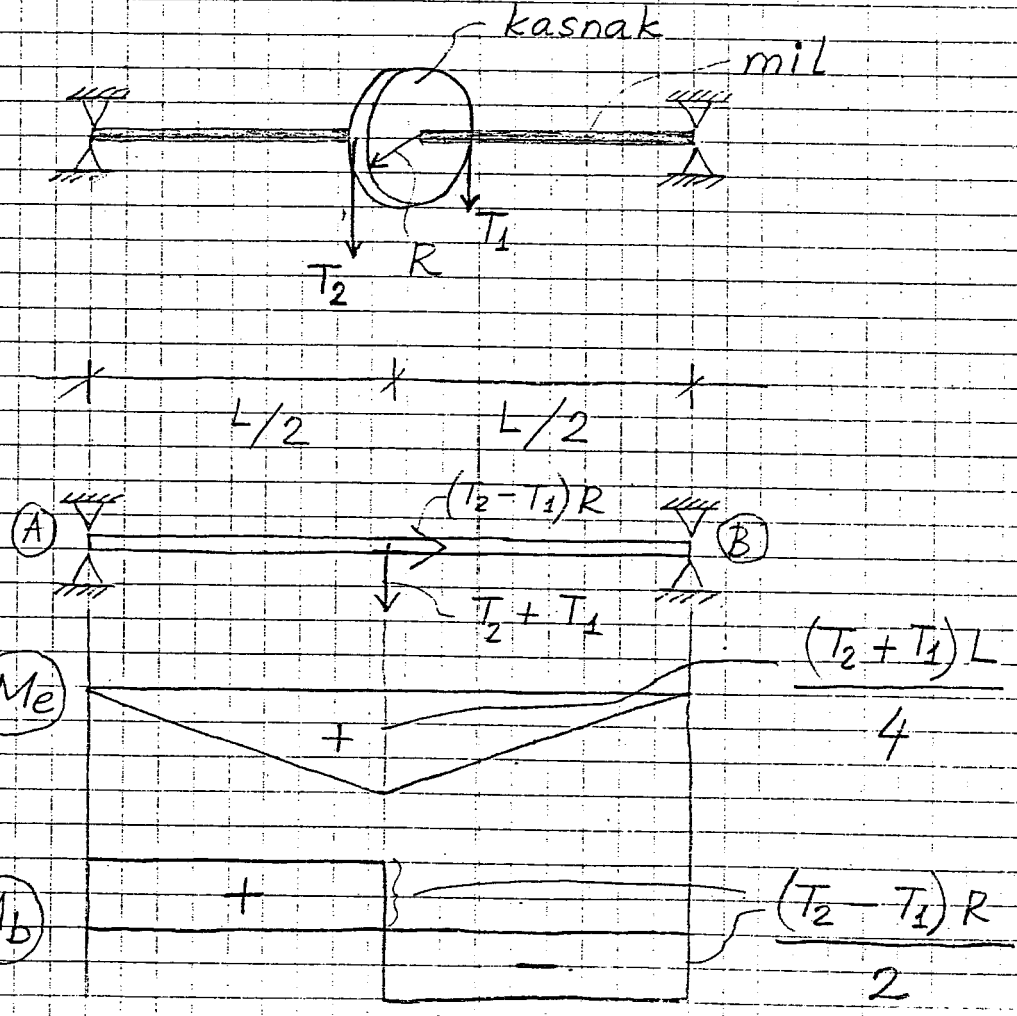
BÖLÜM 5

BURULMALI EĞİLME

Burulmalı eğilmede kesit hem eğilme hem de burulma momentine maruzdur.

ÖRNEK:



M_e : eğilme momenti

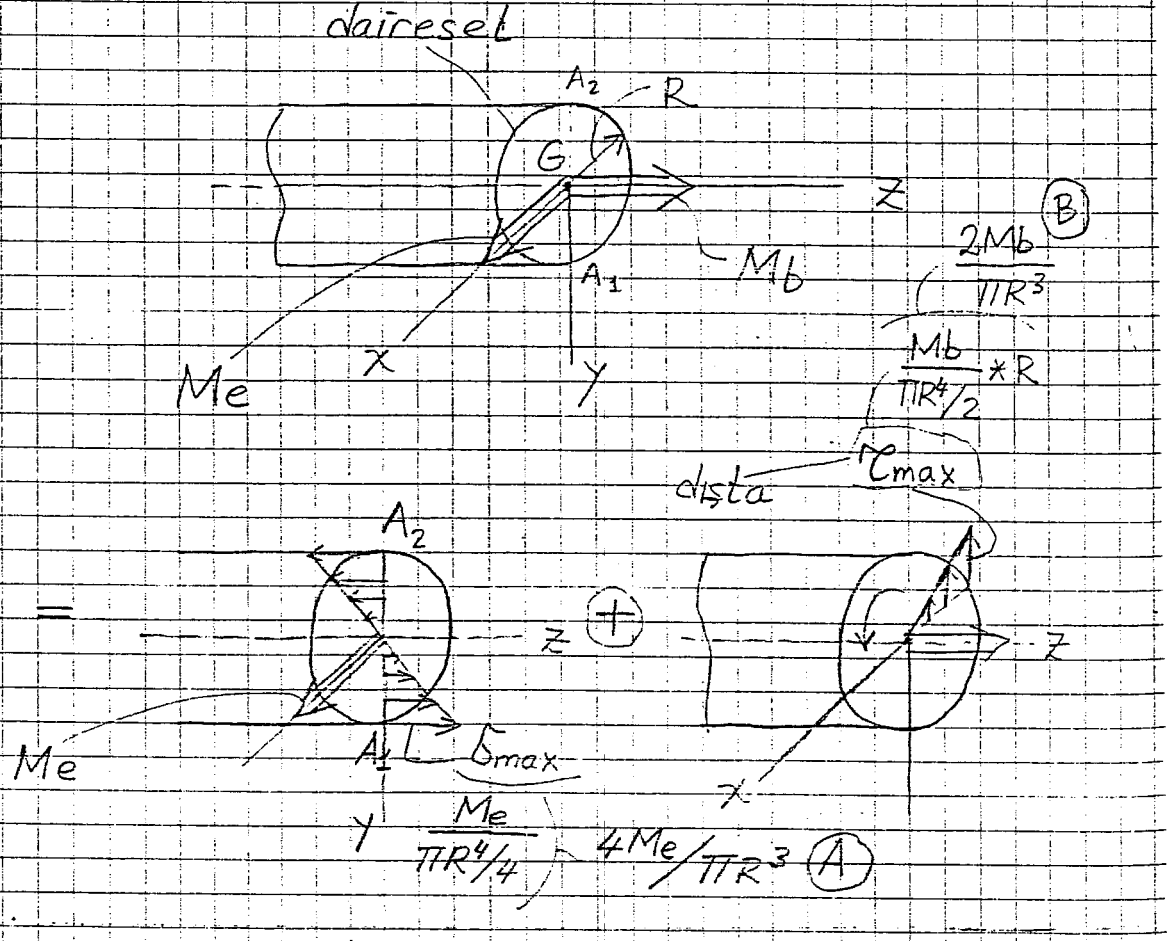
M_b : burulma momenti

AB mili hem eğilme momentine hem de burulma momentine maruz dur.

GERİLME HESABI

Kabuller:

- Kesit dairesel
- $\sigma_{em} = \sigma'_{em}$

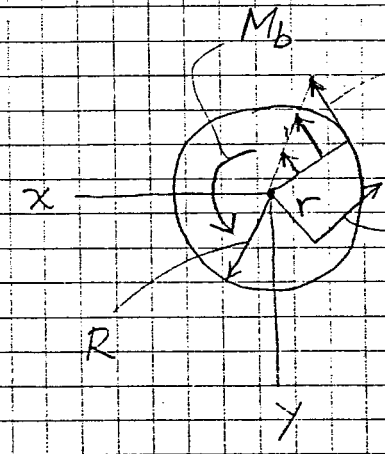


$$\sigma = \frac{M_e}{I_x} y \qquad I_x = \frac{\pi R^4}{4}$$

$$\tau = \frac{M_b}{I_o} r$$

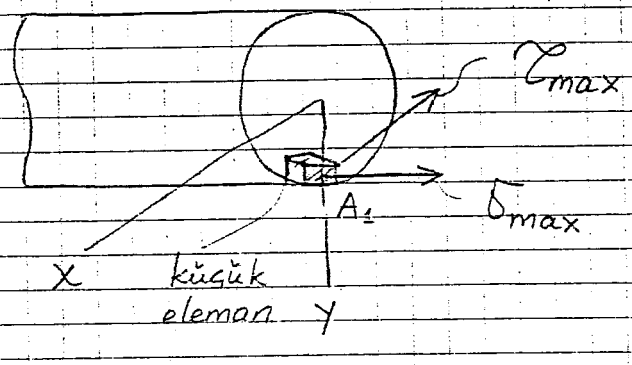
- M_b nin meydana getirdiği kayma gerilmesi

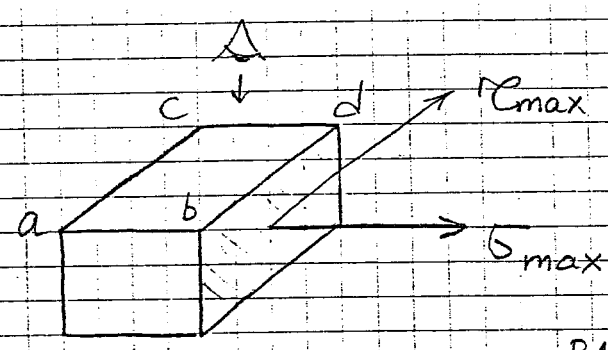
Hatırla:



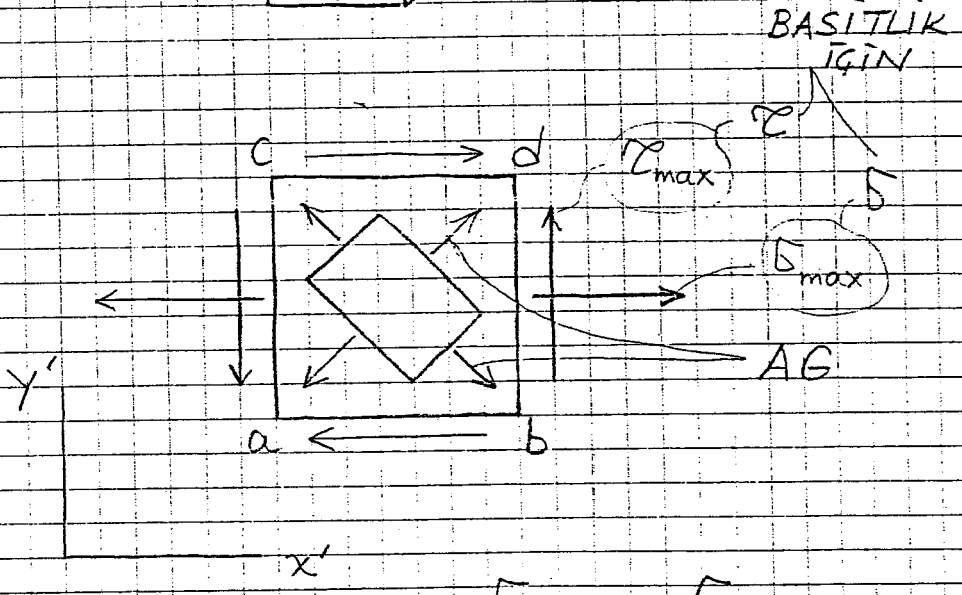
A_1, A_2 → max zorlanmaya maruz

A_1 noktası:





BASİTLİK İÇİN



$\sigma_{x'} = \sigma$

$\sigma_{y'} = 0$

$$\tau_{x'y'} = + \tau$$

AG:

$$\sigma_1 = \frac{\sigma_{x'} + \sigma_{y'}}{2} + r \qquad \frac{\sigma}{2}$$

$$\sigma_2 = \frac{\sigma_{x'} + \sigma_{y'}}{2} - r$$

$$r = \sqrt{\left(\frac{\sigma_{x'} - \sigma_{y'}}{2}\right)^2 + \tau_{x'y'}^2}$$

$$= \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2}$$

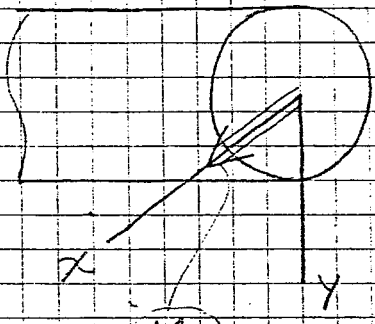
$$\Rightarrow \quad \sigma_{1,2} = \frac{\sigma}{2} \mp \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} \quad (*)$$

(A), (B) $\rightarrow$ (*):

$$\Rightarrow \quad \boxed{\sigma_{1,2} = \frac{2}{\pi R^3}\left[M_e \mp \sqrt{M_e^2 + M_b^2}\right]}$$

BOYUTLANDIRMA

$$\left.\begin{aligned} \sigma_1 &= \frac{2}{\pi R^3}\left[M_e + \sqrt{M_e^2 + M_b^2}\right] > 0 \\ \sigma_2 &= \frac{2}{\pi R^3}\left[M_e - \sqrt{M_e^2 + M_b^2}\right] < 0 \\ \sigma_3 &= 0 \end{aligned}\right\} \quad (**)$$



$= M_x$

$\oplus$ ve $\ominus$ olabilir

EBNGH

En Büyük Normal Gerilme Hipotezi:

$$\Rightarrow \sigma_{max} \leq \sigma_{em}$$

$$\Rightarrow \boxed{\max \left| \frac{2}{\pi R^3} \left[M_e + \sqrt{M_e^2 + M_b^2} \right] \right| \leq \sigma_{em}} \quad (I)$$

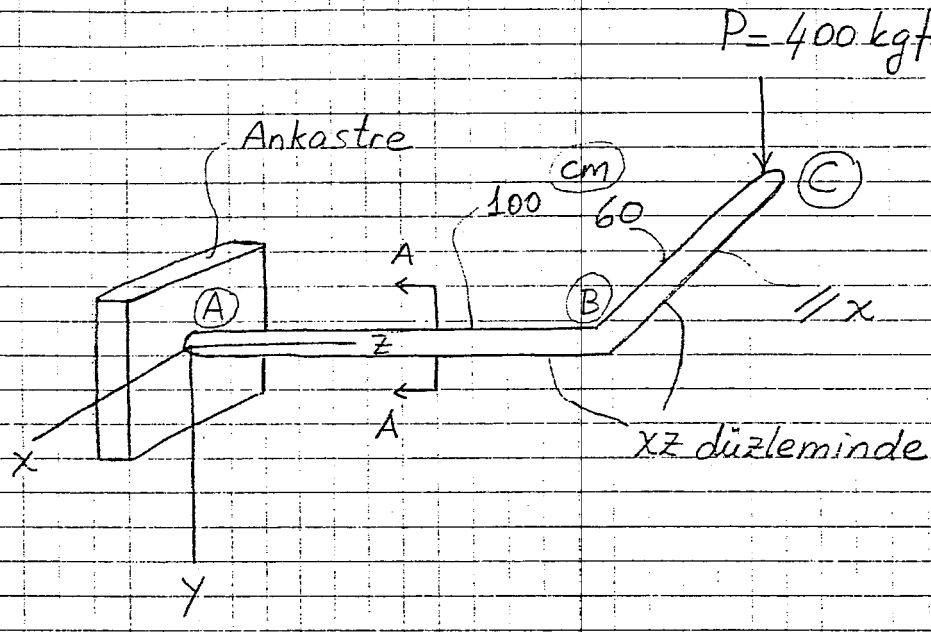
TH:

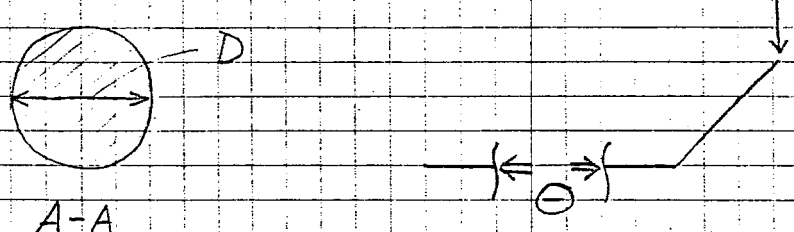
$$\underbrace{\sigma_1}_{\text{işaret dahil en büyük asal gerilme}} - \underbrace{\sigma_3}_{\text{işaret dahil en küçük asal gerilme}} \leq \sigma_{em}$$

(**):

$$\Rightarrow \boxed{\frac{4}{\pi R^3} \sqrt{M_e^2 + M_b^2} \leq \sigma_{em}} \quad (II)$$

ÖRNEK:





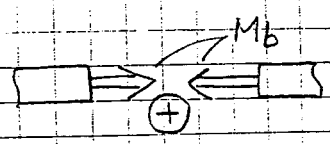
$$\therefore \sigma_{em} = \sigma_{em}' = 2000 \text{ kgf/cm}^2$$

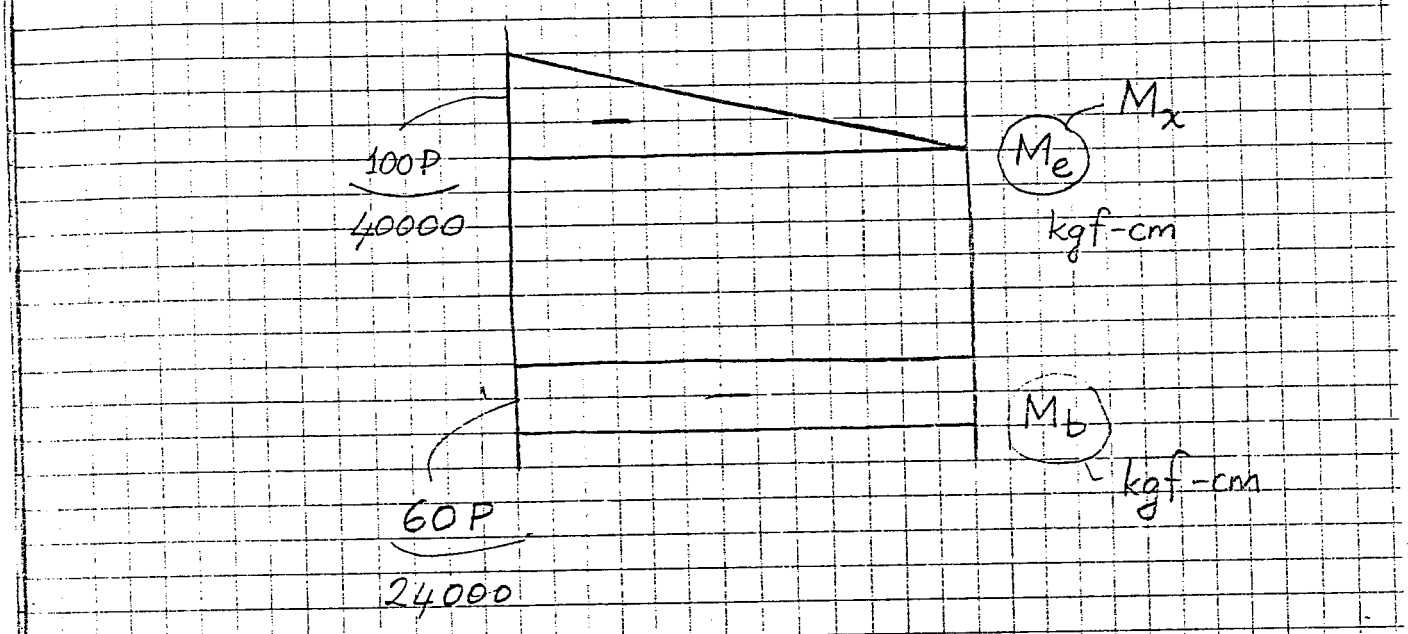
$D = ?$

BC → sadece eğilmeye maruz

AB → hem eğilme hem de burulmaya maruz

AB çubuğu daha gayrimüsaittir ve dolayısıyla boyutlandırma AB çubuğuna göre yapılacaktır.





(A) kesiti → en gayri müsait

$$\Rightarrow M_e = M_x = -40000 \Big| \text{kgf-cm}$$
$$M_b = -24000$$

EBNGH:

$$\Rightarrow (T): \quad \frac{2}{\pi R^3}\left|-40000 \mp \sqrt{(-40000)^2+(-24000)^2}\right| \leq 2000$$

$$\frac{2}{\pi R^3}\left|-40000 \mp 46648\right| \leq 2000$$

$\Rightarrow R \geq 3.02\ cm$

$\Rightarrow D = 2R \geq 6.04\ cm$

$\Rightarrow SEG \rightarrow D = 8\ cm$

TH:

$\Rightarrow$ (II) :

$$\frac{24}{\pi R^3}\sqrt{\left(40000\right)^2+\left(24000\right)^2} \leq 2000$$

$$46648$$

$\Rightarrow R \geq 3.10\ cm$

$\Rightarrow D \geq 6.20\ cm$

$\Rightarrow SEG \rightarrow D = 8\ cm$