Panel in whole construction and weakest part of panel

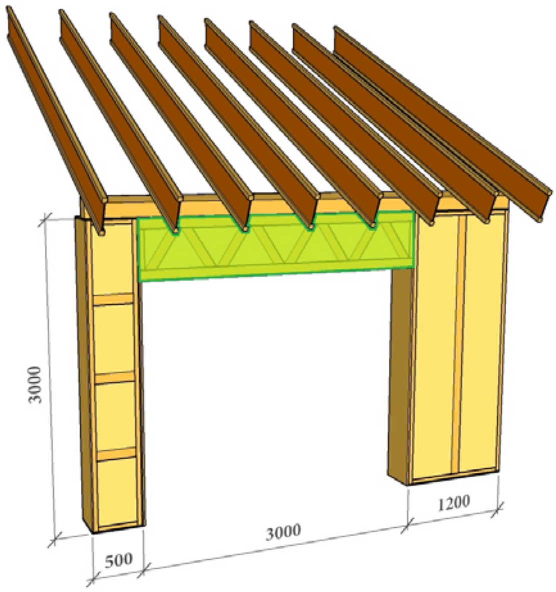


Fig 1. Total view

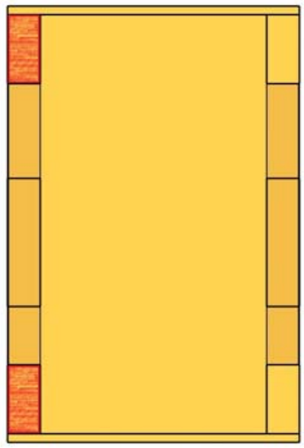


Fig 2. Side section of panel

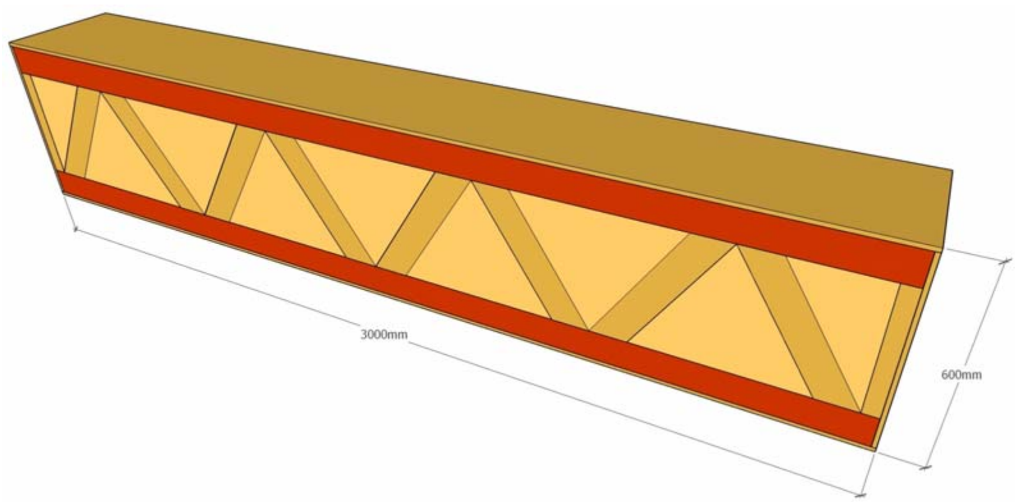


Fig 3. 3D view of panel

Lintel members design

Geometric parameters:

Height: $h := 95 \cdot mm$

Width: $b := 45 \cdot mm$

Section area: $A := h \cdot b = 0.004 \ m^2$

Span: $B := 6.0 \ m$

Moment of inertia: $I := \frac{b \cdot h^3}{12} = 321.516 \ cm^4$

Section modulus about the strong axis: $W := \frac{b \cdot h^2}{6} = 67.688 \ cm^3$

Factor for constant load: $\gamma_G := 1.35$

Factor for variable load: $\gamma_Q := 1.30$

Permanent action:

$g_{k1} := 2.4\ kPa$

$g_{d1} := g_{k1} \cdot \gamma_G = 3.24\ kPa$

Variable action:

$q_{ks} := 0.8 \cdot 1.0 \cdot 1.0 \cdot 1.6 \cdot kPa = 1.28\ kPa$ $\qquad q_{kw} := 0.89 \cdot kPa$

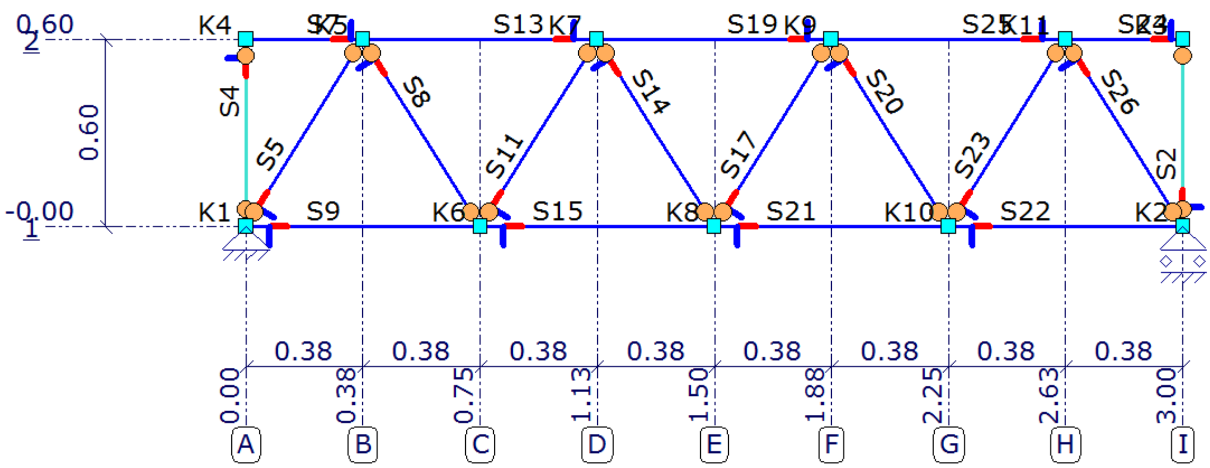
$q_{k1} := q_{ks} + q_{kw} = 2.17\ kPa$

$q_{d1} := q_{k1} \cdot \gamma_Q = 2.821\ kPa$

Sum of roof actions: $P_1 := g_{d1} + q_{d1} = 6.061\ kPa$

Loading on the wall: $p := P_1 \cdot B \cdot 0.5 = 18.183\ \dfrac{kN}{m}$

<u>Calculation is made according to finite element program "MatrixFrame":</u>



<u>Max forces in the lintel web:</u>

Max Axial compressive force in S19: $N_{C.max.d} := 33.20\ kN$

Max Axial tension force in S15 and S21: $N_{T.max.d} := 33.20\ kN$

Max Shear force in S13 and S25: $V_{max.d} := 7.10\ kN$

Max Bending force in S19: $M_{max.d} := 0.60\ kN \cdot m$

Physical/mechanical wood properties:

Characteristic bending strength $f_{m.k} := 24 \cdot \frac{N}{mm^2}$

Mean value of modulus of elasticity parallel to the grain $E_{0.mean} := 11000 \cdot \frac{N}{mm^2}$

Characteristic shear strength $f_{v.k} := 2.5 \cdot \frac{N}{mm^2}$ $f_{v.k.ply} := 2.9 \cdot \frac{N}{mm^2}$

Characteristic tenssion strength parallel to the grain $f_{t.0.k} := 14 \cdot \frac{N}{mm^2}$

Characteristic compressive strength parallel to the grain $f_{c.0.k} := 21 \cdot \frac{N}{mm^2}$

Mean value of shear modulus $G_{mean} := 690 \cdot \frac{N}{mm^2}$

Factors in use:

Partial factor for massive wood $\gamma_M := 1.30$

Deformation factor $k_{def} := 0.6$

Modification factor for duration of load and moisture content $k_{mod} := 0.7$ $k_{mod.short} := 0.9$

Depth factor for massive wood

h <150mm $k_h := min\left(\left(\frac{150 \cdot mm}{h}\right)^{0.2}, 1.3\right) = 1.096$

Ultimate Limit States (ULS)
Bending strength

Design moment $M_d := M_{max.d}$

Design bending strength $f_{m.d} := \frac{f_{m.k} \cdot k_{mod} \cdot k_h}{\gamma_M} = 14.159 \ \frac{N}{mm^2}$

Design section modulus about strong axis $W_d := \frac{M_d}{f_{m.d}} = 42.375 \ cm^3$

$\sigma_{m.y.d} := \frac{M_d}{W} = 8.864 \ \frac{N}{mm^2}$ $h := \sqrt{\frac{6 \cdot W_d}{b}} = 0.075 \ m$

$h := 95 \cdot mm$

Shear strength

Design shear force $V_d := V_{max.d}$

Design shear stress $\tau_{v.d} := \frac{3}{2} \cdot \frac{V_d}{A + 12\ \mathbf{mm} \cdot b} = 2.212\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Design shear strength $f_{v.d} := \frac{k_{mod} \cdot (f_{v.k} + f_{v.k.ply})}{\gamma_M} = 2.908\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Compressive stress

Design value of the end reaction $N_d := N_{C.max.d}$

Design compressive stress perpendicular to the grain $\sigma_{c.0.d} := \frac{N_d}{A} = 7.766\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Design compressive stress $f_{c.0.d} := \frac{k_{mod} \cdot f_{c.0.k}}{\gamma_M} = 11.308\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Tenssion stress

Design value of the end reaction $N_{T.d} := N_{T.max.d}$

Design compressive stress perpendicular to the grain $\sigma_{t.0.d} := \frac{N_{T.d}}{A} = 7.766\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Design compressive stress $f_{t.0.d} := \frac{k_{mod} \cdot f_{t.0.k} \cdot k_h}{\gamma_M} = 8.26\ \frac{\mathbf{N}}{\mathbf{mm}^2}$

Serviceability Limit States (SLS)

Limiting values for deflections

$u_{fin.g} := 3 \cdot \mathbf{mm}$

$u_{lim} := \frac{3\ \mathbf{m}}{300} = 10\ \mathbf{mm}$ $\Psi_2 := 0$

$u_{inst.G} := u_{fin.g} \cdot (1 + k_{def}) = 4.8\ \mathbf{mm}$

$u_{net.lim} := \frac{3\ \mathbf{m}}{250} = 12\ \mathbf{mm}$