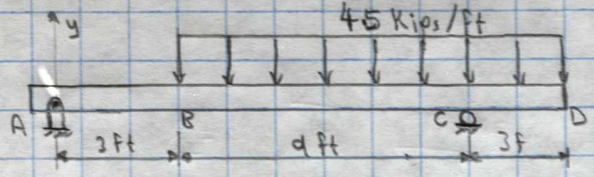
Theory of Structures I
CVG 3140

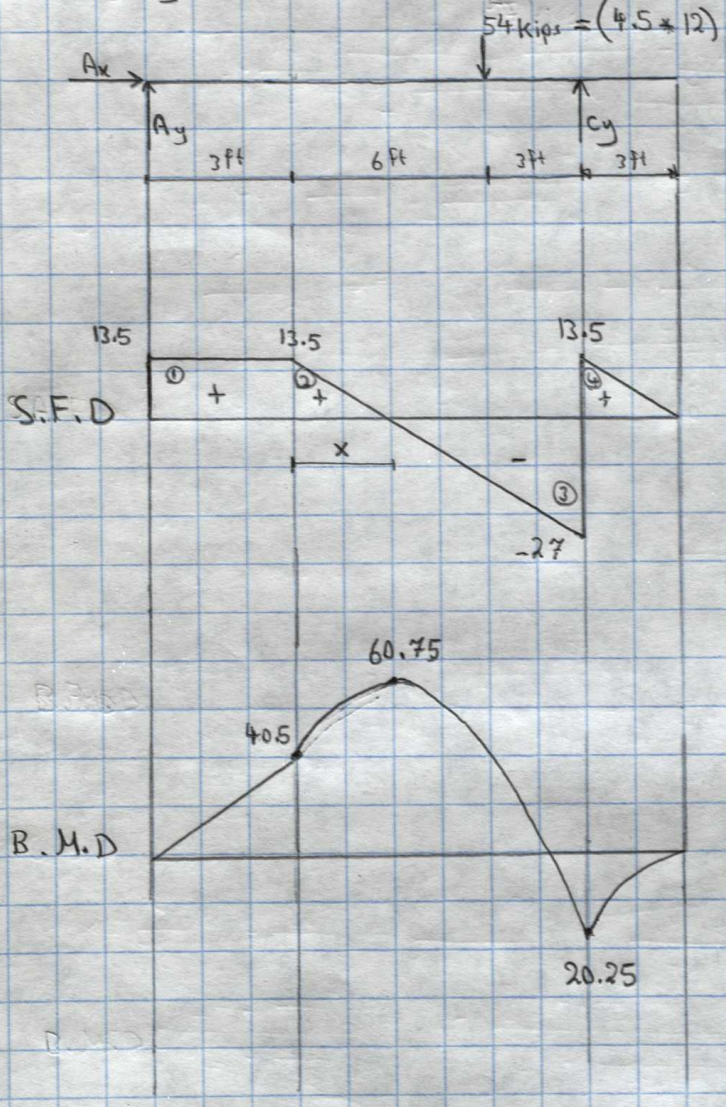
Assignment # 1

Part (1) :-

(a)



By idealizing the member:



$\pm \rightarrow \Sigma F_x = 0$ $\quad A_x = 0$

$+\uparrow \Sigma F_y = 0$ $\quad A_y + C_y - 54 = 0$ --- (1)

$\circlearrowleft \Sigma M_A = 0$ $\quad 54(9) - C_y(12) = 0$

$C_y = \frac{54(9)}{12}$ $\quad C_y = 40.5$ kips $\uparrow$

Subtitute in Equation (1)

$A_y + 40.5 - 54 = 0$ $\quad A_y = 13.5 \uparrow$

Area Calculations:

$A_1 = 13.5 * 3 = 40.5$ Kips.ft

$A_2 = 0.5 * 13.5 * 3 = 20.25$ Kips.ft

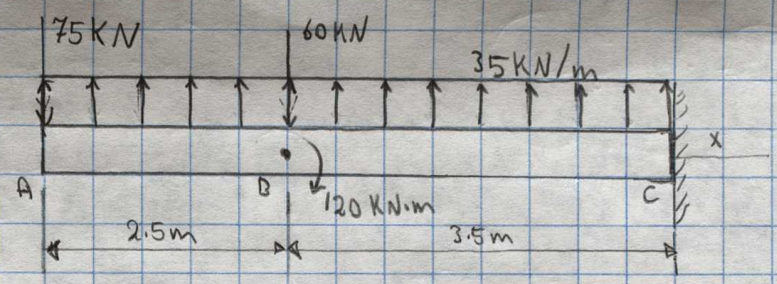
$A_3 = 0.5 * 27 * 6 = 81$ Kips.ft

$A_4 = 0.5 * 13.5 * 3 = 20.25$ Kips.ft

Hint:- $\frac{x}{13.5} = \frac{9 - x}{|13.5 + 27|}$

$x = 3$

(b)



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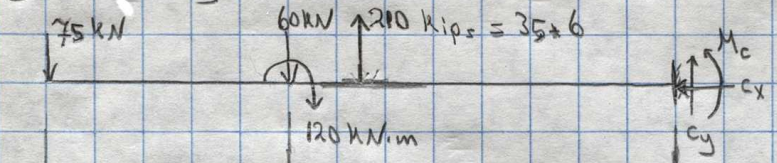


$\pm\rightarrow \Sigma F_x = 0 \qquad C_x = 0$

$+\uparrow \Sigma F_y = 0$

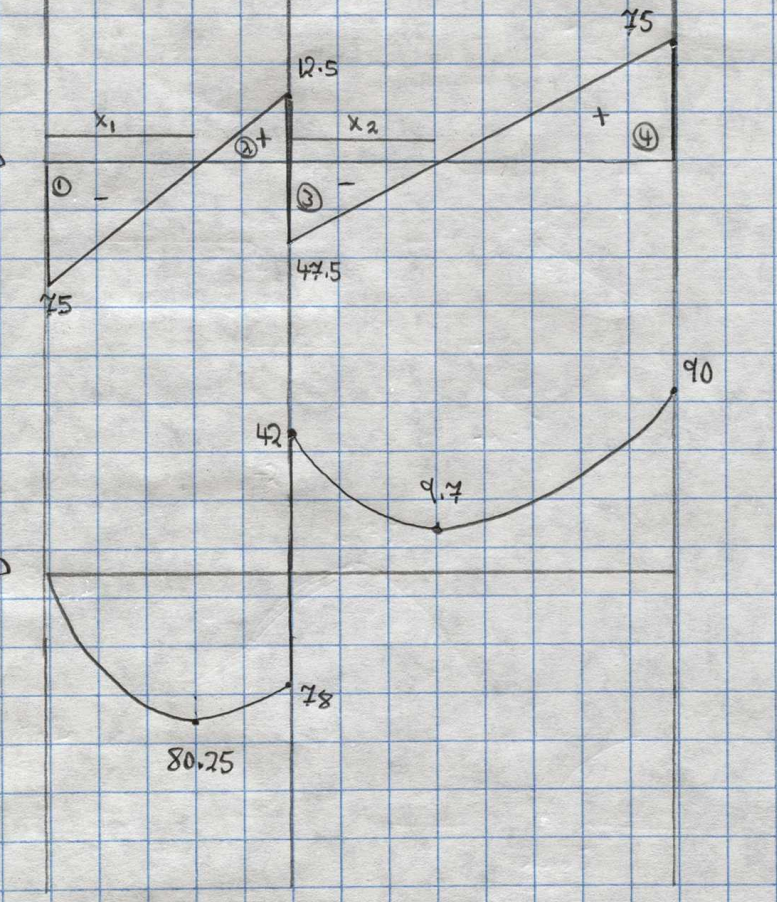
$C_y + 210 - 60 - 75 \qquad C_y = -75\,KN \downarrow$

$\circlearrowleft \Sigma M_c = 0$

$M_c + 210(3) - 60(3.5) + 120 - 75(6) = 0$

$M_c = -90\ KN.m \circlearrowleft$

S.F.D



B.M.D

$A_1 = 0.5 * 75 * 2.14 = 80.25\ KN.m$

$A_2 = 0.5 * 12.5 * (2.5 - 2.14) = 2.25\ KN.m$

$A_3 = 0.5 * 47.5 * 1.36 = 32.3\ KN.m$

$A_4 = 0.5 * 75 * (3.5 - 1.36) = 80.25\ KN.m$

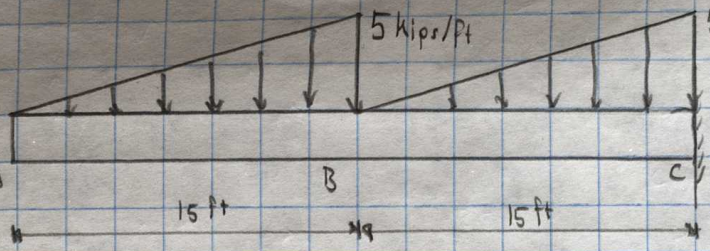
Hint :- $\dfrac{x_1}{75} = \dfrac{2.5}{|12.5 + 75|}$

$x_1 \approx 2.14\ m$

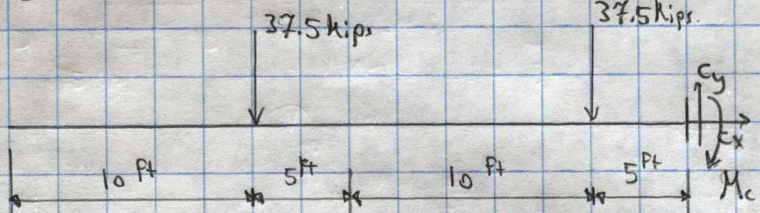
$\dfrac{x_2}{47.5} = \dfrac{3.5}{|47.5 + 75|}$

$x_2 \approx 1.36\ mm$

(c)



By idealizing the member :



$\pm \rightarrow \Sigma F_x = 0 \quad C_x = 0$

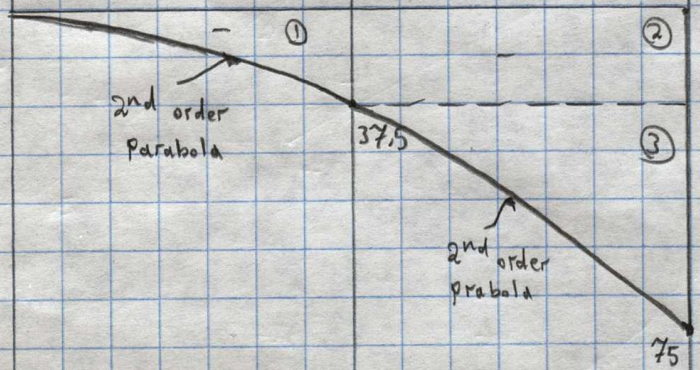
$+\uparrow \Sigma F_y = 0 \quad C_y - 37.5 - 37.5 = 0$

$C_y = 75 \text{ kips} \uparrow$

$\curvearrowleft + \Sigma M_c = 0 \quad M_c - 37.5(5) - 37.5(20) = 0$

$M_c = 937.5 \text{ kips.ft} \curvearrowright$

S.F.D

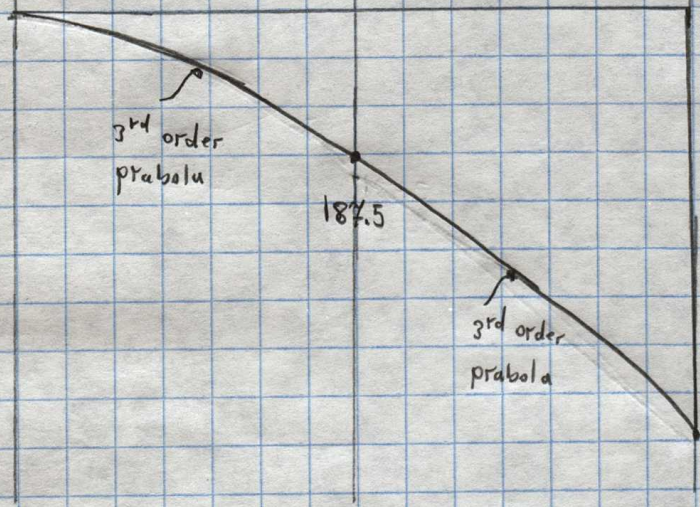


$A_1 = \frac{1}{3} bh = \frac{1}{3} * 15 * 37.5 = 187.5 \text{ kips.ft}$

$A_2 = 15 * 37.5 = 562.5 \text{ kips.ft}$

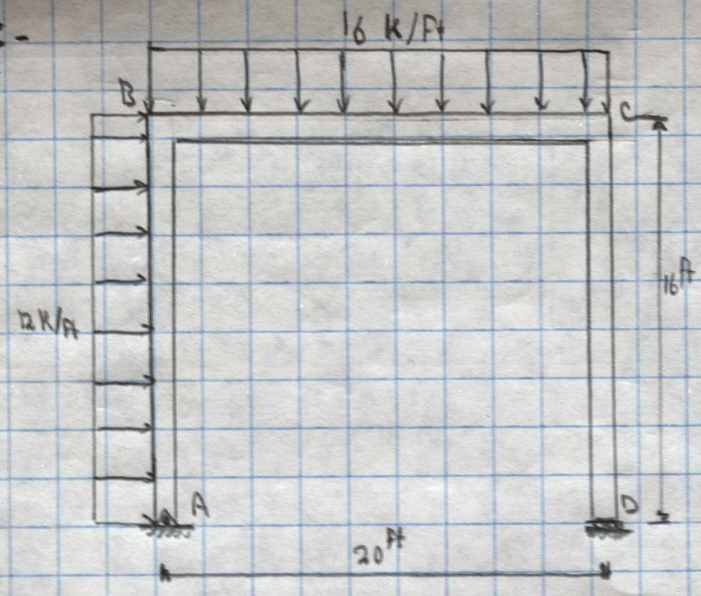
$A_3 = \frac{1}{3} bh = \frac{1}{3} * 15 * 37.5 = 187.5 \text{ kips.ft}$

B.M.D

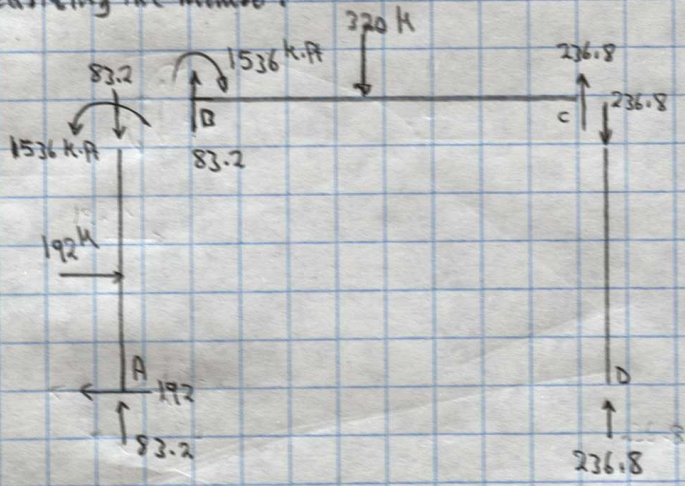


Part (2):-

(a)



By idealizing the member:



$\circlearrowleft \Sigma M_A = 0$

$192(8) + 320(10) - D_y(20) = 0$

$D_y = 236.8\ k \uparrow$

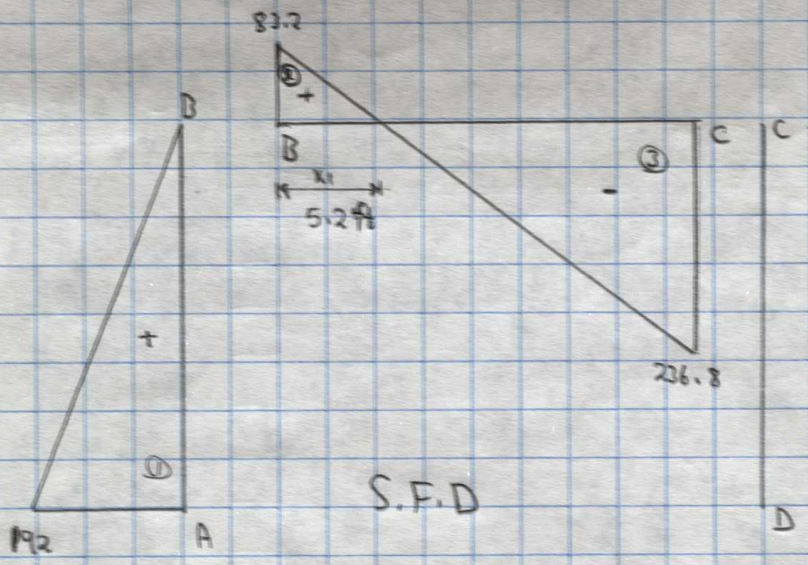
$\stackrel{+}{\rightarrow} \Sigma F_x = 0 \quad 192 - A_x = 0 \quad A_x = -192\ k \leftarrow$

$+\uparrow \Sigma F_y = 0 \quad A_y - 320 + 236.8 = 0 \quad A_y = 83.2\ k \uparrow$

Member (C-D): $+\uparrow \Sigma F_y = 0 \quad 236.8 - C_y = 0 \quad C_y = -236.8\ k \downarrow$

Member (B-C): $+\uparrow \Sigma F_y = 0 \quad 236.8 - 320 + B_y = 0 \quad B_y = 83.2\ k \uparrow$

$\circlearrowleft \Sigma M_B = 0 \quad M_B + 320(10) - 236.8(20) = 0 \quad M_B = 1536\ \text{kips.ft} \circlearrowleft$



S.F.D

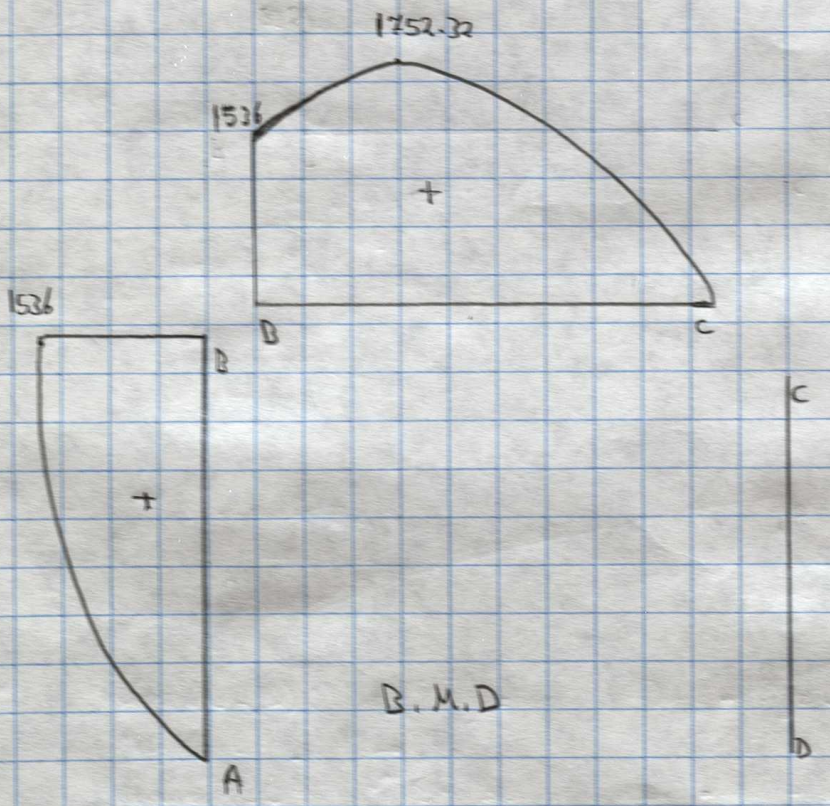
$A_1 = 0.5 * 192 * 16 = 1536$ K.ft

$A_2 = 0.5 * 83.2 * 5.2 = 216.32$ K.ft

$A_3 = 0.5 * 236.8 * (20 - 5.2) = 1752.32$ K.ft

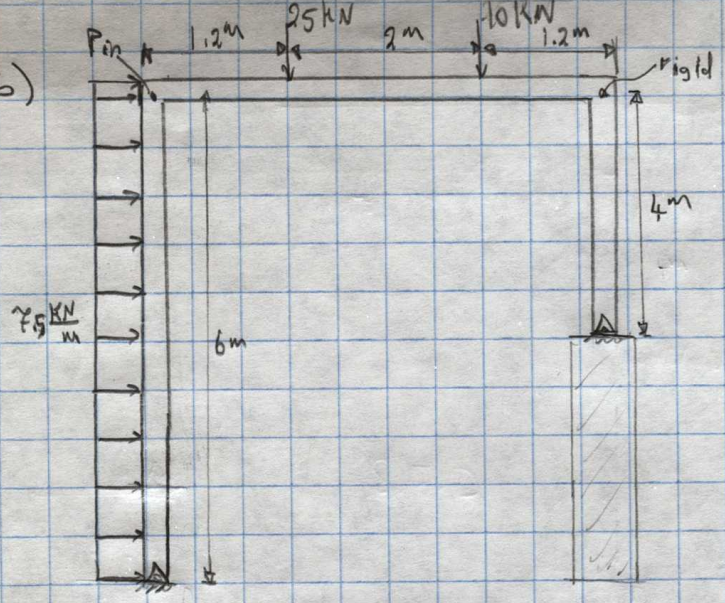
Hint :- $\frac{x_1}{83.2} = \frac{20}{|83.2 + 236.8|}$

$x_1 = 5.2$ ft

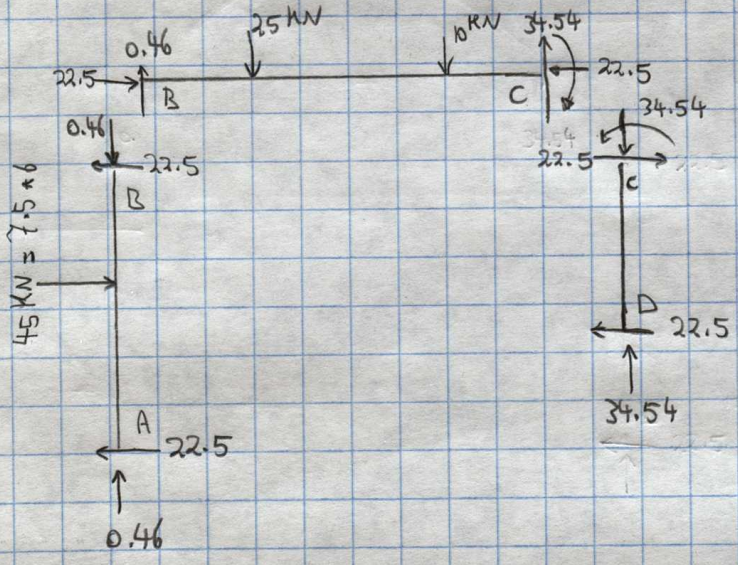


B.M.D

(b)



By idealizing the member:



Taking the left column:

$\curvearrowright \Sigma M_A = 0 \quad 45(3) - B_y(6) = 0$

$B_y = 22.5\ KN \leftarrow$

$\pm\rightarrow \Sigma F_x = 0 \quad 45 - 22.5 - A_x = 0$

$A_x = 22.5\ KN \leftarrow$

Taking the entire frame:

$\pm\rightarrow \Sigma F_x = 0 \quad 45 - 22.5 - D_x = 0$

$D_x = 22.5\ KN \leftarrow$

$\curvearrowright \Sigma M_A = 0 \quad 45(3) + 25(1.2) + 10(3.2) - 22.5(2) - D_y(4.4) = 0$

$D_y = 34.54\ KN \uparrow$

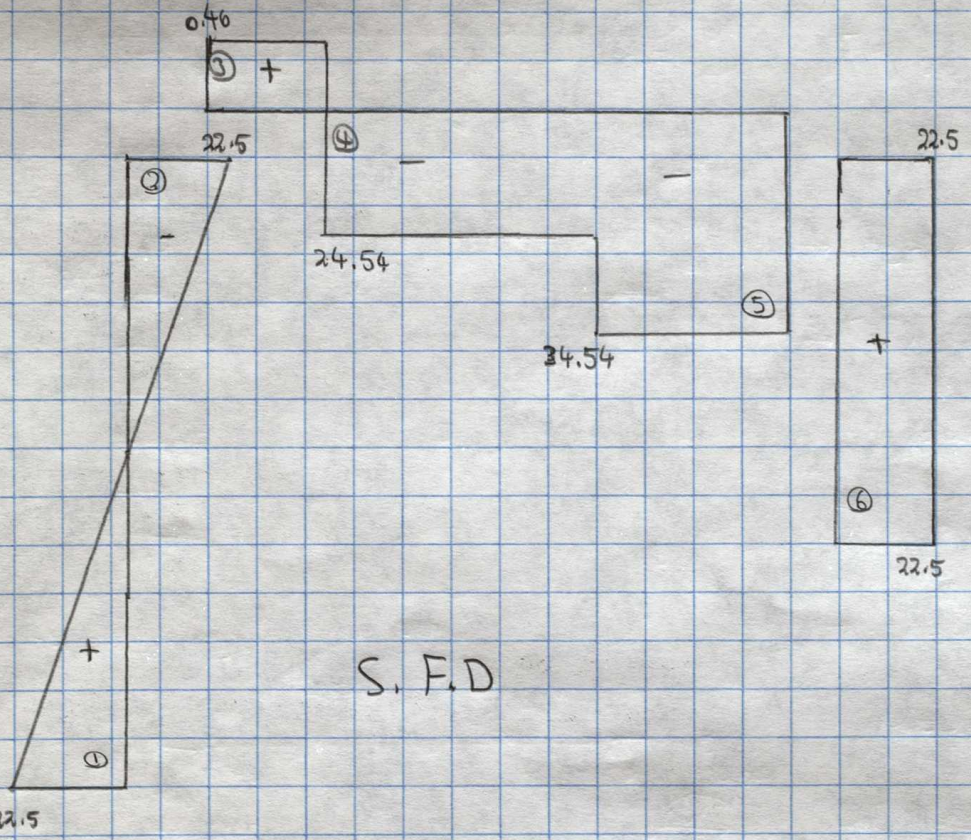
$+\uparrow \Sigma F_y = 0 \quad 34.54 - 25 - 10 + A_x = 0$

$A_x = 0.46\ KN \uparrow$

Taking the beam:

$\curvearrowright \Sigma M_C = 0 \quad M_C - 10(1.2) - 25(3.2) + 0.46(4.4) = 0$

$M_C = 90\ KN.m \curvearrowright$



S. F. D

$A_1 = 0.5 * 22.5 * 3 = 33.75$ KN.m

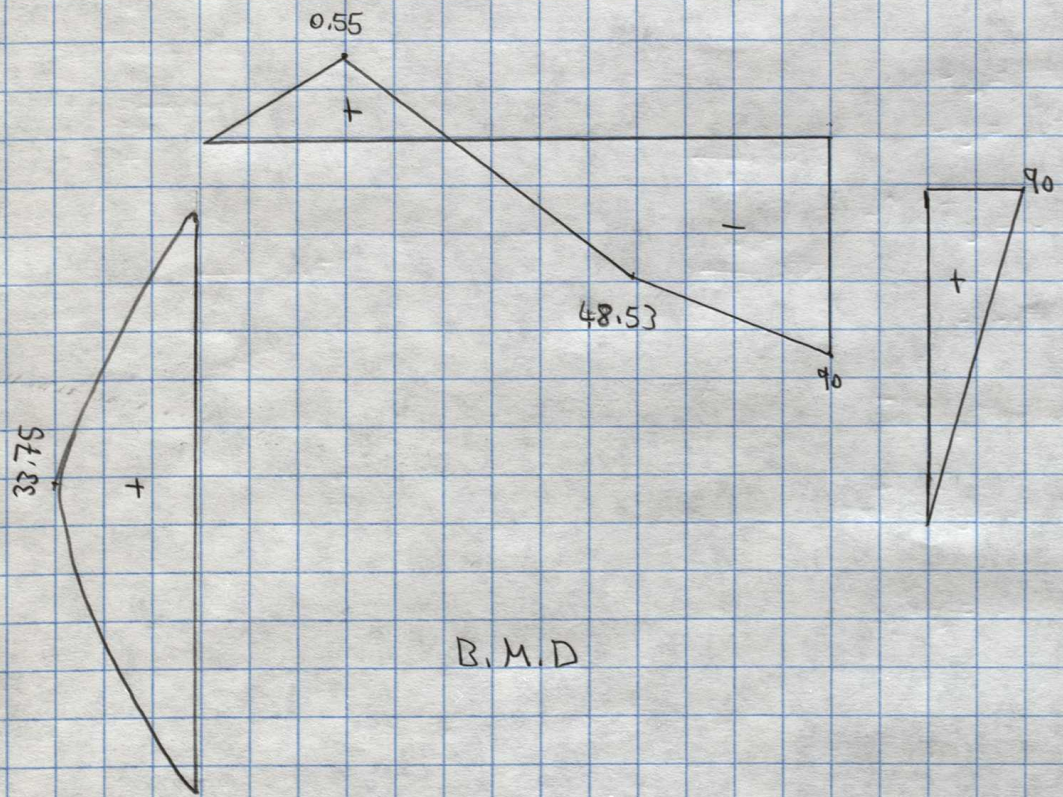
$A_2 = 0.5 * 22.5 * 3 = 33.75$ KN.m

$A_3 = 0.46 * 1.2 = 0.55$ KN.m

$A_4 = 24.54 * 2 = 49.08$ KN.m

$A_5 = 34.54 * 1.2 = 41.44$ KN.m

$A_6 = 22.5 * 4 = 90$ KN.m



B. M. D