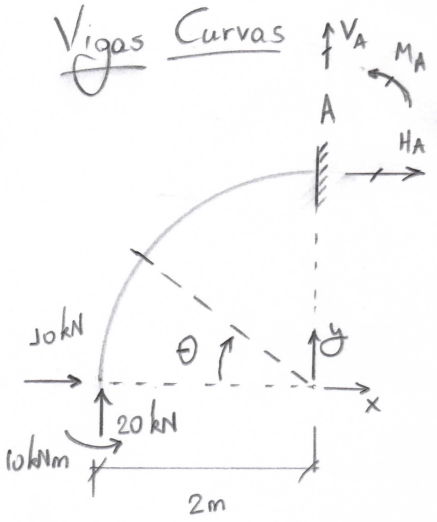
Vigas Curvas



Achar os esforços solicitantes em função da coordenada angular θ.

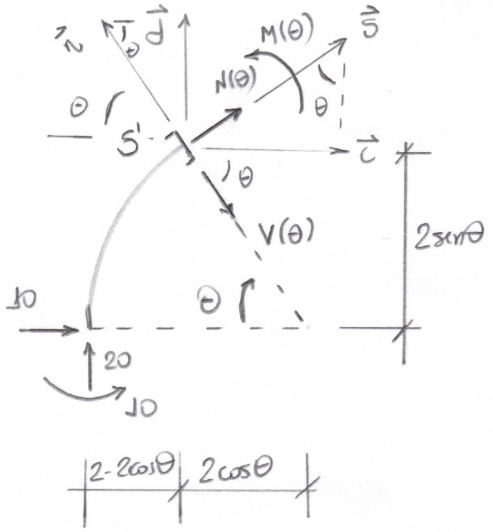
Reações de apoio:

$\sum F_x = 0$: $10 + H_A = 0 \Rightarrow \underline{H_A = -10\,kN}$ ←

$\sum F_y = 0$: $20 + V_A = 0 \Rightarrow \underline{V_A = -20\,kN}$ ↓

$\sum M_A = 0$: $M_A + 10 - 20.2 + 10.2 = 0 \Rightarrow \underline{M_A = 10\,kN.}$ ↺

Fazendo o corte na posição θ:



escrevendo a relação entre sistemas:

$\vec{i} = -\cos\theta\,\vec{n} + \operatorname{sen}\theta\,\vec{s}$

$\vec{j} = \operatorname{sen}\theta\,\vec{n} + \cos\theta\,\vec{s}$

Logo:

$10\vec{i} = -10\cos\theta\,\vec{n} + 10\operatorname{sen}\theta\,\vec{s}$

$20\vec{j} = 20\operatorname{sen}\theta\,\vec{n} + 10\cos\theta\,\vec{s}$

Fazendo o equilíbrio nas coordenadas locais:

$\sum F_n = 0$: $-V(\theta) - 10\cos\theta + 20\operatorname{sen}\theta = 0$

$\therefore \boxed{V(\theta) = -10\cos\theta + 20\operatorname{sen}\theta}$

$\sum F_s = 0$: $N(\theta) + 10\operatorname{sen}\theta + 20\cos\theta = 0$

$\therefore \boxed{N(\theta) = -10\operatorname{sen}\theta - 20\cos\theta}$

$\sum M_{S'} = 0$: $M(\theta) + 10 + 10.2\operatorname{sen}\theta - 20.2(1-\cos\theta) = 0$

$M(\theta) = -10 - 20\operatorname{sen}\theta + 40 - 20\cos\theta \quad (= -10 - 10R\operatorname{sen}\theta + 20R(1-\cos\theta))$

$M(\theta) = -20\operatorname{sen}\theta - 20\cos\theta + 30$

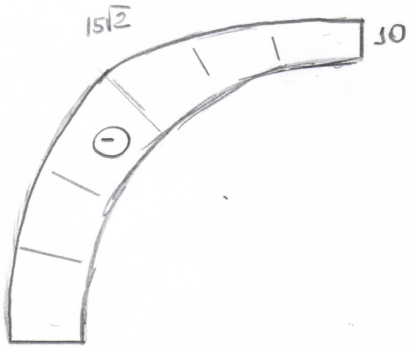
Note que $\frac{1}{R}\frac{dM}{d\theta} = V$.

$\frac{dM}{d\theta} = -20\cos\theta + 20\sin\theta$ $\quad \frac{1}{R}\frac{dM}{d\theta} = \frac{1}{2}(-20\cos\theta + 20\sin\theta) =$

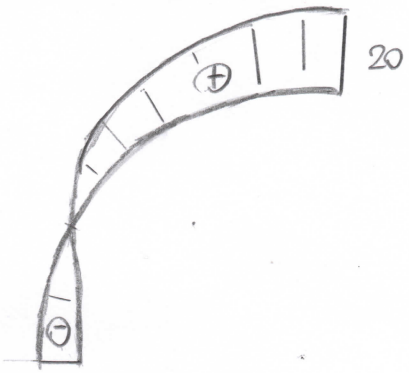
$= -10\cos\theta + 20\sin\theta = V(\theta)$

* coordenadas cilíndricas

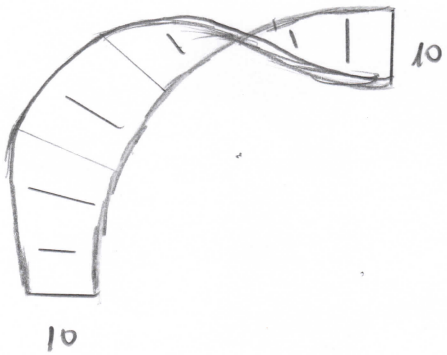
Diagramas:



N [kN]



V [kN]



M [kNm]