Reinforced Concrete Beam

Simple-span rectangular beam under uniform gravity load. YAML quantities are converted by Pint in `calc.py`. This sheet only presents the results.

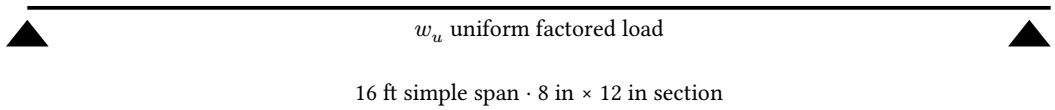

Figure 1: 16 ft simply supported beam, 8 in × 12 in rectangular section.

Loads and Beam Demand

$L = 16 \ \text{ft}$	Simple span
$B_t = 6.25 \ \text{ft}$	Tributary width
$D = 55 \ \text{psf}$	Dead load including superimposed dead
$L_L = 20 \ \text{psf}$	Live load
$w_{\text{sw}} = 0.1 \ \text{kip/ft}$	Beam self-weight
$w_u = 1.2w_D + 1.6w_L = 0.733 \ \text{kip/ft}$	Factored uniform line load
$M_u = w_u \frac{L^2}{8} = 23.44 \ \text{kip·ft}$	Maximum positive moment
$V_u = w_u \frac{L}{2} = 5.86 \ \text{kip}$	Support shear

Flexural Strength

$b_w = 8 \ \text{in}$	Beam width
$h = 12 \ \text{in}$	Overall depth
$d = 12 \ \text{in}$	Effective depth
$f'_c = 3 \ \text{ksi}$	Concrete compressive strength
$f_y = 50 \ \text{ksi}$	Steel yield strength
$A_s = 0.62 \ \text{in}^2$	Provided tension steel (2 No. 5)
$a = A_s \frac{f_y}{0.85 f'_c b_w} = 1.52 \ \text{in}$	Equivalent compression-block depth
$\varepsilon_t = 0.0171$	Net tensile strain
$\varphi = 0.9$	Strength reduction factor
$\varphi M_n = \varphi A_s f_y (d - \frac{a}{2}) = 26.13 \ \text{kip·ft}$	Design flexural strength

Flexural strength **OK**

M_u: 23.44 kip·ft φM_n: 26.13 kip·ft D/C: 0.9

Minimum Steel and Concrete Shear

$A_{\text{s,min}} = 0.384 \ \text{in}^2$	Minimum longitudinal steel

$A_{s,prov} = 0.62\ \text{in}^2$ Provided longitudinal steel

Minimum longitudinal reinforcement OK

$A_{s,min}$: 0.38 in² $A_{s,prov}$: 0.62 in² D/C: 0.62

$V_c = 2\sqrt{f'_c}b_w d = 10.52\ \text{kip}$ Concrete shear strength

$\varphi V_c = 7.89\ \text{kip}$ Design concrete shear strength

Concrete shear OK

V_u: 5.86 kip φV_c: 7.89 kip D/C: 0.74