SE 276B/MAE 232B Finite Elements in Solid Mechanics II **J. S. Chen**
Winter 2020

Computer Assignment #1 Due January 30, 2020

An elastic spherical ball is subjected to an internal pressure as shown below:

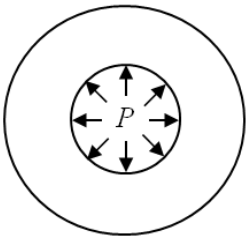

Figure 1 Cross-sectional view of the hollow sphere

The spherical ball is made of a linear elastic material with inner radius R_i = *10.0 in*, outer radius R_o = *20.0 in*, Young's modulus $E = 1000.0$ *psi*, Poisson's ratio $\nu = 0.3$, and is subjected to an internal pressure $P = 10.0$ *psi*.

The analytical solution of this problem is given below:

$$\sigma_{rr} = \frac{PR_i^3(R_o^3 - r^3)}{r^3(R_i^3 - R_o^3)}$$

$$\sigma_{\theta\theta} = \sigma_{\phi\phi} = -\frac{PR_i^3(2r^3 + R_o^3)}{2r^3(R_i^3 - R_o^3)}$$

$$\boldsymbol{\varepsilon} = \mathbf{C}^{-1}\boldsymbol{\sigma}$$

$$u_r = r\varepsilon_{\theta\theta} = r\varepsilon_{\phi\phi}$$

Obtain FEM solutions using 11, 21, and 41 2-node linear elements and 3-node quadratic elements.

1. Compare FEM radial displacement solutions u_r with analytical solution at the inner and outer surfaces of the ball for different mesh refinements, and make discussions.

2. Compare FEM radial stress solutions σ_{rr} with analytical solution at the middle of the ball thickness for different mesh refinements, and make discussions.

3. Compare FEM circumferential stress solutions $\sigma_{\theta\theta}$ with analytical solution at the middle of the ball thickness for different mesh refinements, and make discussions.