A Context Sensitive Solutions (CSS) Webinar
MnDOT’s Move to Greater Flexibility in Design

Tuesday, December 11, 2012 – 9:30 am to 11:30 am – U of MN CECC

MN Trunk Highway 1 Southeast of Ely

MN CSAH 3 – Excelsior Blvd in St. Louis Park

Your Destination...Our Priority
Webinar Presenters / Panelists

• **Scott Bradley** – FASLA, Director of CSS, MnDOT
• **Jim Rosenow** – P.E., Design Flexibility Engineer, MnDOT
• **Mike Elle** – P.E., Design Standards Engineer, MnDOT
• **Julie Skallman** – P.E., State Aid Division Director, MnDOT
• **Amr Jabr** – P.E., Asst. Engineering Services Division Director, MnDOT

Thanks to the University of Minnesota Center for Transportation Studies and their Continuing Education Conference Center for supporting this MnDOT Webinar
Growing out of ISTEA 1991 and NHSDA 1995, this 1997 FHWA Guide explored and illustrated flexibilities and opportunities that already exist to balance community, environmental, safety, and mobility objectives in our transportation projects.

*Sufficient flexibility permitted to encourage independent designs tailored to particular situations* (Consistent with AASHTO Green Book)

Provoked Birth of CSS
Birth of Context Sensitive Design & Solutions

Since a 1998 Thinking Beyond The Pavement Workshop, FHWA and AASHTO have promoted Context Sensitive Design ... now Context Sensitive Solutions ... as a desired national transportation approach (Designation of 5 Pilot States to Advance the Effort ... MN, KY, UT, MD, CT)

1998 National Workshop

Articulated 15 CSD / CSS Principles

Online Resource Center

www.contextsensitivesolutions.org
MnDOT Was Positioned for Leadership in CSS

Initial MnDOT “Pilot State” Effort (1999 & 2000)

As a “pilot state”, MnDOT partnered with FHWA’s MN Division & U of MN Center for Transportation Studies in advancing our CSD / CSS approach.

Assembled steering team & advisory group that guided a Principle-Based Approach, Training Development and Deployment, Development of Policy (Tech Memo) and Marketing with an emphasis on (6) Core Principles that were deemed critically important … many deemed Flexibility in Design as the most important principle.

www.dot.state.mn.us (Search A to Z for Context Sensitive Solutions)
Supporting the MnDOT Strategic Vision & Plan

**Strategic Vision:**
Global leader in transportation committed to upholding public needs & collaboration with internal & external partners to create a safe, efficient & sustainable transportation system for the future.

**Strategic Directions:**
- Safety
- Mobility
- Innovation
- Leadership
- Transparency
CSS & MnDOT’s Strategic Vision & Plan
CSS Designated as a Flagship Initiative in December 2009

- To integrate CSS as a business model
- To build customer relationships & trust
- To improve processes & decision-making
- To balance competing objectives
- To seek collaborative & right-sized solutions
- To improve return on investments
- To achieve 20+ CSS-correlated benefits
Applying CSS Principles As The Foundation

Create a lasting value for the community

Use agency resources effectively

Maintain environmental harmony

Address community and social issues

Address aesthetic treatments

Utilize a range of design choices & flexibility

Document project decisions

Track and meet all commitments

Use full range of communication strategies

Achieve consensus on purpose and need

Address alternatives and all modes

Achieve a safe facility for users and community

Use interdisciplinary teams

Involve stakeholders and the public

Seek to fully understand the context

(Graphic from NCHRP Report 642)
MnDOT’s Flexibility in Design Forum
Learning From Ourselves and Others  February, 2009
(Maryland, Massachusetts, Pennsylvania, Kentucky, Missouri, Washington, FHWA)

www.dot.state.mn.us (Search A to Z for Context Sensitive Solutions)
The Forum brought together leaders in the application of flexibility in design to share knowledge and experiences in helping to inform MnDOT’s next steps and action planning in tailoring development and implementation of a strategic and performance based Flexibility in Design Initiative.
Why Flexibility in Design is Important

Born Out of Necessity:

- Revenue Limitations
- Increasing Needs
- Increasing Costs
- Deteriorating Infrastructure
- Diminishing Resources
- Complete Streets
- Socio-Economic Concerns
- Environmental Concerns
- Quality of Life Concerns
A Couple of Thoughts to Take Away Today

Even if you’re on the right track, you’ll get run over if you sit there.

(Will Rogers)

A lesson is truly learned if we modify our actions to reflect what we now know.

(Vernon LaPlante)
Some Themes – Balancing Competing Objectives

Community / Regulatory / Transportation Issues & Objectives Across Multiple Modes

It’s Difficult To Balance Competing Objectives Within Overly Conservative Design Approaches & Standards
Some Themes - Reallocating Cross-Section Space

How Much Space Do You Really Need and For What?
Some Themes - Substantive vs. Nominal Safety

Nominal Guidelines & Design Standards are often seen and used as general Absolutes without adequately evaluating applicability to unique attributes.

Actual Needs and Substantive Safety and Performance fall on a continuum based upon unique roadway, setting, and user attributes.
Right-Sizing design elements to the point of diminishing returns for Higher Benefit to Cost Ratios and the capability to achieve greater public benefits without greater cost.
Learning From Others - KY Practical Solutions

Options for improving mobility and safety on their existing system of two-lane highways

<table>
<thead>
<tr>
<th>Cross Section</th>
<th>Crashes per Year</th>
<th>Cost/Mile (millions)</th>
<th>Travel Speed (mph)</th>
<th>Miles improved w/$500 000</th>
<th>Miles</th>
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<tbody>
<tr>
<td>2 Lane 12 ft L 8 ft S</td>
<td>2.9</td>
<td>$7.7</td>
<td>46.7</td>
<td>4/2/2008</td>
<td>69.4</td>
</tr>
</tbody>
</table>

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<td>4 Lane 12 ft L 8 ft S</td>
<td>2.4</td>
<td>$21.5</td>
<td>55.9</td>
<td></td>
<td>23.3</td>
</tr>
</tbody>
</table>
The Improved 2 Lane Cross Section has Higher Return on Investment as compared to the 4 Lane Cross Section

At a System Level you get a 200% increase in miles you improve, a 150% increase in total crash reductions and a 9% increase in total travel time reductions ... therefore, a more Practical Solution with a $500 million budget

### Road Improvement Example

<table>
<thead>
<tr>
<th>Cross Section</th>
<th>Crashes per Year</th>
<th>Cost (millions)</th>
<th>Speed (mph)</th>
<th>Total Reductions</th>
<th>Miles</th>
<th>Crashes</th>
<th>Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lane, 10 ft/2 ft</td>
<td>5.4</td>
<td>--</td>
<td>41.4</td>
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</tr>
<tr>
<td>2 Lane, 12 ft/8 ft</td>
<td>2.9</td>
<td>$7.2</td>
<td>46.7</td>
<td>69.4</td>
<td>173.5</td>
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<td>367.8</td>
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More miles, fewer crashes and fewer delays for same budget!
Learning From Others - MODOT

Ensuring Projects as Good Solutions for the Context ... “Right Sizing”

- Improvements considered based on their contribution to the system instead of their individual perfection

- Each District was challenged to cut the budget of their STIP by 10% while still delivering the Program

- Engineers were told to put their design manuals on the shelf and follow 3 rules:
  1) Every project must get safer
  2) Collaboration is needed in every solution
  3) Practical solutions must function properly without leaving maintenance challenges
Learning From Others - MODOT

- The challenge resulted in savings of $400 Million across a 5-year STIP
- Missouri demonstrated the largest drop in traffic fatalities in 2006 and the downward trend continued
- 5-year STIP delivered under budget
- Pavement condition went from 3rd worst to 9th best
- 83% of MODOT’s major roads were elevated to good condition (up 47%)
- Customer satisfaction with MODOT rose to 78% in 2008 and 90% of the newspaper editorials were positive
- 95% of customers believed MODOT projects were the right solutions
MN TH 100 Retrofit - St. Louis Park Case Study
Narrowed Lanes & Shoulders to Add 3rd Lane Each Direction

Reduced Congestion & Crashes (13:1 Benefit To Cost Ratio)
MN TH 61 North Shore Hwy Reconstruction Case Studies

Flexibility in Design Along Good Harbor Bay

- Explored Higher Design Speed Alignments
- Limited Use Safety Rest Area
- Shoreline & Creek Erosion
- State Park Land
- Historic Overlook & Vistas
- Cliff & Falling Rock Area
- Commercial Development
- Residential Development

Selected Lower Design Speed (55mph)

Reduced Design Speed Maximized Geometric Flexibility to Balance Competing Objectives and Reduced Costs & Annual Crashes (56%)
MN TH 61 North Shore Hwy Reconstruction Case Studies

Influencing Driver Behavior Through Schroeder, MN

Vehicle Simulator Evaluation of Potential Traffic Calming Options

Contrasting Pavement Colors had the Most Pronounced Influence

More than a 70% Decrease in the Annual Average of Post-Reconstruction Crashes
 MN TH 38 Reconstruction Case Study

2005 AASHTO Best CSS Project Award - National Best Practices in CSS Competition

Flexibility in Design:

• Reduced design speed (50 mph) provided greater geometric flexibility to address constraints and balance the competing objectives

• Upgraded to 10-ton road but maintaining much of the existing horizontal & vertical alignments ... balanced with strategic spot and intersection improvements where accident frequency was documented

• 12' lanes, 4' paved shoulders with 2’ of added reinforced soft shoulder, rumble stripes, steeper back slopes and variable ditch cross-sections to minimize adverse environmental impacts and costs
MN TH 38 Reconstruction Case Study

Some Lessons Learned:

• Reconstruction was advanced 10 years ahead of schedule

• Reduced adverse impacts dramatically and costs by more than 40%

• Non-conformance with nominal standards and geometric design guidelines, does not mean a highway will be “substantively” unsafe ... it all depends on the unique combinations of circumstances / attributes

• Total accidents were reduced 55% + in the 5-year analysis after completion of the first reconstruction segment ... even more so in the second reconstruction segment
MN CSAH 3 Excelsior Blvd Case Study
Flexibility in Design - St. Louis Park, MN

Case Study in ITE’s 2006 Proposed Recommended Practice Publication
MN CSAH 3 Excelsior Blvd Case Study

- Reduced design speed and flexibility in design (narrowed lanes, shortened turn lanes, etc.) reallocated space to balance stakeholder needs and objectives while also calming traffic and improving safety for all modes and users.

- Other improvements include on street and off street parking in shared mid-block structures, pedestrian safety and comfort amenities, off route bicycle accommodation, near and far side transit stops, public seating and green spaces to create integrated & mutually supportive transportation and land use.

- Crashes were reduced over 60% in the first segment of reconstruction.
MnDOT Advanced Flexibility in Design Workshops
Piloted in 2009 and Typically Offered Twice a Year

2.5 Day “Roll Up Your Sleeves” Workshop Focus Includes:
• Rationale for Using Design Flexibility
• Introduction to a Performance Based Approach & Tools
• Using Traffic Data
• Serving All Modes / Users of Transportation
• Risk Management & Safety
• Selecting Design Speed
• Allocating Space in Confined Cross-Sections & Intersections
• Designing Horizontal & Vertical Alignments
• Designing Freeway Interchanges
• Minimizing Construction Impacts
• Classroom Exercises & ADA Field Walk

www.dot.state.mn.us (Search A to Z for Context Sensitive Solutions)
New Tools for Performance Based Flexibility in Design

New AASHTO Highway Safety Manual “Predictive Modeling” Tools

Existing Option 1

20,000 ADT

26.3 crashes/mile

17.2 crashes/mile

Option 2

8.6 crashes/mile

4.2 crashes/mile

Option 3
For Questions and More Info:
Scott Bradley – Mn/DOT Director of CSS
scott.bradley@state.mn.us

CSS – The Road Best Traveled

Your Destination...Our Priority
2009 Flexible Design Forum

Breakout Sessions:

1) Institutional challenges
2) Performance objectives
3) Design flexibility

2009 Flexible Design Forum

Breakout Sessions – highest-voted institutional challenges:

1. Culture, silos, authority and discretion
2. Project versus system perspective
3. Overly conservative and rigid standards
4. Perception that flexibility defeats safety
5. Competing performance measures
2009 Flexible Design Forum

Breakout Sessions – highest-voted institutional challenges:

6. Lack of technical knowledge, data and understanding
7. Multimodal priorities and perspectives
8. Purpose and need issues / lack of clarity
9. Design speed, speed management
10. Liability and design exception concerns
2009 Flexible Design Forum

Breakout Sessions – other noteworthy concerns:

- Inconsistent application – district to district, project to project, person to person
- No common philosophy on design exceptions
- FHWA rigid and inconsistent
- Perfect being the enemy of good
- Lack of agreement on what’s good enough
2009 Flexible Design Forum

Highest Voted Next Steps:

1. Emphasize purpose & need and scoping process
2. Expand training and resources
3. Review and update trunk highway design standards
   - Flexibility
   - Alignment with AASHTO criteria
4. Develop and define the vision
2009 Flexible Design Forum

Highest Voted Next Steps:

5. Involve the right people and perspectives
6. Develop policy and guidelines
7. Research, document and disseminate case studies
8. State Aid rules and standards should also be addressed
Advanced Flexibility in Design Curriculum

• Piloted four months after the Flexible Design Forum (June 2009)
• Latest offering was last month
• Seeks to give design practitioners the expertise they need to apply flexibility
  – ...or at least orient them to the flexible design mindset and teach them how to learn more
Advanced Flexibility in Design Curriculum

Correlates to Next Steps:

1. Emphasize purpose & need and scoping process
2. Expand training and resources
7. Research, document and disseminate case studies
Re-think of Trunk Highway Road Design Policies

Correlates to Next Steps:

3. Review and update trunk highway design standards
   – Flexibility
   – Alignment with AASHTO criteria

5. Involve the right people and perspectives

6. Develop policy and guidelines
Re-think of Trunk Highway Road Design Policies

Root problem: AASHTO
Re-think of Trunk Highway Road Design Policies

Root problem: Minnesota
Re-think of Trunk Highway Road Design Policies

Additional/related institutional issues:
- Culture has the same inertia as written word
- ‘Bigger is better’ mentality
- Association of spending with benefit
- Oversimplification – i.e. one size fits all
- ‘Perfect project’ mentality
- Confusion with need, problem and scope
Design Standards,
Changes to the 13 Controlling Criteria

A Move Towards Greater Design Flexibility

Mike Elle
December, 2012
“Standard” Does Not Mean “Best”

“Unfortunate that the word "standards" should have been chosen. Strictly interpreted, the meaning would indicate that the standard design was the best design.

Standards are merely recommended designs which are to be adhered to unless conditions indicate that a variation in the design would meet them better.

To neglect the detailed study of local conditions often results not only in an unwarranted increase in cost, but may result in a type of construction which fits poorly the location where used”.

AASHTO

A Policy on Geometric Design of Highways and Streets.

“GREEN BOOK” 2011
“GREEN BOOK”

Single Print ($200)

Web Single user ($164)

Web 5-user ($720)

Web 10-user ($1,280)
Roadway Design Standards, Guides, and References.
The *Green Book* covers a wide range of geometric elements and design dimensions.

- Thirteen criteria, commonly referred to as the: **13 controlling criteria.**
- Identified by FHWA as having substantial importance to the operational and safety performance of any highway. Such that special attention should be paid to them in design decisions.
Standards / Policy

Federal Highway Administration

Adopts AASHTO for the NHS

Green Book

Interstate Design Standards

State Standards Must Meet Green Book Values as a Minimum
• 13 Controlling Criteria

1. Design speed
2. Lane width
3. Shoulder width
4. Bridge width
5. Horizontal alignment
6. Super-elevation
7. Vertical alignment
8. Grade
9. Stopping sight distance
10. Cross slope
11. Vertical clearance
12. Lateral offset to obstruction
13. Structural capacity
13 Controlling Criteria

1. Design speed (TM)
2. Lane width (TM)
3. Shoulder width (TM)
4. Bridge width (TM)
5. Horizontal alignment (TM)
6. Super-elevation (TM)
7. Vertical alignment (RDM)
8. Grade (TM)
9. Stopping sight distance (RDM)
10. Cross slope (TM)
11. Vertical clearance (TM)
12. Lateral offset to obstruction (RDM)
13. Structural capacity (ongoing)
Design Standards (Before)

MnDOT Standard

Any design element below the red line required a design exception.

FHWA Minimum Criteria when setting State Standards

AASHTO Standard Range

Your Destination... Our Priority
Design Standards (After)

Range of available standards are now available.

MnDOT Standard Range

Very project & corridor specific.

Documentation !!

AASHTO Standard Range

Your Destination...Our Priority
13 Controlling Criteria

1. Design speed (TM)
2. Lane width (TM)
3. Shoulder width (TM)
4. Bridge width (TM)
5. Horizontal alignment (TM)
6. Super-elevation (TM)
7. Vertical alignment (RDM)
8. Grade (TM)
9. Stopping sight distance (RDM)
10. Cross slope (TM)
11. Vertical clearance (TM)
12. Lateral offset to obstruction (RDM)
13. Structural capacity (ongoing)
### Technical Memorandums

MnDOT's active technical memorandums (TM) and historical TMs dating to 1990 are available here.

#### Search by TMM / Subject

<table>
<thead>
<tr>
<th>Tech Memo</th>
<th>Subject</th>
<th>Status</th>
<th>Issue Date</th>
<th>Expire Date</th>
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<tr>
<td>09-12-MAT-03</td>
<td>Pavement Selection Process</td>
<td>Active</td>
<td>10/14/2009</td>
<td>9/26/2011</td>
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<td>09-03-ENV-01</td>
<td>Uniform Seed Mixtures</td>
<td>Active</td>
<td>5/29/2009</td>
<td>1/01/2014</td>
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<td>09-13-TS-05</td>
<td>Pedestrian (Curb) Ramp Guidelines</td>
<td>Active</td>
<td>12/10/2008</td>
<td>12/10/2013</td>
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<tr>
<td>09-13-ENV-01</td>
<td>Noise Exemption</td>
<td>Active</td>
<td>12/05/2009</td>
<td>12/05/2013</td>
</tr>
</tbody>
</table>
2. Lane Width

Tech Memo 12-07-TS-02
Traveled Lane Width Standards for State Highways

- Final selection of the traveled lane width should be thoroughly documented
- Two tables; one for Rural and the other for Urban/Suburban
- Both based on Functional Classification and design speeds, Rural adds ADT.
- Values follow Green Book, and range from 9’ – 12’
3. **Shoulder Width**

Tech Memo 12-12-TS-06

Shoulder Width Standards for State Highways

- Final selection of the shoulder width should be thoroughly documented
- Three tables; one for Collectors, Arterials, and Interstates/Freeways
- Based on Rural and Urban/Suburban, ADT, # of Lanes and configuration, Left and Right, usable and paved
- Numerous qualifying notes and design guidance
10. Cross Slope

Tech Memo 10-05-TS-02
Traveled Way Pavement Cross-Slopes

• Final selection of the cross-slope should be thoroughly documented.
• One Table; Pavement Cross Slope on Tangent Sections.
• Based on Functional Classification, Rural and Urban
• Numerous qualifying notes
10. Vertical Clearance

Tech Memo 11-16-B-07
Vertical Clearance Requirements for New Construction

- Final selection of the vertical clearance should be thoroughly documented.
- One Table; Vertical Clearance for Underpasses.
- Based on structure type, new bridges, and new pavement under existing bridges.
- Numerous qualifying notes and design guidance.
- Super Load OSOW corridor guidance included.
Contact:  Mike Elle  
Office of Project Management and Technical Support  
Michael.elle@state.mn.us  
(651) 366–4622
So, where do we go from here?

Vision

Policy

Projects

Education & Outreach
Education and Outreach

- Continued offerings and continuous improvement of advanced flexibility class
- Development of more courses?
- Rollout of 13 Controlling Criteria changes
Education and Outreach

• **13cc rollout**
  - In-person sessions at design offices
  - Ongoing customer support

• **Additional informal sessions & seminars**
Education and Outreach

• Goals:
  – Broad statewide expertise
  – Everyone on board and rowing in the same direction
  – Continuous and ongoing communication
  – Feedback loop into policy refinements
Policy

(Specifically, road design policy and criteria)

• Incorporation of 13cc revisions
  – Each on their own time frame
• ‘Flexible-ization’ and selective relaxation of the general design elements
Policy

MnDOT Design Policies:
- Right-sizing and alignment with AASHTO
- Exploration of flexibility
- Innovative methods and approaches
  - Integration with the HSM
  - Other performance-based strategies
Policy

The National Scene:

• Green Book visioning
  – HSM integration
  – Distinguishing between new construction and reconstruction

• Pushing for more practical and sustainable ways of doing things
Projects

- Early and continuous involvement
- New methods, tools, procedures for right-sizing designs?
Flexibility in Design Webinar

December 11, 2012

Julie Skallman

MnDOT State Aid
Complete Streets External Advisory Group

- Meeting since July, 2010
- Advise us on implementation on trunk highways
- Suggested more progress could be made with flexibility on local roads
- Caused us to move more quickly
State Aid Rules

- Required by statute
- Force and effect of law
- Variances are allowed by statute
- Apply only to CSAH and MSAS systems
- 30,000 CSAH – 3500 MSAS miles
Local Roads

- Agency determines their own standards
- 16,000 miles of city streets
- 15,000 miles of county roads
- 60,000 miles of township roads
State Aid Standards

- Adopted November 2012
- Allow on-road bike lanes
- Reduced width standards
http://www.dot.state.mn.us/stateaid/BikePathRules/On-Road-BikePath.pdf
State Aid for Local Transportation

MnDOT's State Aid for Local Transportation (SALT) Division works closely with local levels of government to ensure the state maintains a safe, effective and coordinated highway network.

In addition to funding support, staff from SALT provides technical assistance in highway and bridge design, construction and maintenance, authorizes grants for bridge construction, coordinates local federally funded projects and provides overall management of the state aid system.
### 8820.9941 Minimum Design Standards: On-Road Bicycle Facility for Urban; New or Reconstruction Projects

<table>
<thead>
<tr>
<th>Functional Classification and Projected Traffic Volume</th>
<th>Design Speed</th>
<th>Lane Width (a)</th>
<th>Curb Reaction Distance (d)</th>
<th>Parking Lane Width (f)</th>
<th>Bikeway Design Roadways with Two Travel Lanes Urban Curb and Gutter</th>
<th>Bikeway Design Roadways with Four or More Travel Lanes Urban Curb and Gutter</th>
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<tbody>
<tr>
<td>Collectors or Locals with ADT &lt; 2,000</td>
<td>25-30</td>
<td>10-12 (e)</td>
<td>2</td>
<td>7-10</td>
<td>&lt;500 SL</td>
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<tr>
<td></td>
<td>35-40</td>
<td>11-12</td>
<td>2</td>
<td>8-10</td>
<td>&lt;500 SL 500-2,000 WOL 4-16 or BL5-6</td>
<td>BL5-6</td>
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<tr>
<td></td>
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<td>11-12</td>
<td>4(b)</td>
<td>10</td>
<td>BL6orPS 8orSUP</td>
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Next Steps

- Monitor use of the revised standards in designs
- Identify any additional modifications needed
Discussion / Questions