BASINÇLI TÜPLER (İNCE CİDARLI)

SİLİNDİRLER İÇİN

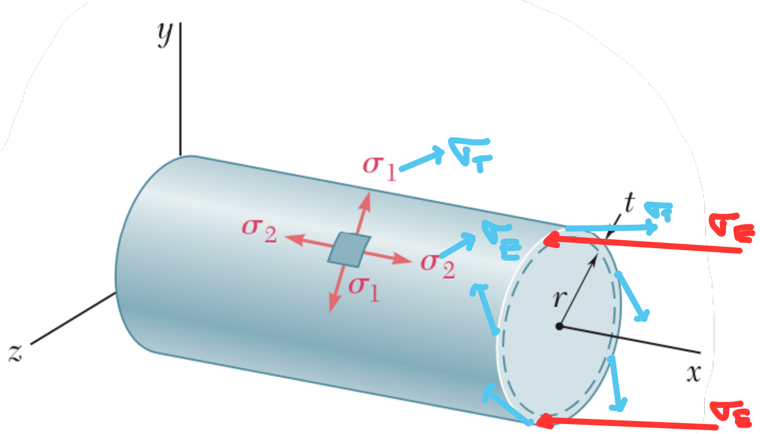


Fig. 7.47 Pressurized cylindrical vessel.

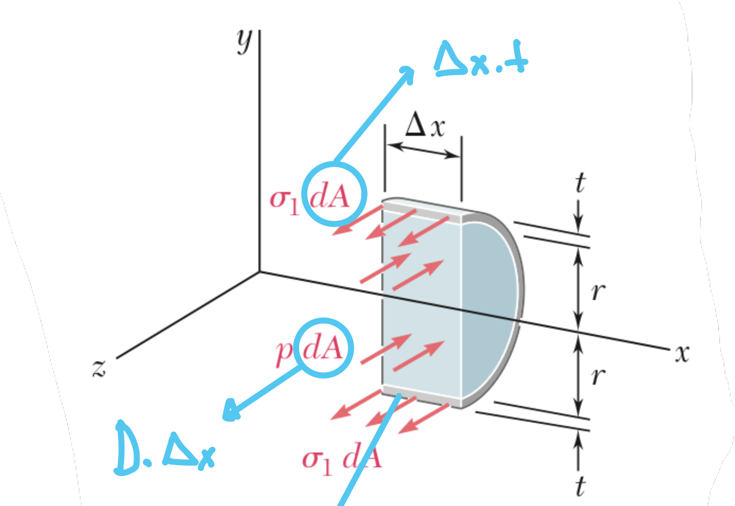


Fig. 7.48 Free body to determine hoop stress.

Δx t

$$\Sigma F_z = 0$$

$$\Rightarrow + \sigma_1 . dA - P . dA = 0$$

$$\Rightarrow 2 . \sigma_1 . dA = P . dA$$

$$\Rightarrow 2 . \sigma_T . \cancel{\Delta x} . t = P . D . \cancel{\Delta x}$$

$$\Rightarrow \quad \sigma_T = \frac{P . D_o}{2 . t} \quad , \quad D_o = \frac{D + d}{2}$$

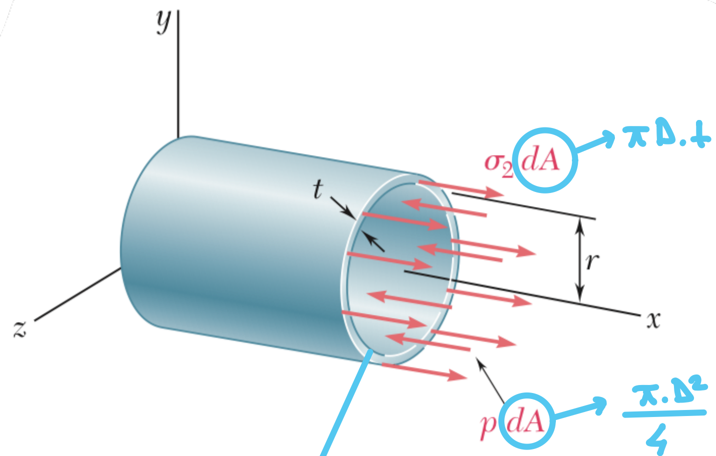


Fig. 7.49 Free body to determine longitudinal stress.

$$\Sigma F_x = 0$$

$$\Rightarrow \; + \sigma_2 . dA - P . dA = 0$$

$$\Rightarrow \; \sigma_E . \cancel{\pi} . \cancel{D} t = P . \frac{\cancel{\pi} . \cancel{D^2}}{4}$$

$$\Rightarrow \; \sigma_E = \frac{P . D_o}{4t}$$

$$\sigma_T = 2 \times \sigma_E$$

KÜRE için

$$\Sigma F_x = 0$$

$$\Rightarrow \quad \sigma_1 = \sigma_2 = \sigma_K = \sigma_E^s = \frac{\pi . D_0}{4t}$$

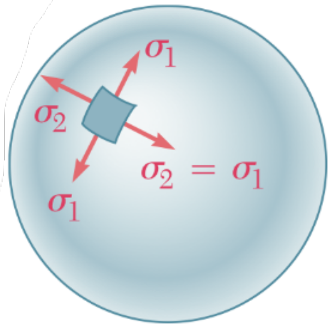


Fig. 7.51 Pressurized spherical vessel.

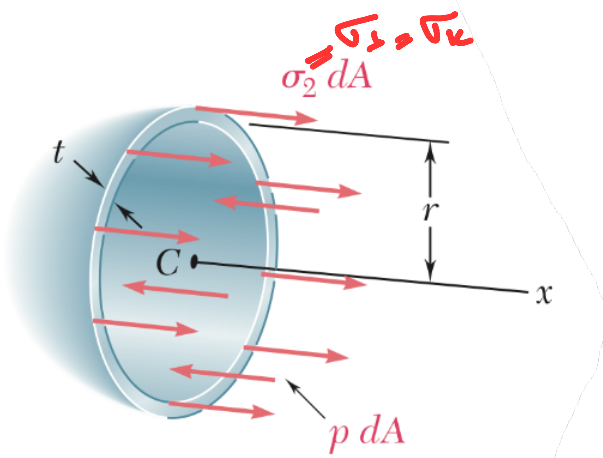
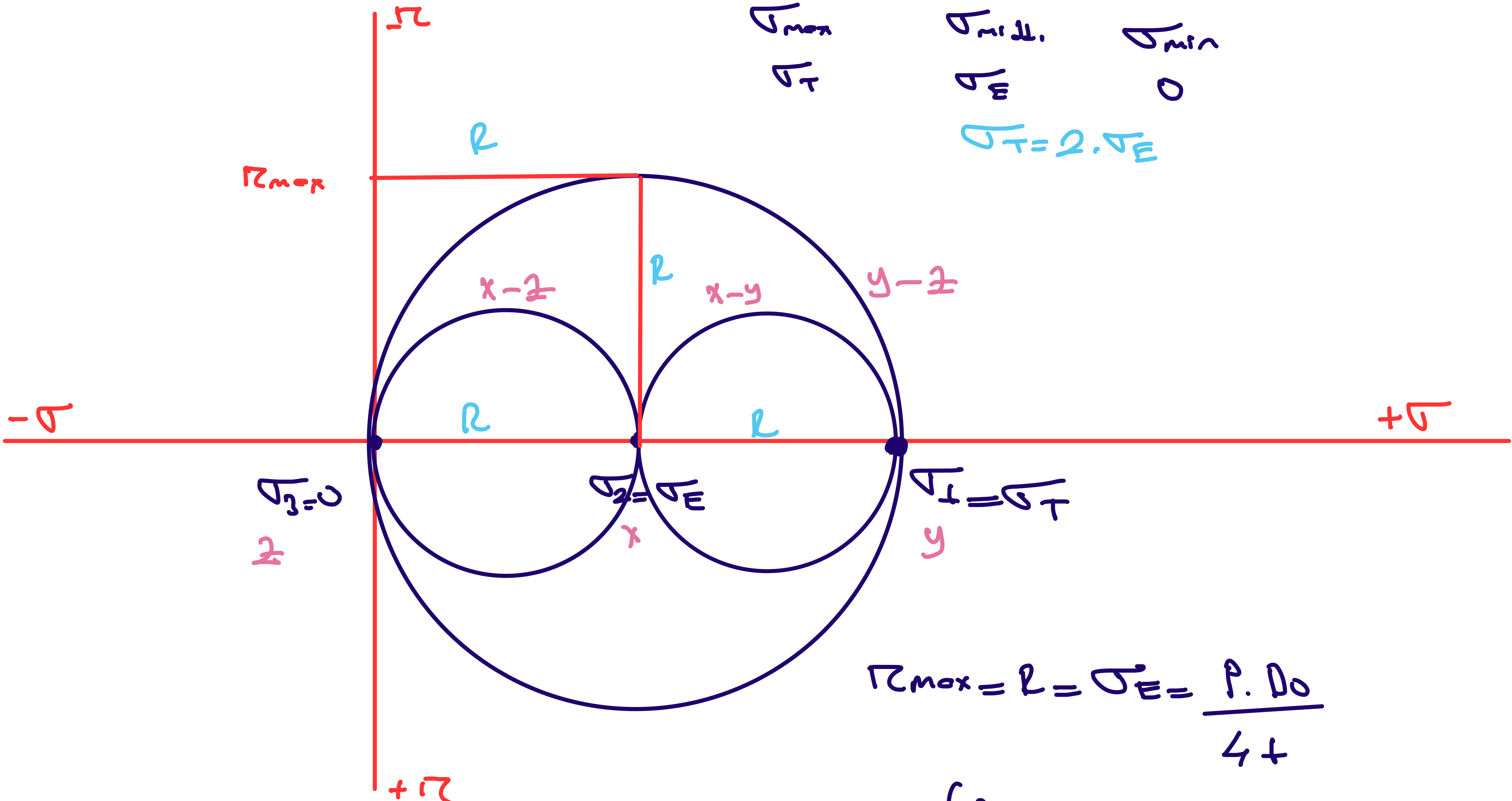


Fig. 7.52 Free body to determine wall stress.

SİLİNDİR İÇİN MOHR ÇEMBERİ

σ_1	σ_2	σ_3
σ_{max}	$\sigma_{mid.}$	σ_{min}
σ_T	σ_E	0

$\sigma_T = 2 . \sigma_E$



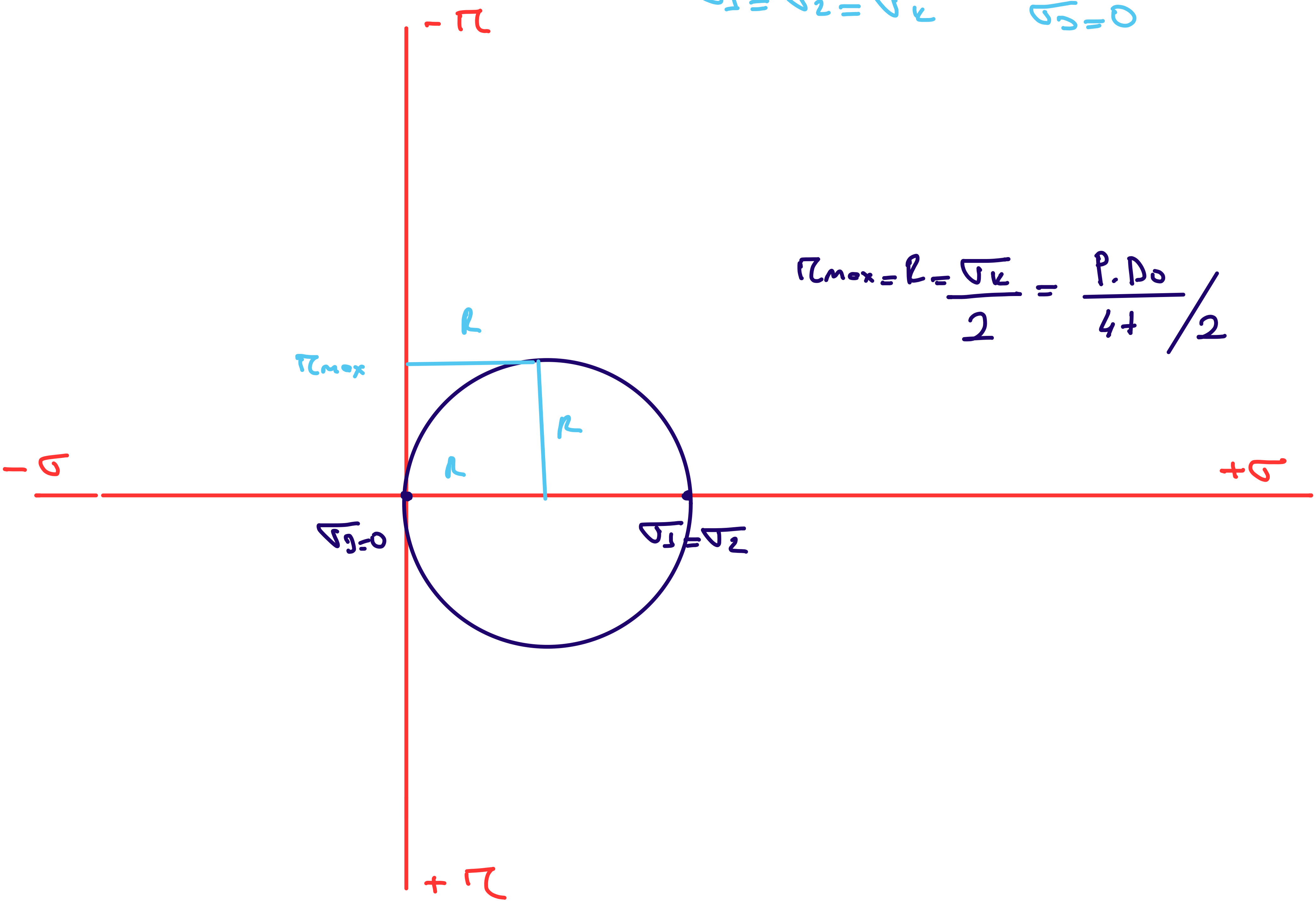
$$\tau_{max} = R = \sigma_E = \frac{P . D_o}{4t}$$

(DEĞERSEL OLARAK)

KÜRE İÇİN MOHR ÇEMBERİ:

$\sigma_1 \qquad \sigma_2 \qquad \sigma_3$

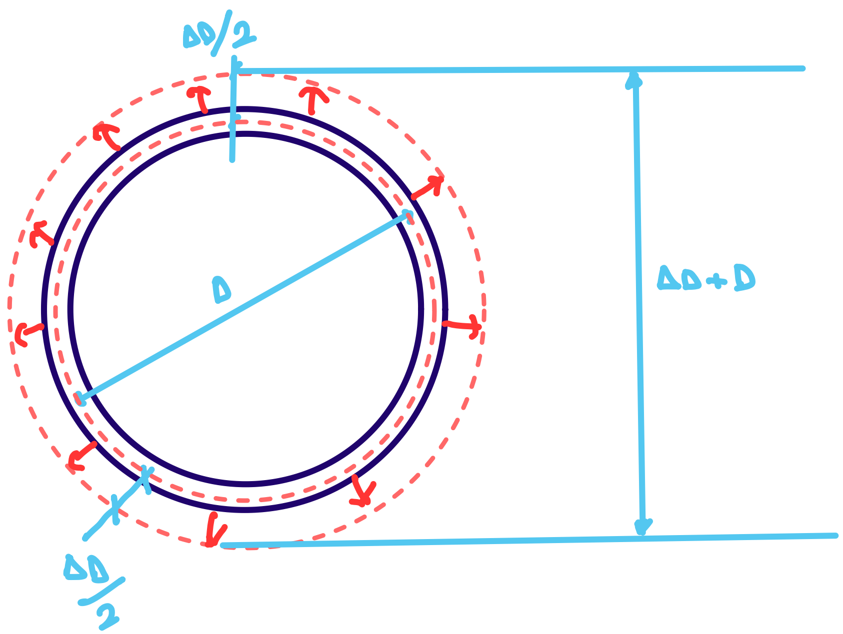
$\sigma_1 = \sigma_2 = \sigma_k \qquad \sigma_3 = 0$



$$\tau_{max} = R = \frac{\sigma_k}{2} = \frac{P \cdot D_o}{4t} \Big/ 2$$

CIDARDAKİ DEĞİŞİM (SİLİNDİR)

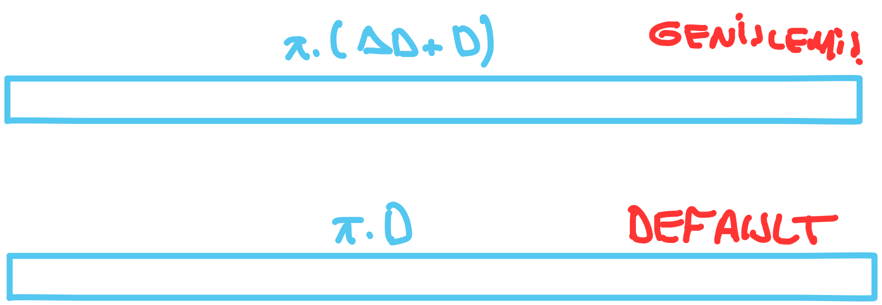
$$\varepsilon = \frac{L_{son} - L_{ilk}}{L_{ilk}} = \frac{\Delta \text{Çevre}}{\text{Çevre}}$$



$$\varepsilon = \frac{[\pi.(\Delta D + D)] - \pi D}{\pi D} = \frac{\Delta D}{D_0}$$

$$\varepsilon = \frac{\sigma_T}{E}$$

$$\Rightarrow \quad \frac{\Delta D}{D_0} = \frac{P.D_0}{2.t.E}$$



$$\boxed{\Rightarrow \quad \Delta D = \frac{P.D_0^2}{2tE}}$$

TERMAL ETKİ

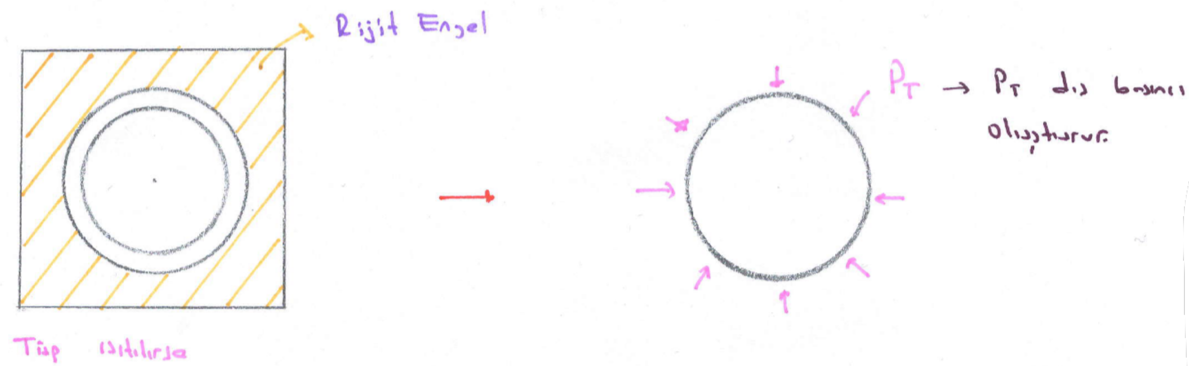
- Isıtma ve basınç olursa;

→ $$\Delta D = \pm \alpha \Delta T D \pm \frac{PD^2}{2Et}$$

(+) Isıtma — (+) iç basınç

(−) Soğutma — (−) Dış basınç

EĞER;

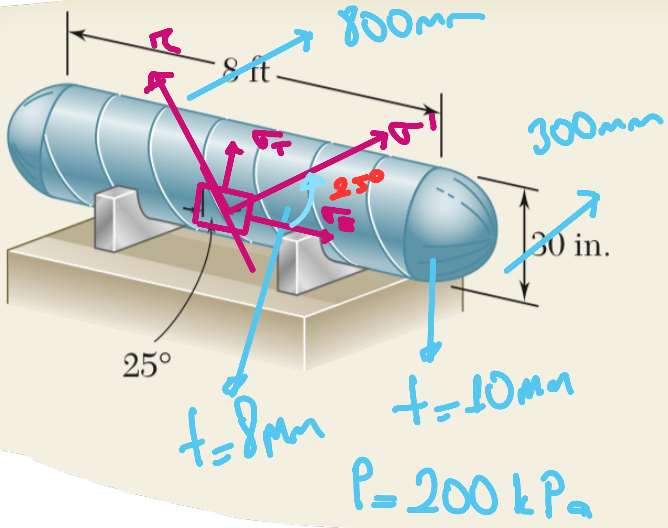


$$\Rightarrow \Delta D = \alpha \Delta T D - \frac{P_T \cdot D^2}{2Et} = 0$$

$$\Rightarrow P_T = \frac{2E\alpha t}{D} \Delta T$$

$\Delta D = 0$

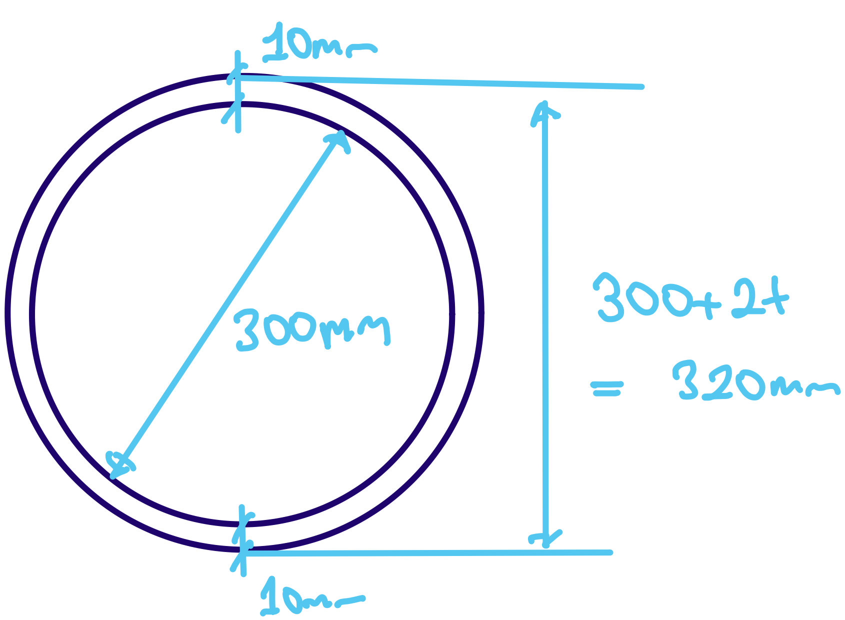
$$\sigma_t = \frac{PD}{2t} = \frac{2E\alpha t D}{D 2t} \cdot \Delta T = \alpha \Delta T E$$



SAMPLE PROBLEM 7.5

A compressed-air tank is supported by two cradles as shown; one of the cradles is designed so that it does not exert any longitudinal force on the tank. The cylindrical body of the tank has a 30-in. outer diameter and is fabricated from a $\frac{3}{8}$-in. steel plate by butt welding along a helix that forms an angle of 25° with a transverse plane. The end caps are spherical and have a uniform wall thickness of $\frac{5}{16}$ in. For an internal gage pressure of 180 psi, determine (*a*) the normal stress and the maximum shearing stress in the spherical caps. (*b*) the stresses in directions perpendicular and parallel to the helical weld.

a.) $\sigma_k = \frac{P \cdot D_o}{4t}$, $\quad D_o = \frac{D+d}{2} = \frac{320+300}{2} = 310\text{ mm}$



$$\sigma_k = \frac{0.2 \cdot 310}{4 \cdot 10} = 1.55\text{ MPa}$$

$$\tau_{max} = \frac{\sigma_k}{2} = 0.775\text{ MPa}$$

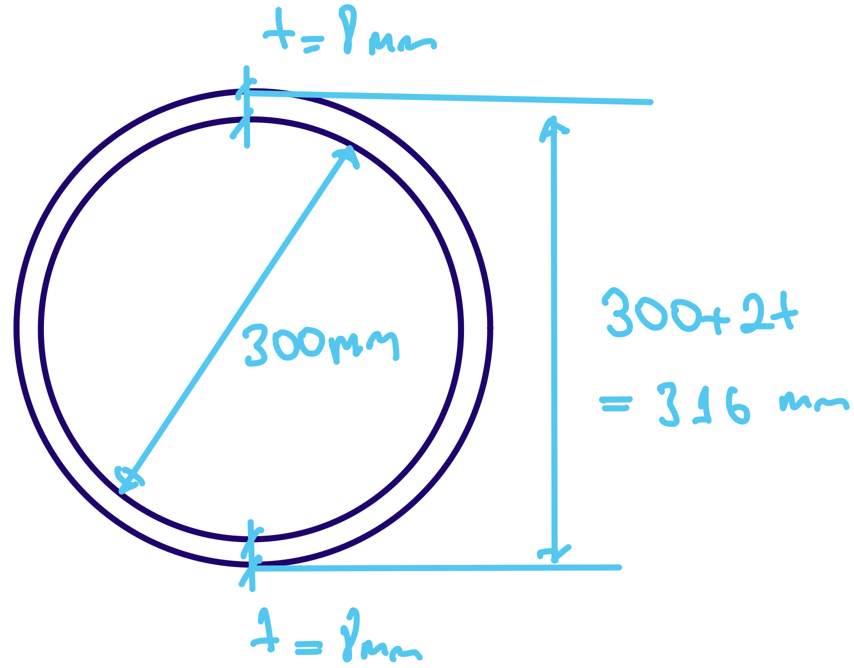
b.)

$$\sigma_T = 2 \times \sigma_E$$

$$\sigma_E = \frac{P \cdot D_o}{4t}$$

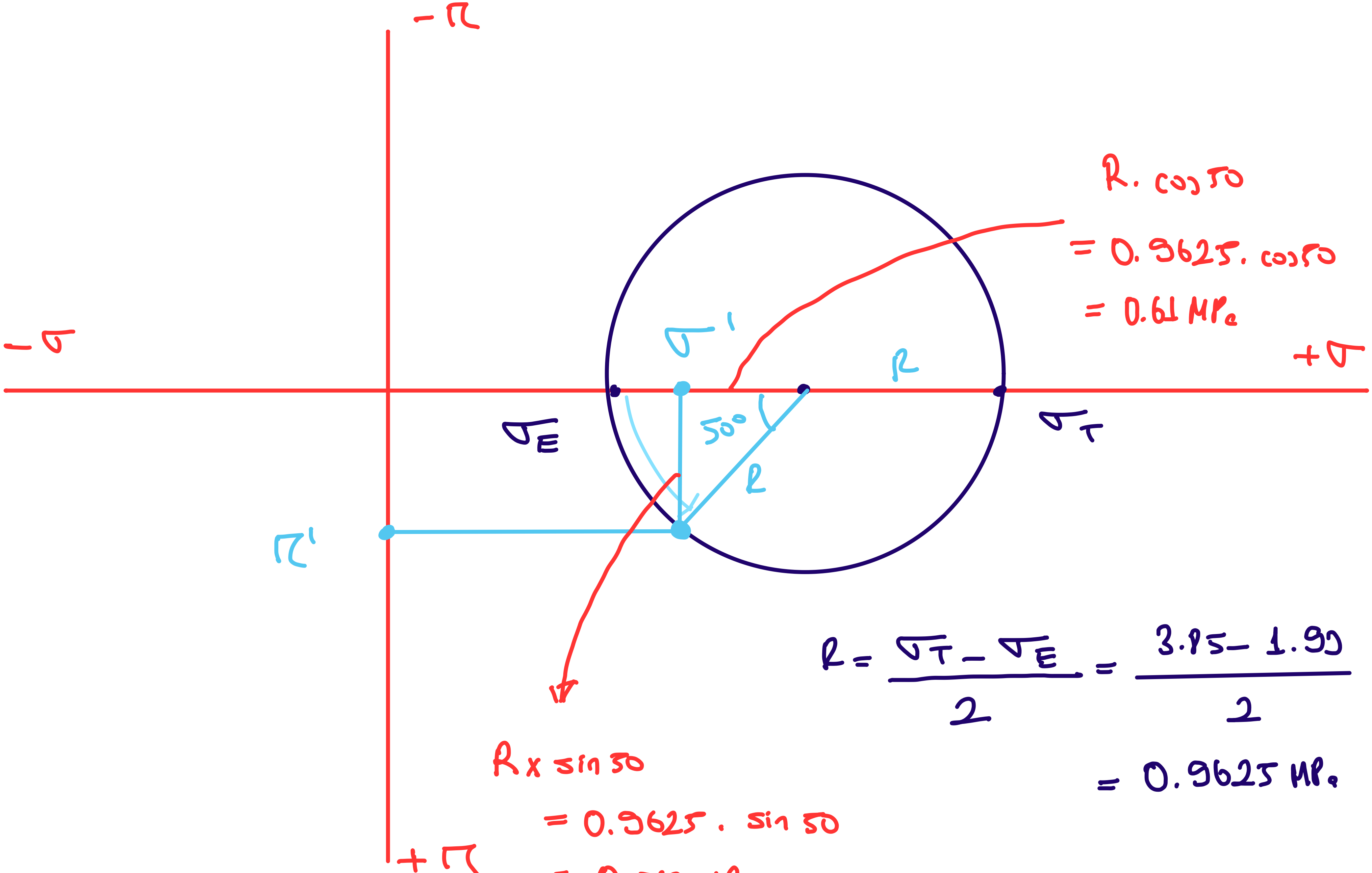
$$D_o = \frac{(300+8+8)+300}{2}$$

$$= 308\,mm$$



$$\sigma_E = \frac{0.2 \cdot 308}{4 \cdot 8} = 1.925\ MPa$$

$$\sigma_T = 2 \times \sigma_E = 3.85\ MPa$$



$R \cdot \cos 50$

$= 0.9625 \cdot \cos 50$

$= 0.61\ \text{MPa}$

$R \times \sin 50$

$= 0.9625 \cdot \sin 50$

$= 0.73\ \text{MPa}$

$$R = \frac{\sigma_T - \sigma_E}{2} = \frac{3.85 - 1.93}{2}$$

$$= 0.9625\ \text{MPa}$$