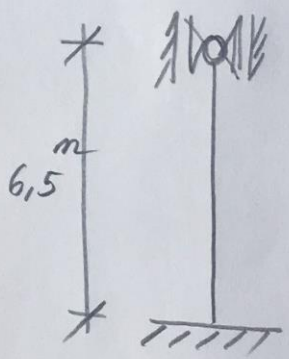
Elastik Stabilite Uygulama

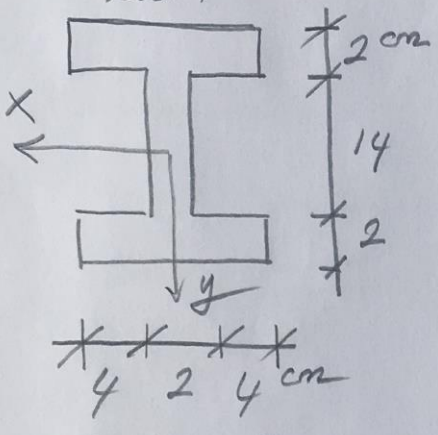


Şekildeki çubukta, $n=2$ güvenliği ile taşınabilecek "P" yükünü bulunuz

$E = 2,1 \cdot 10^7 \ N/cm^2$

$\lambda < \lambda_p = 105 \rightarrow \sigma_k = 31000 - 114\lambda \ (N/cm^2)$

Kesit



$A = 68 \ cm^2$

$J_x = 3030,67 \ cm^4$; $J_y = 342,67 \ cm^4$ } Sizin tarafınızdan hesaplanmış!!

J_{min}

$$i_{min} = \sqrt{\frac{J_{min}}{A}} = \sqrt{\frac{342,67}{68}} = 2,25 \ cm$$

$$l_b = 0,7\,l = 0,7 \cdot (650) = 455 \ cm$$

$$\lambda = \frac{l_b}{i_{min}} = \frac{455}{2,25} = 202,2 > \lambda_p = 105$$

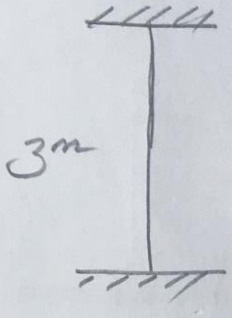
Burkulma elastik bölgede, o halde Euler Bağıntısı;

$$P_k = \frac{\pi^2 E I}{l_b^2} = \frac{\pi^2 \cdot 2,1 \cdot 10^7 \cdot 342,67}{455^2}$$

$$= 342714 \ N$$

Çubuğun emniyetle taşıyacağı yük;

$$P_{em} = \frac{P_k}{n} = \frac{342714}{2} = 171357 \ N$$

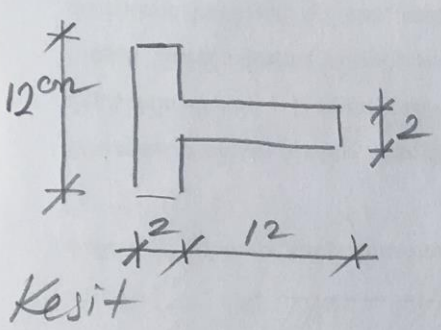


Çubuğun taşıyabileceği "P" yükünü
n=2 emniyeti ile bulunuz.

$E = 2.10^7\ N/cm^2$

$\sigma_k = 31000 - 114\lambda\ (N/cm^2)$

$\lambda_p = 105$



$I_x = 296\ cm^4$, $I_y = 884\ cm^4$

I_{min}

$A = 48\ cm^2$

$$i_{min} = \sqrt{\frac{I_{min}}{A}} = \sqrt{\frac{296}{48}} = 2,48\ cm$$

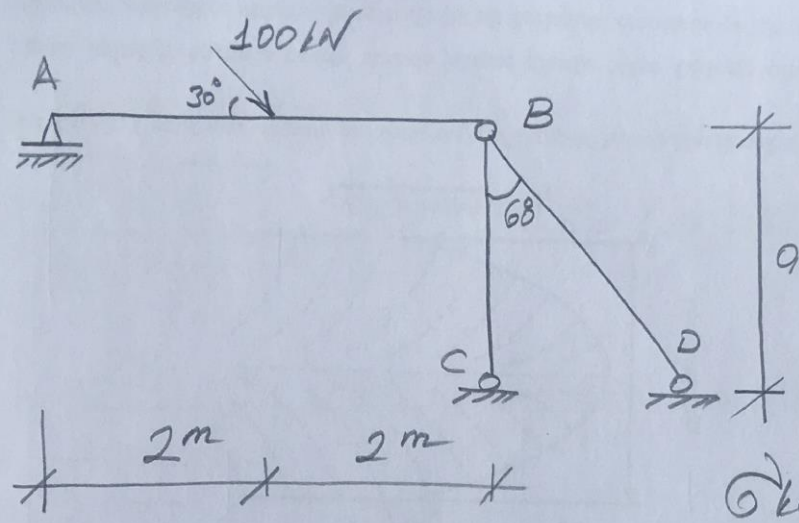
$$\lambda = \frac{\ell_b}{i_{min}} = \frac{0,5.300}{2.48} = 60,48 < \lambda_p = 105$$

Burkulma elastik olmayan bölgede geçerli;
o halde Tetmajer Bağıntısı geçerli

$$\sigma_k = 31000 - 114\,(60,48) = 24105,28\ N/cm^2$$

$$P_k = \sigma_k . A = 24105,28 . 48 = 1157053,4\ N$$

$$P_{em} = \frac{P_k}{n} = 578526,72\ N$$



$\sigma_{em} = 14000 \frac{N}{cm^2}$

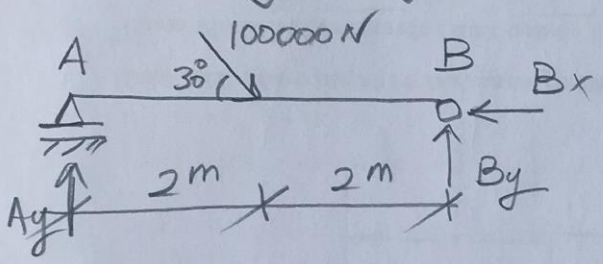
$n = 2$

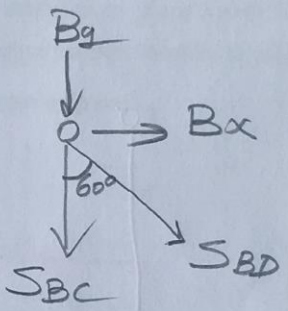
$\lambda_p = 105$

$E = 2{,}1 \cdot 10^7 N/cm^2$

$\sigma_{kr} = 31000 - 114\lambda$ (N/cm^2)

BC ve DC elemanlarını daire kesit olarak boyutlayınız.





$\sum F_x = 0 \quad B_x = 100000 \cdot \cos 30^\circ = 86602{,}5\ N$

$\sum \hat{M}_A = 0 \quad 4B_y = 100000 \cdot \sin 30^\circ \cdot 2 \quad B_y = 25000\ N$

Çubuklarda,

$\pm\rightarrow \sum F_x = 0 \quad B_x + S_{BD} \cdot \sin 60^\circ = 0 \quad S_{BD} = -100.000\ N$ (basınç çubuğu)

$+\downarrow \sum F_y = 0 \quad B_y + S_{BC} + S_{BD} \cdot \cos 60^\circ = 0 \quad S_{BC} = 25000$ (çekme çubuğu)

* Stabilite hesabı sadece basınç çubuğuna yapılır.

Gerilme hesabı; (Boyutlandırma)

BC çubuğu; $\sigma = \frac{25000}{\pi D^2/4} \leq \sigma_{em} = 14000 \rightarrow D = 1{,}5\ cm$

BC çubuğu; $\sigma = \frac{-100000}{\pi D^2/4} \leq 14000 \rightarrow D = 3\ cm$

Stabilite hesabı;

BD basınç çubuğu

$$i = \sqrt{\frac{\pi (D/2)^4 / 4}{\pi D^2 / 4}} = \frac{D}{4}, \quad l_b = l = 100\ cm$$

$$\lambda = \frac{l_b}{i_{min}} = \frac{100}{D/4} = \frac{400}{D}$$

$\lambda > \lambda_p$ varsayalım; $P_{kr} = \frac{\pi^2 E I_{min}}{n l_b^2}$

elastik bölge varsayalım

$$100000 = \frac{\pi^2 \cdot 2{,}1 \cdot 10^7 \cdot I_{min}}{2 \cdot (100)^2}$$

$$I_{min} = 9{,}65 = \frac{\pi (D/2)^4}{4} = \frac{\pi D^4}{64}$$

$D = 3{,}75\ cm > 3\ cm$

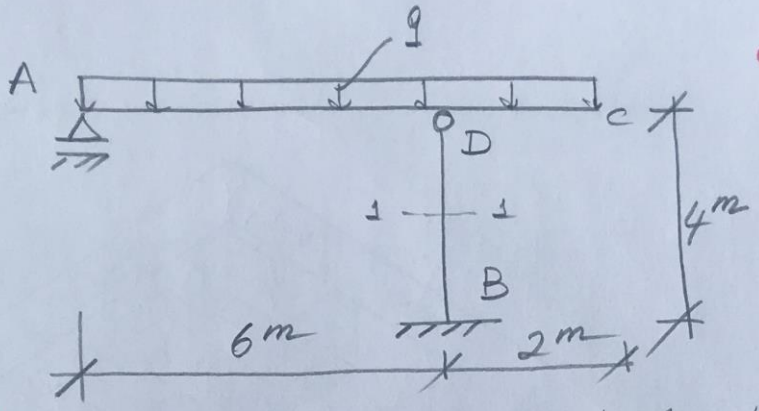
seçilir

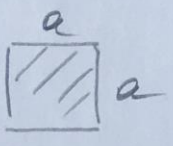
Kontrol; $\lambda = \frac{l_b}{i_{min}} = \frac{400}{3{,}75} = 106{,}7 > \lambda_p = 105$

elastik bölge

BD kolonunu kare 5

a) olarak boyutlayınız,





1-1 Kesiti

$\lambda p = 100$

b) Kolon için $n=2$ güvenlikle taşınabilecek maksimum yükü bulunuz,

c) q yükü ? , $E = 2{,}1 \cdot 10^7 \ N/cm^2$

$$J_{min} = \frac{a \cdot a^3}{12} = J_x = J_y \quad , \quad A = a^2$$

a)

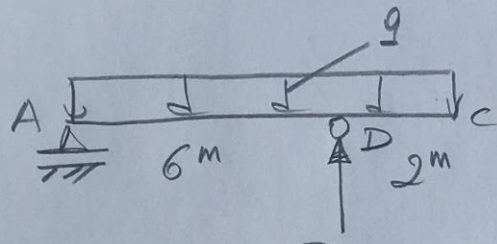
$$i_{min} = \sqrt{\frac{a^4/12}{a^2}} = \frac{a}{2\sqrt{3}} \quad , \quad l_b = 0{,}7\,l = 0{,}7 \cdot 400 = 280 \ cm$$

$$\lambda p = \frac{l_b}{i_{min}} = \frac{280}{\left(\frac{a}{2\sqrt{3}}\right)} = 100 \longrightarrow a = 9{,}7 \ cm$$

b) $$P_{max} = \frac{P_{kr}}{n} = \frac{\pi^2 E I_{min}}{n \cdot l_b^2} = \frac{\pi^2 2{,}1 \cdot 10^7 \cdot \left(\frac{9{,}7^4}{12}\right)}{2 \cdot 280^2}$$

$$= 974177{,}8 \ N$$

c)



$\curvearrowleft \sum M_A = 0$

$P_{max} \cdot 6^m = q \cdot 8^m \cdot 4^m$

$974177{,}8 \cdot 6 = q \cdot 8 \cdot 4$

$$q = 1826{,}6 \ N/cm$$