

VEHICLE AND HIGHWAY MECHANICS AS RELATED TO TRAFFIC

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This committee was formally organized on October 8, after considerable correspondence between members on the subject of a research program

The status of the several problems which seem to merit consideration as prospective research projects is outlined in this report

PROBLEM NO I HEADLIGHTING

While headlight illumination is more a matter of geometry and optics than of mechanics, the committee has considered that it properly falls in its field

I. Object

A Reasons for the proposed research Headlights are perhaps the only accessories of the motor vehicle which are condemned by the average user as unsatisfactory and inadequate. The accident rate at night is excessive as compared with that by day, and headlighting is generally held responsible.

General highway lighting systems are being considered as a remedy for this condition where the amount of traffic will permit the necessary expenditure.

B Information desired What distribution and beam intensity produced from a practicable "bulb candle power" will give the optimum visibility considering all users of the highway?

Can the best overall results be obtained with a single fixed beam system or with a system having more than one beam pattern adjustable to meet different conditions, as open road driving and meeting other cars?

If the latter, what are the optimum number, and beam patterns of the alternative beams?

What is the relative visibility of objects on the highway with practical headlight illumination as compared with practical highway lighting systems?

II Review of existing information

The problem of headlighting with the beam in a fixed location relative to the object to be seen, is a comparatively simple problem of optics which has been studied extensively, and available data are perhaps adequate for the purpose.

The same problem as related to the continuously varying position of the headlight beam on the road is a much more difficult one on which considerable work was done a few years ago at the Bureau of Standards. While by no means adequate to answer the questions stated above under I, the results of this research lead to certain tentative conclusions which may be stated somewhat as follows:

(1) The vertical and horizontal motions of the headlight beam on the road are such that an approaching driver will often be subjected to the full intensity of any single beam pattern which is so adjusted as to illuminate the road sufficiently for safe driving at reasonable speed.

(2) The problem of glare is essentially a relative one, depending very much more on the relative brightness of the approaching beams than on their absolute brightness. So important is this effect that the problem of glare would be practically solved if all headlights could be kept at nearly the same beam intensity, with roughly the same beam pattern.

(3) For a given bulb candle power the best horizontal and vertical spread of beam and the best distribution of intensity differs radically for different types of highways and for different driving speeds, as well as for the two conditions of driving on unoccupied roads and of meeting other vehicles. The optimum horizontal angular spreads vary from 15° to 20° for maximum speeds where the right of way is narrow and the shoulders are obstructed, to 100° or more for slow speeds on sharply curving roads.

For meeting other vehicles a wider beam spread seems desirable than for open road driving under the same road conditions.

(4) The visibility of objects in the right hand traffic lane to the rear of approaching headlights is very poor under all conditions of beam pattern and intensity, when both sets of headlights are alike. The visibility distance under this condition is between 80 and 120 feet for a wide variety of typical conditions.

Apparently the drivers of approaching cars depend very largely upon the fact that the section of highway to the rear of each has just been illuminated by the passage of the car which he is meeting.

(5) The distance at which objects are visible on the highway is roughly proportional to the cube root of the beam intensity. In other words, to produce a given increase in visibility distance requires an increase of candle power proportional to the cube of the distance.

(6) Highway conditions as to speed, curvature, road surfaces and road shoulder conditions are so variable that the problem of optimum illumination is necessarily a statistical one involving compromise as to the relative importance of different factors. In making any detailed studies under fixed conditions care must be taken not to over-emphasize some elements in the problem at the expense of others.

III Procedure and scope

The procedure and scope of a research project are rather pointedly suggested under II. Data should be obtained to answer definitely the questions stated above.

Distances at which objects on the highway can be seen by average drivers under emergency conditions should be determined.

Beam intensities and vertical and horizontal spreads be determined for safe visibility at all reasonable road speeds.

The relationship between foreground illumination and glare intensity for safe seeing should be fully determined for all reasonable road conditions.

Visibility of objects with headlight illumination should be compared with the same for artificial road lighting.

IV Suggested research agencies

Universities.

Industrial laboratories

Bureau of Standards

PROBLEM NO II RIGHT OF WAY

I Object

The general term "right of way," as applied to vehicular traffic, apparently has no clear or adequate definition. As a result the concept is not clearly defined in the minds of drivers, as attested by the fact that "Failure to grant right of way" is one of the most commonly reported causes of accidents.

The handling of vehicles so as not to collide involves the mechanics of manipulation and the geometry of the situation.

A clear concept of what "right of way" ought to mean should be derivable from a study of the conditions under which vehicles may meet.

II Review of existing information and work in progress

There seems to be no existing information on this subject and no work in progress.

Some speculation on the subject however suggests a few points for consideration.

Four general cases may be distinguished.

(1) Where traffic lines cross at intersections, some convention is necessary. Such convention should, (a) give maximum time and distance for the vehicle which must yield, (b) prevent unnecessary blocking of the intersection, (c) make the situation as safe as possible for pedestrians, (d) be simple and clearly understood by the drivers, (e) be ap-

plicable to intersections of all sorts except those which are controlled by lights or officers

(2) Where vehicles may meet on adjacent traffic lanes It seems clear that each vehicle has right of way only in its own traffic lane

(3) Where vehicles moving in the same direction in the same traffic lane may collide, "rear end collisions" Here there is much confusion It is not clear often in law who has right of way, and it is perhaps less clear in practice A definite and universal rule should apply here, and if possible the rule should be in accord with a more general concept of right of way

(4) Where two vehicles are proceeding in the same direction in two traffic lanes Here the general rule is that the right hand vehicle has right of way Growing practice however disregards the rule, apparently without any serious consequences

A right of way concept should be developed to fit in to and clarify the present actual situation For instance, one possible concept which appears to be general in nature may be stated as follows

A vehicle performing any maneuver whatever except traveling at normal and uniform speed in its own traffic lane must yield right of way to any vehicle so proceeding

III Procedure and scope

A careful analytical study should be made of the necessary manipulation, vehicle configuration and ranges of visibility under all the conditions involved, with a view to formulating the simplest and safest right of way code to meet all conditions Special attention should be paid to the problem of intersection

IV Suggested research agencies

Universities

Any agency capable of such independent analytical study

PROBLEM NO III OVERTAKING AND PASSING

I Object

The overtaking and passing of other vehicles on the road is a performance always fraught with a certain amount of danger, and is the contributing cause of a large number of serious accidents This is particularly important when it becomes necessary to break up lines of cars which have collected on sections where passing is difficult

A much more thorough knowledge of this problem in its relation to highway design and traffic control is needed

II Existing information

It has been determined by a series of measurements that the overtaking and passing of another vehicle under certain specified typical conditions requires an amount of time which is substantially independent of the initial speed of the two vehicles

This indicates that the distance required for safe passing is proportional to the speed, and affords a basis for estimating the distance required for safe passing, and thus for rational regulations

III Suggested procedure

Determine what distances are required for safe passing of one or more vehicles under a variety of highway conditions and with different classes of vehicles

Make a study of the formation and breaking of queues of cars in relation to the passing facilities of the highway

Determine what modifications can be made in highway and traffic control conditions to permit safe passing and abatement of queues

IV Suggested agencies

Universities or any other groups having the necessary facilities

PROBLEM NO IV MECHANICS OF STEERING

I Object

The steering requirements for safe and comfortable driving involve rather complex and delicate adjustments. Some, if not most modern cars, are satisfactory when new

Definite knowledge should be had as to the need of attention to the steering mechanisms of used cars, not only with reference to the danger of actual failure but also as to the effect of maladjustment, backlash, etc., on control of the vehicle

II Existing information

The various car manufacturers have made studies of steering system designs, particularly with reference to ease of handling and mechanical safety both of the mechanism and of the car on the road. There is however little information as to the safety of handling cars with worn or loose steering gears. Also, safety in emergencies as affected by steering gear reduction seems not to have been studied

III Scope and procedure

Measurements should be made with a variety of vehicles and steering gear adjustments which will show the accuracy and speed with which said vehicles can be steered and controlled under conditions which may occur in emergencies

Data should be collected from any available sources dealing with the problem of steering as related to accidents. Frequent cases of steering into obstructions suggest that such a study may show some surprising results.

IV Agencies suggested

Universities

Research laboratories of the automotive industry

Bureau of Standards

PROJECT NO V VEHICLE BRAKES

The general subject of brake action and brake requirement for safety has been for some time a project of the American Standards Association under a committee for which the A A A and the Bureau of Standards are sponsors.

At a recent meeting of this committee, which formulated the existing Brake Safety Code of the Hoover Conference, it was determined that a revision of this code should be undertaken and that a thorough study of the problem of brakes with reference to safety should be undertaken to this end.

A reorganization of the Brake Safety Code Committee is now in progress and active work on the research program will be undertaken soon. In view of this activity it would seem that the Committee on Highway and Vehicle Mechanics can consider that this project is in competent hands, with prospect of early results.

DISCUSSION

ON

VEHICLE AND HIGHWAY MECHANICS

COL R P PARROTT, *General Electric Co*. The painstaking research which Dr Dickenson has bestowed on his important theme leaves, perhaps, only one aspect of the subject that might be suggested as a supplement to his thoughtful presentation. I refer to the illumination of through-trunk highways for night driving.

Year by year, there is a steady increase in the number of drivers who use our highways by night, and there is every indication that the number will continue to grow larger. This pronounced trend accentuates the importance of highway practice that will give night motorists a due share of consideration.

In this respect, it is suggested that the time is ripe for scientific consideration as to the effect of highway illumination on the safety of main roads after dark, on the decrease in the number of accidents

to persons and cars, and on the economics of highway traffic. A specific direction might well be given to such research by the experimental illumination of portions of road where the record of accidents indicates especially difficult or dangerous conditions.

This suggestion does not imply that *all* paved roads are so heavily traveled during the dark hours as to demand or even justify their illumination, it is meant simply to point out the possible value of scientifically planned lighting judiciously applied to the correction of unfavorable conditions where they exist.

There was a time when highway illumination of a high standard was prohibitive in cost. To obviate this, experimental research has been conducted over a period of years. This practical study has embraced every condition of weather and atmosphere, every month of the year, every degree of illuminating intensity, all feasible locations and heights of units, and other contributing factors. These prolonged technical investigations point to the conclusion that the illumination of main trunk lines of traffic is economically practical. In addition this illumination will afford to the public the freest use of the highways at all hours, at reasonably fast speed, and with a high factor of safety for motorists and pedestrians.

It is the opinion of many well-informed engineers and scientific authorities, who have specialized in the intensive study of highway lighting, that main rural traffic arteries can be illuminated adequately and at reasonable expense, and that hazardous sections of these roads should be illuminated. They are also of the opinion that the Highway Research Board and others interested in promoting a safer, more flexible use of our highways should commence to give this subject their serious consideration.

EXTENT OF DESIRABILITY FOR STATE CONTROL OF TRAFFIC REGULATION IN MUNICIPALITIES

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Reduction of accidents, highway efficiency and uniformity in methods of handling traffic are desirable.

In many places traffic conditions create costly and annoying delays and serious accident losses. The situation calls for systematic and concentrated attention.

Divers systems of rules and regulations are an annoying hardship for drivers and too frequently bring well intentioned drivers into conflict with police officers and the courts. The public is entitled to reasonable, and lucid uniformity of traffic control.