LAB WEEK # 9
NORTON 13.31 a-f

ME 340
3/5/99

MINIMUM FORCE = 150 lb
WORKING DEFLECTION 1 in
SPRING RATE = 75 lb/in
2.1 in dia HOLE 0.1 in CLEARANCE = D_o → $D = 2.0 - .25 = 1.75$
0.25 in dia WIRE
UNPEENED MUSIC WIRE SQUARED & GROUND ENDS
15% CLASH ALLOWANCE

ⓐ FIND STRESSES AND FACTOR OF SAFETY IN FATIGUE

$$\tau_i = K_s \frac{8FC}{\pi d^2} = 1.07 \frac{8(150lb)7}{\pi(.25in)^2} = 45,776\ psi$$

$$K_s = 1 + \frac{0.5}{C} = 1 + \frac{0.5}{7} = 1.07$$

$$C = \frac{1.75}{.25} = 7$$

$$F_m = \frac{225lb + 150lb}{2} = 187.5\,lb$$

$$F_{alt} = \frac{225lb - 150lb}{2} = 37.5lb$$

$$\tau_m = K_s \frac{8F_mC}{\pi d^2} = 1.07 \frac{8(187.5lb)7}{\pi(.25in)^2} = 57,219\ psi$$

$$\tau_{alt} = K_w \frac{8F_{alt}C}{\pi d^2} = 1.2 \frac{8(37.5lb)7}{\pi(0.25in)^2} = 12,834\ psi$$

$$K_w = \frac{4C-1}{4C-4} + \frac{0.615}{C} = \frac{28-1}{28-4} + \frac{0.615}{7} = 1.2$$

$$S_{us} = 0.67\sigma_{ult} = 0.67(225,000\ psi) = 150,750\ psi$$

$$S_{ew} = 45,000\ psi$$

$$S_{es} = 0.707 \frac{S_{ew}S_{us}}{S_{us} - 0.707S_{ew}} = 0.707 \frac{45(150.75)}{150.75 - 0.707(45)} = 57,037\ psi$$

$$N_f = \frac{S_{es}(S_{us} - \tau_i)}{S_{es}(\tau_m - \tau_i) + S_{us}\tau_a}$$

$$= \frac{57(151-46)}{57(57-46)+151(13)} = 2.3$$

(b) FIND SHUT HEIGHT

$$N_a = \frac{dG}{8KC^3} = \frac{0.25in(11.7\times10^6 psi)}{8(751b/in)7^3} = 14.2 \text{ ROUND TO } 14.25$$

$$N_t = N_a + 2 = 16.25$$

$$L_s = 16.25(0.25in) = 4.0625in$$

(c) FIND THE STRESS AND SAFETY FACTOR AT SHUT HEIGHT

$$y_{clash} = 0.15(4.0625in) = 0.61in$$

$$F_s = 751b(0.61in) + 2251b = 2701b$$

$$\tau_s = K_s\frac{8F_sC}{\pi d^2} = 1.07\frac{8(2701b)7}{\pi(0.25in)^2} = 82,396 psi$$

$$n_y = \frac{101.25}{82.396}\frac{ksi}{ksi} = 1.2$$

$$\tau_y = 45\%\sigma_{ut} = 45\%(225ksi) = 101.25 ksi$$

(d) $N_t = 16.25$ (SEE ABOVE) TOTAL COILS

(e) $L_f = y_{clash} + L_w + L_i + L_s = 0.61 + 1 + 2 + 4.0625 = 7.67in$ FREE LENGTH

(f) $\frac{2}{\pi N_a}\frac{d}{D^2}\sqrt{\frac{Gg}{32\gamma}} = \frac{2}{\pi(14.25)(1.75in)^2}\frac{0.25in}{}\sqrt{\frac{11.7\times10^6(386)}{32(0.285)}} = 81 Hz$

NATURAL FREQUENCY