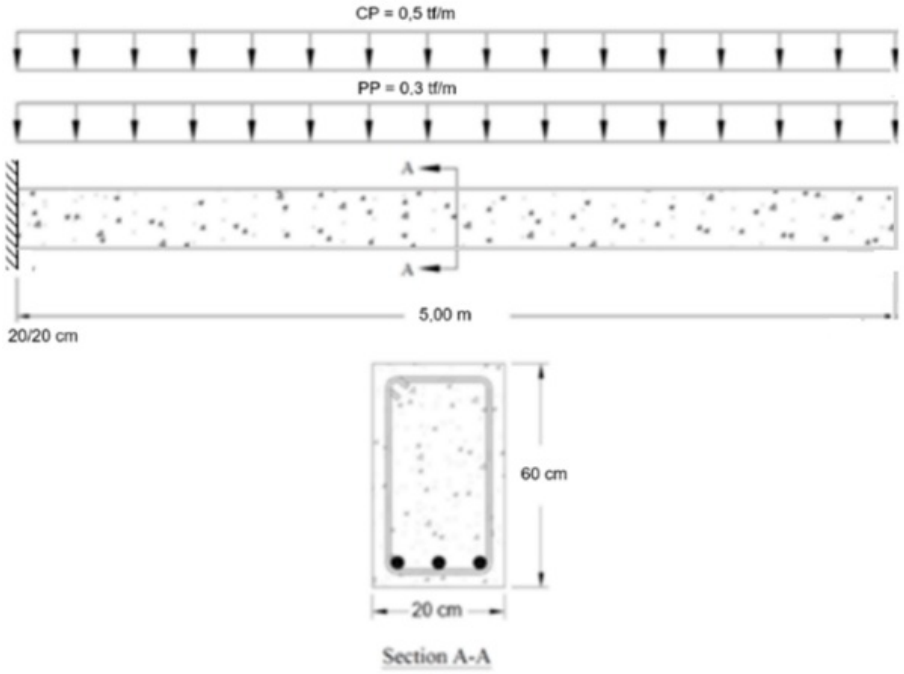
Vigas - Flexão Simples - Balanço 1

FLEXÃO SIMPLES

Neste exemplo, será dimensionada a armadura longitudinal e transversal de uma viga submetida a Flexão Simples utilizando como base a Norma ACI318-19, conforme dados abaixo:

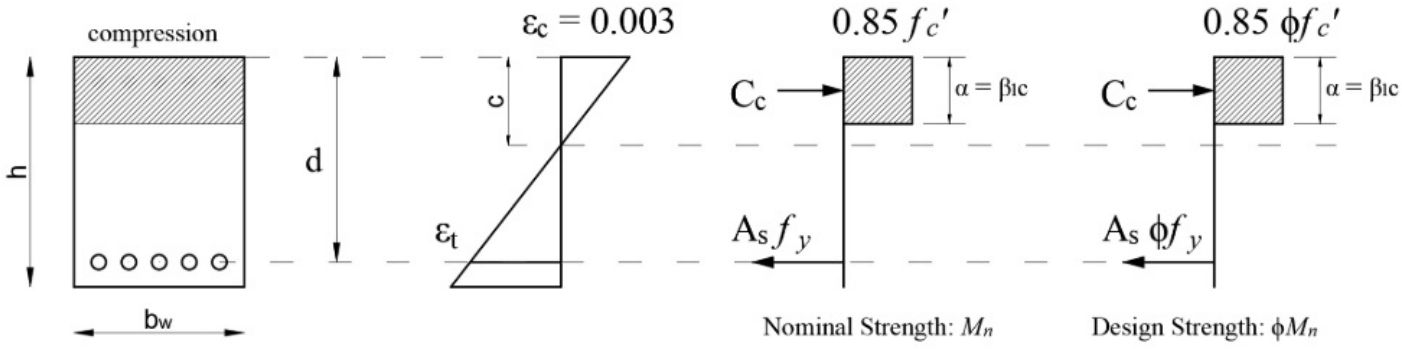


Concreto - C25 (4000 psi) / Aço – ADN420 (60 ksi)

bw: 8 in / h: 24 in

Mu:

TQS = 1239,14 kN.m	**Software B = 1190,46 kN.m**	**Software C = 1230,29 kN.m**



Flexão:

$$M_n = \frac{Mu}{\emptyset} = \frac{1239,14}{0,9} = 1376,67\ \boldsymbol{kip.in}$$

$$d = h - C_c - d_{be} - \frac{d_b}{2} = 24 - 1{,}57 - 0{,}375 - 0{,}3125 = \mathbf{21{,}75\ in}$$

$$R_n = \frac{M_{n,req}}{b_w \cdot d^2} = \frac{1376{,}67}{8 \cdot 21{,}75^2} = 0{,}363\ ksi = 363{,}90\ \boldsymbol{psi}$$

$$\rho = \left(0{,}85 \cdot \frac{f'_c}{f_y}\right) \cdot \left[1 - \sqrt{1 - \left(\frac{2 \cdot R_n}{0{,}85 \cdot f'_c}\right)} = (0{,}85 \cdot \frac{4}{60}) \cdot (1 - \sqrt{1 - \left(\frac{2 \cdot 0{,}363}{0{,}85 \cdot 4}\right)}) = \mathbf{0{,}0064}\right.$$

$$\boldsymbol{A_s} = \rho \cdot b_w \cdot d = 0{,}0064 \cdot 8 \cdot 21{,}75 = \mathbf{1{,}12\ in^2}$$

As,min (ACI 318-19 – 9.6.1.2)

$$\left(\frac{3 \cdot \sqrt{f'_c}}{f_y}\right) \cdot b_w \cdot d = \left(\frac{3 \cdot \sqrt{4000}}{60000}\right) \cdot 8 \cdot 21{,}75 = \mathbf{0{,}55\ in^2}$$

$$\left(\frac{200}{f_y}\right) \cdot b_w \cdot d = \left(\frac{200}{60000}\right) \cdot 8 \cdot 21{,}75 = \mathbf{0{,}58\ in^2}$$

$$\boldsymbol{A_{s,min}} = \mathbf{0{,}60\ in^2}$$

TQS = 1,12 in2	**Software B = 1,21 in2**	**Software C = 1,10 in2**

1,24 in2 ≥ 1,12 in2 → OK!

4#5 → 1,24 *in2*

øMn (1404,48 kip.in) ≥ Mu (1239,14 kip.in) → OK!!

Verificação do fator de redução (ACI318-19 – 21.2.2)

$$\alpha = \frac{A_s \cdot f_y}{0{,}85 \cdot f'_c \cdot b_w} = \frac{1{,}12 \cdot 60}{0{,}85 \cdot 4 \cdot 8} = 2{,}47\ in$$

$$Linha\ Neutra: \boldsymbol{c} = \frac{\boldsymbol{\alpha}}{\boldsymbol{\beta_1}} = \frac{\mathbf{2{,}47}}{\mathbf{0{,}85}} = 2{,}90\ \boldsymbol{in}$$

$$\varepsilon_t = 0{,}003 \cdot \left(\frac{d - c}{c}\right) = 0{,}003 \cdot \left(\frac{21{,}75 - 2{,}90}{2{,}90}\right) = \mathbf{0{,}0195}$$

0,0195≥ 0,005 → OK! Tension Controlled! → ø 0,90 OK!

Cortante:

TQS	Software B	Software C
Vu = 12,35 kips	Vu = 12,10 kips	Vu = 12,26 t
Vu,design = 12,35 kips	Vu,design = 10,69 kips	Vu,design = 10,58 t

$$V_n = V_c + V_s$$

$$\boldsymbol{V_u = 12,35\ kips}$$

$$\boldsymbol{V_{u,design} = 12,35\ kips}$$

$$V_c = 2 \cdot \lambda \cdot \sqrt{f'_c} \cdot b_w \cdot d = 2 \cdot 1 \cdot \sqrt{4000} \cdot 8 \cdot 21,75 = 22,01\ \boldsymbol{kips}$$

$$\boldsymbol{V_n = \frac{V_{u,design}}{\emptyset_{0,75}} = V_c + V_s \ \rightarrow\ V_s = 0\ kips \ \rightarrow\ V_n = 16,47\ kips}$$

$$V_{s,lim} = 8 \cdot \sqrt{f'_c} \cdot b_w \cdot d = 8 \cdot \sqrt{4000} \cdot 8 \cdot 21,75 = \boldsymbol{88,03\ kips}$$

Vs ≤ Vs,lim OK!

Ø0,75 → øVn ≥ Vu → 12,35 ≥ 12,35 → OK!!

Área de Aço:

$$A_v = \frac{V_s \cdot s}{f_{yt} \cdot d} = \frac{A_v}{s} = \frac{0}{60 \cdot 21,75} = 0\ in^2$$

$$\boldsymbol{\frac{A_{v,min}}{s} = \frac{0,75 \cdot \sqrt{f'_c} \cdot b_w}{f_{yt}} = 0,0063\ in^2}$$

$$\boldsymbol{\frac{A_{v,min}}{s} = \frac{50 \cdot b_w}{f_{yt}} = 0,0067\ in^2}$$

$$\boldsymbol{A_v \geq A_{v,min} \rightarrow 0,00 \leq 0,0067 \rightarrow A_{v,min}!!}$$

Espaçamento:

$$\boldsymbol{s \leq s_{max} \ \rightarrow\ s_{max} = menor\ valor\ entre\ s_1\ e\ s_2}$$

$$\boldsymbol{s_1 = \frac{d}{2} = 10,88\ in\ ou\ s_2 = 24\ in \ \rightarrow\ 10,88\ in! \rightarrow 10\ in!!}$$

$$\boldsymbol{\emptyset_t = \#3 \ \rightarrow \#3\ @\ 10\ in}$$

øVn (23,89 kips) ≥ Vu (12,35 kips)