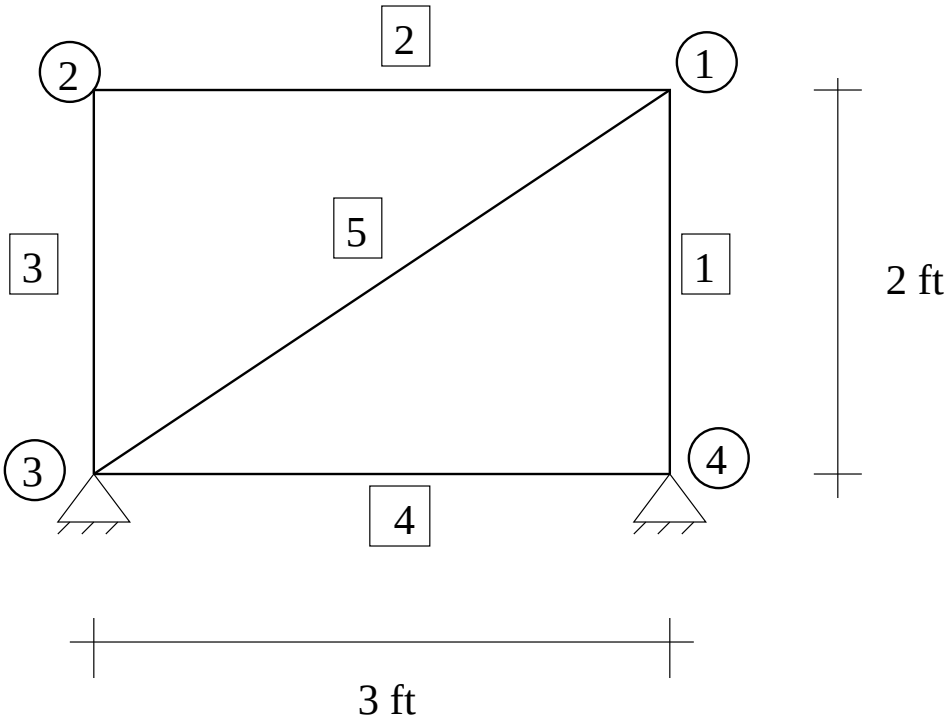
HW 4: Due Feb. 17

1. Consider the truss shown below. Assume the bars are steel $E = 30 \times 10^6$ psi. The vertical bars have a diameter of 0.5 in, the horizontal 0.75 in, and the diagonal 1.0 in. Use the number scheme shown and your program from Lab 3 to help solve this problem. [Note you should not have any need to use the $\boldsymbol{K}$ matrix to solve this problem.]



   (a) Find the compatibility matrix for the truss.

   (b) Find the diagonal matrix $\lceil AE/L \rfloor$.

   (c) Assume $u_{1x} = -0.1$ in, $u_{1y} = 0.1$ in, $u_{2x} = 0.1$ in, $u_{2y} = 0.0$ in.

      i. Find the strains in the 5 bars.

      ii. What are the stresses in the 5 bars?

      iii. What are the internal forces in the 5 bars?

      iv. What forces must have been applied to nodes 1 and 2?

      v. What are the support reactions at nodes 3 and 4?

2. Consider the force field $\boldsymbol{F}(x, y) = 10xy\boldsymbol{e}_x + 5y\boldsymbol{e}_y$ (N). Does this force field emmenate from a potential? i.e., is it conservative?

3. Find an expression for the end-rotation of a circular bar loaded with a torque, T_o, at its end. Assume the bar is built-in at the other end, has a length L, and a constant torional rigidity GJ. Use conservation of energy to solve this problem.

4. A solid circular bar is bent 90^o at two locations and is built-in at one end. Assume A, I, J, E, and G are constants.

   (a) Using conservation of energy, determine a formula for the vertical deflection at the point of load application. [$\alpha = 10/9$ for round bars.]

   (b) Let $L = 200$ mm and the diameter of the bar be $d = 30$ mm. What is the percent contribution to the total deflection from axial loading, bending, torsion, and direct shear? Assume $E/G = 2$.

   (c) Repeat with $L = 500$ mm and $d = 10$ mm.