

Due Monday, September 7th, 12:00 midnight

This homework is considering the analysis of plane truss as discussed in class. A list of MATLAB programs that were discussed in class is provided that contain all essential elements for the analysis of trusses. An example problem is given.

Start this work by investing considerable time to review the structure and fine details of the provided programs (doing so will be very helpful in subsequent homework as all FEM programs share similar programming structure). It is important that all tasks that have been programmed clearly provide you a direct one-to-one link with the theory you learned in lectures.

Problem 1 - Analysis of a three bar structure (hand calculation)

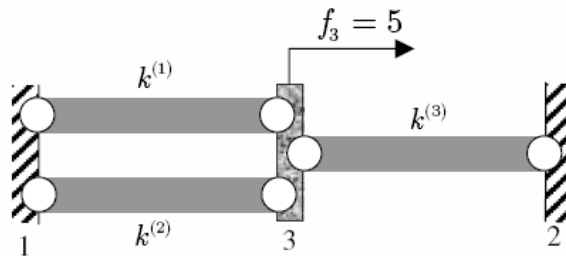


Figure 1: Three-bar problem

Three bars are joined as shown in Figure 1. The left and right ends are both constrained, i.e. prescribed displacement is zero at both ends. There is a force of 5 N acting on the middle node. The nodes are numbered starting with the nodes where displacements are prescribed. You may consider $k^{(e)}$ as the spring constant and is known.

- Assemble the global stiffness and force matrix.
- Partition the system and solve for the nodal displacements u_3 .
- Compute the reaction forces.

Problem 2 - Analysis of a plane truss structure (hand calculation)

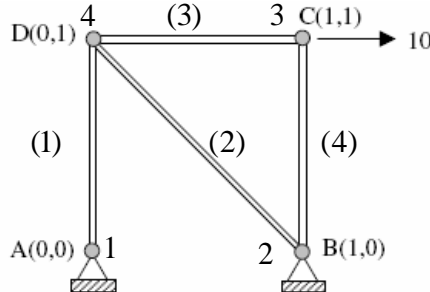


Figure 2: A plane truss structure

Consider the truss structure given in Figure 2. Nodes A and B are fixed. A force equal to 10 N acts in the positive x -direction at node C. Coordinates of joints are given in meters. Young's modulus E and the cross-sectional area A constants.

- Assemble the global stiffness and force matrix.
- Partition the system and solve for the nodal displacements.
- Compute the stresses and reactions.

Problem 3 - Analysis of two plane truss structures (MatLab)

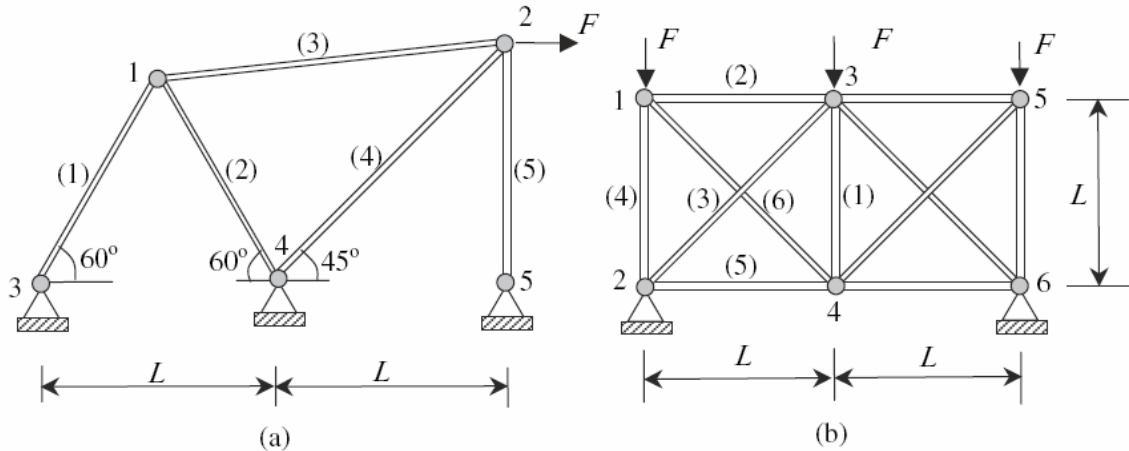


Figure 3: Two plane truss structures

Using the MATLAB finite element code, find the displacements and stresses in the two truss structures given in Figure 3. Plot the deformed structure with MATLAB. For truss structure (b), exploit the symmetry. For the two trusses, check the equilibrium at node 1. The Young's modulus $E = 10^{11}$ Pa, cross sectional areas of all bars $A = 10^{-2} m^2$, forces $F = 10^3$ N and $L = 2$ m.

Problem 4 - Analysis of two plane truss structures (ANSYS)

Repeat the solution of Problem 3 using ANSYS as described in your recitation. Provide a complete list of the command steps that you used to solve this problem with ANSYS and compare your answers with those obtained with MATLAB.