

# AASHTOWare Bridge Design & Rating Update

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Chair, AASHTOWare Bridge Task Force

Presented to the

RADBUG

Albany, New York

August 4, 2015

# Agenda

- Bridge Rating and Design Update
- Task Force Members

# AASHTOWare Bridge Rating Design Update

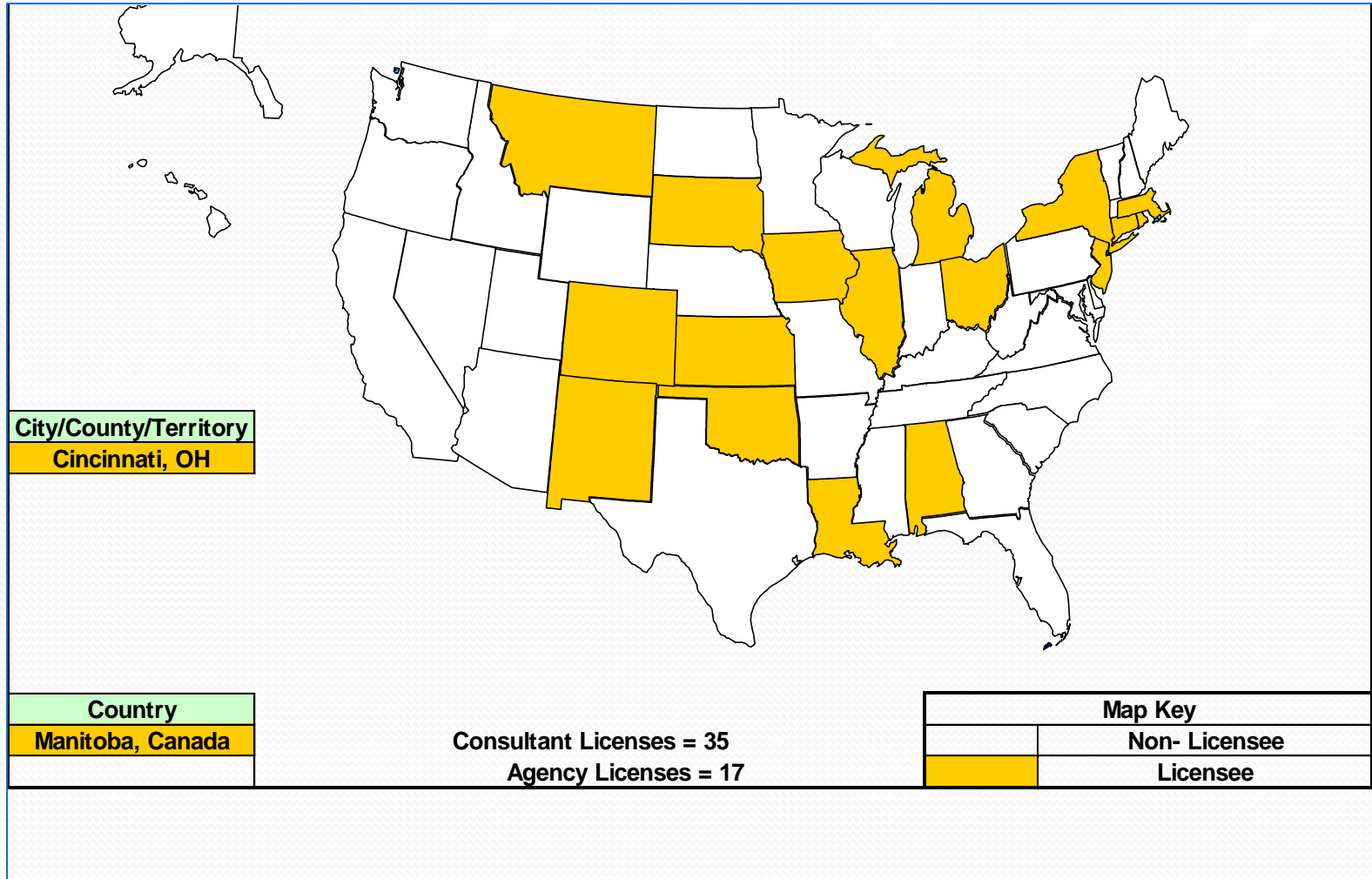


AASHTO Bridge Design Rating  
Website <http://aashto.mbakercorp.com>



# AASHTOWare Bridge Design

## Current Participation



# Comprehensive Bridge Software

AASHTOWare Bridge Design and Rating

***“A Software Success Story”***

*A 16 year history of the development progression  
from common to complex bridge analysis  
for more than 40 agencies and 600 consultants!*

# Steel Girder Superstructures

- Rolled shapes
- Welded plate girders
- Built-up I-shapes





# P/S Concrete Superstructures

## Precast shapes

- I beams
- Boxes
- Multi-stem Tee
- U beams





# Reinforced Concrete Superstructures

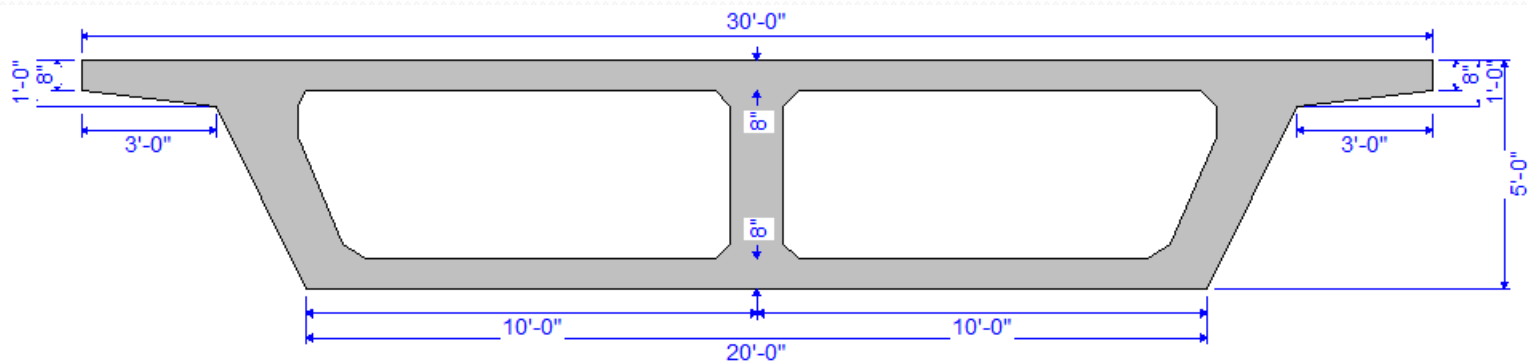
- Tee beams
- Slabs
- I beams



# Multi-cell boxes

Reinforced Concrete

Post-tension Concrete



# Trusses

- Deck
- Through
- Combination
- Counters





# Floor Systems

- Girder-Floorbeam-Stringer
- Girder-Floorbeam
- Truss-Floorbeam-Stringer
- Truss-Floorbeam
- Floorbeam-Stringer



# Floor Systems

- Floor trusses



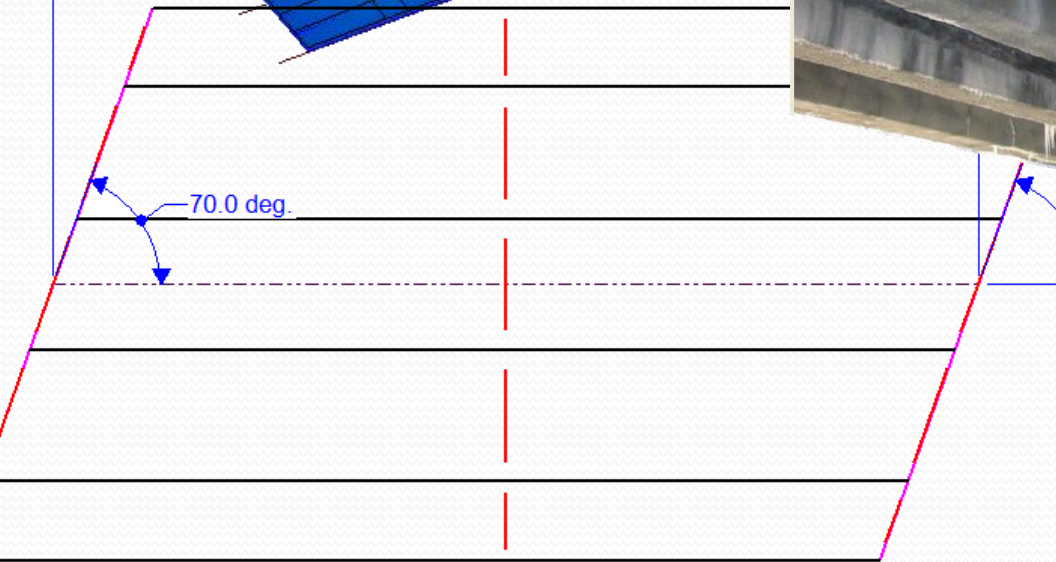
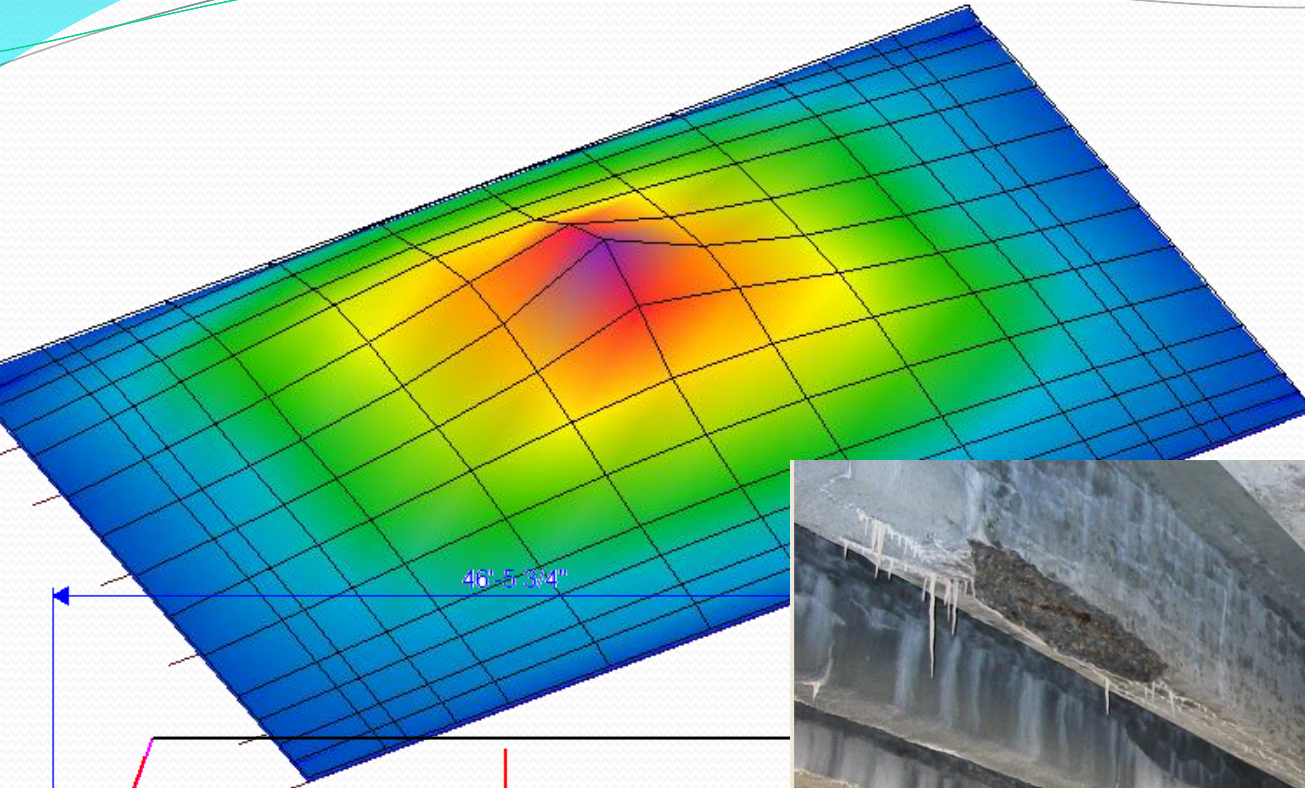


# R/C Box Culverts

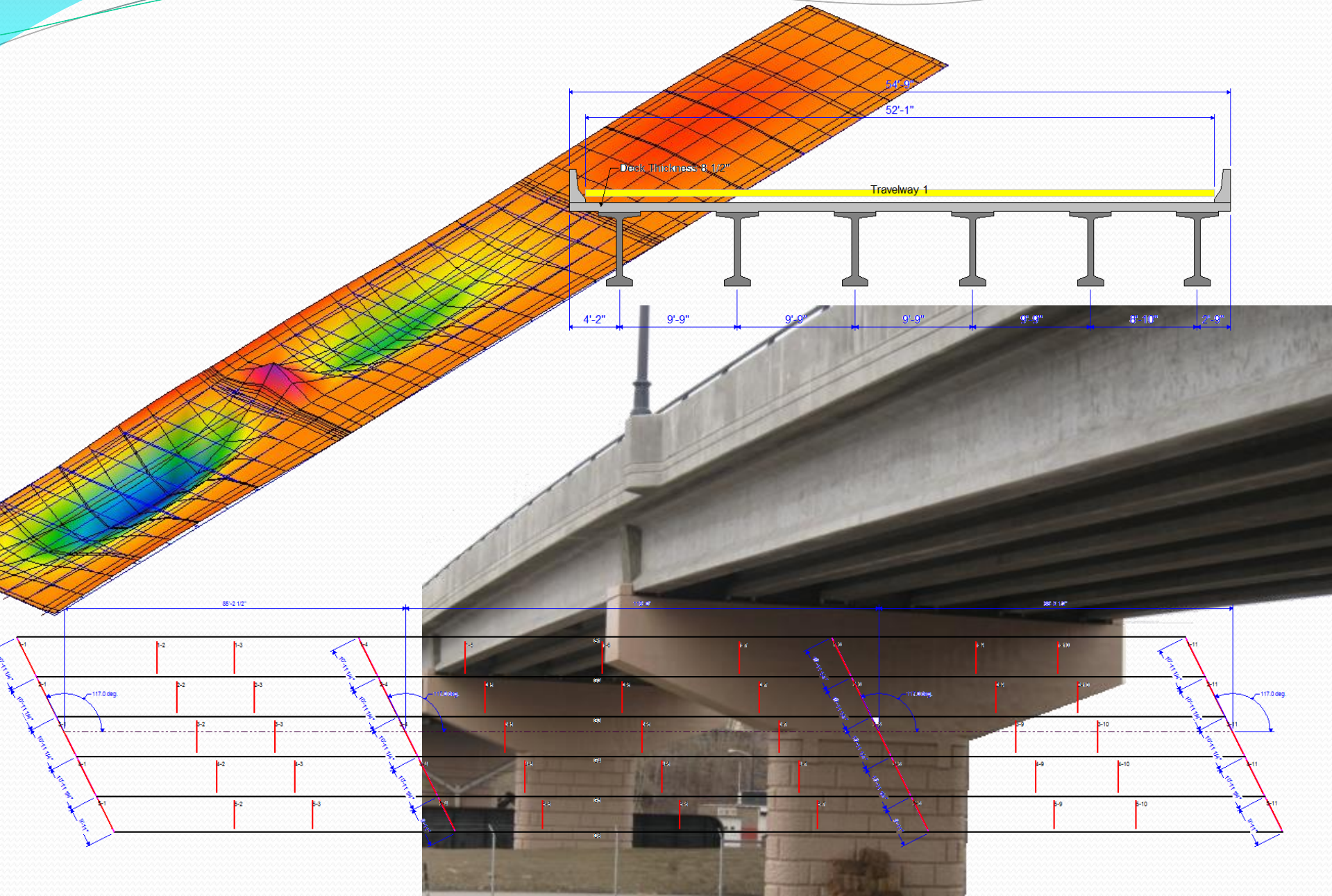




# 3D Analysis – R/C Multi-girder



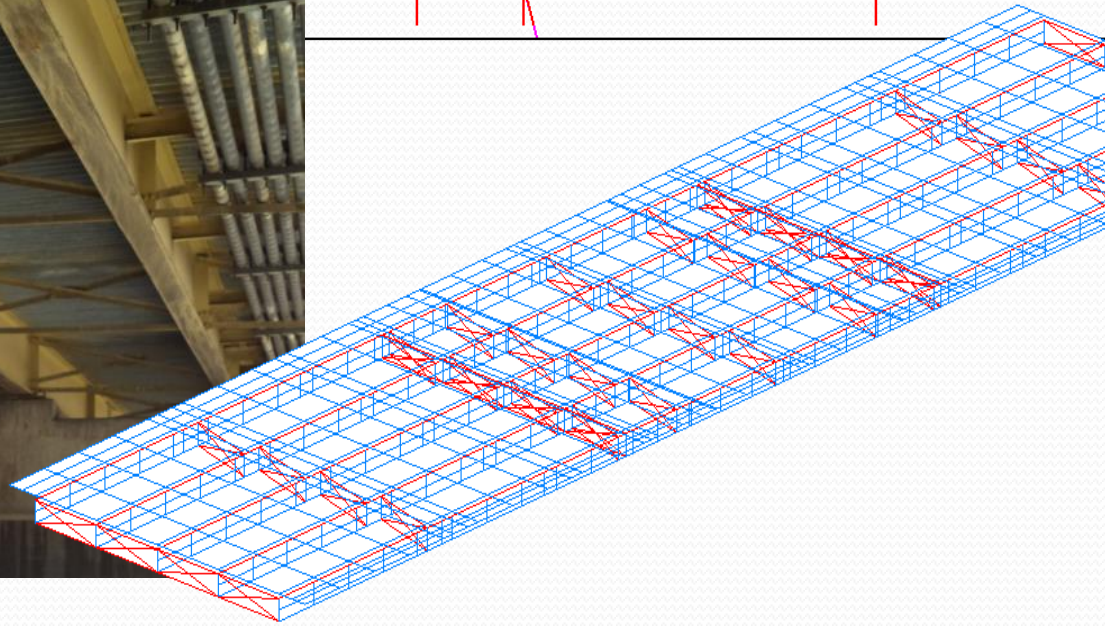
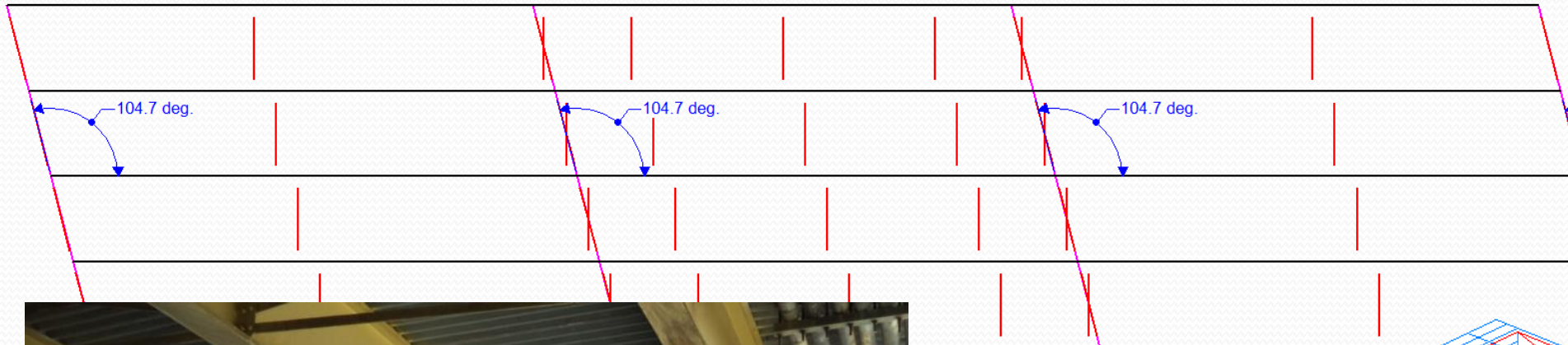
# 3D Analysis – P/S Multi-girder



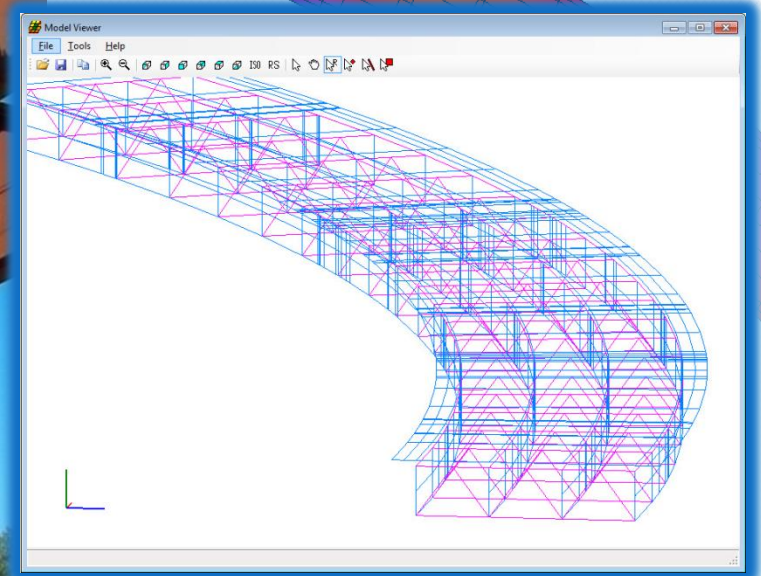
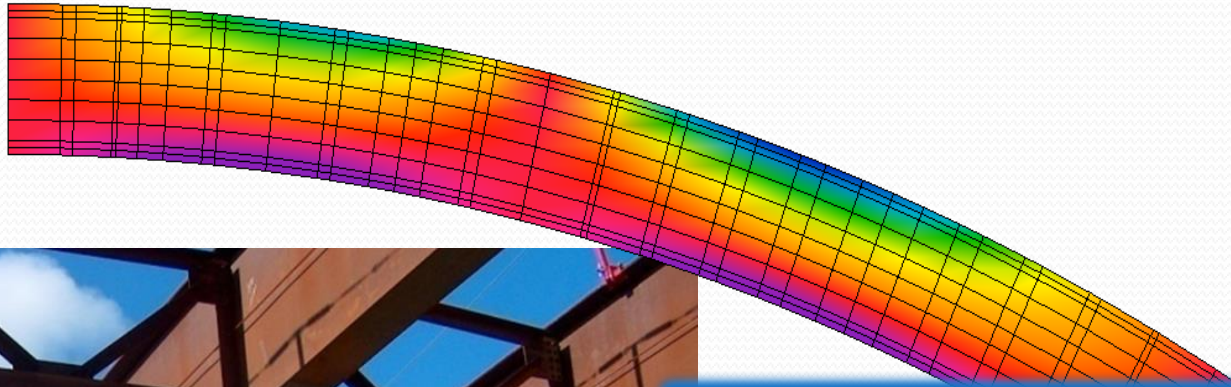


# 3D Analysis - Steel Multi-girder

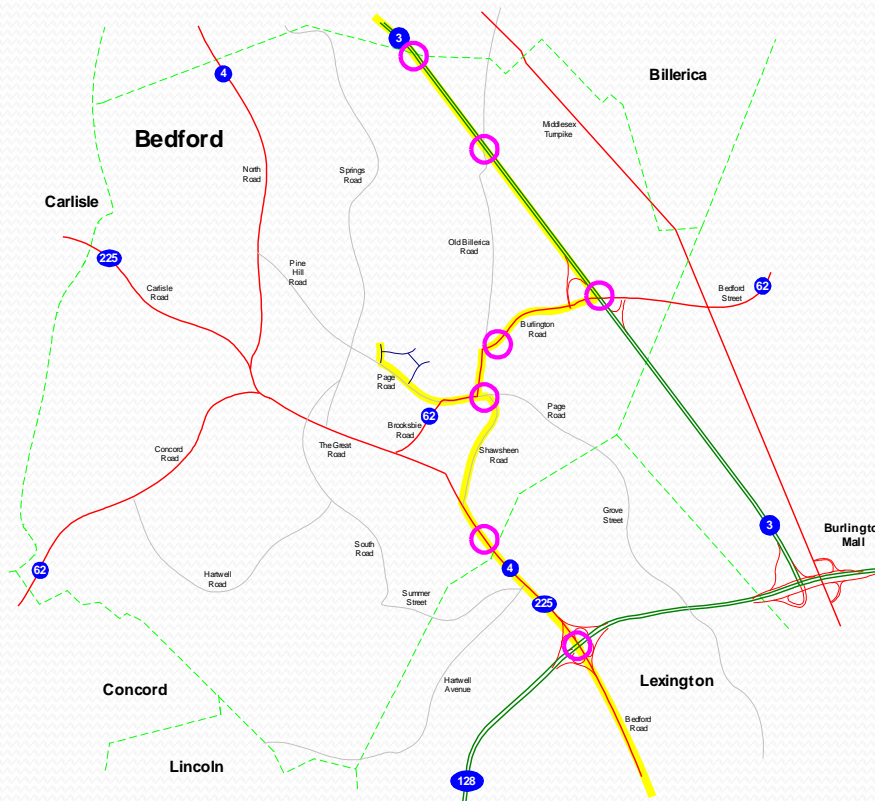
## Straight - 3D



# 3D Analysis – Curved Steel Girder



# Permit Routing & Nonstandard Gage





# AASHTO Spec Checking

Virtis/Opis/OpisSub - PCITrainingBridge4

File Edit View Bridge Substructure Tools Window Help

Preliminary

Bridge Workspace - PCITrainingBridge4

PCITrainingBridge4

Specification Checks for Member Alternative #2 (9.9.4) - 21 of

- Superstructure Component
  - Prestress Calculations
  - Stage 1
  - Stage 2
  - Stage 3
    - Member Alternative #2 (9.9.4)
      - Span 1 - 0.00 ft.
      - Span 1 - 0.05 ft.
      - Span 1 - 0.70 ft.
      - Span 1 - 2.00 ft.
      - Span 1 - 4.95 ft.
      - Span 1 - 6.00 ft.
      - Span 1 - 12.00 ft.
      - Span 1 - 24.00 ft.
      - Span 1 - 36.00 ft.
      - Span 1 - 48.00 ft.
      - Span 1 - 60.00 ft.
      - Span 1 - 72.00 ft.
      - Span 1 - 84.00 ft.
      - Span 1 - 96.00 ft.
      - Span 1 - 108.00 ft.
      - Span 1 - 115.05 ft.
      - Span 1 - 118.00 ft.
      - Span 1 - 118.00 ft.
      - Span 1 - 119.95 ft.
      - Span 1 - 120.00 ft.

Specification Reference

- 2.5.2.6.2 Criteria for Deflection
- 5.11.4.2 Bonded Strand
- 5.4.2.5 Poisson's Ratio
- 5.4.2.6 Modulus of Rupture
- 5.7.2.2 Rectangular Stress Dis
- 5.7.3.2 Flexural Resistance (Pr
- 5.7.3.3.2 Minimum Reinforcem
- 5.8.2.5 Minimum Transverse R
- 5.8.2.7 Maximum Spacing of Tr
- 5.8.3.3 Nominal Shear Resistar
- 5.8.3.4 Procedures for Determ
- 5.8.3.5 Longitudinal Reinforc
- 5.8.4 Interface Shear Transfer
- 5.8.4.4 Minimum Area of Interf
- 5.9.4.2.1 Compression Stresse
- 5.9.4.2.2 Tension Stresses
- Computation of Vp
- Cracked\_Moment\_of\_Inertia S
- Cracked\_Moment\_of\_Inertia S
- PS\_Basic\_Properties Calculatio
- PS\_Gross\_Composite\_Section\_

Spec Check Detail for 5.9.4.2.1 Compression Stresses

5 Concrete Structures

5.9 Prestressing and Partial Prestressing

5.9.4 Stress Limits for Concrete

5.9.4.2 For Stresses at Service Limit State After Losses - Fully Prestressed Compone

5.9.4.2.1 Compression Stresses

(AASHTO LRFD Bridge Design Specifications, Fourth Edition - 2007)

PS I Wide - At Location = 60.0000 (ft) - Left Stage 3

Input:

Girder f'c = 6.50 (ksi) Slab f'c = 4.00 (ksi)

Section Properties: Gross

Ag = 767.00 (in<sup>2</sup>) epg = 29.69 (in)

St = 15421.29 (in<sup>3</sup>) Sb = 14912.64 (in<sup>3</sup>)

Stc = 63853.46 (in<sup>3</sup>) Sbc = 20086.00 (in<sup>3</sup>)

Slabtc = 63853.46 (in<sup>3</sup>) Pe = 1045.20 (kip)

Slabtct = 63853.46 (in<sup>3</sup>)

Service I Loads:

MDL1 = 3097.50 (kip-ft)

MDL2 = 540.00 (kip-ft)

Pos MCS = 0.00 (kip-ft) Neg MCS = 0.00 (kip-ft)

Pos MLL+I = 2673.56 (kip-ft) Neg MLL+I = 0.00 (kip-ft)

Summary:

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Final Compressive Stresses Due to Permanent and Transient Loads:  
(Service I: PS + DL + LL)

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Final allowable compression stress limit = -3.90 (ksi)

	Top Beam (ksi)	Bottom Beam (ksi)
PS:	0.65	-3.44
DL:	-2.51	1.66
C&S:	0.00	0.00
LL:	-0.50	0.00
Sum =	-2.36	-1.79
Allow =	-3.90	-3.90



# AASHTO Spec Checking

Multiple versions supported...

The screenshot shows a software window titled "Member Alternative Description". At the top, there is a text field labeled "Member Alternative:" containing the text "Plate Girder". Below this are several tabs: "Description", "Specs", "Factors", "Engine", "Import", and "Control Options". The "Specs" tab is active, displaying a table with the following columns: "Analysis Method Type", "Analysis Module", "Selection Type", "Spec Version", and "Factors".

Analysis Method Type	Analysis Module	Selection Type	Spec Version	Factors
ASD	AASHTO ASD	System Default	MBE 2nd 2014i, Std 17th	N/A
LFD	AASHTO LFD	System Default	MBE 2nd 2014i, Std 17th	2002 AASHTO Std. Specifications
LRFD	AASHTO LRFD	System Default	LRFD 7th	2014 AASHTO LRFD Specifications
LRFR	AASHTO LRFR	Override	MBE 2nd 2014i, LRFD 7th	2011 (2014 Interim) AASHTO LRFR Spec

The "Analysis Module" column for all rows is highlighted with a red box. The "Spec Version" column for the LRFR row is also highlighted with a red box, and its dropdown menu is open, showing a list of options including "MBE 2nd 2014i, LRFD 7th" (which is selected and highlighted in blue), "MBE 1st 2010i, LRFD 5th", "MBE 1st 2010i, LRFD 5th 201", "MBE 1st, LRFD 4th 2008i", "MBE 1st, LRFD 4th 2009i", "MBE 2nd 2011i, LRFD 5th", "MBE 2nd 2011i, LRFD 5th 201", "MBE 2nd 2011i, LRFD 6th", "MBE 2nd 2013i, LRFD 6th 201", "MBE 2nd 2014i, LRFD 7th", "MBE 2nd, LRFD 5th", and "MBE 2nd, LRFD 5th 2010i".

# Enhancements for 6.7 – June 2015

## User Group Top Enhancements

### Bridge Design / Bridge Rating - Top User Group (RADBUG) Balloted Enhancements

Ranking	Description	Status
1	Copy and paste shear reinforcement ranges	Included in 6.7 release
2	Consider sloped portion of bent longitudinal reinforcement in bending and shear capacities	Included in 6.7 release
3	Perform 3D FEM analysis for dead load and/or live load only	Included in 6.7 release
4	Non-standard gage vehicle analysis on floor system superstructures	Included feasibility study of 3D floor system model in 6.8 Work Plan
6	Revise culvert LFD LL distribution computation	Included in 6.7 release
14	Consider development length of deck reinforcements	Included in 6.7 release

# Enhancements not in 6.7 – June 2015

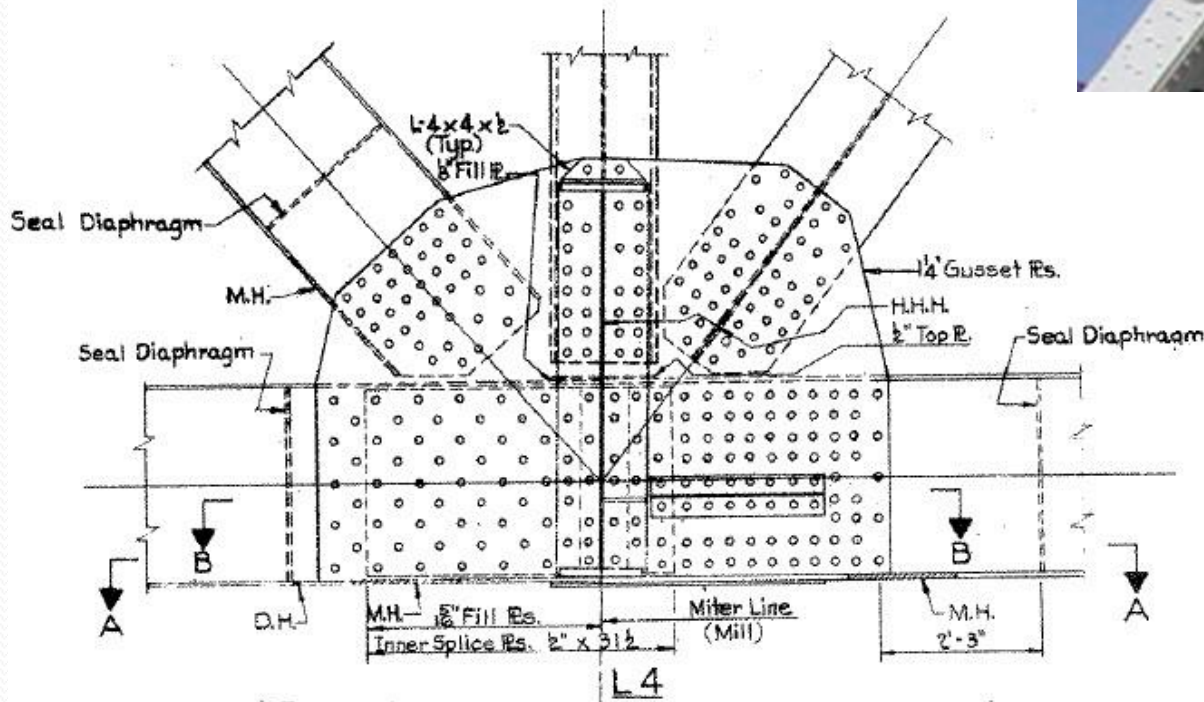
## User Group Top Enhancements

Combined Ranking	BrR Ranking	BrD Ranking	Description	Status
5	4	19	Timber Design and Rating	Consider in Modernization
7	7	40	Linking engine error to GUI Windows	Consider in Modernization
8	13	5	Analysis of Trusses	Consider in Modernization
9	5	65	Pull ADT from BrM	
10	18	9	Avg Kg to calculate LLDF when different for both sides	

# Enhancements for 6.7 – June 2015

## Gusset Plate Rating

- Includes LRFR Truss Rating



# Enhancements for 6.7 – June 2015

## Splice Analysis and Rating for Steel Girders

- LRFD, LRFR, LFR
- Hybrid splices
- Splices for Curved Girders
- Simple for Dead Load, Continuous for Live Load



# Enhancements for 6.7 – June 2015

- Cut Top Strand for Prestress Concrete Beams
- Splayed Girder Computation of Distribution Factors
- Implement RC Slab System in Substructure
- LRFR for Floor System
- AISC Steel Shape Update



# Enhancements for 6.7 – June 2015

- LRFR Lateral Flange Moment Report
- AASHTO Engine Specification updates
  - ❑ MBE 2<sup>nd</sup> Edition, 2015 interim
  - ❑ LRFD 7<sup>th</sup> Edition 2015 interim
- Other Maintenance Improvements
  - ❑ Allow negative epsilon in concrete shear computation
  - ❑ Report actions for both sides of a point-of-interest
  - ❑ User-defined DL distribution by percentage

# Design Tools - Update

## Automated Prestressed Concrete Beam Design

- Completed the software design
  - Phase 1 – Single Beam Design
  - Phase 2 – Framing Plan Design
- Nearly complete with the user interface development for Phase 1
- Release of Phase 1
  - 1<sup>st</sup> quarter 2016



# Enhancements for 6.8 – June 2016

- User Requested Enhancements (from this meeting)
- Specification updates from SCOBS 2015 meeting
- Maintenance Items
- Bug Fixes

# Enhancements for 6.8 – June 2016

- LFD DF 1994 Guide Spec (Michigan DOT)
- NSG for Floor Systems
- Curved Steel Girder – Diaphragm Spec Checking
- Strain Compatibility Modification for PS Beam Capacity

# Design Tools Update

## Steel Plate Girder Design Optimization

- Software design is in progress
  - Defining requirements
  - Preparing user interface mockups
  - Formulating the steel design algorithm



# Additional Items

- Creation and Updated FAQ
- <https://aashto.mbakercorp.com/Pages/FAQs.aspx>



# 2014 Non-voters Discussion

- Successful
- Generated a lot of good ideas and questions

# Things the Task Force learned

- Not everybody is getting the information they need
  - Quarterly Email updates in addition to annual newsletter and web page updates (email list is over 700 folks)
- Not everybody is aware of the capabilities of software
  - FAQ, web page updates, quarterly email updates
- Still a lot of enhancement ideas
  - Suggest that consultants work with their DOT agencies so all are on the same page
- Not everybody had access to JIRA
  - Created a read only user so everybody can see incidents

# 2015 Survey

- Bridge Rating is primary load rating software for most respondents
- Bridge Design is more limited or secondary design software
- Bridge Rating is used to load rate bridges in design phase also

# 2015 Survey

- There were a lot of respondents that didn't know 6.7 had been released
  - Survey sent on 6/23/2015
  - Email status update sent on 7/7/2015
  - Agencies notified about download on 7/6/2015
  - So depending on when one responded to the survey determined if they knew it was out

# 2015 Survey

- Speed of Analysis (3D)
  - Discuss in Modernization presentation
- Reports
  - Discuss in Modernization presentation
- Speed of multiple bridges for permitting
  - Shannon will have a presentation on an approach

# AASHTOWare Bridge Task Force

<b>Chair</b>	<b>Todd Thompson</b>	<b>South Dakota</b>
<b>Vice Chair</b>	<b>Eric Christie</b>	<b>Alabama</b>
<b>Member – BrM</b>	<b>Bruce Novakovich</b>	<b>Oregon</b>
<b>Member – BrM</b>	<b>Thomas Martin</b>	<b>Minnesota</b>
<b>Member – BrM</b>	<b>Mark Faulhaber</b>	<b>Kentucky</b>
<b>Member – BrM</b>	<b>Beckie Curtis</b>	<b>Michigan</b>
<b>FHWA Liaison – BrM</b>	<b>Derek Constable</b>	<b>FHWA</b>
<b>Member – BrR</b>	<b>Joshua Dietsche</b>	<b>Wisconsin</b>
<b>Member – BrD</b>	<b>Jeff Olsen</b>	<b>Montana</b>
<b>Member – BrD</b>	<b>Dean Teal</b>	<b>Kansas</b>
<b>Member – BrR</b>	<b>Amjad Waheed</b>	<b>Ohio</b>
<b>FHWA Liaison – BrDR</b>	<b>Tom Saad</b>	<b>FHWA</b>

# AASHTOWare Bridge Task Force

- How to become Task Force Member
  - Active with the product – user group officer, TAG
  - Willing to volunteer your time
  - Support of your DOT management
  - Technical Expertise
  - Leadership and Management Skills
  - Employed by AASHTO Member State

# AASHTOWare Bridge Task Force

- How to become Task Force Member
  - When there is an opening
  - Email sent to all regarding the opening
  - Need to submit a resume
  - Need to submit management approval
    - Travel and time demands
  - AASHTO Project Manager, SCOJD liaison and current Chair review and interview and recommend the new member(s) to SCOJD
  - SCOJD appoints all task force members and chairs



# Contact Information

- Todd Thompson
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- [todd.thompson@state.sd.us](mailto:todd.thompson@state.sd.us)

# Questions & Comments



Thank you for your continued support!