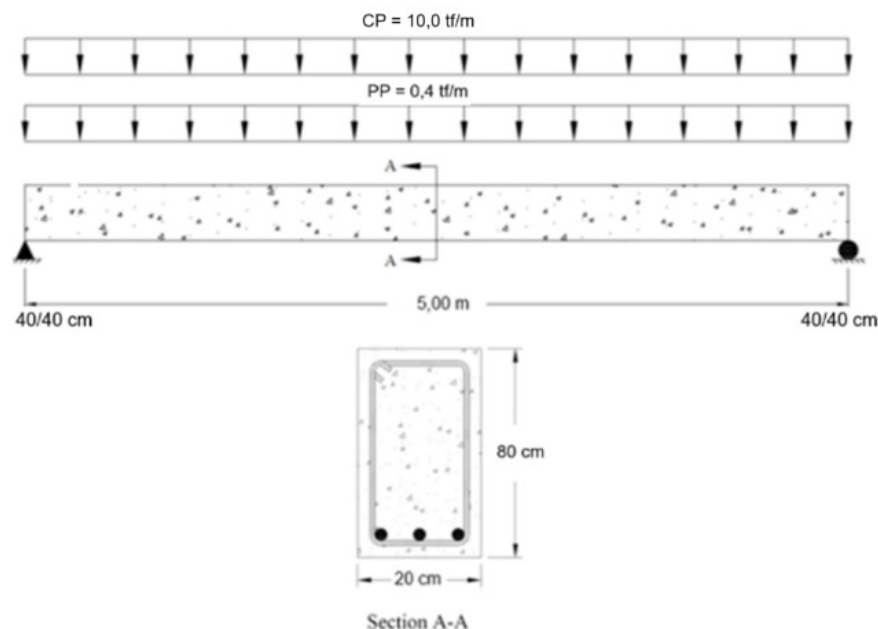


Vigas - Flexão Simples 9

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:

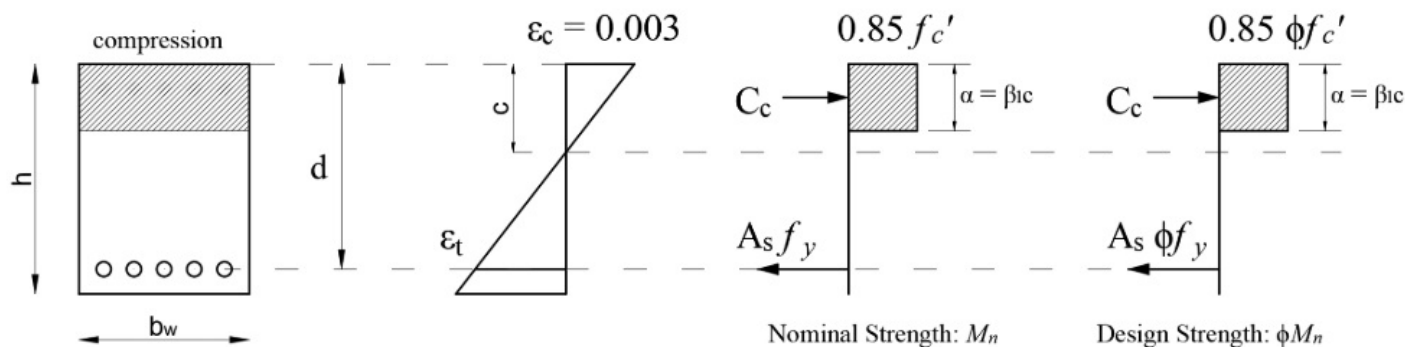


Concreto - C25 (4000 psi) / Aço – ADN420 (60 ksi)

bw: 8 in / h: 31,50 in

Mu:

TQS = 2738,19 kip.in	Software B = 2750,58 kip.in	Software C = 2720,49 kip.in
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Flexão:

$$M_n = \frac{M_u}{\phi} = \frac{2738,19}{0,9} = 3042,43 \text{ kip.in}$$

$$d = h - C_c - d_{be} - \frac{d_b}{2} = 31,50 - 1,57 - 0,375 - 0,375 = 29,19 \text{ in}$$

$$R_n = \frac{M_{n,req}}{b_w \cdot d^2} = \frac{3042,43}{8 \cdot 29,19^2} = 0,447 \text{ ksi} = 446,49 \text{ psi}$$

$$\rho = \left(0,85 \cdot \frac{f'_c}{f_y}\right) \cdot \left[1 - \sqrt{1 - \left(\frac{2 \cdot R_n}{0,85 \cdot f'_c}\right)}\right] = \left(0,85 \cdot \frac{4}{60}\right) \cdot \left(1 - \sqrt{1 - \left(\frac{2 \cdot 0,447}{0,85 \cdot 4}\right)}\right) = 0,0080$$

$$A_s = \rho \cdot b_w \cdot d = 0,0080 \cdot 8 \cdot 29,19 = 1,87 \text{ in}^2$$

As,min (ACI 318-19 – 9.6.1.2)

$$\left(\frac{3 \cdot \sqrt{f'_c}}{f_y}\right) \cdot b_w \cdot d = \left(\frac{3 \cdot \sqrt{4000}}{60000}\right) \cdot 8 \cdot 29,19 = 0,74 \text{ in}^2$$

$$\left(\frac{200}{f_y}\right) \cdot b_w \cdot d = \left(\frac{200}{60000}\right) \cdot 8 \cdot 29,19 = 0,78 \text{ in}^2$$

$$A_{s,min} = 0,78 \text{ in}^2$$

TQS = 1,87 in ²	Software B = 2,02 in ²	Software C = 1,59 in ²
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2,20 in² ≥ 1,87 in² → OK!

5#6 → 2,20 in²

øMn (3178,91 kip.in) ≥ Mu (2738,19 kip.in) → OK!!

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

$$\alpha = \frac{A_s \cdot f_y}{0,85 \cdot f'_c \cdot b_w} = \frac{1,87 \cdot 60}{0,85 \cdot 4 \cdot 8} = 4,12 \text{ in}$$

$$\text{Linha Neutra: } c = \frac{\alpha}{\beta_1} = \frac{4,12}{0,85} = 4,85 \text{ in}$$

$$\varepsilon_t = 0,003 \cdot \left(\frac{d - c}{c}\right) = 0,003 \cdot \left(\frac{29,19 - 4,85}{4,85}\right) = 0,015$$

0,015 ≥ 0,005 → OK! Tension Controlled! → ø 0,90 OK!

Cortante:

TQS	Software B	Software C
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Vu = 78,65 kips	Vu = 72,43 kips	Vu = 80,15 kips
Vu,design = 49,83 kips	Vu,design = 48,90 kips	Vu,design = 48,73 kips

$$V_n = V_c + V_s$$

$$V_u = 78,65 \text{ kips}$$

$$V_{u,design} = 49,83 \text{ kips}$$

$$V_c = 2 \cdot \lambda \cdot \sqrt{f'_c} \cdot b_w \cdot d = 2 \cdot 1 \cdot \sqrt{4000} \cdot 8 \cdot 29,19 = 29,53 \text{ kips}$$

$$V_n = \frac{V_{u,design}}{\phi_{0,75}} = V_c + V_s \rightarrow V_s = 36,91 \text{ kips} \rightarrow V_n = 66,44 \text{ kips}$$

$$V_{s,lim} = 8 \cdot \sqrt{f'_c} \cdot b_w \cdot d = 8 \cdot \sqrt{4000} \cdot 8 \cdot 29,19 = 118,13 \text{ kips}$$

$V_s \leq V_{s,lim}$ OK!

$\phi_{0,75} \rightarrow \phi V_n \geq V_u \rightarrow 49,83 \geq 49,83 \rightarrow \text{OK!!}$

Área de Aço:

$$A_v = \frac{V_s \cdot s}{f_{yt} \cdot d} = \frac{A_v}{s} = \frac{36,91}{60 \cdot 29,19} = 0,021 \text{ in}^2$$

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

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

$$A_v \geq A_{v,min} \rightarrow 0,021 \geq 0,0067 \rightarrow \text{OK!!}$$

Espaçamento:

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

$$s_1 = \frac{d}{2} = 14,60 \text{ in ou } s_2 = 24 \text{ in} \rightarrow 14,6 \text{ in!} \rightarrow 10 \text{ in!!}$$

$$\phi_t = \#3 \rightarrow \#3 @ 10 \text{ in}$$

$$\phi V_n (51,04 \text{ kips}) \geq V_u (49,83 \text{ kips})$$