

MCEN 5023/ASEN 5012 Homework 9

(Due on 11/08/2006 before the class)

1. (35 points) For pure bending (Figure 1), the Airy stress function is given by:

$$\phi = ay^3 + by^2 + cx^3,$$

where a , b , and c are constants.

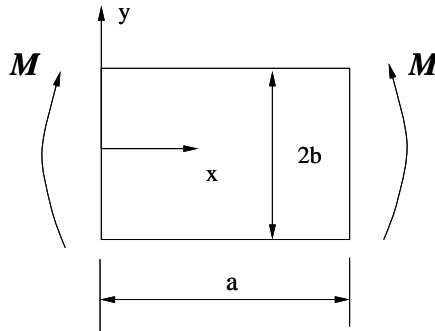


Figure 1. Pure bending.

- a) (10 points) Obtain the stress components σ_{11} , σ_{22} , σ_{12} .
- b) (25 points) Determine the constants a , b , and c by considering boundary conditions. (Note, you may take the depth of the beam is h)
2. (35 points) In the class, we obtained the stress components for pressure vessel (Figure 2). The in-plane displacements for pressure vessel are

$$u_r = C_1 r + \frac{C_2}{r}, \quad u_\theta = 0,$$

where C_1 and C_2 are constants.

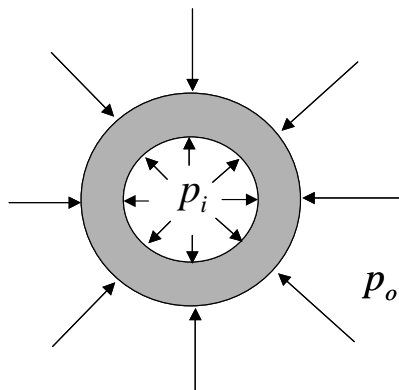


Figure 2. Pressure vessel. The inner diameter is $2a$ and the outer diameter is $2b$.

- a) (25 points) If the two ends of the vessel are free to move, determine C_1 and C_2 . The material parameter is E and ν . (You should use E and ν in your answer)

- b) (10 points) Determine the displacement u_r for the case if the two ends of the vessel are fixed. (You should write down your answer in terms of E , ν , a , b , p_i , and p_o .)
3. (30 points) A thick wall vessel is embedded in a rigid media (as shown in Fig. 3). The inner radius of the vessel is a and the outer radius is b . The material of the vessel has the Young's modulus of E and Poisson's ratio of $\nu=0$. The pressure in the vessel is p . Please determine the stress component σ_{rr} and $\sigma_{\theta\theta}$ in the vessel.

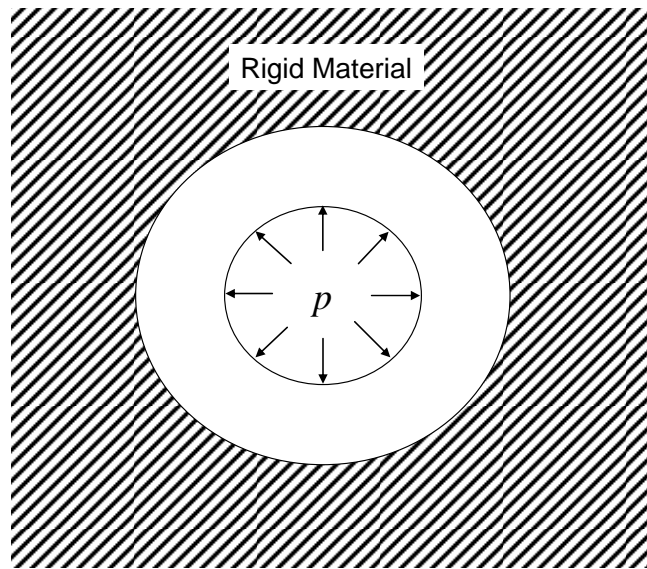


Figure 3. A thick wall pressure vessel embedded in a rigid media.

(Hint: since the media surrounding the vessel is rigid, no matter how large a force is applied, the rigid media has no displacement.)