

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Mechanical Engineering 2.001 Mechanics and Materials I Fall 2006

Problem Set 9

Distributed: Wednesday, November 15, 2006

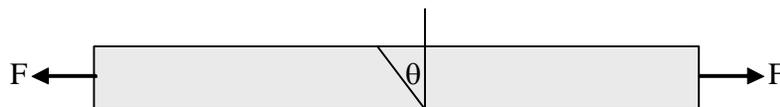
Due: Wednesday, November 22, 2006 *

* Skipping classes is a bad idea. That said, if you will be on an airplane during class on Wednesday, you may drop your pset off in advance at TA office hours, at my office, or at the office of my assistant, sticking it under the door if necessary.

Problem 1: Hibbeler 10-6

Problem 2: Hibbeler 10-67. A symbolic answer in terms of σ_y will suffice; there's no need to convert to SI units just to give a numerical answer.

Problem 3: You're building a small-scale wooden model of a structure of interest, and you're in a hurry to get it done quickly. Part of the model needs to be a structural member that has a length L and a square cross-section with side length $L/10$, and this structural member will be loaded in tension. At the last minute, you realize that you don't have any pieces of wood that are long enough; your longest pieces have a length of $0.8L$. You do, however, have a bottle of glue that you can use to glue two pieces together to get the total length that you need. Your glue can withstand 1MPa of shear stress and 3MPa of normal stress. You also have a saw that you can use to cut the ends of the pieces of wood at any angle that you like prior to gluing. At what angle θ should you cut the wood faces if you want the resulting beam to be able to withstand the largest possible tensile load? (For the purposes of this problem, you cannot cut any dove tails or other fancy shapes into the faces of the wood to get a stronger connection.)



Problem 4: You decided to measure the pressure inside a soda can by sticking a strain gauge along the axial direction when it is sealed, popping the can open to release the pressure, and using the strain gauge to measure the resulting strain (as compared to when the soda can was sealed). However, your hands were shaky, and you didn't quite get the strain gauge to line up along the axial direction – you were instead off by an angle of ϕ from the axial direction. If your soda can has a radius R , wall thickness t , Young's modulus E , and Poisson ratio ν , derive an equation for p in terms of the given parameters, the angle ϕ , and your measured strain.

