# Factors of Educational Value for Obtaining Safe Night Driving Speeds

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The problem of speed limits is always more or less controversial. First is the matter of convincing the legislator who must attack the problem from the layman's point of view, since he is usually not a professional driver, although he is a law-maker.

After he is convinced, and a law is passed, the drivers on the road must have respect for the regulation in order to secure compliance. In Iowa, night accidents had built up to an alarming extent. There were also many day accidents under the basic speed law. It was felt that a speed law with stipulated limits was desirable but it seemed difficult to set up sufficient proof to support such a speed law for daytime. Consequently it was decided to concentrate on a night speed limit. Factors used in publicizing the need for such a measure and the approach made are discussed. Comparison of 1955-56 with 298 night fatalities, and 1956-57 with 260 fatalities was significant enough and seems to support the reasons for establishing such a law, and the methods used in getting it passed. Analysis of the break-down and factors emphasized are discussed.

● DATA ARE available from various sources to establish a reasonable speed at night for most any locality (1, 2, 3, 4, 5). By integrating these data into a suitable brochure or short paper to be used at public meetings and as a source of guidance to the legislature, the job was accomplished. The various legal associations were enlisted to assist, and a number of public meetings were held to develop sentiment for the measure. Iowa is an average state in most respects and mean values were thought to be satisfactory for most of the elements used.

## PERCEPTUAL DISTANCE

By reducing the problem to its simplest terms, that is the relation between the seeing or perceptual distance, not sight distance, and the stopping distance, the approach was made understandable to the layman. First data were presented to show about what distance a driver can see ahead of him at night. Rober's data (4) were used as a base and a table of calculations was made for different intensities of headlights. Since statuatory limitations are set at 75,000 bcp and many lights to not come up to this standard on high beams, no trouble was met in establishing this value for most situations, i.e., a seeing distance at night. Since other factors would mostly tend to limit this to lower values, and since they are mostly well understood by the average driver, they were merely enumerated and some average values presented. No formulation was necessary but in constructing a table a simple product sufficed. Since it may be assumed for safety that most hazards appear on the roadways unexpectedly no allowance was made for this factor. There remained five elements that should be considered. These are:

1. Beam candle power of the headlights.
2. Reflection factor of the object being illuminated, brightness or the amount of light being reflected.
3. Atmospheric conditions through which the beam must pass and the driver must see.
4. Glare effects which are frequently encountered.
5. Visual acuity of the driver which has been found to average around 90 percent

although most states license drivers with 50 percent vision or less. Iowa requires 20/40 vision, while Idaho and some other states specify only 20/70.

Since the base used assumed more or less optimal conditions all the other values for individual cases would tend to lower the distance given in the table by an amount approximately equal to the product of the values. Suppose with a given beam candle power one can see ahead 200 ft to identify an object of a 7 percent reflection factor. With visibility at 90 percent the same object would be seen at 180 ft. A person with acuity of 20/25 or 80 percent would see the object at around 144 ft. Thus a table was used illustrating the perceptual distance for several conditions.

## STOPPING DISTANCE

By using the standard formula for stopping distance as,

$$\frac{V^2}{30F \pm 0.3p} + 1.467VT,$$

where V is the speed in miles per hour, f, the coefficient of friction and p, the percent grade as a whole number. Reaction time distance is included in the expression 1.467 VT, where 1.467 is the speed distance ratio, V is the velocity in miles an hour, and a T of .75 second is used as the "agreed upon" time for reaction. Stopping distance was used to include both braking and reaction time distance as stated. A number of stopping distance charts have been published which do not always agree but which approximate the formula $\frac{V^2}{10}$, the latter being on the conservative side on dry pavement surfaces. The longer formula with an insertion of the proper values will give a much closer approximation. The various factors were tabled and explained.

Another table was constructed showing a reasonable stopping distance for the various conditions of traction with a correction for gradient, at several speeds. By matching the perceptual distance with the stopping distance and moving across to the speed column a quick evaluation could be made that seemed to be quite convincing and settled arguments rather quickly. The scheme was used by the courts to settle cases where all the conditions were known. Decisions were upheld by the Iowa Supreme Court in a test case.

The usefulness of such a plan is shown by the reduction in night fatalities from 298 in 1955-56 to 260 in 1956-57. By analysis of variance for the entire year to offset seasonal variations changes, this difference was found significant. By considering the increase in traffic for the second year this was even more significant perhaps than the data showed. Probably this effect was offset by efforts to reduce traffic accidents late in the second year. However, the fatal accidents during daylight hours under the basic speed law seemed to increase slightly for the same period.

## SUMMARY

A breakdown of the principal factors in nighttime stopping distance as related to seeing distance was made as an aid to legislators and to the driving public to develop an appreciation of nighttime hazards. Considering the limitations involved, the project seemed an effective educational device for the following reasons:

1. A night speed law of 60 mph maximum was passed although a 50 mph limit was requested by the Commissioner.
2. During the following year nighttime fatal accidents were reduced significantly over the previous year under the basic law.
3. Convictions using the system for violations were upheld by the Supreme Court of Iowa.
4. Scientific data may be effectively used in accident reduction programs.

## REFERENCES

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