UNC GRADE 7 ROLLED THREADS 90% PRELOAD 99% RELIABILITY

2.75 in SOLID STEEL 5,000 lb FLUCTUATING EXTERNAL LOAD

FIND FOS AGAINST FATIGUE, YIELD, SEPARATION

\( C = \frac{8}{9} \) (STEEL JOINTS & BOLT

\( F_c = 0.70 A_t S_p = 0.70 (0.1063 in^2) 105 kpsi = 7813 lb \)

\( F_b, \min = P_b, \min + F_c = C (P_{ext, \min}) + F_c = \frac{1}{9} (0) + 7813 lb = 7813 lb \)

\( F_b, \max = P_b, \max + F_c = C (P_{ext, \max}) + F_c = \frac{1}{9} (5000) + 7813 lb = 8369 lb \)

FOS YIELD \( N_y = \frac{11.9 kpsi}{8369 lb} = 1.46 \)

\( P_m, \max = (1 - C) P_{ext, \max} - F_c = (1 - \frac{1}{9}) 5000 lb - 7813 lb = -3369 lb \)

SEPARATION AT \( P_m = F_c \) \( \frac{P_{ext, \text{sep}}}{(1 - C)} = \frac{7813 lb}{8369 lb} = 0.7901 lb \)

FOS SEPARATION \( N_{sep} = \frac{0.7901 lb}{5000 lb} = 1.76 \)

\( \sigma_a = \frac{F_a}{A_t} = \frac{F_{\text{max}} - F_{\text{min}}}{2 A_t} = \frac{2781 lb}{0.1063 in^2} = 261 kpsi \)

\( \sigma_m = \frac{F_m}{A_t} = \frac{F_{\text{max}} + F_{\text{min}}}{2 A_t} = \frac{8190 lb}{0.1063 in^2} = 761 kpsi \)

\( S_e = C_{\text{LOAD}} C_{\text{SIZE}} C_{\text{SURF}} C_{\text{TEMP}} C_{\text{RELIEF}} K_a \frac{S_{ut} - \sigma_i}{S_{ut} - \sigma_{alt}} = \frac{0.7 (0.92 (1) 0.81 (\frac{1}{3}) 133}{761 - 73.5} = 8.5 kpsi \)

\( N_p = \frac{S_e (S_{ut} - \sigma_i)}{S_e (\sigma_{\text{surf}} - \sigma_i) + S_{ut} \sigma_{alt}} = \frac{8.5 (133 - 73.5)}{8.5 (76.1 - 73.5) + 133 (2.6)} = 1.4 \)

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