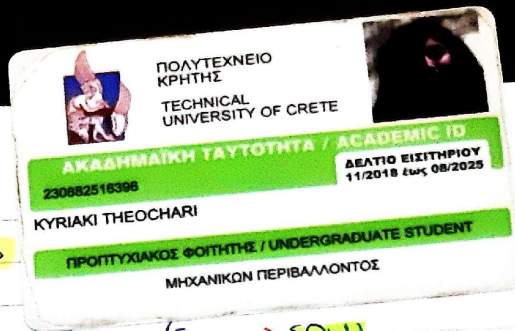
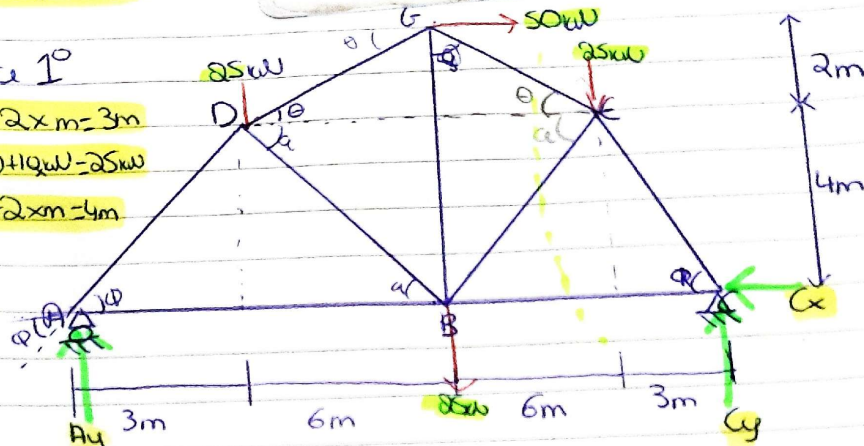




Θωρακισμένη κωπία
 Δωρεάν S, x=0.5
 2018050043

Θέμα 1^ο
 $L=2+2 \times m=3m$
 $P=20+10m=25kN$
 $H=3+2 \times m=4m$



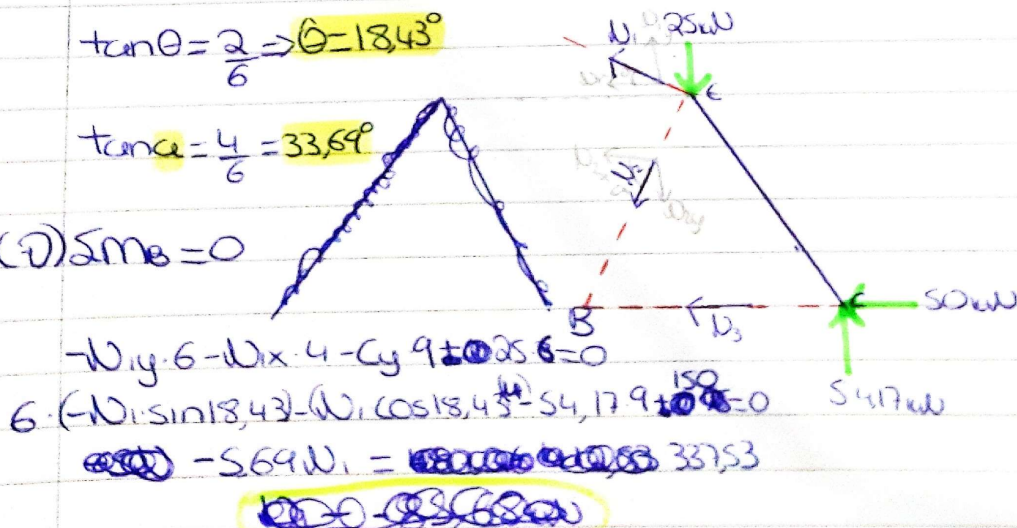
$$\begin{aligned} \sum F_x = 0 & \quad \sum F_y = 0 & \quad \sum M_C = 0 \\ -C_x + 50 = 0 & \quad A_y + C_y - 25 - 25 - 25 = 0 & \quad A_y \cdot 18 - 25 \cdot 9 - 25 \cdot 15 + 50 \cdot 6 - 25 \cdot 3 = 0 \\ C_x = 50kN & \quad A_y + C_y = 75 & \quad 18A_y = 225 - 375 + 300 - 75 = 0 \\ & \quad C_y = 54,17kN & \quad 18A_y = +375 \\ & & \quad A_y = 20,83kN \end{aligned}$$

Μέθοδος Ritter (μέθοδος κοπής)

$$\tan \theta = \frac{2}{6} \Rightarrow \theta = 18,43^\circ$$

$$\tan \alpha = \frac{4}{6} = 33,69^\circ$$

$$\sum M_B = 0$$



$$-W_1 \cdot 6 - W_2 \cdot 4 - C_y \cdot 9 + 25 \cdot 6 = 0$$

$$6 \cdot (-W_1 \sin 18,43) - W_2 \cos 18,43 - 54,17 \cdot 9 + 25 \cdot 6 = 0$$

$$-5,69 W_1 = 180,006 - 150,000 = 30,006$$

$$W_1 = -52,73kN$$

$$\Rightarrow W_1 = -59,32kN$$

Συνολ

$$(2) \sum M_C = 0$$

$$50 \cdot 4 + W_3 \cdot 4 - 54,17 \cdot 3 = 0$$

$$200 + 4W_3 - 162,51 = 0$$

$$4W_3 = -37,49$$

$$W_3 = 9,37 \text{ kN}$$

$$(2) \sum M_C = 0$$

$$-W_{Ay} \cdot 9 + W_{By} \cdot 3 - W_{ix} \cdot 4 - 25 \cdot 3 = 0$$

$$-9W_{Ay} - (69,32 \cdot 3) + 59,32 \cdot 4 \cdot \cos 18,43 - 25 \cdot 3 = 0$$

$$\sin 18,43$$

$$-9W_{By} - 56,26 + 225 - 75 = 0$$

$$9W_{By} = 93,74$$

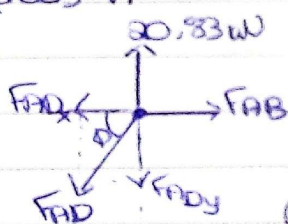
$$W_{By} = 10,42$$

$$W_2 \sin 33,69 = 10,42$$

$$\Rightarrow W_2 = 18,08 \text{ kN}$$

методы узлов

Узел А



$$\tan \phi = \frac{4}{3}$$

$$\phi = 53,13^\circ$$

$$\sum F_x = 0$$

$$F_{AB} - F_{ADx} = 0$$

$$F_{AB} = F_{ADx}$$

$$F_{AB} = 26,04 \cos 53,13$$

$$F_{AB} = 15,62 \text{ kN}$$

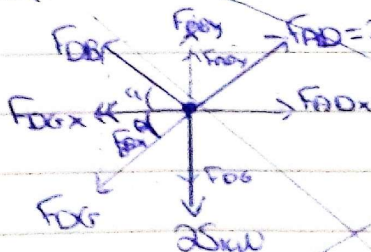
$$\sum F_y = 0$$

$$20,83 - F_{ADy} = 0$$

$$\Rightarrow F_{ADy} = 20,83$$

$$F_{AD} = \frac{20,83}{\sin \phi} = 26,04 \text{ kN}$$

Узел D



$$\sum F_x = 0$$

$$F_{ADx} - F_{DBx} - F_{DGx} = 0$$

$$26,04 \cos 53,13 - F_{DB} \cos 18,43 - F_{DB} \cos 33,69 = 0$$

$$F_{DB} \cos 18,43 - F_{DB} \cos 33,69 = 15,62$$

$$\sum F_y = 0$$

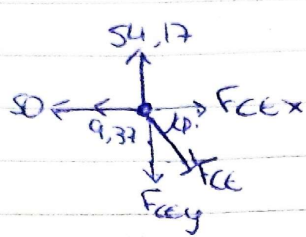
$$F_{DBy} + F_{ADy} - 25 - F_{DGy} = 0$$

$$F_{DB} \sin 33,69 + 26,04 \sin 53,13 - 25 - F_{DB} \sin 18,43 = 0$$

$$F_{DB} \sin 33,69 - F_{DB} \sin 18,43 = 4,17$$

$$24,18 \text{ kN}$$

Karbox C



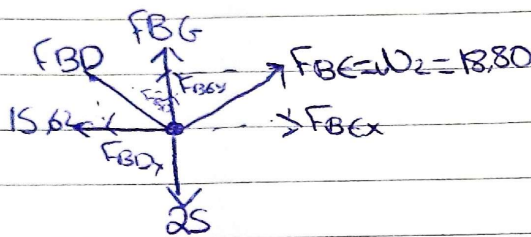
$$\sum F_y = 0$$

$$54,17 - F_{cey} = 0$$

$$F_{cey} = 54,17$$

$$F_{ce} = 67,71 \text{ kN}$$

Karbox B



$$\sum F_x = 0$$

$$F_{BCx} - 15,62 - F_{BDx} = 0$$

$$18,80 \cdot \cos 33,69 - 15,62 = F_{BDx}$$

$$F_{BDx} = 0,02$$

$$F_{BD} = 0,04 \text{ kN}$$

$$\sum F_y = 0$$

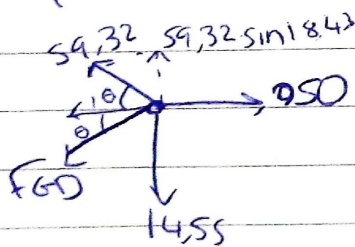
$$F_{BG} + F_{BDy} + F_{BCy} - 25 = 0$$

$$F_{BG} + 0,04 \cdot \sin 33,69 + 18,80 \cdot \sin$$

$$33,69 - 25 = 0$$

$$F_{BG} = 14,55 \text{ kN}$$

Karbox G



$$\sum F_x = 0$$

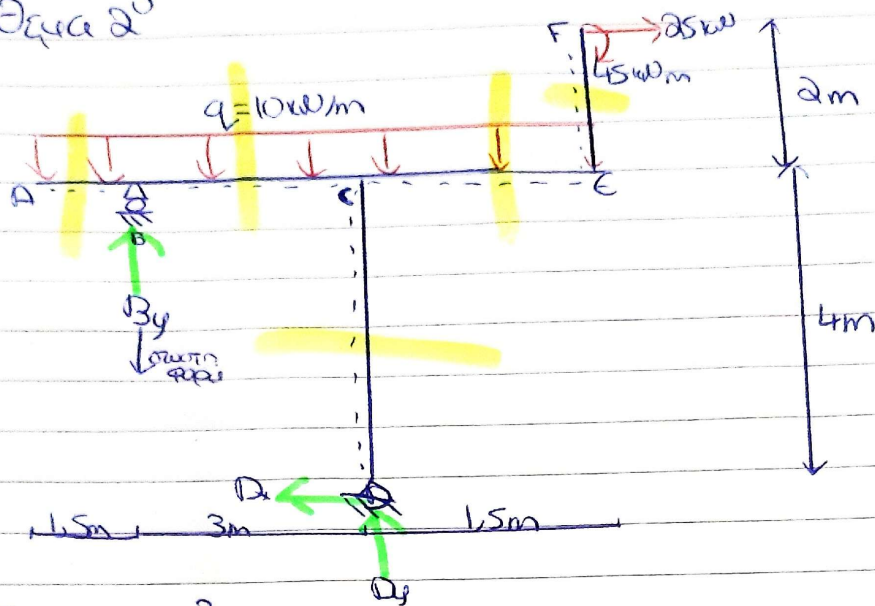
$$50 - 59,32 \cos 18,43 - F_{GD} \cos 18,43 = 0$$

$$F_{GD} = \frac{-6,28}{\cos 18,43}$$

$$F_{GD} = -6,62 \text{ kN}$$

Σ F_{GD} = 3

Exercice 2°



$$a = 2 + 2x = 3m$$

$$b = 3 + 2x = 4m$$

$$q = 5 + 10x = 10 \text{ kN/m}$$

$$m = 40 + 10x = 45 \text{ kNm}$$

$$P = 20 + 10x = 25 \text{ kN}$$

$$\sum F_x = 0$$

$$25 - D_x = 0$$

$$D_x = 25 \text{ kN}$$

$$\sum F_y = 0$$

$$B_y + D_y - 10 \cdot 6 = 0$$

$$B_y + D_y = 60$$

$$D_y = 95 \text{ kN}$$

$$\sum M_D = 0$$

$$B_y \cdot 3 + 25 \cdot 6 + 45 - 10 \cdot 6 \cdot (4.5 - 3) = 0$$

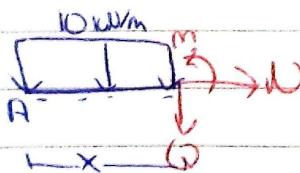
$$3B_y + 150 + 45 - 60(1.5) = 0$$

$$3B_y = -105$$

$$B_y = -35 \text{ kN} \text{ along } x\text{-axis}$$

5 topics

Topic AB: uniformly distributed load $0.5 \times 5 = 1.5 \text{ (m)}$



$$\sum F_x = 0$$

$$Q = 0 \text{ kN}$$

$$\sum F_y = 0$$

$$-Q - 10x = 0$$

$$Q = -10x$$

$$Q(0) = 0 \text{ kN}$$

$$Q(1.5) = -15 \text{ kN}$$

$$\sum M = 0$$

$$-m - 10x \cdot x = 0$$

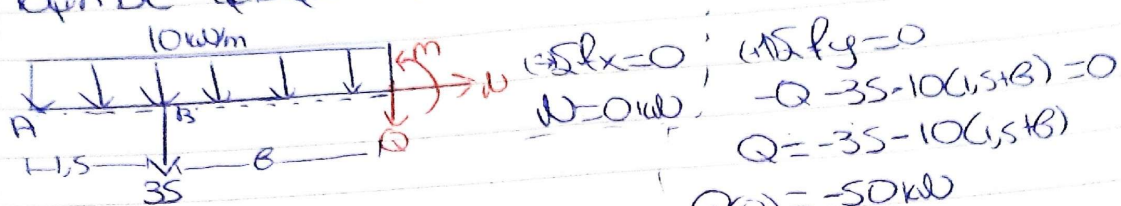
$$m = -5x^2$$

$$m(0) = 0 \text{ kNm}$$

$$m(1.5) = -11.25 \text{ kNm}$$

Σ x i d a t a

Topan BC qatari uqari 0.5 ≤ 3 (m)



$$\sum M = 0$$

$$-m - 10 \frac{(1.5+3)(1.5+3)}{2} - 35 \cdot 3 = 0$$

$$m = -35 \cdot 3 - 5(1.5+3)^2$$

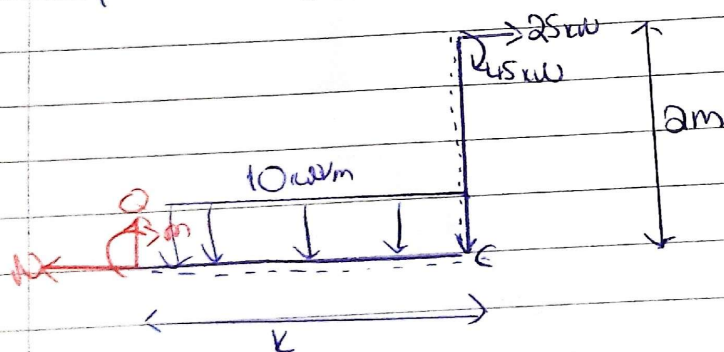
$$= -35 \cdot 3 - 5(1.5^2 + 2 \cdot 1.5 \cdot 3 + 3^2)$$

$$m(0) = -11.25 \text{ kNm}$$

$$m(3) = -35 \cdot 3 - 5(1.5^2 + 2 \cdot 1.5 \cdot 3 + 3^2)$$

$$m(3) = -206.25 \text{ kNm}$$

Topan CE qatari uqari 0 ≤ x ≤ 1.5 (m)



$$\sum F_x = 0$$

$$25 - W = 0$$

$$W = 25 \text{ kN}$$

$$\sum F_y = 0$$

$$Q - 10k = 0$$

$$Q = 10k$$

$$Q(0) = 0 \text{ kN}$$

$$Q(1.5) = 15 \text{ kN}$$

$$\sum M = 0$$

$$45 + 25 \cdot 2 + 10 \cdot k \cdot \frac{k}{2} + m = 0$$

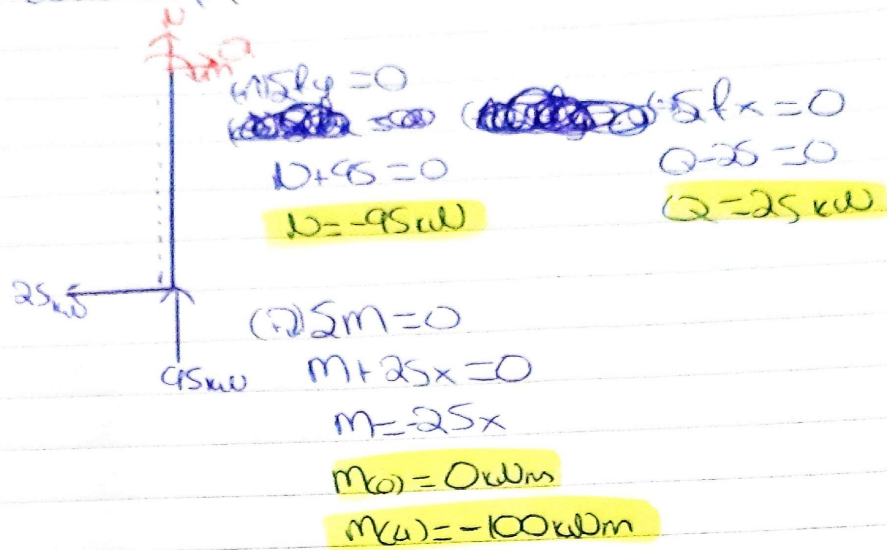
$$m = -95 + 5k^2$$

$$m(0) = -95 \text{ kNm}$$

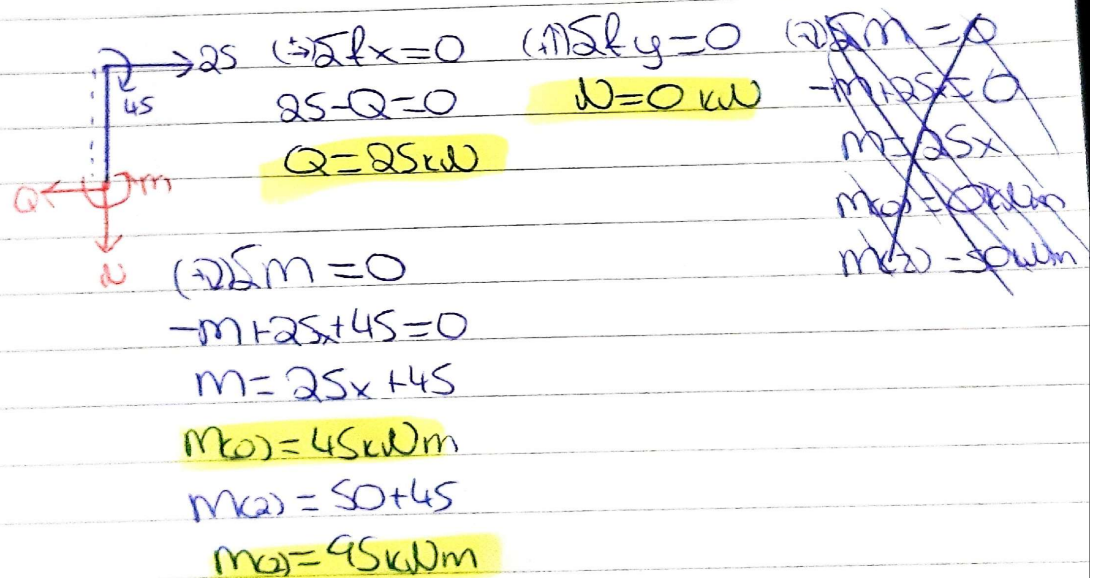
$$m(1.5) = -106.25 \text{ kNm}$$

Σ f i d a s

Open DC beam supports: $0 \leq x \leq 4(m)$



Open FE beam supports: $0 \leq y \leq 2(m)$



$\Sigma F = 0$

