

EC5 Timber Fastener Capacity Check

EN 1995-1-1:2004

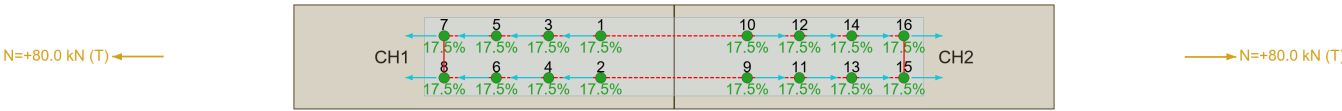
Date: 2026-08-11
Load Case: manual

Input Data Summary

Timber class	GL24h
Service class	1
Load duration	Medium-term
Fastener type	Bolt
Fastener diameter	16 mm
Fastener grade	4.6 (240/400)
Plate thickness	10.0 mm
Plate grade	S355
Plate type	Inserted
Number of plates	2
Outer plate $\pm y$	50.0 mm
Slot tolerance	0.0 mm (per side)
Recess	0.0 mm/end
a3 end-distance offset	0.0 mm

Connection Views

SIDE VIEW (XZ)



• eta ≤ 70% • 70% < eta ≤ 90% • 90% < eta ≤ 100% • eta > 100% FAIL

Members

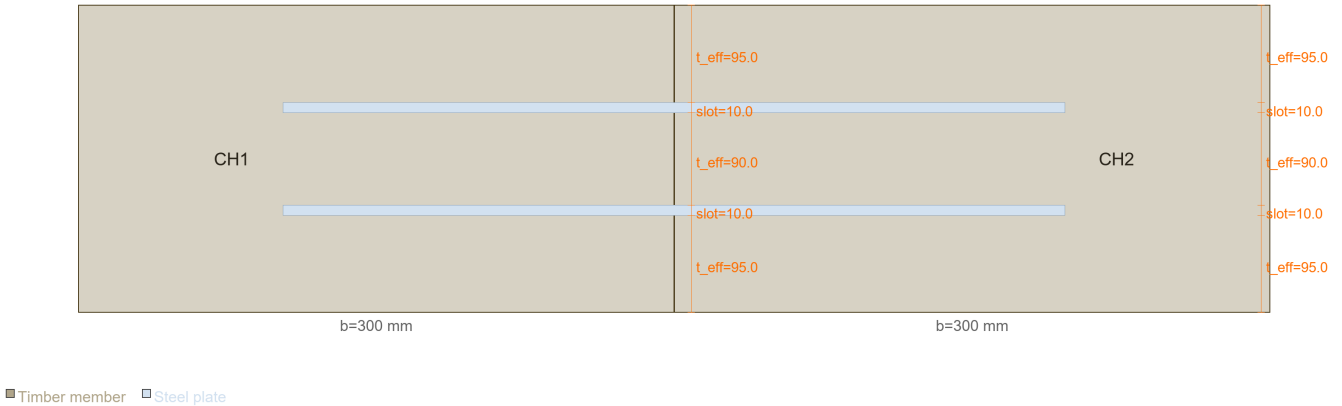
Name	Bearing	b [mm]	h [mm]	Cross-section
CH1	Yes	300	160	300 x 160
CH2	No	300	160	300 x 160

Member Loads (LC: manual)

Member	N [kN]	T/C	Vz [kN]	Vy [kN]	My [kNm]	Mz [kNm]	T [kNm]
CH1 / End	80.00	T	0.00	0.00	0.00	0.00	0.00
CH2 / End	80.00	T	0.00	0.00	0.00	0.00	0.00

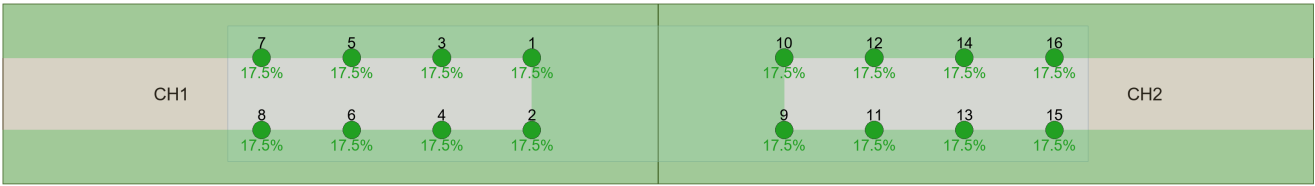
Equilibrium (Forces through node): X +0.00 Y +0.00 Z +0.00 kN Mx +0.00 My +0.00 Mz +0.00 kNm (balanced)
+ Lever arm (fastener group centroid x Vz): My -0.00 kNm
Equilibrium (Forces through fastener centroid): X +0.00 Y +0.00 Z +0.00 kN Mx +0.00 My -0.00 Mz +0.00 kNm (balanced)

TOP VIEW (XY)



Spacing Validation - S8.5.1.1(3)

SIDE VIEW (XZ)



eta ≤ 70% 70% < eta ≤ 90% 90% < eta ≤ 100% eta > 100% FAIL

a3 end-distance + a4 edge-distance zones, shown exactly as the on-screen side view (green = pass, red = fail).

Member CH1

a1 PARALLEL SPACING
a1,min = (4 + cos α)·d = 80.0 mm actual = 80.0 mm ✓ PASS
a2 PERPENDICULAR SPACING
a2,min = 64.0 mm actual = 64.0 mm ✓ PASS
a3,t END DISTANCE (loaded)
a3,t,min = max(7d, 80) = 112.0 mm actual = 112.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth+)
a4,c,min = 3d = 48.0 mm actual = 48.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth-)
a4,c,min = 3d = 48.0 mm actual = 48.0 mm ✓ PASS

Member CH2

a1 PARALLEL SPACING
a1,min = (4 + cos α)·d = 80.0 mm actual = 80.0 mm ✓ PASS
a2 PERPENDICULAR SPACING
a2,min = 64.0 mm actual = 64.0 mm ✓ PASS
a3,t END DISTANCE (loaded)
a3,t,min = max(7d, 80) = 112.0 mm actual = 112.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth+)
a4,c,min = 3d = 48.0 mm actual = 48.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth-)
a4,c,min = 3d = 48.0 mm actual = 48.0 mm ✓ PASS

Fastener Capacity - EN 1995-1-1:2004

Failure-mode compatibility (S8.1.3(2)): COMPATIBLE. All 16 multi-shear fastener(s) have every shear plane in the yielding family, so the per-plane Johansen capacities ARE summed (Sigma basis).

Fastener	a[°]	t [mm]	f _{ha}	V _{Ed,Σ}	F _{vRd,Σ}	ηΣ%	V _{Ed,pl}	F _{vRd,pl}	ηpl%	Compat	LC	Status	Md
B1	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B2	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B3	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B4	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B5	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B6	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B7	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B8	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B9	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B10	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B11	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B12	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B13	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B14	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B15	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g
B16	0	95/10/90/10/95	26.5	10.00	57.02	17.5	3.33	14.25	23.4	Yes	man...	PASS	g m m g

Gray values are supplementary and never set the row verdict.

Compatible-mode fasteners: $\eta = V_{Ed,\Sigma} / F_{v,Rd,\Sigma}$

Mode-incompatible fasteners: $\eta = V_{Ed,gov} / F_{v,Rd,gov}$ per S8.1.3(2)

Per-plane capacities cannot be summed across embedment + yielding mode families.

Fastener Johansen Derivation - EN 1995-1-1:2004

Critical fastener B2 (member CH1)

EN 1995-1-1:2004 · Bolt · governs LC manual

EMBEDMENT STRENGTH, PARALLEL TO GRAIN - EC5 (8.32)

$$f_{h,0,k} = 0.082 \cdot (1 - 0.01 \cdot d) \cdot \rho_k = 0.082 \cdot (1 - 0.01 \cdot 16.0) \cdot 385 = \mathbf{26.52 \text{ MPa}}$$

SOFTWOOD CORRECTION FACTOR - EC5 (8.33)

$$k_{90} = 1.35 + 0.015 \cdot d = 1.35 + 0.015 \cdot 16.0 = \mathbf{1.590}$$

EMBEDMENT STRENGTH AT ANGLE α - EC5 (8.31)

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \cdot \sin^2 \alpha + \cos^2 \alpha} = 26.52 / (1.590 \cdot 0.0000 + 1.0000) = \mathbf{26.52 \text{ MPa}}$$

CHARACTERISTIC YIELD MOMENT - EC5 (8.30)

$$M_{y,Rk} = 0.3 \cdot f_{u,k} \cdot d^{2.6} = 0.3 \cdot 400 \cdot 16.0^{2.6} = \mathbf{162141 \text{ N}\cdot\text{mm}}$$

ROPE EFFECT - EC5 §8.2.2(2)

$$F_{ax,Rk} = \min(F_{tens,Rk}, F_{wash,Rk}) = \min(56.52, 12.82) = \mathbf{12.82 \text{ kN}} \quad (\text{washer-bearing, } d_w = 50 \text{ mm})$$
$$F_{ax,Rk}/4 = 12.82 / 4 = \mathbf{3.20 \text{ kN}} \quad (\text{rope term; capped at } 0.25 \cdot F_{v,Rk,jhs} \text{ per mode})$$

JOHANSEN MODE (f) - EC5 (8.11)

$$F_{v,Rk} = f_{h,1,k} \cdot t_1 \cdot d = 26.52 \cdot 95.0 \cdot 16.0 = \mathbf{40.31 \text{ kN}}$$



JOHANSEN MODE (g) - EC5 (8.11) ← GOVERNS

$$F_{v,Rk} = f_{h,1,k} \cdot t_1 \cdot d \cdot [\sqrt{(2 + 4M_{y,Rk}/(f_{h,1,k} \cdot d \cdot t_1^2))} - 1] = 40309 \cdot 0.4729 = \mathbf{19.06 \text{ kN}}$$



JOHANSEN MODE (h) - EC5 (8.11)

$$F_{v,Rk} = 2.30 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} = 2.30 \cdot \sqrt{162141 \cdot 26.52 \cdot 16.0} = \mathbf{19.08 \text{ kN}}$$



INNER-PLANE MODE (l) - EC5 (8.13)

$$F_{v,Rk} = 0.5 \cdot f_{h,\alpha,k} \cdot t_{inner} \cdot d = 0.5 \cdot 26.52 \cdot 90.0 \cdot 16.0 = \mathbf{19.09 \text{ kN}}$$



INNER-PLANE MODE (m) - EC5 (8.13) ← GOVERNS

$$F_{v,Rk} = 2.3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,\alpha,k} \cdot d} = 2.3 \cdot \sqrt{162141 \cdot 26.52 \cdot 16.0} = \mathbf{19.08 \text{ kN}}$$



PER-PLANE CAPACITY (4 shear planes, §8.1.3(1)) - EC5 (8.1.3)

Plane outer-1 (outer, $t=95.0$ mm): $F_{v,Rk} = 22.27 \text{ kN}$ [mode g]

Plane inner-L (inner, $t=90.0$ mm): $F_{v,Rk} = 22.28 \text{ kN}$ [mode m]

Plane inner-R (inner, $t=90.0$ mm): $F_{v,Rk} = 22.28 \text{ kN}$ [mode m]

Plane outer-2 (outer, $t=95.0$ mm): $F_{v,Rk} = 22.27 \text{ kN}$ [mode g]

$$F_{v,Rk,total} = \Sigma \text{ planes} = \mathbf{89.09 \text{ kN}}$$

MODE COMPATIBILITY (§8.1.3(2)) - EC5 (8.1.3)

per-plane modes: **g|m|m|g**

one family -> COMPATIBLE: per-plane capacities summed

DESIGN CAPACITY - EC5 §2.4.1 (2.17)

$$F_{v,Rd} = \frac{k_{mod} \cdot F_{v,Rk}}{\gamma_M} = (0.80 \cdot 89.09) / 1.25 = \mathbf{57.02 \text{ kN}}$$

UTILISATION - EC5 (2.17)

$$\eta = \frac{V_{Ed}}{F_{v,Rd}} = 10.00 / 57.02 = \mathbf{0.18} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

Effective Fastener Count (n_{ef}) - S8.5.1.1(4)

Member CH1

N_{EF} FAMILY ROUTING

Family routing: bolt -> 8.5.1.1(4)

EFFECTIVE FASTENER COUNT - per row ($\alpha = 0.0^\circ$) - EC5 (8.34/8.35)

Row 1 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 16)})$, interp $\alpha \rightarrow n_{ef} = 2.74$

Row 2 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 16)})$, interp $\alpha \rightarrow n_{ef} = 2.74$

$\Sigma n_{ef} = 2.74 + 2.74 = 5.48$ effective fasteners

N_{EF} REDUCTION DISABLED

Perpendicular screw reinforcement provided.

EC5 row-reduction result is not used for group capacity.

Reason: Perpendicular screw reinforcement

Pre-override $\Sigma n_{ef} = 5.48$; used $\Sigma n_{ef} = 8.00$

GROUP CHARACTERISTIC CAPACITY - EC5 (8.1.1)

$F_{v,Rk,group} = \Sigma n_{ef} \cdot F_{v,Rk,fast} = 8.00 \cdot 89.09 = 712.8$ kN

GROUP DESIGN CAPACITY - EC5 (8.1.1)

$F_{v,Rd,group} = \Sigma n_{ef} \cdot F_{v,Rd} = 8.00 \cdot 57.02 = 456.2$ kN

GROUP UTILISATION (EC5) - EC5 (8.1.1) / (2.17)

$\eta = F_{Ed} / (\Sigma n_{ef} \cdot F_{v,Rd}) = 80.00 / (8.00 \cdot 57.02) = 0.18 \leq 1.0 \quad \checkmark \text{ PASS}$

Member CH2

N_{EF} FAMILY ROUTING

Family routing: bolt -> 8.5.1.1(4)

EFFECTIVE FASTENER COUNT - per row ($\alpha = 0.0^\circ$) - EC5 (8.34/8.35)

Row 1 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 16)})$, interp $\alpha \rightarrow n_{ef} = 2.74$

Row 2 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 16)})$, interp $\alpha \rightarrow n_{ef} = 2.74$

$\Sigma n_{ef} = 2.74 + 2.74 = 5.48$ effective fasteners

GROUP CHARACTERISTIC CAPACITY - EC5 (8.1.1)

$F_{v,Rk,group} = \Sigma n_{ef} \cdot F_{v,Rk,fast} = 5.48 \cdot 89.09 = 488.2$ kN

GROUP DESIGN CAPACITY - EC5 (8.1.1)

$F_{v,Rd,group} = \Sigma n_{ef} \cdot F_{v,Rd} = 5.48 \cdot 57.02 = 312.5$ kN

GROUP UTILISATION (EC5) - EC5 (8.1.1) / (2.17)

$\eta = F_{Ed} / (\Sigma n_{ef} \cdot F_{v,Rd}) = 80.00 / (5.48 \cdot 57.02) = 0.26 \leq 1.0 \quad \checkmark \text{ PASS}$

Block Shear (CH1) - EC5 Annex A

Settings: plug shear = OFF block-shear sum = ON

NET FRACTURE LENGTHS + MATERIAL - EC5 Annex A $L_{net,v} = \Sigma l_{v,i} = \mathbf{585.0\ mm}$ $L_{net,t} = \text{gross} - \Sigma \text{holes} = \mathbf{47.0\ mm}$ $f_{t,0,k} = 19.2\ \text{MPa} \quad f_{v,k} = 3.5\ \text{MPa} \quad k_{cr} = 0.67 \quad k_{mod} = 0.80 \quad \gamma_M = 1.25$
SEGMENT 0 (outer, t_seg = 95.0 mm) ← GOVERNS - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 95.0 = \mathbf{37235\ mm^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 95.0 = \mathbf{4465\ mm^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(128.6, 91.2) = \mathbf{128.59\ kN\ (tension)}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 128.59 / 1.25 = \mathbf{82.30\ kN}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 27.14 / 82.30 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
SEGMENT 1 (inner, t_seg = 90.0 mm) - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 90.0 = \mathbf{35276\ mm^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 90.0 = \mathbf{4230\ mm^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(121.8, 86.4) = \mathbf{121.82\ kN\ (tension)}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 121.82 / 1.25 = \mathbf{77.97\ kN}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 25.71 / 77.97 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
SEGMENT 2 (outer, t_seg = 95.0 mm) - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 95.0 = \mathbf{37235\ mm^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 95.0 = \mathbf{4465\ mm^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(128.6, 91.2) = \mathbf{128.59\ kN\ (tension)}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 128.59 / 1.25 = \mathbf{82.30\ kN}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 27.14 / 82.30 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
BLOCK SHEAR SUM (plastic redistribution, GOVERNS) - EC5 Annex A $\Sigma F_{bs,Rk} = 128.59 + 121.82 + 128.59 = \mathbf{379.01\ kN}$ $\Sigma F_{bs,Rd} = k_{mod} \cdot \Sigma F_{bs,Rk} / \gamma_M = 0.80 \cdot 379.01 / 1.25 = \mathbf{242.56\ kN}$ $\eta = N_{Ed} / \Sigma F_{bs,Rd} = 80.00 / 242.56 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$

Block Shear (CH2) - EC5 Annex A

Settings: plug shear = OFF block-shear sum = ON

NET FRACTURE LENGTHS + MATERIAL - EC5 Annex A $L_{net,v} = \Sigma l_{v,i} = \mathbf{585.0\text{ mm}}$ $L_{net,t} = \text{gross} - \Sigma \text{holes} = \mathbf{47.0\text{ mm}}$ $f_{t,0,k} = 19.2\text{ MPa} \quad f_{v,k} = 3.5\text{ MPa} \quad k_{cr} = 0.67 \quad k_{mod} = 0.80 \quad \gamma_M = 1.25$
SEGMENT 0 (outer, t_seg = 95.0 mm) ← GOVERNS - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 95.0 = \mathbf{37235\text{ mm}^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 95.0 = \mathbf{4465\text{ mm}^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(128.6, 91.2) = \mathbf{128.59\text{ kN (tension)}}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 128.59 / 1.25 = \mathbf{82.30\text{ kN}}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 27.14 / 82.30 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
SEGMENT 1 (inner, t_seg = 90.0 mm) - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 90.0 = \mathbf{35276\text{ mm}^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 90.0 = \mathbf{4230\text{ mm}^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(121.8, 86.4) = \mathbf{121.82\text{ kN (tension)}}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 121.82 / 1.25 = \mathbf{77.97\text{ kN}}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 25.71 / 77.97 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
SEGMENT 2 (outer, t_seg = 95.0 mm) - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 585.0 \cdot 95.0 = \mathbf{37235\text{ mm}^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 47.0 \cdot 95.0 = \mathbf{4465\text{ mm}^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(128.6, 91.2) = \mathbf{128.59\text{ kN (tension)}}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 128.59 / 1.25 = \mathbf{82.30\text{ kN}}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 27.14 / 82.30 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$
BLOCK SHEAR SUM (plastic redistribution, GOVERNS) - EC5 Annex A $\Sigma F_{bs,Rk} = 128.59 + 121.82 + 128.59 = \mathbf{379.01\text{ kN}}$ $\Sigma F_{bs,Rd} = k_{mod} \cdot \Sigma F_{bs,Rk} / \gamma_M = 0.80 \cdot 379.01 / 1.25 = \mathbf{242.56\text{ kN}}$ $\eta = N_{Ed} / \Sigma F_{bs,Rd} = 80.00 / 242.56 = \mathbf{0.33 \leq 1.0 \checkmark PASS}$

Member Net Cross-Section - S5.2 / S6.1

Member CH1

NET WIDTH + HOLE DIAMETER - EC5 5.2

$$b_{\text{net}} = W - n_{\text{pl}} \cdot (t_{\text{steel}} + 2 \cdot \text{slot}) = 300.0 - 2 \cdot (10.0 + 2 \cdot 0.0) = \mathbf{280.0 \text{ mm}} \quad (\text{steel-plate slot removed})$$
$$d_0 = d + \text{oversize} = 16 + 1 = \mathbf{17 \text{ mm}} \quad (\text{drilled timber hole})$$

NET CROSS-SECTION AREA - EC5 5.2

$$A_{\text{net}} = A_{\text{gross}} - n \cdot d_0 \cdot b = 44800 - 2 \cdot 17 \cdot 280 = \mathbf{35280 \text{ mm}^2}$$

DESIGN TENSILE STRENGTH (parallel) - EC5 6.1.2

$$f_{t,0,d} = k_{\text{mod}} \cdot k_h \cdot f_{t,0,k} / \gamma_M = 0.80 \cdot 1.0718 \cdot 19.2 / 1.25 = \mathbf{13.170 \text{ MPa}}$$

NET-SECTION TENSILE UTILISATION - EC5 6.1.2

$$\eta = \sigma_{t,0,d} / f_{t,0,d} = 2.268 / 13.170 = \mathbf{0.17} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

Member CH2

NET WIDTH + HOLE DIAMETER - EC5 5.2

$$b_{\text{net}} = W - n_{\text{pl}} \cdot (t_{\text{steel}} + 2 \cdot \text{slot}) = 300.0 - 2 \cdot (10.0 + 2 \cdot 0.0) = \mathbf{280.0 \text{ mm}} \quad (\text{steel-plate slot removed})$$
$$d_0 = d + \text{oversize} = 16 + 1 = \mathbf{17 \text{ mm}} \quad (\text{drilled timber hole})$$

NET CROSS-SECTION AREA - EC5 5.2

$$A_{\text{net}} = A_{\text{gross}} - n \cdot d_0 \cdot b = 44800 - 2 \cdot 17 \cdot 280 = \mathbf{35280 \text{ mm}^2}$$

DESIGN TENSILE STRENGTH (parallel) - EC5 6.1.2

$$f_{t,0,d} = k_{\text{mod}} \cdot k_h \cdot f_{t,0,k} / \gamma_M = 0.80 \cdot 1.0718 \cdot 19.2 / 1.25 = \mathbf{13.170 \text{ MPa}}$$

NET-SECTION TENSILE UTILISATION - EC5 6.1.2

$$\eta = \sigma_{t,0,d} / f_{t,0,d} = 2.268 / 13.170 = \mathbf{0.17} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

Checks Not Performed

Perpendicular Splitting - S8.1.4

CH1: not assessed (auto: $|V_z|=0.00$ kN < threshold 0.10 kN)

CH2: not assessed (auto: $|V_z|=0.00$ kN < threshold 0.10 kN)

Fastener Capacity

EN 1993-1-8:2005 + AC:2009 (Steel plate gate)

Independent of EC5/FprEN Johansen
F4 conservative path (steel/bolt check)
MIN end/edge distances, resultant fastener magnitude

Fastener	Class	V_Ed,pl[kN]	F_b,Rd[kN]	etaB%	V_Ed,pn[kN]	F_v,Rd[kN]	etaV%	Gov	Status
B1	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B2	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B3	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B4	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B5	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B6	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B7	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B8	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B9	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B10	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B11	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B12	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B13	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B14	inn/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B15	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS
B16	end/edg	5.00	128.00	3.9	3.33	30.14	11.1	shear	PASS

Plate S355, t = 10.0 mm, gamma_M2 = 1.25, threads in shear. 16 fasteners checked, 0 EC3-FAIL.
Only the Status cell is coloured by verdict (green PASS / red FAIL); all other values are neutral.
Per-plate demand sums two adjoining face forces (multi-plate Q5).
EC3 is an INDEPENDENT verification - both timber Johansen and this steel gate must pass independently.

Steel Plate Net Cross-Section (EN 1993-1-1 6.2.3 / 6.2.4)

Net rupture / gross yield of the plate(s) carrying each member axial force

Member	Type	N_Ed[kN]	A_net[mm2]	N_Rd[kN]	eta%	Status
CH1	tension	80.0	1680	616.9	13.0	PASS
CH2	tension	80.0	1680	616.9	13.0	PASS

Tension: min(gross yield $A \cdot f_y / \gamma_{M0}$, net rupture $0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$); compression uses the gross area.

Verdict

Member	Check	eta [%]	Status
CH1	Critical fastener (B2)	17.5	PASS
CH2	Critical fastener (B9)	17.5	PASS
CH1	Group capacity (n_ef)	17.5	PASS
CH2	Group capacity (n_ef)	25.6	PASS
CH1	Block / plug shear	33.0	PASS
CH2	Block / plug shear	33.0	PASS
CH1	Net cross-section	17.2	PASS
CH2	Net cross-section	17.2	PASS

Failure-mode compatibility (S8.1.3(2)): COMPATIBLE

FINAL VERDICT: PASS

Governing utilisation: eta = 33.0% (CH1 Block / plug shear)