

PROJECT SAMPLE PROJECT IN LONDON	ENGINEER
DOCUMENT No. STR-CALC-548	REVISION 0
TITLE PLANTROOM STEELWORKS	Pages 47



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Annex A: Structural Analysis

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1 Basic Data

1.1 References

1.1.1 Norms and Standards

- [1] BS EN 1990:2002, Eurocode – Basis of structural design.
- [2] BS EN 1993-1, Eurocode 3 – Design of steel structures – Parts 1, 4 & 8.
- [3] BS EN 1999-1, Eurocode 9 – Design of aluminium structures – Parts 1 & 4.

1.1.2 Document Reference

- [4] *Structural Analysis – EWS 07. Stahlkonstruktion Variante 5 – gesamte Konstruktion. 18.09.2014.*
- [5] *Structural Analysis – EWS 07. Stahlkonstruktion Variante 5 - Südwand. 18.09.2014.*

1.1.3 System Drawing Reference

- [6] W3100-WB-L10-F-PL-001, WestBuilding EWS-7. Level 10 Steelwork.
- [7] W3100-WB-L10-F-PL-003, WestBuilding EWS-7. Level 10 Without louvres for clarification.

1.1.4 Structural Analysis Software

- [8] Nemetschek. *SCIA Engineer v.13.0.* Structural Analysis & Design Software for Construction and Engineering.

1.2 Materials

Minimum properties of materials used unless stated otherwise.

Part	Grade	Modulus of elasticity E [N/mm ²]	Yield or 0.2% proof strength, f _o [N/mm ²]	Tensile strength f _u [N/mm ²]
Aluminium: $\gamma_{M0,M1} = 1.1$; $\gamma_{M2} = 1.25$				
Architectural profiles	EN AW-6060 T66	70 000	≥ 150	≥ 195
Structural profiles	EN AW-6060 T66	70 000	≥ 150	≥ 195
Steel: $\gamma_{M0,M1} = 1.0$; $\gamma_{M2} = 1.1$				
Plates	S275	210 000	275	430
Rolled sections	S275	210 000	275	430
Fasteners: $\gamma_{M2} = 1.25$				
Bolts	8.8	-	640	800
Anchors	10.9	-	900	1000

1.3 Loads

The following loads are in accordance with Gartner structural calculations [4] [5].

1.3.1 Dead Load (D)

Selfweight of the framing profiles are generated by the software Scia [8].

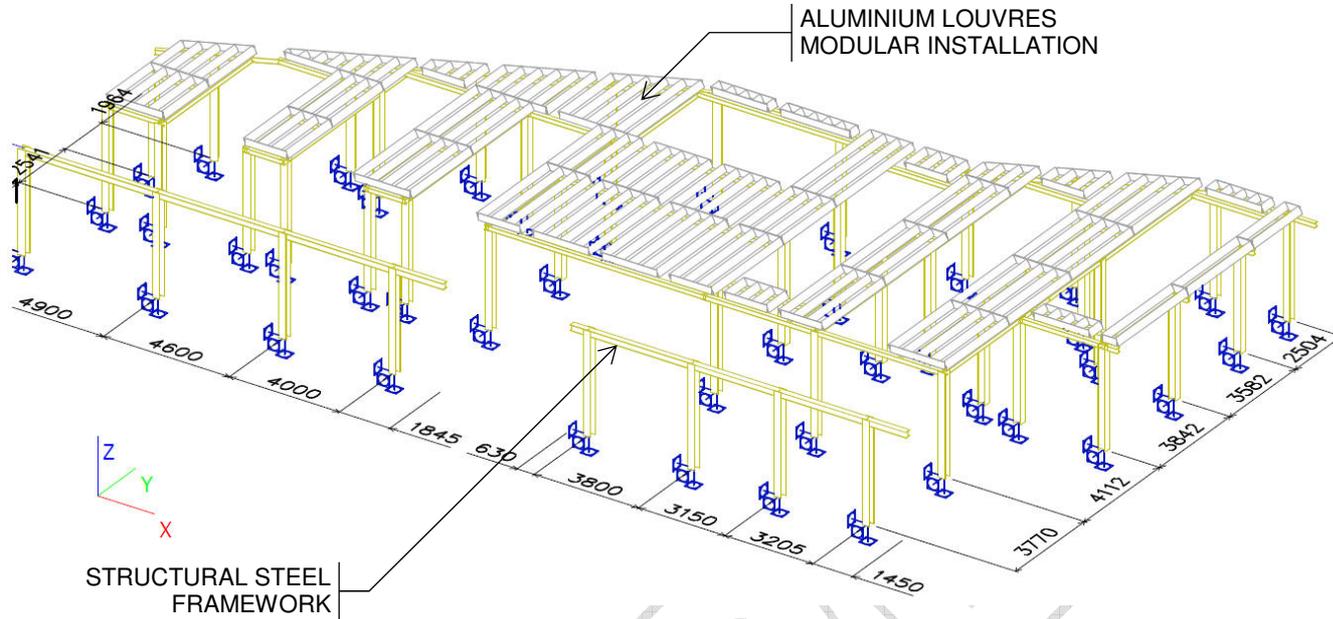
1.3.2 Wind Load (W)

Net pressure = +/- 1.81 kN/m²

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2 Framing Structural Analysis

2.1 Steelwork Structural Model



2.2 Structural Analysis

Refer to Annex A.

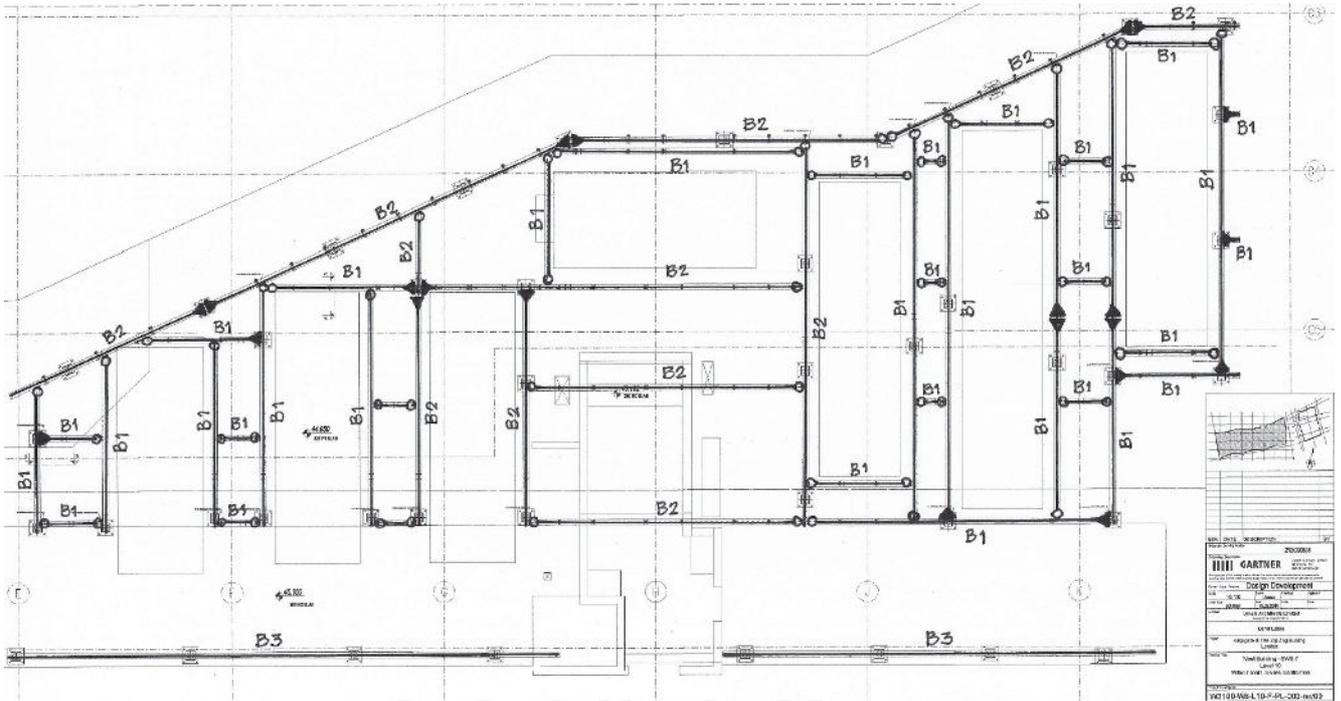
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3 Joints and Connections

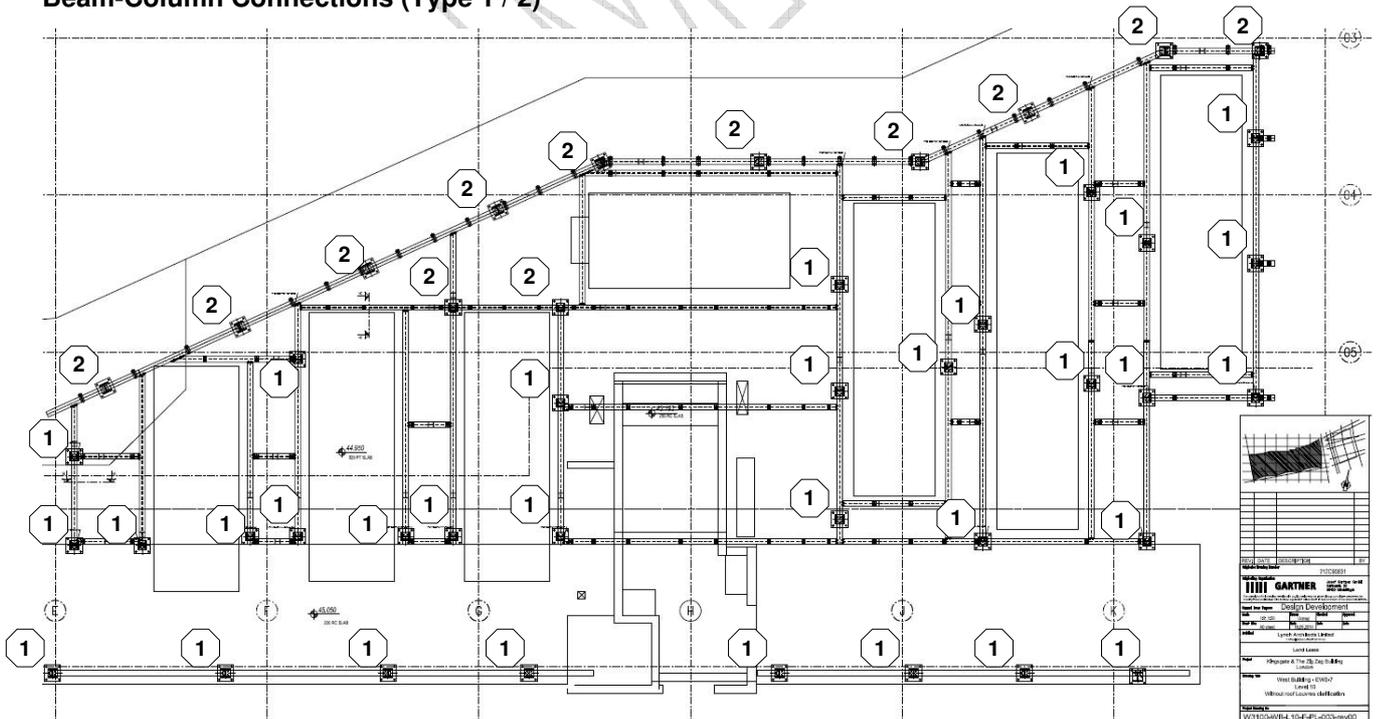
Every load combination in each joint has been calculated internally, however, only the most critical joint and load combination is presented in the report.

3.1 Key Plan

Beam-End Connections (Moment / Hinged)



Beam-Column Connections (Type 1 / 2)



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3.2 Design Strength of connections

3.2.1 Fastener bolts to BS EN 1993-1-8

Conservatively consider nominal shims of 10mm to accommodate 0 to 20mm joint tolerance.

M16 / 8.8

$$\beta_p = 9 \cdot 16 / (8 \cdot 16 + 3 \cdot 20) = 0.766$$

$$F_{v,Rd} = 0.766 \cdot 0.6 \cdot 156.7 \cdot 800 / 1.25 = 46.09 \text{ kN}$$

$$F_{t,Rd} = 0.9 \cdot 156.7 \cdot 800 / 1.25 = 90.24 \text{ kN}$$

Bearing to gusset plates 10mm / S275,

$$F_{b,Rd} = 1.5 \cdot 16 \cdot 10 \cdot 430 / 1.25 = 82.56 \text{ kN}$$

M20 / 8.8

$$\beta_p = 9 \cdot 20 / (8 \cdot 20 + 3 \cdot 20) = 0.818$$

$$F_{v,Rd} = 0.818 \cdot 0.6 \cdot 244.79 \cdot 800 / 1.25 = 76.89 \text{ kN}$$

$$F_{t,Rd} = 0.9 \cdot 244.79 \cdot 800 / 1.25 = 141.00 \text{ kN}$$

Bearing to gusset plates 10mm / S275,

$$F_{b,Rd} = 1.5 \cdot 20 \cdot 10 \cdot 430 / 1.25 = 103.20 \text{ kN}$$

3.2.2 Welds to BS EN 1993-1-8

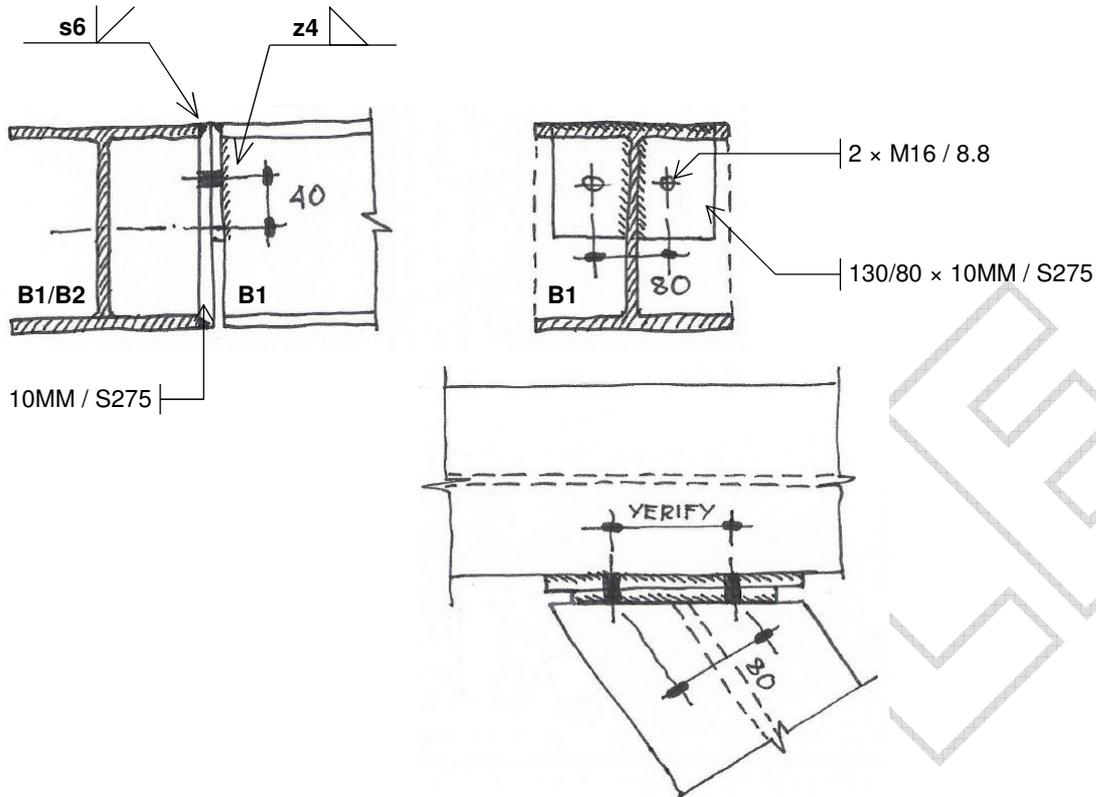
Conservative weld design resistance.

Weld

$$F_{w,Rd} \geq 430 \cdot \sqrt{3} / (3 \cdot 0.85) / 1.25 = 233.66 \text{ N/mm}^2$$

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3.3 B1-End Connection (Hinged)



i Design forces: ULS Envelope

Refer to structural analysis results Annex A, section 6.1.

$$N_{Ed} = 13.38 \text{ kN}$$

$$V_{y,Ed} = 20.19 \text{ kN}$$

$$V_{z,Ed} = 5.64 \text{ kN}$$

$$M_{x,Ed} = 0.61 \text{ kN}$$

ii Bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(20.19^2 + 5.64^2)}/4 + 0.61/0.08 = 12.86 \text{ kN}$$

$$F_{t,Ed} = 13.38/2 = 6.69 \text{ kN}$$

2 x M16 / 8.8

$$F_{v,Ed}/F_{v,Rd} = 0.28 < 1.0$$

$$F_{t,Ed}/F_{t,Rd} = 0.07 < 1.0$$

iii B1-End plate check to BS EN 1993-1-1

$$M_{Ed} = 6.69 \cdot 40 = 267.6 \text{ kN}\cdot\text{mm}$$

130/80 x 10mm / S275

$$M_{pl,Rd} = 1.2 \cdot 80 \cdot 10^2 / 6 \cdot 275 / 1.0 = 440.0 \text{ kN}\cdot\text{mm}$$

$$0.61 < 1.0$$

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iv B1/B2-Side plate check to BS EN 1993-1-1

$$a = (161.8 - 80) / 2 = 40.9 \text{ mm}$$

$$M_{Ed} = 13.38 \cdot 40.9 (161.8 - 40.9) / 161.8 = 408.91 \text{ kN}\cdot\text{mm}$$

150 × 10mm / S275

$$M_{pl,Rd} = 150 \cdot 10^2 / 4 \cdot 275 / 1.0 = 1031.25 \text{ kN}\cdot\text{mm}$$

$$0.40 < 1.0$$

v Weld check to BS EN 1993-1-8

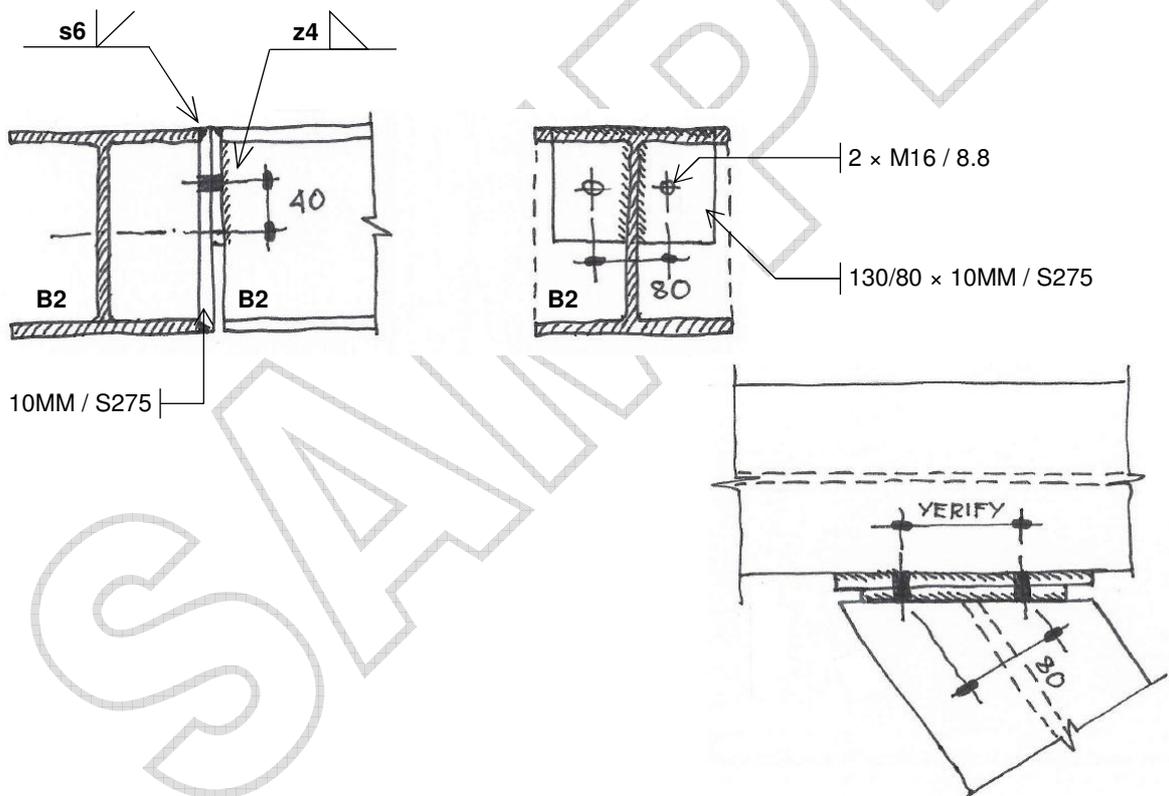
4mm back-to-back fillet weld

$$a = 0.707 \cdot 4.0 = 2.83 \text{ mm}$$

$$F_{w,Ed} = [(13380 + 20190 + 5640) / (2 \cdot 80) + 610000 / (2 \cdot 80^2 / 6)] / 2.83 = 187.63 \text{ N/mm}^2$$

$$F_{w,Ed} / F_{w,Rd} = 0.80 < 1.0$$

3.4 B2-End Connection (Hinged)



i Design forces: ULS Envelope

Refer to structural analysis results Annex A, section 6.2.

$$N_{Ed} = 17.02 \text{ kN}$$

$$V_{y,Ed} = 15.60 \text{ kN}$$

$$V_{z,Ed} = 10.09 \text{ kN}$$

$$M_{x,Ed} = 0.53 \text{ kN}$$

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- ii Bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(15.6^2 + 10.09^2)}/4 + 0.53/0.08$$

$$= 11.27 \text{ kN}$$

$$F_{t,Ed} = 17.02/2 = 8.51 \text{ kN}$$

4 × M16 / A2-70

$$F_{v,Ed}/F_{v,Rd} = 0.24 < 1.0$$

$$F_{t,Ed}/F_{t,Rd} = 0.09 < 1.0$$

- iii B2-End plate check to BS EN 1993-1-1

$$M_{Ed} = 8.51 \cdot 40 = 340.4 \text{ kN}\cdot\text{mm}$$

130/80 × 10mm / S275

$$M_{pl,Rd} = 1.2 \cdot 80 \cdot 10^2 / 6 \cdot 275 / 1.0 = 440.0 \text{ kN}\cdot\text{mm}$$

$$0.77 < 1.0$$

- iv B2-Side plate check to BS EN 1993-1-1

$$a = (161.8 - 80)/2 = 40.9 \text{ mm}$$

$$M_{Ed} = 17.02 \cdot 40.9 \cdot (161.8 - 40.9) / 161.8$$

$$= 519.82 \text{ kN}\cdot\text{mm}$$

150 × 10mm / S275

$$M_{pl,Rd} = 150 \cdot 10^2 / 4 \cdot 275 / 1.0 = 1031.25 \text{ kN}\cdot\text{mm}$$

$$0.50 < 1.0$$

- v Weld check to BS EN 1993-1-8

4mm back-to-back fillet weld

$$a = 0.707 \cdot 4.0 = 2.83 \text{ mm}$$

$$F_{w,Ed} = [(17020 + 15600 + 10090)/(2 \cdot 80) + 530000/(2 \cdot 80^2 / 6)]/2.83$$

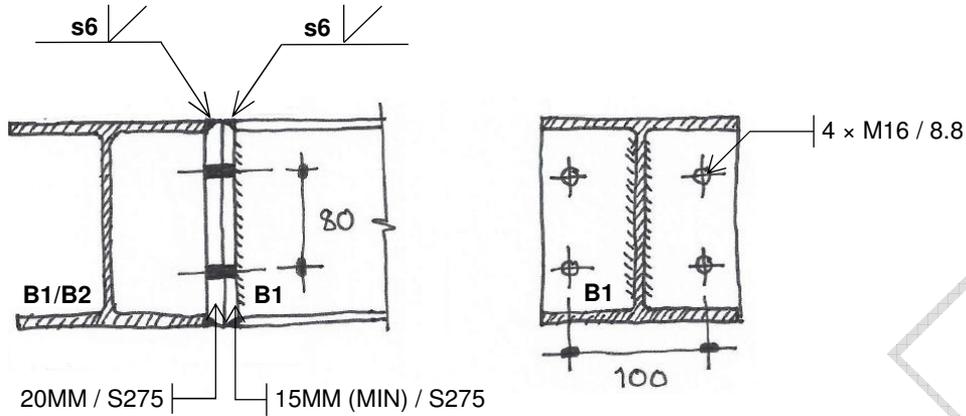
$$= 182.11 \text{ N/mm}^2$$

$$F_{w,Ed}/F_{w,Rd} = 0.78 < 1.0$$

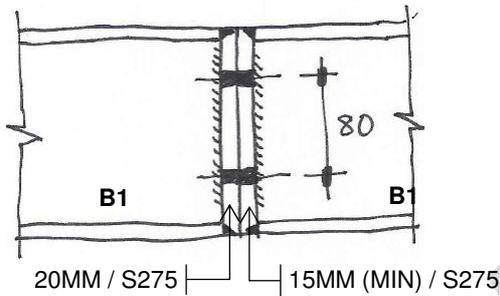
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3.5 B1-End Connection / -Splice Joint (Moment)

END CONNECTION



SPLICE JOINT



- i Design forces: Member B14[0.00m]/CO202

Refer to structural analysis results Annex A, section 6.3.

$$\begin{aligned}
 N_{Ed} &= -18.19 \text{ kN} \\
 V_{y,Ed} &= 0.16 \text{ kN} \\
 V_{z,Ed} &= 3.66 \text{ kN} \\
 M_{x,Ed} &= 0.54 \text{ kN} \\
 M_{y,Ed} &= 9.17 \text{ kN}\cdot\text{m} \\
 M_{z,Ed} &= 1.04 \text{ kN}
 \end{aligned}$$

- ii Bolts check to BS EN 1993-1-8

$$\begin{aligned}
 F_{v,Ed} &= \sqrt{(0.16^2 + 3.66^2)}/4 + 0.54/0.064/4 \\
 &= 3.02 \text{ kN}
 \end{aligned}$$

$$F_{t1,Ed} = 9.17/0.08/2 + 1.04/0.1/2 = 62.51 \text{ kN}$$

$$F_{t2,Ed} = 9.17/0.08/2 - 1.04/0.1/2 = 52.11 \text{ kN}$$

4 x M16 / A2-70

$$F_{v,Ed}/F_{v,Rd} = 0.06 < 1.0$$

$$F_{t,Ed}/F_{t,Rd} = 0.69 < 1.0$$

- iii B1-End plate check to BS EN 1993-1-1

$$M_{Ed} = 62.51 \cdot 50 = 3.12 \text{ kN}\cdot\text{m}$$

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15mm / S275

$$b_{eff} = (152.4 + 152.2/2) = 228.5 \text{ mm}$$

$$M_{pl,Rd} = 228.5 \cdot 15^2 / 4 \cdot 275 / 1.0 = 3.53 \text{ kN}\cdot\text{m}$$

$$\underline{0.88} < 1.0$$

iv B1/B2-Side plate check to BS EN 1993-1-1

$$a = (161.8 - 80) / 2 = 40.9 \text{ mm}$$

$$M_{Ed} = (62.51 + 52.11) \cdot 40.9 (161.8 - 40.9) / 161.8$$

$$= 3.50 \text{ kN}\cdot\text{m}$$

200 x 20mm / S275

$$M_{pl,Rd} = 200 \cdot 20^2 / 4 \cdot 275 / 1.0 = 6.57 \text{ kN}\cdot\text{m}$$

$$\underline{0.53} < 1.0$$

v Weld check to BS EN 1993-1-8

6mm single bevel partial penetration groove weld

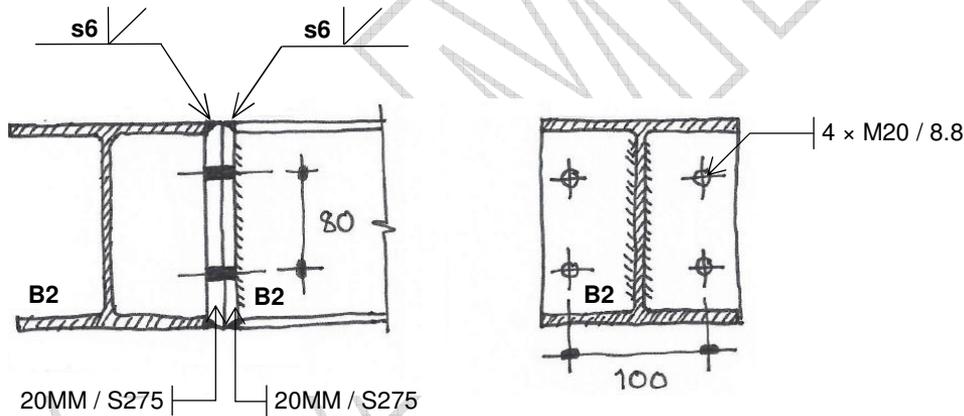
$$F_{w,Ed} = [18190 / (2 \cdot 152.2) + 9170000 / (152.4 \cdot 152.2) + 1040000 / (2 \cdot 152.2^2 / 6)] / 6$$

$$= 98.30 \text{ N/mm}^2$$

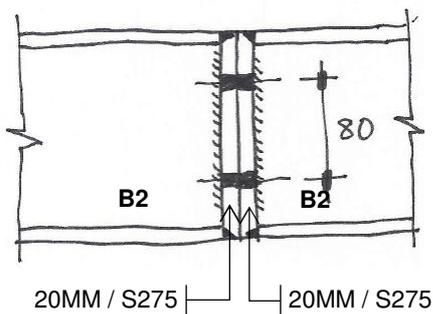
$$F_{w,Ed} / F_{w,Rd} = \underline{0.42} < 1.0$$

3.6 B2-End Connection / -Splice Joint (Moment)

END CONNECTION



SPLICE JOINT



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i Design forces: Member B6[0.00m]/CO222

Refer to structural analysis results Annex A, section 6.4.

$$N_{Ed} = -3.39 \text{ kN}$$

$$V_{y,Ed} = 1.36 \text{ kN}$$

$$V_{z,Ed} = 13.46 \text{ kN}$$

$$M_{x,Ed} = 0.51 \text{ kN}$$

$$M_{y,Ed} = 15.51 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed} = 2.4 \text{ kN}$$

ii Bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(1.36^2 + 13.46^2)}/4 + 0.51/0.064/4$$

$$= 5.37 \text{ kN}$$

$$F_{t1,Ed} = 15.51/0.08/2 + 2.4/0.1/2 = 108.94 \text{ kN}$$

$$F_{t2,Ed} = 15.51/0.08/2 - 2.4/0.1/2 = 84.94 \text{ kN}$$

4 × M20 / 8.8

$$F_{v,Ed}/F_{v,Rd} = 0.07 < 1.0$$

$$F_{t,Ed}/F_{t,Rd} = 0.77 < 1.0$$

iii B2-End plate check to BS EN 1993-1-1

$$M_{Ed} = 108.94 \cdot 50 = 5.45 \text{ kN}\cdot\text{m}$$

20mm / S275

$$b_{eff} = (161.8 + 154.4/2) = 239.0 \text{ mm}$$

$$M_{pl,Rd} = 239 \cdot 20^2 / 4 \cdot 275 / 1.0 = 6.57 \text{ kN}\cdot\text{m}$$

$$0.83 < 1.0$$

iv B2-Side plate check to BS EN 1993-1-1

$$a = (161.8 - 80)/2 = 40.9 \text{ mm}$$

$$M_{Ed} = (108.94 + 84.94) \cdot 40.9 \cdot (161.8 - 40.9) / 161.8$$

$$= 5.92 \text{ kN}\cdot\text{m}$$

200 × 20mm / S275

$$M_{pl,Rd} = 200 \cdot 20^2 / 4 \cdot 275 / 1.0 = 6.52 \text{ kN}\cdot\text{m}$$

$$0.91 < 1.0$$

v Weld check to BS EN 1993-1-8

6mm single bevel partial penetration groove weld

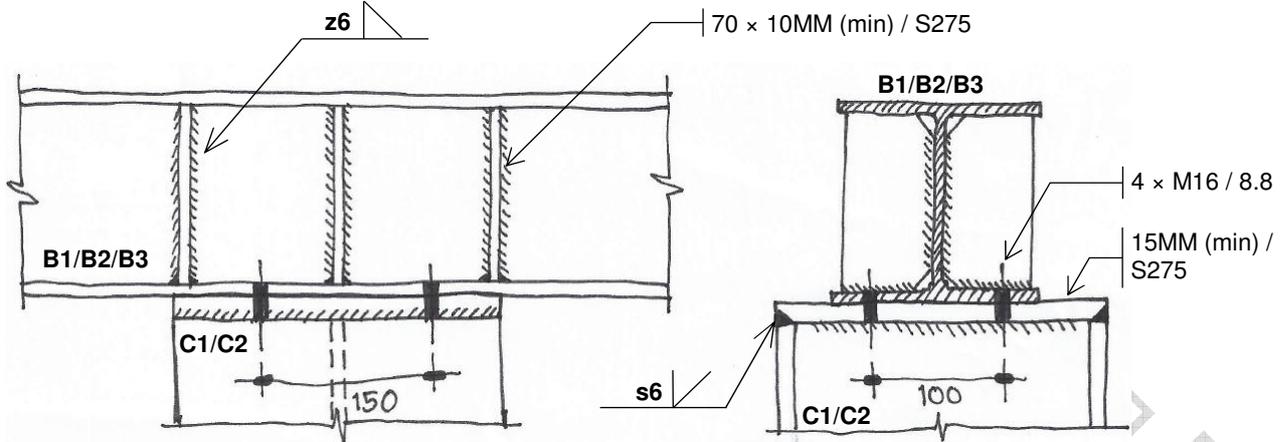
$$F_{w,Ed} = [33900/(2 \cdot 154.4) + 15510000/(161.8 \cdot 154.4) + 2400000/(2 \cdot 154.4^2 / 6)]/6$$

$$= 172.11 \text{ N/mm}^2$$

$$F_{w,Ed}/F_{w,Rd} = 0.74 < 1.0$$

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3.7 Beam-Column Connection (Type 1)



- i Design forces: FC6-Member B63 / CO202

Refer to structural analysis results Annex A, section 7.2.

$$\begin{aligned}
 N_{Ed} &= -7.02 \text{ kN} \\
 V_{y,Ed} &= 4.45 \text{ kN} \\
 V_{z,Ed} &= 16.86 \text{ kN} \\
 M_{x,Ed} &= 0.01 \text{ kN} \\
 M_{y,Ed} &= 10.40 \text{ kN}\cdot\text{m} \\
 M_{z,Ed} &= 5.92 \text{ kN}
 \end{aligned}$$

- ii Bolts check to BS EN 1993-1-8

$$\begin{aligned}
 F_{v,Ed} &= \sqrt{(4.45^2 + 16.86^2)}/4 + 0.01/0.09/4 \\
 &= 4.39 \text{ kN} \\
 F_{t,Ed} &= -7.02/4 + 10.40/0.1/2 + 5.92/0.15/2 \\
 &= 69.98 \text{ kN}
 \end{aligned}$$

4 × M16 / 8.8

$$\begin{aligned}
 F_{v,Ed}/F_{v,Rd} &= 0.04 < 1.0 \\
 F_{t,Ed}/F_{t,Rd} &= 0.77 < 1.0
 \end{aligned}$$

- iii Flange stiffener check to BS EN 1993-1-1

$$N_{Ed} = 69.98 \text{ kN}$$

70×10mm / S275

$$\begin{aligned}
 N_{Rd} &= 70 \cdot 10 \cdot 275 / 1.0 = 192.50 \text{ kN} \\
 &0.36 < 1.0
 \end{aligned}$$

Weld check BS EN 1993-1-8,

6mm back-to-back fillet weld

$$\begin{aligned}
 F_{w,Ed} &= 69980 / (2 \cdot 0.707 \cdot 6 \cdot 70) = 117.84 \text{ N/mm}^2 \\
 F_{w,Ed}/F_{w,Rd} &= 0.50 < 1.0
 \end{aligned}$$

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iv Column top plate check to BS EN 1993-1-1

$$M_{Ed} = 69.98 \cdot 75 = 5.25 \text{ kN}\cdot\text{m}$$

15mm / S275

$$b_{eff} = (254.1 + 254.6/2) = 381.40 \text{ mm}$$

$$M_{pl,Rd} = 381.4 \cdot 15^2 / 4 \cdot 275 / 1.0 = 5.90 \text{ kN}\cdot\text{m}$$

$$\underline{0.89 < 1.0}$$

Weld check to BS EN 1993-1-8,

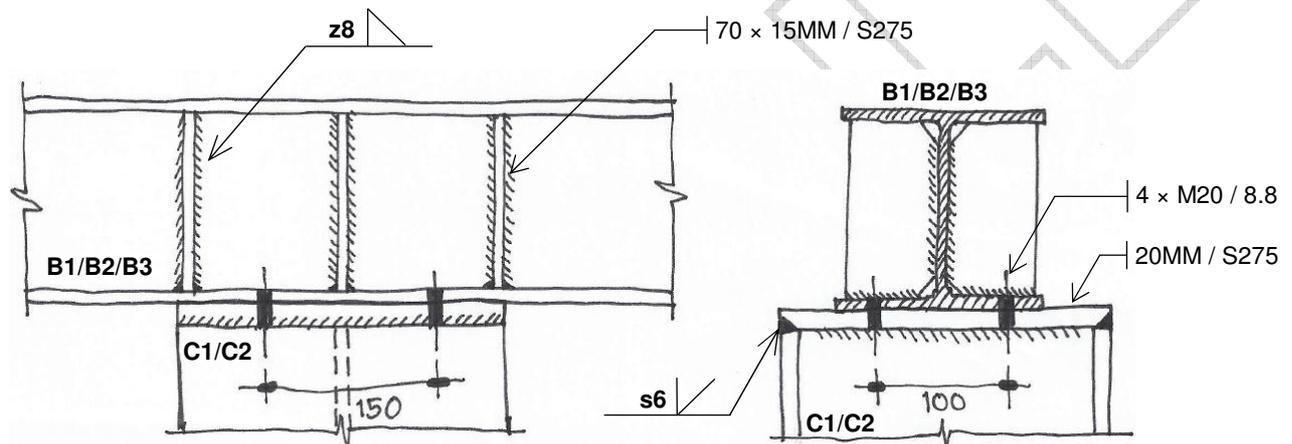
6mm single bevel partial penetration groove weld

$$F_{w,Ed} = [6998 / (2 \cdot 254.6) + 10400000 / (254.1 \cdot 254.6) + 5920000 / (2 \cdot 254.6^2 / 6)] / 6$$

$$= 74.72 \text{ N/mm}^2$$

$$F_{w,Ed} / F_{w,Rd} = \underline{0.32 < 1.0}$$

3.8 Beam-Column Connection (Type 2)



i Design forces: FC9-Member B69 / CO222

Refer to structural analysis results Annex A, section 7.3.

$$N_{Ed} = -8.92 \text{ kN}$$

$$V_{y,Ed} = 4.52 \text{ kN}$$

$$V_{z,Ed} = 16.59 \text{ kN}$$

$$M_{x,Ed} = 0.02 \text{ kN}\cdot\text{m}$$

$$M_{y,Ed} = 23.69 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed} = 6.66 \text{ kN}\cdot\text{m}$$

ii Bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(4.52^2 + 16.59^2) / 4} + 0.02 / 0.09 / 4$$

$$= 4.31 \text{ kN}$$

$$F_{t,Ed} = -8.92 / 4 + 23.69 / 0.1 / 2 + 6.66 / 0.15 / 2$$

$$= 138.42 \text{ kN}$$

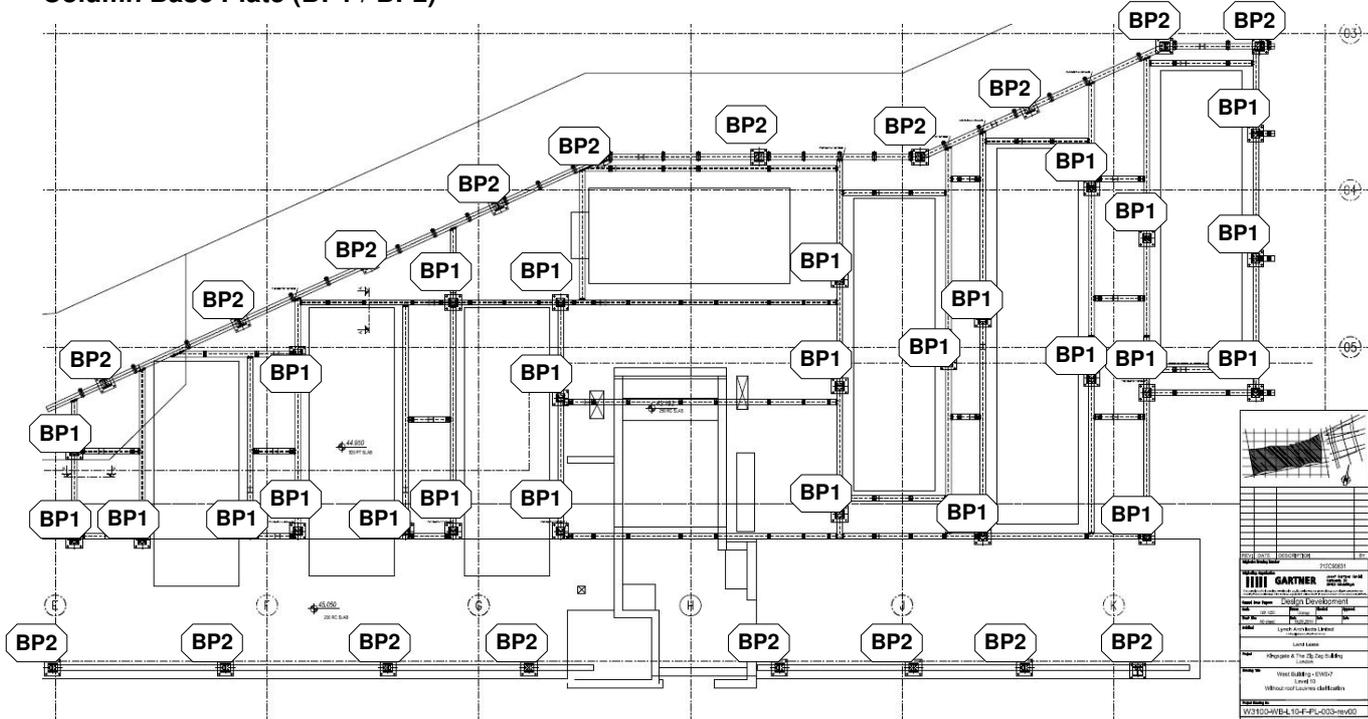
4 x M20 / 8.8

$$F_{v,Ed} / F_{v,Rd} = \underline{0.06 < 1.0}$$

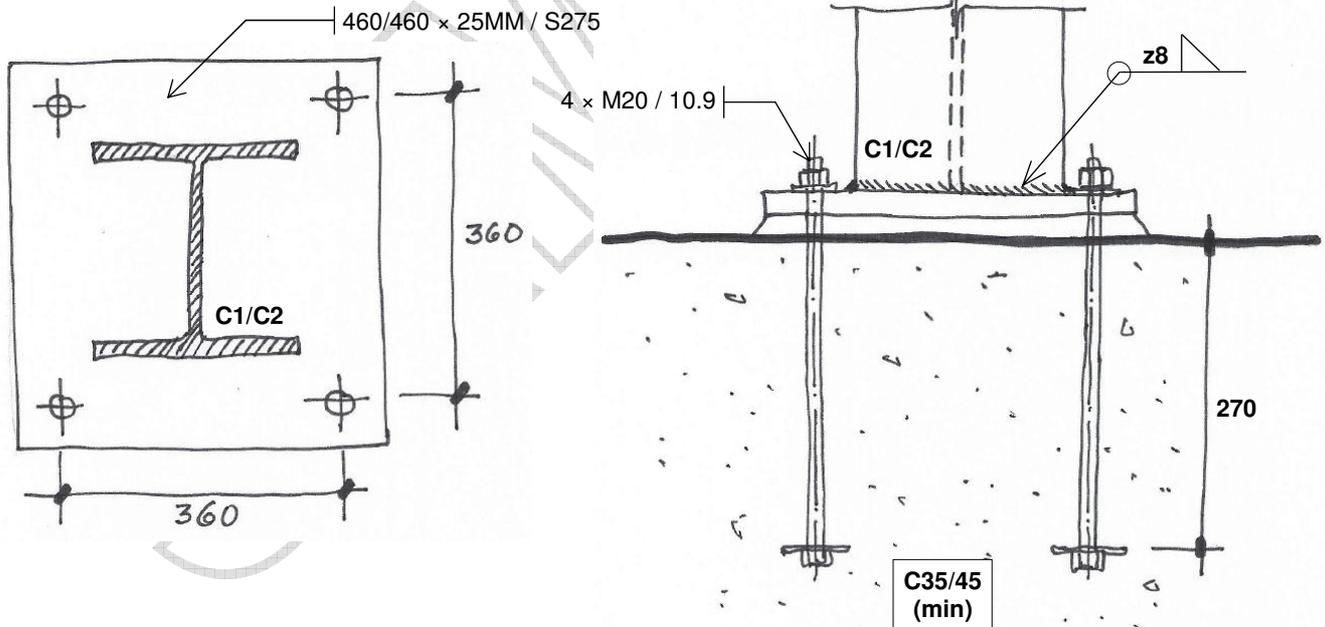
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4 Column Base Plate

Column Base Plate (BP1 / BP2)



4.1 Base plate for Columns in the Middle Structure (BP1)



i Design forces: Sn13/N134 / CO211

Refer to structural analysis results Annex A, section 8.2.

$$N_{Ed} = -4.24 \text{ kN}$$

$$V_{x,Ed} = 14.80 \text{ kN}$$

$$V_{y,Ed} = 6.03 \text{ kN}$$

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$$M_{x,Ed} = 13.68 \text{ kN}$$

$$M_{y,Ed} = 47.53 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed} = 0.0 \text{ kN}$$

ii Anchor bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(14.8^2 + 6.03^2)}/4 = 4.0 \text{ kN}$$

$$F_{t,Ed} = -4.24/4 + 13.68/0.36/2 + 47.53/0.36/2$$

$$= 83.95 \text{ kN}$$

4 × M20 / 10.9

$$F_{v,Rd} = 0.5 \cdot 244.8 \cdot 1000 / 1.25 = 97.92 \text{ kN}$$

$$F_{t,Rd} = 0.9 \cdot 244.8 \cdot 1000 / 1.25 = 176.25 \text{ kN}$$

$$F_{t,Ed} / F_{t,Rd} = \underline{0.48} < 1.0$$

iii Anchorage check to ETAG 001:Annex C

$$N_{Ed} = 83.95 \text{ kN}$$

h_{ef} = 270mm C35/45

$$A^{\circ}_{c,N} / A_{c,N} = 3 \cdot 270(1.5 \cdot 270 + 360/2) / (9 \cdot 270^2)$$

$$= 0.72$$

$$N_{Rd,c} = 0.72 \cdot 7.2 \sqrt{45 \cdot 275^{1.5}} / 1.5 = 105.72 \text{ kN}$$

$$N_{Ed} / N_{Rd,c} = \underline{0.79} < 1.0s$$

iv Base plate check to BS EN 1993-1-1

$$M_{Ed} = 83.95(360-254)/2 = 4.45 \text{ kN}\cdot\text{m}$$

460×460×25mm / S355

$$M_{pl,Rd} = 230 \cdot 25^2 / 4 \cdot 355 / 1.0 = 12.76 \text{ kN}\cdot\text{m}$$

$$\underline{0.35} < 1.0$$

Weld check BS EN 1993-1-8,

8mm all-around fillet weld

$$a = 2 \cdot 0.707 \cdot 8 = 11.3 \text{ mm}$$

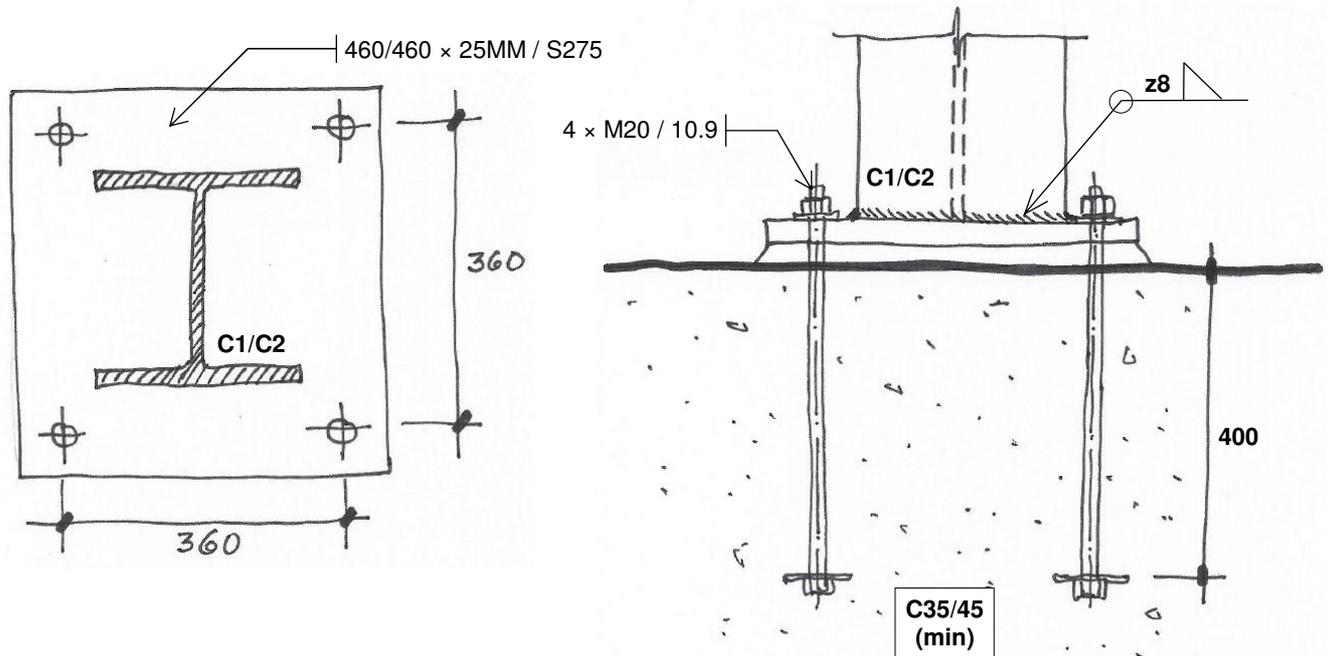
$$F_{w,Ed} = [4240 / (2 \cdot 254.6) + 13680000 / (254.1 \cdot 254.6) + 47530000 / (2 \cdot 254.6^2 / 6)] / 11.3$$

$$= 216.8 \text{ N/mm}^2$$

$$F_{w,Ed} / F_{w,Rd} = \underline{0.93} < 1.0$$

PROJECT SAMPLE PROJECT IN LONDON	NAME	DATE
TITLE PLANTROOM STEELWORKS	REVISION	PAGES 17 of 47

4.2 Base plate for Columns at North & South Wall (BP2)



i Design forces: Sn6/N95 / CO222

Refer to structural analysis results Annex A, section 8.3.

$$N_{Ed} = -9.62 \text{ kN}$$

$$V_{x,Ed} = 1.62 \text{ kN}$$

$$V_{y,Ed} = 31.44 \text{ kN}$$

$$M_{x,Ed} = 115.97 \text{ kN}$$

$$M_{y,Ed} = 3.10 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed} = 0.02 \text{ kN}$$

ii Anchor bolts check to BS EN 1993-1-8

$$F_{v,Ed} = \sqrt{(1.62^2 + 31.44^2)}/4 + 0.02/0.25/4$$

$$= 7.89 \text{ kN}$$

$$F_{t,Ed} = -9.62/4 + 115.97/0.36/2 + 3.10/0.36/2$$

$$= 162.97 \text{ kN}$$

4 x M20 / 10.9

$$F_{v,Rd} = 0.5 \cdot 244.8 \cdot 1000 / 1.25 = 97.92 \text{ kN}$$

$$F_{t,Rd} = 0.9 \cdot 244.8 \cdot 1000 / 1.25 = 176.25 \text{ kN}$$

$$F_{t,Ed} / F_{t,Rd} = 0.77 < 1.0$$

iii Anchorage check to ETAG 001:Annex C

$$N_{Ed} = 162.97 \text{ kN}$$

h_{ef} = 400mm: C35/45

$$A^{\circ}_{c,N} / A_{c,N} = 3 \cdot 400(1.5 \cdot 400 + 360/2) / (9 \cdot 400^2)$$

PROJECT SAMPLE PROJECT IN LONDON	NAME	DATE
TITLE PLANTROOM STEELWORKS	REVISION	PAGES 18 of 47

$$= 0.65$$

$$N_{Rd,c} = 0.65 \cdot 7.2 \sqrt{45} \cdot 400^{1.5} / 1.5 = 167.44 \text{ kN}$$

$$N_{Ed} / N_{Rd,c} = \underline{0.97} < 1.0$$

iv Base plate check to BS EN 1993-1-1

$$M_{Ed} = 162.97 \cdot 55 = 8.96 \text{ kN}\cdot\text{m}$$

460×460×25mm / S275

$$M_{pl,Rd} = 230 \cdot 25^2 / 4 \cdot 275 / 1.0 = 9.88 \text{ kN}\cdot\text{m}$$

$$\underline{0.91} < 1.0$$

Weld check BS EN 1993-1-8,

8mm all-around fillet weld

$$a = 2 \cdot 0.707 \cdot 8 = 11.3 \text{ mm}$$

$$F_{w,Ed} = [9620 / (2 \cdot 256.3) + 115970000 / (260.3 \cdot 256.3) + 3100000 / (2 \cdot 256.3^2 / 6)] / 11.3$$

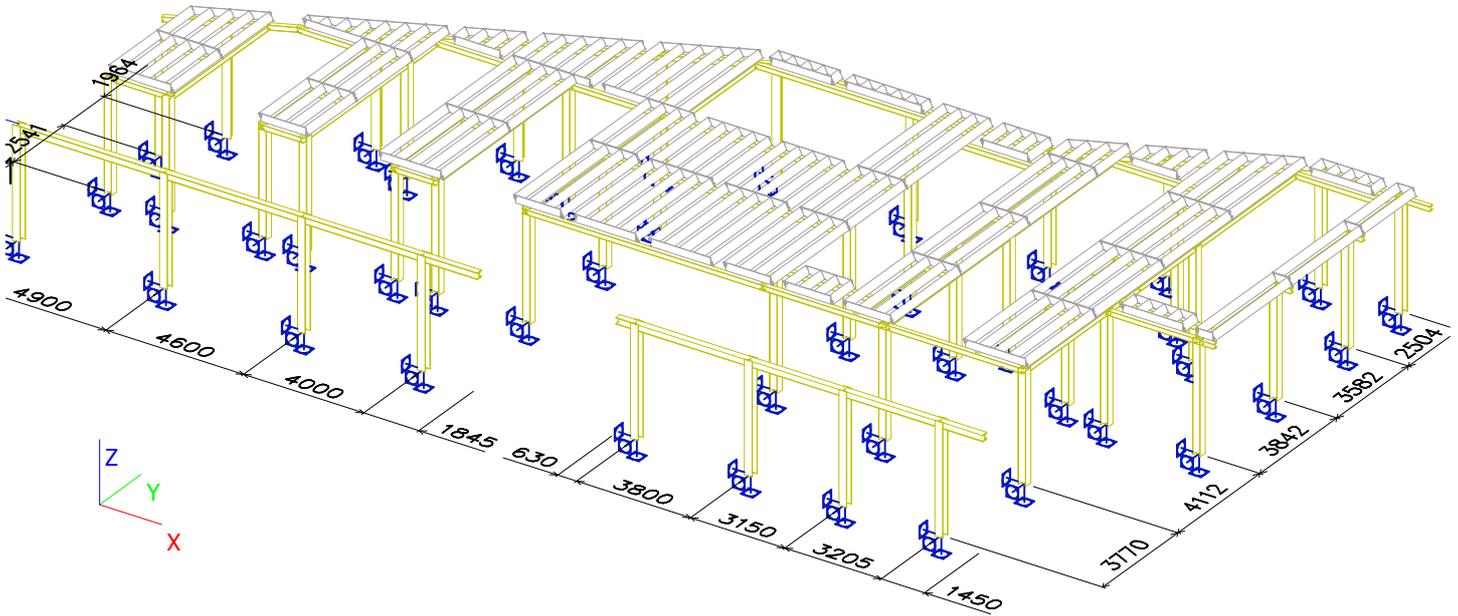
$$= 168.19 \text{ N/mm}^2$$

$$F_{w,Ed} / F_{w,Rd} = \underline{0.72} < 1.0$$

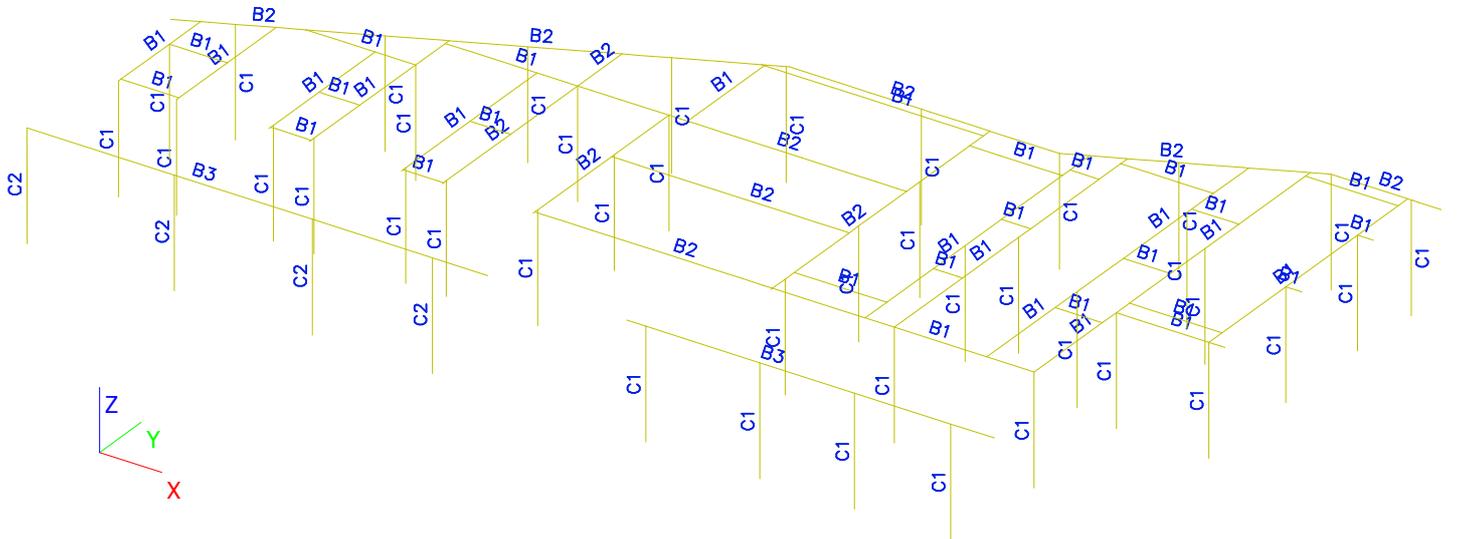
SAMPLE

1. Structural model

1.1. Analysis model



1.2. Steel Member ID's

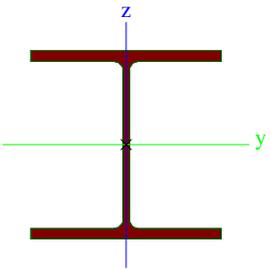
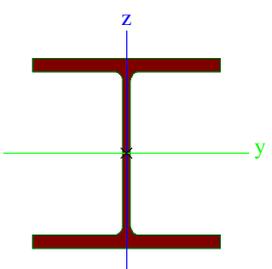
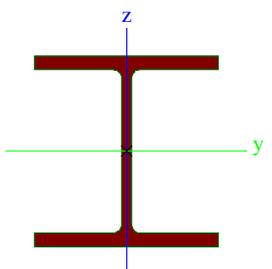
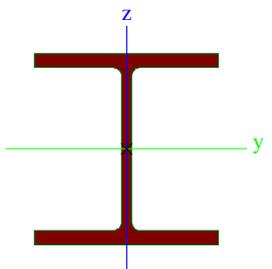


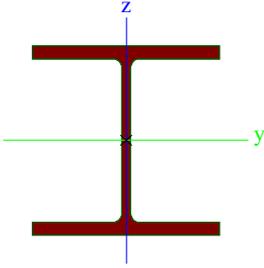
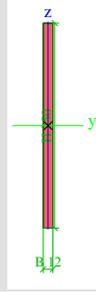
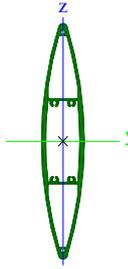
1.3. Bill of material

Name	Mass [kg]	Surface [m ²]	Volume [cm ³]
Total results :	26648.01	804.482	4329188

Material	Mass [kg]	Surface [m ²]	Unit volume mass [kg/m ³]	Volume [cm ³]
S 275	22801.88	498.548	7850.00	2904698
EN-AW 6060 T6	3846.12	305.934	2700.00	1424491

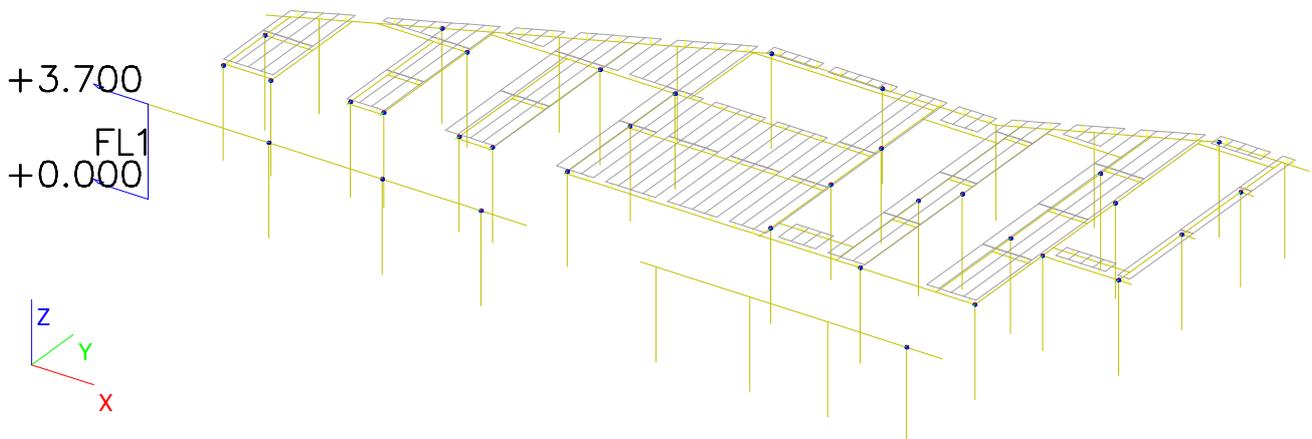
1.4. Cross-sections

	Name, Type	C1	UC254/254/73
	Item material, Fabrication	S 275	rolled
	H, B [mm]	254	255
	t, s [mm]	14	9
	R [mm]	13	
	A [cm ²]	93	
	A y, z [cm ²]	67	23
	I y, z [cm ⁴]	11410	3908
	I w [cm ⁶], t [cm ⁴]	561970	58
	Wel y, z [cm ³]	898	307
	Wpl y, z [cm ³]	992	465
	Name, Type	C2	UC254/254/89
	Item material, Fabrication	S 275	rolled
	H, B [mm]	260	256
	t, s [mm]	17	10
	R [mm]	13	
	A [cm ²]	113	
	A y, z [cm ²]	82	28
	I y, z [cm ⁴]	14271	4858
	I w [cm ⁶], t [cm ⁴]	716627	102
	Wel y, z [cm ³]	1096	379
	Wpl y, z [cm ³]	1224	575
	Name, Type	B1	UC152/152/37
	Item material, Fabrication	S 275	rolled
	H, B [mm]	162	154
	t, s [mm]	12	8
	R [mm]	8	
	A [cm ²]	47	
	A y, z [cm ²]	33	13
	I y, z [cm ⁴]	2211	706
	I w [cm ⁶], t [cm ⁴]	39842	19
	Wel y, z [cm ³]	273	92
	Wpl y, z [cm ³]	309	140
	Name, Type	B2	UC152/152/37
	Item material, Fabrication	S 275	rolled
	H, B [mm]	162	154
	t, s [mm]	12	8
	R [mm]	8	
	A [cm ²]	47	
	A y, z [cm ²]	33	13
	I y, z [cm ⁴]	2211	706
	I w [cm ⁶], t [cm ⁴]	39842	19
	Wel y, z [cm ³]	273	92
	Wpl y, z [cm ³]	309	140

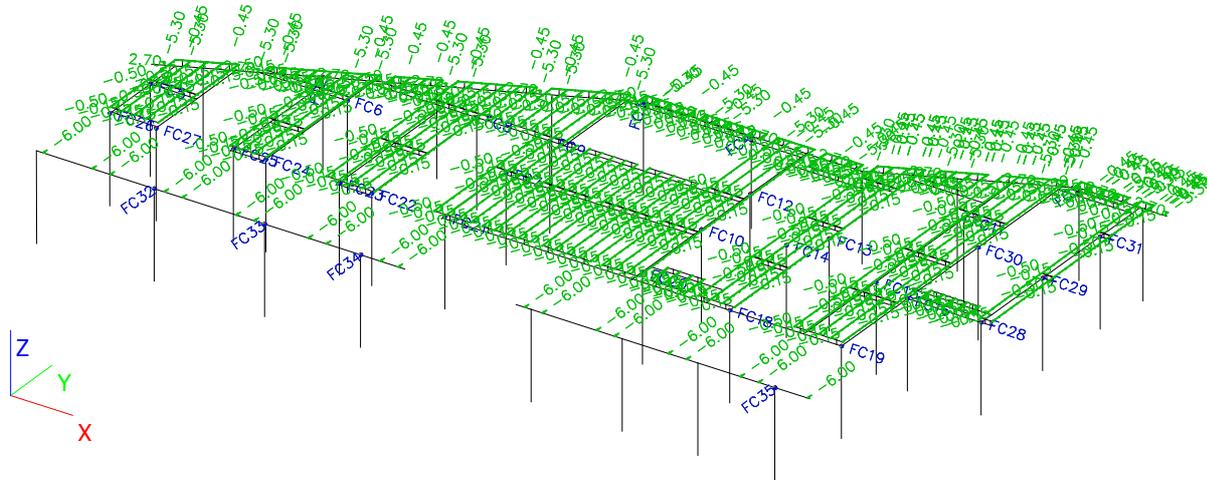
	Name, Type	B3	UC203/203/60
	Item material, Fabrication	S 275	rolled
	H, B [mm]	210	206
	t, s [mm]	14	9
	R [mm]	10	
	A [cm ²]	76	
	A y, z [cm ²]	54	20
	I y, z [cm ⁴]	6126	2065
	I w [cm ⁶], t [cm ⁴]	196908	47
	Wel y, z [cm ³]	584	201
	Wpl y, z [cm ³]	656	305
	Name, Type	B4	Rectangle
	Item material, Fabrication	EN-AW 6060 T6	general
	A [cm ²]	30	
	A y, z [cm ²]	25	25
	I y, z [cm ⁴]	1562	4
	I w [cm ⁶], t [cm ⁴]	174	14
	Wel y, z [cm ³]	125	6
Wpl y, z [cm ³]	188	9	
	Name, Type	B5	Louvre
	Item material, Fabrication	EN-AW 6060 T6	extrusion
	A [cm ²]	25	
	A y, z [cm ²]	14	20
	I y, z [cm ⁴]	1298	72
	I w [cm ⁶], t [cm ⁴]	0	7
	Wel y, z [cm ³]	94	29
Wpl y, z [cm ³]	151	39	

2. Loads [kN; kN/m; °C]

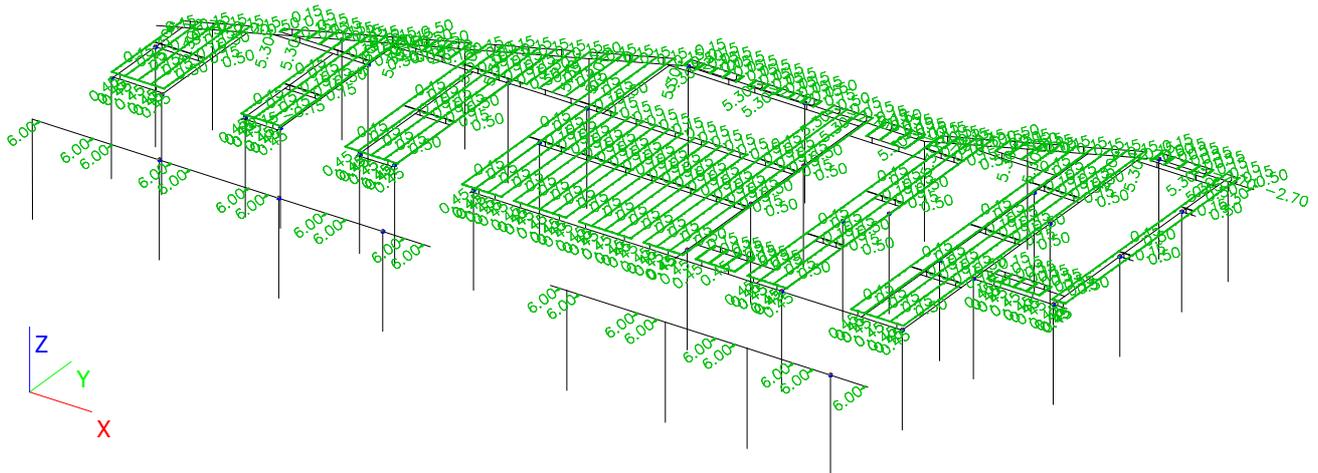
2.1. LC1: Dead load



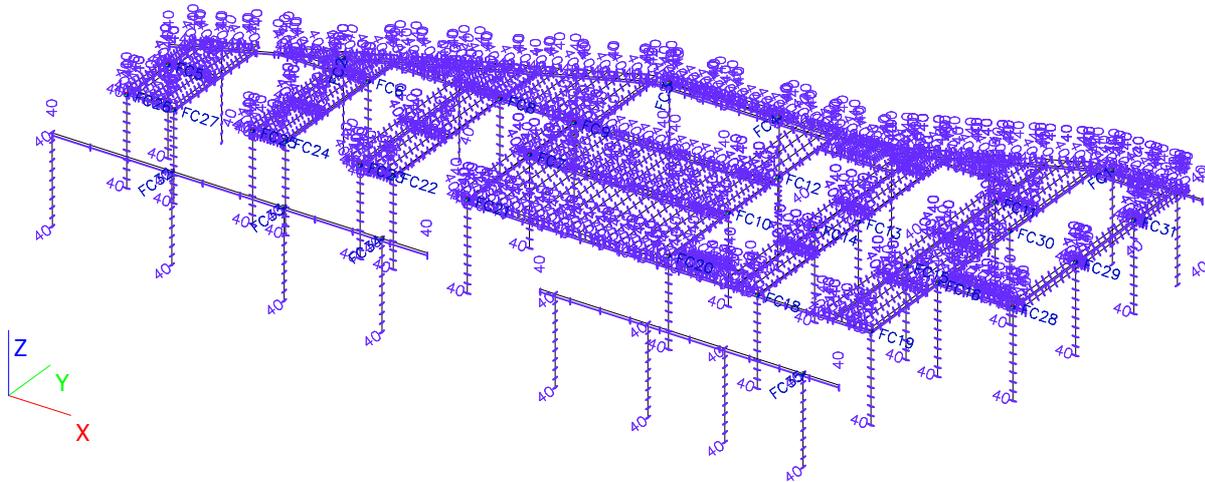
2.2. LC2: Wind load (NW-SE)



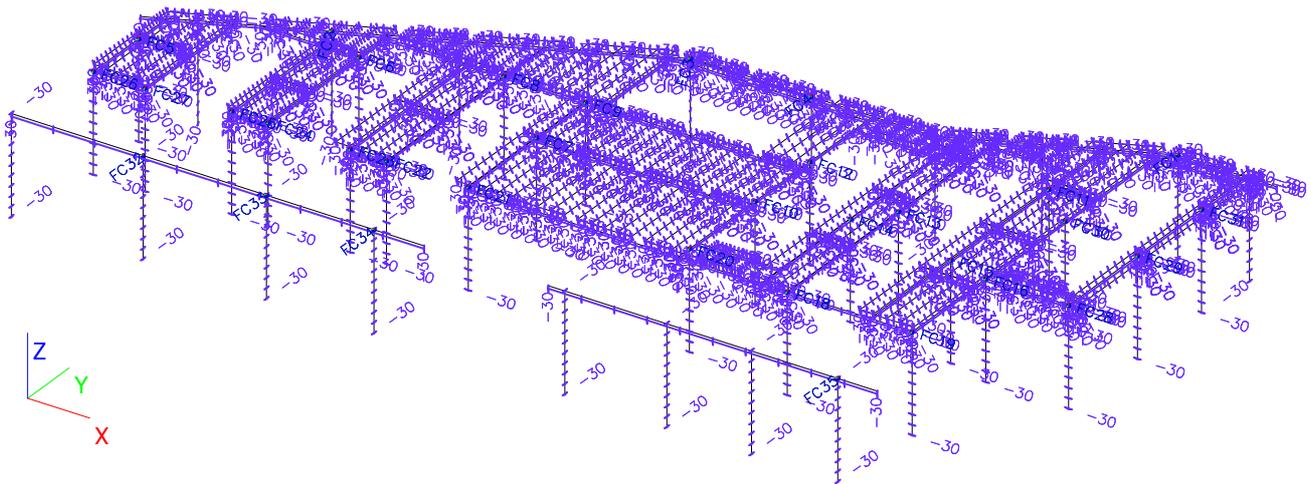
2.3. LC3: Wind load (SE-NW)



2.4. LC4: Temperature load (Summer)



2.5. LC5: Temperature load (Winter)



2.6. Combinations

Name	Description	Type	Load cases	Coeff. [-]
CO101	(D) + (W1)	Linear - serviceability	LC0 - Structure Selfweight	1.10
			LC1 - Dead load	1.00
			LC2 - Wind NW-SE	1.00
CO102	(D) + (W2)	Linear - serviceability	LC0 - Structure Selfweight	1.10
			LC1 - Dead load	1.00
			LC3 - Wind SE-NW	1.00
CO201	1.35(D) + 1.5(W1) + 0.6·1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	1.50
			LC4 - Temperature + 40°C	0.90
CO202	1.35(D) + 1.5(W1) + 0.6·1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	1.50
			LC5 - Temperature - 30°C	0.90
			LC3 - Wind SE-NW	1.50
CO203	1.35(D) + 0.5·1.5(W1) + 1.5(T1)	Linear -	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35

 	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

Name	Description	Type	Load cases	Coeff. [-]
CO203	1.35(D) + 05·1.5(W1) + 1.5(T1)	Ultimate	LC2 - Wind NW-SE	0.75
			LC4 - Temperature + 40°C	1.50
CO204	1.35(D) + 0.5·1.5(W1) + 1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	0.75
			LC5 - Temperature - 30°C	1.50
CO211	1.0(D) + 1.5(W1) + 0.6·1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	1.50
			LC4 - Temperature + 40°C	0.90
CO212	1.0(D) + 1.5(W1) + 0.6·1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	1.50
			LC5 - Temperature - 30°C	0.90
CO213	1.0(D) + 05·1.5(W1) + 1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	0.75
			LC4 - Temperature + 40°C	1.50
CO214	1.0(D) + 0.5·1.5(W1) + 1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC2 - Wind NW-SE	0.75
			LC5 - Temperature - 30°C	1.50
CO221	1.35(D) + 1.5(W2) + 0.6·1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	1.50
			LC4 - Temperature + 40°C	0.90
CO222	1.35(D) + 1.5(W2) + 0.6·1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	1.50
			LC5 - Temperature - 30°C	0.90
CO223	1.35(D) + 05·1.5(W2) + 1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	0.75
			LC4 - Temperature + 40°C	1.50
CO224	1.35(D) + 0.5·1.5(W2) + 1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.50
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	0.75
			LC5 - Temperature - 30°C	1.50
CO231	1.0(D) + 1.5(W2) + 0.6·1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	1.50
			LC4 - Temperature + 40°C	0.90
CO232	1.0(D) + 1.5(W2) + 0.6·1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	1.50
			LC5 - Temperature - 30°C	0.90
CO233	1.0(D) + 05·1.5(W2) + 1.5(T1)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	0.75
			LC4 - Temperature + 40°C	1.50
CO234	1.0(D) + 0.5·1.5(W2) + 1.5(T2)	Linear - ultimate	LC0 - Structure Selfweight	1.00
			LC1 - Dead load	1.35
			LC3 - Wind SE-NW	0.75
			LC5 - Temperature - 30°C	1.50

2.7. Result classes

Name	List
All SLS	CO101 - Linear - serviceability CO102 - Linear - serviceability
All ULS	CO201 - Linear - ultimate

 	Project	King's Gate House, London
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	Description	Annex A: Structural Analysis
	National code	EC - EN

Name	List
All ULS	CO202 - Linear - ultimate CO203 - Linear - ultimate CO204 - Linear - ultimate CO211 - Linear - ultimate CO212 - Linear - ultimate CO213 - Linear - ultimate CO214 - Linear - ultimate CO221 - Linear - ultimate CO222 - Linear - ultimate CO223 - Linear - ultimate CO224 - Linear - ultimate CO231 - Linear - ultimate CO232 - Linear - ultimate CO233 - Linear - ultimate CO234 - Linear - ultimate

 	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

3. Calculation protocol

Calculation protocol

Calculation protocol.

Linear calculation

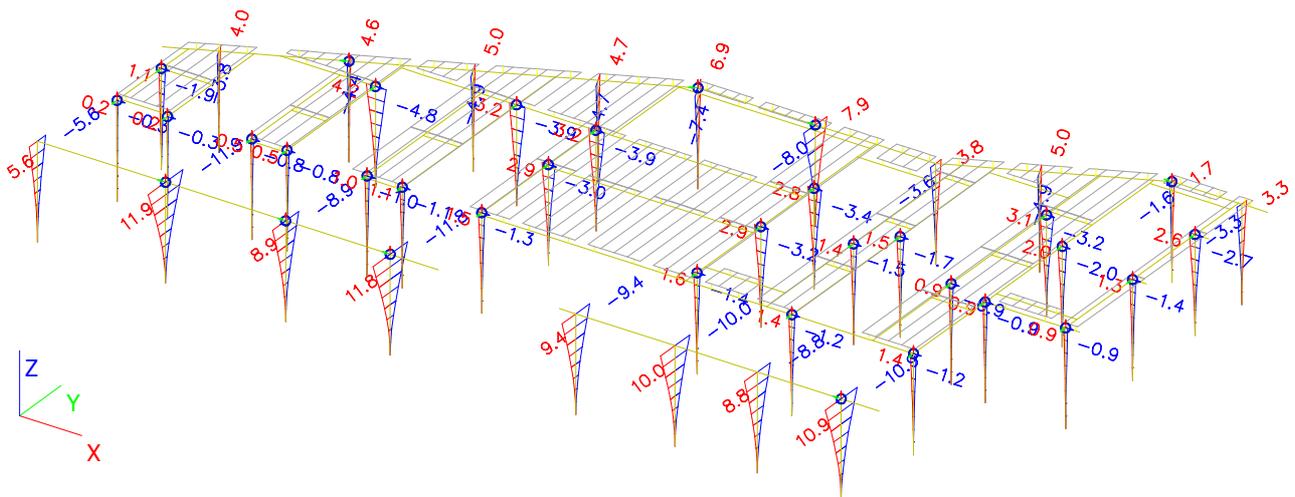
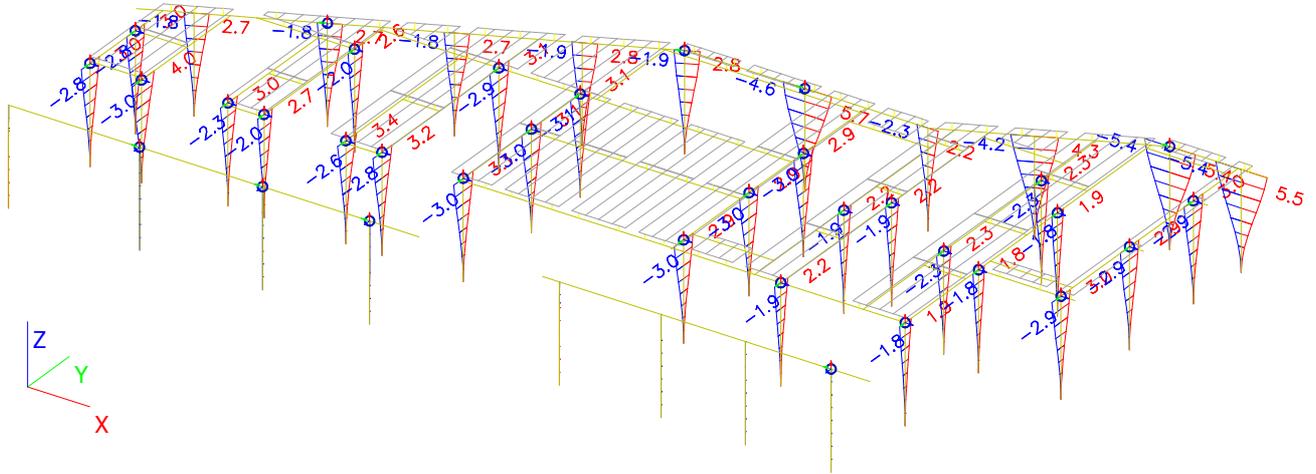
Number of 2D elements	0
Number of 1D elements	2908
Number of mesh nodes	2636
Number of equations	15816
Loadcases	LC0
	LC2
	LC3
	LC4
	LC5
Bending theory	Mindlin
Start of calculation	17.10.2014 15:14
End of calculation	17.10.2014 15:14

Sum of loads and reactions.

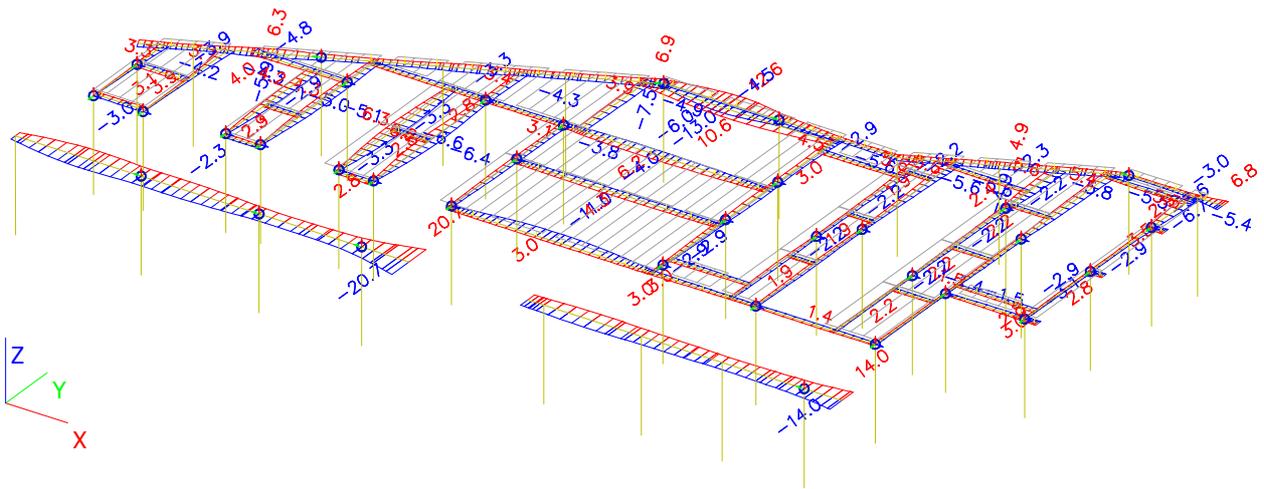
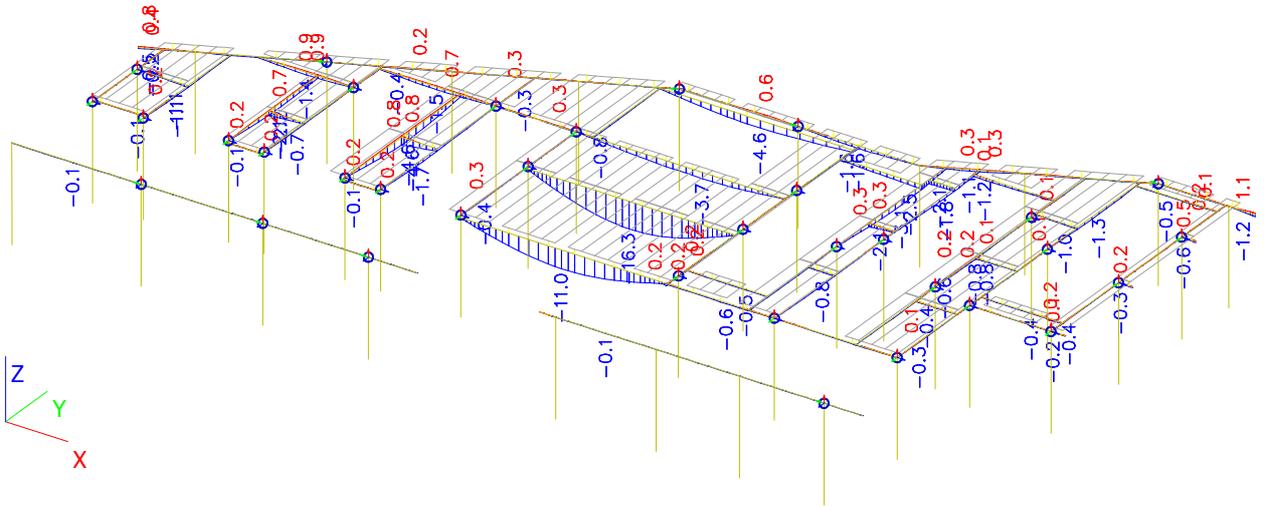
	[kN]	X	Y	Z
Loadcase LC0	loads	0.0	0.0	-261.4
	reactions in nodes	-0.0	0.0	261.4
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC1	loads	0.0	0.0	0.0
	reactions in nodes	0.0	0.0	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC2	loads	147.2	-247.9	43.4
	reactions in nodes	-147.2	247.9	-43.4
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC3	loads	-132.9	249.3	-42.9
	reactions in nodes	132.9	-249.3	42.9
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC4	loads	0.0	0.0	0.0
	reactions in nodes	0.0	-0.0	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC5	loads	0.0	0.0	0.0
	reactions in nodes	0.0	0.0	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0

4. Deflections [mm]

4.1. Column deflections



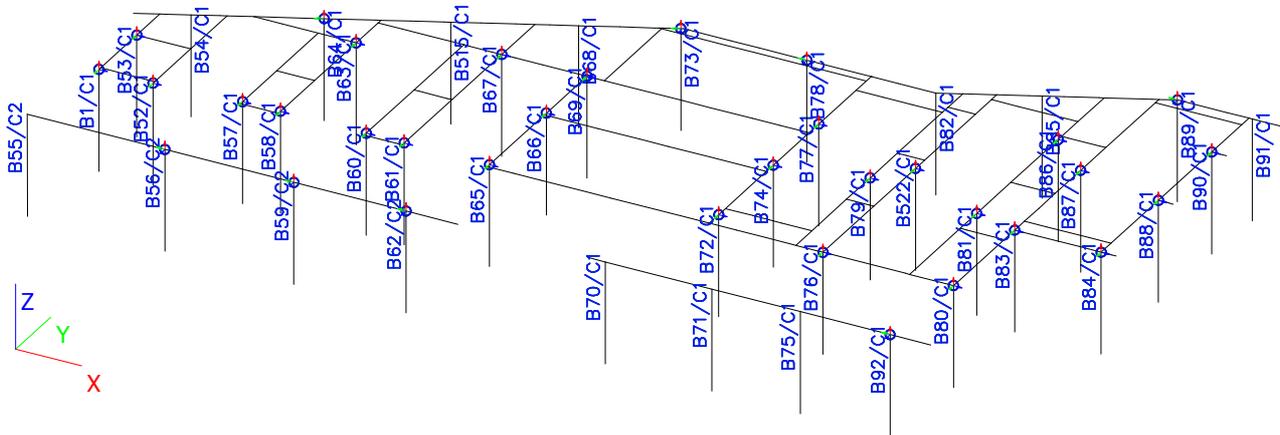
4.2. Beam deflections



5. Member Code Checks

5.1. Design of Columns

5.1.1. Column ID's



5.1.2. Column check - Summary

Linear calculation, Extreme : Cross-section
 Selection : All
 Class : All ULS
 Layer : Columns

Case	Member	css	mat	dx [m]	un.check [-]	sec.check [-]	stab.check [-]
CO201/1	B78	C1 - UC254/254/73	S 275	0.000	0.39	0.28	0.39
CO221/2	B92	C1 - UC254/254/73	S 275	0.000	0.34	0.31	0.34
CO201/1	B78	C1 - UC254/254/73	S 275	0.000	0.39	0.28	0.39
CO221/2	B62	C2 - UC254/254/89	S 275	0.000	0.38	0.34	0.38
CO222/3	B56	C2 - UC254/254/89	S 275	0.000	0.35	0.34	0.35
CO221/2	B62	C2 - UC254/254/89	S 275	0.000	0.38	0.34	0.38

 	Project	King's Gate House, London
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	Description	Annex A: Structural Analysis
	National code	EC - EN

5.1.3. Column check - Detailed for C1

Linear calculation, Extreme : Member

Selection : B78

Class : All ULS

EN 1993-1-1 Code Check

Member B78	UC254/254/73	S 275	CO201/1	0.39
-------------------	---------------------	--------------	----------------	-------------

Basic data EC3 : EN 1993		
partial safety factor Gamma M0 for resistance of cross-sections		1.00
partial safety factor Gamma M1 for resistance to instability		1.00
partial safety factor Gamma M2 for resistance of net sections		1.25

Material data		
yield strength fy	275.0	MPa
tension strength fu	430.0	MPa
fabrication	rolled	

Warning: The selected steel grade is using the default thickness reduction table! Please review the thickness reduction in the Material Library.

.....SECTION CHECK.....

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).

ratio 23.29 on position 0.000 m

ratio		
maximum ratio	1	65.01
maximum ratio	2	74.86
maximum ratio	3	109.88

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).

ratio 7.77 on position 0.000 m

ratio		
maximum ratio	1	8.32
maximum ratio	2	9.24
maximum ratio	3	13.75

==> Class cross-section 1

The critical check is on position 0.000 m

Internal forces		
NEd	-9.57	kN
Vy,Ed	-13.46	kN
Vz,Ed	15.05	kN
TEd	-0.07	kNm
My,Ed	-56.73	kNm
Mz,Ed	30.63	kNm

Compression check

According to article EN 1993-1-1 : 6.2.4 and formula (6.9)

Section classification is 1.

Table of values		
Nc,Rd	2560.25	kN
Unity check	0.00	-

Torsion check

According to article EN 1993-1-1 : 6.2.7. and formula (6.23)

Table of values		
tau t,Rd	159.5	MPa
tau t, Ed	1.7	MPa
Unity check	0.01	-

Shear check (Vy)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
Vc,Rd	1165.11	kN
Unity check	0.01	-

Shear check (Vz)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
Vc,Rd	405.10	kN
Unity check	0.04	-

Bending moment check (My)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)

Section classification is 1.

	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

Table of values		
Mc,Rd	272.82	kNm
Unity check	0.21	-

Bending moment check (Mz)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
Section classification is 1.

Table of values		
Mc,Rd	127.98	kNm
Unity check	0.24	-

Combined bending, axial force and shear force check

According to article EN 1993-1-1 : 6.2.9.1. and formula (6.41)
Section classification is 1.

Table of values		
MNVy,Rd	272.82	kNm
MNVz,Rd	127.98	kNm

alfa 2.00 beta 1.00
Unity check 0.28 -

Element satisfies the section check !

....:STABILITY CHECK:....

Flexural Buckling Check

According to article EN 1993-1-1 : 6.3.1.1. and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System Length L	3.700	3.700	m
Buckling factor k	1.99	0.61	
Buckling length Lcr	7.363	2.265	m
Critical Euler load Ncr	4362.65	15782.83	kN
Slenderness	66.51	34.97	
Relative slenderness Lambda	0.77	0.40	
Limit slenderness Lambda,0	0.20	0.20	

The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4)

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	992	cm ³
Elastic critical moment Mcr	1545.26	kNm
Relative slenderness Lambda,LT	0.42	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	3.700	m
k	1.00	
kw	1.00	
C1	1.75	
C2	0.00	
C3	1.00	

The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4)

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)
Interaction Method 1

Table of values		
kyy	0.979	
kyz	0.747	
kzy	0.529	
kzz	1.002	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	93	cm ²
Wy	992	cm ³
Wz	465	cm ³
NRk	2560.25	kN
My,Rk	272.82	kNm
Mz,Rk	127.98	kNm
My,Ed	-56.73	kNm
Mz,Ed	30.63	kNm
Interaction Method 1		
Mcr0	882.39	kNm
reduced slenderness 0	0.56	
Psi y	0.018	
Psi z	-0.626	
Cmy,0	0.794	
Cmz,0	1.000	

Table of values	
Cmy	0.977
Cmz	1.000
CmLT	1.000
muy	1.000
muz	1.000
wy	1.105
wz	1.500
npl	0.004
aLT	0.995
bLT	0.008
cLT	0.130
dLT	0.447
eLT	1.585
Cyy	0.999
Cyz	0.937
Czy	0.952
Czz	0.998

Unity check (6.61) = 0.00 + 0.20 + 0.18 = 0.39
 Unity check (6.62) = 0.00 + 0.11 + 0.24 = 0.35

Shear buckling check

in buckling field 1
 According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values	
hw/t	26.244

The web slenderness is such that the Shear Buckling Check is not required.
 Element satisfies the stability check !

5.1.4. Column check - Detailed for C2

Linear calculation, Extreme : Member
 Selection : B62
 Class : All ULS

EN 1993-1-1 Code Check

Member B62	UC254/254/89	S 275	CO221/2	0.38
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Basic data EC3 : EN 1993	
partial safety factor Gamma M0 for resistance of cross-sections	1.00
partial safety factor Gamma M1 for resistance to instability	1.00
partial safety factor Gamma M2 for resistance of net sections	1.25

Material data		
yield strength fy	275.0	MPa
tension strength fu	430.0	MPa
fabrication	rolled	

Warning: The selected steel grade is using the default thickness reduction table! Please review the thickness reduction in the Material Library.

.....SECTION CHECK.....

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).
 ratio 19.45 on position 0.000 m

ratio		
maximum ratio	1	65.10
maximum ratio	2	74.96
maximum ratio	3	111.63

==> Class cross-section 1
 Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).
 ratio 6.38 on position 0.000 m

ratio		
maximum ratio	1	8.32
maximum ratio	2	9.24
maximum ratio	3	13.00

==> Class cross-section 1
The critical check is on position 0.000 m

Internal forces		
NEd	-10.78	kN
Vy,Ed	4.48	kN
Vz,Ed	30.79	kN
TEd	-0.11	kNm
My,Ed	-113.46	kNm
Mz,Ed	-9.73	kNm

Compression check

According to article EN 1993-1-1 : 6.2.4 and formula (6.9)
Section classification is 1.

Table of values		
Nc,Rd	3107.50	kN
Unity check	0.00	-

Torsion check

According to article EN 1993-1-1 : 6.2.7. and formula (6.23)

Table of values		
tau t,Rd	159.5	MPa
tau t, Ed	1.9	MPa
Unity check	0.01	-

Shear check (Vy)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
Vc,Rd	1418.16	kN
Unity check	0.00	-

Shear check (Vz)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
Vc,Rd	481.86	kN
Unity check	0.06	-

Bending moment check (My)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
Section classification is 1.

Table of values		
Mc,Rd	336.56	kNm
Unity check	0.34	-

Bending moment check (Mz)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
Section classification is 1.

Table of values		
Mc,Rd	158.21	kNm
Unity check	0.06	-

Combined bending, axial force and shear force check

According to article EN 1993-1-1 : 6.2.9.1. and formula (6.41)
Section classification is 1.

Table of values		
MNVy,Rd	336.56	kNm
MNVz,Rd	158.21	kNm

alfa 2.00 beta 1.00
Unity check 0.18 -

Element satisfies the section check !

.....**STABILITY CHECK**.....

Flexural Buckling Check

According to article EN 1993-1-1 : 6.3.1.1. and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System Length L	3.700	3.700	m
Buckling factor k	2.00	0.57	
Buckling length Lcr	7.409	2.100	m
Critical Euler load Ncr	5388.50	22825.01	kN
Slenderness	65.93	32.03	
Relative slenderness Lambda	0.76	0.37	
Limit slenderness Lambda,0	0.20	0.20	

The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4)

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	1224	cm ³
Elastic critical moment Mcr	2102.01	kNm
Relative slenderness Lambda,LT	0.40	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	3.700	m

Mcr Parameters	
k	1.00
kw	1.00
C1	1.77
C2	0.00
C3	1.00

The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4)

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)
Interaction Method 1

Table of values		
kyy	0.984	
kyz	0.768	
kzy	0.521	
kzz	1.004	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	113	cm ²
Wy	1224	cm ³
Wz	575	cm ³
NRk	3107.50	kN
My,Rk	336.56	kNm
Mz,Rk	158.21	kNm
My,Ed	-113.46	kNm
Mz,Ed	-9.73	kNm
Interaction Method 1		
Mcr0	1184.80	kNm
reduced slenderness 0	0.53	
Psi y	-0.004	
Psi z	-0.702	
Cmy,0	0.789	
Cmz,0	1.000	
Cmy	0.981	
Cmz	1.000	
CmLT	1.000	
muy	1.000	
muz	1.000	
wy	1.117	
wz	1.500	
npl	0.003	
aLT	0.993	
bLT	0.003	
cLT	0.193	
dLT	0.189	
eLT	2.607	
Cyy	1.000	
Cyz	0.905	
Czy	0.977	
Czz	0.996	

Unity check (6.61) = 0.00 + 0.33 + 0.05 = 0.38

Unity check (6.62) = 0.00 + 0.18 + 0.06 = 0.24

Shear buckling check

in buckling field 1

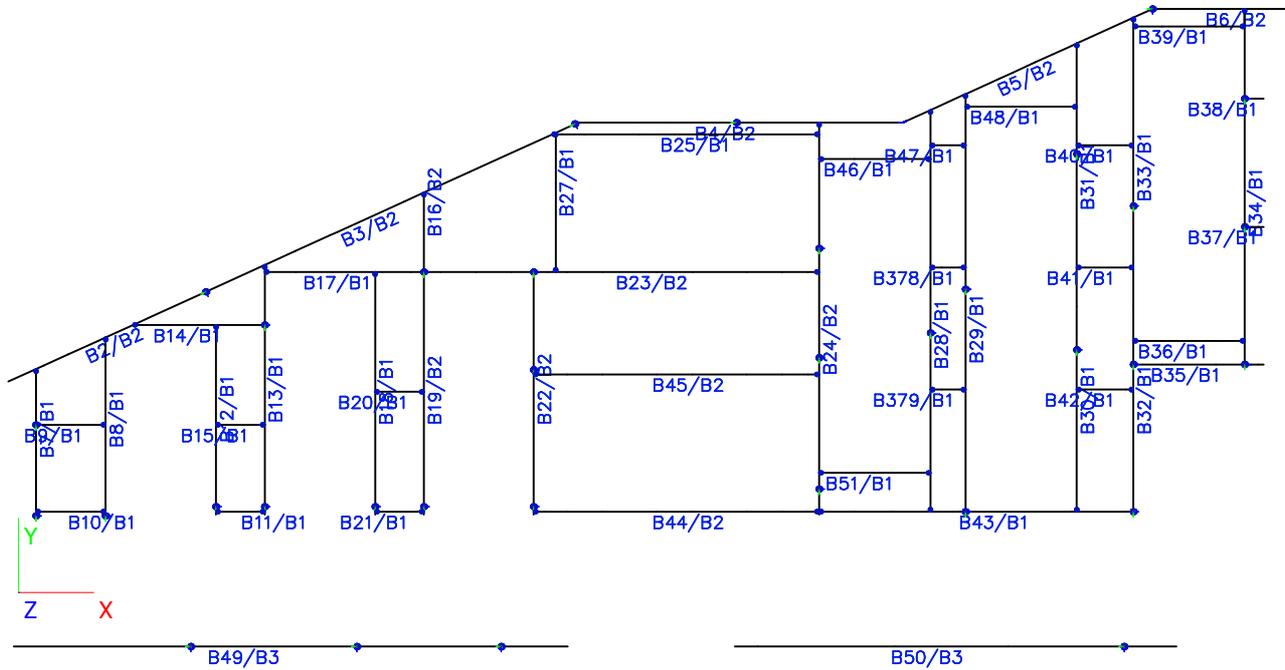
According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values	
hw/t	21.913

The web slenderness is such that the Shear Buckling Check is not required.
Element satisfies the stability check !

5.2. Design of Beams

5.2.1. Beam ID's (Beam End-Release)



5.2.2. Beam check - Summary

Linear calculation, Extreme : Cross-section
 Selection : All
 Class : All ULS
 Layer : Beams

Case	Member	css	mat	dx [m]	un.check [-]	sec.check [-]	stab.check [-]
CO222/3	B5	B2 - UC152/152/37	S 275	7.010	0.54	0.54	0.00
CO222/3	B5	B2 - UC152/152/37	S 275	7.010	0.54	0.54	0.00
CO201/1	B6	B2 - UC152/152/37	S 275	2.551	0.41	0.41	0.37
CO223/4	B28	B1 - UC152/152/37	S 275	9.847	0.29	0.25	0.29
CO223/4	B28	B1 - UC152/152/37	S 275	9.847	0.29	0.25	0.29
CO223/4	B28	B1 - UC152/152/37	S 275	6.820	0.29	0.04	0.29
CO201/1	B49	B3 - UC203/203/60	S 275	9.075	0.34	0.34	0.22
CO201/1	B49	B3 - UC203/203/60	S 275	9.075	0.34	0.34	0.22
CO221/2	B49	B3 - UC203/203/60	S 275	9.500	0.23	0.15	0.23

5.2.3. Beam check - Detailed for B1

Linear calculation, Extreme : Member
 Selection : B28
 Class : All ULS

EN 1993-1-1 Code Check

Member B28	UC152/152/37	S 275	CO223/4	0.29
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Basic data EC3 : EN 1993		
partial safety factor Gamma M0 for resistance of cross-sections		1.00
partial safety factor Gamma M1 for resistance to instability		1.00
partial safety factor Gamma M2 for resistance of net sections		1.25

Material data		
yield strength fy	275.0	MPa
tension strength fu	430.0	MPa
fabrication	rolled	

Warning: The selected steel grade is using the default thickness reduction table! Please review the thickness reduction in the Material Library.

.....SECTION CHECK:.....

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).
 ratio 15.45 on position 4.991 m

ratio		
maximum ratio	1	65.84
maximum ratio	2	75.81
maximum ratio	3	108.10

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).
 ratio 5.70 on position 4.991 m

ratio		
maximum ratio	1	8.32
maximum ratio	2	9.24
maximum ratio	3	13.15

==> Class cross-section 1

The critical check is on position 9.847 m

Internal forces		
NEd	-2.55	kN
Vy,Ed	3.62	kN
Vz,Ed	-0.03	kN
TEd	0.01	kNm
My,Ed	3.76	kNm
Mz,Ed	9.44	kNm

Compression check

According to article EN 1993-1-1 : 6.2.4 and formula (6.9)
 Section classification is 1.

Table of values		
Nc,Rd	1295.25	kN
Unity check	0.00	-

Shear check (Vy)

According to article EN 1993-1-1 : 6.2.6. and formula (6.17)

Table of values		
Vc,Rd	571.51	kN
Unity check	0.01	-

Shear check (Vz)

According to article EN 1993-1-1 : 6.2.6. and formula (6.17)

Table of values		
Vc,Rd	226.34	kN
Unity check	0.00	-

Bending moment check (My)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
 Section classification is 1.

Table of values		
Mc,Rd	84.91	kNm
Unity check	0.04	-

Bending moment check (Mz)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
 Section classification is 1.

Table of values		
Mc,Rd	38.38	kNm
Unity check	0.25	-

Combined bending, axial force and shear force check

According to article EN 1993-1-1 : 6.2.9.1. and formula (6.41)
 Section classification is 1.

Table of values		
MNVy,Rd	84.91	kNm
MNVz,Rd	38.38	kNm

alfa 2.00 beta 1.00
 Unity check 0.25 -

Element satisfies the section check !

....:STABILITY CHECK:....

Flexural Buckling Check

According to article EN 1993-1-1 : 6.3.1.1. and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System Length L	6.226	3.027	m
Buckling factor k	2.53	0.90	
Buckling length Lcr	15.764	2.729	m
Critical Euler load Ncr	184.38	1965.03	kN
Slenderness	230.10	70.48	
Relative slenderness Lambda	2.65	0.81	
Limit slenderness Lambda,0	0.20	0.20	

Warning: slenderness 230.10 is larger then 200.00 !

The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4)

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	309	cm ³
Elastic critical moment Mcr	236.53	kNm
Relative slenderness Lambda,LT	0.60	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	3.027	m
k	1.00	
kw	1.00	
C1	1.19	
C2	0.08	
C3	1.00	

The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4)

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)

Interaction Method 1

Table of values		
kyy	1.017	
kyz	0.720	
kzy	0.538	
kzz	1.009	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	47	cm ²
Wy	309	cm ³
Wz	140	cm ³
NRk	1295.25	kN
My,Rk	84.91	kNm
Mz,Rk	38.38	kNm
My,Ed	-6.40	kNm
Mz,Ed	9.44	kNm
Interaction Method 1		
Mcr0	197.96	kNm
reduced slenderness 0	0.65	
Psi y	0.000	
Psi z	-0.159	
Cmy,0	0.993	
Cmz,0	0.999	
Cmy	0.999	
Cmz	0.999	
CmLT	1.000	
muy	1.000	
muz	1.000	
wy	1.131	
wz	1.500	
npl	0.002	
aLT	0.991	
bLT	0.004	
cLT	0.059	
dLT	0.045	
eLT	0.156	
Cyy	0.996	
Cyz	0.960	
Czy	0.981	
Czz	0.992	

Unity check (6.61) = 0.00 + 0.08 + 0.18 = 0.26

Unity check (6.62) = 0.00 + 0.04 + 0.25 = 0.29

Shear buckling check

in buckling field 1

	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values	
hw/t	17.350

The web slenderness is such that the Shear Buckling Check is not required.
Element satisfies the stability check !

5.2.4. Beam check - Detailed for B2

Linear calculation, Extreme : Member
Selection : B5
Class : All ULS

EN 1993-1-1 Code Check

Member B5	UC152/152/37	S 275	CO222/3	0.54
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Basic data EC3 : EN 1993	
partial safety factor Gamma M0 for resistance of cross-sections	1.00
partial safety factor Gamma M1 for resistance to instability	1.00
partial safety factor Gamma M2 for resistance of net sections	1.25

Material data		
yield strength fy	275.0	MPa
tension strength fu	430.0	MPa
fabrication	rolled	

Warning: The selected steel grade is using the default thickness reduction table! Please review the thickness reduction in the Material Library.

....SECTION CHECK....

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).
ratio 15.45 on position 3.350 m

ratio		
maximum ratio 1	66.30	
maximum ratio 2	76.35	
maximum ratio 3	112.84	

==> Class cross-section 1
Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).
ratio 5.70 on position 3.350 m

ratio		
maximum ratio 1	8.32	
maximum ratio 2	9.24	
maximum ratio 3	13.04	

==> Class cross-section 1

The critical check is on position 7.010 m

Internal forces		
NEd	11.53	kN
Vy,Ed	12.35	kN
Vz,Ed	0.82	kN
TEd	-1.47	kNm
My,Ed	4.99	kNm
Mz,Ed	1.38	kNm

Normal force check

According to article EN 1993-1-1 : 6.2.3. and formula (6.5)

Table of values		
Nt,Rd	1295.25	kN
Unity check	0.01	-

Torsion check

According to article EN 1993-1-1 : 6.2.7. and formula (6.23)

Table of values		
tau t,Rd	159.5	MPa
tau t, Ed	86.5	MPa
Unity check	0.54	-

Shear check (Vy)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
Vc,Rd	429.99	kN
Unity check	0.03	-

Shear check (Vz)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

 	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

Table of values		
Vc,Rd	170.30	kN
Unity check	0.00	-

Bending moment check (My)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
Section classification is 1.

Table of values		
Mc,Rd	84.91	kNm
Unity check	0.06	-

Bending moment check (Mz)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)
Section classification is 1.

Table of values		
Mc,Rd	38.38	kNm
Unity check	0.04	-

Combined bending, axial force and shear force check

According to article EN 1993-1-1 : 6.2.9.1. and formula (6.41)
Section classification is 1.

Table of values		
MNVy,Rd	84.91	kNm
MNVz,Rd	38.38	kNm

alfa 2.00 beta 1.00
Unity check 0.04 -

Element satisfies the section check !

....:STABILITY CHECK:....

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	309	cm ³
Elastic critical moment M _{cr}	24553.50	kNm
Relative slenderness Lambda _{LT}	0.06	
Limit slenderness Lambda _{LT,0}	0.40	

M _{cr} Parameters		
LTB length	0.214	m
k	1.00	
k _w	1.00	
C ₁	1.02	
C ₂	0.00	
C ₃	1.00	

The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4)

Shear buckling check

in buckling field 1

According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values	
hw/t	17.350

The web slenderness is such that the Shear Buckling Check is not required.

Element satisfies the stability check !

5.2.5. Beam check - Detailed for B3

Linear calculation, Extreme : Member

Selection : B49

Class : All ULS

EN 1993-1-1 Code Check

Member B49	UC203/203/60	S 275	CO201/1	0.34
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Basic data EC3 : EN 1993	
partial safety factor Gamma M0 for resistance of cross-sections	1.00
partial safety factor Gamma M1 for resistance to instability	1.00
partial safety factor Gamma M2 for resistance of net sections	1.25

Material data		
yield strength f _y	275.0	MPa
tension strength f _u	430.0	MPa
fabrication	rolled	

 	Project	King's Gate House, London
	Part	Plantroom Steelworks
	Description	Annex A: Structural Analysis
	National code	EC - EN

Warning: The selected steel grade is using the default thickness reduction table! Please review the thickness reduction in the Material Library.

.....**SECTION CHECK**.....

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).

ratio 17.11 on position 0.000 m

ratio		
maximum ratio	1	65.63
maximum ratio	2	75.57
maximum ratio	3	101.58

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).

ratio 6.20 on position 0.000 m

ratio		
maximum ratio	1	8.32
maximum ratio	2	9.24
maximum ratio	3	12.79

==> Class cross-section 1

The critical check is on position 9.075 m

Internal forces		
N _{Ed}	-6.89	kN
V _{y,Ed}	-17.75	kN
V _{z,Ed}	-1.62	kN
T _{Ed}	1.81	kNm
M _{y,Ed}	-0.96	kNm
M _{z,Ed}	-2.42	kNm

Compression check

According to article EN 1993-1-1 : 6.2.4 and formula (6.9)

Section classification is 1.

Table of values		
N _{c,Rd}	2101.00	kN
Unity check	0.00	-

Torsion check

According to article EN 1993-1-1 : 6.2.7. and formula (6.23)

Table of values		
tau _{t,Rd}	159.5	MPa
tau _{t, Ed}	53.9	MPa
Unity check	0.34	-

Shear check (V_y)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
V _{c,Rd}	805.09	kN
Unity check	0.02	-

Shear check (V_z)

According to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula (6.25)

Table of values		
V _{c,Rd}	300.85	kN
Unity check	0.01	-

Bending moment check (M_y)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)

Section classification is 1.

Table of values		
M _{c,Rd}	180.42	kNm
Unity check	0.01	-

Bending moment check (M_z)

According to article EN 1993-1-1 : 6.2.5. and formula (6.12)

Section classification is 1.

Table of values		
M _{c,Rd}	83.97	kNm
Unity check	0.03	-

Combined bending, axial force and shear force check

According to article EN 1993-1-1 : 6.2.9.1. and formula (6.41)

Section classification is 1.

Table of values		
MNV _{y,Rd}	180.42	kNm
MNV _{z,Rd}	83.97	kNm



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alfa 2.00 beta 1.00
 Unity check 0.03 -

Element satisfies the section check !

.....**STABILITY CHECK**.....

Flexural Buckling Check

According to article EN 1993-1-1 : 6.3.1.1. and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System Length L	4.600	15.345	m
Buckling factor k	1.22	1.00	
Buckling length Lcr	5.614	15.345	m
Critical Euler load Ncr	4028.68	181.74	kN
Slenderness	62.69	295.18	
Relative slenderness Lambda	0.72	3.40	
Limit slenderness Lambda,0	0.20	0.20	

Warning: slenderness 295.18 is larger than 200.00 !

The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4)

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	656	cm ³
Elastic critical moment Mcr	150.64	kNm
Relative slenderness Lambda,LT	1.09	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	15.345	m
k	1.00	
kw	1.00	
C1	1.77	
C2	0.00	
C3	1.00	

The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4)

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)

Interaction Method 1

Table of values		
kyy	1.021	
kyz	0.577	
kzy	0.545	
kzz	0.827	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	76	cm ²
Wy	656	cm ³
Wz	305	cm ³
NRk	2101.00	kN
My,Rk	180.42	kNm
Mz,Rk	83.97	kNm
My,Ed	-1.89	kNm
Mz,Ed	-21.60	kNm
Interaction Method 1		
Mcr0	85.11	kNm
reduced slenderness 0	1.46	
Psi y	0.911	
Psi z	0.000	
Cmy,0	0.999	
Cmz,0	0.785	
Cmy	0.999	
Cmz	0.785	
CmLT	1.012	
muy	1.000	
muz	1.000	
wy	1.123	
wz	1.500	
npl	0.003	
aLT	0.992	
bLT	0.003	
cLT	0.002	
dLT	0.000	
eLT	0.000	
Cyy	0.992	
Cyz	0.981	
Czy	0.964	
Czz	0.987	

Unity check (6.61) = 0.00 + 0.01 + 0.15 = 0.16



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Unity check (6.62) = 0.00 + 0.01 + 0.21 = 0.22

Shear buckling check

in buckling field 1

According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values	
hw/t	19.277

The web slenderness is such that the Shear Buckling Check is not required.
Element satisfies the stability check !

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6. Beam End-Connection Design Forces

6.1. B1 (Hinged) - End Connection

Linear calculation, Extreme : Global, System : Principal

Selection : B10..B13,B15,B18,B20,B21,B27,B28,B36,B39..B42,B44,B46..B48,B51

Class : All ULS

Member	Case	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]
B46	CO223/4	3.083	-15.71	-0.04	-1.14	0.00
B27	CO221/2	0.000	14.00	0.00	1.06	0.04
B13	CO222/3	6.968	9.75	-15.19	-3.36	0.30
B13	CO211/5	6.968	-8.10	20.41	1.93	-0.27
B44	CO222/3	7.910	1.83	-2.32	-6.46	0.60
B44	CO221/2	0.000	-1.46	2.31	6.40	-0.61
B44	CO232/6	0.000	9.59	2.41	4.98	-0.63
B44	CO221/2	7.910	-8.96	-2.41	-6.46	0.63

6.2. B2 (Hinged) - End Connection

Linear calculation, Extreme : Global, System : Principal

Selection : B16,B23,B24,B45

Class : All ULS

Member	Case	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]
B23	CO211/5	10.950	-19.72	-0.39	9.25	-0.37
B23	CO222/3	10.950	16.78	0.92	-8.67	0.15
B24	CO231/7	10.945	12.99	-18.43	-3.12	0.00
B24	CO202/8	10.945	-13.28	15.99	-1.50	0.00
B45	CO222/3	7.910	-5.90	-0.23	-9.82	0.06
B23	CO212/9	10.950	-5.07	0.41	9.84	-0.37
B23	CO212/9	0.000	-3.74	-1.04	0.74	0.21

6.3. B1 (Moment) - End Connection

Linear calculation, Extreme : Global, System : Principal
 Selection : B9,B29,B31,B33,B35,B37,B38
 Class : All ULS

Member	Case	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
B33	CO201/1	8.066	-10.14	9.78	-1.93	-0.05	0.00	0.00
B33	CO232/6	8.066	8.76	-9.29	-1.89	0.06	0.00	0.00
B33	CO222/3	8.066	8.65	-9.36	-2.64	0.07	0.00	0.00
B33	CO211/5	8.066	-10.03	9.85	-1.18	-0.06	0.00	0.00
B9	CO221/2	1.927	-4.19	1.57	-6.77	0.10	-9.09	3.83
B29	CO201/1	0.000	-4.61	0.51	3.94	0.00	-8.25	-0.78
B9	CO211/5	1.927	2.82	1.15	2.43	-0.20	3.47	0.70
B9	CO202/8	0.000	0.86	-3.36	3.45	0.31	0.00	0.00
B9	CO212/9	1.927	3.76	-1.46	3.37	-0.17	5.24	-4.15
B9	CO204/10	1.927	2.23	-2.16	0.67	-0.06	2.13	-4.67
B9	CO233/11	1.927	-2.75	2.50	-4.38	0.03	-6.07	5.10

6.4. B2 (Moment) - End Connection

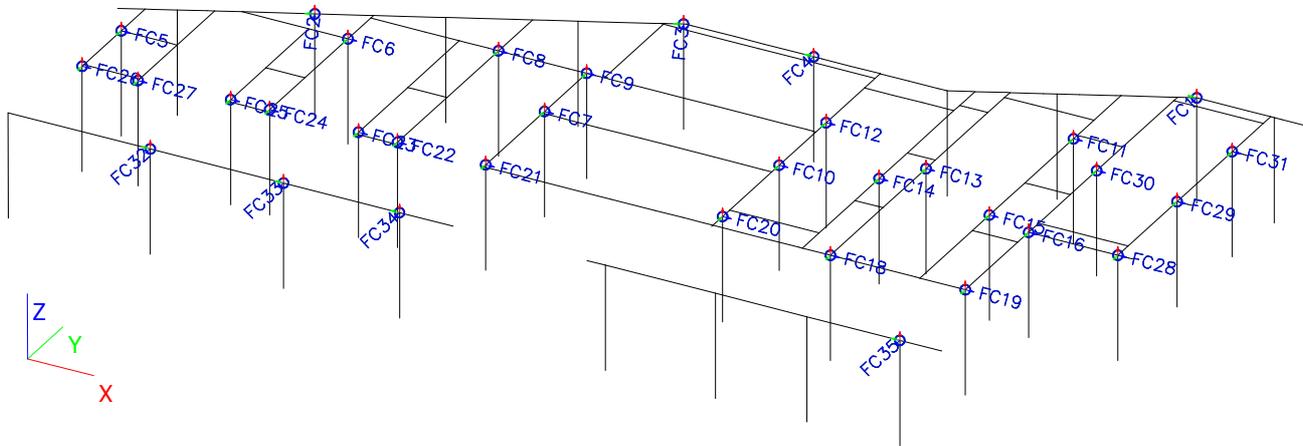
Linear calculation, Extreme : Global, System : Principal
 Selection : B2..B6,B13,B14,B17,B19,B22,B23
 Class : All ULS

Member	Case	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
B3	CO233/11	0.000	-31.89	-4.65	5.66	0.53	-7.56	3.48
B3	CO204/10	0.000	24.40	3.75	-2.06	-0.46	4.43	-2.76
B13	CO222/3	6.968	9.75	-15.19	-3.36	0.30	0.00	0.00
B13	CO211/5	6.968	-8.10	20.41	1.93	-0.27	0.00	0.00
B6	CO211/5	0.000	5.76	1.08	-11.94	-0.47	14.28	-1.91
B6	CO222/3	0.000	-5.82	-1.15	13.38	0.51	-15.44	1.98
B5	CO222/3	7.615	6.63	0.58	-2.16	-1.44	3.90	1.98
B4	CO222/3	0.000	9.05	-13.23	3.99	1.39	-5.23	5.38
B23	CO212/9	10.950	-5.07	0.41	9.84	-0.37	14.40	0.33
B3	CO212/9	11.333	-13.47	8.01	-1.86	0.57	4.42	-5.83
B3	CO221/2	11.333	17.02	-6.49	2.85	-0.59	-4.60	6.00

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7. Beam/Column Connection Design forces

7.1. Connection ID's



7.2. Connection forces, Type 1

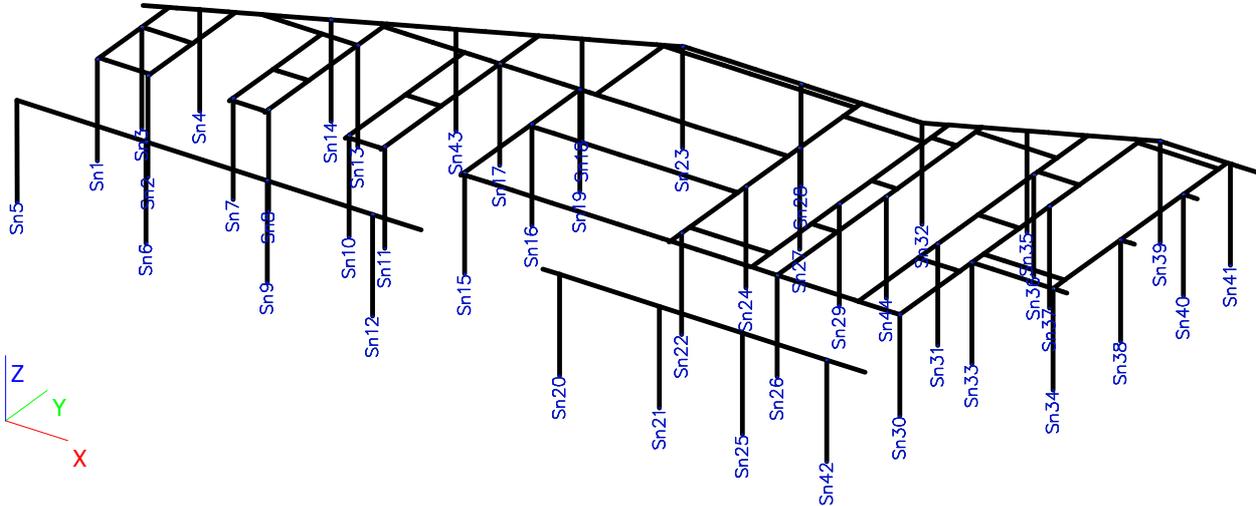
Case	Connection	Node	Beams	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
CO232/6	FC26	N2	B1	-4.94	6.82	0.26	0.00	0.02	-9.93
CO222/3	FC10	N128	B74	12.28	7.53	9.06	-0.01	0.74	-12.91
CO201/1	FC28	N56	B84	9.32	-7.43	-5.26	0.01	-5.17	10.39
CO221/2	FC7	N114	B66	7.77	7.55	8.04	0.02	0.66	-12.93
CO201/1	FC32	N96	B56	2.48	-1.91	-30.91	-0.01	-0.44	3.39
CO221/2	FC32	N96	B56	2.48	-1.91	30.91	0.01	0.44	3.39
CO231/7	FC34	N108	B62	4.80	4.48	30.79	-0.11	0.45	-6.85
CO202/8	FC34	N108	B62	1.61	-3.35	-30.79	0.11	-0.45	5.24
CO201/1	FC18	N48	B76	6.71	-6.49	-6.65	0.00	-8.83	8.76
CO232/6	FC18	N48	B76	6.47	4.52	6.30	0.00	7.43	-4.41
CO211/5	FC10	N128	B74	1.04	-7.29	-10.41	0.02	-0.85	12.04

7.3. Connection forces, Type 2

Case	Connection	Node	Beams	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
CO212/9	FC5	N14	B53	-7.27	-4.38	-7.88	0.03	-5.75	6.48
CO222/3	FC8	N27	B67	20.21	6.00	9.72	0.01	9.81	-9.99
CO222/3	FC4	N135	B78	7.27	-12.24	15.00	0.06	-1.27	19.06
CO211/5	FC4	N135	B78	3.41	13.65	-15.00	-0.07	1.08	-19.74
CO202/8	FC6	N23	B63	10.14	-4.58	-18.14	-0.01	-15.10	6.79
CO231/7	FC3	N126	B73	5.90	-1.44	17.31	-0.04	1.09	2.83
CO201/1	FC4	N135	B78	5.59	13.46	-15.05	-0.07	1.03	-19.17
CO201/1	FC3	N126	B73	5.69	8.97	-13.17	0.07	-0.91	-14.56
CO202/8	FC8	N27	B67	-0.43	-5.37	-17.36	0.00	-21.54	7.33
CO222/3	FC9	N38	B69	9.45	4.43	16.37	-0.02	23.47	-6.54
CO201/1	FC1	N8	B89	-4.81	13.52	3.03	0.00	5.50	-22.45
CO232/6	FC1	N8	B89	13.72	-12.17	-1.20	0.00	-3.79	19.60

8. Support Reaction Forces [kN; kN-m]

8.1. Support ID's



8.2. Reactions for Columns in the Middle Structure, BP1

Linear calculation, Extreme : Global

Selection : Sn1..Sn3,Sn7,Sn8,Sn10,Sn11,Sn13,Sn15..Sn17,Sn19,Sn22,Sn24,Sn26,Sn27,Sn29..Sn31,Sn33,Sn34,Sn36..Sn38,Sn40,Sn44

Class : All ULS

Rotated supports

Support	Case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
Sn13/N109	CO202/8	-18.14	4.58	14.12	-10.16	-52.02	-0.01
Sn19/N118	CO222/3	16.37	-4.43	13.43	9.83	37.10	-0.02
Sn3/N91	CO222/3	3.45	-7.75	14.37	15.43	5.32	-0.01
Sn3/N91	CO211/5	-2.58	7.52	-2.48	-15.03	-5.99	0.00
Sn3/N91	CO212/9	-7.88	4.38	-4.62	-9.73	-23.40	0.03
Sn17/N115	CO222/3	9.72	-6.00	24.19	12.19	26.17	0.01
Sn2/N90	CO211/5	-1.47	7.11	7.06	-17.20	-5.33	0.00
Sn2/N90	CO222/3	1.11	-6.30	4.62	16.90	4.03	0.00
Sn13/N109	CO231/7	15.83	-6.39	4.68	13.62	47.88	0.00
Sn11/N105	CO221/2	1.89	-1.49	6.94	5.09	6.84	-0.05
Sn11/N105	CO212/9	-1.97	3.63	6.42	-7.92	-7.13	0.05

8.3. Reactions for Columns at North South Walls, BP2

Linear calculation, Extreme : Global

Selection : Sn4..Sn6,Sn9,Sn12,Sn14,Sn18,Sn20,Sn21,Sn23,Sn25,Sn28,Sn32,Sn35,Sn39,Sn41..Sn43

Class : All ULS

Support	Case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
Sn28/N134	CO211/5	-13.65	15.00	6.07	-56.58	-30.78	-0.07
Sn4/N92	CO223/4	12.74	-3.00	12.56	18.07	33.45	0.00
Sn6/N95	CO221/2	1.91	-30.91	7.31	113.94	3.67	0.01
Sn6/N95	CO201/1	1.91	30.91	7.31	-113.94	3.67	-0.01
Sn41/N156	CO232/6	11.61	-4.20	-5.55	17.24	25.86	-0.05
Sn39/N154	CO222/3	12.09	1.08	19.52	-0.47	25.36	0.00
Sn6/N95	CO211/5	1.96	30.91	4.19	-113.94	3.76	-0.01
Sn6/N95	CO222/3	-1.73	-30.91	10.90	113.94	-3.23	0.01



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Support	Case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
Sn23/N125	CO201/1	-13.65	8.24	9.67	-35.72	-36.88	0.07
Sn4/N92	CO221/2	12.10	-5.51	15.93	27.33	33.55	0.00
Sn5/N94	CO221/2	4.98	-14.34	8.74	53.23	10.64	-0.14
Sn5/N94	CO211/5	4.88	14.34	6.50	-53.23	10.54	0.14