

AASHTOWare BrD/BrR 7.3

Timber Structure Tutorial

TMBR3- Single Span Timber Beam - Glulam Example

BrD and BrR Training

TMBR1- Single Span Timber Beam Example

From the Bridge Explorer create a new bridge and enter the following description data:

Timber Example Glulam

Bridge ID: NBI structure ID (8):

Template Superstructures
 Bridge completely defined Culverts
 Substructures

Description | Description (cont'd) | Alternatives | Global reference point | Traffic | Custom agency fields

Name: Year built:

Description:

Location: Length: ft

Facility carried (7): Route number:

Feat. intersected (6): Mi. post:

Default units:

Bridge association... BrR BrD BrM

OK Apply Cancel

Close the window by clicking OK. This saves the data to memory and closes the window.

TMBR3- Single Span Timber Beam – Glulam Example

To add a new timber material for timber deck, click on Materials, Timber, Sawn in the tree and select New from the Manage group of the Workspace toolbar from the menu (or right mouse click on Sawn and select New). Click the Copy from Library button and select the following material from the library.

Library Data: Materials - Timber - Sawn

Name	Description	Library	Units	Grading method	Species	Commercial grade	Size class	Grading rule agency
Southern Pine	Southern Pine	Standard	US Customary	Visual	Southern Pine	No. 1	2" - 4" thick, 5" - 6" wide	SPIB
Southern Pine	Southern Pine	Standard	US Customary	Visual	Southern Pine	Select Structural	2" - 4" thick, 5" - 6" wide	SPIB
Southern Pine	Southern Pine	Standard	US Customary	Visual	Southern Pine	No. 2	2" - 4" thick, 2" - 4" wide	SPIB
Southern Pine	Southern Pine	Standard	US Customary	Visual	Southern Pine	No. 1	2" - 4" thick, 2" - 4" wide	SPIB
Southern Pine	Southern Pine	Standard	US Customary	Visual	Southern Pine	Select Structural	2" - 4" thick, 2" - 4" wide	SPIB
Southern Pine (Dry...	Southern Pine (Dry o...	Standard	US Customary	Visual	Southern Pine (Dry o...	Select Structural	5" x 5" & larger	SPIB

OK Apply Cancel

Click OK and the following window will open. Change the name of the material to “Deck Timber” from Southern Pine. The ASD Tabulated Design Values in the ASD tab of this window and the LRFD Reference design values in the LRFD tab of this window are based on dry conditions and do not include any adjustment factors based on usage conditions. Click OK to save this timber material to memory and close the window.

Bridge Materials - Timber - Sawn

Name:

Description:

General ASD LRFD

Grading method:

Species:

Commercial grade:

Size classification:

Grading rules agency:

Density: kcf

Copy to library... Copy from library... OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Bridge Materials - Timber - Sawn

Name: Deck Timber

Description: Southern Pine

General ASD LRFD

Bending: 1.5 ksi

Tension (parallel): 0.825 ksi

Shear (parallel): 0.090 ksi

Compr. (perp): 0.565 ksi

Compr. (parallel): 1.650 ksi

Modulus of elasticity: 1600.00 ksi

Notes:

Copy to library... Copy from library... OK Apply Cancel

Bridge Materials - Timber - Sawn

Name: Deck Timber

Description: Southern Pine

General ASD LRFD

Bending: 1.100 ksi

Tension (parallel): 0.675 ksi

Shear (parallel): 0.175 ksi

Compr. (perp): 0.565 ksi

Compr. (parallel): 1.450 ksi

Modulus of elasticity: 1400.00 ksi

Notes:

Copy to library... Copy from library... OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

To add a new timber material for timber beam, click on Materials, Timber, Glued Laminated in the tree and select New from the Manage group of the Workspace toolbar from the menu (or right mouse click on Glued Laminated and select New). Enter the details of this material as shown in images below:

Bridge Materials - Timber - Glued Laminated

Name:

Description:

General | ASD design values | LRFD design values

Grading method:

Species outer:

Species core:

Combination:

Density: kcf

TMBR3- Single Span Timber Beam – Glulam Example

Bridge Materials - Timber - Glued Laminated

Name:

Description:

General ASD design values LRFD design values

Loaded perpendicular to wide faces of lamination

Tension zone stressed in tension:	<input type="text" value="2.000"/>	ksi
Compr. zone stressed in tension:	<input type="text" value="1.000"/>	ksi
Compr. perp. to grain (tension):	<input type="text" value="0.650"/>	ksi
Compr. perp. to grain (compr.):	<input type="text" value="0.560"/>	ksi
Shear parallel to grain:	<input type="text" value="0.165"/>	ksi
Modulus of elasticity:	<input type="text" value="1600.000"/>	ksi

Loaded parallel to wide faces of lamination

Bending:	<input type="text" value="1.450"/>	ksi
Compr. perp. to grain:	<input type="text" value="0.560"/>	ksi
Shear parallel to grain:	<input type="text" value="0.145"/>	ksi
Shear parallel to grain (not edge glued):	<input type="text" value="0.075"/>	ksi
Modulus of elasticity:	<input type="text" value="1500.000"/>	ksi

Axially loaded

Tension parallel to grain:	<input type="text" value="1.000"/>	ksi
Compr. parallel to grain:	<input type="text" value="1.550"/>	ksi
Modulus of elasticity:	<input type="text" value="1500.000"/>	ksi

Notes:

TMBR3- Single Span Timber Beam – Glulam Example

Bridge Materials - Timber - Glued Laminated

Name:

Description:

General ASD design values LRFD design values

Loaded perpendicular to wide faces of lamination

Tension zone stressed in tension: ksi

Compr. zone stressed in tension: ksi

Compr. perp. to grain (tension): ksi

Compr. perp. to grain (compr.): ksi

Shear parallel to grain: ksi

Modulus of elasticity: ksi

Loaded parallel to wide faces of lamination

Extreme fiber in bending: ksi

Compr. perp. to grain: ksi

Shear parallel to grain (horz.): ksi

Modulus of elasticity: ksi

Axially loaded

Tension parallel to grain: ksi

Compr. parallel to grain: ksi

Modulus of elasticity: ksi

Fasteners

Specific gravity top or bottom face: ksi

Specific gravity side face: ksi

Notes:

Copy to library... Copy from library... OK Apply Cancel

The ASD Tabulated Design Values in the ASD tab of this window and the LRFD Reference design values in the LRFD tab of this window are based on dry conditions and do not include any adjustment factors based on usage conditions. Click OK to save this timber material to memory and close the window.

TMBR3- Single Span Timber Beam – Glulam Example

Add a new timber beam shape by clicking on Beam Shapes, Timber, Rectangular in the tree and selecting New from the Manage group of the Workspace toolbar (or double click on Rectangular). Enter the following data. Enter the actual beam dimensions to be used to calculate section properties on the Dimensions tab. Enter the nominal dimensions of the beam on the Properties tab and click on Compute button to compute the section properties. Click OK to save the data to memory and close the window.

The screenshot shows the 'Timber Shape - Rectangular' dialog box with the 'Dimensions' tab selected. The 'Name' field contains '6 x 18 beam'. The 'Description' field is empty. A diagram of a rectangular beam is shown with a width of 5.5000 in and a height of 17.5000 in. The 'Copy to library...', 'Copy from library...', 'OK', 'Apply', and 'Cancel' buttons are visible at the bottom.

The screenshot shows the 'Timber Shape - Rectangular' dialog box with the 'Properties' tab selected. The 'Name' field contains '6 x 18 beam'. The 'Description' field is empty. The 'Properties' section contains the following data:

Area:	96.25	in ²
Nominal load:	33.40	lb/ft
Moment of inertia:	2456.4	in ⁴
CG from bottom:	8.7500	in
Section modulus, top:	280.7	in ³
Section modulus, bottom:	280.7	in ³
Nominal width:	6.00	in
Nominal depth:	18.0000	in

The 'Compute' button is highlighted. The 'Copy to library...', 'Copy from library...', 'OK', 'Apply', and 'Cancel' buttons are visible at the bottom.

TMBR3- Single Span Timber Beam – Glulam Example

To enter the appurtenances to be used within the bridge, expand the tree branch labeled Appurtenances. To define a generic railing, double click on Generic in the tree and input the generic railing dimensions as shown below. Click OK to save the data to memory and close the window.

Bridge Appurtenances - Generic

Name:

Description:

All dimensions are in inches

Distance from edge to centroid:

Barrier load: kip/ft

Width:

Effective wind height:

Reference Line

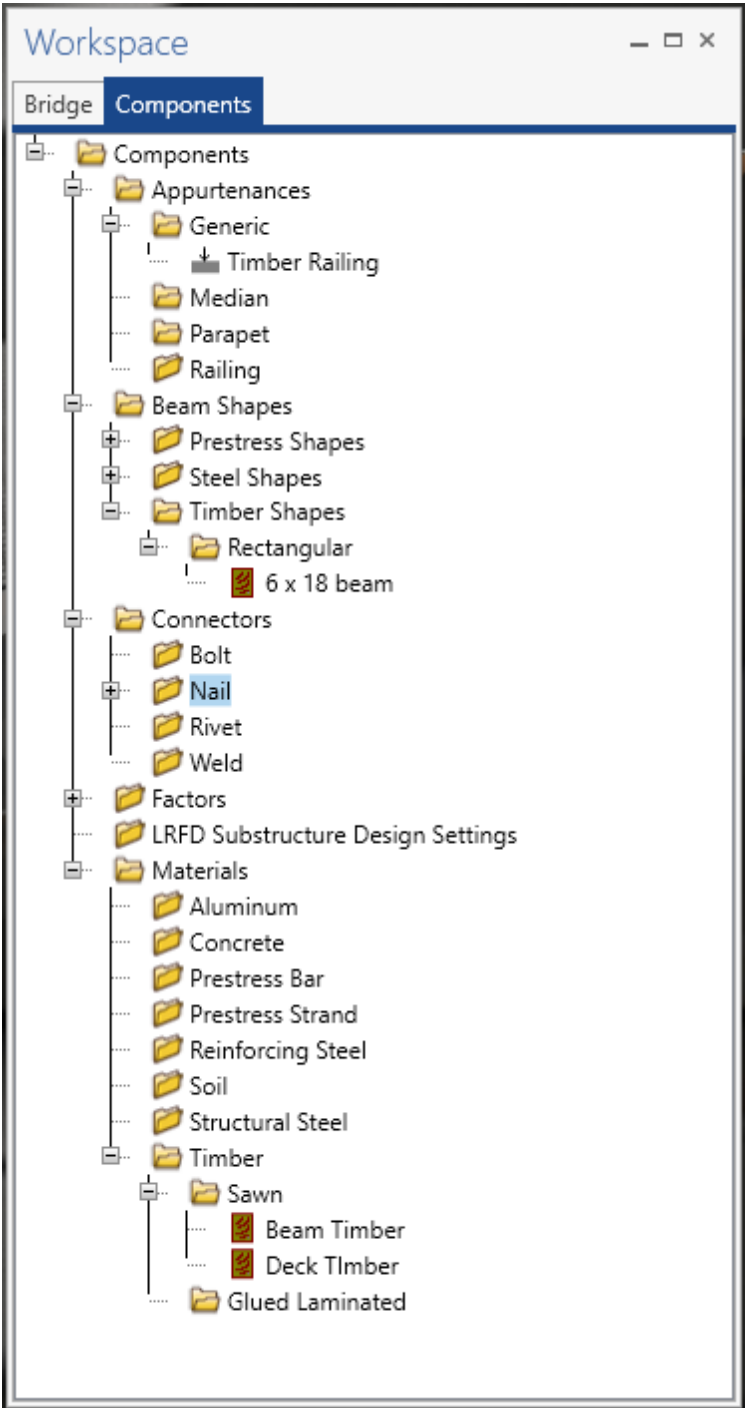
Generic Shape

Back Front

Copy from library... OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

To create a nail definition, expand the Connectors tree item and double click on Nail.



TMBR3- Single Span Timber Beam – Glulam Example

Define the nail as shown below. Click OK to save to memory and close the window.

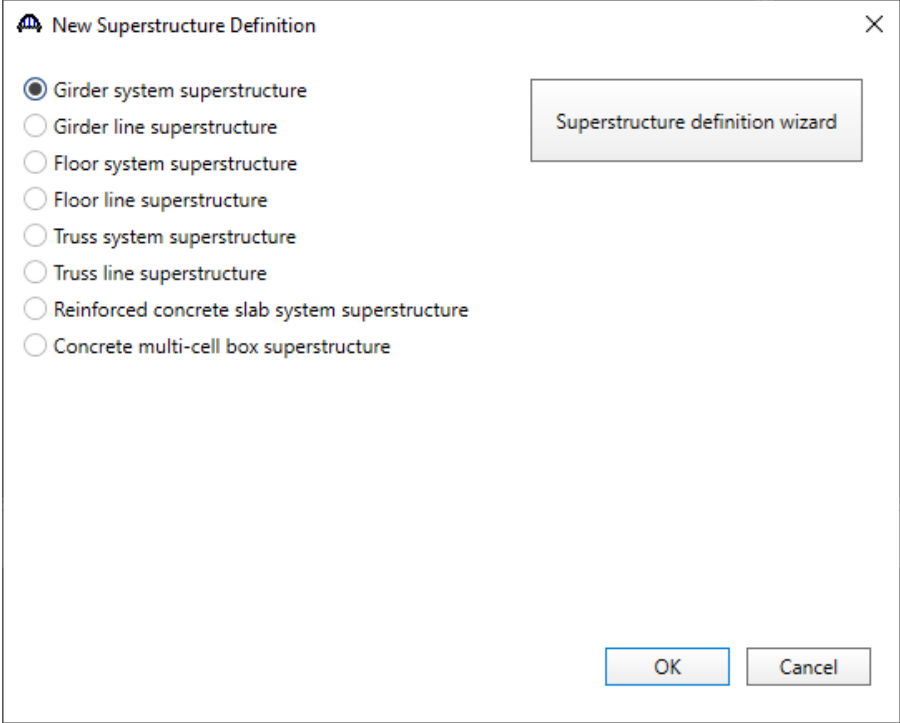
The screenshot shows a software dialog box titled "Structure Definition Connectors - Nail". It contains the following fields and controls:

- Name:
- Description:
- Length: in
- Diameter: in
- Pennyweight: (dropdown menu)

At the bottom of the dialog are four buttons: "Copy from library...", "OK", "Apply", and "Cancel".

TMBR3- Single Span Timber Beam – Glulam Example

Double click on SUPERSTRUCTURE DEFINITIONS (or click on SUPERSTRUCTURE DEFINITIONS and select New from the Manage group of the Workspace toolbar or right mouse click on SUPERSTRUCTURE DEFINITIONS and select New from the popup menu) to create a new structure definition. The dialog shown below will appear.



TMBR3- Single Span Timber Beam – Glulam Example

Select Girder System Superstructure and the Superstructure Definition window will open. Enter the appropriate data as shown below.

Girder System Superstructure Definition

Definition Analysis Specs Engine

Name: Structure Definition - Glulam

Description: Glulam beams with Nail Laminated Deck

Default units: US Customary

Number of spans: 1

Number of girders: 13

Enter span lengths along the reference line:

Span	Length (ft)
1	17.00

Modeling

Multi-girder system MCB

With frame structure simplified definition

Deck type: Timber Deck

For PS/PT only

Average humidity: %

Member alt. types

Steel

P/S

R/C

Timber

P/T

Horizontal curvature along reference line

Horizontal curvature

Distance from PC to first support line: ft

Superstructure alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Start tangent length: ft

Radius: ft

Direction: Left

End tangent length: ft

Distance from last support line to PT: ft

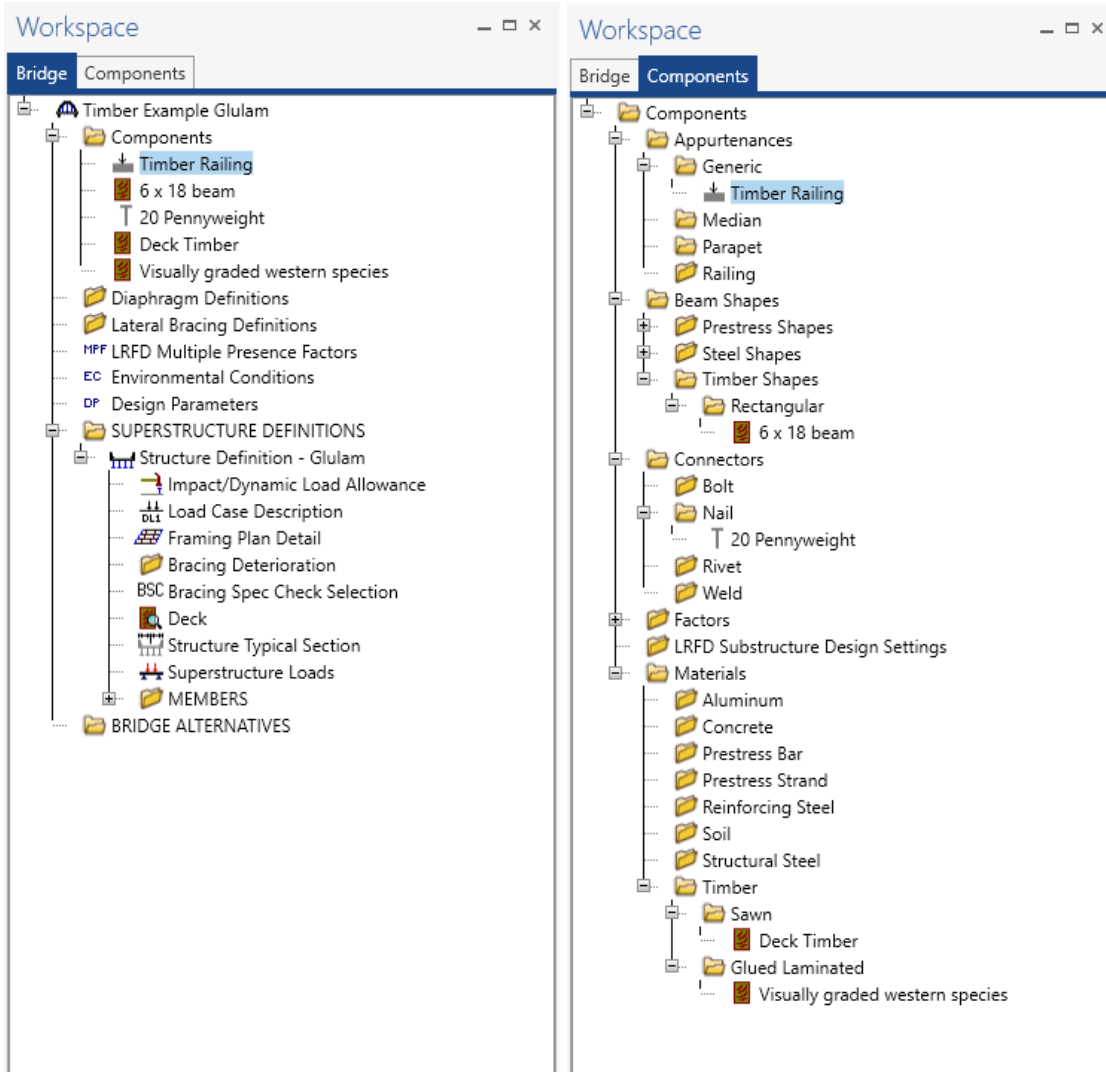
Design speed: mph

Superelevation: %

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

The partially expanded Bridge Workspace tree for each of its tabs are shown below:



TMBR3- Single Span Timber Beam – Glulam Example

Click Load Case Description to define the dead load cases. The completed Load Case Description window is shown below.

Load case name	Description	Stage	Type	Time* (days)
▶ Railing DL		Non-composite (Stage 1)	D,DC	
Wearing Surface DL		Non-composite (Stage 1)	D,DW	

*Prestressed members only Add default load case descriptions

New Duplicate Delete

OK Apply Cancel

Double-click on Framing Plan Detail to describe the framing plan. Enter the appropriate data as shown below.

Number of spans: 1 Number of girders: 13

Layout Diaphragms

Support	Skew (degrees)
▶ 1	0.000
2	0.000

Girder spacing orientation

Perpendicular to girder

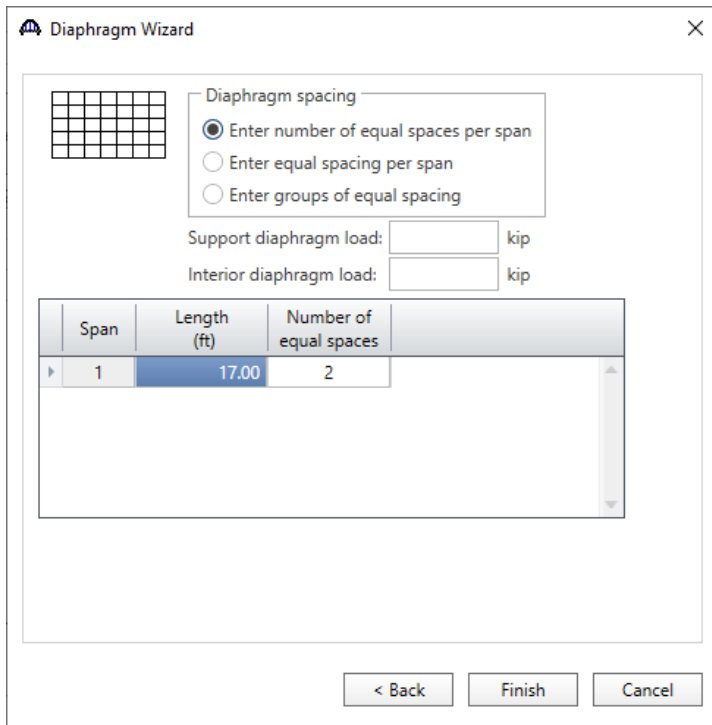
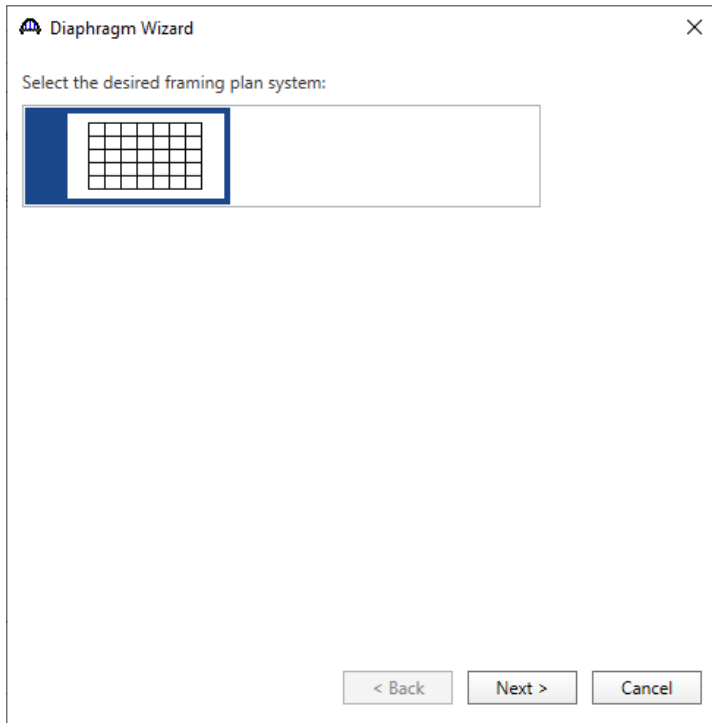
Along support

Girder bay	Girder spacing (ft)	
	Start of girder	End of girder
▶ 1	2.00	2.00
2	2.00	2.00
3	2.00	2.00
4	2.00	2.00
5	2.00	2.00
6	2.00	2.00
7	2.00	2.00
8	2.00	2.00
9	2.00	2.00
10	2.00	2.00
11	2.00	2.00
12	2.00	2.00

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Switch to the Diaphragms tab to enter diaphragm spacing. Select the Diaphragm Wizard button to have BrR generate the diaphragm locations for you. The following window will appear. Select the Next button to continue.



Enter 2 equal spaces in the span and click the Finish button.

TMBR3- Single Span Timber Beam – Glulam Example

The Diaphragm Wizard generates the following diaphragm locations.

Structure Framing Plan Details

Number of spans: 1 Number of girders: 13

Layout Diaphragms

Girder bay: 1 Copy bay to... Diaphragm wizard...

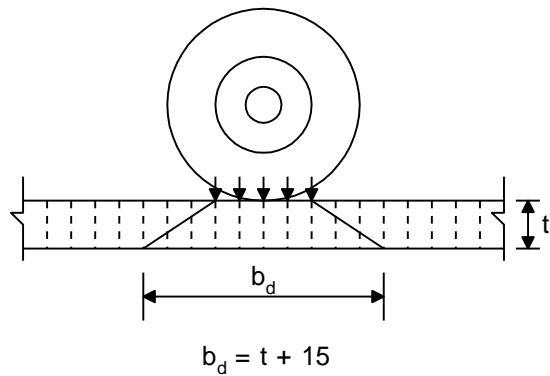
Support number	Start distance (ft)		Diaphragm spacing (ft)	Number of spaces	Length (ft)	End distance (ft)		Load (kip)	Diaphragm
	Left girder	Right girder				Left girder	Right girder		
1	0.00	0.00	0.00	1	0.00	0.00	0.00	--Not Assigned--	
1	0.00	0.00	8.50	1	8.50	8.50	8.50	--Not Assigned--	
1	17.00	17.00	0.00	1	0.00	17.00	17.00	--Not Assigned--	

New Duplicate Delete

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Enter the deck description by double-clicking on Deck in the Bridge Workspace tree. BrR/BrD only supports transverse timber decks. Select the type of deck as Nail-Laminated. The timber material to be used for the deck is selected from the list of bridge materials described above. Select the 20 Pennyweight nail definition as the Nail. The Deck LL distribution width is the wheel load distribution width in the direction perpendicular to the deck span as per AASHTO Standard Specifications for Highway Bridges, Article 3.25.1.1. This value equals 18.5” for this structure.



Deck

Description Specs Adjustment factors Factors Engine

Default rating method: ASD

Deck rating parameters:

- Deck continuous over more than 2 spans
- Consider axle weight reduction
- Ignore shear

Timber deck type: Nail-Laminated Deck

Timber material: Deck Timber

Total deck thickness: 3.5000 in Nominal thick: 4.0000 in

Lamination thickness: 1.5000 in Nominal width: 2.0000 in

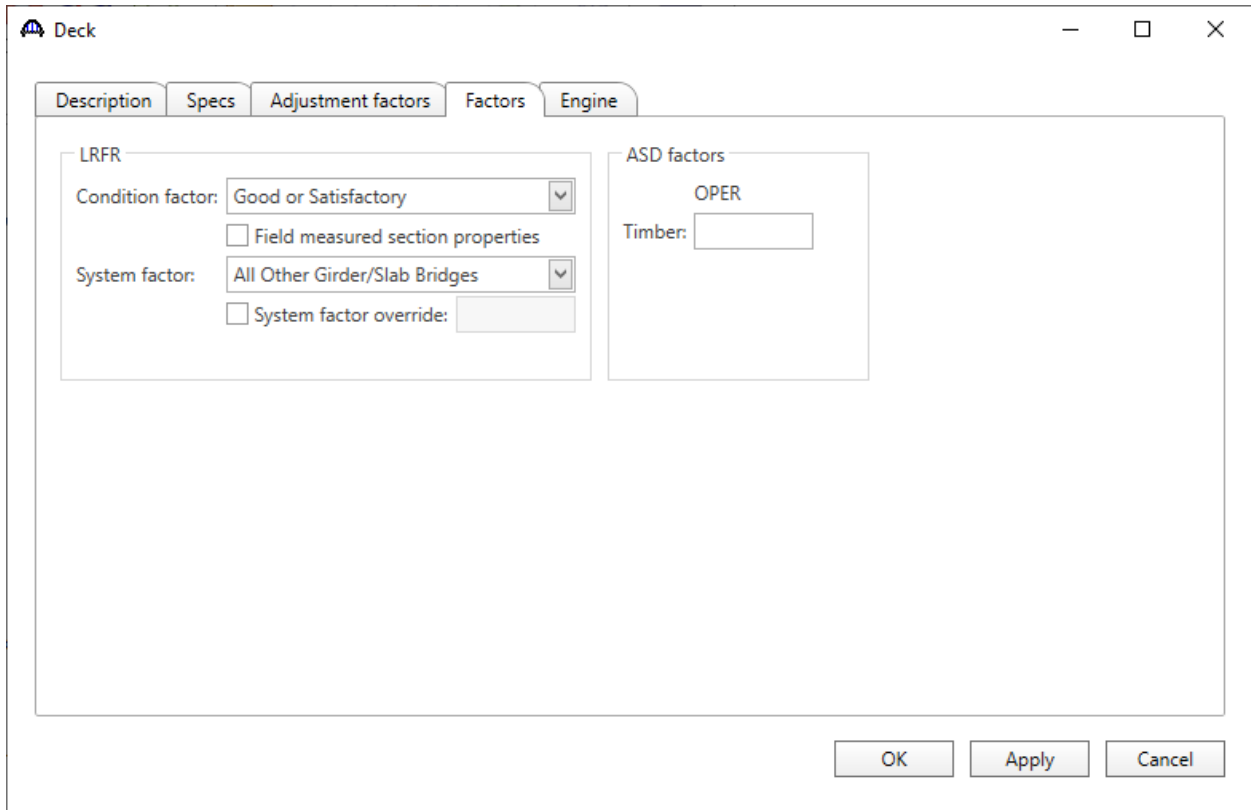
Deck LL distribution width: 18.5000 in

Nail: 20 Pennyweight

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

The Factors tab of the Deck window allows you to enter the LRFR and ASD factors to be used for the deck.



The image shows a software window titled "Deck" with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains a tabbed interface with five tabs: "Description", "Specs", "Adjustment factors", "Factors", and "Engine". The "Factors" tab is currently selected and active. Inside the "Factors" tab, there are two main sections: "LRFR" and "ASD factors".

LRFR Section:

- Condition factor: A dropdown menu showing "Good or Satisfactory".
- Field measured section properties
- System factor: A dropdown menu showing "All Other Girder/Slab Bridges".
- System factor override: A text input field.

ASD factors Section:

- OPER: A label above a text input field.
- Timber: A text input field.

At the bottom right of the window, there are three buttons: "OK", "Apply", and "Cancel".

TMBR3- Single Span Timber Beam – Glulam Example

The Adjustment factors tab of the Deck window allows you to modify the ASD tabulated design values and LRFD reference design values entered on the Bridge Materials – Timber – Sawn window. Use the Compute button to compute the adjustment factors for the deck timber material based on Wet usage conditions. Enter the shear factor as 1.0.

Deck

Description Specs Adjustment factors Factors Engine

Moisture condition for shear/flexure: Wet

Moisture condition for bearing: Wet

Moisture condition for modulus: Wet

Compute

ASD	LRFD
Wet service (flexure) (C_M): 0.85	Wet service (flexure) (C_M): 0.850
Wet service (shear) (C_M): 0.97	Wet service (shear) (C_M): 0.970
Wet service (bearing) (C_M): 0.67	Wet service (bearing) (C_M): 0.670
Wet service (modulus) (C_M): 0.90	Wet service (modulus) (C_M): 0.900
Shear (C_t): 1.00	Format conversion (C_{KF}):
Flat use (C_{fu}): 1.00	Format conversion (bearing) (C_{KF}):
Repetitive use (C_r): 1.15	Size (flexure) (C_F): 1.000
Load duration (C_D): 1.15	Size (modulus) (C_F): 1.000
Size (C_F): 1.00	Flat use (C_{fu}): 1.000
	Incising (flexure, shear) (C_i): 0.800
	Incising (bearing) (C_i): 1.000
	Incising (modulus) (C_i): 0.950
	Deck (C_d): 1.150
	Time effect (STRENGTH-I) (C_λ): 0.800
	Time effect (STRENGTH-II) (C_λ): 1.000

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Next define the structure typical section by double-clicking on Structure Typical Section in the Bridge Workspace tree. Input the data describing the typical section as shown below.

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line | Distance from right edge of deck to superstructure definition ref. line

Deck thickness | Superstructure Definition Reference Line

Left overhang | Right overhang

Deck | Parapet | Railing | Generic | Lane position | Striped lanes | Wearing surface

Superstructure definition reference line is within the bridge deck.

	Start	End
Distance from left edge of deck to superstructure definition reference line:	12.83 ft	12.83 ft
Distance from right edge of deck to superstructure definition reference line:	12.83 ft	12.83 ft
Left overhang:	0.83 ft	0.83 ft
Computed right overhang:	0.83 ft	0.83 ft

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Generic Appurtenances:

Enter the railings on the Generic tab. Click New to add a row to the table. Enter the following data. The completed tab is shown below.

The screenshot shows the 'Structure Typical Section' window with the 'Generic' tab selected. A diagram at the top shows a rectangular shape with 'Back' and 'Front' labels. Below it is a table with columns for Name, Load case, Measure to, Edge of deck dist. measured from, Distance at start (ft), Distance at end (ft), and Front face orientation. Two rows of 'Timber Railing' data are shown. Buttons for 'New', 'Duplicate', 'Delete', 'OK', 'Apply', and 'Cancel' are visible at the bottom.

Name	Load case	Measure to	Edge of deck dist. measured from	Distance at start (ft)	Distance at end (ft)	Front face orientation
Timber Railing	Railing DL	Back	Left Edge	0.00	0.00	Right
Timber Railing	Railing DL	Back	Right Edge	0.00	0.00	Left

TMBR3- Single Span Timber Beam – Glulam Example

Lane Positions:

Select the Lane Position tab. Enter the values shown below or click the Compute... button to automatically compute the lane positions. A dialog showing the results of the computation opens. Click Apply to apply the computed values. The Lane Position tab is populated as shown below.

Structure Typical Section

Diagram showing Travelway 1, Travelway 2, and Superstructure Definition Reference Line. Dimensions (A) and (B) are indicated.

Deck | Parapet | Railing | Generic | **Lane position** | Striped lanes | Wearing surface

Travelway number	Distance from left edge of travelway to superstructure definition reference line at start (A) (ft)	Distance from right edge of travelway to superstructure definition reference line at start (B) (ft)	Distance from left edge of travelway to superstructure definition reference line at end (A) (ft)	Distance from right edge of travelway to superstructure definition reference line at end (B) (ft)
1	-12.00	12.00	-12.00	12.00

LRFD fatigue

Lanes available to trucks:

Override Truck fraction:

Compute

New Duplicate Delete

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Enter the following wearing surface information on the Wearing Surface tab.

The screenshot shows a software window titled "Structure Typical Section" with a diagram of a timber beam cross-section and a "Wearing surface" configuration tab. The diagram labels include "Distance from left edge of deck to superstructure definition ref. line", "Distance from right edge of deck to superstructure definition ref. line", "Deck thickness", "Superstructure Definition Reference Line", "Left overhang", and "Right overhang". The "Wearing surface" tab contains the following fields and options:

- Wearing surface material: 3" timber planks
- Description: (empty text box)
- Wearing surface thickness: 3.0000 in Thickness field measured (DW = 1.25 if checked)
- Wearing surface density: 50.000 pcf
- Load case: Wearing Surface DL (dropdown menu)
- Copy from library... (button)

At the bottom right of the window are buttons for "OK", "Apply", and "Cancel".

TMBR3- Single Span Timber Beam – Glulam Example

Describing a member:

The member window shows the data that was generated when the structure definition was created. No changes are required at this time. After a Member Alternative is defined it will appear in the list of member alternatives.

Member

Member name: G2 Link with: -- None --

Description:

Existing	Current	Member alternative name	Description
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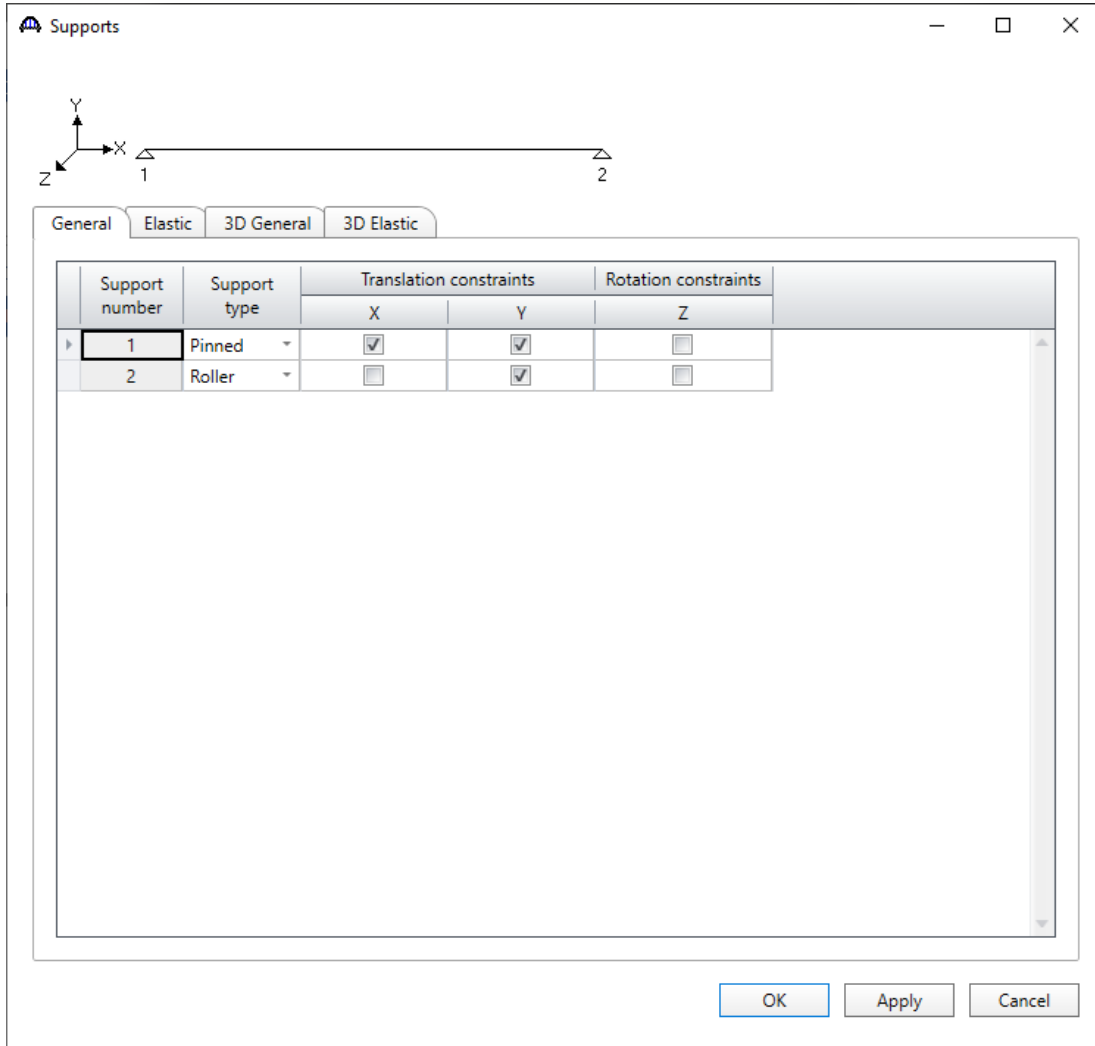
Number of spans: 1

Span no.	Span length (ft)
1	17.00

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

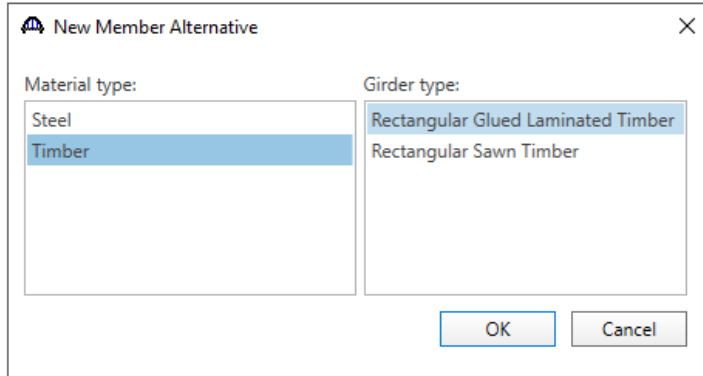
Support constraints were generated when the structure definition was created and are shown below.



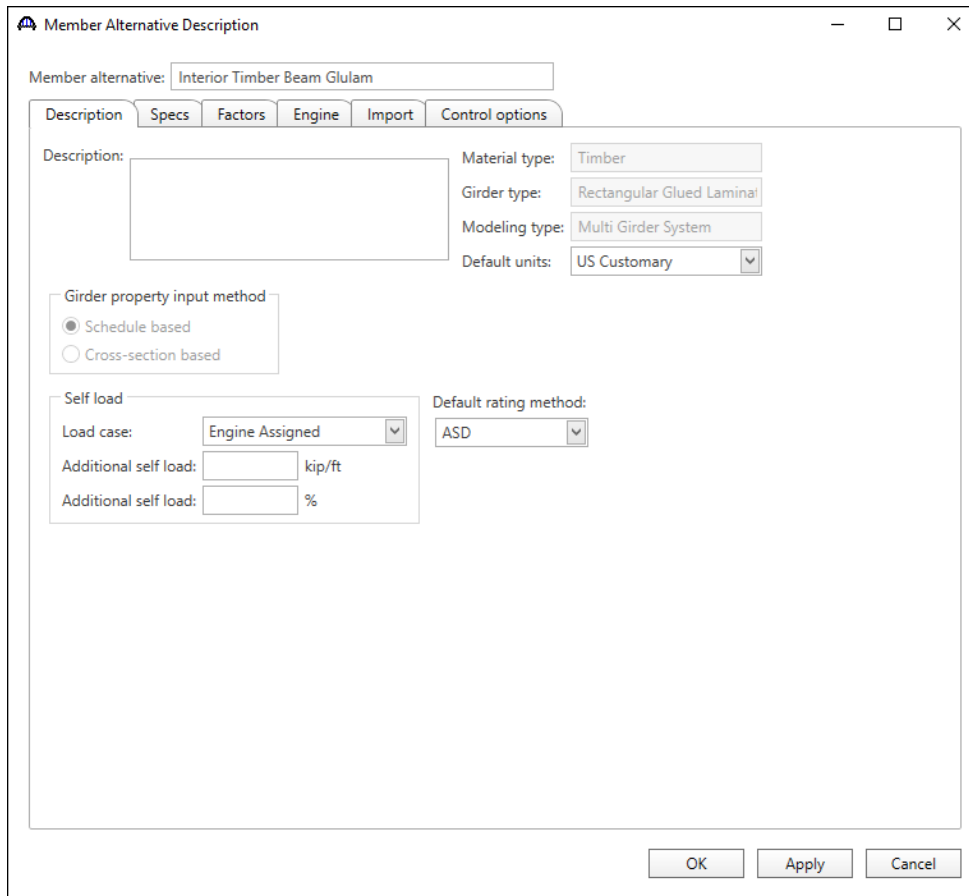
TMBR3- Single Span Timber Beam – Glulam Example

Defining a Member Alternative:

Double click MEMBER ALTERNATIVES in the tree to create a new alternative. The New Member Alternative dialog shown below will open. Select Timber for the Material Type and Rectangular Glued Laminated Timber for the Girder Type. Only Timber is available for the Material Type since a timber deck type was selected on the Structure Definition window. Timber decks are limited to timber beams in BrR/BrD.

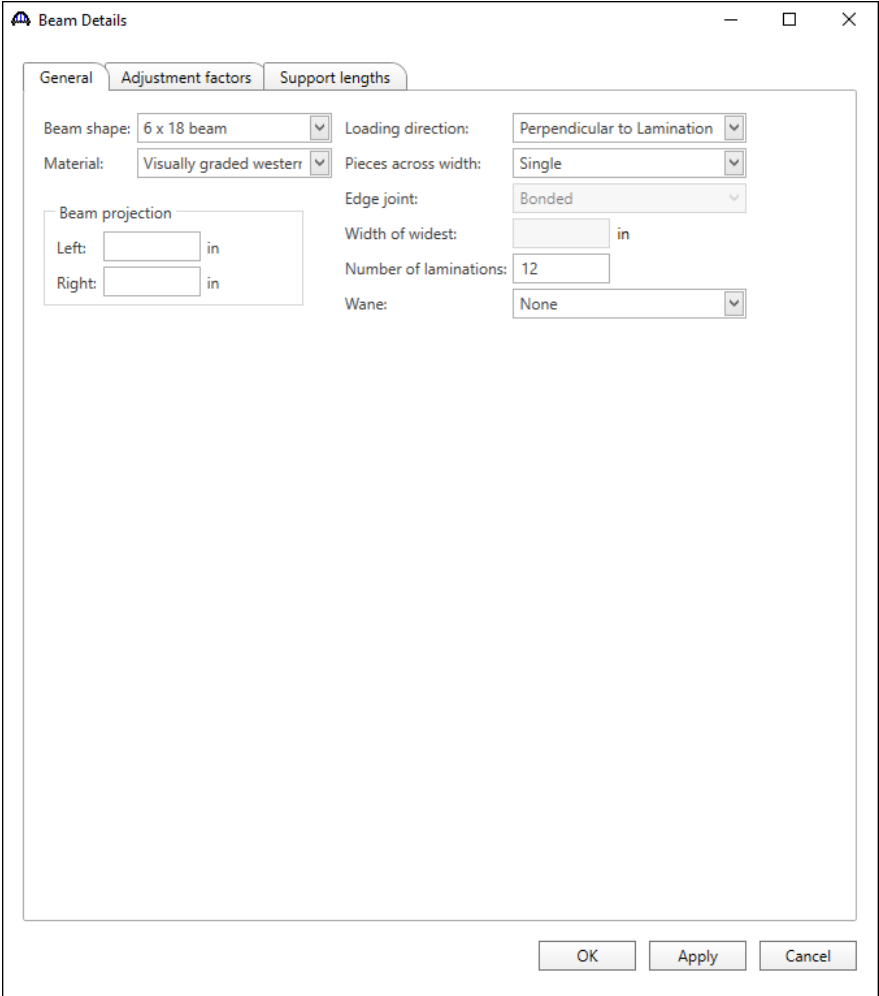


Enter the following data for the Member Alternative. Click OK to save to memory and close the window.



TMBR3- Single Span Timber Beam – Glulam Example

Open the Beam Details window by double clicking on Beam Details in the tree. The Beam Details window is shown below.



TMBR3- Single Span Timber Beam – Glulam Example

The Adjustment Factors tab of the Beam Details window allows you to enter adjustment factors to modify the ASD tabulated design values and the LRFD Reference design values entered on the Bridge Materials – Timber – Glued Laminated window. The tabulated design values modified by these adjustment factors produce the design allowable stresses.

Select the Wet condition for Shear/Flexure, Bearing and Modulus. Use the Compute button to calculate the factors for the beam based on the Wet moisture conditions.

Beam Details

General | **Adjustment factors** | Support lengths

Moisture condition for shear/flexure: Wet
Moisture condition for bearing: Wet
Moisture condition for modulus: Wet

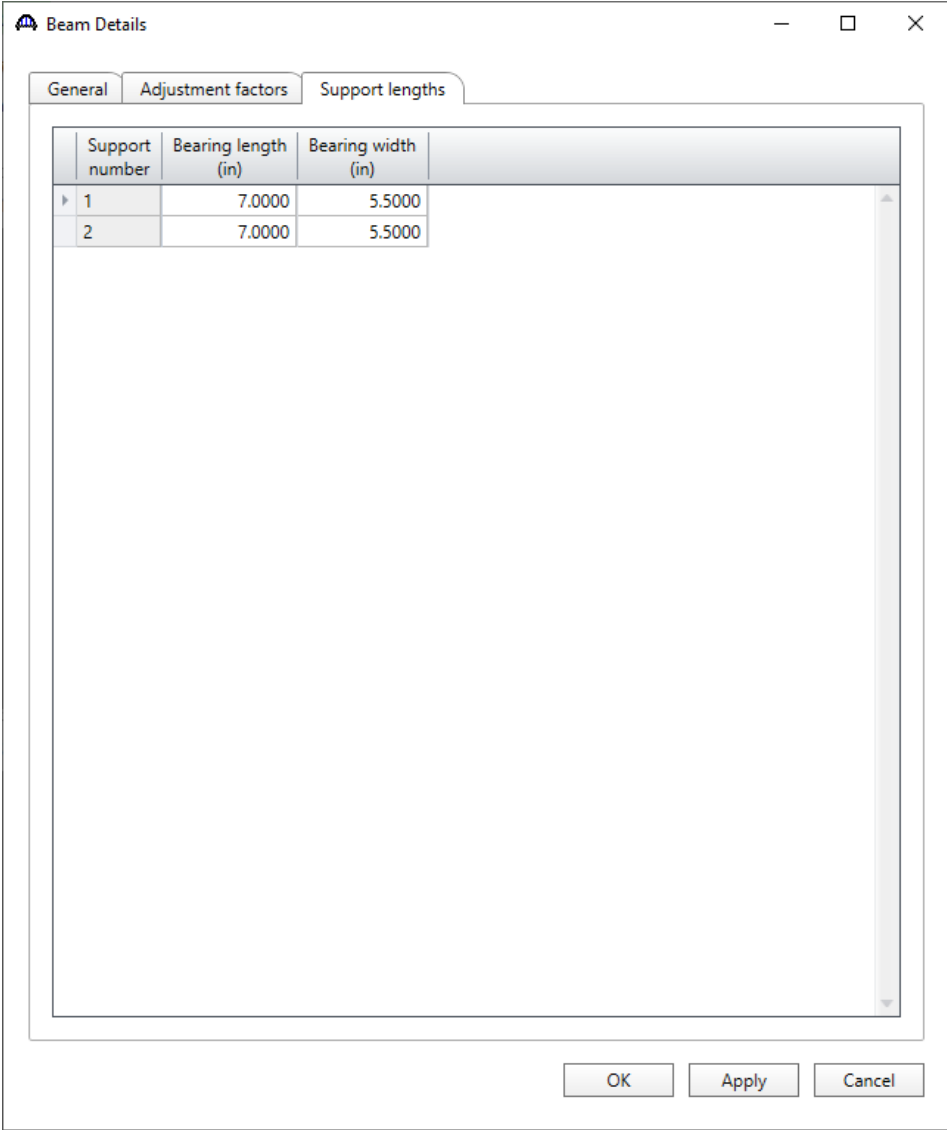
Compute

ASD	LRFD
Wet service (flexure) (C_M): 0.800	Wet service (flexure) (C_M): 0.800
Wet service (shear) (C_M): 0.875	Wet service (shear) (C_M): 0.875
Wet service (bearing) (C_M): 0.530	Wet service (bearing) (C_M): 0.530
Wet service (modulus) (C_M): 0.833	Wet service (modulus) (C_M): 0.833
Load duration (C_D): 1.150	Format conversion (C_{KF}):
Size (C_F): 1.000	Format conversion (bearing) (C_{KF}):
Volume (C_V):	Volume (C_V):
Bearing (C_b):	Flat use (C_{fu}): 1.000
Beam stability (C_s):	Bearing (C_b):
	Time effects (STRENGTH - I) (C_t): 0.800
	Time effects (STRENGTH - II) (C_t): 1.000
	Beam stability (C_s):

OK Apply Cancel

TMBR3- Single Span Timber Beam – Glulam Example

Enter the following data on the Support Lengths tab. Click OK to save to memory and close the Beam Details window.



TMBR3- Single Span Timber Beam – Glulam Example

Open the Live Load Distribution window and in the Standard tab, use the Compute from Typical Section button to compute the following live load distribution factors for Standard live load distribution factors.

The screenshot shows the 'Live Load Distribution' window with the 'Standard' tab selected. The 'Distribution factor input method' section has three radio buttons: 'Use simplified method' (selected), 'Use advanced method', and 'Use advanced method with 1994 guide specs'. There is also a checkbox for 'Allow distribution factors to be used to compute effects of permit loads with routine traffic' which is unchecked. Below this is a table with the following data:

Lanes loaded	Distribution factor (wheels)			
	Shear	Shear at supports	Moment	Deflection
▶ 1 Lane	0.522	1.000	0.444	0.154
Multi-lane	0.550	1.000	0.500	0.308

At the bottom of the window, there are buttons for 'Compute from typical section...', 'View calcs', 'OK', 'Apply', and 'Cancel'.

TMBR3- Single Span Timber Beam – Glulam Example

The live load distribution factors are computed as follows:

Moment DF (AASHTO Table 3.23.1)

$$\text{Single Lane Moment DF} = \frac{S}{4.5} = \frac{2}{4.5} = 0.4444$$

$$\text{Multi Lane Moment DF} = \frac{S}{4.0} = \frac{2}{4.0} = 0.5000$$

Shear at Supports DF (AASHTO Article 3.23.1.2)

By simple beam distribution, both single and multi lane Shear at Support DF = 1.0000

Shear DF (AASHTO Article 3.23.1.2 refers to AASHTO Article 13.6.5.2)

$$V_{LL} = 0.50[(0.60V_{LU}) + V_{LD}] \quad (\text{AASHTO Eq. 13-10})$$

where V_{LU} = shear due to undistributed wheel loads (ie, one line of wheels carried by one bending member) = 1

V_{LD} = shear due to wheel loads distributed laterally as specified for moment in Article 3.23

$$\text{Single Lane Shear DF} = 0.50[(0.60(1) + 0.4444)] = 0.5222$$

$$\text{Multi Lane Shear DF} = 0.50[(0.60(1) + 0.5000)] = 0.5500$$

Deflection DF

$$\text{Single Lane Deflection DF} = \frac{1 \text{ lane} * 2 \text{ wheels/lane}}{13 \text{ beams}} = 0.1538$$

$$\text{Multi Lane Deflection DF} = \frac{2 \text{ lane} * 2 \text{ wheels/lane}}{13 \text{ beams}} = 0.3077$$

TMBR3- Single Span Timber Beam – Glulam Example

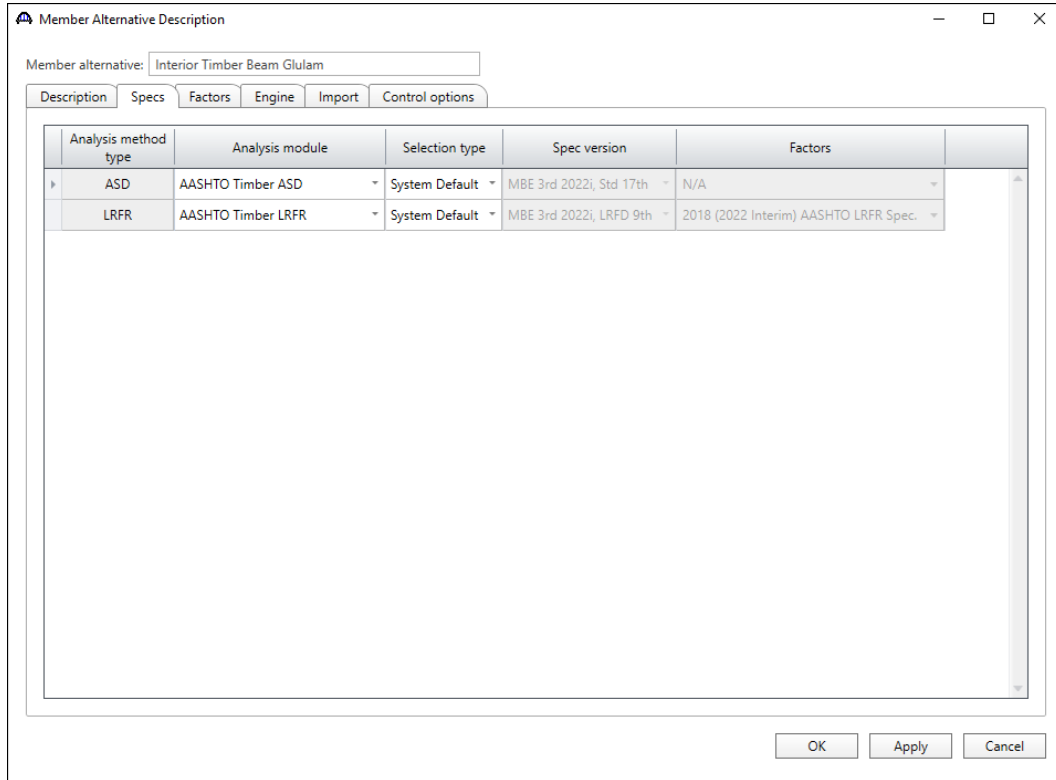
Define Points of Interest using the Point of Interest window shown below. A window for defining a Point of Interest is opened by double clicking on the Points of Interest tree item.

The screenshot shows a dialog box titled "Point Of Interest" with standard window controls (minimize, maximize, close) in the top right corner. The dialog is divided into several sections:

- Input fields:** "Distance from leftmost support:" with a text box containing "8.50" and "ft or"; "Span:" with a dropdown menu showing "Span 1"; "Fraction:" with a text box containing "0.500000".
- Side selection:** A group box labeled "Side" containing two radio buttons: "Left" (unselected) and "Right" (selected).
- Tabbed interface:** A row of tabs at the bottom of the main content area: "ASD design values" (selected), "ASD adjustment factors", "ASD operating stress percentage", "LRFD design values", "LRFD adjustment factors", "Bracing", and "Engine".
- Override design values:** A checkbox labeled "Override design values" is currently unchecked.
- Loaded perpendicular to wide faces of lamination:** A group box containing five rows of text labels followed by text input boxes and the unit "ksi":
 - Tension zone stressed in tension:
 - Compr. zone stressed in tension:
 - Compr. perp. to grain (tension):
 - Compr. perp. to grain (compr.):
 - Shear parallel to grain:
- Loaded parallel to wide faces of lamination:** A group box containing four rows of text labels followed by text input boxes and the unit "ksi":
 - Bending:
 - Compr. perp. to grain:
 - Shear parallel to grain:
 - Shear parallel to grain (not edge glued):
- Buttons:** Three buttons are located at the bottom right: "OK", "Apply", and "Cancel".

TMBR3- Single Span Timber Beam – Glulam Example

To select the analysis module for both ASD and LRFR analysis method types, double click on the member alternative Interior Timber Beam and click on the Specs tab. To run ASD analysis using AASHTO timber engine, select AASHTO Timber ASD option from the Analysis module options for ASD analysis method type. Similarly, to run LRFR analysis using AASHTO timber engine, select AASHTO Timber LRFR option from the Analysis module options for LRFR analysis method type.



TMBR3- Single Span Timber Beam – Glulam Example

To perform a rating, select the Analysis Settings button on the Analysis group of the Design/Rate toolbar. To run ASD analysis, select ASD as the Rating Method, select the HS 15-44 vehicle to be used in the rating in inventory and operating and click OK.

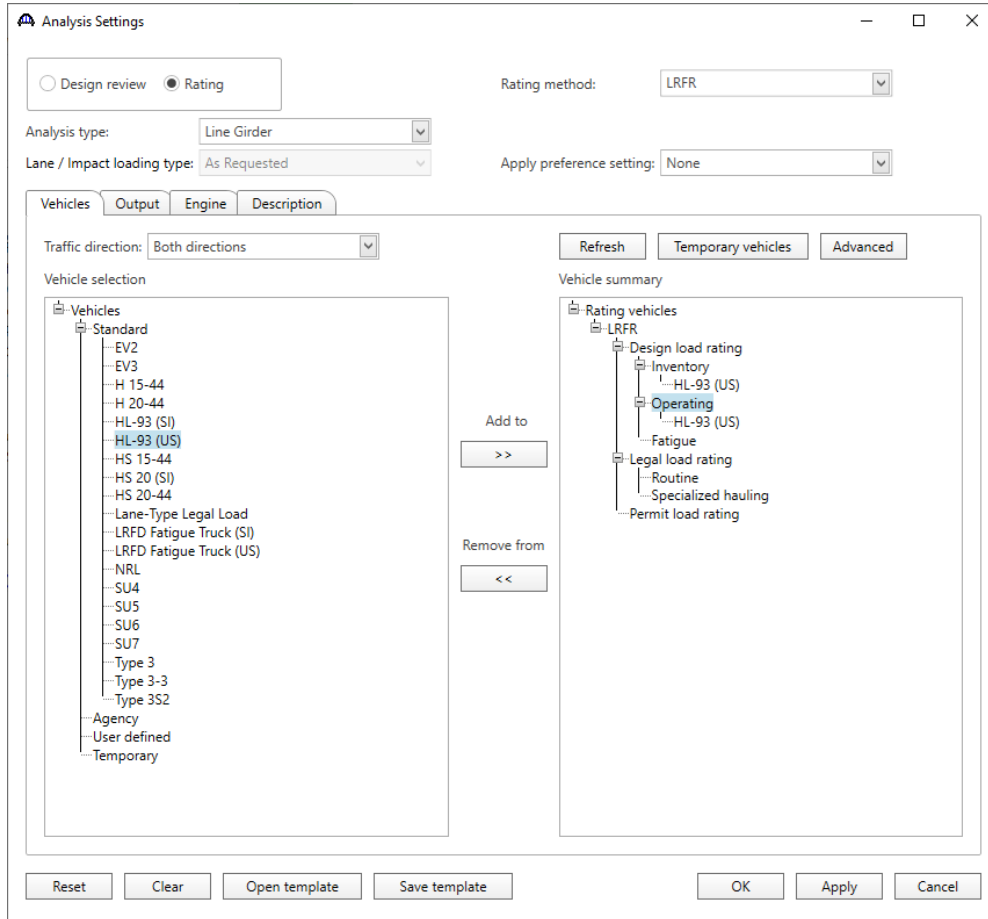
Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the Tabular Results button on the Results group of the Design/Rate toolbar. The window shown below will open.

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 15-44	Axle Load	ASD	Inventory	20.47	0.758	0.00	1 - (0.0)	Bearing Stress	As Requested	As Requested
HS 15-44	Axle Load	ASD	Operating	27.69	1.026	0.00	1 - (0.0)	Bearing Stress	As Requested	As Requested
HS 15-44	Lane	ASD	Inventory	24.51	0.908	0.00	1 - (0.0)	Bearing Stress	As Requested	As Requested
HS 15-44	Lane	ASD	Operating	33.16	1.228	0.00	1 - (0.0)	Bearing Stress	As Requested	As Requested

AASHTO ASR Engine Version 7.3.0.3001
Analysis preference setting: None

TMBR3- Single Span Timber Beam – Glulam Example

To run LRFR analysis, in the Analysis Settings window, select LRFR as the Rating Method, select the HL-93(US) vehicle in inventory and operating and click OK.



Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the Tabular Results button on the toolbar. The window shown below will open.

