Exam Number: ----------

Department of Mechanical Engineering

Michigan State University

Solid Mechanics
Ph.D. Qualifying Examination

January 2006

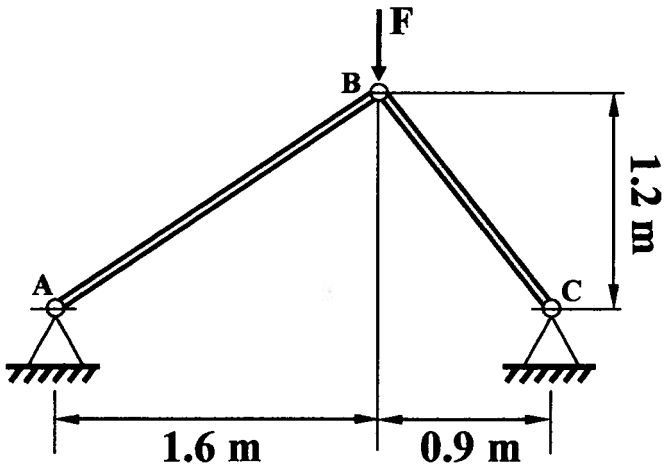
Open Book Open Notes
All Questions are weighted equally.

Prepared by

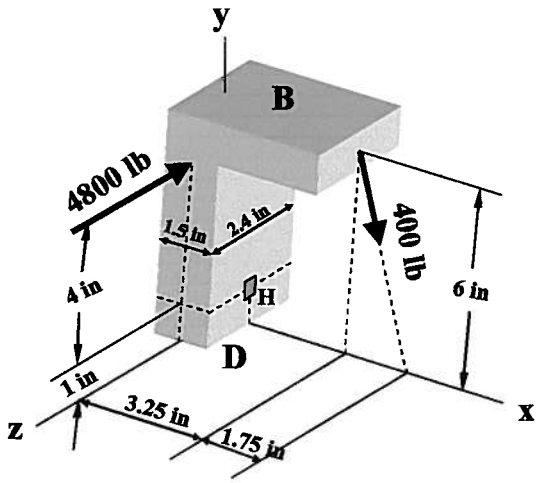
Farhang Pourboghrat
Patrick Kwon

Final Version: 11/08/05

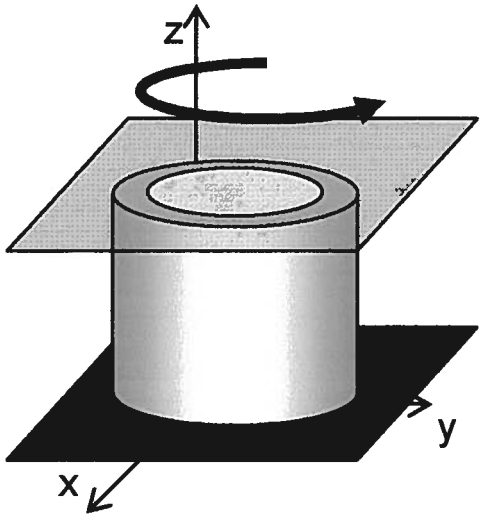
1. The pin-connected aluminum-alloy frame shown carries a concentrated load F. Assuming buckling can only occur in the plane of the frame, determine the value of F that will cause instability. Assume $E = 70\ GPa$ for the alloy. Both members have 50 mm by 50 mm square cross sections.



2. Two forces are applied to the post BD as shown (base is fixed). Knowing that the vertical portion of the post has a cross section of 1.5 x 2.4 in, determine the principal stresses, principal planes, and maximum shearing stress at point H.



3. Determine the yield strength required from the material in order to withstand the internal pressure (P=1MPa) and torsion (T=1kNm) on the closed-end cylindrical pressure vessel. One bottom side of the vessel fastened to the base. The outer radius is 15cm and the thickness is 1cm.



4. The beam is loaded as shown below. (a) Determine the reaction forces and moments for the beam shown below. (b) Determine the slope at C when EI=1000N·m^2.