

Reinforced Concrete Beam

Simple-span rectangular beam under uniform gravity load. Numbers come from calc.py. This sheet only presents them.

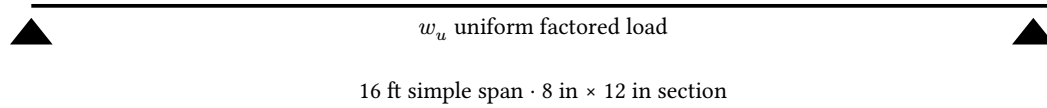


Figure 1: 16 ft simply supported beam, 8 in × 12 in rectangular section.

Loads and Beam Demand

$$L = 16 \text{ ft}$$

$$B_t = 6.25 \text{ ft}$$

$$D = 55 \text{ psf}$$

$$L_L = 20 \text{ psf}$$

$$w_{sw} = 0.1 \text{ kip/ft}$$

$$w_u = 1.2w_D + 1.6w_L = 0.733 \text{ kip/ft}$$

$$M_u = \frac{w_u L^2}{8} = 23.44 \text{ kip}\cdot\text{ft}$$

$$V_u = \frac{w_u L}{2} = 5.86 \text{ kip}$$

Simple span

Tributary width

Dead load including superimposed dead

Live load

Beam self-weight

Factored uniform line load

Maximum positive moment

Support shear

Section and Reinforcement

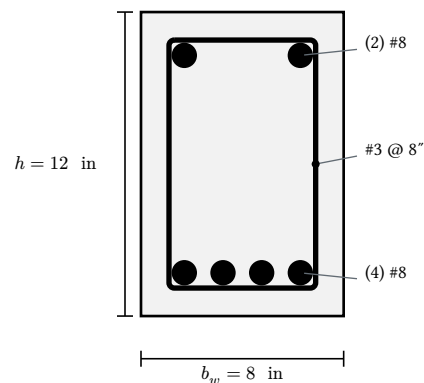


Figure 2: Beam cross-section

Flexural Strength

$$b_w = 8 \text{ in}$$

$$h = 12 \text{ in}$$

$$d = 9.5 \text{ in}$$

$$f'_c = 3 \text{ ksi}$$

Beam width

Overall depth

Effective depth

Concrete compressive strength

$$f_y = 60 \text{ ksi}$$

Steel yield strength

$$A_s = 3.14 \text{ in}^2$$

Provided tension steel (4 No. 8)

$$a = \frac{A_s f_y}{0.85 f'_c b_w} = 9.24 \text{ in}$$

Equivalent compression-block depth

$$\varepsilon_t = -0.0004$$

Net tensile strain

$$\varphi = 0.65$$

Strength reduction factor

$$\varphi M_n = \varphi A_s f_y \left(d - \frac{a}{2} \right) = 49.83 \text{ kip}\cdot\text{ft}$$

Design flexural strength

Flexural strength

OK

$$M_u: 23.44 \text{ kip}\cdot\text{ft} \quad \varphi M_n: 49.83 \text{ kip}\cdot\text{ft}$$

D/C: 0.47

Minimum Steel and Concrete Shear

$$A_{s,\min} = 0.25 \text{ in}^2$$

Minimum longitudinal steel

$$A_{s,\text{prov}} = 3.14 \text{ in}^2$$

Provided longitudinal steel

Minimum longitudinal reinforcement

OK

$$A_{s,\min}: 0.25 \text{ in}^2 \quad A_{s,\text{prov}}: 3.14 \text{ in}^2$$

D/C: 0.08

$$V_c = 2\sqrt{f'_c} b_w d = 8.33 \text{ kip}$$

Concrete shear strength

$$\varphi V_c = 6.24 \text{ kip}$$

Design concrete shear strength

Concrete shear

OK

$$V_u: 5.86 \text{ kip} \quad \varphi V_c: 6.24 \text{ kip}$$

D/C: 0.94