

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 3.72 \text{ m}$ $\lambda_{rel} = 0.74$
 $\sigma_{cr} = 46.86 \text{ MPa}$ $k_{crit} = 1.00$

FORMUŁY WERYFIKACYJNE:

$\sigma_{m,y,d}/f_{m,y,d} = 16.32/18.24 = 0.89 < 1.00$ (6.11) OK.

$\sigma_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 16.32/(1.00 \cdot 18.24) = 0.89 < 1.00$ (6.33) OK

$\tau_{z,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00$ (6.13) OK

SGU

$u_{fin,z} = 1.6 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm}$ OK.

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_c = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 24.0 \text{ cm}$	$A_y = 48.00 \text{ cm}^2$	$A_z = 144.00 \text{ cm}^2$	$A_x = 192.00 \text{ cm}^2$
$b_f = 8.0 \text{ cm}$	$I_y = 9216.00 \text{ cm}^4$	$I_z = 1024.00 \text{ cm}^4$	$I_x = 676.7 \text{ cm}^4$
$e_a = 4.0 \text{ cm}$	$W_{ely} = 768.00 \text{ cm}^3$	$W_{elz} = 256.00 \text{ cm}^3$	
$e_s = 4.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona
 $\beta_{a0} = 0.70 \text{ mm/min}$
 Ścianki zabezpieczone : Brak
 $d_{ef} = 1.6 \text{ cm}$

$t = 0.25 \text{ h}$ $t_{surf} = 0.00 \text{ min}$
 $d_{char} = 1.1 \text{ cm}$

$h_{f,fi} = 20.8 \text{ cm}$
 $I_{y,fi} = 3663.4 \text{ cm}^4$
 $W_{y,fi} = 351.40 \text{ cm}^3$

$b_{f,fi} = 4.9 \text{ cm}$
 $A_{f,fi} = 101.1 \text{ cm}^2$
 $I_{z,fi} = 198.2 \text{ cm}^4$
 $W_{z,fi} = 81.74 \text{ cm}^3$

NAPRĘŻENIA

$\sigma_{m,y,d,fi} = M_Y/W_{y,fi} = 5.30/351.40 = 15.09 \text{ MPa}$
 $\tau_{z,d,fi} = 1.5 \cdot -0.04/101.12 = -0.01 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d,fi} = 29.90 \text{ MPa}$
 $f_{v,d,fi} = 4.02 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 3.66$ m $\Lambda_{rel\ m} = 1.11$
 $\sigma_{cr} = 20.96$ MPa $k_{crit} = 0.72$

SPRAWDZENIE SGN W SYTUACJI POŻARU R15:

$\sigma_{m,y,d,fi}/f_{m,y,d,fi} = 15.09/29.90 = 0.50 < 1.00$ (6.11) OK.

$\sigma_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 15.09/(0.72 \cdot 29.90) = 0.70 < 1.00$ (6.33) OK.

$\tau_{z,d,fi}/f_{v,d,fi} = 0.01/4.02 = 0.00 < 1.00$ (6.13) OK

2.1.7. Platwie P-2 18x24 cm**SGN****MATERIAŁ GL26h**

$g_M = 1.25$
 $f_{m,0,k} = 26.00$ MPa
 $f_{t,0,k} = 20.80$ MPa
 $f_{c,0,k} = 26.00$ MPa
 $f_{v,k} = 3.50$ MPa
 $f_{t,90,k} = 0.50$ MPa
 $f_{c,90,k} = 2.50$ MPa
 $E_{0,moyen} = 12100.00$ MPa
 $E_{0,05} = 10100.00$ MPa
 $G_{moyen} = 650.00$ MPa
 Klasa użyteczności: 2
 $\beta_c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 24.0$ cm			
$b_f = 18.0$ cm	$A_y = 185.14$ cm ²	$A_z = 246.86$ cm ²	$A_x = 432.00$ cm ²
$e_a = 9.0$ cm	$I_y = 20736.00$ cm ⁴	$I_z = 11664.00$ cm ⁴	$I_x = 24611.0$ cm ⁴
$e_s = 9.0$ cm	$W_{ely} = 1728.00$ cm ³	$W_{elz} = 1296.00$ cm ³	

NAPRĘŻENIA

$\sigma_{c,0,d} = N/A_x = 20.00/432.00 = 0.46$ MPa
 $\sigma_{m,y,d} = M_y/W_y = 12.72/1728.00 = 7.36$ MPa
 $\tau_{z,d} = 1.5 \cdot -0.05/432.00 = -0.00$ MPa

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d} = 16.64$ MPa
 $f_{m,y,d} = 18.24$ MPa
 $f_{v,d} = 2.24$ MPa

Współczynniki i parametry dodatkowe

$k_h = 1.10$ $k_{h_y} = 1.10$ $k_{mod} = 0.80$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 3.72$ m $\Lambda_{rel\ m} = 0.37$
 $\sigma_{cr} = 193.84$ MPa $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

LY = 3.60 m

Lambda_rel Y = 0.84

LFY = 3.60 m

Lambda Y = 51.96

ky = 0.88

kcy = 0.88

względem osi Z:

LZ = 1.80 m

Lambda_rel Z = 0.56

LFZ = 1.80 m

Lambda Z = 34.64

kz = 0.67

kcz = 0.96

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{c,0,d}/(k_c \cdot y \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} = 0.46/(0.88 \cdot 16.64) + 7.36/18.24 = 0.44 < 1.00 \quad (6.23) \quad \text{OK}$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 7.36/(1.00 \cdot 18.24) = 0.40 < 1.00 \quad (6.33) \quad \text{OK}$$

$$\text{Tau}_{z,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad (6.13) \quad \text{OK}$$

SGU

$$u_{fin,z} = 0.7 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm} \quad \text{OK}$$

SGN w sytuacji pożaru R60 – czas 60 minut**MATERIAŁ GL26h**

gM,fi = 1.00

fm,0,k = 26.00 MPa

ft,0,k = 20.80 MPa

fc,0,k = 26.00 MPa

fv,k = 3.50 MPa

ft,90,k = 0.50 MPa

fc,90,k = 2.50 MPa

E0,moyen = 12100.00 MPa

E0,05 = 10100.00 MPa

Gmoyen = 650.00 MPa

Klasa użyteczności: 2

Beta c = 0.10

PARAMETRY PRZĘKROJU:

ht=24.0 cm

bf=18.0 cm

ea=9.0 cm

Ay=185.14 cm²Iy=20736.00 cm⁴Az=246.86 cm²Iz=11664.00 cm⁴Ax=432.00 cm²Ix=1660.4 cm⁴**PARAMETRY ODPORNOŚCI OGNOWEJ**

Metoda : Uproszczona

beta0 = 0.70 mm/min

Ścianki zabezpieczone : Brak

def = 4.9 cm

t = 1.00 h

dchar = 4.2 cm

tsurf = 0.00 min

hf,fi = 14.2 cm

Iy,fi = 1956.6 cm⁴Wy,fi = 275.57 cm³

bf,fi = 8.2 cm

Ay,fi = 116.4 cm²Iz,fi = 652.5 cm⁴Wz,fi = 159.13 cm³**NAPRĘŻENIA**

$$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 20.00/116.44 = 1.72 \text{ MPa}$$

$$\text{Sig}_{m,y,d,fi} = M/Y_{y,fi} = 5.46/275.57 = 19.82 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{c,0,d,fi} = 29.90 \text{ MPa}$$

$$f_{m,y,d,fi} = 29.90 \text{ MPa}$$

$$f_{v,d,fi} = 4.02 \text{ MPa}$$

$$\tau_{z,d,fi} = 1.5 \cdot -0.04 / 116.44 = -0.01 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_{fi} = 1.15 \quad k_{mod_fc} = 1.00 \quad k_{mod_ft} = 1.00 \quad k_{mod_fb} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 3.52 \text{ m} \quad \lambda_{rel\ m} = 0.57$$

$$\sigma_{cr} = 78.82 \text{ MPa} \quad k_{crit} = 1.00$$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

$$L_Y = 3.60 \text{ m} \quad \lambda_Y = 87.82$$

$$\lambda_{rel\ Y} = 1.42 \quad k_Y = 1.56$$

$$L_{FY} = 3.60 \text{ m} \quad k_{cY} = 0.45$$

względem osi Z:

$$L_Z = 1.80 \text{ m} \quad \lambda_Z = 76.04$$

$$\lambda_{rel\ Z} = 1.23 \quad k_Z = 1.30$$

$$L_{FZ} = 1.80 \text{ m} \quad k_{cZ} = 0.58$$

FORMUŁY WERYFIKACYJNE:

$$\sigma_{c,0,d,fi} / (k_{cY} \cdot f_{c,0,d,fi}) + \sigma_{m,y,d,fi} / f_{m,y,d,fi} = 1.72 / (0.45 \cdot 29.90) + 19.82 / 29.90 = 0.79 < 1.00 \quad (6.23) \text{ OK.}$$

$$\sigma_{m,y,d,fi} / (k_{crit} \cdot f_{m,y,d,fi}) = 19.82 / (1.00 \cdot 29.90) = 0.66 < 1.00 \quad (6.33) \quad \text{OK.}$$

$$\tau_{z,d,fi} / f_{v,d,fi} = 0.01 / 4.02 = 0.00 < 1.00 \quad (6.13) \quad \text{OK}$$

2.1.8. Platwie P-3

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 32.0 \text{ cm}$	$A_y = 170.67 \text{ cm}^2$	$A_z = 341.33 \text{ cm}^2$	$A_x = 512.00 \text{ cm}^2$
$b_f = 16.0 \text{ cm}$	$I_y = 43690.67 \text{ cm}^4$	$I_z = 10922.67 \text{ cm}^4$	$I_x = 29928.1 \text{ cm}^4$
$e_a = 8.0 \text{ cm}$	$W_{ely} = 2730.67 \text{ cm}^3$	$W_{elz} = 1365.33 \text{ cm}^3$	
$e_s = 8.0 \text{ cm}$			

NAPRĘŻENIA

$$\sigma_{c,0,d} = N / A_x = 20.00 / 512.00 = 0.39 \text{ MPa}$$

$$\sigma_{m,y,d} = M_Y / W_y = 6.27 / 2730.67 = 2.30 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{c,0,d} = 12.48 \text{ MPa}$$

$$f_{m,y,d} = 13.29 \text{ MPa}$$

Współczynniki i parametry dodatkowe

kh = 1.10 kh_y = 1.06 kmod = 0.60 Ksys = 1.00

PARAMETRY ZWICHRZENIOWE:

lef = 3.88 m Lambda_rel m = 0.46
Sig_cr = 125.50 MPa k_crit = 1.00

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
LY = 3.60 m	Lambda Y = 38.97	LZ = 1.80 m	Lambda Z = 38.97
Lambda_rel Y = 0.63	ky = 0.71	Lambda_rel Z = 0.63	kz = 0.71
LFY = 3.60 m	kcy = 0.95	LFZ = 1.80 m	kcZ = 0.95

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{c,0,d}/(k_{c,y} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} = 0.39/(0.95 \cdot 12.48) + 2.30/13.29 = 0.21 < 1.00 \quad (6.23) \quad \text{OK}$

$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 2.30/(1.00 \cdot 13.29) = 0.17 < 1.00 \quad (6.33) \quad \text{OK}$

SGU

$u_{fin,z} = 0.3 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm} \quad \text{OK}$

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

gM,fi = 1.00
f_{m,0,k} = 26.00 MPa
f_{t,0,k} = 20.80 MPa
f_{c,0,k} = 26.00 MPa
f_{v,k} = 3.50 MPa
f_{t,90,k} = 0.50 MPa
f_{c,90,k} = 2.50 MPa
E_{0,moyen} = 12100.00 MPa
E_{0,05} = 10100.00 MPa
G_{moyen} = 650.00 MPa
Klasa użyteczności: 2
Beta_c = 0.10

PARAMETRY PRZĘKROJU:

ht=32.0 cm	Ay=170.67 cm ²	Az=341.33 cm ²	Ax=512.00 cm ²
bf=16.0 cm	Iy=43690.67 cm ⁴	Iz=10922.67 cm ⁴	Ix=1453.3 cm ⁴
ea=8.0 cm	Wely=2730.67 cm ³	Welz=1365.33 cm ³	
es=8.0 cm			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona	t = 1.00 h	tsurf = 0.00 min
beta0 = 0.70 mm/min	dchar = 4.2 cm	
Ścianki zabezpieczone : Brak		
def = 4.9 cm		
hf,fi = 22.2 cm	bf,fi = 6.2 cm	
	A,fi = 137.6 cm ²	

$I_y, fi = 5652.9 \text{ cm}^4$
 $W_y, fi = 509.27 \text{ cm}^3$

$I_z, fi = 440.9 \text{ cm}^4$
 $W_z, fi = 142.23 \text{ cm}^3$

NAPRĘŻENIA

$\text{Sig}_{c,0,d,fi} = N/Ax, fi = 20.00/137.64 = 1.45 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = MY/Wy, fi = 4.92/509.27 = 9.67 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 3.68 \text{ m}$ $\text{Lambda}_{rel\ m} = 0.91$
 $\text{Sig}_{cr} = 31.38 \text{ MPa}$ $k_{crit} = 0.88$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 3.60 \text{ m}$	$\text{Lambda}_Y = 56.17$	$LZ = 1.80 \text{ m}$	$\text{Lambda}_Z = 100.57$
$\text{Lambda}_{rel\ Y} = 0.91$	$k_y = 0.94$	$\text{Lambda}_{rel\ Z} = 1.62$	$k_z = 1.89$
$LFY = 3.60 \text{ m}$	$k_{cy} = 0.84$	$LFZ = 1.80 \text{ m}$	$k_{cz} = 0.35$

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{c,0,d,fi}/(k_{cy} * f_{c,0,d,fi}) + \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 1.45/(0.84 * 29.90) + 9.67/29.90 = 0.38 < 1.00 \quad (6.23)$
 OK.

$\text{Sig}_{m,y,d,fi}/(k_{crit} * f_{m,y,d,fi}) = 9.67/(0.88 * 29.90) = 0.37 < 1.00 \quad (6.33)$ OK

2.1.9. Platwie P-4 24x40 cm

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 0.10$

PARAMETRY PRZEKROJU:

$ht = 40.0 \text{ cm}$	$A_y = 360.00 \text{ cm}^2$	$A_z = 600.00 \text{ cm}^2$	$A_x = 960.00 \text{ cm}^2$
$bf = 24.0 \text{ cm}$	$I_y = 128000.00 \text{ cm}^4$	$I_z = 46080.00 \text{ cm}^4$	$I_x = 114647.0 \text{ cm}^4$
$ea = 12.0 \text{ cm}$	$W_{ely} = 6400.00 \text{ cm}^3$	$W_{elz} = 3840.00 \text{ cm}^3$	
$es = 12.0 \text{ cm}$			

NAPRĘŻENIA

$\text{Sig}_{c,0,d} = N/A_x = 63.00/960.00 = 0.66 \text{ MPa}$
 $\text{Sig}_{m,y,d} = MY/W_y = 19.57/6400.00 = 3.06 \text{ MPa}$
 $\text{Sig}_{m,z,d} = MZ/W_z = 19.57/3840.00 = 5.10 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d} = 12.48 \text{ MPa}$
 $f_{m,y,d} = 13.00 \text{ MPa}$
 $f_{m,z,d} = 13.68 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_h = 1.10$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 7.44 \text{ m}$ $\text{Lambda}_{rel m} = 0.48$
 $\text{Sig}_{cr} = 112.19 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 7.38 \text{ m}$	$\text{Lambda}_Y = 63.94$	$LZ = 3.69 \text{ m}$	$\text{Lambda}_Z = 53.28$
$\text{Lambda}_{rel Y} = 1.03$	$k_y = 1.07$	$\text{Lambda}_{rel Z} = 0.86$	$k_z = 0.90$
$LFY = 7.38 \text{ m}$	$k_{cy} = 0.74$	$LFZ = 3.69 \text{ m}$	$k_{cz} = 0.87$

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{c,0,d}/(k_{c,z} * f_{c,0,d}) + k_m * \text{Sig}_{m,y,d}/f_{m,y,d} + \text{Sig}_{m,z,d}/f_{m,z,d} = 0.60 < 1.00 \quad (6.24)$ OK.

$\text{Sig}_{m,y,d}/(k_{crit} * f_{m,y,d}) = 3.06/(1.00 * 13.00) = 0.24 < 1.00 \quad (6.33)$ OK

SGU

$u_{fin,y} = 3.1 \text{ cm} < u_{fin,max,y} = L/200.00 = 3.7 \text{ cm}$ OK.

$u_{fin,z} = 1.1 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.7 \text{ cm}$ OK.

SGN w sytuacji pożaru R60 – czas 60 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 40.0 \text{ cm}$	$A_y = 360.00 \text{ cm}^2$	$A_z = 600.00 \text{ cm}^2$	$A_x = 960.00 \text{ cm}^2$
$b_f = 24.0 \text{ cm}$	$I_y = 128000.00 \text{ cm}^4$	$I_z = 46080.00 \text{ cm}^4$	$I_x = 20285.4 \text{ cm}^4$
$e_a = 12.0 \text{ cm}$	$W_{ely} = 6400.00 \text{ cm}^3$	$W_{elz} = 3840.00 \text{ cm}^3$	
$e_s = 12.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona

beta0 = 0.70 mm/min

Ścianki zabezpieczone : Brak

def = 4.9 cm

t = 1.00 h

tsurf = 0.00 min

dchar = 4.2 cm

hf,fi = 30.2 cm

Iy,fi = 32593.3 cm⁴Wy,fi = 2158.49 cm³

bf,fi = 14.2 cm

A,fi = 428.8 cm²Iz,fi = 7205.9 cm⁴Wz,fi = 1014.92 cm³**NAPRĘŻENIA**

Sig_c,0,d,fi = N/Ax,fi = 63.00/428.84 = 1.47 MPa

Sig_m,y,d,fi = MY/Wy,fi = 15.27/2158.49 = 7.07 MPa

Sig_m,z,d,fi = MZ/Wz,fi = 15.27/1014.92 = 15.04 MPa

NAPRĘŻENIA DOPUSZCZALNE

f_c,0,d,fi = 29.90 MPa

f_m,y,d,fi = 29.90 MPa

f_m,z,d,fi = 29.90 MPa

Współczynniki i parametry dodatkowe

km = 0.70

kfi = 1.15

kmod_fc = 1.00

kmod_ft = 1.00

kmod_fb = 1.00

PARAMETRY ZWICHRZENIOWE:

lef = 7.25 m

Lambda_rel m = 0.68

Sig_cr = 56.83 MPa

k_crit = 1.00

PARAMETRY WYBOCZENIOWE:

względem osi Y:

LY = 7.38 m

Lambda_rel Y = 1.37

LFY = 7.38 m

Lambda Y = 84.69

ky = 1.49

kcy = 0.48

względem osi Z:

LZ = 3.69 m

Lambda_rel Z = 1.45

LFZ = 3.69 m

Lambda Z = 90.05

kz = 1.62

kcz = 0.43

FORMUŁY WERYFIKACYJNE: $(\text{Sig}_{c,0,d,fi}/k_{c,z} * f_{c,0,d,fi}) + k_m * \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} + \text{Sig}_{m,z,d,fi}/f_{m,z,d,fi} = 0.78 < 1.00 \quad (6.24)$ $\text{Sig}_{m,y,d,fi}/(k_{crit} * f_{m,y,d,fi}) = 7.07/(1.00 * 29.90) = 0.24 < 1.00 \quad (6.33)$ **2.1.10. Platwie P-5 24x32 cm****SGN****MATERIAŁ GL26h**

gM = 1.25

f_m,0,k = 26.00 MPa

f_t,0,k = 20.80 MPa

f_c,0,k = 26.00 MPa

f_v,k = 3.50 MPa

f_t,90,k = 0.50 MPa

f_c,90,k = 2.50 MPa

E_0,moyen = 12100.00 MPa

E_0,05 = 10100.00 MPa

G_moyen = 650.00 MPa

Klasa użyteczności: 2

Beta_c = 1.00

PARAMETRY PRZEKROJU:

ht=32.0 cm			
bf=24.0 cm	Ay=329.14 cm ²	Az=438.86 cm ²	Ax=768.00 cm ²
ea=12.0 cm	Iy=65536.00 cm ⁴	Iz=36864.00 cm ⁴	Ix=77783.0 cm ⁴
es=12.0 cm	Wely=4096.00 cm ³	Welz=3072.00 cm ³	

NAPRĘŻENIA

$\text{Sig}_{m,y,d} = MY/W_y = 14.60/4096.00 = 3.57 \text{ MPa}$
 $\text{Sig}_{m,z,d} = MZ/W_z = 14.60/3072.00 = 4.75 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d} = 13.29 \text{ MPa}$
 $f_{m,z,d} = 13.68 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_h = 1.10$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 6.46 \text{ m}$ $\text{Lambda}_{rel m} = 0.42$
 $\text{Sig}_{cr} = 148.93 \text{ MPa}$ $k_{crit} = 1.00$

FORMUŁY WERYFIKACYJNE:

$k_m \cdot \text{Sig}_{m,y,d} / f_{m,y,d} + \text{Sig}_{m,z,d} / f_{m,z,d} = 0.70 \cdot 3.57 / 13.29 + 4.75 / 13.68 = 0.54 < 1.00 \quad (6.12) \quad \text{OK.}$

$\text{Sig}_{m,y,d} / (k_{crit} \cdot f_{m,y,d}) = 3.57 / (1.00 \cdot 13.29) = 0.27 < 1.00 \quad (6.33) \quad \text{OK}$

SGU

$u_{fin,y} = 2.2 \text{ cm} < u_{fin,max,y} = L/200.00 = 3.2 \text{ cm} \quad \text{OK.}$

$u_{fin,z} = 1.3 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.2 \text{ cm} \quad \text{OK}$

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta } c = 1.00$

PARAMETRY PRZEKROJU:

ht=32.0 cm			
bf=24.0 cm	Ay=329.14 cm ²	Az=438.86 cm ²	Ax=768.00 cm ²
ea=12.0 cm	Iy=65536.00 cm ⁴	Iz=36864.00 cm ⁴	Ix=47478.6 cm ⁴
es=12.0 cm	Wely=4096.00 cm ³	Welz=3072.00 cm ³	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona

beta0 = 0.70 mm/min

Ścianki zabezpieczone : Brak

def = 1.6 cm

t = 0.25 h

tsurf = 0.00 min

dchar = 1.1 cm

hf,fi = 28.8 cm

Iy,fi = 41721.7 cm⁴Wy,fi = 2892.32 cm³

bf,fi = 20.8 cm

A,fi = 601.5 cm²Iz,fi = 21791.3 cm⁴Wz,fi = 2090.29 cm³**NAPRĘŻENIA**

Sig_m,y,d,fi = MY/Wy,fi = 11.41/2892.32 = 3.94 MPa

Sig_m,z,d,fi = MZ/Wz,fi = 11.41/2090.29 = 5.46 MPa

Współczynniki i parametry dodatkowe

NAPRĘŻENIA DOPUSZCZALNE

f m,y,d,fi = 29.90 MPa

f m,z,d,fi = 29.90 MPa

km = 0.70

kfi = 1.15

kmod_fc = 1.00

kmod_ft = 1.00

kmod_fb = 1.00

PARAMETRY ZWICHRZENIOWE:

lef = 6.39 m

Lambda_rel m = 0.45

Sig_cr = 127.93 MPa

k crit = 1.00

FORMUŁY WERYFIKACYJNE:

$$km * Sig_{m,y,d,fi} / f_{m,y,d,fi} + Sig_{m,z,d,fi} / f_{m,z,d,fi} = 0.70 * 3.94 / 29.90 + 5.46 / 29.90 = 0.27 < 1.00 \quad (6.12) \text{ OK.}$$

$$Sig_{m,y,d,fi} / (k_{crit} * f_{m,y,d,fi}) = 3.94 / (1.00 * 29.90) = 0.13 < 1.00 \quad (6.33)$$

OK

2.1.11. Płatwie P-6 16x20 cm**SGN****MATERIAŁ** GL26h

gM = 1.25

f m,0,k = 26.00 MPa

f t,0,k = 20.80 MPa

f c,0,k = 26.00 MPa

f v,k = 3.50 MPa

f t,90,k = 0.50 MPa

f c,90,k = 2.50 MPa

E 0,moyen = 12100.00 MPa

E 0,05 = 10100.00 MPa

G moyen = 650.00 MPa

Klasa użyteczności: 2

Beta c = 1.00

PARAMETRY PRZEKROJU:

ht=20.0 cm

bf=16.0 cm

ea=8.0 cm

es=8.0 cm

Ay=142.22 cm²Iy=10666.67 cm⁴Wely=1066.67 cm³Az=177.78 cm²Iz=6826.67 cm⁴Welz=853.33 cm³Ax=320.00 cm²Ix=13544.1 cm⁴**NAPRĘŻENIA**

Sig_m,y,d = MY/Wy = 7.71/1066.67 = 7.23 MPa

NAPRĘŻENIA DOPUSZCZALNE

f m,y,d = 18.30 MPa

$$\begin{aligned}\text{Sig}_{m,z,d} &= MZ/Wz = 7.71/853.33 = 9.03 \text{ MPa} \\ \text{Tau}_{y,d} &= 1.5 \cdot -0.06/320.00 = -0.00 \text{ MPa} \\ \text{Tau}_{z,d} &= 1.5 \cdot -0.06/320.00 = -0.00 \text{ MPa}\end{aligned}$$

$$\begin{aligned}f_{m,z,d} &= 18.30 \text{ MPa} \\ f_{v,d} &= 2.24 \text{ MPa}\end{aligned}$$

Współczynniki i parametry dodatkowe

$$k_m = 0.70 \quad k_h = 1.10 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$\begin{aligned}l_{ef} &= 3.64 \text{ m} & \lambda_{rel,m} &= 0.38 \\ \text{Sig}_{cr} &= 182.13 \text{ MPa} & k_{crit} &= 1.00\end{aligned}$$

FORMUŁY WERYFIKACYJNE:

$$k_m \cdot \text{Sig}_{m,y,d} / f_{m,y,d} + \text{Sig}_{m,z,d} / f_{m,z,d} = 0.70 \cdot 7.23/18.30 + 9.03/18.30 = 0.77 < 1.00 \quad (6.12) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d} / (k_{crit} \cdot f_{m,y,d}) = 7.23 / (1.00 \cdot 18.30) = 0.39 < 1.00 \quad (6.33) \quad \text{OK}$$

$$\text{Tau}_{y,d} / f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad \text{OK.}$$

$$\text{Tau}_{z,d} / f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad (6.13) \quad \text{OK}$$

SGU

$$u_{fin,y} = 1.4 \text{ cm} < u_{fin,max,y} = L/200.00 = 1.8 \text{ cm} \quad \text{OK.}$$

$$u_{fin,z} = 0.9 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm} \quad \text{OK.}$$

SGN w sytuacji pożaru R15 – czas 15 minut

MATERIAŁ GL26h

$$\begin{aligned}g_{M,fi} &= 1.00 \\ f_{m,0,k} &= 26.00 \text{ MPa} \\ f_{t,0,k} &= 20.80 \text{ MPa} \\ f_{c,0,k} &= 26.00 \text{ MPa} \\ f_{v,k} &= 3.50 \text{ MPa} \\ f_{t,90,k} &= 0.50 \text{ MPa} \\ f_{c,90,k} &= 2.50 \text{ MPa} \\ E_{0,moyen} &= 12100.00 \text{ MPa} \\ E_{0,05} &= 10100.00 \text{ MPa} \\ G_{moyen} &= 650.00 \text{ MPa} \\ \text{Klasa użyteczności} &: 2 \\ \text{Beta}_c &= 1.00\end{aligned}$$

PARAMETRY PRZEKROJU:

$$\begin{aligned}h_t &= 20.0 \text{ cm} & A_y &= 142.22 \text{ cm}^2 & A_z &= 177.78 \text{ cm}^2 & A_x &= 320.00 \text{ cm}^2 \\ b_f &= 16.0 \text{ cm} & I_y &= 10666.67 \text{ cm}^4 & I_z &= 6826.67 \text{ cm}^4 & I_x &= 6191.8 \text{ cm}^4 \\ e_a &= 8.0 \text{ cm} & W_{ely} &= 1066.67 \text{ cm}^3 & W_{elz} &= 853.33 \text{ cm}^3 \\ e_s &= 8.0 \text{ cm}\end{aligned}$$

PARAMETRY ODPORNOŚCI OGNOWEJ

$$\begin{aligned}\text{Metoda} &: \text{Uproszczona} & t &= 0.25 \text{ h} & t_{surf} &= 0.00 \text{ min} \\ \text{beta}_0 &= 0.70 \text{ mm/min} & d_{char} &= 1.1 \text{ cm} \\ \text{Ścianki zabezpieczone} &: \text{Brak}\end{aligned}$$

def = 1.6 cm

hf,fi = 16.9 cm

Iy,fi = 5123.0 cm⁴

Wy,fi = 608.07 cm³

bf,fi = 12.9 cm

A,fi = 216.5 cm²

Iz,fi = 2979.4 cm⁴

Wz,fi = 463.72 cm³

NAPRĘŻENIA

Sig_{m,y,d,fi} = MY/Wy,fi = 3.69/608.07 = 6.08 MPa

Sig_{m,z,d,fi} = MZ/Wz,fi = 3.69/463.72 = 7.97 MPa

Tau_{y,d,fi} = 1.5*-0.03/216.52 = -0.00 MPa

Tau_{z,d,fi} = 1.5*-0.03/216.52 = -0.00 MPa

NAPRĘŻENIA DOPUSZCZALNE

f_{m,y,d,fi} = 29.90 MPa

f_{m,z,d,fi} = 29.90 MPa

f_{v,d,fi} = 4.02 MPa

Współczynniki i parametry dodatkowe

km = 0.70

kfi = 1.15

kmod_{fc} = 1.00

kmod_{ft} = 1.00

kmod_{fb} = 1.00

PARAMETRY ZWICHRZENIOWE:

lef = 3.58 m

Lambda_{rel m} = 0.42

Sig_{cr} = 145.22 MPa

k_{crit} = 1.00

FORMUŁY WERYFIKACYJNE:

km*Sig_{m,y,d,fi}/f_{m,y,d,fi} + Sig_{m,z,d,fi}/f_{m,z,d,fi} = 0.70*6.08/29.90 + 7.97/29.90 = 0.41 < 1.00 (6.12) OK.

Sig_{m,y,d,fi}/(k_{crit}*f_{m,y,d,fi}) = 6.08/(1.00*29.90) = 0.20 < 1.00 (6.33)

OK.

Tau_{y,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00

OK.

Tau_{z,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 (6.13)

OK.

2.1.12. Płatwie P-7 22x24 cm

SGN

MATERIAŁ GL26h

gM = 1.25

f_{m,0,k} = 26.00 MPa

f_{t,0,k} = 20.80 MPa

f_{c,0,k} = 26.00 MPa

f_{v,k} = 3.50 MPa

f_{t,90,k} = 0.50 MPa

f_{c,90,k} = 2.50 MPa

E_{0,moyen} = 12100.00 MPa

E_{0,5} = 10100.00 MPa

G_{moyen} = 650.00 MPa

Klasa użyteczności: 2

Beta_c = 0.10

PARAMETRY PRZEKROJU:

ht=24.0 cm

bf=22.0 cm

ea=11.0 cm

es=11.0 cm

Ay=252.52 cm²

Iy=25344.00 cm⁴

Wely=2112.00 cm³

Az=275.48 cm²

Iz=21296.00 cm⁴

Welz=1936.00 cm³

Ax=528.00 cm²

Ix=35990.2 cm⁴

NAPRĘŻENIA

$\text{Sig}_{c,0,d} = N/A_x = 63.00/528.00 = 1.19 \text{ MPa}$
 $\text{Sig}_{m,y,d} = MY/W_y = 7.82/2112.00 = 3.70 \text{ MPa}$
 $\text{Sig}_{m,z,d} = MZ/W_z = 7.82/1936.00 = 4.04 \text{ MPa}$
 $\text{Tau}_{y,d} = 1.5 \cdot -0.06/528.00 = -0.00 \text{ MPa}$
 $\text{Tau}_{z,d} = 1.5 \cdot -0.06/528.00 = -0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d} = 16.64 \text{ MPa}$
 $f_{m,y,d} = 18.24 \text{ MPa}$
 $f_{m,z,d} = 18.30 \text{ MPa}$
 $f_{v,d} = 2.24 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_h = 1.10$ $k_{mod} = 0.80$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 3.72 \text{ m}$ $\text{Lambda}_{rel m} = 0.32$
 $\text{Sig}_{cr} = 259.14 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 3.60 \text{ m}$	$\text{Lambda}_Y = 51.96$	$LZ = 1.80 \text{ m}$	$\text{Lambda}_Z = 28.34$
$\text{Lambda}_{rel Y} = 0.84$	$k_Y = 0.88$	$\text{Lambda}_{rel Z} = 0.46$	$k_Z = 0.61$
$LFY = 3.60 \text{ m}$	$k_{cY} = 0.88$	$LFZ = 1.80 \text{ m}$	$k_{cZ} = 0.98$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d}/k_{cY} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.44 < 1.00 \quad (6.23)$ OK.

$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 3.70/(1.00 \cdot 18.24) = 0.20 < 1.00 \quad (6.33)$ OK

$\text{Tau}_{y,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00$ OK.

$\text{Tau}_{z,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad (6.13)$ OK

SGU

$u_{fin,y} = 0.4 \text{ cm} < u_{fin,max,y} = L/200.00 = 1.8 \text{ cm}$ OK.

$u_{fin,z} = 0.4 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm}$ OK.

SGN w sytuacji pożaru R60 – czas 60 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 0.10$

PARAMETRY PRZĘKROJU:

ht=24.0 cm			
bf=22.0 cm	Ay=252.52 cm ²	Az=275.48 cm ²	Ax=528.00 cm ²
ea=11.0 cm	Iy=25344.00 cm ⁴	Iz=21296.00 cm ⁴	Ix=3942.8 cm ⁴
es=11.0 cm	Wely=2112.00 cm ³	Welz=1936.00 cm ³	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona		
beta0 = 0.70 mm/min	t = 1.00 h	tsurf = 0.00 min
Ścianki zabezpieczone : Brak	dchar = 4.2 cm	
def = 4.9 cm		
hf,fi = 14.2 cm	bf,fi = 12.2 cm	
Iy,fi = 2911.0 cm ⁴	A,fi = 173.2 cm ²	
Wy,fi = 410.00 cm ³	Iz,fi = 2148.8 cm ⁴	
	Wz,fi = 352.25 cm ³	

NAPRĘŻENIA

$\text{Sig}_{c,0,d,fi} = N/Ax,fi = 63.00/173.24 = 3.64 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = MY/Wy,fi = 3.79/410.00 = 9.25 \text{ MPa}$
 $\text{Sig}_{m,z,d,fi} = MZ/Wz,fi = 3.79/352.25 = 10.76 \text{ MPa}$
 $\text{Tau}_{y,d,fi} = 1.5 \cdot -0.03/173.24 = -0.00 \text{ MPa}$
 $\text{Tau}_{z,d,fi} = 1.5 \cdot -0.03/173.24 = -0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$
 $f_{m,z,d,fi} = 29.90 \text{ MPa}$
 $f_{v,d,fi} = 4.02 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHZENIOWE:

$l_{ef} = 3.52 \text{ m}$ $\text{Lambda}_{rel m} = 0.42$
 $\text{Sig}_{cr} = 148.15 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
LY = 3.60 m	Lambda Y = 87.82	LZ = 1.80 m	Lambda Z = 51.11
Lambda_rel Y = 1.42	ky = 1.56	Lambda_rel Z = 0.83	kz = 0.87
LFY = 3.60 m	kcy = 0.45	LFZ = 1.80 m	kcz = 0.88

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d,fi}/k_{c,y} \cdot f_{c,0,d,fi}) + \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} + k_m \cdot \text{Sig}_{m,z,d,fi}/f_{m,z,d,fi} = 0.83 < 1.00 \text{ (6.23) OK}$
 $\text{Sig}_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 9.25/(1.00 \cdot 29.90) = 0.31 < 1.00 \text{ (6.33) OK}$
 $\text{Tau}_{y,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 \text{ OK}$
 $\text{Tau}_{z,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 \text{ (6.13) OK}$

2.1.13. Platow P-8 24x24 cm**SGN****MATERIAŁ GL26h**

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$

$f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_c = 0.10$

PARAMETRY PRZĘKROJU:

$h_t = 24.0 \text{ cm}$	$A_y = 288.00 \text{ cm}^2$	$A_z = 288.00 \text{ cm}^2$	$A_x = 576.00 \text{ cm}^2$
$b_f = 24.0 \text{ cm}$	$I_y = 27648.00 \text{ cm}^4$	$I_z = 27648.00 \text{ cm}^4$	$I_x = 40919.0 \text{ cm}^4$
$e_a = 12.0 \text{ cm}$	$W_{ely} = 2304.00 \text{ cm}^3$	$W_{elz} = 2304.00 \text{ cm}^3$	
$e_s = 12.0 \text{ cm}$			

NAPRĘŻENIA

$\text{Sig}_{c,0,d} = N/A_x = 63.00/576.00 = 1.09 \text{ MPa}$
 $\text{Sig}_{m,y,d} = M_y/W_y = 10.87/2304.00 = 4.72 \text{ MPa}$
 $\text{Sig}_{m,z,d} = M_z/W_z = 10.87/2304.00 = 4.72 \text{ MPa}$
 $\text{Tau}_{y,d} = 1.5 \cdot 0.01/576.00 = 0.00 \text{ MPa}$
 $\text{Tau}_{z,d} = 1.5 \cdot 0.01/576.00 = 0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d} = 16.64 \text{ MPa}$
 $f_{m,y,d} = 18.24 \text{ MPa}$
 $f_{m,z,d} = 18.24 \text{ MPa}$
 $f_{v,d} = 2.24 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_h = 1.10$ $k_{mod} = 0.80$ $K_{sys} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 3.60 \text{ m}$	$\text{Lambda}_Y = 51.96$	$LZ = 1.80 \text{ m}$	$\text{Lambda}_Z = 25.98$
$\text{Lambda}_{rel Y} = 0.84$	$k_y = 0.88$	$\text{Lambda}_{rel Z} = 0.42$	$k_z = 0.59$
$LFY = 3.60 \text{ m}$	$k_{cy} = 0.88$	$LFZ = 1.80 \text{ m}$	$k_{cz} = 0.99$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d}/k_{cy} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.51 < 1.00 \quad (6.23) \quad \text{OK.}$
 $\text{Tau}_{y,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad \text{OK.}$
 $\text{Tau}_{z,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad (6.13) \quad \text{OK.}$

SGU

$u_{fin,y} = 0.5 \text{ cm} < u_{fin,max,y} = L/200.00 = 1.8 \text{ cm} \quad \text{OK.}$
 $u_{fin,z} = 0.5 \text{ cm} < u_{fin,max,z} = L/200.00 = 1.8 \text{ cm} \quad \text{OK.}$

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$

$f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_{tc} = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 24.0 \text{ cm}$	$A_y = 288.00 \text{ cm}^2$	$A_z = 288.00 \text{ cm}^2$	$A_x = 576.00 \text{ cm}^2$
$b_f = 24.0 \text{ cm}$	$I_y = 27648.00 \text{ cm}^4$	$I_z = 27648.00 \text{ cm}^4$	$I_x = 5014.6 \text{ cm}^4$
$ea = 12.0 \text{ cm}$	$W_{ely} = 2304.00 \text{ cm}^3$	$W_{elz} = 2304.00 \text{ cm}^3$	
$es = 12.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona	$t = 1.00 \text{ h}$	$t_{\text{surf}} = 0.00 \text{ min}$
$\beta_{ta} = 0.70 \text{ mm/min}$	$d_{\text{char}} = 4.2 \text{ cm}$	
Ścianki zabezpieczone : Brak		
$d_{\text{ef}} = 4.9 \text{ cm}$		
$h_{f,fi} = 14.2 \text{ cm}$	$b_{f,fi} = 14.2 \text{ cm}$	
$I_{y,fi} = 3388.2 \text{ cm}^4$	$A_{f,fi} = 201.6 \text{ cm}^2$	
$W_{y,fi} = 477.21 \text{ cm}^3$	$I_{z,fi} = 3388.2 \text{ cm}^4$	
	$W_{z,fi} = 477.21 \text{ cm}^3$	

NAPRĘŻENIA

$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 63.00/201.64 = 3.12 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = M_y/W_{y,fi} = 5.44/477.21 = 11.40 \text{ MPa}$
 $\text{Sig}_{m,z,d,fi} = M_z/W_{z,fi} = 5.44/477.21 = 11.40 \text{ MPa}$
 $\text{Tau}_{y,d,fi} = 1.5 \cdot -0.03/201.64 = -0.00 \text{ MPa}$
 $\text{Tau}_{z,d,fi} = 1.5 \cdot -0.03/201.64 = -0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$
 $f_{m,z,d,fi} = 29.90 \text{ MPa}$
 $f_{v,d,fi} = 4.02 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_{fi} = 1.15$ $k_{\text{mod}_{fc}} = 1.00$ $k_{\text{mod}_{ft}} = 1.00$ $k_{\text{mod}_{fb}} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 3.60 \text{ m}$	$\Lambda_Y = 87.82$	$LZ = 1.80 \text{ m}$	$\Lambda_Z = 43.91$
$\Lambda_{\text{rel } Y} = 1.42$	$k_y = 1.56$	$\Lambda_{\text{rel } Z} = 0.71$	$k_z = 0.77$
$LFY = 3.60 \text{ m}$	$k_{ey} = 0.45$	$LFZ = 1.80 \text{ m}$	$k_{ez} = 0.93$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d,fi}/k_{fc,y} \cdot f_{c,0,d,fi}) + \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} + k_m \cdot \text{Sig}_{m,z,d,fi}/f_{m,z,d,fi} = 0.88 < 1.00 \text{ (6.23) OK.}$

$\text{Tau}_{y,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00$ OK.

$\text{Tau}_{z,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 \text{ (6.13) OK}$

2.1.14. Platwie P-9 24x36 cm

SGN

MATERIAŁ GL26h

$gM = 1.25$	$f_{m,0,k} = 26.00 \text{ MPa}$	$f_{t,0,k} = 20.80 \text{ MPa}$	$f_{c,0,k} = 26.00 \text{ MPa}$
$f_{v,k} = 3.50 \text{ MPa}$	$f_{t,90,k} = 0.50 \text{ MPa}$	$f_{c,90,k} = 2.50 \text{ MPa}$	$E_{0,\text{moyen}} = 12100.00$
$E_{0,05} = 10100.00 \text{ MPa}$	$G_{\text{moyen}} = 650.00 \text{ MPa}$	Klasa użyteczności: 2	$Beta_c = 0.10$

PARAMETRY PRZEKROJU:

$ht = 36.0 \text{ cm}$	$A_y = 345.60 \text{ cm}^2$	$A_z = 518.40 \text{ cm}^2$	$A_x = 864.00 \text{ cm}^2$
$bf = 24.0 \text{ cm}$	$I_y = 93312.00 \text{ cm}^4$	$I_z = 41472.00 \text{ cm}^4$	$I_x = 96215.0 \text{ cm}^4$
$ea = 12.0 \text{ cm}$	$W_{ely} = 5184.00 \text{ cm}^3$	$W_{elz} = 3456.00 \text{ cm}^3$	
$es = 12.0 \text{ cm}$			

NAPRĘŻENIA

$Sig_{c,0,d} = N/A_x = 63.00/864.00 = 0.73 \text{ MPa}$
 $Sig_{m,y,d} = M_y/W_y = 18.37/5184.00 = 3.54 \text{ MPa}$
 $Sig_{m,z,d} = M_z/W_z = 18.37/3456.00 = 5.32 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d} = 12.48 \text{ MPa}$
 $f_{m,y,d} = 13.13 \text{ MPa}$
 $f_{m,z,d} = 13.68 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_h = 1.10$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 7.20 \text{ m}$ $\Lambda_{rel m} = 0.46$
 $Sig_{cr} = 124.46 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$LY = 7.20 \text{ m}$	$\Lambda_Y = 69.28$	$LZ = 3.60 \text{ m}$	$\Lambda_Z = 51.96$
$\Lambda_{rel Y} = 1.12$	$k_y = 1.17$	$\Lambda_{rel Z} = 0.84$	$k_z = 0.88$
$LFY = 7.20 \text{ m}$	$k_{ey} = 0.67$	$LFZ = 3.60 \text{ m}$	$k_{ez} = 0.88$

FORMUŁY WERYFIKACYJNE:

$Sig_{c,0,d}/(k_{c,z}*f_{c,0,d}) + k_m*Sig_{m,y,d}/f_{m,y,d} + Sig_{m,z,d}/f_{m,z,d} = 0.64 < 1.00 \quad (6.24)$ OK.

$Sig_{m,y,d}/(k_{crit}*f_{m,y,d}) = 3.54/(1.00*13.13) = 0.27 < 1.00 \quad (6.33)$ OK

SGU

$u_{fin,y} = 3.0 \text{ cm} < u_{fin,max,y} = L/200.00 = 3.6 \text{ cm}$ OK.

$u_{fin,z} = 1.4 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.6 \text{ cm}$ OK.

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

$gM_{fi} = 1.00$	$f_{m,0,k} = 26.00 \text{ MPa}$	$f_{t,0,k} = 20.80 \text{ MPa}$	$f_{c,0,k} = 26.00 \text{ MPa}$
------------------	---------------------------------	---------------------------------	---------------------------------

$f_{v,k} = 3.50 \text{ MPa}$ $f_{t,90,k} = 0.50 \text{ MPa}$ $f_{c,90,k} = 2.50 \text{ MPa}$ $E_{0,\text{moyen}} = 12100.00$
 MPa
 $E_{0,05} = 10100.00 \text{ MPa}$ $G_{\text{moyen}} = 650.00 \text{ MPa}$ Klasa użyteczności: 2 $\text{Beta } c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 36.0 \text{ cm}$ $A_y = 345.60 \text{ cm}^2$ $A_z = 518.40 \text{ cm}^2$ $A_x = 864.00 \text{ cm}^2$
 $b_f = 24.0 \text{ cm}$ $I_y = 93312.00 \text{ cm}^4$ $I_z = 41472.00 \text{ cm}^4$ $I_x = 16467.7 \text{ cm}^4$
 $e_a = 12.0 \text{ cm}$ $W_{ely} = 5184.00 \text{ cm}^3$ $W_{elz} = 3456.00 \text{ cm}^3$
 $e_s = 12.0 \text{ cm}$

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona
 $\beta_{a0} = 0.70 \text{ mm/min}$ $t = 1.00 \text{ h}$ $t_{\text{surf}} = 0.00 \text{ min}$
 Ścianki zabezpieczone : Brak
 $d_{\text{ef}} = 4.9 \text{ cm}$ $d_{\text{char}} = 4.2 \text{ cm}$
 $h_{f,fi} = 26.2 \text{ cm}$ $b_{f,fi} = 14.2 \text{ cm}$
 $I_{y,fi} = 21281.9 \text{ cm}^4$ $A_{f,fi} = 372.0 \text{ cm}^2$
 $W_{y,fi} = 1624.57 \text{ cm}^3$ $I_{z,fi} = 6251.5 \text{ cm}^4$
 $W_{z,fi} = 880.49 \text{ cm}^3$

NAPRĘŻENIA

$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 63.00/372.04 = 1.69 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = M_y/W_{y,fi} = 14.34/1624.57 = 8.83 \text{ MPa}$
 $\text{Sig}_{m,z,d,fi} = M_z/W_{z,fi} = 14.34/880.49 = 16.29 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$
 $f_{m,z,d,fi} = 29.90 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_{fi} = 1.15$ $k_{\text{mod}_{fc}} = 1.00$ $k_{\text{mod}_{ft}} = 1.00$ $k_{\text{mod}_{fb}} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{\text{ef}} = 7.00 \text{ m}$ $\text{Lambda}_{\text{rel } m} = 0.63$
 $\text{Sig}_{\text{cr}} = 65.58 \text{ MPa}$ $k_{\text{crit}} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y: względem osi Z:
 $L_Y = 7.20 \text{ m}$ $\text{Lambda } Y = 95.20$ $L_Z = 3.60 \text{ m}$ $\text{Lambda } Z = 87.82$
 $\text{Lambda}_{\text{rel } Y} = 1.54$ $k_y = 1.74$ $\text{Lambda}_{\text{rel } Z} = 1.42$ $k_z = 1.56$
 $L_{FY} = 7.20 \text{ m}$ $k_{cy} = 0.39$ $L_{FZ} = 3.60 \text{ m}$ $k_{cz} = 0.45$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d,fi}/k_{c,z} * f_{c,0,d,fi}) + k_m * \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} + \text{Sig}_{m,z,d,fi}/f_{m,z,d,fi} = 0.88 < 1.00 \text{ (6.24) OK}$
 $\text{Sig}_{m,y,d,fi}/(k_{\text{crit}} * f_{m,y,d,fi}) = 8.83/(1.00 * 29.90) = 0.30 < 1.00 \text{ (6.33) OK}$

2.1.15. Dźwigar D-5 22x120 cm

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: I
 $\beta_{c,0} = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 120.0 \text{ cm}$			
$b_f = 22.0 \text{ cm}$	$A_y = 409.01 \text{ cm}^2$	$A_z = 2230.99 \text{ cm}^2$	$A_x = 2640.00 \text{ cm}^2$
$e_a = 11.0 \text{ cm}$	$I_y = 3168000.00 \text{ cm}^4$	$I_z = 106480.00 \text{ cm}^4$	$I_x = 376726.2 \text{ cm}^4$
$e_s = 11.0 \text{ cm}$	$W_{ely} = 52800.00 \text{ cm}^3$	$W_{elz} = 9680.00 \text{ cm}^3$	

NAPRĘŻENIA

$\text{Sig}_{m,y,d} = M_Y/W_y = 462.12/52800.00 = 8.75 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d} = 12.48 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{h,y} = 1.00$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 4.84 \text{ m}$ $\lambda_{rel,m} = 0.67$
 $\text{Sig}_{cr} = 57.69 \text{ MPa}$ $k_{crit} = 1.00$

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{m,y,d}/f_{m,y,d} = 8.75/12.48 = 0.70 < 1.00$ (6.11) OK.

$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 8.75/(1.00 \cdot 12.48) = 0.70 < 1.00$ (6.33) OK

SGU

$u_{fin,z} = 41.0 \text{ mm} < u_{fin,max,z} = L/300.00 = 50.1 \text{ mm}$ OK

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$

$f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: 1
 $\beta_c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 120.0 \text{ cm}$	$A_y = 409.01 \text{ cm}^2$	$A_z = 2230.99 \text{ cm}^2$	$A_x = 2640.00 \text{ cm}^2$
$b_f = 22.0 \text{ cm}$	$I_y = 3168000.00 \text{ cm}^4$	$I_z = 106480.00 \text{ cm}^4$	$I_x = 62049.9 \text{ cm}^4$
$ea = 11.0 \text{ cm}$	$W_{ely} = 52800.00 \text{ cm}^3$	$W_{elz} = 9680.00 \text{ cm}^3$	
$es = 11.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona
 $\beta_{t0} = 0.70 \text{ mm/min}$
 Ścianki zabezpieczone : Brak
 $\delta_{ef} = 4.9 \text{ cm}$

$t = 1.00 \text{ h}$
 $d_{char} = 4.2 \text{ cm}$
 $t_{surf} = 0.00 \text{ min}$

$h_{f,fi} = 110.2 \text{ cm}$
 $I_{y,fi} = 1360577.8 \text{ cm}^4$
 $W_{y,fi} = 24692.88 \text{ cm}^3$

$b_{f,fi} = 12.2 \text{ cm}$
 $A_{f,fi} = 1344.4 \text{ cm}^2$
 $I_{z,fi} = 16675.5 \text{ cm}^4$
 $W_{z,fi} = 2733.69 \text{ cm}^3$

NAPRĘŻENIA

NAPRĘŻENIA DOPUSZCZALNE

$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 5.58/1344.44 = 0.04 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = M_y/W_{y,fi} = 363.27/24692.88 = 14.71 \text{ MPa}$

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 4.64 \text{ m}$
 $\text{Sig}_{cr} = 20.65 \text{ MPa}$

$\text{Lambda}_{rel m} = 1.12$
 $k_{crit} = 0.72$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

$L_Y = 15.03 \text{ m}$
 $\text{Lambda}_{rel Y} = 0.76$
 $L_{FY} = 15.03 \text{ m}$

$\text{Lambda Y} = 47.25$
 $k_y = 0.81$
 $k_{cy} = 0.91$

względem osi Z:

$L_Z = 2.50 \text{ m}$
 $\text{Lambda}_{rel Z} = 1.15$
 $L_{FZ} = 2.50 \text{ m}$

$\text{Lambda Z} = 70.99$
 $k_z = 1.20$
 $k_{cz} = 0.64$

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{c,0,d,fi}/(k_{cy} \cdot f_{c,0,d,fi}) + \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 0.04/(0.91 \cdot 29.90) + 14.71/29.90 = 0.49 < 1.00 \quad (6.23)$
 OK.

$\text{Sig}_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 14.71/(0.72 \cdot 29.90) = 0.68 < 1.00 \quad (6.33)$

OK

2.1.16. Dźwigar D-6 20x120 cm

SGN

MATERIAŁ GL26h

gM = 1.25
 $f_{m,0,k} = 26.00$ MPa
 $f_{t,0,k} = 20.80$ MPa
 $f_{c,0,k} = 26.00$ MPa
 $f_{v,k} = 3.50$ MPa
 $f_{t,90,k} = 0.50$ MPa
 $f_{c,90,k} = 2.50$ MPa
 $E_{0,moyen} = 12100.00$ MPa
 $E_{0,05} = 10100.00$ MPa
 $G_{moyen} = 650.00$ MPa
 Klasa użyteczności: 1
 $Beta_c = 1.00$

PARAMETRY PRZEKROJU:

ht=120.0 cm			
bf=20.0 cm	Ay=342.86 cm ²	Az=2057.14 cm ²	Ax=2400.00 cm ²
ea=10.0 cm	Iy=2880000.00 cm ⁴	Iz=80000.00 cm ⁴	Ix=286400.0 cm ⁴
es=10.0 cm	Wely=48000.00 cm ³	Welz=8000.00 cm ³	

NAPRĘŻENIA

NAPRĘŻENIA DOPUSZCZALNE

$Sig_{m,y,d} = MY/W_y = 243.26/48000.00 = 5.07$ MPa

$f_{m,y,d} = 12.48$ MPa

Współczynniki i parametry dodatkowe

kh_y = 1.00 kmod = 0.60 Ksys = 1.00

PARAMETRY ZWICHRZENIOWE:

lef = 4.84 m Lambda_rel m = 0.74
 $Sig_{cr} = 47.96$ MPa k_crit = 1.00

FORMUŁY WERYFIKACYJNE:

$Sig_{m,y,d}/f_{m,y,d} = 5.07/12.48 = 0.41 < 1.00$ (6.11)

OK

$Sig_{m,y,d}/(k_{crit} * f_{m,y,d}) = 5.07/(1.00 * 12.48) = 0.41 < 1.00$ (6.33)

OK

SGU

$u_{fin,z} = 23.6$ mm < $u_{fin,max,z} = L/300.00 = 50.1$ mm

OK

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

gM,fi = 1.00
 $f_{m,0,k} = 26.00$ MPa
 $f_{t,0,k} = 20.80$ MPa
 $f_{c,0,k} = 26.00$ MPa
 $f_{v,k} = 3.50$ MPa

$f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: I
 $\beta_c = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 120.0 \text{ cm}$			
$b_f = 20.0 \text{ cm}$	$A_y = 342.86 \text{ cm}^2$	$A_z = 2057.14 \text{ cm}^2$	$A_x = 2400.00 \text{ cm}^2$
$e_a = 10.0 \text{ cm}$	$I_y = 2880000.00 \text{ cm}^4$	$I_z = 80000.00 \text{ cm}^4$	$I_x = 36708.6 \text{ cm}^4$
$e_s = 10.0 \text{ cm}$	$W_{ely} = 48000.00 \text{ cm}^3$	$W_{elz} = 8000.00 \text{ cm}^3$	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona		
$\beta_{ta} = 0.70 \text{ mm/min}$	$t = 1.00 \text{ h}$	$t_{surf} = 0.00 \text{ min}$
Ścianki zabezpieczone : Brak	$d_{char} = 4.2 \text{ cm}$	
$d_{ef} = 4.9 \text{ cm}$		
$h_{f,fi} = 110.2 \text{ cm}$	$b_{f,fi} = 10.2 \text{ cm}$	
$I_{y,fi} = 1137532.2 \text{ cm}^4$	$A_{f,fi} = 1124.0 \text{ cm}^2$	
$W_{y,fi} = 20644.87 \text{ cm}^3$	$I_{z,fi} = 9745.4 \text{ cm}^4$	
	$W_{z,fi} = 1910.87 \text{ cm}^3$	

NAPRĘŻENIA

$\sigma_{c,0,d,fi} = N/A_{x,fi} = 2.80/1124.04 = 0.02 \text{ MPa}$
 $\sigma_{m,y,d,fi} = M_y/W_{y,fi} = 190.70/20644.87 = 9.24 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 4.64 \text{ m}$ $\lambda_{rel\ m} = 1.34$
 $\sigma_{cr} = 14.52 \text{ MPa}$ $k_{crit} = 0.56$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
$L_Y = 15.03 \text{ m}$	$\lambda_Y = 47.25$	$L_Z = 2.50 \text{ m}$	$\lambda_Z = 84.90$
$\lambda_{rel\ Y} = 0.76$	$k_y = 0.81$	$\lambda_{rel\ Z} = 1.37$	$k_z = 1.49$
$L_{FY} = 15.03 \text{ m}$	$k_{cy} = 0.91$	$L_{FZ} = 2.50 \text{ m}$	$k_{cz} = 0.48$

FORMUŁY WERYFIKACYJNE:

$\sigma_{c,0,d,fi}/(k_{cy} \cdot f_{c,0,d,fi}) + \sigma_{m,y,d,fi}/f_{m,y,d,fi} = 0.02/(0.91 \cdot 29.90) + 9.24/29.90 = 0.31 < 1.00 \quad (6.23)$
 OK.

$\sigma_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 9.24/(0.56 \cdot 29.90) = 0.56 < 1.00 \quad (6.33)$
OK

2.1.17. Dźwigar D-7 18x176 cm**SGN****MATERIAŁ** GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_{c,1} = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 176.0 \text{ cm}$			
$b_f = 18.0 \text{ cm}$	$A_y = 293.94 \text{ cm}^2$	$A_z = 2874.06 \text{ cm}^2$	$A_x = 3168.00 \text{ cm}^2$
$e_a = 9.0 \text{ cm}$	$I_y = 8177664.00 \text{ cm}^4$	$I_z = 85536.00 \text{ cm}^4$	$I_x = 320091.0 \text{ cm}^4$
$e_s = 9.0 \text{ cm}$	$W_{ely} = 92928.00 \text{ cm}^3$	$W_{elz} = 9504.00 \text{ cm}^3$	

NAPRĘŻENIA**NAPRĘŻENIA DOPUSZCZALNE** $f_{v,d} = 2.24 \text{ MPa}$ $\tau_{z,d} = 1.5 \cdot 124.21 / 3168.00 = 0.59 \text{ MPa}$ **Współczynniki i parametry dodatkowe** $k_h = 1.10 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$ **FORMUŁY WERYFIKACYJNE:** $\tau_{z,d} / f_{v,d} = 0.59 / 2.24 = 0.26 < 1.00 \quad (6.13)$

OK

SGU $u_{fin,z} = 0.2 \text{ cm} < u_{fin,max,z} = L / 300.00 = 2.4 \text{ cm}$

OK

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ** GL26h

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$

$E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\beta_c = 1.00$

PARAMETRY PRZĘKROJU:

$h_t = 176.0 \text{ cm}$			
$b_f = 18.0 \text{ cm}$	$A_y = 293.94 \text{ cm}^2$	$A_z = 2874.06 \text{ cm}^2$	$A_x = 3168.00 \text{ cm}^2$
$e_a = 9.0 \text{ cm}$	$I_y = 8177664.00 \text{ cm}^4$	$I_z = 85536.00 \text{ cm}^4$	$I_x = 29596.3 \text{ cm}^4$
$e_s = 9.0 \text{ cm}$	$W_{e_y} = 92928.00 \text{ cm}^3$	$W_{e_z} = 9504.00 \text{ cm}^3$	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona		
$\beta_{a0} = 0.70 \text{ mm/min}$	$t = 1.00 \text{ h}$	$t_{\text{surf}} = 0.00 \text{ min}$
Ścianki zabezpieczone : Brak	$d_{\text{char}} = 4.2 \text{ cm}$	
$d_{\text{ef}} = 4.9 \text{ cm}$		
$h_{f,fi} = 166.2 \text{ cm}$	$b_{f,fi} = 8.2 \text{ cm}$	
$I_{y,fi} = 3137080.5 \text{ cm}^4$	$A_{f,fi} = 1362.8 \text{ cm}^2$	
$W_{y,fi} = 37750.67 \text{ cm}^3$	$I_{z,fi} = 7636.4 \text{ cm}^4$	
	$W_{z,fi} = 1862.55 \text{ cm}^3$	

NAPRĘŻENIA

NAPRĘŻENIA DOPUSZCZALNE

$\sigma_{m,y,d,fi} = M_y / W_{y,fi} = 128.71 / 37750.67 = 3.41 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$
 $k_{\text{mod}_{fc}} = 1.00$
 $k_{\text{mod}_{ft}} = 1.00$
 $k_{\text{mod}_{fb}} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{\text{ef}} = 5.93 \text{ m}$
 $\lambda_{\text{rel},m} = 2.29$
 $\sigma_{\text{cr}} = 4.94 \text{ MPa}$
 $k_{\text{crit}} = 0.19$

FORMUŁY WERYFIKACYJNE:

$\sigma_{m,y,d,fi} / f_{m,y,d,fi} = 3.41 / 29.90 = 0.11 < 1.00 \quad (6.11)$
OK.

$\sigma_{m,y,d,fi} / (k_{\text{crit}} \cdot f_{m,y,d,fi}) = 3.41 / (0.19 \cdot 29.90) = 0.60 < 1.00 \quad (6.33)$
OK

2.1.18. Dźwigar D-8 20x196 cm

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,\text{moyen}} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{\text{moyen}} = 650.00 \text{ MPa}$

Klasa użyteczności: 2
Beta c = 1.00

PARAMETRY PRZEKROJU:

ht=196.0 cm			
bf=20.0 cm	Ay=362.96 cm ²	Az=3557.04 cm ²	Ax=3920.00 cm ²
ea=10.0 cm	Iy=12549226.67 cm ⁴	Iz=130666.67 cm ⁴	Ix=489054.4 cm ⁴
es=10.0 cm		Wely=128053.33 cm ³	
		Welz=13066.67 cm ³	

NAPRĘŻENIA

NAPRĘŻENIA DOPUSZCZALNE

$f_{v,d} = 1.68 \text{ MPa}$

$\tau_{z,d} = 1.5 \cdot 121.02 / 3168.00 = 0.57 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_h = 1.10$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

FORMUŁY WERYFIKACYJNE:

$T \tau_{z,d} / f_{v,d} = 0.47 / 1.68 = 0.28 < 1.00$ (6.13)

OK

SGU

$u_{fin,z} = 0.1 \text{ cm} < u_{fin,max,z} = L / 300.00 = 2.5 \text{ cm}$

OK.

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 Beta c = 1.00

PARAMETRY PRZEKROJU:

ht=196.0 cm			
bf=20.0 cm	Ay=362.96 cm ²	Az=3557.04 cm ²	Ax=3920.00 cm ²
ea=10.0 cm	Iy=12549226.67 cm ⁴	Iz=130666.67 cm ⁴	Ix=63592.5 cm ⁴
es=10.0 cm	Wely=128053.33 cm ³	Welz=13066.67 cm ³	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona
 $\beta_{a0} = 0.70 \text{ mm/min}$
 Ścianki zabezpieczone : Brak
 $\delta_{ef} = 4.9 \text{ cm}$

$t = 1.00 \text{ h}$ $t_{surf} = 0.00 \text{ min}$
 $\delta_{char} = 4.2 \text{ cm}$
 $\delta_{f,fi} = 10.2 \text{ cm}$

$h_{f,fi} = 186.2 \text{ cm}$
 $I_{y,fi} = 5487290.5 \text{ cm}^4$
 $W_{y,fi} = 58939.75 \text{ cm}^3$

$A_{fi} = 1899.2 \text{ cm}^2$
 $I_{z,fi} = 16466.4 \text{ cm}^4$
 $W_{z,fi} = 3228.71 \text{ cm}^3$

NAPRĘŻENIA

$\text{Sig}_{m,y,d,fi} = M_Y/W_{y,fi} = 105.96/58939.75 = 1.80 \text{ MPa}$

$\text{Tau}_{z,d,fi} = 1.5 \cdot -0.32/1899.24 = -0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d,fi} = 29.90 \text{ MPa}$

$f_{v,d,fi} = 4.02 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 6.48 \text{ m}$ $\text{Lambda}_{rel m} = 2.04$
 $\text{Sig}_{cr} = 6.23 \text{ MPa}$ $k_{crit} = 0.24$

FORMUŁY WERYFIKACYJNE:

$\text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 1.80/29.90 = 0.06 < 1.00$ (6.11) OK.

$\text{Sig}_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 1.80/(0.24 \cdot 29.90) = 0.25 < 1.00$ (6.33) OK.

$\text{Tau}_{z,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00$ (6.13) OK

2.1.19. Platwie P-10 16x36 cm

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 36.0 \text{ cm}$	$A_y = 257.14 \text{ cm}^2$	$A_z = 462.86 \text{ cm}^2$	$A_x = 720.00 \text{ cm}^2$
$b_f = 20.0 \text{ cm}$	$I_y = 77760.00 \text{ cm}^4$	$I_z = 24000.00 \text{ cm}^4$	$I_x = 62400.0 \text{ cm}^4$
$e_a = 10.0 \text{ cm}$	$W_{ely} = 4320.00 \text{ cm}^3$	$W_{elz} = 2400.00 \text{ cm}^3$	
$e_s = 10.0 \text{ cm}$			

NAPRĘŻENIA

$\text{Sig}_{m,y,d} = M_Y/W_y = 54.30/4320.00 = 12.57 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d} = 17.51 \text{ MPa}$

Współczynniki i parametry dodatkowe

$$k_{h,y} = 1.05 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 7.27 \text{ m} \quad \text{Lambda}_{rel} = 0.54$$

$$\text{Sig}_{cr} = 90.59 \text{ MPa} \quad k_{crit} = 1.00$$

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{m,y,d}/f_{m,y,d} = 12.57/17.51 = 0.72 < 1.00 \quad (6.11) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 12.57/(1.00 \cdot 17.51) = 0.72 < 1.00 \quad (6.33) \quad \text{OK}$$

SGU

$$u_{fin,z} = 3.3 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.6 \text{ cm} \quad \text{OK}$$

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 36.0 \text{ cm}$	$A_y = 257.14 \text{ cm}^2$	$A_z = 462.86 \text{ cm}^2$	$A_x = 720.00 \text{ cm}^2$
$b_f = 20.0 \text{ cm}$	$I_y = 77760.00 \text{ cm}^4$	$I_z = 24000.00 \text{ cm}^4$	$I_x = 35457.3 \text{ cm}^4$
$e_a = 10.0 \text{ cm}$	$W_{ely} = 4320.00 \text{ cm}^3$	$W_{elz} = 2400.00 \text{ cm}^3$	
$e_s = 10.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona	$t = 0.25 \text{ h}$	$t_{surf} = 0.00 \text{ min}$
$\text{beta}_0 = 0.70 \text{ mm/min}$	$d_{char} = 1.1 \text{ cm}$	
Ścianki zabezpieczone : Brak		
$d_{ef} = 1.6 \text{ cm}$		
$h_{f,fi} = 32.9 \text{ cm}$	$b_{f,fi} = 16.9 \text{ cm}$	
$I_{y,fi} = 49776.5 \text{ cm}^4$	$A_{f,fi} = 553.5 \text{ cm}^2$	
$W_{y,fi} = 3030.54 \text{ cm}^3$	$I_{z,fi} = 13096.5 \text{ cm}^4$	
	$W_{z,fi} = 1554.48 \text{ cm}^3$	

NAPRĘŻENIA

$$\text{Sig}_{m,y,d,fi} = MY/W_{y,fi} = 23.18/3030.54 = 7.65 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{m,y,d,fi} = 29.90 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_{fi} = 1.15 \quad k_{mod_fc} = 1.00 \quad k_{mod_ft} = 1.00 \quad k_{mod_fb} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$\begin{aligned} l_{ef} &= 7.21 \text{ m} & \lambda_{rel,m} &= 0.60 \\ \text{Sig}_{cr} &= 72.54 \text{ MPa} & k_{crit} &= 1.00 \end{aligned}$$

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 7.65/29.90 = 0.26 < 1.00 \quad (6.11) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 7.65/(1.00 \cdot 29.90) = 0.26 < 1.00 \quad (6.33) \quad \text{OK}$$

2.1.20. Płatwie P-11 20x36 cm**SGN****MATERIAŁ GL26h**

$$\begin{aligned} g_M &= 1.25 \\ f_{m,0,k} &= 26.00 \text{ MPa} \\ f_{t,0,k} &= 20.80 \text{ MPa} \\ f_{c,0,k} &= 26.00 \text{ MPa} \\ f_{v,k} &= 3.50 \text{ MPa} \\ f_{t,90,k} &= 0.50 \text{ MPa} \\ f_{c,90,k} &= 2.50 \text{ MPa} \\ E_{0,moyen} &= 12100.00 \text{ MPa} \\ E_{0,05} &= 10100.00 \text{ MPa} \\ G_{moyen} &= 650.00 \text{ MPa} \\ \text{Klasa użyteczności} &: 2 \\ \text{Beta } c &= 0.10 \end{aligned}$$

PARAMETRY PRZEKROJU:

$$\begin{aligned} h_t &= 36.0 \text{ cm} & A_y &= 257.14 \text{ cm}^2 & A_z &= 462.86 \text{ cm}^2 & A_x &= 720.00 \text{ cm}^2 \\ b_f &= 20.0 \text{ cm} & I_y &= 77760.00 \text{ cm}^4 & I_z &= 24000.00 \text{ cm}^4 & I_x &= 62400.0 \text{ cm}^4 \\ e_a &= 10.0 \text{ cm} & W_{ely} &= 4320.00 \text{ cm}^3 & W_{elz} &= 2400.00 \text{ cm}^3 \\ e_s &= 10.0 \text{ cm} \end{aligned}$$

NAPRĘŻENIA

$$\begin{aligned} \text{Sig}_{c,0,d} &= N/A_x = 63.00/720.00 = 0.88 \text{ MPa} \\ \text{Sig}_{m,y,d} &= MY/W_y = 54.30/4320.00 = 12.57 \text{ MPa} \end{aligned}$$

NAPRĘŻENIA DOPUSZCZALNE

$$\begin{aligned} f_{c,0,d} &= 16.64 \text{ MPa} \\ f_{m,y,d} &= 17.51 \text{ MPa} \end{aligned}$$

Współczynniki i parametry dodatkowe

$$k_h = 1.10 \quad k_{h_y} = 1.05 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 7.27 \text{ m} \quad \lambda_{rel,m} = 0.54$$

$\text{Sig}_{cr} = 90.59 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

$LY = 7.28 \text{ m}$

$\text{Lambda}_{rel} Y = 1.13$

$LFY = 7.28 \text{ m}$

$\text{Lambda} Y = 70.05$

$k_y = 1.18$

$k_{cy} = 0.66$

względem osi Z:

$LZ = 3.64 \text{ m}$

$\text{Lambda}_{rel} Z = 1.02$

$LFZ = 3.64 \text{ m}$

$\text{Lambda} Z = 63.05$

$k_z = 1.05$

$k_{cz} = 0.75$

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{c,0,d}/(k_{cy} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} = 0.88/(0.66 \cdot 16.64) + 12.57/17.51 = 0.80 < 1.00 \quad (6.23) \quad \text{OK}$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 12.57/(1.00 \cdot 17.51) = 0.72 < 1.00 \quad (6.33) \quad \text{OK}$$

SGU

$$u_{fin,z} = 3.3 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.6 \text{ cm}$$

OK

SGN w sytuacji pożaru R60 – czas 60 minut

MATERIAŁ GL26h

$g_{M,fi} = 1.00$

$f_{m,0,k} = 26.00 \text{ MPa}$

$f_{t,0,k} = 20.80 \text{ MPa}$

$f_{c,0,k} = 26.00 \text{ MPa}$

$f_{v,k} = 3.50 \text{ MPa}$

$f_{t,90,k} = 0.50 \text{ MPa}$

$f_{c,90,k} = 2.50 \text{ MPa}$

$E_{0,moyen} = 12100.00 \text{ MPa}$

$E_{0,05} = 10100.00 \text{ MPa}$

$G_{moyen} = 650.00 \text{ MPa}$

Klasa użyteczności: 2

$\text{Beta}_c = 0.10$

PARAMETRY PRZEKROJU:

$ht = 36.0 \text{ cm}$

$bf = 20.0 \text{ cm}$

$ea = 10.0 \text{ cm}$

$es = 10.0 \text{ cm}$

$A_y = 257.14 \text{ cm}^2$

$I_y = 77760.00 \text{ cm}^4$

$W_{ely} = 4320.00 \text{ cm}^3$

$A_z = 462.86 \text{ cm}^2$

$I_z = 24000.00 \text{ cm}^4$

$W_{elz} = 2400.00 \text{ cm}^3$

$A_x = 720.00 \text{ cm}^2$

$I_x = 6994.8 \text{ cm}^4$

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona

$\text{beta}_0 = 0.70 \text{ mm/min}$

Ścianki zabezpieczone : Brak

$\text{def} = 4.9 \text{ cm}$

$t = 1.00 \text{ h}$

$d_{char} = 4.2 \text{ cm}$

$t_{surf} = 0.00 \text{ min}$

$h_{f,fi} = 26.2 \text{ cm}$

$I_{y,fi} = 15287.0 \text{ cm}^4$

$W_{y,fi} = 1166.95 \text{ cm}^3$

$h_{f,fi} = 10.2 \text{ cm}$

$A_{f,fi} = 267.2 \text{ cm}^2$

$I_{z,fi} = 2317.0 \text{ cm}^4$

$W_{z,fi} = 454.31 \text{ cm}^3$

Współczynniki i parametry dodatkowe

$$k_{h,y} = 1.06 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 5.50 \text{ m} \quad \text{Lambda}_{rel} = 0.83$$

$$\text{Sig}_{cr} = 37.45 \text{ MPa} \quad k_{crit} = 0.94$$

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{m,y,d}/f_{m,y,d} = 11.50/17.72 = 0.65 < 1.00 \quad (6.11) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 11.50/(0.94 \cdot 17.72) = 0.69 < 1.00 \quad (6.33) \quad \text{OK}$$

SGU

$$u_{fin,z} = 2.2 \text{ cm} < u_{fin,max,z} = L/200.00 = 2.7 \text{ cm} \quad \text{OK}$$

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta } c = 1.00$

PARAMETRY PRZEKROJU:

$h_t = 32.0 \text{ cm}$			
$b_f = 10.0 \text{ cm}$	$A_y = 76.19 \text{ cm}^2$	$A_z = 243.81 \text{ cm}^2$	$A_x = 320.00 \text{ cm}^2$
$ea = 5.0 \text{ cm}$	$I_y = 27306.67 \text{ cm}^4$	$I_z = 2666.67 \text{ cm}^4$	$I_x = 2628.6 \text{ cm}^4$
$es = 5.0 \text{ cm}$	$W_{ely} = 1706.67 \text{ cm}^3$	$W_{elz} = 533.33 \text{ cm}^3$	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona		
$\text{beta}_0 = 0.70 \text{ mm/min}$	$t = 0.25 \text{ h}$	$t_{surf} = 0.00 \text{ min}$
Ścianki zabezpieczone : Brak	$d_{char} = 1.1 \text{ cm}$	
$def = 1.6 \text{ cm}$		
$h_{f,fi} = 28.8 \text{ cm}$	$b_{f,fi} = 6.9 \text{ cm}$	
$I_{y,fi} = 13707.1 \text{ cm}^4$	$A_{f,fi} = 197.6 \text{ cm}^2$	
$W_{y,fi} = 950.23 \text{ cm}^3$	$I_{z,fi} = 772.7 \text{ cm}^4$	
	$W_{z,fi} = 225.62 \text{ cm}^3$	

NAPRĘŻENIA

$$\text{Sig}_{m,y,d,fi} = M_{y,fi}/W_{y,fi} = 10.89/950.23 = 11.46 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{m,y,d,fi} = 29.90 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_{fi} = 1.15 \quad k_{mod_fc} = 1.00 \quad k_{mod_ft} = 1.00 \quad k_{mod_fb} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 5.44 \text{ m} \quad \text{Lambda_rel m} = 1.13$$

$$\text{Sig_cr} = 20.29 \text{ MPa} \quad k_{crit} = 0.71$$

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 11.46/29.90 = 0.38 < 1.00 \quad (6.11) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d,fi}/(k_{crit} * f_{m,y,d,fi}) = 11.46/(0.71 * 29.90) = 0.54 < 1.00 \quad (6.33) \quad \text{OK}$$

2.1.22. Platwie P-13 18x32 cm**SGN****MATERIAŁ** GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta c} = 0.10$

PARAMETRY PRZEKROJU:

$h_t = 32.0 \text{ cm}$			
$b_f = 18.0 \text{ cm}$	$A_y = 207.36 \text{ cm}^2$	$A_z = 368.64 \text{ cm}^2$	$A_x = 576.00 \text{ cm}^2$
$e_a = 9.0 \text{ cm}$	$I_y = 49152.00 \text{ cm}^4$	$I_z = 15552.00 \text{ cm}^4$	$I_x = 40163.0 \text{ cm}^4$
$e_s = 9.0 \text{ cm}$	$W_{ely} = 3072.00 \text{ cm}^3$	$W_{elz} = 1728.00 \text{ cm}^3$	

NAPRĘŻENIA

$$\text{Sig}_{c,0,d} = N/A_x = 63.00/576.00 = 1.09 \text{ MPa}$$

$$\text{Sig}_{m,y,d} = M_Y/W_y = 20.06/3072.00 = 6.53 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{c,0,d} = 16.64 \text{ MPa}$$

$$f_{m,y,d} = 17.72 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_h = 1.10 \quad k_{h_y} = 1.06 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 5.50 \text{ m} \quad \text{Lambda_rel m} = 0.49$$

$$\text{Sig_cr} = 108.78 \text{ MPa} \quad k_{crit} = 1.00$$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

LY = 5.40 m

Lambda_rel Y = 0.94

LFY = 5.40 m

Lambda Y = 58.46

ky = 0.98

kcy = 0.81

względem osi Z:

LZ = 2.70 m

Lambda_rel Z = 0.84

LFZ = 2.70 m

Lambda Z = 51.96

kz = 0.88

kecz = 0.88

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{c,0,d}/(k_{c,y} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} = 1.09/(0.81 \cdot 16.64) + 6.53/17.72 = 0.45 < 1.00 \quad (6.23) \quad \text{OK.}$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 6.53/(1.00 \cdot 17.72) = 0.37 < 1.00 \quad (6.33) \quad \text{OK}$$

SGU

$$u_{fin,z} = 1.2 \text{ cm} < u_{fin,max,z} = L/200.00 = 2.7 \text{ cm}$$

OK

SGN w sytuacji pożaru R60– czas 60 minut**MATERIAŁ** GL26h

gM,fi = 1.00

f_{m,0,k} = 26.00 MPaf_{t,0,k} = 20.80 MPaf_{c,0,k} = 26.00 MPaf_{v,k} = 3.50 MPaf_{t,90,k} = 0.50 MPaf_{c,90,k} = 2.50 MPaE_{0,moyen} = 12100.00 MPaE_{0,05} = 10100.00 MPaG_{moyen} = 650.00 MPa

Klasa użyteczności: 2

Beta_c = 0.10**PARAMETRY PRZĘKROJU:**

ht=32.0 cm

bf=18.0 cm

ea=9.0 cm

es=9.0 cm

Ay=207.36 cm²Iy=49152.00 cm⁴Wely=3072.00 cm³Az=368.64 cm²Iz=15552.00 cm⁴Welz=1728.00 cm³Ax=576.00 cm²Ix=3130.7 cm⁴**PARAMETRY ODPORNOŚCI OGNOWEJ**

Metoda : Uproszczona

beta₀ = 0.70 mm/min

Ścianki zabezpieczone : Brak

def = 4.9 cm

t = 1.00 h

dchar = 4.2 cm

tsurf = 0.00 min

hf,fi = 22.2 cm

Iy,fi = 7476.4 cm⁴Wy,fi = 673.55 cm³

bf,fi = 8.2 cm

A,fi = 182.0 cm²Iz,fi = 1020.0 cm⁴Wz,fi = 248.79 cm³**NAPRĘŻENIA**

$$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 63.00/182.04 = 3.46 \text{ MPa}$$

$$\text{Sig}_{m,y,d,fi} = M/Y_{y,fi} = 11.27/673.55 = 16.73 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{c,0,d,fi} = 29.90 \text{ MPa}$$

$$f_{m,y,d,fi} = 29.90 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_{fi} = 1.15 \quad k_{mod_fc} = 1.00 \quad k_{mod_ft} = 1.00 \quad k_{mod_fb} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$$l_{ef} = 5.30 \text{ m} \quad \text{Lambda_rel m} = 0.84$$

$$\text{Sig_cr} = 36.79 \text{ MPa} \quad k_{crit} = 0.93$$

PARAMETRY WYBOCZENIOWE:

względem osi Y:		względem osi Z:	
LY = 5.40 m	Lambda Y = 84.26	LZ = 2.70 m	Lambda Z = 114.06
Lambda_rel Y = 1.36	ky = 1.48	Lambda_rel Z = 1.84	kz = 2.27
LFY = 5.40 m	kcy = 0.49	LFZ = 2.70 m	kcz = 0.28

FORMUŁY WERYFIKACYJNE:

$$\text{Sig}_{c,0,d,fi}/(k_{c,z}*f_{c,0,d,fi}) + k_m*\text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} = 3.46/(0.28*29.90) + 0.70*16.73/29.90 = 0.81 < 1.00 \quad (6.24) \quad \text{OK}$$

$$\text{Sig}_{m,y,d,fi}/(k_{crit}*f_{m,y,d,fi}) = 16.73/(0.93*29.90) = 0.60 < 1.00 \quad (6.33) \quad \text{OK}$$

2.1.23. Platwie P-14 24x28 cm**SGN****MATERIAŁ GL26h**

$$g_M = 1.25$$

$$f_{m,0,k} = 26.00 \text{ MPa}$$

$$f_{t,0,k} = 20.80 \text{ MPa}$$

$$f_{c,0,k} = 26.00 \text{ MPa}$$

$$f_{v,k} = 3.50 \text{ MPa}$$

$$f_{t,90,k} = 0.50 \text{ MPa}$$

$$f_{c,90,k} = 2.50 \text{ MPa}$$

$$E_{0,moyen} = 12100.00 \text{ MPa}$$

$$E_{0,05} = 10100.00 \text{ MPa}$$

$$G_{moyen} = 650.00 \text{ MPa}$$

$$\text{Klasa użyteczności: } 2$$

$$\text{Beta } c = 0.10$$

PARAMETRY PRZEKROJU:

ht=28.0 cm			
bf=24.0 cm	Ay=310.15 cm ²	Az=361.85 cm ²	Ax=672.00 cm ²
ea=12.0 cm	Iy=43904.00 cm ⁴	Iz=32256.00 cm ⁴	Ix=59351.0 cm ⁴
es=12.0 cm	Wely=3136.00 cm ³	Welz=2688.00 cm ³	

NAPRĘŻENIA

$$\text{Sig}_{c,0,d} = N/Ax = 63.00/672.00 = 0.94 \text{ MPa}$$

$$\text{Sig}_{m,y,d} = MY/Wy = 17.32/3136.00 = 5.52 \text{ MPa}$$

$$\text{Sig}_{m,z,d} = MZ/Wz = 17.32/2688.00 = 6.44 \text{ MPa}$$

$$\text{Tau}_{y,d} = 1.5*-0.04/672.00 = -0.00 \text{ MPa}$$

$$\text{Tau}_{z,d} = 1.5*-0.04/672.00 = -0.00 \text{ MPa}$$

NAPRĘŻENIA DOPUSZCZALNE

$$f_{c,0,d} = 16.64 \text{ MPa}$$

$$f_{m,y,d} = 17.96 \text{ MPa}$$

$$f_{m,z,d} = 18.24 \text{ MPa}$$

$$f_{v,d} = 2.24 \text{ MPa}$$

Współczynniki i parametry dodatkowe

$$k_m = 0.70 \quad k_h = 1.10 \quad k_{mod} = 0.80 \quad K_{sys} = 1.00$$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 5.42 \text{ m}$ $\Lambda_{rel \text{ m}} = 0.37$
 $\text{Sig}_{cr} = 189.31 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

$LY = 5.40 \text{ m}$ $\Lambda_Y = 66.81$
 $\Lambda_{rel \text{ Y}} = 1.08$ $k_Y = 1.12$
 $LFY = 5.40 \text{ m}$ $k_{cy} = 0.70$

względem osi Z:

$LZ = 2.70 \text{ m}$ $\Lambda_Z = 38.97$
 $\Lambda_{rel \text{ Z}} = 0.63$ $k_Z = 0.71$
 $LFZ = 2.70 \text{ m}$ $k_{cz} = 0.95$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d}/k_{cy} * f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m * \text{Sig}_{m,z,d}/f_{m,z,d} = 0.64 < 1.00 \quad (6.23)$ OK.

$\text{Sig}_{m,y,d}/(k_{crit} * f_{m,y,d}) = 5.52/(1.00 * 17.96) = 0.31 < 1.00 \quad (6.33)$ OK

$\text{Tau}_{y,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00$ OK

$\text{Tau}_{z,d}/f_{v,d} = 0.00/2.24 = 0.00 < 1.00 \quad (6.13)$ OK

SGU

$u_{fin,y} = 1.5 \text{ cm} < u_{fin,max,y} = L/200.00 = 2.7 \text{ cm}$ OK

$u_{fin,z} = 1.1 \text{ cm} < u_{fin,max,z} = L/200.00 = 2.7 \text{ cm}$ OK

SGN w sytuacji pożaru R60 – czas 60 minut**MATERIAŁ** GL26h

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 0.10$

PARAMETRY PRZEKROJU:

$ht = 28.0 \text{ cm}$	$A_y = 310.15 \text{ cm}^2$	$A_z = 361.85 \text{ cm}^2$	$A_x = 672.00 \text{ cm}^2$
$bf = 24.0 \text{ cm}$	$I_y = 43904.00 \text{ cm}^4$	$I_z = 32256.00 \text{ cm}^4$	$I_x = 8832.3 \text{ cm}^4$
$ea = 12.0 \text{ cm}$	$W_{ely} = 3136.00 \text{ cm}^3$	$W_{elz} = 2688.00 \text{ cm}^3$	
$es = 12.0 \text{ cm}$			

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona	$t = 1.00 \text{ h}$	$t_{surf} = 0.00 \text{ min}$
$\text{beta}_0 = 0.70 \text{ mm/min}$	$d_{char} = 4.2 \text{ cm}$	
Ścianki zabezpieczone : Brak		
$d_{ef} = 4.9 \text{ cm}$	$bf_{fi} = 14.2 \text{ cm}$	

$h_{f,fi} = 18.2 \text{ cm}$
 $I_{y,fi} = 7133.8 \text{ cm}^4$
 $W_{y,fi} = 783.93 \text{ cm}^3$

$A_{fi} = 258.4 \text{ cm}^2$
 $I_{z,fi} = 4342.7 \text{ cm}^4$
 $W_{z,fi} = 611.64 \text{ cm}^3$

NAPRĘŻENIA

$\text{Sig}_{c,0,d,fi} = N/A_{x,fi} = 63.00/258.44 = 2.44 \text{ MPa}$
 $\text{Sig}_{m,y,d,fi} = MY/W_{y,fi} = 8.62/783.93 = 10.99 \text{ MPa}$
 $\text{Sig}_{m,z,d,fi} = MZ/W_{z,fi} = 8.62/611.64 = 14.09 \text{ MPa}$
 $\text{Tau}_{y,d,fi} = 1.5 \cdot 0.02/258.44 = 0.00 \text{ MPa}$
 $\text{Tau}_{z,d,fi} = 1.5 \cdot 0.02/258.44 = 0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{c,0,d,fi} = 29.90 \text{ MPa}$
 $f_{m,y,d,fi} = 29.90 \text{ MPa}$
 $f_{m,z,d,fi} = 29.90 \text{ MPa}$
 $f_{v,d,fi} = 4.02 \text{ MPa}$

Współczynniki i parametry dodatkowe

$k_m = 0.70$ $k_{fi} = 1.15$ $k_{mod_fc} = 1.00$ $k_{mod_ft} = 1.00$ $k_{mod_fb} = 1.00$

PARAMETRY ZWICHRZENIOWE:

$l_{ef} = 5.22 \text{ m}$ $\text{Lambda}_{rel\ m} = 0.48$
 $\text{Sig}_{cr} = 111.22 \text{ MPa}$ $k_{crit} = 1.00$

PARAMETRY WYBOCZENIOWE:

względem osi Y:

$LY = 5.40 \text{ m}$ $\text{Lambda}_Y = 102.78$
 $\text{Lambda}_{rel\ Y} = 1.66$ $k_Y = 1.95$
 $LFY = 5.40 \text{ m}$ $k_{cy} = 0.34$

względem osi Z:

$LZ = 2.70 \text{ m}$ $\text{Lambda}_Z = 65.87$
 $\text{Lambda}_{rel\ Z} = 1.06$ $k_Z = 1.10$
 $LFZ = 2.70 \text{ m}$ $k_{cz} = 0.71$

FORMUŁY WERYFIKACYJNE:

$(\text{Sig}_{c,0,d,fi}/k_{c,y} \cdot f_{c,0,d,fi}) + \text{Sig}_{m,y,d,fi}/f_{m,y,d,fi} + k_m \cdot \text{Sig}_{m,z,d,fi}/f_{m,z,d,fi} = 0.94 < 1.00 \text{ (6.23) OK.}$

$\text{Sig}_{m,y,d,fi}/(k_{crit} \cdot f_{m,y,d,fi}) = 10.99/(1.00 \cdot 29.90) = 0.37 < 1.00 \text{ (6.33) OK.}$

$\text{Tau}_{y,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 \text{ OK}$

$\text{Tau}_{z,d,fi}/f_{v,d,fi} = 0.00/4.02 = 0.00 < 1.00 \text{ (6.13) OK}$

2.1.24. Platwie P-15 24x24 cm

SGN

MATERIAŁ GL26h

$g_M = 1.25$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 1.00$

PARAMETRY PRZEKROJU:

ht=24.0 cm			
bf=24.0 cm	Ay=288.00 cm ²	Az=288.00 cm ²	Ax=576.00 cm ²
ea=12.0 cm	Iy=27648.00 cm ⁴	Iz=27648.00 cm ⁴	Ix=40919.0 cm ⁴
es=12.0 cm	Wely=2304.00 cm ³	Welz=2304.00 cm ³	

NAPRĘŻENIA

$\text{Sig}_{m,y,d} = MY/W_y = 17.21/2304.00 = 7.47 \text{ MPa}$
 $\text{Sig}_{m,z,d} = MZ/W_z = 17.21/2304.00 = 7.47 \text{ MPa}$
 $\text{Tau}_{y,d} = 1.5 \cdot -0.04/576.00 = -0.00 \text{ MPa}$
 $\text{Tau}_{z,d} = 1.5 \cdot -0.04/576.00 = -0.00 \text{ MPa}$

NAPRĘŻENIA DOPUSZCZALNE

$f_{m,y,d} = 18.24 \text{ MPa}$
 $f_{m,z,d} = 18.24 \text{ MPa}$
 $f_{v,d} = 2.24 \text{ MPa}$

Współczynniki i parametry dodatkowe

km = 0.70 kh = 1.10 kmod = 0.80 Ksys = 1.00

FORMUŁY WERYFIKACYJNE:

$\text{km} \cdot \text{Sig}_{m,y,d} / f_{m,y,d} + \text{Sig}_{m,z,d} / f_{m,z,d} = 0.70 \cdot 7.47 / 18.24 + 7.47 / 18.24 = 0.70 < 1.00 \quad (6.12) \quad \text{OK.}$

$\text{Tau}_{y,d} / f_{v,d} = 0.00 / 2.24 = 0.00 < 1.00 \quad \text{OK.}$

$\text{Tau}_{z,d} / f_{v,d} = 0.00 / 2.24 = 0.00 < 1.00 \quad (6.13) \quad \text{OK}$

SGU

$u_{fin,y} = 1.7 \text{ cm} < u_{fin,max,y} = L/200.00 = 2.7 \text{ cm} \quad \text{OK}$

$u_{fin,z} = 1.8 \text{ cm} < u_{fin,max,z} = L/200.00 = 2.7 \text{ cm} \quad \text{OK.}$

SGN w sytuacji pożaru R15 – czas 15 minut**MATERIAŁ GL26h**

$g_{M,fi} = 1.00$
 $f_{m,0,k} = 26.00 \text{ MPa}$
 $f_{t,0,k} = 20.80 \text{ MPa}$
 $f_{c,0,k} = 26.00 \text{ MPa}$
 $f_{v,k} = 3.50 \text{ MPa}$
 $f_{t,90,k} = 0.50 \text{ MPa}$
 $f_{c,90,k} = 2.50 \text{ MPa}$
 $E_{0,moyen} = 12100.00 \text{ MPa}$
 $E_{0,05} = 10100.00 \text{ MPa}$
 $G_{moyen} = 650.00 \text{ MPa}$
 Klasa użyteczności: 2
 $\text{Beta}_c = 1.00$

PARAMETRY PRZEKROJU:

ht=24.0 cm			
bf=24.0 cm	Ay=288.00 cm ²	Az=288.00 cm ²	Ax=576.00 cm ²
ea=12.0 cm	Iy=27648.00 cm ⁴	Iz=27648.00 cm ⁴	Ix=23308.0 cm ⁴
es=12.0 cm	Wely=2304.00 cm ³	Welz=2304.00 cm ³	

PARAMETRY ODPORNOŚCI OGNOWEJ

Metoda : Uproszczona
 $\text{beta}_0 = 0.70 \text{ mm/min}$
 Ścianki zabezpieczone : Brak
 $t = 0.25 \text{ h}$
 $d_{char} = 1.1 \text{ cm}$
 $t_{surf} = 0.00 \text{ min}$

def = 1.6 cm

hf,fi = 20.8 cm

Iy,fi = 15748.6 cm⁴

Wy,fi = 1510.66 cm³

bf,fi = 20.8 cm

A,fi = 434.7 cm²

Iz,fi = 15748.6 cm⁴

Wz,fi = 1510.66 cm³

NAPRĘŻENIA

Sig_m,y,d,fi = MY/Wy,fi = 8.52/1510.66 = 5.64 MPa

Sig_m,z,d,fi = MZ/Wz,fi = 8.52/1510.66 = 5.64 MPa

Tau y,d,fi = 1.5*0.02/434.72 = 0.00 MPa

Tau z,d,fi = 1.5*0.02/434.72 = 0.00 MPa

NAPRĘŻENIA DOPUSZCZALNE

f m,y,d,fi = 29.90 MPa

f m,z,d,fi = 29.90 MPa

f v,d,fi = 4.02 MPa

Współczynniki i parametry dodatkowe

km = 0.70 kfi = 1.15 kmod_fc = 1.00 kmod_ft = 1.00 kmod_fb = 1.00

FORMUŁY WERYFIKACYJNE:

$km * Sig_{m,y,d,fi} / f_{m,y,d,fi} + Sig_{m,z,d,fi} / f_{m,z,d,fi} = 0.70 * 5.64 / 29.90 + 5.64 / 29.90 = 0.32 < 1.00$ (6.12) OK.

$Tau_{y,d,fi} / f_{v,d,fi} = 0.00 / 4.02 = 0.00 < 1.00$

OK

$Tau_{z,d,fi} / f_{v,d,fi} = 0.00 / 4.02 = 0.00 < 1.00$ (6.13)

OK