NCHRP Project 7-29

Development of an 8th Edition of the AASHTO Green Book (GB8)

TRB Safety Performance and Analysis Committee (ACS20)

July 30, 2021

Texas A&M Transportation Institute

Ingrid Potts and Karen Dixon

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NCHRP Project 7-29 Development of GB8

- Texas A&M Transportation Institute
  - Ingrid Potts, Principal Investigator
  - Karen Dixon, Co-Principal Investigator
- VHB
- Toole Design
- Harwood Road Safety, LLC
- Exponent (John Campbell)

Texas A&M Transportation Institute

vhb

TOOLE DESIGN

Harwood Road Safety, LLC

Exponent

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Outline

I. Project Overview
II. Evolution to a “New” Green Book
III. Examples of Why Project Purpose and Context Matter
IV. Performance-Based Design
V. Discussion

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Project Objective

- Develop a draft 8th Edition *Green Book* (GB8) suitable for balloting through AASHTO processes

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Research Approach

PHASE I (May 2021 to December 2021)

- Task 1—Kickoff Meeting
- Task 2—Review Materials from Past and Ongoing Projects
- Task 3—Develop White Paper
- Task 4—Draft Author's Guide
- Task 5—Develop Annotated Outline for GB8
- Task 6—Develop Work Plan for Phase II
- Task 7—Prepare Interim Report

PHASE II (December 2021 to May 2023)

- Task 8—Develop First Draft of GB8
- Task 9—Develop Second Draft of GB8
- Task 10—Prepare Other Final Deliverables

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Project Tasks

- Task 1—Kickoff Meeting (held with project panel on May 3, 2021)
- Task 2—Review Materials from Past and Ongoing Projects
  - Research conducted specifically for GB8
    - NCHRP Project 20-7/Task 423 (*GB8 Vision* report)
    - NCHRP Project 7-27 (Update of Design Vehicles)
    - NCHRP Project 15-56 (Ramp Design Speed)
    - NCHRP Project 15-72 (AASHTO Context Classifications)
    - NCHRP Project 15-77 (Aligning Geometric Design with Roadway Context)—drafts of GB8 Part IV chapters
  - Research on performance-based approaches to geometric design
  - Other research and policies relevant to GB8

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Project Tasks

- Task 3—Develop White Paper
  - Will clearly and concisely state the purpose of GB8 and how it is intended to be used by planners, designers, other transportation professionals, and agency policy makers
  - Will draw from four key sources in documenting expectations for GB8:
    - AASHTO SCOH resolution in design flexibility
    - *GB8 Vision* report, prepared in NCHRP Project 20-7/Task 423
    - NCHRP Report 839, *A Performance-Based Highway Geometric Design Process*
    - GB7 Chapter 1, “New Framework for Geometric Design”

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Project Tasks

- Task 3—Develop White Paper (cont'd)
  - Will present guiding principles (based on those established by the TCGD)
  - Will include diagrams or "maps" that show the relationships between the *Green Book* and other resources, including other AASHTO guides and national publications such as:
    - FHWA Manual on Uniform Traffic Control Devices (MUTCD)
    - TRB *Highway Capacity Manual* (HCM)
    - AASHTO *Highway Safety Manual* (HSM)
    - AASHTO *Roadside Design Guide*
    - TRB *Human Factors Guidelines*
    - NACTO guides
    - ITE publications
    - USDOT policies and regulations

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Project Tasks

- Task 4—Draft Author's Guide
  - Promote consistency across the writing team
  - Provide content developers with a clear, concise, and prescriptive description of the intent, formatting, organization, and the "look and feel" of individual GB8 elements.
  - Include a document template (or "style guide") that will convey the desired look, formatting, and layout of GB8
  - Include a glossary of terms and phrases to be used or avoided in GB8
  - Provide direction for:
    - Layout, organization, and formatting of chapters, topics, and subtopics
    - Development and use of graphics
    - Guidance for compatibility and elimination of redundancy between chapters
    - Hypertext linking
    - Principles for inclusion in a glossary and indexing
    - Coordination of technical editing

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Project Tasks

- Task 5—Develop Annotated Outline
  - Review chapter organization recommended by the TCGD and the annotated outline presented in the appendix to the *GB8 Vision* report.
  - Make sure chapter organization:
    - Serves the needs of practitioners
    - Is consistent with GB8 objectives (as defined in white paper)
    - Provides a logical place for all of the material that should go in GB8

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Project Tasks

- Task 6—Develop Work Plan for Phase II
  - Overall work plan will include three specific management plans:
    - **Document management plan** for development, review, and revision of GB8 content
    - **Review plan** that provides for organized review of the GB8 content by the project panel and the AASHTO TCGD
    - **Communication and outreach plan** for interacting with and seeking input from AASHTO committees and outside groups concerning GB8 content and the relationship of GB8 to the publications and policies of those groups

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Project Tasks

- Task 7—Prepare Interim Report
  - Results of the Task 2 review of past and ongoing projects
  - Revised Task 3 white paper
  - Revised Task 4 Author's Guide
  - Revised Task 5 annotated outline
  - Work plan for Phase II

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Project Tasks

- Task 8—Develop First Draft of GB8
  - First draft will be developed in two stages:
    - First stage will consist of drafting individual parts/chapters; each part/chapter will undergo initial review (staggered review process, as drafts of individual parts/chapters are completed)
    - Second stage will consist of revising individual parts/chapters in response to comments and then providing the document as a whole for review
- Task 9—Develop Second Draft of GB8
  - Revision of first complete draft (from end of Task 8) in response to review comments

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Project Tasks

- Task 10—Prepare Other Final Deliverables
  - Final report
  - Implementation plan
  - Presentation materials

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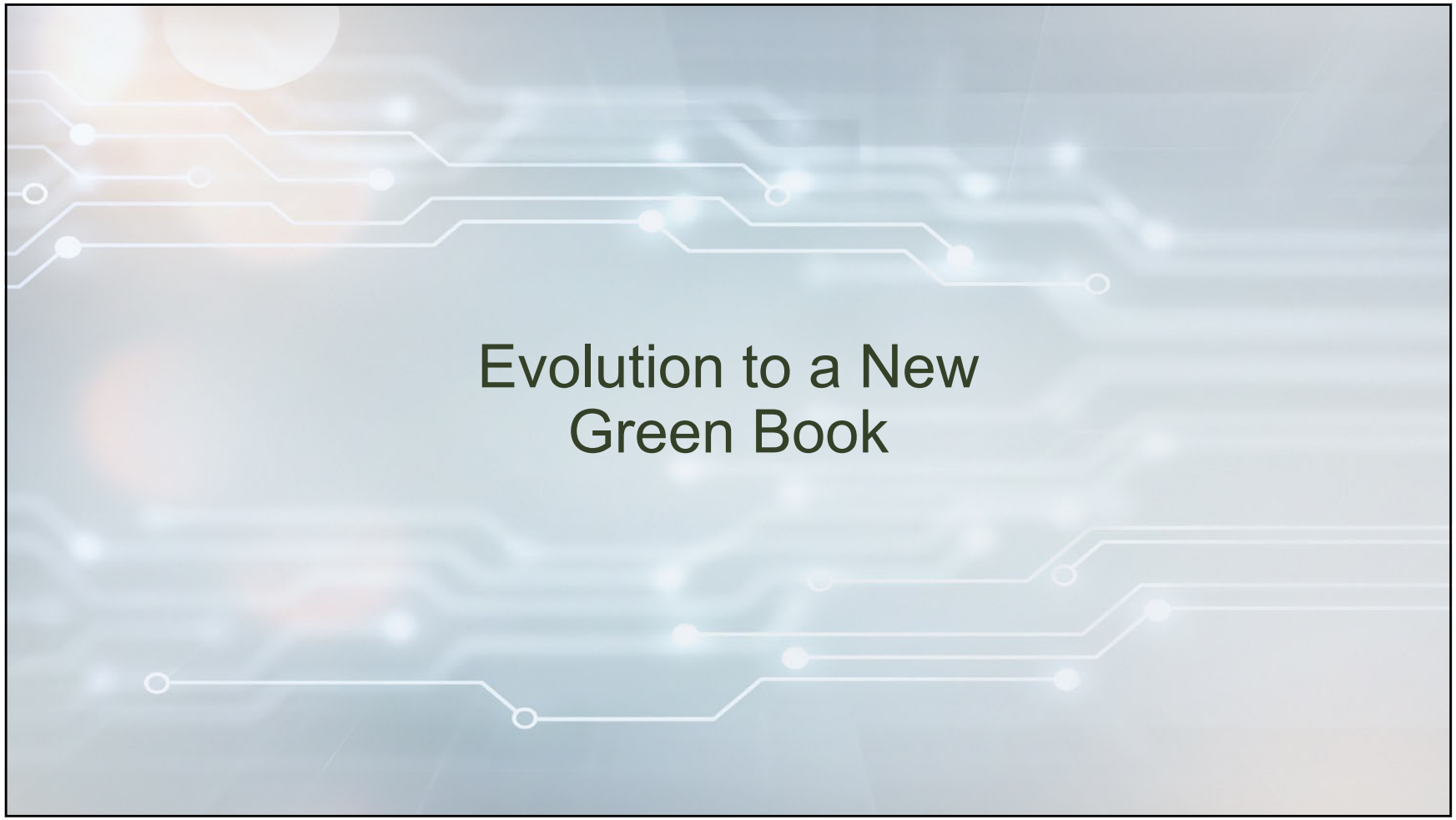

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NCHRP Report 785 (2014)

What is the motivation for integrating performance-based analysis into project development and geometric design decisions?

- Limited resources
- Projects developed within physically constrained environments
- How roadways are designed has a direct impact on performance measures beyond average delay or travel time for an automobile (such as people's ability to comfortably travel by foot, bike, and transit)

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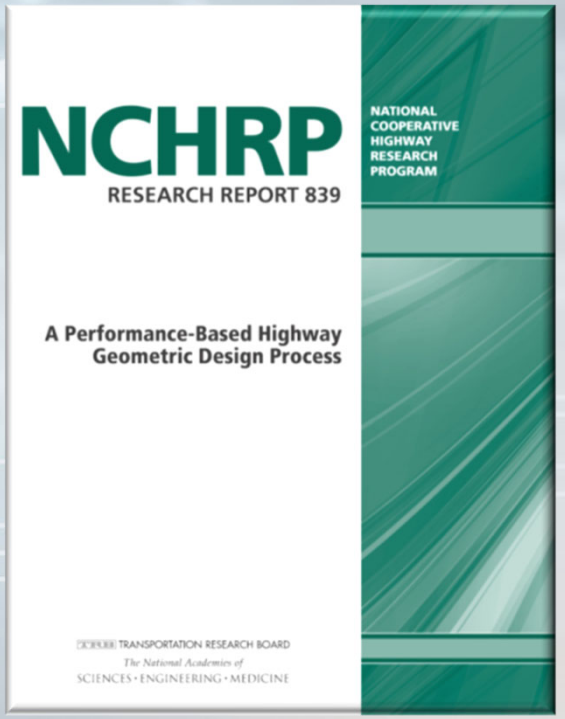
NCHRP Research Report 839 (2017)

- Notes the vehicle-centric nature of the industry
- Dictates a movement to performance-based design
- Recommends a restructured *Green Book*



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Standing Committee on Highways (SCOH) Resolution (2016)

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 address designing in and for a multi-modal transportation system; and be it further

RESOLVED, Subcommittee on Design (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.

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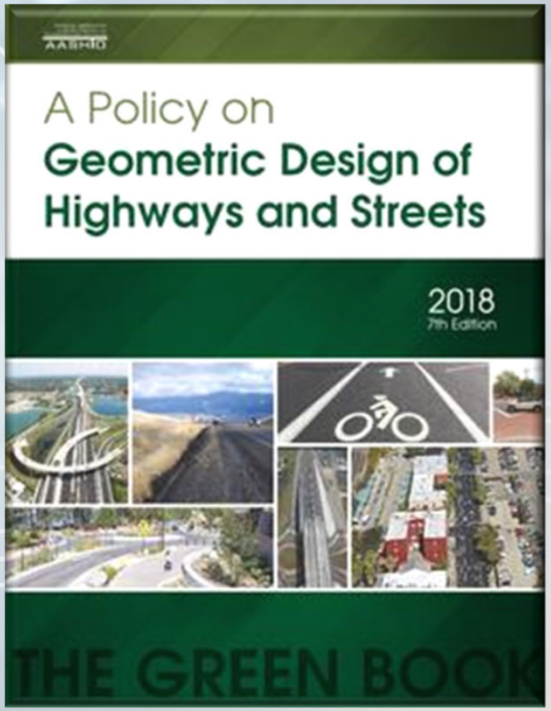
7th Edition of Green Book (2018) Newly Rewritten Introduction

From NCHRP Report 839 and the SCOH Resolution

- Importance of project type:
  - New construction
  - Reconstruction
  - Projects on existing roads
- Greater emphasis on multimodal needs
- New framework based on context classification and functional classification
- Encourages flexible design



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Context Classification for Geometric Design
(from NCHRP Research Report 855; 2018)

Rural areas

- Rural context
- Rural town context

Urban areas

- Suburban context
- Urban context
- Urban core context

Category	Density	Land Use	Setback
Rural	Lowest (few houses or other structures)	Agricultural, natural resource preservation, and outdoor recreation uses with some isolated residential and commercial	Usually large setbacks
Rural Town	Low to medium (single-family houses and other single-purpose structures)	Primarily commercial uses along a main street (some adjacent single-family residential)	On-street parking and sidewalks with predominately small setbacks
Suburban	Low to medium (single- and multifamily structures and multistory commercial)	Mixed residential neighborhood and commercial clusters (includes town centers, commercial corridors, big box commercial and light industrial)	Varied setbacks with some sidewalks and mostly off-street parking
Urban	High (multistory, low-rise structures with designated off-street parking)	Mixed residential and commercial uses, with some institutional and industrial and prominent destinations	On-street parking and sidewalks with mixed setbacks
Urban Core	Highest (multistory and high-rise structures)	Mixed commercial, residential and institutional uses within and among predominately high-rise structures	Small setbacks with sidewalks and pedestrian plazas

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New Framework for Geometric Design

Purpose and Need Statement to determine where project falls in design framework

- Applicable context class
- Applicable functional class
- Project type considerations
- Performance-based design

Functional Class	Context Class				
	Rural	Rural Town	Suburban	Urban	Urban Core
Local Road or Street					
Collector Road or Street					
Arterial Road or Street					
Freeway					

Note: This framework together with an assessment of multimodal needs and performance measures should guide the flexible approach to the design of projects. The shaded cell, representing a freeway in a rural town context, is unlikely to occur often.

Figure 1-1, AASHTO Green Book 7

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NCHRP Project 20-07 (Task 423) New Framework for GB8 (2019)

Vision and Roadmap for GB8

- Literature review of performance-based approaches to planning and design
- Outreach meetings to identify user needs
- Development of GB8 outline

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Tentative High-Level Outline for the 8th Edition of the *Green Book*

- Part I – Introduction
- Part II – Performance-based Evaluations
- Part III – Geometric Elements and Configurations
- Part IV – Facility Design in Context

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Guiding Principles for GB8 Development

- Fully integrates the thought process of performance-based design into all aspects of project development and design decision-making
- Addresses the issues in the SCOH Resolution of 2016, namely the increase in non-motorized traffic and severe crashes nationwide
- Makes progress toward realizing a primary recommendation of *NCHRP Report 839*, that dimensional design criteria have known and proven research, empirical, or experiential bases
- Acknowledges the changed nature of our industry, specifically the movement from new construction to the reconstruction and preservation of the existing system

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Guiding Principles for GB8 Development

- Takes to heart the inherent fiscal limitations of the industry and advocates for a financially sustainable design process at both the program and project levels
- Presents an approach and thought process of designing in and for a multimodal transportation system
- Recognizes that public works profoundly affect the health, safety, and welfare of citizens and accepts the charge to improve the public's quality of life as an overarching objective
- Utilizes context as the primary organizing basis of road and street design—and thereby of this design guidance

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Guiding Principles for GB8 Development

- Champions a flexible design approach as the only way to harmonize user needs and functional performance with environmental, contextual, and community considerations
- Appreciates the merit of predictability and uniformity across the roadway system—and the need to balance flexibility with consistency
- Maintains the prominence of the fundamentals of facility design, especially the traditions of engineering care and craftsmanship

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Examples of why it's important to establish the purpose and need of a project, consider context, and identify multimodal user needs…

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Context and Roadway Character

Classified as a "Principal Arterial"

- 3 interchanges
- Wide medians
- Overhead interstate-style signing
- 50-mph speed, AND
- Frequent direct access to adjacent land use
- Frequent bus stops
- Mixed residential and commercial land use on both sides

TOOLE DESIGN

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Design Solutions?

- 45-mph speed limit
- Wider lanes
- Fences
- Sidewalks next to road
- Fewer crossing opportunities
- Maintain high speeds and manage access

TOOLE DESIGN

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Context and Roadway Character

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What constitutes “suburban”?

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What constitutes “suburban”?

TOOLE DESIGN

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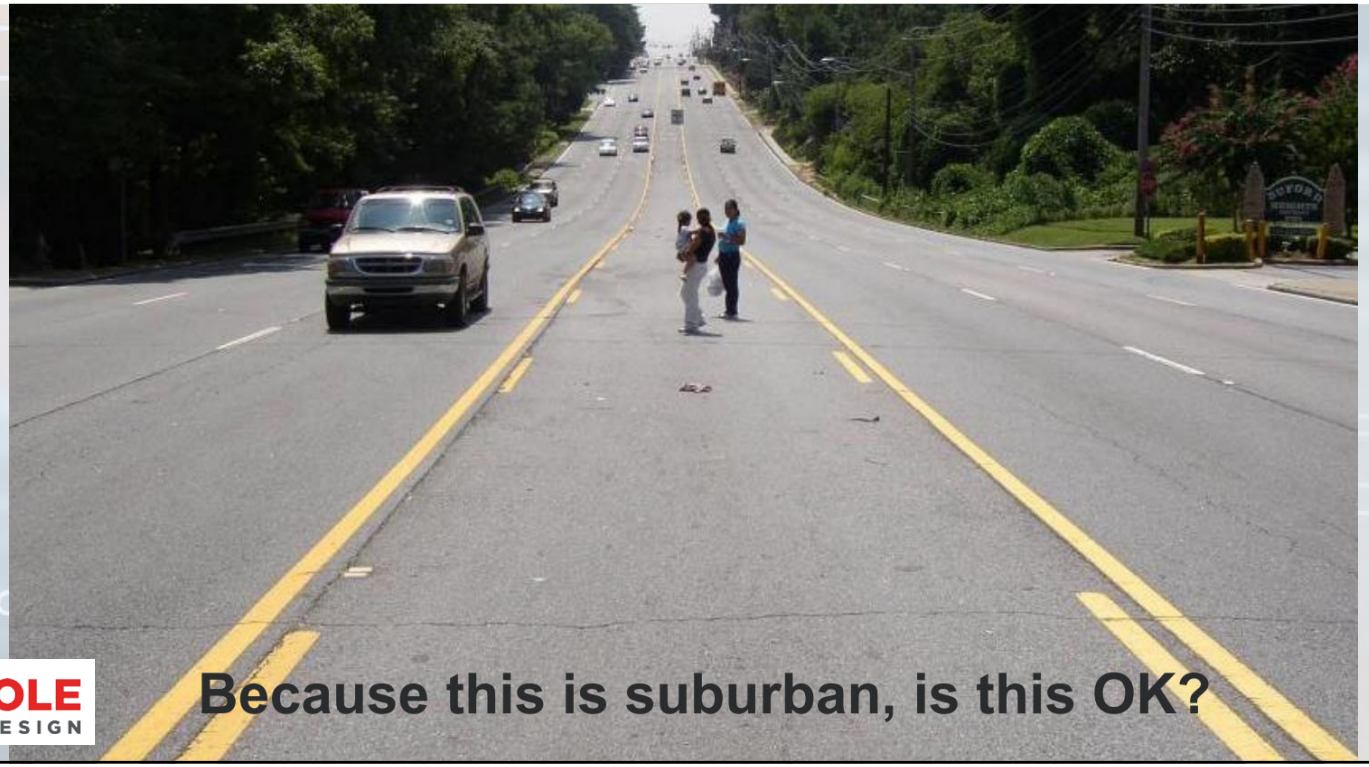
What constitutes “suburban”?



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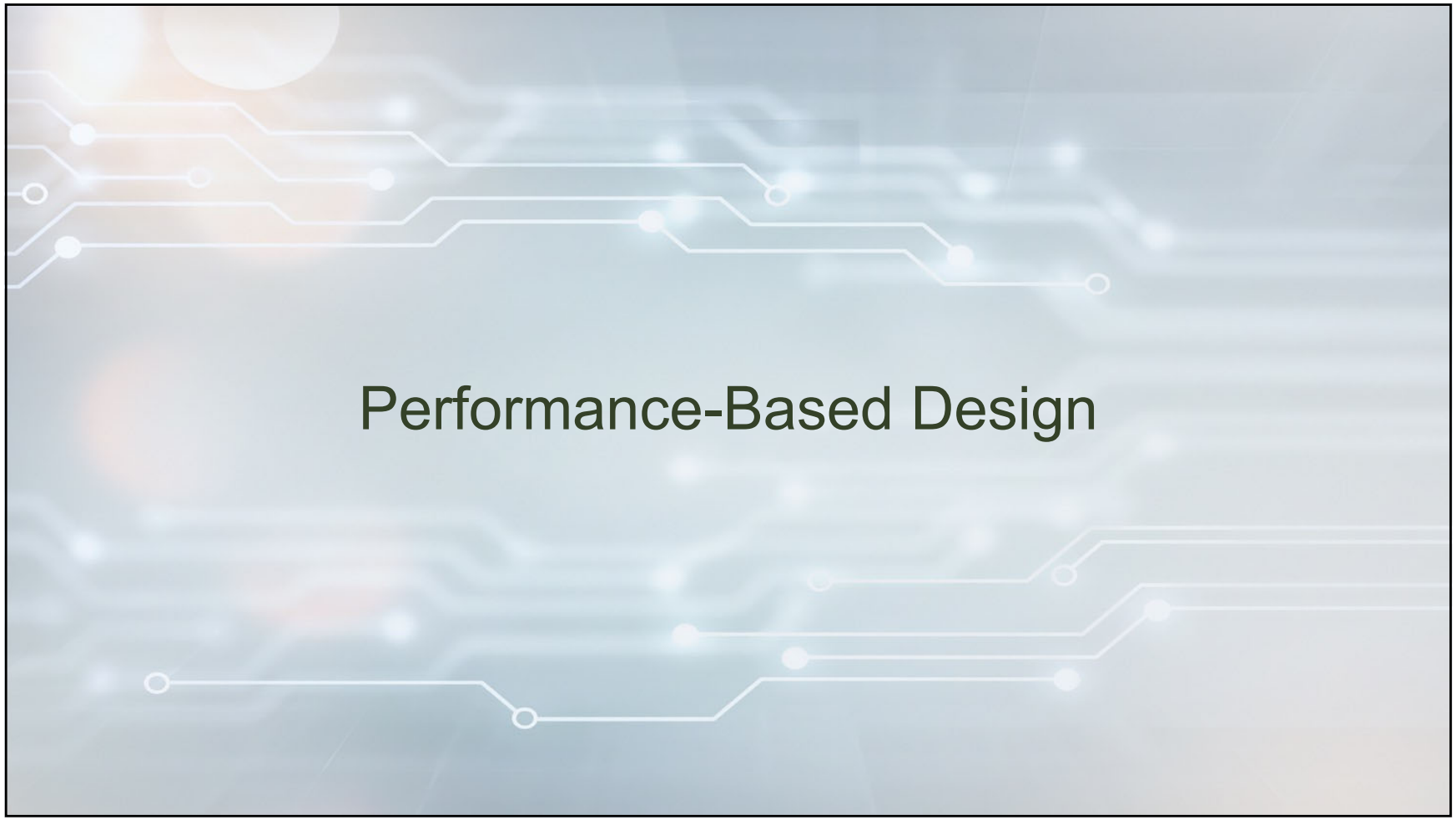

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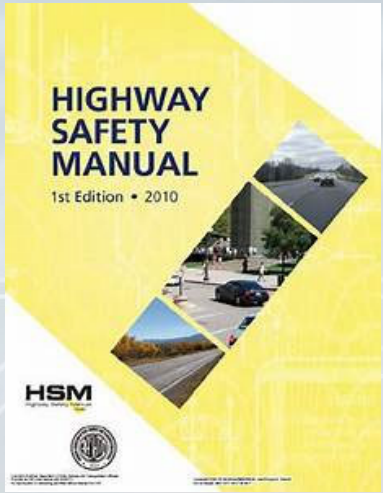
Performance-Based Design

- Unstated concept in previous Green Book editions:

  If a project is designed in accordance with GB criteria, the project will operate safely and efficiently.

  - ‘Maybe’ appropriate when safety effects of design criteria were poorly understood.
  - However, HSM provides body of quantitative knowledge on safety effects of geometric elements

- Performance-based design has goal of meeting specific operational and/or safety targets established for each project.



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Performance-Based Design

Quantitative Safety Knowledge in HSM

Geometric design elements in HSM1	To be added in HSM2
Lane width	Roundabouts
Shoulder width	Shoulder-use lanes
Horizontal curve length	Additional intersection configurations and traffic control types
Horizontal curve radius	HOT/HOV lanes
Superelevation and presence or absence of spiral transition	Six-lane and one-way arterials
Grades	Bicyclists and Pedestrians
Driveway density	
Passing lanes	
Two-way left-turn lanes	
Intersection skew angle	
Median width	
Right-turn lane	
Left-turn lane	

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Discussion

- In what ways might GB8 be able to directly consider safety?
- What might performance-based design look like in GB8?
- What should be the relationship between GB8 and HSM2?
- What are your thoughts about the high-level GB8 organization?
  - Part I – Introduction
  - Part II – Performance-based Evaluations
  - Part III – Geometric Elements and Configurations
  - Part IV – Facility Design in Context

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Contact Info

Ingrid Potts, P.E.
Texas A&M Transportation Institute
i-potts@tti.tamu.edu
816-210-5524

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