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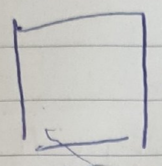
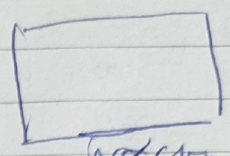
supe las cun par betul las !!

Q4 · a)





ade..!

$L = 1.5$, both ends pinned, $S_y = 170$ MPa

$E = 207$ GPa

For square design

$C = 1$ (0.5), $\frac{L}{k}$, $k = \sqrt{\frac{I}{A}}$

Table A-18

(1) $I = \frac{1}{12} bh^3$

$= \frac{1}{12}(15 \times 10^{-2})(15 \times 10^{-2})^3$

$= 4218.75 \times 10^{-8}\ m^4$

$A = 15 \times 15 \times 10^{-2} \times 10^{-2}$

$= 225 \times 10^{-4}$ m.

$k = \sqrt{\frac{I}{A}} = \sqrt{\frac{4218.75 \times 10^{-8}}{225 \times 10^{-4}}}$

(0.5) $= \sqrt{0.001875}$

(0.5) $= 0.0433$

$\frac{L}{k} = \frac{1.5}{0.04}$

(0.5) $= 34.64$

$\left(\frac{L}{k}\right)_1 = \left(\frac{2\pi \times 1 \times 207 \times 10^9}{170 \times 10^6}\right)^{1/2}$

$= 87.47$ (0.5)

$\left(\frac{L}{k}\right) < \left(\frac{L}{k}\right)_1 \rightarrow$ short column

(1) $P_{cr} = 15^2 \times 10^{-4} \left[170 \times 10^6 - \left(\frac{170 \times 10^6}{2\pi} \times 34.64\right)^2 \frac{1}{207 \times 10^9}\right]$

$= 248.6$ kN

For rectangular design

$C = 1$ (0.5), $\frac{L}{k}$, $k = \sqrt{\frac{I}{A}}$

$I = \frac{1}{12} bh^3 = \frac{1}{12}(18 \times 10^{-2})(13 \times 10^{-2})^3$

(1) $= 3295.5 \times 10^{-8}\ m^4$

$A = 13(18)(10^{-4}) = 234 \times 10^{-4}\ m^2$ (0.5)

$k = \sqrt{\frac{3295.5 \times 10^{-8}}{234 \times 10^{-4}}} = 0.03132$

(0.5) $\frac{L}{k} = \frac{1.5}{0.03132} = 47.89$

(0.5) $\left(\frac{L}{k}\right)_1 = \left(\frac{2\pi \times 1 \times 207 \times 10^9}{170 \times 10^6}\right)^{1/2}$

(0.5) $= 87.47$

→ short column.

$P_{cr} = 18 \times 13 \times 10^{-4}$

(1) $\left[170 \times 10^6 - \left(\frac{170 \times 10^6}{2\pi} \times 47.89\right)^2 \frac{1}{207 \times 10^9}\right]$

$= 3788$ kPa.

(1) → ~~steel~~ 2nd design is better because can support Pcr.

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b) Nt ⇒ squared & ground, Na = 10, C = 10, D = 40 mm

Nt = Na + 2 (1)

= 10 + 2 = 12. 0.5 calculation

Ls = dNt

C = D/d, 10 = 40/d → d = 4 mm (1)

Ls = 4 (12) = 48 mm (1) ✓

0.5 eqn

c) φ = 30°, N steel = 30, N cast iron = 70.

H = 15000, speed: 160 rev/min, m = 8mm

δc = −450 MPa

From eqn (14-14)

$-450 = -C_p \sqrt{\frac{W_t K_v}{F \cos\phi}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$ ✓

From page 29

$V = \frac{\pi (240 \times 10^{-3})(1600)}{60} = 20.1$ (1) ✓

$d_p = 8 \times 30 = 240$ mm $d_g = 8 \times 70 = 560$ mm (1)

From eqn (14-6b)

$K_v = \frac{6.1 + V}{6.1} = \frac{6.1 + 20.1}{6.1} = 4.2$ (1) ✓

From eqn 13-6b

$W_t = \frac{60\,000 (15)}{\pi (240)(1200)} = 0.9947$ kN (1)

From eqn (14-12)

$r_1 = \frac{240 \sin 30^\circ}{2} = 60$ mm $r_2 = \frac{560 \sin 30^\circ}{2} = 140$ mm. (1)

From table 14-8 $C_p = 174$

$-450 = -174 \sqrt{\frac{0.9947 \times 10^3 \times 4.2}{F \cos 30^\circ}\left(\frac{1}{60 \times 10^{-3}} + \frac{1}{140 \times 10^{-3}}\right)}$

$\frac{-450}{-174} = \sqrt{\frac{114858}{F}}$ (1)

$F = \frac{114858}{6.688}$. $F = 17173$ N

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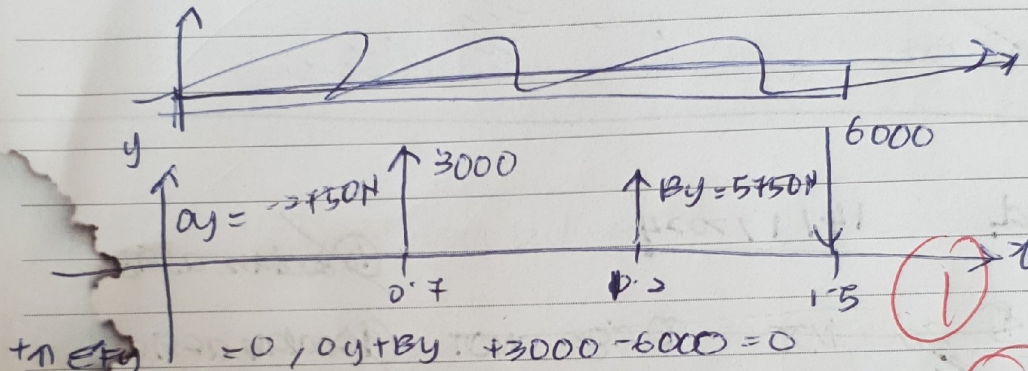
Q3. a) AISI 1018, $P_A = 3000N$, $S_{ut} = 400\ MPa$, $S_y = 320\ MPa$, $d = 40mm$, $n = 1$ end mill keyseat.

$P_A (300 \times 10^{-3}) - P_C (150 \times 10^{-3}) = 0$ ①

$3000(0.3) - P_C(0.15) = 0$

$P_C = 6000N$



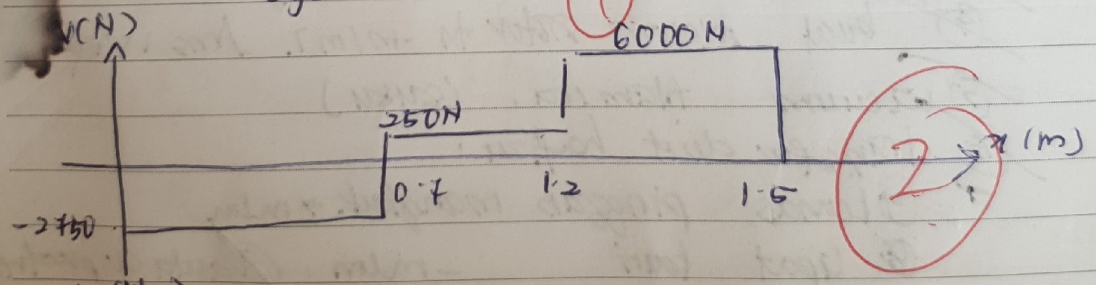
① ①

$+\uparrow \sum F_y = 0$, $a_y + B_y + 3000 - 6000 = 0$

$+\circlearrowleft \sum M_O = 0$, $-3000(0.7) - B_y(1.2) + 6000(1.5) = 0$ ① ①

$B_y = 5750N$ ①

$a_y = -2750N$



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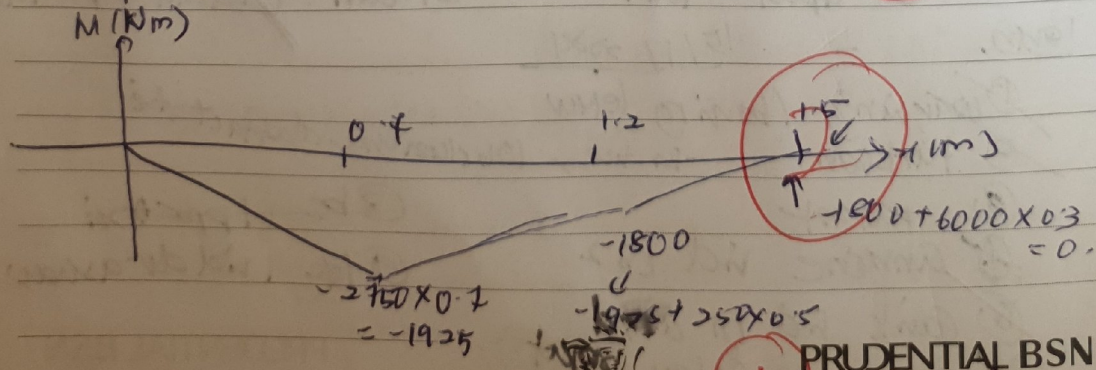

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$M_a = M_{max} = 1925\ Nm$

Critical location = at

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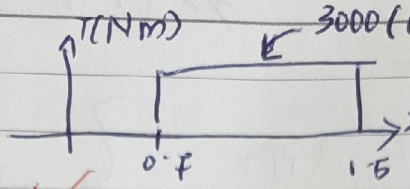
Torque diagram



Tm = 900m

From Table 7-1, $\frac{r}{d} = 0.02$, $K_t = 2.14$, $K_{ts} = 3.0$

From mean (6-32) $K_f = 1 + q(K_t - 1)$, $K_{fs} = (1 + q_s(K_{ts} - 1)$

From table 6-20, $r = 0.02(40) = 0.8$, $S_{ut} = 0.4$ GPa

$q = 0.68$ $q_s = 0.68$

$K_f = 1 + 0.64(2.14 - 1) = 1.73$ $K_{fs} = 1 + 0.68(3-1) = 2.36$

From eqn (6-8) $S_e = 0.5 S_{ut} = 0.5(400) = 200$ MPa

From eqn (6-19) $k_a = a S_{ut}^{b} = 57.7 (400)^{-0.718} = 0.781$

From eqn (6-20) $k_b = 1.24(40)^{-0.107} = 0.8153$

$k_c = 1$

From eqn (6-18) $S_{et} = 0.781 \times 0.8153 \times 200 = 124.35$ MPa

From eqn (7-12)

$$d = \left\{ \frac{16 \times 2}{\pi} \left[4 \left(\frac{1.73 \times 1925}{124.35 \times 10^6} \right)^2 + 3 \left(\frac{900 \times 2.36}{220 \times 10^6} \right)^2 \right]^{1/2} \right\}^{1/3}$$

$= 0.083$m $= 8.3$m the calculation has to be repeated since calculated is far from initial.

b) $F = PA = 3000$N.

Obtain shear stress

$S_y = 0.577 S_y = n \frac{F}{12 \times 10^{-3} L}$, $S_y = 300$ MPa.

$0.577(300 \times 10^6) = \frac{3000 \times 2.2}{12 \times 10^{-3} \times L}$ $\Rightarrow L = 0.00317$m

Normal stress

$S_y = \frac{nF}{6 \times 10^{-3} L}$ $300 \times 10^6 = \frac{2.2 \times 3000}{6 \times 10^{-3} L}$, $L = 0.003667$

Choose the larger $L = 0.003667$m

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=7