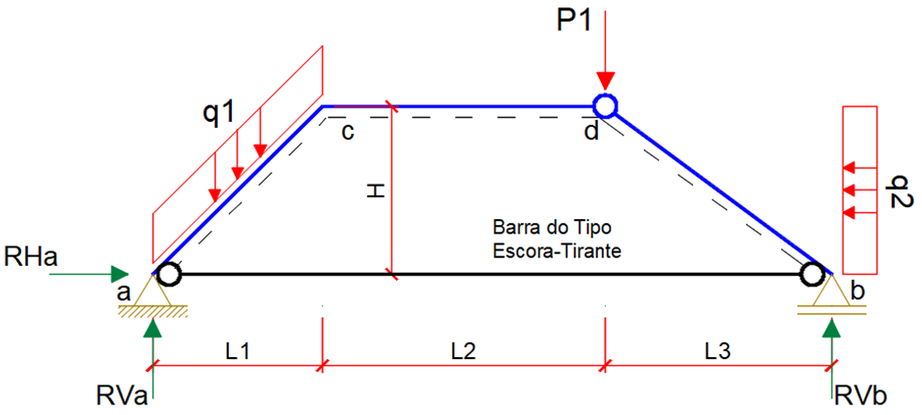
B2T4NB0429A

Considerando o modelo estrutural esboçado responda os questionamentos.

$q1 := 25\ \frac{kN}{m}$ $q2 := 12\ \frac{kN}{m}$ $P1 := 60\ kN$ $L1 := 2,5\ m$ $L2 := 4,0\ m$ $L3 := 3,0\ m$ $H := 4,0\ m$



Questões:

Q01) Qual o esforço cortante na barra "ac" na coordenada x = 2,0 m (contada a partir do ponto "a" ao longo da barra "ac") [em kN e sinal conforme a convenção]?

Q02) Qual o esforço axial na barra "ac" na coordenada x = 1,0 m (contada a partir do ponto "a" ao longo da barra "ac") [em kN e sinal conforme a convenção]?

Q03) Qual o esforço cortante na barra "db" na coordenada x = 1,5 m (contada a partir do ponto "d" ao longo da barra "db") [em kN e sinal conforme a convenção]?

Q04) Qual o esforço axial na barra "db" na coordenada x = 3,5 m (contada a partir do ponto "d" ao longo da barra "db") [em kN e sinal conforme a convenção]?

Q05) Qual o momento fletor no meio da barra "ac" [em kNm e sinal conforme a convenção]?

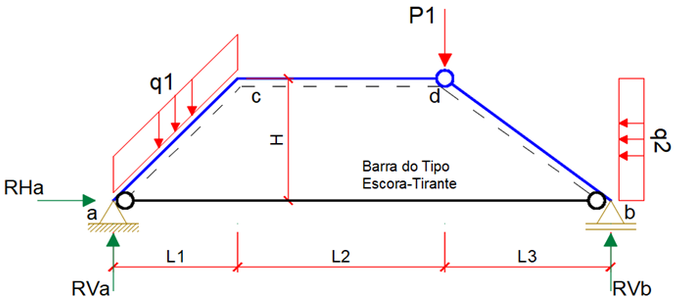
Q06) Qual o esforço axial na barra "ab"(barra do tipo escora tirante) [em kN e sinal conforme a convenção]?

Reações de Apoio:

$Lac := \sqrt{L1^2 + H^2} = 4,717\ m$

$Ldb := \sqrt{L3^2 + H^2} = 5\ m$

$Lab := L1 + L2 + L3 = 9,5\ m$



ΣMa = 0 (+) antihorário

RVb.Lab-q1.Lac.L1/2-P1.(L1+L2)+ q2.H^2/2 = 0

$RVb := \frac{1}{Lab} \cdot \left(q1 \cdot Lac \cdot \frac{L1}{2} + P1 \cdot (L1 + L2) - \frac{q2 \cdot H^2}{2} \right) = 46,4638\ kN$

ΣFh = 0 (+) para direita

RHa - q2.H = 0

$RHa := q2 \cdot H = 48\ kN$

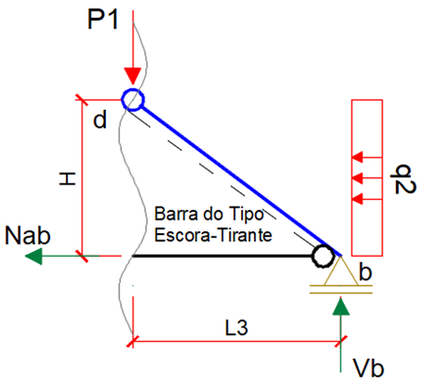
ΣFv = 0 (+) para cima

RVa - P1 - q1.Lac + RVb = 0

$RVa := P1 + q1 \cdot Lac - RVb = 131,461\ kN$

Esforço na barra Escora-Tirante:

Procedendo um corte passando pela rótula "d"
e seccionando a barra "ab" conforme indicado ao lado:



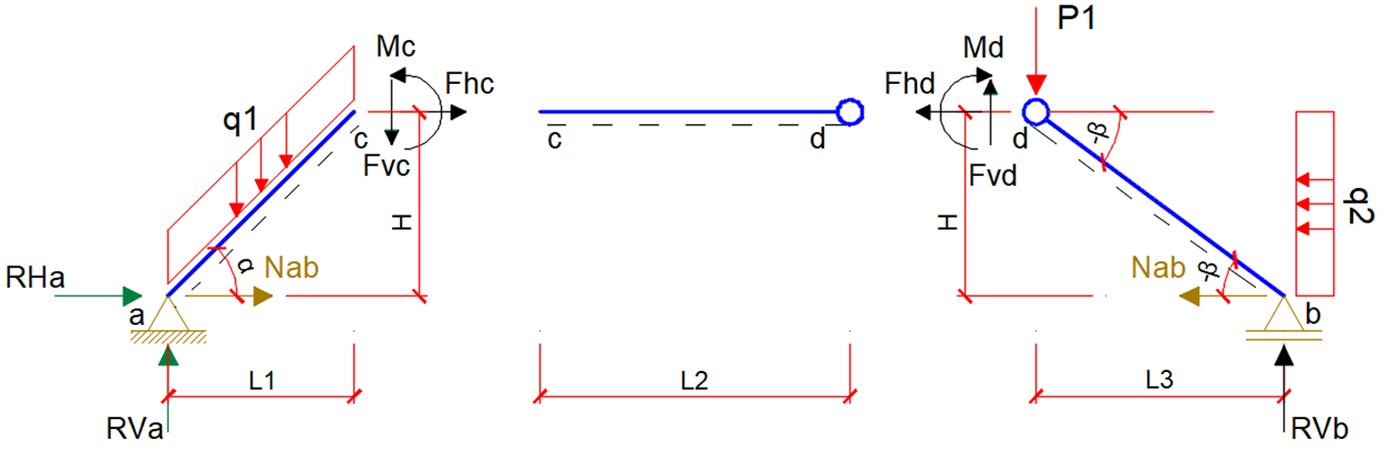
ΣMd = 0 (+) horário

Nab.H - Vb.L3 + q2.H^2/2 = 0

$$Nab := \frac{1}{H} \cdot \left(RVb \cdot L3 - \frac{q2 \cdot H^2}{2} \right)$$

$$Q06 := Nab = 10,8478 \text{ kN}$$

Equilíbrio Individual das Barras "ac" e "db" na Horizontal e Vertical:



$$Fvc := -RVb + P1 = 13,5362 \text{ kN} \qquad Fva := RVa = 131,461 \text{ kN}$$

$$Fhc := -Nab - q2 \cdot H = -58,8478 \text{ kN} \qquad Fha := -RHa - Nab = -58,8478 \text{ kN}$$

$$Mc := RVb \cdot (L2 + L3) - Nab \cdot H - \frac{q2 \cdot H^2}{2} - P1 \cdot L2 = -54,1449 \text{ kN m}$$

$$Fvd := RVa - q1 \cdot Lac - P1 = -46,4638 \text{ kN} \qquad Fvb := -RVb = -46,4638 \text{ kN}$$

$$Fhd := -RHa - Nab = -58,8478 \text{ kN} \qquad Fhb := -Nab = -10,8478 \text{ kN}$$

$$Md := RVa \cdot (L1 + L2) - (RHa + Nab) \cdot H - q1 \cdot Lac \cdot \left(\frac{L1}{2} + L2 \right) = 7,8427 \cdot 10^{-13} \text{ kN m}$$

Decomposição dos Esforços nodais e Equações V, N e M:

Barra "ac":

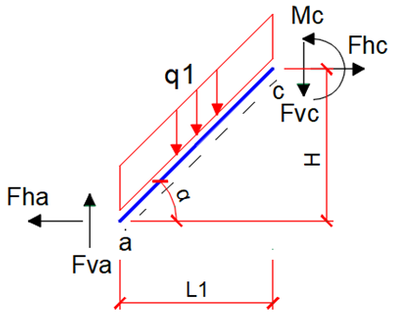
$$cos\alpha := \frac{L1}{Lac} = 0,53 \qquad sen\alpha := \frac{H}{Lac} = 0,848$$

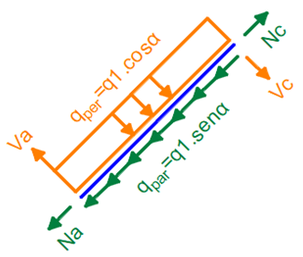
$$Va := Fva \cdot cos\alpha + Fha \cdot sen\alpha = 19,7713 \text{ kN}$$

$$Na := -Fva \cdot sen\alpha + Fha \cdot cos\alpha = -142,668 \text{ kN}$$

$$Vc := Fvd \cdot cos\alpha + Fhd \cdot sen\alpha = -74,5286 \text{ kN}$$

$$Nc := -Fvd \cdot sen\alpha + Fhd \cdot cos\alpha = 8,2119 \text{ kN}$$





$qac_per := q1 \cdot cos\alpha = 13,25 \ \frac{kN}{m}$

$qac_par := q1 \cdot sen\alpha = 21,2 \ \frac{kN}{m}$

$Vac(x) := Va - qac_per \cdot x$

$Nac(x) := Na + qac_par \cdot x$

$Mac(x) := Va \cdot x - \frac{qac_per \cdot x^2}{2}$

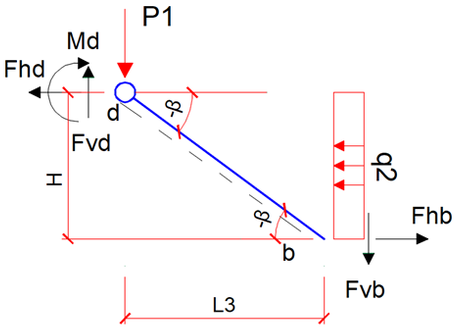
$Q01 := Vac(2\ m) = -6,7286\ kN$

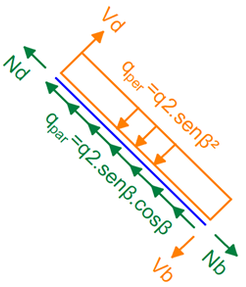
$Q02 := Nac(1\ m) = -121,468\ kN$

$Q05 := Mac\left(\frac{Lac}{2}\right) = 9,7791\ kN\ m$

Barra "db":

$cos\beta := \frac{L3}{Ldb} = 0,6 \qquad sen\beta := \frac{H}{Ldb} = 0,8$





$Vd := Fvd \cdot cos\beta + Fhd \cdot (-sen\beta) = 19,2\ kN$

$Nd := -Fvd \cdot (-sen\beta) + Fhd \cdot cos\beta = -72,4797\ kN$

$Vb := Fvb \cdot cos\beta + Fhb \cdot (-sen\beta) = -19,2\ kN$

$Nb := -Fvb \cdot (-sen\beta) + Fhb \cdot cos\beta = -43,6797\ kN$

$qdb_per := q2 \cdot sen\beta^2 = 7,68 \ \frac{kN}{m}$

$qdb_par := q2 \cdot sen\beta \cdot cos\beta = 5,76 \ \frac{kN}{m}$

$Vdb(x) := Vd - qdb_per \cdot x$

$Ndb(x) := Nd + qdb_par \cdot x$

$Q03 := Vdb(1,5\ m) = 7,68\ kN$

$Q04 := Ndb(3,5\ m) = -52,3197\ kN$

Resultados:

$Q01 = -6,7286\ kN$
$Q02 = -121,468\ kN$
$Q03 = 7,68\ kN$
$Q04 = -52,3197\ kN$
$Q05 = 9,7791\ kN\ m$
$Q06 = 10,8478\ kN$
