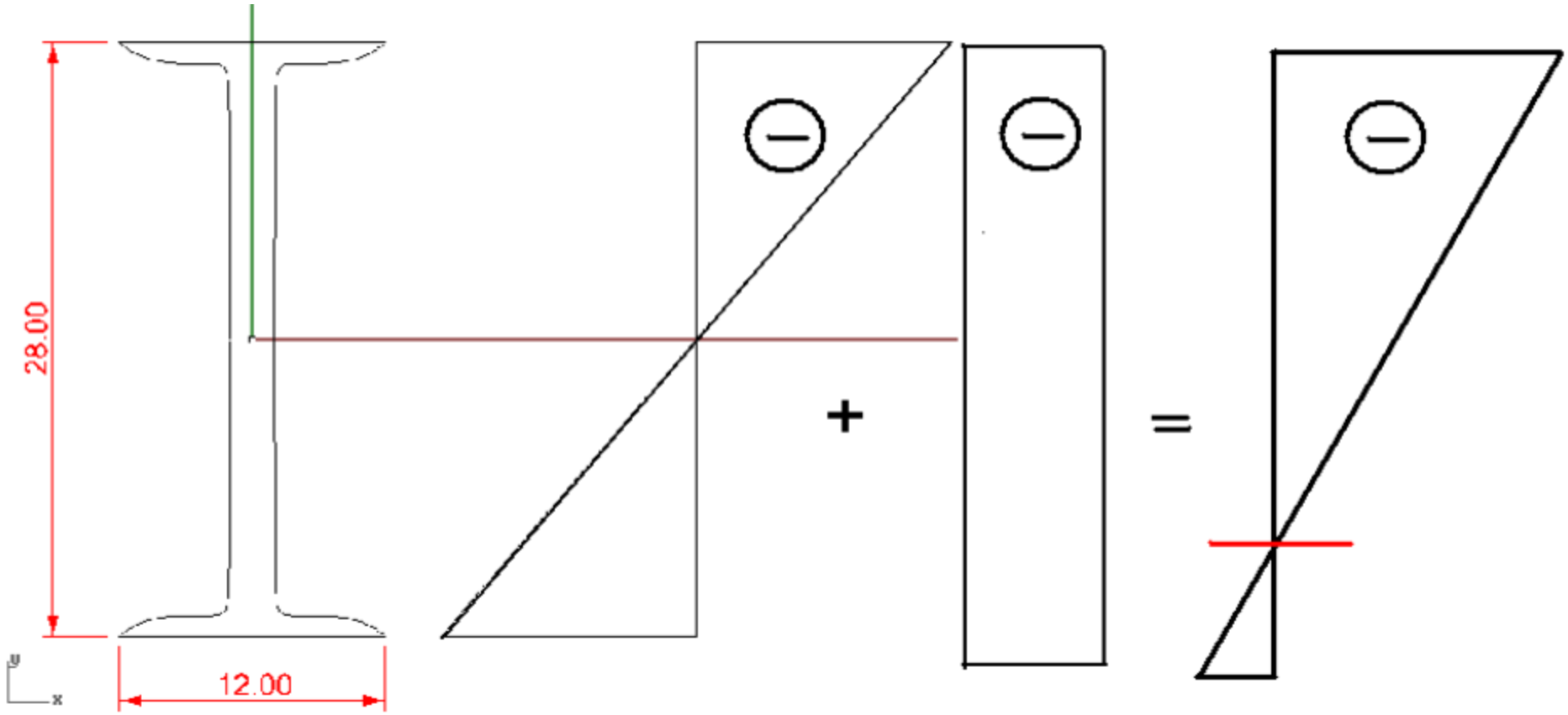
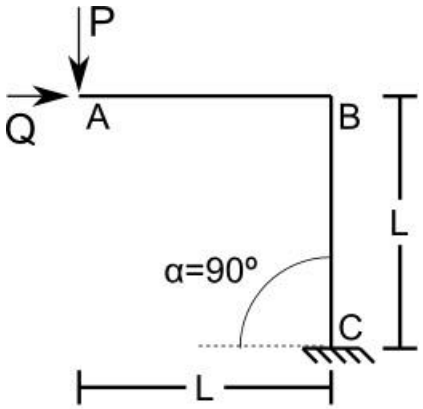
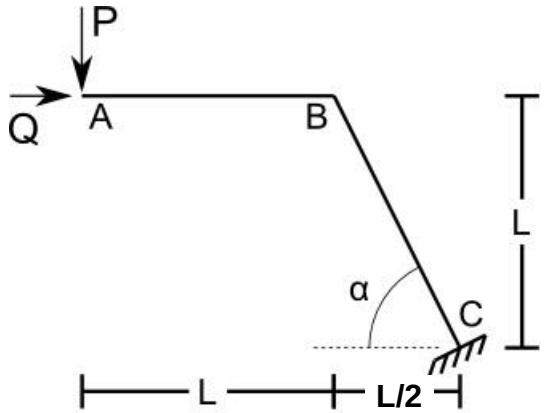
Pórticos

Flexión Compuesta



Flexión Directa Presoflexión





Caso particular de barras en ángulo ortogonal.

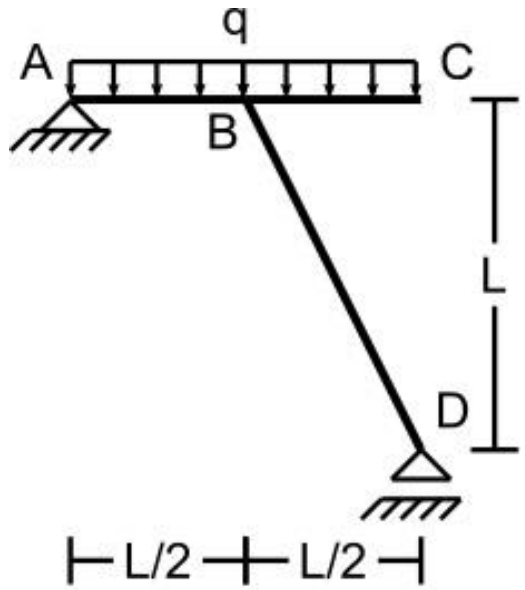
En B: $N^I=V^D$

$V^I=N^D$

$M^I=M^D$

Es decir, el cortante y la directa se invierten, y el momento se transmite.

Ejemplo



Sum(Fv)=0

$R_A+R_D=qL$

Sum(M_A)=0

$q*L*L/2-R_D*L=0$

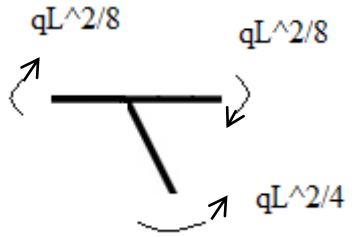
$R_D=qL/2$

$R_A=qL/2$

cos(α)=1/raíz(5)

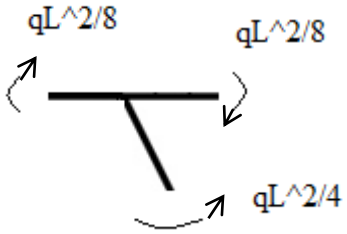
sen(α)= 2/raíz(5)

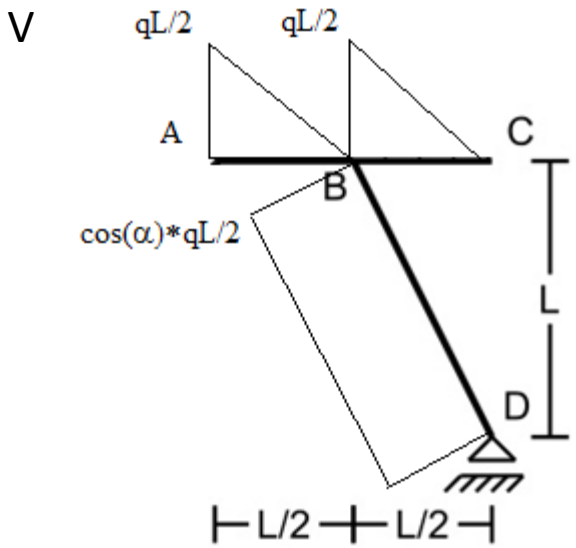
Fuerzas verticales en BD:

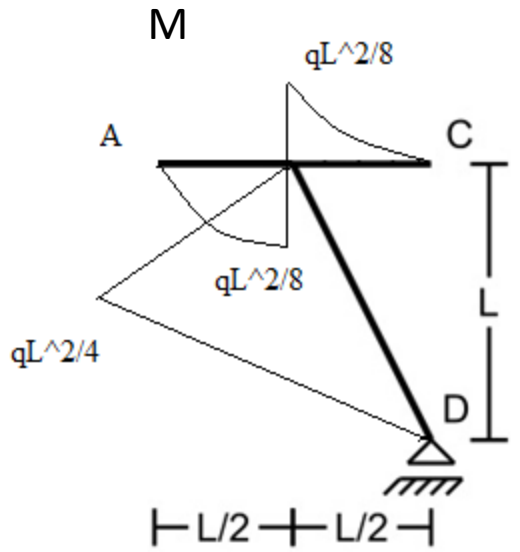


Diagramas

Momentos en el nudo=0

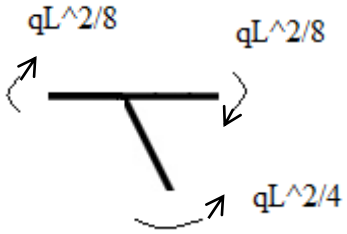


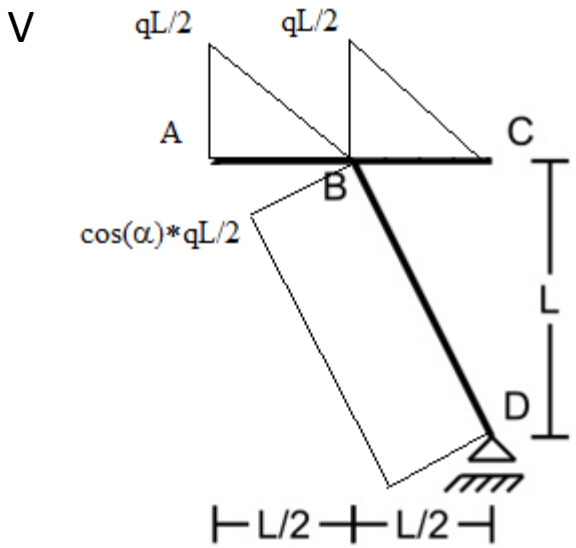


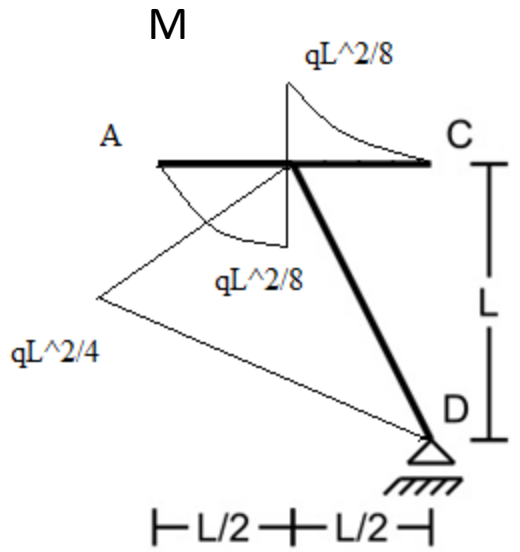


Diagramas

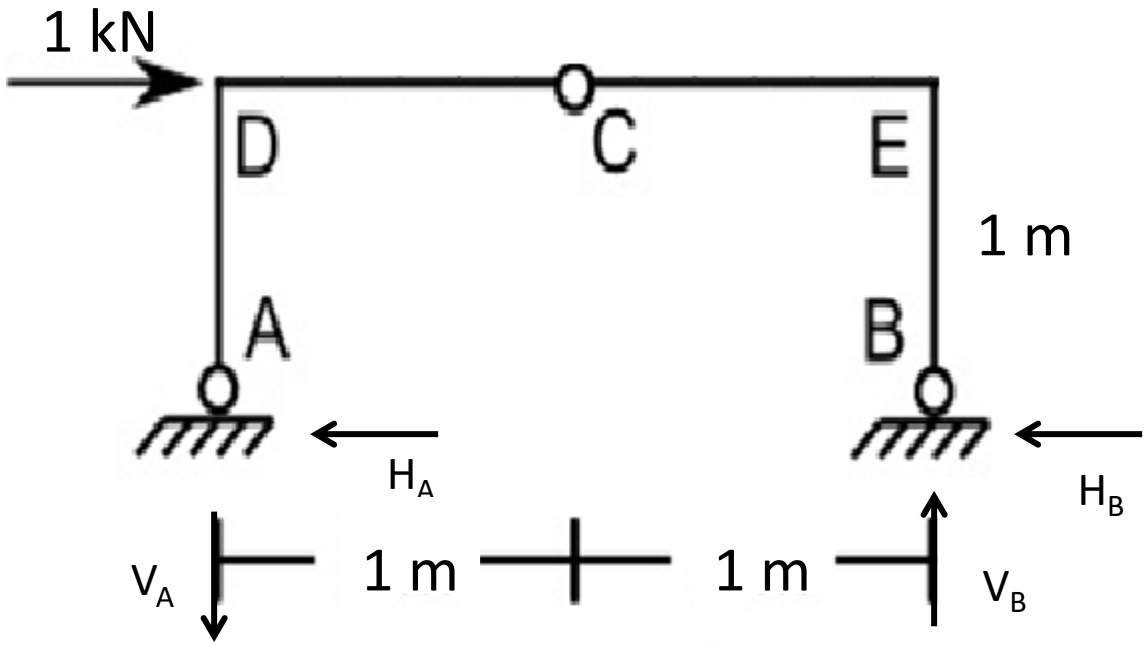
Momentos en el nudo=0







Ejemplo



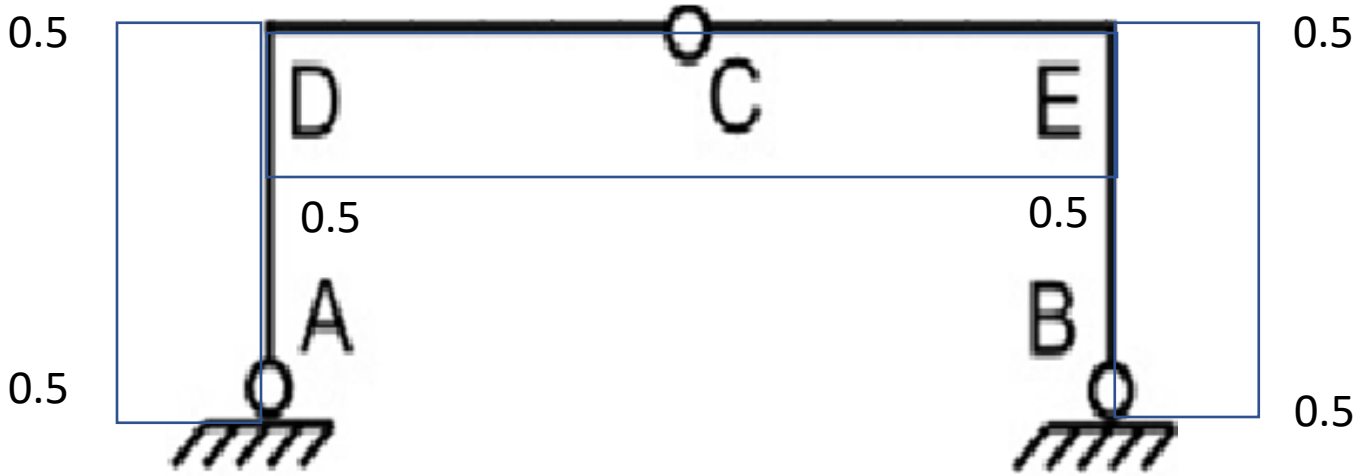
$-V_A+V_B=0$

$H_A+H_B= 1$ kN

$Sum(M_A)=0$

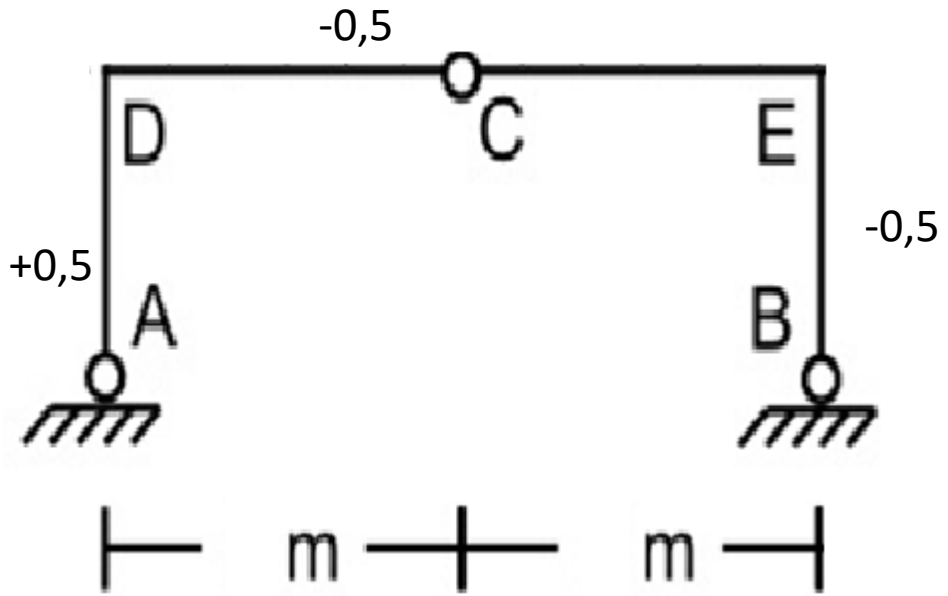
$Sum(M_{izqC})=0$

V(kN)

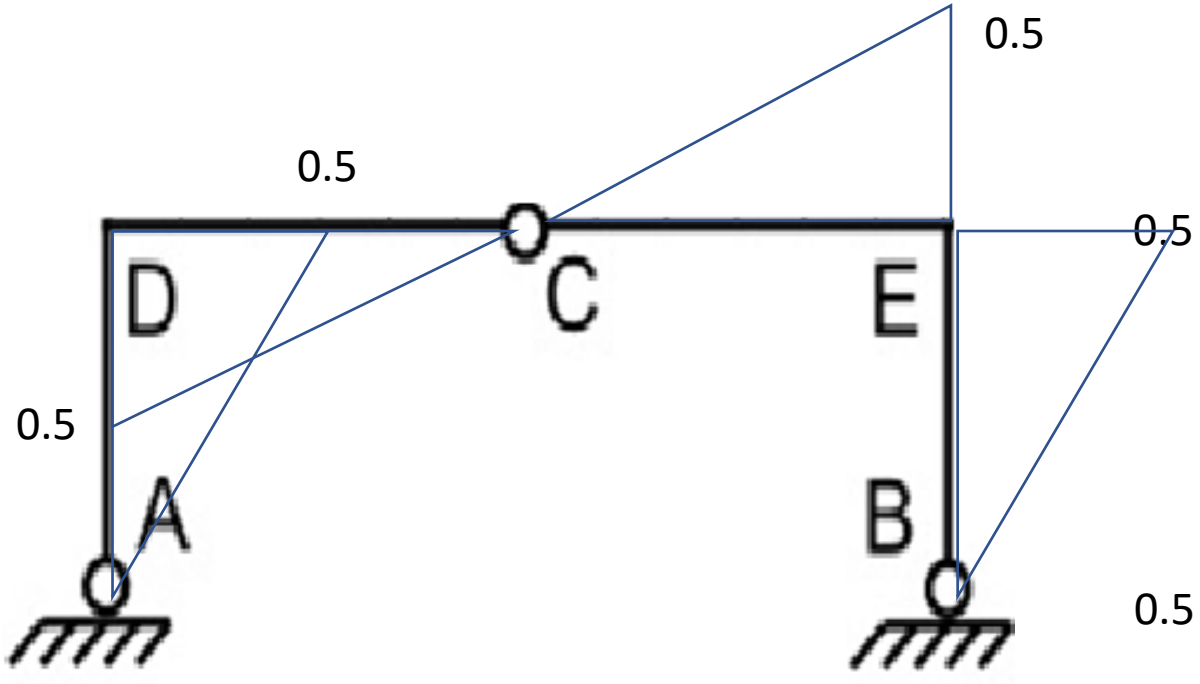


Tensiones Rasantes máximas

Diagrama de Directa N

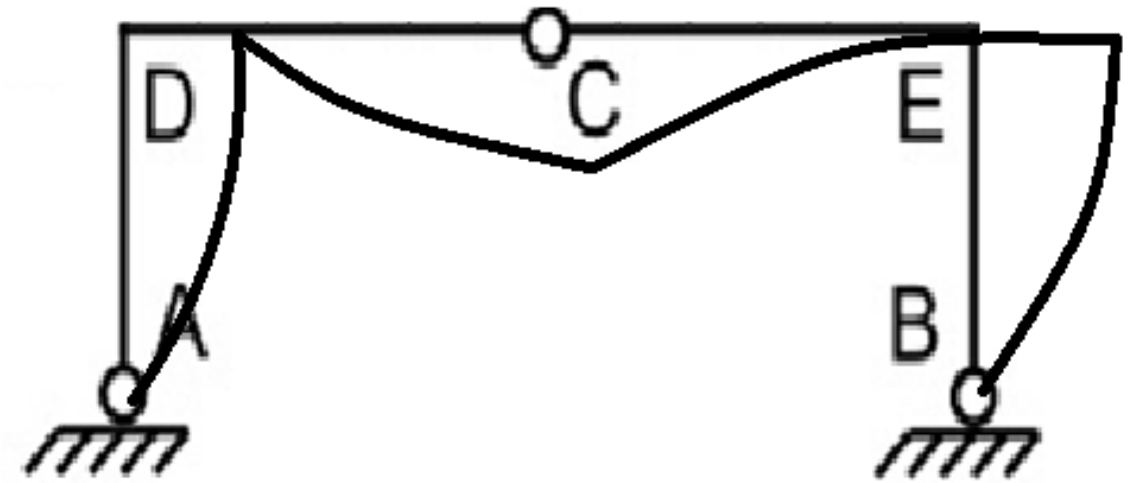


M(kN.m)

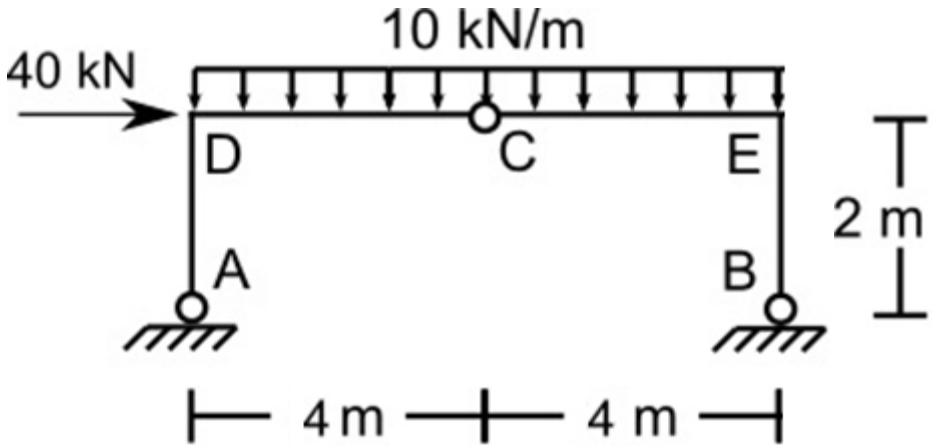


Tensiones Normales máximas (tensiones por M + tensiones por N)

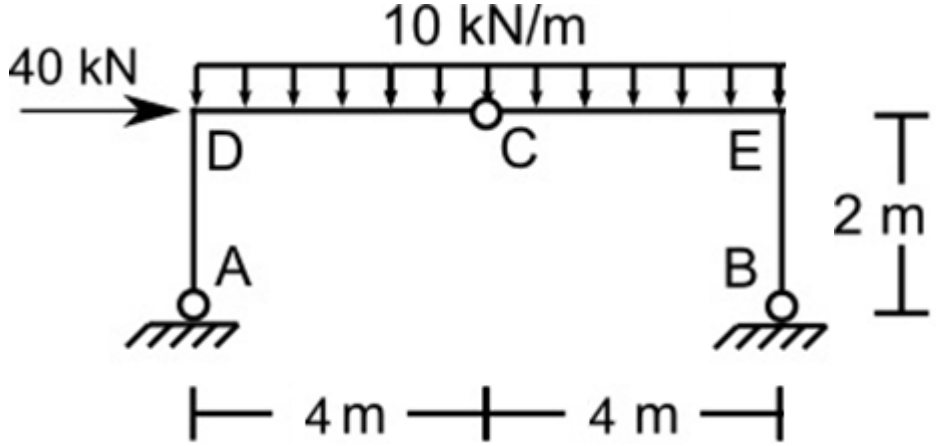
Ejemplo



Arco de tres Articulaciones



Arco de tres articulaciones

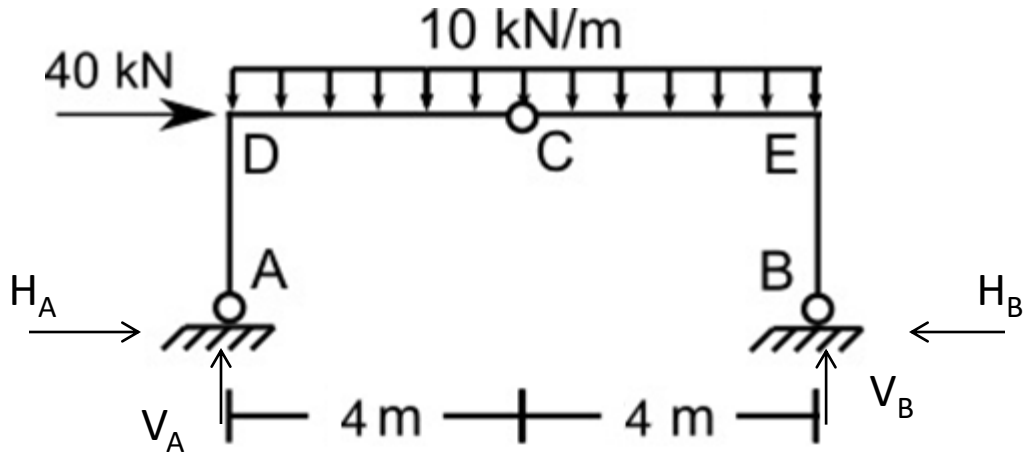


Suma(M_A)=0
40.2+10.8.4=8.V_B→ V_B= 50 kN

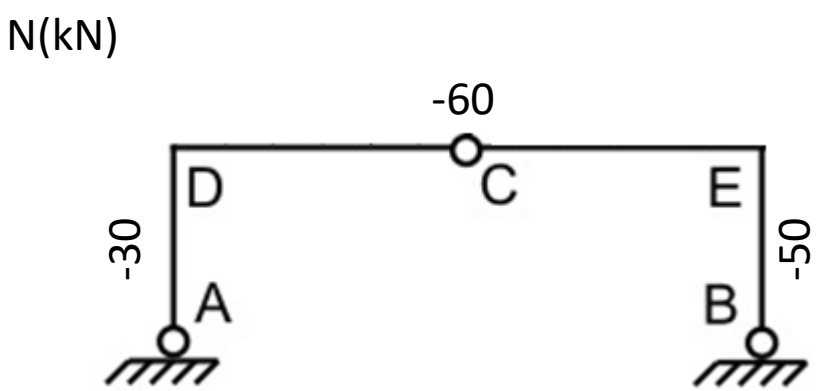
Suma(F_V)=V_A+50-10.8 =0
V_A=30 kN

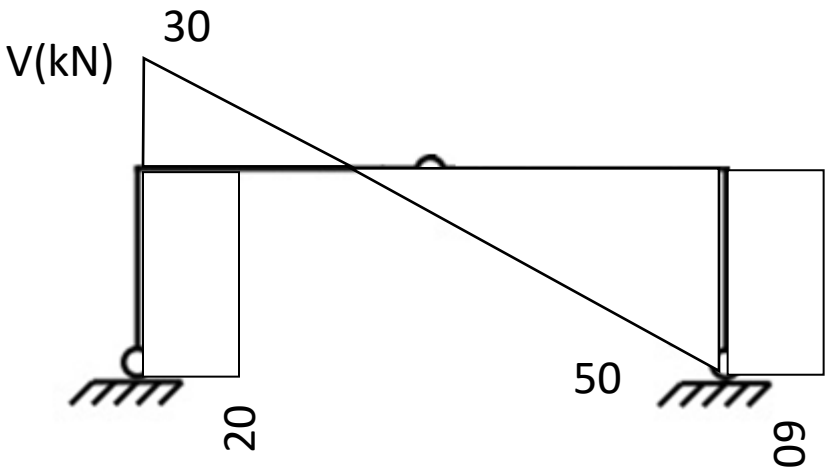
Suma (M_{derC}) = 4.10.2-50.4+H_B.2
H_B=60kN

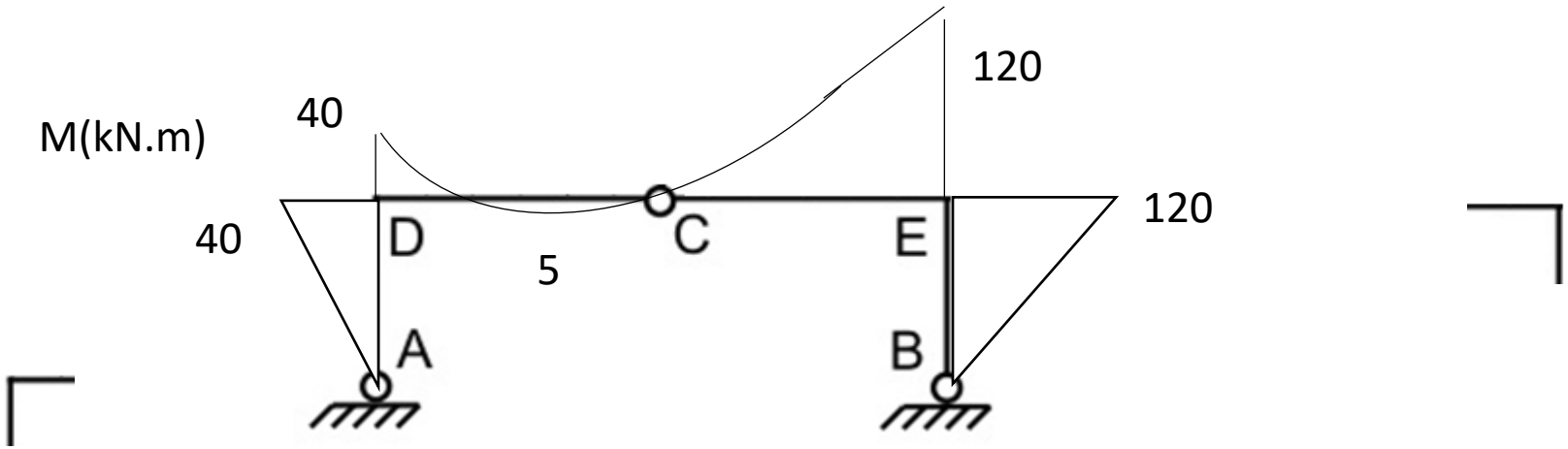
H_A=20kN



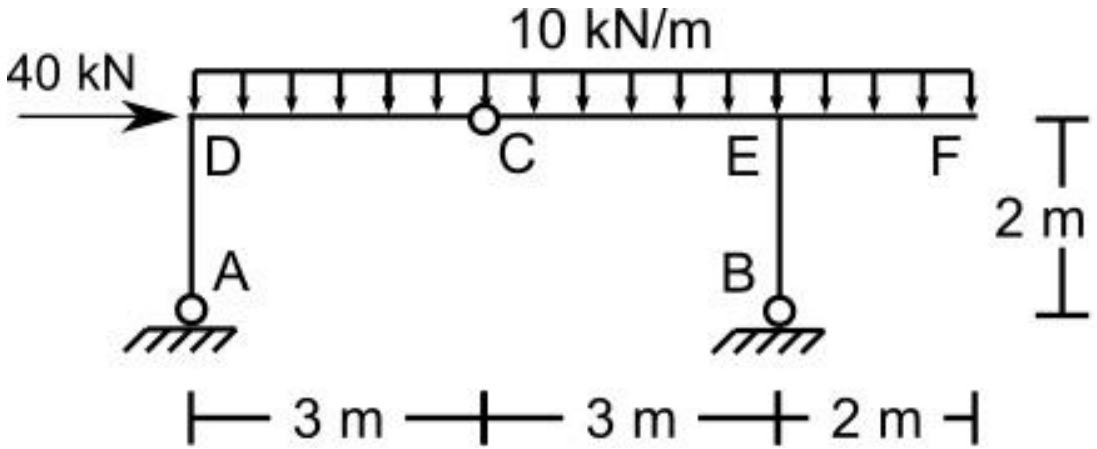
Diagramas







Arco de tres articulaciones



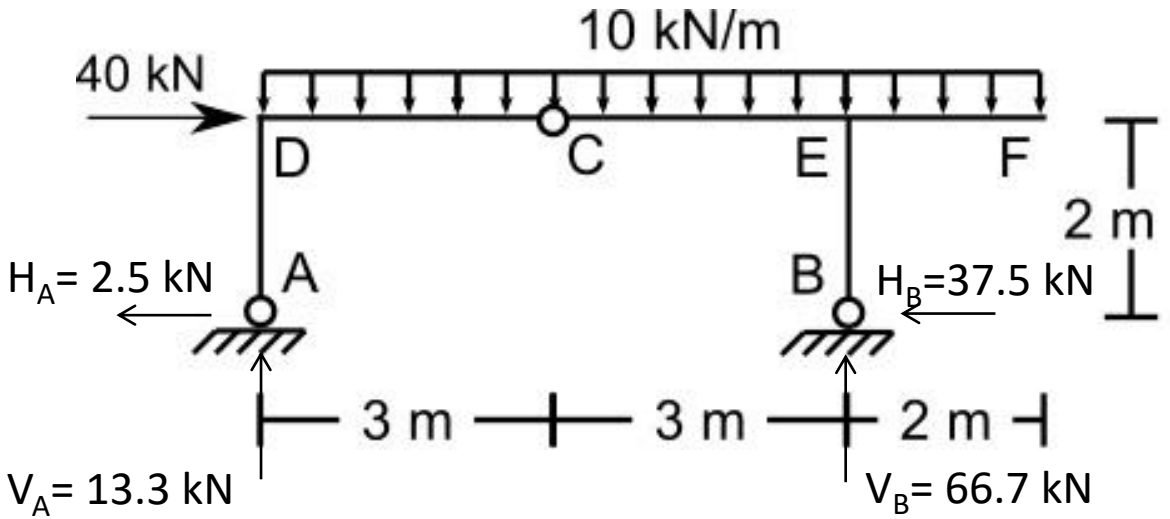
Suma(M_A)= 0 40.2+10.8. 4-V_B.6=0 → V_B= 66.7 kN

Suma(F_V)= 0 V_A+V_B=80 → V_A= 13.3 kN

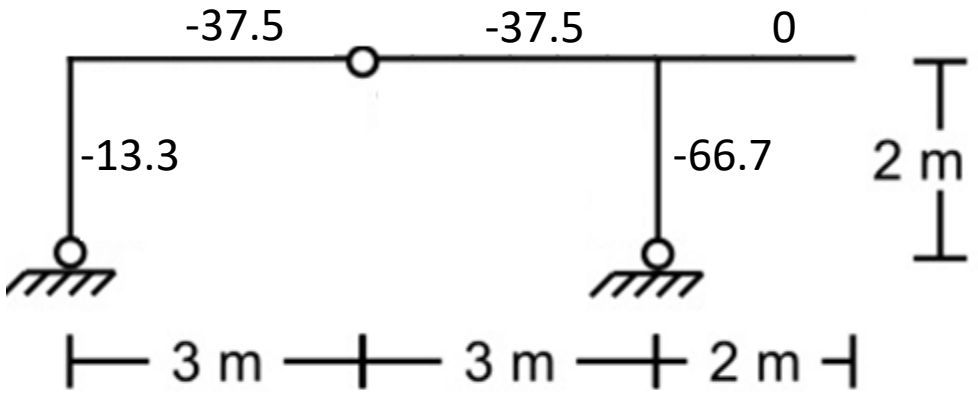
Suma(M_{derC})=0 10*5*2.5-66.7*3+H_B.2=0 → H_B=37.5 kN

H_A= 2.5 kN

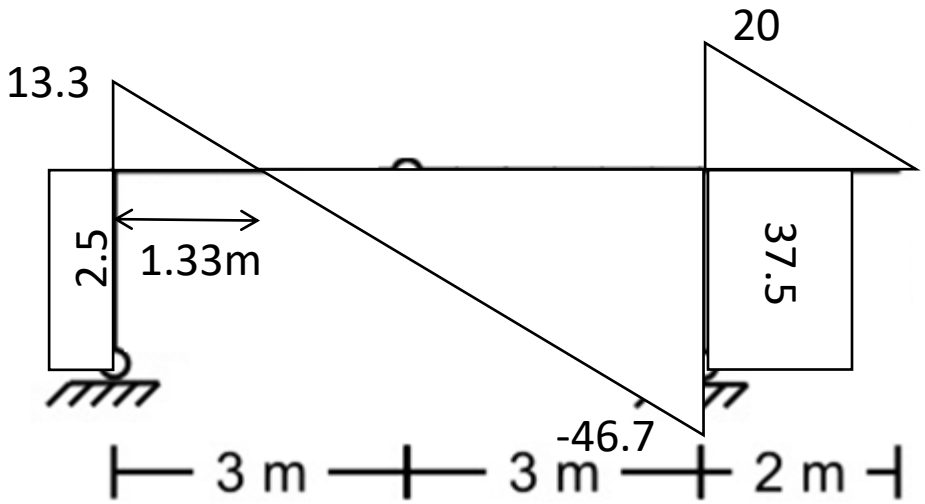
Reacciones

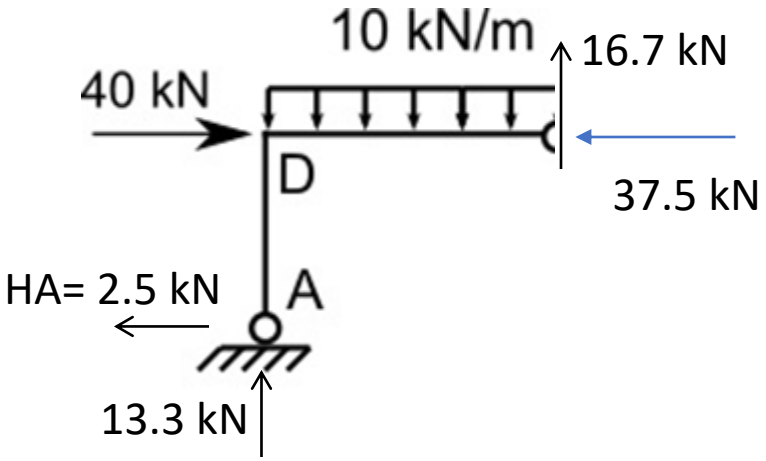

10 kN/m
40 kN
D
C
E
F
2 m
H_A= 2.5 kN
A
B
H_B=37.5 kN
3 m
3 m
2 m
V_A= 13.3 kN
V_B= 66.7 kN

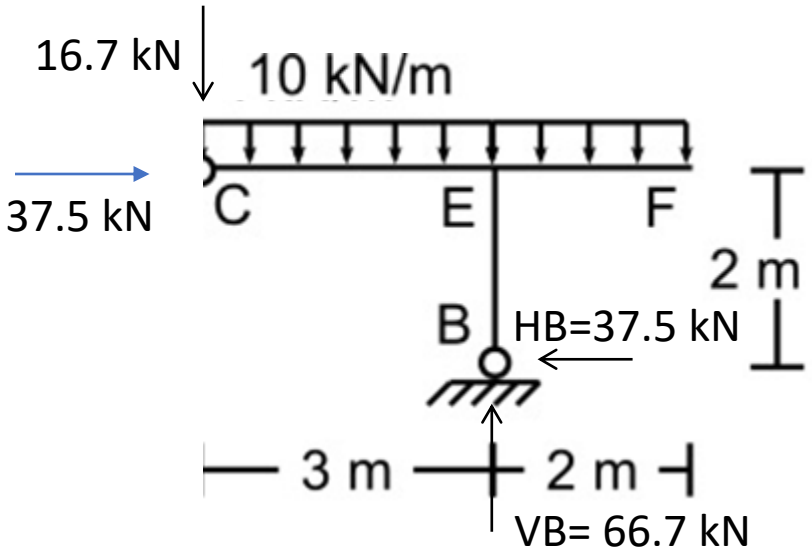
N(kN)



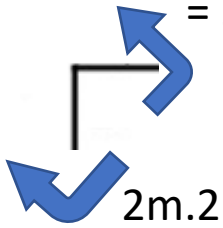
V(kN)





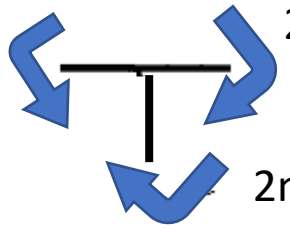


3m.16.7 kN-10kN/m*3m*1.5m
= 5kN.m



2m.2.5 kN
= 5kN.m

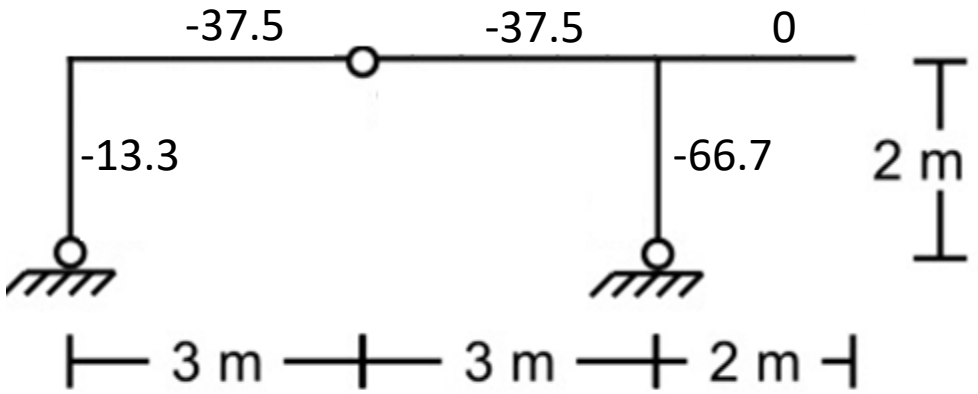
3*16.7+10*3*1.5
=95 kN.m



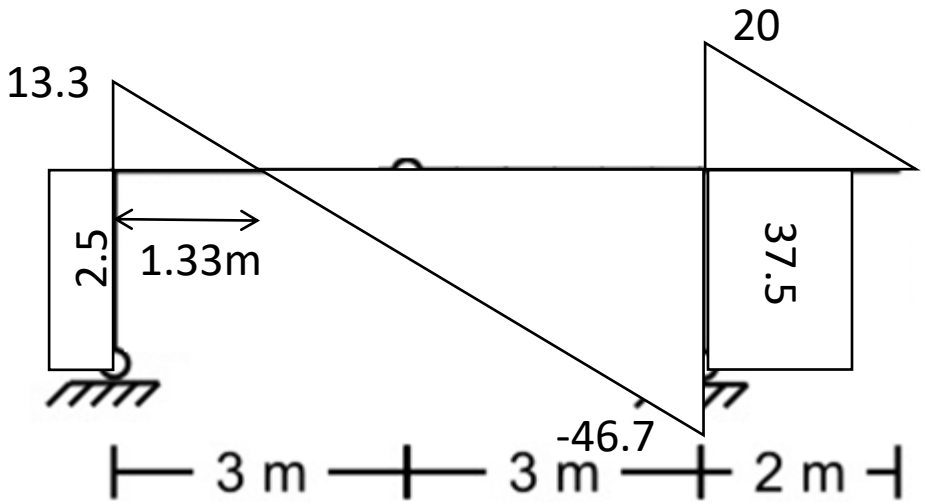
10kN/m*2m*1m=
20 kN.m

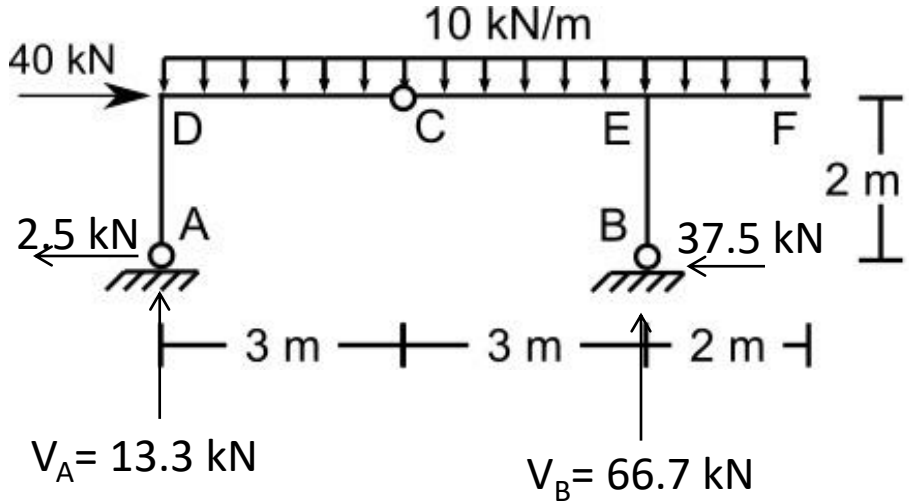
2m*37.5 kN=
75 kN.m

N(kN)

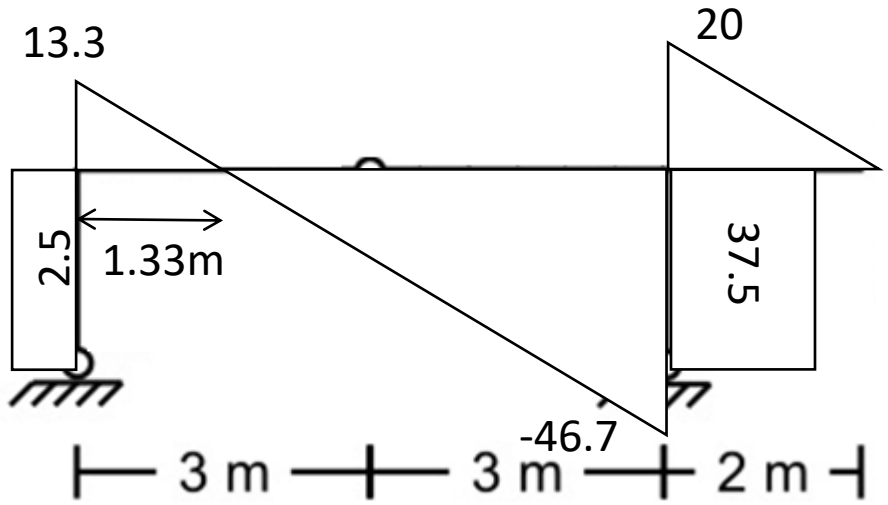


V(kN)

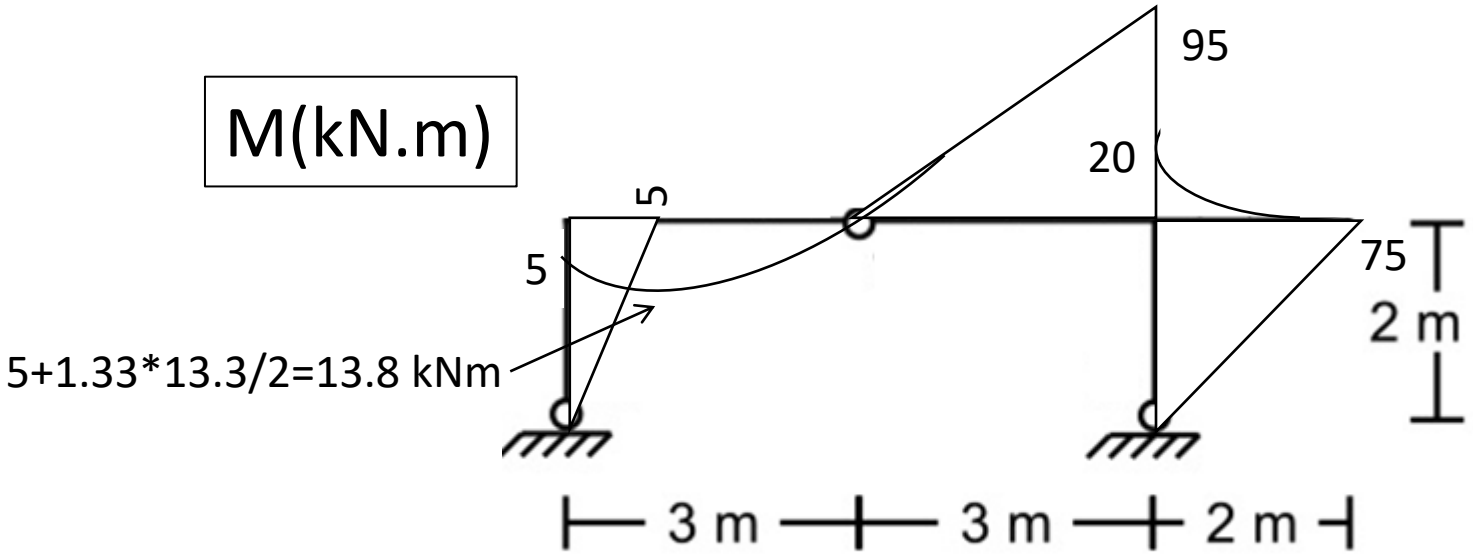



40 kN
10 kN/m
D
C
E
F
2 m
2,5 kN
A
B
37.5 kN
3 m
3 m
2 m
V_A= 13.3 kN
V_B= 66.7 kN

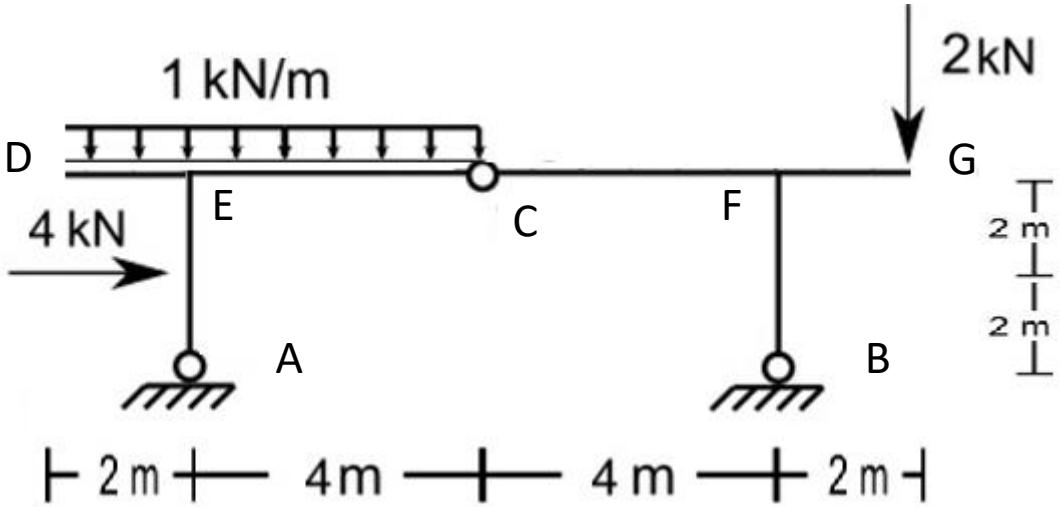
V(kN)


13.3
20
2.5
1.33m
37.5
-46.7
3 m
3 m
2 m

M(kN.m)


95
20
5
5
75
2 m
5+1.33*13.3/2=13.8 kNm
3 m
3 m
2 m

Ejemplo



Suma(FV)=0
VA+VB=2+6

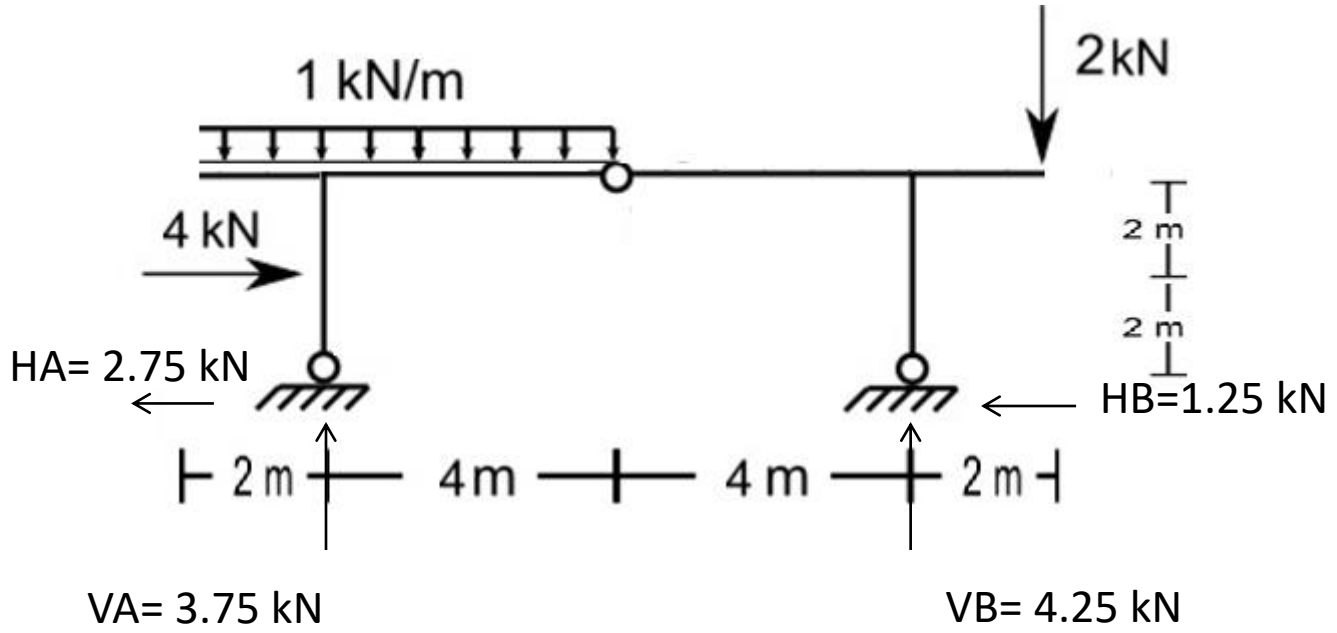
Suma(MA)=0
4*2+4*2-2*1+2*10-8*VB=0→VB=4.25 kN

Suma(FH)=0
HA+HB=4

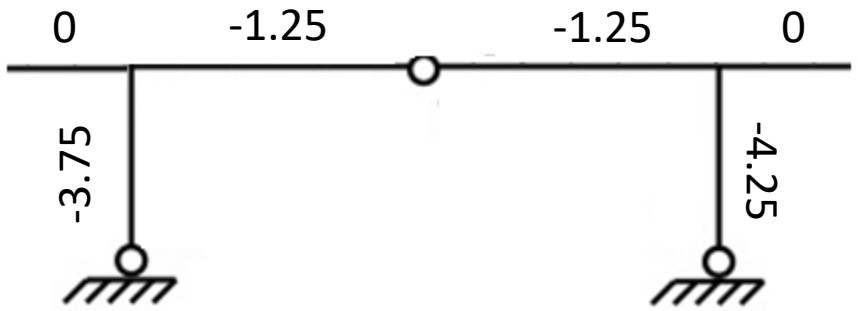
Suma(MCderecha)=0
-VB*8+HB*4+2*6=0→HB=1.25 kN

VA=3.75 kN

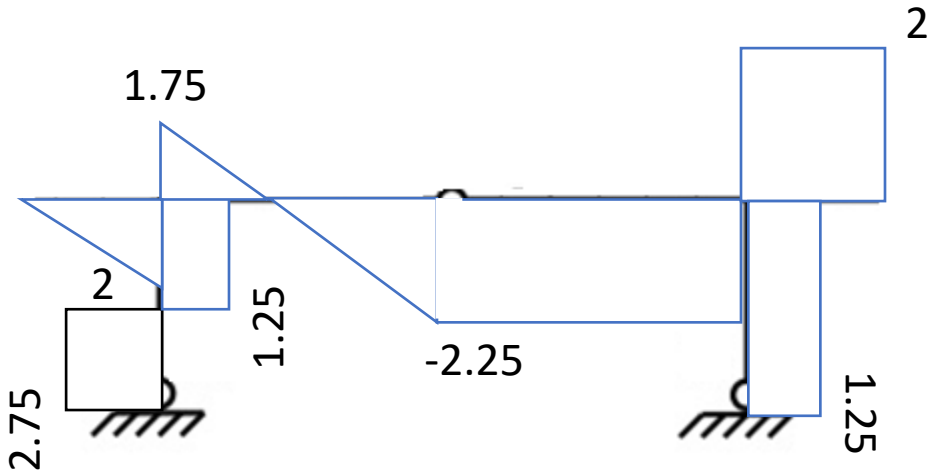
HA=2.75 kN

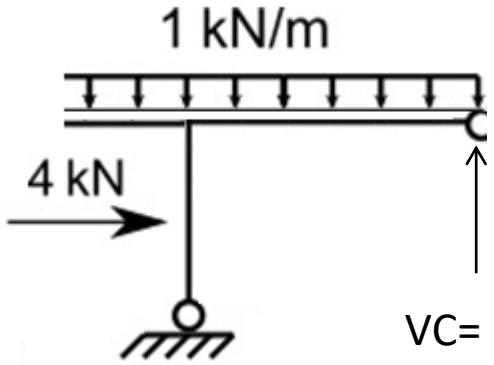

1 kN/m
2kN
4 kN
2 m
2 m
HA= 2.75 kN
HB=1.25 kN
2 m
4m
4 m
2 m
VA= 3.75 kN
VB= 4.25 kN

N(kN)

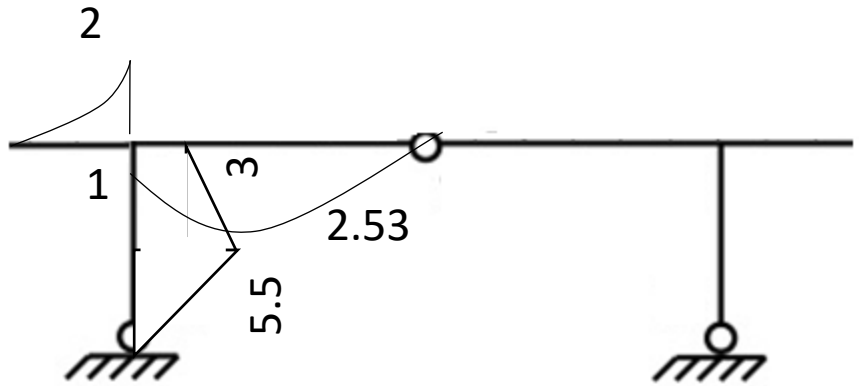

0
-1.25
-1.25
0
-3.75
-4.25

V(kN)

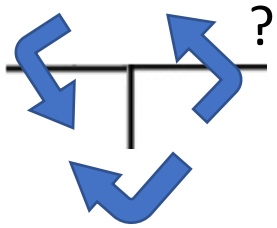


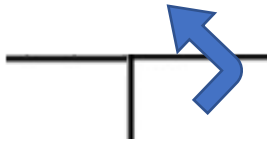


VC= 2.25 kN



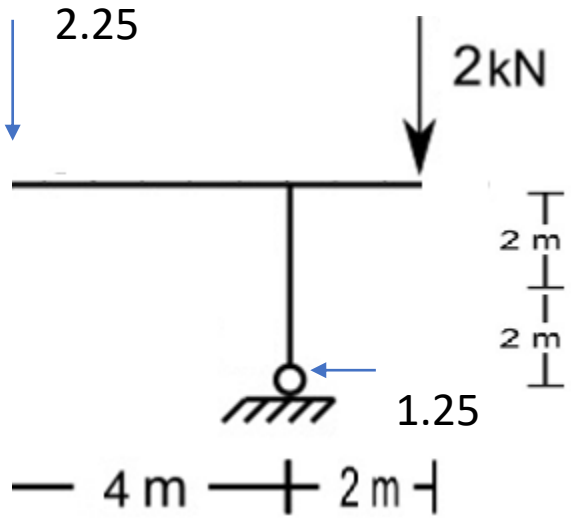
2 kNm=2*1



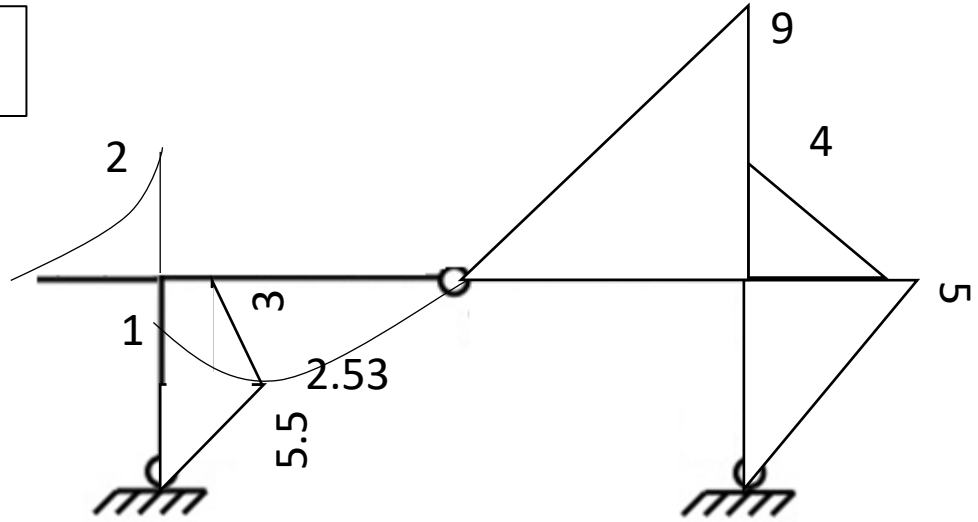


1 kNm=2.25 kN.4m - 4kN.2m

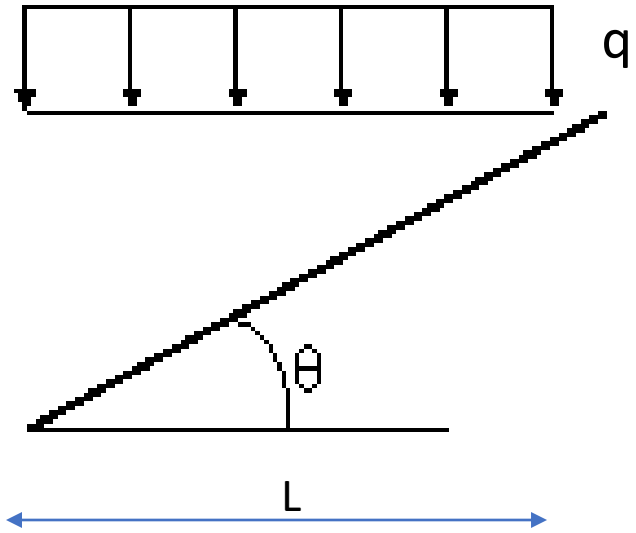
3 kNm=-2.75kN.4m + 4kN.2m



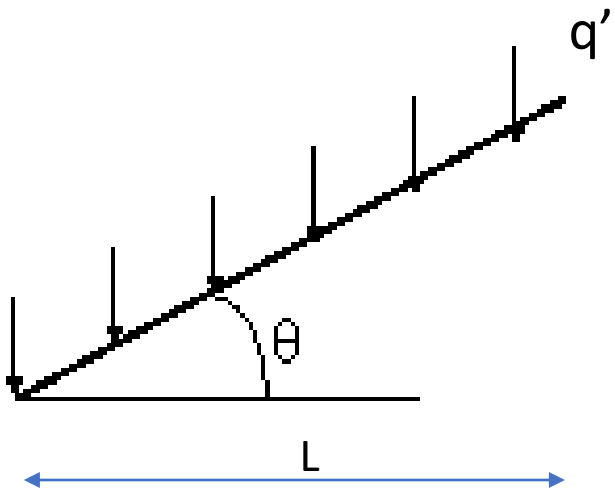
M(kN.m)



Carga distribuida

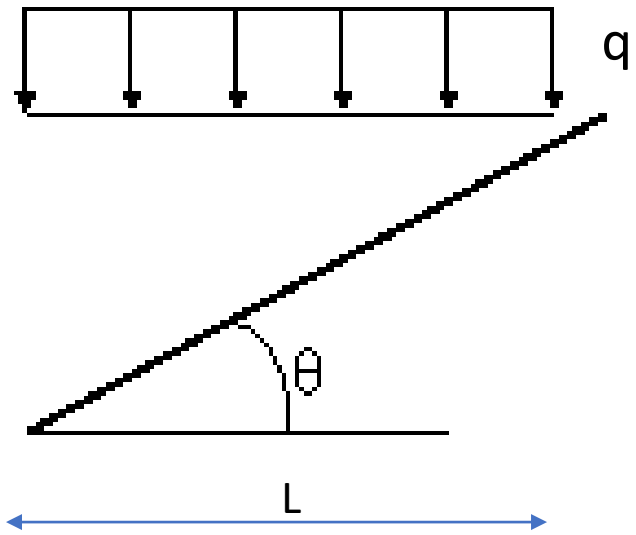


R= q*L

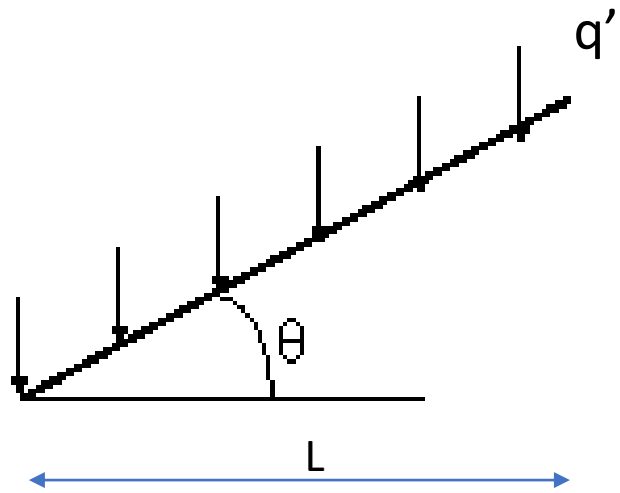


R= q’*L/cos (Θ)

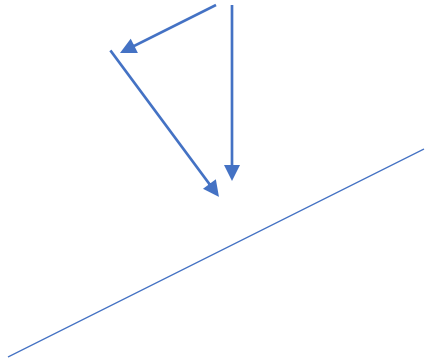
Carga distribuida



R= q*L

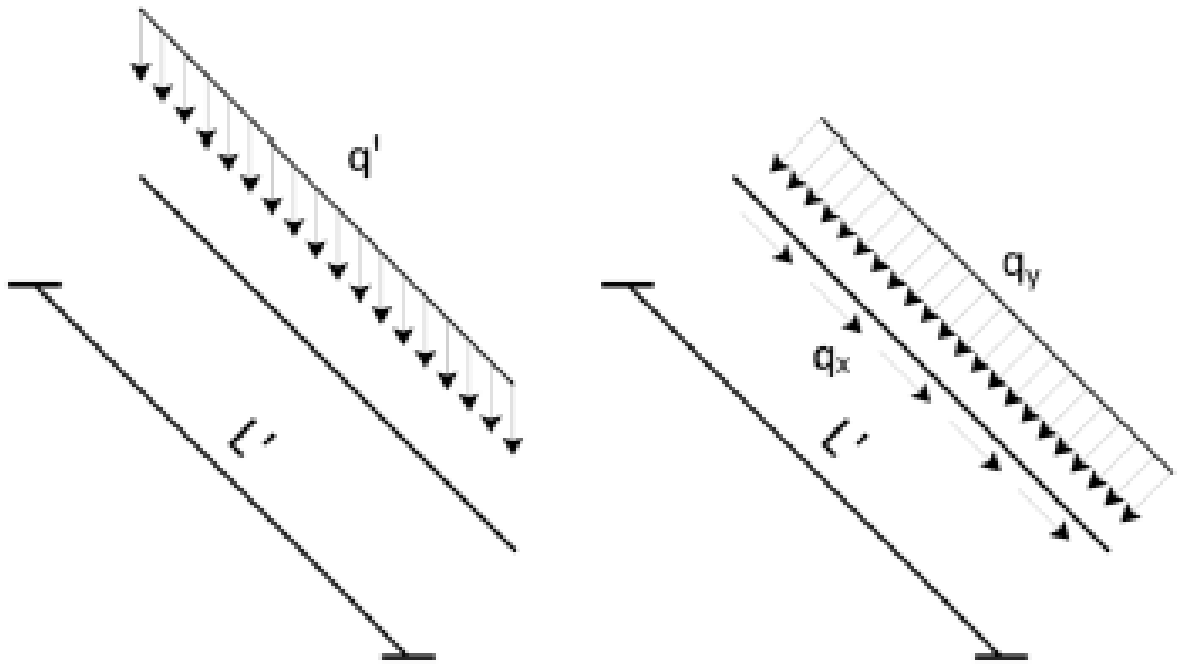


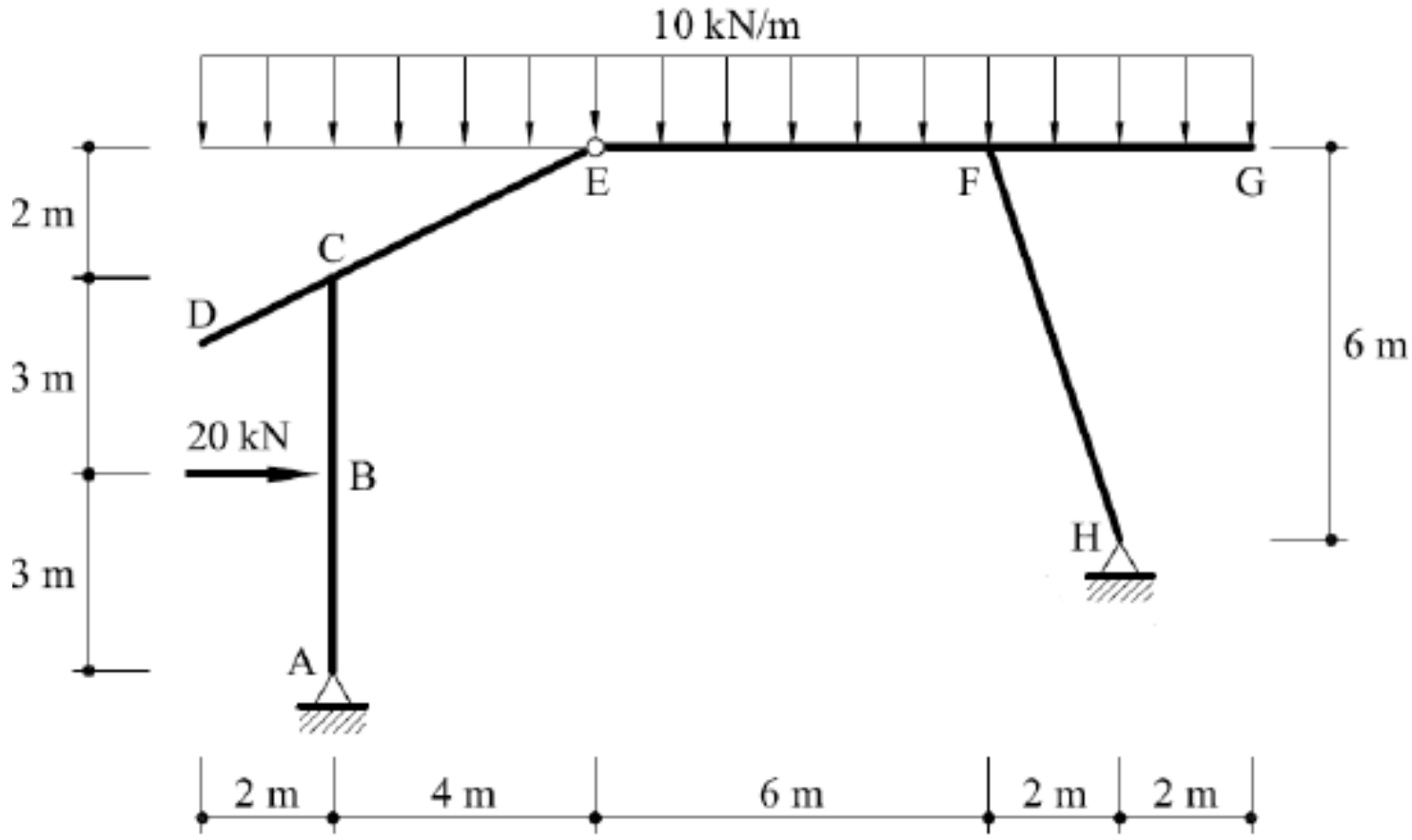
R= q’*L/cos (Θ)



Puede resultar útil trabajar con la carga en los ejes locales de la barra, por lo que descomponemos en cargas q_x y q_y

$$q_y = q' cos\alpha$$
$$q_x = q' sen\alpha$$




10 kN/m
E
F
G
C
D
2 m
3 m
3 m
20 kN
B
A
H
6 m
2 m
4 m
6 m
2 m
2 m

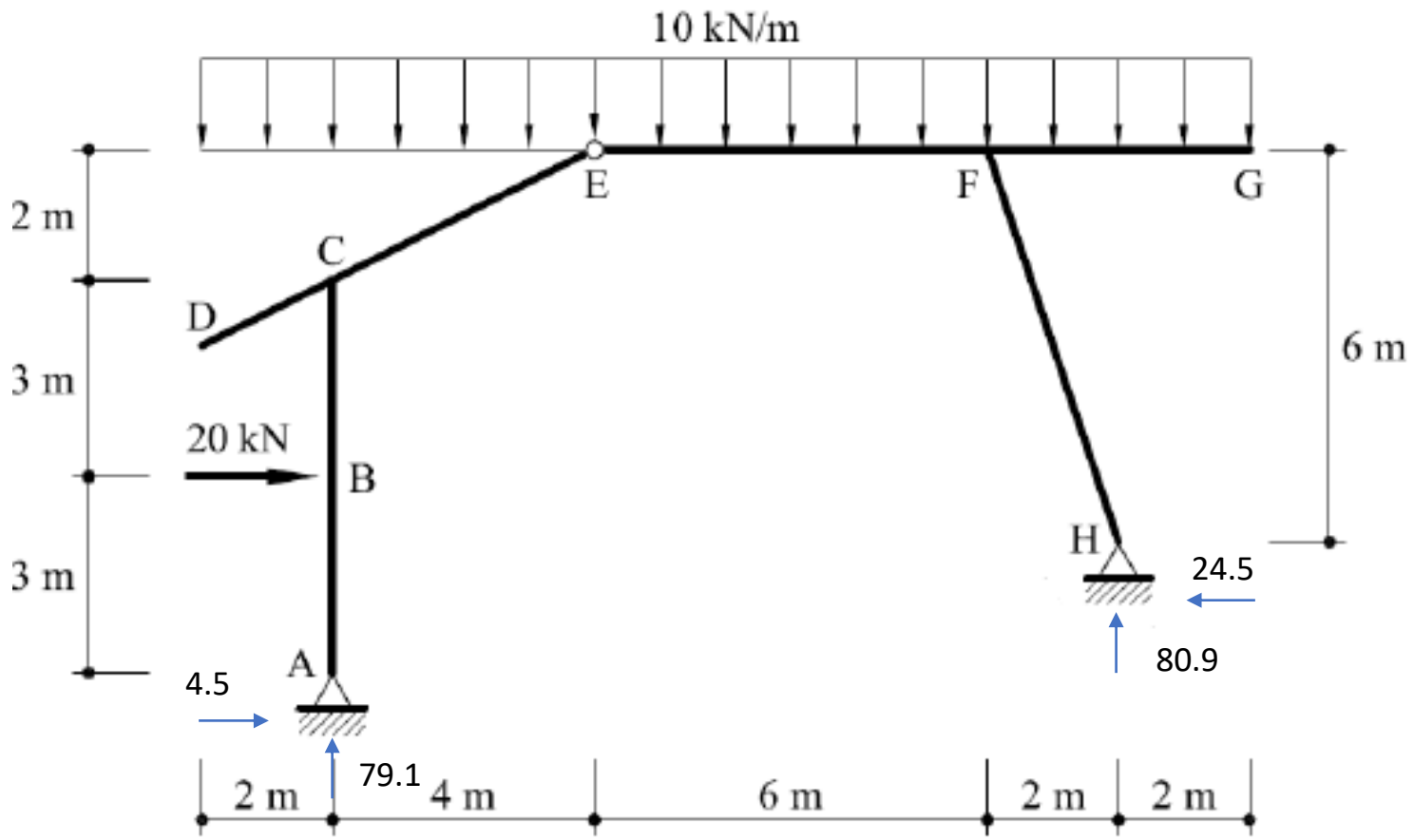
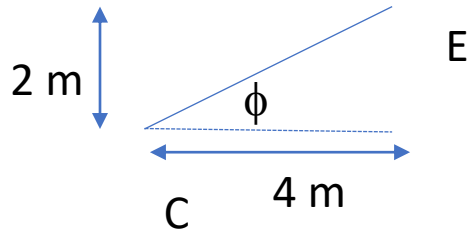

10 kN/m
E
F
G
2 m
C
D
3 m
20 kN
B
3 m
6 m
H
24.5
80.9
A
4.5
79.1
2 m
4 m
6 m
2 m
2 m

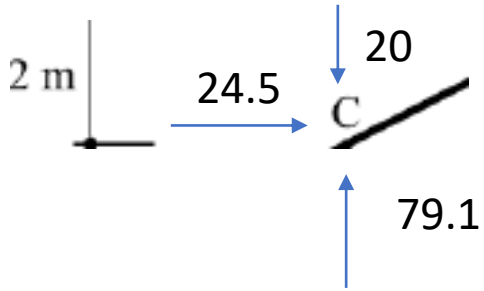
Diagrama de Directa



Tan ϕ = 2/4

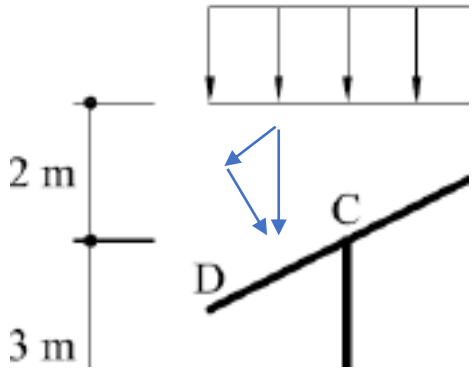
cos ϕ = 0.8944

sen ϕ = 0.4472



59.1*0.4475+24.5*0.8944= 48.4 kN

19.1*0.4475+24.5*0.8944= 30.5 kN

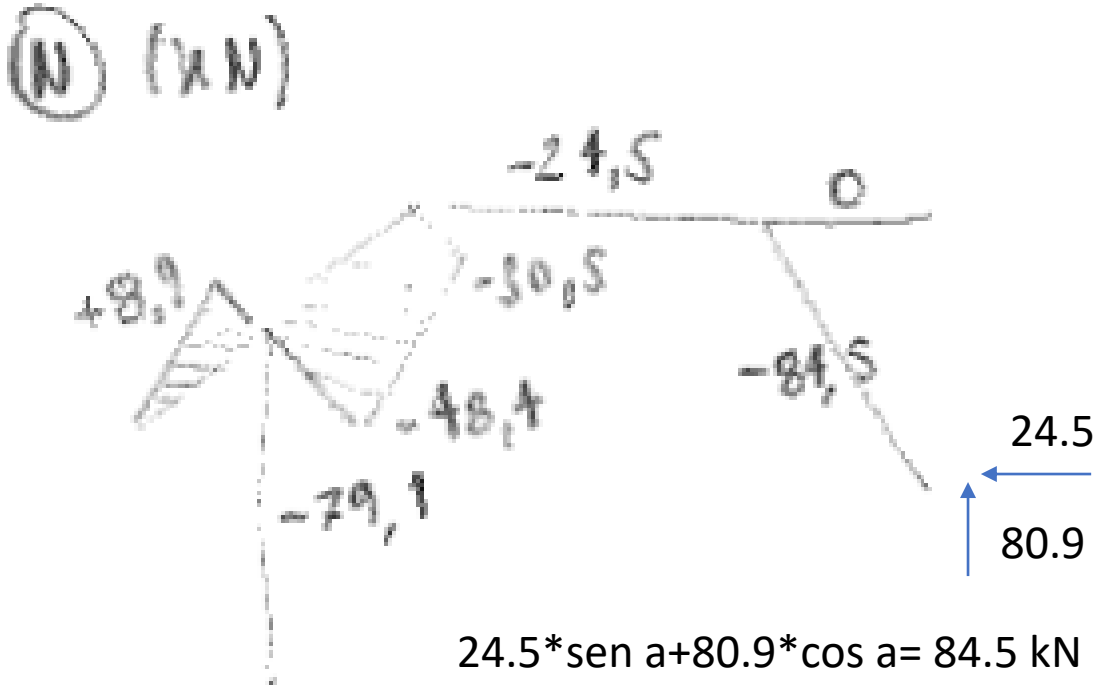


qN= 10 *0.4472

qV= 10 *0.8944

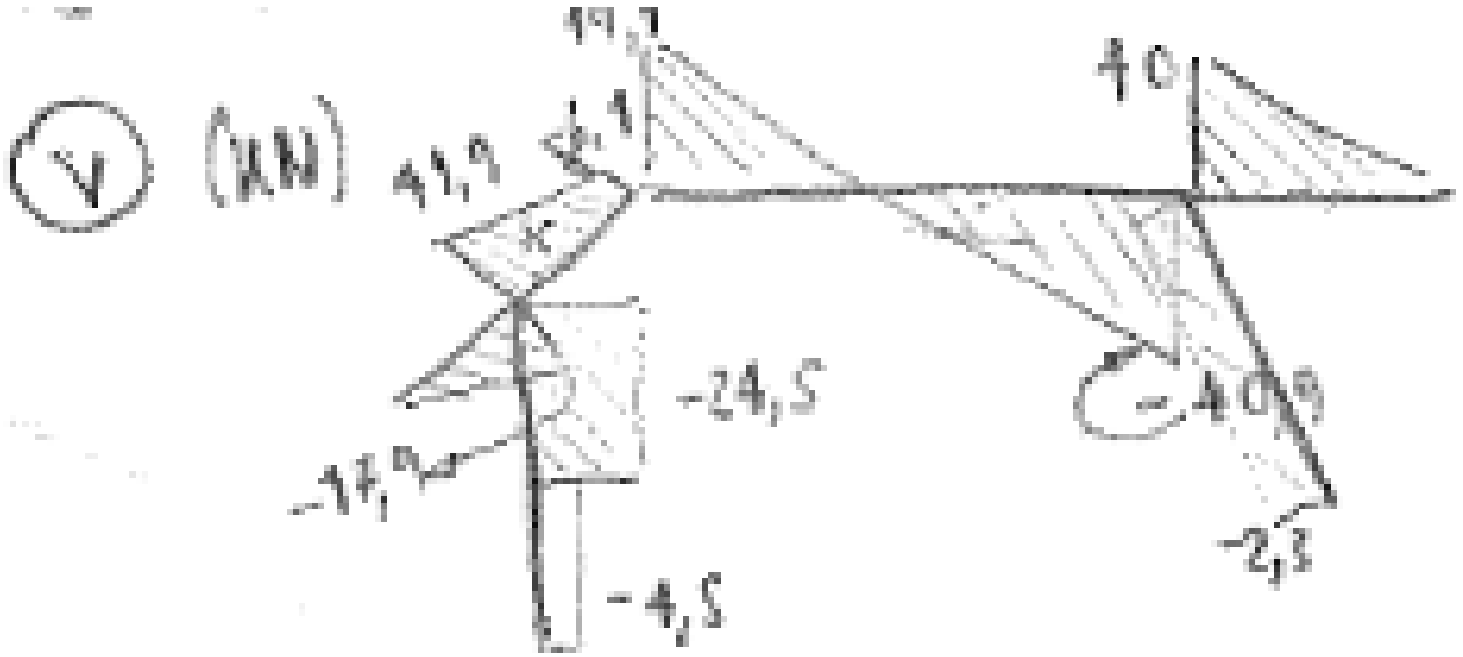
Directa DC en C

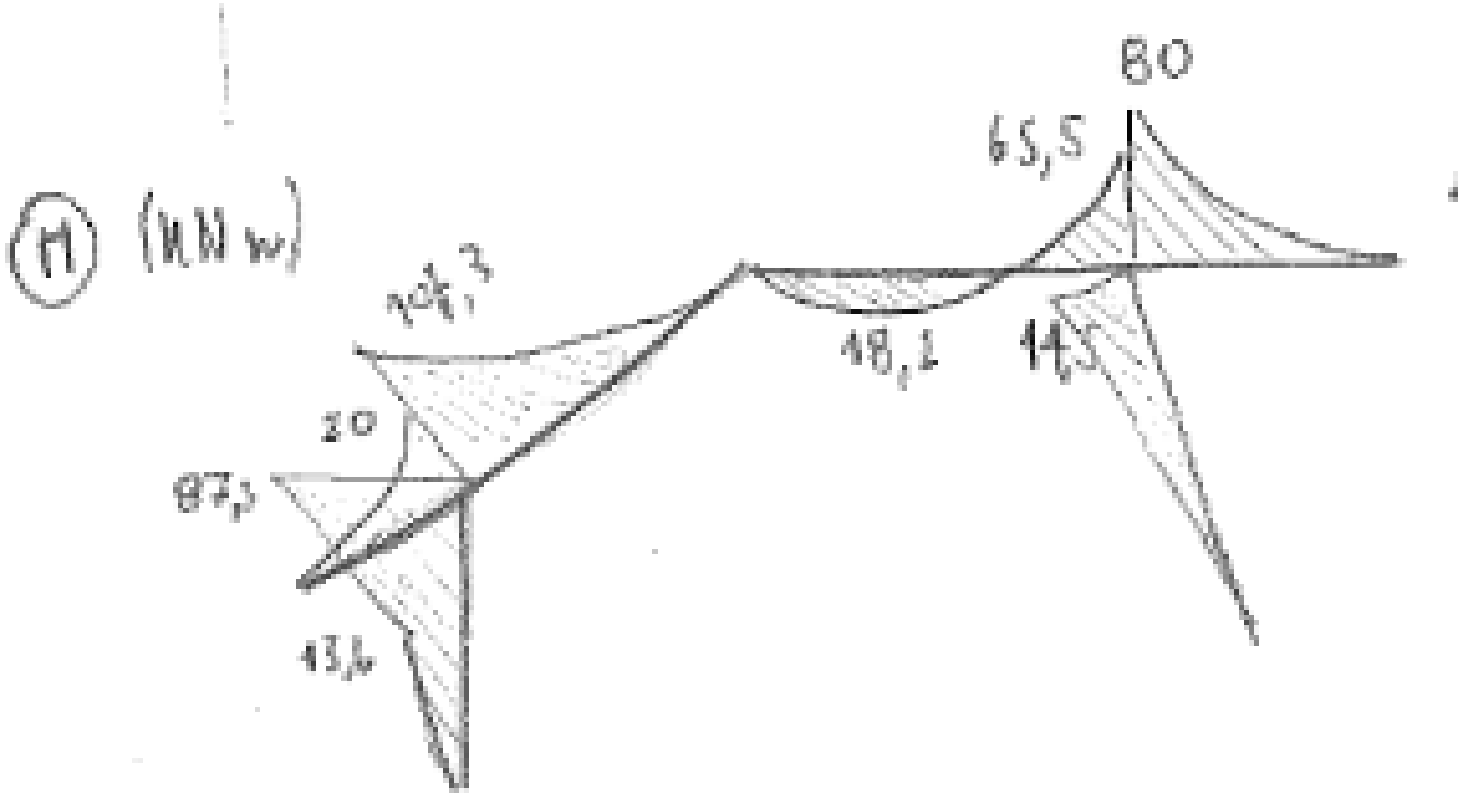
N_{DC}= 2*10*0.4472=8.9 kN



24.5*sen a+80.9*cos a= 84.5 kN

Diagrama de Cortante



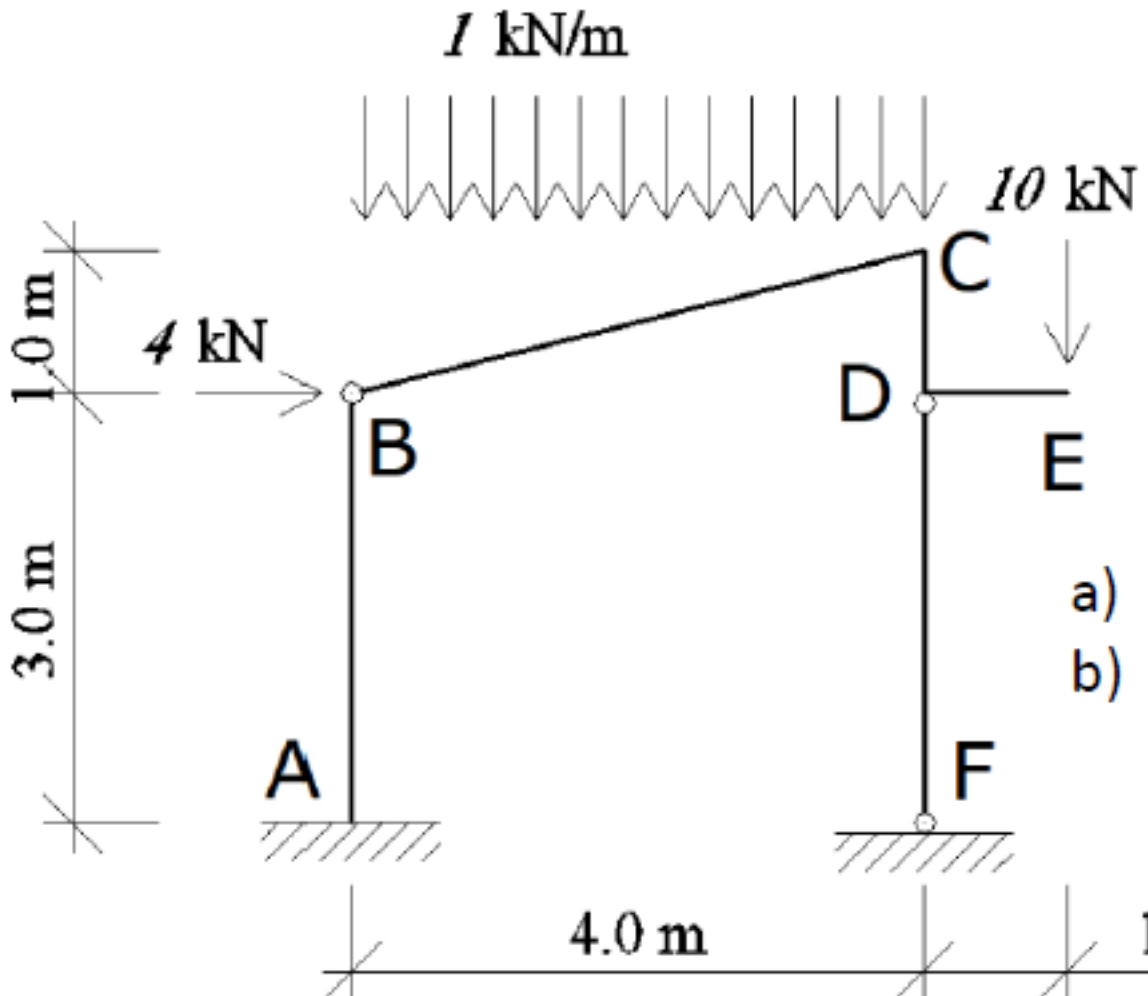


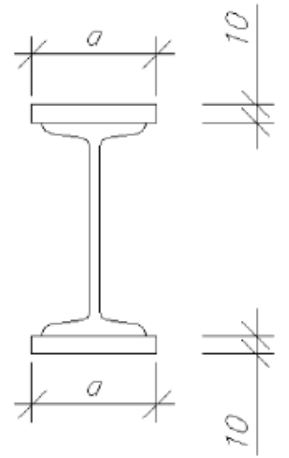
Gere, 5ª Ed. (2002): 5.12

Ortiz Berrocal, 3ª Ed. (2007): 6.5

Beer, 3ª Ed. (2004): 4.12

La estructura de la figura 4, ABCDEF, se encuentra sometida a una carga uniformemente distribuida hacia abajo de 1 kN/m en el tramo BC, a una carga puntal de 10 kN hacia abajo aplicada en el punto E y a una carga puntual de 4 kN horizontal y hacia la derecha aplicada en el punto B. La estructura se materializa mediante una sección formada por un perfil PNI 120 y dos planchuelas metálicas de 10 mm de espesor cada una; siendo éstas del mismo material que el perfil. Se pide:





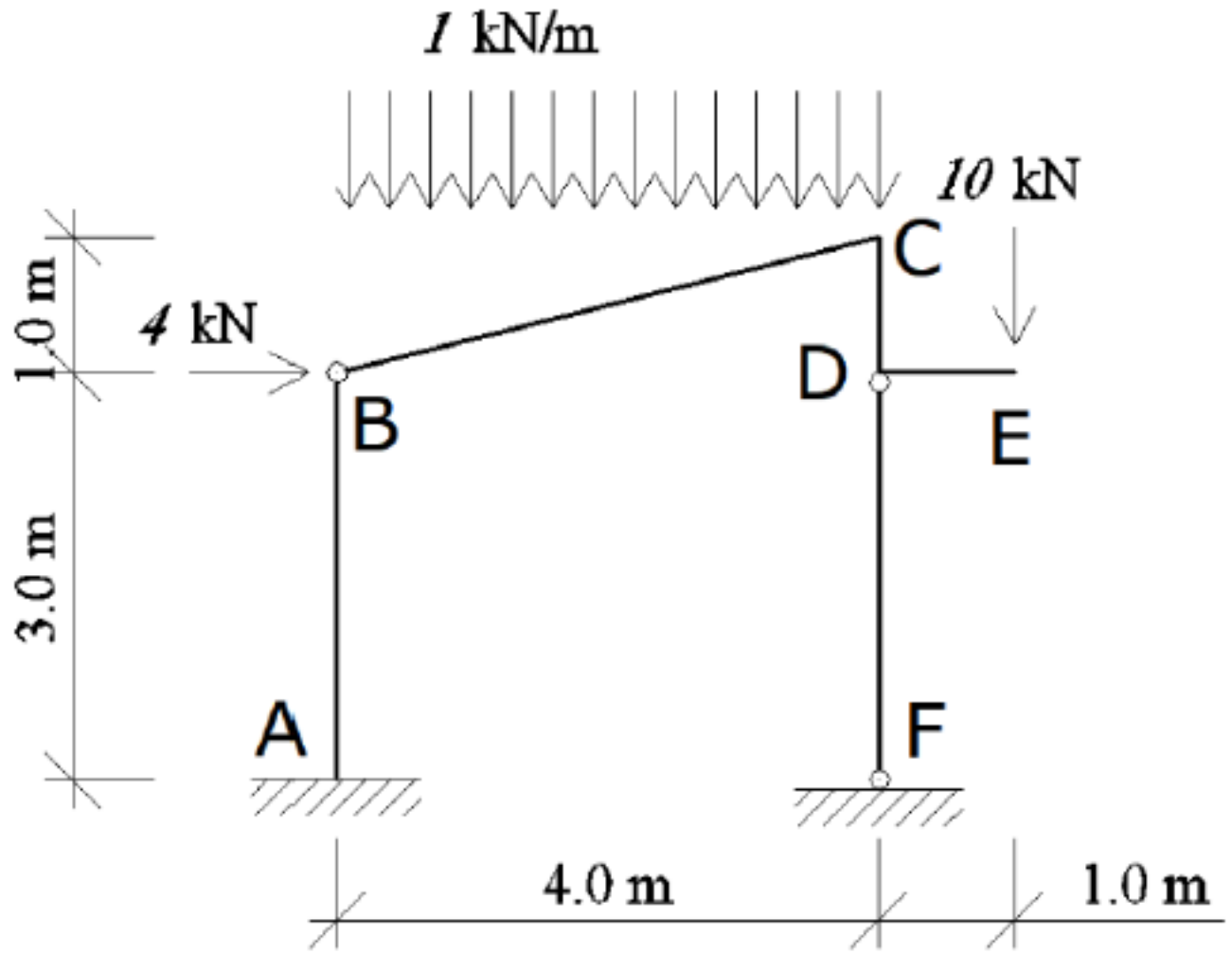
UNIDADES EN *mm.*

a) Trazar los diagramas de solicitaciones.

b) Hallar el valor del ancho a de las planchuelas,

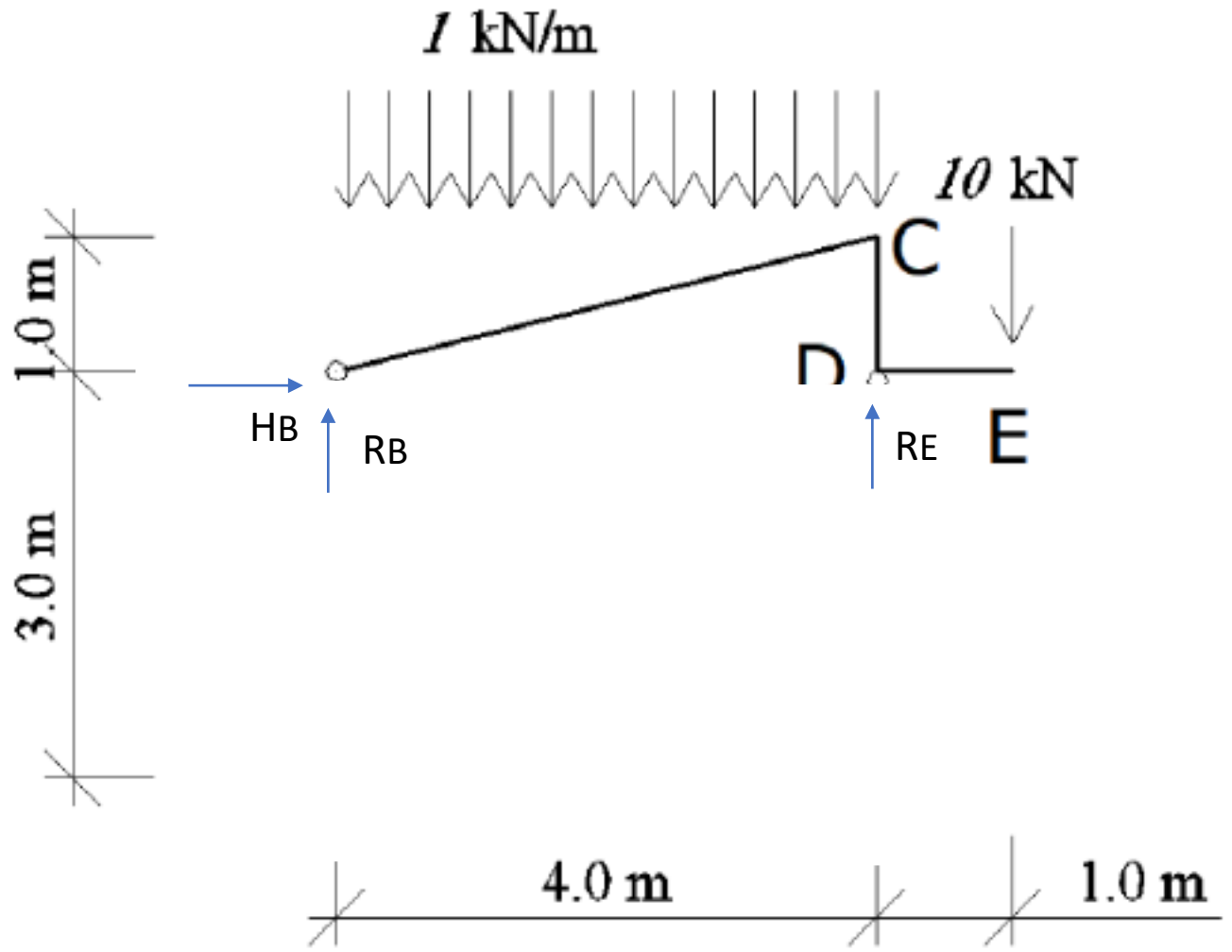
tensión normal admisible de 140 MPa
tensión rasante admisible de 90 MPa

Hallar reacciones



cos (alfa)=4/raiz(17)
cos (alfa)= 0.97

sen (alfa)=1/raiz(17)
sen (alfa)= 0.24



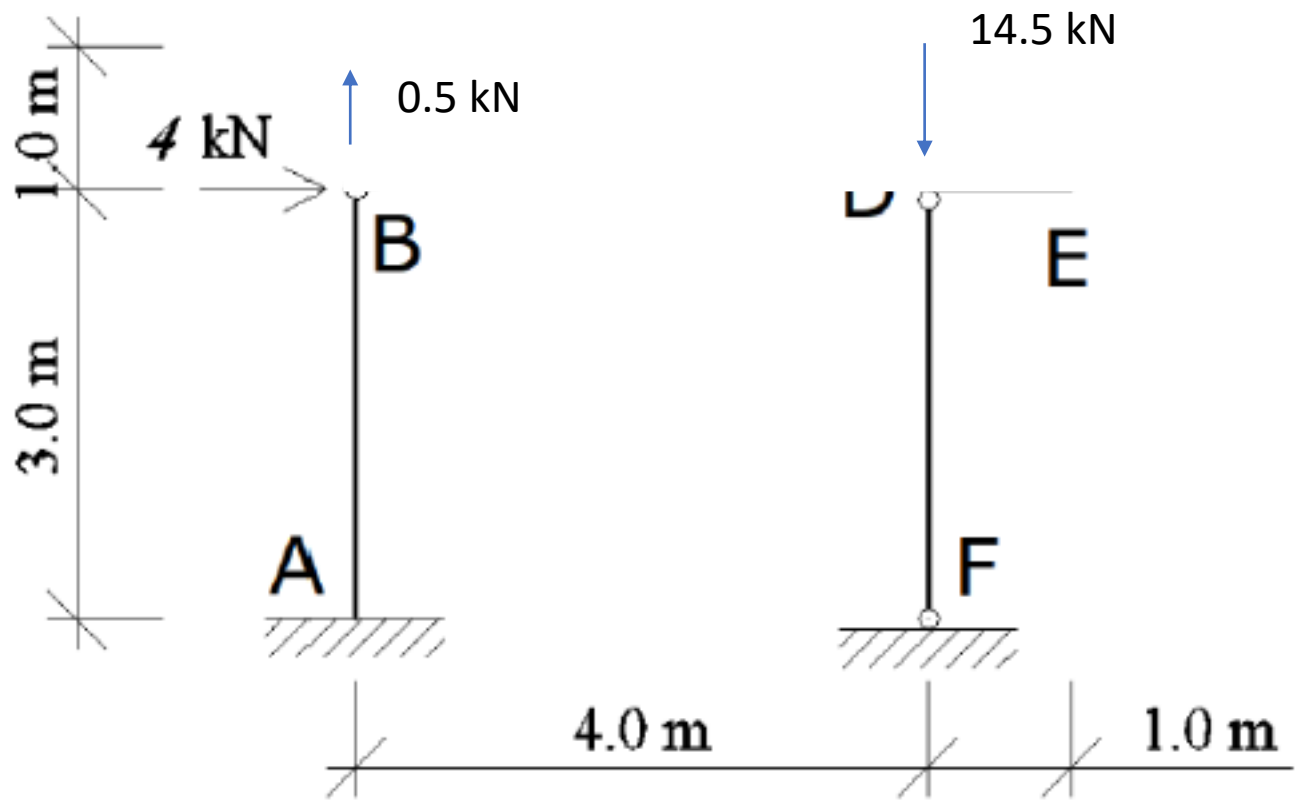
Suma(M_B)=0

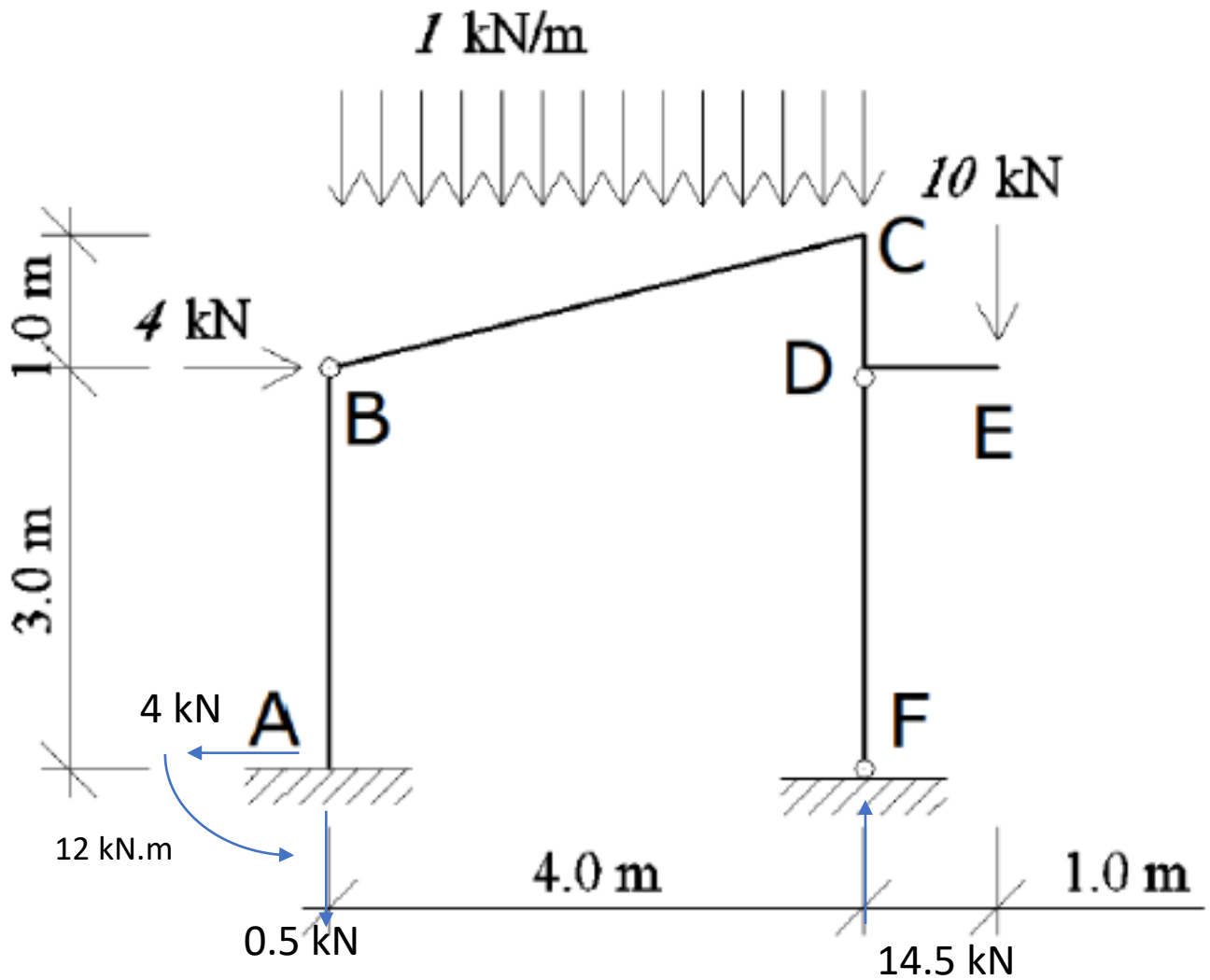
4*2+50-4*R_E=0

R_E= 14,5 kN

R_B= -0,5 kN

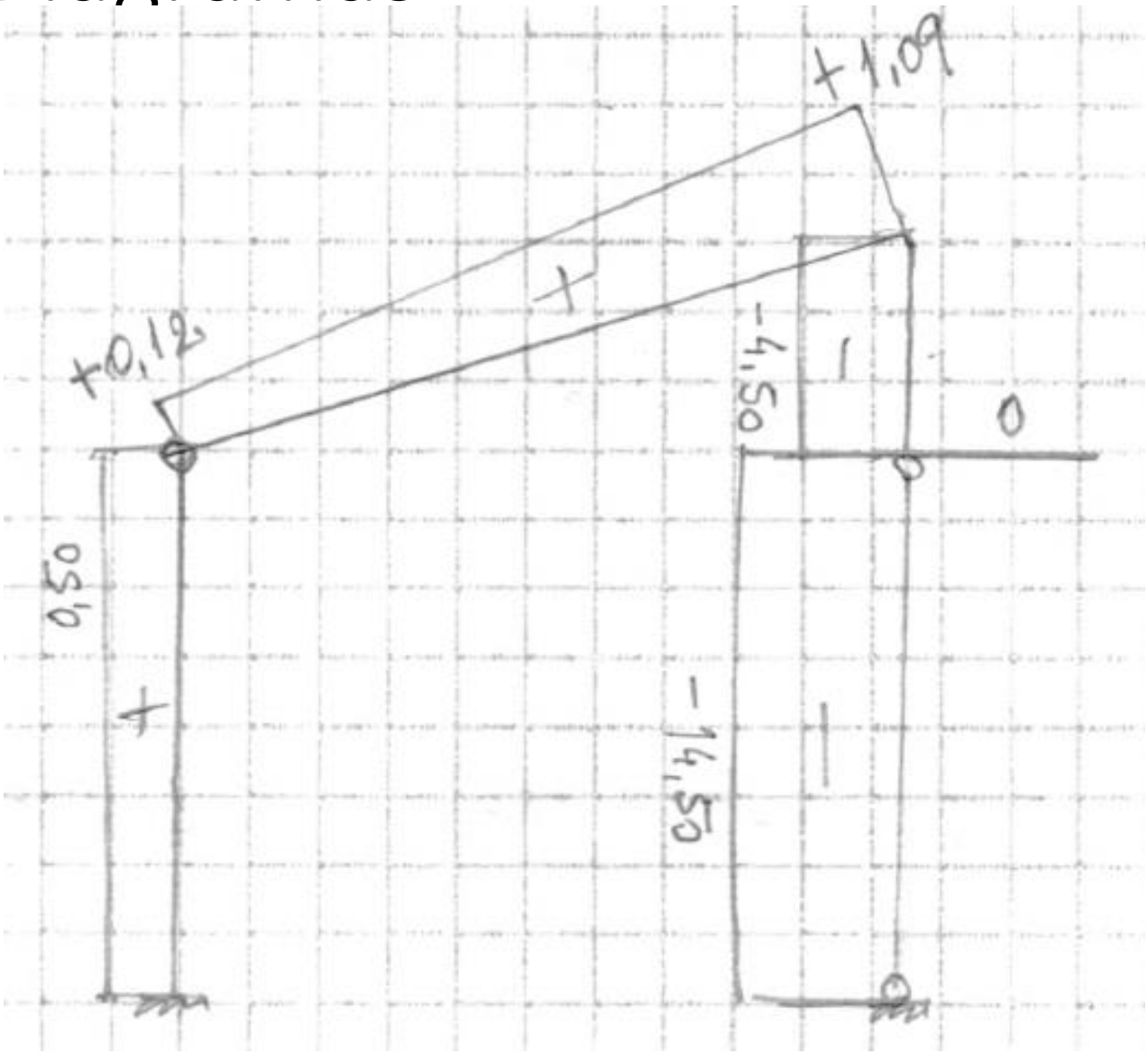
Hallar reacciones

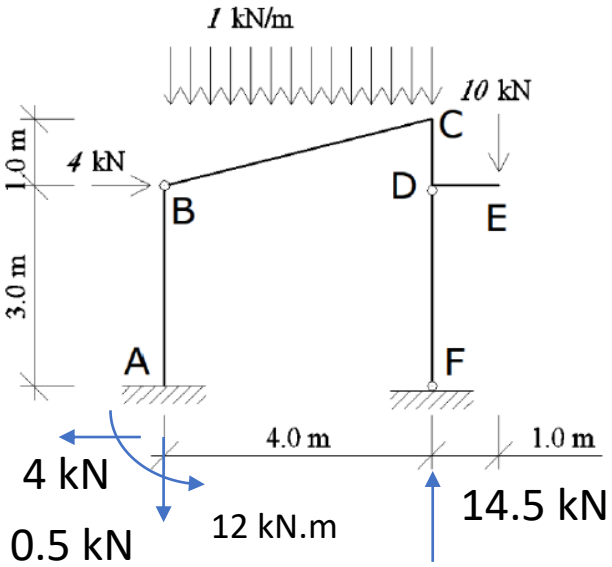



1 kN/m
10 kN
C
4 kN
1.0 m
D
B
E
3.0 m
4 kN
A
F
12 kN.m
4.0 m
1.0 m
0.5 kN
14.5 kN

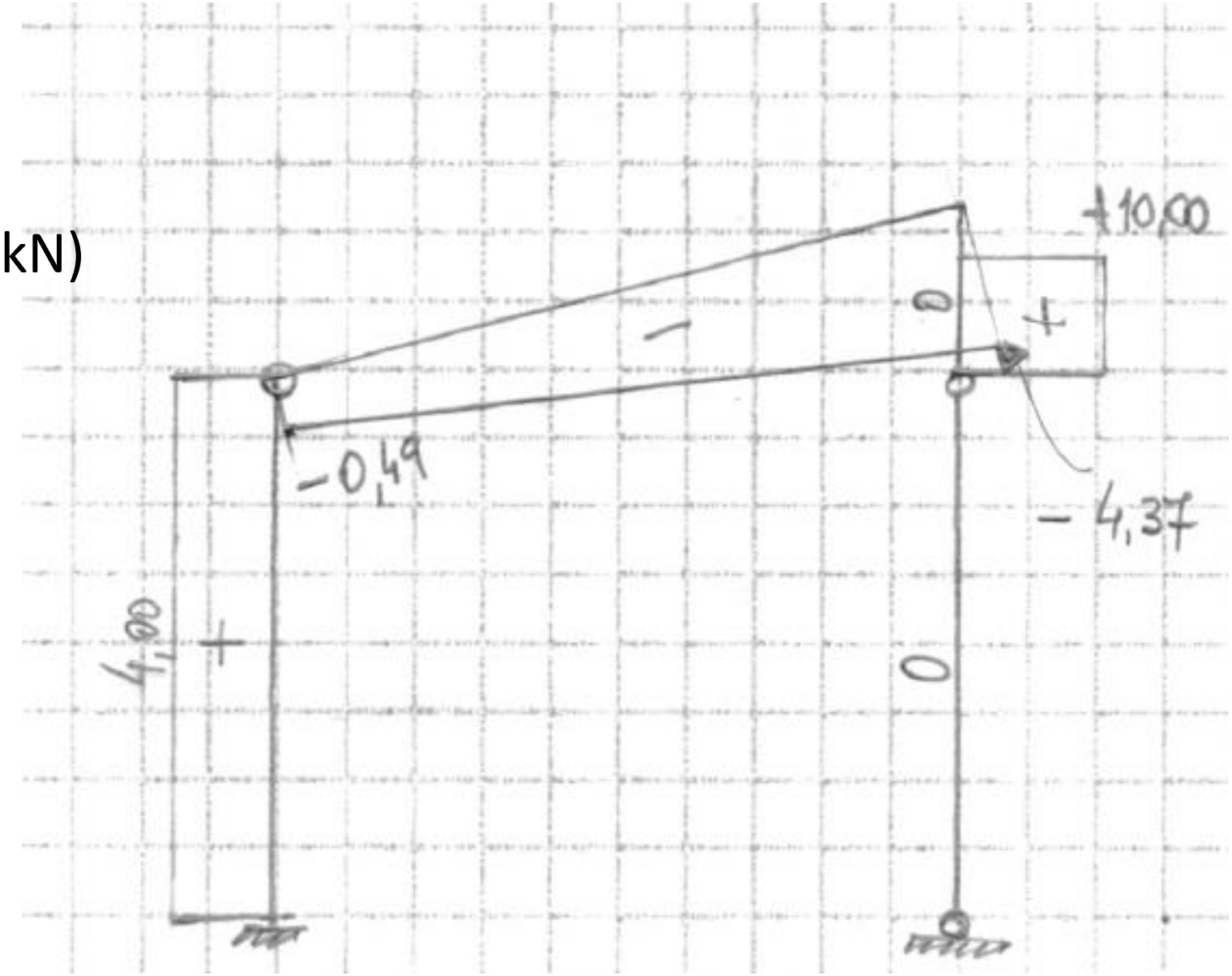
Trazar Diagramas

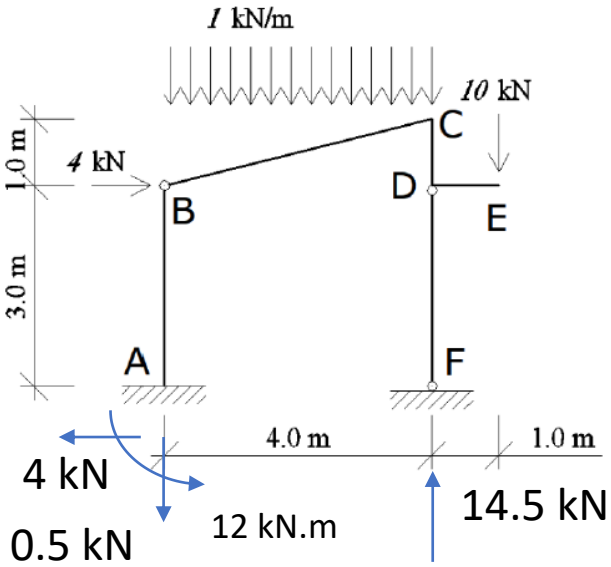
- N (kN)

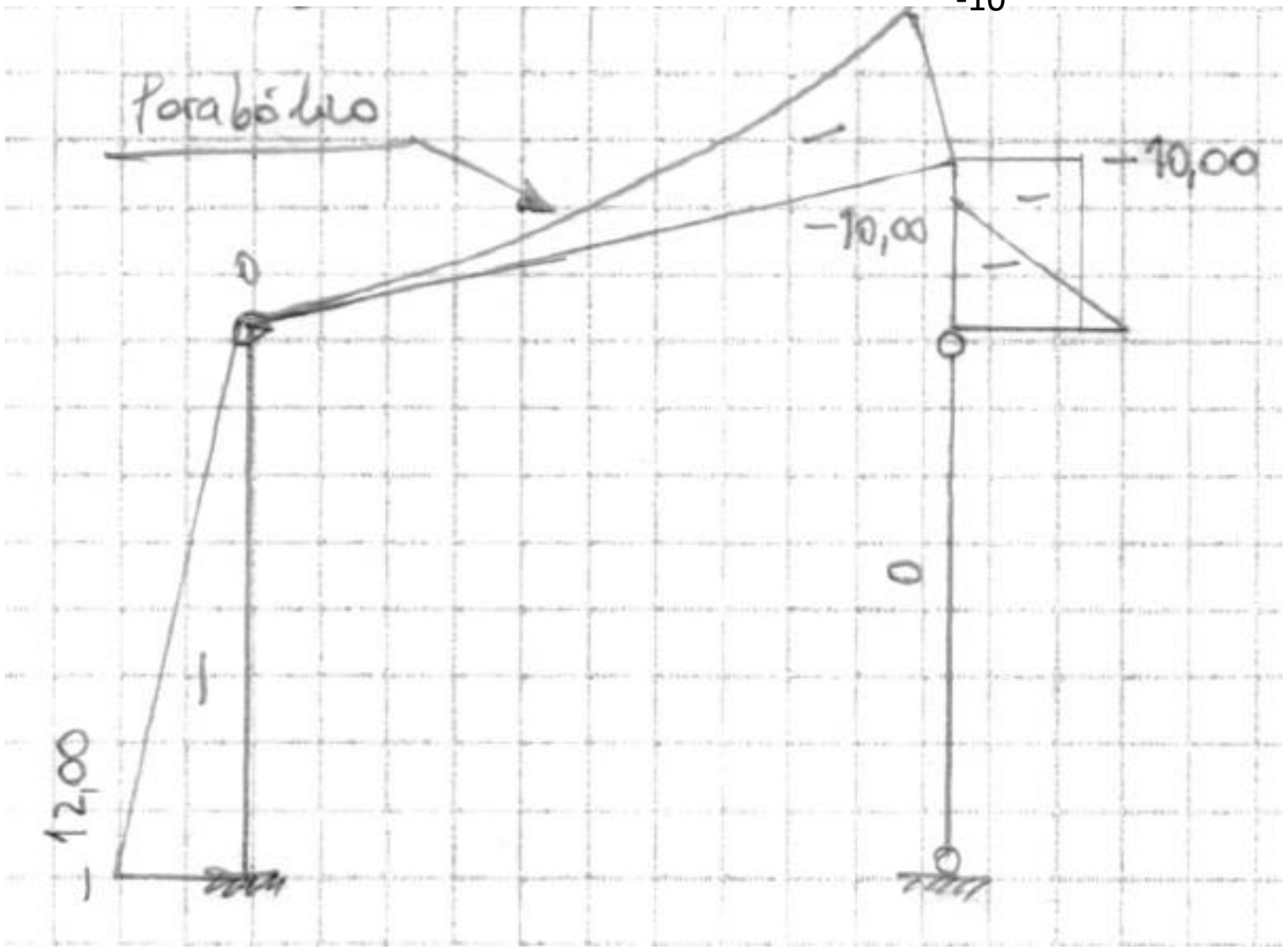


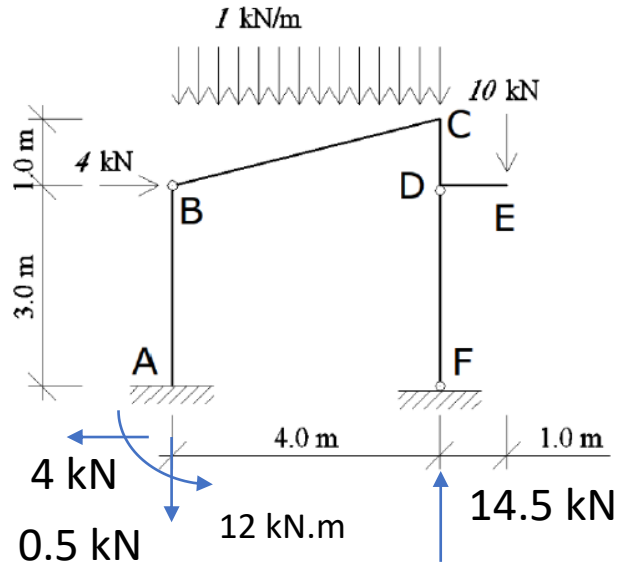


- V(kN)


+10,00
-0,49
-4,37
4,00
+
-
+
0


1 kN/m
10 kN
C
1.0 m
4 kN
B
D
E
3.0 m
A
F
4.0 m
1.0 m
4 kN
0.5 kN
12 kN.m
14.5 kN


Parábola
-10,00
-10,00
0
0
-12,00


1 kN/m
10 kN
C
4 kN
1.0 m
B
D
E
3.0 m
A
F
4.0 m
1.0 m
4 kN
0.5 kN
12 kN.m
14.5 kN

Dimensionado

- En barra AB: Mmax= 12 kNm y N= +0.5 kN
- En CD: M =10 kNm y N= -4.5 kN
- N= -14.5 kN
- V= -10 kN

PNI 12

$$I_x = 328 \times 10^4$$

$$I_x = 2 \cdot \left(\frac{a\,10^3}{12} + 10 \cdot a \cdot 65^2 \right)$$

Placas

$$I_x = 328 \times 10^4 + 84{,}67 \times 10^3 \cdot a \quad [mm^4]$$

PNI 12

EN A: Mmax= 12 kNm y N= +0.5 kN

$$\sigma = \frac{500}{14{,}20 \times 10^2 + 20 \cdot a} + \frac{12 \times 10^6 \cdot 70}{328 \times 10^4 + 84{,}67 \times 10^3 a} \leq 140$$

$$237{,}076 \times 10^6 \cdot a^2 + 9{,}174 \times 10^9 a - 542{,}376 \times 10^9 \geq 0$$

$$a \geq 32{,}25 \text{ mm}, \text{ luego } \underline{\underline{a = 33 \text{ mm}}}$$

VERIFICO ON CD: M =10 kNm y N= -4.5 kN

$$A = 2{,}080 \times 10^3 \ mm^2$$

$$I_x = 6{,}074 \times 10^6 \ mm^4$$

$$|\sigma| = 117{,}4 \leq 140 \ MPa \quad (ok)$$

VERIFICO A CORTANTE:

$$M_x = 31{,}8 \times 10^3 + 10.33 \cdot 65 = 53{,}25 \times 10^3 \ mm^3$$

$$\tau = \frac{53{,}25 \times 10^3 \cdot 10000}{6{,}074 \times 10^6 \cdot 5{,}1} = 17{,}2 \ MPa \leq 90 \ MPa$$

→ ok ✓