Elizabeth Hilton, Secretary  
AASHTO Technical Committee on Geometric Design  
Federal Highway Administration (HIPA-20)  
300 East 8th Street, Room 826  
Austin, TX  78701  

September 19, 2014

Members, Technical Committee on Geometric Design

Dear Members,

The annual meeting of the AASHTO Subcommittee on Design, Technical Committee on Geometric Design was held in Salt Lake City, UT during the period July 22 through July 24, 2014. Mr. Jeff Jones, Chair, called the meeting to order at 1:30 p.m. on July 22.

Attendance

The following members were present:

Mr. Reza Amini, Oklahoma Department of Transportation  
Mr. Kent R. Belleque, Oregon Department of Transportation  
Mr. James O. Brewer, Kansas Department of Transportation  
Mr. R. Marshall Elizer, American Public Works Association  
Mr. Mike Fugett, Arkansas State Highway and Transportation Department  
Mr. Kevin M. Herritt, California Department of Transportation  
Ms. Elizabeth Hilton, Federal Highway Administration  
Mr. Jeff C. Jones, Tennessee Department of Transportation  
Mr. Mark A. Leiferman, South Dakota Department of Transportation  
Ms. Deanna L. Maifield, Iowa Department of Transportation  
Mr. Eric E. Marabello, Maryland Department of Transportation  
Mr. James A. Rosenow, Minnesota Department of Transportation  
Mr. Brent Story, Georgia Department of Transportation  
Mr. Barton Thrasher, Virginia Department of Transportation  
Mr. Stanley W. Wood, Massachusetts Department of Transportation  
Mr. Robert Wunderlich, National League of Cities
The following members were not in attendance:

Mr. Donald A. Lyford, New Hampshire Department of Transportation
Mr. Reza Maleki, Port Authority of New York and New Jersey
Mr. Joe W. Ruffer, National Association of County Engineers
Mr. Richard D. Wilder, New York State Department of Transportation

Also in attendance during all or part of the meeting were:

Mr. Richard Coakley, CH2M HILL
Mr. Doug Harwood, MRI Global
Mr. Tim Neuman, CH2M HILL
Mr. Brian Ray, Kittelson and Associates
Ms. Greta Smith, AASHTO Project Delivery
Ms. Brooke Struve, Federal Highway Administration
Dr. Paula Sind-Prunier, National Transportation Safety Board
Mr. Ray Derr, Transportation Research Board

Miscellaneous Business

- General comments –
  - Intro/Welcome/Membership -
    - Off – Rick Bruce (Region 3), Max Valero (NM , Region 4)
    - On – Kevin Herritt (Region 4)
  - Volunteers to help coordinate with Structures committee on Tunnel design and IH standards – Mark Leiferman & Kevin Herritt (Ch 4), Elizabeth Hilton
  - 2015 Meeting plans – AASHTO will help coordinate and sign the room guarantees. Kent looking for options in Portland, OR. Shooting for mid-July in Portland for 3.5 days – Kent and Greta will coordinate.
- Update of AASHTO Activities (Greta Smith)
  - 100th Anniversary of AASHTO!
  - King Gee – Now AASHTO Director of Engineering and Technical Services
    - He’s directed the organization to produce a five-year strategic plan
  - Access to Green Book (GB) files – posted on AASHTO SharePoint portal for download. Design/TCGD and login to see folders with Chapters. Ask Greta if you have questions.
- Federal Rules Adoption (Hilton) – Updating of 23 CFR 625 to adopt the 2011 GB is in the works, and will hopefully be completed this fall. After this revision is complete, FHWA plans to look closely at a more significant revision to 625, which Rosenow suggests is needed. Committee members are invited to submit ideas for rules changes to Elizabeth Hilton. Eric Marabello mentioned a memo from MD division to state re: Design Exceptions.
- NCHRP (Derr) – Design Speed for Ramps (NCHRP 15-56), and Horizontal Sightlines (NCHRP 15-59) projects selected. Send Ray nominations for panel members.
• Deanna – AASHTO publications – online and PDF not showing up for purchase. Greta will check.

NCHRP Report Updates

NCHRP 15-47: Guidelines for Geometric Design of Very Low-Volume Roads (ADT <=400vpd) (Doug Harwood)

• First edition published 2001
• This effort is part of Improved Highway Design Process project by CH2M HILL (NCHRP 15-47)
• Bart Thrasher is panel chair
• Surveyed highway agencies and got comments from TRB Low-Volume Roads Committee
• Tech memo submitted January 2014. Work should be completed this year.
• Key Issues and Preliminary Recommendations include:
  o Issues
    ▪ Raise the ADT above 400? Looking at crash frequency/severity in range of ADT 0-2000 and make recommendation. Discussion about purpose of this guide and why these criteria aren’t part of the Green Book.
    ▪ Should the scope of the guidelines be expanded to include all very low-volume collector roads, whether or not they primarily serve familiar drivers? Team trying to look at data to see if there is a relationship between crashes and familiar/unfamiliar drivers. Collectors and local roads may look exactly the same in the field.
  o Preliminary Recommendations
    ▪ Keep low-volume collector roads within the scope of the guidelines
    ▪ Re-title to better match scope of the guidelines
    ▪ Keep guidelines as separate stand-alone document rather than incorporating into the Green Book, although selective incorporation can be considered.
    ▪ Change format to be more like 2011 Green Book, including numbered sections.
    ▪ Refer to new or updated documents in the guidelines: Green Book, MUTCD, HSM, RDG, Bike Guide, Ped Guide, and PROWAG.
    ▪ Incorporate/reference USFS Road Preconstruction Handbook
    ▪ Limit scope to geometric design of public roads (not private roads or off-highway trails)
    ▪ Add photos as appropriate and to the extent available. Send photos to Doug please!
    ▪ Do not include percent trucks as an explicit factor in design guidelines. Discuss the types of trucks that should be expected on each type of road.
    ▪ Do not include a separate category of design guidelines for ultra low-volume roads (ADT < 100 vpd)
    ▪ Retain all 10 road types/functional subclasses
    ▪ Assess whether/what should be said about systemic safety improvements
- Update horizontal curve design changes made in 2004 GB
- Look at modified friction coefficients for rural resource recovery roads
- Update horizontal clearance/lateral offset language
- Review/update design examples

Additional Discussion
- Question about whether this guide applies to urban residential streets. Current guidelines do address urban streets, but limited/no data is available.

NCHRP 15-50: Guidelines for Integrating Safety and Cost-Effectiveness into Resurfacing, Restoration and Rehabilitation Projects (Doug Harwood)

- Half-way complete. Doug is the prime contractor.
- Objectives/Scope
  - Develop 3R guidelines
  - Update TRB Special Report 214
  - Main focus on rural two lane, rural multilane and urban/suburban arterials
  - Should freeways be considered? Panel considering adding rural and urban/suburban freeways, based on suggestions by TCGD.
  - Consider all projects regardless of funding source
- Tasks
  - Literature review done
  - Reviewed existing 3R guidelines
  - 2nd interim report due late this year, along with 1st draft
  - Outline changes needed to other AASHTO documents
  - Develop and test cost-effectiveness tool
- Role of 3R guidelines
  - Guidelines – not national policy
  - No recommendations on FHWA policy are anticipated
- Key issues for Candidate 3R Projects
  - Which 3R projects should be resurfaced WITHOUT accompanying geometric improvements?
  - Which 3R projects should be resurfaced WITH accompanying geometric improvements? (and which geometric improvements should be implemented)
  - How should highway agencies make such decisions?
  - How can highway agencies make better decisions given current safety knowledge?
- Priorities for Guidelines
  - Technical issues needed for engineering decisions
  - Safety rather than operations
  - Focus on issues that can be addressed quantitatively
  - Not focusing on administrative issues
• Planned research in Phase 2:
  - Six building blocks for approaches to 3R project design decisions – looking at these to determine what to include
    - Safety effectiveness measures
    - Revised dimensional criteria (update to SR 214)
    - Safety performance approach (Committee discussion: All modes? Data may be scarce. Discussion about exposure)
    - Cost-effectiveness or B/C analysis procedure for single project
    - Cost-effectiveness or B/C analysis procedure for group of projects
    - Develop computer tool for evaluating single or multiple projects?
• Alternative approaches to 3R design decisions – dimensional approach or cost-effectiveness approach, or combination. Also discuss knowledge gaps for 3R design decisions.
• List of Improvement types they plan to address
  - Lane widening
  - Shoulder widening
  - Shoulder and C/L rumble strips
  - Superelevation improvement
  - Realignment of horizontal curves
  - Intersection left- and right-turn lanes
  - Striping and delineation
  - Guardrail rehabilitation/installation
  - Clear zone restoration
  - Roadside slope flattening
• Draft document and 2nd Interim report by the end of the year
• Committee Discussion
  - Definition of 3R (vague and various definitions abound)
  - Discussion about scope of 3R projects and how to get most safety impact from projects
  - Discussion about ADA compliance and resurfacing projects
  - Graphical concept (visual) aids in understanding. However, these would be based on cost assumptions, even though cost can vary greatly. Would only be illustrative and discussion about how it would hold up over time. Perhaps the assumptions could be included in the spreadsheet so they could be modified by States and graphs would better fit their conditions.

NCHRP 17-53: Evaluation of the 13 Controlling Elements of Design (Doug Harwood) – NCHRP Report 783

• Didn’t look at intersection design, roadside design, access control or 3R
• Didn’t look at Structural Capacity or Vertical Clearance, nor much at Design Speed, since not geometric elements
• Looked at safety and operational impacts of each controlling criteria not excepted above
• Looked at application to rural two-lane highways, rural multilane highways, urban/suburban arterials, and freeways

• Preliminary Findings:
  o Bridge Width – no evidence of increased crash frequencies or severities for bridge width narrower than approach width
  o Stopping Sight Distance on rural 2-lane highways – crash rate affected by reduced SSD only when a hidden intersection, driveway or horizontal curve was present
    ▪ Ostensibly only for rural two-lane highways, but the findings probably apply more broadly
  o There are interactions between lane and shoulder width that should be taken into account in making design decisions.

• Developed models/evaluated:
  o Curve and Grade Effects
  o Speed Effects of Horizontal Curves
  o Stopping Sight Distance on Ty 1 crests (upgrade followed by downgrade)

• Performed sensitivity analysis – ranked importance of influence of each criteria on operations and safety

• From sensitivity analysis - Controlling criteria in preliminary order of descending safety effects:
  o Shoulder width
  o Lane width
  o Grade
  o Horizontal curve radius
  o Superelevation
  o SSD (w/hidden feature)
  o Bridge width*
  o Cross slope*
  o Sag vertical curve length*
  o SSD (w/o hidden feature) *
  o Lateral offset*
    * - Zero, negligible or undocumented effects

• If all 13 criteria are kept, preliminary recommendation is to rename 3 as follows:
  o Horizontal curve radius (instead of horizontal alignment)
  o Sag vertical curve length (instead of vertical alignment)
  o Lateral offset (instead of horizontal clearance)

• At this point, it doesn’t look like any new controlling criteria will be recommended

• Some criteria may be able to be dropped (preliminary recommendations for state policies):
  o Sag vertical curves (headlight criteria not essential), but they didn’t research. Further research recommended. Committee discussion about importance of nighttime visibility of pedestrians.
- Horizontal clearance (now lateral offset). Reconcile language between GB and RDG regarding this term in light of the creation of the new term “enhanced lateral offset” in the 2011 RDG. FHWA language still references ‘horizontal clearance’.
- Others depending on roadway type
  - Various preliminary recommendations for each roadway type
    - 2-lane rural:
      - Shoulder width
      - Lane width <11’
      - Horizontal curve radius
      - Superelevation
      - Grade
      - SSD (w/hidden feature)
      - Cross slope
    - Urban/suburban arterials:
      - Possibly only lane width (<10’) and SSD (w/hidden features) unless design speed >45mph that are designed more like rural highway
      - Comment: NCHRP 03-112 about to begin looking at lane widths on urban/suburban arterials
      - Committee discussion about urban vs. suburban design, shoulder width application to curbed sections, curb offsets.
  - Committee Discussion:
    - Implications for new construction

**Wednesday, July 23**

NCHRP 15-34A – Performance-based Analysis of Geometric Design of Highways and Streets (Brian Ray)

Brian provided a Word file that contains recommended changes to Green Book. This will be emailed to committee members.

- Looks at outcomes of design decisions as measure of design effectiveness
- Performance categories: Access(ibility) to destinations, Mobility, Quality of Service, Reliability, Safety
- Process Framework: project initiation, concept development, evaluation, selected alternative
- Lots of process flowcharts showing relationship between design, environmental analysis, project development phases and stakeholder input
- Focus on identifying project outcomes: whom are we serving, what are we trying to achieve?
- Geometric Design Elements (understanding what we know and don’t know):
  - Each element categorized as to whether there is an expected benefit, indirect benefit, or no expected benefit
  - Look at roadway segments and nodes (intersections and interchanges)
o Examines a wide range of geometric elements
  o Detailed tables for each performance category and specific to facility type
- Project examples contained in last chapter

FHWA efforts on Performance Based Practical Design (PBPD) (Brooke Struve)

- Working group formed about two years ago
- Interviewed selected states that have implemented some form of practical design policy
  o Meet purpose and need relying on engineering decisions rather than just relying on standards
  o Eliminating inessential project elements
  o Reduce costs to deliver more projects across the agency
- Concerns
  o Overemphasis on short-term cost savings
  o Elimination of desired project elements
  o Performance analysis tools not consistently used to support decisions
- Emphasize performance-based practical design, not just practical design
- Emphasis on planning-level corridor or system performance needs
- Utilize existing flexibilities
- Next steps:
  o Develop informational materials: Briefing package, Q&As, case studies, website
  o Not seen as a Federal policy
  o Prepare FHWA staff to assist States with training and technical assistance if States are interested
- AASHTO committee/researcher discussion
  o States shortsighted (not focusing on long-term benefit)? Sometimes due to lack of long-term financial sustainability
  o Sometimes the ‘build to standards’ project isn’t really a ‘great’ project, it may be overkill and bigger isn’t always better.
  o Much of the focus is ‘common-sense’ design, including how to maintain traffic during construction. More intentional consideration of traffic control. Not always design considerations – overall project decisions.
  o This umbrella shouldn’t be a license for bad design.
  o Can’t be focused on least initial cost, need to look at life-cycle cost analysis. What are long-range impacts of not doing something today?
  o We’re not shifting from ‘great’ to ‘good’ but rather from ‘standard project’ to ‘great project’. Build to meet need rather than to meet a standards book.
NCHRP Project 15-47: Improved Geometric Design Process (Tim Neuman) – Project to develop flexible design process that meets needs of geometric designers in the future

- Looked at a lot of design process concepts/initiatives – CSS, VE, etc. Matrix of what we’ve learned from these initiatives contained in White Paper 3.
- It’s all about defining and addressing the problem
  - Road user mobility
  - Access (to land, property, regions, etc.)
  - Safety (crashes and their outcomes)
  - Infrastructure state-of-good-repair
- Not meeting standards is not a problem – it’s a condition.
- Key preliminary findings reflected in white papers:
  - Interdisciplinary project development is here to stay (CSS)
  - Context matters – and it varies (non-motorized users, land use[type, intensity and future], new construction v reconstruction)
  - Providing multimodal solutions is now the rule (not the exception)
  - Dimensional design criteria should be based only on measurable performance effects
  - Speed is an essential input to determination of design and dimensions
  - AASHTO criteria currently produce uneven outcomes; thus programmatic uniformly cost-effectiveness is not currently possible
  - Many current criteria are insensitive to key context influencers of performance (road type and volume)
  - Some AASHTO criteria are based on outdated and/or overly simplistic models lacking scientific basis
  - Legal framework requires provision of minimum threshold limits and design values
  - Nominal and substantive safety differ in meaningful ways
  - AASHTO criteria should more completely reflect known interactive effects (e.g. grade and curvature)
  - AASHTO policy should replace dimensional guidance with direct performance where possible.
  - Advances in technology should be acknowledged and incorporated (information modeling, traffic operations simulation, safety performance modeling)
  - The notion of ‘conservatism’ in policy and leadership in highway engineering needs a 180 degree shift; i.e. what we have historically considered ‘conservative’ may actually be a non-conservative expenditure of resources and may result in poorer rather than better performance, in either on project-specific or programmatic basis.
  - Geometric design should be iterative to optimize performance. Context much more robust than urban/rural and level/rolling/mountainous.
  - Design process should consider maintenance and operations (life cycle rather than least-cost initial cost decision-making)
- Example – curves designed same way regardless of context, vehicles using roadway, volume, etc?
• References to performance-based design, and can learn a lot from design-build best-value projects and alternative technical concepts (ATCs). Some states are looking at incorporating ATCs into design-bid-build projects.

• Guiding principles for Highway Design Process
  o Fundamental basis for geometric design
    ▪ Objectively performance based
    ▪ Address all potential, legal road users
    ▪ Integrate operational solutions
    ▪ Forward looking
  o Attributes of the Design Process: Efficient, scalable, replicable, transparent, defensible
  o Conducted within the applicable social and policy framework
    ▪ Accountability and responsibility (agency and individuals/PE)
    ▪ Constrained, limited and directed by policies, priorities and laws
    ▪ Program sustainability

• Opportunities for Significant Change
  o Context definitions
  o Speed
  o Reconstruction (existing land use, observable volume, speed, crashes) different from new construction (no existing land interface, reliance on volume forecasts, etc.)
  o Update basic functional models
  o Different basis or models for different contexts (vehicle types, horizontal curves, etc.)
  o Revisit sight distance model reflective of context
  o Incorporate risk-based approach to SSD design

• Basic context elements – looking at ITE Context Zone model to develop basic framework. Could combine with different road types, giving 30 combinations of approaches to geometric design.

• Discussion
  o NCHRP project on functional class – RFP has been released. Marshall and Stanley on the panel for that.
  o CalTrans added ‘place types’ that are similar to ITE context zones

Discussion about possible changes to FHWA controlling criteria (Hilton)

FHWA Questions to get input from committee members:

1. Design Speed - most agencies don’t grant exceptions on this criterion. Does it need to be a controlling criterion? Should it be something different like a design control that is not eligible for an exception?
   • Design speed is still used for corridor issues, but may only do 5 a year. Allows states to do a DE for one issue rather than multiple criteria.
   • FHWA divisions have been reluctant to issue exceptions for design speed and states have been required to right exceptions for other criteria.
• Inconsistent message from FHWA on whether design speed exceptions are OK.
• Guidance in Mitigation Strategies suggests only using design speed exception if changing speed for entire corridor.
• If it is simply a matter of how design exceptions are documented, then using the exception that is most defensible is best.
• Building corridor in suburban area in segments. Segment 1 built to design speed, then posted at a higher speed, then the original design speed is no longer good enough for the next segment.
• Makes you think through the choice and evaluate way to solve it.
• Some states don’t allow design exception for design speed.
• Design speed is there, one way or the other. Part of choosing the appropriate horizontal curve is based on the design speed input.
• If design speed is no longer controlling, then FHWA doesn’t have the opportunity to have input.

2. Should controlling criteria be context specific?
• Many things in urban environment that are many more times important than 13 CC.
• Problem with this is that some apply the criteria in current Green Book based on urban or rural census zones.
• We make our best guess on what the context will be.
• MA has determined that the standards for the NHS, whether urban or rural, are 12’ lanes and 8’ shoulders.
• Most seem to be basing criteria on urban or rural context, rather than census boundaries.
• Building context into criteria is a good thing.
• Qatar has added weaving and accel/decel lane length to their controlling criteria as a performance standard.

3. Structural Capacity
• Never seen a design exception for this.
• Up to the bridge people.
• Structural issue, not a highway issue. Would simply result in load limit sign.

4. Bridge width
• Would pursue a shoulder exception even if it meets the minimum bridge width.
• Pursuing a programmatic exception for bridge width for roadways that aren’t going to be widened.
• Placement of guardrail and parapet should be outside shoulder.
• Research specific to existing bridges and suggests that narrow bridge can remain in place if there is no crash pattern. Does not necessarily apply to new construction.
• For projects that are specifically bridge replacement, once was a major problem when the bridges were narrower than the approach roadway.
• Based on economic analysis of Minnesota, narrow bridges result in program-wide cost savings of $5 million. May not be the best ROI for safety improvement.
• Some are looking at bridge width as complying with the standard if it matches the approaches, whether or not the approaches meet the standard with lane and shoulder.
• No harm in keeping bridge width, along with design speed.

5. Vertical curves and SSD
• Australian study indicates that the degree of deviation from the standard is important. Also NCHRP 400.
• Duplicative to have SSD and vertical curve length. Sag vertical curves may not be critical.
• Don’t recall ever fixing a sag curve, rather use design exception.
• If you always get a design exception and always get approved, what is the point of the exception?
• According to FHWA Mitigation Strategies for Design Exceptions, lighting a sag curve makes it go away as an exception

6. Type of Project
• For 3R, we’d typically have different criteria, so what we have in the Green Book is for new construction and reconstruction. The distinction between new and reconstruction is minor. Splitting hairs. Keep it simple.

General Discussion on Controlling Criteria

• Process/documentation – getting more extensive and more time consuming. Hurting flexibility and practical design. Please streamline documentation and provide more consistency across Divisions. Timeliness also an issue – need Division concurrence during scoping. Get legal input – are we documenting too much? Some skepticism on HSM use.
• Question about 2-lane rural lane width – very little difference between 11’ and 12’
• Could we adopt a design exception threshold that is different (lesser) than the Green Book? (Rosenow). Should we even adopt Green Book or just have thresholds for exceptions based on performance outcomes.
• FHWA requiring exceptions when state standards aren’t met vs. when Green Book isn’t met (Rosenow) – due to FHWA approval of state design manual
• Regulation update – make sure design exception process doesn’t get in the way of performance-based design. Different solutions for different contexts. Different set of controls if state is committed to performance-based process?
• Maybe need parallel process to NEPA – does NEPA apply? CE? EA? EIS? (Elizer) Perhaps programmatic agreement (Marabello)?
• These design features may be expectations, philosophical desires, rather than controlling criteria.
• Be explicit about what is part of the controlling criteria and what is not.
Joint meeting with TRB committees AFB10 and AHB65

1. Group introductions – about 55 people in attendance
2. Marcus Brewer’s presentation on research needs statements (see attached handout)
   - 5 RNS advanced to NCHRP balloting. Two were selected. Another on DDIs will be incorporated into an FY14 project on DDIs (3-113). TRB Highway Safety Performance Committee is working to resubmit the statement on Communicating the Reliability of Crash Prediction Models for consideration in FY16.
   - Four more statements have been completed for submission for FY16 consideration. These need to be prioritized. Marcus will send the three statements and decide which to pursue.
     - Criteria for Modal Conflicts (Struve, others)
     - CMFs for Corridor Access Management – may be more appropriate for Highway Safety Performance Committee to pursue. Low level of interest.
     - Design of High-Speed Arterial Median Acceleration Lanes – Low level of interest.
     - Design Guidelines for J-Turn intersections
       - Already covered with RCUT guide?
       - Need criteria for unsignalized J-Turn scenario?
       - Decision - Synthesis more appropriate since many are in place. (Shaw, Sutherland, others)
     - Design of Refuge Areas on Managed Lane Corridors (resubmit)
   - 33 RNS have not been completed. Topics from prior meetings. Need a lead author on 9 of them. Need volunteers on 10 statements (some overlap with prior 9).
   - Of 8 synthesis topics, 3 were completed and submitted
   - Problem statements due to AASHTO committees by Aug. 15. Due to AASHTO Executive Council of the Subcommittee on Design by Sept. 1
3. Top 6 research needs ideas from the AIIS (To be prioritized by AASHTO):
   1. In-service performance evaluation of innovative design - Ray, Jenior, Sutherland, Sanberg, Powell, Jeff Jones & others
   2. Quantifying B/C for alt intersections
   3. Signing and marking at alt intersections [Coordinate with AASHTO SCOTE]– Gil Chlewicki, Thrasher, Milton Carrasco
   4. Queue spillback at intersections adjacent to DCD (and within influence area)
   5. Pedestrian accommodation - Shaw, Isebrands, Russ, Stanley Wood & others
   6. Surrogate measures of safety

NTSB report on wrong-way entry (Dr. Paula Sind-Prunier)

   - Based on multiple investigations between 1968 and 2011
   - Relatively infrequent but severe - 261 accidents involving 367 fatalities over 6-year period
• Focus on investigation
  o Human performance
  o Highway design
  o Traffic control
• Discussed 3 accidents in detail
  o Alcohol and/or medications a major factor
  o Can’t always determine how driver entered highway in wrong direction
  o Red directional pavement markers common in several accidents – NTSB theory that they don’t stand out to drivers expecting to see red tail lights.
  o Found deficiencies at almost every ramp where driver may have entered in the wrong direction
• Challenges
  o High speeds
  o Lack of survivors
• CA, TX, AZ have conducted studies but results not widely publicized
• FHWA has taken limited role in issue of wrong-way driving. FHWA focused more on Green Book and IH Standards. NTSB has asked FHWA to:
  o ID approaches used by states
  o Id countermeasures
• Conclusions
  o Most crashes in #1 lane (left lane in correct direction of travel)
  o DWI primary cause – accounting for 60% of collisions associated with wrong-way excursions
  o Alcohol impairment present in 1/3 of all fatal crashes
  o New DWI countermeasures and renewed emphasis needed. Interlocks would reduce numbers but they only address repeat offenders.
  o Driver Alcohol Detection System for Safety (DADSS) project looking at vehicle technology
  o Older drivers overrepresented in wrong-way crashes
  o Available data inadequate to determine extent of drug involvement
  o Wrong-way monitoring programs used by some states help identify trends
  o Most methods to stop wrong-way drivers present considerable risk. Very hard to stop driver.
  o In-vehicle navigation system alerts could enhance safety. Consistent messaging key for alerting impaired drivers
  o State sign inventories have identified controlled-access highway signage that isn’t compliant with MUTCD
  o Exit ramps need to be made “readily distinguishable” from entrance ramps – signage, markings and lighting can help. Geometry can help.
  o Interchange design influences
- ParClo most likely to be involved. Full cloverleaf rarely involved. Diamonds in the middle.
- Limited federal guidance (resounding conclusion) for implementing strategies proven effective by the states

- Some states looking at signage improvements
  - Lower signs
  - Larger signs
  - Multiple signs on same post
  - Retro-reflective tape to post
  - Implementing standard wrong-way package

- Report contains 15 safety recommendations, including one to AASHTO: Revise Green Book to address issues of ramp design and pavement channelization in ways that will reduce instances of drivers traveling in the wrong direction as they enter access ramps.

- Improvements
  - Ramp geometries – sharp corner radii, obtuse angle, non-traversable medians
  - Lighting
  - Design guidance about parclo issues

- Reaction from committee members
  - Lighting good idea
  - Discussion on non-freeway divided highways? Happens there too but wasn’t looked at in this study. In Texas, seems to be an urban freeway issue.
  - NCHRP project getting started looking traffic control devices to prevent wrong way entry (3-117)

**NACTO Urban Street Design Guide (Greta Smith)**

Several states have recognized the NACTO *Urban Street Design Guide*. NACTO believes AASHTO is too slow, not innovative enough, not enough focus on urban, lower speed streets. AASHTO is considering issuing some kind of recognition of the guide. They’d like feedback from this group. Also, are their topics in the NACTO guide that we should pursue (coverage, research, etc.)

Discussion about how much easier the NACTO guide is to read. AASHTO hasn’t integrated the modes well (separate guides for cars, bikes, ped). Chapter 2 safety discussion is focused on rural. ITE *Designing Walkable Urban Thoroughfares* another good reference. NACTO guide doesn’t seem as rooted in research as the AASHTO guides are.

There was discussion among the committee about the role of AASHTO and transportation engineers in developing facilities that serve all users. Balancing needs of all modes must be specific to context and considered in the planning process. AASHTO urban content is very similar to what was in AASHTO documents 40 years ago. NACTO guide does a good job of looking at situations holistically... how to combine elements into a coherent facility.
Should Green Book be split back up into urban (and integrate bike, pedestrian, public transportation and motor vehicles) and rural? Discussion took place about updating the 2004 bridging document (Achieving Flexibility in Highway Design).

Maybe FHWA/AASHTO needs to issue some guidance or white paper on how to use these guides together. AASHTO may be the right group for this to originate from. New AASHTO pedestrian guide is coming soon and NCHRP project starting soon to update the AASHTO bicycle guide. Green Book represents State of the Practice based on research, not necessarily the State of the Art. MA and CA have produced more integrated design guidance… perhaps these are good references for others.

Guidance from the committee to AASHTO: Use the versions issued by State DOTs already to draft something offline for AASHTO to issue. Jeff Jones lead.

Is there interest in revising the bridging document? Not interested in updating at this time.

**Ranking research topics to submit to NCHRP**

1. In Service Performance of Alternative Intersections and Interchanges -13 (Jones, others?)
2. Ped/Bike/Transit Accommodations at Alternative Intersections and Interchanges-11 (Wood, others?)
3. Refuge Areas Managed Lanes - 9
4. Median Acceleration Lanes on High Speed Arterials - 6

**Proposed changes to Interstate Design Standards (Hilton)**

Elizabeth walked through the draft changes to the Interstate standards that were provided to the committee in advance. Discussion of changes captured in the electronic Word file. Discussion items as follows (captured by Brooke):

- Clarify shall/should/etc in policy memo, regulation or in this document
- Emphasize that this is written as a standard, which is different from how the Green Book is written.
- This will have to go thru the balloting process with the states, with 2/3 approving, which can be a lengthy process.
- Recommendation to leave the title the same and use the full title in the general comments.
- The word ‘shall’ may denote a mandatory condition for which there is no exception.
- The language about extraordinary instances provides some flexibility when projects get delayed for politics/environment.
- Concern was raised that by having the table for design speed loses the idea that 70 is preferred for rural, whether or not mountainous. Table does not preclude using 70.
- Suggestion to eliminate metric units - unlikely
• Unclear distinctions between level, rolling, & mountainous terrain that can be applied differently.

• Lane width – can’t look at this alone. Should be considered in conjunction with shoulder width. We don’t have enough research data to support a change, yet. May be ready to make a change in GB update, but not ready to do now in Interstate Stds.

• Shoulders on 3+ lanes in one direction – should the standard be 10’ and use design exceptions as the means of opening the discussion, or do we reduce the standard to 4’ to reduce the number of exceptions. The discussion should be happening anyway, but is it? Having a 4’ paved shoulder with additional stabilized shoulder is beneficial for meeting water quality requirements.

• Median width – refer to NCHRP 22-21. Did not make any specific recommendations on median width for design, did recommend RDG for median barrier requirements in medians up to 60’ in width to prevent crossover crashes. Challenge for having same document for new construction and reconstruction, where changing this value would prompt design exceptions for existing facilities where the median width is less than 60’. Report also recommends 1:8 slopes in freeway medians. Little basis for the 36’ value. If changed to 60’, need to coordinate with roadside committee. Kevin is on committee; Nick Artimovich is the FHWA secretary.

• Refer to the text in chapter 8 of the Green Book for Roadside Design

• Discussion of whether the 8:1 slope findings for median is applicable to outer side slopes. Decided there are other implications such as cost effectiveness, constrained right-of-way, and so forth. RD committee should lead any changes relative to this, not the update to the Interstate Standards.

• Curbs- MGS design is appropriate with 6” curbs. However, curb may be placed for drainage in locations where there is no barrier, where 4” may be the limit. Significant vaulting characteristics between 4” and 6” curbs. Use paragraph 8.2.5 from the Green Book.

Thursday, July 24

Research Project Review

Chapter authors were asked to give a rundown of what parts of each report they plan to incorporate. Jim Brewer started with Chapter 9, but due to time constraints we modified our approach.

• Chapter 9
  o NCHRP web-only document 178 and Report 707 (Aux Through Lanes at Signalized Intersections) – no changes recommended
  o NCHRP Report 780 (Design Guidance for Intersection Auxiliary Lanes) – Contains many suggested revisions to GB.
  o NCHRP Report 745 (Left Turn Accommodations at Unsignalized Intersections) and Web only Doc 193 (Development of Left-Turn Lane Warrants for Unsignalized Intersections) – submitted in 2010 and references 2004 GB.
  o NCHRP Report 659 & Web-only 151 (Geometric Design of Driveways) – impacts multiple chapters.
  o Use of AASHTO SharePoint site for chapter editing
• Use Microsoft Track Change mode for editing. Double underline additions, single strike-through deletions, embed comments into text with different font.

• Some reports include suggested revisions to the Green Book.

• One report had a lot of recommended changes – Auxiliary lanes at Intersections report for example …. AASHTO publications will insert this text in Chapter 9 for us for our review. If others have a similar circumstance, remember this service is available through Greta Smith and Ray Derr.

• Will ask Greta to post file that contains the 2011 Ballot draft (shows all changes from the 2004 GB). It wouldn’t reflect final changes made by AASHTO publication staff, but may be a good reference for chapter authors.

• We need to track which reports were reviewed, what was included, etc. to answer questions later regarding what triggered various changes.

• Would be helpful if TRB and/or NCHRP could break down by Chapter for the committee to consider. Could we poll core researchers for suggestions on which documents the committee should be looking at? That’s basically what we got from Eric Donnell. Doug volunteered to review list and add anything he knows of that may be missing.

• NCHRP could pay someone to produce a comprehensive list of projects with suggested language for each chapter. Possibly they could produce a Word file to paste suggestions in for authors to review, and perhaps a way to track what we incorporate.

• Some TRB papers might provide some insight on why some of these changes are recommended.

• There are also non-NCHRP reports that may be of interest (FHWA, others).

• Input to Chapter authors for their consideration during review/editing:
  o Chapter 1
    ▪ Track current NCHRP report on functional class
    ▪ May start laying groundwork for context zones.
    ▪ Clarify that ‘urban’ in GB doesn’t mean you have to follow planning census tracks
    ▪ Access and mobility chart (Fig. 1-5) – seems to be sticking point for planning community. Vehicle centric. Will look at alternatives.
    ▪ Foreword – references TRB SR 214 – tracking Doug’s study to drop in new reference.
    ▪ Foreword – Clarify that GB is for new construction and reconstruction. Third paragraph talks a lot about 3R after saying GB doesn’t apply to 3R. Will look at rewriting.
    ▪ Foreword - Rewrite to reflect performance-based design, HSM and integrating all modes. Also, maybe reflect use of other industry guidance and design flexibility.
    ▪ Long run would like to see GB say more about differences between new construction and reconstruction. May not be able to fully get there with this edition.
    ▪ Foreword – This is really a Preface based on technical writing guides.
o Chapter 2

- Design vehicle turning templates need updating based on AutoTurn. NCHRP 505 updated truck numbers based on AutoTurn. Unclear what the problem is. Does USDOT have truck data that would be helpful? Are the templates needed if all agencies use AutoTurn? Could info be tabulated instead to highlight minimum corner radius?
- Review NCHRP web only 151 (Driveways)
- Review ped language for consistency with current Ped Guide

o Chapter 3

- Rosenow - P. 3-25 – Fig. 3-6 (page 3-32 is Table 3-7) – look at two friction factor curves (English and Metric) – metric values are soft-converted on Fig. 3-6. Friction factors in table 3-7 appear to be hard converted. Results in significant differences in minimum radius between Metric and English.
- Rosenow – p.3-3 thru 3-5, Eq 3-1 thru 3-3. Equations use different numbers of significant digits. Jim thinks they should be the same to be consistent.
- Page 3-62: “typical minimum” … should Table 3-17 be titled “minimum super runoff” for consistency? Revise for consistency
- Page 3-114: Section 3.4.2: Glitches in numbers emailed to Brooke a couple of years ago. (Rosenow)
- Page 3-149: Section 3.4.6 – Last paragraph about ‘where practical, longer SSD should be used’. Rosenow thinks even NCHRP 400 said benefit is negligible. Language survives from pre-2001 editions; may have been overlooked by Report 400 as verbiage needing revision. 13 Controlling Criteria project by Harwood suggests this has no safety benefit other than where certain features exist within sight-restricted regions. Perhaps add language about ‘hidden features’.
- Pp 3-157 to 3-161: Sag vertical curves – limited/no safety benefit from longer sags
- Additional speed distance curves for trucks (NCHRP 730)
- New research (MRI) re: superelevation on sharp curves with steep grades suggested changes for GB

o Chapter 4

- PROWAG update
- If values shown here for lane width (example) and also shown under functional chapters, do readers look in Chapter 4? If not, are values needed here? Perhaps specifics could be deleted with general discussion of considerations and referencing other functional chapters for dimensions
- Why is Curb B considered ‘sloping’? Very vertical and would be allowed on Interstate if considered sloping.
- Shoulder cross slope (p. 4-11) – Can cross slope less than 2% be used as long as it’s not less than traveled way? Perhaps remove specifics if covered in functional chapters.
- Tunnel revisions in coordination with Interstate Standards and AASHTO Structures committee.
- Chapter 5
  - Track Very Low Volume Road project

- Chapter 6
  - Eliminate references to ‘desirable’ values in the chapter
  - Table 6-5 – revise based on low volume results
  - Incorporate AASHTO Bike/Ped guide update

- Chapter 7
  - Break out criteria based on low vs high-speeds – differences in context
  - May steal ITE Context Zones graphic
  - NCHRP 15-48 project - Intermediate-Speed Roadways that Serve All Users
  - Geometric Design of Transit Facilities has discussion of lane width for transit
  - 03-112 Project - Operational and Safety Considerations in Making Lane Width Decisions on Urban and Suburban Arterials
  - Figures 7-2 thru 7-5 got scrambled in format translation. Rosenow can provide original DGN files for cleanup.
  - Table 7-3 (rural lane/shoulder widths) – values have been in GB a long time and predate HSM. Are they still valid or do they need to be revised? Low Volume roads project is revisiting those values for <400ADT.
  - FHWA Mitigation Strategies (Table 1 under Design Speed) – Range here for design speed (40-70) but Mitigation strategies gives more rigid table.

- Chapter 8
  - Review revisions to Interstate Standards
  - Anything on managed lanes? NCHRP 15-49
  - SHRFP2 Project L07 on reducing non-recurring congestion

- Chapter 9
  - Rosenow – ISD Figures 9-16 thru 9-21 may not be necessary. Can just rely on the tables. Some graphs represent more vehicles than in tables, but those vehicles could be added to tables. Double lines (example Fig. 9-17) not needed and are confusing.
  - Wunderlich – Are Figures 9-23 thru 9-30 still used or needed? Some of this may be contrary to other guidance and no longer needed.
  - Belleque – Report 650 talked about J-turn and T-offset. Should these be included? Perhaps other alt-intersections also? Rosenow suggests some discussion of geometry, especially the u-turn movement, is needed. Critical vehicle is not necessarily WB-67 (SU-40 has larger outside turning radius).
  - PROWAG review and DOJ/DOT joint technical assistance
Chapter 10

- Page 10-76 & 10-77: Terms “dropped” and “reduced” are not consistent with use of these terms in MUTCD. Impacts Figure 10-52 and associated text.
- NCHRP 730 and 687 recommend changes.
- NCHRP 3-105 (design of loop ramps)
- Track – draft HSM chapter on freeways and ramps due out in August.
- Add some discussion of DDIs (probably in interchange portion)
- Update acceleration figures from 1940s (look in TRR). NCHRP 730 said values old but still basically work okay. Concern that accel lanes are routinely over-designed. Report 730 reference to using 85% value is allowable – how would that work with the minimum lengths shown in the GB?
- Add speed distance curves for trucks?
- Pages 10-83 thru 10-86 re: Wrong Way entry (NTSB), esp with respect to parclo.
- P. 10-102: Shoulders and Lateral offset – eliminate reference to combination width of left and right shoulder widths?
- P. 10-89: Table 10-1: Ramp design speeds as high as 65mph, but on page 10-93 ramp grade values stop at 50mph. Add ramp grades up to 65mph.
- P. 10-108: Note 2 should reference 1000 ft as equivalent to 300 m.
- Fig. 10-69 uses Lg and La but figure below Table 10-3 just uses L
- Fig. 10-68 (p. 10-106) notes: “Freeway distributor road” term not used in GB. Appears to be old ITE reference. Define or eliminate.
- Page 10-93: Easier to read/digest values in tabular format.

General


Closing

The next meeting of the committee is scheduled for Portland, OR with Kent Belleque hosting. The dates in July have not been finalized but will be announced as soon as available.

The annual meeting of the Technical Committee was adjourned at 4:30 PM on July 24.

Sincerely yours,

Elizabeth Hilton
Secretary, AASHTO Technical Committee on Geometric Design