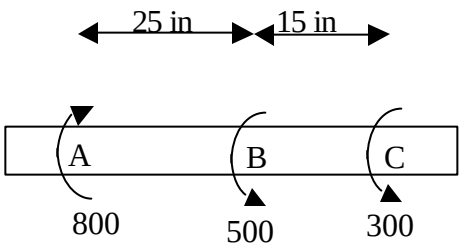
Below are four questions from last year's quizzes.

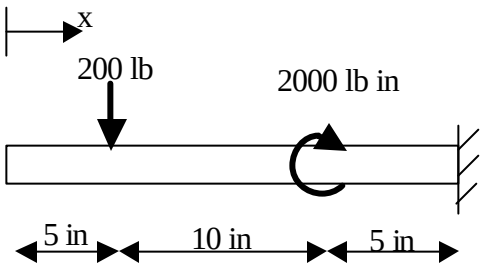
1. (20 points) The solid steel shaft shown has a diameter of 4" and is subjected to the three external twisting moments (each in lb-in).

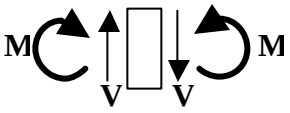


(i) Determine the shear stress at the surface of the shaft at a cross-section 6" to the left of point B.

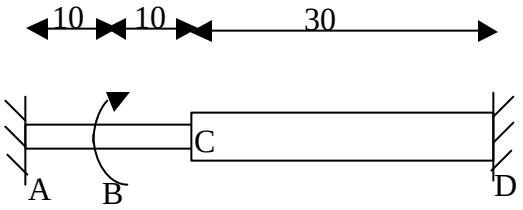
(ii) Assume the rotation ? of the cross-section at B is zero. Determine the rotations at the cross-sections A and C. (G for steel was given)

2. (30 points) The beam shown is cantilevered at the right end. Determine the support reactions. Then, draw the shear force and bending moment diagrams labeling key points so that values are all clear. What are the maximum and minimum bending moments?





Convention for Positive V and M



3. (30 points) The steel shaft shown is fixed at ends A and D. (G for steel was given) All dimensions are in cm. The diameter of ABC is 2 cm and the diameter of CD is 4 cm. A twisting moment of 300 N-m is applied in the direction shown at the point B, a distance of 10 cm from the left end.

(i) Determine the reactions at the ends A and D.

(ii) Consider the cross-section half way between B and C. Find the shear stress at a radial distance of 0.5 cm from the center line of the shaft in this cross-section.

(iii) Determine the rotation ? of the cross-section at C.

4. (25 points). The steel beam shown has a uniform cross-section that is drawn beneath the beam.

(i) Find the support reactions, and draw the shear force and bending moment diagrams, labeling key points. **Indicate your sign conventions for V and M by circling the appropriate choices shown beneath the cross-section.**

(ii) Determine the cross-sectional properties necessary for calculating bending stresses.

(iii) Determine the maximum tensile and compressive stress at two points along the beam: where the bending moment is most positive and most negative. For each of those points, indicate clearly whether the tension is on the top or the bottom of the beam.