There are 3 questions with 75 total points possible. Unless told specifically how to solve a problem, you may use any method you wish. Show all work to receive full credit. If you cannot determine the answer for a problem that is needed for another question, assume a reasonable value and continue.

1. For each of the following beams, state the expected flexural failure mode—plastic hinge, lateral torsional buckling (LTB), or local buckling. If the failure is by LTB, is it elastic or inelastic? Reference any charts or tables used. List any assumptions you have to make.
   
   (a) (6 points) W27×146 (Z_x = 464 in^3) with maximum unbraced length (L_b) of 10 feet.
   
   (b) (6 points) W33×118 (Z_x = 415 in^3) with L_b = 14 feet.
   
   (c) (6 points) W30×99 (Z_x = 312 in^3) with L_b = 18 feet and C_b = 1.14.
   
   (d) (6 points) W27×94 (Z_x = 278 in^3) with L_b = 21.5 feet and C_b = 1.67.

2. (10 points) Find the plastic hinge capacity, M_p, for the built-up section below, which is constructed using A36 steel plates. Bending is about the X-X axis. You may neglect the welds. (Hint: The area center will not be at the same location as the centroid.)

3. The beam below is braced laterally only at the ends. The point load consists of a 24 kip dead and 52 kip live load. The beam is made of A992 steel. Neglect self-weight for all parts of the problem.

   (a) (7 points) Find C_b for the beam.
   
   (b) (16 points) Taking into account C_b as calculated in part (a), find the lightest W-section that will work. Check shear, but you may neglect deflection serviceability.
   
   (c) (6 points) Which limit state controlled your design in part (b)—plastic hinge, inelastic LTB, elastic LTB, or local buckling? Explain.
   
   (d) (12 points) If a 12 kip axial live load were added to the beam, would your section from part (b) still be adequate? Neglect second-order effects (P-δ and P-Δ). If your section turns out to be slender for compression, ignore this fact and calculate the axial capacity as if local buckling would not control.