B1T4NA0827A

Trace as linhas de influência de momentos fletores para as seções "S1", "S2" e "S3" e considerando as cargas de roda indicadas responda os questionamentos:

Q01) Qual o mínimo momento fletor que ocorre na seção "S2" [em kNm]?
Q02) Qual o máximo momento fletor que ocorre na seção "S2" [em kNm]?
Q03) Qual o mínimo momento fletor que ocorre na seção "S1" [em kNm]?
Q04) Qual o máximo momento fletor que ocorre na seção "S1" [em kNm]?
Q05) Qual o mínimo momento fletor que ocorre na seção "S3" [em kNm]?
Q06) Qual o máximo momento fletor que ocorre na seção "S3" [em kNm]?

$P1 := 50,0\ kN$ $P2 := 90,0\ kN$

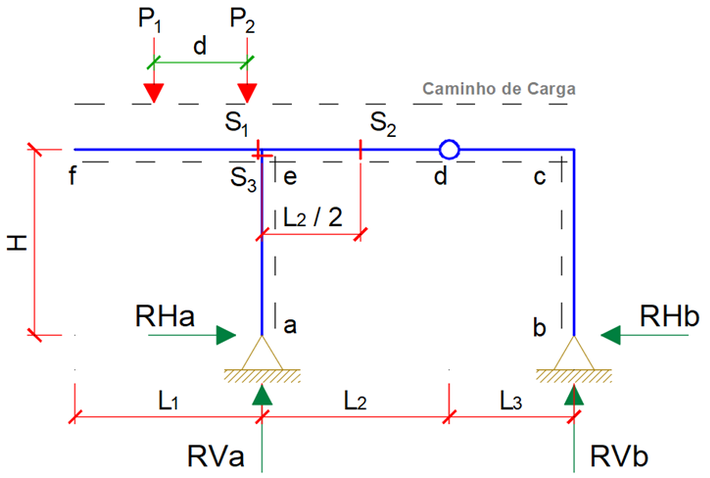
$d := 2,0\ m$

$H := 5,0\ m$

$L1 := 4,0\ m$

$L2 := 6,0\ m$

$L3 := 3,0\ m$



LI de RVa e RHa:

$\Sigma Mb = 0$ (+) horário $P := 1$

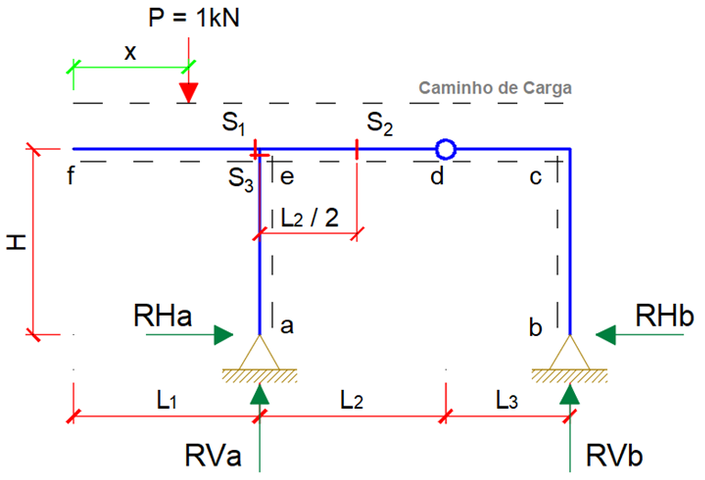
$RVa(x) \cdot (L2 + L3) - P \cdot (L1 + L2 + L3 - x) = 0$

$RVa(x) := \frac{P \cdot (L1 + L2 + L3 - x)}{(L2 + L3)} = \frac{13 - x}{9}$

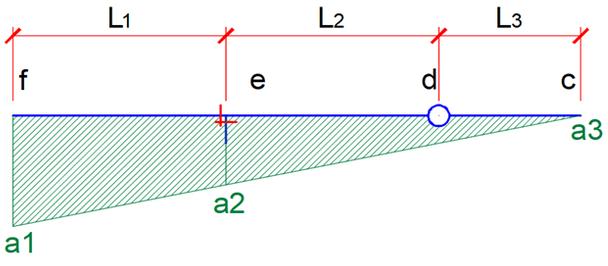
$a1 := RVa(0) = 1,4444$

$a2 := RVa(L1) = 1$

$a3 := RVa(L1 + L2 + L3) = 0$



Esboço da LI de RVa(x):



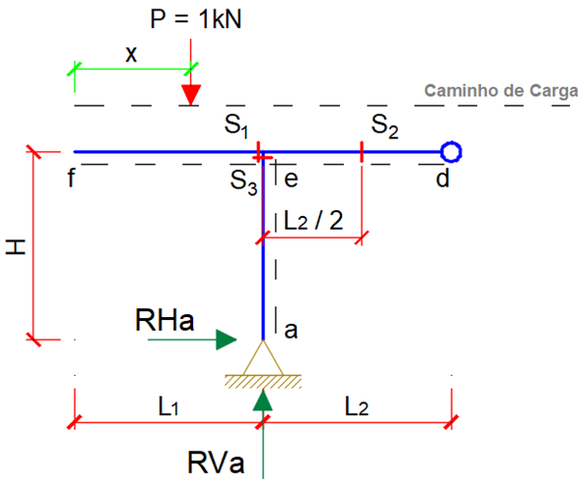
$\Sigma Md = 0$ (+) anti-horário

*Considerando a carga P na esquerda da rótula "d":

$$RHa_Pesq_d(x)\cdot H - RVa(x)\cdot L2 + P\cdot(L1 + L2 - x) = 0$$

$$RHa_Pesq_d(x) := \frac{RVa(x)\cdot L2 - P\cdot(L1 + L2 - x)}{H}$$

$$RHa_Pesq_d(x) = \frac{2\cdot(13 - x) - 3\cdot(10 - x)}{15}$$

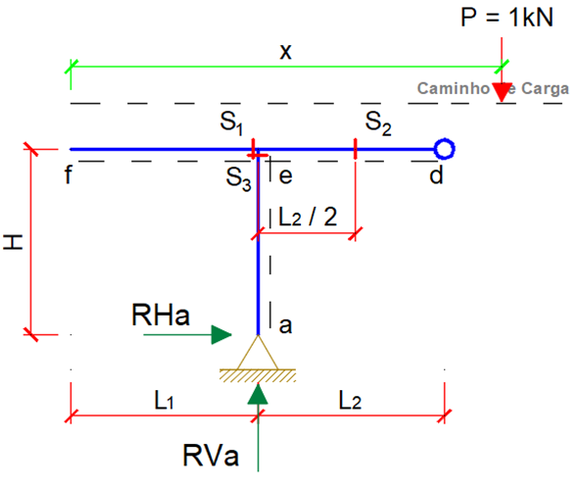


*Considerando a carga P na direita da rótula "d":

$$RHa_Pdir_d(x)\cdot H - RVa(x)\cdot L2 = 0$$

$$RHa_Pdir_d(x) := \frac{RVa(x)\cdot L2}{H}$$

$$RHa_Pdir_d(x) = \frac{2\cdot(13 - x)}{15}$$



Esboço da LI de RHa(x):

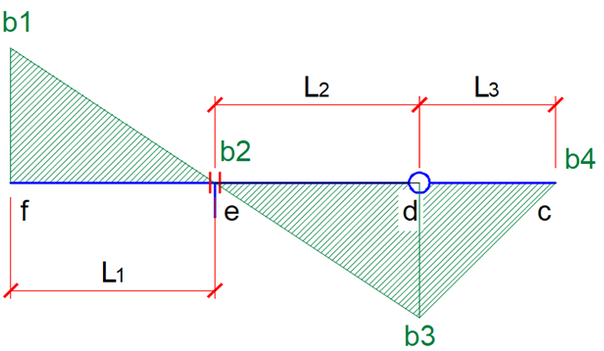
$$b1 := RHa_Pesq_d(0) = -0,26667$$

$$b2 := RHa_Pesq_d(L1) = 0$$

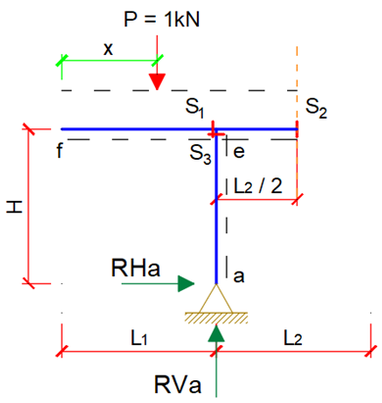
$$b3 := RHa_Pesq_d(L1 + L2) = 0,4$$

$$b3 := RHa_Pdir_d(L1 + L2) = 0,4$$

$$b4 := RHa_Pdir_d(L1 + L2 + L3) = 0$$

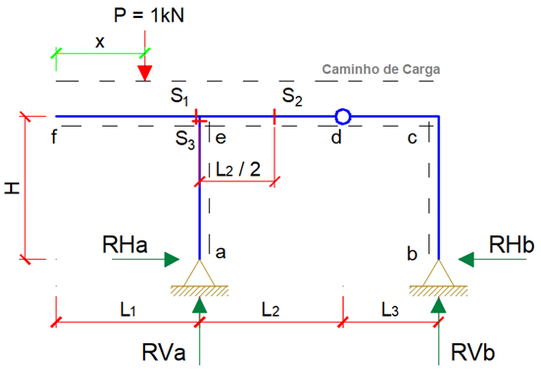


LI de Ms2:



* Fazendo um corte em S2 e olhando para a esquerda, duas situações precisam sem ponderadas:
1) Carga P na esquerda da seção S2;
2) Carga P na direita da seção S2;

** Considerando que RHa(x) é representada por uma função por partes com dois intervalos definidos (à esquerda de "d" e à direita de "d"), o equacionamento de momentos fletores na seção S2 de fato acaba sendo definido em 3 intervalos:
i) Carga P na esquerda de S2 e logo na esquerda de "d";
ii) Carga P na direita de S2 porém na esquerda de "d";
iii) Carga P na direita de S2 e também na direita de "d";



Intervalo (i) carga P na esquerda de S2:

$$Ms2i(x) := RVa(x)\cdot\frac{L2}{2} - RHa_Pesq_d(x)\cdot H - P\cdot\left(L1 + \frac{L2}{2} - x\right)$$

$$Ms2i(x) = -\frac{-13 + x + 2\cdot(13 - x) - 3\cdot(10 - x) + 3\cdot(7 - x)}{3}$$

Intervalo (ii) carga P na direita de S2 porém na esquerda de "d":

$$Ms2ii(x) := RVa(x)\cdot\frac{L2}{2} - RHa_Pesq_d(x)\cdot H$$

$$Ms2ii(x) = \frac{13 - x - 2\cdot(13 - x) + 3\cdot(10 - x)}{3}$$

Intervalo (iii) carga P na direita de S2 e na direita de "d":

$$Ms2iii(x) := RVa(x)\cdot\frac{L2}{2} - RHa_Pdir_d(x)\cdot H$$

$$Ms2iii(x) = -\frac{13 - x}{3}$$

$$c1 := Ms2i(0) = -1,3333$$

$$c2 := Ms2i(L1) = 0$$

$$c3 := Ms2i\left(L1 + \frac{L2}{2}\right) = 1$$

$$c3 := Ms2ii\left(L1 + \frac{L2}{2}\right) = 1$$

$$c4 := Ms2ii(L1 + L2) = -1$$

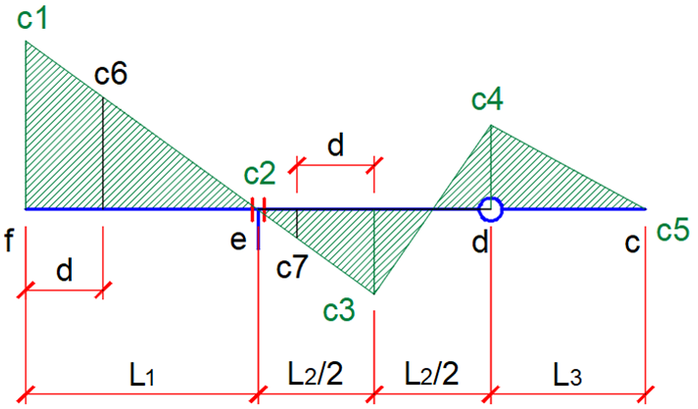
$$c4 := Ms2iii(L1 + L2) = -1$$

$$c5 := Ms2iii(L1 + L2 + L3) = 0$$

$$c6 := Ms2i(d) = -0,66667$$

$$c7 := Ms2i\left(L1 + \frac{L2}{2} - d\right) = 0,3333$$

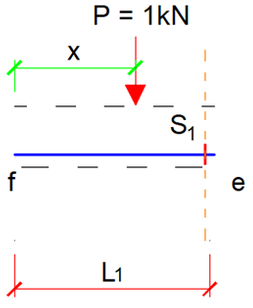
Esboço da LI de Ms2(x)



$$Ms2_min := P2\cdot c1\ \text{m} + P1\cdot c6\ \text{m} = -153,33\ \text{kN m}$$

$$Ms2_max := P2\cdot c3\ \text{m} + P1\cdot c7\ \text{m} = 106,67\ \text{kN m}$$

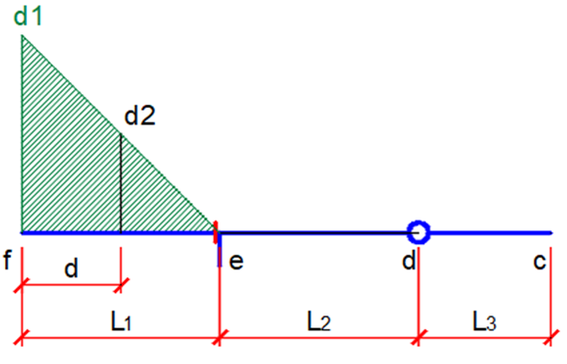
LI de Ms1:



$$Ms1_Pesq_S1(x) := -P\cdot(L1 - x) = -(4 - x)$$

$$Ms1_Pdir_S1(x) := 0$$

Esboço da LI de Ms1(x):



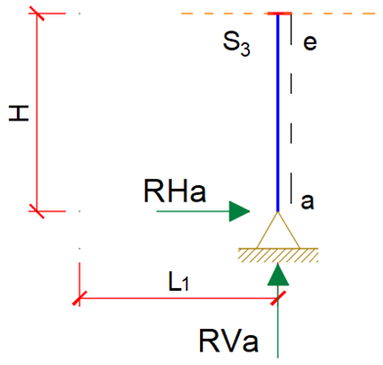
$$d1 := Ms1_Pesq_S1(0) = -4$$

$$d2 := Ms1_Pesq_S1(d) = -2$$

$$Ms1_min := P2\cdot d1\ \text{m} + P1\cdot d2\ \text{m} = -460\ \text{kN m}$$

$$Ms1_max := 0$$

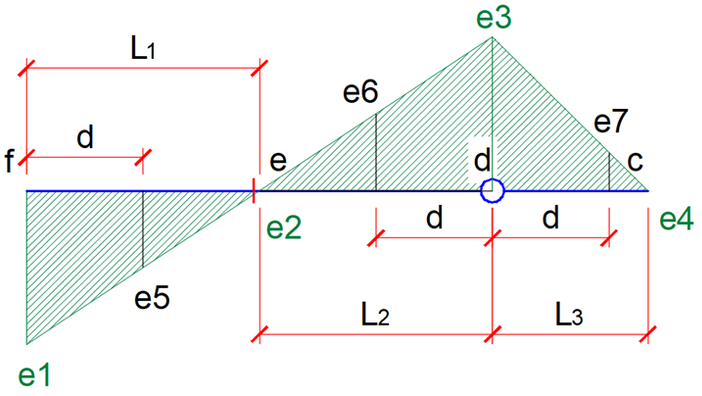
LI de Ms3:



$$Ms3_Pesq_d(x) := -RHa_Pesq_d(x)\cdot H = -\frac{2\cdot(13-x)-3\cdot(10-x)}{3}$$

$$Ms3_Pdir_d(x) := -RHa_Pdir_d(x)\cdot H = -\frac{2\cdot(13-x)}{3}$$

Esboço da LI de Ms3(x):



$e1 := Ms3_Pesq_d(0) = 1,3333$

$e2 := Ms3_Pesq_d(L1) = 0$

$e3 := Ms3_Pesq_d(L1 + L2) = -2$

$e3 := Ms3_Pdir_d(L1 + L2) = -2$

$e4 := Ms3_Pdir_d(L1 + L2 + L3) = 0$

$e5 := Ms3_Pesq_d(d) = 0,6667$

$e6 := Ms3_Pesq_d(L1 + L2 - d) = -1,3333$

$e7 := Ms3_Pdir_d(L1 + L2 + d) = -0,6667$

$Ms3_min := P2\cdot e3\ \text{m} + P1\cdot e6\ \text{m} = -246,67\ \text{kN m}$

$Ms3_max := P2\cdot e1\ \text{m} + P1\cdot e5\ \text{m} = 153,33\ \text{kN m}$

$Q01 := Ms2_min = -153,33\ \text{kN m}$

$Q02 := Ms2_max = 106,67\ \text{kN m}$

$Q03 := Ms1_min = -460\ \text{kN m}$

$Q04 := Ms1_max = 0\ \text{kN m}$

$Q05 := Ms3_min = -246,67\ \text{kN m}$

$Q06 := Ms3_max = 153,33\ \text{kN m}$
