AASHTOWare BrDR 7.5.0 Reinforced Concrete Structure Tutorial FRM1 – Reinforced Concrete Frame Example

Introduction - Elevation

FRM1 – Two span reinforced concrete frame example



Structure typical section at Pier



Structure Typical Section at Pier









Material Properties

Slab Concrete: Class A (US) fc = 4.0 ksi, modular ratio n = 8Slab Reinforcing Steel: AASHTO M31, Grade 60 with Fy = 60 ksi

Parapets

Weigh 300 lb/ft each. If slab cross section entered as 12" wide strip, member load due to parapets will be (2*300 lb/ft)/27' = 22 lb/ft.

BrDR Training

FRM1 – Reinforced Concrete Frame Example

Topics Covered

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

This example demonstrates entering a reinforced concrete frame in BrDR using the Compute Bent Stiffness window.

In this example a girder line superstructure definition that has a frame leg support will be added to **RCTrainingBridge1**. Double click on **BID11 RCTrainingBridge1** from the **Bridge Explorer** and open its **Bridge Workspace** tree.

Br 🖁				AASH	TOWare Bridge Design and Rating			?	- 🗆	×
BRIDGE EXPLORER BRIDGE	FOLDE	R	RATE	TOOLS VIEW						
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😭 Favorites Folder			BID	Bridge ID	Bridge Name	District	County	Facility	Locati	0
🖉 Recent Bridges			1	TrainingBridge1	Training Bridge 1(LRFD)	District 11	01 Abbeville	SR 0051	Pittsburg	h 🔺
E 📁 All Bridges			2	TrainingBridge2	Training Bridge 2(LRFD)	Unknown	Unknown (P)	N/A	N/A	
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			5	PCITrainingBridge2	PCITrainingBridge2(LRFD)					
			6	PCITrainingBridge3	PCI TrainingBridge3(LFD)					
			7	PCITrainingBridge4	PCITrainingBridge4(LRFD)					
			8	PCITrainingBridge5	PCI TrainingBridge5(LFD)					
			9	PCITrainingBridge6	PCITrainingBridge6(LRFD)					
			10	Example7	Example 7 PS (LFD)					
			▶ 11	RCTrainingBridge1	RC Training Bridge1(LFD)					
			12	TimberTrainingBridge1	Timber Tr. Bridge1 (ASD)					
			13	FSys GFS TrainingBridge1	FloorSystem GFS Training Bridge 1	District 6	15 Colleton	NJ-Turnpike	NJCity	
										•
						Total Bridg	e Count:	31		

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 window shown below

New Superstructure Definition	
○ Girder system superstructure	
Girder line superstructure	Superstructure definition wizard
 Floor system superstructure 	
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	
	OK Cancel

Select Girder line superstructure, click OK to open Girder Line Superstructure Definition window and enter

data as shown below:

efinition Analy	rsis Engine		
ame:	FrameLine	Deck type:	
escription:		Concrete V	
		For PS/PT only	
		Average humidity:	
		%	
efault units:	US Customary	Member alt. types	
eference line lengt	h: ft	Steel	
Live load lanes	LRFD fatigue	P/S	
Multi-lane	Truck lanes:		
Single lane	Override	P/T	
	Truck fraction:		

Load Case Description

Open the Load Case Description window and use the Add default load case descriptions button to create the following load cases.

Load case name	Description	Stage	Туре		Time* (days)	
DC1	DC acting on non-composite section	Non-composite (Stage 1) *	D,DC	*		-
DC2	DC acting on long-term composite section	Composite (long term) (Stage 2) *	D,DC	-		
DW	DW acting on long-term composite section	Composite (long term) (Stage 2) *	D,DW	*		
SIP Forms	Weight due to stay-in-place forms	Non-composite (Stage 1)	D,DC	-		

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

Member

Create the following girder line member by double clicking on **Members** in the **Bridge Workspace** tree to open the **Member** window. Select the **Frame member simplified definition** checkbox. Check **Support 2** in the **Frame connections** grid to signify that support 2 of this member is supported by a frame leg that will be simplified as a support with spring constants. Enter data in this window as shown below.

A Member	- 🗆 X
Member name: Slabline	
Description:	Modeling © Open girder MC8 ✓ Frame member simplified definition
Existing Current Member alternative name Description Number of spans: 2 Span Frame connections Girder spacing: ft 1 Support Frame connections 2 30.00 1 1 2 2 3 3 1 1 1 1	Deck concrete crack control parameter (Z): 130.000 kip/in Deck exposure factor: Member location Member location Exterior OK Apply Cancel



Girder Member Loads

Expand the **SlabLine** member in the **BWS** tree and double click on **Member Loads** to open the **Girder Member Loads** window. This structure has 2 parapets each weighing 300 lb/ft. In this tutorial, a 12" wide strip of slab will be defined as the member so the parapet load applied to this member will be (2*300 lb/ft)/27' = 22 lb/ft. Click **New** to add a row in the **Uniform** tab and enter the data as shown below:

Girde	er Member Loads					-		
Ł		+ + +	+ + +	Ł				
	trian load:] lb/ft Concentrated	Settlement					
	Load case name	Span	Uniform load (kip/ft)	WS field measured*	Description			
Þ	DC1 -	All Spans 🔹	0.022					
							~	
*DV	N=1.25 if checked				New Duplicate	D	elete	
					ОК Арг	oly	Cance	el

Supports

Since **Frame member simplified definition** was selected on the Member window, the **Supports** window now displays **Support 2** as a frame connection with all constraints fixed.

	1			2		
ene	eral Elas	tic				
	Support	Support	Translation	constraints	Rotation constraints	
	number	type	Х	Y	Z	
	1	Pinned *	\checkmark	1		-
	2	Frame Connection *	\checkmark	✓	V	
	3	Roller *		\checkmark		

On the Elastic tab, select the **Rotation Spring Constant** cell for **Support 2**. The **View/Compute...** button will now be activated.



Compute Bent Stiffness

With Z column for support 2 selected, click the View/Compute... button to open the Compute Bent Stiffness window. Enter the following data for the column and click the Compute button to compute the column stiffness coefficient.

A Compute Bent Stiffne	255						×
Support: 2		Num	ber of girders:	1			
Column							
Bent cap width: 48.0	000 in	Colu	mn length:	15.000	ft		
Number of columns:	1	Perce	ent fixity at bas	e: 100.0	%		
Column cross section							
Cross section type	Mate	rial:	Class A (US)	•	•		
Rectangular	Circular Top d	lepth:	24.0000	in	Top width:	48.0000	in
Cross section dimer Constant Tap	Botto	om depth:	24.0000	in	Bottom wid	th: 48.0000	in
Computed bent stiffne							
Properties at top of	column			Modulus	of elasticity:	3,644.15	ksi
Area:	1,152.00	in^2					
Moment of inertia:	55,296.00	in^4		Percent I stiffness	bent per girder:	7.41	%
Properties at bottor	n of column					Compute]
Area:	1,152.00	in^2		Compute		4477930.603	kip-in/rad
Moment of inertia:	55,296.00	in^4		bent stiff			
				Compute stiffness	ed bent per girder:	331814.6577	kip-in/rad
						Apply	Cancel

The column stiffness coefficient is computed using the Stiffness Method. In the stiffness method, a unit rotation in the Z direction is applied to the top of the column with all other displacements equal to zero. The member end loads that are required to produce this unit rotation are the stiffness coefficients. The moment applied at the top of the column to produce this unit rotation is the stiffness coefficient computed in this window.

The following diagram shows the frame leg and the moment applied to produce the unit rotation. Engineering judgement needs to be applied to determine the length of the frame leg based on the geometry and reinforcement of the frame structures to be analyzed.



For this case, the moment required to produce a unit rotation at the top of the cantilever column is $M_a = 4EI/L$.

The **Percent bent stiffness per girder** field is the percent of one column's stiffness that is applied to this girder line member. For this example, the percent stiffness is computed as follows. Engineering judgement needs to be applied to determine the width of slab to model as a member and the percentage of the column to apply to this strip when entering slab structures with frame legs.

$$\frac{2 \text{ columns}}{324"} \times 12" \text{strip} \times 100\% = 7.41\% \text{ column}$$

The column stiffness coefficient is computed as follows:

$$\frac{4EI}{L} \times Percentage = \frac{4(3644.15ksi)(55296in^4)}{180"} \times 7.41\% = 331,814.7kip - in/rad$$

Click the **Apply** button to apply this stiffness coefficient to **Support 2**.

Supports window will be populated as shown below.

	→× <u>~</u> 1			2			
				2			
en	neral Ela	astic				 	
	Support	Translation s	spring constant ip/in)	Rotation spring constant (kip-in/rad)	Override computed Z		
	number	X	Y	Z	rotation spring constant		
	1						
Þ	2			331814.6577			
	-						

Member Alternative

Create a reinforced concrete slab member alternative as follows. Double click on **MEMBER ALTERNATIVES** on the **Bridge Workspace** tree to open the window as shown below. Select **Reinforced Concrete** for **Material Type**, **Reinforced Concrete Slab** for **Girder Type** and click **OK**.

/laterial type:	Girder type:
Post tensioned concrete	Advanced Concrete RC
Prestressed (pretensioned) concrete	Reinforced Concrete I
Reinforced concrete	Reinforced Concrete Slab
Steel	Reinforced Concrete Tee
Timber	
	OK Cancel

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

mber altern	ative: 12"	Slab							
Description	Specs	Factors	Engine	Import	Control options				
Description:					Material type:	Reinforced Concre	te		
					Girder type:	Reinforced Concret	te Slab		
					Modeling type:	Open Girder			
					Default units:	US Customary	~		
Sustained	self load:		signed kip/ft	6.0000	Default rating metho	sd: ▼			
Additional		eter (Z)		Exposure	factor				

Cross - section based input.

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



Cross Sections

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

Section 1

A Cross Sections	-		×
Name: Section 1 Type: Reinforced Concrete Slab			
Dimensions Reinforcement			
Concrete material: Class A (US)			
Modular ratio:			
in			
18.0000 in			
ОК Арр	dy	Cance	al
			_

Cross Sections								-	
ne: Section 1	Type: Reinfor	ced C	oncrete Slab						
imensions Reinforcement									
Distance from top of slab	Row		Std bar count	LRFD bar count	Bar size	Distance (in)	Material	Bar sp (ir	
* •	Top of Slab	*	1.00	1.00	5 -	2.4375	Grade 60 🔻	,	
<u>+</u>	Bottom of Slab		2.00	2.00	9 -	3.1250	Grade 60 🔹		
	4				III				
	4				III	New	Duplicate		elete

Section 2

A Cross Sections	-		×
Name: Section 2 Type: Reinforced Concrete Slab			
Dimensions Reinforcement			
Concrete material: Class A (US)			
Modular ratio:			
12.0000 in			
ОК А	pply	Cance	el –

ne: 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)	
		Top of Slab 🔹	2.00	2.00	9 -	2.6875	Grade 60 🔻		-
<u>+</u>	Þ	Bottom of Slab	2.00	2.00	9 -	3.1250	Grade 60 🔻		
									-
							New	Duplicate	Delete

Section 3

A Cros	ss Section	15										-		×
Name:	Section	n 3		Type:	Reinforced Cond	crete Slab]							
Dim	ensions	Reinforcement												
							rete material: Jlar ratio:	Class A (US)		~			
		<u>←</u>	12.000	0 in	<u>>i</u> †↑									
					36.0000) in								
									(DK	Арр	ly	Canc	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

Cross Section Ranges

Double click on the **Cross Section Ranges** node in the **Bridge Workspace** tree to input the cross sections over the length of the member as shown below.

Start Distance	Length Start Section	End	l tion						
Start section	End section		Web variation		port nber	Start distance (ft)	Length (ft)	End distance (ft)	
Section 1	Section 1	Ŧ	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 1	Section 1	*	None *	2	-	10.000	20.000	30.000	

Shear Reinforcement Ranges and **Bracing Ranges** are not applicable to this member so data will not be entered in these windows. **Points of Interest** will not be entered since there is no overriding information for this bridge.

Live Load Distribution

To enter the live load distribution factors, double click on **Live Load Distribution** on the **Bridge Workspace** tree and enter the **Standard** factors as shown below:

	Load Distrik	Julion												
tan	ndard LR	FD												
- D)istribution f	factor inp	out method											
	Use simpl			Use advand	ced method		Use adva	anced met	hod with	1994 gu	ide specs			
	Allow distrib	bution fac	ctors to be u	used to com	npute effects (of per	rmit loads	with rout	ine traffic	:				
				ution factor	·									
	Lanes loaded		(M Shear at	vheels)		-								
		Shear	supports	Moment	Deflection									
	1 Lane			0.172	0.167	-								-
Þ	Multi-lane			0.172	0.167									
														*
													 	*

The Standard distribution factor for a slab member is computed as follows:

AASHTO Article 3.24.3

Distribution width, E, for a wheel is 4 + 0.06S but shall not exceed 7'.

S = span length = 30'

 $E = 4 + 0.06 * 30' = 5.8' \le 7'$

Moment
$$DF = \frac{1 \text{ wheel}}{5.8'} = 0.1724 \text{ wheel/ ft}$$

The cross section that will be entered for this member alternative is 12" wide so the wheel distribution factor is per foot. If the cross section were 24" wide, the distribution factor would be computed as 2*0.1724=0.3448.

The deflection distribution factor is calculated as the number of lanes divided by the number of girders. For a reinforced concrete slab bridge, the number of girders is taken as the lane width divided by the strip width. Our lane width is 12 feet, and our strip width is 12" or 1 foot.

$$Deflection DF = \frac{1 \, lane * 2 \, wheels/lane}{(12'/1')} = 0.1667 \, wheel \, / \, ft$$

• Use simplified method Use advanced method • Allow distribution factors to be used to compute effects of permit loads with routine traffic Action: Deflection • Use simplified method • Support Start distance (ft) End distance (ft) Distribution factor (lanes) 1 • 0.00 60.000 60.000 0.083		Use simp		t method									
Support Start distance (ft) Length (ft) End distance (ft) Distribution factor (lanes) 1 0.00 60.000 60.000 0.100 0.083	_		lified metho	od O U	lse advanced m	ethod							
Action: Deflection													
Support number Start distance (ft) Length (ft) End distance (ft) Distribution factor (lanes) 1 0.00 60.000 60.00 0.100 0.083				-1	ed to compute	effects of p	ermit loads w	ith routine traffic					
Support number Length (ft) End distance (ft) (lanes) 1 0.00 60.000 60.00 0.083	\cti	on: Defle	ction 🗸										
Support number Length (ft) Length (ft) Length (ft) Length (ft) 1 0.00 60.00 0.100 0.083			Start			Distribut	tion factor						
(ft) 1 1 Multi-lane 1 • 0.00 60.00 0.100 0.083			distance			(la	nes)						
Compute from View calce Delete													
		1 *	0.00	60.000	60.00	0.100	0.083						
typical section	Ca	ompute fro	m .	Former 1					N	Dist	Duplicate] [)elete
				/iew calcs					Ne	ZW	Duplicate		Delete
				/iew calcs					Ne	2W	Duplicate		Delete
				/iew calcs					Ne	2W	Duplicate		Delete
				/iew calcs					Ne	2W	Duplicate		Delete
OK Apply Cance				/iew calcs					Ne	2W	Duplicate		Delete

Navigate to the **LRFD** tab and enter the live load distribution factors for **each Action** as shown below:

andard LRF Distribution factor input method Use simplified method I Use simplified method Use advanced method Allow distribution factors to be used to compute effects of permit loads with routine traffic science Image: Start (R) Support distance (R) End distance (Interest (Intere	Distribution factor input method Use simplified method Use simplif												-	-		
• Use simplified method Use advanced method Allow distribution factors to be used to compute effects of permit loads with routine traffic Image: Start distance (ft) End distance (lines) 1 • 0.00 60.00 0.079 0.096	Use simplified method Use advanced method Allow distribution factors to be used to compute effects of permit loads with routine traffic tion: Image: Compute field method Support Start (ft) End distance (lanes) number distance (ft) End distance (lanes) 1 0.00 60.000 0.079 0.096	Dis	ard LRF	D												
Allow distribution factors to be used to compute effects of permit loads with routine traffic Autors Moment Support Start distance Length End distance Distribution factor (Inne) 1 ar Multi-lane 1 - 0.00 60.000 60.000 0.079 0.096 Compute from View calcs View calcs View calcs New Duplicate Delete	Allow distribution factors to be used to compute effects of permit loads with routine traffic tion: Moment v Support Start distance Length End distance (1) I lane Multi-lane 1 0.00 60.000 60.000 0.079 0.096 0.096 0.000 0.		tribution fa	actor input	t method											
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OK Apply Cancel	OK Apply Cancel				/iew calcs					[New	Du	plicate	D	elete	
OK Apply Cancel	OK Apply Cancel				/iew calcs					[New	Du	plicate	D	elete	
OK Apply Cancel	OK Apply Cancel				/iew calcs						New	Du	olicate	D	elete	
					/iew calcs					[Du		D		
					/iew calcs							Du				

Start distance (ft)	Length (ft)	nd distance (lane:	oution factor (lanes) Multi-lane	ion factor nes) Multi-lane	Istribution factor (lanes)	
Start distance (ft)	Length End distan (ft) (ft)	d distance (ft) Distribution I lane N	oution factor (lanes) Multi-lane	ion factor nes) Multi-lane	bistribution factor (lanes) lane Multi-lane	
Start distance (ft)	Length End distar (ft) (ft)	(lane) (lane) (ft) 1 lane M	(lanes) Multi-lane	nes) Multi-lane	(lanes) lane Multi-lane	
distance (ft)	(ft) (ft)	(lane) (lane) (ft) 1 lane M	(lanes) Multi-lane	nes) Multi-lane	(lanes) lane Multi-lane	
distance (ft)	(ft) (ft)	(ft) 1 lane M	Multi-lane	Multi-lane	lane Multi-lane	
1 1 1	60.000 60					
0.00	80000 80	0000 00/9	3 0.030	0.090	0014 00040 I	
om	lique entre				New Dunicate Del	New Duplicate Delete
	View calcs				New Duplicate Del	New Duplicate Delete
om on	/iew calcs				New Duplicate Del	New Duplicate Delete

The live load distribution factors for LRFD analysis are calculated as shown below. For single lane, the distribution factor = 12" member*0.0066 lanes/inch = 0.079 lanes. For multi lane, the distribution factor = 12"*0.008lanes/" = 0.096 lanes.

AASHTO Article 4.6.2.3

Equivalent width of strip per lane, E, for both shear and moment single lane

$$\begin{split} E &= 10.0 + 5.0 \sqrt{L_1 W_1} \\ L_1 &= span \ length \leq 60' = 30' \\ W_1 &= modified \ edge - edge \ width \ of \ bridge \leq 30' \ for \ single \ lane = 27' \\ E &= 10 + 5.0 * \sqrt{(30)(27)} = 152" \\ Moment \ and \ Shear \ DF &= \frac{1 \ lane}{152"} = 0.0066 \ lane/inch \\ For multi \ lane: \\ E &= 84.0 + 1.44 \sqrt{L_1 W_1} \leq \frac{12.0 W}{N_L} \\ W_1 &= modified \ edge - edge \ width \ of \ bridge \leq 60' \ for \ multi \ lane = 27' \\ W &= width \ edge - edge \ of \ bridge = 27' \\ N_L &= number \ of \ lanes \\ E &= 84 + 1.44 \sqrt{(30)(27)} = 125 \leq \frac{12 \ (27)}{2} = 162 \\ Moment \ and \ Shear \ DF &= \frac{1 \ lane}{125"} = 0.008 \ lane/inch \\ Deflection \ DF &= \frac{\# \ lanes}{(Lane \ width/Strip \ width)} * Multiple \ Presence \ Factor \\ Single \ lane \ Deflection \ DF &= \frac{1 \ lane}{(12'/1')} \ (1.20) = 0.100 \ lanes \end{split}$$

Multi lane Deflection DF = $\frac{2 \text{ lanes}}{(12' * 2 / 1')}$ (1.0) = 0.0833 lanes

LFR Rating

The description of this structure is complete. To perform an **LFR** rating, click the **Analysis Settings** button on the Analysis group of the **DESIGN/RATE** ribbon which opens the **Analysis Settings** window.

Bridge Workspace - Timber Example	e Sawn	ANALYS	IS REPORTS	?	-	×
BRIDGE WORKSPACE WORKSPACE TOO	LS VIEW	/ DESIGN/R	ATE REPORTING	3		^
Analysis Settings Analysis Analysis Analysis Analysis						

Select the vehicle to be used in the rating as shown below and click **OK**.

Design review Rating nalysis type: Line Girder Impact loading type: As Requested Vehicles Output Engine Description Traffic direction: Both directions Vehicle selection Vehicle selection -Atternate Military Loading -Atternate Military Loading -Ev2	[ference setting: Refresh /ehicle summar	Temporary vehicles	v V Advanced	1	
Vehicles Output Engine Description Traffic direction: Both directions Vehicle selection Vehicle selection Vehicle standard Atternate Military Loading	[Refresh /ehicle summary	Temporary vehicles		1	
Vehicles Output Engine Description Traffic direction: Both directions Image: Source of the source of t	[Refresh /ehicle summary	Temporary vehicles			
Traffic direction: Both directions ♥ Vehicle selection B-Vehicles P-Standard ↓ Alternate Military Loading	[/ehicle summaŋ		Advanced	1	
Vehicle selection	[\ [/ehicle summaŋ		Advanced	1	
È-Vehicles È-Standard ├-Alternate Military Loading	\ [,			
⊖-Standard ├─Alternate Military Loading						
- EV2 - EV3 - H 15-44 - H 20-44 - HS 15-44 - HS 20 (51) - HS 20-44 - NRL - SU4 - SU5 - SU6 - SU7 - Type 3-3 - Type 3-3 - Type 3-3 - Type 3-3 - Type 3-3 - Type 3-2 - Agency - User defined - Temporary	Add to >> Remove from <<	i⊟-Rating vehic i⇒-Inventor - HS 2 - Operatir - Legal op - Permit in - Permit o	y 0-44 Ig ierating iventory			

Tabular Results

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

When the rating is complete the results can be reviewed by clicking the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon. The window shown below will open.

4	Analysis Re	sults - 12" S	lab								-	- 🗆	\times	
	Print Print													
Rep	ort type:		C Lane/	Impact load	ding type	Displa	Display Format							
Ra	ting Results	Summary		As request		led Single	Single rating level per row \sim							
	Live Load	Live Load Type	Rating Method	Rating Level			Location (ft)	Location Span-(%)	Limit State		Impact	Lane		
	HS 20-44	Axle Load	LFR	Inventory	51.70	1.436	20.00	1 - (66.7)	Design	Flexure - Concrete	As Requested	As Requeste	d	
	HS 20-44	Lane	LFR	Inventory	81.13	2.254	40.00	2 - (33.3)	Design	Flexure - Concrete	As Requested	As Requeste	d	
	SHTO LFR En	-											÷	
Analysis preference setting: None Close												se		

LRFD Analysis

To perform an LRFD analysis, click the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon which opens the **Analysis Settings** window. Select the vehicle to be used in the analysis as shown below and click **OK**.

Design review Rating alysis type: Line Girder Impact loading type: As Requested chicles Output Engine Description Traffic direction: Both directions Vehicle selection -Vehicles -Vehicles -Vehicle -Vehi		ethod: ierence setting: Refresh	LRFD None Temporary vehicles	>		
ie / Impact loading type: As Requested /ehicles Output Engine Description Description Traffic directions: Both directions Vehicle selection Image: Selection Image: Selection Image: Selection				~		
Vehicles Output Engine Description Traffic directions: Both directions Image: Compared to the section Vehicle selection Image: Compared to the section				~		
Traffic directions		Refresh	Temporany vehicles			
Vehicle selection		Refresh	Temporany vehicles		_	
ia-√ehicles				Advanced]	
		/ehicle summar Design vehi	-			_
-Alternate Military Loading -EV2 -EV3 -HL-93 (JS) -HS 20 (SI) -HS 20 (SI) -HS 20-44 -URED Fatigue Truck (SI) -LRED Fatigue Truck (US) -Agency -User defined -Temporary	Add to >> Remove from	⊖-Design 1 -HL-5 Permi -Permi -Permi Fatigue	oads 93 (US) oads			

Tabular Results

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

When the rating is finished the results can be reviewed by clicking the Tabular Results button on the Results group

of the **DESIGN/RATE** ribbon. The window shown below will open.

c	rt type	:		:	Stage				Dead L	Dead Load Case			
Dead Load Actions 🗸 🗸					Non-composite (Stage 1) V				Load Case 1 - Self Load(Stage 1 🗸				
	Span	Location (ft)	% Span	Side	Moment (kip-ft)	Shear (kip)	Axial (kip)	Torsion (kip-ft)	Reaction (kip)	X Deflection (in)	Y Deflection (in)		
r	1	0.00		Right	0.00	2.20	0.00	0.00	2.20	0.0000	0.0000		
ŀ	1	3.00	10.0	Both	5.59	1.53	0.00	0.00		0.0000	-0.0202		
	1	6.00	20.0	Both	9.16	0.85	0.00	0.00		0.0000	-0.0365		
	1	9.00	30.0	Both	10.70	0.18	0.00	0.00		0.0000	-0.0462		
	1	12.00	40.0	Both	10.22	-0.50	0.00	0.00		0.0000	-0.0482		
	1	15.00	50.0	Both	7.71	-1.17	0.00	0.00		0.0000	-0.0428		
	1	18.00	60.0	Both	3.18	-1.85	0.00	0.00		0.0000	-0.0319		
	1	20.00	66.7	Both	-0.96	-2.30	0.00	0.00		0.0000	-0.0232		
	1	21.00	70.0	Both	-3.38	-2.52	0.00	0.00		0.0000	-0.0188		
	1	24.00	80.0	Both	-12.04	-3.27	0.00	0.00		0.0000	-0.0079		
	1	27.00	90.0	Both	-23.20	-4.22	0.00	0.00		0.0000	-0.0017		
	1	29.00	96.7	Both	-32.41	-5.03	0.00	0.00		0.0000	-0.0002		
	1	30.00	100.0	Left	-37.66	-5.48	0.00	0.00	10.95	0.0000	0.0000		
	2	0.00	0.0	Right	-37.66	5.48	0.00	0.00	10.95	0.0000	0.0000		
	2	1.00	3.3	Both	-32.41	5.03	0.00	0.00		0.0000	-0.0002		
	2	3.00	10.0	Both	-23.20	4.22	0.00	0.00		0.0000	-0.0017		
	2	6.00	20.0	Both	-12.04	3.27	0.00	0.00		0.0000	-0.0079		
	2	9.00	30.0	Both	-3.38	2.52	0.00	0.00		0.0000	-0.0188		
	2	10.00	33.3	Both	-0.96	2.30	0.00	0.00		0.0000	-0.0232		
	2	12.00	40.0	Both	3.18	1.85	0.00	0.00		0.0000	-0.0319		
	2	15.00	50.0	Both	7.71	1.17	0.00	0.00		0.0000	-0.0428		
	2	18.00	60.0	Both	10.22	0.50	0.00	0.00		0.0000	-0.0482		
	2	21.00	70.0	Both	10.70	-0.18	0.00	0.00		0.0000	-0.0462		
	2	24.00	80.0	Both	9.16	-0.85	0.00	0.00		0.0000	-0.0365		
	2	27.00	90.0	Both	5.59	-1.53	0.00	0.00		0.0000	-0.0202		
	2	30.00	100.0	Left	0.00	-2.20	0.00	0.00	2.20	0.0000	0.0000		