

Homework #8 (yes, we apparently skipped 6 & 7)
Elements of Mechanical Design
Bolt calculations

1. (normal loading) Four $\frac{1}{4}$ -20 grade 5 square-head steel bolts are clamping a $\frac{3}{4}$ " piece of steel & a $\frac{3}{4}$ " piece of aluminum, both 4" wide. Find an appropriate fastener length on McMaster Carr. What is the bolt stiffness and the member stiffness? If the joint is subjected to a 100 lb normal load, what is the force in the bolt and the force in the member when the fastener is pre-tightened to "reusable" load? What is the maximum normal stress in the fastener?
2. (shear loading) The plates in problem 1 are now subjected to a shear load of 500 lb. The bolt holes in each plate are located 1" from the edge of the plate.
 - a. how close is the bolt to a bearing failure (actual force/failure force)?
 - b. how close is the plate to a bearing failure?
 - c. how close is the bolt to a shear failure (assume the threads are not in the shear plane)?
 - d. how close is the weakest plate to edge shear failure?
 - e. how close is the weakest plate to tensile yield across the bolt holes?
 - f. the steel plate necks down to a 1" width. How close to yield is this section?