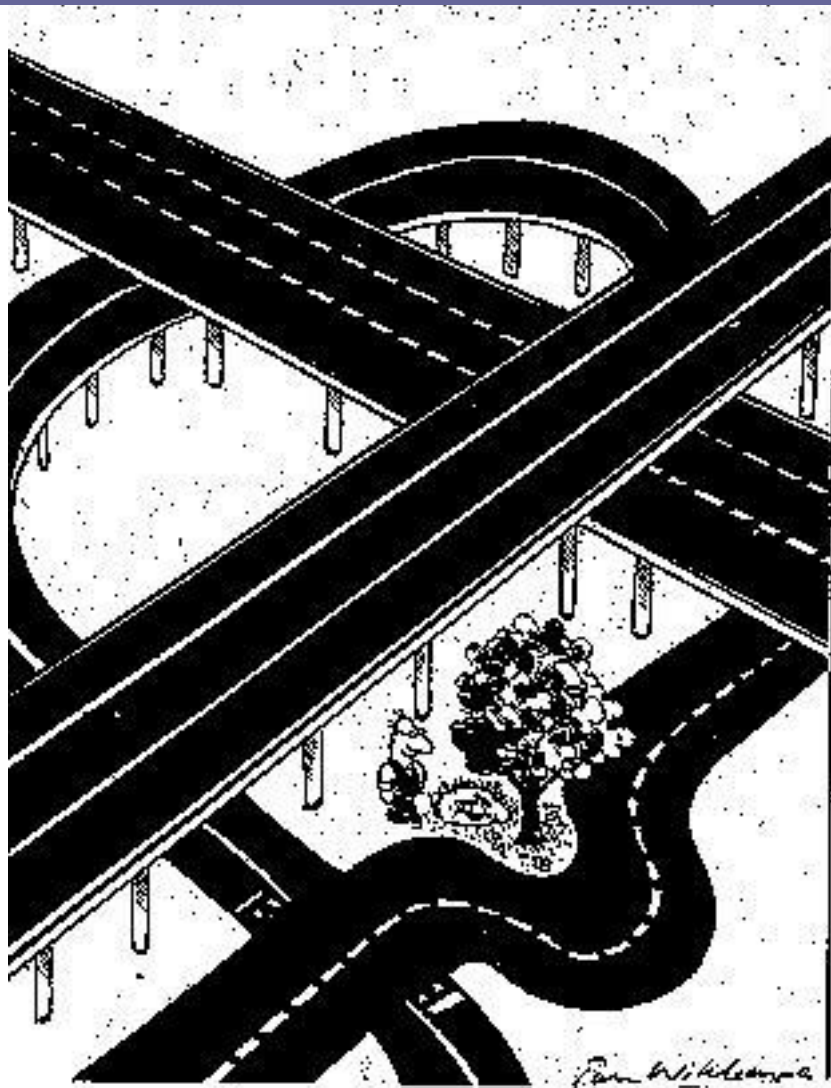


DESIGN GUIDELINES & SAFETY





Flexibility in Design





Learning Objectives

- ◆ Safety and roadway design
- ◆ Design principles



Old Excuse

~~It hasn't been done before~~

~~It's not how we do it!~~

~~I don't know how!~~

It won't work



Basic Tenet

- “Well-designed” roads should
- ◆ Handle traffic efficiently and safely
 - ◆ Fit nicely into their surroundings
 - ◆ Address community’s needs and desires



In Other Words

A project is successful if

- ◆ It works
- ◆ It's safe
- ◆ People like it
- ◆ It was done on time and within budget



Safety & Roadway Design

- ◆ Each design assumes a safety level
- ◆ Section 109, Title 23, USC
 - Need for balancing of safety, mobility, economic considerations, protection and enhancement of natural environment, and preservation of community values
 - Safety is **not paramount** over other considerations
- ◆ Tradeoffs among design, cost, and safety
- ◆ Aim to achieve a “reasonable” level of safety & service



Safety Levels

- ◆ Nominal safety
 - Measured as compliance to standards, warrants and guidelines
 - Yes/No
- ◆ Substantive safety
 - Measured by crash frequency and severity
 - Continuous scale



Fix the Safety Problem...





Whose Safety?





A Safe Roadway?

In the space below, please list what are the top three items that make a roadway safe



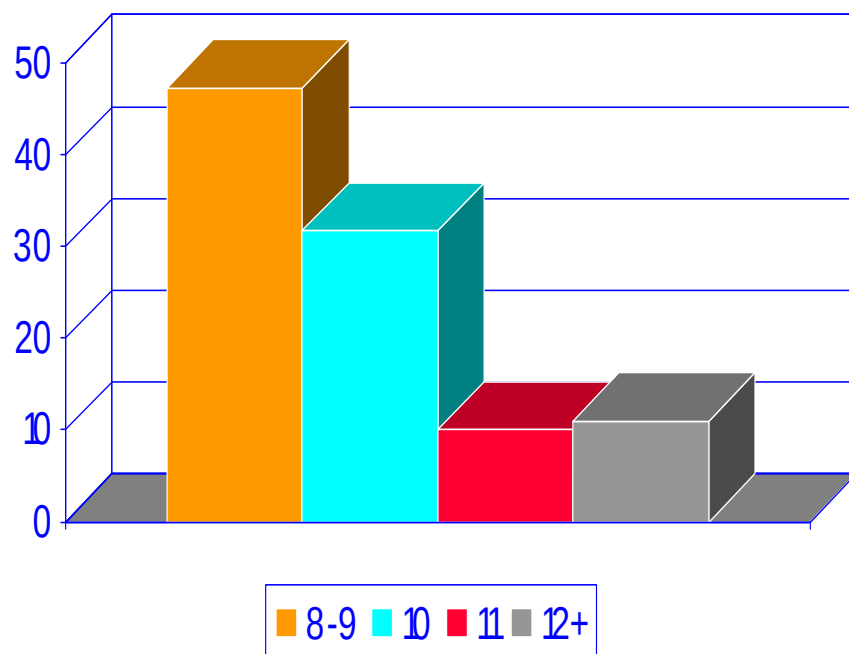
A Safe Roadway?

- ◆ Wide roads with medians
- ◆ Grade separated intersections
- ◆ Smooth roads
- ◆ Proper signing
- ◆ Driver expectancy
- ◆ Proper vert & horiz design values
- ◆ Good drivers
- ◆ Road with no cars
- ◆ High design standards



Geometric Features & Safety--1

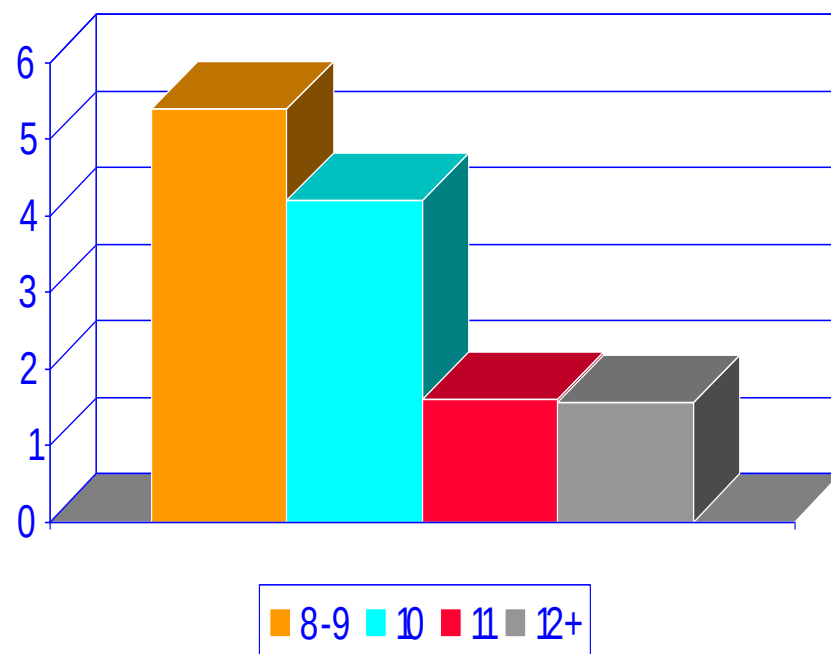
Percent Crashes



(feet)

Lane Width, 2L2W Rural Roads

Crashes per Mil VMT

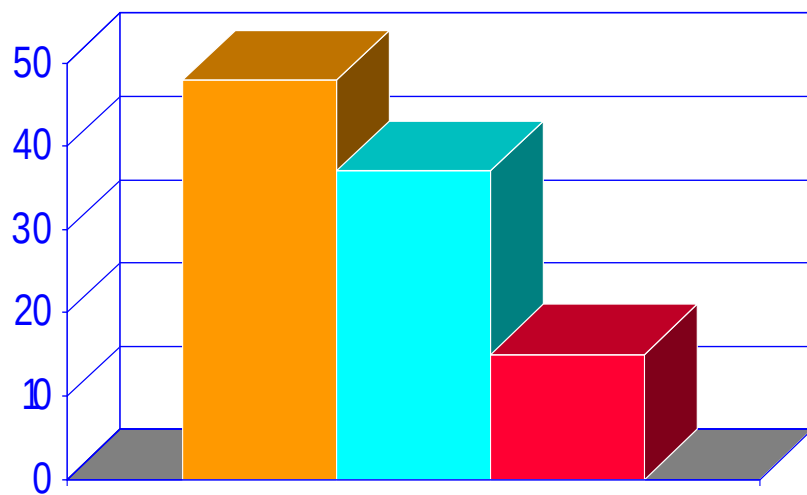


(feet)



Geometric Features & Safety--2

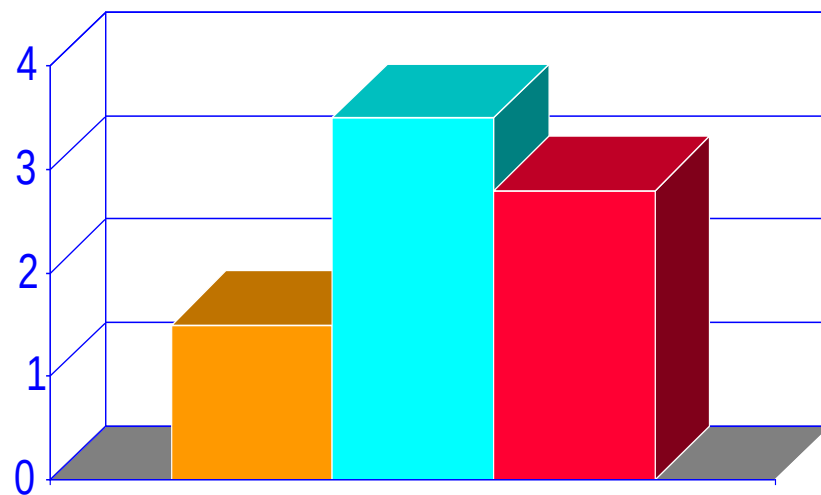
Percent Crashes



■ <3 ■ 3-5 ■ 6+

(feet)

Crashes per Mil VMT



■ <3 ■ 3-5 ■ 6+

(feet)

Shoulder Width, 2L2W Rural Roads



Geometric Features & Safety- -3

- ◆ Addition of turning lanes/bays
- ◆ Traffic islands
- ◆ Roadway improvements & Safety
 - Report KTC-96-13

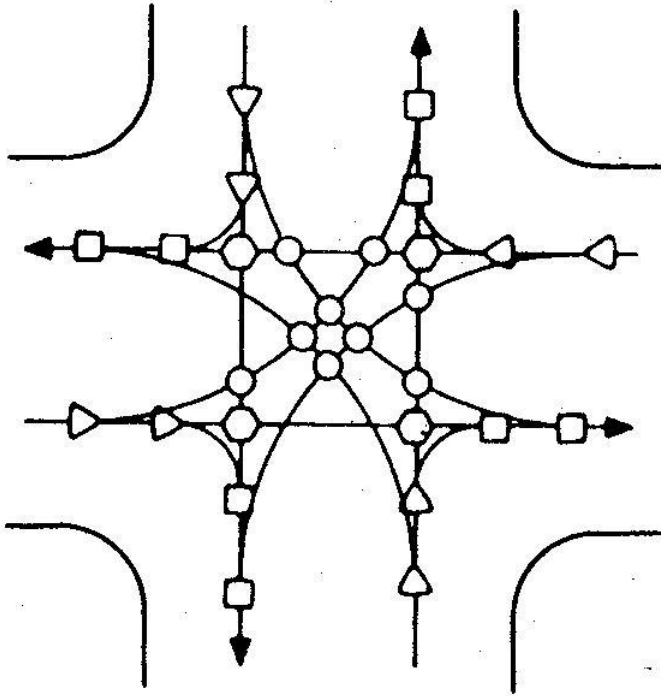


Traffic Islands

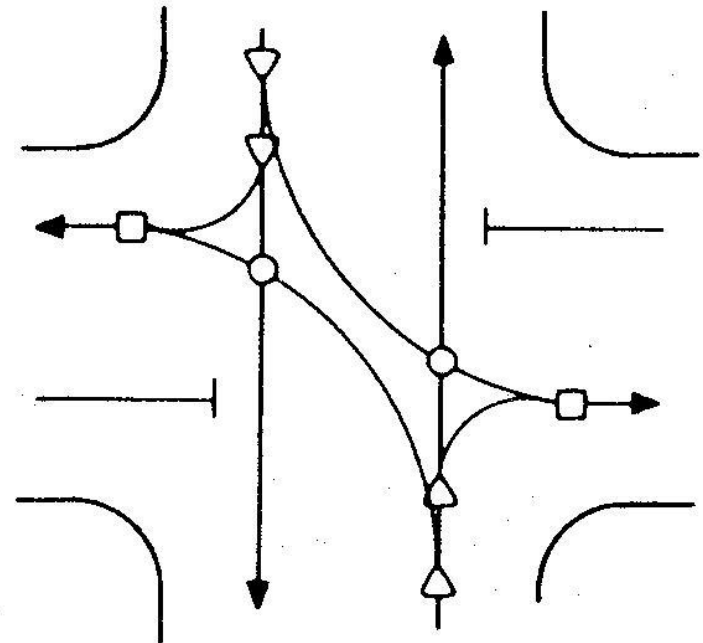




Traffic Control & Safety-1



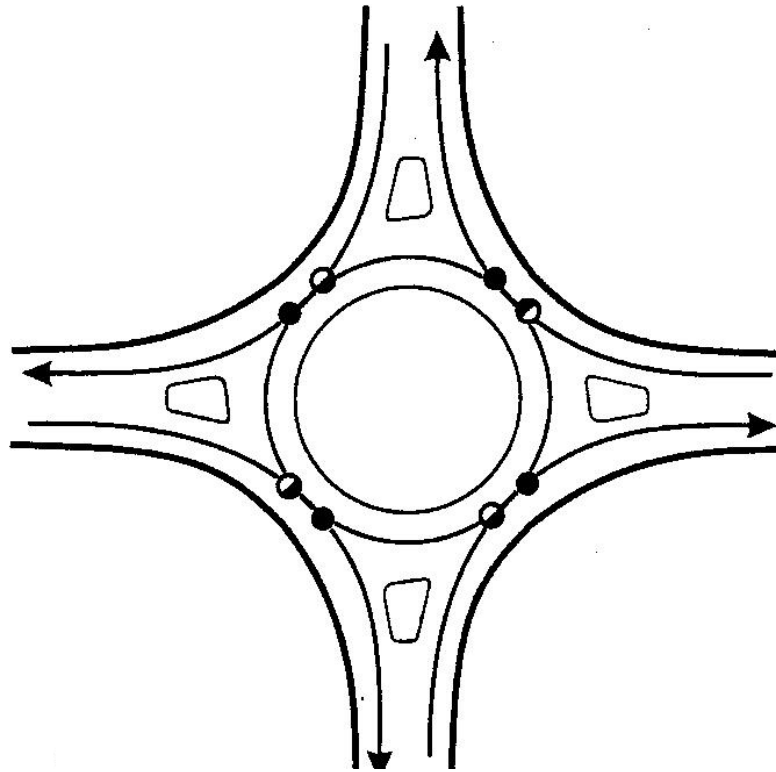
Without signal



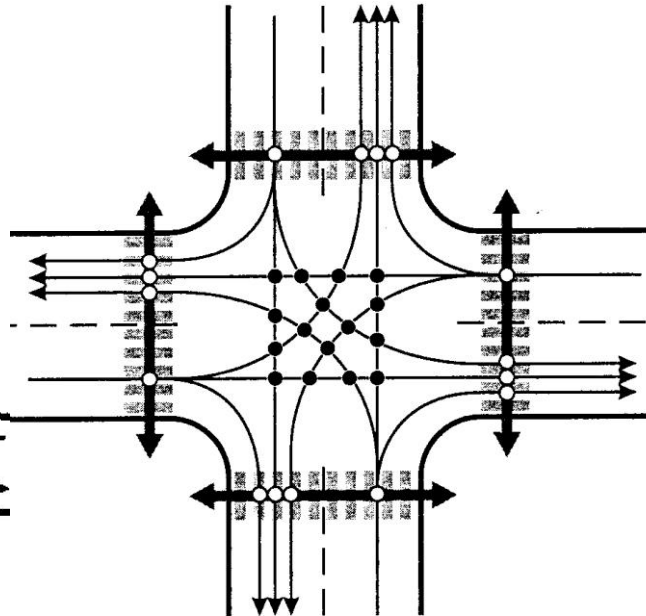
With signal



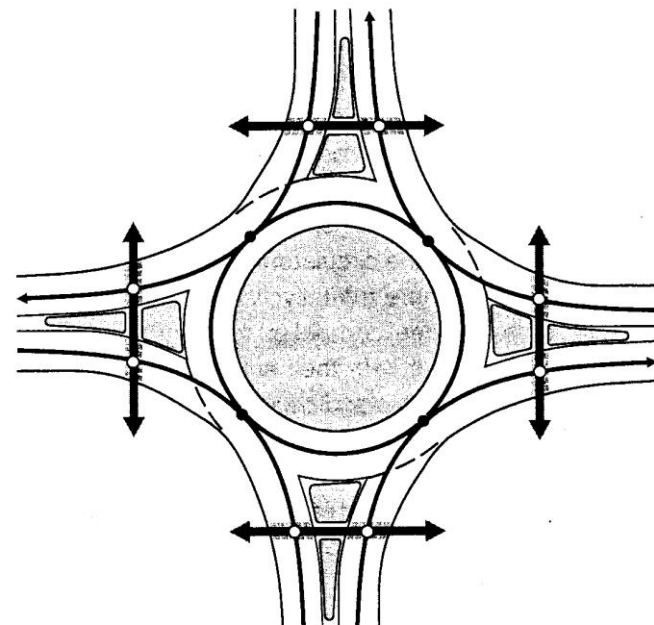
Traffic Control & Safety-2



Roundabout



Pedestrians





Roundabouts--1



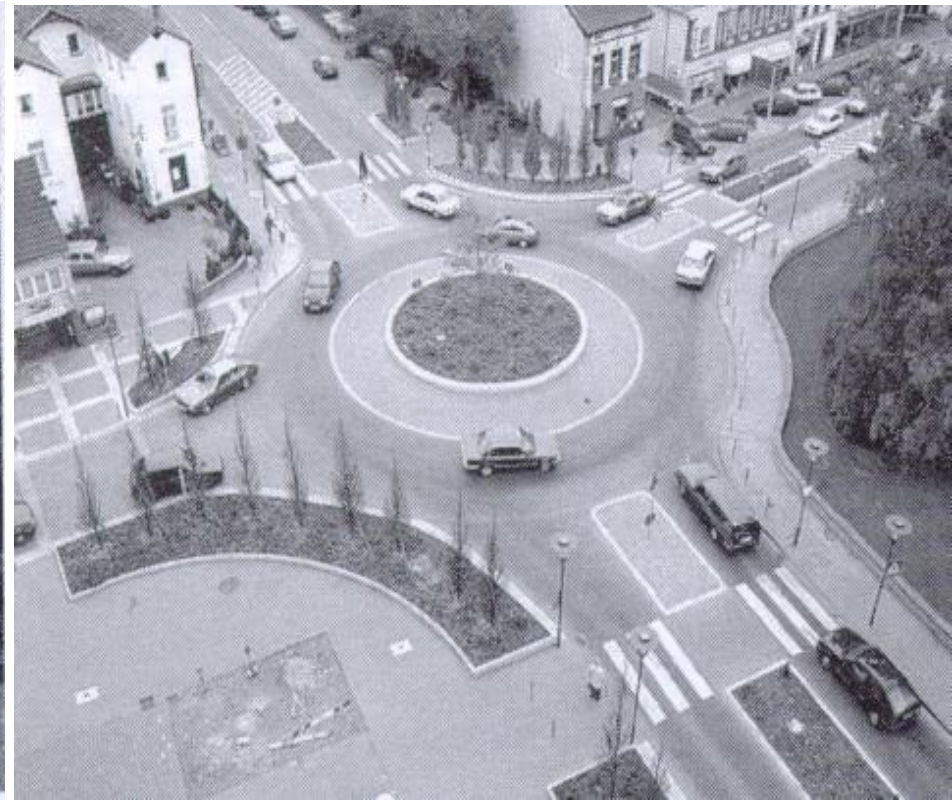


Roundabouts--2

Before



After





Roundabouts--3

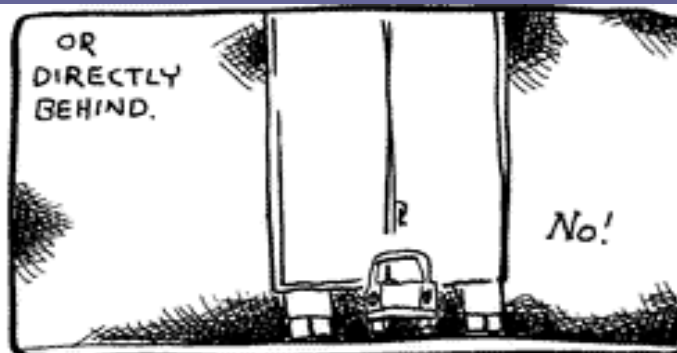


Hard Choices

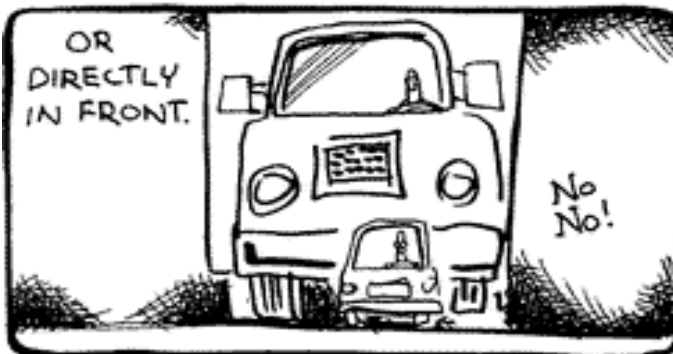
SAFETY ALERT: DON'T DRIVE IN BIG TRUCKS' 'NO-ZONES', WHERE THE DRIVER CAN'T SEE YOU. FOR EXAMPLE: ALONGSIDE THE TRUCK.



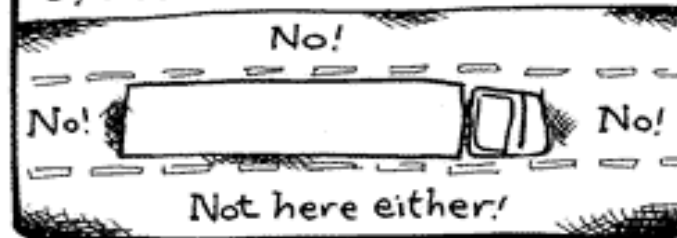
OR DIRECTLY BEHIND.



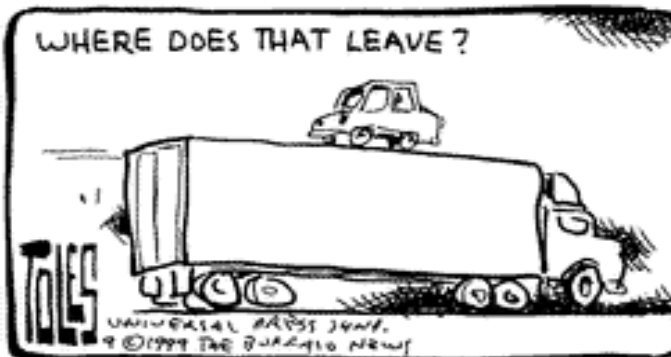
OR DIRECTLY IN FRONT.



IN OTHER WORDS, THE 'NO-ZONES' ARE: IN FRONT OF, IN BACK OF, TO THE LEFT OF, OR TO THE RIGHT OF, TRUCKS.



WHERE DOES THAT LEAVE?





Alternative Solutions

- ◆ Avoid
- ◆ Minimize
- ◆ Mitigate
- ◆ Enhance

And if none of these work...



Design Exception

- ◆ Uses in lane & shoulder widths, clear zones, design speeds, median widths and types, right-of-way...
- ◆ Could be avoided with the use of **creative** design

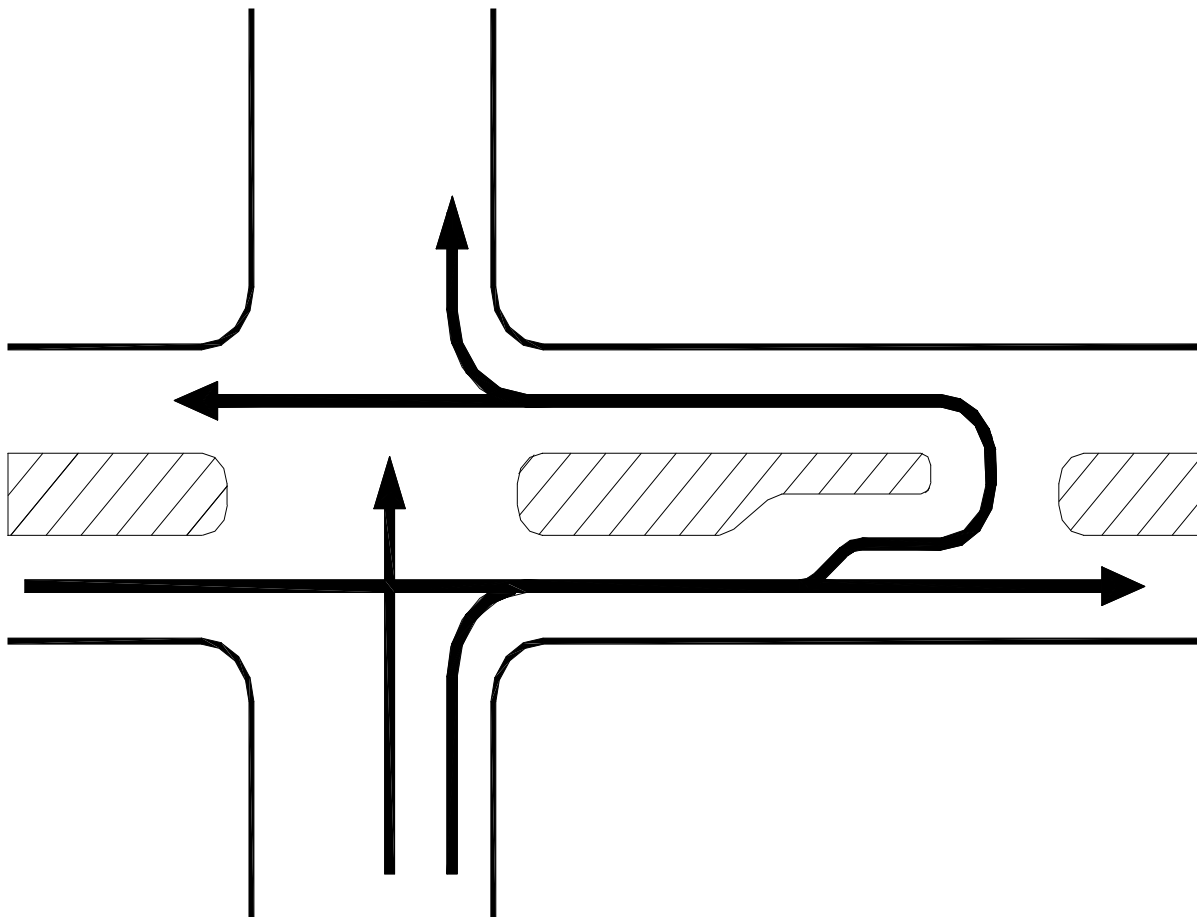


Creative Design

- ◆ Alternative design speeds
 - Design consistency
- ◆ Radii & superelevation combinations
- ◆ Slopes for clear zones
- ◆ Innovative traffic alternatives
- ◆ Horizontal & vertical alignment as a unit



Left-turn Treatments



Median U-turns

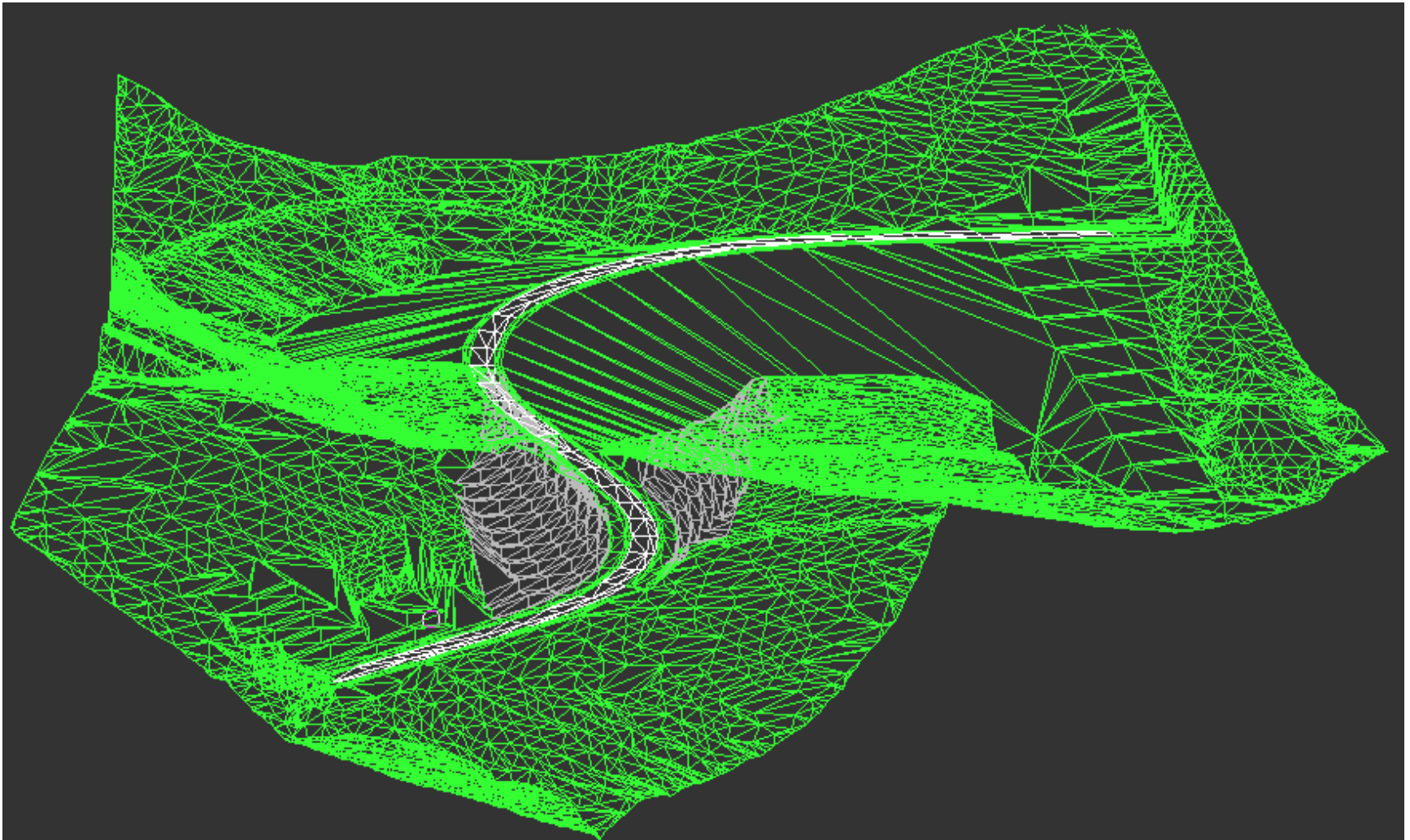


2+1 Lanes





3-D Alignment





Case Study

Given the “design commitments” and your area of concern:

- Determine possible safety concerns within the project; &
- Identify actions to resolve these concerns.

Q1

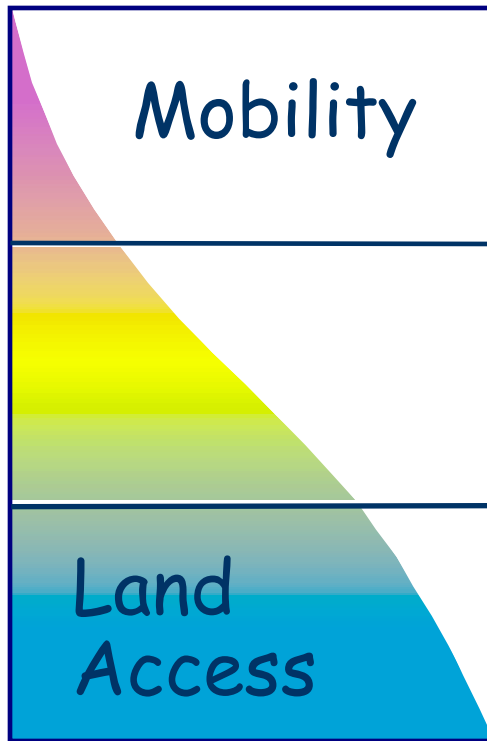


Design Choices

- ◆ Functional class
- ◆ Design speed
- ◆ Corridor
- ◆ Cross section



Functional Class



Mobility

Arterial

Collectors

Land
Access

Locals



Functional Class--1





Functional Class--2





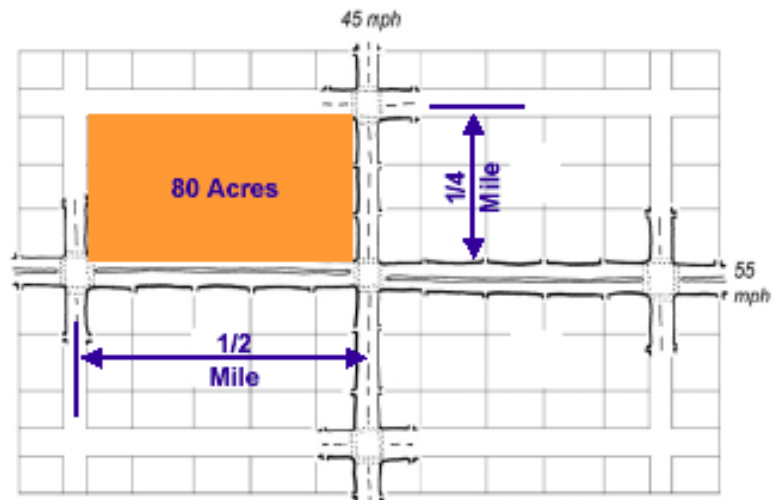
Functional Class--3





Access Management

- ◆ Concerns with
 - Safety
 - Capacity
 - Delays
 - Environmental impacts





Design Speed

A **selected speed** used to determine the various geometric features of the roadway... as high a design speed as practical to attain a desired degree of safety, mobility, and efficiency within the constraints of environmental quality, economics, aesthetics, and social or political impacts



Design Speeds (mph)

Highway Type	Rural			Urban & Suburban
	Level	Rolling	Mountain	
Freeway	70	70	50-60	50-70
Arterial	65-70	50-60	40-50	30-60
Collector	40-60	30-50	20-40	30 & up
Local	30-50	20-40	20-30	20-30

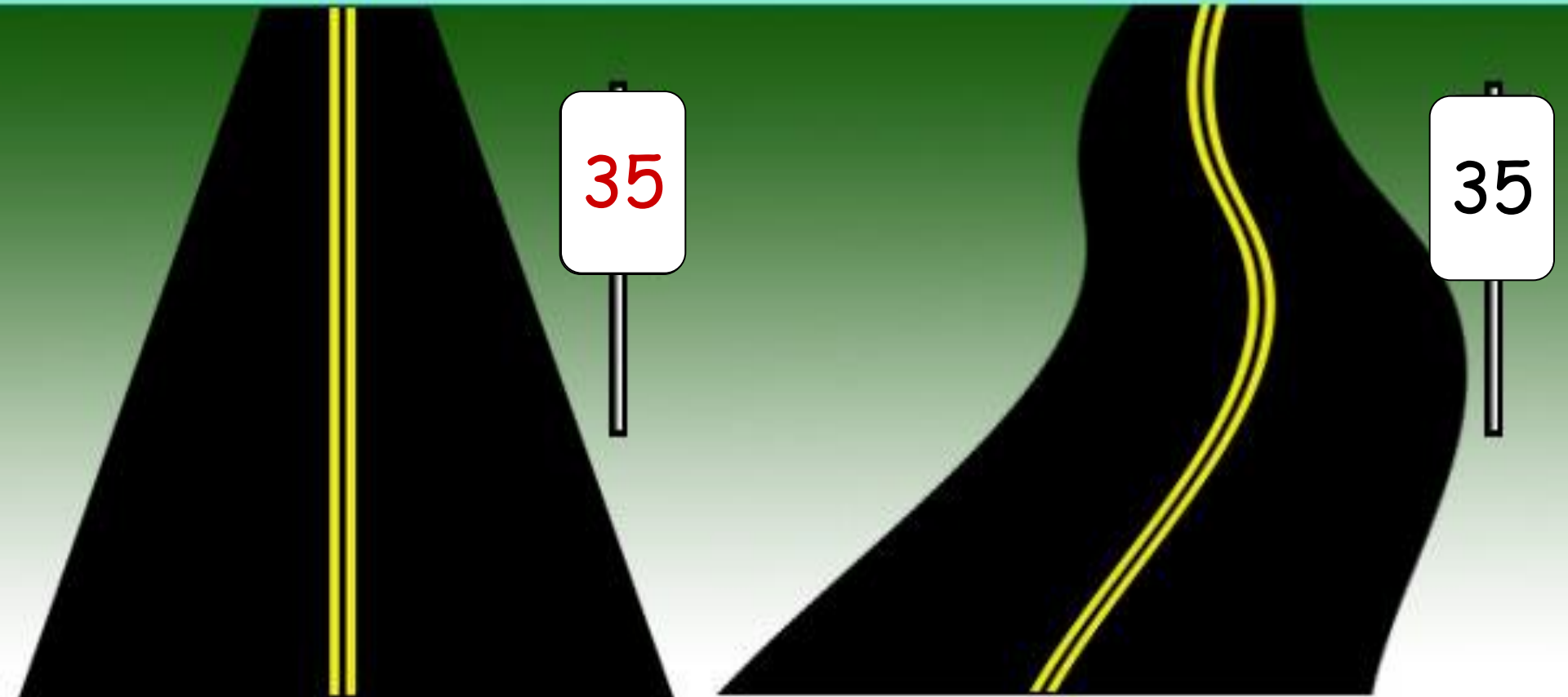


Speed Limit

- ◆ Design speed **NOT** Speed limit
- ◆ Speed Limit
 - approximately 85th-percentile operating speed
 - Local policies



Design speed-Speed Limit





Operating Speed

- ◆ Desired speed for driver
- ◆ Design speed = Operating speed
- ◆ Design Consistency



Design/Operating Speeds





Cross Section

- ◆ Number of lanes
- ◆ Width of lanes
- ◆ Median
- ◆ Shoulder
- ◆ Clear zones
- ◆ Sidewalks/Bikeways
- ◆ Transit/Parking



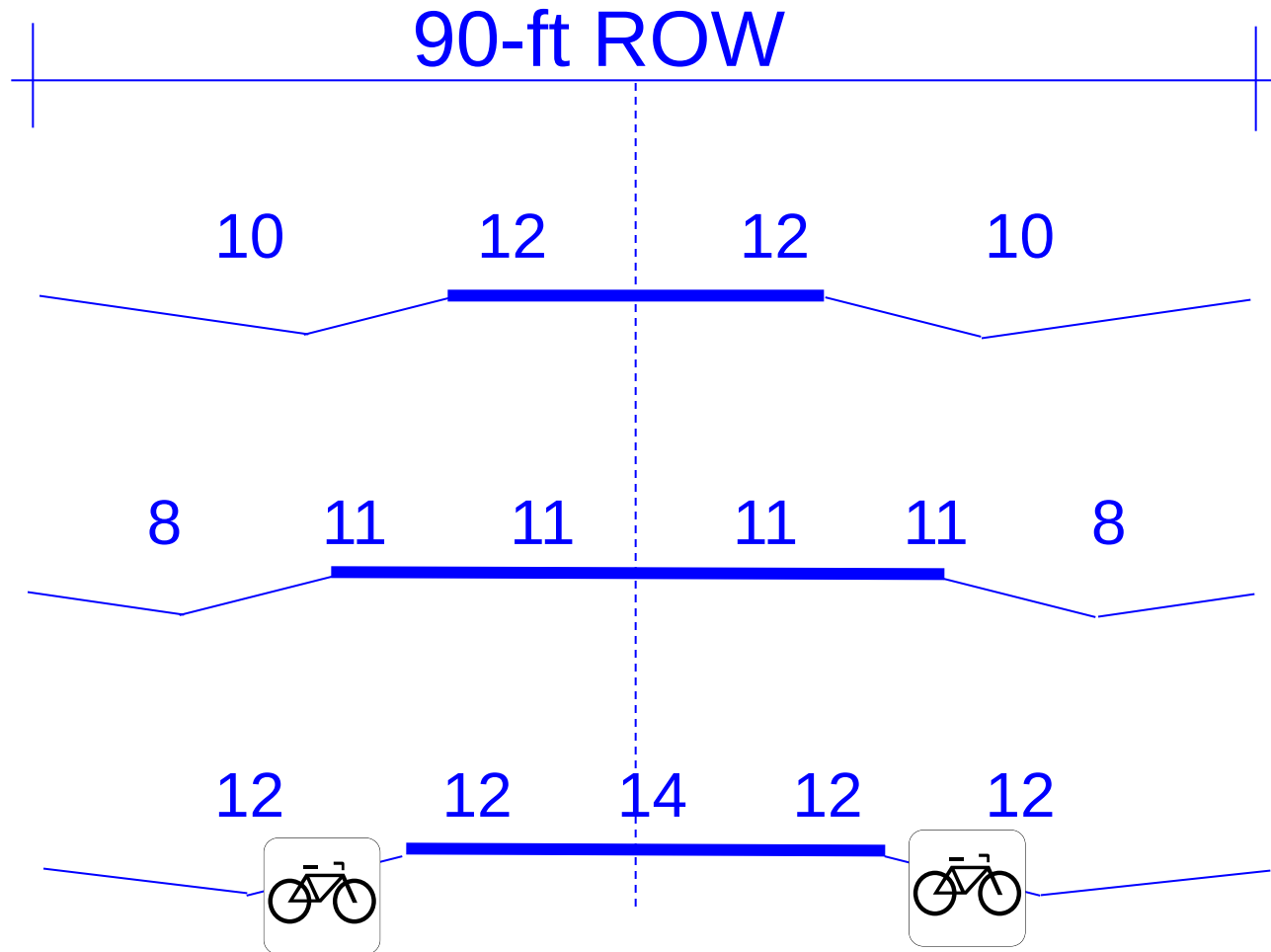
Curb to curb



Edge
elements



Cross Section Tradeoffs





Level of Service--1

- ◆ Rating of acceptable level of congestion
- ◆ LOS definitions
 - A: Free flow, low traffic
 - B: Stable flow, noticeable traffic
 - C: Stable flow, traffic interactions
 - D: High density, movement restrictions
 - E: Maximum flow, capacity, little freedom
 - F: Unstable flow, no freedom, stop & go



Level of Service--2

- ◆ Function of
 - Facility type
 - Location
- ◆ Desirable design values

	<u>Rural</u>	<u>Urban</u>
Arterial	B/C	C
Collector	C/D	D
Local	D	D



Level of Service--3

Road Cross Section	LOS/Speed
4l, 12' lanes, 6' shldr, Median @55 mph	B/55
4l, 12' lanes, 6'shldr, No median @ 55 mph	B/53
4l, 11' Lanes, 6' shldr, No median @55 mph	B/51
4l, 11'lanes, 6' shldr, No median @50 mph	B/47
2l, 12' lanes, 6' shldr, @50 mph	D/45



Self-Enforcing, Self-Explaining Road





Demand vs Capacity



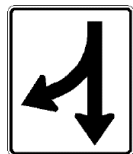


Only Autos?





Cross Section Tradeoffs-2



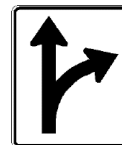
14



12



12



14

TO



11



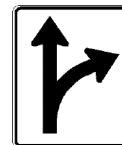
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10



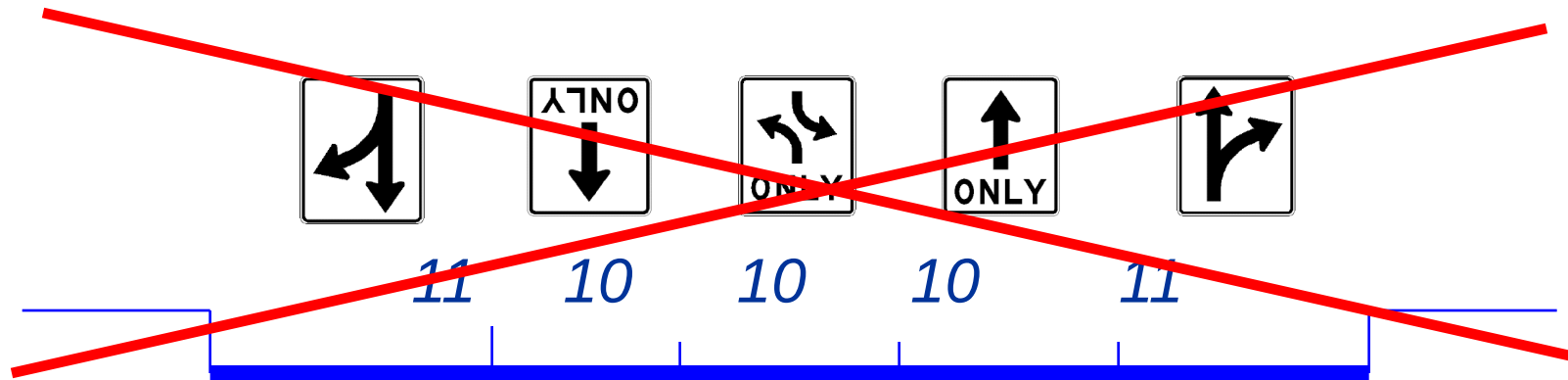
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11



Public Input





Existing Conditions





Summary

- ◆ Flexibility in applying guidelines
- ◆ “Bigger” **not** always safer
- ◆ Design exception process
- ◆ Innovative traffic solutions
- ◆ Technology advancements