INSTRUCTIONS:

This quiz is open-book and open-note, and you may work with your classmates. Please answer all questions and show all of your work.

GIVEN:

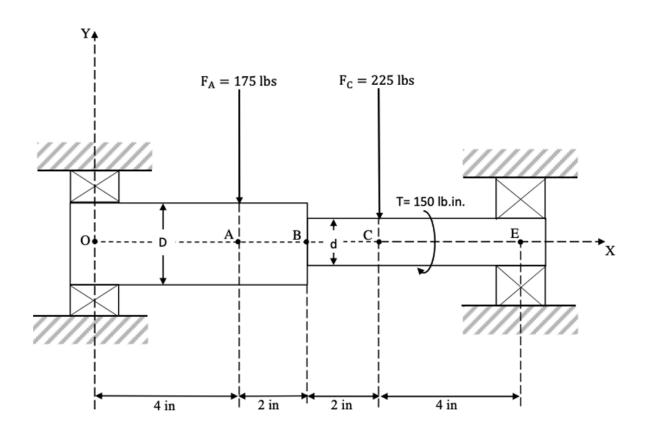
An AISI 1030 hot rolled steel shaft is rotating at a constant speed in the simply supported bearings at points *O* and *E*.

The shaft has a yield strength $S_y = 37.5$ ksi, ultimate tensile strength $S_{ut} = 68$ ksi, and a fullycorrected endurance limit of $S_e = 18.3$ ksi.

The two constant diameters of the stepped shaft are D = 2 in and d = 1.2 in.

The constant vertical loads at locations A and C are $F_A = 175$ lbf and $F_C = 225$ lbf and the shaft transmits a constant torque T = 150 lbf-in.

The fatigue stress concentration factors at the step are $K_f = 3$ for bending and $K_{fs} = 2.5$ for torsion.



FIND:

- 1) Sketch diagrams showing the internal loads (bending and torsion) acting on the rotating shaft.
- 2) Identify the critical cross-section of the shaft.
- 3) For a point on the circumference of the shaft at the critical cross-section, sketch the bending stress as a function of time.
- 4) For a point on the circumference of the shaft at the critical cross-section, sketch the torsional shear stress as a function of time.
- 5) The factor of safety for infinite life using the Goodman criterion.
- 6) The factor of safety for yielding.