Quiet Week Example No. 3

The propped-cantilevered beam shown has a circular cross-section (of radius r), and is made of a ductile material having a Young's modulus of E and yield strength of σ_Y.

The beam has a transverse load P and an axial torque T applied at the free end D, where $T = Pa$. Here we are asked to determine the factor of safety against yielding on either the top or lower surfaces of the beam. In this solution, anticipate the following steps:

   i. Equilibrium analysis
   ii. Deflection analysis (for finding external reactions in indeterminate structures)
   iii. Internal resultant analysis (including shear force/bending moment diagrams)
   iv. Location and description of the critical state of stress
   v. Mohr's circle for the critical state of stress
   vi. Failure analysis

SOLUTION