PROYECTO DE UNA GASOLINERA

UD4. DIMENSIONADO DE LA ESTRUCTURA

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1.DIMENSIONADO

IMPERFECCIONES

Se incrementa el valor del axil a causa de las imperfecciones del pórtico sobre la viga contraviento.

Viga de canto variable
Sección central: 24x120 cm
Nx = -7 KN - 2 Fuerzas de Nx(-) = 3.5 KN
Mz = 343.08 KN - 2 Pares de fuerzas de Nx(+,-) = 171.54 KN

1.5% N(-) = 0.015 x (3.5 + 171.54) x 4 pórticos = 10.5 KN

Viga
Sección: 24x75 cm
Nx = 94.68 KN - 2 Fuerzas de Nx(-) = 47.34 KN
Mz = 141.9 KN - 2 Pares de fuerzas de Nx(+,-) = 70.95 KN

1.5% N(-) = 0.015 x (47.34 + 70.95) x 4 pórticos = 7.09 KN

ESTRUCTURA DE MADERA (VIGA CANTO VARIABLE)

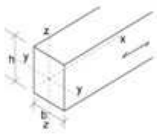
1.RESISTENCIA

Por ser de canto variable se dimensionaran los extremos y centro de viga donde se encuentran las mayores solicitaciones.

Sección superior (240x750 mm)
Nx = - 5.9 - 10.5 = - 16.4 KN Vy = 141.59 KN Mz = -51.81 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	750	180000	22500000	7200000

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICUA	a°
	16,400	51,810,000	0	141,590	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.09	2.30	0.00	1.18	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.48 %	11.42 %	0.00 %	51.21 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
0.00 %
0.00 %

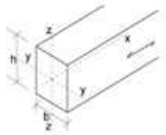
$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
0.00 %
0.00 %

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$
11.42 %
8.00 %

Sección central (240x1200 mm)

Nx = - 9.3 - 10.5 = - 19.8 KN Vy = -65.03 KN Mz = 585.68 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	1200	288000	57600000	11520000



duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICUA	a°
	19,800	585,680,000	0	65,030	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.07	10.17	0.00	0.34	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.36 %	50.44 %	0.00 %	14.70 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

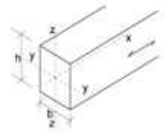
$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 50.44\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 35.31\ \%$$

Sección inferior (240x1600 mm)

Nx = - 19.54 - 10.5 = - 30.04 KN Vy = -192.27 KN Mz = - 805.2 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	1600	384000	102400000	15360000



duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICUA	a°
	30,040	805,000,000	0	192,270	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.08	7.86	0.00	0.75	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.41 %	38.99 %	0.00 %	32.60 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 39.00\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 27.30\ \%$$

2.ESTABILIDAD

Se comprobará la sección central e inferior de la viga donde las solicitaciones son mayores

Sección central (240x1200 mm)

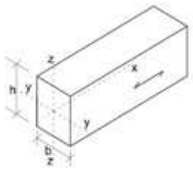
Nx = - 9.3 - 10.5 = - 19.8 KN Mz = 585.68 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	1200	25,000	288,000	346
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	57,600,000	11,520,000	1,382,400,000	4,832,870,400	69

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
19,800	585,680,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.07	10.17	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
0 % resistencia	50 % resistencia	0 % resistencia



PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	51 %
0 %	48 %

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0 %	86 %

PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
61.34	360.84
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
26.75	0.77
λrel,y	λrel,z
1.00	5.85
Ky	Kz
1.06	18.19
Xy	Xz
0.69	0.03
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
16.74	
λrel,m	
1.23	
Kcrit	
0.59	

Sección inferior (240x1600 mm)

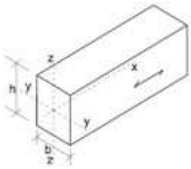
Nx = - 19.54 - 10.5 = - 30.04 KN Vy = -192.27 KN Mz = - 805.2 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	1600	25,000	384,000	462
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	102,400,000	15,360,000	1,843,200,000	6,676,070,400	69

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
30,040	805,200,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.08	7.86	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
0 % resistencia	39 % resistencia	0 % resistencia



PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	39 %
0 %	42 %

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0 %	88 %

PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
46.01	360.84
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
47.56	0.77
λrel,y	λrel,z
0.75	5.85
Ky	Kz
0.82	18.19
Xy	Xz
0.85	0.03
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
12.78	
λrel,m	
1.48	
Kcrit	
0.46	

3.RESISTENCIA INCENDIO

Anteriormente se calculo la sección reducida de la viga que equivalía a 49 mm por cada lado. De modo que las secciones quedarían como sigue.

Sección superior (142x652 mm)

Nx = - 5.9 - 10.5 = - 16.4 KN Vy = 141.59 KN Mz = -51.81 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	652	92584	10060794.67	2191154.667

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Mxd (−) (N) OBLICU	a°
	16,400	51,810,000	0	141,590	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.18	5.15	0.00	2.29	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.93 %	25.54 %	0.00 %	99.56 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(−)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 25.55\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 17.89\,\%$$

Sección central (142x1102 mm) NO CUMPLE

Nx = - 9.3 - 10.5 = - 19.8 KN Vy = -65.03 KN Mz = 585.68 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	1102	156484	28740894.67	3703454.667

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Mxd (−) (N) OBLICU	a°
	19,800	585,680,000	0	65,030	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.13	20.38	0.00	0.62	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.66 %	101.08 %	0.00 %	27.06 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(−)
-	-	no cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

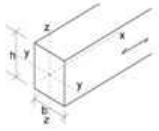
$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 101.09\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 70.76\,\%$$

Sección inferior (142x1502 mm)

Nx = - 19.54 - 10.5 = - 30.04 KN Vy = -192.27 KN Mz = - 805.2 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	1502	213284	53392094.67	5047721.333



duracion carga	clase de servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (−) (N) OBLICU	a°
	30,040	805,200,000	0	192,270	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.14	15.08	0.00	1.35	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	0.74 %	74.81 %	0.00 %	58.69 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(−)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 74.81\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 52.37\,\%$$

La sección central de la viga no cumple a momento en incendio de modo que se debe modificar el canto de la misma. Se ha observado en las tablas que debe el aumento tiene que ser como mínimo de 10 cm. Al ser de canto variable se tiene que modificar esta variación. Actualmente se encuentra en 75 cm a 160 cm.

Para que es su punto medio tenga un canto de 130 cm. La variación deberá ser de 95 cm a 160 cm.

VIGA DE CANTO VARIABLE: 240x(950 – 1600) mm

4.ESTABILIDAD INCENDIO

Se comprobará la sección central e inferior de la viga donde las solicitaciones son mayores

Sección central (240x1200 mm) NO CUMPLE

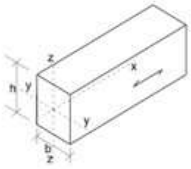
Nx = - 9.3 - 10.5 = - 19.8 KN Mz = 585.68 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	1102	25,000	156,484	318
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	28,740,895	3,703,455	262,945,281	966,397,877	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
19,800	585,680,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.13	20.38	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
1% resistencia	101% resistencia	0% resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
66.80	609.88
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
22.56	0.27
λrel,y	λrel,z
1.08	9.89
Ky	Kz
1.17	50.41
Xy	Xz
0.63	0.01
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
6.54	
λrel,m	
2.07	
Kcrit	
0.23	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	no cumple
0%	102%
0%	137%

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	no cumple
0%	1937%

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

Sección inferior (240x1600 mm) NO CUMPLE

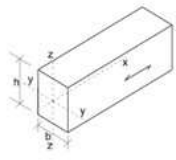
Nx = - 19.54 - 10.5 = - 30.04 KN Vy = -192.27 KN Mz = - 805.2 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	1502	25,000	213,284	434
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	53,392,095	5,047,721	358,388,215	1,348,169,611	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
30,040	805,200,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.14	15.08	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
1% resistencia	75% resistencia	0% resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
49.01	609.88
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
41.91	0.27
λrel,y	λrel,z
0.80	9.89
Ky	Kz
0.87	50.41
Xy	Xz
0.83	0.01
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
4.86	
λrel,m	
2.40	
Kcrit	
0.17	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	no cumple
0%	76%
0%	126%

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	no cumple
0%	1933%

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

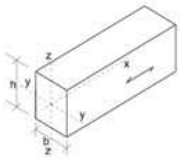
No cumple ninguna de las dos secciones a inestabilidad en caso de incendio. De modo que se aumenta a 400 mm de sección que cumple en los dos casos.

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	302	1102	25,000	332,804	318
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	61,125,001	16,751,135	2,529,421,335	8,370,869,719	87

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
19,800	585,680,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.06	9.58	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
0 % resistencia	48 % resistencia	0 % resistencia



PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	48 %
0 %	40 %

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0 %	41 %

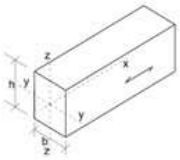
PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
66.80	286.76
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
22.56	1.22
λrel,y	λrel,z
1.08	4.65
Ky	Kz
1.17	11.76
Xy	Xz
0.63	0.04
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
28.09	
λrel,m	
1.00	
Kcrit	
0.81	

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	302	1502	25,000	453,604	434
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	113,552,201	22,831,401	3,447,541,601	12,043,350,786	87

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
30,040	805,200,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.07	7.09	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
0 % resistencia	35 % resistencia	0 % resistencia



PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	36 %
0 %	32 %

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0 %	33 %

PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
0.9	1.0
λy	λz
49.01	286.76
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
41.91	1.22
λrel,y	λrel,z
0.80	4.65
Ky	Kz
0.87	11.76
Xy	Xz
0.83	0.04
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
21.17	
λrel,m	
1.15	
Kcrit	
0.70	

ESTRUCTURA DE MADERA (VIGA)

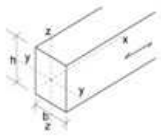
1.RESISTENCIA

Sección (240x750 mm)

Nx = - 94.68 - 7.09 = - 101.77 KN Vy = 65.23 KN Mz = 141.9 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	750	180000	22500000	7200000

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	101,770	141,900,000	0	65,230	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.57	6.31	0.00	0.54	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	2.96 %	31.28 %	0.00 %	23.59 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 31.37\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 21.99\ \%$$

2.INESTABILIDAD

Sección (240x750 mm)

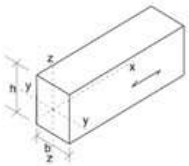
Nx = - 94.68 - 7.09 = - 101.77 KN Mz = 141.9 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	750	11,000	180,000	217
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	22,500,000	7,200,000	864,000,000	2,759,270,400	69

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
101,770	141,900,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.57	6.31	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
3 % resistencia	31 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
50.81	158.77
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
39.00	3.99
λrel,y	λrel,z
0.82	2.58
Ky	Kz
0.89	4.05
Xy	Xz
0.81	0.14
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
58.19	
λrel,m	
0.69	
Kcrit	
1.00	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	35 %
0 %	43 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Mzd

Myd	Myd, Nxd (-)
-	cumple
0 %	31 %

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

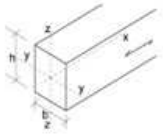
3.RESISTENCIA INCENDIO

Sección (142x652 mm)

Nx = - 94.68 - 7.09 = - 101.77 KN Vy = 65.23 KN Mz = 141.9 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	652	92584	10060794.67	2191154.667

duracion carga	clase de servicio	Kmod	γm
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	101,770	141,900,000	0	65,230	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	1.10	14.10	0.00	1.06	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	5.76 %	69.96 %	0.00 %	45.87 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 70.29\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \quad 49.31\,\%$$

4.INESTABILIDAD INCENDIO

Sección (142x652 mm) NO CUMPLE

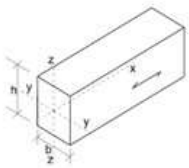
Nx = - 94.68 - 7.09 = - 101.77 KN Mz = 141.9 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	652	11,000	92,584	188
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	10,060,795	2,191,155	155,571,981	536,904,677	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
101,770	141,900,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
1.10	14.10	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
6 % resistencia	70 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
58.44	268.35
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
29.47	1.40
λrel,y	λrel,z
0.95	4.35
Ky	Kz
1.01	10.38
Xy	Xz
0.73	0.05
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
24.36	
λrel,m	
1.07	
Kcrit	
0.76	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	no cumple
0 %	78 %
0 %	163 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	no cumple
0 %	200 %

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

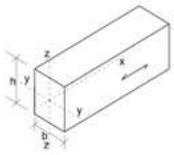
Se aumenta el ancho total a 300 mm. De modo que quedaría una sección de 202 mm en el caso de incendio. Se comprueba que cumple.

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	202	652	11,000	131,704	188
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	14,311,835	4,434,035	447,837,501	1,441,707,058	58

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
101,770	141,900,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.77	9.91	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
4 % resistencia	49 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
58.44	188.64
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
29.47	2.83
λrel,y	λrel,z
0.95	3.06
Ky	Kz
1.01	5.46
Xy	Xz
0.73	0.10
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
47.61	
λrel,m	
0.77	
Kcrit	
0.98	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0%	55%
0%	75%

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0%	65%

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

ESTRUCTURA DE MADERA (CORREAS)

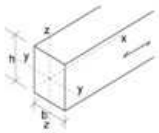
1.RESISTENCIA

Sección (300x400 mm)

Nx = - 81.86 KN Vy = 14.59 KN Mz = 20.08 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	300	400	120000	8000000	6000000

duracion carga	clase de servicio	Kmod	γm
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Ixd (−) (N) OBLICUA	a°
	81,860	20,080,000	0	14,590	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.68	2.51	0.00	0.18	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
13.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	3.58 %	12.45 %	0.00 %	7.92 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(−)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 12.58\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 8.84\,\%$$

2. INESTABILIDAD

Sección (300x400 mm)

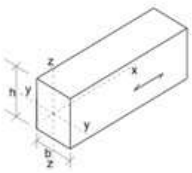
Nx = - 81.86 KN Mz = 20.08 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	300	400	6,000	120,000	115
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	8,000,000	6,000,000	900,000,000	1,839,000,000	87

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)
81,860	20,080,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.68	2.51	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
4 % resistencia	12 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
51.96	69.28
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
37.29	20.97
λrel,y	λrel,z
0.84	1.12
Ky	Kz
0.91	1.21
Xy	Xz
0.80	0.60
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
254.05	
λrel,m	
0.33	
Kcrit	
1.00	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	17 %
0 %	15 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Mzd

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

Myd	Myd, Nxd (-)
-	cumple
0 %	8 %

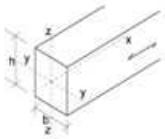
$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

3. RESISTENCIA INCENDIO

Sección (202x302 mm)

Nx = - 81.86 KN Vy = 14.59 KN Mz = 20.08 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	202	302	61004	3070534.667	2053801.333



duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	81,860	20,080,000	0	14,590	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	1.34	6.54	0.00	0.36	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	7.03 %	32.44 %	0.00 %	15.57 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 32.93\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 23.20\,\%$$

4. INESTABILIDAD INCENDIO

Sección (202x302 mm)

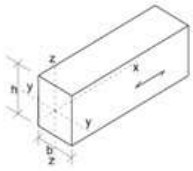
Nx = - 81.86 KN Mz = 20.08 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	202	302	6,000	61,004	87
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	3,070,535	2,053,801	207,433,935	480,092,791	58

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
81,860	20,080,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
1.34	6.54	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
7 % resistencia	32 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
68.82	102.89
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
21.25	9.51
λrel,y	λrel,z
1.12	1.67
Ky	Kz
1.21	2.03
Xy	Xz
0.60	0.31
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
159.78	
λrel,m	
0.42	
Kcrit	
1.00	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)
-
0 %
0 %

Nxd (-), Myd y/o Mzd
cumple
44 %
45 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Myd

Myd
-
0 %

Myd, Nxd (-)
cumple
33 %

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

ESTRUCTURA DE MADERA (SOPORTE CENTRAL)

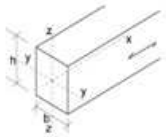
Se dimensionarán los dos extremos del pilar

1.RESISTENCIA

Sección superior (240x1600 mm)

Nx = - 246.352 KN Vy = 139.439 KN Mz = 804.864 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	1600	384000	102400000	15360000



duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	246,352	804,964,000	0	139,439	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	0.64	7.86	0.00	0.54	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	3.36 %	38.99 %	0.00 %	23.64 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

0.00 %
0.00 %

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

0.00 %
0.00 %

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

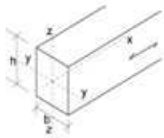
$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

39.11 %
27.41 %

Sección inferior (240x750 mm)

Nx = - 254.978 KN Vy = 139.439 KN Mz = 0 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	750	180000	22500000	7200000



duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	254,978	0	0	139,439	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	1.42	0.00	0.00	1.16	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	cumple	-	-	cumple	-	-	
0.00 %	7.42 %	0.00 %	0.00 %	50.43 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	-

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

0.00 %
0.00 %

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

0.00 %
0.00 %

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

0.55 %
0.55 %

2. INESTABILIDAD

Sección superior (240x1600 mm)

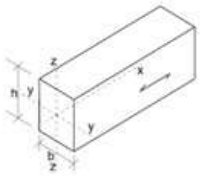
Nx = - 246.352 KN Mz = 804.864 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	1600	5,700	384,000	462
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	102,400,000	15,360,000	1,843,200,000	6,676,070,400	69

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
246,352	804,864,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.64	7.86	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
3 % resistencia	39 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
12.34	82.27
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
661.01	14.87
λrel,y	λrel,z
0.20	1.33
Ky	Kz
0.51	1.49
Xy	Xz
1.02	0.46
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
56.06	
λrel,m	
0.71	
Kcrit	
1.00	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	42 %
0 %	35 %

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0 %	22 %

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

Sección inferior (240x750 mm)

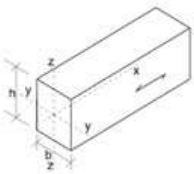
Nx = - 254.978 KN Mz = 0 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	750	5,700	180,000	217
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	22,500,000	7,200,000	864,000,000	2,759,270,400	69

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
254,978	0	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
1.42	0.00	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
7 % resistencia	0 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
26.33	82.27
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
145.24	14.87
λrel,y	λrel,z
0.43	1.33
Ky	Kz
0.60	1.49
Xy	Xz
0.97	0.46
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
112.30	
λrel,m	
0.50	
Kcrit	
1.00	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
cumple	-
8 %	0 %
16 %	0 %

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	-
0 %	0 %

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

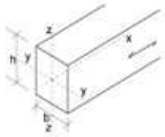
2. RESISTENCIA INCENDIO

Sección superior (142x1502 mm)

Nx = - 246.352 KN Vy = 139.439 KN Mz = 804.864 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	1502	213284	53392094.67	5047721.333

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Ixd (-) (N) OBLICU	a°
	246,352	804,864,000	0	139,439	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	1.16	15.07	0.00	0.98	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	-	-	-	cumple	-	-	
0.00 %	6.05 %	74.77 %	0.00 %	42.56 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	cumple

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 75.14\ \%$$

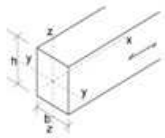
$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 52.71\ \%$$

Sección inferior (142x652 mm)

Nx = - 254.978 KN Vy = 139.439 KN Mz = 0 KNm

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	652	92584	10060794.67	2191154.667

duracion carga	clase de servicio	Kmod	ym
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Ixd (-) (N) OBLICU	a°
	254,978	0	0	139,439	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	2.75	0.00	0.00	2.26	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	cumple	-	-	cumple	-	-	
0.00 %	14.43 %	0.00 %	0.00 %	98.05 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	-

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 2.08\ \%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 2.08\ \%$$

2. INESTABILIDAD INCENDIO

Sección superior (142x1502 mm) NO CUMPLE

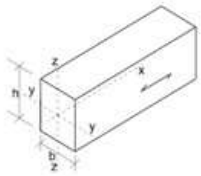
Nx = - 246.352 KN Mz = 804.864 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	1502	5,700	213,284	434
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	53,332,095	5,047,721	358,388,215	1,348,169,611	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
246,352	804,864,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
1.16	15.07	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
6 % resistencia	75 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
13.15	139.05
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
582.52	5.21
λrel,y	λrel,z
0.21	2.26
Ky	Kz
0.51	3.24
Xy	Xz
1.02	0.18
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
21.30	
λrel,m	
1.15	
Kcrit	
0.70	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0 %	81 %
0 %	86 %

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	no cumple
0 %	148 %

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

Sección inferior (142x652 mm)

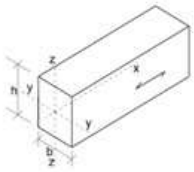
Nx = - 254.978 KN Mz = 0 KNm

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	652	5,700	92,584	188
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	10,060,795	2,191,155	155,571,981	536,904,677	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
254,978	0	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
2.75	0.00	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
14 % resistencia	0 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
30.28	139.05
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
109.77	5.21
λrel,y	λrel,z
0.49	2.26
Ky	Kz
0.64	3.24
Xy	Xz
0.95	0.18
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
47.01	
λrel,m	
0.77	
Kcrit	
0.98	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
cumple	-
15 %	0 %
80 %	0 %

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	-
0 %	0 %

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

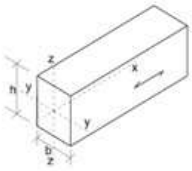
No cumple la inestabilidad de la sección superior en incendio. Se aumenta el ancho del soporte a 300 mm. De modo que en incendio quedaría 202 mm y se comprueba que cumple.

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	202	1502	5,700	303,404	434
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	75,952,135	10,214,601	1,031,674,735	3,777,055,391	58

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
246,352	804,864,000	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
0.81	10.60	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
4 % resistencia	53 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	flexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
13.15	97.75
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
582.52	10.54
λrel,y	λrel,z
0.21	1.53
Ky	Kz
0.51	1.89
Xy	Xz
1.02	0.34
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
42.53	
λrel,m	
0.81	
Kcrit	
0.95	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
-	cumple
0%	57%
0%	49%

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	cumple
0%	43%

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

ESTRUCTURA DE MADERA (SOPORTES EXTREMOS)

Los cortantes y momentos en los soportes extremos son despreciables. Por tanto se dimensionara únicamente a compresión donde existan las mayores solicitaciones.

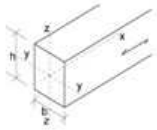
1.RESISTENCIA

Sección (240x500 mm)

Nx = - 168.9 KN

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	240	500	120000	10000000	4800000

duracion carga	clase de servicio	Kmod	γm
corta	2	0.9	1.25



Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (−) (N) OBLICU	a°
	168,900	0	0	0	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	1.41	0.00	0.00	0.00	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	cumple	-	-	-	-	-	
0.00 %	7.38 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(−)
-	-	-

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.54\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.54\,\%$$

2.INESTABILIDAD

Sección (240x500 mm)

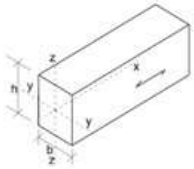
Nx = - 168.9 KN

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	240	500	10,000	120,000	144
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	10,000,000	4,800,000	576,000,000	1,607,270,400	69

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (−) (N)	Myd (Nmm)	Mzd (Nmm)
168,900	0	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
1.41	0.00	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
7 % resistencia	0 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
69.28	144.34
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
20.97	4.83
λrel,y	λrel,z
1.12	2.34
Ky	Kz
1.21	3.45
Xy	Xz
0.60	0.17
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
89.75	
λrel,m	
0.56	
Kcrit	
1.00	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
cumple	-
12 %	0 %
44 %	0 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Mxd

Myd	Myd, Nxd (-)
-	-
0 %	0 %

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

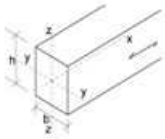
$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

3.RESISTENCIA INCENDIO

Sección (142x402 mm)

Nx = - 168.9 KN

Madera	b (mm)	h (mm)	A (mm2)	Wy (mm4)	Wz (mm4)
GL28h	142	402	57084	3824628	1350988



duracion carga	clase de servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (+) (N)	Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)	Tzd (N)	Tyd (N)	Nxd (-) (N) OBLICU	a°
	168,900	0	0	0	0	0	0
σt,0,d N/mm2	σc,0,d N/mm2	σm,y,d N/mm2	σm,z,d N/mm2	Tzd N/mm2	Tyd N/mm2	σc,α,d N/mm2	
0.00	2.96	0.00	0.00	0.00	0.00	0.00	
ft,0,k (N/mm2)	fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)	fv,z,k (N/mm2)	fv,y,k (N/mm2)	fc,90,k (N/mm2)	
19.5	26.5	28	28	3.2	3.2	3	
ft,0,d (N/mm2)	fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)	fv,z,d (N/mm2)	fv,y,d (N/mm2)	fc,α,d (N/mm2)	
14.04	19.08	20.16	20.16	2.30	2.30	2.16	
-	cumple	-	-	-	-	-	
0.00 %	15.51 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	

Myd, Mzd	Myd, Mzd, Nx(+)	Myd, Mzd, Nx(-)
-	-	-

$$\frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\frac{\sigma_{t,0,d}}{f_{t,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 0.00\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 2.40\,\%$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1 \qquad 2.40\,\%$$

4.INESTABILIDAD INCENDIO

Sección (142x402 mm) NO CUMPLE

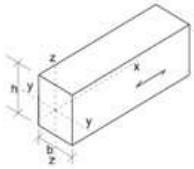
Nx = - 168.9 KN

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	142	402	10,000	57,084	116
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	3,824,628	1,350,988	95,920,148	298,297,344	41

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
168,900	0	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
2.96	0.00	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
16 % resistencia	0 % resistencia	0 % resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte	lexión en Z (eje débil)
nº apoyos intermedios	nº apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
86.17	243.95
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
13.56	1.69
λrel,y	λrel,z
1.40	3.96
Ky	Kz
1.59	8.70
Xy	Xz
0.43	0.06
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
41.25	
λrel,m	
0.82	
Kcrit	
0.94	

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

PANDEO FLEXIONAL _causa Nxd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
no cumple	-
36 %	0 %
255 %	0 %

$$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

$$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	-
0 %	0 %

$$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$$

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$$

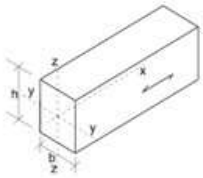
La sección no cumple a inestabilidad en incendio. Se aumenta el ancho a 300 mm de modo que quedan 202 en incendio, y se comprueba si cumple.

Madera	b (mm)	h (mm)	L barra (mm)	A (mm2)	iy (mm4)
GL28h	202	402	10,000	81,204	116
	Wy (mm3)	Wz (mm3)	Iz (mm4)	Itor (mm4)	iz (mm4)
	5,440,668	2,733,868	276,120,668	754,839,725	58

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

Las solicitaciones se han de meter en las casillas en valor absoluto.

Nxd (-) (N)	Myd (Nmm)	Mzd (Nmm)
168,900	0	
σc,0,d (N/mm2)	σm,y,d (N/mm2)	σm,z,d N/mm2
2.08	0.00	0.00
fc,0,k (N/mm2)	fm,y,k (N/mm2)	fm,z,k (N/mm2)
26.5	28	28
fc,0,d (N/mm2)	fm,y,d (N/mm2)	fm,z,d (N/mm2)
19.08	20.16	20.16
11% resistencia	0% resistencia	0% resistencia



PANDEO FLEXIONAL	
flexión en Y (eje fuerte)	lexión en Z (eje débil)
n° apoyos intermedios	n° apoyos intermedios
0	0
βy	βz
1.0	1.0
λy	λz
86.17	171.49
σc,crit,y (N/mm2)	σc,crit,z (N/mm2)
13.56	3.42
λrel,y	λrel,z
1.40	2.78
Ky	Kz
1.59	4.62
Xy	Xz
0.43	0.12
PANDEO TORSIONAL	
BETAv	
0.95	-
σm,crit (N/mm2)	
78.27	
λrel,m	
0.60	
Kcrit	
1.00	

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

PANDEO FLEXIONAL _causa Nzd(-)

Nxd (-)	Nxd (-), Myd y/o Mzd
cumple	-
25%	0%
91%	0%

$\frac{\sigma_{c,0,d}}{\chi_{c,y} f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

$\frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} + k_m \frac{\sigma_{m,y,d}}{f_{m,y,d}} + \frac{\sigma_{m,z,d}}{f_{m,z,d}} \le 1$

PANDEO TORSIONAL_causa Myd

Myd	Myd, Nxd (-)
-	-
0%	0%

$\sigma_{m,d} \le k_{crit} \cdot f_{m,d}$

$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{\chi_{c,z} f_{c,0,d}} \le 1$

ESTRUCTURA DE MADERA (VIGA CANTO VARIABLE)

Sección viga mixta (IPN 300 + HP-35 60x20)

IPN 300 + HP-35 60x20

Mz(+) = 226.2 < 514.68
Mz(-) = -274.92 < 288.26

RÉGIMEN PLÁSTICO DE LA ESTRUCTURA MIXTA

DATOS

VIGA	HORMIGÓN (N/mm2)	bs (mm)	hs (mm)	ACERO estruct. (N/mm2)	ACERO armar (N/mm2)	n	ϕ (mm)	RECUB. MECANICO (mm)
IPN 300	35	600	200	275	500	3	20	40

FLEXIÓN POSITIVA

* CLASE DE SECCIÓN ALMA	CLASE DE SECCIÓN ALA	F.N.	Zn (mm)		Zcdg1 (mm)	Zcdg2 (mm)	Z1 (mm)	Z2 (mm)	MplRD (KN.m)
CLASE 1	CLASE 1	F.N. HORMIGÓN	SI	110.52	-----	-----	294.74	310.00	514.68
		F.N. PERFIL ALA	NO	-----	-----	-----	-----	-----	-----
		F.N. PERFIL ALMA	NO	-----	-----	-----	-----	-----	-----

FLEXIÓN NEGATIVA

* CLASE DE SECCIÓN ALMA	* CLASE DE SECCIÓN ALA	F.N.	h' (mm)		Zcdg1 (mm)	Zcdg2 (mm)	Z1 (mm)	Z2 (mm)	MplRD (KN.m)
CLASE 1	CLASE 1	F.N. PERFIL ALA	NO	-----	-----	-----	-----	-----	-----
		F.N. PERFIL ALMA	SI	72.26	16.42	69.11	194.76	390.89	288.26

RESUMEN DIMENSIONADO

VIGA DE CANTO VARIABLE: 400x(950 a 1600) mm

VIGA: 300x750 mm

SOPORTE CENTRAL: 300x(750 a 1600) mm

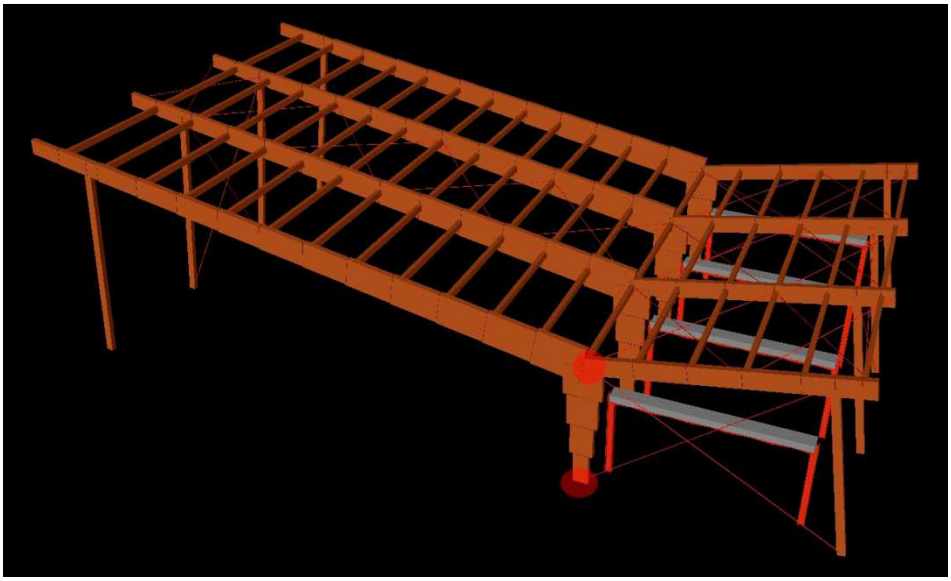
SOPORTE EXTREMO: 300x500 mm

CORREAS: 300x400 mm

VIGA MIXTA: IPN 300 + HP-35 60x20

PILAR METÁLICO: HEB 260

2.UNIONES



Unión soporte de canto variable con cimentación

La solicitación a cortante es 139.276 KN en la base del pilar.

Se toma como solución un nudo articulado de la siguiente forma.

La resistencia de un perno de diámetro 25 mm para doble cortadura de acero es 25,900 N. La solicitación a cortante es 139,276 KN en la base del pilar. Por tanto se necesitan 3 pernos. 25,900 x 2 x 3=155,400 > 139,276

duración carga	clase servicio	Kmod	ym
corta	2	0.9	1.25

cortadura
doble acero

Clavija	L (mm)	d (mm)	fu (N/mm2)	My,rk (Nmm)
pernos	308	25	600	776,098
	308	-		

Madera	e (mm)	α	t (mm)	fh,k (N/mm2)
GL28h	300	0	300	25.22
			-	

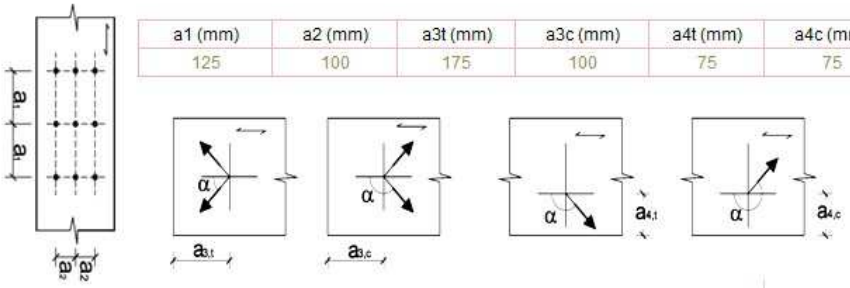
Placa Acero	e (mm)	fy (N/mm2)	Fv,rd (N) Placa de acero
S275	4	275	14,575

Fv,rd (N)
-
Fv,rd (N)
-
Fv,rd (N)
25,900

resistencia de cálculo por plano de corte y por clavija

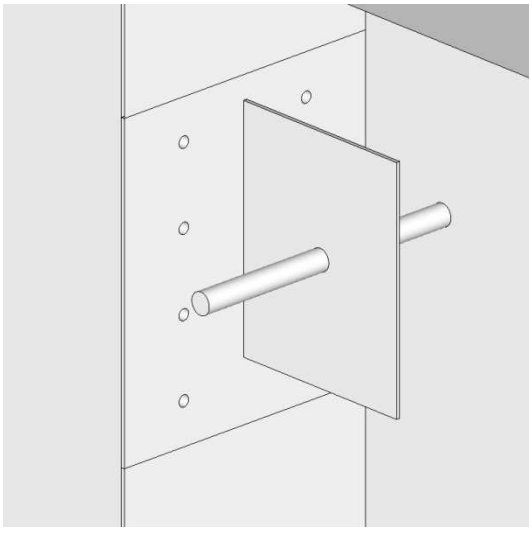
DISPOSICIONES CONSTRUCTIVAS DE LAS CLAVIJAS EN LA MADERA

a1 (mm)	a2 (mm)	a3t (mm)	a3c (mm)	a4t (mm)	a4c (mm)	Pretaladro (mm)
125	100	175	100	75	75	26



Unión soporte de canto variable con viga corta

La solicitación a cortante de de 50.57 K



El perno atraviesa la vida de 30 cm de ancho. Para conseguir que no se transmita momento a se propone colocar un único perno.

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

cortadura
doble madera

Clavija	L (mm)	d (mm)	fu (N/mm2)	My,rk (Nmm)
pernos	304	22	600	556,636
	304	-		

Madera	e (mm)	α	t (mm)	fh,k (N/mm2)
GL28h	150	0	150	26.22
			-	

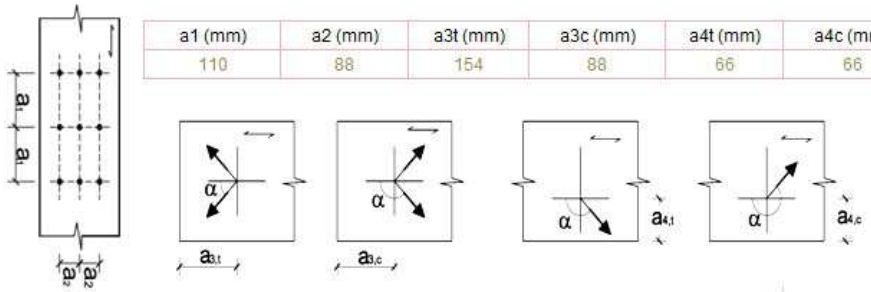
Placa Acero	e (mm)	fy (N/mm2)	Fv,rd (N) Placa de acero
S275	4	275	12,826

Fv,rd (N)
-
Fv,rd (N)
29,509
Fv,rd (N)
-

resistencia de cálculo por plano de corte y por clavija

DISPOSICIONES CONSTRUCTIVAS DE LAS CLAVIJAS EN LA MADERA

a1 (mm)	a2 (mm)	a3t (mm)	a3c (mm)	a4t (mm)	a4c (mm)	Pretaladro (mm)
110	88	154	88	66	66	23



Con un perno de 22 mm y resistencia 600 se consigue 29.5 KN a cortante.

29.5x2 = 59 > 50.57 KN

La chapa se suelda a otra unida al soporte con tornapuntas

duración carga	clase servicio	Kmod	γm
corta	2	0.9	1.25

cortadura
simple

Clavija	L (mm)	d (mm)	fu (N/mm2)	My,rk (Nmm)
tornapuntas	200	12	600	115,118
	304	-		

Madera	e (mm)	α	t (mm)	fh,k (N/mm2)
GL28h	300	0	196	29.59
			48	

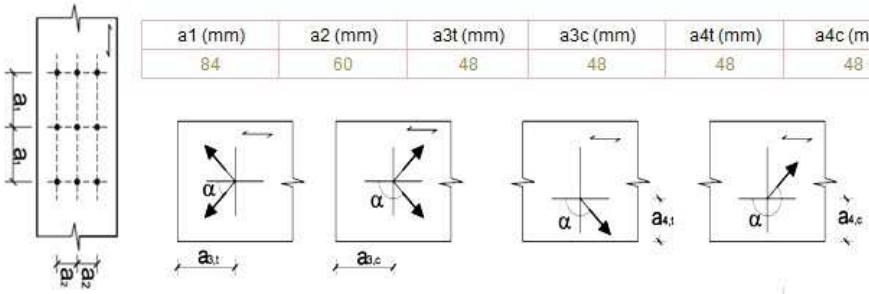
Placa Acero	e (mm)	fy (N/mm2)	Fv,rd (N) Placa de acero
S275	4	275	6,996

Fv,rd (N)
7,486
Fv,rd (N)
-
Fv,rd (N)
-

resistencia de cálculo por plano de corte y por clavija

DISPOSICIONES CONSTRUCTIVAS DE LAS CLAVIJAS EN LA MADERA

a1 (mm)	a2 (mm)	a3t (mm)	a3c (mm)	a4t (mm)	a4c (mm)	Pretaladro (mm)
84	60	48	48	48	48	12



Con 8 (4 por cada lado) de 12 mm y resistencia 600 se con sigue una resistencia a cortante por tornapunta de 7.49 KN

7.48x8 = 59.84 > 50.57 KN