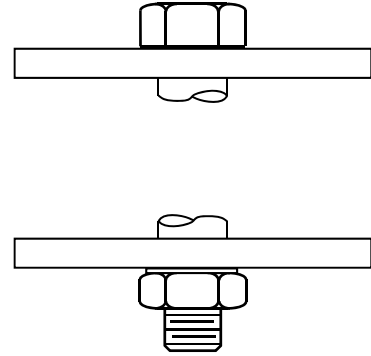
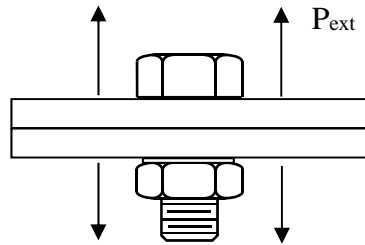


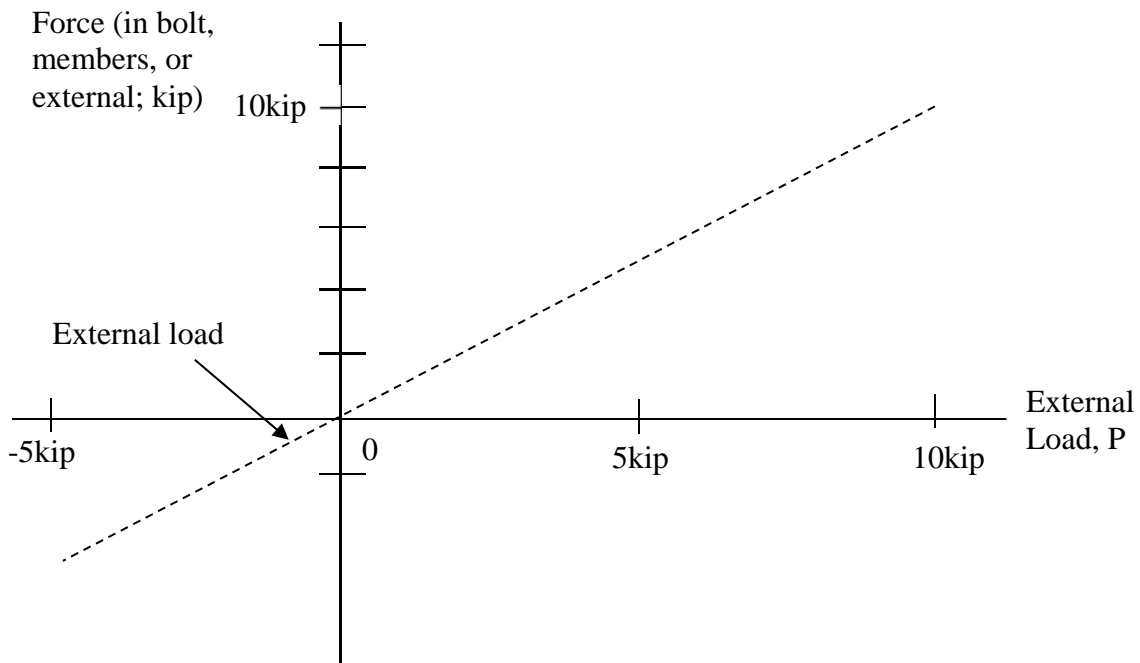
ME 328 – Machine Design
Spring 2017, Assignment 11

- 1) (5 pts) *Educational purpose: is there more to design than number crunching? (hint: yes).* Briefly describe the main advantage(s) to using a high strength fastener (such as SAE Grade 5 or higher, or ISO Class 8.8 or higher). Describe the main “dangers” or risks associated with using high strength fasteners. There must be advantages and disadvantages otherwise there would not be multiple strengths to choose from.
- 2) (10 pts) *Educational purpose: learn to design a fastened tension joint with consideration to joint separation.* Given a 3/8-24 UNF SAE Grade 5 bolt. An external tensile load of 2200 pounds is applied to the joint. On the same graph, plot factor of safety for joint separation and also the load factor (n) as a function of preload (for preload from zero to 100% of proof). Assume grip length is 2.4 inches. Based on this, what can you generally say about preload magnitude (is higher better, worse, same)? What preload would you recommend for this part assuming no fatigue loading?
- 3) (5 pts) *Educational purpose: textbooks are awesome storage of human knowledge. However, since engineers must work in the physical world, they need to continually develop their physical senses. This exercise provides hands-on opportunity to interact with the physical world.* In SH110 along the window, there is a small red box with a number of items in it: standard fasteners (bolts and nuts), two thread gages (one ISO, one UN), and a blue fastener gage to determine diameter of the bolts and the nuts. The fasteners are a mixture of ISO and UN of various diameters and pitch (coarse and fine). Using the gages, identify them as ISO or UN – identify their diameters, and identify their pitch (“pitch” for ISO, “threads per inch” for UN – INCLUDE identifying them as coarse or fine). Notice that all of the fasteners are very nearly the same size so you will have to take care to make sure you are measuring accurately. Also note that some of the nuts “sort of work” on different sized fasteners (not quite “good enough” though). Do NOT force the nuts, use only light finger torque. For this assignment, properly specify the fasteners in the red box (eg. 8X1.25 – coarse, 5/8 - 24UNC). Note, there is “tabulated” data on the blue gage to help classify coarse or fine pitch.
- 4) (15 pts) *Educational purpose: of all the problems on this assignment, **this is the MOST IMPORTANT**. It should help you understand how force is carried in a tension joint. Understanding is more important than being able to use a calculator.* Given: A fastened tensile joint has a joint constant, $C = 0.2$, and requires an external force of 6000 pounds to cause joint separation. Create free body diagrams by showing all three forces (F_b , F_m , P_{ext}) on the sectioned sketch below. Plot to scale the force in the bolt as well as the force between the members as a function of external load for an external load going from 5000 pounds **compression** to 10,000 pounds **tension**. The three forces on the graph (external, bolt, members) must show that equilibrium is maintained. Use a straight edge and be neat and clear. Assume no failure (yielding nor fracture) in the bolt. Discuss, explain or show calculations to justify your graph. Notice that the equation $F_b = CP + F_i$ is an equation for a line (of the form: $y = mx + b$), as is the equation $F_m = (1-C)P - F_i$. NOTE: regarding “sign” of F_m (positive or negative); in FBD language, if *up* is positive then *down* is negative. But what really matters is that your interpretation of the FBD results in $\sum \mathbf{F} = 0$.

Sketches for Problem 4:



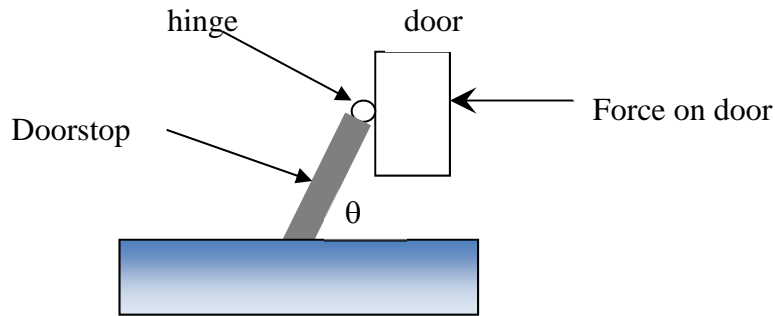
Complete this graph:



A rest from fasteners...for now...

- 5) (5 pts) Read the article by James G. Skakoon, *Self-Help* (Mechanical Engineering, Vol. 131, No. 7, July 2009, pp. 44-49). A PDF copy is available on the course web page. Briefly, explain how the concept of “self-help” could be applied to the door stop design shown below. Could this door stop be designed to prevent the door from moving regardless of how much

force is applied (i.e. self-locking)? Assume the coefficient of friction between the doorstop and the floor is 0.6 is there an angle (θ) that would result in “self-locking”?



- 6) Draw a free-body diagram for the slip-jaw wrench shown here. For the orientation shown here, will this wrench design be self-helping if turned clockwise or counter clockwise or neither or both? A slip-jaw wrench will be available in SH1110 for you to experience “hands on” learning.

