Highway Sight Distance Design Issues: An Overview

JOHN C. GLENNON

This paper presents a brief overview of the conference session at which the papers in this Record were presented. The goal of this session was to present the best current thinking on the development and presentation of design criteria and values for stopping sight distance, passing sight distance, intersection sight distance, decision sight distance, and railroad-highway grade crossing sight distance. In looking at the adequacy of current design criteria and values, a major focus was the compatibility of these values with current and future operations of large trucks.

The papers in this Record were presented at a conference session held at the TRB Annual Meeting in Washington, D.C., on January 26, 1989. The session, "Highway Sight Distance Designs Issues," was cosponsored by two TRB committees: Geometric Design (A2A02) and Operational Effects of Geometrics (A3A08). Not only do these two committees have a long history of cosponsoring TRB sessions, workshops, and symposia concerning topics of timely interest, but they also have a longstanding focus on highway design policies in general and highway sight distance criteria in particular. This latter interest is manifested by the fact that seven of eleven participants in this outstanding conference session were members of these committees.

The seed for this session began when the members of TRB Committee A2A02 decided in 1986 to make sight distance its priority topic. At that time, the intention of the committee was to work toward a formal presentation of both the shortcomings of the current AASHTO Policy on Geometric Design for Highways and Streets (Green Book) and some clear recommendations for updating that publication (*1*). At about the same time, Committee A3A08 initiated planning for a midyear conference entitled "Beyond the Green Book." This conference, which focused on gaps in the Green Book and tools needed to supplement it, was held on November 9–10, 1987, in Austin, Texas (proceedings of the "Beyond the Green Book" conference are currently in press).

By far the major point of discussion that emerged from floor discussions and workshops at the midyear conference was the need to evaluate and update highway sight distance design values. Researchers pointed out not only the lack of evidence on safety effectiveness but also several inconsistencies of logic in the Green Book. Designers who attended the midyear conference were concerned with updated design values in the Green Book, particularly as they apply to reconstruction projects. In January 1988, therefore, Committee A2A02 decided to sponsor a session on sight distance at the 1989 Annual Meeting and was immediately joined in the effort by Committee A3A08.

John C. Glennon, Chartered. 8340 Mission Road, Suite B-12, Prairie Village, Kans. 66206.

IDENTIFICATION OF GREEN BOOK NEEDS

One of the major concerns about the Green Book is the level of commitment given to its production. This was the first major AASHTO design policy produced by AASHTO alone. Although inputs and critiques were solicited from selected segments of the industry, the major contributions were made by members of the AASHTO Task Force on Geometric Design, who individually prepared the chapters through generous donations of their time. Although these efforts are to be applauded, the question remains whether this level of effort represents an appropriate dedication of the highway community as a whole to a publication that directly affects the application of billions of dollars in highway funds. This author suggests that efforts were inadequate to make the Green Book an adequate reflection of the technology available at the time it was published. In particular, the following major needs have been identified by Committee A2A02 and should be addressed in future updates of the Green Book (many of these themes are evident in the papers presented in this Record).

Update Policies in More Timely Manner

The Green Book was the first major update of national highway design policies in 11 years for urban highways and in 19 years for rural highways. A more dynamic process should be adopted to ensure that policies are reviewed and updated in a more timely fashion. Although an update is under way at this writing, it appears that the revisions will be mostly cosmetic.

Involve Research Community

The Green Book failed to recognize major recent research findings both in the updating of policies and in the presentation of reference lists at the end of each chapter. The research community, through TRB and other appropriate groups, should be brought directly into the process to identify, critique, and evaluate research for inclusion in the design policies.

Develop Definitive Research Synthesis Program

A well-defined program of pragmatic research should be developed to synthesize methodologies to be incorporated into design policies that will promote optimization, design consistencies, and operational effectiveness.

Expand Design Criteria for Flexibility

A major shortcoming of all past design policies is that they have failed to acknowledge the need for design criteria structured to be sensitive to site-specific conditions, particularly with regard to the functional class of roadway. Many of the concerns about tort liability for design deficiencies could be abated by giving proper attention to developing design criteria that demonstrably reflect the operational and safety needs of the particular roadway. Detailed discussions of which design dimensions can be altered and which cannot, and how much they can be altered under differing conditions of traffic volume, composition, and speed; surrounding terrain and development; and functional class of roadway could go a long way toward the better use of highway funds. These discussions should of course include the tradeoffs among operational, safety, and economic goals.

Develop a Clearer Connection Between Design and Traffic Operational Criteria

In comparing the Green Book with the 1978 *Manual of Uniform Traffic Control Devices* (*2*), Committee A2A02 identified several major incompatibilities that are either ignored or rationalized away by these publications. The committee's position is that every design criterion should reflect the anticipated operation of the highway, including the compatible application of traffic control devices.

Stress the Importance of Highway Maintenance

The safe and efficient operation of highways depends on the continued maintenance of design factors such as cross-slope, superelevation, pavement skid resistance, sight distance, and related factors. The Green Book should emphasize the need to maintain these critical features.

Write Policies for Wider Audience

Current AASHTO policies, including the Green Book, are written almost entirely from the perspective of a state department of transportation. Broader consideration should be given to the wide variety of local jurisdictions that could use the policies as authoritative documents if the policies were properly focused.

EXAMPLES OF SIGHT DISTANCE DESIGN CONCERNS

The subject of highway sight distance offers an excellent illustration of the committees' concerns about design standards and the Green Book. Sight distance is one of the most basic design inputs affecting horizontal alinement, vertical alinement, and cross-sectional elements. Focusing on sight distance within the context of the Green Book thus represents a first meaningful step toward addressing the many concerns of both Committee A2A02 and Committee A3A08.

The two committees cosponsoring the 1989 conference session have identified several aspects of sight distance design that they believe need further consideration and development. Many of these concerns have been expressed above, several are repeated in the other papers in this Record, and a few are outlined further below.

Stopping Sight Distance

1. The Green Book model for stopping sight distance, which was adopted 50 years ago, is overly simplistic and clearly inappropriate for all highways under all operating conditions. Although the model inputs have been subjected to considerable fine tuning over the years, the model has scarcely been scrutinized for its relevance to the driving task. Valid concerns persist that the parameters used to exercise the model do not correspond to human visual limitations, to the likelihood that a given event will occur (for example, a 6-inch stationary object in the road), or to the ability to decelerate large vehicles. Several authors in this Record (Hall and Turner; Neuman; Urbanik et al.; and Harwood et al.) suggest more meaningful approaches to determining stopping sight distance design values.
2. The Green Book does not treat sight distance requirements relative to site-specific design or operational features (such as intersections).
3. The Green Book does not recognize possible design vehicle variances. For example, traffic data indicate that the eye height for a pickup truck driver may be more appropriate as the stopping sight distance for low-volume rural roads.
4. The Green Book stopping sight distance values are inconsistent for highway curves, not only because locked-wheel braking would cause loss of control, but also because the truck driver's eye height advantage is lost for sight obstructions such as walls or continuous vegetation (*3*).
5. Recent accident research, reported by Urbanik et al. in this Record, demonstrates some insensitivity of safety to Green Book design values. For example, the 6-inch stationary object does not represent a frequent or severe hazard. Also, highway sections with deficient sight distance (compared with Green Book values) do not necessarily show adverse accident experience.

Passing Sight Distance

1. The Green Book model incorrectly represents the sight distance need because it minimizes the possibility of aborting the pass (*4*).
2. A more appropriate operational model was first postulated in 1969, and several papers since that time have reiterated the flaws in the AASHTO model and presented usable alternatives (*4–9*).
3. Design and operational values given in the Green Book and in the *Manual on Uniform Traffic Control Devices* are incompatible (*4*, *5*, *7*).
4. The Green Book indirectly discourages any effective "design" for passing zones because it only considers overly long vertical curve lengths (Harwood et al. in this Record).
5. Recent use of the Green Book model has led several authors (*10–13*; Harwood et al., in this Record) to draw

flawed conclusions about the passing sight distance needs of large trucks.

Intersection Sight Distance

1. The Green Book presents Case I intersection sight distance as an alternative, then admits that it is not a safe practice. This flaw was first pointed out in the 1940 AASHO Policy (*14*).
2. The Green Book considers seeing the top inch of a passenger car as an adequate design object for intersection sight distance. This criterion is wholly inadequate for nighttime conditions where a vehicle cannot be seen above terrain obstructions until its headlights are visible.
3. The Case III-B sight distances are not practical, particularly if the design turning vehicle is a large truck (Mason et al., in this Record).

Railroad-Highway Grade Crossing Sight Distance

The minimum Green Book sight triangle actually promotes truck-train collisions because the truck cannot stop but can only clear from the sighting point (Fitzpatrick et al., in this Record). If the truck driver brakes, the truck will collide with the train before coming to a full stop. If the driver begins to stop and then decides to proceed, he will collide with the train before clearing the crossing.

CONCLUSIONS

Many issues persist concerning the development, presentation, adequacy, and usability of the AASHTO design values for highway sight distance design. This Record not only addresses a majority of these issues, but also provides different perspectives on many of the issues. The concerned reader should read all of the papers and all of the major cited references to see how they fit together to form a representative body of knowledge on the subject of highway sight distance design.

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Publication of this paper sponsored by Committee on Geometric Design.