	35.40	21	59.3	0	0.0	10	28.2	2.69
MAR. 1973	45.80	29	63.3	1	2.2	26	56.8	3.71
APR. 1973	50.10	24	47.9	2	4.0	24	47.9	4.21
MAY 1973	49.40	33	66.8	1	2.0	17	34.4	2.27
JUNE 1973	54.40	29	53.3	3	5.5	28	51.5	4.47
JUL. 1973	59.70	42	70.4	5	8.4	32	53.6	3.48
AUG. 1973	61.60	31	50.3	1	1.6	24	39.0	3.37
SEP. 1973	48.50	25	51.5	0	0.0	14	28.9	3.10
OCT. 1973	49.60	28	56.5	3	6.0	27	54.4	3.41
NOV. 1973	47.80	32	66.9	2	4.2	23	48.1	3.17
DEC. 1973	42.30	40	94.6	0	0.0	13	30.7	2.01
JAN. 1974	37.30	46	123.3	0	0.0	17	45.6	1.78
FEB. 1974	34.50	23	66.7	0	0.0	8	23.2	2.80
MAR. 1974	41.30	12	29.1	1	2.4	12	29.1	4.38
APR. 1974	46.30	17	36.7	0	0.0	11	23.8	2.68
MAY 1974	51.80	33	63.7	0	0.0	29	56.0	3.48
JUNE 1974	54.40	20	36.8	1	1.8	8	14.7	2.23
JUL. 1974	56.00	23	41.1	0	0.0	22	39.3	3.35
AUG. 1974	59.00	22	37.3	2	3.4	15	25.4	3.57
SEP. 1974	44.20	12	27.1	0	0.0	11	24.9	3.04
OCT. 1974	45.00	21	46.7	0	0.0	14	31.1	3.50
NOV. 1974	42.90	19	44.3	0	0.0	7	16.3	1.53

TABLE A5. DATA FOR THREE LANE HIGHWAYS (34 MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	3.81	8	210.0	1	26.2	8	210.0	2.69
JAN. 1972	3.33	5	150.2	0	0.0	3	90.1	2.00
FEB. 1972	3.37	8	237.4	0	0.0	9	267.1	2.38
MAR. 1972	3.89	9	231.4	1	25.7	3	77.1	3.17
APR. 1972	4.17	10	239.8	1	24.0	14	335.7	4.30
MAY 1972	4.50	3	66.7	0	0.0	4	88.9	6.67
JUNE 1972	4.70	9	191.5	0	0.0	3	63.8	2.89
JUL. 1972	4.94	14	283.4	0	0.0	8	161.9	2.14
AUG. 1972	4.80	6	125.0	0	0.0	3	62.5	3.83
SEP. 1972	4.36	7	160.6	1	22.9	8	183.5	5.71
OCT. 1972	4.19	12	286.4	2	47.7	11	262.5	2.83
NOV. 1972	3.91	17	434.8	0	0.0	17	434.8	3.12
DEC. 1972	3.77	14	371.4	0	0.0	6	159.2	2.57
JAN. 1973	3.51	11	313.4	0	0.0	9	256.4	2.91
FEB. 1973	3.67	6	163.5	0	0.0	2	54.5	2.83
MAR. 1973	4.08	9	220.6	0	0.0	8	196.1	4.00
APR. 1973	4.34	10	230.4	0	0.0	4	92.2	2.35
MAY 1973	4.64	7	150.9	2	43.1	10	215.5	3.64
JUNE 1973	4.94	6	121.5	0	0.0	4	81.0	3.25
JUL. 1973	5.14	10	194.6	0	0.0	10	194.6	2.35
AUG. 1973	5.04	6	119.0	0	0.0	1	19.8	1.42
SEP. 1973	4.53	7	154.5	2	44.2	10	220.8	3.64
OCT. 1973	4.36	4	91.7	0	0.0	7	160.6	5.00
NOV. 1973	4.03	8	198.5	0	0.0	8	198.5	3.31
DEC. 1973	3.66	6	163.9	0	0.0	2	54.6	1.83
JAN. 1974	3.36	8	238.1	0	0.0	14	416.7	3.75
FEB. 1974	3.49	7	200.6	0	0.0	3	86.0	1.71
MAR. 1974	3.93	4	101.8	0	0.0	4	101.8	2.88
APR. 1974	4.38	7	159.8	0	0.0	4	91.3	2.93
MAY 1974	4.64	4	86.2	0	0.0	6	129.3	3.50
JUNE 1974	4.84	5	103.3	0	0.0	4	82.6	2.50
JUL. 1974	5.09	11	216.1	0	0.0	7	137.5	1.91
AUG. 1974	4.99	8	160.3	0	0.0	9	180.4	1.94
SEP. 1974	4.48	7	156.3	0	0.0	3	67.0	1.71
OCT. 1974	4.53	5	110.4	1	22.1	4	88.3	4.40
NOV. 1974	4.23	4	94.6	0	0.0	1	23.6	1.62

TABLE A6. DATA FOR FOUR LANE, UNDIVIDED, HIGHWAYS (35MILES)

MONTH	VOLUME (MVM)	TOTAL ACCIDENTS	ACCIDENT RATE (ACC PER 100MVM)	TOTAL FATALITIES	FATALITY RATE (FAT PER 100MVM)	TOTAL INJURIES	INJURY RATE (INJ PER 100MVM)	SEVERITY INDEX
DEC. 1971	8.09	26	321.4	2	24.7	10	123.6	2.79
JAN. 1972	6.96	16	229.9	0	0.0	6	86.2	1.47
FEB. 1972	7.17	26	362.6	1	13.9	14	195.3	2.23
MAR. 1972	8.23	23	279.5	0	0.0	17	206.6	2.39
APR. 1972	8.75	16	182.9	1	11.4	11	125.7	3.81
MAY 1972	9.28	23	247.8	2	21.6	15	161.6	2.13
JUNE 1972	9.70	23	237.1	0	0.0	1	10.3	1.10
JUL. 1972	9.91	23	232.1	0	0.0	20	201.8	3.09
AUG. 1972	10.20	28	274.5	1	9.8	19	186.3	2.36
SEP. 1972	9.28	31	334.1	0	0.0	21	226.3	2.63
OCT. 1972	8.86	25	282.2	0	0.0	12	135.4	2.32
NOV. 1972	8.54	31	363.0	1	11.7	18	210.8	3.05
DEC. 1972	8.54	26	304.4	1	11.7	21	245.9	3.02
JAN. 1973	7.87	23	292.2	2	25.4	15	190.6	2.98
FEB. 1973	8.11	20	246.6	0	0.0	6	74.0	1.80
MAR. 1973	8.97	27	301.0	3	33.4	15	167.2	2.94
APR. 1973	9.54	23	241.1	0	0.0	13	136.3	2.80
MAY 1973	10.00	25	250.0	0	0.0	22	220.0	2.82
JUNE 1973	10.50	22	209.5	1	9.5	19	181.0	3.70
JUL. 1973	10.70	20	186.9	0	0.0	20	186.9	2.98
AUG. 1973	10.60	23	217.0	2	18.9	9	84.9	2.78
SEP. 1973	9.75	33	338.5	0	0.0	14	143.6	1.97
OCT. 1973	9.75	36	369.2	0	0.0	15	153.8	1.96
NOV. 1973	9.23	31	335.9	1	10.8	14	151.7	2.19
DEC. 1973	8.37	19	227.0	0	0.0	18	215.1	2.95
JAN. 1974	7.79	15	192.6	0	0.0	9	115.5	2.40
FEB. 1974	7.86	11	139.9	0	0.0	9	114.5	2.45
MAR. 1974	8.43	8	94.9	1	11.9	2	23.7	4.19
APR. 1974	9.35	17	181.8	0	0.0	11	117.6	1.59
MAY 1974	9.72	26	267.5	0	0.0	11	113.2	2.56
JUNE 1974	9.96	30	301.2	0	0.0	22	220.9	2.45
JUL. 1974	10.60	17	160.4	0	0.0	13	122.6	2.59
AUG. 1974	10.20	25	245.1	0	0.0	15	147.1	2.14
SEP. 1974	9.26	26	280.8	0	0.0	15	162.0	2.10
OCT. 1974	9.26	29	313.2	1	10.8	18	194.4	2.28
NOV. 1974	8.77	26	296.5	0	0.0	18	205.2	2.52