Project:
Project no:
Author:

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 CON1

Design

Name	CON1
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2022)

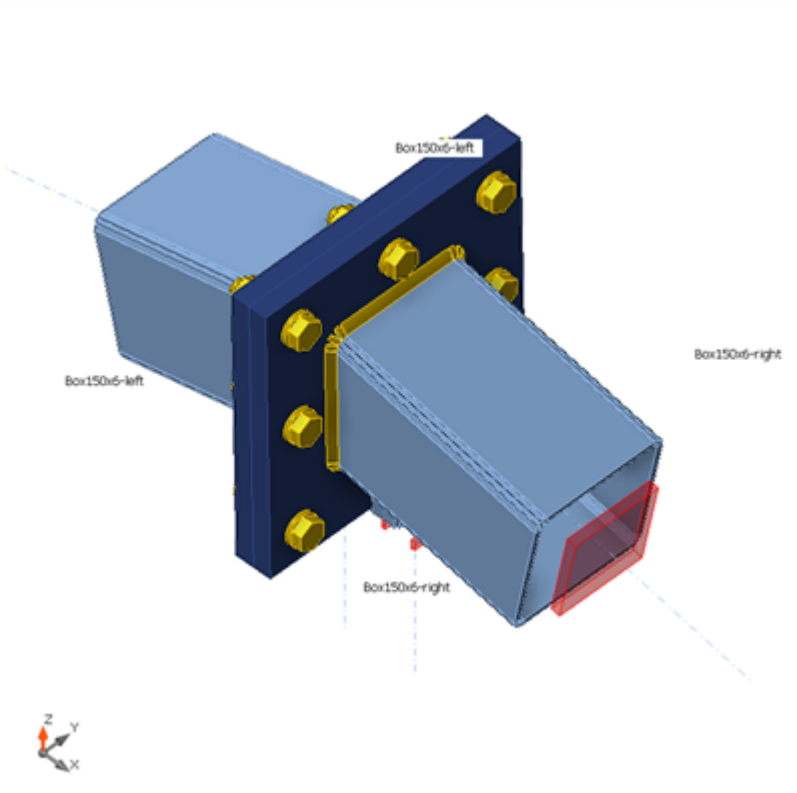
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
Box150x6-right	1 - Box150x150x6(RHS150x150)	0.0	-11.3	0.0	0	0	0
Box150x6-left	1 - Box150x150x6(RHS150x150)	-180.0	-13.4	0.0	0	0	0
UNP60-right	2 - UNP60(U60)	0.0	-90.0	-90.0	0	-43	0
UNP60-left	2 - UNP60(U60)	0.0	-90.0	90.0	0	-39	0

Supports and forces

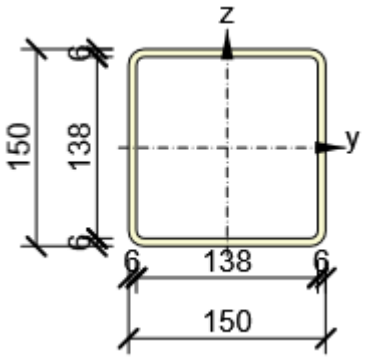
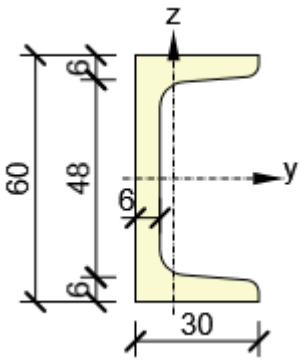
Name	Support	Forces in	X [mm]
Box150x6-right / end	N-Vy-Vz-Mx-My-Mz	Node	0
Box150x6-left / end	Vy-Mx-Mz	Node	0
UNP60-right / end	Vy-Mx-Mz	Node	0
UNP60-left / end	Vy-Mx-Mz	Node	0



Cross-sections

Name	Material
1 - Box150x150x6(RHS150x150)	A1085. Gr.A
2 - UNP60(U60)	A572 Gr.50

Cross-sections

Name	Material	Drawing
1 - Box150x150x6(RHS150x150)	A1085. Gr.A	
2 - UNP60(U60)	A572 Gr.50	

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]
LE1	Box150x6-right / End	365.0	0.0	30.0	0.0	12.0	0.0
	Box150x6-left / End	365.0	0.0	30.0	0.0	12.0	0.0
	UNP60-right / End	0.0	0.0	0.0	0.0	0.0	0.0
	UNP60-left / End	0.0	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]
LE1	1.8	0.0	-97.5	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.4 < 5.0%	OK
Loc. deformation	0.2 < 3%	OK
Bolts	88.0 < 100%	OK
Welds	99.8 < 100%	OK
Buckling	Not calculated	
GMNA	Not calculated	

Plates

Name	Material	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
Box150x6-right	A1085. Gr.A	6.0	LE1	311.3	0.4	0.0	OK
Box150x6-left	A1085. Gr.A	6.0	LE1	310.6	0.1	0.0	OK
UNP60-right-bfl 1	A572 Gr.50	6.0	LE1	247.6	0.0	0.0	OK
UNP60-right-tfl 1	A572 Gr.50	6.0	LE1	247.8	0.0	0.0	OK
UNP60-right-w 1	A572 Gr.50	6.0	LE1	217.0	0.0	0.0	OK
UNP60-left-bfl 1	A572 Gr.50	6.0	LE1	204.9	0.0	0.0	OK
UNP60-left-tfl 1	A572 Gr.50	6.0	LE1	203.8	0.0	0.0	OK
UNP60-left-w 1	A572 Gr.50	6.0	LE1	155.8	0.0	0.0	OK
PP1a	A572 Gr.50	20.0	LE1	299.2	0.0	70.0	OK
PP1b	A572 Gr.50	20.0	LE1	302.0	0.0	71.1	OK

Design data

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

Detailed result for Box150x6-right

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 Box150x6-left

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 UNP60-right-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 UNP60-right-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 UNP60-right-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 UNP60-left-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 UNP60-left-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 UNP60-left-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 PP1a

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 PP1b

Design values used in the analysis

$\phi F_y =$ 310.3 MPa

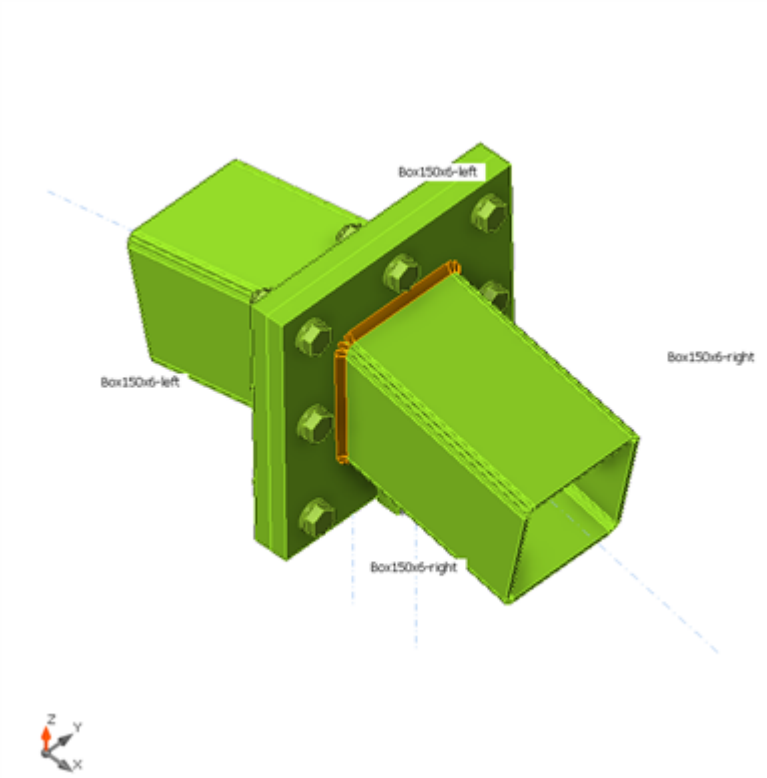
Where:

$F_y = 344.7$ MPa – characteristic yield strength

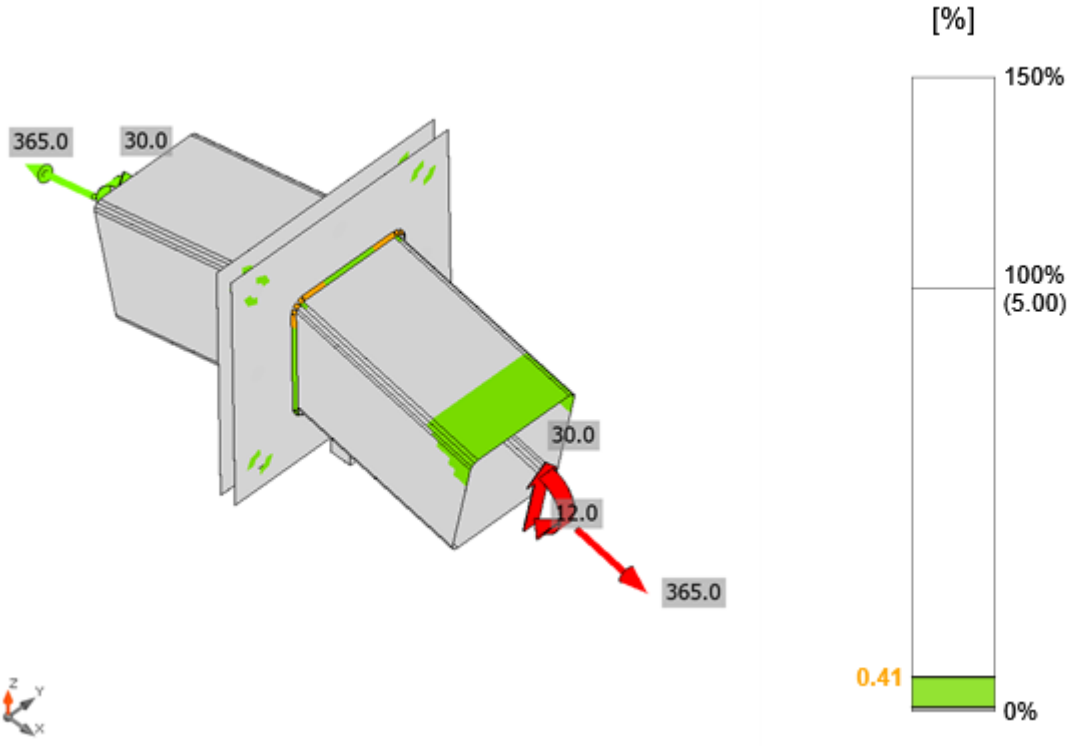
$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

Loc. deformation

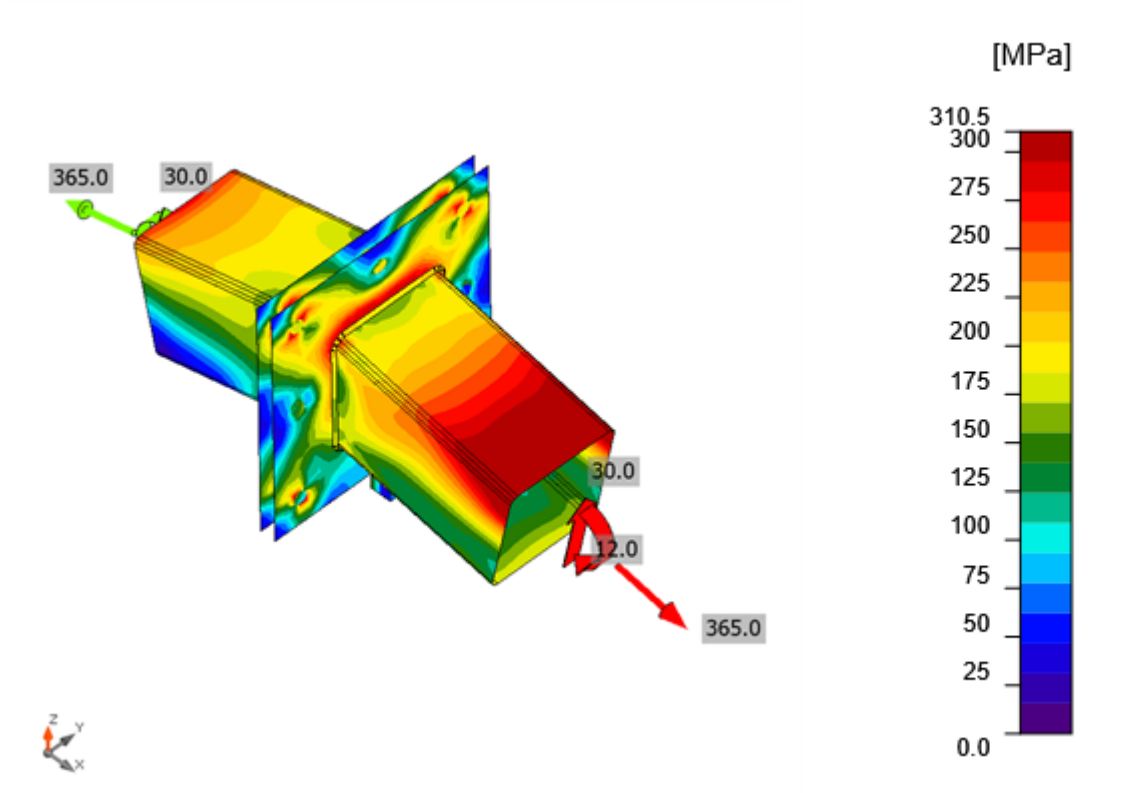
Name	d_0 [mm]	Loads	δ [mm]	δ_{lim} [mm]	δ/d_0 [%]	Check status
Box150x6-right	150	LE1	0	5	0.2	OK
Box150x6-left	150	LE1	0	5	0.2	OK



Overall check, LE1

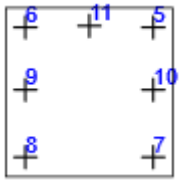


Strain check, LE1



Equivalent stress, LE1

Bolts

Shape	Item	Grade	Loads	F_t [kN]	V [kN]	$\phi R_{n,bearing}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B5	16 A325M - 1	LE1	73.7	8.1	209.7	78.9	14.5	0.0	OK	OK
	B6	16 A325M - 1	LE1	73.8	8.1	209.7	79.0	14.4	0.0	OK	OK
	B7	16 A325M - 1	LE1	63.6	8.2	209.8	68.0	14.6	0.0	OK	OK
	B8	16 A325M - 1	LE1	63.5	8.2	209.8	68.0	14.6	0.0	OK	OK
	B9	16 A325M - 1	LE1	81.0	5.5	258.1	86.7	9.9	0.0	OK	OK
	B10	16 A325M - 1	LE1	81.0	5.5	258.1	86.7	9.9	0.0	OK	OK
	B11	16 A325M - 1	LE1	82.2	5.1	188.7	88.0	9.1	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 B5

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 73.7 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 8.1 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 209.7 \quad \text{kN} \quad \geq \quad V = \quad 8.1 \quad \text{kN}$$

Where:

$l_c = 26$ 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 B6

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 73.8 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 8.1 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 209.7 \quad \text{kN} \quad \geq \quad V = \quad 8.1 \quad \text{kN}$$

Where:

$l_c = 26$ 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 B7

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 63.6 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 8.2 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 209.8 \quad \text{kN} \quad \geq \quad V = \quad 8.2 \quad \text{kN}$$

Where:

$l_c = 26$ 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 B8

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 63.5 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 8.2 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 209.8 \quad \text{kN} \quad \geq \quad V = \quad 8.2 \quad \text{kN}$$

Where:

$l_c = 26$ 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 B9

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 81.0 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 5.5 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 5.5 \quad \text{kN}$$

Where:

$l_c = 94$ 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 B10

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 81.0 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 5.5 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 258.1 \quad \text{kN} \quad \geq \quad V = \quad 5.5 \quad \text{kN}$$

Where:

$l_c = 94$ 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 B11

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

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 93.5 \quad \text{kN} \quad \geq \quad F_t = \quad 82.2 \quad \text{kN}$$

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)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 56.1 \quad \text{kN} \quad \geq \quad V = \quad 5.1 \quad \text{kN}$$

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)

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

$$\phi R_n = \quad 188.7 \quad \text{kN} \quad \geq \quad V = \quad 5.1 \quad \text{kN}$$

Where:

$l_c = 23$ 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
PP1a	Box150x6-right	E70xx	◢ 5.0	◢ 7.1	564	5	LE1	5.1	5.1	99.8	99.8	OK	OK
PP1b	Box150x6-left	E70xx	◢ 5.0	◢ 7.1	564	5	LE1	4.9	5.1	95.7	95.7	OK	OK
Box150x6-right-w 1	UNP60-right	E70xx	◢ 4.0	◢ 5.7	27	9	LE1	8.7	11.4	76.1	59.8	OK	OK
Box150x6-right-w 1	UNP60-right	E70xx	◢ 4.0	◢ 5.7	27	9	LE1	8.7	11.4	76.1	59.7	OK	OK
Box150x6-right-w 1	UNP60-right	E70xx	◢ 4.0	◢ 5.7	54	8	LE1	7.3	9.6	76.3	51.9	OK	OK
Box150x6-left-w 1	UNP60-left	E70xx	◢ 4.0	◢ 5.7	28	9	LE1	8.9	11.9	74.9	53.5	OK	OK
Box150x6-left-w 1	UNP60-left	E70xx	◢ 4.0	◢ 5.7	28	9	LE1	8.9	11.9	75.0	54.4	OK	OK
Box150x6-left-w 1	UNP60-left	E70xx	◢ 4.0	◢ 5.7	54	8	LE1	7.5	9.9	75.4	51.7	OK	OK

Design data

Material	F_{exx} [MPa]
E70xx	482.6

Detailed result for PP1a / Box150x6-right - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 5.1 kN ≥ $F_n =$ 5.1 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

$A_{we} =$ 24 mm^2 – effective area of weld critical element

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

Detailed result for PP1b / Box150x6-left - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 5.1 kN ≥ $F_n =$ 4.9 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

$A_{we} =$ 24 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-right-w 1 / UNP60-right - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 11.4 kN ≥ $F_n =$ 8.7 kN

Where:

$F_{nw} =$ 416.7 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
  - $\theta =$ 66.5° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 37 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-right-w 1 / UNP60-right - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 11.4 kN ≥ $F_n =$ 8.7 kN

Where:

$F_{nw} =$ 417.0 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
  - $\theta =$ 66.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 37 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-right-w 1 / UNP60-right - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 9.6 kN ≥ $F_n =$ 7.3 kN

Where:

$F_{nw} =$ 416.6 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
  - $\theta =$ 66.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 31 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-left-w 1 / UNP60-left - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 11.9 kN ≥ $F_n =$ 8.9 kN

Where:

$F_{nw} =$ 430.5 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
  - $\theta =$ 79.1° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 37 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-left-w 1 / UNP60-left - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 11.9 kN ≥ $F_n =$ 8.9 kN

Where:

$F_{nw} =$ 431.8 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
  - $\theta =$ 81.2° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 37 mm^2 – effective area of weld critical element

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

Detailed result for Box150x6-left-w 1 / UNP60-left - 1

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

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 9.9 kN ≥ $F_n =$ 7.5 kN

Where:

$F_{nw} =$ 431.0 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
  - $\theta =$ 79.9° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 31 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	28.59	2.50	71.49

Bolts

Bolt assembly	Total weight [kg]	Unit cost [US$/kg]	Cost [US$]
16 A325M	2.01	6.00	12.08

Welds

Weld type	Throat thickness [mm]	Leg size [mm]	Total weight [kg]	Unit cost [US$/kg]	Cost [US$]
Fillet weld	5.0	7.1	0.22	45.00	10.01
Fillet weld	4.0	5.7	0.03	45.00	1.24

Hole drilling

Bolt assembly cost [US$]	Percentage of bolt assembly cost [%]	Cost [US$]
12.08	30.0	3.62

Cost summary

Cost estimation summary	Cost [US$]
Total estimated cost	98.43

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
PP1	P20.0x300-304 (A572 Gr.50)		1	Fillet: 5.0	1133	16 A325M	7
	P20.0x300-304 (A572 Gr.50)		1				
CUT1				Fillet: 4.0	109		
CUT2				Fillet: 4.0	110		

Symbol explanation

Fillet weld	throat thickness of weld

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	E70xx	5.0	7.1	1133
Fillet	E70xx	4.0	5.7	219

Bolts

Name	Grip length [mm]	Count
16 A325M	40	7

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