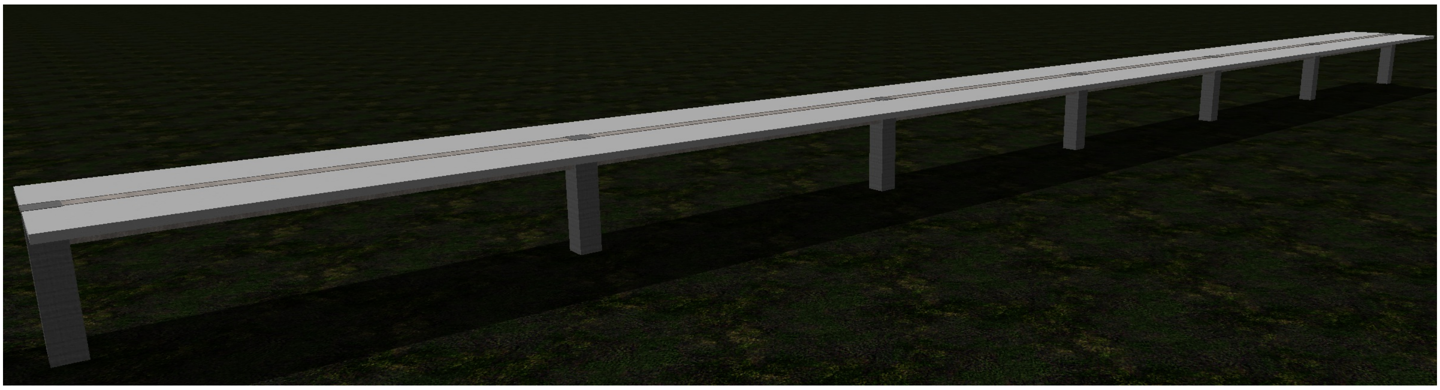
Vigas - ACI Example - Continous Beam

FLEXÃO SIMPLES

Neste exemplo, será dimensionada a armadura longitudinal e transversal de uma viga submetida a Flexão Simples seguindo modelo do ACI-SP17-14 - Beam Example 1 - Continous Interior Beam:



Given:

Load

Service additional dead load D = 15 psf

Service live load L = 65 psf

Material properties

fy = 60000 psi

fck = 5000 psi

Ec = 4030000 psi

Es = 29000000 psi

Span length: 36 ft

Beam width: 18 in.

Beam Depth: 30 in

Column dimensions: 24 in. x 24 in

Tributary width: 14 ft

Slab thickness: 7 in.

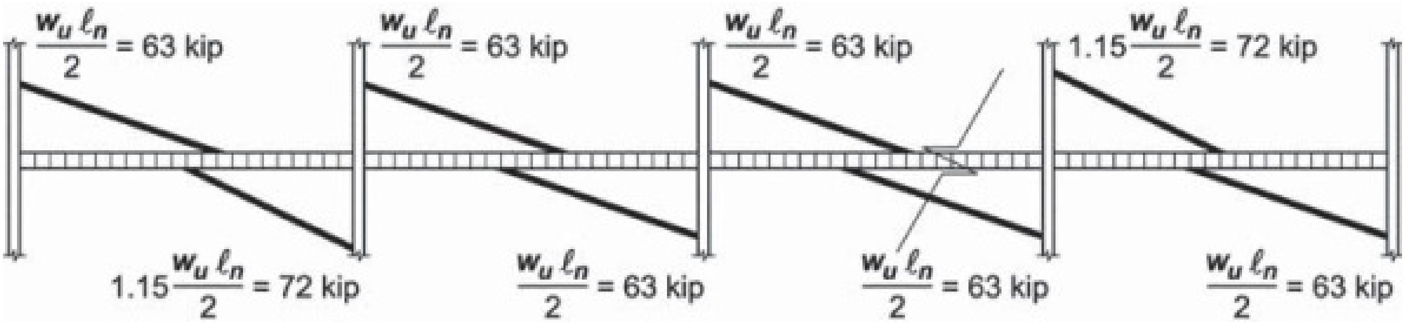
Self-weight

Beam: wb = 0.56 kip/ft

Slab: ws = 1.1 kip/ft

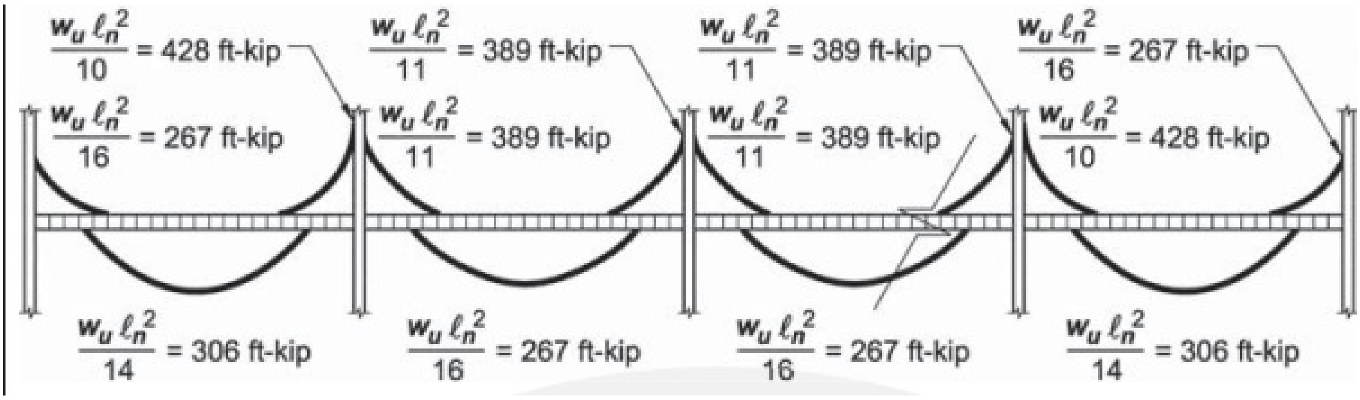
Shear diagram:

ACI



Moment diagram:

ACI



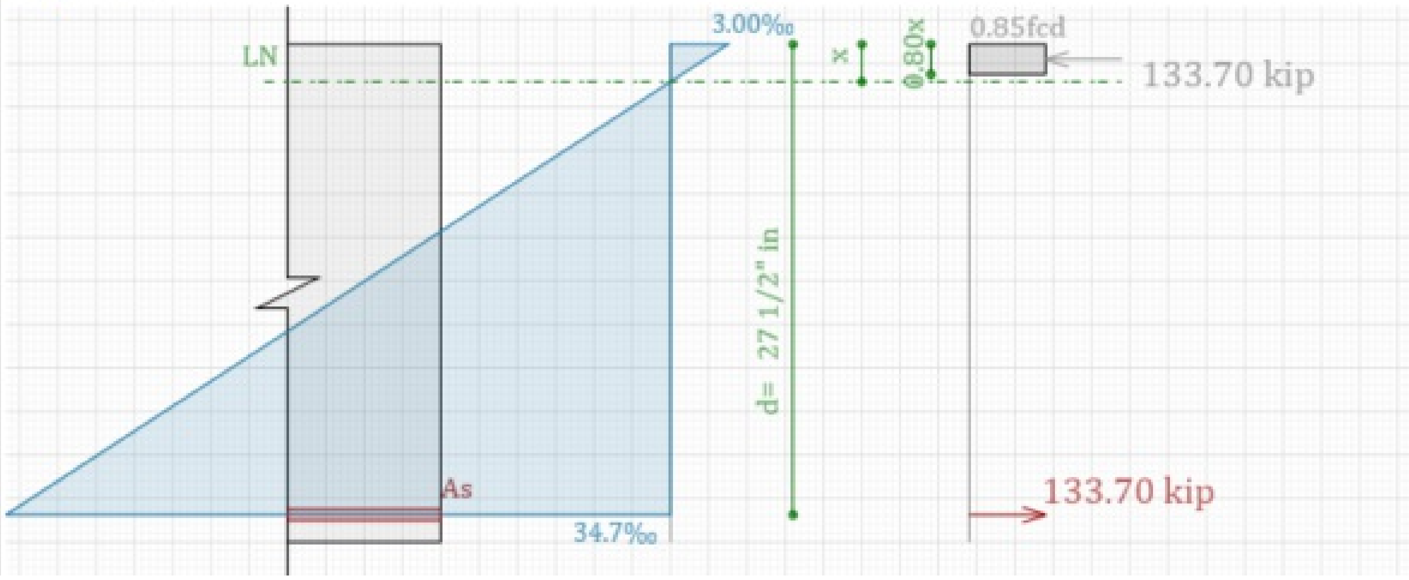
Required Reinforcement:

1.

e2cd12baee3b0a5ae658f12d0f3c5018.emf

A_s = 2.23 in2
A_s' = 0.00 in2
x = 2 1/4" in
β_X = x/d = 0.08

Equilíbrio

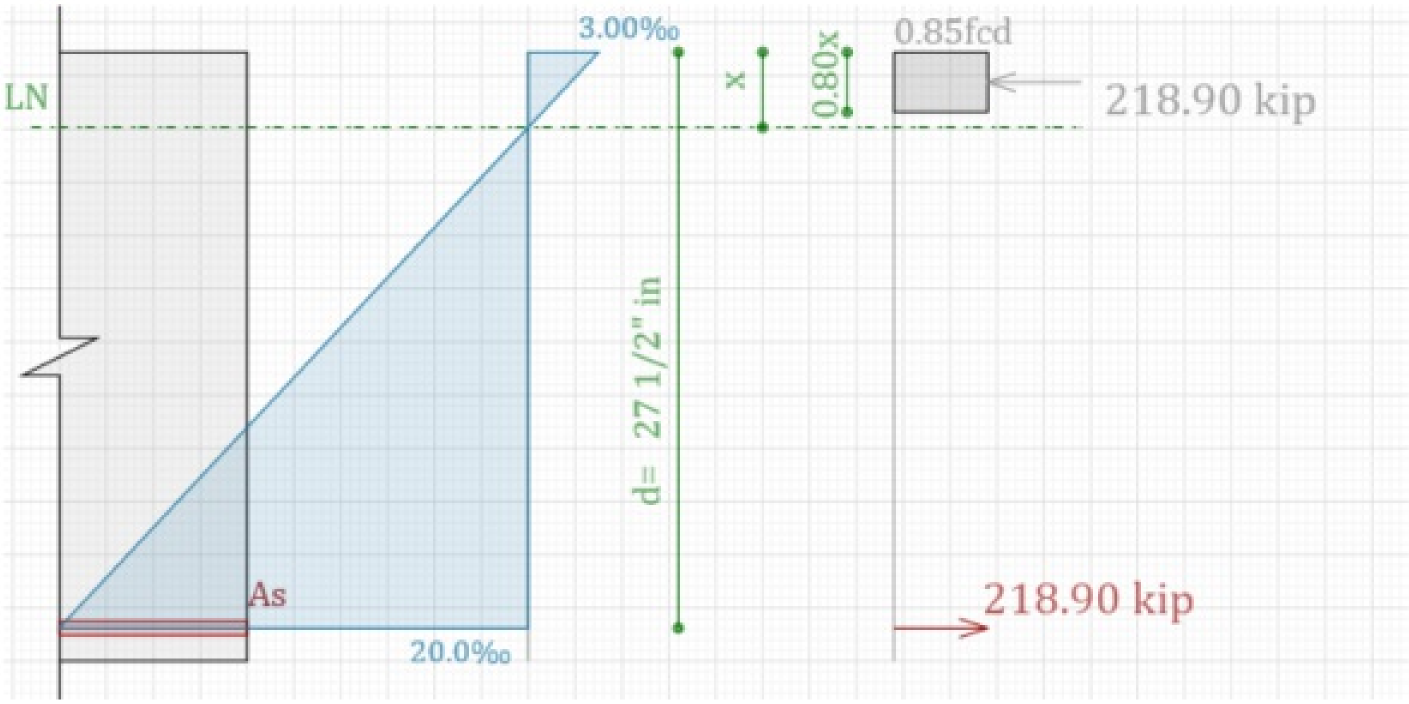


2.

7b0744ad505e578ae069a3800968c6c9.emf

A_s = 3.65 in2
A_s' = 0.00 in2
x = 3 5/8" in
β_X = x/d = 0.13

Equilíbrio

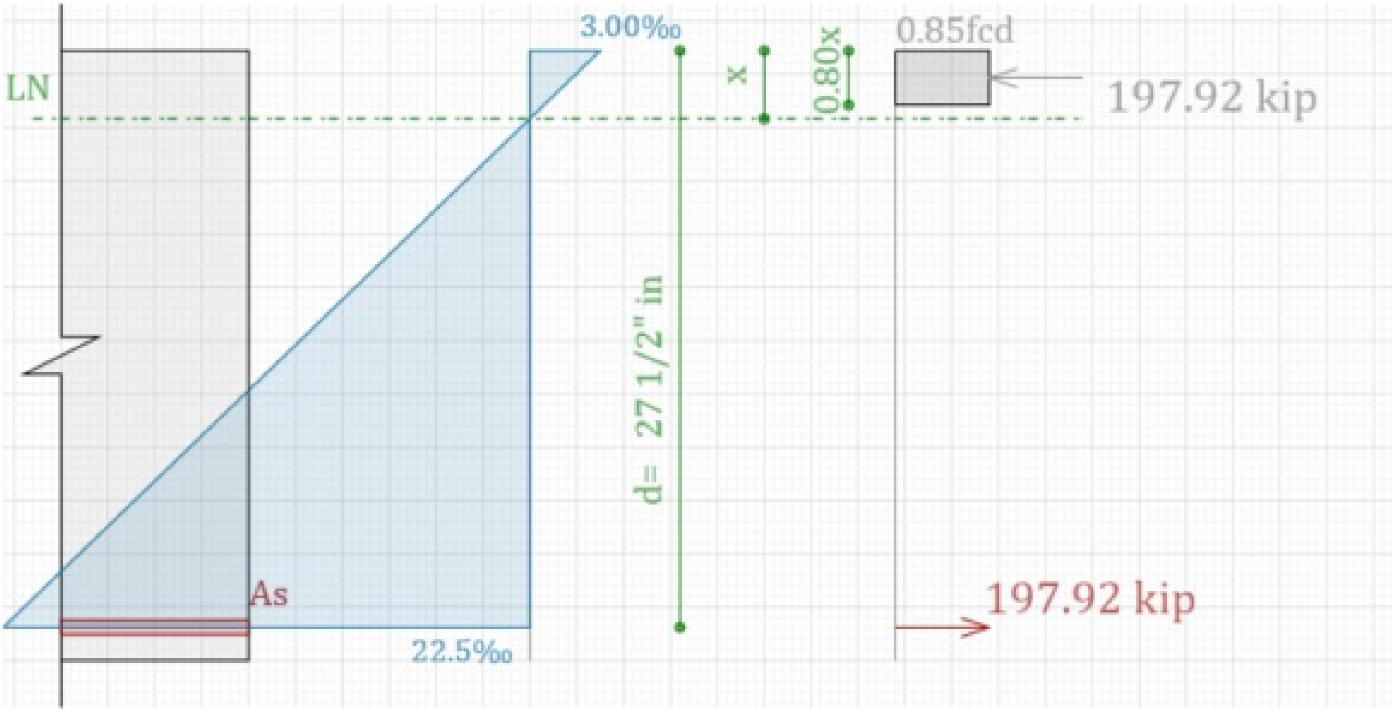


3.

0bd5bd25b8aae25ef2b4c017aeaae245.emf

A_s = 3.30 in2
A_s' = 0.00 in2
x = 3 1/4" in
β_X = x/d = 0.12

Equilíbrio



4.

afd5c50b02514925f87365d88464db2c.emf

A_s = 2.49 in2
A_s' = 0.00 in2
x = 3/8" in
β_X = x/d = 0.01

Equilíbrio

5.

52713e9e7893402cd563e88b8098cc19.emf

A_s = 2.17 in2
A_s' = 0.00 in2
x = 3/8" in
β_X = x/d = 0.01

Equilíbrio

Tension Controlled! → ø 0,90 OK!

As,min (ACI 318-19 – 9.6.1.2)

$$\left(\frac{3\cdot\sqrt{f'_c}}{f_y}\right)\cdot b_w\cdot d=\left(\frac{3\cdot\sqrt{4000}}{60000}\right)\cdot 18\ \cdot 27{,}50=\mathbf{1{,}57\ in^2}$$

$$\left(\frac{200}{f_y}\right)\cdot b_w\cdot d=\left(\frac{200}{60000}\right)\cdot 18\cdot 27{,}50=1{,}65\ \boldsymbol{in^2}$$

$$A_s\geq A_{s,min}\rightarrow OK!!$$

Shear:

$$V_n=\ V_c+V_s$$

$$\boldsymbol{V_u=72\ kip}$$

$$\boldsymbol{V_{u,design}=63{,}5\ kip}$$

$$V_c=2\cdot\lambda\cdot\sqrt{f'_c}\cdot b_w\cdot d=2\cdot 1\cdot\sqrt{5000}\cdot 18\cdot 27{,}5=70\ \boldsymbol{kip}$$

$$\boldsymbol{V_n=\frac{V_{u,design}}{\emptyset_{0,75}}=V_c+V_s\quad\rightarrow\quad V_s=14,67\ kip\quad\rightarrow\quad V_n=84,67\ kip}$$

$$V_{s,lim}=\ 8\cdot\sqrt{f'_c}\cdot b_w\cdot d=8\cdot\sqrt{5000}\cdot 18\cdot 27{,}50=\mathbf{280}\ \boldsymbol{kip}$$

Vs ≤ Vs,lim OK!

Ø0,75 → øVn ≥ Vu → 63,50 ≥ 63,50 → OK!!

Shear Reinforcement:

$$A_v=\frac{V_s\ \cdot s}{f_{yt}\cdot d}=\frac{A_v}{s}=\frac{14{,}67}{60\cdot 27{,}50}=0{,}009\ in^2/in$$

$$\boldsymbol{\frac{A_{v,min}}{s}=\frac{0,75\cdot\sqrt{f'_c\cdot b_w}}{f_{yt}}=0,014\ in^2/in}$$

$$\frac{A_{v,min}}{s} = \frac{50 \cdot b_w}{f_{yt}} = 0,015\ in^2/in$$

$$A_v \geq A_{v,min} \ \rightarrow \ 0,009 \ \leq 0,015 \ \rightarrow \ A_{v,min}!!$$

Espaçamento:

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

$$s_1 = \frac{d}{2} = 13,8\ in \ \ ou\ \ s_2 = 24\ in \ \ \rightarrow \ 13,8\ in! \ \rightarrow 12\ in!!$$

$$\emptyset_t = \#3 \ \rightarrow \#3\ @\ 12\ in \ \rightarrow 0,018\ in^2/in$$

øVn (75,62 kip) ≥ Vu (63,50 kip)

Final Design using #7 and #3 stirrups in TQS: