MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Mechanical Engineering
2.001 Mechanics and Materials I
Fall 2006

Problem Set 7

Distributed: Wednesday, November 1, 2006
Due: Wednesday, November 8, 2006

Problem 1: Hibbeler 3-33

Problem 2: Hibbeler 4-70

Problem 3: Hibbeler 4-73 (I interpret this problem to mean that the concrete slab is in contact with a fixed abutment on one side already, and that it is only out of contact on the opposite side.)

Problem 4: A cube with side length L rests inside a square hole (length = width = L, and height h = 2L). (So the walls of the hole extend much higher than the height of the block, and the block fits perfectly in the hole in the lateral directions when it is first put inside.) The contact between the cube and the hole is frictionless, and the cube has a Young's modulus E, a Poisson ratio ν, and a coefficient of thermal expansion α. What is the displacement of the top of the cube if the temperature is increased by an amount ΔT?

Problem 5: A vacuum sphere is a spherical pressure vessel that is designed to hold a vacuum. (One use for a big vacuum sphere is to provide a brief burst of pumping capacity; a relatively small pump gradually pumps out the vacuum sphere, and then the vacuum sphere pumps out some other space at a very high rate.)

Consider a thin-walled vacuum sphere with radius R and wall thickness t. When it is fully pumped out, the gauge pressure inside is -P, where P is atmospheric pressure. Calculate the state of stress in the wall of the sphere in terms of P, R, and t. How much does the sphere's radius change when it is pumped down to vacuum?

Problem 6: A rigid block of weight W = 1kN rests over a soda can of radius R = 0.1m and wall thickness t = 1mm. The pressure inside the can is P = 0.1MPa. Determine the state of stress in the wall of the can (that is, the components of stress in the circumferential direction and along the can's length).

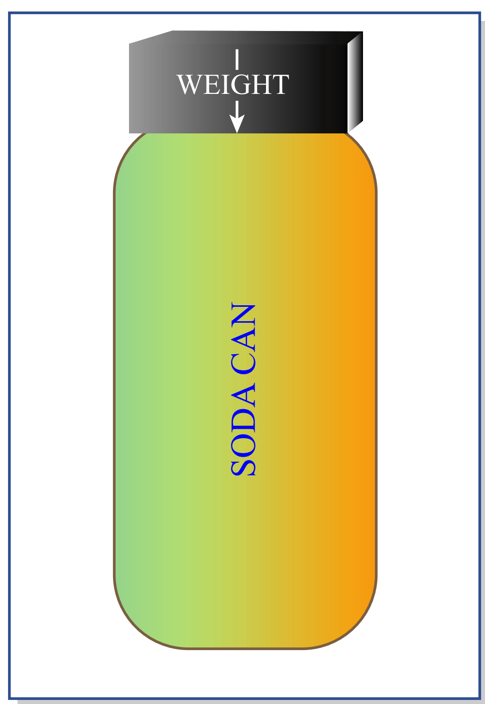

Figure by MIT OCW.