ME 323: Mechanics of Materials ***Homework Sets H30***

Summer 2024 ***Assigned/Due: July 23/July 25***

A circular cross-sectioned shaft having an outer radius of R and length L is acted upon by forces F and P, and an axial torque T at its right end. The material of the shaft (aluminum alloy 2014-T6) is ductile and has a yield strength of σ_Y (see the tables in Chapter 2 for the numerical values of the yield strength of this material).

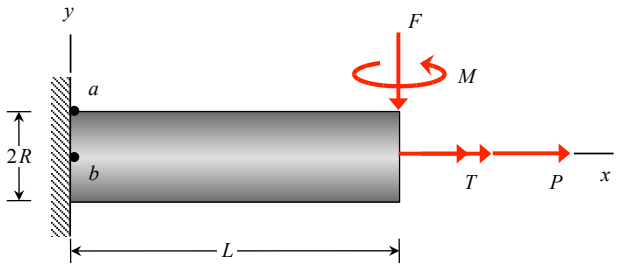
a) Determine the stress components at points "a" and "b" in the shaft, where "a" is on the top surface of the shaft along the y-axis, and "b" is on the front surface of the shaft along the z-axis. Show these components on the stress elements provided below. Leave your answers in terms of the variables defined here in the problem statement.

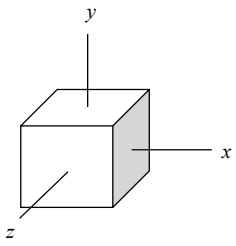
b) Compute the *numerical* values for the principal components of stress and the absolute maximum shear stress at point "a".

c) Compute the *numerical* value for the yielding factors of safety at point "a" using the maximum shear stress (MSS) theory.

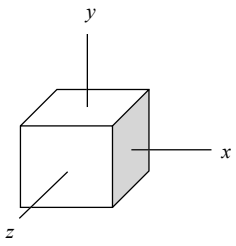
d) Compute the *numerical* value for the yielding factors of safety at point "a using the maximum distortional energy (MDE) theory.

For your numerical answers, use the following: $P = 2$ kN, $F = 500$ N, $T = 600$ N-m, $R = 20$ mm and $L = 1.5$ m.





stress element for point "a"



stress element for point "b"