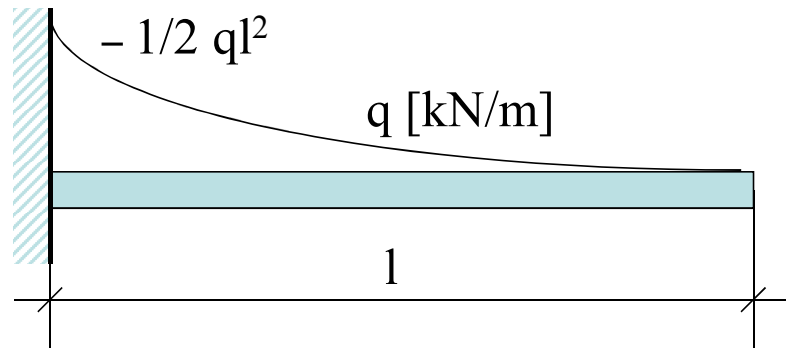
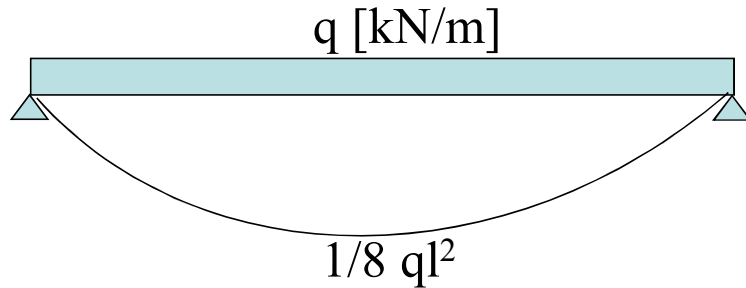


Bending moments [kNm] on a beam

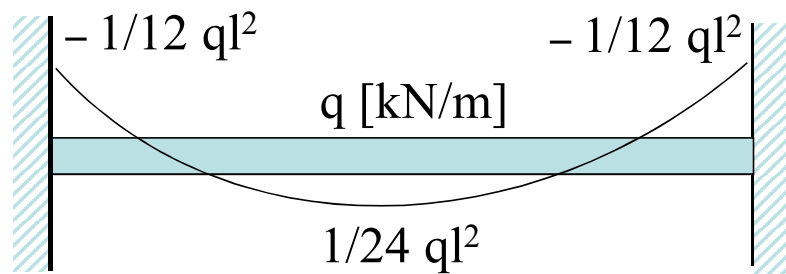
Cantilevered beam



Simply supported beam



Fixed beam



Basic formulae for reinforced concrete

| Structural member | Design resistance | Notes |
|-----------------------|--|------------------------------|
| Beam, slab, simple r. | $M_{Rd} = A_s f_{yd} \left(d - \frac{A_s f_{yd}}{2 b f_{cd}} \right)$ | d effective depth |
| Beam, slab approx. | $M_{Rd} = A_s f_{yd} z$ | $z \sim 0,9 d$ int. arm |
| Short column | $N_{Rd} = \alpha A_c f_{cd} + A_s f_{yd}$ | α red. coefficient |
| Beam – shear | $V_{Rd} = \tau_c b_w d$ | τ_c des. shear strength |
| Slab - punching s. | $V_{Rd} = \tau_c u d$ | u critical peripheral |
| Column, plain con. | $N_{Rd} = b h_w f_{cd} \Phi$ | Φ red. due to eccentr. |

Indicative dimensions of slabs

Slabs

One way spanning slabs

| | | h_{\min} |
|-------------------------------|-------------------|---|
| – simple supported..... | $l_1/25 - l_1/20$ | (50 mm) |
| – continuous and fixed | $l_1/33 - l_1/30$ | (50 mm up to 1 m) (60 mm up to 1,5 m) (70 mm above 1,5 m) |
| – cantilevered | $l_1/10$ | (50 mm) |

Indicative dimensions of slabs

Slabs

Two way slabs

| | | h_{\min} |
|-------------------------|-----------------------|------------|
| – simply supported..... | $l_1/33$ | (100 mm) |
| – partially fixed | $l_1/40$ | |
| - fully fixed ... | $1,2 (l_1 + l_2)/105$ | (100 mm) |

Indicative dimensions of slabs

h_{\min}

Two ways lighten (ribbed) slabs

- simply supported..... $l_1/20$
- partially or fully fixed $l_1/25$

Locally supported slabs

- flat slab $l_2/33$ (160 mm)
- enlarged heads..... $(l_2 - 2c/3)/35$ (120 mm)

l_2 is a greater span, c effective width of the head

Indicative dimensions of concrete beams

- | | h | b |
|--|-------------------------|------------------|
| Simply supported and continuous beams | | |
| – with imposed loads | $l_1/15 - l/12$ | (0,33 – 0,4) h |
| – roof ... | $l_1/17 - l_1/14$ | (0,33 – 0,4) h |

Cantilever beams

- with imposed loads $l/5$ (0,33 – 0,4) h
- roof $l/10$ (0,33 – 0,4) h

Indicative dimensions of concrete components

| | h | b |
|----------------------------|--------------------|-----------------|
| Beams | | |
| – with imposed loads | $l/12 - 1/8$ | $(0,3 - 0,5) h$ |
| – roofs | $l/14 - l/12$ | $(0,3 - 0,5) h$ |

Columns

– middle column of a multistorey building

$$A_s = \frac{\sum N_d}{0,8 f_{cd} + \rho_s f_{yd}}$$

Minimum dimensions:

- 200 mm, cast in situ
- 140 mm, prefabricated columns