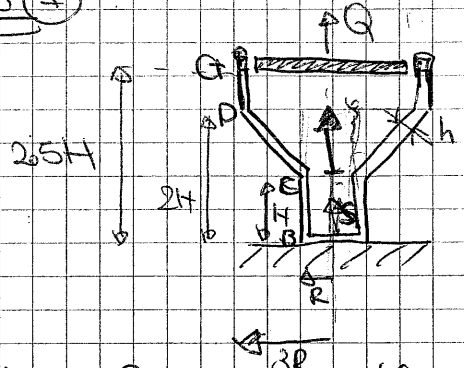
09/02/11
Esercitazione

Esercizio (1)

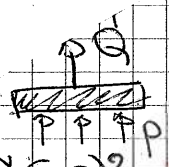


$E = 0{,}5\ GPa$, $\nu = 0{,}33$, $\sigma_{amm} = 3\ MPa$
$h = 4\ mm$
$R = 80\ mm$
$H = 120\ mm$

Asse trascurato

a) Determinare Q per avere $\varphi = 5$ (coeff. sicurezza) nella parte cilindrica DE
b) Con Q trovato, rappresentare i diagr. qualitativi delle sollecitazioni
c) Valutare φ del recipiente senza considerare effetti locali

a)



Rec. sottile (pressione uniforme)

$Q = -p\pi(3R)^2$

$\sigma_\varphi = 0$

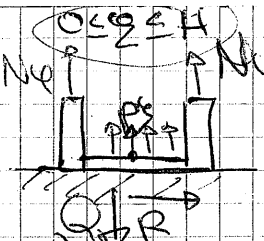
$\sigma_\theta = \frac{p\,3R}{h}$ → $\sigma_{id} = |\sigma_\theta - \sigma_\varphi| = \sigma_\theta = \left|\frac{3Rp}{h}\right| = \frac{\sigma_{amm}}{\varphi}$ (si impone)

$|p| = \frac{h\sigma_{amm}}{3R\varphi} = 0{,}01\ MPa$ → uniforme in tutto il recipiente

$|Q| = |p\pi(3R)^2| = \boxed{1{,}81\ kN}$

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b) $0 \le \xi \le H$



$N_\varphi 2\pi R = -p\pi R^2 + Q$

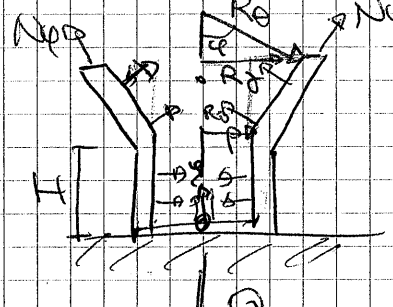
$\boxed{N_\varphi = -\frac{pR}{2} + \frac{Q}{2\pi R}}$

$\boxed{N_\theta = -pR}$

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($p > 0$) → è depressione

$H \le \xi \le 2H$



$2R = H \operatorname{tg}\alpha \rightarrow \operatorname{tg}\alpha = \frac{2R}{H} \rightarrow \alpha = 58°$

$R_\gamma = R + (\xi - H)\cdot\frac{2R}{H}$

$N_\varphi \cos\alpha\, 2\pi R_\gamma = Q - p\pi R_\gamma^2$

$\boxed{N_\varphi = \frac{Q - p\pi\left[R + (\xi - H)\frac{2R}{H}\right]^2}{2\pi\cos\alpha\left[R + (\xi - H)\frac{2R}{H}\right]}}$

$0 \le \varphi \le 90°$

$R_\theta = R$, $R_\varphi \to \infty$

$R_\gamma = R + (\xi - H)\operatorname{tg}(90 - \varphi)$

$R_\theta = \frac{R_\gamma}{\sin\varphi}$

$\boxed{N_\theta = -p\left[R + (\xi - H)\frac{2R}{H}\right]}$

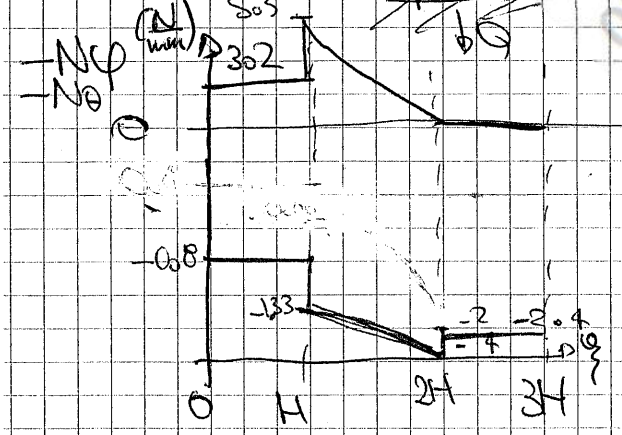
$H \le \xi \le 3H$



$N_\varphi 2\pi(3R) = -p\pi(3R)^2 + Q$

$\xi = 3H \rightarrow \boxed{N_\varphi = 0}$

$\boxed{N_\theta = -p3R}$

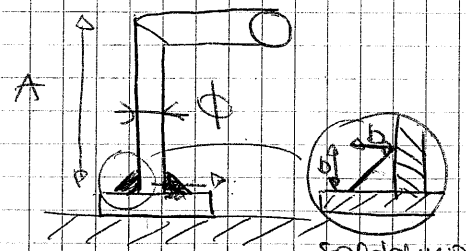


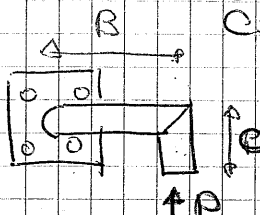
$\xi = H \rightarrow R_\gamma = R$ ⊕ $\begin{cases} N_\varphi = -5.32\ \text{N/mm} \\ N_\theta = -1.33\ \text{N/mm} \end{cases}$

$\xi = 2H \rightarrow R_\gamma = 3R$ ⊖ $\begin{cases} N_\varphi = -2\ \text{N/mm} \\ N_\theta = -4\ \text{N/mm} \end{cases}$

c) $\sigma_{id,max} = \sigma_{id}(H^+) = 1.65\ \text{MPa} \rightarrow \frac{\text{Comm}}{\sigma_{id,max}} = \boxed{1.8}$

Esercizio 2

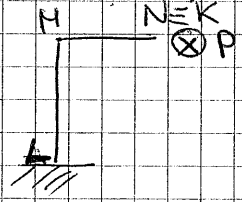


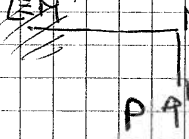


$A = 1500\,mm$ $\quad \Phi = 100\,mm$
$B = 800\,mm$
$C = 250\,mm$
$b = 5\,mm$
$\sigma_{amm,acciaio} = 500\,MPa$
$f_1 = 0.8$
$f_2 = 0.7$
$P = 6\,KN$

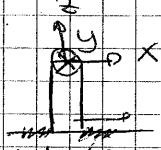
Verifica della saldatura –

Modello di calcolo:

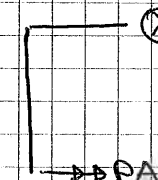




$a = \frac{b}{\sqrt{2}} = 3.54\,mm$



(sez. resistente ribaltata)



Sollecitazioni	tensioni trave	tensioni saldature
$M_z = PB$	τ_{zs}	$\tau_{\perp,Mz}$
$M_x = -PA$	σ_z	$\sigma_\perp$
$T_y = P$	τ_{yx}	$\tau_{\perp,Ty}$

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$M_z = 4.8\,KN\cdot m = 4800\,KN\cdot mm$



$\Omega = \frac{\pi(\Phi+a)^2}{4} = 8420\,mm^2$

$\tau_{\perp,Mz} = \frac{M_z}{2\Omega a} = 80.5\,MPa$

$M_x = 9\,KN\cdot m = 9000\,KN\cdot mm$

$J_{x,\text{sez. resistente saldature}} = \frac{\pi}{64}\left[(\Phi+2a)^4 - \Phi^4\right] = 1.54\cdot 10^6\,mm^4$

$\sigma_{z,max} = \sigma_z\left(\frac{\Phi+2a}{2}\right) = \frac{M_x}{J_x}\left(\frac{\Phi+2a}{2}\right) = 210.3\,MPa$

$T_y = 6\,KN$

$\tau_{\perp,Ty} \approx \frac{T_y}{A_{sez,saldature}} = 5.2\,MPa$

$A_{sez} = \frac{\pi}{4}\left[(\Phi+2a)^2 - \Phi^2\right] \approx 1151\,mm^2$

Verifica secondo il criterio delle forze massime:

$$\sqrt{\sigma_\perp^2 + \tau_\perp^2 + \tau_\parallel^2} \overset{?}{\leq} f_1 \text{ Gauss, base} = 400\,\text{MPa}$$

$\sigma_\perp = 0$

$\tau_\parallel = (\tau_{\parallel,m2} + \tau_{\parallel,\tau_V})^2$

$= 324{,}85\,\text{MPa}$

OK

- $|\sigma_\perp| + |\tau_\perp| \overset{?}{\leq} f_2$ Gauss, base $= 350\,\text{MPa}$

$\sigma_\perp = 0$

$= 312{,}31\,\text{MPa}$

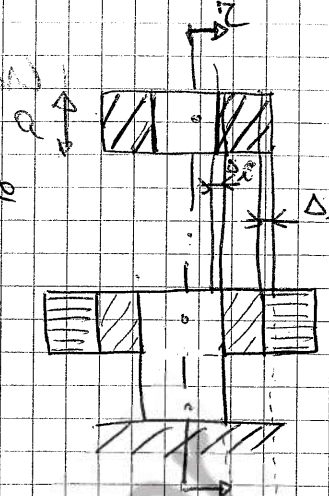
OK

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23-02-11
Esercitazione

Esercizio 1

$E = 2.5\,MPa$
$\nu = 0.49$
$a = 20\,mm$
→ cilindro toroidale elastomerico di sez. nom. quadrata



Interferenze di montaggio:
$\Delta i = 0.8\,mm$
$\Delta e = 0.6\,mm$

Perno e anello metallico ∞ rigidi

a) Andamento qualitativo delle tensioni nell'elastomero dopo il montaggio in funzione di r

b) $\mu = 0.75$ coeff. attrito elastomero - metallo
Momento massimo M_0 che si può applicare al perno senza che ci sia scorrimento? Su quale sup. avviene lo scorrimento?

c) Per $M = 0.5\,M_0$, massima forza prima che si verifichi lo scorrimento?

a) Elastomero ≡ cilindro cavo sottoposto a $\begin{cases} P_{int} = P_{e,i} \\ P_{est} = P_{e,e} \end{cases}$ contemporaneamente!

sovrapposizione effetti di $P_{e,i}$ e $P_{e,e}$ per cilindro cavo

$$\begin{cases} \Delta i = |u(r)|_{r=R_i} = \dfrac{(1-\nu)(P_{e,i}R_i^2 - P_{e,e}R_e^2)}{E(R_e^2-R_i^2)} R_i + \dfrac{(1+\nu)R_i^2R_e^2(P_i-P_e)}{E(R_e^2-R_i^2)} \cdot \dfrac{1}{R_i} \\ -\Delta e = |u(r)|_{r=R_e} = \dfrac{(1-\nu)(P_{e,i}R_i^2 - P_{e,e}R_e^2)}{E(R_e^2-R_i^2)} R_e + \dfrac{(1+\nu)R_i^2R_e^2(P_i-P_e)}{E(R_e^2-R_i^2)} \cdot \dfrac{1}{R_e} \end{cases}$$

dove $R_e = 1.5a = 30\,mm$
$R_i = 0.5a = 10\,mm$

$$\frac{1-\nu}{E(R_e^2-R_i^2)} = 2.55\cdot10^{-4}\,(N\cdot mm)^{-1}$$

$$\frac{1+\nu}{E(R_e^2-R_i^2)} = 7.65\cdot10^{-4}\,(N\cdot mm)^{-1}$$

Risolvo le matrici:

$$\Delta i = 0.255P_i - 2.295P_e + 6.705(P_i - P_e)$$
$$\Delta i = 6.96P_i - 9P_e \rightarrow P_e = \frac{6.96P_i - \Delta i}{9}$$

$$-\Delta e = 0.765P_i - 6.885P_e + 2.25(P_i - P_e)$$
$$-\Delta e = 3P_i - 9.12P_e = 3P_i - \frac{9.12}{9}(6.96P_i - \Delta i)$$

$$P_i = \frac{-\Delta e - 1.013\Delta i}{-3.0528} \rightarrow \begin{cases} P_i = 0.348\,MPa \\ P_e = 0.180\,MPa \end{cases}$$

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