CH 14 HWK

14.9 NORTON

ME 340
11/19/98

$\frac{7}{16}$ UNC GRADE 7 ROLLED THREADS 70% PRELOAD 99% RELIAB

2.75 in SOLID STEEL 5,000 lb FLUCTUATING EXTERNAL LOAD

FIND FOS AGAINST FATIGUE, YIELD, SEPARATION

$C = 1/9$ (STEEL JOINTS & BOLT

$F_i = 0.70 A_t S_p = 0.70(0.1063 in^2)105 kpsi = 7813 lb$

$F_{b,min} = P_{b,min} + F_i = C(P_{ext,min}) + F_i = \frac{1}{9}(0) + 7813 lb = 7813 lb$

$F_{b,max} = P_{b,max} + F_i = C(P_{ext,max}) + F_i = \frac{1}{9}(5{,}000) + 7813 lb = 8369 lb$

FOS YIELD, $N_y = \frac{115 kpsi}{\frac{8369 lb}{0.1063 in^2}} = 1.46$

$P_{m,max} = (1-C)P_{ext,max} - F_i = (1-\frac{1}{9})5000 lb - 7813 lb = -3369 lb$

SEPARATION AT $P_m = F_i$; $P_{ext,sep} = \frac{7813 lb}{(1-\frac{1}{9})} = 8790 lb$

FOS SEPARATION, $N_{sep} = \frac{8790 lb}{5000 lb} = 1.76$

$\sigma_a = \frac{F_a}{A_t} = \frac{F_{max} - F_{min}}{2A_t} = \frac{2781 b}{0.1063 in^2} = 2.61 kpsi$

$\sigma_m = \frac{F_m}{A_t} = \frac{F_{max} + F_{min}}{2A_t} = \frac{8190 lb}{.1063 in^2} = 76.1 kpsi$

$S_e = C_{LOAD} C_{SIZE} C_{SURF} C_{TEMP} C_{RELIAB} \frac{1}{K_f} \frac{S_{ut}}{2} = 0.7(.94)0.72(1)0.81(\frac{1}{3})\frac{133}{2}$

$C_{SIZE} = 0.869(\frac{7}{16})^{-0.097}$ $= 8.5 kpsi$

$N_f = \frac{S_e(S_{ut} - \sigma_i)}{S_e(\sigma_m - \sigma_i) + S_{ut}\sigma_{alt}} = \frac{8.5(133 - 73.5)}{8.5(76.1 - 73.5) + 133(2.0)} = 1.4$

NOTE: THESE ANSWERS VARY SIGNIFICANTLY FROM THE ANSWERS IN THE SOLUTIONS MANUAL DUE TO USE OF THE EFFECTIVE CYLINDER METHOD.