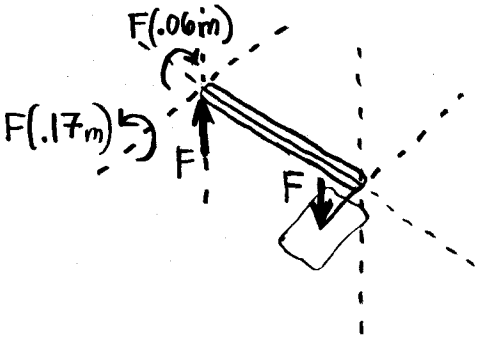
6.3 NORTON

ME 340
1/7/99



F VARIES FROM 0-1500N
PEDAL ARM IS 15mm dia.
S_{ut} = 500 MPa, FIND F.O.S. IN FATIGUE

CRITICAL POINT IS LOCATED ON TOP OF CRANK ARM NEAR BIKE FRAME.

BENDING STRESS:

$$\sigma_b = \frac{32M}{\pi d^3} = \frac{32(F)\,0.17m}{\pi (0.015m)^3}$$

$$\sigma_{b,max} = 769.6\ MPa$$

$$\sigma_{b,min} = 0$$

TORSIONAL STRESS:

$$\tau_T = \frac{16T}{\pi d^3} = \frac{16(F)\,0.06m}{\pi (0.015m)^3}$$

$$\tau_{T,max} = 135.8\ MPa$$

$$\tau_{T,min} = 0$$

VON MISES STRESS:

$$\sigma' = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2} \quad [2\text{-}0] \text{ EQN } 5\text{-}7d$$

$$\sigma'_{max} = \sqrt{(770MPa)^2 + 3(136MPa)^2} = 805.2\ MPa$$

$$\sigma'_{min} = 0$$

$$\sigma'_a = \frac{805.2 - 0}{2} = 402.6\ MPa \quad ; \quad \sigma'_m = \frac{805.2 + 0}{2} = 402.6\ MPa$$

STATIC FACTOR OF SAFETY AGAINST FRACTURE:

$$n_s = \frac{500\ MPa}{805.\ MPa} = 0.62$$

OOOPS! THIS PART FAILS AS SOON AS THE RIDER GETS ON FOR THE FIRST TIME.

OH, WELL. WE'LL CHECK THE "FACTOR OF SAFETY IN FATIGUE" ANYWAY

NEED CORRECTED ENDURANCE LIMIT.

$$S_e = S_e' C_{LOAD} C_{SIZE} C_{SURF} C_{TEMP} C_{RELIAB} \quad \text{EQN 6.6 pg 376}$$

$$= 0.5(500MPa)\,1\,(0.91)\,0.78\,(1)\,1 = 177\,MPa$$

WHERE

$C_{LOAD} = 1$ (BENDING) EQN 6.7a pg 376

$C_{SIZE} = 1.189(15mm)^{-0.097} = 0.91$ EQN 6-7b

$C_{SURF} = 0.78$ FIG 6-26 (ASSUME MACHINED)

$C_{TEMP} = 1$ EQN 6-7f (ASSUME $T \leq 450°C$)

$C_{RELIAB} = 1$ TABLE 6-4 (ASSUME 50% RELIABILITY)

FACTOR OF SAFETY IN FATIGUE:

$$N_f = \frac{S_e S_{ut}}{\sigma_a' S_{ut} + \sigma_m' S_e} = \frac{500(177)}{403(500+177)} = 0.32$$

(EQN 6.18c, P 416)

WHICH MEANS THIS PART HAS A FINITE LIFE ($n_f < 1$), BUT WE ALREADY KNEW THAT.