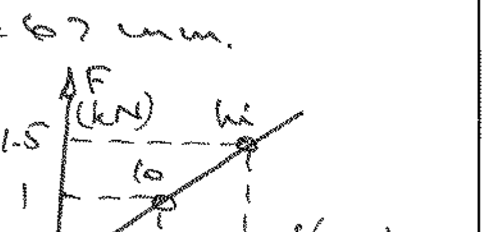
A229 $\quad D_o \le 0.96 \times 70 = 67$ mm.

$\hat{F} = 1500$ N $\quad \check{F} = 1000$ N

∴ $F_m = 1250$ N $\quad F_a = 250$ N.



Design via the Goodman approach of (5b) in which

$F_e = 2F_m C K_s/(S_{es}/S_{ut})$
$\quad + 2F_a C K_h/(S_{es}/S_{ut})$

$= 2\times1.25\, CK_s/0.63 + 2\times0.25\, CK_h/0.13$ kN

* $= C(3970 K_s + 3850 K_h)$ N.

Assuming a design factor of 1.1

Adopting an approach similar to worked ex.

Trial $C = 7.5$ then

$F_e = 7.5\left(3970\left(1+\frac{1}{15}\right) + 3850\,\frac{7.5+0.6}{7.5-0.6}\right) = 66.0$ kN

∴ $F_{ut} \ge 1.1\times66 = 72.6$ kN (eq. 5a).

Try $d = 8$ with $F_{ut} = 62.8$ (table).

∴ F_e necessary $= 62.8/1.1 = 57.1$ kN

so solve * above for C by iterating

$$C = \frac{57100}{3970K_s + 3850K_h}$$

C : 7.5 6.49 6.37 6.35 $\boxed{6.35}$

For $C = 6.35$ $\quad D = 6.35\times8 = 50.8$ mm

∴ $D_o = D+d = 50.8+8 = 58.8 \le 67$ mm — OK.

Now, having apparently settled major parameters, look at consequences.

$k = (1.5-1)/30 = 16.7$ N/mm $\quad k = \frac{Gd}{8n_a C^3}$

∴ $n_a = 79e3\times8/8\times16.7\times6.35^3$

$= 18.5$ pretty large; buckling probs?

$n_t = 20.5$ Table 1 – squared & ground.

$L_s = 20.5\times8 = 164$ mm.

Now $\delta_{hi} = F_{hi}/k = 1500/16.7 = 90$ mm

Assume 10% clash allowance, so

$\delta_s \ge 1.1\,\delta_{hi} = 99$ mm.

∴ $L_0 = L_s+\delta_s = 164+99 = 263$ mm.

For buckling safety, from (3)

$L_{0crit} = \frac12 c_1 \delta_{hi}\left[1+(c_2 D/c_1\lambda\delta_{hi})^2\right]$

$= \frac12 1.23\times90\left[1+(2.62\times50.8/1.23\times0.5\times90)^2\right]$

$= 325$ mm — no end rotation.

Since $L_0 < L_{0crit}$, buckling is no problem.

Check yield when solid — $S_{ys} = 0.48\, S_{ut}$

& from Table 2 $\quad S_{ys} = 0.48\,\frac{2630+8(2180+56\times8)}{1+8(1.6+0.08\times8)}$

$= \underline{600}$ MPa

& τ_s from (1) $= 1.08\times8(16.7\times99)\times6.35/\pi\times8^2 = \underline{455}$ MPa

$< S_{ys}$ so OK.