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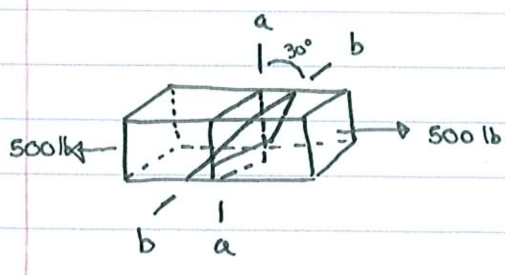
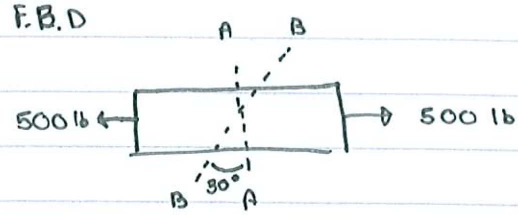
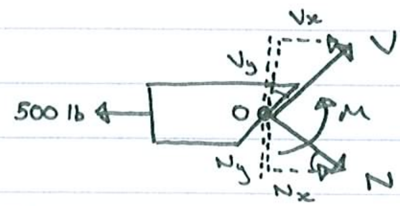


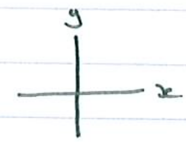


N - Normal force

V - Shear force

M - moment





$\overset{+}{\leftarrow} \Sigma F_x = 0 \Rightarrow +500\text{ lb} - V_x - N_x$

$N_x \Rightarrow \cos 30° = ADJ/HYP \Rightarrow N_x = N\cos 30°$

$V_x \Rightarrow \sin 30° = OPP/HYP \Rightarrow V_x = V\sin 30°$

$\therefore \Sigma F_x = 0 \Rightarrow 500\text{ lb} - \sin 30° \cdot V - \cos 30° \cdot N$

$\overset{\uparrow}{+} \Sigma F_y = 0 \Rightarrow V_y - N_y$

$N_y = \sin 30° = OPP/HYP \Rightarrow N_y = N\sin 30°$

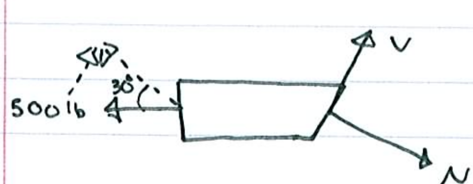
$V_y = \cos 30° = ADJ/HYP \Rightarrow V_y = V\cos 30°$

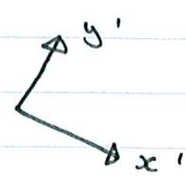
$\therefore \Sigma F_y = 0 \Rightarrow V\cos 30° - N\sin 30°$

$\circlearrowleft + \Sigma M_O = 0$

(moments are a multiplication of force by distance, but all forces pass through point O)

To solve for N and V, adapt 500 lb force to x' and y' frame





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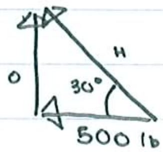


$$\cos 30° = \frac{500\text{ lb}}{H} \Rightarrow H = \frac{500\text{ lb}}{\cos 30°}$$

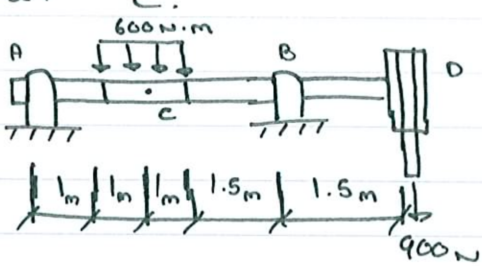
etc...

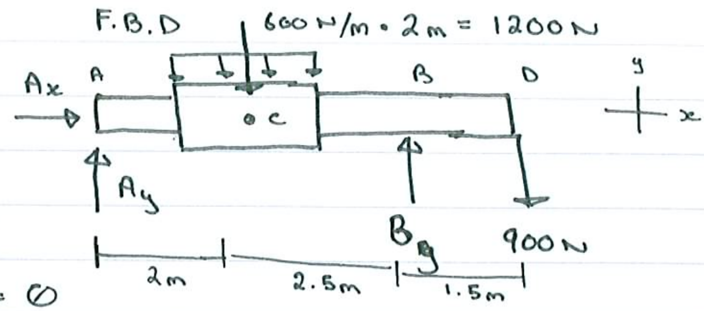
$\nearrow^{+} \Sigma F_{y'} = 0$

$\Sigma F_{x'} = 0$

Example 1.2 (Problem 1-4)

The shaft is supported by a smooth thrust bearing at A and a smooth journal bearing at B. Determine the resultant internal loadings acting on the cross section at C.





$\overset{+}{\rightarrow} \Sigma F_x = 0 \Rightarrow + A_x = 0$

$+\uparrow \Sigma F_y = 0 \Rightarrow A_y + B_y - 1200\text{ N} - 900\text{ N}$

$\circlearrowleft + M$ (should be: $\circlearrowleft + \Sigma M$) $= 0$

so, using point A (cancel out A_x, A_y)

$\circlearrowleft + M_A = (-1200\text{ N} \cdot 2\text{m}) + (B_y \cdot 4.5\text{ m}) - (900\text{ N} \cdot 6\text{m})$

$\circlearrowleft + M_A = 0$

Solve for B_y (1733.33 N)

Use B_y to solve for A_y (366.67 N)

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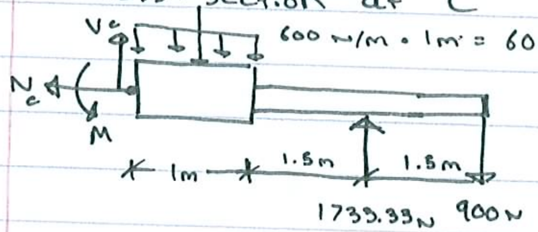
Cont'd ..

Cross-section at C



$\overset{+}{\rightarrow} \Sigma F_x = 0$

$\therefore N_c = 0$

$+\uparrow \Sigma F_y = 0$

$0 = V_c - 600N + 1733.33N - 900N$

$V_c = -233N$

(therefore V_c acts in the opposite sense to that shown on the FBD)

$\circlearrowleft + \Sigma M_c = 0$

$0 = M - (600N \cdot 0.5m) + (1733.33N \cdot 2.5m) \ldots$

$\ldots - (900N \cdot 4.0m)$

$M = -433 Nm$

(therefore real moment is not $\circlearrowleft^+$, but $\circlearrowright^+$)

1.3 Stress

Stress : intensity of internal loadings

↳ F/A

Assumptions : • homogeneous (same mechanical and physical properties throughout material's volume)

• Isotropic (same mechanical and physical properties along any (in all) directions)

Tutorial tomorrow (Sept. 15)

will take attendance.

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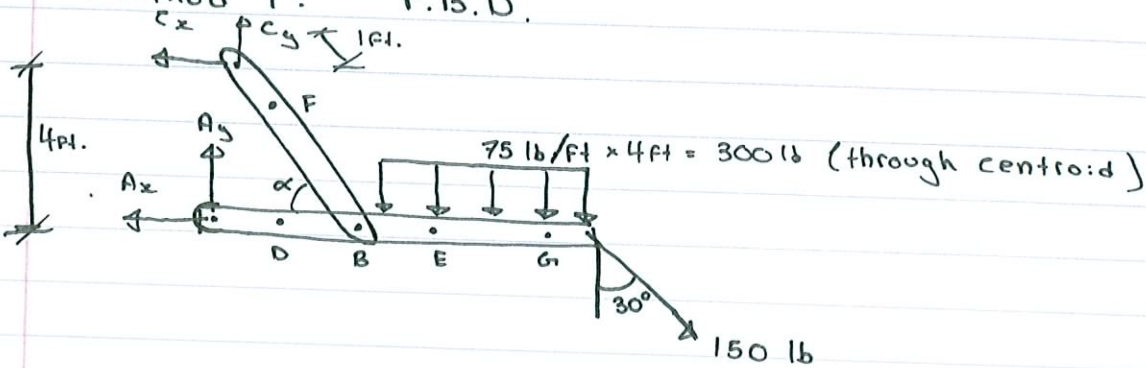
Example 1-12: (From textbook)

Method 1: F.B.D.



Member CB is a bar. If the external forces are along the longitudinal direction and weight is neglected.
~ it is subjected to longitudinal force.

$\overset{+}{\rightarrow} \Sigma F_x = \emptyset \Rightarrow -A_x + 150 \sin 30° - C_x = \emptyset$

$(C_x = F_c \cos\alpha$
$F_c \cos\alpha = 3/5)$

$\uparrow + \Sigma F_y = \emptyset \Rightarrow A_y + F_c \sin\alpha - 300\text{ lb} - 150\text{ lb} \cdot \cos 30° = \emptyset$

$(C_y = F_c \sin\alpha$
$F_c \sin\alpha = 4/5)$

$\circlearrowleft + \Sigma M_A = \emptyset \Rightarrow (F_c \sin \overset{4/5}{\alpha} \cdot 3\text{ ft}) - (300\text{ lb} \cdot 5\text{ ft}) - (150\text{ lb} \cos 30° \cdot 7\text{ ft})$

$F_c = +1003.9$ lb

Bar BC is in tension

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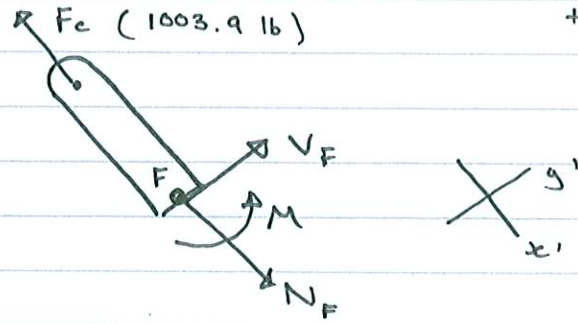
@ point F



$+\nearrow \Sigma F_{y'} = 0$

$V_F = 0$ (no other y' Forces)

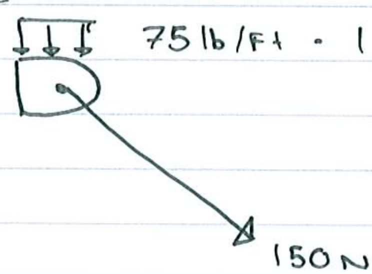
$+\searrow \Sigma F_{x} = 0$

$N_F = 1003.9$ lb

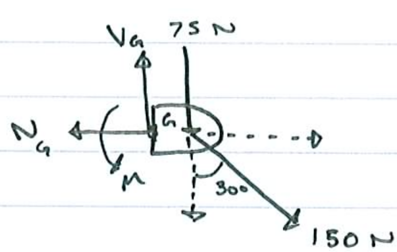
$\circlearrowleft + \Sigma M_F = 0$

$M_F = 0$ (all Forces run through point F)

@ point G



so...



$\overset{\rightarrow}{+} \Sigma F_x = 0 \Rightarrow -N_G + 150N \cdot \sin 30° = 0$

$\uparrow + \Sigma F_y = 0 \Rightarrow V_G + 150N \cdot \cos 30° = 0$

$\circlearrowleft + \Sigma M_G = 0 \Rightarrow M - (75N \cdot (0.5\,Ft)) - (150N \cdot \cos 30° (0.95)$