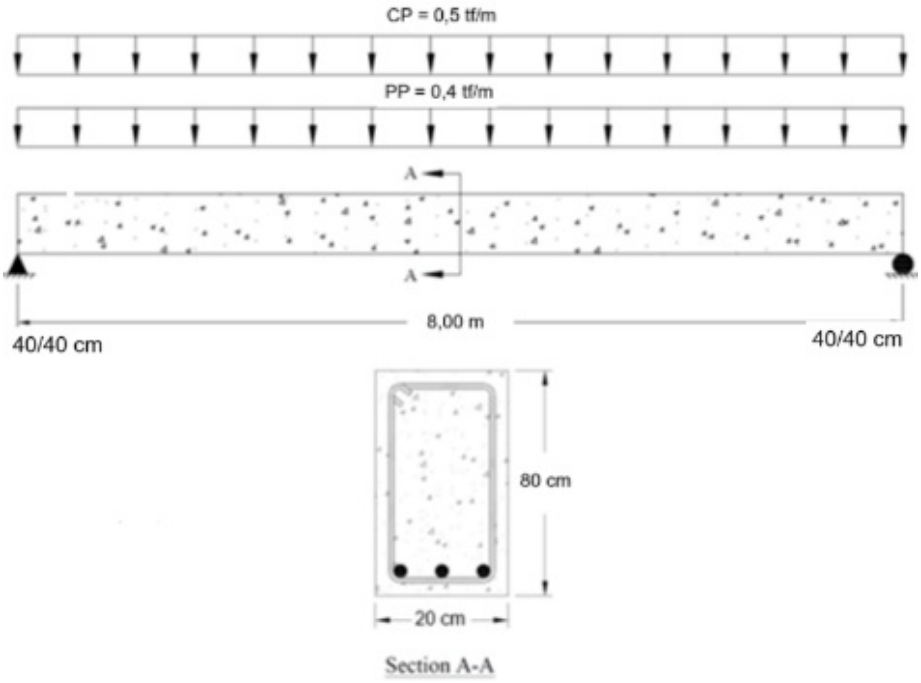
Vigas - Flexão Simples 6

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:

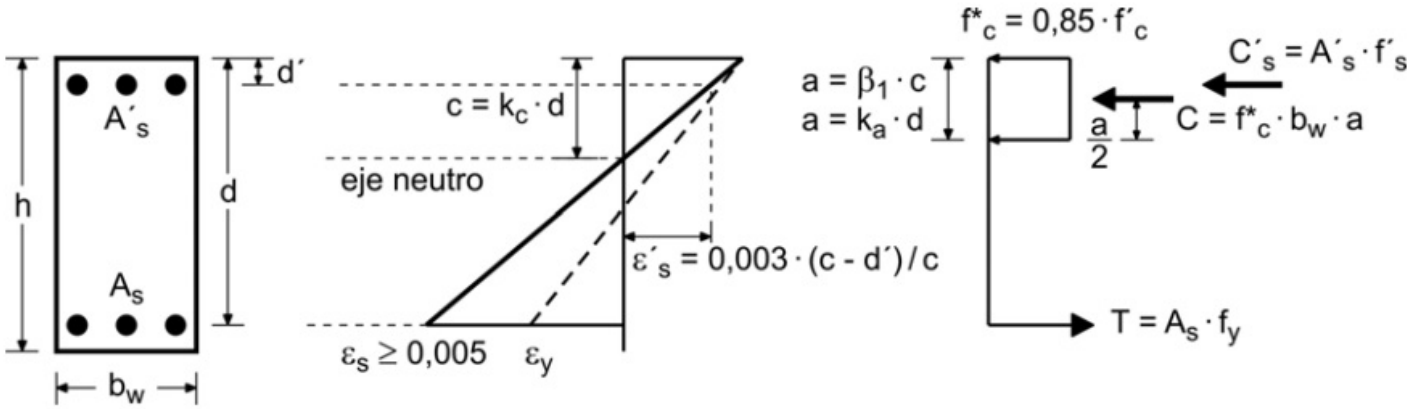


Concreto: H-25 / Aço: ADN420

bw: 20 cm / h: 80 cm

Mu:

TQS = 60,0 kN.m	**Software B = 60,8 kN.m**	**Software C = 62,2 kN.m**



Flexão:

$$M_n = \frac{Mu}{\emptyset} = \frac{60,00}{0,9} = 66,67\ kN.m$$

$$d = h - C_c - d_{be} - \frac{d_b}{2} = 80 - 2 - 0{,}6 - 0{,}6 = \mathbf{76{,}80\ cm}$$

$$m_n = \frac{M_n}{0{,}85 \cdot f'_c \cdot b_w \cdot d^2} = \frac{66{,}67}{0{,}85 \cdot 25000 \cdot 0{,}20 \cdot 0{,}768^2} = \mathbf{0{,}0266}$$

$$k_a = 1 - (1 - 2 \cdot m_n)^{\frac{1}{2}} = 1 - (1 - 2 \cdot 0{,}0266)^{\frac{1}{2}} = \mathbf{0{,}027}$$

$$\boldsymbol{x = \frac{k_a \cdot d}{0{,}85} = 2{,}44\ cm}$$

$$\boldsymbol{A_s = \frac{k_a \cdot f *_c \cdot b_w \cdot d}{f_y} = \frac{0{,}027 \cdot 21{,}25 \cdot 20 \cdot 76{,}8}{420} = 2{,}10\ cm^2}$$

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

$$A_{s1,min} = \frac{0{,}25 \cdot \sqrt{f'_c}}{f_y} \cdot b_w \cdot d = \frac{0{,}25 \cdot \sqrt{25}}{420} \cdot 20 \cdot 76{,}8 = 4{,}57\ cm^2$$

$$A_{s2,min} = \frac{1{,}4 \cdot b_w \cdot d}{f_y} = \frac{1{,}4 \cdot 20 \cdot 76{,}8}{420} = 5{,}12\ cm^2$$

$$A_{s,req} = A_s \cdot 1{,}33 = 2{,}80\ cm^2 \rightarrow TQS\ adota\ adicional\ devido\ a\ altura\ da\ viga \rightarrow 3{,}36\ cm^2$$

TQS = 3,36 cm²	Software B = 2,79 cm²	Software C = 5,04 cm²

3,39 cm² ≥ 3,36 cm² → OK!!

$3\text{Ø}12\ mm \rightarrow 3{,}39\ cm^2$

øMn (96,01 KN.m) ≥ Mu (60,00 KN.m) → OK!!

Cortante:

TQS	Software B	Software C
Vu = 5,05 t	Vu = 4,79 t	Vu = 5,00 t
Vu,design = 3,83 t	Vu,design = 3,82 t	Vu,design = 3,80 t

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

$$V_n = V_c + V_s$$

$$\boldsymbol{V_u = 5{,}05\ t}$$

$$\boldsymbol{V_{u,design} = 3{,}83\ t}$$

$$V_c = \left(1 + \frac{N_u}{14 \cdot A_g}\right)\sqrt{f'_c} \cdot \frac{1}{6} \cdot b_w \cdot d = \left(1 + \frac{0}{14 \cdot 0{,}12}\right)\sqrt{25} \cdot \frac{1}{6} \cdot 2 \cdot 7{,}68 = 12{,}80\ t$$

$$V_{c,lim} = 0{,}3 \cdot \sqrt{f'_c} \cdot bw \cdot d \cdot \sqrt{1 + \frac{0{,}3 \cdot N_u}{A_g}} = 23{,}04\ t$$

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

$$\boldsymbol{V_n = \frac{V_{u,design}}{\emptyset_{0,75}} = V_c + V_s \rightarrow V_s = 0\ t \rightarrow V_n = 5{,}11\ t}$$

$$V_{s,lim} = \frac{2}{3} \cdot \sqrt{f'_c} \cdot b_w \cdot d = 51{,}45\ t$$

Ø0,75 → øVn ≥ Vu → 3,83 ≥ 3,83 → OK!!

Área de Aço:

$$A_v = \frac{V_s \cdot s}{f_{yt} \cdot d} = \frac{0 \cdot 100}{4{,}2 \cdot 76{,}8} = 0{,}00\ cm^2/m$$

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

$$\boldsymbol{A_v \geq A_{v,min} \rightarrow 0{,}00 \leq 1{,}55 \rightarrow Adotado\ A_{v,min}}!!$$

Espaçamento:

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

$$\boldsymbol{s_1 = \frac{d}{2} = 38{,}4\ cm\ \ ou\ \ s_2 = 400\ mm \rightarrow\ \ Adotado{:}35\ cm}!$$

$$\boldsymbol{\emptyset_t = 6\ mm \rightarrow A_v = 1{,}60\ cm^2/m \rightarrow \emptyset 6\ c/\ 35\ cm}$$

Øt = 6 mm → Av = 1,60 cm²/m → ø6 c/ 35 cm

øVn (13,44 t) ≥ Vu (3,83 t) → OK!!