reational areas.

What I have said is a feeble expression of the facts and conditions which prevail in Oregon. What we have done is not enough, but the spirit and emphasis back of our task, supplemented by our love for and our appreciation of Nature's gifts to Oregon, will make it easy to carry on to greater accomplishment.

MINNESOTA ROADSIDE SURVEY
PROGRESS REPORT ON ACCIDENT, ACCESS POINT AND ADVERTISING SIGN STUDY IN MINNESOTA

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Minnesota, in cooperation with some 13 other states, actively participated in a study to determine the degree of relationship that exists between highway accidents and geometric design features. The study was initiated in 1947 in response to a joint request made by the National Safety Council and the Bureau of Public Roads. The compilation of data in the field and in the office, as well as the entering of information on tabulating cards, followed the procedures outlined by the Bureau of Public Roads. A duplicate set of tabulating cards was forwarded to the Bureau of Public Roads for an analysis which included similar information supplied by the other cooperating states.

In 1948, while the field work for this study was still in progress, the Bureau of Public Roads suggested that Minnesota include with this study an inventory of all advertising signs and access points along the routes comprising the original study. From this additional information an analysis of the effect of advertising signs and access points on highway accidents was to be made.

Although all of the rural mileage on U. S. 52 in Minnesota was originally selected as the study route, it was subsequently felt that its 370 miles did not adequately reflect the several predominant types of rural routes in the state. To overcome this deficiency and further enhance the value of the survey, an additional 140 miles of several rural trunk highways were added, increasing the study to a total of 510 miles.

The mileages of various types of roadway included in the expanded study were: 420 miles of two lane roadway, 31 miles of three lane, 27 miles of four lane undivided and 32 miles of four lane divided roadway. This paper, however will deal only with the two lane roads which constituted over 82 percent of the mileage studied.

The several roadway elements which were encountered on the 420 miles of two lane roadway and their frequency per mile are shown in Table 1.

TABLE 1

FREQUENCY OF ROADWAY ELEMENTS

Roadway Element	Frequency per Mile
Tangent	1 03
Curve	0 99
Intersection	1 52
Structure	0 13
Railroad Crossing	0 04

As would be expected, the tangent and curve sections occurred with approximately the same frequency: 1.03 and 0.99 respectively. Intersections of all types had a frequency of 1.52, structures 0.13 and railroad crossings 0.04. The frequency of the two latter elements were deemed insufficient to warrant detailed analysis at this time.

The tangent and curve elements, the only ones which are adaptable to linear measure, comprised 343 and 77 miles respectively of the two lane roads.

There also were 639 intersections of all types on these roads. Of these, 374 were of the junction type (T and Y) and 265 were of the crossing type. These were actual intersections with public roads and should not be confused with access points which will be discussed later.

The original survey called for a study of accidents which occurred during 1948, but preliminary tabulations revealed their occurrence on certain roadway types was insufficient to permit a complete analysis. It was therefore decided to include accidents occurring on these roadways in 1949 and, in order to present the accident data on the customary annual basis, it was necessary to average the 1948 and 1949 accidents.

Advertising signs, placed on roadsides for the sole purpose of attracting the attention of the motorist, were one of the roadside features studied. The survey disclosed that there were 4,069 advertising signs located along the two lane roads. This number does not include, however, those signs which were attached to or painted on buildings along the road.

These advertising signs varied greatly with respect to size. Nearly 49 percent had a surface area of less than 12 square feet. Included in this group were the multitude of small signs found along most rural highways with 57 of these being series signs, 41 of which were of the "Burma Shave" type. According to commercial display authorities, those small signs are the most difficult to control with respect to their location along the road because of their comparative low cost. Only 828 or approximately 20 percent of all the signs were of the large or "billboard" variety, having areas in excess of 72 square feet. The remaining 31 percent of the signs were of an intermediate size ranging from 12 to 72 square feet in area.

The shape of the signs was given consideration because of their possible conflict with highway markers and directional indicators. Of the ten categories of shapes used, the five most predominant were horizontally rectangular, vertically rectangular, square, round, and diamond shaped. By far the most popular were the horizontally rectangular signs which accounted for over 63 percent of all the signs.

Color, used to attract the motorists' attention to the message conveyed on these signs, was also noted. Because of the numerous color combinations used, it was necessary to differentiate between that used for the message and that used for the background. The colors used most frequently to convey the message were white and black. White was used for this purpose on approximately one-third of the signs and black was used on 23 percent of them; brown, green and orange being used on the remaining 44 percent of the signs. The most popular background colors were white, yellow, and red, in that order, although little preference was shown as to choice of these three colors. Other colors were used in a few instances, either to convey the message or to serve as background. Brown apparently was the least desirable of any color.

In considering the use of illumination on signs, it must be remembered that the study sections were rural in character and signs attached to or painted on roadside buildings were not included, consequently, most of the signs were of the non-illuminated type. Our study revealed that approximately 79 percent of the signs had no illumination. Reflectorized signs accounted for another 15 percent and the remaining six percent were illuminated by incandescent, neon or some combination of lighting.

Considering all of the physical aspects of these signs, it was interesting to note that out of the 4,069 signs only 21 used either red or green lights, or words such as "Stop", "Caution,", "Slow", etc. or an arrow as a sign or within a sign.

The proximity of signs to the center of the roadway is apparently influenced

to some extent by the practice of attaching the small signs to fences along the right-of-way boundaries. More than 90 percent of all the signs were located from 30 to 100 feet from the center line of the roadway, with the median distance for all signs being 51.6 feet. Only 15 signs were located 200 feet or more from the center line. It was of interest to note that 551 or 13.5 percent of all the signs observed were found to be located on the premises of establishments producing or merchandising the product advertised.

The frequency of signs per mile of tangent and curve indicated a preference for locating signs on curves. Although there were 3,133 signs on tangent sections and 936 on curve sections, the frequency per mile on curve sections was significantly greater than on tangent sections, being 12.1 as compared to 9.1.

A total of 620 signs located on tangent sections and 224 on curve sections were located within a distance of 200 feet from an intersection. The incidence of these signs will be considered when the variance of accident rates at intersections is later explored.

Access points were the other roadside features for which information was obtained during the course of the survey. For study purposes, any provision for vehicular access to the study roadway was considered an access point, and using this criterion a total of 4,257 such access points were tabulated. To provide a comparison of the relative importance of these access points, they were classified as to the kind of facility served. These facilities included farm dwellings, home units, fields, public roads, private roads, public buildings, manufacturing plants, cemeteries and churches, public parks, historic sites, combinations of the above and commercial roadside activities. These commercial activities included taverns, gas stations, cabin camps, motels, small and seasonal businesses.

Field entrances, facilities which provide little traffic service, were the most frequently encountered type of access point. The 1,463 observed along the two lane roads accounted for 34 percent of the 4,257 access points. The next in frequency of occurrence were public roads and to tabulate these points on a basis which would permit comparison with frequencies of other access points, a crossing type intersection was considered as two access points. A total of 1,018 or 24 percent of all access points were thus considered to serve public roads. Access points serving farm dwellings ranked third in the frequency of occurrence and accounted for 860 or 20 percent of the access points. Home units and roadside activities, which were fourth and fifth in sequence, numbered 474 and 337 respectively. The large number of access points serving farm dwellings or identified as field entrances reflects the predominantly agricultural characteristics of the area traversed by the study roads. With the exception of the public roads, which are usually thought of as intersections, very few of the access points were controlled with stop signs.

The angle of incidence was measured for all access facilities. Uniformity in recording these angles was insured by always measuring them either to the right or left from the center line of the roadway. For 78 percent of the 4,257 access points the angle of incidence varied from 70 to 110 degrees.

Visibility, often a contributing factor in accident occurrence, was evaluated for these access points. The visibility was considered restricted if obstructions did not permit an unlimited view of the study route from a point on the access facility 40 feet from the center line of the roadway. In this manner 401 or only about 10 percent of the access facilities were found to have restricted visibility. The causes for these restrictions were the customary ones such as banks, trees, brush, buildings or signs. There was little indication that the angle of incidence had any influence upon visibility at the access points.

Many other characteristics of rural highways were evaluated and tabulated such as traffic volumes, shoulder widths, kinds of terrain, surface types, surface widths, and operating speeds.

Time does not permit a review of the findings with respect to these other characteristics.

In making the compilation of accidents to be used for this study, all accidents which occurred on the study roadway, regardless of cause, were included. As stated previously, this was done for those occurring during 1948 and 1949. The resultant annual average for the two lane roads was 730 accidents.

The occurrence of these accidents with respect to the various roadway elements studied were: 393 on tangent sections, 119 on curve sections, 201 at intersections and only 17 at structures and railroad crossings. The frequency of accidents per mile on tangent sections is considerably lower than that for

TABLE 2

ACCIDENTS AT CURVES

Degree of Curve	Rate per Million Vehicle Miles
Less than 3	1 37
3 but less than 5	2 48
5 and over	3 86

curve sections being 1. 14 as compared with 1. 54 on curves. The 201 accidents assigned to intersections averaged but 0. 31 per intersection.

Accident rates per million vehicle miles of travel were computed for tangent sections of routes carrying specified traffic volumes. This rate was 1. 0 for the tangent sections having an annual daily traffic volume less than two thousand vehicles per day, while sections carrying two to four thousand vehicles per day had an accident rate of 1. 9 per million vehicle miles. Routes carrying more than four thousand vehicles per day had an accident rate of 1. 5 per million vehicle miles, but the mileage in this traffic volume group was relatively small.

Accident rates for curve sections of the study routes were computed for each degree of curvature. However, in order to reduce the fluctuations in rate which could be attributed to the variation in sample size, the data was grouped by degree of curvature increments. The accident rates for these groupings are shown in Table 2.

In order to make possible a logical analysis of accidents which took place at intersections, certain intersections with the accidents assigned to them were eliminated from consideration. One such group were the few intersections which had traffic volumes exceeding 5,000 vehicles per day. Also eliminated were those which had no provision for traffic control. All the remaining intersections had traffic volumes less than 5,000 vehicles per day and were traffic controlled.

These intersections were then classified according to type, whether

TABLE 3

ACCIDENT RATES FOR INTERSECTIONS*
BY PERCENT CROSS TRAFFIC

	Crossing Type		Junction Type	
	No	Acc Rate**	No	Acc Rate**
Less than 10% Cross Traffic	250	0.40	343	0 21
More than 10% Cross Traffic	8	3 20	14	1 16

* With controls

** Per million vehicles per year (intersectional volumes)

crossing or junction type. They were further classified according to the percentage of cross traffic. In Table 3 are presented the accident rate data obtained.

As might be expected, accident rates for crossing type intersections were higher than those for junction type in both cross traffic volume groups. The accident rates for intersections having more than ten percent cross traffic were several times greater than those for intersections having less than ten percent cross traffic.

The intersections having less than ten percent cross traffic were segregated and reclassified as to frequency of advertising signs located at or near these intersections. They were then grouped according to the frequency of signs and the accident rates for each group were computed. The results are shown in Table 4.

It is interesting to note that the accident rates for both types of intersections were considerably higher at intersections having four or more signs than at intersections where there were less than four signs.

TABLE 4

ACCIDENT RATES FOR INTERSECTIONS* BY FREQUENCY OF SIGNS

Sign Frequency	Crossing Type No	Crossing Type Acc Rate**	Junction Type No	Junction Type Acc Rate**
No Signs	103	0 31	146	0 15
1, 2 or 3 signs	111	0.32	155	0 20
4 or more signs	36	0.91	42	0 44

* With controls and less than ten percent cross traffic

** Per million vehicles per year (intersectional volumes)

An investigation was made regarding the accident rates for roadway sections along which were located access facilities serving commercial roadside activities. These sections were defined to include the portion of roadway within 300 feet of one or more of these activities. The 337 roadside activities created 177 such sections which included 25 miles of road. The average number of vehicles which traveled these 25 miles was not appreciably different from the average traffic volume for the entire 420 miles of two lane roadway.

Of the 512 accidents assigned to all tangent and curve sections on the 420 miles of two lane roadway, 81 or slightly less than 16 percent occurred on the 25 mile composite section which represented only six percent of the total miles studied. Accidents assigned to intersections were not included. Accident rates per million vehicle miles were computed for each roadway group and are presented in Table 5.

The accident rate of 3. 80 for road sections fronting these roadside commercial activities is significantly greater than the 1. 45 rate for the remaining sections of the roadway.

A comparison of intersection accidents on these 25 miles of road with intersection accidents on the remaining mileage definitely substantiates the variance found on tangent and curve sections. There were 69 accidents at the 134 intersections located within the 25 miles. Thus it was found that over 34 percent of the intersectional accidents occurred at only 21 percent of the intersections.

TABLE 5

COMPARISON OF ACCIDENT RATES ON ROAD SECTIONS WITH AND WITHOUT ROADSIDE COMMERCIAL ACTIVITIES

	With Activities	Without Activities	All Road Sections
Length in Miles	25	395	420
Number of Accidents	81	431	512
Million Vehicle Miles	21.325	297.375	318 700
Accident Rate	3.80	1.45	1 60

The foregoing discussion constitutes a brief resumé of the more important findings thus far in the Minnesota Roadside Study. The possibilities of evaluating the significance of the contributions made by roadside features and roadway characteristics to accident occurrence have not been exhausted.

The volume and variety of the information obtained in the course of this study had the initial tendency to overwhelm the analyst. The magnitude of the relationships which it was possible to develop forced those in charge of the study to devise new methods for handling the data and the result has been the adoption of a new system of arraying the information on tabulating cards. With the adoption of this system, further exhaustive analyses are now possible.

With the completion of these analyses, a comprehensive report will be prepared summarizing the results of the survey.