

AASHTOWare Bridge Technical Update



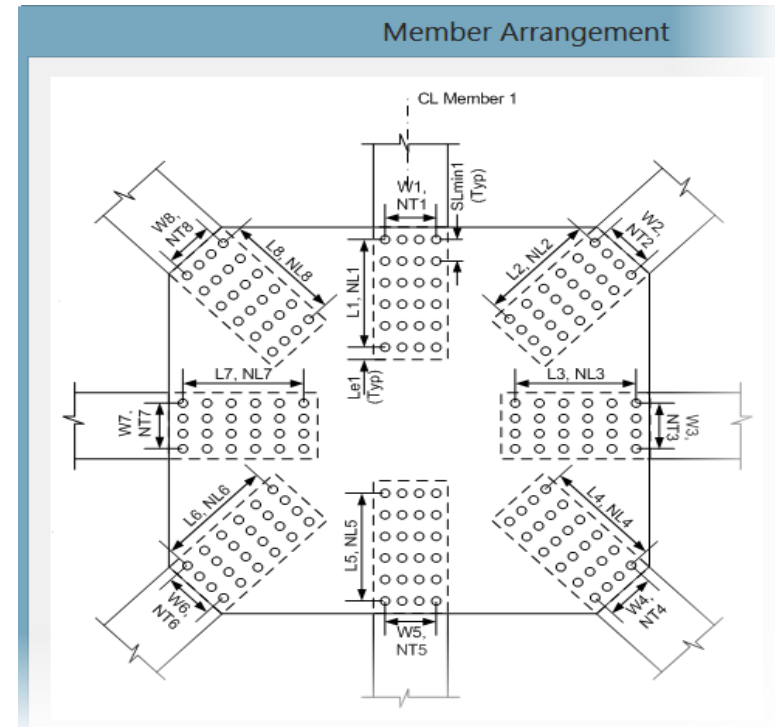
AASHTOWare Bridge Rating/Design
User Group Training Meeting
Albany – August 2015



6.7 New Feature – Gusset Plates

Gusset Plate Rating

- Joint effort by Oklahoma and AASHTO
- LRFR
- LFR
- Includes LRFR rating of longitudinal trusses



Truss and Gusset Plates

- Includes specification checking for the truss members (LFR and LRFR)

Specification Checks for Truss 1 - 17 of 375

Superstructure Component

Stage 3

Truss 1

- U0U1
- U1U2
- U2U3
- U3U4
- U4U5
- U5U6
- L0U0
- L4U6
- U0L1
- L1U2
- U2L2
- L2U4
- U4L3
- L3U6
- L1U1
- L2U3
- L3U5
- L0L1
- L1L2
- L2L3
- L3L4

Truss 1 Panel Points

Specification Reference

- 10.54.1.1 Maximum Axial Load Capacity
- 10.54.2.1 Compute Fe
- ✗ 6B.4 Axial Tension and Compression
- 6B5.3.1 Gusset Plate Bolt Slip Resistance
- ✗ L6B.2.6.1 Gusset Plate Axial Force Rating
- L6B.2.6.1 Gusset Plate Bearing Resistance
- L6B.2.6.1 Gusset Plate Bolt Shear Resistance
- ✓ L6B.2.6.1 Gusset Plate Bolt Slip Rating
- ✗ L6B.2.6.1 Gusset Plate Bolt Slip Rating
- L6B.2.6.1 Gusset Plate Bolt Slip Resistance
- NA L6B.2.6.1 Gusset Plate Axial Force Rating
- NA L6B.2.6.3 Gusset Plate Axial Force Rating
- L6B.2.6.4 Gusset Plate Bolt Slip Resistance
- L6B.2.6.5 Gusset Plate Bolt Slip Resistance
- L6B.2.6.5 Gusset Plate Bolt Slip Resistance
- L6B.2.6.5 Gusset Plate Bolt Slip Resistance
- LFD Steel Truss

For the truss member

For the gusset plate

Spec Check Detail for L6B.2.6.1 Gusset Plate Bolt Slip Resistance Rating

Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
Appendix L6B
L6B.2 Capacity of Steel Members (Part D, Strength Design Method)
L6B.2.6 Gusset Plates
L6B.2.6.1 Gusset Plate Bolt Slip Resistance Rating
(AASHTO Manual for Bridge Evaluation, Second Edition with 2015 Interims)

Gusset Plate - Truss Member U2U3: Panel Point U2 Stage 3

BOLT SLIP RESISTANCE RATING FACTOR CALCULATIONS

$$RF = \frac{C - A1 * DL(\$Load)}{A2 * LL(1+I) (\$Load)}$$

where,

C = 111.330 (kip)
User Override DL = Infinity (kip)
A1 = Dead Load Factor

Computation detail

Truss and Gusset Plates

- Includes specification checking for the gusset plates

Specification Checks for Truss 1 - 2 of 375

Specification Reference

- ✓ L6B.2.6.1 Gusset Plate Shear Rating
- 📁 L6B.2.6.3 Gusset Plate Shear Resistance

Spec Check Detail for L6B.2.6.1 Gusset Plate Shear Rating

Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
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(AASHTO Manual for Bridge Evaluation, Second Edition with 2015 Interims)

Gusset Plate - L2 GP (L4 Mathcad): Panel Point L2 Stage 3

Member Percentage Load Transfer:

Member	Load Transfer (%)
L1L2	100.00
L2L3	100.00
L2U3	100.00
L2U4	100.00
U2L2	100.00

Consider Chord Splice : No
Continuous Chord Member : Yes

$$C = A1 * VDL$$

$$RF = \frac{A2 * VLL(1+I)}{C}$$

VERTICAL SHEAR RATING FACTOR CALCULATIONS

C = 110.246 (kip)
VDL Left = 2.740 (kip)
VDL Right = 2.740 (kip)
A1 = Dead Load Factor
A2 = Live Load Factor

For the panel point gusset plates (entire connection)

Gusset Plates

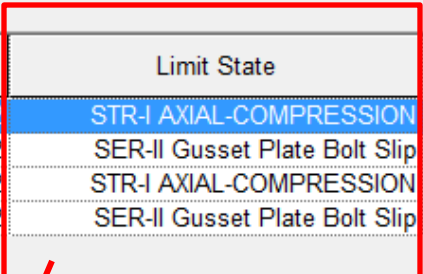
- Rating results

Analysis Results - Truss 1

Report Type: Rating Results Summary
 Lane/Impact Loading Type: As Requested Detailed
 Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Element Name	Limit State	Impact	Lane
HL-93 (US)	Truck + Lane	LRFR	Inventory	33.23	0.923	L1U2	STR-I AXIAL-COMPRESSION	As Request	As Requeste
HL-93 (US)	Truck + Lane	LRFR	Operatin	33.36	0.927	L2L3 : L2	SER-II Gusset Plate Bolt Slip	As Request	As Requeste
HL-93 (US)	Tandem + Lane	LRFR	Inventory	24.78	0.991	L1U2	STR-I AXIAL-COMPRESSION	As Request	As Requeste
HL-93 (US)	Tandem + Lane	LRFR	Operatin	28.32	1.133	L2L3 : L2	SER-II Gusset Plate Bolt Slip	As Request	As Requeste

AASHTO Truss LRFR Engine Version 6.7.0.2003
 Analysis Preference Setting: None



Limit State

STR-I AXIAL-COMPRESSION

SER-II Gusset Plate Bolt Slip

STR-I AXIAL-COMPRESSION

SER-II Gusset Plate Bolt Slip

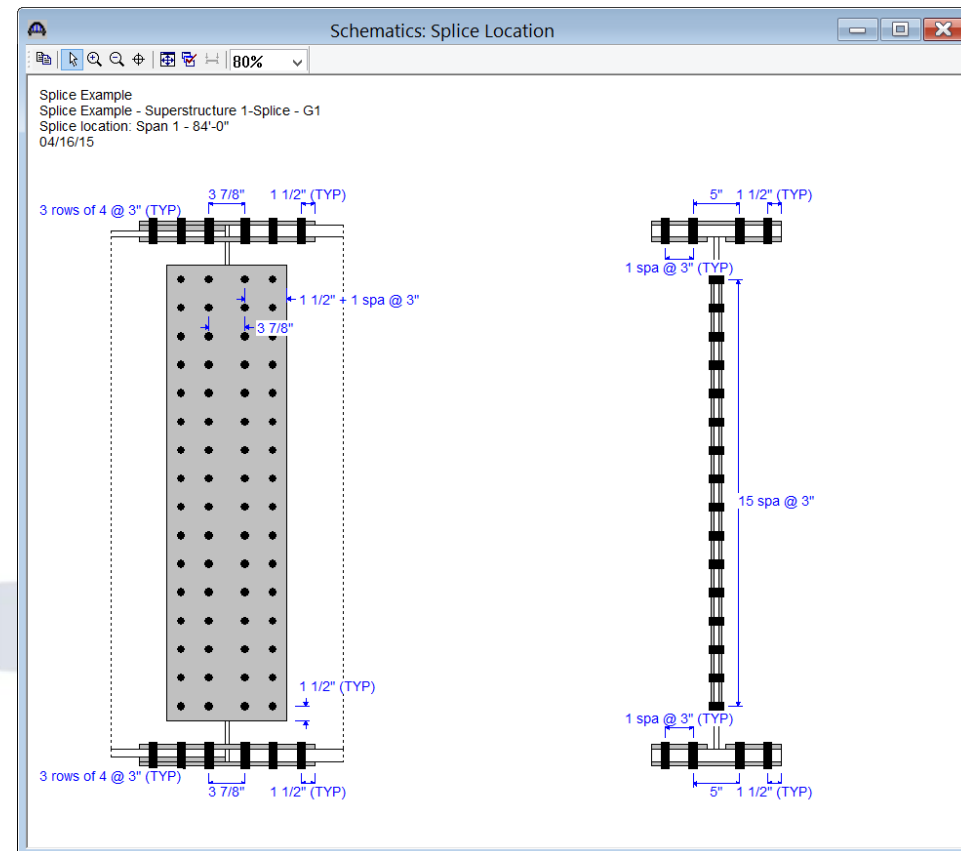
Controlling limit state



6.7 New Feature – Splice Analysis

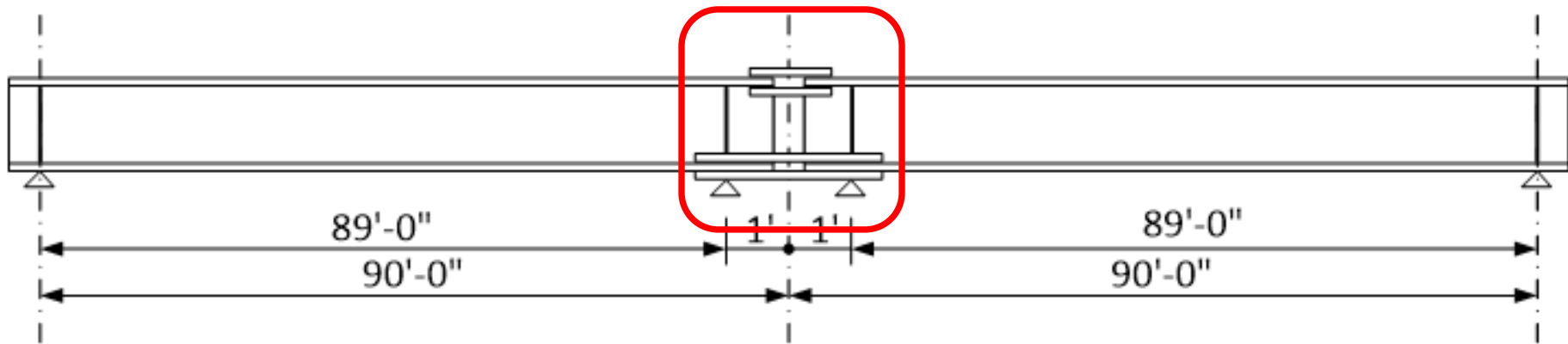
Analysis based on LFRD and LFD specs for steel plate girders

- LRFD splice analysis
- LRFR and LFR
- Hybrid girder splice capability
- Curved girder splice capability
- Partially funded by NYSDOT



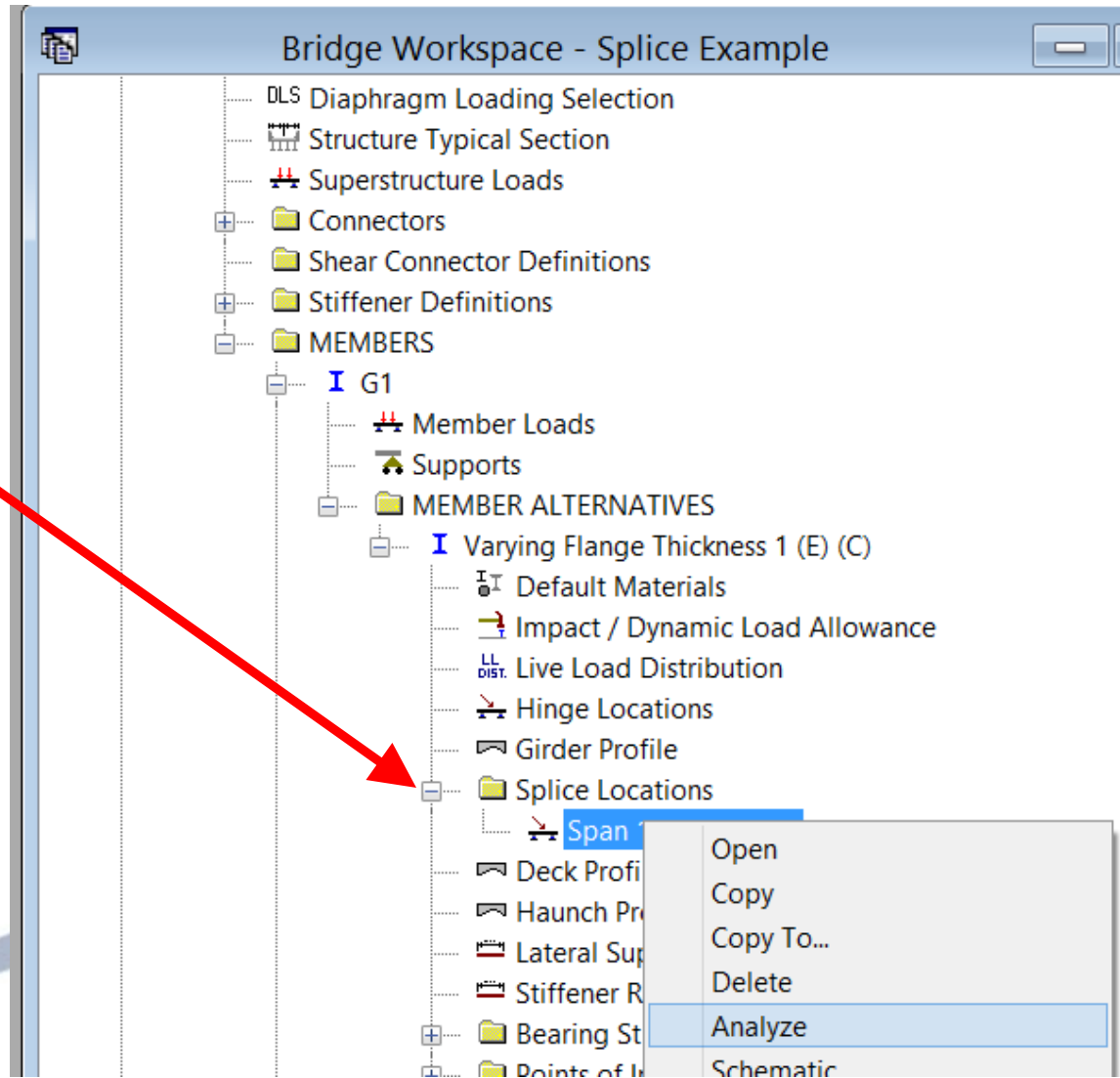
Splice Analysis

- Simple for DL, continuous for LL splice analysis



Splice Analysis

- Analyze an individual splice



6.7 New Feature – Cut Top Strand

Cut Top Strands for Prestress Beams

- Funded by Michigan DOT
- Reduce tensile stresses in the top of the beam at release
- Straight pretensioned strands placed at top of beam
- Strands are debonded over majority of the center of the beam and then cut
- After cutting, only ends are engaged

6.7 New Feature – LL Distribution

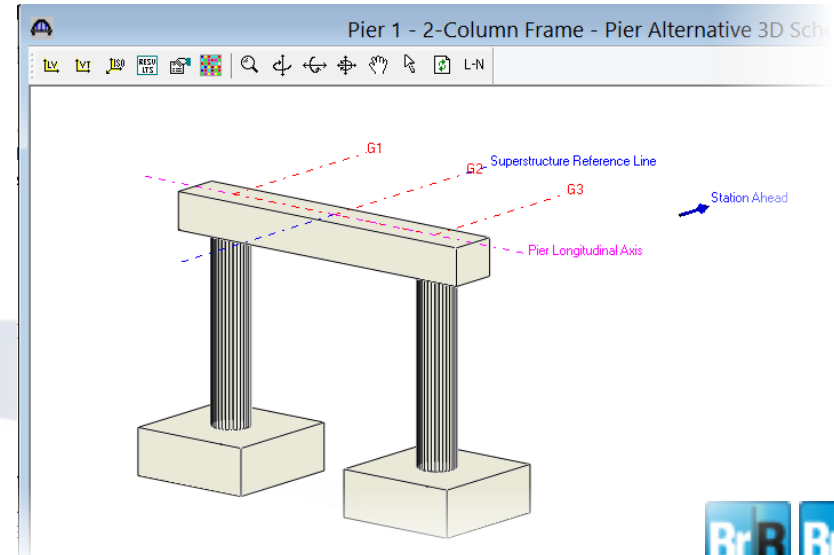
Splayed Girder Computation of Distribution Factors

- Funded by Michigan DOT and Illinois DOT
- Enhance the DF computations to include splayed girder configurations
- Generates a table of DF
- Standard and LFRD spec

6.7 New Feature – R/C Slab System

R/C slab system in substructure

- Funded by KS DOT
- Analysis and spec-checking of a pier supporting a slab system superstructure
- Load transfer of superstructure is uniformly distributed



6.7 New Feature – Culvert

Culvert - General Procedure Shear Computation Method

- Add control options to select the “General Procedure”
- Control options for LRFD and LRFR



6.7 New Feature – Culvert

Culvert – Exposure Factor

- Funded by Illinois DOT
- Allows entry of different exposure factors for different surfaces



6.7 New Feature – Floor System

LRFR for Floor System and Truss System

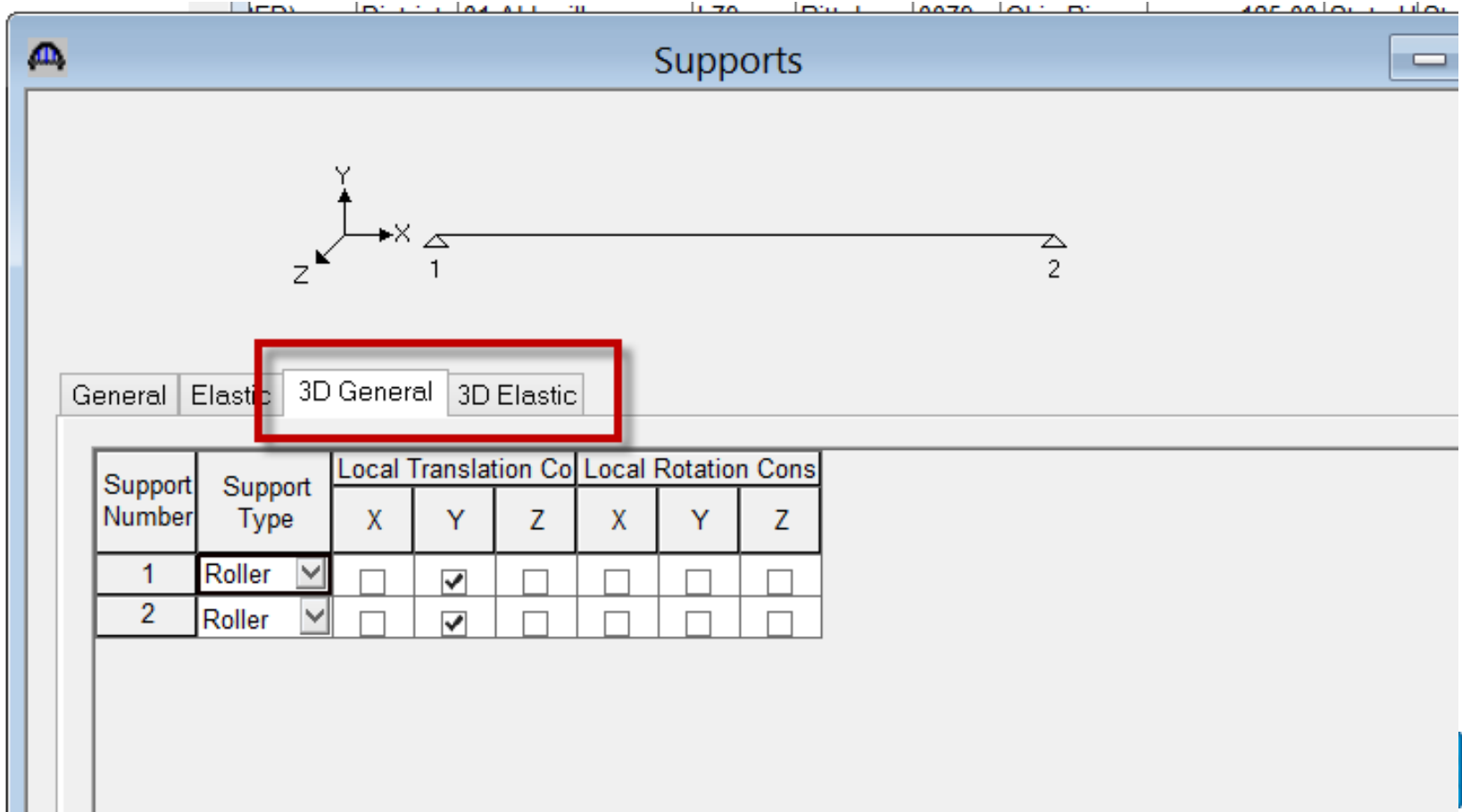
- Ranked in the top 10 UG voting for past 3 years
- Adds LRFR analysis for:
 - Main Girders
 - Floorbeams
 - Stringers



6.7 New Feature – 3D Modeling

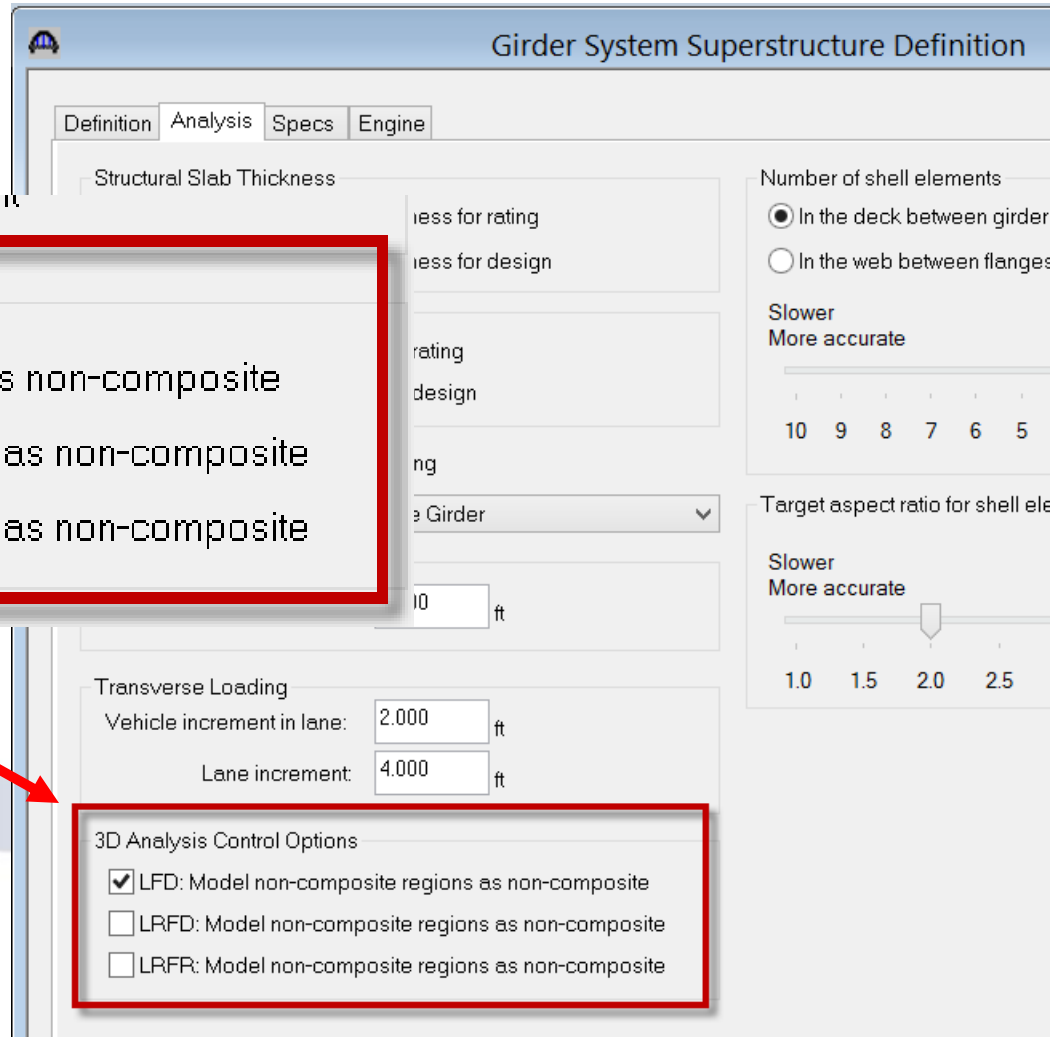
Straight Girder 3D Modeling Improvements

- Support constraint options



6.7 New Feature – 3D Modeling

Straight Girder 3D Modeling Improvements



3D Analysis Control Options

- LFD: Model non-composite regions as non-composite
- LRFD: Model non-composite regions as non-composite
- LRFR: Model non-composite regions as non-composite

3D Analysis Control Options

- LFD: Model non-composite regions as non-composite
- LRFD: Model non-composite regions as non-composite
- LRFR: Model non-composite regions as non-composite

6.7 New Feature – Steel Shapes

- Library Update - AISC Steel Shapes (14th Edition)

The image displays a software interface for managing steel shape libraries. It consists of several overlapping windows:

- Library - Steel Shapes - Rolled Beam:** Shows a W14x398 shape with a description "W 14x398 Imported from AISC Tables (1994)" and a year of 1994 highlighted in a red box.
- Library - Steel Shapes - Roll:** Shows the same W14x398 shape with a description "W 14x398 Imported from AISC Tables (2011)" and a year of 2011 highlighted in a red box. Below the text is a technical drawing of the steel shape with dimensions: $t_f = 2.8500$, $k_1 = 2.1250$, $k = 3.4400$, $d = 18.3000$, and $tw = 1.7700$.
- Steel Shape Selection:** A dialog box with "Shape Designation: W30" and "Library" options for Standard (selected) and Agency. It contains a table of shapes with a year column highlighted in red.

Shape	Year	Depth (in)
W 30 x 90	2011	29.50
W 30 x 90	1994	29.53
W 30 x 99	1994	29.65
W 30 x 99	2011	29.70
W 30 x 108	1994	29.83
W 30 x 108	2011	29.80
W 30 x 116	2011	30.00
W 30 x 116	1994	30.01
W 30 x 124	1994	30.17

6.7 New Feature

- LRFD/LRFR Lateral Flange Moment Report

Top Flange Lateral Moments Summary

Live Load Type 3

Impact = ** %

Span 1

Location (ft)	Percent	DC Load (kip-ft)	DW Load (kip-ft)	+(LL+I) (kip-ft)	Controlling Live Load	-(LL+I) (kip-ft)	Controlling Live Load
0.00(R)	0.0	0.02	0.02	0.12	Axle Load	-0.06	Axle Load
16.13(L)	10.0	0.02	-0.02	0.56	Axle Load	-0.68	Axle Load
16.13(R)	10.0	0.02	-0.02	0.56	Axle Load	-0.68	Axle Load
20.16(L)	12.5	0.04	0.09	0.87	Axle Load	-0.55	Axle Load
20.16(R)	12.5	0.03	0.10	0.87	Axle Load	-0.55	Axle Load
32.25(L)	20.0	0.04	0.08	0.84	Axle Load	-0.45	Axle Load
32.25(R)	20.0	0.02	0.05	0.84	Axle Load	-0.45	Axle Load
40.31(L)	25.0	0.05	0.13	1.05	Axle Load	-0.47	Axle Load
40.31(R)	25.0	0.06	0.16	1.05	Axle Load	-0.47	Axle Load
48.38(L)	30.0	0.09	0.07	0.77	Axle Load	-0.49	Axle Load
48.38(R)	30.0	0.09	0.07	0.77	Axle Load	-0.49	Axle Load

6.7 Updated Feature

- AASHTO Engine Specification Updates
 - ❑ MBE 2nd Edition, 2015 interim
 - ❑ LRFD 7th Edition 2015 interim

Member Alternative Description

Member Alternative: Plate

Description Specs Factors Engine Import Control Options

Analysis Method Type	Analysis Module	Selection Type	Spec Version
ASD	AASHTO ASD	System Default	MBE 2nd 2015i, Std 17th
LFD	AASHTO LFD	System Default	MBE 2nd 2015i, Std 17th
LRFD	AASHTO LRFD	System Default	LRFD 7th 2015i
LRFR	AASHTO LRFR	Override	

MBE 1st 2010i, LRFD 5th
 MBE 1st 2010i, LRFD 5th 2010i
 MBE 1st, LRFD 4th 2008i
 MBE 1st, LRFD 4th 2009i
 MBE 2nd 2011i, LRFD 5th
 MBE 2nd 2011i, LRFD 5th 2010i
 MBE 2nd 2011i, LRFD 6th
 MBE 2nd 2013i, LRFD 6th 2013i
 MBE 2nd 2014i, LRFD 7th
MBE 2nd 2015i, LRFD 7th 2015i
 MBE 2nd, LRFD 5th
 MBE 2nd, LRFD 5th 2010i

MBE 1st 2010i, LRFD 5th
 MBE 1st 2010i, LRFD 5th 2010i
 MBE 1st, LRFD 4th 2008i
 MBE 1st, LRFD 4th 2009i
 MBE 2nd 2011i, LRFD 5th
 MBE 2nd 2011i, LRFD 5th 2010i
 MBE 2nd 2011i, LRFD 6th
 MBE 2nd 2013i, LRFD 6th 2013i
 MBE 2nd 2014i, LRFD 7th
MBE 2nd 2015i, LRFD 7th 2015i
 MBE 2nd, LRFD 5th
 MBE 2nd, LRFD 5th 2010i

User Requested Enhancements

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

6.7 Maintenance Enhancements

- 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 - 2016

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 the first phase
 - 1st quarter 2016



Design Tools – 2016

Steel Plate Girder Design Optimization

- Software design is in progress
 - Formulating the steel design algorithm




Support Site - aashto.mbakercorp.com

https://aashto.mbakercorp.com/Pages/default.aspx

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Welcome

AASHTOWare Bridge Design and Rating Products are comprehensive bridge design and load rating tools developed by AASHTO. For an agencies' bridge inventory, the products store detailed bridge descriptions sufficient for structural analysis. AASHTOWare Bridge Rating (BrR) is the tool for rating bridge superstructures in accordance with the AASHTO Manual for Condition Evaluation of Bridges, AASHTO Manual for Bridge Evaluation, AASHTO Standard Specification and AASHTO LRFD Specification. AASHTOWare Bridge Design (BrD) is a tool for assisting in the design of both superstructure and substructures in accordance with the AASHTO LRFD specification. The two products share much of their user interface and database. When both products are licensed a bridge can be

Highlighted Posts

[AASHTOWare Bridge Design and Rating Version 6.7 - New Features](#)

















Support Site - aashto.mbakercorp.com

Training

More than 50 tutorials

Tutorials

<input type="checkbox"/>	Type	Name	File Size	File Date
Category : 3D FEM Analysis (2)				
		STL8 - Single Span Steel 3D Example	812 KB	4/28/2015
		STL9 - Curved Steel 3D Example	1952 KB	4/28/2015
Category : Culvert (1)				
		CVT1 - Two-Cell RC Box Culvert Example	1339 KB	4/24/2015
Category : Distribution Factor Analysis (3)				
		DF1 - DistributionFactorAnalysisExample	702 KB	9/16/2008
		DF2 - DistributionFactorAnalysis Example	771 KB	7/22/2008
		DF3 - DistributionFactorAnalysis(LRFR)	459 KB	4/24/2015
Category : Feature (17)				
		2014 Spec Update Overview	773 KB	8/4/2014
		ADJ1 - Adjacent Lane	1999 KB	8/4/2014
		Bridge X - Bridge Exchange Feature Example	318 KB	9/16/2008
		Capacity Override	317 KB	1/1/2014
		EI1 - ExportingImportingData	475 KB	7/26/2012
		F1 - FlaredGirderExample	682 KB	4/28/2015
		Field Verified Wearing Surface Thickness	799 KB	7/26/2012
		General Preferences	989 KB	7/26/2012

Thank you



Reception Today

Immediately following RADBUG



Tuesday, August 4th
5:30 p.m. to 7:30 p.m.

Refreshments will be served



Courtyard/Patio
Holiday Inn Wolf Road