

EC5 Timber Fastener Capacity Check

EN 1995-1-1:2004

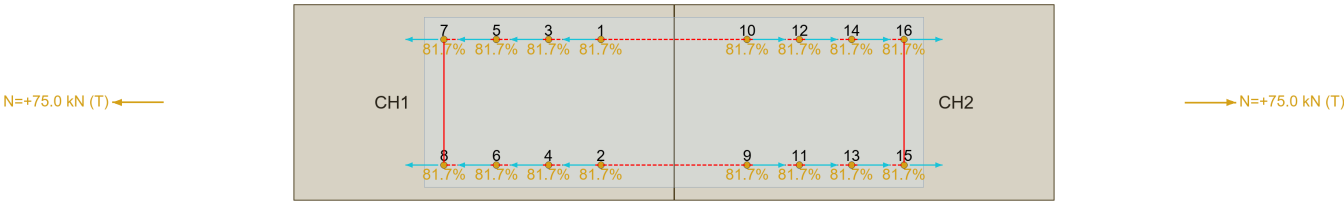
Date: 2026-08-11
Load Case: manual

Input Data Summary

Timber class	GL24h
Service class	1
Load duration	Medium-term
Fastener type	Dowel
Fastener diameter	7.5 mm
Fastener grade	Rothoblaas SBD 7.5
Dowel strength	p = 2 mm, L = 235 mm, M _{y,k} = 75.00 Nm, L _{eff} = 220 mm
Plate thickness	10.0 mm
Plate grade	S355
Plate type	Inserted
Number of plates	1
Slot tolerance	1.0 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

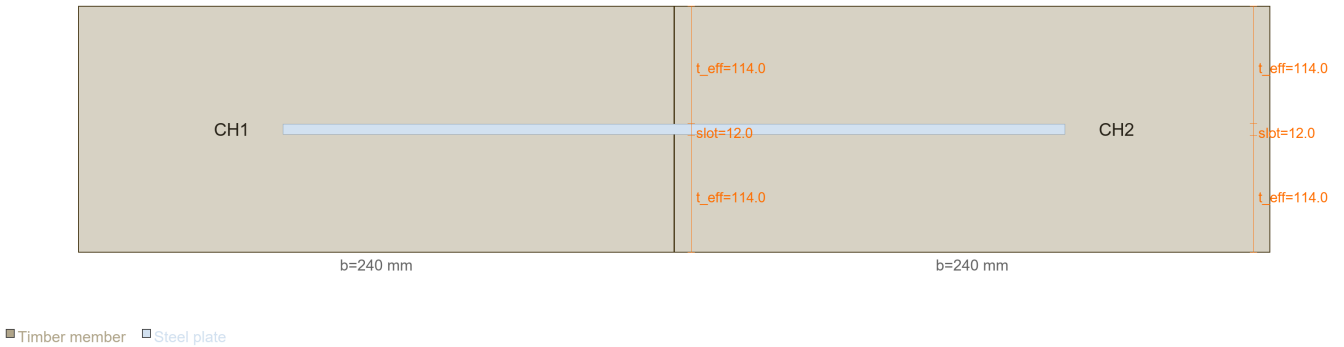
Name	Bearing	b [mm]	h [mm]	Cross-section
CH1	Yes	240	300	240 x 300
CH2	No	240	300	240 x 300

Member Loads (LC: manual)

Member	N [kN]	T/C	Vz [kN]	Vy [kN]	My [kNm]	Mz [kNm]	T [kNm]
CH1 / End	75.00	T	0.00	0.00	0.00	0.00	0.00
CH2 / End	75.00	T	0.00	0.00	0.00	0.00	0.00

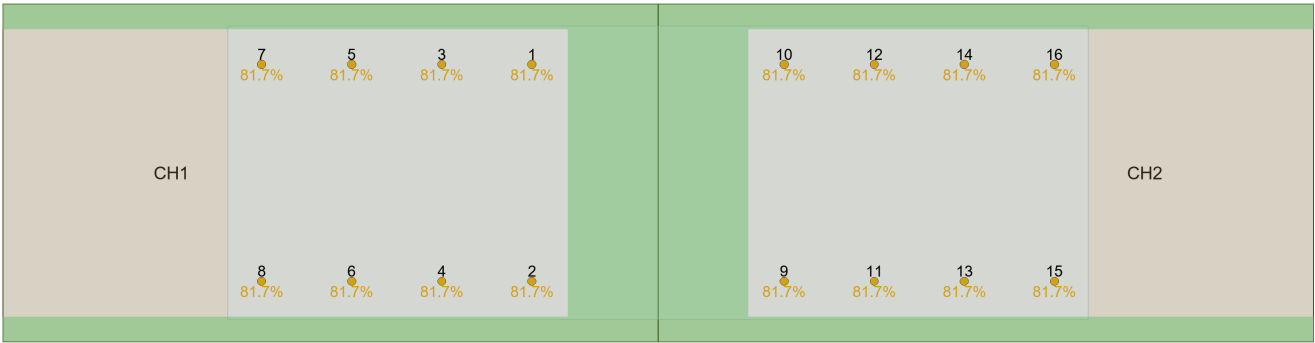
Equilibrium (Forces through node): X +0.00 Y +0.00 Z +0.00 kN Mx +0.00 My +0.00 Mz +0.00 kNm (balanced)
+ Lever arm (fastener group centroid x Vz): My -0.00 kNm
Equilibrium (Forces through fastener centroid): X +0.00 Y +0.00 Z +0.00 kN Mx +0.00 My -0.00 Mz +0.00 kNm (balanced)

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
a _{1,min} = (3 + 2 cos α)·d = 37.5 mm actual = 80.0 mm ✓ PASS
a2 PERPENDICULAR SPACING
a _{2,min} = 22.5 mm actual = 192.0 mm ✓ PASS
a3,t END DISTANCE (loaded)
a _{3,t,min} = max(7d, 80) = 80.0 mm actual = 112.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth+)
a _{4,c,min} = 3d = 22.5 mm actual = 54.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth-)
a _{4,c,min} = 3d = 22.5 mm actual = 54.0 mm ✓ PASS

Member CH2

a1 PARALLEL SPACING
a _{1,min} = (3 + 2 cos α)·d = 37.5 mm actual = 80.0 mm ✓ PASS
a2 PERPENDICULAR SPACING
a _{2,min} = 22.5 mm actual = 192.0 mm ✓ PASS
a3,t END DISTANCE (loaded)
a _{3,t,min} = max(7d, 80) = 80.0 mm actual = 112.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth+)
a _{4,c,min} = 3d = 22.5 mm actual = 54.0 mm ✓ PASS
a4,c EDGE DISTANCE (unloaded, Depth-)
a _{4,c,min} = 3d = 22.5 mm actual = 54.0 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
D1	0	112/10/96	29.2	9.37	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D2	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D3	0	112/10/96	29.2	9.37	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D4	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D5	0	112/10/96	29.2	9.37	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D6	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D7	0	112/10/96	29.2	9.37	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D8	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D9	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D10	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D11	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D12	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D13	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D14	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D15	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h
D16	0	112/10/96	29.2	9.38	11.47	81.7	4.69	5.74	81.7	Yes	man...	PASS	h h

Gray values are supplementary and never set the row verdict.

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

Mode-incompatible fasteners: $\eta = V_{Ed,gov} / F_{vRd,gov}$ 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 D2 (member CH1)

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

EMBEDMENT STRENGTH, PARALLEL TO GRAIN - EC5 (8.32)

$$f_{h,0,k} = 0.082 \cdot (1 - 0.01 \cdot d) \cdot \rho_k = 0.082 \cdot (1 - 0.01 \cdot 7.5) \cdot 385 = \mathbf{29.20 \text{ MPa}}$$

SOFTWOOD CORRECTION FACTOR - EC5 (8.33)

$$k_{90} = 1.35 + 0.015 \cdot d = 1.35 + 0.015 \cdot 7.5 = \mathbf{1.463}$$

EMBEDMENT STRENGTH AT ANGLE α - EC5 (8.31)

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \cdot \sin^2 \alpha + \cos^2 \alpha} = 29.20 / (1.463 \cdot 0.0000 + 1.0000) = \mathbf{29.20 \text{ MPa}}$$

CHARACTERISTIC YIELD MOMENT - EC5 (8.30)

$$M_{y,Rk} = 0.3 \cdot f_{u,k} \cdot d^{2.6} = 0.3 \cdot 1327 \cdot 7.5^{2.6} = \mathbf{75000 \text{ N}\cdot\text{mm}}$$

(f_u synthesised to reproduce the published M_y)

JOHANSEN MODE (f) - EC5 (8.11)

$$F_{v,Rk} = f_{h,1,k} \cdot t_1 \cdot d = 29.20 \cdot 111.5 \cdot 7.5 = \mathbf{24.42 \text{ kN}}$$



JOHANSEN MODE (g) - EC5 (8.11)

$$F_{v,Rk} = f_{h,1,k} \cdot t_1 \cdot d \cdot [\sqrt{(2 + 4M_{y,Rk} / (f_{h,1,k} \cdot d \cdot t_1^2))} - 1] = 24420 \cdot 0.4526 = \mathbf{11.05 \text{ kN}}$$



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

$$F_{v,Rk} = 2.30 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} = 2.30 \cdot \sqrt{75000 \cdot 29.20 \cdot 7.5} = \mathbf{9.32 \text{ kN}}$$



PER-PLANE CAPACITY (2 shear planes, §8.1.3(1)) - EC5 (8.1.3)

Plane outer-1 (outer, $t=111.5 \text{ mm}$): $F_{v,Rk} = 9.32 \text{ kN}$ [mode h]

Plane outer-2 (outer, $t=96.5 \text{ mm}$): $F_{v,Rk} = 9.32 \text{ kN}$ [mode h]

$F_{v,Rk,total} = \Sigma \text{ planes} = \mathbf{18.64 \text{ kN}}$

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

per-plane modes: **h|h**

one family -> COMPATIBLE: per-plane capacities summed

DESIGN CAPACITY - EC5 §2.4.1 (2.17)

$$F_{v,Rd} = \frac{k_{mod} \cdot F_{v,Rk}}{\gamma_M} = (0.80 \cdot 18.64) / 1.30 = \mathbf{11.47 \text{ kN}}$$

UTILISATION - EC5 (2.17)

$$\eta = \frac{V_{Ed}}{F_{v,Rd}} = 9.38 / 11.47 = \mathbf{0.82} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

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

Member CH1

N_{EF} FAMILY ROUTING

Family routing: dowel -> 8.5.1 (EN 8.6(1))

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

Row 1 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 8)})$, interp $\alpha \rightarrow n_{ef} = \mathbf{3.31}$

Row 2 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 8)})$, interp $\alpha \rightarrow n_{ef} = \mathbf{3.31}$

$\Sigma n_{ef} = 3.31 + 3.31 = \mathbf{6.62 \text{ effective fasteners}}$

GROUP CHARACTERISTIC CAPACITY - EC5 (8.1.1)

$F_{v,Rk,group} = \Sigma n_{ef} \cdot F_{v,Rk,fast} = 6.62 \cdot 18.64 = \mathbf{123.4 \text{ kN}}$

GROUP DESIGN CAPACITY - EC5 (8.1.1)

$F_{v,Rd,group} = \Sigma n_{ef} \cdot F_{v,Rd} = 6.62 \cdot 11.47 = \mathbf{76.0 \text{ kN}}$

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

$\eta = F_{Ed} / (\Sigma n_{ef} \cdot F_{v,Rd}) = 75.00 / (6.62 \cdot 11.47) = \mathbf{0.99 \leq 1.0 \checkmark \text{ PASS}}$

Member CH2

N_{EF} FAMILY ROUTING

Family routing: dowel -> 8.5.1 (EN 8.6(1))

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

Row 1 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 8)})$, interp $\alpha \rightarrow n_{ef} = \mathbf{3.31}$

Row 2 (n=4): $\min(4, 4^{0.9 \cdot 4} \sqrt{80/(13 \cdot 8)})$, interp $\alpha \rightarrow n_{ef} = \mathbf{3.31}$

$\Sigma n_{ef} = 3.31 + 3.31 = \mathbf{6.62 \text{ effective fasteners}}$

GROUP CHARACTERISTIC CAPACITY - EC5 (8.1.1)

$F_{v,Rk,group} = \Sigma n_{ef} \cdot F_{v,Rk,fast} = 6.62 \cdot 18.64 = \mathbf{123.4 \text{ kN}}$

GROUP DESIGN CAPACITY - EC5 (8.1.1)

$F_{v,Rd,group} = \Sigma n_{ef} \cdot F_{v,Rd} = 6.62 \cdot 11.47 = \mathbf{76.0 \text{ kN}}$

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

$\eta = F_{Ed} / (\Sigma n_{ef} \cdot F_{v,Rd}) = 75.00 / (6.62 \cdot 11.47) = \mathbf{0.99 \leq 1.0 \checkmark \text{ PASS}}$

Block Shear (CH1) - EC5 Annex A

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

NET FRACTURE LENGTHS + MATERIAL - EC5 Annex A $L_{net,v} = \sum l_{v,i} = \mathbf{651.5\text{ mm}}$ $L_{net,t} = \text{gross} - \sum \text{holes} = \mathbf{184.5\text{ mm}}$ $f_{t,0,k} = 19.2\text{ MPa} \quad f_{v,k} = 3.5\text{ MPa} \quad k_{cr} = 0.67 \quad k_{mod} = 0.80 \quad \gamma_M = 1.25$
SEGMENT 0 (outer, t_seg = 114.0 mm) ← GOVERNS - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 651.5 \cdot 114.0 = \mathbf{49762\text{ mm}^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 184.5 \cdot 114.0 = \mathbf{21033\text{ mm}^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(605.8, 121.9) = \mathbf{605.75\text{ kN (tension)}}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 605.75 / 1.25 = \mathbf{387.68\text{ kN}}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 37.50 / 387.68 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$
SEGMENT 1 (outer, t_seg = 114.0 mm) - EC5 Annex A $A_{net,v} = k_{cr} \cdot L_{net,v} \cdot t_{seg} = 0.67 \cdot 651.5 \cdot 114.0 = \mathbf{49762\text{ mm}^2}$ $A_{net,t} = L_{net,t} \cdot t_{seg} = 184.5 \cdot 114.0 = \mathbf{21033\text{ mm}^2}$ $F_{bs,Rk} = \max(1.5 \cdot A_{net,t} \cdot f_{t,0,k}, 0.7 \cdot A_{net,v} \cdot f_{v,k}) = \max(605.8, 121.9) = \mathbf{605.75\text{ kN (tension)}}$ $F_{bs,Rd} = k_{mod} \cdot F_{bs,Rk} / \gamma_M = 0.80 \cdot 605.75 / 1.25 = \mathbf{387.68\text{ kN}}$ $\eta_{seg} = \text{demand} / F_{bs,Rd} = 37.50 / 387.68 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$
BLOCK SHEAR SUM (plastic redistribution, GOVERNS) - EC5 Annex A $\Sigma F_{bs,Rk} = 605.75 + 605.75 = \mathbf{1211.50\text{ kN}}$ $\Sigma F_{bs,Rd} = k_{mod} \cdot \Sigma F_{bs,Rk} / \gamma_M = 0.80 \cdot 1211.50 / 1.25 = \mathbf{775.36\text{ kN}}$ $\eta = N_{Ed} / \Sigma F_{bs,Rd} = 75.00 / 775.36 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$

Block Shear (CH2) - EC5 Annex A

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

NET FRACTURE LENGTHS + MATERIAL - EC5 Annex A $L_{\text{net,v}} = \Sigma l_{\text{v,i}} = \mathbf{651.5\text{ mm}}$ $L_{\text{net,t}} = \text{gross} - \Sigma \text{holes} = \mathbf{184.5\text{ mm}}$ $f_{\text{t,0,k}} = 19.2\text{ MPa} \quad f_{\text{v,k}} = 3.5\text{ MPa} \quad k_{\text{cr}} = 0.67 \quad k_{\text{mod}} = 0.80 \quad \gamma_{\text{M}} = 1.25$
SEGMENT 0 (outer, t_seg = 114.0 mm) ← GOVERNS - EC5 Annex A $A_{\text{net,v}} = k_{\text{cr}} \cdot L_{\text{net,v}} \cdot t_{\text{seg}} = 0.67 \cdot 651.5 \cdot 114.0 = \mathbf{49762\text{ mm}^2}$ $A_{\text{net,t}} = L_{\text{net,t}} \cdot t_{\text{seg}} = 184.5 \cdot 114.0 = \mathbf{21033\text{ mm}^2}$ $F_{\text{bs,Rk}} = \max(1.5 \cdot A_{\text{net,t}} \cdot f_{\text{t,0,k}}, 0.7 \cdot A_{\text{net,v}} \cdot f_{\text{v,k}}) = \max(605.8, 121.9) = \mathbf{605.75\text{ kN (tension)}}$ $F_{\text{bs,Rd}} = k_{\text{mod}} \cdot F_{\text{bs,Rk}} / \gamma_{\text{M}} = 0.80 \cdot 605.75 / 1.25 = \mathbf{387.68\text{ kN}}$ $\eta_{\text{seg}} = \text{demand} / F_{\text{bs,Rd}} = 37.50 / 387.68 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$
SEGMENT 1 (outer, t_seg = 114.0 mm) - EC5 Annex A $A_{\text{net,v}} = k_{\text{cr}} \cdot L_{\text{net,v}} \cdot t_{\text{seg}} = 0.67 \cdot 651.5 \cdot 114.0 = \mathbf{49762\text{ mm}^2}$ $A_{\text{net,t}} = L_{\text{net,t}} \cdot t_{\text{seg}} = 184.5 \cdot 114.0 = \mathbf{21033\text{ mm}^2}$ $F_{\text{bs,Rk}} = \max(1.5 \cdot A_{\text{net,t}} \cdot f_{\text{t,0,k}}, 0.7 \cdot A_{\text{net,v}} \cdot f_{\text{v,k}}) = \max(605.8, 121.9) = \mathbf{605.75\text{ kN (tension)}}$ $F_{\text{bs,Rd}} = k_{\text{mod}} \cdot F_{\text{bs,Rk}} / \gamma_{\text{M}} = 0.80 \cdot 605.75 / 1.25 = \mathbf{387.68\text{ kN}}$ $\eta_{\text{seg}} = \text{demand} / F_{\text{bs,Rd}} = 37.50 / 387.68 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$
BLOCK SHEAR SUM (plastic redistribution, GOVERNS) - EC5 Annex A $\Sigma F_{\text{bs,Rk}} = 605.75 + 605.75 = \mathbf{1211.50\text{ kN}}$ $\Sigma F_{\text{bs,Rd}} = k_{\text{mod}} \cdot \Sigma F_{\text{bs,Rk}} / \gamma_{\text{M}} = 0.80 \cdot 1211.50 / 1.25 = \mathbf{775.36\text{ kN}}$ $\eta = N_{\text{Ed}} / \Sigma F_{\text{bs,Rd}} = 75.00 / 775.36 = \mathbf{0.10 \leq 1.0 \checkmark PASS}$

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

Member CH1

NET WIDTH + HOLE DIAMETER - EC5 5.2

$$b_{\text{net}} = W - n_{\text{pl}} \cdot (t_{\text{steel}} + 2 \cdot \text{slot}) = 240.0 - 1 \cdot (10.0 + 2 \cdot 1.0) = \mathbf{228.0 \text{ mm}} \quad (\text{steel-plate slot removed})$$
$$d_0 = d + \text{oversize} = 7.5 + 0 = \mathbf{7.5 \text{ mm}} \quad (\text{drilled timber hole})$$

NET CROSS-SECTION AREA - EC5 5.2

$$A_{\text{net}} = A_{\text{gross}} - n \cdot d_0 \cdot b = 68400 - 2 \cdot 7.5 \cdot 228 = \mathbf{64980 \text{ mm}^2}$$

DESIGN TENSILE STRENGTH (parallel) - EC5 6.1.2

$$f_{t,0,d} = k_{\text{mod}} \cdot k_h \cdot f_{t,0,k} / \gamma_M = 0.80 \cdot 1.0718 \cdot 19.2 / 1.30 = \mathbf{12.663 \text{ MPa}}$$

NET-SECTION TENSILE UTILISATION - EC5 6.1.2

$$\eta = \sigma_{t,0,d} / f_{t,0,d} = 1.154 / 12.663 = \mathbf{0.09} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

Member CH2

NET WIDTH + HOLE DIAMETER - EC5 5.2

$$b_{\text{net}} = W - n_{\text{pl}} \cdot (t_{\text{steel}} + 2 \cdot \text{slot}) = 240.0 - 1 \cdot (10.0 + 2 \cdot 1.0) = \mathbf{228.0 \text{ mm}} \quad (\text{steel-plate slot removed})$$
$$d_0 = d + \text{oversize} = 7.5 + 0 = \mathbf{7.5 \text{ mm}} \quad (\text{drilled timber hole})$$

NET CROSS-SECTION AREA - EC5 5.2

$$A_{\text{net}} = A_{\text{gross}} - n \cdot d_0 \cdot b = 68400 - 2 \cdot 7.5 \cdot 228 = \mathbf{64980 \text{ mm}^2}$$

DESIGN TENSILE STRENGTH (parallel) - EC5 6.1.2

$$f_{t,0,d} = k_{\text{mod}} \cdot k_h \cdot f_{t,0,k} / \gamma_M = 0.80 \cdot 1.0718 \cdot 19.2 / 1.30 = \mathbf{12.663 \text{ MPa}}$$

NET-SECTION TENSILE UTILISATION - EC5 6.1.2

$$\eta = \sigma_{t,0,d} / f_{t,0,d} = 1.154 / 12.663 = \mathbf{0.09} \leq \mathbf{1.0} \quad \checkmark \text{ PASS}$$

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
D1	end/edg	9.37	54.00	17.4	4.69	28.13	16.7	bear	PASS
D2	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D3	inn/edg	9.37	54.00	17.4	4.69	28.13	16.7	bear	PASS
D4	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D5	inn/edg	9.37	54.00	17.4	4.69	28.13	16.7	bear	PASS
D6	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D7	end/edg	9.37	54.00	17.4	4.69	28.13	16.7	bear	PASS
D8	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D9	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D10	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D11	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D12	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D13	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D14	inn/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D15	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS
D16	end/edg	9.38	54.00	17.4	4.69	28.13	16.7	bear	PASS

Plate S235, 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	75.0	2430	611.0	12.3	PASS
CH2	tension	75.0	2430	611.0	12.3	PASS

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

Verdict

Member	Check	eta [%]	Status
CH1	Critical fastener (D2)	81.7	PASS
CH2	Critical fastener (D9)	81.7	PASS
CH1	Group capacity (n_ef)	98.7	PASS
CH2	Group capacity (n_ef)	98.7	PASS
CH1	Block / plug shear	9.7	PASS
CH2	Block / plug shear	9.7	PASS
CH1	Net cross-section	9.1	PASS
CH2	Net cross-section	9.1	PASS

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

FINAL VERDICT: PASS

Governing utilisation: eta = 98.7% (CH1 Group capacity (n_ef))