AASHTOWare BrDR 7.5.0 Multi-Cell Box LFR Tutorial MCB3 – Post-Tensioned Multi-Cell Box LFR Example

Topics Covered

- Post-tensioned concrete multicell box data entry
- Live load distribution factor calculations
- LFR analysis and results

This example describes entering a post-tensioned multicell box superstructure into AASHTOWare BrDR. The superstructure is not integral with the substructure.

Analysis Methods

Post-tensioned concrete multicell box (MCB) superstructures can be analyzed in the following ways:

- LFR and LRFR
- Full box section including each individual webline

Post-Tensioned Concrete Multi-Cell Box Data Entry

From the Bridge Explorer, click on the bridge **BID 27 MultiCell Box Examples** in the sample database and select **Open** from the **Bridge** group of the **BRIDGE** ribbon to open this bridge as shown below.

Br			AAS	HTOWare Bridge Design and R	ating ? — 🗆	\times
BRIDGE EXPLORER BRIDG	FOLDER		RATE	TOOLS VIEW		
New Open Batch ~ Bridge	Find Copy	Paste N	Co To 1anag	py Remove Delete From		
F Open (Ctrl+O) P Recent Bridges			BID	Bridge ID LKFD Substructure Example 5	Bridge Name LKFD SUDStructure Example 3	D
🖻 🎾 All Bridges			23	LRFD Substructure Example 4	LRFD Substructure Example 4 (NHI Hammer Head)	
🗄 🎾 Templates			24	Visual Reference 1	Visual Reference 1	Un
Deleted Bridges			25	Culvert Example 1	Culvert Example 1	
			26	Curved Guide Spec	Curved Guide Spec Example(LFR)	
		>	27	MultiCell Box Examples	Multi Cell Box Examples	
			28	Gusset Plate Example	Gusset Plate Example	Un
			29	Splice Example	Splice Example	
			30	Simple DL-Cont LL-Splice	Simple DL Splice	Un
			31	MetalCulvertExample1	MetalCulvertExample 1	-
			-			•
					Total Bridge Count: 31	

The partially expanded Bridge Workspace (BWS) tree is shown below.



Superstructure Definitions

Create a new MCB (multicell box) superstructure definition. Click on **Superstructure Definitions** in the **BWS** to open the **New Superstructure Definition** window. Select Concrete multi-cell box superstructure and click **OK**.

A New Superstructure Definition		\times
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		
O Concrete multi-cell box superstructure		
Advanced concrete multi-cell box superstructure		
and a second second second second		

Concrete Multi-Cell Box Superstructure Definition

Enter the following data for the superstructure definition. Select the **Post-tensioned** checkbox. This will display the **PT** windows in the **BWS** tree.

Name: PT MCB Description: Left: 12 in Default units: US Customary V Number of spans: 2 0 Span lengths Average humidity: 60 % Enter span lengths along the reference line: Structure type Span length Structure type Image: span length Structure type Structure model for LLDF computation Structure Image: span length Image: span length Structure model for LLDF computation Verage in the span length side connected to adjacent structure Image: span length Verage in the span length Image: span length Image: span length Image: span length Verage in the span length Image: span length Image: span length <t< th=""><th>Definition Analysis</th><th>Specs Factors Engi</th><th>ine Control options</th><th></th></t<>	Definition Analysis	Specs Factors Engi	ine Control options	
Description: Default units: Number of spans: 2 2 2 Span lengths 2 2 2 Span lengths 2 2 2 Span lengths along the reference line: Span lengths Center span lengths along the reference line: Structure type Consider substructure simplified definition Integral with substructure Consider substructure skew in F£ section f 2 Post-tensioned Center structure Right side connected to adjacent structure Right side connected to adjacent structure Center	Name:	PT MCB		
Description: Left: 12 in Number of spans: 20 Number of cells: 20 Structure model for LLDF computation Structure model for LLDF computation Structure model for LLDF computation Structure model for dadjacent structure Right side connected to adjacent structure Right side connected to adjacent structure Number of end to en				End projections
Right: 12 Inter span lengths Number of spans: 2 2 Structure span 2 1 1111.5 2 1111.5 Verage humidity: 60 % Structure model for LLDF computation Structure Right: 1 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 111.5 2 12.61 3.70 2.61 1.61 3.70 2.70 3.70<	Description:			Left: 12 in
Default units: US Customary V Number of spans: 2 Number of cells: 2 Structure span lengths along the reference line: Structure type Structure simplified definition 1 111.5 2 111.5 Structure model for LLDF computation Standalone Left side connected to adjacent structure Right side connected to adjacent structure Right side connected to adjacent structure Structure model for the structure shows in FE section p				Right: 12 in
Number of spans: 2 Number of cells: 2 Structure model for LLDF computation Structure model for LLDF computation Structure adjacent structure Right side connected to adjacent structure Right side connected to adjacent structure	Default units:	US Customary 🗸 🗸	Span lengths	Average humidity: 60 %
Number of cells: 2) Structure model for LLDF computation Standalone Left side connected to adjacent structure Right side connected to adjacent structure	Number of spans:	2 0	Enter span lengths along the reference line:	⊂ Structure type
Structure model for LLDF computation Standalone Image: Computation of the structure Left side connected to adjacent structure Image: Computation of the structure	Number of cells:	2 🗘	Span Length	Frame structure simplified definition
Structure model for LLDF computation Structure model for LLDF computation Standalone			(ft)	Integral with substructure
Structure model for LLDF computation Standalone left side connected to adjacent structure Right side connected to adjacent structure w v v				Consider substructure skew in FE section pr
	Standalone	CLUF computation		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conn	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conn	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure nected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conne	ected to adjacent structure		Analyze webs only
	Standalone Left side conne Right side conn	LLUP computation		Analyze webs only

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

Load Case Description

Expand the newly added superstructure definition **PT MCB** folder in the **BWS** tree and double click on the **Load Case Description** node. Use the **Add default load case descriptions** button to create the following load cases.



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

Concrete Stress Limits

Double click on the **Concrete Stress Limits** folder in the **BWS** tree and enter a **Name**, **Concrete material** and click the **Compute** button to fill the stress limit data for the beam concrete.

A Stress Limit Sets - Cond	crete				_		\times
Name: Bea	am Stress Limit						
Description:							
Corrosion condition: Mod	derate	\sim					
Final allowable tensio	n stress limit coef. (U	S) override:					
Concrete material: PT E	Beam Concrete 4.5 ks	i v					
Ca	ompute						
	LFD		LRFD				
Initial allowable compress	ion: 2.4	ksi	2.6	ksi			
Initial allowable tension:	0.1897367	ksi	0.1896	ksi			
Final allowable compression	on: 2.7	ksi	2.7	ksi			
Final allowable tension:	0.4030509	ksi	0.4030509	ksi			
Final allowable DL compre	ession: 1.8	ksi	2.025	ksi			
Final allowable slab comp	ression:	ksi		ksi			
Final allowable compression (LL+1/2(Pe+DL))	on: 1.8	ksi	1.8	ksi			
)K	Apply	Cano	el
					199	Curre	

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

Post Tension Losses

Double click on the **Post Tension Losses** folder in the **BWS** tree and select the **Lump Sum** Loss method.

· · · · · ·			⊂ Lump sum l	osses	J	
Loss method:	Lump Sum					
Anchor set:		in	Initial loss:	20		ksi
Coefficient of friction:			Final loss:	45		ksi
Wobble coefficient:		per ft				
P/S transfer stress ratio:						
Transfer time:		Hours				
Age at deck placement:		Days				
Final age:		Days				

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

Structure Cross Sections

Double click on the Structure Cross Sections folder in the BWS tree and enter the following data.





h

	Location in cells	Exterior web fillet	Interior web fillet	Horiz (in)	Vert (in)
>	Тор			4	4
	Bottom	\sim	 Image: A set of the set of the	4	4

Now that all the dimensions are entered, click the Compute properties button.





Create another cross section by copying **Section 1** and making edits to it. To copy, select **Section 1**, right-click and select **Copy** (or click on the **Copy** button from the **Manage** group of the **WORKSPACE** ribbon). Now select **Structure Cross Sections** folder, right-click and select **Paste** (or click on the **Paste** button from the **Manage** group of the **WORKSPACE** ribbon).



Bridge Works	pace - Mu	ultiCell Bo	x Examples		ANALYS	ilS	REPO	ORTS		?	_		×
BRIDGE WORKSPACE	WORKS	PACE	TOOLS	VIEW	DESIGN/R	ATE	REPOR	RTING					
A Check Out	E Save	👶 Rest	ore 🔀 ert Close	é Export	2 Refresh	Dpen (New	Copy	Paste	Duplicate	di Delete	Schemati	c
	B	Bridge						Ma	anage				

Now double click on the copied cross section to open its window. Rename the new cross section to **Section 2**, revise the depth to 8' and click on the **Compute properties** button as shown below.



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

Schematic – Section 1

With **Section 1** selected in the **BWS** tree, click on the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) to view the cross section as shown below.



Similarly, schematic for Section 2 is shown below.



Tendon Profile Definitions – Profile tab

Double click on the **Tendon Profile Definition** folder in the **BWS** tree and create the following tendon profile. Enter the data shown below for the 3 tabs.

file	name:	Tendon		Ending	span: 1	~	End distan	ce from	end s	pan: 0	''					
rof	ile P	ost tensioning Stress limit	s													
- 1	nflection	n point entry method														
	O Per	centage Distance	Assig	ned to: B	ox Unit	~										
				Inf	lection poir	nts				Vertica	al offset					
	Span	Profile type		Left (%)	Low (%)	Right (%)	Left end (in)	Measu fror	ured m	Low (in)	Measu from	red 1	Right end (in)	Meas fro	ured m	
	_	Tupo 3	~		40	15	28	Тор	~	48	Bottom	\sim	10	Тор	\sim	F
>	1	Type 5														

ile name	e: Tendor	ı		S	tarting span: nding span:	1	~	Start distance into start spa	n: 0	ft ft		
ofile	Post tens	ioning	Stress limits	-	nanig span							
restress	s material:	1/2" (7W	270) LR	\sim	Duc	t grouting	g: Gro	uted \lor				
acking e	end:	Left End	~		Duc	t diamete	er: 2	in				
Total	put metho Jacking I jacking fo	d force () rce: 975	Strands	Jacking Numbe	stress ratio: of ducts pe	0.75 er web: 0						
Total	put metho Jacking I jacking fo Distribute	d force rce: 975 equally	Strands 0.5 kip	Jacking Numbe) stress ratio: er of ducts pe	0.75 er web: 0						
Total	put metho Jacking Jacking fo Distribute	d force 975 equally	Strands 0.5 kip Percent (%)	Jacking Numbe) stress ratio: er of ducts pe	0.75 er web: 0		Duct	Strands per			
Total	put metho Jacking Jacking fo Distribute Web	d i force 975 equally	Strands 0.5 kip Percent (%)	Jacking Numbe	stress ratio: of ducts pe	0.75 r web: 0		Duct	Strands per duct			
Total	Jacking Jacking fo Distribute Web WEB	d force 975 equally 0 1 2	Strands 9.5 kip Percent (%)	Jacking Numbe tage 33.33333	stress ratio: er of ducts pe	0.75 r web: 0		Duct	Strands per duct			•

Click the **Compute Values** button followed by **OK** to apply the data and close the window.

Ending span: 2 End distance from end span: 0 ft Profile Post tensioning Stress limits Image: Compute Values 0 ft Image: Compute Values Image: Compute Values Image: Compute Values 0 ft	ofile name:	Tendon		Starting span:	1	~	Start distan	ce into start span:	0	ft		
Profile Post tensioning Stress limits LRFD LFD rior to seating: 218.7 ksi at anchorages and couplers immediately after anchor set: 189 ksi Isewhere along length of member immediately after anchor set: 199.8 ksi 199.4 ksi 194.4 ksi			C ((()	Ending span:	2	~	End distanc	e from end span:	0	ft		
trior to seating: 218.7 ksi 218.7 ksi at anchorages and couplers immediately after anchor set: 189 ksi 189 ksi Isewhere along length of member immediately after anchor set: 199.8 ksi 201.69 ksi at service limit state after losses: 194.4 ksi 194.4 ksi	Profile F	Post tensioning	Stress limits		LRFD		LFD					
At anchorages and couplers immediately after anchor set: 189 ksi 189 ksi Isewhere along length of member immediately after anchor set: 199.8 ksi 201.69 ksi It service limit state after losses: 194.4 ksi 194.4 ksi	Prior to seat	ting:			218.7	ksi	218.7	ksi				
Isewhere along length of member immediately after anchor set: 199.8 ksi 201.69 ksi it service limit state after losses: 194.4 ksi 194.4 ksi	At anchorag	ges and couplers	immediately after	anchor set:	189	ksi	189	ksi				
it service limit state after losses: Compute Values Compute Values	lsewhere a	long length of m	nember immediatel	ly after anchor set:	199.8	ksi	201.69	ksi				
	At service lir	mit state after lo:	sses: Comp	ute Values	194.4	ksi	194.4	ksi				

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

Cross Section Ranges

Double click on the **Cross Section Range Properties** node in the **BWS** tree and assign the cross sections as shown below.

	Start see	ction	Er	nd sectio	n	Depth vary		Solid section	Sup	oport mber	Start distance (ft)	Length (ft)	End distance (ft)			
>	Section 1	~	Sectio	n 1	~	None	\sim		1	~	0	1	1			
	Section 1	\sim	Sectio	n 2	~	Parabolic Concave	\sim		1	~	1	107.5	108.5			
	Section 2	~	Sectio	n 2	~	None	\sim		1	\sim	108.5	6	114.5			
	Section 2	~	Sectio	n 1	~	Parabolic Concave	\sim		2	\sim	3	107.5	110.5			
	Continue 1	~	Section	n 1	~	None	~		2	~	110.5	1	111 5			
	Section 1		Section		-				2	-	110.3			_	~	
ros	s Section 1	ges Post ter	nsioning	Effec	ctive su	pports			-				····-		-	
ros ros Post	is Section T	rges Post ter es: Lump ments	nsioning p Sum Lo	Effec	ctive su	pports							·····	-		
ros Post	is Section Ran is sections t tension losse endon assign Tendon	iges Post ter es: Lump ments profile	nsioning p Sum Lo Start span	Effect osses Start dis into star (ft	ctive su stance rt span)	pports	nce pan							-		

Effective supports allow to shift the specification check point at the centerline of the support to the location entered below. Shear will be checked at a distance dv from the location entered below.

A	Cro	ss Sectio	on Ranges		_		×
	Cro	ss sectio	ns Post	tensioning	Effective supports		
		Span	From start (in)	From end (in)			
	>	1		36		-	ň.
		2	36				



Schematic – Cross Section Range Properties

Select **Cross Section Range Properties** node in the **BWS** tree and click the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) as shown below.

Bridge Workspace - MultiCell Box Ex	amples	ANALYSIS	REPORTS	?	— C	ı x
BRIDGE WORKSPACE TO	OLS VIEW	DESIGN/RATE	REPORTING		_	
 Check Out Check In Validate Save Revert 	Close Export R	Copen	New Copy	Paste Duplicate	Delete Sch	ematic
Bridge			Ma	nage		
Workspace	s> ×	Schematic	\$	X Report		x x
The product of t	ice 🧍	Analysis				\$ ×
Cross Section Range Propertie Structure Typical Section H Framing Plan Detail L Superstructure Loads Shrinkage Time Supports Slab Reinforcement blst. Live Load Distribution Points of Interest	S Copen Analyze S View Sumr Q View Detai Schematic General Pr Close Bridg	mary Report iled Report eferences ge Workspace				

MCB Cross Section Ranges				- 🗆 X
🗈 🖹 🕄 🔍 🕂 🔁 🔂 🖂 🗾 🗸				÷
MultiCol Base Services MultiCol Base Jane John (PT MCB Controllion)				
	preyers			
Bestimph.	11 F	•	11.0	

Structure Typical Section – Deck tab

Double click on the **Structure Typical Section** node in the **BWS** tree and locate the superstructure definition



Structure Typical Section – Deck (cont'd) tab

Enter the following data for the **Structural overlay density and thickness**. The overlay is applied in the self load DC load case.

🕰 Structure Typical Section - Segment 1					_	×
Distance from left edge of deck to superstructure definition ref. line Superstructure De	finition /	1				
Deck Deck (cont'd) Parapet Median	Railing Ge	eneric Sidewalk Lane position	Striped lanes	Wearing surface		
Sacrificial wear thickness:	in	Structural overlay density:	0.14	kcf		
Top slab crack control parameter	kip/in	Structural overlay thickness:	1	in		
Sustained modular ratio factor:		Bottom slab crack control parameter:		kip/in		
Top slab exposure factor:		Bottom slab exposure factor:				
Inside void slab crack control parameter:	kip/in	Inside void slab exposure factor:				
	And the		ر به به	and a straight the		

Structure Typical Section – Generic tab

Enter the barriers.

Structure	Typical Section - Segment 1							_	
	Generic S	hape							
sk	Front								
	I								
Deck [Deck (cont'd) Parapet	Median	Railing Ge	eneric Sidewal	k Lane pos	sition Strip	ed lanes V	Wearing surface	
	Name	Load case	Measure to	Edge of deck	Distance at	Distance at	Front face		
		LUGU COSE	incusure to	from	(ft)	end (ft)	orientation		
> 12" E	Barrier ~	DC1 V	Back V	from	(ft)	end (ft) 0	orientation		-

Structure Typical Section – Lane position tab

Use the **Compute** button to enter the following lane positions then click **OK** to apply the data and close the window.

A Structure Typical Section - Segment 1	_		×
(A) (A) Travelway 1 Travelway 2 Travelway 1 Travelway 2 Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface			
Travelway numberDistance from left edge of travelway to superstructure definition reference line at start (A) (ft)Distance from right edge of travelway to superstructure definition reference line at start (B) (ft)Distance from right edge of travelway to superstructure definition reference line at start (B) (ft)Distance from right edge of travelway to superstructure definition reference line at end (A)Distance from right edge of travelway to superstructure definition reference line at end (A)			
> 1 -14 14 -14 14			
LRFD fatigue Lanes available to trucks: OverrideTruck fraction: OK A	cate Apply	Uelete Cancel	

Structure Typical Section - Schematic

The **Schematic** for the **Structure Typical Section** will appear as follows. The webs are not visible in the schematic because the cross section at the start of the structure was marked as 'Solid'.

Schematic	– 🗆 X
Bridge Typical Section	$\sim \times$
🗄 🗈 Q Q 🕂 🗃 🗟 🛏 80% 🗸 🗸	÷
MultiCell Box Examples Multi Cell Box Examples - PT MCB 3/25/2014	
28'-0"	
Travelway 1	
	-

Framing Plan Detail – Interior diaphragms tab

Enter the following diaphragm locations on the **Framing Plan Detail** window. The diaphragms only contribute to the dead load on the structure. They do not provide a structural role in the box analysis. Enter the **diaphragm thickness** and the AASHTO engine will compute diaphragm load based on the box cross section properties and diaphragm thickness.

A 9	Struc	ture Frami	ng Plan Det	ails							_		×
Nu	mbe	er of spans:	2										
L	.ayo	ut Inter	ior diaphra	gms									
		Stagger pe	erpendicula	r diaphragms									
		Span number	Start distance (ft)	Diaphragm spacing (ft)	Number of spaces	Length (ft)	End distance (ft)	Diaphragm thickness (in)	Diaphragm Ioad (kip)				
	>	1 ~	0	55.75	1	55.75	55.75	12					
		2 ~	0	55.75	1	55.75	55.75	12					
										Jan Jan J		 _	

Framing Plan Detail - Schematic

With **Framing Plan Details** node selected in the **BWS** tree, click on the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) to view the framing plan.

Frami	ng Plan						– o ×
Malificati Ras Malificati Ras Torrescos	Langle FIES						Ŧ
		HTMP			me.		
5			60 E	Yerre		110	7
12.12			in the second se			10	

Slab Reinforcement

Open the **Slab Reinforcement** window and enter the following reinforcement in the **Cells-top slab** and **Cellsbottom slab** of the box.

A	Sla	Reinforcement															-		×
1	ype:	Multi Cell Box																	
ſ	Tra	sverse reference lines	Cells-top slab	ells-bottom slab	Overhangs	;													
		Cell	Material	Reference point	Direction	Start distance (ft)	Length (ft)	End distance (ft)	Number of bars	Number bars for left web	Bar size	Clear cover (in)	Measured from	Bar spacing (in)	Side cover (in)	Start fully developed	End fully develope	d	
		1 ~	Grade 60 🗸 🗸	Support 1 🛛 🗠	Left 🗸	0	223	223	4	2	8 ~	2	Top of Slab \sim				 		
		an seal a		من الد				j		<u> </u>			and and a second				<u> </u>		

A :	lab	Reinforcement															-		Х
Тур	e:	Multi Cell Box																	
	frans	overse reference lines	Cells-top slab	ells-bottom slab	Overhangs	5													
		Cell	Material	Reference point	Direction	Start distance (ft)	Length (ft)	End distance (ft)	Number of bars	Number bars for left web	Bar size	Clear cover (in)	Measured from	Bar spacing (in)	Side cover (in)	Start fully developed	End fully developed	ł	
	>	1 ~	Grade 60 🗸 🗸	Support 1 V	Left 🗸	0	223	223	4	2	8 ~	2	Bottom of Slab \sim			\checkmark	\checkmark	1	
			and granted	~	p					,			and a second					-	

Live Load Distribution

Full beam multicell box live load distribution factors is the sum of each web live load distribution factors. If user has entered the live load distribution factors for each web, the beam distribution factors will be the sum of the user entered distribution factors.

If the web distribution factors are empty, each web distribution factors are computed and the sum of all the web distribution factors are used as the beam distribution factors.

If both beam and web distribution factors are not entered or computed, the program computes the distribution factors during the analysis.

Stondord live	a load a	distribution	footomo fo	a ontino	harman	uning the	Commute	fmom 4		contion	hutton
Siandard IIV	елоастс	IISTIDUTION	Tactors to	or entire	реанн	using me	Compute	тгош і	voicar	section	DUITOIT
Station of the	• 1044 •		1000010 10			abing the	00000000000				0 000011

ve L	.oad Distribu	tion								
and	lard LRF)								
Di	istribution fa	ctor inpu	ut method -							
0	Use simp	lified me	ethod	Use adva	anced method	Computed date:				
_						·				
	Allow distrib	ution fac	ctors to be u	used to com	npute effects of	permit loads with rout	ine traffic			
			Distrib	ution factor	r					
	Lanes loaded		(W	vheels)						
		Shear	supports	Moment	Deflection					
>	1 Lane									1
	Multi-lane									
Cor typ	mpute from vical section		View calcs							Ŧ

🕰 Live Load Distribution _ \times Standard LRFD Distribution factor input method Use simplified method Use advanced method Computed date: 12/20/2023 10:53:58 Allow distribution factors to be used to compute effects of permit loads with routine traffic Distribution factor (wheels) Lanes loaded Shear at Shear Moment Deflection supports > 1 Lane 4.1000744 4.6513754 4.1000744 2 Multi-lane 5.467465 4 4.3065476 4.3065476

The computed Live Load Distribution window is shown below.

Vertical Shear Reinforcement Definitions

Create the following stirrup definition.

🕰 Shear	Reinforcement Definition - Vert	ical			_		×
Name:	#5 Stirrup]					
		Material: Bar size:	Grade 60			~	
	Vertical	Number of legs: Inclination (alpha):	2 90	Degrees			
	Reinforceme	nt					
				ОК Ар	pply	Cance	el

WEB1 – Shear Reinforcement Ranges

Expand **WEBS** folder -> **WEB1** and double click on the **Shear Reinforcement Ranges** node. Select the input reference type as **Centerline bearings**. Click the **Stirrup wizard** button and enter the following data.

stance	t	Maxim	um interior	Spacing Right Start						
Noi	eference type oids Cen	terline bearing Maxim	as um interior	spacing: 18 in	Mea	sured from rid	aht end	ofspan		
Start d	distance: 15	in			Sta	rt distance:	39	in		
	Name	Number of spaces	Spacing (in)			Name	N	lumber of spaces	Spacing (in)	
> #	#5 Stirrup 🛛 🖂	12	6	A	>	#5 Stirrup	~	18	5	A
#!	#5 Stirrup 🛛 🗠	12	9			#5 Stirrup	~	18	7	
#!	#5 Stirrup 🛛 🗡	12	14			#5 Stirrup	~	24	9	
				New Duplicate Delete						New Duplicate Delete

Select Span 2 in the Wizard and enter the following data followed by clicking Apply span.

eft St	tart	Maxim	um interior	Spacing	Right Start Distance						
in:	Voids Cer	nterline bearing Maxim	gs um interior	spacing: 18 in				-			
Star	isured from left end int distance: 39	d of span in				Star	t distance:	ignt e 15	nd of span		
	Name	Number of spaces	Spacing (in)				Name		Number of spaces	Spacing (in)	
>	#5 Stirrup 🛛 🗠	18	5		▲	>	#5 Stirrup	\sim	12	6	A
	#5 Stirrup ∨	18	7				#5 Stirrup	~	12	9	
	- Soundp										
				New Duplicate	Delete						New Duplicate Delete

Click the Apply all button to create the stirrup ranges for each span as shown below.

Span 1 will show the following data.

🕰 We	b Shear Reinforceme	ent Ranges -	WEB1				- 🗆 X
Sta Dist	artSpacing →					<	
Spa	voids O Ce an ranges	enterline be	arings		Linke	d with: Non	ne V
SI	pan: 1 v Name	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)	
	#5 Stirrup 🗸	1.25	1	0	0	1.25	A
	#5 Stirrup 🗸	1.25	12	6	6	7.25	
	#5 Stirrup 🗸	7.25	12	9	9	16.25	
	#5 Stirrup 🗸	16.25	12	14	14	30.25	
	#5 Stirrup 🗸	30.25	13	18	19.5	49.75	
	#5 Stirrup 🗸	49.75	1	18	1.5	51.25	
	#5 Stirrup 🗸	51.25	14	18	21	72.25	
	#5 Stirrup 🛛 🗸	72.25	24	9	18	90.25	
	#5 Stirrup 🛛 🗠	90.25	18	7	10.5	100.75	
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							OK Apply Cancel

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

WEB2 – Shear Reinforcement Ranges

Expand the **WEB2** folder and double click on the **Shear Reinforcement Ranges** node. Select **WEB1** in the **Linked** with field. The data from **WEB1** will appear in this window as read only. If data is changed in the **WEB1 Shear Reinforcement Ranges** window in the future, those changes will be reflected in this window. Do the same for **WEB3**, linking it to **WEB1**.

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>	#5 Stirrup 🛛 🗠	29.25	13	18	19.5	48.75					
	#5 Stirrup 🛛 🗠	48.75	1	18	1.5	50.25					
	#5 Stirrup 🛛 🗠	50.25	14	18	21	71.25					
	#5 Stirrup 🛛 🗠	71.25	24	9	18	89.25					
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Click **OK** to apply the changes and close the window.

LFR Analysis and Results

To run an LFR analysis on the **PT MCB** superstructure definition, click on the **Analysis Settings** window from the **Analysis** group of the **DESIGN/RATE** ribbon.

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Click on the Open template button in the Analysis Settings window, select the HS 20 LFR Rating from the

analysis templates and click **Open**.

n , (Open Template					
	Templates	Description	Analysis	Owner	Public / Private	
	HL 93 Design Review	HL 93 Design Review	LRFD		Public	L
>	HS 20 LFR Rating	HS 20 LFR Rating	LFR		Public	
	LRFR Design Load Rating	LRFR Design Load Rating	LRFR		Public	Γ
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ne / Impact loading type: As Requested	 Apply preference 	Apply preference setting: None							
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The updated Analysis Settings window is shown below.

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

With **PT MCB** superstructure selected in the **BWS** tree, click on the **Analyze** button from the **Analysis** group of the **DESIGN/RATE** ribbon.

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Tabular Results

The full multicell box width is analyzed for flexure and shear and then each webline is analyzed for shear. Once the analysis is complete, click on the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon. The **Analysis Results** window shows the critical rating factors considering the full box and each webline.

Bridge Worksp	ace - MultiCell Box Example	s	ANALYSIS	REPORTS	?	_	×
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HS 20-44	Axle Load	LFR	Inventory	4.40	0.122	114.50	2 - (2.7)	WEB3	Design Shear - Concrete	As Requested	As Requested			
HS 20-44	Axle Load	LFR	Operating	8.36	0.232	114.50	2 - (2.7)	WEB3	Design Shear - Concrete	As Requested	As Requested			
HS 20-44	Lane	LFR	Inventory	12.82	0.356	114.50	2 - (2.7)	WEB3	Design Shear - Concrete	As Requested	As Requested			
HS 20-44	Lane	LFR	Operating	17.59	0.489	114.50	2 - (2.7)	WEB3	Design Shear - Concrete	As Requested	As Requested			
AASHTO LFR Er Analysis prefere	ngine Version ence setting:	n 7.5.0.3001 None												₽
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Specification Check Detail

Select the **Specification Check Detail** button from the **Results** group of the **DESIGN/RATE** ribbon for the full box and each webline Spec check details.



