ASAMBLARI DEMONTABILE

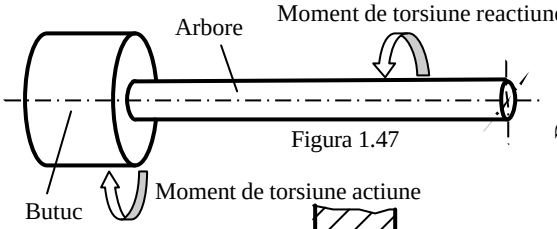


Figura 1.47

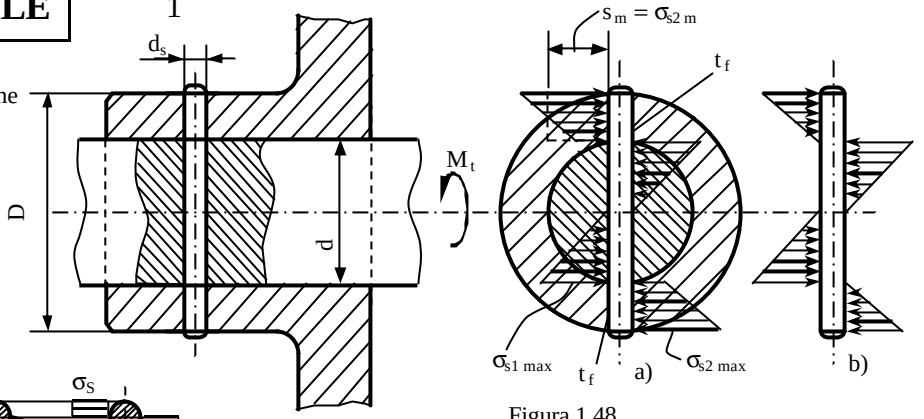


Figura 1.48

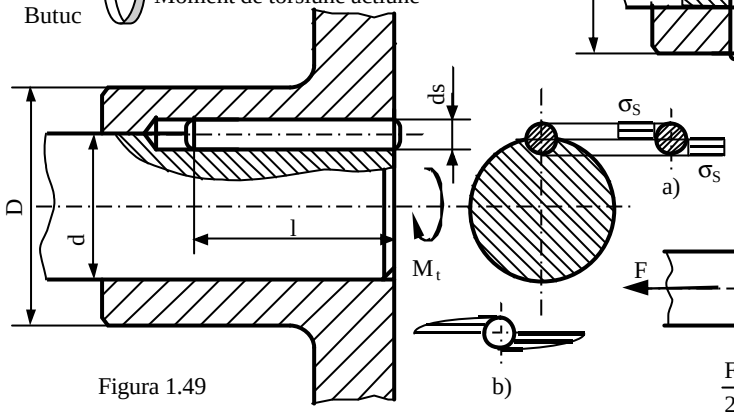


Figura 1.49

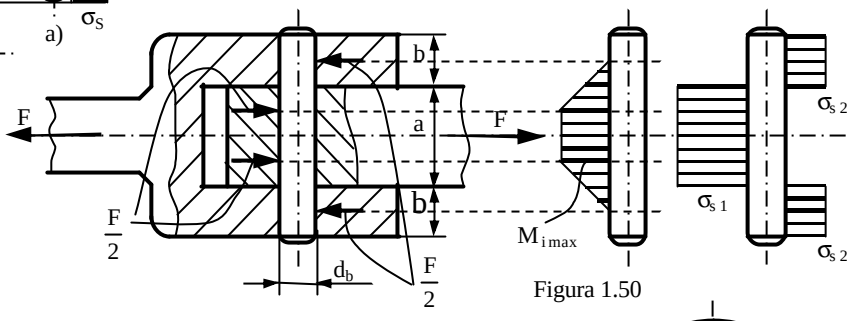
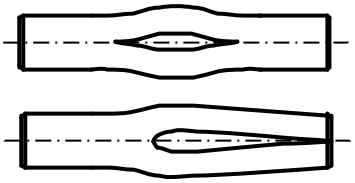
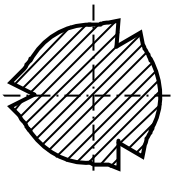


Figura 1.50

Figura 1.51





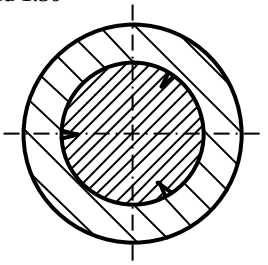


Figura 1.52

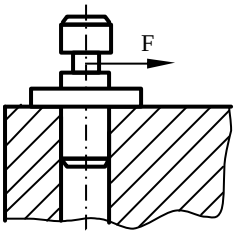


Figura 1.53.a

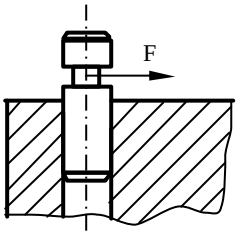


Figura 1.53.b

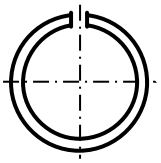


Figura 1.54.a

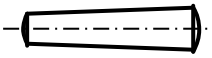


Figura 1.54.b

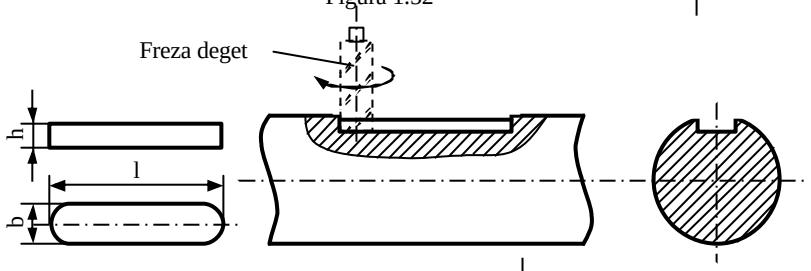


Figura 1.55

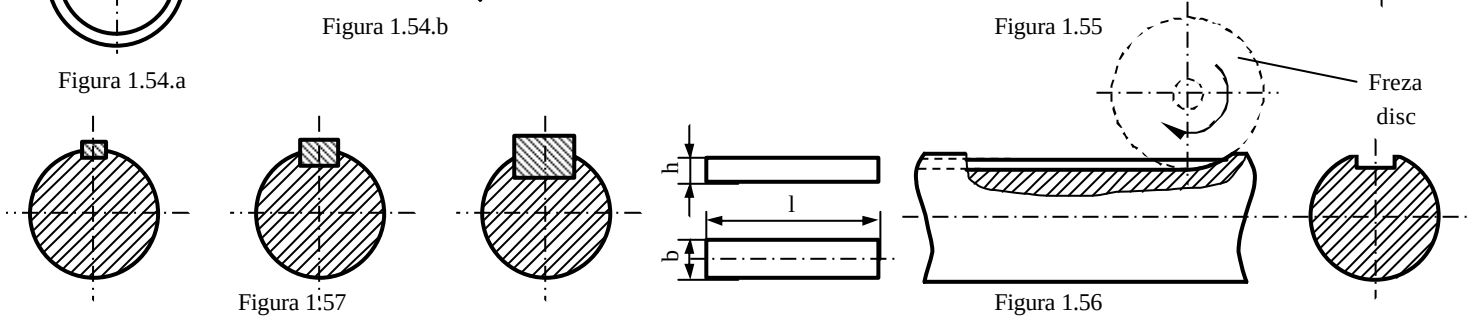


Figura 1.56

Figura 1.57

$$\begin{cases} \frac{1}{2}\cdot\sigma_{s1max}\cdot\frac{d}{2}\cdot d_s\cdot\frac{2}{3}\cdot d = M_{tc} \Rightarrow \sigma_{s1max} \le \sigma_{sa(stift-arbore)} \\ \sigma_{s2m}\cdot\frac{D-d}{2}\cdot d_s\cdot\frac{D+d}{2} = M_{tc} \Rightarrow \sigma_{s2m} \le \sigma_{sa(stift-butuc)} \\ \tau_f\cdot\frac{\pi}{4}\cdot d_s^2\cdot d = M_{tc};\ \ \tau_f \le \tau_{af\ stift} \end{cases} \qquad (1.39)$$

Recomandari constructive: $\frac{d_s}{d} = 0{,}2...0{,}3$; $\frac{D}{d} = 2$ (otel/otel); $\frac{D}{d} = 2{,}5$ (fonta/otel).

$$\begin{cases} \sigma_s\cdot\frac{d_s}{2}\cdot l\frac{d}{2} = M_{tc} \Rightarrow \sigma_s \le \sigma_{asmin} \\ \tau_f\cdot d_s\cdot l\cdot\frac{d}{2} = M_{tc} \Rightarrow \tau_f \le \tau_{af} \end{cases}, \text{ recomandari: } \frac{d_s}{d} = 0{,}13\ldots0{,}16;\quad \frac{1}{d} = 1\ldots1{,}5. \qquad (1.40)$$

$$\begin{cases} 2\cdot\sigma_{s2}\cdot d\cdot b = F \Rightarrow \sigma_{s2} \le \sigma_{s2a\,min} \\ \sigma_{s1}\cdot d\cdot a = F \Rightarrow \sigma_{s1} \le \sigma_{s1a\,min} \\ \dfrac{F}{2}\cdot\left(\dfrac{a}{4}+\dfrac{b}{2}\right) = M_{i\,max};\ \ \sigma_i = \dfrac{M_{i\,max}}{\dfrac{\pi\cdot d_b^3}{32}} \le \sigma_{ai} \end{cases} \quad (1.41)$$

$$\sigma_s\cdot\frac{h}{2}\cdot l\cdot\left(\frac{d}{2}\pm\frac{h}{4}\right) = M_{tc}$$

$$\sigma_s\cdot\frac{h}{2}\cdot l\cdot\frac{d}{2} \cong M_{tc} \Rightarrow \sigma_s \le \sigma_{sa} \quad (1.42)$$

$$\tau_f\cdot b\cdot l\cdot\frac{d}{2} = M_{tc} \Rightarrow \tau_f \le \tau_{af}$$

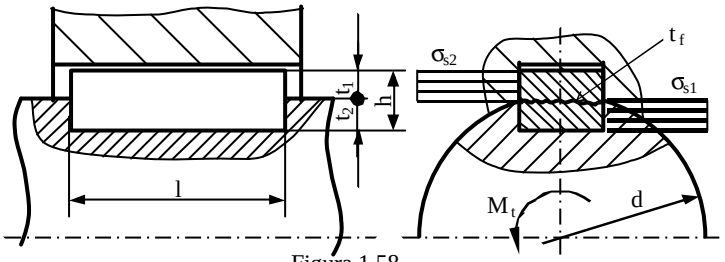


Figura 1.58

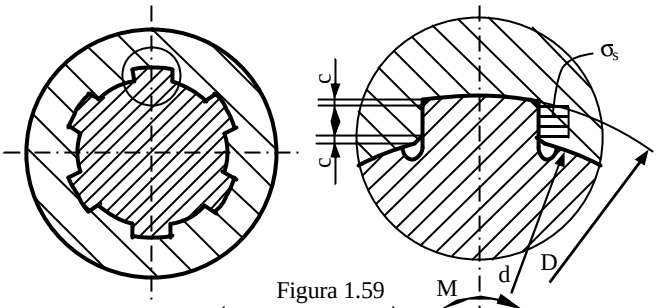


Figura 1.59

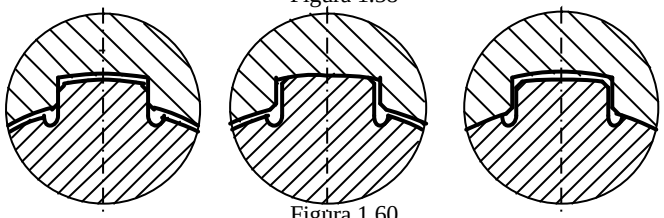


Figura 1.60

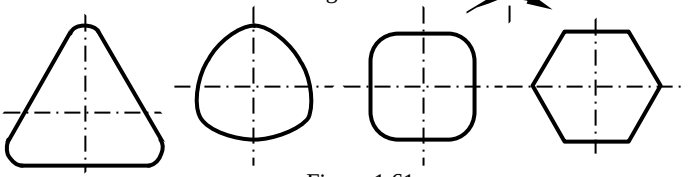


Figura 1.61

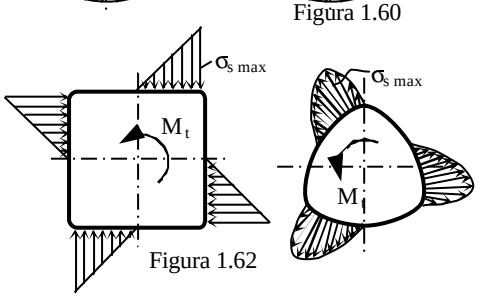
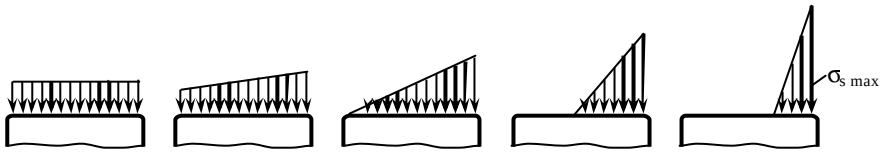


Figura 1.62



1.63.a 1.63.b 1.63.c 1.63.d 1.62.e

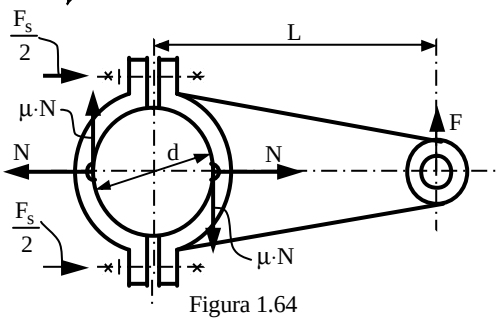
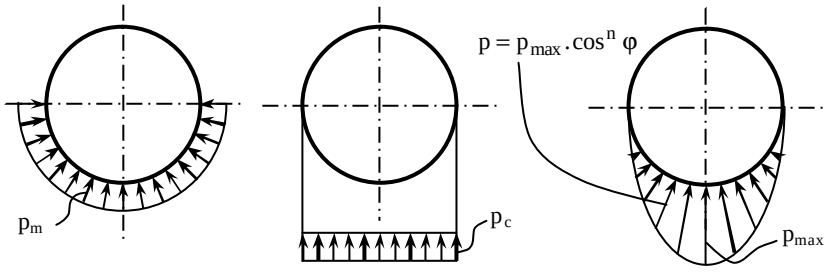


Figura 1.64



1.65.a 1.65.b 1.65.c

$$r_m = \frac{D+d}{2}$$

$$S_{nec} = \frac{M_{tc}}{r_m\cdot\sigma_{as}} \quad (1.43)$$

$$s' = 0{,}75\cdot z\cdot\left(\frac{D-d}{2}-2\cdot c\right)$$

$$L_{nec} \ge \frac{S_{nec}}{s'}$$

$$2\cdot\left(\frac{1}{2}\cdot\sigma_{smax}\cdot\frac{a}{2}\cdot l\cdot\frac{2}{3}\cdot a\right) = M_{tc} \Rightarrow \sigma_{smax} \le \sigma_{sa} \quad (1.44)$$

$$\mu\cdot N\cdot d \ge M_{tc} \quad (1.45)$$

$$M_{tc} = k_1\cdot k_2\cdot F\cdot L$$

$$N = \frac{M_{tc}}{\mu\cdot d} = F_s \quad (1.46)$$

$$\sigma_s = \frac{N}{b \cdot d} \le \sigma_{as} \quad (1.47)$$

Pentru cazul din figura 1.65 c): daca n = 1: $p_{max} = \frac{4}{\pi} \cdot p_c$;daca n = 2: $p_{max} = \frac{3}{2} \cdot p_c$.

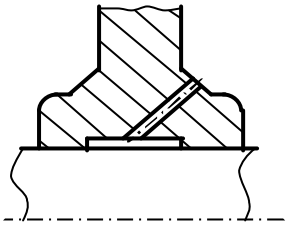


Figura 1.67

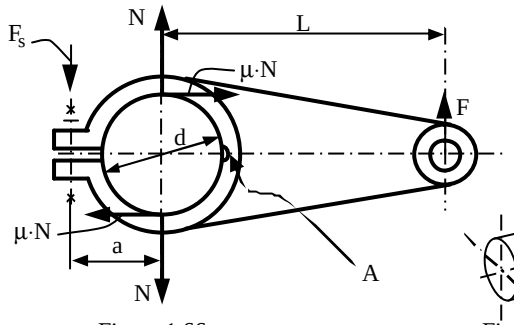


Figura 1.66

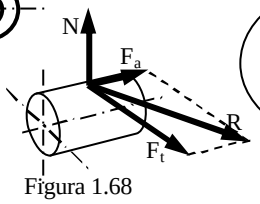


Figura 1.68

Figura 1.67

$$F_s \cdot \left(a + \frac{d}{2}\right) - N \cdot \frac{d}{2} - \mu \cdot N \cdot \frac{d}{2} = 0 \quad (1.48)$$

$\mu \cdot N \cdot d \ge M_{tc}$ (conditia de ne-patinare).

$$\Rightarrow N = \frac{M_{tc}}{\mu \cdot d}; \quad F_s = \frac{N \cdot \frac{d}{2} \cdot (1 + \mu)}{a + \frac{d}{2}} \quad (1.49)$$

$$\Rightarrow F_s = \frac{M_{tc} \cdot (1 + \mu)}{\mu \cdot (2 \cdot a + d)} \quad \text{® Cu } F_s \text{ se dimensioneaza suruburile.} \quad (1.50)$$

$$\sigma_s = \frac{N}{d \cdot b} \le \sigma_{as} \quad (1.51)$$

$$p_{min} = \sigma_{s\,min} = \frac{F_a}{\mu \cdot \pi \cdot d \cdot l} \quad (1.52)$$

$$p_{min} = \sigma_{s\,min} = \frac{2 \cdot M_t}{\mu \cdot \pi \cdot d^2 \cdot l} \quad (1.53)$$

$$R = \sqrt{F_a^2 + F_t^2}; \quad N = \frac{R}{\mu}; \quad p_{min} = \frac{N}{\pi \cdot d \cdot l} \quad (1.54)$$

$$p_{min} = \sigma_{s\,min} = \frac{\sqrt{F_a^2 + \left(\frac{2 \cdot M_t}{d}\right)^2}}{\mu \cdot \pi \cdot d \cdot l} \quad (1.55)$$

$$S_{min} = \Delta d + \Delta b = d_a - d_b \quad (1.56)$$

$$\Delta a = \sigma_{s\,min} \cdot \frac{K_a}{E_a} \cdot d; \quad K_a = \frac{d^2 + d_1^2}{d^2 - d_1^2} - \mu_a$$
$$\Delta b = \sigma_{s\,min} \cdot \frac{K_b}{E_b} \cdot d; \quad K_b = \frac{d^2 + d_1^2}{d^2 - d_1^2} - \mu_b \quad (1.57)$$

$$S_{min} = \sigma_{s\,min} \cdot \left(\frac{K_a}{E_a} + \frac{K_b}{E_b}\right) \cdot d \quad (1.58)$$

$$S_{mintot} = S_{min} + S_r + S_t \quad (1.59)$$

$$S_r = 1{,}2 \cdot (R_{maxa} + R_{maxb}) \quad (1.60)$$

$$S_t = [\alpha_b \cdot (t_b - t_0) - \alpha_a \cdot (t_a - t_0)] \cdot d \quad (1.61)$$

$$\frac{\sigma_{t\,max} - \sigma_{r\,max}}{2} = 0{,}5 \cdot \sigma_c \rightarrow \text{dupa teoria tensiunilor tangentiale} \quad (1.62)$$

$$\frac{\sigma_{t\max} - \sigma_{r\max}}{2} = 0{,}75 \cdot \sigma_c \rightarrow \text{dupa teoria energetica} \quad (1.63)$$

Pentru butuc: $\sigma_{t\max_b} = \sigma_s \cdot \frac{d_2^2 + d^2}{d_2^2 - d^2}$; $\sigma_{r\max_b} = -\sigma_s$

Pentru arbore: $\sigma_{t\max_a} = -2 \cdot \sigma_s \cdot \frac{d^2}{d^2 - d_1^2}$; $\sigma_{r\max_a} = \sigma_s$

$$\frac{\sigma_{s\max_b} \cdot \left[\frac{d_2^2 + d^2}{d_2^2 - d^2} - (-1)\right]}{2} = 0{,}5 \cdot \frac{\sigma_{cb}}{c_c} \quad (1.64)$$

$$\left|\frac{\sigma_{s\max_a} \cdot \left[-2 \cdot \frac{d^2}{d^2 - d_1^2} - (1)\right]}{2}\right| = 0{,}5 \cdot \frac{\sigma_{ca}}{c_c} \quad (1.65)$$

$$\sigma_{s\max} = \min\left(\sigma_{s\max b}, \sigma_{s\max a}\right) \quad (1.66)$$

$$S_{\max} = \sigma_{s\max} \cdot \left(\frac{K_a}{E_a} + \frac{K_b}{E_b}\right) \cdot d \quad (1.67)$$

$$S_{\max tot} = S_{\max} + S_r + S_t \quad (1.68)$$

$$S_{\max}^{STAS} \le S_{\max tot} \text{ si } S_{\min}^{STAS} \ge S_{\min tot} \quad (1.69)$$

$$S_{\max}^{STAS} + J = \alpha_b \cdot (t - t_0) \cdot d \Rightarrow t \quad (1.70)$$

$$S_{\max}^{STAS} + J = \alpha_a \cdot (t_0 - t) \cdot d \Rightarrow t \quad (1.71)$$

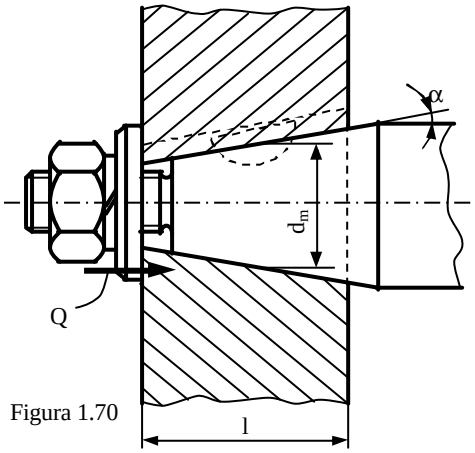
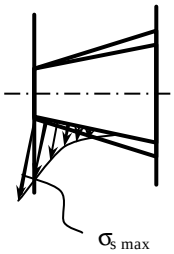
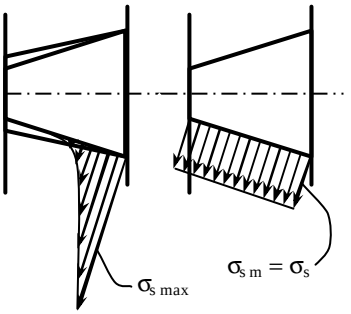


Figura 1.70

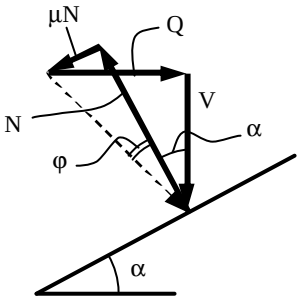


1.71.a



1.71.b

1.71.c



1.72

$$Q = N \cdot (\mu \cdot \cos\alpha + \sin\alpha)$$

$$N = \frac{2 \cdot M_{tc}}{\mu \cdot d_m} \quad (1.72)$$

$$M_{tc} = k_1 \cdot k_2 \cdot M_{t\,nominal} \quad (1.73)$$

$$\sigma_s = \frac{N}{\pi \cdot d_m \cdot l} \le \sigma_{sa} \quad (1.74)$$

$$M_{tc} = K_1 \cdot K_2 \cdot M_{tn}$$

$$N = \frac{2 \cdot M_{tc}}{\mu \cdot d}; \quad \sigma_s = \frac{N}{\pi \cdot d \cdot l} \le \sigma_{sa} \quad (1.75)$$

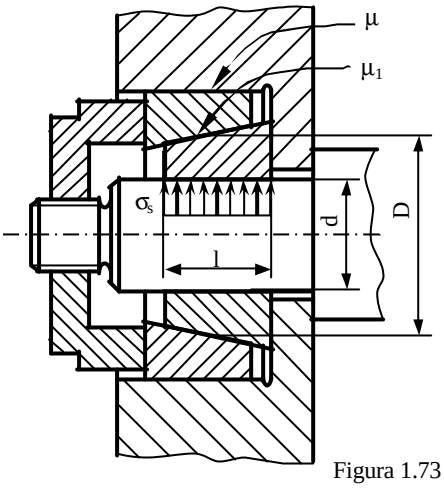
$$F_{a1} = N \cdot [tg(\alpha + \varphi_1) + tg\varphi] \quad (1.76)$$

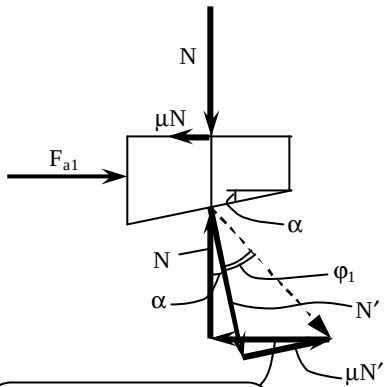
$$F_{a0} = \frac{E \cdot S}{l_0} \cdot \Delta l_r \quad (1.77)$$

$$tg(\alpha + \varphi_1) = \frac{\Delta l_r}{\Delta l_a} \quad (1.78)$$

$$F_{a0} = \frac{2 \cdot E \cdot \frac{\pi \cdot (D^2 - d^2)}{4}}{\frac{D + d}{4}} \cdot \Delta l_a \cdot tg(\alpha + \varphi_1) \quad (1.79)$$

$$\sigma_{sm} \cdot \pi \cdot d \cdot l \cdot \mu \cdot \frac{d}{2} = M_{tc} \quad (1.80)$$





$H' = N \cdot (\mu_1 \cdot \cos\alpha + \sin\alpha)$

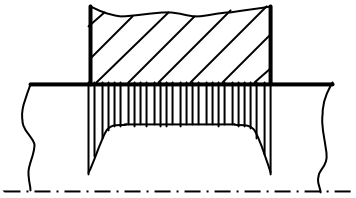


Figura1.76

Figura 1.73

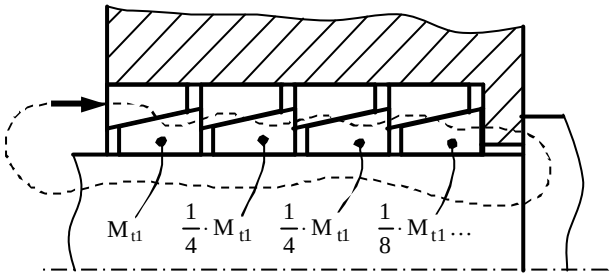


Figura 1.74

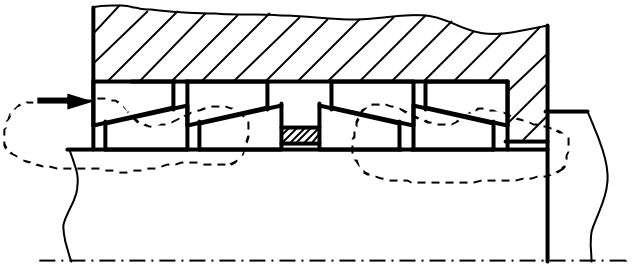


Figura 1.75

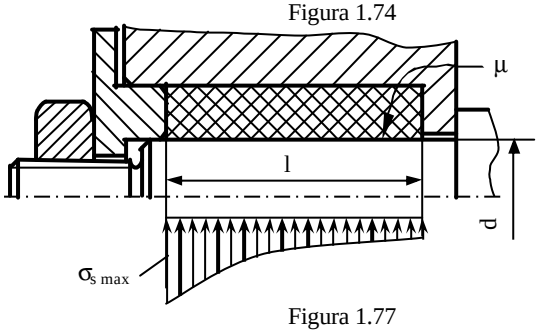


Figura 1.77

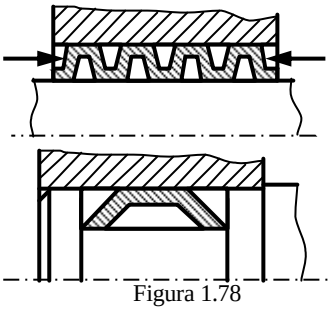


Figura 1.78

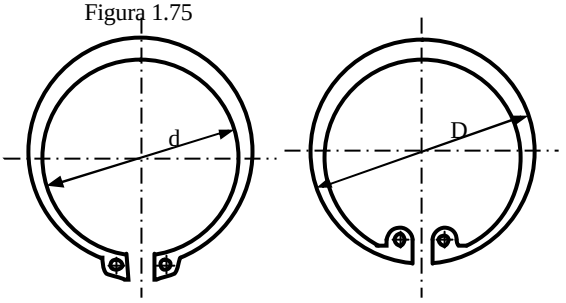
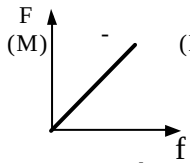


Figura 1.79

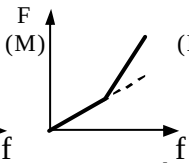
Tabelul 1.2

Marca	STAS	s_c [MPa]	s_R [MPa]	Alungirea la rupere, A%	Tipuri de arcuri
OLC 55A	795-80	880	1080	6	lamelare, cu foi, spirale
OLC 65A		780	980	10	lamelare, cu foi, spirale, elicoidale
OLC 75A		880	1080	9	
OLC 85A		980	1130	8	
51 Si 18A	795-80	1080	1180	6	cu foi, elicoidale
56 Si 17A		1270	1480		cu foi, elicoidale, disc, inelare
60 Si 15A		1080	1270		
51 VCr 11A		1180	1320		cu foi, elicoidale, disc, inelare, bara de torsiune
61 Si 2 WA	11514-80	1668	1864	5	elicoidale, bara de torsiune
40 Cr130	3583-80	1250	1650	–	elicoidale
12 TiNiCr 180	11523-80	1450	1650	–	elicoidale



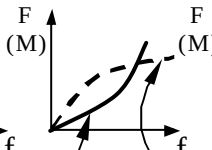
arcuri metalice (Hooke)

1.80.a

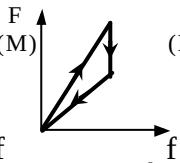


arcuri metalice de înaltimi diferite

1.80.b

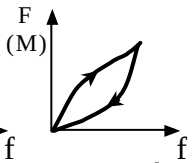


1.80.c



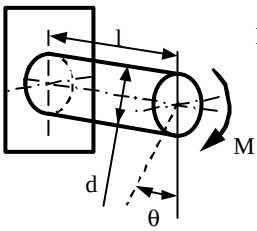
arcuri metalice cu foi (histerezis)

1.80.d

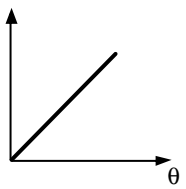


arcuri din cauciuc (histerezis)

1.80.e



1.81.a



1.81.b

$$c = \frac{dF}{df} \text{ sau } c = \frac{dM}{d\theta} \qquad (1.81)$$

$$L = \int F \cdot df \text{ sau } L = \int M \cdot d\theta \qquad (1.82)$$

$$k_v = \frac{L}{V} \qquad (1.83)$$

$$k_u = \frac{\frac{L}{V}}{\frac{\tau_{max}^2}{G}}$$, pentru solicitarea de torsiune, sau

$$k_u = \frac{\frac{L}{V}}{\frac{\sigma_{max}^2}{E}}$$, pentru solicitarea de încovoiere sau de tractiune-compresiune. (1.84)

$$k_u = k_v \cdot \frac{G}{\tau_{max}^2}$$, pentru solicitarea de torsiune, sau

$$k_u = k_v \cdot \frac{E}{\sigma_{max}^2}$$, pentru solicitarea de încovoiere sau de tractiune-compresiune. (1.85)

$$L_h = L - L' \quad (1.86)$$

$$\eta = \frac{L'}{L} = 1 - \frac{L_h}{L} \quad (1.87)$$

$$\delta = \frac{L - L'}{L + L'} = \frac{1 - \eta}{1 + \eta} \quad (1.88)$$

$$\tau_t = \frac{M_t}{W_p} \le \tau_{at} \quad (1.89)$$

$$\theta = \frac{M_t \cdot l}{G \cdot I_p} = \frac{32 \cdot M_t \cdot l}{\pi \cdot G \cdot d^4} \quad (1.90)$$

$$c = \frac{\pi \cdot d^4 \cdot G}{32 \cdot l} \quad (1.91)$$

$$L = \frac{M_t \cdot \theta}{2} = \frac{M_t^2 \cdot l}{2 \cdot G \cdot I_p} = \frac{(W_p \cdot \tau_{at})^2 \cdot l}{2 \cdot G \cdot I_p} = \frac{\left(\frac{\pi}{16} \cdot d^3 \cdot \tau_{at}\right)^2 \cdot l}{2 \cdot G \cdot \frac{\pi \cdot d^4}{32}} \quad (1.92)$$

$$L = 0{,}25 \cdot \frac{\tau_{t\,max}^2}{G} \cdot V \quad (1.93)$$

$$d_{nec} = \sqrt[3]{\frac{16 \cdot M_t}{\pi \cdot \tau_{at}}} \text{ sau } l_{nec} = \frac{\pi \cdot d^4 \cdot \theta \cdot G}{32 \cdot M_t} \quad (1.94)$$

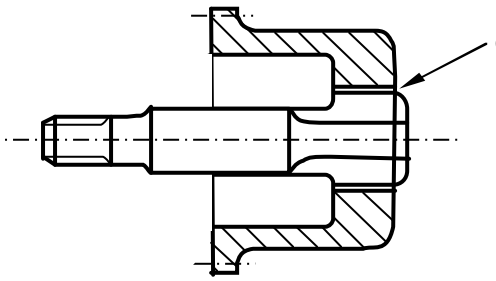
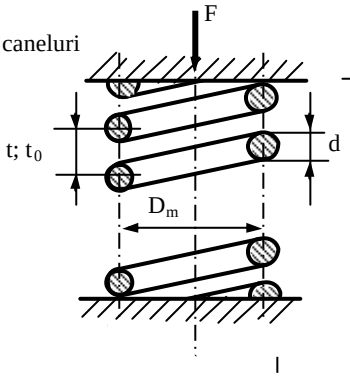
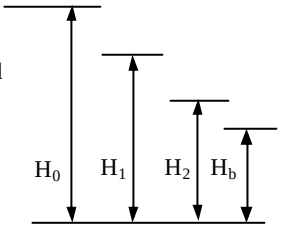


Figura 1.82





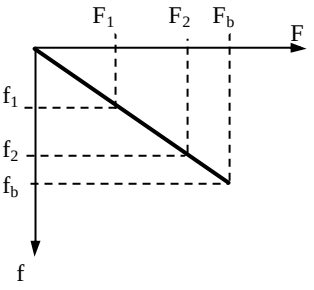


Figura 1.83

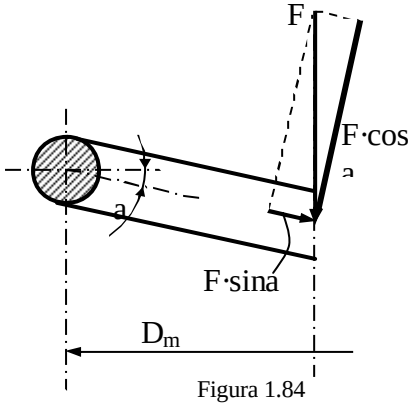
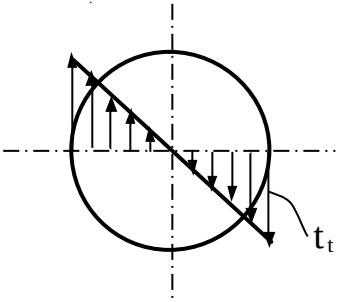


Figura 1.84



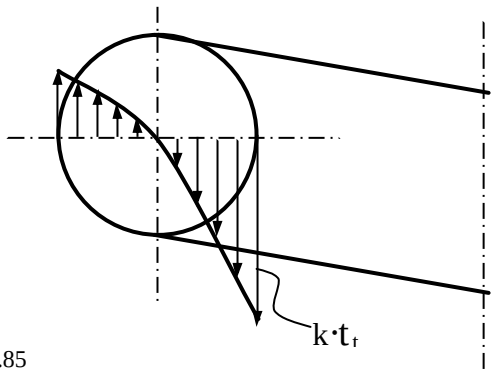


Figura 1.85

$$M_t = \frac{F \cdot \cos\alpha \cdot D_m}{2} \quad (1.95)$$

$$M_i = \frac{F \cdot \sin\alpha \cdot D_m}{2} \quad (1.96)$$

$$F_{\perp} = F \cdot \cos\alpha \tag{1.97}$$

$$F_N = F \cdot \sin\alpha \tag{1.98}$$

$$\tau_t = \frac{M_t}{W_p} = \frac{8 \cdot F \cdot D_m}{\pi \cdot d^3} \tag{1.99}$$

$$\tau_f = \frac{F}{A} = \frac{4 \cdot F}{\pi \cdot d^2}, \tag{1.100}$$

$$\tau = \frac{4 \cdot F}{\pi \cdot d^2} \cdot \left(2 \cdot \frac{D_m}{d} + 1\right) = \frac{4 \cdot F}{\pi \cdot d^2} \cdot (2 \cdot i + 1), \text{ unde: } i = \frac{D_m}{d} \text{ este indicele arcului (raportul de înfasurare)} \tag{1.101}$$

$$\tau = \tau_t = \frac{8 \cdot F \cdot i}{\pi \cdot d^2} \tag{1.102}$$

$$\tau_{max} = k \cdot \tau \tag{1.103}$$

$$k = \frac{i + 0{,}5}{i - 0{,}5} \tag{1.104}$$

$$\tau_{max} = \frac{8 \cdot k \cdot D_m \cdot F}{\pi \cdot d^3} = \frac{8 \cdot k \cdot i \cdot F}{\pi \cdot d^2} \le \tau_a \tag{1.105}$$

$$d_{nec} \ge \sqrt{\frac{8 \cdot k \cdot F \cdot i}{\pi \cdot \tau_{at}}}; \text{ cu } D_m = i \cdot d \tag{1.106}$$

$$f = \frac{D_m}{2} \cdot \theta; \quad \theta = \frac{M_t \cdot l}{G \cdot I_p} \tag{1.107}$$

$$f = \frac{8 \cdot F \cdot i^3 \cdot n}{G \cdot d} \tag{1.108}$$

$$c = \frac{G \cdot d^4}{8 \cdot n \cdot D_m^3} \tag{1.109}$$

$$n = \frac{f \cdot G \cdot d^4}{8 \cdot D_m^3 \cdot F} \tag{1.110}$$

$$W = \frac{F \cdot f}{2} \tag{1.111}$$

$$F = \frac{\pi \cdot d^3 \cdot \tau_a}{8 \cdot D_m} \text{ (pentru } k = 1\text{)}$$
$$F = \frac{\pi \cdot d^2 \cdot \tau_a}{8 \cdot k \cdot D_m} \text{ (pentru } k \text{ real)} \tag{1.112}$$

$$f = \frac{M_t \cdot \pi \cdot D_m \cdot n}{G \cdot I_p} = \frac{F \cdot \frac{D_m}{2} \cdot \pi \cdot D_m \cdot n}{G \cdot I_p} = \frac{\pi \cdot n \cdot D_m^2 \cdot F}{2 \cdot G \cdot I_p} \tag{1.113}$$

$$W = \left(\frac{0{,}25}{k^2}\right) \cdot \frac{\tau_{max}^2}{G} \cdot V \tag{1.114}$$

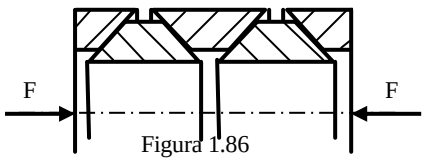
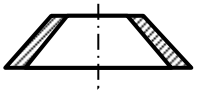
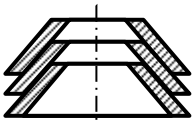
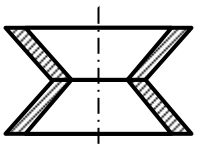
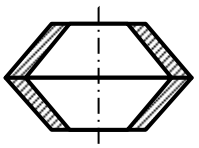


Figura 1.86


1.87.a


1.87.b


1.87.c


1.87.d

$$\sigma_{i\,max} = \frac{6 \cdot F \cdot l}{b \cdot h^2} \le \sigma_{ai} \tag{1.115}$$

$$\sigma_{i\,max} = \frac{M_{max}}{W_z} = \frac{6 \cdot F \cdot l}{b \cdot h^2} \le \sigma_{a\,i} \tag{1.116}$$

$$\sigma_{i\,x} = \frac{M_x}{W_{zx}} = \frac{F \cdot x}{W_z \cdot \frac{x}{l}} = \frac{F \cdot l}{W_z} = \sigma_{i\,max} \tag{1.117}$$

$$W_{zx} = \frac{b_x \cdot h_x^2}{l} = W_z \cdot \frac{x}{l} = \frac{b \cdot h^2}{6} \cdot \frac{x}{l} \tag{1.118}$$

$$b_x = b_0 + (b - b_0) \cdot \frac{x}{l} \tag{1.119}$$

$$S_{nec} = \sqrt[3]{\frac{6 \cdot F \cdot l}{\left(\frac{b}{h}\right) \cdot \sigma_{a\,i}}} \tag{1.120}$$

$$f_1 = \frac{F \cdot l^3}{3 \cdot E \cdot I_z};\quad I_z = \frac{b \cdot h^3}{12} \text{ (figura 1.78.a)} \tag{1.121}$$

$$f_2 = \frac{F \cdot l^3}{2 \cdot E \cdot I_z};\quad f_2 > f_1 \text{ (figura 1.78.b)}$$

$$f_3 = \frac{F \cdot l^3}{3 \cdot E \cdot I_z} \cdot \frac{3 \cdot \left(3 \cdot \beta^2 - 4 \cdot \beta + 2 \cdot \beta^2 \cdot \ln \beta\right)}{2 \cdot (1-\beta)^3}; \text{ (figura 1.78.c)}$$

$$f_2 > f_3 > f_1$$

$$L_1 = \frac{1}{18} \cdot \frac{\sigma_{i\max}^2}{E} \cdot V;$$

$$L_2 = \frac{1}{6} \cdot \frac{\sigma_{i\max}^2}{E} \cdot V; \tag{1.122}$$

$$L_3 = \frac{1}{6} \cdot \frac{\left(3 \cdot \beta^2 - 4 \cdot \beta + 1 - 2 \cdot \beta^2 \cdot \ln \beta\right)}{2 \cdot (1-\beta)^3 \cdot (1+\beta)} \cdot \frac{\sigma_{i\max}^2}{E} \cdot V$$

$$E_e = k_e \cdot E \tag{1.123}$$

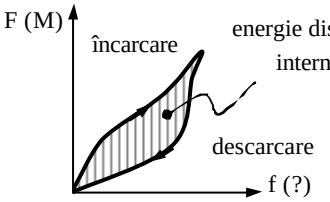


Figura 1.89

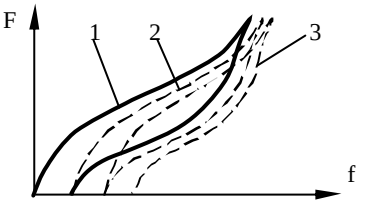


Figura 1.90

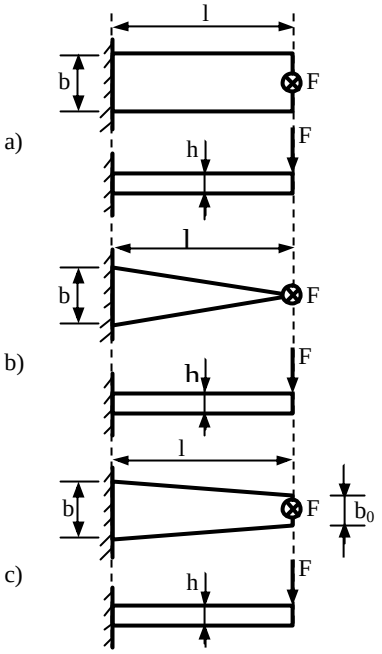
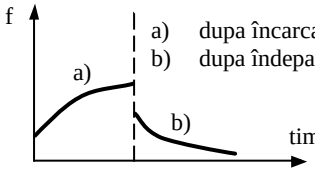


Figura 1.88



a) după încarcare, sub sarcina F = ct;
b) după îndepartarea sarcinii.

Figura 1.91

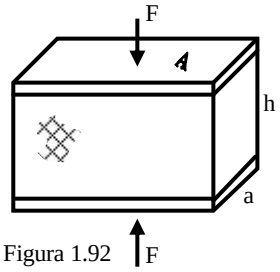


Figura 1.92

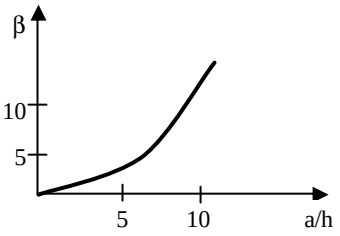


Figura 1.93

$$F = E \cdot \frac{A}{h} \cdot f \tag{1.124}$$

$$F = \beta \cdot E \cdot \frac{A}{h} \cdot f \text{ , unde } \beta = f\left(\frac{a}{h}\right) \text{ cu variatia prezentata în figura 1.93} \tag{1.125}$$

$$\tau_f = \frac{F}{A} = \gamma \cdot G;\quad \gamma = \frac{F}{A \cdot G}\ tg\gamma = \frac{f}{s} \tag{1.126}$$

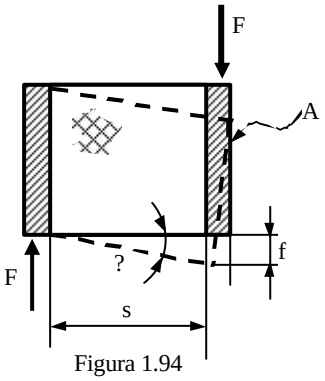


Figura 1.94

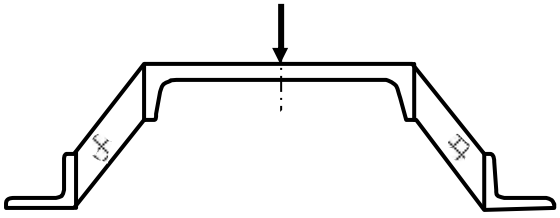


Figura 1.95

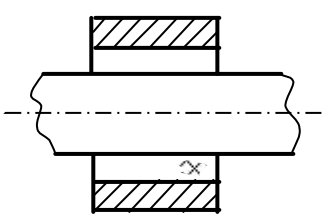


Figura 1.96

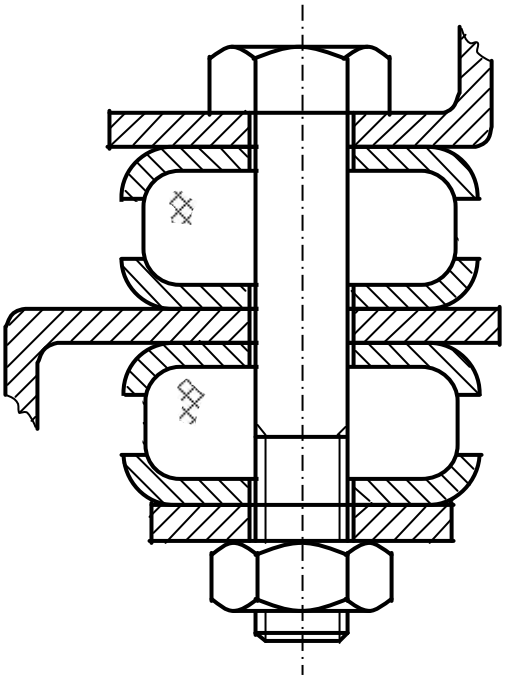


Figura 1.97