

Calculation B-01: roof beam, grid line C

Simply supported IPE 300, S355, span 6.0 m, uniform load.

Input

Design load (ULS)	w	24.0 kN/m
Service load (SLS)	w_k	16.0 kN/m
Span	L	6.0 m
Elastic section modulus	W_{el}	557 cm ³
Second moment of area	I_y	8356 cm ⁴
Yield strength	f_y	355 MPa

Bending

$$\begin{aligned}M_{Ed} &= w \cdot \frac{(L)^2}{8} \\&= 24.00 \cdot \frac{(6.00)^2}{8} \\&= 108.00 \text{ (kNm, design moment at midspan)}\end{aligned}$$

$$\begin{aligned}M_{Rd} &= W_{el} \cdot \frac{f_y}{\gamma_{M0}} \cdot \frac{1}{1 \times 10^6} \\&= 557000.00 \cdot \frac{355}{1.00} \cdot \frac{1}{1 \times 10^6} \\&= 197.74 \text{ (kNm, elastic resistance)}\end{aligned}$$

$$\begin{aligned}\eta &= \frac{M_{Ed}}{M_{Rd}} \\&= \frac{108.00}{197.74} \\&= 0.55 \text{ (utilisation)}\end{aligned}$$

Deflection

$$\begin{aligned}\delta &= 5 \cdot w_k \cdot \frac{(L \cdot 1000)^4}{384 \cdot E \cdot I_y} \\&= 5 \cdot 16.00 \cdot \frac{(6.00 \cdot 1000)^4}{384 \cdot 210000 \cdot 83560000.00} \\&= 15.39 \text{ (mm)}\end{aligned}$$

$$\begin{aligned}\delta_{lim} &= L \cdot \frac{1000}{250} \\&= 6.00 \cdot \frac{1000}{250} \\&= 24.00 \text{ (mm)}\end{aligned}$$

Result

Utilisation in bending 0.55; deflection 15.4 mm against a limit of 24.0 mm (L/250). **OK.**