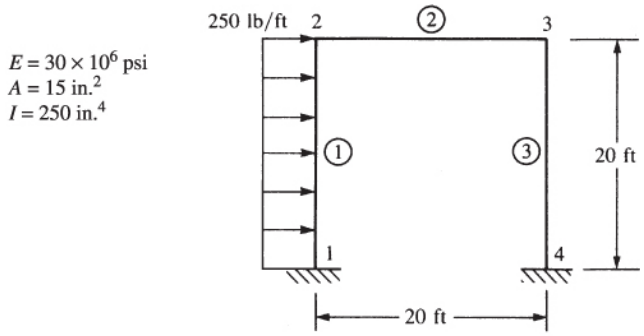
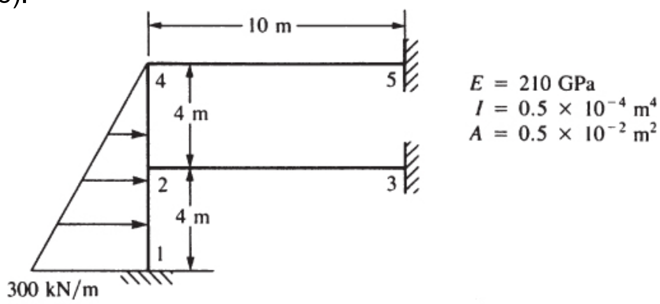
CIVL 7117/8117 - Finite Element Methods in Structural Mechanics
Final Exam Fall 2017

Name: ______________________________

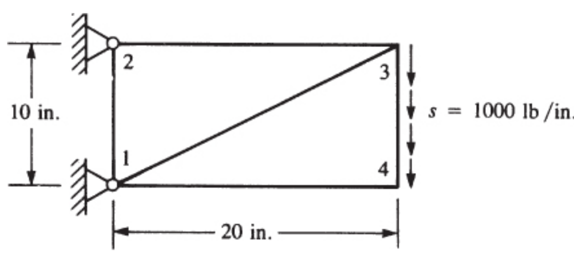
1. For the ridge frame shown below, determine the displacements and rotations of the nodes, the element forces, and the reactions (Problem 5-8).



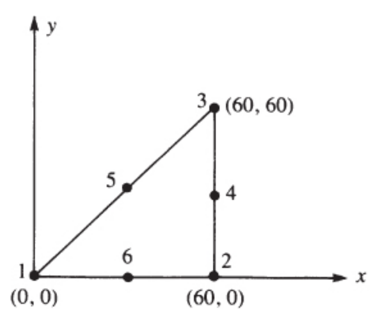
2. For the ridge frame shown below, determine the displacements and rotations at the nodes, the element forces, and the reactions (Problem 5.28).



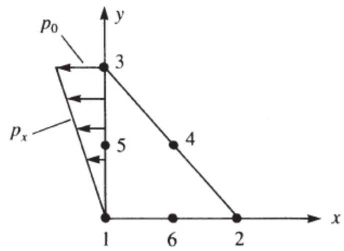
3. Determine the nodal displacements and the element stresses, including principal stresses, for the thin plate shown below with a uniform shear load acting on the right edge. Use E = 30 x 10^6 psi, ν = 0.30, and t = 1 in. (Problem 6.13).



4. Evaluate the shape functions for the linear-strain triangle shown below. Then evaluate the [*B*] matrix. Units are millimeters (Problem 8.7).

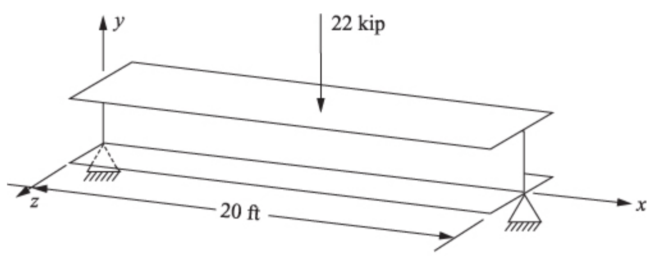


5. For the element show below subjected to the linearly varying line load acting over the vertical side, determine the nodal force replacement system. Compare the results to those obtained for a same load acting over a CST element (Problem 8.4).

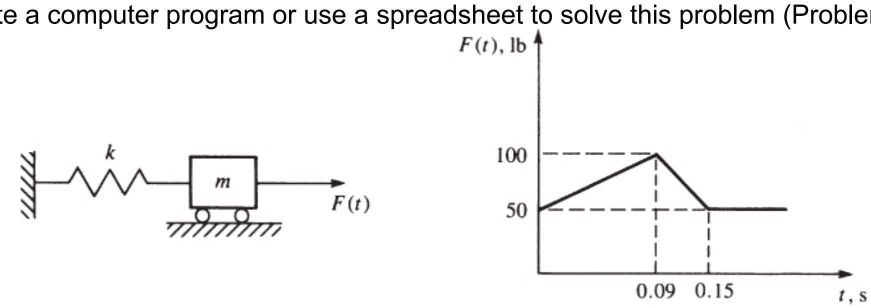


6. Write Matlab scripts to evaluate the stiffness matrix for a Q4 and Q8 element using Gaussian quadrature. Verify your code results for the Q4 by comparing to Example 10.4 in the textbook.

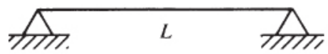
7. For the simply supported structural steel W 14 x 61 wide flange beam shown below, compare the shell element results with classical beam bending results for deflection and bending stress. The beam is subjected to a central vertical load of 22 kips. The cross-sectional area is 17.9 in.^{2}, depth is 13.89 in., flange width is 9.995 in., flange thickness is 0.645 in., web thickness is 0.375 in., and the moment of inertia about the strong axis is 640 in.^{4} (Problem 12.5).



8. For the spring-mass system shown below, determine the mass displacement, velocity, and acceleration for five time steps using the central difference method. Let k = 2,000 lb./ft. and m = 2 slugs. Use a time step of Δt = 0.03 s. You might want to write a computer program or use a spreadsheet to solve this problem (Problem 16.5).



9. For the beam shown below, determine the natural frequencies using first two and then three elements. Let *E*, ρ, and *A* be constant for the beam (Problem 16.11c).



10. For the rigid frame shown below, determine the maximum displacements, velocities, and accelerations using SAP2000 (Problem 16.16).