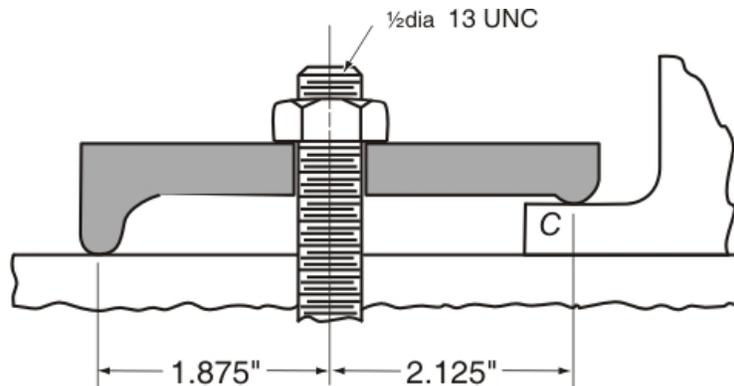


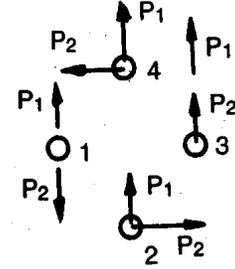
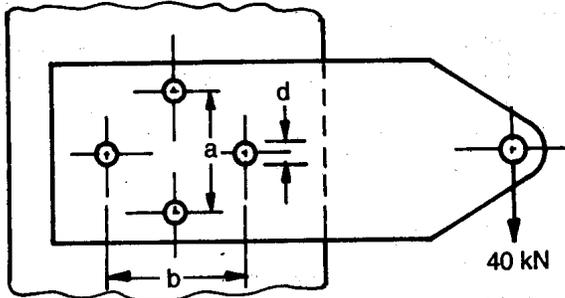
**330:148 (g) Machine Design**  
**Assignment 4 (Screw and fastener design)**

**Due date September 24, 2007**

1. A lifting eye on a shipping container is made from grade 5 bolting material and has a  $\frac{3}{4}$ -UNC threads. If the container weighs 5,000 pounds, is this acceptable if a factor of safety of 3 is desired? (Ans. Yes, 5.678)
2. A  $\frac{5}{8}$  – UNF steel bolt has an effective length of 8 inches, which is also the approximate length of the unthreaded shank area. If the elongation after tightening is 0.015 inch:
  - a. What is the stress in the shank area? (Ans. 56,250 lb/in<sup>2</sup>)
  - b. What is the stress in the threaded area? (Ans. 67,411 lb/in<sup>2</sup>)
  - c. What grade material should be specified if a safety factor of 1.5 is desired based on the proof strength? (Ans. SAE grade 7)
  - d. If the threads were lubricated, what torque would be needed to tighten this bolt? (Ans. 1618 in-lb)
  - e. Using the turn-off nut method, what angle of tightening would be required? (Ans. 97.2°)
3. The cylinder head of a 10-inch diameter compressor is attached by 12 studs made from SAE grade 5 material. The cylinder has a pressure of 300 psi. For a safety factor of 2:
  - a. Select the stud size. (Ans. 5/16 UNC or 5/16 UNF studs)
  - b. To preload these studs with lubrication to 80 percent proof strength, calculate the required torque. (Ans. 167.025 in-lb)
4. The nut on the milling machine clamp in Fig. is turned 30° after snug. Assuming the clamp is stiff and the effective length of the stud is 2 inches, find:
  - a. The elongation in the stud. (Ans. 0.00641 in)
  - b. The stress in the stud. (Ans. 96,154 lb/in<sup>2</sup>)
  - c. The force at point C (Ans. 6396 lb)



5. A bracket is fitted to the channel with 4 bolts. The dimensions  $a = b = 150$  mm distance of load from the C. G. of the bolt arrangement is 300 mm. Find the diameter of the bolts. Take  $\tau = 37.5$  MPa. (Ans. 41.2 mm)



6. A jack with a 2-inch square-thread screw is supporting a load of 12 tons. It is expected that the coefficient of friction could vary from 0.10 to 0.15.
- What is the torque required to raise this load? (5006 in-lb)
  - What is the torque required to lower this load? (1536.8 in-lb)
  - Will this always be self-locking? (self locking)
7. If an acme thread is loaded in tension and needs to lift a load of 25,000 pounds, select a screw size that would have a tensile stress below 15,000 psi. (select 1.75 in thread)
8. A square-thread screw, with a  $1\frac{3}{4}$ -inch diameter, exerts a force of 22,000 pounds.
- What is the axial stress in this screw? ( $14,295 \text{ lb/in}^2$ )
  - What torque would be required to lift this load if  $f = 0.2$ ? (4946 in-lb)
  - What is the efficiency of this system? (28.3%)