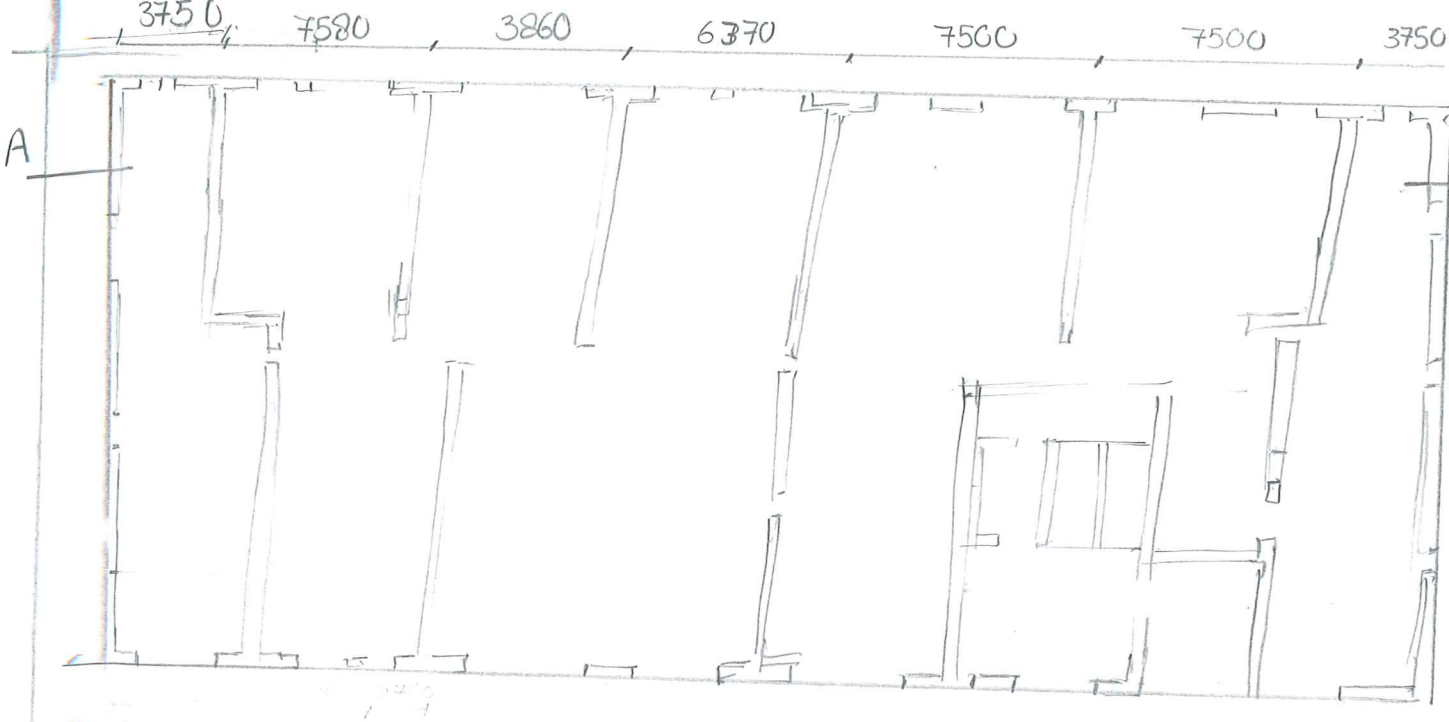
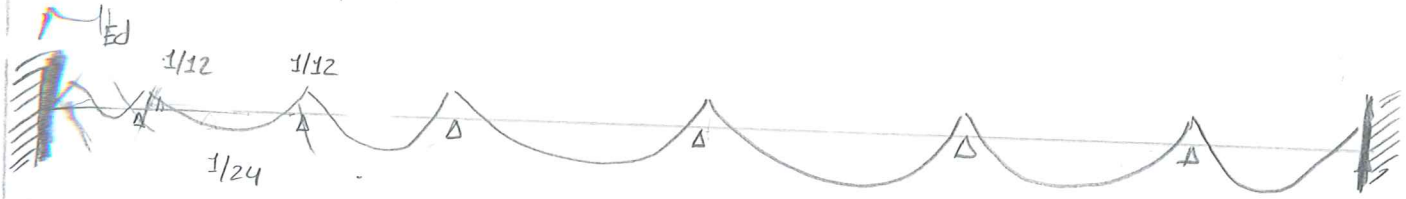
Design of Reinforced Concrete Slab: One-way





* Maximum Span 7500 mm
* M_{ED_1} (Top Reinforcment) $= \frac{1}{12}(F)(L)^2 = \frac{1}{12}(13,65)(7,5)^2 = 63,98$ KN.m
* M_{ED_2} (Bot Reinforcment) $= \frac{1}{24}(F)(L)^2 = \frac{1}{24}(13,65)(7,5)^2 = 32$ KN.m
* $\Delta = \frac{1}{384}\frac{(F_k)(L)^4}{EI} = \frac{1}{384} * \frac{(9,81)(7500)^4}{30000 * (1,01 * 10^9)} = 2,67$ mm
* $I = \frac{1}{12}(b)(h)^3 = \frac{1}{12}(1000)(230)^3 = 1,01 * 10^9$ mm^4
* Coefficient of Creep & Shrinkage $\varphi = 4$ (2,8-3,4)
* Long Term Deflection $= \varphi * (\Delta) = 4 * 2,67 = 10,8$ mm $< \frac{L}{250} = \frac{7500}{250} = 30$ mm

$h = \frac{1}{3} * 7500 = 214 \Rightarrow 230$ mm

$\therefore$ OK

Load Table : General Floor :

Name	Calculation	Ch. Load	ΔF	Design load	
Dead Load					
Self Weight	0,23*25	5,75	1,35	7,8	
Flooring		1,36	1,35	1,8	
Sum(Σ)		7,11	1,35	9,6	
Impose load					
Live load		1,5	1,5	2,25	
Partition		1,2	1,5	1,8	
Sum(Σ)		2,7	1,5	4,05	
Sum(Σ)		9,81		13,65	

$$\mu = \frac{M_{Ed1}}{b * d^2 * \eta * f_{cd}} = \frac{(63{,}98 * 10^6)}{1000 * 199^2 * 1 * 20} = 0{,}081$$

$$d = 230 - 25 - \frac{12}{2} = 199\ mm$$

$C_{30}^{30/37} \rightarrow f_{ck} = 30\ Mpa \Rightarrow f_{cd} = \frac{f_{ck}}{\gamma_M} = \frac{30}{1{,}5} = 20\ Mpa$

$\zeta = 0{,}958$

$$A_{s,req} = \frac{M_{Ed1}}{\zeta * d * f_{yd}} = \frac{(63{,}98 * 10^6)}{0{,}958 * 199 * 435} = 771{,}5\ mm^2$$

Design of Reinforcement $\phi 10/100$; $A_{s,prov} = 785\ mm^2 > A_{s,req} = 771{,}5\ mm^2$

$$\mu = \frac{M_{Ed2}}{b * d^2 * \eta * f_{cd}} = \frac{(32 * 10^6)}{1000 * 199^2 * 1 * 20} = 0040$$

$\therefore$ OK

$\zeta = 0{,}980$

$$A_{s,req} = \frac{M_{Ed2}}{\zeta * d * f_{yd}} = \frac{(32 * 10^6)}{0{,}980 * 199 * 435} = 377\ mm^2$$

Design of the Reinforcement $\phi 10/200$; $A_{s,prov} = 393\ mm^2 > A_{s,req} = 377\ mm^2$

Design of Underground Level - Column :

Load Area = $7,5 * 4,875 = 36,5\ m^2$

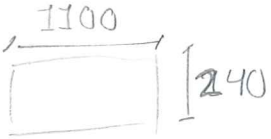
$N_{Ed} = (13,65 * 6 * 36,5) + (0,24 * 1,1 * 3 * 25) + (0,22 * 4 * 15 * 25) = 3339,2\ KN$

(Floors + self weight of column + Reinforced Concrete wall)

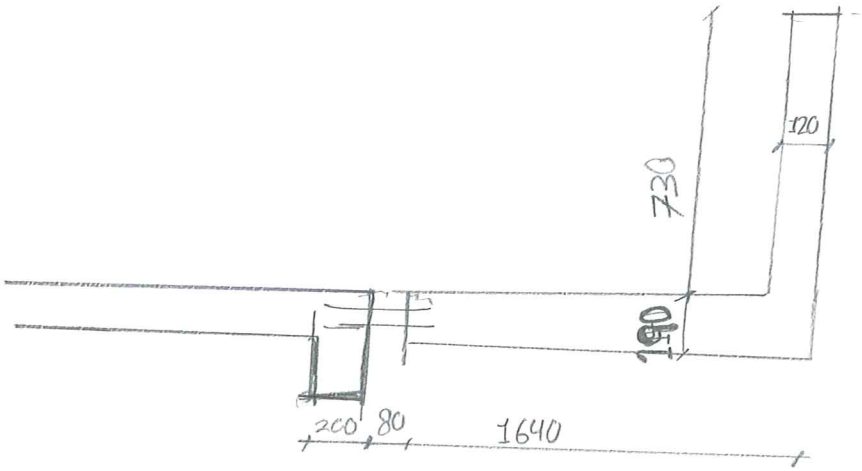
$N_{Rd} = A_c * F_{cd} + 0,02(Ac) * F_{yj} * 0,8 = (240 * 1100 * 20) + 0,02 * 240 * 1100 * 400 * 0,8$

$N_{Rd} = 6969,6\ KN > N_{Ed} = 3339,2\ KN$ ∴ OK

Dimensions of the Column :



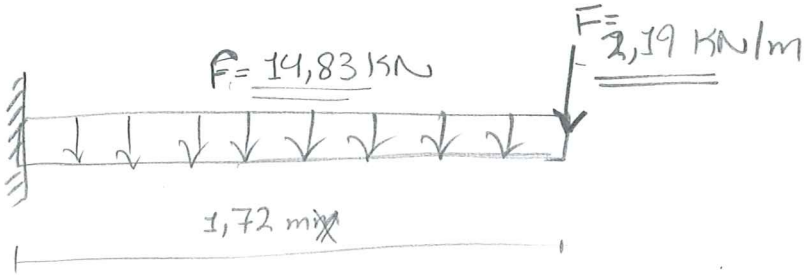
Design of Balcony RC Slab:



Name	Calculation	ch-Load	γ_F	Design Load
Dead Load				
Self Weight	0,12*25	4,75	1,35	6,41
FLOORING		1,79	1,35	2,42
SUM(Σ)		6,54		8,83
Impose load				
Live Load		3	1,5	4,5
Snow Load		1	1,5	1,5
Sum (Σ)		4		6,0
Sum(Σ)		10,54		14,83

Areped load : 0,12*0,73*25 = 2,19 kN/m

Structure Scheme of Balcony:



$M_{ED} = \frac{1}{2}(F)(L)^2 + F*L = \frac{1}{2}(14,83)(1,72)^2 + (2,19)(1,72) = 25,7$ KN.M

$V_{ED} = 14,83 * 1,73 + 2,19 = 27,7$ KN

Schöck Isokorb type D:

D20M... VV6

$M_{RD} = 28,7$ KN.M ✓

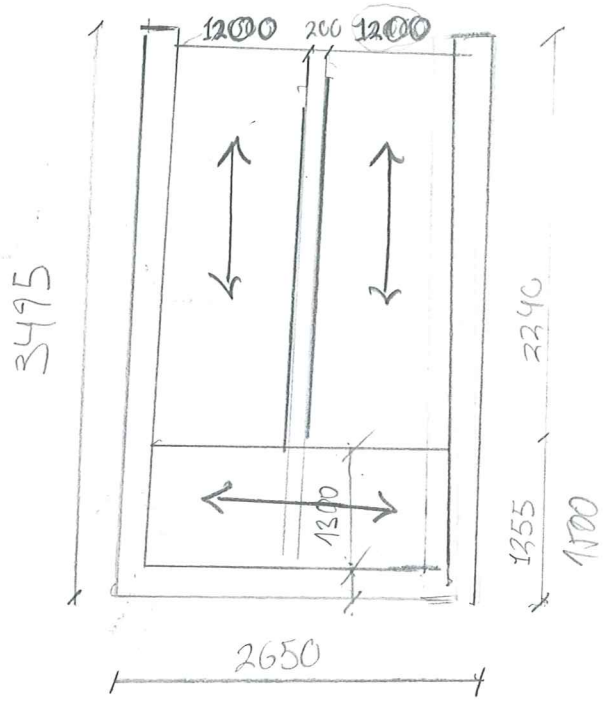
$V_{RD} = 52$ KN ✓

Design Geometry of the Stair Case :

- Height of the Floor : h_K = 3000 mm
- Depth of the Main Slab : h_s = 230 mm
- Depth of the Floor Structure : h_F = 130 mm
- Thickness of Cladding of the Stairs : h_c = 15 mm

Dimension of the Stair Case :

- Ideal height of One Step is : 170 mm
- 3000/170 = 17,65 $\Rightarrow$ 18 steps
- Height of Step h = 3000/18 = 166,7 mm
- Width of One Step $b = 630 - 2h = 630 - 2(166,7) = 296,6$ mm
- Design : Stair Case with 166,7/280 mm Steps ... 2 Flights, 9 Steps in Each Flight
- Width of the Flight : 1200 mm
- Width of the gab between Flight : 200 mm
- Width of the Landing : 1255 mm
- Width of Stair Case : 1200*2 + 200 = 2600 mm
- Slope Of the Stair Case : $\alpha = \arctan(166,7/280) = 34,19^\circ$



Primary check of the depth of the Slab:

- The Stair Case is Considered in one-way Slab with span 2720 mm.
  The Slab will be Simply Supported ⇒ The depth should be atleast
  2720/25 = 108,8 mm
- The depth of Landing = 140 mm
- The depth of Flight = 140 mm
- 140 mm > 108,8 mm ∴ OK

Perpindicular & head Clearance of the Stair Case:

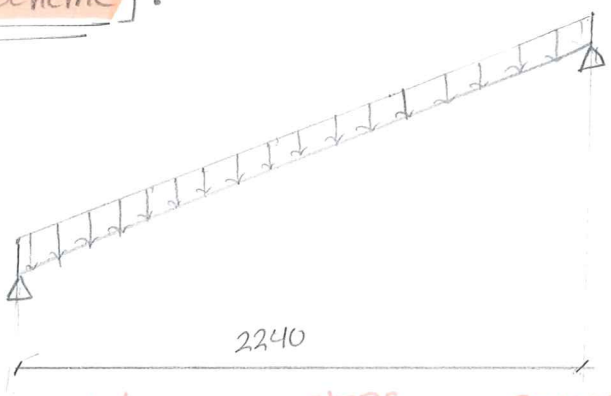
- Head Clearance of the StairCase Should be More than $1500+750/\cos\alpha$
  $= 1500+750/\cos(34,19) = 2371$ mm & more than 2100 mm

- Head Clearance of Our StairCase is $h_1 = h_K - h_s - h_F - h = 3000-230-130-166$
  $h_1 = 2474$ mm $\geq h = 2371$ mm $\therefore$ ok

- Perpendicular Clearance of StairCase Should be More than
  $750+1500*\cos(\alpha) = 750+1500*\cos(34,19) = 2038$ mm & more than 1900 mm

- $h_2 = h_1\cos\alpha = 2474*\cos(34,19) = 2125$ mm $\therefore$ ok

Structure Scheme:



Dead load: $=$ slab $(0,165*25)$ + steps $\left(\frac{0,167}{2}*25\right)$ + ceramic $(0,015*2*20) = 6,8$ KN/m²

Live Load: 3 KN/M²

$F_{df} = (F_d * 1,35)+(F_L * 1,5) = (6,8*1,35)+(3*1,5) = 13,68$ KN/M²

$M_{Ed} = \frac{1}{12} F_{df} L^2 = \frac{1}{12}(13,68)(2,24)^2 = 5,7$ KN.m/m

$d = 140 - 25 - \frac{10}{2}$

$d = 110\ mm$

$$\mu = \frac{M_{Ed}}{b * d^2 * \eta * f_{cd}} = \frac{(5{,}7 * 10^6)}{1000 * 110^2 * 1 * 20} = 0{,}024$$

$$\zeta = 0{,}99$$

$$A_{s,req} = \frac{M_{Ed}}{\zeta * d * f_{yd}} = \frac{(5{,}7 * 10^6)}{0{,}99 * 110 * 435} = 120\ mm^2$$

Design of the Reinforcment: $\phi 8/200$; $A_{s,prov} = 251\ mm^2 > A_{s,req} = 120\ mm^2$