

Lab-7

Develop the function for Elemental stiffness Matrix

1. Number all of the nodes and all of the elements.
2. Identify the Displacement Degrees of Freedom in Global Directions.

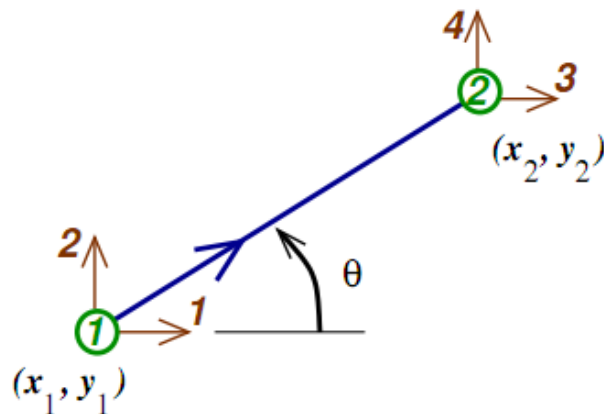
Number all the structural degrees of freedom in your truss. In a 2D (planar) truss, each node can have a maximum of two degrees of freedom: one in the global X-direction and one in the global Y -direction.

3. Node Locations.

Write the (x, y) coordinates of each node using units consistent with E and A. In other words, if E and A are given in kN/cm^2 and cm^2 , write the (x, y) coordinates in terms of centimetres.

4. Define each element.

Draw each element of your truss individually and draw the local coordinates in the global directions. For example, if element number N is a diagonal truss element, and the global directions are X: horizontal and Y: vertical, draw element number N like this:



where 1,2,3,4 are the element coordinates of the truss element in the global directions. The local coordinates are always numbered 1,2,3,4 with 1 and 3 pointing in the global X direction (to the right) and with 2 and 4 pointing in the global Y direction (up). Some or all of these four coordinates will line up with the structural degrees of freedom that you

identified in step 2., above. The angle θ is the counter clockwise angle from element coordinate 1 to the truss element.

5. Element Stiffness Matrices in Global Coordinates, K.

Element Stiffness Matrices in Global Coordinates, K. For each element, find its (4x4) element stiffness matrix, by evaluating the equations below:

$$L = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$ls = (x_2 - x_1)/L$$

$$lm = (y_2 - y_1)/L$$

$$K = \frac{EA}{L} \begin{bmatrix} ls^2 & ls lm & -ls^2 & -ls lm \\ ls lm & lm^2 & -ls lm & -lm^2 \\ -ls^2 & -ls lm & ls^2 & ls lm \\ -ls lm & -lm^2 & ls lm & lm^2 \end{bmatrix}$$

You should understand where these equations come from, why this matrix is symmetric, why the diagonal terms are all positive, and what the off-diagonal terms mean.