AASHTOWare BrDR 7.5.0 Reinforced Concrete Structure Tutorial RC4 – Two Span Reinforced Concrete Slab Example

#### **BrDR** Training

### RC4 – Two Span Reinforced Concrete Slab Example

### Topics Covered

- Reinforced concrete slab input as girder line.
- Cross section based input.
- Slab depth varies parabolically over the pier.

### Reinforced concrete slab input as girder line

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

🕰 2SpanRCSIab		- 0	×
Bridge ID: 2SpanRCSI	ab NBI structure ID (8): 2SpanRCSIab Bridge completely defined	<ul> <li>Superstructures</li> <li>Culverts</li> <li>Substructures</li> </ul>	5
Description Desc	ription (cont'd) Alternatives Global reference point Traffic Custom agency fields		
Name:	2 Span RC Slab Year built:	]	
Description:			
Location:	Length:	ft	
Facility carried (7):	Route number: -1	j	
Feat. intersected (6):	Mi. post:		
Default units:	US Customary		
Bridge associa	tion BrR BrD BrM		
L	ОК Ар	ply Cance	:1

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

## Bridge Components

To enter the materials to be used by members of the bridge, go to the **Components** tab of the Bridge Workspace, and click on to expand the tree for **Materials**. The tree with the expanded Materials branch is shown below:



To add a new concrete material, click on **Concrete** in the tree and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on Concrete and select **New**).



Add the concrete material by selecting from the Concrete Materials Library by clicking the **Copy from library** button. The following window opens:

<b>A</b>	Library Data:	Materials - Concrete												-		×
	Name	Description	Library	Units	f'c	f'ci	alpha	DL density	Modulus density	Std modulus of elasticity	LRFD modulus of elasticity	Poisson's ratio	Modulus of rupture			
	Class A	Class A cement concrete	Standard	SI / Metric	28.00		0.0000108000	2400.00	2320.00	25426.08	27730.36	0.200	3.33			-
Þ	Class A (US)	Class A cement concrete	Standard	US Customary	4.000		0.0000060000	0.150	0.145	3644.15	3986.55	0.200	0.480			
	Class B	Class B cement concrete	Standard	SI / Metric	17.00		0.0000108000	2400.00	2320.00	19811.84	23520.23	0.200	2.60			
	Class B (US)	Class B cement concrete	Standard	US Customary	2.400		0.0000060000	0.150	0.145	2822.75	3368.12	0.200	0.372			
	Class C	Class C cement concrete	Standard	SI / Metric	28.00		0.0000108000	2400.00	2320.00	25426.08	27730.36	0.200	3.33			
	Class C (US)	Class C cement concrete	Standard	US Customary	4.000		0.0000060000	0.150	0.145	3644.15	3986.55	0.200	0.480			
												OK	Appl	у	Can	cel

Select the Class A (US) material and click OK.

The selected material properties are copied to the **Bridge Materials – Concrete** window as shown below.

Name:	Class A (US)			
Description:	Class A cement concrete	2		
Compressive	strength at 28 days (f'c):	4.0000006	ksi	
Initial compre	essive strength (f'ci):		ksi	
Composition	of concrete:	Normal ~		
Density (for o	dead loads):	0.15	kcf	
Density (for r	modulus of elasticity):	0.145	kcf	
Poisson's rati	0:	0.2		
Coefficient of	f thermal expansion (α):	0.000006	1/F	
Splitting tens	ile strength (fct):		ksi	
LRFD Maxim	um aggregate size:		in	
	Compute			
Std modulus	of elasticity (Ec):	3644.147704	ksi	
LRFD modulu	us of elasticity (Ec):	3986.548657	ksi	
Std initial mo	odulus of elasticity:		ksi	
LRFD initial n	nodulus of elasticity:		ksi	
Std modulus	of rupture:	0.474342	ksi	
LRFD modulu	us of rupture:	0.48	ksi	
Shear factor:		1		

Click **OK** to apply the data and close the window.

Add the following Reinforcement Steel (Grade 60) in the same manner.

🗛 Bridge Mat	terials - Reinforc	ing Steel				_		×
Name:	Grade 60							
Description:	60 ksi reinforci	ng steel						
Material prop	perties							
Specified yie	ld strength (fy):	60.000		ksi				
Modulus of e	elasticity (Es):	29000.00		ksi				
Ultimate stre	ngth (Fu):	90.000		ksi				
Туре —								
Plain								
О Ероху								
Galvan	nized							
	Copy t	o library	Copy f	rom library	OK	Apply	Cano	:el

Since this example is a reinforced concrete slab, beam shapes need not be defined. The slab will be entered later as a cross section.

The reinforced concrete slab will be entered as **Girder line Structure Definition** in BrDR. Since a Structure Typical Section is not defined for girder line structures, appurtenances are not defined. The dead load due to the appurtenances will be entered later as member loads.

The default impact factors for LRFD and LFD will be used, so the next step will be to define a Superstructure. Bridge Alternatives will be added after a superstructure is defined.

#### 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.

Select **Girder line Superstructure** from the **New Superstructure Definition** window, click **OK** to open the **Girder Line Superstructure Definition** window. Enter the data as shown below.

Girder system superstructure   Girder line superstructure   Ploor line superstructure   Truss ine superstructure   Reinforced concrete slab system superstructure   Advanced concrete multi-cell box superstructure   Advanced concrete multi-cell box superstructure   OK   Cancel	Girder system superstructure   Girder line superstructure   Poor system superstructure   Poor line superstructure   Poor line superstructure   Beinforced concrete slab system superstructure   Concrete multi-cell box superstructure   Advanced concrete multi-cell box superstructure   OK   Cancel	Girder system superstructure Girder line superstructure Poor system superstructure Poor ine superstructure Poor ine superstructure Poor ine superstructure Poor ine superstructure Poor is supe			×	
OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Description:       —         For PS/PT only       —         Average humidity:       %         Peference line length:       ft         Use load lanes       USFD faigue         Wulki-lane       —         Ownede       —	Advanced concrete multi-cell box superstructure         OK         Cancel         Girder Line Superstructure Definition         Definition         Analysis         Engine         Name:         Slab Girderline         Deck type:         Concrete         For PS/PT only         Average humidity:         %         Default units:         US Customary         Member alt types         Steel         %         %         % Nubli-lane         % RC         % Nubli-lane         % RC         % Nubli-lane         % Reference line length:         % RC         % Nubli-lane         % Nuck lanes:         % Nuck lanes:         % RC         % RC	Advanced concrete multi-cell box superstructure         OK       Cancel         Girder Line Superstructure Definition       -         Definition       Analysis       Engine         Name:       Stab Girderline       Deck type:         Definition       Analysis       Engine         Name:       Stab Girderline       Deck type:         Definition       Analysis       Engine         Name:       Stab Girderline       Deck type:         Default units:       US Customary       Wember alt. types         Default units:       US Customary       Wember alt. types         We load later       FIP for forgour       Steel         O'Multi-lates       Truck fraction:       I'mber         O'Multi-lates       Truck fraction:       P/T	) Girder system su ) Girder line super ) Floor system sup ) Floor line super: ) Truss system sup ) Truss line super: ) Reinforced conc ) Concrete multi-	uperstructure erstructure perstructure structure perstructure structure crete slab system superstructure cell box superstructure	Superstructure definition wizard	
OK       Cancel         Girder Line Superstructure Definition       —         Definition       Anabysis       Engine         Name:       Slab Girderline       Deck type:         Description:       For PS/PT only         Average humidity:       %         Default units:       US Customary         Wether alt. types       Steel         Ive load lanes       LRFD fatigue         Wulti-lane       Truck lanesi:         Single lane       Coverride         Truck fraction:       P/T	OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Description:       —         Generation:       —         Perfault units:       US Customany         Wether alt types       —         Reference line length:       Tt         Uve load lanes       URFD fatigue         Verende       —         Override       —         Truck Iners:       —         Truck fraction:       —	OK       Cancel         Girder Line Superstructure Definition       -         Definition       Aaalysis         Engine       Deck type:         Darme:       Slab Girderline         Definition:       For PS/PT only         Average humidity:       %         Default unite:       US Customary         Ceference line length:       ft         P/S       %         Okduiti-lane       P/S         Single lane       Truck fraction:	Advanced concr	rete multi-cell box superstructure		
OK       Cancel         Girder Line Superstructure Definition       –         Definition       Analysis         Engine       –         Name:       Slab Girderline         Description:       Concrete         For PS/PT only       Average humidity:         %       Poseful units:         US Customary       Member alt. types         efference line length:       ft         Ve load lanes       Image: RPC 1         Wuiti-lane       Image: RPC 1         Nuti-lane       Image: RPC 1         Override       P/T	OK       Cancel         Girder Line Superstructure Definition       -         Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:       For PS/PT only         Pefault units:       US Customary       Member alt. types         Reference line length:       ft         Uve load lanes       LREP fatigue       P/S         Wulti-lane       Steel       P/S         Single lane       Coverride       P/T	Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Deck type:         Description:         For PS/PT only         Persues line langth:         Tt         Steel         P/S         Single lane         Truck fraction:				
OK       Cancel         Girder Line Superstructure Definition       —       —         Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:       —       —         Graderline       Deck type:       —         Default units:       US Customary       Member alt. types         Reference line length:       —       t         Ve load lanes       —       —         Override       —       …         Override       …       …         Nuti-lane       —       …         Nuti-lane       …       …         Override       …       …         Pr5       …       …         Pr6       …       …         Override       …       …         Truck fraction:       …       …	OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Deck type:         Description:         For PS/PT only         Average humidity:         %         Default units:         US Customary         Member alt. types         Steel         P/S         Multi-lane         Override         We load lanes:         Override         P/S         YRC         Override         P/T	OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Deck type:         Description:       —         For PS/PT only         Average humidity:         %         Default units:       US Customary         It       —         Ve load lanes:       —         Override       —         Multi-lane       —         Nerride:       —         Single lane       —         Nuck fraction:       —				
OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Description:       —         For PS/PT only         Average humidity:         %         Default units:       US Customary         Reference line length:       It         Image:       —         Override       —         Override       —         P/T       —	OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Description:       —         For PS/PT only	OK       Cancel         Girder Line Superstructure Definition       —         Definition       Analysis         Engine       —         Name:       Slab Girderline         Description:       —         For PS/PT only       —         Average humidity:       —         5%       —         Default units:       US Customary         Live load lanes       LRFD fatigue         Multi-lane       Truck lanes:         Override       —         Multi-lane       Truck fraction:				
Girder Line Superstructure Definition     -       Definition     Analysis       Engine       Name:     Slab Girderline       Description:     Concrete       For PS/PT only       Average humidity:       %       Default units:     US Customary       Reference line length:     ft       Stab ans:     Truck lanes:       Override     P/T	Girder Line Superstructure Definition       -         Definition       Analysis         Engine       -         Name:       Slab Girderline         Description:       Concrete         For PS/PT only         Average humidity:         %         Default units:       US Customary         Reference line length:       ft         Vive load lanes:       P/S         Override       P/S         Override       P/T	Gider Line Superstructure Definition       -         Definition       Analysis         Engine       -         Name:       Slab Girderline         Description:       Concrete         For PS/PT only         Average humidity:         %         Default units:       US Customary         Reference line length:       ft         Vie load lanes:       P/S         Override       P/S         Override       P/T			OK Cancel	
Girder Line Superstructure Definition – Definition Analysis Engine Name: Slab Girderline Deck type: Description:  Concrete For PS/PT only Average humidity. For PS/PT only Average humidity. % Default units: US Customary  Member alt. types Reference line length: t Live load lanes  RFD fatigue VRC  Truck lanes: Override P/T	Girder Line Superstructure Definition – Definition Analysis Engine Name: Slab Girderline Deck type: Description: Concret For PS/PT only Average humidity: % Default units: US Customary  Member alt. types Reference line length: t Steel P/S Welval lanes	Girder Line Superstructure Definition – Definition Analysis Engine Name: Slab Girderline Deck type: Description: Concrete  For PS/PT only Average humidity: % Default units: US Customary  Member alt. types Reference line length: t Live load lanes URFD fatigue NRFD			OK Cancel	
Gider Line Superstructure Definition       Analysis       Engine         Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:	Gider Line Superstructure Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:       Gorcrete       For PS/PT only         Average humidity:       %         Default units:       US Customary       Member alt. types         Reference line length:       It RFD fague       Steel         Wutti-lane       Override       Steel         Override       P/S       P/S         Truck faction:       The faction:       P/T	Gider Line Superstructure Definition     Definition     Analysis   Engine     Name:   Slab Girderline   Deck type:   Description:     For PS/PT only   Average humidity:   %     Default units:   US Customary   eterence line length:   Itruck lanes:   Override   Single lane   Override   P/T				
Girder Line Superstructure Definition	Girder Line Superstructure Definition	Girder Line Superstructure Definition     -       Definition     Analysis       Image: Stab Girderline     Deck type:       Description:     Concrete       For PS/PT only       Average humidity:       %       Default units:     US Customary       Image:				
Definition     Analysis     Engine       Name:     Slab Girderline     Deck type:       Description:     Concrete     For PS/PT only       Average humidity:     %       Default units:     US Customary     Member alt. types       Reference line length:     ft     Steel       Uve load lanes     LRFD fatigue     P/S       Owerride     Override     P/T       Truck lanes:     Override     P/T	Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:       Concrete       For PS/PT only         Average humidity:       %         Default units:       US Customary       Member alt. types         Reference line length:       ft       Steel         Uve load lanes       LRFD fatigue       P/S         Multi-lane       Truck lanes:       Qverride         Override       P/T       P/T	Definition       Analysis       Engine         Name:       Slab Girderline       Deck type:         Description:       Concrete       For PS/PT only         Average humidity:       %         Default units:       US Customary       Member alt. types         Reference line length:       ft       Steel         Uve load lanes       LRFD fatigue       P/S         Multi-lane       Truck lanes:       Qverride         Override       P/T       P/T	Girder Line Superstruc	cture Definition		- 0
Name:     Slab Girderline     Deck type:       Description:     Concrete     Concrete       For PS/PT only     Average humidity:     Stephender       Default units:     US Customary     Member alt. types       Reference line length:     ft     Steel       Wulti-lane     LRFD fatigue     P/S       Override     Override     Timber       Override     P/T	Name:     Slab Girderline     Deck type:       Description:     Concrete       For PS/PT only     Average humidity:       Average humidity:     %       Default units:     US Customary       Reference line length:     ft       Live load lanes     LRFD fatigue       Override     P/S       Override     Truck lanes:       Verride     P/T	Name:     Slab Girderline     Deck type:       Description:     Concrete       For PS/PT only     Average humidity:       Average humidity:     %       Default units:     US Customary       Reference line length:     ft       Wember alt: types       Member alt: types       On or the line length:     ft       Inck lanes:     P/S       Override     P/T	Definition Analysis	s Engine		
Description:	Description:	Description:				
Default units:       US Customary         Member alt. types         Reference line length:       ft         LkFD fatigue       P/S         Multi-lane       Truck lanes:         Override       Timber         Override       P/T	Default units:       US Customary         Werage humidity:       %         %       %         Reference line length:       ft         LkPE load lanes       LRFD fatigue         Multi-lane       Truck lanes:         Override       P/T         Truck fraction:       P/T	Default units:       US Customary       ✓         Member alt. types       %         Reference line length:       ft       Steel         Ive load lanes       LRFD fatigue       P/S         Multi-lane       Truck lanes:       Imber         Override       Timber       P/T	Name:	Slab Girderline	Deck type:	
Default units:     US Customary       Member alt. types       Reference line length:     ft       Live load lanes     LFPD fatigue       Multi-lane     Truck lanes:       Override     Truck fraction:	Default units:     US Customary       Member alt. types       Reference line length:     ft       LkFD fatigue     P/S       Multi-lane     Truck lanes:       Override     P/T	Default units:     US Customary       Member alt. types       Reference line length:     ft       LkFD fatigue     P/S       Multi-ane     Truck lanes:       Oweride     P/T	Name: Description:	Slab Girderline	Deck type: Concrete	
Default units:     US Customary     Member alt. types       Reference line length:     ft     Steel       Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     ØR/C       Override     Timber     Truck fraction:	Default units:     US Customary       Reference line length:     ft       Live load lanes     LFPD fatigue       Multi-lane     Truck lanes:       Single lane     Override       Truck fraction:     P/T	Default units: US Customary W Reference line length: LKFD fatigue Multi-lane Single lane Ucveride Truck fraction: US Customary M Member alt. types Steel P/S K/C Timber P/T	Name: Description:	Slab Girderline	Deck type: Concrete  For PS/PT only	
Reference line length:     ft     Steel       Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     Ø R/C       Override     Timber       Truck fraction:     P/T	Reference line length:     ft     Steel       Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     R/C       Single lane     Override     Truck fraction:	Reference line length:     ft     Steel       Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     R/C       Single lane     Override     Timber       Truck fraction:     P/T	Name: Description:	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: %	
Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     Imber       Single lane     Override     Truck fraction:	Live load lanes     LRFD fatigue       Image: Multi-lane     Truck lanes:       Override     Truck fraction:	Live load lanes     LRFD fatigue     P/S       Multi-lane     Truck lanes:     Imber       Single lane     Override     Truck fraction:	Name: Description:	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: %	
Multi-lane     Truck lanes     Gerride     Truck fraction:	Multi-lane     Truck lanes:     Gerride     Truck fraction:	Multi-lane     Truck lanes:     Single lane     Truck fraction:	Name: Description: Default units: Reference line length:	Slab Girderline	Deck type: Concrete V For PS//PT only Average humidity: % Member alt. types	
Single lane     Important       Truck fraction:     P/T	Single lane     Important       Truck fraction:     P/T	Single lane     Image: Coverride       Truck fraction:     P/T	Name: Description: Default units: Reference line length:	Slab Girderline	Deck type: Concrete For PS//PT only Average humidity: % Member alt. types Steel P/S	
Truck fraction:	Truck fraction:	Truck fraction:	Name: Description: Default units: Reference line length: Live load lanes Multi-lane	Slab Girderline       US Customary       Image: Customary       Image: Customary	Deck type: Concrete For PS/PT Only Average humidity: % Member alt. types Steel P/S V R/C	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline       US Customary       t       t       t       t       Truck lanes:       Override	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S V R/C Timber	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S V R/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S R/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S R/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline	Deck type: Concrete For PS/PT only Average humidity: %  Member alt. types Steel P/S K/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline       US Customary       ▼       ft       LRFD fatigue       Truck lanes:       Override       Truck fraction:	Deck type: Concrete V For PS/PT only Average humidity: Steel P/S R/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline         US Customary         ▼         ft         LRFD fatigue         Truck lanes:         Override         Truck fraction:	Deck type: Concrete V For PS/PT only Average humidity: Steel P/S R/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline       US Customary	Deck type: Concrete For PS/PT only Average humidity: S Member alt. types Steel P/S KC Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Mutti-lane Single lane	Slab Girderline         US Customany         ▼         •	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S KC Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Mutti-lane Single lane	Slab Girderline         US Customany         ▼         •	Deck type: Concrete For PS/PT only Average humidity: 56 56 56 76 76 76 76 76 76 76 76 76 7	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline         US Customary         •	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types 5 Steel P/S K/C Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Mutti-lane Single lane	Slab Girderline         US Customary         •	Deck type: Concrete For PS/PT only Average humidity: \$ Member alt. types Steel P/S ▼ R/C □ Timber P/T	
			Name: Description: Default units: Reference line length: Live load lanes Multi-lane Single lane	Slab Girderline         US Customary         i         ft         LRFD fatigue         Truck lanes:         Override         Truck fraction:	Deck type: Concrete For PS/PT only Average humidity: % Member alt. types Steel P/S K/C Timber P/T	

Click **OK** to apply the data and close the window.

Navigate to the **Bridge Alternatives** node in the **Bridge Workspace** tree and create a new **Bridge Alternative**, a new **Structure**, and a new **Structure Alternative** as shown in **STL1 tutorial**.



The partially expanded Bridge Workspace tree is shown below:

#### Load Case Description

Double click on the **Load Case Description** node in the Bridge Workspace tree to open the **Load Case Description** window and define the dead load cases as shown below. The completed **Load Case Description** window is shown below.

	Description	Stage	Туре	Time* (days)	
Stage 1 DC DL	Parapets	Non-composite (Stage 1)	D,DC -		

Click **OK** to apply the data and close the window.

#### Member

Open the **Member** window by selecting **Member** in **Bridge Workspace** tree and click on **New** from the **Manage** tab of the **WORKSPACE** ribbon (or by double clicking on **Member** in bridge workspace tree).



Fill in the window with the following information. If F1 is pressed while this window is active, the Help topic for the Member window will be displayed. This **Help** topic describes that girder spacing, and member location are not required for a slab member, therefore no data will be entered for those items.

The first Member Alternative created will automatically be assigned as the **Existing** and **Current** Member alternative for this Member.

A Member		-		$\times$
Member name:	12" Slabline			
Description:	Modeling     Open girder OMCB     Frame member simplified definition			
Number of span	Existing       Current       Member alternative name       Description         ns:       2       2       Deck concrete crack control parameter (Z);       130.000         ft       1       30.00       Deck concrete crack control parameter (Z);       130.000         kip/in       Deck exposure factor:       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Member location       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);         Image: Control parameter (Z);       Image: Control parameter (Z);       Image: Control parameter (Z);       I			×
	OK App	y	Cance	el

Click **OK** to apply the data and close the window.

#### Member Loads

Expand 12" Slabline in the Bridge Workspace tree and double click on Member Loads to open the Girder Member Loads window. This structure has 2 parapets each weighing 300 lb/ft. A 12" wide strip of slab is defined as the member, and the bridge cross section has a width of 27 ft. So, the parapet load applied to this member will be (2\*300 lb/ft)\*1'/27' = 22 lb/ft.

Girde	er Member Loads					_		×
Į	<u> </u>	+ + +	+ + +	<u>_</u>				
Pedest	trian load:	lb/ft	Settlement					
	Load case	Span	Uniform load	WS field measured*	Description			
Þ	Stage 1 DC DL *	All Spans 🔹	0.022				<b>A</b>	
							~	
*DV	N=1.25 if checked				New Duplicate	D	elete	
					ОК Арр	bly	Cance	!

Click **New** to add a row in **Uniform** tab of this window and enter the data as shown below:

Click **OK** to apply the data and close the window.

#### Member Alternative

Select **MEMBER ALTERNATIVES** in the **Bridge Workspace** tree and click on **New** from the **Manage** group of the **WORKSPACE** ribbon (or double-click **MEMBER ALTERNATIVES** in the tree) to create a new alternative.



The New Member Alternative window shown below will open. Select **Reinforced Concrete** for the **Material type**, **Reinforced Concrete Slab** for the **Girder type** and click **OK**.

A New Member Alternative	×
Material type:	Girder type:
Post tensioned concrete Prestressed (pretensioned) concrete	Advanced Concrete RC Reinforced Concrete I
Reinforced concrete	Reinforced Concrete Slab
Steel Timber	Reinforced Concrete Tee
	OK Cancel

The Member Alternative Description window will open. Enter the data as shown below.

	auve: 12	wide slab li	ine							
Description	Specs	Factors	Engine	Import	Control options					
Description: r					Material type:	Reinforced Concret	e			
					Girder type:	Reinforced Concret	e Slab			
					Modeling type:	Open Girder				
					Default units:	US Customary	~			
Sustained	modular r	atio factor	Right:	6.0000	in					
Self load Load case: Additional	self load:	Engine Ass	signed kip/ft	~	Default rating metho	od:				
Additional Crack cont Bottom of	self load: trol param beam: 1	eter (Z) 70.000	% kip/in	Exposur Bottom	e factor					
Crack con	trol param beam: 1	eter (Z) 70.000	kip/in	Exposur Bottom	e factor				 	

Click **OK** to apply the data and close the window.

# Cross section based input

#### **Cross Sections**

Expand 12" wide slab line (E) (C) member alternative on the Bridge workspace tree and double click on Cross Sections to open the Cross Sections window and create a new cross section. This member contains three cross sections as illustrated below.



Enter each cross-section **Dimensions** and **Reinforcement** data as shown below:

### Section 1

A Cross Sections	-		Х
Name: Section 1 Type: Reinforced Concrete Slab			
Dimensions Reinforcement			
Concrete material: Class A (US)			
Modular ratio:			
12.0000 in			
±			
ОК Арр	ly	Cance	el 🛛

me: Section 1	Type: I	Reinforce	d Co	oncrete Slab							
Dimensions Reinforcement											
Distance from top		Row		Std bar count	LRFD bar count	Bar size	Distance (in)	Material	Bar sp (i	pacing n)	
• •	Top of S	Slab	*	1.00	1.00	5 *	2.4375	Grade 60 🔹	-		^
<u> </u>	Bottom	of Slab	Ŧ	2.00	2.00	9 -	3.1250	Grade 60 🔹	-		
	1					M					
						WI	New	Duplicate		Delete	-

### Section 2:

A Cross Sections	-		×
Name: Section 2 Type: Reinforced Concrete Slab			
Dimensions Reinforcement			
Concrete material: Class A (US)			
Modular ratio:			
12.0000 in			
18.0000 in			
OK Apply		Cance	el

Cross Sections								-		
ame: Section 2		Type: Reinforced C	oncrete Slab							
Dimensions Reinforcement										
Distance from top		Row	Std bar count	LRFD bar count	Bar size	Distance (in)	Material	Bar spacing (in)		]
$\frac{1}{T}$		Top of Slab	2.00	2.00	9 -	2.6875	Grade 60 🔻		<b>A</b>	
<u>+</u>	Þ	Bottom of Slab	2.00	2.00	9 -	3.1250	Grade 60 🔹			l
									Ţ	
							New	Duplicate	Delete	
							OK	Apply	Cance	21

### Section 3:

Cross Sections	-		×
Name: Section 3 Type: Reinforced Concrete Slab			
Dimensions Reinforcement			
Concrete material: Class A (US)			
Modular ratio:			
1 36,0000 in			
OK App	ly	Cance	el

ne: Section 3		Type: Reinforce	ed Co	oncrete Slab							
imensions Reinforcement											
Distance from top		Row		Std bar count	LRFD bar count	Bar size	Distance (in)	Material	Bar spacing (in)		
· · · · · · · · · · · · · · · · · · ·		Top of Slab	Ŧ	2.00	2.00	9 -	2.6875	Grade 60 🔻			^
	Þ	Bottom of Slab	*	2.00	2.00	9 -	3.1250	Grade 60 👻			
											÷
								New	Duplicate	Delete	~

#### Slab depth varies parabolically over the pier

#### Cross Section Ranges

Double click on the Cross Section Ranges in the Bridge Workspace tree to open the Cross Section Ranges

window. Apply the cross sections over the length of the member as shown below:

<b>A</b>	Cross Section Ranges	;					_		×
[	Start Distance	Length Length Start End Section Sec	t tion						
	Start section	End section	Web variation	Support number	Start distance (ft)	Length (ft)	End distance (ft)		
►	Section 1 *	Section 1 *	None *	1 *	0.000	20.000	20.000		-
	Section 2 *	Section 3 *	Parabolic Concave *	1 *	20.000	9.000	29.000		
	Section 3 *	Section 3 *	None *	1 *	29.000	2.000	31.000		
	Section 3 *	Section 2 *	Parabolic Concave *	2 -	1.000	9.000	10.000		
	Section 3 *	Section 3 *	None *	2 -	10.000	20.000	30.000		
									*
					New	Du	plicate	Delete	•
					ОК	4	Apply	Cance	I

Click **OK** to apply the data and close the window.

Shear Reinforcement Ranges and Bracing Ranges are not applicable to this member so no data will be entered in these windows. There is no requirement to define any **points of interest** since none of the information entered will be overridden in this example.

#### Live Load Distribution

Open the **Live Load Distribution** window from the **Bridge Workspace** tree and go to the **LRFD** tab. Click the **Compute from typical section...** button, enter values as shown below in the pop-up window.

Overall slab width:	27.00	ft
Number of lanes:	2	
Slab width:	12.0000	in
Skew:	0	Degrees

Click **Continue** to compute the live load distribution factors. Once the Analysis is complete, click the **OK** button in the **LRFD Distribution Factor** Progress window to apply these factors in the Live Load Distribution window.

#### Deflection distribution factors:

		oution												
tandaı	rd LR	FD												
Dist	ribution f	factor input	method											
0	Use sim	plified met	hod	Use advanced	method									
	low distri	ibution fact	ors to be u	ad to compute	offects of a	ormit loads u	with	routin	o troffic					
	Deflect	ion act	ors to be u	sed to compute	enects of p	Jennic Iodus v	with	Toutin	e tranic					
Action	: Defiect	tion V												
s	Support	Start distance	Length	End distance	Distribu (Ia	tion factor ines)								
r	number	(ft)	(ft)	(ft)	1 Jane	Multi-lane								
> 1														
	~	0	60	60	0.1	0.0833333								
	~	0	60	60	0.1	0.0833333								
Com typic	✓ pute from al section	n h	60 iew calcs	60	0.1	0.0833333				New	Du	plicate	Delete	

Moment and shear have the same distribution factors (moment is shown below).

tribution f Use sim Ilow distri	D actor input plified meth bution facto	method —	Use advanced	method						
tribution f Use sim Illow distri n: Momer	actor input plified meth bution facto	method	Use advanced	method						
Use sim Ilow distri	plified meth	hod ()	Use advanced	method						
llow distri	bution facto			linethod						
n: Momer		ors to be us	sed to compute	effects of perm	it loads with ro	utine traffic				
	nt v									
Support	Start	Length	End distance	Distributio (land	on factor es)					
number	(ft)	(ft)	(ft)	1 lane	Multi-lane					
- ×	0	30	30	0.0787906	0.096013				4	2
2 ~	0	30	30	0.0787906	0.096013					
npute from cal section	l Vi	iew calcs					New Duplic	ate	Delete	
	pute from cal section	distance (ft) v 0 v 0 v 0 v 0 v 0 v 0 v 0 v 0 v 0 v 0	umber     distance (ft)     Length (ft)       V     0     30       V     0     30       V     0     30       Section     View calcs	Support     distance (ft)     Length     End distance (ft)       V     0     30     30       V     0     30     30       V     0     30     30       V     0     30     30       v     0     30     30	opport number     distance (ft)     tend distance (ft)     (ft)     (lan       V     0     30     30     0.0787906       V     0     30     30     0.0787906       V     0     30     30     0.0787906	Support number     distance (ft)     Length (ft)     End distance (ft)     (lanes)       V     0     30     30     0.0787906     0.096013       V     0     30     30     0.0787906     0.096013       V     0     30     30     0.0787906     0.096013       V     0     30     30     0.0787906     0.096013	Opport         distance         Length         End distance         (lanes)           ✓         0         30         30         0.0787906         0.096013           ✓         0         30         30         0.0787906         0.096013           ✓         0         30         30         0.0787906         0.096013           ✓         0         30         30         0.0787906         0.096013	Support         distance         Lengun         Endustance         ((anes)           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013	Support         distance         Length         end distance         (lanes)           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013           v         0         30         30         0.0787906         0.096013	Support         Clarger         Clarger <t< td=""></t<>

The member alternative can now be analyzed.

## LRFR Rating

To perform an **LRFR** rating, click the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon which opens the **Analysis Settings** window.

Br	Bridge W	/orkspace - 2Sp	anRCSIab		ANALYSIS	5	REPORTS	?	-	×
BRIDGE WO	RKSPACE	WORKSPACE	TOOLS	VIEW	DESIGN/RA	TE	REPORTING			^
<b>*</b>	*			<b>∽</b> }}	2 📙					
Analysis Ana Settings	lyze Analysis Events	Tabular Spec Results Chec	ification   ck Detail <b>(</b>	Engine Resu Dutputs Gra	ults Save ph Results					
Ana	lysis		Res	sults						

Click the **Open template** button and select the **LRFR Design Load Rating** to be used in the rating and click **OK**.

The Analysis Settings will be as shown below.

Design review   Rating	Rating method: LRFR 💌	
alysis type: Line Girder v ne / Impact loading type: As Requested v /ehicles Output Engine Description	Apply preference setting: None	
Traffic direction: Both directions	Refresh Temporary vehicles Advanced	
Venicle selection B→Vehicles B→Vehicles + EV2 - EV3 - H 15-44 - H 20-44 - HL-93 (US) - HS 15-44 - HS 20 (SI) - HS 20 (SI) - HS 20-44 - Lane-Type Legal Load - LRFD Fatigue Truck (SI) - LRFD Fatigue Truck (US) - NRL - SU4 - SU4 - SU5 - SU6 - SU7 - Type 3-3 - Type 3-3 - Type 3-3 - Type 3S2 - Agency - User defined - Temporary	Add to Ad	



Next click the Analyze button on the DESIGN/RATE ribbon to perform the rating.

#### **Tabular Results**

When the rating is finished you can review the results by clicking the **Tabular Results** button on the **Results** group of the **DESIGN/RATE** ribbon. The window shown below will open.

🗛 Ana	lysis Results - 12"	wide slab line									-		×
Prin	t t												
Report t	ype:	- Lane/Impact	t loading type	Display Format									
Rating	Results Summary	As reque	ested O Detailed	Single rating level pe	r row 🗸								
									1				
	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	57.85	1.607	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested		-
	HL-93 (US)	Truck + Lane	LRFR	Operating	74.99	2.083	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested		
	HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Inventory	116.52	3.237	36.00	2 - (20.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested		
	HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Operating	151.05	4.196	36.00	2 - (20.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested		
	HL-93 (US)	Tandem + Lane	LRFR	Inventory	56.17	1.560	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested		
	HL-93 (US)	Tandem + Lane	LRFR	Operating	72.82	2.023	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested		
AASHIO	LKEK Engine Ver	sion 7.5.0.3001											
Analysis	preference setting	g: None											
												Clo	ose

#### LRFD Design Review

To perform an LRFD design review, click the Analysis Settings button on the Analysis group of the

DESIGN/RATE ribbon which opens the Analysis Settings window. Note: The Design review option is only

available if you have a license for the BrD software.

Bridge V	Vorkspace - 2SpanRCSIab	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
at a 🗄	📄 🗣 🎽	< 📙				
Analysis Analyze Analysis Settings Events	Tabular Specification Engine Res Results Check Detail Outputs Gra	ults Save aph Results				
Analysis	Results					

Select the vehicles to be used in the analysis as shown below and click **OK**.

Analysis Settings		×
Design review     Rating	Design method:	
Analysis type: Line Girder   Lane / Impact loading type: As Requested  Vabiclas: Output Engine Description	Apply preference setting: None	
Traffic direction: Both directions	Refresh Temporary vehicles Advanced	
<ul> <li>□ - Vehicles</li> <li>□ - Alternate Military Loading</li> <li>□ - EV2</li> <li>□ EV3</li> <li>□ - HL-93 (SI)</li> <li>□ - HL-93 (US)</li> <li>□ - HS 20 (SI)</li> <li>□ - HS 20 (SI)</li> <li>□ - LRFD Fatigue Truck (SI)</li> <li>□ - LRFD Fatigue Truck (US)</li> <li>□ - Agency</li> <li>□ - User defined</li> <li>- Temporary</li> </ul>	Add to Remove from < <	
Reset Clear Open template Save te	mplate OK Apply Cancel	

Next click the **Analyze** button on the ribbon to perform the analysis.

Bridge W	ANALYSIS	REPORTS		
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING	
Analysis Settings Analysis Analysis Analysis	Tabular Specification Engine Results Results Check Detail Outputs Gra Results	llts Save ph Results		

#### Engine Outputs

The BrDR LRFD analysis will generate a spec check results file. Click the Engine Outputs button on the

**Results** group of the **DESIGN/RATE** ribbon to open the following window.

To view the spec check results, double click the Spec Check Results in this window.

	🕰 2SpanRCSlab —			×	
	□-SpanRCSlab □-Slab Girderline □-12" Slabline □-12" wide slab line □-AASHTO_LRFD □-Stage 3 Spec Check Results (Monday Dec. 12, 2022 1 □-Log File □-AASHTO_LRFR □-Stage 3 Spec Check Results □-Log File	6:43	8:05)		
					`
4	(			>	

The spec check results file will be displayed as shown below.

	\\   \ C				753 20		6			0 -		×
C:\Users\Shara	nvaRao\Doc	anyakao\Do	cuments (AASF	I Oware brok	/ SI\2Spar		Searc	.n		,o +	w w	255 🖌
Bridge ID : 2St	Bridge ID : 2SpanRCSlab NBI Structure ID : 2SpanRCSlab											
Bridge : 2 Spar			Bridg	e Alt :								
Superstructure Def : Slab Girderline												
Member : 12"	Slabline				Member Alt : 12" wide slab line							
Analysis Prefe	rence Setti	ing :										
AASHTO LRF	D Specifi	cation, Ed	ition 9, Inter	<u>im 0</u>								
Specificat	tion Cl	heck S	ummary	7								
	Arti	cle		State	15							
Fle	xure (5.6	32.5633	3)	Pase								
C	rack Cont	rol (5.6.7)	· /	Pase	;							
Shear (5.7	.3.3, 5.7.2	.5, 5.7.2.6,	5.7.3.5)	Ignore by	User							
Fatigue (5.5.3.2)				Pase	Pass							
D	(2.5.2.6.2)	Pase	5									
<u> </u>	•.•											
Girder Po	ositive	Flexui	re Analy	<b>SIS</b>								
Location	IC	Load	Mr	Mu	D			<b>C</b> 1				
(ft)	LS	Comb	(kip-ft)	(kip-ft)	De	sign Katio Mir/Mu		Code				
0.000	STR-I	1	120.79	0.00		99	.000	Pass				
3.000	STR-I	2	120.79	36.25		3	.332	Pass				
6.000	STR-I	2	120.79	59.41		2	.033	Pass				
9.000	STR-I	2	120.79	70.33		1	.718	Pass				
12.000	STR-I	2	120.79	70.27	70.27 1.71			Pass				
15.000	STR-I	2	120.79	62.50	62.50		.933	Pass				
18.000	STR-I	2	120.79	46.13		2	.618	Pass				
20.000	SIK-I	2	120.70	31.68		3	.810	Pass				
21.000	SIK-I	2	122.75	24.19		17	.074	Pass				
24.000	FAI-I FAT-I	4	218.66	8.02 4.40		17	.123	Pass				
27.000	TAT-I	4	210.00	4.40		49	.000	газэ П				~