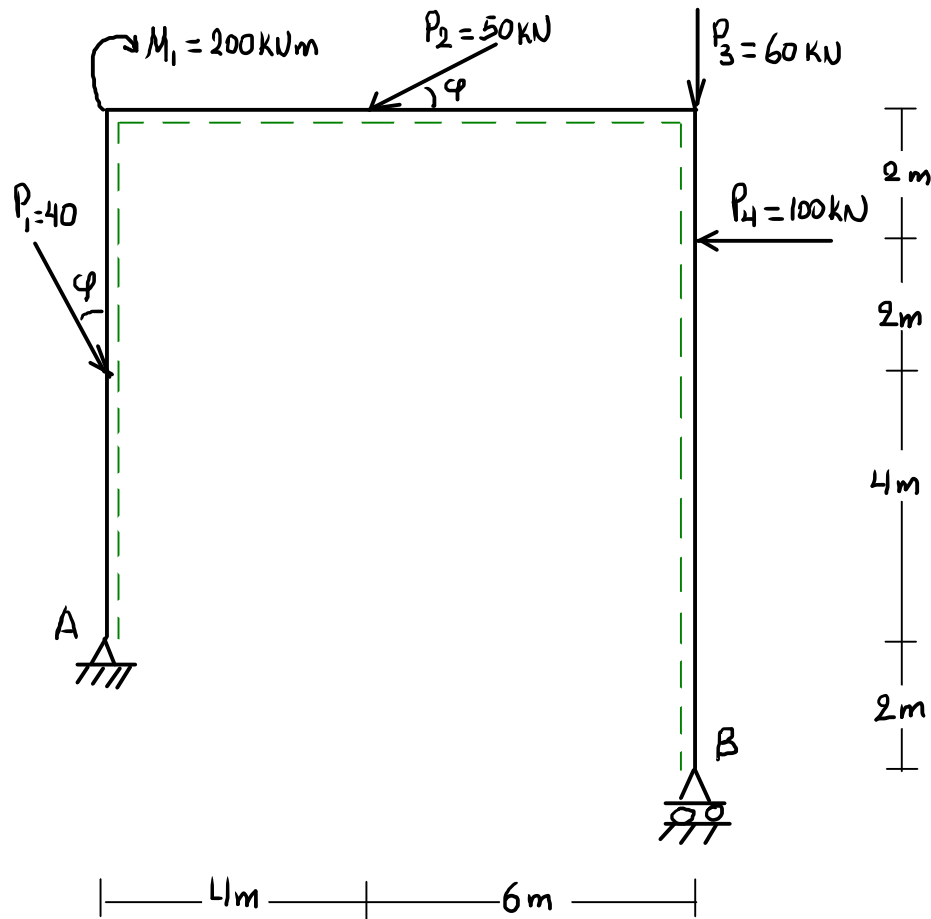


Υπολογίστε και σχεδιάστε διαγράμματα M, N, V σε πλαίσια



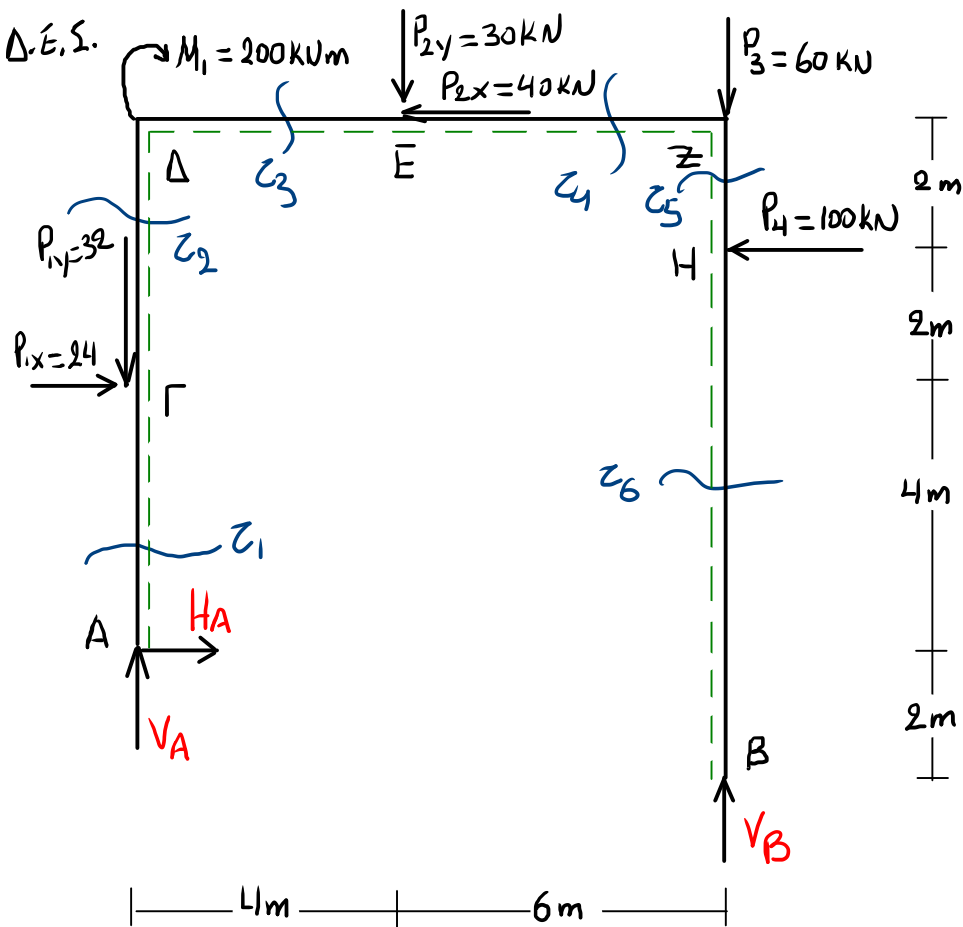
$$\cos \varphi = 0,8, \sin \varphi = 0,6$$

$$P_{1x} = P_1 \cdot \sin \varphi = 40 \cdot 0,6 = 24 \text{ kN}$$

$$P_{1y} = P_1 \cdot \cos \varphi = 40 \cdot 0,8 = 32 \text{ kN}$$

$$P_{2x} = P_2 \cdot \cos \varphi = 50 \cdot 0,8 = 40 \text{ kN}$$

$$P_{2y} = P_2 \cdot \sin \varphi = 50 \cdot 0,6 = 30 \text{ kN}$$



$$\begin{aligned}
 (+) \sum F_x = 0 &\Rightarrow H_A + P_{1x} - P_{2x} - P_4 = 0 \\
 &\Rightarrow H_A + 24 - 40 - 100 = 0 \\
 &\Rightarrow H_A = 116 \text{ kN} \quad (1)
 \end{aligned}$$

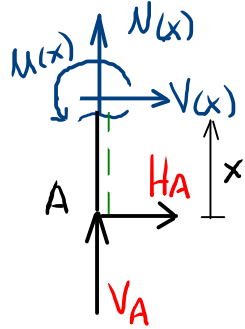
$$\begin{aligned}
 (+) \uparrow \sum F_y = 0 &\Rightarrow V_A - P_{1y} - P_{2y} - P_3 + V_B = 0 \\
 &\Rightarrow V_A - 32 - 30 - 60 + V_B = 0 \\
 &\Rightarrow V_A + V_B = 122 \quad (2)
 \end{aligned}$$

$$\begin{aligned}
 (+) \sum M_A = 0 &\Rightarrow -P_{1x} \cdot 4 - M_1 + P_{2x} \cdot 8 - P_{2y} \cdot 4 \\
 &\quad - P_3 \cdot 10 + P_4 \cdot 6 + V_B \cdot 10 = 0 \\
 &\Rightarrow -24 \cdot 4 - 200 + 40 \cdot 8 - 30 \cdot 4 - 60 \cdot 10 \\
 &\quad + 100 \cdot 6 + V_B \cdot 10 = 0 \\
 &\Rightarrow -96 - 200 + 320 - 120 - 600 + 600 + \\
 &\quad V_B \cdot 10 = 0 \Rightarrow V_B = 9,6 \text{ kN} \quad (3)
 \end{aligned}$$

$$(2) \stackrel{(3)}{\Rightarrow} V_A = 112,4 \text{ kN}$$

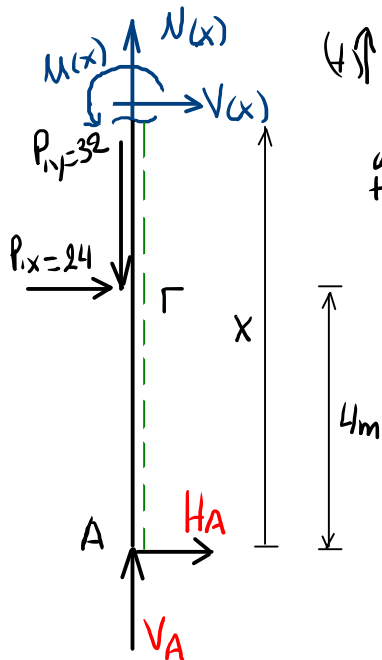
* Τομές ανάμεσα σε οριζόντια ασυνέχεια φορτίου
 ή οριζόντια ασυνέχεια γεωμετρίας (αλλαγές στη διεύθυνση του φορτίου)

$\tau_1: A\Gamma, 0 \leq x < 4$



$$\begin{aligned}
 (+) \uparrow \sum F_y = 0 &\Rightarrow V_A + N(x) = 0 \Rightarrow N(x) = -V_A \Rightarrow N(x) = -112,4 \text{ kN} \\
 (+) \rightarrow \sum F_x = 0 &\Rightarrow H_A + V(x) = 0 \Rightarrow V(x) = -H_A \Rightarrow V(x) = -116 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) + H_A \cdot x = 0 \Rightarrow M(x) = -116x \quad \left| \begin{array}{l} A: x=0, M(0)=0 \\ \Gamma: x=4, M(4)=-464 \text{ kNm} \end{array} \right.
 \end{aligned}$$

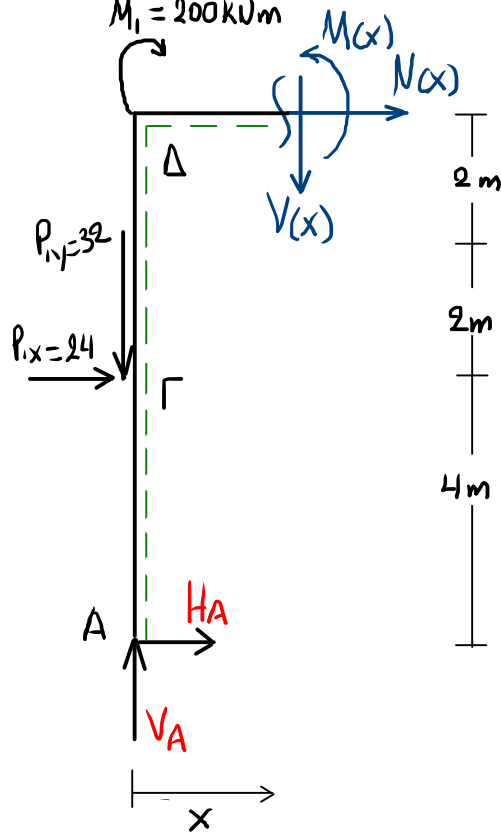
$\tau_2: \Gamma\Delta, 4 \leq x \leq 8$



$$\begin{aligned}
 (+) \rightarrow \sum F_x = 0 &\Rightarrow H_A + P_{1x} + V(x) = 0 \Rightarrow V(x) = -H_A - P_{1x} \Rightarrow V(x) = -140 \text{ kN} \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow V_A - P_{1y} + N(x) = 0 \Rightarrow N(x) = P_{1y} - V_A \Rightarrow N(x) = -80,4 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) + P_{1x} \cdot (x-4) + H_A \cdot x = 0 \\
 &\Rightarrow M(x) = -24(x-4) - 116x \\
 &\Rightarrow M(x) = -140x + 96 \quad \left| \begin{array}{l} \Gamma: x=4, M(4)=-464 \text{ kN}\cdot\text{m} \\ \Delta: x=8, M(8)=-1024 \text{ kN}\cdot\text{m} \end{array} \right.
 \end{aligned}$$

$z_3: \Delta E, 0 \leq x < 4$

$M_1 = 200 \text{ kNm}$

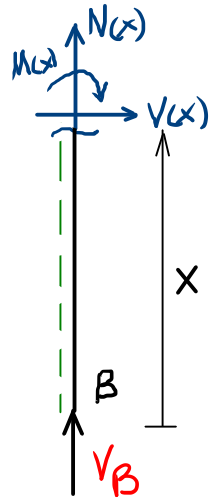


$$\begin{aligned} (+) \sum F_x = 0 &\Rightarrow H_A + P_{1x} + N(x) = 0 \Rightarrow N(x) = -H_A - P_{1x} \\ &\Rightarrow N(x) = -140 \text{ kN} \end{aligned}$$

$$\begin{aligned} (+) \uparrow \sum F_y = 0 &\Rightarrow V_A - P_{1y} - V(x) = 0 \Rightarrow V(x) = V_A - P_{1y} \\ &\Rightarrow V(x) = 80,4 \text{ kN} \end{aligned}$$

$$\begin{aligned} \curvearrowright \sum M_x = 0 &\Rightarrow M(x) - M_1 + P_{1x} \cdot 4 + P_{1y} \cdot x + H_A \cdot 8 - V_A \cdot x = 0 \\ &\Rightarrow M(x) = 80,4x - 824 \quad \left\{ \begin{array}{l} \Delta: x=0, M(0) = -824 \text{ kNm} \\ \bar{E}: x=4, M(4) = -502,4 \text{ kNm} \end{array} \right. \end{aligned}$$

$\tau_6: BH, 0 \leq x < 8$

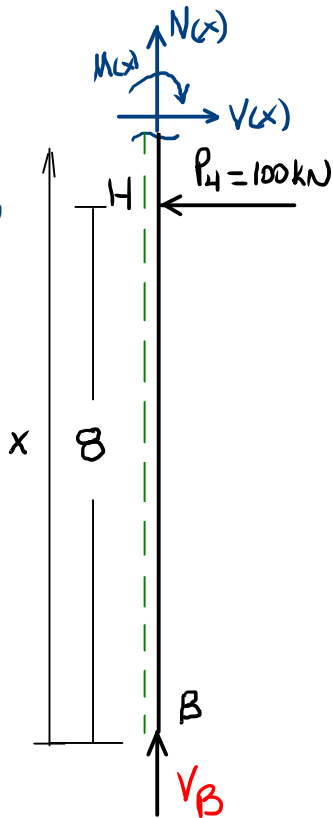


$$\overset{(+)}{\rightarrow} \Sigma F_x = 0 \Rightarrow V(x) = 0$$

$$\overset{(+)}{\uparrow} \Sigma F_y = 0 \Rightarrow V_B + N(x) = 0 \Rightarrow N(x) = -V_B \Rightarrow N(x) = -9,6 \text{ kN}$$

$$\overset{+}{\curvearrowright} \Sigma M_x = 0 \Rightarrow -M(x) = 0 \Rightarrow M(x) = 0$$

$\tau_5: HZ, 8 \leq x < 10$



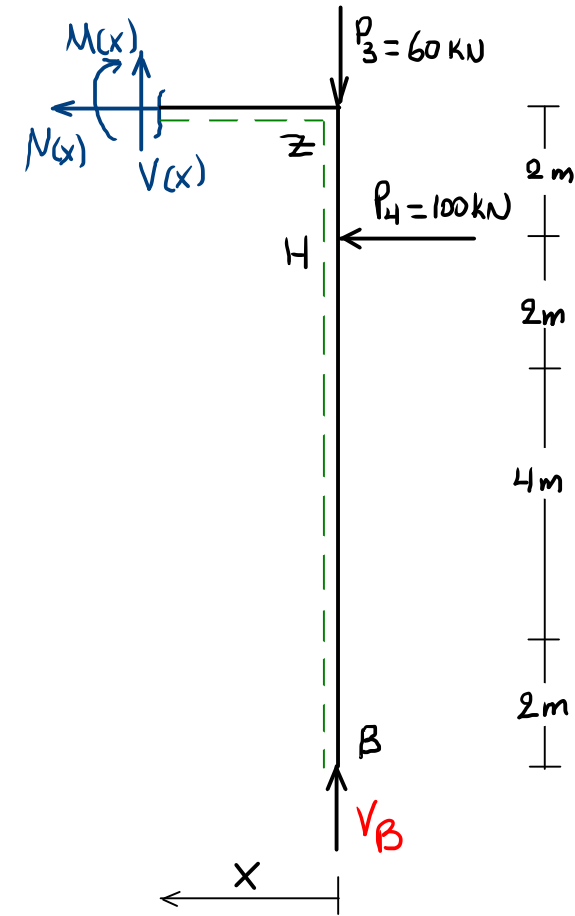
$$\overset{(+)}{\rightarrow} \Sigma F_x = 0 \Rightarrow -P_H + V(x) = 0 \Rightarrow V(x) = P_H \Rightarrow V(x) = 100 \text{ kN}$$

$$\overset{(+)}{\uparrow} \Sigma F_y = 0 \Rightarrow V_B + N(x) = 0 \Rightarrow N(x) = -V_B \Rightarrow N(x) = -9,6 \text{ kN}$$

$$\overset{+}{\curvearrowright} \Sigma M_x = 0 \Rightarrow -M(x) - P_H \cdot (x - 8) = 0$$

$$\Rightarrow M(x) = -100x + 800 \quad \left| \begin{array}{l} H: x=8, M(8)=0 \\ Z: x=10, M(10)=-200 \end{array} \right.$$

$Z_4: ZE, 0 \leq x < 6$

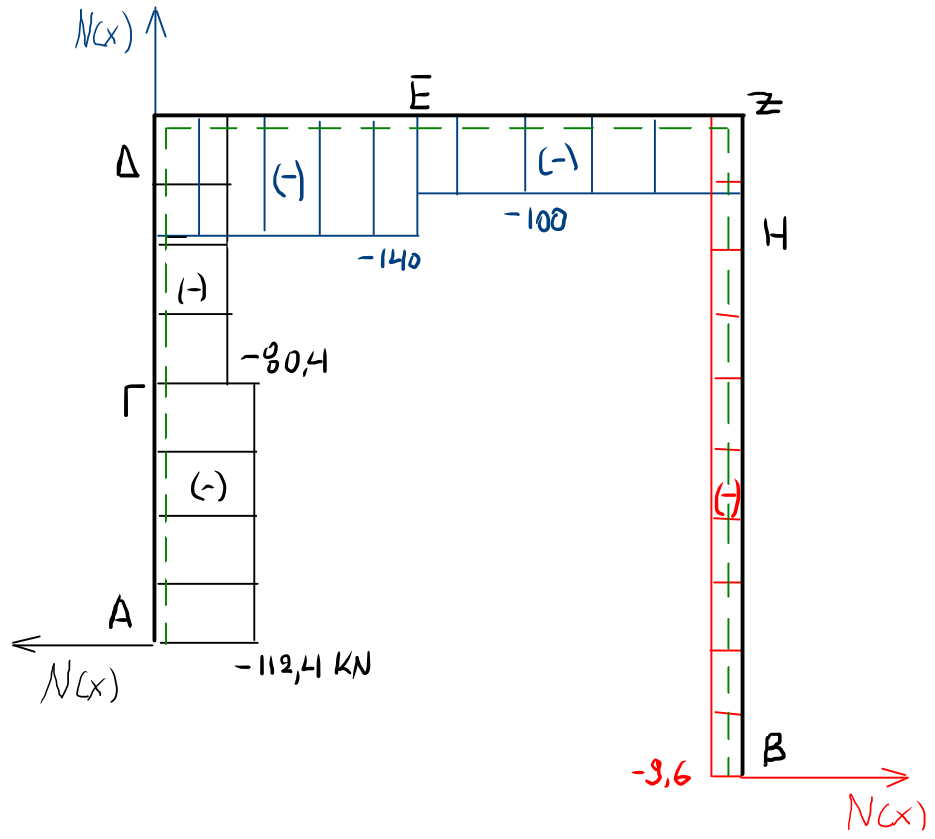


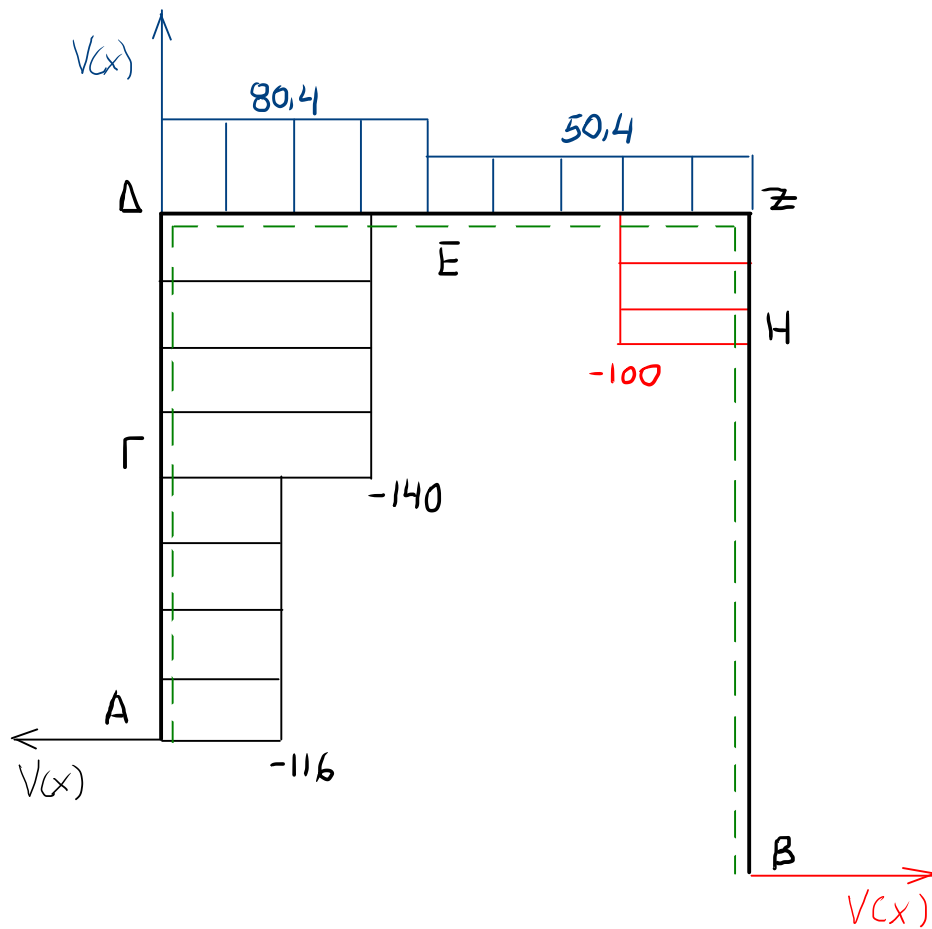
$$\begin{aligned} (+) \sum F_x = 0 &\Rightarrow -p_4 - N(x) = 0 \Rightarrow N(x) = -p_4 \\ &\Rightarrow N(x) = -100 \text{ kN} \end{aligned}$$

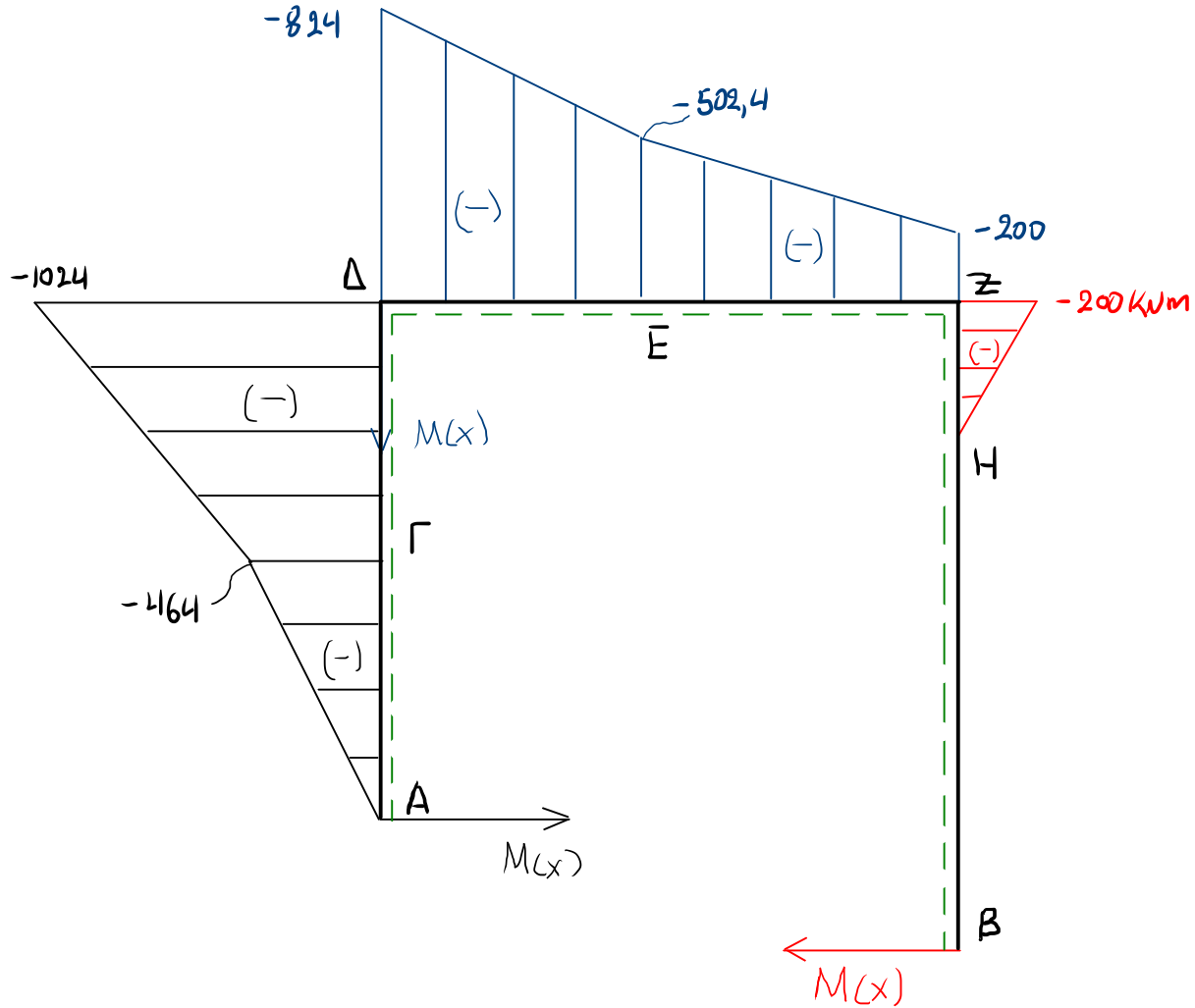
$$\begin{aligned} (+) \sum F_y = 0 &\Rightarrow V_B - p_3 + V(x) = 0 \\ &\Rightarrow V(x) = p_3 - V_B \Rightarrow V(x) = 50,4 \text{ kN} \end{aligned}$$

$$\begin{aligned} (+) \sum M_x = 0 &\Rightarrow -M(x) - p_3 \cdot x - p_4 \cdot 2 + V_B \cdot x = 0 \\ &\Rightarrow M(x) = -50,4x - 200 \end{aligned} \quad \left\{ \begin{array}{l} Z: x=0, M(0) = -200 \\ E: x=6, M(6) = -502,4 \text{ kNm} \end{array} \right.$$

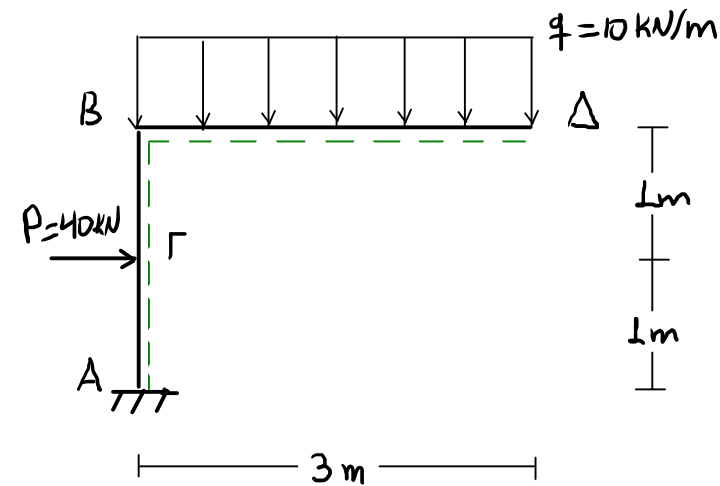
ΣΧΕΔΙΑΣΗ διαγραμμάτων $N(x)$, $V(x)$, $M(x)$



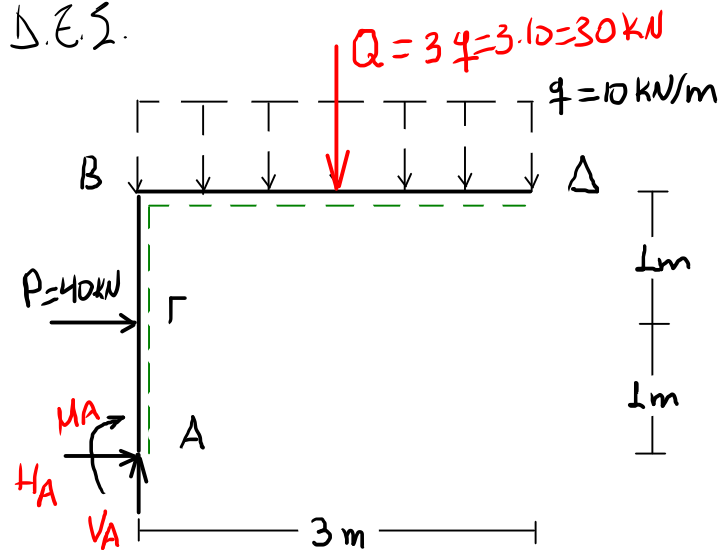




1ο Παράδειγμα: (6Ελ. 500 Βαθμύνης)



Δ.Ε.Σ.

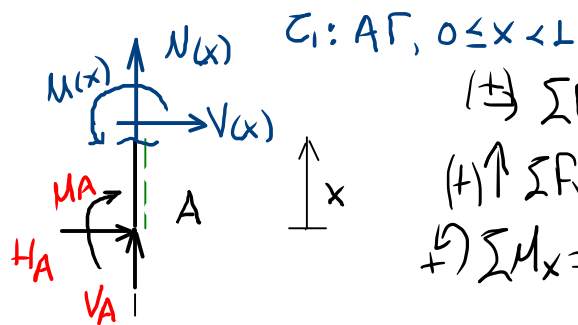
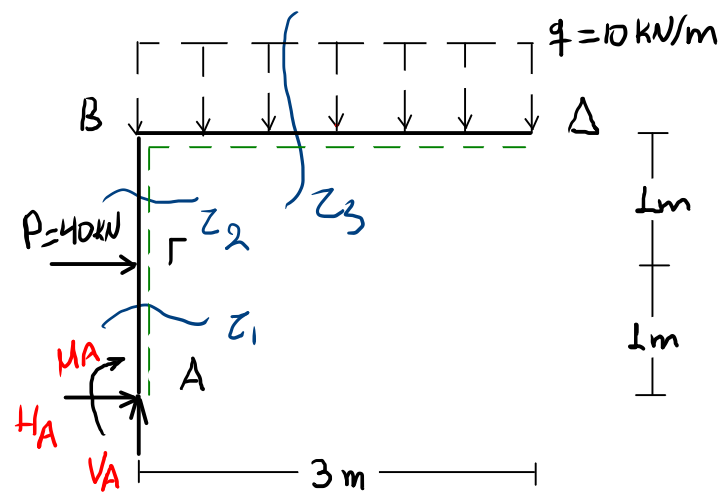


$$(+)\rightarrow \sum F_x = 0 \Rightarrow H_A + P = 0 \Rightarrow H_A = -40 \text{ kN}$$

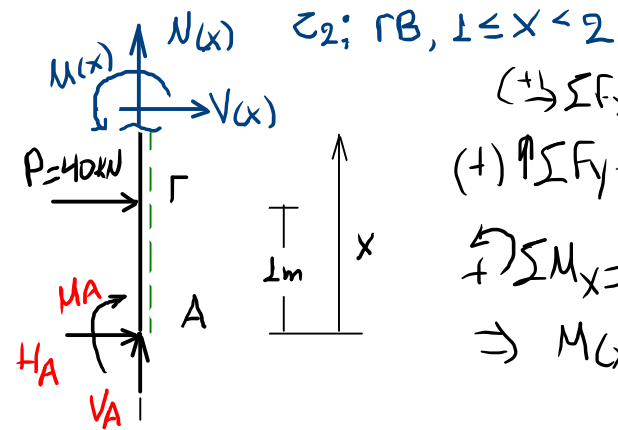
$$(+)\uparrow \sum F_y = 0 \Rightarrow V_A - Q = 0 \Rightarrow V_A = 30 \text{ kN}$$

$$\curvearrowright \sum M_A = 0 \Rightarrow -M_A - P \cdot 1 - Q \cdot \frac{3}{2} = 0$$

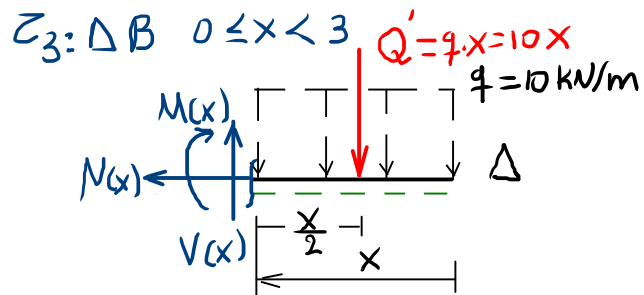
$$\Rightarrow M_A = -85 \text{ kN}\cdot\text{m}$$



$$\begin{aligned}
 (+) \sum F_x = 0 &\Rightarrow H_A + V(x) = 0 \Rightarrow V(x) = -H_A \Rightarrow V(x) = 40 \text{ kN} \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow V_A + N(x) = 0 \Rightarrow N(x) = -V_A \Rightarrow N(x) = -30 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) - M_A + H_A \cdot x = 0 \\
 &\Rightarrow M(x) = 40x - 85 \quad \left| \begin{array}{l} A: x=0, M(0) = -85 \text{ kNm} \\ \Gamma: x=1, M(1) = -45 \text{ kNm} \end{array} \right.
 \end{aligned}$$



$$\begin{aligned}
 (+) \sum F_x = 0 &\Rightarrow H_A + P + V(x) = 0 \Rightarrow V(x) = -H_A - P = -(-40) - 40 = 0 \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow V_A + N(x) = 0 \Rightarrow N(x) = -V_A = -30 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) + P(x-1) + H_A \cdot x - M_A = 0 \Rightarrow M(x) = +P + M_A \\
 &\Rightarrow M(x) = -45 \text{ kNm}
 \end{aligned}$$



$$\begin{aligned}
 (+) \rightarrow \sum F_x = 0 &\Rightarrow -N(x) = 0 \Rightarrow N(x) = 0 \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow V(x) - Q' = 0 \Rightarrow V(x) = 10x \\
 &\quad \left| \Delta, x=0, V(0) = 0 \right. \\
 &\quad \left| B: x=3, V(3) = 30 \text{ kN} \right.
 \end{aligned}$$

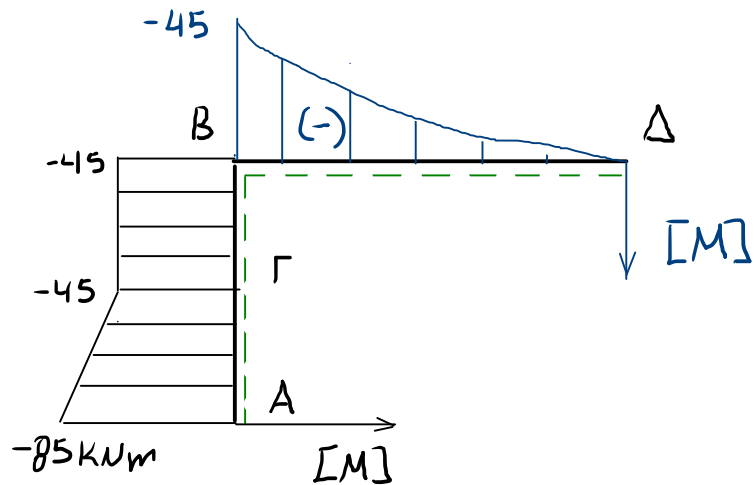
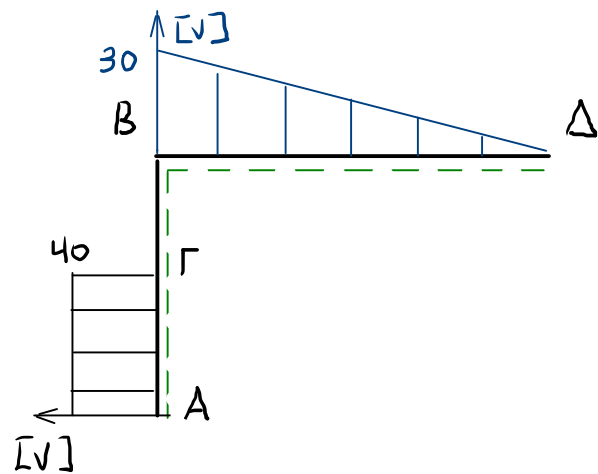
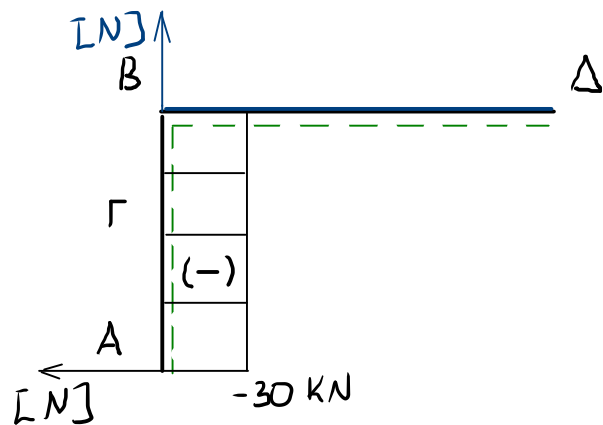
$$\begin{aligned}
 (+) \sum M_x = 0 &\Rightarrow -M(x) - Q' \frac{x}{2} = 0 \\
 \Rightarrow M(x) &= -10x \frac{x}{2} \Rightarrow M(x) = -5x^2
 \end{aligned}$$

$$\begin{aligned}
 &\left| \Delta: x=0, M(0) = 0 \right. \\
 &\left| B: x=3, M(3) = -45 \text{ kNm} \right.
 \end{aligned}$$

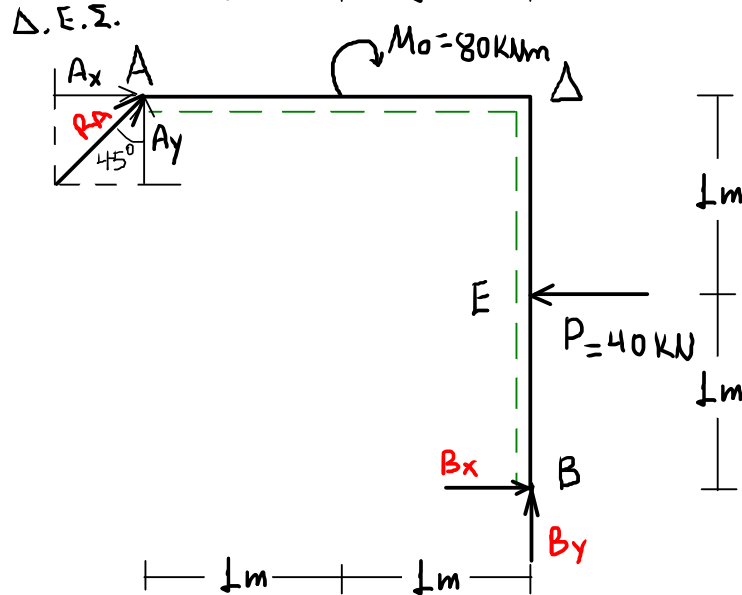
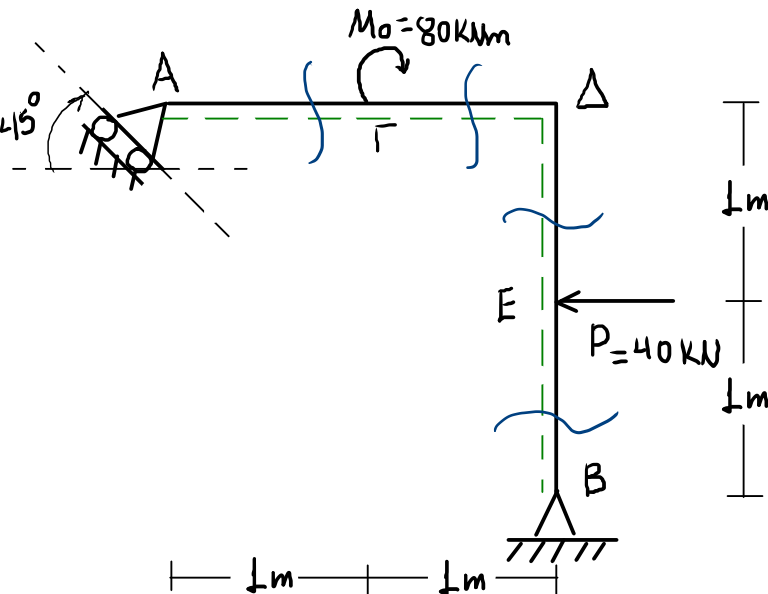
$$\frac{dM(x)}{dx} = 0 \Rightarrow -10x = 0 \Rightarrow x = 0 \quad \text{ακρότατο στο άνω ή στο Δ}$$

$$\frac{d^2M(x)}{dx^2} = -10 < 0 \quad \text{βρέχει στα κοίλα κάτω} \\
 \text{άρα μέγιστο στο αριστερό Δ.}$$

Σχεδίαση διαγραμμάτων N, V, M



2ο Παράδειγμα (ΓΕΛ 502 Βαθδύνης)



* κεικλιμένη κύλιση στο σημείο Α κατά 45°

$$A_x = R_A \eta \mu 45^\circ = \frac{\sqrt{2}}{2} R_A$$

$$A_y = R_A \sigma \nu \mu 45^\circ = \frac{\sqrt{2}}{2} R_A$$

$$\begin{aligned} (+) \rightarrow \sum F_x = 0 &\Rightarrow A_x - P + B_x = 0 \Rightarrow \frac{\sqrt{2}}{2} R_A - 40 + B_x = 0 \quad (1) \end{aligned}$$

$$\begin{aligned} (+) \uparrow \sum F_y = 0 &\Rightarrow A_y + B_y = 0 \Rightarrow \frac{\sqrt{2}}{2} R_A + B_y = 0 \quad (2) \end{aligned}$$

$$\begin{aligned} \curvearrowright \sum M_A = 0 &\Rightarrow -M_o - P \cdot 1 + B_x \cdot 2 + B_y \cdot 2 = 0 \\ &\Rightarrow -80 - 40 + 2B_x + 2B_y = 0 \\ &\Rightarrow B_x + B_y = 60 \quad (3) \end{aligned}$$

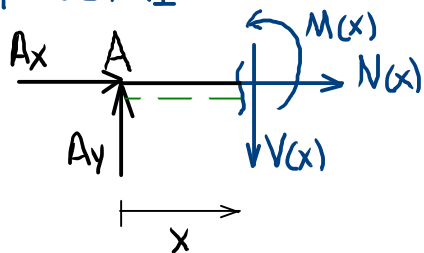
$$(1) - (2): \Rightarrow -40 + B_x - B_y = 0 \Rightarrow B_x - B_y = 40 \quad (4)$$

$$(3) + (4): \Rightarrow 2B_x = 100 \Rightarrow B_x = 50, (3) \Rightarrow B_y = 10$$

$$(2) \Rightarrow R_A = \frac{2}{\sqrt{2}} (-10) = -10 \frac{2}{\sqrt{2}} \text{ kN}$$

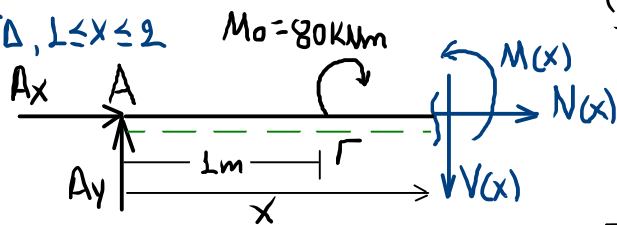
$$\Rightarrow A_x = A_y = -10 \text{ kN}$$

$Z_1: A\Gamma \quad 0 \leq x < 1$

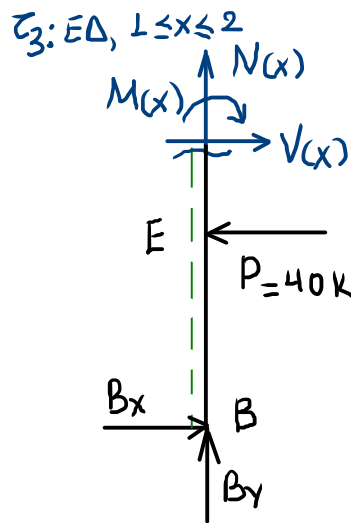


$$\begin{aligned}
 (+) \rightarrow \sum F_x = 0 &\Rightarrow A_x + N(x) = 0 \Rightarrow N(x) = -10 \text{ kN} \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow A_y - V(x) = 0 \Rightarrow V(x) = -10 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) - A_y \cdot x = 0 \Rightarrow M(x) = -10 \cdot x \quad \left| \begin{array}{l} A: x=0, M(0)=0 \\ \Gamma: x=1, M(1)=-10 \text{ kNm} \end{array} \right.
 \end{aligned}$$

$Z_2: \Gamma\Delta, 1 \leq x \leq 2$



$$\begin{aligned}
 (+) \rightarrow \sum F_x = 0 &\Rightarrow A_x + N(x) = 0 \Rightarrow N(x) = -A_x = -10 \text{ kN} \\
 (+) \uparrow \sum F_y = 0 &\Rightarrow A_y - V(x) = 0 \Rightarrow V(x) = -10 \text{ kN} \\
 \curvearrowright \sum M_x = 0 &\Rightarrow M(x) - M_0 - A_y \cdot x = 0 \\
 \Rightarrow M(x) &= 80 - 10 \cdot x \quad \left| \begin{array}{l} \Gamma: x=1, M(1)=70 \text{ kNm} \\ \Delta: x=2, M(2)=60 \text{ kNm} \end{array} \right.
 \end{aligned}$$



$$^{(+)} \sum F_x = 0 \Rightarrow B_x - P + V(x) = 0 \Rightarrow V(x) = P - B_x = 40 - 50 = -10 \text{ kN}$$

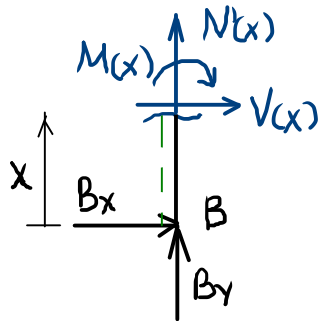
$$^{(+)} \uparrow \sum F_y = 0 \Rightarrow B_y + N(x) = 0 \Rightarrow N(x) = -B_y = -10 \text{ kN}$$

$$^{(+)} \sum M_x = 0 \Rightarrow -M(x) - P \cdot (x-1) + B_x \cdot x = 0$$

$$\Rightarrow M(x) = x(B_x - P) + P \Rightarrow M(x) = x(50 - 40) + 40$$

$$\Rightarrow M(x) = 10x + 40 \quad \left| \begin{array}{l} E: x=1, M(1) = 50 \text{ kNm} \\ D: x=2, M(2) = 60 \text{ kNm} \end{array} \right.$$

$\tau_4: BE, 0 \leq x < 1$



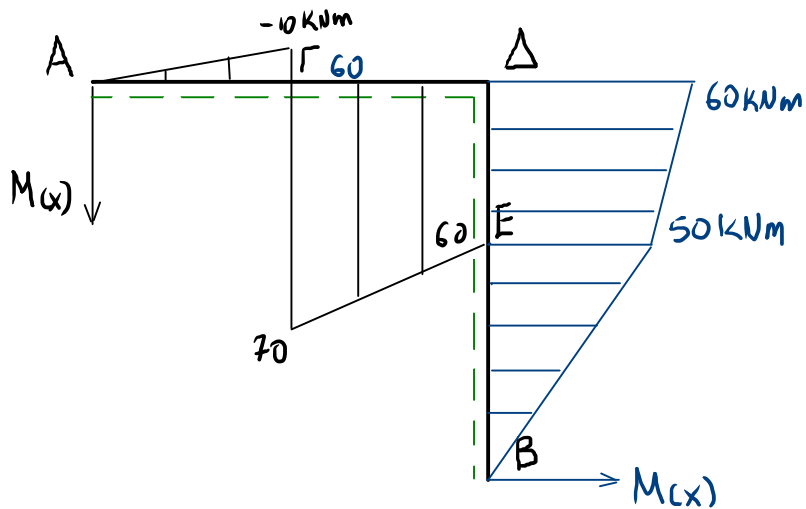
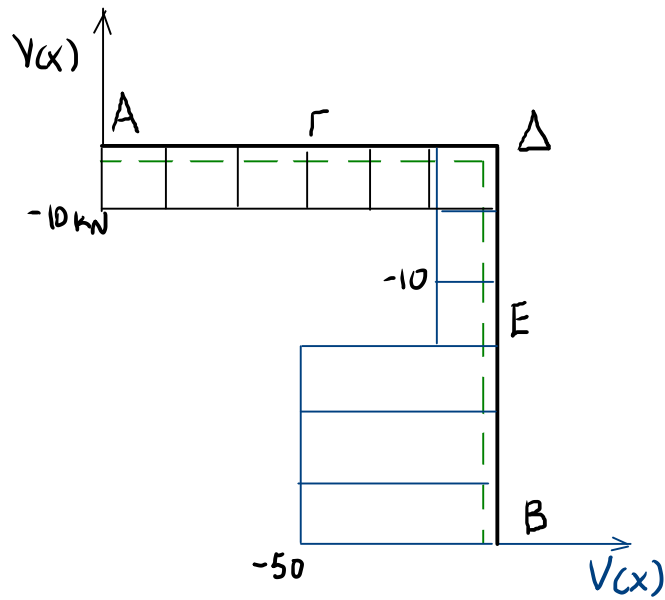
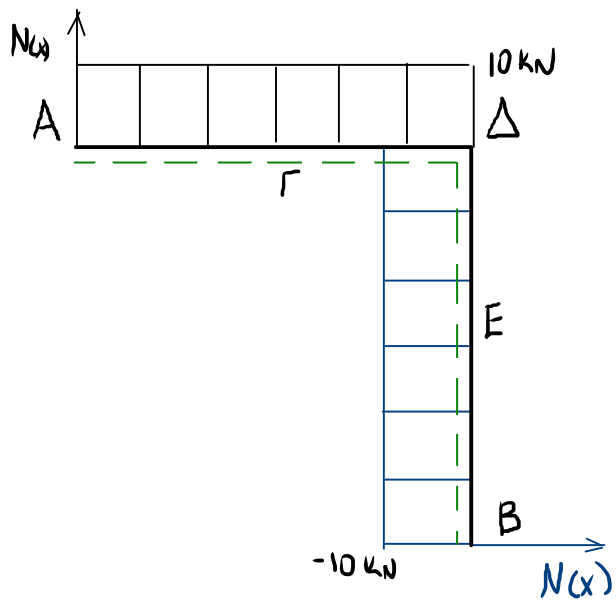
$$^{(+)} \sum F_x = 0 \Rightarrow B_x + V(x) = 0 \Rightarrow V(x) = -B_x = -50 \text{ kN}$$

$$^{(+)} \uparrow \sum F_y = 0 \Rightarrow B_y + N(x) = 0 \Rightarrow N(x) = -B_y = -10 \text{ kN}$$

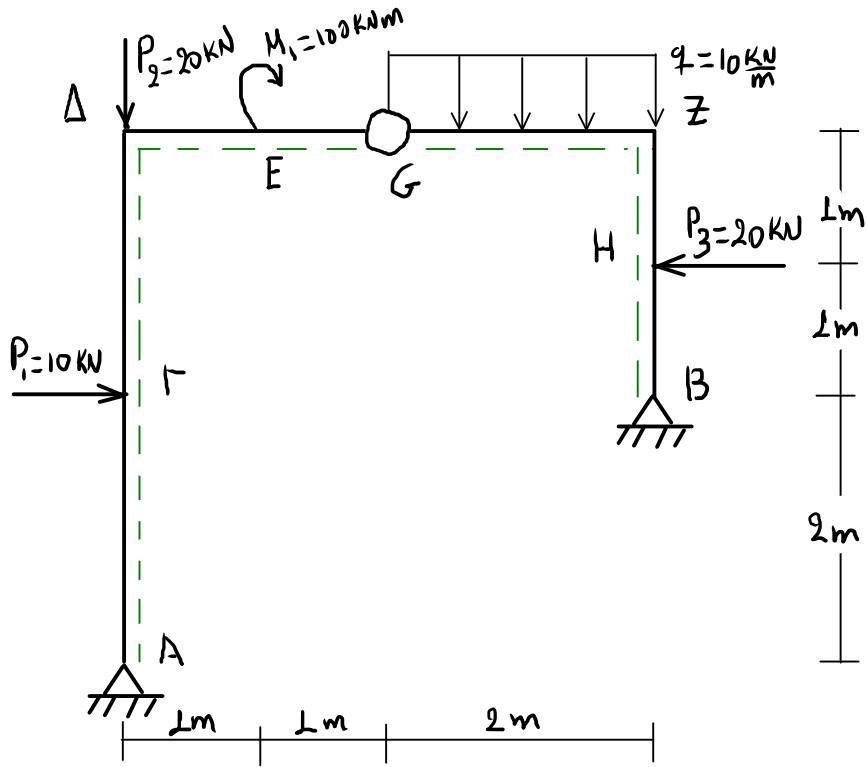
$$^{(+)} \sum M_x = 0 \Rightarrow -M(x) + B_x \cdot x = 0 \Rightarrow M(x) = B_x \cdot x$$

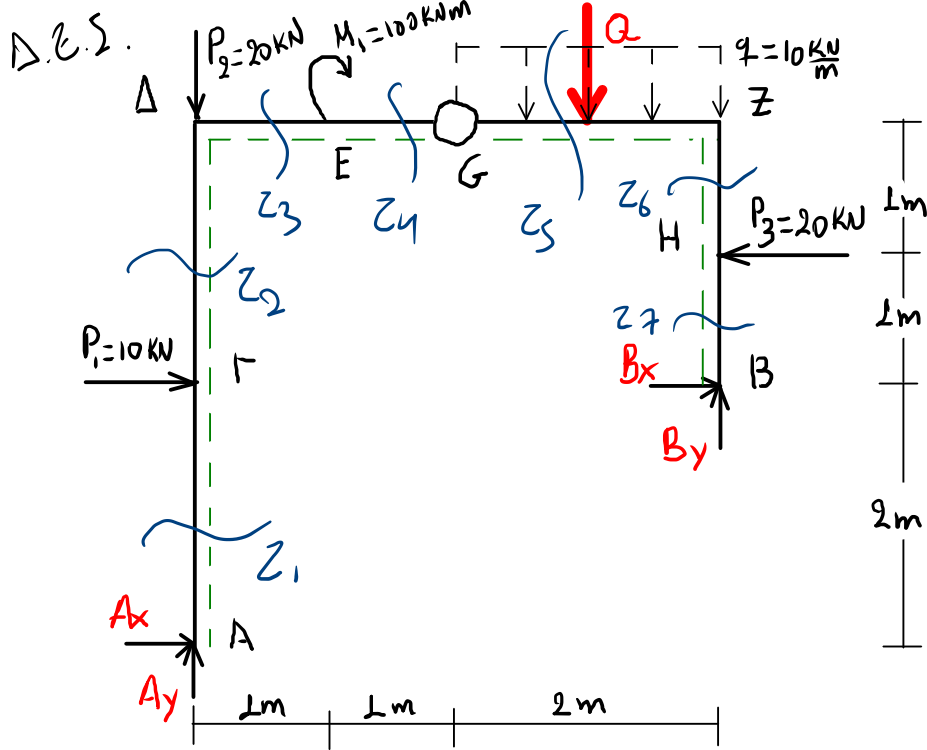
$$\Rightarrow M(x) = 50 \cdot x \quad \left| \begin{array}{l} B: x=0, M(0) = 0 \\ E: x=1, M(1) = 50 \text{ kNm} \end{array} \right.$$

Σχεδίαση Διαγραμμάτων M, N, V



Τριχοθρῶς Πλαίσιο:



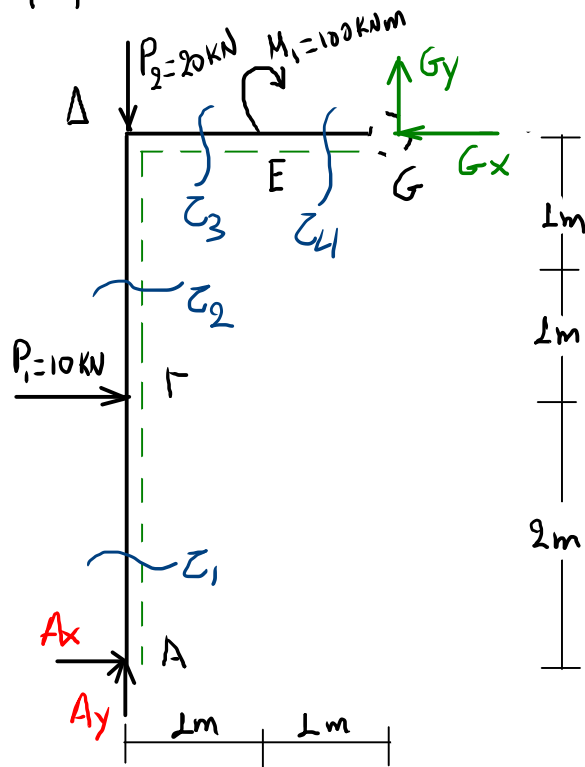


$$Q = 2q = 2 \cdot 10 = 20 \text{ kN}$$

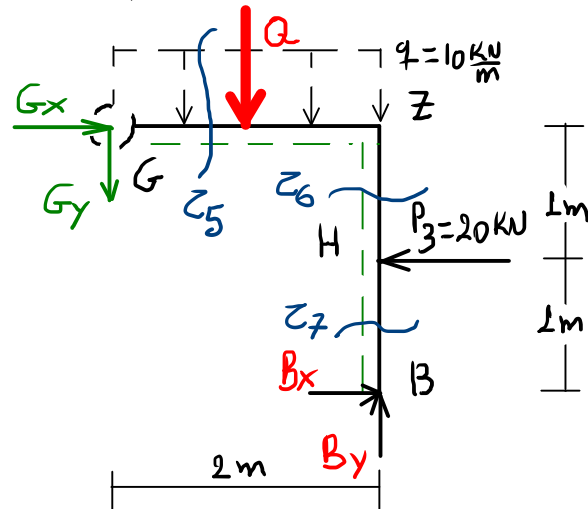
$$\begin{aligned}
 (1) \quad \sum F_x = 0 &\Rightarrow A_x + P_1 - P_3 + B_x = 0 \Rightarrow A_x + B_x = P_3 - P_1 \Rightarrow A_x + B_x = 10 \quad (1) \\
 (2) \quad \sum F_y = 0 &\Rightarrow A_y - P_2 - Q + B_y = 0 \Rightarrow A_y + B_y = Q + P_2 \Rightarrow A_y + B_y = 40 \quad (2) \\
 (3) \quad \sum M_A = 0 &\Rightarrow -P_1 \cdot 2 - M_1 - Q \cdot 3 + P_3 \cdot 3 - B_x \cdot 2 + B_y \cdot 4 = 0 \Rightarrow \\
 &\quad -20 - 100 - 60 + 60 - 2B_x + 4B_y = 0 \Rightarrow -2B_x + 4B_y = 120 \Rightarrow -B_x + 2B_y = 60 \\
 (4) \quad \sum M_G = 0 &\Rightarrow -Q \cdot 1 - P_3 \cdot 1 + B_x \cdot 2 + B_y \cdot 2 = 0 \Rightarrow -20 - 20 + 2B_x + 2B_y = 0 \Rightarrow B_x + B_y = 20 \quad (3) \\
 (3) + (4) : 3B_y &= 80 \Rightarrow B_y = 26,67 \text{ kN} \quad (5) \\
 (2) \stackrel{(5)}{\Rightarrow} A_y &= 13,33 \text{ kN}, \quad (4) \stackrel{(5)}{\Rightarrow} B_x = -6,67 \text{ kN} \quad (6), \quad (1) \stackrel{(6)}{\Rightarrow} A_x = 16,67 \text{ kN}
 \end{aligned}$$

Υπολογισμός Εξωτερικών Αντιστάσεων:

Τμήμα AG



Τμήμα GB

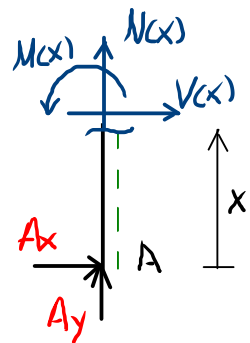


$$AG: \begin{cases} (+) \sum F_x = 0 \Rightarrow A_x + P_1 - G_x = 0 \Rightarrow G_x = 26,67 \text{ kN} \\ (+) \uparrow \sum F_y = 0 \Rightarrow A_y - P_2 + G_y = 0 \Rightarrow G_y = +6,67 \text{ kN} \end{cases}$$

$$GB: \begin{cases} (+) \sum F_x = 0 \\ (+) \uparrow \sum F_y = 0 \end{cases} \left\{ \begin{array}{l} \text{Θα πρέπει να ληφθούν υπόψη} \\ \text{οι αντιδράσεις από το τμήμα AG} \end{array} \right.$$

Υπολογισμός ενταξιακών μεγεθών M, N, V (Τμήτα ΑΓ)

$\Sigma_1: \text{ΑΓ}, 0 \leq x < 2$

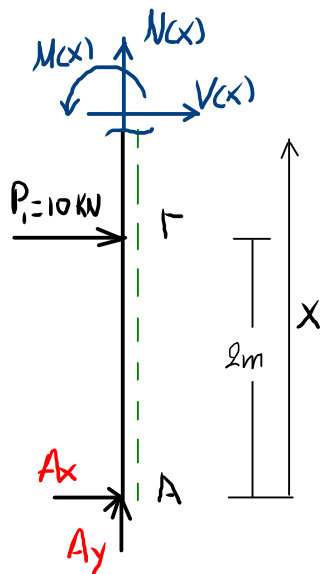


$$(+ \rightarrow) \sum F_x = 0 \Rightarrow A_x + V(x) = 0 \Rightarrow V(x) = -A_x = -16,67 \text{ kN}$$

$$(+ \uparrow) \sum F_y = 0 \Rightarrow A_y + N(x) = 0 \Rightarrow N(x) = -A_y = -13,33 \text{ kN}$$

$$(\curvearrowleft) \sum M_x = 0 \Rightarrow M(x) + A_x \cdot x = 0 \Rightarrow M(x) = -16,67 \cdot x \quad \left| \begin{array}{l} \text{Α: } x=0, M(0)=0 \\ \Gamma: x=2, M(2)=-33,34 \end{array} \right.$$

$\Sigma_2: \Gamma\Delta, 2 \leq x \leq 4$



$$(+ \rightarrow) \sum F_x = 0 \Rightarrow A_x + P_1 + V(x) = 0 \Rightarrow V(x) = -26,67 \text{ kN}$$

$$(+ \uparrow) \sum F_y = 0 \Rightarrow A_y + N(x) = 0 \Rightarrow N(x) = -13,33 \text{ kN}$$

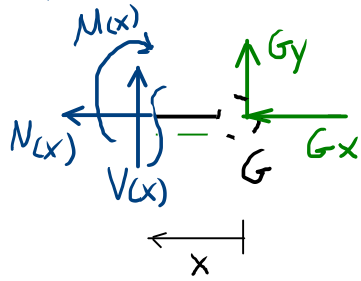
$$(\curvearrowleft) \sum M_x = 0 \Rightarrow M(x) + P_1 \cdot (x-2) + A_x \cdot x = 0$$

$$\Rightarrow M(x) + 10(x-2) + 16,67x = 0$$

$$\Rightarrow M(x) = -26,67x + 20$$

$$\left| \begin{array}{l} \Gamma: x=2, M(2) = -33,34 \text{ kNm} \\ \Delta: x=4, M(4) = -86,68 \text{ kNm} \end{array} \right.$$

$\Sigma_4: GE, 0 \leq x < 1$



$$(+)\sum F_x = 0 \Rightarrow -N(x) - G_x = 0 \Rightarrow N(x) = -G_x \Rightarrow N(x) = -26,67$$

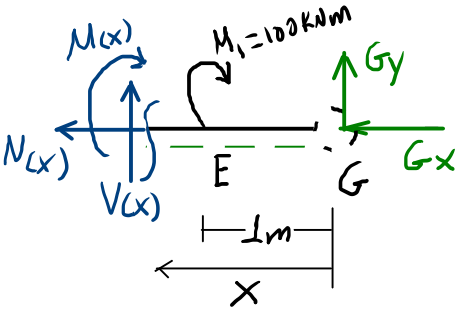
$$(+)\sum F_y = 0 \Rightarrow V(x) + G_y = 0 \Rightarrow V(x) = -G_y = -6,67 \text{ kN}$$

$$(+)\sum M_x = 0 \Rightarrow -M(x) + G_y \cdot x = 0 \Rightarrow M(x) = 6,67x$$

$$| G: x=0, M(0) = 0$$

$$| E: x=1, M(1) = 6,67 \text{ kNm}$$

$\Sigma_3: E\Delta, 1 \leq x < 2$



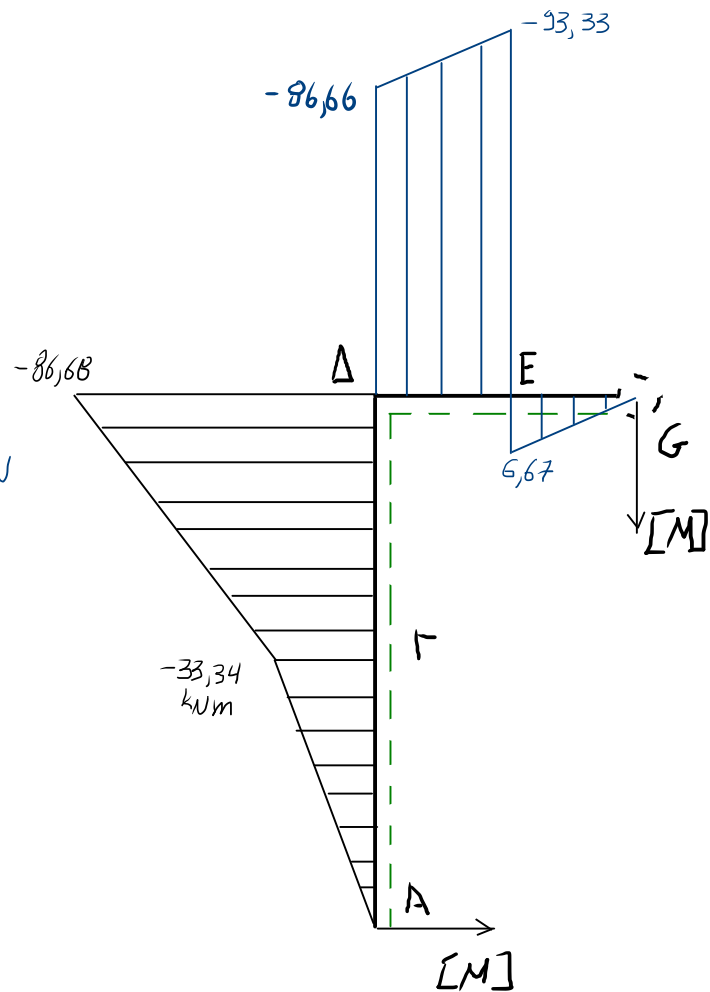
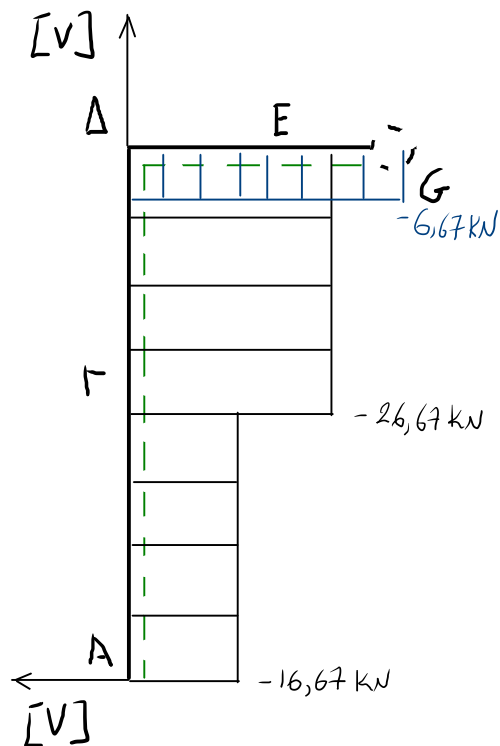
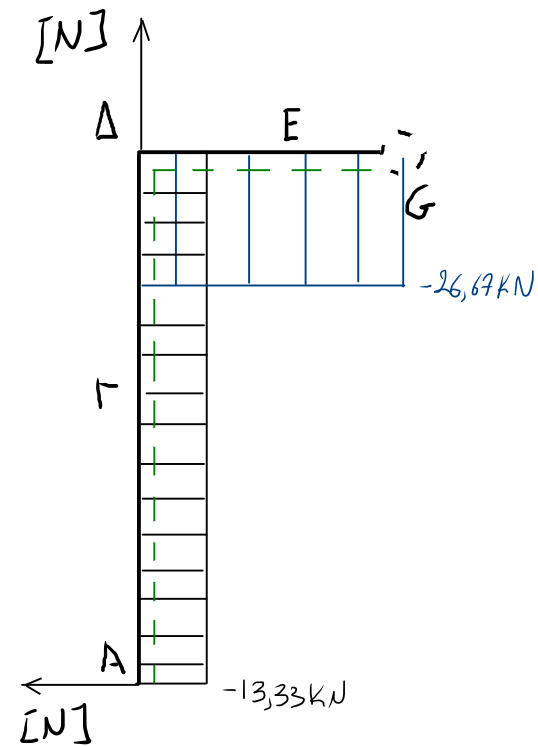
$$(+)\sum F_x = 0 \Rightarrow -N(x) - G_x = 0 \Rightarrow N(x) = -G_x = -26,67 \text{ kN}$$

$$(+)\sum F_y = 0 \Rightarrow V(x) + G_y = 0 \Rightarrow V(x) = -G_y = -6,67 \text{ kN}$$

$$(+)\sum M_x = 0 \Rightarrow -M(x) - M_1 + G_y \cdot x = 0$$

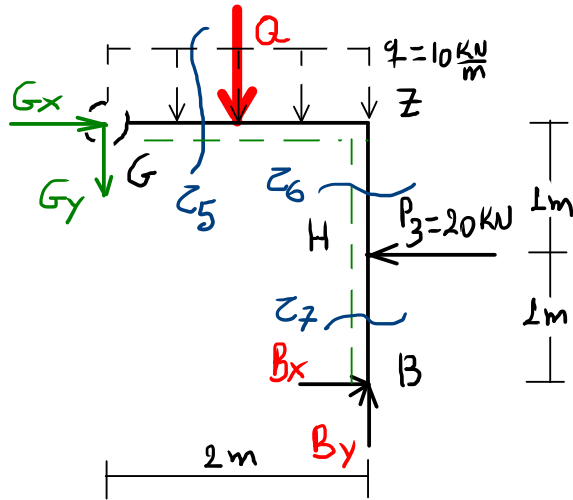
$$\Rightarrow M(x) = -100 + 6,67x \quad \left| \begin{array}{l} E: x=1, M(1) = -93,33 \\ \Delta: x=2, M(2) = -86,66 \end{array} \right.$$

Διαγράμματα M, N, V (Τμήτα AG)

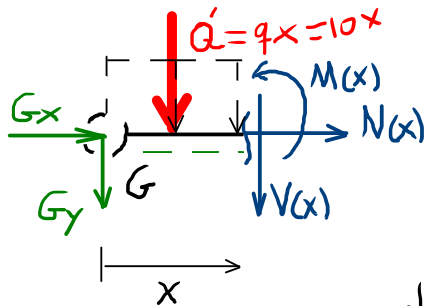


Υπολογισμός ενταστικών μεγεθών M, N, V (Τμήμα GB)

Τμήμα GB



$C_5: GZ, 0 \leq x \leq 2$



$$(+)\sum F_x = 0 \Rightarrow G_x + N(x) = 0 \Rightarrow N(x) = -G_x = -26,67 \text{ kN}$$

$$(+)\uparrow \sum F_y = 0 \Rightarrow -G_y - Q' - V(x) = 0 \Rightarrow V(x) = -6,67 - 10x$$

$$\Rightarrow V(x) = -10x - 6,67 \quad \left| \begin{array}{l} G: x=0 \Rightarrow V(0) = -6,67 \text{ kN} \\ Z: x=2 \Rightarrow V(2) = -26,67 \text{ kN} \end{array} \right.$$

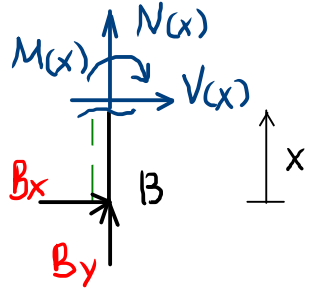
$$\uparrow \sum M_x = 0 \Rightarrow M(x) + Q' \cdot \frac{x}{2} + G_y \cdot x = 0$$

$$\Rightarrow M(x) = -6,67x - 5x^2 \quad \left| \begin{array}{l} G: x=0, M(0) = 0 \\ Z: x=2, M(2) = -33,34 \text{ kNm} \end{array} \right.$$

$$\frac{dM(x)}{dx} = 0 \Rightarrow -6,67 - 10x = 0 \Rightarrow x = -0,667$$

$$\frac{d^2M}{dx^2} = -10 < 0 \Rightarrow \text{γράφει να κοίτα προς τα κάτω άρα έχει μέγιστο}$$

$\tau_2: BH, 0 \leq x < 1$



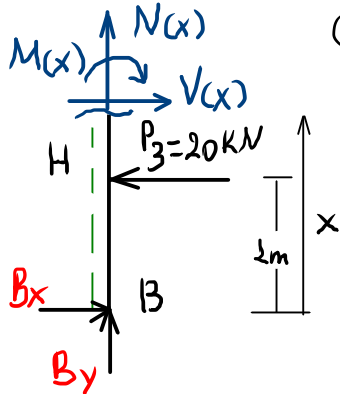
$$(+)\rightarrow \sum F_x = 0 \Rightarrow B_x + V(x) = 0 \Rightarrow V(x) = -B_x = 6,67 \text{ kN}$$

$$(+)\uparrow \sum F_y = 0 \Rightarrow B_y + N(x) = 0 \Rightarrow N(x) = -B_y = -26,67 \text{ kN}$$

$$(+)\curvearrowright \sum M_x = 0 \Rightarrow -M(x) + B_x \cdot x = 0 \Rightarrow M(x) = -6,67 \cdot x$$

$$\left. \begin{array}{l} B: x=0, M(0)=0 \\ H: x=1, M(1)=-6,67 \end{array} \right\}$$

$\tau_6: HZ, 1 \leq x \leq 2$



$$(+)\rightarrow \sum F_x = 0 \Rightarrow B_x - P_3 + V(x) = 0 \Rightarrow V(x) = P_3 - B_x = 26,67 \text{ kN}$$

$$(+)\uparrow \sum F_y = 0 \Rightarrow B_y + N(x) = 0 \Rightarrow N(x) = -B_y = -26,67 \text{ kN}$$

$$(+)\curvearrowright \sum M_x = 0 \Rightarrow -M(x) - P_3 \cdot (x-1) + B_x \cdot x = 0$$

$$\Rightarrow M(x) = -20(x-1) - 6,67x$$

$$\Rightarrow M(x) = -26,67x + 20 \quad \left| \begin{array}{l} H: x=1, M(1) = -6,67 \text{ kNm} \\ Z: x=2, M(2) = -33,34 \text{ kNm} \end{array} \right.$$

Διαγράμματα M, N, V (Τμήτα GB)

