1. Solve Problem 2.5-3 using two beam elements. Write matrix equation after applying boundary conditions.

2. Consider a bar element with three nodes, as shown in the figure. When the solution is approximated by \( u(x) = N_1(x)u_1 + N_2(x)u_2 + N_3(x)u_3 \), calculate interpolation functions \( N_1(x), N_2(x), N_3(x) \). When a distributed load \( q_0 \) is uniformly distributed on the element, calculate work-equivalent nodal forces.

3. Use the Rayleigh-Ritz method to determine the deflection \( v(x) \), bending moment \( M(x) \), and shear force \( V(x) \) for the beam shown in the figure. Assume \( EI = 1,000 \) N-m\(^2\), \( L = 1 \) m, and \( p_0 = 100 \) N/m, and \( C = 100 \) N-m. The displacement is expressed as \( v(x) = c_0 + c_1x + c_2x^2 + c_3x^3 \). Make sure the displacement boundary conditions are satisfied a priori. **Hint:** Potential energy of a couple is calculated as \( V = -Cdv / dx \), where the rotation is calculated at the point of application of the couple.


5. A space frame structure as shown in the figure consists of 25 truss members. All members have the same circular cross-sections with diameter \( d = 0.5 \) in. At nodes 1 and 2, a constant force \( F = 60,000 \) lb is applied in the \( y \)-direction. Four nodes (7, 8, 9, and 10) are fixed on the ground. The frame structure is made of a steel material whose properties are Young’s modulus \( E = 3 \times 10^7 \) psi, Poisson’s ratio \( \nu = 0.3 \). Calculate displacements of all nodes and stress of all members using finite element software. Provide a plot that shows labels for elements and nodes along with boundary conditions. Provide deformed geometry of the structure and a table of stress in each element.