AASHTOWare Bridge Design and Rating

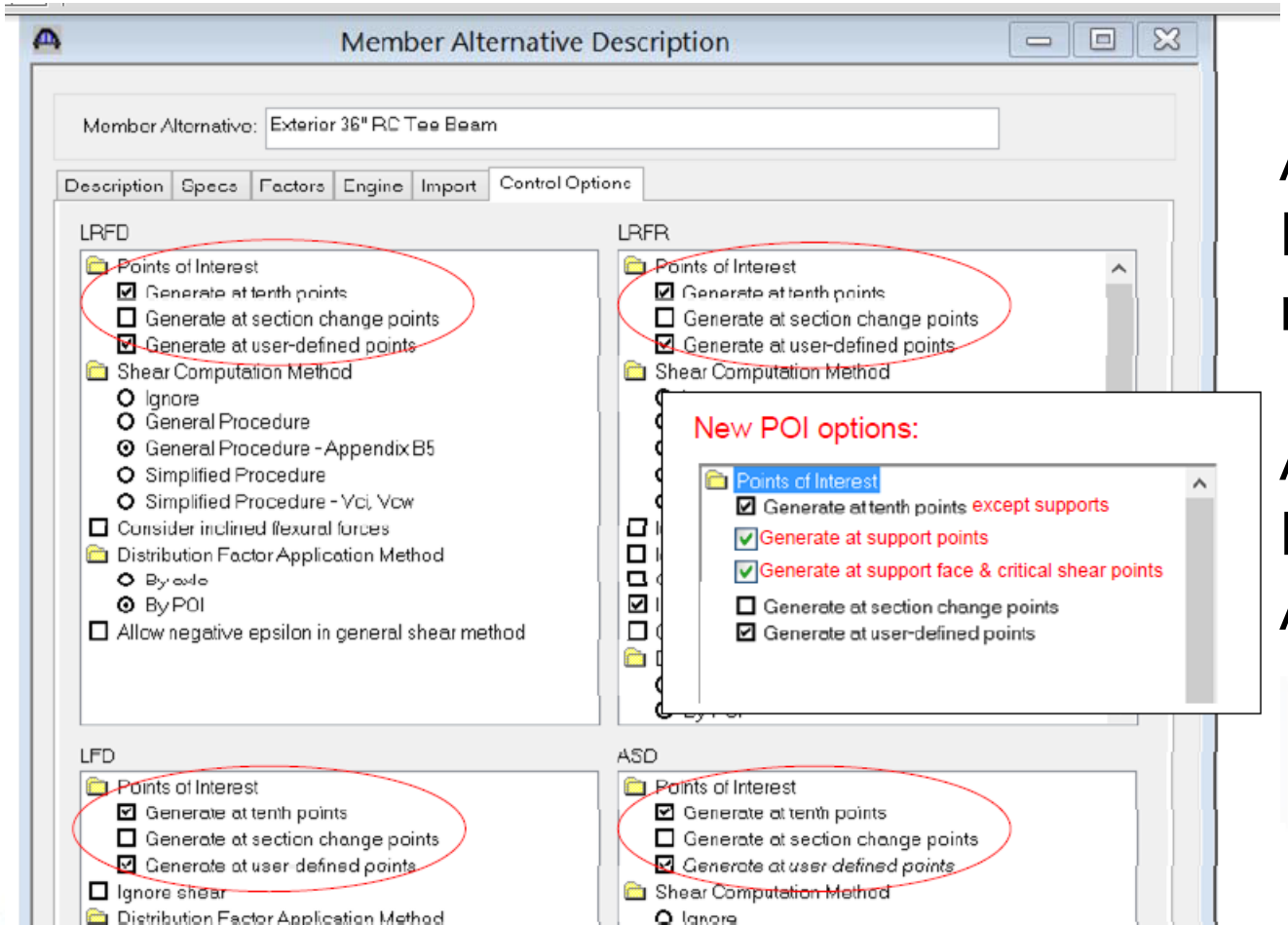
Technical Update

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)



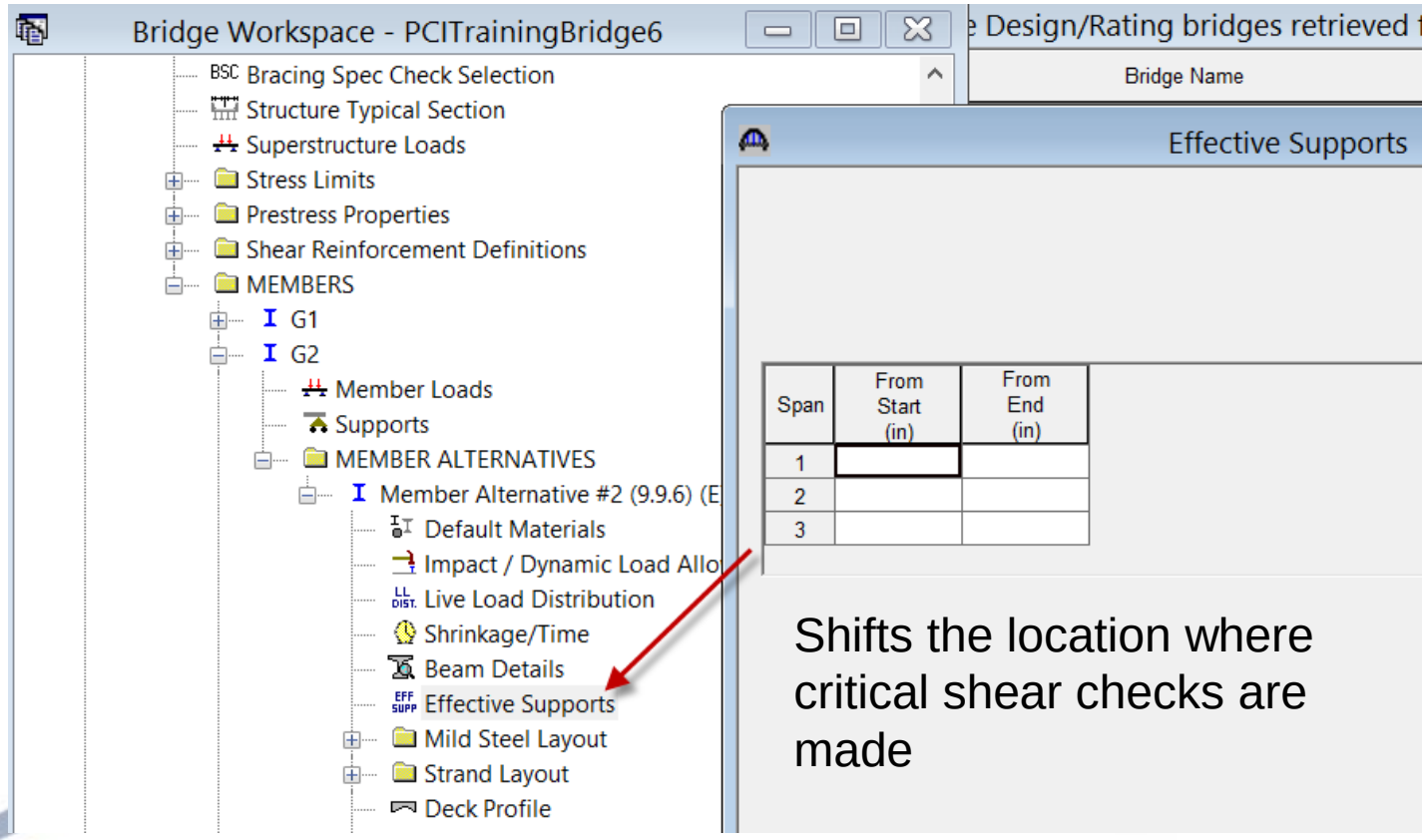
Applies to P/S, R/C and MCB members

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)



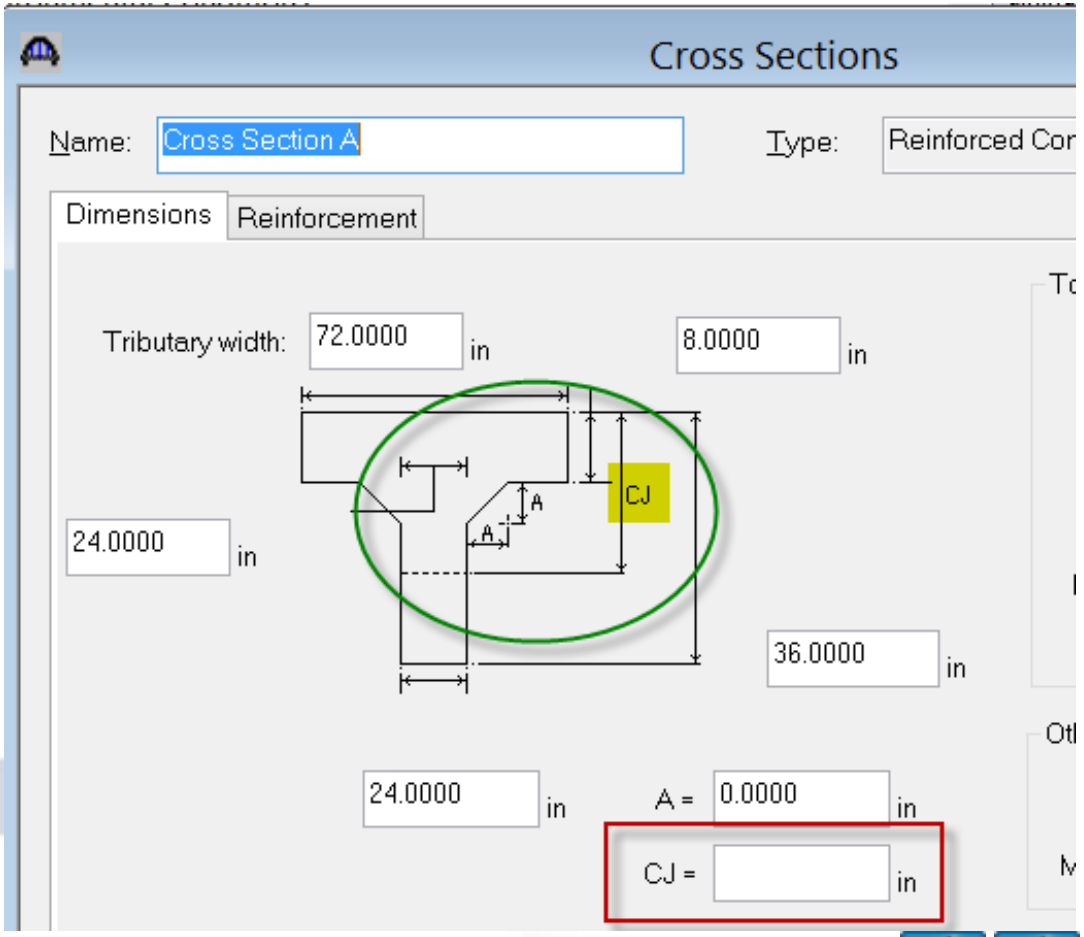
Enhancements for 6.7.1 – March 2016

Concrete Tee Beam Enhancement (Caltrans)

- Construction Joint for RC Tee Beams

For both cross-section based and schedule based

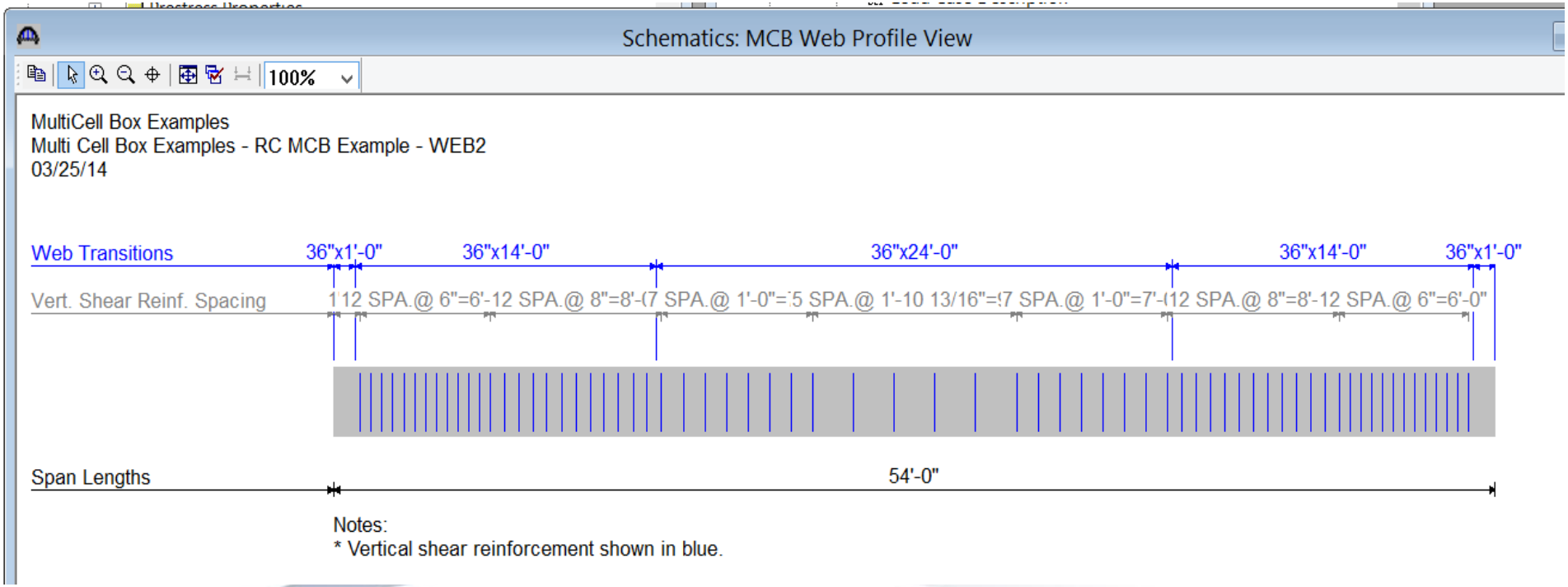
Development length is adjusted for bars in close proximity to the joint



Enhancements for 6.7.1 – March 2016

Multi-cell Concrete Box Enhancement (Caltrans)

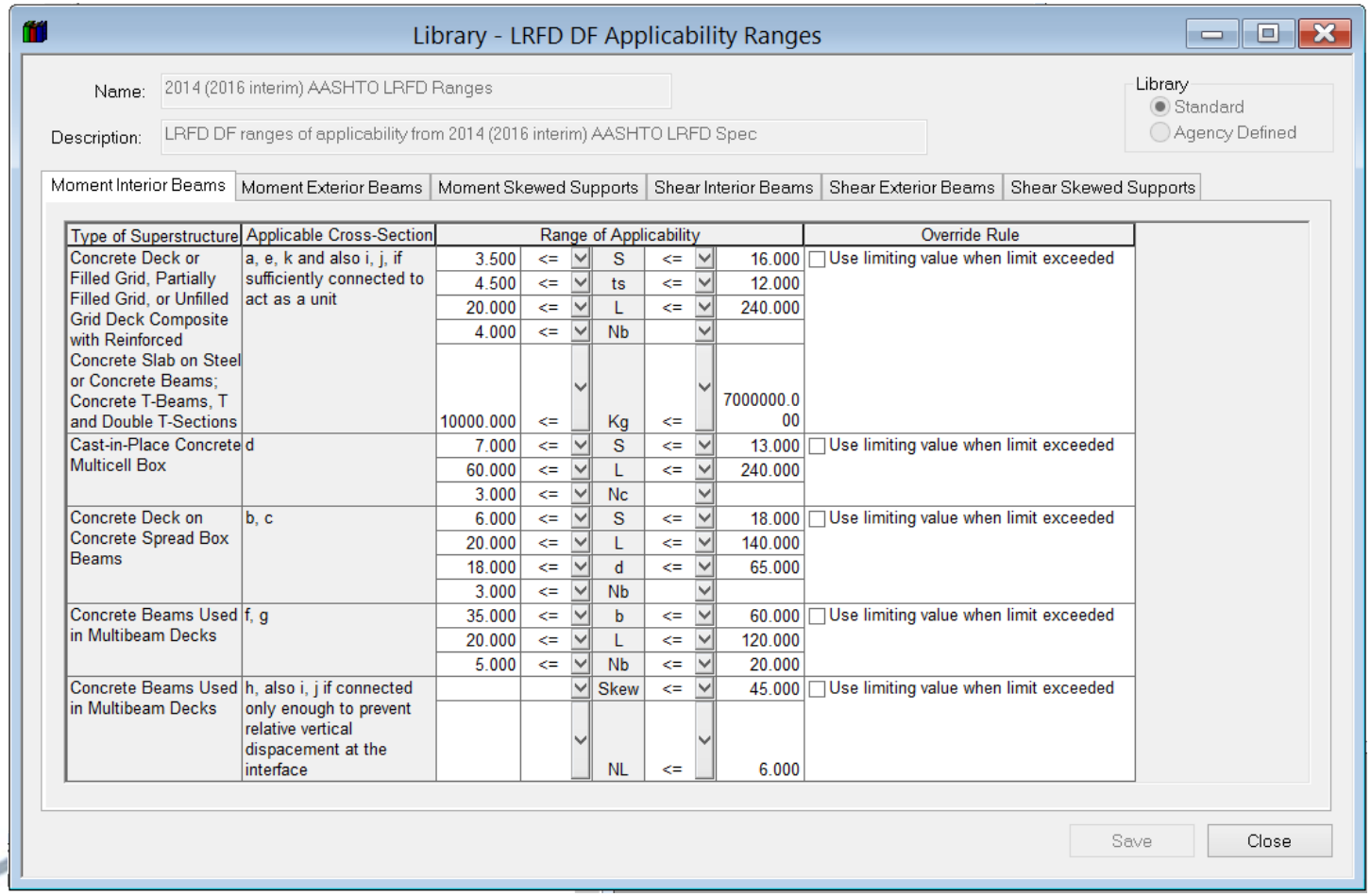
- Added a Web Schematic to Show Stirrups and Dimensions



Enhancements for 6.7.1 – March 2016

Steel and Concrete Enhancement (Caltrans)

- Added Range of Applicability Override for LRFD Distribution Factors Calculations



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 Concrete Slab on Steel or Concrete Beams; Concrete T-Beams, T and Double T-Sections	a, e, k and also i, j, if sufficiently connected to act as a unit	3.500	<=	S	<=	16.000	Use limiting value when limit exceeded
		4.500	<=	ts	<=	12.000	
		20.000	<=	L	<=	240.000	
		4.000	<=	Nb			
		10000.000	<=	Kg	<=	7000000.000	
Cast-in-Place Concrete Multicell Box	d	7.000	<=	S	<=	13.000	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	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	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 dispacement at the interface			Skew	<=	45.000	Use limiting value when limit exceeded
				NL	<=	6.000	

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	☐ Use limiting value when limit exceeded
4.500	<=	ts	<=	12.000	
20.000	<=	L	<=	240.000	
4.000	<=	Nb			
10000.000	<=	Kg	<=	7000000.000	
7.000	<=	S	<=	13.000	☐ U
60.000	<=	L	<=	240.000	

Override Rules

1. When the Override Rule checkbox is not selected and the range violated, BrDR will use the Lever Rule Override.
2. When the Override Rule checkbox is selected and the variable
   a. When the value of the variable is smaller than the range use the lowest applicability range value.
   b. When the value of the variable is larger than the range o use the Lever Rule Override
3. When the Override Rule checkbox is selected and the variable
   a. When the value of the variable is smaller than the range use the Lever Rule Override.
   b. When the value of the variable is larger than the range o use highest applicability range value.

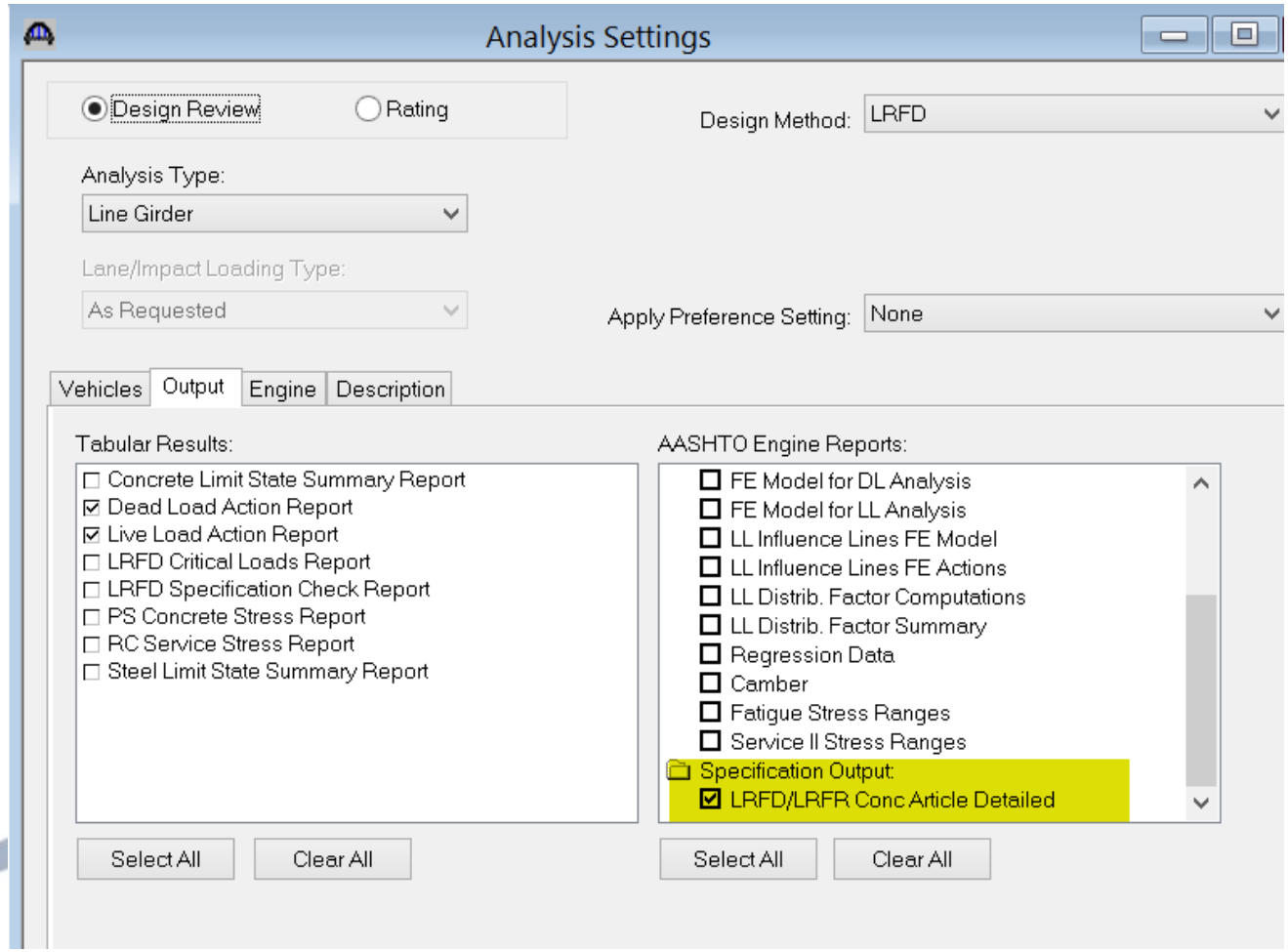
If range is violated and checkbox is unchecked use Lever Rule.

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

Enhancements for 6.7.1 – March 2016

Concrete Enhancement (Caltrans)

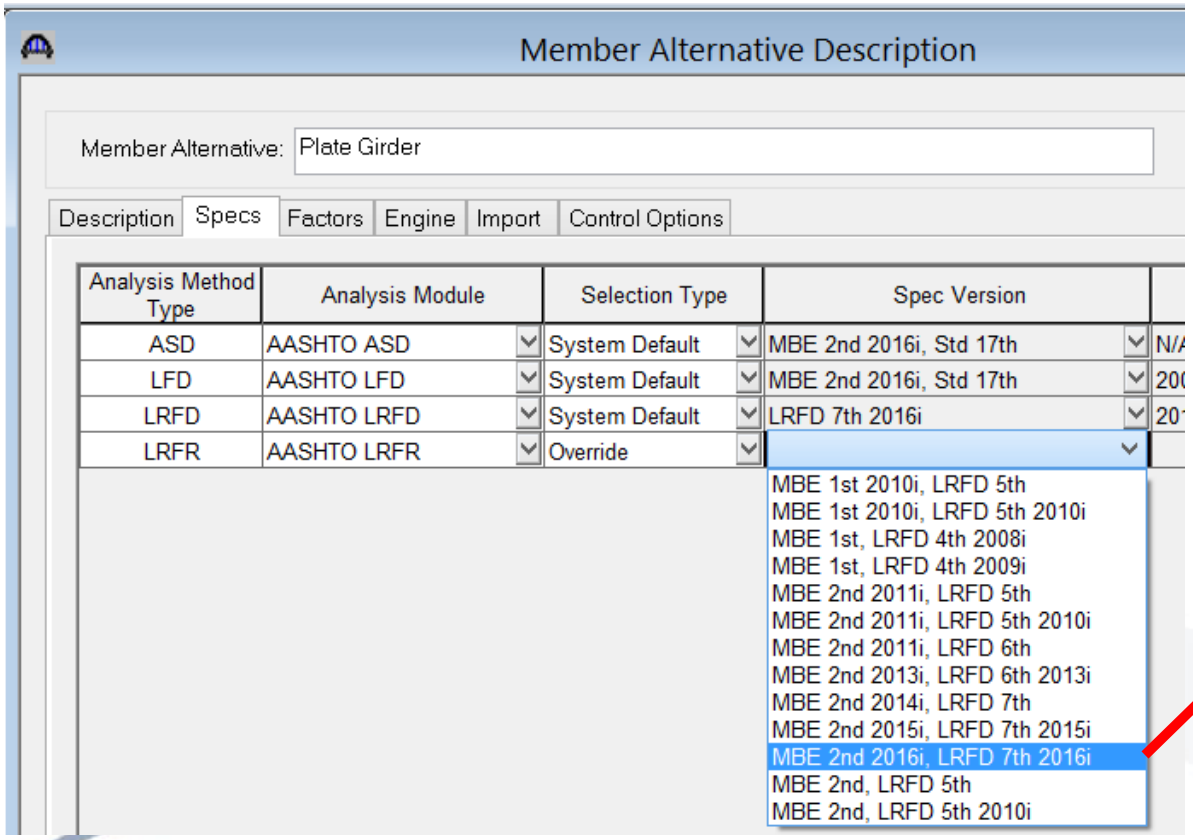
- Option to disable concrete spec article output



Enhancements for 6.8 – July 2016

Annual AASHTO Engine Specification Updates

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



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

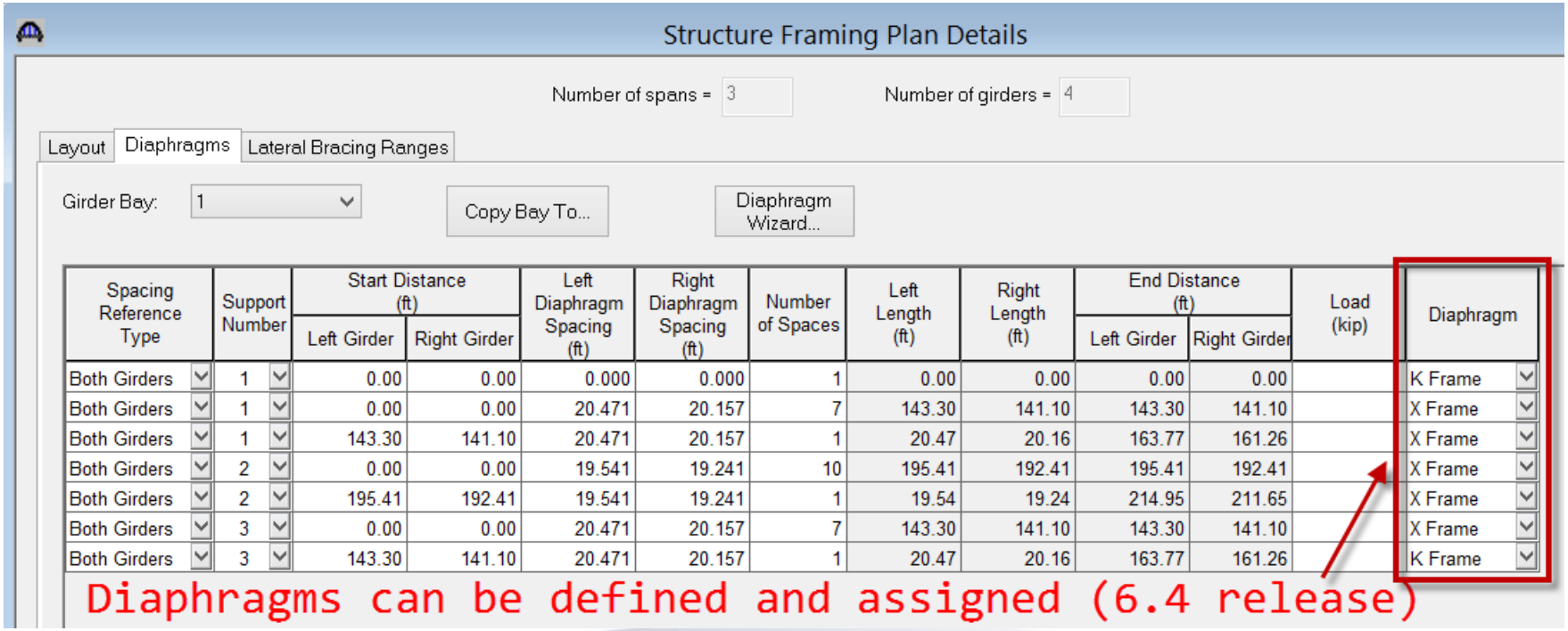
Curved Girder Part 3 – Diaphragm and Lateral Bracing Spec-checking and Rating

- 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

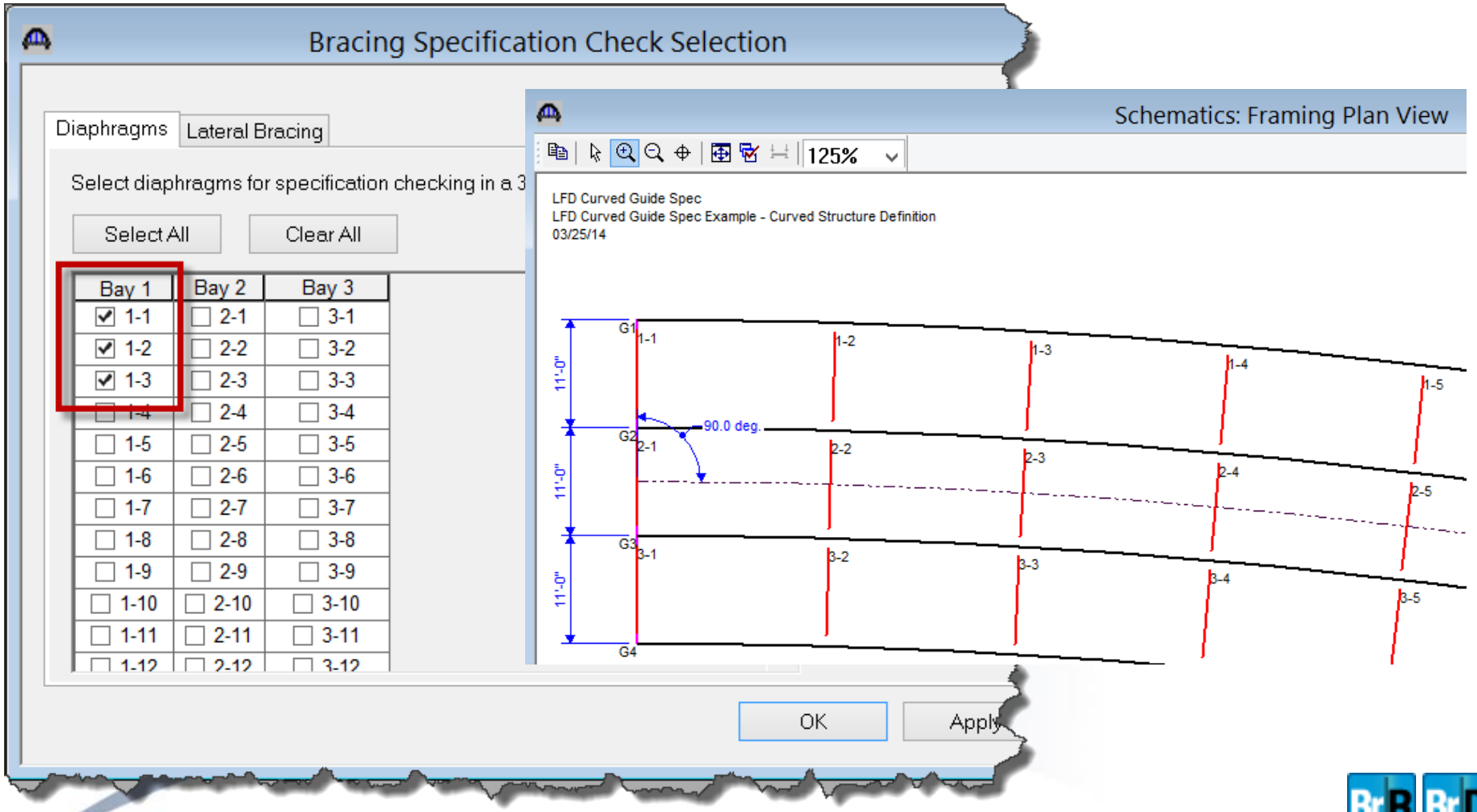
Curved Girder Part 3 – Diaphragm and Lateral Bracing Spec-checking and Rating



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

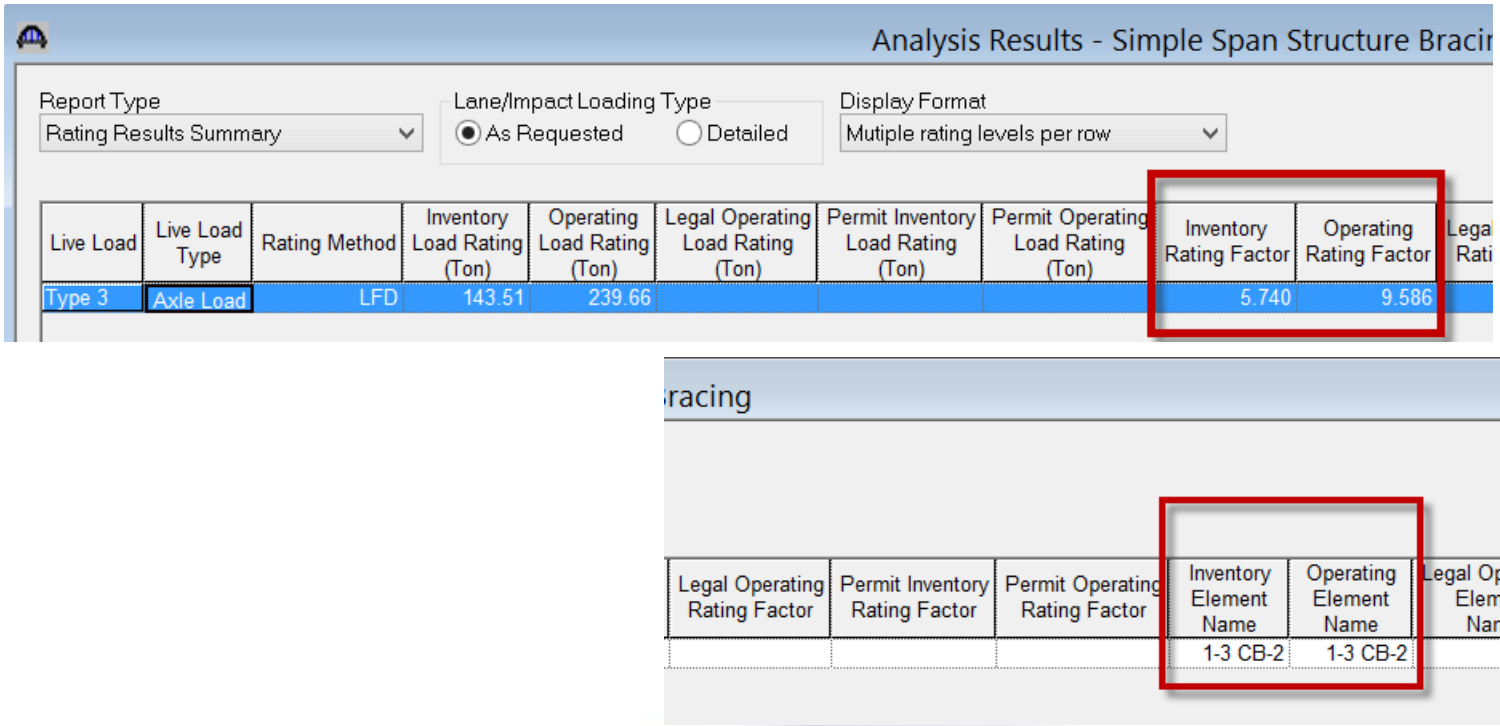
Enhancements for 6.8 – July 2016

- Selection of bracing members to be evaluated



Enhancements for 6.8 – July 2016

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



Enhancements for 6.8 – July 2016

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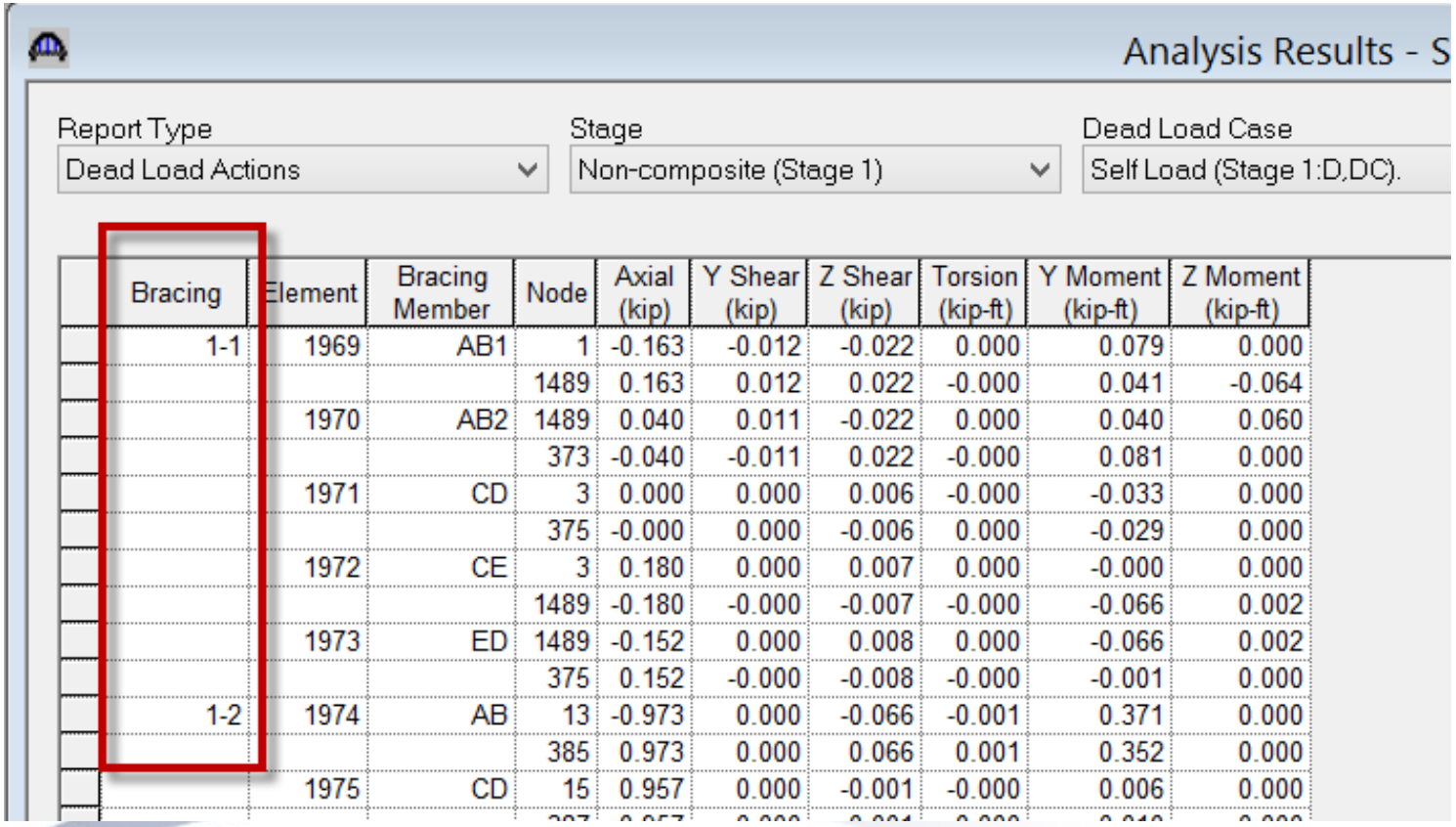


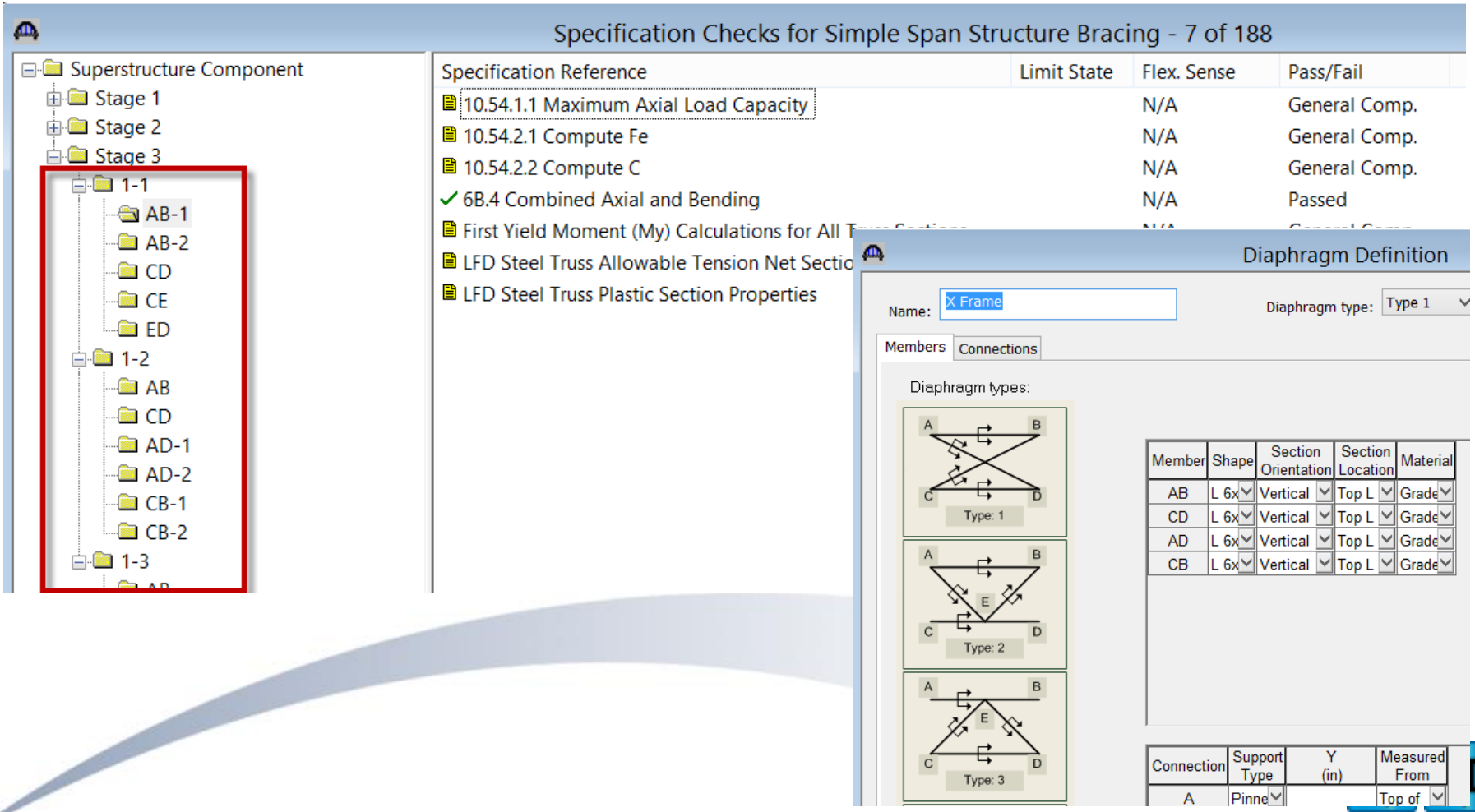
Analysis Results - S

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

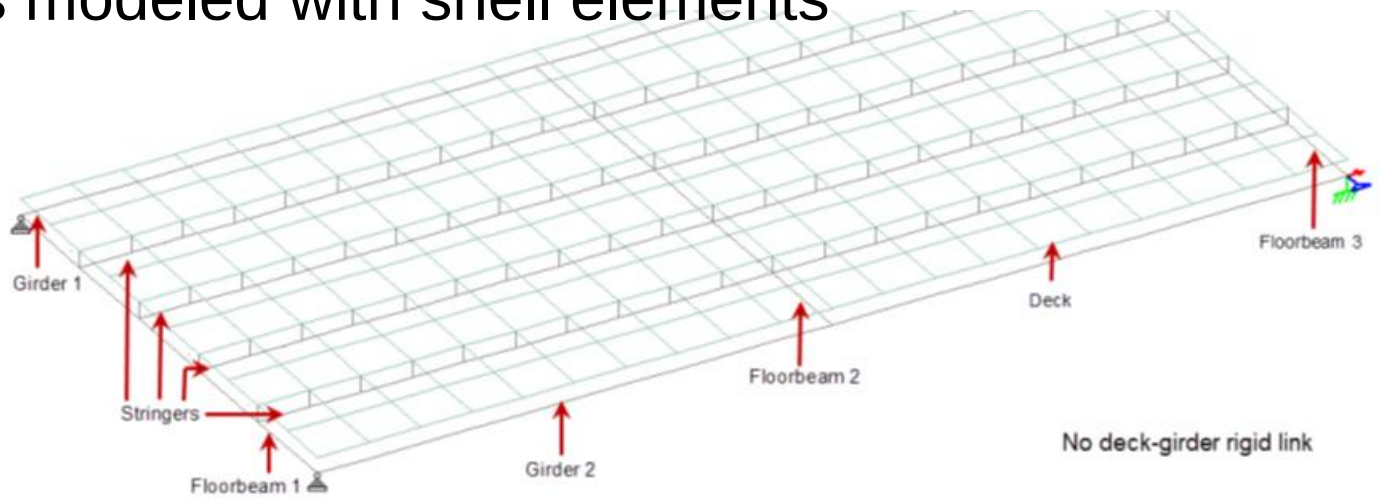
- Spec-checking and Rating results for bracing members can be reviewed



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

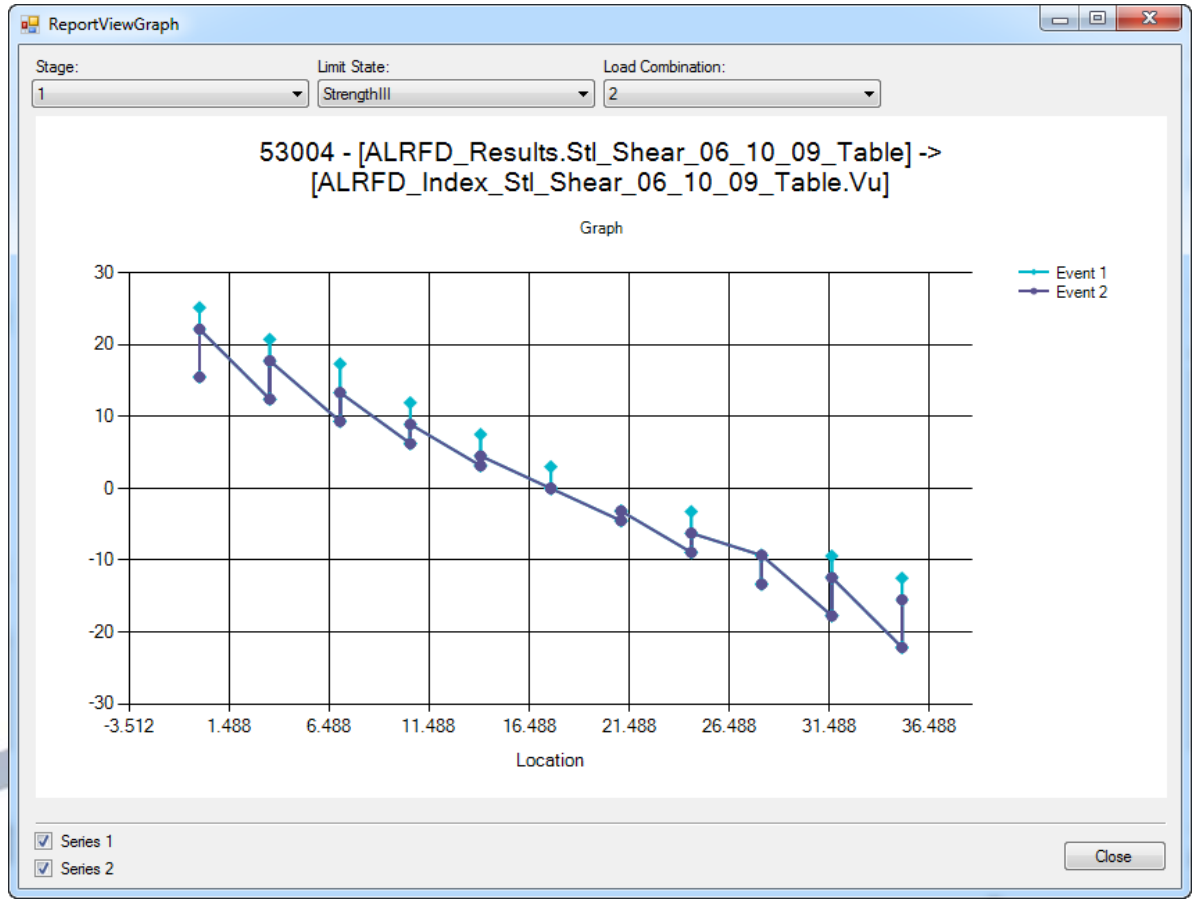
COMPARE RESULTS

	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

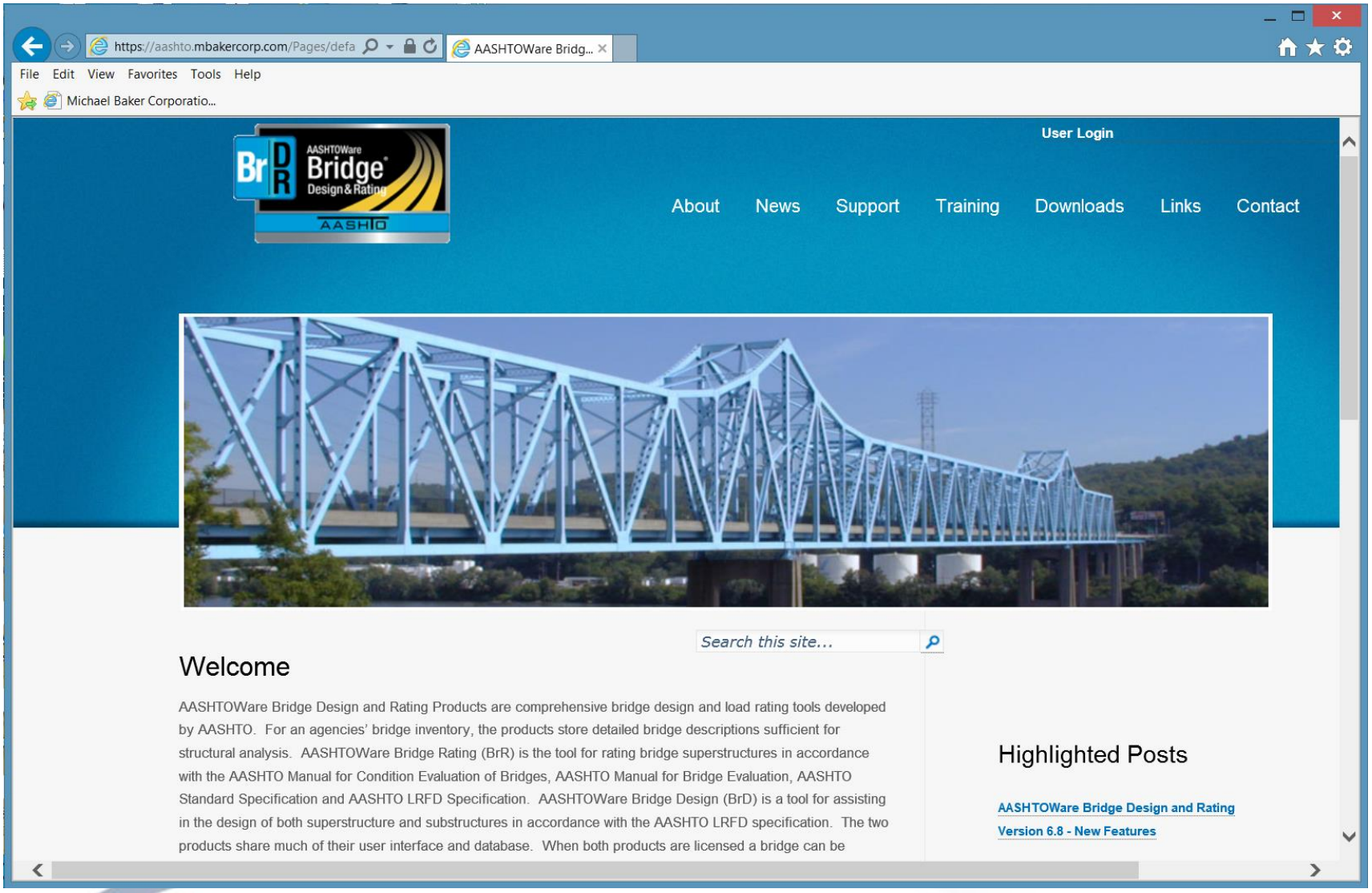
User Group Balloted Enhancements:

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



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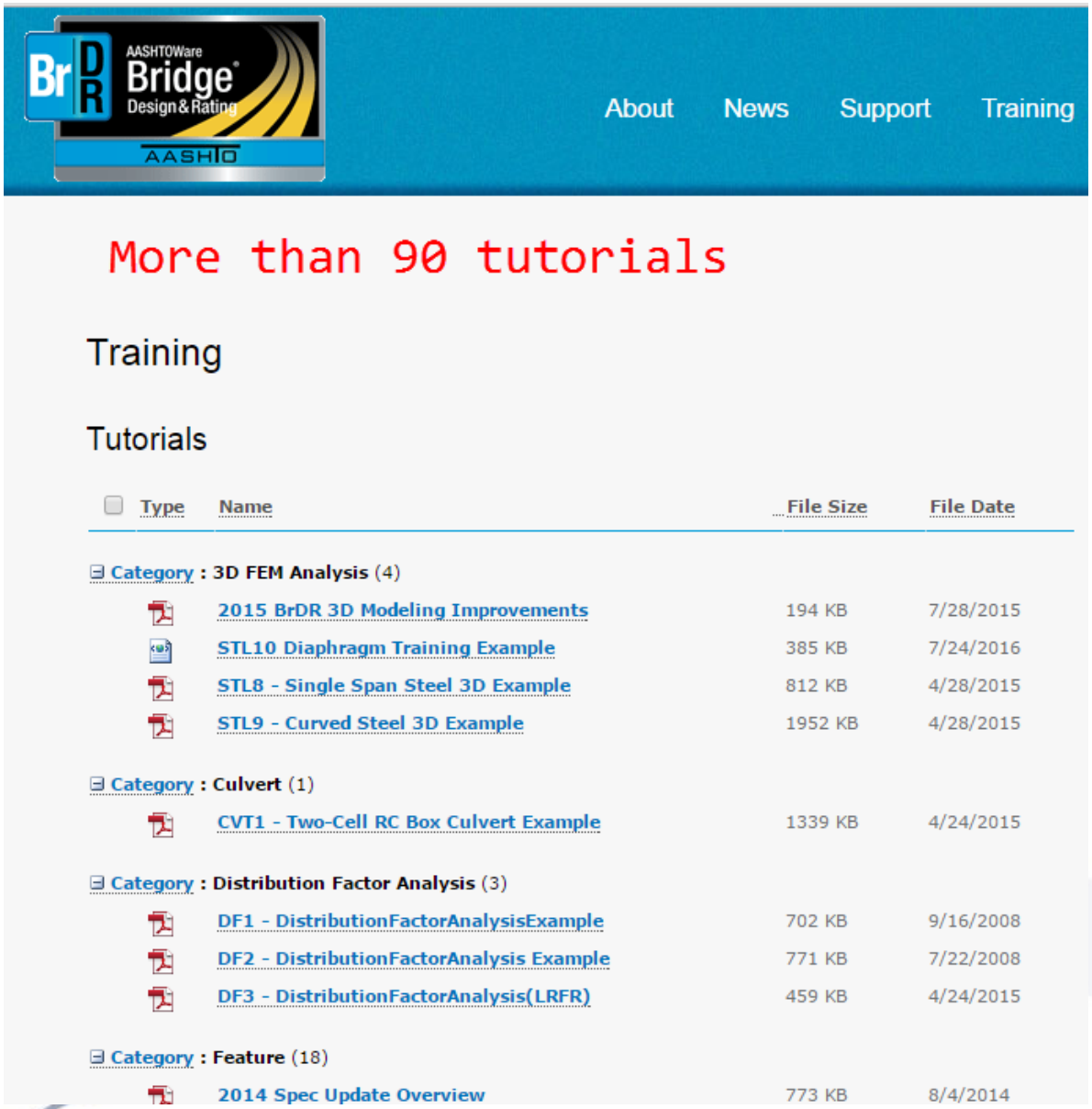

Currently updating all tutorials to the 6.8 release

Thank you