Context Sensitive Solutions for Transportation Projects

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Outline
- Framework and Principles
- Public Involvement
- Structured Decision Making
- Design Flexibility
- Safety
Framework & Principles

Context Sensitive Approach

- Asks about the purpose and need of a transportation project, and then addresses:
  - Safety
  - Mobility
  - Preservation
    - Aesthetic characteristics
    - Historic and cultural resources
    - Environmental and other community values
- Context Sensitive Solutions involves a collaborative, interdisciplinary approach in which citizens and agencies are part of the design team.
Where did CSD/CSS come from?

- Emerging interest in cultural and other resources, and concern over intrusions on the landscape
- Our customers have expressed widespread dissatisfaction with highway projects
  - Perceived need challenged
  - Physical impacts of improvements unacceptable
  - Concerns about safety and effects of high speed roads

Legislative Background on CSD/CSS

- NEPA Act of 1969
- ISTEA of 1991 (Section 1016a addressed preservation of historic and scenic resources)
- NHS Designation Act of 1995
  - Provided flexibility in funding
  - Stressed importance of preserving historic and scenic resources
  - Provided for transportation enhancement projects
  - Allowed for the development of flexible design criteria for Federal-aid projects not on the NHS
Every project has a context --

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
Collaborative Stakeholder and Public Involvement

Context-Sensitive Solutions Revolve Around People

- Context-Sensitive Solutions involves a collaborative, interdisciplinary approach in which citizens and agencies are part of the planning and design team.
Who are stakeholders?

- People who could potentially be affected by the project
  - Positive impact as well as negative
  - Direct impact as well as indirect

- People who have a “stake” in the success or failure of the project
  - Individuals
  - Public groups
  - Private groups
  - Elected officials
  - Non-governmental organizations
  - Government agencies
  - Owning agency

Stakeholders Often Have Competing Objectives

- Business access vs. traffic safety
- Auto-oriented vs. pedestrian-friendly design
- Revitalization/improved image vs. status quo
- Economic development vs. smart growth
- Farmland development vs. farmland preservation
- Increased traffic capacity vs. minimized neighborhood impacts
- Sidewalks vs. loss of parking
“Competing” Objectives May Provide Opportunities

- Highlights different interpretations of community vision
- Improves in-depth discussion of trade-offs
- Enables stakeholders to learn from – and empathize with – other points of view
- Allows planners/designers to understand the “context” for decision-making
- Encourages planners/designers to develop comprehensive solutions that find common ground and balance needs

Some Common Areas for Stakeholder Input

- Definition of the problem
- Preferred methods of communication
- Development of evaluation criteria (their issues become basis for ranking alternatives)
- Ideas for preliminary solutions
- Recommendations for most viable solutions
- Aesthetics and access
Stakeholder Challenges

- Potential stakeholders are often hard to identify and engage
  - Freight interests, commuters, low income populations
  - Only a small percentage of stakeholders attend meetings
- Opposition must be included
  - May be more difficult and time-consuming to gain buy-in but the rewards are great
  - Speak to opponents and key stakeholders before the media does

Structured Decision Making
Historical Perspective and Context

- 1960s - Decide, Announce, Defend
- 1970s - Review and Comment
- 1980s - Collaboration, Advisory Committees, Public Involvement
- 1990s - Decision Science

A Structured Decision Process:

- Specifies technical milestones and related opportunities for public involvement
- Ensures dialogue with stakeholders affects decisions
- Integrates public involvement with overall project management
A structured approach can more than double the odds of success

Success

- Structured decision approach
- Traditional (advocacy) approach

Managing the Structured Decision Process:

- Decision points in the process
- Who will make each decision
- Who will make recommendations for each decision
- Who will be consulted on each decision
- How will recommendations and comments be transmitted to decision makers
Design Flexibility

Overview of Highway Design Process

- Design Controls
- Design Philosophy
- Design Criteria and “Standards”

Designers and stakeholders are faced with conditions and controls over which they have no control; but also, designers have choices.
Guidelines for Design Levels of Service (per AASHTO)

- Design Level of Service is a choice that involves trade-offs
- Higher LOS means
  - Larger “footprint” (greater adverse impacts and costs)
  - Improved safety (sometimes)
- Lower LOS
  - Lesser R/W and other physical impacts
  - More operation under congestion
  - Less reliability

<table>
<thead>
<tr>
<th>Highway Type</th>
<th>Type of Area and Appropriate Level of Service</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Rural Level</td>
</tr>
<tr>
<td>Freeway</td>
<td>B</td>
</tr>
<tr>
<td>Arterial</td>
<td>B</td>
</tr>
<tr>
<td>Collector</td>
<td>C</td>
</tr>
<tr>
<td>Local</td>
<td>D</td>
</tr>
</tbody>
</table>

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.

Considerations in selecting an appropriate design level of service

Existing 4-lane crossing (twin two-lane suspension bridges that must be replaced)

- New 8-lane bridge (LOS C) => $400 million*
- New 6-lane bridge (LOS D) => $350 million*

*includes approaches and adjacent interchanges

Illustration -- I-74 Mississippi River Bridge Replacement -- Quad Cities (IL and IA)
Design vehicle is a choice that has operational, safety and design implications
- “Larger vehicle” emphasizes operations at the expense of surrounding land, and potentially pedestrians
- assumed operations may vary based on context

Design Speed
- Controls the design of most geometric elements
  - Operational and safety implications
  - Cost, right-of-way implications
- Should be established for long segments of a route
- Represents a choice by the designer
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 (2001)

See pages 66 through 72 of 2001 AASHTO Policy on Geometric Design of Highways and Streets for discussion of design speed

How many different ways can we assemble this typical section within the AASHTO Policy design values?

- Lanes (10 to 12 ft; special transit lanes)
- Border area (provision for pedestrians, plantings)
- Median (2 to 30 ft; raised versus flush)
- Median plantings (yes/no, types)
- Other features (lighting, appurtenances)
Example ‘Whole corridor’ solution--‘Road Diets’

- Conversion of 4-lane undivided street
- Flush median left turn lane for safety and accessibility
- Bike lanes
- Sidewalks
- Utility poles and trees offset from traveled way

Photo courtesy of Michigan Department of Transportation

Safety
Our “customers” -- the traveling public, highly value safety.

“Participants from focus groups agreed that safety is the most important transportation concern.”

How do our customers define safety?

- Based on personal driving experiences
- Comfort or discomfort (with traffic, conditions, a site, etc.)
- Lower speeds are safe; faster speeds are dangerous
A Highway Engineer’s View of Safety

- Wide lanes, full paved shoulders, tangent, level alignment, unlimited sight distance, roadsides free of obstructions
- Low traffic volume

Have you ever heard this before?

“I don’t agree with the philosophy of CSS -- safety always comes first in everything we do. In any event, if we ever compromised safety on a project we’d get sued!”
Putting ‘Safety’ in Its Proper Perspective

We routinely “trade off” safety in many decisions we make; in this context…

*CSS is nothing new or different*

Where does funding for roadways go?

- Pavement and bridge replacement
- Economic initiatives
- Capacity enhancement
- Emergencies
- Legislated projects or programs
- Hazard elimination
The ‘myth’ of highway safety as our primary decision tool

Trade-offs We Routinely Make

- Capacity versus safety
  - Permitted versus protected signal phasing
  - Right turn on Red
- Economics versus safety
  - 2-lane versus 4-lane rural highways
  - 4-lane undivided versus divided highways
  - Access control (driveway permits)
- Stakeholder preferences
  - Rumble strips versus shoulder use by bicyclists

“From a planning perspective, we can’t afford to build the perfect road.”
Mark Wandro, Director, Iowa DOT

Des Moines Register, December 29, 2003

Two Ways to Look at Safety as Highway Engineers, Planners and Stakeholders*

- **Nominal Safety** is examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures
- **Substantive Safety** is the expected or actual crash frequency and severity for a highway or roadway

*Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999
Nominal Safety

There are three aspects of nominal safety:
- Roadway design must enable road users to behave legally
- Roadway design should enable the vast majority of users to operate without difficulties
- Owning agency requires protection against claims of moral, professional, and legal liability

AASHTO Policies and design manuals currently serve as surrogates for “safe” design practice in the minds of many.

When roadway design professionals talk about “safety,” more often than not they are talking about adherence to standards, which is nominal safety.
Substantive Safety*

The performance of the road -- actual or expected -- as measured or quantified in terms of accidents (number, type, severity, etc.)

- A function of what resources are available (roadway design and construction, maintenance, enforcement, emergency medical services)
- A function of the "context" of the location

*Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999

The technology of substantive safety is emerging; it will be increasingly important to stay current

NCHRP Report 374
Effect of Highway Standards on Safety

NCHRP Report 500

NCHRP Report 362
Roadway Widths for Low Traffic Volumes

IHSDM:
Interactive Highway Safety Design Model

Safety
There are now models and tools for estimating substantive safety

- New models for predicting the safety effects of design decisions on horizontal and vertical alignment; cross section, and intersection design features
- Design consistency (speed profiles) model

New tools for addressing substantive safety

Go to http://safety.transportation.org/
FHWA’s Interactive Highway Safety Design Model focuses on performance

IHSDM Crash Prediction Module enables evaluation of expected safety performance of design alternatives

IHSDM Design Consistency Module enables evaluation of expected speed profile of design alternatives

Why is it important to quantify substantive safety?

- Design Criteria (nominal safety)
- Traffic Noise
  - Model 1.0
  - CAL3QHC
  - Mobile 5a
  - 3-D Visualization
  - CITYGREEN
- HCM
- CORSIM
- PASSER
- TRANSYT7F
- VISSIM
- GEOPAK Plans
- Cost Models
- Real estate appraisals
- DOT databases

More Quantitative

Greater Weight

Safety Impacts
Environmental Impacts
Traffic Operations
Right-of-Way
Costs

Context Sensitive Solutions
Why is it important to quantify substantive safety?

If the design of each alternative meets criteria, do we then consider them comparable in terms of safety when evaluating which alternative to select?

When design criteria can not be met, is it always true that substantive safety is “compromised”?

\[ \text{Safe Design Practices} \]

In other words, does nominal safety \( = \) substantive safety ?
Many “nominally safe” locations experience accident problems

Full Cloverleaf Interchanges:
- Loops create weaving (crossroad, mainline)
- Severe speed changes are required for exiting and entering traffic
- Research indicates poor safety history for moderate to high volumes of traffic
- Cloverleafs are included in the AASHTO design policy

Some “nominally unsafe” locations experience no crashes
Why nominal safety is not the same as substantive safety

Functional Basis of AASHTO Design Criteria

<table>
<thead>
<tr>
<th></th>
<th>Safety Research</th>
<th>Traffic Operations</th>
<th>Sensitive to Traffic Volume?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross Section</td>
<td>Yes (Rural only)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Roadside Design</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Stopping Sight Distance</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

A simple model for a meaningful discussion of safety on any project

Nominal Safety

- Meets
- Does Not Meet

Substantive Safety

- Meets
- Does Not Meet

Any project or problem can be categorized in one of these four quadrants.
Where should we be concerned? Where are adverse design impacts worth bearing?

Nominal Safety
- Meets
- Does Not Meet

Substantive Safety
- Meets
- Does Not Meet

Substantive and nominal safety drive decisions and project approaches

Nominal Safety Criteria
- Meets
  - Infrastructure improvements only (no need or justification for geometric revisions)
- Does Not Meet
  - Consider 3R criteria
  - Incorporate only low cost safety enhancements
  - "Upgrade" to full standards may not be cost-effective (consider design exceptions to avoid costs and impacts)

Substantive Safety Criteria
- Meets
  - Targeted safety improvements (low or high cost depending on extent of problem)
  - Focus on proven, cost-effective solutions
- Does Not Meet
  - Complete reconstruction to current criteria probably warranted (no or very minimal design exceptions)
  - Consider special targeted safety enhancements
Making good choices means understanding the **substantive performance** of urban streets

- Spacing, control, and capacity of intersections is more important to mobility than typical section
- Traffic signals may increase crash frequency (but lower crash severity)
- Lower speeds are safer (produce lower severity)
- 12-foot lanes are NOT substantively safer than 11-ft lanes; and 10-ft lanes may be almost as good as 11-ft lanes in some contexts
- Any median is better than none; raised medians are substantively safer
- Access management has a substantial safety benefit (as well as operational benefits)

Making good choices means understanding the **substantive performance** of rural highways

- Quality of the roadside (clear zone, frequency, proximity and type of objects) is the most important factor
- Quality of alignment (horizontal curvature) influences crashes
- Intersections (presence, channelization and relationship to alignment) are critical
- Total cross section (lane and shoulder width) influences crash frequency, but only up to a point (about 30 feet)
- Consistency in speed between sections enhances safety (alignment affects speed behavior)
Summary of Safety and CSD/CSS

- The alternatives development process involves a series of choices (not mandates)
- Design criteria (AASHTO) form the basis of highway design alternatives
  - AASHTO criteria are based on many factors, only one of which is safety
  - The AASHTO Policy is flexible
- There can be a significant difference in the substantive safety of two alternatives, each of which may be nominally safe

Summary of Safety and CSD/CSS

- Meaningful involvement of safety in the CSD/CSS environment requires understanding of
  - Nominal safety
  - Substantive safety
- Use quantitative methods and tools for estimating safety effects to aid design decisions
- Consider both substantive and nominal safety in design decision-making
  - Apply the simple safety framework
CSS demands that we truly function as professionals -- which is nothing new!

“The design professional applies the design criteria or standards, chooses minimum, above-minimum or desirable values, and develops the composition of the facility in three dimensions. Thus the attitude and capability of the designer can play a significant role in determining operational efficiency and safety.”

*Philosophical Considerations in Highway Design* -- Jack E. Leisch

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**NCHRP Report 480 Documents ‘Best Practices’ for CSD/CSS**

- Review of Literature
- Phone and personal interviews
- Visits to Pilot States
- Synthesis of documents and studies
- Collection of Case Studies
- Development of ‘Best Practices’ Guide and CD
Questions and Discussion

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