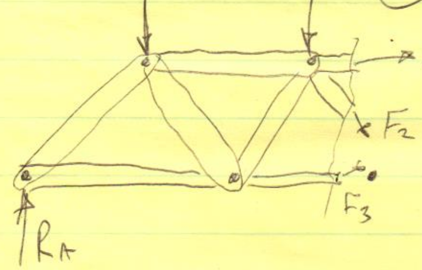
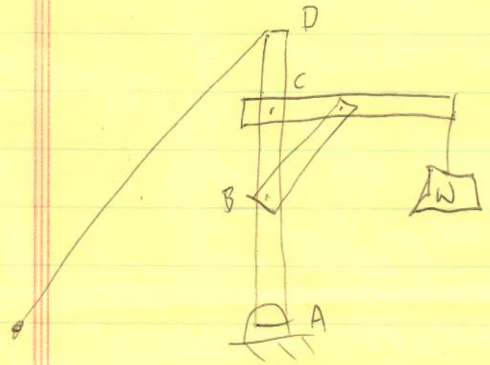
~~LECTURE 12~~ CHAPTER 7: FORCES IN BEAMS

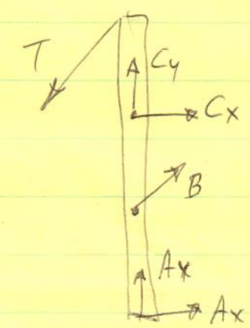
SO FAR, WE HAVE:

- DETERMINED EXTERNAL REACTION FORCES USING FBD'S
- FOUND INTERNAL FORCES ON STRAIGHT ~~ME~~ 2-FORCE MEMBERS



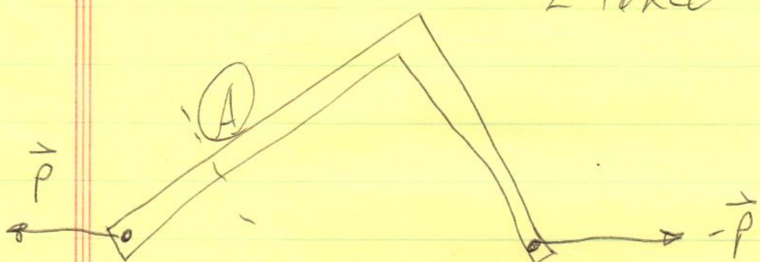
WE'VE ALSO FOUND EXTERNAL FORCES ON MULTIFORCE MEMBERS:

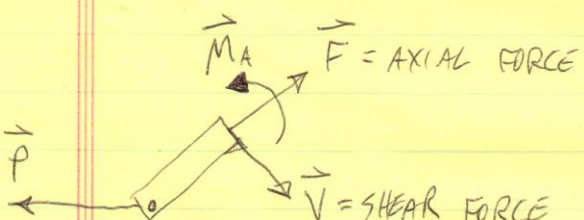




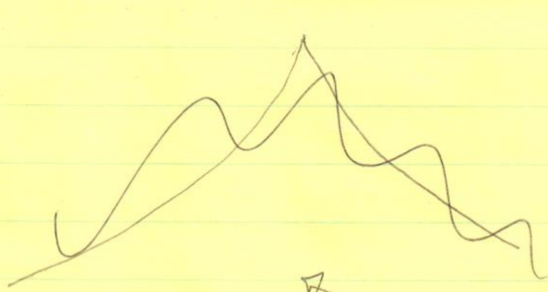
IN THIS LECTURE, WE WILL FIND OUT HOW TO DETERMINE INTERNAL FORCES AND MOMENTS IN TWO-FORCE MEMBERS WHICH ARE NOT STRAIGHT AND MULTI-FORCE MEMBERS.

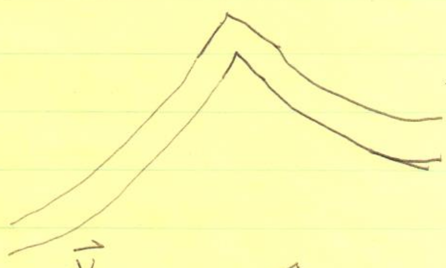
2-FORCE MEMBER

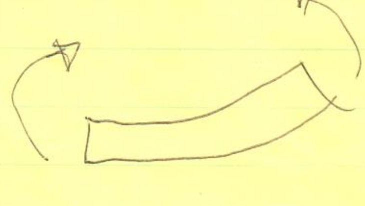


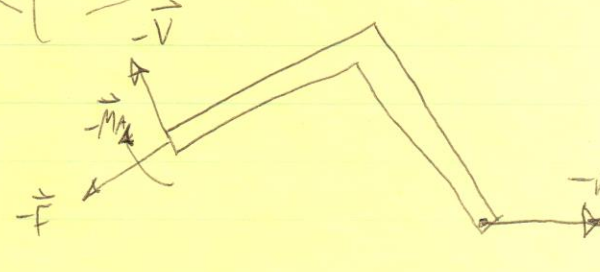


$\vec{M}_A$ = BENDING MOMENT AT POINT A.

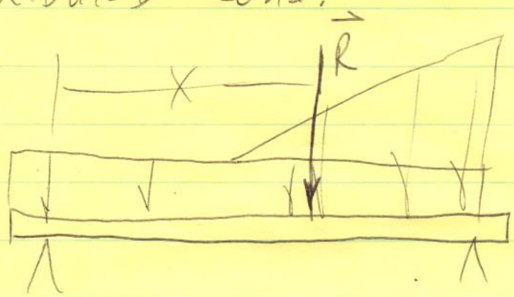






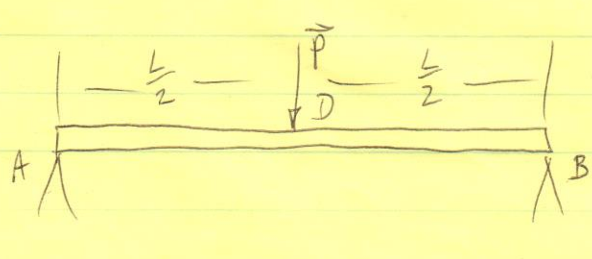


IN OUR DISCUSSION ON CENTROIDS, WE WERE ABLE TO FIND THE RESULTANT FORCE AND ITS LOCATION FOR A BEAM WITH A DISTRIBUTED LOAD.

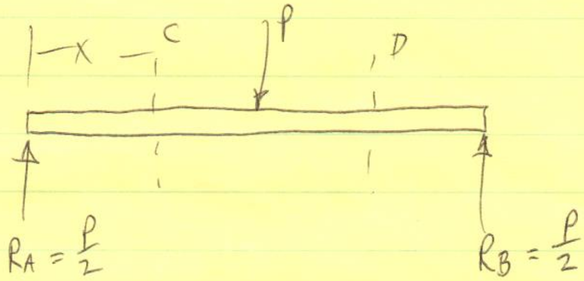


THIS WAS USED TO FIND THE REACTIONS AT THE SUPPORTS, BUT IT GAVE ~~to~~ NO INFORMATION ON INTERNAL FORCES ~~(sh)~~ (SHEAR) OR BENDING MOMENTS.

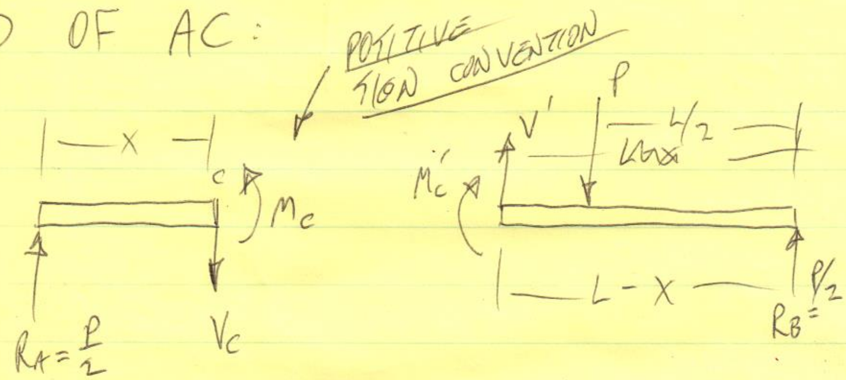
LET'S LOOK AT THE SIMPLEST CASE:



FIND THE SHEAR AND BENDING MOMENT ALONG THE BEAM



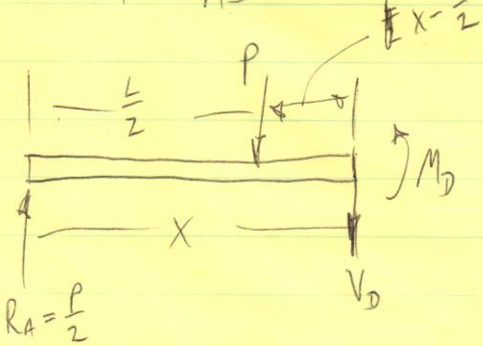
FBD OF AC:



$\Sigma F_y = 0 : V = \frac{P}{2}$

$\Sigma M_C = 0 \; +\circlearrowleft : \; M_C = \frac{1}{2} P x$

FBD OF AD:



$\Sigma F_y = 0 : \frac{P}{2} - P - V_D = 0$

$V_D = -\frac{P}{2}$

$\cancel{\Sigma M_D = 0 \; +\circlearrowleft}$

$\cancel{M_D - \frac{1}{2} P x + \frac{1}{2} P L = 0}$

$\cancel{M_D = \frac{1}{2} P (x - L)}$

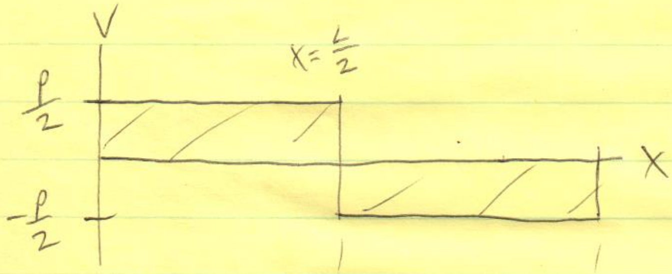
$\sum M_D = 0$ +↺

$M_D - \frac{1}{2}Px + (x - \frac{L}{2})P = 0$

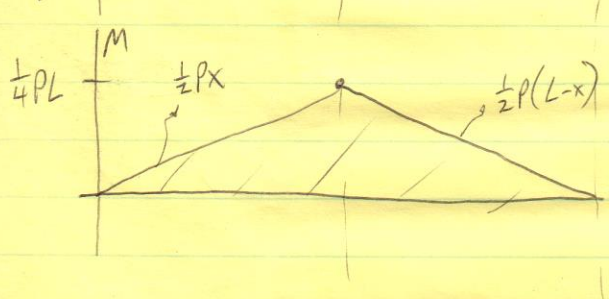
$M_D = \frac{1}{2}Px - Px + \frac{1}{2}PL$

$M_D = \frac{1}{2}P(L - x)$

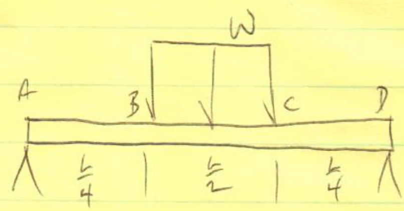
SHEAR DIAGRAM:

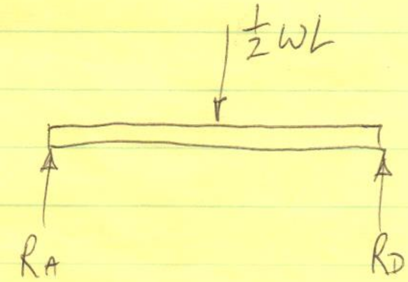


BENDING MOMENT DIAGRAM:



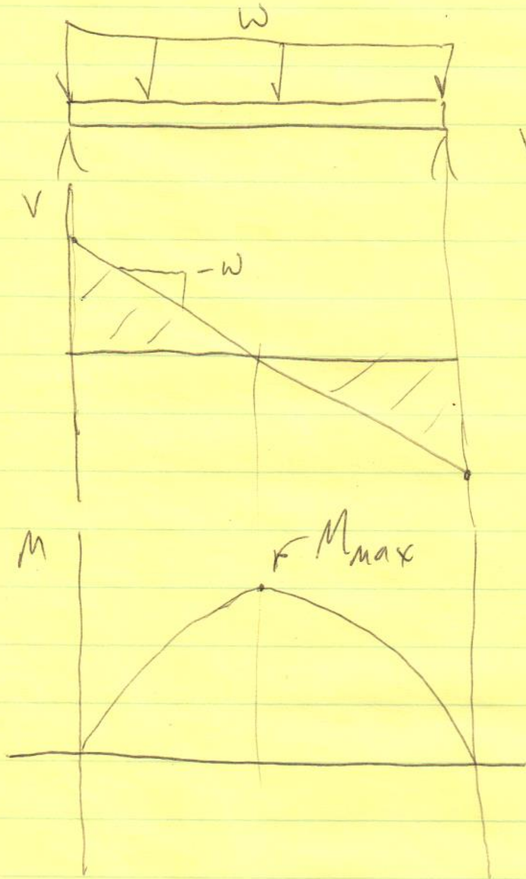
EXAMPLE PROB. 7.30





FOR A BEAM WITH A UNIFORM DISTRIBUTED LOAD

$$\frac{dV}{dx} = -w \left(\frac{LB}{FT}\right)$$



dummy variable

$$\underbrace{V_2 - V_1}_{} = -\int_{x_1}^{x_2} w \, dz$$

$V = ax + b$ LINEAR

dummy var.

$$\frac{dM}{dx} = V \quad , \quad M_2 - M_1 = \int_{x_1}^{x_2} V \, dz$$

$M = a\frac{x^2}{2} + bx + c$ 2ND ORDER

WHERE $\frac{dM}{dx} = 0 \Rightarrow$ MAXIMUM VALUE FOR $M(x)$

THIS IS USEFUL FOR NON-UNIFORM LOADINGS.