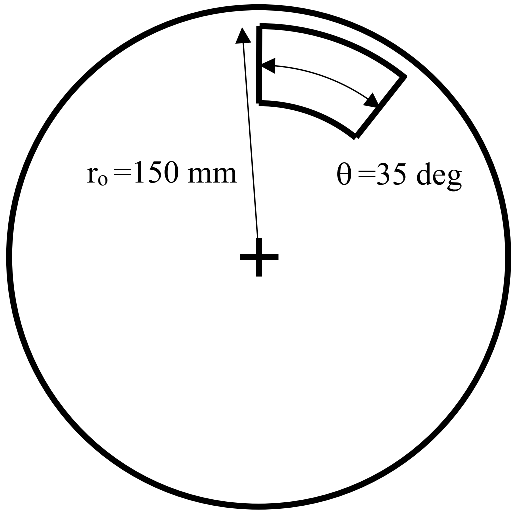


Design a disk brake to provide maximum torque with sintered metal friction material

given constraints $r_o = 150$ mm $\theta = 35$ deg

choose N = 2 brake with floating caliper

choose $p_{MAX} = 2000$ kPa = 2 MPa $\mu_{MAX} = 0.45$ Table 17-1 Norton sintered metal

recommend $r_i = 0.577\ r_o = 86.55$ mm Eq. 17.7 Norton

choose $r_i = 85$ mm

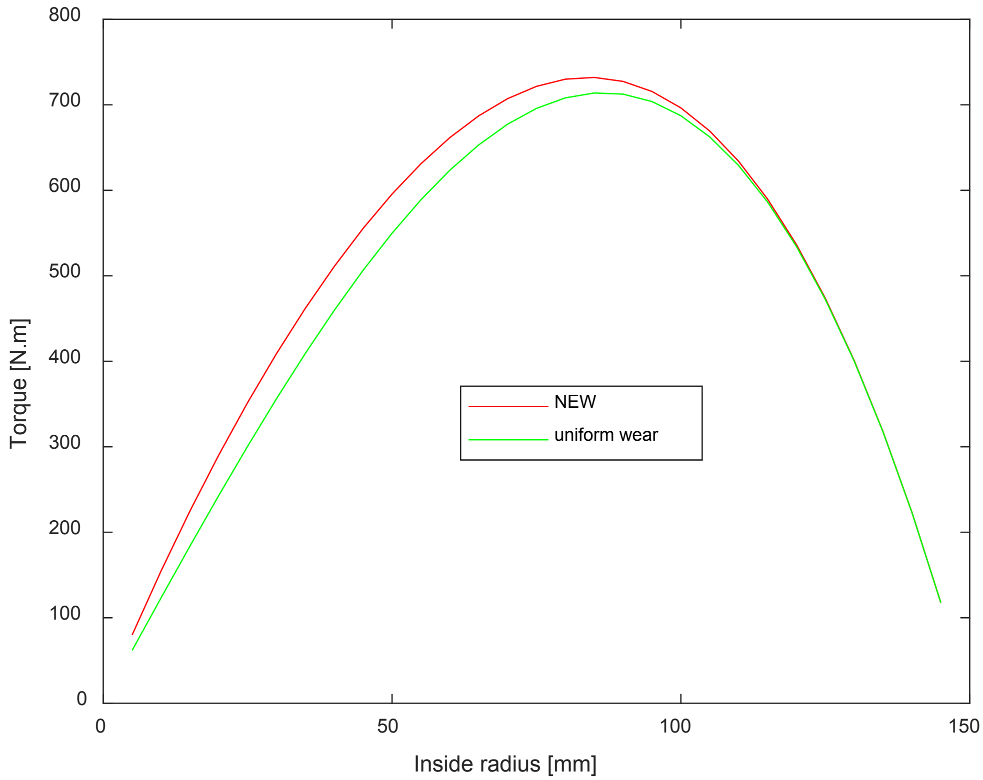
design for long-term use with uniform wear p_{MAX} occurs at r_i Eq. 17.4e

$$F_{MAX} = r_i \theta p_{MAX}\left(r_o - r_i\right) = \left(85\text{mm}\right)\left(35\,\text{deg}\right)\left(\frac{\pi\ \text{rad}}{180\,\text{deg}}\right)\left(2\text{MPa}\right)\left(150\text{mm} - 85\text{mm}\right)$$ Eq. 17.5b Norton

$F_{MAX} = 6750$ N = 1518 lbf

$T = N\,\mu\,F\left(r_o + r_i\right)/2 = 713813$ N.mm = 713.8 N.m = 526.5 ft.lbf Eq. 17.6 Norton

r_i [mm]	F_{MAX} [N]	T [N.m]
50	6109	549.8
80	6842	708.1
85	6750	713.8
90	6597	712.5

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% brake.m - disk brake for ME 360
% HJSIII, 18.12.05

% constants
d2r = pi / 180;

% design parameters
N = 2;              % number of rubbing faces
ro = 150;           % outside radius [mm]
theta_deg = 35;     % shoe angle [deg]
theta_rad = theta_deg * d2r;
mu = 0.45;          % coefficient of friction - Table 17-1
p_max = 2;          % maximum pressure [MPa] - Table 17-1

% try different inside radii
ri = ( 5 : 5 : 145 );      % inside radius [mm]

% maximum force based on p_max for uniform wear
F = ri *theta_rad .*p_max .*(ro - ri);   % [N]

% uniform wear
Tuni = N *mu .*F .*(ro + ri) /2;   % [N.mm]
Tuni = Tuni /1000;    % [N.m]

% new - constant pressure
Tnew = N *mu *F *2 .*(ro^3 - ri.^3) /3 ./(ro^2 - ri.^2);  % [N.mm]
Tnew = Tnew / 1000;    % [N.m]

plot( ri, Tnew, 'r', ri, Tuni,'g' )
xlabel( 'Inside radius [mm]' )
ylabel( 'Torque [N.m]' )
legend( 'NEW', 'uniform wear' )

% bottom of brake
```

NEW - uniform pressure

$r_i = 85$ mm   F = 6750 N

$$T_{NEW} = N\,\mu\,F\,\frac{2}{3}\frac{\left(r_o^{\,3} - r_i^{3}\right)}{\left(r_o^{\,2} - r_i^{2}\right)} = 732.0 \text{ N.m} = 539.9 \text{ ft.lbf}$$ Eq. 17.3 Norton

$$A = \frac{\theta}{2}\left(r_o^{\,2} - r_i^{2}\right) = \frac{(35\text{ deg})}{2}\left(\frac{\pi\text{ rad}}{180\text{ deg}}\right)\left((150\text{ mm})^2 - (85\text{ mm})^2\right) = 4665\text{ mm}^2$$ Eq. 17.1b Norton

p = F / A = 1.446 MPa = 1446 kPa   OK   Table 17-1 Norton clutch $N_{FACE} = 1$ $\theta = 2\pi$ rad = 360 deg woven friction material $\mu = 0.4$

OD = 12 inch ID = 6 inch F = 700 lbf

$r_o = 6$ in $r_i = 3$ in

design for long-term use with uniform wear p_{MAX} occurs at r_i

$T = N\,\mu\,F\left(r_o + r_i\right)/\,2 = 1260$ in.lbf = 105 ft.lbf Eq. 17.6 Norton

$$p_{MAX} = \frac{F}{r_i\,\theta\left(r_o - r_i\right)} = \frac{700\text{ lbf}}{\left(3\text{ in}\right)\left(2\pi\text{ rad}\right)\left(6\text{ in} - 3\text{ in}\right)} = 12.4\text{ psi}$$ Eq. 17.5a Norton

OK Table 17-1 Norton

$$T_{NEW} = N\,\mu\,F\,\frac{2}{3}\frac{\left(r_o^{\,3} - r_i^{\,3}\right)}{\left(r_o^{\,2} - r_i^{\,2}\right)} = 1307\text{ in.lbf} = 108.9\text{ ft.lbf}$$ Eq. 17.3 Norton

recommend $r_i = 0.577\ r_o = 3.46$ inch Eq. 17.7 Norton

choose $r_i = 3.5$ inch ID = 7 inch

T = 1330 in.lbf = 110.8 ft.lbf Eq. 17.6 Norton

$p_{MAX} = 12.7$ psi Eq. 17.5a Norton

$T_{NEW} = 1361$ in.lbf = 113.4 ft.lbf Eq. 17.3 Norton