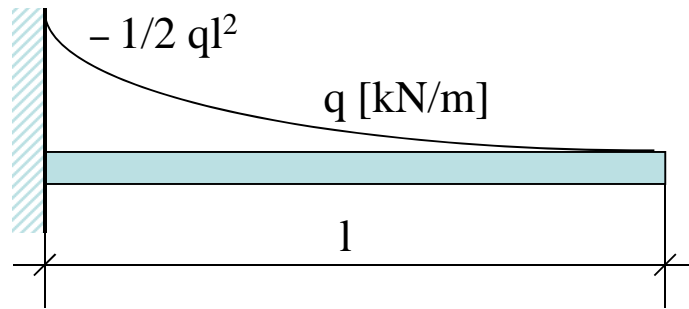
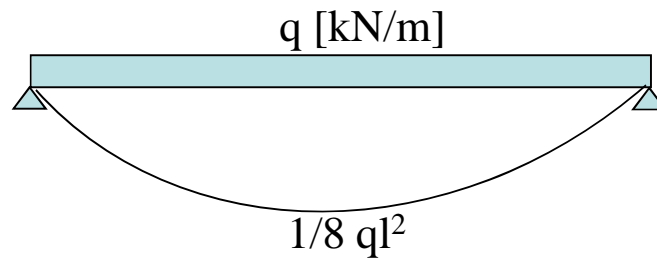


Bending moments [kNm] on a beam

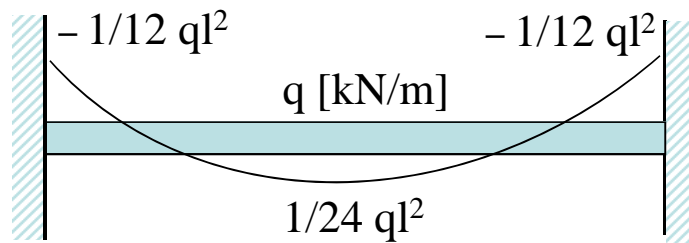
Cantilevered beam



Simply supported beam



Fixed beam



Basic formulae for reinforced concrete

Structural member	Design resistance	Notes
Beam, slab, simple r.	$M_{Rd} = A_s f_{yd} \left(d - \frac{A_s f_{yd}}{2b f_{cd}} \right)$	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 eccentric.

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

- withy 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