AE6114 - Fundamentals of Solid Mechanics - Fall 2020

Test 2 - Thursday, October 29^{th} 2020

Notes: (i) Solve the exam on your own sheets of paper; (ii) write your name on the top-right corner of this page and in the same place for every solution page; and (iii) attach the formula sheet used during the exam.

Problem 1 [60 Points]

A cube made of two perfectly glued pieces of isotropic, linearly elastic material is subjected to a known uniform pressure p on its lateral faces as shown in Figure 1(a). The cube is clamped between fixed, **frictionless** plates so that the strain through its height is zero (Figure 1(b)). Assume that the **stress state is homogeneous** throughout the cube (it doesn't change with the position) and the Lame constants, λ and μ, are also known,

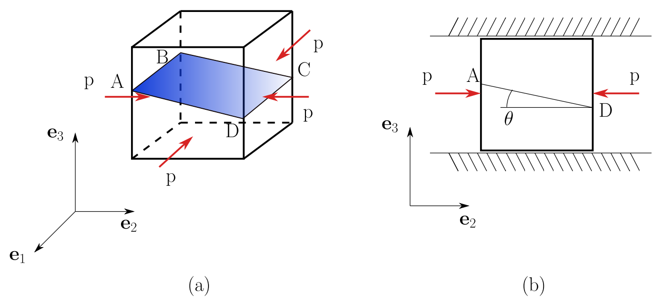

Figure 1: Schematics for Problem 1

1. Find the expression for the tractions on each face of the cube.
2. With the tractions found in (1) and Hooke's Law, find all the components of the stress tensor, σ_{ij}.
3. Now that you know the full stress state inside the cube, determine the value of applied pressure p that would make interface between the pieces fail, assuming that the glue has a shear strength τ_u (Hint: you can use the shear stress on the plane $ABCD$ and compare it with the strength of the glue)

Problem 2 [40 Points]

Let us consider the same cube as in the previous problem, but for a different loading scenario. Now the side faces are free and the pressure p is applied to the top and bottom faces as shown in Figure 2.

1. Determine the value of applied pressure p that would make interface between the pieces fail.
2. Based on your calculations, at which angle θ you should glue the two pieces to get maximum strength. Justify your answer for both cases.
3. Considering that Poisson's ratio $\nu = \frac{\lambda}{2(\lambda+\mu)}$ must hold values between -1 and 1/2, determine, for a given theta, which loading condition is more favorable? Justify your answer.

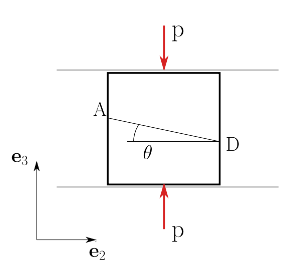

Figure 2: Schematics for Problem 2