Wall Formwork Statics

Concrete pressure: DIN 18218
Deflections: DIN 18202

NIOB MANDATORY CONTINUOUS PROFESSIONAL DEVELOPMENT PROGRAMME

Engr. LARRISON TOWOH
HEAD, DESIGN OFFICE

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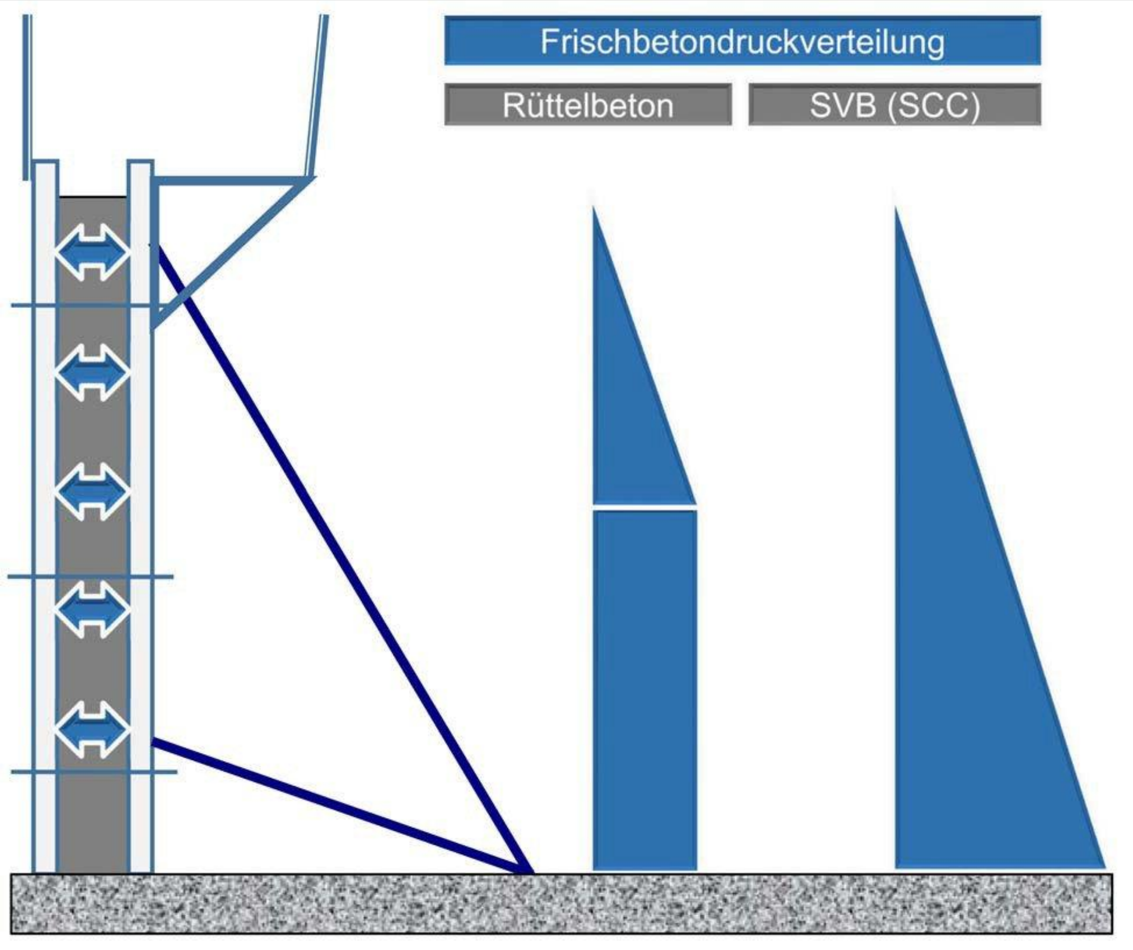
Content

- **Concrete Pressure: DIN 18218**
- Deflections: DIN 18202

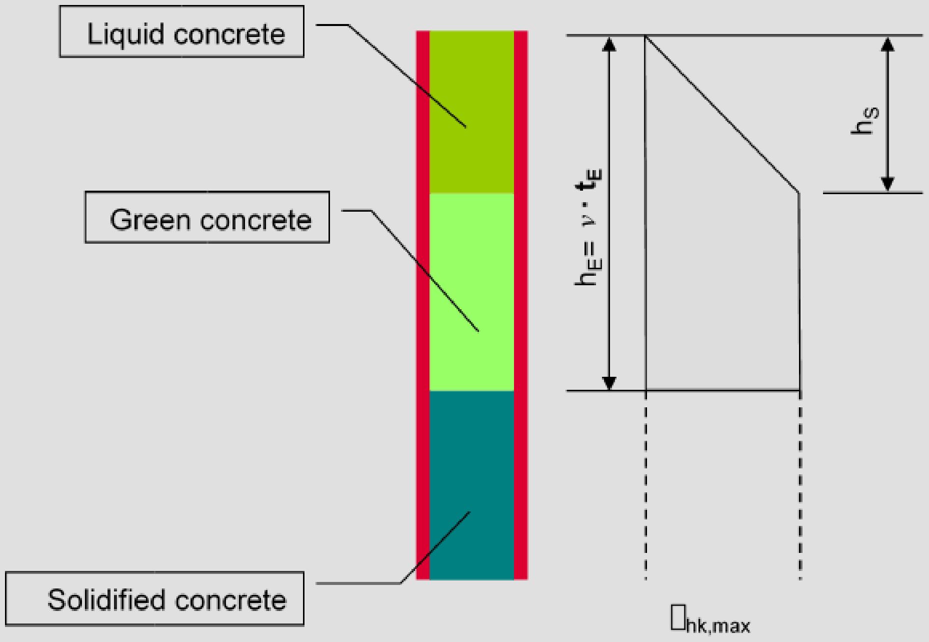


Principle of double-headed formwork
Bild: Christian Hofstadler Graz

Concrete Pressure: DIN 18218

Important Terms and definition

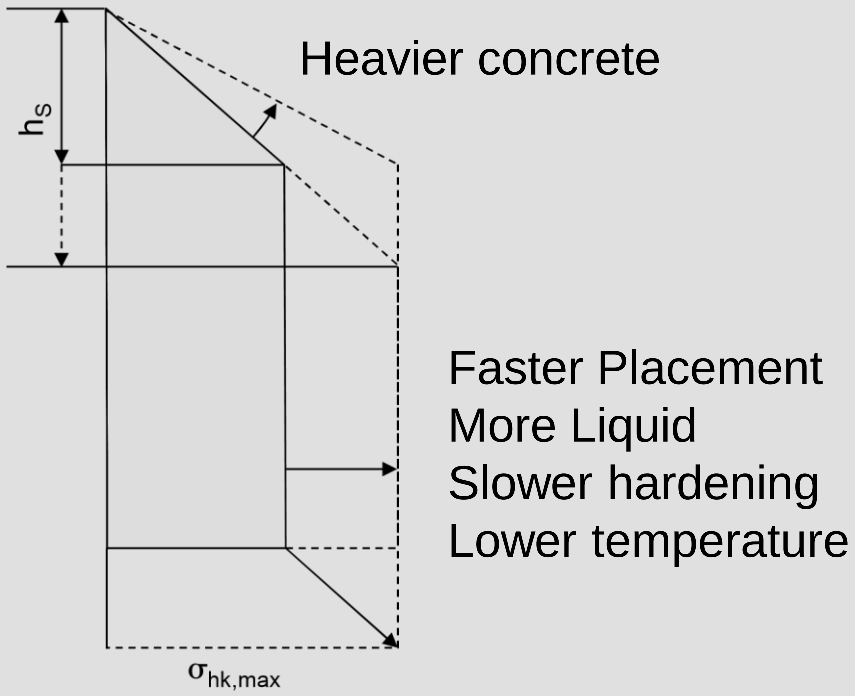
- Horizontal concrete pressure σ_h [kN/m²]
- Placing rate v [m/h]
- Hydrostatic pressure height hs [m]
- Fresh concrete density γc [kN/m³]
- Placing temperature Tc,placing [° K]
- Reference temperature Tc,Ref [° K] *
- End of setting t_E [h] *
- Immersion depth of the vibrator hv [m]



Simplifiedprogressionof theconcretepressure

Concrete Pressure: DIN 18218

- Parameters
- Concreting height
- Type of placement
- Compaction method
- Placing rate
- Consistency faster placement
- Concrete density
- Concrete temperature
- Solidification time
  - Cement type (fast, slow)
  - Aggregates such as limestone powder
  - Concrete and environment temperature



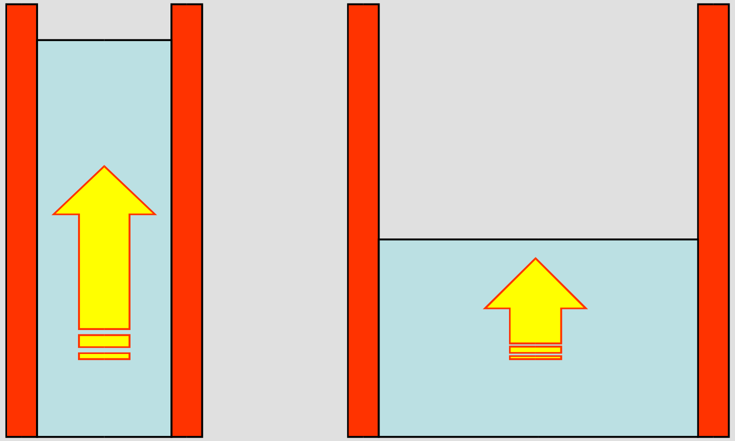
Concrete Pressure: DIN 18218

- Placement rate v_b in m/h
- placement method:
  - Bucket

    Delivery rate 7-8m^3/h
  - Concrete pump

    Delivery rate 30-40m^3/h

- Geometry of the building
  - Slabs and foundations
  - Walls
  - Columns



Slender geometry
higher placement rate

wide geometry
lower placement rate

Concrete Pressure: DIN 18218 – standard conditions

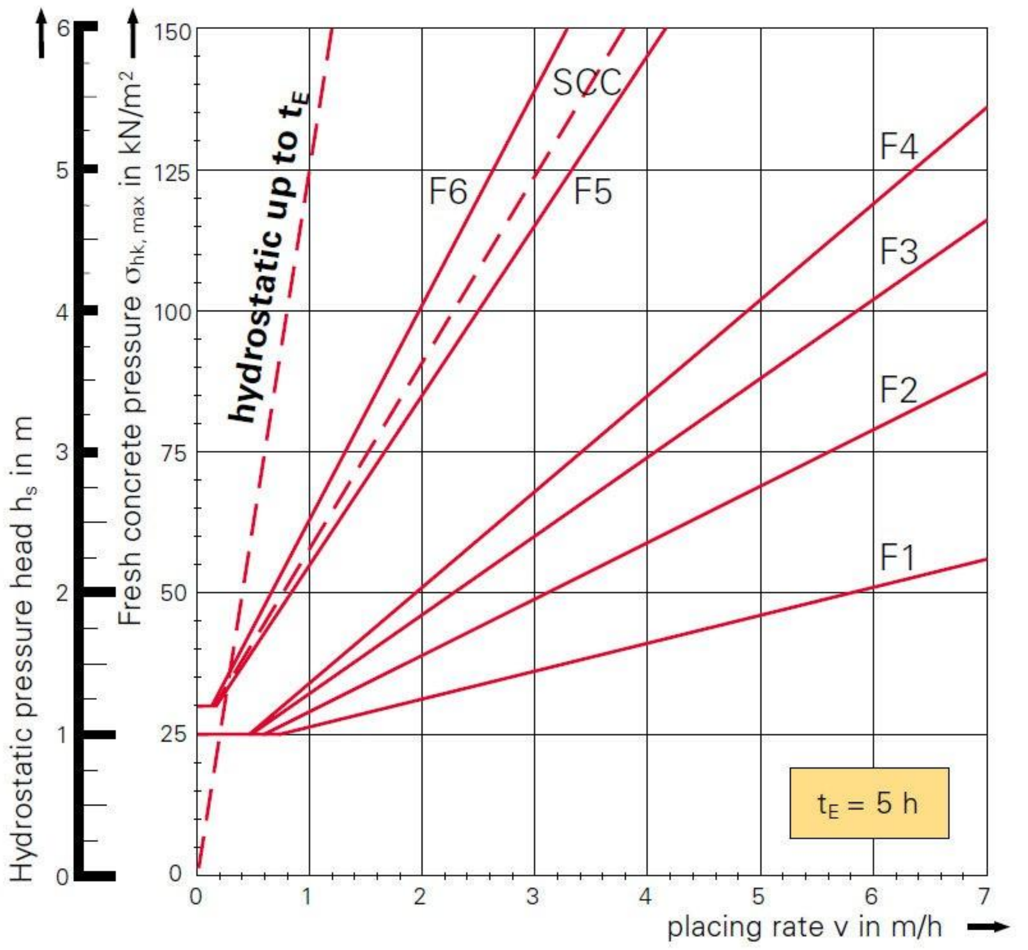
- **Fresh concrete density**
  - Standard fresh concrete density $\gamma_c = 25\ kN/m^3$
- **Formwork**
  - The formwork has to be tight
- **Only for vertical formwork**
  - max. inclination ±5°
- **Vibrator**
  - Just for application of usual internal vibrator
- **Concreting**
  - Only for placement from above

Concrete Pressure: DIN 18218 – standard conditions

PERI

t_E	Solidification time = 5 h
γc	concrete density = 25 kN/m³
σhk,max	max. concrete pressure in kN/m²
v	placing rate in m/h
h_S	Hydrostatic pressure height in m

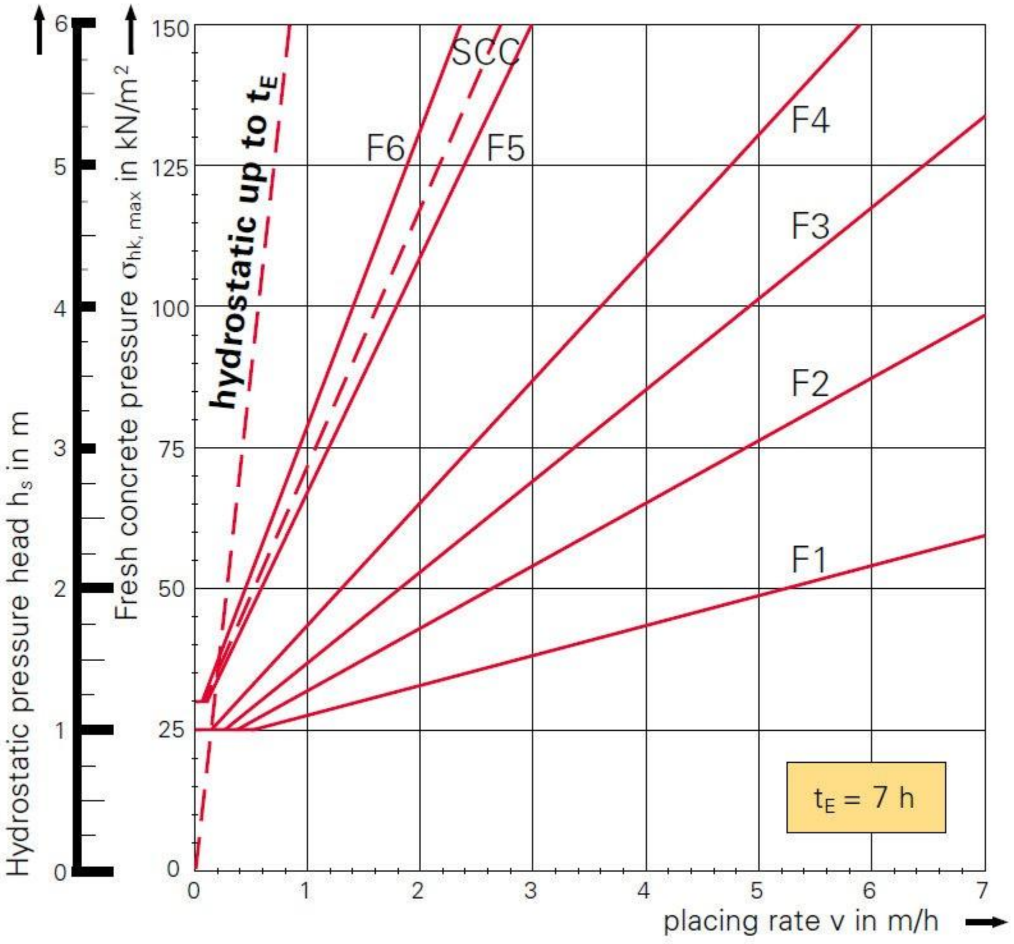
Chart 1 according to DIN 18218:2010-01, Fig. B.1



Concrete Pressure: DIN 18218 – standard conditions

t_E	Solidification time = 7 h
γc	concrete density = 25 kN/m³
$\sigma hk,max$	max. concrete pressure in kN/m²
v	placing rate in m/h
h_S	Hydrostatic pressure height in m

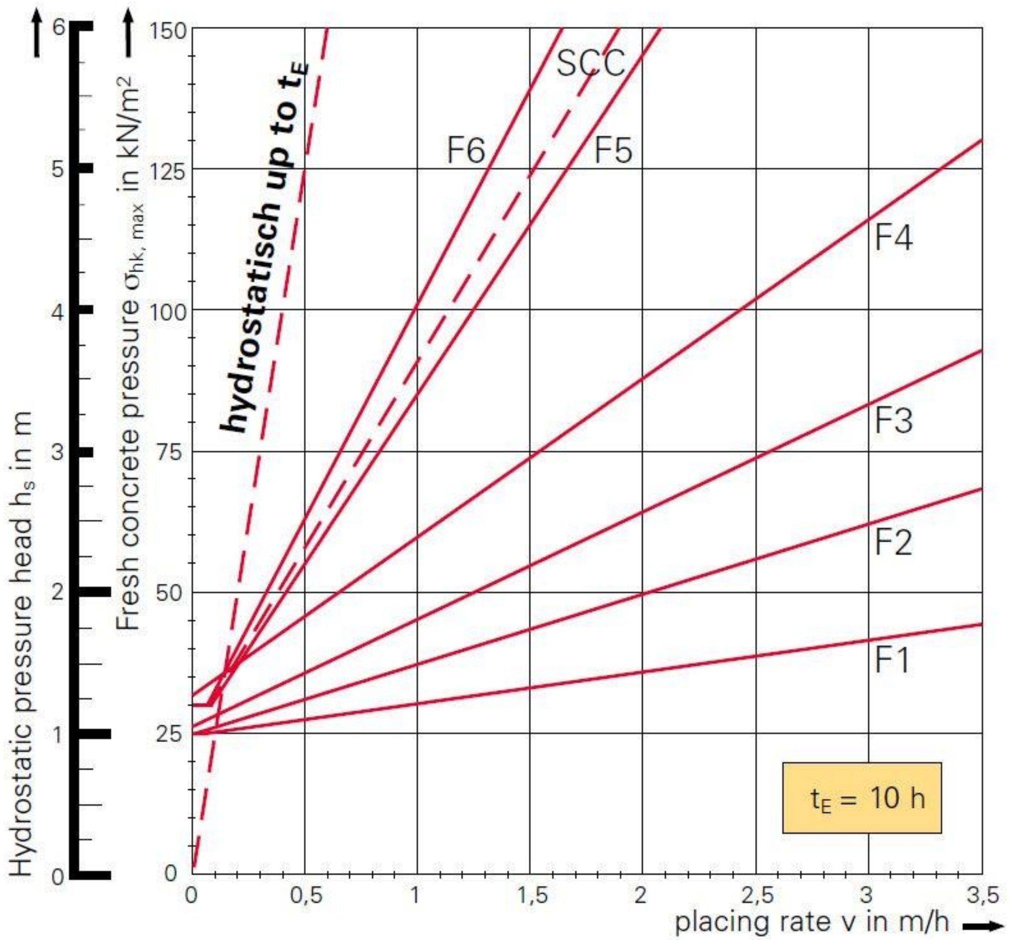
Chart 2 according to
DIN 18218:2010-01, Fig. B.2



Concrete Pressure: DIN 18218 – standard conditions

t_E	Solidification time = 10 h
γc	concrete density = 25 kN/m³
σhk,max	max. concrete pressure in kN/m²
v	placing rate in m/h
h_S	Hydrostatic pressure height in m

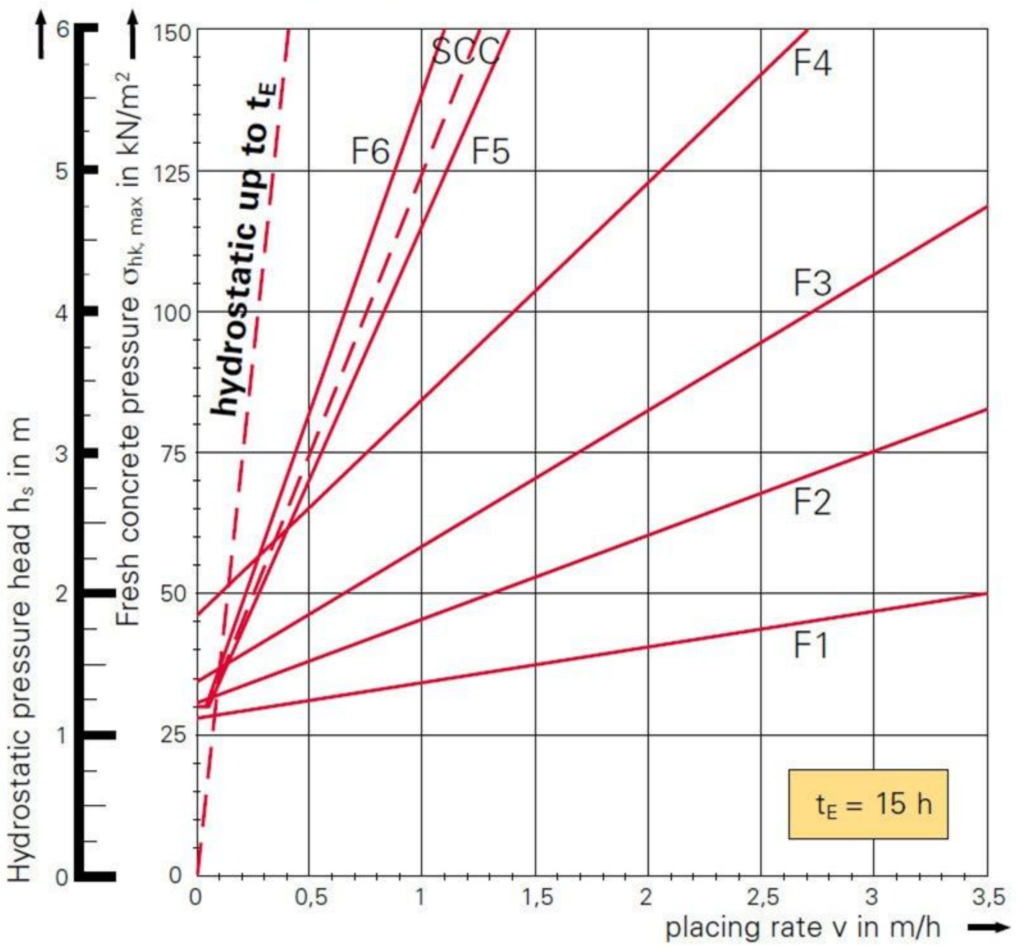
Chart 3 according to
DIN 18218:2010-01, Fig. B.3



Concrete Pressure: DIN 18218 – standard conditions

t_E	Solidification time = 15 h
γc	concrete density = 25 kN/m³
σhk,max	max. concrete pressure in kN/m²
v	placing rate in m/h
h_S	Hydrostatic pressure height in m

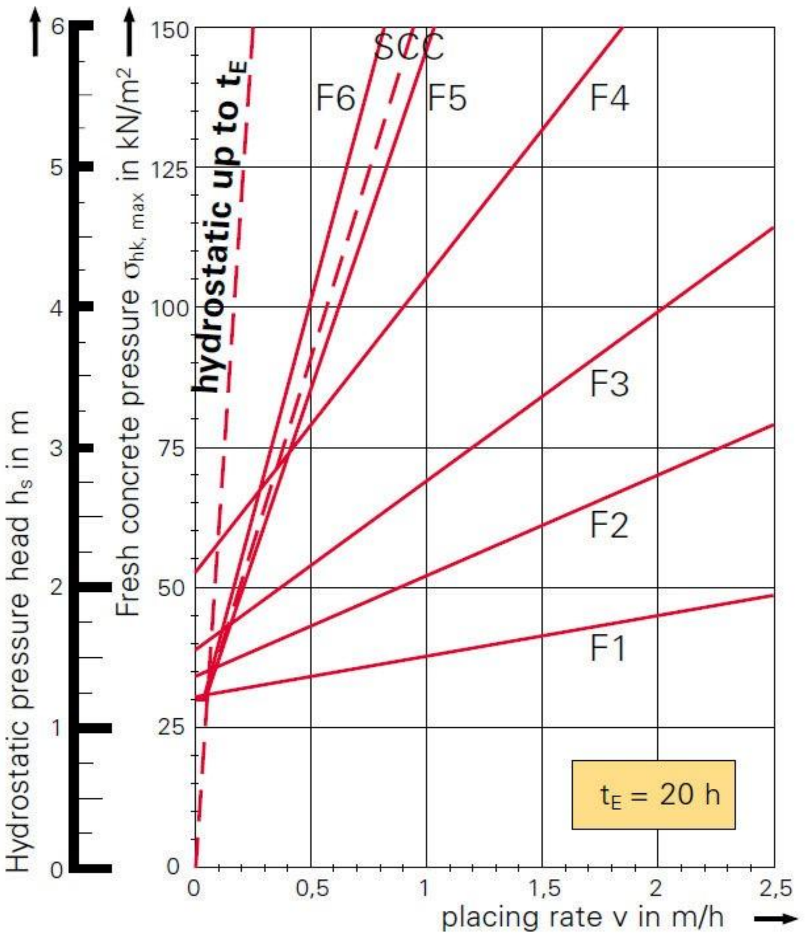
Chart 4 according to
DIN 18218:2010-01, Fig. B.4



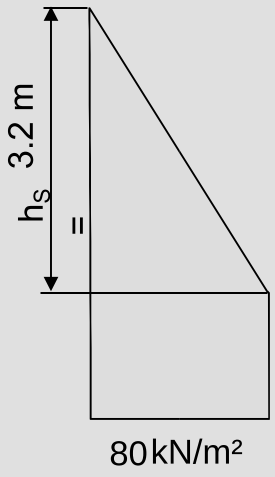
Concrete Pressure: DIN 18218 – standard conditions

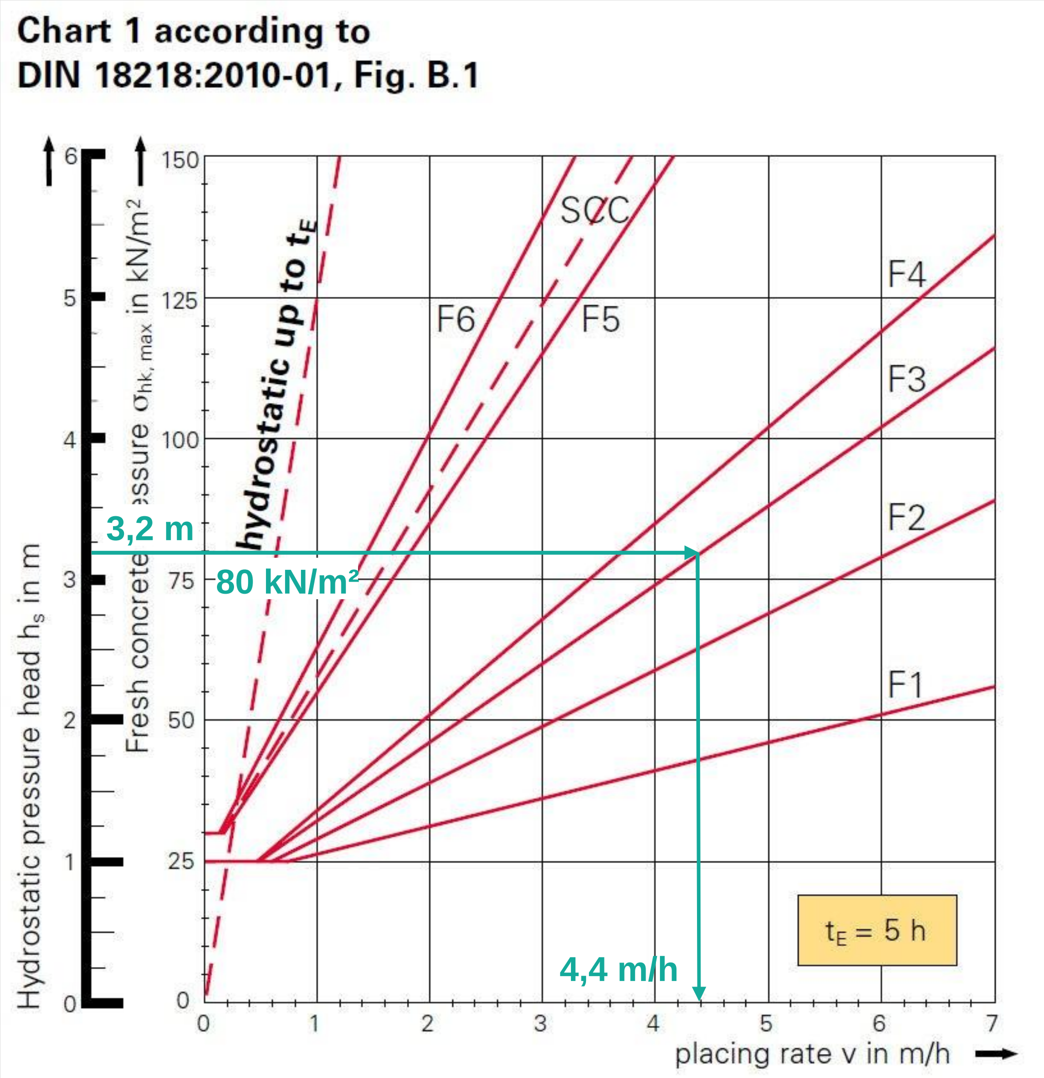
t_E	Solidification time = 20 h
γc	concrete density = 25 kN/m³
σhk,max	max. concrete pressure in kN/m²
v	placing rate in m/h
h_S	Hydrostatic pressure height in m

Chart 5 according to
DIN 18218:2010-01, Fig. B.5



Concrete Pressure: DIN 18218 – standard conditions





Concrete Pressure: DIN 18218 – standard conditions

Chart 2 according to
DIN 18218:2010-01, Fig. B.2

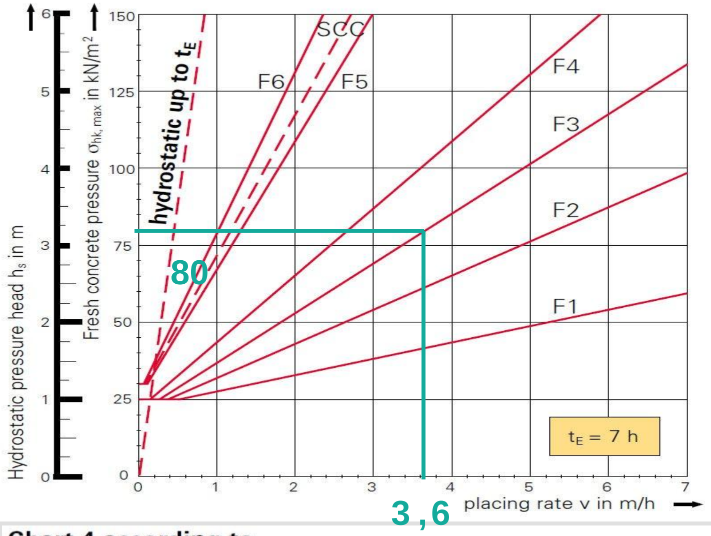
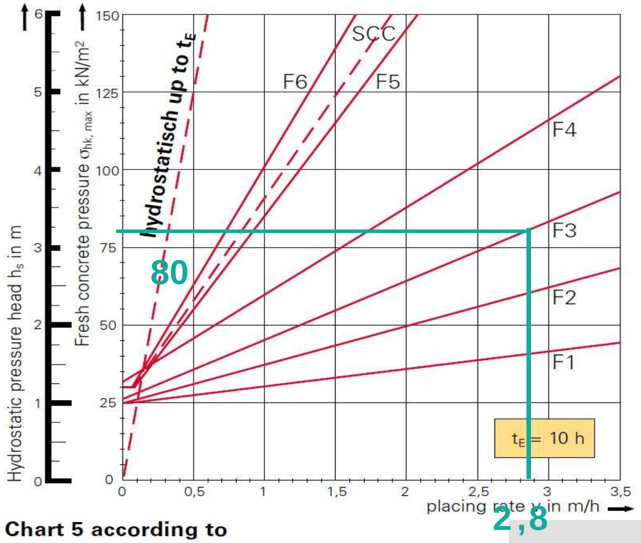


Chart 3 according to
DIN 18218:2010-01, Fig. B.3



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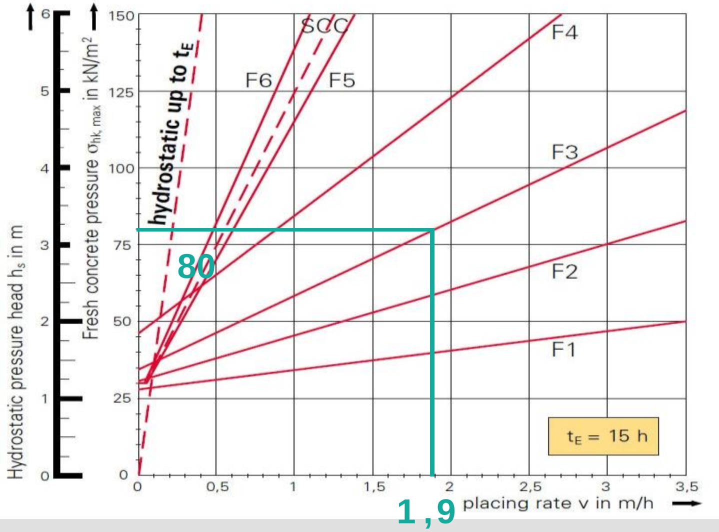
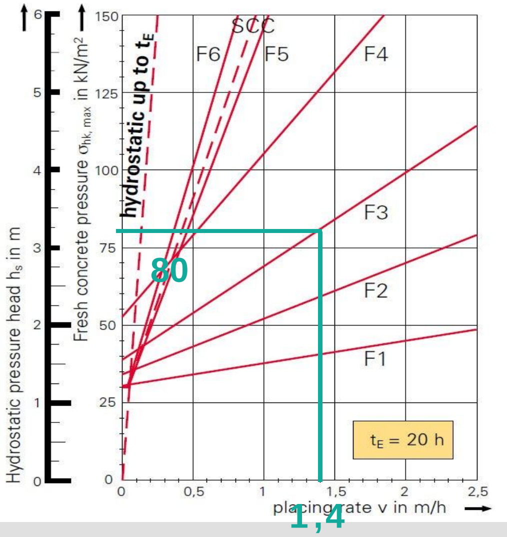


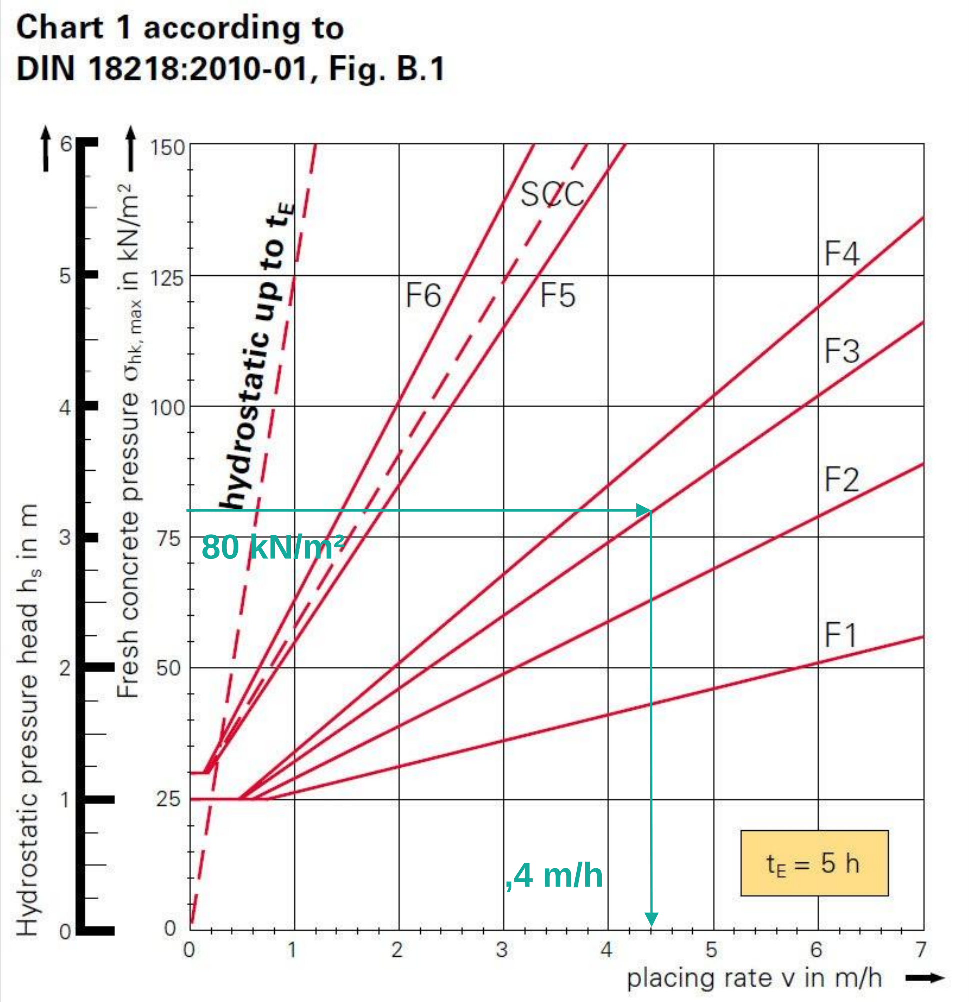
Chart 5 according to
DIN 18218:2010-01, Fig. B.5



Concrete Pressure: DIN 18218 – standard conditions

- **EXAMPLE 1 – concrete density ≠ 25 kN/m²**

- Consistency F3
- Formwork designed for $\sigma_{hk,max}$ = 80 kN/m²
- **concrete density γ_c = 25 kN/m³**



Concrete Pressure: DIN 18218 – standard conditions

■ **EXAMPLE 1 – concrete density ≠ 25 kN/m²**

■ Consistency F3

■ Formwork designed for $\sigma_{hk,max}$ = 80 kN/m²

■ **concrete density γ_c ≠ 25 kN/m³**

■ **concrete density γ_c ≠ 30 kN/m³**

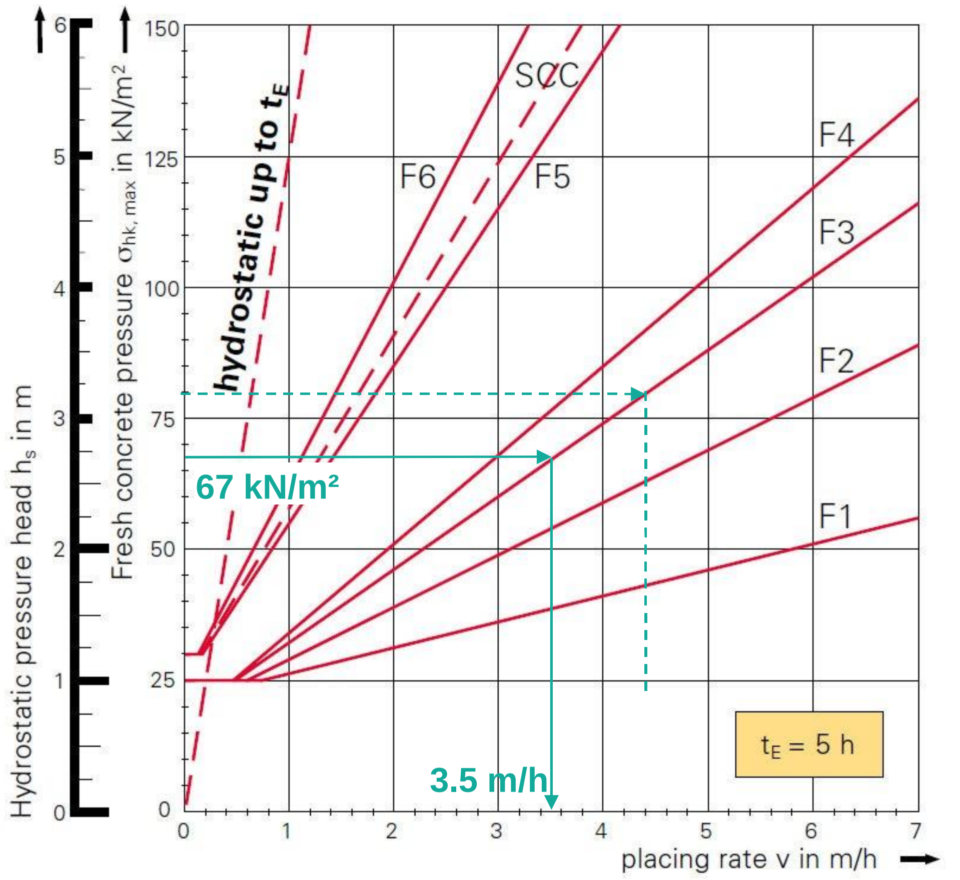
■ Correction factor K = γ_c / 25 kN/m³

■ K = 30 / 25 = 1.2

■ σ'hk,chart = 80 / 1.2 = 67 kN/m²

max. v = 3.5 m / h

Chart 1 according to
DIN 18218:2010-01, Fig. B.1



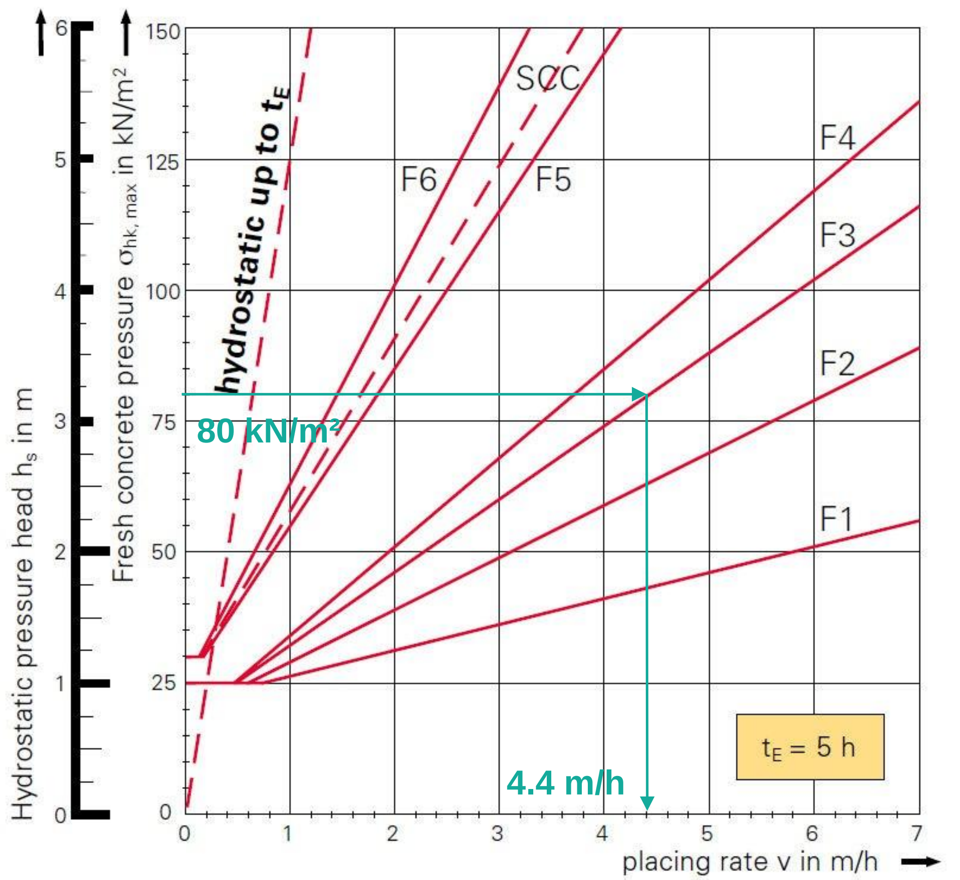
Concrete Pressure: DIN 18218 – standard conditions

- **EXAMPLE 2 – Tc,placing > Tc,Ref**

- Consistency F3
- Formwork designed for $\sigma_{hk,max} = 80$ kN/m²

- **concrete temperature Tc,placing = Tc,Ref**

Chart 1 according to
DIN 18218:2010-01, Fig. B.1



Concrete Pressure: DIN 18218 – Example 2

- Consistency F3
- Formwork designed for $\sigma_{hk,max}$ = 80 kN/m²

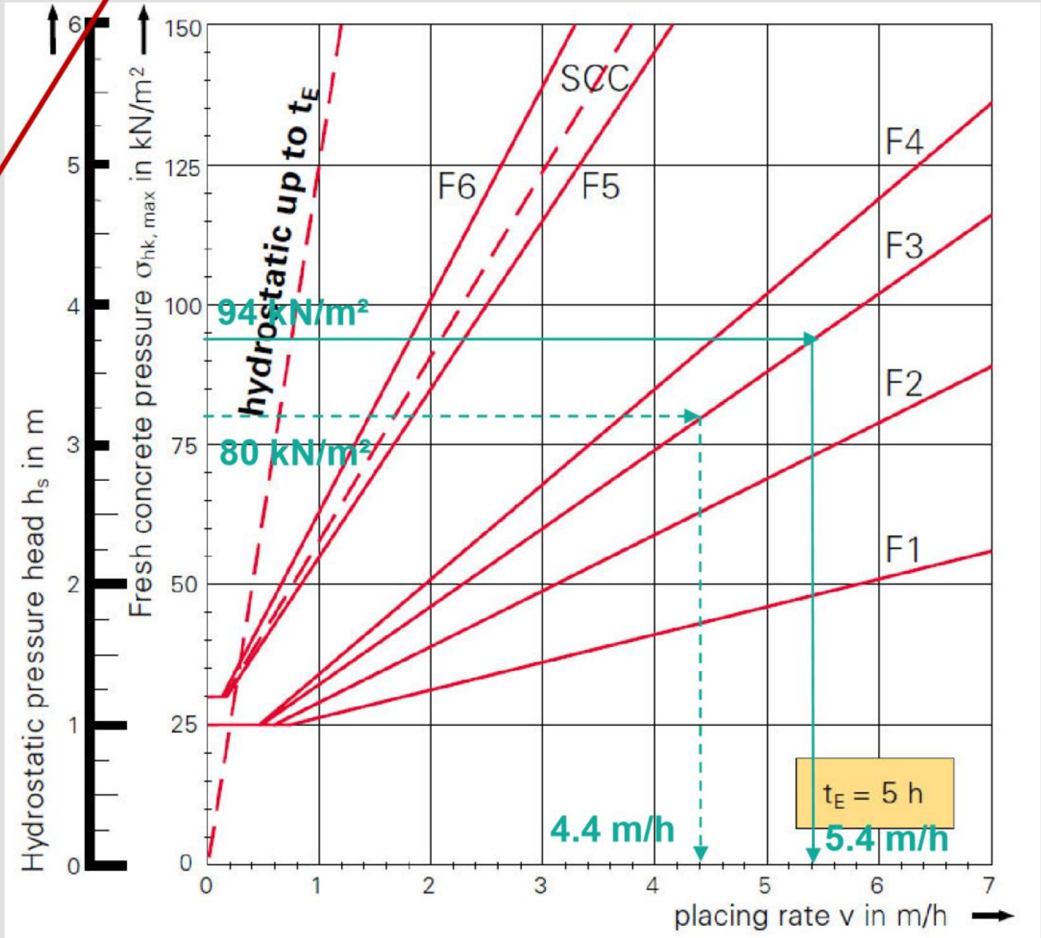
- **concrete temperature $T_{c,placing}$ ≠ $T_{c,Ref}$**
- **concrete temperature $T_{c,placing}$ > $T_{c,Ref}$**

  20°C 15°C

σ can be reduced by 3% per 1°C (max. reduction 30%)

- Correction factor $K = 1 - 0.03 \times \Delta T_c$
  - $K = 1 - 0.03 \times 5 = 0.85$
- $\sigma'_{hk,chart} = \sigma_{hk,max} / K$
- $\sigma'_{hk,chart} = 80 / 0.85 = 94$ kN/m²

→ max. v = 5.4 m / h



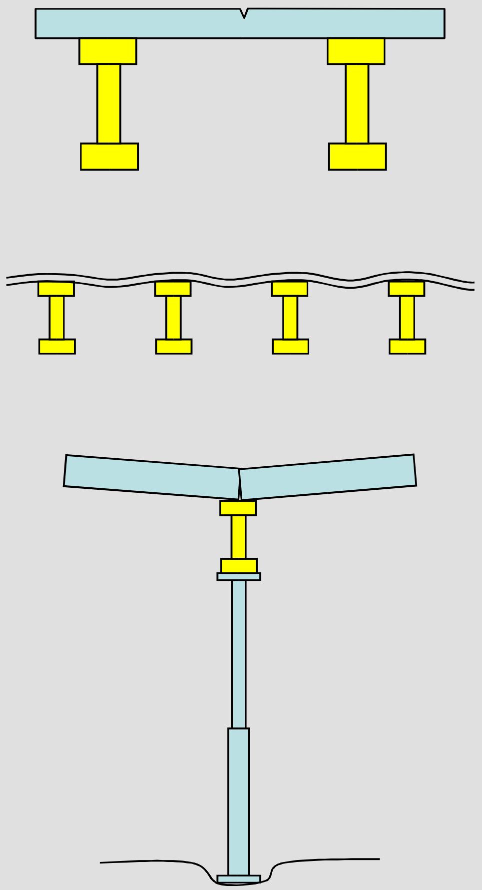
Tolerances – types of deflections

- Concrete Pressure: DIN 18218
- Deflections: DIN 18202

Tolerances – types of deflections

Distance of the measurement points

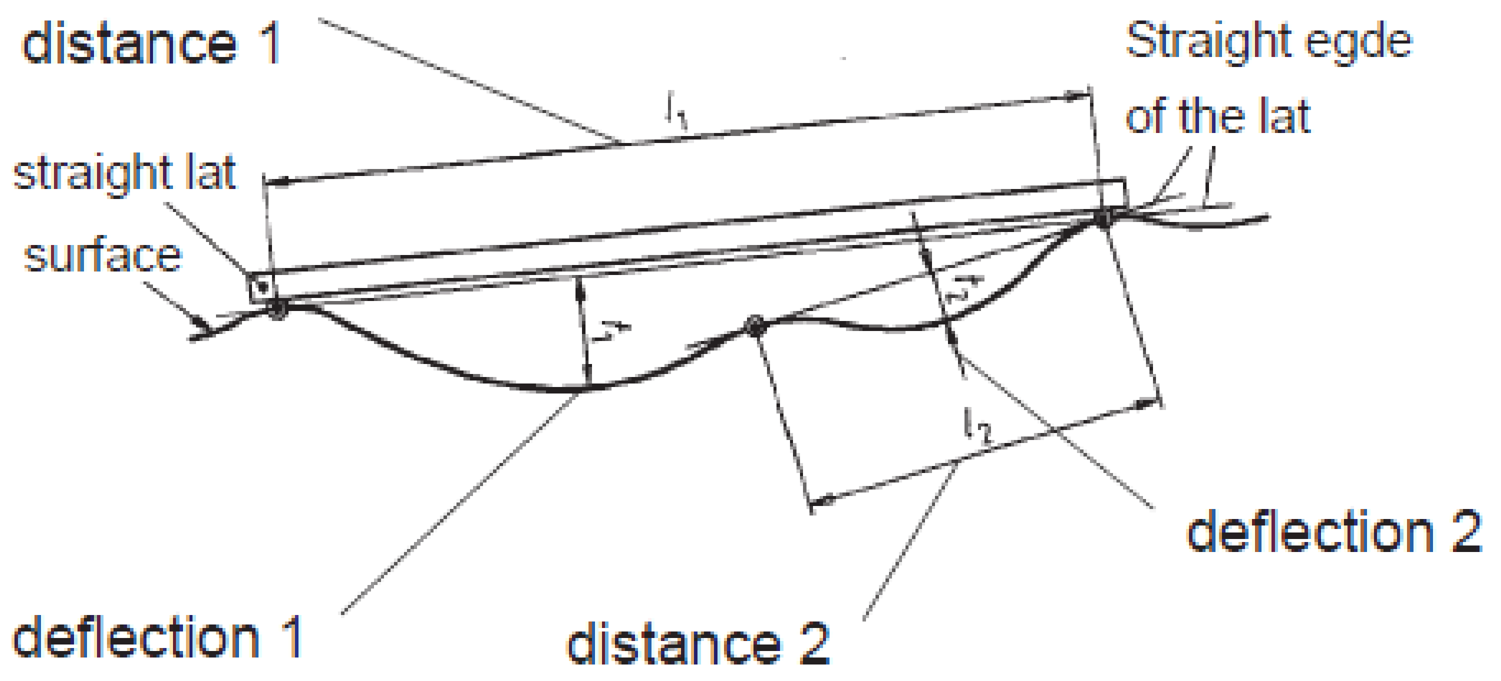
- selective irregularities
  - grooves, notches
- local irregularities
  - dents caused by plywood deflection
  - deflection of the formwork girder
- regional irregularities
  - prop settlement
  - faulty aligning of the form panel
  - excessive tie rod elongation



Tolerances – types of deflections

Distance of the measurement points

- from exaltation to exaltation



Tolerances – DIN 18202, Table 3

Extract from DIN 18 202, Structural Engineering Tolerances, May 1986 edition
Table 3. Deflection tolerances

Line	1	2	3	4	5	6
		Position deviations (limit values), in mm, for dist. between measuring points, in m, up to				
		0.1	1[1]	4[1]	10[1]	15[1]
1	Unfinished surfaces of slabs, concrete bases, and subfloors	10	15	20	25	30
2	Unfinished surfaces of slabs, concrete bases and subfloors to more stringent specifications, eg to take floating screeds, industrial floors, tiles, composite screeds Finished surfaces for secondary purposes, eg in stores, cellars, basements	5	8	12	15	20
3	Floors with finished surfaces, eg screeds as wearing surfaces, screeds to take flooring Flooring, tiles, trowelled finishes and glued flooring	2	4	10	12	15
4	Floors with finished surfaces to more stringent specifications, eg with self-levelling screeds	1	3	9	12	15
5	Wall surfaces and soffits of structural slabs that are unfinished	5	10	15	25	30
6	Wall surfaces and soffits of slabs that are finished, eg plastered walls, wall claddings, suspended ceilings	3	5	10	20	25
7	As in line 6, but more stringent specifications	2	3	8	15	20

[1]) Intermediate values are to be taken from Figures 1 and 2 and rounded to whole mm.

Tolerances - measurement of deflections

- **Diagram** (PERI design tables)

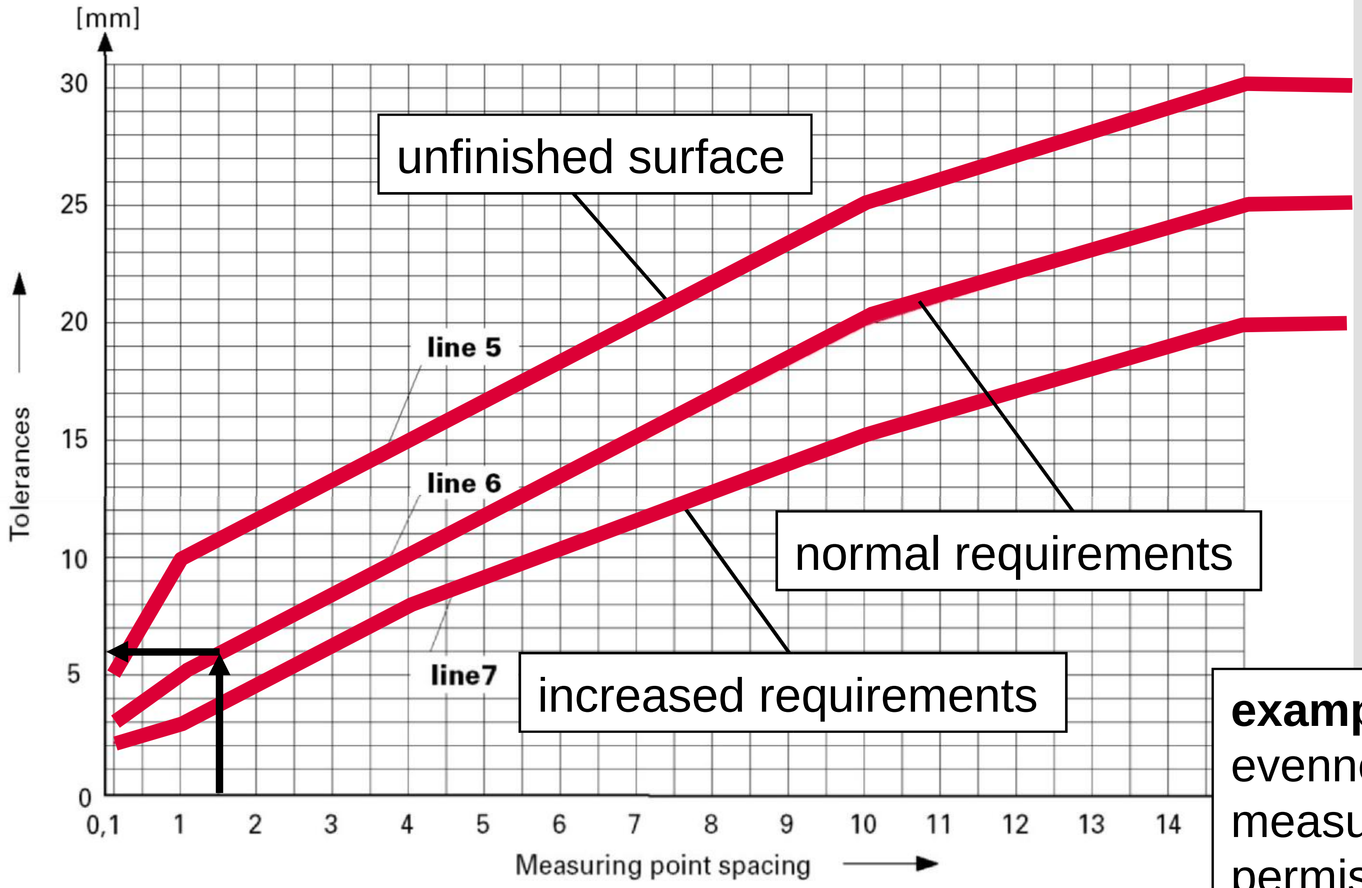


Figure 2 Deflection tolerances of wall surfaces and slab soffits (according to lines of Table 3)

example:
evenness according to line 6
measurement distance: 1,50 m
permissible deflection: 6 mm

Wall Formwork Reference Project

Panel Framed Wall Formwork

Wall Formwork Reference Project

Girder Wall Formwork

Thank you

For your

attention!

Successfulconstructionwith