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16. Abstract

This analytical study evaluated the advantages and disadvantages of several curve-lighting strategies that involved moving one or both low beams by various amounts. Two curve radii were examined (80 m and 240 m) for both curve directions (left and right). Recent market-weighted median U.S. and ECE tungsten-halogen low beam patterns, and a recent median U.S. HID beam pattern were used. Seven lateral positions were of interest, corresponding to the lane of travel and the left adjacent lane, and additional lanes of travel to the left and right or off-road objects. The dependent variable was the maximum distance of 3-lux illumination (combined from both lamps) at a plane 0.25 m above the roadway.

The main findings for the short-radius curves were: (1) All of the examined curve-lighting strategies tended to perform substantially better than the nominal aim. (2) The improved performance for given lateral positions in the visual field tended not to be coupled with worsened performance for other lateral positions of interest. (3) The differences among the curve-lighting strategies were small. (4) The best strategy involved moving both lamps in parallel by 15° into the curve.

The main findings for the large-radius curves were: (1) The best strategy depended on the curve direction, beam pattern, and lateral position in the visual field. (2) There were performance trade-offs between left and right lateral positions (especially for the right curve), with improvements in one lateral area generally being paired with decrements in the other.

In conclusion, for short-radius left and right curves, moving both lamps in parallel should substantially increase the visibility of objects in one's lane of travel, in several additional lanes of travel to the left and right, and off the road. Thus, implementing such a curve-lighting strategy is recommended for small-radius curves. On the other hand, because of the lateral trade-offs of benefits and costs for large-radius curves, additional research is needed to better understand the desirable approach for these types of curves. Finally, because of the inherent lateral asymmetry of low beams, future research should also further explore the benefits of asymmetric shifts for left and right curves.

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