

A. Výpočet ložiska

```
1  clc
2  clear all
3
4  % Vypocet kulickoveho loziska s kosuhlym stykem
5  d_i = 2*6.417e-3; %m
6  d_o = 2*9.597e-3; %m
7  d = 3.175e-3; %m
8  r_i = 1.59e-3; %m X
9  r_o = 1.59e-3; %m X
10 n = 10;
11 beta = 15 * pi/180; %deg
12 E_a = 2.1e11; %Pac
13 v_a = 0.3; %Poissonova konstanta
14 E_b = 3.2e11; %Pa
15 v_b = 0.29; %Poissonova konstanta
16
17 omega_i_rpm = 20000;
18 omega_i = omega_i_rpm/60*2*pi; %rad/s
19 omega_rozjezd_rpm = linspace(2e4, 1.4e5, 100);
20 omega_o = 0;
21 eta_40 = 56.4659689622261; %mPa s Castrol
22 eta_120 = 6.98633758026716; %mPa s Castrol 0W30
23 %delta_s = linspace(0, 10e-6, 100); %m
24 B = 3.6e-3; %m sirka pouzdra
25 D = 2.4e-3; %m prumer pouzdra
26 W = linspace(0,5000,1000); %N load on most heavily loaded ball
27
28 d_e = 0.5 *(d_i+d_o); %roztec
29 c_d = d_o - d_i - 2*d; % radialni vule
30 R_ri = r_i/d; %race conformity
31 R_ro = r_o/d;
32
33 %Ekvivaletni radius
34 R_xi = (d*(d_e - d*cos(beta)))/(2*d_e);
35 R_xo = (d*(d_e + d*cos(beta)))/(2*d_e);
36 R_yi = (R_ri*d)/(2*R_ri - 1);
37 R_yo = (R_ro*d)/(2*R_ro - 1);
38
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39 R_i = (R_xi*R_yi)/(R_xi + R_yi); %m
40 R_o = (R_xo*R_yo)/(R_xo + R_yo); %m
41
42 %Efektivni modul pruznosti
43 E_eff = 2/((1-v_a^2)/E_a + (1-v_b^2)/E_b); %Pa
44
45 %Deformace struktury dle Hertze, bodovy kontakt, Hamrock
46 alpha_ro = R_yo/R_xo;
47 alpha_ri = R_yi/R_xi;
48
49 k_i = alpha_ri^(2/pi);
50 k_o = alpha_ro^(2/pi);
51 q_a = pi/2 - 1;
52
53 epsilon_i = 1 + q_a/alpha_ri;
54 epsilon_o = 1 + q_a/alpha_ro;
55 F_i = pi/2 + q_a*log(alpha_ri);
56 F_o = pi/2 + q_a*log(alpha_ro);
57
58 %Vypocet tuhosti
59 K_i= pi * k_i * E_eff / F_i ^ (3/2) * (2*epsilon_i * R_i/9)^0.5;
60 K_o= pi * k_o * E_eff/ F_o ^ (3/2) * (2*epsilon_o * R_o/9)^0.5;
61 K_el = K_i * K_o / (K_i + K_o);
62 syms x
63 f = K_el * sin (x * 360/n * pi/180);
64 K = symsum(f, 0, n/2);
65 K = vpa(K)
66
67 % Vypocet deformace
68 delta_i = (W/K_i).^(2/3);
69 delta_o = (W/K_o).^(2/3);
70
71 delta = (W/K).^(2/3);
72
73 %Vypocet odstredive sily
74 gamma = d*cos(beta) /d_e;
75 n_m = 0.5 * (omega_rozjezd_rpm * (1 - gamma ));
76 F_c = 2.26e-11 * (d*1000)^3 * n_m.^2 * d_e*1000;
77 F_c2 = pi^3 * 3200/(10800) * d^3 * n_m.^2 * d_e;
78
79 figure(1)
80 plot(n_m, F_c, n_m, F_c2)
81 set(gca, 'fontweight', 'bold')
82 title ('Vypocet odstredive sily', 'fontsize', 14)
83 xlabel('Otacky [RPM]', 'fontsize', 12)
84 ylabel('Odstrediva sila [N]', 'fontsize', 12)
85
86

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87 %Vypocet rozmeru eliptickeho kontaktu
88 F_r = 7000;
89
90 a_i = 2 * ((6*k_i^2*epsilon_i*F_r*R_i)/(pi*E_eff)).^(1/3);
91 b_i = 2 * ((6*epsilon_i*F_r*R_i)/(pi*E_eff*k_i)).^(1/3);
92 a_o = 2 * ((6*k_o^2*epsilon_o*F_r*R_o)/(pi*E_eff)).^(1/3);
93 b_o = 2 * ((6*epsilon_o*F_r*R_o)/(pi*E_eff*k_o)).^(1/3);
94
95 %Vypocet Hertzova tlaku
96 p_i = (3*F_r)/(2*pi*a_i.*b_i);
97 p_o = (3*F_r)/(2*pi*a_o.*b_o);
98
99
100 %Vypocet tloustky olejove vrstvy
101 H_40 = log10(log10(eta_40) + 1.2);
102 H_100 = log10(log10(eta_120) + 1.2);
103 F_40 = 0.885 - 0.864*H_40;
104
105 Z = (7.81 * H_40 - H_100)^1.5 * F_40;
106 a_EHL = 5.1e-9 * Z * (log(eta_120));

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