ALDOT’s
Performance Based, Practical Design Guide

Alabama Department of Transportation
Performance-Based, Practical Design Guide

ALDOT Transportation Conference
February 10, 2021
A Policy on Geometric Design of Highways and Streets

2018 7th Edition

THE GREEN BOOK
New Framework for Geometric Design

STANDING COMMITTEE ON HIGHWAYS (SCOH)
ADMINISTRATIVE RESOLUTION
TITLE: DIRECTION ON FLEXIBILITY IN DESIGN STANDARDS

WHEREAS, The AASHTO A Policy on Geometric Design of Highways and Streets (commonly referred to as the “Green Book”) serves as the preeminent design guidance for streets and roadways in the United States; and

WHEREAS, The Green Book is a research based, peer developed set of design standards, which serves as the basis of design for all roads on the National Highway System, as well as many state and local roads; and

WHEREAS, The next edition of the Green Book is currently under development; and

WHEREAS, Increases in bicycle and pedestrian volumes have been recorded nationwide in large cities, suburbs, and small towns, along with corresponding increases in collisions and fatalities; and

WHEREAS, Funding and right-of-way constraints are a continual challenge for transportation facility owners; and

WHEREAS, Additional, robustly-researched guidance is needed on how best to incorporate other modes of travel when designing safe and efficient roadways that serve all users; and

WHEREAS, The design philosophy that incorporates a multi-faceted approach to street and highway design has been described using various terms, including flexibility in design, context sensitive solutions, practical design, and complete streets; and

WHEREAS, Other publications provide examples for multi-modal street design, but there does not exist research-based, peer-reviewed design guidance that fully address the technical design-related aspects of these issues; and now, therefore, be it

RESOLVED, AASHTO should provide guidance to state DOTs and other users of the Green Book regarding flexibility in design; and be it further

RESOLVED, This guidance should follow the AASHTO model of being research-based and peer-reviewed; and be it further

RESOLVED, The Subcommittee on Design (SCOD) is tasked with developing this guidance, both in the short term (next Green Book edition) and the longer term; and be it further

RESOLVED, This guidance should assist in educating engineers and designers on the flexibility inherent in the Green Book, as well as new and additional guidance on specific design issues; and be it further

RESOLVED, This guidance should address designing in and for a multi-modal transportation system; and be it further

RESOLVED, SCOD should coordinate with and possibly include other AASHTO publications in a future set of flexible design standards; and finally be it

RESOLVED, SCOD should identify gaps in necessary research and develop a plan to fill those gaps.

Approved by the Standing Committee on Highways
May 25, 2016 in Des Moines, IA
Green Book should be even more research based

Funding and ROW Constraints are a continuous challenge for Transportation Agencies

Proposed improvements should be based on observed and predictive performance
Quotes from Chapter 1

- Every dollar spent on a road that is performing well and anticipated to continue performing well is a dollar that is not available to be spent on a road that is performing poorly.

- It is important to understand that noncompliance with geometric design criteria is not, by itself, a performance issue for a project on an existing road.
... such noncompliance with geometric design criteria only becomes an issue to be addressed in the project purpose and need if that noncompliance has resulted in (or is forecast to result in) poor performance that is correctable by a geometric design improvement and that the agency chooses to address.
Alabama Department of Transportation

Performance-Based, Practical Design Guide
ACKNOWLEDGEMENT

The Alabama Department of Transportation is indebted to the Minnesota DOT for allowing their PBPD Guide to be used as a framework for our guide. This has saved countless hours in the preparation of this guide, and it is truly appreciated.
A new concept in one sense - the Highway Safety Manual

An old concept in another - the Highway Capacity Manual is a performance manual
Values in this Guide are not new minimums

Design Exceptions from AASHTO values are still required

Documenting the decision is a very important component
Practical design brings a proper balance of economic realities and project needs. Its formation and development have been provoked by two main realizations:

1. The road building industry must do business in a more financially sustainable, results-oriented, and context sensitive way.
2. A more flexible and data-driven design approach is necessary to realize this objective.
Practical Design

- Developed by Missouri DOT to “build good projects everywhere rather than perfect projects somewhere.”

- Based on the concept of “Right Sizing” the project to fit the context
Understood that there is not a flowchart for this approach and the thought process will develop over time.

ALDOT adopts the practical design concept, and this is not optional.
ALDOT’s Performance Based, Practical Design Guide

Performance Based Design

NCHRP Report 785: Performance Based Analysis of Geometric Design of Highways and Streets

NCHRP Report 839: A Performance-based Highway Geometric Design Process
Performance Based Design

- Past performance - crash analysis and operational knowledge

“Is there an existing problem that needs to be solved on this project?”
Performance Based Design

Predictive performance - Highway Safety Manual analysis

“What are the appropriate dimensions of the features we are addressing?”

Find the balance between safety and capacity
FUNDAMENTAL DESIGN CONTROLS
Level of Service

- Level of Service C was a previous goal

- For Urban Streets, a level of service of D or lower is suggested as an appropriate balance between design-year, peak-hour operation and off-peak safety

- Consider designing for an interim-year traffic volume less than the 20-year design goal.
Design Speed

On urban routes be aware that design features such as curvature and clear zone may be based on an appropriate design speed for rush hour characteristics, but off-peak traffic unimpeded by congestion will operate at higher speeds.
Design Vehicle

- Interstate WB-67 semitrailer vehicles should be used as control vehicles where such combination trucks can realistically be expected. It should be used as the design vehicle for freeway ramp terminals with crossroads, rest areas and other routes that are high volume truck facilities connected to a freeway.

- The dimensions of the WB-67 exceed the legal allowance for kingpin-to-center-rear-tandem (KCRT) dimension in Alabama. Use WB-62 outside of the areas noted above.
CROSS SECTIONAL ELEMENTS
Cross Section Composition

- On projects adding capacity to an existing facility, tradeoffs between lane and shoulder widths within the existing roadbed may be considered using a predictive safety tool such as IHSDM.
- Region Safety Engineers and the Traffic and Safety Operations Office can assist.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>ExpectedCrashes</th>
<th>Crash Rate (Crashes/mi/yr)</th>
<th>Travel Crash Rate (crashes/million veh-mi)</th>
<th>Fatal (K)</th>
<th>Incapacitating Injury (A)</th>
<th>Non-Incapacitating Injury (B)</th>
<th>Possible Injury (C)</th>
<th>Property Damage Only (O)</th>
<th>Crash Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>246.65</td>
<td>40.05</td>
<td>0.83</td>
<td>1.64</td>
<td>4.31</td>
<td>22.43</td>
<td>34.31</td>
<td>183.97</td>
<td>$18,435,426.29</td>
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<tr>
<td>2</td>
<td>260.24</td>
<td>42.25</td>
<td>0.87</td>
<td>1.92</td>
<td>5.05</td>
<td>26.50</td>
<td>40.63</td>
<td>186.14</td>
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<td>3</td>
<td>244.45</td>
<td>39.69</td>
<td>0.82</td>
<td>2.30</td>
<td>4.66</td>
<td>25.65</td>
<td>37.56</td>
<td>174.29</td>
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<td>4</td>
<td>253.65</td>
<td>41.18</td>
<td>0.85</td>
<td>2.11</td>
<td>4.89</td>
<td>26.25</td>
<td>39.30</td>
<td>181.10</td>
<td>$21,193,539.85</td>
</tr>
</tbody>
</table>
**Lane Widths**

- 10-foot lane widths are generally acceptable for the design of urban streets up to a design speed of 35 mph.
- For streets with design speeds of 40 mph and above, 11-foot lanes are normally suitable, although lesser widths can be considered.
- 12-foot lanes should be used on urban and suburban streets where design speed is high (i.e. 50 mph and greater)
Shoulder Width

- NCHRP Report 783 states, “Shoulder width has the largest effect on crash frequency of any of the controlling criteria for rural highways.”

- When analyzing crash types associated with shoulder width effects on two lane rural roads, consider single-vehicle run-off-road and also multiple vehicle head-on, opposite direction sideswipe and same-direction sideswipe.

- Shoulders should be provided for high speed urban routes. For low speed urban and suburban streets, they have no documented effect on safety, and they add crossing distance for pedestrians.

- On rural routes there is little recognized safety benefit for shoulders wider than 8’.
Bridge Width

Typical roadway approach across the state
Bridge Width

Typical bridge replacement - 10’ shoulders
Bridge Width

Proposed 6’ Shoulders - Potential Savings over $4 million
Bridge Width

- Evaluate 6’ minimum for rural bridges with narrow approaches and no foreseeable upgrading to a 4-lane facility.

- For complex bridges, major river crossings, bridges with a single span greater than 200 feet, or bridges exceeding 250 feet in overall length, conduct a risk assessment of non-standard width options that weighs the various modal, cost and performance factors. Consult with the Region Engineer, Bridge Bureau and Design Bureau.
ROADSIDE DESIGN
Clear Zone

Low-speed urban and suburban streets

- Follow the guidance in the AASHTO Roadside Design Guide, Chapter 10. A lateral offset to obstruction of 1.5 feet should normally be provided along all curbed streets in the 20 to 35 mph range.

- The “enhanced lateral offset” of 4 to 6 feet discussed in Chapter 10 should be considered where contextually appropriate for design speeds of 40 mph or greater.
SIGHT DISTANCES
Stopping Sight Distance

- New construction projects generally can and should be designed to provide the full stopping sight distances presented in the AASHTO Green Book.

- Projects on existing alignment should generally not correct stopping sight distances to meet the nominal standard unless there is a horizontal curve or intersection hidden by the restriction or a sight distance-related crash pattern.

- It is not normally justified for bridges to have wider-than-typical dimensions expressly to provide additional sight distance on the inside of curves unless an intersection or horizontal curve is hidden by the restriction.
Intersection Sight Distance

- Intersection sight distance (ISD) provision is highly encouraged at public road intersections and higher-volume driveway entrances where practical.
Intersection Sight Distance

Target Fatal and Injury Crashes - 40 mph

Available Intersection Sight Distance (ft)

CMF: Target Crashes

250ft CMF = 2.27

300ft CMF = 1.92

1.26/2.27 = Resulting CMF 0.56

600ft CMF = 1.26

1.26/1.92 = Resulting CMF 0.66

Figure 10. Example 2: target fatal and injury crashes.
ALIGNMENT ELEMENTS
Desirable maximum curve radii are given for new alignment rural and high-speed urban facilities. However, many factors can be present that do not allow this usage.

<table>
<thead>
<tr>
<th>Design Speed, mph</th>
<th>Maximum Desirable Dc or Minimum Desirable Radius</th>
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</thead>
<tbody>
<tr>
<td>30</td>
<td>400-ft radius</td>
</tr>
<tr>
<td>40</td>
<td>8° 00’</td>
</tr>
<tr>
<td>50</td>
<td>5° 00’</td>
</tr>
<tr>
<td>60</td>
<td>3° 00’</td>
</tr>
<tr>
<td>70</td>
<td>2° 00’</td>
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</table>
Length of horizontal curve has historically been an underemphasized parameter in road design but has gained prominence with the *Highway Safety Manual*’s (Chapter 10) publication. Drivers tend to track poorly through short curves, which may account for some of their safety deficit.

\[
CMF_{3r} = \frac{(1.55 \times L_c) + \left(\frac{80.2}{R}\right) - (0.012 \times S)}{(1.55 \times L_c)} \quad (10-13)
\]

<table>
<thead>
<tr>
<th>Curve Length (ft)</th>
<th>Curve Radius (ft)</th>
<th>CMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>1480</td>
<td>1.307654752</td>
</tr>
<tr>
<td>300</td>
<td>1480</td>
<td>1.615309503</td>
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</tbody>
</table>
The next AASHTO Green Book, Version 8, is in the planning stage and will be focused even more toward a Performance-Based, Practical Design Highway Geometric Design Process.
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