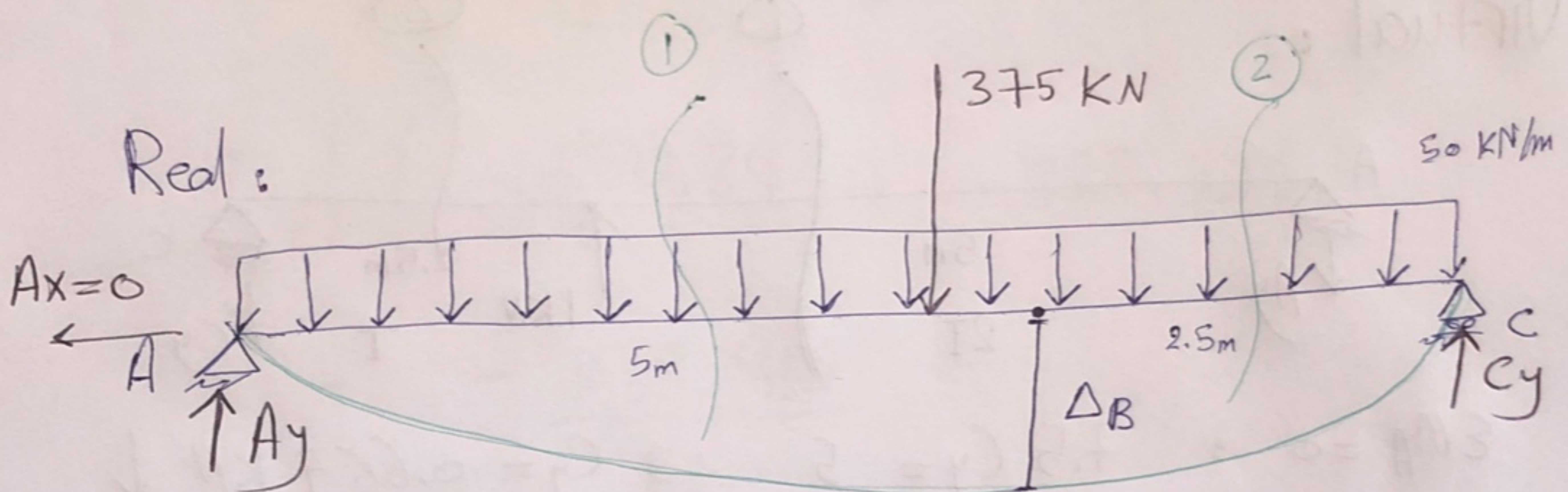
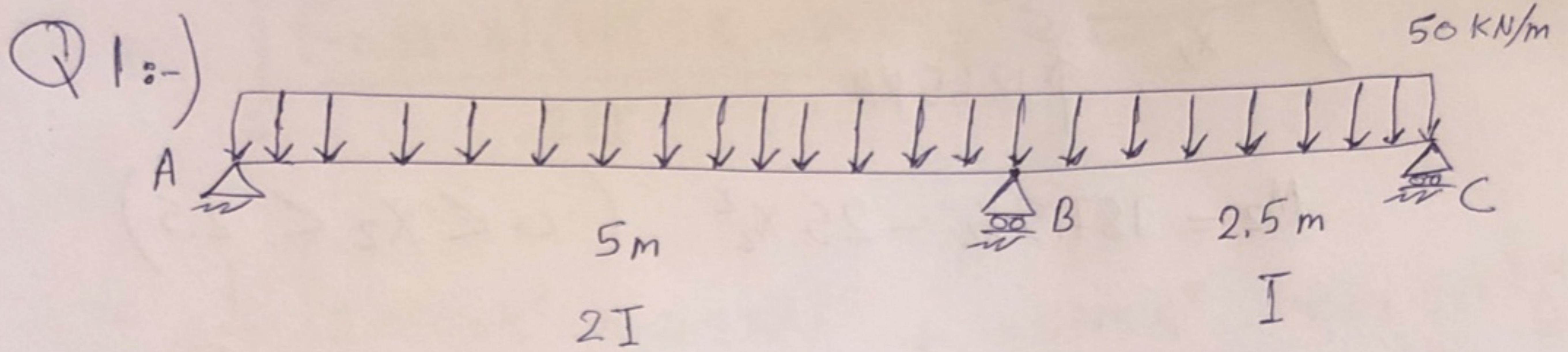


Mohammad Al-Swaity } Structural Analysis 1
 1181136 } HW # 8

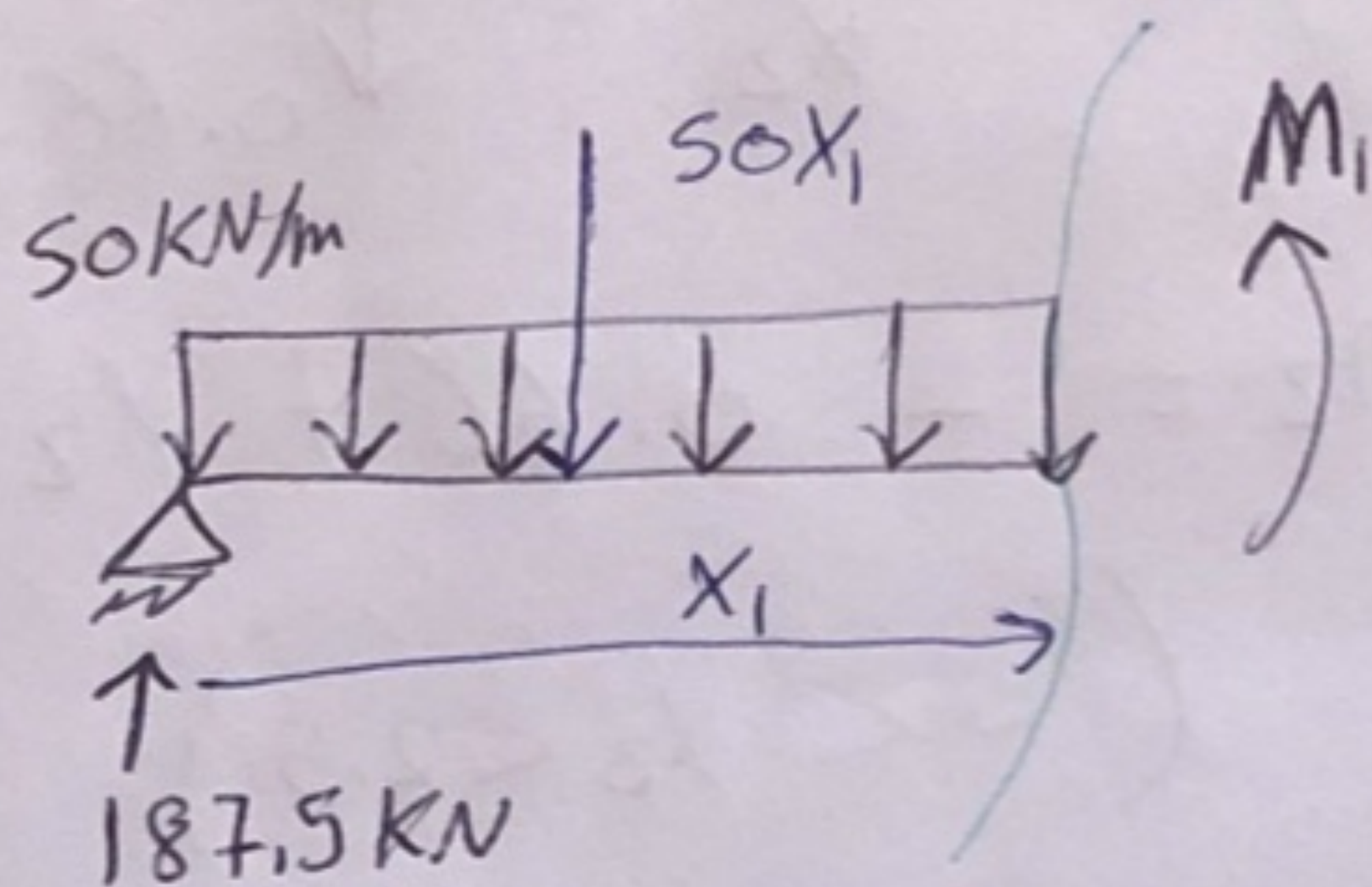


$$\sum M_A = 0 : 7.5 C_y = 1406.25$$

$$C_y = 187.5 \text{ kN} \uparrow$$

$$\sum F_y = 0 : A_y = 187.5 \text{ kN} \uparrow$$

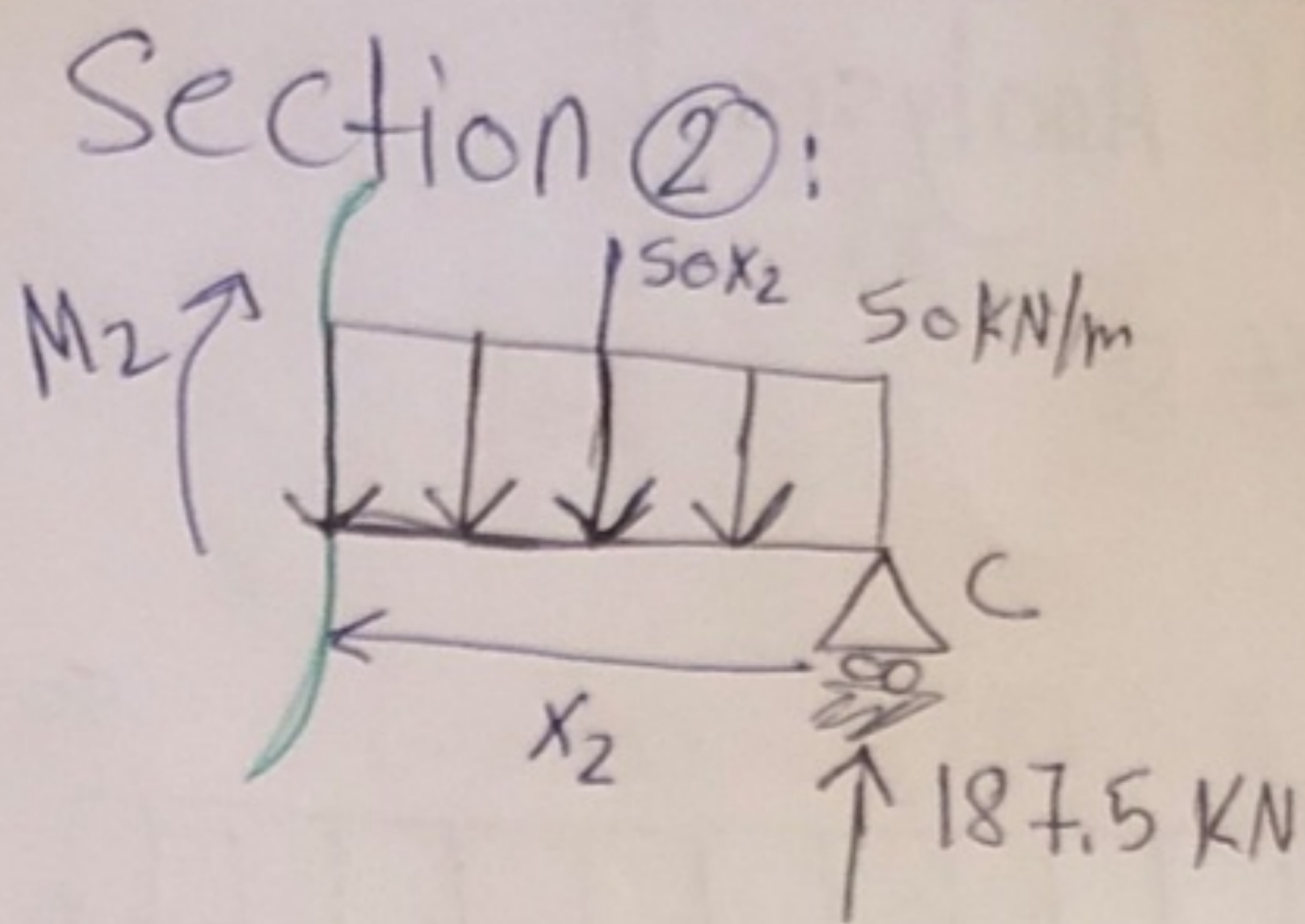
Section ①:



$$M_1 = 187.5 x_1 - \frac{50 x_1^2}{2}$$

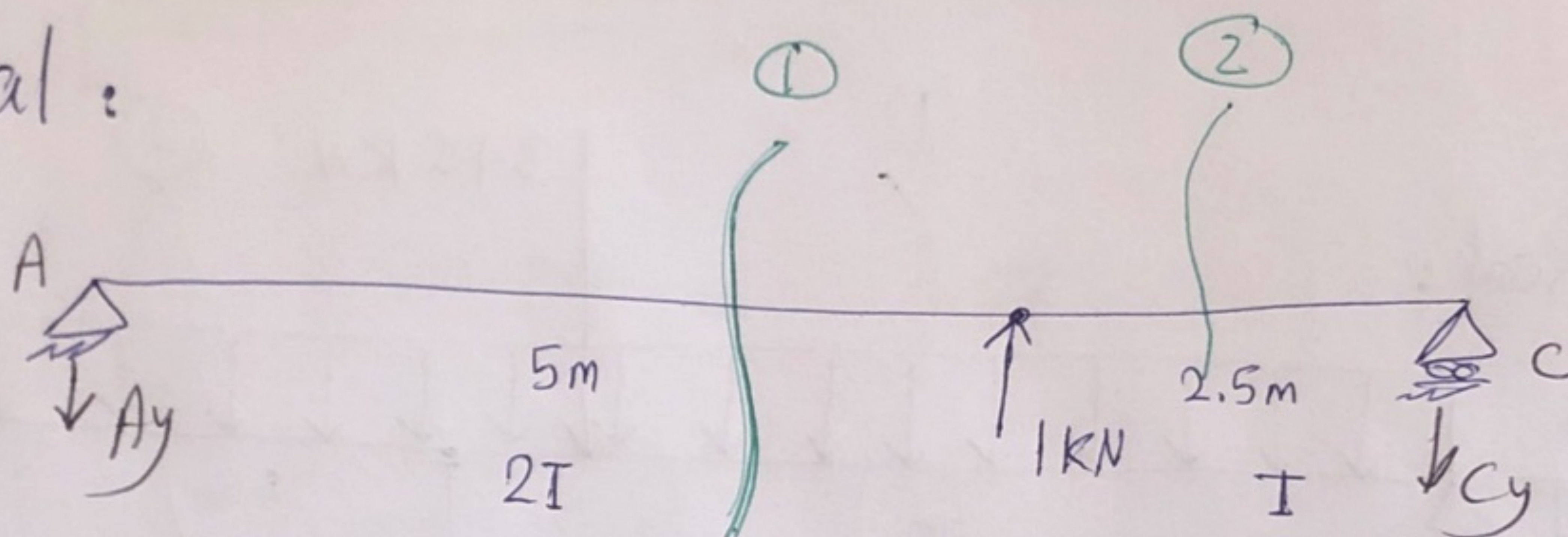
$$= 187.5 x_1 - 25 x_1^2$$

$$(0 < x_1 < 5)$$



$$M_2 = 187.5 x_2 - 25 x_2^2 \quad (0 < x_2 < 2.5)$$

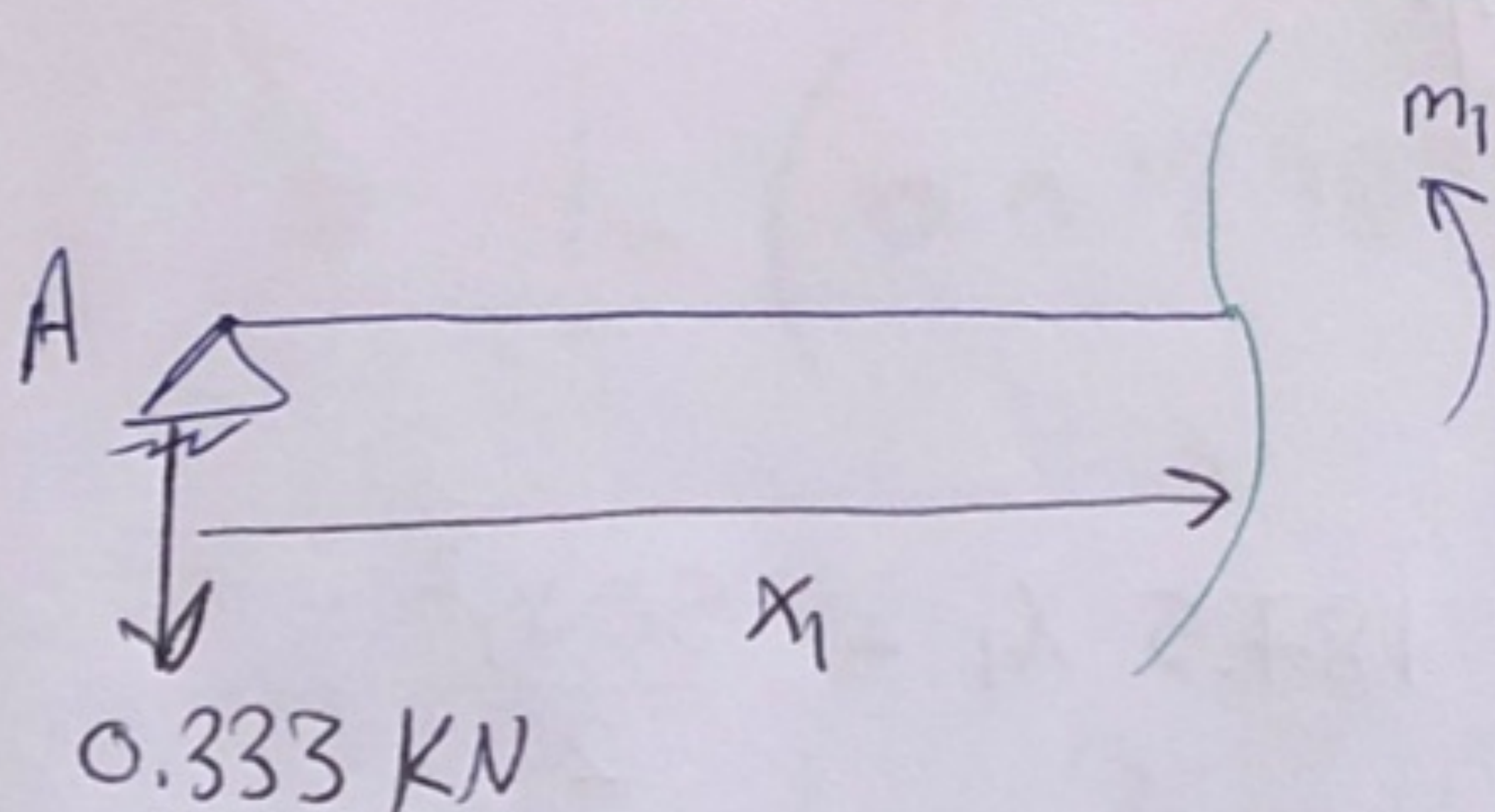
Virtual:



$$\sum M_A = 0 : 7.5 C_y = 5 \rightarrow C_y = 0.667 \text{ kN} \downarrow$$

$$\sum F_y = 0 : A_y = 0.333 \text{ kN} \downarrow$$

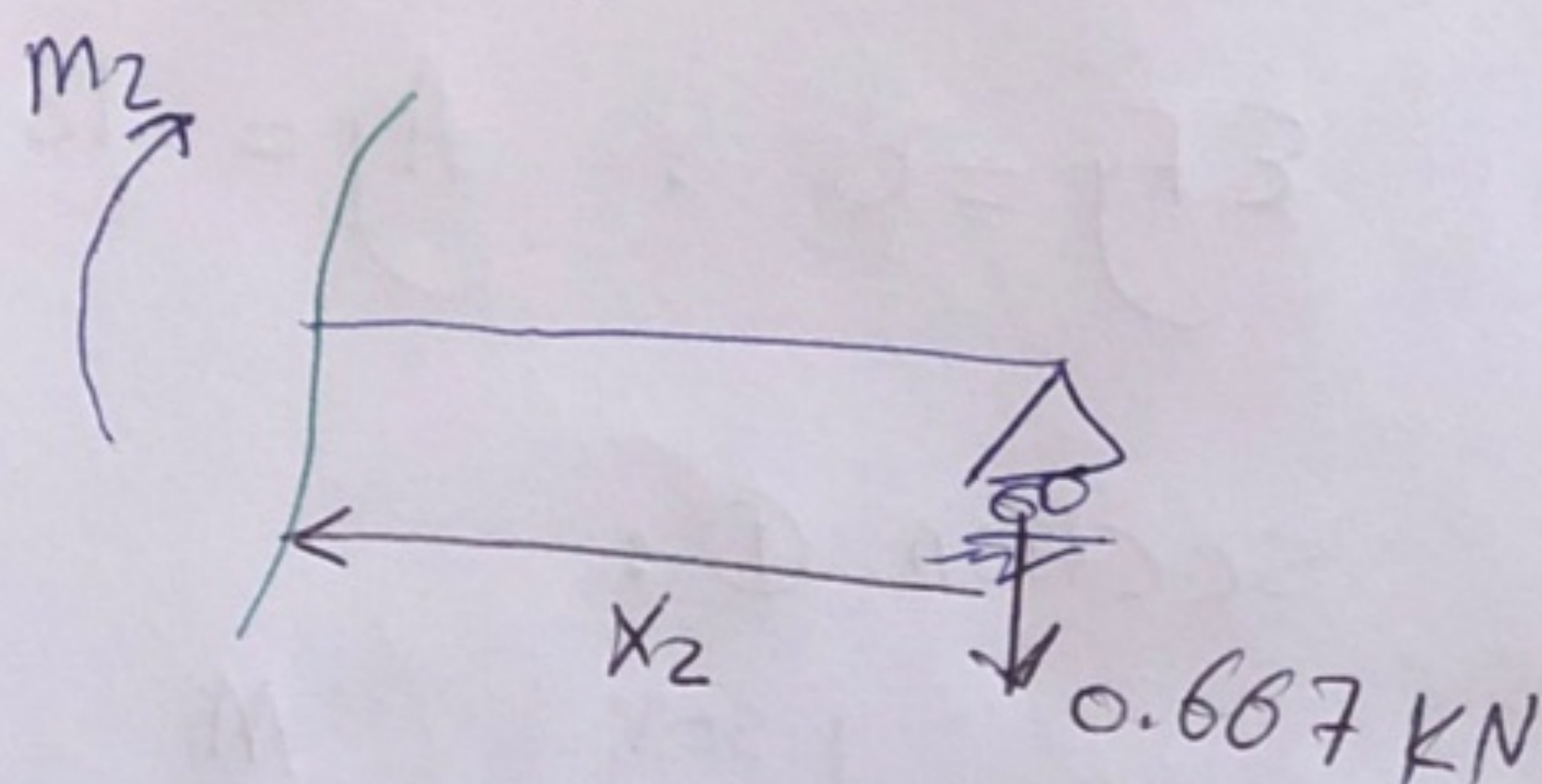
Section ①:



$$m_1 = -0.333 x_1$$

$$(0 < x_1 < 5)$$

Section ②:



$$m_2 = -0.667 x_2$$

$$(0 < x_2 < 2.5)$$

$$\Delta_B = \int_0^5 \frac{m_1 M_1}{2EI} dx + \int_0^{2.5} \frac{m_2 M_2}{EI} dx$$

$$= \int_0^5 \frac{(-0.333 x_1)(187.5 x_1 - 25 x_1^2)}{2EI} dx + \int_0^{2.5} \frac{(-0.667)(187.5 x_2 - 25 x_2^2)}{EI} dx$$

$$= \frac{1}{EI} \left[\frac{2.08125 x_1^4 - 20.8125 x_1^3}{2} \Big|_0^5 + 4.16875 x_2^4 - 41.6875 x_2^3 \Big|_0^{2.5} \right]$$

$$= \frac{1}{EI} (-650.39 + -488.525)$$

$$= -\frac{1138.915}{EI}$$

$$J_{BB} = \int_0^5 \frac{m_1^2}{2EI} dx + \int_0^{2.5} \frac{m_2^2}{EI} dx$$

$$= \frac{1}{EI} \left(0.0184815 x_1^3 \Big|_0^5 + 0.1483 x_2^3 \Big|_0^{2.5} \right)$$

$$= \frac{1}{EI} (2.31019 + 2.317)$$

$$= \frac{4.63}{EI}$$

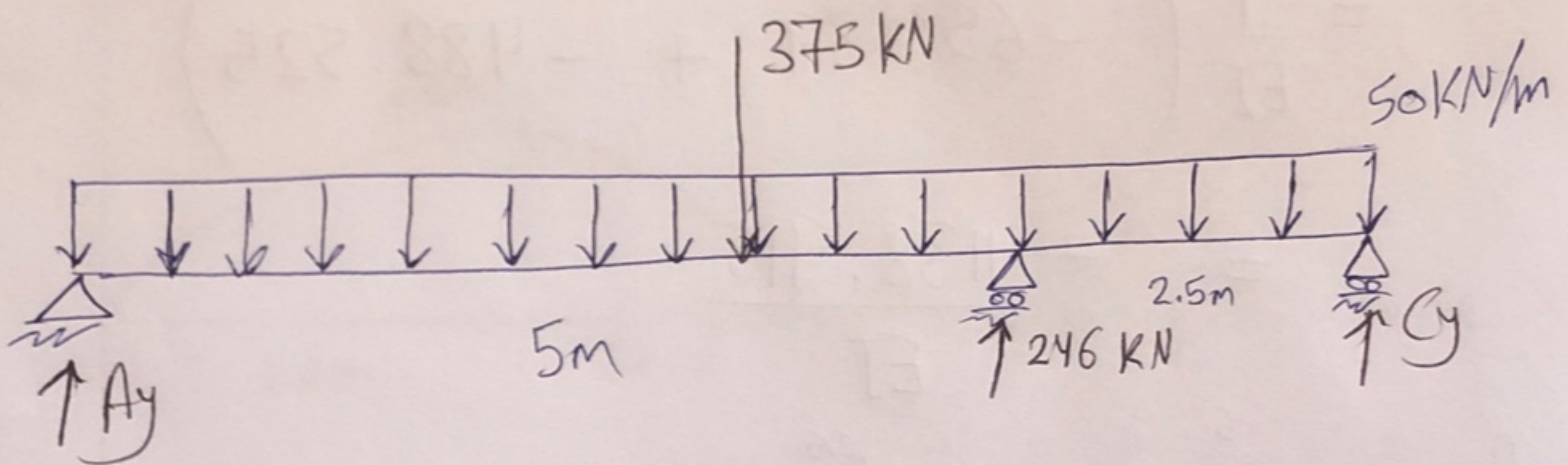
3

→ Compatibility Eq:

$$0 = \Delta_B + B_y f_{BB}$$

$$\frac{1138.915}{EI} = B_y \cdot \frac{4.63}{EI}$$

$$B_y = 246 \text{ KN } \uparrow$$



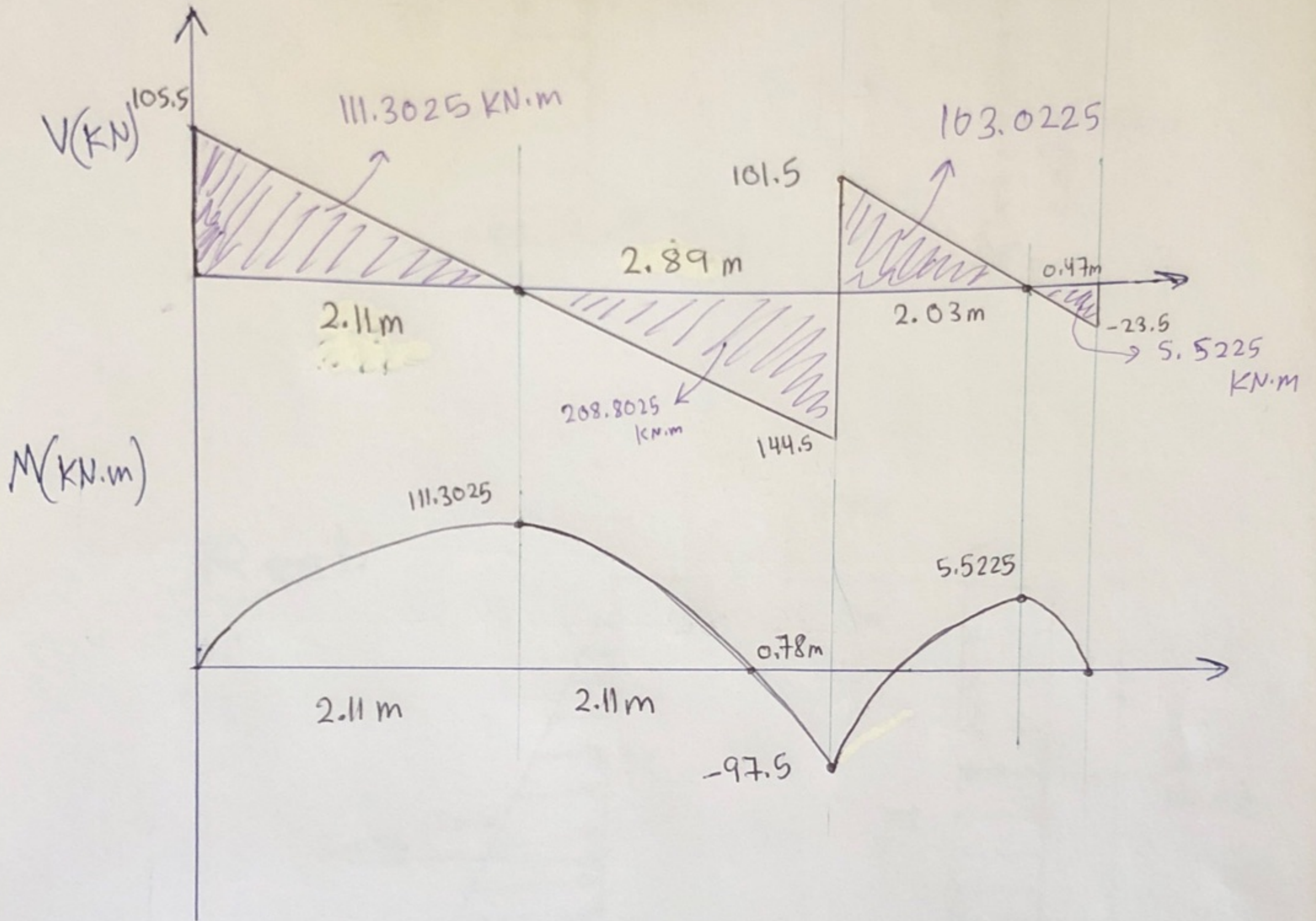
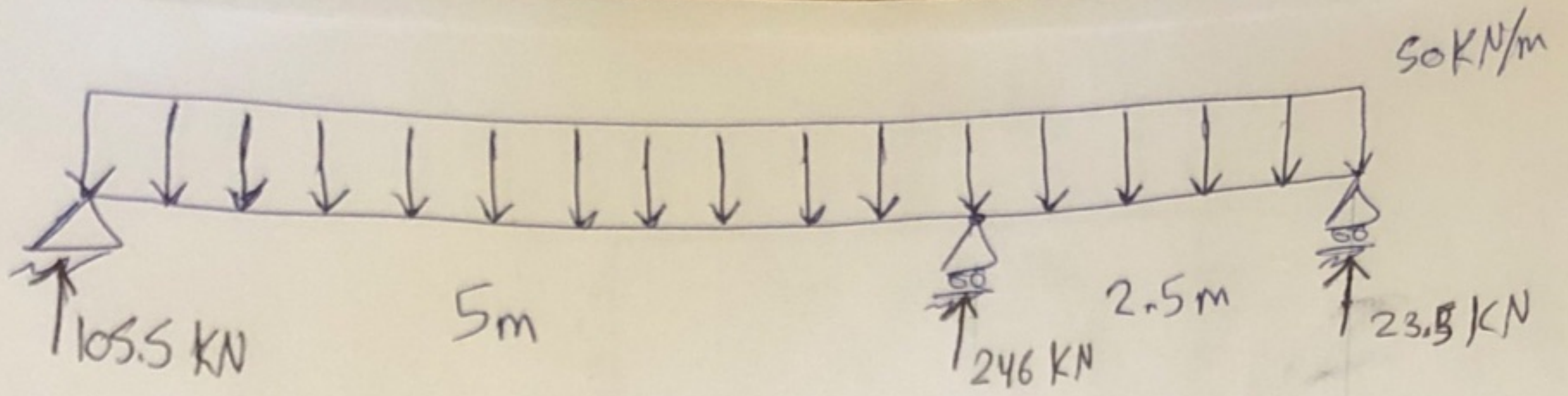
$$\sum M_c = 0: -(7.5)A_y + (1406.25) - (675) = 0$$

$$A_y = 105.5 \text{ KN } \uparrow$$

$$\sum F_y = 0: C_y = 375 - 105.5 - 246$$

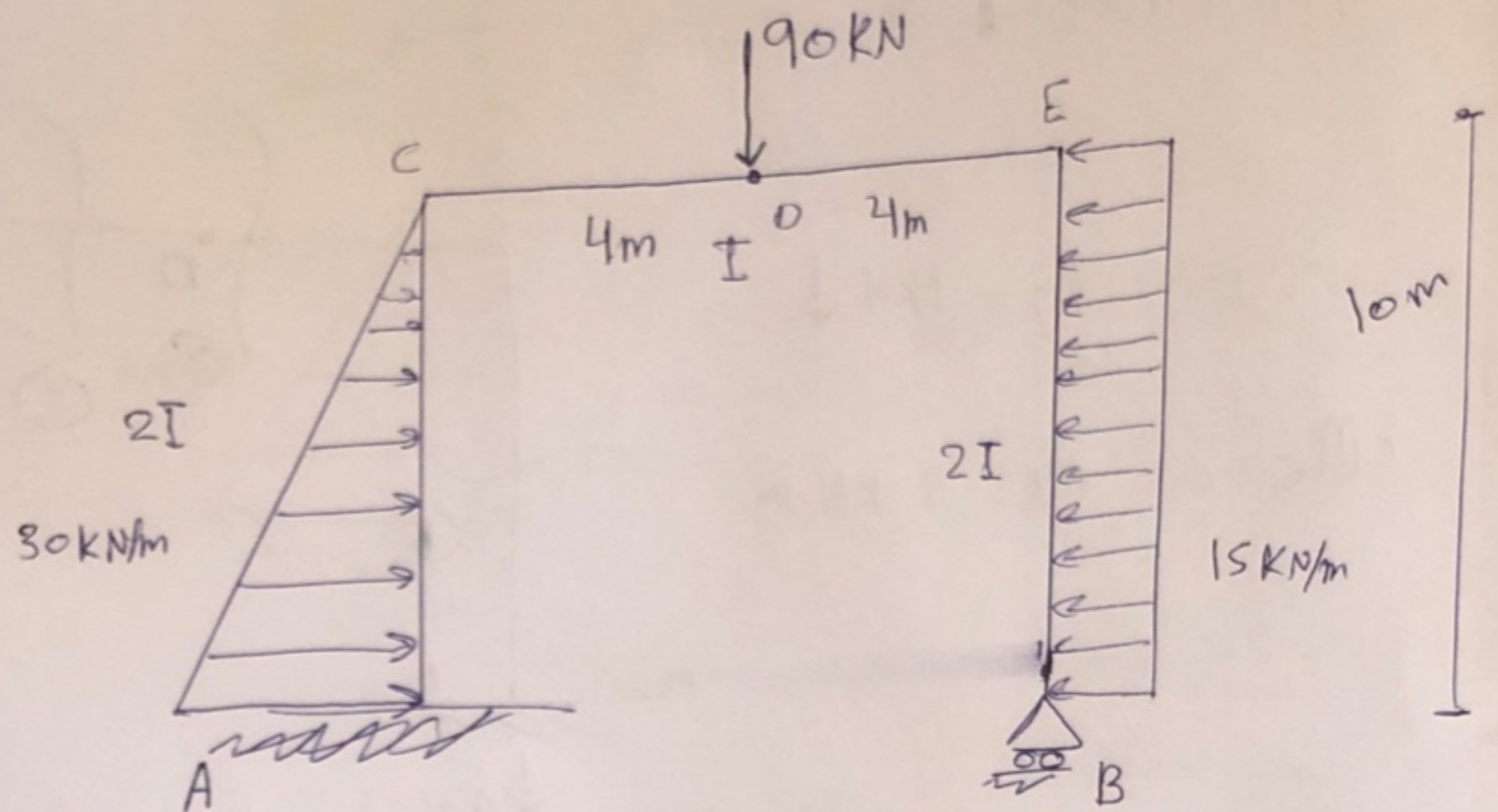
$$C_y = 23.5 \text{ KN } \uparrow$$

4

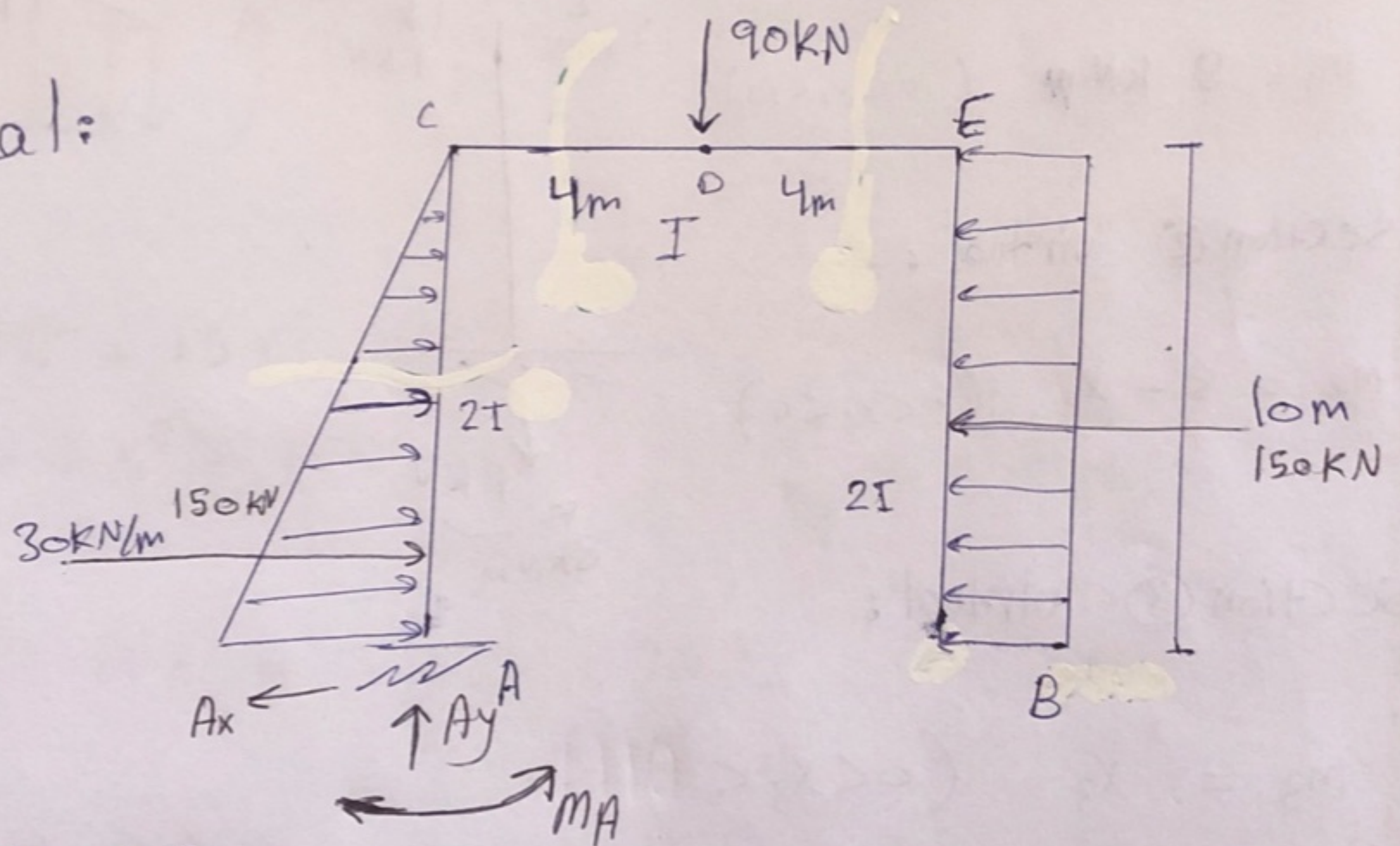


5

Q 2:-)



Real:



$$\sum F_x = 0: -A_x - 150 + 150 = 0$$

$$A_x = 0$$

$$\sum M_A = 0: +M_A - 150 \left(\frac{10}{3}\right) - 360 + 750$$

$$M_A = 110 \text{ kN}\cdot\text{m}$$

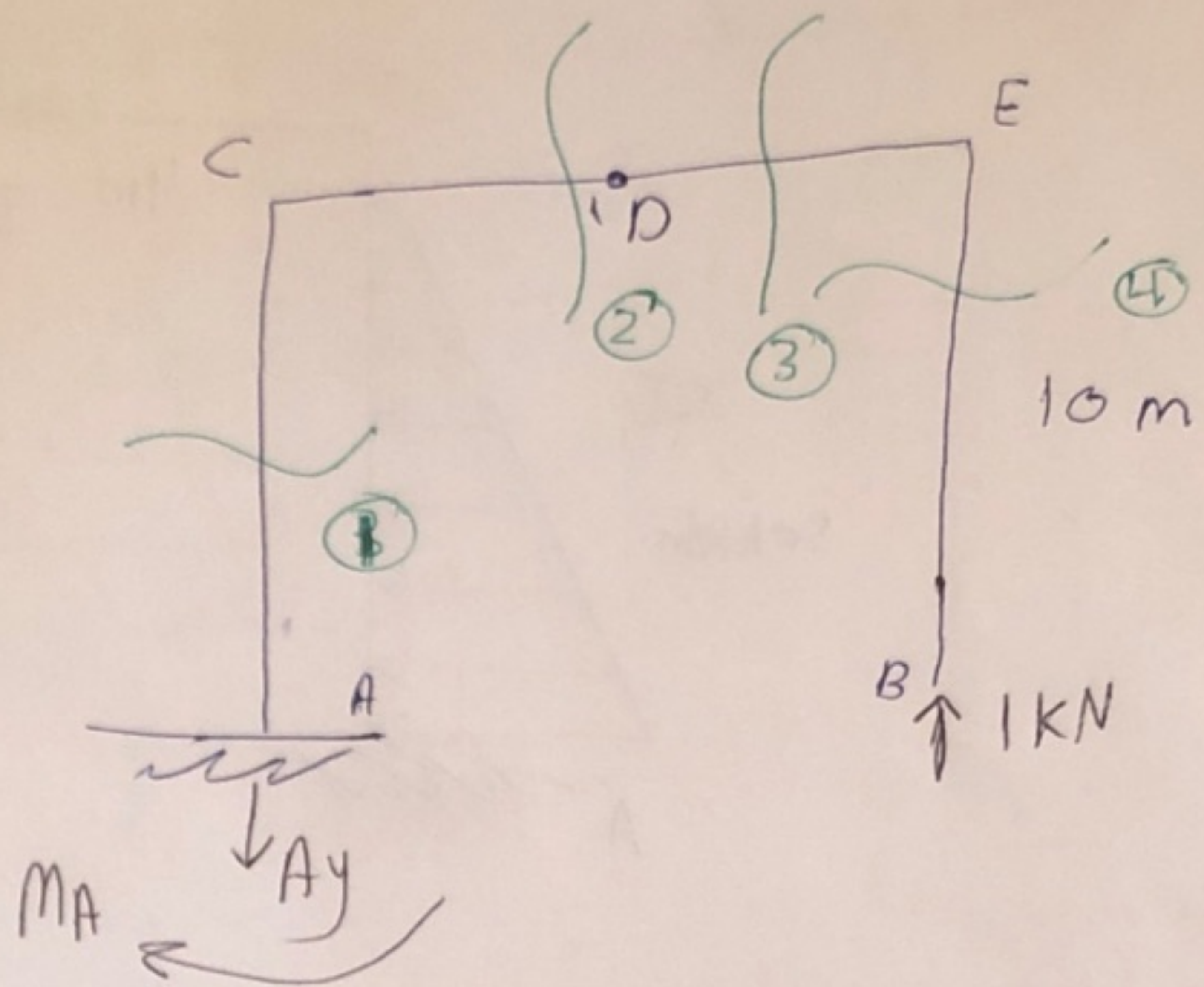
$$\sum F_y = 0: A_y = 90 \text{ kN} \uparrow$$

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Virtual :

$$\sum F_y = 0 : A_y = 1 \text{ KN } \downarrow$$

$$\sum M_C = 0 : M_A = 8 \text{ KN}\cdot\text{m}$$



section ① virtual :

$$m_1 = 8 \text{ KN}\cdot\text{m} \quad (0 < x_1 < 10)$$

section ② virtual :

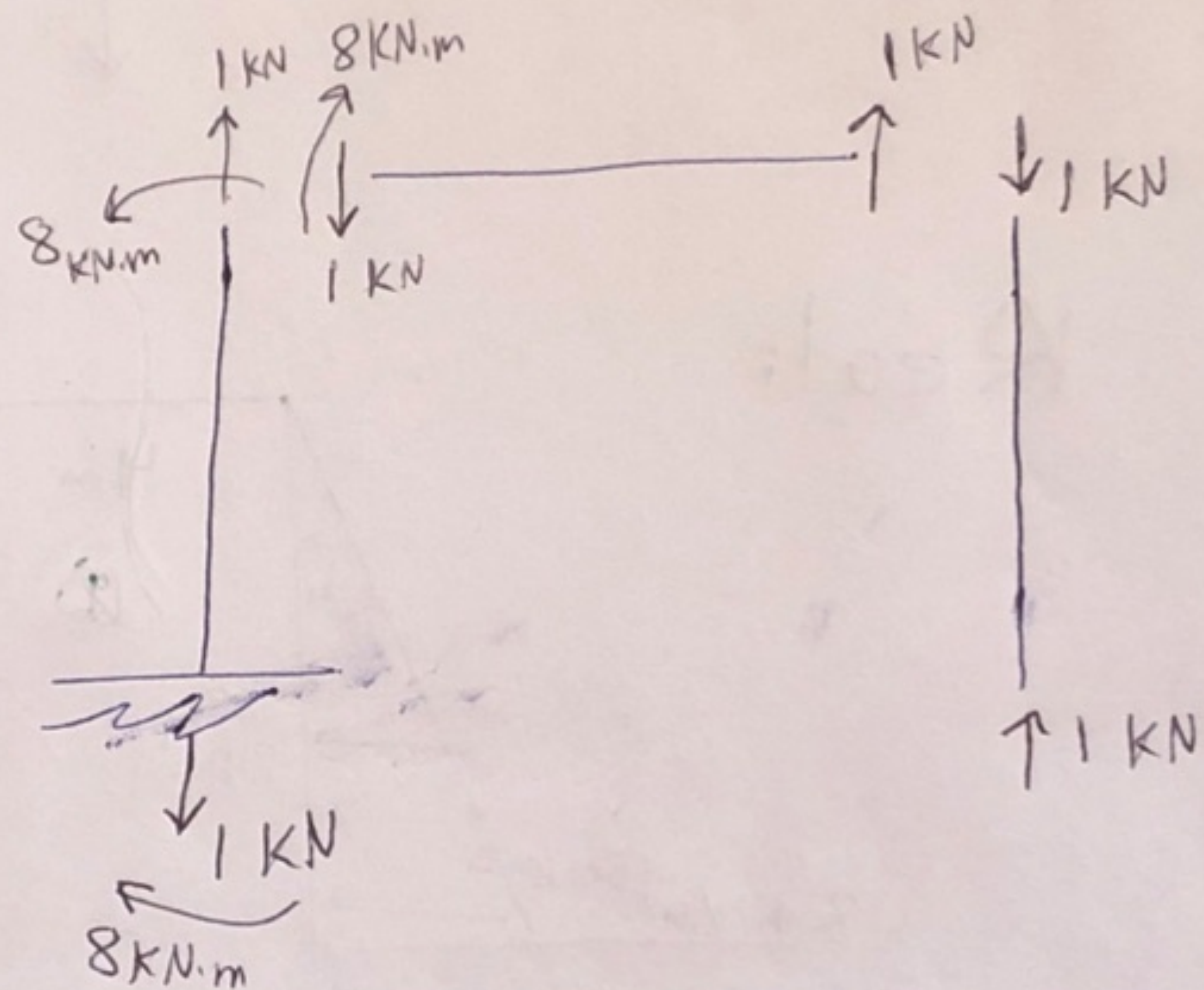
$$m_2 = 8 - x_2 \quad (0 < x_2 < 4)$$

section ③ virtual :

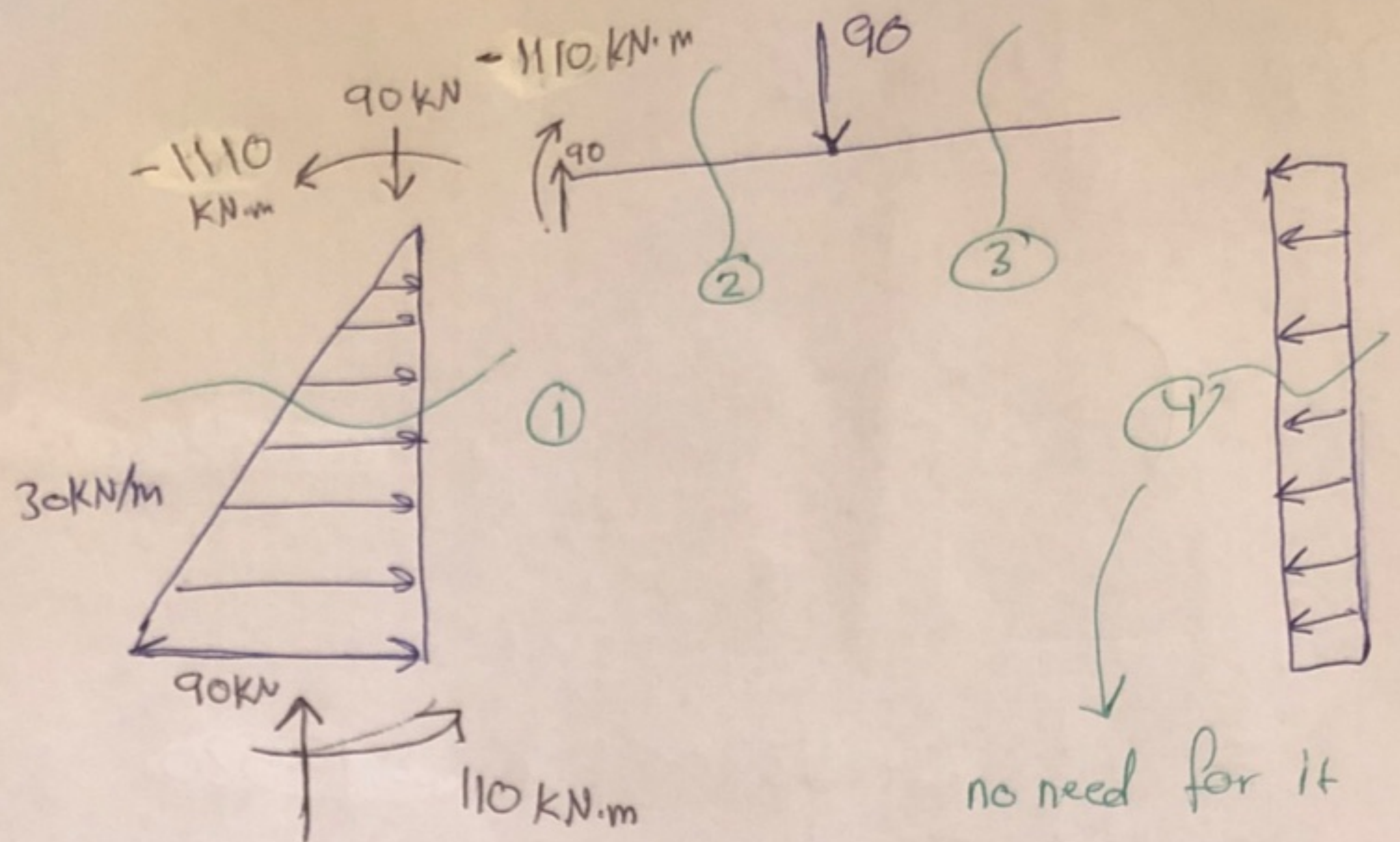
$$m_3 = x_3 \quad (0 < x_3 < 4)$$

section ④ :

$$m_4 = 0$$

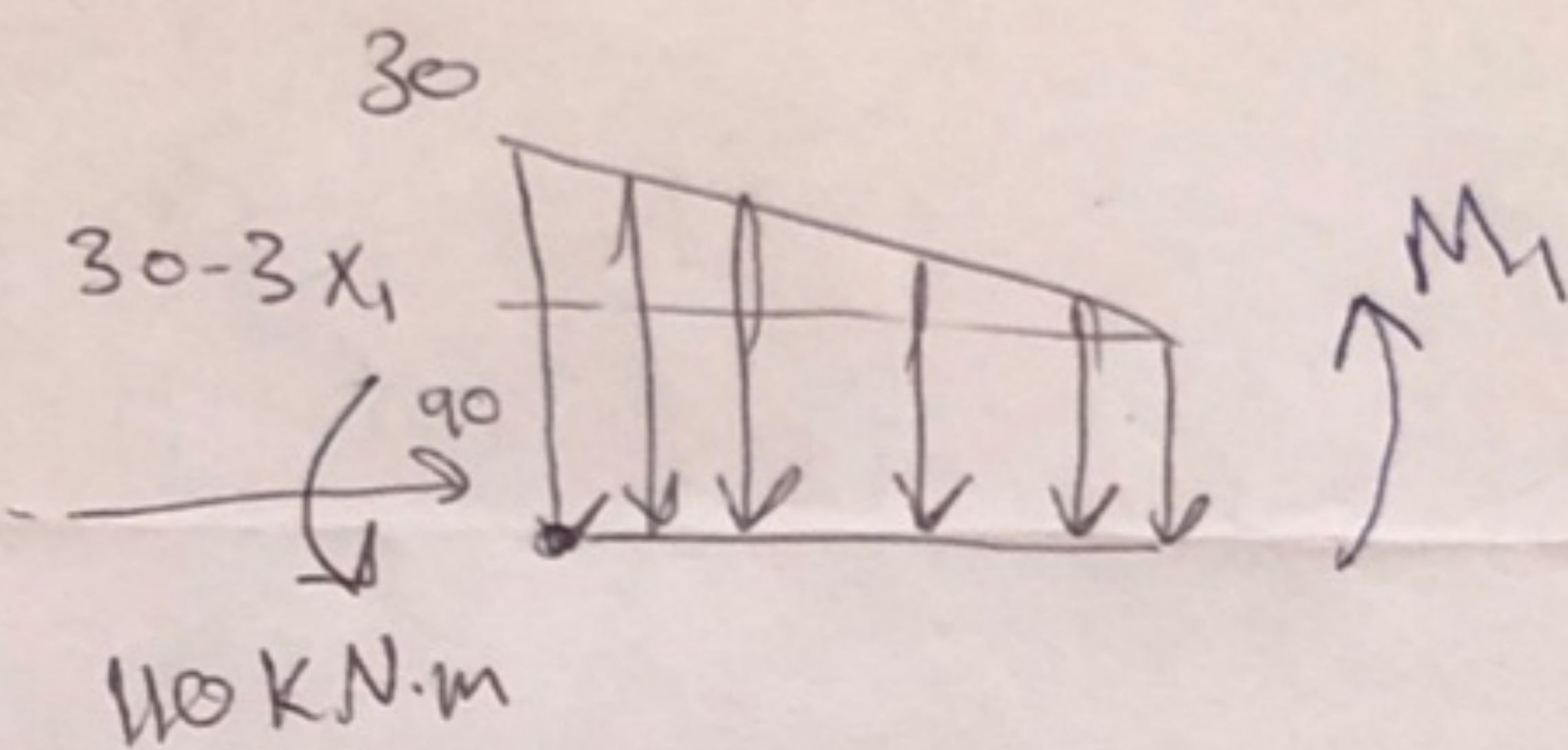


Real:



no need for it
because $m_y = 0$

Section ①:
Real



$$M_1 = -15x_1^2 + 1.5x_1^3 - 10x_1^3 - 110$$

$$M_1 = -8.5x_1^3 - 15x_1^2 - 110 \quad (0 < x_1 < 10)$$

$$\text{section ②: } M_2 = -1110 + 90x_2 \quad (0 < x_2 < 4)$$

$$\text{section ③: } M_3 = -1110 + 90x_3 + 360 - 90x_3$$

$$M_3 = -750 \text{ kNm} \quad (0 < x_3 < 4)$$

$$\Delta_B = \int_0^{10} \frac{M_1 m_1}{2EI} dx + \int_0^4 \frac{M_2 m_2}{EI} dx + \int_0^4 \frac{M_3 m_3}{EI} dx + \int_0^{10} \frac{M_4 m_4}{2EI} dx$$

$$= \left(\frac{-8.5x_1^4 - 20x_1^3 - 880x_1}{EI} \Big|_0^{10} + \frac{-30x_2^3 + 915x_2^2 - 8880x_2}{EI} \Big|_0^4 + \frac{-750}{EI} \Big|_0^4 \right)$$

$$= \frac{1}{EI} (-113800 + -22800 + -3000)$$

$$= \frac{-139600}{EI}$$

$$\int_{BB} = \int_0^{10} \frac{m_1^2}{2EI} dx + \int_0^4 \frac{m_2^2}{EI} dx + \int_0^4 \frac{m_3^2}{EI} dx + \int_0^{10} \frac{m_4^2}{2EI} dx$$

$$= \left(\frac{64x_1}{2EI} \Big|_0^{10} + \frac{64x_2 - 8x_2^2}{EI} + \frac{x_2^3}{3EI} \Big|_0^4 + \frac{x_3^3}{3EI} \Big|_0^4 \right)$$

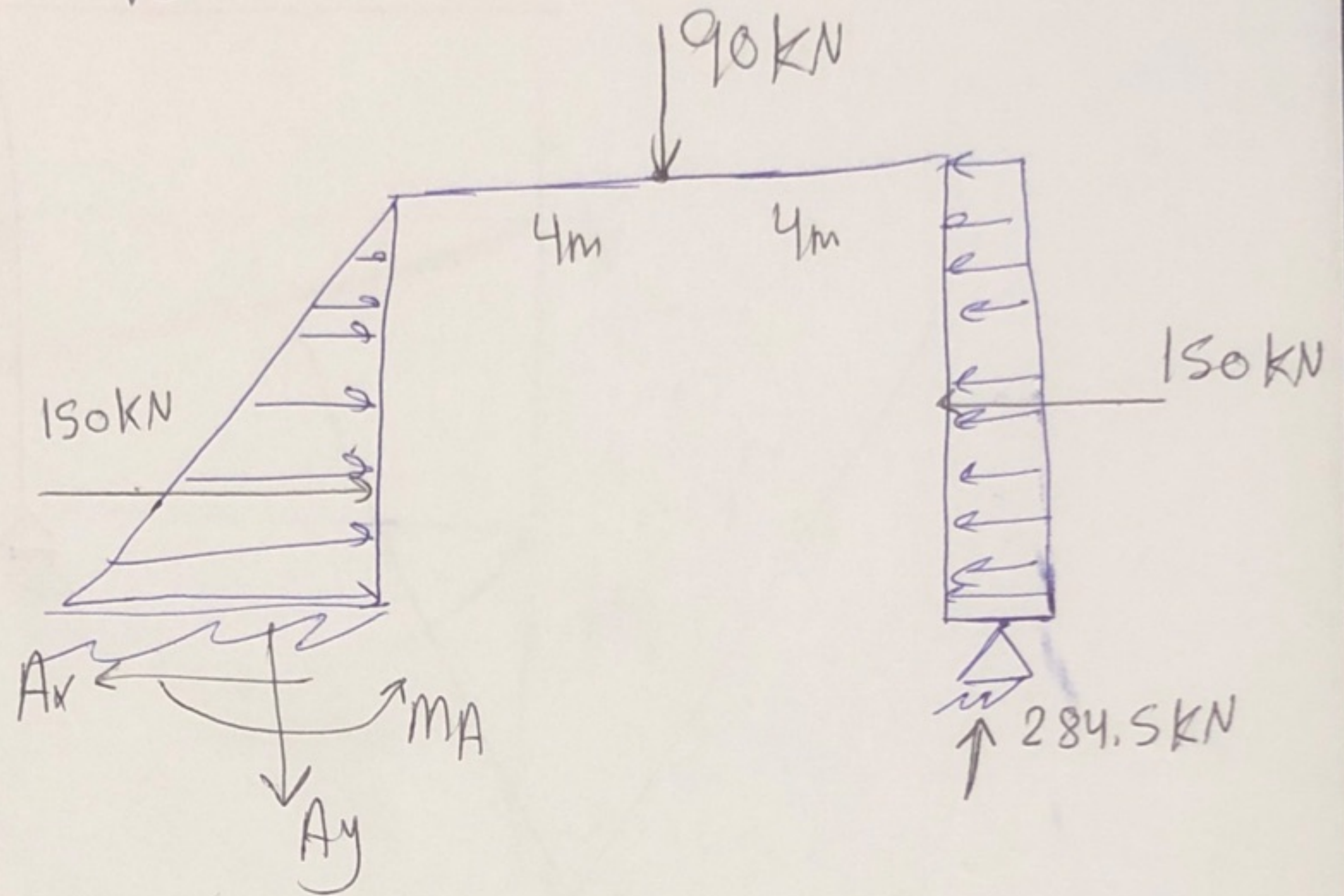
$$= \left(\frac{320}{EI} + \frac{-149.667}{EI} + \frac{21.33}{EI} \right)$$

$$= \frac{490.667}{EI}$$

$$0 = \Delta_B + B_y \int_{BB}$$

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$$B_y = \frac{-\Delta_B}{\delta_{BB}} = \frac{139600}{490.667} = 284.5 \text{ kN}$$



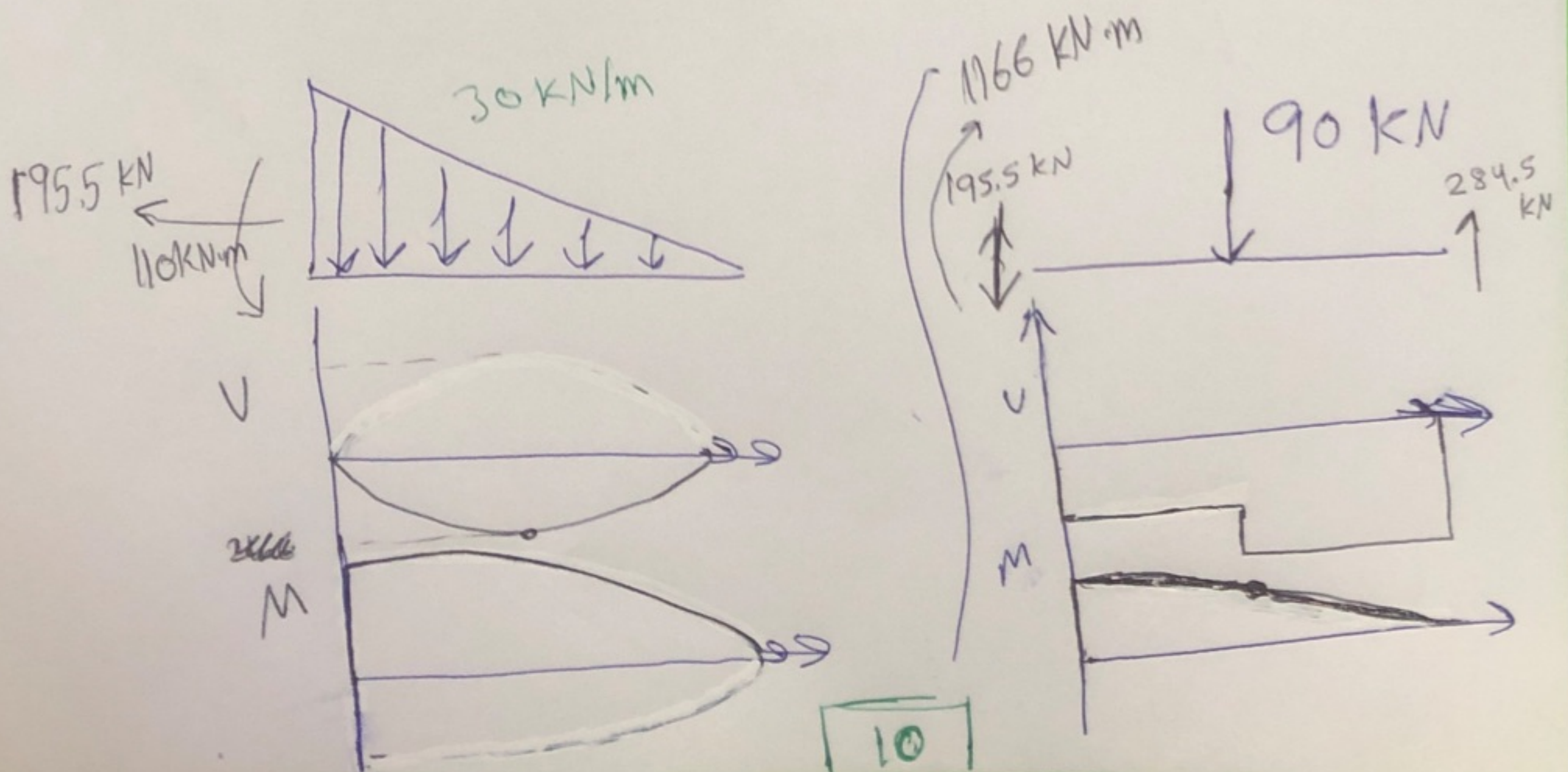
$$A_x = 0$$

$$\sum F_y = 0: -A_y - 90 + 284.5 = 0$$

$$A_y = 195.5 \text{ kN}$$

$$\sum M_A = 0: M_A = -(284.5)(8) - (150)(5) + 360 + (150)\left(\frac{10}{3}\right)$$

$$M_A = -2166 \text{ kN}\cdot\text{m}$$



*

