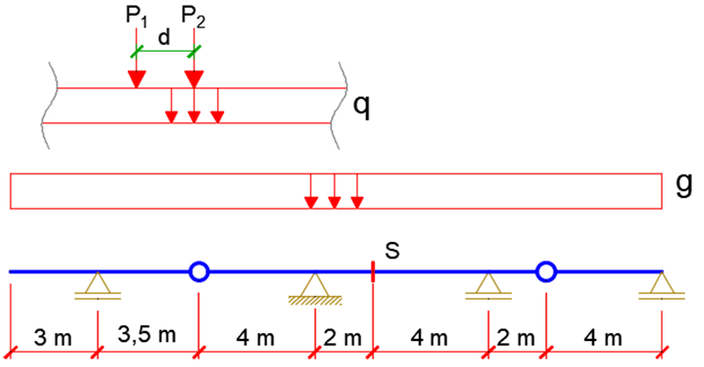
TE2_E02-07

Calcular o máximo e mínimo momento fletor e esforço cortante que podem ocorrer na seção "S" indicada:



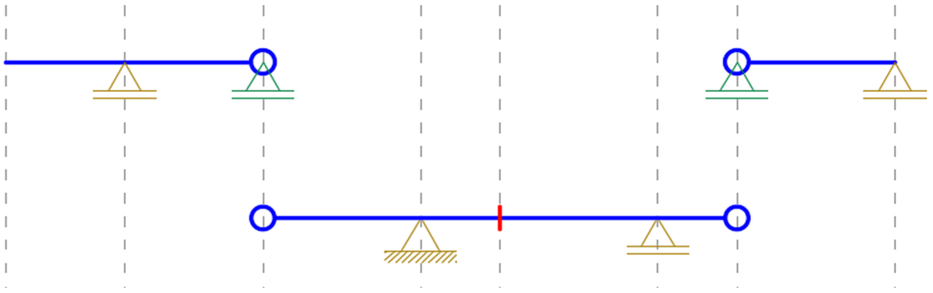
- Dados:

$d := 2,0\ \text{m}$

$P1 := 90\ \text{kN}$ $\quad P2 := 50\ \text{kN}$

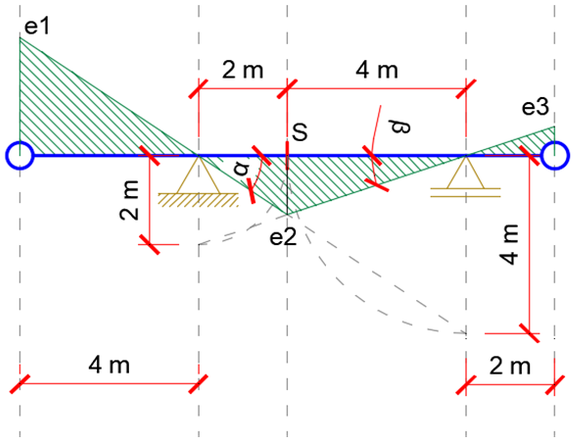
$q := 10\ \frac{\text{kN}}{\text{m}}$ $\quad g := 25\ \frac{\text{kN}}{\text{m}}$

Esquema Funcional:



LI de Ms:

Traçado da LI de Partida - LI da viga componente simples que contém a seção de interesse:



$tg\alpha := \frac{4\ \text{m}}{4\ \text{m} + 2\ \text{m}} = 0,6667$ $\quad tg\beta := \frac{2\ \text{m}}{2\ \text{m} + 4\ \text{m}} = 0,3333$

$tg\alpha + tg\beta = 1$

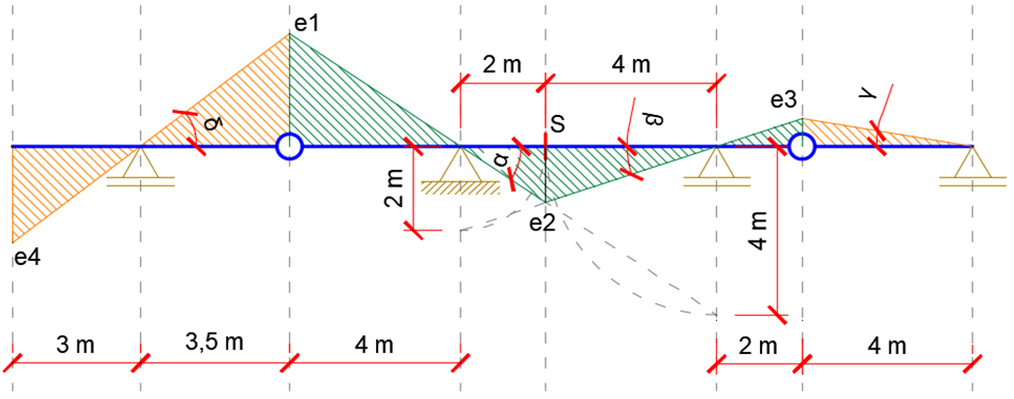
$e1 := 4\ \text{m} \cdot (-tg\alpha) = -2,6667\ \text{m}$

$e2 := 2\ \text{m} \cdot tg\alpha = 1,3333\ \text{m}$

$e2 := 4\ \text{m} \cdot tg\beta = 1,3333\ \text{m}$

$e3 := 2\ \text{m} \cdot (-tg\beta) = -0,6667\ \text{m}$

Prolongamento da LI para as vigas adjacentes:

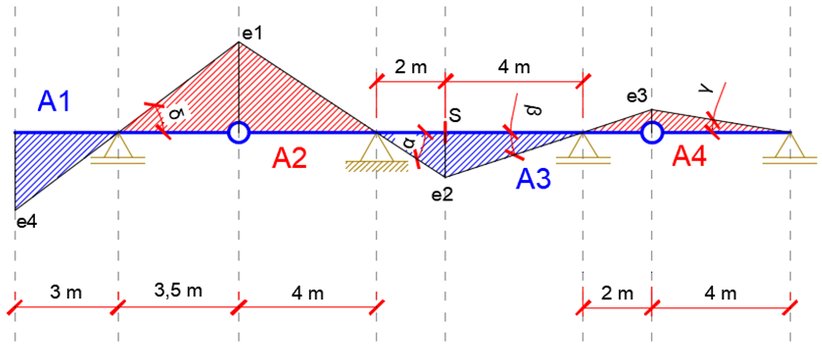


$tg\delta := \frac{|e1|}{3,5\ \text{m}} = 0,7619$

$e4 := 3\ \text{m} \cdot tg\delta = 2,2857\ \text{m}$

$tg\gamma := \frac{|e3|}{4\ \text{m}} = 0,1667$

Cálculo das áreas de influência:



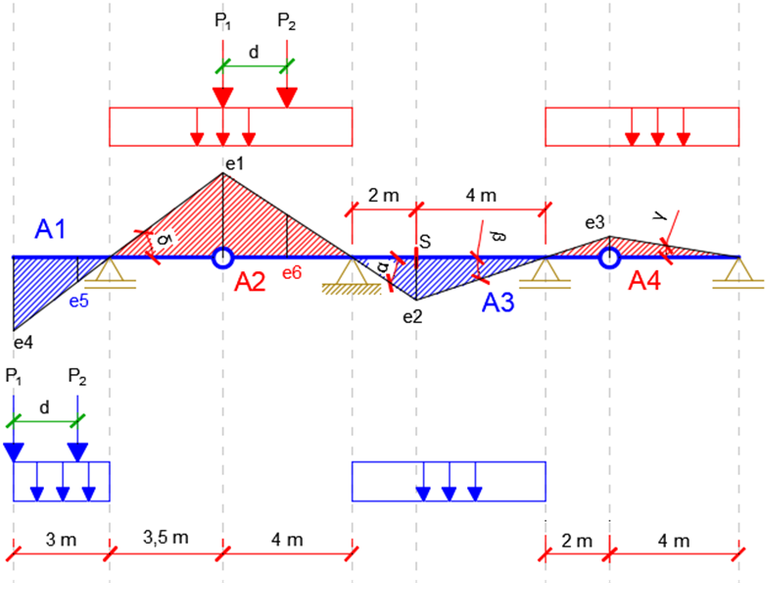
$A1 := 3\ \text{m} \cdot \frac{e4}{2} = 3,4286\ \text{m}^2$

$A2 := (3,5+4)\ \text{m} \cdot \frac{e1}{2} = -10\ \text{m}^2$

$A3 := (2+4)\ \text{m} \cdot \frac{e2}{2} = 4\ \text{m}^2$

$A4 := (2+4)\ \text{m} \cdot \frac{e3}{2} = -2\ \text{m}^2$

Posicionamento das cargas de roda e multidão:



$d = 2\ \text{m}$

$e5 := (3\ \text{m} - d) \cdot tg\delta = 0,7619\ \text{m}$

$e6 := (-(4\ \text{m} - d)) \cdot tg\alpha = -1,3333\ \text{m}$

Efeito da carga permanente:

$Ms_perm := (A1 + A2 + A3 + A4) \cdot g = -114,3\ \text{kN m}$

Máximo Ms:

Carga de Rodas: $Ms_max_roda := P1 \cdot e4 + P2 \cdot e5 = 243,8\ \text{kN m}$

Carga de Multidão: $Ms_max_mult := (A1 + A3) \cdot q = 74,29\ \text{kN m}$

$Ms_max := Ms_max_roda + Ms_max_mult + Ms_perm = 203,8\ \text{kN m}$

Mínimo Ms:

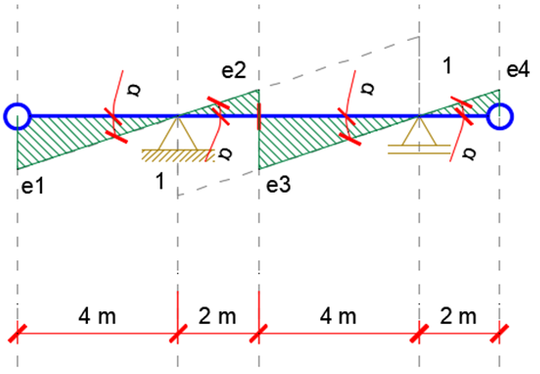
Carga de Rodas: $Ms_min_roda := P1 \cdot e1 + P2 \cdot e6 = -306,7\ \text{kN m}$

Carga de Multidão: $Ms_min_mult := (A2 + A4) \cdot q = -120,0\ \text{kN m}$

$Ms_min := Ms_min_roda + Ms_min_mult + Ms_perm = -541,0\ \text{kN m}$

LI de Vs:

Traçado da LI de Partida - LI da viga componente simples que contém a seção de interesse:



$tg\alpha := \frac{1\ \text{m}}{4\ \text{m} + 2\ \text{m}} = 0,1667$

$e1 := 4 \cdot tg\alpha = 0,6667$

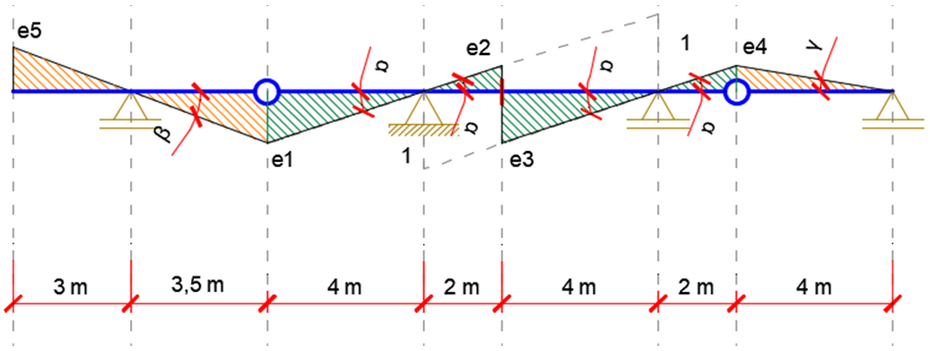
$e2 := 2 \cdot (-tg\alpha) = -0,3333$

$e3 := 4 \cdot tg\alpha = 0,6667$

$e4 := 2 \cdot (-tg\alpha) = -0,3333$

$|e2| + |e3| = 1$

Prolongamento da LI para as vigas adjacentes:

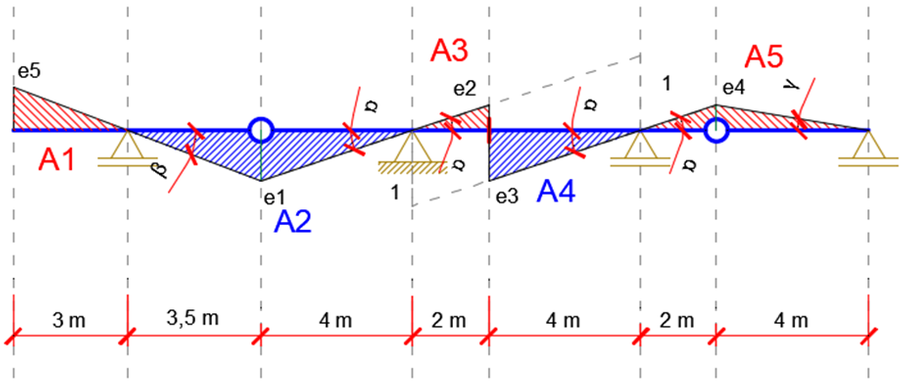


$tg\beta := \frac{|e1|\ \mathrm{m}}{3,5\ \mathrm{m}} = 0,1905$

$e5 := 3 \cdot (-tg\beta) = -0,5714$

$tg\gamma := \frac{|e4|\ \mathrm{m}}{4\ \mathrm{m}} = 0,0833$

Cálculo das áreas de influência:



$A1 := 3\ \mathrm{m} \cdot \frac{e5}{2} = -0,8571\ \mathrm{m}$

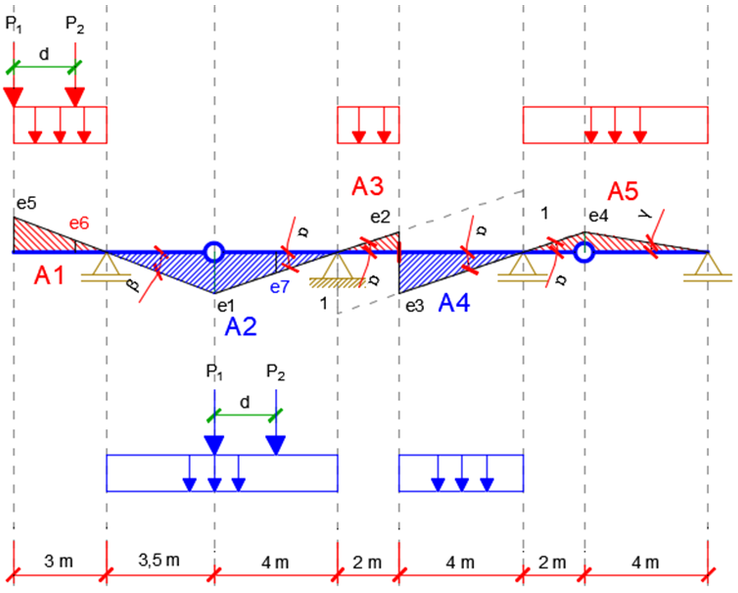
$A2 := (3,5+4)\ \mathrm{m} \cdot \frac{e1}{2} = 2,5\ \mathrm{m}$

$A3 := 2\ \mathrm{m} \cdot \frac{e2}{2} = -0,3333\ \mathrm{m}$

$A4 := 4\ \mathrm{m} \cdot \frac{e3}{2} = 1,3333\ \mathrm{m}$

$A5 := (2+4)\ \mathrm{m} \cdot \frac{e4}{2} = -1\ \mathrm{m}$

Posicionamento das cargas de roda e multidão:



$d = 2\ \mathrm{m}$

$e7 := (4\ \mathrm{m} - d) \cdot tg\alpha \cdot \frac{1}{\mathrm{m}} = 0,3333$

$e6 := (3\ \mathrm{m} - d) \cdot (-tg\beta) \cdot \frac{1}{\mathrm{m}} = -0,1905$

Efeito da carga permanente:

$Vs_perm := (A1 + A2 + A3 + A4 + A5) \cdot g$

$Vs_perm = 41,07\ \mathrm{kN}$

Máximo Vs:

Carga de Rodas: $Vs_max_roda := P1 \cdot e1 + P2 \cdot e7 = 76,67\ \mathrm{kN}$

Carga de Multidão: $Vs_max_mult := (A2 + A4) \cdot q = 38,33\ \mathrm{kN}$

$Vs_max := Vs_max_roda + Vs_max_mult + Vs_perm = 156,1\ \mathrm{kN}$

Mínimo Vs:

Carga de Rodas: $Vs_min_roda := P1 \cdot e5 + P2 \cdot e6 = -60,95\ kN$

Carga de Multidão: $Vs_min_mult := (A1 + A3 + A5) \cdot q = -21,90\ kN$

$Vs_min := Vs_min_roda + Vs_min_mult + Vs_perm = -41,79\ kN$
