

fc_age

expected strength of a concrete as a function of age and strength at 28 days of age



$$f_{c28} := 350 \cdot \frac{\text{kgf}}{\text{cm}^2}$$

strength at 28 days

$$\alpha := 4$$

$\alpha=4.00$ for cement Type I and moist curing
 $\alpha=2.30$ for cement Type III and moist curing
 $\alpha=1.00$ for cement Type I and steam curing
 $\alpha=0.70$ for cement Type III and steam curing

$$\beta := 0.85$$

$\beta=0.85$ for cement Type I and moist curing
 $\beta=0.92$ for cement Type III and moist curing
 $\beta=0.95$ for cement Type I and steam curing
 $\beta=0.98$ for cement Type III and steam curing

$$\text{Sets} := 1$$

1 for quick setting of concrete (42.5R, 52.5 and 52.5R with w/c less than 0.60, 32.5R and 42.5 with w/c less than 0.50)
0 for normal or slow setting of concrete



$$\text{End_chart} := 1 \cdot \text{year}$$

month, year (singular) also permitted units for time

$$f_c(t) := \frac{\frac{t}{\text{day}}}{\alpha + \beta \cdot \frac{t}{\text{day}}} \cdot f_{c28}$$

according to Branson

$$f_c(28 \cdot \text{day}) = 352.52 \frac{\text{kgf}}{\text{cm}^2}$$

not wholly coherent, see

$$\text{ages} := \begin{pmatrix} 3 \\ 7 \\ 28 \\ 90 \\ 360 \end{pmatrix} \cdot \text{day} \quad f_{c1s} := \begin{pmatrix} 0.4 \\ 0.65 \\ 1 \\ 1.2 \\ 1.35 \end{pmatrix} \cdot f_{c28} \quad f_{c2s} := \begin{pmatrix} 0.55 \\ 0.75 \\ 1 \\ 1.15 \\ 1.2 \end{pmatrix} \cdot f_{c28} \quad \text{EHE table 30.4.b}$$

$$F_{c1}(t) := \text{linterp}(\text{ages}, f_{c1s}, t) \qquad F_{c2}(t) := \text{linterp}(\text{ages}, f_{c2s}, t)$$

$$F_{cEHE}(t) := \begin{cases} F_{c2}(t) & \text{if } \text{Sets} = 1 \\ F_{c1}(t) & \text{otherwise} \end{cases}$$

$$FcEP_93(t) := f_{c28} \cdot \frac{\frac{\left(\frac{t}{day}\right)^{0.75}}{\left(\frac{t}{day}\right)^{0.75} + 5.5}}{\frac{28^{0.75}}{28^{0.75} + 5.5}}$$

commentary to art. 35.9

Parts := 200

$$j := 1..Parts + 1$$

$$Fc_j := fc\left[\frac{End_chart}{Parts} \cdot (j - 1)\right]$$

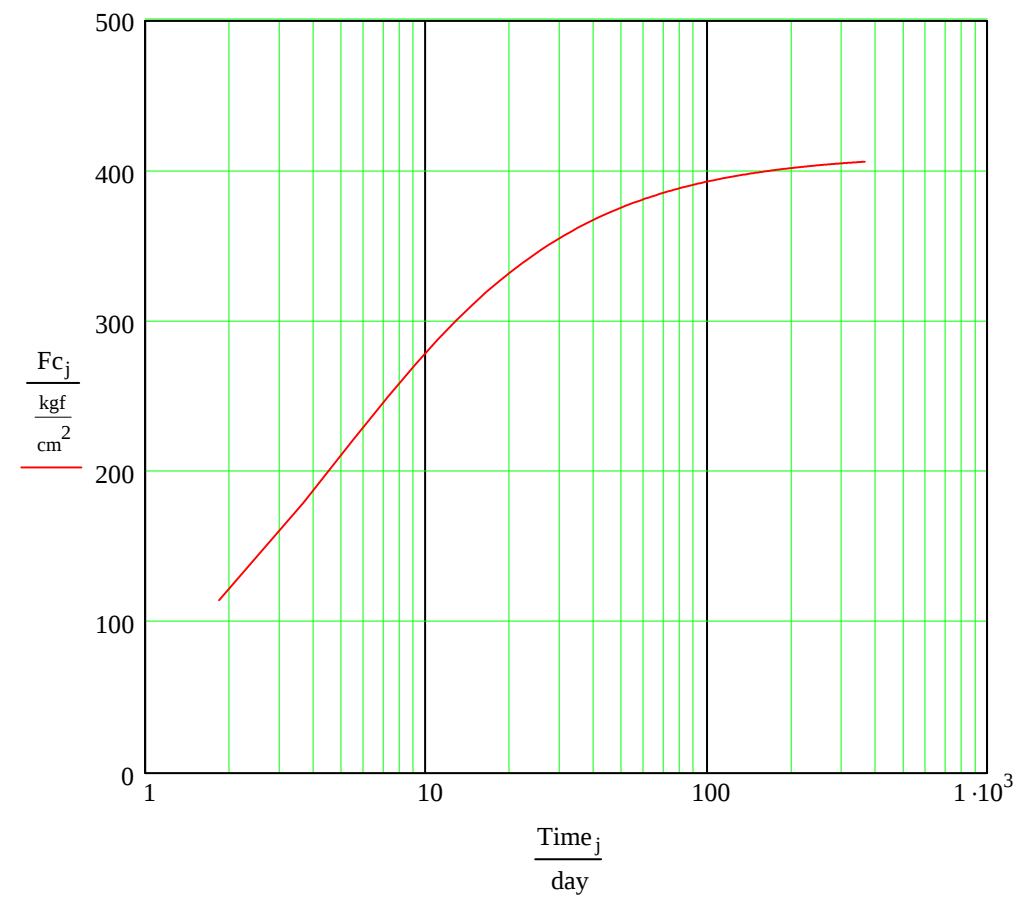
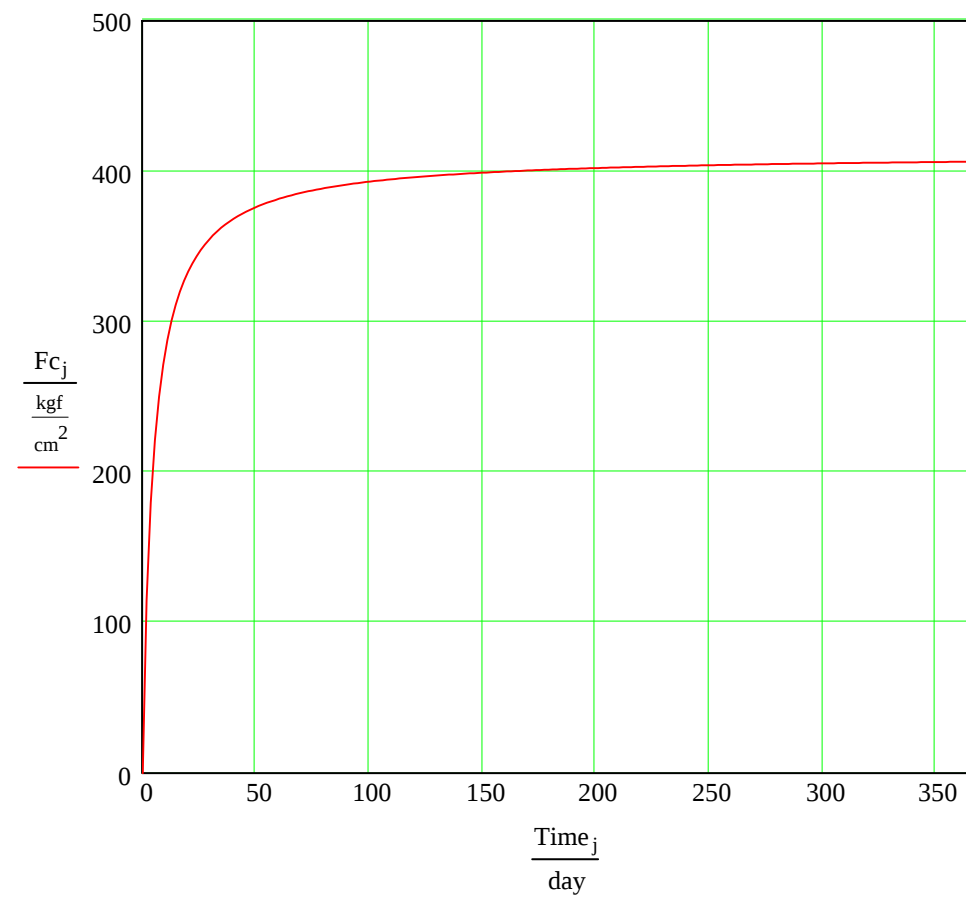
$$Time_j := \frac{End_chart}{Parts} \cdot (j - 1)$$

$$FcQ_j := Fc2\bigl(Time_j\bigr)$$

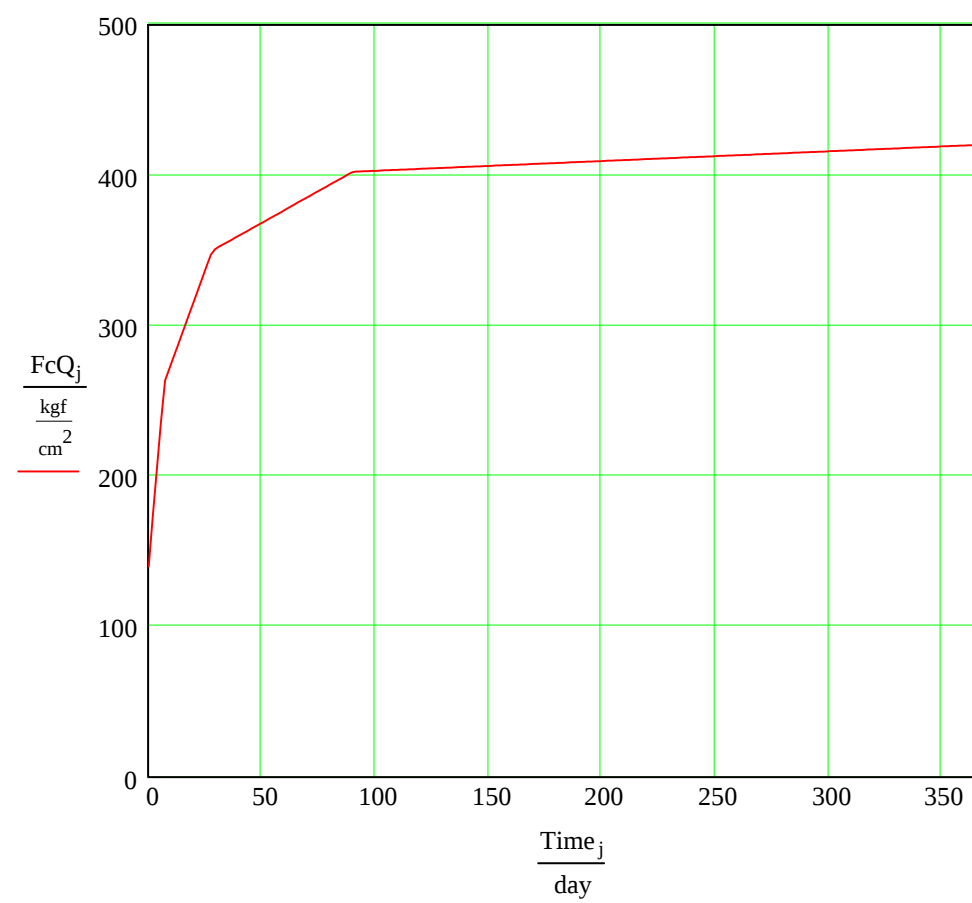
$$FcS_j := Fc1\bigl(Time_j\bigr)$$

$$FcEP_j := FcEP_93\bigl(Time_j\bigr)$$

Compressive strength as a function of age, Branson's

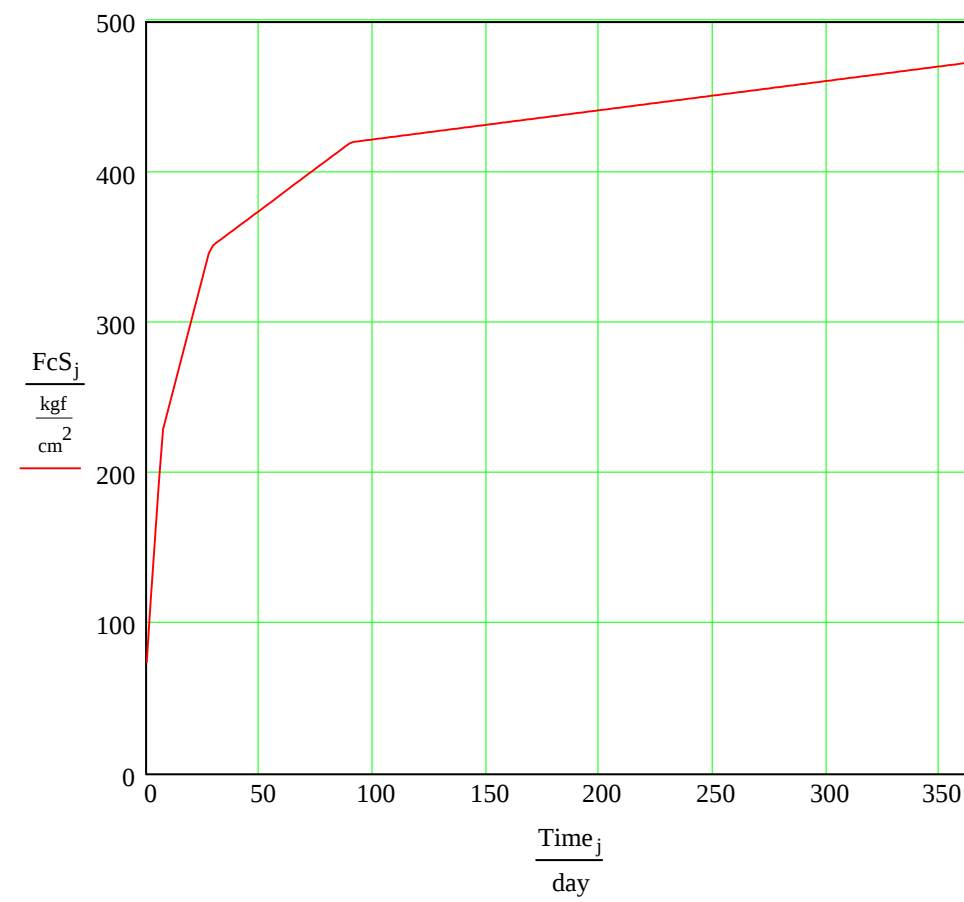


Compressive strength as a function of age, EHE Table 30.4.b
Concrete that sets quickly

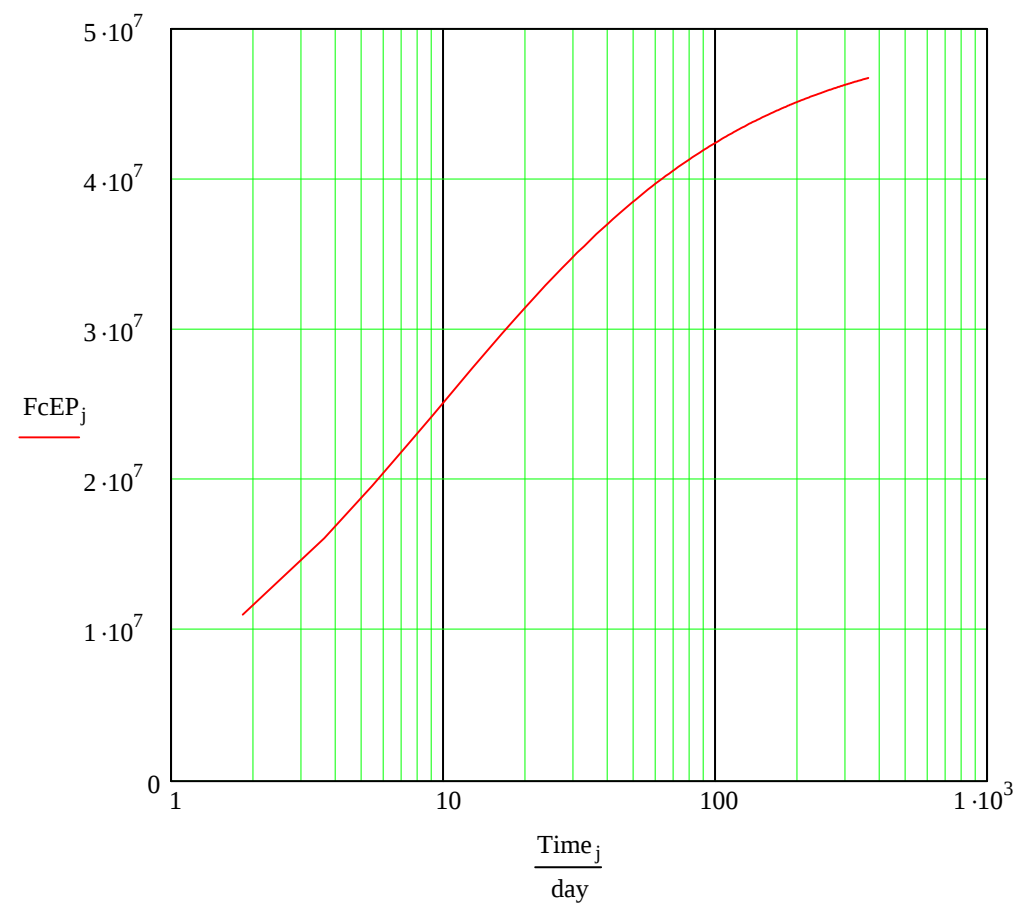
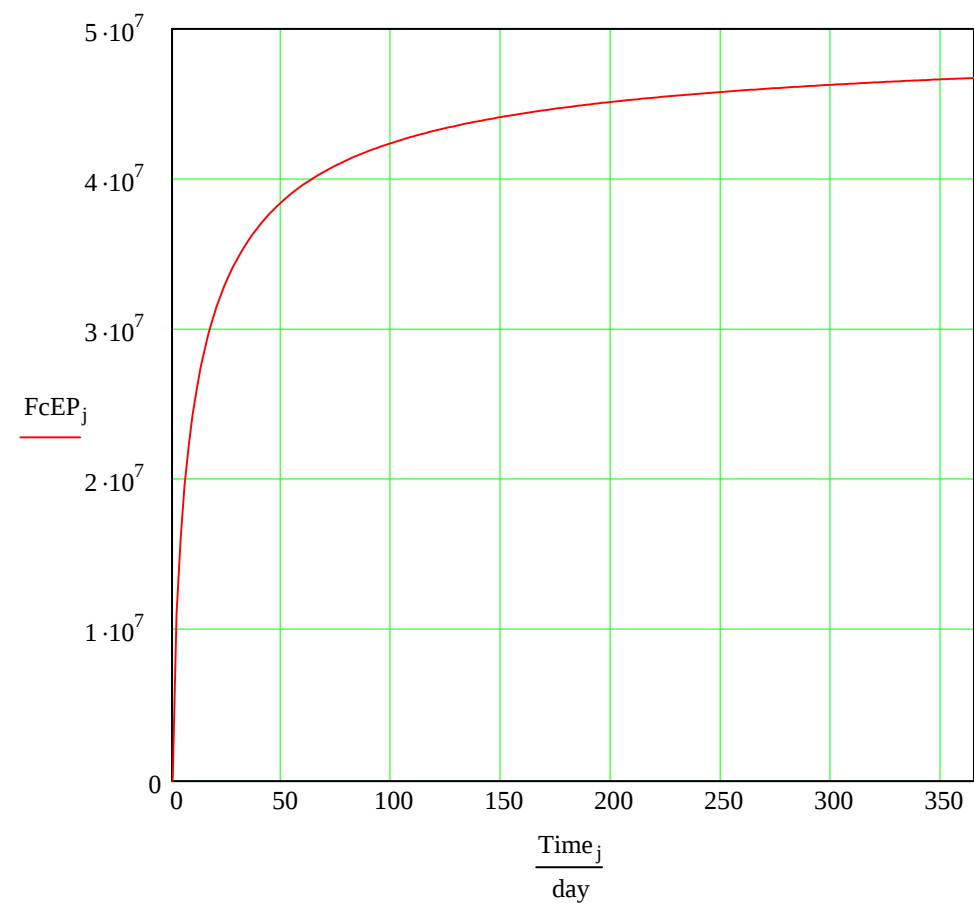


Compressive strength as a function of age, EHE Table 30.4.b

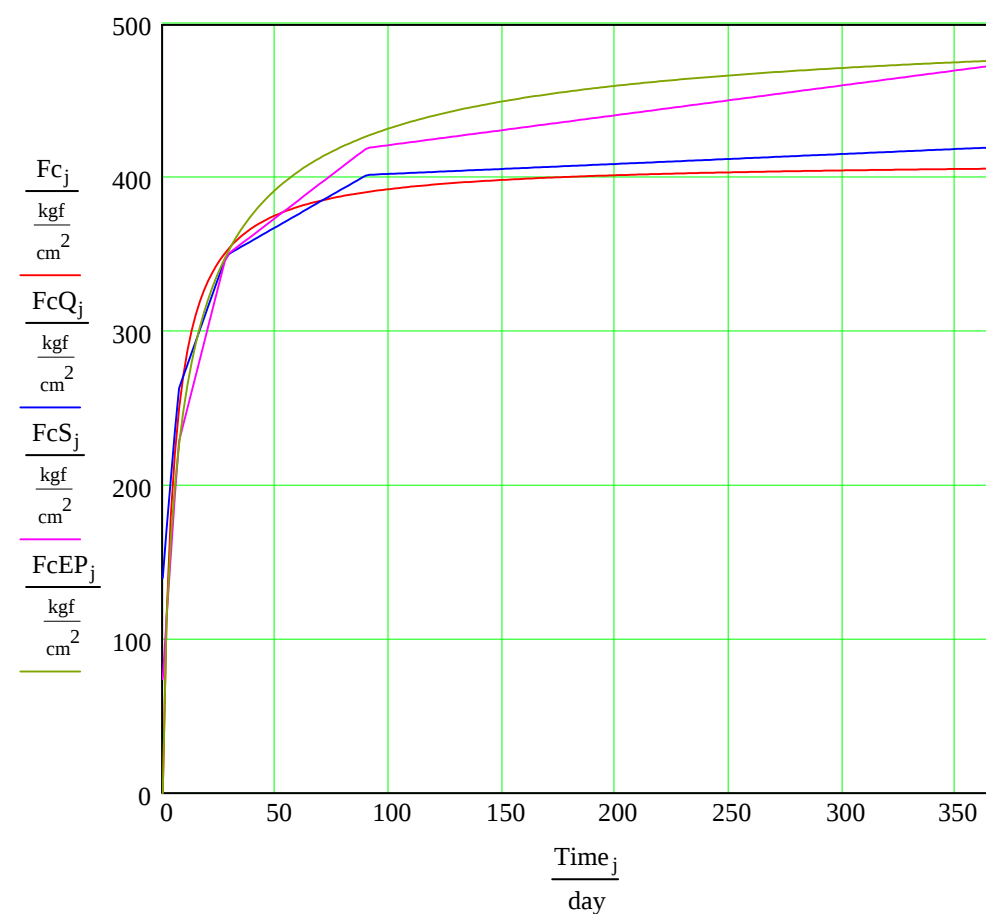
Concrete that sets slowly:



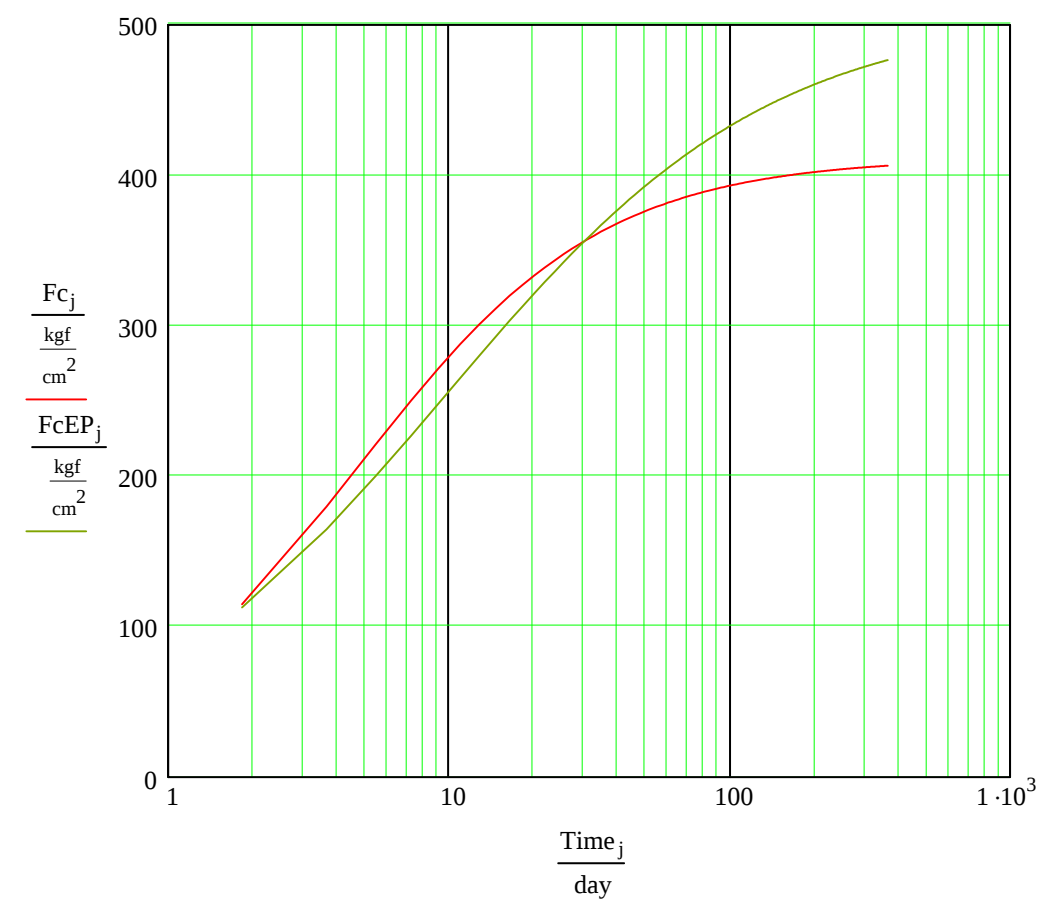
Compressive strength as a function of age, EP-93 comm. to 35.9



Compressive strength as a function of age, comparative chart



$$f_{c28} = 350 \frac{\text{kgf}}{\text{cm}^2}$$



Prediction of compressive strength at given age

$t := 20 \cdot \text{day}$

$$f_c(t) = 333.33 \frac{\text{kgf}}{\text{cm}^2}$$

$$f_c(t) = 32.69 \text{ MPa}$$

$$f_c(t) = 4.74 \text{ ksi}$$

Branson's, in red

$$F_{cEHE}(t) = 316.67 \frac{\text{kgf}}{\text{cm}^2}$$

$$F_{cEHE}(t) = 31.05 \text{ MPa}$$

$$F_{cEHE}(t) = 4.5 \text{ ksi}$$

EHE code (linear interpolation between given points, pertaining to the line representing setting time)

$$F_{cEP_93}(t) = 321.3 \frac{\text{kgf}}{\text{cm}^2}$$

$$F_{cEP_93}(t) = 31.51 \text{ MPa}$$

$$F_{cEP_93}(t) = 4.57 \text{ ksi}$$

EP-93 commentary to 35.9 more consistent with quick settings as proper of prestressed concrete