LESSON 6: DEFINITION OF STRESS AND DIRECT STRESS PROBLEMS

LESSON OBJECTIVES
1. Define Stress.
2. Compute the normal and shear stresses on a member, if the stress is uniform.
3. Identify compression vs tension normal forces on a member.
4. Determine the Factor of Safety for a member, given the failure stresses for the material.

IN-CLASS PROBLEMS
1. Determine the normal stress $\sigma$ in member (2), then report the Factor of Safety (F.S.) of member (2)
   Given: Member (2) has a cross-section that is a 4” square tube with an 1/8” wall thickness, as shown.
   The steel fails if $\sigma$ reaches 30ksi in tension or 20 ksi in compression.
   Note: a kip is 1000 lbs. 1 ksi = 1000psi.

2. For the clevis connection shown, determine the maximum applied load $P$ that can be supported by the
   10-mm-diameter pin if the pin fails at a shear stress of 95 MPa.
   Then, determine the normal stress in the bar, for $P_{\text{max}}$.
   Given: the thickness of the bar, $t = 10\text{mm}$. The width of the bar, $b = 25\text{mm}$.

Hint on SI Units:
1 MPa = $1 \times 10^6$ Pa = $1 \times 10^6$ N/m$^2$
Note that 1 N/mm$^2$ = 1 MPa (work this out to prove it to yourself).
Homework (This will not be handed in but students should do these problems. Solutions will be posted.)

3. The connection consists of five (5) 10-mm diameter bolts. If the average shear stress in the bolts must be limited to 120 MPa, determine the maximum force $P$ that the connection can withstand.

4. Two 6-inch wide wooden boards are to be joined by splice plates that will be fully glued onto the contact surfaces, as shown below. The glue to be used can safely support a shear stress of 120 psi. Determine the smallest allowable length $L$ that can be used for the splice plates for an applied load of $P = 10000$ lbs.

5. Determine the normal stress $\sigma$ in member (3), then report the Factor of Safety (F.S.) of member (3)
   Given: Member (3) is a round steel bar with a diameter $\frac{1}{2}$". The steel fails if $\sigma$ reaches 30ksi.
   Note: a kip is 1000 lbs. 1 ksi = 1000psi.