

# REPORT OF COMMITTEE ON LIGHT AS AFFECTING HIGHWAY TRAVEL AT NIGHT

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## SYNOPSIS

In April, 1939, a comprehensive statement on highway lighting was prepared following appointment by the Highway Research Board of a working committee and selection of a number of studies which should be made.

Recent studies of driver behavior both in daytime and after dark by the Public Roads Administration are adding data to that already available relating to light as it affects night highway travel.

A day-and-night study on a one-mile lighted section of U. S. Route 422 near Chagrin Falls, Ohio, reveals some interesting data. They are based on partially completed analyses, and certain conditions at the location studied not considered normal must be taken into account in interpreting their significance. Further studies on longer illuminated stretches and under different conditions may prove they are not typical.

1. Average night speeds were somewhat lower than average day speeds, both without and with highway illumination.
2. The percentages of cars traveling faster than 45.5 m.p.h. were smaller at night than in the day, both without and with highway illumination.
3. At night, the average speed was slightly less with highway illumination than with no fixed illumination.
4. At night, with fixed illumination, a wet pavement did not result in a reduced average speed, though the percentage of cars exceeding 45.5 m.p.m. was lower for the wet pavement.

Night traffic fatalities decreased about one-fifth from 1937 to 1938. The decrease for daytime deaths was somewhat smaller.

Nevertheless, nearly two out of three traffic fatalities still occur at night despite the much lower mileage driven after dark. Based on mileage, the motor vehicle death rate is three times as high at night as in the day.

Night accidents as a class are more serious than daytime crashes.

The need for doing something to reduce the night toll is therefore apparent. While there are a number of factors which help increase the night toll, visibility is unquestionably the primary factor. If a prudent driver in normal conditions can see well, he can protect himself against most hazards. Hence major aspects of the problem are light and driver behavior.

## HIGHWAY LIGHTING RESEARCH

Last year, following a conference of 31 specialists, the Highway Research Board decided to explore these problems of driver behavior at night and of light as it affects night highway travel.

A working committee was appointed which outlined a series of studies which should be made. These were reported at last year's meeting and will not be repeated now, though the above review was deemed advisable for purposes of orientation. In April, 1939, a quite comprehensive general statement concerning the project was prepared, and is available to those interested. The purpose of this paper is to report progress made.

## RECENT STUDIES

While studies have been made in a number of locations, major known prog-

ress has resulted from the work of two agencies—the Public Roads Administration and the State of New Jersey.

Extensive studies of driver behavior both in daytime and after dark, are being made by the Public Roads Administration. Ingenious devices have been developed to make analyses of volumes, speeds, time spacing between cars, transverse positions of cars, overtaking and passing practices, etc. Most of the studies to date have been on unlighted two-lane rural highways without roadside reflectors.

These studies will provide very valuable information for this research by indicating what normal practices are without roadside reflectors or fixed illumination aids. And it should be emphasized that for all except a very small but important percentage of road mileage, drivers will have to continue to depend on headlighting for night seeing.

Hence there should also be reported the highly significant development of the new sealed-beam headlamp. This new design was developed as a joint undertaking of automobile and headlamp manufacturers and of the American Association of Motor Vehicle Administrators. Nearly all of the 1940 models have the new head-lighting, which is generally regarded to be a substantial improvement over any of the earlier headlights.

#### CHAGRIN FALLS, OHIO, STUDY

The Public Roads Administration has recently cooperated further in a similar day and night study on the one-mile lighted section of U. S. route 422 near Chagrin Falls, Ohio. In this study, the General Electric Company also cooperated, both in extending the period of illumination of this demonstration installation of their equipment and in arranging for the lights to be turned off certain nights so that studies could be made for both lighted and unlighted conditions.

The main purpose of the study was to determine to what extent driver behavior varied under conditions of daylight and night with and without lights. To these variables there was unexpectedly added a variety of weather conditions, including rain and snow.

Excerpted from a progress report of the Public Roads Administration is the following description of the location, the study equipment used and some of the kinds of findings which will result from complete analysis:

"The highway, as it approaches the lighted section, is a horizontal tangent, slightly undulating. About a fourth of a mile from the first light and within the lighted section, the road rises slightly and then drops sharply on about seven per cent grade for a distance of approximately one-half mile. There are two horizontal curves on this grade, one of them being very sharp. The remaining one-fourth mile of the section is approximately a level tangent.

"The pavement is portland cement concrete in fairly good condition, having a nominal width of 20 feet increasing to 27 feet on the hill. The shoulders on the 20-foot pavement are 10 feet wide, flat and well seeded. A two-foot width adjoining the pavement is graveled clay. The 27-foot width on the hill has a six-inch curb.

"The lighting consists of incandescent lamps in specially designed reflectors mounted 25 feet high, 125 feet apart, and extending five feet out over the edge of the pavement. All lights are on the same side of the road.

"Three types of traffic study equipment were used: The passing study equipment, the speed-placement equipment, and the newly-developed speed counter. Some duplication of information will result from this practice which will serve as an accurate check on the equipment and methods employed.

"The speed counter was operated continuously, resulting in a complete speed record by hours of all vehicles, classifying them into twenty speed groups. This machine in its present form is capable of recording the speed of over 95 per cent of the traffic and the results are highly valuable in showing the distribution of speeds. A summary of the results of this portion of the study is included as a part of this report.

"The passing study equipment was set up on the tangent at the top of the hill, beginning at

a point 125 feet ahead of the first light and extending over the rise and down to the point of curvature of the first curve, which was also the point of widening of the pavement. Only two of the recording units were used because of topographic conditions. Consequently, the passing study section covered about one-third mile of highway on a portion of which passing was restricted by limited sight distance. Because of this short distance, and the low volume of traffic prevailing, the number of passings was naturally quite low. The equipment was operated during the afternoons and evenings until about 10 o'clock for four days. The lights were off on alternate evenings. A count of the passings for seven hours of operation on one afternoon and evening reveals that only 37 passings were recorded. The total number, therefore, will probably not exceed 150 and the analysis will not require any great length of time.

"However, it is believed that other information available on these charts will be of considerably more importance, or at least of greater interest than the passings themselves. It will be possible to note the changes in speeds as cars enter the lighted section and the variations in speeds and spacings between vehicles anywhere in the section. The observance of a "Hill" sign near the end of the study section, as exhibited by the number of cars and trucks slowing down at that point, the effect of a 35 m.p.h. speed limit sign on the opposite side of the road, and the indifference to the double-striped no-passing zone will make interesting studies in themselves.

"The speed-placement study was operated at three locations. Two days were spent with the detectors about midway of the passing study sections, this being the location at which the speed counter was operated. The third and fourth days were spent at the center of the sharp curve on the grade, and on the

fifth day, the equipment was operated on the level section at the bottom of the hill. The hours of operation were about the same as those for the passing study. These studies will show, not only the effect of illumination on vehicle speeds, but also how the transverse position varies with the ability of the drivers to see the pavement edge."

The said progress report warns of certain conditions which must be taken into account in interpreting the significance of results, as follows:

"First, the traffic volumes are relatively low, and the effect of lights on the speed of traffic as shown here may be quite different from that under heavier traffic conditions that normally might be expected on sections of road justifying illumination (from a volume viewpoint). Second, a variety of topographic conditions in the short length of road probably prevented drivers from assuming a "normal" behavior under any one condition. Third, the novelty of the lights being off for the first time in several years may well have had an influence. Fourth, the number of vehicles for which the speed was recorded at night is not great, although probably these records exceed in number and accuracy any heretofore collected. Fifth, the final criterion of effectiveness of such an installation should be the effect on safety and 'before and after' accident records. Finally, a 35 m.p.h. speed limit was marked, though not enforced on the section."

The speed data have been most completely analyzed at this time. Bearing in mind the cautions above listed, there are indicated several interesting points, a number of which are summarized in Table 1.

TABLE 1  
SPEED STUDY DATA

One Mile Lighted Section of U. S. Route 422, Near Chagrin Falls, Ohio

	Average M.P.H.		Percentage Over 45.5 M.P.H.	
	Road dry	Road wet	Road dry	Road wet
Day .....	38.5	36.5	20.3	12.1
Night, highway lighting on .....	35.0	35.8	12.4	8.4
Night, highway lighting off .....	36.8	....	13.0	....

The following points shown in Table 1 warrant attention:

1. Average night speeds were somewhat lower than average day speeds, both without AND WITH highway illumination. Apparently good visibility did not produce a general temptation to speed up.
2. The percentages of cars traveling faster than 45.5 m.p.h. were smaller at night than in the day, both without and with highway illumination. The tendency to drive at high speed was not increased by good lighting.
3. At night, the average speed was slightly less with highway illumination than with no fixed illumination, though the difference was not significant.
4. At night with fixed illumination, a wet pavement did not result in a reduced average speed, though the percentage of cars exceeding 45.5 m.p.h. was lower for the wet pavement.

From 6 to 8 P. M., the night period of heavier traffic, there was a somewhat higher speed on the dry pavement. From

that time on throughout the night, the detailed tables showed that there was a somewhat higher speed on the wet pavement. This apparently illogical higher speed as traffic thins out may be due to the fact that when the pavement is wet the gain in visibility upon entering the lighted section is relatively much greater than when the pavement is dry.

Further studies in longer illuminated stretches and under different conditions may prove that these interesting indications are not typical.

Unfortunately, no satisfactory before-and-after accident data are available for this section of highway nor for stretches of highway just beyond the lighted section. It is known that no fatality or serious accident has been reported involving a car leaving this lighted section.

#### FURTHER STUDIES PLANNED

Further progress on this lighting research project is now assured. The Public Roads Administration is starting a study of existing information relating to the project. In addition, it appears likely that a research specialist will be assigned to prepare quite specific plans for studies which are needed.