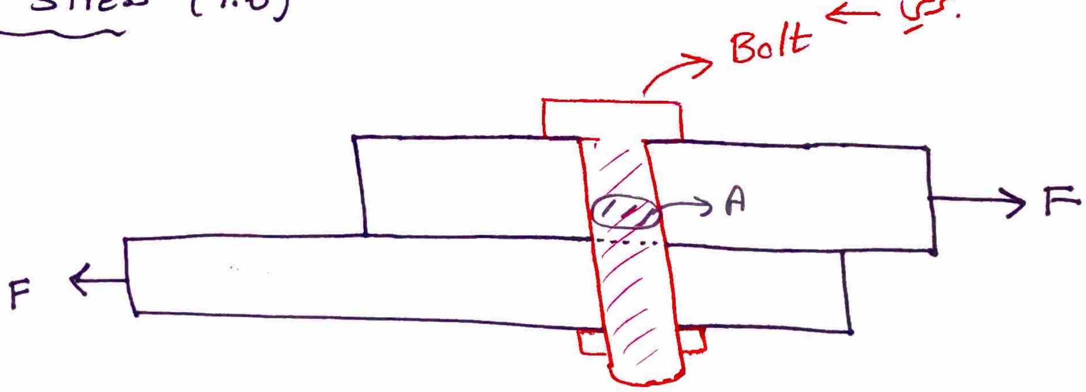
Last class
- → Normal stress ($\sigma = \frac{P}{A}$)
- → shear stress

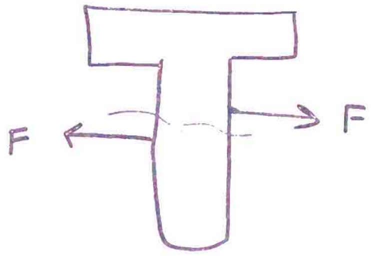
* Stress induced from internal forces

– Shear stress (1.6)

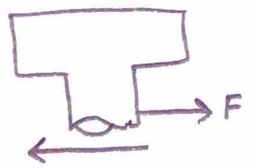


F.B.D of Bolt

$$\tau = \frac{P}{A} \Rightarrow \tau = \frac{F}{A}$$



"Single shear"



$P = F$

internal force $P = F$

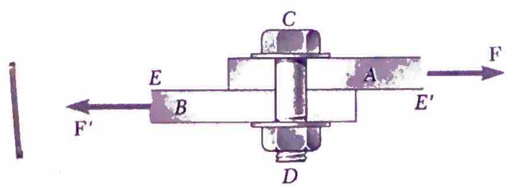


Fig. 1.16 Bolt subject to single shear.

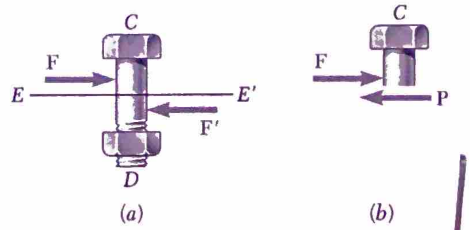
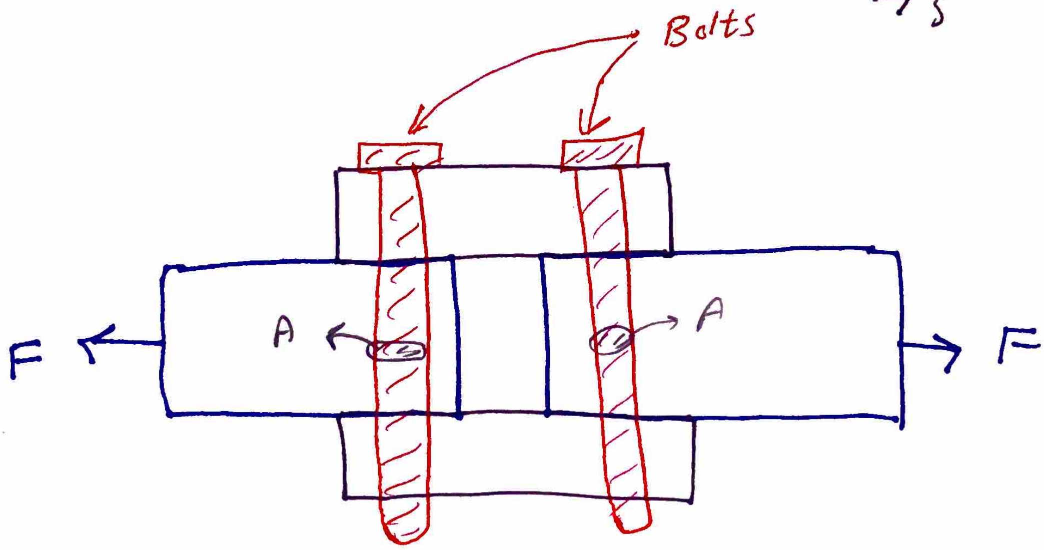


Fig. 1.17

cont'd shear stress

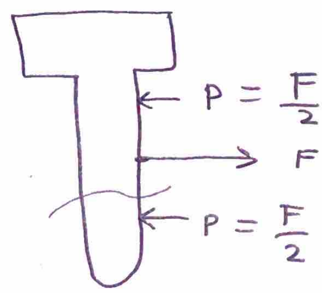


$$\tau = \frac{V}{A} = \frac{F}{2A}$$

$$\tau = \frac{F}{2A}$$

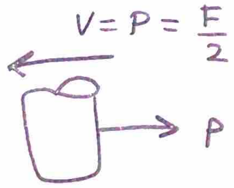
"Double shear"

F.B.D of Bolt



$\Sigma F = 0$

$\Rightarrow P = \frac{F}{2}$



$\Sigma F = 0 \Rightarrow V = P$

$V = \frac{F}{2}$

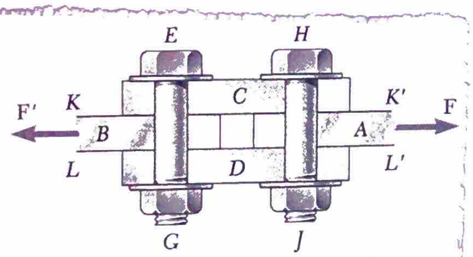
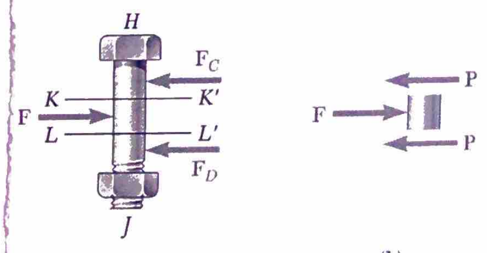


Fig. 1.18 Bolts subject to double shear.



(a) (b)

Fig. 1.19

1.7 BEARING STRESS IN CONNECTIONS

Bolts, pins, and rivets create stresses in the members they connect, along the *bearing surface,* or surface of contact. For example, consider again the two plates A and B connected by a bolt CD that we have discussed in the preceding section (Fig. 1.16). The bolt exerts on plate A a force **P** equal and opposite to the force **F** exerted by the plate on the bolt (Fig. 1.20). The force **P** represents the resultant of elementary forces distributed on the inside surface of a half-cylinder of diameter d and of length t equal to the thickness of the plate. Since the distribution of these forces—and of the corresponding stresses—is quite complicated, one uses in practice an average nominal value σ_b of the stress, called the *bearing stress,* obtained by dividing the load P by the area of the rectangle representing the projection of the bolt on the plate section (Fig. 1.21). Since this area is equal to td, where t is the plate thickness and d the diameter of the bolt, we have

$$\sigma_b = \frac{P}{A} = \frac{P}{td} \tag{1.11}$$

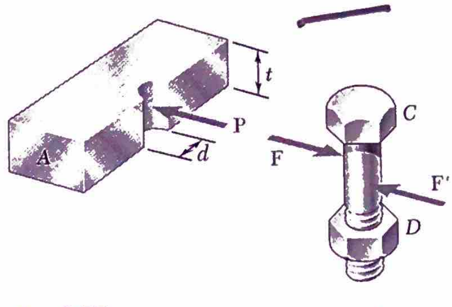


Fig. 1.20

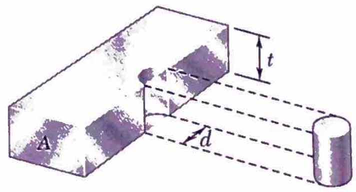


Fig. 1.21

σ_b: Bearing stress (Pa)

1.11 stresses in Oblique plane

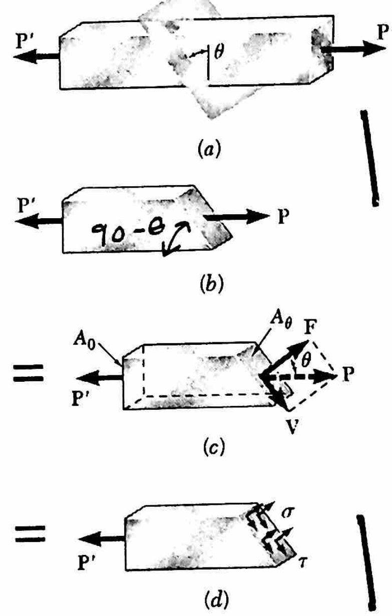


Fig. 1.28

Normal stress (σ)

$$\sigma = \frac{F}{A_\theta} \Rightarrow$$

$$F = P\cos\theta$$

$$A_0 = A_\theta \cos\theta \Rightarrow A_\theta = \frac{A_0}{\cos\theta}$$

$$\sigma = \frac{P\cos\theta}{A_0/\cos\theta} \Rightarrow \sigma = \frac{P}{A_0}\cos^2\theta$$

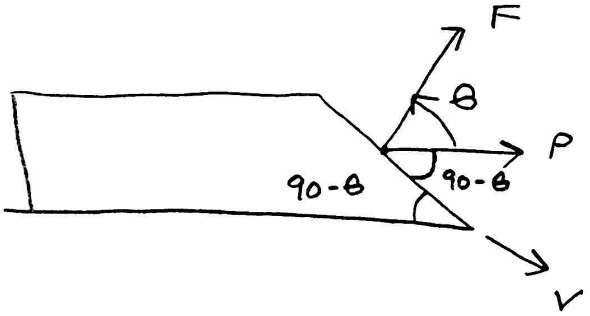
Shear stress (τ)

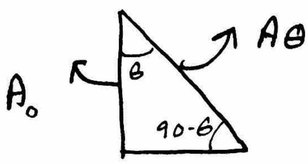
$$\tau = \frac{V}{A_\theta}$$

$$V = P\sin\theta$$

$$A_\theta = \frac{A_0}{\cos\theta}$$

$$\Rightarrow \tau = \frac{P}{A}\sin\theta\cos\theta$$





1.13 Design Considerations

↳ Factor of safety (N)

self-reading & included in all exams