ME-340 EXAM #3-A
FALL- 1998
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$d := 0.25$ $C := 15.2$ $D := C \cdot d$ $D = 3.8$

$Nt := 18$ $Na := Nt - 2$ $Na = 16$

$G := 11.5 \cdot 10^6$

$k := \frac{(d \cdot G)}{\left(8\ C^3 \cdot Na\right)}$ $k = 6.4$

$\sigma_{ult} := 180 \cdot 10^3$ $\tau_{yp} := \sigma_{ult} \cdot 0.45$ $\tau_{yp} = 8.1 \cdot 10^4$

$K_s := 1.04$ $K_w := 1.1$

$F_{solid} := \frac{\left(\pi \cdot d^2\right)}{\left(8 \cdot C \cdot K_s\right)} \cdot \tau_{yp}$ $F_{solid} = 125.8$

$\delta_F := \frac{F_{solid}}{k}$ $\delta_F = 19.7$

$\delta_{solid} := d \cdot Nt$ $\delta_{solid} = 4.5$

$\delta s := \delta_{solid}$ $\delta := \delta s + \delta_F$ $\delta = 24.2$

$S_{ew} := 67500$ $S_{us} := 0.67 \cdot \sigma_{ult}$ $S_{us} = 1.2 \cdot 10^5$

$S_e := 0.707 \cdot \left[\frac{\left(S_{ew} \cdot S_{us}\right)}{S_{us} - \left(0.707 \cdot S_{ew}\right)} \right]$ $S_e = 7.9 \cdot 10^4$

$F_{min} := 30$ $F_{max} := 90$

$F_m := \left[\frac{\left(F_{max} + F_{min}\right)}{2} \right]$ $F_{alt} := \left[\frac{\left(F_{max} - F_{min}\right)}{2} \right]$

$F_m = 60$ $F_{alt} = 30$

$$\sigma_{min} := \frac{\left(8 \cdot F_{min} \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_m := \frac{\left(8 \cdot F_m \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_{alt} := \frac{\left(8 \cdot F_{alt} \cdot C \cdot K_w\right)}{\pi \cdot d^2}$$

$$\sigma_{min} = 1.9 \cdot 10^4 \qquad \sigma_m = 3.9 \cdot 10^4 \qquad \sigma_{alt} = 2 \cdot 10^4$$

$$N_{fs} := \left[\left[\frac{\left[S_e \cdot \left(S_{us} - \sigma_{min}\right)\right]}{S_e \cdot \left(\sigma_m - \sigma_{min}\right) + S_{us} \cdot \sigma_{alt}}\right]\right] \qquad N_{fs} = 2$$

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$d := 0.25$ $C := 15.2$ $D := C \cdot d$ $D = 3.8$

$Nt := 18$ $Na := Nt - 2$ $Na = 16$

$G := 11.5 \cdot 10^6$

$k := \frac{(d \cdot G)}{\left(8\ C^3 \cdot Na\right)}$ $k = 6.4$

$\sigma_{ult} := 250 \cdot 10^3$ $\tau_{yp} := \sigma_{ult} \cdot 0.45$ $\tau_{yp} = 1.1 \cdot 10^5$

$K_s := 1.04$ $K_w := 1.1$

$F_{solid} := \frac{\left(\pi \cdot d^2\right)}{\left(8 \cdot C \cdot K_s\right)} \cdot \tau_{yp}$ $F_{solid} = 174.7$

$\delta_F := \frac{F_{solid}}{k}$ $\delta_F = 27.3$

$\delta_{solid} := d \cdot Nt$ $\delta_{solid} = 4.5$

$\delta s := \delta_{solid}$ $\delta := \delta s + \delta_F$ $\delta = 31.8$

$S_{ew} := 45000$ $S_{us} := 0.67 \cdot \sigma_{ult}$ $S_{us} = 1.7 \cdot 10^5$

$S_e := 0.707 \cdot \left[\frac{\left(S_{ew} \cdot S_{us}\right)}{S_{us} - \left(0.707 \cdot S_{ew}\right)} \right]$ $S_e = 3.9 \cdot 10^4$

$F_{min} := 60$ $F_{max} := 120$

$F_m := \left[\frac{\left(F_{max} + F_{min}\right)}{2} \right]$ $F_{alt} := \left[\frac{\left(F_{max} - F_{min}\right)}{2} \right]$

$F_m = 90$ $F_{alt} = 30$

$$\sigma_{min} := \frac{\left(8 \cdot F_{min} \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_m := \frac{\left(8 \cdot F_m \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_{alt} := \frac{\left(8 \cdot F_{alt} \cdot C \cdot K_w\right)}{\pi \cdot d^2}$$

$$\sigma_{min} = 3.9 \cdot 10^4 \qquad \sigma_m = 5.8 \cdot 10^4 \qquad \sigma_{alt} = 2 \cdot 10^4$$

$$N_{fs} := \left[\left[\frac{\left[S_e \cdot \left(S_{us} - \sigma_{min}\right)\right]}{S_e \cdot \left(\sigma_m - \sigma_{min}\right) + S_{us} \cdot \sigma_{alt}}\right]\right] \qquad N_{fs} = 1.2$$

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$d := .00635$ $C := 15.2$ $D := C \cdot d$ $D = 0.097$

$Nt := 18$ $Na := Nt - 2$ $Na = 16$

$G := 80.8 \cdot 10^9$

$k := \frac{(d \cdot G)}{\left(8\ C^3 \cdot Na\right)}$ $k = 1.1 \cdot 10^3$

$\sigma_{ult} := 1500 \cdot 10^6$ $\tau_{yp} := \sigma_{ult} \cdot 0.45$ $\tau_{yp} = 6.8 \cdot 10^8$

$K_s := 1.04$ $K_w := 1.1$

$F_{solid} := \frac{\left(\pi \cdot d^2\right)}{\left(8 \cdot C \cdot K_s\right)} \cdot \tau_{yp}$ $F_{solid} = 676.1$

$\delta_F := \frac{F_{solid}}{k}$ $\delta_F = 0.6$

$\delta_{solid} := d \cdot Nt$ $\delta_{solid} = 0.1$

$\delta s := \delta_{solid}$ $\delta := \delta s + \delta_F$ $\delta = 0.707$

$S_{ew} := 310 \cdot 10^6$ $S_{us} := 0.67 \cdot \sigma_{ult}$ $S_{us} = 1 \cdot 10^9$

$S_e := 0.707 \cdot \left[\frac{\left(S_{ew} \cdot S_{us}\right)}{S_{us} - \left(0.707 \cdot S_{ew}\right)} \right]$ $S_e = 2.8 \cdot 10^8$

$F_{min} := 133.50$ $F_{max} := 391.50$

$F_m := \left[\frac{\left(F_{max} + F_{min}\right)}{2} \right]$ $F_{alt} := \left[\frac{\left(F_{max} - F_{min}\right)}{2} \right]$

$F_m = 262.5$ $F_{alt} = 129$

$$\sigma_{min} := \frac{\left(8 \cdot F_{min} \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_m := \frac{\left(8 \cdot F_m \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_{alt} := \frac{\left(8 \cdot F_{alt} \cdot C \cdot K_w\right)}{\pi \cdot d^2}$$

$$\sigma_{min} = 1.3 \cdot 10^8 \qquad \sigma_m = 2.6 \cdot 10^8 \qquad \sigma_{alt} = 1.4 \cdot 10^8$$

$$N_{fs} := \left[\left[\frac{\left[S_e \cdot \left(S_{us} - \sigma_{min}\right)\right]}{S_e \cdot \left(\sigma_m - \sigma_{min}\right) + S_{us} \cdot \sigma_{alt}}\right]\right] \qquad N_{fs} = 1.4$$

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$d := 0.25$ $C := 14.2$ $D := C \cdot d$ $D = 3.5$

$Nt := 16$ $Na := Nt - 2$ $Na = 14$

$G := 11.5 \cdot 10^6$

$k := \frac{(d \cdot G)}{\left(8\ C^3 \cdot Na\right)}$ $k = 9$

$\sigma_{ult} := 200 \cdot 10^3$ $\tau_{yp} := \sigma_{ult} \cdot 0.45$ $\tau_{yp} = 9 \cdot 10^4$

$K_s := 1.04$ $K_w := 1.1$

$F_{solid} := \frac{\left(\pi \cdot d^2\right)}{\left(8 \cdot C \cdot K_s\right)} \cdot \tau_{yp}$ $F_{solid} = 149.6$

$\delta_F := \frac{F_{solid}}{k}$ $\delta_F = 16.7$

$\delta_{solid} := d \cdot Nt$ $\delta_{solid} = 4$

$\delta s := \delta_{solid}$ $\delta := \delta s + \delta_F$ $\delta = 20.7$

$S_{ew} := 45000$ $S_{us} := 0.67 \cdot \sigma_{ult}$ $S_{us} = 1.3 \cdot 10^5$

$S_e := 0.707 \cdot \left[\frac{\left(S_{ew} \cdot S_{us}\right)}{S_{us} - \left(0.707 \cdot S_{ew}\right)} \right]$ $S_e = 4.2 \cdot 10^4$

$F_{min} := 80$ $F_{max} := 140$

$F_m := \left[\frac{\left(F_{max} + F_{min}\right)}{2} \right]$ $F_{alt} := \left[\frac{\left(F_{max} - F_{min}\right)}{2} \right]$

$F_m = 110$ $F_{alt} = 30$

$$\sigma_{min} := \frac{\left(8 \cdot F_{min} \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_m := \frac{\left(8 \cdot F_m \cdot C \cdot K_s\right)}{\pi \cdot d^2} \qquad \sigma_{alt} := \frac{\left(8 \cdot F_{alt} \cdot C \cdot K_w\right)}{\pi \cdot d^2}$$

$$\sigma_{min} = 4.8 \cdot 10^4 \qquad \sigma_m = 6.6 \cdot 10^4 \qquad \sigma_{alt} = 1.9 \cdot 10^4$$

$$N_{fs} := \left[\left[\frac{\left[S_e \cdot \left(S_{us} - \sigma_{min}\right)\right]}{S_e \cdot \left(\sigma_m - \sigma_{min}\right) + S_{us} \cdot \sigma_{alt}}\right]\right] \qquad N_{fs} = 1.1$$

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Problem #2

$L := 25 \qquad b := 2 \qquad d := 4 \qquad I := \frac{\left(b \cdot d^3\right)}{12} \qquad I = 10.7$

$P := 30720 \qquad E := 30 \cdot 10^6$

$$k := \frac{(3 \cdot E \cdot I)}{L^3}$$

$k = 6.144 \cdot 10^4$

$$\delta := \frac{P}{k}$$

$\delta = 0.5$

$$f := \frac{1}{k}$$

$f = 1.6 \cdot 10^{-5}$

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Problem #2

$L := 20 \qquad b := 4 \qquad d := 2 \qquad I := \frac{\left(b \cdot d^3\right)}{12} \qquad I = 2.7$

$P := 30000 \qquad E := 30 \cdot 10^6$

$k := \frac{(3 \cdot E \cdot I)}{L^3}$

$k = 3 \cdot 10^4$

$\delta := \frac{P}{k}$

$\delta = 1$

$f := \frac{1}{k}$

$f = 3.3 \cdot 10^{-5}$

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Problem #2

$L := 0.635 \quad b := .0508 \quad d := 0.1016 \qquad I := \frac{\left(b \cdot d^3\right)}{12} \qquad I = 4.4 \cdot 10^{-6}$

$P := 133630 \qquad E := 207 \cdot 10^9$

$$k := \frac{(3 \cdot E \cdot I)}{L^3}$$

$k = 1.077 \cdot 10^7$

$$\delta := \frac{P}{k}$$

$\delta = 0.012$

$$f := \frac{1}{k}$$

$f = 9.3 \cdot 10^{-8}$

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Problem #2

$L := 25 \qquad b := 4 \qquad d := 4 \qquad I := \frac{\left(b \cdot d^3\right)}{12} \qquad I = 21.3$

$P := 61440 \qquad E := 30 \cdot 10^6$

$$k := \frac{(3 \cdot E \cdot I)}{L^3}$$

$k = 1.229 \cdot 10^5$

$$\delta := \frac{P}{k}$$

$\delta = 0.5$

$$f := \frac{1}{k}$$

$f = 8.1 \cdot 10^{-6}$

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Problem #3

$\sigma_{ult} := 180000$ $\sigma_{yp} := 0.75 \cdot \sigma_{ult}$ $S_p := 0.65 \cdot \sigma_{ult}$ $S_e := 0.33 \cdot S_p$

$\sigma_{yp} = 1.4 \cdot 10^5$ $S_p = 1.17 \cdot 10^5$ $S_e = 3.9 \cdot 10^4$

$A_t := 0.663$ $N := 48$

$F_i := 0.9 \cdot S_p \cdot A_t$ $F_i = 7 \cdot 10^4$

$\sigma_i := \frac{F_i}{A_t}$ $\sigma_i = 1.053 \cdot 10^5$

$P_{total} := 7200000$ $P_{ext} := \frac{P_{total}}{N}$ $P_{ext} = 1.5 \cdot 10^5$

$F_b := \frac{P_{ext}}{9} + F_i$ $F_b = 8.6 \cdot 10^4$

$\sigma_b := \frac{F_b}{A_t}$ $\sigma_b = 1.3 \cdot 10^5$

$\eta_{yp} := \frac{\sigma_{yp}}{\sigma_b}$ $\eta_{yp} = 1.035$

$F_m := \frac{(8 \cdot P_{ext})}{9} - F_i$ $F_m = 6.4 \cdot 10^4$

Joint separates, design is not satisfactory.

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Problem #3

$\sigma_{ult} := 190000$ $\sigma_{yp} := 0.85 \cdot \sigma_{ult}$ $S_p := 0.85 \cdot \sigma_{yp}$ $S_e := 0.38 \cdot S_p$

$\sigma_{yp} = 1.6 \cdot 10^5$ $S_p = 1.373 \cdot 10^5$ $S_e = 5.2 \cdot 10^4$

$A_t := 0.606$ $N := 96$

$F_i := 0.9 \cdot S_p \cdot A_t$ $F_i = 7.5 \cdot 10^4$

$\sigma_i := \frac{F_i}{A_t}$ $\sigma_i = 1.235 \cdot 10^5$

$P_{total} := 14400000$ $P_{ext} := \frac{P_{total}}{N}$ $P_{ext} = 1.5 \cdot 10^5$

$F_b := \frac{P_{ext}}{9} + F_i$ $F_b = 9.2 \cdot 10^4$

$\sigma_b := \frac{F_b}{A_t}$ $\sigma_b = 1.5 \cdot 10^5$

$\eta_{yp} := \frac{\sigma_{yp}}{\sigma_b}$ $\eta_{yp} = 1.069$

$F_m := \frac{(8 \cdot P_{ext})}{9} - F_i$ $F_m = 5.8 \cdot 10^4$

Joint separates, design is not satisfactory.

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Problem #3

$\sigma_{ult} := 180000$ $\sigma_{yp} := 0.85 \cdot \sigma_{ult}$ $S_p := 0.65 \cdot \sigma_{ult}$ $S_e := 0.38 \cdot S_p$

$\sigma_{yp} = 1.5 \cdot 10^5$ $S_p = 1.17 \cdot 10^5$ $S_e = 4.4 \cdot 10^4$

$A_t := 0.606$ $N := 24$

$F_i := 0.9 \cdot S_p \cdot A_t$ $F_i = 6.4 \cdot 10^4$

$\sigma_i := \frac{F_i}{A_t}$ $\sigma_i = 1.053 \cdot 10^5$

$P_{total} := 3600000$ $P_{ext} := \frac{P_{total}}{N}$ $P_{ext} = 1.5 \cdot 10^5$

$F_b := \frac{P_{ext}}{9} + F_i$ $F_b = 8 \cdot 10^4$

$\sigma_b := \frac{F_b}{A_t}$ $\sigma_b = 1.3 \cdot 10^5$

$\eta_{yp} := \frac{\sigma_{yp}}{\sigma_b}$ $\eta_{yp} = 1.152$

$F_m := \frac{(8 \cdot P_{ext})}{9} - F_i$ $F_m = 7 \cdot 10^4$

Joint separates, design is not satisfactory.

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Problem #3

$\sigma_{ult} := 1240 \cdot 10^{6}$ $\sigma_{yp} := 0.70 \cdot \sigma_{ult}$ $S_p := 0.85 \cdot \sigma_{yp}$ $S_e := 0.33 \cdot S_p$

$\sigma_{yp} = 8.7 \cdot 10^{8}$ $S_p = 7.378 \cdot 10^{8}$ $S_e = 2.4 \cdot 10^{8}$

$A_t := 561 \cdot 10^{-6}$ $N := 48$

$F_i := 0.9 \cdot S_p \cdot A_t$ $F_i = 3.7 \cdot 10^{5}$

$\sigma_i := \frac{F_i}{A_t}$ $\sigma_i = 6.64 \cdot 10^{8}$

$P_{total} := 32 \cdot 10^{6}$ $P_{ext} := \frac{P_{total}}{N}$ $P_{ext} = 6.667 \cdot 10^{5}$

$F_b := \frac{P_{ext}}{9} + F_i$ $F_b = 4.5 \cdot 10^{5}$

$\sigma_b := \frac{F_b}{A_t}$ $\sigma_b = 8 \cdot 10^{8}$

$\eta_{yp} := \frac{\sigma_{yp}}{\sigma_b}$ $\eta_{yp} = 1.09$

$F_m := \frac{\left(8 \cdot P_{ext}\right)}{9} - F_i$ $F_m = 2.2 \cdot 10^{5}$

Joint separates, design is not satisfactory.

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Problem #4

$d := 1.25$ $d_c := 1.5$ $d_p := 1.15$ $\mu := 0.15$

$N := 1$ $p := 0.2$ $L := N \cdot p$ $L = 0.2$ $y := 2.0$

$P := 5500$ $\alpha_r := 14.5$ $\alpha := \left(\frac{\pi}{180}\right) \cdot \alpha_r$ $\alpha = 0.3$

$$T := \left(\frac{P \cdot d_p}{2}\right) \cdot \frac{\left[\mu \cdot \left(\pi \cdot d_p\right) + L \cdot \cos(\alpha)\right]}{\left(\pi \cdot d_p \cdot \cos(\alpha) - \mu \cdot L\right)} + \mu \cdot \frac{P \cdot d_c}{2} \qquad T = 1.3 \cdot 10^3$$

$$\eta := \frac{(P \cdot L)}{(2 \cdot \pi \cdot T)} \qquad \eta = 0.136$$

$$N_t := \frac{y}{L} \qquad N_t = 10$$

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Problem #4

$d := 1.50$ $d_c := 1.75$ $d_p := 1.375$ $\mu := 0.125$

$N := 2$ $p := 0.25$ $L := N \cdot p$ $L = 0.5$ $y := 2.0$

$P := 6600$ $\alpha_r := 14.5$ $\alpha := \left(\frac{\pi}{180}\right) \cdot \alpha_r$ $\alpha = 0.3$

$$T := \left(\frac{P \cdot d_p}{2}\right) \cdot \frac{\left[\mu \cdot \left(\pi \cdot d_p\right) + L \cdot \cos(\alpha)\right]}{\left(\pi \cdot d_p \cdot \cos(\alpha) - \mu \cdot L\right)} + \mu \cdot \frac{P \cdot d_c}{2} \qquad T = 1.8 \cdot 10^3$$

$$\eta := \frac{(P \cdot L)}{(2 \cdot \pi \cdot T)} \qquad \eta = 0.284$$

$$N_t := \frac{y}{L} \qquad N_t = 4$$

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Problem #4

$d := 1.25$ $d_c := 1.38$ $d_p := 1.15$ $\mu := 0.13$

$N := 3$ $p := 0.20$ $L := N \cdot p$ $L = 0.6$ $y := 2.5$

$P := 5000$ $\alpha_r := 14.5$ $\alpha := \left(\frac{\pi}{180}\right) \cdot \alpha_r$ $\alpha = 0.3$

$$T := \left(\frac{P \cdot d_p}{2}\right) \cdot \frac{\left[\mu \cdot \left(\pi \cdot d_p\right) + L \cdot \cos(\alpha)\right]}{\left(\pi \cdot d_p \cdot \cos(\alpha) - \mu \cdot L\right)} + \mu \cdot \frac{P \cdot d_c}{2} \qquad T = 1.3 \cdot 10^3$$

$$\eta := \frac{(P \cdot L)}{(2 \cdot \pi \cdot T)} \qquad \eta = 0.359$$

$$N_t := \frac{y}{L} \qquad N_t = 4.2$$

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Problem #4

$d := 1.375$ $d_c := 1.625$ $d_p := 1.25$ $\mu := 0.11$

$N := 2$ $p := 0.25$ $L := N \cdot p$ $L = 0.5$ $y := 6.0$

$P := 6600$ $\alpha_r := 14.5$ $\alpha := \left(\frac{\pi}{180}\right) \cdot \alpha_r$ $\alpha = 0.3$

$$T := \left(\frac{P \cdot d_p}{2}\right) \cdot \frac{\left[\mu \cdot \left(\pi \cdot d_p\right) + L \cdot \cos(\alpha)\right]}{\left(\pi \cdot d_p \cdot \cos(\alpha) - \mu \cdot L\right)} + \mu \cdot \frac{P \cdot d_c}{2} \qquad T = 1.6 \cdot 10^3$$

$$\eta := \frac{(P \cdot L)}{(2 \cdot \pi \cdot T)} \qquad \eta = 0.329$$

$$N_t := \frac{y}{L} \qquad N_t = 12$$