

2016 MIDAS Complex Bridge Test Drive Event



Lucas Park(CAE Consultant)
E mail: Lucaspark@midasit.com

MIDAS STEEL COMPOSITE TEST DRIVE EVENT

STEEL COMPOSITE BRIDGE EVENT

May.09	Steel Composite Bridge Analysis & Design <ul style="list-style-type: none"> - Different Modeling Methods - Modifying a model from Wizard - Analysis / Design
May.11	Cable Stayed Bridge Analysis <ul style="list-style-type: none"> - Modeling through Wizard/Modification - Auto-adjusting Cable Pretension forces - Construction Stages
May.12	Suspension Bridge Analysis <ul style="list-style-type: none"> - Modeling through Wizard/Modification - Auto calculation of tensions in main Cables and Coordinates - Steel column design of irregular sections

Steel Composite Test Drive Event 05/16/2015

Tutorial Based Modeling

Skewed, Curved Bridge

Overview

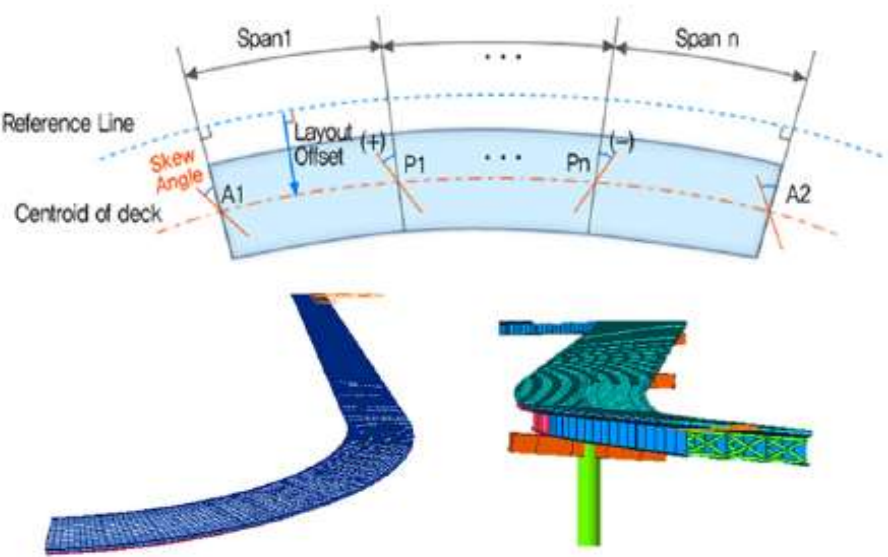
- Bridge overview**
 - ✓ 3 span continuous composite girder bridge
 - ✓ Span length: 1@80 ft, 1@100ft & 1@80ft
 - ✓ Carriageway width: 31 ft
 - ✓ Unit system: Kip, ft
- Lane definition**
 - ✓ Notional lanes
 - ✓ Location and numbering of the lanes
- Vehicle load**
 - ✓ Load Model
- Moving load analysis option**
 - ✓ Concurrent forces
- Result evaluation**
 - ✓ Shear Force Diagram(CS1 to CS3)
 - ✓ Moment Diagram(CS1 to CS3)
 - ✓ Truss Forces Table
 - ✓ Moving Load MV ALL
 - ✓ Support Reaction @ Last CS

Program Version	Civil 2016
Program License	Registered, Trial
Revision Date	May 05, 2016

1

MIDAS Information Technology Co., Ltd.

Multi-Curve Option Explanation



About MIDAS

Company Size

540

Engineers

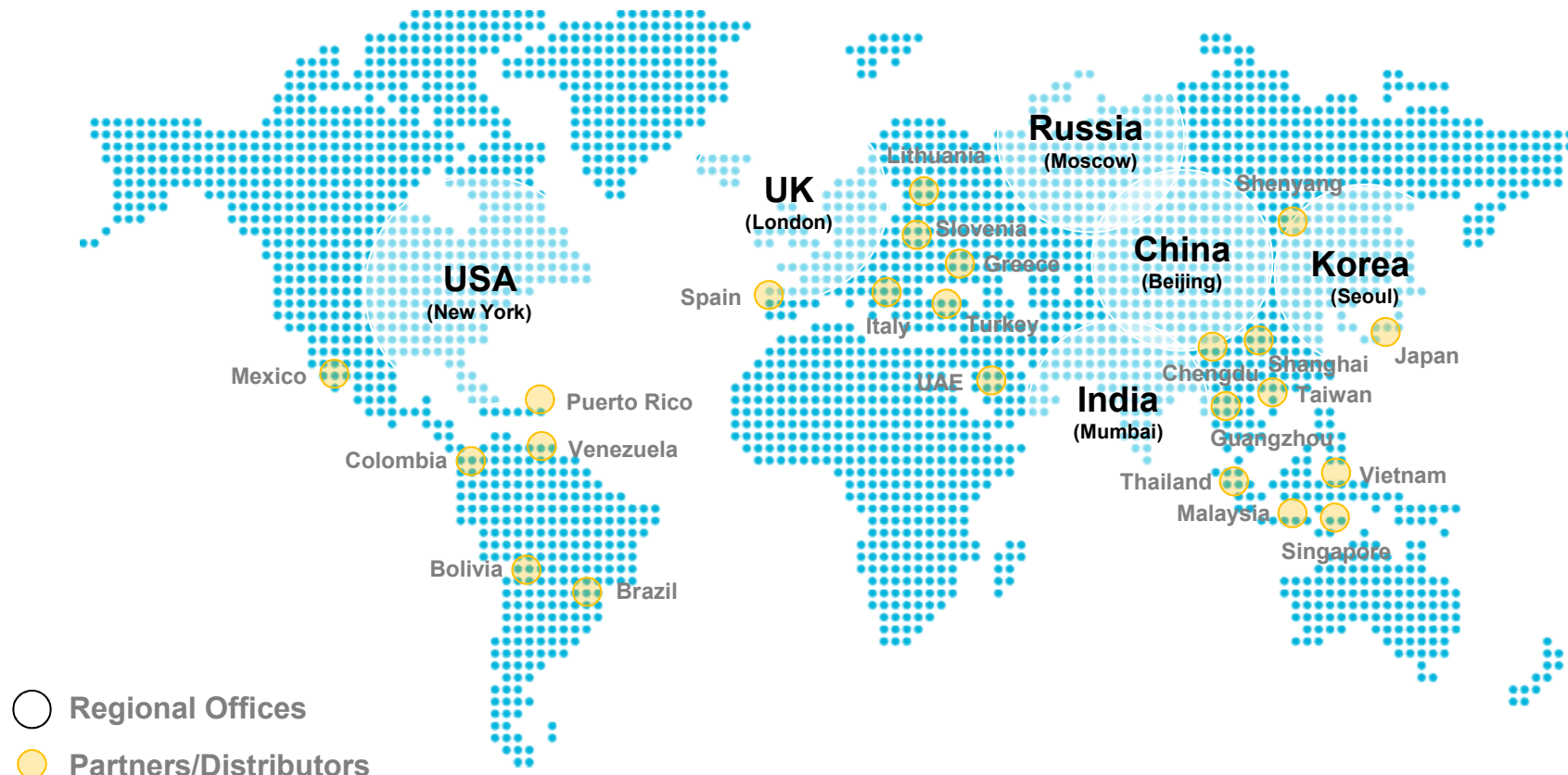
Established

1989





World wide existence



○ Regional Offices

● Partners/Distributors

8

Branch Offices

100,000

Number of Licenses

→ “Biggest CAE Software Developer” in Civil Engineering

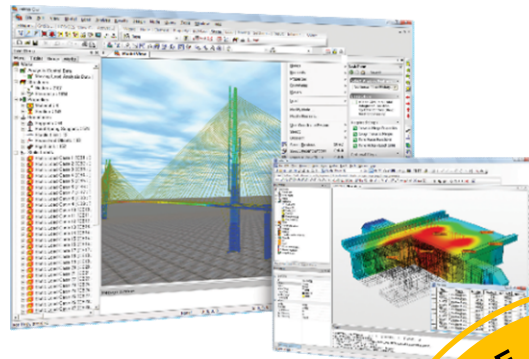
Bridge

midas Civil

Integrated Solution System for Bridge and Civil Structures

midas FEA

Advanced Nonlinear and Detailed Analysis System



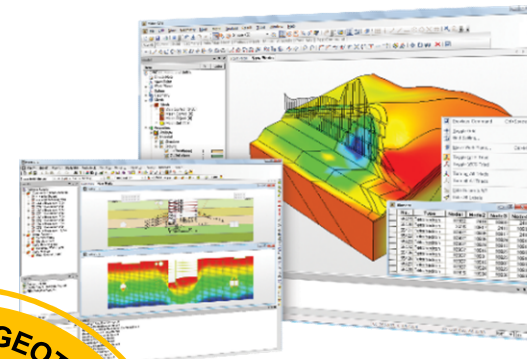
Geotechnical

GTS NX

GeoTechnical analysis System

SoilWorks

Geotechnical Solutions for practical Design



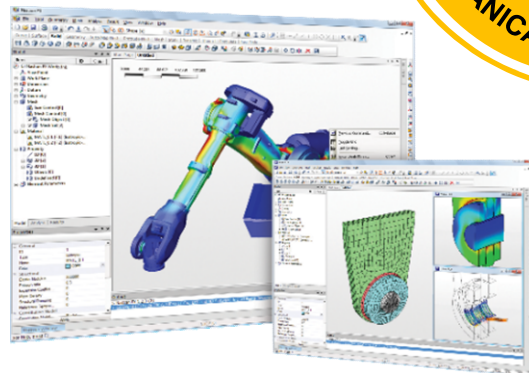
Mechanical

midas NFX

Total Solutions for Mechanical Engineering in structural Mechanics and CFD

midas FX+

General Pre & Post Processor for Finite Element Analysis



Building

midas Gen

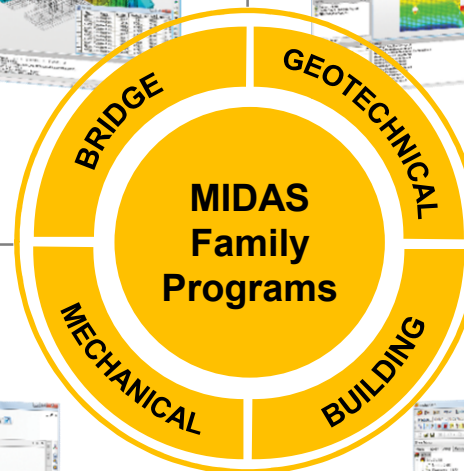
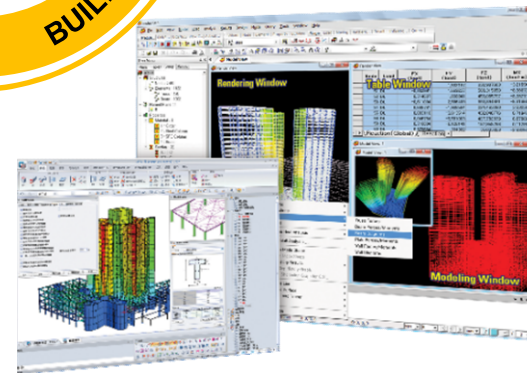
Integrated System for building and General Structures

midas DShop

Auto-Drawing Module and generate Structural drawing and Bill of Materials

midas Design+

Structural engineer's tools

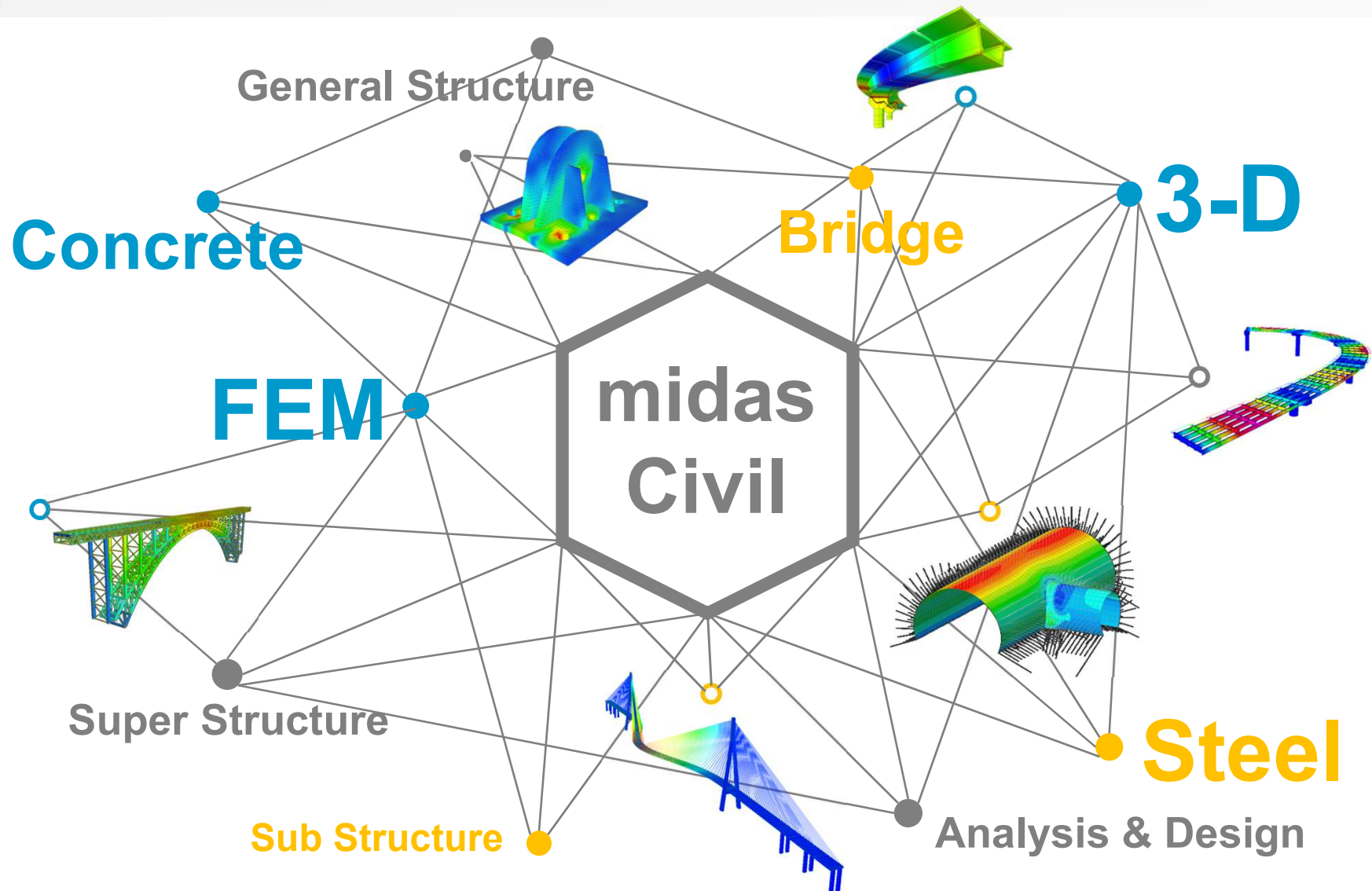


→ USERS Across North America (partial list)





midas Civil Bridge Engineering Software



→ What kind of bridge type can midas Civil handle?

Conventional Bridge



Culvert



Frame Bridge



Slab Bridge



Precast (Spliced)
Girder Bridge



Integral Bridge



Steel Plate (Flare)
Girder Bridge



Steel Box Girder
Bridge

Staged Segmental Bridge



Balanced
Cantilever Method
Bridge



Incremental
Launching Method
Bridge



Movable
Scaffolding
Method Bridge



Precast Segmental
Method Bridge



Fill Staging Method
Bridge

Cable-stayed Bridge & Suspension Bridge



Cable Stayed
Bridge



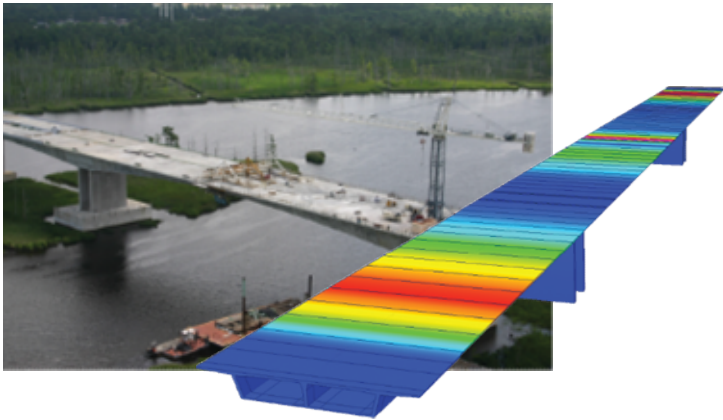
Extra-dosed Bridge



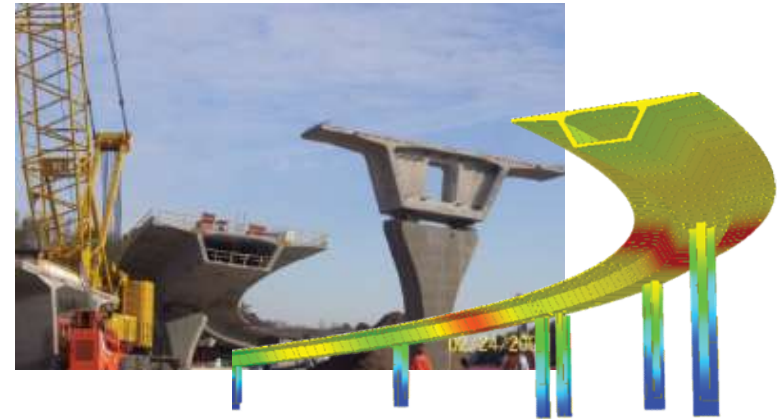
Suspension Bridge

→ Few project examples - USA

US 17 Wilmington By Pass in USA



Lee Roy Selmon Flyovers in FL USA



Port Access Bridge, Alaska

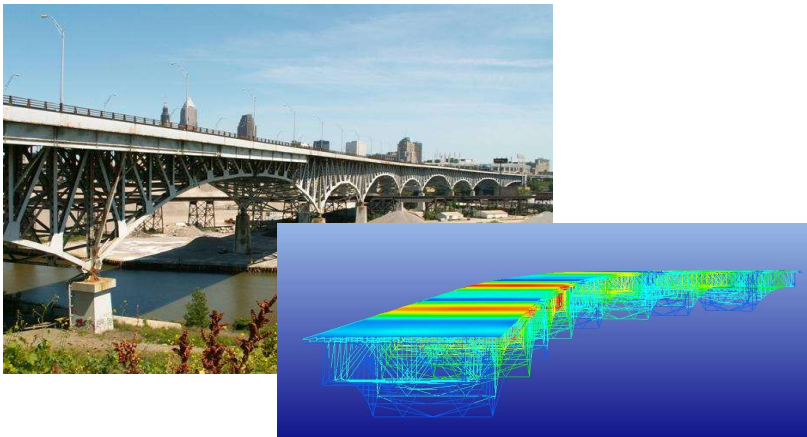


Galena Creek bridge in NV USA

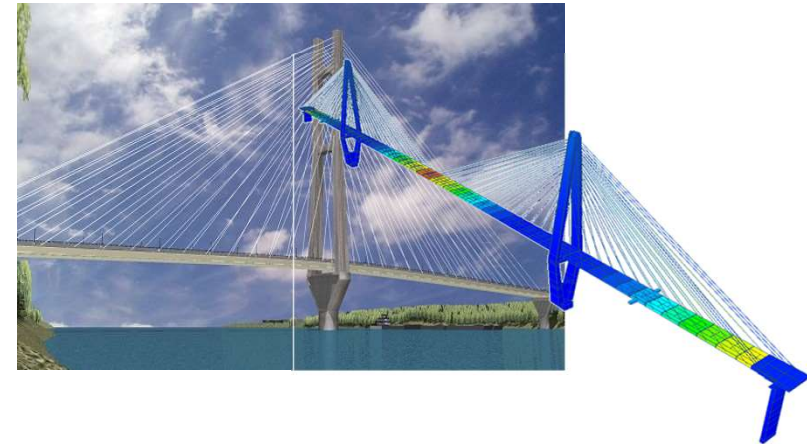


→ Few project examples - USA

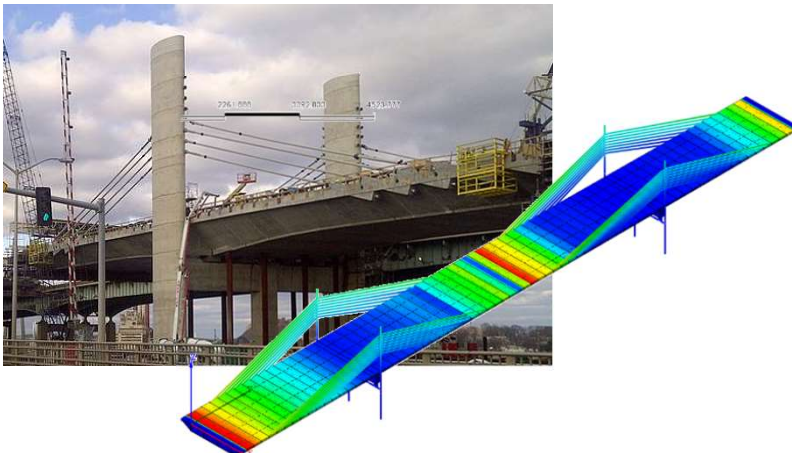
Innerbelt Bridge in Cleveland OH



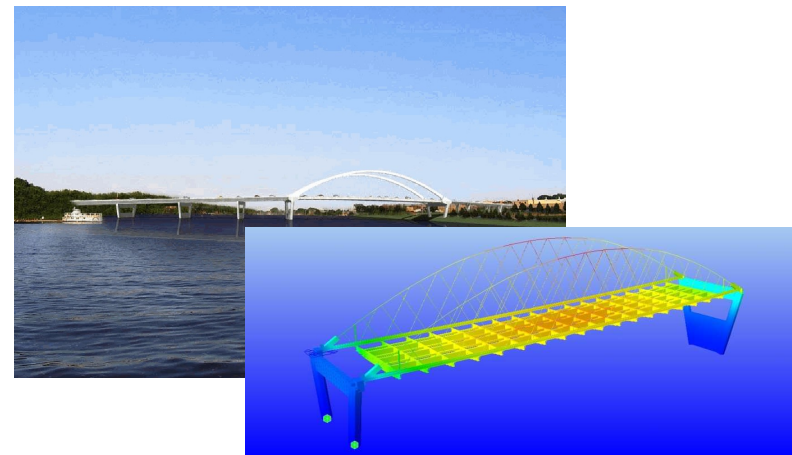
Ironton-Russell Bridge



Pearl Harbor Memorial Bridge



Hastings Bridge

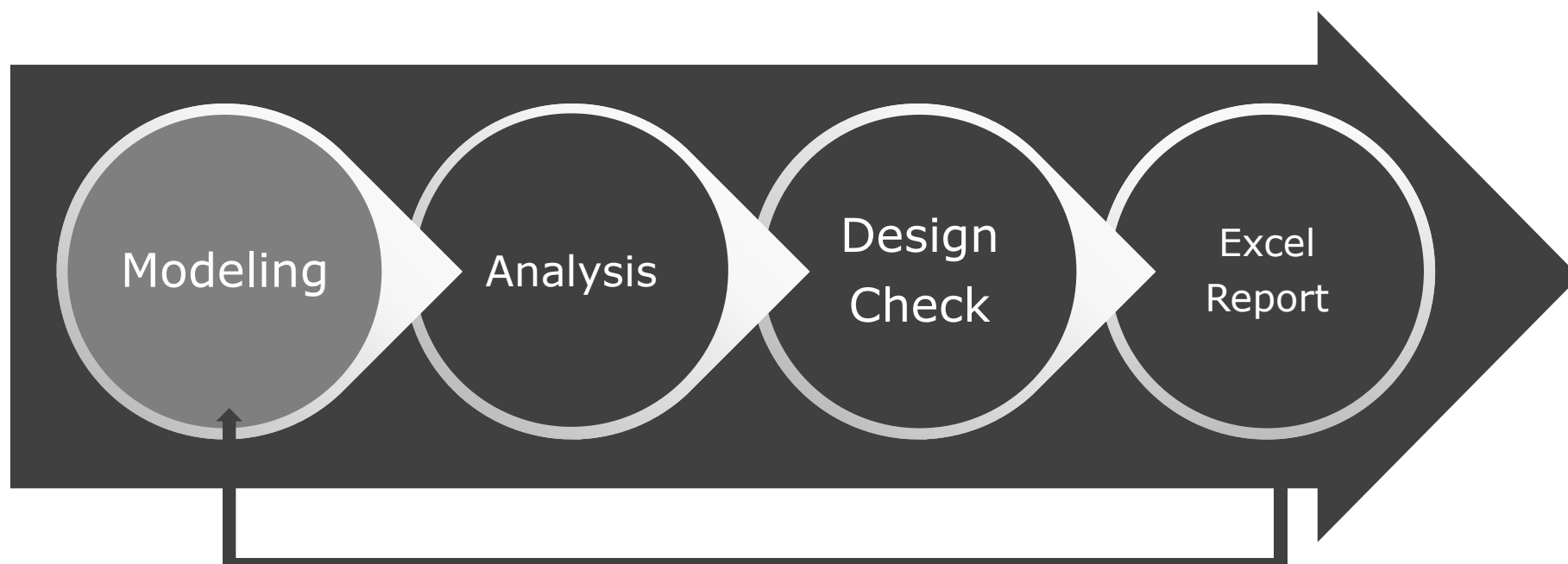




Overview

- **Modeling Part**
 - Wizard Part
 - Auto CAD
 - Generate different modeling types
- **Analysis**
 - Review Result Value
 - Moment/Shear/Stress/Deflection/Reaction
- **Design Check Parameter**
- **Excel Report**

→ Demonstration

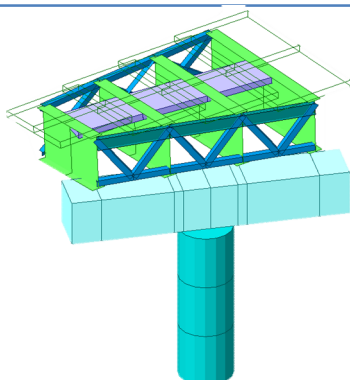


- Wizard
- Node & Element
- Drawing Program
- Modeling Type
 - Plate Element
 - Frame Element
- Static Load Analysis
- Moving Load Analysis
- Flexure Strength
- Shear
- Constructability
- Servicability
- Auto-Generation

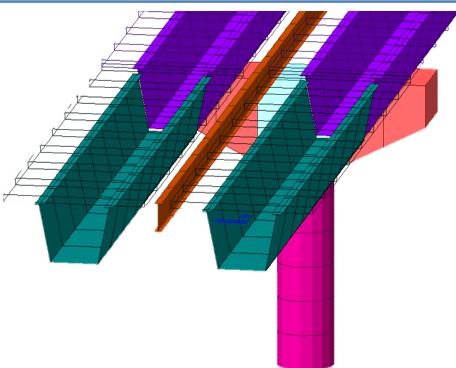
→

All Types of Steel Girder

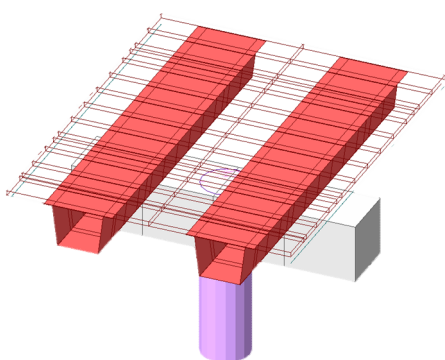
Steel-I Girder



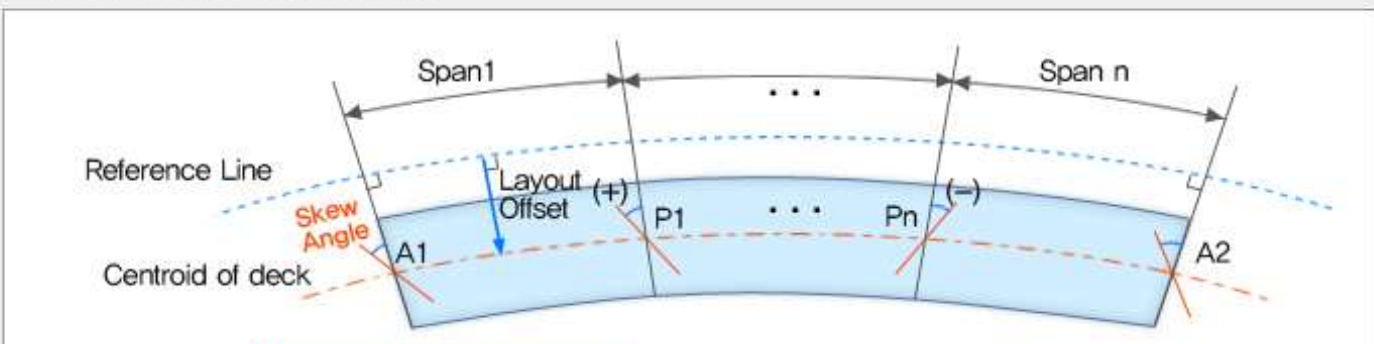
Steel-Tub Girder



Steel-Box Girder



Layout | Section | Load | Construction Stage



The diagram illustrates a curved bridge deck with multiple spans labeled 'Span 1', '...', and 'Span n'. A dashed line represents the 'Reference Line'. The 'Centroid of deck' is shown as a solid line. 'Layout Offset' is indicated as the distance between the reference line and the centroid. Points 'A1', 'P1', '...', 'Pn', and 'A2' are marked along the deck. A 'Skew Angle' is shown at point A1. The layout offset is labeled as '(+)' for the first span and '(-)' for the last span.

Girder Type

Composite Steel I

Composite Steel I

Composite Steel Box

Composite Steel Tub

Span Information

Support Skew Angle

☐ Radius

0

ft

Type

☒ Concave

☐ Convex

Modeling Type

All Frame

ft Deck Width

43

ft

Layout Offset

0

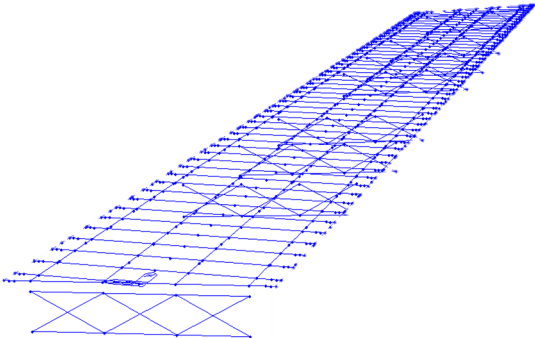
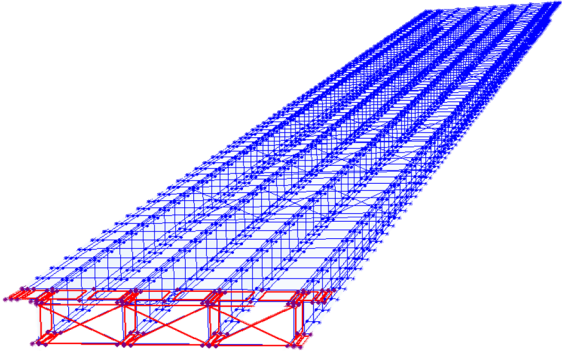
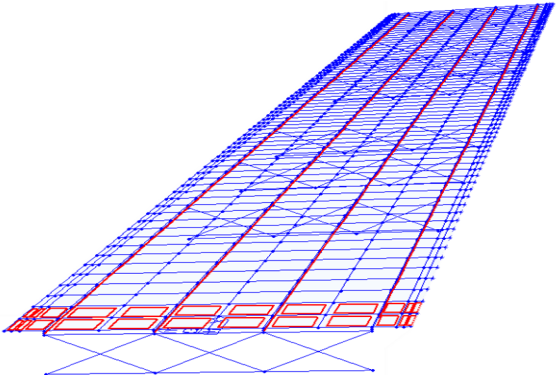
ft

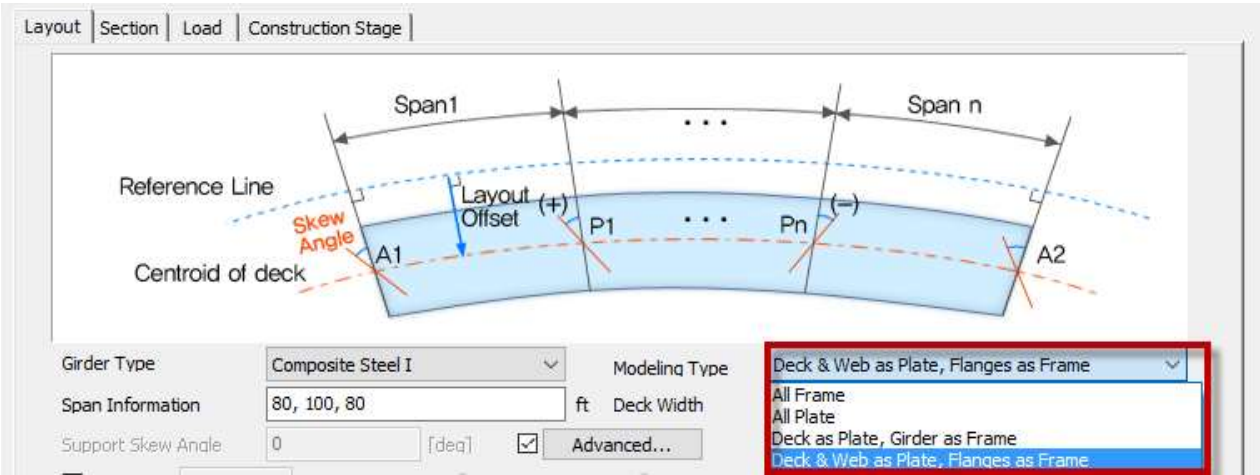
☐ Multi-Curve

Advanced...

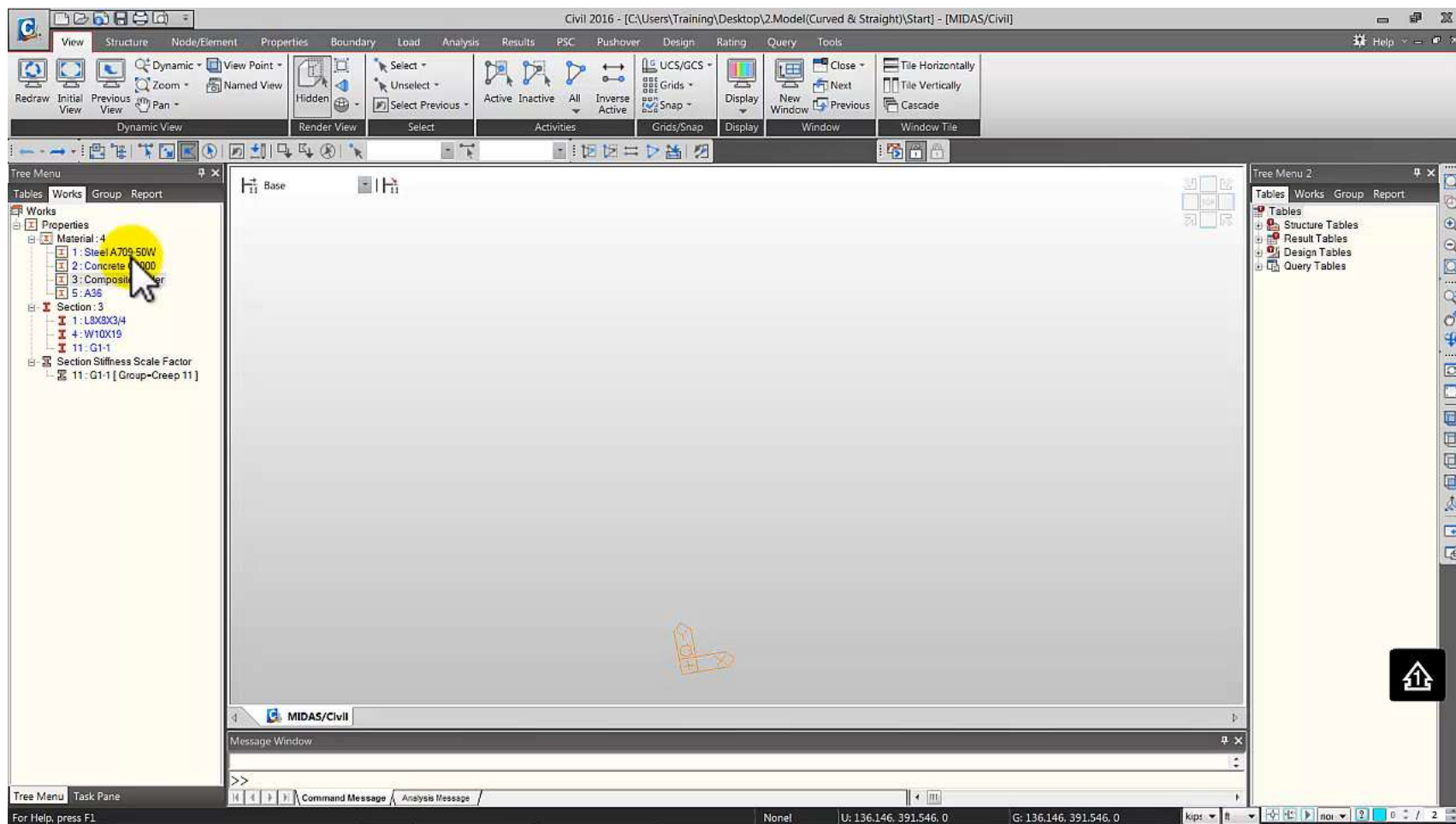
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All Modeling Type

All Frame	All Plate	Deck as Plate & Girder as Frame
		



→ Drawing Program Import/Export



➔ Load Combination(Envelope)

Auto-Generation

Load Combinations

General | Steel Design | Concrete Design | SRC Design | Composite Steel Girder Design

Load Combination List

No	Name	Active	Type	Description
1	scLCB1	Stren	Add	Strength-I: 1.75M[1], 1.25(cD)
2	scLCB2	Stren	Add	Strength-II: 1.35M[1], 1.25(cD)
3	scLCB3	Stren	Add	Strength-IV: 1.50(cD), 1.50(cD)
4	scLCB4	Servi	Add	Service-I: 1.00M[1], 1.00(cD)
5	scLCB5	Servi	Add	Service-II: 1.30M[1], 1.00(cD)
6	scLCB6	Servi	Add	Service-III: 0.80M[1], 1.00(cD)
7	scLCB7	Servi	Add	Service-IV: 1.00(cD), 1.00(cD)
8	scLCB8	Servi	Add	Fatigue-I: 1.50M[1], 1.00(cD)
9	scLCB9	Servi	Add	Fatigue-II: 0.75M[1], 1.00(cD)

Load Cases and Factors

LoadCase	Factor
MVL(MV)	1.7500
Dead Load	1.2500
Erection L	1.2500
Erection L	1.5000
Creep Sec	0.5000
Shrinkage	0.5000

Automatic Generation of Load Combinations

Option
☒ Add ☐ Replace

Code Selection
☐ Steel ☐ Concrete ☐ SRC ☒ Steel Composite

Design Code : AASHTO-LRFD 12

Manipulation of Construction Stage Load Case
☐ ST Only ☐ CS Only ☒ ST+CS
ST : Static Load Case CS : Construction Stage

Load Modifier : 1

☒ Load Factors for Permanent Loads (Yp)

Load Factor for Settlement : 1

☐ Structural Plate Box Structures(Metal Box Culverts)

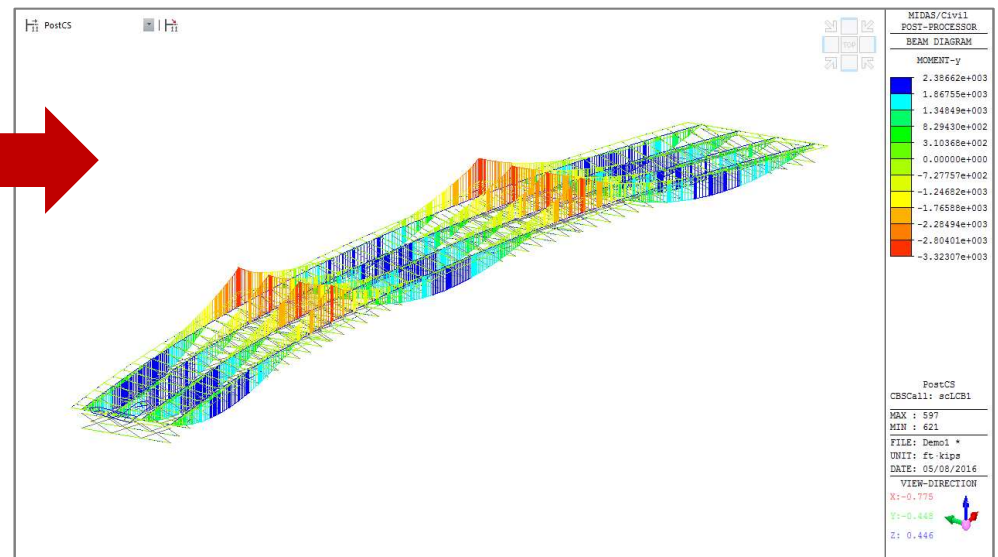
Condition for Temperature
☐ Deformation Check ☒ All Other Effects

File Name: C:\Users\Wswpar\W\Desktop\WSteel Model\WDemo 1.lcp

Copy Import... Auto Generation... Spread Sheet Form

OK Cancel

Moment/Shear Values(Envelope)



→

Design Check Output

Table Format

Span	Positive/ Negative	Strength Limit(Flexure)				
		Elem	part	Lcom	Mu/Mr	CHK
S1-L	Pos	107	I[117]	scLCB1	0.66	OK
S1-R	Pos	386	I[296]	scLCB1	0.40	OK
S2-L	Pos	93	I[104]	scLCB1	0.49	OK
S2-R	Pos	32	I[47]	scLCB1	0.34	OK
S3-L	Pos	417	I[327]	scLCB1	0.32	OK
S3-R	Pos	360	J[35]	scLCB1	0.24	OK
S4-L	Pos	404	I[314]	scLCB1	0.15	OK
S4-R	Pos	347	I[257]	scLCB1	0.15	OK

Graph Format



Automatic Excel Report Format

II. Strength Limit State - Flexural Resistance

1. Flexure

■ Positive moment

- Flange Lateral bending Stress (AASHTO LRFD Bridge, 2012, 6.10.1.6)

Because of discretely braced tension flange (for curved bridge)

$$f_l = \frac{M_u}{S_l} = \frac{M_w}{t_{ft}(b_{ft})^2/6} = \frac{545.359}{108.000} = 5.050 \text{ ksi}$$

→ List of Design Check

Required Design Parameter

- Check Strength Limit State
- Check Service Limit State
- Check Fatigue Limit State
- Check Constructability
- Check Shear Connector
- Check Longitudinal Stiffener

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC						
54	II. Strength Limit State - Flexural Resistance																																		
55	1. Flexure																																		
56	■ Positive moment																																		
57	1) Design Forces and Stresses																																		
58	Loadcombination Name										sclCB1																								
59	Loadcombination Type										FX-MAX																								
60	Component		M _u (kips-in)					V _u (kips)					T (kips-in)																						
61			Steel (M _{D1})	Long-term (M _{D2})	Short-term	Sum																													
62	Forces	(+)	14920.812	6476.404	21800.744	43197.960	-45.905	433.787																											
63																																			
64	Component		f _{c1} (ksi)																																
65			Steel (M _{D1})	Long-term (M _{D2})	Short-term	Sum																													
66	Stresses	Top	-5.698	-1.029	-1.384	-8.111																													
67		Bot	5.281	1.960	6.112	13.353																													
68																																			
69	2) Cross-section Proportions																																		
70	① Web Proportions (AASHTO LRFD Bridge, 2012, 6.10.2.1)																																		
71	D	=	138.000	≤	150																							 OK						
72	t _w																																		
73																																			
74	② Flange Proportions (AASHTO LRFD Bridge, 2012, 6.10.2.2)																																		
75	b _f	=	4.500	≤	12																							 OK						
76	2t _w																																		
77	b _f	=	16.000	≥	D/6	=	11.500																					 OK						
78	t _f	=	2.000	≥	1.1t _w	=	0.550																					 OK						
79	I _{yc}	=	$\frac{t_{fc} \cdot b_{tc}^3}{12}$	=	682.663	in ⁴																													
80	I _{yt}	=	$\frac{t_{ft} \cdot b_{tt}^3}{12}$	=	972.002	in ⁴																													
81	I _{yt}	=	$\frac{t_{ft} \cdot b_{tt}^3}{12}$	=	972.002	in ⁴																													
82	0.1	≤	$\frac{I_{yc}}{I_{yt}}$	=	0.702	≤	10.0																					 OK						
83																																			
84																																			
85																																			
86	3) Flexural Strength Limit State in positive flexure																																		
87	■ Section Classification (AASHTO LRFD Bridge, 2012, 6.10.6.2)																																		
88	min (F _{yc} , F _{yt})	=	50.000	ksi	≤	70.0	ksi																					 OK						
89	D	=	138.000	≤	150																							 OK						
90	t _w																																		
91	2 · D _{cp}	=	0.000	≤	3.76 √ $\frac{E_s}{F_{yc}}$	=	90.553																					 OK						
92	t _w	=	0.000	≤	3.76 √ $\frac{E_s}{F_{yc}}$	=	90.553																												
93	in which :																																		
94	D _{cp}	=	0.000	in																															
95																																			
96	. Compact section.																																		

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THANK YOU

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