

# ANGRENAJE

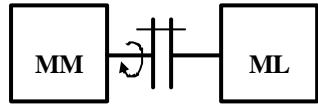


Figura 1.1.a

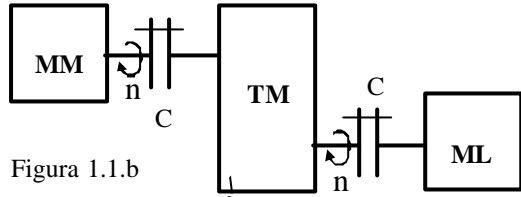


Figura 1.1.b

1

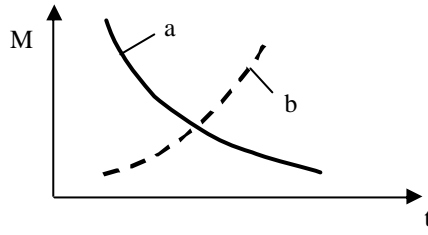


Figura 1.2.a

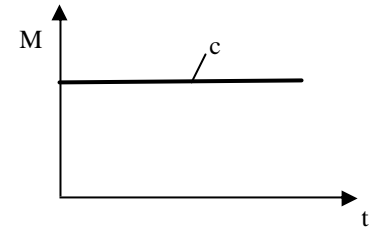


Figura 1.2.b

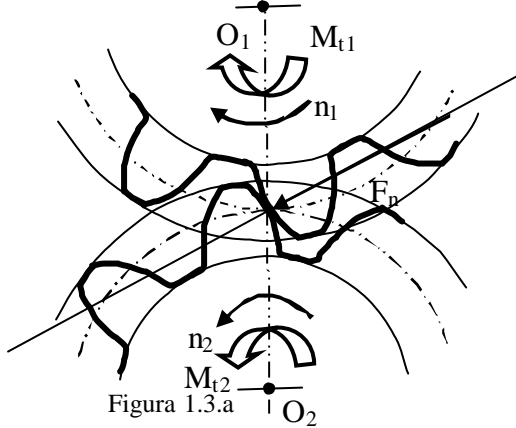


Figura 1.3.a

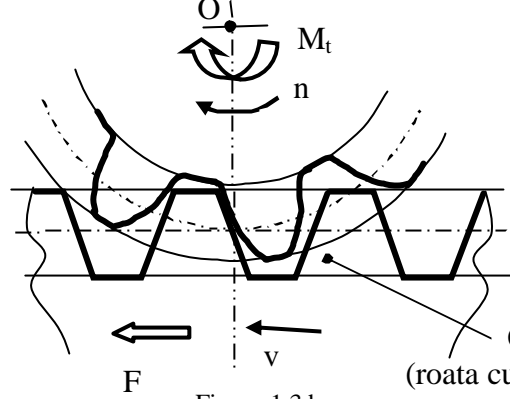


Figura 1.3.b

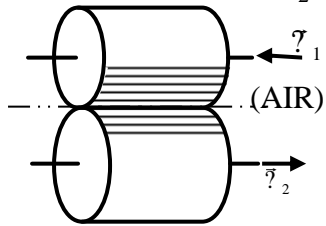


Figura 1.4.a

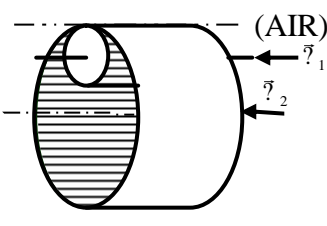


Figura 1.4.b

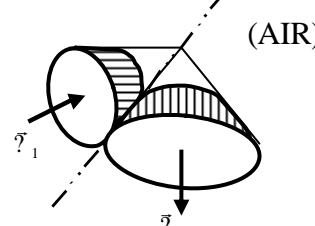
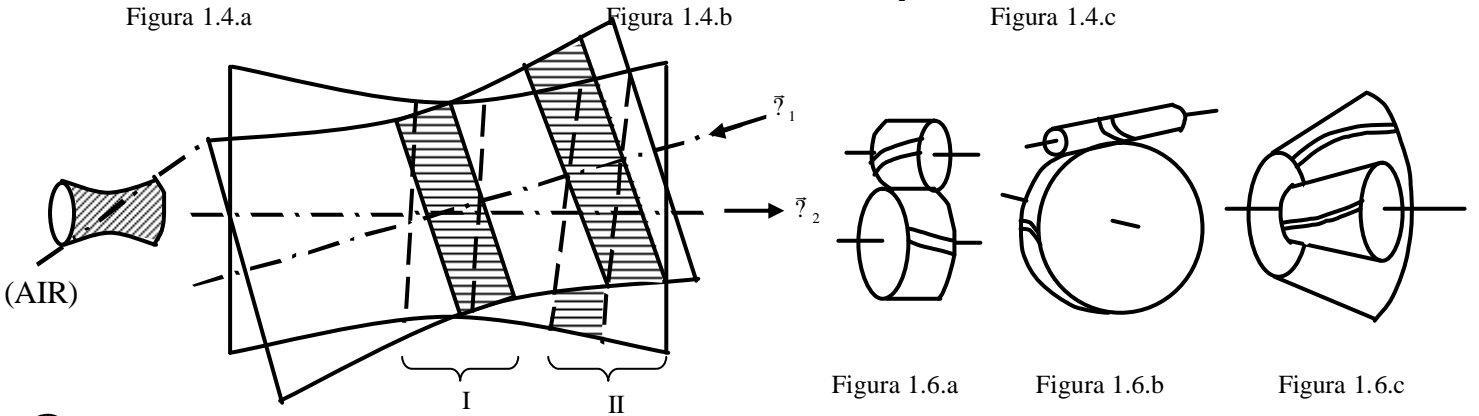


Figura 1.4.c



Ⓘ ROTI ELICOIDALE

Figura 1.5

Ⓜ ROTI HIPOIDE

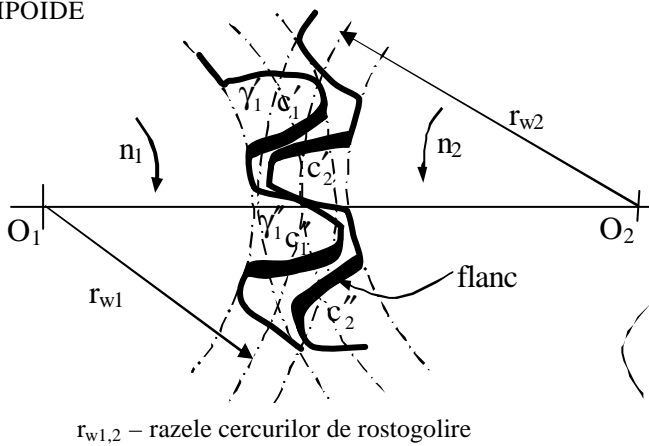


Figura 1.7.a

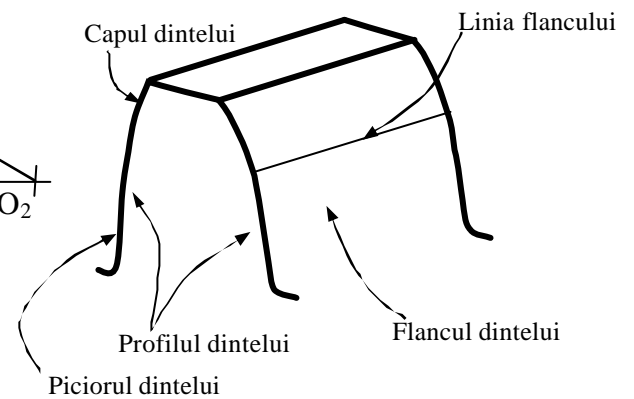
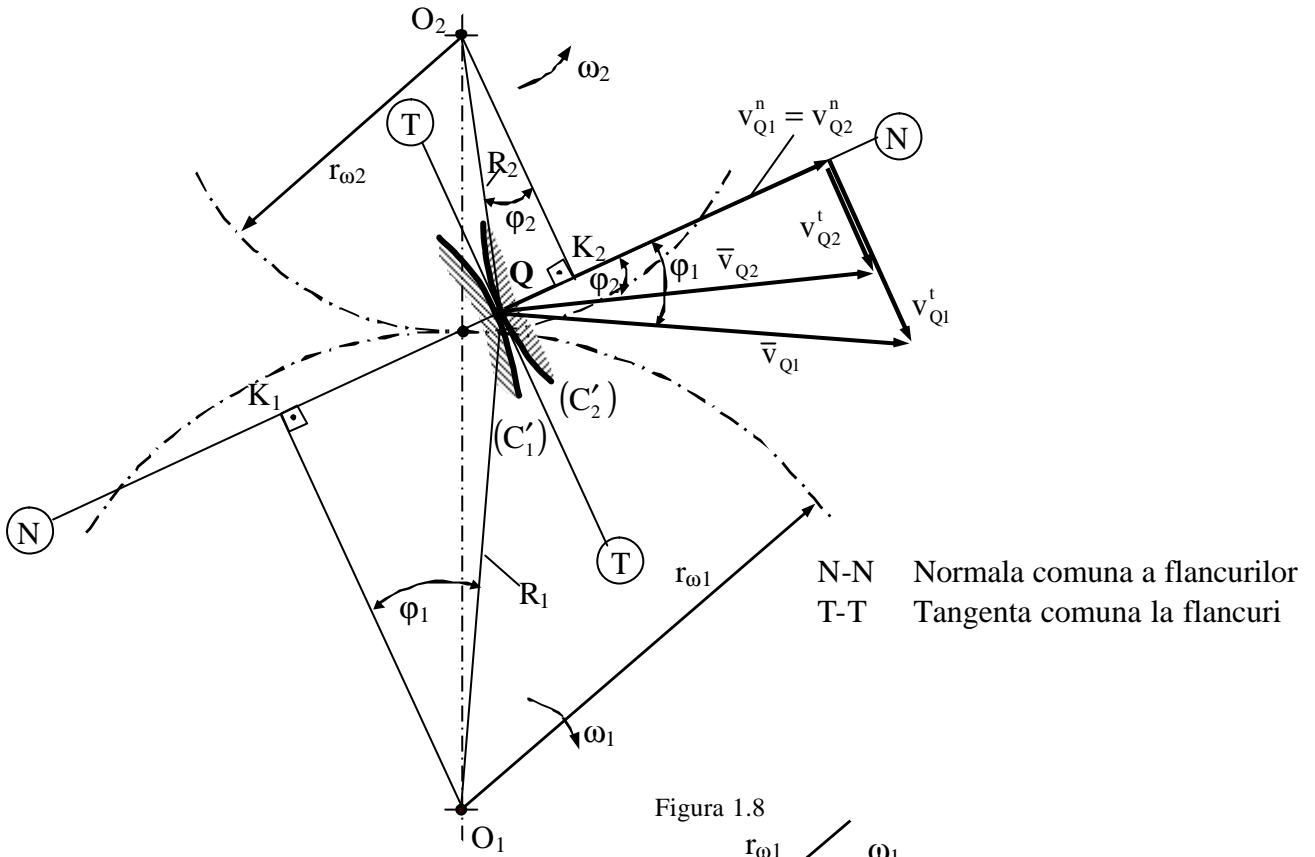


Figura 1.7.b

$r_{w1,2}$  – razele cercurilor de rostogolire



N-N Normala comuna a flancurilor  
T-T Tangenta comuna la flancuri

Figura 1.8

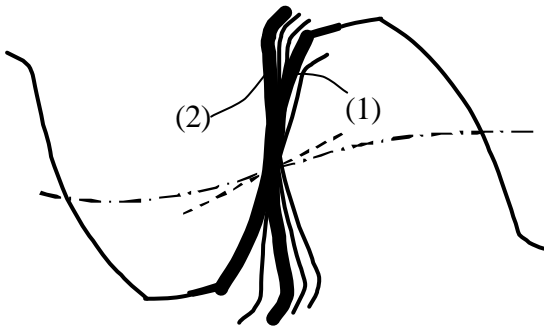


Figura 1.9

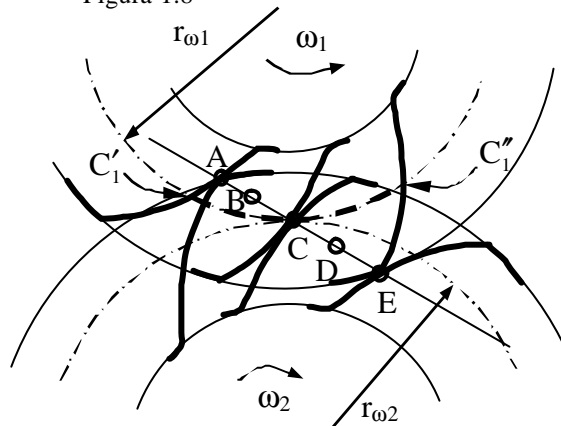


Figura 1.10

$$r_x = \frac{r_b}{\cos \alpha_x} \tag{1.1}$$

$$r_b \cdot (\theta_x + \alpha_x) = r_b \cdot \text{tg} \alpha_x \tag{1.2}$$

$$\theta_x = \text{tg} \alpha_x - \alpha_x \tag{1.3}$$

$$\text{inv} \alpha_x = \text{tg} \alpha_x - \alpha_x \tag{1.4}$$

$$\rho_x = |\overline{TX}| = r_b \cdot \text{tg} \alpha_x \tag{1.5}$$

$$p_x = \frac{p_b}{\cos \alpha_x} \tag{1.6}$$

$$i_{1-2} = \frac{\omega_1}{\omega_2} = \frac{r_{w2}}{r_{w1}} = \frac{r_{b2}}{r_{b1}} = \text{ct.} \tag{1.7}$$

$$\cos \alpha_w = \frac{r_{b1}}{r_{w1}} = \frac{r_{b2}}{r_{w2}} \tag{1.8}$$

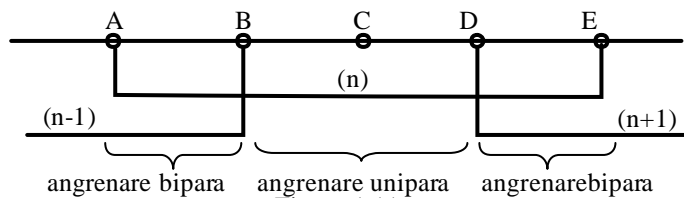


Figura 1.11

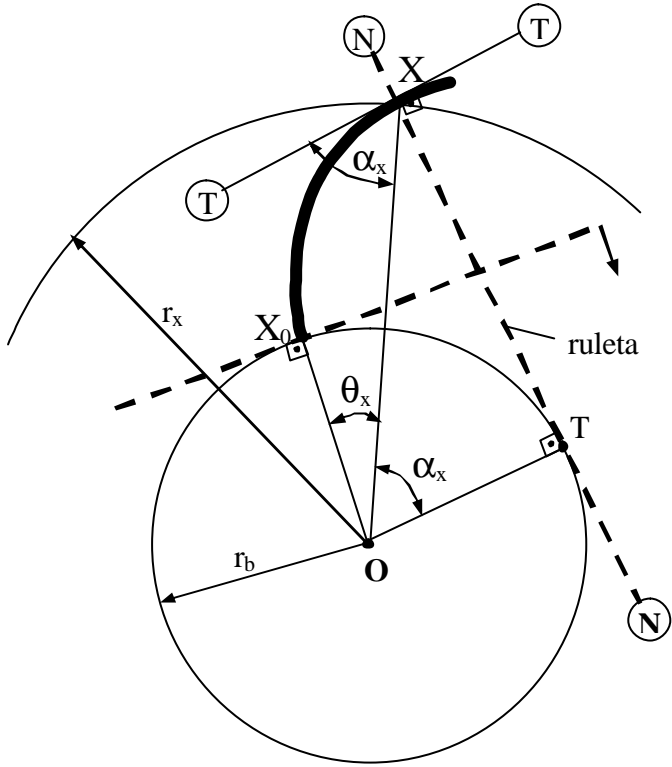


Figura 1.12

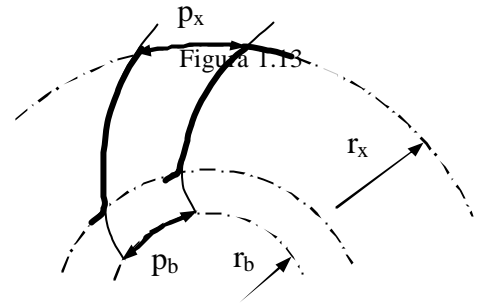
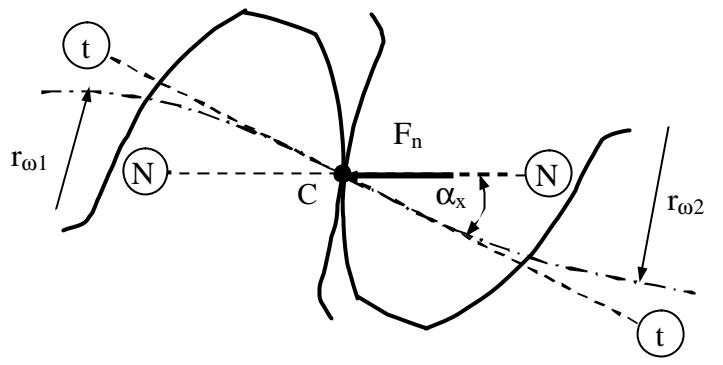


Figura 1.14

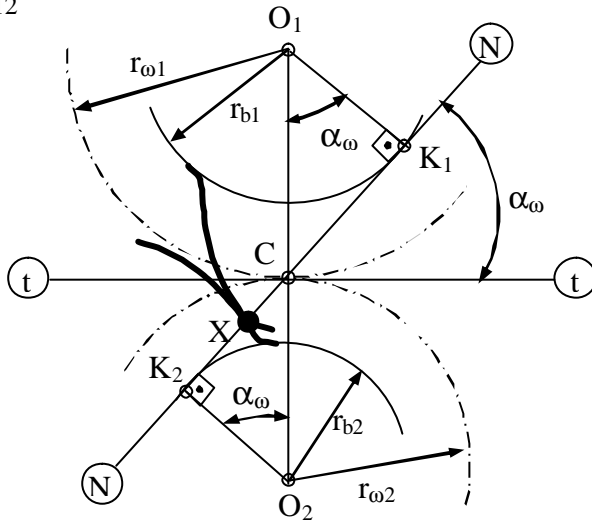


Figura 1.15

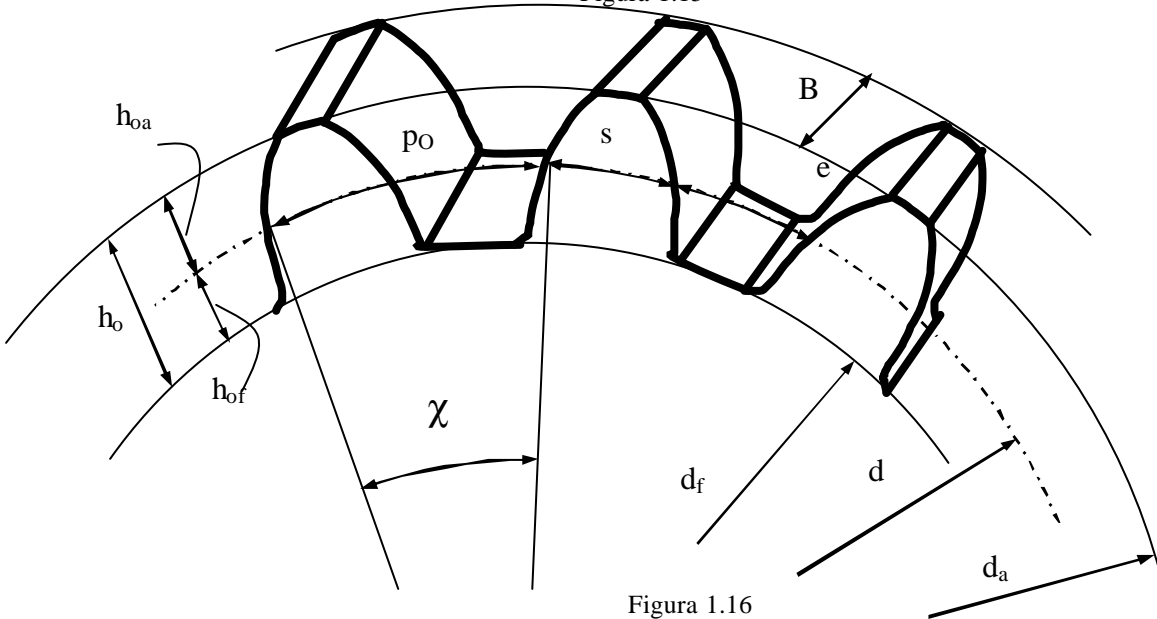


Figura 1.16

Modulul  $m$  poate fi obținut din relațiile  $p_o \cdot z = \pi \cdot d$ , respectiv  $m = p / \pi$  și  $m = d / z$ . Valorile modulului sunt standardizate prin STAS 822 – 82. Modulul standardizat permite reducerea numărului sculelor de danturat și asigură interschimbabilitatea roților dinate. La roți dinate cilindrice cu dantura dreaptă și la cele cu dantura înclinată, modulul standardizat se regăsește într-un plan normal pe dinte. La roți conice, modulul standardizat este modulul maxim. La angrenaje melcate, modulul axial este cel care se standardizează. Având această mărime se mai pot calcula:

- diametrul de divizare  $d = m \cdot z$ ;
- diametrul de cap  $d_a = d + 2 \cdot h_{oa}$ ;
- diametrul de picior  $d_f = d - 2 \cdot h_{of}$ ;
- înălțimea capului dintelui  $h_{oa} = h_{oa}^* \cdot m$ ;
- înălțimea piciorului dintelui  $h_{of} = h_{of}^* \cdot m$ ;
- înălțimea dintelui  $h_o = h_{oa} + h_{of}$ ;
- înălțimea de referință a capului dintelui  $h_{oa}^* = 1$ ;
- înălțimea piciorului dintelui  $h_{of}^* = 1,25$ .

Cercul de divizare este un cerc de rostogolire la prelucrare.

Elementele geometrice ale danturii drepte sunt definite de profilul standardizat numit cremaliera de referință (STAS 821 – 82). Negativ acestui profil se numește cremaliera generatoare care se materializează prin taisyul activ, drept, al sculelor de danturat. Ambele cremalieri sunt reprezentate în figura 1.17.

În figura 1.17 identificăm următoarele elemente geometrice importante:

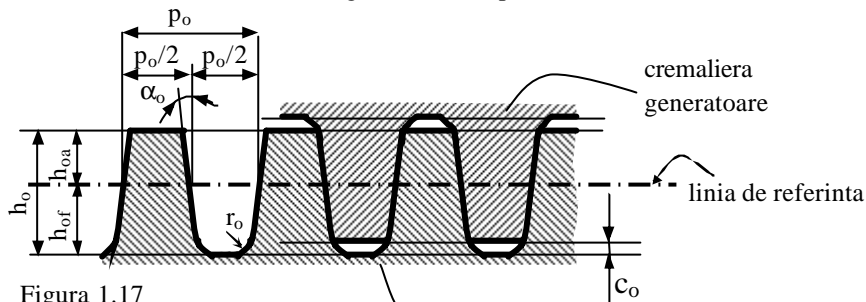


Figura 1.17

- unghiul profilului de referință  $\alpha_o = 20^\circ$ ;
- pasul de referință  $p_o = \pi \cdot m$ ;
- înălțimea capului de referință  $h_{oa} = h_{oa}^* \cdot m$ ;
- înălțimea piciorului de referință  $= h_{of}^* \cdot m$ ;
- jocul de referință la cap  $c_o = c_o^* \cdot m$ ;
- înălțimea dintelui de referință  $h_o = h_{oa} + h_{of}$

în care:  $h_{oa}^* = 1$ ;  $h_{of}^* = 1,25$ ;  $c_o^* = 0,25$ . Se remarcă faptul că muchiile sculelor aschiitoare sunt drepte, ceea ce înseamnă că sunt cele mai ieftine cu putinta.

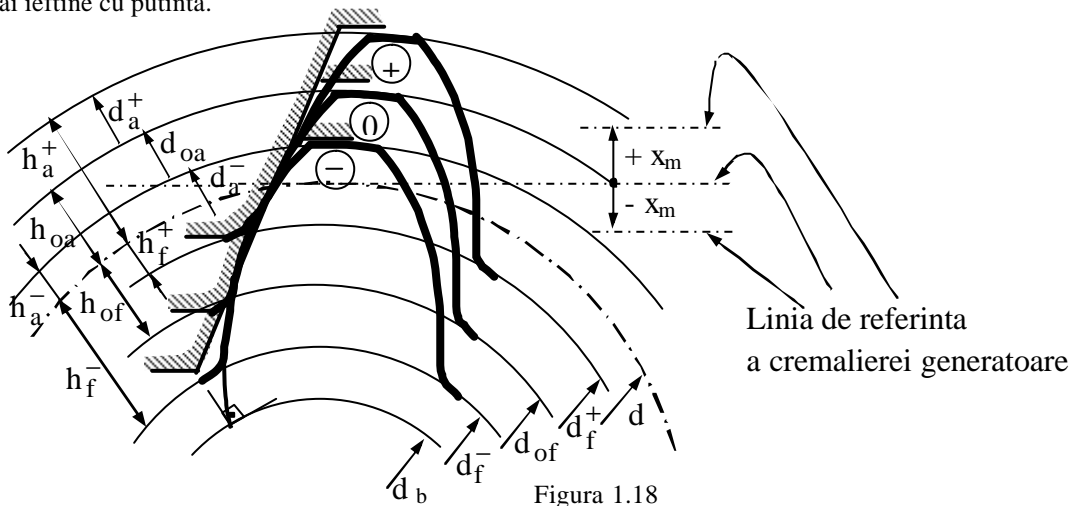


Figura 1.18

$$s_o = m \cdot \frac{\pi}{2} \quad (1.9)$$

$$s^- = s_o - 2 \cdot x \cdot m \cdot \operatorname{tg} \alpha_o; \quad s^- = m \cdot \left( \frac{\pi}{2} - 2 \cdot x \cdot \operatorname{tg} \alpha_o \right) \quad (1.10)$$

$$s^+ = s_o + 2 \cdot x \cdot m \cdot \operatorname{tg} \alpha_o; \quad s^+ = m \cdot \left( \frac{\pi}{2} + 2 \cdot x \cdot \operatorname{tg} \alpha_o \right) \quad (1.11)$$

$$\epsilon_o = m \cdot \frac{\pi}{2} \quad (1.12)$$

$$e^- = e_o + 2 \cdot x \cdot m \cdot \operatorname{tg} \alpha_o; \quad e^- = m \cdot \left( \frac{\pi}{2} + 2 \cdot x \cdot \operatorname{tg} \alpha_o \right) \quad (1.13)$$

$$e^+ = e_0 - 2 \cdot x \cdot m \cdot \operatorname{tg} \alpha_0; \quad e^+ = m \cdot \left( \frac{\pi}{2} - 2 \cdot x \cdot \operatorname{tg} \alpha_0 \right) \quad (1.14)$$

Tabelul 1.1

DANTURA PLUS	DANTURA ZERO	DANTURA MINUS
$h_a^+ = m \cdot (h_{oa}^* + x)$	$h_{oa} = m \cdot h_{oa}^* = m$	$h_a^- = m \cdot (h_{oa}^* - x)$
$h_f^+ = m \cdot (h_{of}^* - x)$	$h_{of} = m \cdot h_{of}^* = 1,25 \cdot m$	$h_f^- = m \cdot (h_{of}^* + x)$
$h^+ = h_a^+ + h_f^+ = 2,25 \cdot m$	$h_o = m \cdot (h_{oa}^* + h_{of}^*) = 2,25 \cdot m$	$h^- = h_a^- + h_f^- = 2,25 \cdot m$
$d = m \cdot z$	$d = m \cdot z$	$d = m \cdot z$
$d_w^+ = d \cdot \cos \alpha_0 / \cos \alpha_w$	$d_w = d$	$d_w^- = d \cdot \cos \alpha_0 / \cos \alpha_w$
$d_a^+ = d + 2 \cdot h_a^+$	$d_a = d + 2 \cdot h_{oa}$	$d_a^- = d + 2 \cdot h_a^-$
$d_f^+ = d - 2 \cdot h_f^+$	$d_f = d - 2 \cdot h_{of}$	$d_f^- = d - 2 \cdot h_f^-$

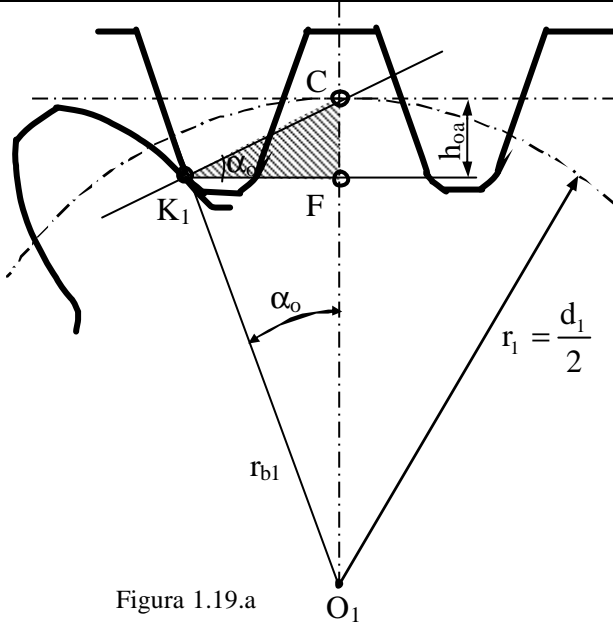


Figura 1.19.a

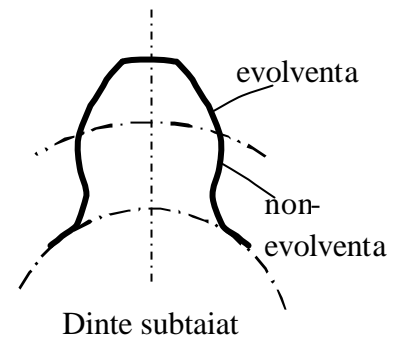


Figura 1.19.b

$$h_{0a} = CK_1 \cdot \sin \alpha_0 = d_1 \cdot \sin \frac{\alpha_0^2}{2} = m \cdot z_{1\min} \cdot \sin \frac{\alpha_0^2}{2} \quad (1.15)$$

$$z_{1\min} = 2 \cdot \frac{h_{0a}}{m} \cdot \sin \alpha_0^2 = 2 \cdot \frac{h_{0a}^*}{\sin \alpha_0^2} = \frac{2}{\sin \alpha_0^2} \quad (1.16)$$

Pentru unghiul de referință  $\alpha_0 = 20^\circ$  standardizat, se obține numărul minim teoretic de dinți al unei roti care se poate prelucra fără subtaiere și anume:  $z_{1\min} \cong 17$  dinți (1.17)

$$z_{1\min \text{ practic}} = \frac{5}{6} \cdot z_{1\min} \cong 14 \text{ dinți} \quad (1.18)$$

$$d_{A1} = \frac{d_{b1}}{\cos \alpha_{A1}} \quad (1.19)$$

$$d_{E2} = \frac{d_{b2}}{\cos \alpha_{E2}} \quad (1.20)$$

$$\operatorname{tg} \alpha_{A1} = 2 \cdot \pi \cdot \frac{(\varepsilon_a - \varepsilon_2)}{z_1} \quad (1.21)$$

$$\operatorname{tg} \alpha_{E2} = 2 \cdot \pi \cdot \frac{(\varepsilon_a - \varepsilon_2)}{z_2} \quad (1.22)$$

$$\varepsilon_\alpha = \varepsilon_1 + \varepsilon_2 - \varepsilon_a \quad (1.23)$$

$$\varepsilon_1 = \frac{(d_{a1}^2 - d_{b1}^2)^{\frac{1}{2}}}{2 \cdot \pi \cdot m \cdot \cos \alpha_0} \quad (1.24)$$

$$\varepsilon_2 = \frac{(d_{a2}^2 - d_{b2}^2)^{\frac{1}{2}}}{2 \cdot \pi \cdot m \cdot \cos \alpha_0} \quad (1.25)$$

$$\varepsilon_a = a \cdot \frac{\sin \alpha_0}{\pi \cdot m \cdot \cos \alpha_0} \quad (1.26)$$

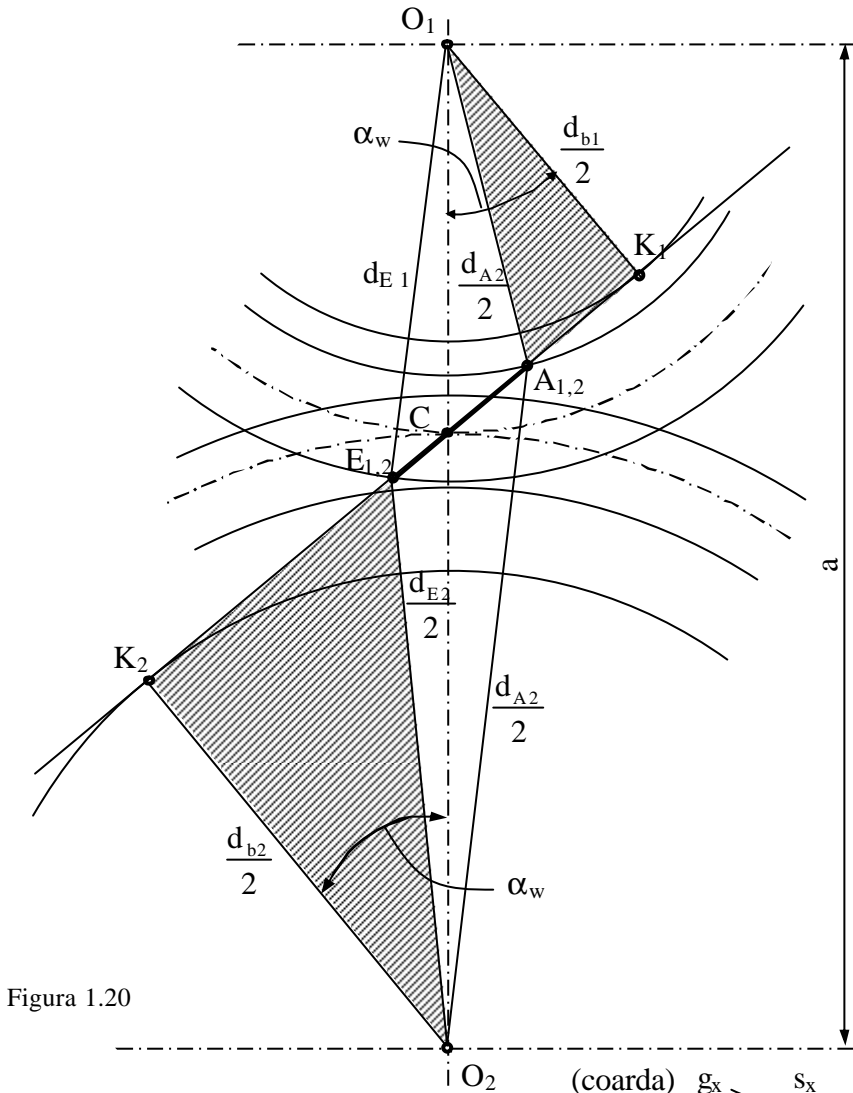


Figura 1.20

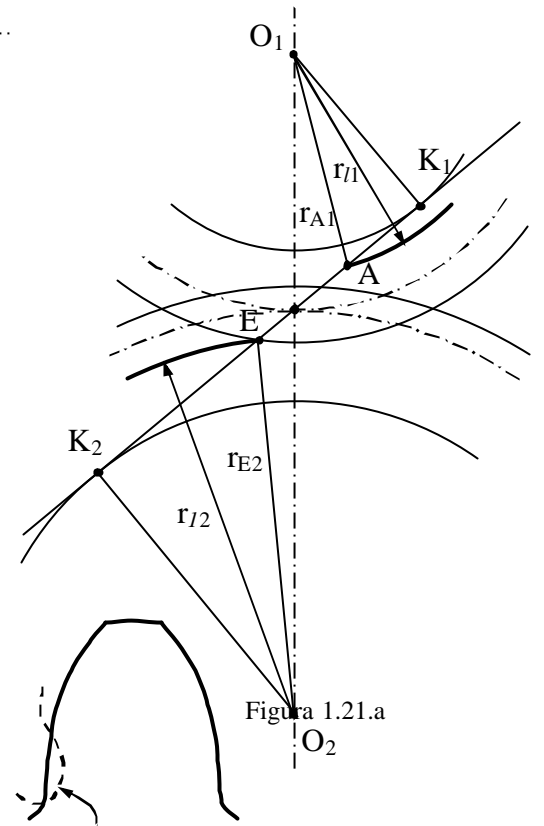


Figura 1.21.a

curba dupa care se produce uzura daca exista interferenta

Figura 1.21.b

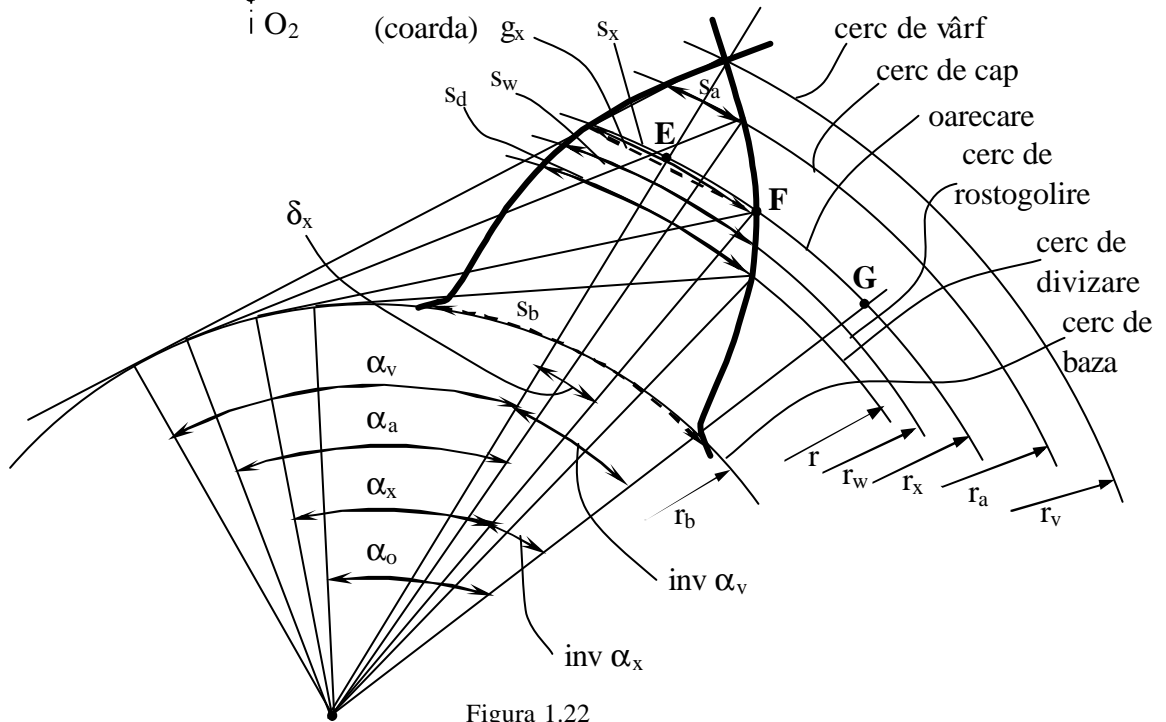


Figura 1.22

$$d_{11,2} = d_{b1,2} \cdot \left\{ 1 + \left[ \operatorname{tg} \alpha_0 - 2 \cdot \frac{(1 - x_{1,2})}{z_{1,2} \cdot \cos \alpha_0 \cdot \sin \alpha_0} \right]^2 \right\}^{\frac{1}{2}} \quad (1.27)$$

$$dA1 \geq dl 1 \quad (1.28)$$

$$dE2 \geq dl 2 \quad (1.29)$$

$$x_{nec} = \frac{(z_{min} - z)}{z_{min}}; \quad z < z_{min} \quad \text{si} \quad z_{min} = 17 \quad (1.30)$$

$$\frac{s_x}{2} = r_x \cdot \text{inv}\alpha_v - r_x \cdot \text{inv}\alpha_x \quad (1.31)$$

$$s_d = 2 \cdot r \cdot (\text{inv}\alpha_v - \text{inv}\alpha_0) \quad (1.32)$$

$$r_w = r \cdot \frac{\cos\alpha_0}{\cos\alpha_w} \quad (1.33)$$

$$r_x = r \cdot \frac{\cos\alpha_0}{\cos\alpha_x} \quad (1.34)$$

$$s_d^+ = s^+ = \frac{p_0}{2} + 2 \cdot x \cdot m \cdot \text{tg}\alpha_0 = m \cdot \left( \frac{\pi}{2} + 2 \cdot x \cdot \text{tg}\alpha_0 \right) \quad (1.35)$$

$$2 \cdot r \cdot (\text{inv}\alpha_v - \text{inv}\alpha_0) = m \cdot \left( \frac{\pi}{2} + 2 \cdot x \cdot \text{tg}\alpha_0 \right) \quad (1.36)$$

$$\text{inv}\alpha_v = \frac{1}{z} \cdot \left( \frac{\pi}{2} + 2 \cdot x \cdot \text{tg}\alpha_0 \right) + \text{inv}\alpha_0 \quad (1.37)$$

$$s_x = 2 \cdot r_x \cdot \left\{ \frac{\left[ \frac{\pi}{2} + 2 \cdot x \cdot \text{tg}\alpha_0 \right]}{z} + \text{inv}\alpha_0 - \text{inv}\alpha_x \right\} \quad (1.38)$$

$$s_x = m \cdot z \cdot \cos\alpha_0 \cdot \frac{\left\{ \frac{\left[ \frac{\pi}{2} + 2 \cdot x \cdot \text{tg}\alpha_0 \right]}{z} + \text{inv}\alpha_0 - \text{inv}\alpha_x \right\}}{\cos\alpha_x} \quad (1.39)$$

$$g_x = 2 \cdot r_x \cdot \sin\delta_x = 2 \cdot r_x \cdot \frac{\sin(\text{inv}\alpha_v - \text{inv}\alpha_x)}{\cos\alpha_x} \quad (1.40)$$

$$p_{w1} = p_{w2} = p_w = p_0 \cdot \frac{\cos\alpha_0}{\cos\alpha_w} = \pi \cdot m \cdot \frac{\cos\alpha_0}{\cos\alpha_w} \quad (1.41)$$

$$s_{w1} = m \cdot z_1 \cdot \cos\alpha_0 \cdot \left\{ \frac{\left[ \frac{\pi}{2} + 2 \cdot x_1 \cdot \text{tg}\alpha_0 \right]}{z_1} + \text{inv}\alpha_0 - \text{inv}\alpha_w \right\} \cdot \frac{1}{\cos\alpha_w} \quad (1.42)$$

$$e_{w2} = m \cdot z_2 \cdot \cos\alpha_0 \cdot \left\{ \frac{\left[ \frac{\pi}{2} - 2 \cdot x_2 \cdot \text{tg}\alpha_0 \right]}{z_2} - \text{inv}\alpha_0 + \text{inv}\alpha_w \right\} \cdot \frac{1}{\cos\alpha_w} \quad (1.43)$$

$$x_1 + x_2 = (z_1 + z_2) \cdot \frac{(\text{inv}\alpha_w - \text{inv}\alpha_0)}{2} \cdot \text{tg}\alpha_0 \quad (1.44)$$

$$a_0 = r_1 + r_2 = m \cdot \frac{(z_1 + z_2)}{2} \quad (1.45)$$

$$a = r_{w1} + r_{w2} = m \cdot \frac{(z_1 + z_2)}{2} \cdot \frac{\cos\alpha_0}{\cos\alpha_w} \quad (1.46)$$

$$c = a - (r_{a1} - r_{f2}) \quad \text{sau} \quad c = a - (r_{a2} - r_{f1}) \quad (1.47)$$

$$c = a_0 \cdot \left( \frac{\cos\alpha_0}{\cos\alpha_w} - 1 \right) + c_0 - m \cdot (x_1 + x_2) \quad (1.48)$$

$$v_{Q1}^t = K_1 Q \cdot \omega_1 = \rho_1 \cdot \omega_1 \quad (1.49)$$

$$v_{Q2}^t = K_2 Q \cdot \omega_2 = \rho_2 \cdot \omega_2 \quad (1.50)$$

$$v_a = v_{Q1}^t - v_{Q2}^t; \quad v_a = \rho_1 \cdot \omega_1 - \rho_2 \cdot \omega_2 \quad (1.51)$$

$$v_a = \pm q \cdot (\omega_1 + \omega_2) \quad (1.52)$$

$$x_{\min} = \frac{z_{\min} - z}{z_{\min}} \tag{1.53}$$

$$x_1 + x_2 = (z_1 + z_2) \cdot \frac{(\text{inv}\alpha_w - \text{inv}\alpha_0)}{2 \cdot \text{tg}\alpha_0} \tag{1.54}$$

$$\cos\alpha_w = \frac{a_0 \cdot \cos\alpha_0}{a} \tag{1.55}$$

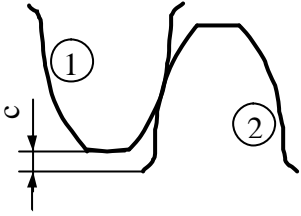


Figura 1.23

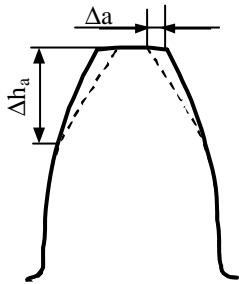


Figura 1.25.a

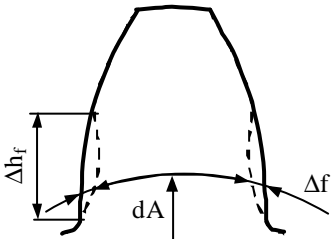


Figura 1.25.b

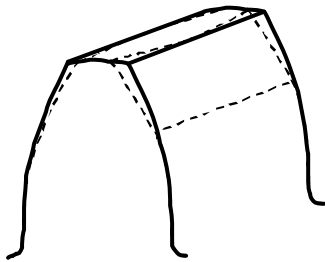


Figura 1.25.c

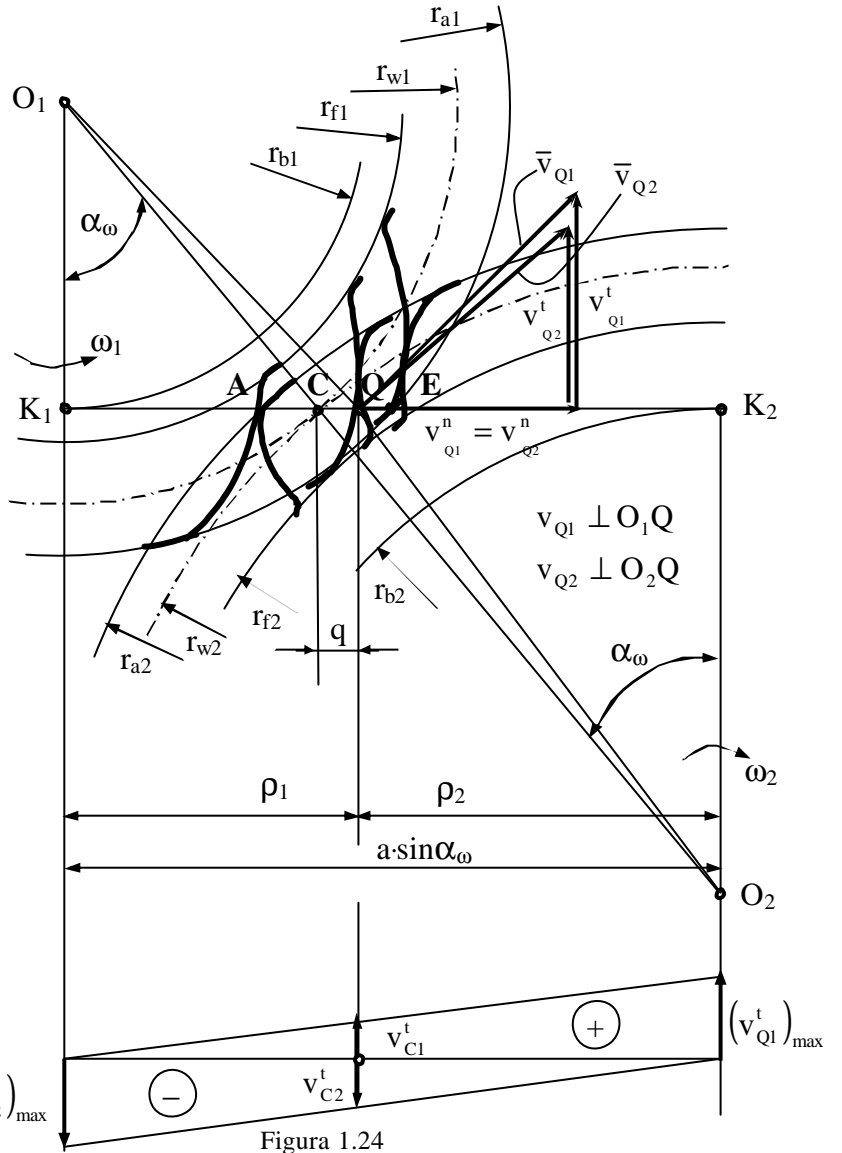


Figura 1.24

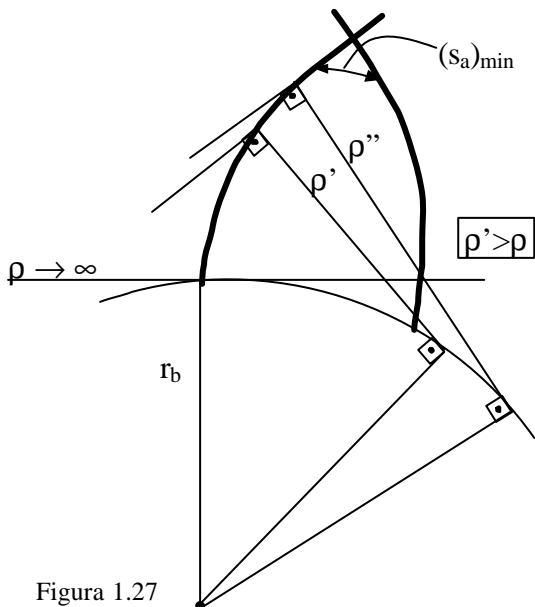


Figura 1.27

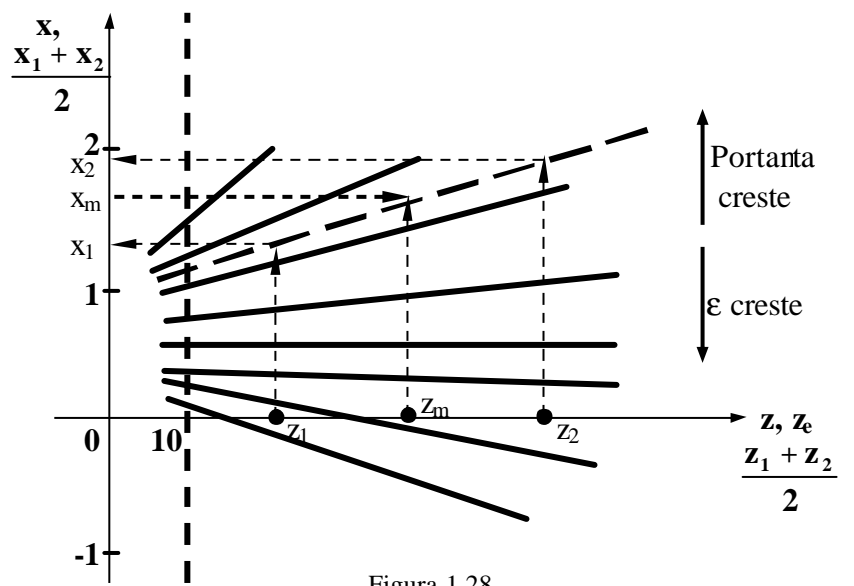


Figura 1.28



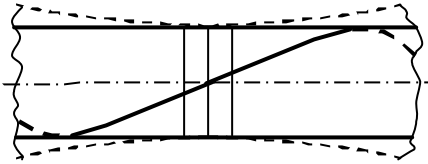


Figura 1.29

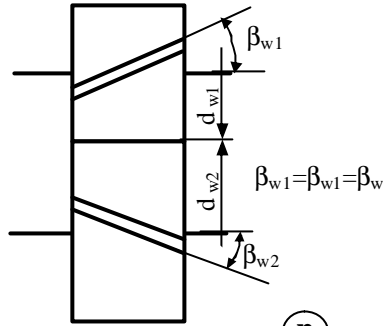


Figura 1.30

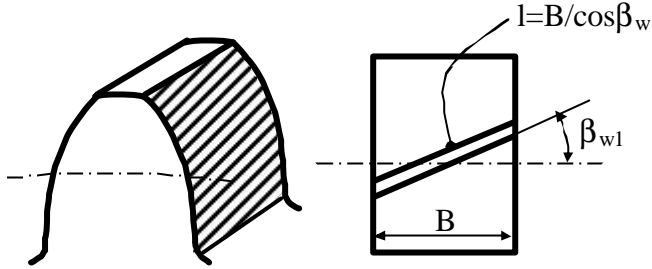


Figura 1.31

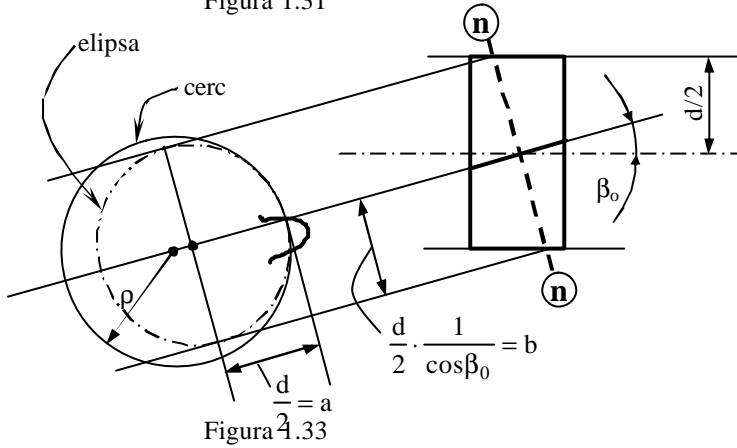


Figura 1.33

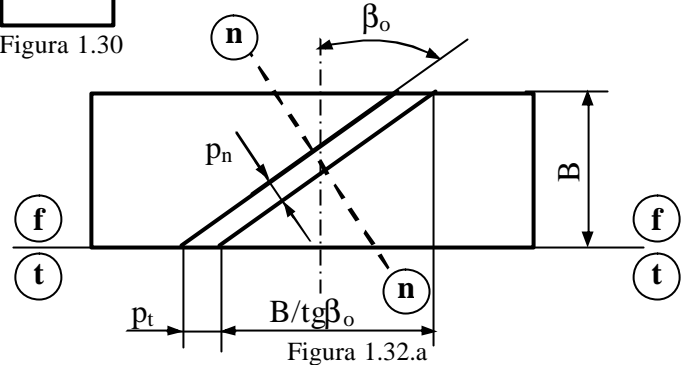


Figura 1.32.a

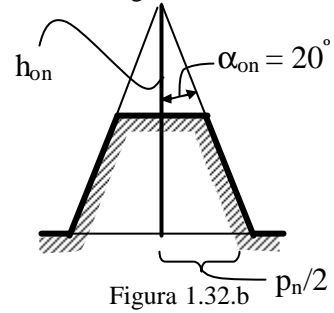


Figura 1.32.b

$$p_t = \frac{p_n}{\cos \beta_0} \quad (1.56)$$

$$m_t = \frac{m_n}{\cos \beta_0} \quad (1.57)$$

$$h_{0n} = h_{0t} = \frac{p_n}{2} \cdot \operatorname{tg} \alpha_{0n} = \frac{p_t}{2} \cdot \cos \beta_0 \cdot \operatorname{tg} \alpha_{0n}; \quad \alpha_{0n} = \alpha_0 = 20^\circ \quad (1.58)$$

$$\operatorname{tg} \alpha_{0t} = \frac{\operatorname{tg} \alpha_{0n}}{\cos \beta_0} \quad (1.59)$$

$$h_{0a} = h_{0a}^* \cdot m_n; \quad h_{0a}^* = 1 \text{ pentru } x = 0 \quad (1.60)$$

$$h_{0f} = h_{0f}^* \cdot m_n; \quad h_{0f}^* = 1,25 \text{ pentru } x = 0 \quad (1.61)$$

$$h_0 = h_{0a} + h_{0f} \quad (1.62)$$

$$\rho = \frac{b^2}{a} = \frac{d}{2 \cdot \cos^2 \beta_0}; \quad \rho = m_t \cdot \frac{z}{2 \cdot \cos^2 \beta_0} \quad (1.63)$$

$$\rho = m_n \cdot \frac{z_{\text{ech}}}{2 \cdot \cos^3 \beta_0} \quad (1.64)$$

$$z_{\text{ech}} = \frac{z}{\cos^3 \beta_0} \quad (1.65)$$

**Date de intrare pentru calculul angrenajului:**  $z_1$  și  $z_2$ ;  $m_h$  (standardizat, după ce a fost predimensionat din calculul la oboseala prin încovoiere la piciorul dintelui);  $\beta_0$ ;  $a_w$  (valoare impusă prin standardizare, după predimensionarea la solicitarea de oboseala superficială de contact);  $h_{0a}^* = 1$ ;  $c_0^* = 0,25$ ;  $\alpha_{0n} = 20^\circ$ .

**Marimi calculate :**

- Distanța de referință dintre axe pentru angrenajul fără deplasare de profil:

$$a = m_n \cdot \frac{(z_1 + z_2)}{2 \cdot \cos \beta_0} \quad (1.66)$$

- Unghiul de presiune de referință în plan frontal:

$$\alpha_t = \operatorname{arctg} \frac{\operatorname{tg} \alpha_n}{\cos \beta_0} \quad (1.67)$$

- Unghiul real de angrenare în plan frontal, cu respectarea distanței impuse dintre axe ( $a_w$ ), necesitând deplasarea danturii:

$$\alpha_{wt} = \arccos \frac{a \cdot \cos \alpha_t}{a_w} \quad (1.68)$$

- Numerele de dinti ale rotilor echivalente:

$$z_{n1,2} = \frac{z_{1,2}}{\cos^3 \beta_0} \quad (1.69)$$

- Suma coeficientilor deplasariilor de profil în plan normal:

$$x_{n1} + x_{n2} = (\text{inv } \alpha_{wt} - \text{inv } \alpha_t) \cdot \frac{z_1 + z_2}{2 \cdot \text{tg } \alpha_n} \quad (1.70)$$

- Coeficientii minimi ai deplasariilor de profil în plan normal, pentru evitarea subtaierii:

$$x_{n1 \min} = \frac{(17 - z_{n1})}{17} \quad \text{si} \quad x_{n2 \min} = \frac{(17 - z_{n2})}{17} \quad (1.71)$$

$$\text{cu verificarile: } x_{n1} \geq x_{n1 \min}, \text{ respectiv } x_{n2 \min} \geq x_{n2}. \quad (1.72)$$

- Diametrele cercurilor de divizare:

$$d_{1,2} = m_n \cdot z_{1,2} \quad (1.73)$$

- Diametrele cercurilor de baza:

$$d_{b1,2} = d_{1,2} \cdot \cos \alpha \quad (1.74)$$

- Diametrele cercurilor de rostogolire:

$$d_{w1,2} = d_{1,2} \cdot \frac{\cos \alpha_t}{\cos \alpha_{wt}} \quad (1.75)$$

- Diametrele cercurilor de picior:

$$d_{f1,2} = m_n \cdot \left[ \frac{z_{1,2}}{\cos \beta_0} - 2 \cdot (h_{0a}^* + c_0^* - x_{n1,2}) \right] \quad (1.76)$$

- Diametrele cercurilor de cap:

$$d_{a1,2} = m_n \cdot \left[ \frac{z_{1,2}}{\cos \beta_0} + 2 \cdot (h_{0a}^* + x_{n1,2}) \right] \quad (1.77)$$

- Arcul dintelui pe cercul de divizare în plan normal si în plan frontal:

$$s_{n1,2} = m_n \cdot (0,5 \cdot \pi + 2 \cdot x_{n1,2} \cdot \text{tg } \alpha_n) \quad (1.78)$$

$$s_{t1,2} = s_{n1,2} / \cos \beta_0 \quad (1.79)$$

- Unghiul de presiune al profilului pe cercurile de cap în plan frontal:

$$\alpha_{at1,2} = \arccos \left( d_{1,2} \cdot \frac{\cos \alpha_t}{d_{a1,2}} \right) \quad (1.80)$$

- Unghiul de înclinare a danturii pe cilindrii de cap:

$$\beta_{a1,2} = \arctg \left( d_{a1,2} \cdot \frac{\text{tg } \beta_0}{d_{1,2}} \right) \quad (1.81)$$

- Arcul dintelui pe cercul de cap în plan normal si în plan frontal:

$$s_{an1,2} = d_{a1,2} \cdot \left[ \frac{\frac{\pi}{2} \pm 2 \cdot x_{1,2} \cdot \text{tg } \alpha_n}{z_{1,2}} \pm (\text{inv } \alpha_t - \text{inv } \alpha_n) \right] \quad (1.82)$$

$$s_{an1,2} = \frac{s_{at1,2}}{\cos \beta_{a1,2}} \quad (1.83)$$

- Pentru a nu se produce ruperea vârfului dintelui este necesar ca:

$$s_{an1,2} \geq s_{an \min} \quad \text{în care } s_{an \min} = 0,25 \cdot m_n, \text{ pentru oteluri de îmbunătățire si } s_{an \min} = 0,4 \cdot m_n, \text{ pentru oteluri durificate.} \quad (1.84)$$

- Verificarea gradului de acoperire:

$$\epsilon_\alpha = \left[ (d_{a1}^2 - d_{b1}^2) + (d_{a2}^2 - d_{b2}^2) - 2 \cdot a_w \cdot \sin \alpha_{wt} \right] \cdot \frac{\cos \beta_0}{2 \cdot \pi \cdot m_n \cdot \cos \alpha_t} \quad (1.85)$$

$$\epsilon_\beta = B \cdot \frac{\sin \beta_0}{\pi \cdot m_n} \quad (1.86)$$

$$\epsilon_\gamma = \epsilon_\alpha + \epsilon_\beta \quad (1.87)$$

$$\epsilon_\gamma \geq 1,1 \dots 1,3 \quad (1.88)$$

- Latimea rotii conduse si a rotii conducătoare:

$$B_2 = \psi_d \cdot d_1 \quad (1.89)$$

$$B_1 = B_2 + (5\text{mm} \dots 30\text{mm}) \tag{1.90}$$

- Diametrul începutului evolventic:

$$d_{11,2} = d_{b1,2} \cdot \left\{ 1 + \left[ \text{tg}\alpha_t - \left( 2 \cdot \frac{(1 - x_{n1,2})}{z_{1,2} \cdot \sin \alpha_t \cdot \cos \alpha_t} \right) \right]^2 \right\}^{\frac{1}{2}} \tag{1.91}$$

- Diametrul începutului angrenării și diametrul sfârșitului angrenării:

$$d_{A1} = \frac{d_{b1}}{\cos \alpha_{A1}} \quad \text{și} \quad d_{E2} = \frac{d_{b2}}{\cos \alpha_{E2}} \tag{1.92}$$

$$\text{în care: } \text{tg}\alpha_{A1} = 2 \cdot \pi \cdot \frac{(\epsilon_a - \epsilon_2)}{z_1} \tag{1.93}$$

$$\text{tg}\alpha_{E2} = 2 \cdot \pi \cdot \frac{(\epsilon_a - \epsilon_1)}{z_2} \tag{1.94}$$

$$\epsilon_a = \frac{a_w \cdot \sin \alpha_w t}{\pi \cdot m_t \cdot \cos \alpha_t} \tag{1.95}$$

$$\epsilon_1 = \frac{(d_{a1}^2 - d_{b1}^2)^{\frac{1}{2}}}{2 \cdot \pi \cdot m_t \cdot \cos \alpha_t} \tag{1.96}$$

$$\epsilon_2 = \frac{(d_{a2}^2 - d_{b2}^2)^{\frac{1}{2}}}{2 \cdot \pi \cdot m_t \cdot \cos \alpha_t} \tag{1.97}$$

- Cu aceste precizări, verificarea interferenței devine:

$$d_{A1} \geq d_{11} \tag{1.98}$$

$$d_{E2} \geq d_{12} \tag{1.99}$$

$$d_{11,2} \geq 0 \tag{1.100}$$

- Verificarea jocului la picior:

$$c_{1,2} = a - \frac{(d_{f1(2)} + d_{a2(1)})}{2} \tag{1.101}$$

$$c_{1,2} \geq 0,1 \cdot m_n \tag{1.102}$$

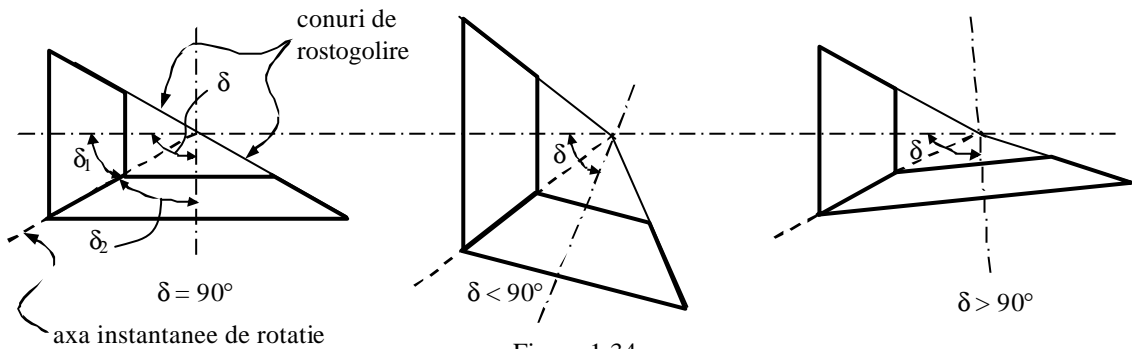


Figura 1.34

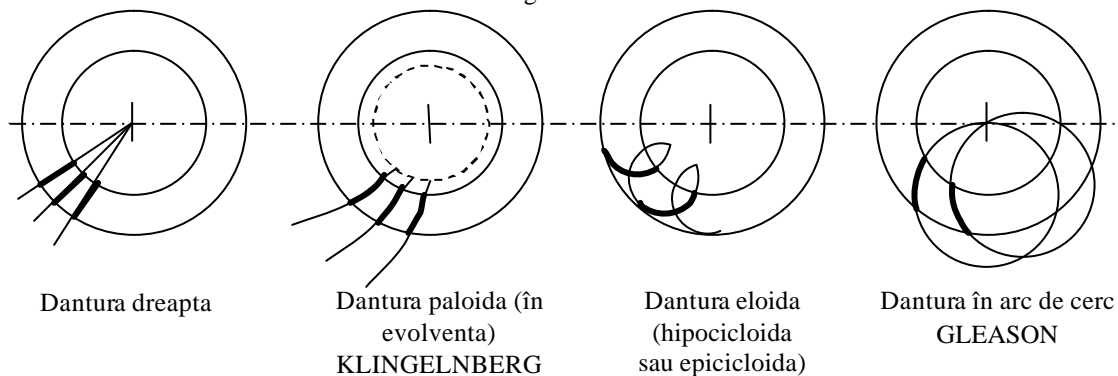


Figura 1.35

$$h_{0a} = h_{0an}^* \cdot m; \quad h_{0an}^* = 1 \tag{1.103}$$

$$h_{0f} = h_{0fn}^* \cdot m; \quad h_{0fn}^* = 1,25 \tag{1.104}$$

$$h_0 = h_{0a} + h_{0f} = 2,25 \tag{1.105}$$

$$d_{1,2} = m \cdot z_{1,2} \tag{1.106}$$

$$dm_{1,2} = mm \cdot z_{1,2} \tag{1.107}$$

$$dm = d - B \cdot \sin \delta_1 \tag{1.108}$$

$$dm = d \cdot \left(1 - \frac{B}{2} \cdot R\right) \tag{1.109}$$

De regula,  $B / R = 1 / 3$ , astfel încât:  $d_m = d \cdot \left(1 - \frac{1}{6}\right)$  (1.110)

$$m_m = 5 \cdot \frac{m}{6} \tag{1.111}$$

$$d_{a1,2} = d_{1,2} + 2 \cdot h_{0a} \cdot \cos \delta_{1,2} \tag{1.112}$$

$$d_{f1,2} = d_{1,2} + 2 \cdot h_{0f} \cdot \cos \delta_{1,2} \tag{1.113}$$

$$R_{1,2} = \frac{d_{1,2}}{2} \cdot \sin \delta_{1,2}; \quad R_1 = R_2 = R; \quad R_{m1,2} = \frac{d_{m1,2}}{2} \cdot \sin \delta_{1,2} \tag{1.114}$$

$$R_{1,2} = R_{1,2} - B_{1,2}; \quad B_1 = B_2 = B \tag{1.115}$$

$$\operatorname{tg} \theta_{a1,2} = \frac{h_{0a}}{R_{1,2}} \tag{1.116}$$

$$\operatorname{tg} \theta_{f1,2} = \frac{h_{0f}}{R_{1,2}} \tag{1.117}$$

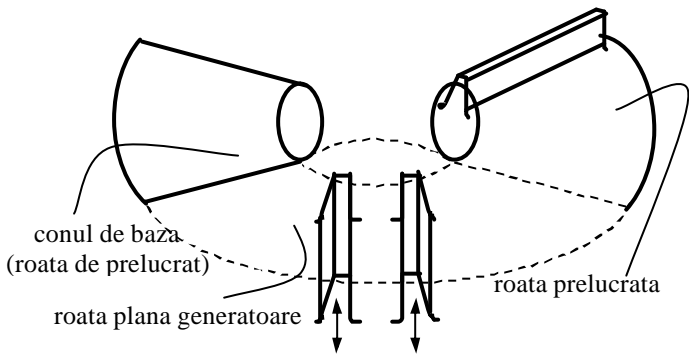


Figura 1.36

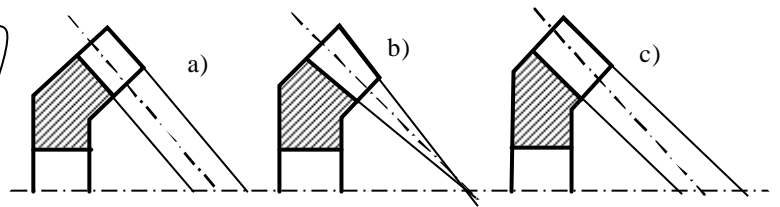


Figura 1.37

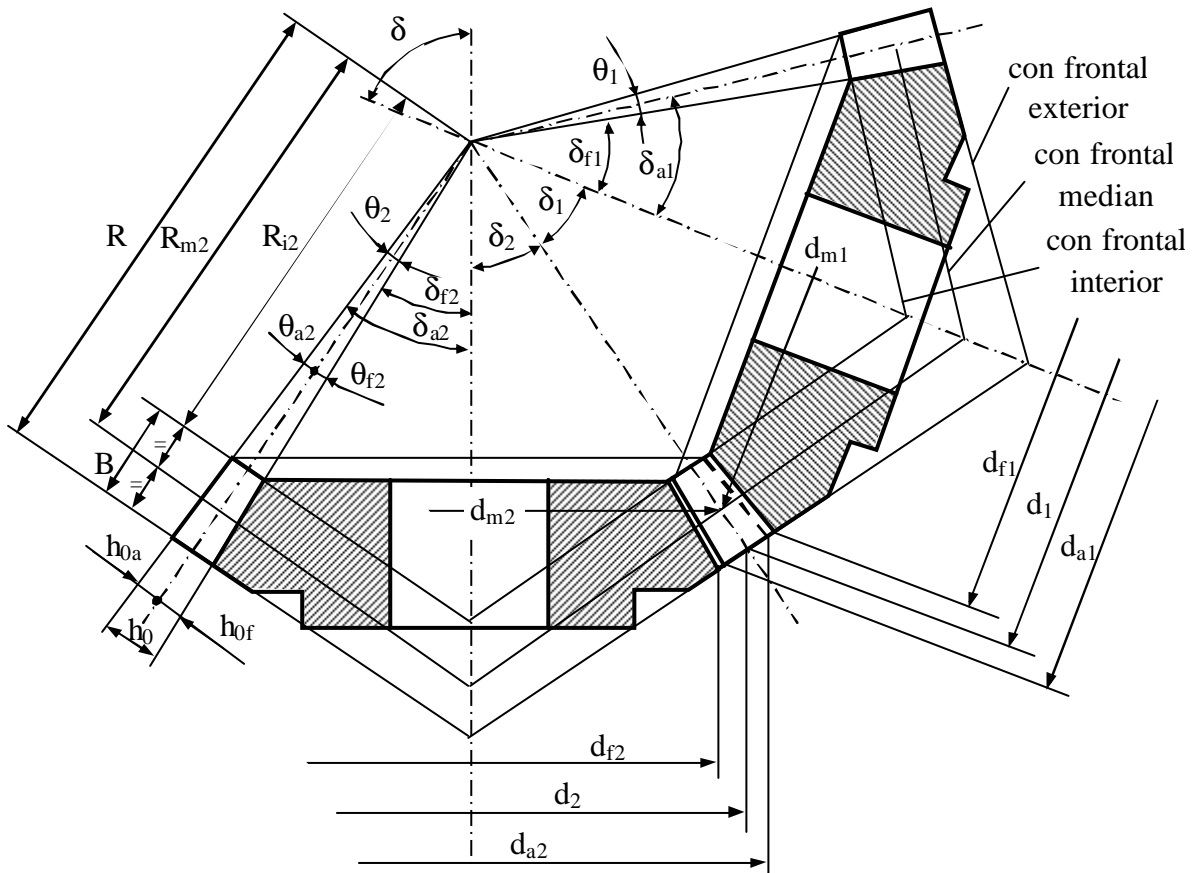


Figura 1.38

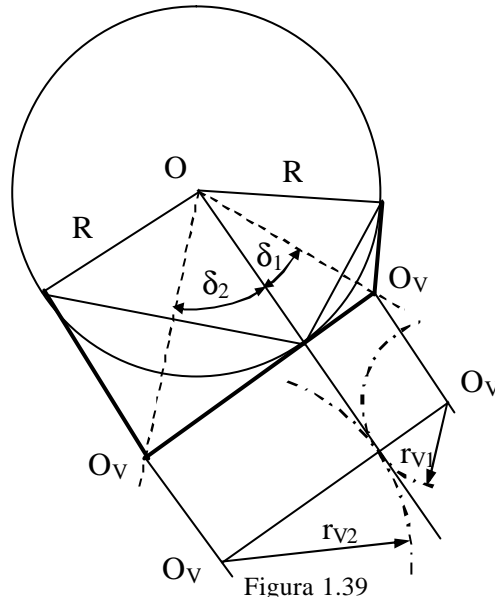


Figura 1.39

$$i_{1,2} = \frac{n_1}{n_2} = \frac{d_1}{d_2} = \frac{z_2}{z_1} = \frac{2 \cdot R_2 \cdot \sin \delta_2}{2 \cdot R_1 \cdot \sin \delta_1} = \frac{\sin \delta_2}{\sin \delta_1} \tag{1.118}$$

$$i_{1,2} = \frac{1}{\operatorname{tg} \delta_1} = \operatorname{tg} \delta_2 \tag{1.119}$$

$$r_{v1,2} = \frac{r_{1,2}}{\cos \delta_{1,2}} \tag{1.120}$$

$$z_{v1,2} = \frac{z_{1,2}}{\cos \delta_{1,2}} \tag{1.121}$$

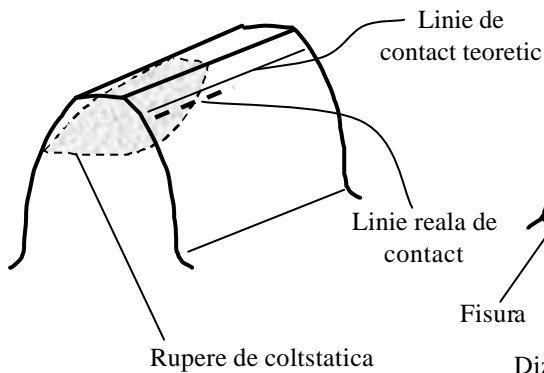


Figura 1.40

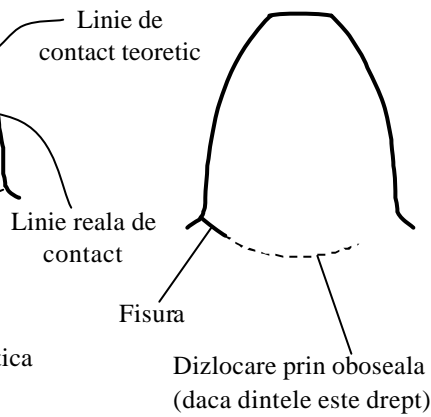


Figura 1.41

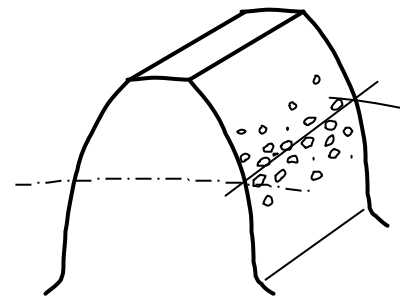


Figura 1.42

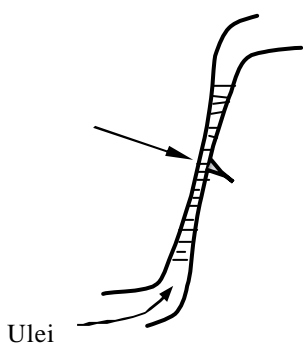


Figura 1.43.a

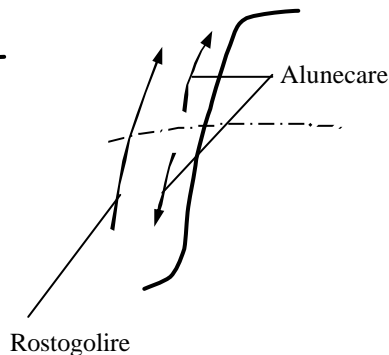


Figura 1.43.b

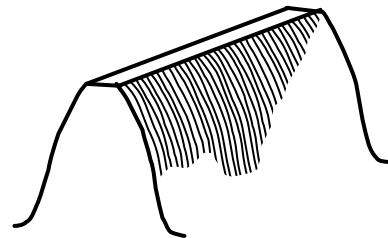


Figura 1.44

$$F_{r1,2} = 2 \cdot \frac{M_{t1,2}}{d_{w1,2}} \tag{1.122}$$

$$F_{r1,2} = F_{t1,2} \cdot \operatorname{tg} \alpha_w \tag{1.123}$$

$$F_{n1,2} = \frac{F_{t1,2}}{\cos \alpha_w}, \text{ respectiv } F_{n1,2} = \frac{F_{t1,2}}{\cos \alpha_0} \tag{1.124}$$

$$F_{t1,2} = 2 \cdot \frac{M_{t1,2}}{d_{w1,2}} \quad (1.125)$$

$$F_{r1,2} = F_{t1,2} \cdot \frac{\operatorname{tg} \alpha_{0n}}{\cos \beta_0} = F_{t1,2} \cdot \operatorname{tg} \alpha_t, \text{ în care } \alpha_{0n} = \alpha_0 = 20^\circ \quad (1.126)$$

$$F_{a1,2} = F_{t1,2} \cdot \operatorname{tg} \beta_0 \quad (1.127)$$

$$F_{n1,2} = \frac{F_{t1,2}}{\cos \beta_0} \cdot \cos \alpha_{0n} \quad (1.128)$$

$$F_{t1,2} = 2 \cdot \frac{M_{t1,2}}{d_{m1,2}} \quad (1.129)$$

$$F_{r1} = F_{a2} = F_{t1,2} \cdot \operatorname{tg} \alpha_0 \cdot \cos \delta_1 \quad (1.130)$$

$$F_{a1} = F_{r2} = F_{t1,2} \cdot \operatorname{tg} \alpha_0 \cdot \sin \delta_1 \quad (1.131)$$

$$F_{n1,2} = \frac{F_{t1,2}}{\cos \alpha_0} \quad (1.132)$$

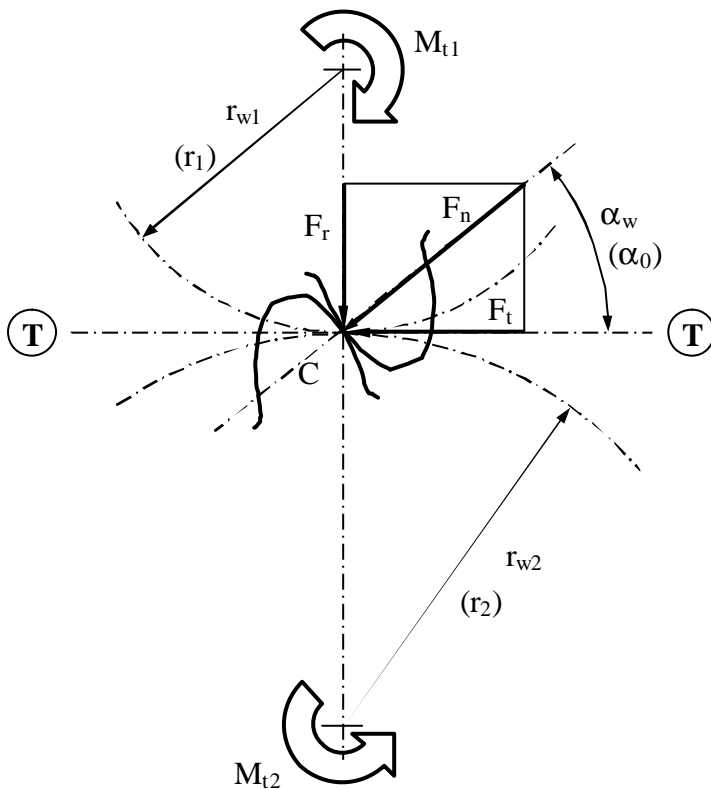


Figura 1.45

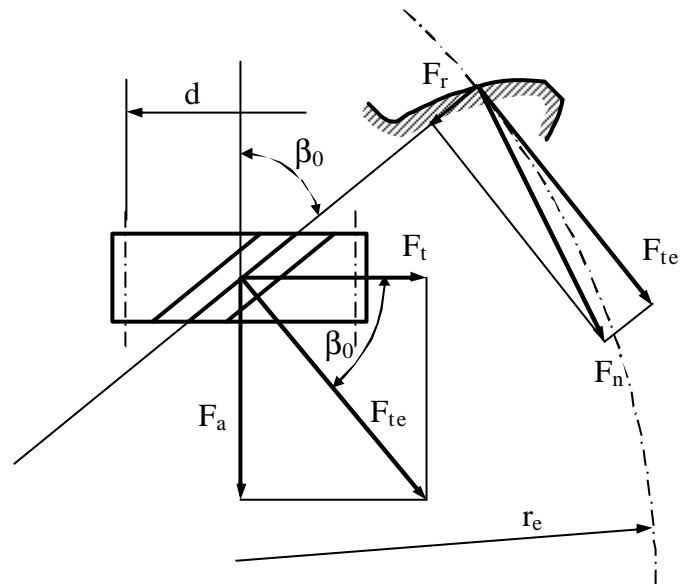


Figura 1.46

Tabelul 1.2

Caracteristica masinii motoare	Caracteristica masinii conduse		
	Uniforma (agitator de lichid, ventilator centrifugal)	Soc moderat (transportor cu banda cu sarcina variata moderat, ma laxor, masina-unealta)	Soc puternic (presa mecanica, concasor, compresor cu un cilindru)
Uniforma (motor electric, turbina)	1	1,25	> 1,75
Soc moderat (motor cu ardere inerna cu 4 ÷ 6 cilindrii)	1,25	1,5	> 2
Soc puternic (motor cu ardere inerna cu 1 ÷ 3 cilindrii)	1,5	1,75	> 2,25

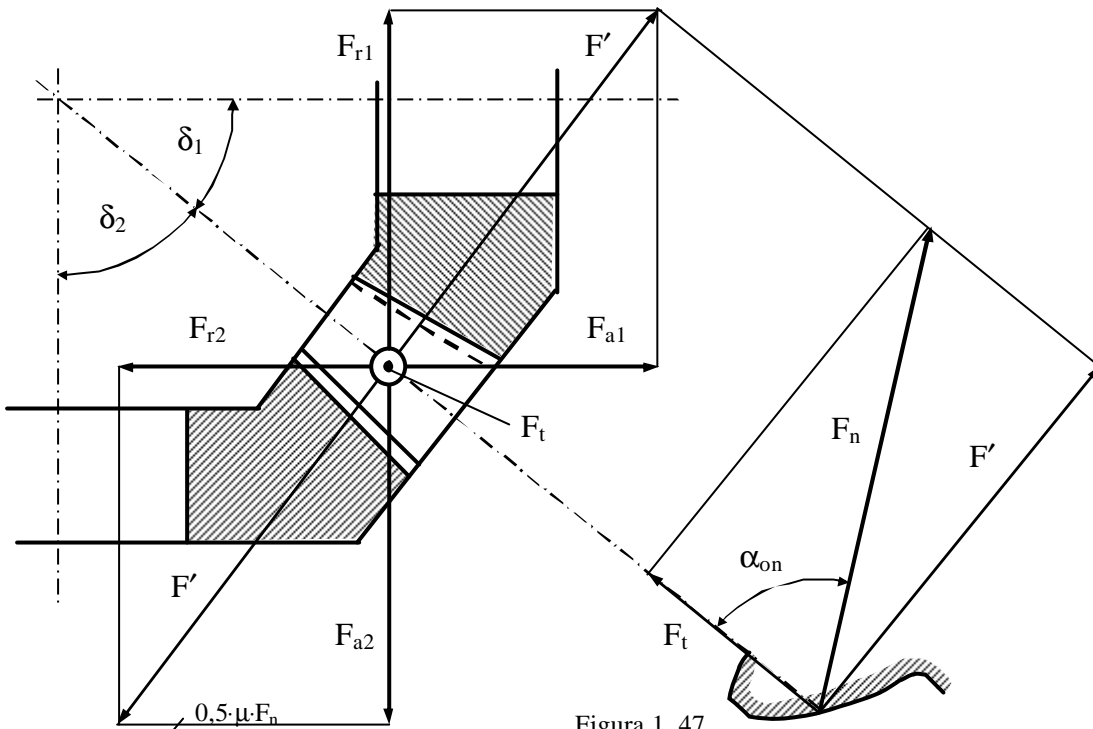


Figura 1.47

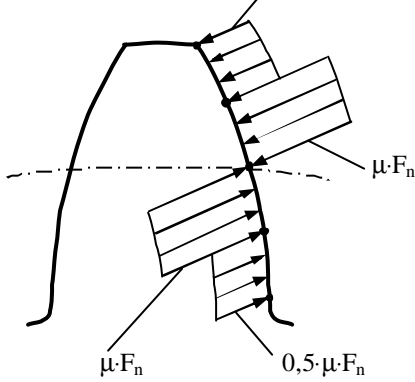


Figura 1.48

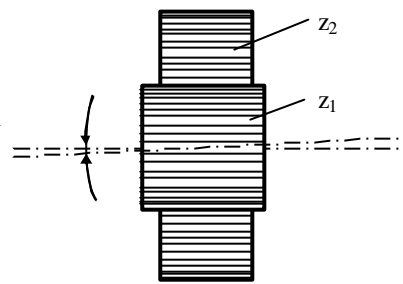


Figura 1.49.a



Figura 1.49.b

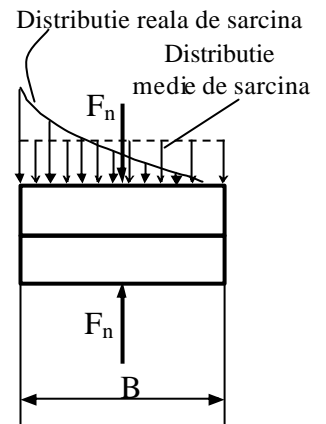


Figura 1.49.c

$$P_f = F_f \cdot v_a = \mu \cdot F_n \cdot |\overline{CX}| \cdot (\omega_1 + \omega_2)$$

(1.133)

$$\text{Cum } |\overline{CX}|_{\text{mediu}} = \frac{(\overline{CE} + \overline{CA})}{2} = \frac{\epsilon_\alpha \cdot p_b}{4}, \text{ rezulta: } P_f = \mu \cdot F_n \cdot \epsilon_\alpha \cdot p_b \cdot \frac{(\omega_1 + \omega_2)}{4}$$

(1.134)

$$M_{fl} = \frac{P_f}{\omega_1} = \mu \cdot F_n \cdot \epsilon_\alpha \cdot p_b \cdot \frac{\left(1 + \frac{\omega_2}{\omega_1}\right)}{4}$$

(1.135)

$$\Psi_A = \frac{\pi}{2} \cdot \mu \cdot \epsilon_\alpha \cdot \left(\frac{1}{z_1} + \frac{1}{z_2}\right)$$

(1.136)

$$\eta = 1 - \Psi_A$$

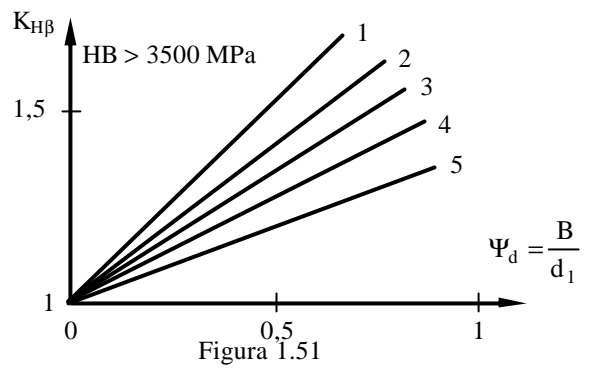
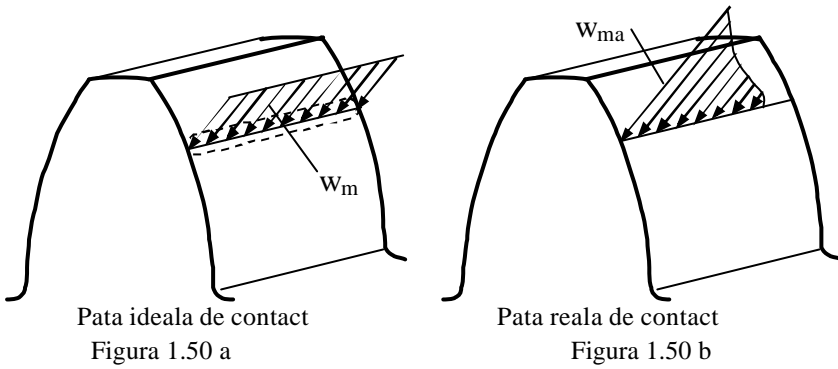
(1.137)

$$\eta = 1 - \frac{\pi}{2} \cdot \mu \cdot \epsilon_\alpha \cdot \left(\frac{1}{z_1} + \frac{1}{z_2}\right)$$

(1.138)

Tabelul 1.3

Tipul angrenajului	Coefficientul mediu de frecare
Angrenaje uzuale din oteluri de îmbunatatire	0,08...0,10
Angrenaje din oteluri durificate cu dantura rectificata unse cu uleiuri aditivate	0,04...0,07
Angrenaje care functioneaza în medii deschise	0,12...0,16



Pata ideală de contact  
Figura 1.50 a

Pata reală de contact  
Figura 1.50 b

Figura 1.51

$$K_F \text{ sau } H\beta = \frac{w_{\max}}{w_{\text{med}}} > 1$$

$$(1.139)$$

Tabelul 1.4

Duritatea	Pozitia rotii fata de lagare	$\gamma_d$
HB < 3500 MPa	Pinion rezemat simetric	1,0...1,3
	Pinion rezemat asimetric	0,7...0,9
	Pinion în consola	0,5...0,6
HB > 3500 MPa	Pinion rezemat simetric	0,5
	Pinion rezemat asimetric	0,4
	Pinion în consola	0,3

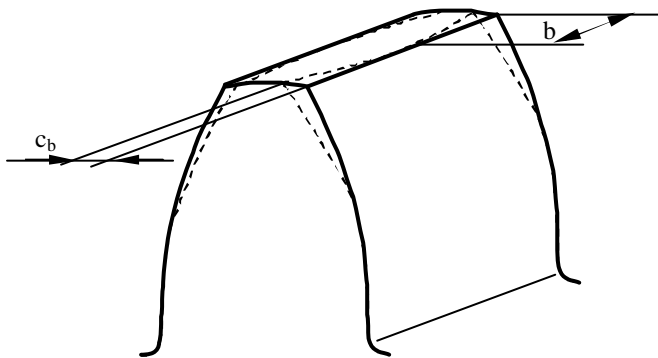


Figura 1.52

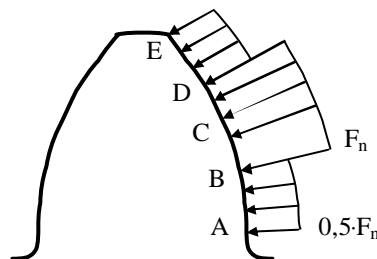


Figura 1.53

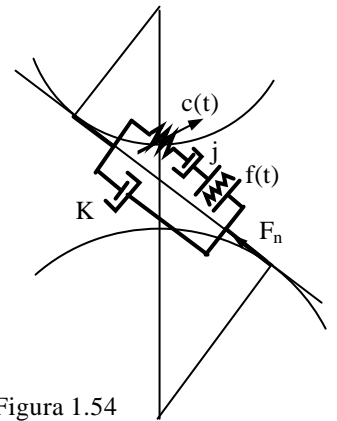


Figura 1.54  
(1.140)

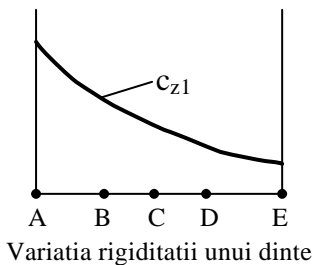
$$F_{nA} = F_{nE} = K_{\alpha} \cdot F_n$$

$$c_z = \frac{F_n}{f}$$

$$\frac{1}{c_z} = \frac{1}{c_{z1}} + \frac{1}{c_{z2}}$$

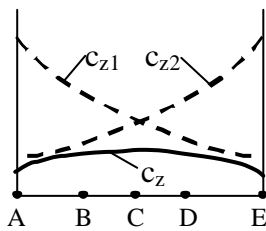
$$(1.141)$$

$$(1.142)$$



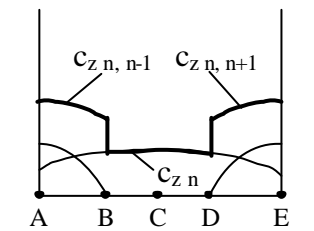
Variația rigidității unui dinte

Figura 1.55.a



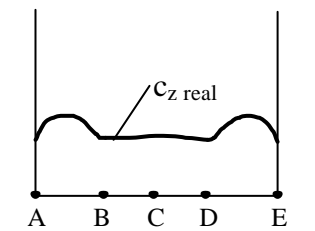
Variația rigidității unei perechi de dinți

Figura 1.55.b



Variația rigidității perechilor succesive de dinți

Figura 1.55.c



Variația rigidității tinând cont de amortizarea uleiului

Figura 1.55.d

$$K_v = 1 + \frac{M_t \text{ dinamic}}{M_t \text{ nominal}}$$

$$(1.143)$$

$$F_{n\text{Calcul}}^E = F_{nC}^E = F_{nC} = F_n \cdot K_A \cdot K_{\alpha} \cdot K_v \cdot K_{F\beta}$$

$$(1.144)$$



$$\sigma_F = \frac{(F_{tC}^E \cdot h_F)}{\left( B \cdot \frac{S_F^2}{6} \right)} \tag{1.145}$$

$$\sigma_F = F_{tC}^C \cdot \left( \frac{\cos \alpha_E}{\cos \alpha_0} \right) \cdot \frac{h_F}{B \cdot \frac{S_F^2}{6}} \tag{1.146}$$

$$Y_F = 6 \cdot \left( \frac{h_F}{m} \right) \cdot \frac{\cos \alpha_E}{\left( \frac{S_F}{m} \right)^2 \cdot \cos \alpha_0} \tag{1.147}$$

$$\sigma_F = \frac{F_{t1,2} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F}{B \cdot m} \leq \sigma_{Fp1,2} \tag{1.148}$$

$$\sigma_{Fp} = \frac{\sigma_{Flim} \cdot K_{FN} \cdot Y_{Fx} \cdot Y_S}{S_F} \tag{1.149}$$

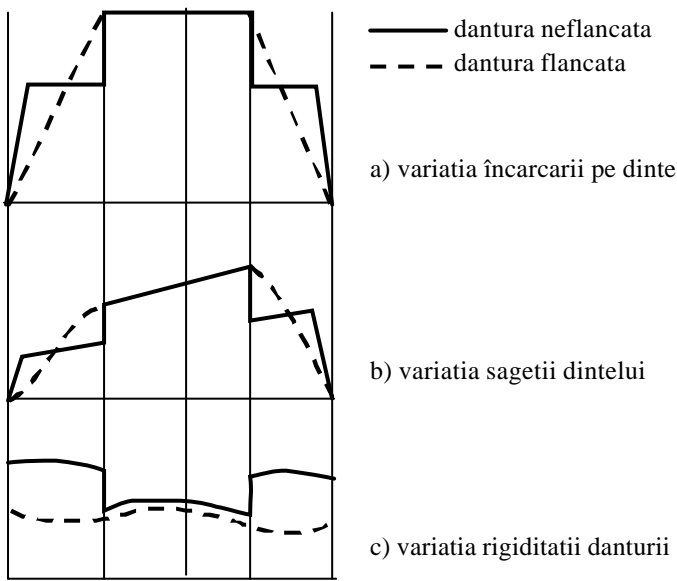


Figura 1.56

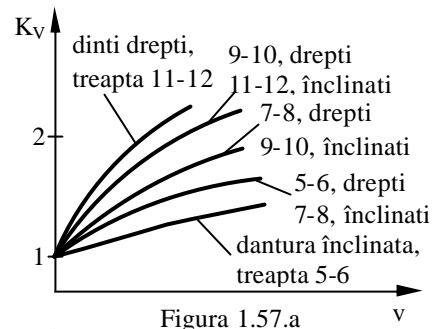


Figura 1.57.a

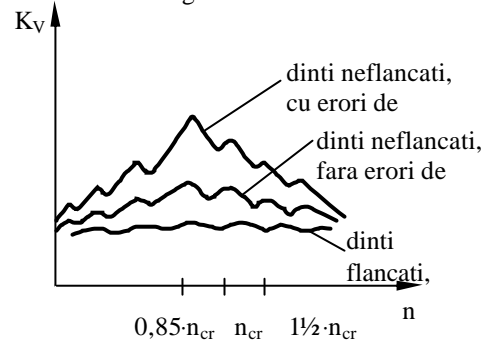


Figura 1.57.b

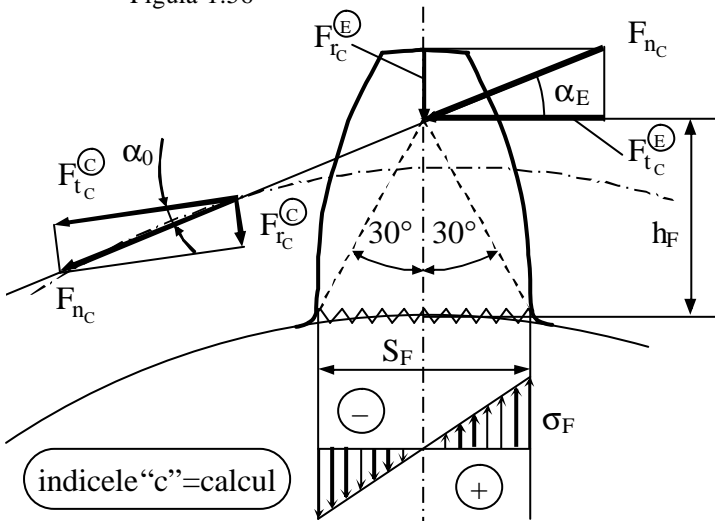


Figura 1.58

indicele "c"=calcul

$$m \geq M_{t1} \cdot (i_{1,2} + 1) \cdot \frac{K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F}{\Psi_a \cdot a^2 \cdot \left( \frac{\sigma_{Flim}}{S_F} \right) \cdot Y_S \cdot K_{FN} \cdot Y_{Fx}} \tag{1.150}$$

$$\sigma_F = \frac{F_{t1,2} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F}{B \cdot m_n} \leq \sigma_{Fp1,2} \tag{1.151}$$

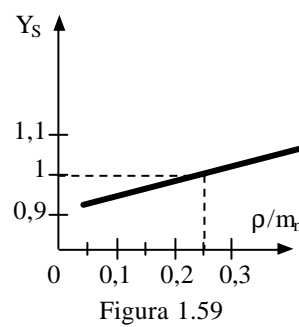


Figura 1.59

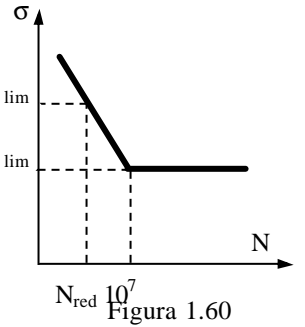


Figura 1.60

$$m_n \geq M_{tl} \cdot (i_{1,2} + 1) \cdot \frac{K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F \cdot Y_\beta}{\Psi_a \cdot a^2 \cdot \left( \frac{\sigma_{Flim}}{S_F} \right) \cdot Y_S \cdot K_{FN} \cdot Y_{Fx}} \quad (1.152)$$

$$\sigma_F = \frac{F_{t1,2} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F}{B \cdot m_m} \leq \sigma_{Fp1,2} \quad (1.153)$$

$$m_m \geq 4 \cdot \frac{M_{tl} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{F\beta} \cdot Y_F \cdot \sin \delta_1}{\Psi_{Rm} \cdot d_{m1}^2 \cdot \left( \frac{\sigma_{Flim}}{S_F} \right) \cdot Y_S \cdot K_{Fn} \cdot Y_{Fx}} \quad (1.154)$$

$$\sigma_H = \left( 0,175 \cdot \frac{F_{nC} \cdot E}{B \cdot \rho} \right)^{\frac{1}{2}} \quad (1.155)$$

$$\rho_{1C} = r_{w1} \cdot \sin \alpha_w = r_1 \cdot \cos \alpha_0 \cdot \frac{\sin \alpha_w}{\cos \alpha_w} = d_1 \cdot \cos \alpha_0 \cdot \frac{\operatorname{tg} \alpha_w}{2} \quad (1.156)$$

$$\rho_{2C} = r_{w2} \cdot \sin \alpha_w = r_2 \cdot \cos \alpha_0 \cdot \frac{\sin \alpha_w}{\cos \alpha_w} = d_2 \cdot \cos \alpha_0 \cdot \frac{\operatorname{tg} \alpha_w}{2} \quad (1.157)$$

$$\frac{1}{\rho} = 2 \cdot \frac{(i_{1,2} + 1)}{d_1 \cdot i_{1,2} \cdot \cos \alpha_0 \cdot \operatorname{tg} \alpha_w} \quad (1.158)$$

$$\sigma_{H1,2} = Z_{M1,2} \cdot Z_H \cdot \left[ \frac{F_{t1,2} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{H\beta} \cdot (i_{1,2} + 1)}{B \cdot d_{1,2} \cdot i_{1,2}} \right]^{\frac{1}{2}} \leq \sigma_{Hp1,2} \quad (1.159)$$

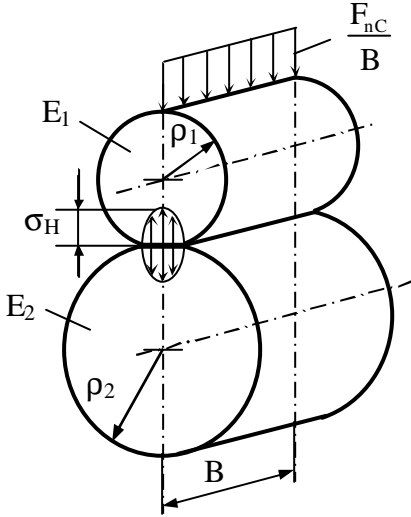


Figura 1.61

$$a_{\min} \geq (i_{1,2} + 1) \cdot \sqrt[3]{\frac{M_{tl} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{H\beta} \cdot Z_M^2 \cdot Z_H^2 \cdot S_H^2}{2 \cdot \Psi_a \cdot i_{1,2} \cdot \sigma_{Hlim}^2 \cdot K_{HN}^2 \cdot Z_R^2 \cdot Z_W^2}} \quad (1.160)$$

$$\sigma_{H1,2} = Z_M \cdot Z_{HC} \cdot Z_\epsilon \cdot \left[ \frac{F_{t1,2} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{H\beta} \cdot (i_{1,2} + 1)}{B \cdot d_{1,2} \cdot i_{1,2}} \right]^{\frac{1}{2}} \leq \sigma_{Hp1,2} \quad (1.161)$$

$$a_{\min} \geq (i_{1,2} + 1) \cdot \sqrt[3]{\frac{M_{tl} \cdot K_A \cdot K_\alpha \cdot K_V \cdot K_{H\beta} \cdot Z_M^2 \cdot Z_\epsilon^2 \cdot S_H^2}{2 \cdot \Psi_a \cdot i_{1,2} \cdot \sigma_{Hlim}^2 \cdot K_{HN}^2 \cdot Z_R^2 \cdot Z_W^2}} \quad (1.162)$$

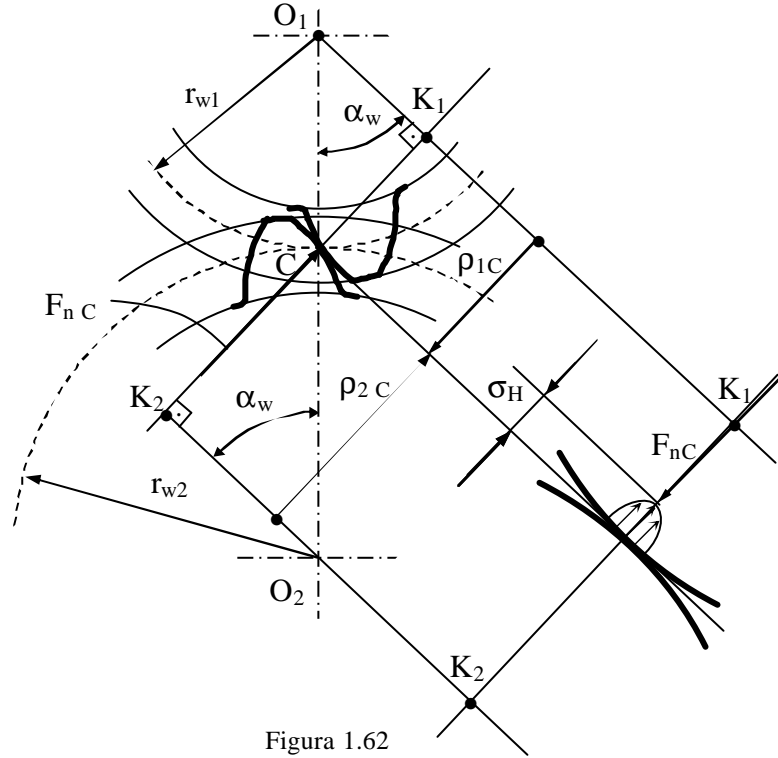


Figura 1.62

$$\sigma_{H1,2} = Z_M \cdot Z_{Hv} \cdot \left[ \frac{F_{t1,2} \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot (i_v + 1)^{\frac{1}{2}}}{B \cdot d_{mv1} \cdot i_v} \right]^{\frac{1}{2}} \leq \sigma_{Hp1,2} \quad (1.163)$$

$$d_{m1} \geq \left[ 4 \cdot \frac{M_{t1} \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot Z_M^2 \cdot Z_{Hv}^2}{i_{1,2} \cdot \Psi_{Rm} \cdot \sigma_{Hp}^2} \right]^{\frac{1}{3}} \quad (1.164)$$

Tabelul 1.5

$b_0$	45°	50°	75°	86°
$z_1$	7	6	4	1

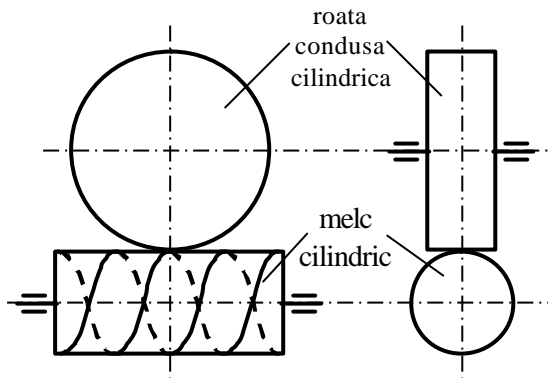


Figura 1.63

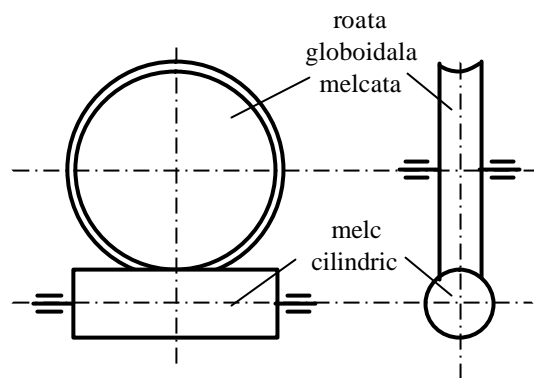


Figura 1.64

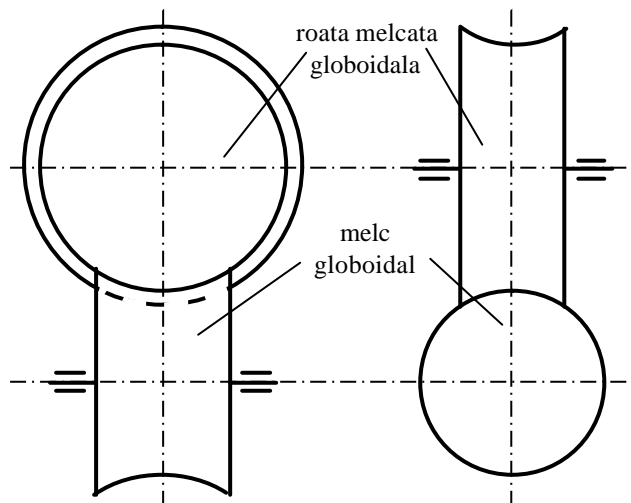


Figura 1.65

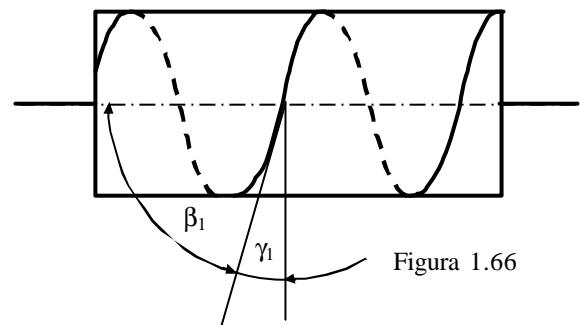


Figura 1.66

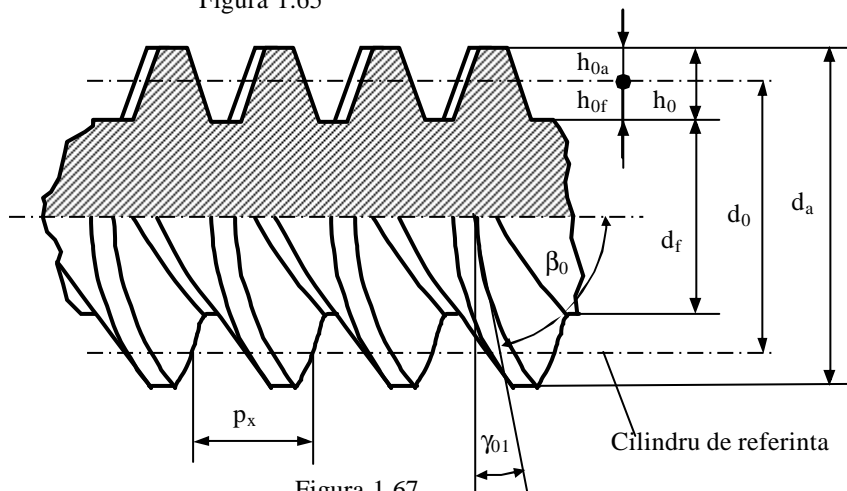


Figura 1.67

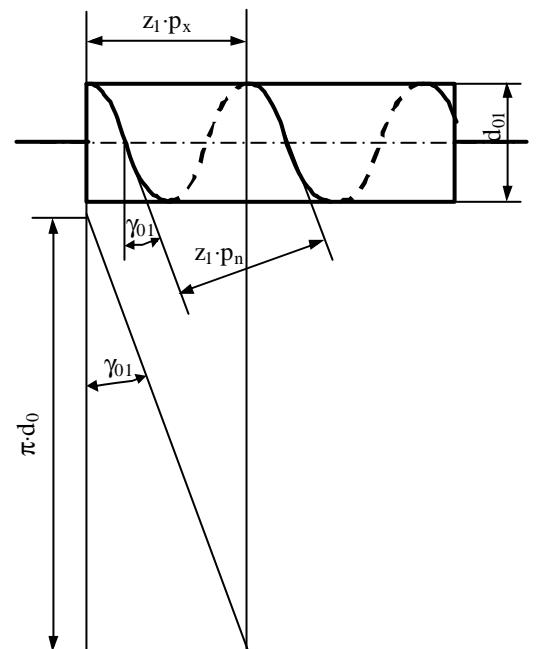


Figura 1.68

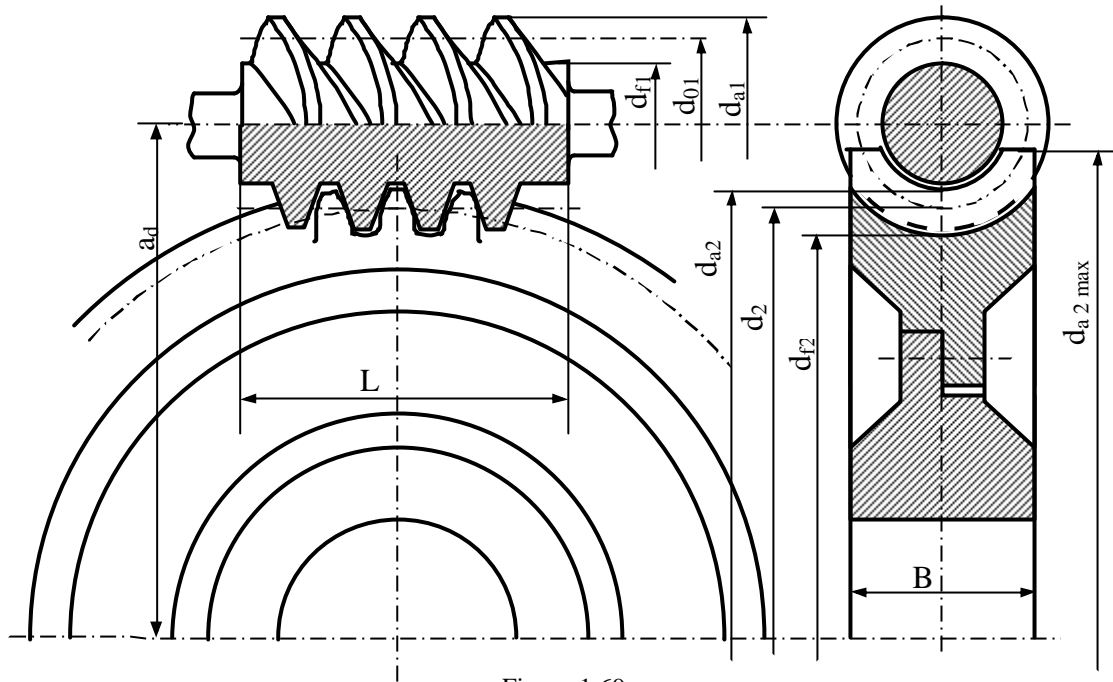


Figura 1.69

$$p_n = p_x \cdot \cos \gamma_{01} \quad (1.165)$$

$$m_n = m_x \cdot \cos \gamma_{01} \quad (1.166)$$

$$\operatorname{ctg} \gamma_{01} = \operatorname{tg} \beta_0 = \pi \cdot \frac{d_{01}}{p_{x1} \cdot z_1} \quad (1.167)$$

$$\operatorname{ctg} \gamma_{01} = \pi \cdot \frac{d_{01}}{\pi \cdot m_{x1} \cdot z_1} \quad (1.168)$$

$$d_{01} = m_{x1} \cdot z_1 \cdot \operatorname{ctg} \gamma_{01} \quad (1.169)$$

$$d_{01} = m \cdot q \quad (1.170)$$

$$q = z_1 \cdot \operatorname{ctg} \gamma_{01} = z_1 \cdot \operatorname{tg} \beta_0 \quad (1.171)$$

Tabelul 1.6

Q $\beta$	g <sub>01</sub> Ŷ	hŶ	d <sub>0</sub> β	Bβ
QŶ	g <sub>01</sub> β	hβ	d <sub>0</sub> Ŷ	BŶ

$$h_{0a} = h_{0ax}^* \cdot m = m \quad (1.172)$$

$$h_{of} = h_{ofx}^* \cdot m = 1,25 \cdot m \text{ sau } h_{of} = h_{ofx}^* \cdot m = 1,20 \cdot m \quad (1.173)$$

$$h_0 = (h_{0ax}^* + h_{ofx}^*) \cdot m = 2,25 \cdot m \text{ sau } h_0 = (h_{0ax}^* + h_{ofx}^*) \cdot m = 2,20 \cdot m \quad (1.174)$$

$$\text{Diametrul de referinta al melcului: } d_{01} = m \cdot q \quad (1.175)$$

$$\text{Diametrul de cap al melcului: } d_{a1} = d_{01} + 2 \cdot h_{0a} = m \cdot (q + 2) \quad (1.176)$$

$$\text{Diametrul de picior al melcului: } d_{f1} = d_{01} - 2 \cdot h_{of} = m \cdot (q - 2,5) \quad (1.177)$$

$$\text{Diametrul de divizare rostogolire al melcului: } d_{w1} = d_1 = d_{01} = m \cdot q \quad (1.178)$$

$$L = (11 + 0,06 \cdot z_2) \cdot m, \text{ pentru } z_1 = 1 \text{ sau } z_1 = 2 \quad (1.179)$$

$$L = (12,5 + 0,09 \cdot z_2) \cdot m, \text{ pentru } z_1 = 3 \text{ sau } z_1 = 4 \quad (1.180)$$

$$\text{Diametrul de rostogolire si de divizare a rotii melcate: } d_{w2} = d_2 = d_{02} = m \cdot z_2 \quad (1.181)$$

$$d_{a2} = d_{02} + 2 \cdot h_{0a} = m \cdot (z_2 + 2) \quad (1.182)$$

$$\left. \begin{aligned} d_{f2} &= d_{02} - 2 \cdot h_{of} = m \cdot (z_2 - 2,5) \\ \text{sau} \\ d_{f2} &= d_{02} - 2 \cdot h_{of} = m \cdot (z_2 - 2,4) \end{aligned} \right\} \quad (1.183)$$

$$d_{a2\max} \leq d_{a2} + 2 \cdot m, \text{ pentru } z_1 = 1 \quad (1.184)$$

$$d_{a2\max} \leq d_{a2} + 1,5 \cdot m, \text{ pentru } z_1 = 2 \text{ sau } z_1 = 3 \quad (1.185)$$

$$d_{a2\max} \leq d_{a2} + m, \text{ pentru } z_1 = 4 \quad (1.186)$$

$$\text{Raza de curbura a suprafeței de vârf este: } r_{E2} = \frac{d_{01}}{2} - m \quad (1.187)$$

$$B \leq 0,75 \cdot d_{a1}, \text{ pentru } z_1 \leq 3 \quad (1.188)$$

$$B \leq 0,67 \cdot d_{a1}, \text{ pentru } z_1 = 4 \quad (1.189)$$

$$\text{Semiunghiul coroanei melcate: } \sin \theta = \frac{B}{d_{a1} + 0,5 \cdot m} \quad (1.190)$$

$$\text{Unghiul de înclinare al danturii rotii melcate } \beta_{02} = \gamma_{01} \quad (1.191)$$

$$\text{Distanța dintre axe } a_d = (d_1 + d_2) / 2 = 0,5 \cdot (q + z_2) \cdot m \quad (1.192)$$

Tabelul 1.7

Clasa	Simbolul melcului	Caracterizare
Melci riglati	ZE	Melc în evolventa
	ZA	Melc arhimedic
Melci neriglati	ZN <sub>1</sub>	Melc cu profil rectiliniu în plan normal pe dinte
	ZN <sub>2</sub>	Melc cu prifil rectiliniu în plan normal pe gol
	ZK <sub>1</sub>	Melc generat cu freza disc dublu conica
	ZK <sub>2</sub>	Melc generat cu freza deget conica

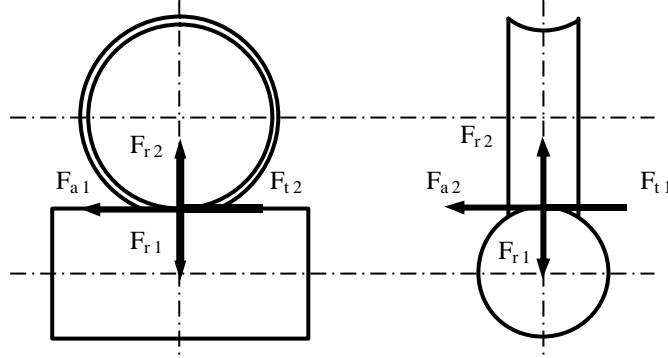


Figura 1.70

$$\eta = \eta_a \cdot \eta_u \cdot \eta_l \cdot \eta_v \quad (1.193)$$

$$\eta_a = \frac{\text{tg} \gamma_{01}}{\text{tg}(\gamma_{01} + \phi')} \quad (1.194)$$

$$F_{t1} = F_{a2} = \frac{2 \cdot M_{t1}}{d_{01}} \quad (1.195)$$

$$F_{t2} = F_{a1} = \frac{F_{t1}}{\text{tg}(\gamma_{01} + \phi')} \quad (1.196)$$

$$F_{r1} = F_{r2} = \frac{F_{t1} \cdot \cos \phi' \cdot \text{tg} \gamma_{01}}{\text{tg}(\gamma_{01} + \phi')} \quad (1.197)$$

$$F_{n1} = F_{n2} = \frac{F_{t1}}{\sin \gamma_{01} \cdot \cos \alpha_{0n}} \quad (1.198)$$

$$\sigma_H = \left( 0,175 \cdot \frac{F_{nc} \cdot E}{I_{\min} \cdot \rho_{n2}} \right)^{\frac{1}{2}} \quad (1.199)$$

$$\frac{1}{\rho} = \frac{1}{\rho_{2n}} = 2 \cdot \frac{\cos \beta_2}{d_{w2} \cdot \sin \alpha_w} \quad (1.200)$$

$$F_{nc2} = F_{n2} \cdot K_A \cdot K_V \cdot K_{H\beta} = F_{t2} \cdot \frac{K_A \cdot K_V \cdot K_{H\beta}}{\cos \alpha_{0n} \cdot \cos \gamma_{01}} \quad (1.201)$$

$$F_{nc2} = F_{t2} \cdot \frac{K_A \cdot K_V \cdot K_{H\beta}}{\cos \alpha_{0n} \cdot \cos \beta_2} \quad (1.202)$$

$$l = \theta \cdot \pi \cdot d_{w1} \quad (1.203)$$

$$l_{\min} = \frac{0,75 \cdot l \cdot \varepsilon}{\cos \beta_2} \quad (1.204)$$

$$l_{\min} = \frac{1,3 \cdot d_{w1}}{\cos \beta_2} \quad (1.205)$$

$$\sigma_H = Z_M \cdot Z_{Hv} \cdot \left[ \frac{F_{t2} \cdot K_A \cdot K_V \cdot K_{H\beta}}{1,3 \cdot d_{w1} \cdot d_{w2}} \right]^{\frac{1}{2}} \leq \sigma_{Hp2} \quad (1.206)$$

$$a_{\min} \geq (z_2 + q) \cdot \left[ \frac{M_{t2} \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot (Z_M \cdot Z_H)^2}{5,2 \cdot \sigma_{Hp2}^2 \cdot z_2^2 \cdot q} \right]^{\frac{1}{3}} \quad (1.207)$$

$$\sigma_{F2} = F_{t2} \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot K_\alpha \cdot Y_{F2n} \leq \sigma_{Fp} \quad (1.208)$$

$$m_{n2} \geq 0,86 \cdot \frac{M_{t2} \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot K_\alpha \cdot Y_{F2n} \cdot (z_2 + q)^2}{\sigma_{Fp2} \cdot a^2 \cdot q \cdot z_2} \quad (1.209)$$

Dantura dreapta  
(roți cilindrice)

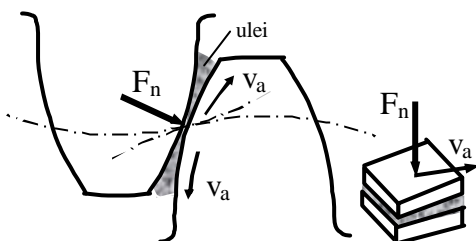


Figura 1.71.a

$$10^3 \cdot P_1 \cdot (1 - \eta) = K \cdot S \cdot (t_u - t_0)$$

$$t_u = t_0 + 10^3 \cdot \frac{P_1 \cdot (1 - \eta)}{K \cdot S} \leq t_{ua}$$

$$P_{1T} = \frac{K \cdot S \cdot (t_{ua} - t_0)}{10^3 \cdot (1 - \eta)} \geq P_1$$

$$a_{\min} = 12,076 \cdot \left[ \frac{P_1 \cdot (1 - \eta)}{K \cdot (t_{ua} - t_0)} \right]^{\frac{1}{1,7}}$$

$$h_{\min} = 0,035 \cdot \sqrt{\eta_0 \cdot v \cdot \rho} \quad (1.214)$$

$$t_M = t_{med} + \frac{265 \cdot C_f \cdot \mu \cdot F_n \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot (v_{t1} - v_{t2})}{B \cdot \cos \alpha_{0t} \cdot \sqrt{\frac{b_H}{2}} \cdot (\sqrt{v_{t1}} + \sqrt{v_{t2}})} \cdot \frac{5,5}{5,5 - R_t} \leq t_{Ma} \quad (1.215)$$

$$b_H = 0,021 \cdot \sqrt{\frac{F_t \cdot K_A \cdot K_V \cdot K_{H\beta} \cdot \rho_1 \cdot \rho_2}{(\rho_1 + \rho_2) \cdot B \cdot \cos \alpha_t}} \quad (1.215)$$

$$t_{Ma} = \frac{t_{Mlim}}{1,2 \dots 2(3)} \quad (1.216)$$

Dantura dreapta  
(roți conice)

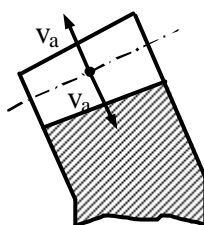


Figura 1.71.b

Dantura înclinată

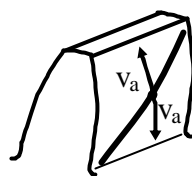


Figura 1.71.c

Angrenajul melcat

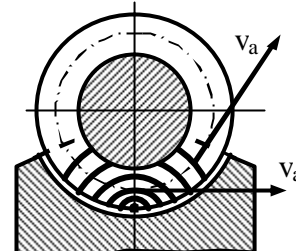


Figura 1.71.d

$$(1.210)$$

$$(1.211)$$

$$(1.212)$$

$$(1.213)$$

Tabelul 1.8

Tipul uleiului	$t_{Ma}$ [°C]
TIN 42 EP	150...160
TIN 125 EP	250...280
TIN 300 EP	330...360
T 80 EP 2	330...369
T 90 EP 2	360...400
T 140 EP 2	> 400

