Achieving Community Objectives Through Infrastructure Design

Context Sensitive Solutions Workshop

Session 4

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March 9-10, 2010

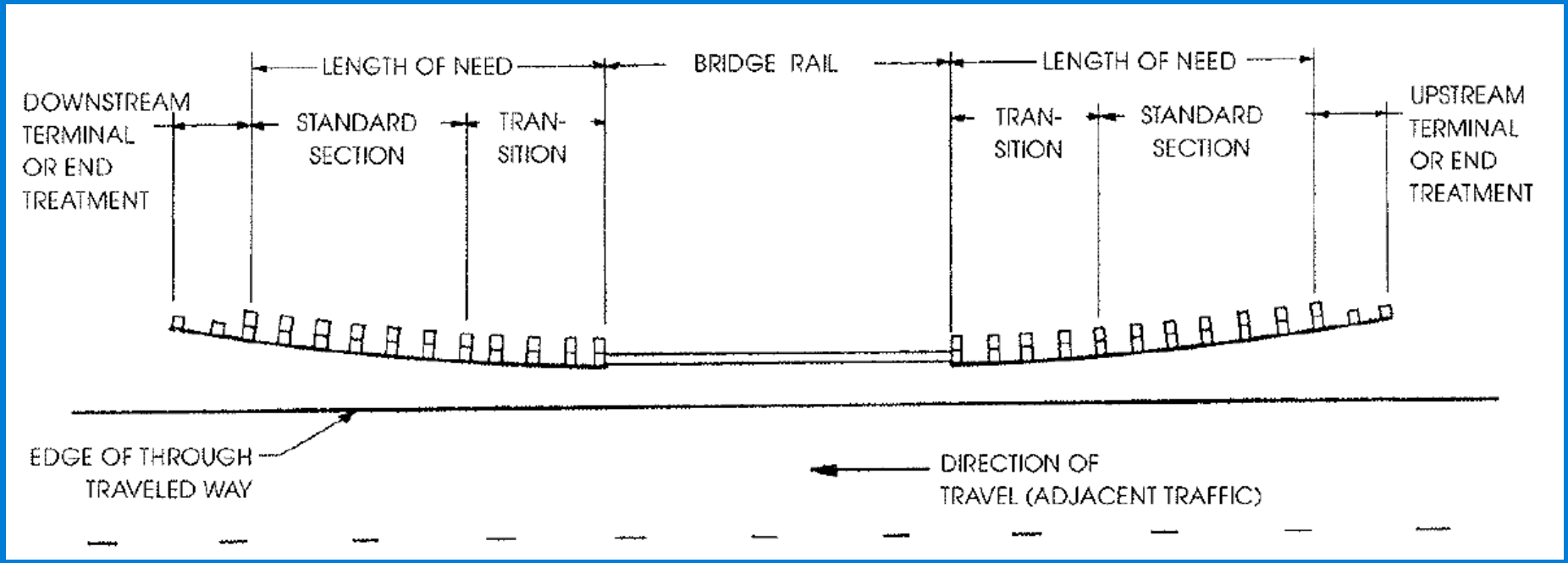
HRGreen

Session 4 Objectives

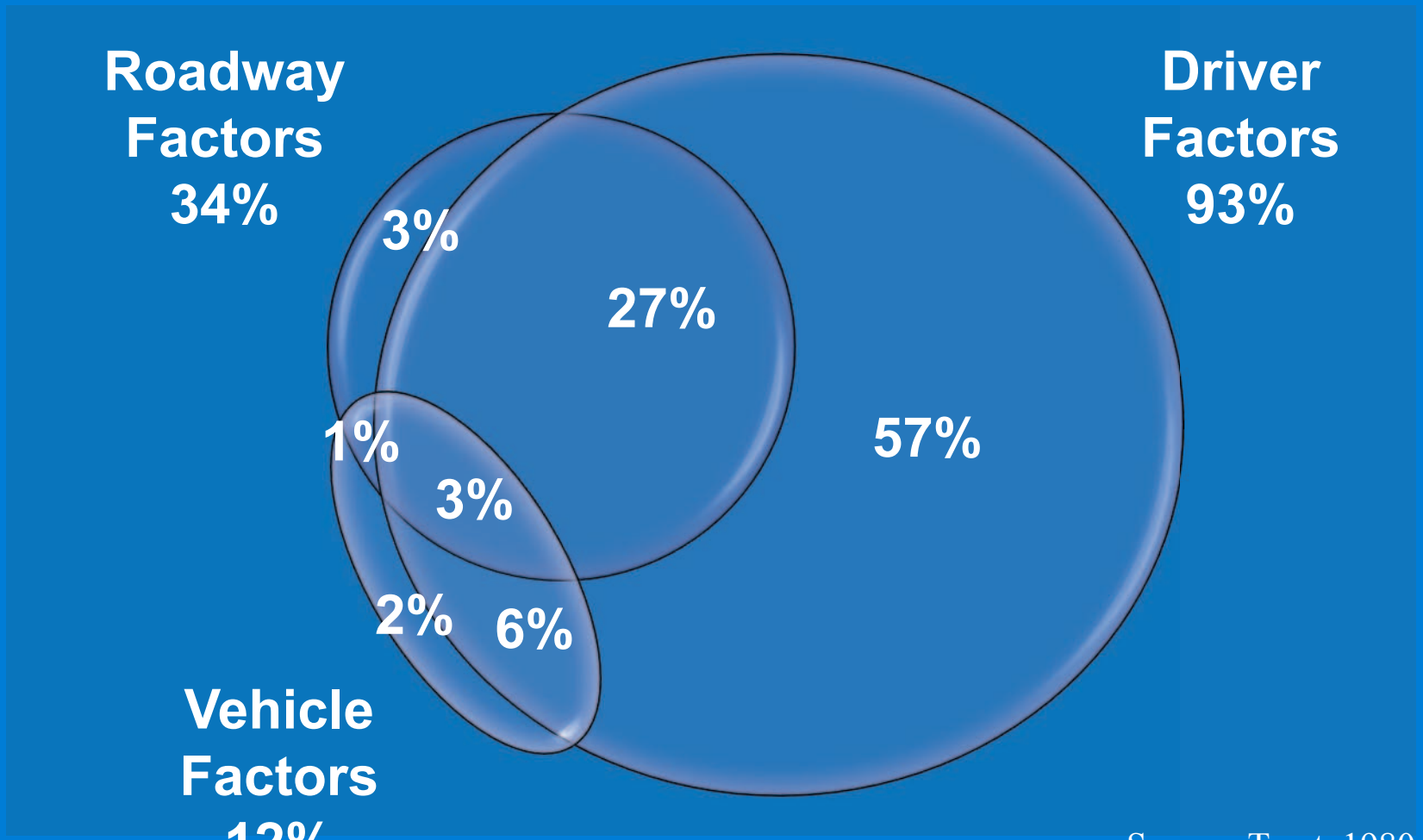
- Safety
- Values change as the context changes
  - Technical
  - Regulatory
  - Community
- Community Based Design Approach

How Safe is Safe?

- Intersections, 2-Lane Highways?
- Guardrail example:

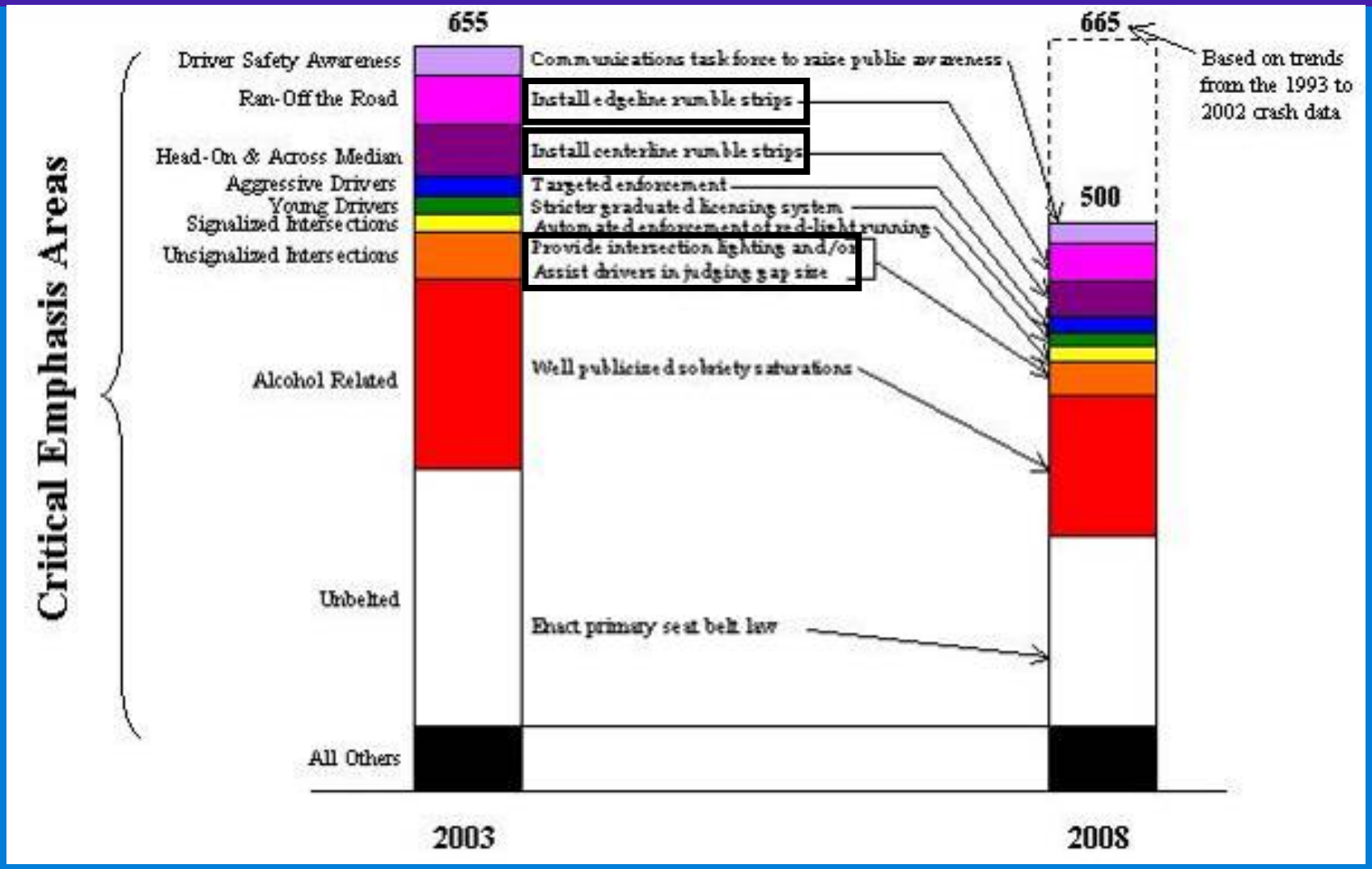


Contributing Factors to MV Crashes



Source: Treat, 1980

Notion: "Better roads" can cure highway fatalities



Source: Minnesota Comprehensive Highway Safety Plan

Comprehensive Safety

- Safety
  - Vehicle Design
    - Preventing Crashes
    - Reducing Injuries
  - Human Behavior
  - Roadway Design

Vehicle Design

- **1973** Energy-absorbing steering column
- **1974** Energy-absorbing bumpers
- **1974** Gas tank relocated for enhanced safety

1978 Child booster cushion for children
1982 Under-run protection
1982 Door mirrors of wide-angle type
1984 ABS, anti-locking brakes
1986 Brake lights at eye level
1986 Three-point seat belt in the middle of the rear seat
1987 Seat belt pre-tensioner
1987 Driver's airbag
1990 Integrated booster cushion for children
1991 SIPS, side impact collision protection
1991 Automatic height adjustment of front seat belts
1993 Three-point inertia-reel seat belt in all the seats
1994 SIPS, side-impact airbags
1997 ROPS, Roll-Over Protection System convertible (C70)
1998 WHIPS, protection against whiplash injuries
1998 IC, inflatable curtain,
1998 DSTC, Dynamic Stability and Traction Control
2000 Volvo Cars Safety Centre inaugurated in Göteborg
2000 ISOFIX attachments for child seats
2000 Two-stage airbag
2000 Volvo On Call safety system
2000 Volvo Cars Safety Centre new crash laboratory inaugurated
2001 Volvo Safety Concept Car (SCC)
2002 RSC, Roll Stability Control

Comprehensive Safety

- Towards Zero Death Initiative's 4E's
  - Engineering
  - Education
  - Enforcement
  - Emergency Medical Services

Defining Safety for Road Design

SHORTCUT: ABOUTCSS.org

U.S. Department of Transportation Federal Highway Administration

PPS PROJECT for PUBLIC SPACES

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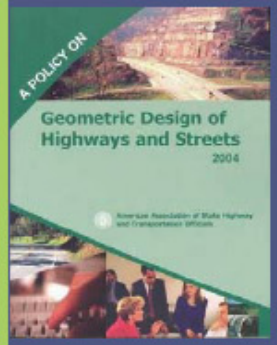
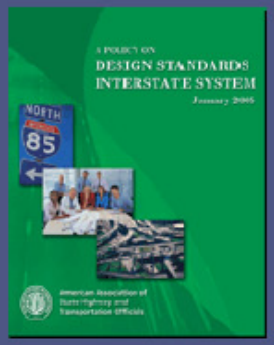
NOMINAL SAFETY

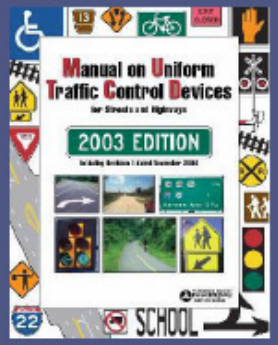
examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures

SUBSTANTIVE SAFETY

actual or expected crash frequency and severity for a highway or roadway segment or intersection







Nominal Safety

The concept of nominal safety is considering whether a design element meets minimum criteria

- It is a simple “Yes/No” assessment

Substantive Safety

- **Actual Safety Performance**
  - **Crash frequency** (number of crashes per mile or location over a specified time period).
  - **Crash type** (run-off-road, intersection, pedestrian, etc.).
  - **Crash severity** (fatality, injury, property damage).

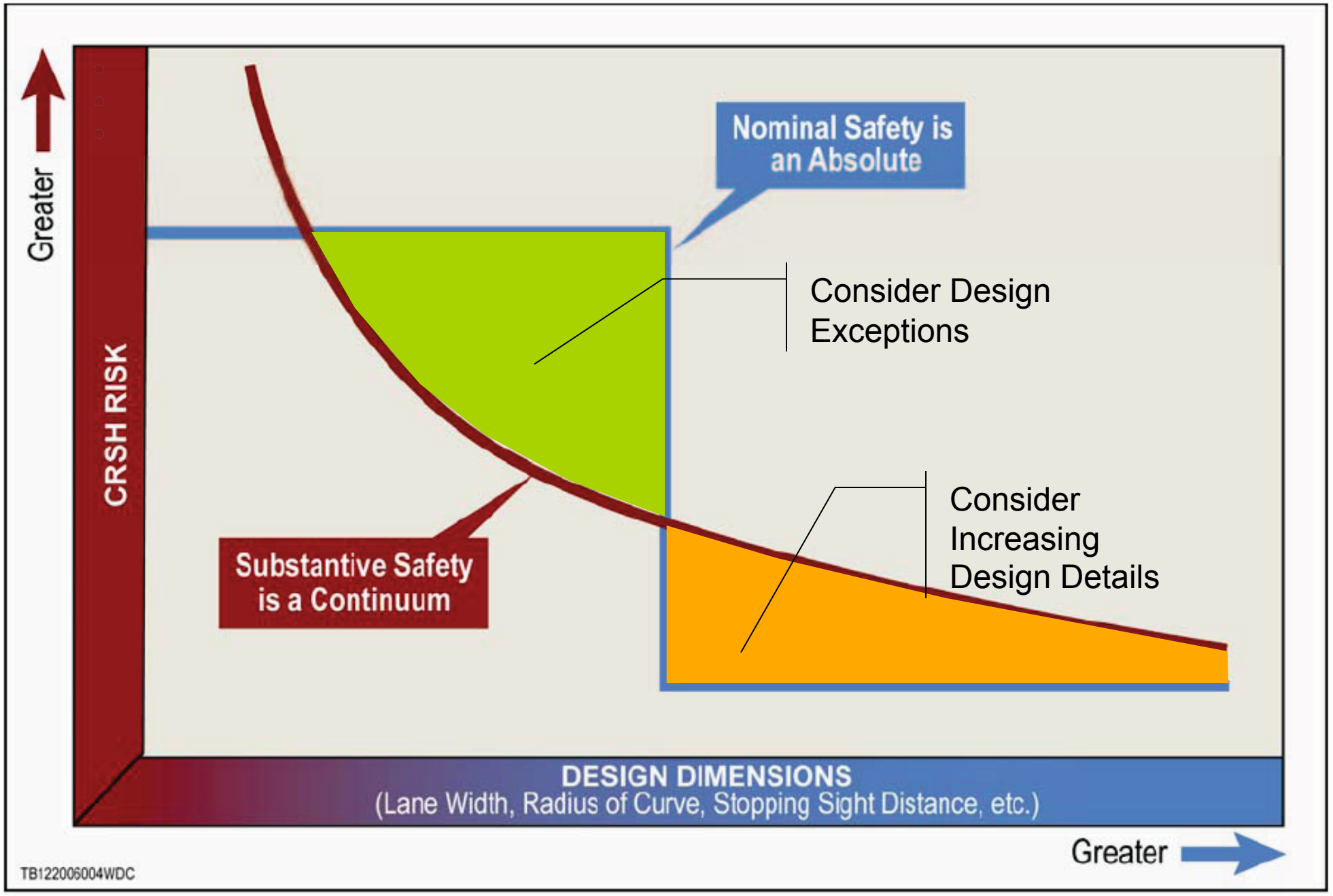
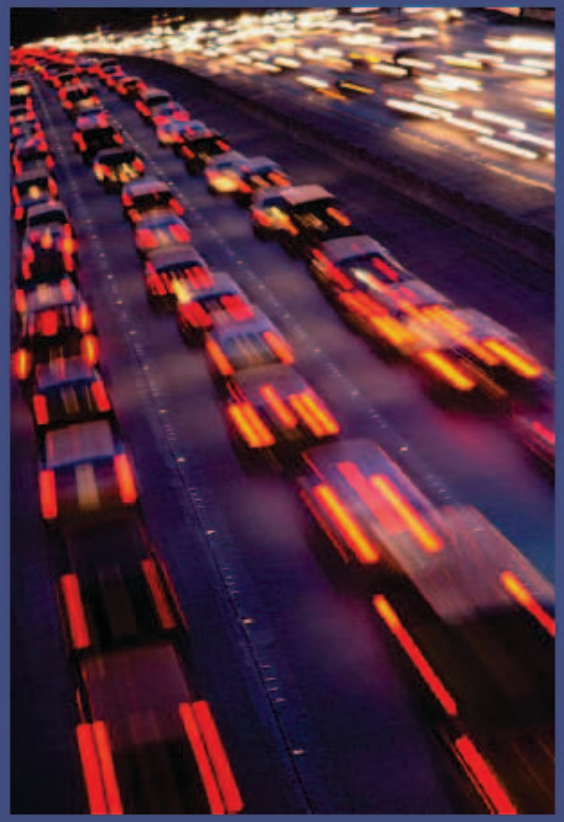


FIGURE 1

Comparison of nominal and substantive concepts of safety. A primary goal of design exception mitigation is to increase substantive safety. (Source: NCHRP Report 480, Transportation Research Board, 2002)

Characterize the Risk

- What variables influence the risk?
  - Exposure
    - Traffic Volume
    - Location
    - Duration
  - Extent
    - Degree of variance from nominal
  - Severity
    - Define worst-case scenario outcome



SHORTCUT: ABOUT CSS .org

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GEOMETRIC DESIGN
Applying Flexibility & Risk Management

NHI

What is Risk Management for Geometric Design?

Risk management in geometric design involves applying *engineering knowledge* and *judgment* to *evaluate design* trade-offs and incorporate performance prediction tools and technologies to enable the *balancing* of competing project interests including but not limited to cost, operational efficiency, environmental issues, social concerns, and specific safety measures.

RISK MANAGEMENT = DESIGN CONSIDERATIONS

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Risk Management in Transportation

Risk comes in many forms and is inherent in the delivery and operation of transportation projects. Examples of where risk is incurred:

- Project cost (cost escalation, changes to project scope)
- Level of engineering analysis (greater investigation generally means fewer unknowns)
- Serviceability (when projects fail to satisfy performance demands)
- Legal claims and tort liability
- Safety (geometric design, structure design, geotechnical design)

Adapted from: FHWA Federal Lands Highway Division *Project Development and Design Manual*. March 2008

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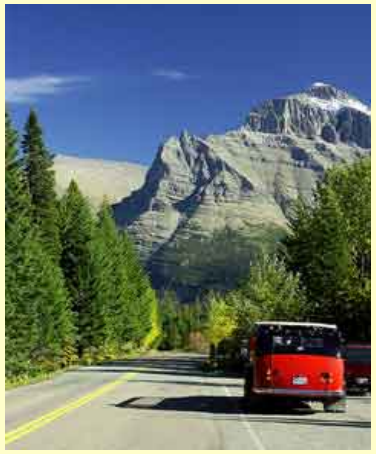
Risk Basis for Improving Design

- In many cases, the ***risks associated with decisions can be mitigated with inclusion or enhancement of other features***, which may offset the risk.



- The ***evaluation of risk is an <u>interdisciplinary</u> process*** requiring involvement of project team members and stakeholders based on the specific issues and an evaluation of risk tolerability.

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Assessing the Risks

- Risk assessment is the process of assessing the *probability* and *severity* of adverse consequences associated with activities, recommendations or designs.
- For most transportation projects the risk assessment is not a complicated quantitative assessment, but rather a *practical assessment based on experience, engineering judgment and historical standard of practice*.
- To the extent possible, *risks should be quantified*, both on the basis of their potential probability and for their potential consequences.

Additional Safety Resources

- Mitigation Strategies for Design Exceptions
  (FHWA Publication)
- Interactive Highway Safety Design Model (IHSDM) http://www.ihsdm.org
- Highway Safety Manual (HSM)
  http://www.highwaysafetymanual.org/

Additional Safety Resources

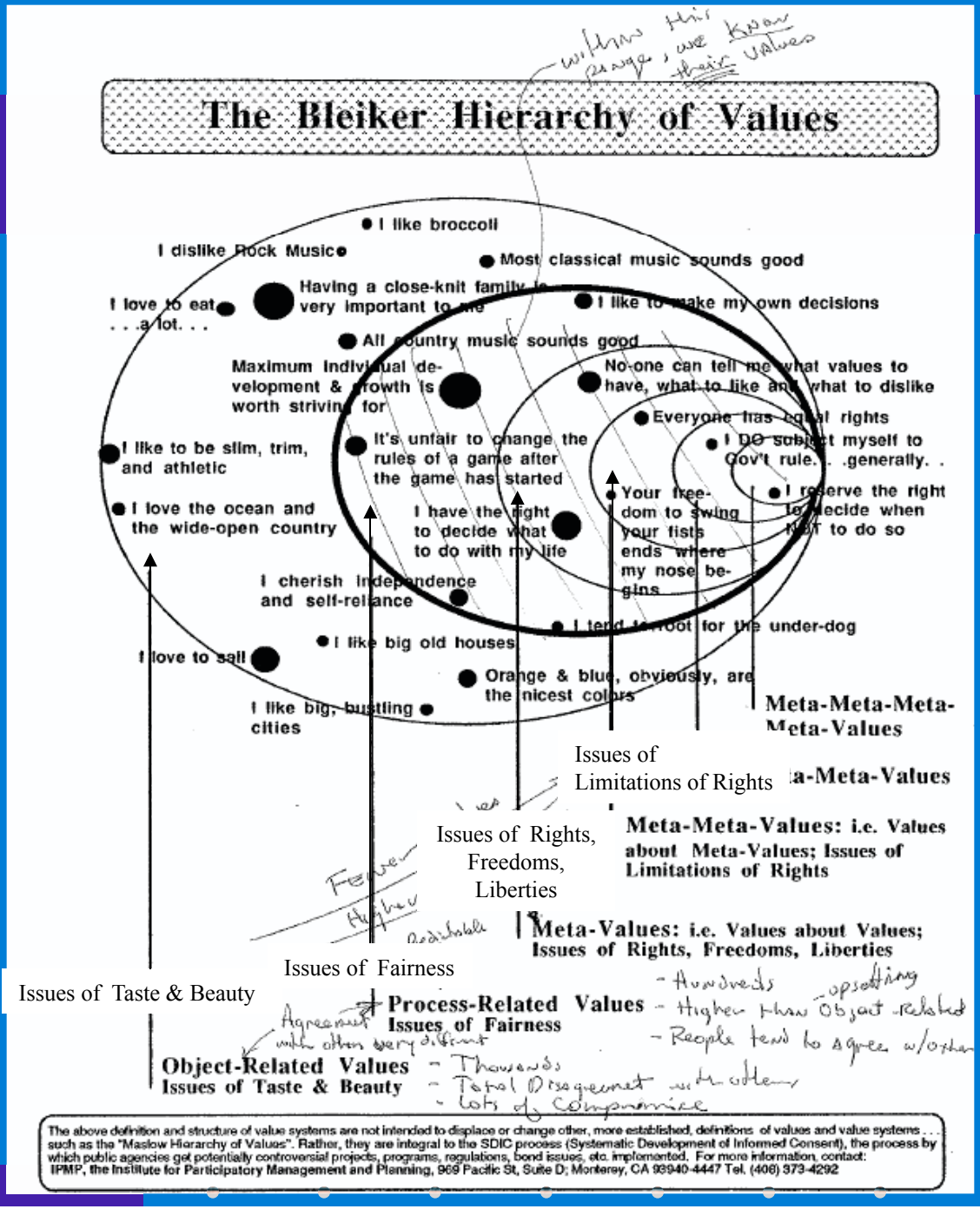
- A Guide for Achieving Flexibility in Highway Design (AASHTO Publication)
- Mn/DOT Office of Traffic, Safety and Operations

  http://www.dot.state.mn.us/trafficeng/safety
- NCHRP Report 500-Series Safety Guides

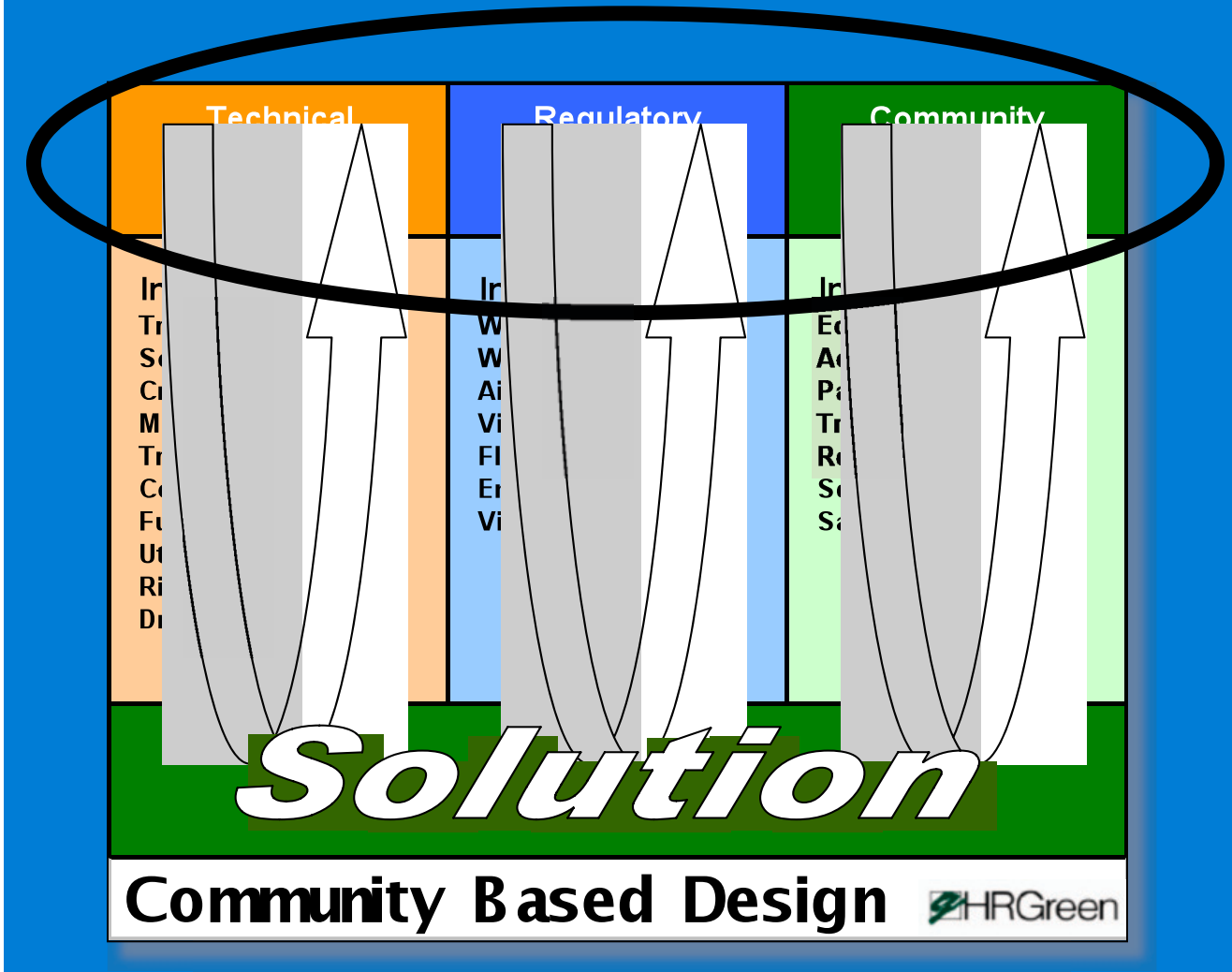
  http://safety.transportation.org/plan.aspx

Values

- From SDIC Training



Values and the Problem Statement



Existing concerns with the stakeholders, regardless of your project!

Concerns with the stakeholders because of your project!

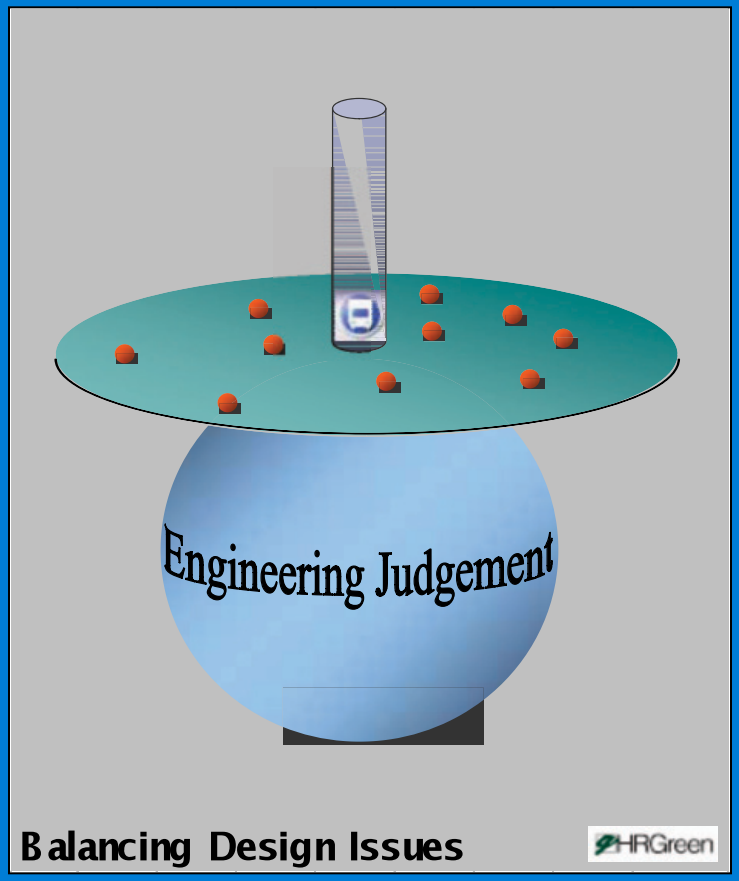
Detroit Lakes- Access Management

Community Based Design

- Historical Perspective
- Community Based Design
- Return on Investment
- Network Solutions
- Functional Classification vs. Context
- Speed, Mobility and Access
- Target Operating Speed
- Flexibility in Development of Alternatives

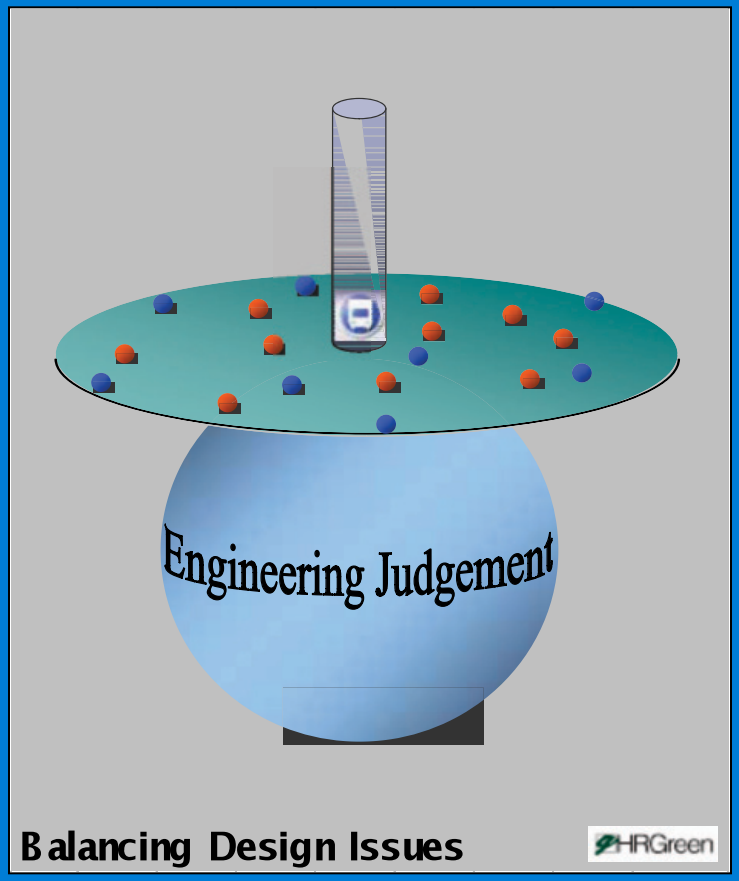
Historical Perspective

Balancing technical marbles and vehicles.



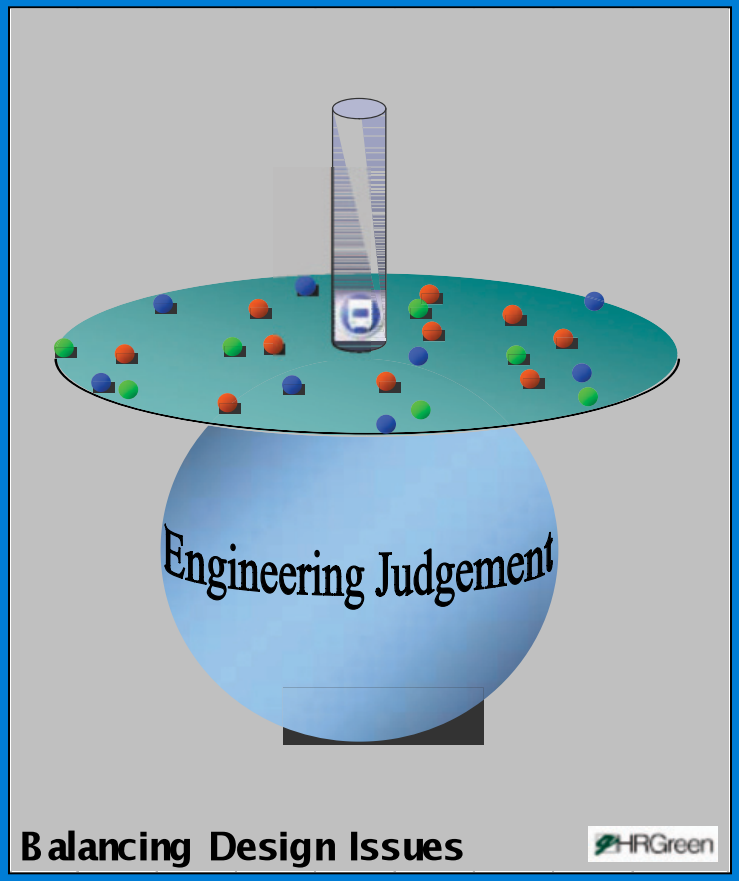
Historical Perspective

Balancing technical *and environmental* marbles and vehicles.



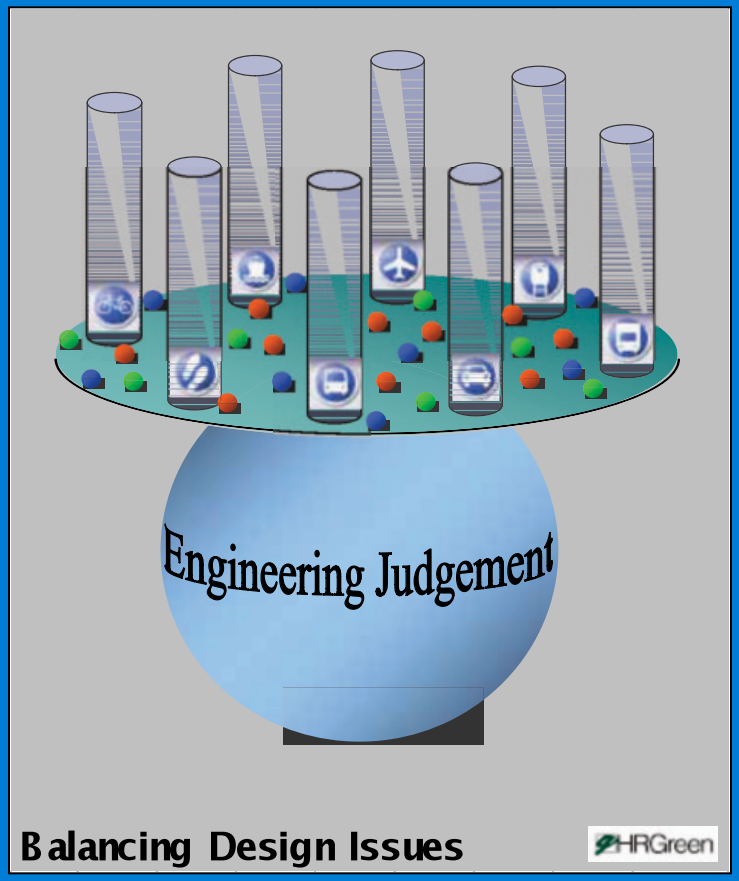
Historical Perspective

Balancing technical and environmental *and social* marbles and vehicles.



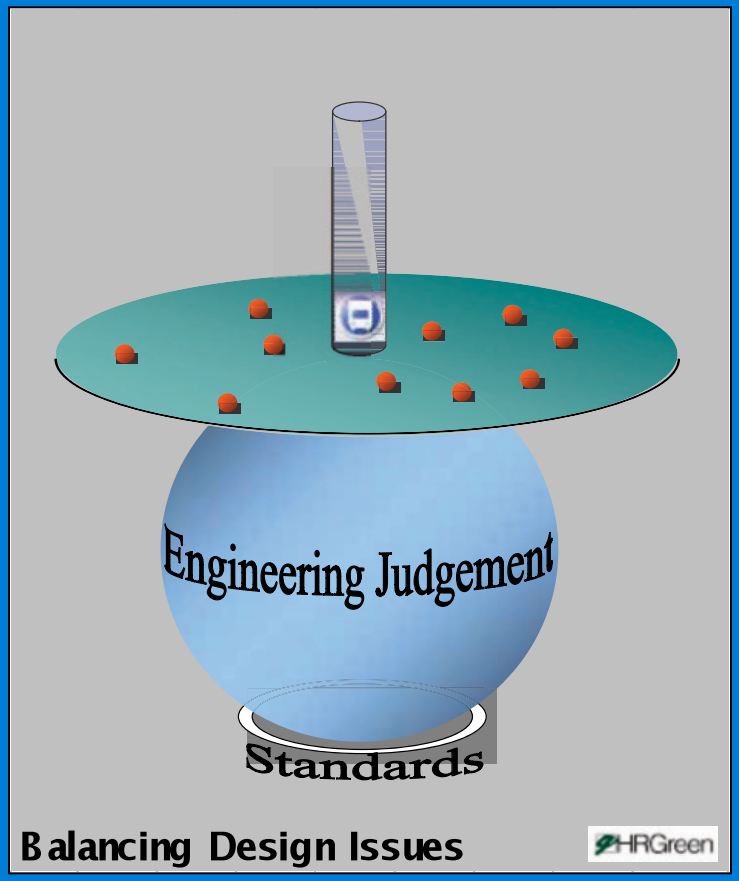
Historical Perspective

Balancing technical and environmental and social "marbles" and vehicle, *transit, pedestrian, cycling, freight rail, shipping, aviation modes*!



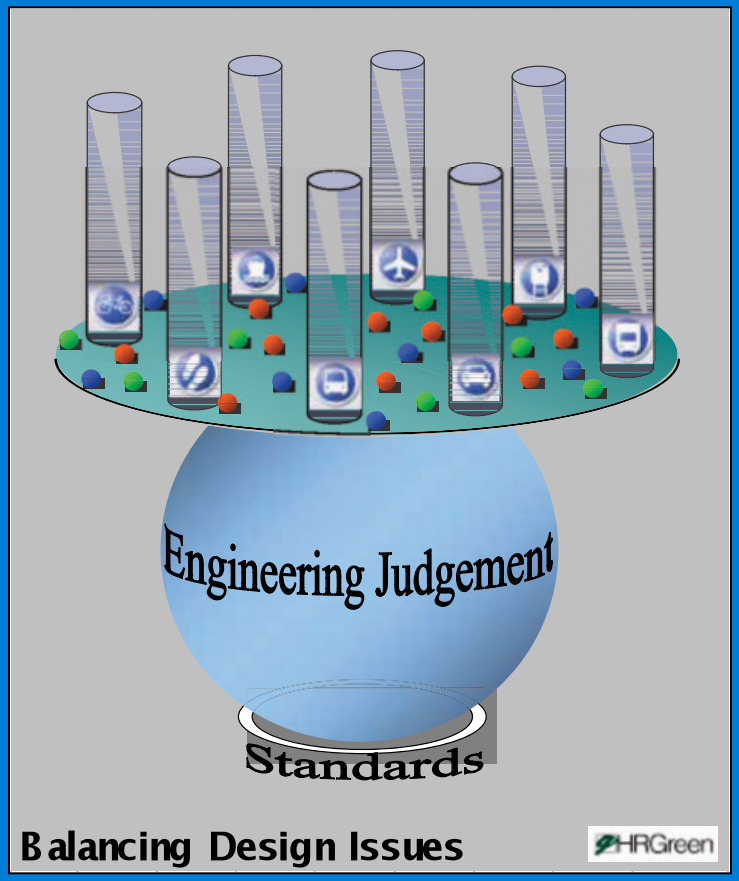
Historical Perspective

Most Standards were developed back then.



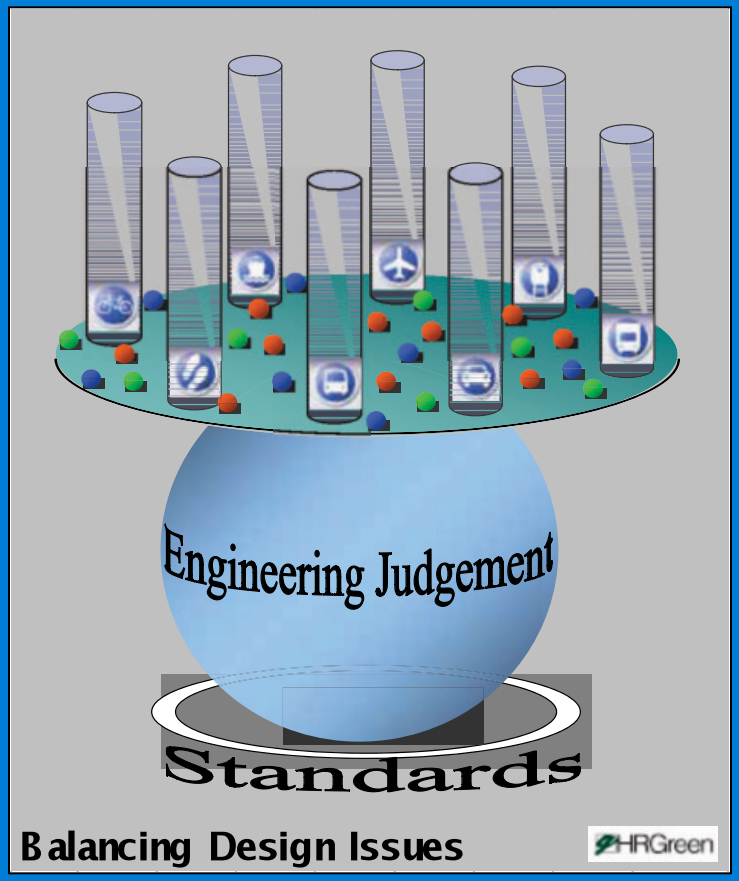
Historical Perspective

Today's need to balance is limited by current standards



Future Standards?

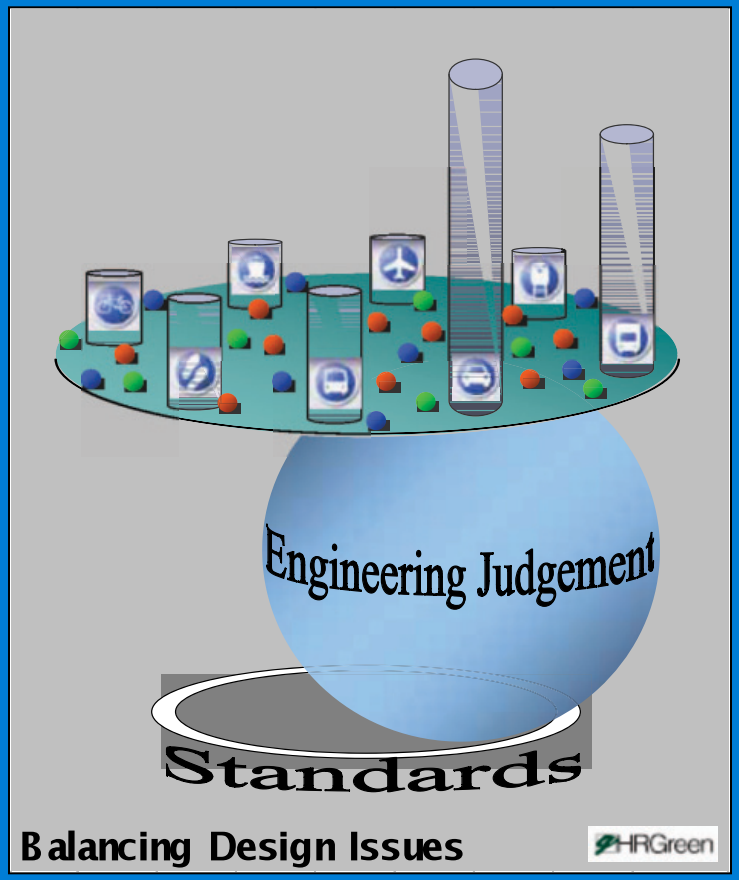
New standards are being considered to allow greater flexibility



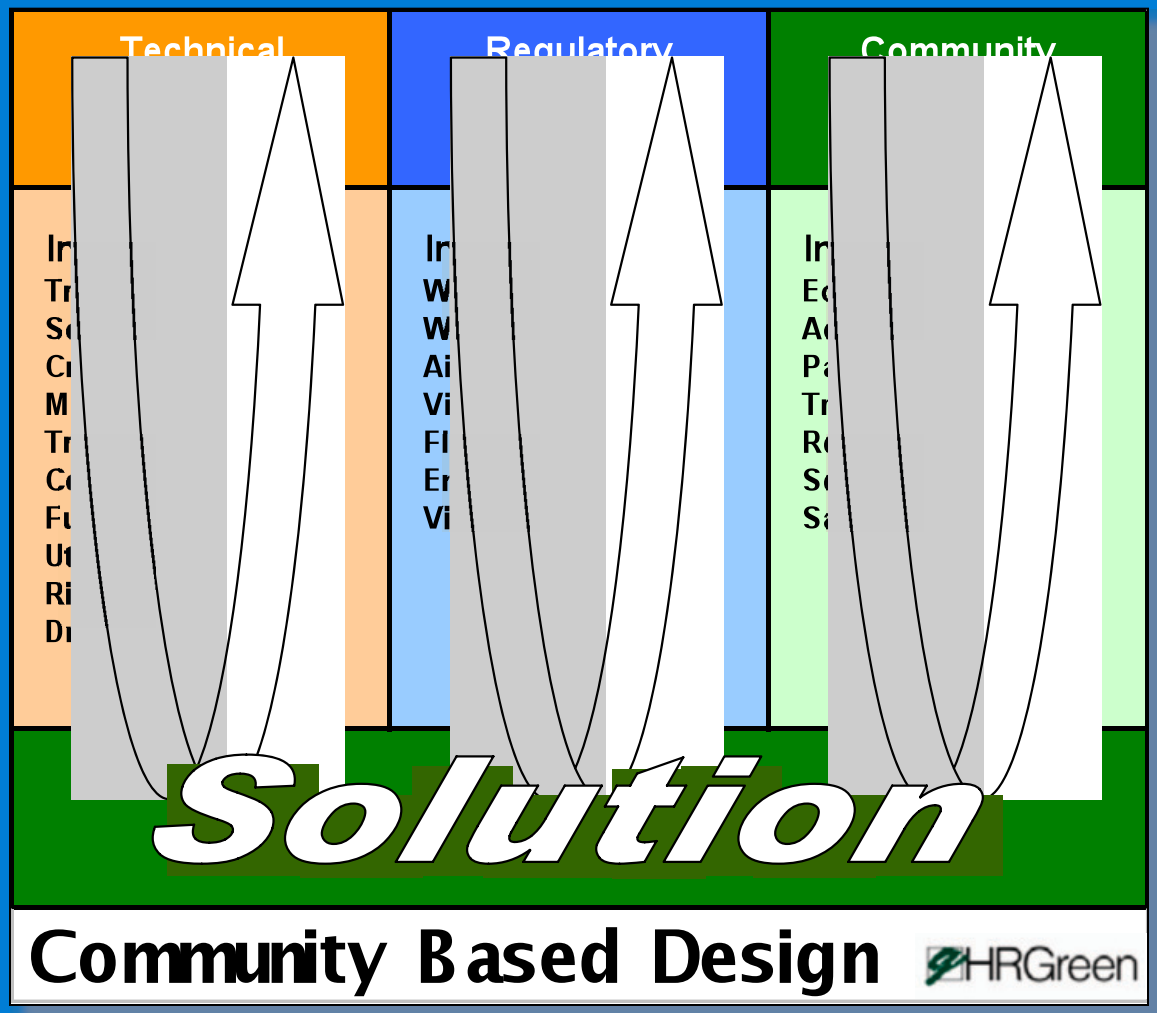
Real Project Scenario

New standards are being considered to allow greater flexibility

To address real world situations.



Community Based Design

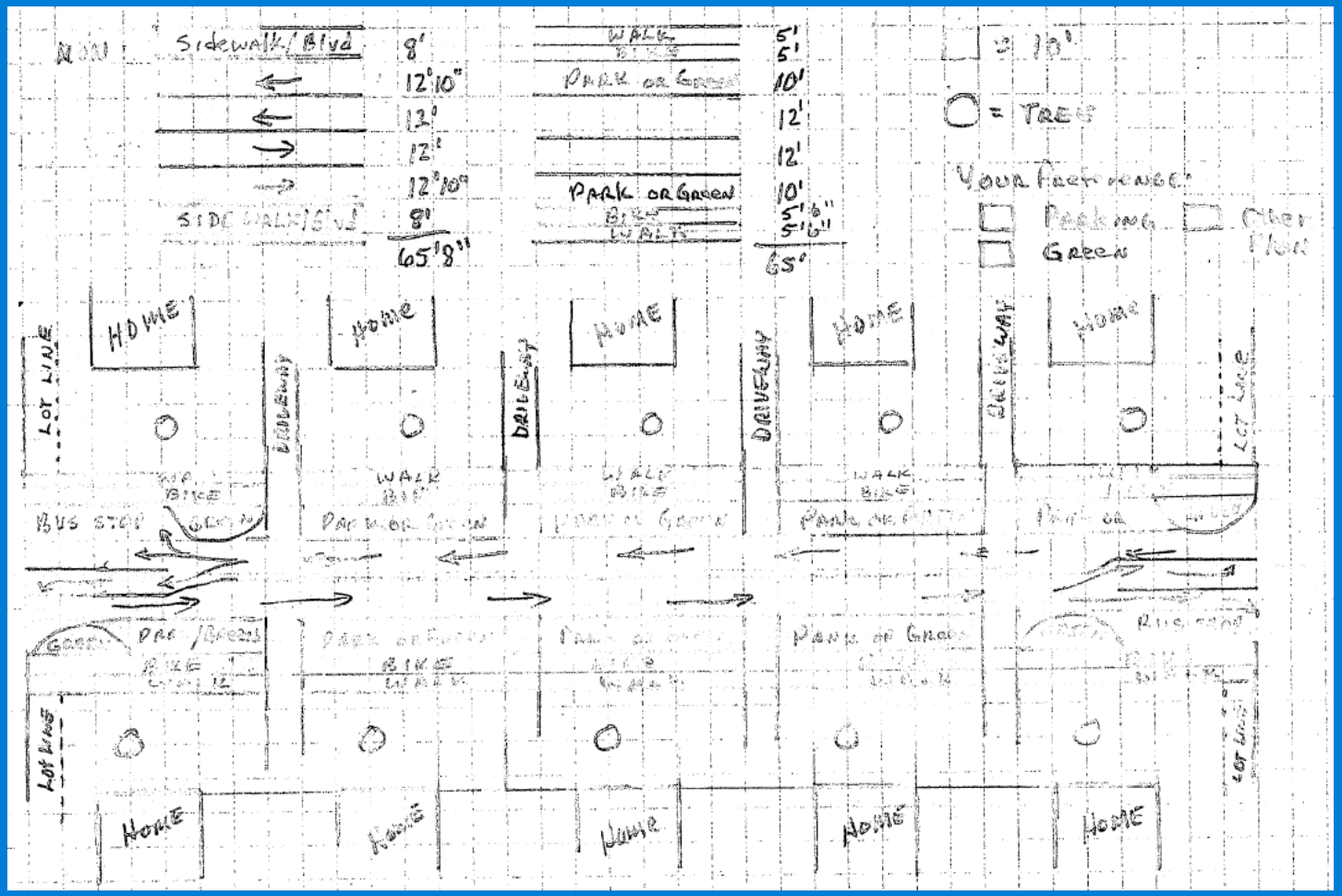


Comprehensive "Real" Problem Statement

Public Inputs and Agency Coordination in a collaborative environment with an interdisciplinary team.

A solution that addresses real problems and is supported.

Engaged Public: 2-Lane Alternative



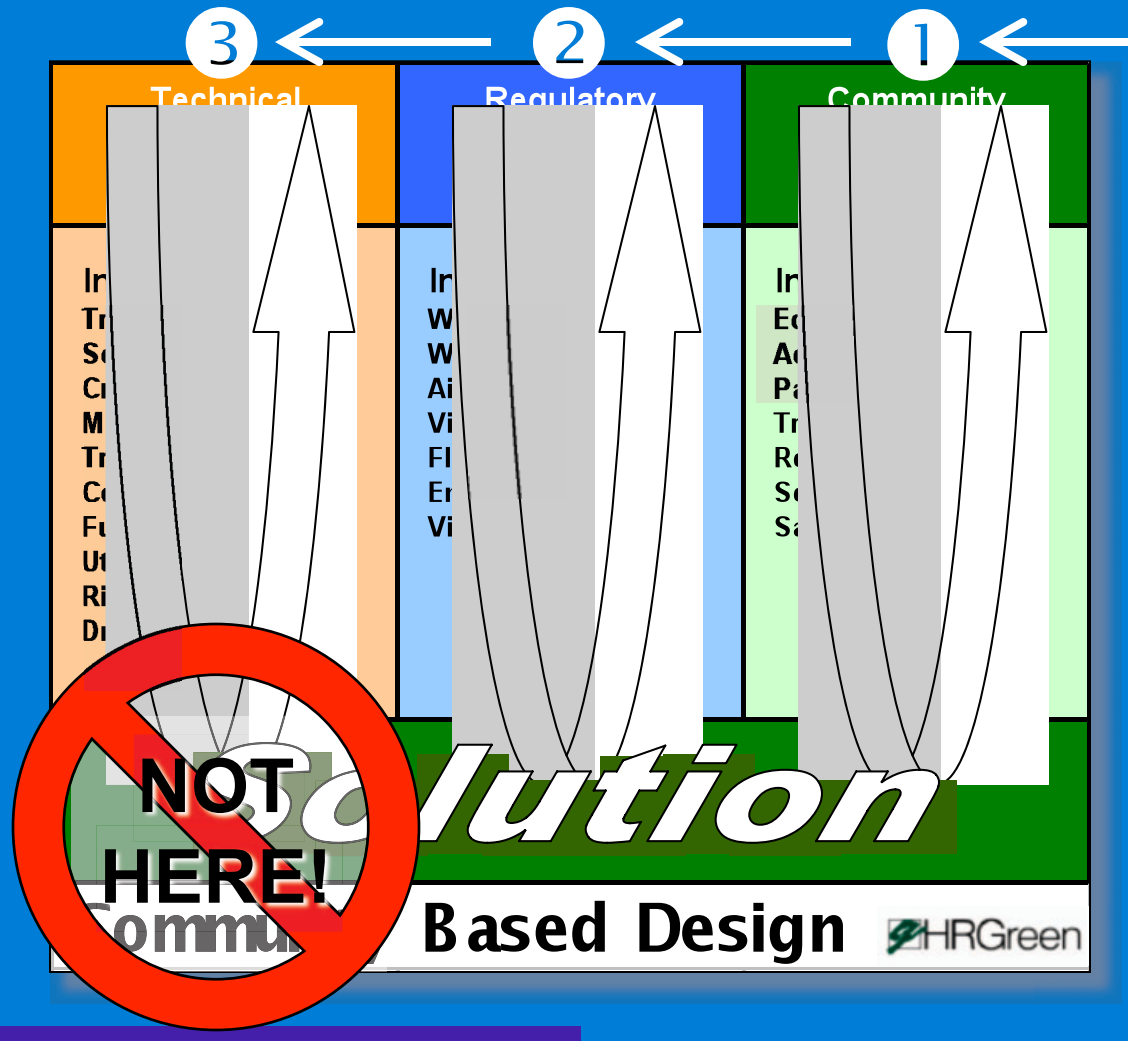
Frustrated Public

Can form groups such as:

Citizens Requesting Action on Pinebrook Trail- Organizational Network

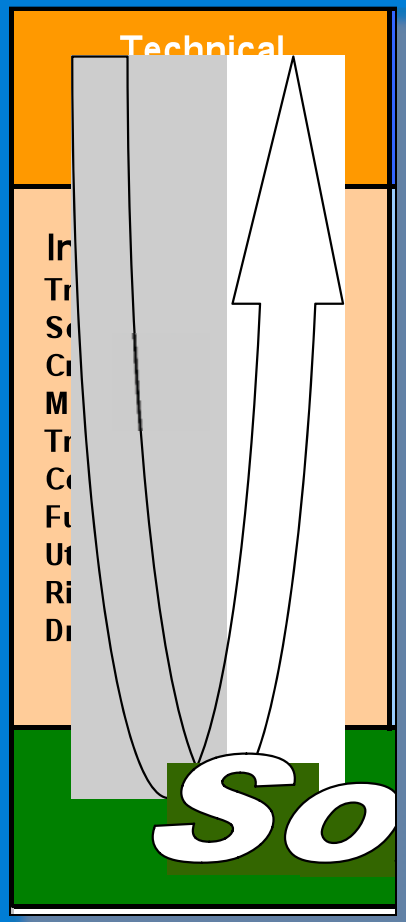
(CRAPT-ON)

Community Based Design

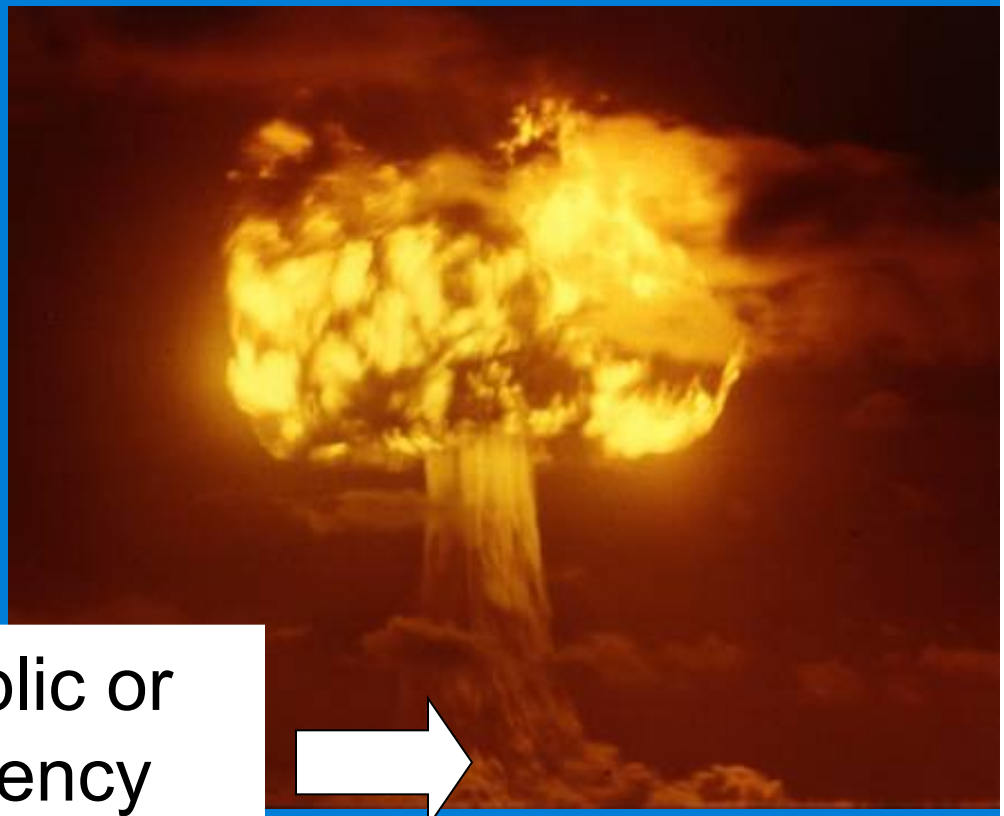


Traditional Design Approach

(Or… Design and Defend…)



Public or Agency Coordination



Return on Investment

- Missouri: We were building “spots of perfection” and fatalities were increasing.

- Kentucky: “Practical Solutions” are intended to deliver the highest rate of return for the investment.

Return on Investment: MoDOT

The Dangers of Rigid Standards

the way things were

Return On Investment: Kentucky

Road Improvement Example

Available budget $500 m to improve 2 lane roads

Cross Section	Crashes per Year	Cost (millions)	Speed (mph)	Miles	Total Reductions	
					Crashes	Travel
2 Lane, 10 ft/2 ft	5.4	--	41.4	--	--	--
2 Lane, 12 ft/8 ft	2.9	$7.2	46.7	69.4	173.5	367.8
4 Lane, 12 ft/8 ft	2.4	$21.5	55.9	23.3	69.9	337.9

More miles, fewer crashes and fewer delays for same budget!

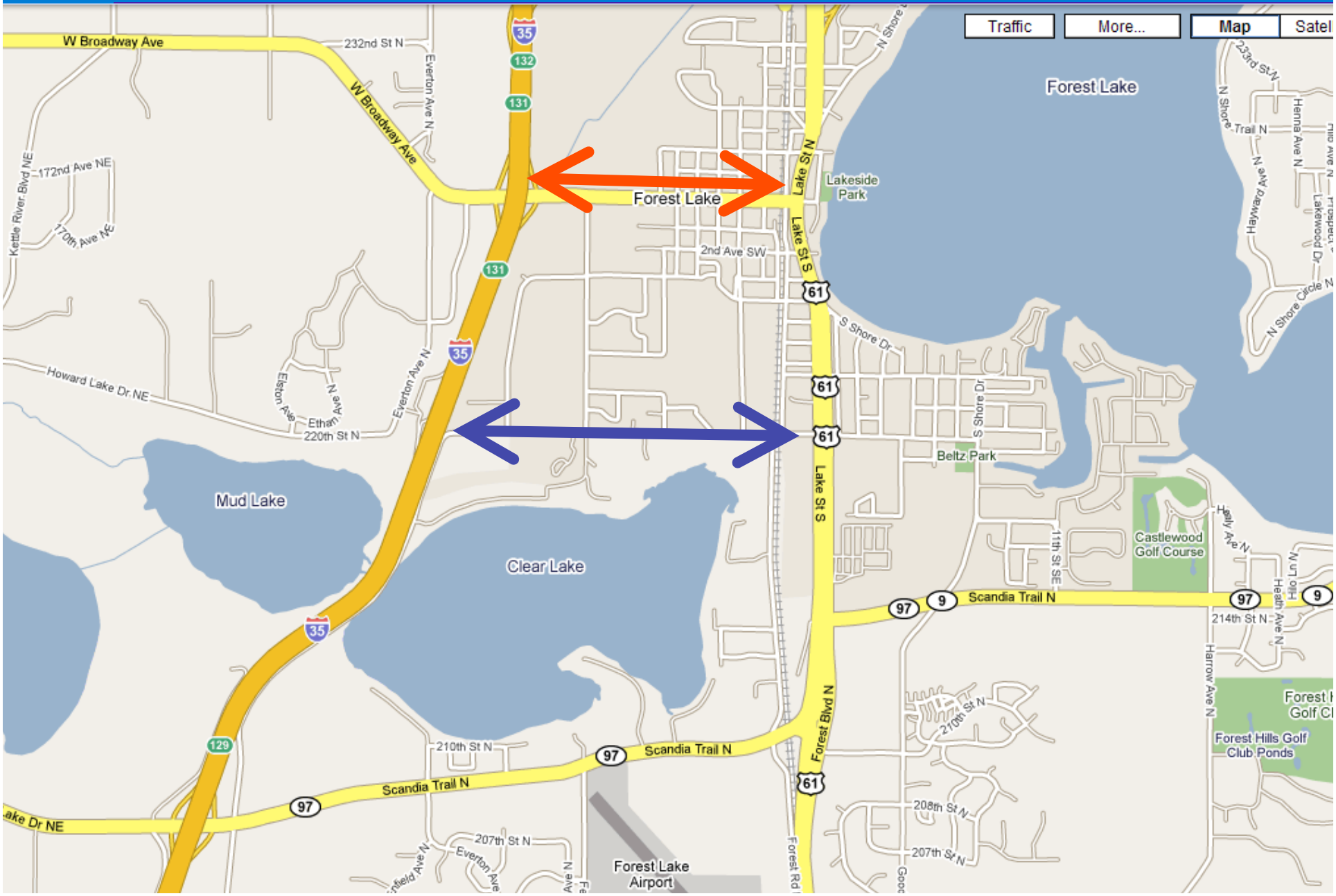
Summary

- More projects with same funds
  - Decreased traffic delays
  - Improved safety
- Potential for setting system-wide approach and priorities
- Appropriate and contextual design

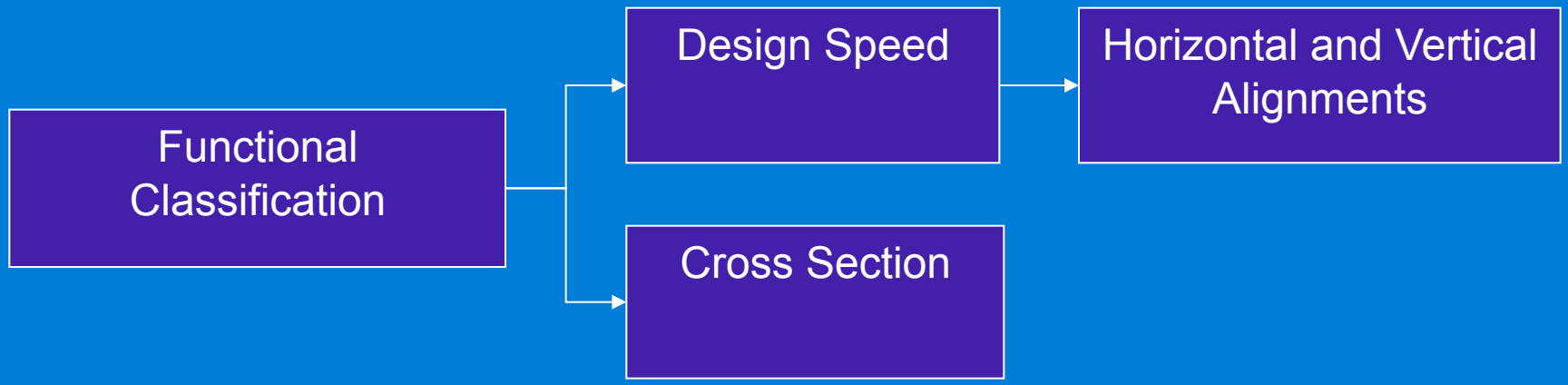
Network Solutions

- Gaps/connection
- Capacity of network/ spot improvements
- Intersections: signal network/ interconnection
- Inter-jurisdictional

Network Solutions



Functional Classification vs. Context



Functional Classification does not change when context changes.

Result: Identical design criteria applied to different contexts

PENNDOT: Smart Transportation

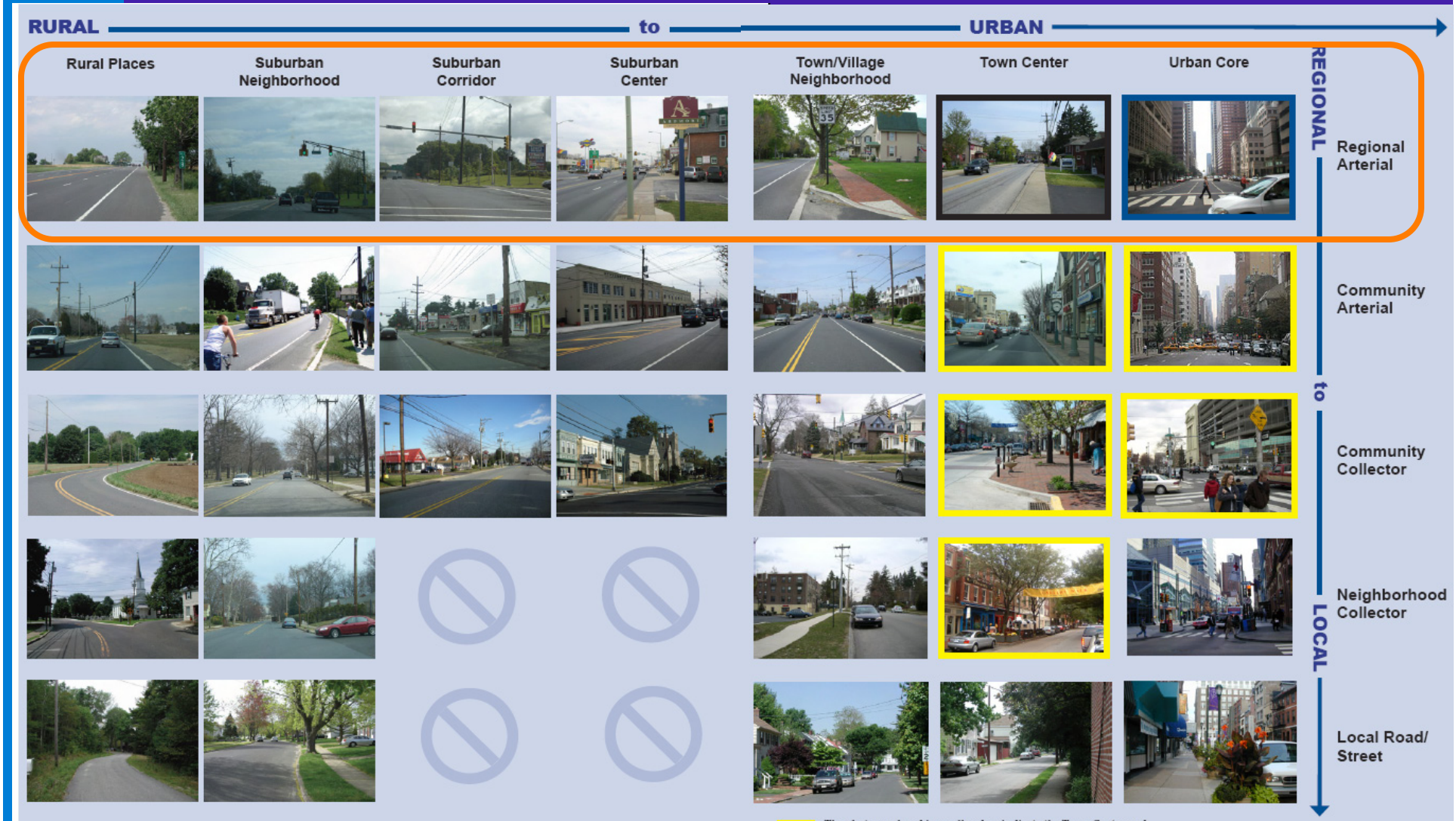


Figure 5.1 Roads in Context

The photos enclosed in a yellow box indicate the Town Center and Core City streets that also operate as a local or regional Main Street.

PENNDOT: Smart Transportation

Table 6.2 Matrix of Design Values

	Regional Arterial	Rural	Suburban Neighborhood	Suburban Corridor	Suburban C	Town/Village	Town/Village Center	Urban Core
Roadway	Lane Width[1]	11' to 12'	11' to 12' (14' to 15' outside lane if no shoulder or bike lane)	11' to 12' (14' to 15' outside lane if no shoulder or bike lane)	11 (14' ou if n		10' to 12' outside lane shoulder or ike lane)	10' to 12' (14' outside lane if no shoulder or bike lane)
Roadway	Paved Shoulder Width[2]	8' to 10'	8' to 10'	8' to 12'	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)
Roadway	Parking Lane[3]	NA	NA	NA	8' parallel	8' parallel; see 7.2 for angled	8' parallel; see 7.2 for angled	8' parallel
Roadway	Bike Lane	NA	(if no		5' to 6'	5' to 6'	5' to 6'	5' to 6'
Roadway	Median	4' to 6'	16' to 6' to 8' for pedestrians only	6' to 8' for pedestrians only	o 18' for LT; 6' to 8' for pedestrians only	16' to 18' for LT; 6' to 8' for pedestrians only	16' to 18' for LT; 6' to 8' for pedestrians only	16' to 18' for LT; 6' to 8' for pedestrians only
Roadway	Curb Return	30' to 50'	25' to 35'	30' to 50'	25' to 50'	15' to 40'	15' to 40'	15' to 40'
Roadway	Travel Lanes	2 to 6	2 to 6	4 to 6	4 to 6	2 to 4	2 to 4	2 to 6
Roadside	Clear Sidewalk Width	NA	5'	5' to 6'	5' to 6'	6' to 8'	6' to 10'	6' to 12'
Roadside	Buffer[4]	NA	6'+	6' to 10'	4' to 6'	4' to 6'	4' to 6'	4' to 6'
Roadside	Shy Distance	NA	NA	NA	0' to 2'	0' to 2'	2'	2'
Roadside	Total Sidewalk Width	NA	5'	5' to 6'	9' to 14'	10' to 16'	12' to 18'	12' to 20'
Speed	Desired Operating Speed	45-55	35-40	35-55	30-35	30-35	30-35	30-35

Range of Values

All modes

1 12' preferred for regular transit routes, and heavy truck volumes > 5%, particularly for speeds of 35 mph or greater.
2 Shoulders should only be installed in urban contexts as a retrofit of wide travel lanes to accommodate bicyclists.
3 Buffer is assumed to be planted area (grass, shrubs and/or trees) for suburban neighborhood and corridor contexts; street furniture/car door zone for other land use contexts. Min. of 6' for transit zones.
4 Curb return radius should be as small as possible. Number of lanes, on street parking, bike lanes, and shoulders should be utilized to determine effective radius.

Speed, Mobility and Access

- Design Speed Decision profound impact on all design decisions
- Mobility is more important than speed
- Effective Access is critical to local concerns/ values
- Roadway design needs to balance context's demands

Target Operating Speed

Design Speed
Posted Speed
Operating Speed

} Target Speed

Target Speed is the speed at which vehicles *should operate* on a thoroughfare in a specific context, consistent with the *level of multimodal activity* generated by *adjacent land uses* to provide for the mobility for motor vehicles and *safe* environment for pedestrians and bicyclists.

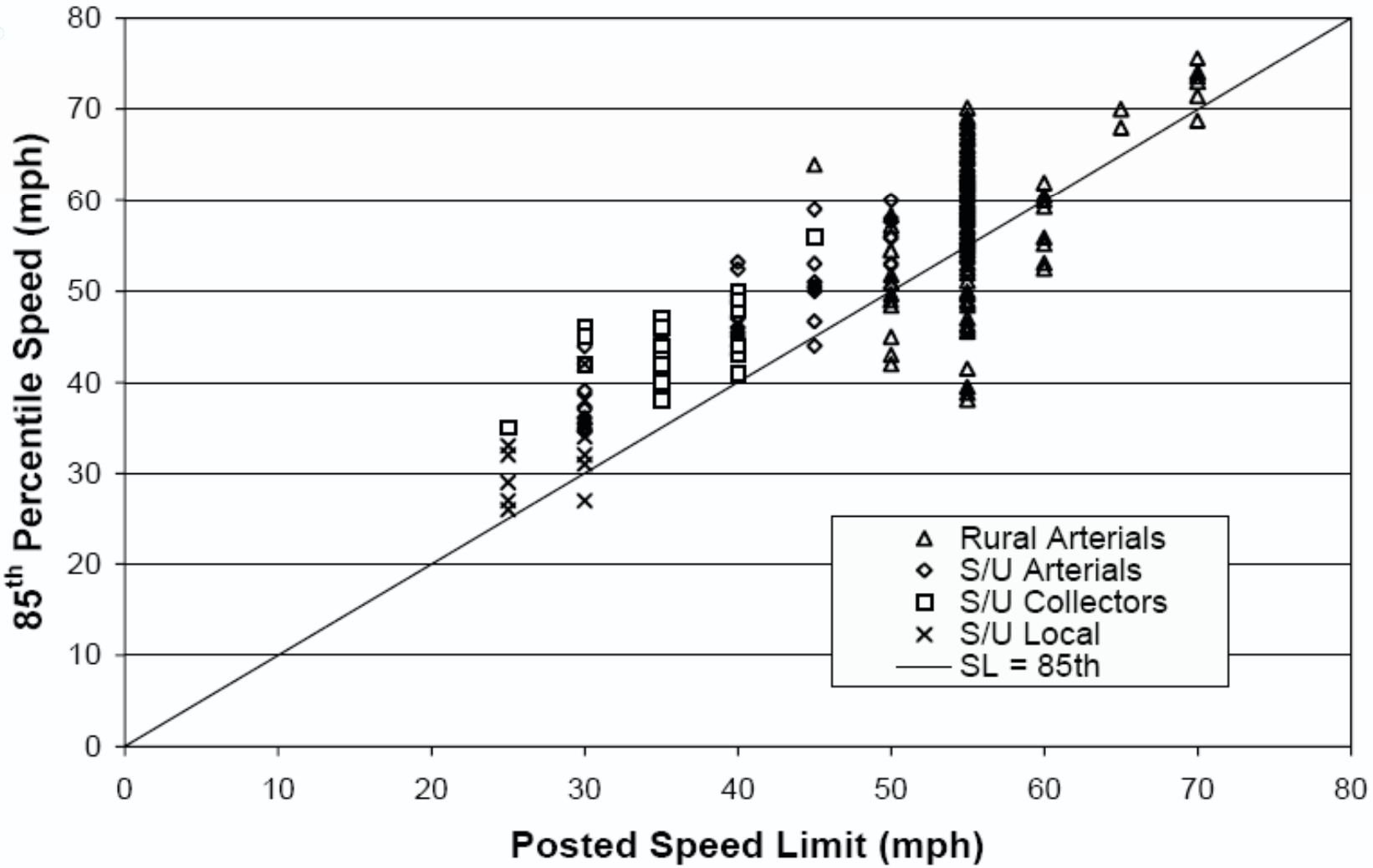


Figure 6. 85th percentile speed versus posted speed for NCHRP, Texas, and FHWA data.

Source: NCHRP Report 504

Suburban/ Urban Speeds

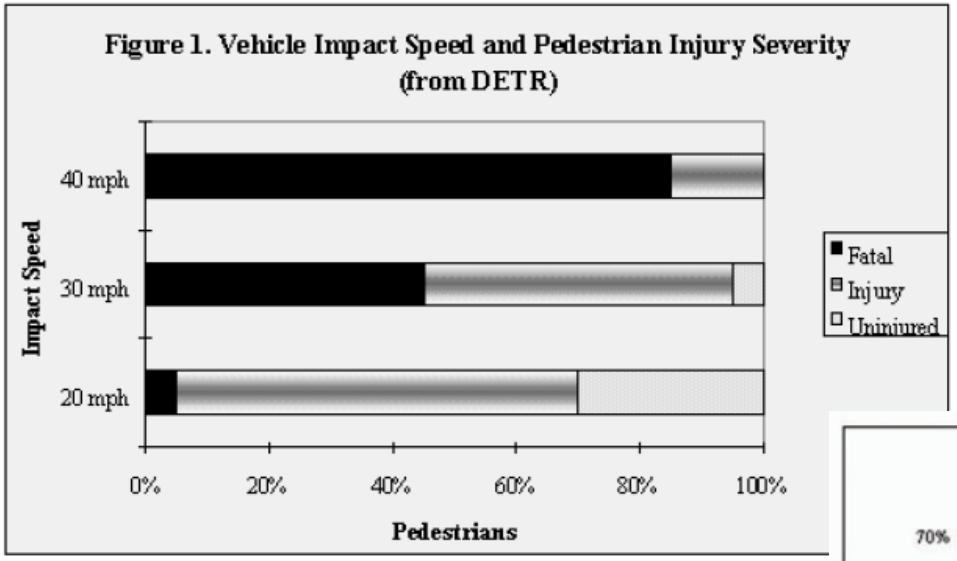
Table 24 Percentile speed that equals posted speed by area type and posted speed

How do you select Design Speed?

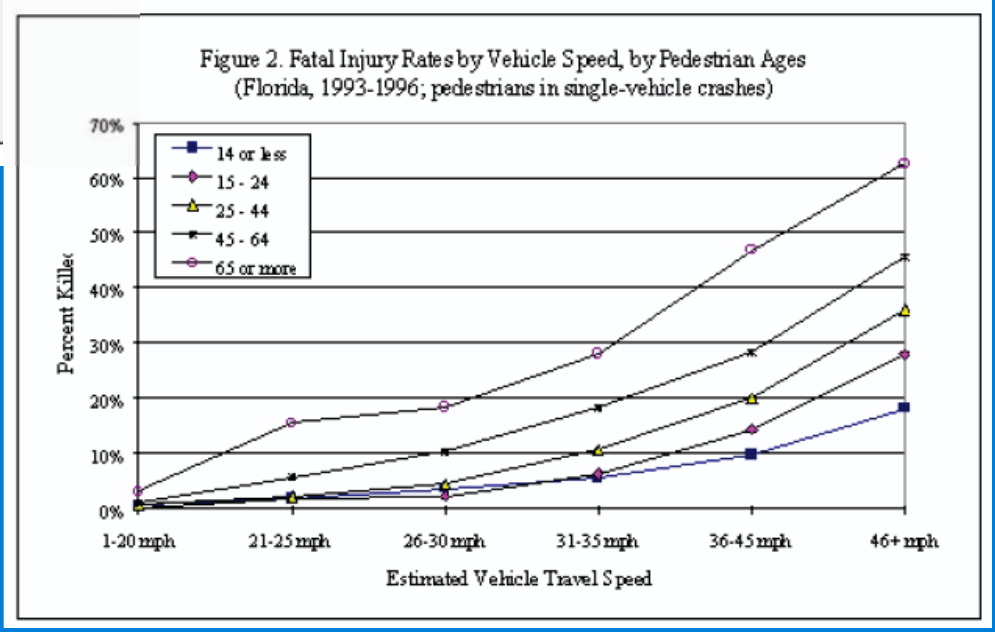
Area Type	Speed Limit (mph)	Percentile at or below Given Speed:			Number of Sites
		Speed Limit	Speed Limit Plus 5 mph	Speed Limit Plus 10 mph	
Suburban/ Urban	25	42	77	94	7
	30	28	64	86	19
	35	22	62	90	23
	40	32	68	92	25
	45	37	70	90	15
	50	43	76	95	9
	55	48	80	95	6

Source: NCHRP Report 504

Vehicle Speeds and Pedestrians

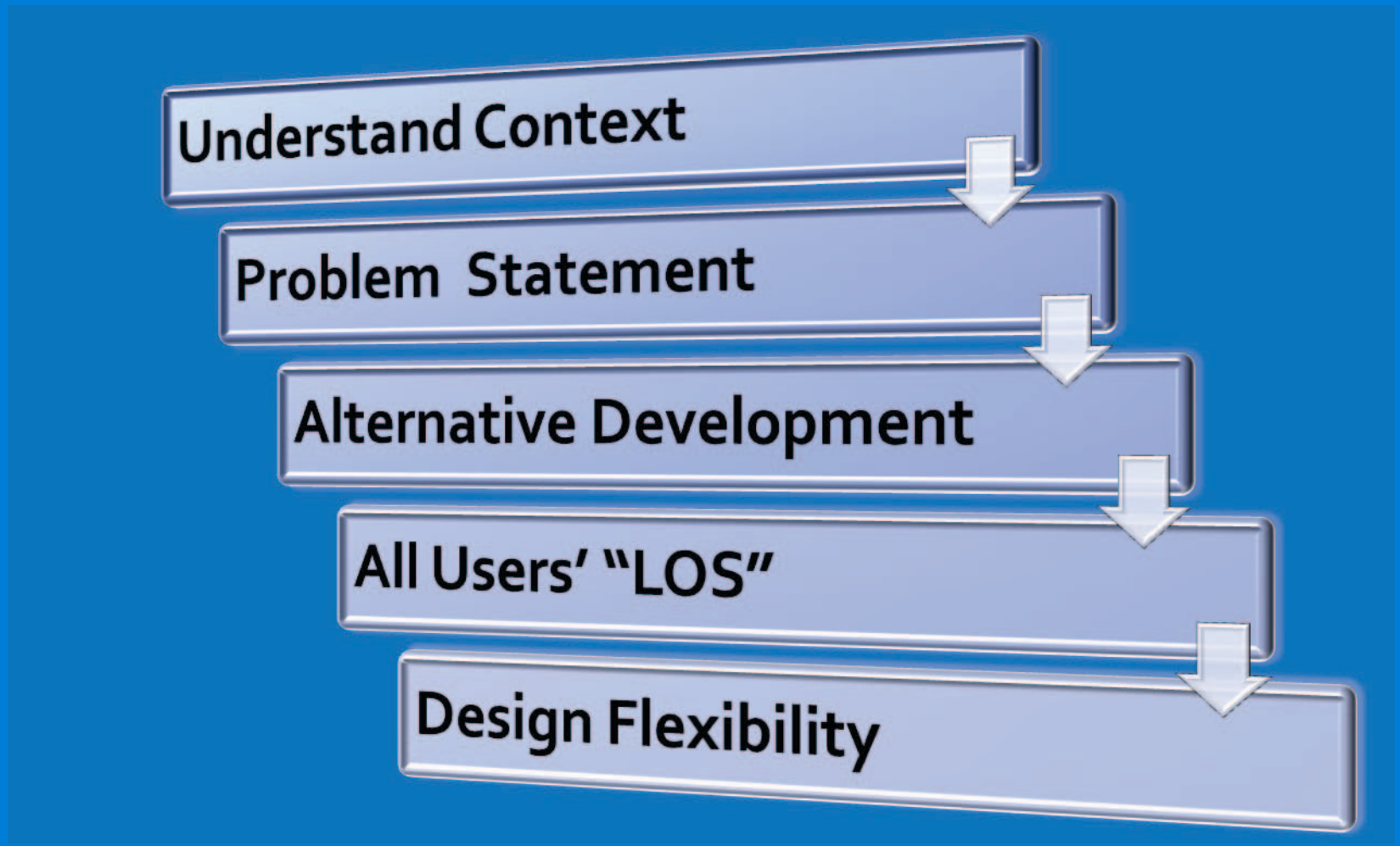


UK: Department of Environment, Transport, and the Regions, (DETR)



Florida, 1993-1996; pedestrians in single-vehicle crashes

Community Based Design Process



How do I document?

- Mn/DOT's Roundabout Documentation has good examples
  - Formalized Design Report- documenting design decisions
  - Knowledge Transfer from Mn/DOT Roundabouts

Session 4 Objectives

- Safety
  - Perform a Substantive Safety analysis
  - Consider all modes
  - Assess and manage project risks

Session 4 Objectives

Values change as the context changes

- Technical
- Regulatory
- Community

Session 4 Objectives

- Community Based Design Approach
  - Consider a "Community First' approach to building a problem statement
  - Get input and feedback from the stakeholders on regulatory and community issues
  - Don't "fall in love" with your design