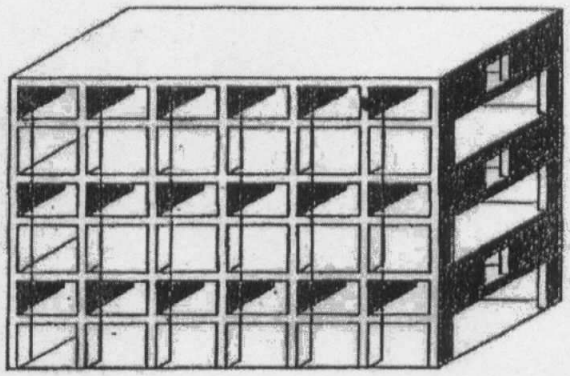
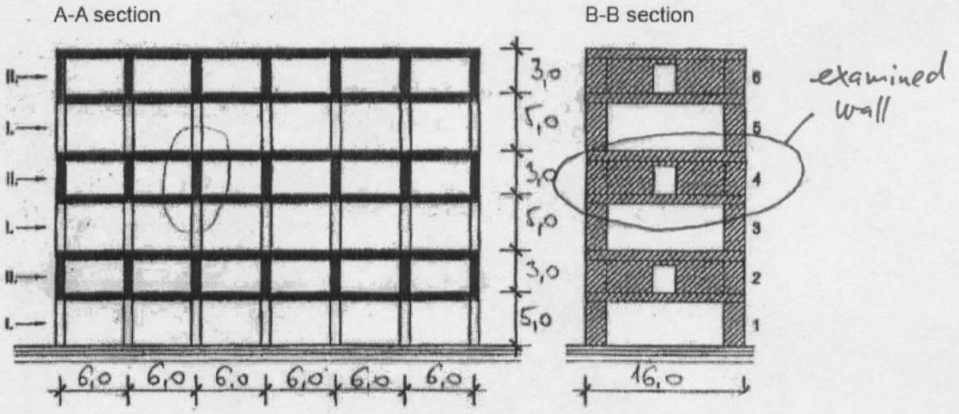
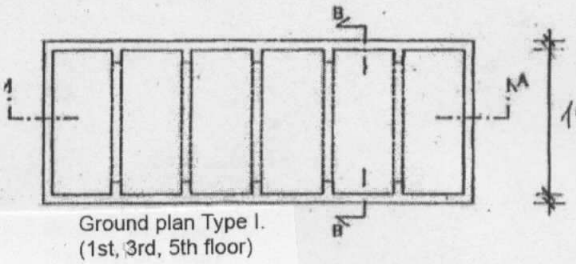
Approximate calculation for a wall-structure

Let's define the required amount of the steel in the given wall-structure!



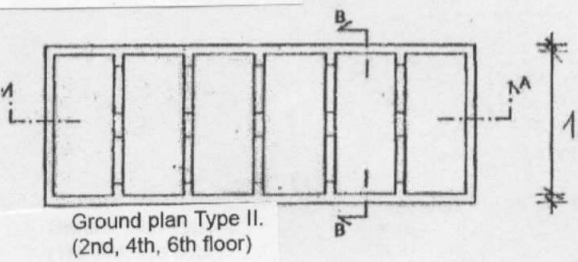
→ tube-shuttering





→ big place for public functions (stores, exhibition gallery)

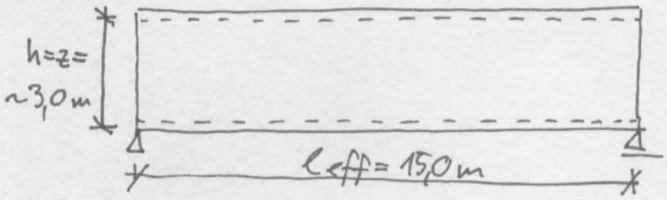
Ground plan Type I.
(1st, 3rd, 5th floor)

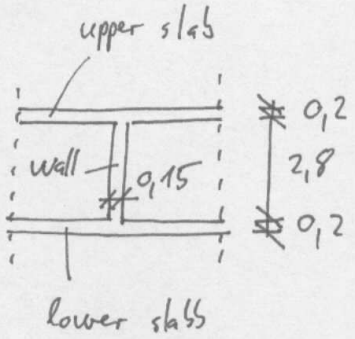


→ narrow rooms for service functions.

Ground plan Type II.
(2nd, 4th, 6th floor)

Data: Wall-structures per 6 m.





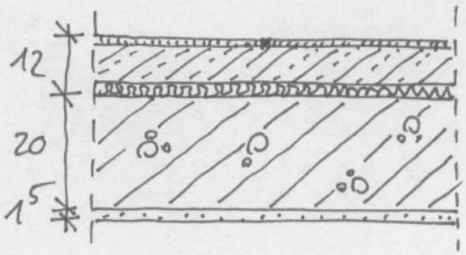
Loading area: $t = 6$ m

$f_{cd} = 16{,}6$ N/mm² (C25/30)

$f_{yd} = 435$ N/mm²

$q_k = 5$ kN/m²

Load analysis



	V	γ	g_k
cover:	0,02	16	0,32
seat-concrete	0,06	22	1,32
isolation	negligable		
RC slab	0,20	25	5
mortar	0,015	18	0,25
		$\Sigma \doteq$	7,0 kN/m²

dead-load of the wall:

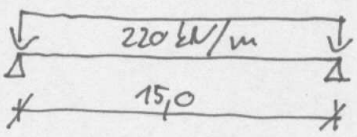
$$g_{kw} = 0{,}15 \cdot 2{,}8 \cdot 2{,}5 \cong 12{,}0 \text{ kN/m}$$

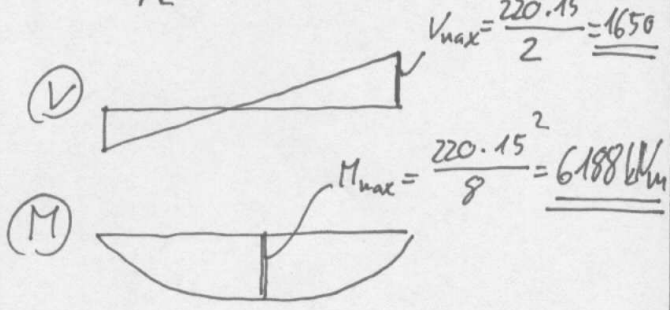
total load: (t: 2 slabs! g_{kw}; γ_k; 2 slabs t)

$$P_{ed} = 1{,}35 \cdot \left(7{,}0 \cdot 6 \cdot 2 + 12\right) + 1{,}5 \cdot 5 \cdot 2 \cdot 6 = 220 \text{ kN/m}$$

(γ_g, g_k, q_k)

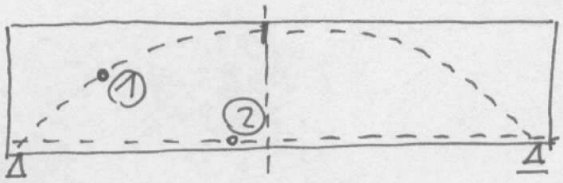
Statical modell

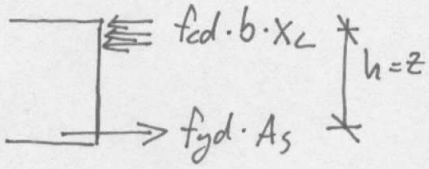




Geometry → $l/h = 15/3{,}0 = 5{,}0 \Rightarrow$ wall-structure

We can calculate it, as an arch!

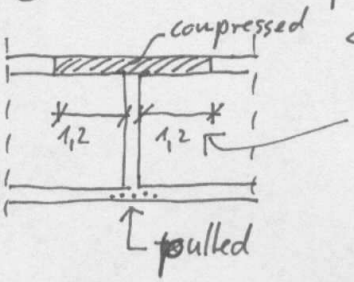




behaves like an arch:

① zone of the compressed concrete → thrust-line-shape

② zone of the pulled steel → tie-bar



⇐ the compression can be either in the slab!

$b_{eff} = 0{,}15 + 2 \cdot 1{,}2 = \underline{2{,}55\,m}$

$z \cdot f_{cd} \cdot b \cdot x_c = f_{yd} \cdot z \cdot A = M_{Rd} \geq M_{Ed}$

$$A_s = \frac{M_{Ed}}{z \cdot f_{yd}} = \frac{6188 \cdot 10^6}{3000 \cdot 435} = 4742 \Rightarrow \underline{20\,\phi\,18}\ (5090\,mm^2)$$

Control: $A_c \cdot f_{cd} = 2250 \cdot 200 \cdot 16{,}6 \cdot 10^{-3} = 8466\,kN = N_c$

⇑ The maximum normal force, the concrete can take.

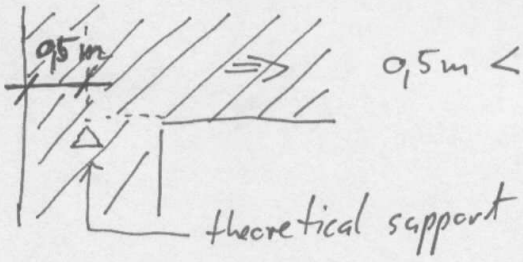
$$N_{Rd} = \frac{M_{Rd}}{z} = \frac{6198}{3} = 2063\,kN < 8466\,kN \checkmark$$

Important: all of the steel bars should be moored!

$F_{Ed} = 2063\,kN$ (as above)

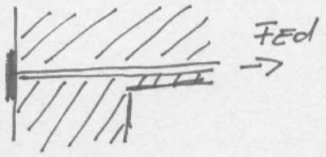
using hooked bars (based on EC):

$$l_{min} = 0{,}7 \cdot c \cdot \phi = 0{,}7 \cdot 40 \cdot 18 = 504\,mm$$

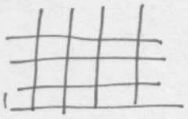
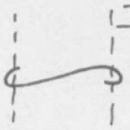


$0{,}5m < l_{min} \Rightarrow$ ↯

Solution: Let's weld the bars to a steel plate!



What other types of steel we need?

- twosided reticulated:  $2\phi 12/150$
- linking hooks:  $4\,d_b/\ 4d_b\ \phi 8/m^2$
- along the free edges  U-shape $\phi 12/150$