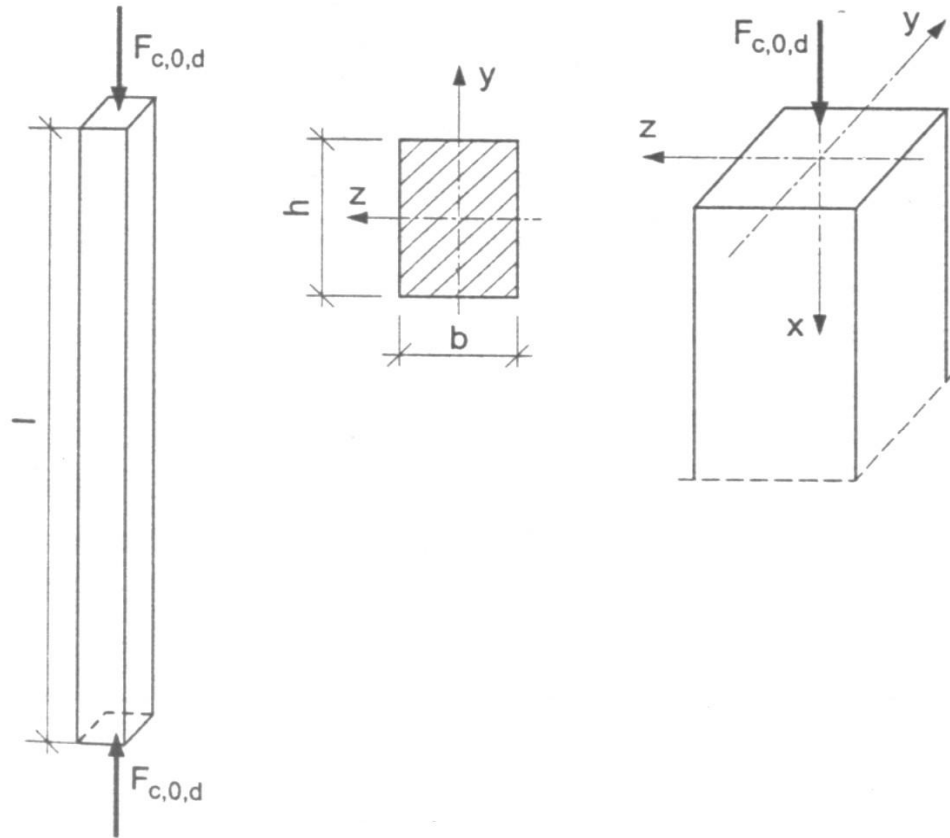


ZADANIE 5



Zadanie5/2

SŁUP 10/5, l=40 cm

Przyjęto drewno klasy C 24

$f_{m,k} =$	24 MPa
$f_{c,0,k} =$	21 MPa
$E_{0,mean} =$	11 GPa
$E_{0,05} =$	7,4 GPa

$b =$	5 cm
$h =$	10 cm

$N_d =$	40,00 kN
---------	----------

$W_y = bh^2/6 =$	83,33 cm ³
------------------	-----------------------

$I_y = bh^3/12 =$	416,67 cm ⁴
-------------------	------------------------

$A = bh =$	50,00 cm ²
------------	-----------------------

$i_y = \sqrt{\frac{I_y}{A}} =$	2,89 cm
--------------------------------	---------

$i_z = \sqrt{\frac{I_z}{A}} =$	1,44 cm
--------------------------------	---------

$l_y =$	0,40 m
---------	--------

$\mu_y =$	1,00
-----------	------

$l_{c,y} = \mu l_y =$	0,40 m
-----------------------	--------

$f_{m,k} =$	24 MPa
$f_{c,0,k} =$	21 MPa
$E_{0,mean} =$	11 GPa
$E_{0,05} =$	7,4 GPa

$b =$	5 cm
$h =$	10 cm

$N_d =$	40,00 kNm
---------	-----------

$W_y = bh^2/6 =$	83,33 cm ³
------------------	-----------------------

$W_z = hb^2/6 =$	41,67 cm ³
------------------	-----------------------

$I_z = hb^3/12 =$	104,17 cm ⁴
-------------------	------------------------

$A = bh =$	50,00 cm ²
------------	-----------------------

$i_z = \sqrt{\frac{I_z}{A}} =$	1,44 cm
--------------------------------	---------

$l_z =$	0,40 m
---------	--------

$\mu_z =$	1,00
-----------	------

$l_{c,z} = \mu l_z =$	0,40 m
-----------------------	--------

Zadanie5/3

$$\lambda_{c,y} = l_{c,y}/i_y = 13,86$$

$$\sigma_{c,crit,y} = \pi^2 E_{0,05} / \lambda_{c,y}^2 = 380,39 \text{ MPa}$$

$$\lambda_{rel,y} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,y}}} = 0,23496 < 0,5$$

nie uwzględnia się wybożenia względem osi y

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_y = 0,5[1 + \beta_c(\lambda_{rel,y} - 0,5) + \lambda_{rel,y}^2] = 0,501099$$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = 1,059661 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$k_{c,y} = 1$$

$$\frac{\sigma_{c,0,d}}{k_{c,y} f_{c,0,d}} \leq 1$$

$$\lambda_{c,z} = l_{c,z}/i_z = 27,71$$

$$\sigma_{c,crit,z} = \pi^2 E_{0,05} / \lambda_{c,z}^2 = 95,10 \text{ MPa}$$

$$\lambda_{rel,z} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,z}}} = 0,4699206 < 0,5$$

nie uwzględnia się wybożenia względem osi z

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_z = 0,5[1 + \beta_c(\lambda_{rel,z} - 0,5) + \lambda_{rel,z}^2] = 0,607405$$

$$k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}} = 1,007798 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$k_{c,z} = 1$$

$$\frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \leq 1$$

Zadanie5/4

0,6190476 <

1

SŁUP 10/5, l=85 cm

Przyjęto drewno klasy C 24

$f_{m,k} =$	24 MPa
$f_{c,0,k} =$	21 MPa
$E_{0,mean} =$	11 GPa
$E_{0,05} =$	7,4 GPa

$b =$	5 cm
$h =$	10 cm

$N_d =$	40,00 kN
---------	----------

$W_y =$	$bh^2/6 =$	83,33 cm ³
---------	------------	-----------------------

$I_y =$	$bh^3/12 =$	416,67 cm ⁴
---------	-------------	------------------------

$A = bh =$	50,00 cm ²
------------	-----------------------

$$i_y = \sqrt{\frac{I_y}{A}} = 2,89 \text{ cm}$$

$$i_z = \sqrt{\frac{I_z}{A}} = 1,44 \text{ cm}$$

$l_y =$	0,85 m
---------	--------

$\mu_y =$	1,00
-----------	------

$l_{c,y} = \mu l_y =$	0,85 m
-----------------------	--------

0,619048 <

1

$f_{m,k} =$	24 MPa
$f_{c,0,k} =$	21 MPa
$E_{0,mean} =$	11 GPa
$E_{0,05} =$	7,4 GPa

$b =$	5 cm
$h =$	10 cm

$N_d =$	40,00 kNm
---------	-----------

$W_y =$	$bh^2/6 =$	83,33 cm ³
---------	------------	-----------------------

$W_z =$	$hb^2/6 =$	41,67 cm ³
---------	------------	-----------------------

$I_z =$	$hb^3/12 =$	104,17 cm ⁴
---------	-------------	------------------------

$A = bh =$	50,00 cm ²
------------	-----------------------

$$i_z = \sqrt{\frac{I_z}{A}} = 1,44 \text{ cm}$$

$l_z =$	0,85 m
---------	--------

$\mu_z =$	1,00
-----------	------

$l_{c,z} = \mu l_z =$	0,85 m
-----------------------	--------

Zadanie5/5

$$\lambda_{c,y} = l_{c,y} / i_y = 29,44$$

$$\sigma_{c,crit,y} = \pi^2 E_{0,05} / \lambda_{c,y}^2 = 84,24 \text{ MPa}$$

$$\lambda_{rel,y} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,y}}} = 0,499291 < 0,5$$

nie uwzględnia się wyboczenia względem osi y

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_y = 0,5[1 + \beta_c(\lambda_{rel,y} - 0,5) + \lambda_{rel,y}^2] = 0,624575$$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = 1,000189 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$k_{c,y} = 1$$

$$\frac{\sigma_{c,0,d}}{k_{c,y} f_{c,0,d}} \leq 1$$

$$\lambda_{c,z} = l_{c,z} / i_z = 58,89$$

$$\sigma_{c,crit,z} = \pi^2 E_{0,05} / \lambda_{c,z}^2 = 21,06 \text{ MPa}$$

$$\lambda_{rel,z} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,z}}} = 0,9985814 > 0,5$$

uwzględnia się wyboczenia względem osi z

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_z = 0,5[1 + \beta_c(\lambda_{rel,z} - 0,5) + \lambda_{rel,z}^2] = 1,048441$$

$$k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}} = 0,731041 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$k_{c,z} = 0,731040571$$

$$\frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \leq 1$$

$$\frac{\sigma_{c,0,d}}{k_{c,y} f_{c,0,d}} \leq 1$$

0,6190476 <

1

SŁUP 10/5, l = 100 cm

Przyjęto drewno klasy C 24

$f_{m,k} = 24$ MPa

$f_{c,0,k} = 21$ MPa

$E_{0,mean} = 11$ GPa

$E_{0,05} = 7,4$ GPa

$b = 5$ cm

$h = 10$ cm

$N_d = 40,00$ kN

$W_y = bh^2/6 = 83,33$ cm³

$I_y = bh^3/12 = 416,67$ cm⁴

$A = bh = 50,00$ cm²

$i_y = \sqrt{\frac{I_y}{A}} = 2,89$ cm

$l_y = 1,00$ m

$\mu_y = 1,00$

Zad

$$\frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \leq 1$$

0,846803 <

1

$f_{m,k} = 24$ MPa

$f_{c,0,k} = 21$ MPa

$E_{0,mean} = 11$ GPa

$E_{0,05} = 7,4$ GPa

$b = 5$ cm

$h = 10$ cm

$N_d = 40,00$ kNm

$W_y = bh^2/6 = 83,33$ cm³

$W_z = hb^2/6 = 41,67$ cm³

$I_z = hb^3/12 = 104,17$ cm⁴

$A = bh = 50,00$ cm²

$i_z = \sqrt{\frac{I_z}{A}} = 1,44$ cm

$l_z = 1,00$ m

$\mu_z = 1,00$

Zadanie5/7

$$l_{c,y} = \mu l_y = 1,00 \text{ m}$$

$$\lambda_{c,y} = l_{c,y} / i_y = 34,64$$

$$\sigma_{c,crit,y} = \pi^2 E_{0,05} / \lambda_{c,y}^2 = 60,86 \text{ MPa}$$

$$\lambda_{rel,y} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,y}}} = 0,587401 > 0,5$$

uwzględnia się wyboczenia względem osi y

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_y = 0,5[1 + \beta_c(\lambda_{rel,y} - 0,5) + \lambda_{rel,y}^2] = 0,68126$$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = 0,974343 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$\frac{\sigma_{c,0,d}}{k_{c,y} f_{c,0,d}} \leq 1$$

$$l_{c,z} = \mu l_z = 1,00 \text{ m}$$

$$\lambda_{c,z} = l_{c,z} / i_z = 69,28$$

$$\sigma_{c,crit,z} = \pi^2 E_{0,05} / \lambda_{c,z}^2 = 15,22 \text{ MPa}$$

$$\lambda_{rel,z} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,z}}} = 1,1748016 > 0,5$$

uwzględnia się wyboczenia względem osi z

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_z = 0,5[1 + \beta_c(\lambda_{rel,z} - 0,5) + \lambda_{rel,z}^2] = 1,25756$$

$$k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}} = 0,58609 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$\frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \leq 1$$

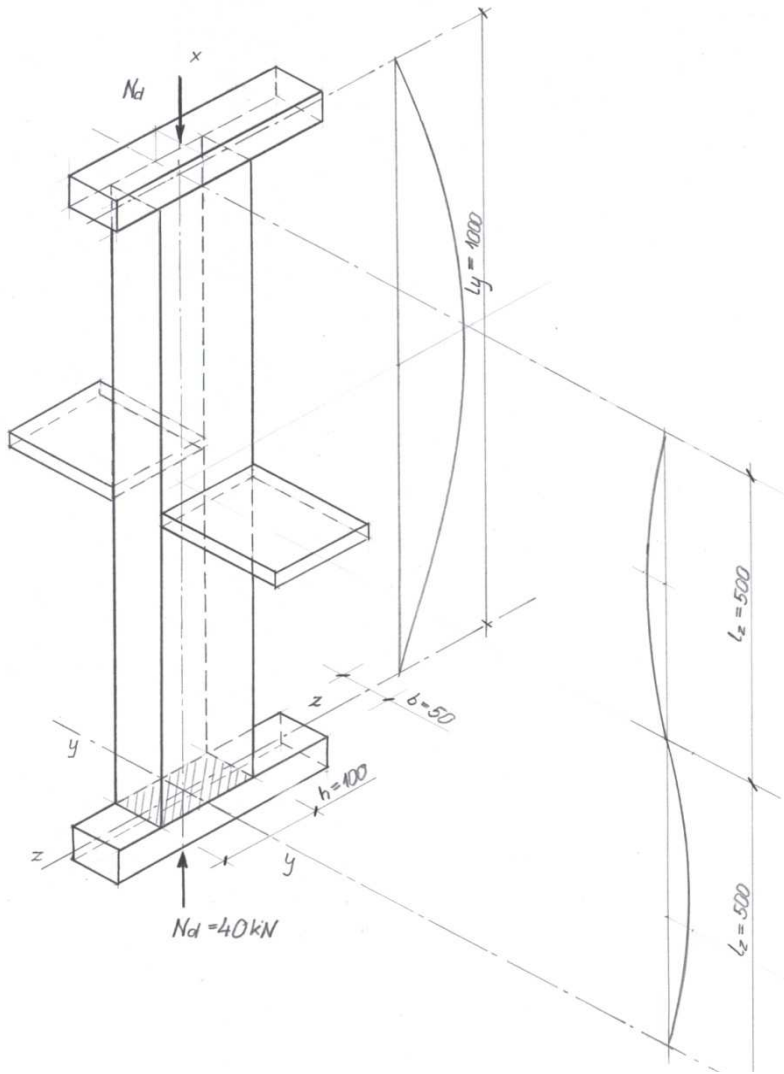
Zadanie5/8

0,635349 <

1

1,056232 >

1



Zadanie5/9



$f_{m,k} = 24 \text{ MPa}$
 $f_{c,0,k} = 21 \text{ MPa}$
 $E_{0,mean} = 11 \text{ GPa}$
 $E_{0,05} = 7,4 \text{ GPa}$

$b = 5 \text{ cm}$
 $h = 10 \text{ cm}$

$N_d = 40,00 \text{ kN}$

$W_y = bh^2/6 = 83,33 \text{ cm}^3$

$I_y = bh^3/12 = 416,67 \text{ cm}^4$

$A = bh = 50,00 \text{ cm}^2$

$i_y = \sqrt{\frac{I_y}{A}} = 2,89 \text{ cm}$

$l_y = 1,00 \text{ m}$

$\mu_y = 1,00$

$l_{c,y} = \mu l_y = 1,00 \text{ m}$

$\lambda_{c,y} = l_{c,y}/i_y = 34,64$

$f_{m,k} = 24 \text{ MPa}$
 $f_{c,0,k} = 21 \text{ MPa}$
 $E_{0,mean} = 11 \text{ GPa}$
 $E_{0,05} = 7,4 \text{ GPa}$

$b = 5 \text{ cm}$
 $h = 10 \text{ cm}$

$N_d = 40,00 \text{ kNm}$

$W_y = bh^2/6 = 83,33 \text{ cm}^3$
 $W_z = hb^2/6 = 41,67 \text{ cm}^3$

$I_z = hb^3/12 = 104,17 \text{ cm}^4$

$A = bh = 50,00 \text{ cm}^2$

$i_z = \sqrt{\frac{I_z}{A}} = 1,44 \text{ cm}$

$l_z = 0,50 \text{ m}$

$\mu_z = 1,00$

$l_{c,z} = \mu l_z = 0,50 \text{ m}$

$\lambda_{c,z} = l_{c,z}/i_z = 34,64$

Zadanie5/10

$$\sigma_{c,crit,y} = \pi^2 E_{0,05} / \lambda_y^2 = 60,86 \text{ MPa}$$

$$\lambda_{rel,y} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,y}}} = 0,587401 > 0,5$$

uwzględnia się wybożenia względem osi y

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_y = 0,5[1 + \beta_c(\lambda_{rel,y} - 0,5) + \lambda_{rel,y}^2] = 0,68126$$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = 0,974343 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$\frac{\sigma_{c,0,d}}{k_{c,y} f_{c,0,d}} \leq 1$$

$$0,635349 < 1$$

$$\sigma_{c,crit,z} = \pi^2 E_{0,05} / \lambda_z^2 = 60,86 \text{ MPa}$$

$$\lambda_{rel,z} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,z}}} = 0,5874008 > 0,5$$

uwzględnia się wybożenia względem osi z

$$\beta_c = (\text{dla drewna litego}) = 0,2$$

$$k_z = 0,5[1 + \beta_c(\lambda_{rel,z} - 0,5) + \lambda_{rel,z}^2] = 0,68126$$

$$k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}} = 0,974343 \leq 1$$

$$k_{mod} = (\text{dla 1 klasy użytkowania i obciążeń zmiennych}) = 0,8$$

$$\gamma_m = 1,3$$

$$f_{c,0,d} = f_{c,0,k} * k_{mod} / \gamma_m = 12,92 \text{ MPa}$$

$$\sigma_{c,0,d} = N_d / A = 8,00 \text{ MPa}$$

$$\frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \leq 1$$

$$0,635349 < 1$$