AFEM: Axisymmetric Project Verification Tests

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Chapter 1

Introduction

This document compiles several types of closed form verification tests that can be compared against in the finite element solutions. It provides several examples and the closed form solutions for these examples.

Chapter 2

Example 1: Uniaxial Stress on Bar

This example performs a simple uniaxial stress test on an axisymmetric bar. An example of a mesh that could be applied to this problem

2.1 Closed form solution

Chapter 3

Example 2: Pressure Applied to Simply Supported Circular Plate

3.1 Closed form solution

The equation for the displacement of the center of the plate is as follows:

$$\delta = \frac{3F(1-\nu^2)D_L^2}{8\pi E h^3}\left(\frac{D_S^2}{D_L^2}\left[1+\frac{(1-\nu)(D_s S^2 - D_L^2)}{2(1+\nu)D^2}\right] - \left(1+\ln\frac{D_s}{D_L}\right)\right) \tag{3.1}$$

Vitmar, F. F., and Pukh, V. P., "Method of Determining Sheet Glass Strength," Zavodskava Laboratoriya, Vol. 29, No. 7, 1963, pp. 863-867.

Chapter 4

Example 3: Thick walled pressure vessel

4.1 Closed form solution

The radial displacement of a thick walled pressure vessel at radius r is:

$$u(r) = \frac{1-\nu}{E}\frac{(r_i^2 p_i - r_o^2 p_o)r}{r_o^2 - r_i^2} + \frac{1+\nu}{E}\frac{(p_i - p_o)r_i^2 r_o^2}{(r_o^2 - r_i^2)r} \tag{4.1}$$