greentech engineering

Chapter #7 CONNETIONS DESIGN

Fruitland Vertical Farm and Marketplace

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Team 12

Chapter Lead(s):

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PROJECT OVERVIEW

The City of Hamilton has retained GreenTech Engineering (GreenTech) to complete the design and consultation for the Fruitland Vertical Farm and Marketplace located at the intersection of North Service Road and Fruitland Road in Stoney Creek, Ontario. The City of Hamilton's 2031 Master Plan (2015) identifies the need for sustainable infrastructure, with the goal of implementing innovative solutions for the problems threatening today's society. To fulfill this need, the City has chosen to implement a vertical farm in a community slated for urban development in the coming years.

The objective of the Fruitland Vertical Farm and Marketplace is to provide an alternate means of food production in a population-dense environment. The proposed undertaking will seek to act as a "sustainable landmark" within the City of Hamilton by implementing sustainable structural, stormwater, transportation, and geotechnical practices throughout its design and construction.

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7.1 DESIGN APPROACH

Greentech Engineering recognizes the importance of enhancing the triple bottom line of our stakeholders being people, planet, profit and these concepts are reflected in our design approach. People are at the core of Greentech Engineering as we focus on safety, ease of construction and familiar structural design to decrease the chances of errors. All member loads are calculated conservatively to ensure the safety and proper serviceability of the occupants and workers. Sustainability is at the core of Greentech Engineering services and it is also at the core of the project, Fruitland Vertical Farm and Marketplace and this too was an important factor in the overall design. Although it is important to be conservative and have built-in redundancy into our structural system, our engineers also recognize that the more material used, the more embodied carbon will be part of the project. It is our aim to design the connections efficiently – for instance our decision to design connections for different pair of structural members, which reflect our aim to decrease the material used in the structural system. With an aim to decrease material naturally follows savings which increase profit and increasing the overall value of the project for developers. The connections were first manual design using Handbook of Steel Design Construction CSA S16-14, and then import to IDEA Statica for sufficient checks. Structural framing members were selected from ASTM Grade A992 steel, while connection members were selected from CSA G40.21 Grade 300W steel. Bolt assembly used in the project is A325 with F_u of 825 MPa, and matching electrode weld E49xx with X_u of 490 MPa.

7.2 JOIST – GIRDER CONNECTIONS DESIGN

7.2.1 Joist – Girder Connections Design Overview

The goal of joist to girder connection is to design to transfer shear from joist to girder, but not moment. In the other word, the connection allows certain degree of rotation, but must be restrained any lateral movements. According to CSA S16-14, one of the connection methods that matching all these criteria is shear tab. In this project, there are two type of shear tab connections were designed for Exterior joist – girder connection and Interior joist – girder connection.

7.2.2 Exterior Joist – Girder Connection

In this type of connection, two structural members were connected through double angle sections. Angle sections were attached to the webs of structural members using ¾ inch bolts. This would allow the rotation of top and bottom flange of supported member, but also prevent the movements in any direction. Figure 1 shows a typical Exterior joist – girder connection.

The design was repeated for different combination of structural members:

Level	Joist Section	Girder Section	Angle Section	Bolt Size
2nd Floor	W310x45	W460x89	L76x76x7.9	¾ inch
3rd Floor	W310x45	W460x89	L76x76x7.9	¾ inch
4th Floor	W310x45	W460x89	L76x76x7.9	¾ inch
Roof 1	W200x31	W360x51	L76x76x7.9	¾ inch
Roof 2	W360x39	W530x92	L76x76x7.9	¾ inch

Table 1: Exterior Joist - Girder Connection Summary

For sample calculation and IDEA Statica results, refer to Appendix C

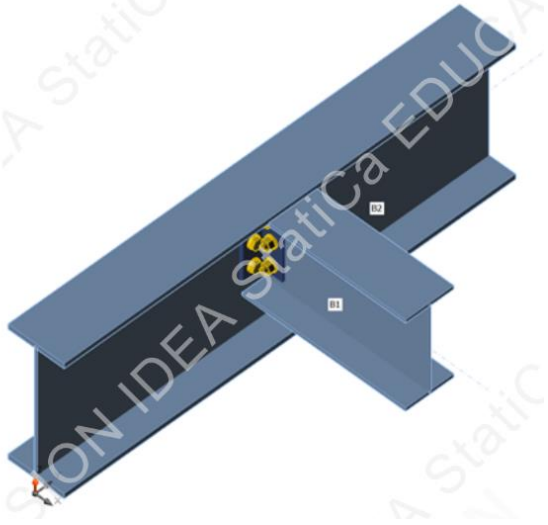


Figure 1: Typical Exterior Joist - Girder Connection

7.2.3 Interior Joist – Girder Connection

In this type of connection, two structural members were connected through double angle sections. Angle sections were bolted to supported member using ¾ inch bolts and welded to supporting member. This would allow the rotation of top and bottom flange of supported member, but also prevent the movements in any direction. Figure 2 shows a typical Interior joist – girder connection.

The design was repeated for different combination of structural members:

Level	Joist Section	Girder Section	Angle Section	Bolt Size	Weld Size
2nd Floor	W310x45	W460x89	L76x76x7.9	¾ inch	6 mm
3rd Floor	W310x45	W460x89	L76x76x7.9	¾ inch	6 mm
4th Floor	W310x45	W460x89	L76x76x7.9	¾ inch	6 mm
Roof 1	W200x31	W360x51	L76x76x7.9	¾ inch	6 mm
Roof 2	W360x39	W530x92	L76x76x7.9	¾ inch	6 mm

Table 2: Interior Joist - Girder Connection Summary

For sample calculation and IDEA Statica results, refer to Appendix C

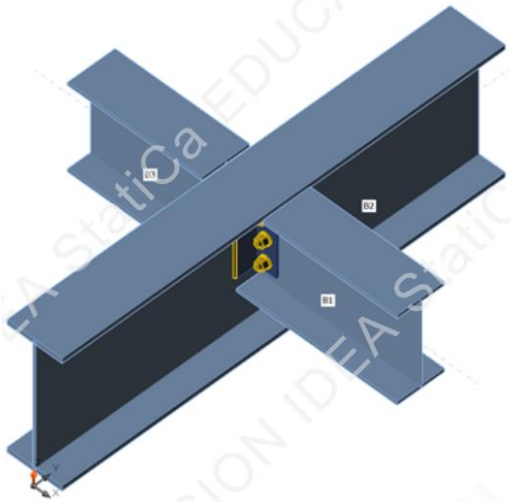


Figure 2: Typical Interior Joist - Girder Connection

7.3 BEAM – COLUMN CONNECTIONS DESIGN

7.3.1 Beam - Column Connections Design Overview

Similar to joist – girder connection, shear tab was also designed for beam – column connection. However, it is noted that at one column location, two types of shear tab are connected to the same column, namely girder – column connection and joist – column connection.

7.3.2 Girder – Column Connection

In this type of connection, two structural members were connected through double angle sections. Angle sections were attached to the web of joist and web of column using ¾ inch bolts. This would allow the rotation of top and bottom flange of joist, but also prevent the movements in any direction. Figure 4 shows a typical Joist – column connection.

The design was repeated for different combination of structural members:

Level	Girder Section	Column Section	Angle Section	Bolt Size
2nd Floor	W310x45	W200x52	L76x76x7.9	¾ inch
	W310x45	W200x86	L76x76x7.9	¾ inch
3rd Floor	W310x45	W200x52	L76x76x7.9	¾ inch
	W310x45	W200x71	L76x76x7.9	¾ inch
4th Floor	W310x45	W200x42	L76x76x7.9	¾ inch
	W310x45	W200x52	L76x76x7.9	¾ inch
Roof 1	W360x51	W200x42	L76x76x7.9	¾ inch
Roof 2	W530x92	W200x42	L76x76x7.9	¾ inch

Table 3: Girder - Column Connection Summary

For sample calculation and IDEA Statica results, refer to Appendix C

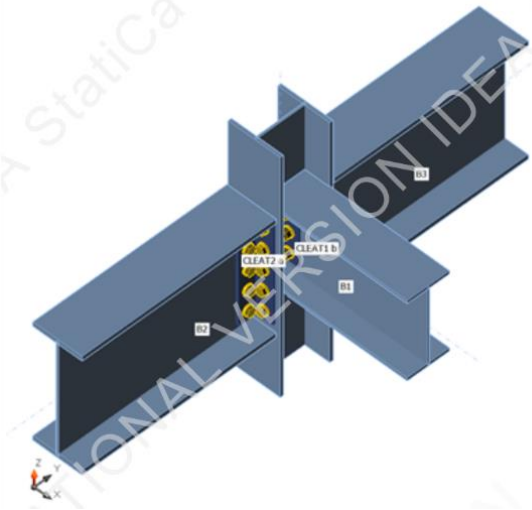


Figure 3: Typical Girder – Column Connection

7.3.3 Joist - Column Connection

In this type of connection, two structural members were connected through double angle sections. Angle sections were attached to the web of girder and flange of column using ¾ inch bolts. This would allow the rotation of top and bottom flange of girder, but also prevent the movements in any direction. Figure 3 shows a typical Girder – column connection.

The design was repeated for different combination of structural members:

Level	Girder Section	Column Section	Angle Section	Bolt Size
2nd Floor	W460x89	W200x52	L76x76x7.9	¾ inch
	W460x89	W200x86	L76x76x7.9	¾ inch
3rd Floor	W460x89	W200x52	L76x76x7.9	¾ inch
	W460x89	W200x71	L76x76x7.9	¾ inch
4th Floor	W460x89	W200x42	L76x76x7.9	¾ inch
	W460x89	W200x52	L76x76x7.9	¾ inch
Roof 1	W200x31	W200x42	L76x76x7.9	¾ inch
Roof 2	W360x39	W200x42	L76x76x7.9	¾ inch

Table 4: Joist - Column Connection Summary

For sample calculation and IDEA Statica results, refer to Appendix C

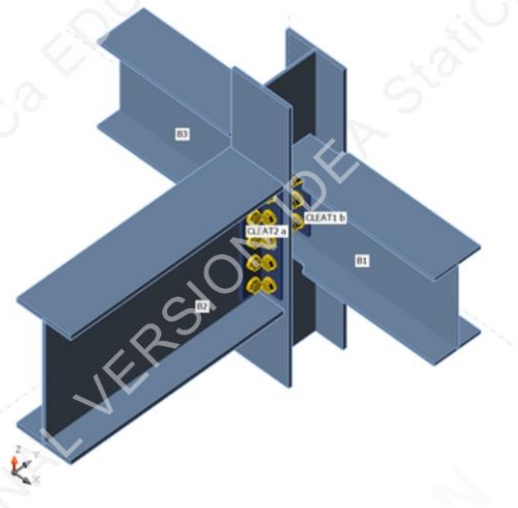


Figure 4: Typical Joist – Column Connection

7.4 CHEVRON BRACE CONNECTIONS DESIGN

7.4.1 Chevron Brace Connections Design Overview

The chevron bracing connection requires the most detail in comparison to the other connections within the Fruitland Vertical Farm and Marketplace building. The channels for the bracing are changed at each level and thus an easily detailed connection which can be replicated with ease for the contractors is required. Taking advantage of offsite construction, endplates are welded onto the ends of channel and plates sized 300x200x10 are then fillet welded concentrically to the end plate in order to straddle the gusset plate. There are two connections which require detailing; one which is the top chevron connection which has one gusset plate supporting the

loads from two channels and the second connection is the single channel connecting to a gusset plate which is welded to a column and a baseplate or beam.

7.4.2 Chevron Brace Connection

A summary of the tensile loads and connections are provided in Table 5 below. A design for the largest load was conducted and the same design was implemented at each level. A design check was still required at each level to ensure the connection was still sufficient because a smaller channel was used and thus there was a smaller weldable area.

Level	Load (CF/TF)	Member	Bolt	Weld Size
1ST FLR	Tf=701 kN	C200X28	7/8 inch	10mm
2ND FLR	Tf=533 kN	C200X21	7/8 inch	10mm
3RD FLR	Tf=374 kN	C180X15	7/8 inch	10mm
4TH FLR	Tf=177 kN	C180X15	7/8 inch	10mm

Table 5: Chevon Brace Connection Summary

Figure 5 below shows a typical chevron bracing connection. For sample calculation and IDEA Statica results, refer to Appendix C.

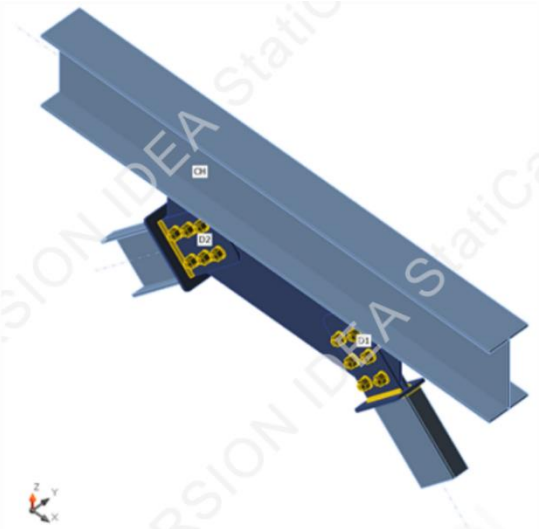


Figure 5: Typical Chevron Brace Connection

It is also important to note that the singular channel connection to the gusset plate which occurs on the channel is the same as the connection seen in Figure 5 above. The only exception is that the gusset plate is welded to the column and the adjacent beam or baseplate. Details for the connection can be seen in the structural detail drawings.

7.5 COLUMN SPLICE CONNECTIONS DESIGN

7.5.1 Column Splice Connections Design Overview

In an effort to lower the embodied carbon emissions of the project GreenTech engineers changed the size of the column at each level. A connection between these two columns is required. In reality, this connection doesn't require much engineering as it consists of two plates welded to the ends of both connecting columns and then 4 anchors holding these plates together. There is no moment or shear coming to these columns and solely compressive load and thus as long as the two 10mm thick plates can avoid crushing, the connection is sound. Regardless, an analysis and calcs were performed on the connection to ensure it was safe and to assess the tensile capacity of such a connection.

7.5.2 Column Splice Connection

A splice connection consisting of endplates anchored together was required for this splice because of the different sized columns coming together. Typically what may be seen between columns of the same size are splice plates anchored on each side of the web and at the exterior of each flange but this would not be practical in this scenario. Table 6 below shows a summary of the loads and the connection designed for the splice plates.

Where Largest Load Occurs	**Load (CF/TF)**	**Member(s)**	**Bolts**	**Welds**
COL TO COL @J8	Cf=927 kN	W200X42 TO W200X52	¾ inch	10mm
COL TO COL @J8	Cf=1453 kN	W200x52 TO W200X71	¾ inch	10mm
COL TO COL @J8	Cf=1948 kN	W200X71 TO W200X86	¾ inch	10mm

Table 6: Column Splice Connection Summary

Figure 6 shows a typical isometric view of this connection.

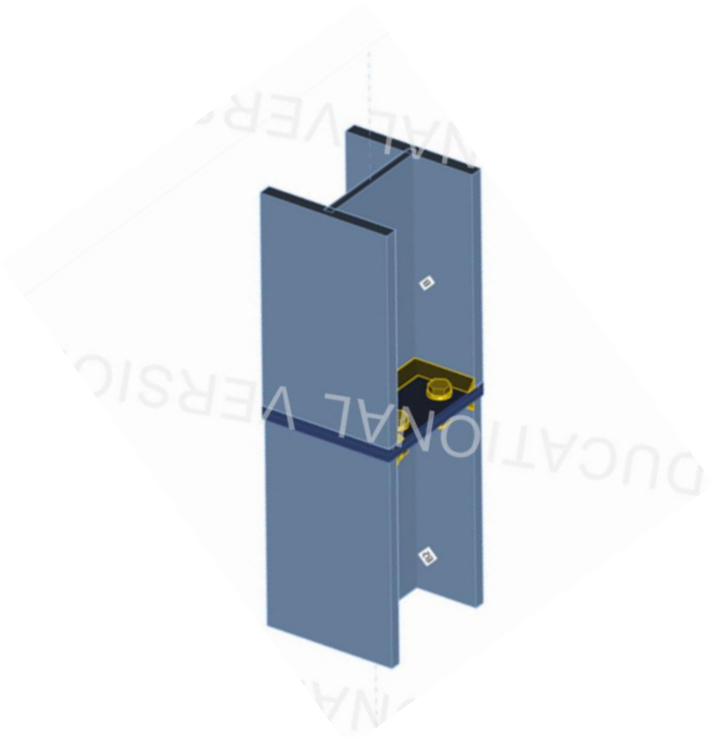


Figure 6: Typical Column Splice Connection

For sample calculation and IDEA Statica results, refer to Appendix C.

7.6 BASED PLATE CONNECTIONS DESIGN

7.6.1 Base Plate Connections Design Overview

Base plate connection is similar to that of the column splice connection in that it is mainly governed by compression. Detailed calculations were followed from the CISC handbook and this can be seen in Appendix C. Like the column splice connection, a base plate is welded onto the column end off site and is then brought to site to be anchored into the foundations (which is out of scope for GreenTech Engineering). Four ¾" anchors are sufficient and standard for all baseplates within this project.

7.6.2 Base Plate Connection

The base plates were designed based off of the column with the largest load. Each column is a W200 section and thus the layout of the anchors and the column relative to the perimeter of the baseplate remains consistent between each column. The only time a base plate changes in length is when a chevron brace is to be welded to it in which case additional base plate is required to

ensure that the 300W 300x300x10 gusset plate for the chevron brace can be welded onto a steel surface. A summary of the loads and connections can be seen in Table 7 below.

Where Largest Load Occurs	Load (CF/TF)	Members	Bolts	Welds
W200X86 @ J8	Cf=1948 kN	W200X86	¾ inch	10mm
W200X52 @ J4	Cf=1205 kN	W200x52	¾ inch	10mm
W200X42 @F2-1	Cf=434 kN	W200x42	¾ inch	10mm

Table 7: Base Plate Connection Summary

Figure 7 below shows an isometric drawing of the base plate connection.

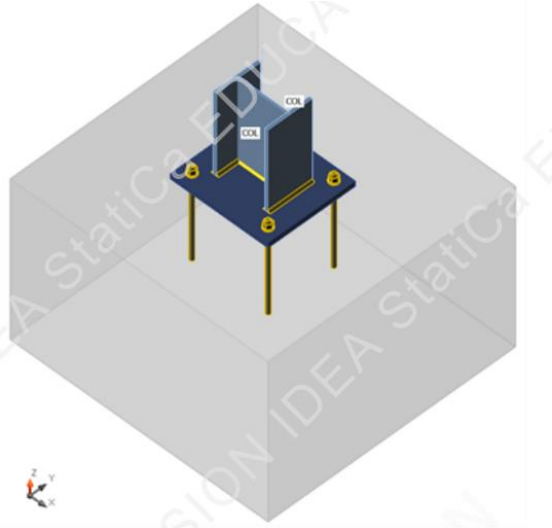
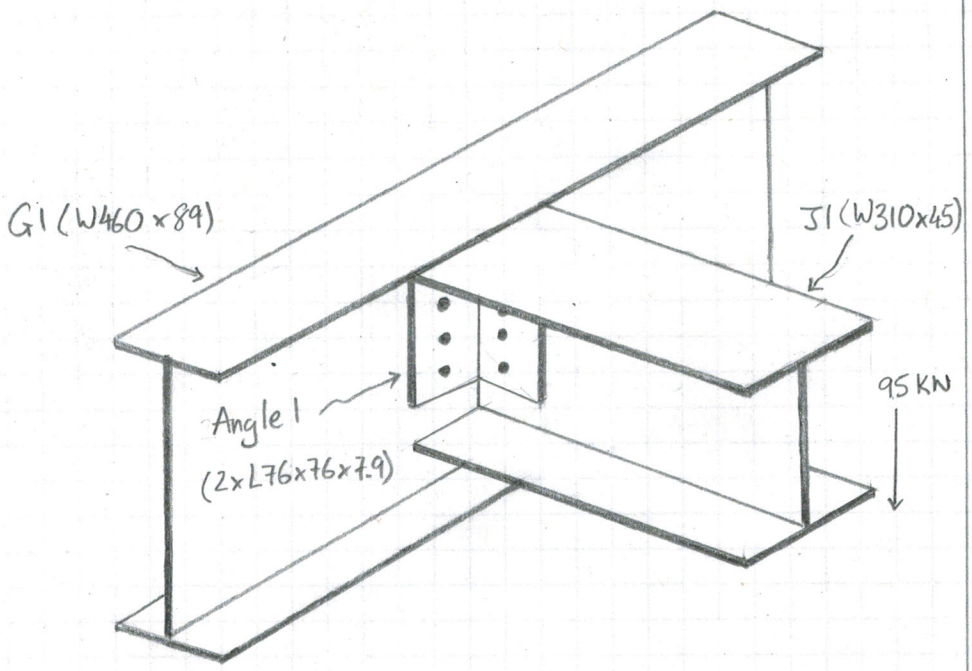


Figure 7: Typical Base Plate Connection

For sample calculation and IDEA Statica results, refer to Appendix C.

- Exterior Joist - Girder connection



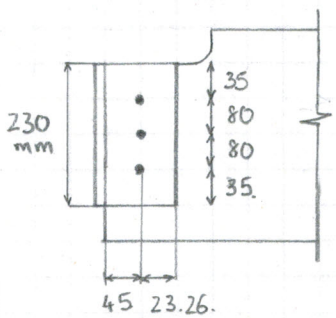
- Angle 1 : (G1 - J1 connection)

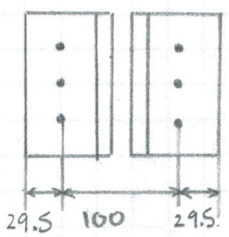
using A325 3/4' bolts $\Rightarrow F_{ubolt} = 825\,MPa$.

$V_f = 95\,kN$

- From Table 3-36, 3-37, choose section L76 x 76 x 7.9 300W steel with L = 230mm and 3 bolts

S16-14 Table 3-36
Table 3-37





- Check bolt on girder:

1) Shear resistance:

$V_r = 0.6\,\phi_b\, n\, m\, A_b\, F_u\, (0.7)$ Assume thread intercepted — S16-14 §13.2.1.2(c)

S16-14 §13.1(c)

$\phi_b = 0.8$

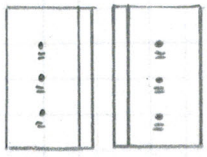
$n = 6 \quad m = 1$

$A_b = 285\,(mm^2) \quad F_u = 825\ MPa$

$V_r = 0.6\,(0.7)\,(0.8)\,(6)\,(1)\,(285)\,(825)$

$\Rightarrow V_r = 474\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay

2) Bolt bearing:



$B_r = 3\,\phi_{br}\, n\, t\, d\, F_u$

S16-14 §13.12.1.2(a)

S16-14 §13.1(g)

$\phi_{br} = 0.8$

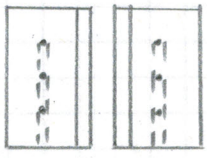
$n = 6 \quad F_u = 440\ MPa$

$t = 7.9\ mm \quad d = 19.05\ mm$

$B_r = 3\,(0.8)\,(6)\,(7.9)\,(19.05)\,(440)$

$\Rightarrow B_r = 958\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay.

3) Bolt tear-out



$T_r = \phi_u\,(0.6)\,A_{gv}\,\frac{F_y + F_u}{2}$

S16-14 §13.11

S16-14 §13.1(a)

$\phi_u = 0.75$

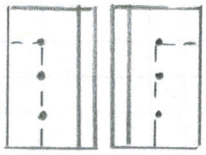
$A_{gv} = 4\,(2\times 80 + 35)\,(7.94) = 6193.2\ (mm^2)$

$\Rightarrow T_r = (0.75)\,(0.6)\,(6193.2)\,\frac{440+300}{2}$

$\Rightarrow T_r = 1031\ (kN) > T_f = 95\ (kN) \Rightarrow$ okay

4) Block shear

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$



S16-14 §13.11.

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 1.0$

$A_n = (19.0)(7.94)(2) = 301.7 \ (mm^2)$

$A_{gv} = 2\,(2 \times 80 + 35)(7.94) = 3096.6 \ (mm^2)$

$$T_r = (0.75)\left[(1.0)(301.7)(440) + (0.6)(3096.6)\frac{300+440}{2}\right]$$

$\Rightarrow T_r = 615 \ (kN) > T_f = 95 \ (kN) \Rightarrow$ okay

- Check bolt on joist:

1) Shear resistance

$V_r = 0.6\,\phi_b\, n\, m\, A_b\, F_u\, (0.7)$ Assume thread intercepted S16-14 §13.12.1.2(c)

$\phi_b = 0.8$ S16-14 §13.1(c)

$m = 2 \qquad n = 3$

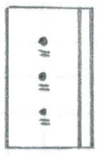
$A_b = 285 (mm^2) \qquad F_u = 825 \ (MPa)$

$V_r = (0.6)(0.7)(0.8)(3)(2)(285)(825)$

$\Rightarrow V_r = 474 \ (kN) > V_f = 95 \ (kN) \Rightarrow$ okay

2) Bolt bearing

$B_r = 3\,\phi_{br}\, n\, t\, d\, F_u$



S16-14 §13.12.1.2(a)

$\phi_{br} = 0.8$ S16-14 §13.1(g)

$t = 7.94 \ mm \qquad d = 19.05 \ mm.$

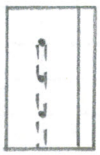
$n = 3$ $\quad F_u = 440$ MPa.

$B_r = 3(0.8)(3)(7.94)(19.05)(440)$

$\Rightarrow B_r = 160\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay.

3) Bolt tear-out:

$$T_r = \phi_u (0.6) A_{gv} \frac{F_y + F_u}{2}$$



S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

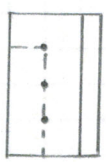
$A_{gv} = 4(2\times 80 + 35)(7.94) = 6193.2\ (mm^2)$

$$\Rightarrow T_r = 0.75(0.6)(6193.2)\frac{300+440}{2}$$

$\Rightarrow T_r = 1031\ (kN) > T_f = 95\ (kN) \Rightarrow$ okay

4) Block shear

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$



S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 0.6$ S16-14 Fig 2-26(b).

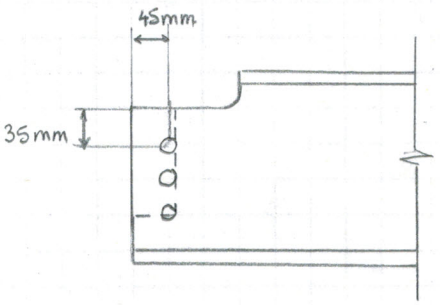
$A_n = 2(12.76)(7.94) = 202.6\ (mm^2)$

$A_{gv} = 2(80\times 2 + 35)(7.94) = 3096.6\ (mm^2)$

$$T_r = (0.75)\left[(0.6)(202.6)(440) + 0.6(3096.6)\frac{300+440}{2}\right]$$

$\Rightarrow T_r = 556\ (kN) > T_f = 95\ (kN) \Rightarrow$ okay

- Check block shear on coped beam



$F_y = 345\ MPa$

$F_u = 450\ MPa$

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$ S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 0.9$ S16-14 Fig 2-26(1)

$A_{gv} = (35 + 80 \times 2)(6.6) = 1287\ (mm^2)$

$A_n = (45 - 21/2)(6.6) = 227.7\ (mm^2)$

$$T_r = 0.75 \left[(0.9)(227.7)(450) + 0.6\,(1287) \frac{345 + 450}{2} \right]$$

$\Rightarrow T_r = 299\,(KN) > T_f = 95\,(KN) \Rightarrow$ okay.

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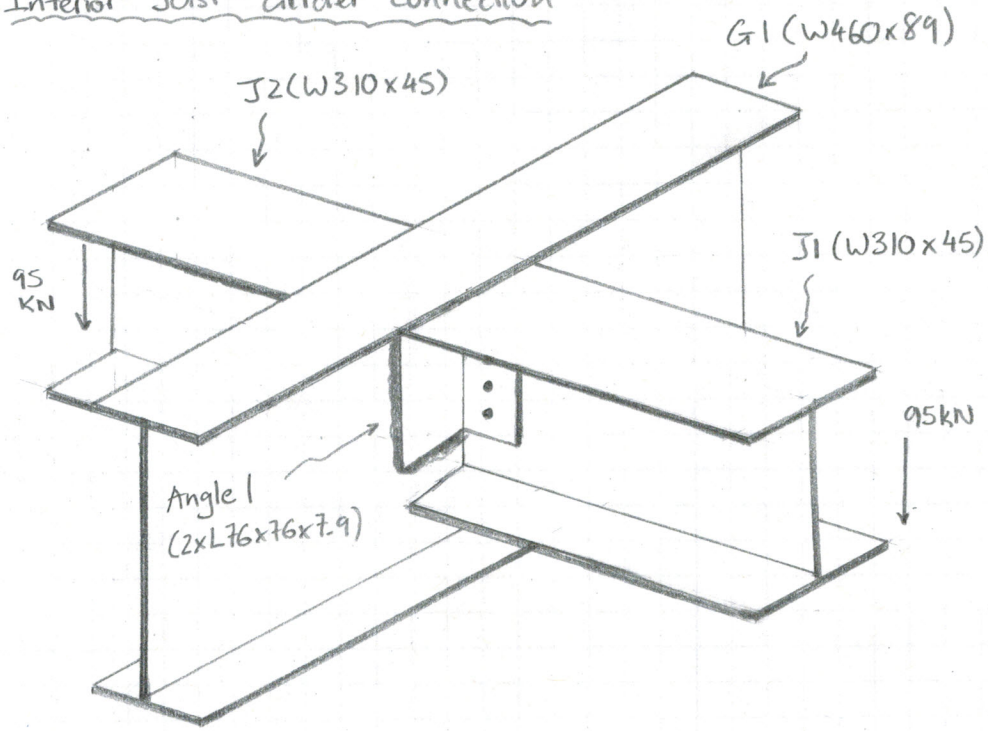
	Title:	Date:	Page: 1

- Interior Joist - Girder connection

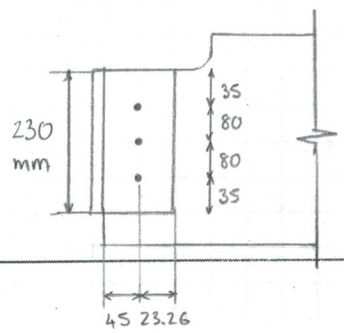


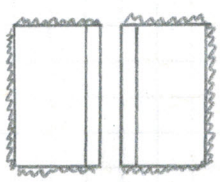
- Angle 1: (G1 - J1 connection).
- Using A325 3/4" bolts ⇒ $F_{ubolt} = 825\ MPa$.
- Fillet weld matching electrode E49xx $X_u = 490\ MPa$.

$V_f = 95\ kN$

- From Table 3-37, 3-38, choose section L76x76x7.9 300W steel with L = 230mm and 3 bolts and Fillet weld size = 6mm.

S16-14 Table 3-37
Table 3-38





- Check bolt on joist

(Similar to exterior joist - girder connection).

1) Shear resistance.

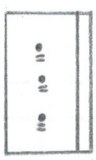
$V_r = 0.6\,\phi_b\, n\, m\, A_b\, F_u\, (0.7)$ Assume thread intercepted — S16-14 §13.12.1.2(c)

$m = 2 \qquad n = 3$

$\Rightarrow V_r = 474\,(kN) > V_f = 95\,(kN) \Rightarrow$ okay

2) Bolt bearing

$B_r = 3\,\phi_{br}\, n\, t\, d\, F_u$ — S16-14 §13.12.1.2(a)

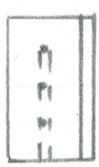


$n = 3$

$\Rightarrow B_r = 160\,(kN) > V_f = 95\,(kN) \Rightarrow$ okay

3) Bolt tear-out

$T_r = \phi_u\,(0.6)\,A_{gv}\,\frac{F_y + F_u}{2}$ — S16-14 §13.11

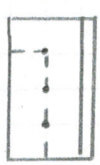


$A_{gv} = 6193.2\,(mm^2)$

$\Rightarrow T_r = 1031\,(kN) > V_f = 95\,(kN) \Rightarrow$ okay

4) Block shear

$T_r = \phi_u \left[U_t\, A_n\, F_u + 0.6\, A_{gv}\, \frac{F_y + F_u}{2} \right]$ — S16-14 §13.11.



S16-14 Fig 2-26 (3)

$U_t = 0.6$

$A_n = 202.6\,(mm^2)$

$A_{gv} = 3096.6\,(mm^2)$

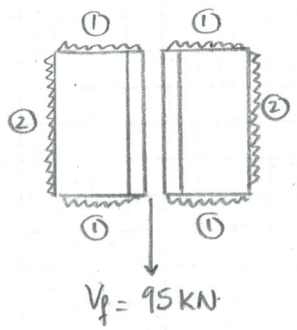
$\Rightarrow T_r = 556\,(kN) > T_f = 95\,(kN) \Rightarrow$ okay

- Check weld on girder

$V_r = 0.67 \phi_w A_w X_u (1 + 0.5 \sin^{1.5}\theta) M_w$

$\phi_w = 0.67$

$X_u = 490\ MPa$



S16-14 §13.13.2.2

S16-14 §13.1(2)

For weld ①:

$\theta = 90°$

$A_w = \frac{s}{\sqrt{2}} L = \frac{6}{\sqrt{2}} (76.2) = 323.29\ (mm^2)$

$M_w = \frac{0.85 + \theta_1/600}{0.85 + \theta_2/600} = \frac{0.85 + 90°/600}{0.85 + 90°/600} = 1.0$

$V_{r_1} = 0.67(0.67)(323.29)(490)[1 + 0.5\sin^{1.5}(90°)](1.0)$

$\Rightarrow V_{r_1} = 107\ (kN)$

For weld ②:

$\theta = 0°$

$A_w = \frac{s}{\sqrt{2}} L = \frac{6}{\sqrt{2}} \times 230 = 975.81\ (mm^2)$

$M_w = \frac{0.85 + \theta_1/600}{0.85 + \theta_2/600} = \frac{0.85 + 0/600}{0.85 + 90/600} = 0.85$

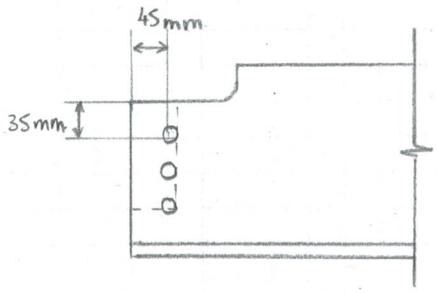
$V_{r_2} = 0.67(0.67)(975.81)[1 + 0.5\sin^{1.5}(0)](0.85)$

$\Rightarrow V_{r_2} = 372\ (kN)$

$\Rightarrow V_{r\,total} = 4V_{r_1} + 2V_{r_2} = 4(107) + 2(372)$

$\Rightarrow V_{r\,total} = 1172\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay

- Check block shear on coped beam



$F_y = 345 MPa$

$F_u = 450 MPa$

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$ S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 0.9$ S16-14 Fig 2-26(1)

$A_{gv} = 1287 (mm^2)$

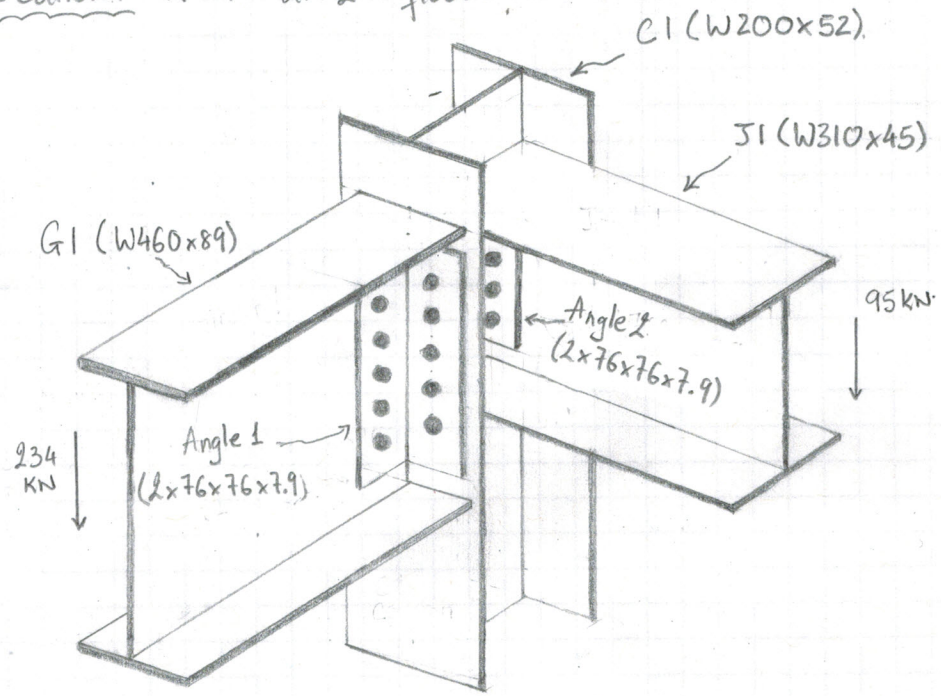
$A_n = 227.7 (mm^2)$

$$T_r = (0.75) \left[(0.9)(227.7)(450) + (0.6)(1287) \frac{345 + 450}{2} \right]$$

$\Rightarrow T_r = 299 (kN) > T_f = 95 (kN) \Rightarrow$ okay

McMaster University ENGINEERING	Name:	ID #:	
	Title: Sample calculation for Beam - Column connection.	Date:	Page: 1

- Location: K-4 at 2nd floor.



- Angle 1: (G1 - C1 connection).

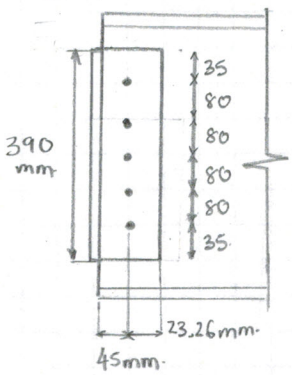
Using A325 3/4" bolts. $\Rightarrow F_{ubolt} = 825\ MPa$

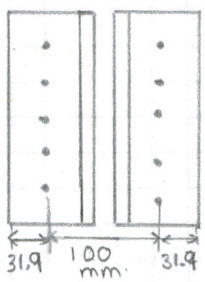
$V_f = 234\ kN$

- From Table 3-37, choose section L76x76x7.9. S16-14 Table 3-37

300W steel with length = 390 mm and 5 bolts

$F_y = 300\ MPa$ $F_u = 440\ MPa$





- Check bolts on column

1) Shear resistance

$V_r = 0.6\,\phi_b\, n\, m\, A_b\, F_u\, (0.7)$ Assume thread intercepted. S16-14 §13.12.1.2 (c)

$\phi_b = 0.8$ S16-14 §13.1 (c)

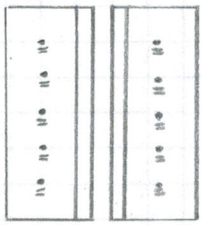
$n = 10 \quad m = 1$

$A_b = 285\ (mm^2) \quad F_u = 830\ MPa$

$\Rightarrow V_r = 0.6(0.8)(10)(1)(285)(825)(0.7)$

$\Rightarrow V_r = 790\ (KN) > V_f = 234\ (KN) \Rightarrow$ okay.

2) Bolt bearing



$B_r = 3\,\phi_{br}\, n\, t\, d\, F_u$ S16-14 §13.12.1.2 (a)

$\phi_{br} = 0.8$ S16-14 §13.1 (g)

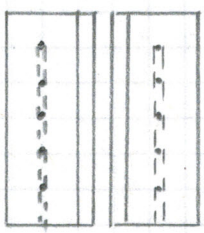
$n = 10$

$t = 7.94\ mm \quad d = 19.05\ mm \quad F_u = 440\ MPa$

$B_r = 3(0.8)(10)(7.94)(19.05)(440)$

$\Rightarrow B_r = 1597\ (KN) > V_f = 234\ (KN) \Rightarrow$ okay

3) Bolt tear-out:



$T_r = \phi_u\, (0.6)\, A_{gv}\, \frac{F_y + F_u}{2}$ S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1 (a)

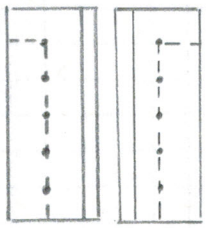
$A_{gv} = 4 \times (4 \times 80 + 35)(7.94) = 11274.8\ (mm^2)$

$\Rightarrow T_r = (0.75)(0.6)(11274.8)\, \frac{300 + 440}{2}$

$\Rightarrow T_r = 1877\ (KN) > T_f = 234\ (KN) \Rightarrow$ okay.

4) Block shear:

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$



S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 1.0$ S16-14 §13.11(a)

$A_n = (19.0mm) \times (7.94) \times 2 = 301.7\ (mm^2)$

$A_{gv} = 2 \times (4 \times 80 + 35)(7.94) = 5637.4\ (mm^2)$

$$T_r = 0.75 \left[(1.0)(301.7)(440) + 0.6(5637.4) \frac{300+440}{2} \right]$$

$\Rightarrow T_r = 1038\ (KN) > T_f = 234\ (KN) \Rightarrow$ okay

Check bolt on girder:

1) Shear resistance

$V_r = 0.6\, \phi_b\, m\, n\, A_b F_u (0.7)$ Assume thread intercepted S16-14 §13.12.1.2(c)

$\phi_b = 0.8$ S16-14 §13.1(c)

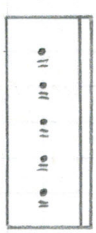
$n = 5 \quad m = 2$

$A_b = 285\ (mm^2) \quad F_u = 825\ MPa.$

$\Rightarrow V_r = 0.6(0.8)(0.7)(5)(2)(285)(825)$

$\Rightarrow V_r = 790\ (KN) > V_f = 234\ (KN) \Rightarrow$ okay

2) Bolt bearing



$B_r = 3\, \phi_{br}\, n\, t\, d\, F_u$ S16-14 §13.12.1.2(a)

$\phi_{br} = 0.8$ S16-14 §13.1(g)

$t = 7.94\,mm$ $\quad d = 19.05\,mm$

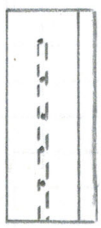
$n = 5$ $\quad F_u = 440\,MPa$

$B_r = 3(0.8)(5)(7.94)(19.05)(440)$

$\Rightarrow B_r = 799\,(kN) > V_f = 234\,(kN) \Rightarrow$ okay.

3) Bolt tear - out

$T_r = \phi_u (0.6) A_{gv} \frac{F_y + F_u}{2}$ S16-14 §13.11



$\phi_u = 0.75$ S16-14 §13.1(a)

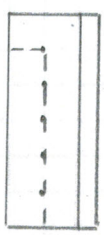
$A_{gv} = 4(4\times80+35)(7.94) = 11274.8\,(mm^2)$

$\Rightarrow T_r = (0.75)(0.6)(11274.8)\frac{300+440}{2}$

$\Rightarrow T_r = 1877\,(kN) > T_f = 234\,(kN) \Rightarrow$ okay.

4) Block shear.

$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_u + F_y}{2} \right]$ S16-14 §13.11.



$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 0.6$ S16-14 Fig 2-26(3)

$A_n = 2(12.76)(7.94) = 202.6\,(mm^2)$

$A_{gv} = 2(4\times80+35)(7.94) = 5637.4\,(mm^2)$

$\Rightarrow T_r = (0.75)\left[(0.6)(202.6)(440) + 0.6(5637.4)\frac{300+440}{2}\right]$

$\Rightarrow T_r = 979\,(kN) > T_f = 234\,(kN) \Rightarrow$ okay.

- Angle 2: (J1 - C1 connection).

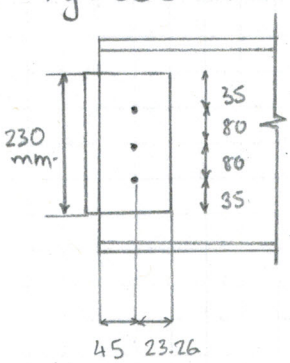
Using A325 3/4" bolt → $F_{u\,bolt} = 825$ (MPa)

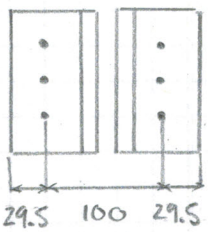
$V_f = 95$ kN

- From Table 3-37, choose Section L76x76x7.9 — S16-14 Table 3-37

300W steel with L = 230mm and 3 bolts.

$F_y = 300$ MPa $\quad F_u = 440$ MPa.





- Check bolt on column:

1) Shear resistance:

$V_r = 0.6\,\phi_b\,n\,m\,A_b\,F_u\,(0.7)$ — Assume thread intercepted — S16-14 §13.2.1.2(c)

$\phi_b = 0.8$ — S16-14 §13.1(c)

$n = 6 \qquad m = 1$

$A_b = 285\ (mm^2) \qquad F_u = 825$ MPa

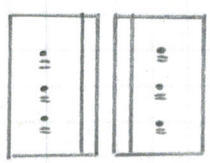
$V_r = 0.6(0.7)(0.8)(6)(1)(285)(825)$

$\Rightarrow V_r = 474\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay

2) Bolt bearing:

$B_r = 3\,\phi_{br}\,n\,t\,d\,F_u$ — S16-14 §13.12.1.2(a)

$\phi_{br} = 0.8$ — S16-14 §13.1(g)



$n = 6$ $\quad F_u = 440\,MPa$

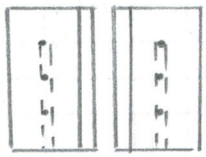
$t = 7.94\,mm$ $\quad d = 19.05\,mm$

$B_r = 3(0.8)(6)(7.94)(19.05)(440)$

$\Rightarrow B_r = 958\,(kN) > V_f = 95\,(kN) \Rightarrow$ okay.

3) Bolt tear-out:

$$T_r = \phi_u (0.6) A_{gv} \frac{F_y + F_u}{2}$$



S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

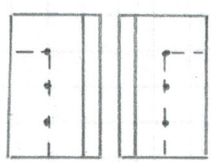
$A_{gv} = 4(2\times80+35)(7.94) = 6193.2\,(mm^2)$

$$\Rightarrow T_r = 0.75(0.6)(6193.2)\frac{300+440}{2}$$

$\Rightarrow T_r = 1031\,(kN) > T_f = 95\,(kN) \Rightarrow$ okay

4) Block-shear:

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$$



S16-14 §13.11

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 1.0$ S16-14 §13.11(a)

$A_n = (19.0)(7.94)(2) = 301.7\,(mm^2)$

$A_{gv} = 2(2\times80+35)(7.94) = 3096.6\,(mm^2)$

$$T_r = (0.75)\left[(1.0)(301.7)(440) + 0.6(3096.6)\frac{300+440}{2}\right]$$

$\Rightarrow T_r = 615\,(kN) > T_f = 95\,(kN) \Rightarrow$ okay.

- Check bolt on joist:

1) Shear resistance.

$V_r = 0.6\,\phi_b\, n\, m\, A_b\, F_u\, (0.7)$ — Assume thread intercepted — S16-14 §13.12.1.2 (c)

$\phi_b = 0.8$ — S16-14 §13.1 (c)

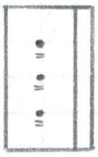
$n = 3 \qquad m = 2$

$A_b = 285\ (mm^2) \qquad F_u = 825\ MPa$

$V_r = 0.6\,(0.8)(3)(2)(285)(825)(0.7)$

$\Rightarrow V_r = 474\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay.

2) Bolt bearing



$B_r = 3\,\phi_{br}\, n\, t\, d\, F_u$ — S16-14 §13.12.1.2 (a)

$\phi_{br} = 0.8$ — S16-14 §13.1 (g)

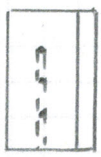
$t = 7.94\ mm \qquad d = 19.05\ mm$

$n = 3 \qquad F_u = 440\ MPa$

$B_r = 3(0.8)(3)(7.94)(19.05)(440)$

$\Rightarrow B_r = 160\ (kN) > V_f = 95\ (kN) \Rightarrow$ okay.

3) Bolt tear-out



$T_r = \phi_u\,(0.6)\,A_{gv}\,\frac{F_y + F_u}{2}$ — S16-14 §13.11

$\phi_u = 0.75$ — S16-14 §13.1 (a)

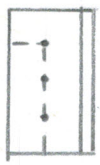
$A_{gv} = 4(2 \times 80 + 35)(7.94) = 6193.2\ (mm^2)$

$\Rightarrow T_r = 0.75(0.6)(6193.2)\,\frac{300+440}{2}$

$\Rightarrow T_r = 1031\ (KN) > T_f = 95\ (kN) \Rightarrow$ okay

4). Block shear:

$$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_u + F_y}{2} \right]$$



S16-14 §13.11.

$\phi_u = 0.75$ S16-14 §13.1(a)

$U_t = 0.6$ S16-14 Fig2-26(b)

$A_n = 2(12.76)(7.94) = 202.6\ (mm^2)$

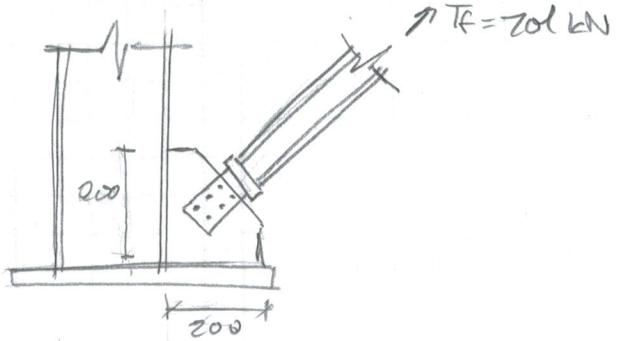
$A_{gv} = 2(80 \times 2 + 35)(7.94) = 3096.6\ (mm^2)$

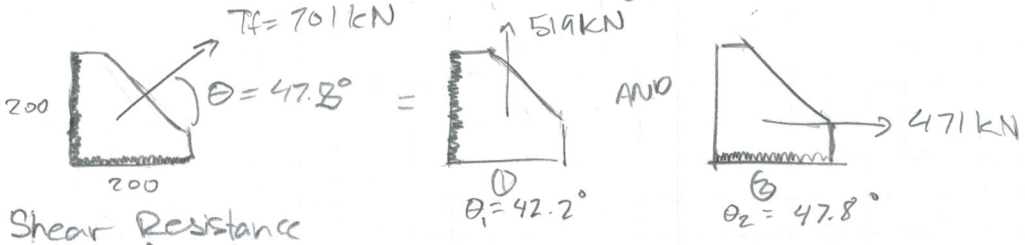
$$T_r = (0.75)\left[(0.6)(202.6)(440) + 0.6(3096.6)\frac{300+440}{2}\right]$$

$\Rightarrow T_r = 556\ (KN) > T_f = 95\ (KN) \Rightarrow$ okay.

Chevron Bracing - Single Gusset Plate

- All connections for this were checked in the previous chevron bracing analysis except for the connection between the gusset plate and the column or baseplate / beam.





Shear Resistance

① $M_w = 1$ for both

$$V_{r1} = 0.67 \phi_w A_w X_u (1 + 0.5 \sin^{1.5}\theta) M_w$$

- NOTE: length of weld leg is 10mm so throat is 7.1 mm
  Using E49xx

$$V_{r1} = 0.67 \times 0.67 \times (2 \times 200 \times 7.1)(490)(1 + 0.5 \sin^{1.5} 42.2) \times 1$$
$$= 796\ kN > 519\ kN$$
$$V_r > V_f \quad \checkmark OK$$

$$V_{r2} = 0.67 \times 0.67 \times (2 \times 200 \times 7.1)(490)(1 + 0.5 \sin^{1.5} 47.8) \times 1$$
$$= 823\ kN > 471\ kN$$
$$V_r > V_f \quad \checkmark OK$$

I also need to check to see if the baseplate / anchors need to be checked for tension.

↳ As seen above the baseplate faces an uplift of $1.4W = 519\ kN$ at most

↳ Referring to the column design chapter, the dead load on a column with the gusset is 383.1 kN (unfactored dead)

↳ Total uplift is $1.4W + 0.9D = 519 - 0.9 \times 383.1$
$= 174\ kN$

Referring back to the baseplate hand calculation section

↳ Tensile resistance for 1 bolt = 88.6 kN
so for 4 bolts $T_r = 88.6 \times 4 = 354.4\ kN > 174\ kN$

↳ Conc. pryout resistance = 479.4 kN > 174 kN

∴ the designed connection for the gusset plate and base plate is sufficient.

CSA 13.13.2.2

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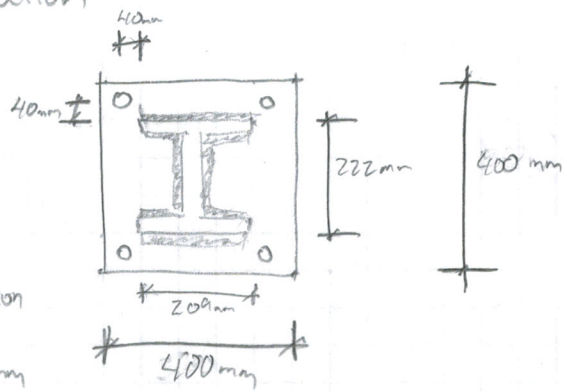
	Title:	Date:	Page: 1

COLUMN BASEPLATE

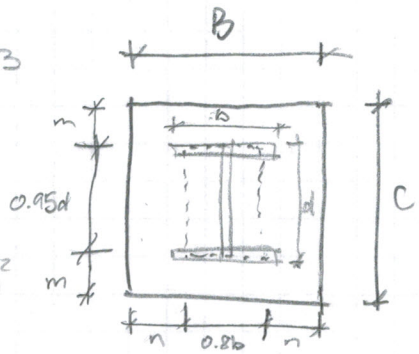
- The column, W200×86, with a load of 1948 kN will be used to demonstrate the validity of the chosen baseplate.
- Dimensions of Baseplate recommended were 369×382 mm
  ↳ we will round this up to 400×400 for our actual design for ease of construction

NOTE:
- anchors are 16 A325M with a length of 300mm
- Welds are 10mm in length giving a Th = 7.1mm
- Plate is 30mm thick
- anchors are 40mm in each direction away from corner of column
- Total offset from column is 80mm in each direction



Following instructions in S16-14 p4-153 S16-14 p.4-153

$d = 222$mm $b = 209$ mm
$B = 369$mm $C = 382$ mm
$m = 85$ mm $n = 100$ mm
$F_y = 300$ MPa $\phi = 0.9$



$$t_p = \sqrt{\frac{2 C_f n^2}{B C \phi f_y}} = \sqrt{\frac{2 \times 1948000 \times (100)^2}{400 \times 400 \times 0.9 \times 300}}$$

$= 30$ mm

Plate design summary is 400×400×30
↳ this plate will be used for all columns for ease of construction and costs
↳ all columns are W200 so it makes sense to keep these dimensions

Anchors for baseplate tensile resistance
↳ no tension is applied to baseplate due to a high gravity compression.
↳ Resistance calculations will be done to show capacity.

- Anchor tensile resistance

CSA A23.3 14-D.6.1

N_{sar} = steel strength of anchor in tension
$= A_{se,N} \times \phi_s \times f_{uta} \times R$ $\quad A_{se,N} = 157 mm^2$ $\quad R = 0.8$
$= 157 \times 0.85 \times 830 \times 0.8$ $\quad \phi_s = 0.85$
$= 88.6 kN$ $\quad f_{uta} = 830 MPa$

- Concrete Pryout Resistance

CSA A23.3 -D.7.3

$V_{cpr} = k_{cp} \times N_{cpr}$ $\quad k_{cp} = 2$ (Conc. pryout factor)
$= 2 \times 239.7$ $\quad N_{cpr} = 239.7 kN$
$= 479.4 kN$

Welds for the baseplate don't require checking as the only force is in compression. For weld resistance please refer to the IDEASTATICA reports.

Column Splices

3 types of splices where section switches
- W200×42 to W200×52
  W200×52 to W200×71
  W200×71 to W200×86

These columns all undergo compression and do not have any lateral force transmitted to it.

There is no gap between columns so ℰ29.3.9 is satisfied — S16-14 ℰ29.3.9

For sample calculations the greatest compressive load for a splice will be used which is W200×71 to W200×86 w/ $C_f = 1948$ kN

Bolts

- Tension Resistance Check — S16-14 ℰ13.12.1.3

$T_r = 0.75 \phi_b A_b F_u$ $A_b = 201\ mm^2$ $F_u = 830$ MPa $\phi_b = 0.8$

$= 0.75(0.8)(201)(830)$

$= 100.1$ kN

→ In reality $T_f = 0$ as gravity loads govern but IDEASTATICA, a connection check program applies $T_f = 3.7$ kN which is found by FEA

→ $T_r = 100.1$ kN $>$ $T_f = 3.7$ kN ✓OK

- Shear Resistance Check — ℰ13.12.1.2

$V_r = r_{st}\ 0.6 \phi_b A_b F_u$ $r_{st} = 0.7$ (reduced due to thread interception)

$= 0.7 \times 0.6 \times 0.8 \times 201 \times 830$ $\phi_b = 0.8$ $A_b = 201\ mm^2$ $F_u = 830$ MPa

$= 56.1$ kN

→ No actual shear applied to connection following load paths

→ Through FEA, IDEASTATICA estimates a possible $V_f = 0.9$ kN

→ $V_r = 56.1$ kN $> V_f = 0.9$ kN ✓OK

- Bearing Resistance Check — ℰ13.12.1.2

$B_r = 3 \times \phi_{br} \times t \times d \times F_u$ $\phi_{br} = 0.8$ $t = 10$ mm $d = 16$ mm $F_u = 450$ MPa

$= 3 \times 0.8 \times 10 \times 16 \times 450$

$= 172.8$ kN

→ Again $B_r = 172.8$ kN $> V_f = 0.9$ kN ✓OK

- Interaction of Tension and Shear — ℰ13.12.1.4

$\left(\frac{V_f}{V_r}\right)^2 + \left(\frac{T_f}{T_r}\right)^2 = 0.0 < 1.0$ ✓OK

where $V_f = 0.9$ kN $V_r = 56.1$ kN

$T_f = 3.7$ kN $T_r = 100.1$ kN

- Hole Tear-Out Resistance Check

$T_r = \phi_u \times 0.6 \times A_{gv}\left(\frac{F_y + F_u}{2}\right)$ $\phi_u = 0.75$ $F_y = 300\,MPa$ $F_u = 450\,MPa$

$A_{gv} = 2 \times \ell_{vt} = 2 \times 58 \times 10 = 1157\,mm^2$

$= 0.75 \times 0.6 \times 1157\left(\frac{300+450}{2}\right)$

$= 195.3\,kN > V_f = 0.9\,kN$ Volc

↳ Bolt connections are all good. Checks are primarily to determine reserve capacity

Cl 13.11

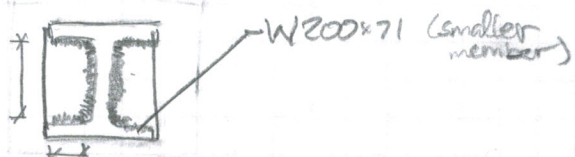
Welds

Cl 13.13.2.2

- Again, no shear force applied to weld so no checks are really required
- For the sake of finding the capacity of the connection an analysis is conducted
- Weld to check;

↳ $T = 148\,mm$ $T < 2a$ ↳ more critical

$2a = 196\,mm$



total length of weld in more critical direction is

$2T = 2 \times 148 = 296\,mm$

↳ NOTE: IDEASTATICA under represents this value

T_h = weld throat width (our weld is 15mm)

$= 10.6\,mm$

A_w = effective weld throat area

$= 2T \times T_h$

$= 296 \times 10.6$

$= 3138\,mm^2$

$M_w = 1.0$

$V_r = 0.67 \times \phi_w A_w X_u (1 + 0.5 \sin^{1.5}\theta)$

$= 0.67 \times 0.67 \times 3138 \times 490 (1.5)$

$= 1030\,kN$

$\theta = 90$ $\sin 90 = 1$

$X_u = 490\,MPa$ → electrode is E49xx

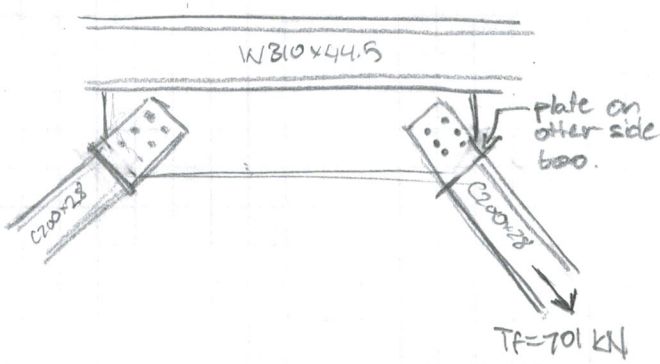
$\phi_w = 0.67$

→ Welds and Bolts are very conservative and are mainly here to bring columns together.

CHEVRON BRACING

Design:

↳ NOTE: Design is tension only bracing, therefore if I design one connection for full load the other connection will also be okay.



↳ Here, the design for the chevron bracing on the bottom floor is done and compared to results in IDEASTATICA
↳ This connection is checked through IDEASTATICA for all levels to ensure it works.

BOLT CHECKS

- Tension Resistance — S13.12.1.3

$T_r = 0.75 \phi_b A_b F_u$ $\phi_b = 0.8$ $A_b = 314 mm^2$ $F_u = 830 MPa$

$= 0.75 \times 0.8 \times 314 \times 830$

$= 156.4 kN$

→ From FEA in IDEASTATICA $T_f = 14.6 kN$ although it is essentially zero following load paths

- Shear Resistance — S13.12.1.2

$V_r = r_{st} \times 0.6 \times \phi_b \times A_b \times F_u$

$r_{st} = 0.7$ because shear plane intercepts threads

$V_r = 0.7 \times 0.6 \times 0.8 \times 314 \times 830$

$= 87.6 kN$

$V_f = \frac{701}{6} \times \frac{1}{2}$ (2 shear planes) $= 60 kN$ ← IDEASTATICA overestimates this slightly for some bolts

$V_r > V_f$ ✓OK

- Bearing Resistance — S13.12.1.2

$B_r = 3 \phi_{br} t d F_u n$ $\phi_{br} = 0.8$ $t = 10mm$ $d = 20mm$ $F_u = 450 MPa$ $n = 6$

$= 3 \times 0.8 \times 10 \times 20 \times 450 \times 6$

$= 1296 kN$ ← value differs in IDEASTATICA, they look at individual bolt

$V_f = 701 kN$

$B_r = 1296 kN > V_f = 701 kN$

- Interaction of Tension & Shear Check
  - ↳ Tension is negligible in this case (really no tension despite IDEASTATICA's check).
  - ↳ thus connection will pass as $V_f/V_r < 1$

§13.12.1.4

- Hde Tear-out Resistance Check (for GP = gusset plate)

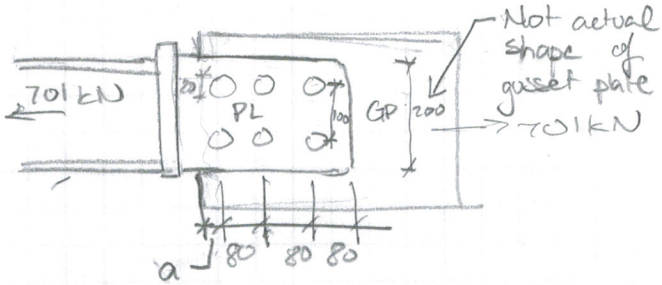
§13.11

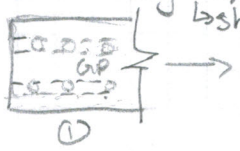
$\phi_u = 0.75$ $F_y = 300MPa$ $F_u = 450MPa$

↳ GP is more critical in cases outlined for ① and ② because the A_{gv} is smaller and there is only one plate.

↳ length of A_{gv} is smaller for GP (assume a=0 to be conservative although a>0 ↳should be min 32mm)

Closer look

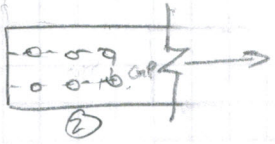




① $A_n = 0$

$A_{gv} = 2 \times 80 \times 10 \times 4 = 6400mm^2$

OR



② $A_n = (100 - 20) \times 10 = 800mm^2$

$A_{gv} = 2 \times 80 \times 10 \times 2 = 3200mm^2$

NOTE: IDEASTATICA results are even more conservative as they assume failure at a singular bolt level.

$T_r = \phi_u \left[U_t A_n F_u + 0.6 A_{gv} \frac{F_y + F_u}{2} \right]$ $U_t = 1.0$ (concentric)

① $T_r = 0.75 \times 0.6 \times 6400 \times \left(\frac{300+450}{2}\right) = 1080kN$

② $T_r = 0.75 \times \left[1.0 \times 800 \times 450 + 0.6 \times 3200 \times \left(\frac{300+450}{2}\right)\right] = 810kN$

$T_r = 810kN > 701kN = T_f$ ✓OK

- Net Section Fracture doesn't apply as the whole plate is connected to gusset plate (not C-section)

- Gross Section Failure (of PL)

§13.2a.1

$T_r = \phi A_g F_y$ $\phi = 0.9$ $A_g = 200 \times 10 \times 2 = 4000mm^2$

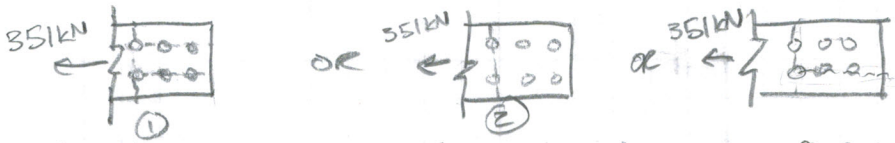
$= 0.9 \times 4000 \times 300$ $F_y = 300MPa$

$= 1080kN$ $T_f = 701kN$

$T_r > T_f \rightarrow 1080 > 701$ ✓OK

- Block Failure for PL connected to GP
  ↳ Possible failure scenarios are below $\frac{701}{2} = 351\,kN$

§13.11



① $A_n = (100-20)\times10 = 800mm^2$ $A_{gv} = (3\times80\times2)\times10 = 4800mm^2$

② $A_n = (200-2\times20)\times10 = 1600mm^2$ $A_{gv} = 0$

③ $A_n = (150-1.5\times20)\times10 = 1200mm^2$ $A_{gv} = 4800/2 = 2400mm^2$

$$T_r = \phi_u\left[U_t A_n F_u + 0.6 A_{gv}\left(\frac{F_y+F_u}{2}\right)\right]$$

① $T_r = 0.75\left[800\times345 + 0.6\times4800\times\left(\frac{400+350}{2}\right)\right]$
$= 1017\,kN$

② $T_r = 0.75[1600\times345]$ (this is net section essentially)
$= 414\,kN$

③ $T_r = 0.75\left[1200\times345 + 0.6\times2400\times\left(\frac{400+350}{2}\right)\right]$
$= 715.5\,kN$

$T_r = 414kN > 351\,kN$ ✓ok

- Bolt Slip (Serviceability)
  ↳ none are considered slip critical joints

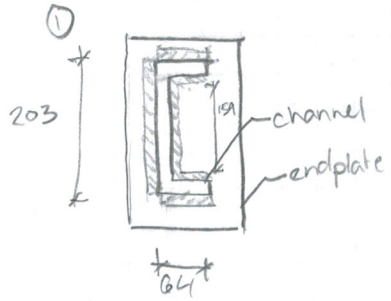
§13.12.2.2

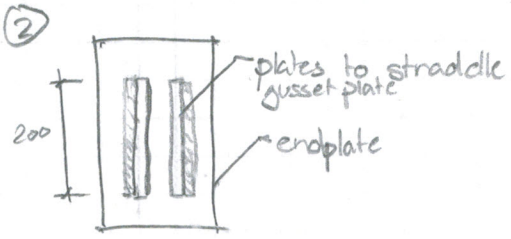
→ In closing, the chevron bracing connection for bolts works and the IDEASTATICA calculations are appropriate and more conservative and thus will be used to check other levels

Welds for Chevron Bracing

↳ There are 2 main welds on first look
1. The C-section welded to an endplate
2. The endplate welded to 2 other plates to straddle the gusset plate

NOTE: welds are hatched





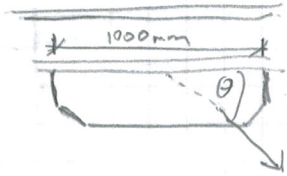
A conservative estimate of weld length for ① is $L = 203 + 159 + 64 \times 2 = 490\,mm$
For ② the total length of weld is $L = 200 \times 2 = 400\,mm$
↳ therefore I only need to check ②'s connection

- Weld resistance check
  ↳ load is perpendicular to welds
  ↳ total load is still 701 kN
  ↳ welds are 10mm w/ $T_h = 7.1\,mm$

$T_r = \phi_w A_n F_u$ where $A_n = b \times t_{net} = 2 \times 200 \times 10 = 2840\,mm^2$ — Cl 13.13.3.2
$= 0.67 \times 2840 \times 440$
$= 837\,kN$
$\phi_w = 0.67$ $F_u = 440\,MPa$
$T_f = 701\,kN$
$T_r > T_f$ ✓ok

↳ There is also a third weld to consider which is the gusset plate to beam.

③



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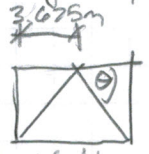


$\theta = \tan^{-1}\left(\frac{4}{3.625}\right) = 47.8^\circ$

Tension perpendicular to weld
$T_{fy} = 701 \sin(47.8) = 519.3\,kN$
$T_r = \phi_w A_n F_u$ where $A_n = b \times t_{net} = 2 \times 1000 \times 10 = 20\,000\,mm^2$
$= 0.67 \times 20000 \times 440$
$= 5896\,kN >> T_f = 519.3\,kN$ ✓ok

Shear resistance of weld ③

$V_r = 0.67 \times \phi_w \times A_w \times X_u \times (1 + 0.5 \sin^{1.5}\theta) M_w$

$\phi_w = 0.67$ $M_w = 1$ (single orientation)

$\theta = 47.8°$

$X_u = 490\ MPa$

$A_w = 2 \times 1000 \times 7.1 = 14\,200\ mm^2$

$= 0.67 \times 0.67 \times 14200 \times 490 (1 + 0.5 \sin^{1.5} 47.8)$

$= 4120\ kN$

$V_f = 701 \cos(47.8)$

$= 471\ kN$

$V_r > V_f$ ✓ok

§13.3.2.2

Project:
Project no:
Author:

Project data

Project name	
Project number	
Author	
Description	
Date	2020-01-23
Design code	CISC

Material

Steel	300W, A992
Concrete	4000 psi

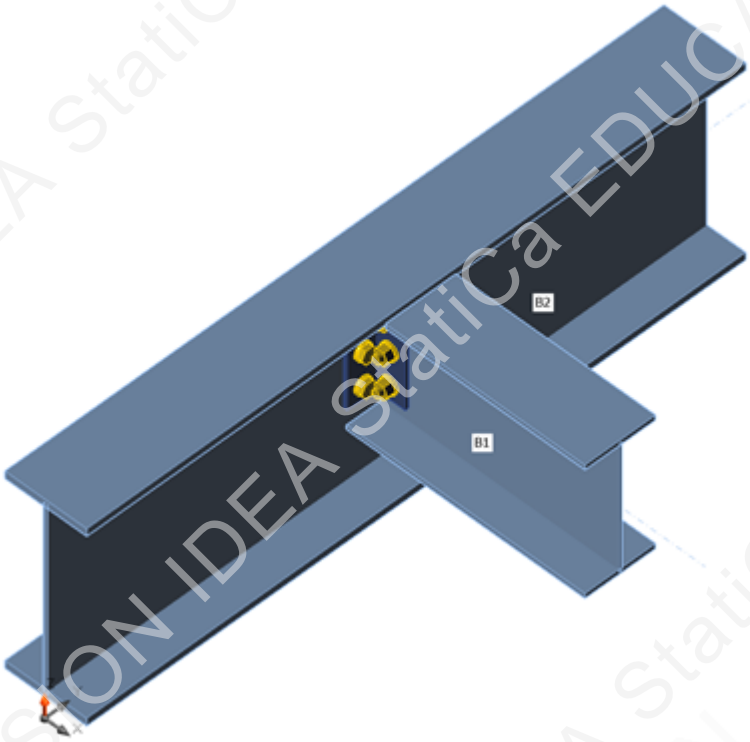
Project item Ext Joist-Girder (2F)

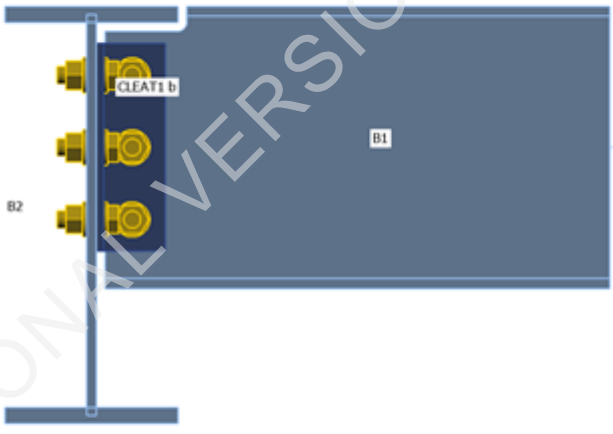
Design

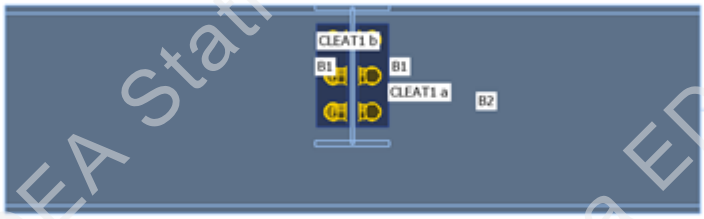
Name	Ext Joist-Girder (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.1 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	14.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	14.5	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	83.2	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	167.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	120.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	167.8	0.0	OK

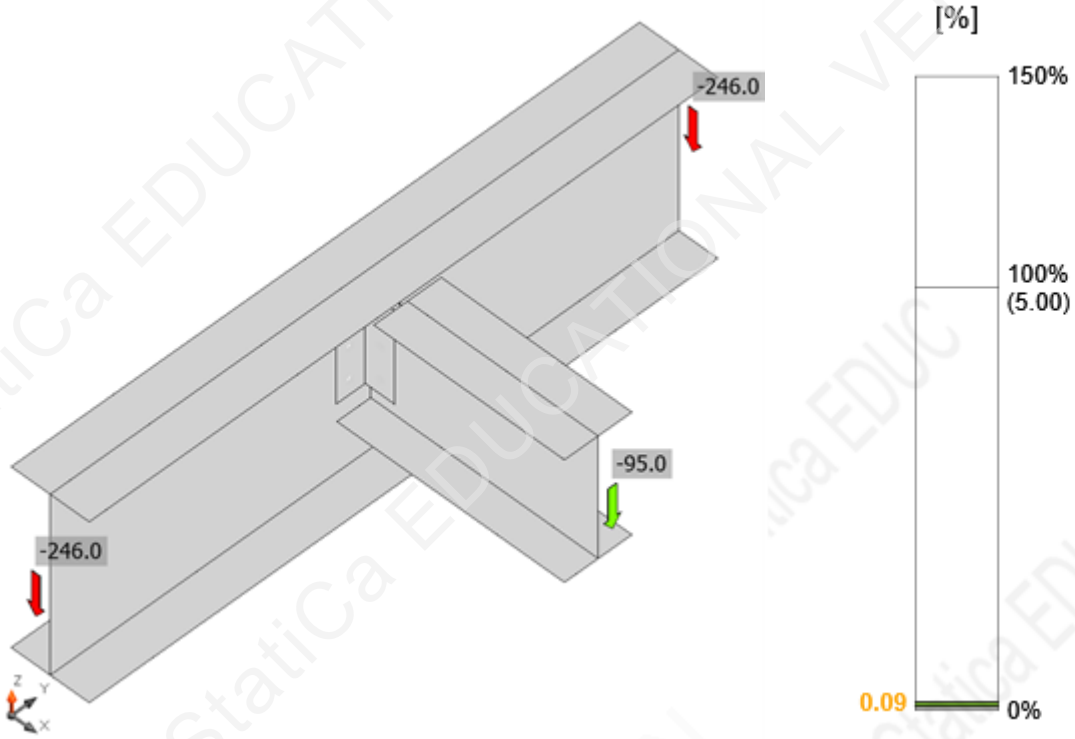
Design data

Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

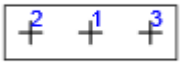
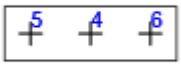
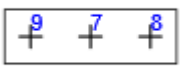
ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.8	15.9	135.2	188.4	2.7	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.6	20.6	135.2	151.4	1.8	30.5	6.9	OK
	B3	3/4 A325 - 1	LE1	10.1	20.9	135.2	109.6	7.2	38.1	7.5	OK
	B4	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B5	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B6	3/4 A325 - 1	LE1	3.5	16.3	163.4	214.4	2.4	20.7	4.3	OK
	B7	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B8	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B9	3/4 A325 - 1	LE1	3.3	16.3	163.4	214.4	2.3	20.7	4.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

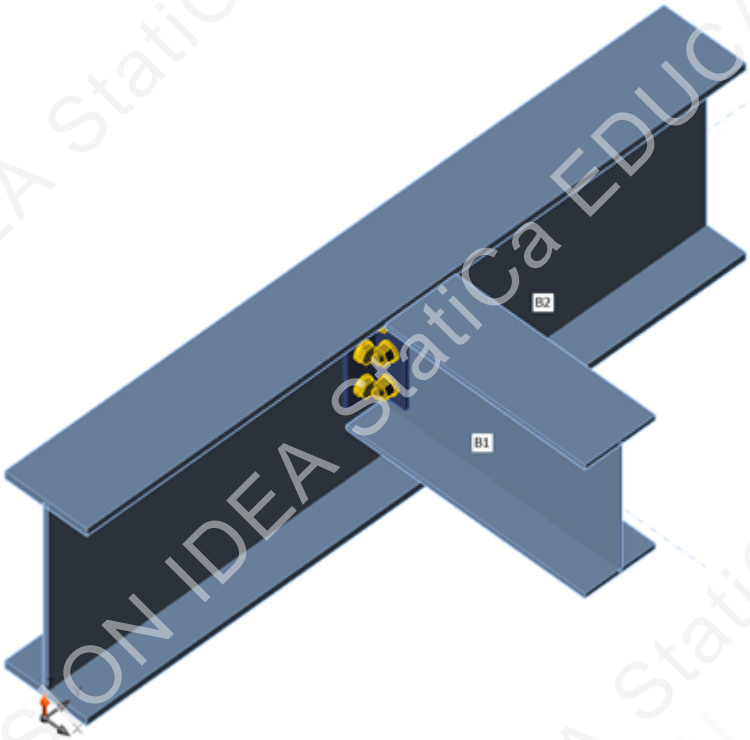
Project item Ext Joist-Girder (3F)

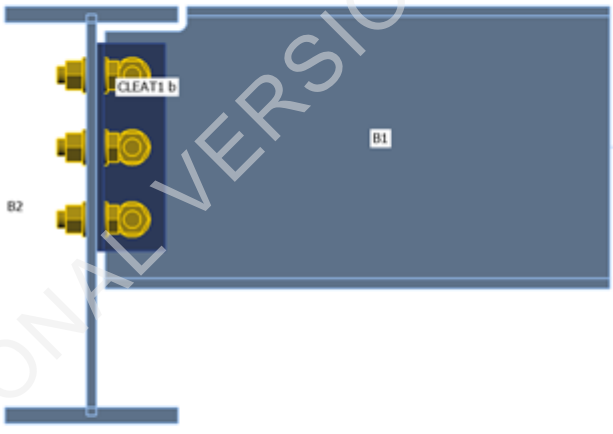
Design

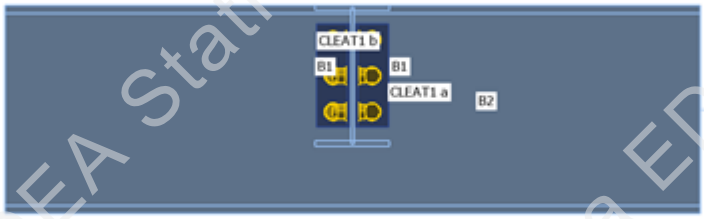
Name	Ext Joist-Girder (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.1 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	14.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	14.5	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	83.2	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	167.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	120.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	167.8	0.0	OK

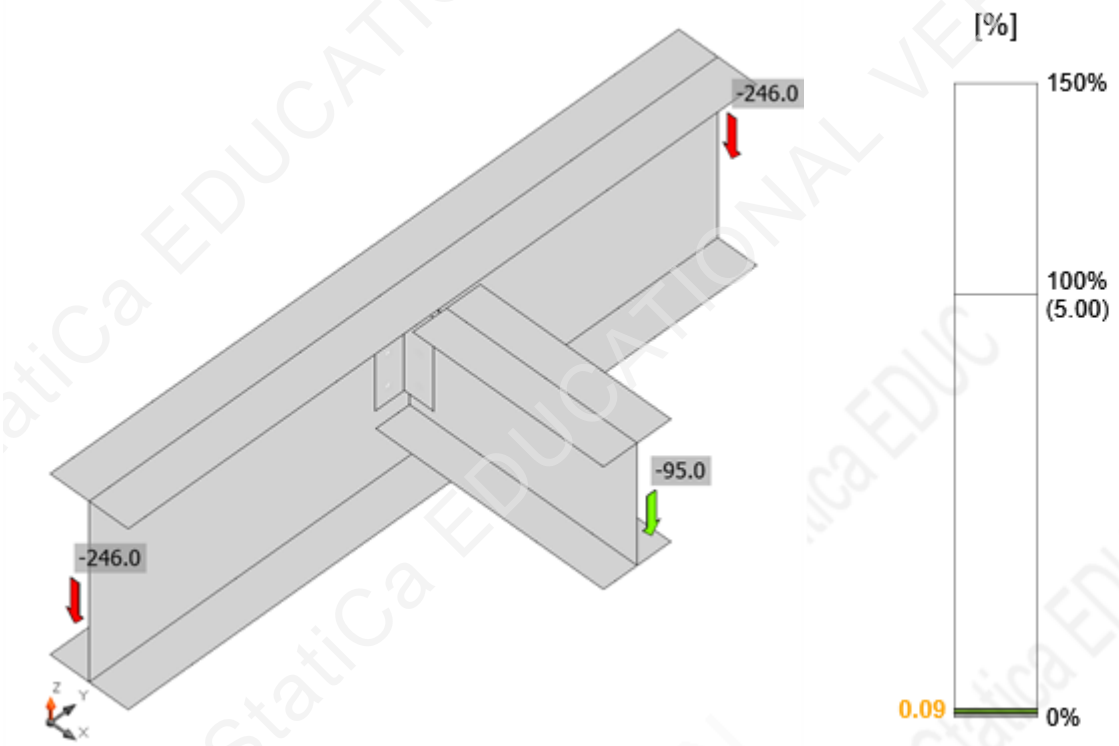
Design data

Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

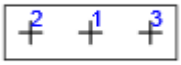
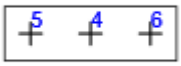
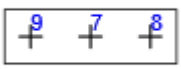
ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.8	15.9	135.2	188.4	2.7	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.6	20.6	135.2	151.4	1.8	30.5	6.9	OK
	B3	3/4 A325 - 1	LE1	10.1	20.9	135.2	109.6	7.2	38.1	7.5	OK
	B4	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B5	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B6	3/4 A325 - 1	LE1	3.5	16.3	163.4	214.4	2.4	20.7	4.3	OK
	B7	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B8	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B9	3/4 A325 - 1	LE1	3.3	16.3	163.4	214.4	2.3	20.7	4.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

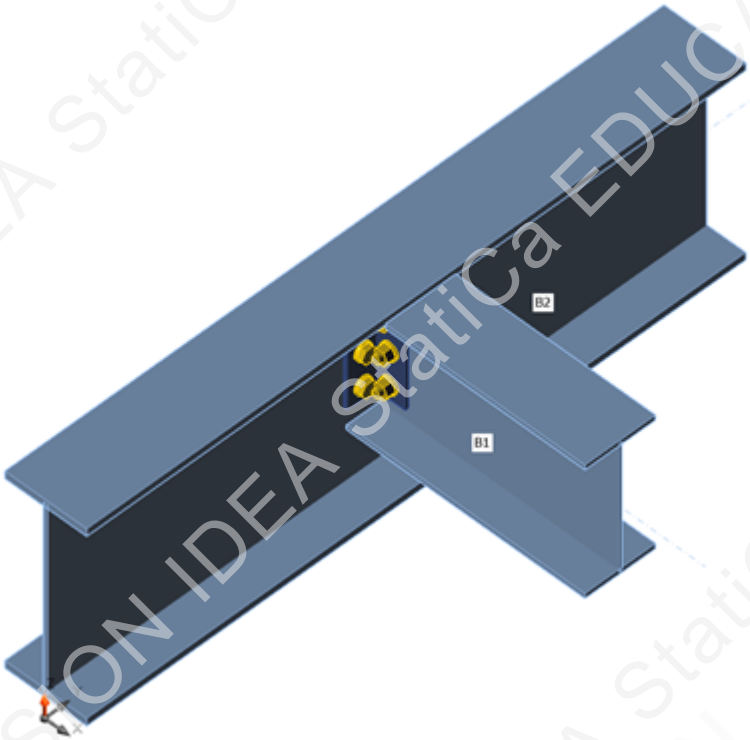
Project item Ext Joist-Girder (4F)

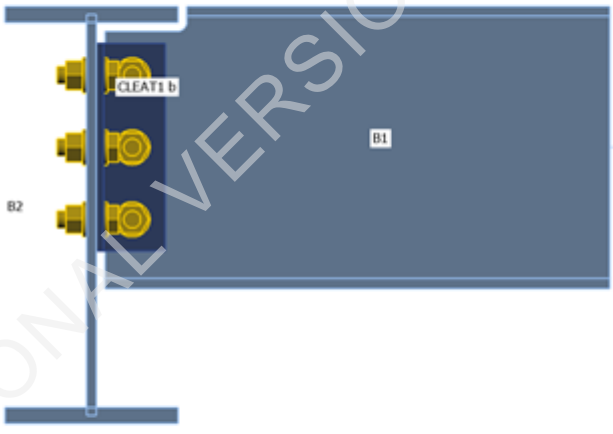
Design

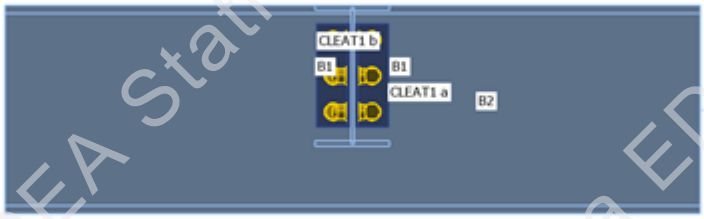
Name	Ext Joist-Girder (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.1 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	14.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	14.5	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	83.2	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	167.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	120.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	167.8	0.0	OK

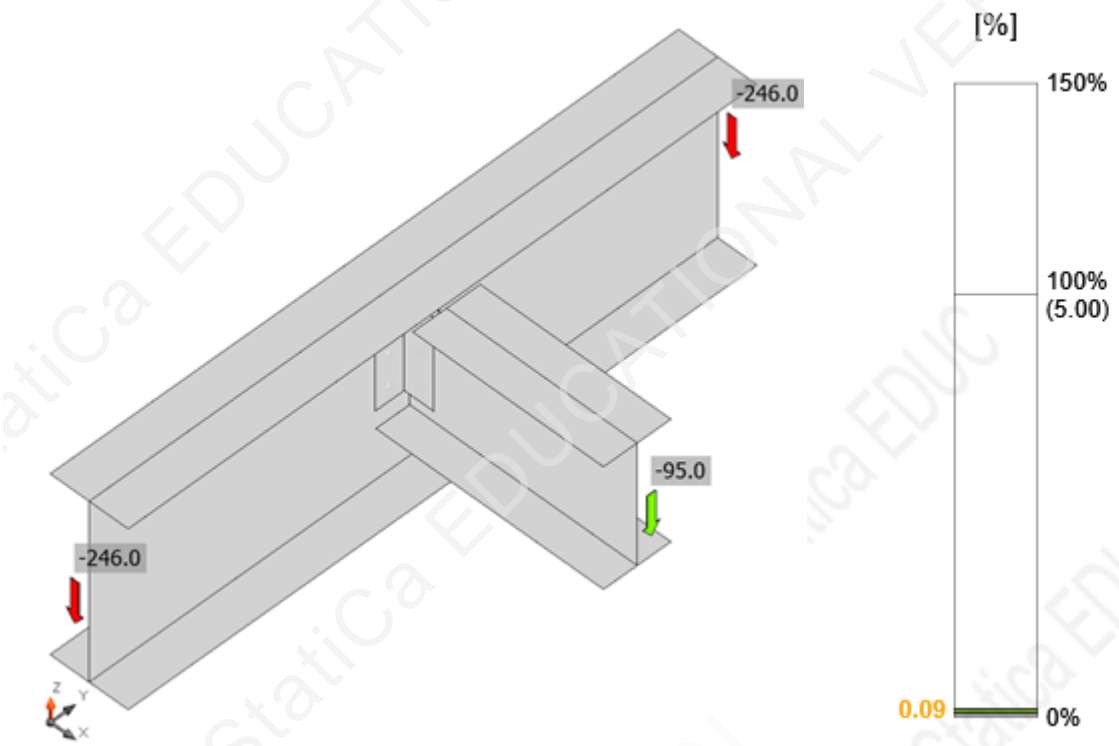
Design data

Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

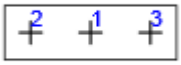
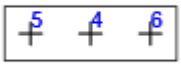
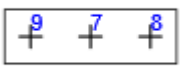
ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.8	15.9	135.2	188.4	2.7	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.6	20.6	135.2	151.4	1.8	30.5	6.9	OK
	B3	3/4 A325 - 1	LE1	10.1	20.9	135.2	109.6	7.2	38.1	7.5	OK
	B4	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B5	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B6	3/4 A325 - 1	LE1	3.5	16.3	163.4	214.4	2.4	20.7	4.3	OK
	B7	3/4 A325 - 1	LE1	1.2	16.1	163.4	214.4	0.8	20.4	4.2	OK
	B8	3/4 A325 - 1	LE1	1.3	15.5	163.4	93.8	0.9	19.6	3.9	OK
	B9	3/4 A325 - 1	LE1	3.3	16.3	163.4	214.4	2.3	20.7	4.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

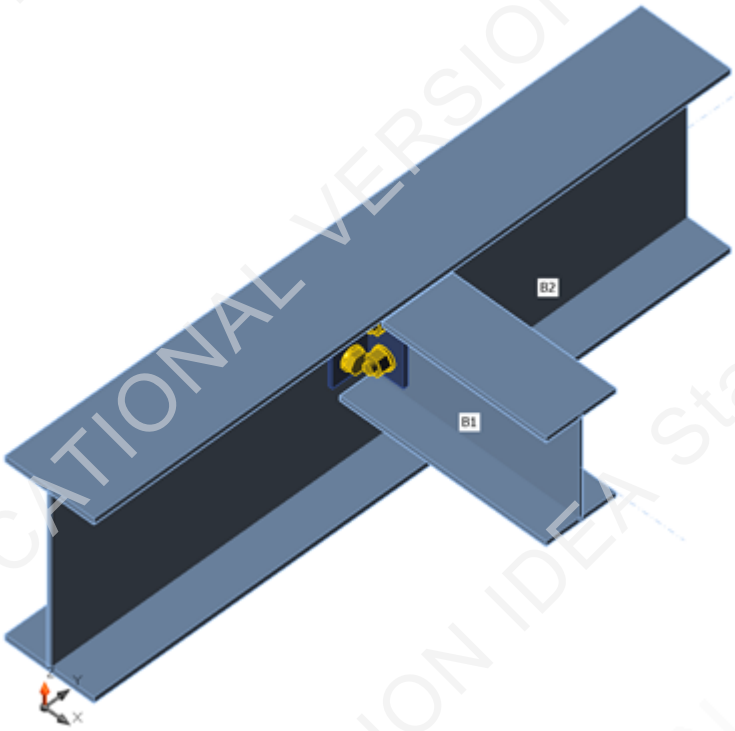
Project item Ext Joist-Girder (R1)

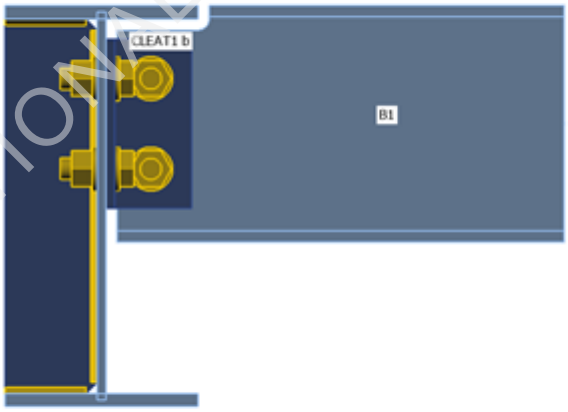
Design

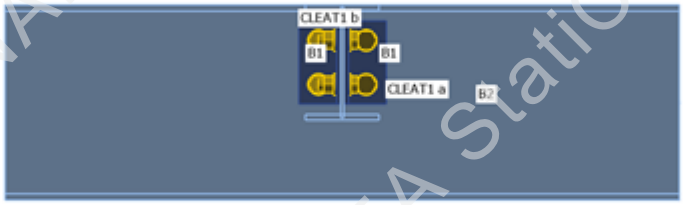
Name	Ext Joist-Girder (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	25.4 < 100%	OK
Welds	2.7 < 100%	OK
Buckling	Not calculated	

Plates

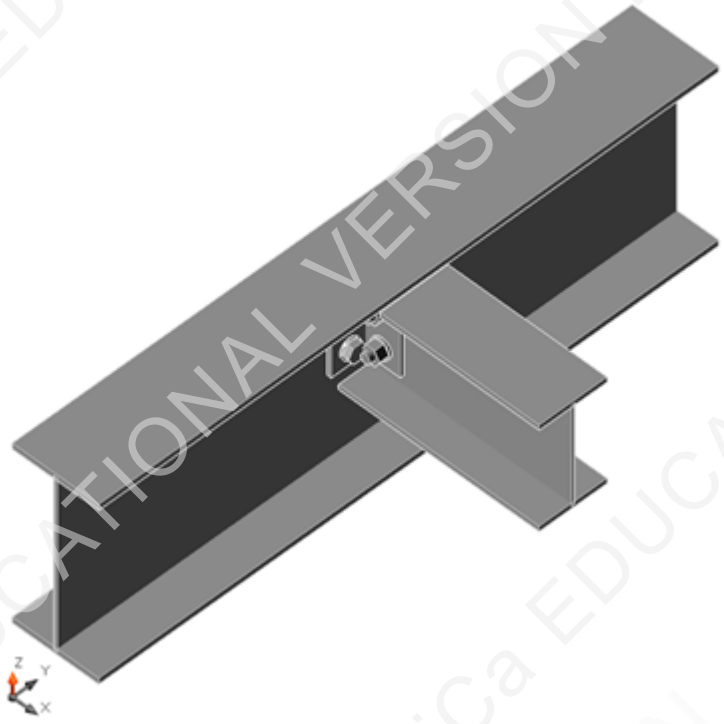
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	229.6	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	8.4	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	8.1	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	58.6	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	81.2	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	104.3	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	81.3	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	104.2	0.0	OK
STIFF1	A992	344.7	11.6	LE1	4.2	0.0	OK

Design data

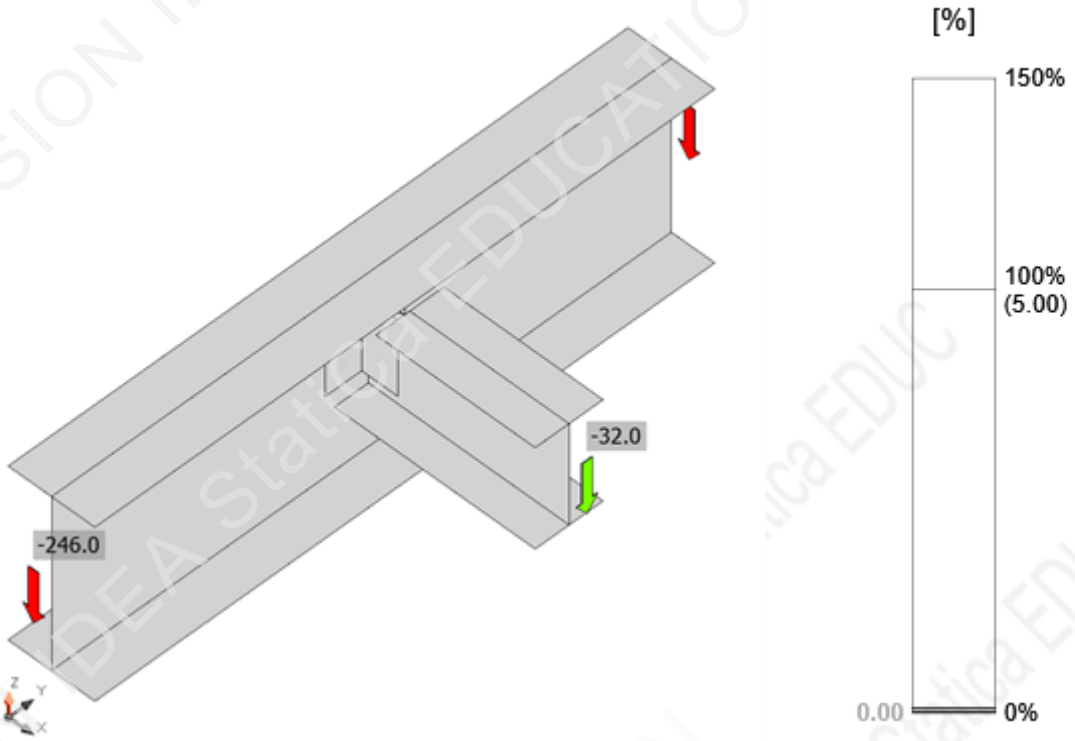
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

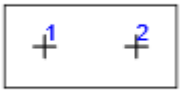
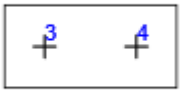
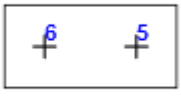


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.9	11.9	131.1	201.9	1.3	18.1	2.3	OK
	B2	3/4 A325 - 1	LE1	6.4	11.8	131.1	93.0	4.5	25.4	2.4	OK
	B3	3/4 A325 - 1	LE1	0.3	7.9	147.5	93.8	0.2	10.0	1.0	OK
	B4	3/4 A325 - 1	LE1	1.6	8.4	147.5	321.4	1.1	10.6	1.1	OK
	B5	3/4 A325 - 1	LE1	0.3	7.9	147.5	93.8	0.2	10.1	1.0	OK
	B6	3/4 A325 - 1	LE1	1.5	8.4	147.5	321.5	1.1	10.6	1.1	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-bfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	72	36	0.3	46.0	0.6	OK
		E49xx	◢4.2◣	◢6.0◣	72	36	0.3	45.9	0.6	OK
B2-w 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	311	39	1.3	48.3	2.7	OK
		E49xx	◢4.2◣	◢6.0◣	311	39	1.3	49.6	2.5	OK
B2-tfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	72	36	0.2	42.9	0.5	OK
		E49xx	◢4.2◣	◢6.0◣	72	36	0.2	43.6	0.4	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2

Item	Value	Unit	Reference
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

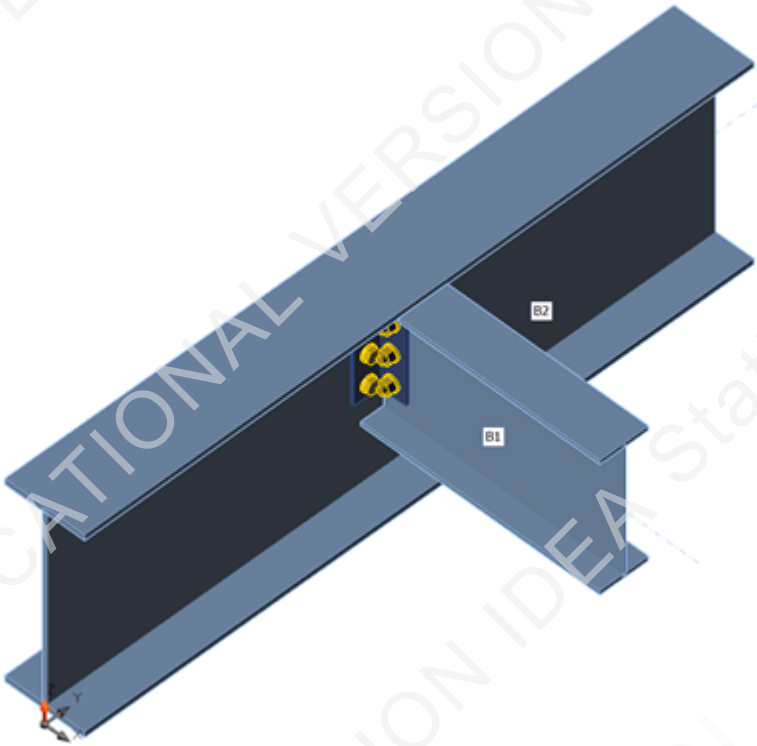
Project item Ext Joist-Girder (R2)

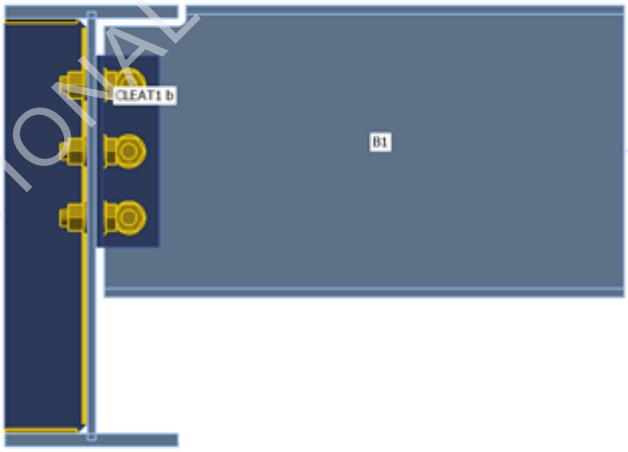
Design

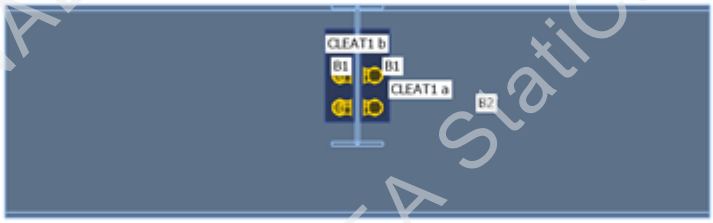
Name	Ext Joist-Girder (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	33.1 < 100%	OK
Welds	3.5 < 100%	OK
Buckling	Not calculated	

Plates

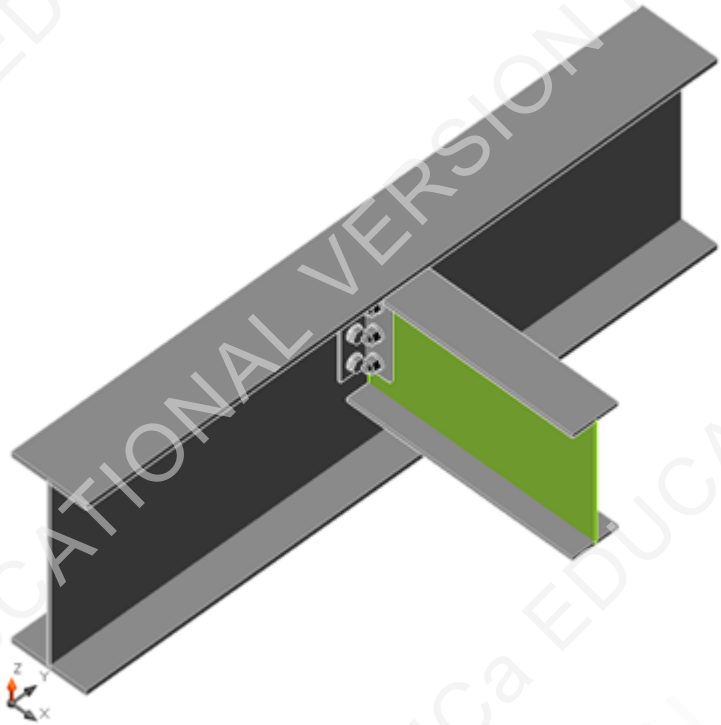
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	301.1	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	11.8	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	11.5	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	67.5	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	101.5	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	140.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	101.3	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	139.7	0.0	OK
STIFF1	A992	344.7	15.6	LE1	6.1	0.0	OK

Design data

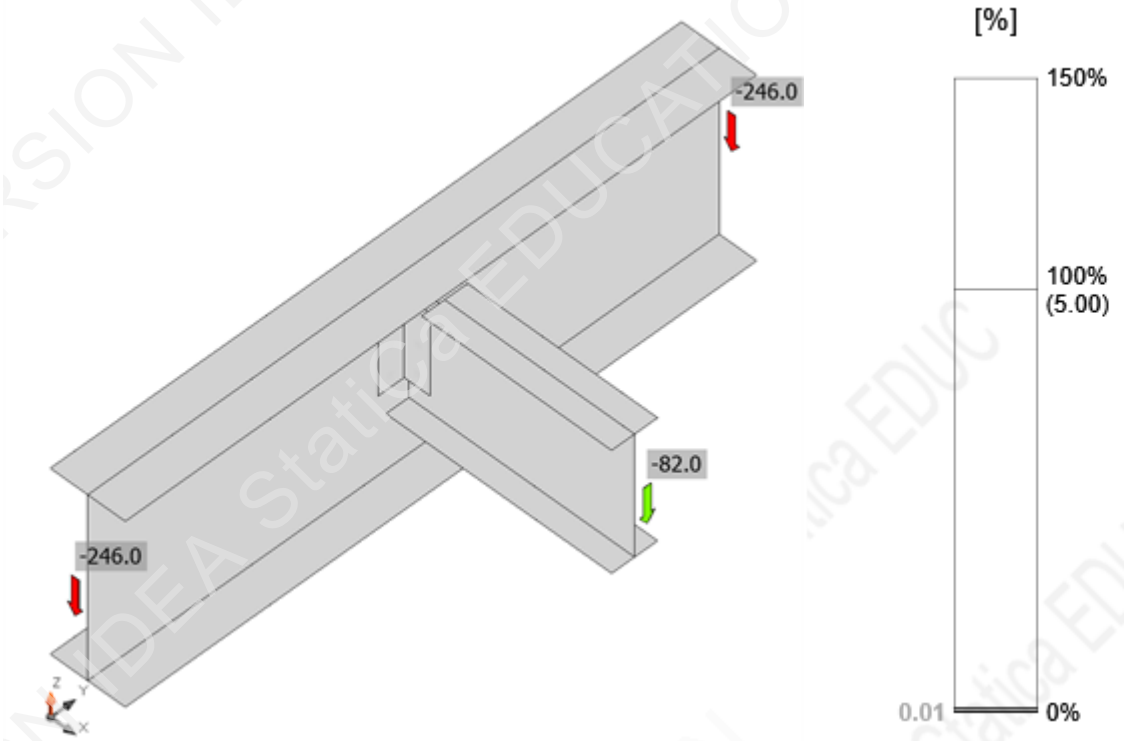
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

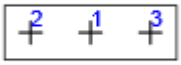
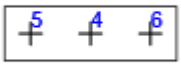
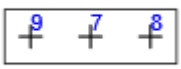


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.2	13.6	133.2	185.5	2.3	20.5	3.0	OK
	B2	3/4 A325 - 1	LE1	2.0	18.0	133.2	215.5	1.4	26.9	5.2	OK
	B3	3/4 A325 - 1	LE1	8.2	17.9	133.2	108.3	5.8	33.1	5.5	OK
	B4	3/4 A325 - 1	LE1	1.2	13.8	163.4	214.4	0.8	17.4	3.0	OK
	B5	3/4 A325 - 1	LE1	1.4	13.4	163.4	93.8	1.0	17.0	2.9	OK
	B6	3/4 A325 - 1	LE1	3.1	14.2	163.4	214.4	2.2	17.9	3.3	OK
	B7	3/4 A325 - 1	LE1	1.1	13.8	163.4	214.4	0.8	17.4	3.0	OK
	B8	3/4 A325 - 1	LE1	1.5	13.4	163.4	93.8	1.0	17.0	2.9	OK
	B9	3/4 A325 - 1	LE1	3.2	14.2	163.4	214.4	2.2	17.9	3.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-bfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	87	43	0.6	55.9	1.1	OK
		E49xx	◢4.2◣	◢6.0◣	87	43	0.6	55.9	1.1	OK
B2-w 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	475	48	2.2	64.1	3.4	OK
		E49xx	◢4.2◣	◢6.0◣	475	48	2.3	64.6	3.5	OK
B2-tfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	87	43	0.7	55.8	1.3	OK
		E49xx	◢4.2◣	◢6.0◣	87	43	0.7	56.0	1.3	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2

Item	Value	Unit	Reference
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

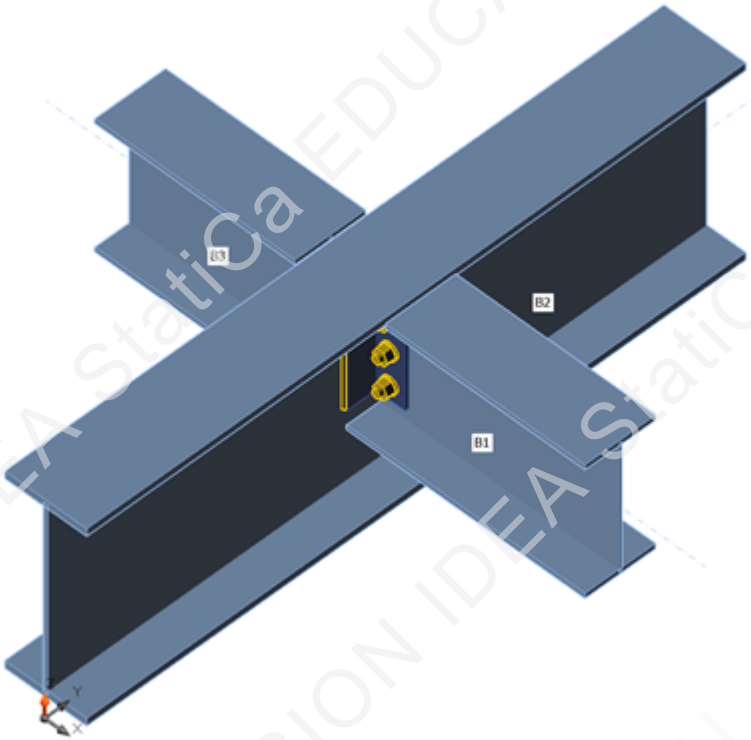
Project item Int Joist-Girder (2F)

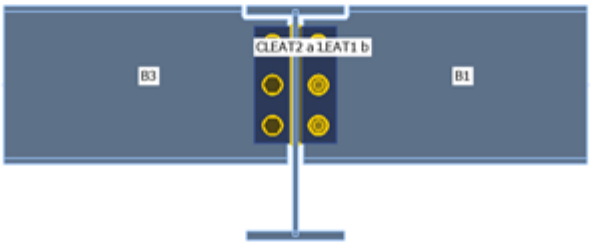
Design

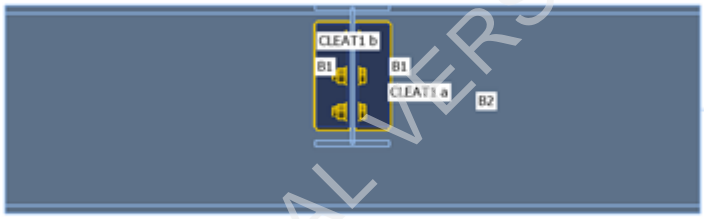
Name	Int Joist-Girder (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.3 < 100%	OK
Welds	29.5 < 100%	OK
Buckling	Not calculated	

Plates

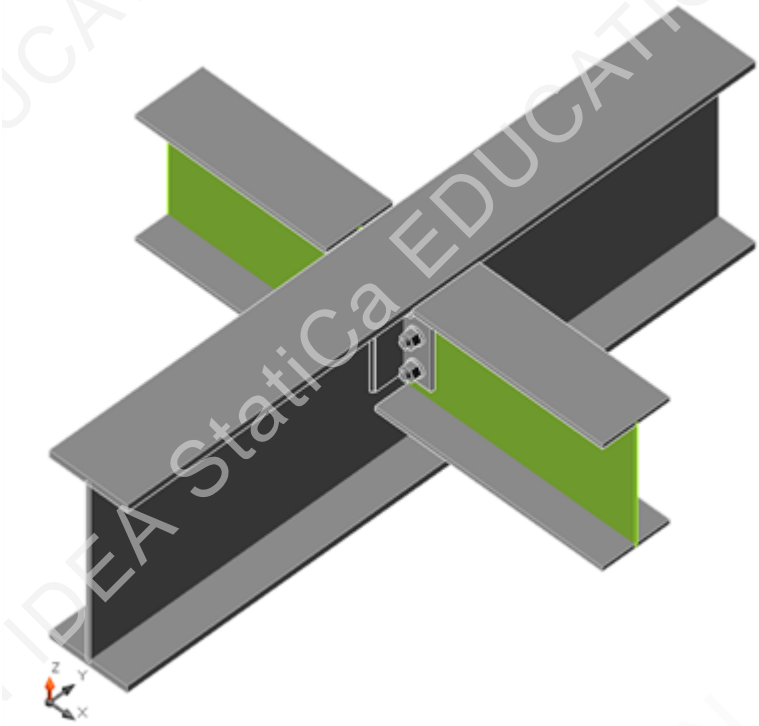
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	29.6	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	29.1	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	39.7	0.0	OK
B3-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK

Design data

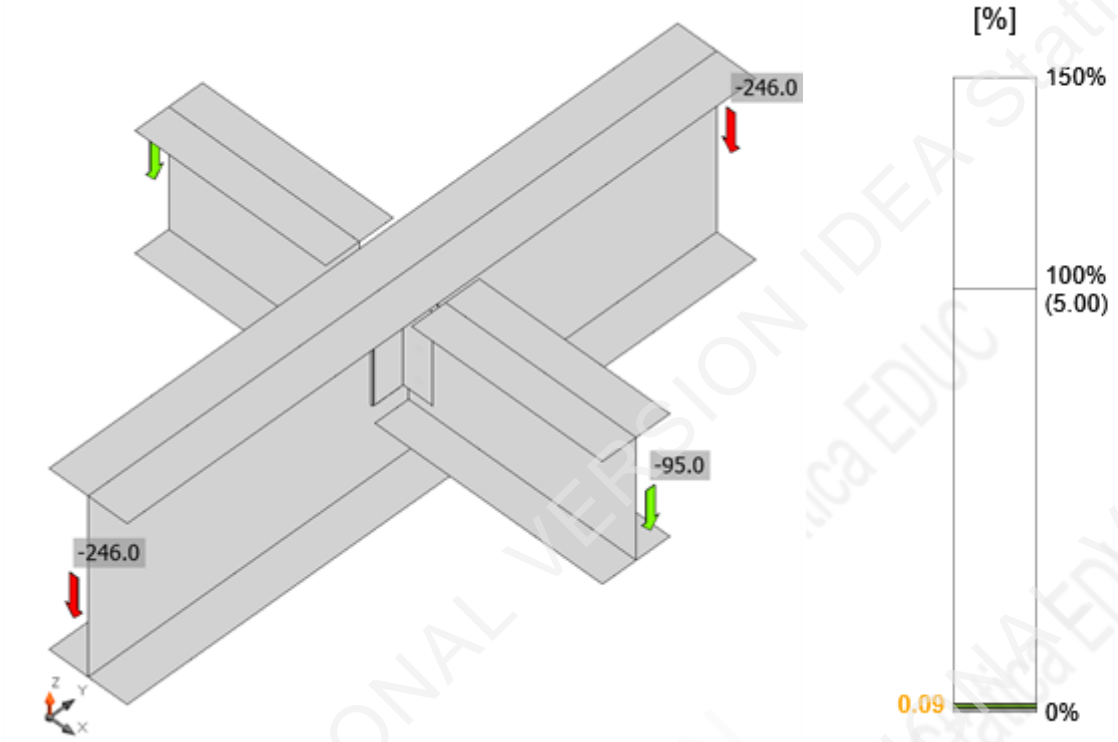
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

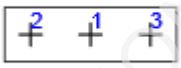
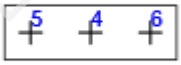


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK
	B3	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B4	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B5	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B6	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

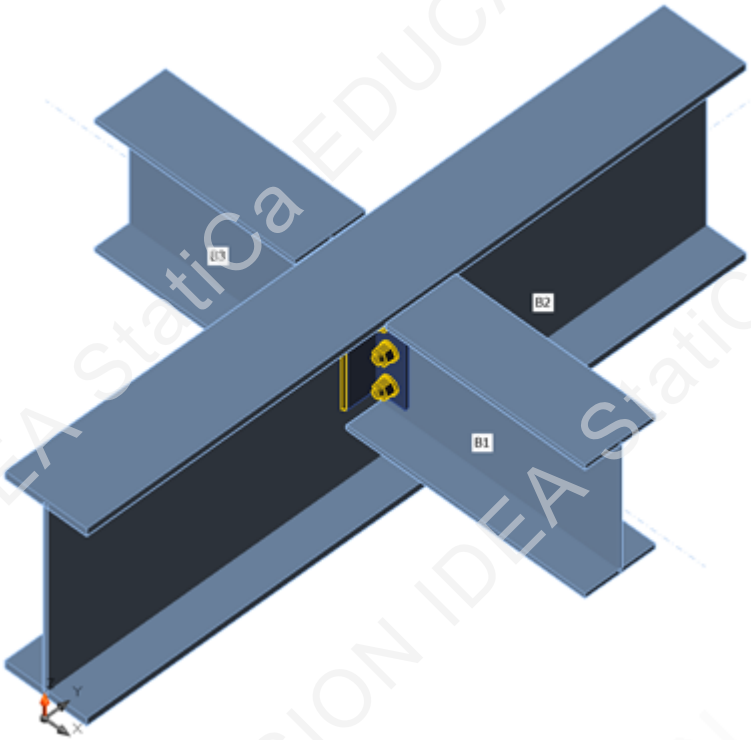
Project item Int Joist-Girder (3F)

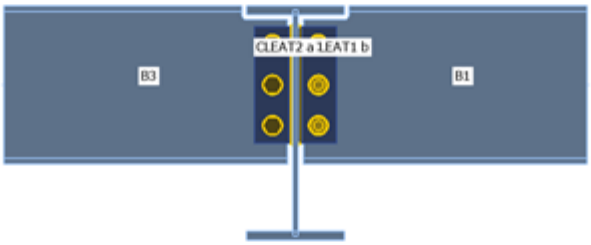
Design

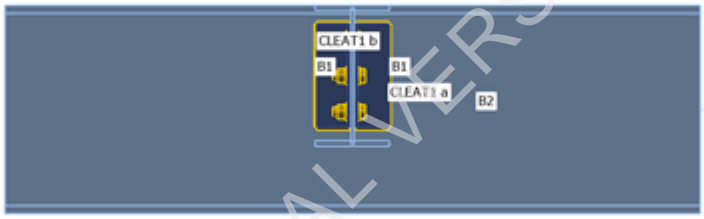
Name	Int Joist-Girder (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.3 < 100%	OK
Welds	29.5 < 100%	OK
Buckling	Not calculated	

Plates

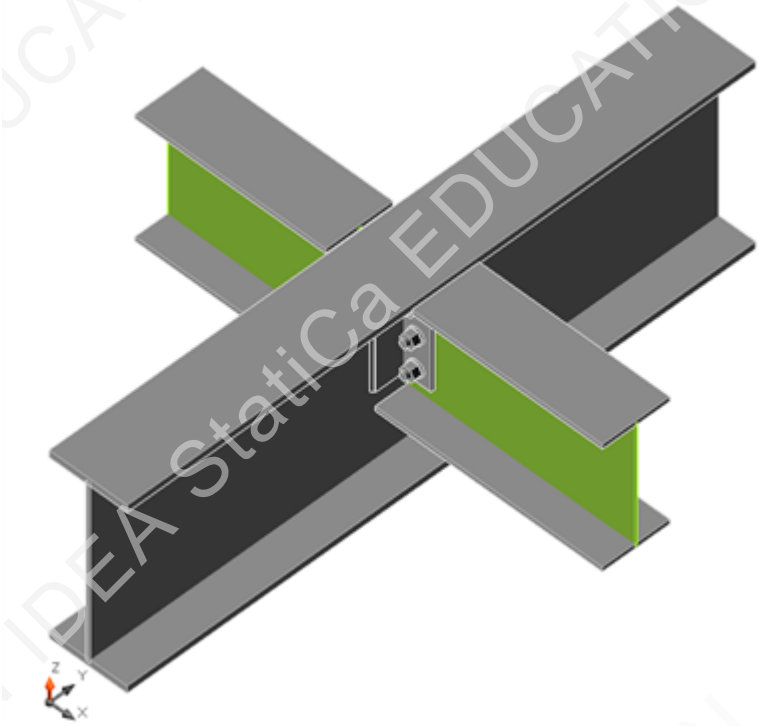
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	29.6	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	29.1	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	39.7	0.0	OK
B3-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK

Design data

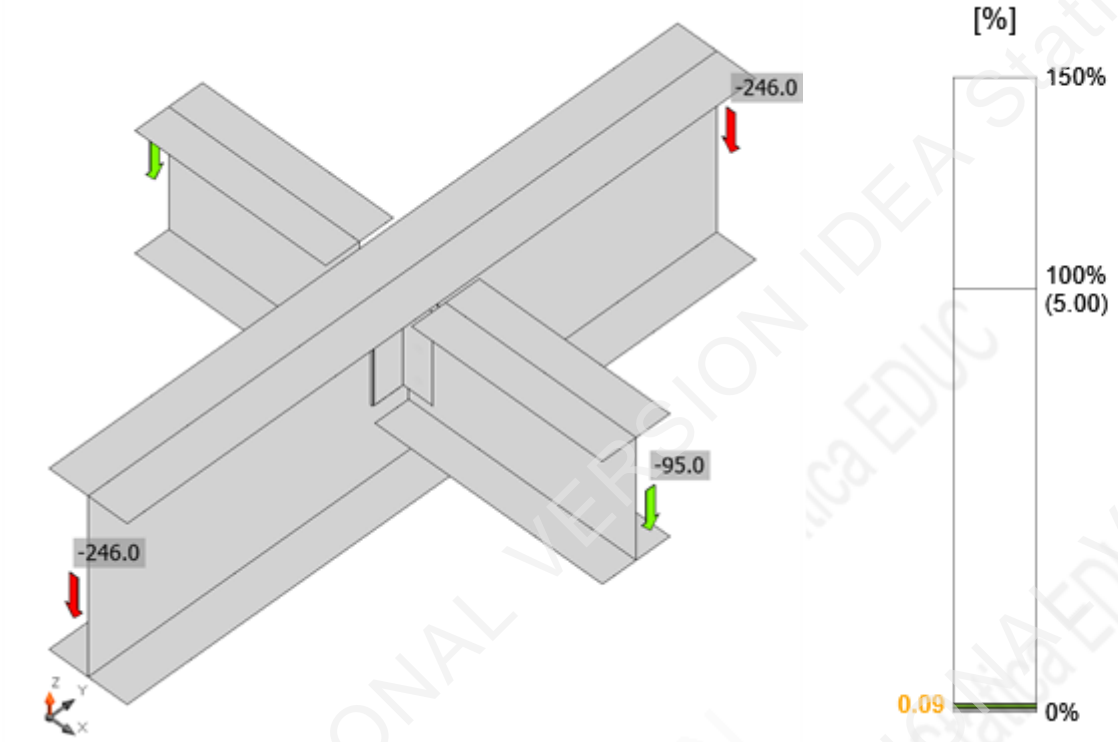
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

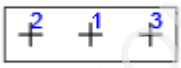
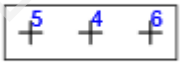


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK
	B3	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B4	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B5	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B6	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

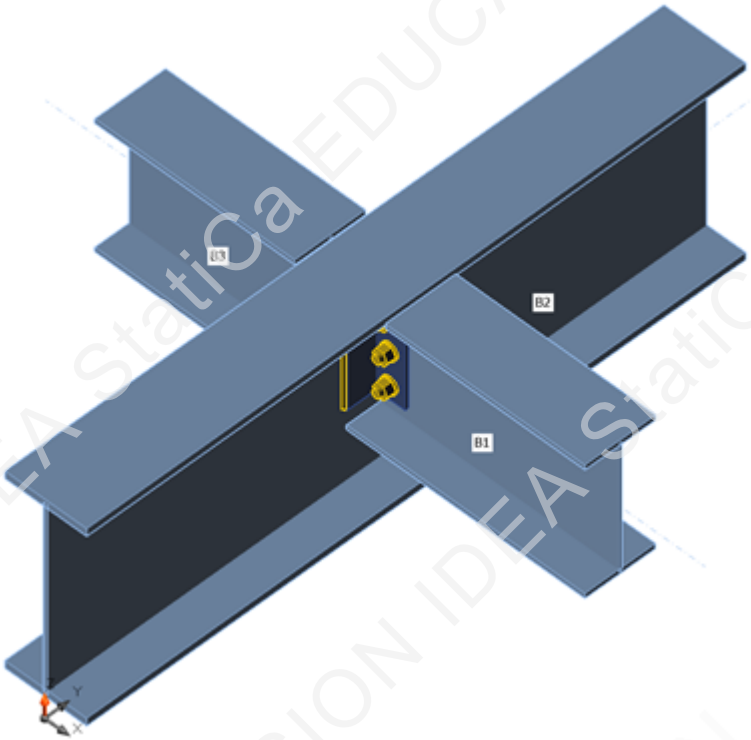
Project item Int Joist-Girder (4F)

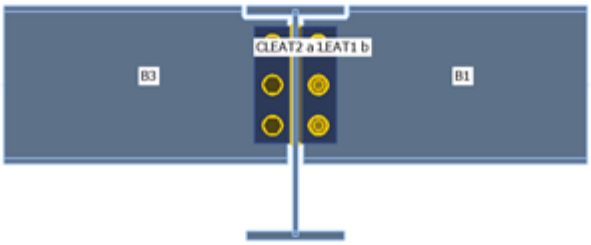
Design

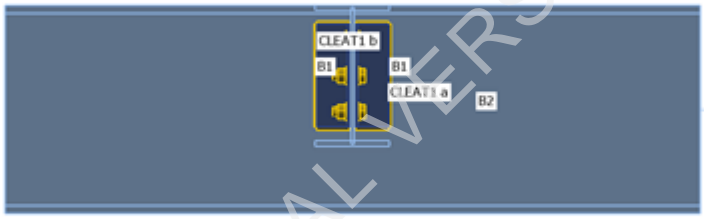
Name	Int Joist-Girder (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	38.3 < 100%	OK
Welds	29.5 < 100%	OK
Buckling	Not calculated	

Plates

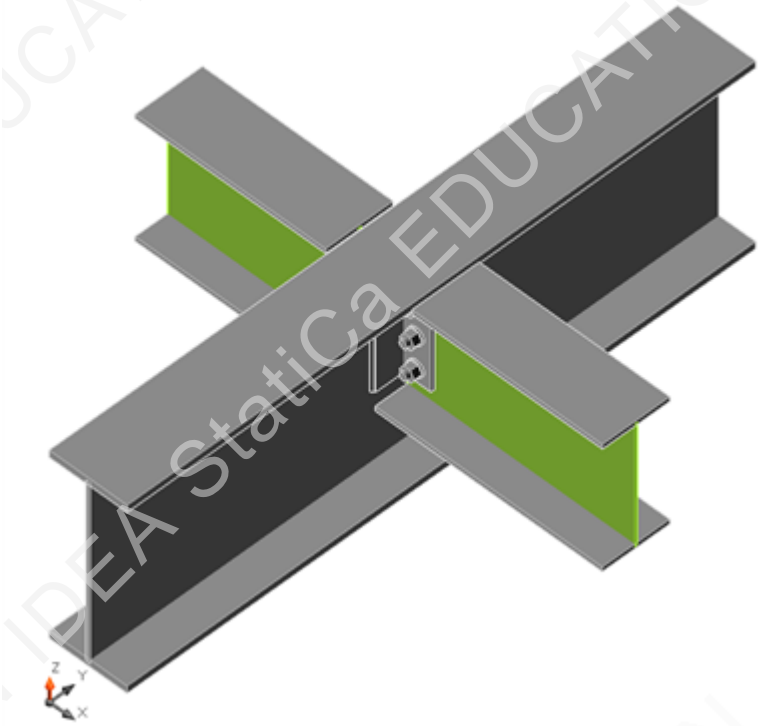
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
B2-bfl 1	A992	344.7	17.7	LE1	29.6	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	29.1	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	39.7	0.0	OK
B3-bfl 1	A992	344.7	11.2	LE1	98.3	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	310.5	0.1	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	130.3	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	130.2	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	124.8	0.0	OK

Design data

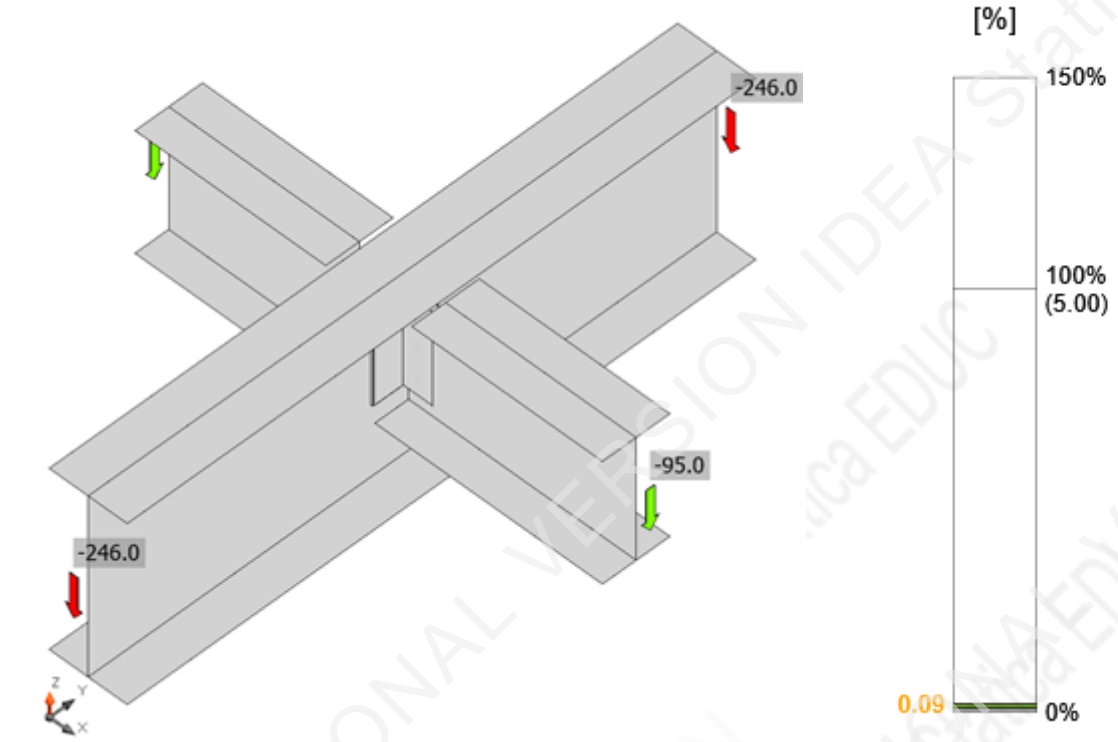
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

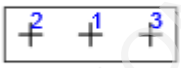
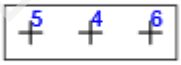


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B2	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK
	B3	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B4	3/4 A325 - 1	LE1	2.0	15.9	135.2	188.4	1.4	23.5	4.1	OK
	B5	3/4 A325 - 1	LE1	4.6	21.0	135.2	109.7	3.2	38.3	7.2	OK
	B6	3/4 A325 - 1	LE1	2.0	20.5	135.2	151.3	1.5	30.4	6.8	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	2.9	13.9	20.9	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	1.7	10.4	16.6	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

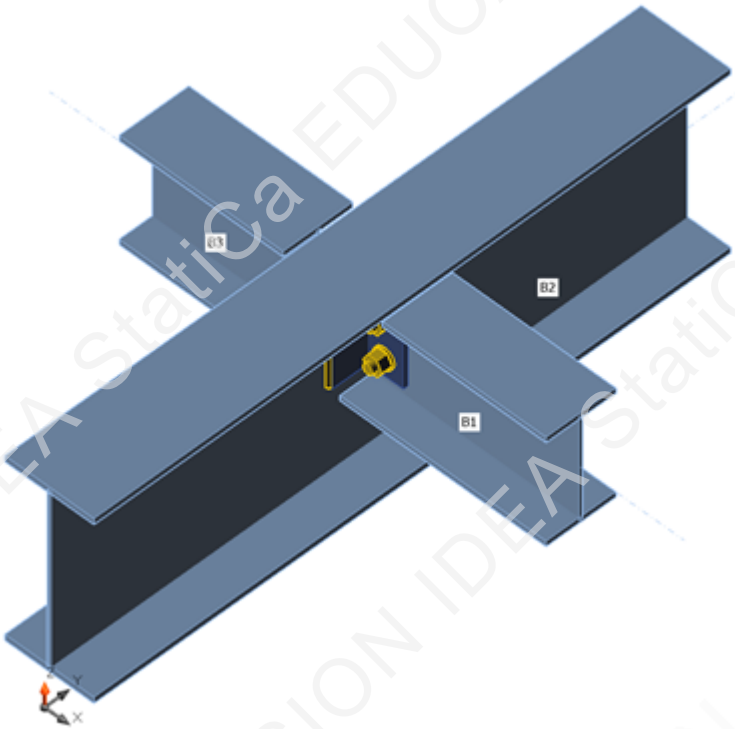
Project item Int Joist-Girder (R1)

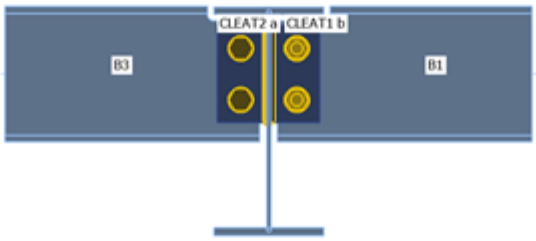
Design

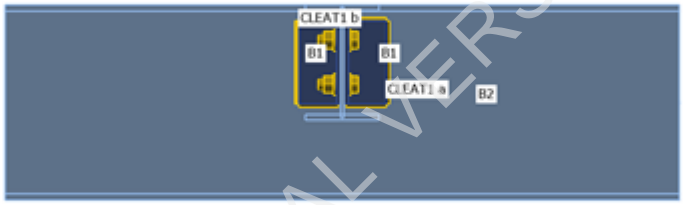
Name	Int Joist-Girder (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	0	0	0	Node
B3	9 - JOI (R1)(W200X31.3)	180.0	0.0	0.0	0	0	73	Node







Cross-sections

Name	Material
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0
	B3	0.0	0.0	-32.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	25.4 < 100%	OK
Welds	14.1 < 100%	OK
Buckling	Not calculated	

Plates

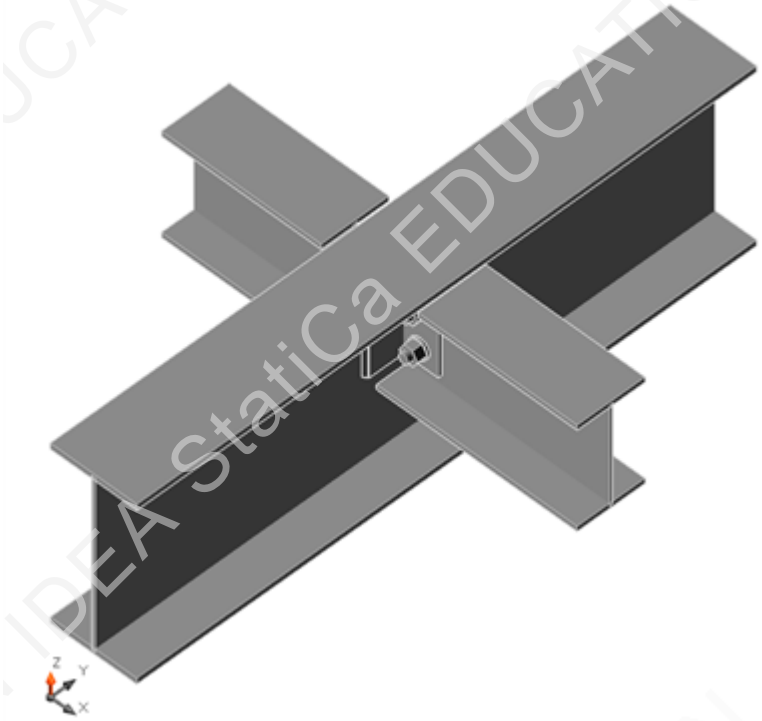
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	229.5	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	16.7	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	16.3	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	26.3	0.0	OK
B3-bfl 1	A992	344.7	10.2	LE1	55.4	0.0	OK
B3-tfl 1	A992	344.7	10.2	LE1	55.7	0.0	OK
B3-w 1	A992	344.7	6.4	LE1	229.5	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	58.7	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	75.9	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	58.7	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	75.9	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	75.8	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	58.7	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	75.9	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	58.7	0.0	OK

Design data

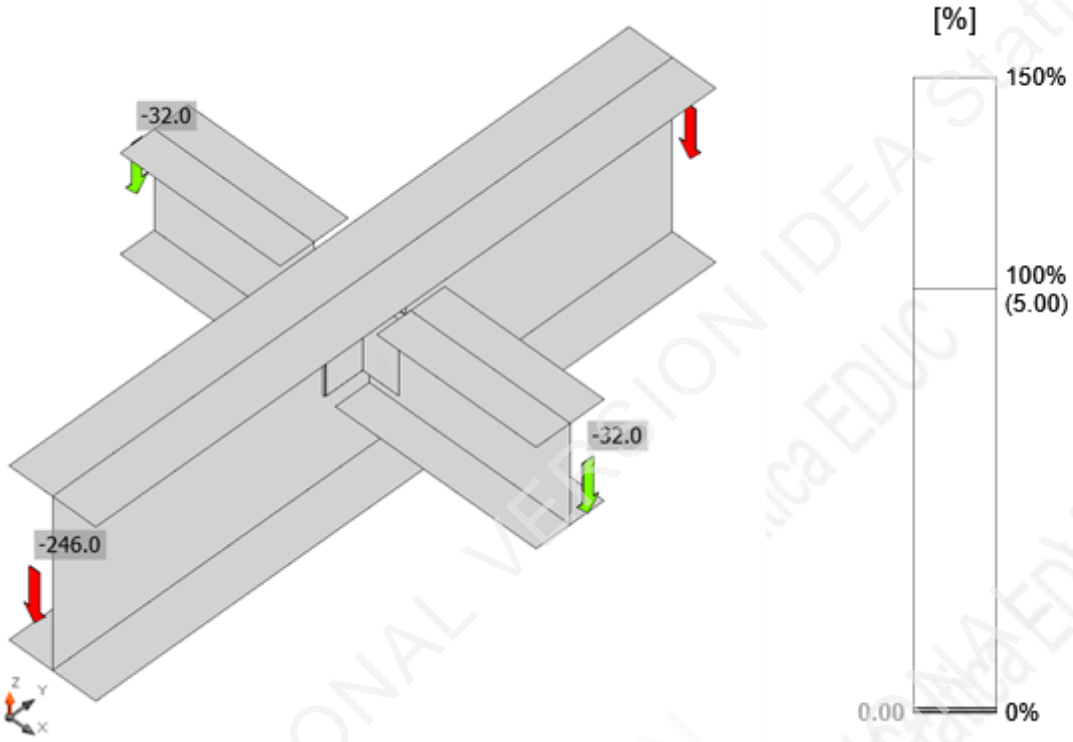
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

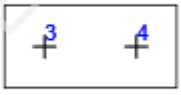


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.1	11.9	131.1	202.3	0.7	18.1	2.3	OK
	B2	3/4 A325 - 1	LE1	2.6	11.8	131.1	93.0	1.8	25.4	2.3	OK
	B3	3/4 A325 - 1	LE1	2.6	11.8	131.1	93.0	1.8	25.4	2.3	OK
	B4	3/4 A325 - 1	LE1	1.1	11.9	131.1	202.3	0.7	18.1	2.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.3	13.1	10.1	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.9	13.8	14.1	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	149	10	0.7	10.7	6.5	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.9	13.8	14.1	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.3	13.1	10.1	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	149	10	0.7	10.7	6.5	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	1.9	13.8	14.1	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	1.3	13.1	10.1	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	149	10	0.7	10.7	6.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	1.3	13.1	10.1	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	1.9	13.8	14.1	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	149	10	0.7	10.7	6.5	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

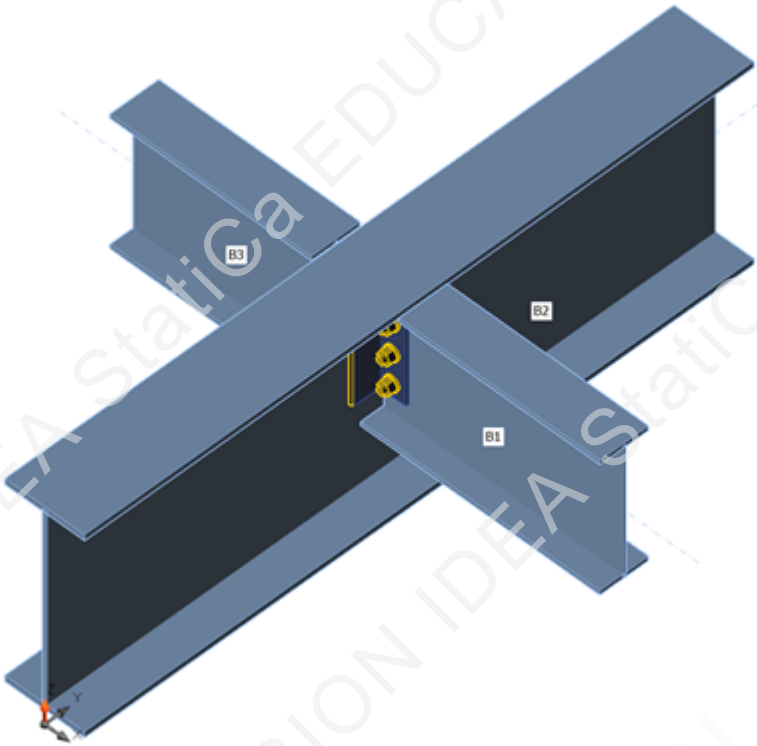
Project item Int Joist-Girder (R2)

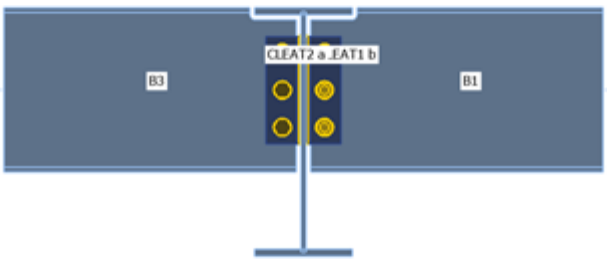
Design

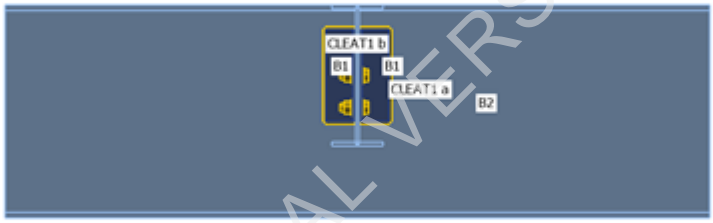
Name	Int Joist-Girder (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (R2)(W360X39)	180.0	0.0	0.0	0	0	90	Node







Cross-sections

Name	Material
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	33.4 < 100%	OK
Welds	25.8 < 100%	OK
Buckling	Not calculated	

Plates

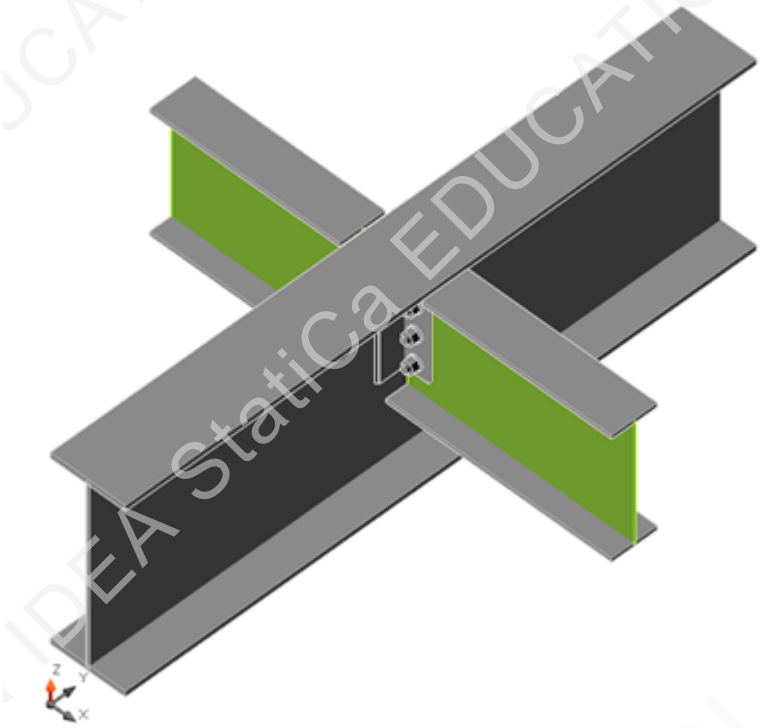
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B1-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	300.8	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	23.6	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	23.1	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	32.5	0.0	OK
B3-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B3-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B3-w 1	A992	344.7	6.5	LE1	300.8	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	109.9	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	112.9	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	109.9	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	113.0	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	113.0	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	109.9	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	112.9	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	109.9	0.0	OK

Design data

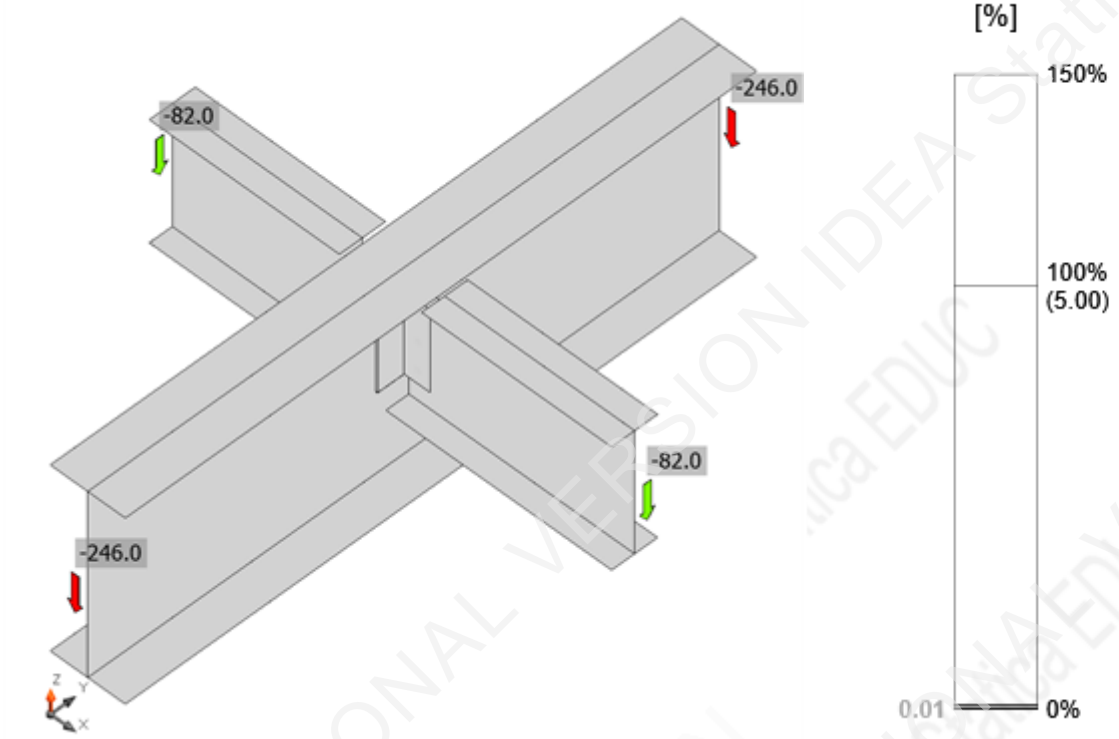
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

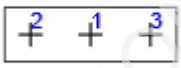
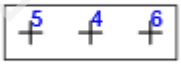


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.7	13.6	133.2	185.5	1.2	20.5	3.0	OK
	B2	3/4 A325 - 1	LE1	1.8	17.8	133.2	215.7	1.2	26.8	5.1	OK
	B3	3/4 A325 - 1	LE1	3.9	18.0	133.2	108.1	2.8	33.4	5.3	OK
	B4	3/4 A325 - 1	LE1	1.7	13.6	133.2	185.5	1.2	20.5	3.0	OK
	B5	3/4 A325 - 1	LE1	3.9	18.0	133.2	108.1	2.8	33.3	5.3	OK
	B6	3/4 A325 - 1	LE1	1.8	17.8	133.2	215.6	1.2	26.8	5.1	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.5	14.0	17.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	3.7	14.2	25.8	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.5	10.4	14.7	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	3.7	14.2	25.8	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.5	14.0	17.5	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	229	10	1.5	10.4	14.7	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	3.7	14.2	25.8	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.5	14.0	17.5	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	229	10	1.5	10.4	14.7	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	2.5	14.0	17.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	3.7	14.2	25.8	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	1.5	10.4	14.7	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

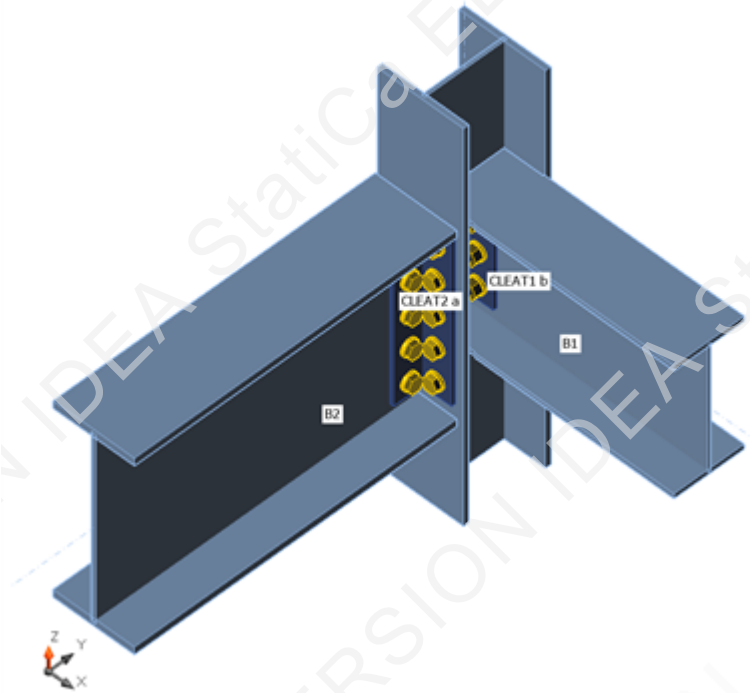
Project item K-4 (2F)

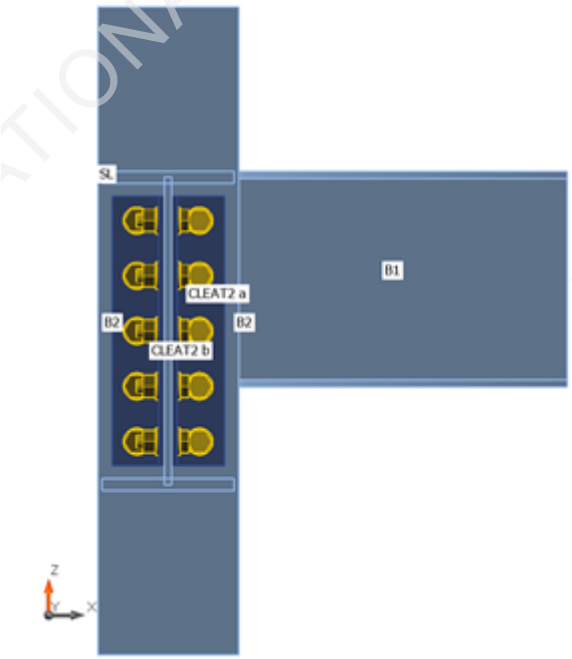
Design

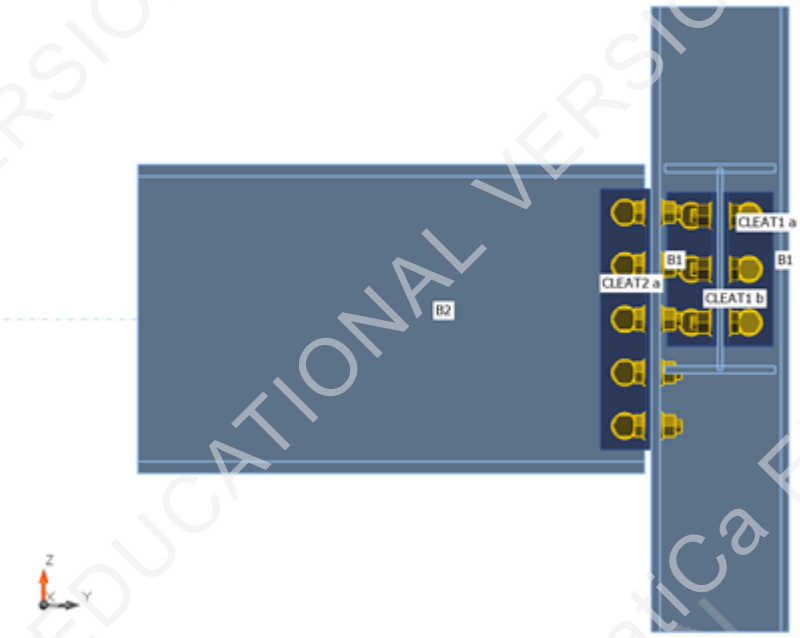
Name	K-4 (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (2F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (2F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	71.1 < 100%	OK
Buckling	Not calculated	

Plates

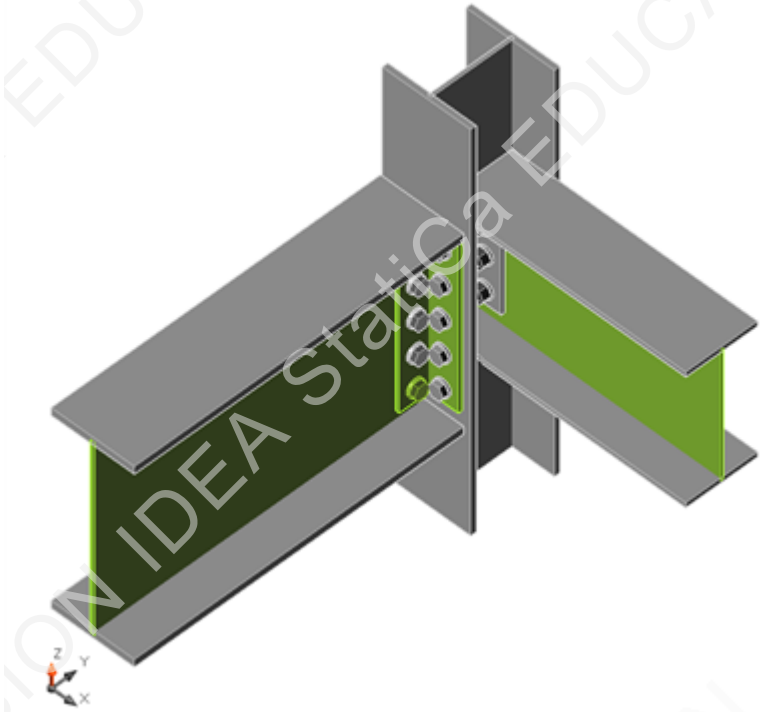
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	193.0	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	28.6	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	171.3	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	273.8	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	164.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	161.4	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	162.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	162.4	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.7	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK

Design data

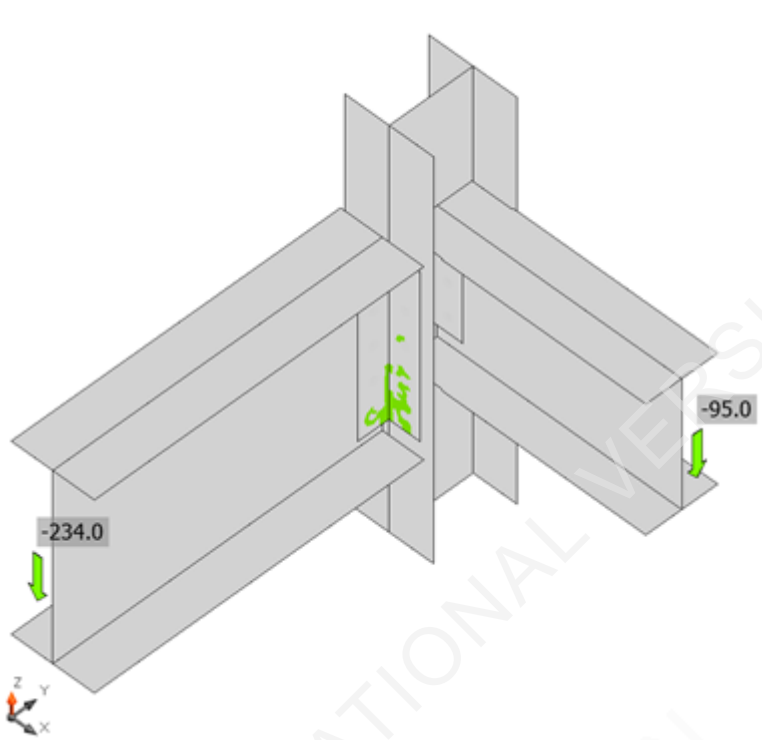
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

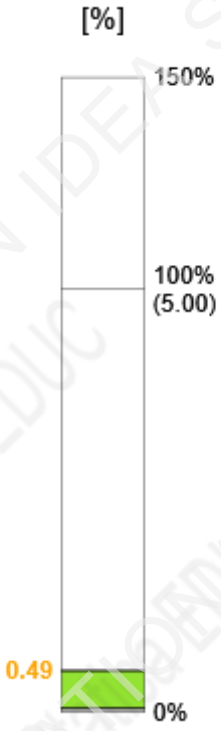
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



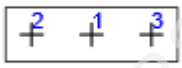
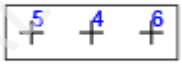
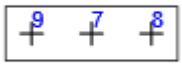
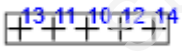
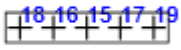
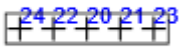
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.7	16.3	135.2	188.4	2.6	23.3	4.3	OK
	B2	3/4 A325 - 1	LE1	9.8	20.8	135.2	109.5	7.0	37.3	7.4	OK
	B3	3/4 A325 - 1	LE1	2.2	21.2	135.2	218.7	1.6	30.6	7.2	OK
	B4	3/4 A325 - 1	LE1	0.7	16.4	161.9	214.4	0.5	20.7	4.3	OK
	B5	3/4 A325 - 1	LE1	2.5	16.7	161.9	214.4	1.8	21.2	4.5	OK
	B6	3/4 A325 - 1	LE1	0.7	16.4	161.9	93.8	0.5	20.7	4.3	OK
	B7	3/4 A325 - 1	LE1	0.7	15.3	161.9	214.4	0.5	19.4	3.8	OK
	B8	3/4 A325 - 1	LE1	2.7	15.4	161.9	214.4	1.9	19.5	3.9	OK
	B9	3/4 A325 - 1	LE1	0.6	15.5	161.9	93.9	0.4	19.6	3.9	OK
	B10	3/4 A325 - 1	LE1	6.5	23.9	215.1	299.7	4.6	30.2	9.3	OK
	B11	3/4 A325 - 1	LE1	10.6	31.7	215.1	169.4	7.5	40.1	16.7	OK
	B12	3/4 A325 - 1	LE1	4.0	30.3	215.1	155.9	2.9	38.3	14.8	OK
	B13	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.0	14.3	71.1	36.3	OK
	B14	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B15	3/4 A325 - 1	LE1	13.3	24.0	163.4	214.4	9.4	30.3	10.1	OK
	B16	3/4 A325 - 1	LE1	35.5	24.3	163.4	214.4	25.1	30.7	15.8	OK
	B17	3/4 A325 - 1	LE1	2.5	23.2	163.4	214.4	1.8	29.4	8.7	OK
	B18	3/4 A325 - 1	LE1	56.9	23.8	163.4	214.4	40.3	30.1	25.3	OK
	B19	3/4 A325 - 1	LE1	5.7	22.0	163.4	93.8	4.0	27.8	7.9	OK
	B20	3/4 A325 - 1	LE1	13.5	24.0	163.4	214.4	9.6	30.3	10.1	OK
	B21	3/4 A325 - 1	LE1	35.5	24.3	163.4	214.4	25.2	30.7	15.8	OK
	B22	3/4 A325 - 1	LE1	2.5	23.2	163.4	214.4	1.8	29.3	8.6	OK
	B23	3/4 A325 - 1	LE1	56.8	23.8	163.4	214.4	40.3	30.1	25.3	OK
	B24	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	4.0	27.8	7.9	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

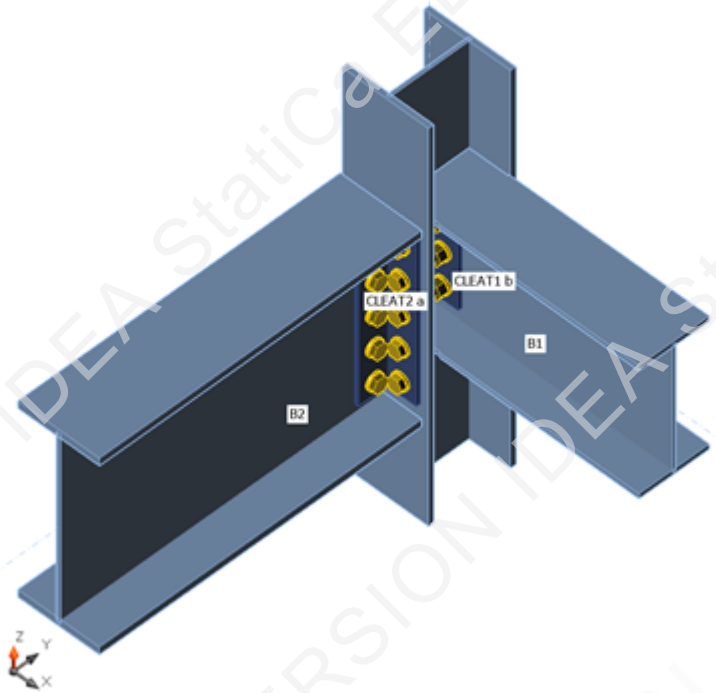
Project item K-4 (3F)

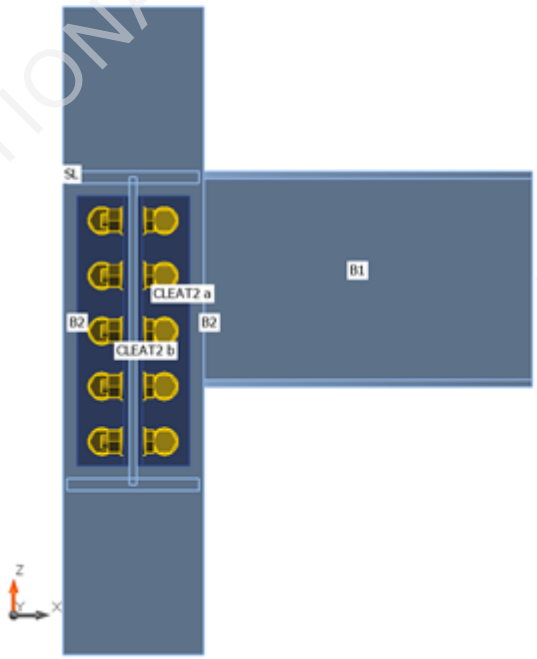
Design

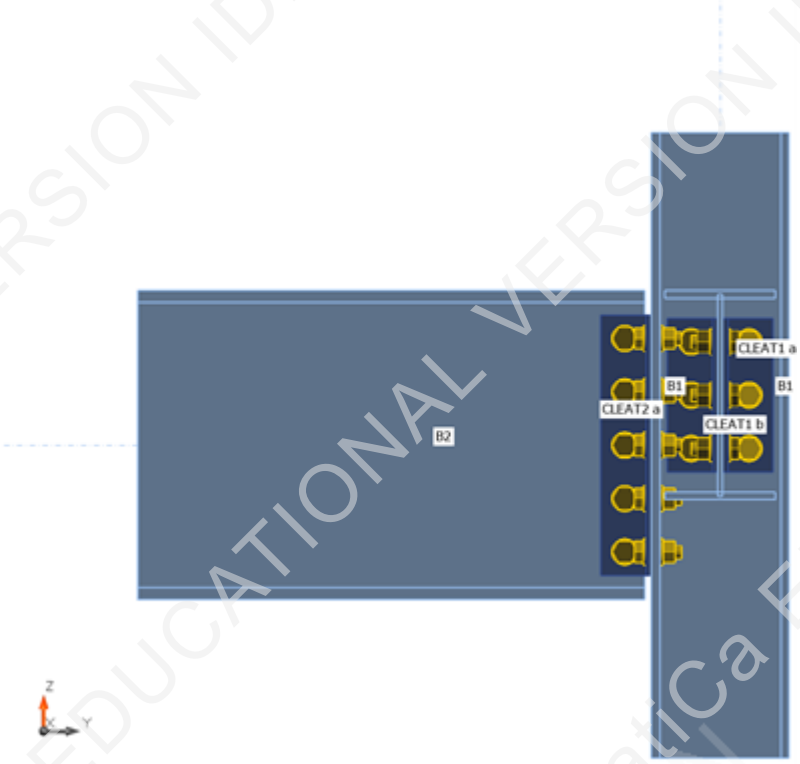
Name	K-4 (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (3F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (3F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	71.1 < 100%	OK
Buckling	Not calculated	

Plates

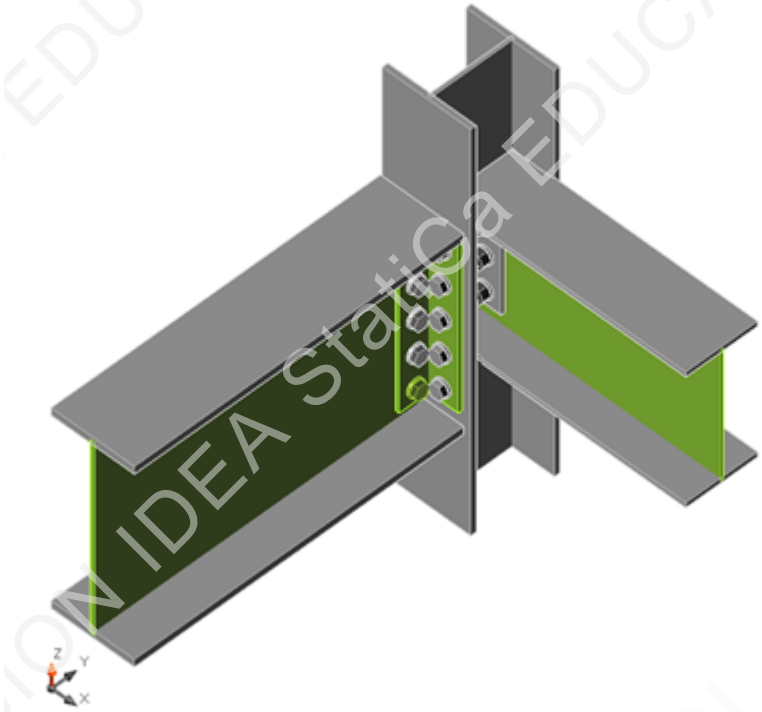
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	193.0	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	28.6	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	171.3	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	273.8	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	164.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	161.4	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	162.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	162.4	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.7	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK

Design data

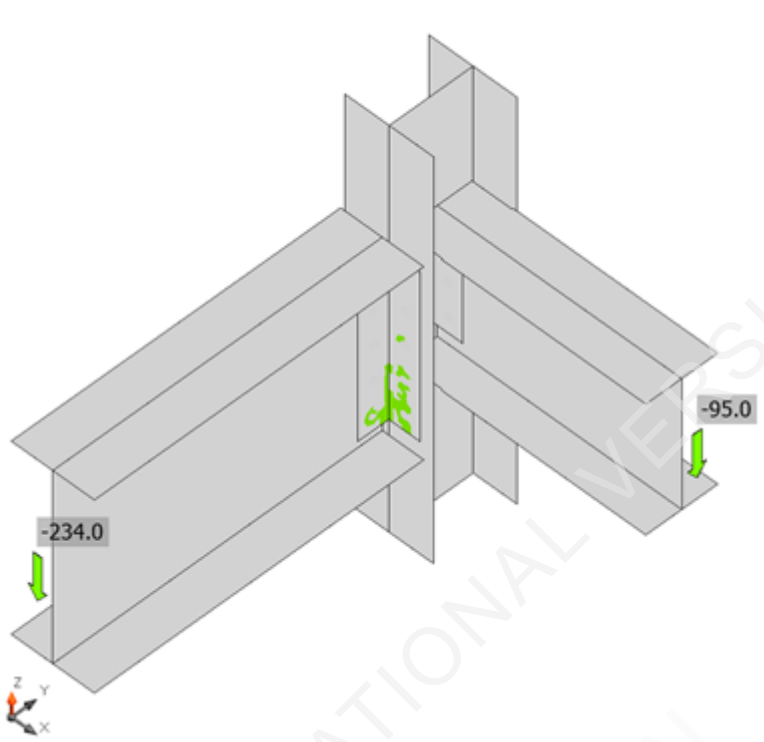
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

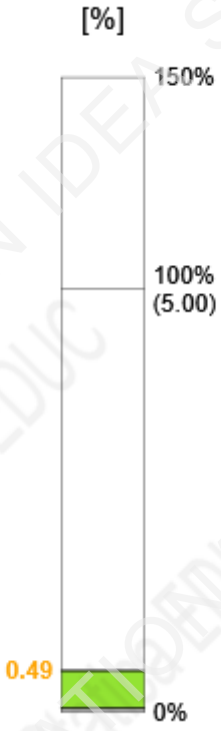
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



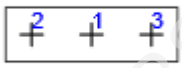
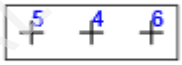
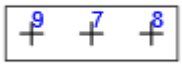
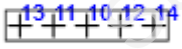
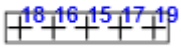
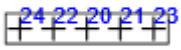
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.7	16.3	135.2	188.4	2.6	23.3	4.3	OK
	B2	3/4 A325 - 1	LE1	9.8	20.8	135.2	109.5	7.0	37.3	7.4	OK
	B3	3/4 A325 - 1	LE1	2.2	21.2	135.2	218.7	1.6	30.6	7.2	OK
	B4	3/4 A325 - 1	LE1	0.7	16.4	161.9	214.4	0.5	20.7	4.3	OK
	B5	3/4 A325 - 1	LE1	2.5	16.7	161.9	214.4	1.8	21.2	4.5	OK
	B6	3/4 A325 - 1	LE1	0.7	16.4	161.9	93.8	0.5	20.7	4.3	OK
	B7	3/4 A325 - 1	LE1	0.7	15.3	161.9	214.4	0.5	19.4	3.8	OK
	B8	3/4 A325 - 1	LE1	2.7	15.4	161.9	214.4	1.9	19.5	3.9	OK
	B9	3/4 A325 - 1	LE1	0.6	15.5	161.9	93.9	0.4	19.6	3.9	OK
	B10	3/4 A325 - 1	LE1	6.5	23.9	215.1	299.7	4.6	30.2	9.3	OK
	B11	3/4 A325 - 1	LE1	10.6	31.7	215.1	169.4	7.5	40.1	16.7	OK
	B12	3/4 A325 - 1	LE1	4.0	30.3	215.1	155.9	2.9	38.3	14.8	OK
	B13	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.0	14.3	71.1	36.3	OK
	B14	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B15	3/4 A325 - 1	LE1	13.3	24.0	163.4	214.4	9.4	30.3	10.1	OK
	B16	3/4 A325 - 1	LE1	35.5	24.3	163.4	214.4	25.1	30.7	15.8	OK
	B17	3/4 A325 - 1	LE1	2.5	23.2	163.4	214.4	1.8	29.4	8.7	OK
	B18	3/4 A325 - 1	LE1	56.9	23.8	163.4	214.4	40.3	30.1	25.3	OK
	B19	3/4 A325 - 1	LE1	5.7	22.0	163.4	93.8	4.0	27.8	7.9	OK
	B20	3/4 A325 - 1	LE1	13.5	24.0	163.4	214.4	9.6	30.3	10.1	OK
	B21	3/4 A325 - 1	LE1	35.5	24.3	163.4	214.4	25.2	30.7	15.8	OK
	B22	3/4 A325 - 1	LE1	2.5	23.2	163.4	214.4	1.8	29.3	8.6	OK
	B23	3/4 A325 - 1	LE1	56.8	23.8	163.4	214.4	40.3	30.1	25.3	OK
	B24	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	4.0	27.8	7.9	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

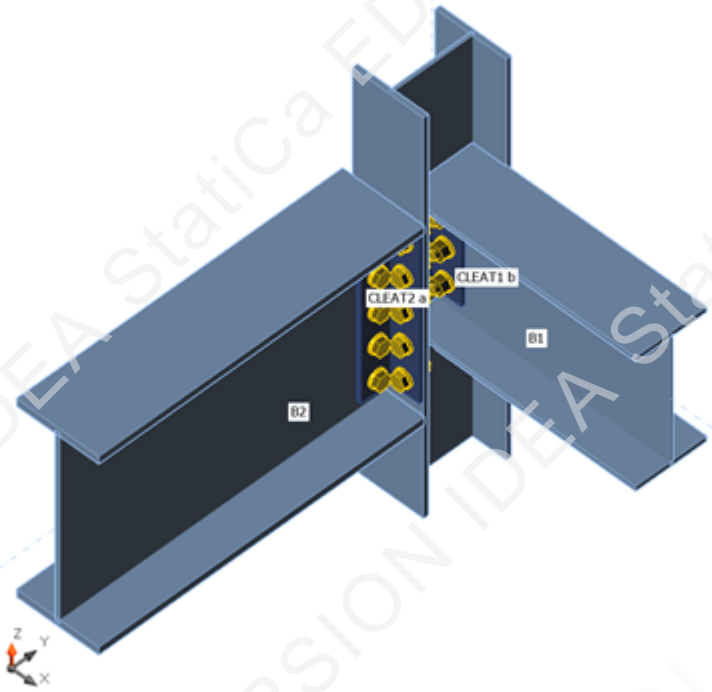
Project item K-4 (4F)

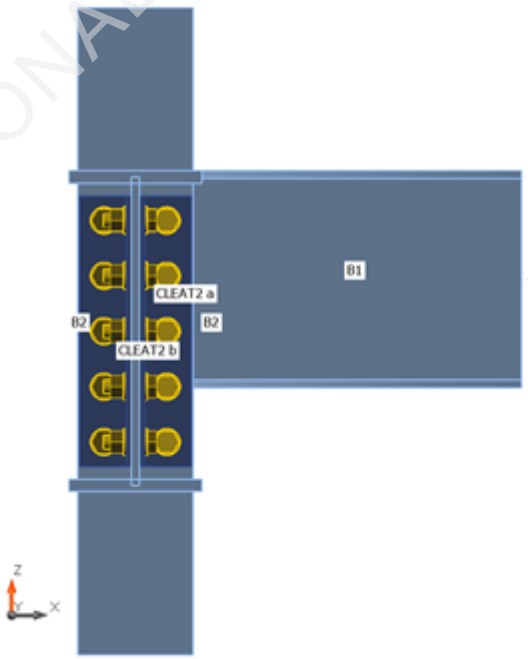
Design

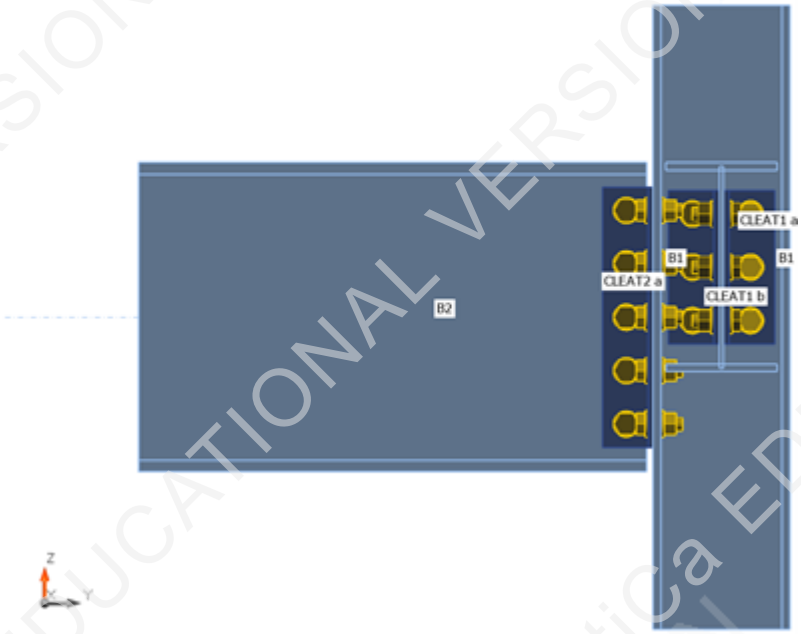
Name	K-4 (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (4F)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (4F) (W200X41.7)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	70.9 < 100%	OK
Buckling	Not calculated	

Plates

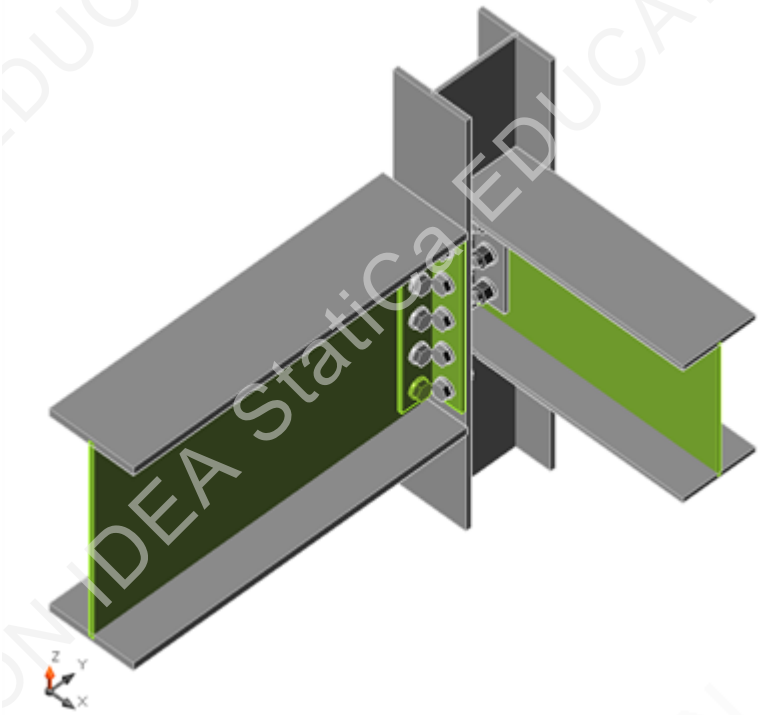
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	223.5	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	32.8	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	188.5	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	96.4	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	96.4	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	275.0	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.2	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	165.4	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	163.6	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	164.0	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	164.6	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK

Design data

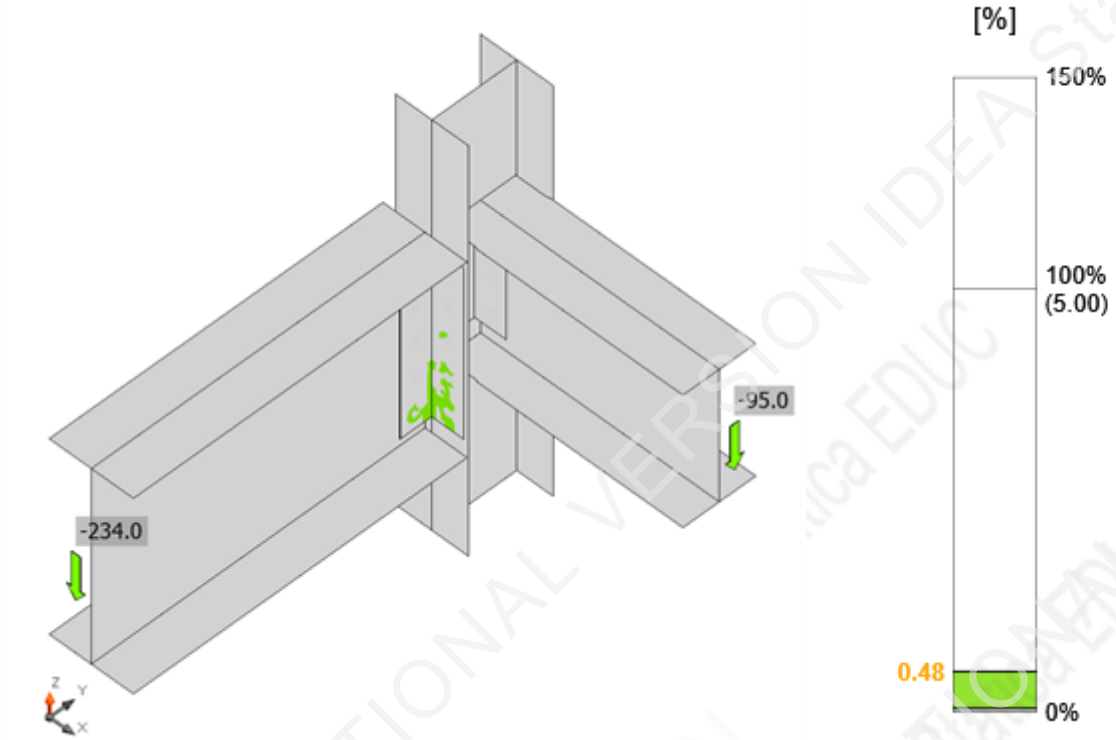
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

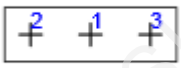
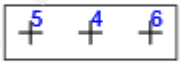
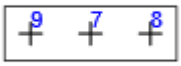
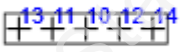
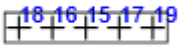
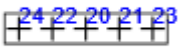


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.7	16.3	135.2	188.4	2.7	23.3	4.3	OK
	B2	3/4 A325 - 1	LE1	10.0	20.8	135.2	109.8	7.1	37.0	7.4	OK
	B3	3/4 A325 - 1	LE1	2.3	21.1	135.2	218.1	1.6	30.5	7.2	OK
	B4	3/4 A325 - 1	LE1	1.0	16.4	147.5	205.5	0.7	20.8	4.3	OK
	B5	3/4 A325 - 1	LE1	2.5	16.7	147.5	205.5	1.8	21.2	4.5	OK
	B6	3/4 A325 - 1	LE1	0.7	16.5	147.5	93.8	0.5	20.8	4.3	OK
	B7	3/4 A325 - 1	LE1	0.9	15.3	147.5	205.5	0.7	19.3	3.7	OK
	B8	3/4 A325 - 1	LE1	2.8	15.3	147.5	205.5	2.0	19.4	3.8	OK
	B9	3/4 A325 - 1	LE1	0.6	15.5	147.5	93.9	0.4	19.7	3.9	OK
	B10	3/4 A325 - 1	LE1	6.4	23.9	215.1	299.7	4.6	30.2	9.3	OK
	B11	3/4 A325 - 1	LE1	10.5	31.6	215.1	169.9	7.4	40.0	16.6	OK
	B12	3/4 A325 - 1	LE1	4.1	30.2	215.1	156.3	2.9	38.3	14.7	OK
	B13	3/4 A325 - 1	LE1	20.2	46.1	215.1	130.1	14.3	70.9	36.1	OK
	B14	3/4 A325 - 1	LE1	3.9	50.0	215.1	108.7	2.8	63.3	40.1	OK
	B15	3/4 A325 - 1	LE1	13.4	23.9	163.4	214.4	9.5	30.2	10.1	OK
	B16	3/4 A325 - 1	LE1	36.1	24.2	163.4	214.4	25.6	30.6	15.9	OK
	B17	3/4 A325 - 1	LE1	2.4	23.2	163.4	214.4	1.7	29.4	8.7	OK
	B18	3/4 A325 - 1	LE1	57.8	23.8	163.4	214.4	41.0	30.1	25.9	OK
	B19	3/4 A325 - 1	LE1	5.7	22.1	163.4	93.8	4.1	28.0	8.0	OK
	B20	3/4 A325 - 1	LE1	13.6	23.9	163.4	214.4	9.7	30.2	10.1	OK
	B21	3/4 A325 - 1	LE1	36.2	24.2	163.4	214.4	25.6	30.7	16.0	OK
	B22	3/4 A325 - 1	LE1	2.4	23.2	163.4	214.4	1.7	29.3	8.6	OK
	B23	3/4 A325 - 1	LE1	57.8	23.8	163.4	214.4	40.9	30.2	25.9	OK
	B24	3/4 A325 - 1	LE1	5.7	22.1	163.4	93.8	4.0	27.9	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

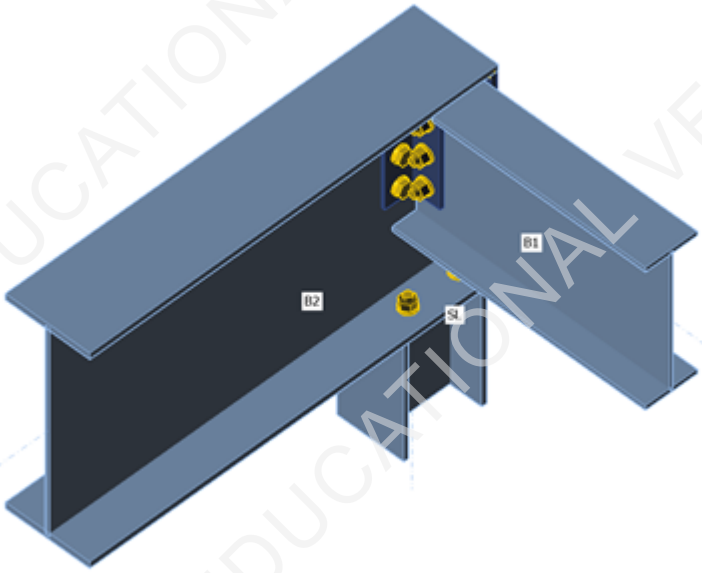
Project item K-4 (R2)

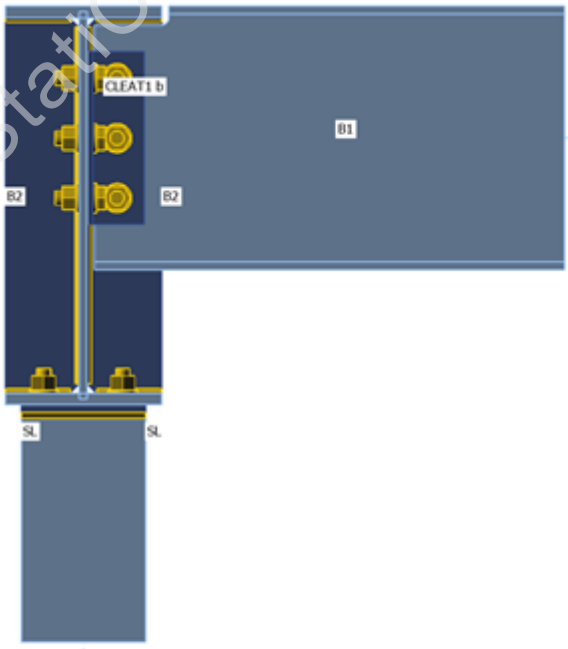
Design

Name	K-4 (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	-110	0	0	Node





Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	33.7 < 100%	OK
Welds	77.3 < 100%	OK
Buckling	Not calculated	

Plates

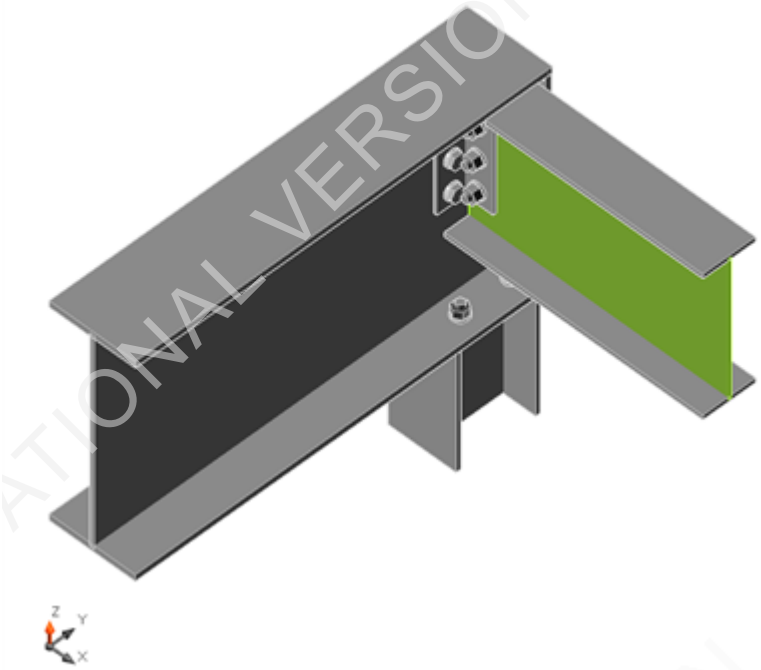
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	13.8	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	148.6	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	156.1	0.0	OK
B1-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	302.0	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	144.4	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	133.1	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	155.8	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	104.1	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	142.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	105.4	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	141.0	0.0	OK
EP1	A992	344.7	10.0	LE1	92.8	0.0	OK
STIFF1	A992	344.7	15.6	LE1	110.1	0.0	OK
STIFF2	A992	344.7	15.6	LE1	109.7	0.0	OK

Design data

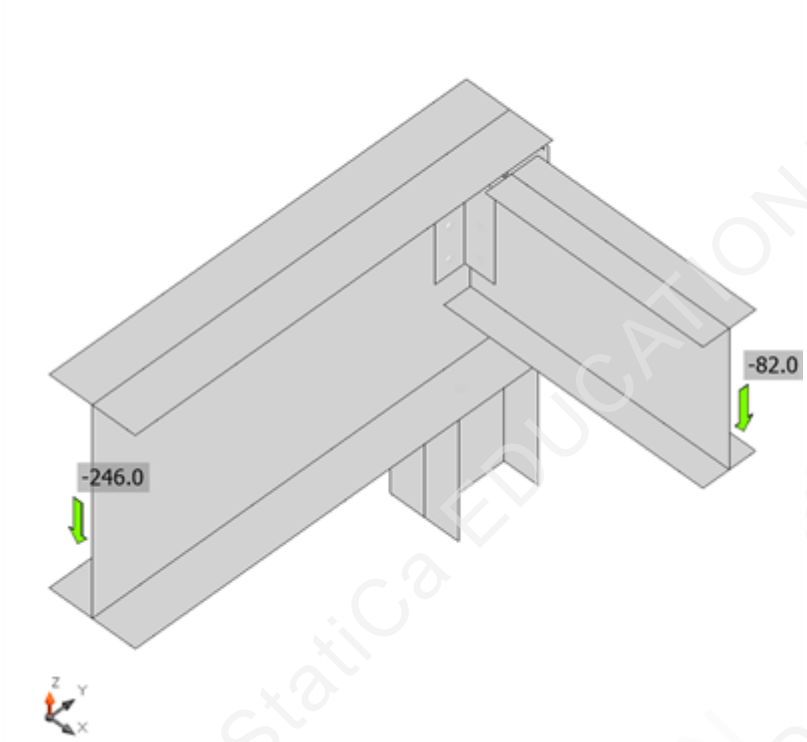
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

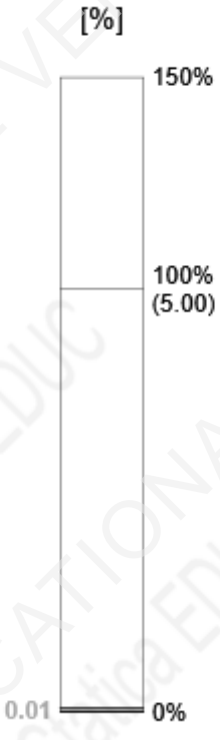
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



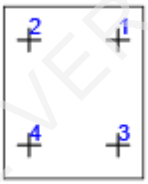
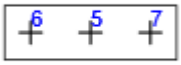
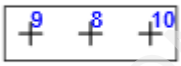
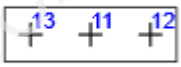
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	6.4	0.1	204.9	143.2	4.5	0.2	0.2	OK
	B2	3/4 A325 - 1	LE1	6.4	0.2	204.9	143.0	4.5	0.2	0.2	OK
	B3	3/4 A325 - 1	LE1	4.3	0.2	204.9	144.7	3.1	0.2	0.1	OK
	B4	3/4 A325 - 1	LE1	4.2	0.2	204.9	145.0	3.0	0.2	0.1	OK
	B5	3/4 A325 - 1	LE1	3.2	14.2	133.2	185.5	2.3	20.5	3.3	OK
	B6	3/4 A325 - 1	LE1	1.9	18.4	133.2	221.5	1.3	26.9	5.4	OK
	B7	3/4 A325 - 1	LE1	8.5	18.4	133.2	106.2	6.0	33.7	5.8	OK
	B8	3/4 A325 - 1	LE1	1.0	14.3	163.4	214.4	0.7	18.1	3.3	OK
	B9	3/4 A325 - 1	LE1	1.3	13.6	163.4	93.9	0.9	17.2	3.0	OK
	B10	3/4 A325 - 1	LE1	2.8	15.1	163.4	214.4	2.0	19.1	3.7	OK
	B11	3/4 A325 - 1	LE1	1.0	13.3	163.4	214.4	0.7	16.8	2.8	OK
	B12	3/4 A325 - 1	LE1	1.1	12.7	163.4	93.8	0.8	16.0	2.6	OK
	B13	3/4 A325 - 1	LE1	2.9	13.7	163.4	214.4	2.0	17.3	3.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	0.7	21.5	3.4	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	0.6	17.1	3.4	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	9.3	23.6	39.2	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	11.2	23.6	47.2	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	11.7	23.8	49.3	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	12.0	23.8	50.3	OK
B2-bfl 1	STIFF1	E49xx	◢4.2	◢6.0	87	43	46.8	60.6	77.3	OK
B2-w 1	STIFF1	E49xx	◢4.2	◢6.0	476	48	14.1	44.7	31.6	OK
B2-tfl 1	STIFF1	E49xx	◢4.2	◢6.0	87	43	7.9	46.1	17.2	OK
B2-bfl 1	STIFF2	E49xx	◢4.2	◢6.0	87	43	46.8	60.6	77.3	OK
B2-w 1	STIFF2	E49xx	◢4.2	◢6.0	476	48	14.2	44.9	31.6	OK
B2-tfl 1	STIFF2	E49xx	◢4.2	◢6.0	87	43	7.9	46.0	17.1	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

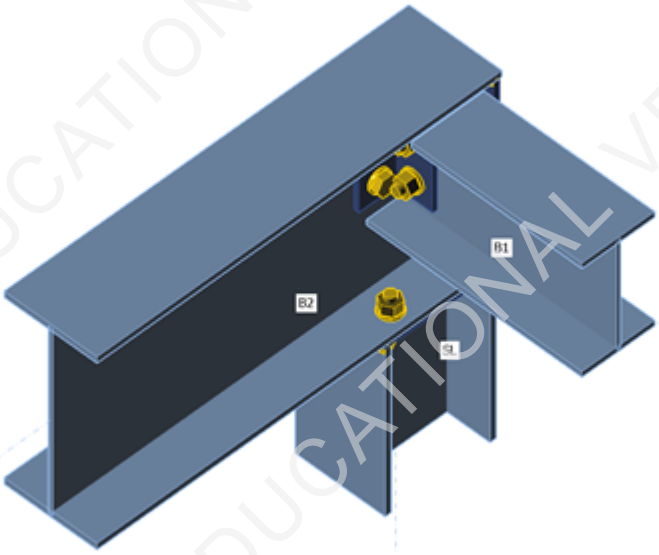
Project item A-4 (R1)

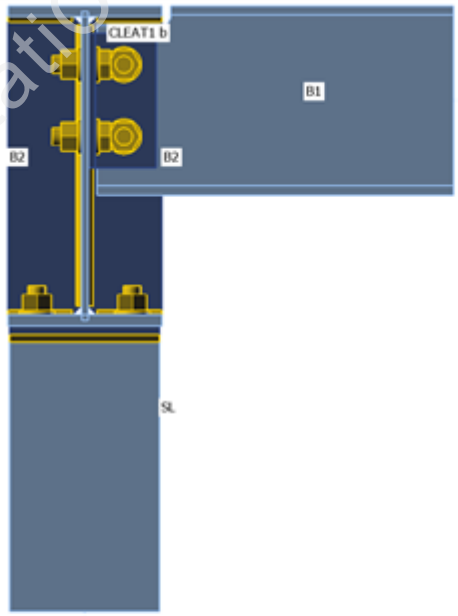
Design

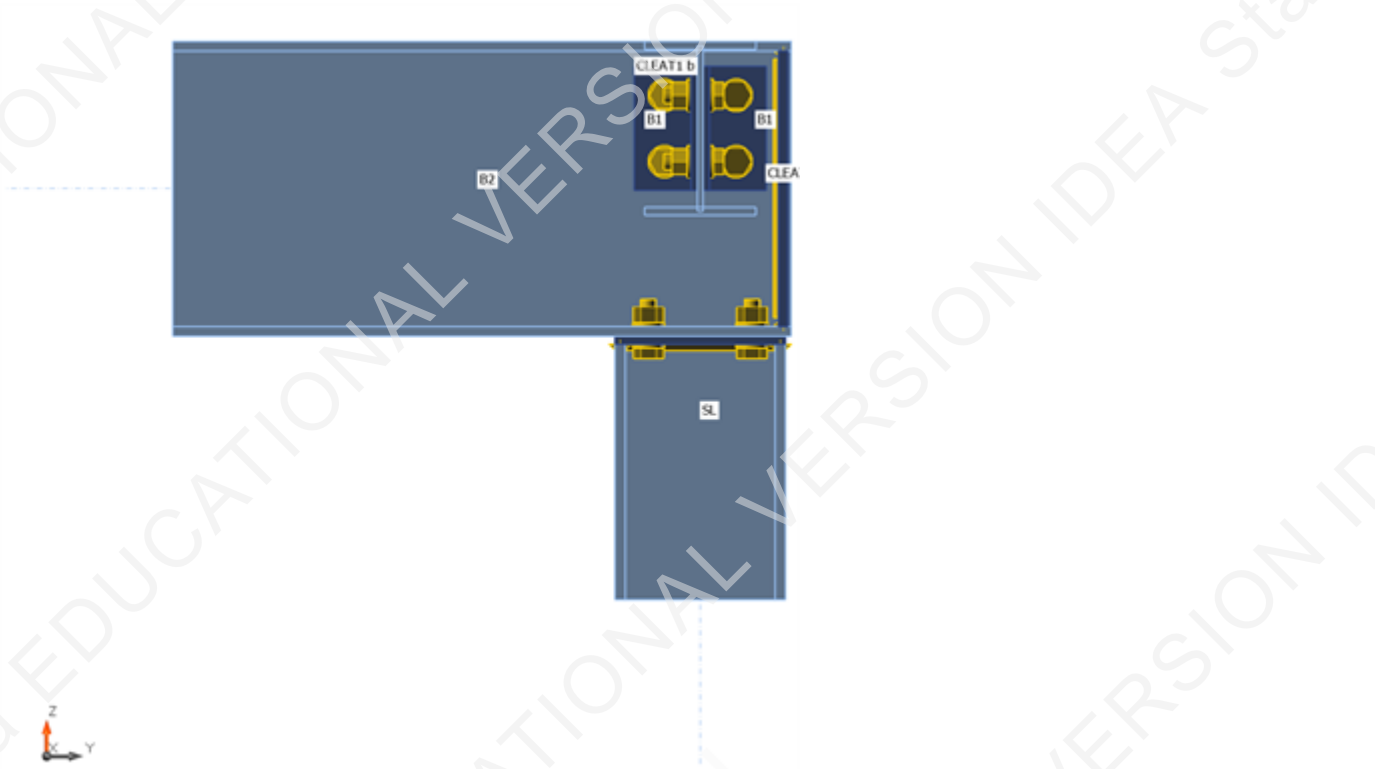
Name	A-4 (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	-110	0	0	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	25.9 < 100%	OK
Welds	39.2 < 100%	OK
Buckling	Not calculated	

Plates

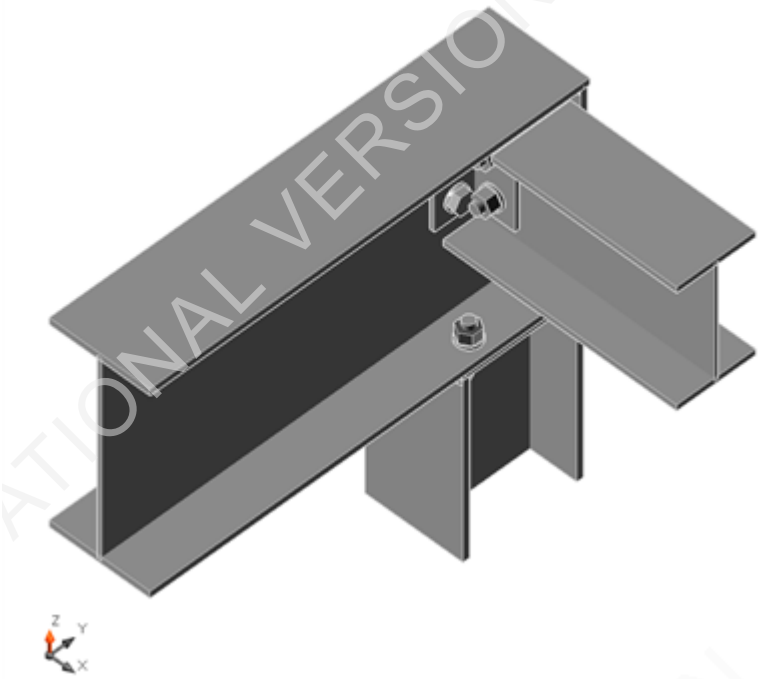
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	3.7	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	52.9	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	58.2	0.0	OK
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	230.0	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	98.3	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	98.3	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	128.2	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	81.4	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	104.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	80.6	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	104.1	0.0	OK
EP1	A992	344.7	10.0	LE1	29.7	0.0	OK
STIFF1	A992	344.7	11.6	LE1	77.1	0.0	OK
STIFF2	A992	344.7	11.6	LE1	75.6	0.0	OK

Design data

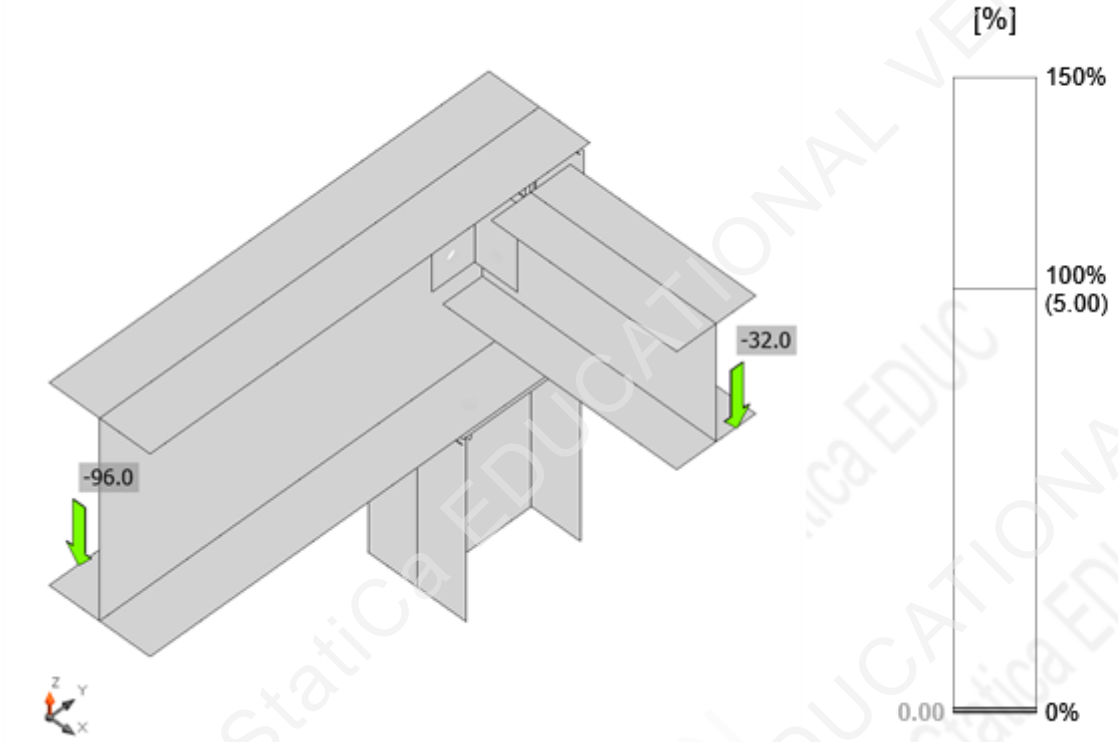
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

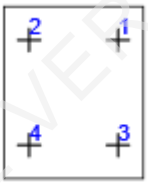
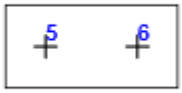
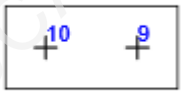


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	2.7	0.2	204.9	144.2	1.9	0.3	0.0	OK
	B2	3/4 A325 - 1	LE1	2.7	0.2	204.9	145.8	1.9	0.3	0.0	OK
	B3	3/4 A325 - 1	LE1	1.1	0.2	204.9	167.2	0.8	0.2	0.0	OK
	B4	3/4 A325 - 1	LE1	1.0	0.2	204.9	166.7	0.7	0.2	0.0	OK
	B5	3/4 A325 - 1	LE1	1.9	12.2	131.1	206.1	1.3	18.1	2.4	OK
	B6	3/4 A325 - 1	LE1	6.5	12.1	131.1	91.4	4.6	25.9	2.6	OK
	B7	3/4 A325 - 1	LE1	0.5	8.2	147.5	93.9	0.3	10.4	1.1	OK
	B8	3/4 A325 - 1	LE1	1.6	8.9	147.5	322.9	1.1	11.3	1.3	OK
	B9	3/4 A325 - 1	LE1	0.4	7.6	147.5	93.9	0.2	9.6	0.9	OK
	B10	3/4 A325 - 1	LE1	1.7	8.0	147.5	205.5	1.2	10.1	1.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	0.2	22.4	0.8	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	0.2	17.0	0.9	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	3.9	23.6	16.4	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	4.7	23.6	20.0	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	4.0	23.6	17.0	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	4.0	23.7	16.7	OK
B2-bfl 1	STIFF1	E49xx	◢4.2	◢6.0	72	36	19.3	49.2	39.2	OK
B2-w 1	STIFF1	E49xx	◢4.2	◢6.0	311	39	5.6	36.5	15.5	OK
B2-tfl 1	STIFF1	E49xx	◢4.2	◢6.0	72	36	3.5	35.4	9.9	OK
B2-bfl 1	STIFF2	E49xx	◢4.2	◢6.0	72	36	19.2	49.2	39.0	OK
B2-w 1	STIFF2	E49xx	◢4.2	◢6.0	311	39	5.9	37.8	15.6	OK
B2-tfl 1	STIFF2	E49xx	◢4.2	◢6.0	72	36	3.1	35.1	8.9	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

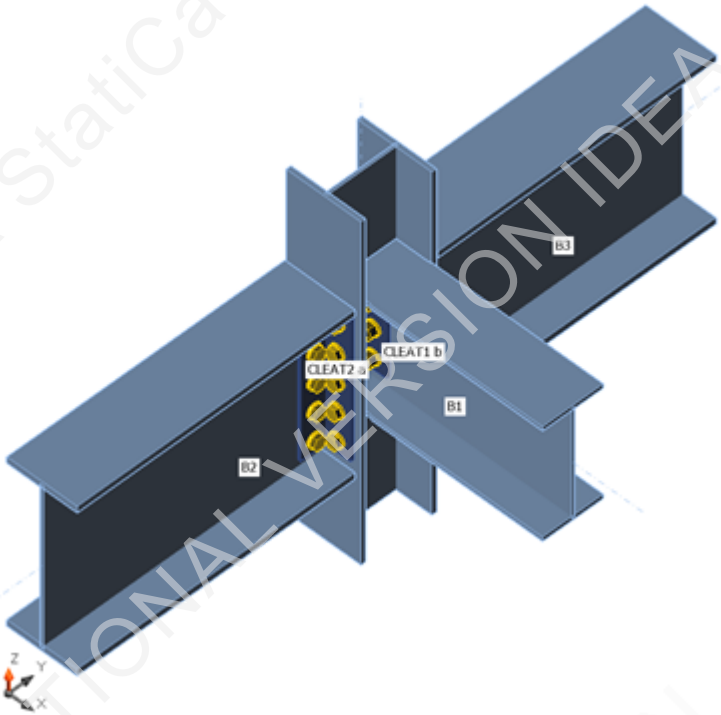
Project item J-4 (2F)

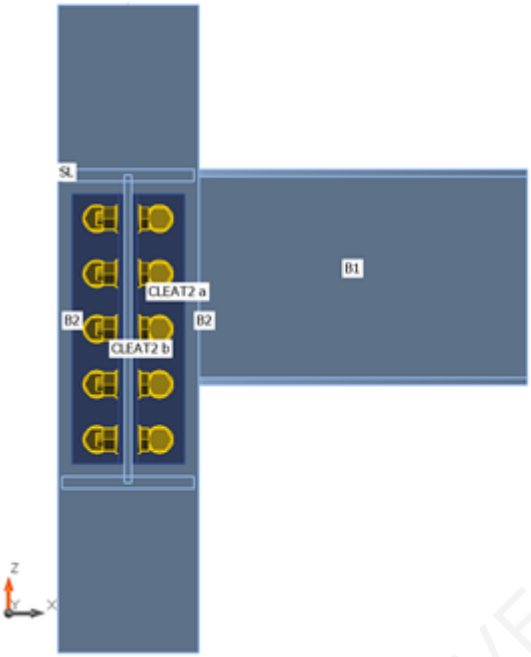
Design

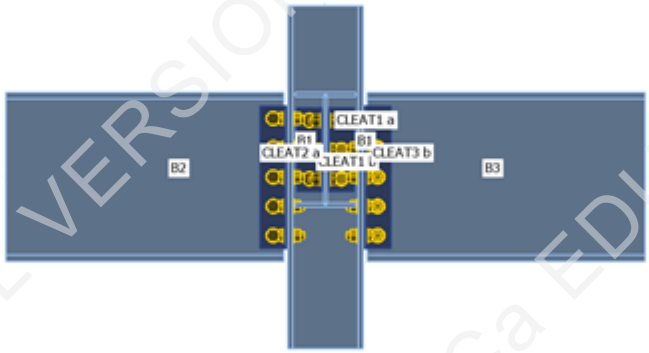
Name	J-4 (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (2F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (2F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	71.0 < 100%	OK
Buckling	Not calculated	

Plates

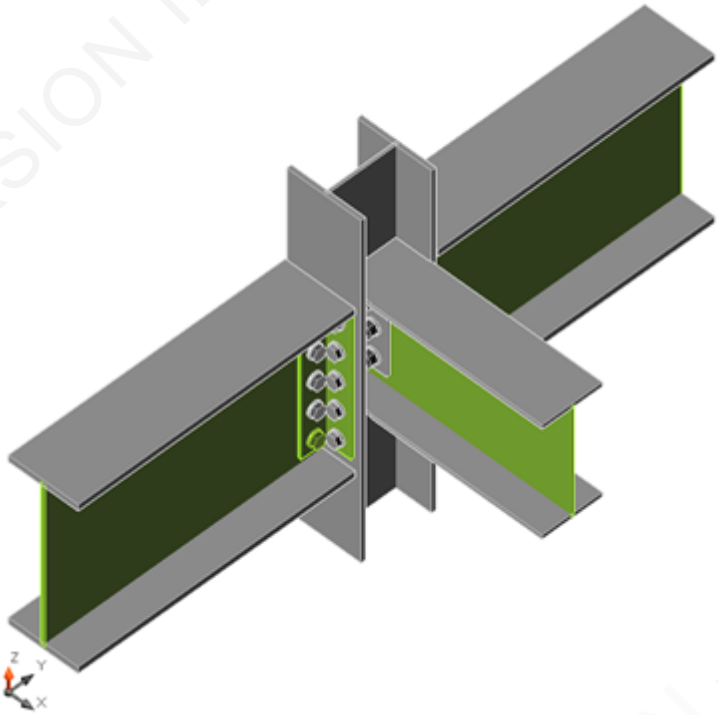
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	196.0	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	196.0	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	186.8	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	273.7	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
B3-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	164.6	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	167.1	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	164.6	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	167.0	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK

Design data

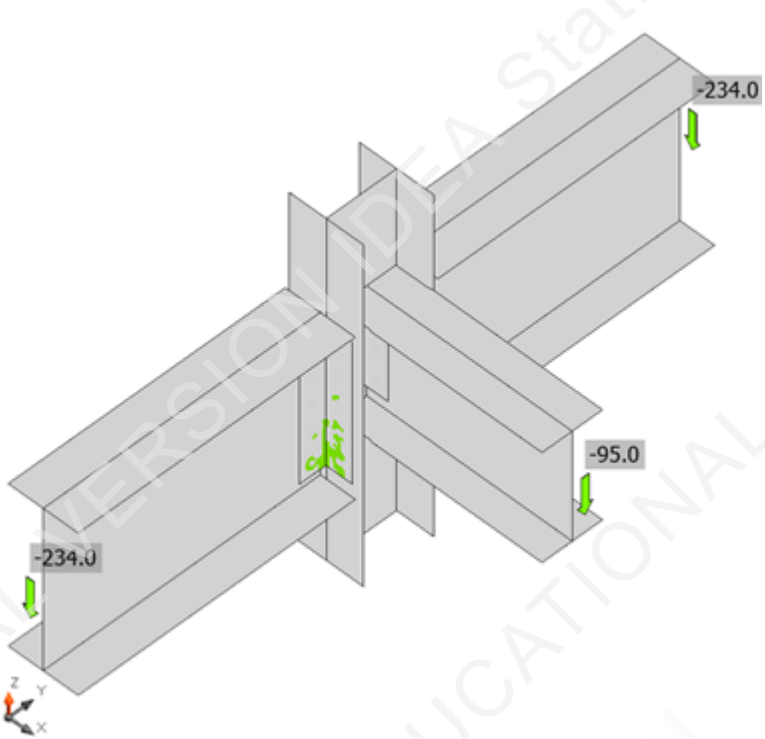
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

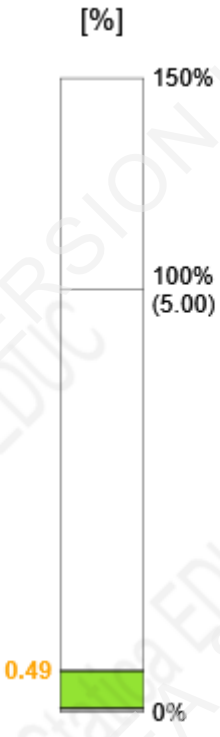
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



Overall check, LE1

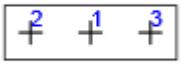
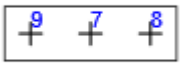
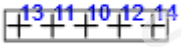
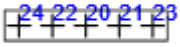
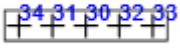


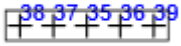


Project:
Project no:
Author:

IDEA StatiCa®
Calculate yesterday's estimates

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.7	15.8	135.2	188.4	2.6	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	9.9	20.4	135.2	111.3	7.1	36.7	7.2	OK
	B3	3/4 A325 - 1	LE1	2.3	20.7	135.2	216.1	1.6	30.7	6.9	OK
	B4	3/4 A325 - 1	LE1	0.7	15.7	161.9	214.4	0.5	19.9	4.0	OK
	B5	3/4 A325 - 1	LE1	2.6	15.9	161.9	214.4	1.8	20.1	4.1	OK
	B6	3/4 A325 - 1	LE1	0.6	16.2	161.9	93.9	0.5	20.5	4.2	OK
	B7	3/4 A325 - 1	LE1	0.7	15.7	161.9	214.4	0.5	19.9	4.0	OK
	B8	3/4 A325 - 1	LE1	2.6	15.9	161.9	214.4	1.8	20.1	4.1	OK
	B9	3/4 A325 - 1	LE1	0.6	16.2	161.9	93.9	0.5	20.5	4.2	OK
	B10	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.4	OK
	B11	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.3	7.6	40.2	16.7	OK
	B12	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.7	2.9	38.4	14.8	OK
	B13	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B14	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B15	3/4 A325 - 1	LE1	14.0	23.7	163.4	214.4	9.9	30.0	10.0	OK
	B16	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B17	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B18	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B19	3/4 A325 - 1	LE1	5.6	22.1	163.4	93.8	4.0	27.9	8.0	OK
	B20	3/4 A325 - 1	LE1	14.2	23.7	163.4	214.4	10.1	30.0	10.0	OK
	B21	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B22	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B23	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B24	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	3.9	27.9	7.9	OK
	B25	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.3	OK
	B26	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.7	2.9	38.4	14.8	OK
	B27	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.4	7.6	40.2	16.7	OK
	B28	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B29	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B30	3/4 A325 - 1	LE1	14.2	23.7	163.4	214.4	10.1	30.0	10.0	OK
	B31	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B32	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B33	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B34	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	3.9	27.9	7.9	OK
	B35	3/4 A325 - 1	LE1	14.0	23.7	163.4	214.4	9.9	30.0	10.0	OK

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B36	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B37	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.0	OK
	B38	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B39	3/4 A325 - 1	LE1	5.6	22.1	163.4	93.8	4.0	27.9	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

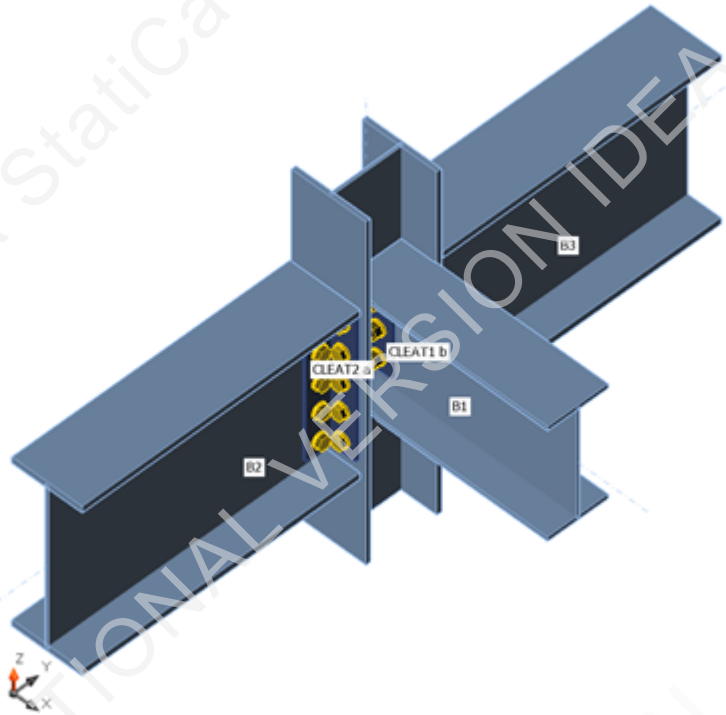
Project item J-4 (3F)

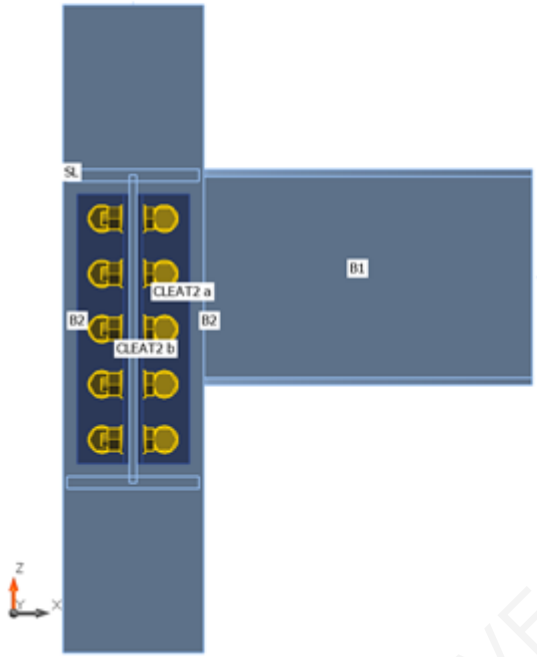
Design

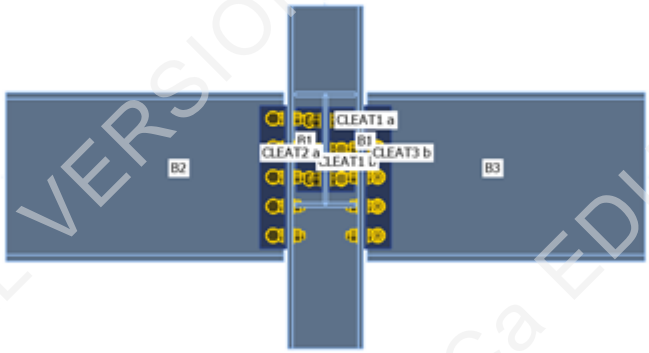
Name	J-4 (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (3F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (3F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	71.0 < 100%	OK
Buckling	Not calculated	

Plates

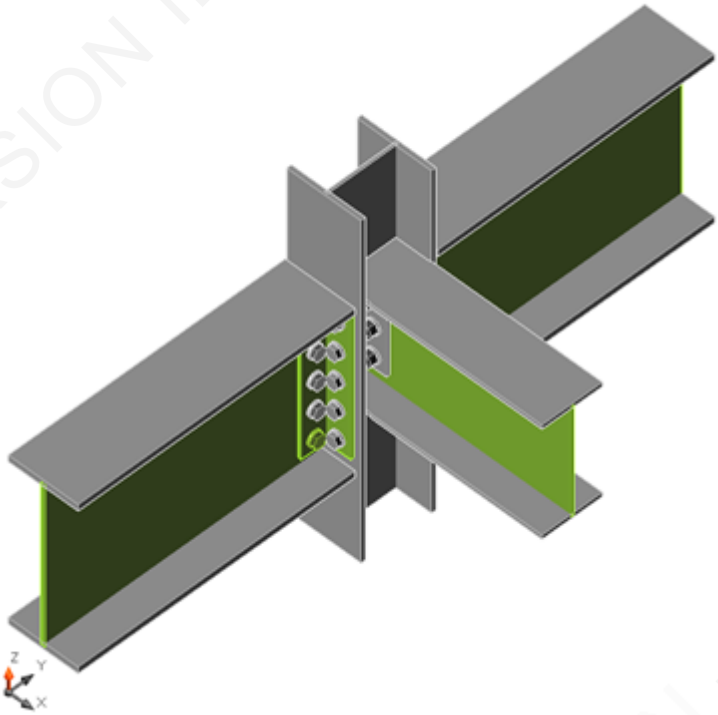
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	196.0	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	196.0	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	186.8	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	98.6	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	273.7	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
B3-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	164.6	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	167.1	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	164.6	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	167.0	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK

Design data

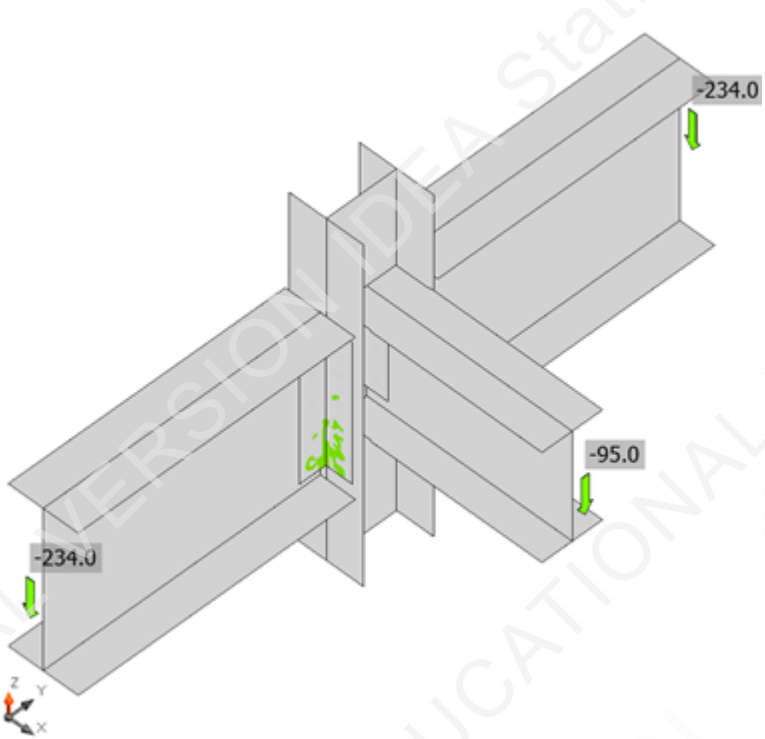
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

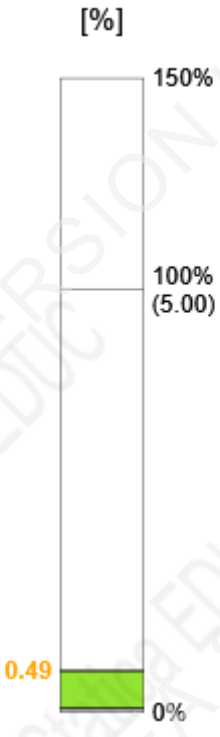
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



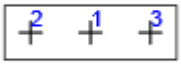
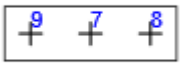
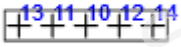
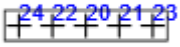
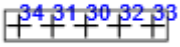
Overall check, LE1

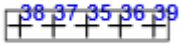




Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.7	15.8	135.2	188.4	2.6	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	9.9	20.4	135.2	111.3	7.1	36.7	7.2	OK
	B3	3/4 A325 - 1	LE1	2.3	20.7	135.2	216.1	1.6	30.7	6.9	OK
	B4	3/4 A325 - 1	LE1	0.7	15.7	161.9	214.4	0.5	19.9	4.0	OK
	B5	3/4 A325 - 1	LE1	2.6	15.9	161.9	214.4	1.8	20.1	4.1	OK
	B6	3/4 A325 - 1	LE1	0.6	16.2	161.9	93.9	0.5	20.5	4.2	OK
	B7	3/4 A325 - 1	LE1	0.7	15.7	161.9	214.4	0.5	19.9	4.0	OK
	B8	3/4 A325 - 1	LE1	2.6	15.9	161.9	214.4	1.8	20.1	4.1	OK
	B9	3/4 A325 - 1	LE1	0.6	16.2	161.9	93.9	0.5	20.5	4.2	OK
	B10	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.4	OK
	B11	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.3	7.6	40.2	16.7	OK
	B12	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.7	2.9	38.4	14.8	OK
	B13	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B14	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B15	3/4 A325 - 1	LE1	14.0	23.7	163.4	214.4	9.9	30.0	10.0	OK
	B16	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B17	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B18	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B19	3/4 A325 - 1	LE1	5.6	22.1	163.4	93.8	4.0	27.9	8.0	OK
	B20	3/4 A325 - 1	LE1	14.2	23.7	163.4	214.4	10.1	30.0	10.0	OK
	B21	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B22	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B23	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B24	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	3.9	27.9	7.9	OK
	B25	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.3	OK
	B26	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.7	2.9	38.4	14.8	OK
	B27	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.4	7.6	40.2	16.7	OK
	B28	3/4 A325 - 1	LE1	20.2	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B29	3/4 A325 - 1	LE1	3.8	50.1	215.1	108.6	2.7	63.4	40.3	OK
	B30	3/4 A325 - 1	LE1	14.2	23.7	163.4	214.4	10.1	30.0	10.0	OK
	B31	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B32	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.1	OK
	B33	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B34	3/4 A325 - 1	LE1	5.6	22.0	163.4	93.8	3.9	27.9	7.9	OK
	B35	3/4 A325 - 1	LE1	14.0	23.7	163.4	214.4	9.9	30.0	10.0	OK

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B36	3/4 A325 - 1	LE1	2.5	23.0	163.4	214.4	1.8	29.1	8.5	OK
	B37	3/4 A325 - 1	LE1	36.3	24.3	163.4	214.4	25.7	30.7	16.0	OK
	B38	3/4 A325 - 1	LE1	56.2	24.2	163.4	214.4	39.8	30.6	25.2	OK
	B39	3/4 A325 - 1	LE1	5.6	22.1	163.4	93.8	4.0	27.9	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

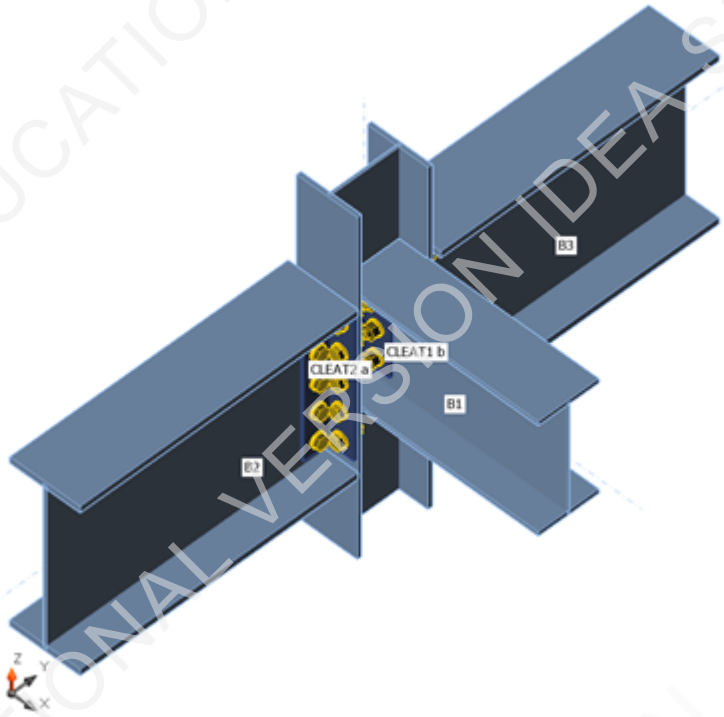
Project item J-4 (4F)

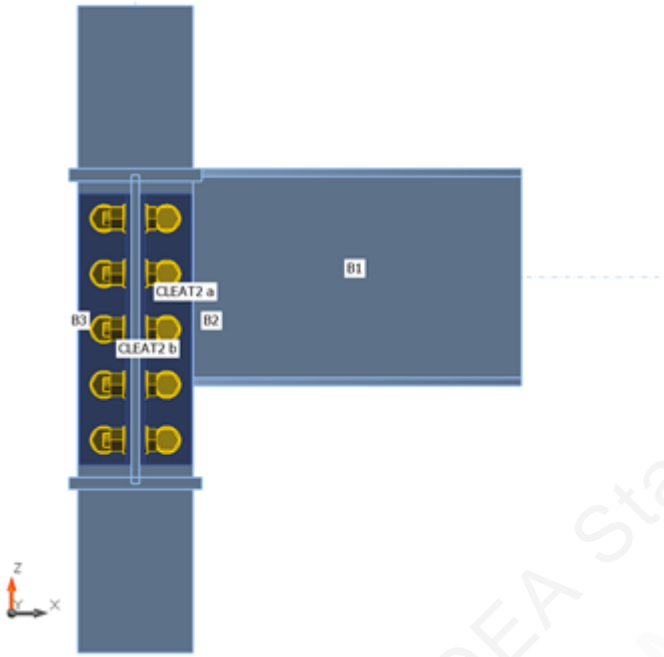
Design

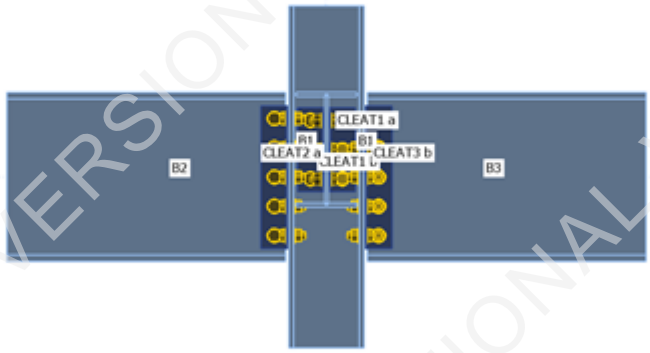
Name	J-4 (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (4F)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - EXT COL (4F) (W200X41.7)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	70.8 < 100%	OK
Buckling	Not calculated	

Plates

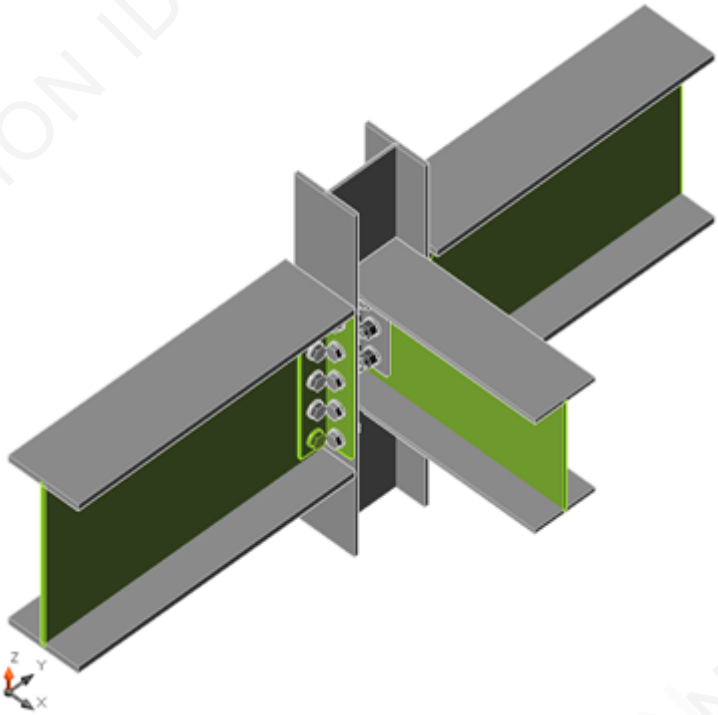
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	228.0	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	228.0	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	209.8	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	96.4	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	96.4	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	274.9	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.2	0.5	OK
B3-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B3-w 1	A992	344.7	10.5	LE1	311.2	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	166.3	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	169.5	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	166.3	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	169.5	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK

Design data

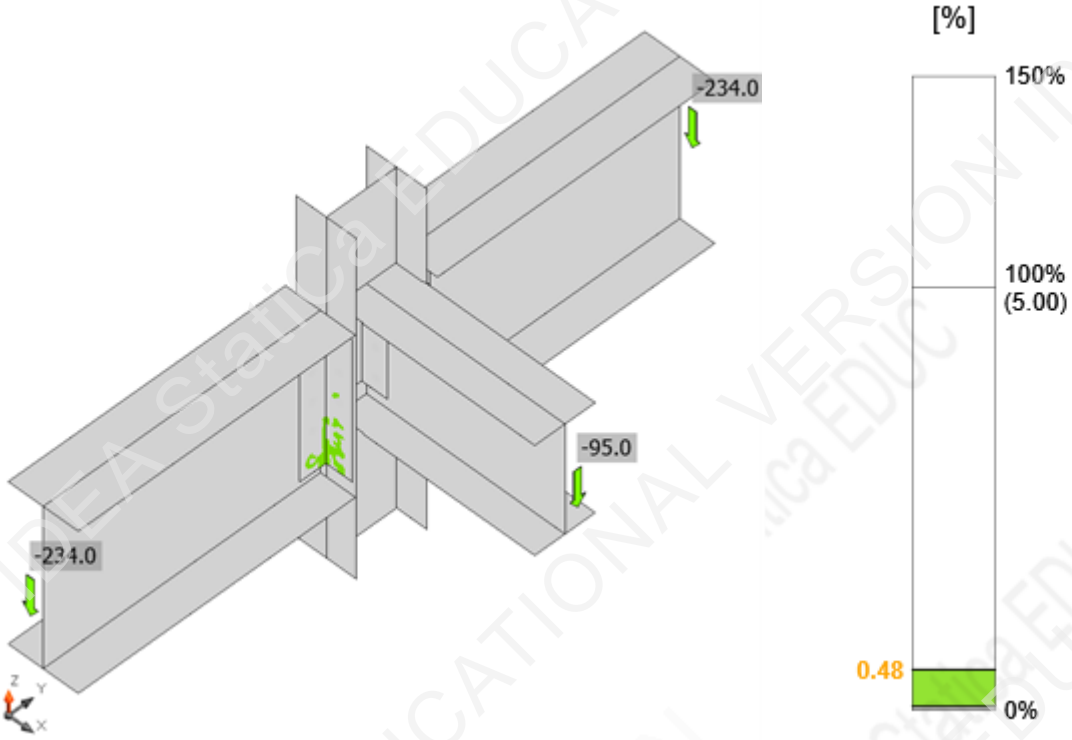
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

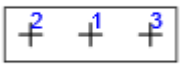
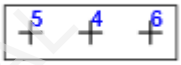
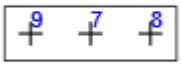
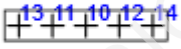
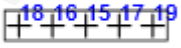
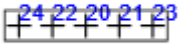
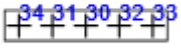
ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

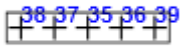


Overall check, LE1



Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.8	15.8	135.2	188.4	2.7	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	10.1	20.3	135.2	111.8	7.2	36.4	7.1	OK
	B3	3/4 A325 - 1	LE1	2.3	20.7	135.2	215.4	1.7	30.6	6.9	OK
	B4	3/4 A325 - 1	LE1	0.9	15.7	147.5	205.5	0.7	19.9	3.9	OK
	B5	3/4 A325 - 1	LE1	2.6	15.8	147.5	205.5	1.8	20.1	4.1	OK
	B6	3/4 A325 - 1	LE1	0.6	16.3	147.5	93.9	0.4	20.6	4.3	OK
	B7	3/4 A325 - 1	LE1	0.9	15.7	147.5	205.5	0.7	19.9	3.9	OK
	B8	3/4 A325 - 1	LE1	2.6	15.8	147.5	205.5	1.8	20.1	4.1	OK
	B9	3/4 A325 - 1	LE1	0.6	16.3	147.5	93.9	0.4	20.6	4.3	OK
	B10	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.3	OK
	B11	3/4 A325 - 1	LE1	10.6	31.7	215.1	169.7	7.5	40.1	16.6	OK
	B12	3/4 A325 - 1	LE1	4.1	30.3	215.1	156.0	2.9	38.3	14.8	OK
	B13	3/4 A325 - 1	LE1	20.1	46.1	215.1	130.2	14.2	70.8	36.1	OK
	B14	3/4 A325 - 1	LE1	3.9	50.0	215.1	108.7	2.8	63.3	40.1	OK
	B15	3/4 A325 - 1	LE1	14.2	23.6	163.4	214.4	10.1	29.9	10.0	OK
	B16	3/4 A325 - 1	LE1	37.0	24.2	163.4	214.4	26.3	30.6	16.3	OK
	B17	3/4 A325 - 1	LE1	2.4	23.0	163.4	214.4	1.7	29.1	8.5	OK
	B18	3/4 A325 - 1	LE1	57.1	24.3	163.4	214.4	40.5	30.7	25.8	OK
	B19	3/4 A325 - 1	LE1	5.7	22.2	163.4	93.8	4.0	28.1	8.0	OK
	B20	3/4 A325 - 1	LE1	14.4	23.6	163.4	214.4	10.2	29.9	10.0	OK
	B21	3/4 A325 - 1	LE1	37.1	24.2	163.4	214.4	26.3	30.7	16.3	OK
	B22	3/4 A325 - 1	LE1	2.4	22.9	163.4	214.4	1.7	29.0	8.4	OK
	B23	3/4 A325 - 1	LE1	57.0	24.3	163.4	214.4	40.4	30.7	25.8	OK
	B24	3/4 A325 - 1	LE1	5.7	22.2	163.4	93.8	4.0	28.0	8.0	OK
	B25	3/4 A325 - 1	LE1	6.6	23.9	215.1	299.7	4.7	30.2	9.3	OK
	B26	3/4 A325 - 1	LE1	4.1	30.3	215.1	156.0	2.9	38.3	14.8	OK
	B27	3/4 A325 - 1	LE1	10.6	31.7	215.1	169.8	7.5	40.1	16.6	OK
	B28	3/4 A325 - 1	LE1	20.1	46.1	215.1	130.2	14.2	70.8	36.1	OK
	B29	3/4 A325 - 1	LE1	3.9	50.0	215.1	108.7	2.8	63.3	40.1	OK
	B30	3/4 A325 - 1	LE1	14.4	23.6	163.4	214.4	10.2	29.9	10.0	OK
	B31	3/4 A325 - 1	LE1	2.4	22.9	163.4	214.4	1.7	29.0	8.4	OK
	B32	3/4 A325 - 1	LE1	37.1	24.2	163.4	214.4	26.3	30.7	16.3	OK
	B33	3/4 A325 - 1	LE1	57.0	24.3	163.4	214.4	40.4	30.7	25.8	OK
	B34	3/4 A325 - 1	LE1	5.7	22.2	163.4	93.8	4.0	28.0	8.0	OK
	B35	3/4 A325 - 1	LE1	14.2	23.6	163.4	214.4	10.1	29.9	10.0	OK

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B36	3/4 A325 - 1	LE1	2.4	23.0	163.4	214.4	1.7	29.1	8.5	OK
	B37	3/4 A325 - 1	LE1	37.0	24.2	163.4	214.4	26.3	30.6	16.3	OK
	B38	3/4 A325 - 1	LE1	57.1	24.3	163.4	214.4	40.5	30.7	25.8	OK
	B39	3/4 A325 - 1	LE1	5.7	22.2	163.4	93.8	4.0	28.1	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

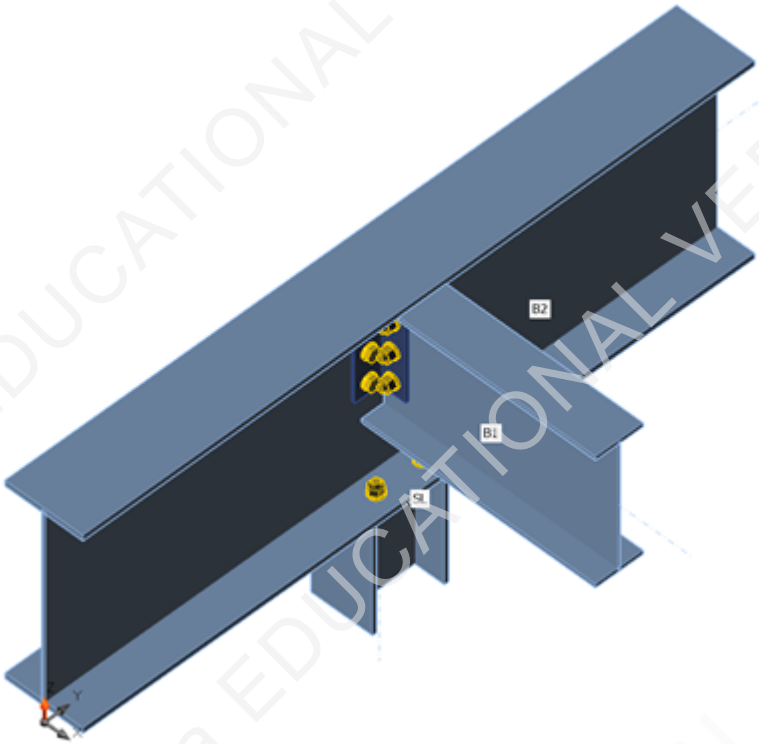
Project item J-4 (R2)

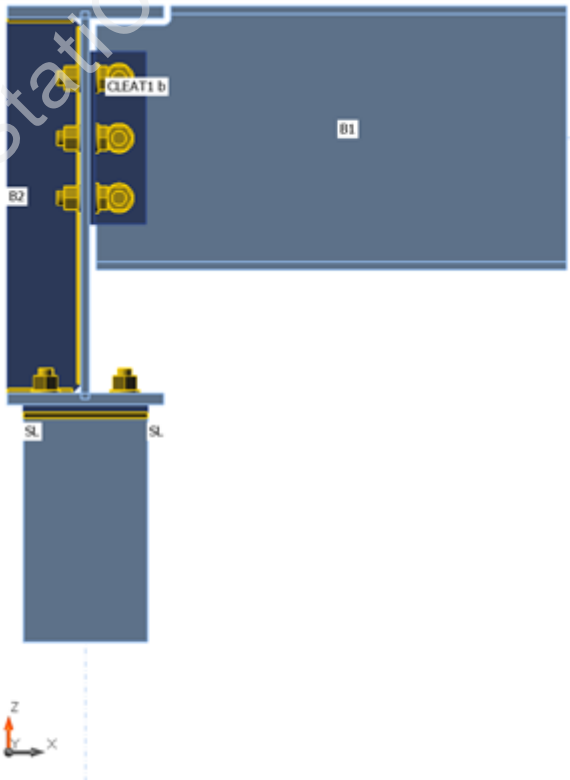
Design

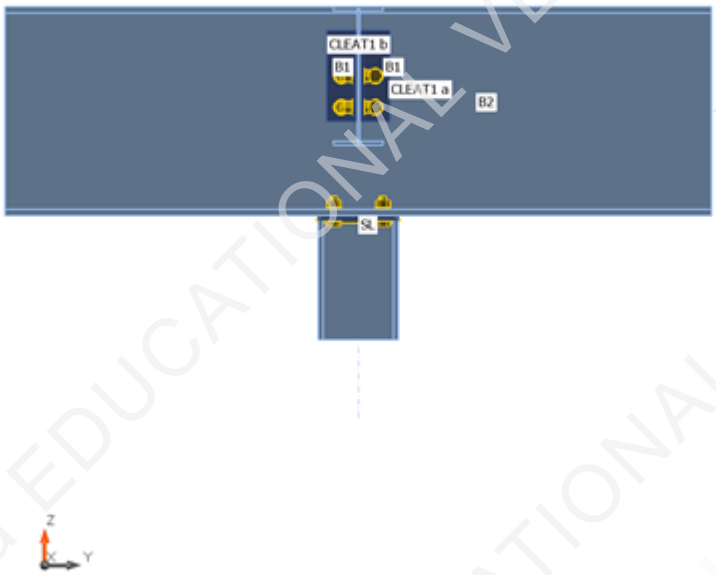
Name	J-4 (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	33.1 < 100%	OK
Welds	75.6 < 100%	OK
Buckling	Not calculated	

Plates

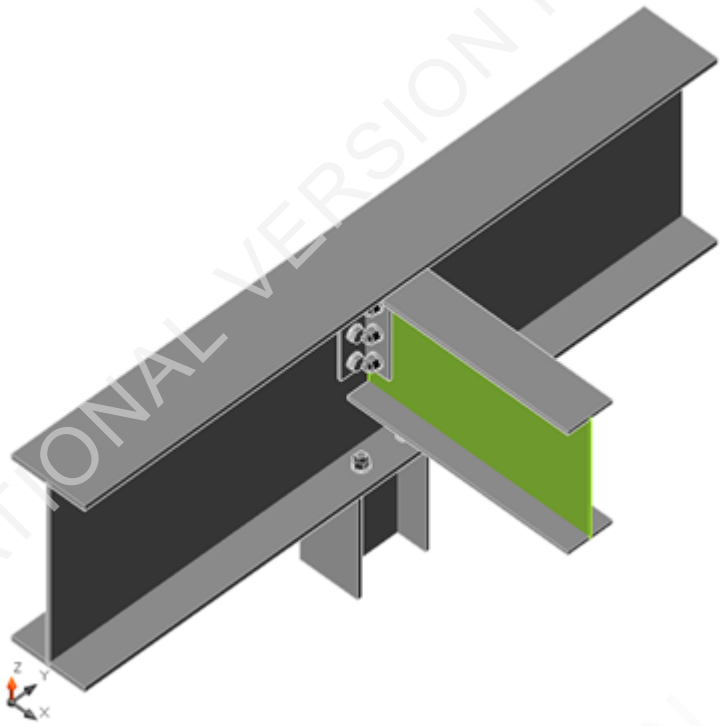
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	166.4	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	167.2	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	182.3	0.0	OK
B1-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	301.2	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	121.9	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	121.3	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	231.1	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	103.4	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	143.2	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	103.1	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	143.2	0.0	OK
EP1	A992	344.7	10.0	LE1	269.6	0.0	OK
STIFF1	A992	344.7	15.6	LE1	67.2	0.0	OK

Design data

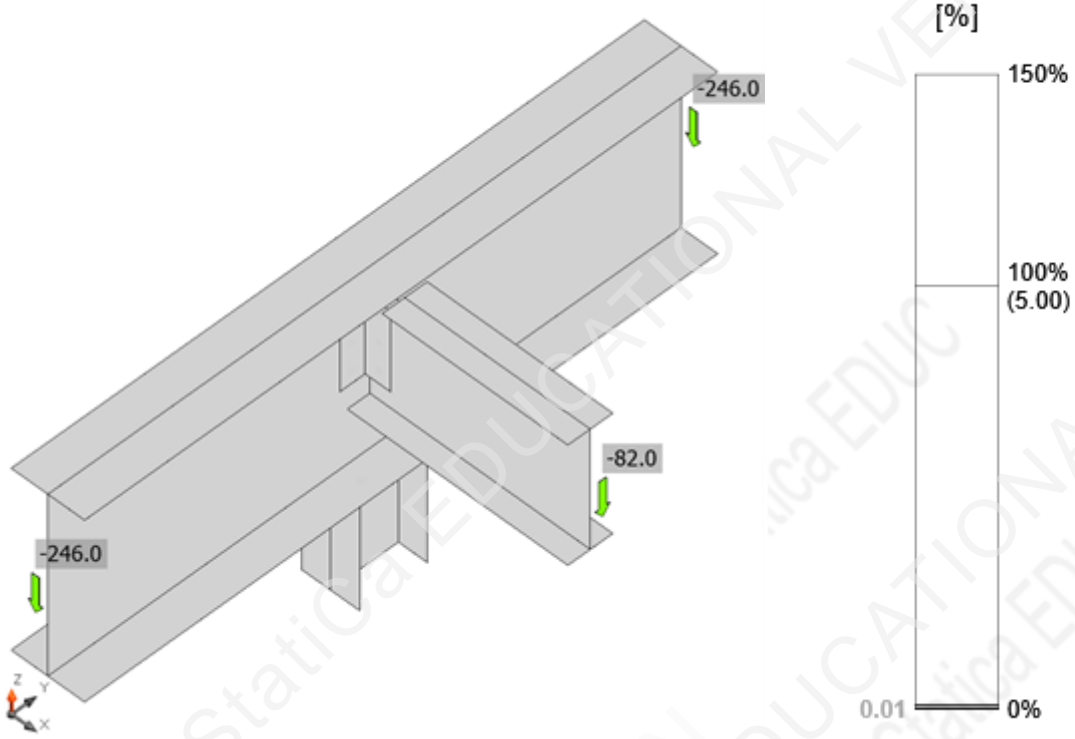
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

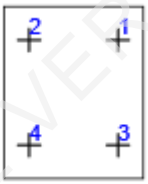
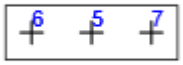
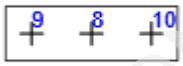
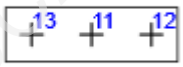


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.3	1.4	204.9	118.7	2.3	1.7	0.1	OK
	B2	3/4 A325 - 1	LE1	4.1	1.3	204.9	109.1	2.9	1.6	0.1	OK
	B3	3/4 A325 - 1	LE1	3.3	1.4	204.9	118.7	2.3	1.7	0.1	OK
	B4	3/4 A325 - 1	LE1	4.2	1.3	204.9	109.1	3.0	1.6	0.1	OK
	B5	3/4 A325 - 1	LE1	3.5	13.6	133.2	185.5	2.5	20.5	3.0	OK
	B6	3/4 A325 - 1	LE1	1.9	18.0	133.2	215.8	1.3	26.9	5.2	OK
	B7	3/4 A325 - 1	LE1	8.6	17.9	133.2	108.3	6.1	33.1	5.5	OK
	B8	3/4 A325 - 1	LE1	1.8	13.6	163.4	214.4	1.3	17.2	3.0	OK
	B9	3/4 A325 - 1	LE1	1.2	12.6	163.4	93.8	0.8	15.9	2.5	OK
	B10	3/4 A325 - 1	LE1	3.5	15.1	163.4	214.4	2.5	19.1	3.7	OK
	B11	3/4 A325 - 1	LE1	1.7	13.6	163.4	214.4	1.2	17.2	3.0	OK
	B12	3/4 A325 - 1	LE1	1.2	12.6	163.4	93.8	0.8	15.9	2.5	OK
	B13	3/4 A325 - 1	LE1	3.6	15.1	163.4	214.4	2.6	19.1	3.7	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	17.9	23.6	75.6	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	17.8	23.6	75.5	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	17.8	23.6	75.5	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	17.9	23.6	75.6	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	13.9	18.5	75.2	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	13.8	18.3	75.2	OK
B2-bfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	87	43	8.1	60.3	13.5	OK
		E49xx	◢4.2◣	◢6.0◣	87	43	8.2	60.3	13.6	OK
B2-w 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	476	48	18.6	50.3	36.9	OK
		E49xx	◢4.2◣	◢6.0◣	476	48	18.6	50.4	36.9	OK
B2-tfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	87	43	1.0	59.8	1.7	OK
		E49xx	◢4.2◣	◢6.0◣	87	43	1.0	59.8	1.7	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

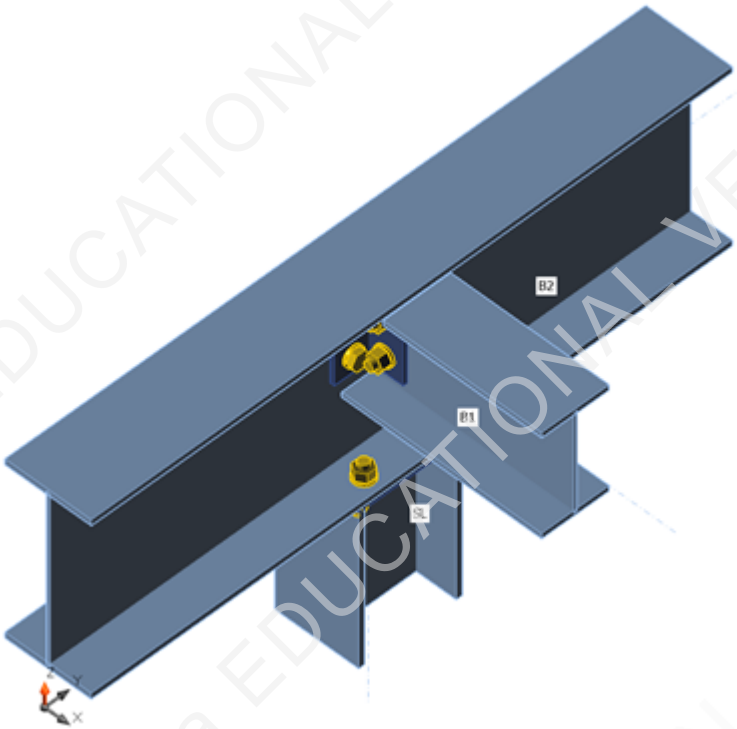
Project item B-4 (R1)

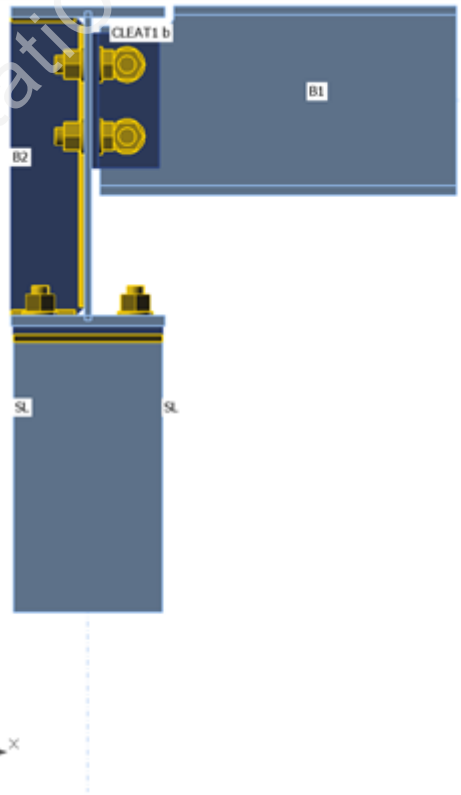
Design

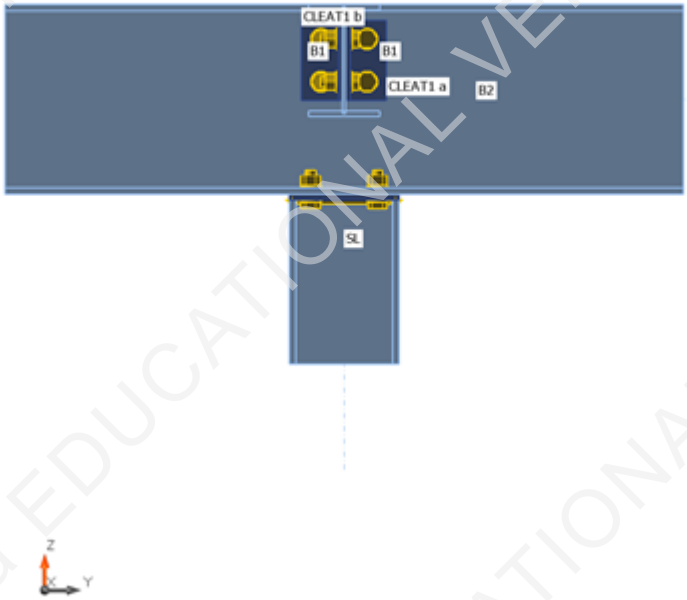
Name	B-4 (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	25.4 < 100%	OK
Welds	39.0 < 100%	OK
Buckling	Not calculated	

Plates

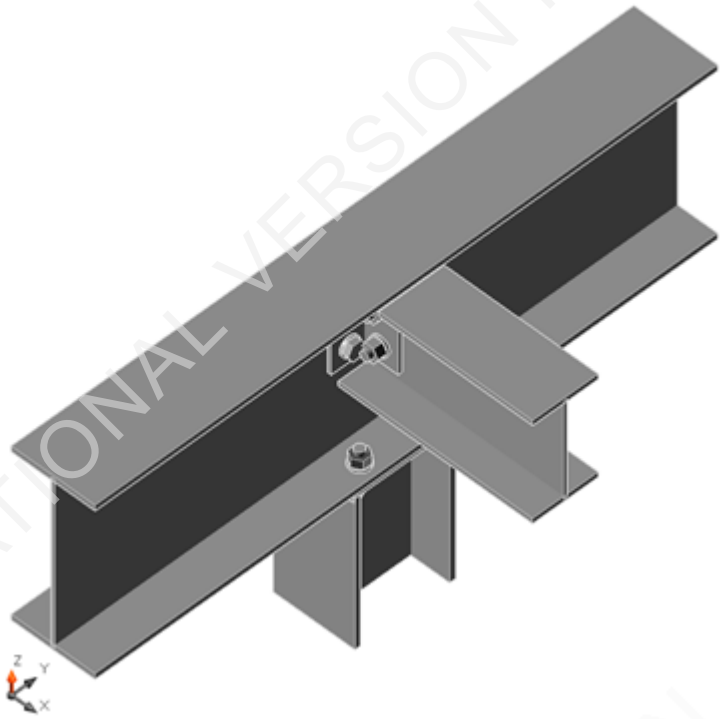
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	72.4	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	72.5	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	89.9	0.0	OK
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	229.6	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	86.6	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	86.2	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	135.8	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	81.0	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	106.3	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	80.9	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	105.8	0.0	OK
EP1	A992	344.7	10.0	LE1	68.0	0.0	OK
STIFF1	A992	344.7	11.6	LE1	46.9	0.0	OK

Design data

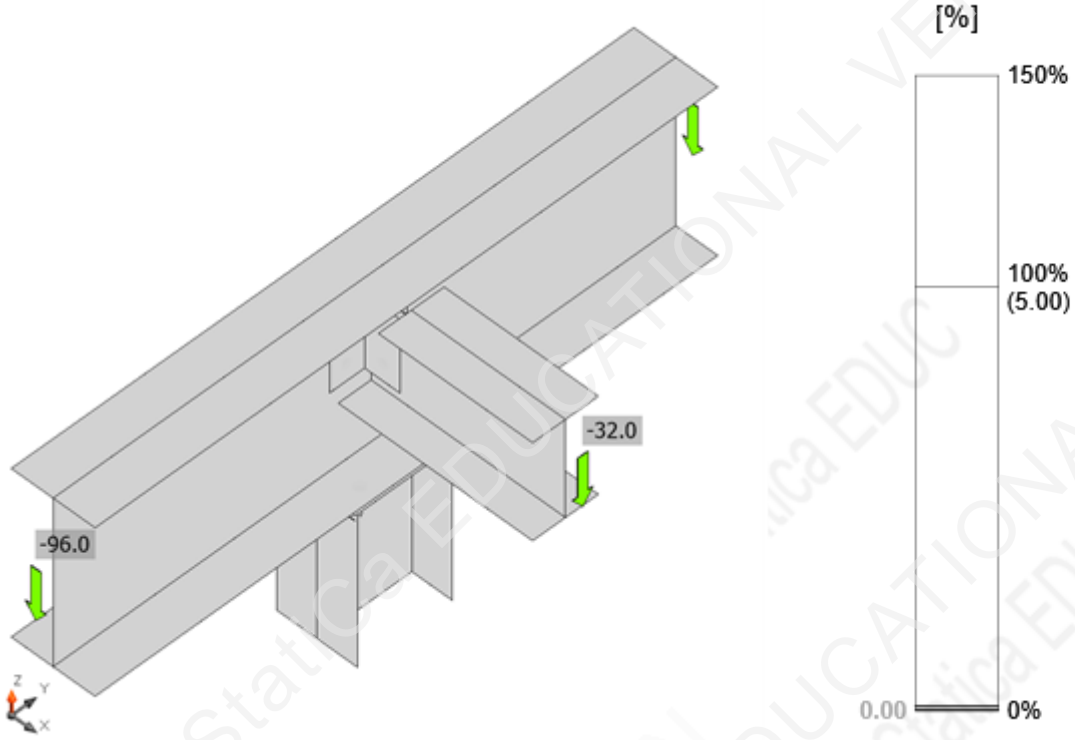
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

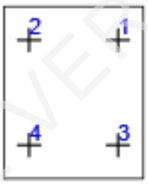
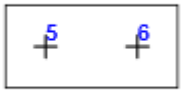
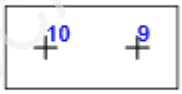


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.9	0.6	204.9	162.7	1.3	0.8	0.0	OK
	B2	3/4 A325 - 1	LE1	2.4	0.6	204.9	141.9	1.7	0.7	0.0	OK
	B3	3/4 A325 - 1	LE1	2.0	0.6	204.9	160.6	1.4	0.8	0.0	OK
	B4	3/4 A325 - 1	LE1	2.3	0.6	204.9	140.7	1.6	0.7	0.0	OK
	B5	3/4 A325 - 1	LE1	1.9	11.9	131.1	202.2	1.3	18.1	2.3	OK
	B6	3/4 A325 - 1	LE1	6.6	11.8	131.1	93.0	4.7	25.4	2.5	OK
	B7	3/4 A325 - 1	LE1	0.4	7.7	147.5	93.8	0.2	9.7	0.9	OK
	B8	3/4 A325 - 1	LE1	1.7	8.6	147.5	205.5	1.2	10.9	1.2	OK
	B9	3/4 A325 - 1	LE1	0.4	7.7	147.5	93.8	0.3	9.7	0.9	OK
	B10	3/4 A325 - 1	LE1	1.8	8.6	147.5	205.5	1.3	10.9	1.2	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	9.0	23.3	38.7	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	6.0	23.6	25.5	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	5.9	23.6	25.0	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	9.0	23.2	39.0	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	7.5	23.8	31.4	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	7.4	23.8	31.1	OK
B2-bfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	72	36	4.0	49.2	8.2	OK
		E49xx	◢4.2◣	◢6.0◣	72	36	3.8	49.5	7.7	OK
B2-w 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	311	39	7.7	40.1	19.3	OK
		E49xx	◢4.2◣	◢6.0◣	311	39	7.7	40.1	19.2	OK
B2-tfl 1	STIFF1	E49xx	◢4.2◣	◢6.0◣	72	36	0.3	49.5	0.5	OK
		E49xx	◢4.2◣	◢6.0◣	72	36	0.2	49.8	0.5	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

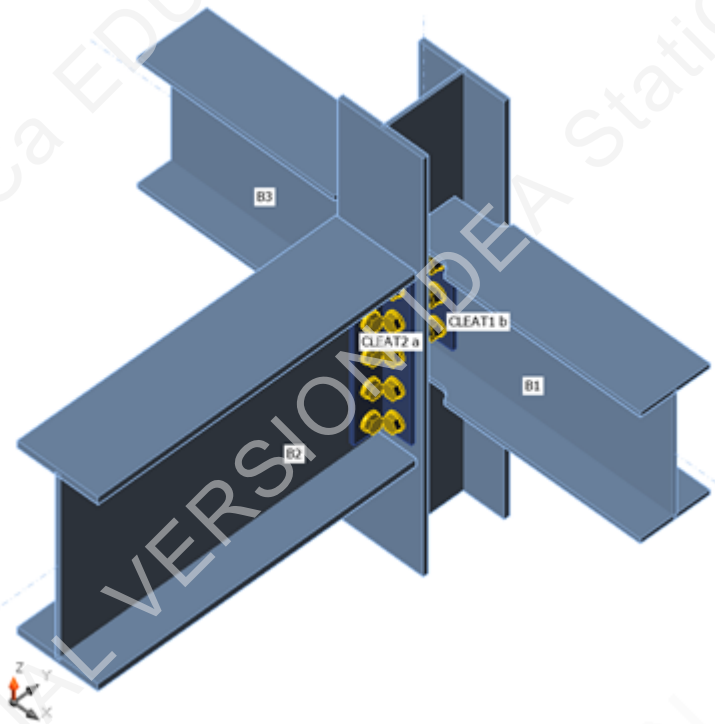
Project item K-5 (2F)

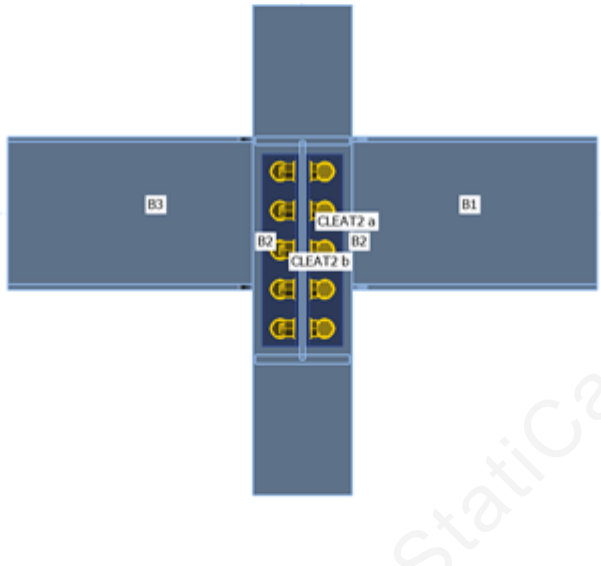
Design

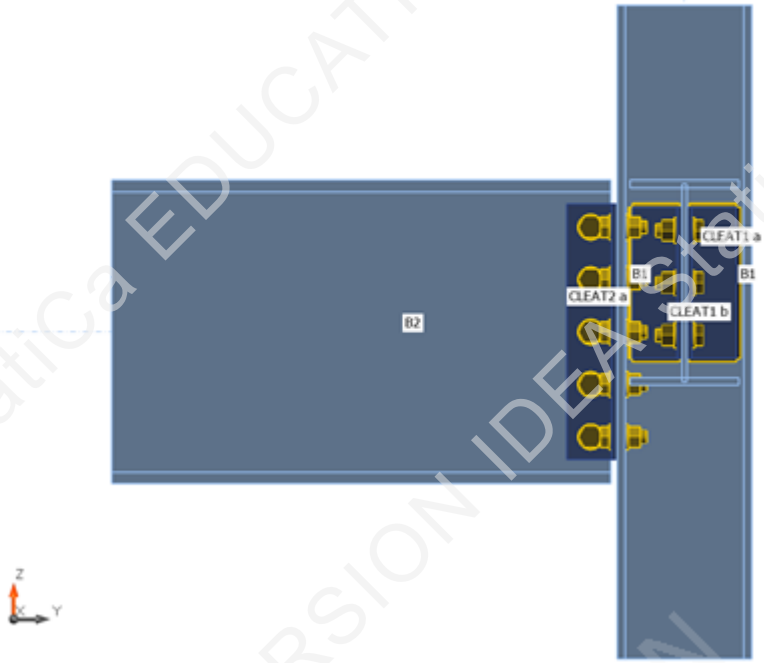
Name	K-5 (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (2F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
1 - EXT COL (2F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.7 < 5%	OK
Bolts	74.3 < 100%	OK
Welds	62.6 < 100%	OK
Buckling	Not calculated	

Plates

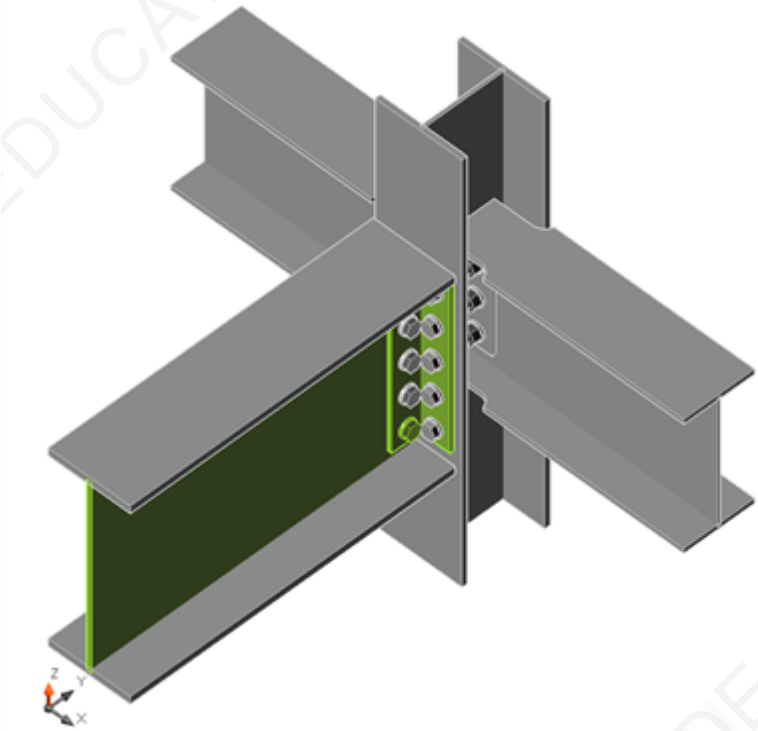
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	212.2	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	35.5	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	107.2	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	237.9	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.6	0.7	OK
B3-bfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	238.0	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.2	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	64.4	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	117.7	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	216.6	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	216.5	0.0	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	117.7	0.0	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	64.4	0.0	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	120.2	0.0	OK

Design data

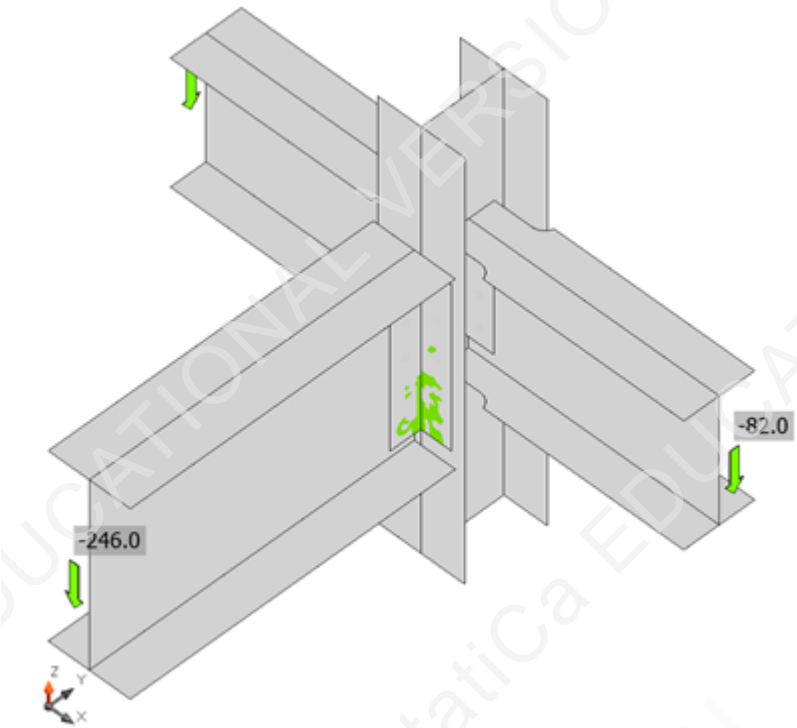
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

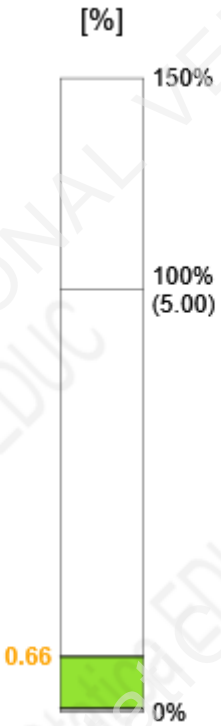
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



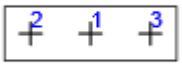
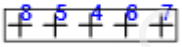
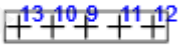
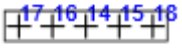
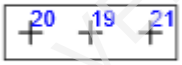
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.7	14.4	135.2	188.4	1.2	20.1	3.3	OK
	B2	3/4 A325 - 1	LE1	3.9	18.5	135.2	108.8	2.8	32.5	5.5	OK
	B3	3/4 A325 - 1	LE1	2.0	18.6	135.2	217.9	1.4	26.4	5.6	OK
	B4	3/4 A325 - 1	LE1	7.1	25.2	215.1	299.7	5.1	31.9	10.4	OK
	B5	3/4 A325 - 1	LE1	11.4	33.6	215.1	168.8	8.1	42.5	18.7	OK
	B6	3/4 A325 - 1	LE1	4.3	32.1	215.1	155.3	3.1	40.6	16.6	OK
	B7	3/4 A325 - 1	LE1	3.9	52.6	215.1	108.5	2.8	66.5	44.3	OK
	B8	3/4 A325 - 1	LE1	21.0	48.3	215.1	130.0	14.9	74.3	39.6	OK
	B9	3/4 A325 - 1	LE1	15.4	25.1	163.4	214.4	10.9	31.8	11.3	OK
	B10	3/4 A325 - 1	LE1	38.7	25.6	163.4	214.4	27.4	32.4	18.0	OK
	B11	3/4 A325 - 1	LE1	2.8	24.2	163.4	214.4	2.0	30.7	9.5	OK
	B12	3/4 A325 - 1	LE1	6.6	23.1	163.4	93.8	4.6	29.3	8.8	OK
	B13	3/4 A325 - 1	LE1	59.3	25.1	163.4	214.4	42.0	31.8	27.8	OK
	B14	3/4 A325 - 1	LE1	15.4	25.1	163.4	214.4	10.9	31.8	11.3	OK
	B15	3/4 A325 - 1	LE1	38.7	25.6	163.4	214.4	27.4	32.4	18.0	OK
	B16	3/4 A325 - 1	LE1	2.8	24.2	163.4	214.4	2.0	30.7	9.5	OK
	B17	3/4 A325 - 1	LE1	6.6	23.1	163.4	93.8	4.7	29.3	8.8	OK
	B18	3/4 A325 - 1	LE1	59.3	25.1	163.4	214.4	42.0	31.8	27.8	OK
	B19	3/4 A325 - 1	LE1	1.7	14.4	135.2	188.4	1.2	20.1	3.3	OK
	B20	3/4 A325 - 1	LE1	2.0	18.6	135.2	214.1	1.4	26.4	5.6	OK
	B21	3/4 A325 - 1	LE1	3.9	18.5	135.2	113.3	2.8	31.2	5.5	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	5.4	12.8	42.6	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.5	12.0	20.8	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.5	21.7	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	7.6	14.2	53.9	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	9.0	14.3	62.6	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	3.0	13.6	21.9	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	7.6	14.2	53.9	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	9.0	14.3	62.6	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	3.0	13.6	21.9	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.4	12.8	42.6	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.5	12.0	20.8	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.5	21.7	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	

Item	Value	Unit	Reference
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

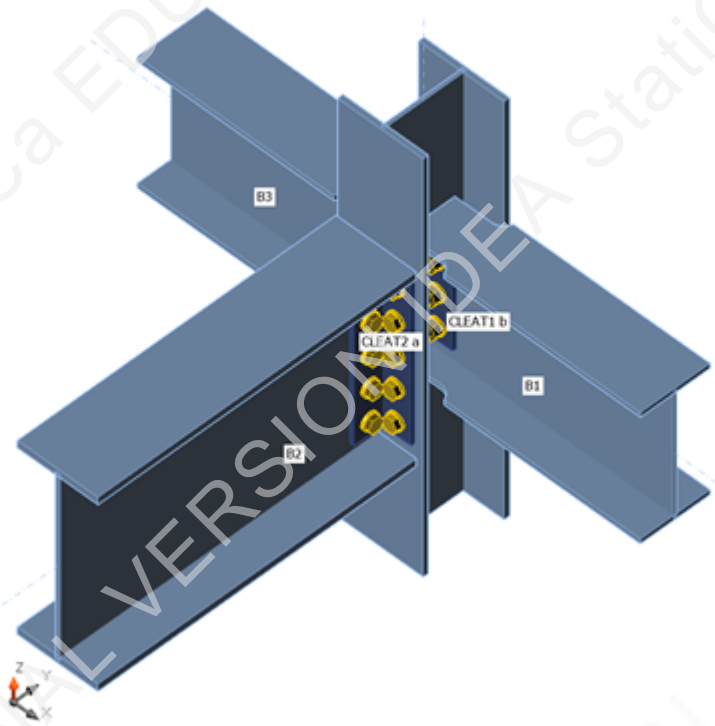
Project item K-5 (3F)

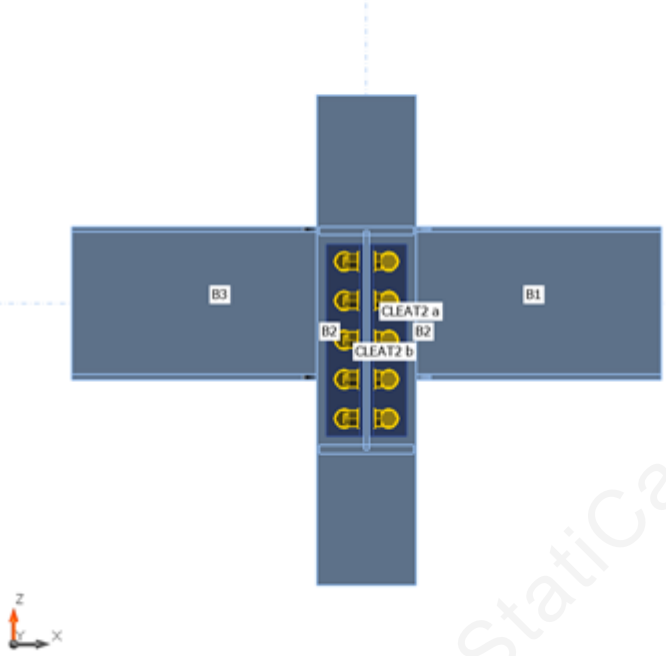
Design

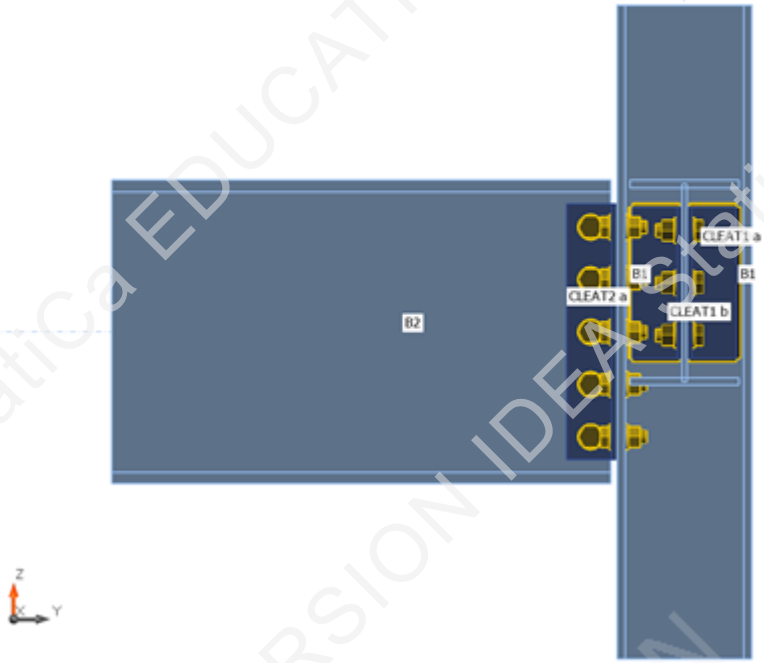
Name	K-5 (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (3F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
1 - EXT COL (3F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.7 < 5%	OK
Bolts	74.3 < 100%	OK
Welds	62.6 < 100%	OK
Buckling	Not calculated	

Plates

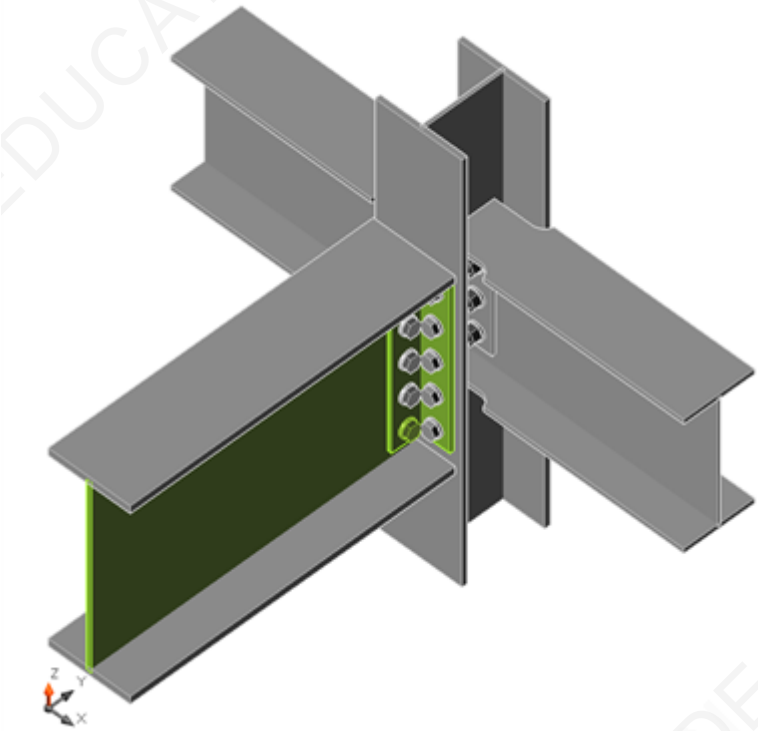
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	212.2	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	35.5	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	107.2	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	237.9	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.6	0.7	OK
B3-bfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	88.1	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	238.0	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.2	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	64.4	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	117.7	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	216.6	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	216.5	0.0	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	117.7	0.0	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	64.4	0.0	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	120.2	0.0	OK

Design data

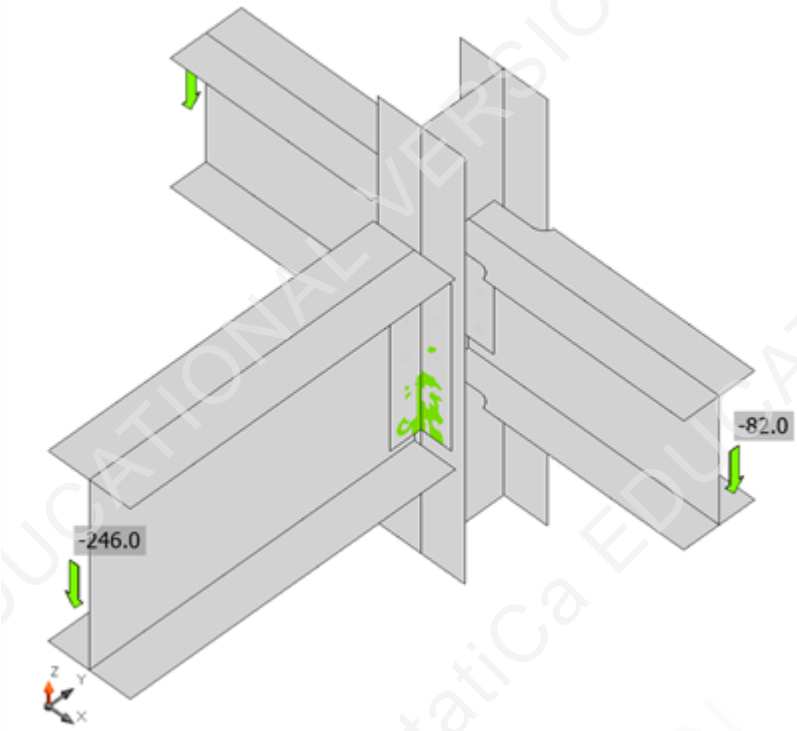
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

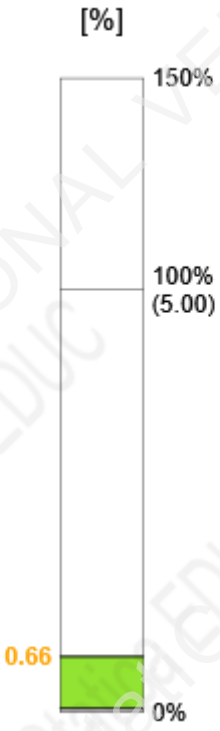
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



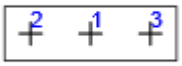
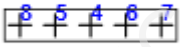
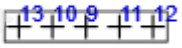
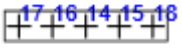
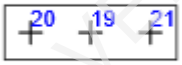
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.7	14.4	135.2	188.4	1.2	20.1	3.3	OK
	B2	3/4 A325 - 1	LE1	3.9	18.5	135.2	108.8	2.8	32.5	5.5	OK
	B3	3/4 A325 - 1	LE1	2.0	18.6	135.2	217.9	1.4	26.4	5.6	OK
	B4	3/4 A325 - 1	LE1	7.1	25.2	215.1	299.7	5.1	31.9	10.4	OK
	B5	3/4 A325 - 1	LE1	11.4	33.6	215.1	168.8	8.1	42.5	18.7	OK
	B6	3/4 A325 - 1	LE1	4.3	32.1	215.1	155.3	3.1	40.6	16.6	OK
	B7	3/4 A325 - 1	LE1	3.9	52.6	215.1	108.5	2.8	66.5	44.3	OK
	B8	3/4 A325 - 1	LE1	21.0	48.3	215.1	130.0	14.9	74.3	39.6	OK
	B9	3/4 A325 - 1	LE1	15.4	25.1	163.4	214.4	10.9	31.8	11.3	OK
	B10	3/4 A325 - 1	LE1	38.7	25.6	163.4	214.4	27.4	32.4	18.0	OK
	B11	3/4 A325 - 1	LE1	2.8	24.2	163.4	214.4	2.0	30.7	9.5	OK
	B12	3/4 A325 - 1	LE1	6.6	23.1	163.4	93.8	4.6	29.3	8.8	OK
	B13	3/4 A325 - 1	LE1	59.3	25.1	163.4	214.4	42.0	31.8	27.8	OK
	B14	3/4 A325 - 1	LE1	15.4	25.1	163.4	214.4	10.9	31.8	11.3	OK
	B15	3/4 A325 - 1	LE1	38.7	25.6	163.4	214.4	27.4	32.4	18.0	OK
	B16	3/4 A325 - 1	LE1	2.8	24.2	163.4	214.4	2.0	30.7	9.5	OK
	B17	3/4 A325 - 1	LE1	6.6	23.1	163.4	93.8	4.7	29.3	8.8	OK
	B18	3/4 A325 - 1	LE1	59.3	25.1	163.4	214.4	42.0	31.8	27.8	OK
	B19	3/4 A325 - 1	LE1	1.7	14.4	135.2	188.4	1.2	20.1	3.3	OK
	B20	3/4 A325 - 1	LE1	2.0	18.6	135.2	214.1	1.4	26.4	5.6	OK
	B21	3/4 A325 - 1	LE1	3.9	18.5	135.2	113.3	2.8	31.2	5.5	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	5.4	12.8	42.6	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.5	12.0	20.8	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.5	21.7	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	7.6	14.2	53.9	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	9.0	14.3	62.6	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	3.0	13.6	21.9	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	7.6	14.2	53.9	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	9.0	14.3	62.6	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	3.0	13.6	21.9	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.4	12.8	42.6	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.5	12.0	20.8	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.5	21.7	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	

Item	Value	Unit	Reference
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

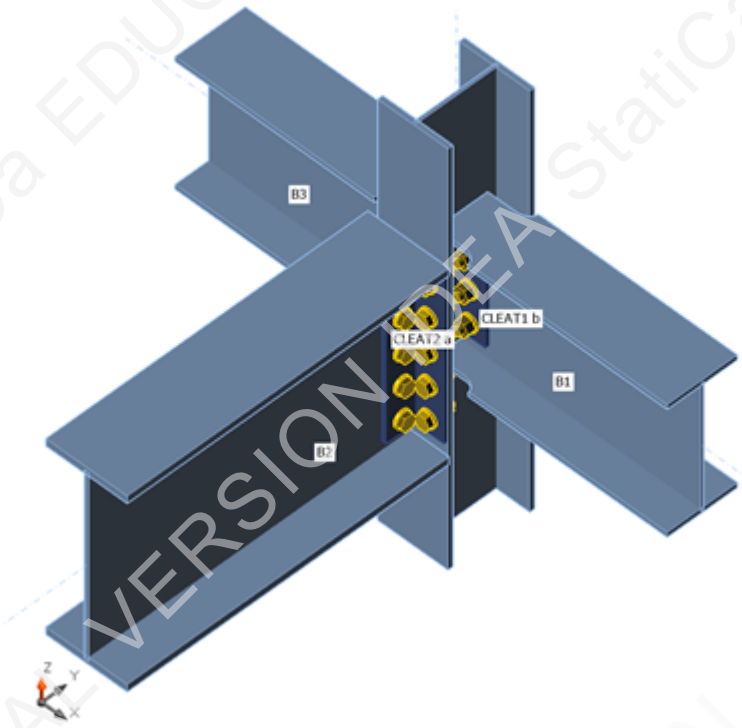
Project item K-5 (4F)

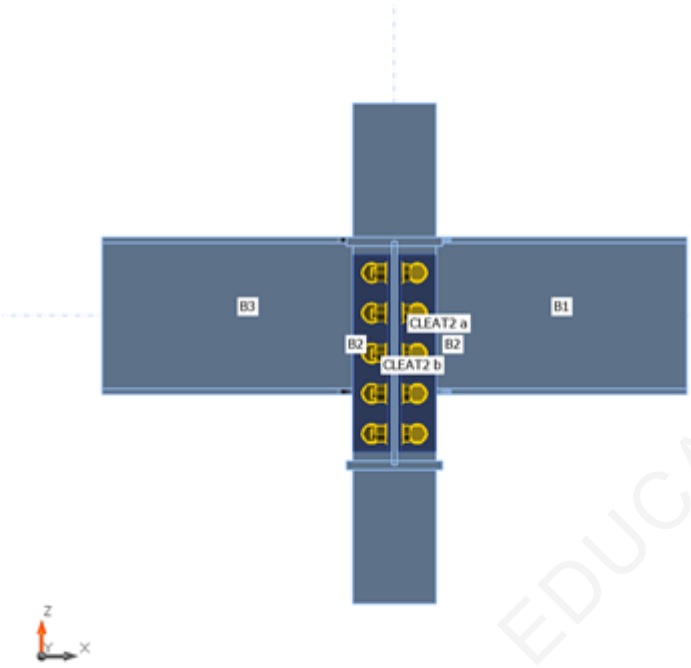
Design

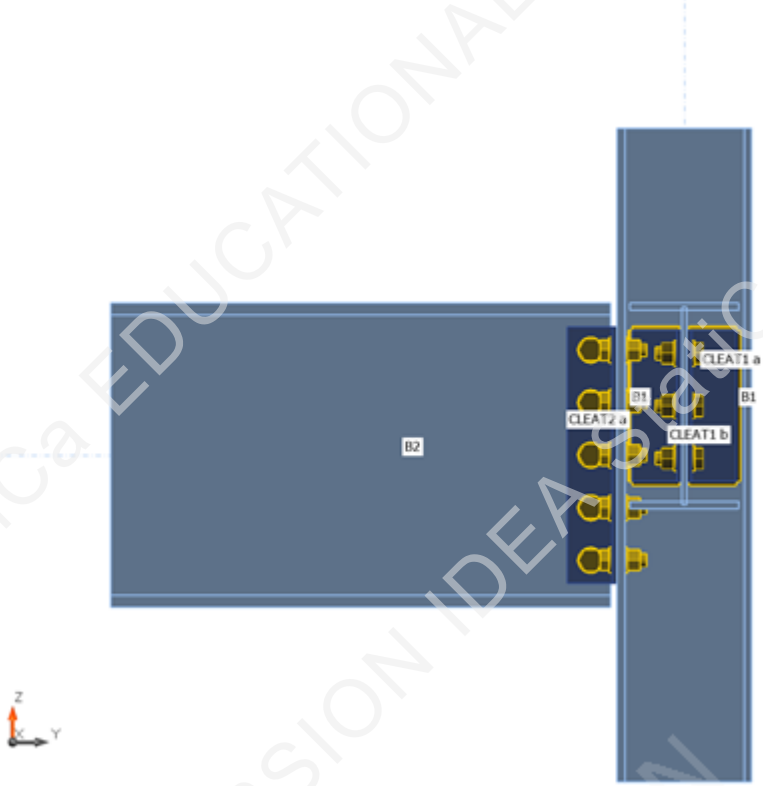
Name	K-5 (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - EXT COL (4F)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node







Cross-sections

Name	Material
1 - EXT COL (4F) (W200X41.7)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.6 < 5%	OK
Bolts	74.1 < 100%	OK
Welds	66.6 < 100%	OK
Buckling	Not calculated	

Plates

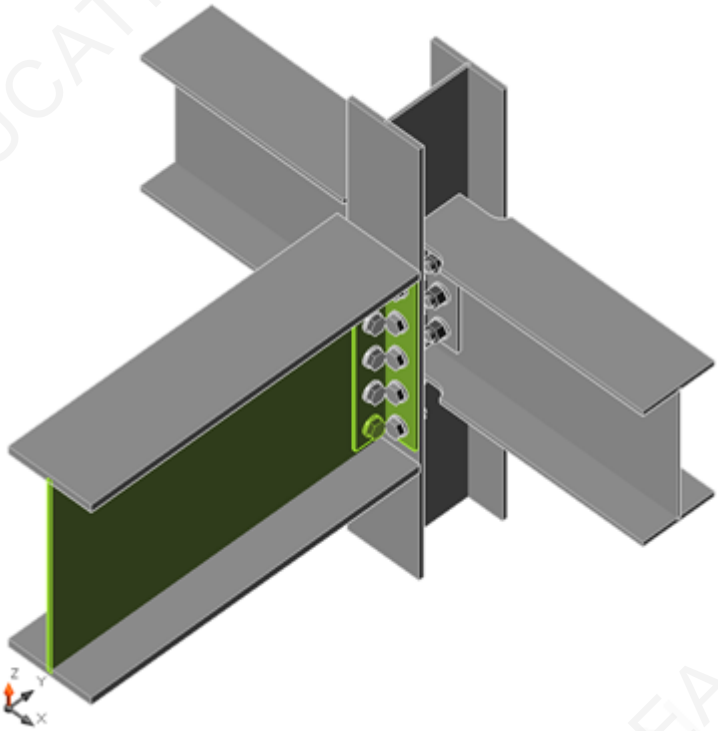
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	227.9	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	39.7	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	118.0	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	86.2	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	86.2	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	236.2	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	137.9	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.6	0.6	OK
B3-bfl 1	A992	344.7	11.2	LE1	86.2	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	86.2	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	236.1	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	120.7	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	67.6	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	122.4	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	224.4	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	270.7	0.4	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	270.7	0.4	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	224.4	0.0	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	122.4	0.0	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	67.6	0.0	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	120.7	0.0	OK

Design data

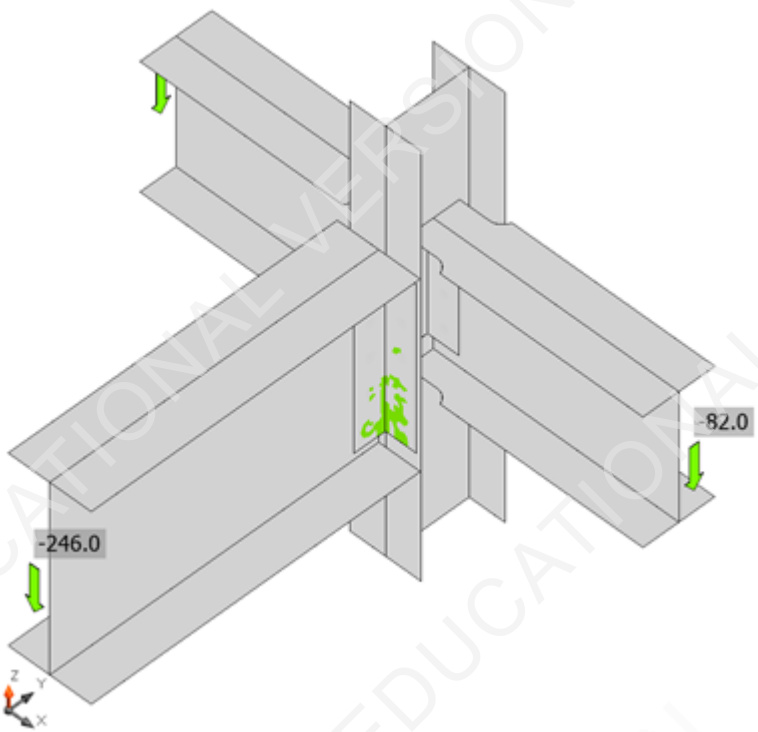
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

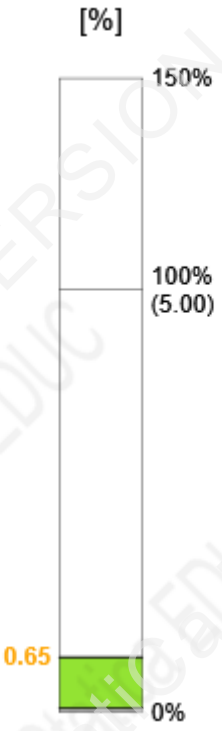
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



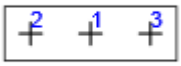
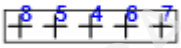
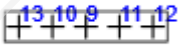
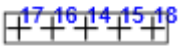
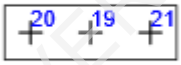
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.7	14.5	135.2	188.4	1.2	20.1	3.4	OK
	B2	3/4 A325 - 1	LE1	3.9	18.5	135.2	109.2	2.8	32.3	5.5	OK
	B3	3/4 A325 - 1	LE1	2.1	18.6	135.2	217.5	1.5	26.3	5.6	OK
	B4	3/4 A325 - 1	LE1	7.1	25.2	215.1	299.7	5.0	31.9	10.4	OK
	B5	3/4 A325 - 1	LE1	11.2	33.5	215.1	169.2	8.0	42.4	18.6	OK
	B6	3/4 A325 - 1	LE1	4.4	32.0	215.1	155.8	3.1	40.5	16.5	OK
	B7	3/4 A325 - 1	LE1	4.1	52.4	215.1	108.5	2.9	66.4	44.1	OK
	B8	3/4 A325 - 1	LE1	21.0	48.2	215.1	130.1	14.9	74.1	39.4	OK
	B9	3/4 A325 - 1	LE1	16.0	25.1	163.4	214.4	11.3	31.7	11.4	OK
	B10	3/4 A325 - 1	LE1	38.9	25.6	163.4	214.4	27.6	32.4	18.1	OK
	B11	3/4 A325 - 1	LE1	2.4	24.2	163.4	214.4	1.7	30.7	9.4	OK
	B12	3/4 A325 - 1	LE1	6.0	23.2	163.4	93.8	4.2	29.3	8.8	OK
	B13	3/4 A325 - 1	LE1	60.1	25.1	163.4	214.4	42.6	31.8	28.3	OK
	B14	3/4 A325 - 1	LE1	16.0	25.1	163.4	214.4	11.3	31.7	11.4	OK
	B15	3/4 A325 - 1	LE1	38.9	25.6	163.4	214.4	27.6	32.4	18.1	OK
	B16	3/4 A325 - 1	LE1	2.4	24.2	163.4	214.4	1.7	30.7	9.4	OK
	B17	3/4 A325 - 1	LE1	5.9	23.2	163.4	93.8	4.2	29.3	8.8	OK
	B18	3/4 A325 - 1	LE1	60.1	25.1	163.4	214.4	42.6	31.8	28.3	OK
	B19	3/4 A325 - 1	LE1	1.7	14.5	135.2	188.4	1.2	20.1	3.4	OK
	B20	3/4 A325 - 1	LE1	2.1	18.6	135.2	213.2	1.5	26.3	5.6	OK
	B21	3/4 A325 - 1	LE1	3.9	18.5	135.2	114.1	2.8	30.9	5.5	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	5.9	12.8	45.8	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.7	11.8	22.6	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.6	22.1	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	8.2	14.2	58.2	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	9.5	14.3	66.6	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	3.3	13.7	24.1	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	8.2	14.2	58.2	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	9.5	14.3	66.6	OK
SL-w 1	CLEAT3 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	3.3	13.7	24.1	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.9	12.8	45.8	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.7	11.8	22.6	OK
SL-w 1	CLEAT3 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.1	9.6	22.1	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	

Item	Value	Unit	Reference
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

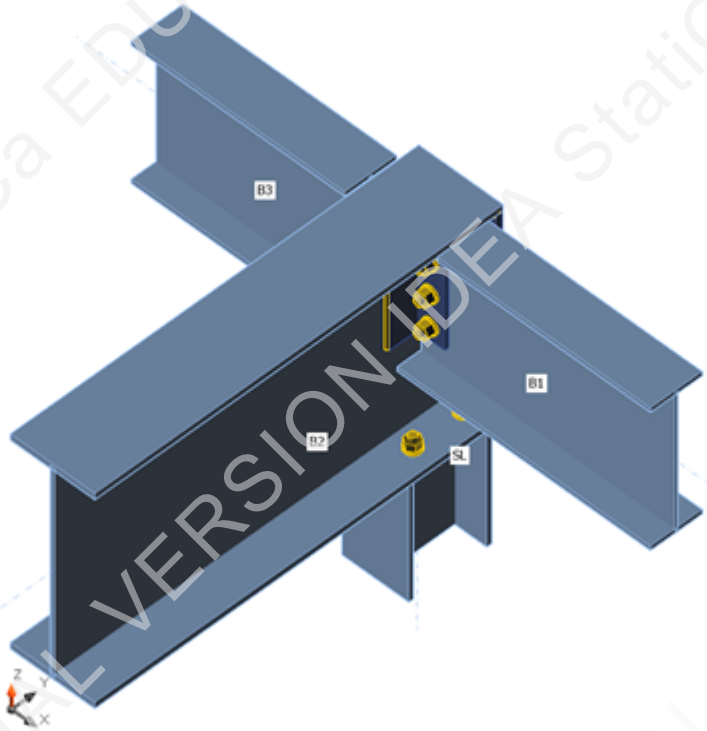
Project item K-5 (R2)

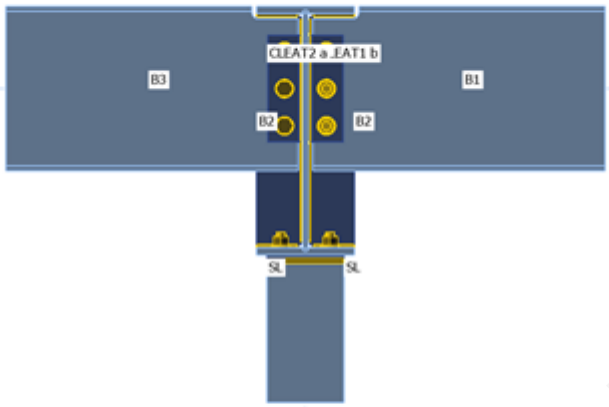
Design

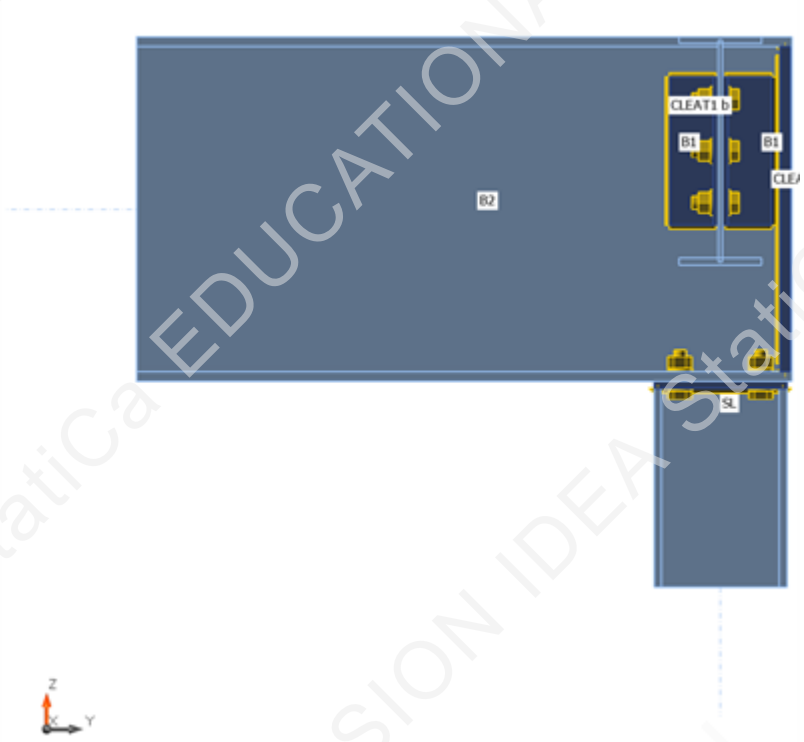
Name	K-5 (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	-110	0	0	Node
B3	2 - JOI (R2)(W360X39)	180.0	0.0	0.0	0	0	90	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	34.2 < 100%	OK
Welds	78.8 < 100%	OK
Buckling	Not calculated	

Plates

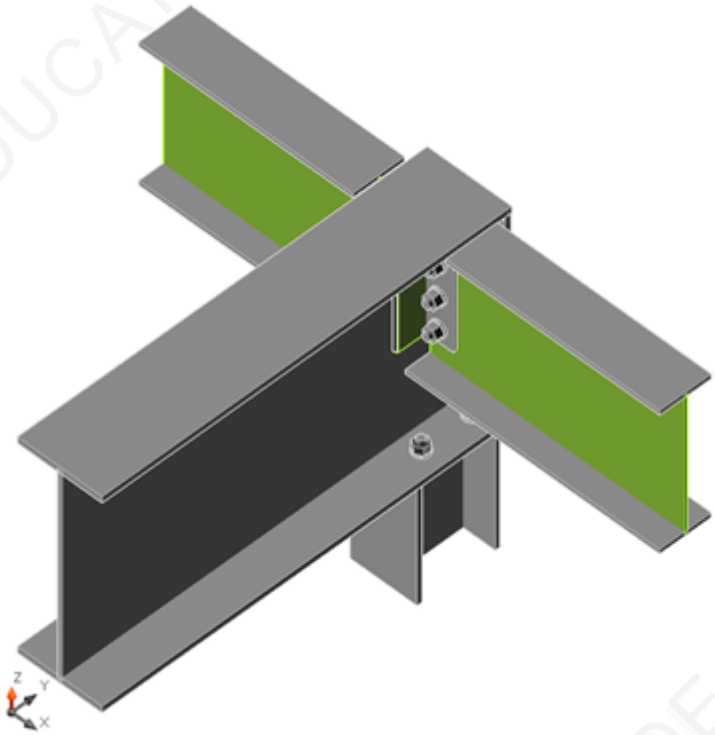
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	22.2	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	162.4	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	181.0	0.0	OK
B1-bfl 1	A992	344.7	10.7	LE1	98.7	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	302.9	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	154.3	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	133.1	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	169.0	0.0	OK
B3-bfl 1	A992	344.7	10.7	LE1	98.7	0.0	OK
B3-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B3-w 1	A992	344.7	6.5	LE1	302.9	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	78.4	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	116.2	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	270.0	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	127.5	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	127.5	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	270.0	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	116.2	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	78.4	0.0	OK
EP1	A992	344.7	10.0	LE1	100.2	0.0	OK
STIFF1	A992	344.7	15.6	LE1	112.5	0.0	OK
STIFF2	A992	344.7	15.6	LE1	112.6	0.0	OK

Design data

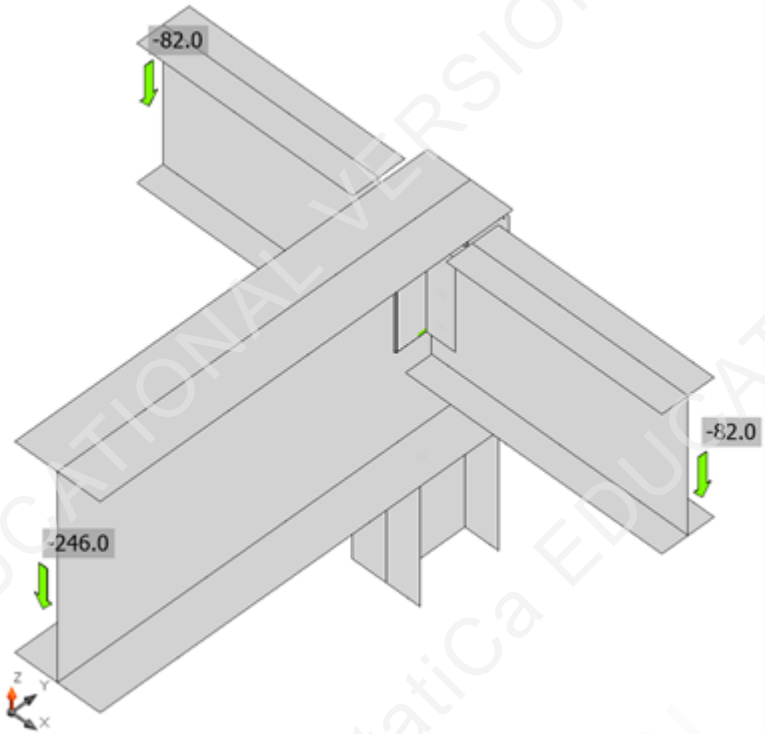
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

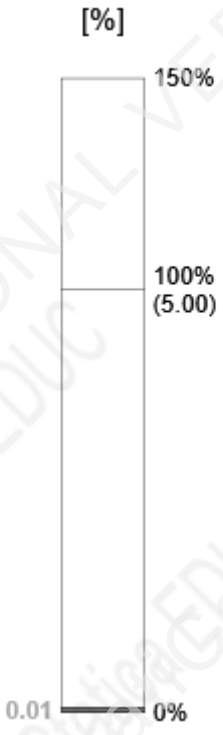
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



Overall check, LE1

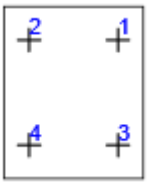
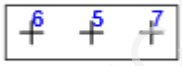
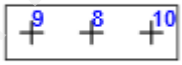




Project:
Project no:
Author:

Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	6.8	0.2	204.9	143.0	4.8	0.3	0.2	OK
	B2	3/4 A325 - 1	LE1	6.8	0.2	204.9	143.0	4.8	0.3	0.2	OK
	B3	3/4 A325 - 1	LE1	0.8	0.2	204.9	160.0	0.6	0.3	0.0	OK
	B4	3/4 A325 - 1	LE1	0.8	0.2	204.9	159.8	0.6	0.3	0.0	OK
	B5	3/4 A325 - 1	LE1	1.7	14.6	133.2	185.5	1.2	20.5	3.4	OK
	B6	3/4 A325 - 1	LE1	1.8	18.8	133.2	220.0	1.3	26.7	5.7	OK
	B7	3/4 A325 - 1	LE1	4.0	19.0	133.2	105.7	2.8	34.2	5.9	OK
	B8	3/4 A325 - 1	LE1	1.7	14.6	133.2	185.5	1.2	20.5	3.4	OK
	B9	3/4 A325 - 1	LE1	4.0	19.0	133.2	110.2	2.8	32.8	5.9	OK
	B10	3/4 A325 - 1	LE1	1.8	18.8	133.2	212.8	1.3	26.7	5.7	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	2.2	22.9	9.6	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	1.1	22.7	4.9	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	10.0	23.3	43.0	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	12.8	23.6	54.2	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	14.1	23.8	59.3	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	14.4	23.8	60.6	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.5	14.0	38.8	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.4	13.1	33.8	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	3.4	10.5	32.3	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	10.8	14.4	75.3	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	8.8	14.3	61.3	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	1.0	9.8	10.6	OK
B2-bfl 1	STIFF1	E49xx	◢4.2	◢6.0	87	43	47.7	60.6	78.8	OK
B2-w 1	STIFF1	E49xx	◢4.2	◢6.0	476	48	21.2	45.2	47.0	OK
B2-tfl 1	STIFF1	E49xx	◢4.2	◢6.0	87	43	7.9	46.0	17.2	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	10.8	14.4	75.3	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	8.8	14.3	61.3	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	228	10	1.0	9.8	10.6	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	5.5	14.0	38.8	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.4	13.1	33.8	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	3.4	10.5	32.3	OK
B2-bfl 1	STIFF2	E49xx	◢4.2	◢6.0	87	43	47.7	60.6	78.8	OK
B2-w 1	STIFF2	E49xx	◢4.2	◢6.0	476	48	21.2	45.2	47.0	OK
B2-tfl 1	STIFF2	E49xx	◢4.2	◢6.0	87	43	7.9	46.0	17.2	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	

Item	Value	Unit	Reference
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

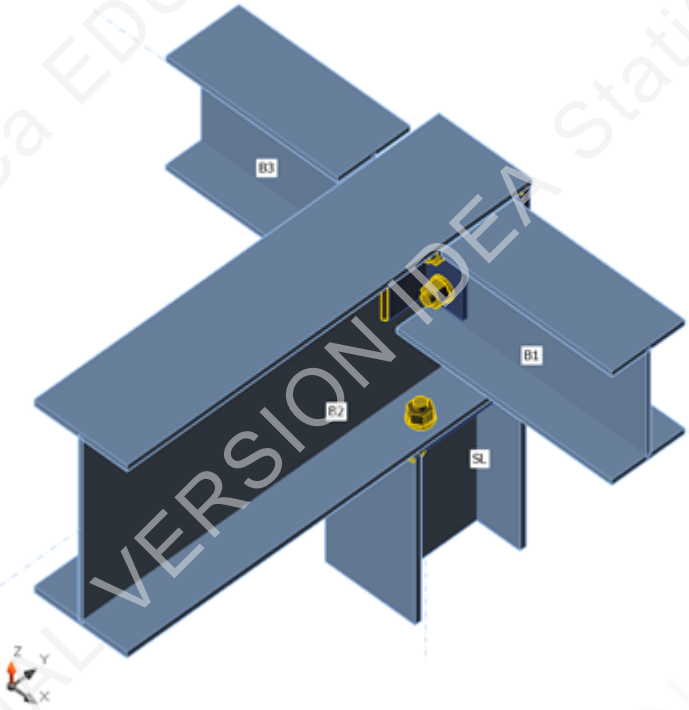
Project item A-5 (R1)

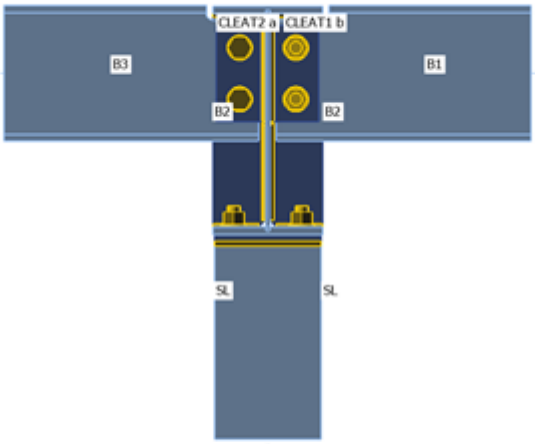
Design

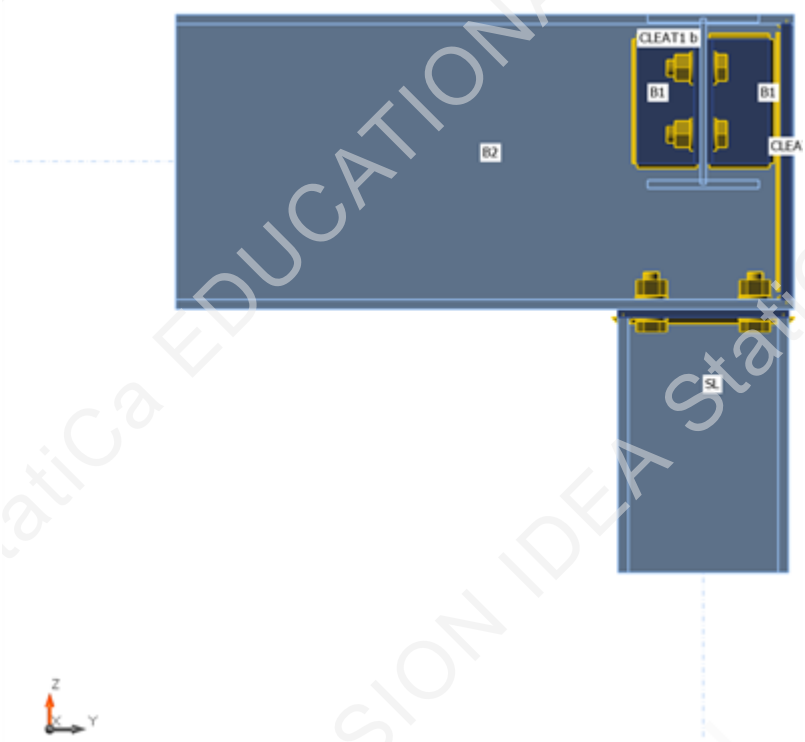
Name	A-5 (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	-110	0	0	Node
B3	9 - JOI (R1)(W200X31.3)	180.0	0.0	0.0	0	0	73	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0
	B3	0.0	0.0	-32.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	26.0 < 100%	OK
Welds	47.0 < 100%	OK
Buckling	Not calculated	

Plates

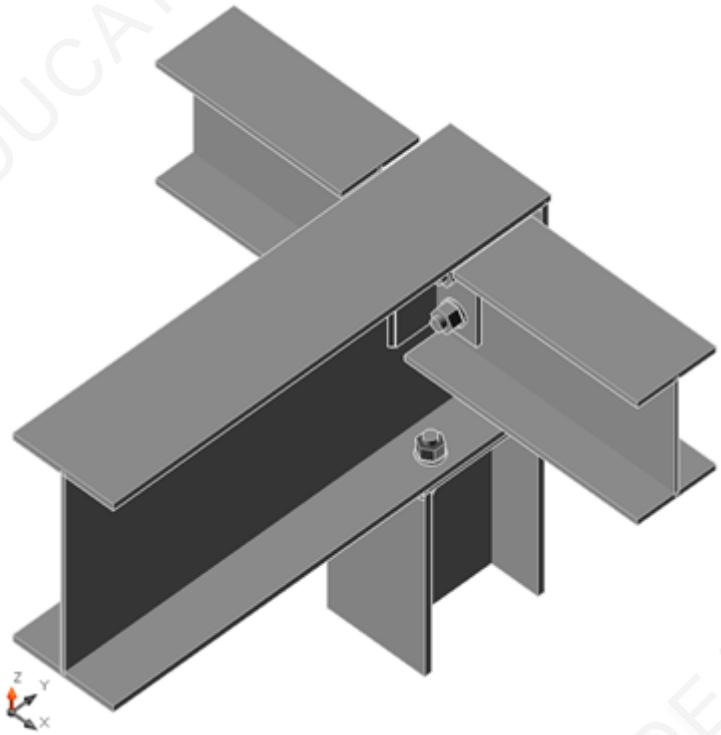
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	9.7	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	59.3	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	65.2	0.0	OK
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	231.5	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	98.3	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	98.3	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	99.3	0.0	OK
B3-bfl 1	A992	344.7	10.2	LE1	55.4	0.0	OK
B3-tfl 1	A992	344.7	10.2	LE1	55.7	0.0	OK
B3-w 1	A992	344.7	6.4	LE1	231.5	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	54.8	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	76.1	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	160.2	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	86.3	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	86.3	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	160.2	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	76.1	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	54.8	0.0	OK
EP1	A992	344.7	10.0	LE1	32.9	0.0	OK
STIFF1	A992	344.7	11.6	LE1	84.7	0.0	OK
STIFF2	A992	344.7	11.6	LE1	84.9	0.0	OK

Design data

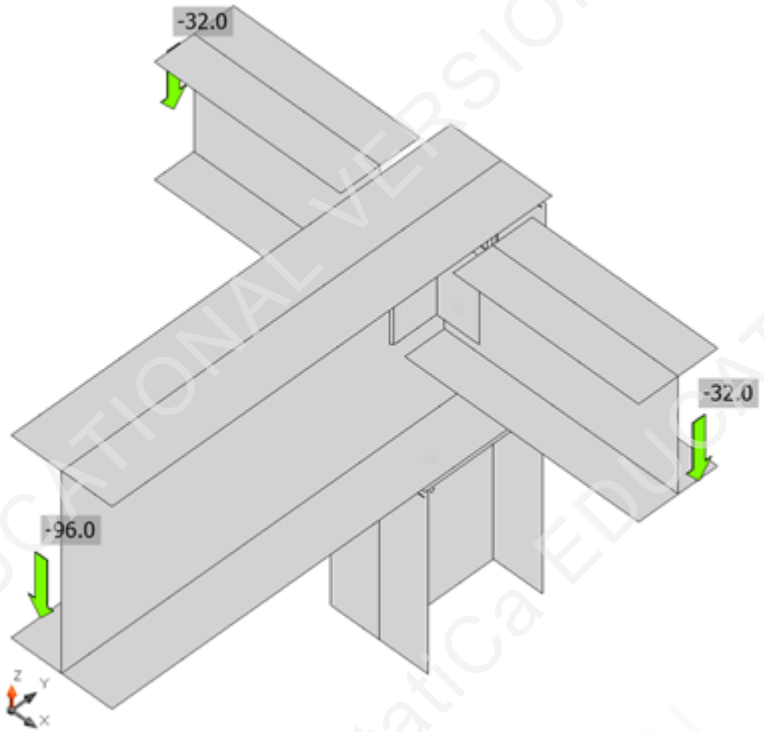
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

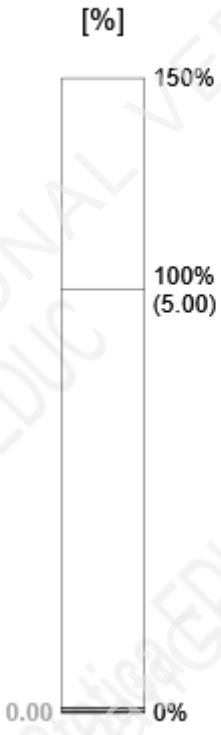
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



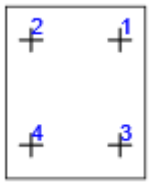
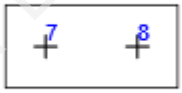
Overall check, LE1





Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	3.0	0.2	204.9	137.1	2.1	0.3	0.0	OK
	B2	3/4 A325 - 1	LE1	3.0	0.2	204.9	137.7	2.1	0.3	0.0	OK
	B3	3/4 A325 - 1	LE1	0.4	0.1	204.9	142.8	0.3	0.2	0.0	OK
	B4	3/4 A325 - 1	LE1	0.4	0.1	204.9	142.8	0.3	0.2	0.0	OK
	B5	3/4 A325 - 1	LE1	1.1	12.3	131.1	207.8	0.8	18.1	2.4	OK
	B6	3/4 A325 - 1	LE1	2.6	12.3	131.1	90.9	1.8	26.0	2.5	OK
	B7	3/4 A325 - 1	LE1	2.6	12.3	131.1	95.2	1.8	24.9	2.5	OK
	B8	3/4 A325 - 1	LE1	1.1	12.3	131.1	143.8	0.8	18.1	2.4	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	1.1	23.1	4.9	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	0.6	23.6	2.4	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	4.2	23.6	17.8	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	5.2	23.6	22.1	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	4.6	23.7	19.5	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	4.6	23.7	19.3	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	13.7	30.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	3.4	13.0	26.5	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	149	10	1.8	9.8	18.2	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	6.8	14.4	47.0	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.2	14.4	36.1	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	149	10	1.2	12.8	9.3	OK
B2-bfl 1	STIFF1	E49xx	◢4.2	◢6.0	72	36	21.3	49.2	43.2	OK
B2-w 1	STIFF1	E49xx	◢4.2	◢6.0	311	39	6.6	36.7	18.1	OK
B2-tfl 1	STIFF1	E49xx	◢4.2	◢6.0	72	36	3.9	35.8	10.9	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	6.8	14.4	47.0	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	5.2	14.4	36.1	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	149	10	1.2	12.8	9.3	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	13.7	30.6	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	3.4	13.0	26.5	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	149	10	1.8	9.8	18.2	OK
B2-bfl 1	STIFF2	E49xx	◢4.2	◢6.0	72	36	21.3	49.2	43.3	OK
B2-w 1	STIFF2	E49xx	◢4.2	◢6.0	311	39	6.6	36.7	18.1	OK
B2-tfl 1	STIFF2	E49xx	◢4.2	◢6.0	72	36	3.9	35.8	10.9	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	

Item	Value	Unit	Reference
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

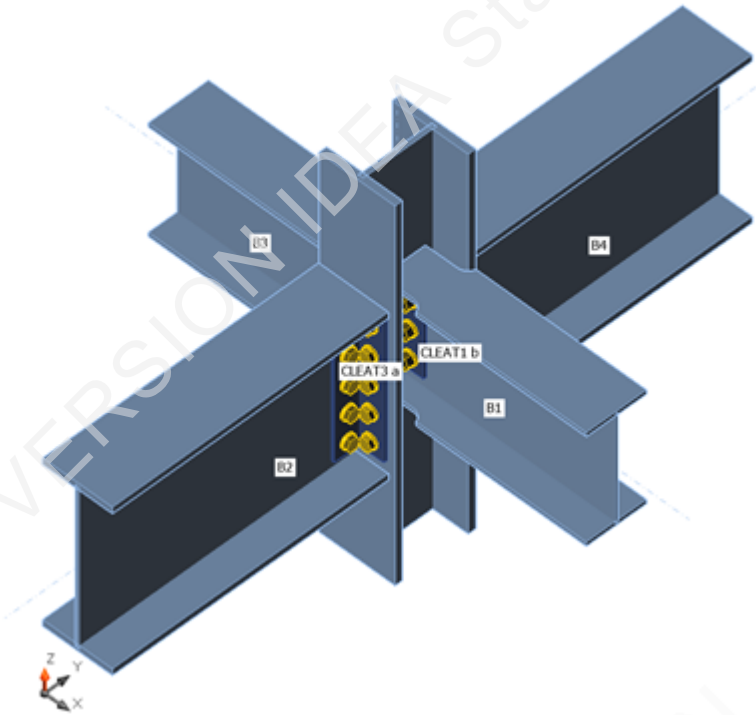
Project item J-5 (2F)

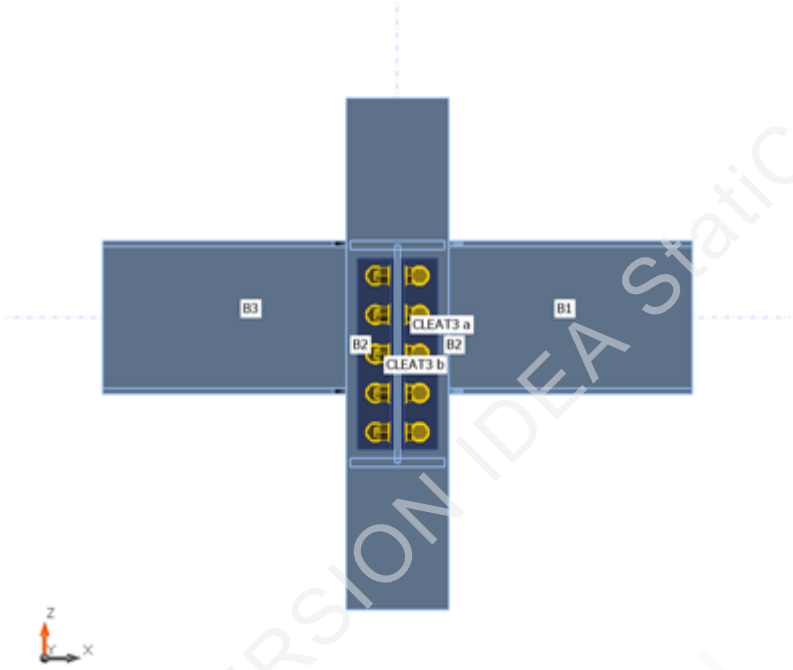
Design

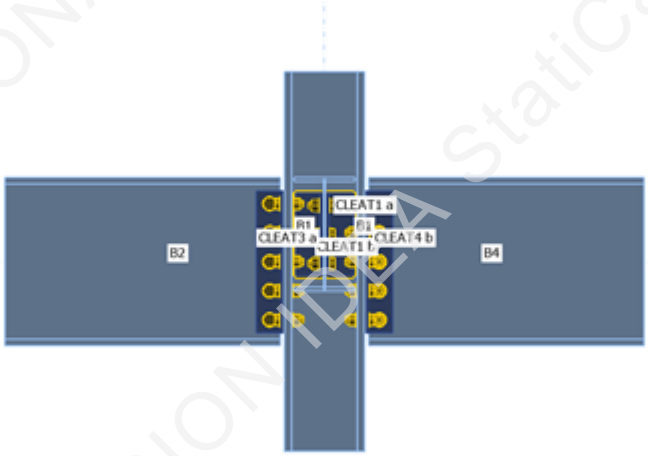
Name	J-5 (2F)
Description	Beam-Column Design (2nd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	9 - INT COL (2F)(W200X86)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node
B4	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
9 - INT COL (2F) (W200X86)	300W
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0
	B4	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.6 < 5%	OK
Bolts	74.5 < 100%	OK
Welds	35.3 < 100%	OK
Buckling	Not calculated	

Plates

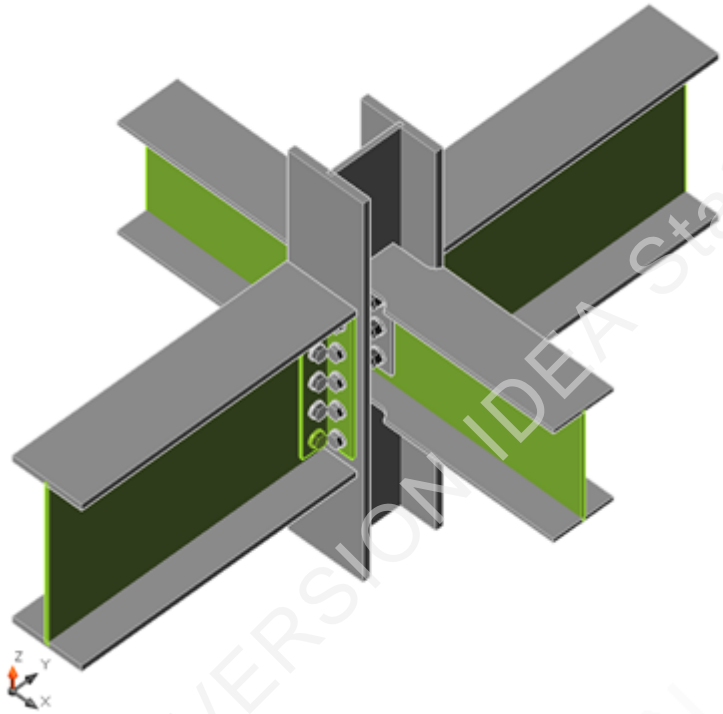
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	300W	300.0	20.6	LE1	95.0	0.0	OK
SL-tfl 1	300W	300.0	20.6	LE1	95.0	0.0	OK
SL-w 1	300W	300.0	13.0	LE1	76.1	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	102.5	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	102.5	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	277.2	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	132.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	132.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.5	0.6	OK
B3-bfl 1	A992	344.7	11.2	LE1	102.5	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	102.5	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	277.3	0.0	OK
B4-bfl 1	A992	344.7	17.7	LE1	132.2	0.0	OK
B4-tfl 1	A992	344.7	17.7	LE1	132.2	0.0	OK
B4-w 1	A992	344.7	10.5	LE1	311.5	0.6	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	137.3	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	153.4	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	137.0	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	153.4	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	153.4	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	137.0	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	153.4	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	137.2	0.0	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 a-w 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT4 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 b-w 1	300W	300.0	7.9	LE1	270.8	0.4	OK

Design data

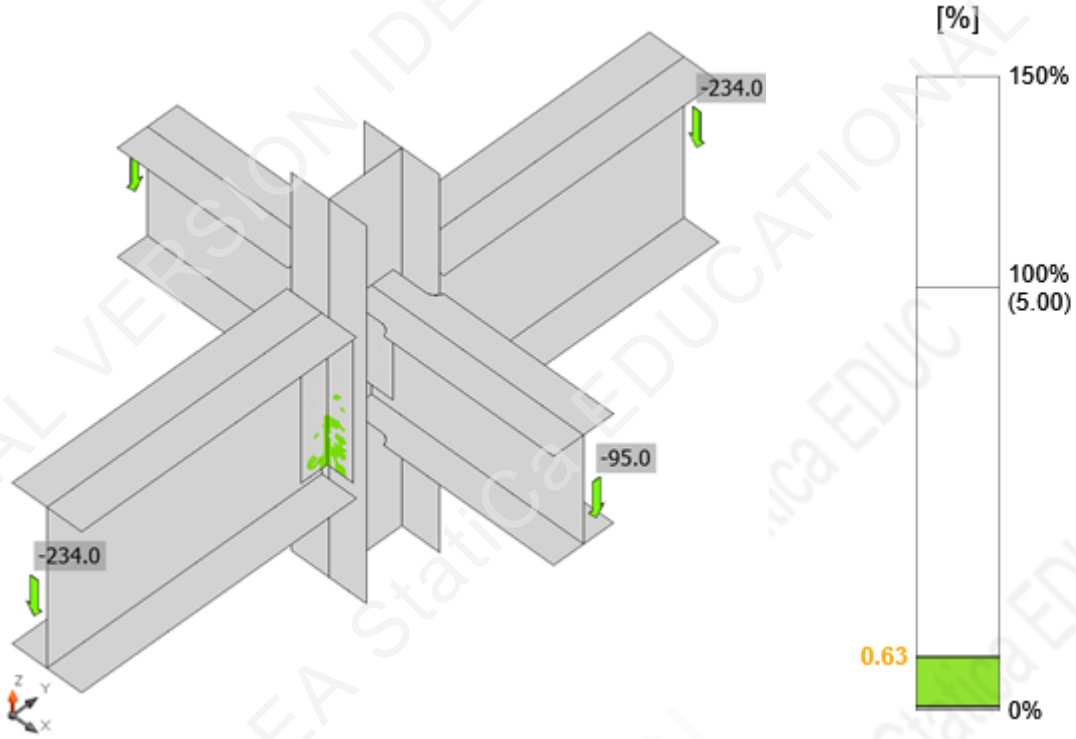
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0
A992	344.7	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

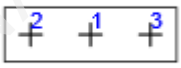
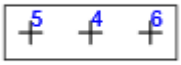
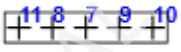
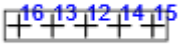
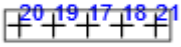
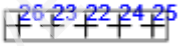
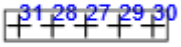
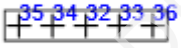


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.9	15.8	135.2	188.4	1.4	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	4.6	21.0	135.2	107.5	3.3	39.0	7.1	OK
	B3	3/4 A325 - 1	LE1	2.4	21.1	135.2	220.9	1.7	31.3	7.2	OK
	B4	3/4 A325 - 1	LE1	1.9	15.8	135.2	188.4	1.4	23.3	4.0	OK
	B5	3/4 A325 - 1	LE1	2.4	21.1	135.2	220.9	1.7	31.3	7.2	OK
	B6	3/4 A325 - 1	LE1	4.6	21.0	135.2	107.5	3.3	39.0	7.1	OK
	B7	3/4 A325 - 1	LE1	7.3	24.0	215.1	299.7	5.2	30.3	9.5	OK
	B8	3/4 A325 - 1	LE1	12.1	32.8	215.1	163.3	8.5	41.5	18.0	OK
	B9	3/4 A325 - 1	LE1	4.0	31.2	215.1	149.8	2.9	39.5	15.7	OK
	B10	3/4 A325 - 1	LE1	3.0	52.2	215.1	107.4	2.1	66.1	43.8	OK
	B11	3/4 A325 - 1	LE1	21.0	47.9	215.1	128.5	14.9	74.5	38.9	OK
	B12	3/4 A325 - 1	LE1	15.4	23.9	163.4	214.4	10.9	30.2	10.3	OK
	B13	3/4 A325 - 1	LE1	37.7	24.5	163.4	214.4	26.7	31.0	16.8	OK
	B14	3/4 A325 - 1	LE1	4.1	22.9	163.4	214.4	2.9	29.0	8.5	OK
	B15	3/4 A325 - 1	LE1	8.1	21.9	163.4	93.8	5.7	27.8	8.0	OK
	B16	3/4 A325 - 1	LE1	55.2	24.2	163.4	214.4	39.1	30.7	24.7	OK
	B17	3/4 A325 - 1	LE1	15.4	23.9	163.4	214.4	10.9	30.2	10.3	OK
	B18	3/4 A325 - 1	LE1	37.7	24.5	163.4	214.4	26.7	31.0	16.8	OK
	B19	3/4 A325 - 1	LE1	4.1	22.9	163.4	214.4	2.9	29.0	8.5	OK
	B20	3/4 A325 - 1	LE1	8.1	21.9	163.4	93.8	5.7	27.8	8.0	OK
	B21	3/4 A325 - 1	LE1	55.2	24.2	163.4	214.4	39.1	30.7	24.7	OK
	B22	3/4 A325 - 1	LE1	7.3	24.0	215.1	299.7	5.2	30.3	9.5	OK
	B23	3/4 A325 - 1	LE1	4.0	31.2	215.1	149.8	2.9	39.5	15.7	OK
	B24	3/4 A325 - 1	LE1	12.0	32.8	215.1	163.3	8.5	41.5	18.0	OK
	B25	3/4 A325 - 1	LE1	21.0	47.9	215.1	128.5	14.9	74.5	38.9	OK
	B26	3/4 A325 - 1	LE1	3.0	52.2	215.1	107.4	2.1	66.1	43.8	OK
	B27	3/4 A325 - 1	LE1	15.3	23.9	163.4	214.4	10.9	30.2	10.3	OK
	B28	3/4 A325 - 1	LE1	4.1	22.9	163.4	214.4	2.9	29.0	8.5	OK
	B29	3/4 A325 - 1	LE1	37.7	24.5	163.4	214.4	26.7	31.0	16.8	OK
	B30	3/4 A325 - 1	LE1	55.2	24.2	163.4	214.4	39.1	30.7	24.7	OK
	B31	3/4 A325 - 1	LE1	8.1	21.9	163.4	93.8	5.7	27.8	8.0	OK
	B32	3/4 A325 - 1	LE1	15.4	23.9	163.4	214.4	10.9	30.2	10.3	OK
	B33	3/4 A325 - 1	LE1	4.1	22.9	163.4	214.4	2.9	29.0	8.5	OK
	B34	3/4 A325 - 1	LE1	37.7	24.5	163.4	214.4	26.7	31.0	16.8	OK
	B35	3/4 A325 - 1	LE1	55.2	24.2	163.4	214.4	39.1	30.7	24.7	OK
	B36	3/4 A325 - 1	LE1	8.1	21.9	163.4	93.8	5.7	27.8	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.8	32.7	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.6	13.0	35.3	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	2.4	12.2	19.9	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.6	13.0	35.3	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.8	32.7	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	2.4	12.2	19.9	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.6	13.0	35.3	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.8	32.7	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.4	12.2	19.9	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.8	32.7	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.6	13.0	35.3	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.4	12.2	19.9	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

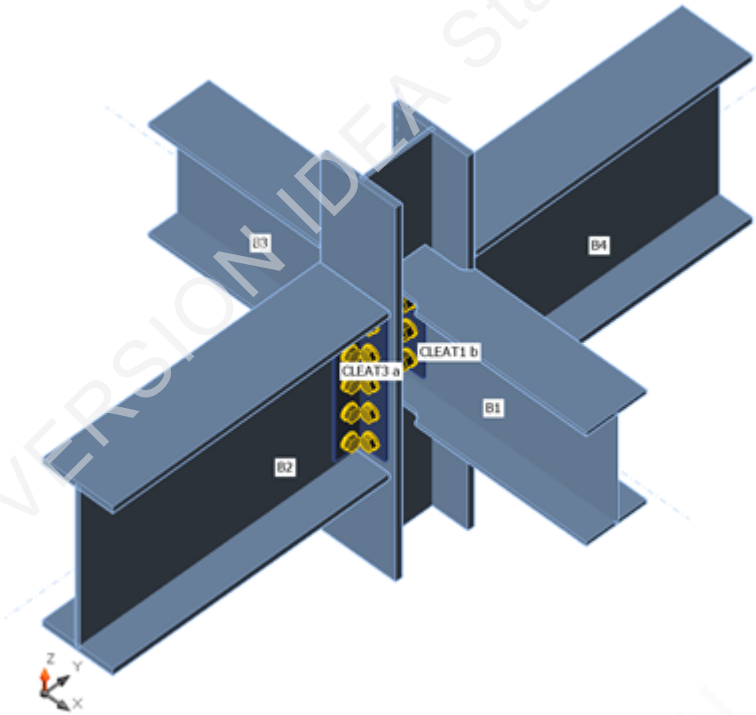
Project item J-5 (3F)

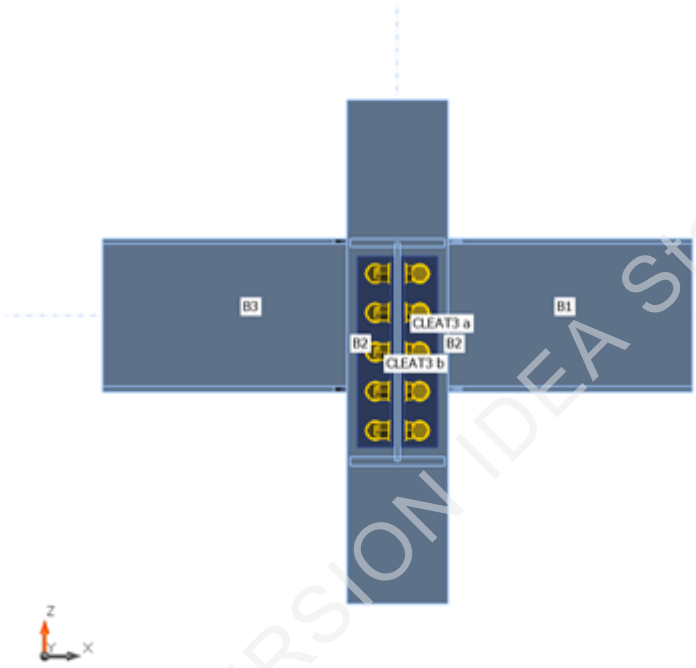
Design

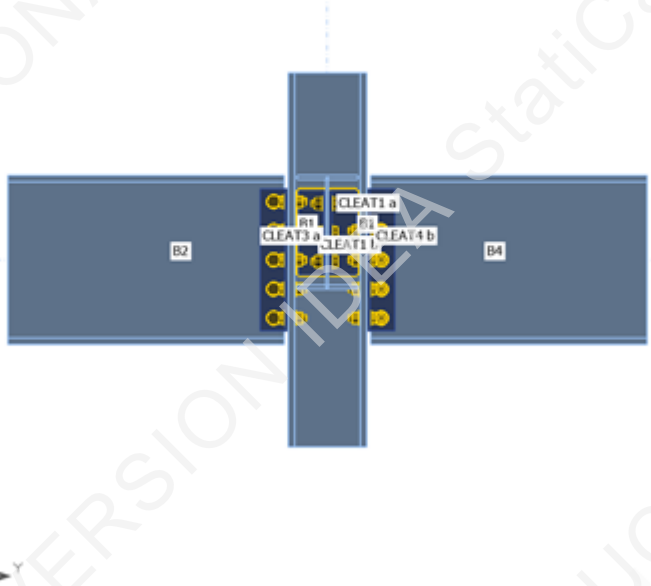
Name	J-5 (3F)
Description	Beam-Column Design (3rd Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	9 - INT COL (3F)(W200X71)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node
B4	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
9 - INT COL (3F) (W200X71)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0
	B4	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.6 < 5%	OK
Bolts	73.2 < 100%	OK
Welds	34.8 < 100%	OK
Buckling	Not calculated	

Plates

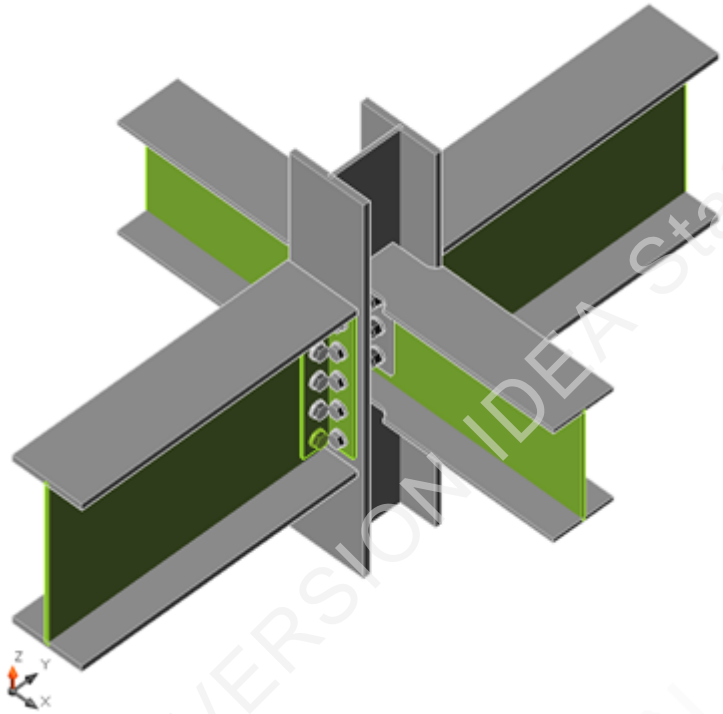
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	17.4	LE1	117.9	0.0	OK
SL-tfl 1	A992	344.7	17.4	LE1	118.0	0.0	OK
SL-w 1	A992	344.7	10.2	LE1	97.3	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	102.2	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	102.2	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	275.8	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.8	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.8	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.4	0.6	OK
B3-bfl 1	A992	344.7	11.2	LE1	102.2	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	102.2	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	275.8	0.0	OK
B4-bfl 1	A992	344.7	17.7	LE1	131.8	0.0	OK
B4-tfl 1	A992	344.7	17.7	LE1	131.8	0.0	OK
B4-w 1	A992	344.7	10.5	LE1	311.4	0.6	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	137.3	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	157.0	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	137.0	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	157.0	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	157.0	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	137.0	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	157.0	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	137.2	0.0	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 a-w 1	300W	300.0	7.9	LE1	270.8	0.4	OK
CLEAT4 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 b-w 1	300W	300.0	7.9	LE1	270.8	0.4	OK

Design data

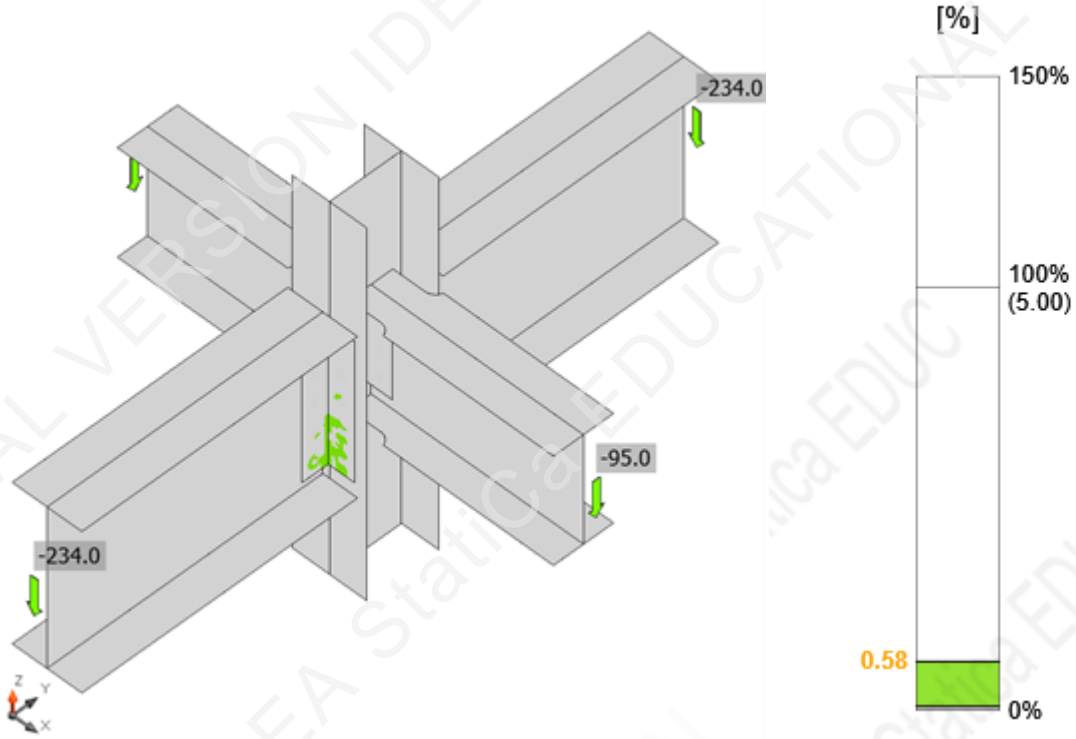
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

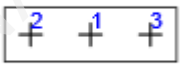
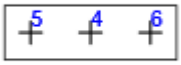
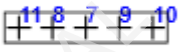
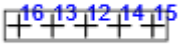
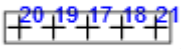
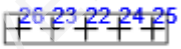
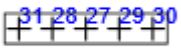
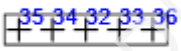


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.9	15.8	135.2	188.4	1.4	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	4.6	20.7	135.2	109.4	3.2	37.8	7.0	OK
	B3	3/4 A325 - 1	LE1	2.5	20.9	135.2	218.1	1.8	30.9	7.0	OK
	B4	3/4 A325 - 1	LE1	1.9	15.8	135.2	188.4	1.4	23.3	4.0	OK
	B5	3/4 A325 - 1	LE1	2.5	20.9	135.2	218.1	1.8	30.9	7.0	OK
	B6	3/4 A325 - 1	LE1	4.6	20.7	135.2	109.4	3.2	37.8	7.0	OK
	B7	3/4 A325 - 1	LE1	7.1	23.9	215.1	299.7	5.0	30.3	9.4	OK
	B8	3/4 A325 - 1	LE1	11.6	32.4	215.1	165.4	8.2	41.0	17.5	OK
	B9	3/4 A325 - 1	LE1	4.0	30.9	215.1	151.7	2.8	39.1	15.4	OK
	B10	3/4 A325 - 1	LE1	3.2	51.4	215.1	107.9	2.3	65.1	42.4	OK
	B11	3/4 A325 - 1	LE1	20.7	47.3	215.1	129.0	14.6	73.2	37.9	OK
	B12	3/4 A325 - 1	LE1	15.0	23.8	163.4	214.4	10.6	30.1	10.2	OK
	B13	3/4 A325 - 1	LE1	37.0	24.5	163.4	214.4	26.2	30.9	16.4	OK
	B14	3/4 A325 - 1	LE1	3.5	22.9	163.4	214.4	2.5	29.0	8.4	OK
	B15	3/4 A325 - 1	LE1	7.1	22.0	163.4	93.8	5.0	27.8	8.0	OK
	B16	3/4 A325 - 1	LE1	55.4	24.3	163.4	214.4	39.3	30.7	24.9	OK
	B17	3/4 A325 - 1	LE1	15.0	23.8	163.4	214.4	10.6	30.1	10.2	OK
	B18	3/4 A325 - 1	LE1	37.0	24.4	163.4	214.4	26.2	30.9	16.4	OK
	B19	3/4 A325 - 1	LE1	3.5	22.9	163.4	214.4	2.5	29.0	8.4	OK
	B20	3/4 A325 - 1	LE1	7.1	22.0	163.4	93.8	5.0	27.8	8.0	OK
	B21	3/4 A325 - 1	LE1	55.4	24.3	163.4	214.4	39.3	30.7	24.8	OK
	B22	3/4 A325 - 1	LE1	7.1	23.9	215.1	299.7	5.0	30.3	9.4	OK
	B23	3/4 A325 - 1	LE1	4.0	30.9	215.1	151.8	2.8	39.1	15.4	OK
	B24	3/4 A325 - 1	LE1	11.6	32.4	215.1	165.4	8.2	41.0	17.5	OK
	B25	3/4 A325 - 1	LE1	20.7	47.3	215.1	129.1	14.6	73.2	37.9	OK
	B26	3/4 A325 - 1	LE1	3.2	51.4	215.1	107.9	2.3	65.1	42.4	OK
	B27	3/4 A325 - 1	LE1	15.0	23.8	163.4	214.4	10.6	30.1	10.2	OK
	B28	3/4 A325 - 1	LE1	3.5	22.9	163.4	214.4	2.5	29.0	8.4	OK
	B29	3/4 A325 - 1	LE1	37.0	24.4	163.4	214.4	26.2	30.9	16.4	OK
	B30	3/4 A325 - 1	LE1	55.4	24.3	163.4	214.4	39.3	30.7	24.8	OK
	B31	3/4 A325 - 1	LE1	7.1	22.0	163.4	93.8	5.0	27.8	8.0	OK
	B32	3/4 A325 - 1	LE1	15.0	23.8	163.4	214.4	10.6	30.1	10.2	OK
	B33	3/4 A325 - 1	LE1	3.5	22.9	163.4	214.4	2.5	29.0	8.4	OK
	B34	3/4 A325 - 1	LE1	37.0	24.5	163.4	214.4	26.2	30.9	16.4	OK
	B35	3/4 A325 - 1	LE1	55.4	24.3	163.4	214.4	39.3	30.7	24.8	OK
	B36	3/4 A325 - 1	LE1	7.1	22.0	163.4	93.8	5.0	27.8	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.5	33.4	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.7	13.5	34.8	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	2.7	12.4	21.8	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.7	13.5	34.8	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.5	33.4	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	2.7	12.4	21.8	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.7	13.5	34.8	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.5	33.4	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.7	12.4	21.8	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.5	13.5	33.4	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.7	13.5	34.8	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	2.7	12.4	21.8	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

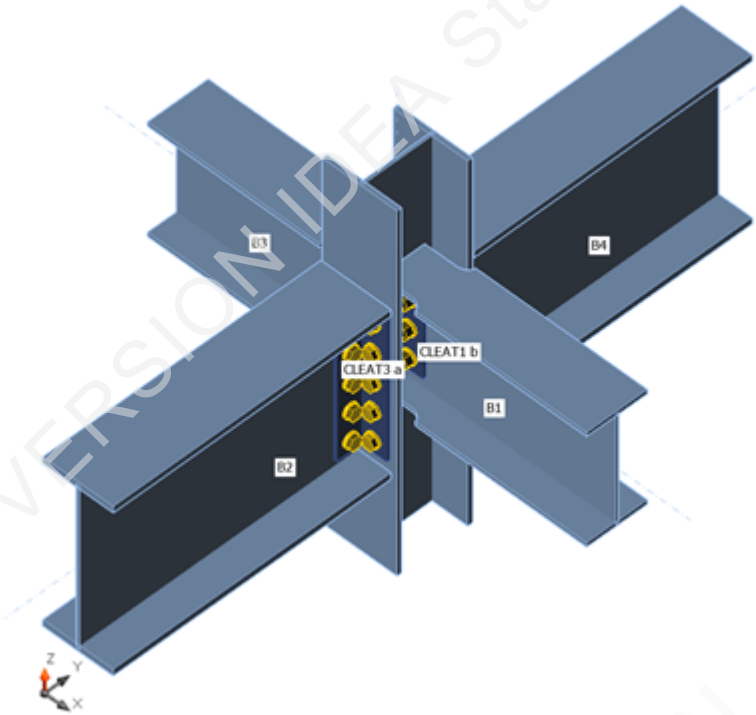
Project item J-5 (4F)

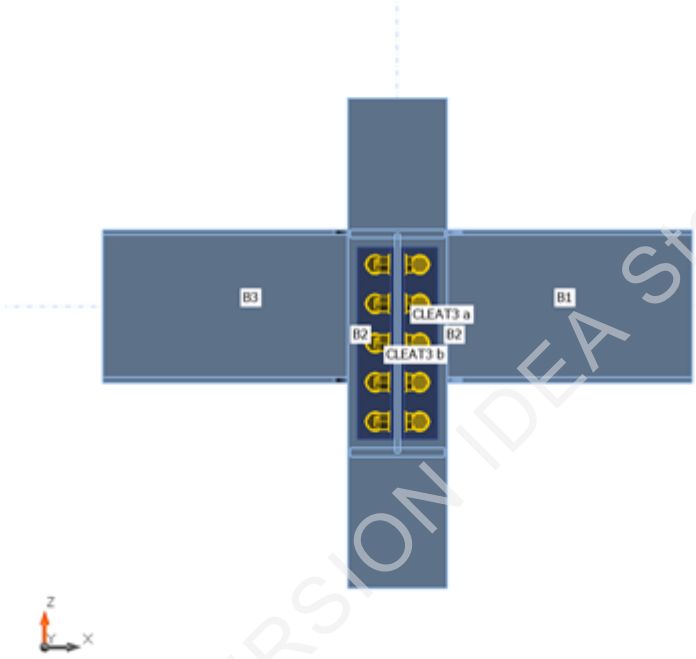
Design

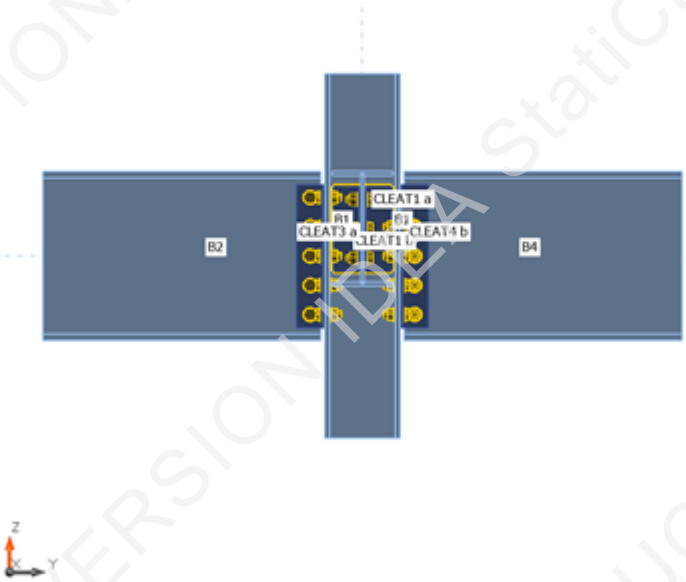
Name	J-5 (4F)
Description	Beam-Column Design (4th Floor)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	9 - INT COL (4F)(W200X52)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (F)(W310X44.5)	0.0	0.0	0.0	0	0	75	Node
B2	4 - GIR (F)(W460X89)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (F)(W310X44.5)	180.0	0.0	0.0	0	0	75	Node
B4	4 - GIR (F)(W460X89)	90.0	0.0	0.0	0	0	0	Node







Cross-sections

Name	Material
9 - INT COL (4F) (W200X52)	A992
2 - JOI (F)(W310X44.5)	A992
4 - GIR (F)(W460X89)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-95.0	0.0	0.0	0.0
	B2	0.0	0.0	-234.0	0.0	0.0	0.0
	B3	0.0	0.0	-95.0	0.0	0.0	0.0
	B4	0.0	0.0	-234.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.5 < 5%	OK
Bolts	71.0 < 100%	OK
Welds	42.8 < 100%	OK
Buckling	Not calculated	

Plates

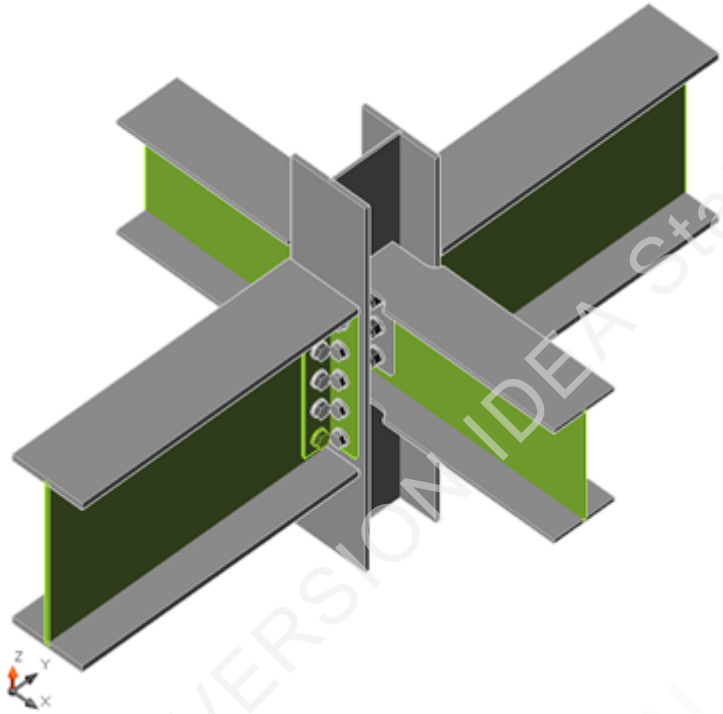
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	12.6	LE1	209.6	0.0	OK
SL-tfl 1	A992	344.7	12.6	LE1	209.6	0.0	OK
SL-w 1	A992	344.7	7.9	LE1	122.0	0.0	OK
B1-bfl 1	A992	344.7	11.2	LE1	102.1	0.0	OK
B1-tfl 1	A992	344.7	11.2	LE1	102.1	0.0	OK
B1-w 1	A992	344.7	6.6	LE1	274.7	0.0	OK
B2-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B2-w 1	A992	344.7	10.5	LE1	311.3	0.5	OK
B3-bfl 1	A992	344.7	11.2	LE1	102.1	0.0	OK
B3-tfl 1	A992	344.7	11.2	LE1	102.1	0.0	OK
B3-w 1	A992	344.7	6.6	LE1	274.7	0.0	OK
B4-bfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B4-tfl 1	A992	344.7	17.7	LE1	131.2	0.0	OK
B4-w 1	A992	344.7	10.5	LE1	311.2	0.5	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	137.6	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	171.5	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	137.4	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	171.5	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	171.5	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	137.3	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	171.5	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	137.6	0.0	OK
CLEAT3 a-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 a-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT3 b-bfl 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT3 b-w 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT4 a-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT4 a-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK
CLEAT4 b-bfl 1	300W	300.0	7.9	LE1	270.5	0.2	OK
CLEAT4 b-w 1	300W	300.0	7.9	LE1	270.6	0.3	OK

Design data

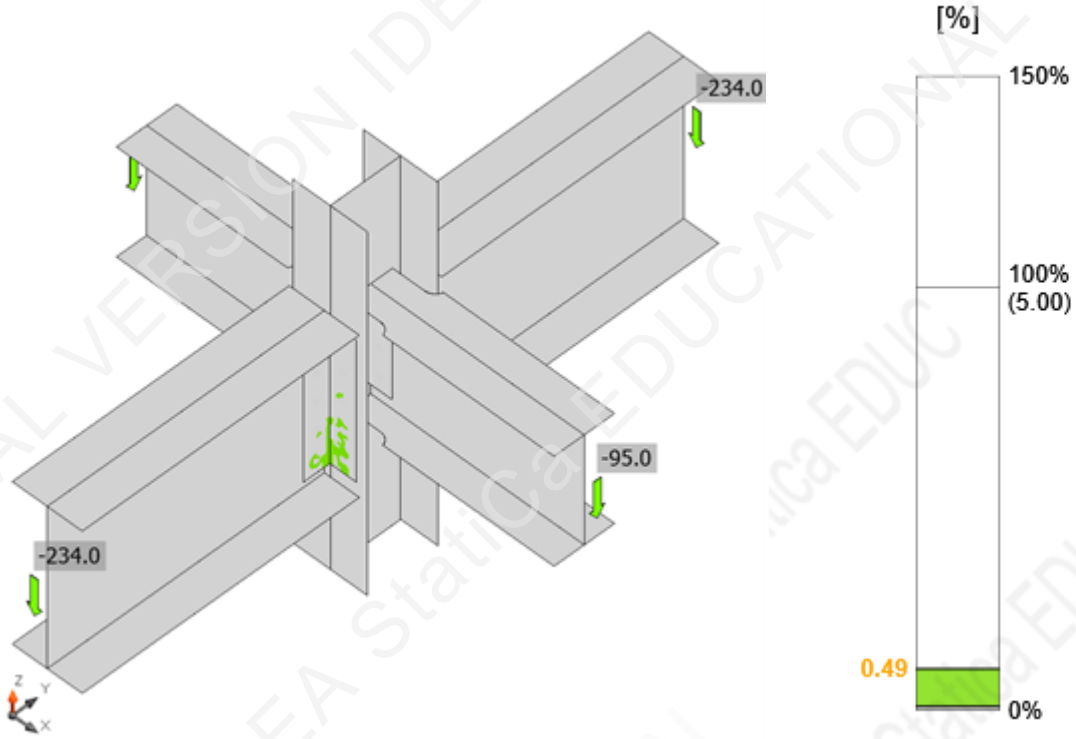
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

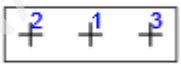
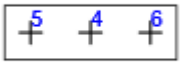
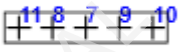
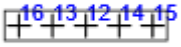
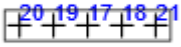
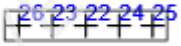
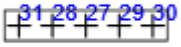
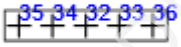


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	1.9	15.7	135.2	188.4	1.3	23.3	4.0	OK
	B2	3/4 A325 - 1	LE1	4.6	20.5	135.2	111.1	3.2	36.8	6.8	OK
	B3	3/4 A325 - 1	LE1	2.6	20.7	135.2	215.9	1.9	30.6	6.9	OK
	B4	3/4 A325 - 1	LE1	1.9	15.7	135.2	188.4	1.3	23.3	4.0	OK
	B5	3/4 A325 - 1	LE1	2.6	20.7	135.2	215.9	1.9	30.6	6.9	OK
	B6	3/4 A325 - 1	LE1	4.6	20.5	135.2	111.1	3.2	36.8	6.8	OK
	B7	3/4 A325 - 1	LE1	6.8	23.9	215.1	299.7	4.8	30.2	9.3	OK
	B8	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.2	7.6	40.2	16.7	OK
	B9	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.4	2.9	38.4	14.8	OK
	B10	3/4 A325 - 1	LE1	3.7	50.1	215.1	108.7	2.6	63.4	40.3	OK
	B11	3/4 A325 - 1	LE1	20.1	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B12	3/4 A325 - 1	LE1	14.7	23.7	163.4	214.4	10.4	29.9	10.1	OK
	B13	3/4 A325 - 1	LE1	36.7	24.3	163.4	214.4	26.0	30.8	16.2	OK
	B14	3/4 A325 - 1	LE1	2.7	22.8	163.4	214.4	1.9	28.9	8.4	OK
	B15	3/4 A325 - 1	LE1	6.1	22.1	163.4	93.8	4.3	27.9	8.0	OK
	B16	3/4 A325 - 1	LE1	56.1	24.3	163.4	214.4	39.7	30.8	25.3	OK
	B17	3/4 A325 - 1	LE1	14.7	23.7	163.4	214.4	10.4	29.9	10.0	OK
	B18	3/4 A325 - 1	LE1	36.7	24.3	163.4	214.4	26.0	30.8	16.3	OK
	B19	3/4 A325 - 1	LE1	2.7	22.8	163.4	214.4	1.9	28.9	8.4	OK
	B20	3/4 A325 - 1	LE1	6.1	22.1	163.4	93.8	4.4	27.9	8.0	OK
	B21	3/4 A325 - 1	LE1	56.1	24.3	163.4	214.4	39.7	30.8	25.3	OK
	B22	3/4 A325 - 1	LE1	6.8	23.9	215.1	299.7	4.8	30.2	9.3	OK
	B23	3/4 A325 - 1	LE1	4.1	30.3	215.1	155.4	2.9	38.4	14.8	OK
	B24	3/4 A325 - 1	LE1	10.7	31.7	215.1	169.2	7.6	40.2	16.7	OK
	B25	3/4 A325 - 1	LE1	20.1	46.2	215.1	130.1	14.3	71.0	36.2	OK
	B26	3/4 A325 - 1	LE1	3.7	50.1	215.1	108.7	2.6	63.4	40.3	OK
	B27	3/4 A325 - 1	LE1	14.7	23.7	163.4	214.4	10.4	29.9	10.0	OK
	B28	3/4 A325 - 1	LE1	2.7	22.8	163.4	214.4	1.9	28.9	8.4	OK
	B29	3/4 A325 - 1	LE1	36.7	24.3	163.4	214.4	26.0	30.8	16.3	OK
	B30	3/4 A325 - 1	LE1	56.1	24.3	163.4	214.4	39.7	30.8	25.3	OK
	B31	3/4 A325 - 1	LE1	6.1	22.1	163.4	93.8	4.4	27.9	8.0	OK
	B32	3/4 A325 - 1	LE1	14.7	23.7	163.4	214.4	10.4	29.9	10.1	OK
	B33	3/4 A325 - 1	LE1	2.7	22.8	163.4	214.4	1.9	28.9	8.4	OK
	B34	3/4 A325 - 1	LE1	36.7	24.3	163.4	214.4	26.0	30.8	16.2	OK
	B35	3/4 A325 - 1	LE1	56.1	24.3	163.4	214.4	39.7	30.8	25.3	OK
	B36	3/4 A325 - 1	LE1	6.1	22.1	163.4	93.8	4.3	27.9	8.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.9	12.9	38.1	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	72	10	5.7	13.2	42.8	OK
SL-w 1	CLEAT1 a-w 1	E49xx	◢4.2	◢6.0	228	10	3.3	12.7	25.6	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	5.7	13.2	42.8	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.9	12.9	38.1	OK
SL-w 1	CLEAT1 b-w 1	E49xx	◢4.2	◢6.0	228	10	3.3	12.7	25.6	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.7	13.2	42.8	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.9	12.9	38.1	OK
SL-w 1	CLEAT2 a-bfl 1	E49xx	◢4.2	◢6.0	228	10	3.3	12.7	25.6	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.9	12.9	38.1	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	5.7	13.2	42.8	OK
SL-w 1	CLEAT2 b-bfl 1	E49xx	◢4.2	◢6.0	228	10	3.3	12.7	25.6	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

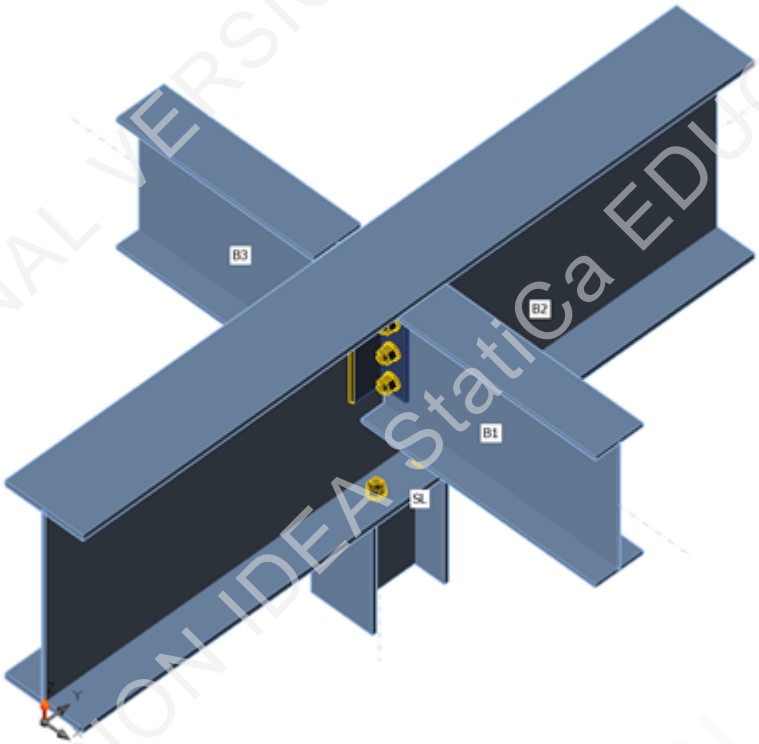
Project item J-5 (R2)

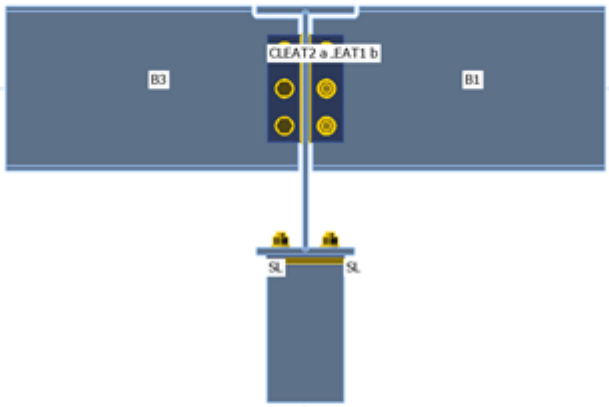
Design

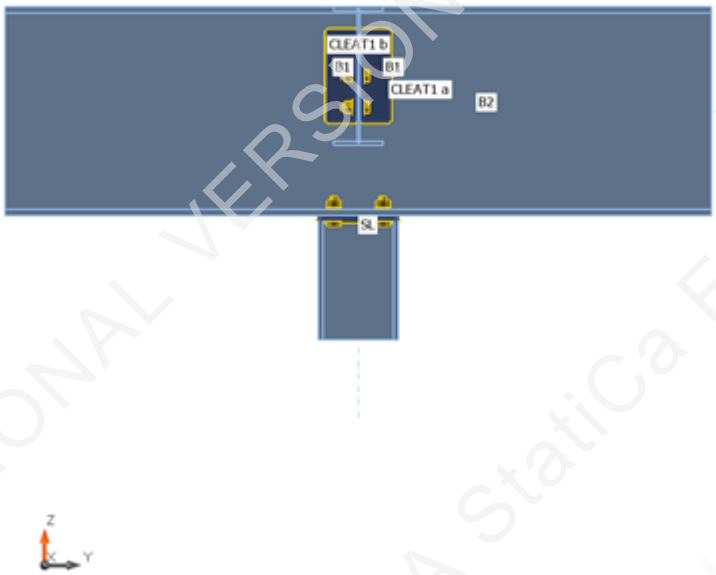
Name	J-5 (R2)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	2 - JOI (R2)(W360X39)	0.0	0.0	0.0	0	0	90	Node
B2	4 - GIR (R2)(W530X92)	-90.0	0.0	0.0	0	0	0	Node
B3	2 - JOI (R2)(W360X39)	180.0	0.0	0.0	0	0	90	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
2 - JOI (R2)(W360X39)	A992
4 - GIR (R2)(W530X92)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-82.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B2	0.0	0.0	-246.0	0.0	0.0	0.0
	B3	0.0	0.0	-82.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	33.6 < 100%	OK
Welds	76.2 < 100%	OK
Buckling	Not calculated	

Plates

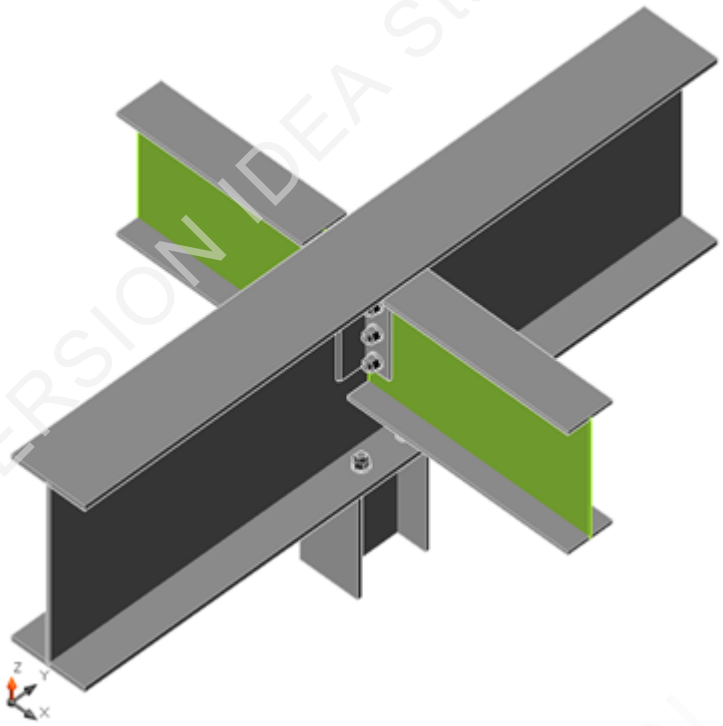
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	188.1	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	188.1	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	195.8	0.0	OK
B1-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B1-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B1-w 1	A992	344.7	6.5	LE1	300.4	0.0	OK
B2-bfl 1	A992	344.7	15.6	LE1	135.1	0.0	OK
B2-tfl 1	A992	344.7	15.6	LE1	120.9	0.0	OK
B2-w 1	A992	344.7	10.2	LE1	237.4	0.0	OK
B3-bfl 1	A992	344.7	10.7	LE1	98.6	0.0	OK
B3-tfl 1	A992	344.7	10.7	LE1	98.8	0.0	OK
B3-w 1	A992	344.7	6.5	LE1	300.4	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	248.3	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	114.5	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	248.3	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	114.4	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	114.5	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	248.3	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	114.5	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	248.2	0.0	OK
EP1	A992	344.7	10.0	LE1	300.9	0.0	OK

Design data

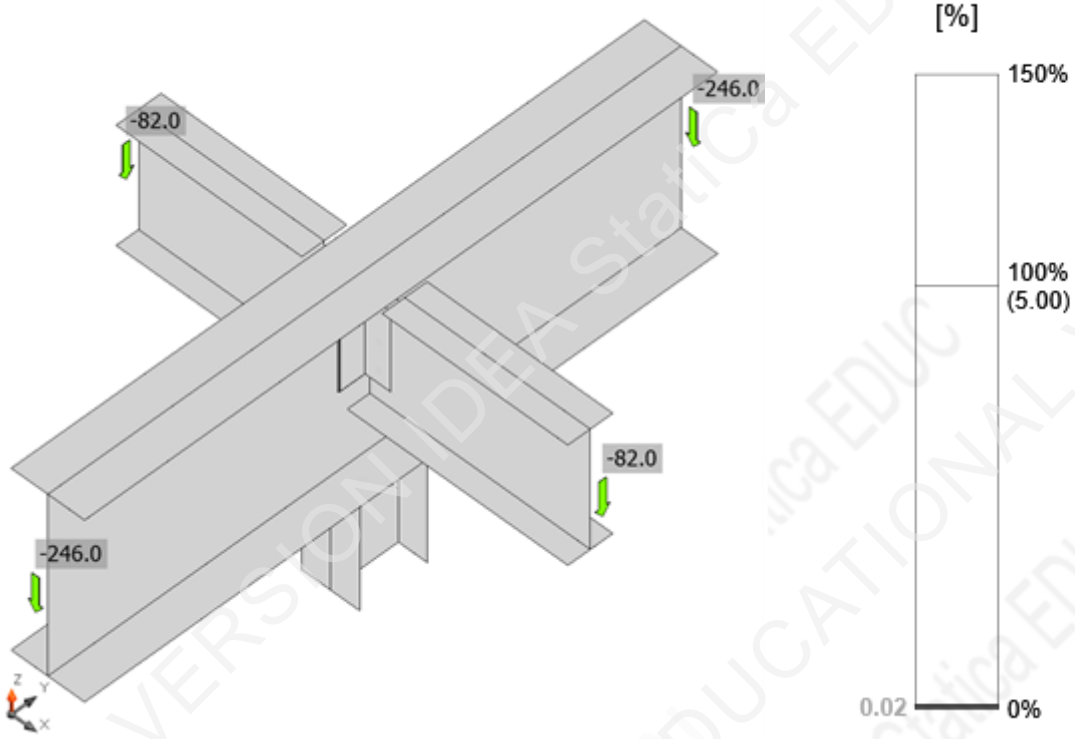
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

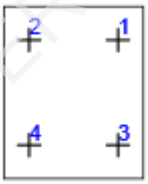
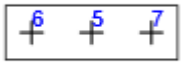


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	4.8	1.6	204.9	109.3	3.4	2.0	0.2	OK
	B2	3/4 A325 - 1	LE1	4.8	1.6	204.9	109.4	3.4	2.0	0.2	OK
	B3	3/4 A325 - 1	LE1	4.8	1.6	204.9	109.3	3.4	2.0	0.2	OK
	B4	3/4 A325 - 1	LE1	4.8	1.6	204.9	109.3	3.4	2.0	0.2	OK
	B5	3/4 A325 - 1	LE1	1.9	13.6	133.2	185.5	1.3	20.5	3.0	OK
	B6	3/4 A325 - 1	LE1	1.7	17.7	133.2	215.3	1.2	26.6	5.0	OK
	B7	3/4 A325 - 1	LE1	3.9	18.1	133.2	107.9	2.8	33.6	5.3	OK
	B8	3/4 A325 - 1	LE1	1.9	13.6	133.2	185.5	1.3	20.5	3.0	OK
	B9	3/4 A325 - 1	LE1	3.9	18.1	133.2	107.9	2.8	33.6	5.3	OK
	B10	3/4 A325 - 1	LE1	1.7	17.7	133.2	215.3	1.2	26.6	5.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	18.0	23.6	76.1	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	18.0	23.6	76.2	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	18.0	23.6	76.2	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	18.0	23.6	76.1	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	16.5	23.8	69.3	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	15.6	23.8	65.7	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.0	14.3	13.8	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	8.4	14.3	59.0	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	229	10	2.5	9.4	27.0	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	8.4	14.3	59.0	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	2.0	14.3	13.8	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	229	10	2.5	9.4	27.0	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	8.4	14.3	59.0	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	2.0	14.3	13.8	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	229	10	2.5	9.4	27.0	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	2.0	14.3	13.8	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	8.4	14.3	59.0	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	229	10	2.5	9.4	27.0	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	

Item	Value	Unit	Reference
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

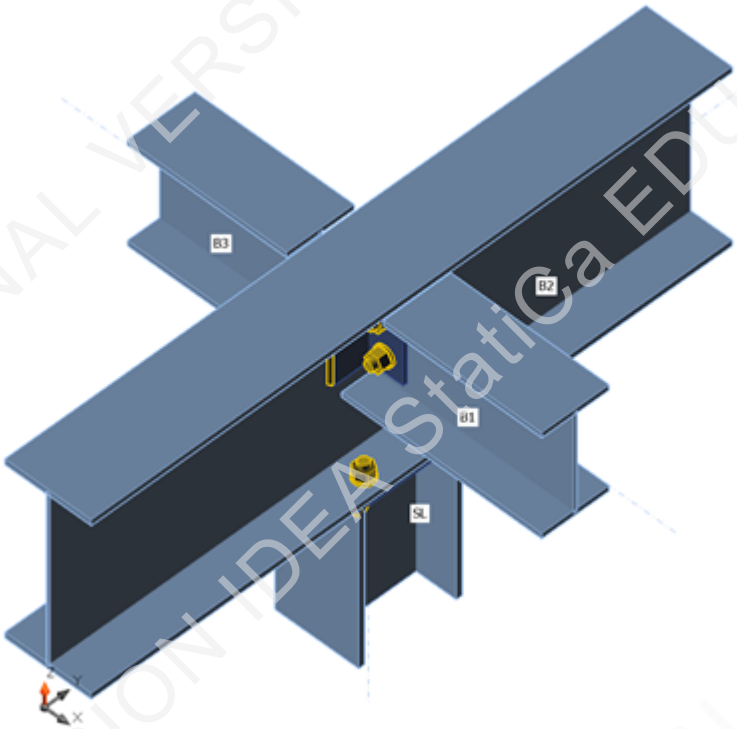
Project item B-5 (R1)

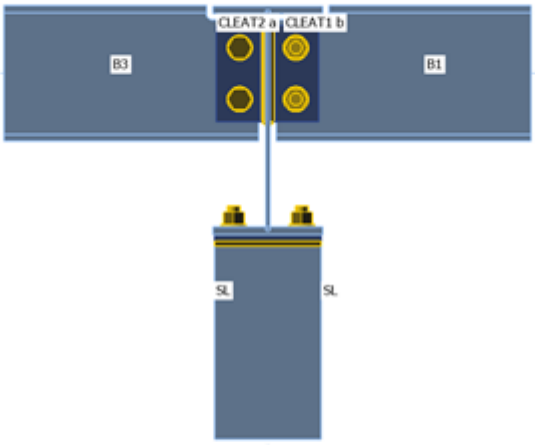
Design

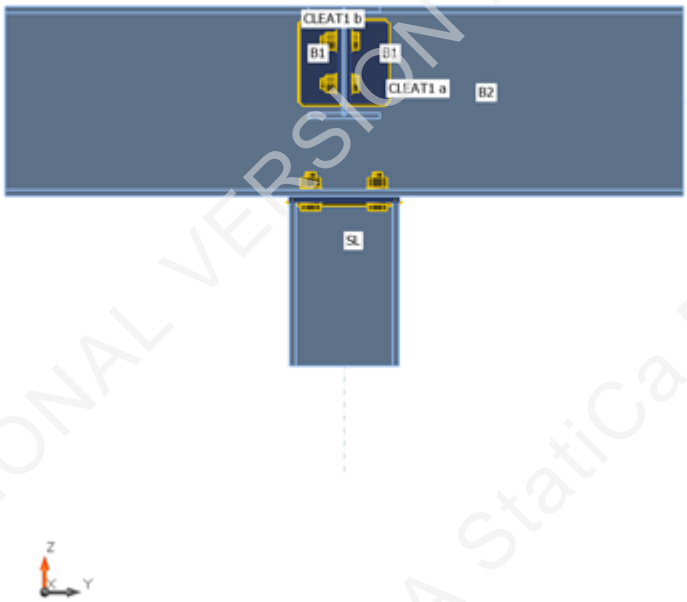
Name	B-5 (R1)
Description	Beam-Column Design (Roof)
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
SL	1 - COL (R2)(W200X41.7)	90.0	90.0	0.0	0	0	0	Node
B1	9 - JOI (R1)(W200X31.3)	0.0	0.0	0.0	0	0	73	Node
B2	10 - GIR (R1)(W360X51)	-90.0	0.0	0.0	0	0	0	Node
B3	9 - JOI (R1)(W200X31.3)	180.0	0.0	0.0	0	0	73	Node







Cross-sections

Name	Material
1 - COL (R2)(W200X41.7)	A992
9 - JOI (R1)(W200X31.3)	A992
10 - GIR (R1)(W360X51)	A992
8 - L76x76x7.9	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
3/4 A325	3/4 A325	19	825.0	285

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0.0	0.0	-32.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0
	B2	0.0	0.0	-96.0	0.0	0.0	0.0
	B3	0.0	0.0	-32.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	25.4 < 100%	OK
Welds	45.4 < 100%	OK
Buckling	Not calculated	

Plates

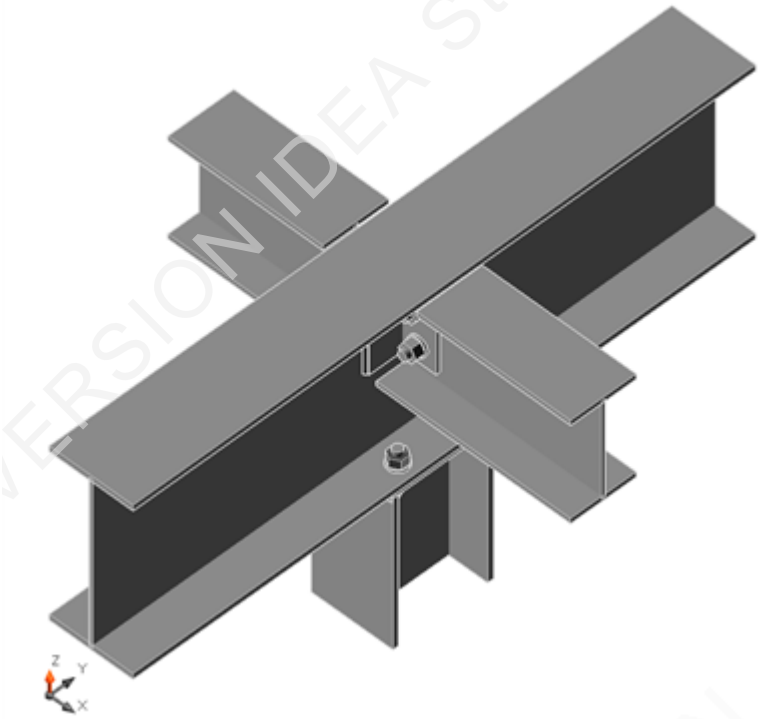
Name	Material	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
SL-bfl 1	A992	344.7	11.8	LE1	83.7	0.0	OK
SL-tfl 1	A992	344.7	11.8	LE1	84.1	0.0	OK
SL-w 1	A992	344.7	7.2	LE1	104.3	0.0	OK
B1-bfl 1	A992	344.7	10.2	LE1	55.3	0.0	OK
B1-tfl 1	A992	344.7	10.2	LE1	55.6	0.0	OK
B1-w 1	A992	344.7	6.4	LE1	229.5	0.0	OK
B2-bfl 1	A992	344.7	11.6	LE1	86.0	0.0	OK
B2-tfl 1	A992	344.7	11.6	LE1	85.9	0.0	OK
B2-w 1	A992	344.7	7.2	LE1	144.7	0.0	OK
B3-bfl 1	A992	344.7	10.2	LE1	55.4	0.0	OK
B3-tfl 1	A992	344.7	10.2	LE1	55.7	0.0	OK
B3-w 1	A992	344.7	6.4	LE1	229.5	0.0	OK
CLEAT1 a-bfl 1	300W	300.0	7.9	LE1	122.6	0.0	OK
CLEAT1 a-w 1	300W	300.0	7.9	LE1	76.6	0.0	OK
CLEAT1 b-bfl 1	300W	300.0	7.9	LE1	122.6	0.0	OK
CLEAT1 b-w 1	300W	300.0	7.9	LE1	76.6	0.0	OK
CLEAT2 a-bfl 1	300W	300.0	7.9	LE1	76.6	0.0	OK
CLEAT2 a-w 1	300W	300.0	7.9	LE1	122.6	0.0	OK
CLEAT2 b-bfl 1	300W	300.0	7.9	LE1	76.6	0.0	OK
CLEAT2 b-w 1	300W	300.0	7.9	LE1	122.5	0.0	OK
EP1	A992	344.7	10.0	LE1	81.2	0.0	OK

Design data

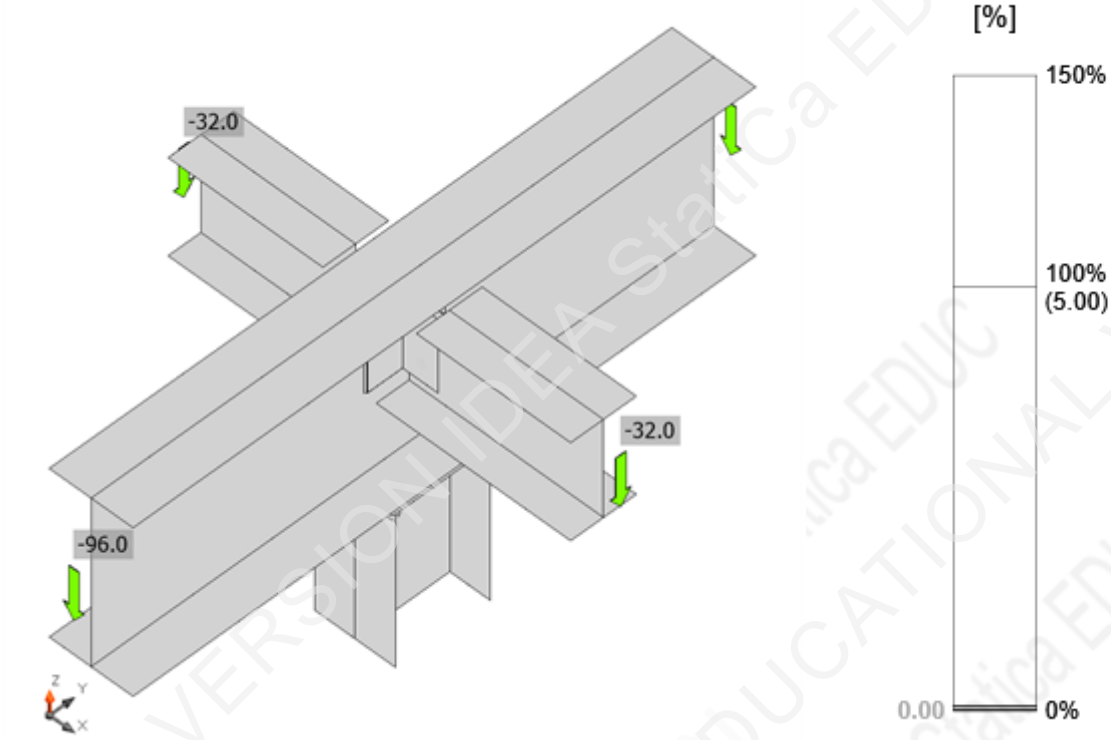
Material	fy [MPa]	ε_{lim} [%]
A992	344.7	5.0
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

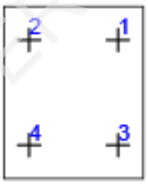
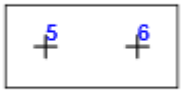
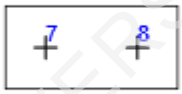


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	3/4 A325 - 1	LE1	2.7	0.7	204.9	137.8	1.9	0.9	0.0	OK
	B2	3/4 A325 - 1	LE1	2.7	0.7	204.9	138.8	1.9	0.9	0.0	OK
	B3	3/4 A325 - 1	LE1	2.6	0.7	204.9	138.5	1.8	0.9	0.0	OK
	B4	3/4 A325 - 1	LE1	2.5	0.7	204.9	139.7	1.8	0.9	0.0	OK
	B5	3/4 A325 - 1	LE1	1.0	11.9	131.1	202.4	0.7	18.1	2.3	OK
	B6	3/4 A325 - 1	LE1	2.6	11.8	131.1	93.1	1.8	25.4	2.3	OK
	B7	3/4 A325 - 1	LE1	2.6	11.8	131.1	93.1	1.8	25.4	2.3	OK
	B8	3/4 A325 - 1	LE1	1.0	11.9	131.1	202.4	0.7	18.1	2.3	OK

Design data

Grade	T_r [kN]	V_r [kN]
3/4 A325 - 1	141.1	79.0

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
EP1	SL-bfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	10.5	23.2	45.4	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	6.9	23.6	29.4	OK
EP1	SL-tfl 1	E49xx	◢5.7◣	◢8.0◣	165	13	6.8	23.6	28.9	OK
		E49xx	◢5.7◣	◢8.0◣	165	13	10.5	23.3	44.8	OK
EP1	SL-w 1	E49xx	◢5.7◣	◢8.0◣	192	13	8.9	23.8	37.4	OK
		E49xx	◢5.7◣	◢8.0◣	192	13	8.9	23.8	37.2	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.1	14.1	8.0	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.2	OK
B2-w 1	CLEAT1 a-bfl 1	E49xx	◢4.2	◢6.0	149	10	0.6	13.7	4.7	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.2	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	72	10	1.1	14.1	8.0	OK
B2-w 1	CLEAT1 b-bfl 1	E49xx	◢4.2	◢6.0	149	10	0.7	13.7	4.7	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.2	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	72	10	1.1	14.1	8.0	OK
B2-w 1	CLEAT2 a-w 1	E49xx	◢4.2	◢6.0	149	10	0.6	13.7	4.7	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	1.1	14.1	8.0	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	72	10	4.2	14.2	29.2	OK
B2-w 1	CLEAT2 b-w 1	E49xx	◢4.2	◢6.0	149	10	0.6	13.7	4.7	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	

Item	Value	Unit	Reference
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

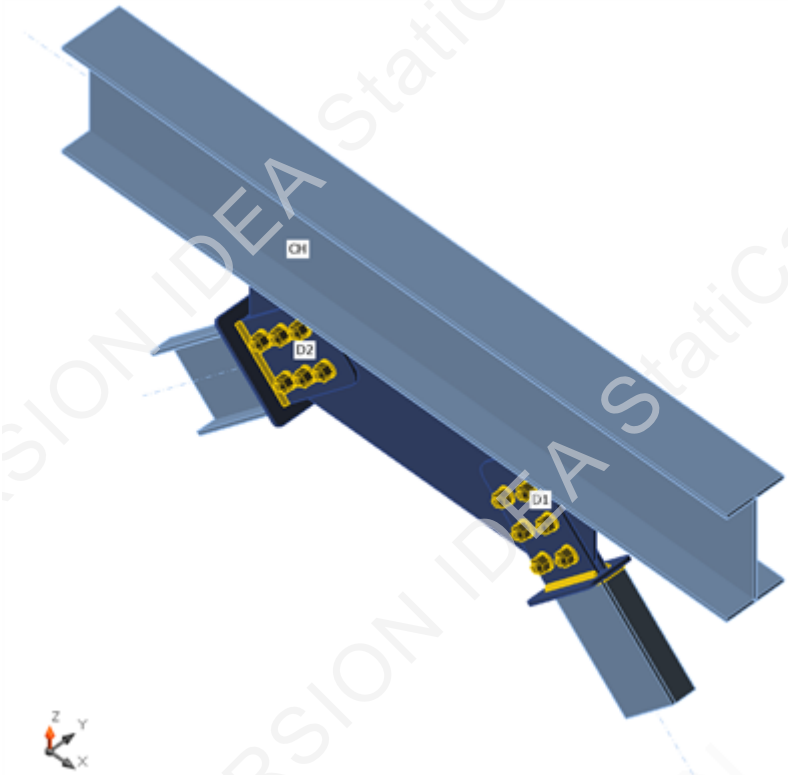
Project item LVL1 TF=701

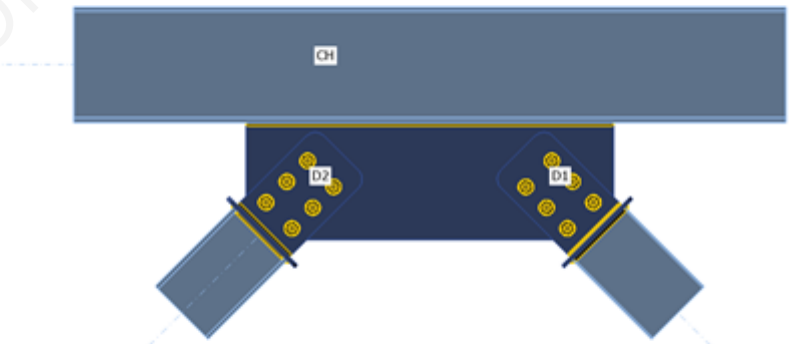
Design

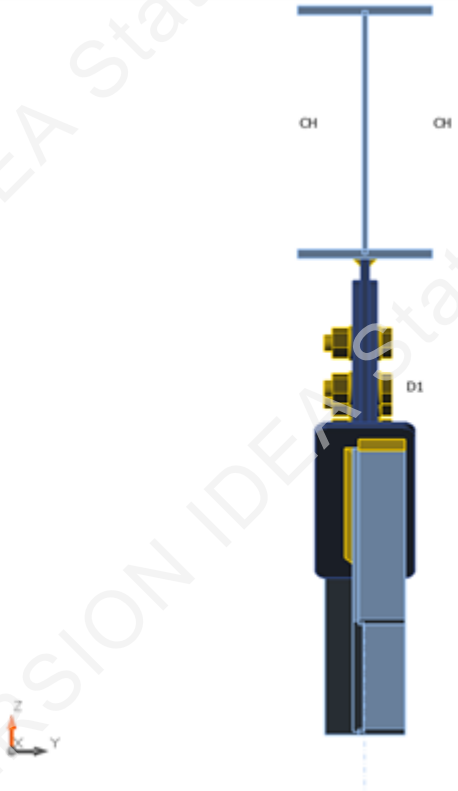
Name	LVL1 TF=701
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
CH	24 - W310X44.5	0.0	0.0	0.0	0	0	0	Node
D1	23 - C200x28	0.0	45.0	0.0	0	0	0	Node
D2	23 - C200x28	180.0	45.0	0.0	0	0	0	Node







Cross-sections

Name	Material
24 - W310X44.5	300W
23 - C200x28	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
20 A325M	20 A325M	20	830.0	314

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	D1	701.0	0.0	0.0	0.0	0.0	0.0
	D2	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	2.3 < 5%	OK
Bolts	73.2 < 100%	OK
Welds	90.2 < 100%	OK
Buckling	Not calculated	

Plates

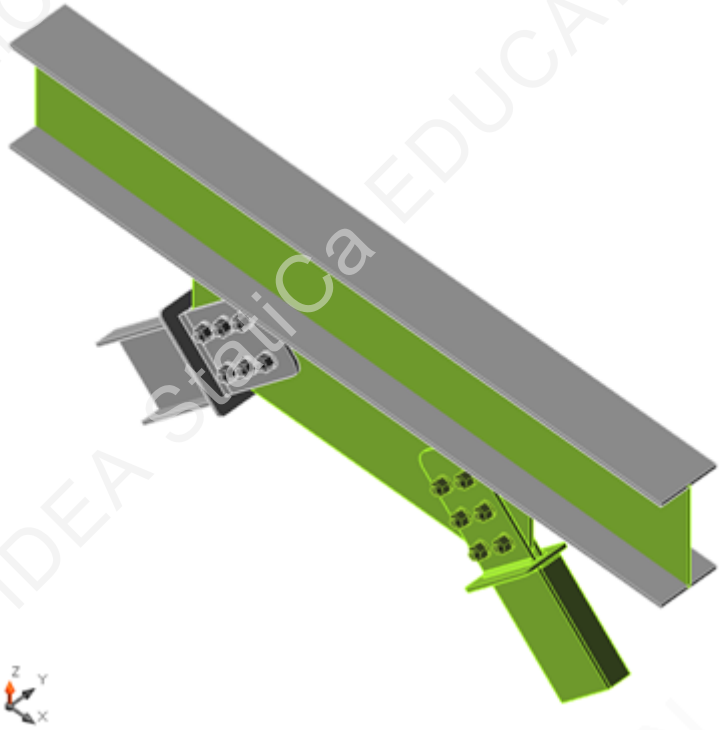
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
CH-bfl 1	300.0	11.2	LE1	243.3	0.0	OK
CH-tfl 1	300.0	11.2	LE1	219.6	0.0	OK
CH-w 1	300.0	6.6	LE1	270.0	0.0	OK
D1-bfl 1	300.0	9.9	LE1	270.4	0.2	OK
D1-tfl 1	300.0	9.9	LE1	270.5	0.2	OK
D1-w 1	300.0	12.4	LE1	271.1	0.6	OK
D2-bfl 1	300.0	9.9	LE1	8.7	0.0	OK
D2-tfl 1	300.0	9.9	LE1	8.0	0.0	OK
D2-w 1	300.0	12.4	LE1	8.6	0.0	OK
SP1	300.0	10.0	LE1	274.5	2.3	OK
CPL1a	300.0	10.0	LE1	270.1	0.0	OK
CPL1b	300.0	10.0	LE1	261.9	0.3	OK
CPL1c	300.0	10.0	LE1	270.6	0.3	OK
CPL2a	300.0	10.0	LE1	3.9	0.0	OK
CPL2b	300.0	10.0	LE1	13.0	0.0	OK
CPL2c	300.0	10.0	LE1	12.0	0.0	OK

Design data

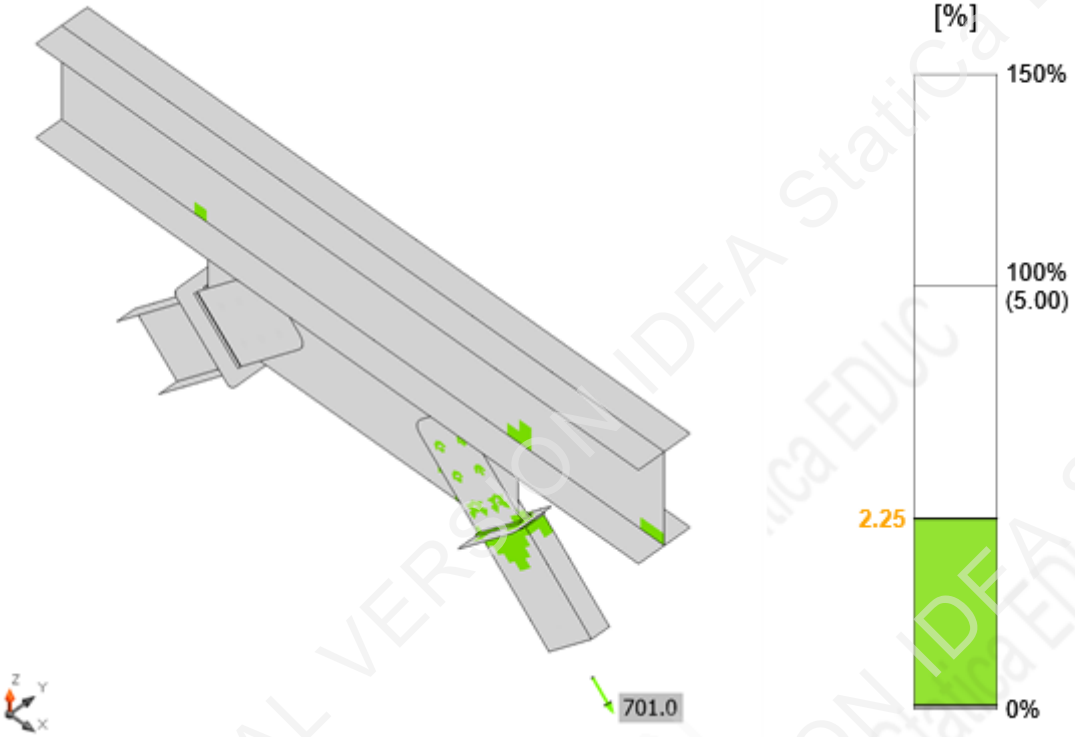
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

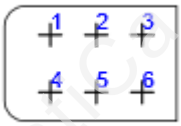
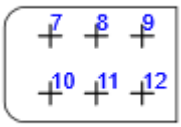


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	20 A325M - 1	LE1	14.6	64.1	216.0	270.0	9.3	73.2	54.4	OK
	B2	20 A325M - 1	LE1	6.1	60.5	216.0	270.0	3.9	69.1	47.8	OK
	B3	20 A325M - 1	LE1	7.3	56.6	216.0	157.6	4.7	68.2	42.0	OK
	B4	20 A325M - 1	LE1	14.8	62.9	216.0	270.0	9.5	71.8	52.5	OK
	B5	20 A325M - 1	LE1	6.5	61.8	216.0	270.0	4.1	70.6	50.0	OK
	B6	20 A325M - 1	LE1	8.5	63.2	216.0	237.3	5.4	72.2	52.5	OK
	B7	20 A325M - 1	LE1	0.1	0.4	216.0	270.0	0.1	0.4	0.0	OK
	B8	20 A325M - 1	LE1	0.2	1.1	216.0	432.2	0.1	1.3	0.0	OK
	B9	20 A325M - 1	LE1	0.3	1.7	216.0	345.1	0.2	2.0	0.0	OK
	B10	20 A325M - 1	LE1	0.6	2.6	216.0	188.7	0.4	3.0	0.1	OK
	B11	20 A325M - 1	LE1	0.3	0.8	216.0	199.8	0.2	0.9	0.0	OK
	B12	20 A325M - 1	LE1	0.1	0.9	216.0	192.6	0.1	1.0	0.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
20 A325M - 1	156.4	87.6

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
CH-bfl 1	SP1	E49xx	◢7.1◣	◢10.0◣	999	38	62.7	83.5	75.0	OK
		E49xx	◢7.1◣	◢10.0◣	999	38	59.3	78.6	75.4	OK
CPL1a	CPL1b	E49xx	◢7.1	◢10.0	199	18	37.8	41.9	90.2	OK
CPL1a	CPL1c	E49xx	◢7.1	◢10.0	199	18	35.5	42.1	84.3	OK
CPL1a	D1-bfl 1	E49xx	◢7.1◣	◢10.0◣	58	29	41.9	61.3	68.3	OK
		E49xx	◢7.1◣	◢10.0◣	58	29	35.6	47.4	75.1	OK
CPL1a	D1-tfl 1	E49xx	◢7.1◣	◢10.0◣	58	29	38.1	50.8	75.0	OK
		E49xx	◢7.1◣	◢10.0◣	58	29	49.5	67.1	73.8	OK
CPL1a	D1-w 1	E49xx	◢7.1◣	◢10.0◣	192	24	43.9	55.9	78.5	OK
		E49xx	◢7.1◣	◢10.0◣	192	24	41.8	55.7	75.0	OK
CPL2a	CPL2b	E49xx	◢7.1	◢10.0	199	18	1.2	42.3	2.8	OK
CPL2a	CPL2c	E49xx	◢7.1	◢10.0	199	18	2.2	42.0	5.1	OK
CPL2a	D2-bfl 1	E49xx	◢7.1◣	◢10.0◣	58	29	1.2	67.0	1.7	OK
		E49xx	◢7.1◣	◢10.0◣	58	29	0.7	56.6	1.2	OK
CPL2a	D2-tfl 1	E49xx	◢7.1◣	◢10.0◣	58	29	0.6	65.2	1.0	OK
		E49xx	◢7.1◣	◢10.0◣	58	29	1.3	67.3	1.9	OK
CPL2a	D2-w 1	E49xx	◢7.1◣	◢10.0◣	193	24	1.2	55.9	2.1	OK
		E49xx	◢7.1◣	◢10.0◣	192	24	1.2	55.6	2.1	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	

Item	Value	Unit	Reference
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

Project item LVL2 TF=533

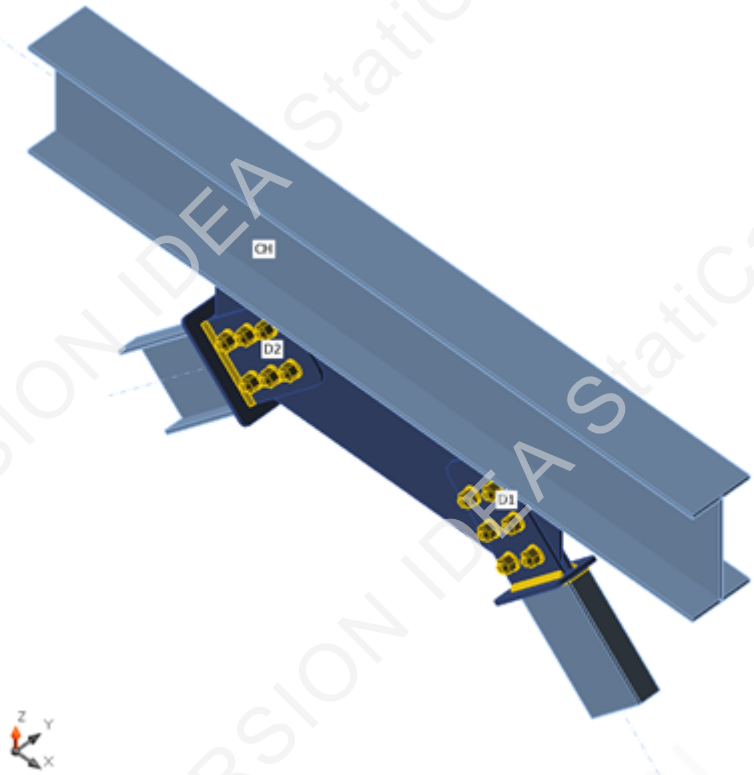
Design

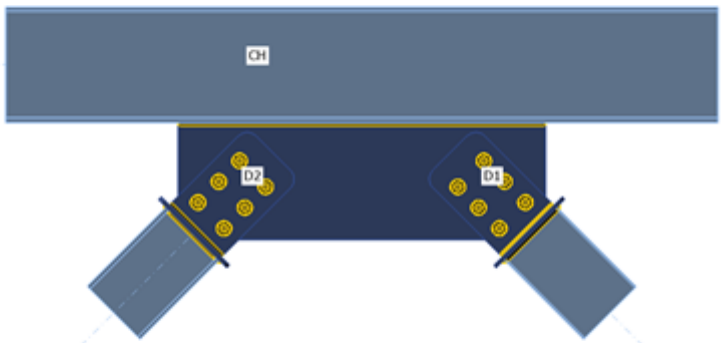
Name	LVL2 TF=533
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

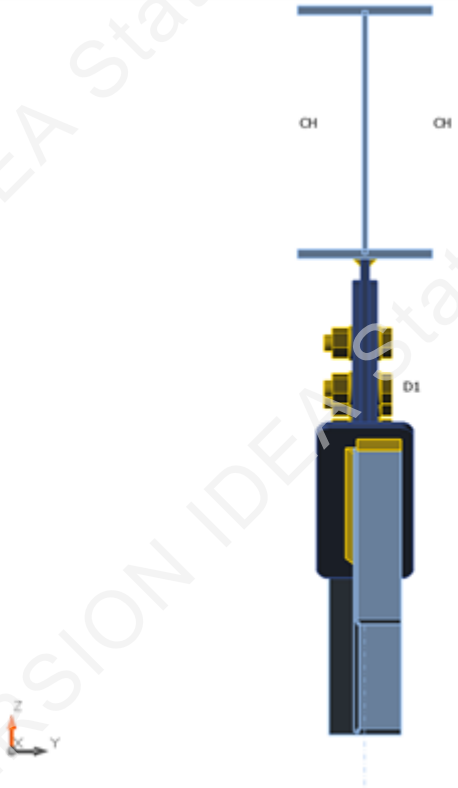
Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
CH	24 - W310X44.5	0.0	0.0	0.0	0	0	0	Node
D1	25 - C200x21	0.0	45.0	0.0	0	0	0	Node
D2	25 - C200x21	180.0	45.0	0.0	0	0	0	Node

Project:	**Fruitland Vertical Farm and MarketPlace**
Project no:	**1**
Author:	**David Moore**





Project:	**Fruitland Vertical Farm and MarketPlace**
Project no:	**1**
Author:	**David Moore**



Cross-sections

Name	Material
24 - W310X44.5	300W
25 - C200x21	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
20 A325M	20 A325M	20	830.0	314

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	D1	533.0	0.0	0.0	0.0	0.0	0.0
	D2	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.6 < 5%	OK
Bolts	55.8 < 100%	OK
Welds	86.0 < 100%	OK
Buckling	Not calculated	

Project:	**Fruitland Vertical Farm and MarketPlace**
Project no:	**1**
Author:	**David Moore**

Plates

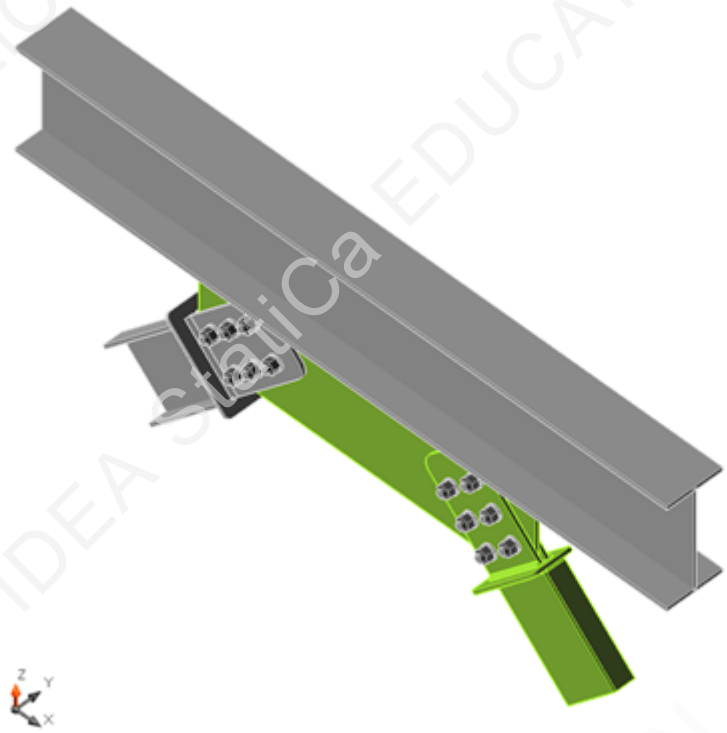
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
CH-bfl 1	300.0	11.2	LE1	183.5	0.0	OK
CH-tfl 1	300.0	11.2	LE1	166.2	0.0	OK
CH-w 1	300.0	6.6	LE1	233.9	0.0	OK
D1-bfl 1	300.0	9.9	LE1	270.4	0.2	OK
D1-tfl 1	300.0	9.9	LE1	270.4	0.2	OK
D1-w 1	300.0	7.7	LE1	270.9	0.4	OK
D2-bfl 1	300.0	9.9	LE1	8.5	0.0	OK
D2-tfl 1	300.0	9.9	LE1	7.2	0.0	OK
D2-w 1	300.0	7.7	LE1	7.1	0.0	OK
SP1	300.0	10.0	LE1	271.3	0.6	OK
CPL1a	300.0	10.0	LE1	262.8	0.0	OK
CPL1b	300.0	10.0	LE1	243.5	0.1	OK
CPL1c	300.0	10.0	LE1	270.2	0.1	OK
CPL2a	300.0	10.0	LE1	3.3	0.0	OK
CPL2b	300.0	10.0	LE1	10.3	0.0	OK
CPL2c	300.0	10.0	LE1	9.0	0.0	OK

Design data

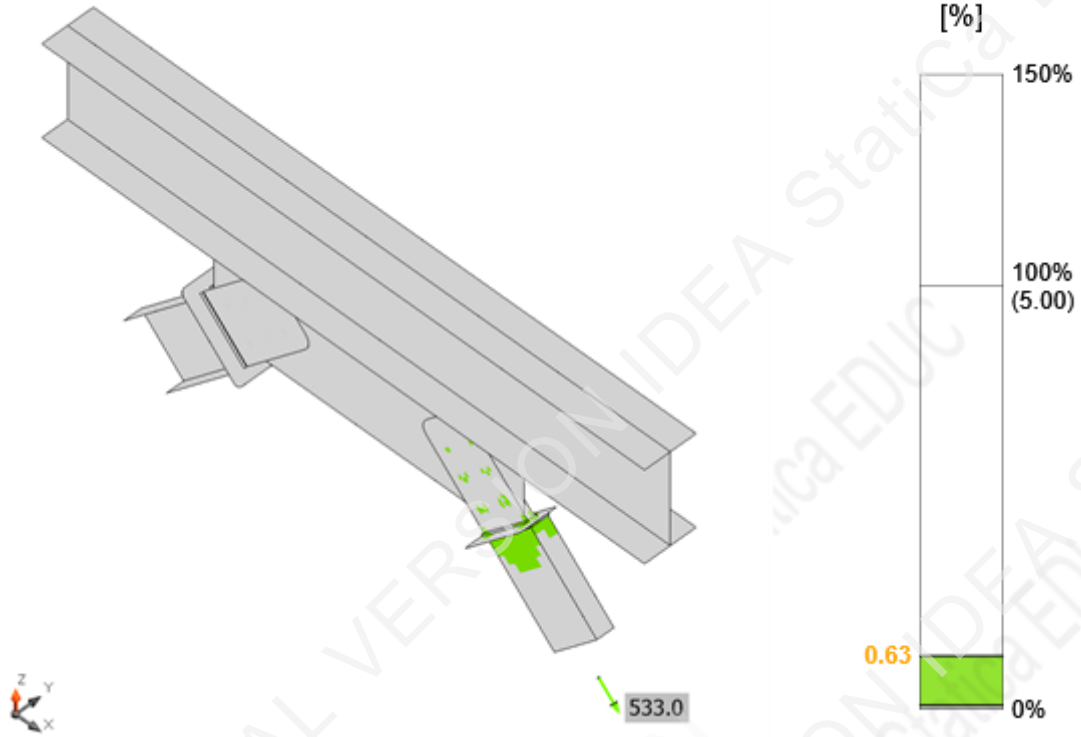
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



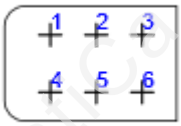
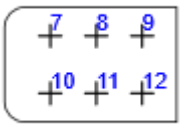
Overall check, LE1



Strain check, LE1

Project:	**Fruitland Vertical Farm and MarketPlace**
Project no:	**1**
Author:	**David Moore**

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	20 A325M - 1	LE1	11.2	48.9	216.0	270.0	7.1	55.8	31.7	OK
	B2	20 A325M - 1	LE1	4.6	47.2	216.0	270.0	3.0	53.9	29.2	OK
	B3	20 A325M - 1	LE1	5.5	45.7	216.0	153.8	3.5	55.5	27.4	OK
	B4	20 A325M - 1	LE1	11.5	48.9	216.0	270.0	7.3	55.8	31.7	OK
	B5	20 A325M - 1	LE1	4.9	47.6	216.0	270.0	3.1	54.4	29.7	OK
	B6	20 A325M - 1	LE1	6.0	48.5	216.0	237.1	3.8	55.4	30.8	OK
	B7	20 A325M - 1	LE1	0.1	0.4	216.0	270.0	0.1	0.4	0.0	OK
	B8	20 A325M - 1	LE1	0.2	0.9	216.0	235.0	0.1	1.0	0.0	OK
	B9	20 A325M - 1	LE1	0.2	1.3	216.0	345.5	0.1	1.5	0.0	OK
	B10	20 A325M - 1	LE1	0.5	2.0	216.0	188.5	0.3	2.3	0.1	OK
	B11	20 A325M - 1	LE1	0.2	0.6	216.0	191.7	0.2	0.7	0.0	OK
	B12	20 A325M - 1	LE1	0.1	0.6	216.0	177.6	0.1	0.7	0.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
20 A325M - 1	156.4	87.6

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
CH-bfl 1	SP1	E49xx	◢7.1◣	◢10.0◣	999	38	54.2	78.9	68.8	OK
		E49xx	◢7.1◣	◢10.0◣	999	38	54.0	78.9	68.4	OK
CPL1a	CPL1b	E49xx	◢7.1	◢10.0	199	18	36.0	41.9	86.0	OK
CPL1a	CPL1c	E49xx	◢7.1	◢10.0	199	18	32.8	41.8	78.5	OK
CPL1a	D1-bfl 1	E49xx	◢7.1◣	◢10.0◣	55	28	45.5	64.2	71.0	OK
		E49xx	◢7.1◣	◢10.0◣	55	28	38.4	51.2	75.0	OK
CPL1a	D1-tfl 1	E49xx	◢7.1◣	◢10.0◣	55	28	38.8	51.7	75.0	OK
		E49xx	◢7.1◣	◢10.0◣	55	28	47.9	64.2	74.6	OK
CPL1a	D1-w 1	E49xx	◢7.1◣	◢10.0◣	192	24	40.3	53.7	75.1	OK
		E49xx	◢7.1◣	◢10.0◣	192	24	40.4	53.6	75.4	OK
CPL2a	CPL2b	E49xx	◢7.1	◢10.0	199	18	0.8	42.3	2.0	OK
CPL2a	CPL2c	E49xx	◢7.1	◢10.0	199	18	1.7	42.2	4.1	OK
CPL2a	D2-bfl 1	E49xx	◢7.1◣	◢10.0◣	55	28	1.1	64.2	1.7	OK
		E49xx	◢7.1◣	◢10.0◣	55	28	0.7	59.3	1.1	OK
CPL2a	D2-tfl 1	E49xx	◢7.1◣	◢10.0◣	55	28	0.6	60.6	0.9	OK
		E49xx	◢7.1◣	◢10.0◣	55	28	1.0	64.2	1.5	OK
CPL2a	D2-w 1	E49xx	◢7.1◣	◢10.0◣	193	24	0.6	55.9	1.1	OK
		E49xx	◢7.1◣	◢10.0◣	192	24	0.8	55.1	1.5	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	

Item	Value	Unit	Reference
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

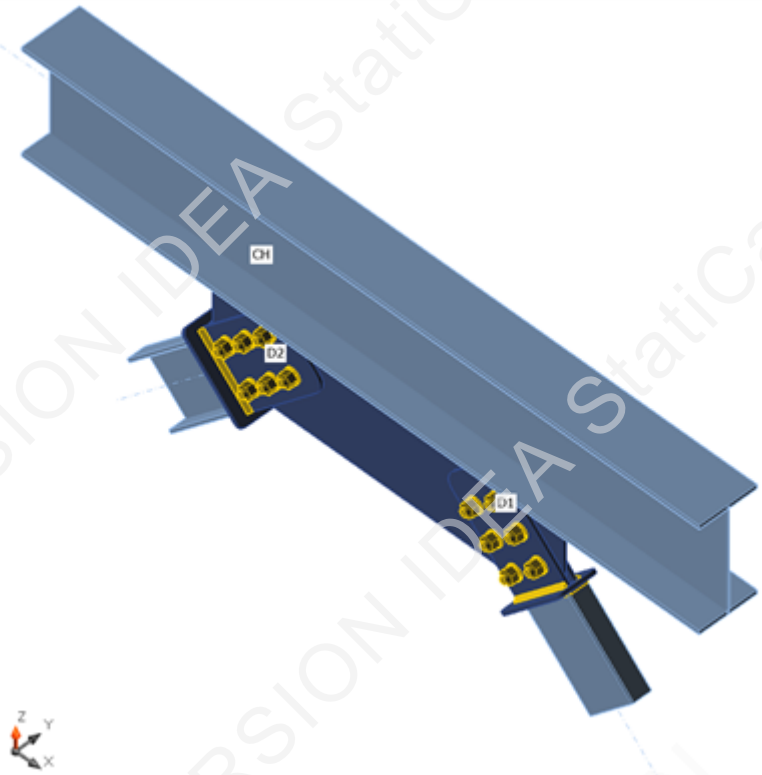
Project item LVL3/4 TF=374

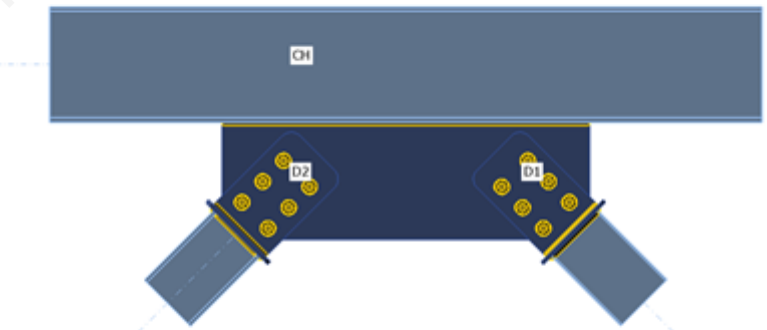
Design

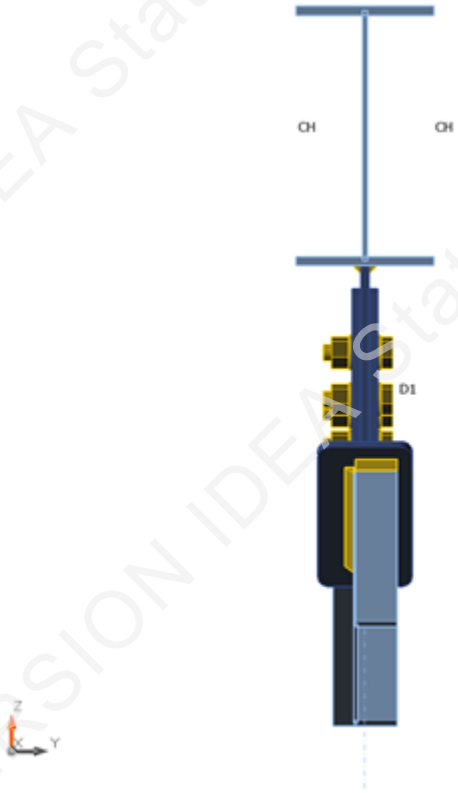
Name	LVL3/4 TF=374
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
CH	24 - W310X44.5	0.0	0.0	0.0	0	0	0	Node
D1	26 - C180x15	0.0	45.0	0.0	0	0	0	Node
D2	26 - C180x15	180.0	45.0	0.0	0	0	0	Node







Cross-sections

Name	Material
24 - W310X44.5	300W
26 - C180x15	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
20 A325M	20 A325M	20	830.0	314

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	D1	374.0	0.0	0.0	0.0	0.0	0.0
	D2	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	40.5 < 100%	OK
Welds	76.6 < 100%	OK
Buckling	Not calculated	

Plates

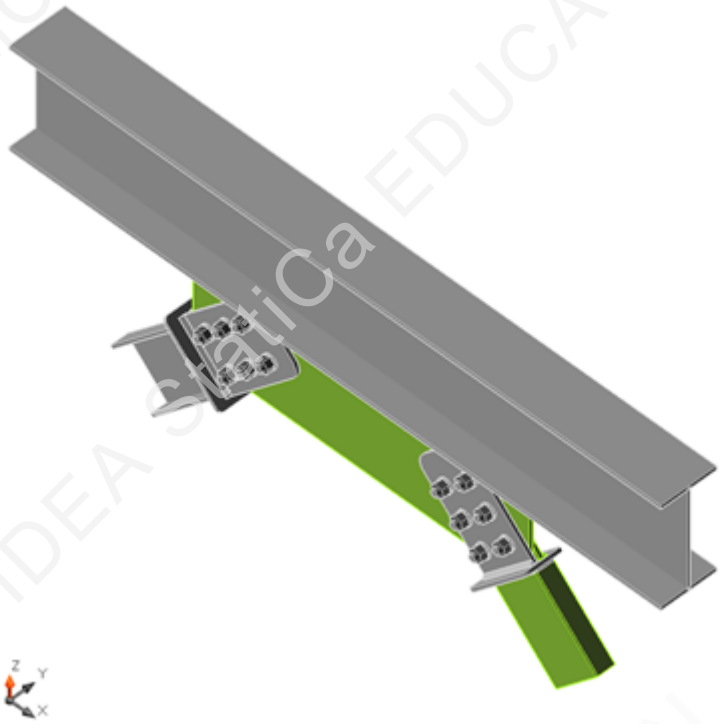
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
CH-bfl 1	300.0	11.2	LE1	128.1	0.0	OK
CH-tfl 1	300.0	11.2	LE1	116.4	0.0	OK
CH-w 1	300.0	6.6	LE1	155.1	0.0	OK
D1-bfl 1	300.0	9.3	LE1	246.1	0.0	OK
D1-tfl 1	300.0	9.3	LE1	254.8	0.0	OK
D1-w 1	300.0	5.3	LE1	270.1	0.0	OK
D2-bfl 1	300.0	9.3	LE1	6.2	0.0	OK
D2-tfl 1	300.0	9.3	LE1	6.1	0.0	OK
D2-w 1	300.0	5.3	LE1	6.1	0.0	OK
SP1	300.0	10.0	LE1	270.2	0.1	OK
CPL1a	300.0	10.0	LE1	135.7	0.0	OK
CPL1b	300.0	10.0	LE1	215.9	0.0	OK
CPL1c	300.0	10.0	LE1	209.7	0.0	OK
CPL2a	300.0	10.0	LE1	1.9	0.0	OK
CPL2b	300.0	10.0	LE1	5.4	0.0	OK
CPL2c	300.0	10.0	LE1	6.0	0.0	OK

Design data

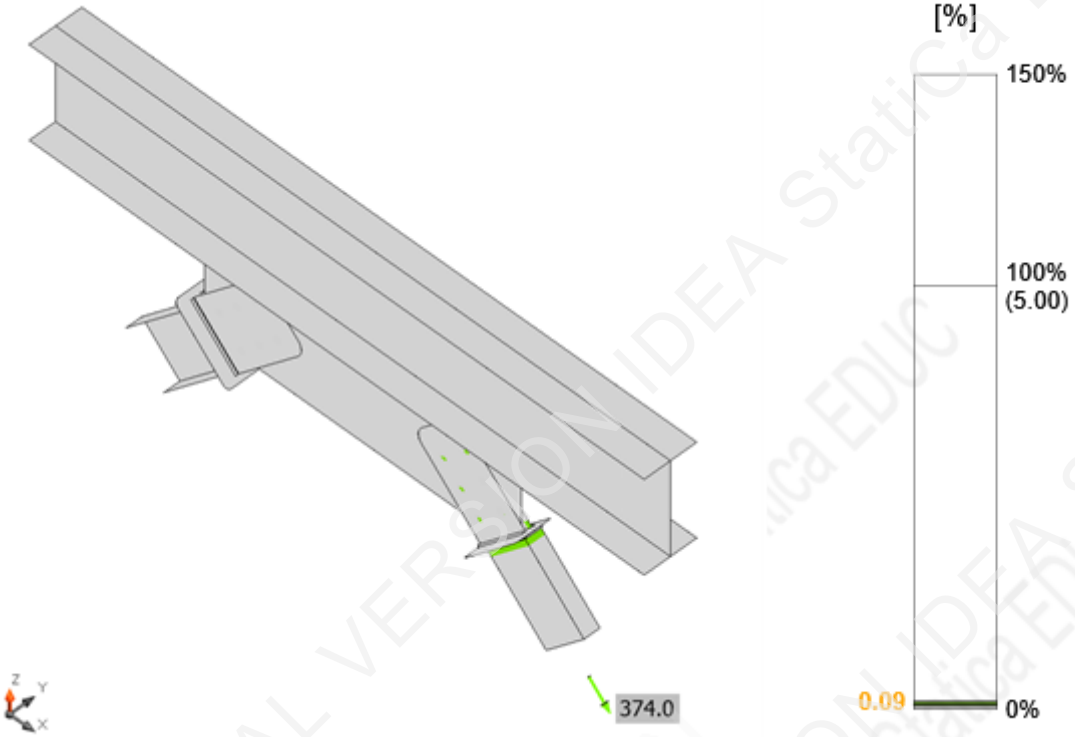
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

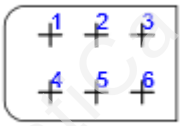
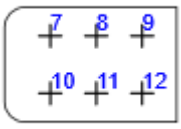


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	20 A325M - 1	LE1	7.3	32.0	216.0	270.0	4.6	36.6	13.6	OK
	B2	20 A325M - 1	LE1	3.2	31.1	216.0	270.0	2.1	35.5	12.7	OK
	B3	20 A325M - 1	LE1	3.8	31.2	216.0	151.3	2.4	40.5	12.8	OK
	B4	20 A325M - 1	LE1	7.3	32.1	216.0	270.0	4.6	36.7	13.7	OK
	B5	20 A325M - 1	LE1	3.3	31.6	216.0	270.0	2.1	36.0	13.0	OK
	B6	20 A325M - 1	LE1	4.0	32.6	216.0	237.2	2.5	37.3	13.9	OK
	B7	20 A325M - 1	LE1	0.1	0.2	216.0	270.0	0.0	0.2	0.0	OK
	B8	20 A325M - 1	LE1	0.1	0.5	216.0	213.9	0.1	0.6	0.0	OK
	B9	20 A325M - 1	LE1	0.1	0.8	216.0	344.0	0.1	0.9	0.0	OK
	B10	20 A325M - 1	LE1	0.2	1.3	216.0	187.7	0.2	1.5	0.0	OK
	B11	20 A325M - 1	LE1	0.1	0.4	216.0	188.4	0.1	0.4	0.0	OK
	B12	20 A325M - 1	LE1	0.0	0.4	216.0	159.9	0.0	0.4	0.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
20 A325M - 1	156.4	87.6

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
CH-bfl 1	SP1	E49xx	◢7.1◣	◢10.0◣	999	38	36.9	78.7	46.8	OK
		E49xx	◢7.1◣	◢10.0◣	999	38	36.9	78.8	46.8	OK
CPL1a	CPL1b	E49xx	◢7.1	◢10.0	199	18	32.1	41.9	76.6	OK
CPL1a	CPL1c	E49xx	◢7.1	◢10.0	199	18	23.4	42.2	55.5	OK
CPL1a	D1-bfl 1	E49xx	◢7.1◣	◢10.0◣	50	25	33.6	58.6	57.3	OK
		E49xx	◢7.1◣	◢10.0◣	50	25	27.5	56.7	48.4	OK
CPL1a	D1-tfl 1	E49xx	◢7.1◣	◢10.0◣	50	25	28.6	56.6	50.5	OK
		E49xx	◢7.1◣	◢10.0◣	50	25	35.0	58.6	59.8	OK
CPL1a	D1-w 1	E49xx	◢7.1◣	◢10.0◣	168	21	21.0	49.1	42.9	OK
		E49xx	◢7.1◣	◢10.0◣	168	21	18.5	47.8	38.7	OK
CPL2a	CPL2b	E49xx	◢7.1	◢10.0	199	18	0.5	42.3	1.2	OK
CPL2a	CPL2c	E49xx	◢7.1	◢10.0	199	18	0.8	42.2	2.0	OK
CPL2a	D2-bfl 1	E49xx	◢7.1◣	◢10.0◣	50	25	0.7	58.6	1.2	OK
		E49xx	◢7.1◣	◢10.0◣	50	25	0.5	57.4	0.9	OK
CPL2a	D2-tfl 1	E49xx	◢7.1◣	◢10.0◣	50	25	0.5	57.5	0.9	OK
		E49xx	◢7.1◣	◢10.0◣	50	25	0.7	58.6	1.2	OK
CPL2a	D2-w 1	E49xx	◢7.1◣	◢10.0◣	168	21	0.6	49.1	1.1	OK
		E49xx	◢7.1◣	◢10.0◣	168	21	0.4	48.7	0.8	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	

Item	Value	Unit	Reference
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

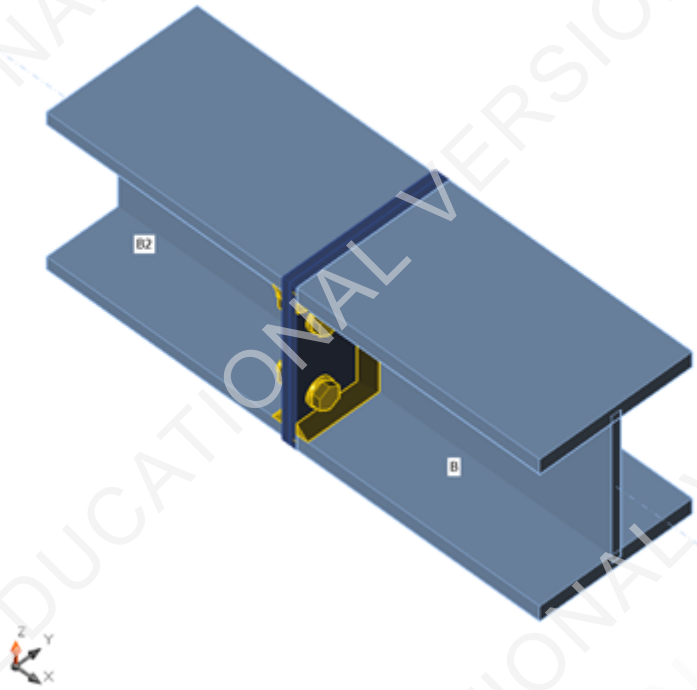
Project item SPLICE W200X42 TO 52

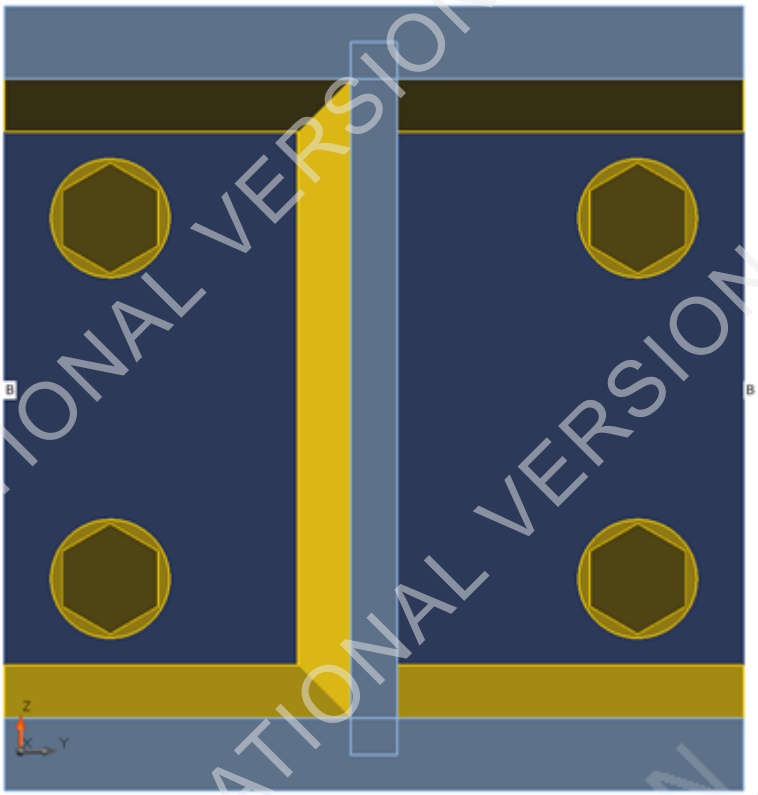
Design

Name	SPLICE W200X42 TO 52
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B	7 - W200X86	0.0	0.0	0.0	0	0	0	Bolts
B2	8 - W200X71	180.0	0.0	0.0	0	0	0	Bolts





Cross-sections

Name	Material
7 - W200X86	300W
8 - W200X71	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B2	-927.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	1.8 < 100%	OK
Welds	53.6 < 100%	OK
Buckling	Not calculated	

Plates

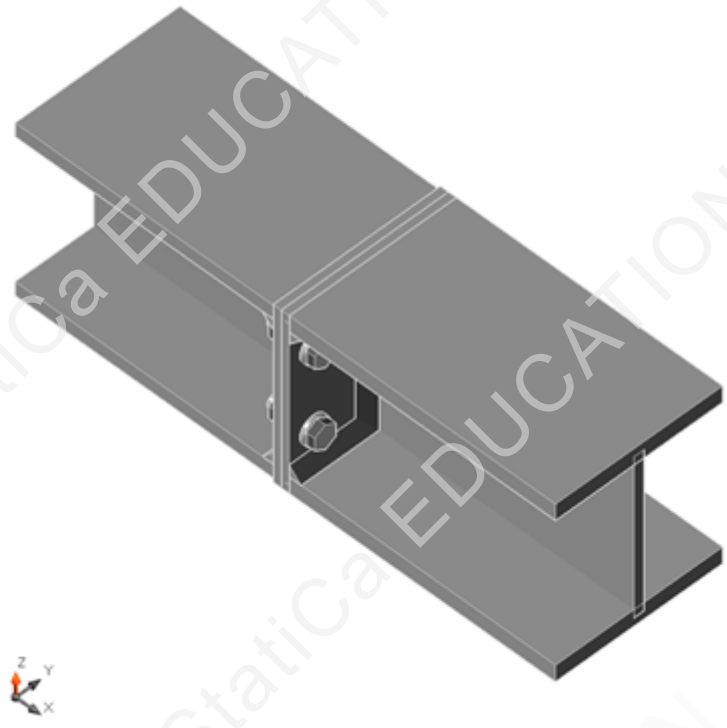
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B-bfl 1	300.0	20.6	LE1	92.2	0.0	OK
B-tfl 1	300.0	20.6	LE1	92.2	0.0	OK
B-w 1	300.0	13.0	LE1	99.0	0.0	OK
B2-bfl 1	300.0	17.4	LE1	112.0	0.0	OK
B2-tfl 1	300.0	17.4	LE1	112.1	0.0	OK
B2-w 1	300.0	10.2	LE1	111.2	0.0	OK
PP1a	300.0	10.0	LE1	72.2	0.0	OK
PP1b	300.0	10.0	LE1	58.4	0.0	OK

Design data

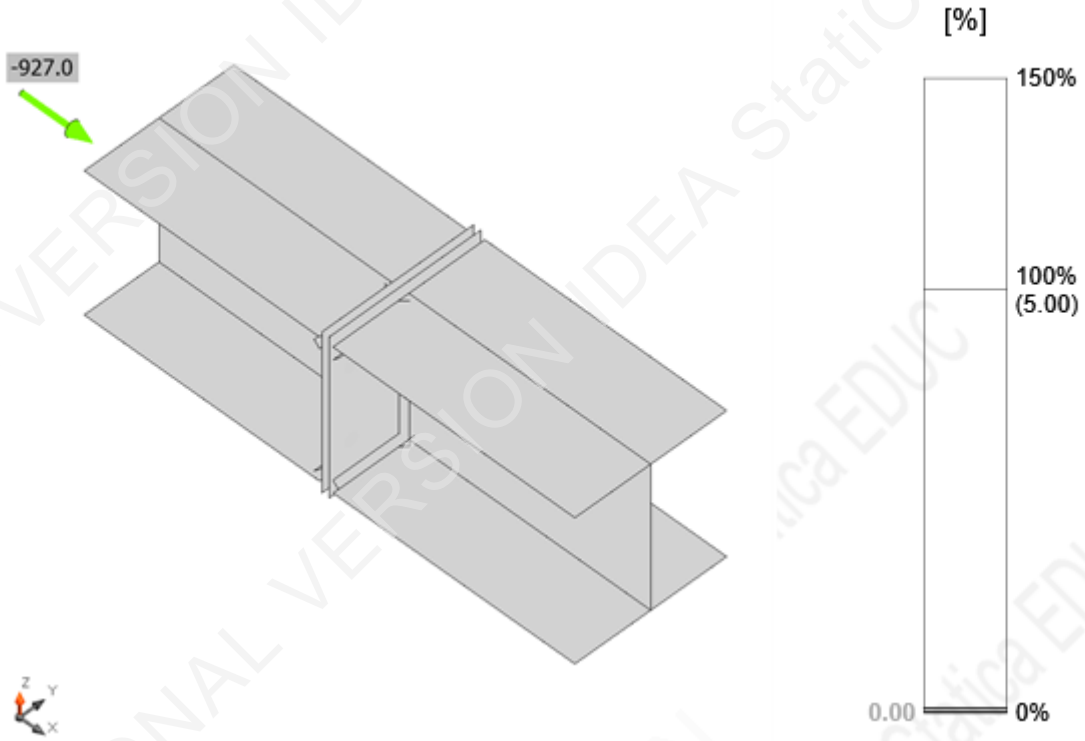
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

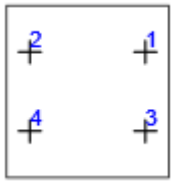


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	16 A325M - 1	LE1	1.8	0.3	172.8	108.8	1.8	0.5	0.0	OK
	B2	16 A325M - 1	LE1	1.8	0.3	172.8	108.7	1.8	0.5	0.0	OK
	B3	16 A325M - 1	LE1	1.8	0.3	172.8	108.8	1.8	0.5	0.0	OK
	B4	16 A325M - 1	LE1	1.8	0.3	172.8	108.7	1.8	0.5	0.0	OK

Design data

Grade	T_r [kN]	V_r [kN]
16 A325M - 1	100.1	56.1

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
PP1a	B-bfl 1	E49xx	◢10.6	◢15.0	208	14	24.3	48.4	50.2	OK
PP1a	B-tfl 1	E49xx	◢10.6	◢15.0	208	14	24.3	48.4	50.3	OK
PP1a	B-w 1	E49xx	◢10.6	◢15.0	201	13	21.8	46.1	47.3	OK
PP1b	B2-bfl 1	E49xx	◢10.6	◢15.0	205	14	25.6	47.7	53.6	OK
PP1b	B2-tfl 1	E49xx	◢10.6	◢15.0	205	14	25.6	47.7	53.6	OK
PP1b	B2-w 1	E49xx	◢10.6	◢15.0	198	14	17.6	48.5	36.4	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

Project:
Project no:
Author:

Project item SPLICE W200X52 TO 71

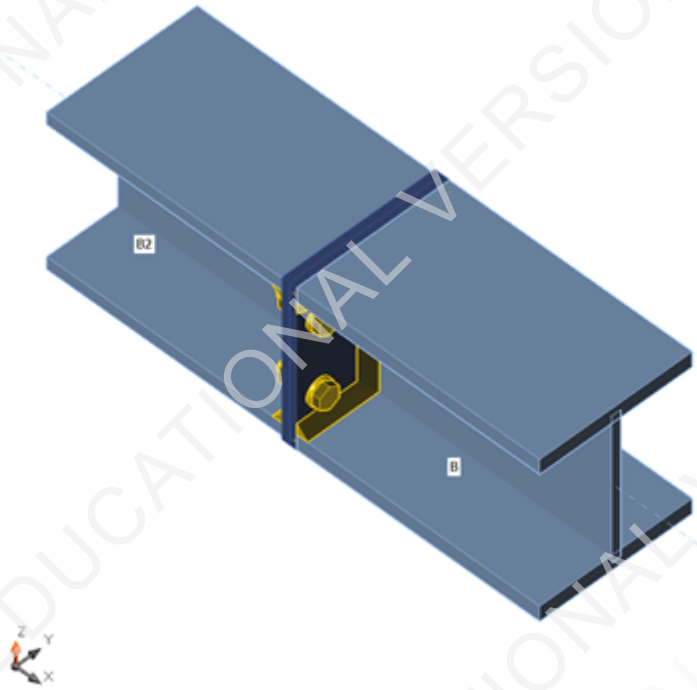
Design

Name	SPLICE W200X52 TO 71
Description	
Analysis	Stress, strain/ simplified loading

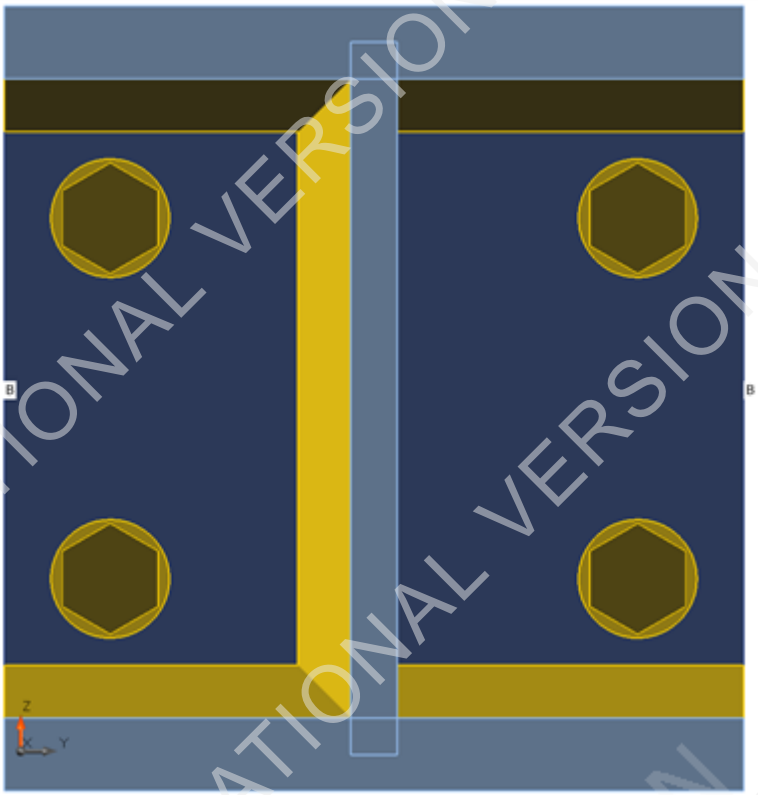
Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B	7 - W200X86	0.0	0.0	0.0	0	0	0	Bolts
B2	8 - W200X71	180.0	0.0	0.0	0	0	0	Bolts

Project:
Project no:
Author:



Project:
Project no:
Author:



Cross-sections

Name	Material
7 - W200X86	300W
8 - W200X71	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B2	-1453.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Bolts	2.8 < 100%	OK
Welds	75.6 < 100%	OK
Buckling	Not calculated	

Project:
Project no:
Author:

Plates

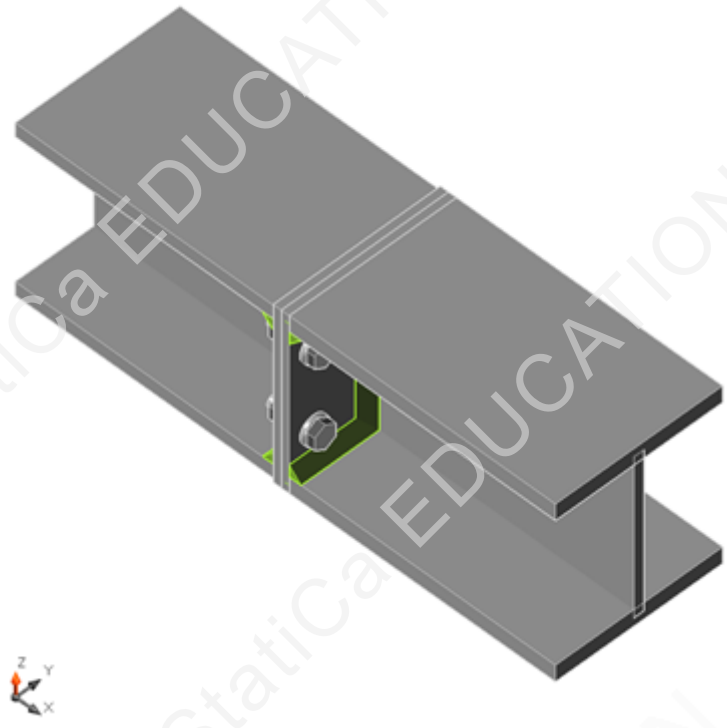
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B-bfl 1	300.0	20.6	LE1	144.4	0.0	OK
B-tfl 1	300.0	20.6	LE1	144.4	0.0	OK
B-w 1	300.0	13.0	LE1	161.6	0.0	OK
B2-bfl 1	300.0	17.4	LE1	181.9	0.0	OK
B2-tfl 1	300.0	17.4	LE1	182.0	0.0	OK
B2-w 1	300.0	10.2	LE1	179.9	0.0	OK
PP1a	300.0	10.0	LE1	111.6	0.0	OK
PP1b	300.0	10.0	LE1	85.4	0.0	OK

Design data

Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

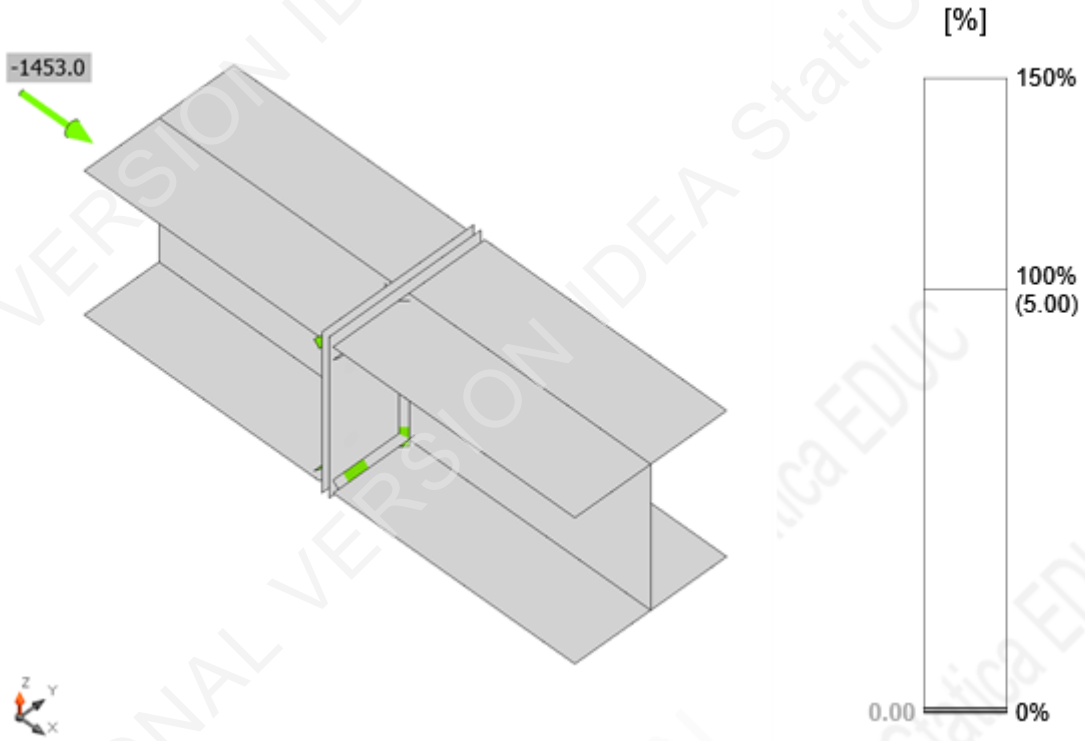
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain



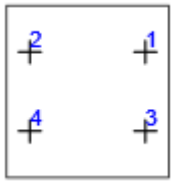
Overall check, LE1

Project:
Project no:
Author:



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	16 A325M - 1	LE1	2.8	0.5	172.8	110.7	2.8	0.9	0.1	OK
	B2	16 A325M - 1	LE1	2.8	0.5	172.8	110.6	2.8	0.9	0.1	OK
	B3	16 A325M - 1	LE1	2.8	0.5	172.8	110.7	2.8	0.9	0.1	OK
	B4	16 A325M - 1	LE1	2.8	0.5	172.8	110.6	2.8	0.9	0.1	OK

Design data

Grade	T_r [kN]	V_r [kN]
16 A325M - 1	100.1	56.1

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
PP1a	B-bfl 1	E49xx	◢10.6	◢15.0	208	14	36.3	48.4	75.1	OK
PP1a	B-tfl 1	E49xx	◢10.6	◢15.0	208	14	36.3	48.4	75.1	OK
PP1a	B-w 1	E49xx	◢10.6	◢15.0	200	13	34.8	46.4	75.0	OK
PP1b	B2-bfl 1	E49xx	◢10.6	◢15.0	205	14	36.1	47.7	75.6	OK
PP1b	B2-tfl 1	E49xx	◢10.6	◢15.0	205	14	36.1	47.7	75.6	OK
PP1b	B2-w 1	E49xx	◢10.6	◢15.0	198	14	36.1	48.8	73.9	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

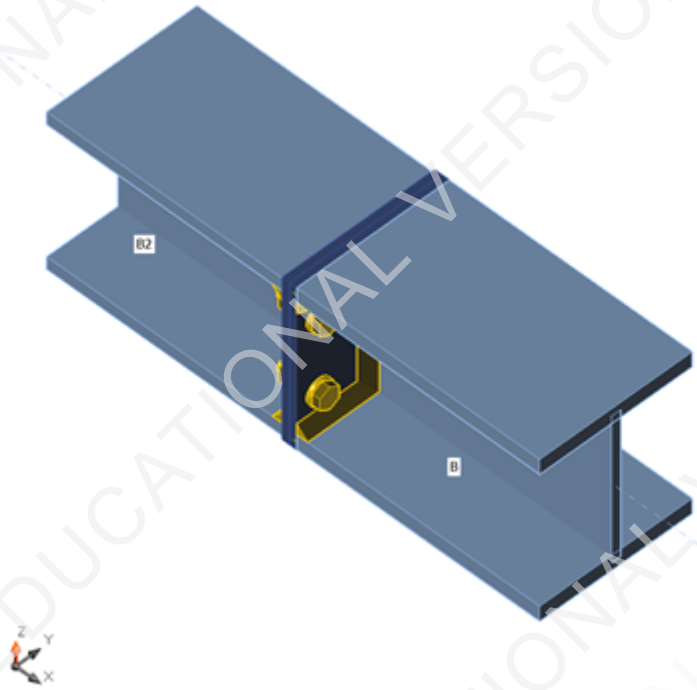
Project item SPLICE W200X71 TO 86

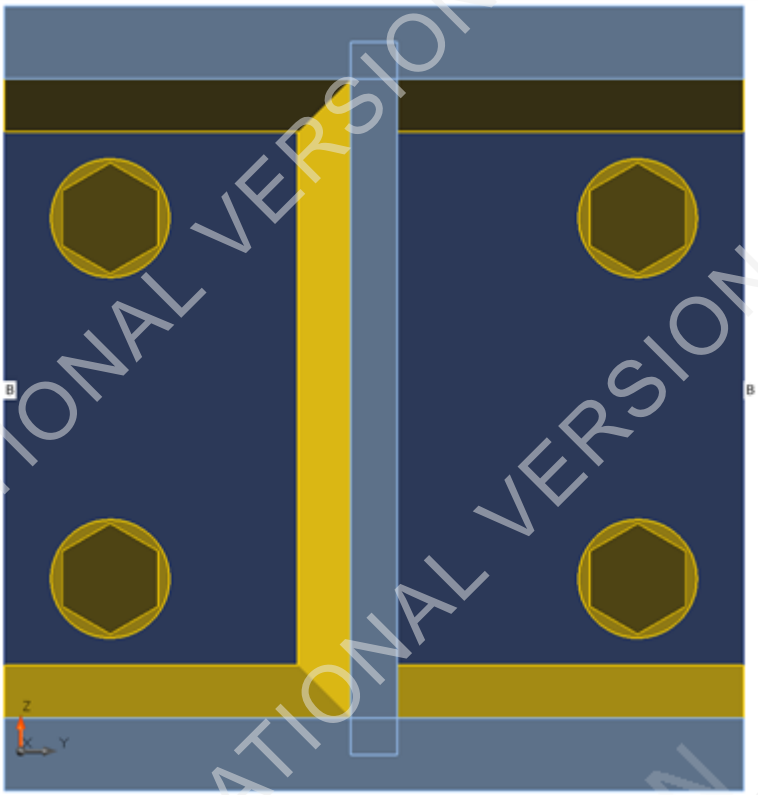
Design

Name	SPLICE W200X71 TO 86
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B	7 - W200X86	0.0	0.0	0.0	0	0	0	Bolts
B2	8 - W200X71	180.0	0.0	0.0	0	0	0	Bolts





Cross-sections

Name	Material
7 - W200X86	300W
8 - W200X71	300W

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B2	-1948.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Bolts	3.7 < 100%	OK
Welds	93.6 < 100%	OK
Buckling	Not calculated	

Plates

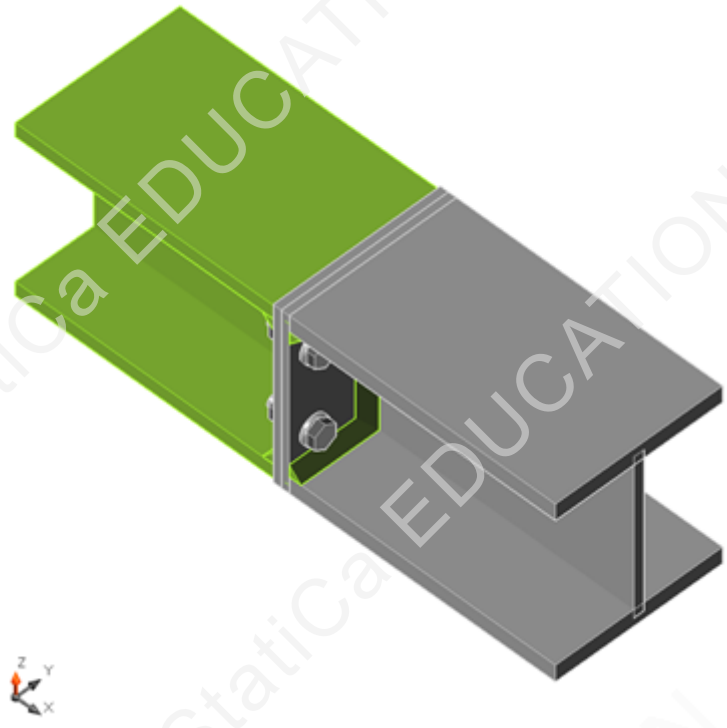
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
B-bfl 1	300.0	20.6	LE1	193.4	0.0	OK
B-tfl 1	300.0	20.6	LE1	193.4	0.0	OK
B-w 1	300.0	13.0	LE1	235.3	0.0	OK
B2-bfl 1	300.0	17.4	LE1	229.8	0.0	OK
B2-tfl 1	300.0	17.4	LE1	229.8	0.0	OK
B2-w 1	300.0	10.2	LE1	270.1	0.1	OK
PP1a	300.0	10.0	LE1	154.1	0.0	OK
PP1b	300.0	10.0	LE1	98.4	0.0	OK

Design data

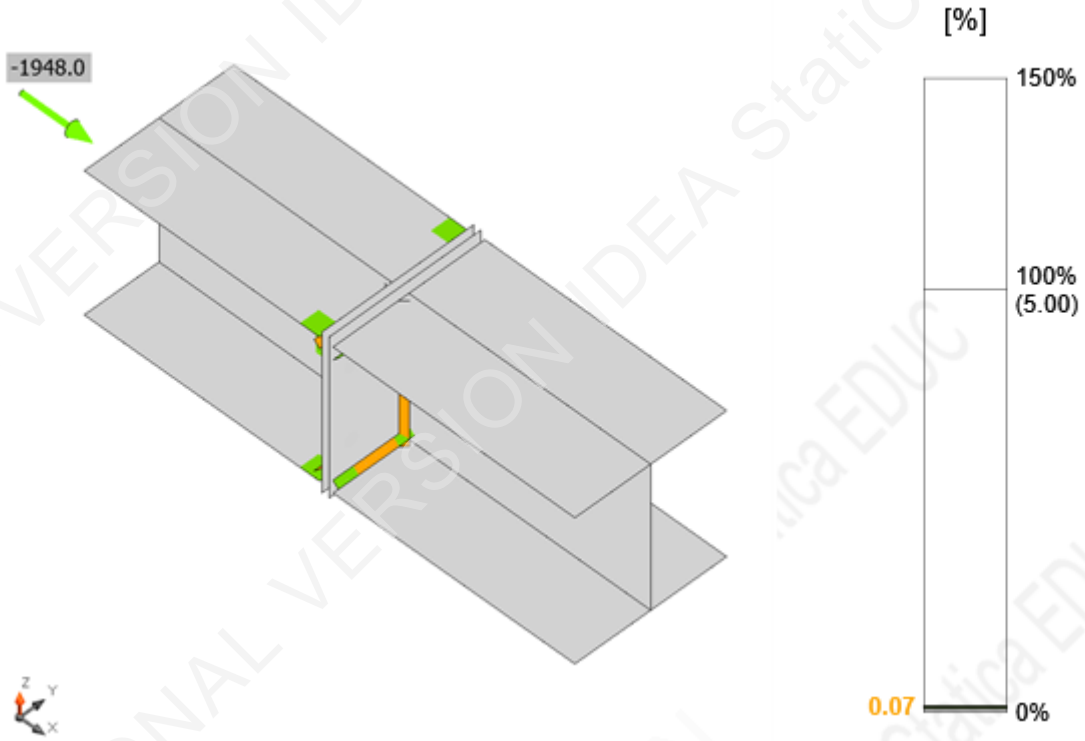
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

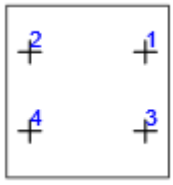


Overall check, LE1



Strain check, LE1

Bolts

Shape	Item	Grade	Loads	T_f [kN]	V_f [kN]	B_r [kN]	$T_{r,bs}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	16 A325M - 1	LE1	3.7	0.9	172.8	195.3	3.7	1.5	0.2	OK
	B2	16 A325M - 1	LE1	3.7	0.9	172.8	195.1	3.7	1.5	0.2	OK
	B3	16 A325M - 1	LE1	3.7	0.9	172.8	195.2	3.7	1.5	0.2	OK
	B4	16 A325M - 1	LE1	3.7	0.9	172.8	195.3	3.7	1.5	0.2	OK

Design data

Grade	T_r [kN]	V_r [kN]
16 A325M - 1	100.1	56.1

Symbol explanation

T_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
B_r	Bearing resistance
$T_{r,bs}$	Tear-out resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
T_r	Tension resistance
V_r	Shear resistance

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
PP1a	B-bfl 1	E49xx	◢10.6	◢15.0	208	14	43.7	48.4	90.3	OK
PP1a	B-tfl 1	E49xx	◢10.6	◢15.0	208	14	43.7	48.4	90.3	OK
PP1a	B-w 1	E49xx	◢10.6	◢15.0	200	13	42.9	46.6	91.9	OK
PP1b	B2-bfl 1	E49xx	◢10.6	◢15.0	205	14	44.7	47.7	93.6	OK
PP1b	B2-tfl 1	E49xx	◢10.6	◢15.0	205	14	44.7	47.7	93.6	OK
PP1b	B2-w 1	E49xx	◢10.6	◢15.0	198	14	45.4	49.4	91.8	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

Project:
Project no:
Author:

Project item W200X42

Design

Name	W200X42
Description	
Analysis	Stress, strain/ simplified loading

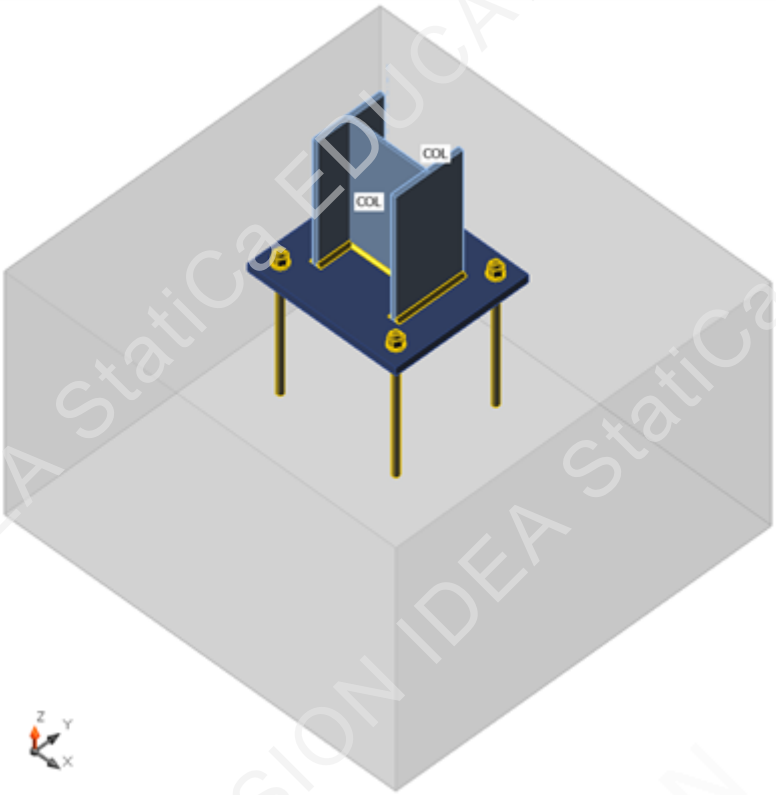
Beams and columns

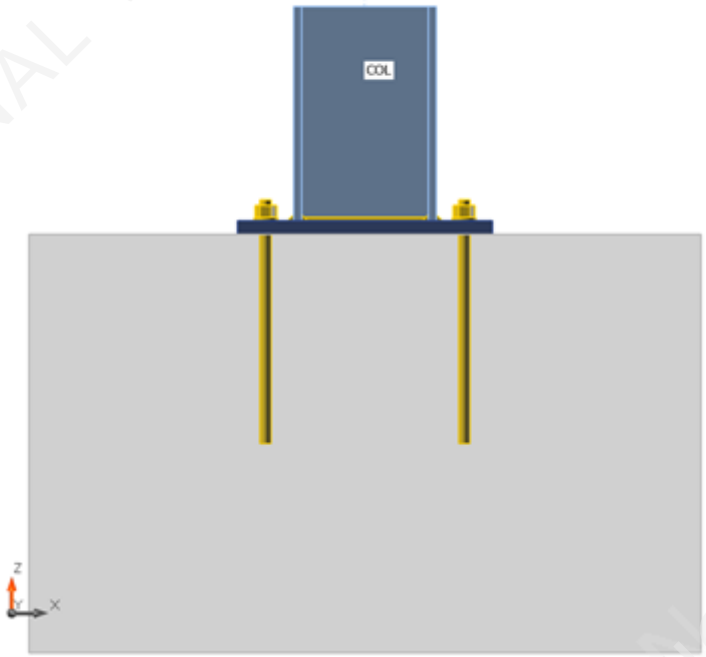
Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
COL	9 - W200X41.7	0.0	-90.0	0.0	0	0	0	Node

Project:

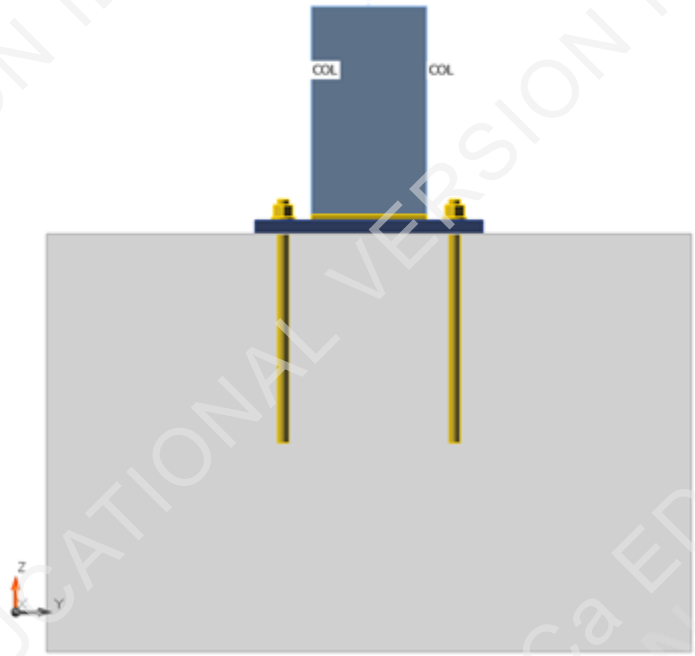
Project no:

Author:





Project:
Project no:
Author:



Cross-sections

Name	Material
9 - W200X41.7	300W

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	COL	-434.0	0.0	0.0	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	926 x 965	mm
Depth	600	mm
Anchor	16 A325M	
Anchoring length	300	mm
Shear force transfer	Friction	

Project:
Project no:
Author:

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5%	OK
Anchors	0.0 < 100%	OK
Welds	66.8 < 100%	OK
Concrete block	13.1 < 100%	OK
Shear	0.0 < 100%	OK
Buckling	Not calculated	

Plates

Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
COL-bfl 1	300.0	11.8	LE1	142.7	0.0	OK
COL-tfl 1	300.0	11.8	LE1	142.2	0.0	OK
COL-w 1	300.0	7.2	LE1	93.6	0.0	OK
BP1	300.0	20.0	LE1	94.9	0.0	OK

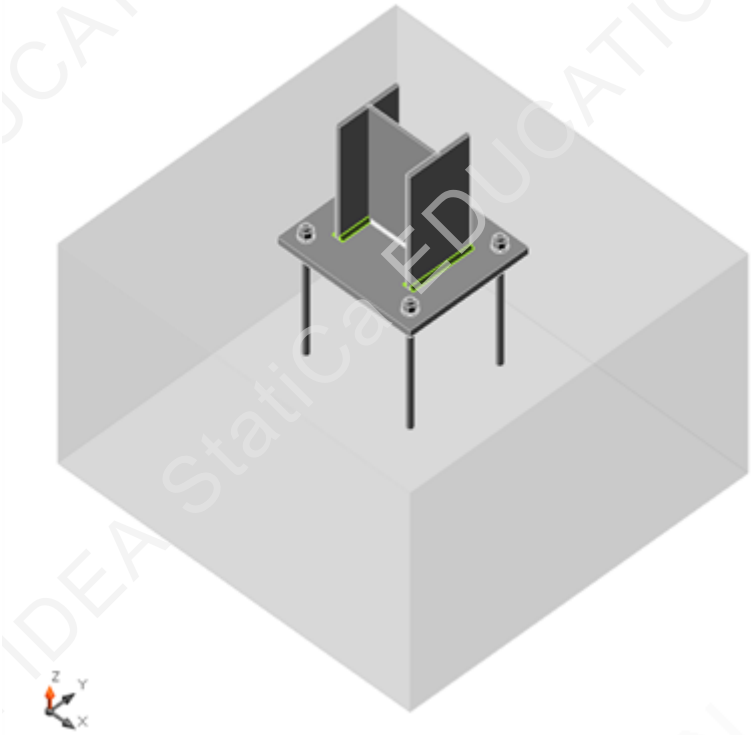
Design data

Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

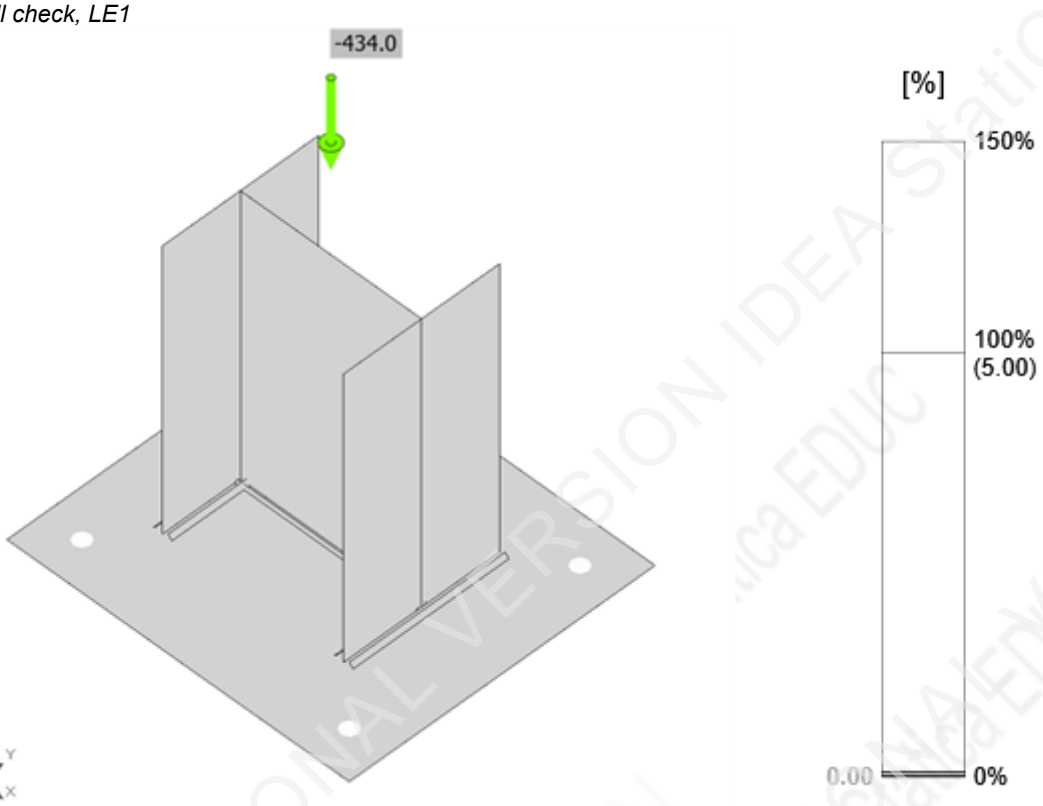
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

Project:
Project no:
Author:



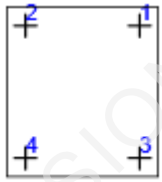
Overall check, LE1



Strain check, LE1

Project:
Project no:
Author:

Anchors

Shape	Item	Loads	N_f [kN]	V_f [kN]	V_{cpr} [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A1	LE1	0.0	0.0	449.7	0.0	0.0	0.0	OK
	A2	LE1	0.0	0.0	449.7	0.0	0.0	0.0	OK
	A3	LE1	0.0	0.0	449.7	0.0	0.0	0.0	OK
	A4	LE1	0.0	0.0	449.7	0.0	0.0	0.0	OK

Design data

Grade	N_{sar} [kN]
16 A325M - 1	88.6

Symbol explanation

N_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
V_{cpr}	Concrete pryout strength – A23.3-14 – D.7.3.
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Interaction of tensile and shear forces – A23.3-14 – Figure D.18.
N_{sar}	Steel strength of anchor in tension – CSA A23.3-14 – D.6.1

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
BP1	COL-bfl 1	E49xx	◢5.9◣	◢8.3◣	166	24	27.9	41.7	66.8	OK
		E49xx	◢5.9◣	◢8.3◣	166	24	27.8	42.4	65.5	OK
BP1	COL-tfl 1	E49xx	◢5.9◣	◢8.3◣	166	24	27.8	42.4	65.5	OK
		E49xx	◢5.9◣	◢8.3◣	166	24	27.8	41.8	66.7	OK
BP1	COL-w 1	E49xx	◢3.6◣	◢5.1◣	192	24	9.2	28.5	32.2	OK
		E49xx	◢3.6◣	◢5.1◣	192	24	9.2	28.5	32.3	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Concrete block

Item	Loads	A_1 [mm2]	A_2 [mm2]	σ [MPa]	F_p [MPa]	Ut [%]	Status
CB 1	LE1	109394	789609	4.0	30.5	13.1	OK

Symbol explanation

A_1	Base plate loaded area in contact with the concrete block
A_2	Concrete supporting area
σ	Average compressive strength under the base plate
F_p	Design bearing strength
Ut	Utilization

Shear in contact plane

Item	Loads	V [kN]	V_r [kN]	μ [-]	Ut [%]	Status
BP1	LE1	0.0	-	0.40	0.0	OK

Symbol explanation

V	Shear force
V_r	Shear resistance
μ	Coefficient of friction between base plate and concrete block
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

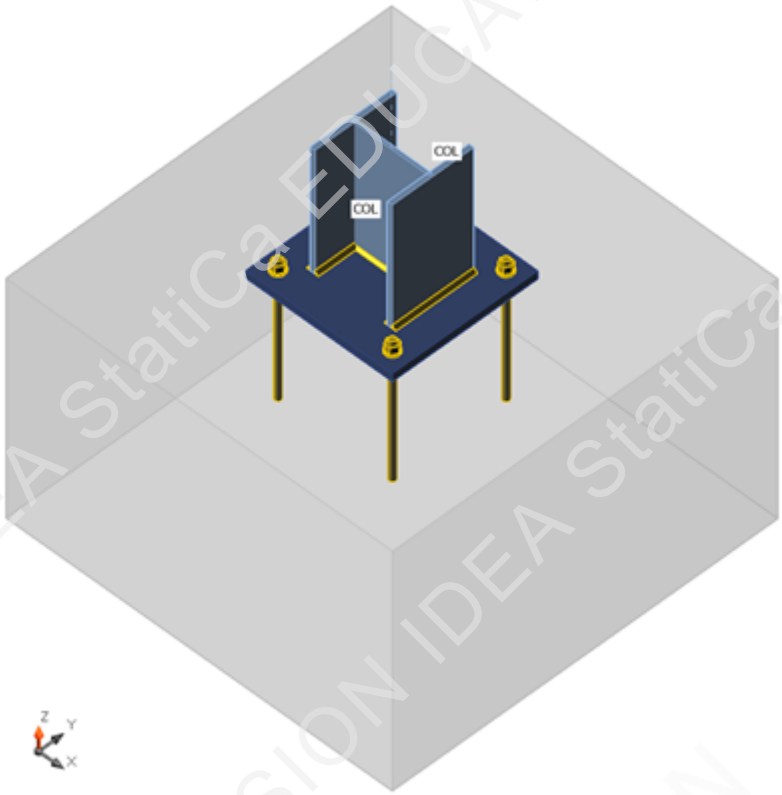
Project item W200X52

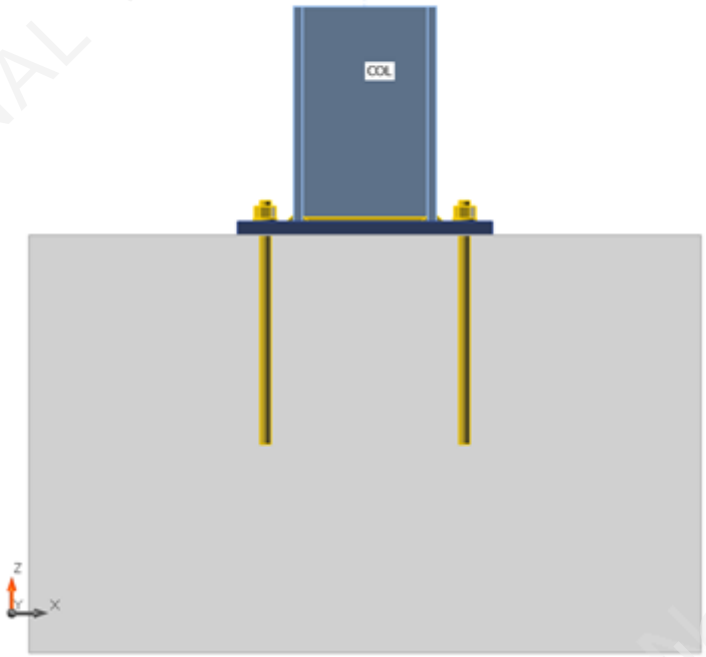
Design

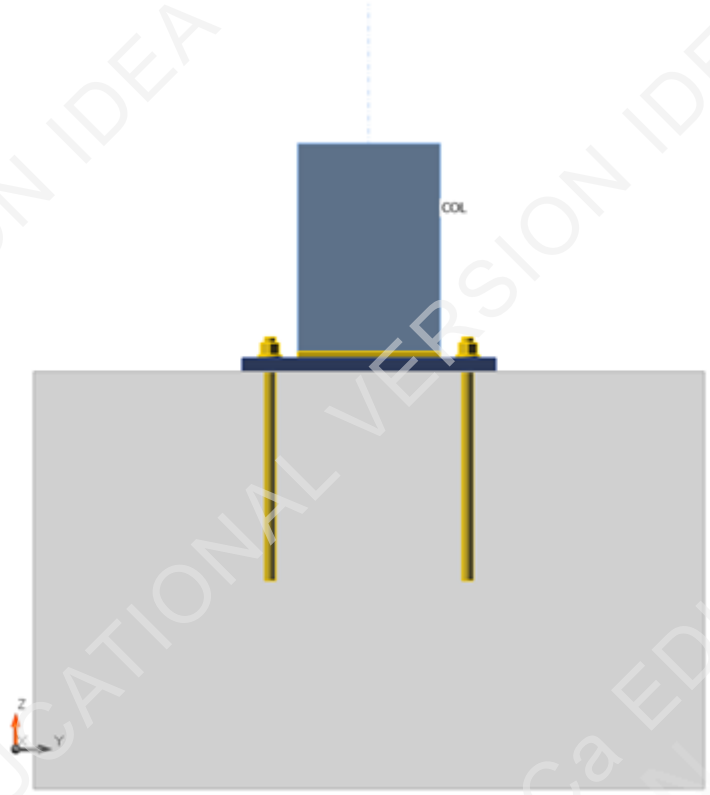
Name	W200X52
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
COL	3 - W200X52	0.0	-90.0	0.0	0	0	0	Node







Cross-sections

Name	Material
3 - W200X52	300W

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	COL	-1205.0	0.0	0.0	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	964 x 966	mm
Depth	600	mm
Anchor	16 A325M	
Anchoring length	300	mm
Shear force transfer	Friction	

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Anchors	0.0 < 100%	OK
Welds	76.2 < 100%	OK
Concrete block	34.6 < 100%	OK
Shear	0.0 < 100%	OK
Buckling	Not calculated	

Plates

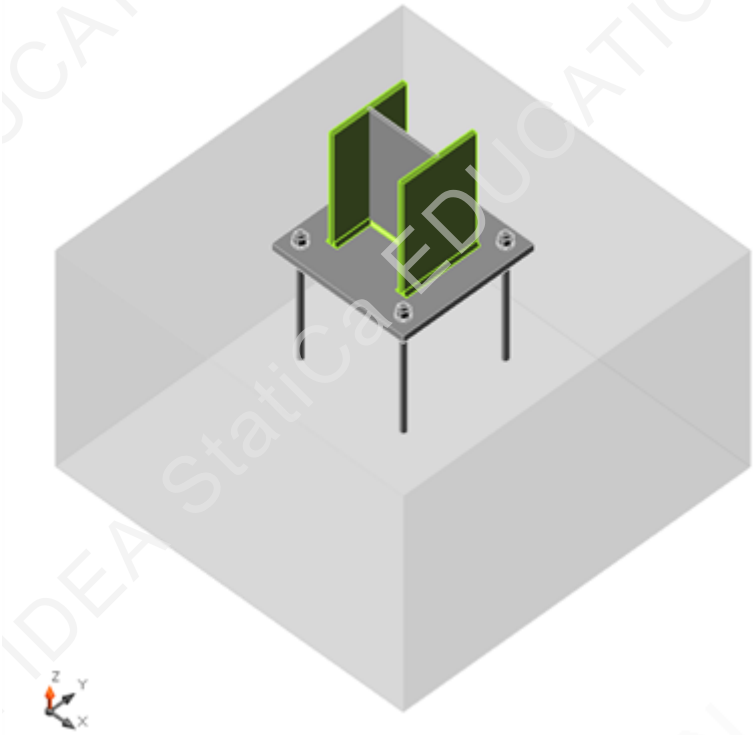
Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
COL-bfl 1	300.0	12.6	LE1	255.6	0.1	OK
COL-tfl 1	300.0	12.6	LE1	256.8	0.1	OK
COL-w 1	300.0	7.9	LE1	219.4	0.0	OK
BP1	300.0	20.0	LE1	237.4	0.0	OK

Design data

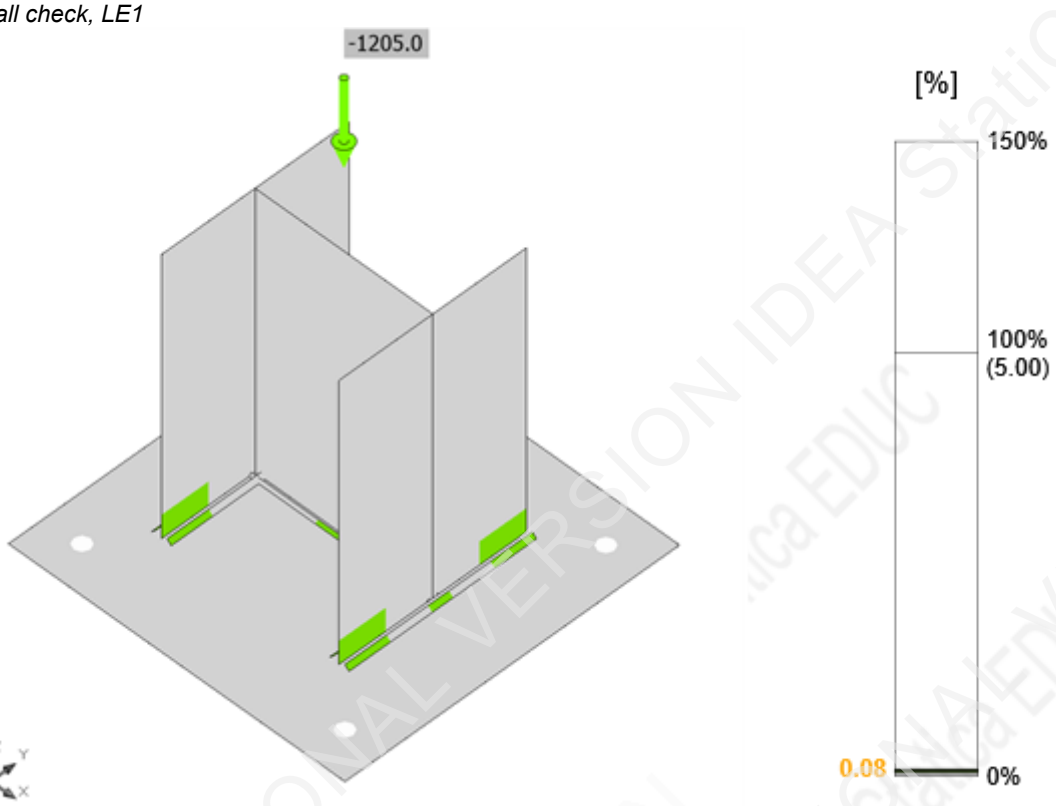
Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

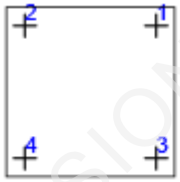


Overall check, LE1



Strain check, LE1

Anchors

Shape	Item	Loads	N_f [kN]	V_f [kN]	V_{cpr} [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A1	LE1	0.0	0.0	469.2	0.0	0.0	0.0	OK
	A2	LE1	0.0	0.0	469.2	0.0	0.0	0.0	OK
	A3	LE1	0.0	0.0	469.2	0.0	0.0	0.0	OK
	A4	LE1	0.0	0.0	469.2	0.0	0.0	0.0	OK

Design data

Grade	N_{sar} [kN]
16 A325M - 1	88.6

Symbol explanation

N_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
V_{cpr}	Concrete pryout strength – A23.3-14 – D.7.3.
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Interaction of tensile and shear forces – A23.3-14 – Figure D.18.
N_{sar}	Steel strength of anchor in tension – CSA A23.3-14 – D.6.1

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
BP1	COL-bfl 1	E49xx	◢6.3◣	◢8.9◣	203	23	35.5	46.6	76.1	OK
		E49xx	◢6.3◣	◢8.9◣	203	23	35.7	46.8	76.2	OK
BP1	COL-tfl 1	E49xx	◢6.3◣	◢8.9◣	203	23	35.6	46.8	76.1	OK
		E49xx	◢6.3◣	◢8.9◣	203	23	35.4	46.6	76.0	OK
BP1	COL-w 1	E49xx	◢4.0◣	◢5.6◣	193	24	23.5	31.4	75.1	OK
		E49xx	◢4.0◣	◢5.6◣	193	24	23.5	31.4	75.1	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Concrete block

Item	Loads	A_1 [mm2]	A_2 [mm2]	σ [MPa]	F_p [MPa]	Ut [%]	Status
CB 1	LE1	114695	802943	10.5	30.5	34.6	OK

Symbol explanation

A_1	Base plate loaded area in contact with the concrete block
A_2	Concrete supporting area
σ	Average compressive strength under the base plate
F_p	Design bearing strength
Ut	Utilization

Shear in contact plane

Item	Loads	V [kN]	V_r [kN]	μ [-]	Ut [%]	Status
BP1	LE1	0.0	-	0.40	0.0	OK

Symbol explanation

V	Shear force
V_r	Shear resistance
μ	Coefficient of friction between base plate and concrete block
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections

Project:
Project no:
Author:

Project item W200X86

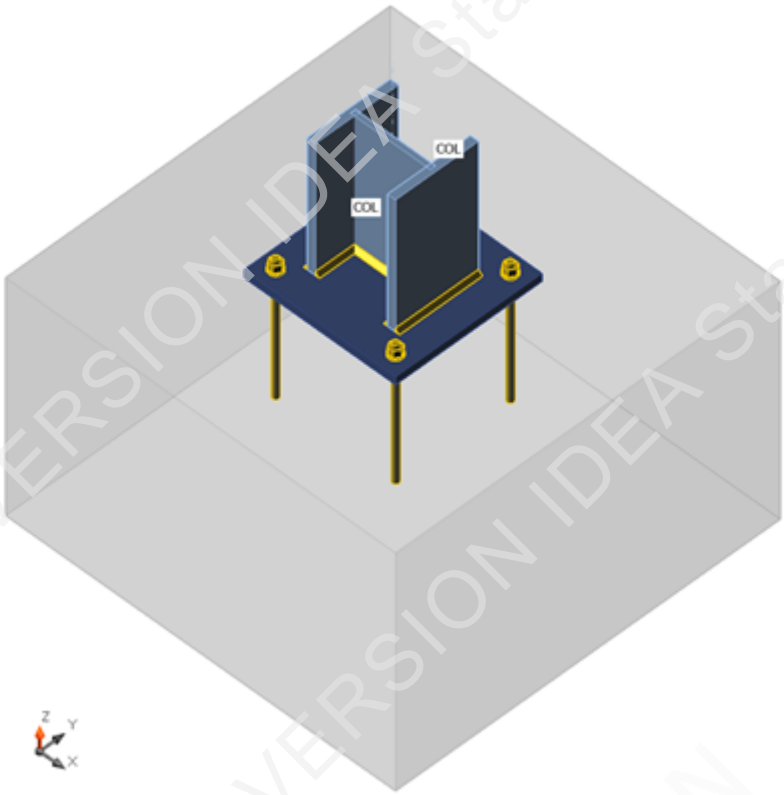
Design

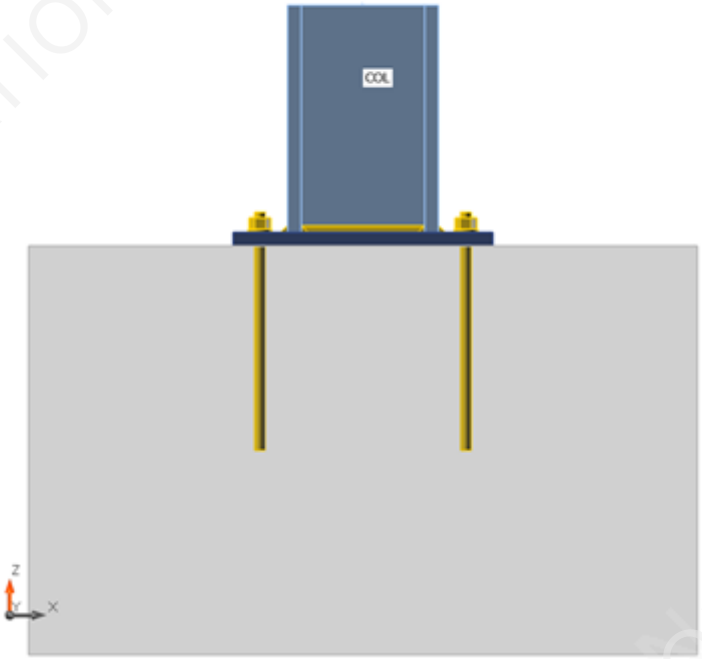
Name	W200X86
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
COL	2 - W200X86	0.0	-90.0	0.0	0	0	0	Node

Project:
Project no:
Author:





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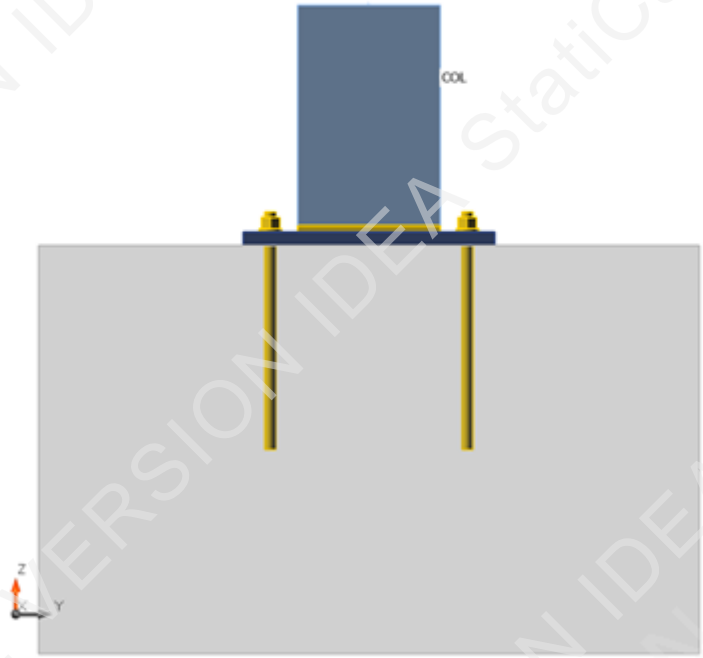


Cross-sections

Name	Material
2 - W200X86	300W

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
16 A325M	16 A325M	16	830.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	COL	-1948.0	0.0	0.0	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	969 x 982	mm
Depth	600	mm
Anchor	16 A325M	
Anchoring length	300	mm
Shear force transfer	Friction	

Project:
Project no:
Author:

IDEA StatiCa
Calculate yesterday's estimates

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5%	OK
Anchors	2.4 < 100%	OK
Welds	87.6 < 100%	OK
Concrete block	54.8 < 100%	OK
Shear	0.0 < 100%	OK
Buckling	Not calculated	

Plates

Name	F_y [MPa]	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Check status
COL-bfl 1	300.0	20.6	LE1	225.4	0.0	OK
COL-tfl 1	300.0	20.6	LE1	224.4	0.0	OK
COL-w 1	300.0	13.0	LE1	244.1	0.0	OK
BP1	300.0	20.0	LE1	270.1	0.1	OK

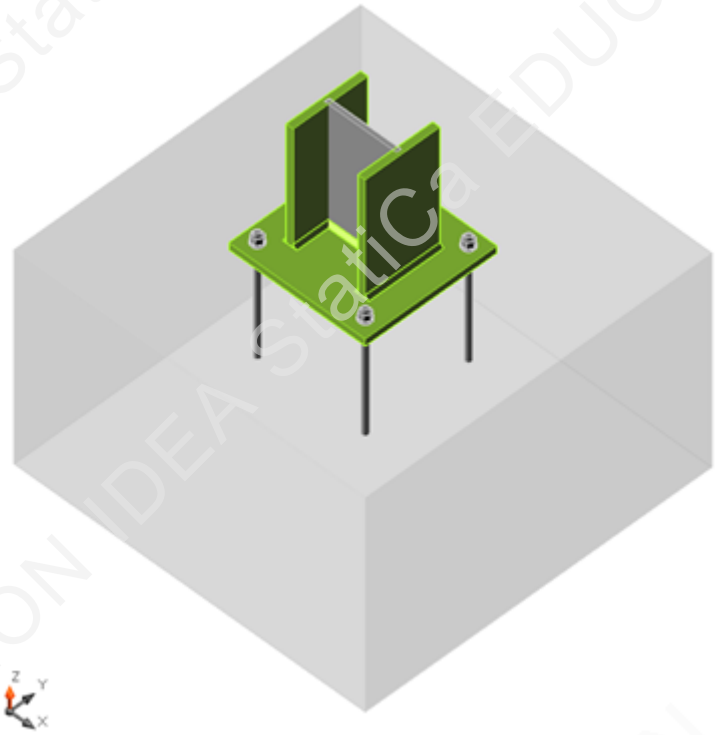
Design data

Material	fy [MPa]	ε_{lim} [%]
300W	300.0	5.0

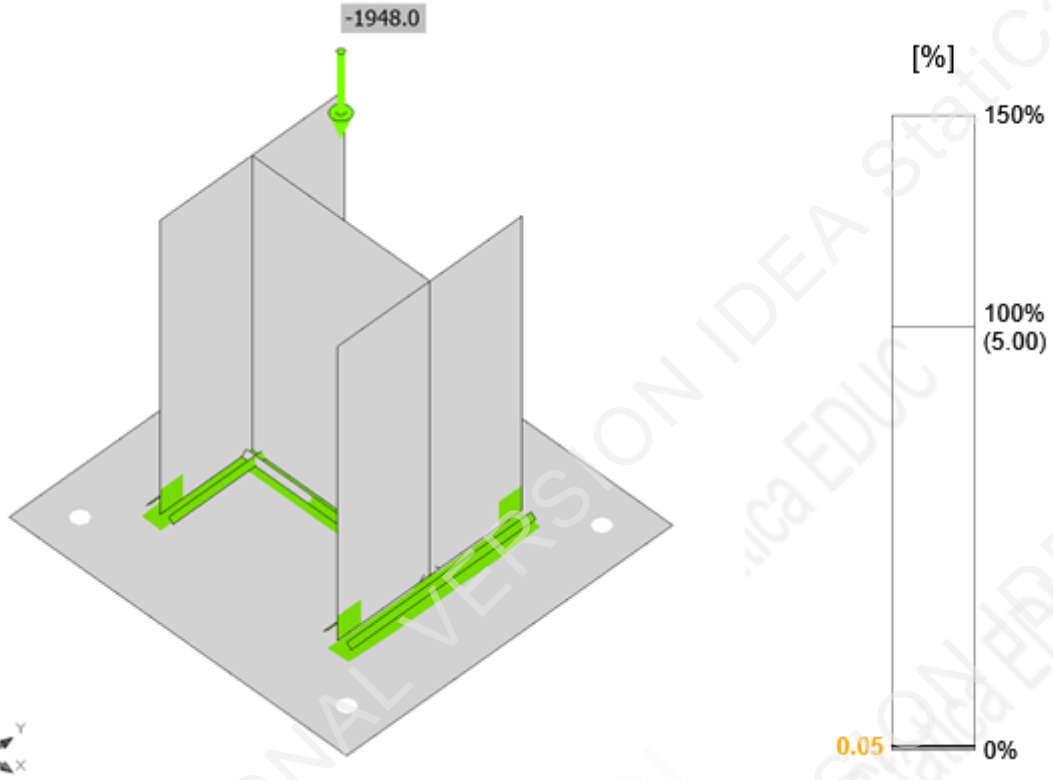
Symbol explanation

ε_{Pl}	Plastic strain
σ_{Ed}	Eq. stress
fy	Yield strength
ε_{lim}	Limit of plastic strain

Project:
Project no:
Author:



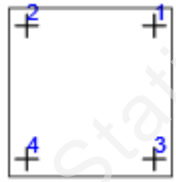
Overall check, LE1



Strain check, LE1

Project:
Project no:
Author:

Anchors

Shape	Item	Loads	N_f [kN]	V_f [kN]	N_{cbr} [kN]	V_{cpr} [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A1	LE1	1.4	0.0	239.3	479.4	2.4	0.0	0.2	OK
	A2	LE1	1.4	0.0	239.3	479.4	2.4	0.0	0.2	OK
	A3	LE1	1.4	0.0	239.3	479.4	2.4	0.0	0.2	OK
	A4	LE1	1.4	0.0	239.3	479.4	2.4	0.0	0.2	OK

Design data

Grade	N_{sar} [kN]
16 A325M - 1	88.6

Symbol explanation

N_f	Tensile force
V_f	Resultant of shear forces Vy, Vz in bolt
N_{cbr}	Concrete breakout strength – CSA A23.3-14 – D.6.2
V_{cpr}	Concrete pryout strength – A23.3-14 – D.7.3.
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Interaction of tensile and shear forces – A23.3-14 – Figure D.18.
N_{sar}	Steel strength of anchor in tension – CSA A23.3-14 – D.6.1

Welds

Item	Edge	Material	T_h [mm]	L_s [mm]	L [mm]	L_c [mm]	F_w [kN]	V_r [kN]	Ut [%]	Status
BP1	COL-bfl 1	E49xx	◢7.1◣	◢10.0◣	209	23	46.0	53.2	86.6	OK
		E49xx	◢7.1◣	◢10.0◣	209	23	46.7	53.3	87.6	OK
BP1	COL-tfl 1	E49xx	◢7.1◣	◢10.0◣	209	23	46.8	53.4	87.6	OK
		E49xx	◢7.1◣	◢10.0◣	209	23	46.0	53.2	86.6	OK
BP1	COL-w 1	E49xx	◢7.1◣	◢10.0◣	201	25	43.9	58.4	75.1	OK
		E49xx	◢7.1◣	◢10.0◣	201	25	43.9	58.4	75.1	OK

Symbol explanation

T_h	Throat thickness
L_s	Leg size of weld
L	Length
L_c	Length of critical weld element
F_w	Force in weld critical element
V_r	Weld resistance
Ut	Utilization

Concrete block

Item	Loads	A_1 [mm2]	A_2 [mm2]	σ [MPa]	F_p [MPa]	Ut [%]	Status
CB 1	LE1	117678	797936	16.7	30.5	54.8	OK

Symbol explanation

A_1	Base plate loaded area in contact with the concrete block
A_2	Concrete supporting area
σ	Average compressive strength under the base plate
F_p	Design bearing strength
Ut	Utilization

Shear in contact plane

Item	Loads	V [kN]	V_r [kN]	μ [-]	Ut [%]	Status
BP1	LE1	0.0	-	0.40	0.0	OK

Symbol explanation

V	Shear force
V_r	Shear resistance
μ	Coefficient of friction between base plate and concrete block
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Structural steel ϕ	0.90	-	
Bolts ϕb	0.80	-	
Weld ϕw	0.67	-	
Friction coefficient in slip-resistance	0.30	-	
Limit plastic strain	0.05	-	
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.70	-	
Distance between bolts and edge [d]	1.25	-	
Base metal capacity check at weld fusion face	No		S16-14 - 13.13.2.2
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Large deformations for hollow sections