# Straight Steel Composite Bridge



Program Version	Civil 2015 V2.1
Revision Date	February 6, 2015
Unit	English Unit (kip, ft, inch)

### **Overview**

### Bridge overview

- ✓ 3 span continuous composite girder bridge
- ✓ Span length: 1@80 ft, 1@100ft & 1@80ft
- ✓ Carriageway width: 31 ft
- ✓ Unit system: Kip, ft
- <u>Tutorial Overview</u>
  - ✓ Steel Composite Girder Bridge Wizard
    - Geometry, property, boundary, load, & construction stage set up.
  - ✓ Moving Load
- <u>Result Evaluation</u>
  - ✓ Moving Load Analysis Result

### **<u>1. Bridge Specifications</u>**

- Bridge type: Straight bridge
  Span length: 80 ft, 100ft, 80ft
  Road way: 31 ft
- Spacing of cross beams: 16ft, 16.7ft





### 2. Purpose



This tutorial is for describing how to define load rating details and observe load rating result extracted in Excel Spreadsheet format. This tutorial mainly focuses on load rating procedure and extracting excel spreadsheet. Prerequisite steps, such as modeling, static & moving load analysis, and design check, are available in separate tutorials in followi

https://drive.google.com/open?id=0B-wfdCwh0 wJfYUFkMTV6TEs2aHc&authuser=0



Description           1: Produce           1: Positive moment           1: Diagonalization formest and Streams           1: Diagonalization Type : MY-MAX           Composent         Streams           1: Diagonalization Type : MY-MAX           Composent         Streams           0: Diagonalization Type : MY-MAX           Composent         Streams           0: Open response         Streams           0: Web Prepertores (ASHTO LEPD Bridge 2012 € 10.2.1)	Str	enat	h Li	mit 9	state	- Flex	ural F	lesis	tance										
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### <u>Outline</u>

- 1. Bridge Overview
- 2. <u>Purpose</u>

#### **Load Rating Procedure**

- 3. Define Rating Parameter
  - 3.A. Load Rating parameter Information
- 4. Define Bridge Rating Group Setting
- 5. Modify Composite Material
  - 5.A. Modify Composite Material
- 6. Define Rating Case(Service Limit State)
  - 6-1. Define Rating Case(Strength Limit State)
  - 6-2. Define Rating Case(Fatigue Limit State)
    - 6.A. Define Rating Case
    - 6.B. Define Rating Case

- 7. Longitudinal Reinforcement
  - 7-1. Longitudinal Reinforcement
    - 7.A. Steel Reinforcement
- 8. Transverse Stiffener
- 9. Unbraced Length
- 10. Fatigue Parameter
- 11. Curved Bridge Information
- 12. Diagnostic Test Result
- 13. Rating Design Result Tables
- 14. Position for Rating Output

### **Result**

15. Excel Report

#### **Step3. Define Rating Parameters** Civil 2015 - [C:\Users\swpark\Desktop\TS\Chris\06.02.2015\S View Structure Node/Element Properties Boundary Load Analysis Results PSC Pushover Design Rating Tools ::[0 AASHTO-LRFD12 AASHTO-LRFD12 x Steel Rating Design Code Bet N SC Bridge Steel Bridge Common Rating Design Code : AASHTO-LRFD12 🕂 Rating Design Code.. 3 Para. • 📆 Rating Parameters... OK Cancel 🕞 📮 🔜 💉 🔉 👫 🔒 🦰 🗕 🗸 🗕 🔚 Rating Group Setting... Steel Bridge Load Rating Parameters x 5 4 System factor 1 Update by Code Strength Limit State Strength Resistance Factor Resistance factor for yielding (Phi\_y) 0.95 0.8 Resistance factor for fracture(Phi\_u) 0.9 Resistance factor for axial comp. (Phi c) Resistance factor for flexure (Phi\_f) 1 1 Resistance factor for shear(Phi\_v) 0.85 Resistance factor for shear connector(Phi se) 1 Resistance factor for bearing(Phi\_b) Girder Type for Box/Tub Section Single Box Sections Multiple Box Sections Consider St. Venant Torsion and Distortion Stresses Option For Strength Limit State Appendix A6 for Negative Flexure Resistance in Web Compact / NonCompact Sections Mn<=1.3RhMy in Positive Flexure and Compact Sections(6.10.7.1.2-3)</p> Post-buckling Tension-field Action for Shear Resistance(6.10.9.3.2) Service Limit State Limiting Stresses in Structural Steel Auto-Calculation O User Input Design Load 0 0 **Tensile Stress** Legal Load / Permit Load 0 0 Tensile Stress kips/ft^2 Fatique Limit State Application of Diagnostic Test Result Strain Load Test Measurement Oisplacement 10 ancel OK

1. Click Rating Tab 2. Click Rating Design Code. 3. Select AASHTO-LRFD 12 4. Enter System factor: 1 5. Click Update by Code (Resistance factors can be manually modified at user's preference) and users can modify each Resistance factor with their preference. 6. Check on Strength Limit State 7. Check on Service Limit State 8. Check on Auto-Calculation 9. Check on Fatigue Limit State 10. Click OK

<u>3.A. Load Rati</u>	ing parameter In	formation	(i)	
Steel Bridge Load Rating Paramet	ters	X	Girder Type for In Multiple	Box/Tub Section Box Section, St. Venant Torsion and Distortion
System factor 1		Update by Code	stresses are	e optional according to Article 6.11.2.3.
Strength Limit State			In Single F	Roy Section St. Venanat Torsion and Distortion
Strength Resistance Factor			III Shigic I	
Resistance factor for yielding (	(Phi_y)	0.95	are automa	itically considered.
Resistance factor for fracture(	(Phi_u)	0.8	$\bigcirc$	
Resistance factor for axial com	np.(Phi_c)	0.9	Option For Stre	ength Limit State
Resistance factor for flexure (	Phi_f)	1	• Appendix	A6 option is applied for the flexural strength of
Resistance factor for shear(Ph	i_v)	1	straight co	mposite I Sections in negative flexure with comp
Resistance factor for shear cor	nnector(Phi_se)	0.85	straight co.	inposite i-sections in negative nexure with comp
Resistance factor for bearing(F	Phi_b)	1	act / nonco	ompact webs.
Girder Type for Box/Tub Section	2		Mn value i	s restricted to 1.3RhMy under positive flexure in
Single Box Sections	Multiple Box Section		a continu	ous span based on three conditions stated in Articl
Consider St Venant Torsion	and Distortion Stresses	5		
			C 0.10.7	.2-3.
Appendix A6 for Negative El	lexure Resistance in Web Com	pact		
/ NonCompact Sections	iexure resistance in web com	puer	Service Limit S	State
Mn<=1.3RhMy in Positive Fl	lexure and Compact Sections(	5.10.7.1.2-3)	In Auto-Ca	alculation, the limiting stresses are automatically
Post-buckling Tension-field A	Action for Shear Resistance(6.	10.9.3.2)	calculated	as follows:
<u>e</u>				
Service Limit State				Design Load: f <sub>R</sub> =0.95 R <sub>b</sub> F <sub>vf</sub>
Limiting Stresses in Structural St	llass Tanut			Legal/Permit Load: fp=0.95 F <sub>uk</sub>
Auto-Calculation	O User Input			
Compressive Stress	0	kine/ft^2	• In User ing	out, the limiting stresses can be manually inputted for
Tencile Stress	0	kips/ft-2	design load	d and legal/permit load respectively. The allowed
COSIC DUCSS	·	npart 2	ucsign iodu	a and regar permit road respectively. The anowed
Legal Load / Permit Load			compressiv	ve stress and tensile stress of the steel girder need to
Compressive Stress	0	kips/ft^2	be inputted	1.
Tensile Stress	0	kips/ft^2		
			Amplication of	Dia ana setia Tast na sult
Fatigue Limit State			Application of	Diagnostic Test result
Application of Diagnostic Test Res	sult		Adjustment	factor resulting from the comparison of measured
Load Test Measurement	© Strain	Displacement	test behavior	with the analytical model can be calculated. Select
cood repended enert	O Duant	o objacement	between stra	in and displacement obtained form the diagnostic
		OK Cancel	toot Massar	a value con he entered in Discretion Test Desult
			lest. Wieasure	e value can be entered in Diagnostic Test Result
			Menu	

# **Step4. Define Bridge Rating Group Setting**



- Check on Girder
   Define Condition factor
   Check position I-End and J-End
   Click Add button
- Selected Groups are targeted for the design of the Rating Factor. Structural groups com posed of SRC material properties are shown in the list after performing an analysis.
- Different values of condition factor can be applied to different structure groups of elements.
- Condition Factors

Condition	NBI	<u>ь</u>
Description	Rating	$\Psi_{c}$
good or	6 or	1.00
satisfactory	higher	1.00
fair	5	0.95
noor	4 or	0.85
poor	lower	0.85

\*The Manual For Bridge Evaluation-6A.4.2.3

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### Step5. Modify Composite Material

odify Comp	osite Mate	rial			×
Material List	t ———				
	Name	Steel	Concrete	Main-bar	Sub-bar
1	SRC	A572-50	Grade C4500		
2	A36	A36			
Composite M	laterial Sele	ction			
Steel Mat	erial Selectio	n			
Code :	ASTM(S)				
Hybrid	d Factor				
Grade :	A572-50	<b>•</b>			
Es :	4176000	kips	/ft^2 Fu :	9360	kips/ft^2
Fy :	/200	kips,	/ft^2		
Concrete	Material Sel	ection			
Code :	ASTM(RC)		Grade :	Grade C4500	•
Specified	Compressive	e Strength (fo	:/fck) :	648	kips/ft^2
Reinforce	ment Select	ion	<b>`</b>		
Code :	ASTM(RC)	- 2	)		
Grade of N	1ain Rebar :	Grade	40 3	: 5760	kips/ft^2
Grade of S	Sub-Rebar :		▼ Fys	: 5760	kips/ft^2
			4	Modify	Close

- The objective of this tool is to check whether material property is defined as SRC or not. In order to perform Design Check and Load Rating, for steel composite bridge, only SRC material is allowed to be used. Furthermore, In Modify Composite Material, the steel prop erties for concrete reinforcement are defined.
- For resisting negative moment occurring aro und supports, reinforcing steels in Concrete deck is recommended
- 1. Check steel composite Section is defined to SRC
- 2. Code: ASTM(RC)
- 3. Grade of Main Rebar: Grade 40
- 4. Click Modify button



### 5.A. Modify Composite Material

**μ** ×



Static load analysis and moving load analysis does not require users to select SRC as steel composite materials. Even if the girders are not defined as SRC, there is a way to enter SRC property into the girders at ease.

- 1. Click Steel Icon on Tree Menu
- 2. Right Click

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- 3. Click Properties
- 4. Type of Design
- 5. Select Standard: ASTM(S)
- 6. Select DB: A572-50
- 7. Select ASTM(RC)
- 8. Grade C4000
- 9. Click Ok button

### Step6. Define Rating Case(Service Limit State)

					_			
Define Rating (	Case							×
Static Load C	ombinati	on						
Service Lir	mit State		$\odot$	St	rena	th Limit	State	
© Eatique Li	mit State	<u> </u>						
		-						
(2) Load	Туре	max	min			Load	Cases	
	Before)	1.00	1.00		▶	Creep	Seco	
	(After)	1.00	1.00			Shrinka	age S	_
<b>(4)</b>	Dw	1.00	1.00		*			
	erature		1.00					
	andent		1.00					
Jec Der	manent		1.00					
User	Defined		1.00					
*								
<b></b>								
Live Load Cor	mbinatio	n						
	Live	Load Fa	actors fi	or	Ratir	ng		
Primary Vehicle	e	Live-M	1odel(M	V)		-	1	<b>6</b>
Adiacent Vehi	de	Live-M	1odel(M	v)		•	ol	7
-Evaluation I	ive Load	Model					· · · ·	
		inouci	<u>.</u>					
Oesign Li	ive Load		© Leq	al	Load	/ Permi	t Load	
		_				<u> </u>	、	
Name of Ratin	g Case	S	ervice L	S	Case	e ( <mark>8</mark>		
Description								
Name	Limit St	ate	Descrip	tic	n			
Service LS	Service					(	<u> </u>	م ط ط
Strength L	Strengt	th						ниа
Fatigue LS	Fatigue	2					M	odify
							D	elete
							Close	2

1. Check on Service Limit State
2. Select Load Type: DC(Before)
2-1. Select Load Case: Dead Load(CS)
3. Select Load Type: DC(After)
3-1. Select Load Cases: Erection Load 1(CS)
4. Select Load Type: DW
4-1. Select Load Cases: Erection Load 2(CS)
5. Select Load Type: Secondary
5-1. Select Load Cases: Creep Secondary(CS)
6. Primary Vehicle: 1
7. Adjacent Vehicle: 0
8. Name of Rating Case: Service LS Case
9. Click Add button

# <u>Step6-1. Define Rating Case(Strength Limit State)</u>

efine Rating Case							×
Static Load Combinati Service Limit State	on e (	1.	St	renq	th Limit :	State	
2 Load Type 3 DC (Before) 3 DC (After) 4 DW Temperature 5 T. Gradient 5 Secondary Permanent User Defined *	max 1.25 1.25 1.50	min 0.90 0.90 1.00 1.25 1.25 1.00		*	Load Creep Shrinka	Cases Seco age S	
Live Load Combination	n Load Fa	actors fo	or	Ratir	ng		
Primary Vehicle Adjacent Vehicle Evaluation Live Load	Live-M Live-M Model	1odel(M) 1odel(M) © Leqi	v) v) al I	Load	▼ ▼	1 0	6 7
Name of Rating Case Description	F	atigue L	s	Case	. 8		
Name Limit St Service LS Service Strength L Streng Fatigue LS Fatigue	ate th	Descrip	tio	'n		9 A Mo	dd dify lete
						Close	

1. Check on Strength Limit State
2. Select Load Type: DC(Before)
2-1. Select Load Case: Dead Load(CS)
3. Select Load Type: DC(After)
3-1. Select Load Cases: Erection Load 1(CS)
4. Select Load Type: DW
4-1. Select Load Cases: Erection Load 2(CS)
5. Select Load Type: Secondary
5-1. Select Load Cases: Creep Secondary(CS)
6. Primary Vehicle: 1
7. Adjacent Vehicle: 0
8. Name of Rating Case: Strength LS Case
9. Click Add button

# <u>Step6-2. Define Rating Case(Fatigue Limit State)</u>

efine Ra	ating Case							×
- Static L	.oad Combinati	on						
© Ser	vice Limit State		$\odot$	St	reng	th Limit	State	
• Fat	ique Limit State	2						
$\left( 2\right)$	Load Type	max	min			Load	Cases	
$\mathbf{X}$	DC (Before)	1.00	1.00		$\bullet$	Creep	Seco	
3	DC (After)	1.00	1.00			Shrinka	age S	
$\left( 4 \right)$	DW	1.00	1.00		*			
Y	Temperature		1.00					_
	T. Gradient		1.00					
5	Secondary		1.00					
	Permanent		1.00					
	User Defined		1.00					
*								
I								
livelo	ad Combination							
	Live	Load Fa	actors fi	or	Ratir	ng		
Primary	Vehicle	Live-M	1odel(M	V)		•	1	6
Adjacen	nt Vehicle	Live-N	1odel(M	S		•	0	7
- Evolu	ation Live Load	Model		·,			-	
Evalu	auon Live Load	Model						
⊚ De	esign Live Load		C Leq	al	Load	/ Permi	t Load	
		-			~		、	
Name o	f Rating Case		augue	-5	Case	= (8	)	
Descript	tion					$\sim$		
							_	
Name	Limit St	ate	Descrip	tic	n			
Service	LS Service					(	9	dd
Strengt	th L Strengt	th						uu
Fatigue	LS Fatigue						Mo	dify
							De	lete
						_		
							Close	

1. Check on Fatigue Limit State
2. Select Load Type: DC(Before)
2-1. Select Load Case: Dead Load(CS)
3. Select Load Type: DC(After)
3-1. Select Load Cases: Erection Load 1(CS)
4. Select Load Type: DW
4-1. Select Load Cases: Erection Load 2(CS)
5. Select Load Type: Secondary
5-1. Select Load Cases: Creep Secondary(CS)
6. Primary Vehicle: 1
7. Adjacent Vehicle: 0
8. Name of Rating Case: Strength LS Case
9. Click Add button



Whenever Load cases cannot be selected on the dialog box, click other load types and then get back to the load type you want to take. For example, suppose that you would like to enter creep secondary (CS) into Secondary Load type and you could not see the load case options, select other load type such as DW or DC(After) and get back to Secondary load type. Load Cases options will be available.

Construc	tion Stage Analysis (	Control Data			
-Final St	tage				
🔘 La	ast Stage	🔘 Other Stage	Stage 1		
🔳 Re	estart Construction Sta	age Analysis	Select S	Stages for Re	estart
Analys	is Option				
In Inc	clude Nonlinear Analys	is	Nonlinear Analysis	Control	
(	) Independent Stage		Accumulative :	Stage	_
	Include Equilibrium E	lement Nodal F	orces	-	
In	clude P-Delta Effect O	oly	P-Delta An:	alveie Contro	1
		iny		arysis Corru o	
				1.000 1.00	
🔽 In	dude Time Dependent	Effect	Time Depender	nt Effect Cor	ntrol
Load C	clude Time Dependent Cases to be Distinguish	Effect ed from Dead L	Time Depender	nt Effect Cor ut	ntrol
Load C	dude Time Dependent Cases to be Distinguish Load Case Name	Effect ed from Dead L Type	Time Depender oad for C.S. Outpu Case 1	nt Effect Cor ut Cas	ntrol
Load C No	clude Time Dependent ases to be Distinguish Load Case Name Erection Load 1	Effect ed from Dead L Type DC	Time Depender oad for C.S. Outp Case 1 Barrier	nt Effect Con ut Cas Median	
Load C No 1 Q	clude Time Dependent cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2	Effect ed from Dead L Type DC DW	Time Depender oad for C.S. Outp Case 1 Barrier Wearing Surf	nt Effect Con ut Cas Median Utilit	A Mo
V In Load C No 2	clude Time Dependent cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2	Effect ed from Dead L Type DC DW	Time Depender oad for C.S. Outp Case1 Barrier Wearing Surf	nt Effect Cor ut Cas Median Utilit	A Mo De
Load C No 2	clude Time Dependent cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2	Effect ed from Dead L Type DC DW	Time Depender oad for C.S. Outp Case 1 Barrier Wearing Surf	nt Effect Cor ut Cas Median Utilit	A Ma De
V In Load C No 2 ↓ Loa	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases III	Effect ed from Dead L Type DC DW	Time Depender oad for C.S. Outp Case1 Barrier Wearing Surf	nt Effect Cor ut Cas Median Utilit	A Mo De
V In Load C No 9 1 9 2 ↓ Loa ★ Dead	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases Id 1(CS)	Effect ed from Dead L Type DC DW	Time Depender oad for C.S. Outp Case1 Barrier Wearing Surf	nt Effect Cor ut Cas Median Utilit •	A Mo De
Load C No 2 Load C 2 Loa Erect Creat	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases d 1(CS) Load(CS) tion Load 1(CS) Ion Load 1(CS)	Effect ed from Dead L DC DW DW	Time Depender oad for C.S. Outp Case1 Barrier Wearing Surf struction Stage L struction Stage L	nt Effect Con ut Cas Median Utilit b .oad Case .oad Case .oad Case	A Mo De
✓ In Load C No 1 2 ✓ Loa ▲ Loa ★ Dead Erect Erect Erect	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases III I Load(CS) Load(CS) tion Load 1(CS) tion Load 2(CS) tion Load 3(CS)	Effect ed from Dead L Type DC DW DW	Time Depender oad for C.S. Outp Case 1 Barrier Wearing Surf Struction Stage L struction Stage L struction Stage L	nt Effect Cor ut Cas Median Utilit b Load Case Load Case Load Case Load Case	A Ma
✓ In Load C No 1 2 ✓ Loa ★ Dead Erect Fred Erect Trend	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases d 1(CS) Load(CS) tion Load 2(CS) tion Load 2(CS) tion Load 3(CS) on Primary(CS)	Effect ed from Dead L DC DW DW Con Con Con Con Con	Time Depender oad for C.S. Outp Case1 Barrier Wearing Surf Struction Stage L struction Stage L struction Stage L struction Stage L	nt Effect Cor ut Cas Median Utilit Utilit Load Case Load Case Load Case Load Case Load Case	A Mc De
Load C No 1 2 Load C 1 2 Loa Erect Crect Crect Tend Tend	clude Time Dependent Cases to be Distinguish Load Case Name Erection Load 1 Erection Load 2 III ad Cases Id 1(CS) ▼ I Load(CS) tion Load 1(CS) tion Load 2(CS) tion Load 3(CS) on Primary(CS) on Secondary(CS)	Effect ed from Dead L DC DW DW Con Con Con Con Con Con	Time Depender oad for C.S. Output Case 1 Barrier Wearing Surf Wearing Surf Struction Stage L struction Stage L struction Stage L struction Stage L struction Stage L	nt Effect Cor ut Cas Median Utilit Utilit N Case Caad Case Caad Case Caad Case Caad Case Caad Case Caad Case	A Mo De

The Common mistake committed by beginners is not to define erect ion Load properly. Erection load comes from Construction stage Lo ad Case. So, users must check it before defining Load Cases in Defi ne Load Case window.

In order check Construction Stage Load Case, go to Analysis Tab>> Construction Stage>>Construction Stage Analysis Control Data

- If users have used Steel Girder Wizard, the default construction stage load cases are automatically defined in Midas Civil.
- For example, Erection Load 1 is defined as DC(Barrier and Me dian Strips), and Erection Load 2 is defined as DW(Wearing Su rface load).

### Step 7. Longitudinal Reinforcement

inforcements 🔹 🔻	□ • • • • • • • • • • • • • • • • • • •	Longitudinal Reinforcement Shear Reinforceme
		Same Rebar Data at i & j-end
rget Section & Element		Coordinate
Section : 6		Guide Line : 0 in
T:IN_Sec_2		L I
<b>1</b> 5:EX_Sec_1		Туре
<b>1</b> 6 : IN_Sec_1	<ul> <li>A second sec second second sec</li></ul>	Point     O Arc     O Circle     O Relucting
		Circle Poly Line
• <b>1</b> 9:1N_Sec_1_1		Input Method A
		Ref. Y Left V 4
		Ref. Z Top <b>v</b> Z 4.5
	· · · · · · · · · · · · · · · · · · ·	Num 18
		Spacing 5
		Dia #6 🔻
		Part Part 2 🔻
		Reference for Tapered Section
		Ref. y Left Ref. Z Top
		Ac. 7.92
		As Note
		Add Modily De
		Multi Add
		Type Num CTC (in) D
		1 Line 18 0 #6
y Reinforcements to	EX_Sec_2 G : 54.39271.081 SELE	cT

#### 1. Rating>Longitudinal Reinforcement

2. Check the box for Same Rebar Data

3. Click Line

x

- 4. Ref. Y: Left, Ref. Z: Top, Y: 4in, Z: 4.5in, Num: 21, Spacing: 5in, Dia: #6,
- 5. Click Add
- 6. Click Apply

### Step 7-1. Longitudinal Reinforcement



#### 1. Rating>Longitudianl Reinforcement

- 2. Check the box for Same Rebar Data
- 3. Click Line
- 4. Ref. Y: Left, Ref. Z: Top, Y: 4in, Z: 4.5in, Num: 18, Spacing: 5in, Dia: #6,
- 5. Click Add
- 6. Click Apply

#### 7.A. Steel Reinforcement



Through running Mvall: Live-Model(Moving Load), Negative mome nt takes place at the IN\_Sec2 and EX\_Sec2. So, Steel Reinforcement in the concrete deck is conducted.

### Step 8. Transverse Stiffener

de ansverse Stiffener 🔹	Q 🚓 🔞 🕒 🔢 Grid :	0.5 ft	📝 Snap	Same Stiffeners Data at i & j-end
rget Section & Element Section : 4 1 : IN_Sec_2 1 : IV_Sec_2				I J Transverse Stiffener
S: D(Sec.1 S: If(Sec.1		2 + Y		rpe         Image: Sufferer           Image: Sufferer         Image: Sufferer           Image: Transverse Sufferer         <
Transverse Stiffener	G : 239.00, 23	2.00	SELECT	

As shown above, the dialog box in which users can arrange transver se stiffeners in steel composite section. When the transverse stiffener rs are installed, the existence and spacing between stiffeners determi ne whether the web is stiffened or unstiffened under strength limit st ate. In this tutorial, transverse stiffeners aren't defined.

### Step 9. Unbraced Length

If each span has a different unbraced length, unbraced length must be different depending on span information.



- Rating > Unbraced length
   Select <u>Span 1</u> by using Select by Window Select by Polygon 
   Click Lb box
- 4. Select the unbraced Length or type the length
- 5. Click Apply
- 6. The same procedure will be conducted to Span 2 and Span3

### Step10. Fatigue Parameter



- 1. Properties> Fatigue Parameter
- 2. Click Add/Replace
- 3. Select the whole girders
- 4. Select Category: C
- 5. (ADTT)SL: 1200
- 6. *M*(*n*/*cycle*): 2
- 7. Warping Stress Range: Auto Cal
- Category: Category defined by 75yr-(ADTT)SL equivalent to inf inite life(Table 6.6.1.2.3-2)
- (ADTT)<sub>SL</sub>: Number of trucks per day in a single-lane averaged over the design life(3.6.1.4.2)
- N : Number of cycles per truck passage, value can be taken from table6.6.1.2.5-2

### Step11. Curved Bridge Information

ree Menu	<b>ņ</b>	×
5  S  C  S  P  <b>C</b>   R  R  R	s	
Curved Bridge Info.		
Option		
Add/Replace O Delete		
▼ Both end parts(i & j) have the same type I ] J	1	
Girder Radius 0 in		
Curve Type     Onvex ◎ Concave		
Apply Close	]	

- Radius is used for the review of shear connector's pitch and the moment of inertia of area for the longitudinal stiffener attached to web
- Curve Type-Convex, Concave
- ✓ If convex is selected, Left stiffener is on the side of the web away from the center of curvature and Right stiffener is on the side of t he web toward the center of curvature
- ✓ If concave is selected, the opposite case of the convex is applied. The Left and Right are determined based on the progressing dire ction of the cross section.

\*Note: This model is a straight bridge. So, this tutorial does not con sider Curved Bridge Information

### Step12. Diagnostic Test Result

Tree	Menu			Ψ×
G	S C S P	C  R	R R	S
Dia	agnostic Test Res	ults	•	
<u></u>	Option			
2)	Add/Replace	🔘 Del	ete	
-0	efine Rating			
4	I O	) ©	I & J	
5	Load Test Measu Auto-Calculat	irements ion		
	🔘 User Input			
	Displ.(I)	0.0393	in	
	Displ.(J)	0.0393	in	
	Dynamic Factor	1		
Ľ				
	6	Apply	Close	

- Adjustment factor resulting from the comparison of measured test behavior with the analytical model can be considered to calculate the load-rating factor based on the test result.
- Auto Calculation: Deflection and K<sub>b</sub> are inputted manually for th e diagnostic test to calculate adjustment factor.
- User input: The Adjustment Factor, k, is inputted by users. K is used to calculate the factored load-rating factor(8.8.2.3.1-1)

#### 1. Properties> Diagnostic Test Result

- 2. Option: Add/Replace
- 3. Select the whole girders
- 4. Select position: I
- 5. Load Test Measurements: Auto-Calculation
- 6. Click Apply button

3

### Step13. Rating Design Result Tables

1. Rating>Steel Bridge>Perform Rating Design

2. Rating>Steel Bridge>Rating Design Result Table

#### Service Limit State Summary

						Almahle		_	_	_						_	_	_	-	_											Dea	d Before)	Dead(After)	Short Term	Prill
	Rating Case	Component	Nininum Rating Factor	Location	Relative Location	Stress (iips/ft*2)	Demand (kips/ft*2)	Point	Factor	Stress (kips/ft*2)	Stress (kips/ht*2)	Stress (kipsitt*2)	Stress (kips/ft*2)																						
	Service LS Case_DC-Before(MAX)_DC-After(MAX)_DIV(MAX)_T(	Compression	86.0282	319-1		6840.0000	-837.1356	Top	1.000	-756.9201	-10.4377	-69.7778	-69.7778																						
)	Service LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(	Tension	6.9685	319-1		6840.0000	1427.4744	Baton	1.000	620.8668	29.8920	776.7156	776.7156																						

	Flexu	re	Lir	nit S	tate	<u>Summary</u>						
	Group	Elem.	Part	Relative Location	Positive/Ne gative	Rating Case	LRFD Resistance Factor	System Factor	Condition Factor	Rating Factor	Check OK - OK OK - OK - OK	
	Girder	211	<b>C</b> 20		Negative	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MN)_T(+)_TG(+)_A_V(My-Max)	1,0000	1,0000	0.9500	77.0899	OK	
_		211	(2)		Positive		-					
	-	211	J[217]	-	Negative		-					
	Girder	211	J[217]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	17.8462	OK	
		212	(217)		Negative							
	Girder	212	[217]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1,0000	0.9500	17.8462	OK	
	Girder	212	J[218]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1,0000	0.9500	8.5738	OK	
	A	212	J[218]		Negative							
	A	213	[[218]		Negative							
	Girder	213	[210]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1,0000	0.9500	8.5738	OK	
	A	213	J[24]		Negative							
	Girder	213	J[24]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	8.3581	OK	
	Girder	214	[24]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	8.4136	OK	
_	A	214	[[24]		Negative							
•		214	J[219]	-	Negative		-					
	Girder	214	J[219]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	7.3594	OK	
	A	215	[[219]		Negative							
_	Girder	215	(219)	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	7.3594	0K	
	Girder	215	J[220]	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	6.2796	OK	
		215	J[220]		Negative		-					
	-	216	[220]	-	Negative		-		-			
	Girder	216	(220)	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A V(My-Max)	1.0000	1,0000	0.9500	6.2795	ок	
	A	216	J[35]		Negative							
	Girder	216	J[35]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	6.1723	OK	
	Girder	217	(35)		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1,0000	0.9500	6.1889	OK	
_		217	(35)		Negative							
_	-	217	J[221]	-	Negative		-					
_	Girder	217	J[221]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	6.8985	ок	
_	-	210	(221)		Negative							
_	Girder	218	[221]	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	6.8985	ок	
	-	218	J[222]	-	Negative	•	-	-	-		-	
_	Girder	218	J[222]		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	7.5440	ок	
_	Girder	219	222	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	7.5440	OK	
_	-	219	2222	-	Negative		-					
_		219	J[40]	•	negative					-		
	Girder	219	J[46]	-	Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1,0000	0.9500	7.6553	ок	
	-	220	[46]	-	Negative		-					
-	Girder	220	£40)		Positive	Strength LS Case_DC-Before(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A V(My-Max)	1.0000	1.0000	0.9500	7.6648	OK	
-	Girder	220	3[223]		Positive	Strength L5 Case_DC-Defore(MAX)_DC-After(MAX)_DW(MAX)_T(+)_TG(+)_A V(My-Max)	1.0000	1.0000	0.9500	11.2703	OK	
_		220	1003		riegative							
_	-	221	(223)		Negative	•						
	Girder	221	223		Positive	Strength LS Case_DC-Before(MAX)_DC-Arter(MAX)_DW(MAX)_T(+)_TG(+)_A.V(My-Max)	1.0000	1.0000	0.9500	11.2703	OK	

#### **Strength Limit State Summary** DC(Before) DC(After) Capacity, PhiMn (ft\*kips) LRFD Capacity, PhiFn Positive/ Relative Demand, fbu Winimum Demand, Mu Rating Case Location Resistance Force (ft\*kips) Force (t\*kips) Negative Rating Factor Location (ft\*kips) (kips/ft\*2) Factor Factor Factor (kipsift\*2) 0.0000 1.2500 -254.9106 1.2500 -12.3336 Strength LS Case\_DC-Before(MAX)\_DC-After -336.6924 4588.1723 10000 51006 403-0.0000 \*Note: Element 226-i is determined to be N.G **Shear Strength Rating Factor** LRFD Resistance Factor Relative Location Rating Factor System Factor Par 2.2532 2.4321 2.5291 2.5386 4.1564 4.4410 4.4410 4.5069 4.6077

#### **MIDASoft Inc**

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### Step14. Position for Rating Output

Po	sition for Rati	ng Outpu	t <b>-</b>	)
2	ption			
	Add/Replace	æ	🔘 Delete	
F	Part			
4	1 ©	נ 🔘	© I & J	I
F	Filters for Load	Rating S	Summary	
5	Strength (Fle	xure)		
	C Group	Substru	cture	-
	Strength (Sh	ear)		
	<ul><li>● All</li><li>○ Group</li></ul>	Substru	cture	-
	Service			
	All			_
	Group	Substru	cture	-
	6	Apply	Clo	se

Referring to the previous slide, Element 226-i is determined to be N.G through shear strength rating factor.

- 1. Properties> Position for Rating Output
- 2. Option: Add/Replace
- 3. Select Element 226-i
- 4. Select position: I
- 5. Strength(Flexure & Shear), Service: All
- 6. Click Apply button





### 1. Rating>Steel Bridge>Excel Report

I. Flexure       I. I										Kesu	CHECK RE	FR		ААЗП
Item Positive/ Negative       Mif       Capacity       Dead Load       Live Load         29       1       HL = 33 Inventory       Positive/       M       61364.553       48076.833       28449.875         29       1       HL = 33 Inventory       Positive/       M       61364.553       48076.833       28449.875         Where,       -       -       -       -       -       -       -         Mif $\frac{1}{10000000000000000000000000000000000$													re	1. Flexu
Item       Part       Loom       Positive/ Negative       M/f       Capacity       Dead Load Demand       Live Load Demand         29       L       Dead Load Demand       Dead Load Demand       Demand         28       L       Dead Load Demand       Live Load Demand         M/f       I       Part Iso Positive for the ked with moment unit (kips in)         M/f       I       "M"       I       "Part Iso Planue is checked with moment unit (kips in)       Im       Im <thim< th="">       Im       Im       Im</thim<>														
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Elem.       Part       Loom       Positive/ Negative       Mit       Capacity Capacity       DeadLoad Demand       Demand Demand       Demand Demand         23       I       HL-33 Inventory       Positive       M       61364.553       48076.833       28443.875         Where.       Negative       -       -       -       -       -       -       -         Where.       -								_		_				
$ \begin{array}{c c c c c c c } \hline \begin{tabular}{ c c c c } \hline \begin{tabular}{ c c c c c } \hline \begin{tabular}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c } \hline \begin{tabular}{ c c c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Rating Facto	Load and	Live L Dem	Load and	Dead L Dema	ity	Capac	M/f	ositive/ egative	P) Ne	Lcom		Part	Elem.
	0.467	3.875 -	28449.875		48076.893		61364.5 -	M -	ositive egative	vry P N	HL - 93 Inventory -		Т	29
$\begin{array}{c c c c c c c c c c c c c c c c c c c $														Where
$ \begin{array}{c c c c c c c } \hline Mit & i & flexure is of eccel at its stress unit (kg) & i & i & i & i & i & i & i & i & i & $						-in)	t unit (kins	men	ad with mo	hecke	Elevure is ch		"M"	where,
$ \begin{array}{c} \label{eq:result} I = \frac{1}{2}  \bead Load Demand \\ I = \frac{1}{2}  $							e on ne (nep. est (kei)		a mana	shooko	Flour rois oh		1	M/f
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $									ano	a Dem	Lood Domon	-	capacity	R.F =
Measure Type:       Displacement       Sective? $k_{c}$ (in)										ana	e Load Demand	Live		
Elem.       Part       Loom       Positive/ Negative $\varepsilon_{c} / \Delta_{c} (in)$ $\varepsilon_{c} / \Delta_{c} (in)$ $K_{c}$ $K_{b}$ $K_{b}$ $K_{b}$ 23       1       HL - 93 Inventory       Positive       0.000E+00       1.000E+00       0.000       1.000E         newlich:       -										ent	Displacement		е Туре :	Measur
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Bating Factor         Elem.       Part       Lcom       Capacity (kips)       Dead Load Demand (kips)       Live Load Demand (kips)         29       1       HL-93 Inventory       375.105       -81.923       -66.117       -66.117         /here,       -<														. Shear
$\begin{array}{c c c c c c c c c c c c c c c c c c c $												т	g Facto	l) Ratin
Lieff     Park     Loom     Capacity (kips)     (kips)     Demand (kips)       29     I     HL-93 Inventory     375.105     -81.923     -66.117       Where, RF     -     -     -     -     -       Measure Type:     Displacement     -     -     -       Elem.     Park     Loom $\varepsilon_c / \Delta_c (in)$ $K_{\bullet}$ $K_{\bullet}$ K       23     I     HL-93 Inventory     0.000E+00     1.000E+00     0.000     1.000	Davia a Falan	Load	Live l	emand	d Load D	Dea	().;= _)	14					Deat	El
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Measure Type :         Displacement         Elem.         Part         Lcom         ε <sub>ε</sub> / Δ <sub>ε</sub> (in)         ε <sub>ε</sub> / Δ <sub>ε</sub> (in)         K <sub>4</sub> K <sub>b</sub> K           29         I         HL - 93 Inventory         0.000E+00         1.000E+00         0.000         1.000         1.000										and	e Load Demano	Live		
Elem.         Part         Loom         ε <sub>ε</sub> / Δ <sub>ε</sub> (in)         ε <sub>ε</sub> / Δ <sub>ε</sub> (in)         K <sub>a</sub> K <sub>b</sub> K           29         I         HL-93 Inventory         0.000E+00         1.000E+00         0.000         1.000         1.000           nwhich: </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>ent</td> <td>Displacemen</td> <td></td> <td>e Type :</td> <td>Measur</td>										ent	Displacemen		e Type :	Measur
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														n which
$\epsilon_{c} [\Delta_{c}]$ : maximum calculated strain (displacement) of top or bottom position				tion	tom posit	or bot	nt) of top	ceme	in (displa:	ed strai	num calculated	axim	1°] : u	ε.(/
$K = 1 + K_a \times K_b$											K.	(, s I	= 1+1	к
$K_a = \frac{\epsilon_c}{\epsilon_c} -1$												-1	= 20	— K.