Instructions

In this assignment, you are expected to work out and investigate the results of any ONE of the given problems. The problem is to be worked out using the finite element formulation, applying geometric non-linearity and presenting results in the form of load-deflection curves. Finally, you are expected to comment on the convergence of the solution, total number of iterations and load increments to achieve the results.

Problem 1 - Cantilever subjected to end moment

Problem Description

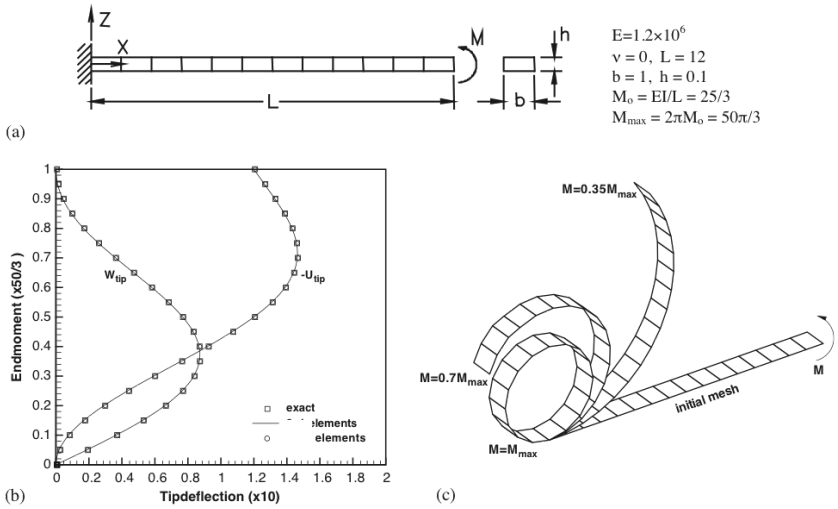


Fig. 3. (a) Cantilever subjected to end bending moment. (b) Load–deflection curves for cantilever subjected to end bending moment. (c) The deformed mesh under the maximum bending moment.

Figure 1: Problem 1

A cantilever beam, when subjected to an end moment, forms a circular arc as shown in figure 1 with a radius R given by the classical flexural formula

$$R = \frac{EI}{M} \tag{1}$$

Using the formula, the analytical normalized deflections can be derived to be

$$\frac{W}{L} = \frac{M_o}{M}\left(1 - cos\frac{M}{M_o}\right) \tag{2}$$

where

$$M_o = \frac{EI}{L} \tag{3}$$

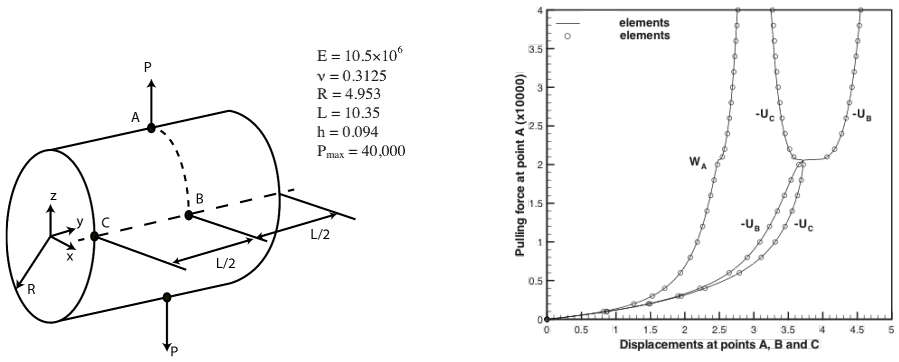
The maximum end moment M_{max} is taken to be πM_o at which the beam will be bent into a circle.

Assignment

- Model a cantilever beam subjected to an end moment as described above. Arrive at a converged solution and present the load-deflection curves
- The results must be presented for two types of elements: Beam and Shell. Compare the results and comment.
- Compare results with the analytical solution
- Comment on the maximum deflection you achieve of the cantilever
- Comment on the accuracy of your results with given sample results in figure 1

Problem 2 - Cylindrical shell subjected to a pull-out force

Problem Description



(a) Cylinder and properties

(b) Results

Figure 2: Cylindrical shell subjected to a pull out force with points A, B and C marked and corresponding load-deflection results

A cylindrical shell free at both edges is shown in figure 2. It is subjected to a pair of radial forces P.

Assignment

- Model the cylinder with the given dimensions and material using shell elements. Apply incremental radial load P. Arrive at a converged solution and present the corresponding load-deflection curves
- Compare with the sample results shown in figure 2 for 2 example mesh densities
- Comment on the accuracy of your results as compared to the ones in figure 2