

m2]

Esercizio ASP. TRUCIOLO

Tornitura:  $\begin{cases} R_m = 480 \text{ N/mm}^2 \\ \frac{1}{n} = 0,197 \end{cases}$

$$n = 860 \text{ giri/min}$$

$$u = 215 \text{ mm/min}$$

$$K_s = 214 R_m^{0,484} \beta^{0,466} \text{ N/mm}^2$$

$$D_i = 80 \text{ mm}$$

$$D_f = 70 \text{ mm}$$

$$\alpha = 2$$

$$\gamma = -50^\circ \parallel \rightarrow \beta = 87^\circ (?) \rightarrow 93^\circ$$

$$P_H = 7 \text{ kW}$$

$$\eta = 0,9$$

$$M_{\text{penetrazione}} = ? \quad P_m \text{ ogni penetrazione} = ?$$

Calcolo  $K_s = 2720 \text{ N/mm}^2$

Il sovraccarico totale  $s = \frac{D_i - D_f}{2} = 5 \text{ mm}$

con  $u = n \cdot e \Rightarrow e = \frac{u}{n} = 0,25 \text{ mm/giro}$

Ipotesi di 1 sgrossatura + 1 finitura

$$P_{sg} = 4,6 \text{ mm}$$

$$P_f = 0,4 \text{ mm}$$

$P_{m(\text{gr})} = 11 \text{ kW} (> P_H \eta) \rightarrow$  Non ce la faccio con una sola penetrazione.

$$P_{m(\text{max})} = P_H \eta = 6,3 \text{ kW} = F_{t\text{max}} \cdot v_t = K_s (e P_{m\text{max}})^{\frac{1,1}{n}} \cdot \frac{\pi D n}{1000}$$

$$F_{t\text{max}} = \frac{P_{m\text{max}}}{\pi D n} = 1748,9 \text{ N} \Rightarrow P_{m\text{max}} = \left( \frac{F_{t\text{max}}}{K_s} \right)^{\frac{1}{1-\frac{1}{n}}} \cdot \frac{1}{e} = 2,31 \text{ mm}$$

$$M_{\text{pen}} = \frac{s - P_f}{P_{m\text{max}}} = 2 \text{ penetrazioni di sgrossatura da } 2,3 \text{ mm}$$

① Sgross.  $P = 2,3 \text{ mm}$   
 $e = 0,25 \text{ mm/giro}$

$F_t = K_s (e P)^{\frac{1,1}{n}} = 1744 \text{ N}$   
 $v_t = \pi D_2 n = 3,6 \text{ m/sec}$

$P_{m①} = F_t v_t = 6,28 \text{ kW}$

② Sgross.  $P = 2,3 \text{ mm}$   
 $e = 0,25 \text{ mm/giro}$

$F_t = 1744 \text{ N}$   
 $v_t = \pi (D_i - 2P_2) n = 3,395 \text{ m/sec}$

$P_{m②} = 5,92 \text{ kW}$

③ Finitura  $P = 0,4 \text{ mm}$   
 $e = 0,25 \text{ mm/giro}$

$F_t = 628,12 \text{ N}$   
 $v_t = \pi (D_i - 2P_3) n = 3,18 \text{ m/sec}$

$P_{m③} = 1,36 \text{ kW}$

M3 Tornitura

ghise  $\frac{1}{m} = 0,137$   
 $HB = 420 \text{ N/mm}^2$

$D_i = 130 \text{ mm}$   
 $D_f = 110 \text{ mm}$   
 $P_H = 16 \text{ kW}$   $\eta = 0,8$

$m = 960 \text{ giri/min}$   
 $\mu = 696 \text{ mm/min} \Rightarrow a = \frac{\mu}{m} = 0,725 \text{ mm/giro}$

$\alpha = 8^\circ$   
 $\gamma = -6^\circ \Rightarrow \beta = 88^\circ$

$\eta_{pomate}$  e  $P_m$  calcoli successivi.

$K_S = 0,9 \text{ HB}^{0,4} \beta^{0,666} \text{ daN/mm}^2$

$P_{m(mex)} = 12,8 \text{ kW} = F_{t(mex)} \cdot v_t \Rightarrow F_{t(mex)} = \frac{12800}{\pi D m} = 1958,83 \text{ N}$

$F_t = K_S (aP)^{\frac{1-\beta}{\beta}} \Rightarrow P_{mex} = \left( \frac{F_{t(mex)}}{K_S} \right)^{\frac{\beta}{1-\beta}} \cdot a = 3,94 \text{ mm}$

$K_S = 0,9 \cdot 420^{0,4} \cdot 88^{0,666} \text{ daN} = 791,71 \text{ N/mm}^2$

$P_{pomate} = \frac{P}{P_{mex}} = \frac{10}{3,94} = 2,54 \rightarrow 3 \text{ pomate di sgrossatura + 1 finitura}$

① Sgrossatura  $a = 0,725 \text{ mm/giro}$   
 $P_1 = 3,3 \text{ mm}$   
 $D = 0,130 \text{ m}$

$F_t = 1680,8 \text{ N}$   
 $v_t = 6,53 \text{ m/sec}$

$P_{m①} = 11 \text{ kW}$

② Sgrossatura  $a = 0,725 \text{ mm/giro}$   
 $P_2 = 3,3 \text{ mm}$   
 $D = 0,1234 \text{ m}$

$F_t = 1680,8 \text{ N}$   
 $v_t = 6,20 \text{ m/sec}$

$P_{m②} = 10,6 \text{ kW}$

③ Sgross  $a = 0,725 \text{ mm/giro}$   
 $P_2 = 3,3 \text{ mm}$   
 $D = 0,1168 \text{ m}$

$F_t = 1680,8 \text{ N}$   
 $v_t = 5,97 \text{ m/sec}$

$P_{m③} = 9,87 \text{ kW}$

④ Finitura  $a = 0,725 \text{ mm/giro}$   
 $P_3 = 0,1 \text{ mm}$   
 $D = 0,1102 \text{ m}$

$F_t = 82,23 \text{ N}$   
 $v_t = 5,54 \text{ m/sec}$

$P_{m④} = 0,655 \text{ kW}$

1.74

Pressure reference

give HB = 250 N/mm<sup>2</sup>

$$L = 50 \text{ mm}$$

$$D = 60 \text{ mm}$$

$$\beta = 80^\circ$$

$$z = 8$$

$$m = 250 \text{ gpc/min}$$

$$Q = 1,8 \text{ mm/gpc}$$

$$P = 4 \text{ mm}$$

$$P_H = 4 \text{ kW} \quad \eta = 0,9$$

$$K_S = 0,9 \text{ HB}^{0,4} \beta^{0,4}$$

$$\frac{1}{n} = 0,137$$

Faltbreite?

$$K_S = 603,78 \text{ N/mm}^2$$

$$F_t = K_S (q_{\max})^{1-\frac{1}{n}}$$

$$\begin{cases} q_{\max} = S_{\max} \cdot l \\ q_{\max} = Q \cdot \sin \beta \cdot l \\ q_{\max} = Q \cdot 2 \sqrt{\frac{P}{D}} \cdot l \\ q_{\max} = \frac{Q}{z} \cdot 2 \sqrt{\frac{P}{D}} \cdot l = 5,81 \text{ mm}^2 \end{cases}$$

$$F_t = 603,78 \text{ N/mm}^2 \cdot (5,81)^{1-0,137} = 2756,31 \text{ N}$$

$$P_m = F_t \cdot v_t = F_t \cdot \pi D m = 2,16 \text{ kW}$$

$$P_{m \max} = 3,6 \text{ kW}$$

$$P_m < P_H \eta \quad \underline{\text{OK}}$$

~~(oppose  $F_t = K_S \cdot 2 \sqrt{\frac{P}{D}} \cdot Q \cdot l = 3507,5 \text{ N}$ )~~

~~$P_m(\text{real}) = \frac{P_m}{z} + 0,15 P_m \quad (??)$~~

MS → Tornitura

$$D_i = 160 \text{ mm}$$

$$D_f = 120 \text{ mm}$$

Numero minimo di passate?

$$P_M = 8 \text{ kW}$$

$$HB = 260 \text{ N/mm}^2$$

$$\eta = 0,8$$

$$m = 800 \text{ g/a/min} = 13/33 \text{ g/s}$$

$$\mu = 430 \text{ mm/min}$$

$$\alpha = 7^\circ$$

$$\beta = -8^\circ \Rightarrow \beta = 94^\circ$$

$$K_S = 0,9 HB^{0,94} \beta^{0,66} \text{ da N/mm}^2 = 668 \text{ N/mm}^2$$

$$\frac{1}{n} = 0,137$$

$$P_M \cdot \eta = 6,4 \text{ kW} = P_{M \max}$$

Sollecitazione

$$L = \frac{160 - 120}{2} = 10 \text{ mm}$$

Calcolo la max profondità di passata possibile

$$P_{M \max} = F_{t \max} \cdot V_t, \quad V_t = \pi D_i \cdot m = 5,86 \text{ m/s}$$

$$F_{t \max} = \frac{6,400 \text{ W}}{V_t} = K_S (e P)^{\frac{2-1}{n}} = 1092,15 \text{ N}$$

$$P_{\max} = \left( \frac{F_{t \max}}{K_S} \right)^{\frac{1}{\frac{2-1}{n}}} \cdot \frac{1}{e}, \quad e = \frac{\mu}{m} = 0,537 \text{ mm/g-ico}$$

$$P_{\max} = 3,29 \text{ mm}$$

$$\text{num passate} = \frac{L}{P_{\max}} = 3,04 \text{ passate}$$

|                          |                         |
|--------------------------|-------------------------|
| 3 passate<br>di spessore | $P = 3,25 \text{ mm}$   |
| ↓                        |                         |
| 1 di finitura            | $P_f = 0,25 \text{ mm}$ |

$$\textcircled{1} F_t = K_S (e P_1)^{\frac{2-1}{n}} = 1080,19 \text{ N}$$

$$V_t = \pi D_i m = 5,86 \text{ m/s}$$

$$P_{M \textcircled{1}} = 6,33 \text{ kW}$$

$$\textcircled{2} F_{t \textcircled{2}} = F_{t \textcircled{1}}$$

$$V_t = \pi (D_i - P_1) m = 5,54 \text{ m/s}$$

$$P_{M \textcircled{2}} = 6,04 \text{ kW}$$

$$\textcircled{3} F_{t \textcircled{3}} = F_{t \textcircled{2}} = F_{t \textcircled{1}}$$

$$V_t = \pi (D_i - 4 P_1) m = 5,32 \text{ m/s}$$

$$P_{M \textcircled{3}} = 5,75 \text{ kW}$$

$$\textcircled{4} F_{t \textcircled{4}} = K_S (e P_4)^{\frac{2-1}{n}} = 118 \text{ N}$$

$$V_t = \pi (D_i - 6 P_1) m = 5,05 \text{ m/s}$$

$$P_{M \textcircled{4}} = 600 \text{ W}$$

m6

Fresature periferice

Fotobila cu  $P_H = 6 \text{ kW}$

$$\eta = 0.9$$

$$K_S = 2.14 R_m^{0.456} \beta^{0.666} d \text{ N/mm}^2$$

$$R_m = 250 \text{ N/mm}^2$$

$$\beta = 0.197$$

$$L = 30 \text{ mm}$$

$$D = 60 \text{ mm}$$

$$z = 8$$

$$m = 650 \text{ g-z/mm}$$

$$Q = 0.5 \text{ mm/g-z}$$

$$P = 4 \text{ mm}$$

$$\beta = 86^\circ \quad P_m = ?$$

$$K_S = 3079 \text{ N/mm}^2$$

$$P_m(\text{max}) = P_H \eta = 5.4 \text{ kW}$$

$$P_m = F_t \cdot v_t, \quad v_t = \pi D_f m$$

$$F_t = K_S (P_m(\text{max}))^{1-\frac{1}{m}} = K_S \left( 2 \sqrt{\frac{P}{D}} \cdot L \cdot Q_z \right)^{1-\frac{1}{m}}, \quad Q_z = \frac{Q}{z}$$

$$P_m = K_S \left( 2 \sqrt{\frac{P}{D}} \cdot L \cdot Q_z \right)^{1-\frac{1}{m}} \cdot \pi D_f m = \underline{3.94 \text{ kW}}$$

$$P_m \leq P_H \eta \quad \underline{\text{OK}} \rightarrow \underline{\text{forbidden}}$$

# FORATURA (1 passada)

M7

$$D_{\text{furo}} = 10 \text{ mm}$$

$$K_{S,1,1} = 827 \text{ N/mm}^2$$

$$\eta = 120^\circ$$

$$Q = 0,58 \text{ mm/giro}$$

$$m = 400 \text{ gzi/mm}$$

$$(z = 0,137)$$

$$\begin{cases} F_t = ? \\ M_t = ? \\ P_m = ? \end{cases}$$

Calcular a força de um  
saco de trabalho

$$F_t = K_S b(h)^{1-z}$$

$$F_t = K_S \left( \frac{D}{2 \sin \frac{\eta}{2}} \right) \cdot \left( \frac{Q}{z \sin \frac{\eta}{2}} \right)^{1-z} = 1449 \text{ N}$$

$$V_t = \pi \frac{D}{2} \cdot m = 0,105 \text{ m/s}$$

$$P_m = 2 F_t \cdot V_t = 304,3 \text{ W}$$

$$M_t = F_t \cdot \frac{D}{2} = 7,24 \text{ N}\cdot\text{m}$$

$$M_t = \frac{P_m}{\omega} \rightarrow M_t = 7,25 \text{ N}\cdot\text{m} \quad \hat{OK}$$

# FORATURA ED ALLARGATURE

M8

$$\begin{cases} F_t = ? \\ M_t = ? \\ P_m = ? \end{cases}$$

$K_{s,11} = 1827 \text{ N/mm}^2$   
 $Z=2$   $\eta = 120^\circ$   
 $z = 0,137$   $Q = 0,2 \text{ mm/giro}$   
 $n = 800 \text{ giri/min}$

$D_1 = 6 \text{ mm}$  (foratura)  
 $D_2 = 8 \text{ mm}$  (1° allarg.)  
 $D_3 = 10 \text{ mm}$  (2° allarg.)

1 FOR

$D_1 = 6 \text{ mm}$

$F_t = K_s h^{1.7} b \rightarrow 2,3094$

$$\begin{cases} h = \frac{Q}{2} \sin \frac{\eta}{2} \\ b = \frac{D_1}{2 \sin \frac{\eta}{2}} \end{cases}$$

$F_t = 511 \text{ N}$

$V_{t①} = \pi \frac{D_1}{2} n = 0,083776 \text{ m/s}$

$P_{m①} = 2 F_t V_t = 85,6 \text{ W}$

$M_{t①} = F_t \cdot \frac{D_1}{2} = \frac{P_{m①}}{2\pi n} = 1,022 \text{ N} \cdot \text{m}$

1 ALL

$D_2 = 8 \text{ mm}$

$P_② = \frac{D_2 - D_1}{2} = 2 \text{ mm}$

$F_t = K_s h^{1.7} b$   
 $0,121085$

$$\begin{cases} h = \frac{Q}{2} \sin \frac{\eta}{2} \\ b = \frac{P_②}{\sin \frac{\eta}{2}} \end{cases}$$

$F_t = 511 \text{ N}$

dimensione per  
velocità di taglio  
e momento  
torcente

$V_{t②} = \pi \left( \frac{D_1 + D_2}{2} \right) n = 0,251 \text{ m/s}$

$M_{t②} = F_t \cdot \left( \frac{D_1 + D_2}{2} \right) = 3,1 \text{ N} \cdot \text{m}$

$P_{m②} = 2 F_t V_t = 256,5 \text{ W}$

2 ALL

$D_3 = 10 \text{ mm}$

$P_③ = \frac{D_3 - D_2}{2} = 2 \text{ mm}$

$F_t = K_s h^{1.7} b = 255 \text{ N}$   
 $1,1542$

$V_{t③} = \pi \left( \frac{D_2 + D_3}{2} \right) n = 0,378 \text{ m/s}$

$M_{t③} = F_t \cdot \left( \frac{D_2 + D_3}{2} \right) = 4,05 \text{ N} \cdot \text{m}$

$P_{m③} = 2 F_t V_t = 192,42 \text{ W}$

Pianificazione forature e vore  
allargature

M 9

$$K_S = 1827 \text{ N/mm}^2$$

$$\eta = 120^\circ$$

$$D = 45 \text{ mm}$$

$$Q = 918 \text{ mm/p-zu}$$

$$\begin{cases} F_{t1} = ? \\ M_{t1} = ? \end{cases}$$

$$P_{max} = 5 \text{ mm}$$

$$(\bar{z} = 0,137)$$

1 foratura e 4 allargature

$$\begin{cases} D_1 = 10 \text{ mm} & \text{forat.} \\ D_2 = 20 \text{ mm} & 1 \text{ allarg.} \\ D_3 = 40 \text{ mm} & 2 \text{ " } \\ D_4 = 45 \text{ mm} & 3 \text{ " } \end{cases}$$

$$\begin{cases} h = \frac{Q}{2} \frac{\sin \frac{\eta}{2}}{2} \\ b = \frac{D_1}{2 \sin \frac{\eta}{2}} \end{cases}$$

1) foratura  
 $P_1 = 5 \text{ mm}$

$$F_{t1} = K_S b h^{1+\bar{z}} = 1166,21 \text{ N}$$

$$M_{t1} = F_{t1} \cdot \frac{D_1}{2} = 5,83 \text{ N}\cdot\text{m}$$

2) allargatura 1

$$P_2 = \frac{D_2 - D_1}{2} = 5 \text{ mm}$$

$$F_{t2} = K_S b h^{1+\bar{z}} = 1166,21 \text{ N}$$

$$M_{t2} = F_{t2} \left( \frac{D_1 + D_2}{2} \right) = 17,5 \text{ N}\cdot\text{m}$$

3) allargatura 2

$$P_3 = \frac{D_3 - D_2}{2} = 5 \text{ mm}$$

$$F_{t3} = K_S b h^{1+\bar{z}} = 1166,21 \text{ N}$$

$$M_{t3} = F_{t3} \left( \frac{D_2 + D_3}{2} \right) = 35 \text{ N}\cdot\text{m}$$

4) allargatura 3

$$P_4 = \frac{D_4 - D_3}{2} = 2,5 \text{ mm}$$

$$F_{t4} = K_S b h^{1+\bar{z}} = 411,1 \text{ N}$$

$$M_{t4} = F_{t4} \cdot \left( \frac{D_3 + D_4}{2} \right) = 17,5 \text{ N}\cdot\text{m}$$



# M1 / Magli e Presse

Magli<sup>2</sup> di effetto

$$P_F = ?$$

$$E = 45 \text{ e } T = 1000^\circ \text{C}$$

$$P_i = 18000 \text{ Kg}$$

$$P_c = 1200 \text{ Kg}$$

$$h = 0,7 \text{ m} \Rightarrow \eta = 0,9$$

$$D_s = 180 \text{ mm}$$

$$A = 12000 \text{ mm}^2$$

$$S = 4 \text{ mm}$$

$$L_d = (P_c + F) \left(1 - \frac{P_c}{P_i}\right) \eta h$$

$$L_m = \frac{(\mu A) \cdot S}{1000} = 674 \text{ Kg m}$$

$$\mu = 13 \text{ Kg/mm}^2 \text{ (de tabella)}$$

$$L_m = L_d \text{ (Cond. necessaria di lavoro)}$$

$$F = \frac{L_d}{\left(1 - \frac{P_c}{P_i}\right) \eta h} - P_c = -138 \text{ Kg} \quad (\text{DATI ERRATI})$$

$$P_F = \frac{4F}{\pi D_s^2} = -5500 \text{ Kg/m}^2$$

M2 Maglia e puzze

Pressa

$$d_p = ?$$

$$P_e = 200 \text{ Kg/cm}^2$$

$$Fe-60 (T=800^\circ) \Rightarrow \mu = 30 \text{ Kg/mm}^2$$

$$A = 3000 \text{ mm}^2$$

$$S = 6 \text{ mm}$$

$$L_m = \frac{(\mu A) S}{1000} \quad \cancel{\frac{A \mu S}{1000}}$$

$$L_d = A_p \frac{P_e S}{1000}$$

$$L_m = L_d \Rightarrow \frac{\mu A S}{1000} = \frac{A_p P_e S}{1000}$$

$$A_p = \frac{\mu}{P_e} A = 45000 \text{ mm}^2 = \frac{\pi d_p^2}{4}$$

$$d_p = \sqrt{\frac{4 \cdot 45000}{\pi}} = 24 \text{ cm}$$

oppure  $L_m = 360 \text{ Kg m}$

$$360 = A_p \frac{P_e S}{1000} \rightarrow \text{calcolo } A_p \text{ e quindi } d_p$$

m3

Presse

$d_e = ?$

$$P_e = 200 \text{ Kg/cm}^2$$

$$F_e = 45 (700^\circ) \rightarrow p = 25 \text{ Kg/mm}^2$$

$$A = 4500 \text{ mm}^2$$

$$s = 3,5 \text{ mm}$$

$$L_m = \frac{p A \cdot s}{1000} = 393,7 \text{ Kg m}$$

$$L_d = \left( \frac{P_e s}{1000} \right) \cdot \frac{\pi (d_e)^2}{4} \rightarrow d_e = \sqrt{\frac{4000 L_d}{P_e s \pi}}$$

da  $L_d = L_m$

$$d_e = 26,76 \text{ cm}$$

M4 Moltiplo e doppio effetto

$$P_F = ?$$

$$\text{ottone (8000)} \rightarrow \rho = 17 \text{ Kg/mm}^3$$

$$P_u = 15.000 \text{ Kg}$$

$$P_c = 600 \text{ Kg}$$

$$h = 0,5 \text{ m} \rightarrow \eta = 0,9$$

$$D_s = 150 \text{ mm}$$

$$A = 15.000 \text{ mm}^2$$

$$s = 5 \text{ mm}$$

$$L_m = L_d$$

$$L_m = \frac{\rho A \cdot s}{1000} = 1275 \text{ Kg m}$$

$$L_d = 1275 = (P_c + F) \left(1 - \frac{P_c}{P_i}\right) \eta h =$$

$$F = \frac{L_d}{\left(1 - \frac{P_c}{P_i}\right) \eta h} - P_c = 2351 \text{ Kg}$$

$$P_F = \frac{F}{S_s} = \frac{4F}{\pi D_s^2} = 13,3 \text{ Kg/cm}^2$$

$$\bullet \underline{L_f} = (P_c + F) \eta h = 1328 \text{ Kg m}$$

$$\cancel{L_i} \neq \cancel{L_f} \quad \underline{L_i} = L_f \frac{P_c}{P_i} = 53 \text{ Kg m}$$

$$\bullet \underline{S_i} = \frac{L_i}{P_i} = 3,5 \text{ mm}$$

$$\bullet \underline{F_d} = \frac{L_d}{s} = 255.000 \text{ Kg}$$

$$\bullet \underline{F_{max}} = \frac{L_f - L_i}{S_i} = 364286 \text{ Kg}$$

(M5)

Maglio e doppio effetto.

$$P_F = ?$$

$$Fe 60 \rightarrow 800^\circ C \rightarrow \rho = 3 \text{ kg/cm}^3$$

$$A = 25.000 \text{ mm}^2$$

$$S = 5 \text{ mm}$$

$$P_i = 40.000 \text{ kg} \quad P_e = 2000 \text{ kg} \quad h = 0.5 \text{ m} \quad (\eta = 0.9)$$

$$D_s = 200 \text{ mm}$$

$$L_m = \frac{\rho A \cdot S}{1000} = 3750 \text{ kg}\cdot\text{m}$$

$$L_d = (P_e + F) \left(1 - \frac{P_e}{P_i}\right) \eta h = L_m$$

$$F = \frac{L_m}{\left(1 - \frac{P_e}{P_i}\right) \eta h} - P_e = 6772 \text{ kg}$$

$$P_F = \frac{4F}{\pi D_s^2} = 21.6 \text{ kg/cm}^2$$

$$\rightarrow L_f = (P_e + F) \eta h = 3967.4 \text{ kg}\cdot\text{m}$$

$$\rightarrow L_i = L_f \cdot \frac{P_e}{P_i} = 197.4 \text{ kg}\cdot\text{m}$$

$$\rightarrow S_i = \frac{L_i}{P_i} = 4.93 \text{ mm}$$

$$\rightarrow F_d = \frac{L_d}{S} = 750.000 \text{ kg}$$

$$\rightarrow F_{max} = \frac{L_f + L_i}{S} = 760669 \text{ kg}$$

Simple effetto

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$$Fe-45 \quad (T=800^\circ C) \rightarrow \rho = 20 \text{ kg/mm}^3$$

$$A = 30'000 \text{ mm}^2$$

$$s = 5 \text{ mm}$$

$$h = ? \quad L_f = ? \quad L_i = ? \quad s_i = ? \quad F_d = ? \quad F_{max} = ?$$

$$P_i = 40'000 \text{ kg}$$

$$P_c = 1800 \text{ kg}$$

$$L_m = \frac{(\rho A \cdot s)}{1000} = 3000 \text{ kg} \cdot \text{m} \quad , \quad \boxed{L_d = P_c \left(1 - \frac{P_c}{P_i}\right) h}$$

$$\text{en } L_d = L_m \quad \text{et } h$$

$$\bullet h = \frac{L_d}{P_c \left(1 - \frac{P_c}{P_i}\right)} = 1,75 \text{ m}$$

$$\bullet L_f = P_c h = 3150 \text{ kg} \cdot \text{m}$$

$$\bullet L_i = \frac{L_f P_c}{P_i} = 162 \text{ kg} \cdot \text{m}$$

$$\bullet s_i = \frac{L_i}{P_i} = 3,5 \text{ mm}$$

$$\bullet F_d = \frac{L_d}{s} = 600'000 \text{ kg}$$

$$\bullet F_{max} = \frac{L_f - L_i}{s_i} = 859430 \text{ kg}$$

Maglio a doppio effetto

[17]

$$Fe-45-800^{\circ}C \rightarrow \rho = 20 \text{ kg/mm}^3$$

$$D_s = ? \quad P_u = 60000 \text{ kg} \quad P_c = 1500 \text{ kg} \quad h = 0,5 \text{ m} \quad (\eta = 0,95)$$

$$A = 35000 \text{ mm}^2$$

$$s = 5 \text{ mm}$$

$$\rho_F = 14 \text{ kg/cm}^3$$

il cas. incrementato  $L_m = \frac{\rho A s}{1000} = 3500 \text{ kg} \cdot \text{m}$

$$L_m = L_d = (P_c + F) \left(1 - \frac{P_c}{P_c}\right) \eta h, \text{ da cui } F = \frac{L_d}{\left(1 - \frac{P_c}{P_c}\right) \eta h} - P_c$$

$$F = 6823 \text{ kg}$$

quindi  $\rho_F = \frac{F}{A_s} \rightarrow A_s = \frac{F}{\rho_F} = 487 \text{ cm}^2$

~~Ds = ?~~  $A_s = \frac{\pi D_s^2}{4} \rightarrow D_s = \sqrt{\frac{4 A_s}{\pi}} = 25 \text{ cm}$