

Release Note

Release Date : Nov. 11, 2023

Product Ver. : Civil 2024 (v1.1)



Enhancements

Enhancements in Civil 2024 (v1.1)

- Pre & Post processing

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2. Equivalent Beam Stress Results for Construction Stage Analysis
3. HL-93TDM considering 100% combined effect of two tandems as per AASHTO LRFD Vehicle Load
4. Time Dependent Material as per IRC 112: 2020
5. Response Spectrum function as per SP 268.1325800.2016
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- Design

7. KDS 24 14 31 : 2018 (강구조 한계상태설계법)의 General Section Design 지원
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9. Steel Composite Design as per AS 5100.6:2017
10. RC, Steel, Steel Composite, and PSC Design as per AASHTO LRFD 2020
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12. Steel Composite Design as per CSA-S6-19
13. Design of Solid web girder as per IRS SBC:2017
14. Other Enhancements



1. Plate Thickness Temperatures

- 열응력 해석에서 Plate 요소의 두께 방향에 대한 비선형 온도를 적용 가능함.
- Plate 두께 온도 기능은 Plate 요소를 슬래브로, 보요소를 거더로 구성한 합성거더에 적용 가능함.

Load > Temperature Loads > Plate Thickness Temperatures

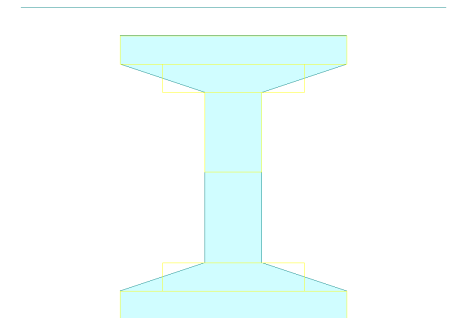
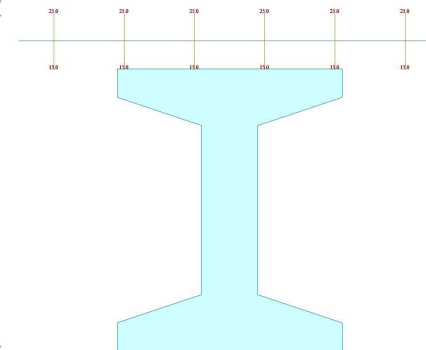
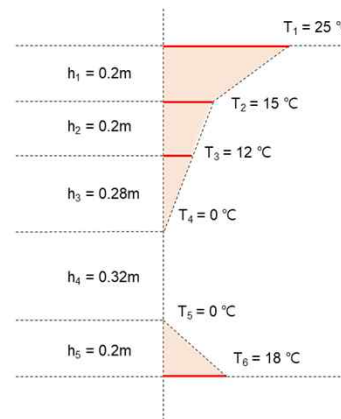
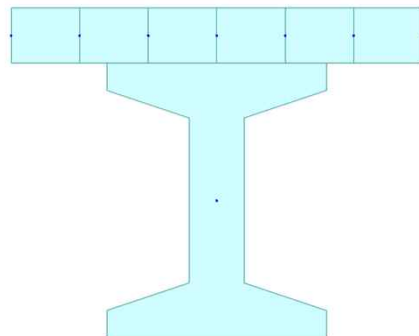
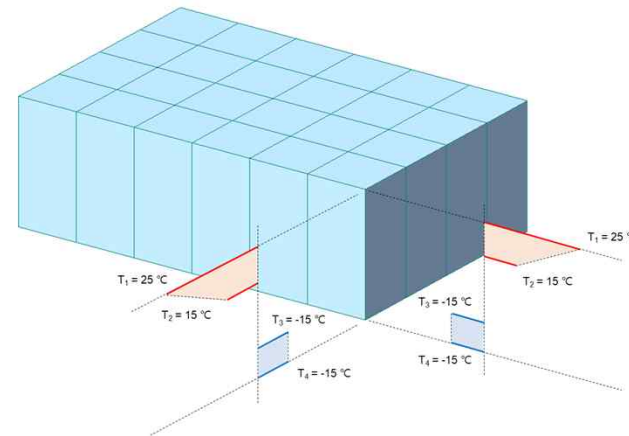
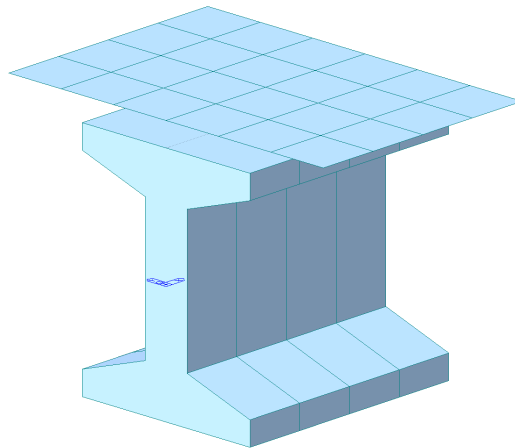
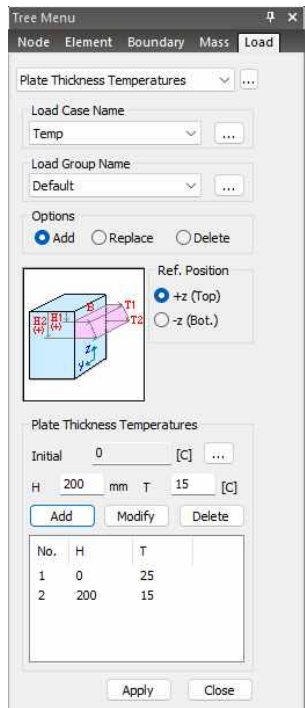


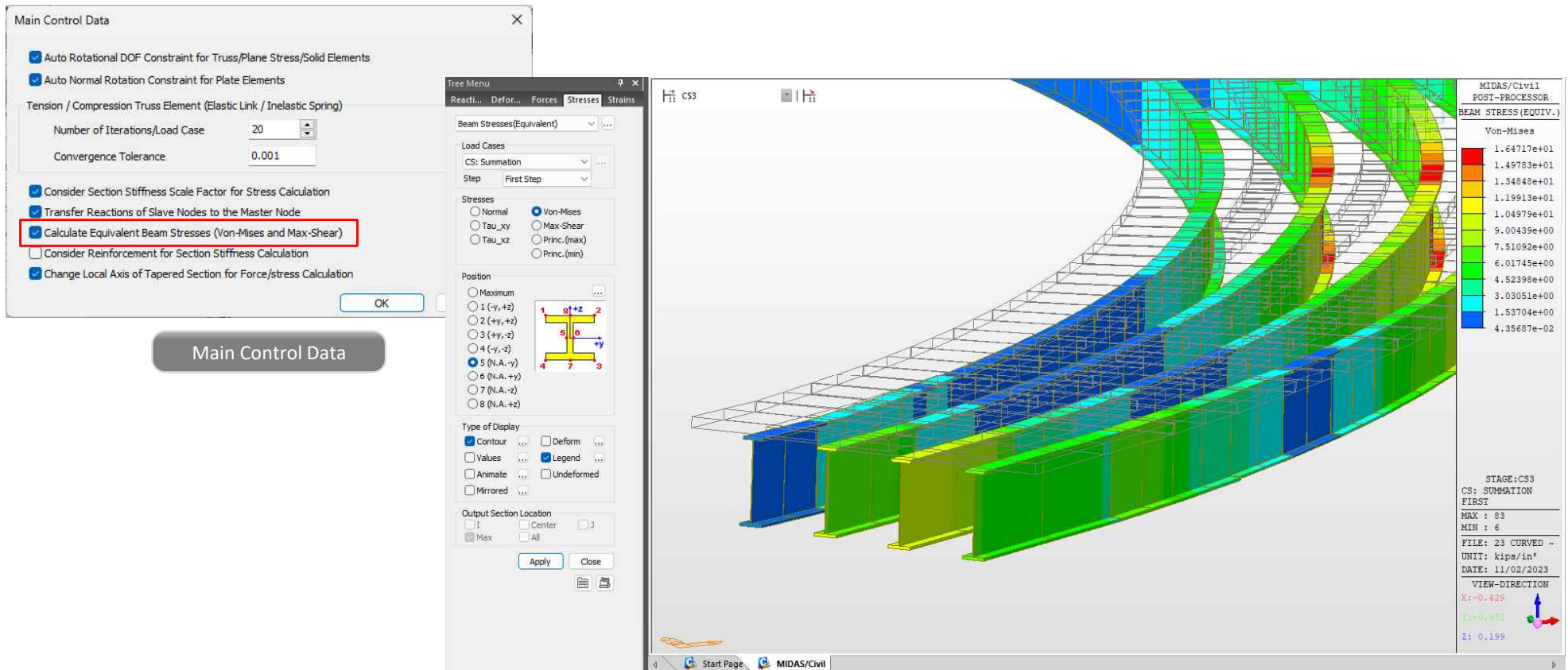
Plate Thickness Temperatures

Beam Section Temperatures

2. Equivalent Beam Stress Results for Construction Stage Analysis

- 시공단계해석의 Steel Composite Section에 대한 Von-Mises 응력을 포함한 Equivalent Beam Stress를 제공함.
- Steel-I (Type 1), Steel-Tub (Type 1), and Steel-Box (Type 1) 에 대한 단면에 적용 가능함.

■ Results > Stresses > Beam Stresses(Equivalent)



Von-Mises Stresses at Centroid of Steel Composite Section

3. HL-93TDM considering 100% combined effect of two tandems as per AASHTO LRFD Vehicle Load

- According to C3.6.1.3.1 AASHTO LRFD 2020, one hundred percent of the combined effect of the two design tandems and the design lane load should be used to investigate negative moment and reactions at interior supports.
- HL-93TDM vehicle load in AASHTO LRFD Load provides the option to consider the combined effect.

▪ Load > Load Type > Moving Load > Vehicle > AASHTO LRFD Load

Define Standard Vehicular Load

Standard Name
AASHTO LRFD Load

Vehicular Load Properties

Vehicular Load Name :
HL-93TDM

Vehicular Load Type :
HL-93TDM

Dynamic Load Allowance :
0 %

(a)

(b)

Lane Support-Neg. Moment/ Reaction		Application
Not assigned		a
Assigned		a, b

No	Load(kips)	Spacing(ft)	W	0.64	kips/ft
1	25	4	D2	26	ft
2	25	end	D3	40	ft

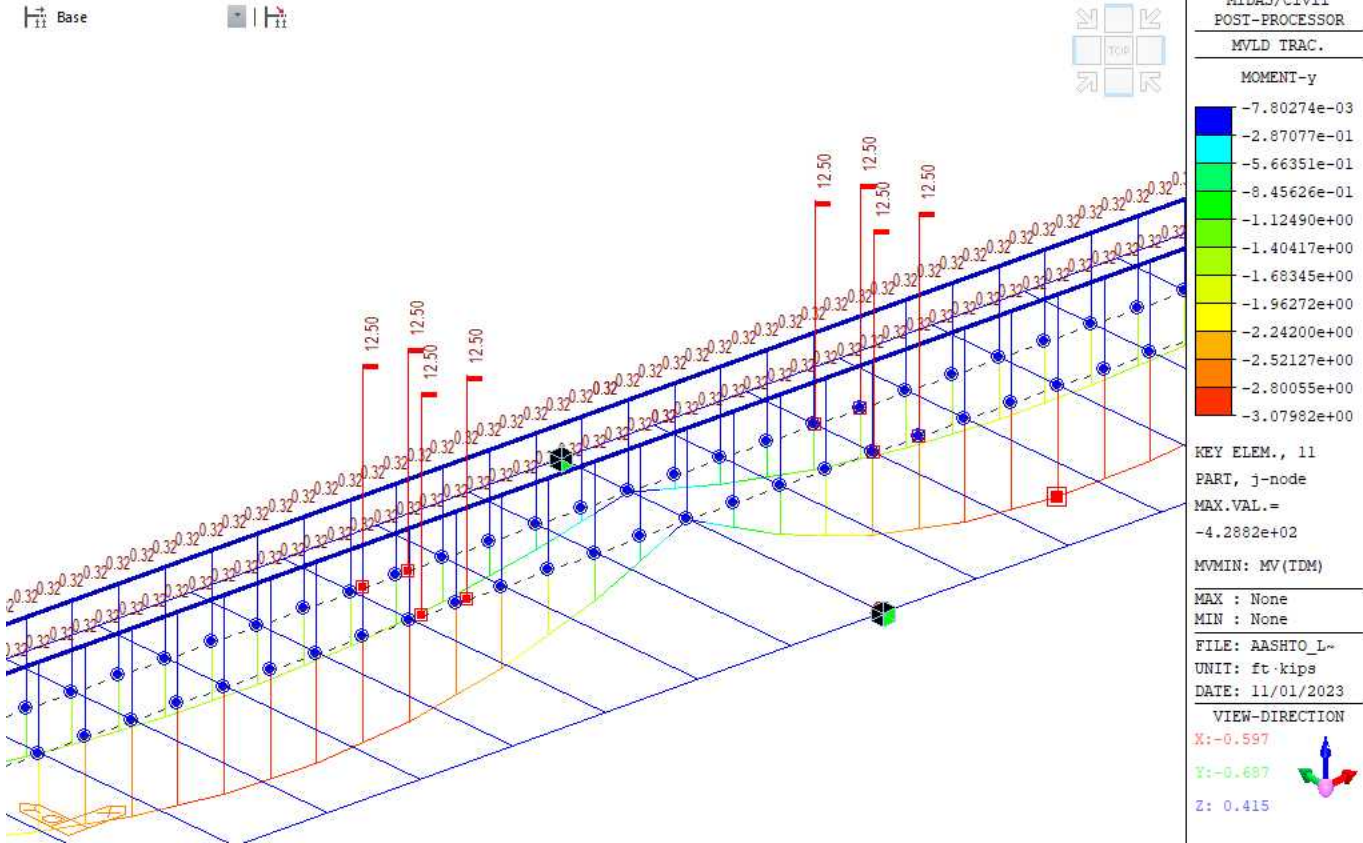
☐ Add Centrifugal Force

☒ Consider Two Tandems in Adjacent Spans

OK

Cancel

Apply



Vehicular Load

4. Time Dependent Material as per IRC 112: 2020

- The time dependent materials for creep/shrinkage and compressive strength as per IRC 112:2020 can be applied.

- Properties > Time Dependent Material > Creep/Shrinkage**
- Properties > Time Dependent Material > Compressive Strength**

Add/Modify Time Dependent Material (Creep / Shrinkage)

Name : Creep shrinkage Code : INDIA(IRC:112-2020)

INDIA(IRC : 112-2020)

Compressive strength of concrete at the age of 28 days : 35 N/mm²

Relative Humidity of ambient environment (40-99) : 70 %

Notional size of member : 700 mm

$h = 2 * A_c / u$ (A_c : Section Area, u : Perimeter in contact with atmosphere)

Type of cement

☐ Slow setting cement

☒ Normal cement

☐ Rapid hardening cement

Age of concrete at the beginning of shrinkage : 3 day(s)

Type of aggregate Basalt, dense limestone aggregates

Show Result... OK Cancel Apply

Time Dependent Material(Creep/Shrinkage)

Add/Modify Time Dependent Material (Comp. Strength)

Name C35 Scale Factor 1.0 Graph Options ☐ X-axis log scale ☐ Y-axis log scale

Type ☒ Code ☐ User

Development of Strength

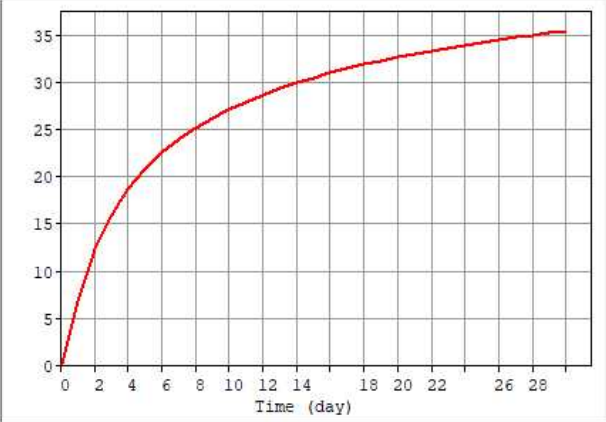
Code : INDIA(IRC:112-2020)

Mean compressive strength of concrete at the age of 28 days ($f_{ck} + \Delta f$) 35 N/mm²

Cement Type(s) Slow Setting cement

Aggregate Type Basalt, dense limestone aggregates:1.2

Redraw Graph



OK Cancel

Time Dependent Material(Compressive Strength)

5. Response Spectrum function as per SP 268.1325800.2016

- The Response Spectrum function provides the design spectrum as per SP 268.1325800.2016.

▪ Load > Load Type > Dynamic Loads > Response Spectrum Functions

Generate Design Spectrum

Design Spectrum : SP 268.1325800.2016

Design Spectral Response Acceleration

Region Seismicity: 7

Soil Category: I

K1 Factor: 0.5

K2 Factor: 1

K3 Factor: 1

K4 Factor: 1

KPsi Factor: 1

Max. Period : 6 (Sec)

OK Cancel

Add/Modify/Show Response Spectrum Functions

Function Name: SP 268.1325800.2016

Spectral Data Type: ☒ Normalized Accel. ☐ Acceleration ☐ Velocity ☐ Displacement

Scaling: ☒ Scale Factor 1 ☐ Maximum Value 0 g

Gravity: 32.171 ft/sec²

Damping Ratio: 0.05

Graph Options: ☐ X-axis log scale ☐ Y-axis log scale

	Period (sec)	Spectral Data (g)
1	0.0000	0.0500
2	0.0600	0.0950
3	0.1000	0.1250
4	0.1200	0.1250
5	0.1800	0.1250
6	0.2400	0.1250
7	0.3000	0.1250
8	0.3600	0.1042
9	0.4200	0.0893
10	0.4800	0.0781
11	0.5400	0.0694
12	0.6000	0.0625
13	0.6600	0.0568
14	0.7200	0.0521

Description: SP 268.1325800.2016: Region=7, Soil=S1, K1=0.50, K2=1.00, K3=1.00, K4=1.00, KPsi=1.0

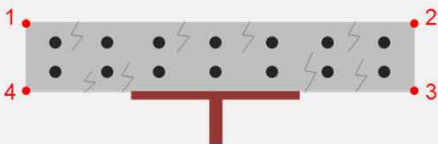
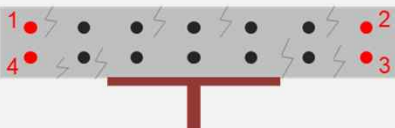
OK Cancel Apply

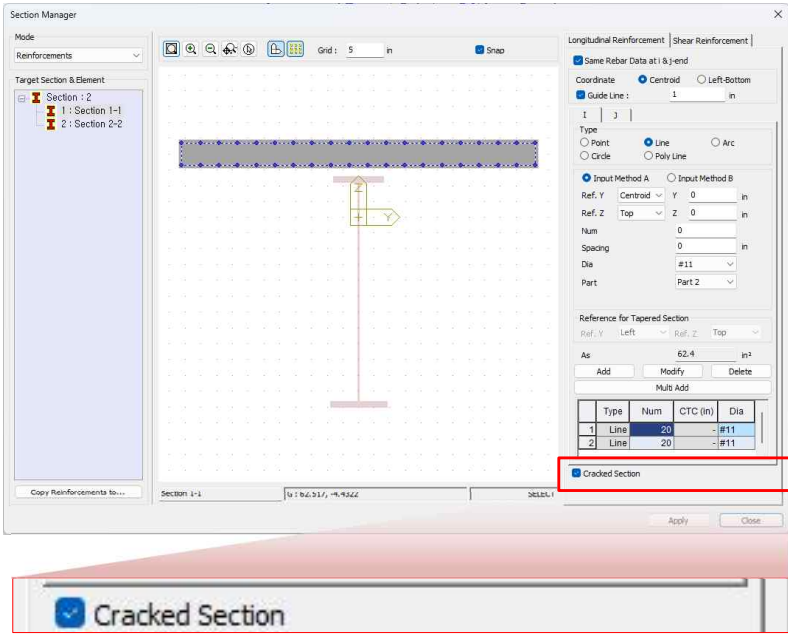
Response Spectrum Functions

6. Stress Calculation for Part2 of Composite Section with Cracked Section option

- The effect of the cracked section option has changed.

- Properties > Section Manager > Reinforcements > Cracked Section
- Results > Stresses > Beam Stresses
- Results > Stresses > Beam Stresses Diagram

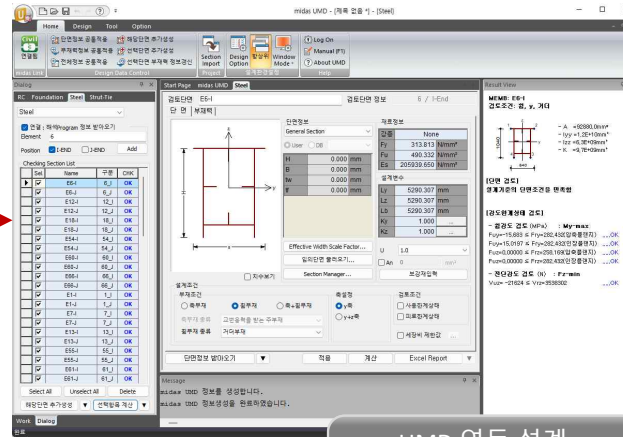
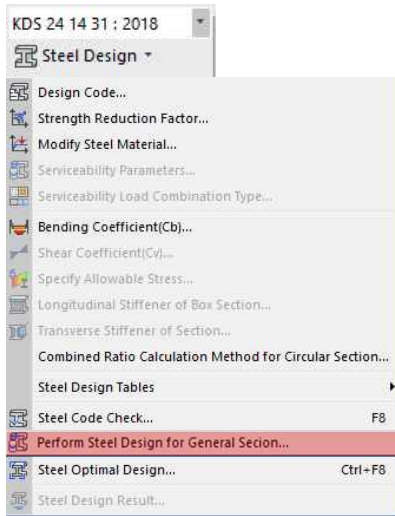
Cracked Section	Previous versions	Civil 2024 (v1.1)
Stress points of Part 2	The corners of a slab section. 	Rebars placed at corners of a slab. 
Stresses of Part 2	Calculate the stresses in the concrete, and hence zero stress value.	Calculate the stresses in the rebars.



7. KDS 24 14 31 : 2018 (강구조 한계상태설계법)의 General Section Design 지원

- DB 단면이 아닌 임의형상 강재 단면에 대한 한계상태설계법 지원
- Stiffener 와 같은 보강재 배치에 대한 설계지원

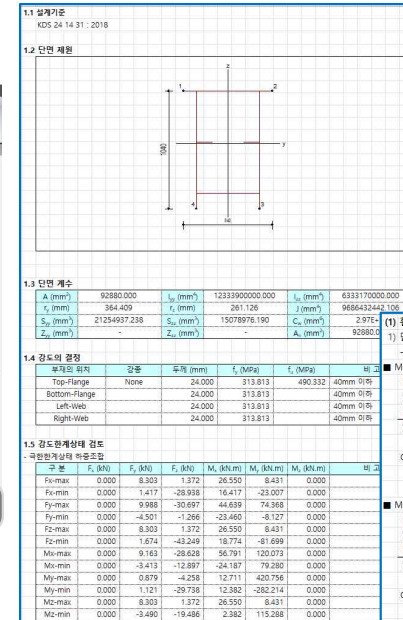
Design > Steel Design > KDS 24 14 31 : 2018 > Perform Steel Design for General Section



UMD 연동 설계



General Section with Steel Design Group



Excel Detail Report

(1) 용접도 검토

1) 단면비 검토

- 복부판의 세장비 검토 (KDS 14 31 10 : 2017 4.3.3.1.2.1)

Member Type : Left-Web

D = 900.000 mm

t_w = 24.000 mm

D = 900.000 = 37.500 ≤ 150.0

t_w = 24.000

여기서, D₁ : 만성영역내에서 압축을 받는 복부판의 높이 (mm)

f_t : 설계하중에 의한 압축응축력의 응력 (MPa)

Member Type : Right-Web

D = 900.000 mm

t_w = 24.000 mm

D = 900.000 = 37.500 ≤ 150.0

t_w = 24.000

여기서, D₁ : 만성영역내에서 압축을 받는 복부판의 높이 (mm)

f_t : 설계하중에 의한 압축응축력의 응력 (MPa)

2) 용접도 검토

- 용접지 용력강소계수 결정

① 복합단면의 용접지 용력강소계수 R_h 결정

R_h = 1.000 (KDS 14 31 20 : 2017 4.3.3.1.1.10)

② 복부판 극부외굴을 고려한 용접지 용력강소계수 R_h 산정

③ 압축응축력 (KDS 14 31 20 : 2017 4.3.3.1.8.2)

Member Type : Top-Flange

Left-Web

Right-Web

④ 인장응축력 (KDS 14 31 20 : 2017 4.3.3.1.8.3)

Member Type : Bottom-Flange

R_h = 1.000

- 압축응축력의 용접도 검토 (KDS 14 31 20 : 2017 4.3.3.2.8.2)

Member Type : Top-Flange

- n = 0 일 경우

k = 4.0

0.57 √ $\frac{KE}{F_{t\Delta}}$ = 0.57 × √ $\frac{4.000}{313.813} \times \frac{1.000}{1.000}$ = 29.204

Δ = √ $1 - 3(f_{t\Delta}/F_{t\Delta})^2$ = 1

f_t × $\frac{w}{t_w} = \frac{600.000}{24.000} = 25.000 \leq 0.57 \sqrt{\frac{KE}{F_{t\Delta}}} = 29.204$

F_{th} = R_hF_tΔ = 313.8128 Mpa

w = 600.000 mm

t_w = 24.000 mm

25.000 ≤ 1.12 √ $\frac{KE}{F_{t\Delta}}$ = 66.301

w = 600.000 mm

t_w = 24.000 mm

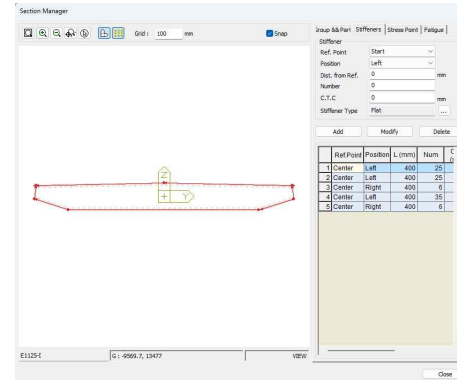
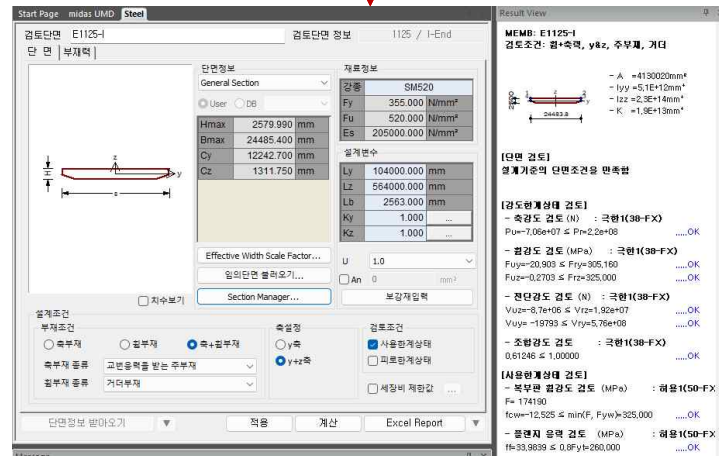
25.000 ≤ 1.40 √ $\frac{KE}{F_{t\Delta}}$ = 82.877

F_{th} = 0.58F_t = 182.01142 Mpa

- DB 단면이 아닌 임의형상 강재 단면에 대한 한계상태설계법 지원
- Stiffener 와 같은 보강재 배치에 대한 설계지원

The image displays a 3D model of a cable-stayed bridge. Three red circles are placed on the bridge deck, with red lines extending from them to three separate software windows at the bottom of the image.

- Start Page:** This window shows the project name 'midas UMD Steel'. It includes tabs for '검토단면 E1125-1' (Check Section E1125-1) and '단면 부재력' (Section Member Forces). The '단면정보' (Section Information) and '자료정보' (Data Information) tabs are visible.
- Result View:** This window displays the results for 'MEMB: E1125-1'. It specifies the '검토조건: 휨+축력, y&z, 주부재, 거더' (Check Condition: Bending + Axial, y&z, Main Member, Girder). The result shows a value of $-A = 4150000 \text{ mm}^2$.
- Section Manager:** This window shows the 'Incap All Part' and 'Stiffness' settings. It includes a 'Show Part' button and a 'Femap' button. The 'Ref. Point' is set to 'Start', and the 'Position' is set to 'Left'.



[1] 국한1(38-FX) (국한1(38-FX))									
하중 조합	검토위치	y (mm)	z (mm)	발생응력 (MPa)	검토위치	y (mm)	z (mm)	발생응력 (MPa)	
국한1(38-FX)		1	-12241.900	983.408	57.598	2	12241.900	983.408	58.146
	3	12142.200	-274.219	-37.722	4	-12142.200	-274.219	-38.266	

(7) 측강도 검토
1) 압축강도 검토
- 압축부재의 세장비 검토 (도로교통건설상설시험법 6.9.3 참고)
$K_y L_y / r_{yy} = 1.00 \times \text{*****} / 1116.506 = 93.148 < 120.0$OK
$K_z L_z / r_{zz} = 1.00 \times \text{*****} / 7393.291 = 76.285 < 120.0$OK
여기서,
K_y : y축에 대한 유효길이계수
K_z : z축에 대한 유효길이계수
L_y : y축에 대한 비지지길이 (mm)
L_z : z축에 대한 비지지길이 (mm)
r_{yy} : y축에 대한 단면 회전반경 (mm)
r_{zz} : z축에 대한 단면 회전반경 (mm)

■ Member Type: Top-Flange
 k = 0.450 (기타 물음부재 : 기타 경우의 전 물음물)

$$\frac{b}{t} = \frac{250.050}{80.000} = 3.126 \leq k \sqrt{\frac{E}{F_y}} = 0.450 \times \sqrt{\frac{205,000}{325,000}} = 11.302 \quad \text{비제장부재}$$

여기서, b : 표 6.9.1에 규정한 물린치의 폭 (mm)
 t : 물린치의 두께 (mm)
 k : 판자굴개수
 F_y : 부재에 발생하는 최대압축응력 (MPa)

- 압축률정지 (압입이 지지면)				
k =	1.400	(바스킨과 단면의 물관치와 설계한 폭부단간 순간격차에 내부 모서리 반경을 뺀 거리)		
b =	42682.221			
t =	80.000	=	533.528 > $k \times \frac{F_c}{F_y}$	= 1.400 × $\sqrt{\frac{205000.0}{325.000}}$
				= 35.161
생장부재				
여기서, b : 폭60.9의 규정된 물관치의 폭 (mm) t : 물관치의 두께 (mm) F _c : 판교굴곡수 F _y : 부재에 발생하는 최대압축응력 (MPa)				

■ Member Type : Bottom-Flange

- 압축플랜지 (압단이 지지판 판)

$k = \frac{1.400}{38224.947} = 477.812 > k_v = \frac{E}{f_y} = 1.400 \times \frac{205000.0}{325.000} = 35.161$ **세장부재**

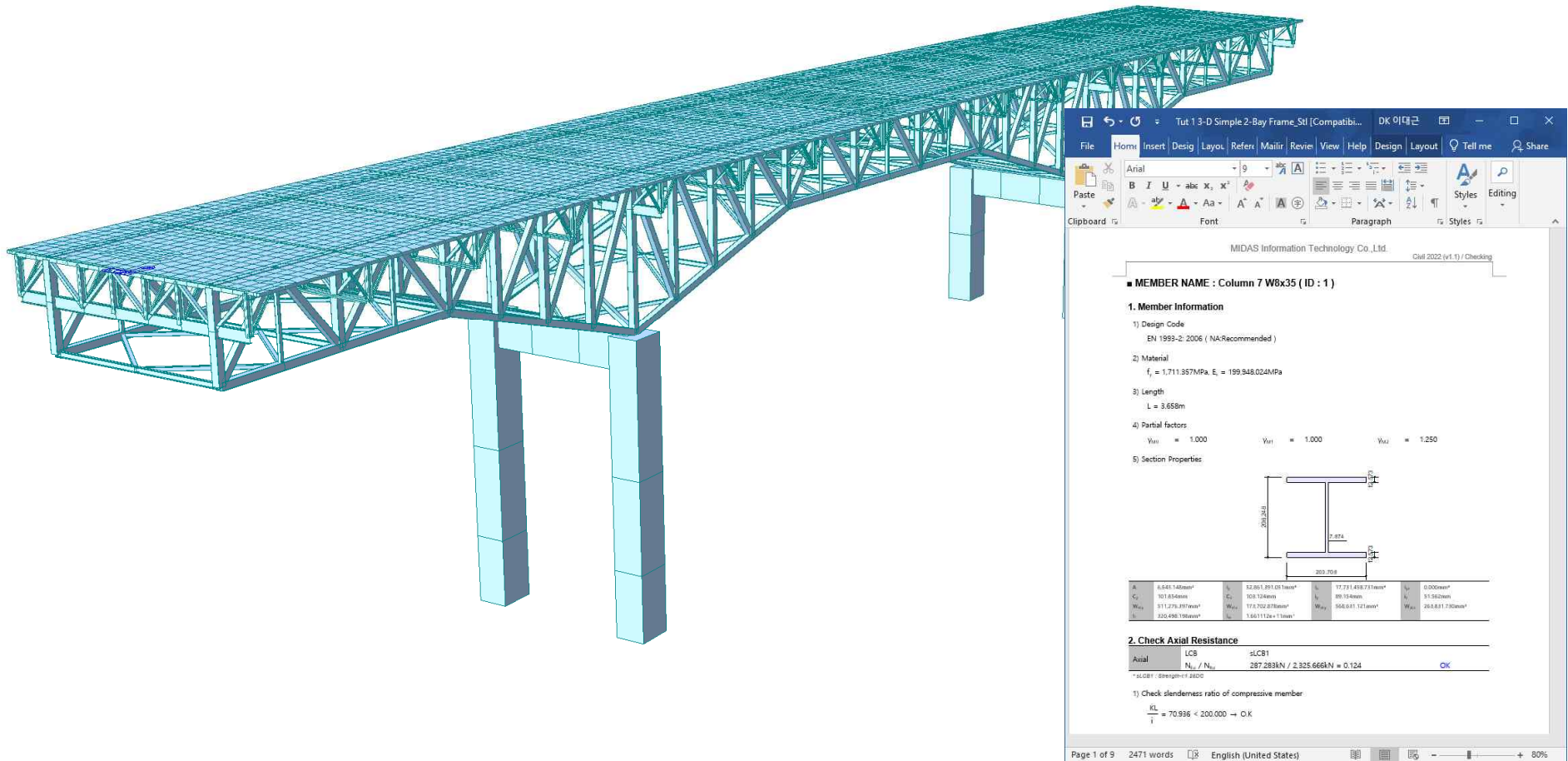
여기서, b : 표 6.9.1에 규정한 플랜지의 폭 (mm)
t : 플랜지의 두께 (mm)
k : 단축계수
E : 보기에 표시되는 치재(아연도금, MPa)

다수의 종방향 보강재 배치

8. Design Calculation Speed

- The multithreading을 활용한 설계 계산이 적용
- 테스트 모델의 경우 설계 계산 시간이 약 40% (40min → 16min)으로 단축됨.
 - Test model 조건 : 2844 beam elements, steel code check as per AASHTO LRFD 2017

Design



9. Steel Composite Girder Design as per AS 5100.6: 2017

- Steel plate girder and tub/box girder with composite slab can be designed for strength, service, and constructability based on AS 5100.6: 2017.
- The results of the code checks can be viewed graphically, in tables and in a detailed report.

■ Design > Steel Design > Design Code

Composite Steel Girder Design Parameters

Code : AS 5100.6:2017 Update by Code

Capacity reduction factor

ULS

Member subject to bending for flexure	0.9
Member subject to bending for web in shear	0.9
Member subject to bending for stiffener	0.9

SLS

Member subject to bending for shear connectors	1
--	---

Ultimate Limit State

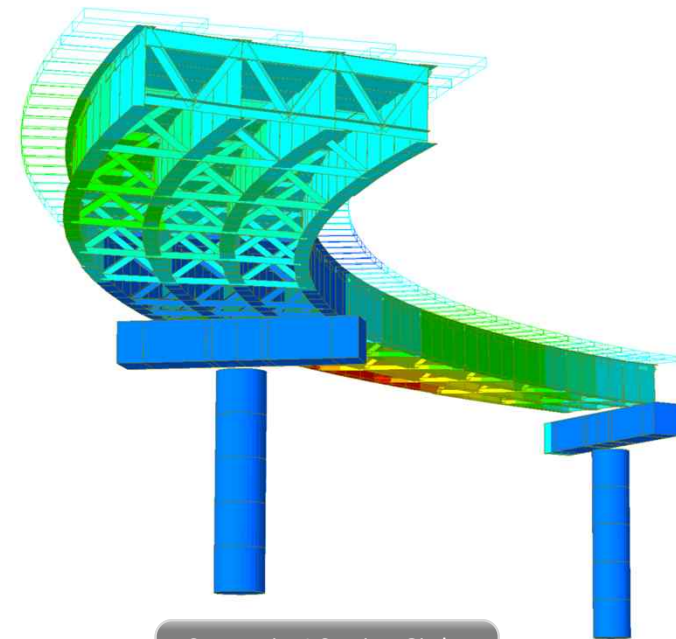
- ☒ Flexure
- ☒ Shear
- ☒ Flexure & Shear & Torsion for Box Girders with Longitudinal Stiffeners
- ☒ Constructibility

Serviceability Limit State

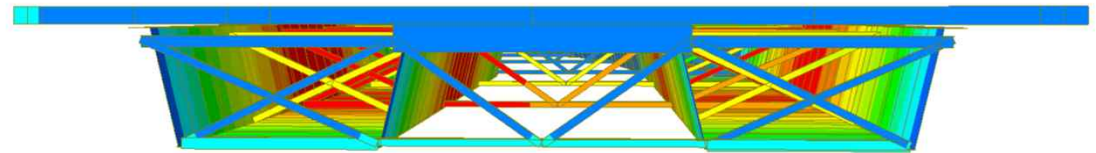
- ☒ Crack Control of Slab
- ☒ Longitudinal Shear

OK Cancel

Design Parameter



Composite I-Section Girder



Composite Box Girder

9. Steel Composite Girder Design as per AS 5100.6: 2017

- To enhance local buckling resistance, longitudinal stiffeners can be positioned in both the web and the box flange.

Design > Composite Design > Longitudinal Reinforcement

Name

LS1

Type

Flat

H

200

mm

B

20

mm

Add

Modify

Delete

Name	Type
LS1	Flat

Stiffener

Position

☐ Both ☐ Left ☒ Right

Reference of d

☐ Top ☒ Bottom

N Left

0

N Right

1

N Bottom

0

N Top

0

C	d (mm)	Stiffener
☒	500	LS1

OK

Cancel

Name

T

Type

Tee

H

125.6

mm

B

146.1

mm

tw

6

mm

tf

8.6

mm

Add

Modify

Delete

Name	Type
T	Tee
Flat	Flat

Stiffener

Position

☒ Both ☐ Left ☐ Right

Reference of d

☒ Top ☐ Bottom

N Left

2

N Right

2

N Bottom

3

N Top

0

C	d (mm)	Stiffener
☒	1862.5	T
☒	800	T

C	d (mm)	Stiffener
☒	390	Flat
☒	390	Flat
☒	390	Flat

OK

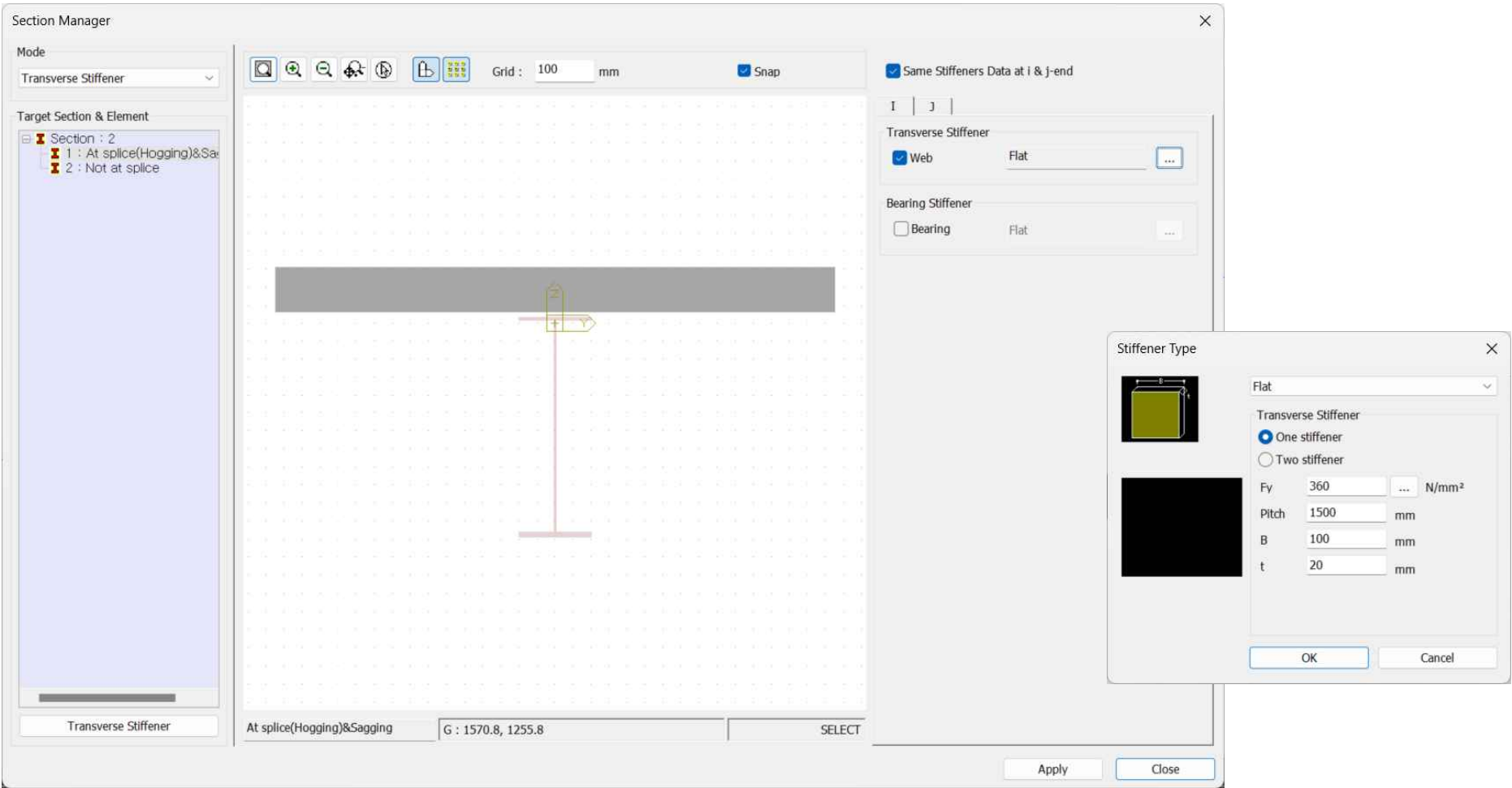
Cancel

Longitudinal Stiffener

9. Steel Composite Girder Design as per AS 5100.6: 2017

- Transverse intermediate stiffeners can be defined to increase the shear resistance of the web.

Design > Composite Design > Transverse Stiffener



Graphical Report

- Longitudinal reinforcement can be entered into the concrete slab. Cracked section will be applied to calculate stresses for the negative moments.

- The screenshot displays the 'Section Manager' software interface. The main workspace shows a cross-section of a beam with a grid of reinforcement points. The left panel, 'Target Section & Element', shows 'Section : 2' with two items: '1 : At splice(Hogging)&Sagging' and '2 : Not at splice'. The right panel, 'Longitudinal Reinforcement', has tabs for 'Longitudinal Reinforcement' and 'Shear Reinforcement'. Under 'Longitudinal Reinforcement', the 'Same Rebar Data at I & J-end' checkbox is checked. The 'Coordinate' is set to 'Centroid' and 'Guide Line' is '0'. The 'Type' is 'Line'. The 'Input Method A' is selected. The 'Ref. Y' is 'Centroid' with a value of '0' mm, and 'Ref. Z' is 'Top' with a value of '0' mm. The 'Num' is '0', 'Spacing' is '0' mm, 'Dia' is 'P5', and 'Part' is empty. The 'Reference for Tapered Section' shows 'Ref. Y' as 'Left' and 'Ref. Z' as 'Top'. The 'As' value is '8444.520000000' mm². Below this are 'Add', 'Modify', and 'Delete' buttons. A 'Multi Add' section contains a table with two rows of reinforcement data.

	Type	Num	CTC (m)	Dia
1	Line	21	-	P16
2	Line	21	-	P16

Longitudinal Reinforcement

9. Steel Composite Girder Design as per AS 5100.6: 2017

- Defining the plasticity and yield limits of the flange plates relies on categorizing the residual stress type.
- Headed studs can be checked for the serviceability limit state.

Design > Composite Design > Residual Stress Type

Residual Stress Type

Option

☒ Add/Replace

☐ Delete

☒ Both end parts(i & j) have the same Residual Stress Type

I | J |

Residual Stress Type

☐ SR

☐ HR

☒ LW

☐ HW

Residual stress (see Notes)	Plasticity limit (λ_{ep})	Stress distribution	Yield limit (λ_{ey})	Stress distribution
SR	10	Compression	16	Compression
HR	9		16	
LW, CF	8		15	
HW	8		14	
SR	30	Compression	45	Compression
HR	30		45	
LW, CF	30		40	
HW	30		35	

Residual Stress Type

Design > Composite Design > Shear Connector

Shear Connector

Option

☒ Add/Replace

☐ Delete

☒ Both end parts(i & j) have the same type

I | J |

Pitch

150

mm

Height

125

mm

Dia

...

22mm

Fu

...

420N/mm²

Transverse Spacing

200

mm

Num. of Shear Connectors

2

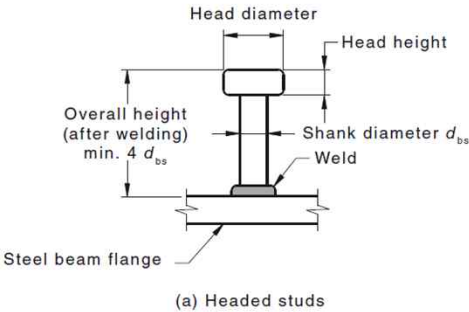
/row

Apply

Close

Longitudinal Shear

$$v_L^* = \frac{V^* A_t y_c}{I_t}$$

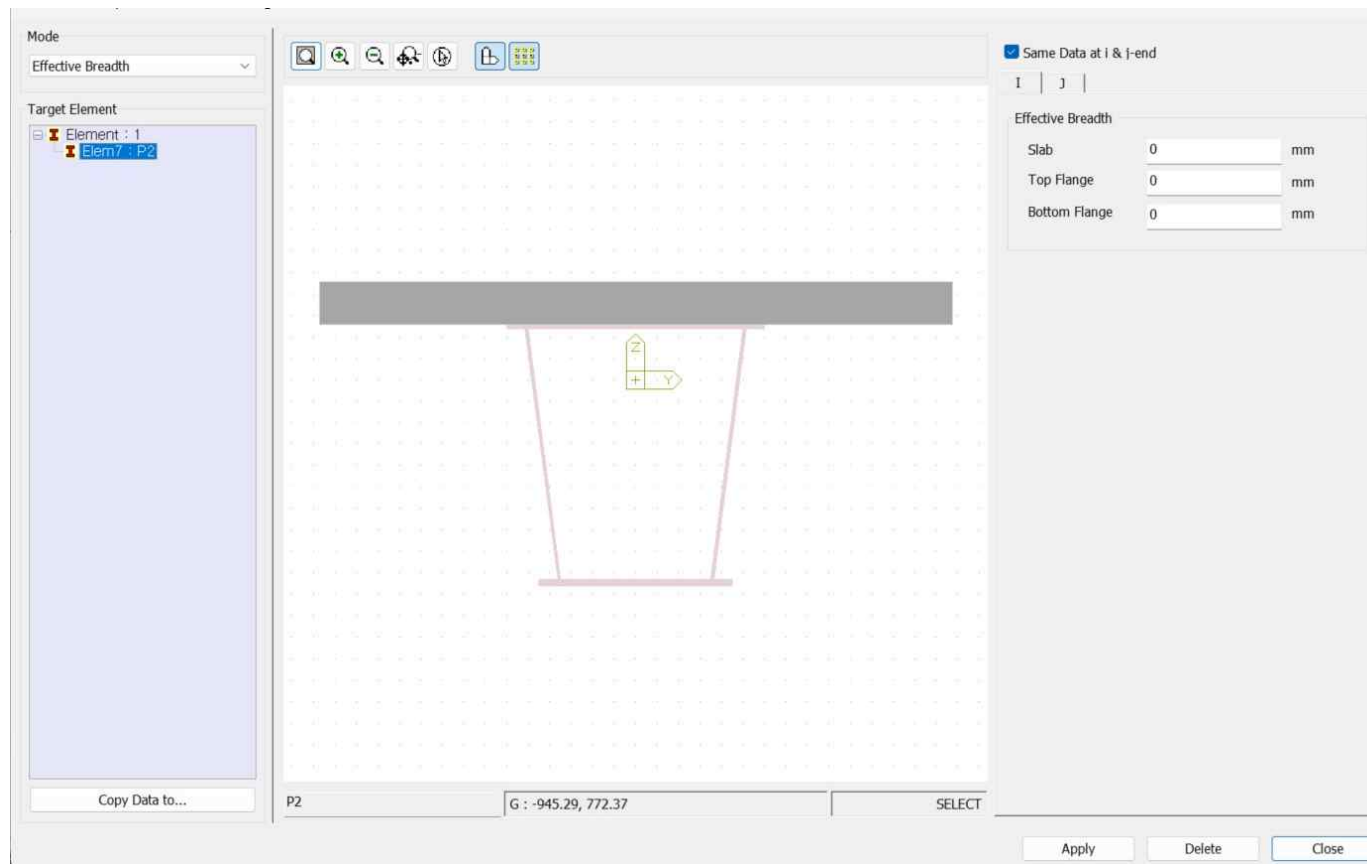


Shear Connector

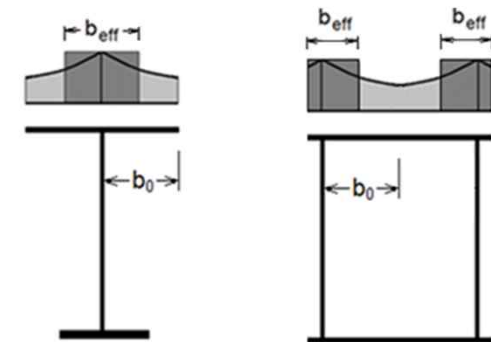
9. Steel Composite Girder Design as per AS 5100.6: 2017

- The effective width of concrete slab, top flange, or bottom flange can be defined.
- The effective section properties to consider the local buckling of the flange plate are determined by the program.

■ Design > Composite Design > *Effective Width by Shear Lag*



Effective Width by Shear Lag



9. Steel Composite Girder Design as per AS 5100.6: 2017

- Design results and detailed calculation procedures are provided in a Word format.

Design > Composite Design > Print Result

Longitudinal shearMemb1.doc [Read-Only] [Compatibility Mode] - Word

File Home Insert Design Layout References Mailings Review View Help Tell me what you want to do

Navigation

MEMBER NAME : Steel Composite : 83 - i

1. Member Information

1) Design Code
AS 5100.6:2017

2) Section Property
Section 2-2

3) Material
Steel
 $f_y = 320.000\text{MPa}$, $E = 200,000.000\text{MPa}$
Concrete
 $f'_c = 32.000\text{MPa}$, $E_c = 30,100.000\text{MPa}$
Reinforcement
 $f_{yv} = 500.000\text{MPa}$, $E_r = 200,000.000\text{MPa}$

4) Length
 $L = 1.441\text{m}$

5) Section Properties

	Steel Section	Short-Term Composite Section	Long Term Composite Section
Area	86,330.473mm ²	185,951.564mm ²	114,055.580mm ²
I _y	5.686783e+10mm ⁴	1.186307e+11mm ⁴	8.481588e+10mm ⁴
I _z	1.199866e+9mm ⁴	7.080595e+10mm ⁴	2.057163e+10mm ⁴
C _y	254.000mm	254.000mm	254.000mm
C _z	905.870mm	1,522.787mm	1,185.789mm

	Short-Term Composite Section(Reinforcement)	Long Term Composite Section(Reinforcement)
Area	96,014.324mm ²	89,558.423mm ²
I _y	6.848039e+10mm ⁴	6.101762e+10mm ⁴
I _z	7.947699e+9mm ⁴	3.449057e+9mm ⁴
C _y	254.000mm	254.000mm
C _z	1,022.345mm	947.494mm

Page 1 of 4 1051 words English (United States) Display Settings 130%

Tub-Section not compactMemb1.doc [Read-Only] [Compatibility Mode] - Word

File Home Insert Design Layout References Mailings Review View Help Tell me what you want to do

Navigation

MEMBER NAME : Steel Composite : 1 - i

1. Member Information

1) Design Code
AS 5100.6:2017

2) Section Property
G1-3

3) Material
Steel
 $f_y = 360.000\text{MPa}$, $E = 200,000.000\text{MPa}$
Concrete
 $f'_c = 32.000\text{MPa}$, $E_c = 30,100.000\text{MPa}$
Reinforcement
 $f_{yv} = 500.000\text{MPa}$, $E_r = 200,000.000\text{MPa}$

4) Length
 $L = 1.000\text{m}$

5) Section Properties

	Steel Section	Short-Term Composite Section	Long Term Composite Section
Area	188,163.617mm ²	386,823.617mm ²	236,046.609mm ²
I _y	7.623030e+10mm ⁴	1.610550e+11mm ⁴	1.096118e+11mm ⁴
I _z	2.857647e+11mm ⁴	8.817447e+11mm ⁴	4.294137e+11mm ⁴
C _y	1,790.000mm	1,790.000mm	1,790.000mm
C _z	635.533mm	1,114.418mm	824.688mm

	Short-Term Composite Section(Reinforcement)	Long Term Composite Section(Reinforcement)
Area	200,227.217mm ²	192,184.817mm ²
I _y	8.611792e+10mm ⁴	7.966363e+10mm ⁴
I _z	3.219155e+11mm ⁴	2.978149e+11mm ⁴
C _y	1,790.000mm	1,790.000mm
C _z	691.714mm	655.043mm

2. Moment Capacity (y-Dir., Negative)

Max. Moment LCB LCB

Page 1 of 3 790 words English (United States) Display Settings 120%

9. Steel Composite Girder Design as per AS 5100.6: 2017

- For all design checks, demand and capacity are represented in a table format.

Design > Composite Design > Design Result Tables

Elem	part	Positive/ Negative	Lcom	Type	CHK	M_demand (N.mm)	ΦMb (N.mm)	fs (N/mm²)	Φfy (N/mm²)
35	J[50]	Pos	scLCB1	FX-MAX	OK	785552117.	3019476	-	-
35	J[287]	Neg	-	-	-	-	-	-	-
35	J[287]	Pos	scLCB1	MY-MIN	OK	-450953350	-	-	-
36	J[51]	Neg	scLCB1	MY-MIN	OK	-176618382	-	-	-
36	J[51]	Pos	-	-	-	-	-	-	-
36	J[288]	Neg	scLCB1	MY-MIN	OK	-325816309	-	-	-
36	J[288]	Pos	-	-	-	-	-	-	-
37	J[52]	Neg	scLCB1	MY-MIN	OK	-489278107	-	-	-
37	J[52]	Pos	-	-	-	-	-	-	-
37	J[289]	Neg	scLCB1	MY-MIN	OK	-660255514	-	-	-
37	J[289]	Pos	-	-	-	-	-	-	-
38	J[53]	Neg	scLCB1	MY-MIN	OK	-840656031	-	-	-
38	J[53]	Pos	-	-	-	-	-	-	-
38	J[290]	Neg	scLCB1	MY-MIN	OK	-107131001	-	-	-
38	J[290]	Pos	-	-	-	-	-	-	-
39	J[54]	Neg	scLCB1	MY-MIN	OK	-132240146	-	-	-
39	J[54]	Pos	-	-	-	-	-	-	-
39	J[291]	Neg	scLCB1	MY-MIN	OK	-159944309	-	-	-
39	J[291]	Pos	-	-	-	-	-	-	-
83	J[10]	Neg	scLCB1	MY-MIN	NG	-225504069	-	-	-
83	J[10]	Pos	-	-	-	-	-	-	-
83	J[332]	Neg	scLCB1	MY-MIN	NG	-190746000	-	-	-
83	J[332]	Pos	-	-	-	-	-	-	-
84	J[95]	Neg	scLCB1	MY-MIN	OK	-158914050	-	-	-
84	J[95]	Pos	-	-	-	-	-	-	-
84	J[333]	Neg	scLCB1	MY-MIN	OK	-129141403	-	-	-
84	J[333]	Pos	-	-	-	-	-	-	-
85	J[96]	Neg	scLCB1	MY-MIN	OK	-101631624	-	-	-
85	J[96]	Pos	-	-	-	-	-	-	-
85	J[334]	Neg	scLCB1	MY-MIN	OK	-765269486	-	-	-
85	J[334]	Pos	-	-	-	-	-	-	-
86	J[97]	Neg	scLCB1	MY-MIN	OK	-538011914	-	-	-
86	J[97]	Pos	-	-	-	-	-	-	-
86	J[335]	Neg	scLCB1	MY-MIN	OK	-324642625	-	-	-

◀ ▶ \Moment capacity/

Elem	part	Lcom	Type	CHK	V*/web (kN)	V* (kN)	ΦVv (kN)
27	J[6]	scLCB1	FZ-MIN	OK	-1373.7	-1373.7	4085.3
27	J[279]	scLCB1	FZ-MIN	OK	-1293.6	-1293.6	4085.3
28	J[43]	scLCB1	FZ-MIN	OK	-1098.1	-1098.1	4085.3
28	J[280]	scLCB1	FZ-MIN	OK	-1018.1	-1018.1	4085.3
29	J[44]	scLCB1	FZ-MIN	OK	-800.2	-800.2	4085.3
29	J[281]	scLCB1	FZ-MIN	OK	-720.2	-720.2	4085.3
30	J[45]	scLCB1	FZ-MIN	OK	-567.0	-567.0	4085.3
30	J[282]	scLCB1	FZ-MIN	OK	-487.0	-487.0	4085.3
31	J[46]	scLCB1	FZ-MIN	OK	-282.7	-282.7	3287.7
31	J[283]	scLCB1	FZ-MA	OK	245.8	245.8	3287.7
32	J[47]	scLCB1	FZ-MA	OK	339.1	339.1	3287.7
32	J[284]	scLCB1	FZ-MA	OK	416.7	416.7	3287.7
33	J[48]	scLCB1	FZ-MA	OK	656.3	656.3	3287.7
33	J[285]	scLCB1	FZ-MA	OK	733.9	733.9	3287.7
34	J[49]	scLCB1	FZ-MA	OK	863.2	863.2	3287.7
34	J[286]	scLCB1	FZ-MA	OK	940.8	940.8	3287.7
35	J[50]	scLCB1	FZ-MA	OK	1077.0	1077.0	3287.7
35	J[287]	scLCB1	FZ-MA	OK	1154.6	1154.6	3287.7
36	J[51]	scLCB1	FZ-MA	OK	1325.0	1325.0	4085.3
36	J[288]	scLCB1	FZ-MA	OK	1405.1	1405.1	4085.3
37	J[52]	scLCB1	FZ-MA	OK	1440.3	1440.3	4085.3
37	J[289]	scLCB1	FZ-MA	OK	1520.4	1520.4	4085.3
38	J[53]	scLCB1	FZ-MA	OK	1758.0	1758.0	4085.3
38	J[290]	scLCB1	FZ-MA	OK	1838.1	1838.1	4085.3
39	J[54]	scLCB1	FZ-MA	OK	2020.8	2020.8	4085.3
39	J[291]	scLCB1	FZ-MA	OK	2100.9	2100.9	4085.3
83	J[10]	scLCB1	FZ-MIN	OK	-2619.4	-2619.4	4085.3
83	J[332]	scLCB1	FZ-MIN	OK	-2539.1	-2539.1	4085.3
84	J[95]	scLCB1	FZ-MIN	OK	-2300.2	-2300.2	4085.3
84	J[333]	scLCB1	FZ-MIN	OK	-2219.9	-2219.9	4085.3
85	J[96]	scLCB1	FZ-MIN	OK	-1937.2	-1937.2	4085.3
85	J[334]	scLCB1	FZ-MIN	OK	-1857.0	-1857.0	4085.3
86	J[97]	scLCB1	FZ-MIN	OK	-1832.2	-1832.2	4085.3
86	J[335]	scLCB1	FZ-MIN	OK	-1751.9	-1751.9	4085.3
87	J[98]	scLCB1	FZ-MIN	OK	-1559.5	-1559.5	3287.7

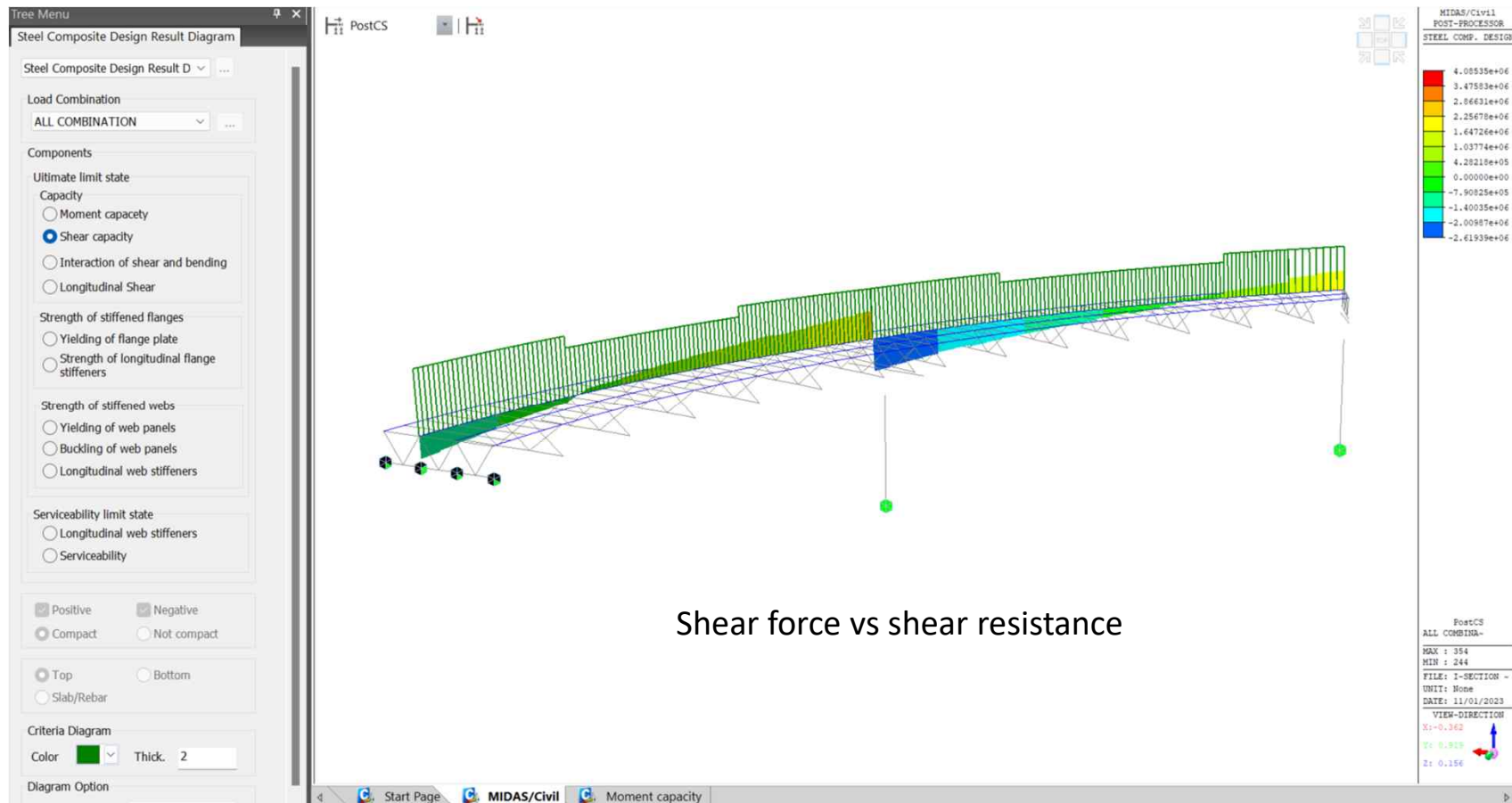
◀ ▶ \Shear capacity/

Design Result Tables

9. Steel Composite Girder Design as per AS 5100.6: 2017

- For all design checks, demand and capacity can be represented in a diagram format.

- Design > Composite Design > Steel Composite Design Result Diagram**



Shear force vs shear resistance

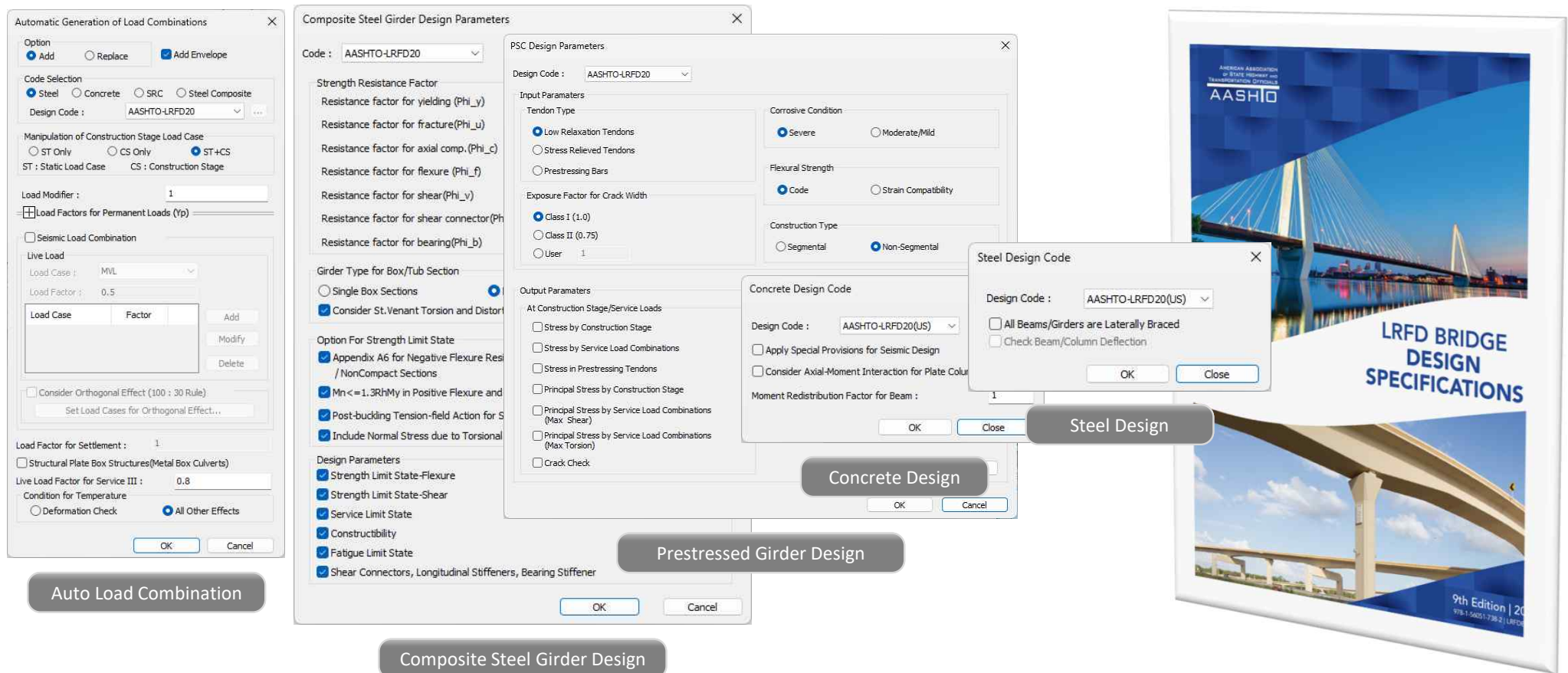
Design Result Diagram

10. RC, Steel, Steel Composite, and PSC Design as per AASHTO LRFD 2020

- RC, Steel, Steel Composite, and PSC Design function as per AASHTO LRFD 2020 has been updated.
- The design report provides SI and US unit options.
- The design report of RC is now generated in Word format, which is faster than text format and enables the user to change the report style with ease.

▪ Design > RC, Steel, and Composite Design

▪ PSC > PSC Design

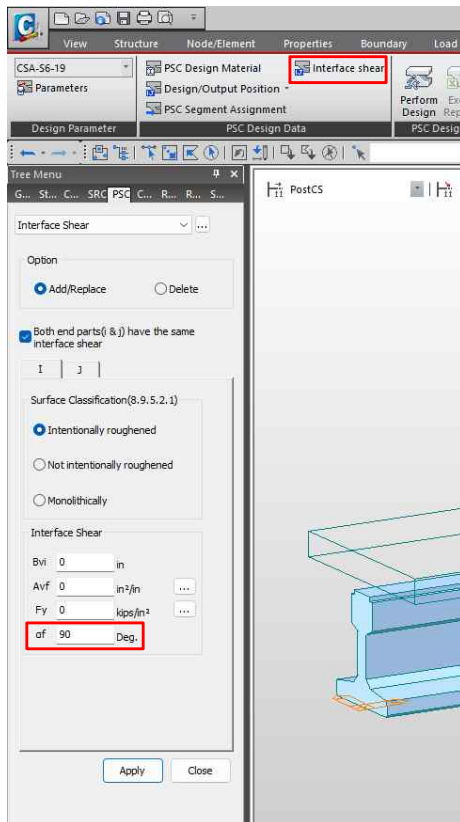


11. PSC Design as per CSA S6:19

- The reinforcement angle α_f is considered in the Interface Shear Transfer function as per 8.9.5.1 and 8.9.5.4, CSA S6:19.

■ PSC > Design Parameter > CSA-S6-19

CSA S6:14



Interface Shear

8.9.5 Interface shear transfer

8.9.5.1 General

A crack shall be assumed to occur along the shear plane and the relative displacement shall be considered to be resisted by cohesion and friction maintained by the shear-friction reinforcement crossing the crack. In lieu of more detailed calculations, the shear resistance of the plane, v , may be calculated as $\phi_c (c + \mu \sigma)$, but v shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa. c and μ shall be as specified in Clause 8.9.5.2 and σ shall be as specified in Clause 8.9.5.3.

8.9.5.3 Value of σ

The value of σ in Clause 8.9.5.1 shall be calculated as follows:

$$\sigma = \rho_v f_y + \frac{N}{A_{cv}}$$

where

$$\rho_v = \frac{A_{vf}}{A_{cv}}$$

9) Interface Shear

• Factored interface shear stress (V_u)

$$V_u = V_f / (b_v d_{v0}) = 3.323 \text{ (MPa)}$$

$$\text{where, } V_f = 2039.154 \text{ (kN)}$$

$$b_v = 300.00 \text{ (mm)}$$

$$d_{v0} = 2045.59 \text{ (mm)}$$

• Interface shear resistance without shear-friction reinforcement ($V_{u, \text{concrete}}$)

$$V_{u1} = \phi_c (c + \mu N/A_{cv}) = 0.375 \text{ (MPa)}$$

Interface shear resistance shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa.

$$V_{u2} = 0.25 \phi_c f'_c = 3.878 \text{ (MPa)}$$

$$V_{u3} = 6.500 \text{ (MPa)}$$

$$\text{Therefore, } V_{u, \text{concrete}} = 0.375 \text{ (MPa)}$$

$$V_{u, \text{concrete}} = 0.375 \text{ (MPa)} < V_u = 3.323 \text{ (MPa)} \quad \text{NG}$$

∴ Shear-friction reinforcement is required.

• Interface shear resistance with shear-friction reinforcement ($V_{u, \text{reinforcement}}$)

$$V_{u1} = \phi_c (c + \mu (\rho_v f_y + N/A_{cv})) = 7.65 \text{ (MPa)}$$

Interface shear resistance shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa.

$$V_{u2} = 0.25 \phi_c f'_c = 3.878 \text{ (MPa)}$$

$$V_{u3} = 6.500 \text{ (MPa)}$$

$$\text{Therefore, } V_{u, \text{reinforcement}} = 3.878 \text{ (MPa)}$$

$$V_{u, \text{reinforcement}} = 3.878 \text{ (MPa)} \geq V_u = 3.323 \text{ (MPa)} \quad \text{OK}$$

CSA S6:19

8.9.5 Interface shear transfer

8.9.5.1 General

A crack shall be assumed to occur along the shear plane and the relative displacement shall be considered to be resisted by cohesion and friction maintained by the shear-friction reinforcement crossing the crack. In lieu of more detailed calculations, the factored shear resistance of the plane shall be computed from

$$v_r = \lambda_1 \phi_c (c + \mu \sigma) + \phi_s \rho_v f_y \cos \alpha_f$$

where the expression $\lambda_1 \phi_c (c + \mu \sigma)$ shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa.

8.9.5.4 Values of σ and ρ_v

The value of σ in Clause 8.9.5.1 shall be calculated as follows:

$$\sigma = \rho_v f_y \sin \alpha_f + \frac{N}{A_{cv}}$$

where

$$\rho_v = \frac{A_{vf}}{A_{cv}}$$

9) Interface Shear

• Factored interface shear stress (V_u)

$$V_u = V_f / (b_v d_{v0}) = 3.323 \text{ (MPa)}$$

$$\text{where, } b_v = 300.000 \text{ (mm)}$$

$$d_{v0} = 2045.592 \text{ (mm)}$$

• Factored interface shear resistance without shear-friction reinforcement ($V_{u, \text{concrete}}$)

$$V_{u1} = \lambda_1 \phi_c (c + \mu N/A_{cv}) = 0.375 \text{ (MPa)}$$

Interface shear resistance shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa.

$$V_{u2} = 0.25 \phi_c f'_c = 3.878 \text{ (MPa)}$$

$$V_{u3} = 6.500 \text{ (MPa)}$$

$$\text{Therefore, } V_{u, \text{concrete}} = 0.375 \text{ (MPa)}$$

$$V_{u, \text{concrete}} = 0.375 \text{ (MPa)} < V_u = 3.323 \text{ (MPa)} \quad \text{NG}$$

∴ Shear-friction reinforcement is required.

• Factored interface shear resistance of the plane (V_u)

$$V_{u1} = \lambda_1 \phi_c (c + \mu \sigma) + \phi_s \rho_v f_y \cos \alpha_f = 7.653 \text{ (MPa)}$$

$\lambda_1 \phi_c (c + \mu \sigma)$ shall not exceed $0.25 \phi_c f'_c$ or 6.5 MPa.

$$V_{u2} = 0.25 \phi_c f'_c + \phi_s \rho_v f_y \cos \alpha_f = 3.878 \text{ (MPa)}$$

$$V_{u3} = 6.5 + \phi_s \rho_v f_y \cos \alpha_f = 6.500 \text{ (MPa)}$$

$$\text{Therefore, } V_u = 3.878 \text{ (MPa)}$$

$$V_u = 3.878 \text{ (MPa)} \geq V_u = 3.323 \text{ (MPa)} \quad \text{OK}$$

11. PSC Design as per CSA S6:19

- The Environmental Exposure option in PSC Design Parameters function has changed as per 8.12.3.4, CSA S6:19.
- The tensile stress of reinforcing steel is now checked along the environmental exposure class.

PSC > Design Parameter > CSA-S6-19

PSC Design Parameters

Design Code : CSA-S6-19

Input Parameters

Tendon Type

☒ Low-relaxation Strand

☐ Smooth High-strength Bar

☐ Deformed High-strength Bar

Flexural Strength

☒ Code

☐ Strain Compatibility

Reinforcing Rebar

☒ Epoxy-coated bars

☐ Uncoated bars

Environmental Exposure

☒ Category A exposure

☐ Category B exposure

Construction Type

☐ Segmental

☒ Non-Segmental

Output Parameters

Serviceability Limit State

☒ Stress for Cross Section at a Construction Stage

☒ Stress for Cross Section at Service Load

☒ Stress in Prestressing Tendons

☒ Principal Stress by Construction Stage

☒ Principal Stress by Service Load Combinations (Max. Shear)

☒ Principal Stress by Service Load Combinations (Max. Torsion)

☒ Control of Cracking

Ultimate Limit State

☒ Flexural resistance

☒ Shear resistance

☒ Torsional resistance

Select All

Unselect All

OK

Cancel

CSA S6:19

8.12.3.4 Tensile stress limits for reinforcing steel

Tensile stress in reinforcing steel produced by the governing cases defined in Clause 8.12.3.3 shall not exceed the following limits:

a) For Category A exposure:
The lesser of
 $\sqrt{\frac{2.8f_{cr}E_s}{\alpha_b d_b}}$
or
300 MPa.
For deck surfaces of slab on girder bridges built with unshored construction that are subject to predominantly live loads, the factor 2.8 shall be replaced by 1.6.

b) For Category B exposure:
The lesser of
 $\sqrt{\frac{3.9f_{cr}E_s}{\alpha_b d_b}}$
or
300 MPa.

5. Crack check (see 8.12.3.2)

In both cases, α_b shall be taken as the ratio of the effective depth of the slab to the total depth of the slab. When bars of a different diameter are used, the area of the bars shall be weighted in proportion to the square of their diameter.

■ Top

- The maximum Service Limit Load Combination : dCB90

- Factored moment : $M_f = -20460.854$ (kN-m)

- Factored axial force : $N_f = 5.403$ (kN)

- Parameters for Control of cracking

$\alpha_b = 1.20$ for Epoxy-coated bars

- Tensile stress limits for reinforcing steel

For Category B exposure:

$\sigma_{max} = \min \left[\sqrt{\frac{3.9f_{cr}E_s}{\alpha_b d_b}} , 300 \text{ MPa} \right] = 300.000 \text{ (MPa)}$

where, $d_b = 12.70$ (mm) : the nominal diameter of a bar or prestressing strand

- Tensile stress in reinforcing steel

In tensile rebar

$\sigma_s = \left(\frac{N_f}{A_{cr}} - \frac{M_f}{I_{cr}} d_s \right) n_s = 1292.153 \text{ (MPa)}$

In prestressing steel

$\sigma_f = \left(\frac{N_f}{A_{cr}} - \frac{M_f}{I_{cr}} d_p \right) n_p = 420.653 \text{ (MPa)}$

MIDAS

23 / 27

11. PSC Design as per CSA S6:19

- The coefficient of allowable stress based on the tendon types has changed.

PSC > Design Parameter > CSA-S6-19

CSA S6:14

Table 8.2
Prestressing tendon stress limits
(See Clause 8.7.1.)

	Tendon type		
	Low-relaxation strand	High-strength bar	
		Smooth	Deformed
At jacking			
Pretensioning	$0.78f_{pu}$	—	—
Post-tensioning	$0.80f_{pu}$	$0.76f_{pu}$	$0.75f_{pu}$
At transfer			
Pretensioning	$0.74f_{pu}$	—	—
Post-tensioning			
At anchorage and couplers	$0.70f_{pu}$	$0.70f_{pu}$	$0.66f_{pu}$
Elsewhere	$0.74f_{pu}$	$0.70f_{pu}$	$0.66f_{pu}$

CSA S6:19

Table 8.2
Prestressing tendon stress limits
(See Clause 8.7.1.)

	Tendon type		
	Low-relaxation strand	High-strength bar	
		Smooth	Deformed
Pretensioning			
Immediately prior to transfer	$0.75f_{pu}$	—	—
Post-tensioning			
At jacking	$0.80f_{pu}$	$0.76f_{pu}$	$0.75f_{pu}$
Immediately after transfer			
At anchorage and couplers	$0.70f_{pu}$	$0.70f_{pu}$	$0.66f_{pu}$
Elsewhere	$0.74f_{pu}$	$0.70f_{pu}$	$0.66f_{pu}$

11. PSC Design as per CSA S6:19

- The formula for the review of shear resistance by transverse reinforcement has changed as per 8.9.1.2, CSA S6:19.

PSC > Design Parameter > CSA-S6-19

CSA S6:14

8.9.1.2 Regions requiring transverse reinforcement

Except for solid slabs, walls, and footings, transverse reinforcement shall be provided in all regions where V_f is greater than $(0.20\phi_c f_{cr} b_v d_v + 0.5\phi_p V_p)$ and T_f is greater than $0.25T_{cr}$.

6) Factored shear resistance by transverse reinforcement (V_s).			
- Judgement		(see 8.9.1.2)	
$0.2\phi_c f_{cr} b_v d_v + 0.5\phi_p V_p =$	2493.152 (kN)	$<$	$V_f = 5522.327$ (kN)
			$\therefore$ Need shear reinforcing
- shear resistance by transverse reinforcement (V_s).		(see 8.9.3.5)	
$V_s = \frac{\Phi_s A_v f_y d_v (\cot\theta + \cot\alpha) \sin\alpha}{s}$	= 20425.169 (kN)		
where, $s =$	150.000 (mm)		
$\alpha =$	90.000 (deg.)		
- Maximum spacing of reinforcement for shear.		(see 8.14.6)	
$0.1\phi_c f_{cr} b_v d_v + V_p =$	9703.873 (kN)	$>$	$V_f = 5522.327$ (kN)
$s_{max} = \text{Min}[0.75d_v, 600(\text{mm})]$	= 600.000 (mm)		
$\therefore s =$	150.000 (mm)	$\leq$	s_{max}
			OK

CSA S6:19

8.9.1.2 Regions requiring transverse reinforcement

Except for footings and walls, transverse reinforcement shall be provided in regions where T_f is greater than $0.25T_{cr}$ and in regions where V_f is greater than $k_v V_c + V_p$. The value of k_v shall be taken as 1.0 for d less than or equal to 300 mm, as 0.5 for d greater than or equal to 600 mm, and as $-0.00167d + 1.5$ for values of d between 300 mm and 600 mm. Quantity d shall be as defined in Clause 8.9.1.5.

6) Factored shear resistance by transverse reinforcement (V_s).			
- Judgement		(see 8.9.1.2)	
$k_v V_c + V_p =$	4091.979 (kN)	$\geq$	$V_f = 3009.777$ (kN)
where, $k_v =$	0.500	effective depth	$d \geq 600\text{mm}$
			$\therefore$ No-need shear reinforcing
- shear resistance by transverse reinforcement (V_s).		(see 8.9.3.5)	
$V_s = \frac{\Phi_s A_v f_y d_v (\cot\theta + \cot\alpha) \sin\alpha}{s}$	= 9872.751 (kN)		
where, $s =$	150.000 (mm)		
$\alpha =$	90.000 (deg.)		

11. PSC Design as per CSA S6:19

- The formula for the angle of inclination(θ) has changed as per 8.9.3.7, CSA S6:19

▪ PSC > Design Parameter > CSA-S6-19

CSA S6:14

8.9.3.7 Determination of β and θ (general method)

The value of β shall be calculated as follows:

$$\beta = \left[\frac{0.4}{(1 + 1500\epsilon_x)} \right] \left[\frac{1300}{(1000 + s_{ze})} \right]$$

For sections containing at least the minimum transverse reinforcement required by Clause 8.9.1.3, s_{ze} shall be taken as 300 mm; otherwise, s_{ze} shall be calculated in accordance with Clause 8.9.3.6. The value of a_g in Clause 8.9.3.6 shall be taken as zero if f'_c is greater than 70 MPa and shall be linearly equal to zero as f'_c goes from 60 to 70 MPa. The angle of inclination, θ , shall be calculated as $(29 + 7000\epsilon_x)(0.88 + s_{ze}/2500)$.

4) Values of β and θ			
- Parameter that account for influence of aggregate size		(see 8.9.3.7)	
$S_{ze} =$	300.000 (mm)	$\therefore A_v \geq A_{v,min}$	
- Values of β and θ			
$\beta =$	$\left[\frac{0.4}{(1 + 1500\epsilon_x)} \right] \cdot \left[\frac{1300}{(1000 + S_{ze})} \right]$		= 0.400
$\theta =$	$(29 + 7000\epsilon_x) \cdot (0.88 + S_{ze}/2500)$		= 29.000 (deg.)

CSA S6:19

8.9.3.7 Determination of β and θ (general method)

The value of β shall be calculated as follows:

$$\beta = \left[\frac{0.4}{(1 + 1500\epsilon_x)} \right] \left[\frac{1300}{(1000 + s_{ze})} \right]$$

For sections containing at least the minimum transverse reinforcement required by Clause 8.9.1.3, s_{ze} shall be taken as 300 mm; otherwise, s_{ze} shall be calculated in accordance with Clause 8.9.3.6. The value of a_g in Clause 8.9.3.6 shall be taken as zero if f'_c is greater than 70 MPa and shall be linearly reduced to zero as f'_c goes from 60 to 70 MPa. The angle of inclination, θ , shall be calculated as $(29 + 7000\epsilon_x)$.

4) Values of β and θ			
- Parameter that account for influence of aggregate size		(see 8.9.3.7)	
$S_{ze} =$	300.000 (mm)	$\therefore A_v \geq A_{v,min}$	
- Values of β and θ			
$\beta =$	$\left[\frac{0.4}{(1 + 1500\epsilon_x)} \right] \cdot \left[\frac{1300}{(1000 + S_{ze})} \right]$		= 0.076
$\theta =$	$(29 + 7000\epsilon_x)$		= 48.911 (deg.)

12. Steel Composite Design as per CSA-S6-19

- Bearing stiffeners can now be designed based on the latest code provisions. Summary report as well as a detailed excel report can be obtained.
- Load combinations and fatigue category details for shear stud connectors have been updated to reflect the latest code provisions. Now shear studs are considered in Category S for fatigue.

- **Results > Load Combination > Composite Steel Girder Design**
- **Design > Composite Design > Composite Steel Girder Design Parameters**
- **Design > Composite Design > Transverse Stiffener**

Automatic Generation of Load Combinations

Option

☒ Add
 ☐ Replace

Code Selection

☐ Steel
 ☐ Concrete
 ☐ SRC
 ☒ Steel Composite

Design Code :

CSA-S6-19

Manipulation of Construction Stage Load Case

☐ ST Only
 ☐ CS Only
 ☒ ST+CS

ST : Static Load Case
 CS : Construction Stage

☐ Load Factors for Permanent Loads

Type of Load	Load Factor		
	Max	Min	Both
Dead Load	☐ 1.20	☐ 0.90	☒
Wearing Surfaces	☒ 1.50	☐ 0.65	☐
Earth Pressure	Define Earth Pressure LoadType		
Passive Earth Pressure	☒ 1.25	☐ 0.50	☐
At-rest Earth Pressure	☒ 1.25	☐ 0.80	☐
Active Earth Pressure	☒ 1.25	☐ 0.80	☐
Backfill Pressure	☒ 1.25	☐ 0.80	☐
Hydrostatic Pressure	☒ 1.10	☐ 0.90	☐
Secondary Prestress Effects	☒ 1.05	☐ 0.95	☐

OK

Cancel

Auto-generation of Load Combinations

Composite Steel Girder Design Parameters

Code : CSA-S6-19 Update by Code

Strength Resistance Factor

Resistance factor for flexure (Φ_{fs})	0.95
Resistance factor for shear (Φ_{fs})	0.95
Resistance factor for compression (Φ_{fs})	0.9
Resistance factor for tension (Φ_{fs})	0.95
Resistance factor for torsion (Φ_{fs})	0.9
Resistance factor for reinforcement (Φ_{fr})	0.9
Resistance factor for shear connector (Φ_{sc})	0.85
Resistance factor for concrete (Φ_{fc})	0.75
Resistance factor for bearing, end (Φ_{fu})	0.75

Girder Type for Box/Tub Section

☒ Single Box Sections
 ☐ Multiple Box Sections

☐ Consider St.Venant Torsion and Distortion Stresses

Option For Construction Stage

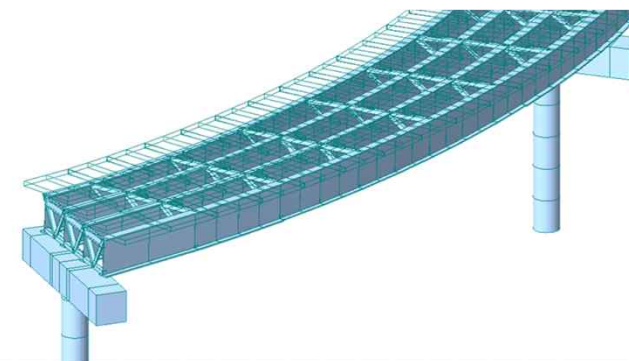
☐ Check Construction Stage Resistance

Design Parameters

☒ Ultimate Limit State-Flexure
☒ Ultimate Limit State-Shear
☒ Service Limit State
☒ Transverse Stiffeners, Longitudinal Stiffeners, Shear Connectors
☒ Fatigue Limit State

OK Cancel

Design code & Parameter input



4. Bearing Stiffener		[10.10.8]
■ Width-to-thickness ratio of plate bearing stiffeners		
b =	75.00 mm	: width of stiffener
t =	20.00 mm	: thickness of stiffener
b/t =	3.75	≤ 200√F _y = 10.00
■ Factored bearing resistance of the bearing stiffeners		
Φ _s =	0.90	: resistance factor for steel
A _b =	6000.00 mm ²	: area of stiffener in contact with the flange
F _y =	400.00 MPa	: yield stress of the stiffener of flange, whichever is less
B _r =	209.88 kN	< B _r = 1.50Φ _s A _b F _y = 3240.00 kN
■ Compressive resistance of bearing section		
Φ _s =	0.90	: resistance factor for steel
A =	7876.00 mm ²	
F _y =	400.00 MPa	: yield stress of the stiffener of flange, whichever is less
n =	1.34	: coefficient for axial buckling resistance.
KL =	547.50 mm	: effective column length (not less than 0.75 times the depth of the girder
I =	6.46E+06 mm ⁴	
r =	√I/A =	28.634 mm
E _s =	200000.00 MPa	: modulus of elastic of steel
λ =	$\frac{KL}{r} \sqrt{\frac{F_y}{\pi^2 E_s}}$	= 0.272
C _r =	209.88 kN	< C _r = Φ _s A _f (1+λ ²ⁿ) ^{1/n} = 2899.82 kN

Detailed excel report – Bearing Stiffener

13. Design of Solid web girder as per IRS SBC:2017

- Detailed calculation report as well as a graphical report can now be generated for solid web steel beam sections based on IRS SBC:2017
- Design checks for I, C, L and T sections based on stress limits provided in IRS are supported.

Design > Steel Design > Design Code

Steel Design Code

Design Code : IRS SBC

☐ All Beams/Girders are Laterally Braced

☐ Check Beam/Column Deflection

OK Close

Preview Window

Prop No: 1

1. Design Information

Design Code: IRS SBC

Unit System: kN, m

Member No: 1

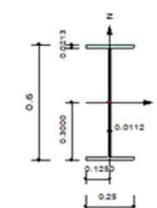
Material: E250 (No:1)

(Fy = 240000, Es = 205000000)

Section Name: ISWB 600 (No:1)

(Rolled : ISWB 600).

Member Length : 8.00000



2. Member Forces

Depth	Top Flange Width	Bottom Flange Width	Web Thickness	Top Flange Thickness	Bottom Flange Thickness
600.0000	250.0000	250.0000	12.5000	12.5000	12.5000

Axial Force: Fxx = 5.00000 (LCB: 1, POS:J)

Bending Moments: My = -160.00, Mz = 0.00000

End Moments: Myi = 0.00000, Myj = -160.00 (for Lb)

Myi = 0.00000, Myj = -160.00 (for Ly)

Mzi = 0.00000, Mzj = 0.00000 (for Lz)

Shear Forces: Fyy = 0.00000 (LCB: 1, POS:I)

Fzz = 40.00000 (LCB: 1, POS:J)

3. Design Parameters

Unbraced Lengths: Ly = 8.00000, Lz = 8.00000, Lb = 8.00000

Effective Length Factors: Ky = 1.00, Kz = 1.00

Moment Factor / Bending Coefficient: Cm1y = 1.00, Cm1z = 1.00

4. Checking Results

Slenderness Ratio: L/r = 152.4 < 300.0 (Membr:1, LCB: 1) O.K

Axial Stress: fat_cal/fat = 293/142056 = 0.002 < 1.000 O.K

Bending Stresses: fby_cal/fby = 45198/150000 = 0.301 < 1.000 O.K

Combined Stress (Tension+Bending): Rmax = fat_cal/fat + fby_cal/fby = 0.582 < 1.000 O.K

MIDAS/Text Editor - [Combined_Axial_C_bendingnShear.acs]

File Edit View Window Help

```

00083 [[[*]]] CHECK AXIAL STRESS.
00084
00085
00086 ( ). Check slenderness ratio of axial tension member (l/r).
00087 [ IRS:SBC-2017 Specification 3.7 TABLE 3.1 ]
00088 -. Lambda = l/r = 152.4 < 300.0 ----> O.K.
00089
00090 ( ). Permissible tensile stress (fat).
00091 [ IRS:SBC-2017 TABLE II AND CL.3.7]
00092 -. fat = 142056.098 KPa.
00093
00094 ( ). Calculate axial tensile stress of member (fat_cal).
00095 -. fat_cal = Fxx/Area = 293.462 KPa.
00096
00097
00098 MIDAS/Civil - Steel Code Checking [ IRS SBC ] Version 9.4.5
00099
00100
00101
00102 ( ). Check ratio of axial stress (fat_cal/fat).
00103 fat_cal 293.462
00104 -. ----- = 0.002 < 1.000 ----> O.K.
00105 fat 142056.098
00106
00107
00108 [[[*]]] CHECK BENDING STRESSES ABOUT MAJOR AXIS.
00109
00110
00111 ( ). Calculate condition for Ix and Iy.
00112 [ IRS:SBC-2017 CL.-3.9.1 ]
00113 -. Ixx = 0.001 m^4.
00114 -. Iyy = 4.702e-05 m^4.
00115
00116 Calculation Procedure is Applicable according to Code.
00117
00118 ( ). Check Requirement of Web Stiffener.
00119 dl 0.557
00120 -. ----- = 49.8 < 175.00 ----> O.K.Web Stiffener Not Required
00121 tl 0.011
00122

```

Steel Design Code

Graphical Report

Text Report

14. Other Enhancements

- Update Interface with BIM software
 - Revit 2024 Interface
 - Tekla 2023 Interface