Night Visibility for Opposing Drivers with High And Low Headlight Beams

RICHARD N. SCHWAB
Electrical Engineer, U. S. Bureau of Public Roads

ABRIDGMENT

• THE RELATIVE visibility of two tasks which are typical of those encountered in the nighttime driving situation was explored using the Visual Task Evaluator (VTE) measurement technique. The tasks were illuminated with either high or low headlight beams. An opposing vehicle was located at one of several longitudinal separations with the same beam configuration as that of the observer's to simulate a single approaching vehicle at one of four different median widths. Disability glare measurements were made with a Pritchard photometer and the overall visibility evaluated through an analytical procedure.

The two tasks studied were (a) a red retro-reflector on the rear of an unlighted, black car, parked 500 ft from the observer on the right shoulder, and (b) a section of standard pavement stripe, 200 ft ahead on the right-hand pavement edge.

The results are given in terms of a Supra Threshold Factor (STF). This factor is a measure of how many times above threshold the visibility of an actual target is.

Figure 1 shows the mean value of STF for each task and beam condition, for all median widths combined, at each of the 5 longitudinal separations measured between approaching vehicles. It appears that the optimum beam choice depends, to a large part, on the task studied. For the driver looking at a section of pavement stripe, the low-beam headlamps facing oncoming low-beam lamps produced better visibility conditions. However, to see the car's retro-reflector, the condition was high-

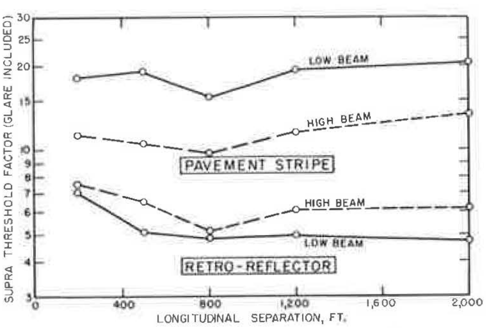

Figure 1.

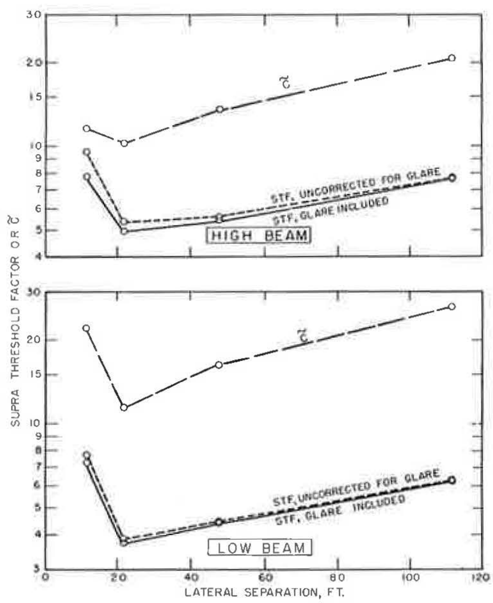

Figure 2.

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beam lamps on both vehicles led to better visibility. There are individual exceptions to the above trends, especially at narrow separations. In general, however, the results show the danger of using a single, simplified target in research on driver visibility.

If the results are plotted, as shown in Figure 2 for the retro-reflector, in terms of the equivalent contrast ($\tilde{C}$) of a standard target, the data show that the target's visibility is affected in some way other than by the illumination from the opposing vehicle's headlight, since this measure is independent of the disability glare effect. An effect, appearing similar to the driver, due to the scattering of light flux by small particles in the atmosphere between the driver's eye and the target, is a possible explanation of this change in visibility due to the opposing vehicle.

The STF values (Fig. 2) have been calculated with and without disability glare being considered. The effect of the disability glare (i. e., scattering of light within the eyeball) appears minor when compared to the atmospheric scatter effect.

Since STF is independent of background luminance and $\tilde{C}$ is not, the curves in Figure 2 being approximately parallel to each other and generally of the same shape would indicate that background luminance is not too important. Since the task size, shape, and duration were not changed, the contrast must, therefore, play the dominant role in determining the visibility for these high contrast tasks.

Further analysis of the data, however, reveals that the shifts in visibility which accompany the switching from low to high or high to low beam are largely determined by changes in the level of adaptation, since contrast for these tasks will show little change. It is, therefore, the adaptation level which largely determines the beam that would give the highest visibility in the particular case.