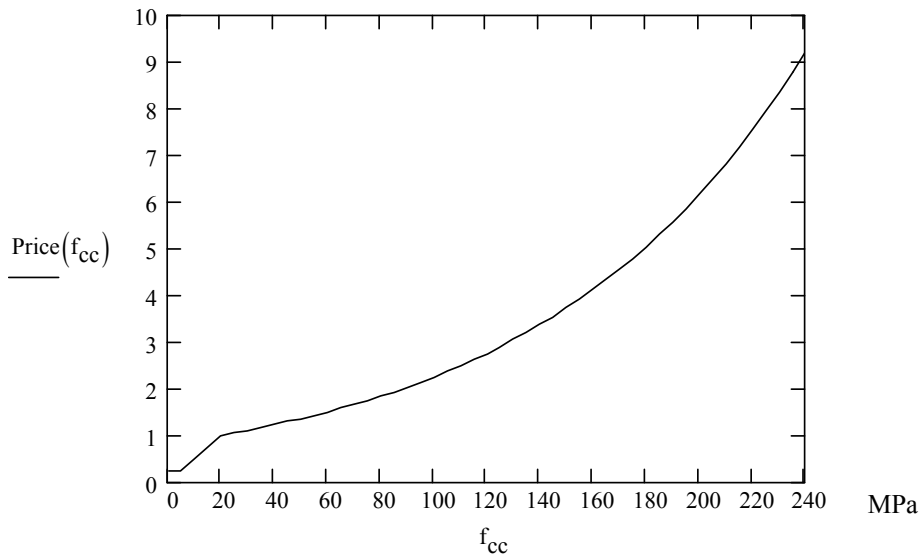


Material properties, prices and safety factors



Relative approximate price of concrete as a function of compressive strength.

The price of concrete is approx. 225-900 dkr/m³ or 0.40 kr/kg for 600-2400kg/m³
 Manufactured concrete 1500 kr/m³ = 0.65 dkr \approx 0.087 € \approx 0.108 \$/kg for 20MPa,
 Painting with basis + 2xEpoxy 180 dkr \approx 24 € \approx 30 \$/m².

ρ kg/m ³	$f_{cc,ave}$ MPa	f_{cc} MPa	$E_{c,ave}$ GPa	E_c GPa	$f_{ct,ave}$ MPa	f_{ct} MPa	λ W/m°C	c_p kJ/m ³	α 10 ⁻⁵ /°C	Price Index
600										
600	3.45	2.30	2.63	2.30	0.30	0.20	0.30	1.00	0.9	0.25
900	3.00		3.00		1.00		0.40	1.00		0.25
950	6.55	5.00								0.25
1200	10.50	7.50	8.00	7.00	2.20	1.80	0.45	1.00	1.1	0.38
1800	20.00	15.00	18.00	16.50	3.20	2.50	0.90	1.00	1.1	1.00
2300		25		34		1.60	0.90	1.00	1.1	1.05
2300		60		42		2.4	0.90	1.00	1.1	1.50
2350		100		43		4	0.90	1.00	1.1	2.24
2400		150		45		8				3.72
2500		240		50						9.23
7850	Fe360	235		210		235			1.1	
7850	Fe510	355		210		355			1.1	

A common price for steel Fe360 is 1.75 €/kg \approx 2 \$/kg \approx 13 dkr/kg.

For steel Fe510 it is 2.67 €/kg \approx 3.33 \$/kg \approx 20 dkr/kg.

A common price for manufactured steel for both is 4 €/kg \approx 5 \$/kg \approx 30 dkr/kg
 + corrosion protection 400 dkr \approx 53 € \approx 67 \$/m²

or fire protection 3 layers 3000 dkr \approx 400 € \approx 500 \$/m².

Partial coefficients according to Euro codes DK-NAD value/CEN-General value:

Dead load 1.0/1.35, Live load 1.5/1.5, Steel yield strength 1.1/1.0, Steel-E 1.0/1.0

Concrete strength 1.45/1.50, Prefab strength 1.40/1.50, Reinforcement 1.20/1.15

Estimated relation between price and performance
for self compacting high strenght concrete

Range of compressive strength for the concrete

$$f_{cc} := 0,5 .. 250 \quad x := 0,5 .. 250$$

Estimated function for the price per m³ related to the price for a 20 MPa concrete

$$a := 0.0101 \quad b := -0.00 \quad c := -20 \cdot b \quad c = 0.000$$

$$P1(f_{cc}) := e^{a \cdot (f_{cc} - 20)} + b \cdot f_{cc} + c \quad P2(f_{cc}) := \frac{1}{20} \cdot f_{cc}$$

$$P3(f_{cc}) := \text{if}(f_{cc} \geq 20, P1(f_{cc}), P2(f_{cc}))$$

$$\text{Price}(f_{cc}) := \text{if}(f_{cc} \geq 5, P3(f_{cc}), P3(5)) \quad \text{Price}(20) = 1.000 \quad \text{Price}(5) = 0.250$$

$$\text{Price}(200) = 6.16$$

$$\text{Price}(60) = 1.498 \quad \text{Price}(25) = 1.052$$

Previous values from version 1, (where Price(30) < 1) and from version 2

$$\text{Price}(30) = 1.106 \quad 0.978 \quad \text{Price}(40) = 1.224 \quad \text{Price}(20) = 1$$

$$\text{Price}(80) = 1.833 \quad 1.147$$

$$a1 := 0.011 \quad a2 := 0.011$$

$$\text{Price}(100) = 2.243 \quad 1.363$$

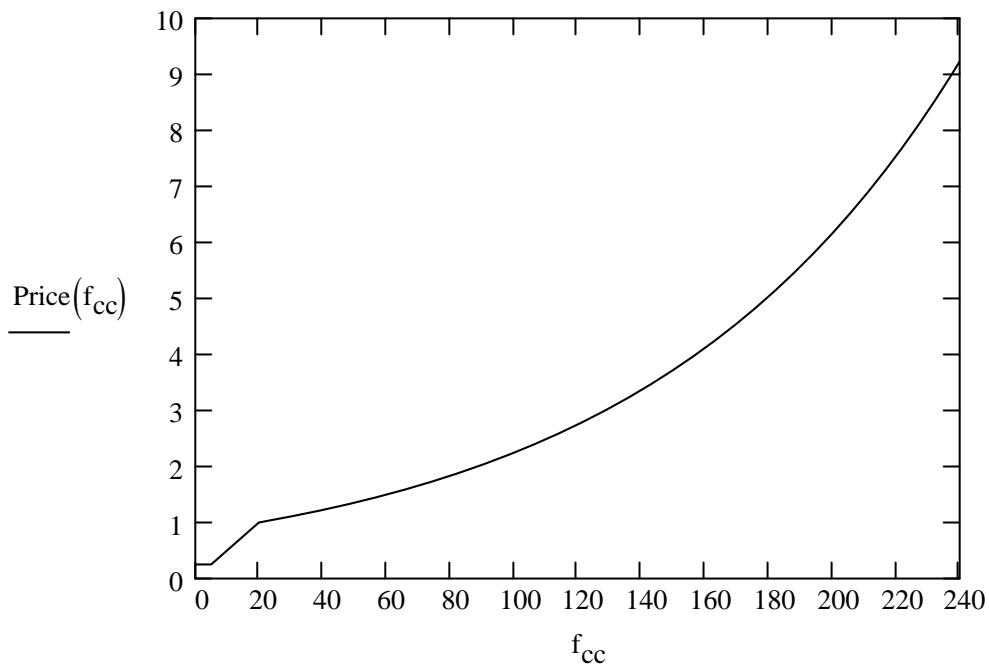
$$b1 := -0.013 \quad b2 := -0.01$$

$$\text{Price}(150) = 3.717 \quad 2.481$$

$$c1 := 0.252 \quad c2 := 0.200$$

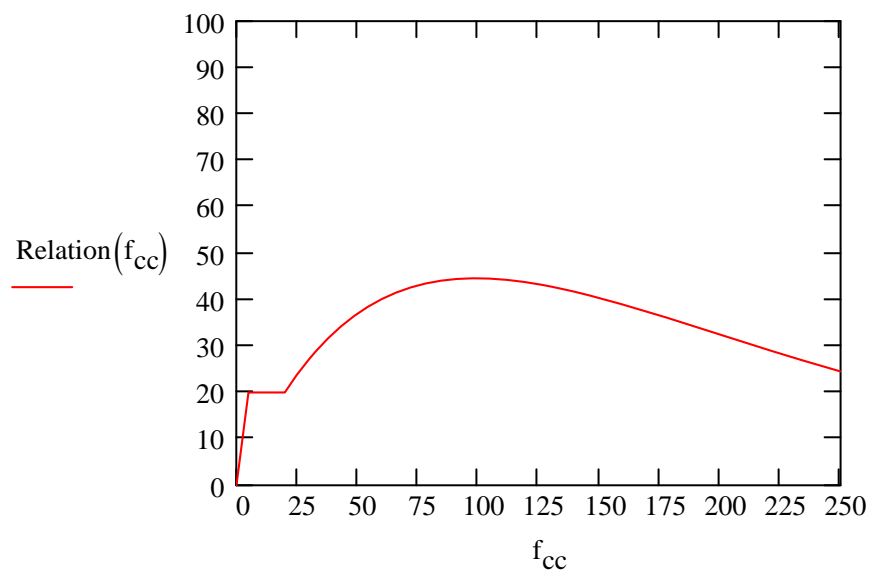
$$\text{Price}(240) = 9.226 \quad 8.378$$

$$\text{Price}(40) \cdot 900 = 1101$$



Price as a function of compressive strength of concrete related to the price at 20 MPa

$$\text{Relation}(f_{cc}) := \frac{f_{cc}}{\text{Price}(f_{cc})}$$



$$\text{Relation}(100) = 44.575$$

$$\text{Relation}(98) = 44.575$$

$$\text{Relation}(99) = 44.577$$

$$\text{Relation}(95) = 44.54$$

$$\text{Relation}(96) = 44.556$$

Max for approx. 100 MPa, where

$$\text{Price}(100) = 2.243$$