ME4291 Finite Element Analysis

Bar Element

Problem Statement

- In this exercise, you will modify the simple FEA script to extend the analysis to a non-uniform bar with traction applied. This will be based on energy formulation discussed in class.

- The Gauss quadrature will be used to perform integration within an element. The Gauss points and weights can be read from data files given.

- To keep the code modular, you will write two function files: one for the calculation of element stiffness matrix and one for nodal forces from traction in the element. Input data of the element properties (EA) and traction will also be read from function files provided.

- The function files that you have created will be called by the modified FEA script.

Tasks

- Write a function file that returns the element stiffness matrix with inputs of the global coordinates of its two nodes.

- Write a function file that returns the nodal forces of an element with inputs of the global coordinates of its two nodes.

- Modify the given FEA script to call the two function files you have created.

- The variation of properties and traction along a bar are given by the two function files (`Input_bar_EA.m` and `Input_bar_traction.m`). The left end of the bar is fixed ($u = 0$) and a load of $F = 10 \ kN$ is applied at the right end. For each of the mesh (coordinates and connectivity) provided, use your script to solve for the displacement profile along the bar.

- Plot the variation of displacement along the length of the bar for each case in a single graph.

- Extend the script to calculate the strain at the center of each element. Plot the variation of strain along the bar for each case in a single graph.