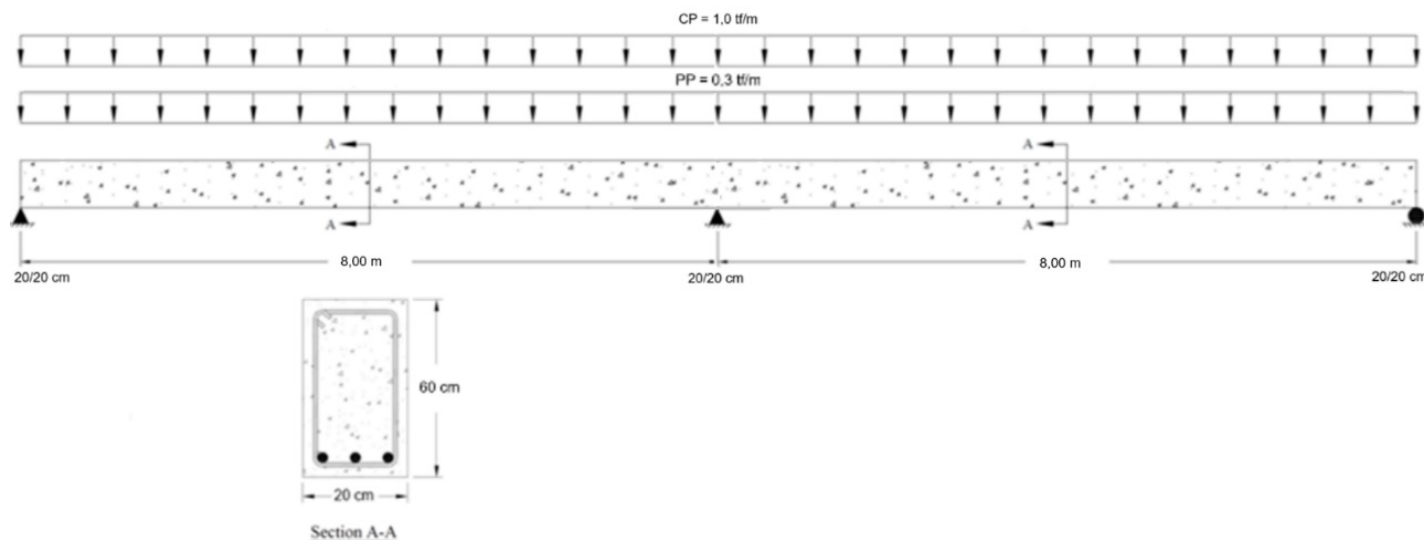


Vigas - Flexão Simples - Viga Continua 3

FLEXÃO SIMPLES

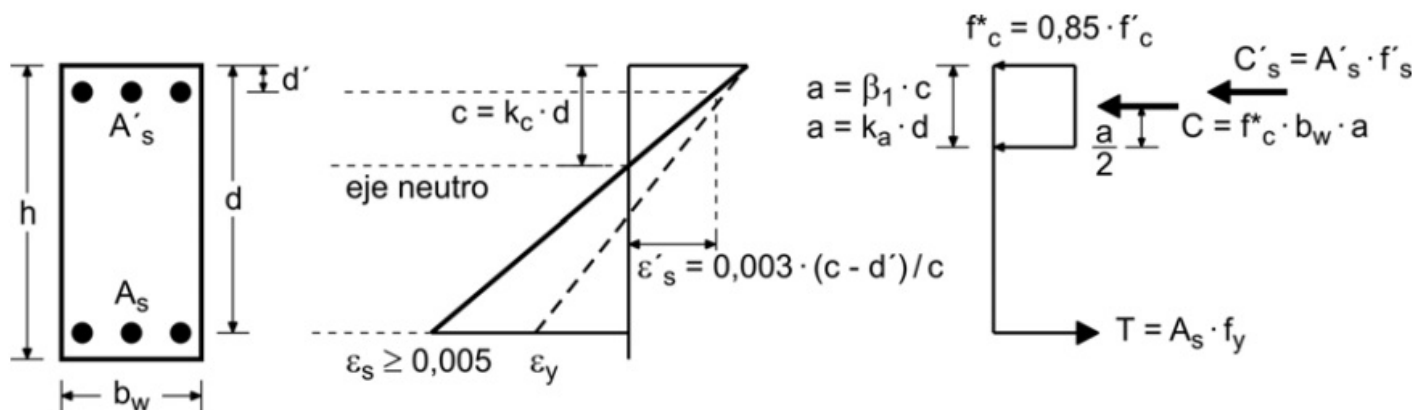
Neste exemplo, será dimensionada a armadura longitudinal e transversal de uma viga submetida a Flexão Simples utilizando como base a Norma Cirsoc-2005, conforme dados abaixo:



Concreto: H-25 / Aço: ADN420

bw: 20 cm / h: 60 cm

TQS:	Software B:	Software C:
Mu+ 77 kN.m	Mu+ 77,3 kN.m	Mu+ 72,5 kN.m
Mu- 141 kN.m	Mu- 142,2 kN.m	Mu- 131,3 kN.m



Flexão+:

$$M_n = \frac{Mu}{\phi} = \frac{77,00}{0,9} = 85,56 \text{ kN.m}$$

$$d = h - C_c - d_{be} - \frac{d_b}{2} = 60 - 2 - 0,6 - 0,8 = 56,60 \text{ cm}$$

$$m_n = \frac{M_n}{0,85 \cdot f'_c \cdot b_w \cdot d^2} = \frac{85,56}{0,85 \cdot 25000 \cdot 0,20 \cdot 0,566^2} = 0,0628$$

$$k_a = 1 - (1 - 2 \cdot m_n)^{\frac{1}{2}} = 1 - (1 - 2 \cdot 0,0628)^{\frac{1}{2}} = 0,0649$$

$$x = \frac{k_a \cdot d}{0,85} = 4,32 \text{ cm}$$

$$A_s = \frac{k_a \cdot f'_c \cdot b_w \cdot d}{f_y} = \frac{0,0649 \cdot 21,25 \cdot 20 \cdot 56,6}{420} = 3,72 \text{ cm}^2$$

$$A_s \geq A_{s,min}$$

$$A_{s1,min} = \frac{0,25 \cdot \sqrt{f'_c}}{f_y} \cdot b_w \cdot d = \frac{0,25 \cdot \sqrt{25}}{420} \cdot 20 \cdot 56,6 = 3,37 \text{ cm}^2$$

$$A_{s2,min} = \frac{1,4 \cdot b_w \cdot d}{f_y} = \frac{1,4 \cdot 20 \cdot 56,6}{420} = 3,76 \text{ cm}^2$$

$$A_{s,req} = A_s \cdot 1,33 = 4,96 \text{ cm}^2$$

TQS = 3,76 cm ²	Software B = 3,73 cm ²	Software C = 3,71 cm ²
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$$3,76 \text{ cm}^2 \geq 3,76 \text{ cm}^2 \rightarrow \text{OK!!}$$

$$2\emptyset 16 \text{ mm} \rightarrow 4,02 \text{ cm}^2$$

$$\phi M_n (82,99 \text{ KN.m}) \geq M_u (77,00 \text{ KN.m}) \rightarrow \text{OK!!}$$

Flexão:-

$$M_n = \frac{M_u}{\phi} = \frac{141}{0,9} = 156,67 \text{ kN.m}$$

$$d = h - C_c - d_{be} - \frac{d_b}{2} = 60 - 2 - 0,6 - 0,8 = 56,60 \text{ cm}$$

$$m_n = \frac{M_n}{0,85 \cdot f'_c \cdot b_w \cdot d^2} = \frac{156,67}{0,85 \cdot 25000 \cdot 0,20 \cdot 0,566^2} = 0,1151$$

$$k_a = 1 - (1 - 2 \cdot m_n)^{\frac{1}{2}} = 1 - (1 - 2 \cdot 0,1151)^{\frac{1}{2}} = 0,1226$$

$$x = \frac{k_a \cdot d}{0,85} = 8,16 \text{ cm}$$

$$A_s = \frac{k_a \cdot f'_c \cdot b_w \cdot d}{f_y} = \frac{0,1226 \cdot 21,25 \cdot 20 \cdot 56,6}{420} = 7,02 \text{ cm}^2$$

$$A_s \geq A_{s,min}$$

$$A_{s1,min} = \frac{0,25 \cdot \sqrt{f'_c}}{f_y} \cdot b_w \cdot d = \frac{0,25 \cdot \sqrt{25}}{420} \cdot 20 \cdot 56,6 = 3,38 \text{ cm}^2$$

$$A_{s2,min} = \frac{1,4 \cdot b_w \cdot d}{f_y} = \frac{1,4 \cdot 20 \cdot 56,6}{420} = 3,77 \text{ cm}^2$$

$$A_{s,req} = A_s \cdot 1,33 = 9,36 \text{ cm}^2$$

TQS = 7,02 cm ²	Software B = 7,20 cm ²	Software C = 6,74 cm ²
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$$8,04 \text{ cm}^2 \geq 7,02 \text{ cm}^2 \rightarrow \text{OK!!}$$

$$4\emptyset 16 \text{ mm} \rightarrow 8,04 \text{ cm}^2$$

$$\emptyset \text{Mn (159,94 KN.m)} \geq \text{Mu (156,67 KN.m)} \rightarrow \text{OK!!}$$

Cortante:

TQS	Software B	Software C
Vu = 8,91 t	Vu = 8,85 t	Vu = 8,71 t
Vu,design = 7,70 t	Vu,design = 7,82 t	Vu,design = 7,50 t

$$\beta_w = \frac{A_s}{b_w \cdot d}$$

$$V_n = V_c + V_s$$

$$V_u = 8,91 \text{ t}$$

$$V_{u,design} = 7,70 \text{ t}$$

$$V_c = \left(1 + \frac{N_u}{14 \cdot A_g}\right) \sqrt{f'_c} \cdot \frac{1}{6} \cdot b_w \cdot d = \left(1 + \frac{0}{14 \cdot 0,12}\right) \sqrt{25} \cdot \frac{1}{6} \cdot 2 \cdot 5,66 = 9,43 \text{ t}$$

$$V_{c,lim} = 0,3 \cdot \sqrt{f'_c} \cdot b_w \cdot d \cdot \sqrt{1 + \frac{0,3 \cdot N_u}{A_g}} = 16,98 \text{ t}$$

$$V_c \leq V_{c,lim} \rightarrow \text{OK!!}$$

$$V_n = \frac{V_{u,design}}{\phi_{0,75}} = V_c + V_s \rightarrow V_s = 0,83 \text{ t} \rightarrow V_n = 10,27 \text{ t}$$

$$V_{s,lim} = \frac{2}{3} \cdot \sqrt{f'_c} \cdot b_w \cdot d = 37,73 \text{ t}$$

$$\phi_{0,75} \rightarrow \phi V_n \geq V_u \rightarrow 7,70 \geq 7,70 \rightarrow \text{OK!!}$$

Área de Aço:

$$A_v = \frac{V_s \cdot s}{f_{yt} \cdot d} = \frac{0,833 \cdot 100}{4,2 \cdot 56,6} = 0,35 \text{ cm}^2/\text{m}$$

$$A_{v,min} = \frac{1}{16} \cdot \sqrt{f'_c} \cdot \frac{b_w \cdot s}{f_{yt}} \geq 0,33 \cdot \frac{b_w \cdot s}{f_{yt}} = 1,55 \text{ cm}^2/\text{m}$$

$$A_v \geq A_{v,min} \rightarrow 035 \leq 1,55 \rightarrow \text{Adotado } A_{v,min}!!$$

Espaçamento:

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

$$s_1 = \frac{d}{2} = 28,3 \text{ cm ou } s_2 = 400 \text{ mm} \rightarrow \text{Adotado: } 28 \text{ cm!}$$

$$\phi_t = 6 \text{ mm} \rightarrow A_v = 2,00 \text{ cm}^2/\text{m} \rightarrow \phi 6 \text{ c/ } 28 \text{ cm}$$

$$\phi_t = 6 \text{ mm} \rightarrow A_v = 2,00 \text{ cm}^2/\text{m} \rightarrow \phi 6 \text{ c/ } 28 \text{ cm}$$

$$\phi V_n (10,66 \text{ t}) \geq V_u (7,70 \text{ t}) \rightarrow \text{OK!!}$$