

AASHTOWare Bridge Design and Rating

Technical Update

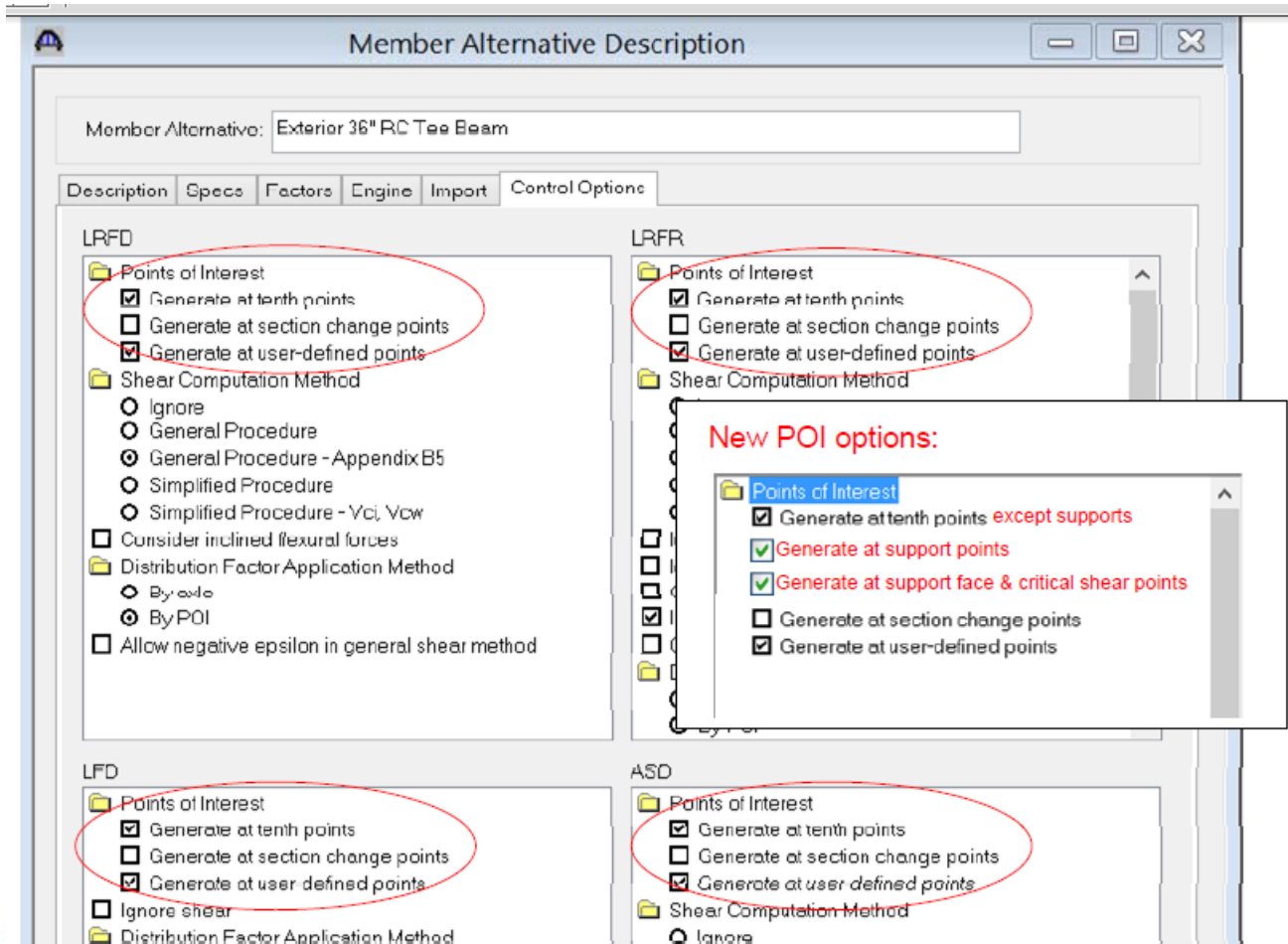
User Group Training Meeting
Chicago – August 2016



Enhancements for 6.7.1 – March 2016

Concrete Enhancement (Caltrans and Task Force)

- Point-of-Interest Control Options – (supports, 10th points, critical shear locations)



Applies to P/S,
R/C and MCB
members

Applies to LRFD,
LRFR, LFD and
ASD

Enhancements for 6.7.1 – March 2016

Concrete Enhancement (Caltrans and Task Force)

- Specify effective support locations for all concrete beams (R/C and P/S members, already in MCB)

Bridge Workspace - PCITrainingBridge6

Design/Rating bridges retrieved

Bridge Name

Effective Supports

Span	From Start (in)	From End (in)
1		
2		
3		

Shifts the location where critical shear checks are made

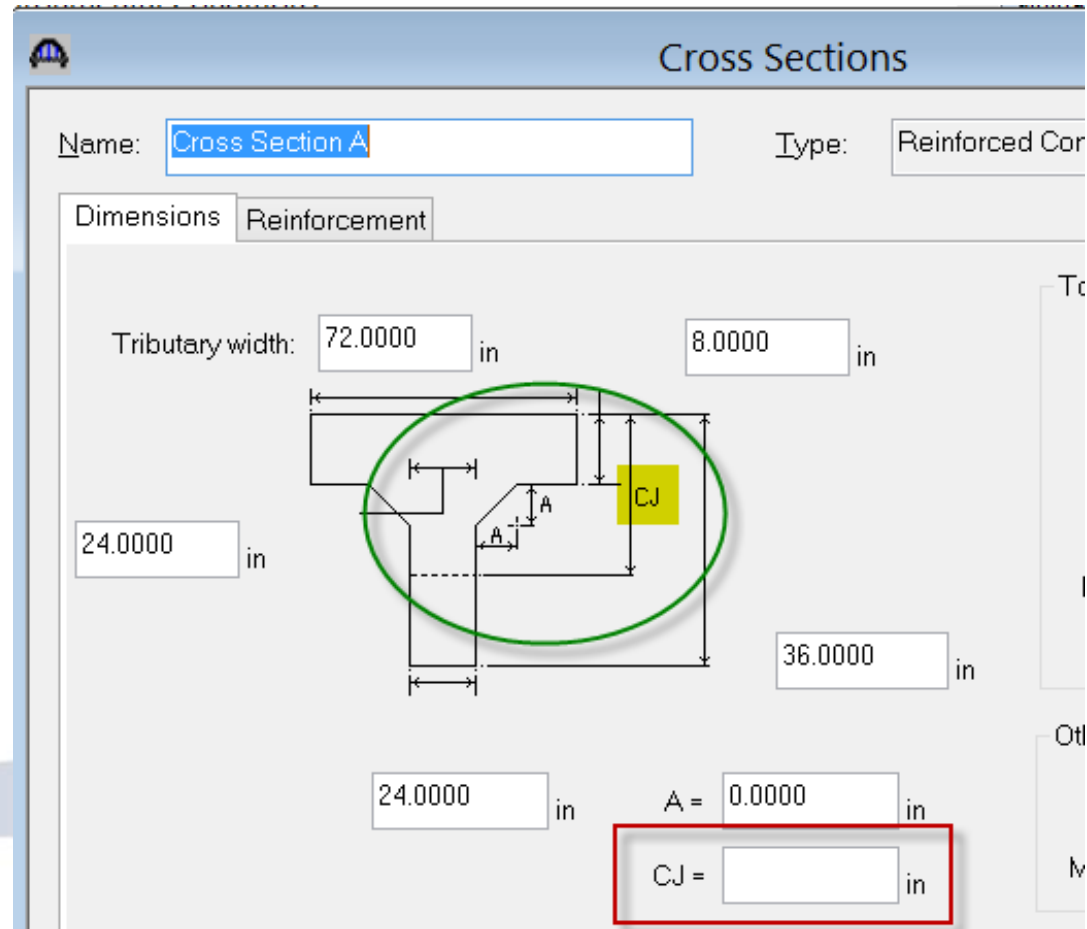
Enhancements for 6.7.1 – March 2016

Concrete Tee Beam Enhancement (Caltrans)

- Construction Joint for RC Tee Beams

For both cross-section based and schedule based

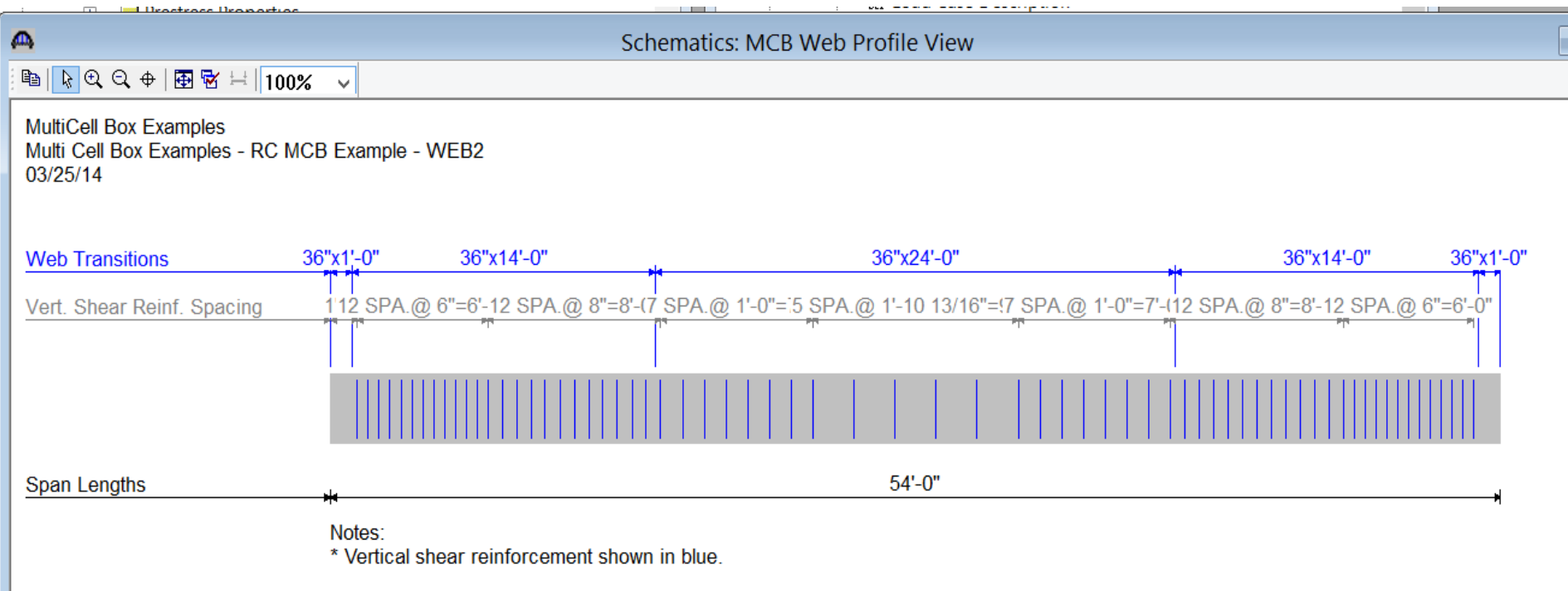
Development length is adjusted for bars in close proximity to the joint



Enhancements for 6.7.1 – March 2016

Multi-cell Concrete Box Enhancement (Caltrans)

- Added a Web Schematic to Show Stirrups and Dimensions



Enhancements for 6.7.1 – March 2016

Steel and Concrete Enhancement (Caltrans)

- Added Range of Applicability Override for LRFD Distribution Factors Calculations

Library - LRFD DF Applicability Ranges

Name: 2014 (2016 interim) AASHTO LRFD Ranges

Description: LRFD DF ranges of applicability from 2014 (2016 interim) AASHTO LRFD Spec

Library: Standard Agency Defined

Moment Interior Beams | Moment Exterior Beams | Moment Skewed Supports | Shear Interior Beams | Shear Exterior Beams | Shear Skewed Supports

Type of Superstructure	Applicable Cross-Section	Range of Applicability				Override Rule	
Concrete Deck or Filled Grid, Partially Filled Grid, or Unfilled Grid Deck Composite with Reinforced	a, e, k and also i, j, if sufficiently connected to act as a unit	3.500	<=	S	<=	16.000	<input type="checkbox"/> Use limiting value when limit exceeded
		4.500	<=	ts	<=	12.000	
		20.000	<=	L	<=	240.000	
		4.000	<=	Nb	<=		
Concrete Slab on Steel or Concrete Beams; Concrete T-Beams, T and Double T-Sections		10000.000	<=	Kg	<=	7000000.00	
Cast-in-Place Concrete Multicell Box		7.000	<=	S	<=	13.000	<input type="checkbox"/> Use limiting value when limit exceeded
		60.000	<=	L	<=	240.000	
		3.000	<=	Nc	<=		
Concrete Deck on Concrete Spread Box Beams	b, c	6.000	<=	S	<=	18.000	<input type="checkbox"/> Use limiting value when limit exceeded
		20.000	<=	L	<=	140.000	
		18.000	<=	d	<=	65.000	
		3.000	<=	Nb	<=		
Concrete Beams Used in Multibeam Decks	f, g	35.000	<=	b	<=	60.000	<input type="checkbox"/> Use limiting value when limit exceeded
		20.000	<=	L	<=	120.000	
		5.000	<=	Nb	<=	20.000	
Concrete Beams Used in Multibeam Decks	h, also i, j if connected only enough to prevent relative vertical displacement at the interface		<=	Skew	<=	45.000	<input type="checkbox"/> Use limiting value when limit exceeded
			<=	NL	<=	6.000	

Save Close



Enhancements for 6.7.1 – March 2016

- Added Range of Applicability Override for LRFD Distribution Factors Calculations (continued)

Range of Applicability					Override Rule	
3.500	<=	▼	S	<=	▼	16.000
4.500	<=	▼	ts	<=	▼	12.000
20.000	<=	▼	L	<=	▼	240.000
4.000	<=	▼	Nb		▼	
		▼			▼	7000000.000
10000.000	<=	▼	Kg	<=	▼	13.000
7.000	<=	▼	S	<=	▼	240.000
60.000	<=	▼	L	<=	▼	

Use limiting value when limit exceeded

Override Rules

- When the Override Rule checkbox is not selected and the range violated, BrDR will use the Lever Rule Override.
- When the Override Rule checkbox is selected and the variable:
 - When the value of the variable is smaller than the range use the lowest applicability range value.
 - When the value of the variable is larger than the range use the Lever Rule Override
- When the Override Rule checkbox is selected and the variable:
 - When the value of the variable is smaller than the range use the Lever Rule Override.
 - When the value of the variable is larger than the range use highest applicability range value.

If range is violated and checkbox is **unchecked** use Lever Rule.

If range is violated and checkbox is **checked** refer to Help.

Enhancements for 6.7.1 – March 2016

Concrete Enhancement (Caltrans)

- Option to disable concrete spec article output

Analysis Settings

Design Review Rating

Design Method: LRFD

Analysis Type: Line Girder

Lane/Impact Loading Type: As Requested

Apply Preference Setting: None

Vehicles Output Engine Description

Tabular Results:

- Concrete Limit State Summary Report
- Dead Load Action Report
- Live Load Action Report
- LRFD Critical Loads Report
- LRFD Specification Check Report
- PS Concrete Stress Report
- RC Service Stress Report
- Steel Limit State Summary Report

AASHTO Engine Reports:

- FE Model for DL Analysis
- FE Model for LL Analysis
- LL Influence Lines FE Model
- LL Influence Lines FE Actions
- LL Distrib. Factor Computations
- LL Distrib. Factor Summary
- Regression Data
- Camber
- Fatigue Stress Ranges
- Service II Stress Ranges
- Specification Output
 - LRFD/LRFR Conc Article Detailed

Select All Clear All

Select All Clear All

Enhancements for 6.8 – July 2016

Annual AASHTO Engine Specification Updates

- ❑ MBE 2nd Edition, 2016 interim
- ❑ LRFD 7th Edition 2016 interim

Member Alternative Description

Member Alternative: Plate Girder

Description Specs Factors Engine Import Control Options

Analysis Method Type	Analysis Module	Selection Type	Spec Version
ASD	AASHTO ASD	System Default	MBE 2nd 2016i, Std 17th
LFD	AASHTO LFD	System Default	MBE 2nd 2016i, Std 17th
LRFD	AASHTO LRFD	System Default	LRFD 7th 2016i
LRFR	AASHTO LRFR	Override	<ul style="list-style-type: none"> 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 2016i, LRFD 7th 2016i 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 2016i, LRFD 7th 2016i
 MBE 2nd LRFD 5th
 MBE 2nd LRFD 5th 2010i

Enhancements for 6.8 – July 2016

Curved Girder Part 3 – Diaphragm and Lateral Bracing Spec-checking and Rating

- Release history for 3D analysis:

Straight multi-girder system rating and design/review	Oct 2012, Version 6.4
Curved steel multi-girder system rating and design/review	July 2013, Version 6.5
Curved girder enhancements	July 2014, Version 6.6
Straight and curved girder model improvements	June 2015, Version 6.7
Straight and curved girder diaphragm spec-check and rating	July 2016, Version 6.8

Enhancements for 6.8 – July 2016

Curved Girder Part 3 – Diaphragm and Lateral Bracing Spec-checking and Rating

Structure Framing Plan Details

Number of spans = Number of girders =

Layout Diaphragms Lateral Bracing Ranges

Girder Bay: Copy Bay To... Diaphragm Wizard...

Spacing Reference Type	Support Number	Start Distance (ft)		Left Diaphragm Spacing (ft)	Right Diaphragm Spacing (ft)	Number of Spaces	Left Length (ft)	Right Length (ft)	End Distance (ft)		Load (kip)	Diaphragm
		Left Girder	Right Girder						Left Girder	Right Girder		
Both Girders	1	0.00	0.00	0.000	0.000	1	0.00	0.00	0.00	0.00		K Frame
Both Girders	1	0.00	0.00	20.471	20.157	7	143.30	141.10	143.30	141.10		X Frame
Both Girders	1	143.30	141.10	20.471	20.157	1	20.47	20.16	163.77	161.26		X Frame
Both Girders	2	0.00	0.00	19.541	19.241	10	195.41	192.41	195.41	192.41		X Frame
Both Girders	2	195.41	192.41	19.541	19.241	1	19.54	19.24	214.95	211.65		X Frame
Both Girders	3	0.00	0.00	20.471	20.157	7	143.30	141.10	143.30	141.10		X Frame
Both Girders	3	143.30	141.10	20.471	20.157	1	20.47	20.16	163.77	161.26		K Frame

Diaphragms can be defined and assigned (6.4 release)

Enhancements for 6.8 – July 2016

- Selection of bracing members to be evaluated

Bracing Specification Check Selection

Diaphragms | Lateral Bracing

Select diaphragms for specification checking in a 3

Select All | Clear All

Bay 1	Bay 2	Bay 3
<input checked="" type="checkbox"/> 1-1	<input type="checkbox"/> 2-1	<input type="checkbox"/> 3-1
<input checked="" type="checkbox"/> 1-2	<input type="checkbox"/> 2-2	<input type="checkbox"/> 3-2
<input checked="" type="checkbox"/> 1-3	<input type="checkbox"/> 2-3	<input type="checkbox"/> 3-3
<input type="checkbox"/> 1-4	<input type="checkbox"/> 2-4	<input type="checkbox"/> 3-4
<input type="checkbox"/> 1-5	<input type="checkbox"/> 2-5	<input type="checkbox"/> 3-5
<input type="checkbox"/> 1-6	<input type="checkbox"/> 2-6	<input type="checkbox"/> 3-6
<input type="checkbox"/> 1-7	<input type="checkbox"/> 2-7	<input type="checkbox"/> 3-7
<input type="checkbox"/> 1-8	<input type="checkbox"/> 2-8	<input type="checkbox"/> 3-8
<input type="checkbox"/> 1-9	<input type="checkbox"/> 2-9	<input type="checkbox"/> 3-9
<input type="checkbox"/> 1-10	<input type="checkbox"/> 2-10	<input type="checkbox"/> 3-10
<input type="checkbox"/> 1-11	<input type="checkbox"/> 2-11	<input type="checkbox"/> 3-11
<input type="checkbox"/> 1-12	<input type="checkbox"/> 2-12	<input type="checkbox"/> 3-12

Schematics: Framing Plan View

LFD Curved Guide Spec
LFD Curved Guide Spec Example - Curved Structure Definition
03/25/14

OK | Apply

Enhancements for 6.8 – July 2016

- Spec-checking and Rating results for bracing members can be reviewed

Analysis Results - Simple Span Structure Bracing

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

Live Load	Live Load Type	Rating Method	Inventory Load Rating (Ton)	Operating Load Rating (Ton)	Legal Operating Load Rating (Ton)	Permit Inventory Load Rating (Ton)	Permit Operating Load Rating (Ton)	Inventory Rating Factor	Operating Rating Factor	Legal Rating Factor
Type 3	Axle Load	LFD	143.51	239.66				5.740	9.586	

Bracing

Legal Operating Rating Factor	Permit Inventory Rating Factor	Permit Operating Rating Factor	Inventory Element Name	Operating Element Name	Legal Operating Element Name	Permit Inventory Element Name
			1-3 CB-2	1-3 CB-2		

Enhancements for 6.8 – July 2016

- Spec-checking and Rating results for bracing members can be reviewed

Analysis Results - S

Report Type: Dead Load Actions Stage: Non-composite (Stage 1) Dead Load Case: Self Load (Stage 1:D,DC)

Bracing	Element	Bracing Member	Node	Axial (kip)	Y Shear (kip)	Z Shear (kip)	Torsion (kip-ft)	Y Moment (kip-ft)	Z Moment (kip-ft)
1-1	1969	AB1	1	-0.163	-0.012	-0.022	0.000	0.079	0.000
			1489	0.163	0.012	0.022	-0.000	0.041	-0.064
	1970	AB2	1489	0.040	0.011	-0.022	0.000	0.040	0.060
			373	-0.040	-0.011	0.022	-0.000	0.081	0.000
	1971	CD	3	0.000	0.000	0.006	-0.000	-0.033	0.000
			375	-0.000	0.000	-0.006	0.000	-0.029	0.000
1972	CE	3	0.180	0.000	0.007	0.000	-0.000	0.000	
		1489	-0.180	-0.000	-0.007	-0.000	-0.066	0.002	
1973	ED	1489	-0.152	0.000	0.008	0.000	-0.066	0.002	
		375	0.152	-0.000	-0.008	-0.000	-0.001	0.000	
1-2	1974	AB	13	-0.973	0.000	-0.066	-0.001	0.371	0.000
			385	0.973	0.000	0.066	0.001	0.352	0.000
	1975	CD	15	0.957	0.000	-0.001	-0.000	0.006	0.000

Enhancements for 6.8 – July 2016

- Spec-checking and Rating results for bracing members can be reviewed

Specification Checks for Simple Span Structure Bracing - 7 of 188

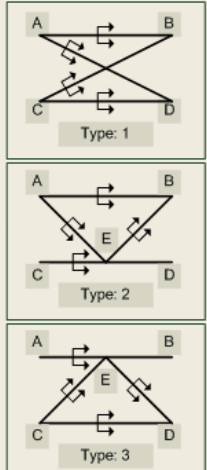
Specification Reference	Limit State	Flex. Sense	Pass/Fail
10.54.1.1 Maximum Axial Load Capacity		N/A	General Comp.
10.54.2.1 Compute Fe		N/A	General Comp.
10.54.2.2 Compute C		N/A	General Comp.
✓ 6B.4 Combined Axial and Bending		N/A	Passed
First Yield Moment (My) Calculations for All T...		N/A	General Comp.
LFD Steel Truss Allowable Tension Net Sectio...			
LFD Steel Truss Plastic Section Properties			

Diaphragm Definition

Name: X Frame Diaphragm type: Type 1

Members Connections

Diaphragm types:



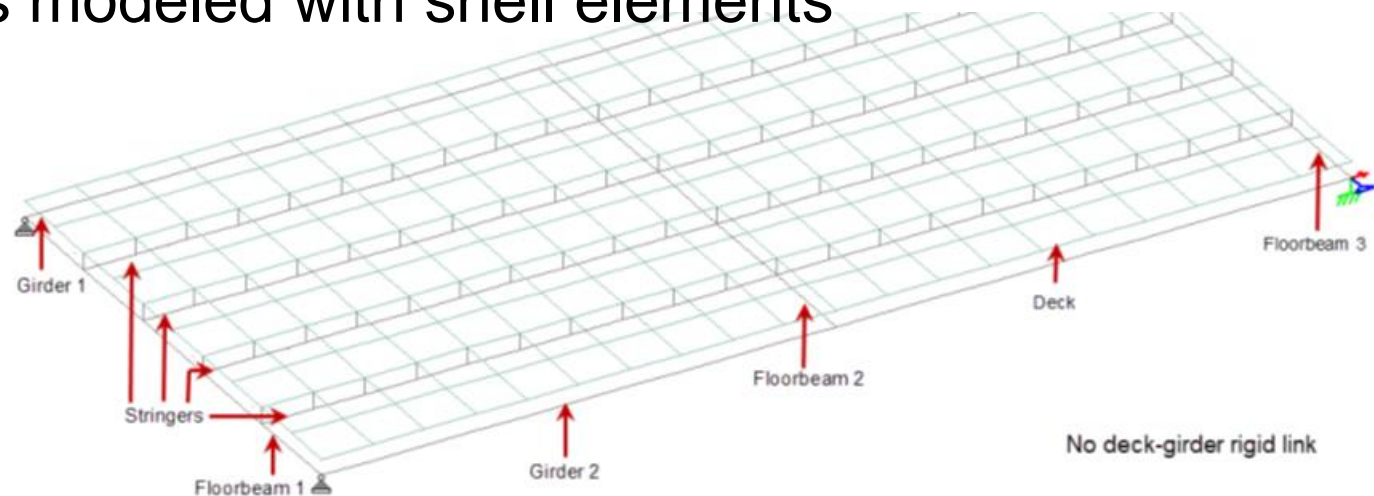
Member	Shape	Section Orientation	Section Location	Material
AB	L 6x	Vertical	Top L	Grade
CD	L 6x	Vertical	Top L	Grade
AD	L 6x	Vertical	Top L	Grade
CB	L 6x	Vertical	Top L	Grade

Connection	Support Type	Y (in)	Measured From
A	Pinne		Top of

Enhancements for 6.8 – July 2016

Non-standard Gage Vehicle Rating of Floor Systems

- Floor systems composed of girders, floor beams and stringers
- Concrete or corrugated metal deck
- Girders, floor beams and stringers are modeled with frame elements
- Deck is modeled with shell elements



Enhancements for 6.8 – July 2016

Regression Comparison Tool

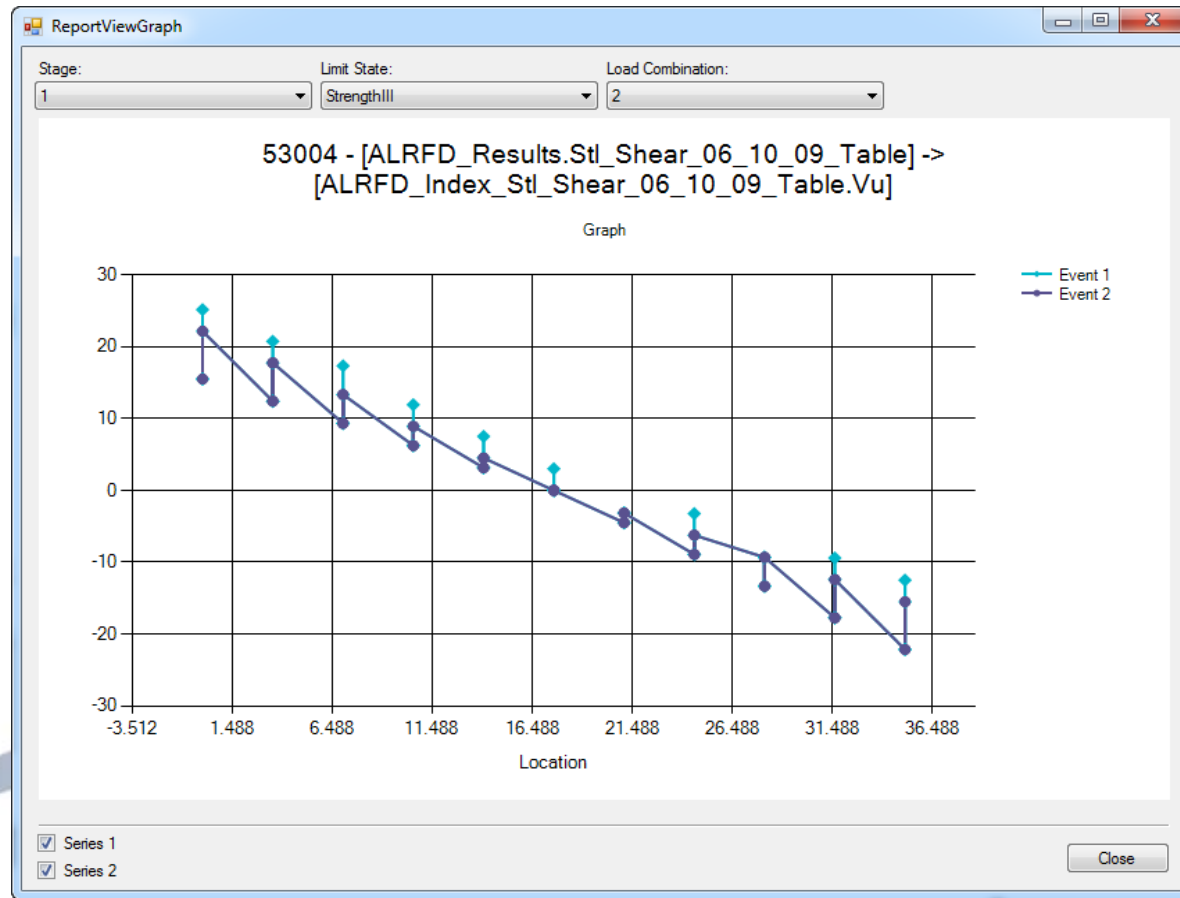
- Easily compare two analyses from two different versions of the software, or different versions of the specification

COMPARE RESULTS										
Bridge	Analysis Event Template	Member Alternative	Event 1	Event 2	Type	Matching	Non Matching Event 1	Non Matching Event 2	Comment	
RTU_10001	Default LRFD Template	LRFD-4-2009:G1:Left Exterior Girder:LRFD-4-2009	v660	~v670	Rtu	176600	0	0	OK!	
RTU_10001	Default LRFD Template	LRFD-5-0000:G1:Left Exterior Girder:LRFD-5-0000	v660	~v670	Rtu	176600	0	0	OK!	
RTU_10001	Default LRFD Template	LRFD-5-2010:G1:Left Exterior Girder:LRFD-5-2010	v660	~v670	Rtu	176600	0	0	OK!	
RTU_10002	Default LRFD Template	LRFD-4-2009:G2:Left Interior Girder:LRFD-4-2009	v660	~v670	Rtu	30569	0	0	OK!	
RTU_10002	Default LRFD Template	LRFD-5-0000:G2:Left Interior Girder:LRFD-5-0000	v660	~v670	Rtu	30569	0	0	OK!	
RTU_10002	Default LRFD Template	LRFD-5-2010:G2:Left Interior Girder:LRFD-5-2010	v660	~v670	Rtu	30556	13	13	TROUBLE!	
RTU_10003	Default LRFD Template	LRFD-4-2009:G1:Copy of Interior Girder:LRFD-4-2009	v660	~v670	Rtu	38653	0	0	OK!	
RTU_10003	Default LRFD Template	LRFD-5-0000:G1:Copy of Interior Girder:LRFD-5-0000	v660	~v670	Rtu	38653	0	0	OK!	
RTU_10003	Default LRFD Template	LRFD-5-2010:G1:Copy of Interior Girder:LRFD-5-2010	v660	~v670	Rtu	38653	0	0	OK!	
RTU_10004	Default LRFD Template	LRFD-4-2009:Typical Interior:Copy of 60_Plate Girder:LRF...	v660	~v670	Rtu	127367	0	0	OK!	
RTU_10004	Default LRFD Template	LRFD-5-0000:Typical Interior:Copy of 60_Plate Girder:LRF...	v660	~v670	Rtu	127367	0	0	OK!	
RTU_10004	Default LRFD Template	LRFD-5-2010:Typical Interior:Copy of 60_Plate Girder:LRF...	v660	~v670	Rtu	127366	0	0	OK!	

Enhancements for 6.8 – July 2016

Regression Comparison Tool

- Display comparison results for a specific attribute graphically



Enhancements for 6.8 – July 2016

Prestressed Concrete Design Tool

- Highlights of the tool:
 - A standalone utility that runs independently outside of BrD
 - LRFD
 - Uses the AASHTO finite element engine and spec-checking modules
 - Capable of using library data from BrD
 - Capable of exchanging design results with BrD
 - Iterates a list of beams, designs the strand pattern and shear reinforcement and reports a design ratio

Enhancements for 6.8 – July 2016

Rating Tool

- Highlights of the tool:
 - Very fast computation of rating factors using precomputed data
 - Computation of flexure and shear capacities in many cases are dependent on the live load – requires more computations by the rating tool
 - Rating results match BrR results
 - Agencies have different reporting requirements – added some configuration options for an agency to customize the feedback

Enhancements for 6.8 – July 2016

User Group Balloted Enhancements:

Incident	Description	Product	Status
JIRA 687 (Ranked #3)	LFR analysis of reinforced concrete and post-tensioned multi-cell box beams	BrR	Completed for 6.8 release
JIRA 553 (Ranked #4)	3D FEM and 3D FEM-Vehicle Path analysis of superstructure with hinges	Both	Completed hinge modeling study for 3D girder system models

Top Maintenance Items:

Incident	Description	Product	Status
VI 10332	Ability to specify design vehicles in the Shear Stud Design Tool and Shear Stirrup Design Tool	BrD	Completed for 6.8 release
VI 12091	Ability to process only applicable limit states based on vehicle categories for reinforced concrete box culverts	Both	Completed for 6.8 release
VI 12135	Culvert Wizard for creating culverts, culvert structure alternatives and assign culvert definitions to alternatives	Both	Completed for 6.8 release
VI 12608	Ability to specify limit states for LRFD design review of reinforced concrete box culverts	BrD	Completed for 6.8 release
JIRA 269	Remove Uniform Load Contraflexure Points dead load case from the Analysis Results window	Both	Completed for 6.8 release
JIRA 452	Ability to enforce unique name for the Bridge Workspace items in a folder	Both	Completed for 6.8 release
JIRA 499	Ability to specify LRFD 6th Edition 2013 Interim for LRFD design review and LRFR analysis of reinforced concrete box culverts	Both	Completed for 6.8 release

Support Site - aashto.mbakercorp.com

The screenshot shows a web browser window displaying the homepage of the AASHTOWare Bridge Design & Rating website. The browser's address bar shows the URL <https://aashto.mbakercorp.com/Pages/defa>. The website features a blue header with the AASHTOWare Bridge Design & Rating logo on the left and a navigation menu on the right including "User Login", "About", "News", "Support", "Training", "Downloads", "Links", and "Contact". Below the header is a large image of a blue steel truss bridge. A search bar is located below the image with the placeholder text "Search this site...". The main content area is divided into two columns. The left column has a "Welcome" section with a paragraph of text. The right column has a "Highlighted Posts" section with a link to "AASHTOWare Bridge Design and Rating Version 6.8 - New Features".

https://aashto.mbakercorp.com/Pages/defa

AASHTOWare Bridge Design & Rating

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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 6.8 - New Features](#)

Support Site - aashto.mbakercorp.com



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More than 90 tutorials

Training

Tutorials

<input type="checkbox"/> Type	Name	File Size	File Date
Category : 3D FEM Analysis (4)			
	2015 BrDR 3D Modeling Improvements	194 KB	7/28/2015
	STL10 Diaphragm Training Example	385 KB	7/24/2016
	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 (18)			
	2014 Spec Update Overview	773 KB	8/4/2014

Currently updating
all tutorials to the 6.8
release



Thank you