

ASEN3112

Recitation 1

Problem 1: (About 10 minutes)

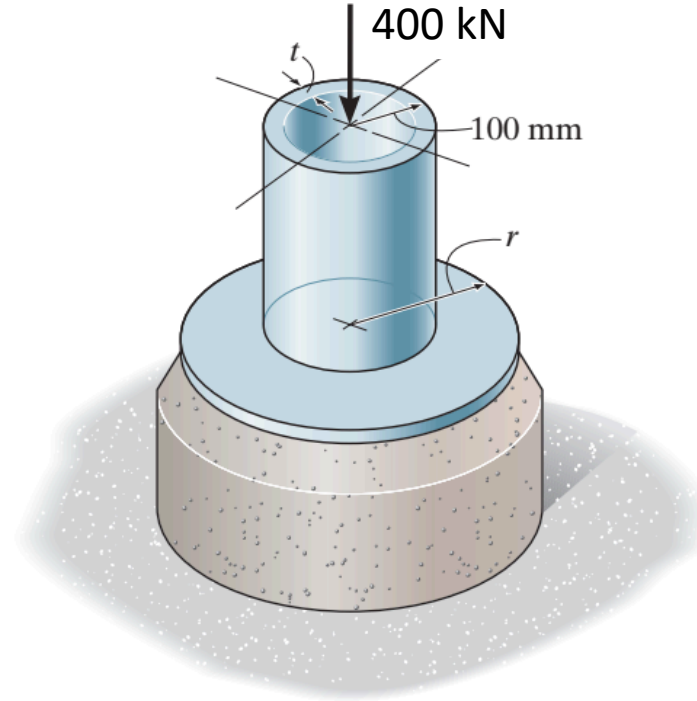


Figure 1: Figure to be analyzed for problem 1.

The steel pipe is supported on the circular base plate and concrete pedestal. If the thickness of the pipe is $t = 4$ mm and the base plate has a radius of 125 mm, determine the factors of safety against failure of the steel and concrete. The applied force is 400 kN, and the normal failure stresses for steel and concrete are $(\sigma_{\text{fail}})_{\text{st}} = 350$ MPa and $(\sigma_{\text{fail}})_{\text{con}} = 25$ MPa, respectively.

Problem 2a: (About 10 minutes)

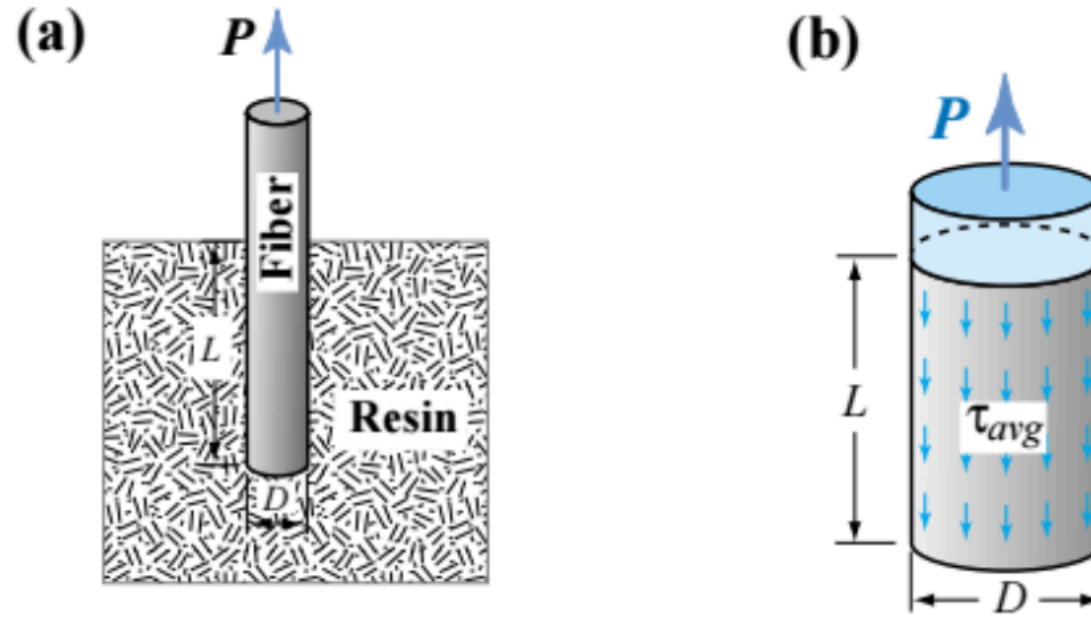


Figure 2: Figure to be analyzed for problem 2a.

A fiber pull-out test is to be conducted to determine the shear strength of the interface between the fiber and the resin matrix in a composite material. See Figure 1(a). Assuming that a uniform shear stress acts over the fiber-resin interface, derive a formula for the shear stress in terms of the applied force P , the fiber length L , and the fiber diameter D . Use the FBD sketched in Figure 1(b).

Problem 2b: (About 10 minutes)

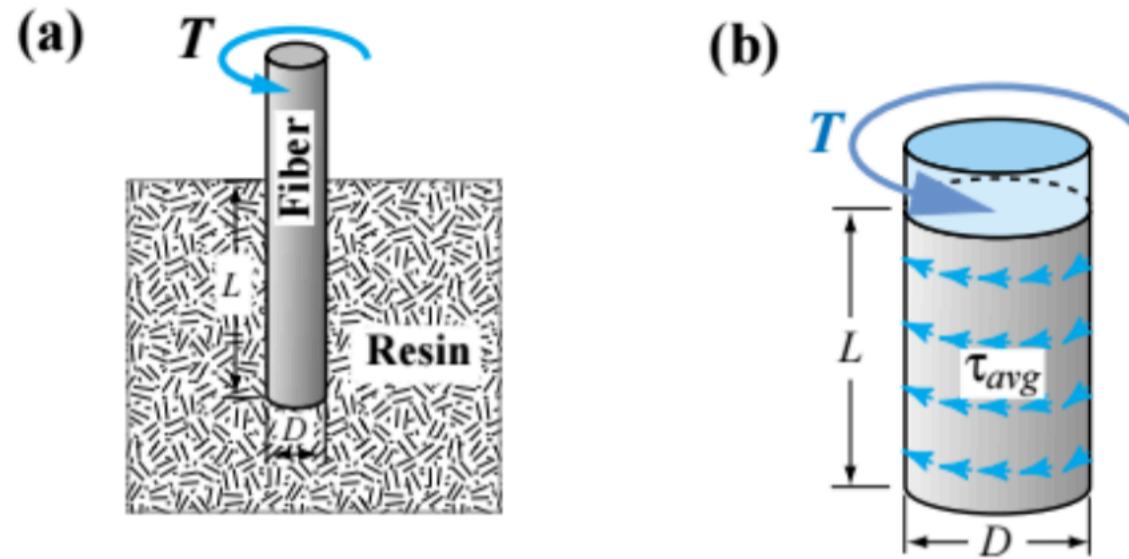


Figure 3: Figure to be analyzed for problem 2b.

A second interface shear strength test applies a torque T to the fiber as shown in Figure 2(a). Assuming a uniform shear stress at the interface, derive a formula for the shear stress in terms of the torque T , the fiber length L , and the fiber diameter D . Use the FBD sketched in Figure 2(b).

Problem 3a: (About 10-15 minutes)

Bolt Connector Design Using Average Shear

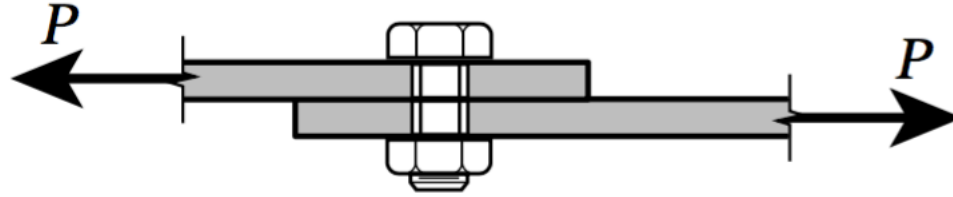


Figure 4: Figure to be analyzed for problem 3a.

A bolt passes through two plates, used to connect two truss members. Given an axial load of 40kN and a safety factor of 4, the bolt fails at a maximum shear of 296MPa. Find the diameter of the bolt using the average shear stress approach.

****Hint:** assume the shear stress over the shear area is uniform.

Problem 3b: (About 5-10 minutes)

Bolt Connector Design with Double Shear Area

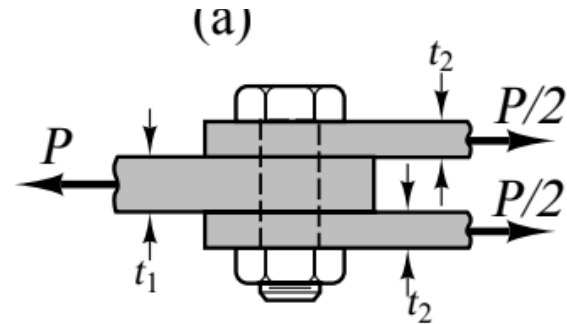


Figure 5: Figure to be analyzed for problem 3b.

A bolt passes through three plates, used to connect three truss members. Given an axial load of 40kN and a safety factor of 4, the bolt fails at a maximum shear of 296MPa. Find the diameter of the bolt using the average shear stress approach.

****Hint:** The effective shear area doubles because we make two cut planes for double shear instead of just one.

Problem 4:
(About 20 minutes)

ASEN 2001
Fall 2019
Exam 3
Question 1

The Ghostbusters have designed a structure to help them capture ghosts. A diagram of the structure is below. The structure consists of three members— BCD , CE , and DEF —and one wire— AD . The cross-sectional area of each member (BCD , CE , and DEF) is 4 in^2 and the cross-sectional area of wire AD is 0.8 in^2 . All joints are pinned joints. All components (the three members, the wire, and the pins at each joint) are made of aluminum with $E = 1.06 \times 10^7 \text{ psi}$, $\sigma_{fail} = 60 \times 10^3 \text{ psi}$, and $\tau_{fail} = 25 \times 10^3 \text{ psi}$.

1. Draw the global free-body diagram of the entire system and calculate the reaction at A.
2. Determine the internal force(s) and moment(s) in the exact middle of member CE .
3. Determine the average normal stress in member CE . Is member CE in tension or compression?
4. Determine the *change in length* of member CE . Does member CE get longer or shorter?
5. If the pin at A is in *double shear*, calculate the diameter of the pin required to give a factor of safety of 3.

