

February 16, 2017

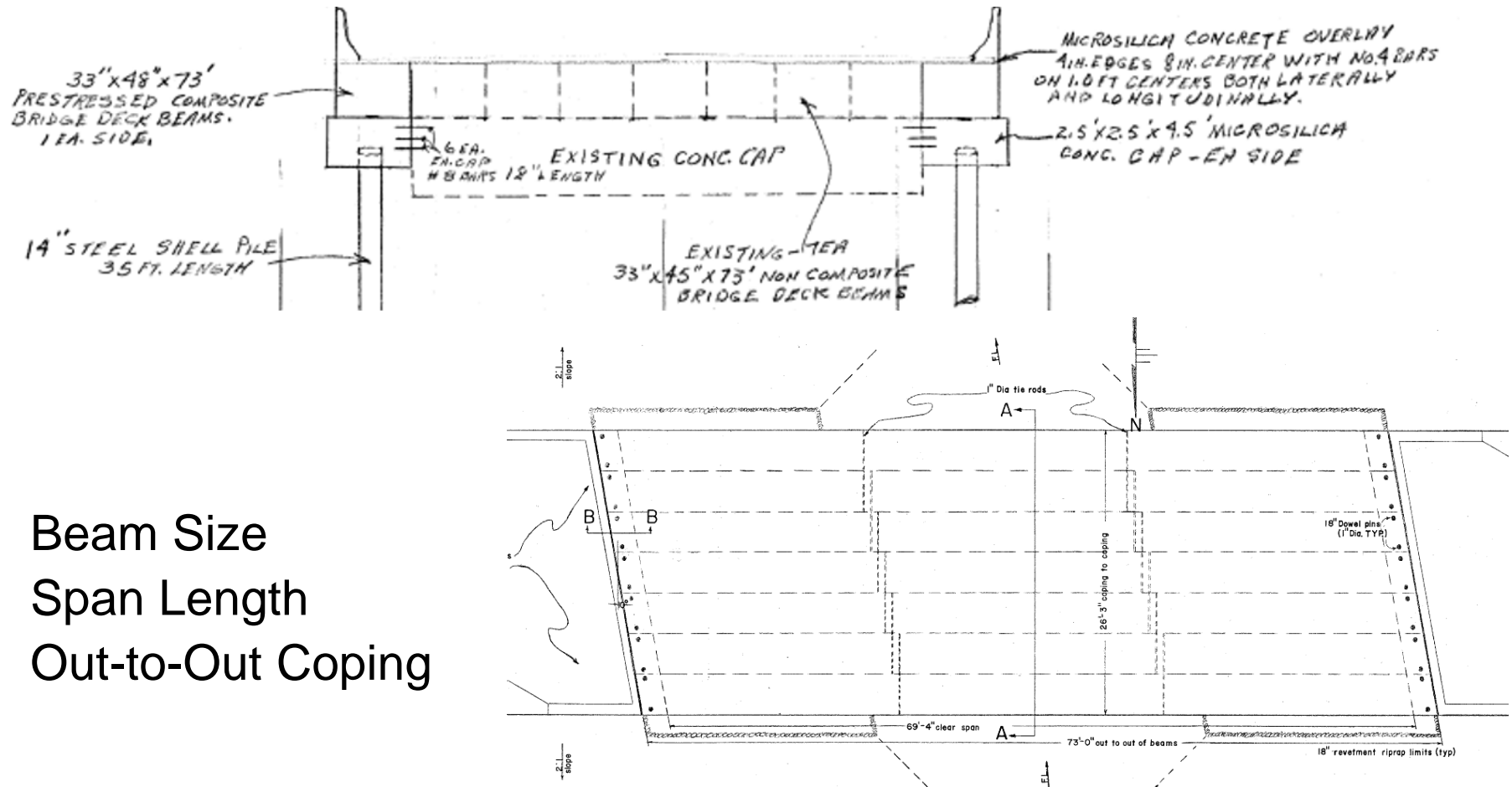
BrR County Rating Example



Collect Information

BrR County Rating Example

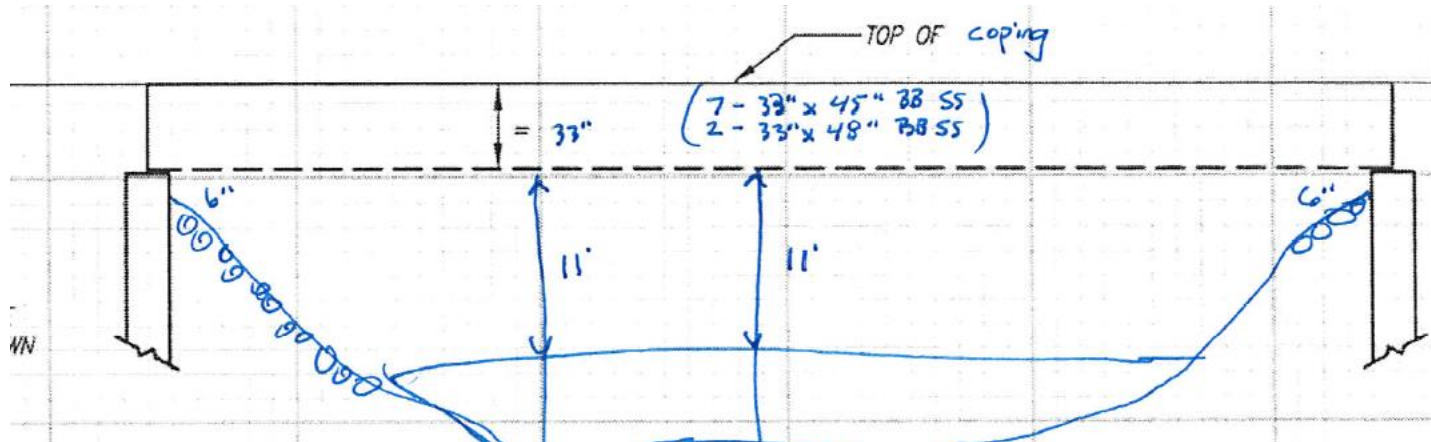
Existing Plans



Beam Size
Span Length
Out-to-Out Coping

BrR County Rating Example

Inspection Notes



- BM 7 - 3 EXP STRANDS
- BM 8 - 1 EXP STRAND

- Confirm Plans
 - Beam Size
 - Span Length
 - Out-to-Out Coping
- Note Deterioration

BrR County Rating Example

BIAS Data

AGE OF SERVICE

27.	Year Built:	1972
-----	-------------	------

GEOMETRIC DATA

48.	Maximum Span Length:	69.2 ft.
-----	----------------------	----------

50A.	Sidewalk/Curb Left:	0 ft.
------	---------------------	-------

51.	Bridge Roadway Width:	31.8 ft.
-----	-----------------------	----------

32.	Approach Roadway Width:	22 ft.
-----	-------------------------	--------

34.	Skew:	10 Degree(s)
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BrR County Rating Example



Box Beam Standard Drawings

■ Material Properties from Bridge Standard PB6

➤ Prestressed Concrete

➤ $f'_{ci} = 4000$ psi

➤ $f'_c = 5000$ psi

➤ Prestressing Strands

➤ 7 Wire Stress Relieved

➤ 250,000 psi or 270,000 psi

➤ Interior Diaphragm Locations

DESIGN DATA _____

SPECIFICATIONS: AASHTO Standard Specifications for Highway Bridges, 1999 Edition.

DIAPHRAGMS: 8" Diaphragms at midspan for spans up to 50' and 6" Diaphragms at the third points for spans from 50' to 75' and at quarter points over 75'.

DRAWINGS: Shop drawings and calculations must be submitted by the manufacturer with the contract. These to include outline of prestressing procedure for graded strands and the pattern being used.

SPAN TABLES: The span tables shown for the various sections on these sheets are based upon the following design conditions: 15-20-26 live load, 28' Roadway, 10' load distribution at quarter points by 1999 AASHTO Specifications, concrete weighing 150 lbs. per cu. ft. with $f'_c = 5000$ psi and $f'_{ci} = 4000$ psi, an allowance of 50 lbs. per sq. ft. for wearing surface, normal steel, and allowable stresses as given in the design specifications.

The prestressing steel shall be 7 wire stress relieved strands of 250,000 P.S.I. minimum tensile strength for standard strands and 270,000 P.S.I. minimum tensile strength for the high strength strands as shown in tables.

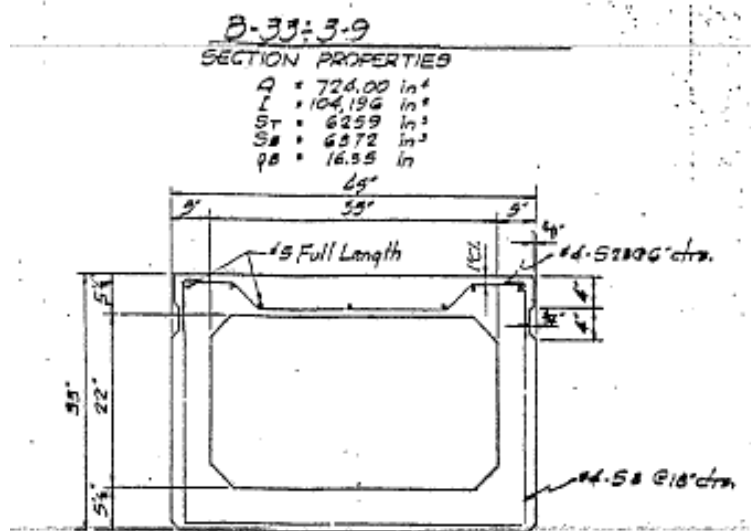
COMPOSITE BEAMS: PB 9A and PB 9B designed with 8" composite slab ($f'_c = 3000$ P.S.I.) and 95 lbs. per sq. ft. for future wearing surface.

BrR County Rating Example

Interior Beams 33"x45"x73' Non-Composite

Assume B-33 3-9

Prestressed Non-Composite Box Beam 3'-9" Wide
Bridge Standard PB 7A



HIGH STRENGTH STRAND 270 K

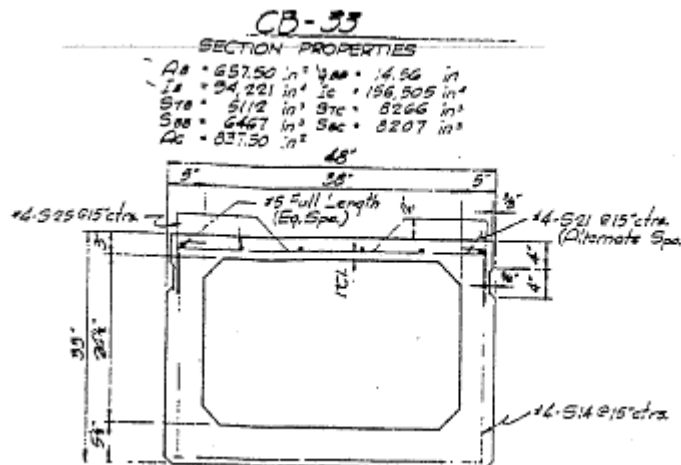
SPAN CCARDS (Feet)	Strand for Temp Erection	1		2	3		4		5	6	WEIGHT (lbs.)
		No.	Row		No.	Row	No.	Row			
57	1.49	22	1			2	13	1			47,100
			2				2				
			3				3				
59	1.48	24	1			1	13	1			48,600
			2				2				
			3				3				
61	1.61	25	1			1	12	1			50,200
			2				2				
			3				3				
63	1.77	27	1			1	13	1			51,700
			2				2				
			3				3				
65	1.93	27	1				16	1			53,200
		2	2				2				
			3				3				
67	2.09	27	1				17	1			54,700
		2	2				2				
			3				3				
69	2.26	27	1				18	1			56,200
		2	2				2				
			3				3				
71	2.42	27	1				18	1	18209		57,700
		2	2				2				
			3				3				

BrR County Rating Example

Exterior Beams 33"x48"x 73' Composite

Assume CB-33

Prestressed Non-Composite Box Beam 4'-0" Wide
Bridge Standard PB 9A



HIGH STRENGTH STRAND 270K

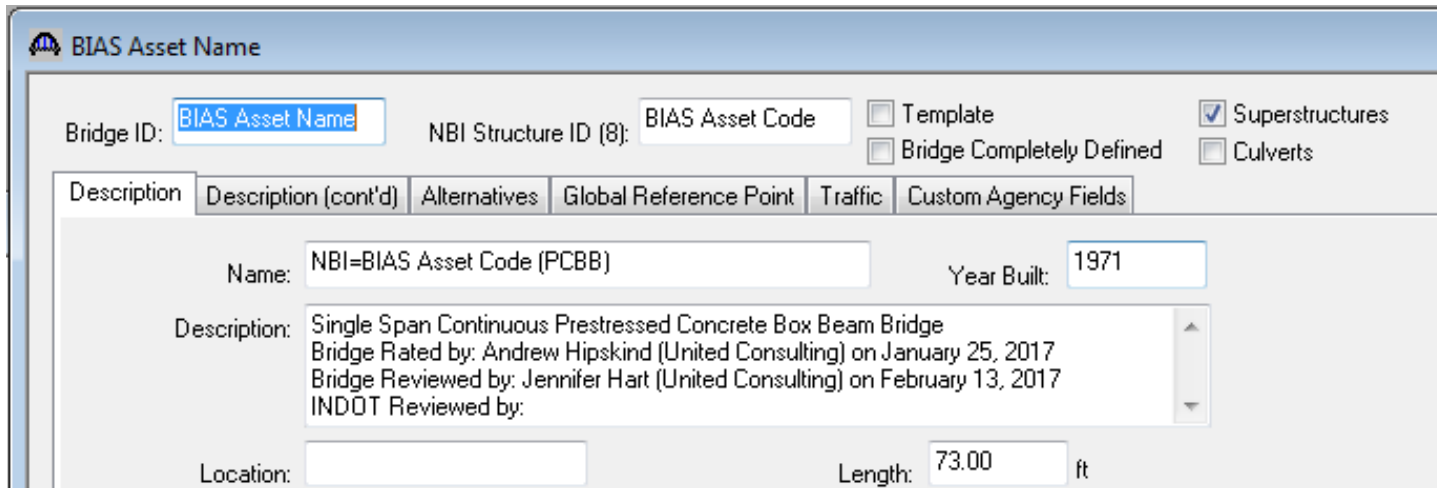
SPAN CL. BOX (Feet)	Slab Dead Load Δ	Span for Temp. End Stress	1		2		3		1		2		3		WEIGHT (lbs.)
			No.	Row	* BOND BREAK	No.	Row	* BOND BREAK	No.	Row	* BOND BREAK	No.	Row	* BOND BREAK	
59	3/8"	1.85	25	1					12	1					45,200
				2						2					
				3						3					
61	3/8"	2.01	27	1					15	1					46,600
				2						2					
				3						3					
63	1/4"	2.20	28	1					16	1					48,000
				2						2					
				3						3					
65	1/4"	2.22	29	1					17	1					49,300
				2						2					
				3						3					
67	3/8"	2.57	29	1					18	1					50,700
				2						2					
				3						3					
69	3/8"	2.76	29	1					19	1	1.229				52,100
				2						2					
				3						3					
71	3/8"	2.95	29	1					20	1	2.623				53,400
				2						2					
				3						3					

Build BrR Model

BrR County Rating Example

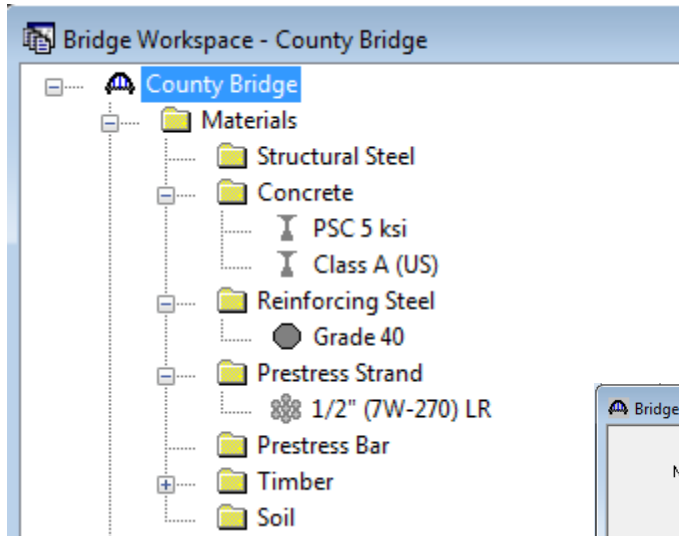
Bridge Description

- **Bridge ID = BIAS Asset Name**
- **NBI = BIAS Asset Code**
- **Description should include:**
 - **Name of individual responsible for the load rating**
 - **Name of individual responsible for review**
 - **Dates for each of the above**

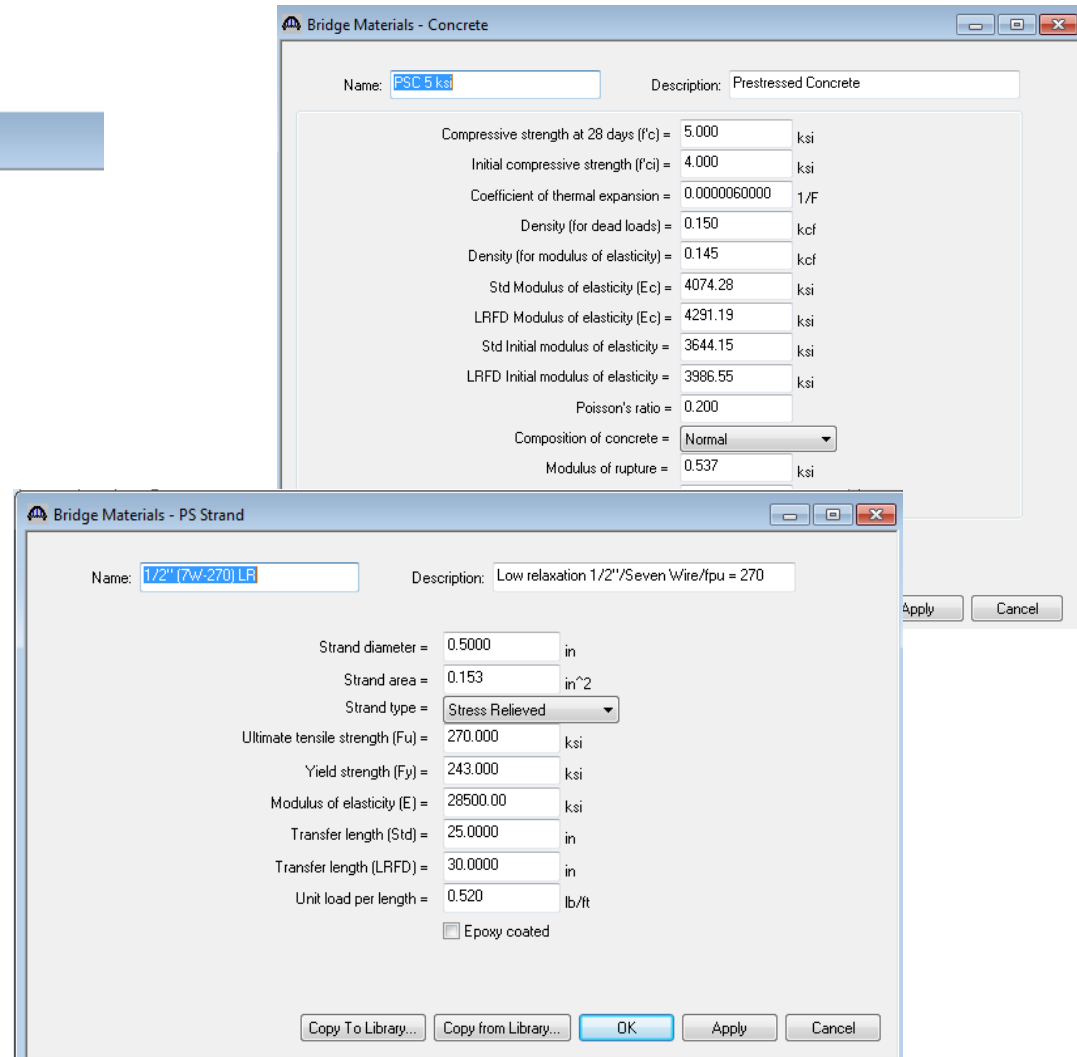
A screenshot of a software form titled 'BIAS Asset Name'. The form contains several input fields and checkboxes. The 'Bridge ID' field is labeled 'BIAS Asset Name'. The 'NBI Structure ID (8)' field is labeled 'BIAS Asset Code'. There are checkboxes for 'Template', 'Bridge Completely Defined', 'Superstructures' (checked), and 'Culverts'. Below these are tabs for 'Description', 'Description (cont'd)', 'Alternatives', 'Global Reference Point', 'Traffic', and 'Custom Agency Fields'. The 'Description' tab is active, showing a 'Name' field with 'NBI=BIAS Asset Code (PCBB)', a 'Year Built' field with '1971', and a 'Description' text area containing 'Single Span Continuous Prestressed Concrete Box Beam Bridge', 'Bridge Rated by: Andrew Hipkind (United Consulting) on January 25, 2017', 'Bridge Reviewed by: Jennifer Hart (United Consulting) on February 13, 2017', and 'INDOT Reviewed by:'. At the bottom, there are 'Location' and 'Length' fields, with 'Length' set to '73.00 ft'.

BrR County Rating Example

Define Materials



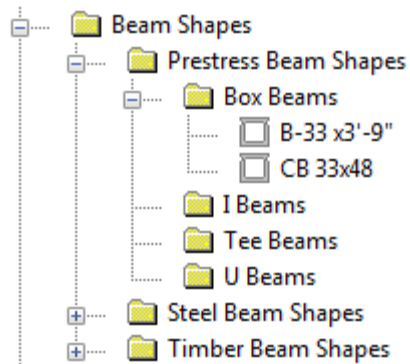
Start by copying materials from Library and make adjustments as needed.



BrR County Rating Example



Define Beam Shapes



PS Box Beam

Name: B-33 x3'-9"

Description:

Type of Void: ☒ Rectangular ☐ Circular

Dimensions

Properties

Mild Steel

Strand Grid

0.3750 in

5.0000 in

45.0000 in

45.0000 in

33.0000 in

5.5000 in

4.0000 in

4.0000 in

T = 5.5000 in

B1 = 3.0000 in

B2 = 3.0000 in

B3 = 3.0000 in

B4 = 3.0000 in

PS Box Beam

Name: B-33 x3'-9"

Description:

Type of Void: ☒ Rectangular ☐ Circular

Dimensions

Properties

Mild Steel

Strand Grid

Row 1

Distance

Row No.	No of Strands	Vertical Distance from bottom (in)	Horizontal Spacing (in)
1	19	1.7500	2.0000
2	1	3.7500	2.0000

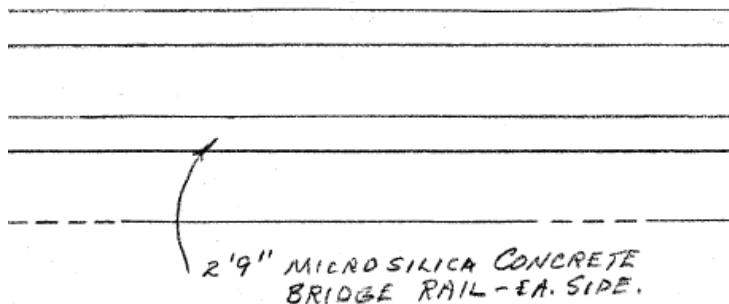
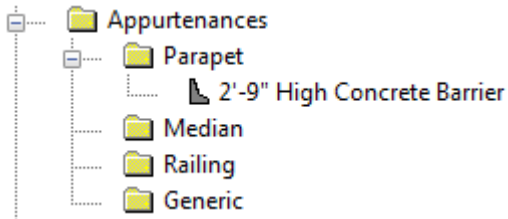
New Duplicate

Copy To Library... Copy from Library... OK Apply

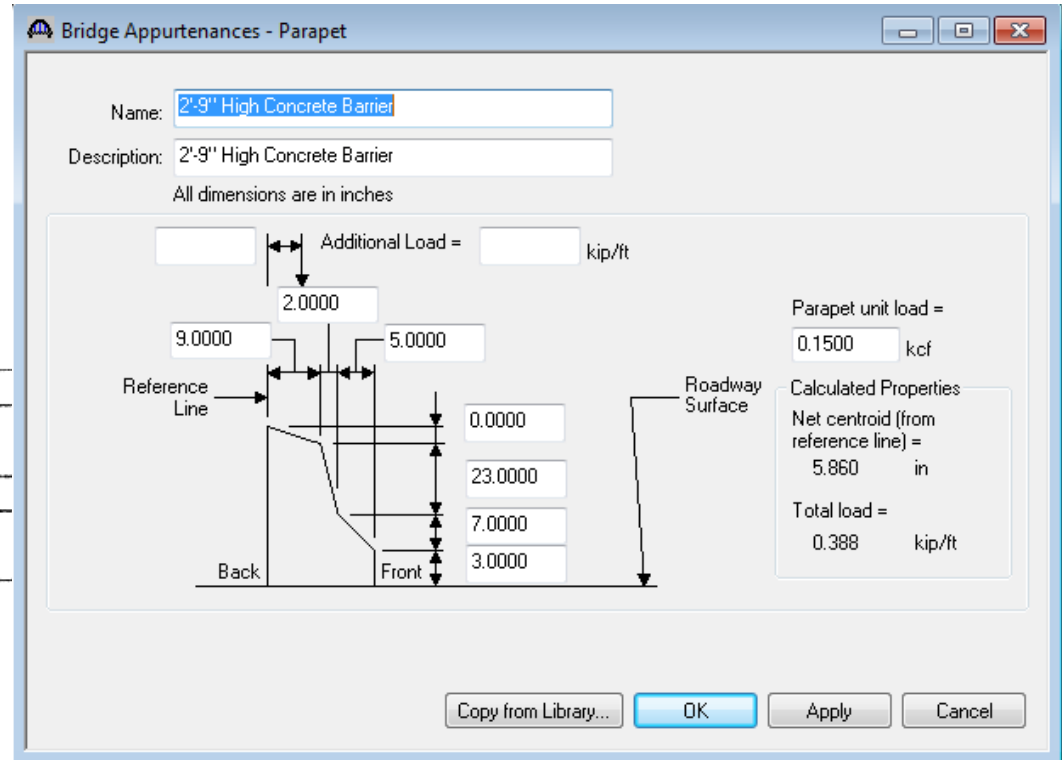
Build beams with dimensions that match the standard drawings

BrR County Rating Example

Define Railing / Appurtenances



*Rehab plans call out 2'-9"
bridge rail each side.*



Bridge Appurtenances - Parapet

Name: 2'-9" High Concrete Barrier

Description: 2'-9" High Concrete Barrier

All dimensions are in inches

Additional Load = kip/ft

2.0000

9.0000

5.0000

Reference Line

Back

Front

0.0000

23.0000

7.0000

3.0000

Roadway Surface

Parapet unit load = kcf

Calculated Properties

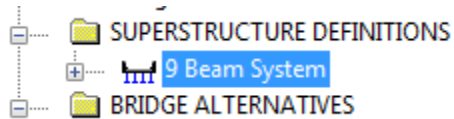
Net centroid (from reference line) = in

Total load = kip/ft

Copy from Library... OK Apply Cancel

BrR County Rating Example

Create Superstructure Definition



New Superstructure Definition

- ☒ Girder System Superstructure
- ☐ Girder Line Superstructure
- ☐ Floor System Superstructure
- ☐ Floor Line Superstructure
- ☐ Truss System Superstructure
- ☐ Truss Line Superstructure
- ☐ Reinforced Concrete Slab System Superstructure
- ☐ Concrete Multi-Cell Box Superstructure

Girder System Superstructure Definition

Definition | Analysis | Specs | Engine

Name: 9 Beam System

Description:

Default Units: US Customary

Number of spans: 1

Number of girders: 9

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	72.33

☐ Frame Structure Simplified Definition

Deck type: Concrete

For PS only

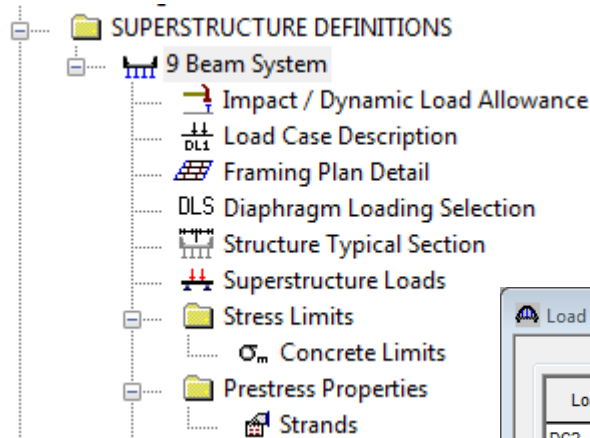
Average humidity: 70.000 %

Member Alt. Types

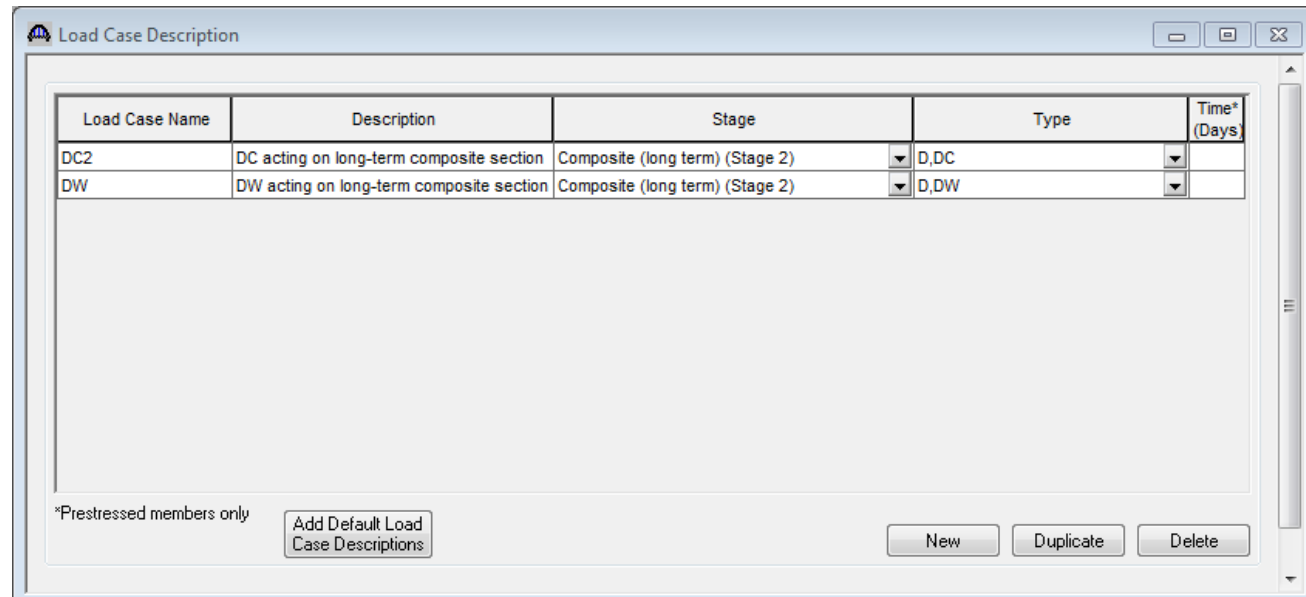
- ☐ Steel
- ☒ P/S
- ☐ R/C
- ☐ Timber

BrR County Rating Example

Create Load Cases



Start by adding Default Load Case Descriptions delete the ones not used.



Load Case Name	Description	Stage	Type	Time* (Days)
DC2	DC acting on long-term composite section	Composite (long term) (Stage 2)	D,DC	
DW	DW acting on long-term composite section	Composite (long term) (Stage 2)	D,DW	

*Prestressed members only

Add Default Load Case Descriptions

New Duplicate Delete

BrR County Rating Example

Create Framing Plan

Structure Framing Plan Details

Number of spans =

Layout Diaphragms

Girder Spacing Orientation

- ☒ Perpendicular to girder
- ☐ Along support

Support	Skew (Degrees)
1	-10.0000
2	-10.0000

Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	3.88	3.88
2	3.75	3.75
3	3.75	3.75
4	3.75	3.75
5	3.75	3.75
6	3.75	3.75
7	3.75	3.75
8	3.88	3.88

Schematics: Framing Plan View

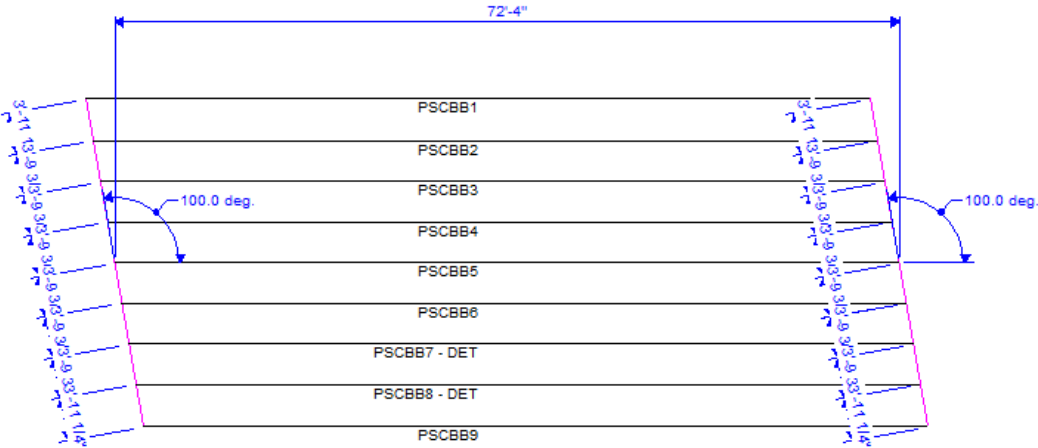
County Bridge
NBI=County Bridge NBI (PCBB) - 9 Beam System
02/14/17

72'-4"

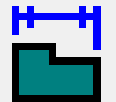
100.0 deg.

100.0 deg.

PSCBB1
PSCBB2
PSCBB3
PSCBB4
PSCBB5
PSCBB6
PSCBB7 - DET
PSCBB8 - DET
PSCBB9



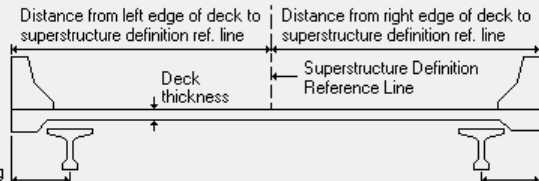
View Schematic icon provides a graphic of the structure to compare with plans/sketches



BrR County Rating Example

Create Structure Typical Section

Structure Typical Section



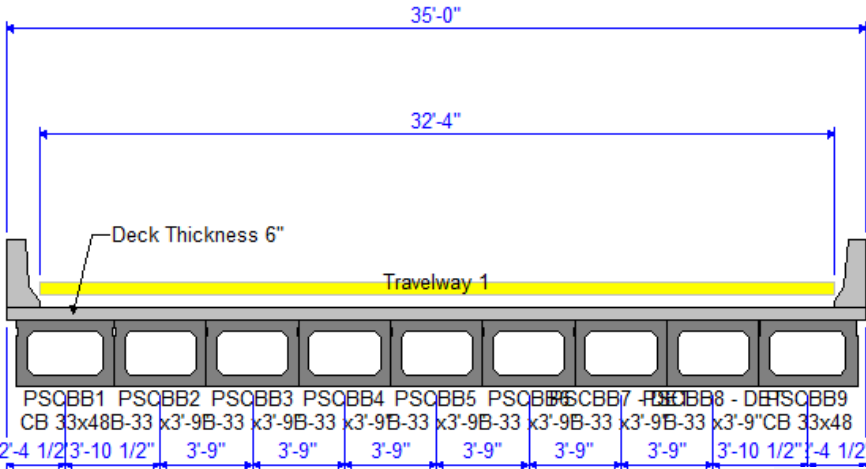
Deck Deck (Cont'd) Parapet Median Railing Generic Sidewalk Lane Position Striped Lanes W

Superstructure definition reference line is the bridge deck.

	Start	End
Distance from left edge of deck to superstructure definition reference line =	17.50 ft	17.50 ft
Distance from right edge of deck to superstructure definition reference line =	17.50 ft	17.50 ft
Left overhang =	2.38 ft	2.38 ft
Computed right overhang =	2.37 ft	2.37 ft

Schematics: Bridge Typical Cross Section View

County Bridge
NBI=County Bridge NBI (PCBB) - 9 Beam System
02/14/17



35'-0"

32'-4"

Deck Thickness 6"

Travelway 1

PSQBB1 PSQBB2 PSQBB3 PSQBB4 PSQBB5 PSQBB6 PSQBB7 PSQBB8 PSQBB9

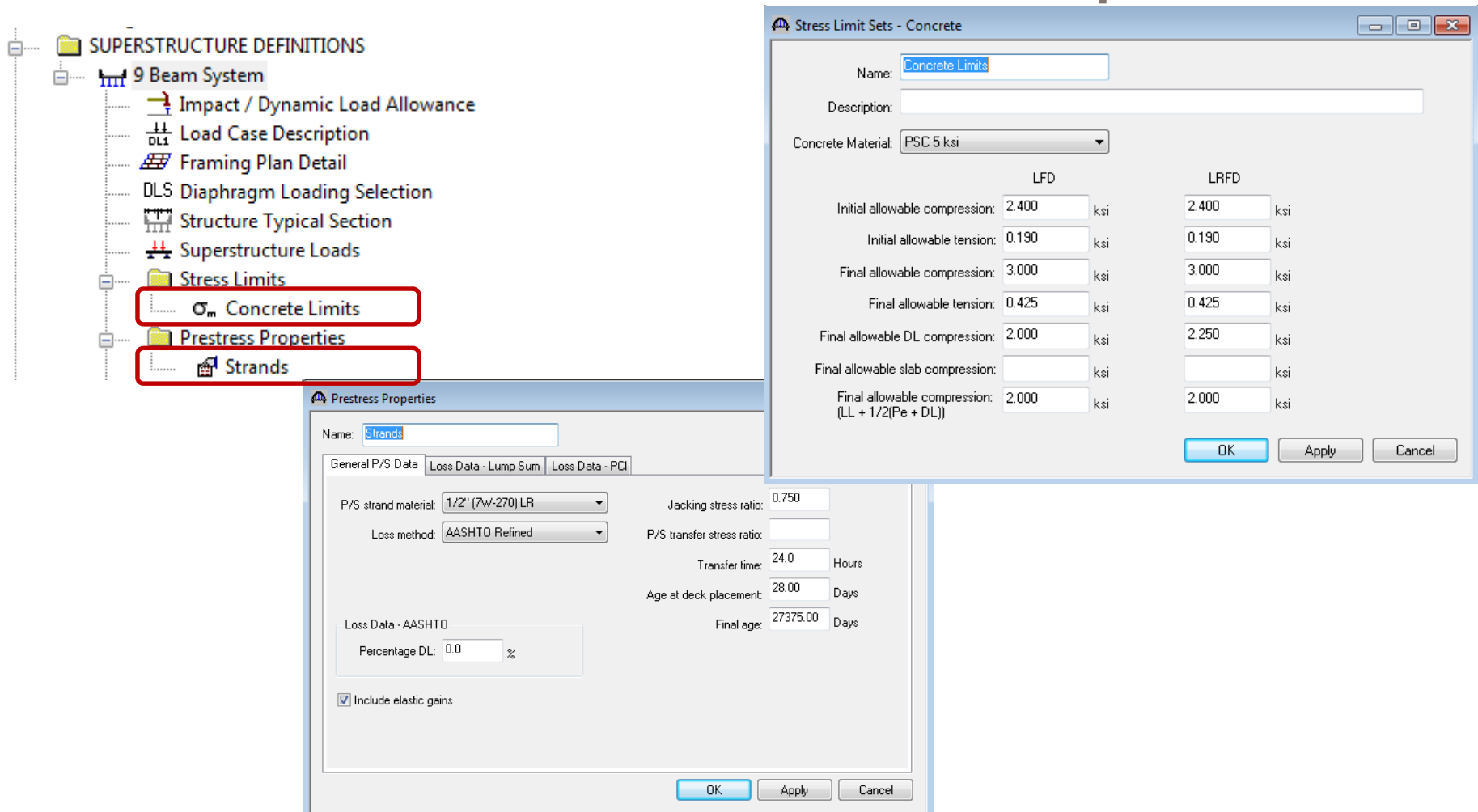
CB 33x48B-33 x3'-9B-33 x3'-9B-33 x3'-9B-33 x3'-9B-33 x3'-9B-33 x3'-9B-33 x3'-9"CB 33x48

2'-4 1/2 3'-10 1/2 3'-9 3'-9 3'-9 3'-9 3'-9 3'-9 3'-10 1/2 2'-4 1/2

BrR uses information in this dialog box to calculate dead loads.

BrR County Rating Example

Define Concrete Stress Limits & Strand Properties



The screenshot displays the software interface for defining concrete stress limits and strand properties. The project hierarchy on the left shows the following structure:

- SUPERSTRUCTURE DEFINITIONS
 - 9 Beam System
 - Impact / Dynamic Load Allowance
 - DL1 Load Case Description
 - Framing Plan Detail
 - DLS Diaphragm Loading Selection
 - Structure Typical Section
 - Superstructure Loads
 - Stress Limits
 - Concrete Limits** (highlighted)
 - Prestress Properties
 - Strands** (highlighted)

The **Stress Limit Sets - Concrete** dialog box is open, showing the following settings:

- Name: Concrete Limits
- Description:
- Concrete Material: PSC 5 ksi
- Concrete Properties Table:

	LFD	LRFD
Initial allowable compression:	2.400 ksi	2.400 ksi
Initial allowable tension:	0.190 ksi	0.190 ksi
Final allowable compression:	3.000 ksi	3.000 ksi
Final allowable tension:	0.425 ksi	0.425 ksi
Final allowable DL compression:	2.000 ksi	2.250 ksi
Final allowable slab compression:	ksi	ksi
Final allowable compression: (LL + 1/2(Pe + DL))	2.000 ksi	2.000 ksi

The **Prestress Properties** dialog box is also open, showing the following settings:

- Name: Strands
- General P/S Data
 - P/S strand material: 1/2" (7W-270) LR
 - Loss method: AASHTO Refined
 - Loss Data - AASHTO
 - Percentage DL: 0.0 %
 - ☒ Include elastic gains
- Jacking stress ratio: 0.750
- P/S transfer stress ratio:
- Transfer time: 24.0 Hours
- Age at deck placement: 28.00 Days
- Final age: 27375.00 Days

Build Individual Members

BrR County Rating Example



Select Control Options

**Generate at 10th points
except at supports**

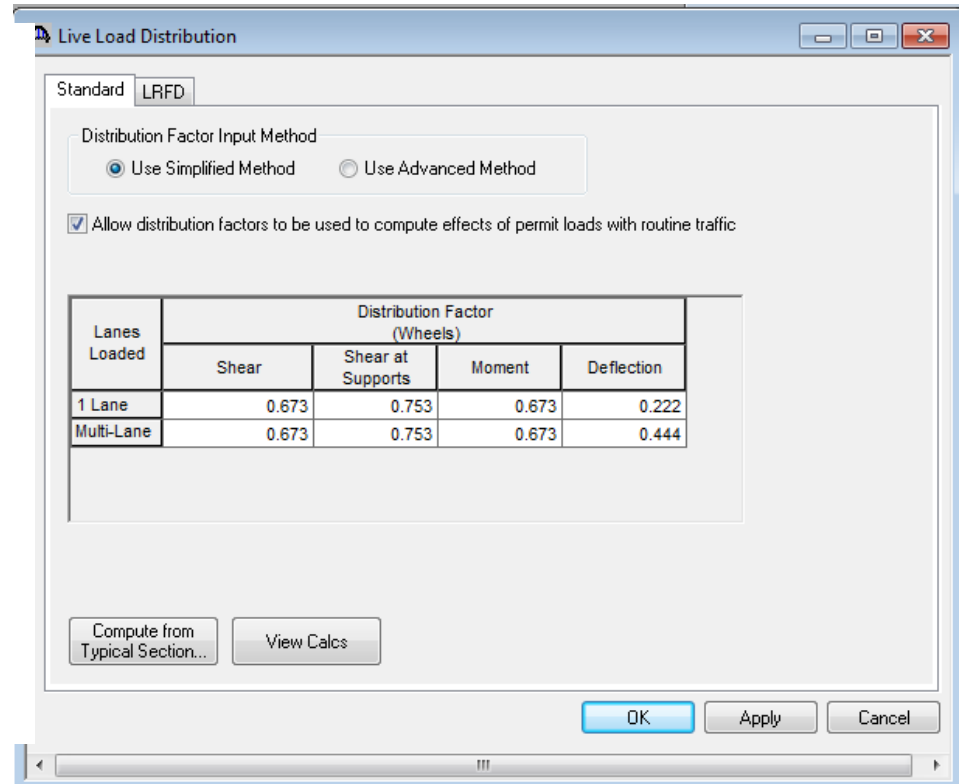
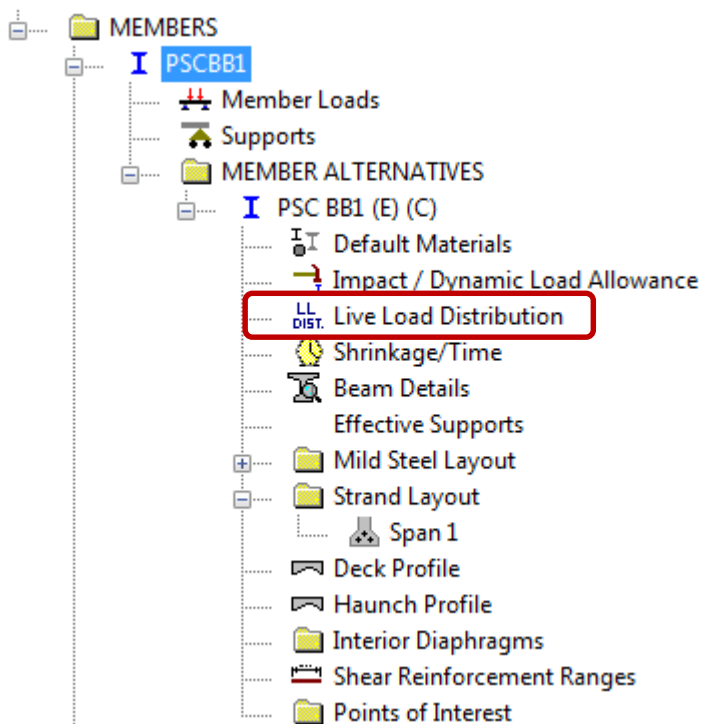
**Generate at support face &
critical shear points**

**Provide information for
Effective Supports within
model**

The screenshot shows the 'Member Alternative Description' dialog box with the 'Member Alternative' set to 'PSC BB1'. The 'Control Options' tab is selected. It contains three panels: LRFD, LRFR, and LFD. The LRFD and LRFR panels have identical settings, while the LFD panel has unique settings. In the LRFD and LRFR panels, 'Generate at tenth points except supports' is checked, 'Generate at support points' is unchecked, 'Generate at support face & critical shear points' is checked, 'Generate at section change points' is checked, and 'Generate at user-defined points' is checked. Under 'Shear Computation Method', 'General Procedure' is selected. Under 'Loss & Stress Calculations', 'Use gross section properties' is selected. Under 'Multi-span analysis', 'Continuous' is selected. In the LFD panel, 'Generate at tenth points except supports' is checked, 'Generate at support points' is unchecked, 'Generate at support face & critical shear points' is checked, 'Generate at section change points' is checked, and 'Generate at user-defined points' is checked. Under 'Shear Computation Method', 'Use AASHTO 1979 Interim code' is selected. In the LRFR panel, 'Ignore design & legal load shear' is unchecked, 'Ignore permit load shear' is unchecked, 'Consider legal load tensile concrete stress' is unchecked, 'Consider splitting resistance article' is unchecked, 'Ignore tensile rating in top of beam' is unchecked, 'Consider deck reinf. development length' is unchecked, 'Consider permit load tensile steel stress' is unchecked, 'Ignore long. reinf. in rating' is checked, 'Distribution Factor Application Method' is set to 'By POI', and 'Allow negative enslin in general shear method' is unchecked.

BrR County Rating Example

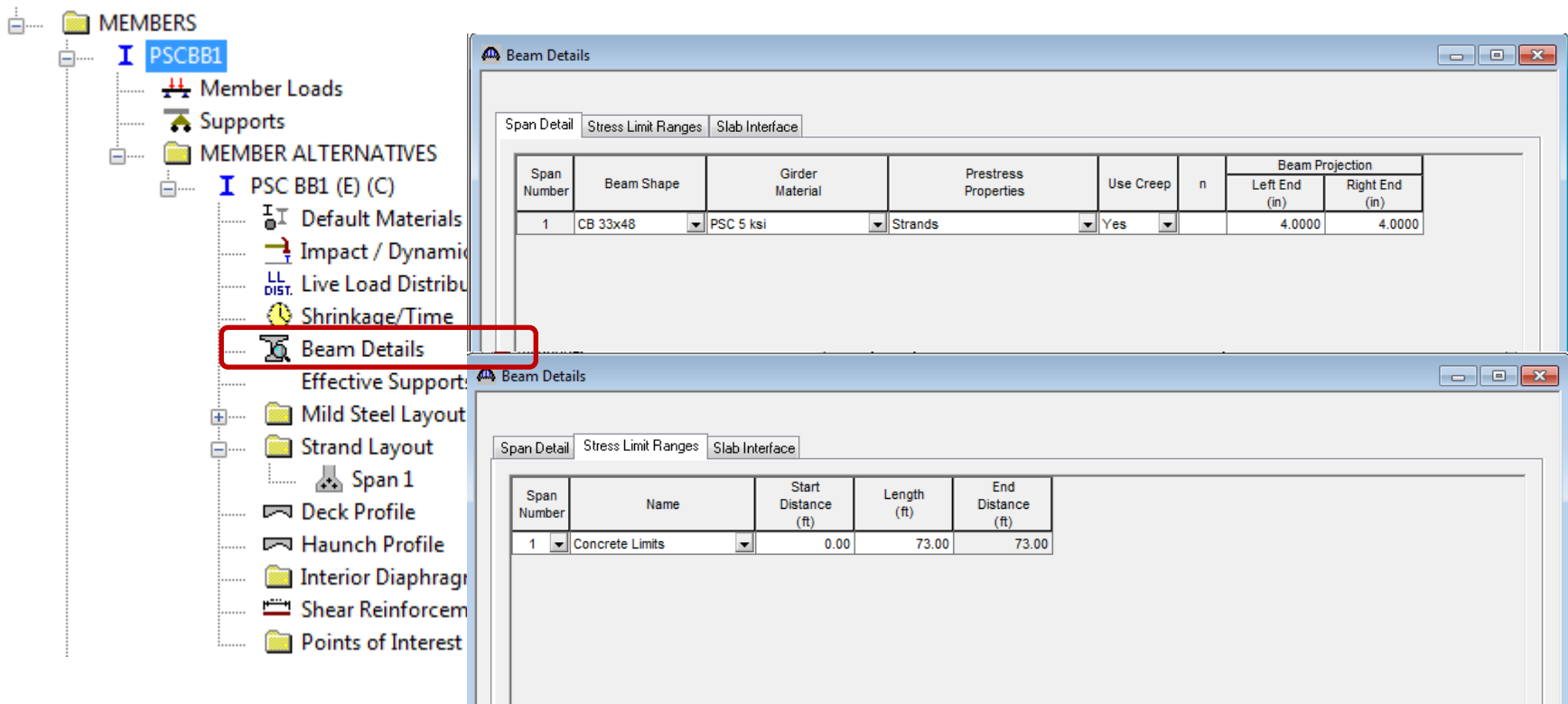
Calculate Live Load Distribution Factor



BrR uses beam information and bridge geometry to compute LLD factors. This does not automatically update when revisions are made to the model.

BrR County Rating Example

Assign Beam Details



The screenshot displays the software interface for assigning beam details. On the left, a project tree shows the hierarchy: MEMBERS > PSCBB1 > MEMBER ALTERNATIVES > PSC BB1 (E) (C). The 'Beam Details' option is highlighted with a red box. The main window shows the 'Beam Details' dialog box with the 'Span Detail' tab selected. The dialog box contains a table with the following data:

Span Number	Beam Shape	Girder Material	Prestress Properties	Use Creep	n	Beam Projection	
						Left End (in)	Right End (in)
1	CB 33x48	PSC 5 ksi	Strands	Yes		4.0000	4.0000

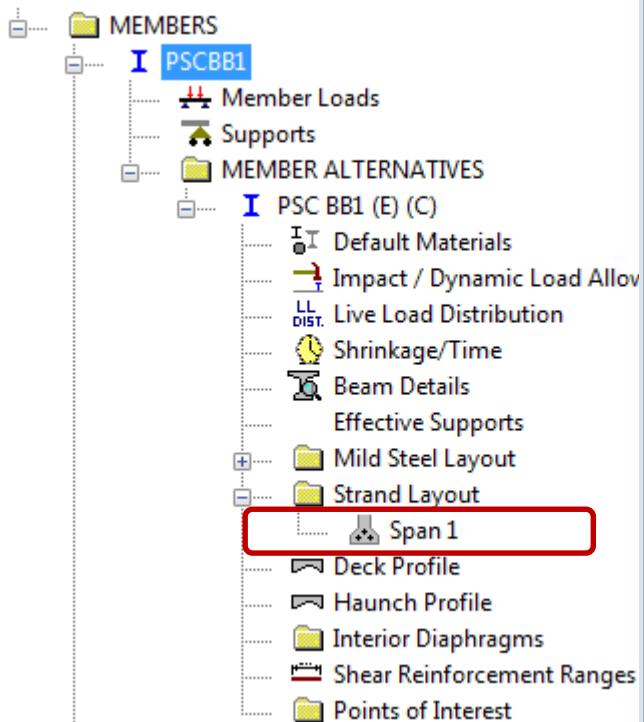
Below the main dialog box, there is another 'Beam Details' dialog box showing the 'Span Detail' tab with the following data:

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	Concrete Limits	0.00	73.00	73.00

Assign previously defined materials to individual beams

BrR County Rating Example

Layout Strands



Strand Layout - Span 1

160%

Description Type

☐ P and CGS only ☒ Strands in rows

Strand Configuration Type

☒ Straight/Debonded ☐ Harped ☐ Harped and straight debonded

☒ Symmetry

☐ Mid span

Debonding

☒ Left

Section Location (in)	Measured and Debonded From
33.0000	End of Beam

New Modify Delete

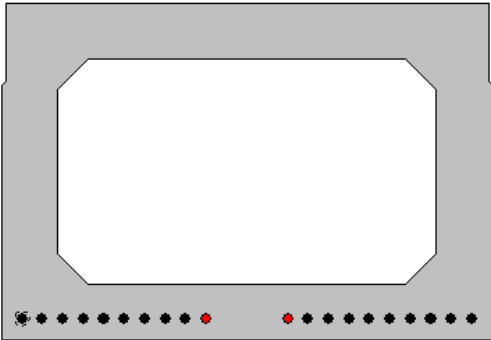
☐ Right

Section Location (in)	Measured and Debonded From
33.0000	End of Beam

New Modify Delete

OK Apply Cancel

Notes:
Strand positions generated by the REVISED method.
Please refer to help for a description of this method.



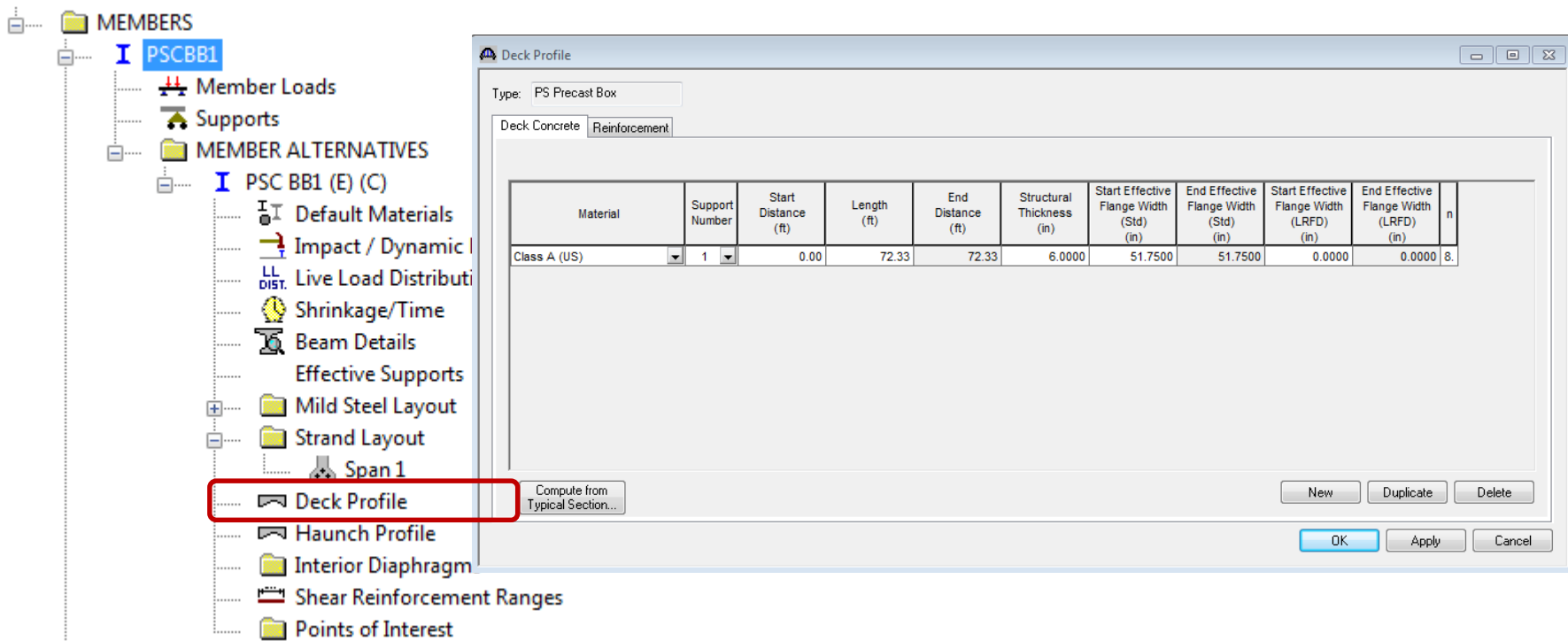
Number of strands = 20
Number of debonded strands (Total/Here/Other) = 2/2/0
CG of strands (measured from bottom of section) = 2.00 in

Legend:

- ✕ No strand at this position at the current section location.
- ✕ No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mild steel.

BrR County Rating Example

Define Deck Profile



The screenshot shows the software interface for defining a deck profile. On the left, a project tree under 'MEMBERS' shows 'PSCBB1' selected. Under 'PSC BB1 (E) (C)', the 'Deck Profile' option is highlighted with a red box. The 'Deck Profile' dialog box is open, showing the 'Reinforcement' tab. The 'Type' is set to 'PS Precast Box'. The 'Deck Concrete' tab is also visible. The dialog contains a table with the following data:

Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width (Std) (in)	End Effective Flange Width (Std) (in)	Start Effective Flange Width (LRFD) (in)	End Effective Flange Width (LRFD) (in)	n
Class A (US)	1	0.00	72.33	72.33	6.0000	51.7500	51.7500	0.0000	0.0000	8

At the bottom of the dialog, there are buttons for 'Compute from Typical Section...', 'New', 'Duplicate', 'Delete', 'OK', 'Apply', and 'Cancel'.

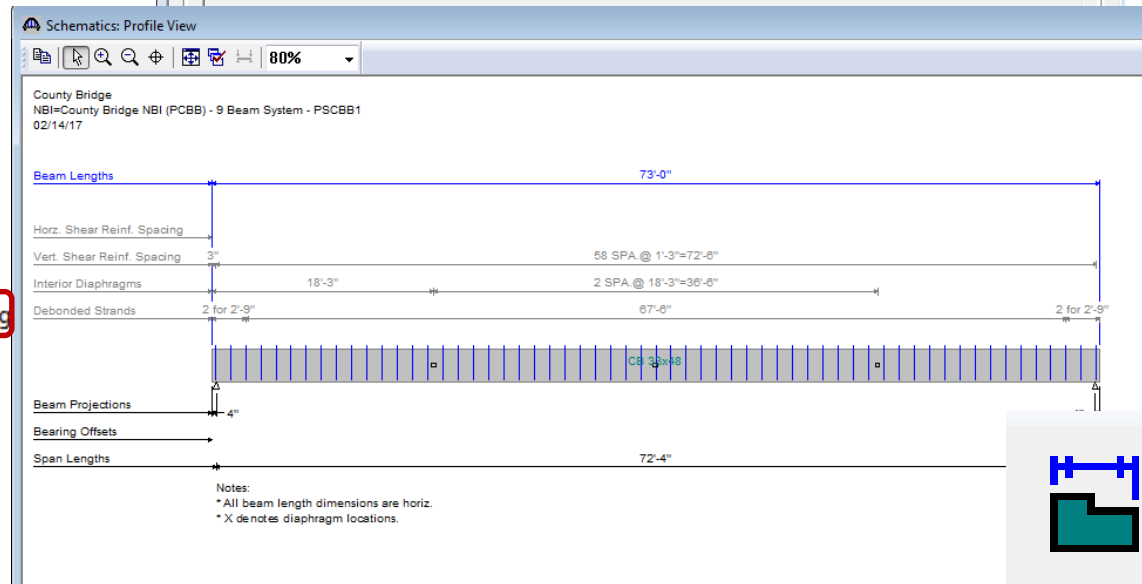
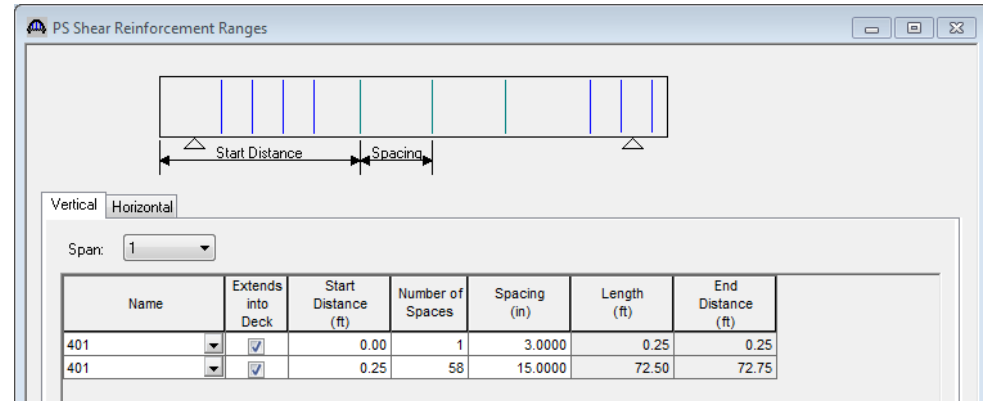
Deck profile is used to calculate effective flange width and not dead loads

BrR County Rating Example

Define Shear Reinforcement Ranges

MEMBERS

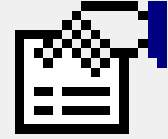
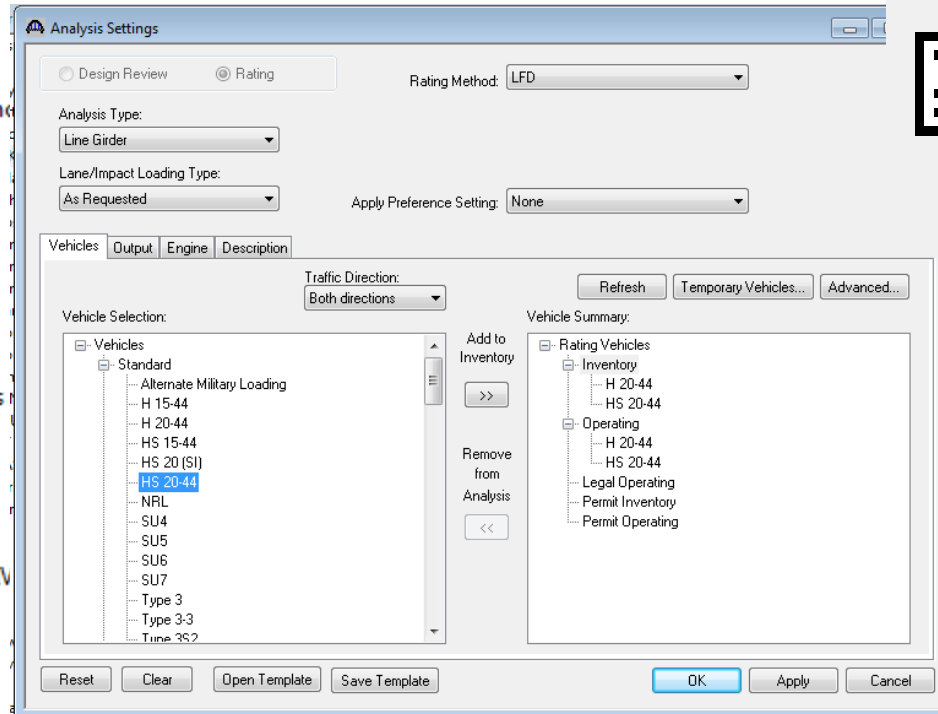
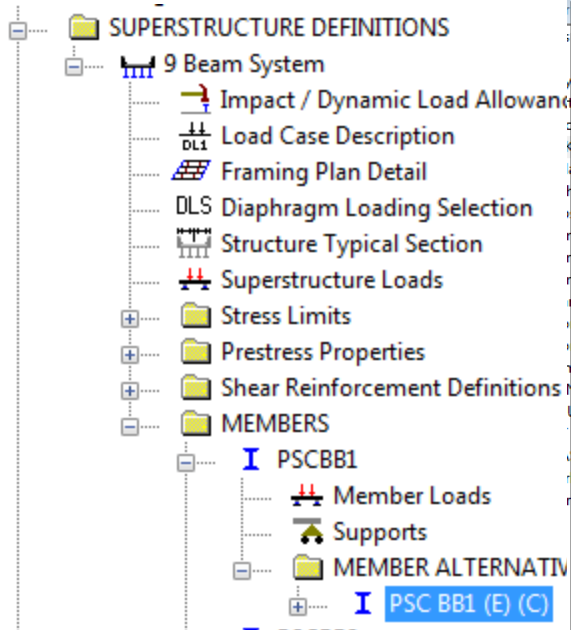
- PSCBB1**
 - Member Loads
 - Supports
 - MEMBER ALTERNATIVES
 - PSC BB1 (E) (C)**
 - Default Materials
 - Impact / Dynamic Load Allowance
 - LL DIST. Live Load Distribution
 - Shrinkage/Time
 - Beam Details
 - Effective Supports
 - Mild Steel Layout
 - Strand Layout
 - Span 1
 - Deck Profile
 - Haunch Profile
 - Shear Reinforcement Range**
 - Points of Interest



Perform Load Rating

BrR County Rating Example

Define Analysis Settings and Perform Rating



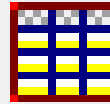
Select Analysis Settings icon to select rating method and vehicles to rate.



Highlight Beam (or System) and select Analyze Icon to perform load rating.

BrR County Rating Example

BrR View Analysis Results



Analysis Results - PSC BB1

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 Operating Rating Factor	Permit Inventory Rating Factor	Permit Operating Rating Factor	Inventory Location (ft)	Inventory Location Span-(%)	Operating Location (ft)	Operating Location Span-(%)	Legal Operating Location (ft)	Legal Operating Location Span-(%)	Permit Inventory Location (ft)	Permit Inventory Location Span-(%)	Permit Operating Location (ft)	Permit Operating Location Span-(%)	Inventory Limit State	Operating Limit State
H 20-44	Lane	LFD	33.24	55.51				1.662	2.775				36.17	1 - (50.0)	36.17	1 - (50.0)							Design Flexure - Concrete	Design Flexure - Conc
HS 20-44	Lane	LFD	59.83	99.91				1.662	2.775				36.17	1 - (50.0)	36.17	1 - (50.0)							Design Flexure - Concrete	Design Flexure - Conc
H 20-44	Axle Load	LFD	37.06	61.89				1.853	3.094				36.17	1 - (50.0)	36.17	1 - (50.0)							Design Flexure - Concrete	Design Flexure - Conc
HS 20-44	Axle Load	LFD	43.56	72.74				1.210	2.021				36.17	1 - (50.0)	36.17	1 - (50.0)							Design Flexure - Concrete	Design Flexure - Conc

AASHTO LFR Engine Version 6.7.1.3001
Analysis Preference Setting: None

Close

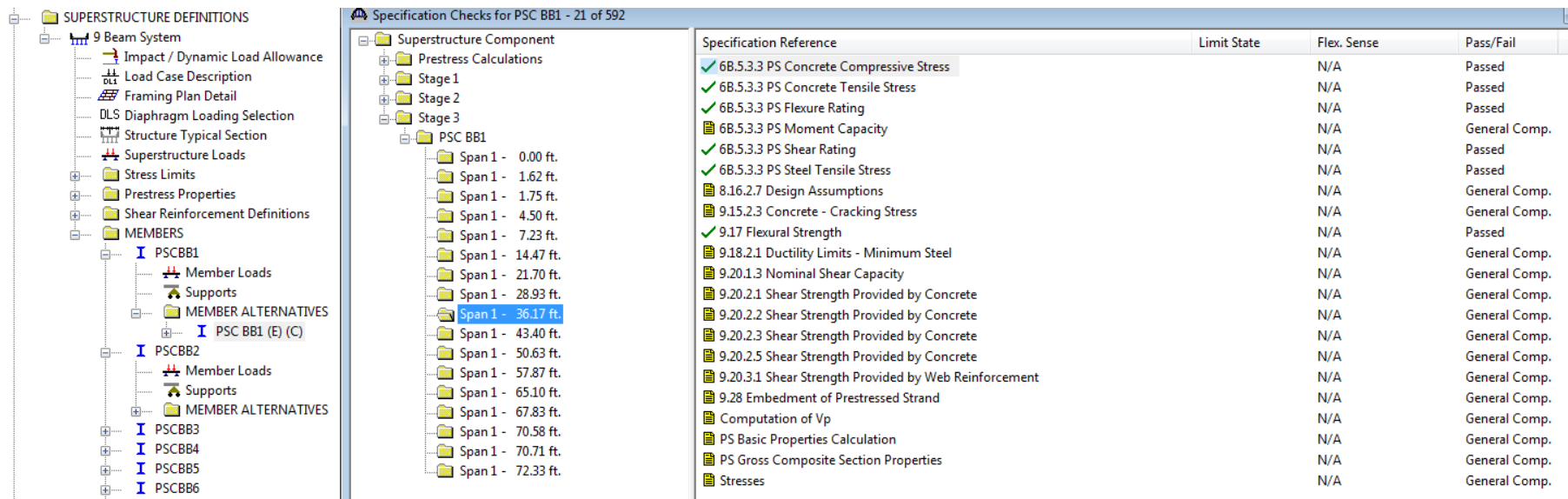
- **Controlling Rating** (*HS20 Inv = 1.210*)
- **Limiting Condition** (*Design Flexure - Concrete*)
- **Location** (*36.17 ft, or 50% of Span 1*)

BrR County Rating Example

BrR View Spec Check



After the controlling location and condition is identified, use the View Spec Check icon to identify the limiting AASHTO Code reference.



Specification Reference	Limit State	Flex. Sense	Pass/Fail
✓ 6B.5.3.3 PS Concrete Compressive Stress		N/A	Passed
✓ 6B.5.3.3 PS Concrete Tensile Stress		N/A	Passed
✓ 6B.5.3.3 PS Flexure Rating		N/A	Passed
6B.5.3.3 PS Moment Capacity		N/A	General Comp.
✓ 6B.5.3.3 PS Shear Rating		N/A	Passed
✓ 6B.5.3.3 PS Steel Tensile Stress		N/A	Passed
8.16.2.7 Design Assumptions		N/A	General Comp.
9.15.2.3 Concrete - Cracking Stress		N/A	General Comp.
✓ 9.17 Flexural Strength		N/A	Passed
9.18.2.1 Ductility Limits - Minimum Steel		N/A	General Comp.
9.20.1.3 Nominal Shear Capacity		N/A	General Comp.
9.20.2.1 Shear Strength Provided by Concrete		N/A	General Comp.
9.20.2.2 Shear Strength Provided by Concrete		N/A	General Comp.
9.20.2.3 Shear Strength Provided by Concrete		N/A	General Comp.
9.20.2.5 Shear Strength Provided by Concrete		N/A	General Comp.
9.20.3.1 Shear Strength Provided by Web Reinforcement		N/A	General Comp.
9.28 Embedment of Prestressed Strand		N/A	General Comp.
Computation of Vp		N/A	General Comp.
PS Basic Properties Calculation		N/A	General Comp.
PS Gross Composite Section Properties		N/A	General Comp.
Stresses		N/A	General Comp.

Tip: Select individual Specification References and dial in to additional detailed computations.

Thank You!

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