Lecture 22

Friday, October 20, 2017 12:14

To do ...

- Quiz 4 – last day today!

- Last TAM 210 Class – Nov 3rd
- **TAM 210 FINAL**
  - **CBTF – 1hr 50 mins**
  - **Thurs – Sunday**
  - **Nov 9th – Nov 12th**

- HW 16 PL due **Tues**
- HW 17 ME due **Thurs**

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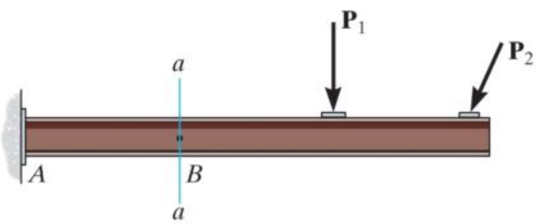
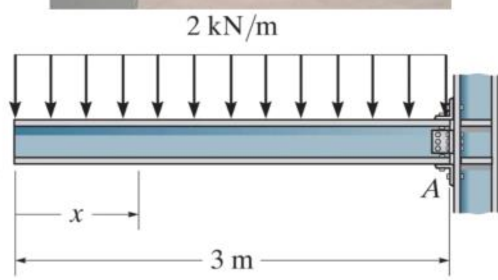
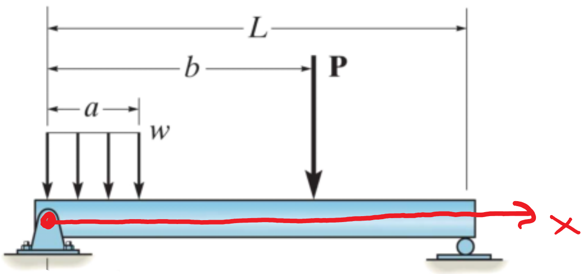
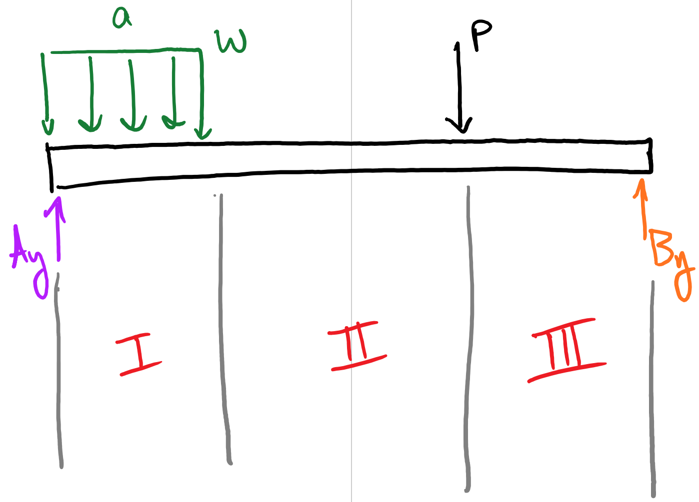
Internal loadings developed in structural members







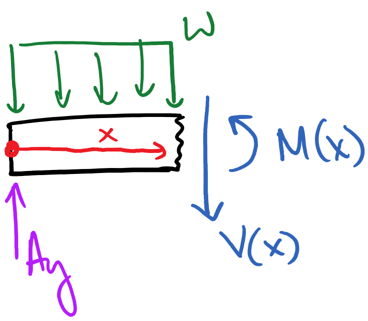
Draw the shear and moment diagrams for the simply supported beam.



* identify Regions to section.

* 3 sections, 3 FBDs

Region I: $0<x<a$



ΣF_y: $A_y - V(x) - xw = 0$

$$V(x) = A_y - xw$$ → linear

$$\left\{ \begin{array}{ll} @\, x=0 & V(x=0) = A_y \\ @\, x=a & V(x=a) = A_y - aw \end{array} \right\}$$

ΣM_x: $M(x) - xA_y + \left(\frac{x}{2}\right)(xw) = 0$

→ quadratic

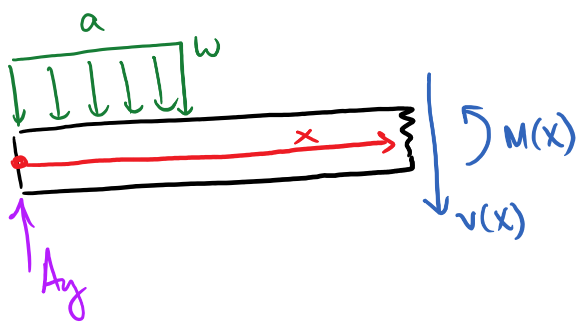
$$\boxed{M(x) = xA_y - \frac{1}{2}wx^2}$$ → quadratic

@ $x=0$ $\quad M(x=0) = 0$!

@ $x=a$ $\quad M(x=a) = aA_y - \frac{1}{2}wa^2$

Q: Why?!

Region II : $a < x < b$



ΣF_y: $A_y - V(x) - aw = 0$

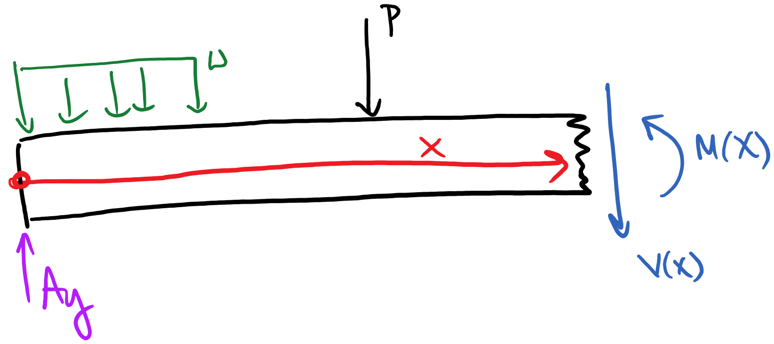
$$\boxed{V(x) = A_y - aw}$$ Constant

ΣM_x: $M(x) - xA_y + \left(x - \frac{a}{2}\right)aw = 0$

$$M(x) = xA_y - \left(x - \frac{a}{2}\right)aw$$

$$\boxed{M(x) = x(A_y - aw) + \frac{1}{2}a^2w}$$ linEAR

Region III : $b < x < L$



$$\Sigma F_y:\quad A_y - V(x) - P - aw = 0$$

$$V(x) = A_y - P - aw$$

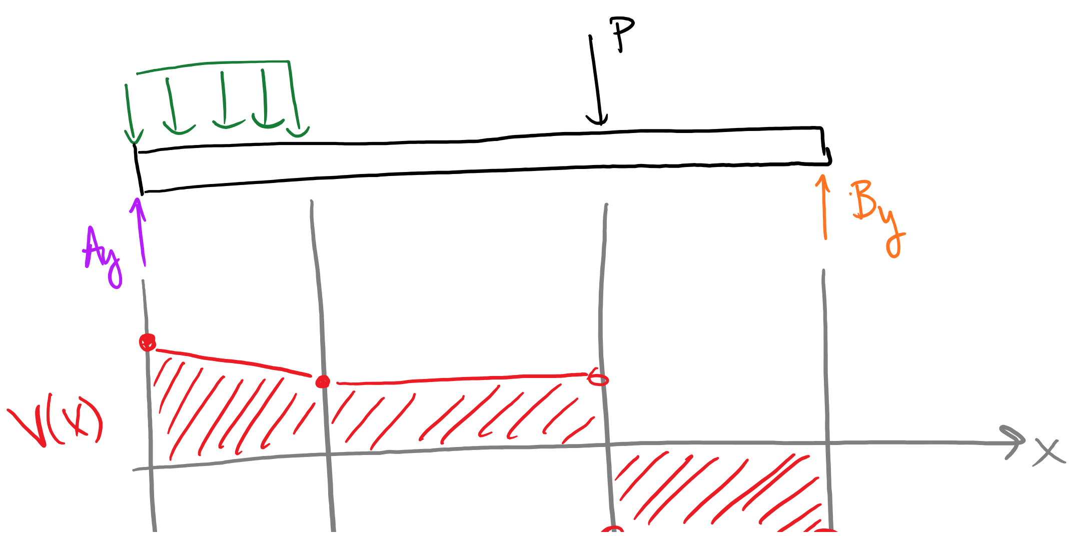
constant

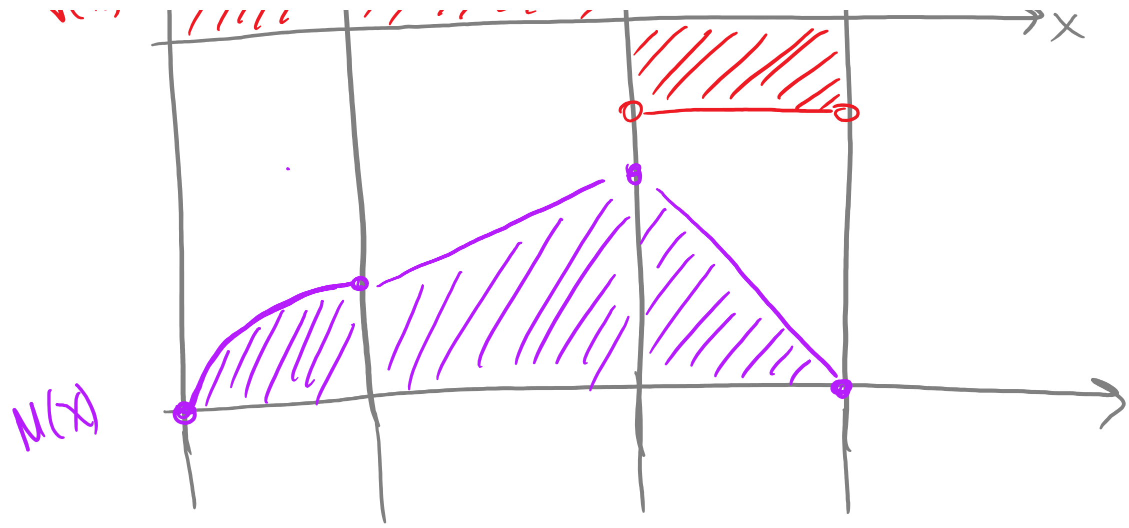
$$\Sigma M_x:\quad M(x) - xA_y + \left(x - \frac{a}{2}\right)aw + (x-b)P = 0$$

$$M(x) = x\left(A_y - aw - P\right) + bP + \frac{1}{2}wa^2$$

linear

Now put it all together and plot!




x
M(x)

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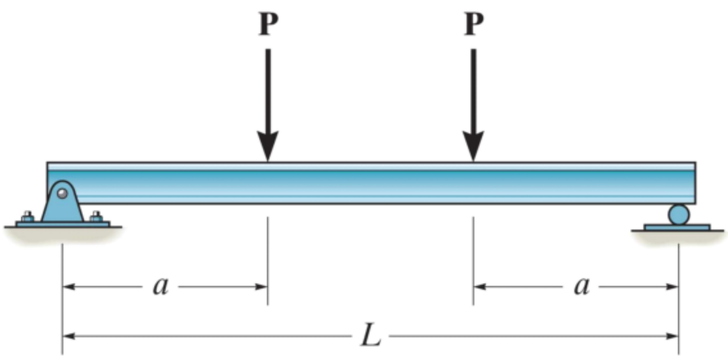
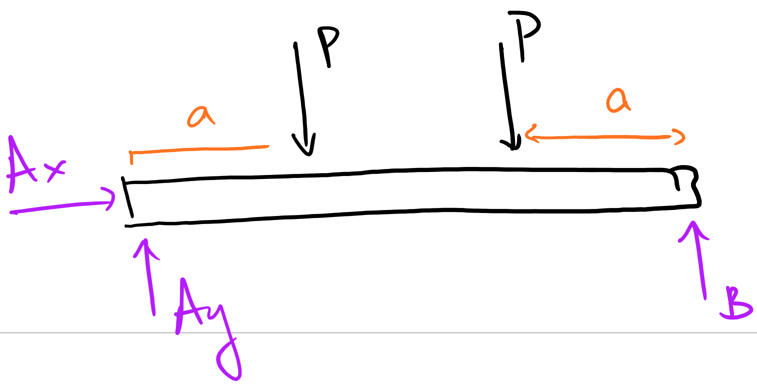


Draw the shear and moment diagrams for the beam.

FBD of beam:



3 unknowns!

$$\Sigma F_x = 0$$

$$A_x = 0$$

$$\Sigma F_y = 0$$

$$A_y + B - 2P = 0$$

$$\Sigma M_A = 0$$

$$-aP - (L-a)P + BL = 0$$

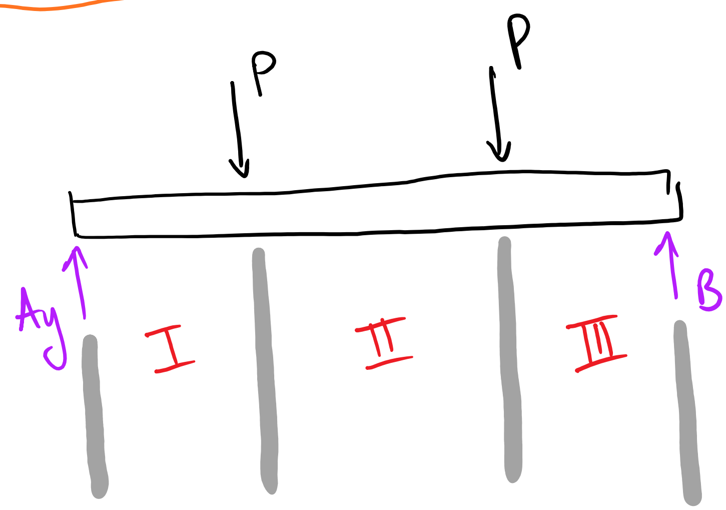
$$-aP + aP - LP + BL = 0$$

$$-aP + aP - LP + BL = 0$$

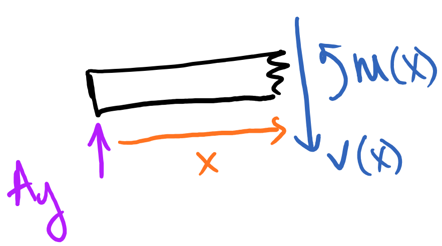
$$\boxed{B = P}$$

$$\therefore \boxed{A_y = 2P - B = P}$$

now section beam:



Region I:



$$\Sigma F_y = 0$$

$$A_y - V(x) = 0$$

$$\therefore \boxed{V(x) = A_y = \text{constant}}$$

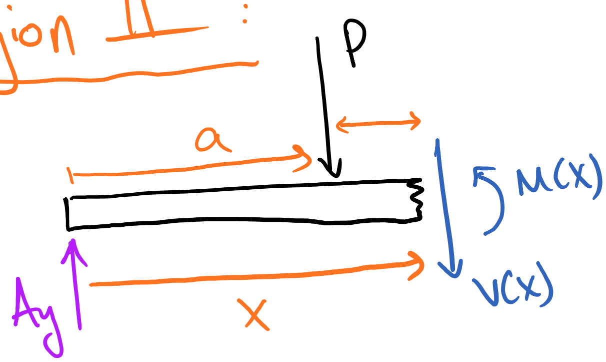
$$\therefore \boxed{V(x) = A_y = \text{constant}}$$

$\Sigma M = 0$

$$M(x) - xA_y = 0$$

$$\therefore \boxed{M(x) = xP}$$

Region II :



$\Sigma F_y = 0$

$$A_y - P - V(x) = 0$$

$$\therefore \boxed{V(x) = A_y - P = P - P = 0 \;!}$$

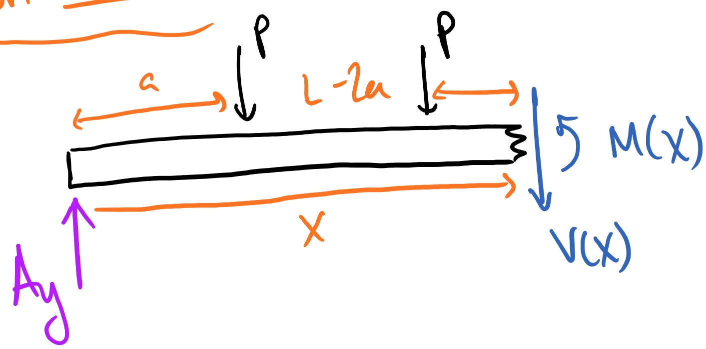
$\Sigma M = 0$

$$M(x) - xP + (x-a)P = 0$$

$$\therefore \boxed{M(x) = Pa = \text{constant}}$$

Region III :

Region III :



$\Sigma F_y = 0$

$A_y - P - P - V(x) = 0$

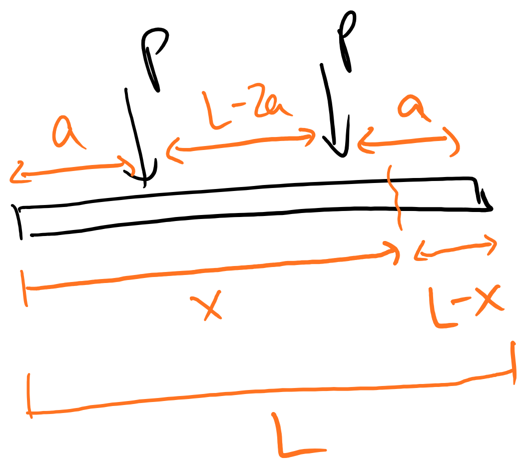
$\therefore \quad \boxed{V(x) = -P}$

$\Sigma M = 0$

$M(x) - xA_y + (x-a)P + \underbrace{(x+a-L)}P = 0$

Q: where does this come from?

use this!

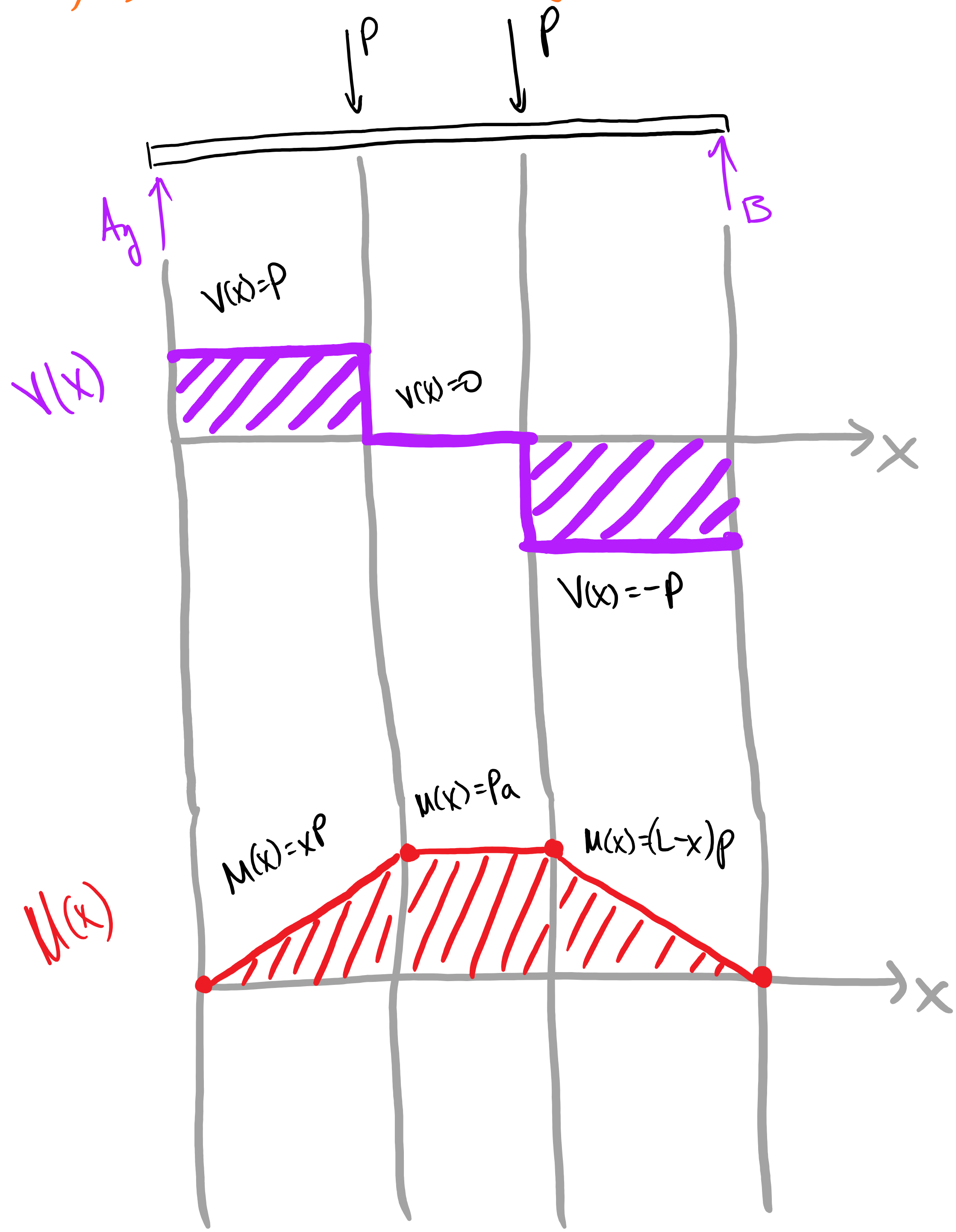


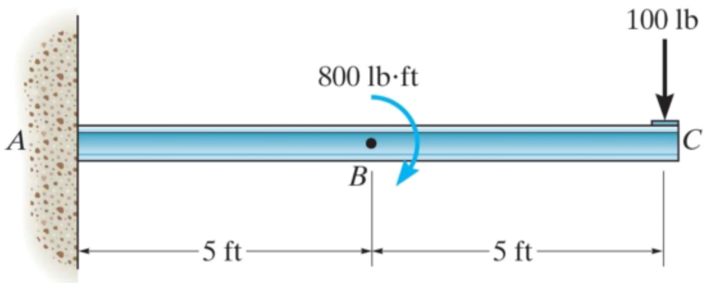
$M(x) - xP + xP - aP + xP + aP - LP = 0$

$\boxed{M(x) = (L-x)P}$

$\therefore$ $M(x) = (L-x)P$

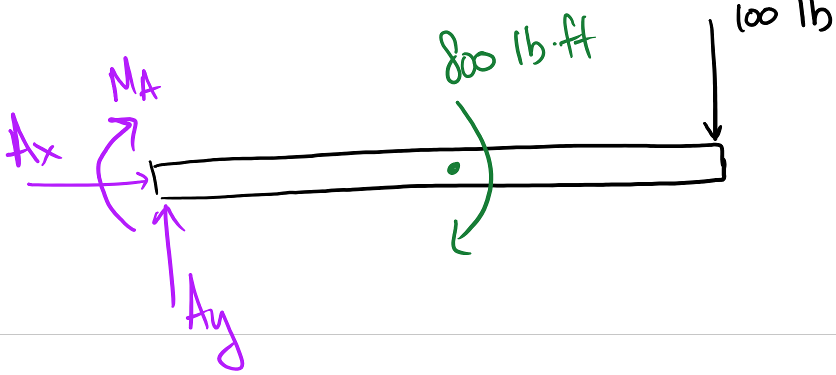
now, shear and bending moment diagrams!





Draw the shear and moment diagrams for the beam.

FBD of beam:



$\Sigma F_x = 0$

$A_x = 0$

$\Sigma F_y = 0$

$A_y - 100\text{ lb} = 0$

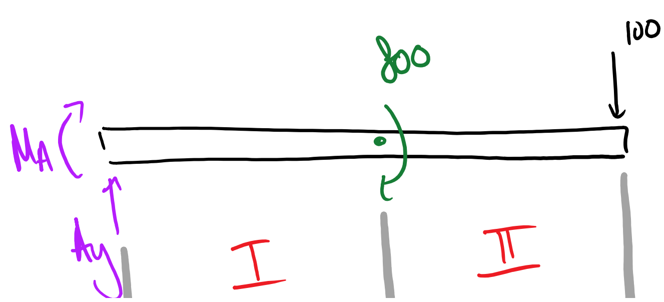
$A_y = 100\text{ lb}$

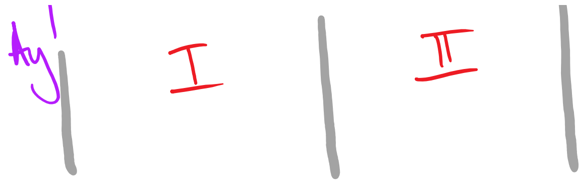
$\Sigma M_A = 0$

$-M_A - 800 - (10)(100) = 0$

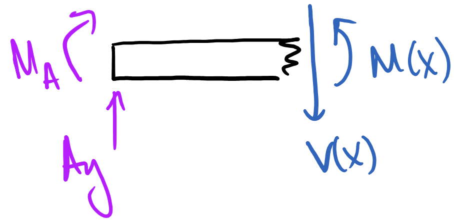
$M_A = -1800\text{ lb·ft}$

Section beam:





Region I :



$\Sigma F_y = 0$

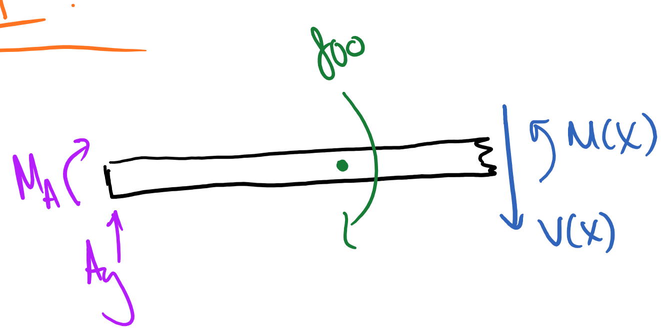
$A_y - V(x) = 0 \quad \therefore \quad \boxed{V(x) = A_y = 100 \text{ lb}}$

$\Sigma M = 0$

$M(x) - M_A - xA_y = 0$

$\therefore \quad \boxed{M(x) = xA_y + M_A = 100x - 1800}$

Region II :



$\Sigma F_y = 0$

$A_y - V(x) = 0 \quad \therefore \quad \boxed{V(x) = A_y = 100 \text{ lb}}$

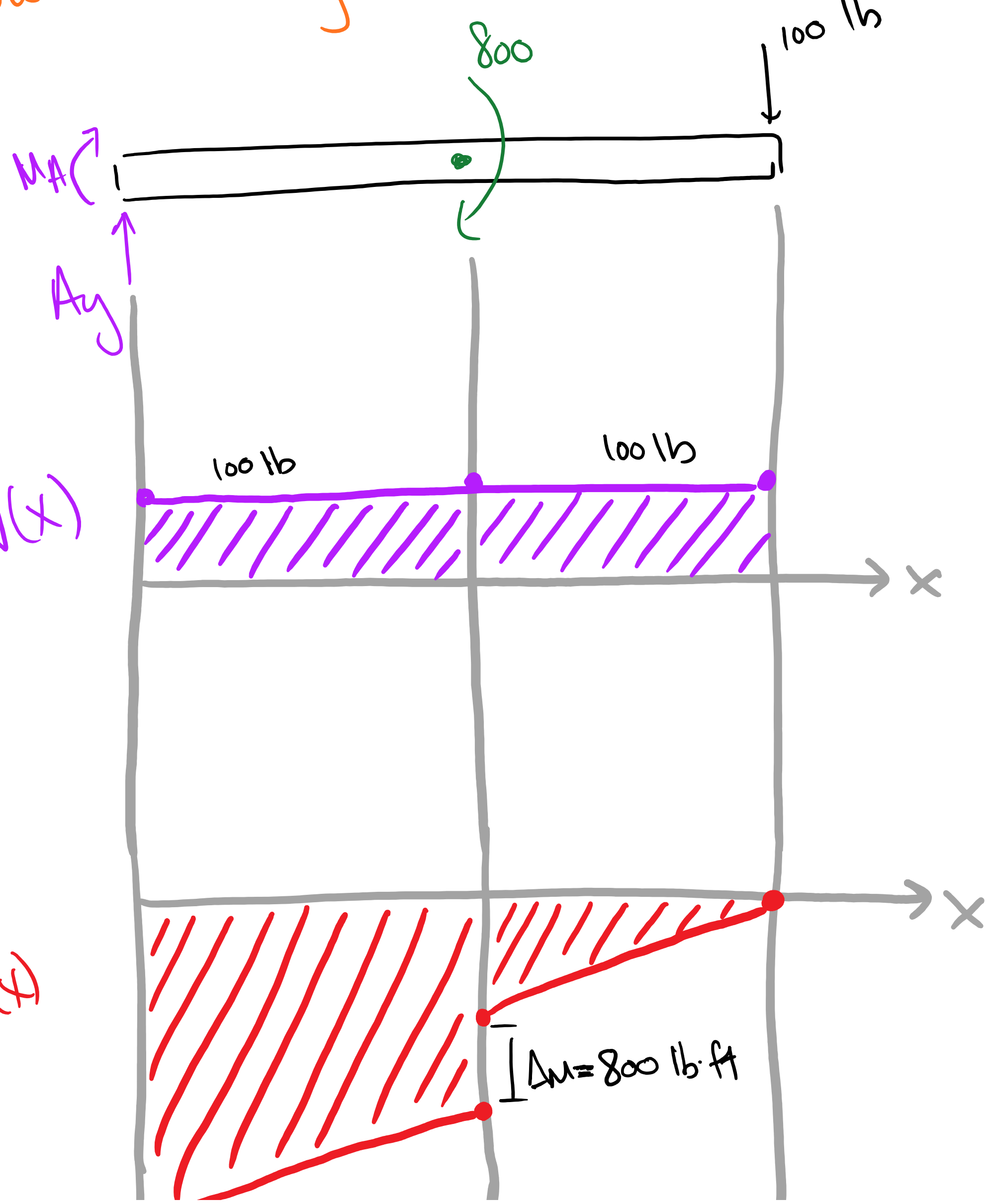
$A_y - V(x) = 0 \quad \therefore \quad \boxed{V(x) = A_y - 100\ \text{lb}}$

$\Sigma M = 0$

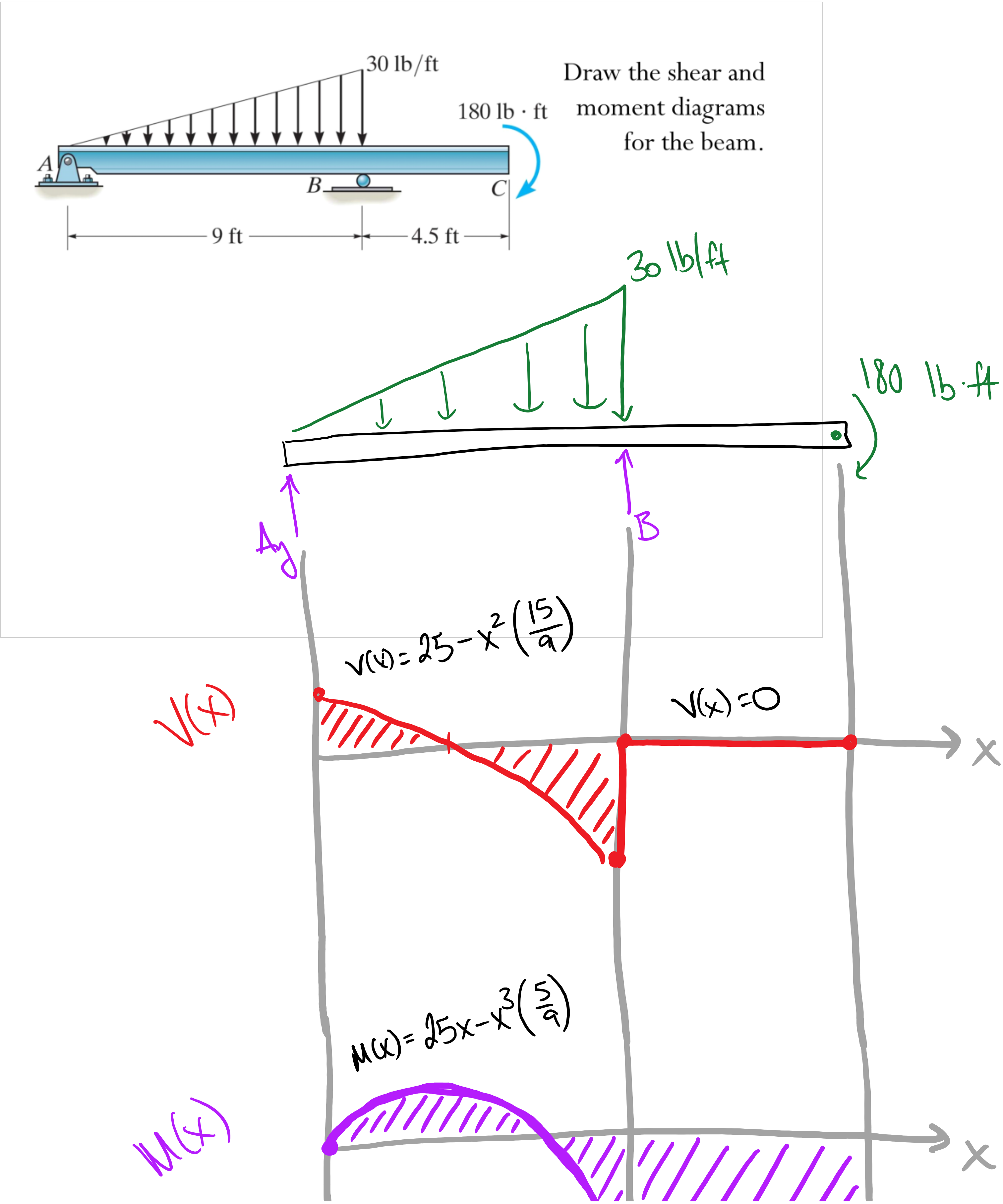
$M(x) - M_A - 800 - xA_y = 0$

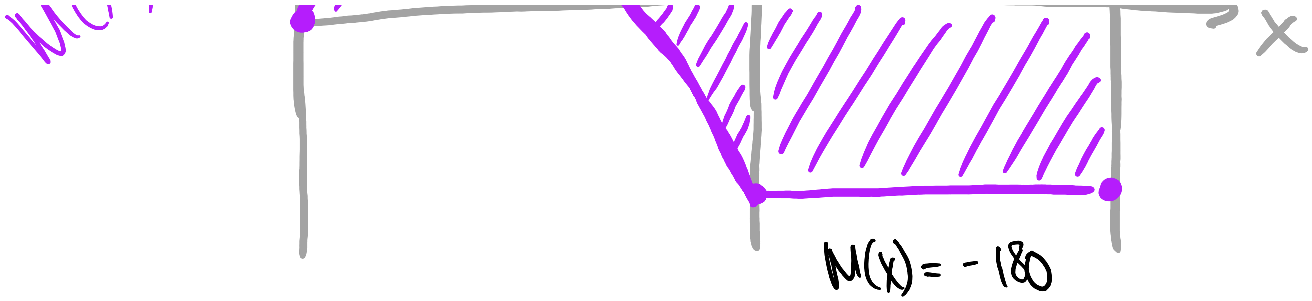
$$\boxed{M(x) = xA_y + M_A + 800 = 100x - 1000 \quad \text{lb·ft}}$$

Now the Diagrams!




-1800


30 lb/ft
180 lb · ft
A
B
C
9 ft
4.5 ft
Draw the shear and moment diagrams for the beam.
30 lb/ft
180 lb·ft
Ay
B
V(x) = 25 − x²(15/9)
V(x)
V(x) = 0
x
M(x) = 25x − x³(5/9)
M(x)
x


M(x) = -180