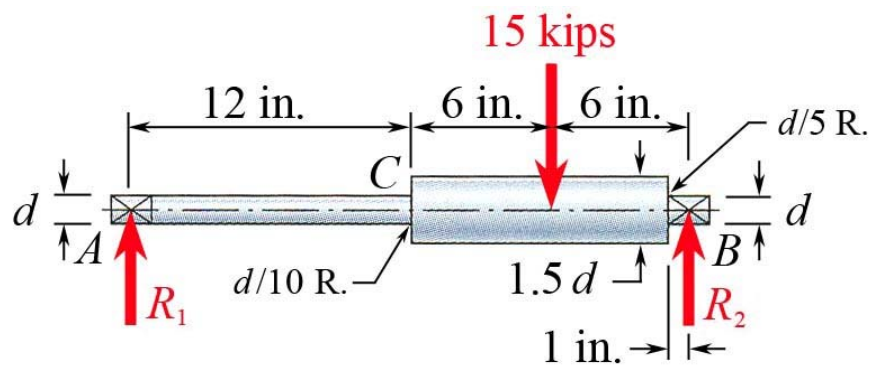


MEEG 4103 Quiz 6.2.081

(Open book, closed notes)

- ② Estimate S'_e for the following materials: (a) AISI 1141 Q&T steel with $S_{ut} = 212$ kpsi, (b) 2024 T3 aluminum.
- ⑧ A shaft made of a 1050 CD steel rotates at a speed of 1200 rev/min and supports a 15-kip bending force as shown, where R_1 and R_2 are bearing forces. Specify a diameter d using a design factor $n_d = 1.8$ for a life of 3 min. (Hint. Let $d = 2.5$ in. in the first trial.)



- (a) $S'_e = 100$ kpsi. ① (b) No S'_e (for nonferrous metals). ①

$$\begin{aligned}
 2. \quad S_{ut} &= 100 \text{ kpsi} & S'_e &= 50 \text{ kpsi} & \sqrt{a} &= 0.0621812\sqrt{\text{in.}} & r &= d/10 \\
 K_t &= 1.68 & K_f &= 1 + q(K_t - 1) & N &= 3600 \text{ cycles} & k_a &= 0.7968 \\
 S_f &= a N^b & f &= 0.844 & R_1 &= 3.75 \text{ kips} & M_C &= 45000 \text{ lb}\cdot\text{in.} \quad ①
 \end{aligned}$$

Trial #1: Let $d = 2.5$ in. $q = 0.889$ $K_f = 1.605$ $k_b = 0.7881$

$$S_e = 31.398 \text{ kpsi} \quad b = -0.14315 \quad a = 226.9 \quad S_f = 70.3 \text{ kpsi}$$

$$\sigma_c = K_f (M_C c / I) = 47.08 \text{ kpsi} \quad n = S_f / \sigma_c = 1.49 < 1.8 \quad \therefore \text{N.G.} \quad ③$$

Trial #2: Let $d = 2.75$ in. $q = 0.894$ $K_f = 1.608$ $k_b = 0.7764$

$$S_e = 30.93 \text{ kpsi} \quad b = -0.14532 \quad a = 230.3 \quad S_f = 70.1 \text{ kpsi}$$

$$\sigma_c = K_f (M_C c / I) = 35.44 \text{ kpsi} \quad n = S_f / \sigma_c = 1.98 > 1.8 \quad \therefore \text{O.K.} \quad ③$$

Choose $d = 2.75$ in. ①