Nguyen Xuan Binh 887799

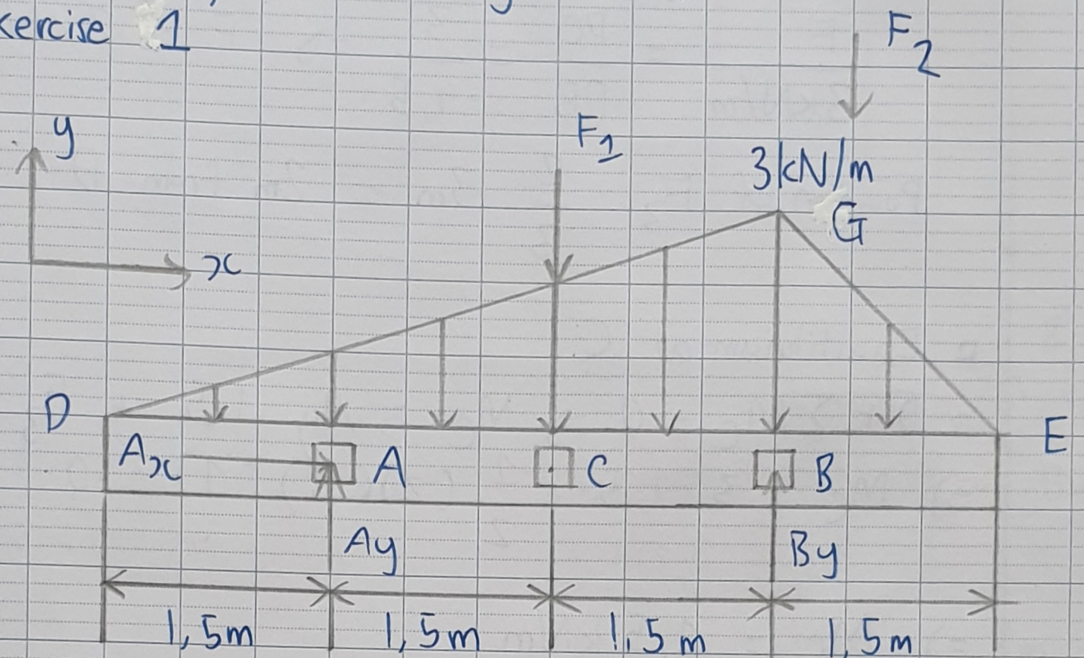
Thứ

Ngày . .

No.

Statics & Dynamics (Assignment 3)

Exercise 1



▫ Position of center of force for load DGB : $\frac{2}{3}\cdot 4,5 = 3m$ from D and for load GBE : $\frac{1}{3}\cdot 1,5 + 4,5 = 5m$ from D

▫ Moment equilibrium at B

$$\circlearrowleft + \sum M_B = 0$$

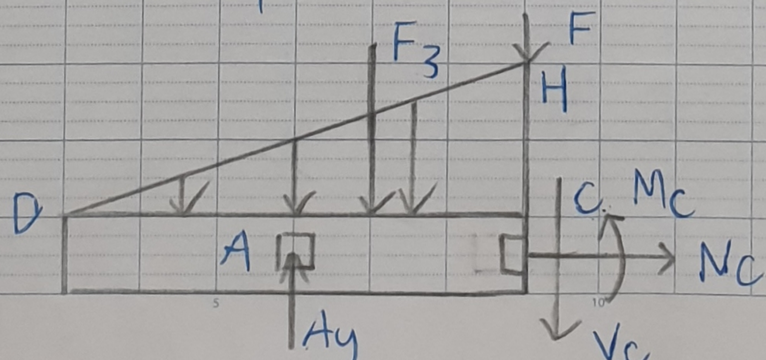
$$\Rightarrow -A_y \cdot 3m + F_1 \cdot (1,5) - F_2 (0,5) = 0$$

$$\Rightarrow -A_y \cdot 3 + \frac{1}{2}(4,5)(3)(1,5) - \frac{1}{2}(1,5)(3)(0,5) = 0$$

$$\Rightarrow -A_y \cdot 3 = -9$$

$$\Rightarrow A_y = 3\ kN$$

Cut the bar at point C and its FBD from left side



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Force of F that tops the load DHC

$$\frac{F}{3kN/m} = \frac{DC}{DB} = \frac{3}{4,5} \Rightarrow F = 2kN/m$$

Position of F_3 : $\frac{2}{3} . 3m = 2m$ from D

▫ Equilibrium at C

- $\curvearrowleft + \sum M_C = 0 \Rightarrow M_C - A_y . 1,5 + F_3 . 1 = 0$

$\Rightarrow M_C - 3 . 1,5 + \frac{1}{2}(2)(3)(1) = 0$

$\Rightarrow M_C = 1,5 \text{ kNm}$

- $\uparrow + \sum F_y = 0 \Rightarrow A_y - V_C - F_3 = 0$

$\Rightarrow 3 - V_C - \frac{1}{2}.(2)(3) = 0$

$\Rightarrow V_C = 0$

- $\rightarrow + \sum F_x = 0 \Rightarrow N_C = 0$

Answer : $N_C = 0 \quad V_C = 0 \quad M_C = 1,5 \text{ kNm}$

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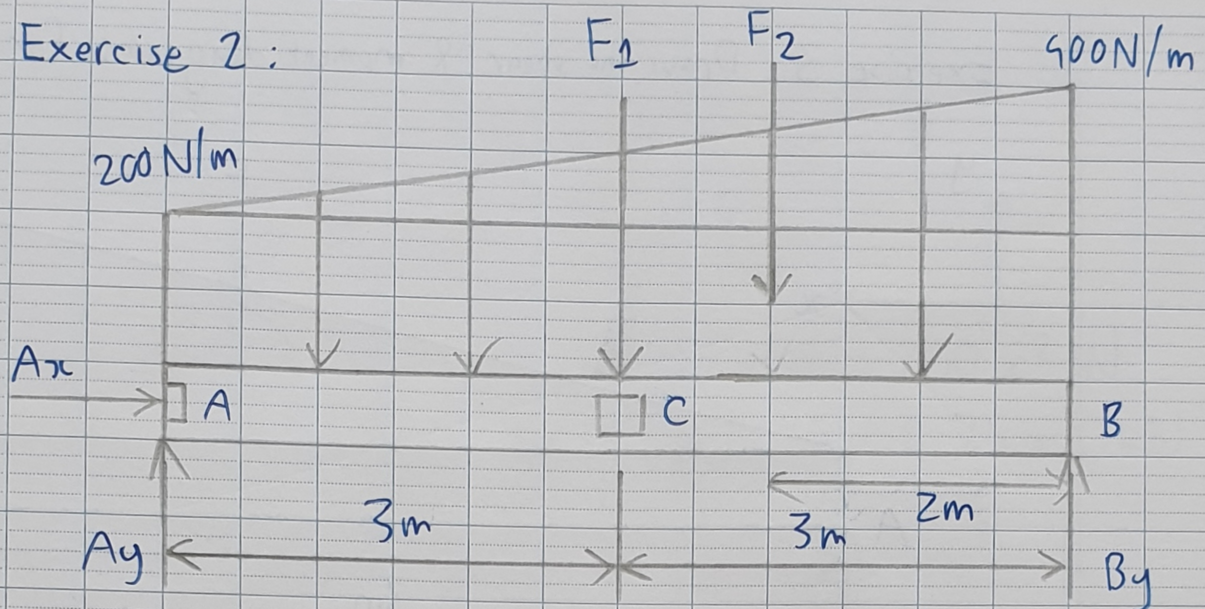
Exercise 2:



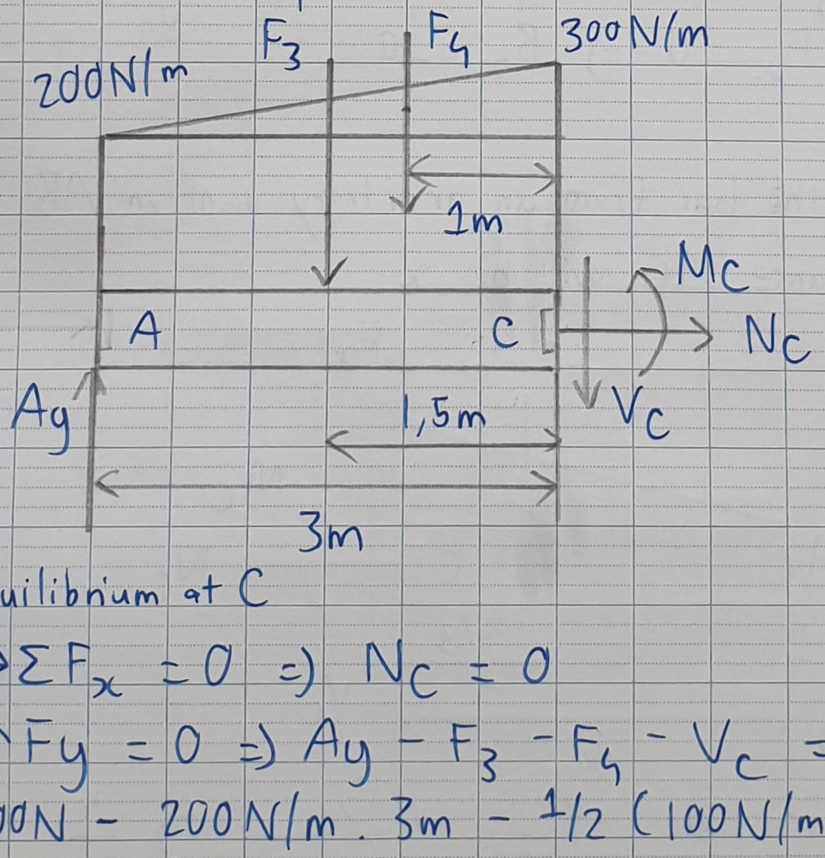
- Moment equilibrium at point B

$\circlearrowleft + \Sigma M_B = 0 \Rightarrow -A_y . 6m + F_1 . 3m + F_2 . 2m = 0$

$\Rightarrow -A_y . 6m + 200 N/m . 6m . 3m + \frac{1}{2} . 200 N/m . 6m . 2m = 0$

$\Rightarrow A_y = 800N$

- Cut the bar at point C from the left



Answer

$N_C = 0$

$V_C = 50N$

$M_C = 1350 N.m$

- Equilibrium at C

$+\rightarrow \Sigma F_x = 0 \Rightarrow N_C = 0$

$+\uparrow F_y = 0 \Rightarrow A_y - F_3 - F_4 - V_c = 0$

$\Rightarrow 800N - 200 N/m . 3m - 1/2 (100 N/m) . 3m - V_c = 0$

$\Rightarrow V_C = 50N$

$\circlearrowleft + \Sigma M_C = 0 \Rightarrow M_C - A_y(3) + F_3(\cancel{3}\ 1,5) + F_4 . 1 = 0$

$\Rightarrow M_C = 800.3 - 600.(1,5) - 150 . 1$

$M_C = 1350 Nm$

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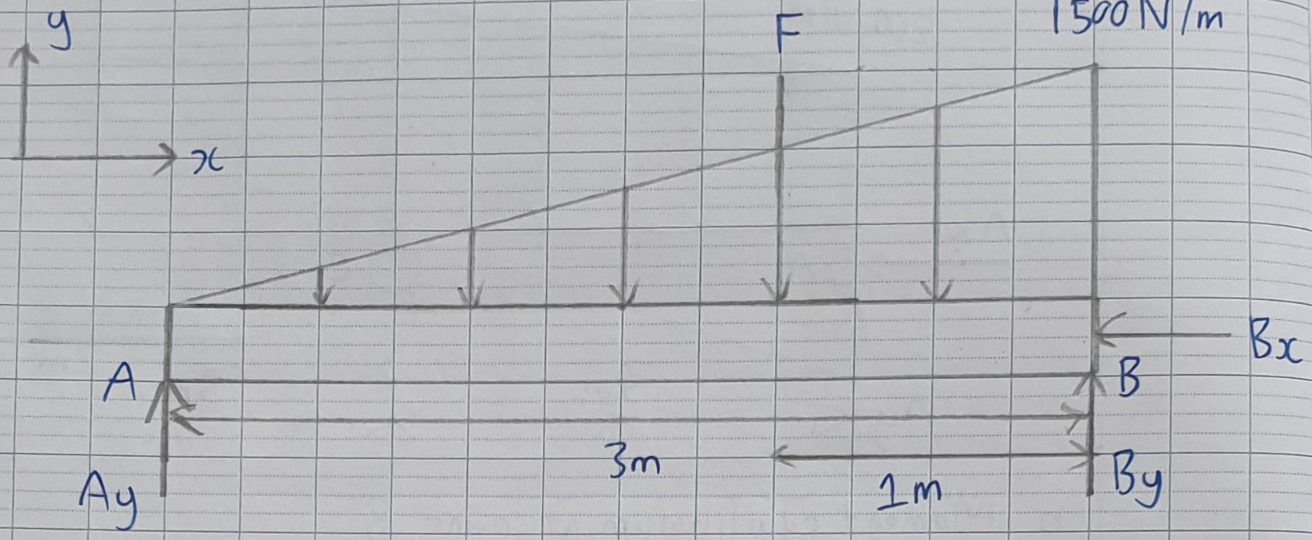
Exercise 3: Draw the shear & moment diagrams for the beam



▫ Equilibrium at B

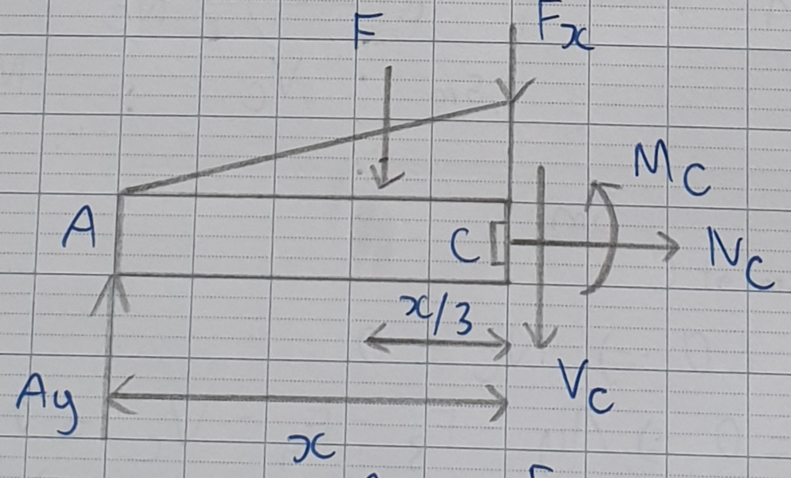
$\circlearrowleft + \Sigma M_B = 0 \Rightarrow -A_y(3m) + F(1m) = 0$

$\Rightarrow -A_y(3m) + \frac{1}{2} \cdot 1500 N/m (3m)(1m) = 0$

$\Rightarrow -A_y(3m) = -2250 N \Rightarrow A_y = 750 N$

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

▫ Cut the bar from an arbitrary point on AB which is C. The distance AC will be x



First we have: $\frac{AC}{AB} = \frac{F_x}{1500 N/m} \Rightarrow \frac{x}{3m} = \frac{F_x}{1500 N/m}$

$\Rightarrow F_x = 500x \; N/m$

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Equilibrium at C :

+ $+\uparrow \Sigma F_y = 0 \Rightarrow A_y - F - V_C = 0$

$\Rightarrow 750N - \frac{1}{2} AC . F_x - V_C = 0$

$\Rightarrow V_C = 750 - \frac{1}{2} x . 500x = (750 - 250x^2) N$

$= (0,75 - 0,25x^2) kN$

+ $\xrightarrow{+} \Sigma F_x = 0 \Rightarrow N_C = 0$

+ $\circlearrowleft + \Sigma M_C = 0 \Rightarrow M_C - A_y . AC + F . \frac{AC}{3} = 0$

$\Rightarrow M_C = 750x - 250x^2 . \frac{x}{3}$

$\Rightarrow M_C = 750x - \frac{250}{3} x^3 (N)$

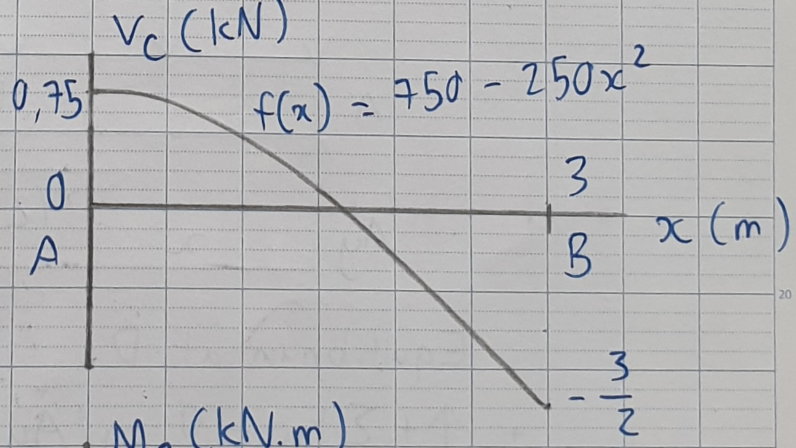
$= 0,75x - \frac{0,25}{3} x^3 (kN)$

Answer

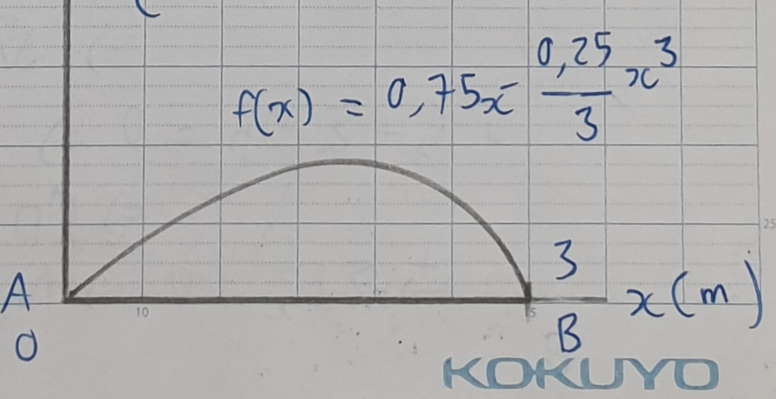
$V_C = (0,75 - 0,25x^2) kN$

$M_C = (0,75x - \frac{0,25}{3} x^3) kN$

The diagram for V_C



The diagram for M_C



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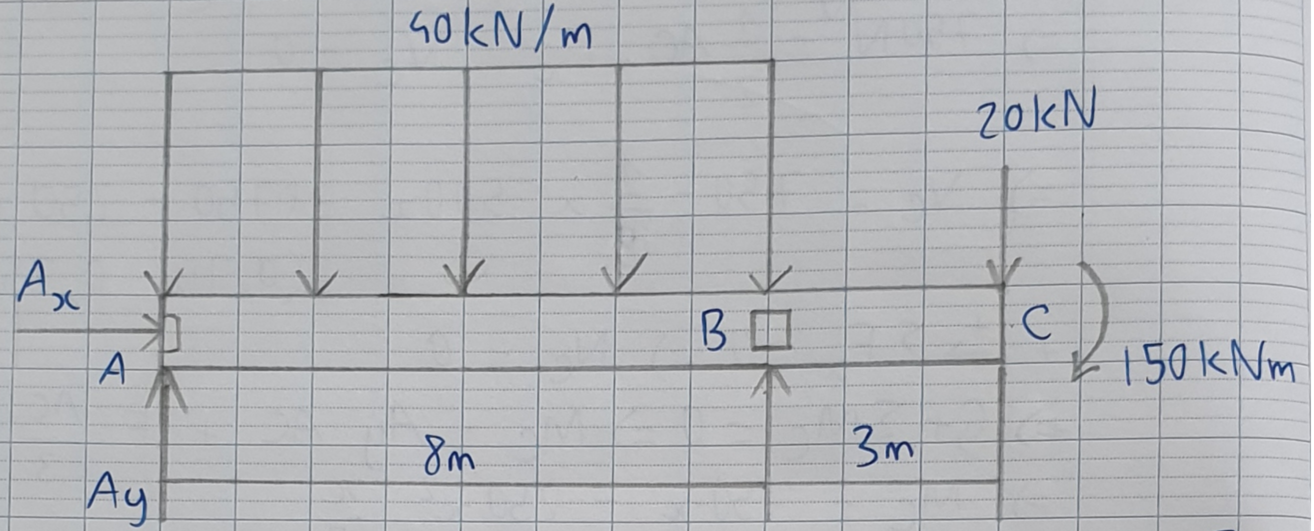
Exercise 4: Draw the shear and moment diagrams for the beam



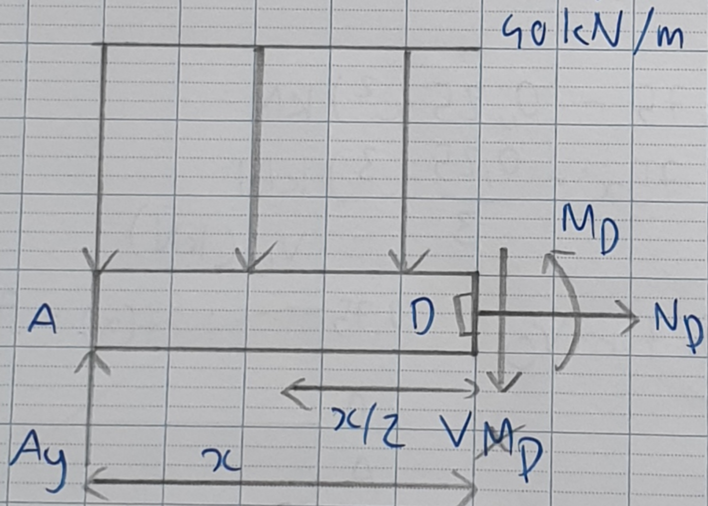
-20.3

- Equilibrium at B

$$\circlearrowleft + \sum M_B = 0 \Rightarrow -A_y(8) - 150 + 40(8)(4) = 0$$

$$\Rightarrow A_y = 133,75 \text{ N}$$

- Cut the bar at D, an arbitrary point on AB



Equilibrium at D

$$+ \uparrow + \sum F_y = 0 \Rightarrow A_y - 40x - V_D = 0$$

$$\Rightarrow V_D = (133,75 - 40x) \text{ kN}$$

$$+ \circlearrowleft + \sum M_D = 0 \Rightarrow -A_y \cdot x + 40x\left(\frac{x}{2}\right) + M_D = 0$$

$$\Rightarrow M_D = (133,75x - 20x^2) \text{ kNm}$$

$$+ \overset{+}{\rightarrow} \sum F_x = 0 \Rightarrow N_D = 0$$

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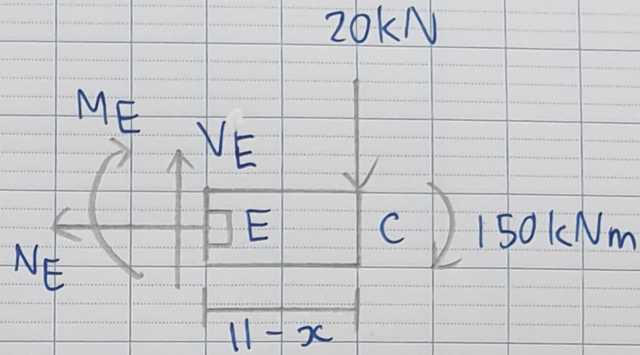
▫ Cut the bar at E, an arbitrary point on BC:



▫ Equilibrium at E

+ $\uparrow + \sum F_y = 0 \Rightarrow V_E - 20\,kN = 0 \Rightarrow V_E = 20\,kN$

+ $\circlearrowleft + \sum M_E = 0 \Rightarrow -M_E - 150 - 20(11-x) = 0$

$\Rightarrow -M_E = 150 + 20(11-x)\,kNm$

Since $150 + 20(11-x)$ is positive $\Rightarrow M_E$ direction is opposite the diagram

Answer: at $D \in AB$: $V_D = (133,75 - 40x)\,kN$

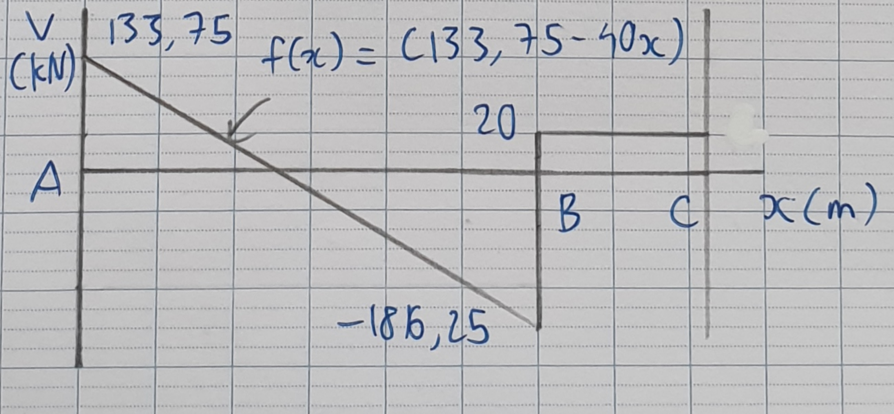
$M_D = (133,75x - 20x^2)\,kNm$

at $E \in BC$: $V_E = 20\,kN$

$M_E = (-370 + 20x)\,kNm$

Diagrams of shear and moment force

+ Shear:



+ Moment