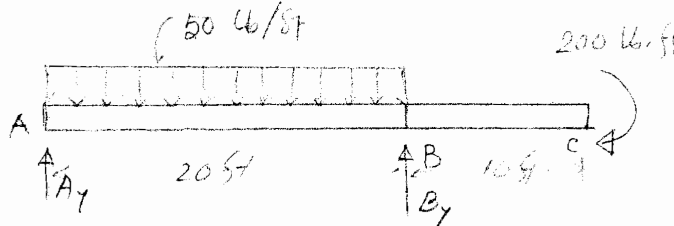
H.W. # 11

Prob. 7-49 (P-345)

Given: Forces shown in Fig.

Req.d:
To draw the shear force and bending moment diagram.



FBD
Fig (a)

Sol.n:

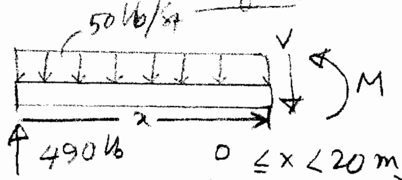
$\circlearrowleft + \Sigma M_A = 0$

$\Rightarrow 50 * 20 * 10 - B_y * 20 + 200 = 0$

$\Rightarrow B_y = 510\ lb$

$\Sigma F_x = 0 \Rightarrow A_y + 510 - 50 * 20 = 0$

$\Rightarrow A_y = 490\ lb$



$0 \le x < 20\ m$
Fig (b) (FBD)

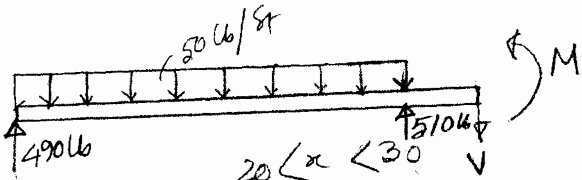
From Fig (b) AB $(0 \le x < 20')$

$\Sigma F_y = 0 \Rightarrow 490 - 50 * x - V = 0$

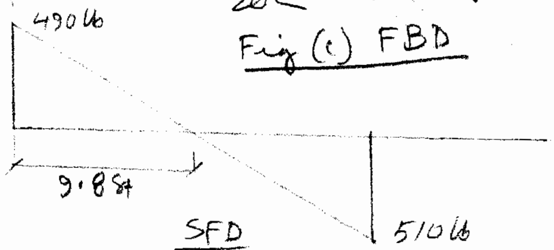
$\therefore V = 490 - 50x$

$\circlearrowleft + \Sigma M = 0 \Rightarrow M + 50 * x * \frac{x}{2} - 490x = 0$

$\Rightarrow M = 490x - 25x^2$



$20 < x < 30$
Fig (c) FBD



SFD
Fig (d)

From Fig (c) BC $(20' < x < 30')$

$\Sigma F_y = 0$

$\Rightarrow 490 + 510 - 50 * 20 - V = 0$

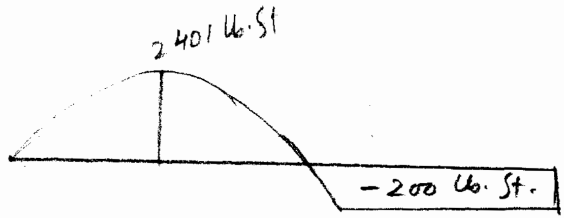
$\Rightarrow V = 0$

$\circlearrowleft + \Sigma M = 0$

$\Rightarrow +M - 490 * x - 510(x - 20) + 50 * 20 * (x - 10) = 0$

$\Rightarrow M = +490x + 510x - 10200 - 1000x + 10,000 = 0$

$\Rightarrow M = -200\ lb\text{-}ft$



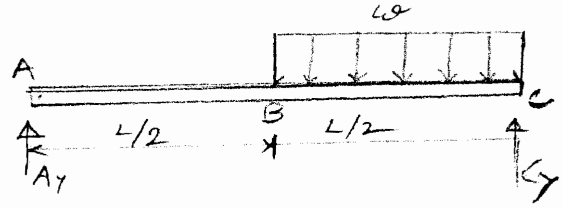
BMD
Fig (e)

Prob 7-50 (P-345)

Given: Forces shown in figure.

Req.d:

To draw shear force and moment diagram for the beam.



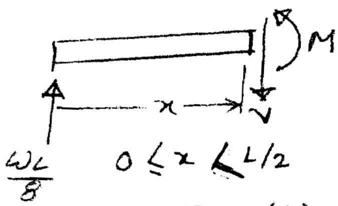
FBD (a)

Sol.n: From FBD (a)

$\Sigma M_A = 0 \Rightarrow C_y * L - \frac{wL}{2}\left(\frac{3L}{4}\right) = 0$

$\Rightarrow C_y = \frac{3}{8} wL$

$\Sigma F_y = 0 \Rightarrow A_y = \frac{wL}{2} - \frac{3wL}{8} = \frac{wL}{8}$

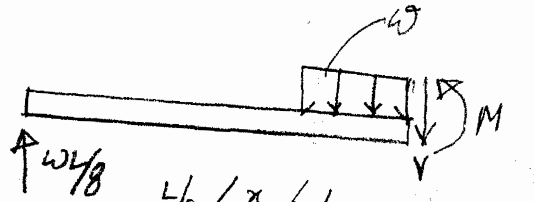


FBD (b)

From FBD (b) [AB $(0 \leq x \leq \frac{L}{2})$]

$+\uparrow \Sigma F_y = 0;\quad V = wL/2$

$\circlearrowleft + \Sigma M = 0;\quad M = \frac{wL}{8} x$



FBD(c)

From FBD (c) BC $(\frac{L}{2} \leq x \leq L)$

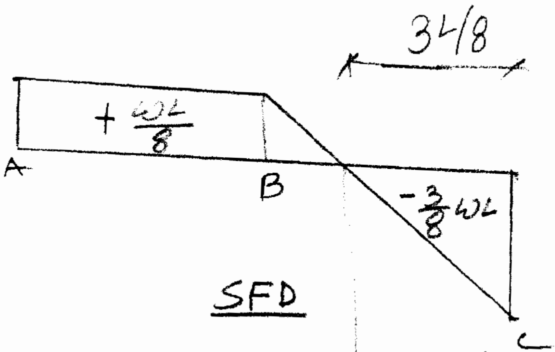
$+\uparrow \Sigma F_y = 0;\ -V - w(x - L/2) + \frac{wL}{8} = 0$

$\Rightarrow V = wL/8 - w(x - L/2)$

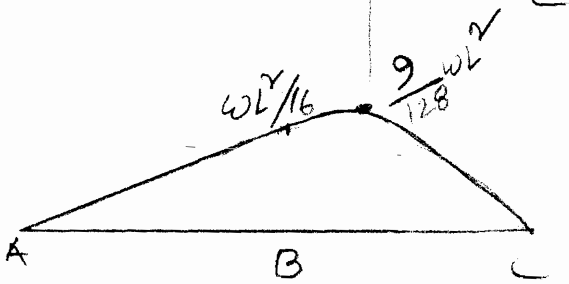
$\circlearrowleft + \Sigma M = 0$

$\Rightarrow -M + \frac{wL}{8} * x - w(x - L/2)\frac{(x - L/2)}{2} = 0$

$\Rightarrow M = \frac{wLx}{8} - \frac{1}{2} w (x - L/2)^2$



SFD



MD

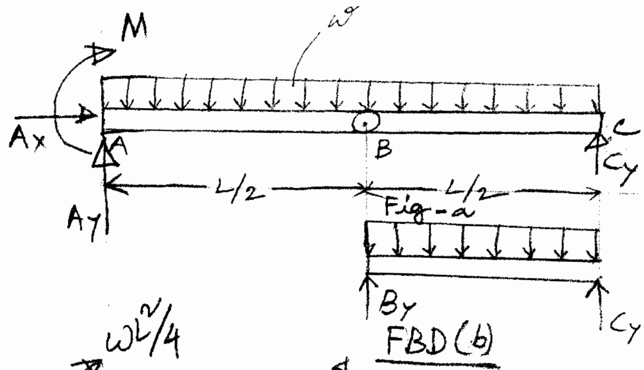
Prob. 7-54 (P-346)

Given:

Forces shown in Fig.

Req.d:

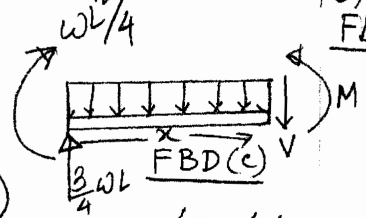
To draw SF and BMD.



Sol.n:

From FBD (b)

$B_y = C_y = \frac{wL/2}{2} = \frac{wL}{4}$ (for symmetry)



$0 < x < L$

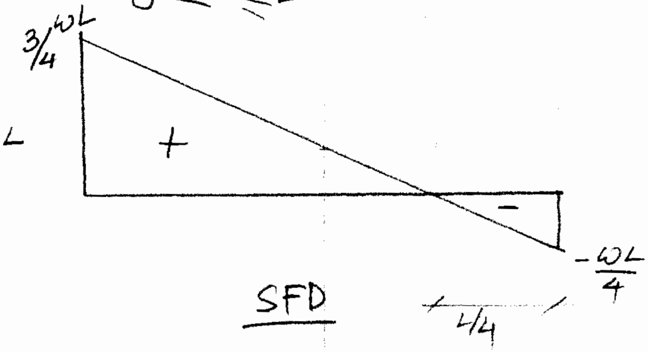
From FBD (a)

$\Sigma F_y = 0 \Rightarrow A_y = wL - \frac{wL}{4} = \frac{3}{4}wL$

$\circlearrowleft + \; \Sigma M_A = -M$

$\Rightarrow \frac{wL}{4}(L) - wL\left(\frac{L}{2}\right) = -M$

$\Rightarrow M = \frac{wL^2}{4}$

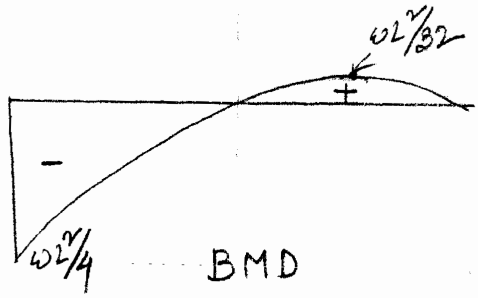


at AC $0 < x < L$ (FBD (c))

$\Sigma F_y = 0$

$\Rightarrow -V - wx + 3/4\, wL = 0$

$\therefore V = -wx + 3/4\, wL$



$\circlearrowleft + \Sigma M = 0$

$\Rightarrow \frac{wL^2}{4} - \frac{3}{4}wL * x + \frac{wx^2}{2} + M = 0$

$\Rightarrow M = -\frac{wL^2}{4} + \frac{3}{4}wLx - \frac{wx^2}{2}$

Note: one section only ??!

Prob. 7-60 (P.-7-60)

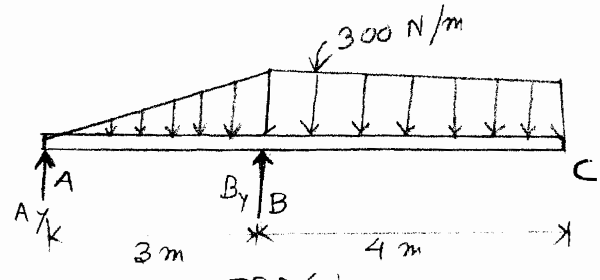
Given: The beam shown.

Req. d:

SFD & BMD.

Sol. n:

First vertical reaction needed.



FBD (a)

from FBD (a)

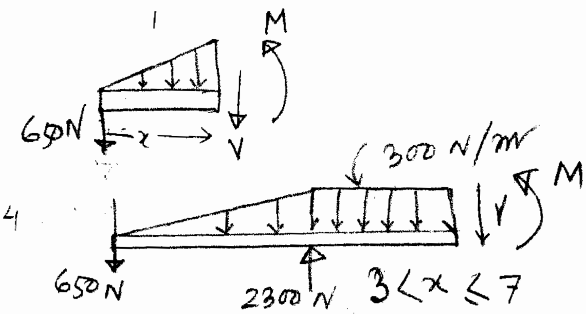
$\circlearrowleft + \Sigma M_A = 0 \Rightarrow B_y * 3 - \frac{1}{2} * 300 * 3 * \frac{2}{3}(3)$

$- 300 * 4 * (\frac{4}{2} + 3) = 0$

$\Rightarrow B_y = 2300 \text{ N}$

$\Sigma F_y = 0 \Rightarrow A_y = \frac{1}{2} * 3 * 300 + 300 * 4$

$- 2300 = -650$



at $0 \leq x \leq 3\text{m}$ (AB)

$\Sigma F_y = 0 \Rightarrow -650 - V - (\frac{1}{2} * \frac{300}{3} * x) * x$

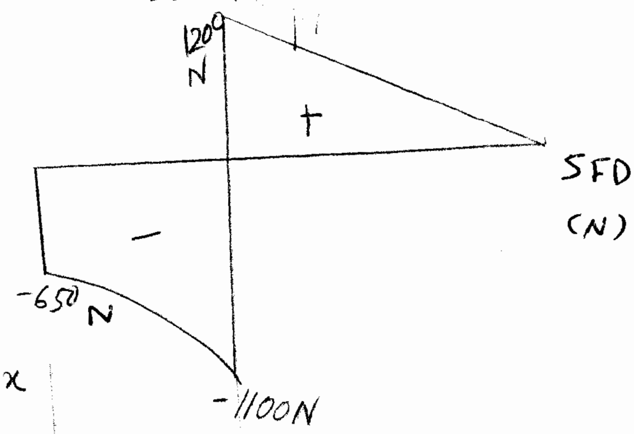
$= 0$

$\Rightarrow V = -650 - 50x^2$

$\circlearrowleft + \Sigma M = 0 \Rightarrow M + 650x + \frac{1}{2} * \frac{300}{3} * x * x * \frac{1}{3} x$

$= 0$

$\therefore M = -650x - \frac{50x^3}{3}$



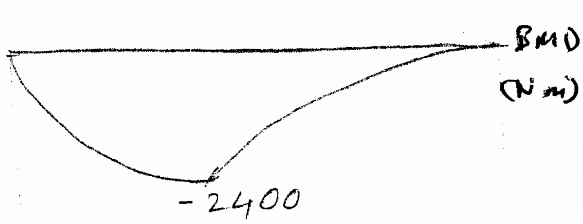
at $3\text{m} < x \leq 7\text{m}$ (BC)

$\Sigma F_y = 0 \Rightarrow -650 - \frac{1}{2} * 3 * 300 - 300(x-3) + 2300 - V$

$= 0$

$\Rightarrow V = -650 - 450 - 300x + 900 + 2300$

$\Rightarrow V = 2100 - 300x.$



$\circlearrowleft + \Sigma M = 0 \Rightarrow$

$\Rightarrow 650 * x - 230(x-3) + \frac{1}{2} * 3 * 300 (x - \frac{2}{3} * 3)$

$+ 300(x-3)(3 + \frac{(x-3)}{2}) = 0$

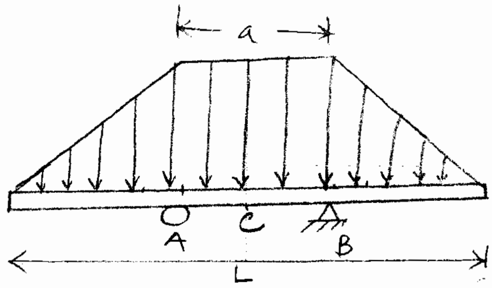
$\Rightarrow M = 2910 - 870x - 300x^2$

Prob-121 (P-375)

Given: Beam shown in Fig.
Moment at center is zero.

Req. d:

The distance "a".



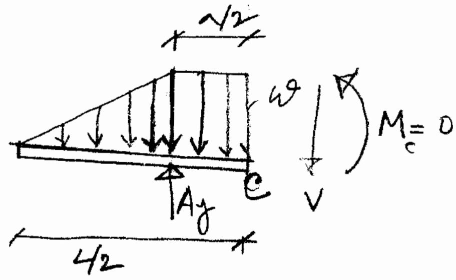
℄

Fig (a)

Sol.n

For Symmetry

$A_y = \frac{1}{2}\left(a/2 + L/2\right)w = \frac{w}{4}(a+L)$



FBD

$(+\Sigma M_c \text{ (center)} = 0$

$\Rightarrow 0 - A_y(a/2) + \frac{1}{2} * \frac{L-a}{2} * w\left(\frac{a}{2} + \frac{L-a}{2*3}\right)$

$+ \frac{a}{2} * w * \frac{a}{4} = 0$

$\Rightarrow -\frac{w}{4}(a+L)\left(\frac{a}{2}\right) + \frac{w(L-a)}{4}\left(\frac{a}{2} + \frac{L-a}{6}\right)$

$+ \frac{wa^2}{8} = 0$

$\Rightarrow \frac{w}{4}\left\{-(a+L)\left(\frac{a}{2}\right) + (L-a)\left(\frac{2a+L}{6}\right)\right.$

$\left. + \frac{a^2}{2}\right\} = 0$

$\Rightarrow -\frac{a^2}{2} - \frac{aL}{2} + \frac{2aL}{6} - \frac{2a^2}{6} + \frac{L^2}{6} - \frac{aL}{6}$

$+ \frac{a^2}{2} = 0$

$\Rightarrow -2a^2 + L^2 - 2aL = 0$

$\Rightarrow -2a^2 - 2La + L^2 = 0$ or $2a^2 + 2La - L^2 = 0$ or $a^2 + La - \frac{L^2}{2} = 0$

$a = \frac{-(-2L) \pm \sqrt{(-2L)^2 - 4(L^2)(-2)}}{2*(-2)} = \frac{L \pm L\sqrt{12}}{-4}$

Taking ⊖ Sign $a = \frac{L - L\sqrt{12}}{-4} \Rightarrow$ $\boxed{a = 0.366L}$

Try "other" methods & compare!!