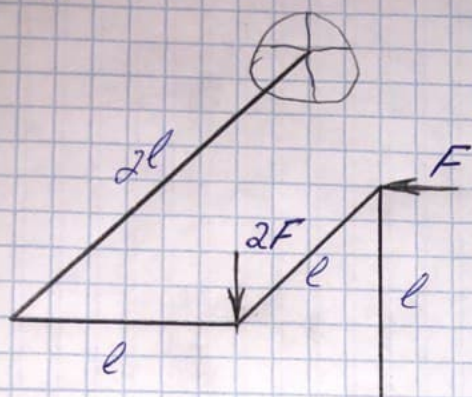


Задача №1



Дано:

$$F = 1 \text{ кН}$$

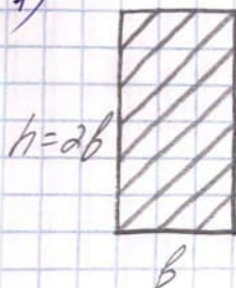
$$l = 200 \text{ мм}$$

$$G_T = 300 \text{ МПа}$$

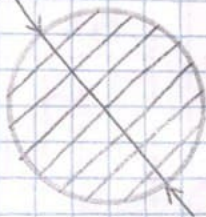
$$[n] = 2$$

Найти: Эпюры M_x и $M_{y,z}$.

1)

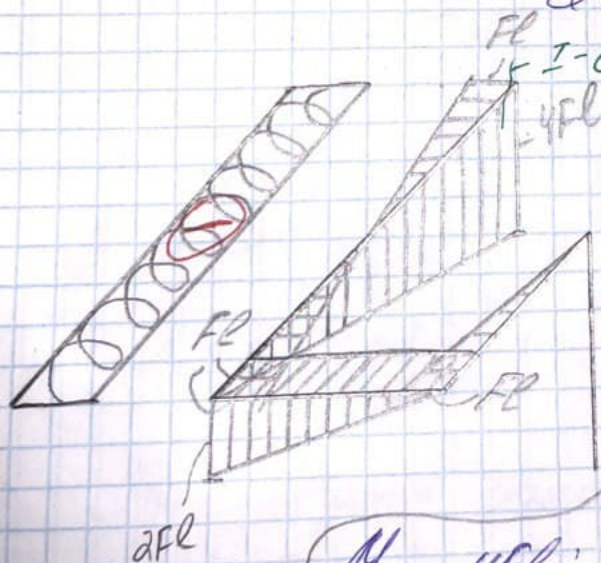


2) d



2) определить диаметр поперечного сечения.

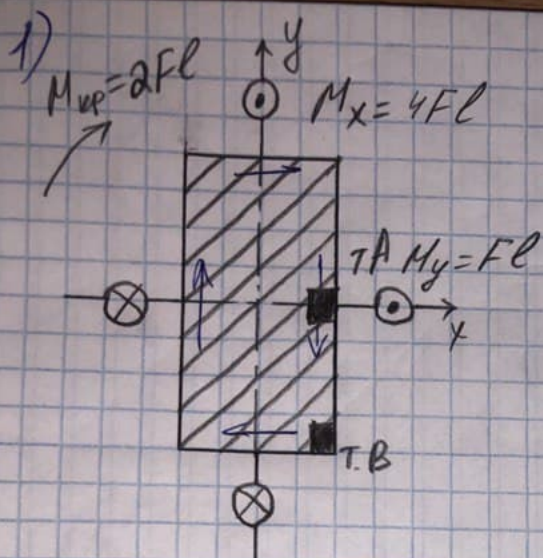
3) определить диаметр равнопрочного круглого сечения.



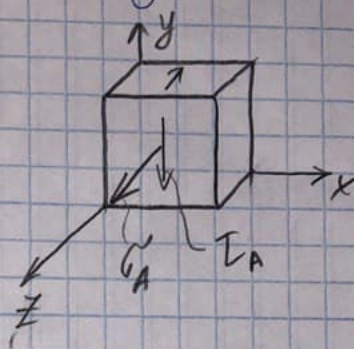
M_z

считаем, что I-ое сечение наиболее опасное т.к.

$$M_x = 4Fl; M_y = Fl; M_z = 2Fl$$



Рассмотрим
точку А.



$$\sigma_A = \frac{M_y}{W_y} = \frac{Fl}{\frac{1}{3}B^3} = \frac{3Fl}{B^3}$$

$$W_y = \frac{1}{6} H B^2 = \frac{1}{3} B^3$$

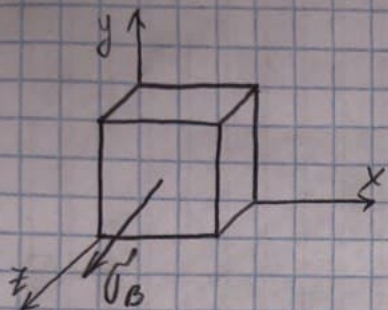
$$\tau_{max} = \frac{M_{кр}}{W_k} = \frac{2Fl}{0,5B^3} = \frac{4Fl}{B^3}$$

$$W_{кр} = \alpha H \cdot B^2 = 0,25 \cdot 2 \cdot B^3 = 0,5B^3$$

$$\frac{H}{B} = 2 \Rightarrow \alpha \approx 0,25$$

$$\sigma_{экв} = \sqrt{\sigma_A^2 + 3\tau^2} = \frac{Fl}{B^3} \sqrt{9 + 3 \cdot 16} \approx 7,56 \frac{Fl}{B^3}$$

Рассмотрим точку В.



$$\sigma_B = \frac{M_x}{W_x} + \frac{M_y}{W_y}$$

$$W_x = \frac{1}{6} B H^2 = \frac{1}{6} B (2B)^2 = \frac{2}{3} B^3$$

$$W_y = \frac{1}{3} B^3$$

$$\sigma_B = \frac{4FL}{\frac{2}{3} B^3} + \frac{FL}{\frac{1}{3} B^3} = (6 + 3) \frac{FL}{B^3} = 9 \frac{FL}{B^3}$$

$$\sigma_B = \sigma_{\text{кв}}$$

$\sigma_{\text{квВ}} > \sigma_{\text{квА}}$ Берем максимальное

$$\sigma_{\text{квmax}} = 9 \frac{FL}{B^3} \leq [\sigma]$$

$$[\sigma] = \frac{\sigma_z}{n} = \frac{300}{2} = 150 \text{ МПа}$$

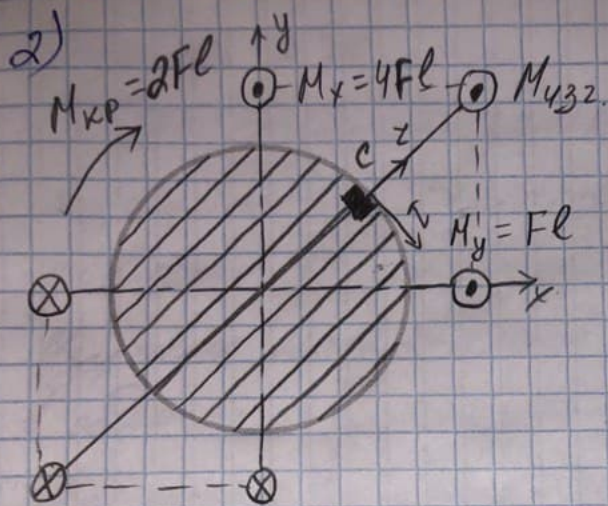
$$B \geq \sqrt[3]{\frac{9FL}{[\sigma]}} = \sqrt[3]{\frac{9 \cdot 10^3 \cdot 200 \cdot 10^3}{150 \cdot 10^6}} = \sqrt[3]{\frac{18}{10^6}} =$$

$$= \frac{2,28}{100} \text{ м} = 22,8 \text{ мм}$$

$$H \geq 45,8 \text{ мм}$$

$$B \geq 22,8 \text{ мм}$$

$$h \geq 45,8 \text{ мм}$$



$$M_{uz2} = \sqrt{M_x^2 + M_y^2} = \sqrt{17} Fl$$

$$\sigma_c = \frac{M_{uz2}}{W_{kz2}} = \frac{\sqrt{17} Fl}{\frac{\pi d^3}{32}} = \frac{32\sqrt{17} Fl}{\pi d^3}$$

$$\tau_c = \frac{M_{kp}}{W_p} = \frac{2Fl}{\frac{\pi d^3}{16}} = \frac{32 Fl}{\pi d^3}$$

По условию прочности Худера Мизеса.

$$\sigma_{\text{экв}} = \sqrt{\sigma^2 + 3\tau^2} = \sqrt{17 + 3 \cdot 1} \cdot \frac{32 Fl}{\pi d^3} = \frac{32\sqrt{20} Fl}{\pi d^3}$$

$$\sigma_{\text{экв}} = \sigma_{\text{max}} \leq [\sigma]$$

$$\frac{32\sqrt{20} Fl}{\pi d^3} \leq 150 \cdot 10^6$$

$$d \geq \sqrt[3]{\frac{32\sqrt{20} \cdot 200}{\pi \cdot 150 \cdot 10^6}} = \sqrt[3]{\frac{60,77}{10^6}} \approx \frac{3,93}{100} \text{ м} =$$

$$= 39,3 \text{ мм.}$$

$$d \geq 39,3 \text{ мм}$$