

TRB/AASHTO
Geometric Design Research Efforts
Supplemental Information

Status Report on Ongoing Projects

Wed, June 14, 3:45 pm - 4:45 pm

Overview

The TRB Committee on Geometric Design (AFB10) is seeking input on our efforts to conduct a strategic research plan to be implemented over the next 10-15 years. This document summarized activities that have occurred over the last four years and current recommendations for a proposed research implementation plan. AFB10 members are presently documenting the activities in an E-Circular to serve as a point of reference.

The objective of the E-Circular publication is to document the efforts leading up to and resulting from the Strategic Geometric Design Research Needs Workshop held in Williamsburg, Virginia, in July 2004. The document will be “snap shot” in time of a state of our geometric design practice as summarized in white papers, subsequent break out work sessions, and recommendations for geometric design research program in a prioritized and sequential order. The document is intended as a framework for a long-range geometric design research program to support organization such as AASHTO, FHWA, and other research sponsoring agencies. From the Williamsburg efforts, 22 research needs statements were created. This remarkable achievement is a testament to the cooperation and contributions of all participating groups.

As AFB10 and our sister TRB committee, the Committee on the Operation Effects of Geometric design (AHB65), move forward in implementing the strategic research plan we seek input and guidance on general priorities, specific research needs that support the strategic plan, and opportunities to understand the continuing needs of the industry. Specifically, we seek input to:

- Validate that current research needs statements reflect the practice needs. Can they be enhanced to better address gaps in current research?
- Consider the proposed research implementation plan. Are the priorities reasonable and what are the specific research needs that should be documented in future needs statements?
- Create a continuous dialogue with AASHTO members. What are the best ways for our TRB committees to interact and collaborate on future geometric research needs?

Background

The TRB Committees on Geometric Design and Operational Effects of Geometrics met jointly with the AASHTO Technical Committee on Geometric Design during the summer of 2002 in Santa Fe, New Mexico. This group participated in a joint one-day brainstorming session on research issues and priority research topics organized under the chapter headings of AASHTO's, *A Policy on Geometric Design of Highways and Streets* (Green Book). As an outcome of this meeting, a group of the TRB committees grouped the Santa Fe discussion results into seven general topic areas and created White Papers on the state of the practice for each area.

In July 2004, members from the TRB committees (AFB10 and AHB65) and the AASHTO Technical Committee, along with FHWA and other professionals with

expertise in geometric design, met to develop recommendations for a geometric design research program to be implemented over the next 10-15 years. The committees conducted the one-day workshop in conjunction with their 2004 midyear meetings held in Williamsburg, Virginia.

This workshop followed this general format:

Morning session - White papers developed jointly by several authors representing the research, practitioner, and agency perspectives were presented on major topics. The primary objective of each white paper was to review the previous research conducted on their respective topic and indicate the basic gaps in this research.

The workshop's technical White Papers were prepared on these topics:

- Combinations of Design Controls/Elements
- User and Vehicle Controls
- Rethinking the Design Process
- Rural Highways
- Freeways and Interchanges
- Intersections
- Urban Streets

Breakout groups – Discussed the fundamental research needed for each topic, along with identifying the time needed and the approximate cost of the research.

Action plan – The entire group developed an action plan to achieve consensus on needed research, prioritize needs, and develop a chronology for accomplishing the research.

The participants of the work session used the white paper information and subsequent break out groups to consolidate the extensive list of potential topics into 22 research topic areas. The AASHTO and TRB attendees independently considered and prioritized the topics. The "vote" summaries are shown in Table 1.

Table 1. Generated Research Topics

No.	Problem Statement Title	AASH TO Votes	TRB Votes	Total Votes
1	Median Design and Barrier Issues in Urban and Rural Environments	13	15	28
2	Performance-based Geometric Design Analysis	7	17	24
3	Multimodal Highway Design for “Complete Streets”	6	17	23
4	Investigation of Alternative Geometric Highway Design Processes	8	12	20
5	Horizontal Curve Design Philosophy	4	14	18
6	Right-turn Interactions and Channelized Right-turns	5	11	16
7	Ramp and Interchange Spacing	9	7	16
8	Transition Zone Design	5	9	14
9	Ramp Design as a System	3	11	14
10	Safety and Operational Tradeoffs of Freeway Lane and Shoulder Widths	4	9	13
11	Safety, Operations, and Usability Tradeoffs of Road User Groups	2	11	13
12	Safety and Operational Impacts of Four-and Six- Lane Cross-sections with Raised versus Two-way Left-turn Lanes	8	4	12
13	Superelevation Criteria for Steep Grades on Horizontal Curves	7	4	11
14	Geometric Design Guidelines for Major Intersection Alternatives to Accommodate Multimodal Users	4	7	11
15	Design, Safety, and Operational Considerations of Pedestrian Treatments at Intersections	3	7	10
16	One- and Two-lane Loop Ramp Design	5	4	9
17	Effectiveness of Mid-block Crossing Treatments	0	7	7
18	Intersection Design to Accommodate Pedestrian Crosswalk Cross Slopes	4	2	6
19	Guidelines for Provision of Sidewalks	4	1	5
20	Safety Effects of Intersection Skew Angle	4	1	5
21	Accommodating Bicyclists on Rural Highways	3	0	3
22	Safety and Operational Effects of Angle versus Parallel Parking	2	0	2

Post Williamsburg Follow Up

Of the research topics generated at the Williamsburg workshop, five (5) were considered to be “highest” priority. These research problem statements were prepared immediately after the workshop and the statements were submitted to the NCHRP for consideration as part of the fiscal year 2006 research program. The five highest priority research topics were:

- Median Design and Barrier Issues in Urban and Rural Environments
- Ramp and Interchange Spacing
- Right-turn Interactions and Channelized Right-turns
- Superelevation Criteria for Steep Grades on Sharp Horizontal Curves
- Performance-based Geometric Design Analysis

NCHRP selected the “Median Design and Barrier Issues in Urban and Rural Environments” and “Performance-Based Geometric Design Analysis” projects for funding in 2006; these are designated as projects 22-21 and 15-34, respectively. The “Ramp and Interchange Spacing” and “Superelevation Criteria for Steep Grades on Horizontal Curves”

projects are included as contingency projects in the NCHRP FY 2006 program, but funds were not available to address these projects.

In addition to the five “highest priority” research needs statements, committee members have generated needs statements for the balance of the 22 topic areas summarized in Williamsburg.

Following the Williamsburg meeting, TRB committee members considered the various topics to categorize and prioritize the topics for future research. The Table 2 provides a legend for the proposed implementation plan shown in Table 3.

Table 2. “Problem Statement Identifiers” Legend for Implementation Plan (Table 3)

Geometric Design Research Categories	Research Program Sequence
M = Methodology	A = Near Term Phase
C = Criteria	B = Second Phase
H = Highways	C = Third Phase
S = Streets	D = Fourth Phase
I = Intersections	
F = Freeways & Interchanges	

Table 3. Proposed Research Implementation Plan

Problem Statement Identifier	Research Topic(s)	Estimated Funding Level (\$)	Estimated Project Duration (months)
M/A	Performance-based Geometric Design Analysis	600,000	36
M/B/C/D	Investigation of Alternative Geometric Highway Design Processes (3 projects)	~4,000,000	>36
	Project 1: Critical Review of Geometric Design Policy Formulation	250,000	18
	Project 2: AASHTO Design Model Research (7 parts)	~3,000,000	>36
	• Part 1: AASHTO Horizontal Curve Model	750,000	36
	• Part 2: Roadside Design Criteria in Urban Environments	500,000	36
	• Part 3: Urban Cross-section Design Values	500,000	24
	• Part 4: Relationship of Level of Service to Substantive Safety	750,000	36

	<ul style="list-style-type: none"> Part 5: Influence of Geometric Design Dimensions on Highway Maintenance 	300,000	24
	<ul style="list-style-type: none"> Part 6: Discretionary Decision-making, Tort Law, Risk Management – Synthesis of State Practice 	200,000	18
	<ul style="list-style-type: none"> Part 7: Sight Distance Criteria 	300,000	24
	Project 3: Alternatives to Current Design Process	500,000	36
C/A	Superelevation Criteria for Steep Grades on Horizontal Curves	300,000	24
C/B	Horizontal Curve Design Philosophy	1,500,000	48
H/A	Median Design and Barrier Issues in Urban and Rural Environments	800,000	42
H/C	Accommodating Bicyclists on Rural Highways	350,000	36
S/A	Safety and Operational Impacts of Four-and Six- Lane Cross-sections with Raised versus Two-way Left-turn Lanes	350,000	30
S/B	Effectiveness of Mid-block Crossing Treatments	250,000	27
S/C	Guidelines for Provision of Sidewalks	500,000	24
S/D	Safety and Operational Effects of Angle versus Parallel Parking	275,000	30
I/A	Multimodal Highway Design for “Complete Streets”	300,000	24
I/B	Right-turn Interactions and Channelized Right-turns	500,000	24
I/C	Safety, Operations, and Usability Tradeoffs of Road User Groups	500,000	30
I/C	Geometric Design Guidelines for Major Intersection Alternatives to Accommodate Multimodal Users	400,000	30
I/C	Design, Safety, and Operational Considerations of Pedestrian Treatments at Intersections	300,000	24
I/C	Intersection Design to Accommodate Pedestrian Crosswalk Cross Slopes	500,000	24
I/D	Safety Effects of Intersection Skew Angle	400,000	36
F/A	Ramp and Interchange Spacing	500,000	30
F/B	Ramp Design as a System	500,000	36
F/C	One- and Two-lane Loop Ramp Design	350,000	18

F/D	Safety and Operational Tradeoffs of Freeway Lane and Shoulder Widths	> \$500,000	> 36
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Next Steps and Opportunities

The E-Circular will be a helpful resource document and provide guidance about the state of various topic areas. The efforts preceding and following Williamsburg will form the basis for a strategic research program to systematically address geometric design issues. The results of future efforts will be strengthened through the continued cooperative efforts of TRB, AASHTO, FHWA, and other transportation professionals.

The geometric design committee looks forward to input from our peers to:

- Validate that current research needs statements reflect the practice needs.
- Consider the proposed research implementation plan.
- Create a continuous dialogue with AASHTO members.

For additional information, please contact James Brewer (JBrewer@ksdot.org), Larry Sutherland (lsutherland@HNTB.com), or Brian Ray (bray@kittelso.com).

Question for Feedback

Please provide any additional comments to Brian Ray at bray@kittelson.com

- **Research Needs Statements:**
 - Are there additional research topics we should be considering?

 - Are the generated topics appropriate?

 - Are the problem statements written properly?

- **Research Implementation Plan:**
 - Is this general plan complementary to AASHTO needs?

 - What are some specific research needs within the topic areas?

- **Ongoing Cooperation and interaction:**
 - What are the best methods to continue our productive interaction?

 - How can TRB committees continue to support AASHTO, FHWA, and other research needs?

- **Are there additional topics on geometric design where you believe:**
 - 1) the design either outdated;

 - 2) the research the designs were based upon is outdated; or

 - 3) no research was ever conducted prior to the geometric design of a specific highway element?

- **Using the categories High, Moderate, and Low, how would you prioritize your suggested topic for research?**

Update on TRB/AASHTO Geometric Design Research Efforts

Status Report on Ongoing Projects

Wed, June 14, 3:45 pm - 4:45 pm

Background

- "Green Book" Brainstorming Session
 - Santa Fe, NM, Summer 2002
 - Discussed research needs organized around chapters of the Green Book
 - A long list of topics and needs that confirmed importance of continued research
- Strategic Geometric Design Research Needs Workshop
 - Williamsburg, VA, July 2004
 - Organized topics to seven categories summarized in "White Papers"
 - Break out sessions to identify research needs
 - Prioritized topics for research needs statements
 - Formed basis for geometric design research program

Post Williamsburg Follow Up

- Five highest priority research topics:
 - Median Design and Barrier Issues in Urban and Rural Environments*
 - Ramp and Interchange Spacing**
 - Right-turn Interactions and Channelized Right-turns
 - Superelevation Criteria for Steep Grades on Sharp Horizontal Curves**
 - Performance-based Geometric Design Analysis*
- * Selected for funding
** Selected as contingency projects

Other Research Needs Topics

- Multimodal Highway Design for "Complete Streets"
- Investigation of Alternative Geometric Highway Design Processes
- Horizontal Curve Design Philosophy
- Transition Zone Design
- Ramp Design as a System
- Safety and Operational Tradeoffs of Freeway Lane and Shoulder Widths
- Safety, Operations, and Usability Tradeoffs of Road User Groups
- Safety and Operational Impacts of Four- and Six-Lane Cross-sections with Raised versus Two-way Left-turn Lanes

Other Research Needs Topics (Cont'd)

- Geometric Design Guidelines for Major Intersection Alternatives to Accommodate Multimodal Users
- Design, Safety, and Operational Considerations of Pedestrian Treatments at Intersections
- One- and Two-lane Loop Ramp Design
- Effectiveness of Mid-block Crossing Treatments
- Intersection Design to Accommodate Pedestrian Crosswalk Cross Slopes
- Guidelines for Provision of Sidewalks
- Safety Effects of Intersection Skew Angle
- Accommodating Bicyclists on Rural Highways
- Safety and Operational Effects of Angle versus Parallel Parking

Strategic Geometric Design Research

- Categories:
 - M: Methodology
 - C: Criteria
 - H: Highways
 - S: Streets
 - I: Intersections
 - F: Freeways and Interchanges
- Table 3 of Summary Handout depicts proposed implementation plan

Feedback

- **Research Needs Statements:**
 - Are there additional research topics we should be considering?
 - Are the generated topics appropriate?
 - Are the problem statements written properly?
- **Research Implementation Plan:**
 - Is this general plan complementary to AASHTO needs?
 - What are some specific research needs within the topic areas?
- **Ongoing Cooperation and interaction:**
 - What are the best methods to continue our productive interaction?
 - How can TRB committees continue to support AASHTO, FHWA, and other research needs?

Feedback

- **Are there additional topics on geometric design where you believe:**
 - 1) the design either outdated;
 - 2) the research the designs were based upon is outdated; or
 - 3) no research was ever conducted prior to the geometric design of a specific highway element?
- **Using the categories High, Moderate, and Low, how would you prioritize your suggested topic for research?**
