Supplier	CLT Layup	FRL	Glue Line Maintained?	Side Exposed
XLam	XL5/220	90 (mins)	No	Underside

Design Methodologies

Design Method	Loading Code	Load Combinations
AS1720.1	AS1170/AS1720	Default Load Combination

Char Data

Phase 3 - Post Protected (mm/min)	Phase 4 - Consolidated (mm/min)
Fast Char	Slow Char
1.40 (mm/min)	0.65 (mm/min)

Underside
Unprotected

Loading Data

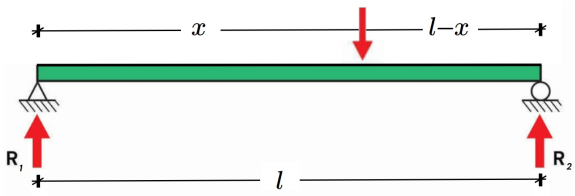
Q (kN)	G_{SDL} (kN)	Condition	Span
10 kN	25 kN	Simply Supported Point Load	5.0 (m)

Load Application

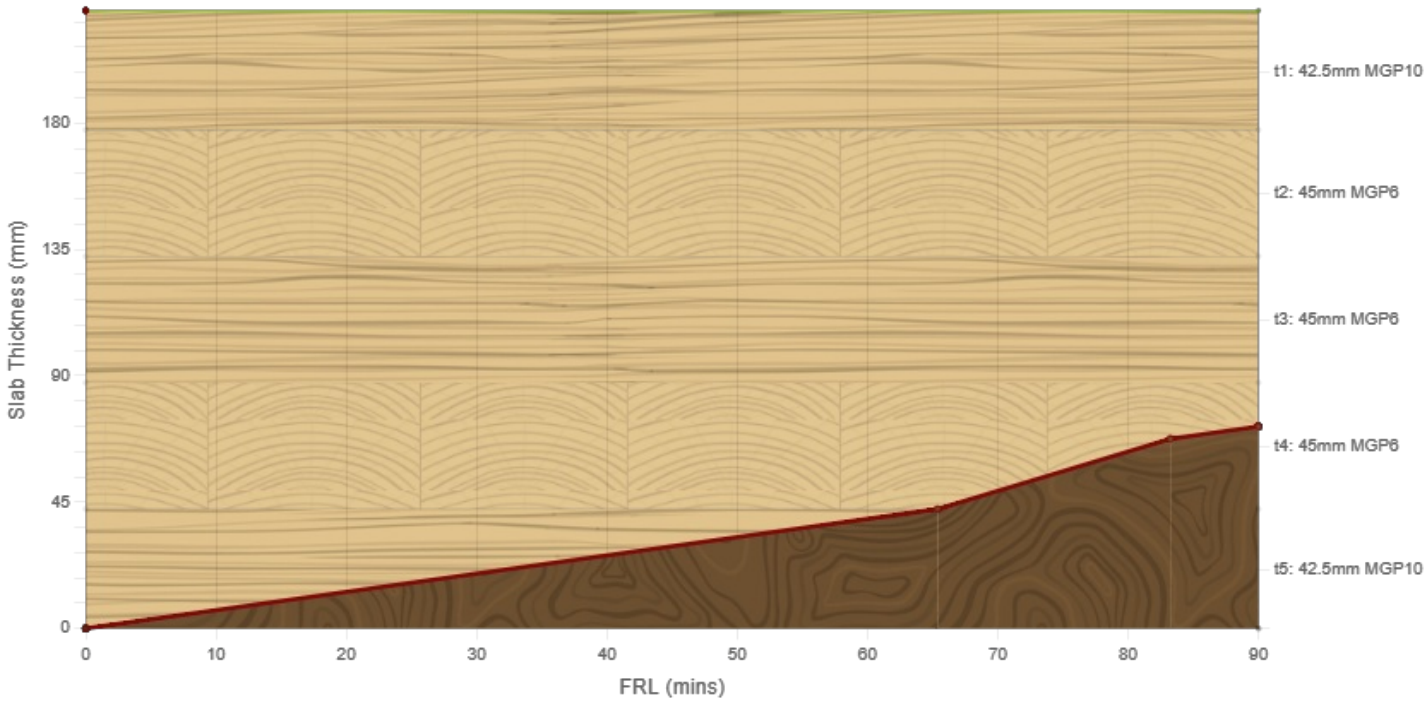
x	b_y	l_y
1.50 (m)	2.00 (m)	3.00 (m)
y	p_x	p_y
1.50 (m)	300 (mm)	300 (mm)

Outputs Summary

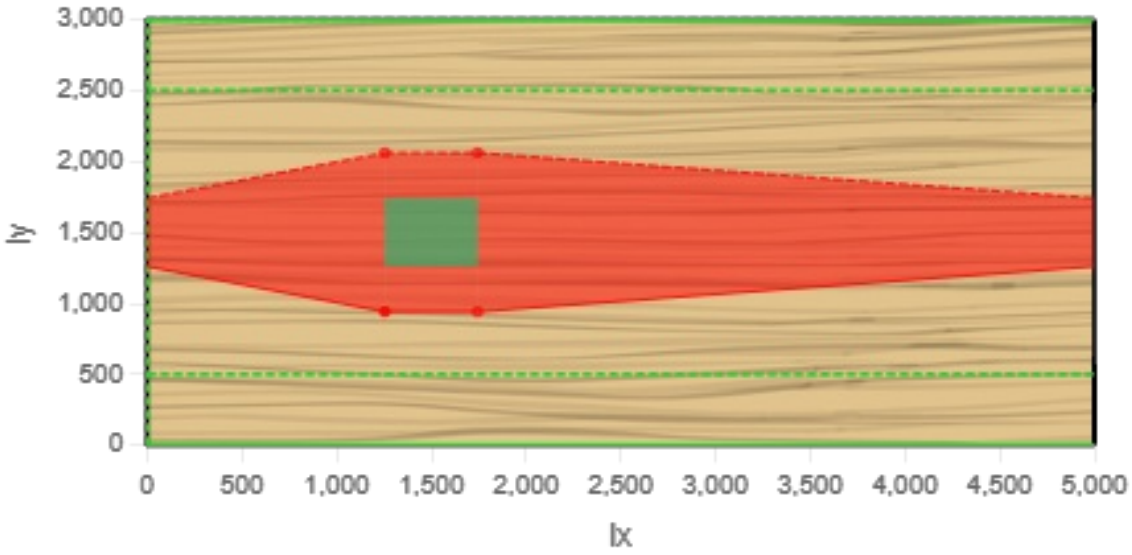
Fire Shear	Fire Bending
OK	OK
37.3%	81.6%



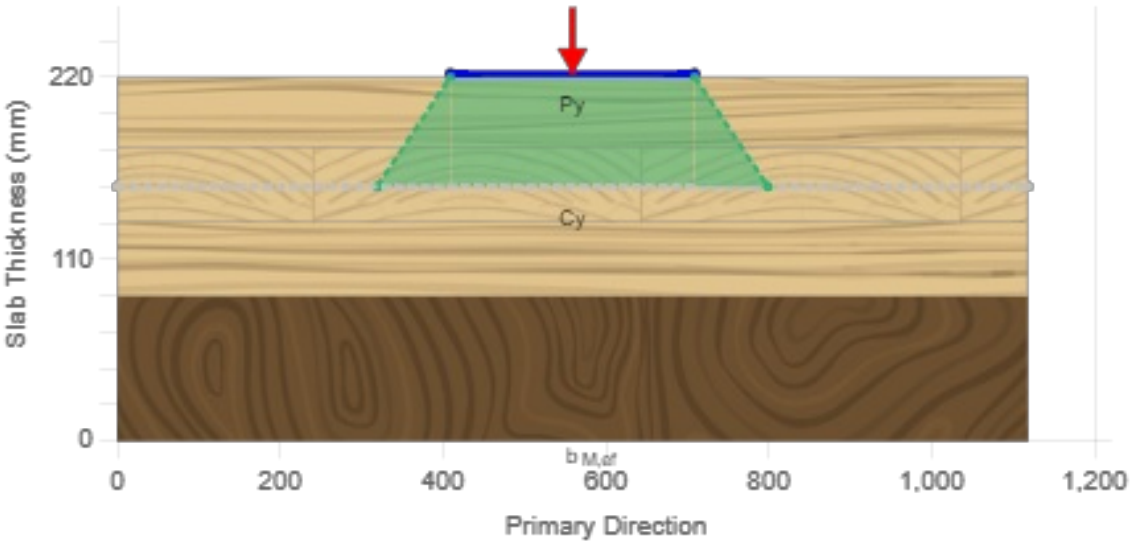
Char Model



Plotting the panel dimensions



Plotting layup dimensions



Zero Strength Layer

External Lamella Properties		Underside	Topside
Scenario	ZSL scenario (as per 7.2.3 EC5)	Tension side for first layer/Unprotected	Tension side for other layers/Unprotected
ZSL (mm)	Zero strength layer removed below char	12	7

Original Section (mm)		1. Charred Section (mm)	2. ZSL Removed (mm)	3. Design Section (mm)	Grade	E (MPa)	f'_b (MPa)	f'_r (MPa)
t_1	42.5	42.5	0	42.5	MGP10	10,000	17	1.2
t_2	45	45	0	45	MGP6	200	10	1.2
t_3	45	45	0	45	MGP6	6,000	10	1.2
t_4	45	15.6	12	0	MGP6	200	10	1.2
t_5	42.5	0	12	0	MGP10	10,000	17	1.2

Calculate Stiffness Via The Extended Gamma Method

$$EI_{eff} = \sum_{i=1}^{n} E_i b_i \frac{h_i^3}{12} + \sum_{i=1}^{n} E_i b_i h_i^2$$

Equation System Matrix: XX-direction

Matrix V		Matrix γ		Matrix S
[2.81e+4 3.49e+4 ; -2.23e+4 -4.07e+4]	*	[0.91 ; 0.91]	=	[5.72e+4 ; -5.72e+4]

Effective Flexural Stiffness: XX-direction

[-]	$E_{i,xx}$ (MPa)	a_i (label)	a_i (mm)	$b_{eff}\, t_i^3/12$ (mm^4)	$b_{eff}\, t_i\, a_i^2$ (mm^4)	γ_i (label)	γ_i (-)	$E_i I_{i\ effγ}$ (Nmm^2)
t_1	10000	a_1	34.60	6.40e+6	5.09e+7	γ_1	0.91	5.24e+11
t_2	0	-	-9.15	0.00e+0	0.00e+0	-	0.00	0.00e+0
t_3	6000	a_2	-54.15	7.59e+6	1.32e+8	γ_2	0.91	7.66e+11
t_4	0	-	0.00	0.00e+0	0.00e+0	-	0.00	0.00e+0
t_5	0	a_3	0.00	0.00e+0	0.00e+0	γ_3	0.00	0.00e+0

Bending Stiffness Properties of CLT		$EI_{effγ}$
$EI_{effγ}$ (Nmm^2) X-X	Bending Stiffness X-X direction	1.29e+12
$EI_{effγ}$ (Nmm^2) Y-Y	Bending Stiffness Y-Y direction	4.56e+10

Stiffness Properties of CLT		XX_Direction	YY_Direction
$EI_{effγ}$ (Nmm^2)	Serviceability stiffness derived from the Extended Gamma method	1.29e+12	4.56e+10
$EI_{effγ}$ (Nmm^2)	Strength stiffness derived from the Extended Gamma method	1.29e+12	4.56e+10

$$Z_{eff} = \frac{EI_{eff}}{E_i} \times \frac{1}{Max(y_c, t_p - y_c)}$$

Outer $lamella_{x\text{-}x}$	t1	
Outer $lamella_{y\text{-}y}$	t2	
$Ei_{x\text{-}x}$ (N/mm^2)	10000	the outer most longtiudnal lamella stiffness (primary direction)
$Ei_{y\text{-}y}$ (N/mm^2)	6000	the outer most longtiudnal lamella stiffness (secondary direction)

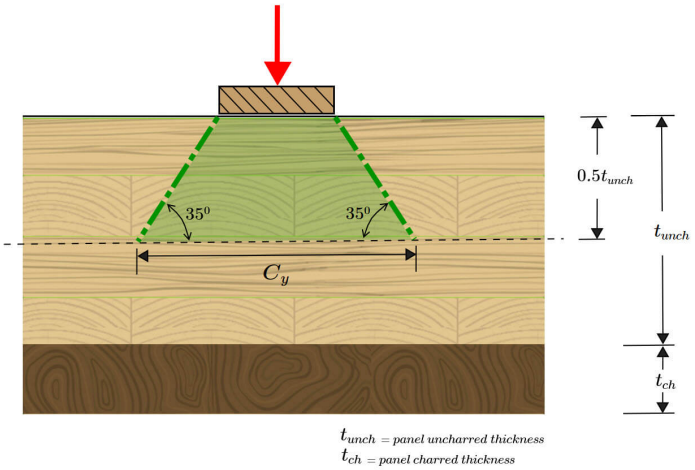
Section Modulus Properties of CLT		
Z_{eff_XX} (mm^3)	Section modulus: XX_direction	2.31e+6
Z_{eff_YY} (mm^3)	Section modulus: YY_direction	3.27e+5

Statical Moment_EQ : XX-direction

[-]	Location	$E_{i,XX}$ (MPa)	$Q_{i,top}$ (Nmm)	$Q_{i,bottom}$ (Nmm^3)	$E_iQ_{i,top}$ (Nmm^3)	$E_iQ_{i,bottom}$ (Nmm)
t_1	above yc	10000	1.47e+6	0.00e+0	1.47e+10	0.00e+0
t_2	mid	200	8.91e+4	5.01e+5	1.78e+7	1.00e+8
t_3	below yc	6000	0.00e+0	2.44e+6	0.00e+0	1.46e+10
t_4	0	0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
t_5	0	0	0.00e+0	0.00e+0	0.00e+0	0.00e+0

	t (mm)	a (mm)	E (Mpa)	EQ (Nmm)
Mid t upper	13.346946022727	6.6734730113636	200	1.78e+7
Mid t lower	-31.653053977273	-15.826526988636	200	-1.00e+8

	Max + (Nmm)	Max - (Nmm)	Abs Max (Nmm)
EQ_R	1.47e+10	-1.46e+10	1.47e+10
EQ_L	1.47e+10	-1.46e+10	1.47e+10



c_x and c_y Calculation

Θ_x (°)	35
Θ_y (°)	35
p_x (mm)	300
p_y (mm)	300
c_x (mm)	489.2
c_y (mm)	489.2
$\Theta_{pyrolysis}$ (°)	15

Effective width calculation: Shear Force

$$b_{V,ef} = 1.25c_y$$

ProHolz Volumne 2 Eq.4.37

$b_{V,ef}$ (mm)	611.5

Effective width calculation: Bending Moment

$$b_{M,ef} = (c_y + 2.0x(1 - \frac{x}{l_x}))k_{ortho} \leq b_{M,max}$$

ProHolz Volumne 2 Eq.4.29

$$b_{M,max} = [0.65l_y; b_y]$$

ProHolz Volumne 2 Eq.4.30

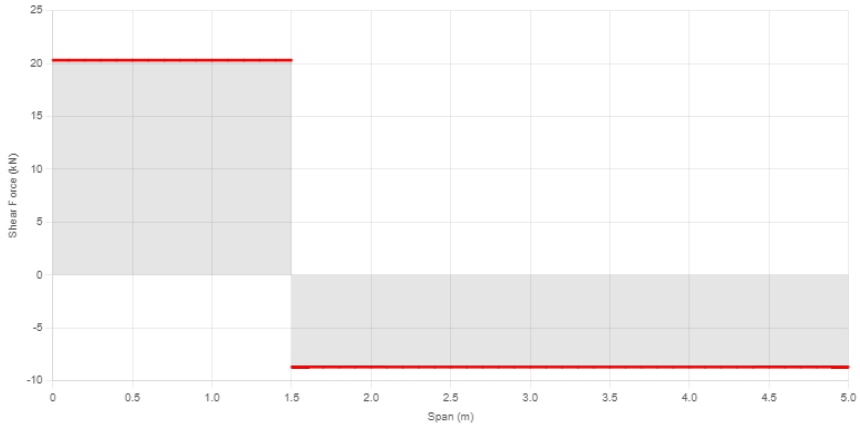
$EI_{x,net}$ (Nmm^2)	1.3e+12
$EI_{y,net}$ (Nmm^2)	4.6e+10
k_{ortho}	0.43
x (mm)	1500
$b_{M,max}$ (mm)	1950
$b_{M,ef}$ (mm)	1122
y (mm)	1500
$b_{M,ef\ upper}$ (mm)	561.17
$b_{M,ef\ near\ edge}$ (mm)	561.17

CLT Toolbox® Point Load (Fire)

Loading

Loading Data	
G (kN)	25.0
Q (kN)	10.0
ψ_L	0.4
P (kN)	29.00

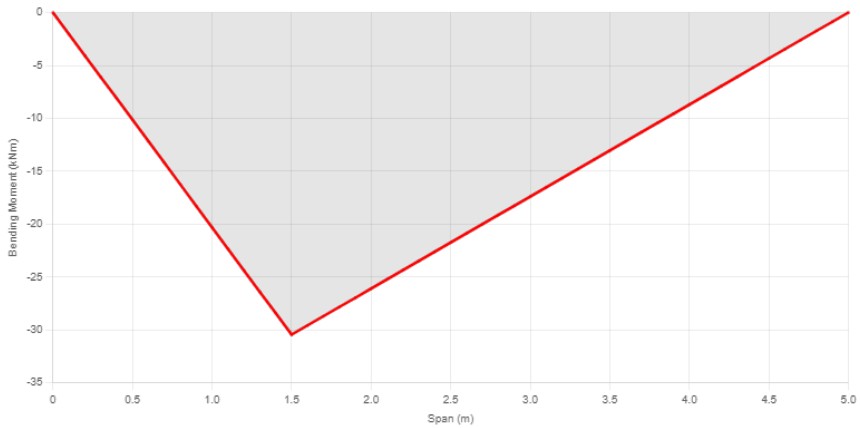
Shear Actions



$b_{V,ef}$ (m)	0.61

Load Combination	1.00G + 0.40Q
V^* (kN)	20.30
$V^* / b_{v,ef}$ (kN/m)	33.20

Bending Moment Actions



$b_{M,ef}$ (m)	1.12

Load Combination	1.00G + 0.40Q
M^*_{max+} (kNm)	0.00
M^*_{max-} (kNm)	-30.45
$M^*_{max+} / b_{M,ef}$(kNm/m)	0.00
$M^*_{max-} / b_{M,ef}$(kNm/m)	-27.13

Bending Design

$$M = \phi k_1 k_4 k_6 k_9 k_{12} f_b Z_{eff}$$

AS1720.1 CT18.2.1

φ	k_4	k_6	k_9	k_{12}
0.9	1	1	1	1

	Negative Moment (Mid-span)	Positive Moment (Hogging)
$Z_{eff,x}$ (mm^3)	2.31e+6	2.31e+6
f'_b (MPa)	17	17

Load Combination	1.00G + 0.40Q	
k_1	0.94	
φM_-(kNm)	33.24	Moment calculation at mid-span
$M^*_{max-}/b_{M,ef}$ (kNm/m)	27.13	
Ratio	*82%*	*82%*
φM_+ (kNm)	33.24	Moment calculation at support (hogging)
$M^*_{max+}/b_{M,ef}$ (kNm)	0.00	
Ratio	*0%*	*0%*

Shear Design

Calculate Rolling Shear Failure

$$V_r = \frac{\phi k_1 k_4 k_6 f'_r E I_{eff} b_{eff}}{(EQ_r)}$$

AS1720.1 CT18.2.5

CLT Handbook First Edition 2.3.1.3

	Max +	Max -	Abs Max	Calculate EQ at critical point for rolling shear
EQ_R (mm^3)	1.47e+10	-1.46e+10	1.47e+10	

Load Combination	1.00G + 0.40Q
k_1	0.94
Critical Layer	["t2"]
f'_r (MPa)	1.20
φVr (kN)	89.11
$V^*/b_{V,ef}$ (kN/m)	33.20
Ratio	*37%* *37%*

Calculate Longitudinal Shear Failure

$$V_L = \frac{\varphi k_1 k_4 k_6 f'_L E I_{eff} b_{ef}}{(EQ_L)}$$

AS1720.1 CL3.2.5

CLT Handbook First Edition 2.3.1.3

	Max +	Max -	Abs Max	Calculate EQ at critical point for longitudinal shear
EQ_L (mm^3)	1.47e+10	-1.47e+10	1.47e+10	

Load Combination	1.00G + 0.40Q
k_1	0.94
f'_c (MPa)	3.80

ϕV_L (kN)	281.83	
$V^*/b_{V,ef}$ (kN/m) L	33.20	
Ratio	*12%*	*12%*