Project:
Project no:
Author:

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Project data

Project name	
Project number	
Author	
Description	
Date	5/10/2025
Code	AISC/ACI

Material

Steel	A992, A572 Gr.50, A1085. Gr.A

Project item Main Truss Connection

Design

Name	Main Truss Connection
Description	Truss to Column Connection
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2022)

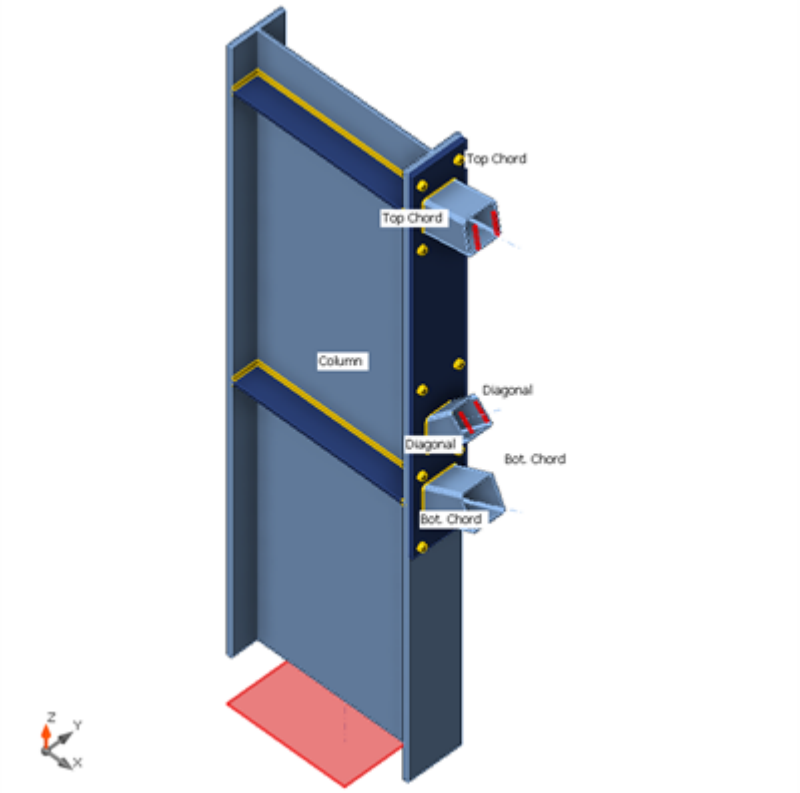
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
Column	4 - I840	0.0	-90.0	0.0	0	0	0
Top Chord	3 - Box 150x6(RHS150x150)	0.0	10.0	0.0	0	0	-300
Bot. Chord	3 - Box 150x6(RHS150x150)	0.0	25.0	0.0	-350	0	-1600
Diagonal	5 - Box 120x6(RHS120x120)	0.0	45.0	0.0	-800	0	-1200

Supports and forces

Name	Support	Forces in	X [mm]
Column / end	N-Vy-Vz-Mx-My-Mz	Node	0
Top Chord / end	Vy-Mx-Mz	Node	0
Bot. Chord / end		Node	0
Diagonal / end	Vy-Mx-Mz	Node	0



Cross-sections

Name	Material
4 - I840	A992
3 - Box 150x6(RHS150x150)	A1085. Gr.A
5 - Box 120x6(RHS120x120)	A1085. Gr.A

Bolts

Name	Diameter [mm]	f_y [MPa]	f_u [MPa]	Gross area [mm^2]
16 A325M	16	660.0	830.0	201

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE2	Column / End	0.0	0.0	0.0	0.0	0.0	0.0
	Top Chord / End	-365.0	0.0	-30.0	0.0	12.0	0.0
	Bot. Chord / End	-400.0	0.0	-5.0	0.0	7.0	0.0
	Diagonal / End	-190.0	0.0	0.0	0.0	0.0	0.0

Unbalanced forces

Name	X [kN]	Y [kN]	Z [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE2	-849.0	0.0	-400.9	0.0	994.8	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	77.3 < 100%	OK
Welds	76.0 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
Column-bfl 1	A992	20.0	LE2	297.8	0.0	0.0	OK
Column-tfl 1	A992	20.0	LE2	253.9	0.0	19.8	OK
Column-w 1	A992	10.0	LE2	308.5	0.0	0.0	OK
Top Chord	A1085. Gr.A	6.0	LE2	178.8	0.0	0.0	OK
Bot. Chord	A1085. Gr.A	6.0	LE2	224.7	0.0	0.0	OK
Diagonal	A1085. Gr.A	6.0	LE2	107.4	0.0	0.0	OK
EP2	A572 Gr.50	20.0	LE2	115.9	0.0	41.4	OK
SP1	A572 Gr.50	15.0	LE2	61.7	0.0	0.0	OK
SP2	A572 Gr.50	15.0	LE2	62.3	0.0	0.0	OK
SP3	A572 Gr.50	15.0	LE2	86.2	0.0	0.0	OK
SP4	A572 Gr.50	15.0	LE2	84.0	0.0	0.0	OK

Design data

Material	F_y [MPa]	ε_{lim} [%]
A992	344.7	5.0
A1085. Gr.A	345.0	5.0
A572 Gr.50	344.7	5.0

Detailed result for Column-bfl 1

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y =$ 344.7 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for Column-tfl 1

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y =$ 344.7 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for Column-w 1

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y =$ 344.7 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for Top Chord

Design values used in the analysis

$\phi F_y =$ 310.5 MPa

Where:

$F_y =$ 345.0 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for Bot. Chord

Design values used in the analysis

$\phi F_y =$ 310.5 MPa

Where:

$F_y =$ 345.0 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for Diagonal

Design values used in the analysis

$\phi F_y =$ 310.5 MPa

Where:

$F_y =$ 345.0 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for EP2

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y =$ 344.7 MPa – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SP1

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y = 344.7$ MPa – characteristic yield strength

$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SP2

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y = 344.7$ MPa – characteristic yield strength

$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SP3

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

Where:

$F_y = 344.7$ MPa – characteristic yield strength

$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SP4

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

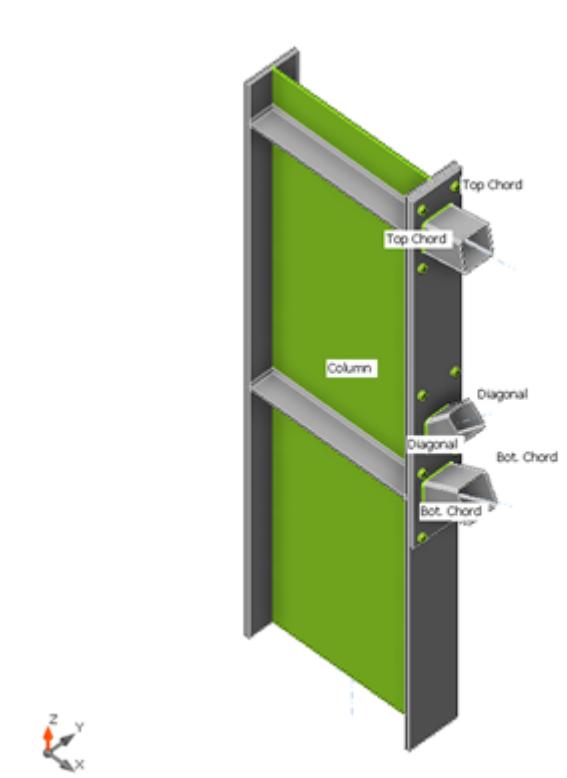
Where:

$F_y = 344.7$ MPa – characteristic yield strength

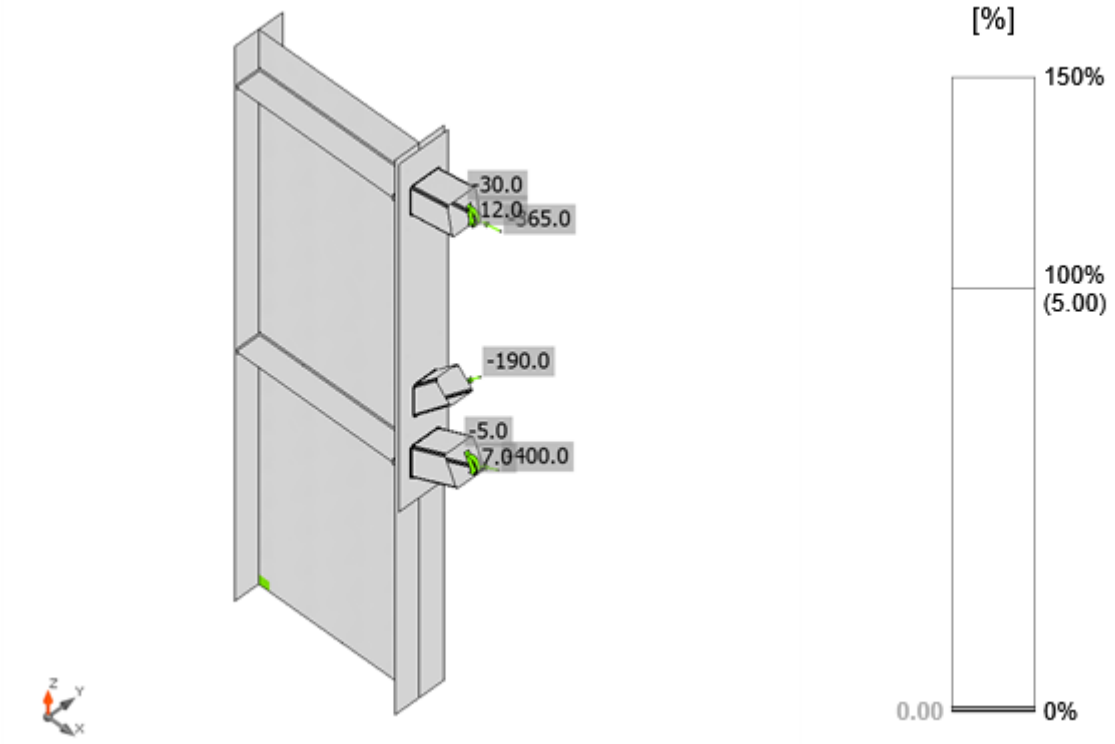
$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

Loc. deformation

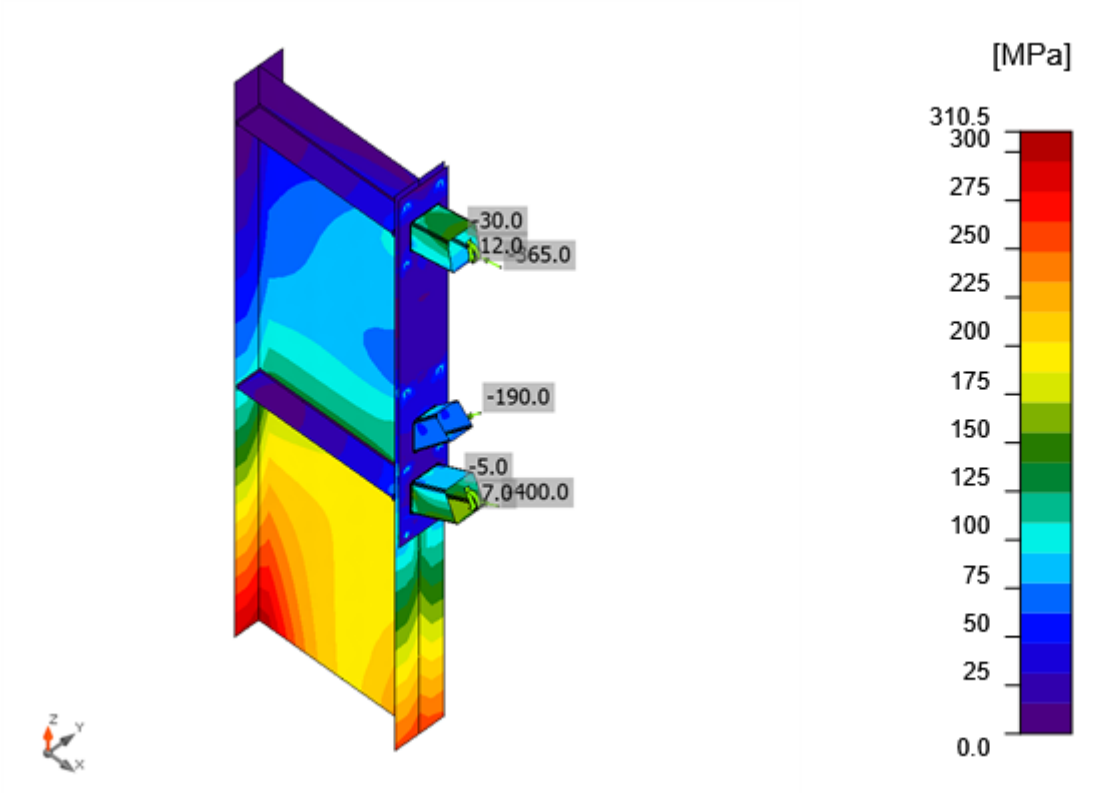
Name	d_0 [mm]	Loads	δ [mm]	δ_{lim} [mm]	δ/d_0 [%]	Check status
Top Chord	150	LE2	0	5	0.0	OK
Bot. Chord	150	LE2	0	5	0.0	OK
Diagonal	120	LE2	0	4	0.0	OK



Overall check, LE2

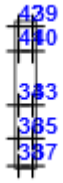


Strain check, LE2



Equivalent stress, LE2

Bolts

Shape	Item	Grade	Loads	F_t [kN]	V [kN]	$\phi R_{n,bearing}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B33	16 A325M - 1	LE2	3.7	42.0	258.1	3.9	74.9	0.0	OK	OK
	B34	16 A325M - 1	LE2	3.6	42.0	258.1	3.8	74.9	0.0	OK	OK
	B35	16 A325M - 1	LE2	0.5	40.9	258.1	0.6	72.9	0.0	OK	OK
	B36	16 A325M - 1	LE2	0.8	40.9	258.1	0.8	72.9	0.0	OK	OK
	B37	16 A325M - 1	LE2	1.5	35.5	258.1	1.6	63.2	0.0	OK	OK
	B38	16 A325M - 1	LE2	1.2	35.5	258.1	1.3	63.2	0.0	OK	OK
	B39	16 A325M - 1	LE2	3.5	38.8	258.1	3.7	69.1	0.0	OK	OK
	B40	16 A325M - 1	LE2	0.4	43.3	258.1	0.5	77.2	0.0	OK	OK
	B41	16 A325M - 1	LE2	0.4	43.3	258.1	0.4	77.3	0.0	OK	OK
	B42	16 A325M - 1	LE2	3.2	38.8	258.1	3.5	69.1	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kN]	$\phi R_{n,shear}$ [kN]
16 A325M - 1	93.5	56.1

Detailed result for B33

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 3.7 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa – nominal tensile stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 42.0 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa – nominal shear stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 42.0 \quad \text{kN}$$

Where:

$l_c = 382$ mm – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 20$ mm – thickness of the plate

$d = 16$ mm – diameter of a bolt

$F_u = 448.2$ MPa – specified minimum tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B34

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 3.6 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa – nominal tensile stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 42.0 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa – nominal shear stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 42.0 \quad \text{kN}$$

Where:

$l_c = 382$ mm – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 20$ mm – thickness of the plate

$d = 16$ mm – diameter of a bolt

$F_u = 448.2$ MPa – specified minimum tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B35

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 0.5 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa – nominal tensile stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 40.9 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa – nominal shear stress AISC 360-22 – Table J3.2

$A_b = 201$ mm^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 40.9 \quad \text{kN}$$

Where:

$l_c = 312$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B36

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 0.8 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 40.9 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 40.9 \quad \text{kN}$$

Where:

$l_c = 312$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B37

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 1.5 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 35.5 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 35.5 \quad \text{kN}$$

Where:

$l_c = 312$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B38

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 1.2 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 35.5 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 35.5 \quad \text{kN}$$

Where:

$l_c = 312$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B39

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 3.5 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 38.8 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 38.8 \quad \text{kN}$$

Where:

$l_c = 53$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B40

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 0.4 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 43.3 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 43.3 \quad \text{kN}$$

Where:

$l_c = 282$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B41

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 0.4 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 43.3 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 43.3 \quad \text{kN}$$

Where:

$l_c = 282$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Detailed result for B42

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 3.2 \quad \text{kN}$$

Where:

$F_{nt} = 620.0$ MPa	– nominal tensile stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 38.8 \quad \text{kN}$$

Where:

$F_{nv} = 372.0$ MPa	– nominal shear stress AISC 360-22 – Table J3.2
$A_b = 201$ mm^2	– gross bolt cross-sectional area
$\phi = 0.75$	– resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 38.8 \quad \text{kN}$$

Where:

$l_c = 53$ mm	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 20$ mm	– thickness of the plate
$d = 16$ mm	– diameter of a bolt
$F_u = 448.2$ MPa	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [mm]	w [mm]	L [mm]	L_c [mm]	Loads	F_n [kN]	ϕR_n [kN]	Ut [%]	Ut_c [%]	Detailing	Status
Column-bfl 1	SP1	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	1.2	91.8	1.4	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	1.6	96.6	1.7	0.0	OK	OK
Column-tfl 1	SP1	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	17.7	103.8	17.1	8.1	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	18.0	102.9	17.5	8.1	OK	OK
Column-w 1	SP1	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	4.8	99.4	4.8	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	4.8	99.0	4.9	0.0	OK	OK
Column-bfl 1	SP2	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	1.2	93.7	1.3	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	1.7	95.7	1.7	0.0	OK	OK
Column-tfl 1	SP2	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	20.2	103.9	19.5	8.7	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	19.0	103.8	18.3	8.1	OK	OK
Column-w 1	SP2	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	4.6	98.8	4.7	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	4.8	99.3	4.8	0.0	OK	OK
Column-bfl 1	SP3	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	7.2	104.1	6.9	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	5.6	97.7	5.7	0.0	OK	OK
Column-tfl 1	SP3	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	22.6	104.0	21.8	11.5	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	17.7	100.2	17.6	8.8	OK	OK
Column-w 1	SP3	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	9.5	101.3	9.4	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	9.1	100.7	9.0	0.0	OK	OK
Column-bfl 1	SP4	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	7.2	104.1	6.9	0.0	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	5.6	97.3	5.8	0.0	OK	OK
Column-tfl 1	SP4	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	21.5	101.2	21.2	10.8	OK	OK
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	120	40	LE2	19.3	99.8	19.4	9.1	OK	OK
Column-w 1	SP4	E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	9.6	100.3	9.6	0.0	OK	OK

Item	Edge	Xu	t_w [mm]	w [mm]	L [mm]	L_c [mm]	Loads	F_n [kN]	ϕR_n [kN]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 8.0 ◣	◢ 11.3 ◣	799	40	LE2	9.4	100.0	9.4	0.0	OK	OK
EP2	Bot. Chord	E70xx	◢ 4.0 ◣	◢ 5.7 ◣	583	10	LE2	6.3	8.3	75.9	54.5	OK	OK
EP2	Diagonal	E70xx	◢ 3.0 ◣	◢ 4.2 ◣	527	5	LE2	1.9	3.1	59.9	41.0	OK	OK
EP2	Top Chord	E70xx	◢ 3.0 ◣	◢ 4.2 ◣	559	10	LE2	4.7	6.2	76.0	55.5	OK	OK
		E70xx	◢ 4.0 ◣	◢ 5.7 ◣	583	10	LE2	6.3	8.3	75.2	50.7	OK	OK
		E70xx	◢ 3.0 ◣	◢ 4.2 ◣	527	10	LE2	4.6	6.2	75.0	46.5	OK	OK
		E70xx	◢ 3.0 ◣	◢ 4.2 ◣	559	10	LE2	4.7	6.2	75.9	57.1	OK	OK

Design data

Material	F_{exx} [MPa]
E70xx	482.6

Detailed result for Column-bfl 1 / SP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 91.8 \quad \text{kN} \quad \geq \quad F_n = \quad 1.2 \quad \text{kN}$$

Where:

$F_{nw} =$ 383.1 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 48.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP1 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 96.6 kN ≥ $F_n =$ 1.6 kN

Where:

$F_{nw} =$ 403.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 58.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 319 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 103.8 kN ≥ $F_n =$ 17.7 kN

Where:

$F_{nw} =$ 433.2 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 84.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP1 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 102.9 kN ≥ $F_n =$ 18.0 kN

Where:

$F_{nw} =$ 429.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 77.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 99.4 kN ≥ $F_n =$ 4.8 kN

Where:

$F_{nw} =$ 414.8 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 65.2° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP1 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 99.0 kN ≥ $F_n =$ 4.8 kN

Where:

$F_{nw} =$ 413.1 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 64.1° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 93.7 kN ≥ $F_n =$ 1.2 kN

Where:

$F_{nw} =$ 390.7 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 51.9° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP2 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 95.7 kN ≥ $F_n =$ 1.7 kN

Where:

$F_{nw} =$ 399.8 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 56.5° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 319 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 103.9 kN ≥ $F_n =$ 20.2 kN

Where:

$F_{nw} =$ 434.1 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 87.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 319 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP2 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 103.8 kN ≥ $F_n =$ 19.0 kN

Where:

$F_{nw} =$ 433.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 84.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 319 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 98.8 kN ≥ $F_n =$ 4.6 kN

Where:

$F_{nw} =$ 412.0 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 63.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP2 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 99.3 kN ≥ $F_n =$ 4.8 kN

Where:

$F_{nw} =$ 414.3 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 64.9° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP3 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 104.1 kN ≥ $F_n =$ 7.2 kN

Where:

$F_{nw} =$ 434.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.9° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP3 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 97.7 kN ≥ $F_n =$ 5.6 kN

Where:

$F_{nw} =$ 407.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 60.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP3 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 104.0 kN ≥ $F_n =$ 22.6 kN

Where:

$F_{nw} =$ 434.3 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.2° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 319 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP3 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 100.2 kN ≥ $F_n =$ 17.7 kN

Where:

$F_{nw} =$ 417.9 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 67.3° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP3 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 101.3 kN ≥ $F_n =$ 9.5 kN

Where:

$F_{nw} =$ 422.7 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 71.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP3 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 100.7 kN ≥ $F_n =$ 9.1 kN

Where:

$F_{nw} =$ 420.2 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 69.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP4 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 104.1 kN ≥ $F_n =$ 7.2 kN

Where:

$F_{nw} =$ 434.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.5° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-bfl 1 / SP4 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 97.3 kN ≥ $F_n =$ 5.6 kN

Where:

$F_{nw} =$ 406.1 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 59.9° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP4 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 101.2 kN ≥ $F_n =$ 21.5 kN

Where:

$F_{nw} =$ 422.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 70.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-tfl 1 / SP4 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 99.8 kN ≥ $F_n =$ 19.3 kN

Where:

$F_{nw} =$ 416.3 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 66.2° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP4 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 100.3 kN ≥ $F_n =$ 9.6 kN

Where:

$F_{nw} =$ 418.4 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 67.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for Column-w 1 / SP4 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 100.0 kN ≥ $F_n =$ 9.4 kN

Where:

$F_{nw} =$ 417.2 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 66.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 320 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for EP2 / Bot. Chord - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 8.3 kN ≥ $F_n =$ 6.3 kN

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 38 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for EP2 / Diagonal - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 3.1 kN ≥ $F_n =$ 1.9 kN

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 14 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for EP2 / Top Chord - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 6.2 kN ≥ $F_n =$ 4.7 kN

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 29 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for EP2 / Top Chord - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 8.3 kN ≥ $F_n =$ 6.3 kN

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 38 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for / - 2

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 6.2 \quad \text{kN} \quad \geq \quad F_n = \quad 4.6 \quad \text{kN}$$

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 29 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for / - 2

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 6.2 \quad \text{kN} \quad \geq \quad F_n = \quad 4.7 \quad \text{kN}$$

Where:

$F_{nw} =$ 289.6 MPa – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 482.6 MPa – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 29 mm^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Cost estimation

Steel

Steel grade	Total weight [kg]	Unit cost [US$/kg]	Cost [US$]
A572 Gr.50	114.90	2.50	287.26

Bolts

Bolt assembly	Total weight [kg]	Unit cost [US$/kg]	Cost [US$]
16 A325M	2.88	6.00	17.26

Welds

Weld type	Throat thickness [mm]	Leg size [mm]	Total weight [kg]	Unit cost [US$/kg]	Cost [US$]
Fillet weld	4.0	5.7	0.15	45.00	6.66
Fillet weld	3.0	4.2	0.15	45.00	6.97
Fillet weld	8.0	11.3	4.18	45.00	188.10

Hole drilling

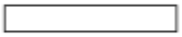
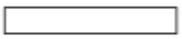
Bolt assembly cost [US$]	Percentage of bolt assembly cost [%]	Cost [US$]
17.26	30.0	5.18

Cost summary

Cost estimation summary	Cost [US$]
Total estimated cost	511.42

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
CUT1							
CUT2							
EP2	P20.0x250-1776 (A572 Gr.50)		1	Double fillet: 4.0	589	16 A325M	10
CUT3							
SP1	P15.0x800-120 (A572 Gr.50)		1				
SP2	P15.0x800-120 (A572 Gr.50)		1				
SP3	P15.0x800-120 (A572 Gr.50)		1				
SP4	P15.0x800-120 (A572 Gr.50)		1				

Symbol explanation

Fillet weld	throat thickness of weld

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Double fillet	E70xx	4.0	5.7	589
Double fillet	E70xx	3.0	4.2	1096
Double fillet	E70xx	8.0	11.3	4160

Bolts

Name	Grip length [mm]	Count
16 A325M	40	10

Symbol explanation

Symbol	Explanation
t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain
F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-22 – J3.7
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-22 – J3.7
t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-22 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-22 – J3.9
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-22 – J3.4
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-22 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-22 – J3.11
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints