Table 3.1 Strength and deformation characteristics for concrete EN 1992-1-1:2004 (E)

$$f_{cm}(f_{ck}) := f_{ck} + 8 \cdot MPa$$

Mean value of concrete cylinder compressive strength

$$f_{ctm}(f_{ck}) := \begin{array}{l} \text{if } (f_{ck} \le 50 \cdot MPa) \\ \quad \text{return } 0.3 \cdot \left(\frac{f_{ck}}{MPa}\right)^{\left(\frac{2}{3}\right)} \cdot MPa \\ \text{else} \\ \quad \text{return } 2.12 \cdot \ln\left(1 + \frac{f_{cm}(f_{ck})}{MPa \cdot 10}\right) \cdot MPa \end{array}$$

Mean value of axial tensile strength of concrete

$$f_{ctk0.05}(f_{ck}) := 0.7 \cdot f_{ctm}(f_{ck})$$

Characteristic axial tensile strength of concrete 5% fractile

$$f_{ctk0.95}(f_{ck}) := 1.3 \cdot f_{ctm}(f_{ck})$$

Characteristic axial tensile strength of concrete 95% fractile

$$E_{cm}(f_{ck}) := 22 \cdot \left(\frac{\frac{f_{cm}(f_{ck})}{MPa}}{10}\right)^{0.3} \cdot GPa$$

Secant modulus of elasticity of concrete

$$\varepsilon_{c1}(f_{ck}) := min\left(\begin{bmatrix} 0.7 \cdot \left(\frac{f_{cm}(f_{ck})}{MPa}\right)^{0.31} \\ 2.8 \end{bmatrix}\right)$$

Compressive strain in the concrete fig. 3.2

$$\varepsilon_{cu1}(f_{ck}) := \begin{array}{l} \text{if } (f_{ck} > 50 \cdot MPa) \\ \quad \text{return } 2.8 + 27 \cdot \left(\frac{\left(98 - \frac{f_{cm}(f_{ck})}{MPa}\right)}{100}\right)^4 \\ \text{else} \\ \quad \text{return } 0.0035 \end{array}$$

Ultimate compressive strain in the concrete fig. 3.2

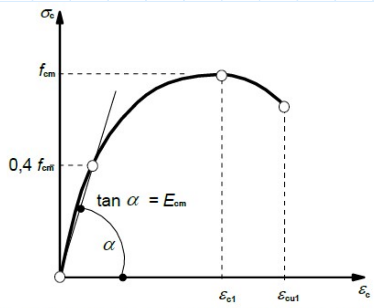

Figure 3.2: **Schematic representation of the stress-strain relation for structural analysis (the use 0.4f_{cm} for the definition of E_{cm} is approximate).**

$$\varepsilon_{c2}(f_{ck}) := \begin{array}{l} \text{if } f_{ck} > 50 \cdot MPa \\ \quad \text{return } \frac{2.6 + 35 \cdot \left(\frac{90 - \frac{f_{ck}}{MPa}}{100}\right)^4}{1000} \\ \text{else} \\ \quad \text{return } 0.0035 \end{array}$$

Compressive strain in the concrete fig. 3.3 Parabola-rectangle

$$\varepsilon_{cu2}(f_{ck}) := \begin{array}{l} \text{if } f_{ck} > 50 \cdot MPa \\ \quad \text{return } 2 + 0.085 \cdot \left(\frac{f_{ck}}{MPa} - 50\right)^{0.53} \\ \text{else} \\ \quad \text{return } 0.002 \end{array}$$

Ultimate compressive strain in the concrete fig. 3.3. Parabola-rectangle

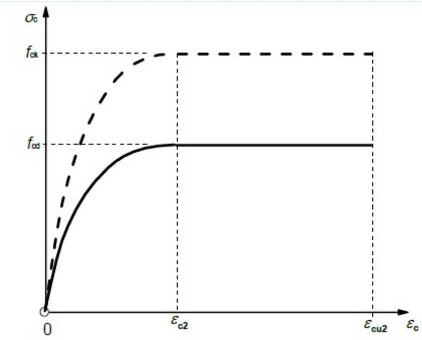

Figure 3.3: Parabola-rectangle diagram for concrete under compression.

$$n(f_{ck}) := \text{if}\left(\left(f_{ck} \le 50 \cdot MPa\right), 2, 1.4 + 23.4 \cdot \left(\frac{90 - \frac{f_{ck}}{MPa}}{100}\right)^4\right)$$

Exponent for equation EC 2 3.17

$$\varepsilon_{c3}(f_{ck}) := \text{if}\left(\left(f_{ck} < 50 \cdot MPa\right), 0.00175, \frac{1.75 + 0.55 \cdot \left(\frac{\frac{f_{ck}}{MPa} - 50}{40}\right)}{1000}\right)$$

Compressive strain in the concrete fig. 3.4. Bi-linear

$$\varepsilon.cu2(f.ck.f) := \text{if}\left(\left(f.ck.f < 50 \cdot MPa\right), 0.0035, \frac{2.6 + 35 \cdot \left(\frac{90 - \frac{f.ck.f}{MPa}}{100}\right)^4}{1000}\right)$$

Ultimate compressive strain in the concrete fig. 3.3. Bi-linear

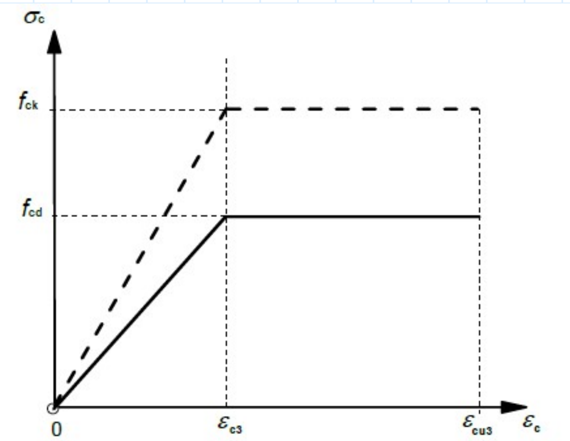

Figure 3.4: Bi-linear stress-strain relation.