

Shoulder Occupancy on Rural Highways

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• GENERAL DISCUSSION of the Bellis report (1) on "Shoulder Use" at the 1958 HRB meeting pointed up the need for additional studies to determine to what extent leisure and emergency shoulder stops should be provided for or prohibited on various highway systems. The effect of these stopping practices on safety of highway operations was also underscored for investigation.

Of recent interest on this subject is the Policy on Safety Rest Areas for the Interstate System (2). This policy presents a complete statement of the problems involved, recommendations for location of sites, and geometric design procedures. Moreover, these policy recommendations lend themselves to general highway usage.

This policy does not prescribe the optimum number of safety rest area sites or indicate minimum or average distances between sites. These decisions depend on local conditions and are related in part to the characteristics of driver behavior on the highway sections under examination. Factual data, needed for making these decisions, can only be obtained by observing and analyzing the habits of drivers and relating such data to other essential information. This thought is well expressed in the AASHO policy "Location and Spacing of Sites" (2, p. 7), as follows:

It is not feasible to indicate minimum or average distances between sites because of the many controlling factors such as traffic volume, topography, availability of favorable local sites, distances between interchanges, distances between available service facilities on crossroads (or frontage roads), extent and character of development along the highway, climatic limitations of use, etc. In general, a sufficient number of sites should be planned along the highway to reasonably accommodate the safety rest needs of Interstate highway travelers and, further, to encourage drivers to use them as

a safety measure to break long periods of travel. Safety rest areas should be provided so that in combination with other stopping opportunities within or near cities and at service facilities on crossroads with interchange connections, there preferably will be facilities available for short stops about every one-half hour driving time.

The foregoing discussions reflect the need for driver behavior information related to stopping practices on highways.

SCOPE OF SURVEY

Early in June 1958, a proposed study on shoulder occupancy was explored in conference with local officials of the Bureau of Public Roads and Mr. Taragin of their Traffic Operations Division of Research. As a result, the Traffic Surveys and Study Section, New York's Bureau of Highway Planning, scheduled a study of driver behavior to collect and analyze information pertaining to highway shoulder occupancy. The primary purpose of this study was to determine the frequency of shoulder use for leisure and emergency stops on rural highways. The stopping practices and related accident potential were also investigated.

In 1949, in conjunction with the Highway Needs Study of that year, New York's highways were classified into three systems, as follows:

1. Interstate and Interregional.
2. Intercity.
3. Feeder.

In 1951, these three classifications (described in the Appendix) were used in the establishment of 33 sites for an annual statewide study of speed. These spot speed sites were adopted as focus points for the survey and approximately 5-mile sections of highway (the maximum distance determined by test for a patrol car to intercept drivers stopping on shoulders for at least five minutes)

centered on each of these focus points were selected for study. All widths of pavement typical of rural New York highways were represented by the 33 sites, providing a basis for an analysis in relation to lanes of travel as well as highway classification.

DESCRIPTION OF STUDY SECTIONS

The statewide sample of study sections was distinguished by the following groupings: On the Interstate and Inter-regional System, there were five 2-lane,

four 3-lane, and one 4-lane sections; on the Intercity System, eleven 2-lane and three 4-lane; and on the Feeder System, eight 2-lane and one 4-lane sections. The total length of the sections was 159.3 miles.

The widths and types of shoulders represented by the study sections were typical of the range of widths and types found on the rural highway system. The range of shoulder width varied from 4 to 35 ft at the locations of the observed stops. Figures 1 through 6 are typical



Figure 1. Typical view of New York highway, showing shoulder detail.



Figure 2. Typical view of New York highway, showing shoulder detail.

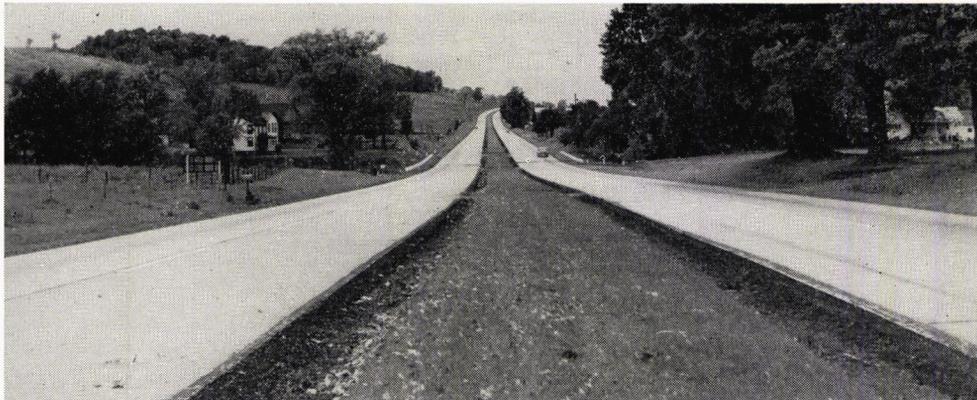


Figure 3. Typical view of New York highway, showing shoulder detail.

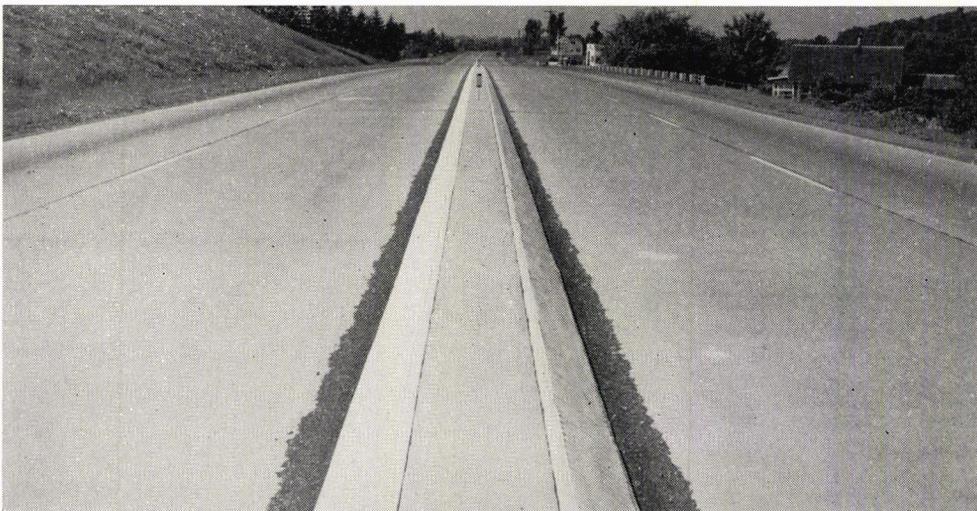


Figure 4. Typical view of New York highway, showing shoulder detail.

views of rural New York highways, showing cross-section details. In the course of the study it was noted that on practically all study sections there was at least one width and length of shoulder providing an undeveloped area for vehicles to park well off the pavement.

Traffic-wise, the 1957 average annual daily traffic data for the 33 study sections provided a range from about 1,700 to more than 11,000 vehicles per day for analysis. More than one-half million vehicle-miles of travel were recorded on the sections during the study.

PROCEDURE

Plans were made to interview drivers stopping along the highway, within the study sections, by means of a pre-tested questionnaire. Data recorded on this questionnaire included, in general, the geometrics of the highway at the stopping point, information about the vehicle and number of occupants, travel and trip information, placement of the vehicle on the shoulder and the traffic count for the period of the study. Figure 13 (Appendix), is a facsimile of the questionnaire used and shows the details of the recorded data.



Figure 5. Typical view of New York highway, showing shoulder detail.



Figure 6. Typical view of New York highway, showing shoulder detail.

In the pre-test of the questionnaire, it was determined that the most feasible period for the study was on weekdays during the daylight hours, generally from 8:00 A.M. to 8:00 P.M. The hazards of intercepting drivers stopped on shoulders during the hours of darkness precluded this technique.

Each of the 33 study sections was patrolled by a crew of two student engineers using an automobile continuously from 8:00 A.M. to 8:00 P.M., during the daylight hours of the selected weekday. Drivers stopped along the highway were

intercepted and interviewed using the questionnaire as a guide for answers. Measurements of the highway cross-section at stops were made immediately after the interview and recorded on the questionnaire. Traffic counts on the study sections were taken by mechanical counters and checked by a manual count maintained by the observers and a third student engineer. The study extended from June 20 through August 25, 1958 and was not interrupted by inclement weather.

The district offices were canvassed to

furnish the reported accident history of the study sections for a 6-year period from 1952 through 1957. The average annual daily traffic counts for these years for each study section were obtained from records maintained in the main office of the Bureau of Highway Planning. These data were collected to analyze the potential accident hazard in relation to stopping practices observed.

ANALYSIS

Frequency of Stops by Highway Classification and Lane of Travel

Data for each study site, including the number and classification of shoulder stops (leisure, emergency and business), were recorded and tabulated by highway classification and travel lanes as shown in Table 6 (Appendix). The vehicle-miles of travel for each site for the 12-hr period of study were next computed and recorded. Finally, the frequency of each classification of stop by type of vehicle, using vehicle-miles of travel as a measure, was computed.

There were 205 leisure, 42 emergency,

and 20 business stops, for a total of 267 drivers who were interviewed at shoulder stops and complete information obtained. Incomplete information was obtained at only 15 stops, and not used in the analysis. Drivers from 17 states outside of New York, Canada and British Columbia were represented in the interviews. Besides the Northeastern States, Ohio, Virginia, Illinois, Michigan, Indiana, Mississippi and Iowa were represented. Thirty-one percent of the stops were by out-of-state vehicles and 69 percent by New York registered vehicles. Twenty percent of the vehicles interviewed at stops were trucks; 80 percent were passenger cars.

As the study sites were located predominately in rural areas, the small number of business stops was incidental to the study and omitted in the analysis, except to reflect statistics for total data.

The frequency of leisure and emergency stops by highway classification and lanes of travel is shown graphically in Figure 7. The statewide average frequency of leisure stops was one for 2,800 vehicle-miles of travel. For both the

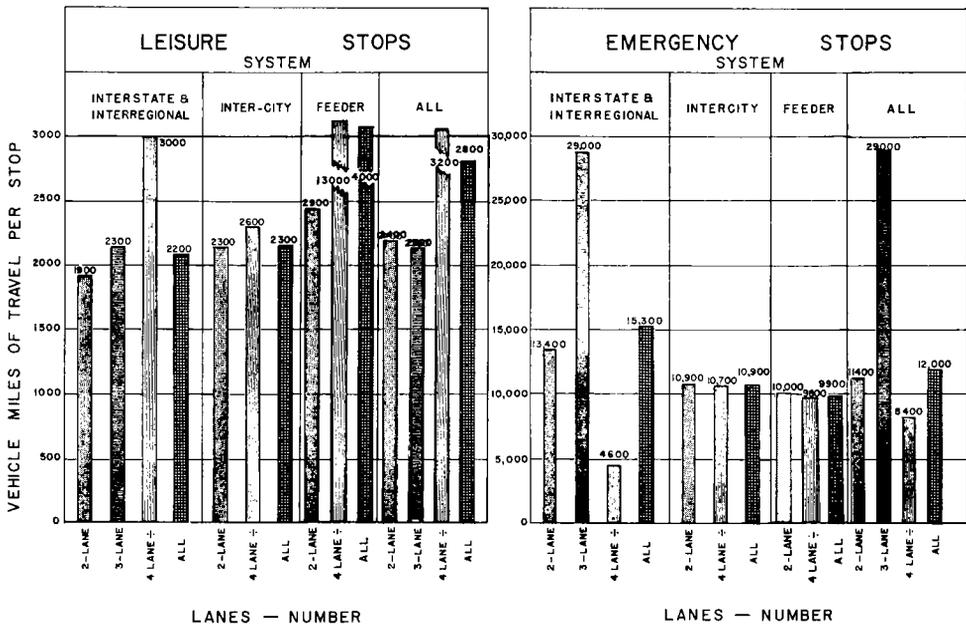


Figure 7. Frequency of stops on shoulder, by lane of travel and system.

Interstate and Interregional and Intercity Systems this frequency was slightly higher, whereas for the Feeder System it was somewhat lower. Within each system, the frequency of leisure stops was lowest for the 4-lane divided highways. This is to be expected, as the longer distance drivers are less inclined to stop voluntarily.

The statewide average frequency of emergency stops was one for 12,000 vehicle-miles of travel. For both the Intercity and Feeder Systems this frequency was slightly higher, whereas for the Interstate and Interregional System it was somewhat lower. Within the Interstate and Interregional System the frequency of emergency stops was significantly higher for the 4-lane divided highways and lower for the 3-lane highways, whereas within the Intercity and Feeder Systems it was quite uniform. It is interesting to note from the study that, on the average, leisure stops were about four times as frequent as emergency stops.

Frequency of Stops by Lane of Travel and AADT Volume Groupings

To investigate the relation between the frequency of leisure and emergency stops with traffic volume, the field and travel data (Table 6) were sorted by lanes of travel regardless of highway classification and combined into volume groupings using the 1957 AADT for each site as an index. The frequency of leisure and emergency stops by type vehicle using vehicle-miles of travel as a measure were computed for each volume group using the combined data (Table 1).

From an examination of the data by lane of travel (Table 1), it appears that there is no significant relation between the frequency of either leisure or emergency stops and the various AADT volume groupings except, as would be expected, the frequency of stops is higher on the lightly traveled local highways (2-lane under 2,000 AADT and 4-lane under 5,000 AADT) than on the heavier traveled highways.

Discussion

The foregoing analyses indicate the effect of considering the types of traffic (2), as defined by travel lane and highway system classification, for determining design factors in providing for safety rest areas. The effect of type of traffic on these kinds of statistics is effectively illustrated by comparison of comparable data for the New Jersey (1) and New York studies.

	Vehicle-Miles of Travel	
	New Jersey	New York
Frequency of leisure stops, all vehicles	480	2,800
Frequency of emergency stops, all vehicles	11,800	12,000
Ratio, leisure to emergency passenger car stops	13.7	6
Ratio, leisure to emergency truck stops	33.8	2.2
Ratio, leisure to emergency stops, all sites	24.6	4.3

It is believed that the higher frequency of the New Jersey leisure stops was generally due to the location of the study sites on comparatively short sections of rural highways contiguous with urban areas. However, the one consistent statistic between the two states is the frequency of emergency stops for all vehicles, one per 12,000 vehicle-miles of travel with 20 percent truck stops.

Before turning attention to the related characteristics of the drivers stopping on shoulders, it may be interesting to point up the volume of leisure and emergency stops expected annually on the New York rural highway system. In 1957, there were 22,800 million vehicle-miles of travel (3) on the New York State rural system. Based on a frequency of one leisure and emergency stop for each 2,800 and 12,000 vehicle-miles of travel, respectively, there would occur annually more than 8 million leisure stops and about 2 million emergency

TABLE 1
FREQUENCY OF LEISURE AND EMERGENCY STOPS ON SHOULDERS BY LANES OF TRAVEL AND AADT VOLUME GROUPINGS

No. of Study Sites	AADT Grouping (1957)	Highway Length (mi)	Identification and Field Data										Frequency of Stops (veh.-mi./stop)																																																																																																			
			Shoulder Stops Interviewed (no.)					Shoulder Stops					Leisure					Emergency																																																																																														
			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Trucks	Pass. Cars	All																																																																																							
(a) 2-LANE HIGHWAYS																																																																																																																
5	Under 2,000	24.5	2	33	35	1	6	7	3	39	42	61,416	30,700	1,900	1,800	61,400	10,200	8,800	20,500	1,600	1,600	1,600	24.7	2	19	21	0	3	3	2	22	24	49,426	24,700	2,600	2,400	24,700	16,500	16,500	24,700	2,300	2,300	2,300	37.5	7	29	36	3	6	9	10	35	45	90,033	12,900	3,100	2,500	30,000	15,000	15,000	9,000	9,000	9,000	2,600	2,600	2,600	15.0	4	19	23	5	0	5	9	19	28	52,826	13,200	2,800	2,300	10,600	10,600	10,600	5,900	5,900	5,900	2,800	2,800	2,800	2	Over 5,000	8.6	0	10	10	0	1	1	0	11	11	26,824	—	2,700	2,700	—	26,800	26,800	—	2,400	2,400	2,400
(b) 3-LANE HIGHWAYS																																																																																																																
4	5,000-10,000	21.2	10	40	50	1	3	4	11	43	54	116,109	11,600	2,900	2,300	116,100	38,700	29,000	10,600	2,700	2,700	2,200																																																																																										
(c) 4-LANE + HIGHWAYS																																																																																																																
3	Under 5,000	16.4	8	20	23	3	4	7	6	24	30	44,649	14,900	2,200	1,900	14,900	11,200	6,400	7,400	1,900	1,900	1,500	5.1	0	4	4	0	2	0	6	6	6	27,397	—	6,800	6,800	—	13,600	13,600	—	4,600	4,600	4,600	3.8	1	2	3	0	4	1	6	7	39,129	39,100	19,600	13,000	—	9,800	9,800	39,100	6,500	6,500	6,500																																																	
(d) ALL HIGHWAYS																																																																																																																
All	—	159.3	29	176	205	13	29	42	42	205	247	507,809	17,500	2,900	2,800	39,100	17,500	12,000	12,100	2,500	2,500	2,100																																																																																										

stops on rural highways in New York. This does not include stops on the urban system, for which there were more than 23,000 million vehicle-miles of travel in 1957.

Type and Purpose of Stopping

Table 2 gives the number and percentage of stops on shoulders for passenger cars, trucks, and all vehicles, by type and purpose of stop. Seventy-three percent of the stops were leisure, 15 percent were emergency, and seven percent were business stops. Fifteen (5 percent) of the stops interviewed were not included in the analysis due to incomplete information.

Figure 8 shows that 43 percent of all the leisure stops were for eating and 36 percent for resting and sleeping. Forty-seven percent of the car and only 14 percent of the truck stops were for eating, whereas 83 percent of the truck and only 28 percent of the car stops were for resting and sleeping. Twenty-five percent of the car stops were for a variety of purposes.

Also, 48 percent of the emergency stops were for making repairs and 52 percent for checking vehicles. Sixty-five

percent of the car and only 8 percent of the truck stops were for making repairs, whereas 92 percent of the truck and only 35 percent of the car stops were for checking vehicles.

Reasons for Emergency Stops

The purpose of the emergency stops were re-examined to determine more precisely the individual reasons for the stops. Table 3 gives the number and percentage of emergency stops for passenger cars, trucks, and all vehicles, by reason. Thirty-seven percent of the stops by cars were for flat tires, 27 percent for checking equipment, 15 percent on account of mechanical failures, 12 percent due to overheating of motors, and smaller percentages on account of car sickness and running out of gas. Seventy-seven percent of the stops by trucks were for checking equipment, 15 percent on account of mechanical failure, and 8 percent due to overheating of motors.

Length of Trips

To determine the trip characteristics of the various classes of drivers stopping on shoulders, the length of trip data for the sample were tabulated by study site and highway classification for local and other New York drivers and for out-of-state drivers (Table 7, Appendix). Figure 9 illustrates the results of this tabulation. The average trip for the out-of-state drivers varied from 750 miles on the Interstate System to 650 on the Intercity and 275 miles on the Feeder Systems. Likewise, the New York drivers other than local drivers averaged 250 miles per trip on the Interstate, 200 on the Intercity and 150 miles on the Feeder Systems.

The average trip for all out-of-state drivers was 3½ times that for all New York drivers (700 against 200 miles); however, only a small number of out-of-state trucks (9), averaging 500-mile trips, were represented in the sample.

Considering travel by type of vehicle, the average trip for New York truck drivers was 200 miles, whereas the out-

TABLE 2
SUMMARY OF TYPE AND PURPOSE OF STOPS ON SHOULDERS

Stop	Type	Purpose	Pass. Cars		Trucks		All	
			No.	% Tot.	No.	% Tot.	No.	% Tot.
Leisure	Eat		83	47	4	14	87	43
	Rest and sleep		50	28	24	83	74	36
	Fish and swim		8	5	0	—	8	4
	Observe scenery		8	5	0	—	8	4
	Check maps		18	10	1	3	19	9
	Walk dogs		2	1	0	—	2	1
	Child care		4	2	0	—	4	2
	Change drivers		3	2	0	—	3	1
	Total		176	100	29	100	205	100
Emergency	Repairs		19	65	1	8	20	48
	Check vehicle		10	35	12	92	22	52
	Total		29	100	13	100	42	100
Business	Hwy. maint.		3	25	5	63	8	40
	Other*		9	75	3	37	12	60
	Total		12	100	8	100	20	100
Other	No information		15	—	0	—	15	5
All	All		232	82	50	18	282	100

* Utility and other business vehicles.

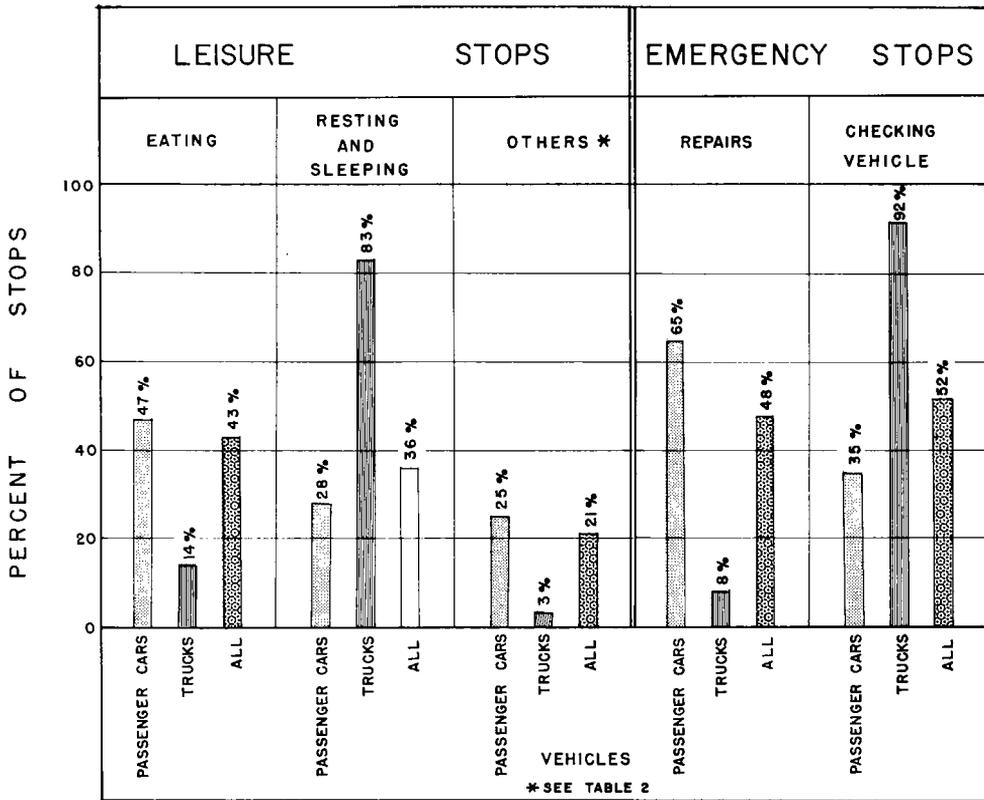


Figure 8. Percentage of stops on shoulders, by type and purpose of stop.

out-of-state truck drivers traveled an average of 500 miles per trip. New York car drivers traveled an average of 200 miles per trip, whereas the out-of-state car drivers traveled an average of 700 miles per trip. It is significant to note that New York truck and car drivers average about the same length of trip (200 miles).

TABLE 3
SUMMARY OF REASONS GIVEN BY DRIVERS FOR EMERGENCY STOPS ON SHOULDERS

Reason	Passenger Cars		Trucks		All	
	No.	%	No.	%	No.	%
Mech. failure	5	15	2	15	7	15
Flat tire	12	37	0	—	12	26
Checking equip.	9	27	10	77	19	42
Overheating	4	12	1	8	5	11
Out of gas	1	3	0	—	1	2
Car sickness	2	6	0	—	2	4
Total	33 ^a	100	13	100	46	100

^a 4 included from the incomplete information group.

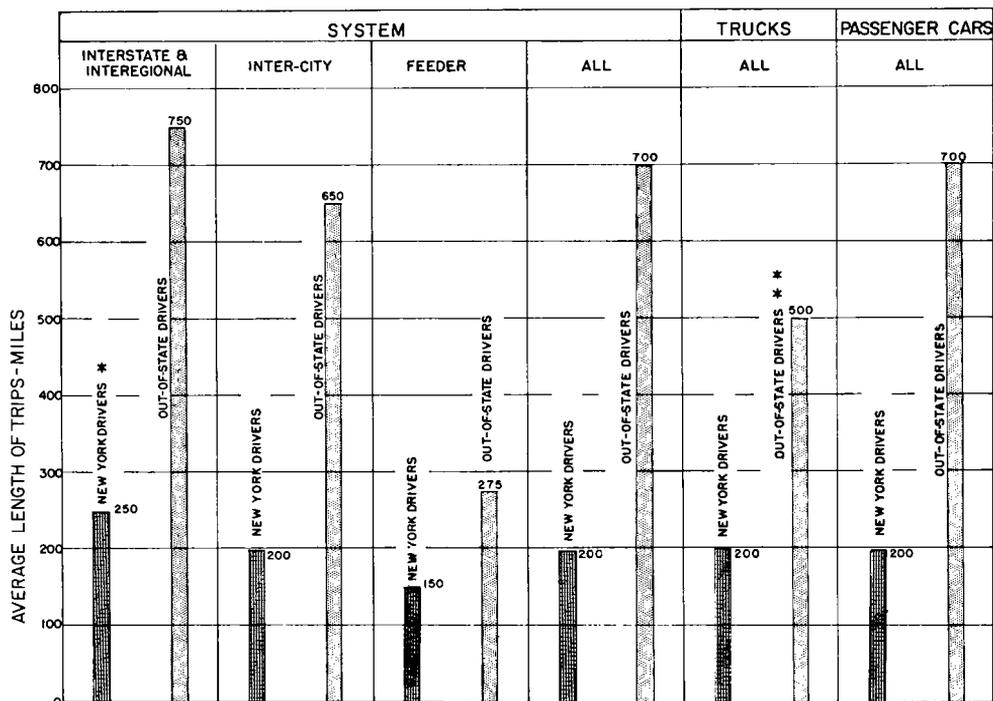
Reasons for Travel

A summary of the reasons for travel given by drivers interviewed at stops on shoulders is given in Table 4. Business and vacation each accounted for 36 percent of the trips, 19 percent of the drivers were on pleasure trips, and 3 percent were on trips to visit relatives. No information on this subject was obtained for 6 percent of the drivers.

Hours Driven Since Last Stop

Figure 10 shows the cumulative frequency distribution of hours driven since last stop by New York and out-of-state drivers. The average time between leisure stops for New York drivers was about 2 1/4 hours, whereas for the out-of-state drivers it was about 2 3/4 hours.

A separate analysis of the distribution



* LOCAL NEW YORK DRIVERS, TRIPS UNDER 10 MILES NOT INCLUDED.
 ** ONLY 9 DRIVERS IN SAMPLE.

Figure 9. Average length of trips for New York and out-of-state drivers stopping on shoulders, by system and type of vehicle.

TABLE 4
 SUMMARY OF THE REASONS FOR TRAVEL GIVEN BY DRIVERS INTERVIEWED AT STOPS ON SHOULDERS

Reason	Number	% Total
Business	96 ^a	36
Vacation	95	36
Pleasure	50	19
Visit relatives	9	3
Unknown	17	6
Total	267	100

^a Home-to-work trips included.

of hours driven since last stop was made for out-of-state (31 percent) and New York (69 percent) drivers, because of the significance of the time element between stops and their average trip lengths (700 against 200 miles) in the determination of the location and spacing of safety rest area sites. Judicial notice should be taken here that the AASHO policy suggests facilities for short stops about every one-half hour of driving time (2,

p. 7). Eighty-eight percent of the New York drivers and 95 percent of the out-of-state drivers exceeded 1/2 hour between leisure stops.

Time of Day and Length of Leisure Stops

To provide a guide for space requirements in safety rest areas, the time of the daytime leisure stops was investigated and the percentages of all leisure stops were related to time of day by hours as follows:

Time of Day	Percentage of Leisure Stops
8-9 A.M.	2
9-10 A.M.	5
10-11 A.M.	11
11-12 A.M.	12
12-1 P.M.	12
1-2 P.M.	18

2-3 P.M.	12
3-4 P.M.	9
4-5 P.M.	7
5-6 P.M.	4
6-7 P.M.	5
7-8 P.M.	3
Total	100

between the hours of 1:00 and 2:00 P.M., with a more or less uniform decrease during the afternoon hours after 3:00 P.M., to 3 percent between the hours of 7:00 and 8:00 P.M. There appears to be a leveling off of leisure stops at 12 percent of the total between the hours of 10:00 A.M. and 1:00 P.M., with 42 percent of the total stops between noon and 3:00 P.M.

Apparently, the daytime leisure stops in New York increase from 2 percent of the total between the hours of 8:00 and 9:00 A.M., to a maximum of 18 percent

The length of time of stopping is also an important factor in exploring space

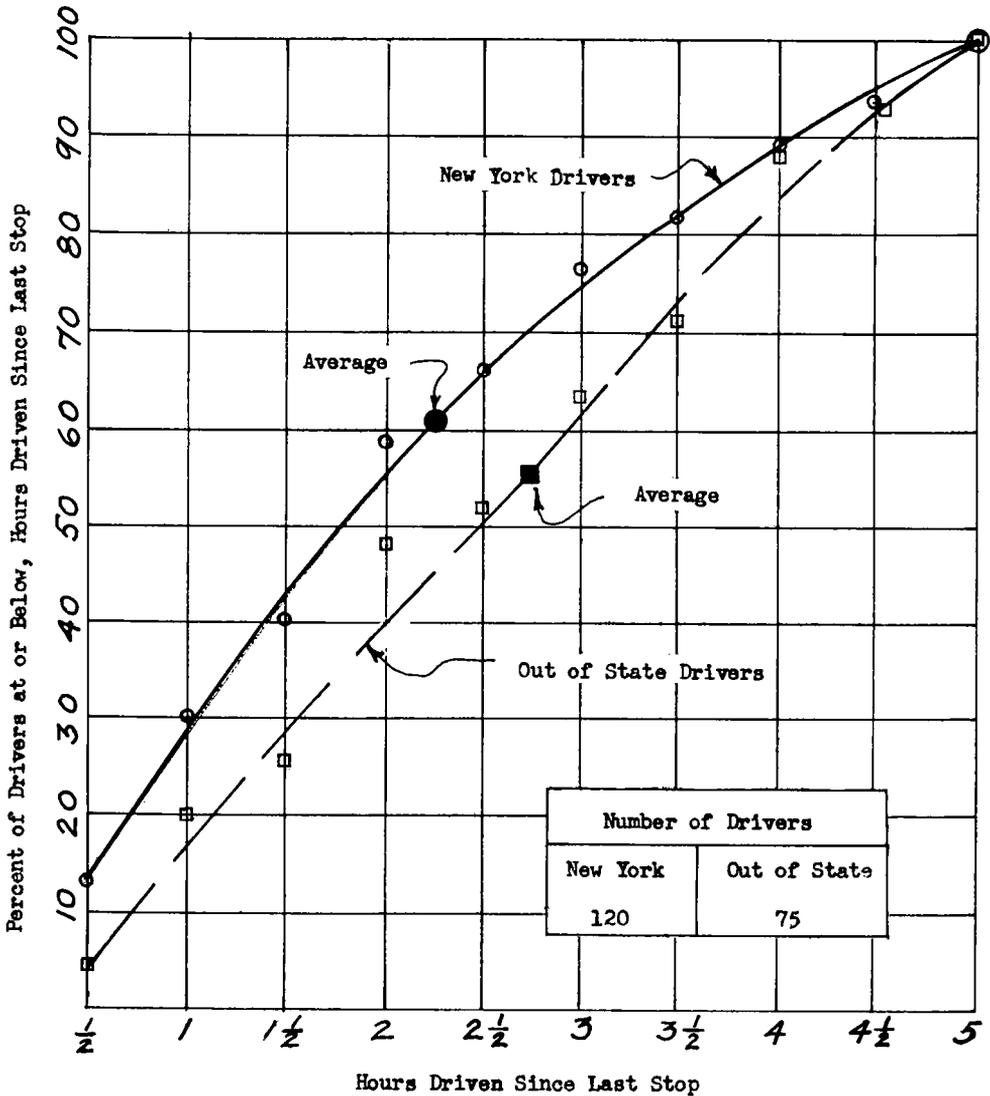


Figure 10. Cumulative frequency distribution of hours driven since last stop by drivers stopping on shoulders.

requirements for safety rest areas, in order to determine the turnover of parking space. These data for all leisure stops were tabulated; the results are shown (Fig. 11) by the cumulative frequency distribution of lengths of leisure stops for drivers stopping on shoulders.

Figure 11 shows that the average length of leisure stops for the sample was about 30 minutes and the median value about 20 minutes. It is to be noted that stops over 45 minutes in length constitute only 6 percent of all the stops.

Distance From Edge of Pavement to Vehicles Stopping on Shoulders

Figure 12 shows the cumulative frequency distribution of distances from

the edge of pavement for 155 vehicles stopping on the shoulder. Only about 3 percent of the vehicles stopped with a distance of 6 feet or more between the edge of pavement and near side of vehicle. Thus, during the length of stops, 97 percent of the vehicles stopping on shoulders presented a continuous accident hazard potential to moving traffic.

Accident Potential of Stopping Practices

On highways where properly designed rest areas are not provided, a vehicle having to stop will influence the normal smooth flow of traffic when it decelerates and again when it resumes its normal speed. Furthermore, it has been found (4) that vehicles parked on

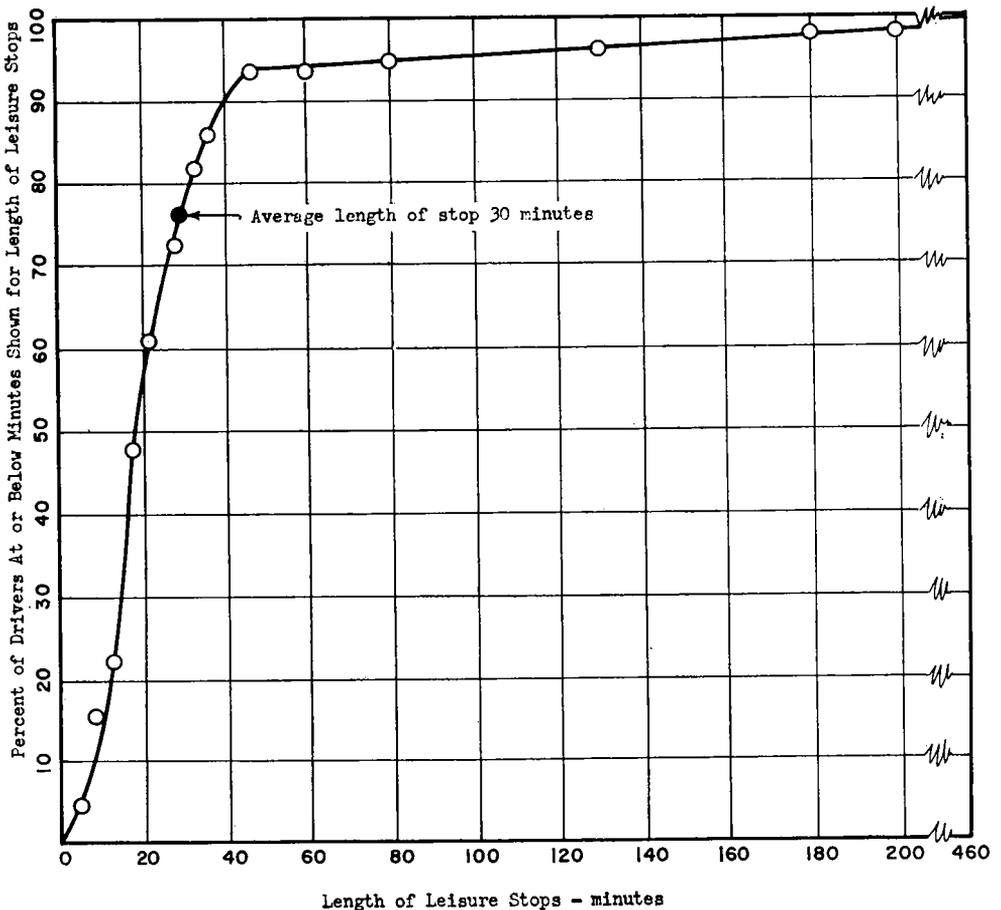


Figure 11. Cumulative frequency distribution of lengths of leisure stops for drivers stopping on shoulders.

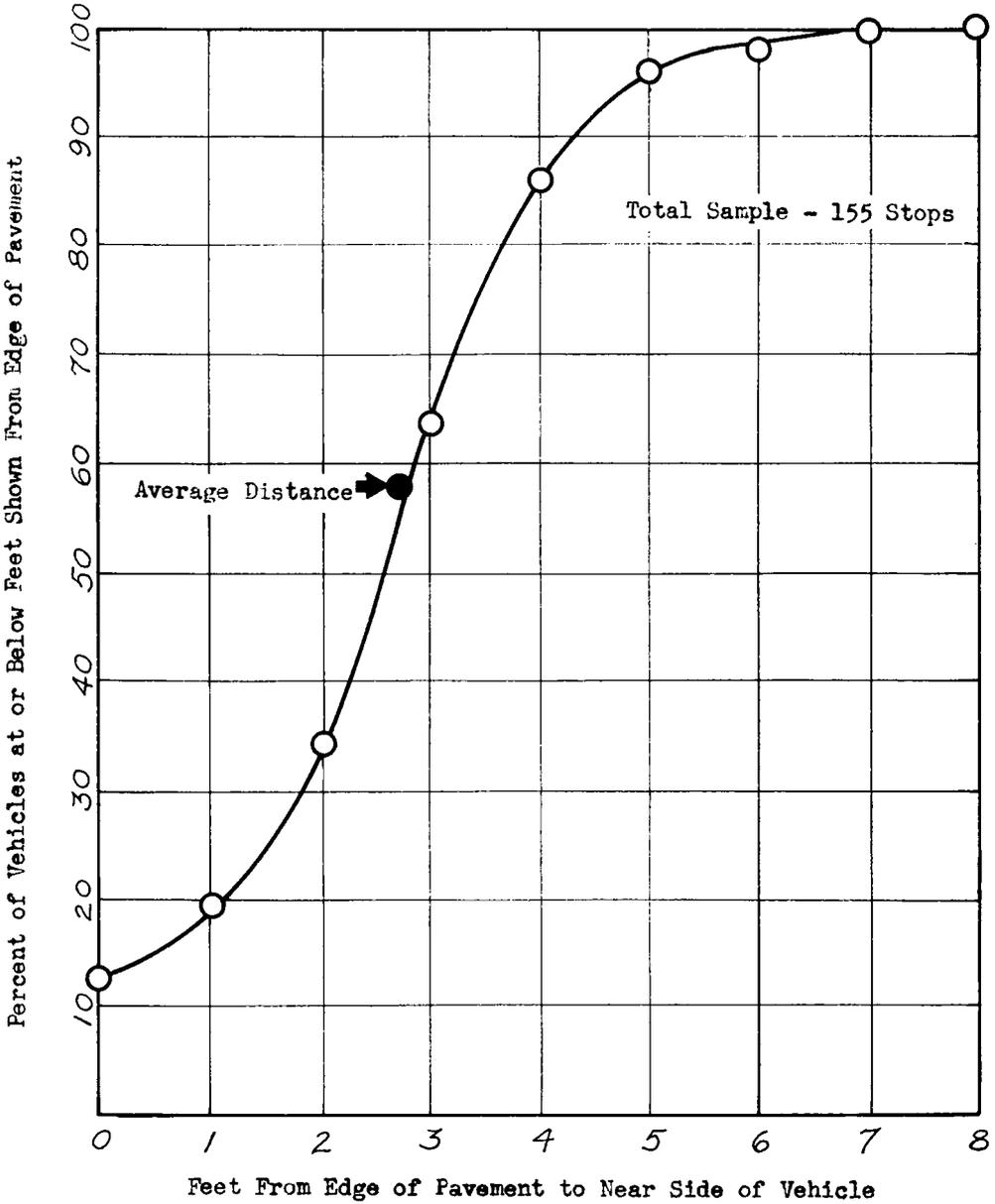
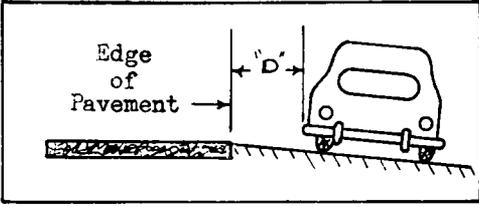


Figure 12. Cumulative frequency distribution of distances from edge of pavement for vehicles stopping on shoulders.

shoulders have an effect on the transverse placement of vehicles in the stream of traffic. This effect increases as the vehicle is parked closer to the edge of the pavement; therefore, the lateral clearance between vehicles desirable for comfort and safety decreases. In some cases, vehicles will cross the centerline due to such objects on the shoulder.

Thus, for each stop on the shoulder there are two interferences with normal traffic, each of which reduces capacity and sets up an accident hazard potential.

To determine the extent of the accident hazard caused by stopping practices, the district offices furnished from their records accident history facts for each study site covering the 6-year period from 1952-57. The vehicle-miles of travel for this period for each site were compiled and the individual site rates for all accidents, fatal, personal injury and property damage were computed.

Rates for shoulder accidents were determined from a separate list of shoulder accidents for the 6-year period. These individual site accident data were arranged by highway system and lane of travel, as shown in Table 8 (Appendix).

It appears, from a comparison of these over-all accident rates with the Motor Vehicle Bureau statistics, that the sample is representative of the accident history of the rural system.

Analysis of Accident Rates

Table 5 shows the accident data arranged by lane of travel and 1957 AADT volume groupings. The last column of this table shows the contribution of shoulder accidents to all accidents.

Shoulder accidents on 2-lane highways represented about 2½ percent of all accidents, with the highest contribution in the 3-4,000 AADT volume group (4

TABLE 5
ACCIDENT HISTORY OF STUDY SITES FOR THE 6-YEAR PERIOD FROM 1952 THROUGH 1957, BY LANES OF TRAVEL AND AADT VOLUME GROUPINGS

Identification and Field Data			Travel	Accident Data for 6-Year Period 1952-57 ^a										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of Sites Incl.	AADT Grouping (1957)	Highway Length (mi)	Vehicle Travel (MVM) ^b	Total Accidents		Fatal ^c		Injury		Prop. Damage		Shoulder Accidents ^d		
				No.	Rate per MVM ^b	No.	Rate per MVM ^b	No.	Rate per MVM ^b	No.	Rate per MVM ^b	No.	Rate per MVM ^b	% Shoulder of All Accidents
(a) 2-LANE HIGHWAYS														
5	Under 2,000	24.5	122.9	98	0.80	10	0.08	27	0.22	63	0.51	3	0.02	2.5
6	2,000-3,000	27.2	155.9	377	2.42	20	0.13	215	1.33	144	0.92	2	0.01	0.5
8	3,000-4,000	37.5	276.1	515	1.87	22	0.08	329	1.19	167	0.61	20	0.07	4.0
3	4,000-5,000	15.0	138.4	126	0.90	1	0.01	42	0.30	83	0.59	3	0.02	2.0
2	Over 5,000	8.6	125.1	249	1.99	16	0.13	106	0.85	128	1.02	3	0.02	1.0
24	Total 2-lane	112.8	818.4	1,365	1.67	69	0.08	719	0.88	585	0.71	31	0.04	2.5
(b) 3-LANE HIGHWAYS														
4	5,000-10,000	21.2	285.2	417	1.46	13	0.05	192	0.67	212	0.74	13	0.05	3.0
(c) 4-LANE + HIGHWAYS														
3	Under 5,000	16.4	84.5	69	0.82	1	0.01	36	0.43	32	0.38	5	0.06	7.0
1	5,000-10,000	5.1	45.1	56	1.24	1	0.02	23	0.51	32	0.71	2	0.04	3.0
1	Over 10,000	3.8	85.1	65	0.76	2	0.02	35	0.41	28	0.33	2	0.02	3.0
5	Total 4-lane	25.3	214.7	190	0.88	4	0.02	94	0.44	92	0.43	9	0.04	4.5
(d) ALL HIGHWAYS														
33	All	159.3	1,318.3	1,972	1.50	86	0.07	1,005	0.76	889	0.68	53	0.04	3.0

^a As reported by District Offices.

^b Million vehicle-miles.

^c Total fatalities.

^d Accidents involving vehicles occupying shoulder (see Appendix for general description).

percent) and the lowest in the 2-3,000 AADT volume group ($\frac{1}{2}$ percent). On 4-lane divided highways, the shoulder accidents represented about $4\frac{1}{2}$ percent of all accidents, with the highest contribution in the lowest volume group (7 percent) and the lowest in the 5-10,000 and over 10,000 AADT groups (3 percent). Shoulder accidents on all rural highways were represented by 3 percent of all accidents.

With the 4-lane divided highways making the highest contribution of shoulder accidents to the total accident picture, it appears, therefore, that the provision of rest areas deserves particular attention on 4-lane highways.

SUMMARY OF RESULTS

The study of stopping practices on 33 rural highway sections in New York revealed the following significant facts:

1. There was one leisure stop for every 2,800 and one emergency stop for every 12,000 vehicle-miles of travel.

2. The frequency of stops was higher on the lightly traveled local highways than on the heavier traveled roads.

3. Nearly 75 percent of all stops were leisure stops.

4. As may be expected, the average length of trip for out-of-state drivers was about $3\frac{1}{2}$ times that for New York drivers (700 against 200 mi).

5. The average time between leisure stops was about $2\frac{1}{2}$ hr for both New York and out-of-state drivers.

6. The average length of leisure stops was 30 min, with only 6 percent exceeding 45 min.

7. More than 40 percent of the leisure stops observed between 8:00 A.M. and 8:00 P.M. occurred between noon and 3:00 P.M. Stops during peak-hour travel were at a minimum.

8. Three percent of all accidents occurred while other vehicles were parked on shoulders, based on available accident reports.

9. Accidents involving shoulder stops were more critical on the 4-lane highways.

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APPENDIX

DESCRIPTION OF 1949 HIGHWAY
CLASSIFICATIONS (5)

The Interstate and Interregional System comprises approximately 1,780 miles. The Interstate and portions of the Interregional systems have been designated as part of the National System of Interstate Highways.

Incorporated in this system is the Thruway and other routes to form an integrated system serving all sections of the state. These routes in general carry high traffic volumes, and have high standards of alignment and grade essential to rapid transportation on long-distance hauls. They comprise the principal North-South and East-West routes serving the bulk of the state's population.

The Intercity System provides a primary system of highway transportation between cities. This system comprises approximately 3,650 miles of state highways. It serves estimated traffic volumes in urban areas between 1,500 vehicles to 5,000 vehicles per day. This group provides primary connecting routes to convenient access points along the Interstate and Interregional system and it also serves the more distant recreation areas.

The Primary Feeder System routes serve either to collect and carry large volumes of traffic to and from urban areas or as connecting links in higher class routes. There are approximately 4,270 miles of highways in this system.

TABLE 6
FREQUENCY OF VEHICLE* STOPS ON SHOULDERS BY LANES OF TRAVEL AND HIGHWAY CLASSIFICATION

Identification and Field Data																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19													
																			Shoulder Stops, Interviewed (No.)												12-hr. Traffic Count
																			Leisure		Emergency		Business		All						
Study Site Number	Loca- tion Code	No. of Lanes	Length (mi)	Date of Study	Hours of Study	Tr.	P. C.	All																							
(a) INTERSTATE AND INTERREGIONAL																															
1	3-2-4 ^b	2	4.4	7/9/58	8A-8P	3	4	7	1	0	1	0	0	0	4	4	8	2,517													
2	6-2-6		4.1	8/13/58		0	10	10	0	1	1	0	0	0	0	11	11	2,309													
3	7-2-1		5.4	7/8/58		0	13	13	1	0	1	0	1	1	14	15	4,612														
4	7-2-4		4.6	7/22/58		0	3	3	1	0	1	0	0	0	1	3	4	3,060													
5	7-2-5		5.9	7/23/58		1	9	10	0	2	2	0	1	1	12	13	3,540														
Total, 2-lane			24.4			4	39	43	3	3	6	0	2	2	7	44	51	---													
6	1-2-1	3	5.4	6/25/58	8A-8P	2	14	16	0	1	1	2	0	2	4	15	19	6,745													
7	3-2-1		5.2	7/24/58		4	12	16	1	1	2	0	0	0	5	13	18	5,349													
8	8-2-3		5.3	6/26/58		2	10	12	0	0	0	0	0	0	2	10	12	6,637													
9	10-2-1		5.3	7/1/58		2	4	6	0	1	1	0	1	1	2	6	8	3,150													
Total, 3-lane			21.2			10	40	50	1	3	4	2	1	3	13	44	57	21,881													
10	3-2-13	4+	6.6	7/30/58	8A-8P	2	4	6	2	2	4	1	0	1	5	6	11	2,767													
Total, Interstate and Interreg.			52.2			16	83	99	6	8	14	3	3	6	25	94	119	---													
(b) INTERCITY																															
11	1-2-2	2	5.4	6/24/58	8A-8P	1	5	6	0	0	0	0	0	1	5	6	2,123														
12	1-2-7		4.4	6/20/58		1	1	2	0	0	0	2	1	3	3	2	5	3,199													
13	2-2-1		5.1	8/1/58		0	17	17	0	0	0	0	0	0	17	17	2,848														
14	3-2-2		5.1	8/6/58		0	5	5	0	1	1	0	3	3	0	9	9	3,926													
15	4-2-3		5.0	8/21/58		4	3	7	3	0	3	0	1	1	7	4	11	2,769													
16	5-2-11		3.5	8/20/58		0	5	5	0	0	0	0	0	0	0	5	5	1,943													
17	6-2-3		4.0	8/12/58		0	2	2	0	1	1	0	0	0	0	3	3	1,383													
18	7-2-3		5.0	7/10/58		1	4	5	1	2	3	0	0	0	2	6	8	2,938													
19	8-2-5		5.2	7/14/58		1	2	3	1	1	2	1	1	2	3	4	7	1,605													
20	9-2-10		5.2	7/17/58		0	4	4	0	1	1	0	0	0	0	5	5	2,108													
21	10-2-4		5.9	7/2/58		0	2	2	0	1	1	0	0	0	3	3	3	1,740													
Total, 2-lane			53.8			8	50	58	5	7	12	3	6	9	16	63	79	---													
22	2-2-2	4+	5.1	7/31/58	8A-8P	0	4	4	0	2	2	0	1	1	0	7	7	5,372													
23	2-2-3		4.8	8/8/58		0	13	13	0	1	1	0	1	1	0	15	15	2,916													
24	9-2-4		5.0	8/25/58		1	3	4	1	1	2	0	0	0	2	4	6	2,478													
Total, 4-lane			14.9			1	20	21	1	4	5	0	2	2	2	26	28	---													
Total, Intercity			68.7			9	70	79	6	11	17	3	8	11	18	89	107	---													
(c) FEEDER																															
25	1-2-6	2	5.0	6/23/58	8A-8P	1	4	5	0	0	0	2	1	3	3	5	8	2,385													
26	2-2-6		5.2	6/27/58		0	3	3	0	0	0	0	0	0	0	3	3	3,444													
27	3-2-12		3.9	8/7/58		0	1	1	0	3	3	0	0	0	4	4	1,594														
28	4-2-5		5.1	8/5/58		2	4	6	1	0	1	0	0	0	3	4	7	2,350													
29	5-2-6		4.3	8/19/58		0	4	4	0	0	0	0	0	0	4	4	1,757														
30	6-2-5		2.9	8/14/58		0	4	4	0	0	0	0	0	0	4	4	1,468														
31	7-2-2		4.5	7/9/58		0	1	1	0	1	1	0	0	0	2	2	1,285														
32	8-2-7		3.7	7/15/58		0	0	0	0	2	2	0	0	0	2	2	1,070														
Total, 2-lane			34.6			3	21	24	1	6	7	2	1	3	6	28	34	---													
33	10-2-5	4+	3.8	7/3/58	8A-4P	1	2	3	0	4	4	0	0	0	1	6	7	10,297													
Total, Feeder			38.4			4	23	27	1	10	11	2	1	3	7	34	41	---													
(d) ALL TYPES																															
Total, All			159.3			29	176	205	13	29	42	8	12	20	50	217	267	---													

* Tr. = trucks; P.C. = passenger cars.

^b District 3, Project 2, District Site Number 4.

TABLE 6—Continued

Travel 20	Shoulder Stops											
	21	22	23	24	25	26	27	28	29	30	31	32
(veh-mi)	Frequency of Stops (veh-mi/stop)											
	Leisure			Emergency			Business			All		
	Tr.	P. C.	All	Tr.	P. C.	All	Tr.	P. C.	All	Tr.	P. C.	All
(a) INTERSTATE AND INTERREGIONAL												
11,075	3,700	2,800	2,203	11,100	—	11,100	—	—	—	2,800	2,800	1,800
9,467	—	900	900	—	9,000	9,500	—	—	—	—	900	900
24,905	—	1,900	1,900	24,900	—	25,000	—	24,900	25,000	24,900	1,800	1,700
14,076	—	4,700	4,700	14,600	—	14,100	—	—	—	14,600	4,700	3,500
20,886	20,900	2,300	2,100	—	10,400	10,400	—	20,900	20,900	20,900	1,700	1,600
80,409	20,100	2,100	1,900	26,800	26,800	13,400	—	40,200	40,200	11,500	1,800	1,600
36,423	18,200	2,600	2,300	—	36,400	36,400	18,200	—	18,200	9,100	2,400	1,900
27,815	7,000	2,300	1,700	27,800	27,800	13,900	—	—	—	5,600	2,100	1,500
35,176	17,600	3,500	2,900	—	—	—	—	—	—	17,600	3,500	2,900
16,695	8,300	4,200	2,800	—	16,700	16,700	—	16,700	16,700	8,300	2,800	2,100
116,109	11,600	2,900	2,300	116,100	38,700	29,000	58,000	116,100	38,700	9,000	2,600	2,000
18,262	9,100	4,600	3,000	9,100	9,100	4,600	18,300	—	18,000	3,700	3,000	1,700
214,780	13,400	2,600	2,200	35,800	26,800	15,300	71,600	71,600	35,800	8,600	2,300	1,800
(b) INTERCITY												
11,464	11,500	2,300	1,900	—	—	—	—	—	—	11,500	2,300	1,900
14,076	14,100	14,100	7,000	—	—	—	7,000	14,100	4,700	4,700	7,000	2,800
14,525	—	900	900	—	—	—	—	—	—	—	900	900
20,023	—	4,000	4,000	—	20,000	20,000	—	6,700	6,700	—	2,200	2,200
13,845	3,500	4,600	2,000	4,600	—	4,600	—	13,900	13,800	2,000	3,500	1,300
6,801	—	1,400	14,000	—	—	—	—	—	—	—	1,400	1,400
5,532	—	2,800	2,800	—	5,500	5,500	—	—	—	—	1,800	1,800
14,690	14,700	3,700	2,900	14,700	7,300	4,900	—	—	—	7,300	2,400	1,800
8,346	8,300	4,200	2,800	8,300	8,300	4,200	8,300	8,300	4,200	2,800	2,100	1,200
10,962	—	2,700	2,700	—	11,000	11,000	—	—	—	—	2,200	2,200
10,266	—	5,100	5,100	—	10,300	10,000	—	—	—	—	3,400	3,400
130,530	16,300	2,600	2,300	26,100	18,600	10,900	43,500	21,800	14,500	8,200	2,100	1,700
27,397	—	6,800	6,800	—	13,700	27,400	—	27,400	27,400	—	4,000	3,900
13,997	—	1,100	1,100	—	14,000	14,000	—	14,000	14,000	—	900	900
12,390	12,400	4,100	3,100	12,400	12,400	6,200	—	—	—	6,200	3,100	2,100
53,784	53,800	2,700	2,600	53,800	1,300	10,700	—	26,900	26,900	26,900	2,100	1,900
184,314	20,500	2,600	2,300	30,700	16,800	10,900	61,400	23,000	16,700	10,200	2,100	1,700
(c) FEEDER												
11,925	11,900	3,000	2,400	—	—	4,000	6,000	11,900	—	4,000	2,400	1,500
17,909	—	6,000	6,000	—	—	—	—	—	—	—	6,000	6,000
6,213	—	6,300	6,200	—	2,100	2,100	—	—	—	—	1,600	1,600
11,985	6,000	3,000	2,000	12,000	—	12,000	—	—	—	4,000	3,000	1,700
7,555	—	1,900	1,900	—	—	—	—	—	—	—	1,900	1,900
4,257	—	1,100	1,100	—	—	—	—	—	—	—	1,100	1,100
5,783	—	5,800	6,000	—	5,800	6,000	—	—	—	—	2,900	3,000
3,959	—	—	—	—	2,000	2,000	—	—	—	—	2,000	2,000
69,586	23,200	3,300	2,900	69,600	11,600	10,000	34,800	69,600	23,200	11,600	2,500	2,000
39,129	39,100	19,600	13,000	—	9,800	9,800	—	—	—	39,100	6,500	5,600
108,715	27,200	4,700	4,000	108,700	10,900	9,900	54,400	108,700	36,200	15,500	3,200	2,700
(d) ALL TYPES												
507,809	17,500	2,900	2,800	39,100	17,500	12,000	63,500	43,300	25,400	10,200	2,300	1,900

TABLE 7
AVERAGE LENGTH OF TRIPS FOR DRIVERS STOPPING ON SHOULDERS, BY LANES OF TRAVEL
AND HIGHWAY CLASSIFICATION

Identification			Average Length of Trips for Drivers Stopping on Shoulders														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Study Site No.	Location Code	No. of Lanes	Trucks			Passenger Cars						All					
			New York		Out-of-State		New York		Out-of-State		New York		Out-of-State				
			Local ^a	Other			Local ^a	Other			Local ^a	Other					
			(no.)	(no.)	(mi)	(no.)	(mi)	(no.)	(no.)	(mi)	(no.)	(mi)	(no.)	(no.)	(mi)	(no.)	(mi)
(a) INTERSTATE AND INTERREGIONAL																	
1	3-2-4	2	1	3	180	0	0	1	0	0	1	200	2	3	180	1	200
2	6-2-6		0	0	0	0	0	0	8	192	3	1,025	0	8	192	3	1,025
3	7-2-1		0	0	0	1	325	1	2	475	10	1,094	1	2	475	11	1,024
4	7-2-4		0	2	275	2	395	0	2	275	1	650	0	4	275	3	140
5	7-2-5		0	1	200	0	0	1	7	257	4	1,581	1	8	250	4	1,581
Total, 2-lane			1	6	200	3	375	3	19	250	19	1,100	4	25	240	22	1,000
6	1-2-1	3	0	3	352	1	700	0	8	312	9	509	0	11	322	10	528
7	3-2-1		0	5	203	0	0	1	4	170	7	886	1	9	188	7	886
8	8-2-3		0	1	87	1	80	2	1	275	5	435	2	2	181	6	376
9	10-2-1		0	1	400	0	0	1	1	70	1	250	1	2	235	1	250
Total, 3-lane			0	10	250	2	400	4	14	250	22	600	4	24	250	24	600
10	3-2-13	4+	0	1	30	3	650	0	4	260	2	500	0	5	220	5	600
Total, Interstate and Interreg.			1	17	200	8	500	7	37	250	43	800	8	54	250	51	750
(b) INTERCITY																	
11	1-2-2	2	0	0	0	0	0	0	4	198	1	300	0	4	198	1	300
12	1-2-7		0	1	320	0	0	0	2	128	0	0	0	3	192	0	0
13	2-2-1		0	0	0	0	0	1	12	189	2	900	1	12	189	2	900
14	3-2-2		0	1	175	0	0	1	1	160	2	975	1	2	168	2	975
15	4-2-3		0	6	227	1	425	0	4	138	0	0	0	10	191	1	425
16	5-2-11		0	0	0	0	0	0	2	213	3	1,242	0	2	213	3	1,242
17	6-2-3		0	0	0	0	0	1	0	0	1	270	1	0	0	1	270
18	7-2-3		1	1	275	0	0	3	1	200	2	170	4	2	238	2	170
19	8-2-5		2	0	0	0	0	2	1	70	0	0	4	1	70	0	0
20	9-2-10		0	0	0	0	0	3	1	65	0	0	3	1	65	0	0
21	10-2-4		0	0	0	0	0	1	2	255	0	0	1	2	255	0	0
Total, 2-lane			3	9	250	1	400	12	30	175	11	750	15	39	200	12	700
22	2-2-2	4+	0	0	0	0	0	2	2	220	2	363	2	2	220	2	363
23	2-2-3		0	0	0	0	0	3	6	134	6	612	3	6	134	6	612
24	9-2-4		0	2	318	0	0	1	2	173	1	175	1	4	245	1	175
Total, 4-lane			0	2	300	0	0	6	10	150	9	500	6	12	200	9	500
Total, Intercity			3	11	250	1	400	18	40	175	20	650	21	51	200	21	650
(c) FEEDER																	
25	1-2-6	2	0	3	49	0	0	0	1	300	3	243	0	4	112	3	243
26	2-2-6		0	0	0	0	0	1	0	0	1	280	1	0	0	1	280
27	3-2-12		0	0	0	0	0	2	1	120	0	0	2	1	120	0	0
28	4-2-5		1	2	100	0	0	2	0	0	1	110	3	2	100	1	110
29	5-2-6		0	0	0	0	0	0	3	166	1	450	0	3	166	1	450
30	6-2-5		0	0	0	0	0	0	3	230	1	250	0	3	230	1	250
31	7-2-2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	8-2-7		0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Total, 2-lane			1	5	70	0	0	6	8	200	7	250	7	13	150	7	250
33	10-2-5	4+	0	0	0	0	0	2	1	300	1	400	2	1	300	1	400
Total, Feeder			1	5	70	0	0	8	9	200	8	275	9	14	150	8	275
(d) ALL TYPES																	
Total, All			5	33	200	9	500	33	86	200	71	700	38	119	200	80	700

^a Trips under 10 miles.

TABLE 8
ACCIDENT HISTORY OF STUDY SITES FOR 6-YEAR PERIOD FROM 1952 THROUGH 1957, BY LANES OF TRAVEL AND HIGHWAY CLASSIFICATION

Identification and Field Data			Traffic Data						Accident Data for 6-Yr Period 1952-57*									
			Shoulder Stops Interviewed		Period '52-'57		All Accidents		Fatal		Personal Injury		Property Damage		Shoulder Accidents ^d			
Study Site No.	Location of Lanes	No. Length (mi)	No.	% Total	1957 AADT	Traffic Count (millions)	MVM ^b	No.	Rate per MVM	No. c	Rate per MVM	No.	Rate per MVM	No.	Rate per MVM	No.	Rate per MVM	
(a) INTERSTATE AND INTERREGIONAL																		
1	3-2-4	2	4.4	8	3	3,103	6.7	29.3	37	1.27	1	0.03	16	0.55	20	0.69	1	0.03
2	6-2-6	4	4.1	11	4	3,306	6.5	26.8	33	1.23	3	0.11	11	0.41	20	0.75	1	0.04
3	7-2-1	6	5.4	15	6	4,455	8.2	44.4	32	0.72	0	0.00	17	0.38	15	0.34	1	0.02
4	7-2-4	4	4.6	4	1	4,128	8.3	38.2	30	0.78	1	0.03	1	0.03	28	0.72	1	0.03
5	7-2-5	5	5.9	13	5	1,822	7.0	41.4	7	0.17	0	0.00	5	0.12	2	0.05	0	0.00
Total, 2-lane			24.4	51	19	—	36.7	180.1	139	0.78	5	0.03	50	0.28	85	0.47	4	0.02
6	1-2-1	3	5.4	19	7	9,377	19.9	107.5	215	2.00	7	0.07	98	0.91	110	1.02	4	0.04
7	3-2-1	7	5.2	18	7	6,110	11.5	60.2	46	0.77	0	0.00	18	0.30	28	0.47	2	0.03
8	8-2-3	5	5.3	12	4	6,172	11.8	62.4	97	1.56	6	0.10	51	0.82	40	0.64	6	0.10
9	10-2-1	8	5.3	8	3	7,163	10.4	55.1	59	1.07	0	0.00	25	0.45	34	0.62	1	0.02
Total, 3-lane			21.2	57	21	—	53.6	285.2	417	1.46	13	0.05	192	0.67	212	0.74	13	0.05
10	3-2-13	4+	6.6	11	4	1,728	3.5	23.3	5	0.21	0	0.00	5	0.21	0	0.00	3	0.13
Total, Interstate and Interreg.			52.2	119	44	—	93.8	488.5	361	1.15	18	0.04	247	0.50	297	0.61	20	0.04
(b) INTERCITY																		
11	1-2-2	2	5.4	6	2	2,971	5.8	31.4	117	3.73	5	0.16	61	1.94	51	1.62	0	0.00
12	1-2-7	4	4.4	5	2	3,663	10.3	45.9	82	1.79	4	0.09	38	0.83	40	0.87	3	0.07
13	2-2-1	6	5.1	17	6	1,757	4.5	22.8	13	0.57	5	0.22	8	0.35	2	0.09	2	0.03
14	3-2-2	9	5.1	9	3	6,825	12.4	63.2	206	8.26	11	0.17	85	1.35	110	1.74	2	0.03
15	4-2-3	11	5.0	11	4	4,389	11.2	55.9	64	1.14	0	0.00	24	0.43	40	0.71	1	0.02
16	5-2-11	5	3.5	5	2	9,318	17.6	61.8	43	0.70	5	0.08	21	0.34	18	0.29	1	0.02

17	6-2.3	4.0	3	1	1,733	4.2	16.7	60	3.60	4	0.24	9	0.54	47	2.82	0	0.00
18	7-2.3	5.0	3	3	1,778	4.5	22.7	3	0.13	1	0.04	0	0.00	2	0.09	0	0.00
19	8-2.5	5.2	3	3	3,290	5.2	26.8	181	6.76	10	0.37	169	6.30	4	0.15	8	0.30
20	9-2.0	5.2	5	2	3,032	6.7	34.9	34	0.98	2	0.06	20	0.57	12	0.34	3	0.09
21	10-2.4	5.9	3	1	2,987	8.2	21.3	68	3.19	1	0.03	28	1.31	39	1.83	1	0.05
Total, 2-lane		53.8	79	29		85.6	403.4	871	2.17	48	0.12	463	1.15	365	0.30	21	0.05
22	2-2.2	4+	7	3	5,000	8.9	45.1	56	1.24	1	0.02	23	0.51	32	0.71	2	0.04
23	2-2.3	4.8	13	6	2,395	5.7	27.5	24	0.88	0	0.00	9	0.33	15	0.55	0	0.00
24	9-2.4	4.0	0	2	2,241	6.7	33.7	40	1.18	1	0.03	22	0.65	17	0.50	2	0.06
Total, 4-lane		14.9	28	11		21.3	106.3	120	1.13	2	0.02	54	0.51	64	0.69	4	0.04
Total, Intercity		63.7	107	40		106.9	509.7	991	1.95	50	0.10	517	1.02	429	0.85	25	0.05

(c) FEEDER

25	1-2.6	5.0	8	3	2,354	7.0	34.8	83	2.39	4	0.12	38	1.09	41	1.18	1	0.03
26	2-2.6	5.2	3	3	3,479	9.8	50.7	88	1.74	2	0.04	49	0.97	37	0.73	3	0.06
27	3-2.12	3.9	4	1	3,784	7.0	27.2	7	0.26	0	0.00	4	0.15	3	0.11	0	0.00
28	4-2.5	5.1	7	3	3,200	6.8	34.5	53	1.53	0	0.00	22	0.64	31	0.89	1	0.03
29	5-2.6	4.3	4	1	2,900	5.8	25.0	1	0.04	0	0.00	1	0.04	0	0.00	0	0.00
30	6-2.5	2.9	4	1	2,210	4.0	11.6	15	1.29	1	0.09	2	0.17	12	1.03	0	0.00
31	7-2.2	4.5	2	1	1,843	4.3	19.3	15	0.78	0	0.00	5	0.26	10	0.52	1	0.05
32	8-2.7	3.7	2	1	2,091	8.6	31.9	43	2.89	9	0.28	85	2.66	1	0.03	0	0.00
Total, 2-lane		34.6	34	12		53.3	235.0	355	1.52	16	0.07	206	0.88	135	0.57	6	0.03
33	10-2.5	3.8	7	3	11,804	22.4	85.1	65	0.76	2	0.02	35	0.41	28	0.33	2	0.02
Total, Feeder		38.4	41	15		75.7	320.1	420	1.32	18	0.06	241	0.76	163	0.51	8	0.03

(d) ALL TYPES

Total, All		159.3	267	100		276.4	1,318.3	1,972	1.50	86	0.07	1,005	0.76	889	0.68	53	0.04
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a As reported by District Offices.
 b XVM = million vehicle-miles.
 c Total fatalities.
 d Accidents involving vehicles occupying shoulder.

TABLE 9
Description of Shoulder Accidents

Study Site No.	Description of Accident
1	Car struck while turning left from right shoulder.
2	Rear collision with car parked on left shoulder.
3	Pulled to shoulder, was hit by passing car.
4	Car struck while parked partially on shoulder.
6	Car 1 hit Car 2, which was parked partly on pavement; oncoming traffic forced 1 into 2. Car 1 pulled onto shoulder and stopped; Car 2 tried to pull around 1, but was forced into 1 by oncoming traffic. Car 1 parked at roadside struck in rear by Car 2. Car pulled onto shoulder and stopped; was struck in rear by car 2.
7	Two parked cars sideswiped; Car 1 parked on shoulder side, sideswiped by Car 2.
8	Cars west 2 hit parked Car 1; Car 3 hit Car 2. Car 1 west skidded into parked Car 2. Parked Car 1 hit by Car 2 in rear. Car 1 turning left struck by Car 2, which then hit Car 3, parked on shoulder. Car 2 hit Car 1 parked on shoulder to discharge passengers. Car 2 parked, hit by Car 1 being forced off road. Parked on east shoulder; Sound Avenue.
9	Car 1 struck in rear while parked partially on shoulder.
10	Car 1 on shoulder; pulled into path of Car 2. Car struck while parked on shoulder.
12	Truck traveling south applied brakes for unknown car, jackknifed, and struck car parked on shoulder. Car parked at Ravena Diner rolled onto pavement and struck four cars on shoulder 500 ft farther down the road. Car 1 skidded on icy pavement and struck delivery truck, which was parked partly on pavement.
13	Operator fell asleep, went off road, hit telephone pole. Car 1 blowout lost control, Car 2 following hit rear of Car 1. Car 1 parked on shoulder hit in rear by Car 2; Car 1 thrown in air, striking tree.
14	Truck had pulled off road to let following cars pass, accident occurred when truck entered highway. Lost control; hit vehicle parked on shoulder.
15	Car 2 pulled onto shoulder to avoid Car 1, which hit him.
16	Ran into rear end of parked school bus.
19	Car 2 backed into parked Car 1. Car 2 lost control, left road, hit parked car and then fence. Car 1 rolled down grade into parked car. Car 2, parked facing south, hit in rear. Car 1 north hit parked Car 2. Car struck state sign, crossed road, and hit parked car. Car 1 parked; Car 2 south lost control, hit. Car 1 north parked, Car 2, also N., attempted to pass Car 1 but didn't have room.
20	Car 2 off road on shoulder to make a left turn; struck by Car 1. Car 1 entered highway on shoulder; Car 2 skidded and struck Car 1 in rear. Car 1 stopped on right side of road on pavement; struck by Car 2 in rear.
21	Parked on east shoulder.
22	South; pedestrian from west to east walked into side of car; operator unable to pull to shoulder as a car parked there. Both south; Car 2 stopped on shoulder to tighten chains, hit in rear by Car 1.
24	Car 1 stopped on shoulder unattended; struck in rear by Car 2. Car 2 parked on shoulder near driveway.
25	Car 1 stopped on shoulder, driver got out and started to cross road, was struck by car near center of pavement.

TABLE 9—Continued

Study Site No.	Description of Accident
26	Car 1 south, Car 2 north passing, slid into Car 1 parked on west shoulder. Car 2 stopped facing north, wheels just off pavement. Car 1 north towing Car 2 pulling to shoulder; Car 3 south struck Car 2.
28	Crane was laying pipe; Car 2 hit him on the shoulder.
31	Stopped, hit in rear.
33	Four cars parked in center mall struck by south-bound car. Car parked on shoulder; opened door, which was hit by passing car.
All	53 Shoulder accidents.

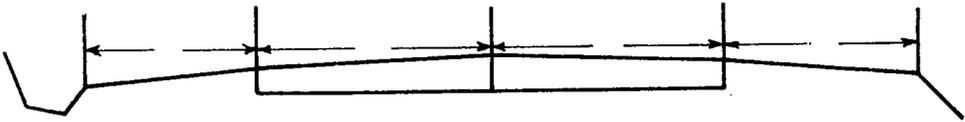
TABLE 10
CLASSIFICATION OF VEHICLES BY STUDY SITE

Study Site Number	Location Code	% of Total	
		Pass. Cars	Trucks and Buses
(a) INTERSTATE AND INTERREGIONAL			
1	3-2-4	84	16
2	6-2-6	88	12
3	7-2-1	91	9
4	7-2-4	87	13
5	7-2-5	93	7
6	1-2-1	82	18
7	3-2-1	84	16
8	8-2-3	79	21
9	10-2-1	88	12
10	3-2-13	86	14
Total	—	86	14
(b) INTERCITY			
11	1-2-2	86	14
12	1-2-7	90	10
13	2-2-1	97	3
14	3-2-2	83	17
15	4-2-3	75	25
16	5-2-11	88	12
17	6-2-3	88	12
18	7-2-3	94	6
19	8-2-5	86	14
20	9-2-10	82	18
21	10-2-4	78	22
22	2-2-2	87	13
23	2-2-3	92	8
24	9-2-4	92	8
Total	—	87	13
(c) FEEDER			
25	1-2-6	71	29
26	2-2-6	91	9
27	3-2-12	80	20
28	4-2-5	88	12
29	5-2-6	85	15
30	6-2-5	90	10
31	7-2-2	90	10
32	8-2-7	95	5
33	10-2-5	80	20
Total	—	85	15
(d) ALL HIGHWAYS			
All	—	86	14

NEW YORK STATE DEPARTMENT OF PUBLIC WORKS
 BUREAU OF HIGHWAY PLANNING
 1958 HIGHWAY SHOULDER OCCUPANCY STUDY

"I'm _____ representing New York State Department of Public Works. We are making a study of the use of highway shoulders and would like you to answer a few questions."

Site _____ Date _____ County _____
 Route _____ Location _____ Weather Conditions _____
 Number of Lanes _____ Width of Pavement _____ Width of Shoulder _____



1. Type of Vehicle _____
 2. Year and Model _____
 3. State of Registration _____
 4. Direction of Travel _____
 5. Number of Occupants _____
 6. Distance From Pavement _____
 7. Physical Conditions of Stopping Area _____
 8. Remarks:

 9. Time of Stopping _____
 10. Time of Resuming Trip _____
 11. Length of Trip _____
 12. Distance Already Traveled _____
 13. Time Since Last Stop _____
 14. Reason For Travel _____
 15. Purpose of Stop _____
 16. Traffic Count - From _____ A.M. to _____ P.M.
- Number _____ Length of Study _____ Monitor _____

Figure 13. Questionnaire form for 1958 highway shoulder occupancy study.

DISCUSSION

R. C. BLENSLEY, *Planning Survey Engineer*, and W. J. BYARS, *Supervising Statistician, Oregon State Highway Department*.—This discussion has been prepared by utilizing data obtained from the 1958 Oregon survey of shoulder use as a guide in comparing methods of obtaining field information and the results obtained from the analysis of the field data.

The Oregon study was conducted on a section of the R. H. Baldock Freeway, US 99 (I 5), between Portland and Salem. The study section was a 4-lane divided highway, 8 mi in length, with 12-ft asphaltic concrete traffic lanes, 4-ft paved and 6-ft graveled shoulders on the right, 4-ft paved shoulders on the left (median), and a 42-ft depressed median between edges of shoulder. This highway is the major north-south commercial and tourist route on the Pacific Coast. At the time of the study, the posted speeds were 70 mph for passenger vehicles and 50 mph for trucks. This section of highway was a full freeway, with no at-grade intersections or access except at the interchanges at each end of the study section. In addition, there were no recreational or commercial attractions along the highway. A special feature of this section was the "NO PARKING ON HIGHWAY SHOULDERS" signs directed to traffic entering the freeway at each of the interchanges.

Some difficulty was encountered in comparing the author's results with Oregon's results because of lack of a complete description of the study sections providing information on the character of the traffic, roadside culture, and physical highway features.

The field procedure used in the New York study differs from that used in the Oregon study in two major respects, as follows:

1. Apparently only one automobile was used to observe shoulder use at any one time in the New York study, whereas two mobile observers cruised the Oregon section from opposite ends at regular intervals.

2. In addition to the mobile observers, a vehicle classifier-observer was stationed on an overcrossing at the middle of the Oregon study section to count and classify traffic and to observe and tabulate shoulder use within a 2-mi control section. There were no vehicle classifiers-observers used in the New York study.

The period of time necessary to provide results within 10 percent of the true value 95 percent of the time was determined for the Oregon study from a 24-hr pilot study. The analysis of the pilot study indicated that a 66-hr sample would be required. However, upon completion of the 66 hr of observation, statistical analysis showed that the desired accuracy had not been achieved due to seasonal variations not present in the pilot study. The pilot study was conducted during April and July, and the remainder of the observations were taken in September. A statistical analysis indicated that the data obtained in September were significantly different from the data obtained in April and July.

The composite Oregon vehicle-miles per stop average was estimated to be within 20 percent of the true value 95 percent of the time. The factors of sample size and data variability are not discussed in the New York study. It is believed that a discussion of the procedures used in establishing the sample size and an indication of the statistical accuracy of the data presented would be valuable to those analyzing the report. Although the group data for all sections appear to have adequate sample size, it should be noted that the individual section statistics are based on only 12-hr observation, and therefore appear to be of questionable accuracy. For the individual study sections stops were not observed for all vehicle types and/or purposes. A lack of sample by vehicle type and/or purpose precludes the possibility of defining the sample size in terms of sampling error by vehicle type and/or purpose. Therefore, the conclusions based on the various subgroupings are subject

to error of undetermined magnitude. Total values reveal that the average number of vehicle-miles per stop would be within 3 percent of the true value 95 percent of the time.

For the Oregon study, it was necessary to establish a control to compensate for stopped vehicles not observed by the mobile observers. This was accomplished by the use of the classifier-observer on the control section. The Oregon study indicated that approximately 25 percent of the stops were not observed by the mobile observers.

The New York analysis of stop frequency is based on 267 driver interviews for which complete information was obtained. Fifteen incomplete interviews, accounting for 9.4 percent of the total stops observed, were excluded from the analysis. No mention is made as to whether observations include 100 percent of the stops on the New York sections. Based on Oregon's experience, it appears that there is a possibility that the analyzed stops on the New York sections could be only 65 to 75 percent of the total stops.

There is a basic difference in the analysis of vehicle-miles per stop data computed for trucks and passenger cars in the New York and Oregon studies. In the New York study, the total of vehicle-miles is divided by the total number of truck stops to obtain vehicle-miles per stop for trucks, whereas for the Oregon study the total of vehicle-miles for trucks only was divided by the number of truck stops to obtain vehicle-miles per stop. The New York procedure does

not allow a direct comparison of different study sections unless the composition of traffic is the same, whereas the Oregon study will allow a direct comparison. In addition to the difficulty of making comparisons, the New York values are misleading in that they indicate infrequent stops by trucks because they account for only a small portion of the total vehicle-miles. Table 11 compares the relative frequency of shoulder stops by purpose for the New York, New Jersey (1), and Oregon studies.

Probably the most striking element of comparison in Table 11 is the large range in values of the vehicle-miles per stop by states. In all instances, the New York data indicate a lower frequency of stops than were observed in the Oregon and New Jersey studies. Oregon's averages fall between the New York and New Jersey values, with the exception of the frequency of emergency stops in Oregon, which is close to the New York average for 4-lane Interstate and Interregional Highways. As pointed out by the author, the frequency of emergency stops was virtually the same in the New Jersey and New York studies. However, leisure and total stops occurred six times more often in New Jersey than in New York. There are four basic reasons for the large range in relative frequency of stops, as follows:

1. Differences in character of travel.
2. Differences in geometric features of the various highways studied, including shoulder parking regulation.

TABLE 11

A COMPARISON OF THE RELATIVE FREQUENCY OF SHOULDER STOPS BY PURPOSE ON NEW YORK AND NEW JERSEY HIGHWAYS WITH THE OREGON R. H. BALDOCK FREEWAY^a

Study Section	No. of Study Sections	Obs. Travel (veh-mi)	Vehicle-Miles Per Stop			
			Leisure	Emerg.	Business	Total
New York:						
All rural hwy.	33	507,809	2,800	12,000	25,400	1,900
Interstate and Interregional	10	214,780	2,200	15,300	35,800	1,800
Int. and Intreg. 4-lane	1	18,262	3,000	4,600	18,000	1,700
Oregon:						
Baldoek Fwy ^b	1	242,576	1,600	3,700	3,700	900
New Jersey:						
All rural hwy.	6	94,270	480	11,800	1,600	318

^a Because of differences in definitions, the breakdowns by purpose of stop may not be exactly comparable between states.

^b Four-lane, interstate highway, parking prohibited.

3. Differences due to sampling variability.

4. Differences resulting from field data collection and analysis procedures.

The first two are not ordinarily subject to control during a study. Differences in character of travel, such as proportions of commuting, tourist, truck, recreational, or through traffic, may be expected to produce significant differences in the type and number of shoulder stops. Geometric features, such as the width and type of shoulders, number of interchanges, and type of access, influence types and numbers of shoulder stops. The presence or absence of scenic attractions, rest facilities, restaurants and other businesses also influence driver parking practices. In view of the dissimilarities in character of traffic, geometric features, and parking restrictions on the highways studied, large variations in the relative frequency of stops on highways are expected. Sampling variability is an inherent error always present in studies of this type, and can only be approximated. However, the reader should be aware of sample limitations.

The fourth factor is one which should be reduced to a minimum in order to maintain comparability of data between the various shoulder use studies and realize the most value from interchange of information. It is evident from a detailed comparison of purpose-of-stop data that definitions account for some differences in certain purpose-of-stop statistics. Differences in methodology have been previously discussed.

Vehicle-miles per stop averages by

purpose of stop and vehicle type for the R. H. Baldock Freeway are shown in Table 12.

Differences in the character of travel and parking practices on the Oregon (Baldock Freeway) and New York highways are apparent from a comparison of the following percentage distribution of stops by purpose:

Type of Stop	% of Total	
	New York	Oregon (Baldock Fwy.)
Emergency stops	15	23
Leisure stops	73	53
Business and other	12	24
Total	100	100

The lower proportion of leisure stops occurring on the Baldock Freeway is to be expected, considering the prohibition of shoulder parking, higher vehicle speeds, and preponderance of through traffic. The differences in purpose-of-stop definition in the two studies might account for much of the percentage difference in leisure stops. However, after adjustment for definitions, the Oregon percentage of leisure stops remained significantly lower than New York. All stops for the purpose of checking vehicle were classed as "emergency" in the New York report, whereas these stops were classified as leisure for passenger cars, and business for trucks in the Oregon study. As a result, it is impractical to make other than a rough comparison of

TABLE 12
AVERAGE VEHICLE-MILES PER STOP BY VEHICLE TYPE AND PURPOSE OF STOP^a,
R. H. BALDOCK FREEWAY^b

Vehicle Type	Vehicle-Miles per Stop					
	Emergency			Leisure	Bus.	All
	Immediate	Deferrable	All			
Light:						
Oregon	7,100	10,300	4,200	1,800	6,100	1,000
Out-of-state	6,500	8,700	3,700	1,700	4,600	900
Trucks	10,000	24,900	7,100	2,100	—	1,600
Buses	5,000	3,900	2,200	1,000	1,000	400
All	6,700	8,400	3,700	1,600	600	600
					3,700	900

^a Because of differences in definitions, the breakdowns by purpose of stop may not be exactly comparable between states.

^b Parking prohibited.

Oregon and New York total emergency stop data.

"Out of gas" and "flat tires" accounted for 2 percent and 26 percent, respectively, of emergency stops on all New York highways studied, whereas they accounted for 35 percent and 10 percent, respectively, of Oregon emergency stops. The higher percentage of "out of gas" and "tire failures" on the Baldock Freeway may be the result of the high vehicle speeds and lack of direct access service areas on the Baldock Freeway.

An analysis of the hours and distance driven since last stop by New York and out-of-state drivers parking on shoulders provides an indication of needed spacing and location of safety rest areas. New York and out-of-state drivers averaged approximately 2½ and 2¾ hr of driving, respectively, since the last stop. Data collected during the Oregon study revealed that the average distance traveled since the last stop for shoulder parked vehicles was 39.5 mi. This distance, in terms of average truck and passenger car speeds on the Baldock Freeway, would amount to approximately 40 to 50 min of driving time.

The analysis of New York shoulder stops by hour of day disclosed that the frequency of stops increased from 8 A.M. to a peak between 1 P.M. and 2 P.M. and gradually declined the rest of the day. Sixty-five percent of the stops occurred between 10 A.M. and 3 P.M. A statistical analysis of vehicle-miles per stop on the Baldock Freeway indicated that the relative frequency of shoulder stops was significantly greater in the afternoon than in the morning, due to the tendency for leisure and emergency stops to occur in the afternoon.

Mr. Billion pointed out that the length of stop is an important factor in determining space requirements for safety rest areas. The New York average length of leisure stops was 30 min, with stops over 30 min accounting for less than 25 percent of all leisure stops. The average duration of leisure stops on the Baldock Freeway was only 7 min, and 10 min for all stops. Five percent of all Oregon shoulder stops were in excess of

30 min. The prohibition of shoulder parking and the lack of roadside attractions are believed to be major factors accounting for the short duration of Oregon stops.

Mr. Billion found that 97 percent of the vehicles stopping on shoulders presented a continuous accident hazard, due to their stopping within 6 ft of the pavement edge. New York shoulder accidents accounted for 3 percent of all accidents on the 33 study sections during the six years (1952-1957) studied, and 4½ percent of accidents on 4-lane highways. Shoulder accidents were not analyzed in the Oregon study, as the highway is relatively new and has only a 2-yr accident history.

The preceding discussion has pointed out certain differences in field observation techniques, analytical procedures, and purposes-of-stop definitions, that affect the accuracy and comparability of shoulder use data. The differences and their effects on shoulder use data are not easily isolated or readily measurable, and therefore are of concern to those using the shoulder use data.

Oregon will start additional phases of its study of freeway shoulder use during 1959. In order that the maximum value may be derived from the Oregon study and those of other states, it is suggested that the HRB Committee on Shoulders and Medians immediately consider recommending uniform definitions for purpose of stop, and standardized major analytical procedures concerned with the computation of vehicle-miles per stop. By maintaining comparability of data, the use and value of the various shoulder use studies will be greatly enhanced.

C. E. BILLION, *Closure*. — Messrs. Blensly and Byars appeared to encounter difficulty in comparing the results of their study with the subject study. This is not surprising, as there was no original intention to make a study that would be comparable with the Oregon one, and only those characteristics were considered which seemed appropriate in context of the research problem undertaken.

They are rather exploratory in stating that there is a possibility that, based on their experience, the stops observed in New York could be only 65 to 75 percent of the total stops. This possibility was thoroughly explored in the pre-testing. In the runs for the record, a team of the field party was recording spot speeds and classifying vehicles at the middle of each study section. This team had a dual mission, consisting of obtaining radar speedometer spot speeds by type of vehicle for another report and spotting vehicles stopping on the shoulder within their range of vision (which on the average was 1 mi in each direction) and intercepting these vehicles, by standby transportation, if not within the range of the mobile observers. There were no occasions reported for these fixed observers to intercept stopped vehicles under these circumstances. For this reason, mention of this fixed team was not included in the New York report under the heading "Procedure." However, due to the importance of recording all stops, and from Oregon's experience, this second observer team should be considered in any individual study.

The author is grateful to Messrs. Blensly and Byars for their statistical determination that to provide results for this type of study within 10 percent of the true value 95 percent of the time, a 66-hr sample was indicated. Also, their determination that the total values for the 33 New York sites revealed that the average number of vehicle-miles per stop would be within 3 percent of the true value 95 percent of the time. It is prudent to note here that the summary of results for the subject report is based on the "totals" data, or a 396-hr sample. Furthermore, the analysis discusses the results of the data on a total basis, or primarily comparisons between the three systems of New York's Highway Classification, with 120-, 168-, and 108-hr samples, respectively.

There are isolated incidents of comparison of data where the sample size does not come up to the 66-hr (data grouped for at least 5 sites) sample size; but these, along with the individual

study section statistics, are presented for comparative purposes only. Ordinarily, the individual study section statistics would not be shown in this type of report and the data would be limited to the group statistics by highway classification, lanes of travel, and/or volume. Inasmuch as this is the first section of a comprehensive report on this subject, the author desired to present all the basic data in detail by study section as an aid to others anticipating similar studies and for the guidance of New York's designers.

It is not realistic to assume that the Oregon and the New York experience in this type of driver behavior would be similar. This is emphasized in the subject report citing the comparison between the results of the New Jersey and the New York statistics. Types of traffic must be considered for determining design factors in providing for safety rest areas. This obviously is a subject for study by individual agencies responsible for adequate and economic design.

For those interested in determining the frequency of stops in New York by type of vehicle travel, similar to Mr. Blensly's interest, Table 10, showing vehicle classification by study site, has been included in the Appendix of the report.

To sum up, the New York study was aimed at obtaining factual data of current driver behavior stopping practices on shoulders as a guide for location and design engineers. To accomplish this aim, data were collected during the summer months when traffic is near its peak. Under these conditions, use of the data reflects maximum or near maximum driver behavior stopping practices for practical design purposes. Under these conditions, seasonal fluctuations in stopping practices are not considered pertinent; that is, it can be expected that safety rest areas will be designed to provide for storage and the turnover of vehicles at or near the maximum needs rather than for off-season needs or a combination of both.

The author aimed his analysis not only at the statistical data and comparisons of frequency of stops and related

data, but also, as a result of conferences with designers, at providing other essential elements (such as *hours driven since last stop* and *time of day and length of leisure stops*) for design guides. An analysis of the accident hazards imposed by stopping practices was considered as pertinent to the over-all design considerations.

Messrs. Blensly and Byars' determin-

ation of the number of hours (66) of this type study sample required for statistical significance within 10 percent of the true value 95 percent of the time is an important contribution to this type study. Apparently, the groupings of the New York study sites by highway classification, and in most cases by lanes of travel, as well as values for all sites, for analysis meet this confidence level.