

Practice Workbook

This workbook is designed for use in Live instructor-led training and for OnDemand selfstudy. The explanations and demonstrations are provided by the instructor in the classroom, or in the OnDemand eLectures of this course available on the Bentley LEARN Server (*learn.bentley.com*).

This practice workbook is formatted for on-screen viewing using a PDF reader. It is also available as a PDF document in the dataset for this course.

Steel Girder Bridge Modeling for OpenRoads Designers

This workbook contains exercises to walk a designer through the process of quickly modeling a steel girder bridge using LEAP Bridge Steel.

Bentley Institute

TRNC01367-1/0001

Description and Objectives

Course Description

This workbook contains exercises for modeling a 3 span curved steel girder bridge.

Skills Taught

- Import data for the horizontal and vertical alignments and/or 3D DTM.
- Set the pier line locations.
- Model the girders and cross frames
- Create a 3D MicroStation drawing of the bridge model.

Import Geometry from Bentley Civil products

In this exercise we will import a chain and profile from one of the Bentley Civil products.

- 1. Start LEAP Bridge Steel.
- 2. Select the Import from Civil tool.

Import from Civil												<u> </u>
Open Civil file(s)	Alignments (in file):		Alignments (selected):		Show:	Alignm	nent	Profile	DTM			Export 🖊
						No.		Alignment	t	Profile	Min Stat	tion Max Station
		_		X								
		22		X								
		2		x		en 0	0 0	4 + 9°	Ri 🖬			
						0 0		· → · + •				Ŧ
	Profiles (in file):		Profiles (selected):									
		_		x								
		> ->		X								
		->		X								
	DTMs (in file):		DTMs (selected):	2								
			,	x								
		~ ~		X								
Import selected elements		2		x	Ident	ify elen	nent				🔒 Warning	gs - Click Here 🔻

3. Click on **Open Civil file(s)**.

Name	Date modified	Туре	Size
301.alg	12/21/2011 12:57 PM	ALG File	364 KB
📄 301-195 Int imp.tin	11/5/2012 11:11 AM	TIN File	1,242 KB
job301.gpk	10/28/2013 11:11 AM	GPK File	170 KB

4. Select the GPK or ALG file from the class folder.

~ ~ ~

- 5. Highlight the file name in the Import from Civil window to see a list of the alignments and profiles.
- Move alignment US301 and profile US301FP to the right.



- 7. Select the alignment and profile by clicking the box to the left of each one.
- 8. Select the profile name as shown below.

	No.	Alignment	Profile	Min Station	Max Station
•	1	US301	US301FP	98+00.0000	223+11.3880
1000					

9. Select Import Selected Elements.

Review Geometry and Define Roadway

This exercise will review the imported geometry as well as define a roadway for the structure. A roadway in LEAP terminology is the combination of an alignment, profile and cross section to define the bridge location.

- 1. Select Alignments.
- 2. Select each alignment from the List window to review the geometry. Fit the view if necessary.

List:	
ALG01	
US301	

- 3. Select Cancel to close the Alignments dialog.
- 4. Select Profiles.
- 5. Select each profile from the List window to review the geometry. Fit the view if necessary.

List	
PROFO	1
US301F	P

- 6. Change the **Drawing scale** to 20:1.
- 7. Select Cancel to close the Profiles dialog.
- 8. Select Cross Sections.

9. Change the Width of each plane to 31.0 and the Vertical % to 4.080.

List: 🔟 🔀	Template:	🔶 Add	Static	on:	F	PG Offset:	PG Noc	le: Plane	-	Add	
XSECT01	TMPL 0	🔹 🔀 Delete	0+00	0.0000	ft	0.0000	ft 2	루 Ir	isert 🔀 🕻	Delete	Export
	Plane	Width Type	e	W	Vidth (ft)		Vertic	al Type	V	ertical (%)	
	▶ 1	Distance				31.0000	Slope				4.08
	2	Distance				31.0000	Slope				4.080
	₹ 8 5	- 9, 81 🖬			2			Type word	s to search for		ة <mark>ب م</mark>
	\ 0 4	- <u>\$</u> <u>8</u> =			6		2 PG	Type word	s to search for	4.080	₽ - : %
	N O S	• 8 B 🕀	4.080	%	3		2 PG	Type word	s to search for	4.080	₽ ▼ 3
	t 0 43	- <u>8</u> <u>8</u> <u></u>	4.080	% 0 ft			2 PG	Type word	s to search for	4.080	₽ - : % 0 ft

- 10. Select **OK** to accept the changes.
- 11. Select Roadways.
- 12. Change the default roadway definition to use the imported alignment and profile.

	No.	Name	Show	Alignment	Profile	Cross Section	Min Station	Max Station
)	. 1	RDWY01	Yes	US301 🗸	US301FP	XSECT01	98+00.0000	223+11.3880

- 13. Select **OK** to accept the changes.
- 14. Select the Save icon to save the work completed. Place the file in the training folder. Name the file 3 span I girder.lbs.



Define the Support Locations and Deck Slab

In this exercise we will use the Pier/Abutment Locations and Deck Slab tools to model the deck. The bridge is a 2 span continuous structure with spans of 90' each.

- 1. Continue in the file 3 span I girder. Ibs created in the previous exercise.
- 2. Select Pier/Abutment Locations.
- 3. Select Add Support. Set the Station to 191+42.67 and the Skew to -15.63.
- 4. Select Add Support to add the next support.
 - a. Set the Input Method to Station.
 - b. Set the Station value to 192+00.10 and the Skew to -14.77.

	No.	Туре	Name	Input Method	Station/ Distance (ft)	Skew/ Bearing	Bearing Line 1	Bearing Line 1 Offset (in)	Bearing Line 2	Bearing Line 2 Offset (in)
•	1	Pier 🗸	Support 01	Station 🗸	191+42.6700	SKEW -15 37 48.00	No	-6.0000	Yes 👻	6.0000
	2	Pier 🗸	Support 02	Station 🗸	192+00.1000	SKEW -14 46 12.00	Yes 👻	-6.0000	No	6.0000

- 5. Select Add Support for the next pier.
 - a. Set the Input Method to Station.
 - b. Set the Station value to 192+87.10 and the Skew to -13.46.

	No.	Туре	Name	Input Method	Station/ Distance (ft)	Skew/ Bearing	Bearing Line 1	Bearing Line 1 Offset (in)	Bearing Line 2	Bearing Line 2 Offset (in)
•	1	Pier 🗸	Support 01	Station 🗸	191+42.6700	SKEW -15 37 48.00	No	-6.0000	Yes 👻	6.0000
	2	Pier 🗸	Support 02	Station 🗸	192+00.1000	SKEW -14 46 12.00	Yes 👻	-6.0000	No	6.0000
	3	Pier 🗸	Support 03	Station 👻	192+87.1000	SKEW -13 27 36.00	Yes 👻	-6.0000	No	6.0000

- 6. Select Add Support for the end abutment.
 - a. Set the Input Method to Station.

b. Set the Station value to 193+44.53 and the Skew to -12.60.

	No.	Туре		Name	Input Method		Station/ Distance (ft)	Skew/ Bearing	Bearing Line 1	Bearing Line 1 Offset (in)	Bearing Line 2	Bearing Line 2 Offset (in)
•	1	Pier	•	Support 01	Station	-	191+42.6700	SKEW -15 37 48.00	No	-6.0000	Yes 👻	6.0000
	2	Pier	-	Support 02	Station	-	192+00.1000	SKEW -14 46 12.00	Yes 👻	-6.0000	No	6.0000
	3	Pier	•	Support 03	Station	-	192+87.1000	SKEW -13 27 36.00	Yes 👻	-6.0000	No	6.0000
	4	Pier	-	Support 04	Station	-	193+44.5300	SKEW -12 36 00.00	Yes 👻	-6.0000	No	6.0000

7. Change support 1 and 4to a **Type** of *Abutment*.

	No.	Туре		Name	Input Method		Station/ Distance (ft)	Skew/ Bearing	Bearing Line 1	Bearing Line 1 Offset (in)	Bearing Line 2	Bearing Line 2 Offset (in)
•	1	Abutment	-	Support 01	Station	-	191+42.6700	SKEW -15 37 48.00	No	-6.0000	Yes 👻	6.0000
_	2	Pier	-	Support 02	Station	-	192+00.1000	SKEW -14 46 12.00	Yes 🗸	-6.0000	No	6.0000
	3	Pier	-	Support 03	Station	-	192+87.1000	SKEW -13 27 36.00	Yes 🗸	-6.0000	No	6.0000
	4	Abutment	-	Support 04	Station	-	193+44.5300	SKEW -12 36 00.00	Yes 🗸	-6.0000	No	6.0000

- 8. Select **OK** to accept.
- 9. Select Deck Slab.
 - a. Set the Deck thickness, Haunch thickness and Sacrificial Wearing Surface thickness as shown.

Deck thickness:	8.5000	in	Haunch thickness:	2.0000	in
Sacrificial Wearing Surface:	0.5000	in			

b. Select **Deck Generator > Pier to Pier Slabs**. This will add 3 slabs total.

	No.	Name	Material	Reference Back	Reference Method	Offset/Station (ft)	Reference Ahead	Reference Method	Offset/Station (ft)
•	1	Slab 01	CIA 👻	Support 01 🗸 🗸	Perpendicular to Support 🚽	• 0.0000	Support 02 🗸	Perpendicular to Support 🛛 🖵	0.0000
	2	Slab 02	CIA 🚽	Support 02 🗸 🗸	Perpendicular to Support	0.0000	Support 03 🗸	Perpendicular to Support 🛛 👻	0.0000
	3	Slab 03	CIA 👻	Support 03 🗸 🗸	Perpendicular to Support	0.0000	Support 04 🗸	Perpendicular to Support 🛛 👻	0.0000

c. Select **OK** to accept the final deck arrangement.



10. A 3D model of the deck will be generated.



Set Girder Locations and Define Girder Member

This exercise will set the location of the girders as well as define the girder members.

1. Select Member Groups.

- a. From the List window, select the icon to create a new member group.
 - b. Set the **Back reference** to Support 01 and the Ahead reference to Support 04.
 - c. Set the Number of members to 7.
 - d. Set the Left Fascia Member > Offset to 3.5.
 - e. Set the Right Fascia Member > Offset to 3.5.



- f. Select **OK** to accept the Member Group definition.
- 2. Select Member Definition.

a. Set the **Beam Elements** to *Web* and select **Add**. Add the first web element.

1	Member Definition	on															
	Group01 -]				Fracture	Critical	Reset	Copy member def	Flange t	Flange thickness multiplier: 8 Export						
	Members:					Beam Elem	ents: Web		▼ Add		🦸 Insert 🔰	Delete		0.0000 ft 🖌			
	Member 01 Member 02	Г	No.	Ref. Span	Start (ft)	Start/ Span L	Length (x) (ft)	x/ Span L	Material		Thickness (in)	Start Height (in)	Variation	End Height (in)	Location Bot. (in)	Location Top (in)	
	Member 03		1	1 🗸	0.0000	0.0000	57.0165	1.0000	Grade 50W	-	0.5000	48.0000	None 👻	48.0000	0.0000	0.0000	

b. Add the remaining Web elements.

ſ		No.	No. Ref. Span			Start (ft)	Start/ Span L	Length (x) (ft)	x/ Span L	Material	Thi	ckness (in)	Start Height (in)	Variation		End Height (in)	Location Bot. (in)	Location Top (in)
		1	1	•	-	0.0000	0.0000	57.0165	1.0000	Grade 50W 🚽	0.	5000	48.0000	None	-	48.0000	0.0000	0.0000
-		2	2		-	0.0000	0.0000	86.3736	1.0000	Grade 50W 🚽	0.	5000	48.0000	None	-	48.0000	0.0000	0.0000
	•	3	3		-	0.0000	0.0000	57.0165	1.0000	Grade 50W 🚽	0.	5000	48.0000	None	-	48.0000	0.0000	0.0000

c. Set the **Beam Elements** to *Top Flange* and select **Add**. Add all 3 Top Flange elements to the table.

	No.	Re Spa	ef. en	Start (ft)	Start/ Span L	Length (x) (ft)	x/ Span L	Material		Thickness (in)	Start Width (in)	Variatio	on	End Width (in)	Web Offset (in)
	1	1	-	0.0000	0.0000	57.0165	1.0000	Grade 50W	-	1.0000	18.0000	None	-	18.0000	0.0000
	2	2	-	0.0000	0.0000	86.3736	1.0000	Grade 50W	-	1.0000	18.0000	None	-	18.0000	0.0000
•	3	3	-	0.0000	0.0000	57.0165	1.0000	Grade 50W	-	1.0000	18.0000	None	-	18.0000	0.0000

d. Set the **Beam Elements** to *Bottom Flange* and select **Add**. Add all 3 Bottom Flange elements to the table.

Γ	No	lo. Ref. Span		Start (ft)	Start/ Span L	Length (x) (ft)	x/ Span L	Material		Thickness (in)	Start Width (in)	Variation	n	End Width (in)	Web Offset (in)
	1		1 👻	0.0000	0.0000	57.0165	1.0000	Grade 50W	-	1.2500	20.0000	None	•	20.0000	0.0000
	2		2 🗸	0.0000	0.0000	86.3736	1.0000	Grade 50W	-	1.2500	20.0000	None	-	20.0000	0.0000
	> 3		3 🗸	0.0000	0.0000	57.0165	1.0000	Grade 50W	-	1.2500	20.0000	None	-	20.0000	0.0000

e. Select Copy member definition to ... > Group 1 > All Members.

- f. Select **OK** to accept the current member definition.
- 3. This will update the 3D model to include the girders, abutments and piers.

Define Cross Frames and Set Cross Frame Locations

This exercise will set the location of the cross frames as well as define the cross frame members.

1. Select Standard Sections List.

- a. Select Angle from the first column.
- b. Select *L40405* from the second column.
- c. Select Add.

American American American American American American American American American Bornal American	L40304 L40354 L40404 L40404 L40355 L40355 L40355 L40356 L40405 L40406 L40406 L40406 L40407 L40357 L40357 L40308 L40407 L40358 L40407 L40358 L40408 L404010 L404510 L404012 L50354 L50305 L50355 L50306		Add Remove	
	L50356	-	Identify element	

d. Select OK.

2. Select Cross-Frame/Diaphragm Definition.

- a. Select New icon to create a new cross frame.
- b. Change the Frame Type to Frame Inverted V.
- c. Set the **Top Strut** and **Bottom Strut** values as shown.

Export 🔑	💽 🖲 👍 🗸 🖓 🕅 🖾 🖂 🗠 🚵		Property	Value	
Member options		Ŧ	Top Strut		
_			Enabled	Yes	
ame Type:			Top Left Distance (in)	4.000000	
ame Invertec 🔻	an average and the sector sector sector sector being the sector	12	Top Right Distance	4.000000	
			Begin Offset (in)	0.000000	
st: 🔟 👗		1.5	End Offset (in)	0.000000	
FD01		1	Section	L40405	
			Material	Grade 50W	
			Center Line Reference	Тор	
			Vertical orientation	Long leg vertical	
			Horizontal orientation	Top leg forward	
			Bottom Strut		
			Enabled	Yes	
			Bottom Left Distance (in)	4.000000	
			Bottom Right Distance (in)	4.000000	
		-	Begin Offset (in)	0.000000	
		-	End Offset (in)	0.000000	
			Section	L40405	
			Material	Grade 50W	
			Center Line Reference	Bottom	
	the local data in the team team team team team team team tea		Vertical orientation	Long leg vertical	
	a ser ser er biller ser ser ser ser ser ser ser re i ser ser se	- 25	Horizontal orientation	Top leg forward	
	The part per a relation relation relation relation relation relation relation	•			
ОК	The most more in the term term term the term term term term term term term				

d. Set the Left Diagonal and Right Diagonal values as shown.

Export 📈			Property	Value
lember options		Ŧ	Horizontal orientation	Top leg forward
, chied op done			Left Diagonal	
me Type:			Bottom Left Distance (in)	4.000000
me Invertec 🔻	of that that is the test test test to test test test test	80.8	Top Right Distance (in)	0.000000
			Begin Offset (in)	0.000000
: 🖾 🔀			End Offset (in)	2.000000
D01	of that that is to from their term to from their term to the from term	89.8	Section	L40405
	[10] BORA DELLA AL ANY AND ANTAL AND AND AND AN AND AND AND AND AND AND		Material	Grade 50W
		_	Center Line Reference	Тор
		- C	Vertical orientation	Long leg vertical
	the second s		Horizontal orientation	Top leg forward
	la service de la construcción de la	1	Right Diagonal	
			Top Left Distance (in)	0.000000
			Bottom Right Distance (in)	4.000000
			Begin Offset (in)	2.000000
			End Offset (in)	0.000000
	la terreta en la constante de ser ser ser ser ser ser ser ser ser se		Section	L40405
			Material	Grade 50W
			Center Line Reference	Тор
	2 01 01 0 1 10 10 10 10 10 10 10 10 10 10 10 10 1 10 10 10 10 10		Vertical orientation	Long leg vertical
		0.00	Horizontal orientation	Top leg forward
	an the the set of the set of the test		Pagin Offset (in)	
ОК			Begin Offset (in)	

- e. Select **OK** to accept the changes.
- 3. Select Cross-Frame/Diaphragm Locations.
 - a. Select Locations Wizard.

b. Populate as shown to create all cross frames.



- c. Select Generate to set the cross frame locations.
- d. Select **OK** to accept the changes.
- e. Review the updated 3D model.

4. Select Appurtenance Locations.

a. With the appurtenance type set to Parapet, select Add twice. This will add a parapet along both edges of the slab.

	No.	Appurtenance Name	Reference Element	Reference Reference Reference Reference Offset Element Offset (it) Location Back Method Offset		Offset (ft)	Reference Ahead	Reference Method	Offset (ft)		
1	1	Parapet 01 🛛 👻	Left edge of slab 🛛 👻	0.0000	Outside face 🛛 👻	Support 01 🗸 👻	Along alignment 🛛 🗸	0.0000	Support 04 🛛 👻	Along alignment 🛛 👻	0.0000
)	2	Parapet 01 🗸 🗸	Right egde of slab 🚽	0.0000	Outside face 🛛 🗸	Support 01 🚽	Along alignment 🚽	0.0000	Support 04 🚽	Along alignment 🚽	0.0000

b. Select **OK** to accept the parapet definition.



5. Select the Save icon to save the work completed.



Create a 3D Drawing of the Bridge

These steps will walk you through exporting the 3D model from LEAP Bridge to create a 3D drawing of the proposed bridge design.

1. Select Export DGN.





- 2. Type in a file name of *RR Crossing*.
- 3. Select Save.
- 4. Select **Yes** upon being prompted to browse the file location.
- 5. Open the resulting file with MicroStation to review the bridge model.
- 6. Attach as a reference the file 3D_Road_Components ref.dgn and bridge01.dgn. Review the bridges relative to the surrounding 3D road.