







Section A-A



Section B-B

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

RC6 – Two Span Reinforced Concrete Slab System Example

Topics Covered

Part 1: Reinforced concrete slab system input. Slab is not integral with pier.

- Schedule based input of slab strip.
- Slab depth varies parabolically over the pier.

Part 2: Frame structure simplified definition slab structure type.

Part 1: Reinforced concrete slab system input. Slab is not integral with pier.

From the Bridge Explorer, select File/New/New Bridge from the menu to create a new bridge and enter the following description data.

🕰 2SpanRCSIab	
Bridge ID: 25panRCSI Description Descripti	ab NBI Structure ID (8): 2SpanRCSIab □ Template ▼ Superstructures Image: Superstructures Image: Superstructures Image: Superstructures Image: Superstructures
Name:	2SpanRCSIab Year Built
Description:	
Location:	Length: ft
Facility Carried (7):	Route Number:
Feat. Intersected (6):	Mi. Post:
Default Units:	US Customary
BridgeWare Associati	on I BrDR I BrD BrM OK Apply Cancel

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

To enter the materials to be used by members of the bridge, 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 File/New from the menu (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.

Name	Description	Library	Units	fc	fci	alpha	DL Density	Modulus Density	Modulus of Elasticity	Poisson's Ratio	Modulus of Rupture
Class A	Class A cement	Standar	SI/Me	28.00		0.000	2400.0	2320.00	25426.08	0.200	3.33
Class A (US)	Class A cement	Standar	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480
Class B	Class B cement	Standar	SI/Me	17.00		0.000	2400.0	2320.00	19811.84	0.200	2.60
Class B (US)	Class B cement	Standar	US Cu	2.400		0.000	0.150	0.145	2822.75	0.200	0.372
Class C	Class C cement	Standar	SI/Me	28.00		0.000	2400.0	2320.00	25426.08	0.200	3.33
Class C (US)	Class C cement	Standar	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480
										Apply	Cance

Select the Class A (US) material and click Ok. The selected material properties are copied to the Bridge Materials - Concrete window as shown below.

🗛 Bridge Mate	erials - Concrete					- • ×
Name:	Class A (US)	Desc	cription:	Class A c	ement concrete	
	Compressive strength at 2	8 days (f'c) =	4.0000	006	ksi	
	Initial compressive str	rength (f'ci) =			ksi	
	Coefficient of thermal	0.0000	06	1/F		
	Density (for c	lead loads) =	0.15		kcf	
	Density (for modulus o	of elasticity) =	0.145		kcf	
	Modulus of ela	asticity (Ec) =	3644.1	49254	ksi	
	Initial modulus (of elasticity =			ksi	
	Poi	sson's ratio =	0.2			
	Composition o	f concrete =	Norma		•	
	Modulus of rupture =			574	ksi	
	S	hear factor =	1			
	Copy To Library Copy from Library OK Apply Cancel					

Click Ok to save the data to memory and close the window. Add the following reinforcement steel details in the same manner.

🗛 Bridge Materials - Reinforcing Steel					
Name: Grade 60	Desc	cription:	60 ksirein	nforcing steel	
	Material Proper	ties			
Specified y	ield strength (Fy) =	60.000	0087	ksi	
Modulus	of elasticity (Es) =	29000.	004206	ksi	
Littim	ate strength (Fu) =	90.000	0131	ksi	
	Type Plain Epoxy Galvanized Other				
Copy To Library	Copy from Libra	ary	ОК	Apply	Cancel



Also add parapet information in similar maner under Appurtenances.

We do not need to define any beam shapes since we are using a reinforced concrete slab. The slab details will be entered later when we define the strip profile.

The default impact factors, standard LRFD and LFD factors will be used so we will skip to superstructure definition. A bridge alternative will be added after we enter the superstructure definition.

Double-click on SUPERSTRUCTURE DEFINITIONS (or click on SUPERSTRUCTURE DEFINITIONS and select File/New from the menu or right mouse click on SUPERSTRUCTURE DEFINITIONS and select New from the popup menu) to create a new Superstructure definition.

New Superstructure Definition	X
Girder Sustem Superstructure	
Girder Line Superstructure	
 Floor System Superstructure 	
Floor Line Superstructure	
Truss System Superstructure	
Truss Line Superstructure	
Reinforced Concrete Slab System Superstructure	
	OK Cancel

Select Reinforced Concrete Slab System Superstructure, click Ok and the RC Slab System Superstructure Definition window will open.

🗛 RC Slab System Super	tructure Definition		
Definition Analysis Sp	ecs Engine		
Name:	Slab System		
Description:		*	
		~	
Default Units:	US Customary Enter Span Lengths Along the Reference		
Number of spans:	2 Line:		
Number of slab strips:	3 Span (ft) 1 30		
	2 30	Member Alt. Types	
		P/S	
		Timber	
		Slab Structure Type	inition
		 Slab integral with pier 	nidori
		 Slab not integral with pier 	
		Contains voids	
		OK Apply C	Cancel

In this superstructure definition, we will select Slab Structure Type as Slab not integral with pier. Number of spans is 2 and Number of slab strips is 3. We are going to set the width of the edge strips to 7.5 ft and the width of the interior strip to 12 ft. Enter the rest of the data as shown above and click on Ok to save the data to memory and close the window.

To enter a slab with voids, select Contains voids in the superstructure definition window which allows you to define void patterns and assign the patterns along the slab. For this example, we are going to define a solid slab so Contains voids should remain unchecked.

We now go back to the BRIDGE ALTERNATIVES and create a new Bridge Alternative, a new Superstructure, and a new Superstructure Alternative with the Slab System we just created as the superstructure definition.

The partially expanded Bridge Workspace tree is shown below.



Open Load Case Description window under Slab System superstructure definition to define the dead load case to be used by the parapets. The completed Load Case Description window is shown below.

Load Case Name	Description	Stage	Туре	Time* (Days)
Stage 1 DC DL	Parapets	Non-composite (Stage 1)	▼ D,DC	•
Prestressed membe	ers only Add Defaul	t Load		
	Case Descr	iptions	New Duplicate	Delete
			OK Apply	Cancel
F	Load Case Name Stage 1 DC DL	Load Case Name Description Stage 1 DC DL Parapets Prestressed members only Add Defaul Case Description Case Description	Load Case Name Description Stage Stage 1 DC DL Parapets Non-composite (Stage 1) Prestressed members only Add Default Load Case Descriptions	Load Case Name Description Stage Type Stage 1 DC DL Parapets Non-composite (Stage 1) D,DC Prestressed members only Add Default Load Case Descriptions New Duplicate

Open Structute Framing Plan Details window and enter data as shown below. Since we are going to set the width of the edge strips to 7.5 ft and the width of the interior strip to 12 ft, enter the CL Strip Spacing as 9.75 ft for both strip bays. Click on Ok to save data and close window.

A Structure Framing Plan Details	- • •
Number of spans = 2 Number of strips = 3	
Layout Support Stew (Degrees) 1 0 2 0 3 0 Strip Strip Spacing (ft) Bay Start of End of Strip 1 9.75 9.75 9.75	
ОК Арг	ly Cancel

🗛 Struct	ture Typical S	ection					- • •
	Half left strip width	Distance from le superstructure o	ft edge of de lefinition ref.	eck to ¦Dis line sup kan	tance from rig verstructure d Superstructu Reference Li	ght edge of decl lefinition ref. line re Definition ine ! ! CL St	k to
Deck Su Dis	Deck (Cont'o perstructure de stance from left	d) Parapet Me finition reference edge of deck to	ine is with	g Generic in Start ft	Sidewalk the brid	Lane Position Ige deck. End 5 ft	Wearing Surface
Dis	stance from righ perstructure del	it edge of deck to finition reference l	ne = 13.5	ft	13.	5 ft	
		Half left strip wi	dth = 3.75	ft	3.7	5 ft	
	Compute	d half right strip wi	dth = 3.75	ft	3.7	5 ft	
					C	ок	Apply Cancel

Now in Structure Typical Section window under Deck tab enter data as shown below.

Also enter Parapet and Lane Position details as shown below in their respective tabs. Then click on Ok to save and close the window.

🗛 s	Structure Typical S	ection							• 🗙
	Back Front								
	Name	Load Case	9	Measure To	Edge of Deck Dist. Measured From	Distance At Start (ft)	Distance At End (ft)	Front Face Orientation	
	Jersey Barrier 💌	Stage 1 DC DL	•	Back 💌	Left Edge 💌	0	0	Right 💌	
	Jersey Barrier 💌	Stage 1 DC DL	•	Back 💌	Right Edge 💌	0	0	Left 💌	
						New	Duplicate	Deleta	e

🕰 Structure Typ	pical Section			- • •			
(A) (B) Superstructure Definition Reference Line Travelway 1 Travelway 2							
Deck Deck	(Cont'd) Parapet Median F	ailing Generic Sidewalk L	ane Position Wearing Surface				
Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	stance From Left Edge of velway to Superstructure befinition Reference Line At Start (A) (ff) (ff) Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ff)		Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)			
1	-12	12	-12	12			
LRFD Fatigue Lanes available to trucks: Override Truck fraction: OK Apply Cancel							

Now select Structure Tyipical Section in the tree and click on View schematics button to open Schematic: Bridge Typical Cross Section View window as shown below. Since we haven't entered the slab strip profile, the slab strips are represented by dotted line boxes in the schematic.



Close the Schematic window and double-click on Bar Mark Definitions in the Bridge Workspace tree to create a new Bar Mark Definition. Enter data for BarMark #1 as shown below. Then click on Ok to save data and close the window. Create another Bar Mark Definition for BarMark #2 in the same manner.





Defining a Member Alternative:

Double-click MEMBER ALTERNATIVES in the tree under the interior strip S2 to create a new alternative. The New Member Alternative dialog shown below will open. Select Reinforced Concrete for the Material Type and Reinforced Concrete Slab for the Girder Type.

New Member Alternative	
Material Type:	Girder Type:
Reinforced Concrete	Reinforced Concrete Slab 🔹
	OK Cancel

Click Ok to close the dialog and create a new member alternative.

🗛 Member Alternative Description	
Member Alternative: Slab Strip S2	
Description Specs Factors Engine Import C	Control Options
Description:	Material Type: Reinforced Concrete
	Girder Type: Reinforced Concrete Slab
	✓ Default Units: US Customary ▼
Girder property input method Schedule based Cross-section based Right: 6) locations Edge beam in in
	Default rating method:
Additional Self Load	LFD •
Additional self load = kip/ft	Analusis Strip
Additional self load = %	 Full slab section width
	O User defined in
	OK Apply Cancel

The first Member Alternative that we create will automatically be assigned as the Existing and Current Member Alternative for this Member. In the Member Alternative Description window enter the data as shown above.

The Analysis Strip selection allows you to specify the width of the strip for the analysis. If User defined is selected, an average reinforcement area per user defined width will be computed based on the reinforcement defined for the full slab section width. For this example, we select Full slab section width.

The Edge beam selection indicates the member alternative is an edge beam in the LRFD live load distribution factors computation. Since we are entering the interior strip, leave Edge beam as unchecked.

Click Ok to save the data and close the window.

Live Load Distribution factors can be computed only after Strip Profile information is entered. To enter Strip Profile information, double-click on Strip Profile in the tree to open Strip Profile window.

Enter strip section and depth details as shown below.

🗛 s	🕰 Strip Profile										
Тур	Type: Reinforced Concrete Slab										
S	Section Depth Reinforcement										
	Sup Num	port iber	Start Distance (ft)	Length (ft)	End Distance (ft)	Start Width (in)	End Width (in)	Concrete Material	Modular Ratio		
	1	•	0	30	30	144	144	Class A (US)			
	2	•	0	30	30	144	144	Class A (US)			
	New Duplicate Delete										
								OK	Apply	Cancel	

AASHTOWare Bridge Design and Rating Training – RC 6 – Two Span Reinforced Concrete Slab System Example

A	Strip Profile									
T	Type: Reinforced Concrete Slab									
	Section Depth Reinforcement									
	Begin Depth (in)	Depth Va	ary	End Depth (in)	Supp Num	ort ber	Start Distance (ft)	Length (ft)	End Distance (ft)	
	18	None	•	18	1	•	0	20	20	
	18	Parabolic	Ŧ	36	1	•	20	9	29	
	36	None	•	36	1	•	29	2	31	
	36	Parabolic	•	18	2	•	1	9	10	
	18	None	•	18	2	•	10	20	30	
								1	New (Duplicate Delete
	OK Apply Cancel									

Now switch to Reinforcement tab and enter reinforcemnt information as shown below.

<u>a</u>	Strip P	Profile																	[- • ×
Ty	Type: Reinforced Concrete Slab																			
		ary bar spacing	incenteri	· [
	Set	Bar Mark	Invert	Measured From		Clear Cover (in)	Number	Start Bar Spacing (in)	End Bar Spacing (in)	Start Side Cover (in)	End Side Cover (in)	Support Number	Directi	on D	Start Distance (ft)	Straight Length (ft)	End Distance (ft)	Start Fully Developed	End Fully Developed	
	1	BarMark #1 💌		Top of Slab	•	1.5	4	6	6	2	2	1 💌	Left	•	0	30	30	V	V	
	2	BarMark #1 📼		Top of Slab	•	1.5	4	6	6	2	2	2 🔻	Left	-	0	30	30	V	V	
	3	BarMark #1 💌		Bottom of Slab	-	2	6	6	6	2	2	1 💌	Left	-	0	30	30	V	V	
	4	BarMark #1 💌		Bottom of Slab	-	2	6	6	6	2	2	2 🔻	Left	-	0	30	30	V	v	
	5	BarMark #2 💌		Top of Slab	-	1.5	6	6	6	2	2	1 💌	Right	-	26	4	30	V	V	
	6	BarMark #2 💌		Top of Slab	-	1.5	6	6	6	2	2	2 🔻	Left	-	0	4	4	V	V	
																	New) Du	iplicate	Delete
																		OK	Apply	Cancel

After strip profile is defined, click on Ok to save data and close the window.

The profile of the slab strip can be viewed by selecting the member alternative and click on the View schematic button on the toolbar. Schematic for Slab Strip S2 member alternaive is as shown below.

A Schematics: RC Profile View											
🖻 🕞 🔍 Q, 🔶 🛃 🕅	ኟ ≒ 80% -										
2SpanRCSlab 2SpanRCSlab - Slab System - S2 07/18/13	2										
Web Transitions	18"x20'-0"	[18"-36"]x9'-0" 36"x2	-0" [36"-18"]x9'-0"	18"x20'-0"							
Vert. Shear Reinf. Spacing	•										
Span Lengths	# 30'-0"			30'-0"	i						
	Notes: * Vertical shear reinforcement shown in blue										

We can now enter the live load distribution factors for this member. Open Live Load Distribution window. Under Standard tab, click on Compute from Typical Section button. Live load distribution factors will be populated as shown below. If live load distribution factors are not entered, the AASHTO Engine will compute the distribution factors during the analysis.

Live Load Di Standard Li Distribution	istribution RFD n Factor Input Method e Simplified Method	l 🔘 Use Adva	nced Method		
Lanes		Distributior (Whee			
Loaded	Shear	Shear at Supports	Moment	Deflection	
1 Lane			2.068966	1]
Multi-Lane			2.068966	1	
Compute f	rom ction View Calcs			ОК	Apply Cancel

Click on Ok to save data and close the window.

We do not need to define any Points of Interest since we will not be overriding any information we have entered. The description of this member alternative is complete.

The member alternative Slab Strip S2 can now be analyzed. To perform LFR analysis, select the View Analysis Settings button on the toolbar to open the window shown below. Click Open Template button and select the HS 20 Rating template to be used in the rating. Click on Ok to save the settings and close the window.

Analysis Settings	
Analysis Type: Line Girder Lane/Impact Loading Type: As Requested Vehicles Output Engine Description	ng: None
Vehicle Selection: Vehicle Selection: Vehicles Add to Rating Add to Rating Add to Rating H 15-44 H 20-44 H 20-44 H 20-44 H 20-44 H 20-44 H 20-44 H 20-44 H 20-44 H 20-44 H 5-14 H 5-14 H 5-20 (SI) HS 15-44 HS 20 (SI) HS 20-44 Lane-Type Legal Load LRFD Fatigue Truck (SI) HS 20-44 SU4 SU4 SU5 SU6 SU7 Table Selection:	Refresh Temporary Vehicles Advanced Vehicle Summary: • Rating Vehicles • LRFR • Design Load Rating • Inventory • Operating • Legal Load Rating • Routine • Specialized Hauling • LFD/ASD • Inventory • HS 20-44 • Operating • HS 20-44
Reset Clear Open Template Save Template	OK Apply Cancel

Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the View Analysis Report on the toolbar. The analysis results window shown below will open.

Analysis Results - Slab Strip S2 Report Type Lane/Impact Loading Type Display Format Rating Results Summary 											
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact		
HS 20-44	Lane	LFD	Inventory	32.19	0.894	34.00	2 - (13.3)	Design Flexure - Concrete	As Requested		
HS 20-44	Lane	LFD	Operating	53.75	1.493	34.00	2 - (13.3)	Design Flexure - Concrete	As Requested		
HS 20-44	Axle Load	LFD	Inventory	26.78	0.744	34.00	2 - (13.3)	Design Flexure - Concrete	As Requested		
HS 20-44	Axle Load	LFD	Operating	44.72	1.242	34.00	2 - (13.3)	Design Flexure - Concrete	As Requested		
AASHTO LFR Analysis Prefe	Engine Version 6 rence Setting: No).5.0.2004 ine								Close	

To perform LRFR analysis, select the View Analysis Settings button on the toolbar to open the window shown below. Click Open Template button and select the LRFR Design Load Rating template to be used in the rating. Click on Ok to save the settings and close the window.

🗛 Analysis Settings	
Design Review Rating	Rating Method:
Analysis Type: Line Girder	Apply Preference Setting: None
Vehicles Dutput Engine Description Traffic Direction: Both directions Vehicle Selection: Image: Vehicles Image: Vehicles <t< td=""><td>Refresh Temporary Vehicles Advanced Vehicle Summary: Vehicle Summary: Add to Rating Rating Vehicles Add to Rating Rating Vehicles Image: Comparison of the streng of the</td></t<>	Refresh Temporary Vehicles Advanced Vehicle Summary: Vehicle Summary: Add to Rating Rating Vehicles Add to Rating Rating Vehicles Image: Comparison of the streng of the
Reset Clear Open Template	Save Template OK Apply Cancel

Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the View Analysis Report on the toolbar. The analysis results window shown below will open.

🕰 Analysis R	esults - Slab Strij	o S2								
Report Type			Lane/Impact	Loading Type	Di	splay Format				
Rating Resu	lts Summary	•	As Reques	sted 🔘 Deta	ailed	ingle rating lev	vel per row 🔹			
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	
HL-93 (US)	Truck + Lane	LRFR	Inventory	24.16	0.671	34.00	2 - (13.3)	STRENGTH-I Concrete Flexure	As Requested	
HL-93 (US)	Truck + Lane	LRFR	Operating	31.32	0.870	34.00	2 - (13.3)	STRENGTH-I Concrete Flexure	As Requested	
HL-93 (US)	Tandem + Lane	LRFR	Inventory	22.95	0.638	12.00	1 - (40.0)	STRENGTH-I Concrete Flexure	As Requested	
HL-93 (US)	Tandem + Lane	LRFR	Operating	29.75	0.826	12.00	1 - (40.0)	STRENGTH-I Concrete Flexure	As Requested	
HL-93 (US)	90%(Truck Pair	LRFR	Inventory	29.36	0.816	34.00	2 - (13.3)	STRENGTH-I Concrete Flexure	As Requested	
HL-93 (US)	90%(Truck Pair	LRFR	Operating	38.06	1.057	34.00	2 - (13.3)	STRENGTH-I Concrete Flexure	As Requested	
I AASHTO LRI Analysis Prefe	FR Engine Versior erence Setting: No	n 6.5.0.200 Ine	14							Close

To perform LRFD design review, open the Analysis Settings window and select the HL 93 Design Review template as shown below.

Analysis Settings	
💿 Design Review 💿 Rating	Design Method: LRFD 👻
Analysis Type: Line Girder Lane/Impact Loading Type: As Requested	Apply Preference Setting: None
Venicies Dutput Engine Description Traffic Direction: Both directions Vehicle Selection: VehiclesStandardAlternate Military LoadingHL-93 (SI)HS 20 (SI)HS 20 (SI)HS 20 (SI)	Refresh Temporary Vehicles Advanced Vehicle Summary: Add to Design Vehicles Add to Design Vehicles HL-93 (US) >> Permit Loads Fatigue Loads Remove from LRFD Fatigue Truck (US) Image: Comparison of the state
Reset Clear Open Template	Save Template OK Apply Cancel

Next click the Analyze button on the toolbar to perform the design review. Click on *b* View Analysis Output button on toolbar and double-click Spec Check Results for a summary of the specification check results.

A 2SpanRCSIab	
2SpanRCSIab	Î
AASHTO_LFD Log File AASHTO_LRFD AASHTO_LRFD Computed distribution factors Computed distribution	E
 Summary of computed distribution factors Detailed calculations of computed distribution factors Spec Check Results Log File 	-
·	►

											x
R	(+)⊕[C:\Users	\SThogarı	ı∖Docume 🔎	>- ¢×	<i>e</i> C:\User	s∖SThoga	aru\D ×		$\hat{\mathbf{m}}$	₿.
Γ	- Bridge : 2Sp	anRCSla	ib			Bridge Alt :					-
	Superstructu	re Def : S	Slab Syst	em							
	Member : S2	2				Member Alt : Slab Strip S2					
	Analysis Pret	ference S	Setting : 1	Vone							
	AASHTO LRFD Specification, Edition 6, Interim 2013 Specification Check Summary										
		Article		State	us						
	Flexure (5	.7.3.2, 5	5.7.3.3.2) Fai	1						
	Crack C	ontrol (5.7.3.4)	Fai	1						
	Shear (5	.8.3.3, 5	5.8.2.5,	Ignore	by						
	5.8.2	2.7, 5.8.2	3.5)	Use	r						
	Fatig	ue (5.5.	3.2)	Pas	s						
	Deflect	ion (2.5.	2.6.2)	Pas	s						
	Girder Positive Flexure Analysis										
	Location LS Load			Mr	Mu	Mr/Mu	Code				
	(ft)		Comb	(kip-ft)	(kip-ft)						
	0.000	STR-I	1	630.40	0.00	99.00	Pass				
	3.000	STR-I	2	630.40	437.40	1.44	Pass				
	6.000	STR-I	2	630.40	727.47	0.87	Fail				-
	•										F

Part 2: Frame structure simplified definition slab structure type.









Slab system with frame leg support can be defined by selecting Slab Structure Type as Frame structure simplified definition in the superstructure definition window.

Double-click on SUPERSTRUCTURE DEFINITIONS and create a new Reinforced Concrete Slab System Superstructure similar to the one we just completed. Select Frame structure simplified definition and specify Frame Connection for support 2. Click Ok to save and close the window.

🗛 RC Slab System Supers	structure Definition	
Definition <u>Analysis</u> Sp Name: Description:	pecs Engine Frame Slab System	
Default Units: Number of spans: Number of slab strips:	US Customary Enter Span Lengths Along the Reference Line: Frame Connect 3 Image: Span Length (ft) Support (ft) 1 30 1 2 30 1 3 Image: Span Length (ft) Support (ft) 1 30 1 2 30 Image: Span Length (ft) 3 Image: Span Length (ft) Image: Span Length (ft) 3 Image: Span Length (ft) Image: Span Length (ft) 1 30 Image: Span Length (ft) Image: Span Length (ft) 1 30 Image: Span Length (ft) Image: Span Length (ft) 1 30 Image: Span Length (ft) Image: Span Length (ft) 1 30 Image: Span Length (ft) Image: Span Length (ft) 2 30 Image: Span Length (ft) Image: Span Length (ft) 3 Image: Span Length (ft) Image: Span Length (ft) Image: Span Length (ft) 3 Image: Span Length (ft) Image: Span Length (ft) Image: Span Length (ft) 3 Image: Span Length (ft) Image: Span Length (ft) Image: Span Length (ft) 4 Ima	tions: Frame Connection Member Alt. Types Steel P/S R/C Timber Slab Structure Type Frame structure simplified definition Slab integral with pier Slab not integral with pier
		Contains voids

Follow the instructions in Part 1 to enter the following data for this superstructure definition.

- 1. Load Case Description
- 2. Structute Framing Plan
- 3. Structure Typical Section
- 4. BarMark #1and BarMark #2
- 5. Member Alternative Description
- 6. Strip Profile

Now we begin the windows with specific information for the Frame structure simplified definition.

Open Structure Framing Plan Detail window, switch to Frame Connections tab and enter data as show below.

A Structure Framing Plan Details															
		ame Conner	tions			Number o	of spans = 2		Numb	er of strip	s = 3				
	ayout														
	Support Line	Bent Cap Width (in)	Number of Columns	Material	Column Length (ft)	Percent Fixity at Base (%)	Column Type	Constant/ Tapered	Top Depth (in)	Bottom Depth (in)	Top Width (in)	Bottom Width (in)	Column Stiffness (kip-in/rad)		
	2	48	2	Class 🔻	15	100	Rectangula 🔻	Consta 💌	24	24	48	48			
	1									ompute					
												OK	Apply	Cancel	

Select the Compute button to open the Compute Column Stiffness dialog. Click on the Compute button to compute the column stiffness coefficient.

Compute Column Stiffness						×		
Support Line: 2			Number of strips	: 3				
Bent Cap Width: 48	} in		Column Length	ε 15	ft			
Number of Columns: 2			Percent Fixity at Base	e 100	%			
Column Cross Section Cross Section Type Rectangular Circular Cross Section Dimensions Constant Tapered	Material: Top Depth: Bottom Depth:	Class A (US) 24 24	 in in Br	Top Width:	48 in			
Computed Column Stiffness Properties at Top of Column Area: 1152 in^2 Modulus of Elasticity: 3644.149254 ksi								
Moment of Inertia: 55	ⁱ²⁹⁶ in^4		Computed Column Stiffness:	8955861.2	²⁰⁵⁹⁹⁵ kip-in/rad			
Properties at Bottom of Column Area: 11 Moment of Inertia: 55	n 52 in^2 ^{;296} in^4		Compute					
					Apply Ca	ncel		

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. You will need to use engineering judgment to determine the length of the frame leg based on the geometry and reinforcement of the frame structures you wish to analyze.



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

The computed column stiffness coefficient is based on the entered number of columns. Click on Apply button to apply this stiffness coefficient to Support 2.

Click Ok to save and close the Structure Framing Plan Detail window.

Open Supports window, Support 2 is a frame connection with all constraints fixed. The computed column stiffness coefficient is entered in the Elastic tab as the Z rotation spring constant.



🕰 Si	upports						- • •
G							
	Support Number	Translation S _i (kip	pring Constant p/ft)	Rotation Spring Constant (kip-in/rad)	Computed Z Rotation Spring		
		Х	Y	Z	Constant		
	1						
	2			8955861.2059			
	3						
						DK Apply	Cancel

In similar manner as performed above, LFR, LRFR and LRFD analysis can be performed by selecting their respective templates. As this slab bridge is not designed with framed connection at pier, we are not going to perfrom rating and design analysis in this example.