AASHTOWare BrDR 7.5.0

# Timber Structure Tutorial

TMBR3- Single Span Timber Beam - Glulam Example

# BrDR Training

# TMBR3- Single Span Timber Beam Example

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

A Timber Example Glula	m							-		×
Bridge ID: Timber Exa	mple Glulam	NBI structur	e ID (8): Timber Exar	mple Glulam	Template Bridge comple	tely defined	<ul> <li>Superstructures</li> <li>Culverts</li> <li>Substructures</li> </ul>			
Description Descr	ription (cont'd)	Alternatives	Global reference p	oint Traffic	Custom agency field	ls				
Name:	Timber Bridge	(Glulam)			Year built:		7			
Description:	Example 7-9 an	d 7-11 from "Ti	nail-laminated deck. mber Bridges: Design JSDA Forest Service, J	, Construction,			_			
Location:					Length:		ft			
Facility carried (7):					Route number:	-1				
Feat. intersected (6):					Mi. post:					
Default units:	US Customary	>								
Bridge associat	tion 🗸 🗹	BrR 🗹 BrD 🗌	BrM							
							OK A	pply	Cance	el

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

#### Bridge – Materials

To add a new timber material for timber deck, in the **Components** tab of the Bridge Workspace, click on **Materials**, **Timber**, **Sawn** and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Sawn** and select **New**).

Bridge Workspace - Timber Example Glulam	ANALYSIS	REPORTS	? —	□ ×
BRIDGE WORKSPACE WORKSPACE TOOLS VIE	W DESIGN/RATE	REPORTING		^
Check Out Check In Validate Save Close Export	Refresh Open Nev	V Copy Paste	Duplicate Delete Schematic	-
Bridge		Manage		
Workspace # ×	Schematic	ųх	Report	щ×
Bridge Components				
<ul> <li>Encomponents</li> <li>Appurtenances</li> <li>Image: Provide the second second</li></ul>				
📁 Concrete 🎾 Prestress Bar	Analysis			Ψ×
Prestress Strand     Prestress Strand     Prestress Strand     Structural Steel     Structural Steel     Prestress Strand     Structural Steel     Prestress Strand     Prestress     Prestress				

#### Click the Copy from Library button and select the following material from the library.

	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	
Þ	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	Ι.
	4 II III III	<u> </u>	<u> </u>	1000	<u> </u>	C 11 D: 10	NI 4	C1 C1 0-1	CDID .	

Click **OK** and the **Bridge Materials** – **Timber - Sawn** window will be populated with the library data. Change the **Name** field 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 Ma	terials - Timb	er - Sawn		_		×
Name:	Deck Timber					
Description:	Southern Pir	e				
General	ASD LR	FD				
Grading r	method:	Visual	~			
Species:		Southern Pine	~			
Commerc	cial grade:	No. 2	$\sim$			
Size class	ification:	2" - 4" thick, 2" - 4" wide	$\checkmark$			
Grading i	rules agency:	SPIB	~			
Density:		0.05 kcf				
Copy to I	ibrary	Copy from library	ОК А	pply	Cance	1

🗛 Bridge Ma	terials - Tim	ber - Sawn			-	_		×
Name:	Deck Timbe	er		]				
Description:	Southern P	ine						
General	ASD LI	RFD						
Bending:		1.5	ksi					
Tension (p	arallel):	0.825	ksi					
Shear (par	allel):	0.090	ksi					
Compr. (p	erp):	0.565	ksi					
Compr. (p	arallel):	1.650	ksi					
Modulus	of elasticity:	1600.00	ksi					
Notes:								
Copy to	library	Copy from I	ibrary	OK	Apply		Cance	el 🛛

🕰 Bridge Ma	terials - Tim	ber - Sawn				_		×
Name:	Deck Timbe	er						
Description:	Southern P	ine						
General	ASD L	RFD						
Bending:		1.100	ksi					
Tension (p	arallel):	0.675	ksi					
Shear (par	allel):	0.175	ksi					
Compr. (p	erp):	0.565	ksi					
Compr. (p	arallel):	1.450	ksi					
Modulus	of elasticity:	1400.00	ksi					
Notes:								
Copy to	library	Copy from I	ibrary	OK	Α	pply	Canc	el

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

me:	Visual	graded weste	rn species					
scription:	Visuall	y graded weste						
General	ASD	design values	LRFD desig	n values				
Grading r	method:	Visual		$\sim$				
Species o	uter:	Douglas Fir-La	arch	~				
Species c	ore:	Douglas Fir-La	arch	~				
Combina	tion:	20F-V3	1	~				
Density:		0.05	kcf					

## TMBR3- Single Span Timber Beam – Glulam Example

me:	Visually graded west	stern spe	cies						
[	Visually graded west	stern spe	cies						
scription:									
General	ASD design values	LRF	D design va	lues					
	d perpendicular to wi				Loaded parallel to wide	le faces of la	mination		_
	zone stressed in ten	_		ksi	Bending:		1.450	ks	i
	zone stressed in ten		.000	ksi	Compr. perp. to grain:		0.560	ks	a
	. perp. to grain (tensio		0.650	ksi	Shear parallel to grain		0.145	ks	a
	perp. to grain (comp		.560	ksi	Shear parallel to grain			ks	i
Shear p	barallel to grain:	0	.165	ksi	Modulus of elasticity:		1500.00	00 ks	i
Modulu	us of elasticity:	1	600.000	ksi					
Axially	loaded								
	_	.000	ksi						
		.550	ksi						
Modulu	us of elasticity: 1	500.000	ksi						
Notes:									
		-							
					A 10				
		Сору	y to library	. C	opy from library	OK	Apply	Ca	ncel
		Сору	y to library	. C	opy from library	OK	Apply	Ca	ncel
Bridge Ma	aterials - Timber - Glu			. C	opy from library	OK	Apply	Ca	ncel
ſ		ued Lami	inated	. C	opy from library	OK	Apply		ncel
ſ	Visually graded wes	ued Lami	inated	. C	opy from library	OK	Apply —		ncel
me:		ued Lami	inated	. C	opy from library	OK	Apply		ncel
me: [ scription:	Visually graded west	Jed Lami	inated cies		opy from library	OK	Apply		ncel
me:	Visually graded wes	Jed Lami	inated		opy from library	OK	Apply —		ncel
me: scription: General	Visually graded west	Jed Lami stern spe stern spe	inated cies cies D design va	lues	Loaded parallel to wic				ncel
me: [ scription: General Loaded	Visually graded west Visually graded west ASD design values	itern spe stern spe LRFI	inated cies cies D design va	lues		le faces of lar	mination		ncel
me: [ scription: General Loaded Tension	Visually graded west Visually graded west ASD design values d perpendicular to win	ued Lami stern spe stern spe LRFE ide faces	inated ccies ccies D design va	llues	Loaded parallel to wic	le faces of lan	nination 50 ksi		ncel
me: [ scription: General Loaded Tension Compr.	Visually graded west Visually graded west ASD design values d perpendicular to win a zone stressed in ten	ued Lami stern spe stern spe ide faces nsion: 2 usion: 1	inated icies Cries D design va s of laminati 2.000	lues ion ksi	Loaded parallel to wic Extreme fiber in bendi	ie faces of lan ng: 1.45 0.56	mination 50 ksi 50 ksi		ncel
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me: scription: General Loaded Tension Compr. Compr.	Visually graded west Visually graded west ASD design values d perpendicular to with zone stressed in ten- zone stressed in ten- perp. to grain (tensio	item spe item spe item spe ide faces nsion: 2 ision: 1 ion): 0 pr.): 0	inated icies D design va s of laminati 2.000 1.450	llues ion ] ksi ] ksi	Loaded parallel to wic Extreme fiber in bendi Compr. perp. to grain: Shear parallel to grain	le faces of lan ng: 1.4: 0.5( (horz.): 0.2:	mination 50 ksi 50 ksi 30 ksi		ncel
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ame: [ General ] Loaded Tension Compr. Compr. Shear p Modulu Axially Tension Compr. Modulu	Visually graded west Visually graded west ASD design values d perpendicular to win a zone stressed in ten zone str	LIRFU LIR	inated ccies ccies D design va c of laminati 2.000 1.450 2.650 2.650 2.265 600.000	lues lon ksi ksi ksi ksi	Loaded parallel to wic Extreme fiber in bendi Compr. perp. to grain: Shear parallel to grain Modulus of elasticity: Fasteners Specific gravity top or	le faces of lan ng: 1.4: 0.55 (horz.): 0.2: 150 bottom faces		ksi	ncel
ime: General Loaded Tension Compr. Compr. Shear p Modulu Axially Tension Compr. Modulu	Visually graded west Visually graded west ASD design values d perpendicular to win a zone stressed in ten zone str	LIRFU LIR	inated ccies ccies D design va c of laminati 2.000 1.450 2.650 2.650 2.265 600.000	lues lon ksi ksi ksi ksi	Loaded parallel to wic Extreme fiber in bendi Compr. perp. to grain: Shear parallel to grain Modulus of elasticity: Fasteners Specific gravity top or	le faces of lan ng: 1.4: 0.55 (horz.): 0.2: 150 bottom faces		ksi	ncel
ame: [ General ] Loaded Tension Compr. Compr. Shear p Modulu Axially Tension Compr. Modulu	Visually graded west Visually graded west ASD design values d perpendicular to win a zone stressed in ten zone str	LIRFU LIR	inated ccies ccies D design va c of laminati 2.000 1.450 2.650 2.650 2.265 600.000	lues lon ksi ksi ksi ksi	Loaded parallel to wic Extreme fiber in bendi Compr. perp. to grain: Shear parallel to grain Modulus of elasticity: Fasteners Specific gravity top or	le faces of lan ng: 1.4: 0.55 (horz.): 0.2: 150 bottom faces		ksi	
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ime: General Loaded Tension Compr. Compr. Shear p Modulu Axially Tension Compr. Modulu	Visually graded west Visually graded west ASD design values d perpendicular to win a zone stressed in ten zone str	LIRFU LIR	inated ccies ccies D design va c of laminati 2.000 1.450 2.650 2.650 2.265 600.000	lues lon ksi ksi ksi ksi	Loaded parallel to wic Extreme fiber in bendi Compr. perp. to grain: Shear parallel to grain Modulus of elasticity: Fasteners Specific gravity top or	le faces of lan ng: 1.4: 0.55 (horz.): 0.2: 150 bottom faces		ksi	ncel

The input values in the **ASD design values** tab of this window and in the **LRFD design values** 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.

#### Timber – Shape

Add a new timber beam shape by clicking on **Beam Shapes**, **Timber Shapes**, **Rectangular** in the **Components** tree and selecting **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on **Rectangular**).

Bridge Workspace - Timber Example Gl	ulam	ANALYSIS	REPORTS		? —	□ ×
BRIDGE WORKSPACE WORKSPACE TOOLS	VIEW	DESIGN/RATE	REPORTING			^
Check Out Check In Validate Save Close	🞸 💭 Export Refre	esh Open Nev	Copy Paste	Duplicate Delete	Schematic	
Bridge			Manage			
Workspace	<mark>ях</mark> S	chematic	ч×	Report		щ×
Bridge Components						
<ul> <li>Components</li> <li>Appurtenances</li> <li>Beam Shapes</li> <li>Prestress Shapes</li> <li>Steel Shapes</li> <li>Timber Shapes</li> <li>For Connectors</li> </ul>						
Image: Image	A	Analysis				Ψ×
n aterials						

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 the **Compute** button to compute the section properties. Click **OK** to save the data to memory and close the window.

🗛 Timber Shape - Rectangul	ar			-		×
Name: 6 x 18 beam						
Description:						
Dimensions Properties						
5.5000	in					
	17.5000 in					
Copy to library.	Copy from libra	ary OK	Appl	y	Cance	el
🗛 Timber Shape - Rectangul	ar			-		×
Name: 6 x 18 beam						
Description:						
Dimensions Properties						
Dimensions	•					
Area:	96.25	in^2				
Area: Nominal load:	96.25 33.40	in^2 Ib/ft				
Nominal load:	33.40	lb/ft				
Nominal load: Moment of inertia:	33.40 2456.4	lb/ft in^4				
Nominal load: Moment of inertia: CG from bottom:	33.40 2456.4 8.7500 280.7	lb/ft in^4 in				
Nominal load: Moment of inertia: CG from bottom: Section modulus, top:	33.40 2456.4 8.7500 280.7	lb/ft in^4 in in^3				
Nominal load: Moment of inertia: CG from bottom: Section modulus, top: Section modulus, bottom	33.40 2456.4 8.7500 280.7 :: 280.7	lb/ft in^4 in in^3 in^3				
Nominal load: Moment of inertia: CG from bottom: Section modulus, top: Section modulus, bottom Nominal width:	33.40 2456.4 8.7500 280.7 :: 280.7 6.00	lb/ft in^4 in in^3 in^3				
Nominal load: Moment of inertia: CG from bottom: Section modulus, top: Section modulus, bottom Nominal width:	33.40       2456.4       8.7500       280.7       280.7       6.00       18.0000	lb/ft   in^4   in^3   in^3   in   in Compute	Аррі		Cance	

# Bridge Appurtenances

To enter the appurtenances to be used within the bridge, expand the **Components** tree branch labeled **Appurtenances**. To define a generic railing, select **Generic** in the **Components** tree and click **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on **Generic**).

Bridge Workspace - Timber Example Glu	ulam	ANALYSIS	REPORTS		? –		×
BRIDGE WORKSPACE WORKSPACE TOOLS	VIEW	DESIGN/RATE	REPORTING				^
Check Out Check In Validate Save Close	🎸 <table-cell> Export Refre</table-cell>		Copy Paste	Duplicate Delete So	thematic		
Bridge			Manage				
Workspace	я × S	chematic	μ×	Report		щ	×
Bridge Components							
Components     Components     Appurtenances     Professional American American American American     Professional American A							
<ul> <li>Pactors</li> <li>Pactors</li></ul>	A	Analysis				4	×

Input the generic railing dimensions as shown below.

🕰 Bridge A	opurtenances - Generic	-		×
Name:	Timber Railing			
Description:				
	All dimensions are in inches			
Distance	from edge to centroid: 5,0000			
	Reference Line Barrier load: 0.060 kip/ft Width: 10.0000			
	Effective wind height: Back Back			
	Copy from library OK Apply		Cance	

Click **OK** to save the data to memory and close the window.

# Bridge Connectors - Nail

To create a nail definition, expand the **Connectors** tree item, select **Nail** in the **Components** tree, and click **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on **Nail**).

Bridge Workspace - Timber Example Glulam	ANALYSIS	REPORTS		? —		:
BRIDGE WORKSPACE WORKSPACE TOOLS VIE	EW DESIGN/RATE	REPORTING				^
Check Out Check In Validate Save Close Export	Refresh Open New	W Copy Paste	Duplicate Delete Sc	thematic		
Bridge		Manage				
Workspace # ×	Schematic	ų×	Report		щ×	
Bridge Components						I
Components     Appurtenances     Point Seam Shapes     Point Source Sourc						
Image: Image	Analysis				Ψ×	

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

A Structure D	efinition Connectors - Nail	_		$\times$
Name:	20 Pennyweight			
Description:				
Length:	4.0000 in			
Diameter:	0.1480 in			
Pennyweight	20d 🗸			
	Copy from library OK App	oly	Cance	el

#### Superstructure Definition

Double click on **SUPERSTRUCTURE DEFINITIONS** (or click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the **Manage** group of the **WORKSPACE** ribbon 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.

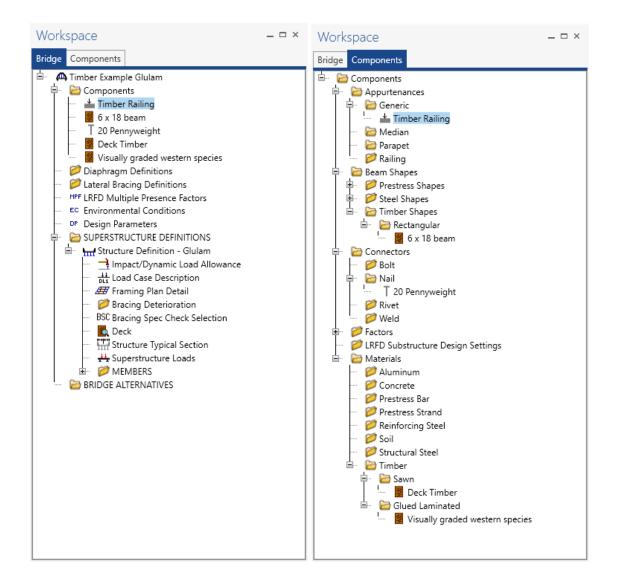
<ul> <li>Girder system superstructure</li> </ul>	
Girder line superstructure	Superstructure definition wizard
<ul> <li>Floor system superstructure</li> </ul>	
Floor line superstructure	
Truss system superstructure	
Truss line superstructure	
Reinforced concrete slab system superstructure	
Concrete multi-cell box superstructure	
Advanced concrete multi-cell box superstructure	

Select Girder System Superstructure and the Girder System Superstructure Definition window will open.

Definition Anal	lysis Specs	Engine				
Vame:	Structure De	finition - Glula	im			Modeling
	Glulam bean	ns with Nail La	minated Deck			Multi-girder system O MCB
						With frame structure simplified definition
Description:						Deck type:
						Timber Deck 🗸
efault units:	US Customa	у 🖌	Enter span lengths			For PS/PT only
lumber of spans:	1 🗘		along the reference line:			Average humidity:
lumber of girders	: 13 🗘		Length			%
			span (ft)			Member alt. types
			1 17.00	<u>_</u>		Steel
						Steel
						P/S
						□ P/S □ R/C
						P/S R/C Timber
						□ P/S □ R/C
				÷		□ P/S □ R/C ☑ Timber
Horizontal curva	iture along refe	rence line		v		□ P/S □ R/C ☑ Timber
Horizontal curva	-		rom PC to first support line:	¥	ft	□ P/S □ R/C ☑ Timber
	irvature			V	ft ft	□ P/S □ R/C ☑ Timber
Horizontal cu Superstructur Curved	irvature re alignment —	Distance fr		·		□ P/S □ R/C ☑ Timber
Horizontal cu Superstructur O Curved Tangent, cu	rvature re alignment	Distance fr Start tange	ent length:		ft	□ P/S □ R/C ☑ Timber
Horizontal cu Superstructur Curved Tangent, cu Tangent, cu	irvature re alignment urved, tangent urved	Distance fr Start tange Radius:	ent length:		ft	□ P/S □ R/C ☑ Timber
Horizontal cu Superstructur O Curved Tangent, cu	irvature re alignment urved, tangent urved	Distance fr Start tange Radius: Direction: End tange	ent length:	Left V	ft ft	□ P/S □ R/C ☑ Timber
Horizontal cu Superstructur Curved Tangent, cu Tangent, cu	irvature re alignment urved, tangent urved	Distance fr Start tange Radius: Direction: End tange	ent length: nt length: rom last support line to PT:	Left V	ft ft ft	□ P/S □ R/C ☑ Timber

Enter the data as shown below.

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



## Load Case Description

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

Load case name	Description	Stage		Туре	Time* (days)	
Railing DL		Non-composite (Stage 1)	*	D,DC -		
Wearing Surface DL		Non-composite (Stage 1)	-	D,DW *		
estressed members only	Add default load					

Click **OK** to save to memory and close the window.

#### Framing Plan Detail

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

Struct	ture Framii	ng Plan Details										-		
mba	r of spans:	1	Number of gird	larra										
inde			Number of gire	JCI S.										
ayoı.	ut Diap	hragms												
				Gi	rder spac	ing orient	tation –							
					Perpend	- licular to g	girder							
	Support	Skew (degrees)			Along s									
Þ	1	0.000	A	_										
	2	0.000				Girder								
					Girder bay	(f Start of								
					55)	girder	girder							
				Þ	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							
					10	2.00	2.00							
					11	2.00	2.00							
					12	2.00	2.00							
			-					-						
_														
										Ok	Apply		Canc	el

Click **OK** to save to memory and close the window.

# Diaphragms

Switch to the **Diaphragms** tab to enter diaphragm spacing. Select the **Diaphragm Wizard** button to have BrDR generate the diaphragm locations. The following window appears. Select the **Next** button to continue.

🕰 Diaphragm Wizard	×
Select the desired framing plan system:	
< Back Next > Cancel	

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

Di Di	iaphragm	Wizard
		Diaphragm spacing     Diaphragm spacing     Enter number of equal spaces per span     Enter equal spacing per span     Enter groups of equal spacing     Support diaphragm load: kip
		Interior diaphragm load: kip
	Span	Length Number of (ft) equal spaces
•	1	17.00 2
		< Back Finish Cancel

# TMBR3- Single Span Timber Beam – Glulam Example

The **Diaphragm Wizard** generates the following diaphragm locations.

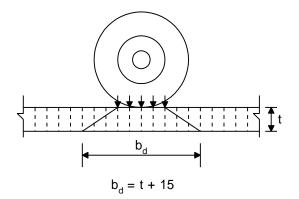
irc	ler b	bay: 1		~	Copy bay t	0		hragm ard					
	Support		dis	tart tance (ft)	Diaphragm spacing	Number of spaces	Length (ft)	End distance (ft)		Load (kip)	Diaphragm		
	numbe		Left girder	Right girder	(ft)		1	Left girder	Right girder	(p)			
Þ	1	*	0.00	0.00	0.00	1	0.00	0.00	0.00		Not Assigned *		-
	1	-	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 Duplica	ate	Delete

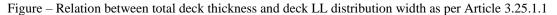
Click **OK** to save to memory and close the window.

#### Deck

Enter the deck description by double-clicking on **Deck** in the **Bridge Workspace** tree. BrDR 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 as shown below. This value equals 18.5" for this structure.





Description	Specs	Adjustment factors	Factors	Engine				
Default rating	method	ASD			neters us over more th weight reductio			
Timber deck t	ype:	Nail-Laminated De	eck 🗸					
Timber mater	ial	Deck TImber	>					
Total deck thi	ckness:	3.5000 in	1	Nominal thick:	4.0000	in		
Lamination th	ickness:	1.5000 in	I	Nominal width:	2.0000	in		
Deck LL distril	bution width	n: 18.5000 in						
Nail:		20 Pennyweight	~					
						OK	Apply	ancel

# Deck – Factors

The **Factors** tab of the **Deck** window provides entries for the **LRFR** and **ASR** factors to be used for the deck.

## Deck – Adjustment factors

The **Adjustment factors** tab of the **Deck** window provides entries to modify the **ASD** tabulated design values and **LRFD** reference design values that were previously entered on the **Bridge Materials – Timber – Glued Laminated** 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**.

Description	Specs	Adjustment	factors	Factors	Engine			 
loisture con	dition for sl	hear/flexure:	Wet		~			
/loisture con	dition for b	earing:	Wet		~			
Aoisture con	dition for m	nodulus:	Wet		>			
			Comp	ute				
ASD						LRFD		
Wet servic	e (flexure) (	C <sub>M</sub> ): 0.85				Wet service (flexure) ( $C_M$ ):	0.850	
Wet servic	e (shear) (C	M): 0.97				Wet service (shear) ( $C_M$ ):	0.970	
Wet servic	e (bearing)	(C <sub>M</sub> ): 0.67				Wet service (bearing) ( $C_M$ ):	0.670	
Wet servic	e (modulus)	) (C <sub>M</sub> ): 0.90				Wet service (modulus) (C <sub>M</sub> ):	0.900	
Shear (C <sub>H</sub> ):		1.00				Format conversion (C <sub>KF</sub> ):		
Flat use (C	<sub>fu</sub> ):	1.00				Format conversion (bearing) ( $C_{KF}$ ):		
Repetitive	use (C <sub>r</sub> ):	1.15				Size (flexure) (C <sub>F</sub> ):	1.000	
Load durat	tion (C <sub>D</sub> ):	1.15				Size (modulus) (C <sub>F</sub> ):	1.000	
Size (C <sub>F</sub> ):		1.00				Flat use (C <sub>fu</sub> ):	1.000	
						Incising (flexure, shear) (C <sub>i</sub> ):	0.800	
						Incising (bearing) (C <sub>i</sub> ):	1.000	
						Incising (modulus) (C <sub>i</sub> ):	0.950	
						Deck (C <sub>d</sub> ):	1.150	
						Time effect (STRENGH-I) ( $C_{\lambda}$ ):	0.800	
						Time effect (STRENGH-II) ( $C_{\lambda}$ ):	1.000	

# Structure Typical Section - Deck

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.

Ľ	<u> </u>	Deck thickness	Reference	Line		5			
overhang 🖡	¥				<u>ا</u>	Right overhang			
eck Pa	rapet Railing	Generic	Lane position	St	riped lanes	Wearing surface			
uperstruc	ture definition ref	ference line is	within		✓ the brid	je deck.			
			Start		End				
	om left edge of d ture definition ref		12.83	ft	12.83	ft			
	om right edge of ture definition ref		12.83	ft	12.83	ft			
eft overha	ing:		0.83	ft	0.83	ft			
omputed	right overhang:		0.83	ft	0.83	ft			

#### Structure Typical Section - Generic Appurtenances

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

Stru	cture Typical Section									_	
sk	<b>▲</b> Fro	— Generic S	hape								
Deck			ic Lane posit	tion Striped	lanes Wearin	g surface					
	Name		Load case	Measure to	Edge of deck dist. measured from	Distance at start (ft)	Distance at end (ft)	Front face orientation			
Þ	Timber Railing	*	Railing DL 👻	Back -	Left Edge 🔹	0.00		Right -			<b></b>
	Timber Railing	-	Railing DL 🔹	Back *	Right Edge 🔹	0.00	0.00	Left -			
								Ne	Duplicate	De	lete
									OK Apply		Cancel

#### Structure Typical Section - Lane Positions

Select the **Lane position** tab. Enter the values shown below or click the **Compute**... button to automatically compute the lane positions. A window 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					-		Х
Travelway 1		e Definition Reference Line velway 2					
Travelway definition	from left edge of	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)			
<b>b</b> 1	-12.00	12.00	-12.00	12.00			
LRFD fatigue Lanes available to tru Override Truck fraction		Compute		New Du	plicate	Delete	
				ОК	Apply	Cance	al

#### Structure Typical Section - Wearing Surface

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

A Structure Typical Section	-		×
Distance from left edge of deck to superstructure definition ref. line superstructure definition ref. line			
Deck     Superstructure Definition     thickness			
Left overhang			
Deck Parapet Railing Generic Lane position Striped lanes Wearing surface			
Wearing surface material: 3" timber planks			
Description:			
Wearing surface thickness: 3,0000 in Thickness field measured (DW = 1.25 if checked)			
Wearing surface density: 50.000 pcf			
Load case: Vearing Surface DL Copy from library			
OK	Apply	Cance	el

## 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.

A Member		-		×
Member name:	G2 Link with: None			
Description:				
	Existing Current Member alternative name Description			-
				-
Number of span	s: Span Span length no. (ft)			
	▶ <u>1</u> <u>17.00</u>			
	ОК Аррі	y	Cance	el de la constante de la consta

#### Support Constraints

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

upp	ports						-		
ľ	→× ~								
iene	eral Elast	tic 3D General	3D Elastic		2				
	Support	Support	Translation	constraints	Rotation constrai	nts			
	number	type	X	γ	Z				
۱.	1	Pinned *	1	V					
	2	Roller -		V					
									1
						OK	Apply	Can	

# Defining a Member Alternative

For girder member **G2**, double click **MEMBER ALTERNATIVES** in the Bridge Workspace tree to create a new alternative. The **New Member Alternative** window shown below will open. Select **Timber** for the Material Type and **Rectangular Glued Laminated Timber** for the Girder Type.

Material type:	Girder type:
Steel	Rectangular Glued Laminated Timber
Timber	Rectangular Sawn Timber
	OK Cancel

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

Description Description:	Specs									
Description:		Factors	Engine	Import	Co	ontrol options				
						Material type:	Timber			
						Girder type:	Rectangular Glued La	minat		
						Modeling type:	Multi Girder System			
						Default units:	US Customary	~		
Load case:		Engine Ass		~	_	fault rating metho SD	v −			
<ul> <li>Schedu</li> <li>Cross-s</li> </ul>		ed								
Load case: Additional		Engine Ass	kip/ft	~	A	SD	~			
Additional	self load:		%							

TMBR3- Single Span Timber Beam – Glulam Example

# Beam Details

Open the Beam Details window by double clicking on Beam Details in the tree. Enter data as shown.

<u></u>							
General A	djustment factors	Suppor	t lengths				
Beam shape:	6 x 18 beam	>	Loading direction:	Perpendicular	to Lamination	~	
Material:	Visually graded w	esterr 🗸	Pieces across width:	Single		~	
Beam proje	ection		Edge joint:	Bonded		$\sim$	
Left:	in		Width of widest:		in		
Right:	in		Number of laminations:	12			
			Wane:	None		$\sim$	

#### Beam Details – Adjustment factors

The **Adjustment factors** tab of the **Beam Details** window provides input entry for adjustment factors to modify the **ASD** tabulated design values and the **LRFD** Reference design values entered previously 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:			
Moisture condition for modulus:			
Compute			
ASD			
Wet service (flexure) (C <sub>M</sub> ): 0.800 Wet service (flexure) (C <sub>M</sub> ):	0.800		
Wet service (shear) (C <sub>M</sub> ): 0.875 Wet service (shear) (C <sub>M</sub> ):	0.875		
Wet service (bearing) (C <sub>M</sub> ): 0.530 Wet service (bearing) (C <sub>M</sub> ):	0.530		
Wet service (modulus) (C <sub>M</sub> ): 0.833 Wet service (modulus) (C <sub>M</sub> ):	0.833		
Load duration (C <sub>D</sub> ): 1.150 Format conversion (C <sub>KF</sub> ):			
Size (C <sub>F</sub> ): 1.000 Format conversion (bearing) (C <sub>KF</sub> )	:		
Volume (C <sub>v</sub> ):			
Bearing (C <sub>b</sub> ): Flat use (C <sub>fu</sub> ):	1.000		
Beam stability (CL): Bearing (Cb):			
Time effects (STRENGTH - I) ( $C_{\lambda}$ ):	0.800		
Time effects (STRENGTH - II) (C <sub>λ</sub> ):	1.000		
Beam stability (C <sub>L</sub> ):			
ОК	Apply	Canc	el

# Beam Details – Support lengths

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

Ger	neral	Adj	ustment factors	Support length	s			
	Supp	ort ber	Bearing length (in)	Bearing width (in)				
₽	1		7.0000	5.5000				A.
	2		7.0000	5.5000				

# Live Load Distribution

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.

Star	ndard LR	FD										
	Distribution f		out method									
	Use simpli			Use advanc	ed method	O Use advar	nced method w	ith 1994 quid	e specs			
								2				
	Allow distrib	bution fac	ctors to be u	used to com	pute effects	f permit loads v	with routine tra	ffic				
				ution factor								
	Lanes loaded		(w Shear at	/heels)								
		Shear	supports	Moment	Deflection							
Þ	1 Lane	0.522	1.000	0.444	0.154							^
	Multi-lane	0.550	1.000	0.500	0.308							
												~
	ompute from		View calcs									
			View calcs						OK	 Apply	 Canc	-

The live load distribution factors are computed as follows:

Moment DF (AASHTO Table 3.23.1)

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

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)

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

where  $V_{LU}$  = shear due to undistributed wheel loads (i.e., 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

Single Lane Shear DF = 0.50[(0.60(1) + 0.4444)] = 0.5222

Multi Lane Shear DF = 0.50[(0.60(1) + 0.5000)] = 0.5500

Deflection DF

Single Lane Deflection DF =  $\frac{1 \ lane * 2 \ wheels/lane}{13 \ beams} = 0.1538$ Multi Lane Deflection DF =  $\frac{2 \ lane * 2 \ wheels/lane}{13 \ beams} = 0.3077$ 

# Point of Interest

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.

A Point Of Interest		-		×
Distance from leftmost support: 8.50 ft or Span: Span 1 v Fraction: 0.500000 Side				
ASD design values ASD adjustment factors ASD operating stress percentage LRFD design values LRFD adjustment factors	Bracing	Engine		
Override 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 (tension):       ksi         Shear parallel to grain:       Shear parallel to grain (not edge glued):				
OK	Ap	ply	Cance	el

#### Member Alternative Description – Specs

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

nber	er alternative: In	terior Timber	Beam Glula	m							
escri	ription Specs	Factors	Engine	Imp	ort Cont	trol op	tions				
4	Analysis method type	Analys	is module		Selection t	type	Spec version	Facto	rs		
·	ASR	AASHTO T	mber ASR	- S	ystem Defa	ult -	MBE 3rd 2022i, Std 17th 👘	N/A		~	-
	LRFR	AASHTO T	mber LRFR	- S	ystem Defa	ult -	MBE 3rd 2022i, LRFD 9th 😁	2018 (2022 Interim) AAS	HTO LRFR Spec.	-	

#### ASR Rating

To perform a rating, select the Analysis Settings button on the Analysis group of the DESIGN/RATE ribbon.



To run an ASR analysis, select **ASR** 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 **Analysis** group of the **DESIGN/RATE** ribbon to perform the rating.

🕰 Analysis Settings			_		×
O Design review   Rating	Rating method:	ASR	~		
Analysis type: Line Girder v Lane / Impact loading type: As Requested v	Apply preference setting:	None	~		
Vehicles Output Engine Description					
Traffic direction: Both directions	Refresh Vehicle summar	Temporary vehicles	Advanced		
	Add to	cles ry 15-44 ng 15-44			
Reset Clear Open template Save te	mplate	ОК	Apply	Cance	el

# Tabular Results

When the rating is finished results can be reviewed by clicking the **Tabular Results** button on the **Results** group of the **DESIGN/RATE** ribbon.

Bridge Workspace - Timber Example Glular	n	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE WORKSPACE TOOLS	VIEW D	DESIGN/RATE	REPORTING			^
Analysis Analyze Analysis Events Analysis Analysis Analysis Events Analysis Events Analysis Events Analysis Events Analysis Results Check Detail Outp	puts Graph					

# The window shown below will open.

Lane/Impact loading type     Display Format       y     Image: Single rating level per row       Live Load     Detailed       Live Load     Rating       Load Rating     Load Rating       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Live Load     ASR       Image: Load     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Level     Image: Cond Rating Rating Factor       Image: Cond Rating Rating Rating Factor     Image: Cond Rating Rating Factor       Image: Cond Rating Rating Rating Rating Factor     Image: Cond Rating Rating Rating Factor       Image: Cond Rating R
Y       Y       Single rating level per row         Single rating level per row       Image: Single rating level per row         Live Load       Rating Method       Rating       Load Rating       Location       Location       Location       Location         Type       Rating Method       Level       (Ton)       Rating Factor       (ft)       Span-(%)       Limit State       Impact       Lane
Live Load Rating Method Rating Load Rating Load Rating Factor (ft) Span-(%) Limit State Impact Lane
Live Load Rating Method Rating Load Rating Load Rating Factor (ft) Span-(%) Limit State Impact Lane
Type kating Method Level (Ton) Rating ractor (ft) Span-(%) Limit State impact Lane
Type kating Method Level (Ton) Kating ractor (ft) Span-(%) Limit State impact Lane
Ave load ASB Inventory 37.16 1.376 0.00 1 - (0.0) Bearing Stress As Bequested As Bequested
The book of the bo
4         Axle Load         ASR         Operating         50.27         1.862         0.00         1 - (0.0)         Bearing Stress         As Requested         As Requested
4 Lane ASR Inventory 44.49 1.648 0.00 1 - (0.0) Bearing Stress As Requested As Requested
4 Lane ASR Operating 60.19 2.229 0.00 1 - (0.0) Bearing Stress As Requested As Requested
4 Lane ASR Inventory 44.49 1.648 0.00 1 - (0.0) Bearing Stress As Requested As Requ

# LRFR Analysis

Similarly, to run an 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**.

Analysis Settings		-	o x
O Design review   Rating	Rating method: LRFR	~	
Analysis type: Line Girder			
Lane / Impact loading type: As Requested	Apply preference setting: None	~	
Vehicles Output Engine Description			
Traffic direction: Both directions	Refresh Temporary vehicles Vehicle summary	Advanced	
<ul> <li>➡ Vehicles</li> <li>➡ Standard</li> <li>↓ EV3</li> <li>↓ H 15-44</li> <li>↓ H 20-44</li> <li>↓ H-93 (IS)</li> <li>↓ H-93 (IS)</li> <li>↓ HS 15-44</li> <li>↓ HS 20-44</li> <li>↓ Lane-Type Legal Load</li> <li>↓ LRPD Fatigue Truck (IS)</li> <li>↓ NR</li> <li>↓ SU4</li> <li>↓ Type 33</li> <li>↓ Type 33</li> <li>↓ Type 352</li> <li>→ Jagency</li> <li>↓ User defined</li> <li>↓ Temporary</li> </ul>	Add to		
Reset Clear Open template Save te	mplate OK	Apply	Cancel

#### Tabular Results

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

Analysis Results - Inte	erior Timber Beam Glula	im								- 1	
Print Print											
ort type:	⊏ Lane/Imp	act loading type	Display Format								
ting Results Summary		quested O Detailed	Single rating level p	oer row							
			]								
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane	
HL-93 (US)	Truck + Lane	LRFR	Inventory	20.68	0.575	0.00	1 - (0.0)	STRENGTH-I Bearing	As Requested	As Request	ed
HL-93 (US)	Truck + Lane	LRFR	Operating	26.81	0.745	0.00	1 - (0.0)	STRENGTH-I Bearing	As Requested	As Request	ed
	Tandem + Lane	LRFR	Inventory	17.98	0.500	0.00	1 - (0.0)	STRENGTH-I Bearing	As Requested	As Request	ed
HL-93 (US)	landem + Lane	Entry									