

# **Context Sensitive Highway Design -- Update**

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District 7**

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## **CSD/CSS Guiding Principles**

- **Address the transportation need**
  - **Safe, financially feasible, implementable**
- **Be an asset to the community**
  - **Accepted by stakeholders; adds lasting value to the community**
- **Be compatible with the natural and built environments**
  - **Implemented with minimal impacts, is aesthetically appropriate**

## **CSS Leads to Outcomes that**

- **Are in harmony with the community and preserve the environment, scenic, aesthetic, historic and natural resource values of the area**
- **Are safe for all users**
- **Solve problems that are agreed upon by a full range of stakeholders**
- **Meet or exceed the expectations of both designers and stakeholders, thereby adding lasting value to the community, the environment, and the transportation system**
- **Demonstrate effective and efficient use of resources (people, time, budget) among all parties**

# The CSS Timeline

## Introduction of CSS

- *'Is this just another 'fad'?'*
- *'We've been doing this all along'*
- FHWA and individual state leadership
- CSS 'travelogues'

## CSS 'Grows up'

- *'It looks like they're serious!'*
- *'We can't do this stuff all the time'*
- AASHTO working with FHWA
- CSS as a process or approach

## Full Institutionalization

- No longer refer to 'CSS' – it's our project development process
- *'We wouldn't think of trying to do a project any other way'*

1995 - 2000

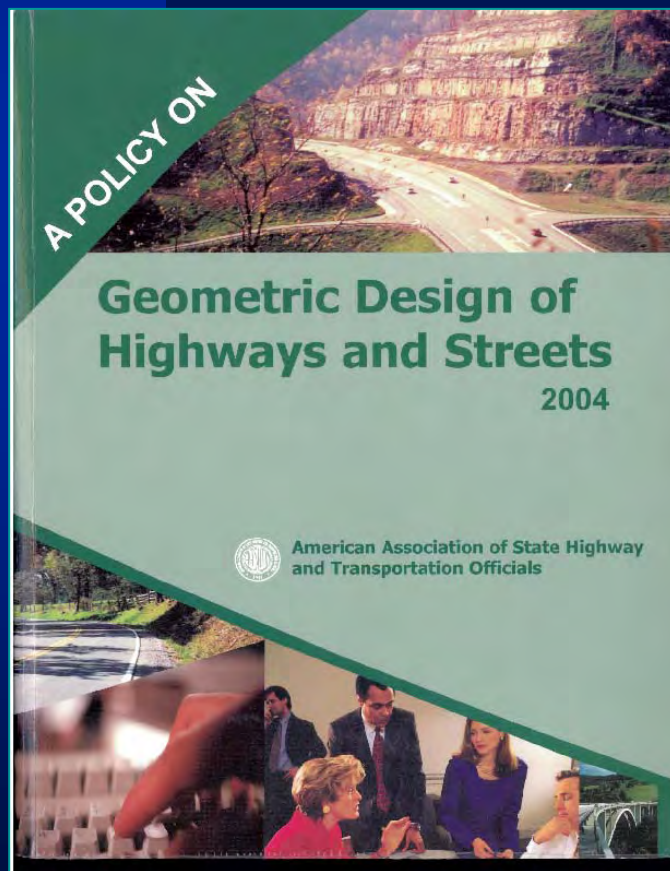


early 2000s



???

# CSD or Flexibility in Design – What does this really mean?



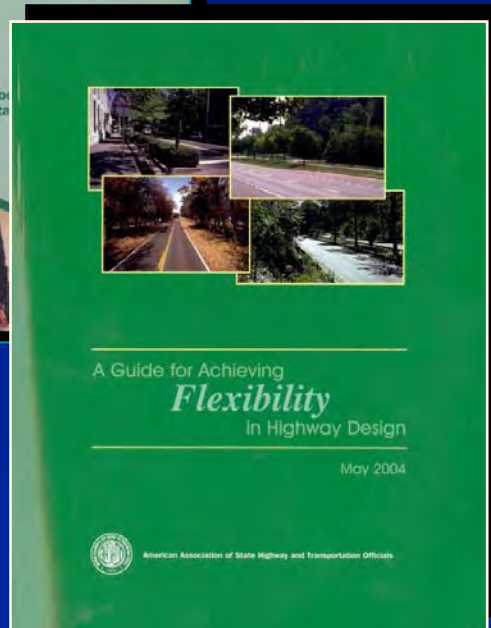
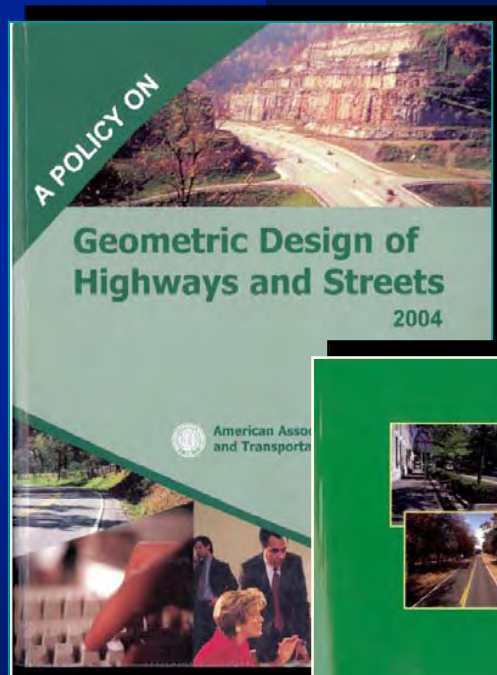
**The Green Book is a tool (not a weapon)**

**–Philosophy and approach – there is plenty of language offering flexibility – refer to it (don't ignore or deny it)**

**–Does your agency have more restrictive guidance than the Green Book; if so, and ask yourself why (what purpose does that serve)?**

**–There are very few 'mandates' and much judgment to be applied**

# Major Themes of AASHTO's “Bridging Document to Flexibility in Design”

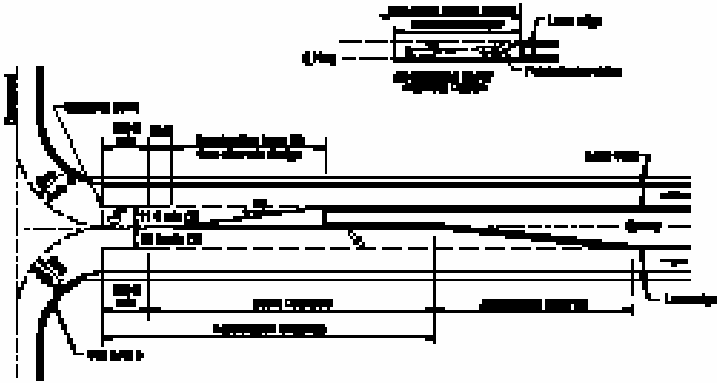


- Design criteria are the basis for design (need to understand their background, history, use)
- Basic design controls are choices made by designers

# Practical highway design issues -- Understanding what the term 'flexibility' really means

- **Standards vs Flexibility – can you have both?**
- **Design Speed**
- **Design Level of Service**
- **Design Vehicle**
- ***Roadside Design***
- **Design Exceptions**

# The Benefits of Standards, Standard Designs, etc.



**Notes:**

- (1) Lane widths of 12 ft are desirable for both the left-turn storage lane and the median acceleration lane.
- (2) For increased storage capacity, consider the left-turn deceleration taper alternate design.
- (3) The minimum total length of the median acceleration lane is shown in Figure 910-15.
- (4) R = 50 ft or use templates for WS-67 design vehicle.
- (5) See Figure 910-8 for right-turn corner design.
- (6) See Table 2 for acceleration taper rate.
- (7) See Standard Plans and MUTCD for pavement marking details.

Posted Speed	Acceleration Taper Rate
55 mph	55:1
50 mph	50:1
45 mph	45:1
40 mph	27:1
35 mph	21:1
30 mph	15:1
25 mph	11:1

Table 2

- Efficiency in plan production (avoid the ‘reinventing the wheel’ syndrome)
- Quality control in design plans, minimizing errors in design, quantities, etc.
- Consistency and clarity for contractors to facilitate low bids and quality in construction

Source: *Washington DOT Design Manual*

# Examples of Flexibility in Application of Design Criteria

- Lane Width
- Design Speed
- Design Traffic
- Design Level of Service
- Roadside Design

## Lane Width

- Lane widths less than 12 feet are clearly within AASHTO policy under many contexts (including rural highways); this is not always a design exception
- Lane widths of less than 12 feet are more often than not *the desirable solution* in urban contexts

# **The definition of design speed reinforces the concept of designer choice**

*“Design speed is a selected speed used to determine the various geometric design features of the roadway. The assumed design speed should be a logical one with respect to the topography, the adjacent land use, and the functional classification of highway.”*

*AASHTO Policy  
on Geometric Design*

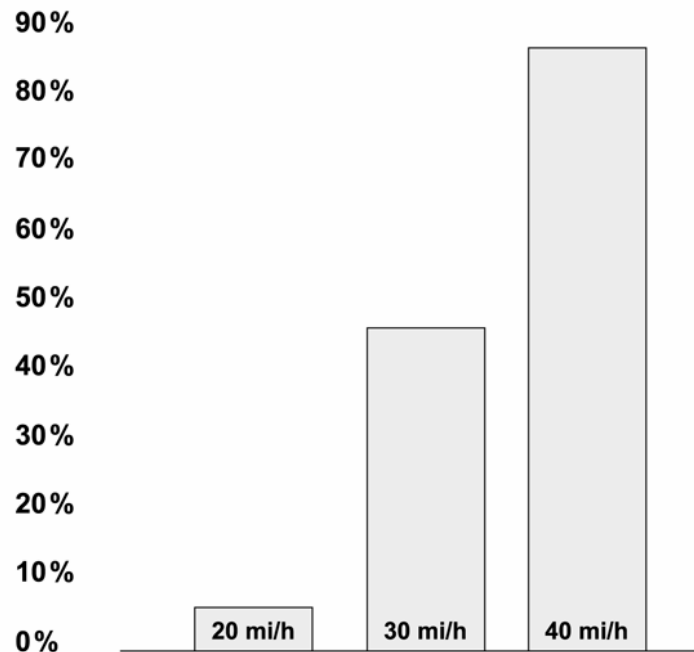
# Design Speed

- Design speed is a choice (not a mandate)
- We're supposed to first establish a design speed and then a posted speed (not the other way around)

# Speed and the Urban Environment

## Fatalities Based on Speed of Vehicle

A pedestrian's chance of death if hit by a motor vehicle:



1 mi/h = 1.61 km/h

- Lower speeds are safer
- Geometry rarely dictates speed; signalized intersection operations often are the predominant factor

# Level of Service (LOS)

Highway Type	Type of Area and Appropriate Level of Service			
	Rural Level	Rural Rolling	Rural Mountainous	Urban and Suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

NOTE: General operating conditions for levels of service (Source: Ref. 11):

A - free flow, with low volumes and high speeds.

B - reasonably free flow, but speeds beginning to be restricted by traffic conditions.

C - in stable flow zone, but most drivers restricted in freedom to select their own speed.

D - approaching unstable flow, drivers have little freedom to maneuver.

E - unstable flow, may be short stoppages.

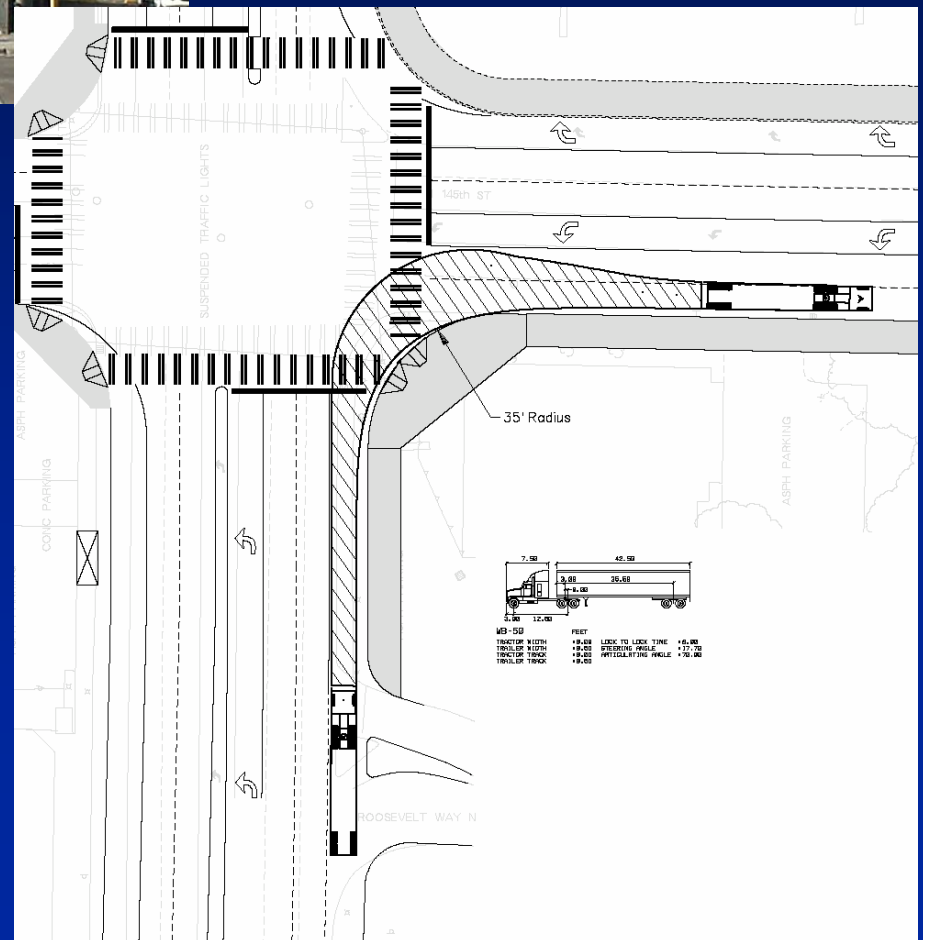
- Design Traffic is a Choice
- LOS 'guidelines' are NOT standards
  - Design for LOS is a location and context specific choice
  - Design for LOS D or E is routine in many locations
  - Design for LOS D or E does not require a design exception

# Design Vehicle



## Design vehicle is a choice

- “Larger vehicle” emphasizes operations at the expense of surrounding land, and potentially pedestrians
- assumed operations may vary based on context



# Roadside Design

- **Concepts of Clear Zone and their applicability**
- **Current AASHTO Guidance**
- **Research on Roadside Design**
- **Expected Changes to the Green Book and Roadside Design Guide**

## Definition of Clear Zone from RDG Glossary of Terms

*'The total roadside border area, starting at the edge of the traveled way, **available for safe use by errant vehicles**. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds and on the roadside geometry.'*

# RDG Technical Guidance for Design of the 'Clear Zone'

15 ft or more for over 6000 vpd for even lower speeds

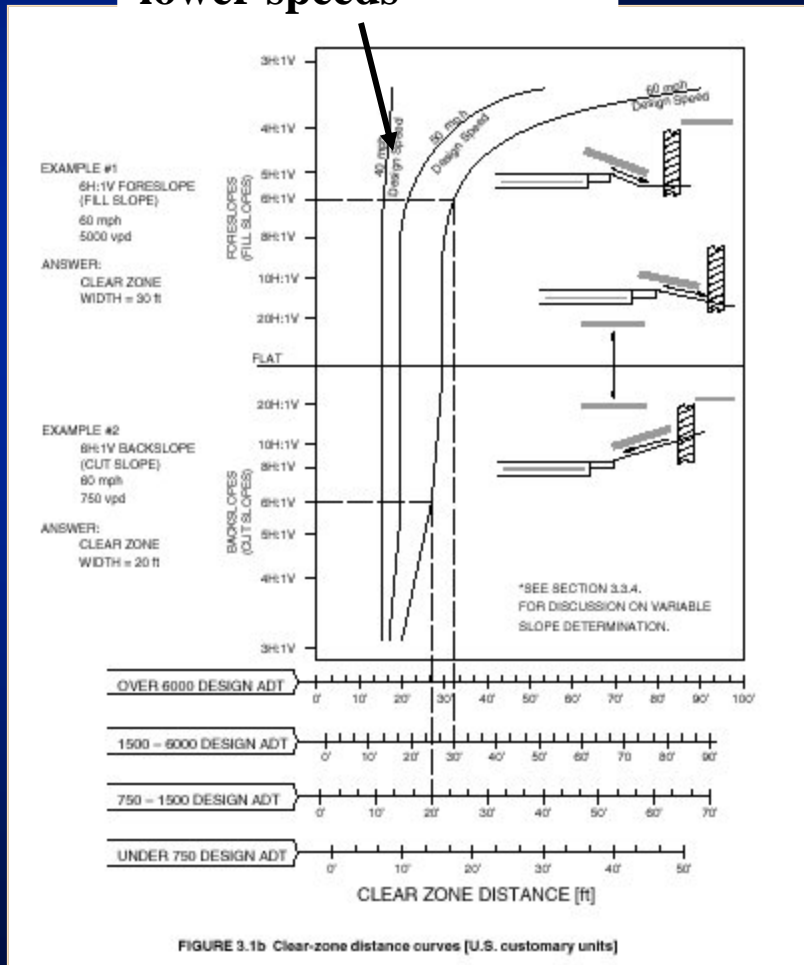


TABLE 3.1 (Cont'd)

[U.S. Customary Units]

DESIGN SPEED	DESIGN ADT	FORESLOPES			BACKSLOPES		
		1V:6H of flatter	1V:5H TO 1V:4H	1V:3H	1V:3H	1V:5H TO 1V:4H	1V:6H or Flatter
40 mph or less	UNDER 750	7 - 10	7 - 10	**	7 - 10	7 - 10	7 - 10
	750 - 1500	10 - 12	12 - 14	**	10 - 12	10 - 12	10 - 12
	1500 - 6000	12 - 14	14 - 16	**	12 - 14	12 - 14	12 - 14
	OVER 6000	14 - 16	16 - 18	**	14 - 16	14 - 16	14 - 16
45-50 mph	UNDER 750	10 - 12	12 - 14	**	8 - 10	8 - 10	10 - 12
	750 - 1500	12 - 14	16 - 20	**	10 - 12	12 - 14	14 - 16
	1500 - 6000	16 - 18	20 - 26	**	12 - 14	14 - 16	16 - 18
	OVER 6000	18 - 20	24 - 28	**	14 - 16	18 - 20	20 - 22
55 mph	UNDER 750	12 - 14	14 - 18	**	8 - 10	10 - 12	10 - 12
	750 - 1500	16 - 18	20 - 24	**	10 - 12	14 - 16	16 - 18
	1500 - 6000	20 - 22	24 - 30	**	14 - 16	16 - 18	20 - 22
	OVER 6000	22 - 24	26 - 32 *	**	16 - 18	20 - 22	22 - 24
60 mph	UNDER 750	16 - 18	20 - 24	**	10 - 12	12 - 14	14 - 16
	750 - 1500	20 - 24	26 - 32 *	**	12 - 14	16 - 18	20 - 22
	1500 - 6000	26 - 30	32 - 40 *	**	14 - 18	18 - 22	24 - 26
	OVER 6000	30 - 32 *	36 - 44 *	**	20 - 22	24 - 26	26 - 28
65-70 mph	UNDER 750	18 - 20	20 - 26	**	10 - 12	14 - 16	14 - 16
	750 - 1500	24 - 26	28 - 36 *	**	12 - 16	18 - 20	20 - 22
	1500 - 6000	28 - 32 *	34 - 42 *	**	16 - 20	22 - 24	26 - 28
	OVER 6000	30 - 34 *	38 - 46 *	**	22 - 24	26 - 30	28 - 30

# Is it 'clear' to you what clear zone means?



**Rural Context – high speed;  
available R/W**



**Urban context – low to moderate  
speed; relatively narrow border area**

# Current AASHTO Technical Guidance on Clear Zone

- Based entirely on open (uncurbed) research
- Addresses only the safety of a vehicle leaving the roadway (ignores activity outside the edge of pavement; and in particular the presence of pedestrians)
- GB and RDG provide conflicting dimensional guidance

# The urban environment is different



# The unique urban environment

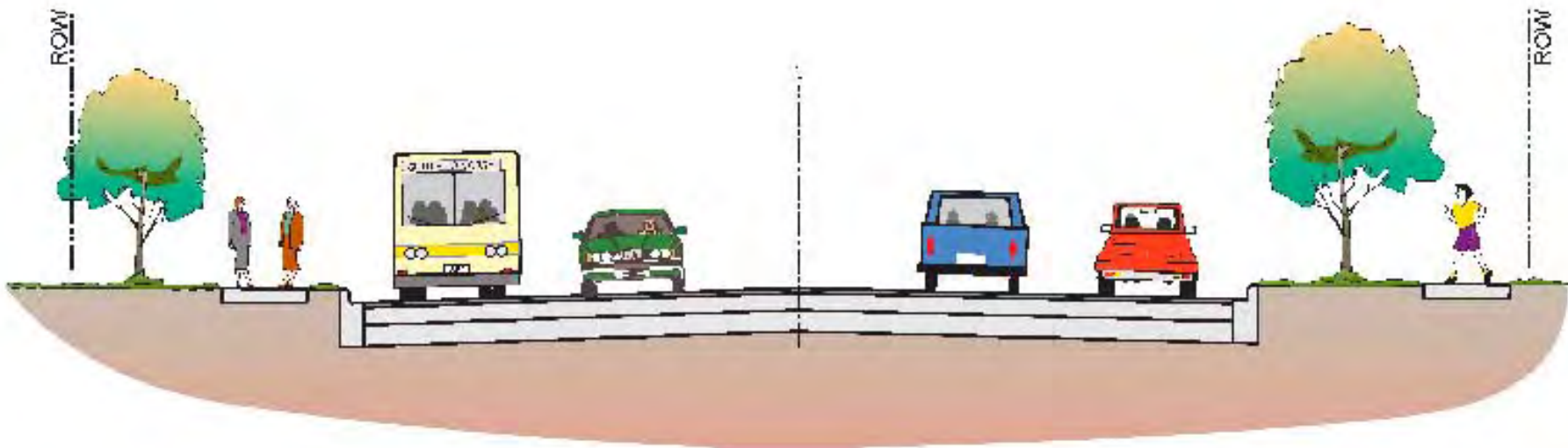


- Right of way is limited
- Pedestrians are prevalent
- Trees, light poles, other roadside objects are frequent
- Curbed sections are common
- Traffic operations differ from rural conditions

# Lingering Questions on Clear Zone and Urban Roadside Design Policy

- Is RDG dimensional guidance really practical in the urban environment?
- How does the presence of a curb comport with the definition of a clear zone?
- How applicable is the RDG technical guidance given its origin?
- Where do pedestrians (sidewalks) fit in all of this?

# Which would meet design policy as most would interpret it?



## OPTION "A"

Fixed objects away from roadway  
Sidewalk adjacent to roadway

## OPTION "B"

Sidewalk away from roadway  
Fixed objects adjacent to roadway

## EXHIBIT 11. URBAN STREET CROSS SECTION OPTIONS

- Which option is 'safer'? For whom?

## Other Clear Zone Issues – From which reference point is it measured?



The clear zone definition refers to 'traveled way' which refers to 'vehicles' – so what about:

- Bike Lanes
- Auxiliary or parking lanes
- Shoulders used as travel lanes

## Recent and ongoing research on Roadside Design Policy

- **NCHRP Project 20-7, Task 171** ‘Identification of Conflicts Related to Clear Zones within AASHTO Publications’
  - Research by CH2M HILL (T. Neuman)
  - 15 recommendations under consideration by AASHTO
- **NCHRP Project 17-11** – ‘*Determination of Safe/Cost Effective Roadside Slopes and Associated Clear Distances*’
- **NCHRP Project 16-04** – ‘*Design Guidelines for Safe and Aesthetic Roadside Treatments in Urban Areas*’

## **Upcoming AASHTO Updates (currently being considered)\***

- **Clarifications on Clear Zone definitions**
- **Definition and role of auxiliary lanes and bike lanes**
- **Curbs and clear zones**
- **Roadside design policy in the urban environment**

*\*Information from Dick Albin/WSDOT; member of AASHTO Roadside Safety Committee*

## Updated definition helps clarify limits of the clear zone

*Traveled Way: the portion of the roadway for the movement of vehicles, **exclusive of shoulders and designated bicycle lanes.***

The clear zone measurement should begin at the edge of the traveled way.

# Auxiliary Lanes

- More guidance would be added to explain uses (e.g., truck climbing, passing, turning, etc.)
- Include these in clear zone unless they serve to handle through traffic
  - Freeways may be exception
  - Up to agencies to interpret

# Horizontal Clearance is NOT Clear Zone



**AASHTO to replace the term horizontal clearance with 'lateral offset' and revise headings and language to clarify misinterpretation of this term**

## Clarification on curbs as fixed objects in the 'clear zone'

**'Although curbs are not considered fixed objects in the context of a clear zone, they do have an effect on the trajectory of an impacting vehicle and may have an effect on a driver's ability to control a vehicle that strikes or overrides one.'**

## Revised guidance on roadside design to fit the context

- New GB text would clarify two considerations in roadside design – **clear zone** and **lateral offset**
- Three environments described
  - Rural (refer to RDG for clear zone design guidance)
  - Urban (lateral offset is needed)
  - Transition (provide greater lateral offset; or reduced clear zone)

## Updated guidance on roadside design for rural conditions

*'In rural environments, where speeds are higher and there are fewer restraints, a **clear zone** appropriate for the traffic volumes, design speed and facility type **should be provided in accordance with the AASHTO Roadside Design Guide**. The values in the Roadside Design Guide are also appropriate for freeways and other controlled access facilities in urban areas.'*

## Updated language on curbs in the clear zone

- Curbs should be used only in limited, special cases in rural areas because of operational effects
- “Sloping curbs, especially those with heights of 4” or less, can be readily traversed by a motorist when necessary. Curbs higher than 4”, whether sloping or vertical, may drag the underside of some vehicles. However, if higher curbs are used, they are not considered fixed objects that would normally be mitigated.”

## Updated roadside design policy guidance in urban environment

- ‘...right of way is often extremely limited and **in many cases it is not practical to establish a clear zone using the guidance in the Roadside Design Guide.**’

## Arterials and other non-access controlled facilities in the urban environment

‘These urban environments are characterized by sidewalks beginning at the face of the curb, enclosed drainage, numerous fixed objects, and frequent traffic stops. These environments typically have lower operating speeds and, in many instances on-street parking is provided. **In these environments a lateral offset to vertical obstructions** is needed to accommodate motorists operating on the highway.’

## Arterials and other non-access controlled facilities in the urban environment

- Where curb is used, the lateral offset is measured from the face of curb; minimum dimension is **1.5 ft**; **3 ft** at intersections
- ‘On facilities without a curb and shoulder widths less than 4 ft a minimum lateral offset of **4 ft** from the edge of the travel way should be provided.’

# Overview of Proposed Policy Guidance

## Context

## Proposed AASHTO Guidance

**Rural** (high speed, generally open sections)



Refer to RDG for **Clear Zone** dimensions

**Transition** (moderate speeds, can include curbed sections)



**Lateral offset** as minimum, but strive for increased lateral offset or reduced clear zone

**Urban** (lower speeds, generally curbed sections)



1.5 ft minimum **lateral offset**; but 4 ft minimum when no curb is present

## **‘Clear Zone’, the design of the roadside, standards and knowledge**

***There is no such thing as a mandated clear zone dimension*** (according to FHWA, RDG and Green Book)

- Clear zone should be established on a project by project basis
- One size most assuredly does not fit all contexts
- Technical guidance in the RDG is not precise and not to be used that way (it is supposed to be ‘flexible’)

# Some final comments -- Clarification of FHWA's 13 Controlling Criteria

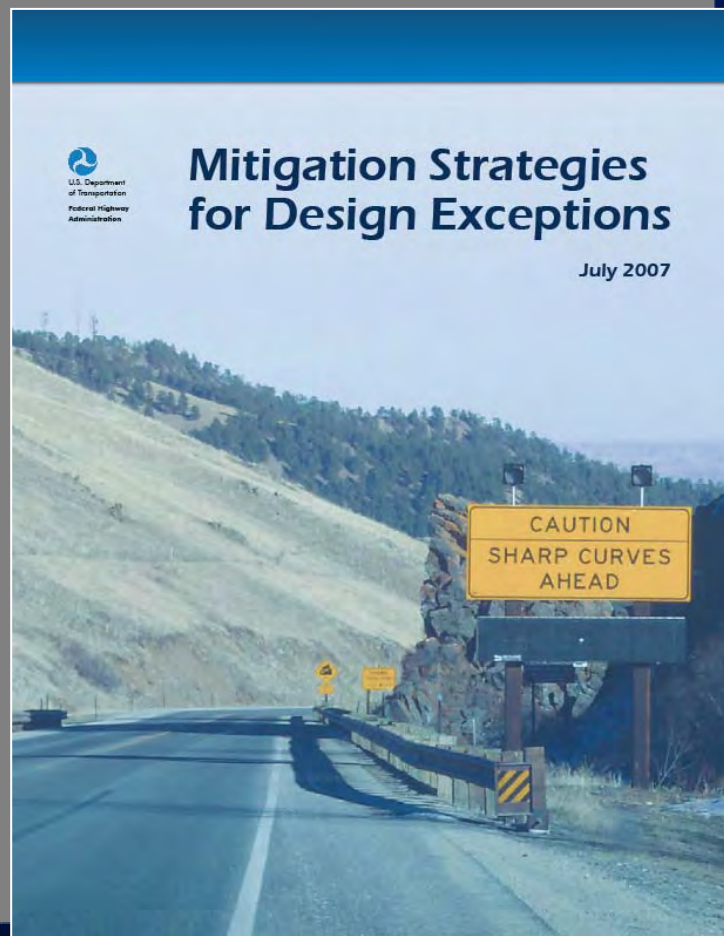


- Lane width
- Shoulder width
- Normal cross slope

- Horizontal curvature
- Superelevation
- Tangent grade
- Vertical curvature
- Vertical clearance
- Stopping sight distance
- Bridge width
- **Horizontal clearance\***
- Structural capacity
- Design Speed

\*soon to be referred to as lateral offset

# FHWA Design Exceptions Guide



- Discusses 13 critical criteria and mitigation strategies
- Presents case studies from DOTs
- Incorporates operational and safety effects of dimensions
- Clarifies horizontal clearance and clear zone issue

## What we're supposed to be doing

- Exercising choice in establishment of design criteria
- Reflecting the context in our choices
- Being creative to produce a design within criteria
- Understanding operational and safety implications when criteria can not be met
- In brief – being professional

# Questions

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