SOLUTION

ME 323: Mechanics of Materials — **Homework H29**

Summer 2025 — **Assigned/due: July 28/July 31**

A 3D bracket is made up of sections OC, CD and DH, as shown below. The bracket is fixed to a wall at end O and is loaded with two forces at end H: a force 2P in the positive x-direction and a force P in the negative y-direction. It is desired to know the states of stress at locations “a” and “b” on the cross-section of OC at B.

a) Complete the FBD of the section of the bracket to the right of location B on OC. Show this on the FBD figure provided on the next page.

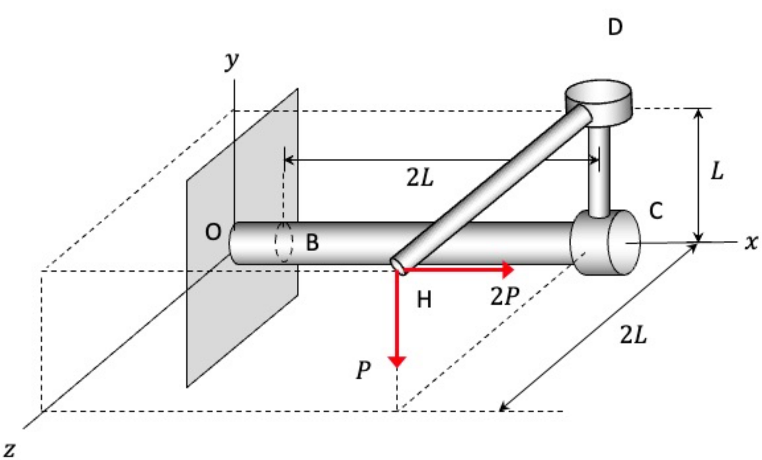
b) Determine the internal resultants shown in your FBD.

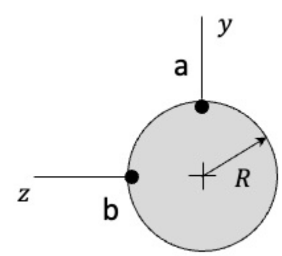
c) Based on your results from b), draw the internal resultants in their actual directions on the positive x-face of the cut at B. Do not include signs.

d) Show the stress distributions acting on the +x-face at the cut at location B. Please use the front/top views of this cut provided on the next page. Show these distributions as they actually are - do not include signs.

e) Fill in the table provided on the next page with the stress components at “a” and “b”. Please do not include signs. Show the relationships between the stress components and applied loads in this table.

f) Based on the results in your table from Part e), show the state of stress at “a” and “b” on the stress elements on the next page.





cross-section of OC at B

Equilibrium

$$\Sigma F_x = 2P - F_x = 0 \Rightarrow F_x = 2P$$

$$\Sigma F_y = F_y - P = 0 \Rightarrow F_y = P$$

$$\Sigma \vec{M}_B = -M_x\hat{i} - M_y\hat{j} + M_z\hat{k} + \overbrace{(2L\hat{i} + L\hat{j} + 2L\hat{k})}^{\bar{r}_{D/B}} \times (2P\hat{i} - P\hat{j})$$

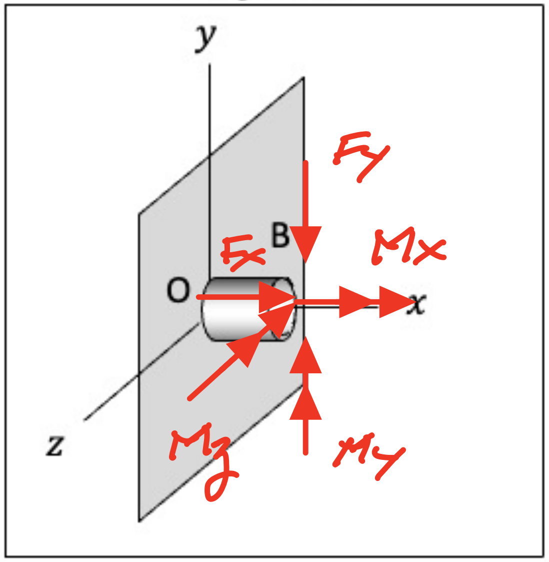
$$= [-M_x + 2PL]\hat{i} + [-M_y + 4PL]\hat{j} + [M_z - 2PL - 2PL]\hat{k}$$

$$\hat{i}: -M_x + 2PL = 0 \Rightarrow M_x = 2PL$$

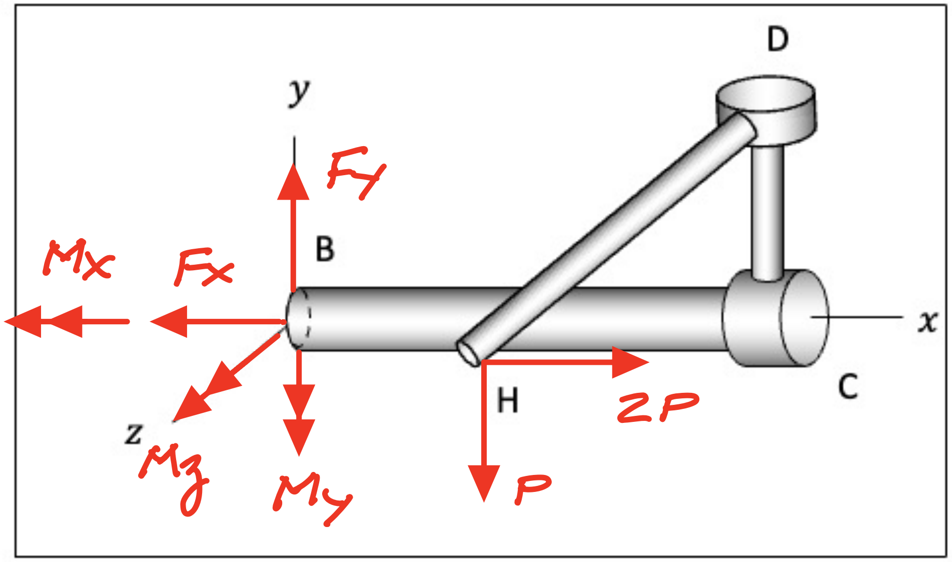
$$\hat{j}: -M_y + 4PL = 0 \Rightarrow M_y = 4PL$$

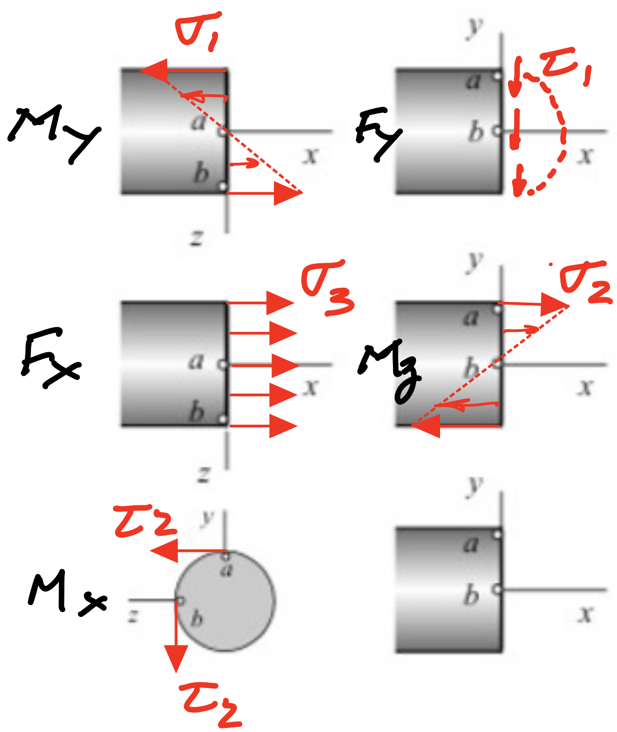
$$\hat{k}: M_z - 4PL = 0 \Rightarrow M_z = 4PL$$

"+" x-face at B



FBD

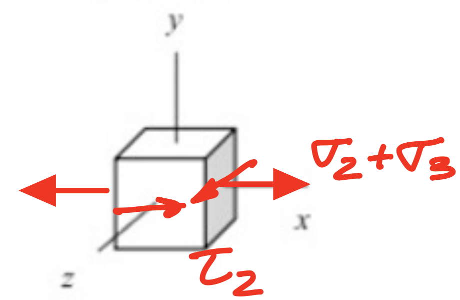




loading	stress comp. @ "a"	stress comp. @ "b"
F_x	$\sigma_3 = \frac{2P}{A}$	$\sigma_3 = \frac{2P}{A}$
F_y	0	$\tau_1 = \frac{4}{3}\frac{P}{A}$
M_x	$\tau_2 = \frac{(2PL)R}{I_P}$	$\tau_2 = \frac{(2PL)R}{I_P}$
M_y	0	$\sigma_1 = \frac{(4PL)R}{I}$
M_z	$\sigma_3 = \frac{(4PL)R}{I}$	0

$A = \pi R^2$; $I = \frac{\pi}{4}R^4$; $I_P = \frac{\pi}{2}R^4$

point "a"



point "b"