ESCUELA UNIVERSITARIA POLITÉCNICA

DE LA ALMUNIA DE DOÑA GODINA (ZARAGOZA)

ANEXOS

CONSTRUCCIÓN DE VIVIENDAS DE NUEVA PLANTA

422. 13. 195

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Director: José Ángel Pérez Benedicto

Fecha: 8 de septiembre de 2015

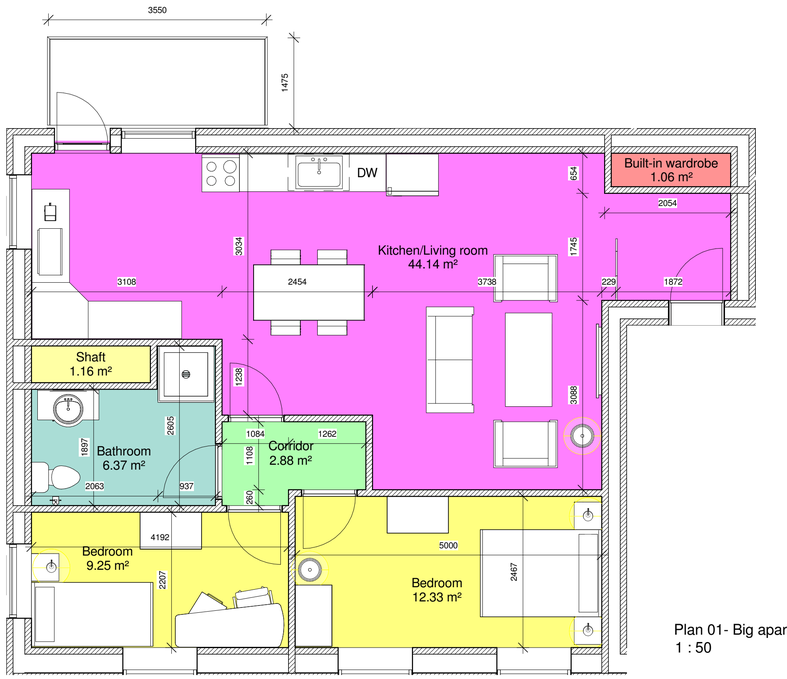
Autor: María Julián Martín
422. 13. 195

INDICE DE CONTENIDO

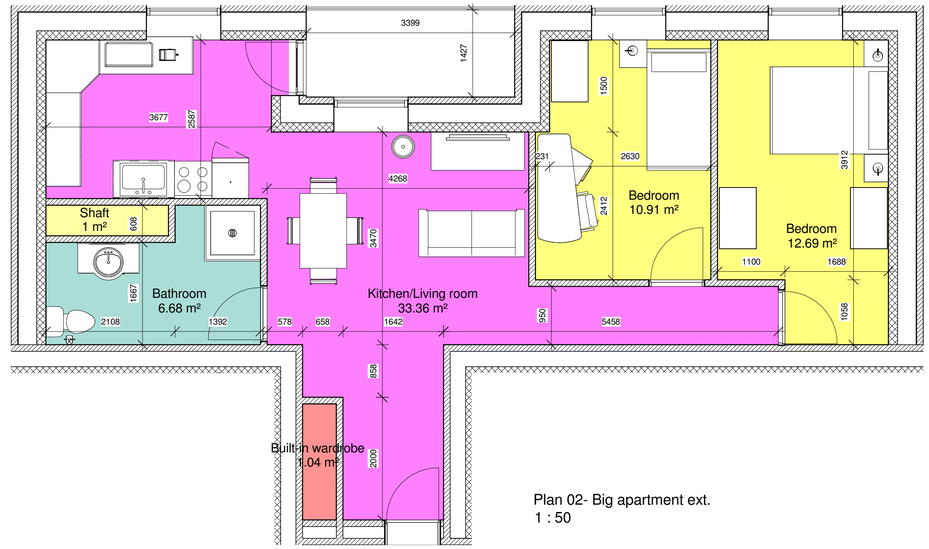
1. ANEXO1 (OUTLINE PROPOSAL)

1.1. BUILDING DESIGN

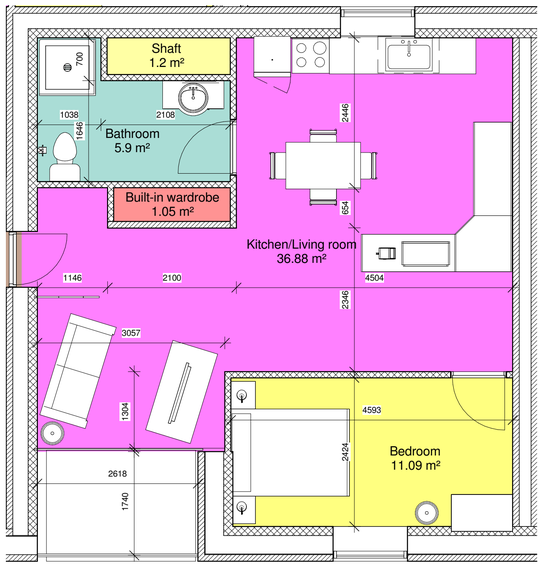
1.1.1. Apartment analysis



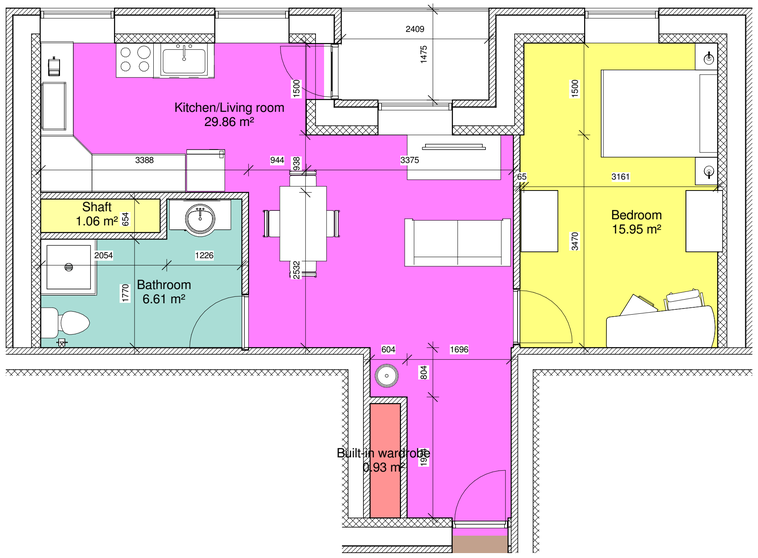
Plan 01- Big apartment
1 : 50



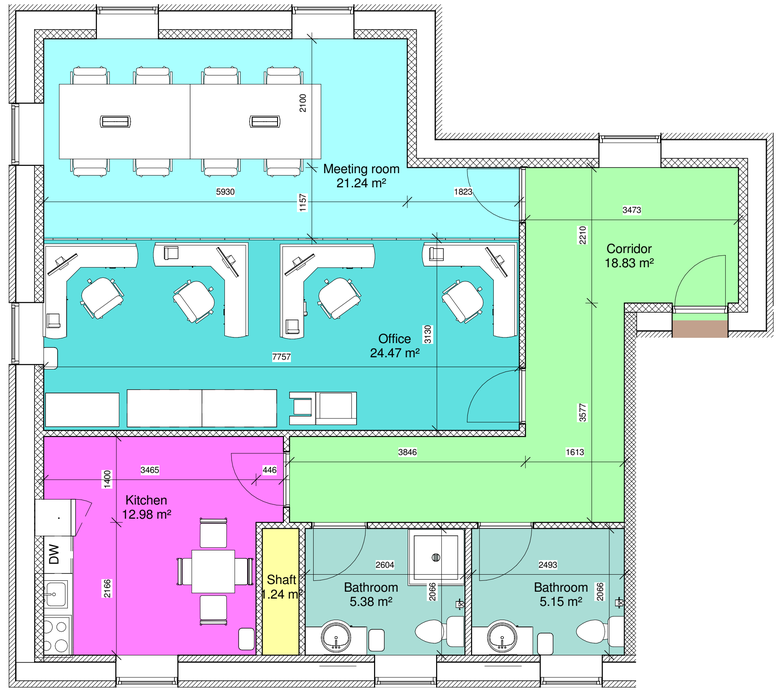
Plan 02- Big apartment ext.
1 : 50



Plan 03- Small apartment
1 : 50



Plan 04- Small apartment ext.
1 : 50



Plan 06- Office
1 : 50

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SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/07/15	
SUBJECT: Apartment plans	SCALE: 1 : 50	12
DRAWN BY: a LTCLWSLITa LT*CI	CLASS: 4thSemAH42	

1.1.2. Bathroom Analysis

BUILDING REGULATION

Bathroom

-The washing and WC fitted at the corners of two adjoining walls such the washing basin can be reached by a person on the WC.

-There must be less than 0.9 m in the side if the WC that faces away from the washbasin.

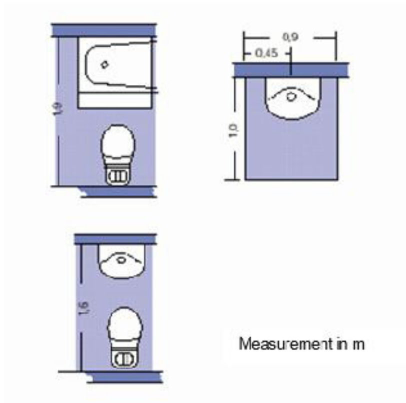
-No fixed furniture must be mounted on the wall next to the WC that faces away from the washbasin.

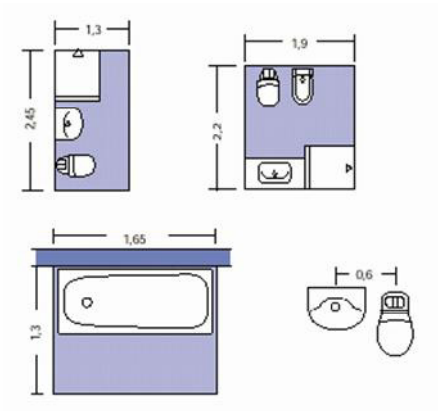
-There must be clear maneuvering area with a diameter of 1.5 in front of the WC, clear of the opening arc of the door.

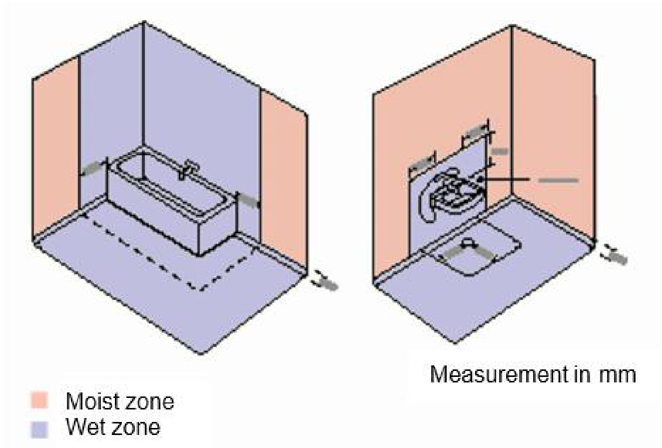
-The toilet seat must be at a height of 48 cm.

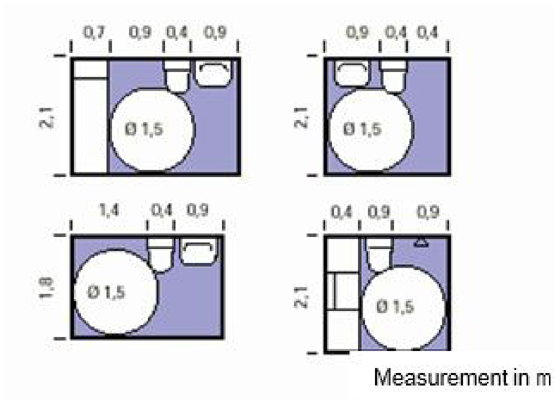
-Lifting armrests must be fittest at a height of 0.8 m both sides of the WC.

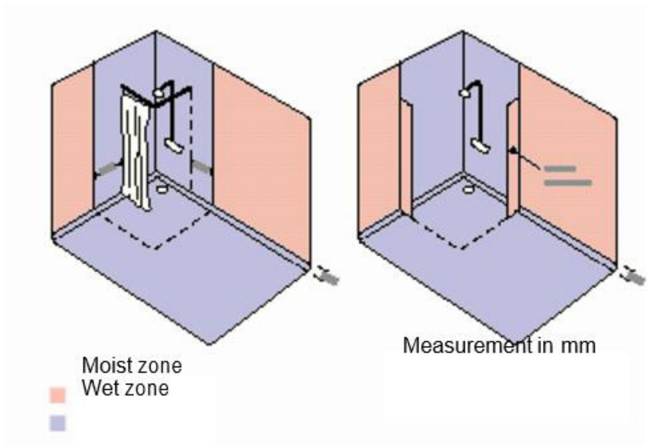
-The washbasin must be fittest at a height of 0.8 m with the drain recessed below of the washbasin.











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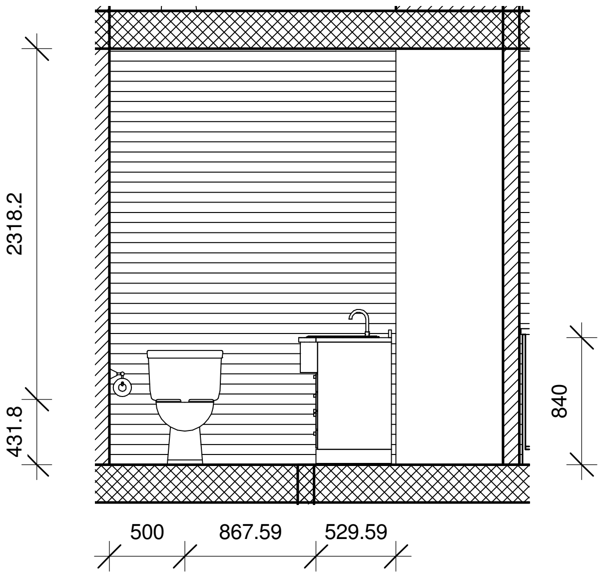
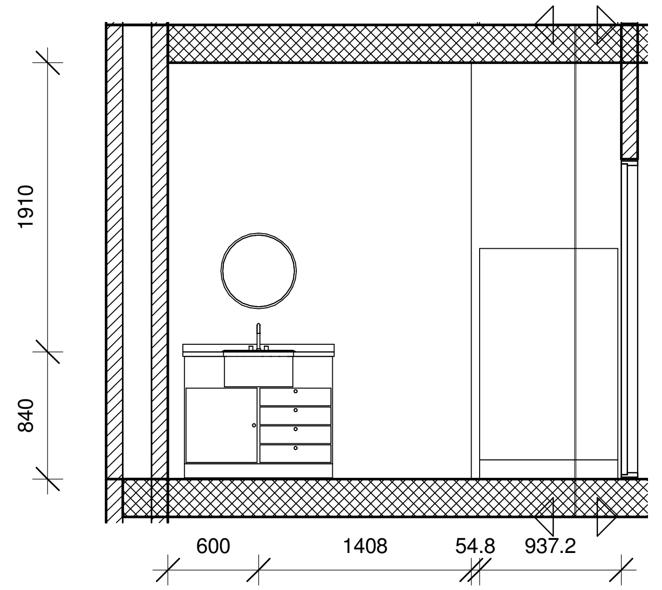
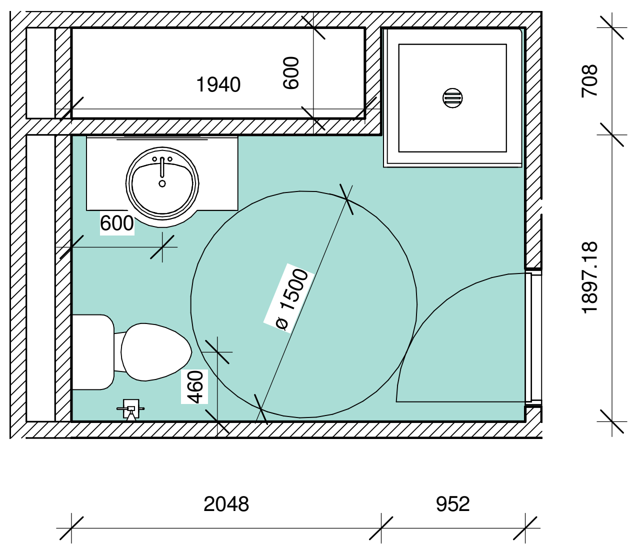


Section 2 bathroom (Big apartment)
1 : 50



Section 3 bathroom (Big apartment)
1 : 50



Plan 01.1- Bathroom Big apartment
1 : 50

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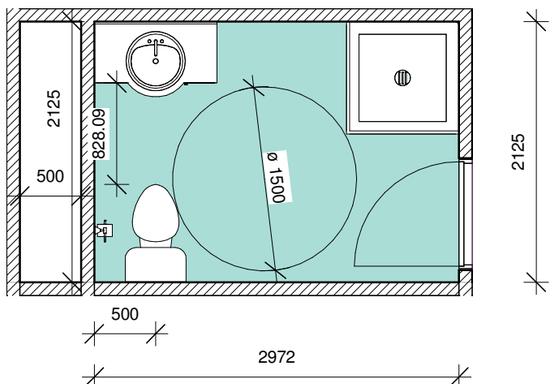
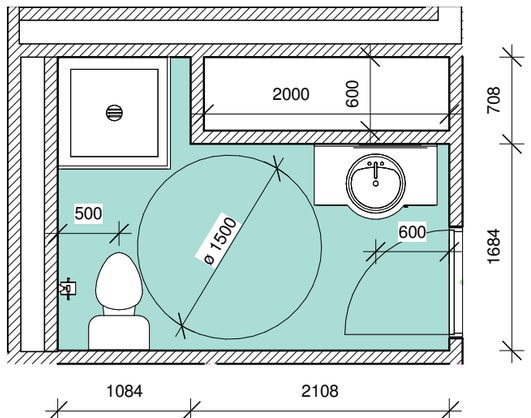
TYPE CITY

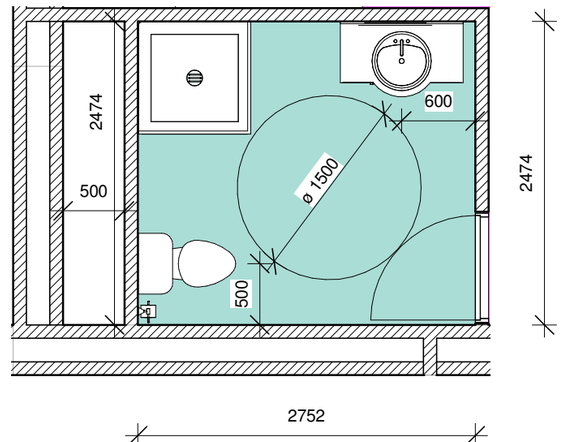
PROJECT: Multi-storey housing	DATE: 03/25/15	01
SUBJECT: 1. Bathroom analysis	SCALE: 1 : 50	
DRAWN BY: [illegible]	CLASS: 4thSemAH42	



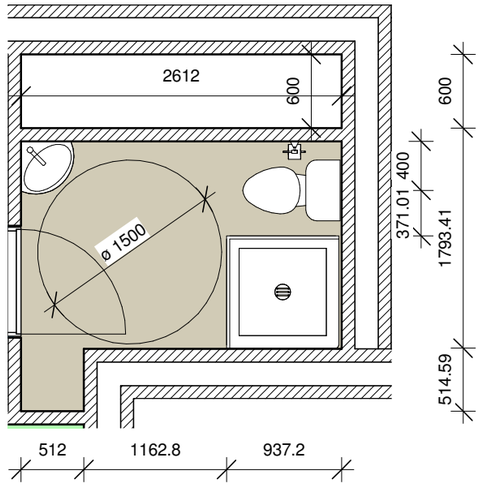
Plan 02.1- Bathroom Big apartment ext.
1 : 50



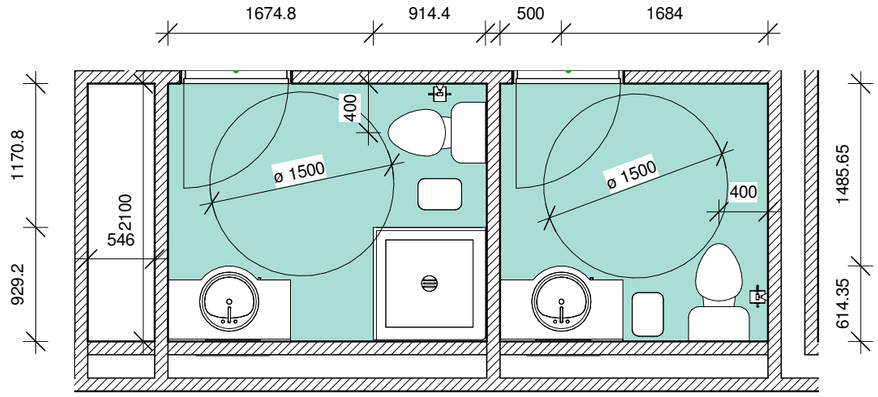
Plan 03.1- Bathroom Small apartment
1 : 50



Plan 04.1- Bathroom Small apartment ext.
1 : 50



Plan 05- Depot of caretaker - Bathroom
1 : 50



Plan 06.1- Office Bathroom
1 : 50

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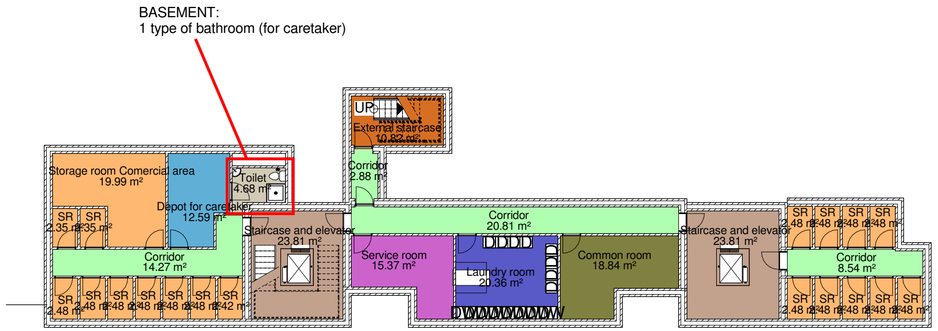
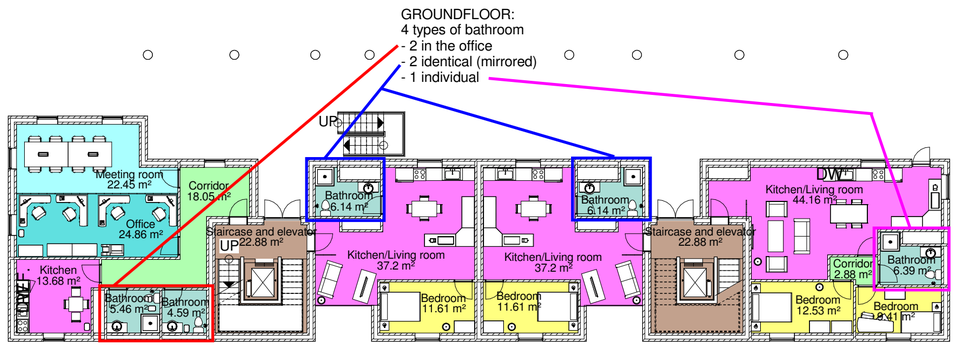
TYPE CITY

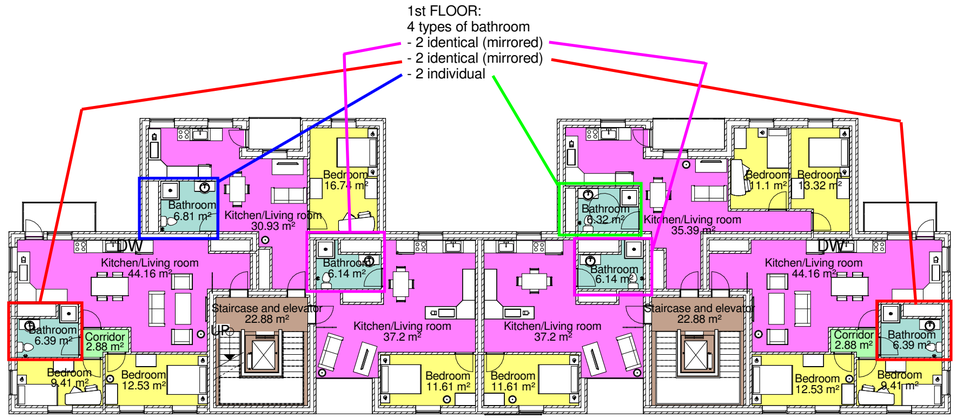
PROJECT: Multi-storey housing	DATE: 03/25/15	**02**
SUBJECT: 2. Bathroom analysis	SCALE: 1 : 50	
DRAWN BY: a LIQLWOGLIIa LIQII	CLASS: 4thSemAH42	



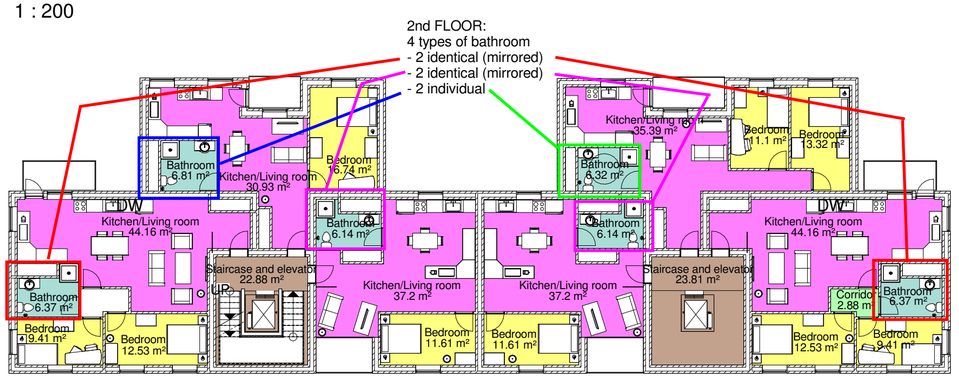
01 Basement Rooms
1 : 200



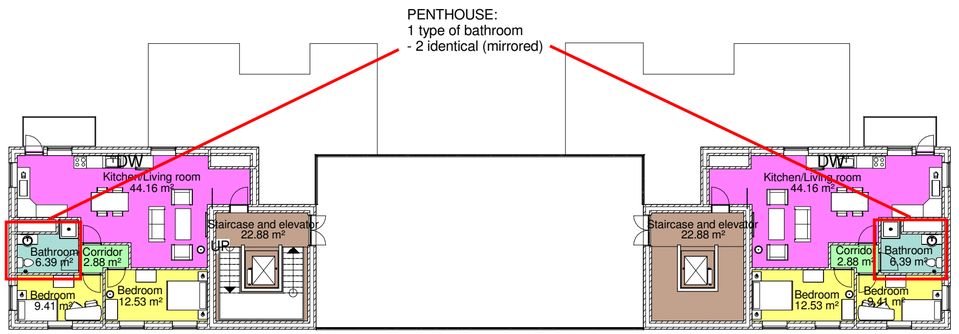
02 Groundfloor, terrain Rooms
1 : 200



03 1 Floor Rooms
1 : 200



04 2 Floor Rooms
1 : 200



05 Penthouse Rooms
1 : 200

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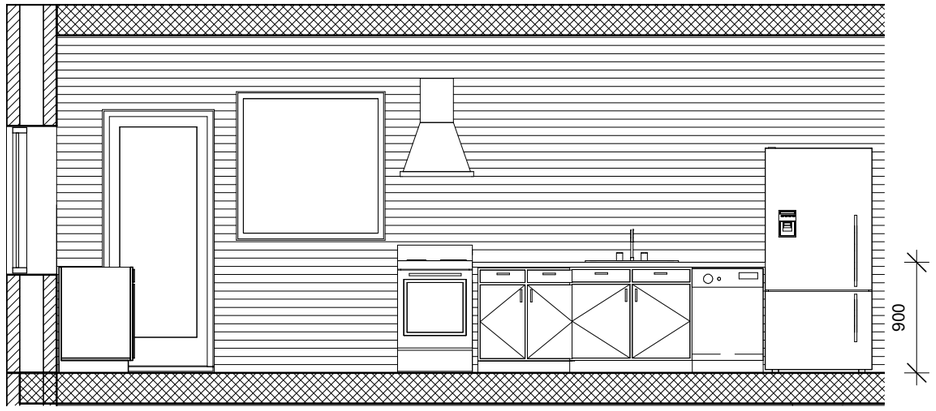
TYPE CITY

PROJECT: Multi-storey housing	DATE: 03/25/15	03
SUBJECT: 3. Bathroom analysis	SCALE: 1 : 200	
DRAWN BY: a LIQLWXLIIa LIQLII	CLASS: 4thSemAH42	

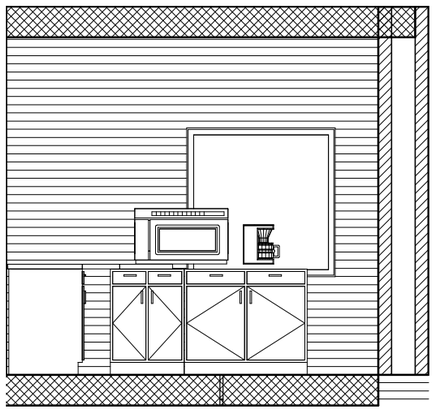
1.1.3. Kitchen Analysis

BUILDING REGULATION

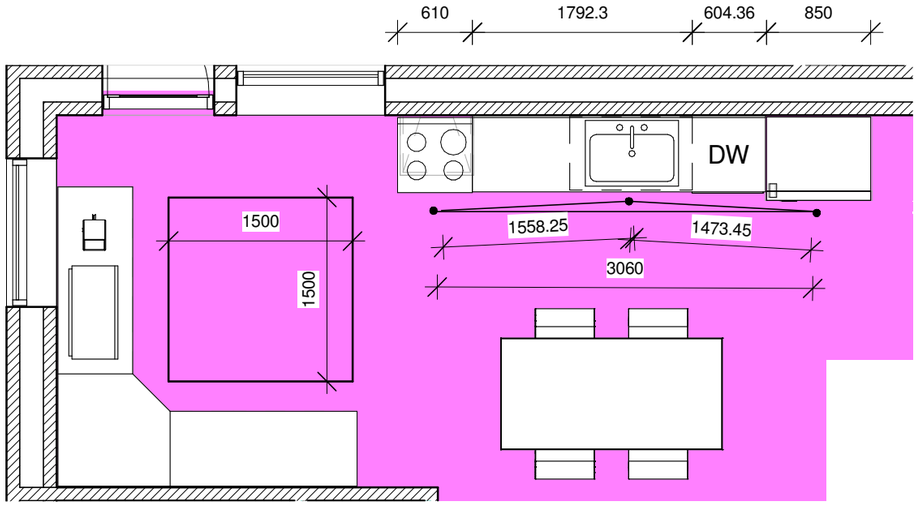
The kitchen may be either a separate room or may form part of a habitable room, ir it may be a cooking recess in residential units of less than 50 m2.



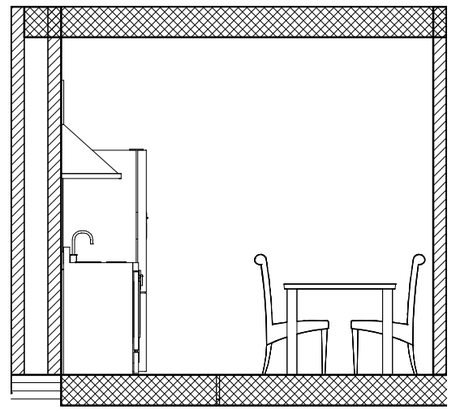
Section 4 kitchen (Big apartment)
1 : 50



Section 5 kitchen (Big apartment)
1 : 50



Plan 01.2- Kitchen Big apartment
1 : 50



Section 6 kitchen (Big apartment)
1 : 50

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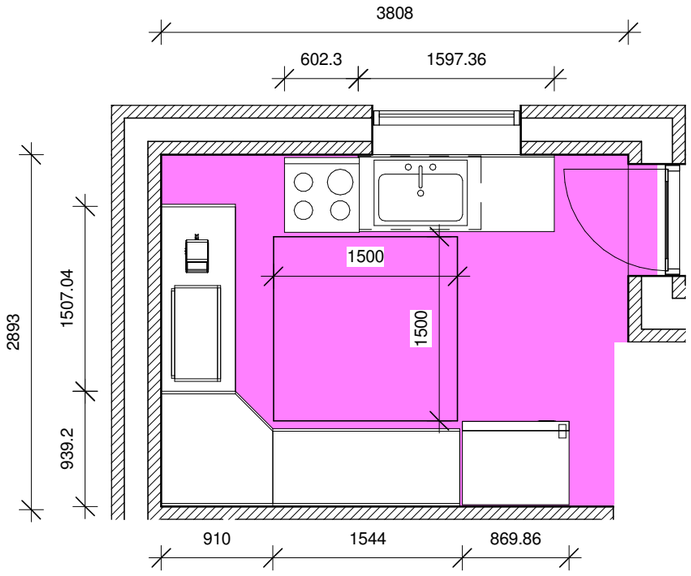
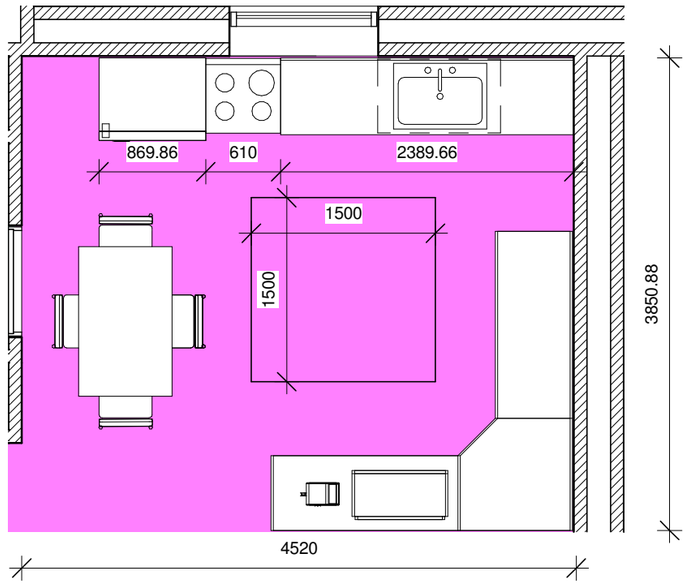
TYPE CITY

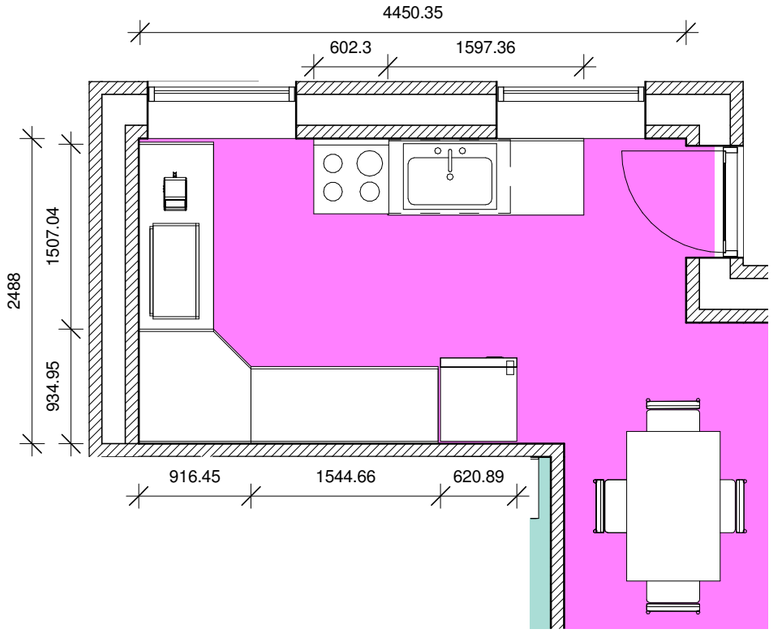
PROJECT: Multi-storey housing	DATE: 03/05/15	
SUBJECT: 1. Kitchen analysis	SCALE: 1 : 50	**04**
DRAWN BY: a LnGLW%GLIIa LnGII	CLASS: 4thSemAH42	



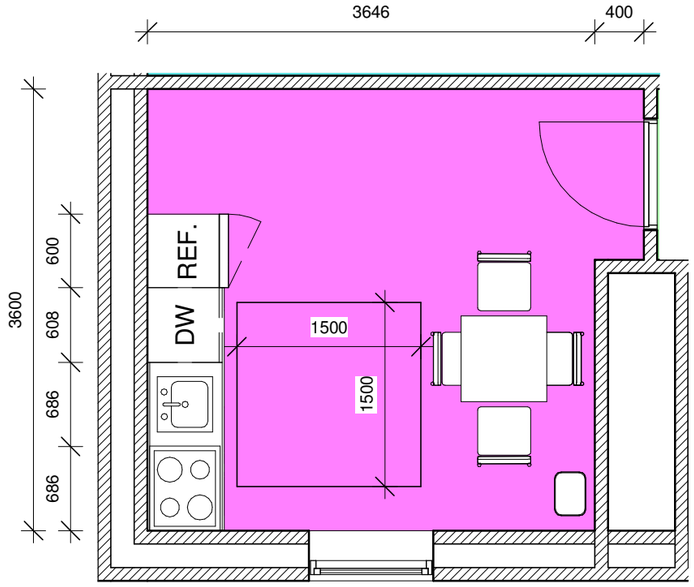
Plan 02.2- Kitchen Big apartment ext.
1 : 50



Plan 03.2- Kitchen Small apartment
1 : 50



Plan 04.2- Kitchen Small apartment ext.
1 : 50



Plan 06.2- Kitchen Office
1 : 50

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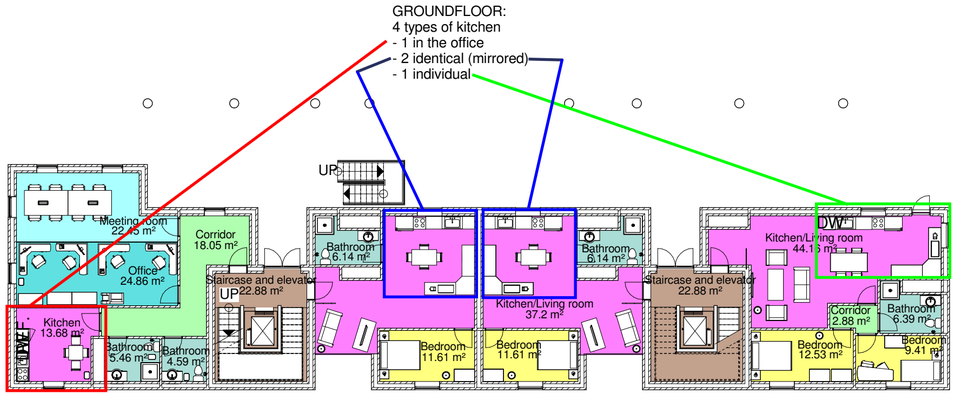
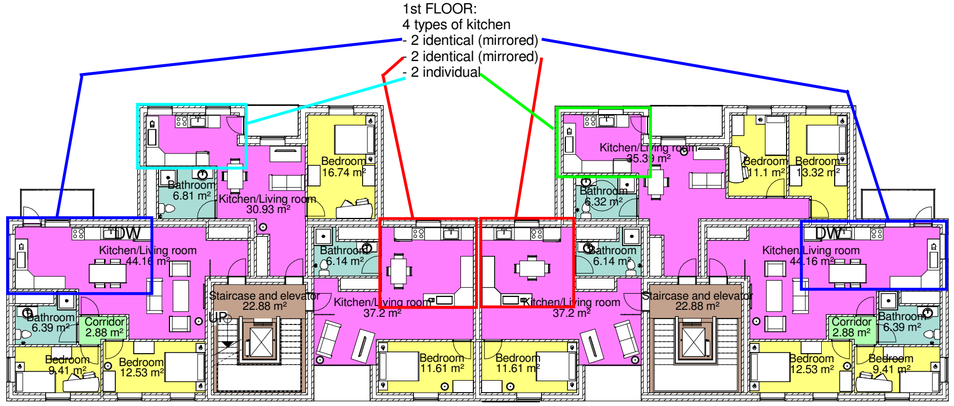
TYPE CITY

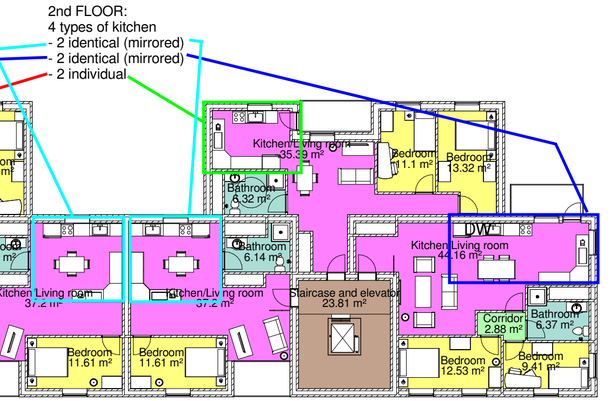
PROJECT: Multi-storey housing	DATE: 03/26/15	**05**
SUBJECT: 2. Kitchen analysis	SCALE: 1 : 50	
DRAWN BY: Group 6	CLASS: 4thSemAH42	



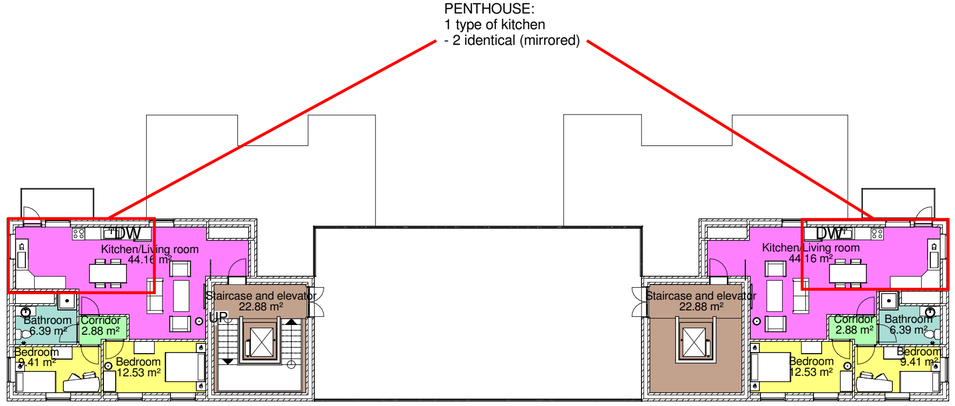
02 Groundfloor, terrain Rooms 2
1 : 200



03 1 Floor Rooms 2
1 : 200



04 2 Floor Rooms 2
1 : 200



05 Penthouse Rooms 2
1 : 200

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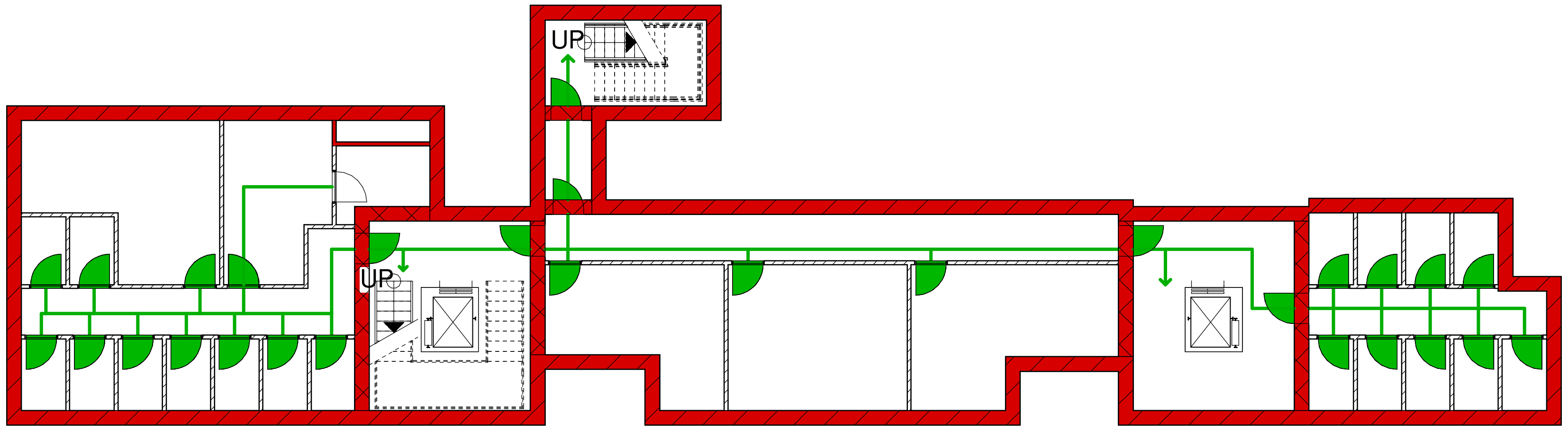
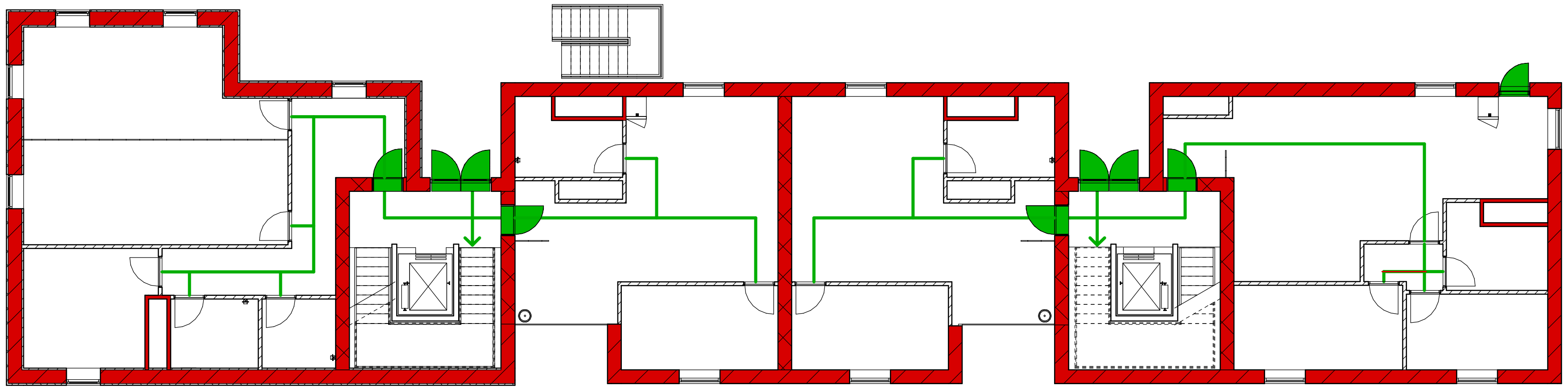
TYPE CITY

PROJECT: Multi-storey housing	DATE: 03/26/15	06
SUBJECT: 3. Kitchen analysis	SCALE: 1 : 200	
DRAWN BY: Group 6	CLASS: 4thSemAH42	

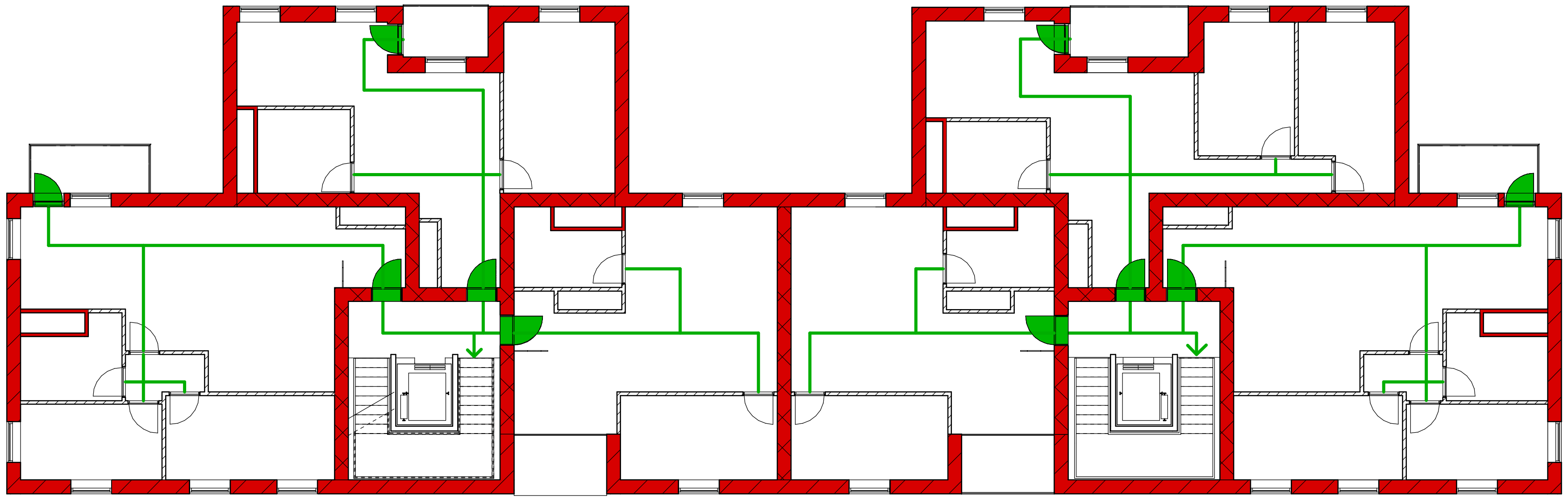
1.1.4. Fire Analysis



01 Basement FIRE
1 : 200



02 Groundfloor, terrain FIRE
1 : 200



03 1 Floor FIRE
1 : 200

EXTERNAL BEARING WALLS
SEPARATION BEARING WALLS
INTERNAL WALLS
DOORS
ESCAPE ROAD

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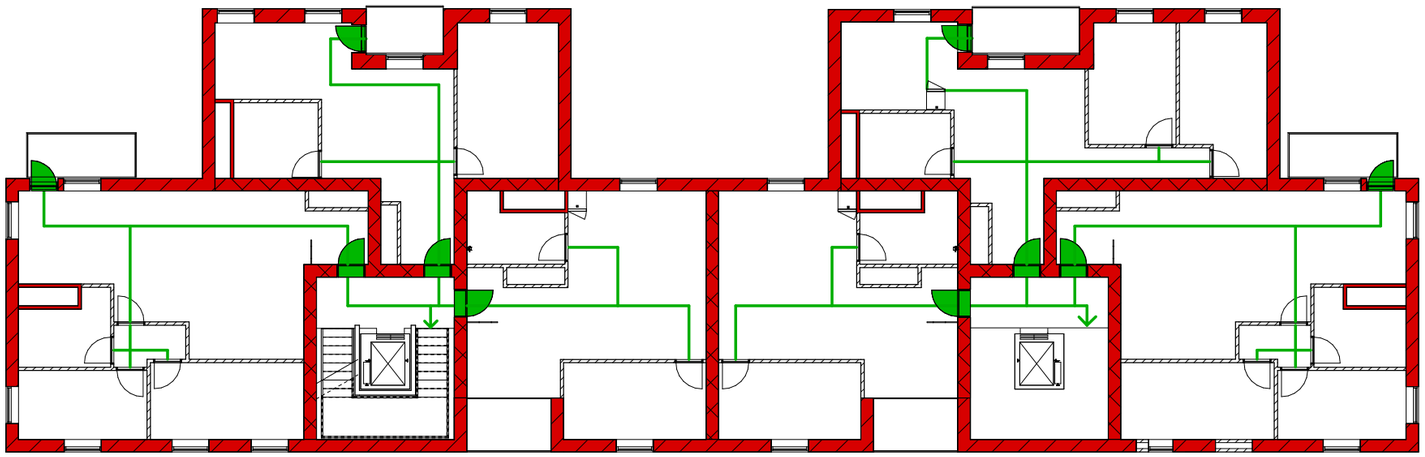
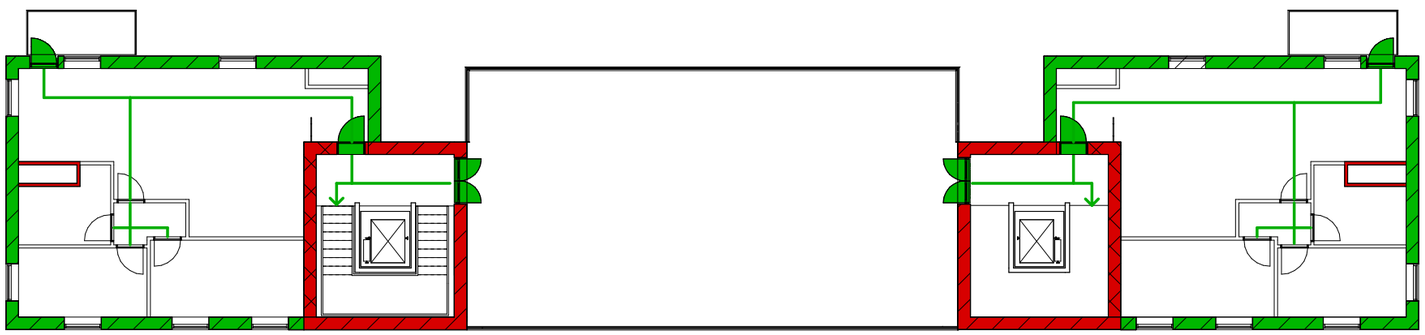
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/09/15	
SUBJECT: 1. Fire analysis	SCALE: 1 : 200	**13**
DRAWN BY: [illegible]	CLASS: 4thSemAH42	



04 2 Floor FIRE
1 : 200



05 Penthouse FIRE
1 : 200

EXTERNAL BEARING WALLS
SEPARATION BEARING WALLS
INTERNAL WALLS
DOORS
PENTHOUSE EXTERNAL BEARING WALLS
ESCAPE ROAD

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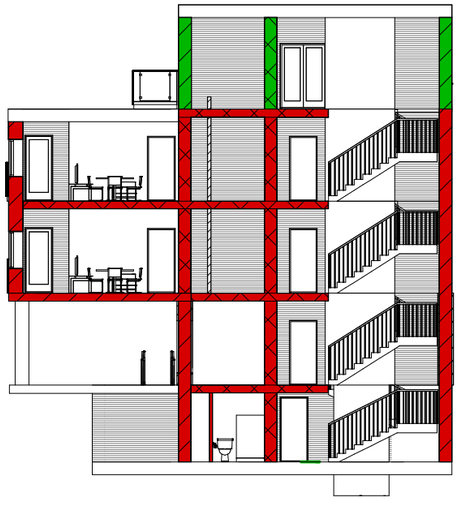
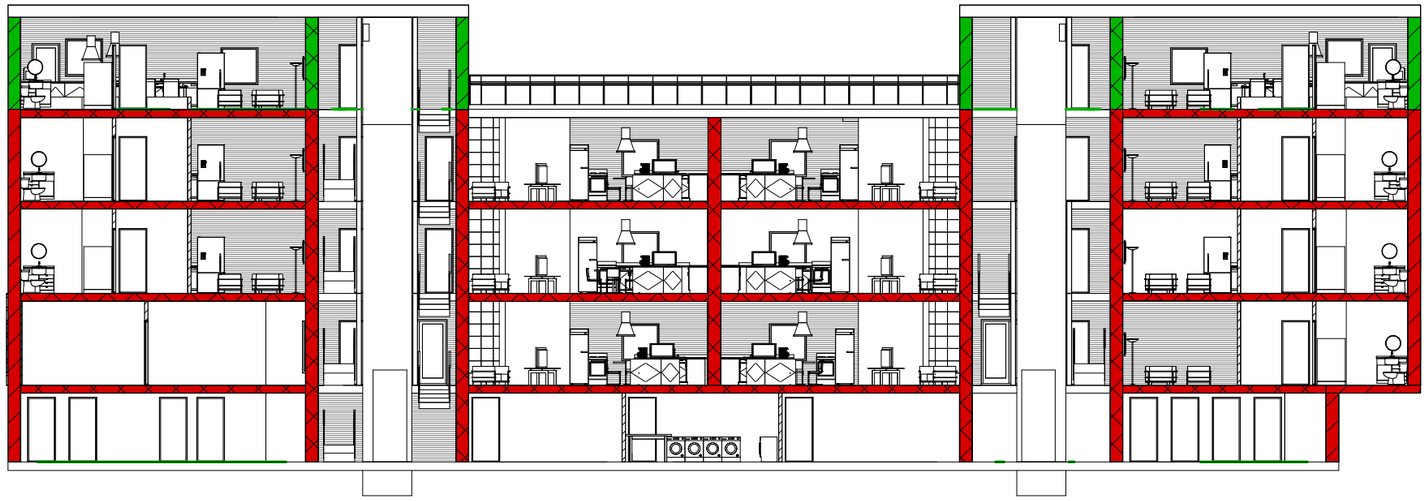
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/09/15	14
SUBJECT: 2. Fire analysis	SCALE: 1 : 200	
DRAWN BY: a LIQLWZ6LIIa LIQII	CLASS:	



1. Section FIRE
1 : 200



2. Section FIRE
1 : 200

EXTERNAL BEARING WALLS
SEPARATION BEARING WALLS
INTERNAL WALLS
DOORS
PENTHOUSE EXTERNAL BEARING WALLS

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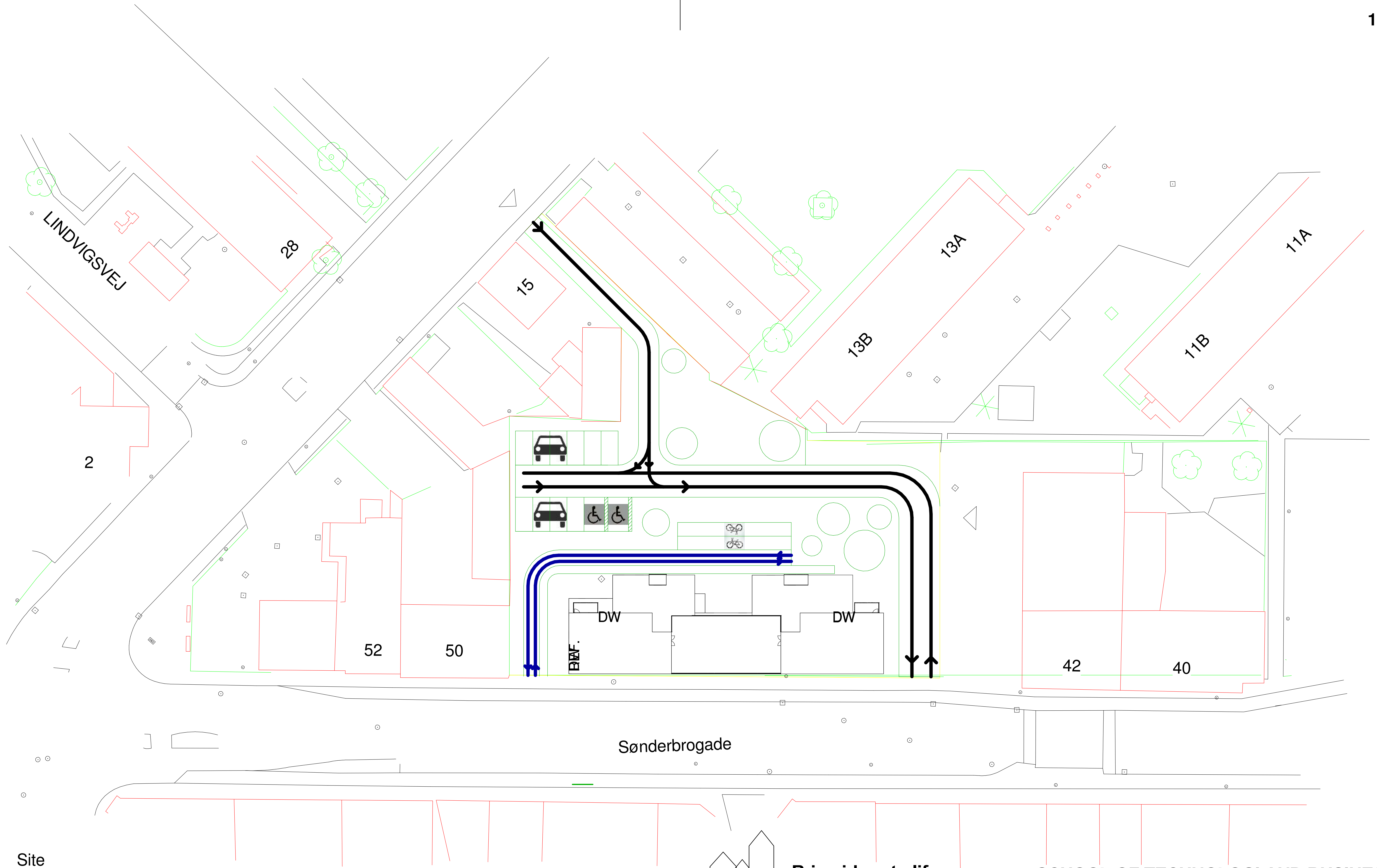
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/09/15	15
SUBJECT: 3. Fire analysis	SCALE: 1 : 200	
DRAWN BY: a LI[GLW3GLIIa LI[GII	CLASS:	

1.1.5. Site Analysis



Site
1 : 500

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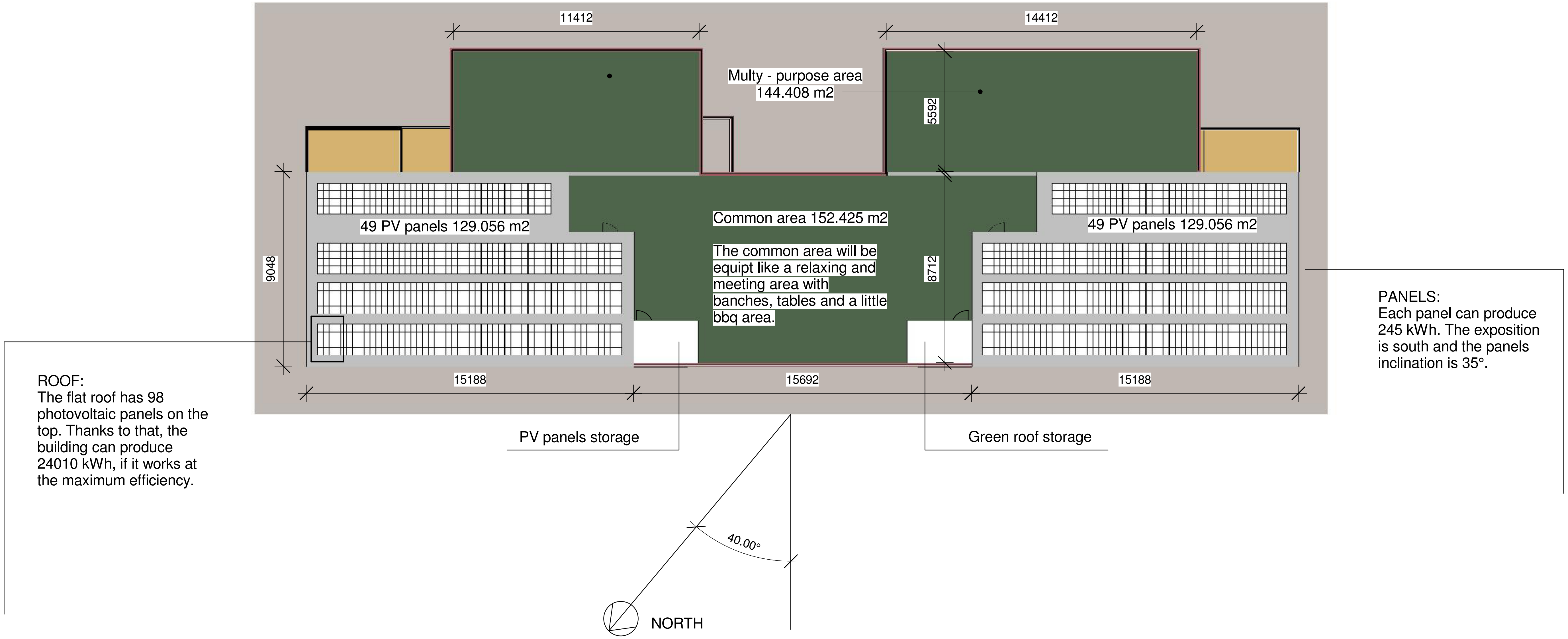
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/09/15	**16**
SUBJECT: Site analysis	SCALE: 1 : 500	
DRAWN BY: [illegible]	CLASS:	

1.1.6. Sustainability Analysis

sustainability analysis
1 : 200



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TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/22/15	**K01_TXX_H7_EX_N1**
SUBJECT: sustainbility analisys	SCALE: 1 : 200	
DRAWN BY: [illegible]	CLASS: AH42S15	

1.1.7. Render

1.2. BUILDING AND PLANNING MANAGEMENT

1.2.1. Project cost

Project : Outline proposal	Date: 15/03/2015	

Total cost including VAT

	Dkr./m2	Cost DKr. Included VAT	Successive estimation DKr. Included VAT	Calculation Scheme design	What is relevant for our project? Where do we find the prices?
Plot acquisition sum	1.464	3.241.196	7.175.788.535	15.886.707.861.793	According to your Tender material
Extra ordinary foundation/piling	243	537.985	1.191.063.261	2.636.933.067.224	Key figures
Main carcass (ground sub-structure)	583	1.290.346	2.856.738.273	6.324.624.278.066	V&S and According to your project
Establish of common outside areas	270	597.762	1.323.403.623	2.929.925.630.249	Key figures
Gas- and sewer contribution	254	562.339	1.244.979.705	2.756.300.407.715	According to your project-se connections Horsens
Charges for connections	562	1.244.230	2.754.640.134	6.098.585.941.481	According to your project-se connections Horsens
Establishing roads and pavements	340	752.737	1.666.508.266	3.689.535.978.832	Key figures
Charges, taxes and interest costs	16	35.423	78.423.918	173.625.222.533	Key figures
Total plot costs	3.732	**8.262.018**	**18.291.545.715**		
Primary building components	5.072	11.228.598			V&S and According to your project
Completions (windows, doors, etc.)	2.019	4.469.995			V&S and According to your project
Surfaces	2.432	5.383.220			V&S and According to your project
Heat, water and sanitary installations	1.323	2.928.235			V&S and According to your project
Mechanical and Electrical installations	110	244.020			V&S and According to your project
Fixed furnishings	802	1.774.688			V&S and According to your project
Other construction costs (other elements)	611	1.353.200			V&S and According to your project
Other costs	692	1.531.155			V&S and According to your project
Total construction costs	13.060	**28.913.111**	-		
Technical consultancy costs included VAT	1.134	2.510.599	5.558.295.217	12.305.687.647.044	Your planing &Fee calculation / Key figures
Other consultants´ costs	124	274.528	607.785.368	1.345.595.474.633	Key figures
Project fee/business manager	342	757.165	1.676.311.256	3.711.239.131.648	Key figures
Board of Directors´ costs	21	46.493	102.931.393	227.883.104.575	Key figures
Interest on construction loan	218	482.637	1.068.525.888	2.365.643.657.016	Key figures
Drying out building	70	154.975	343.104.643	759.610.348.583	Key figures
Commission on guarantees, etc.	325	719.528	1.592.985.843	3.526.762.332.707	Key figures
State per mille charge	29	64.204	142.143.352	314.695.715.842	Key figures
Charges to local council	36	79.702	176.453.816	390.656.750.700	Key figures
Insurance certificates + charges	96	212.537	470.543.510	1.041.751.335.200	Key figures
Contribution to the building defects fund	146	323.234	715.618.255	1.584.330.155.616	Key figures
Total administration costs	2.541	**5.625.601**	12.454.698.542		

	Cost per m2	Total cost	After Successive estim.
Total acquisition sum	19.332	42.800.730	30.746.244.257
Your max budget	20240	44.682.553	
Difference - are you ok?	908	(1.881.823)	30.746.244.257

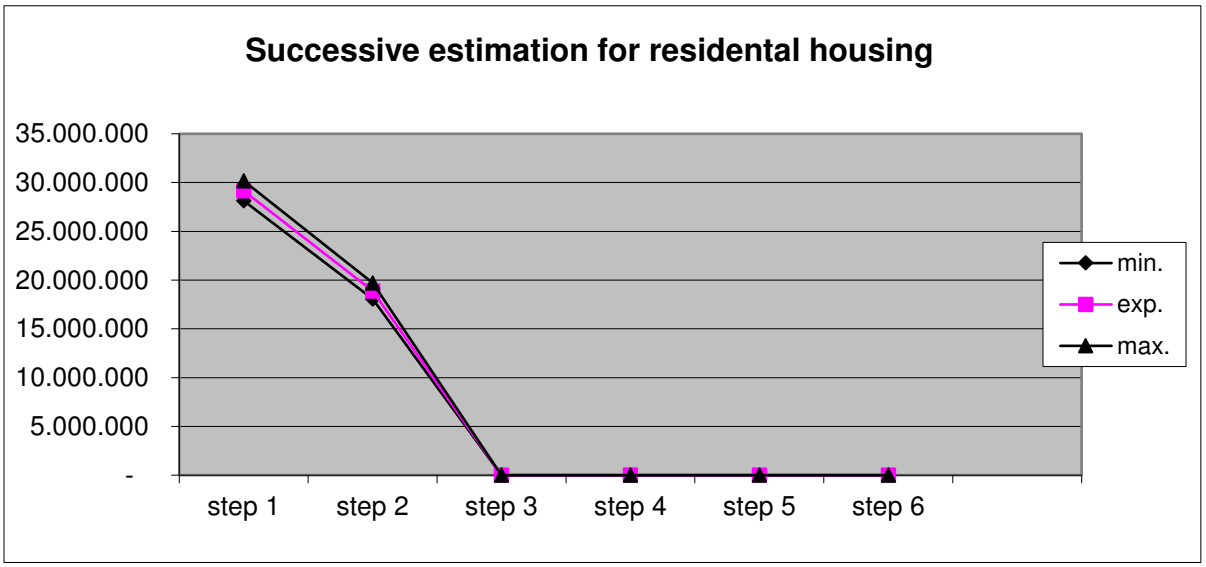
Subject	**Successive Estimation**						**Date**	**20/04/2015**		
Project	**Multi-storey housing**						**Respons.**	[illegible]		
	Step 1						**Size, m2**	**2213,93**		
				unit prices					**Standard**	
Pos.	**Item**	**unit**	**quantity**	**min**	**prob.**	**max.**	**average**	**total**	**deviation**	**Variance**
1	Ground sub-structure	m2	2213,93	528	554	610	560	1.240.063	36	1.313
2	Primary elements	m2	2213,93	4.359	4.593	5.043	4.636	10.263.612	303	91.916
3	Completion	m2	2213,93	1.737	1.820	2.004	1.840	4.074.388	118	13.998
4	Applied finishes	m2	2213,93	2.088	2.204	2.422	2.224	4.924.759	148	21.872
5	Services piped and ducted	m2	2213,93	1.785	1.875	2.079	1.898	4.202.313	130	16.937
6	Electrical installations	m2	2213,93	533	561	616	566	1.254.126	37	1.366
7	Furniture	m2	2213,93	651	685	753	692	1.531.408	45	2.035
8	Building site	m2	2213,93	375	750	1.125	750	1.660.449	332	110.284
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
	Total							29.151.117		259.720

Estimate	**29.151.117**
Uncertainty, +/-	**1.019.254**
Uncertanty, %	**3,5%**
Price per m2	13167,13589

Subject	**Successive Estimation**						**Date**			
Project							**Respons.**	[illegible]		
	Step 2						**Size, m2**	**2213,93**		
				unit prices					**Standard**	
Pos.	**Item**	**unit**	**quantity**	**min**	**prob.**	**max.**	**average**	**total**	**deviation**	**Variance**
1	Ground sub-structure	m2	2213,93	528	554	610	560	1.240.063	36	1.313
2	Primary elements									
2,1	External walls	m2								
2,2	Internal walls	m2								
2,3	Roof	m2								
3	Completion	m2	2213,93	1.737	1.820	2.004	1.840	4.074.388	118	13.998
4	Applied finishes	m2	2213,93	2.088	2.204	2.422	2.224	4.924.759	148	21.872
5	Services piped and ducted	m2	2213,93	1.785	1.875	2.079	1.898	4.202.313	130	16.937
6	Electrical installations	m2	2213,93	533	561	616	566	1.254.126	37	1.366
7	Furniture	m2	2213,93	651	685	753	692	1.531.408	45	2.035
8	Building site	m2	2213,93	375	750	1.125	750	1.660.449	332	110.284
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
							-	-	-	-
	Total							18.887.506		167.804

Estimate	**18.887.506**
Uncertainty, +/-	**819.278**
Uncertanty, %	**4,3%**
Price per m2	8531,21171

	min.	exp.	max.
step 1	28.131.863	29.151.117	30.170.371
step 2	18.068.228	18.887.506	19.706.783
step 3	-	-	-
step 4	-	-	-
step 5	-	-	-
step 6	-	-	-



1.2.2. Area calculation

APARTMENT	Area 1	Nr	Area 2	Subsidised area	Total area (m2)
Ap1	94,23	7	110,86		**776,05**
Ap2	67,86	6	84,50		**507,01**
Ap3	86,90	2	103,53		**207,07**
Ap4	73,09	2	89,73		**179,46**
Nr Apartments		17			
Staircase and elevator	29,57	9	266,13	15,65470588	
External staircase	16,73	1	16,73	0,984117647	

Maria Julian Martin

Apartment 1 (Big apartment)			
Area (different depends the floor) m2	Nr	Total	Media
95,32	3	285,96	
93,6	2	187,2	
93,21	2	186,42	
	7	659,58	94,23

Apartment 2 (Small apartment)			
Area (different depends the floor) m2	Nr	Total	Media
68,79	2	137,58	
67,32	2	134,64	
67,48	2	134,96	
	6	407,18	67,86

Apartment 3 (Ext. Big apartment)			
Area (different depends the floor) m2	Nr	Total	Media
86,8	1	86,8	
86,99	1	86,99	
	2	173,79	86,90

Apartment 4 (Ext. Small apartment)			
Area (different depends the floor) m2	Nr	Total	Media
73,12	1	73,12	
73,06	1	73,06	
	2	146,18	73,09

Staircase and elevator			
Area (different depends the floor) m2	Nr	Total	Media
29,33	6	175,98	
29,91	2	59,82	
30,33	1	30,33	
	9	266,13	29,57

FLOOR	AREA
Basement	314.428
Groundfloor	411.139
1st floor	549.519
2nd floor	549.519
Penthouse	389.327
TOTAL	2213.932

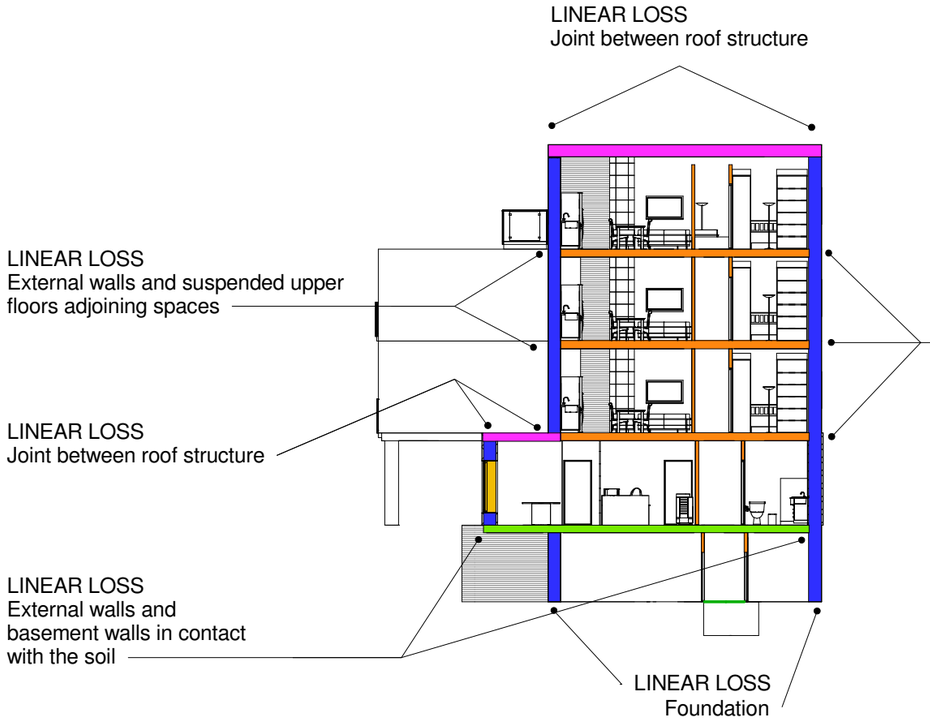
1.2.3. Project Planning

PROJECT PLANNING

Phase	Duration (Days)	February (2015)				March				April				May				June				July				August				September				October				November				December				January (2016)				February				March				April				May				June				July				August				September			
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
OUTLINE	**49**																																																																																
TENDER	**1**																																																																																
CONSIDERATION TIME	**60**																																																																																
GEAR UP	**10**																																																																																
SCHEME DESIGN	**15**																																																																																
DETAIL 1	**15**																																																																																
BUILDING PERMIT	**5**																																																																																
DETAIL 2	**24**																																																																																
CONSTRUCTION	**211**																																																																																
TIME FRAME	**7**																																																																																

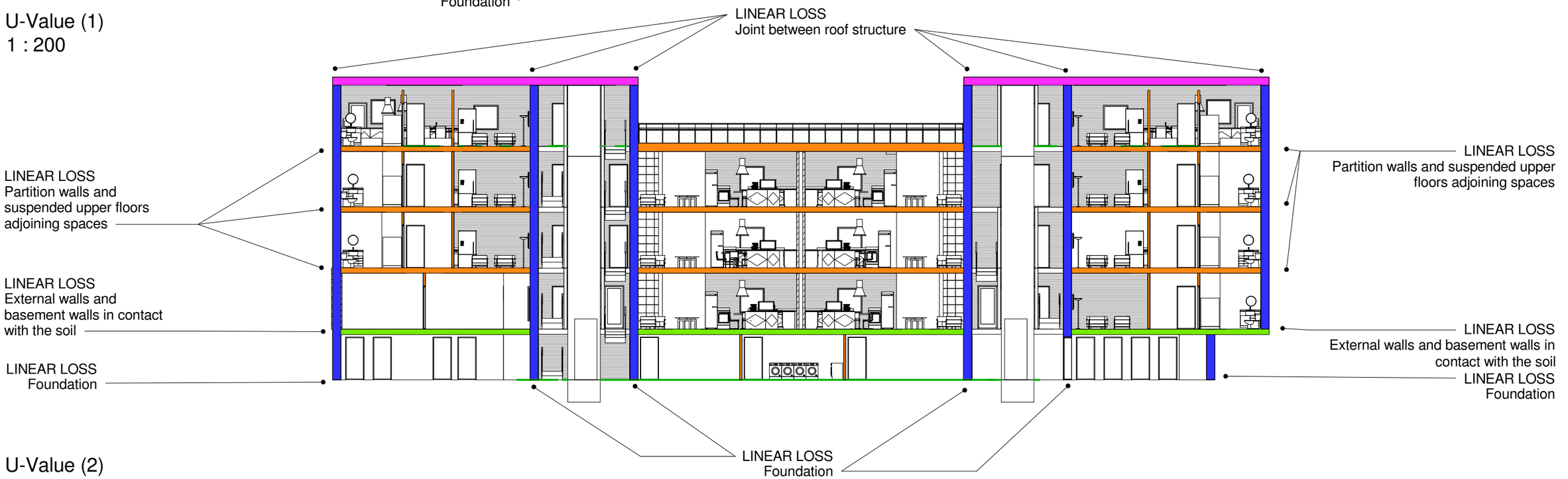
1.3. BUILDING SERVICES

1.3.1. U-Value analysis



U-Value (1)
1 : 200

		DEMAND	RECOMMENDED	BE 2015
	EXTERNAL AND BASEMENT WALLS	0.30	0.15	0.10
	PARTITION AND SUSPENDED FLOORS	0.40	0.40	0.28
	GROUND SLABS AND BASEMENT FLOOR	0.20	0.10	0.07
	CEILING AND ROOF STRUCTURE	0.20	0.20	0.07
	WINDOWS	1.80	1.40	0.98



U-Value (2)
1 : 200

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PROJECT: Multi-storey housing	DATE: 03/26/15	**10**
SUBJECT: U-Value	SCALE: 1 : 200	
DRAWN BY: a LIQLWXLIIa LIQII	CLASS: 4thSemAH42	

U-VALUE Calculation

	DEMAND	RECOMMENDED	BE 2015
EXTERNAL AND BASEMENT WALLS	*0.30*	*0.15*	*0.75*
PARTITION WALLS	*0.40*	*0.40*	*0.08*
GROUND SLABS AND BASEMENT FLOOR	*0.20*	*0.10*	*0.02*
CEILING AND ROOF STRUCTURE	*0.20*	*0.10*	*0.02*
WINDOWS	*1.80*	*1.40*	*0.28*
SUSPENDED FLOORS	*0.50*	*0.40*	*0.08*

1.3.2. Sound analysis

5 Demands for sound classification of dwellings

5.1 Airborne sound insulation

The limit value for airborne sound insulation for each sound class is shown in table 1.

Table 1 – Airborne sound insulation. Limit values indicated as lowest values for weighted reduction number, R'_w or $R'_w + C_{50-3150}$

Room type	Class A $R'_w + C_{50-3150}$ in dB	Class B $R'_w + C_{50-3150}$ in dB	Class C R'_w in dB	Class D R'_w in dB
Between a dwelling or shared living room and premises with noisy activities (business or common spaces)	68	63	60	55
Between a dwelling and spaces outside the dwelling	63	58	55	50
Between shared living rooms mutually	63	58	55	50
Door between dwelling and common spaces	32	32	32	27
NOTE - For class A and B is provided for the airborne sound insulation at low frequencies by adding the spectrum correction, $C_{50-3150}$, to the R'_w value. This spectrum correction is used as a protection against inconvenient low frequency noise.				

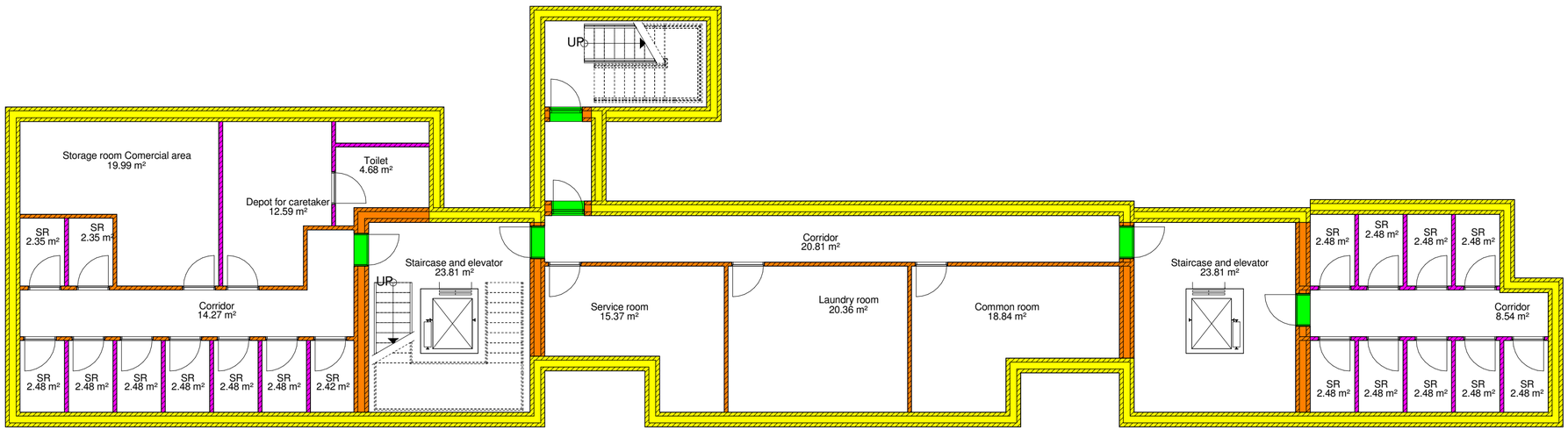
5.2 Impact sound level

The limit values for impact sound level for each sound class are shown in table 2.

Balconies as well as floors and slabs at spaces with a floor space less than 2,5 m^2 must not comply with demands for impact sound level.

Table 2 - Impact sound level. Limit values indicated as highest values for weighted, normalized impact sound level, $L'_{n,w}$ or $L'_{n,w} + C_{I,50-2500}$

Room type	Class A $L'_{n,w} + C_{I,50-2500}$ in dB	Class B $L'_{n,w} + C_{I,50-2500}$ in dB	Class C $L'_{n,w}$ in dB	Class D $L'_{n,w}$ in dB
In living rooms and kitchens as well as at shared living rooms - from premises with noisy activities (business or common spaces)	38	43	48	53
In living rooms and kitchens - from other dwellings and from common spaces	43	48	53	58
In living rooms and kitchens - from shared stairways and passages, from balconies or similar, as well as from toilet- and bath rooms in other dwellings	48	53	58	63
In shared living rooms - from living rooms, other common spaces, stairways, passages, balconies or similar, as well as from toilet- and bath rooms	48	53	58	63
NOTE - For class A and B is provided for the impact sound level at low frequencies by adding the spectrum correction, $C_{I,50-2500}$, to the $L'_{n,w}$ -value. This spectrum correction is used as a protection against inconvenient low frequency noise, which is an ordinary problem in connection with light building-constructions. The spectrum correction is however only to be included, if it is $\geq$ 0 dB.				



01 Basement SOUND
1 : 100

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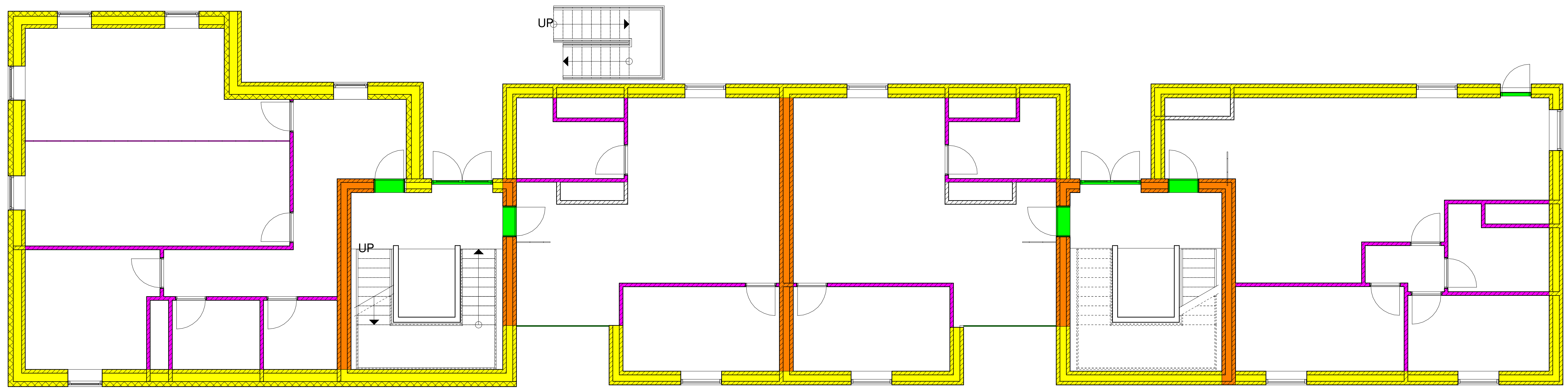
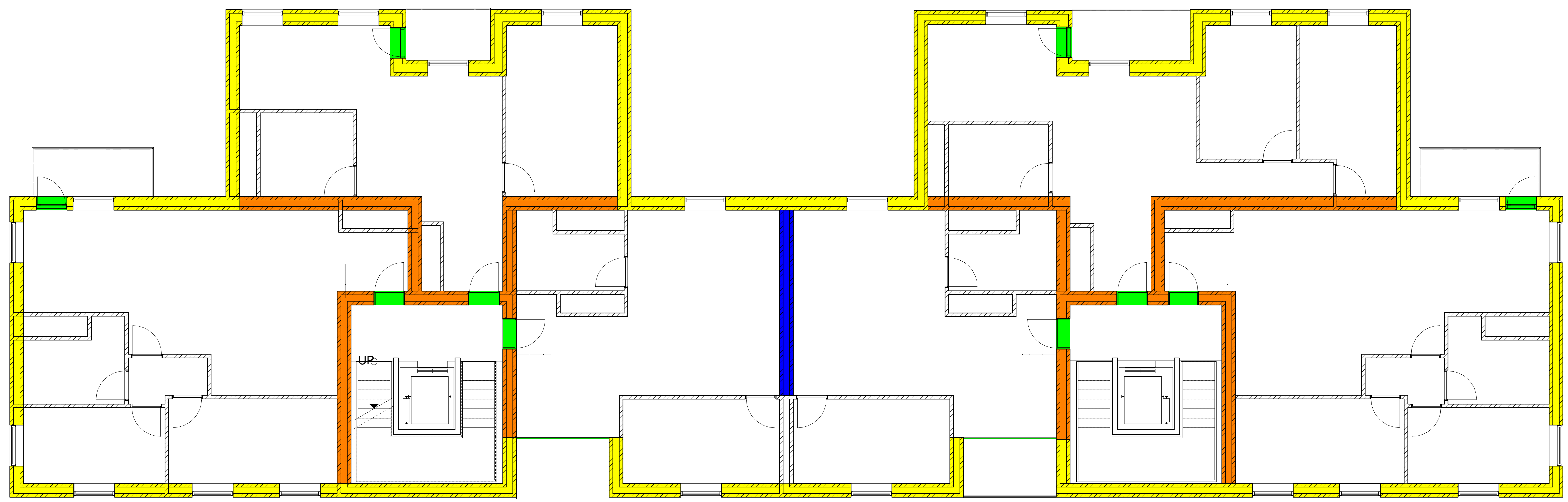
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/16/15	28
SUBJECT: 1. Sound analysis	SCALE: 1 : 100	
DRAWN BY: a LI[1LW%1Ia LI[1I	CLASS: 4thSemAH42	



02 Groundfloor, terrain SOUND
1 : 100



03 1 Floor SOUND
1 : 100

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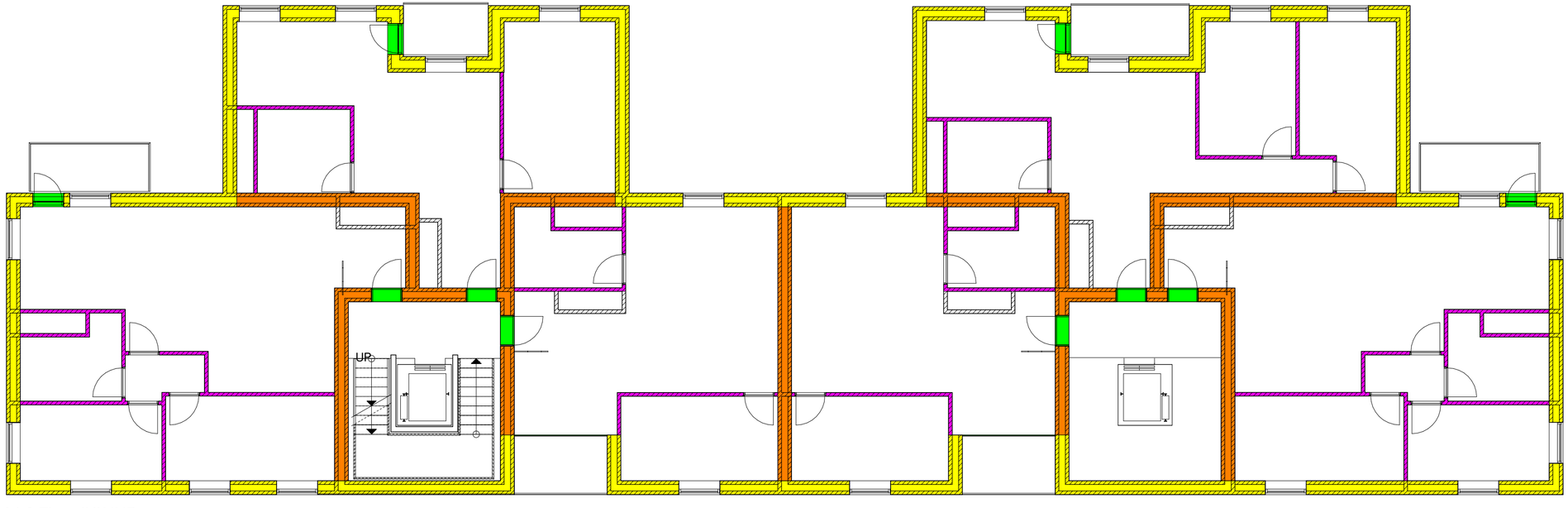
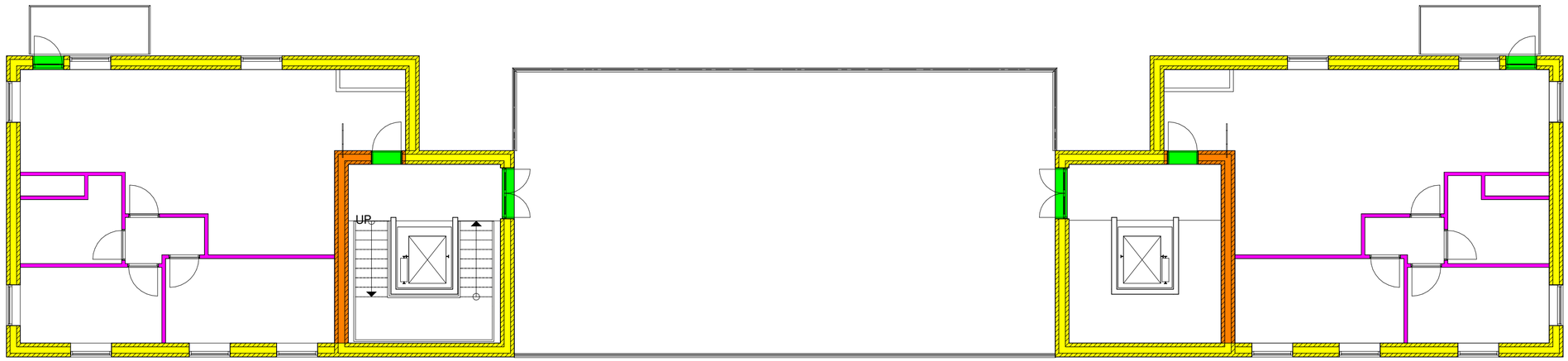
PROJECT: Multi-storey housing	DATE: 04/16/15	
SUBJECT: 2. Sound analysis	SCALE: 1 : 100	**29**
DRAWN BY: [illegible]	CLASS: 4thSemAH42	



04 2 Floor SOUND
1 : 100



05 Penthouse SOUND
1 : 100

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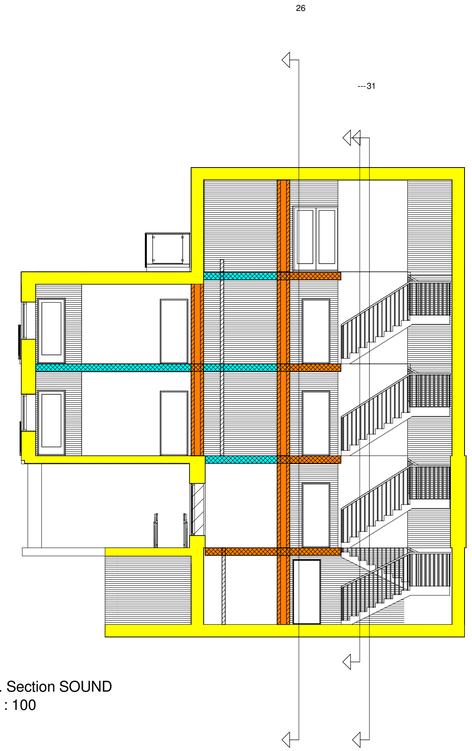
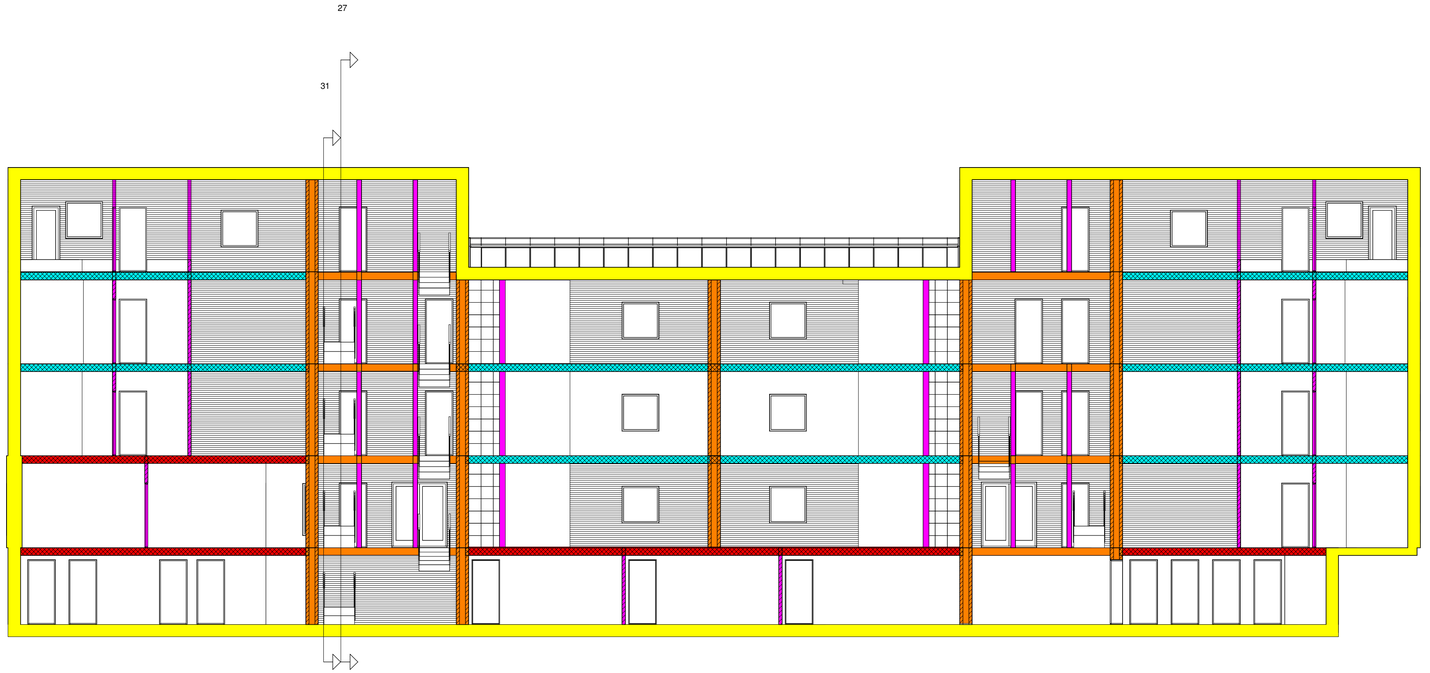
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/16/15	30
SUBJECT: 3. Sound analysis	SCALE: 1 : 100	
DRAWN BY: a LIUWSIIIa LI*GII	CLASS: 4thSemAH42	



1. Section SOUND
1 : 100



2. Section SOUND
1 : 100

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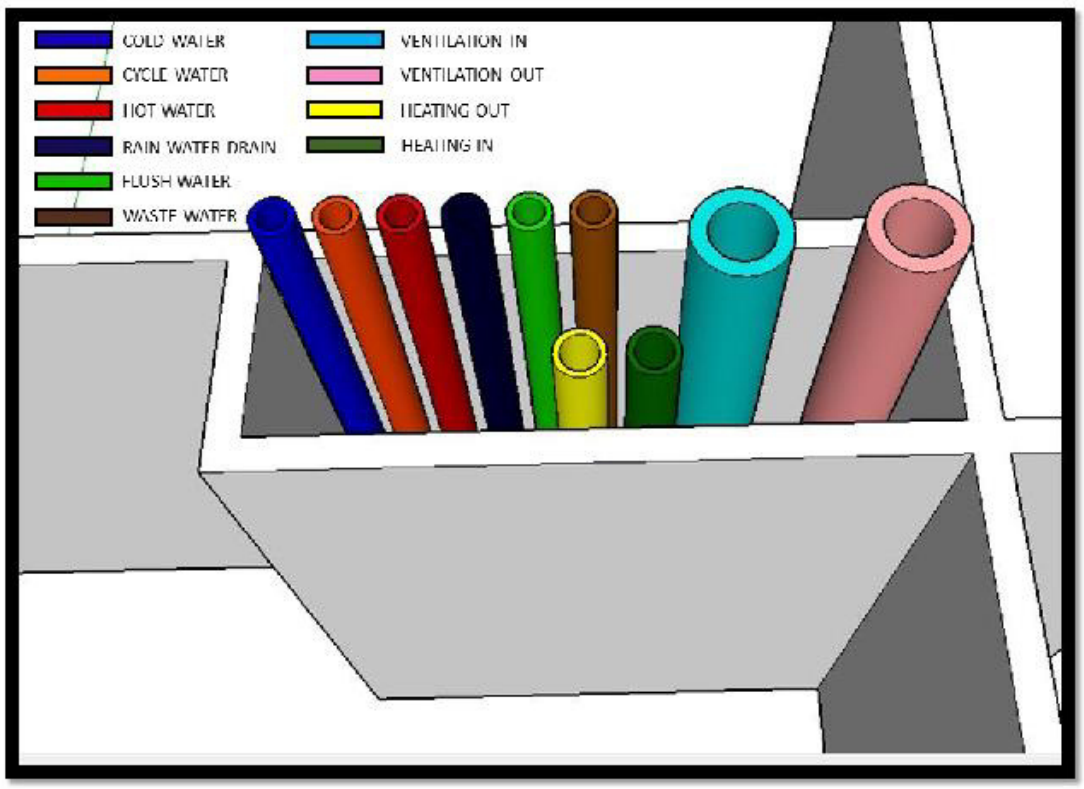
TYPE CITY

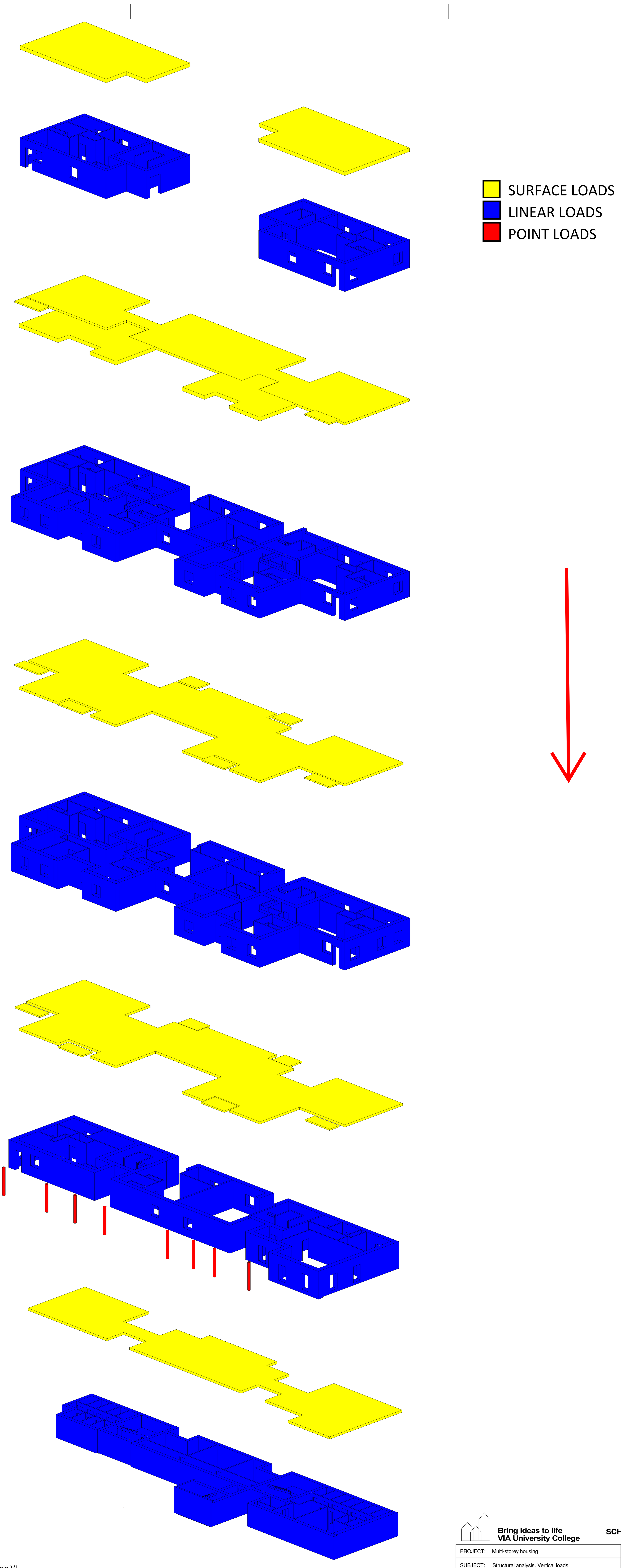
PROJECT: Multi-storey housing	DATE: 04/16/15	
SUBJECT: 4. Sound analysis	SCALE: 1 : 100	31
DRAWN BY: a LNLWSLITa LNGI	CLASS: 4thSemAH42	

1.3.3. Installations shaft



1.4. STRUCTURAL DESIGN

1.4.1. Structural analysis



3D Structural analysis VL

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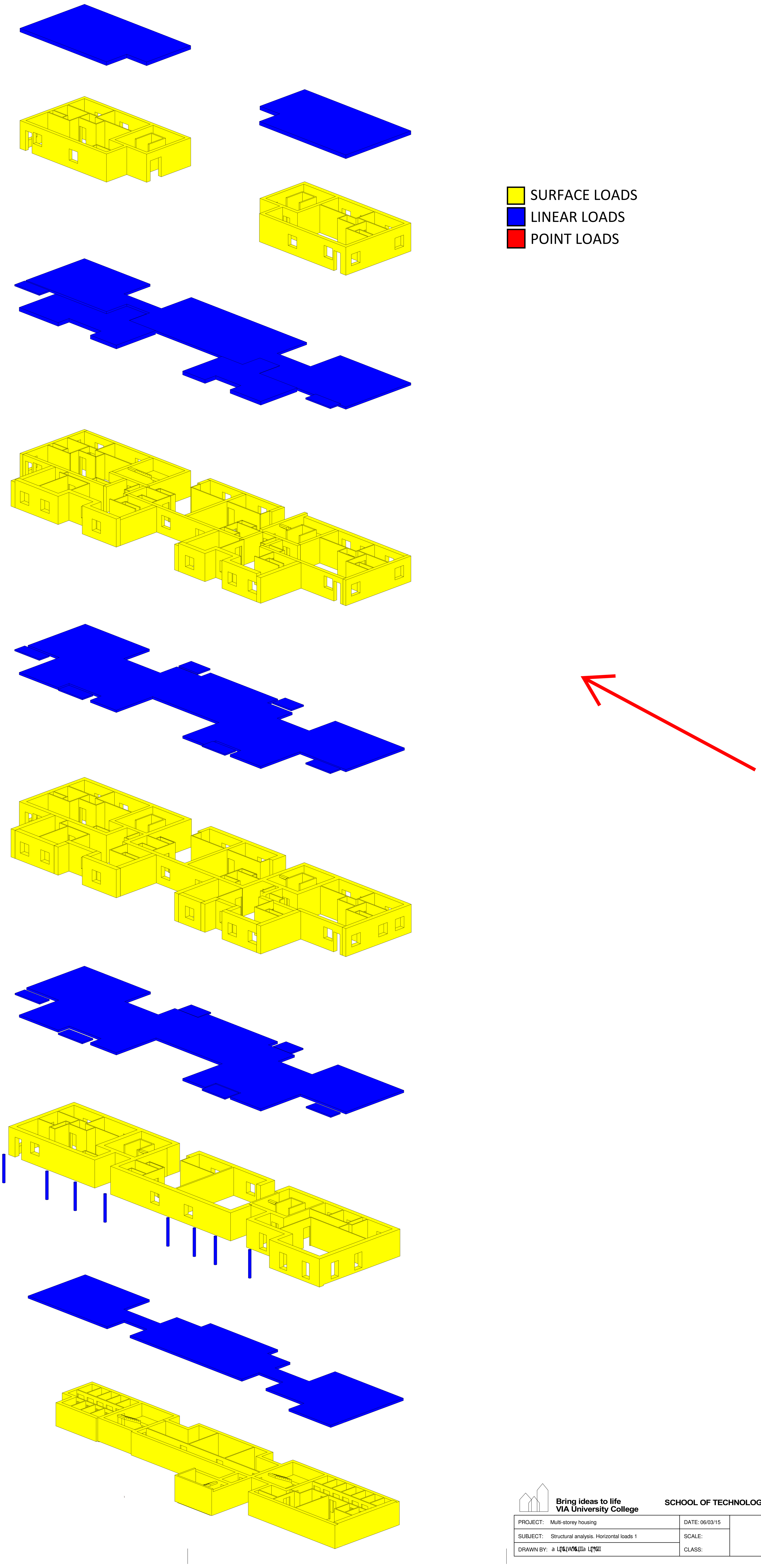
TYPE CITY

PROJECT: Multi-storey housing	DATE: 06/02/15	38
SUBJECT: Structural analysis. Vertical loads	SCALE:	
DRAWN BY: [illegible]	CLASS:	



40

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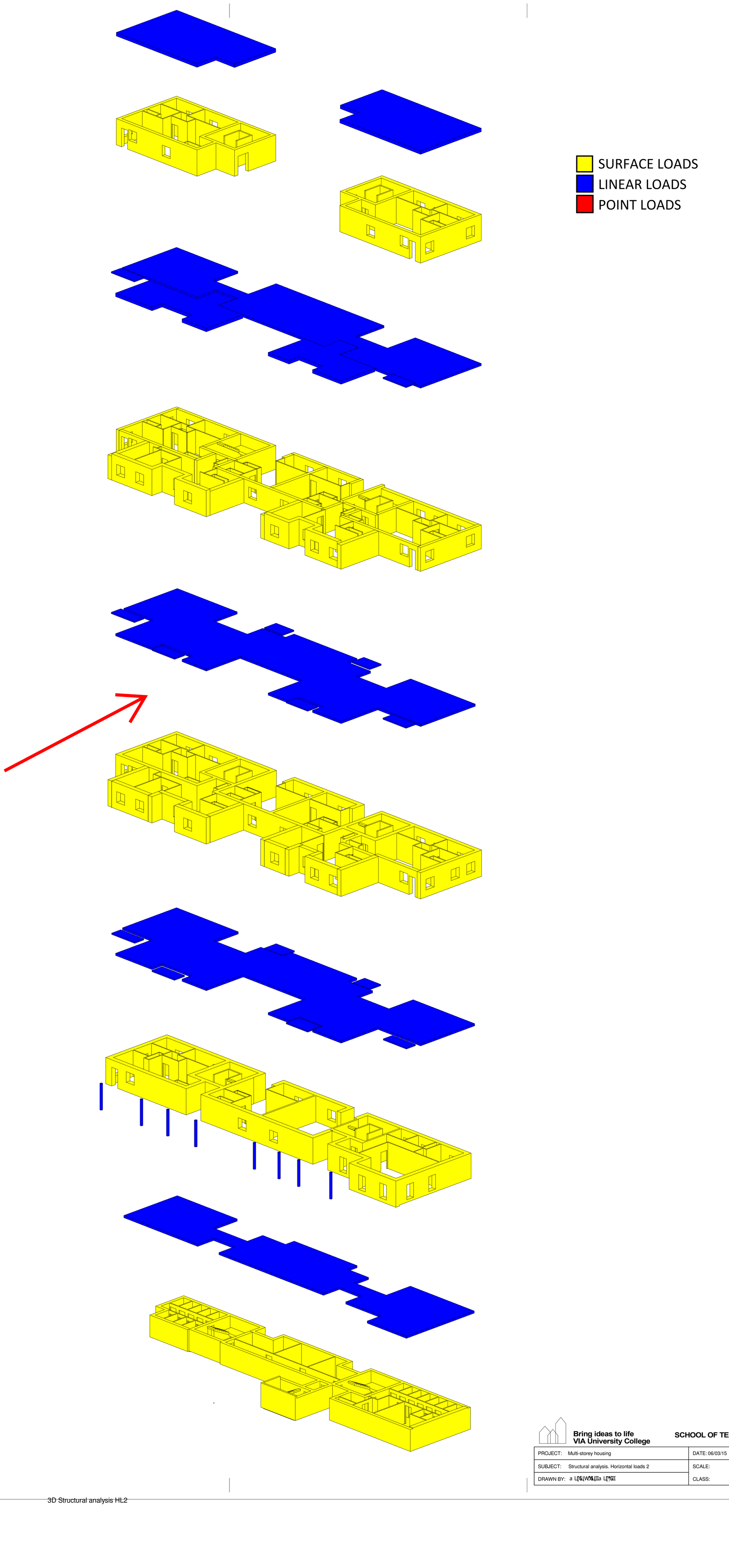
TYPE CITY

PROJECT: Multi-storey housing	DATE: 06/03/15	40
SUBJECT: Structural analysis. Horizontal loads 1	SCALE:	
DRAWN BY: [illegible]	CLASS:	

3D Structural analysis HL1



3D Structural analysis HL2

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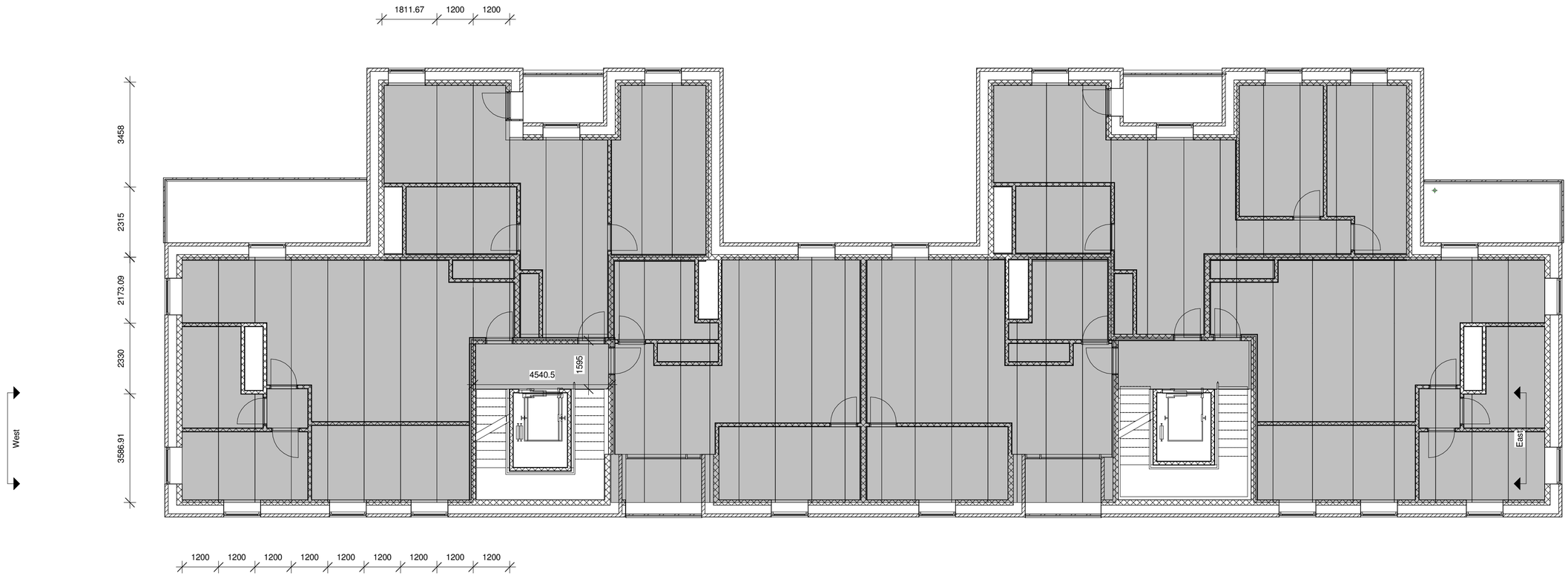
TYPE CITY

PROJECT: Multi-storey housing	DATE: 06/03/15	41
SUBJECT: Structural analysis. Horizontal loads 2	SCALE:	
DRAWN BY: a L[0LW%LIIa L[^CI	CLASS:	

1.4.2. Deck elements plan



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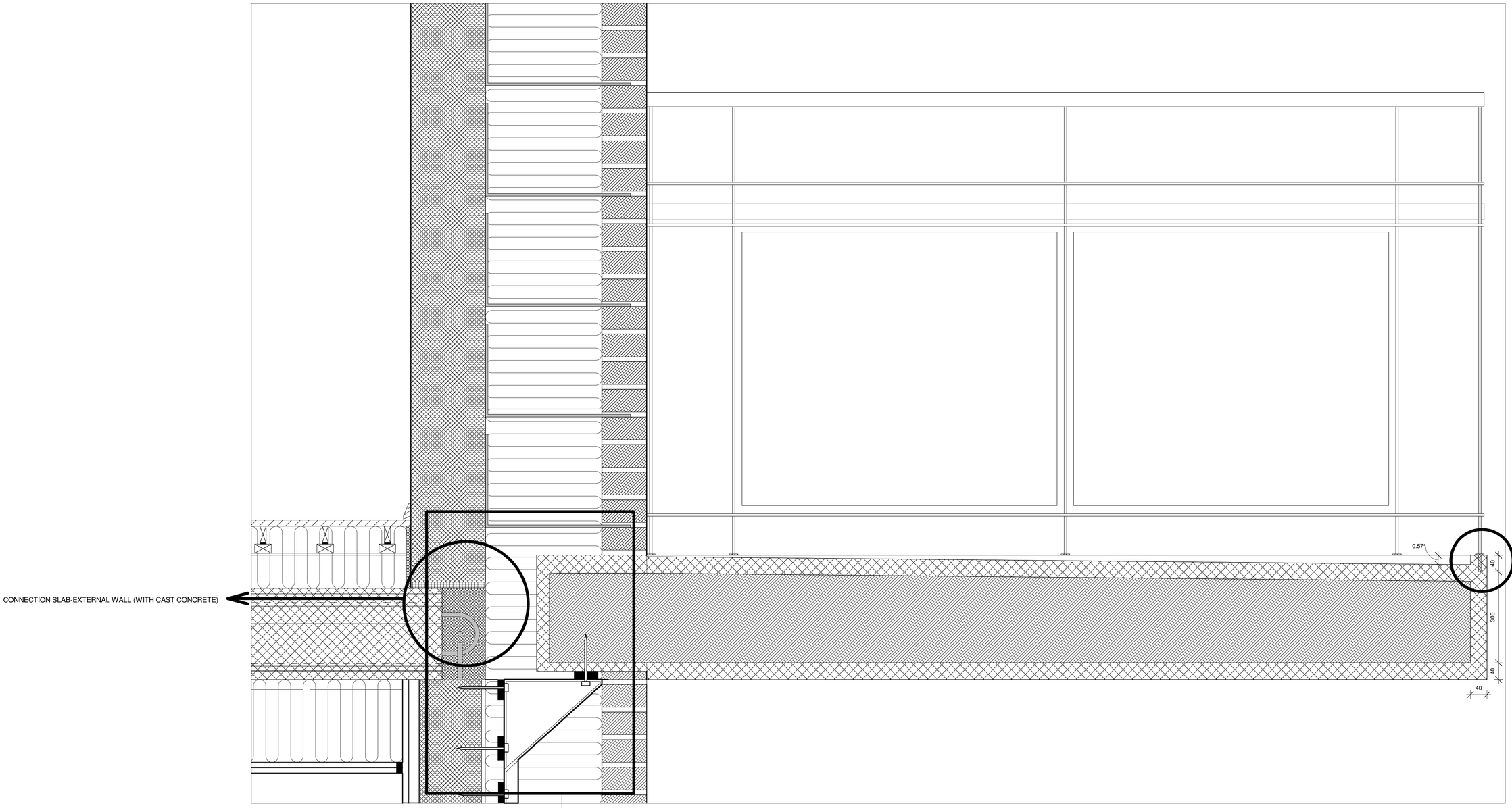
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 05/15/15	K01_TXX_H7_EX_N17
SUBJECT: Deck elements plan	SCALE: 1 : 100	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	

2. ANEXO 2 (SCHEME DESIGN)

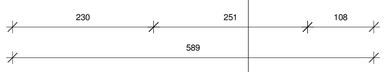
2.1. BUILDING DESIGN

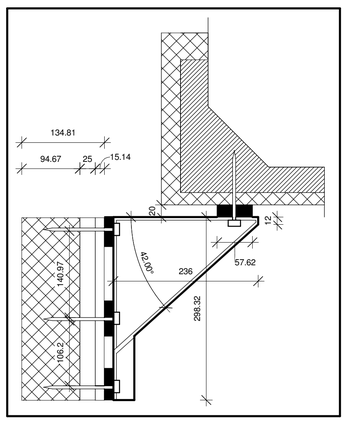
2.1.1. Details



K01_TXX_H7_EX_N06

Connection balconies-rail-ext.wall.
1 : 5





CONNECTION BETWEEN BALCONY AND EXTERNAL LOAD-BEARING WALL WITH STEEL PROFILE

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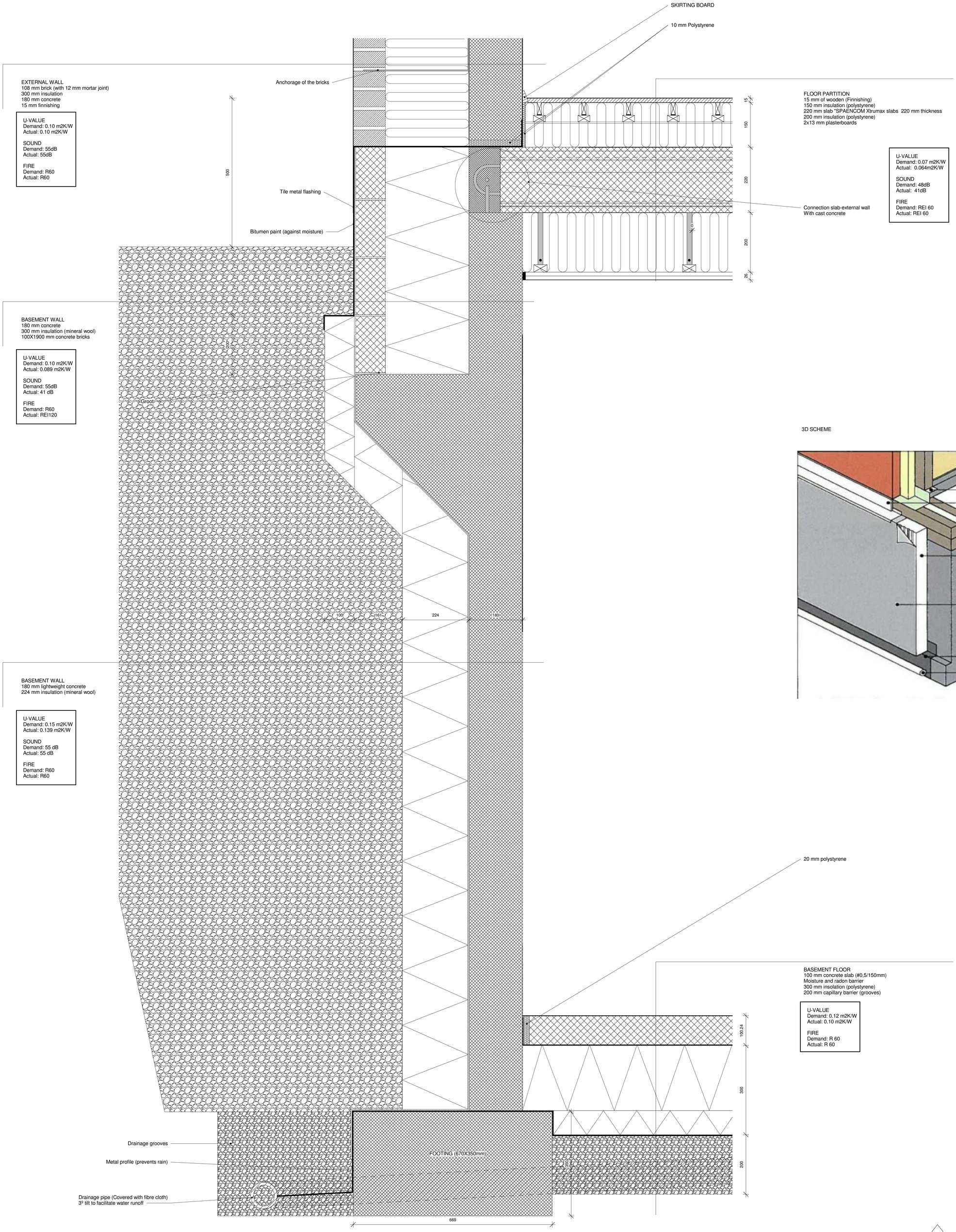
SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/15/15	K01_TXX_H7_EX_N06
SUBJECT: Detail balcony - external wall	SCALE: 1 : 5	
DRAWN BY: a L[t1LW%LIIa L[^GI	CLASS: AH42S15	



EXTERNAL WALL
108 mm brick (with 12 mm mortar joint)
300 mm insulation
180 mm concrete
15 mm finnishing

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.10 m2K/W

SOUND
Demand: 55dB
Actual: 55dB

FIRE
Demand: R60
Actual: R60

BASEMENT WALL
180 mm concrete
300 mm insulation (mineral wool)
100X1900 mm concrete bricks

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.089 m2K/W

SOUND
Demand: 55dB
Actual: 41 dB

FIRE
Demand: R60
Actual: REI120

BASEMENT WALL
180 mm lightweight concrete
224 mm insulation (mineral wool)

U-VALUE
Demand: 0.15 m2K/W
Actual: 0.139 m2K/W

SOUND
Demand: 55 dB
Actual: 55 dB

FIRE
Demand: R60
Actual: R60

FLOOR PARTITION
15 mm of wooden (Finnishing)
150 mm insulation (polystyrene)
220 mm slab "SPAENCOM Xtrumax slabs 220 mm thickness
200 mm insulation (polystyrene)
2x13 mm plasterboards

U-VALUE
Demand: 0.07 m2K/W
Actual: 0.064m2K/W

SOUND
Demand: 48dB
Actual: 41dB

FIRE
Demand: REI 60
Actual: REI 60

BASEMENT FLOOR
100 mm concrete slab (#0,5/150mm)
Moisture and radon barrier
300 mm insolation (polystyrene)
200 mm capillary barrier (grooves)

U-VALUE
Demand: 0.12 m2K/W
Actual: 0.10 m2K/W

FIRE
Demand: R 60
Actual: R 60

Connection basement wall-foundation.
1 : 5

3D SCHEME

K01_TXX_H7_EX_N07

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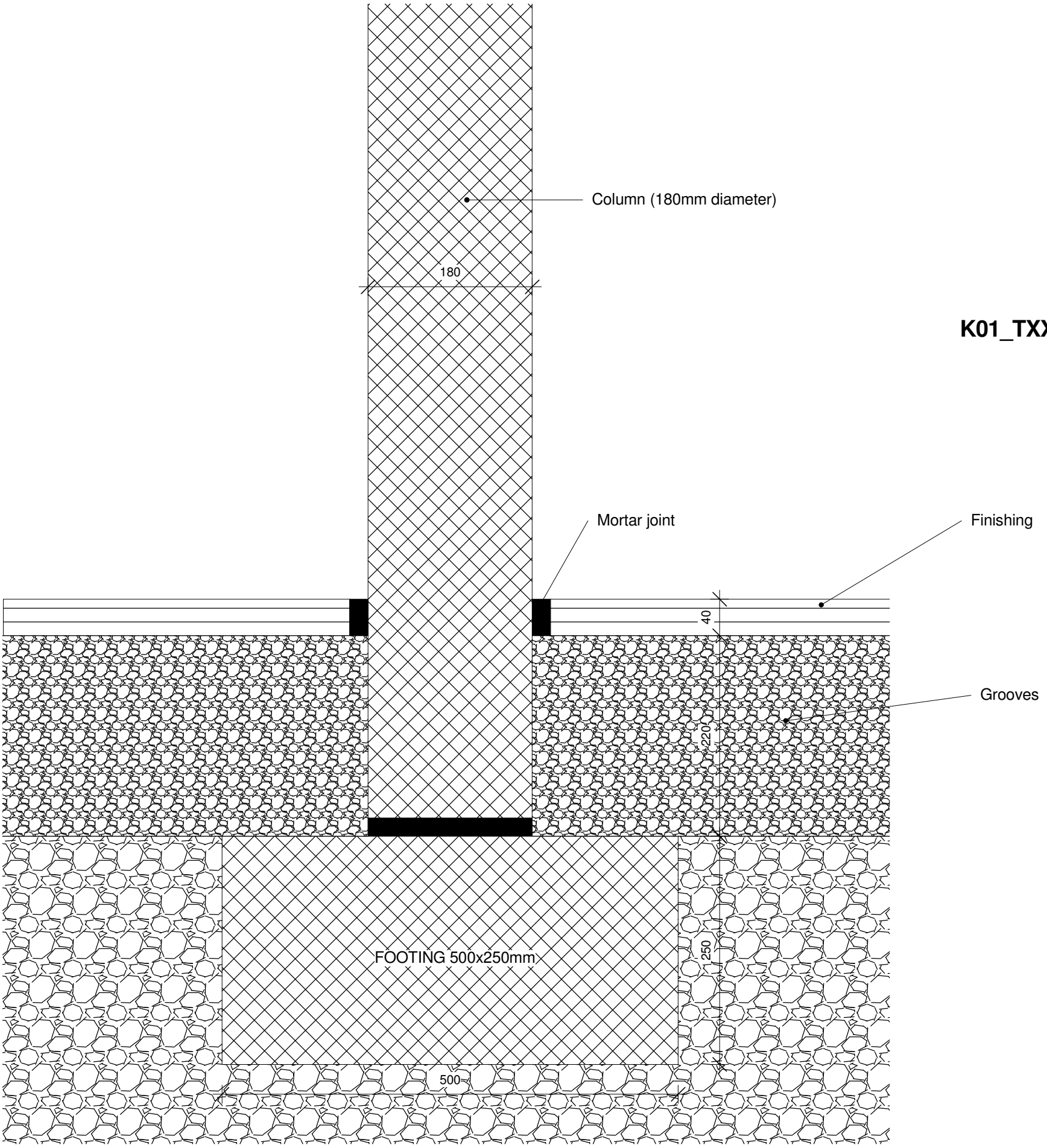
SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 25/05/15	K01_TXX_H7_EX_N07
SUBJECT: Detail Basement wall - foundation	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	



Connection column-foundation.
1 : 5

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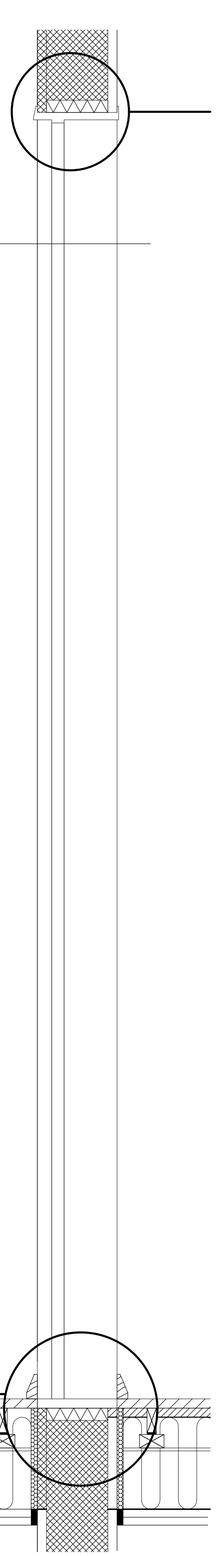
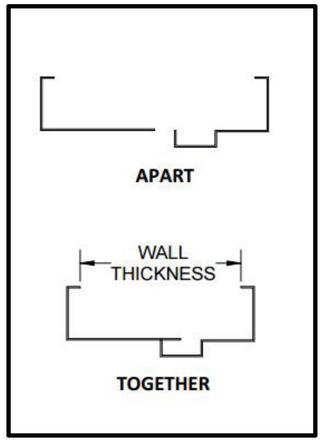
TYPE CITY

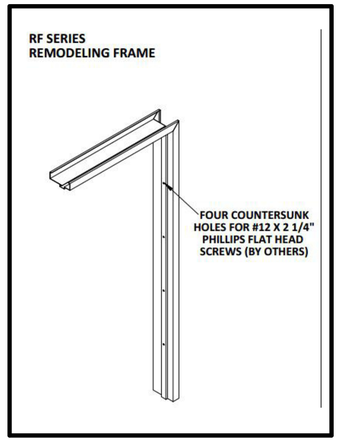
PROJECT: MULTI-STOREY HOUSING	DATE: 06/14/15	**K01_TXX_H7_EX_N10**
SUBJECT: Detail column - foundation	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	

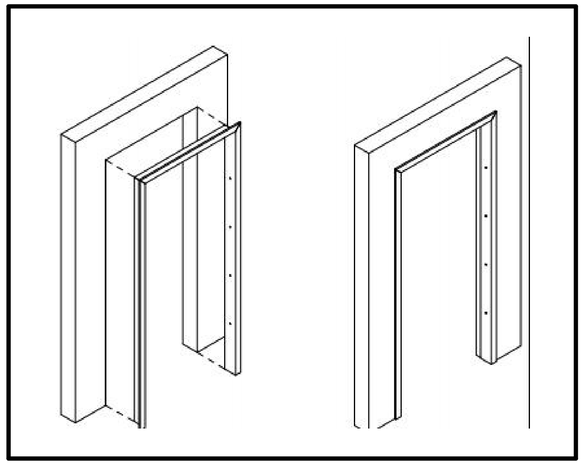


U-VALUE

FIRE:
Demand: BS-30 EI2 30-C
Actual: BS-30 EI2 30-C







K01_TXX_H7_EX_N13

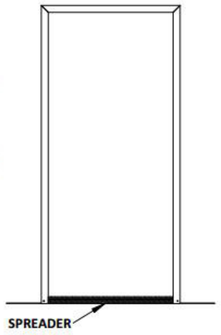
STEEL STUD WALL CONSTRUCTION

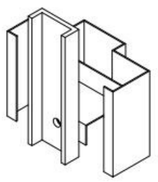
(1) INSTALL MINIMUM OF THREE ANCHORS PER JAMB (BOTH HINGE AND STRIKE). POSITION ANCHORS IN FRAME THROUGH THE THROAT AND TAP ON WITH A HAMMER OR USE WELDED IN Z ANCHOR. FOUR ANCHORS PER JAMB LEG OVER 7'0" HEIGHT.

(2) SQUARE, BRACE, AND PLUMB FRAME AS SHOWN.

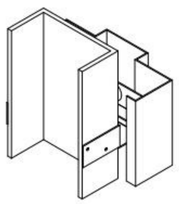
(3) SET SPREADER. ATTACH JAMBS TO FLOOR THROUGH FLOOR ANCHOR OR FLOOR EXTENSION. INSTALL JAMB STUDS TO FLOOR AND CEILING RUNNERS AND TIGHTLY AGAINST FRAME ANCHORS.

(4) ATTACH STUDS TO FRAME ANCHORS AS SHOWN.

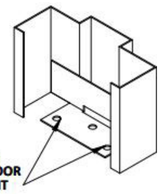




STEEL STUD ANCHOR
Z ANCHOR
CENTER STUDS IN FRAME THROAT OR AS DESIRED AND ATTACH TO ANCHORS WITH SCREWS.

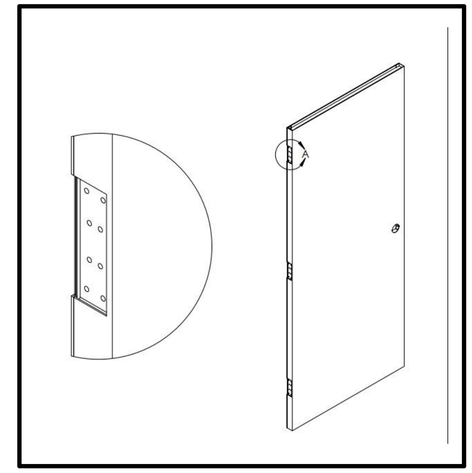


STEEL STUD ANCHOR
UNA ANCHOR



SILL ANCHOR

Connection wall-door-floor.
1 : 5



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TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/15/15	K01_TXX_H7_EX_N13
SUBJECT: Detail door - wall	SCALE: 1 : 5	
DRAWN BY: a LT[LW5LIIa LT^QI	CLASS: AH42S15	

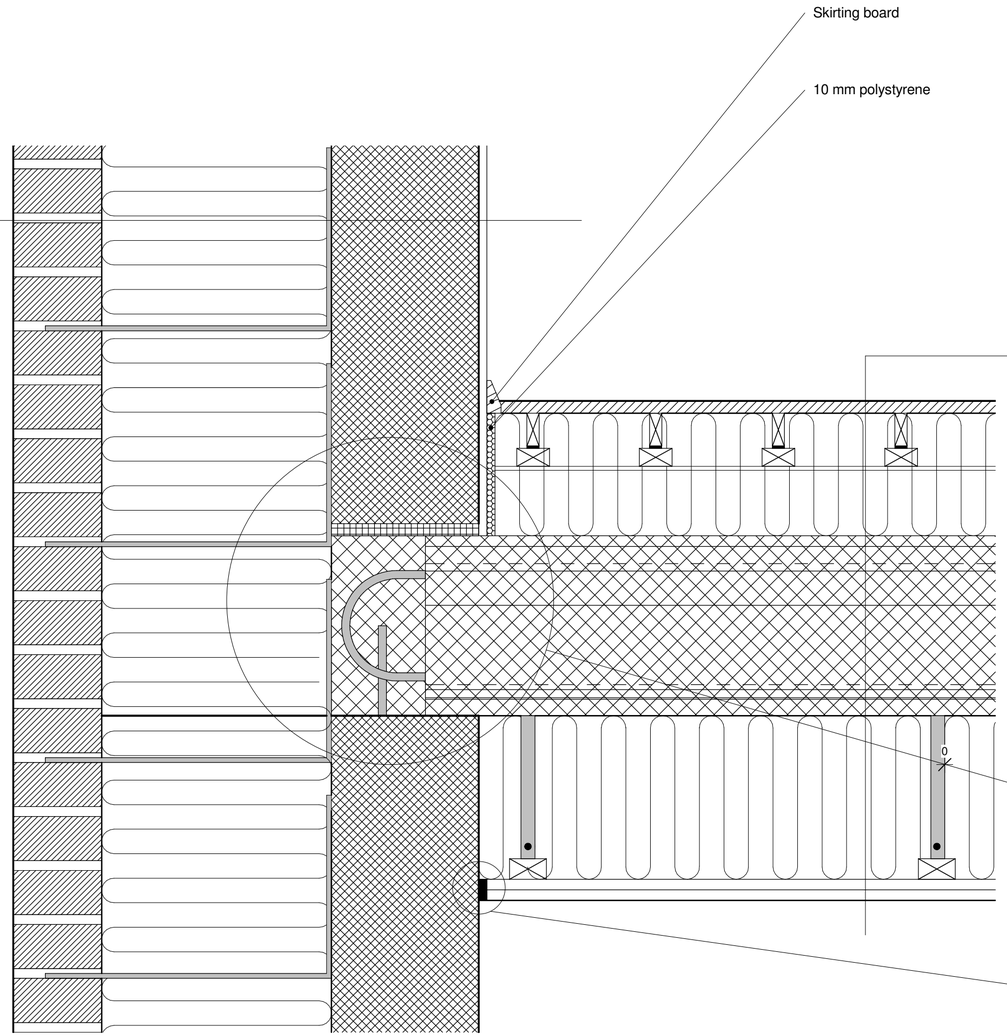
K01_TXX_H7_EX_N04

EXTERNAL WALL
108 mm brick (with 12 mm mortar joint)
300 mm insulation
180 mm concrete
15 mm finnishing

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.10 m2K/W

SOUND
Demand: 55dB
Actual: 55dB

FIRE
Demand: R60
Actual: R60



FLOOR PARTITION
15 mm of wooden (Finnishing)
150 mm insulation (polystyrene)
220 mm slab "SPAENCOM Xtrumax slabs 220 mm thickness
200 mm insulation (polystyrene)
2x13 mm plasterboards

U-VALUE
Demand: 0.07 m2K/W
Actual: 0.064m2K/W

SOUND
Demand: 48dB
Actual: 41dB

FIRE
Demand: REI 60
Actual: REI 60

Connection external wall-floor & external wall-ceiling.
1 : 5

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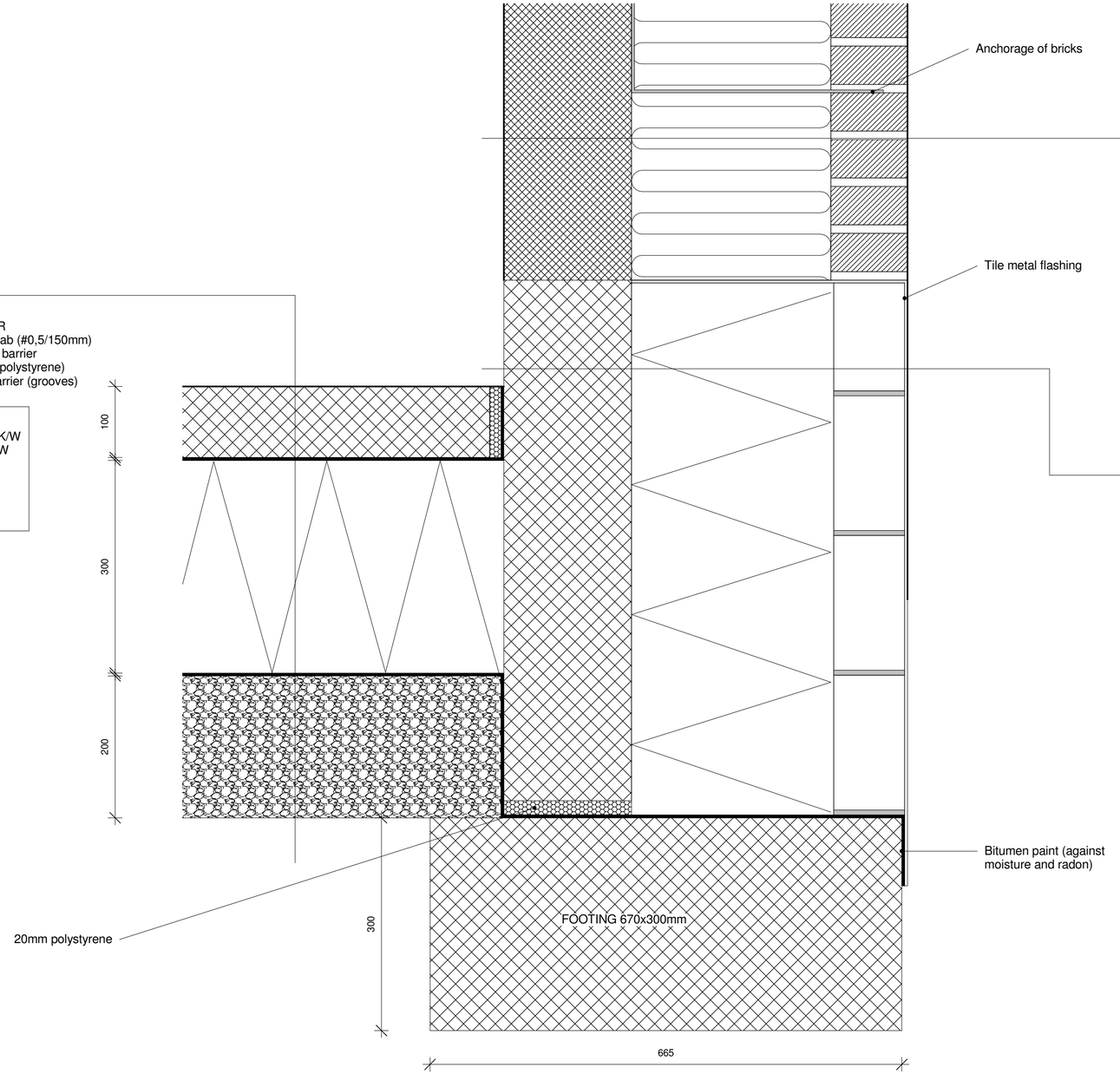
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/13/15	**K01_TXX_H7_EX_N04**
SUBJECT: Detail external wall - floor partition	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	



EXTERNAL WALL
108 mm brick (with 12 mm mortar joint)
300 mm insulation
180 mm concrete
15 mm finnishing

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.10 m2K/W

SOUND
Demand: 55dB
Actual: 55dB

FIRE
Demand: R60
Actual: R60

K01_TXX_H7_EX_N09

BASEMENT WALL
180 mm concrete
300 mm insulation (mineral wool)
100X1900 mm concrete bricks

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.089 m2K/W

SOUND
Demand: 55dB
Actual: 41 dB

FIRE
Demand: R60
Actual: REI120

Connection external wall-foundation.
1 : 5

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TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/14/15	**K01_TXX_H7_EX_N09**
SUBJECT: Detail external wall - foundation	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	

U-VALUE
Demand: 0.10 m2K/W
Actual: 0.10 m2K/W

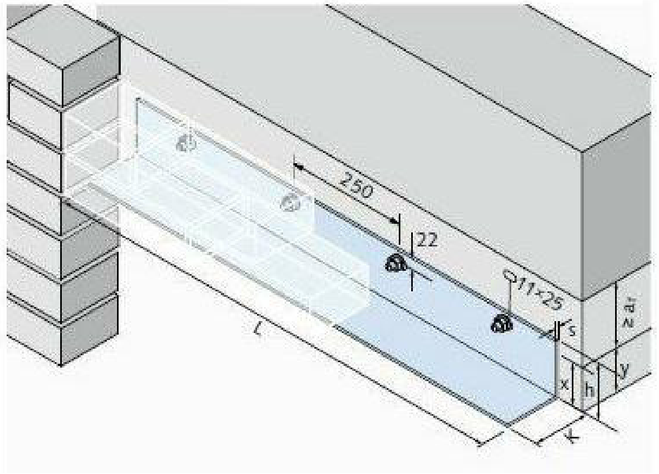
SOUND
Demand: 55dB
Actual: 55 dB

FIRE
Demand: R 60
Actual: R 60

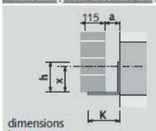
BRICKWORK
Bricks "Rockwool-moroccan sand" 108x228x54 mm

Moroccan sand

STEEL PROFILE



Selecting KW Bolt-on angle



dimensions in mm

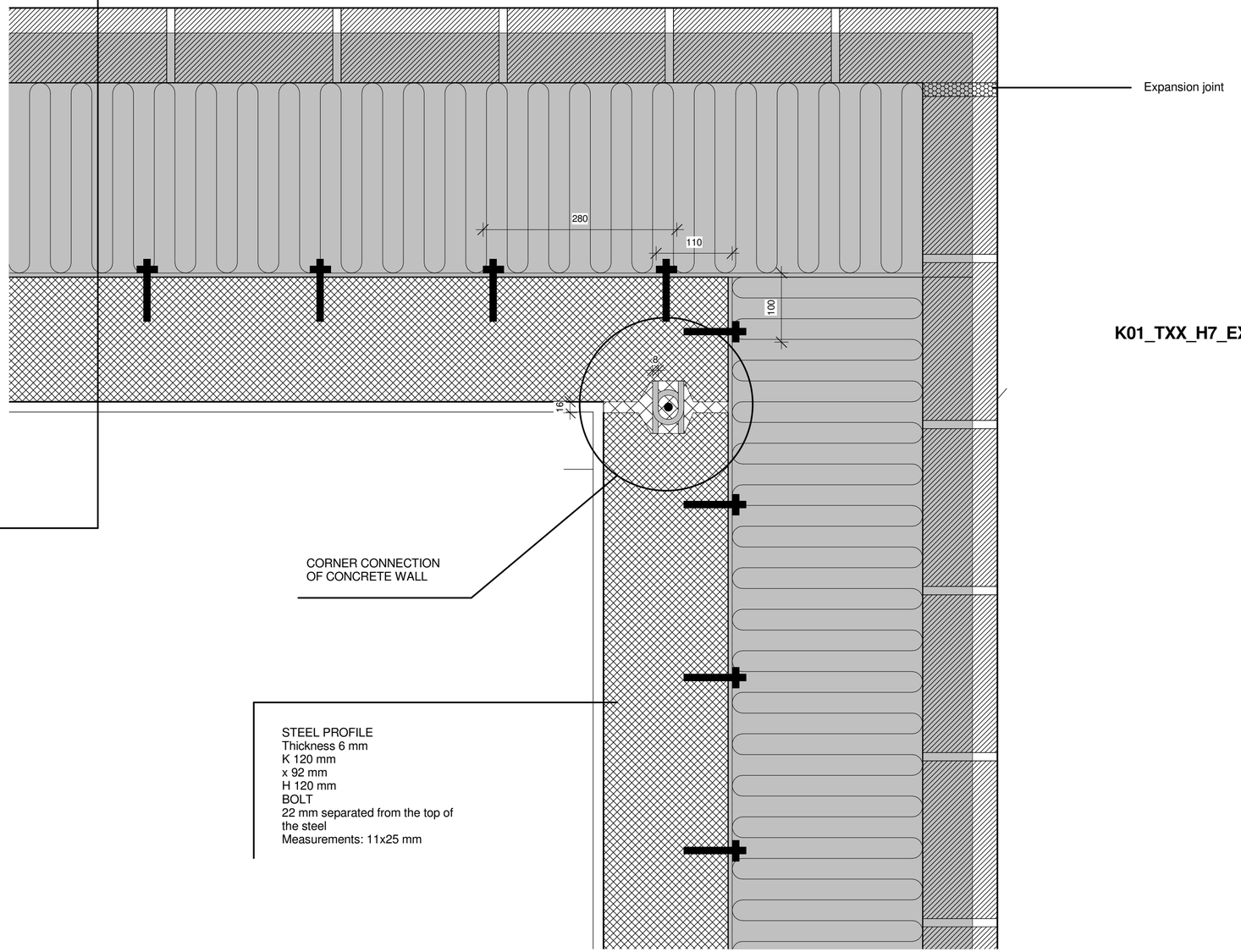
spacing a from wall [mm]	allowable load Fv = 1.2 kN② (FRd = 1.6 kN)			allowable load Fv = 2.1 kN② (FRd = 2,8 kN)			allowable load Fv = 3.2 kN② (FRd = 4.3 kN)		
	length K	x	h	length K	x	h	length K	x	h
10 - 20	**100**	74	100	**100**	72	100	**100**	70	100
30 - 40	**120**	94	120	**120**	92	120	**120**	90	120
material thickness s	4			6			8		

① other brick dimensions are also possible
② load range/bolt-on angle

EXTERNAL WALL
108 mm brick (with
12 mm mortar joint)
281 mm insulation
180 mm concrete
15 mm finnishing

CORNER CONNECTION
OF CONCRETE WALL

STEEL PROFILE
Thickness 6 mm
K 120 mm
x 92 mm
H 120 mm
BOLT
22 mm separated from the top of
the steel
Measurements: 11x25 mm



Connection external wall corner
1 : 5

K01_TXX_H7_EX_N03

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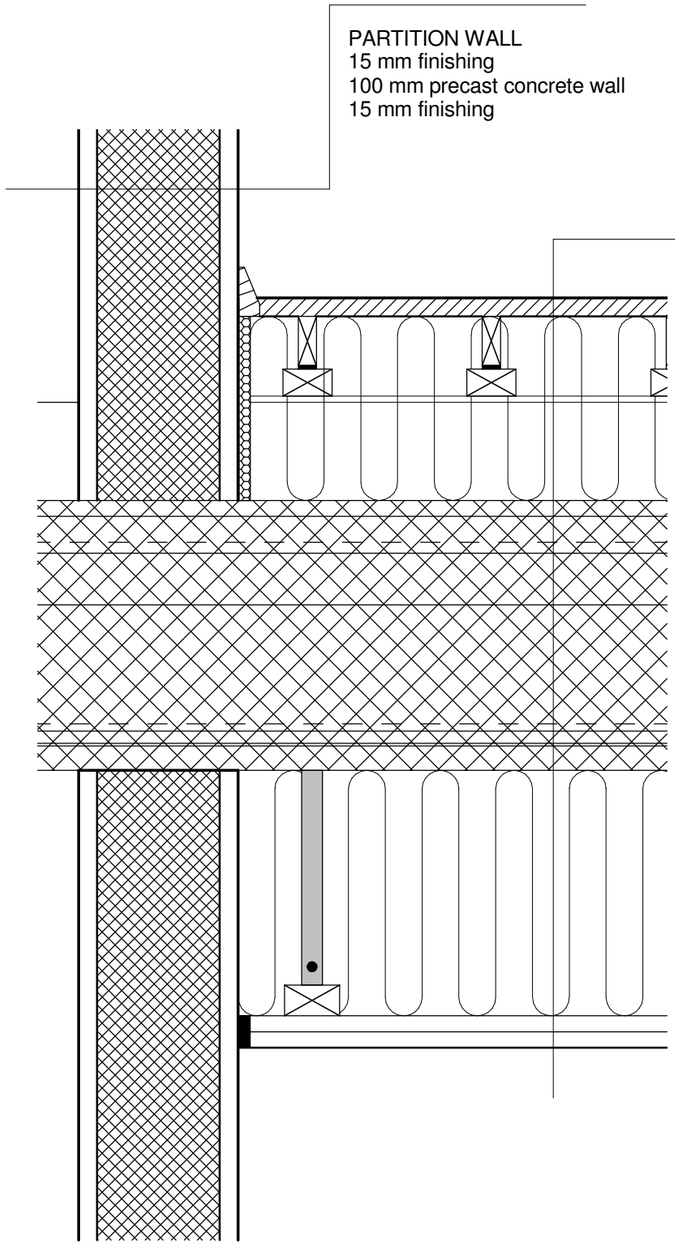
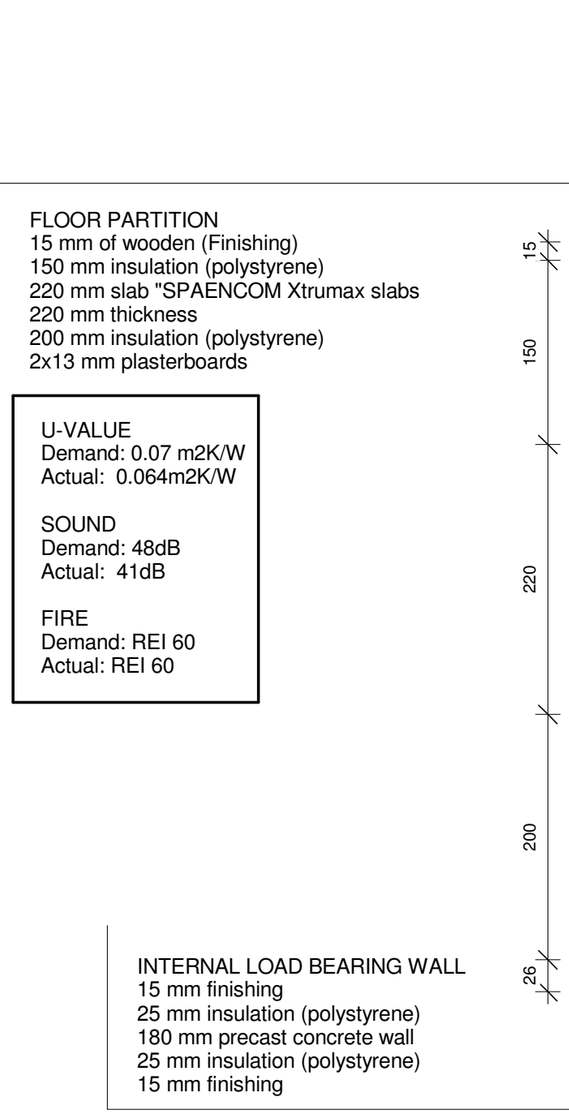
TYPE CITY

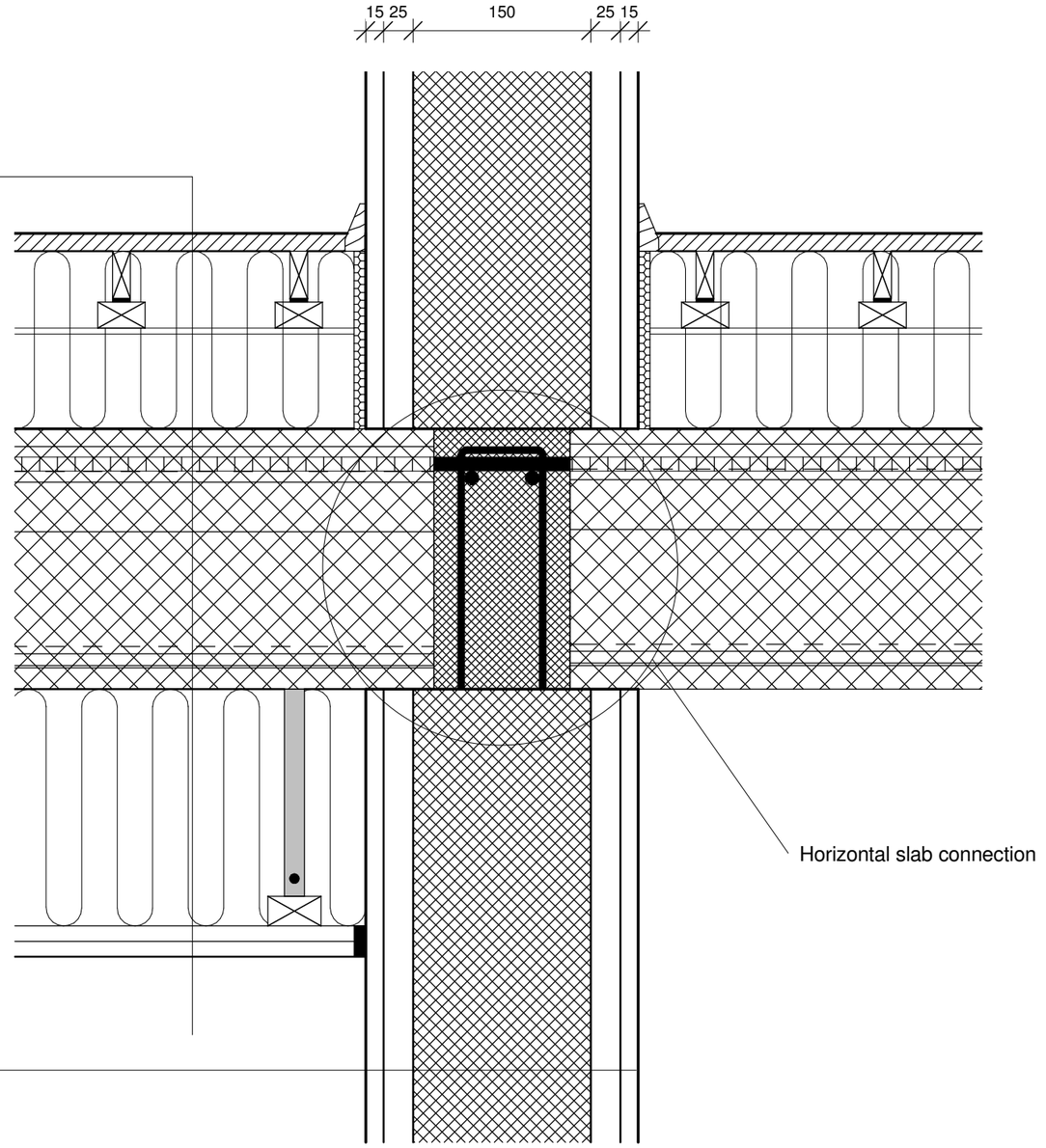
PROJECT: MULTI-STOREY HOUSING	DATE: 06/12/15	**K01_TXX_H7_EX_N03**
SUBJECT: Detail external wall corner	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	



Connection wall-ceiling.
1 : 5

wall-floor & partition





Connection internal load bearing wall- floor partition.
1 : 5

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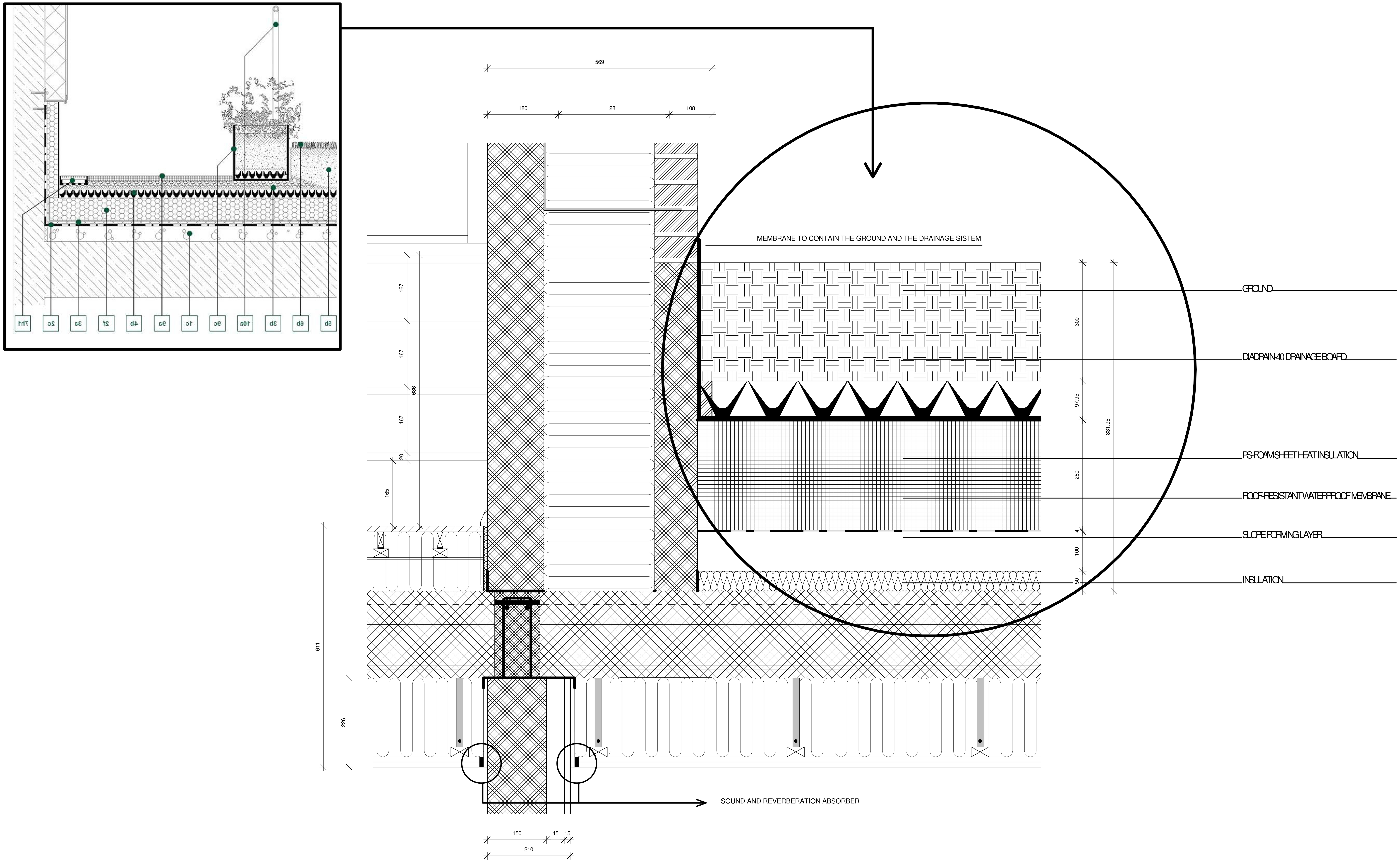
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/13/15	**K01_TXX_H7_EX_N05**
SUBJECT: Details internal walls-floor partition	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	



K01_TXX_H7_EX_N12

Connection green roof-external wall
1 : 5

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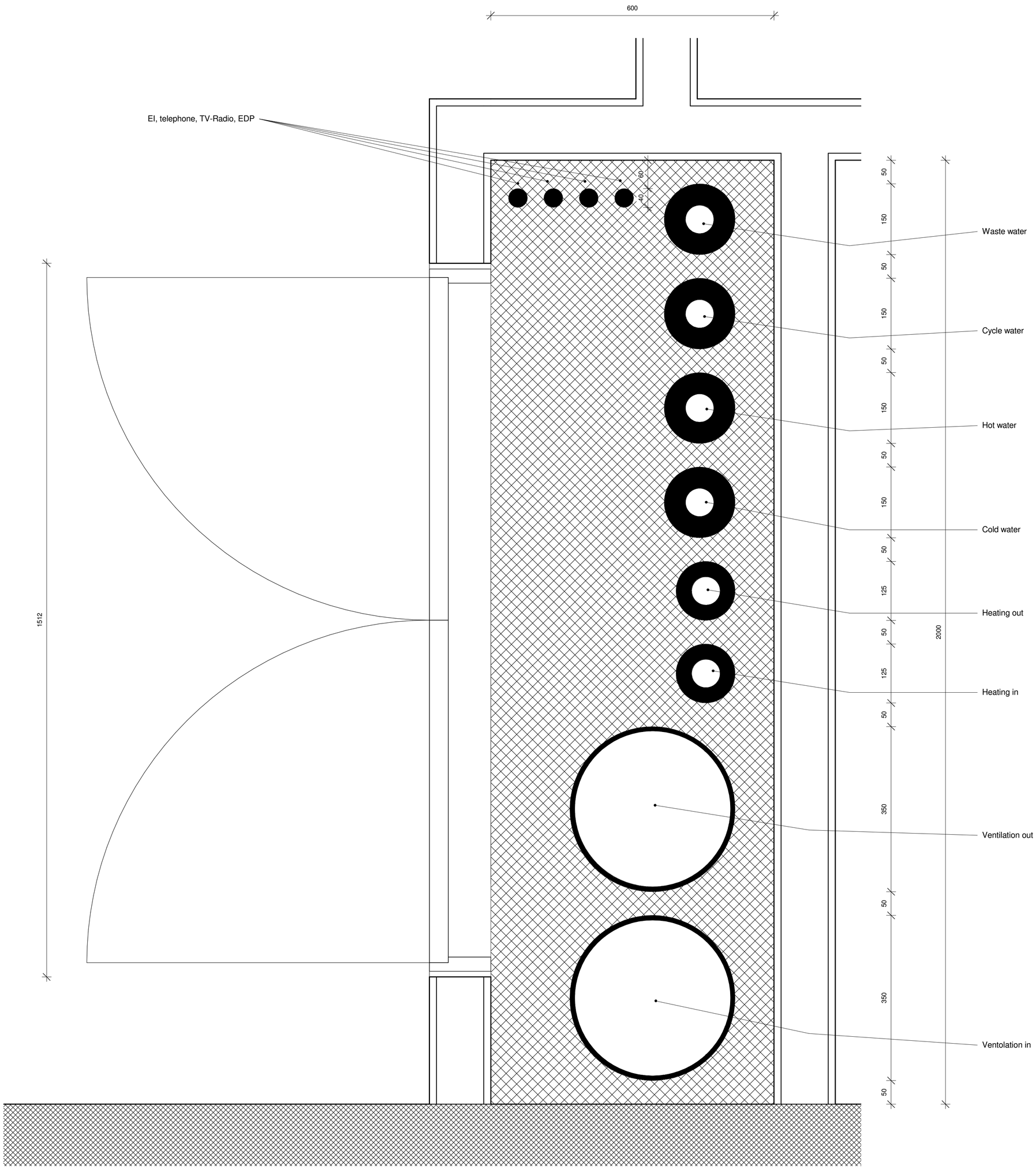
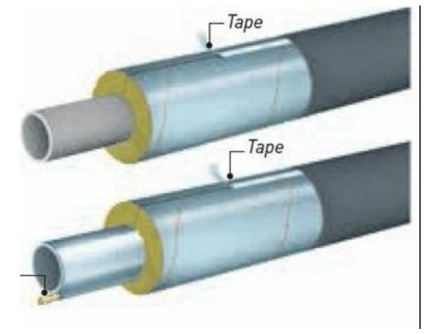
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/15/15	K01_TXX_H7_EX_N12
SUBJECT: Detail green roof - wall	SCALE: 1 : 5	
DRAWN BY: [illegible]	CLASS: AH42S15	

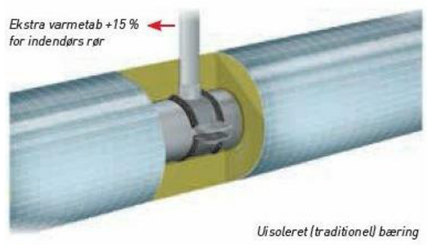


Detail shaft.
1 : 5

COLD WATER INSULATION



HOT WATER INSULATION



VENTILATION INSULATION

K01_TXX_H7_EX_N08

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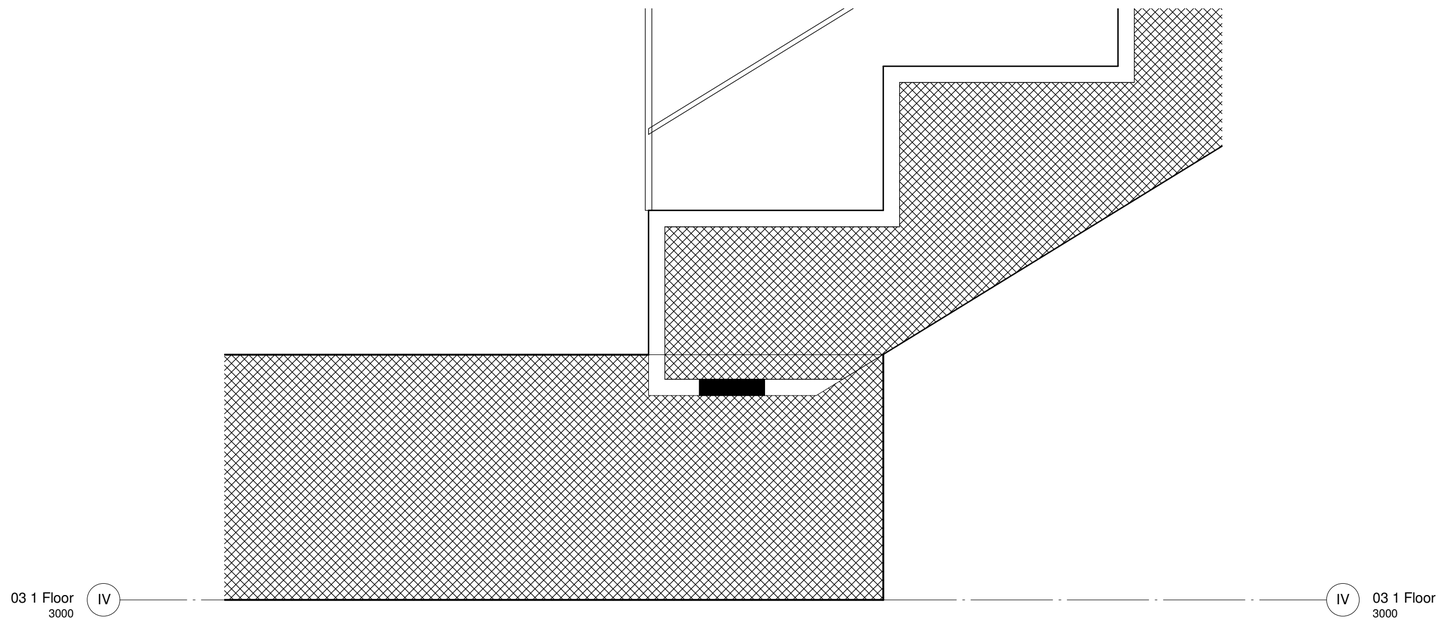
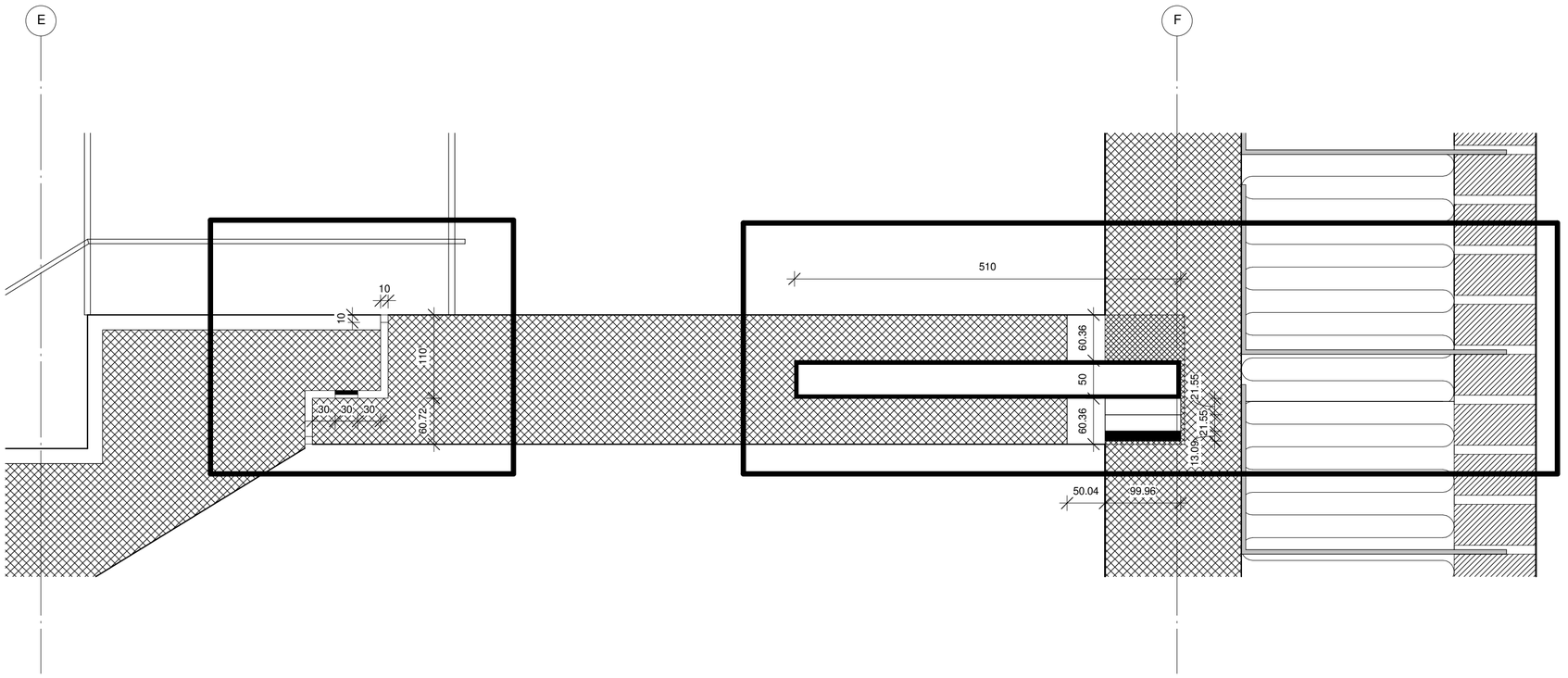
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/14/15	**K01_TXX_H7_EX_N08**
SUBJECT: Detail - Shaft	SCALE: 1 : 5	
DRAWN BY: Maria Julian Martin	CLASS: AH42S15	



Connection stair - floor
1 : 5



Connection stair - landing - ext. wall
1 : 5

K01_TXX_H7_EX_N14

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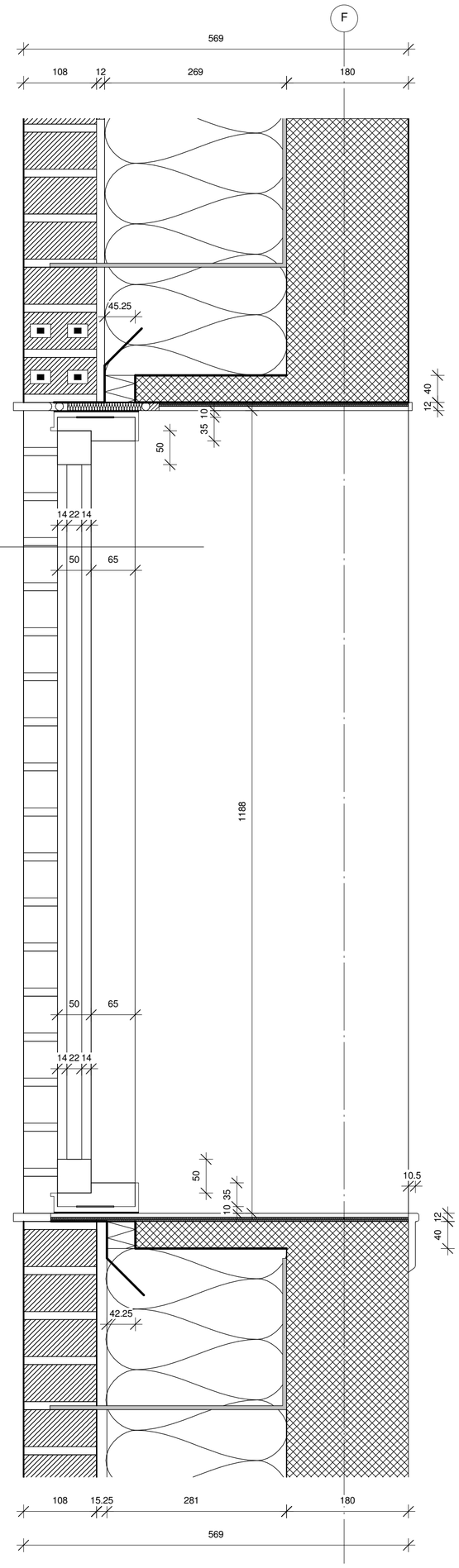
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/15/15	K01_TXX_H7_EX_N14
SUBJECT: Detail Staircase - floor - wall	SCALE: 1 : 5	
DRAWN BY: a LIQLWXQLIa LIQI	CLASS: AH42S15	



U-VALUE

BE 2015: 0.98 m2K/W
Actual: 0.98 m2K/W

Connection window-wall
1 : 5

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TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/15/15	**K01_TXX_H7_EX_N11**
SUBJECT: Detail window - wall	SCALE: 1 : 5	
DRAWN BY: [illegible]	CLASS: AH42S15	

2.2. BUILDING AND PLANNING MANAGEMENT

2.2.1. Building Component Analysis

Building component analysis - Anchors brickwork

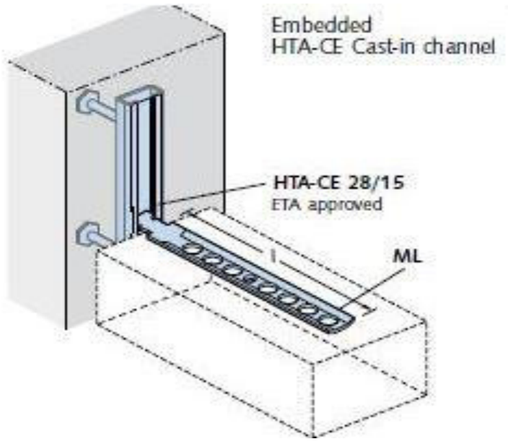
Name: Maria Julian Martin

Class: AH-42 S15 Group6

BR demand:

Subject: External walls

HALFEN Brick Tie Anchor System ML

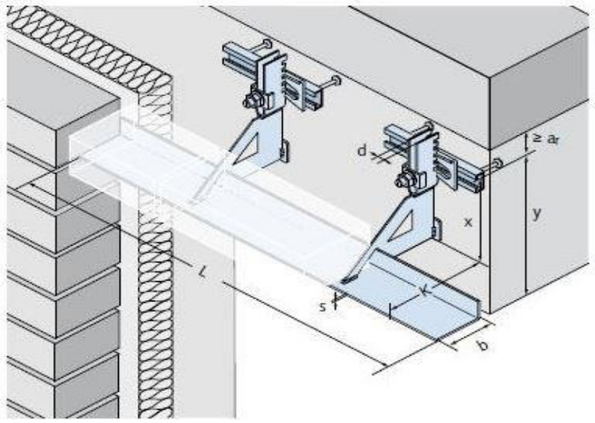


Fire	Sound	U-value	Date: 20/05/2015	👎	👍	👌
-	-	-	Appearance:		X	
			Life expectancy:		X	
			Execution (of work):	X		
Actual:						
			Operation &maintenance:		X	
-	-	-	Price:	X		
			Environmental compatibility:		X	

Remarks:

- HALFEN brick tie anchors ML are tried and tested efficient installlation systems for securing brick walls, masonry in fills, partition walls, brick renders to concrete walls, concrete supports, steel or wooden structures.
- They are able to move freely in the brick tie channels considerably reducing cracks caused by masonry settlement.
- the profiles have a "Haropor" foam filling to prevent concrete ingress. The channels are attached to the concrete using standard nails.
- The HALFEN Bricks tie anchors are inserted at the recomended intervals in the brick wall during the construction. The anchors are inserted in the bricks channels laid flat between the rows of brick and pressed into the mortar. The perforations in the anchors optimise anchorage with the mortar.
- The anchorage to adjacent components (steel reinforced concrete supports or walls) meet the requirements for stability and fire resistance.

Type: HALFEN Continuous HK4-F Angle Support bracket

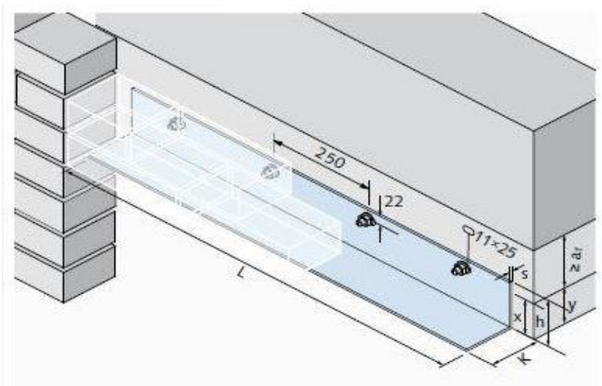


Fire	Sound	U-value	Date: 20/05/2015	👎	👍	👌
-	-	-	Appearance:		X	
			Life expectancy:		X	
			Execution (of work):		X	
Actual:						
			Operation &maintenance:		X	
-	-	-	Price:			X
			Environmental compatibility:		X	

Remarks:

- They are for support of low-height brickwork cladding (parapets above window openings; allows larger brackets spacing)
- Support the brick work while work is in progress until sufficient stability has been reached to avoid excessive defflection of the angle support bracket.
- Brick have to be suitable for application in soldier courses (rough surfaces)

Type: HALFEN KW Bolt-on angle



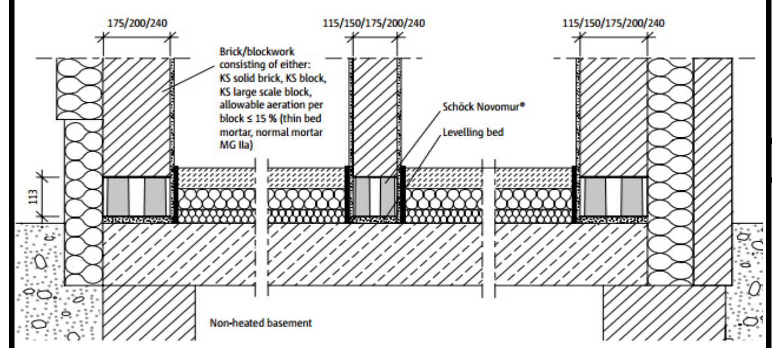
Fire	Sound	U-value	Date: 20/05/2015	👎	👍	👌
-	-	-	Appearance:			X
			Life expectancy:		X	
			Execution (of work):			X
Actual:						
			Operation &maintenance:			X
-	-	-	Price:		X	
			Environmental compatibility:		X	

Remarks:

- The KW bolt-on angle provide a simple alternative for supporting continuous brick veneer. They are used when the suppory structure is intended to remain visible from below but the ventilation gap and the thermal insulation are to be concealed.

Building component analyses

Type: Schöck Novomur



BR demand:			Subject:	Balcony		
Fire	Sound	U-value	Date: 19/09/2014	D	C	B
			Appearance:			X
			Life expectancy:			X
			Execution (of work):		X	
Actual:			Operation &maintenance:		X	
			Price:		X	
			Environmental compatibility:		X	

file:///C:/Users/231622/Downloads/Technical_Information_Schoeck_Novomur_

Name: [illegible]

Class: AH-42 S15 Group6

Remarks:

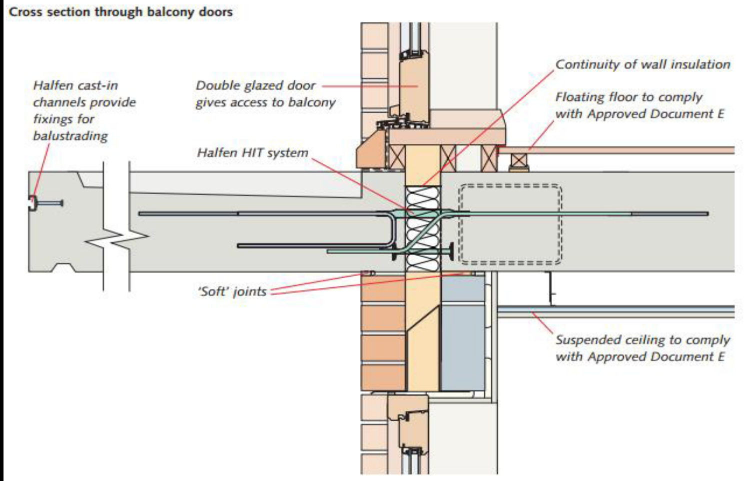
Fire resistance class F 30 and F 90.
No water absorption, w= 0,11 kg$(m^2\ h^{0,5})$. water resistant
Termal characteristic value tested

Schöck Novomur® type	Average thermal conductivity (Novomur®)		Thermal bridge loss coefficient $\psi^{1)}$ (in relation to external dimensions)			Temperature factor f_{RSI} [2)4)] (minimum surface temperature ϑ_{min})[3)]		
	Vertical axis [W/(m·K)]	Horizontal axis [W/(m·K)]	Thermal insulation system[3)] [W/(m·K)]	Double skinned outer wall[3)] [W/(m·K)]	Internal wall [W/(m·K)]	Thermal insulation system[3)]	Double skinned outer wall[3)]	Internal wall
20 - 11,5			-			-		
20 - 15								
20 - 17,5	λ_v = 0,266	λ_h = 0,088	$\psi \le 0{,}144$	$\psi \le 0{,}106$	-	$f_{RSI} \ge 0{,}817$ ($\vartheta_{min} \ge 15{,}4$°C)	$f_{RSI} \ge 0{,}835$ ($\vartheta_{min} \ge 15{,}9$°C)	-
20 - 20								
20 - 24					$\psi = 0{,}185$			$f_{RSI} = 0{,}919$ ($\vartheta_{min} = 18{,}0$°C)

Thermal characteristic values contributed by Prof. Dr. Hauser GmbH, Germany consultant engineers with a wall thickness of 240 mm, basement insulation 115 mm, temperature reduction factor F = 0.5
[1)] where heat transfer resistance outside is R_{se} = 0,04 (m²K)/W and inside is R_{si} = 0,13 (m²K)/W
[2)] $f_{RSI} = (\vartheta_{min} - \vartheta_a)/(\vartheta_i - \vartheta_a)$; where heat transfer resistance outside is R_{se} = 0,04 (m²K)/W and inside is R_{si} = 0,25 (m²K)/W
[3)] where external temperature is ϑ_a = −5°C, inside temperature ϑ_i = +20°C, basement temperature ϑ_k = +10°C
[4)] thermal bridges catalog, Büro für Bauphysik, Hannover

Type:

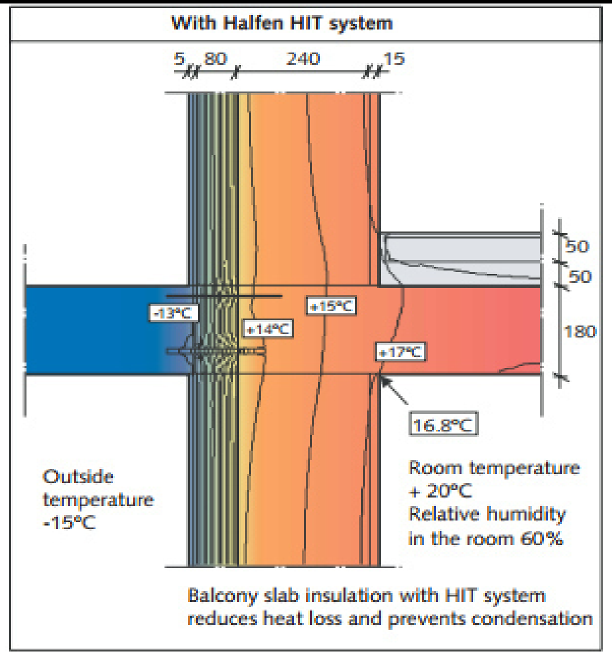
Cross section through balcony doors



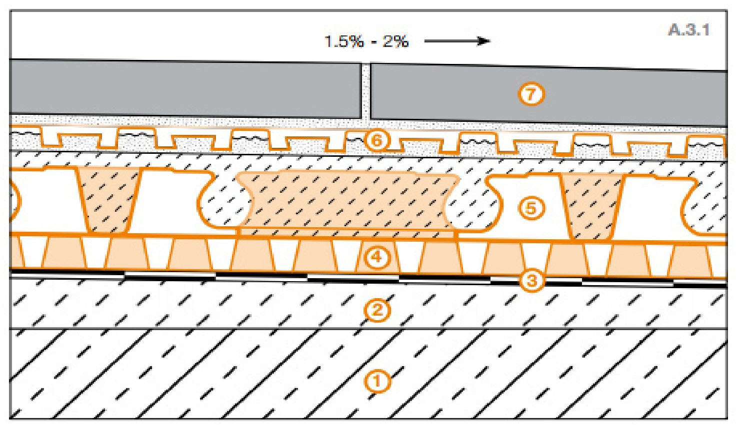
Fire	Sound	U-value	Date: 19/09/2015	D	C	B
			Appearance:			X
			Life expectancy:			X
Actual:			Execution (of work):			X
			Operation &maintenance:			X
			Price:		X	
			Environmental compatibility:		X	

http://downloads.halfen.com/catalogues/uk/media/catalogues/industry_issues/

Remarks:



Type:



Fire	Sound	U-value	Date: 19/09/2016	D	C	B
			Appearance:			X
			Life expectancy:			X
Actual:			Execution (of			X
			Operation &maintenance:			X
			Price:			X
			Environmental compatibility:			X

http://downloads.halfen.com/catalogues/uk/media/catalogues/industry_issues/

Remarks:

1. **Cantilevered concrete slab.**
2. **Sloped screed**
   The construction has to be sufficiently sloped (1.5% - 2%) to allow for proper drainage.
3. **Waterproofing assembly according to DIN 18195.**
4. **Schlüter®-TROBA-PLUS**
   Passive capillary membrane for the effective drainage of seepage and ventilation. It is important to ensure a drainage channel.
5. **Schlüter®-BEKOTEC-DRAIN**
   Thin load distribution layer as a system for damage free and functionally safe floating screeds (cement screed CT-C25-F4 or pervious mortar).
6. **Schlüter®-DITRA-DRAIN**
   Polyethylene drainage mat installed in the thin-bed method, for drainage, ventilation and uncoupling. It is important to ensure a drainage channel.
7. **Ceramic tiles or natural stone pavers**
   Installed (including large format) with a waterproof and weather resistant dry set mortar.

Building component analysis - Brickwork

Name: Maria Julian Martin

Class: AH-42 S15 Group6

BR demand: | **Subject:** External wall

Type:

Nutmeg

Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
-	-	-	Appearance:		X	
			Life expectancy:			X
			Execution (of work):		X	
Actual:						
-	-	-	Operation &maintenance:			X
			Price:		X	
			Environmental compatibility:			X

Remarks:

- Applications in social/domestic housing refurbishment or new build, apartment blocks and high-rise buildings, community regeneration developments, public infrastructure.
-The system features a stone wool insulation core and offers the choice of different insulation thickness and fixing methods to suit different substrate conditions and client requirements. Thermal efficiency, fire safety and exceptional weather protection are combined in a system that could last the life of the building.
- Health and safety: In accordance with REACH health and environment regulations, there are no hazardous classifications associated with ROCKWOOL mineral wool in respect to physical, health and environmental considerations.

Type:

Roman stone

Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
-	-	-	Appearance:	X		
			Life expectancy:			X
			Execution (of work):		X	
Actual:						
-	-	-	Operation &maintenance:			X
			Price:		X	
			Environmental compatibility:			X

Remarks:

- Applications in social/domestic housing refurbishment or new build, apartment blocks and high-rise buildings, community regeneration developments, public infrastructure.
-The system features a stone wool insulation core and offers the choice of different insulation thickness and fixing methods to suit different substrate conditions and client requirements. Thermal efficiency, fire safety and exceptional weather protection are combined in a system that could last the life of the building.
- Health and safety: In accordance with REACH health and environment regulations, there are no hazardous classifications associated with ROCKWOOL mineral wool in respect to physical, health and environmental considerations.

Type:

Moroccan sand

Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
-	-	-	Appearance:			X
			Life expectancy:			X
			Execution (of work):		X	
Actual:						
-	-	-	Operation &maintenance:			X
			Price:		X	
			Environmental compatibility:			X

Remarks:

- Applications in social/domestic housing refurbishment or new build, apartment blocks and high-rise buildings, community regeneration developments, public infrastructure.
-The system features a stone wool insulation core and offers the choice of different insulation thickness and fixing methods to suit different substrate conditions and client requirements. Thermal efficiency, fire safety and exceptional weather protection are combined in a system that could last the life of the building.
- Health and safety: In accordance with REACH health and environment regulations, there are no hazardous classifications associated with ROCKWOOL mineral wool in respect to physical, health and environmental considerations.

Building component analyses - Concrete blocks

Name: Maria Julian Martin

Class: AH-42 S15 Group6

BR demand:

Subject: **Basement wall**

Type: WEBER Leca Universal Blocks

Fire	Sound	U-value
Actual:		
EI 120	41	1,6

Date: 21/05/2015	👎	👍	👌
Appearance:		X	
Life expectancy:			X
Execution (of work):			X
Operation &maintenance:			X
Price:		X	
Environmental compatibility:			X

Remarks:

- Environment directions: **Issue Documentation (HEA 9):** In accordance with BREEAM NOR Table 5.5 is not required to issue documentation for this product. **Pollutants A20 (MAT 1)** Leca® Universal Block Contains no pollutants on BREEAM A-20 list dated 01/04/2013. **Responsible procurement of materials, ISO 14001 (MAT 5).** Weber has ISO 14001 certification for the production of Leca Universalblokk
- Quality and envornmental certifcation: Saint-Gobain Construction materials as is certified according to EN ISO 9001: 2000 (quality) and ISO 14001: 2004 (environment). Working section is implemented in accordance with the requirements of the "Regulations relating to systematic health, environment and safety work in enterprises (Internal Control Regulations)."
- Waste and recycling: Leca Universal Block can be sent to an ordinary public waste deposits. The blocks can be crushed for recycling and used in light fillings on site. On our website you will also find a statement with detailed information on this subject from reeds. ing. Bjørn Vik in BA8 consulting engineers as.

Type: WEBER Leca Basic Block LSX

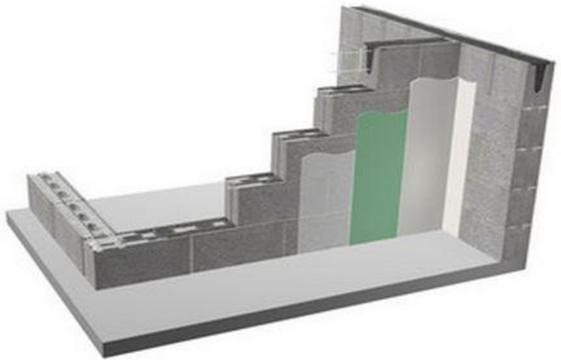
Fire	Sound	U-value
Actual:		
REI 240	43	1,4

Date: 21/05/2015	👎	👍	👌
Appearance:		X	
Life expectancy:			X
Execution (of work):			X
Operation &maintenance:			X
Price:		X	
Environmental compatibility:		X	

Remarks:

- Suitable for most applications both large as small, to exterior walls in uninsulated buildings, fire walls, garages, outbuildings, garden walls, foundation and more. Both bearing and non-load-bearing walls. Leca Basic LSX has tongue and groove that makes it easy to place the blocks correctly. They cemented with weber ready-mixed mortar M5. This is pumpable and adapted for placement with mortar box.
- **Product Benefits**: Up to 30% lighter and 20% stronger than regular Leca blocks.Fast execution. Good resistance to fungus, rot, mildew and pests. Fireproof and robust
-**UMIDITY PROPERTIES:** Leca Basic Block LSX normally have a moisture content of 10-15% by dry weight at shipping. Design value of shrinkage in masonry of Leca block is -0.40 mm / m.

Type: WEBER brick wall Leca Basic



Fire	Sound	U-value
Actual:		
REI 240	42	1,2

Date: 21/05/2015	👎	👍	👌
Appearance:			X
Life expectancy:		X	
Execution (of work):			X
Operation &maintenance:		x	
Price:		X	
Environmental compatibility:		X	

Remarks:

- Rational and fast execution
- Robust and fireproof
- Moisture and decay safe
- Requires little maintenance
- Suitable for most formal both large that slipped, the exterior walls in uninsulated buildings, fire walls, to garages, outbuildings, garden walls and much more.And therefore: To bearing and non-load-bearing walls.In most areas where you have previously used the classic Leca block, the new block with Leca Lock make the job even easier and faster.

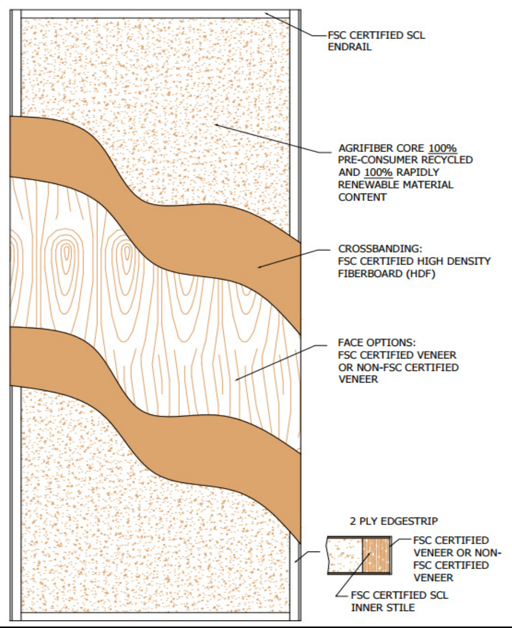
Building component analyses

BR demand: | **Subject:** Doors

Name: a [illegible]

Class: AH-42 S15 Group6

Type: AGRIFIBER CORE DOOR



	Fire	Sound	U-value	Date: 19/09/2014	D	C	B
BR demand	BS-30 EI2 30-C		1.80	Appearance:			x
				Life expectancy:			x
				Execution (of		x	
Actual:	BS-30 EI2 30-C		1.12	Operation &maintenance:		x	
				Price:		x	
				Environmental compatibility:		x	

http://eggersindustries.com/pdf/technical-info/100FSC.pdf
http://www.vtindustries.com/docs/awd-website-brochures/vt_industries_archit

Remarks:

FSC MIX 100% CERTIFIED NEW WOOD W/ FSC CERTIFIED VENEER

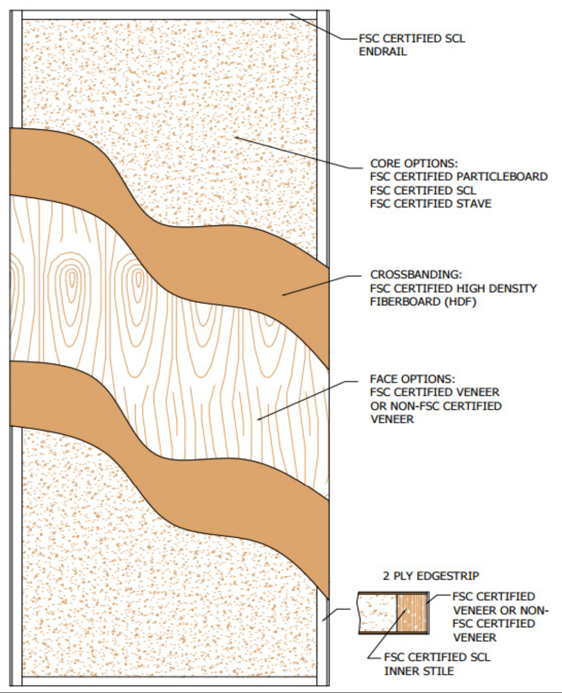
FSC MIX 85% CERTIFIED NEW WOOD W/ NON-FSC CERTIFIED VENEER

70% PRE-CONSUMER RECYCLED CONTENT

70% RAPIDLY RENEWABLE MATERIAL CONTENT

COMPLIES WITH LEED□ EQ 4.4 LOW-EMITTING MATERIALS (NAUF) AND CARB PHASE 2

Type: FSC CERTIFIED CORE DOOR



	Fire	Sound	U-value	Date: 19/09/2015	D	C	B
BR demand	BS-30 EI2 30-C		1.80	Appearance:			x
				Life expectancy:			x
				Execution (of work):		x	
Actual:	BS-30 EI2 30-C		1.12	Operation &maintenance:		x	
				Price:		x	
				Environmental compatibility:		x	

http://eggersindustries.com/pdf/technical-info/100FSC.pdf
http://www.vtindustries.com/docs/awd-website-brochures/vt_industries_archit

Remarks:

FSC MIX 100% CERTIFIED NEW WOOD W/ FSC CERTIFIED VENEER

FSC MIX 97% CERTIFIED NEW WOOD W/ NON-FSC CERTIFIED VENEER

COMPLIES WITH LEED□ EQ 4.4 LOW-EMITTING MATERIALS (NAUF) AND CARB PHASE 2

Notes: The second link on the first two typologies of doors is about u-value, fire and sound.

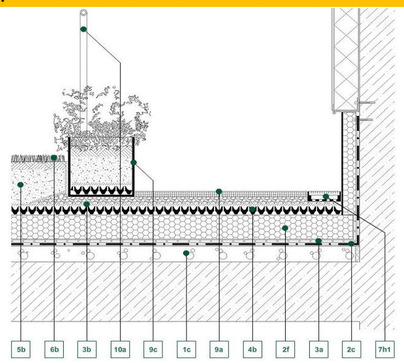
About the doors: the first type will be used for internal doors. The second will be used for access doors.

Building component analyses

Name: a LQGLWXGLQa LQGI

Class: AH-42 S15 Group6

Type: DIADEM 350 DRS PLANTER AND RNF CHANNEL



BR demand:

Subject: Green roof

Fire	Sound	U-value	**Date:** 19/09/2014	D	C	B
			Appearance:			
			Life expectancy:			
			Execution (of			
Actual:						
			Operation &maintenance:			
			Price:			
			Environmental compatibility:			

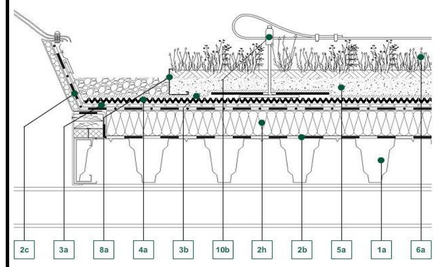
http://www.diademroof.com/Documents/1307623490.pdf
http://www.diademroof.com/junction?csid=17

Remarks:

Decking construction
1c : Slope-forming layer
Water isolation
2c : Roof-resistant waterproof membrane
2f : Extruded PS-foam sheet heat insulation
Geotextile layers
3a : VLU-300 mechanical protecting layer
3b : VLF-150 filter layer
Drainboards
4b : DiaDrain-40 drainage board
Growth medias
5b : SIM-30 extensive growth medium

Vegetation
6b : Perennials, lawn
Hydrotechnical products
7h1 : RNF-8 channel with die-stamped net
Terrace accessories
9a : FK-5 cross spacer
9c : PGE-110 flower boxes
Safety technology
10a : DRS-Standard safety railing system
Total height

Type: DIADEM 150 ROOF/MAINTENACE FLG SAFETY



Fire	Sound	U-value	**Date:** 19/09/2015	D	C	B
			Appearance:			
			Life expectancy:			
			Execution (of work):			
Actual:						
			Operation &maintenance:			
			Price:			
			Environmental compatibility:			

http://www.diademroof.com/Documents/1307623490.pdf
http://www.diademroof.com/junction?csid=11

Remarks:

Decking construction
1a : Steel trapezoidal sheet sloped floor structure
Water isolation
2b : FLW-400 ext. Root barrier, Vapour control layer
2c : Root-resistant waterproof membrane
2h : Stone wool heat insulation
Geotextile layers
3a : VLU-300 mechanical protecting layer
3b : VLF-150 filter layer
Drainboards

Growth medias
5a : SEM-12 extensive growth media
Vegetation
6a : Drought-resistant, herbaceous perennials
Edging element
8a : KLR-AL-8/12 gravel lath
Safety technology
10b : FLG-30 fall arrest system
Total height
1.55 m

http://www.diademroof.com/Documents/1307623490.pdf
http://www.diademroof.com/junction?csid=11

Building component analysis - Insulation

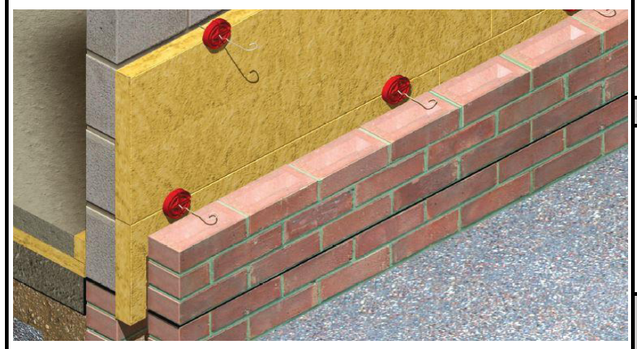
Name: Maria Julian Martin

Class: AH-42 S15 Group6

BR demand:

Subject: External wall insulation

Type: ROCKWOOL HP Partial Fill Cavity Walls



Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
	55dB	0,1	Appearance:			X
			Life expectancy:		X	
			Execution (of work):		X	
Actual:						
			Operation &maintenance:		X	
		0,126	Price:		X	
			Environmental compatibility:			X

Remarks:

- Robust front-face resists damage
- Slabs knit together to eliminate gaps
- Maximises thermal performance
- Water repellent
- HP Partial Fill Cavity Slab has a thermal conductivity of 0.034 W/mK.
- **Fire classification:** HP Partial Fill Cavity Slab is deemed non-combustible and achieves a reaction to fire classification of A1 (BS EN 13501-1)
- Dimensions: HP Partial Fill Cavity Slabs are produced in 1200 x 455mm to suit a vertical wall-tie spacing of 450mm. The slabs are available in standard thicknesses of 50, 80, 100, 120 and 135mm.
- Sustainability: All ROCKWOOL products provide outstanding thermal protection as well as four added benefits:
Fire resistance, acoustic comfort, sustainable materials and durability.

Type: KNAUF INSULATION Mur Isolering

Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
	55dB	0,1	Appearance:			X
			Life expectancy:		X	
			Execution (of work):			X
Actual:						
			Operation &maintenance:			X
		0,124	Price:		X	
			Environmental compatibility:		X	

Remarks:

- Glass wool insulation non combustible with a water-repellent additive
- It is used for external walls. Each piece is perforated, this way it is easyly for the mounting
- There are standard dimensions for the pieces, but also can be produced with another measurements
- Thermal conductivity: 0,032 W/mK
- Glass wool is odorless, not hygroscopic and does not promote the apparition of fungus or mold

Type: BioFoam 2700

Fire	Sound	U-value	**Date:** 20/05/2015	👎	👍	👌
	55dB	0,1	Appearance:		X	
			Life expectancy:		X	
			Execution (of work):			X
Actual:						
			Operation &maintenance:			X
		0,123	Price:		X	
			Environmental compatibility:			X

Remarks:

- Typically the heavy hitter out of the Biofoam Spray Foam Insulation products, Biofoam 2700 is the insulation for heavy duty application.
- Also acting as a moisture vapour barrier to reduce the risk of moisture intrusion.
-Water absorption: 0,33 Kg/m2
- Water vapour permeability: 1,48 Mg/m2HourPa
- THERMAL CONDUCTIVITY: 0,032W/mK
- Density: 33Kg/m3

Building component analyses

BR demand:

Subject: Lift

Name: [illegible]

Class: AH-42 S15 Group6

Type: ARE Miniwatt

Fire	Sound	U-value	Date: 19/09/2014	D	C	B
			Appearance:			x
			Life expectancy:			x
Actual:			Execution (of work):			x
			Operation &maintenance:			x
			Price:		x	
			Environmental compatibility:			x

http://www.areascensori.it/img2/Immagini/ascensori/Miniwatt---1200-x-800-AF
http://www.areascensori.it/prodotti/piattaforma-elevatrice-miniwatt.html
http://www.areascensori.it/

Remarks:

Max capacity: 250 kg
Max velocity: 0,15m/sec
Feeding: 230 V
Power used: 0,15 kW
Overall height: 1400 mm
ARE® elevators offer superior performance to a hydraulic elevator. They use 50% energy less.
There is no need space to house hydraulic power units and control panels.
The motor is located in the shaft and the control panel is integrated into a landing door.

Type: ECOPHASE Lift

Fire	Sound	U-value	Date: 19/09/2015	D	C	B
			Appearance:		x	
			Life expectancy:			x
Actual:			Execution (of work):		x	
			Operation &maintenance:			x
			Price:		x	
			Environmental compatibility:		x	

http://www.ascensorirerman.it/ascensore_basso_consumo.php

Remarks:

kW used: 3kW - 220 V
usage for 1000 kW/h: 440 € - 3280.94 dkk
Total cost (1 year): 941,64 € - 7021.51 dkk

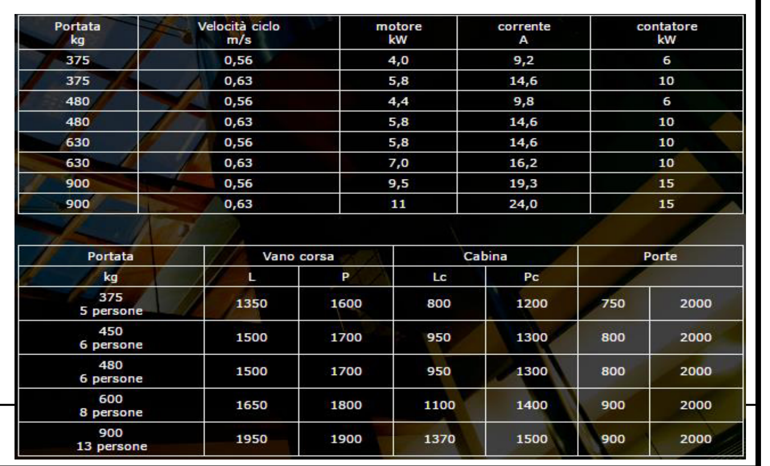
Type: ECOFLUID Power box MRL

Fire	Sound	U-value	Date: 19/09/2016	D	C	B
			Appearance:			x
			Life expectancy:			x
Actual:			Execution (of work):		x	
			Operation &maintenance:		x	
			Price:		x	
			Environmental compatibility:			x

http://www.tulfer.it/it/ecofluid.php
http://www.tulfer.it/public/pagine_allegati/16-catalogo-ecofluid.pdf

Remarks:

Low uphill
No power down
No power in standby
6 people lift 480 kg
ECU 4.4 kW



Portata kg	Velocità ciclo m/s	motore kW	corrente A	contatore kW
375	0,56	4,0	9,2	6
375	0,63	5,8	14,6	10
480	0,56	4,4	9,8	6
480	0,63	5,8	14,6	10
630	0,56	5,8	14,6	10
630	0,63	7,0	16,2	10
900	0,56	9,5	19,3	15
900	0,63	11	24,0	15

Portata	Vano corsa		Cabina		Porte	
kg	L	P	Lc	Pc		
375 5 persone	1350	1600	800	1200	750	2000
450 6 persone	1500	1700	950	1300	800	2000
480 6 persone	1500	1700	950	1300	800	2000
600 8 persone	1650	1800	1100	1400	900	2000
900 13 persone	1950	1900	1370	1500	900	2000

Building component analysis - Modules

Name: Maria Julian Martin

Class: AH-42 S15 Group6

BR demand:

Subject: **Walls**

Type: BOLIGBETON Concete walls

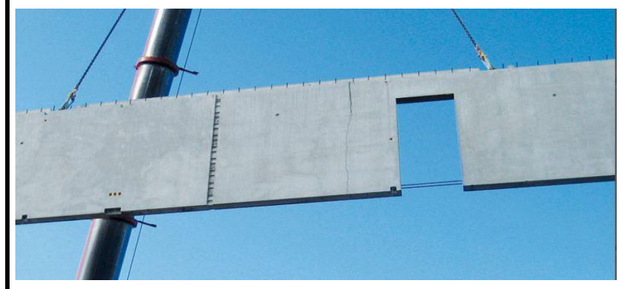
Fire	Sound	U-value
-	55 dB	0,1
Actual:		
-	53 dB	-

Date: 20/05/2015	👎	👍	👌
Appearance:		X	
Life expectancy:			X
Execution (of work):			X
Operation &maintenance:			X
Price:		X	
Environmental compatibility:		X	

Remarks:

- Concrete walls are used in all kinds of bearing and non-loadbearing structures, both interior and exterior. There can be delivered concrete walls in grey or colored concrete walls as well as in environmental classes passive, moderate, aggressive and extra agressive.
- Typical thickness are included our dimensions (150 mm and 180 mm)
- Density: 2,4 T/m3
- Thermal conductivity: 2,3 W/mK

Type: SPAENCOM



Fire	Sound	U-value
-	55 dB	0,1
Actual:		
-	53 dB	-

Date: 20/05/2015	👎	👍	👌
Appearance:		X	
Life expectancy:			X
Execution (of work):			X
Operation &maintenance:			X
Price:		X	
Environmental compatibility:		X	

Remarks:

- Element Geometry: Spæncom walling carried out in the following standard dimensions: 120, 150, 180, 200, 250 and 300 mm. Other thicknesses are executed to order.
- Standard mounts: Spæncom walls, taking into account static and production conditions assigned: Bolts, anchors, steel bearing plates, anchor rails, hårnålebøjler, wall ties, electrical boxes and elrør and various recesses. In addition, there istøbes 2 pcs. tophat recesses in the bottom of the walls of chocking and management of the foundation or underlying element.
- Environmental class: Walling performed by arrangement for use in passive, moderate or aggressive environmental class.
- Sound: The finished wall elements, like other heavy building, good sound-insulating properties.With a wall thickness of 150 mm can thus be achieved airborne sound insulation of 53 dB.Are there special requirements for reverberation time, the walls are delivered with embedded acoustic elements.
- **Fireproof:** Concrete products are some of the most fire-resistant building materials can be used, and only the highest temperatures will cause a building composed of concrete elements, to collapse.

Type: EXPANDING Walls

Fire	Sound	U-value
-	55 dB	0,1
Actual:		
-	-	-

Date: 20/05/2015	👎	👍	👌
Appearance:		X	
Life expectancy:			X
Execution (of work):			X
Operation &maintenance:			X
Price:		X	
Environmental compatibility:			X

Remarks:

- EXPANDING walls are suitable as buildings systems ranging from bungalow to molti-storey buildings. The walls used for residential and institutional buildings as well as for agricultural, commercial and industrial construction.
- They are produced in different strength classes, customized individual applications.
- CO2 Neutral: EXPANDING Elements ability to accumulate heat are crucial to the overall CO2 balance in the building life cycle. After 5 to 20 years achieves houses EXPANSION elements for a better CO2 balance than light construction, and in the following years achieved actual CO2 savings compared to lightweight wood constructions. All over the building life cycle is CO2 reduction significant.

Building component analyses

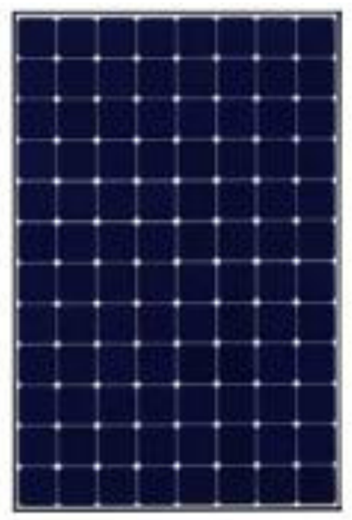
BR demand:

Subject: Photovoltaic panel

Name: [illegible]

Class: AH-42 S15 Group6

Type: SunPower serie X21



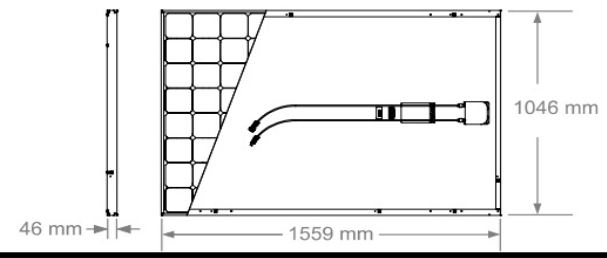
MODULO X21 - 345

Fire	Sound	U-value	Date: 19/09/2014	D	C	B
			Appearance:			x
			Life expectancy:			x
			Execution (of			x
Actual:			Operation &maintenance:			x
			Price:		x	
			Environmental compatibility:			x

http://www.enerevolution.it/custom/enerevolution/writable/downloads/Scheda

Remarks:

This serie can produce 44% electicity more per each module and 75% per meter square in 25 years. The first year we have production around 8-10%, then it will impruve until 21%. SunPower solar cells Maxeon has a log durability and high returns. It is the only one who has a copper base. This serie is the first about Fraunhofer durability test and it kept 100% of power during PVDI complete Atlas 25+ durabitlity test.



Type: Super Solar serie ES250

Fire	Sound	U-value	Date: 19/09/2015	D	C	B
			Appearance:		x	
			Life expectancy:		x	
			Execution (of work):			x
Actual:			Operation &maintenance:			x
			Price:		x	
			Environmental compatibility:			x

http://www.supersolar.it/solare-fotovoltaico/solare-fotovoltaico-schede-tecnich

Remarks:

DIMENSIONI		PARAMETRI ELETTRICI	ES 250
Lunghezza	1663 mm	Potenza massima	250 Wp
Larghezza	998 mm	Tensione a circuito aperto	37,65 V
Altezza	35 mm	Corrente di corto circuito	8,88 A
Intelaiatura	Alluminio	Tensione alla massima potenza	30,56 V
Peso	18,4 kg	Corrente a massima potenza	8,18 A

CARATTERISTICHE TERMICHE		PARAMETRI PER INTEGRAZIONE NEL SISTEMA	
Coefficiente di deriva termica di tensione	-123 mV/°C	Tensione massima di sistema classe II	1000 VDC
Coefficiente di deriva termica di corrente	2,571 mA/°C	Corrente inversa massima ammissibile	Non applicare al modulo tensioni esterne superiori a Voc

MATERIALI IMPIEGATI		ULTERIORI DATI	
Celle per modulo	60	Tolleranza sulla potenza	±3%
Tipo di cella	Silicio policristallino	Scatola di connessione	IP 65
Dimensione della cella	156 mm x 156 mm ±0,5 mm	Connettore	MC type 4

Type: SunPower serie E18/300

Fire	Sound	U-value	Date: 19/09/2016	D	C	B
			Appearance:			x
			Life expectancy:			x
			Execution (of work):			x
Actual:			Operation &maintenance:		x	
			Price:		x	
			Environmental compatibility:			x

http://www.tettosolare.it/imag/item/Sunpower_300_serieE18_black.pdf

Remarks:

DATI ELETTRICI

Misurato in condizioni di prova standard (STC): Irraggiamento 1000 W/m², AM 1,5 e temperatura della cella 25°C

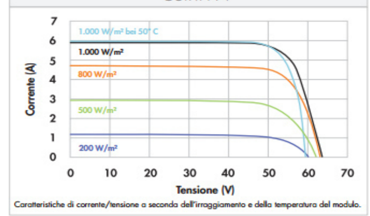
Potenza nominale (+5/– 3 %)	P_{nom}	300 W
Efficienza della cella	η	22,3 %
Efficienza del modulo	η	18,4 %
Tensione di punto di massima potenza	V_{mpp}	54,7 V
Corrente di punto di massima potenza	I_{mpp}	5,49 A
Tensione a vuoto	V_{oc}	64,0 V
Corrente di cortocircuito	I_{sc}	5,87 A
Tensione massima del sistema	IEC	1000 V
Coefficiente di temperatura	Potenza (P)	– 0,38 %/K
	Tensione (V_{oc})	– 176,6 mV/K
	Corrente (I_{sc})	3,5 mA/K
NOCT		46° C +/– 2° C
Corrente nominale del fusibile		20 A
Limite di corrente inversa (3 stringhe)	I_R	14,7 A
Messa a terra		Messa a terra positiva non necessaria

DATI ELETTRICI

Misurato alla temperatura operativa nominale della cella (NOCT): Irraggiamento 800 W/m², 20°C, vento 1 m/s

Potenza nominale	P_{nom}	222 W
Tensione di punto di massima potenza	V_{mpp}	50,2 V
Corrente di punto di massima potenza	I_{mpp}	4,42 A
Tensione a vuoto	V_{oc}	59,7 V
Corrente di cortocircuito	I_{sc}	4,75 A

CURVA I-V



Caratteristiche di corrente/tensione a seconda dell'irraggiamento e della temperatura del modulo.

CONDIZIONI OPERATIVE DI PROVA

Temperatura	Da -40°C a +85°C
Carico max	550 kg/m² (5400 Pa), fronte (es. neve) nelle configurazioni di montaggio specificate
	245 kg/m² (2400 Pa) fronte e retro (es. vento)
Resistenza all'impatto	Grandine: 25 mm a 23 m/s

GARANZIE E CERTIFICAZIONI

Garanzie	25 anni di garanzia limitata sulla potenza
	10 anni di garanzia limitata sul prodotto
Certificazioni	IEC 61215 Ed. 2, IEC 61730 (SCII)

DATI MECCANICI

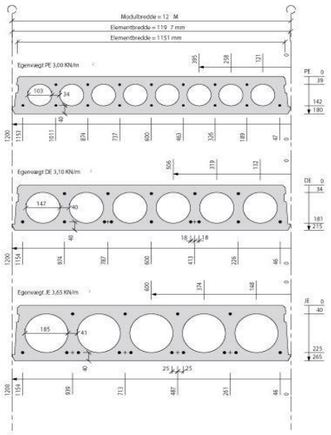
Celle solari	96 celle solari SunPower Maxeon™	Cavi di uscita	Lunghezza dei cavi 1000 mm / Connettori Amphenol (Helios H4)
Vetro anteriore	Vetro temperato ad alta trasmittanza	Telaio	Lega di alluminio anodizzato tipo 6063 (nero)
Scatola di giunzione	IP-65 con 3 diodi bypass 32 x 155 x 128 mm	Peso	18,6 kg

Building component analysis - Slabs

Name: Maria Julian Martin

Class: AH-42 S15 Group6

Type: EXPAN



BR demand:

Subject: **Floor partition**

Fire	Sound	U-value	**Date:** 21/05/2015	👎	👍	👌
REI 60	48	0,07	Appearance:		X	
			Life expectancy:			X
			Execution (of work):		X	
R60	-	0,16	Operation &maintenance:		X	
			Price:		X	
			Environmental compatibility:			X

Remarks:

- Declared values for materials and characteristics concerning. hollow core slabs shown in EC-compliant meles Declaration.
- Hollow core slabs are produced as standard in tighter control class.
- **Environmental class: h**ollow core slabs are produced as standard in passive environmental class. Can also be produced for use in a modified moderate environmental class by appointment, however, will line ends stand free and untreated.

Type: SPAENCOM X22

Fire	Sound	U-value	**Date:** 21/05/2015	👎	👍	👌
REI 60	48	0,07	Appearance:		X	
			Life expectancy:			X
			Execution (of work):			X
R60	-	-	Operation &maintenance:		X	
			Price:		X	
			Environmental compatibility:			X

Remarks:

- Spæncom produces extruded deck in thicknesses of 180, 220, 270, 320 and 400 mm for passive and moderate environmental class. For aggressive environmental class produced tires in 200, 240, 290, 340 and 420 mm.
We call them Xtrumax, so whether the job is residential, commercial, institutional or retail shops may Spæncom meet your requirements for floor separation Xtrumax. Xtrumax plates cut to form the table and can be supplied in any length.

Building component analyses

BR demand: | Subject: Window | Name: [illegible] | Class: AH-42 S15 Group6

Type: VELFAC Classic

Fire	Sound	U-value	Date: 19/09/2014	D	C	B
			Appearance:			x
			Life expectancy:			x
			Execution (of			x
Actual:						
			Operation &maintenance:			x
		0,8	Price:		x	
			Environmental compatibility:		x	

http://velfac.dk/vinduer-erhverv/Produkter/VELFAC-Classic/

Remarks:

External elements aluminium (no maintenance needs).
Internal elements wood.
10 years warranty.
Window Options:
32mm 2-layer , 48mm 3-layer
VELFAC Classic alloy with 2-layer standard glazing meets the requirements of BR10 and design for LE2015 .
VELFAC Classic aluminum with 3-layer standard glazing meet the expected requirements for BR2020 .
Energy class : A, B or C (depending on the pane selection).
Eref : up to 0.4 of a standard window.
Uw value: down to 0,8.

Type: VELFAC Ribo

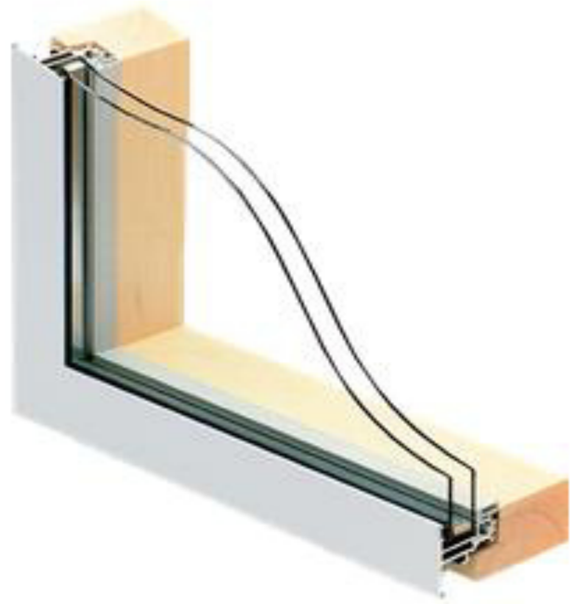
Fire	Sound	U-value	Date: 19/09/2015	D	C	B
			Appearance:			x
			Life expectancy:			x
			Execution (of work):			x
Actual:						
			Operation &maintenance:			x
		0,8	Price:		x	
			Environmental compatibility:		x	

http://www.tubeliteinc.com/wp-content/uploads/2014/02/Vent-Window-Detail
http://www.tubeliteinc.com/technical-data-index-windows-3700/

Remarks:

External elements aluminium (no maintenance needs).
Internal elements wood.
10 years warranty.
Window Options:
28mm 2-layer , 52mm 3-layer.
VELFAC Classic alloy with 2-layer standard glazing meets the requirements of BR10 and design for LE2015 .
VELFAC Classic aluminum with 3-layer standard glazing meet the expected requirements for BR2020 .
Energy class : A, B or C (depending on the pane selection).
Eref : up to 0.4 of a standard window.
Uw value: down to 0,8.

Type: VELFAC 200 ENERGY



Fire	Sound	U-value	Date: 19/09/2016	D	C	B
			Appearance:			x
			Life expectancy:			x
			Execution (of			x
Actual:						
			Operation &maintenance:			x
		0,8	Price:		x	
			Environmental compatibility:			x

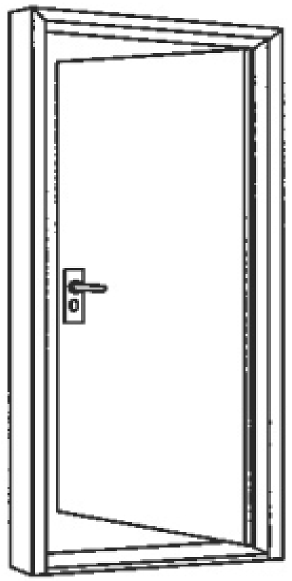
Remarks:

External elements aluminium (no maintenance needs).
Internal elements wood.
10 years warranty.
Window Options:
24mm 2-layer and 48mm 3-layer.
VELFAC 200 ENERGY with 48mm 3-layer standard glass with a rim temperature of 12.4 ° C meets the expected requirements for BR2020.
VELFAC 200 with 2-layer standard glazing meets the requirements of BR10 and design for LE2015.
Energy class : A, B or C (depending on the pane selection).
Eref : up to +8 for a standard window.
Uw value: down to 0,8.

The choosen window has three glazed layers and a steel profile to be connected to the external wall.
It is respecting the fire and sound value and the u-value: windows and skylights 1.65 W/m2k.

2.2.2. Life cycle costing

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**	**6**	**of pages**	
Building component	**Doors**	**Respons.**	[illegible]	**Date:**	**16 - 06 - 15**



DESCRIPTION/SKETCH

Periodic maintenance	**Year**	**Price**
Cleaning	1	0
Cleaning	2	0
Cleaning	3	0
Cleaning	4	0
Cleaning	5	0
Cleaning	6	0
Cleaning	7	0
Cleaning	8	0
Cleaning	9	0
Cleaning	10	0
Cleaning	11	0
Cleaning	12	0
Cleaning	13	0
Cleaning	14	0
Cleaning	15	0
Cleaning	16	0
Cleaning	17	0
Cleaning	18	0
Cleaning	19	0

Only write in yellow areas

Construction costs	**4040**	**DKr**
Lifespan from	**30**	**Years**
to	**50**	**Years**
Reconstruction	**130%**	
Yearly maintenance	**2%**	
The real interest rate	**3%**	

Construction costs	**4040**	**DKr**
Sum, current value	**1188**	**DKr**
Total investment	**5228**	**DKr**

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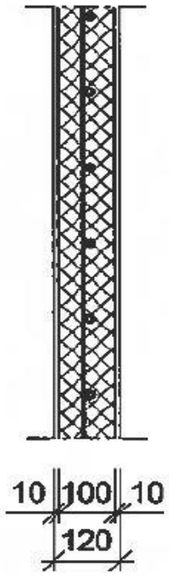
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yearly maintenance	**60,6**	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6
Periodic maintenance/repair		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reconstruction	**5252**															
Current value		**59**	**57**	**55**	**54**	**52**	**51**	**49**	**48**	**46**	**45**	**44**	**43**	**41**	**40**	**39**

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6	60,6
Periodic maintenance/repair	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reconstruction															
Current value	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**

Project	Multistorey housing	Phase	Scheme design	Page	1
Subject	Calculation of life cycle costing	Group	6	of pages	1
Building component	Internal walls	Respons.	Maria Julian	Date:	19/06/2015



Periodic maintenance	Year	Price
Painting	5	1000
Painting	10	1000
Painting	15	1000
Painting	20	1000
Painting	25	1000
Painting	30	1000
Painting	35	1000
Painting	40	1000
Painting	45	1000
Painting	50	1000
Painting	55	1000
Painting	60	1000

Only write in yellow areas

Construction costs	1850	DKr
Lifespan from	60	Years
to	120	Years
Reconstruction	150%	
Yearly maintenance	1%	
The real interest rate	3%	

Construction costs	1850	DKr
Sum, current value	4054	DKr
Total investment	5904	DKr

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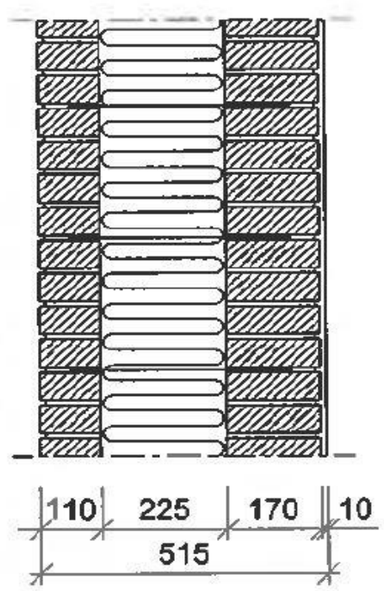
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	18,5	19	19	19	19	18,5	19	19	19	19	18,5	19	19	19	19	18,5	19	19	19	19	18,5	19	19	19	19	18,5	19	19	19	19	18,5
Periodic maintenance/repair																															
Reconstruction	2775					1000					1000					1000					1000					1000					1000
Current value		18	17	17	16	879	15	15	15	14	758	13	13	13	12	654	12	11	11	11	564	10	10	9	9	486	9	8	8	8	420

Project	Multistorey housing	Phase	Scheme design	Page	1
Subject	Calculation of life cycle costing	Group	6	of pages	1
Building component	External walls	Respons.	Maria Julian	Date:	19/06/2015



Periodic maintenance	Year	Price
Cleanning of brickwork	15	70000
Cleanning of brickwork	30	70000
Cleanning of brickwork	45	70000
Cleanning of brickwork	60	70000

Only write in yellow areas

Construction costs	3692	DKr
Lifespan from	60	Years
to	120	Years
Reconstruction	150%	
Yearly maintenance	1%	
The real interest rate	3%	

Construction costs	3692	DKr
Sum, current value	74493	DKr
Total investment	78185	DKr

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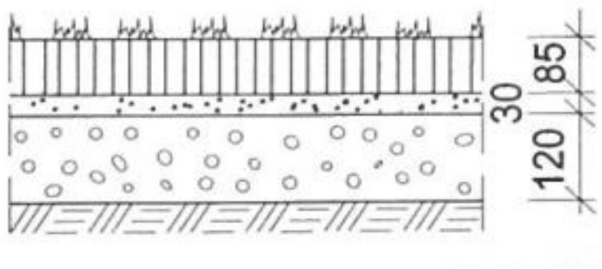
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	36,9	37	37	37	37	37	37	37	37	37	37	37	37	37	37	36,92	37	37	37	37	37	37	37	37	37	37	37	37	37	37	36,92
Periodic maintenance/repair																															
Reconstruction	5538															70000															70000
Current value		36	35	34	33	32	31	30	29	28	27	27	26	25	24	44954	23	22	22	21	20	20	19	19	18	18	17	17	16	16	28854

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**	**6**	**of pages**	
Building component	**Green roof**	**Respons.**	[illegible]	**Date:**	**16 - 06 - 15**



DESCRIPTION/SKETCH

Periodic maintenance	Year	Price
Cleaning	1	1000
Maintenance	2	2706
Cleaning	3	1000
Maintenance	4	2706
Cleaning	5	1000
Maintenance	6	2706
Cleaning	7	1000
Maintenance	8	2706
Cleaning	9	1000
Maintenance	10	2706
Cleaning	11	1000
Maintenance	12	2706
Cleaning	13	1000
Maintenance	14	2706
Cleaning	15	1000
Maintenance	16	2706
Cleaning	17	1000
Maintenance	18	2706
Cleaning	19	1000

Only write in yellow areas

Construction costs	**600**	**DKr**
Lifespan from	**20**	**Years**
to	**40**	**Years**
Reconstruction	**75%**	
Yearly maintenance	**1%**	
The real interest rate	**3%**	

Construction costs	**600**	**DKr**
Sum, current value	**55770**	**DKr**
Total investment	**56370**	**DKr**

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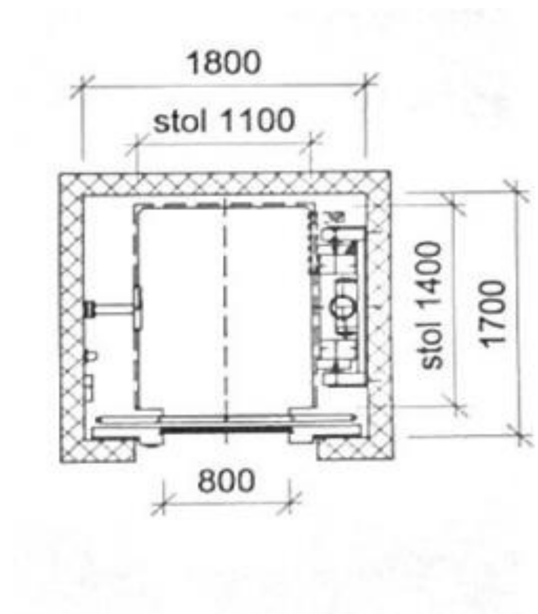
Life cycle costing, Page 98 - 104

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yearly maintenance	**6,0**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Periodic maintenance/repair		1000	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000
Reconstruction	**450**															
Current value		**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Periodic maintenance/repair	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000	2706	1000	2706
Reconstruction															
Current value	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**	**1006**	**2712**

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**	**6**	**of pages**	
Building component	**Lift**	**Respons.**	[illegible]	**Date:**	**16 - 06 - 15**



DESCRIPTION/SKETCH

Periodic maintenance	Year	Price
Cleaning	1	487
Cleaning	2	487
Cleaning	3	487
Cleaning	4	487
Maintenance	5	1589
Cleaning	6	487
Cleaning	7	487
Cleaning	8	487
Cleaning	9	487
Maintenance	10	1589
Cleaning	11	487
Cleaning	12	487
Cleaning	13	487
Cleaning	14	487
Maintenance	15	1589
Cleaning	16	487
Cleaning	17	487
Cleaning	18	487
Cleaning	19	487

Only write in yellow areas

Construction costs	342000	DKr
Lifespan from	20	Years
to	40	Years
Reconstruction	150%	
Yearly maintenance	2%	
The real interest rate	3%	

Construction costs	342000	DKr
Sum, current value	226422	DKr
Total investment	568422	DKr

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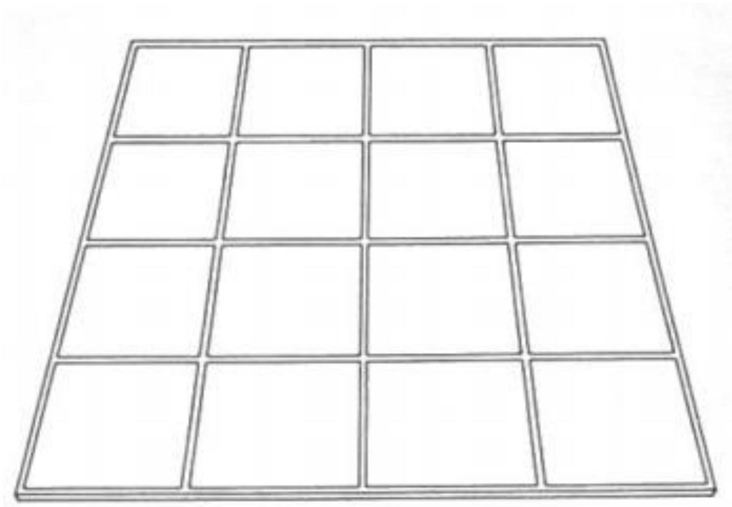
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yearly maintenance	6840,0	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840
Periodic maintenance/repair		487	487	487	487	1589	487	487	487	487	1589	487	487	487	487	1589
Reconstruction	513000															
Current value		7327	7327	7327	7327	8429	7327	7327	7327	7327	8429	7327	7327	7327	7327	8429

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840	6840
Periodic maintenance/repair	487	487	487	487	1589	487	487	487	487	1589	487	487	487	487	1589
Reconstruction															
Current value	7327	7327	7327	7327	8429	7327	7327	7327	7327	8429	7327	7327	7327	7327	8429

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**		**of pages**	
Building component	**Solar panels**	**Respons.**	[illegible]	**Date:**	



DESCRIPTION/SKETCH

Periodic maintenance	**Year**	**Price**
Cleaning	1	360
Cleaning	2	360
Cleaning	3	360
Cleaning	4	360
Cleaning	5	360
Cleaning	6	360
Cleaning	7	360
Cleaning	8	360
Cleaning	9	360
Cleaning	10	360
Cleaning	11	360
Cleaning	12	360
Cleaning	13	360
Cleaning	14	360
Cleaning	15	360
Cleaning	16	360
Cleaning	17	360
Cleaning	18	360
Cleaning	19	360

Only write in yellow areas

Construction costs	133000	DKr
Lifespan from	35	Years
to	40	Years
Reconstruction	130%	
Yearly maintenance	1%	
The real interest rate	3%	

Construction costs	133000	DKr
Sum, current value	21600	DKr
Total investment	154600	DKr

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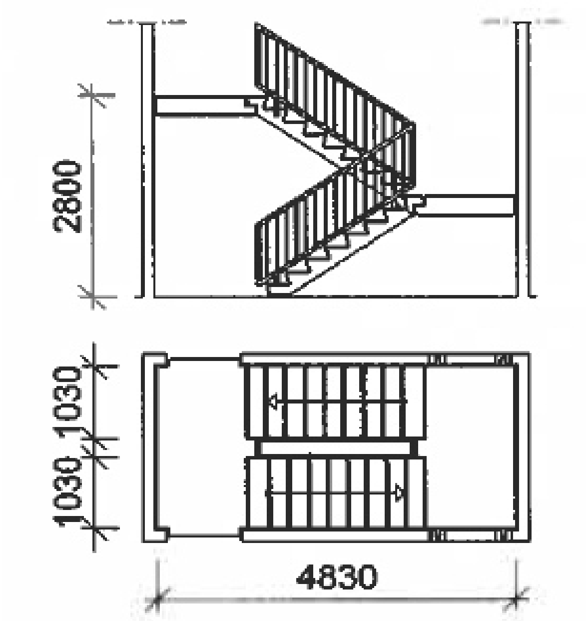
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	1330,0	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
Periodic maintenance/repair		360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
Reconstruction	172900																														
Current value		720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**	**6**	**of pages**	
Building component	**Stairs**	**Respons.**	[illegible]	**Date:**	**16 - 06 - 15**



DESCRIPTION/SKETCH

Periodic maintenance	Year	Price
Cleaning	1	150
Cleaning	2	150
Cleaning	3	150
Cleaning	4	150
Cleaning	5	150
Cleaning	6	150
Cleaning	7	150
Cleaning	8	150
Cleaning	9	150
Cleaning	10	150
Cleaning	11	150
Cleaning	12	150
Cleaning	13	150
Cleaning	14	150
Cleaning	15	150
Cleaning	16	150
Cleaning	17	150
Cleaning	18	150
Cleaning	19	150

Only write in yellow areas

Construction costs	79100	DKr
Lifespan from	60	Years
to	120	Years
Reconstruction	130%	
Yearly maintenance	1%	
The real interest rate	3%	

Construction costs	79100	DKr
Sum, current value	18444	DKr
Total investment	97544	DKr

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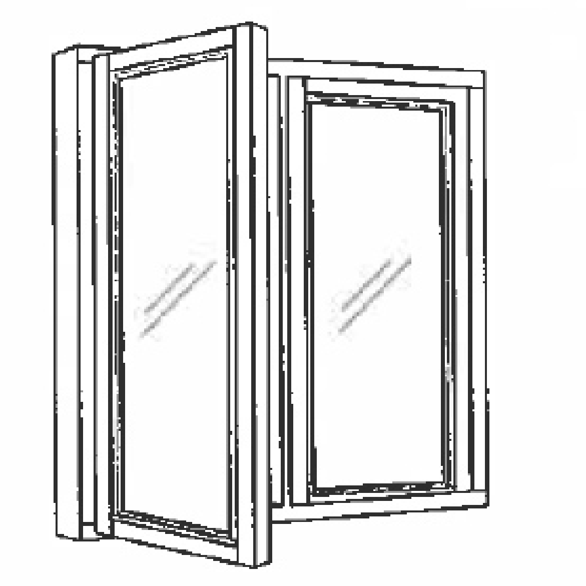
Life cycle costing, Page 98 - 104

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yearly maintenance	791,0	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791
Periodic maintenance/repair		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Reconstruction	102830															
Current value		914	887	861	836	812	788	765	743	721	700	680	660	641	622	604

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791
Periodic maintenance/repair	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Reconstruction															
Current value	586	569	553	537	521	506	491	477	463	449	436	424	411	399	388

Project		Phase		Page	
Subject	Calculation of life cycle costing	Group	6	of pages	
Building component	Window	Respons.	[illegible]	Date:	16 - 06 - 15



DESCRIPTION/SKETCH

Periodic maintenance	Year	Price
Cleaning	1	50
Cleaning	2	50
Cleaning	3	50
Cleaning	4	50
Cleaning	5	50
Cleaning	6	50
Cleaning	7	50
Cleaning	8	50
Cleaning	9	50
Cleaning	10	50
Cleaning	11	50
Cleaning	12	50
Cleaning	13	50
Cleaning	14	50
Cleaning	15	50
Cleaning	16	50
Cleaning	17	50
Cleaning	18	50
Cleaning	19	50

Only write in yellow areas

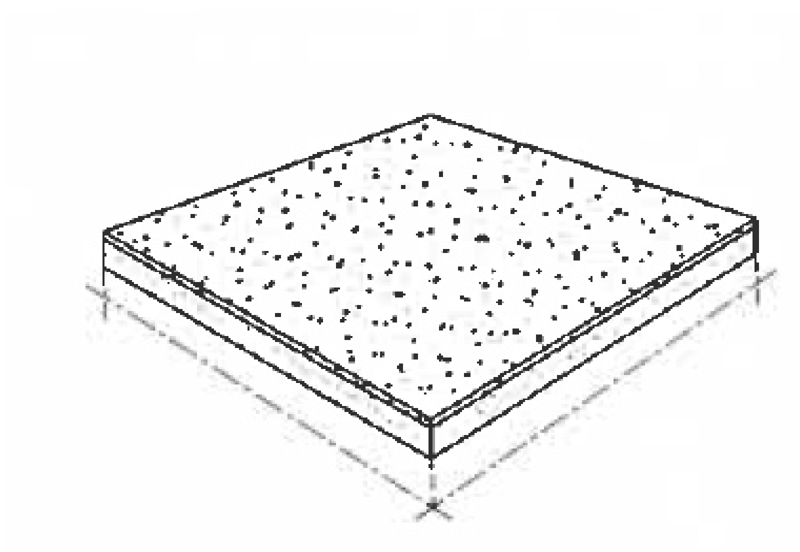
Construction costs	5870	DKr
Lifespan from	50	Years
to	70	Years
Reconstruction	150%	
Yearly maintenance	3%	
The real interest rate	3%	

Construction costs	5870	DKr
Sum, current value	6783	DKr
Total investment	12653	DKr

The Constructing Architects Manual
Life cycle costing, Page 98 - 104

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1	176,1
Periodic maintenance/repair		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Reconstruction	8805																														
Current value		226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226

Project		**Phase**		**Page**	
Subject	**Calculation of life cycle costing**	**Group**	6	**of pages**	
Building component	**Balcony**	**Respons.**	[illegible]	**Date:**	**16 - 06 - 15**



DESCRIPTION/SKETCH

Periodic maintenance	Year	Price
Cleaning	1	0
Cleaning	2	0
Cleaning	3	0
Cleaning	4	0
Cleaning	5	0
Cleaning	6	0
Cleaning	7	0
Cleaning	8	0
Cleaning	9	0
Cleaning	10	0
Cleaning	11	0
Cleaning	12	0
Cleaning	13	0
Cleaning	14	0
Cleaning	15	0
Cleaning	16	0
Cleaning	17	0
Cleaning	18	0
Cleaning	19	0

Only write in yellow areas

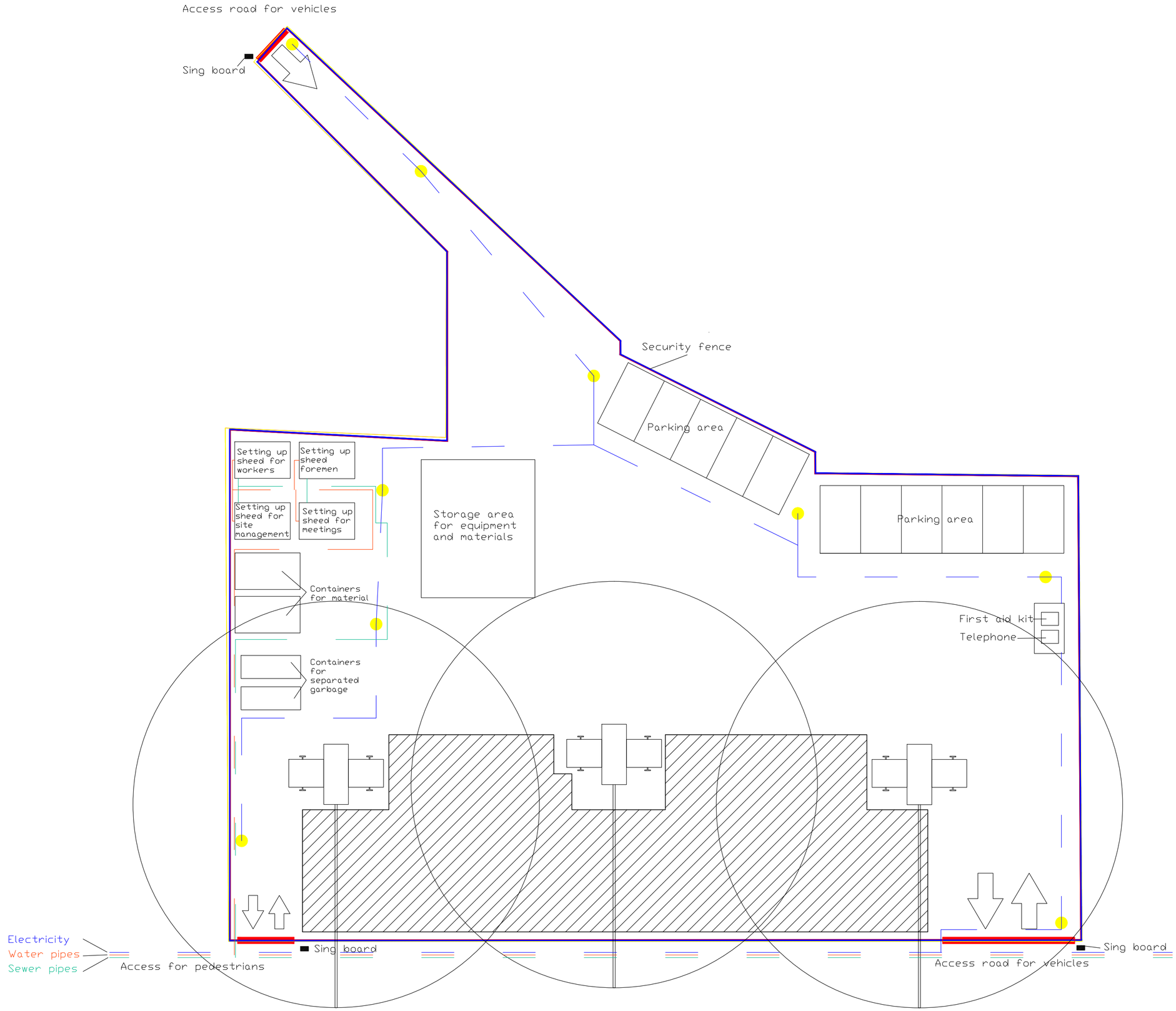
Construction costs	2830	DKr
Lifespan from	40	Years
to	60	Years
Reconstruction	150%	
Yearly maintenance	0%	
The real interest rate	3%	

Construction costs	2830	DKr
Sum, current value	171	DKr
Total investment	3001	DKr

The Constructing Architects Manual
Life cycle costing, Page 98 - 104

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Yearly maintenance	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7
Periodic maintenance/repair		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reconstruction	4245																														
Current value		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

2.2.3. Building Site plan


Access road for vehicles
Sing board
Security fence
Parking area
Parking area
Setting up sheed for workers
Setting up sheed foremen
Setting up sheed for site management
Setting up sheed for meetings
Storage area for equipment and materials
Containers for material
Containers for separated garbage
First aid kit
Telephone
Electricity
Water pipes
Sewer pipes
Access for pedestrians
Sing board
Access road for vehicles
Sing board

2.2.4. Rent Apartment

Rent and financing Social Housing projects - Application

SLON A2014

Project	Multi-storey Housing	Group	6	Class	AH-42

Apartments - Total xx

	Gross m2		items			
Apartment 1	110,86	m2	7	total	776	m2 gross
Apartment 2	84,5	m2	6	total	507	m2 gross
Apartment 3	103,53	m2	2	total	207	m2 gross
Apartment 4	89,73	m2	2	total	179	m2 gross
		m2		total	0	m2 gross
m2 total Gross (subsidized area)					1.670	m2 gross

Maximun cost pr gross m2	20.240	kr. per m2 gross
Maximum cost total	33.791.490	kr.
Total cost - Your tenderbid	**44.682.553**	kr.

Financing - Social Housing projects - by

The City counsil (Kommunal grundkapital)	10% of the total cost	4.468.255	kr.
Loan (Realkredit lån)	88% of the total cost	39.320.647	kr.
Resident Deposits	2% of the total cost	893.651	kr.
Total		44.682.553	kr.

The first year payments of Loan, subsidize and maintaince

Application for loan:

Mail this document including the requested facta (yellow boxes) to your BPM-teacher

From BRF Creditinstitut (lån fra BRF's hjemmeside)						
Mortgage Credit (kontantlån 3,0 % 30 år kurs) rate 94,1						
Amount needed					*39.320.647*	*kr.*
Loan (Lånets hovedstol)					*-*	*kr.*
Payment total (Ydelse i alt)					0	kr. per Year
Contribution (E	0,27% af hovedstolen				0	kr. per Year
Payment whitout contribution (Ydelse ekscl. Bidrag)					0	kr. per Year
Public subsidize (Offentlige tilskud).						
Payment whitout contribution (Ydelse ekscl. Bidrag)					0	kr. per Year
Rent (paid by the residents) maximum	2,80% of the total costs (af anskaffelsessummen)				1.251.111	kr. per Year
Subsidize total (Ydelsesstøtte i alt)					-1.251.111	kr. per Year
Payment by the residents.						
Total payment of the loan (without government grants)		0	-	-1.251.111	1.251.111	kr. per Year
Cost for maintance (Keyfigures) K42014		1.670	*	305	509.210	kr. per Year
Payment by the resident (Beboerbetaling ekscl. Forbrug					1.760.321	kr. per Year

Rent	1.760.321	/	1.670		1.054	kr. pr. m2 per. Year
1. years Rent per Month						
Apartment 1	110,86	*	1.054	12	**9.741**	**kr. per. Month**
Apartment 2	84,5	*	1.054	12	**7.425**	**kr. per. Month**
Apartment 3	103,53	*	-	12	**-**	**kr. per. Month**
Apartment 4	89,73	*	-	12	**-**	**kr. per. Month**

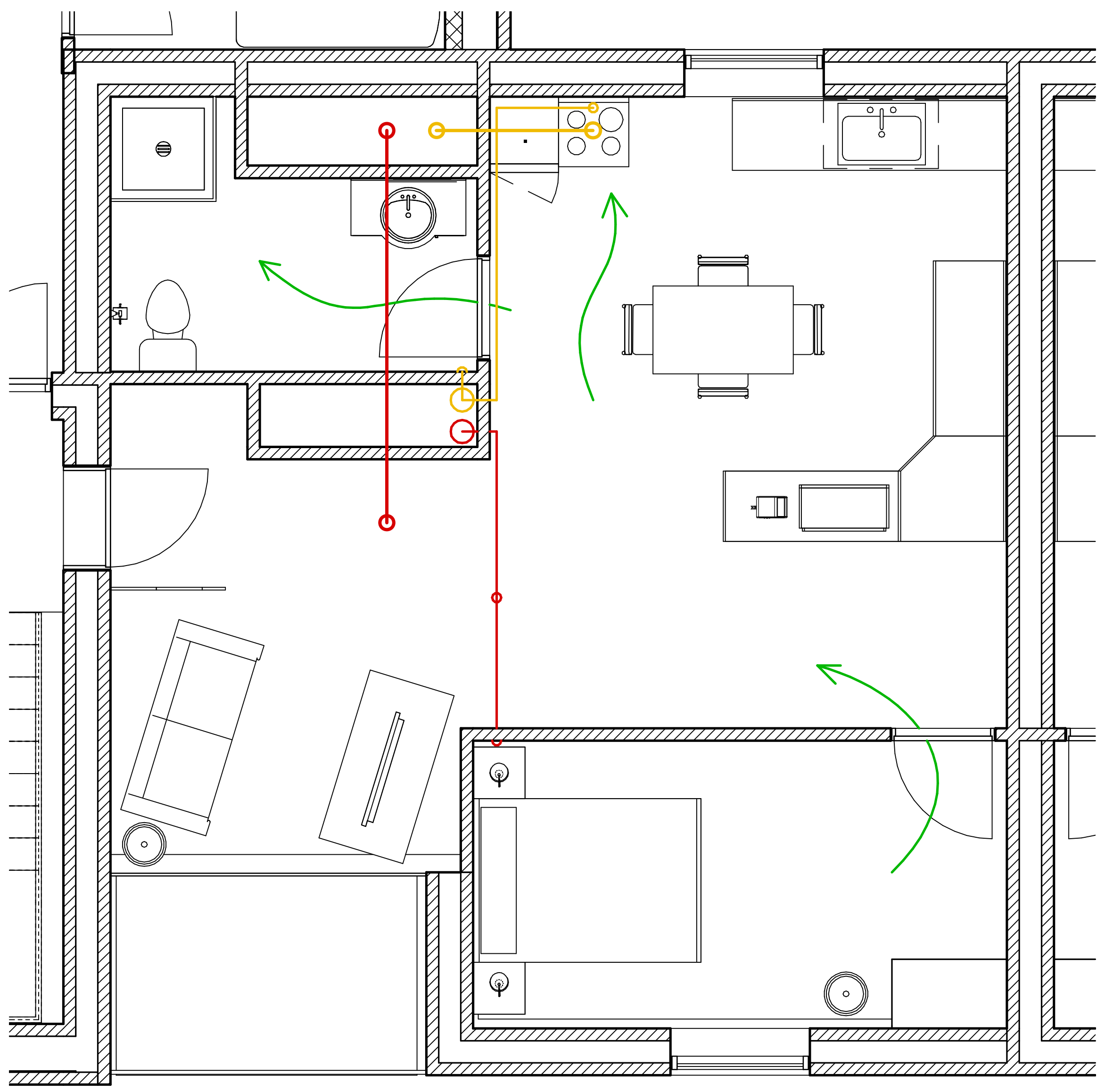
Resident Deposits (payed before moving in)

Resident Deposits per. m2 is	893.651	kr. devided m2	1.670	535	kr/m2
	kr/m2	m2	stk.		
Resident Deposits 2-rooms apartment	535	776	7	**59.340**	**kr.per apartment**
Resident Deposits 3-rooms apartment	535	507	6	**45.230**	**kr.per apartment**
Resident Deposits ?-rooms apartment	535	207	2	**55.416**	**kr.per apartment**
Resident Deposits ?-rooms apartment	535	179	2	**48.030**	**kr.per apartment**
Resident Deposits ?-rooms apartment	535	0	0	**#¡DIV/0!**	**kr.per apartment**

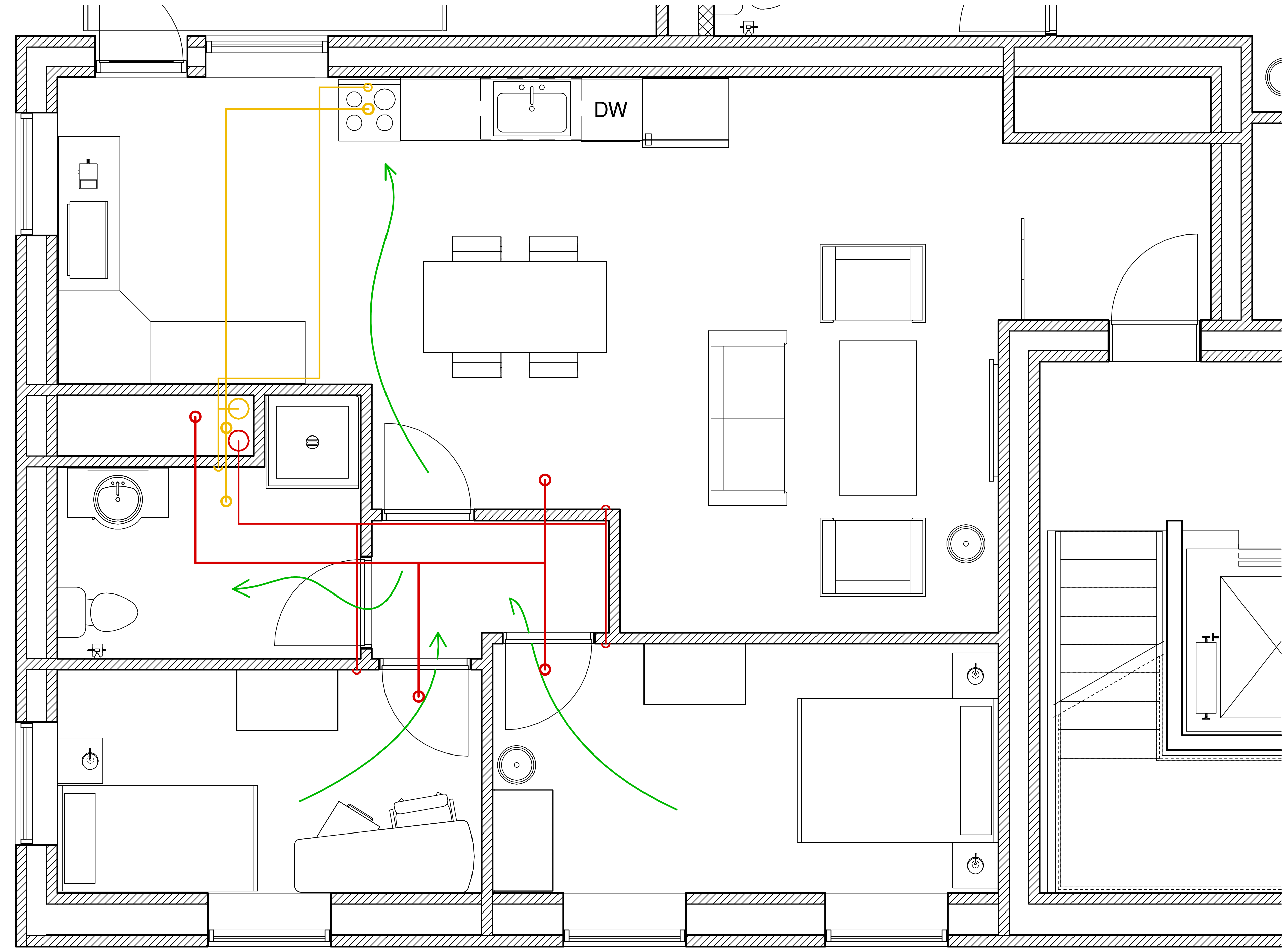
2.3. BUILDING SERVICES

2.3.1. Ventilation Plan

ventilation



04 2 Floor - VENTILATION - Dettaglio 2
1 : 62



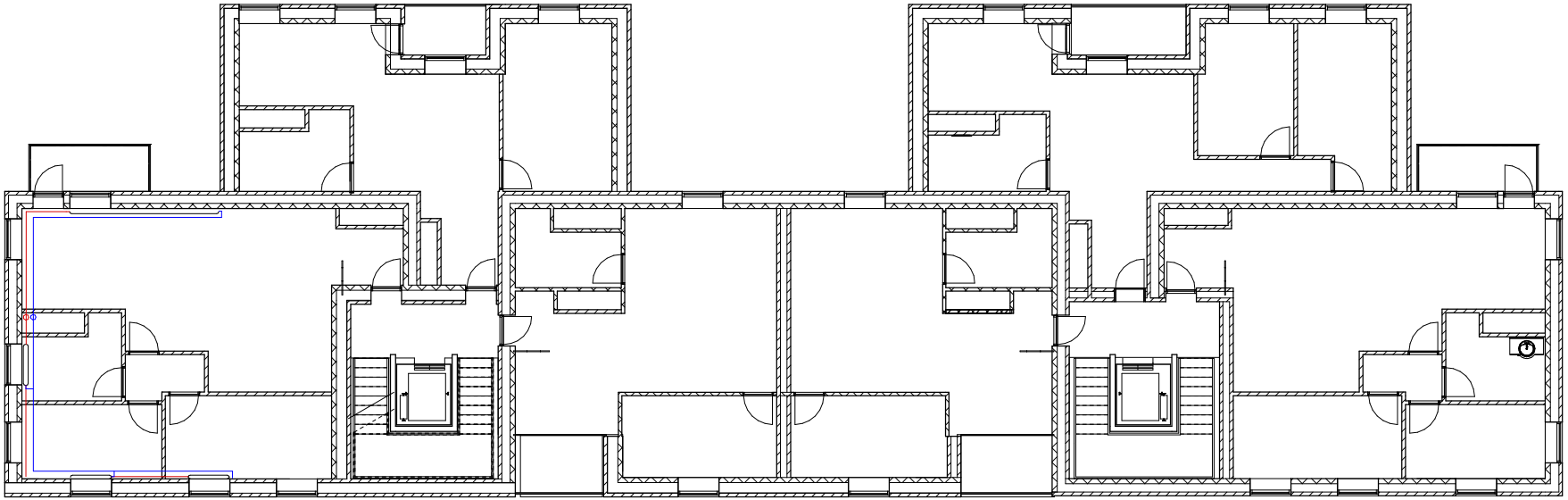
04 2 Floor - VENTILATION - Dettaglio 3
1 : 50

Bring ideas to life
VIA University College

SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

PROJECT: Multi-storey housing	DATE: 04/29/15	ventilation
SUBJECT:	SCALE: As indicated	
DRAWN BY:	CLASS:	

2.3.2. Heating Plan



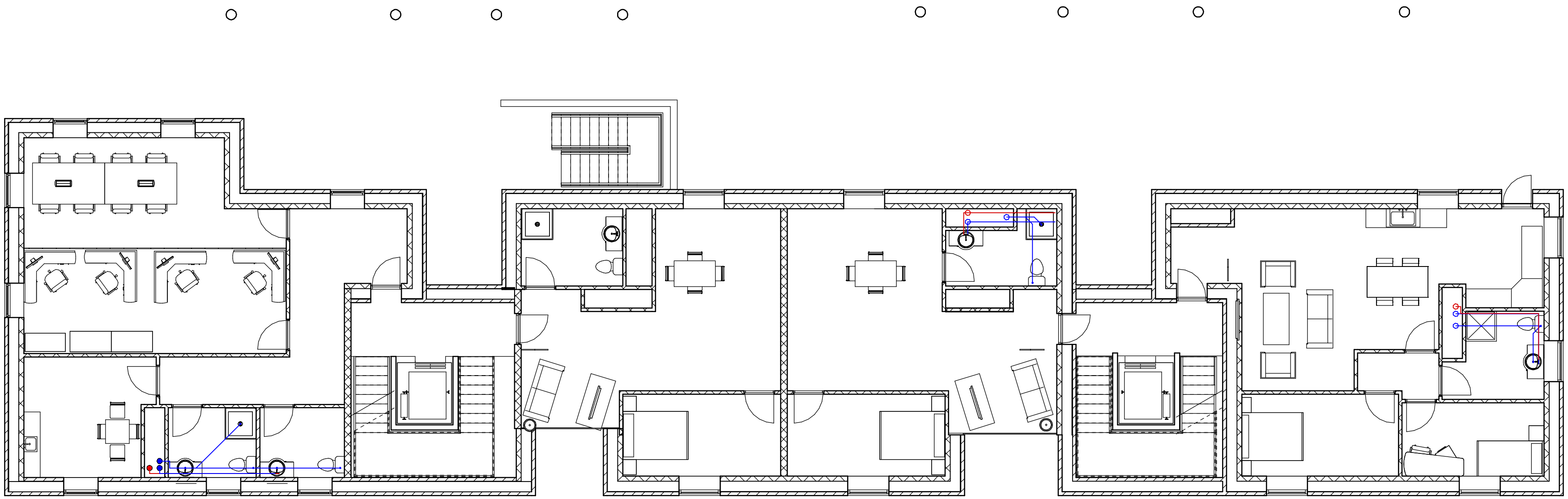
03 1 Floor - heating
1 : 200

Bring ideas to life
VIA University College

SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

PROJECT: Multi-storey housing	DATE: 06/23/15	44
SUBJECT: Unnamed	SCALE: 1 : 200	
DRAWN BY: a LIIGLIWOGLIIa LIIGII	CLASS:	

2.3.3. Water Plan



02 Groundfloor water
1 : 200

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VIA University College

SCHOOL OF TECHNOLOGI AND BUSINESS
TYPE CITY

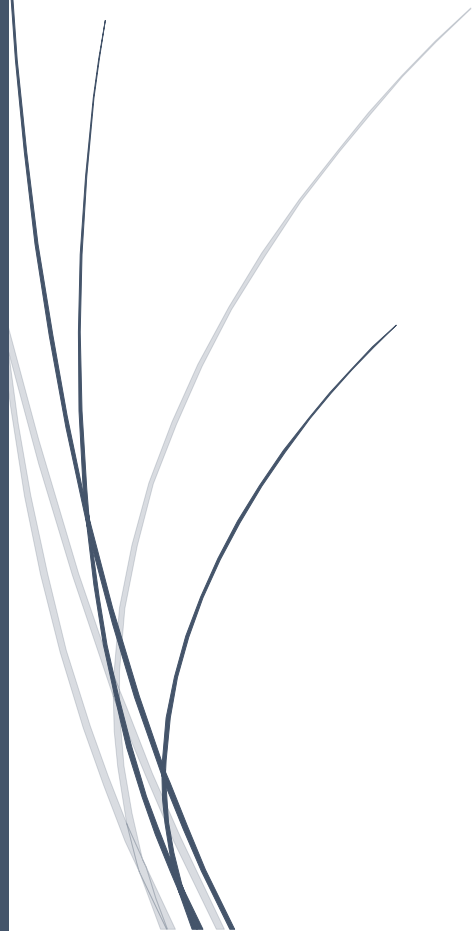
PROJECT: Multi-storey housing	DATE: 06/23/15	**42**
SUBJECT: Water plan	SCALE: 1 : 200	
DRAWN BY: [illegible]	CLASS: AH42S15	

2.4. STRUCTURAL DESIGN

2.4.1. Structural Design Report

3-6-2015

STRUCTURAL DOCUMENTATION



VIA UNIVERSITY COLLEGE, Horsens
GROUP 6 CASH42

CONTENTS

BUILDING DESCRIPTION

This document concerns the calculation of loads and safety for a Multi-story social housing site at Sønderbrogade in Horsens, Denmark.

The groundfloor is divided in two parts; one residential and one for commercial usage. Other floors are only for residential usage. On the top of the building the green roof is the social area with the target to be a meeting place.

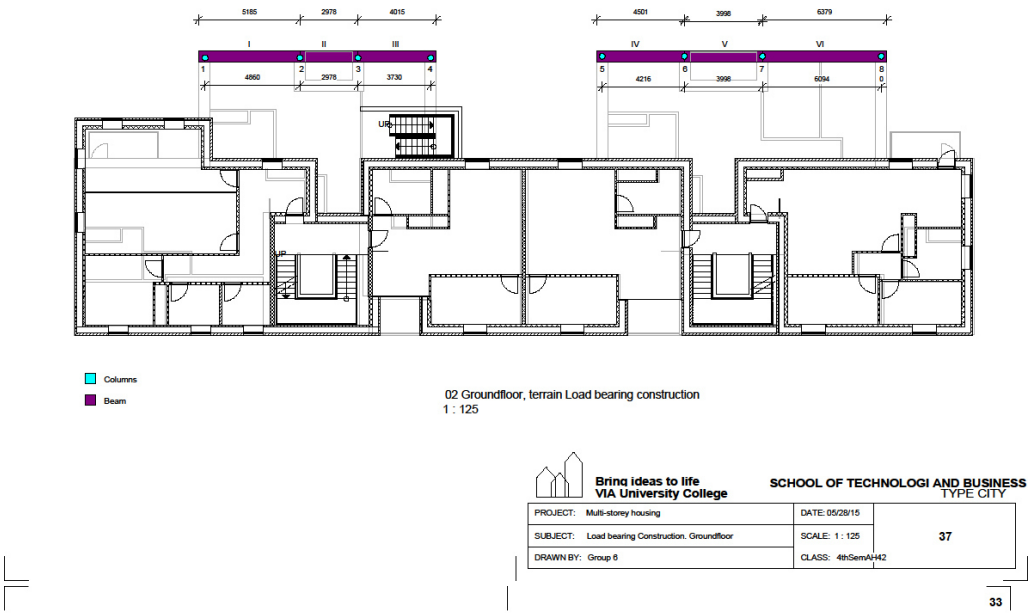
The basement is basically used for storage, laundry and placing the technical installations.

BASIS FOR CALCULATION

The calculations are based on the following standards:

- DS/EN 1990:2007, Eurocode 0: Basis of structural design.
- DS/EN 1991-1-1:2007, Eurocode 1: Action on structures – Part 1-1: General actions – Densities, self weight, imposed loads for buildings.
- DS/EN 1991-1-2:2007, Eurocode 1: Action on structures – Part 1-2: General actions – Actions on structures exposed to fire.
- DS/EN 1991-1-3:2007, Eurocode 1: Action on structures – Part 1-3: General actions – Snow loads.
- DS/EN 1992-1-1:2005, Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings.

LOAD BEARING CONSTRUCTION



All the construction elements are made by prefabricated concrete. We are going to calculate every load bearing element of the plan, and for showing the difference between kinds of work, we colored each one with different colors.

Like the previous plan shows, the red colored walls are load bearing external walls, the green ones, load bearing internal walls; the purple ones are the beams, and the blue ones are the columns.

LOAD BEARING EXTERNAL WALLS

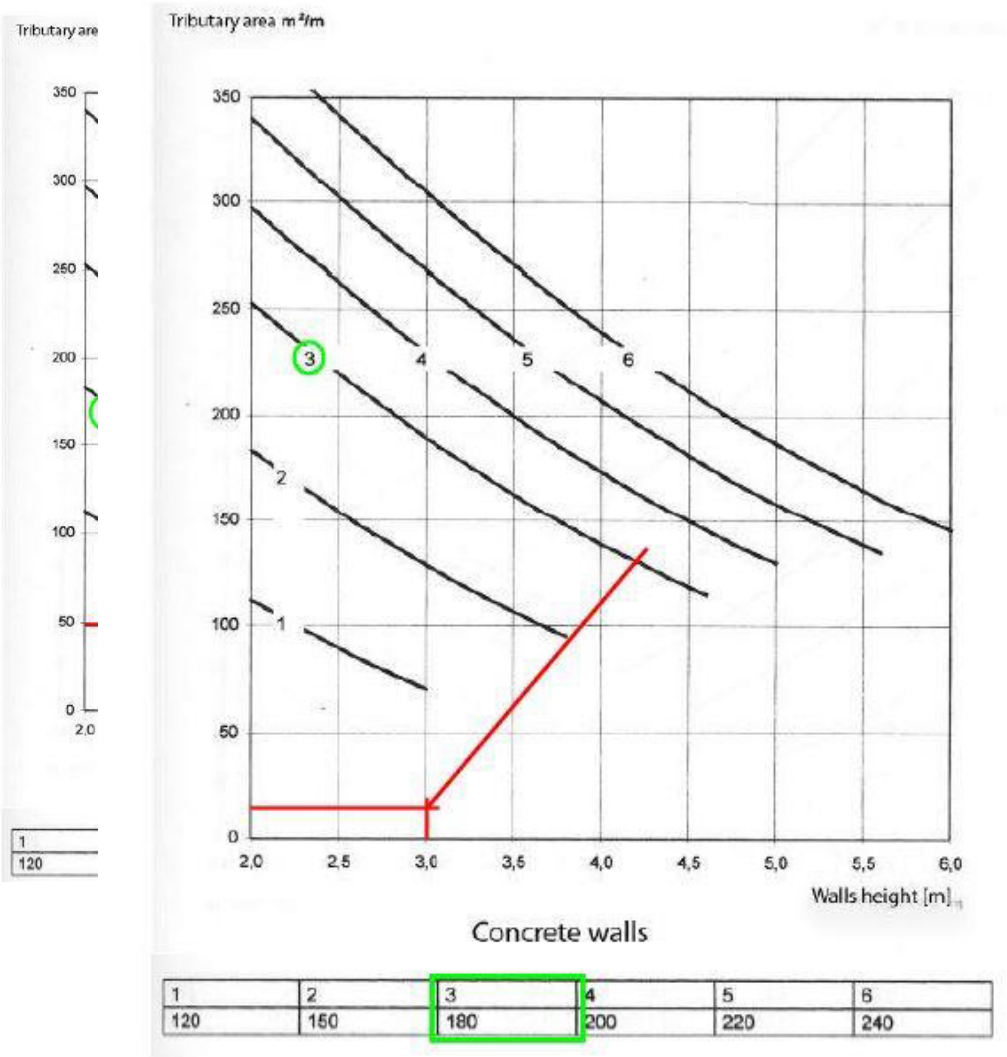
The external walls are made by prefabricated slabs concrete. Each one of them supports their own weight and the load area from center of the room. We calculate them this way:

The wall number 1 supports $(\frac{5.020}{2} + \frac{0.931}{2})$ of load area and its own weight.

Each wall has 3 meters of height, so:

$2.9755m * 1m * 2storeys + 3m * 1m * 2storeys = 11.95m^2/m$ of tributary area.

LOAD BE LOAD BEARING EXTERNAL WALL 1



The wall number 1 has to be minimum 180mm weight.

For the knowledge of all load bearing external walls, we follow the same way:

LOAD BEARING EXTERNAL WALLS. TRIBUTARY AREA												
Nr. Wall	Surface (m2)				Lenght (m)	Nr. Storeys	Total 1	Height (m)	Lenght (m)	Storeys	Total 2	Tributary area m2/m
1	2,510	0,466		**2,976**	1	2	5,951	3	1	2	6,000	11,951
2	0,466	1,760	3,164	**5,390**	1	2	10,779	3	1	2	6,000	16,779
3	2,510	0,466		**2,976**	1	2	5,951	3	1	2	6,000	11,951
4	2,510	0,466		**2,976**	1	2	5,951	3	1	2	6,000	11,951
5	0,466	1,760	3,164	**5,390**	1	2	10,779	3	1	2	6,000	16,779
6	2,510	0,466		**2,976**	1	2	5,951	3	1	2	6,000	11,951
7	4,031			**4,031**	1	4	16,124	3	1	4	12,000	28,124
8	4,050			**4,050**	1	4	16,200	3	1	4	12,000	28,200
9	4,050			**4,050**	1	4	16,200	3	1	4	12,000	28,200
10	4,031	2,621		**6,652**	1	4	26,608	3	1	4	12,000	38,608
11	4,050			**4,050**	1	4	16,200	3	1	4	12,000	28,200
12	4,050	2,621		**6,671**	1	4	26,684	3	1	4	12,000	38,684

LOAD BEARING INTERNAL WALLS. MIN. WIDTH			
Wall	Lenght	Height	Min. Widht
A	5,889	3	150
B	5,316	3	150
C	3,889	3	150
D	4,705	3	150
E	5,316	3	150
F	7,773	3	150

LOAD BEARING INTERNAL WALLS

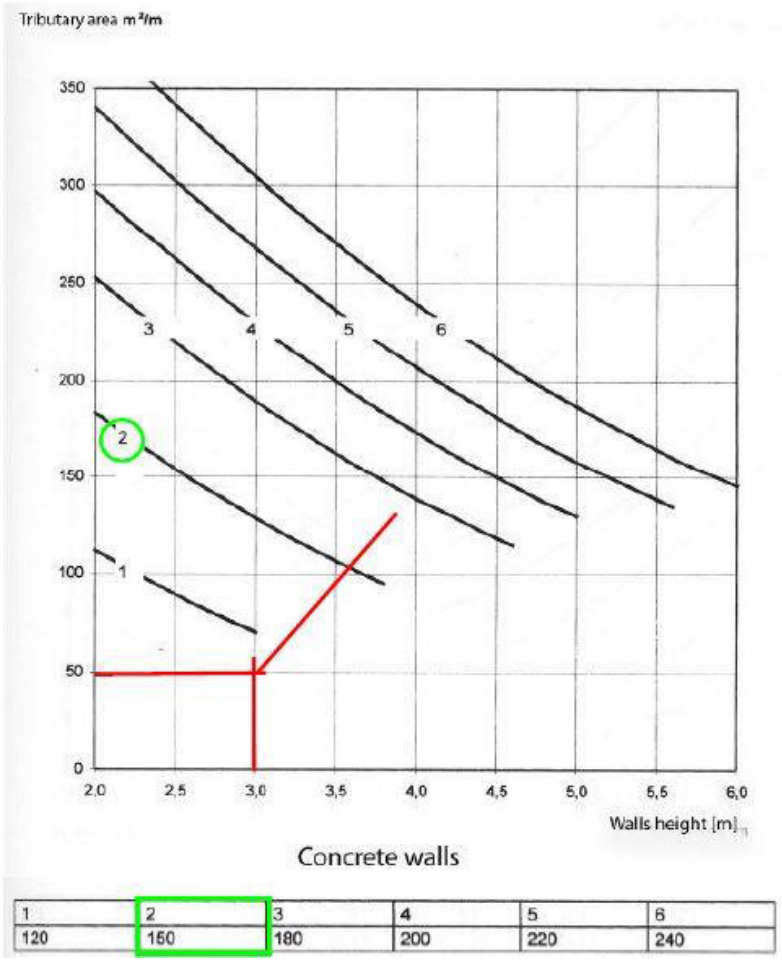
The internal walls are used like partitions of the dwellings and support the slab to make their length shorter. The loaded area is from the centre of the dwelling and the weight of the wall above.

For the wall called A, the calculation is:

$$(2.510 + 1.760 + 4.031 + 1.200)m^2 * 1m * 4storeys + 3m * 1m * 4storeys$$
$$= 50.004m^2$$

The wall A has to be minimum 150mm weight. The other walls are calculated the same way:

LOAD BEARING INTERNAL WALL A



+

LOAD BEARING INTERNAL WALLS. TRIBUTARY AREA													
Nr. Wall	Surface (m2)					Lenght (m)	Nr. Storeys	Total 1	Height (m)	Lenght (m)	Storeys	Total 2	Tributary are am2/m
A	2,510	1,760	4,031	1,200	**9,501**	1	4	38,004	3	1	4	12	50,004
B	1,200	3,164	2,621		**6,985**	1	4	27,940	3	1	4	12	39,940
C	2,510	1,200	4,050		**7,760**	1	4	31,040	3	1	4	12	43,040
D	2,510	1,200	4,050		**7,760**	1	4	31,040	3	1	4	12	43,040
E	3,164	1,200	5,292		**9,656**	1	4	38,624	3	1	4	12	50,624
F	1,760	2,510	1,200	4,050	**9,520**	1	4	38,080	3	1	4	12	50,080

LOAD BEARING INTERNAL WALLS. MIN. WIDTH			
Wall	Lenght	Height	Min. Widht
A	5,889	3	150
B	5,316	3	150
C	3,889	3	150
D	4,705	3	150
E	5,316	3	150
F	7,773	3	150

BEAMS

We have 6 different beams. They are placed in the facade where two apartments "go out" from the building. Each m2 is loaded with:

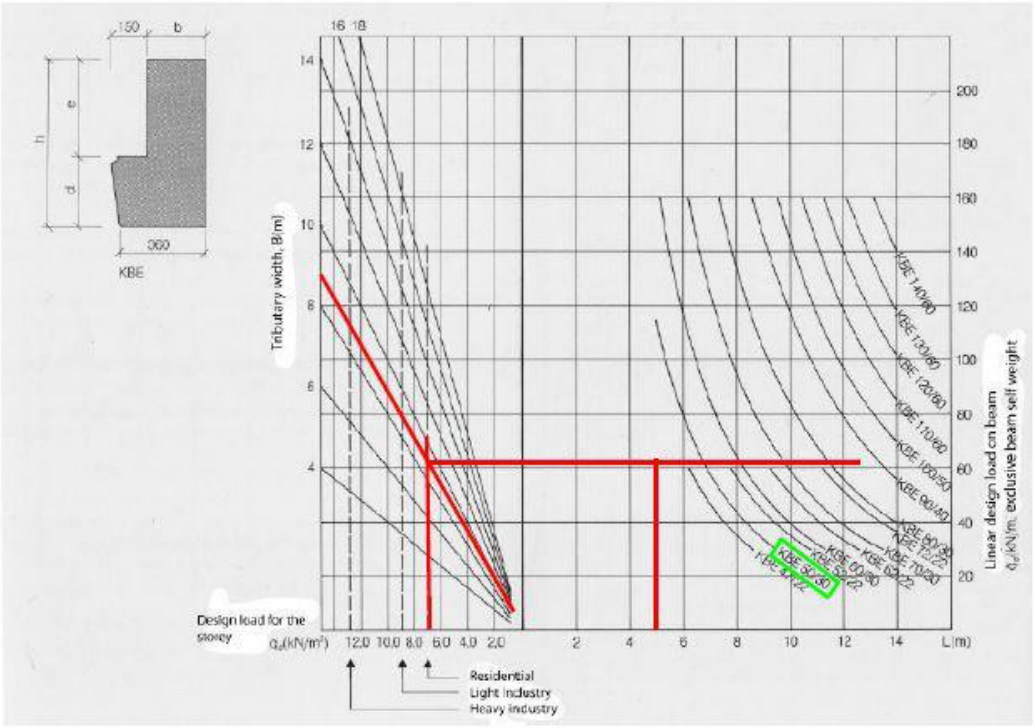
- Slabs: 3.13 kN/m2
- Imposed loads: 2.25kN/m2

To calculate the tributary area:

$$\left(\frac{3.13kN}{m^2} * \frac{2.25kN}{m^2}\right) + (3m * 0.588m) * 2\ storeys = 8.908kN/m$$

We are going to calculate the Beam I, and then a table with the results of the rest. Each beam, has the same properties, excepting the length, this way, we obtain the minimum dimensions of them:

BEAM I



BEAMS		
Beam	Lenght	Size of beam
I	5,185	KBE 50/30
II	2,978	KBE 50/31
III	4,105	KBE 50/32
IV	4,501	KBE 50/33
V	3,998	KBE 50/34
VI	6,379	KBE 50/35

COLUMNS

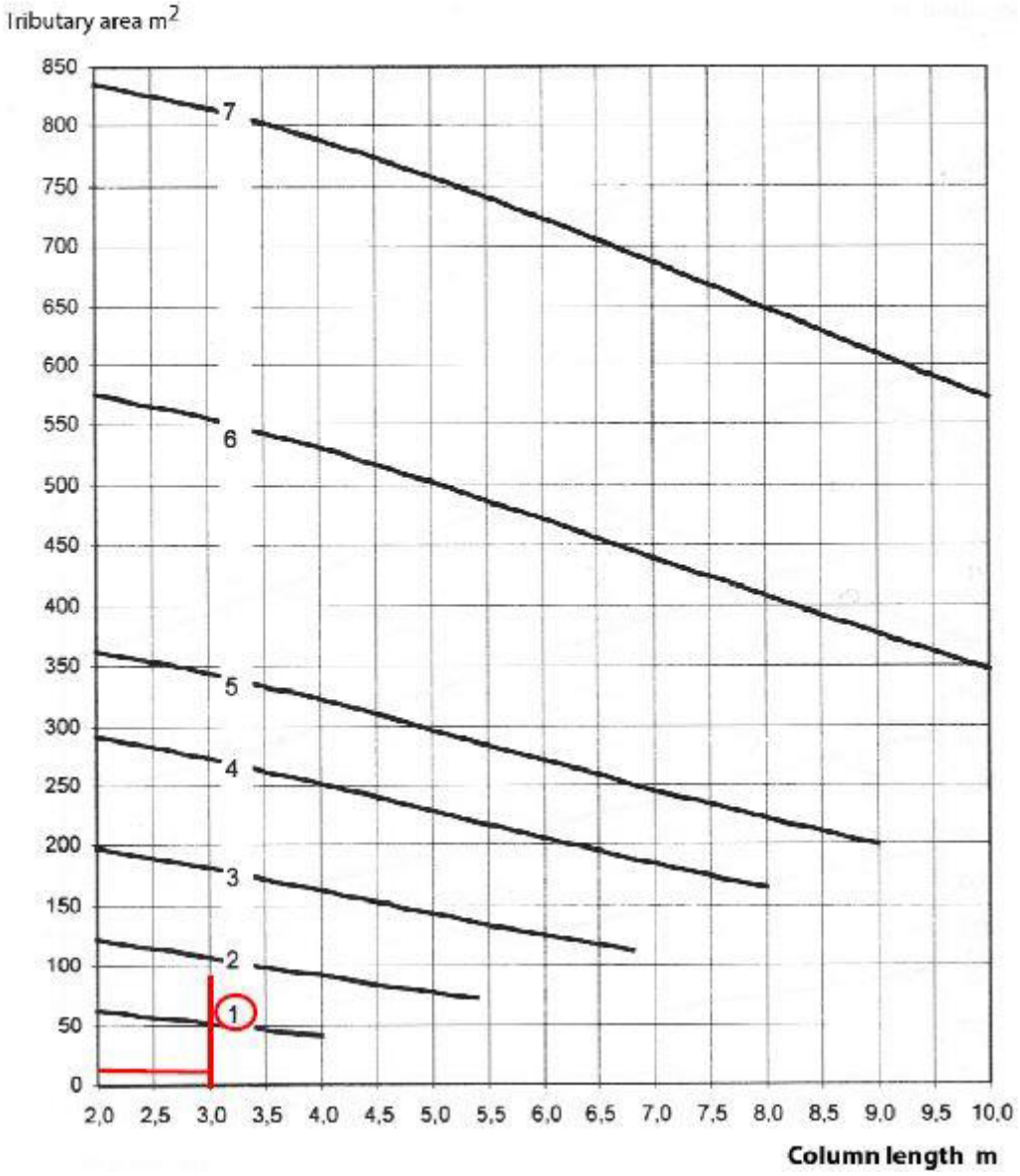
We have eight columns that suport the beams.

- Slab: 3.13 kN/m2
- Imposed load: 2.25kN/m2
- Column: we decided to choose the ones with 180mm of diameter, this way its weight will be: π*0.90^2*3m*25kN/m^2=5.30kN

We are going to calculate the column 1:

- Span of beam on column: $\frac{4.860m}{2}$=2.43m
- Tributary area☹ $\frac{4.680}{2} * 2\ storeys) + 3m * 2\ storeys = 10.68m^2$

1	2	3	4	5	6	7
Ø 180	Ø 240	Ø 300	Ø 360	Ø 400	Ø 500	Ø 600



Tributary area and minimum diameter							
Column	Span of beam on column (m)			Storeys	Hight (m)	**Tributary area (m2)**	**Minimum diameter (mm)**
1	2,430		**2,430**	2	3	**10,86**	**180**
2	2,430	1,489	**3,919**	2	3	**13,84**	**180**
3	1,489	1,865	**3,354**	2	3	**12,71**	**180**
4	1,865		**1,865**	2	3	**9,73**	**180**
5	2,108		**2,108**	2	3	**10,22**	**180**
6	2,108	1,999	**4,107**	2	3	**14,21**	**180**
7	1,999	3,047	**5,046**	2	3	**16,09**	**180**
8	3,047		**3,047**	2	3	**12,09**	**180**

The columns meet the requirements

EXTERNAL WALLS

They only support their own weight. As they have not any structural function, they are not been colored in the plan.

INTERNAL WALLS

They only support their own weight. As they have not any structural function, they are not been colored in the plan.

LOADS

$$S = \mu \cdot C_e \cdot C_t \cdot S_k$$

$\boldsymbol{\mu}$: snow load shape coefficient
$\boldsymbol{S_k}$: Snow load value on the ground for a given location
$\boldsymbol{C_e}$: Exposure coefficient
$\boldsymbol{C_t}$: Thermal coefficient

Ce and Ct are the same and they should be taken 1.0 otherwise specific areas in the topography.

Topography	C_e
Windswept [a]	0,8
Normal [b]	1,0
Sheltered [c]	1,2

[a] *Windswept topography*: flat unobstructed areas exposed on all sides without, or little shelter afforded by terrain, higher construction works or trees.

[b] *Normal topography*: areas where there is no significant removal of snow by wind on construction work, because of terrain, other construction works or trees.

[c] *Sheltered topography*: areas in which the construction work being considered is considerably lower than the surrounding terrain or surrounded by high trees and/or surrounded by higher construction works.

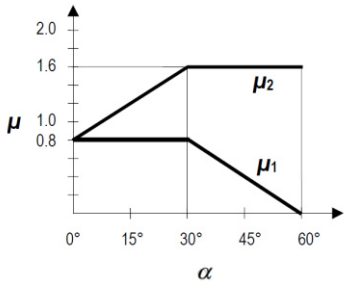


Figure 5.1: Snow load shape coefficients

$$\boldsymbol{S = \mu \cdot C_e \cdot C_t \cdot S_k = 0.8 \cdot 1.0 \cdot 1.0 \cdot 0.9 = 0.72\ kN/m^2}$$

IMPOSED LOADS

- Multi storey house in Horsens, Denmark.
- Domestic area
- Category A (Areas for domestic and residential activities)

Eurocode 1. Part 1-1. Danish National Annex.

CATEGORIES OF LOADED AREA	Eurocode 1 part 1-1 $q_K(kN/m^2)$	Danish National Annex $q_K(kN/m^2)$
Floors	1.5 to 2.0	1.5
Stairs	2.0 to 4.0	3
Balconies	2.5 to 4.0	2.5
Lofts	-	1

Table 6.2 - Imposed loads on floors, balconies and stairs in buildings

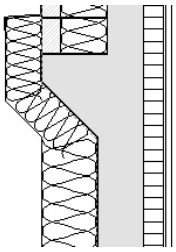
Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A		
- Floors	1,5 to2,0	2,0 to 3,0
- Stairs	2,0 to4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0

Table 6.2 - Imposed loads on floors, balconies and stairs in buildings

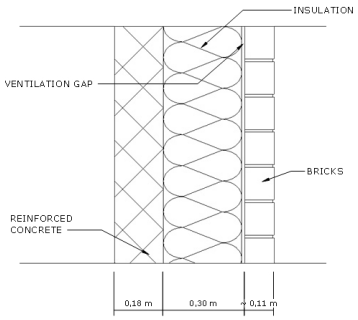
Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A - dwellings		
- A1 dwellings and internal access routes	1,5	2,0
- A2 eaves voids	0,5	0,5
- A3 lofts	1,0	0,5
- A4 stairs	3,0	2,0
- A5 balconies	2,5	2,0

SELF WEIGHT

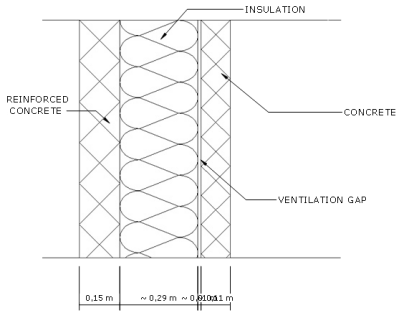
Basement walls				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Plaster	1	0,08	12	0,96
Polystyrene	1	0,31	0,4	0,124
Concrete	1	0,25	24	6
				7,084



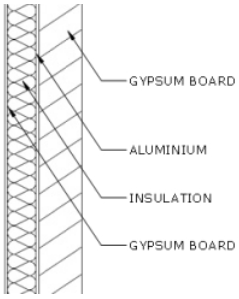
External walls				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Brick	1	0,108	21	2,268
Ventilation gap	1	0,012	0	0
Insulation	1	0,288	0,4	0,1152
Reinforced concrete	1	0,18	24	4,32
				6,7032



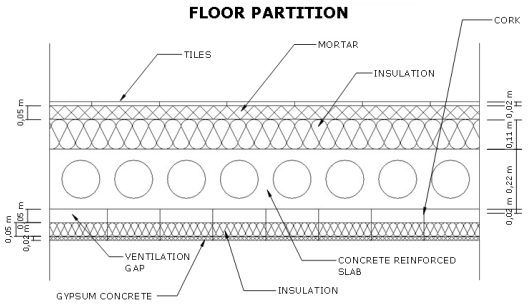
Internal load bearing walls				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Concrete	1	0,108	20	2,16
Ventilation gap	1	0,012	0	0
Insulation	1	0,3	0,4	0,12
Reinforced concrete	1	0,15	24	3,6
				5,88



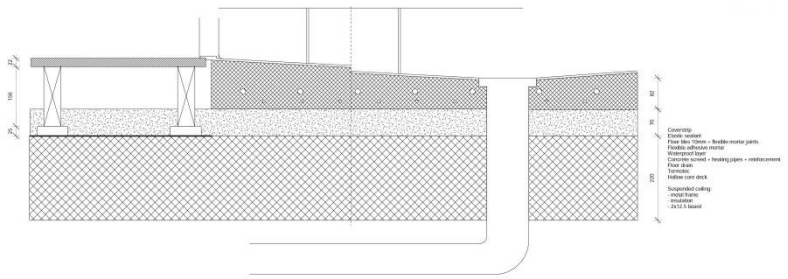
Internal non-loadbearing walls				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Gypsum board	1	0,015	12	0,18
Aluminium	0,05	0,001	27	0,00135
Insulation	0,95	0,1	0,4	0,038
Aluminium	0,05	0,01	27	0,00135
Gypsum board	1	0,015	12	0,18
				0,41285



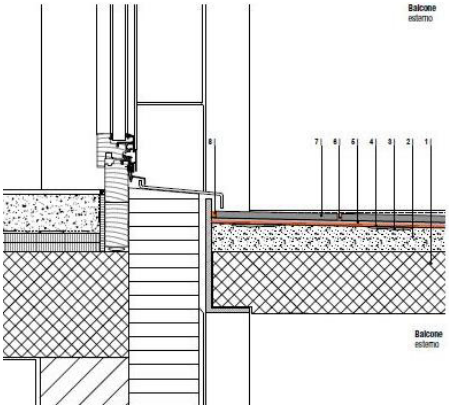
Floor partition				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Tiles	1	0,015	20	0,3
Mortar	1	0,07	19	1,33
Insulation	1	0,11	0,4	0,044
Concrete reinforced slab	1	0,22	3,13	0,6886
Ventilation gap	1	0,005	0	0
Insulation	1	0,005	0,4	0,002
Gypsum concrete	1	0,0015	12	0,018
Cork	1	0,115	0,2	0,023
				2,4056

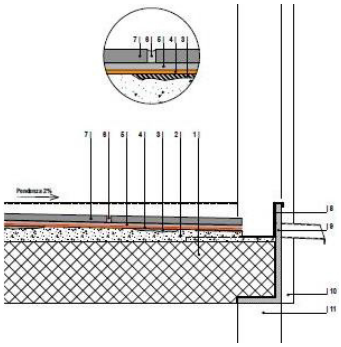


Floor partition - wet room				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Concrete	1	0,082	16	1,312
Insulation	1	0,07	0,3	0,021
Concrete	1	0,22	20	4,4
				5,733

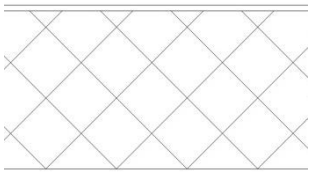


Balcony				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Concrete reinforced	1	0,22	24	5,28
Glass railing	1	0,02	25	0,5
Aluminium frame	1	0,04	27	1,08
				5,78

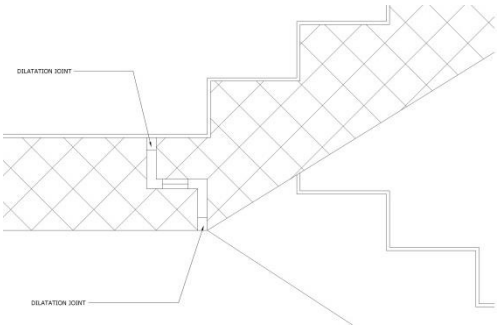




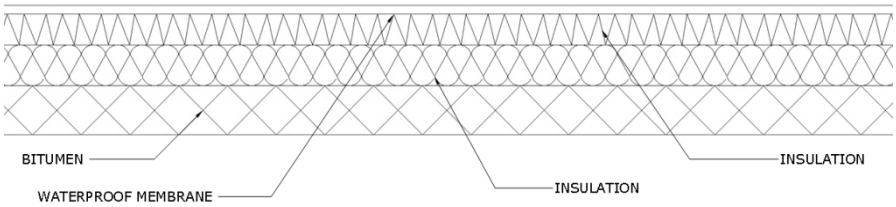
Staircase construction				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Rubber	1	0,1		0
Concrete	1	0,29	20	5,8
				5,8



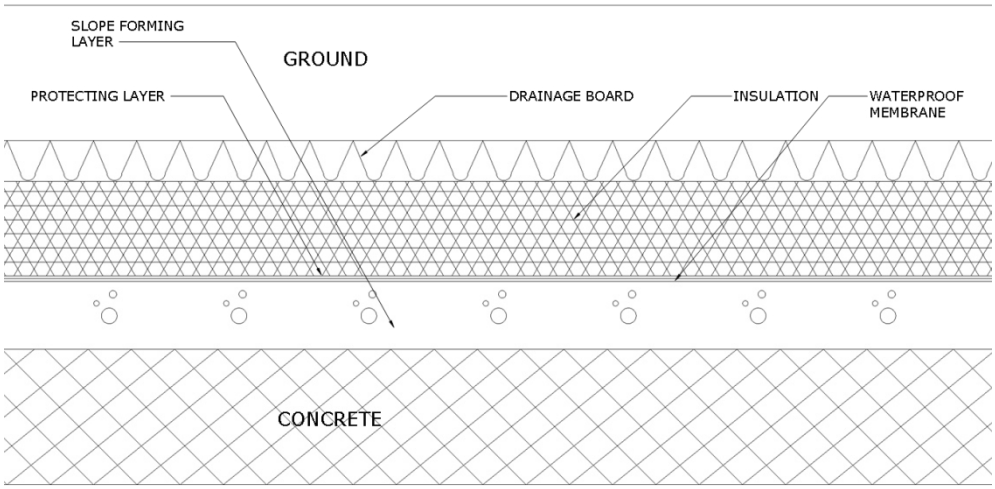
Stairs				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Rise	1	0,1665	24	3,996
Tread	1	0,28	24	6,72
				10,716



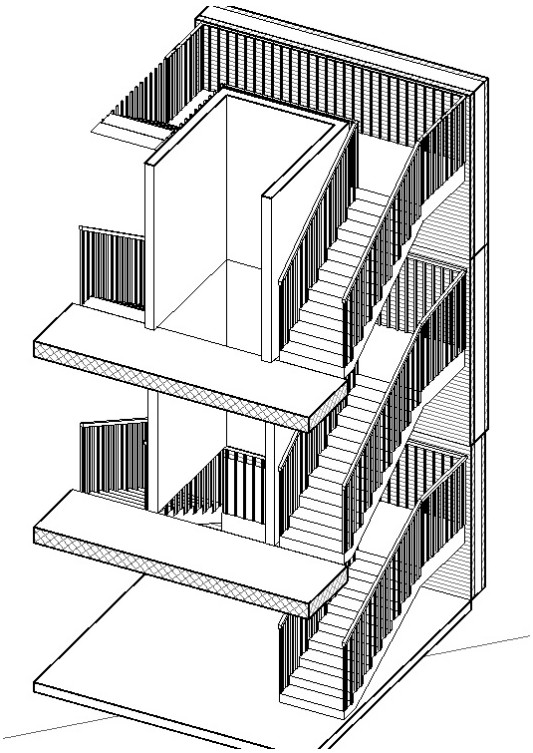
Roof construction				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Bitumen	1	0,33	14	4,62
Polystyrene	1	0,15	0,4	0,06
Polystyrene	1	0,112	0,4	0,0448
				4,68



Green roof construction				
Construction	CF	T [m]	ϒ [kN/m2]	g.k [kN/m2]
Concrete	1	0,5	24	12
Slope forming layer	1	0,25	27	6,75
Water proof membrane	1	0,1	1,6	0,16
Protecting layer	1	0,1	1,2	0,12
Insulation	1	0,35	0,5	0,175
Drainage board	1	0,15	10	1,5
Ground	1	0,35	15	5,25
				25,955



STAIRCASES ANALYSIS

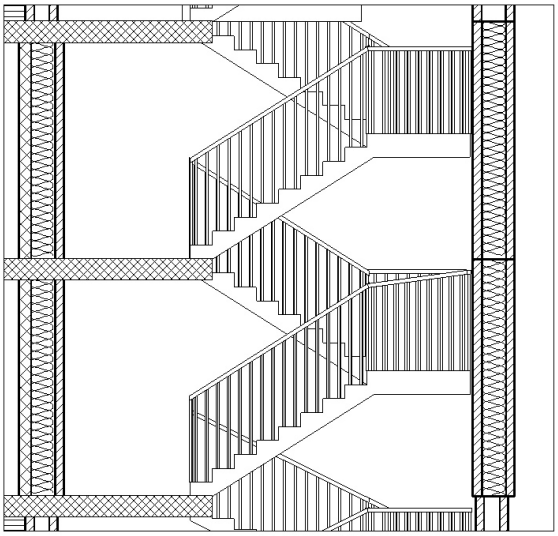


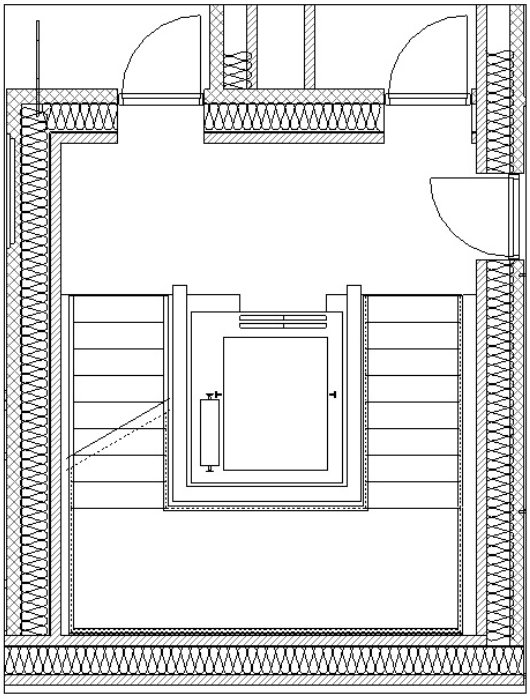
Material used M20 concrete FE 415 steel
Height between two floors 3000mm
Height of each flight 1500mm
Rise 166.5mm
Tread 280mm
Assuming a rise of 166mm and tread of 280mm
Number of risers for in each flight 9
Number of treads 9
Length of each flight 280x9 = 2520mm
Available length for landing 1237x4048 =
= 5007mm2

Loads

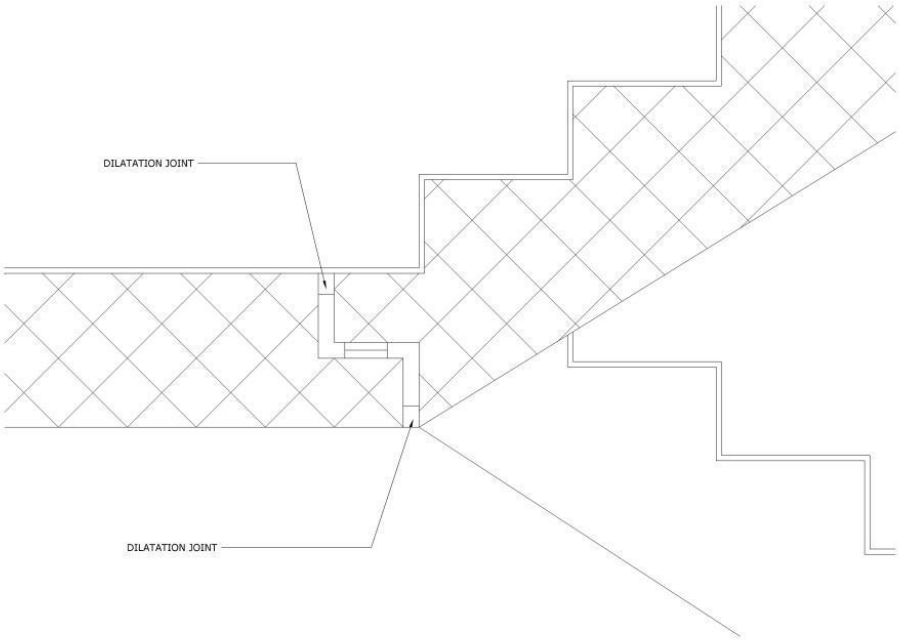
Assume thickness of waist slab 240mm
Weight of each step 0.17x0.28x24 = 1.142 kN/m2
Total number of treads 9
Total weight of steps in one floor 9X1.142 =
= 10.278 kN/m2

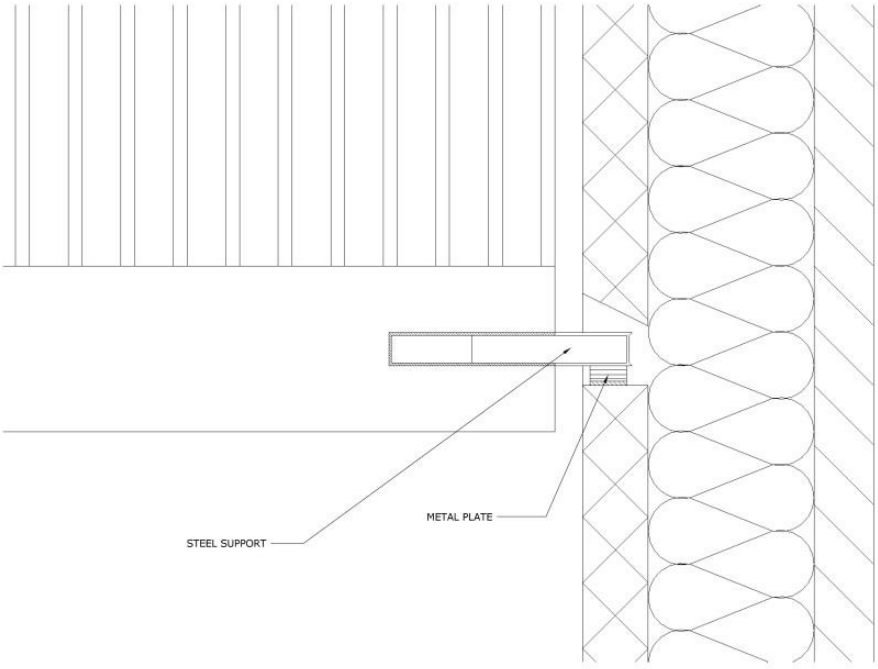
SECTION AND PLAN





Details.


DILATATION JOINT
DILATATION JOINT


METAL PLATE
STEEL SUPPORT

SOIL PARAMETERS

Type of soil.

•Material parameters for drained conditions.

The material parameters for cohesionless types of soil is angle of internal friction φ
Can be understood as the max. angle at which the material can be piled up.

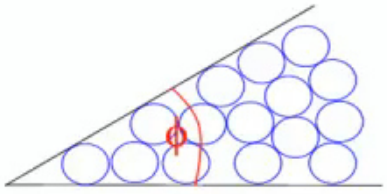


Fig. 8 Internal angle of friction

Angle of internal friction (ϕ)	
Rock	30°
Sand	30-40°
Gravel	35°
Silt	34°
Clay	20°
Loose sand	30-35°
Medium sand	40°
Dense sand	35-45°
Gravel with some sand	34-48°
Silt	26-35°

Fig. 9 Typical values of ϕ

The tributary area we are going to calculate the foundation has the conditions represented in Bore n.2 from level 38.25 to 37.45, and requires the following strength parameters:

Clay: Cv = 35 kN/m2

y/y´= 18/8 kN/m3

Situating the building in the site plan and going to it bore profile, we take 2500mm of basement walls and doing an intersection with Cvr and Cv lines and going down we get the numbers we will need later for the foundation calculation.

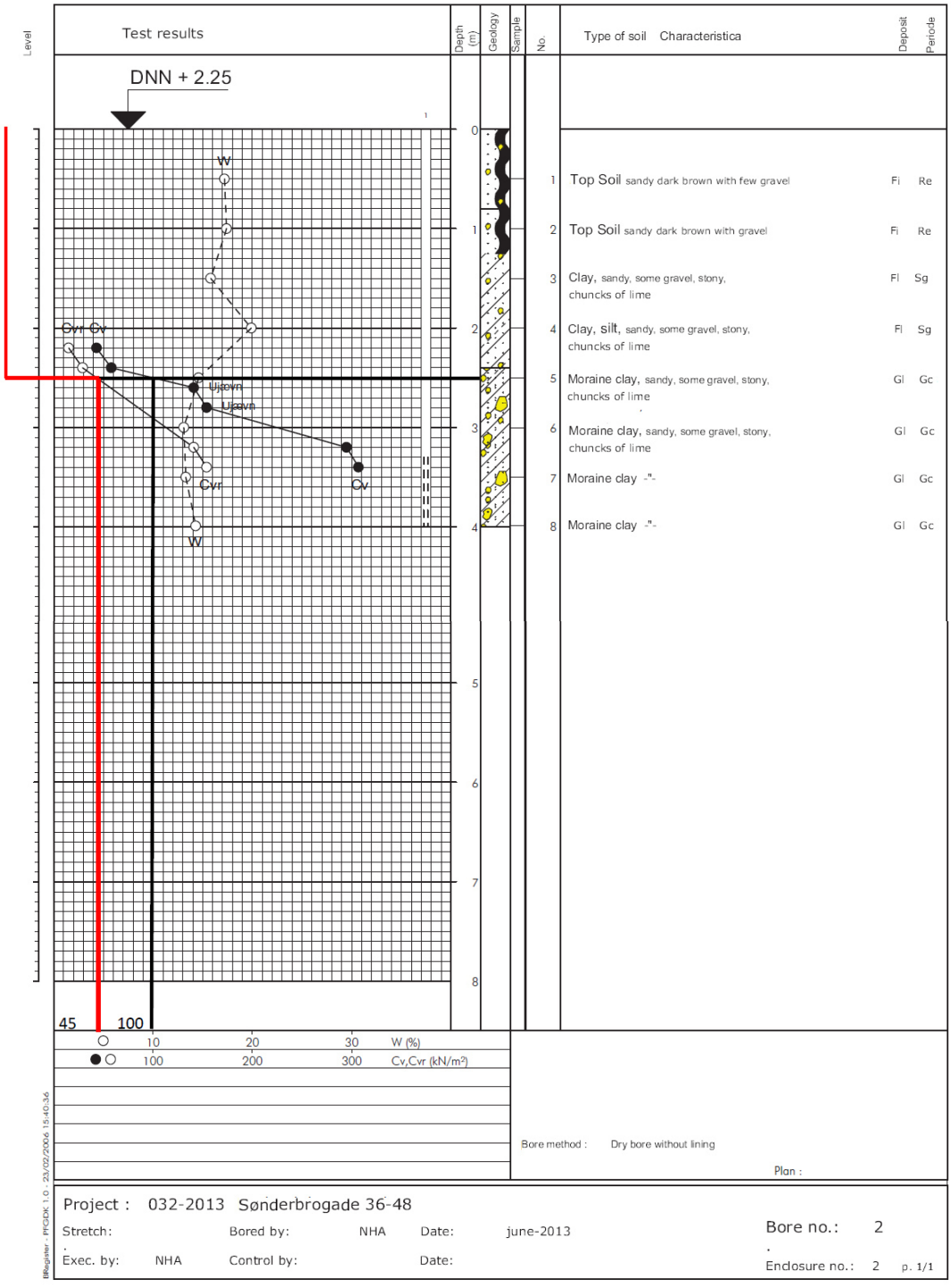
We get Cv = 45 and Cvr = 100. If we divided Cvr by Cv we should get a number less then 5. 100/45 = 2,2 <5.

If we look at the table we can check what type of soil we have.

With that heigh we will build the foundation in Moraine clay. Clay is not that good but we have also sand so we have to check both conditions.

The water table is under level foundation so we don´t have problem with ground water. It also means that when we are excavating the ground water will not coming into the excavation pit and we don't need to pump the water outside.

Bore profile



We are going to calculate two conditions: Undrained and drained conditions.
Undrained conditions has the formula

$$R/A' = (\pi+2)\ c_u\ b_c\ s_c\ i_c + q$$

Where
R is the load on the top of the soil.
A´ is the effective area which is compressed by foundations.
c_u is Cv.
The others are shape factors.
q is the overburden.

Drained conditions has the formula

$$R/A` = c'Nc\ b_c\ s_c\ i_c + q'Nq\ b_q\ s_q\ i_q + 0{,}5\ y'Ny\ b_y\ s_y\ i_y$$

Where
C is clay part that will disappeard because there is no clay in drained conditions.
q is the overburden, basically an extra soil construction permanent part that is there to reduce the uplift of the soil next to the foundation.
Y is the friction part.
The others factors are calculated by empiric formula and their result will be 1.

- q_1 = 2,5 m x 18 kN/m3 = 45 kN/m2
- q_2 =

Load on facade, Imposed load, wind dominant

Building component	Characteristic load			CC2		n	ψ_n	γ	a_n	Reduction factor for openings	Design load	Notes
	g [kN/m²]	q [kN/m²]	Tributary area span [m]	Load pr. meter [kN/m]	Consequense class factor	Category	Storeys	Combination factor	Safety factor	Storey reduction factor		Total load [kN/m]	
Dead load													
Roof	4,50		4,5	20,3	1,0			1	1,0		1,00	20,25	
Top floor	5,00		2,6	13,0	1,0			1	1,0		0,85	11,05	85% due to openings
Second floor	5,00		2,6	13,0	1,0			1	1,0		0,85	11,05	85% due to openings
First floor	5,00		2,6	13,0	1,0			1	1,0		0,85	11,05	85% due to openings
groundfloor	5,00		2,6	13,0	1,0			1	1,0		0,85	11,05	85% due to openings
Basement	5,00		2,6	13,0	1,0			1	1,0		0,85	11,05	85% due to openings
Wall first floor	4,20		3,0	12,6	1,0			1	1,0		0,85	10,71	85% due to openings
Wall second floor	6,10		3,0	18,3	1,0			1	1,0		0,85	15,56	85% due to openings
wall groundfloor	8,05		3,0	24,2	1,0			1	1,0		1,00	24,15	85% due to openings
wall basement	8,05		3,0	24,2	1,0			1	1,0		1,00	24,15	
Foundation	5,63		1,0	5,6	1,0			1	1,0		1,00	5,63	Estimate
										ΣG_d =		155,70	Total load pr. meter [kN/m]
Imposed loads													
Floors		1,50	0,6	0,9	1,0	A	2	0,5	1,5	0,75		0,68	non dominant imposed load, $\psi < a_n$
Staircase		3,00	1,5	4,5	1,0	A	2	0,5	1,5	0,75		3,38	non dominant imposed load, $\psi < a_n$
Balconies		2,50	1,5	3,8	1,0	A	2	0,5	1,5	0,75		2,81	non dominant imposed load, $\psi < a_n$
Lofts		1,00	2,5	2,5	1,0	A	2	0,5	1,5	0,75		1,88	non dominant imposed load, $\psi < a_n$
Office first floor		2,50	2,5	6,3	1,0	B	1	0,6	1,5	1,00		5,63	non dominant imposed load, $\psi < a_n$
										ΣQd =		14,36	
Climatic loads													
Snow		0,72	16,1	11,6	1,0			0,3	1,5			5,21	
										ΣS_d =		5,21	Total load pr. meter [kN/m]
										$\Sigma Gd + \Sigma Qd + \Sigma Sd$ =		175,27	Total load pr. meter [kN/m]

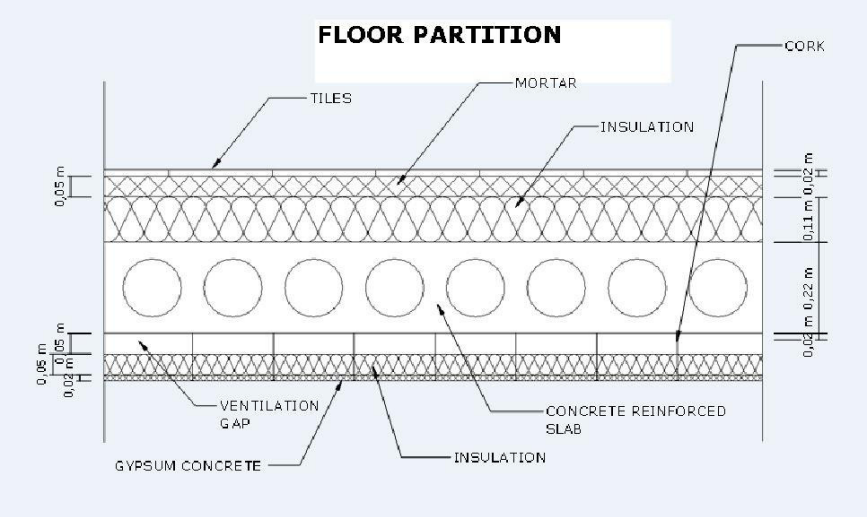
So finally we get:

$$A' = \frac{175{,}27kN}{5{,}14 \cdot 25 \cdot 5{,}25} = 0{,}25 \text{ m} = 250 \text{ mm}$$

FOUNDATION CALCULATION

STRUCTURE

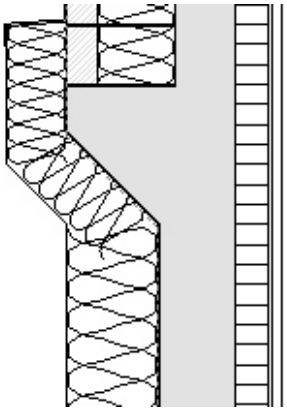
FLOOR PARTITION



- Tiles: 0.3 kN/m^2
- Mortar: 1.33 kN/m^2
- Insulation: 0.044 kN/m^2
- Concrete reinforced slabs: 0.6886 kN/m^2
- Insulation: 0.002 kN/m^2
- Gypsum concrete: 0.018 kN/m^2
- Cork: 0.023 kN/m^2

TOTAL: 2.4056 kN/m^2

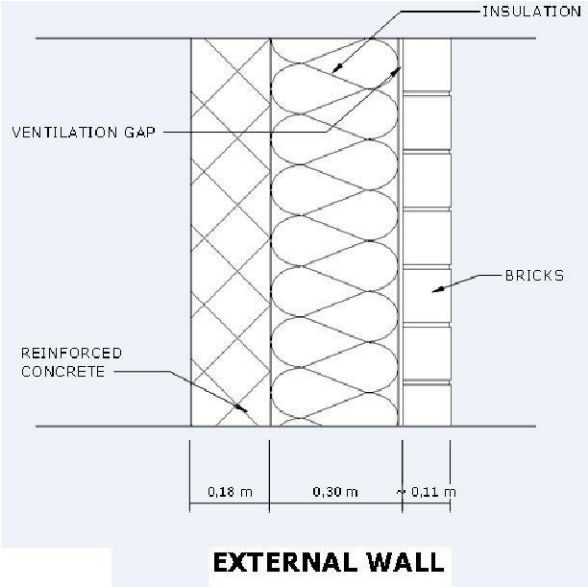
BASEMENT WALL



- Plaster: 0.96 kN/m^2
- Polystyrene: 0.124 kN/m^2
- Concrete: 6 kN/m^2

TOTAL: 7.08 kN/m^2

EXTERNAL WALL

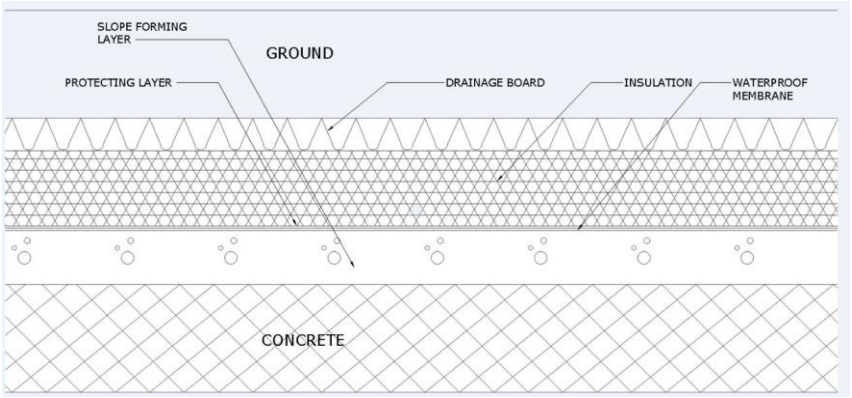


EXTERNAL WALL

- Brick: 2.26 kN/m^2
- Insulation: 0.1152 kN/m^2
- Reinforced concrete: 4.32 kN/m^2

TOTAL: 6.7032 kN/m^2

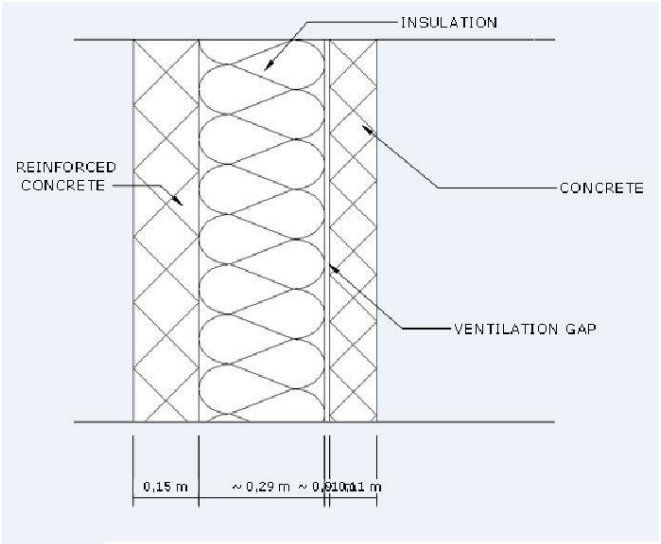
GREEN ROOF



- Concrete: 12 kN/m^2
- Slope forming layer: 6.75 kN/m^2
- Water proof membrane: 0.16 kN/m^2
- Protecting layer: 0.12 kN/m^2
- Insulation: 0.175 kN/m^2
- Drainage board: 1.5 kN/m^2
- Ground: 5.25 kN/m^2

TOTAL: 25.955 kN/m^2

INTERNAL LOAD BEARING WALLS

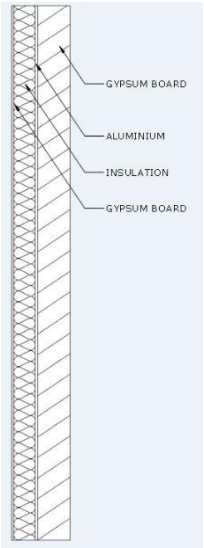


INTERNAL LOAD BEARING WALL

- Concrete: 2.16 kN/m^2
- Insulation: 0.12 kN/m^2
- Reinforced concrete: 3.6 kN/m^2

TOTAL: 5.88 kN/m^2

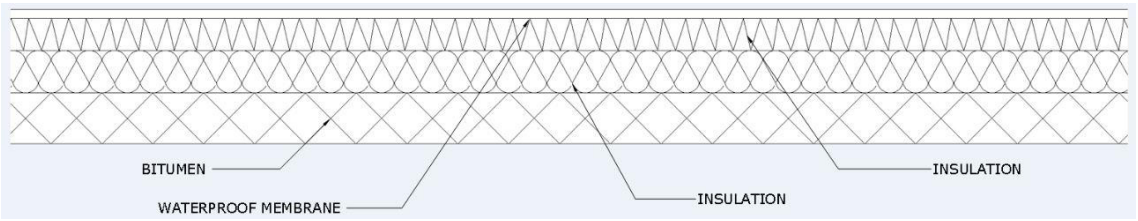
INTERNAL WALLS



- Gypsum board: 0.18 kN/m^2
- Aluminium: 0.00135 kN/m^2
- Insulation: 0.038 kN/m^2
- Aluminium: 0.00135 kN/m^2
- Gypsum board: 0.18 kN/m^2

TOTAL: 0.41285 kN/m^2

ROOF

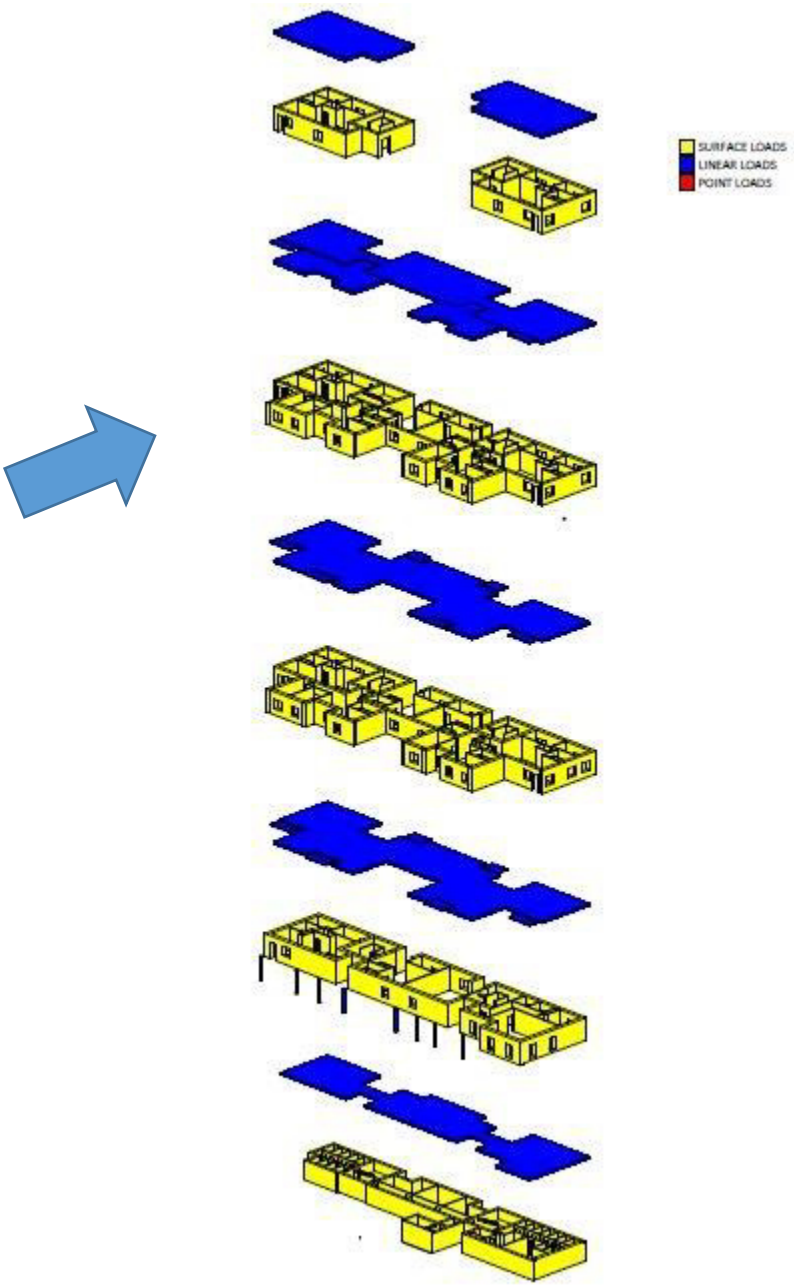


- Bitumen: 4.62 kN/m^2
- Polystyrene: 0.06 kN/m^2
- Polystyrene: 0.0448 kN/m^2

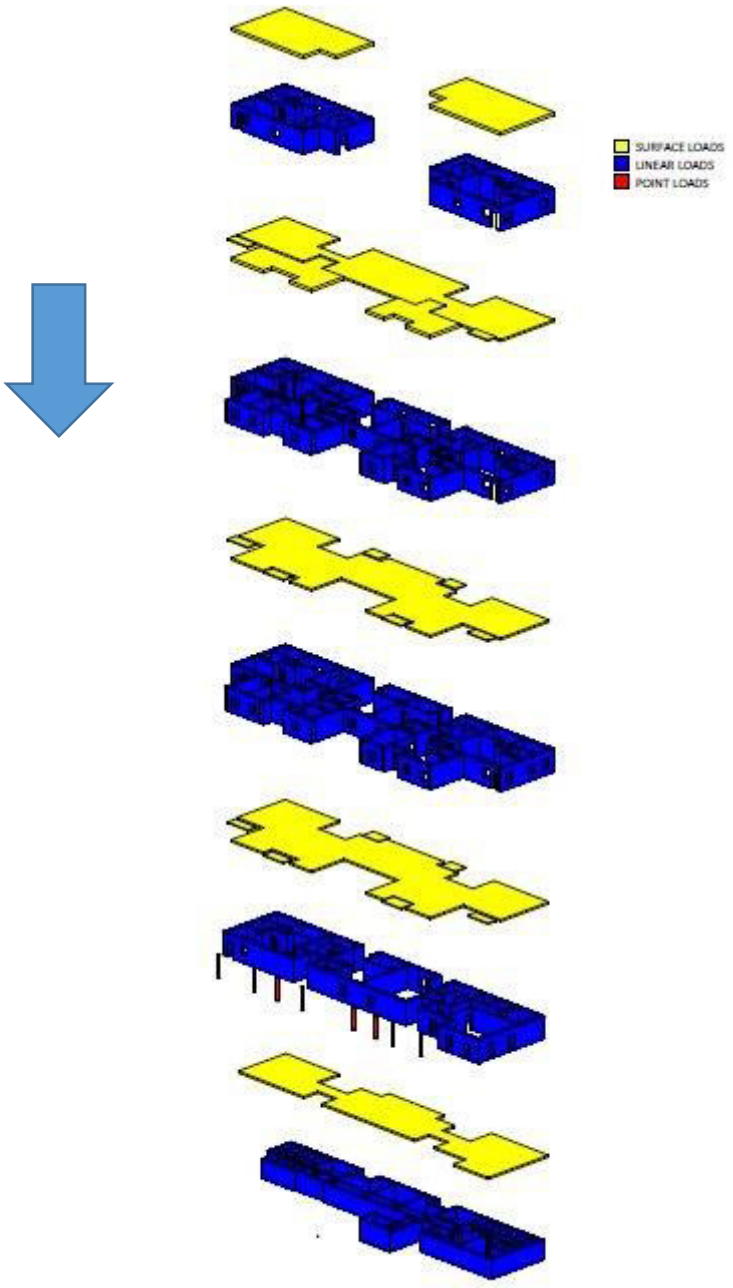
TOTAL: 4.68 kN/m^2

STRUCTURAL ANALYSIS

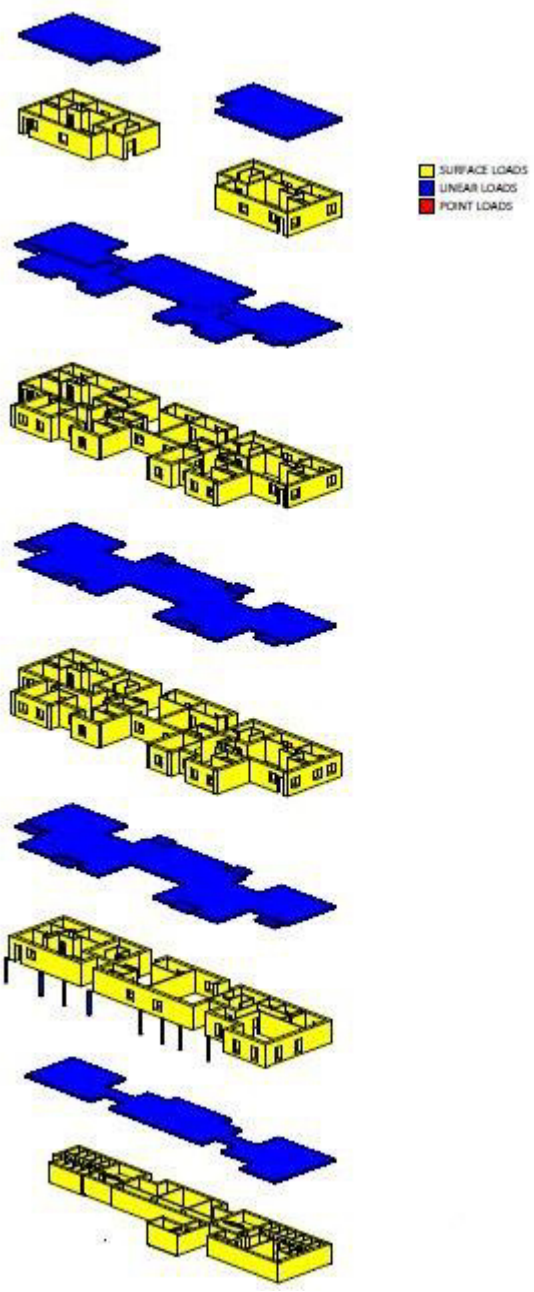
HORIZONTAL LOADS



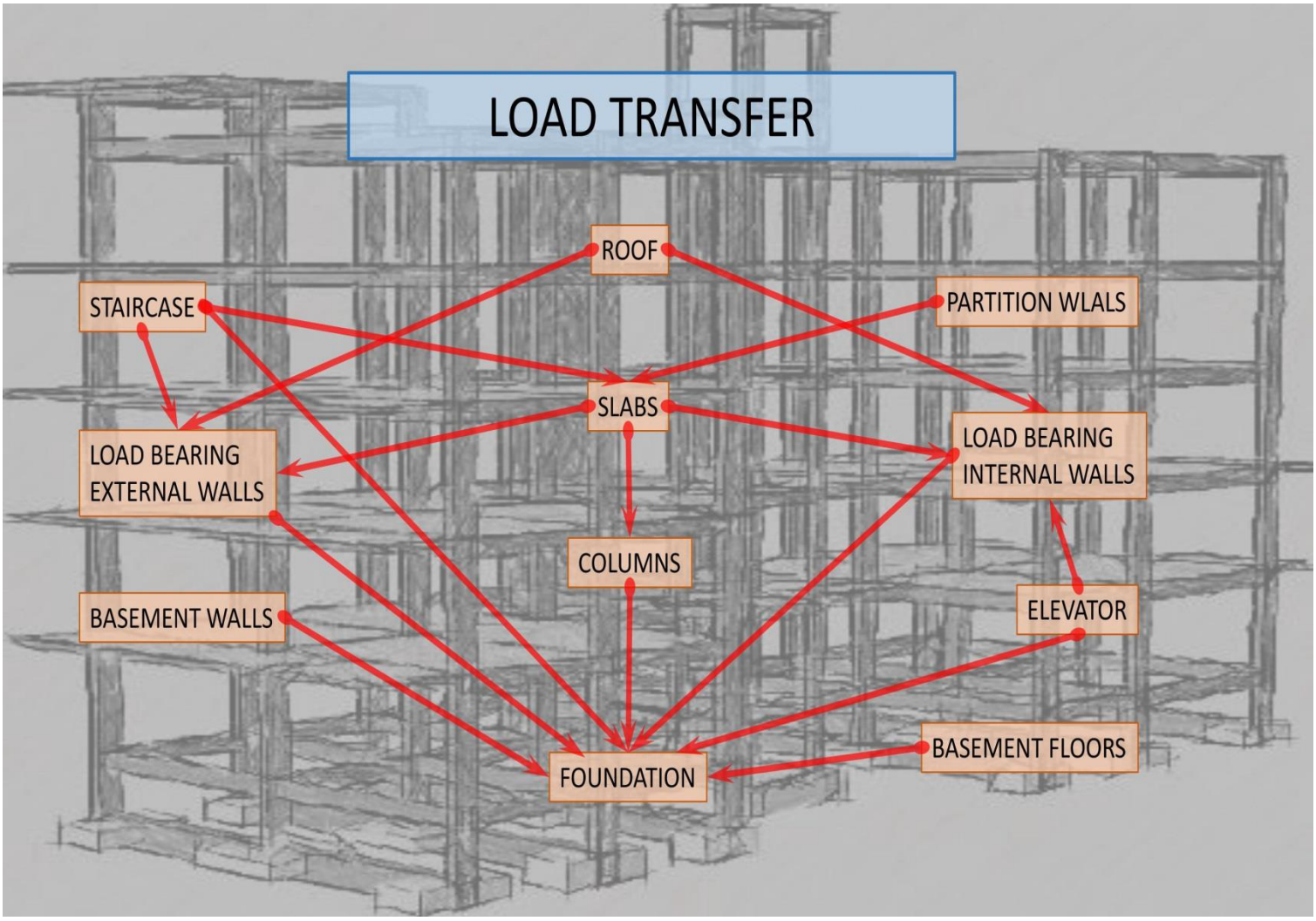
VERTICAL LOADS



HORIZONTAL LOADS

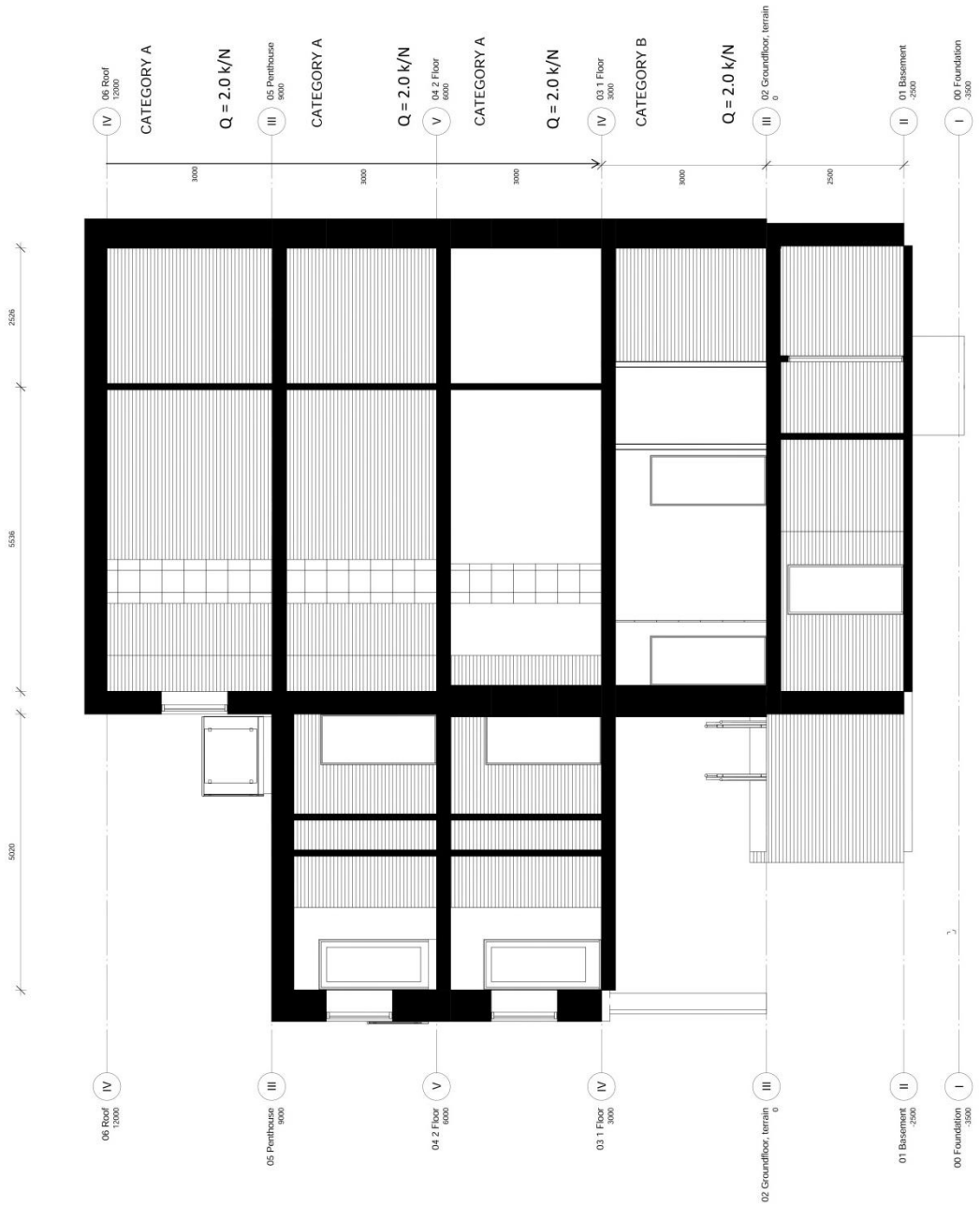


LOAD TRANSFER



DETAILS

Loads section.

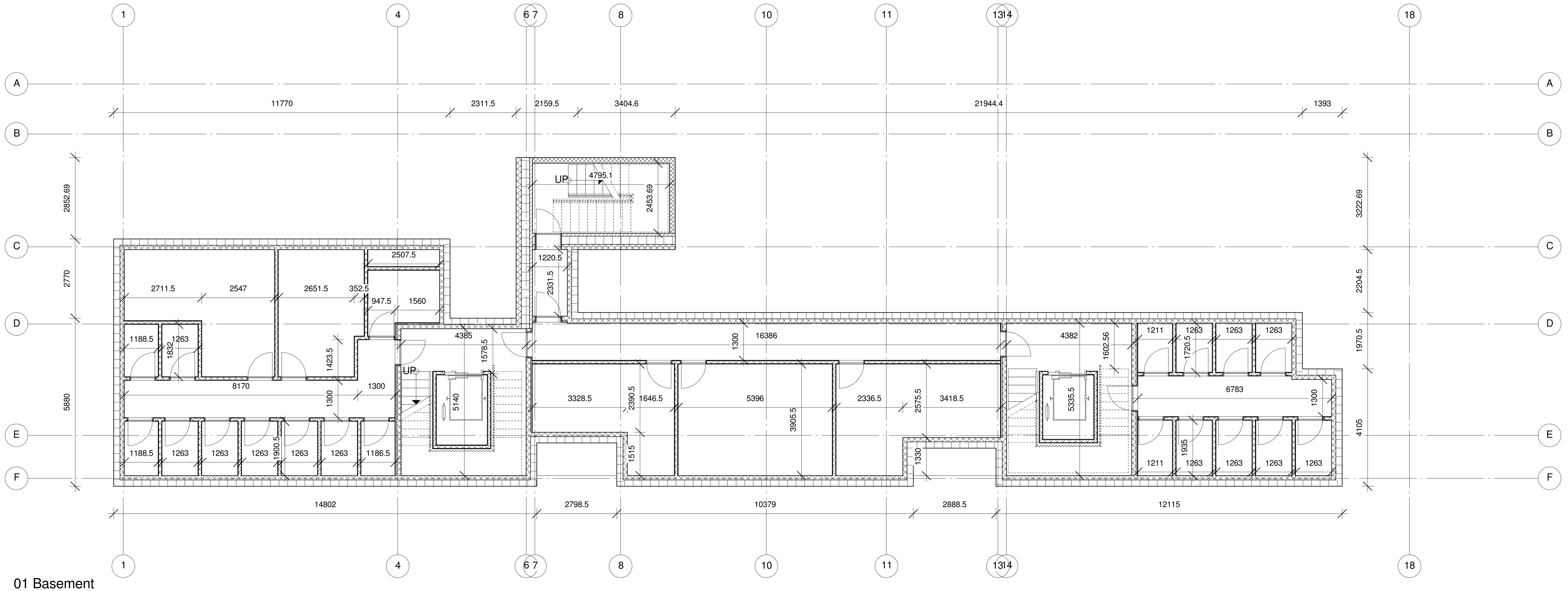


3. ANEXO 3 (DETAIL 1)

3.1. BUILDING DESIGN

3.1.1. Floor Plans

K01_TXX_H7_EX_N19



01 Basement
1 : 100

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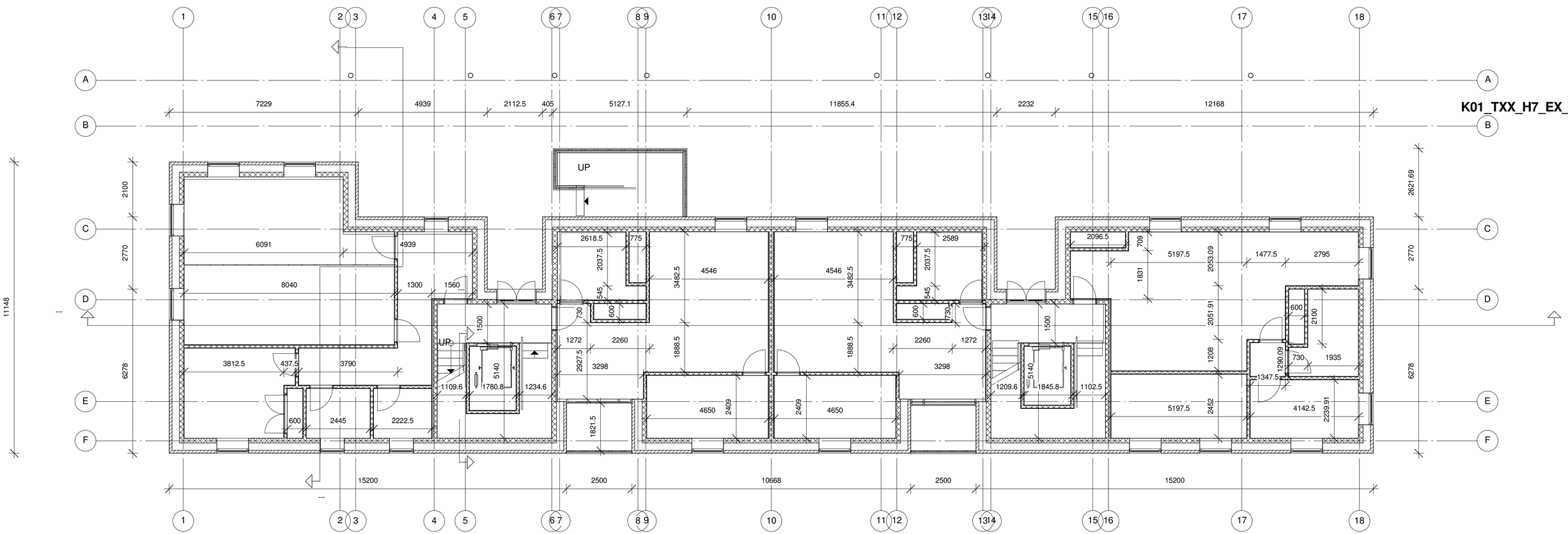
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/22/15	K01_TXX_H7_EX_N19
SUBJECT: Basement plan	SCALE: 1 : 100	
DRAWN BY:	CLASS: AH42S15	



02 Groundfloor, terrain
1 : 100

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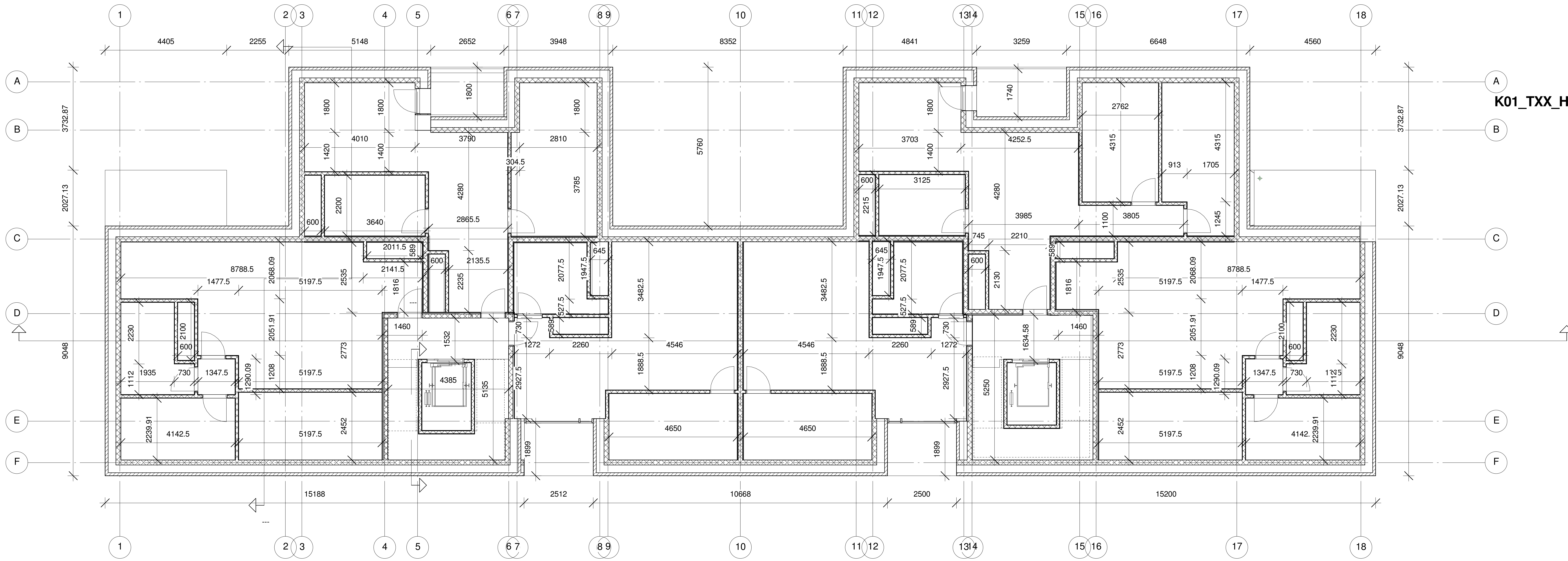
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/22/15	**K01_TXX_H7_EX_N18**
SUBJECT: Ground floor plan	SCALE: 1 : 100	
DRAWN BY: a L[QLWXLIa L[^QI	CLASS:	

K01_TXX_H7_EX_N20



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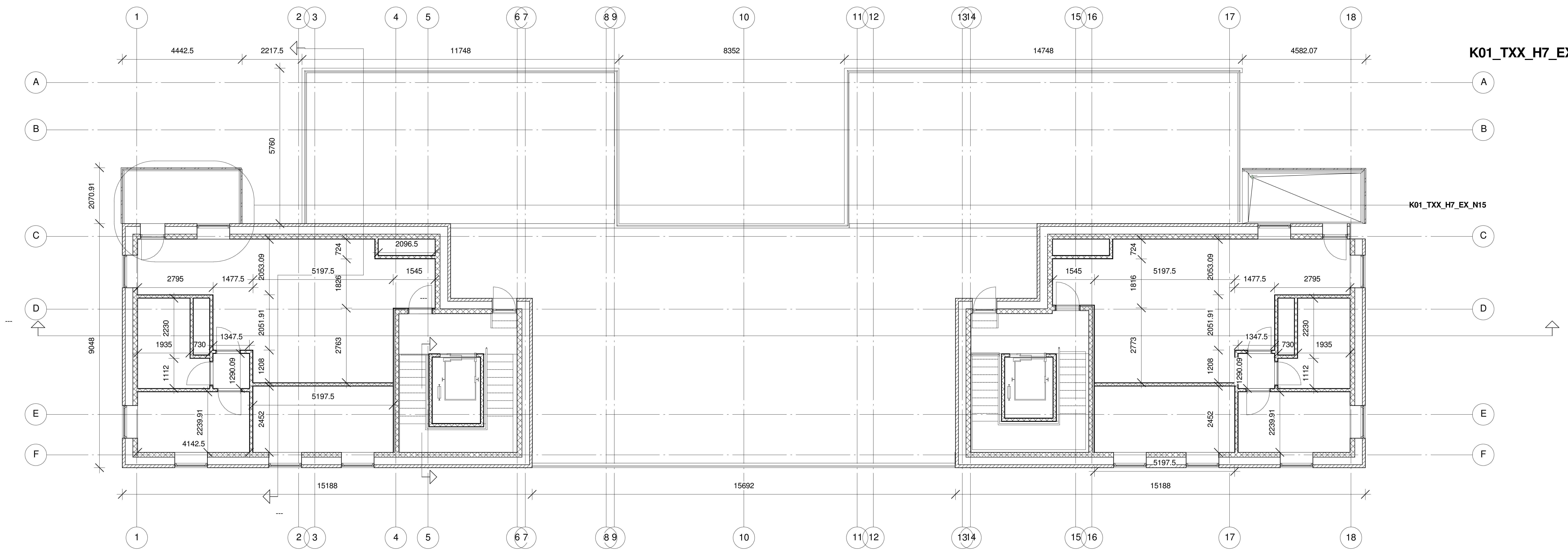
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/22/15	K01_TXX_H7_EX_N20
SUBJECT: First and second floor plan	SCALE: 1 : 100	
DRAWN BY:	CLASS: AH42S15	

K01_TXX_H7_EX_N22



05 Penthouse balcony
1 : 100

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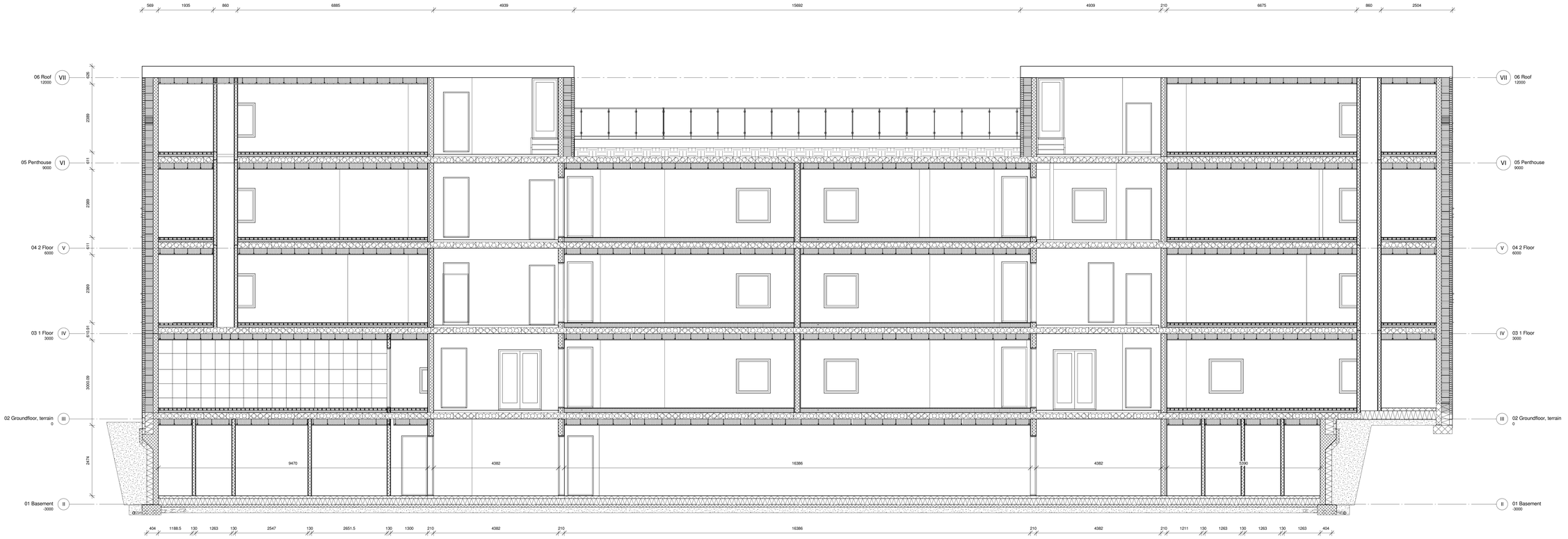
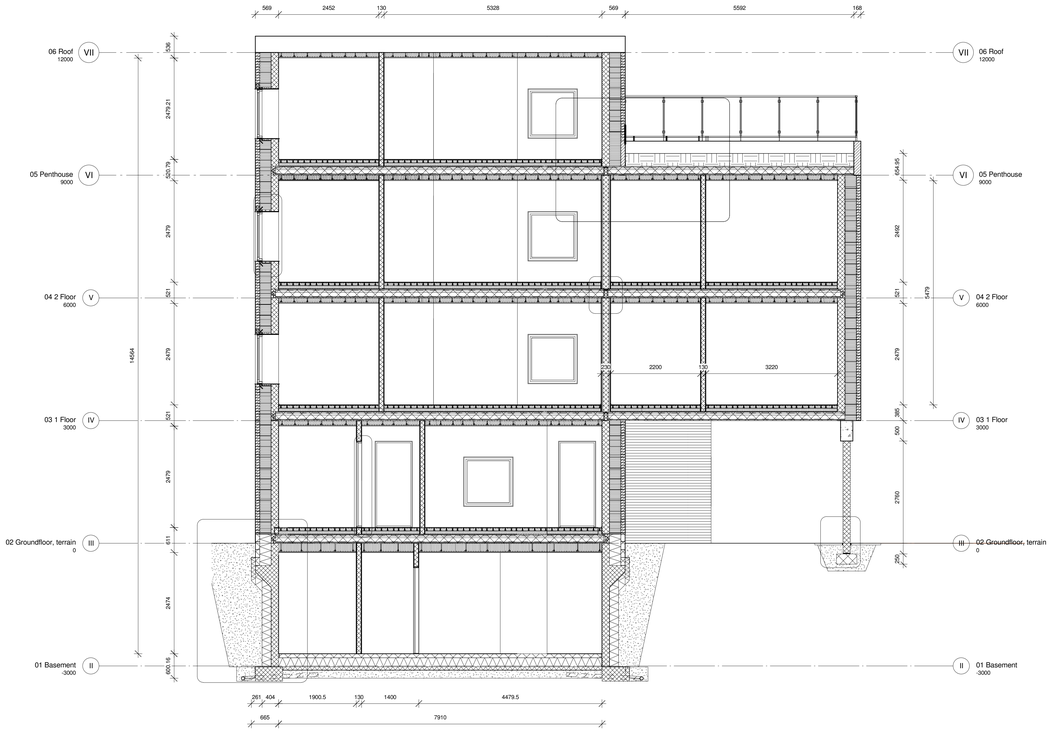
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/22/15	**K01_TXX_H7_EX_N22**
SUBJECT: Penthouse plan	SCALE: 1 : 100	
DRAWN BY: a [illegible]	CLASS: AH42S15	

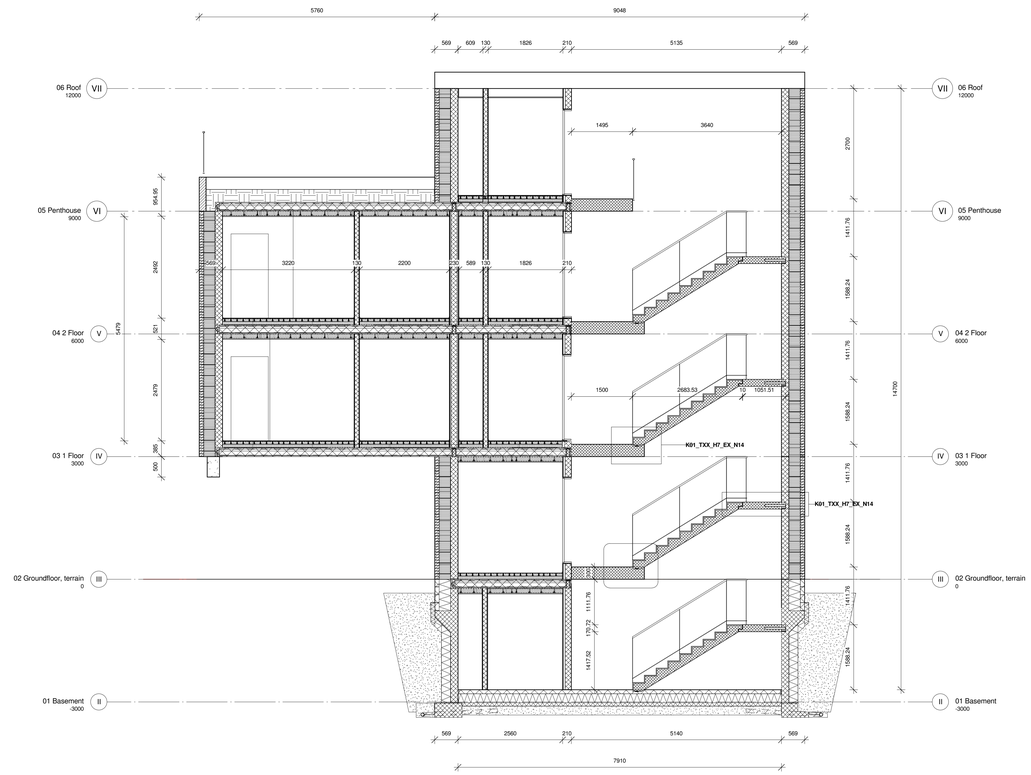
3.1.2. Sections



00 Section 1
1 : 50



00 Section 2
1 : 50



00 Section 3
1 : 50

K01_TXX_H7_EX_N27

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TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/23/15	K01_TXX_H7_EX_N27
SUBJECT: Sections	SCALE: 1 : 50	
DRAWN BY: a L[¶L]W%[]]a L[¶GI	CLASS: AH42S15	

3.1.3. Elevations

East
1 : 50

West
1 : 50

K01_TXX_H7_EX_N30

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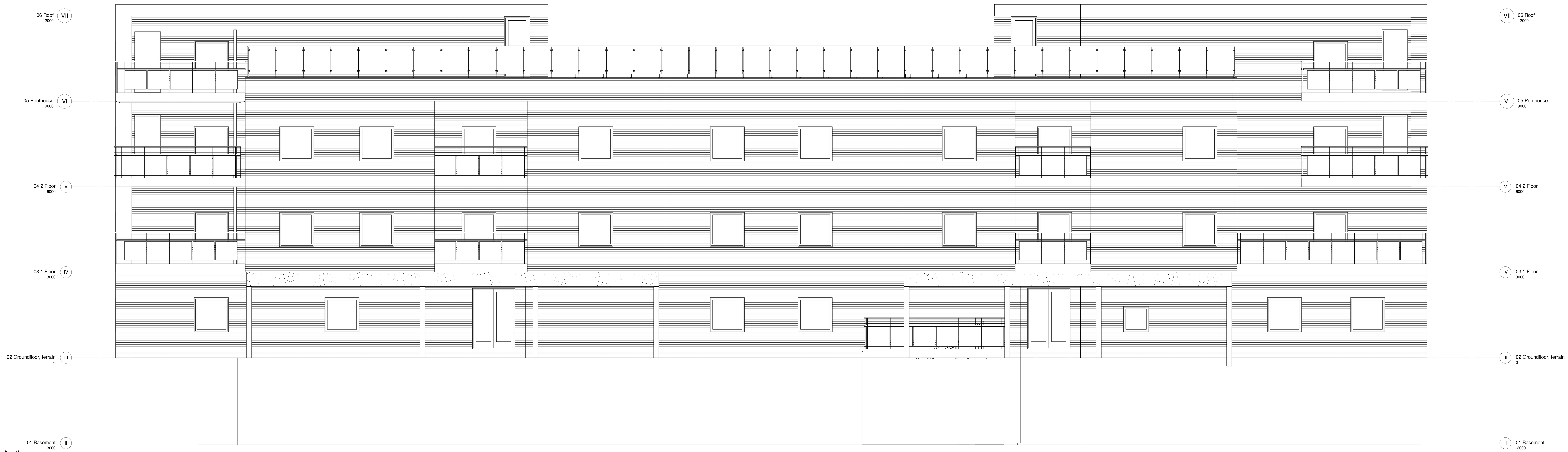
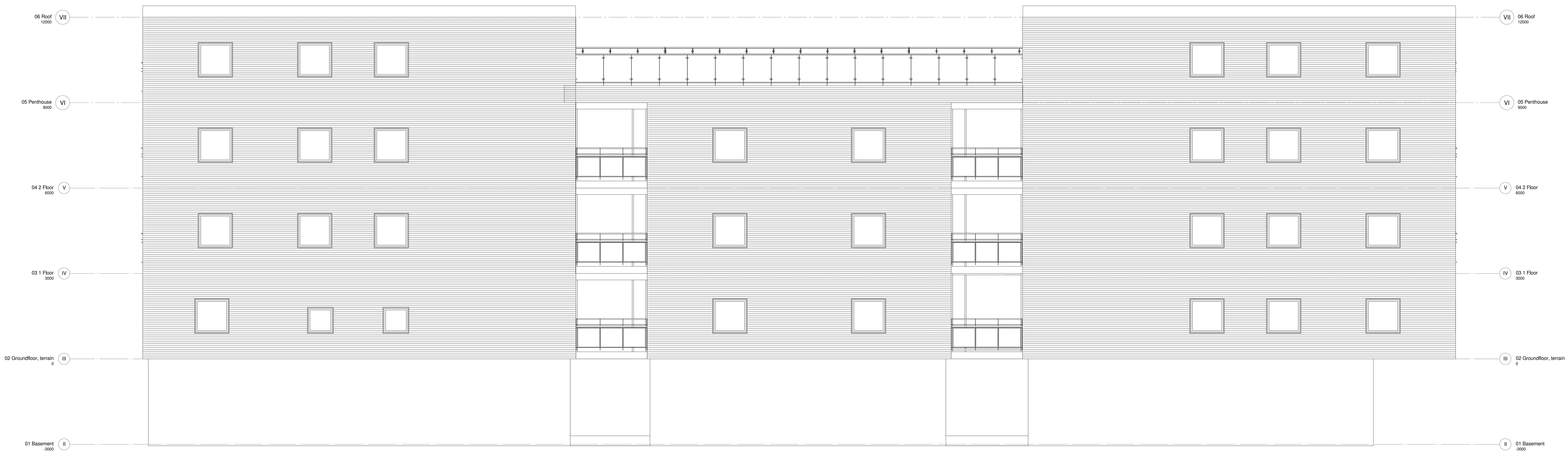
PROJECT: MULTI-STOREY HOUSING	DATE: 06/23/15	**K01_TXX_H7_EX_N30**
SUBJECT: East and West elevations	SCALE: 1 : 50	
DRAWN BY: a LQLWSLLLa LQLGL	CLASS: AH42S15	



North
1 : 50



South
1 : 50

K01_TXX_H7_EX_N23

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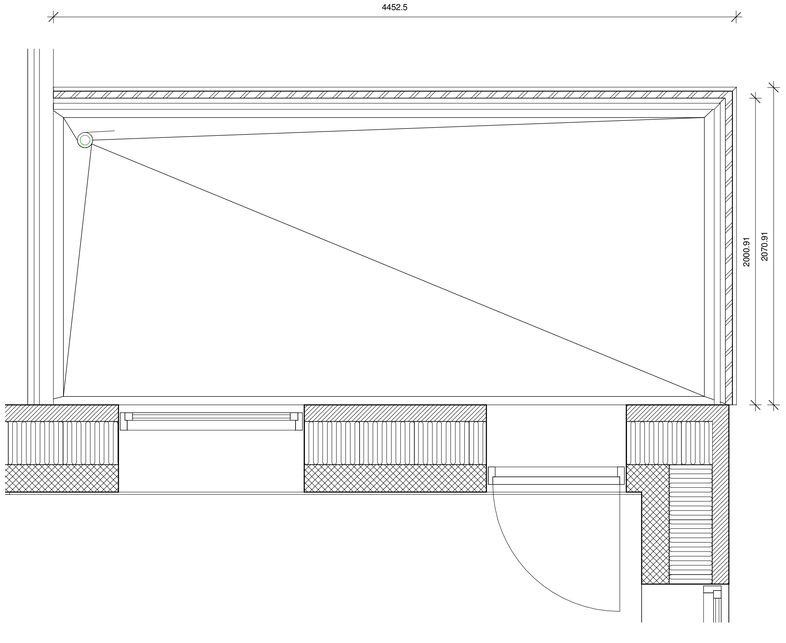
TYPE CITY

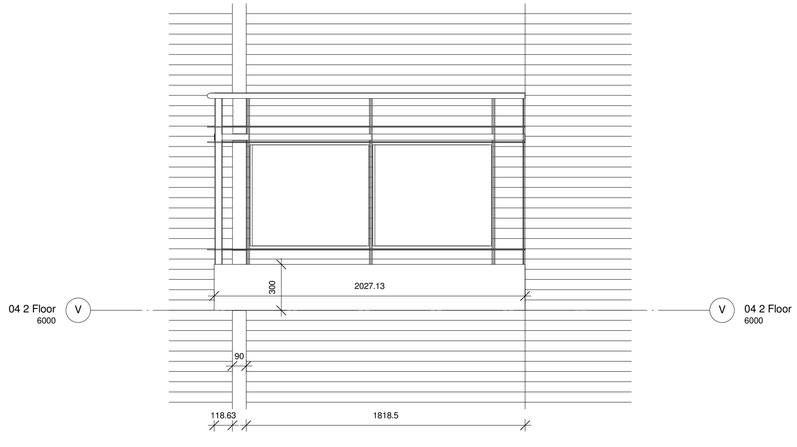
PROJECT: MULTI-STOREY HOUSING	DATE: 06/23/15	**K01_TXX_H7_EX_N23**
SUBJECT: North and South elevations	SCALE: 1 : 50	
DRAWN BY: [illegible]	CLASS: AH42S15	

4. ANEXO 4 (DETAIL 2)

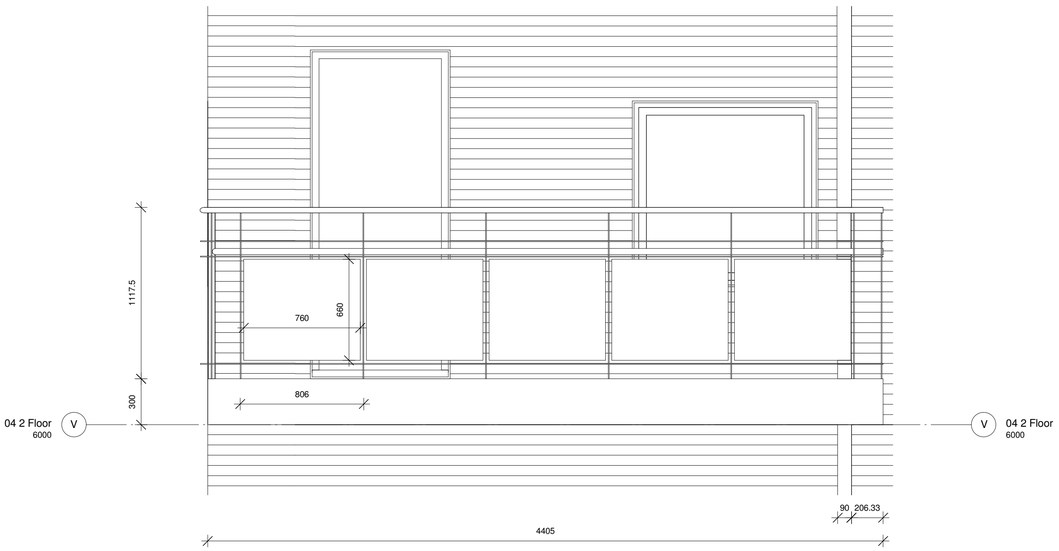
4.1. DESIGN SPECIALIZATION – BALCONIES



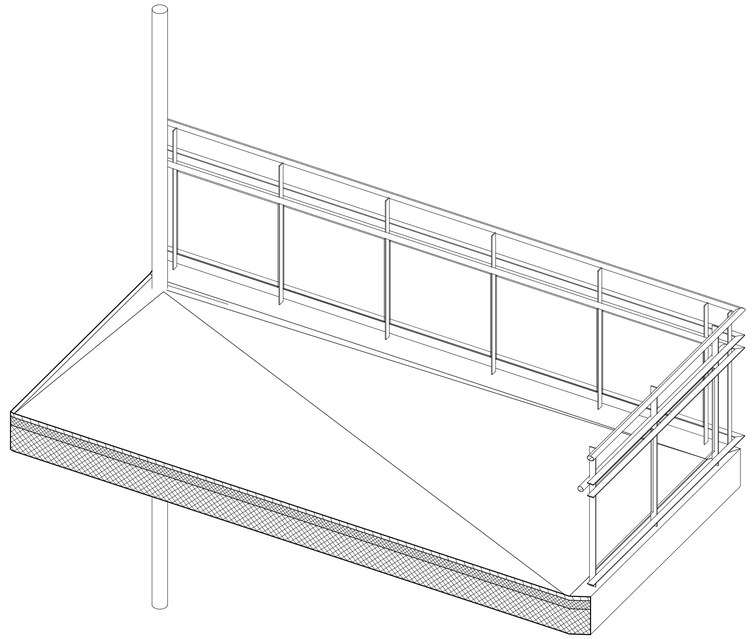
balcony plan
1 : 20



balcony west elevation
1 : 20



balcony north elevation
1 : 20



3D view BALCONY

K01_TXX_H7_EX_N15

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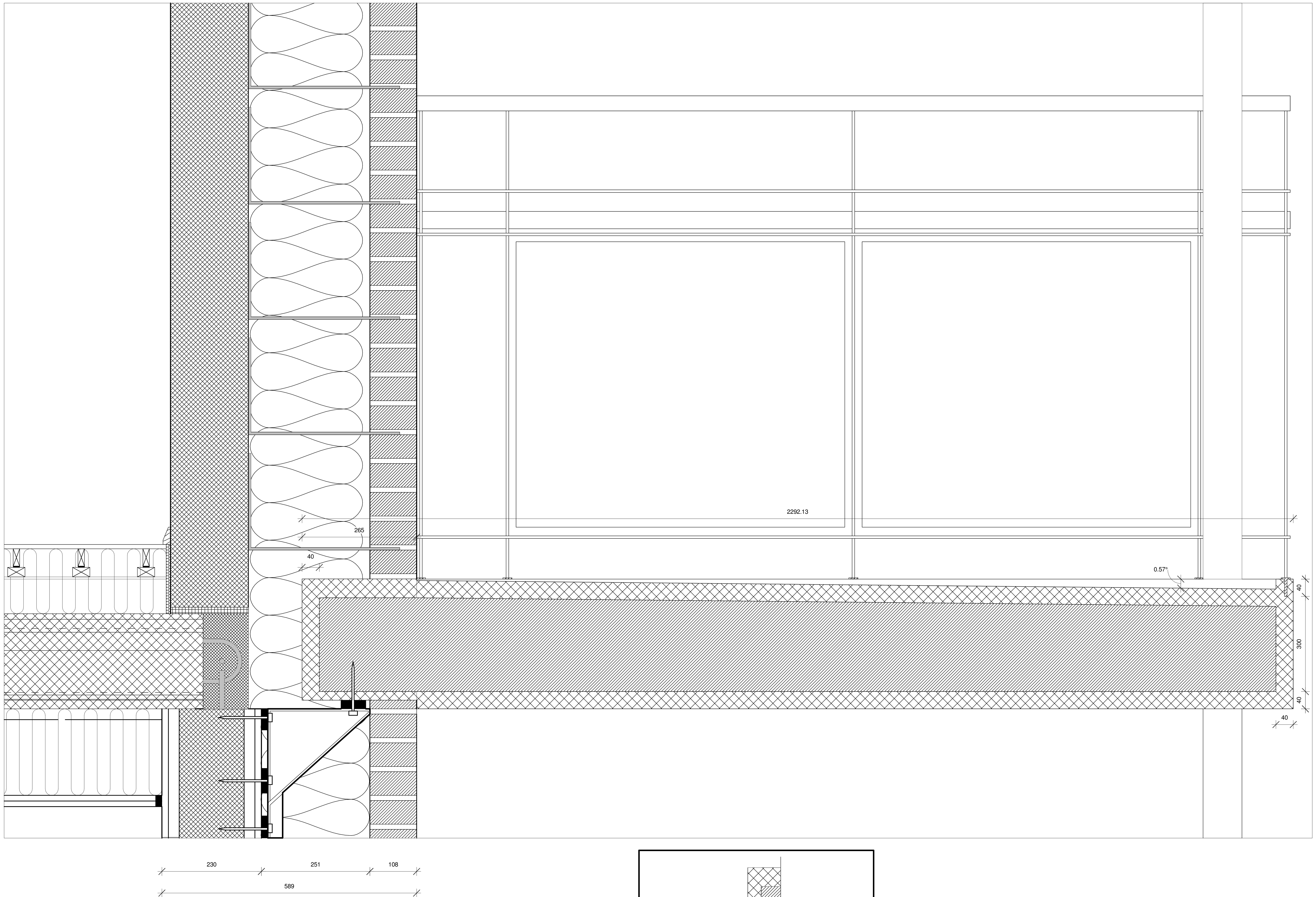
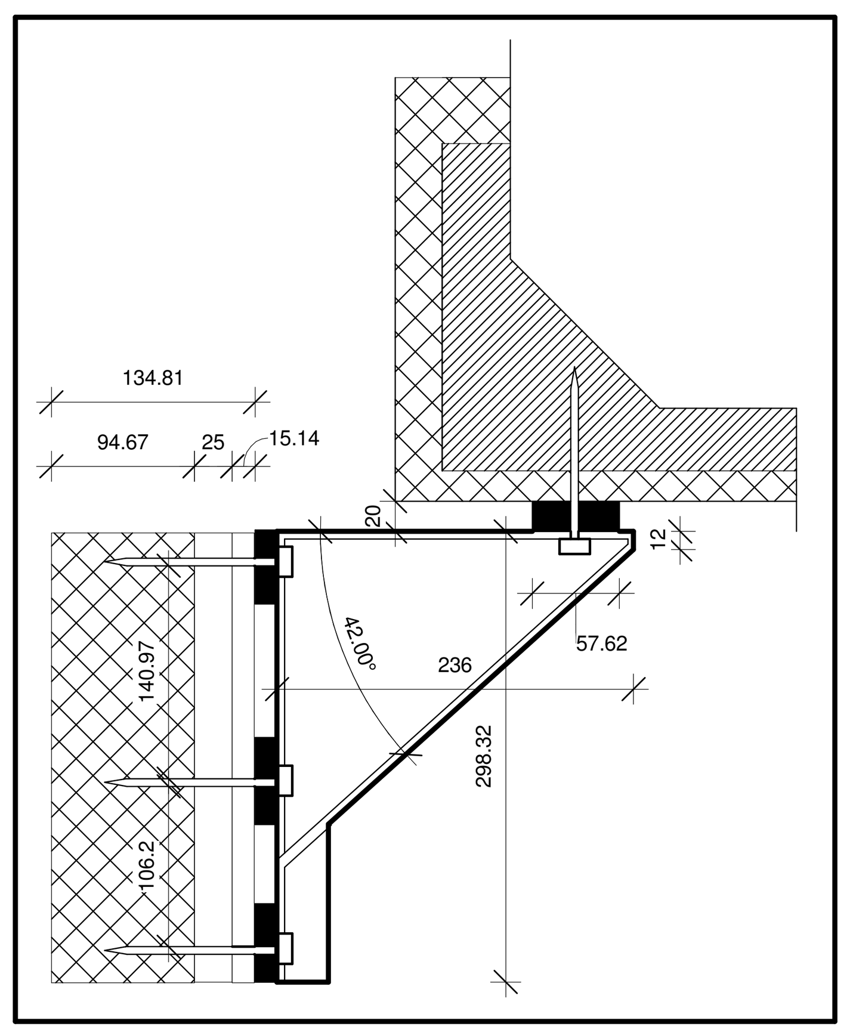
PROJECT: MULTI-STOREY HOUSING	DATE: 06/20/15	K01_TXX_H7_EX_N15
SUBJECT: SPECIALIZATION - balcony	SCALE: 1 : 20	
DRAWN BY: a L[t1W%1Ia L[t^tI	CLASS: AH42S15	



K01_TXX_H7_EX_N16

Connection balconies-rail-ext.wall.
1
1 : 5



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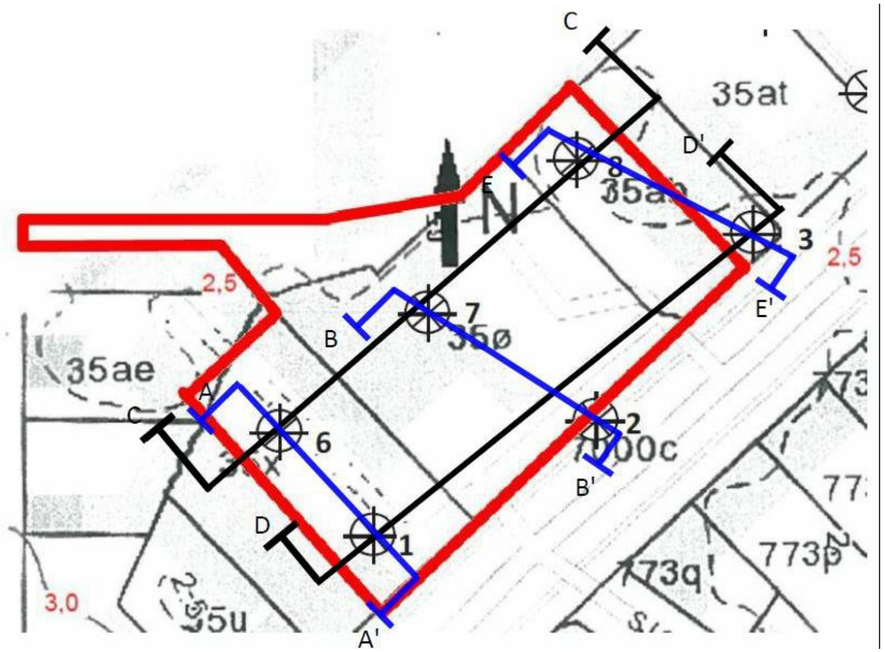
TYPE CITY

PROJECT: MULTI-STOREY HOUSING	DATE: 06/21/15	**K01_TXX_H7_EX_N16**
SUBJECT: SPECIALIZATION - balcony	SCALE: 1 : 5	
DRAWN BY: [illegible]	CLASS: AH42S15	

4.2. CONTRACTOR SPECIALIZATION – SOIL WORKS

4.2.1. Terrain analysis

TERRAIN ANALYSIS



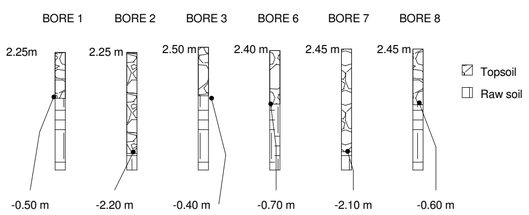
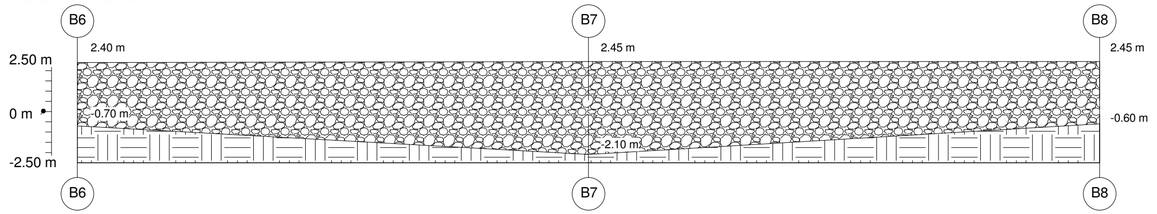


Table 1.

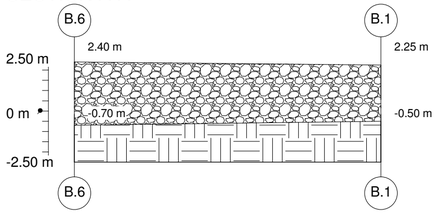
Bore no.	Terrain-level	Foundation conditions OBL level	- depth u. terrain	Floors against soil AFR level	- depth u. terrain
1	2.25	1.75	- 0.50 m	1.75	- 0.50 m
2	2.25	0.05	- 2.20 m	0.95	- 1.30 m
3	2.50	2.10	- 0.40 m	2.10	- 0.40 m
4	2.25	1.95	- 0.30 m	1.95	- 0.30 m
5	1.95	1.75	- 0.20 m	1.75	- 0.20 m
6	2.40	1.70	- 0.70 m	1.70	- 0.70 m
7	2.45	0.35	- 2.10 m	0.35	- 2.10 m
8	2.45	1.85	- 0.60 m	1.85	- 0.60 m
9	2.10	1.80	- 0.30 m	1.80	- 0.30 m
10	2.05	1.75	- 0.30 m	1.25	- 0.30 m

Terrain analysis section
1 : 200

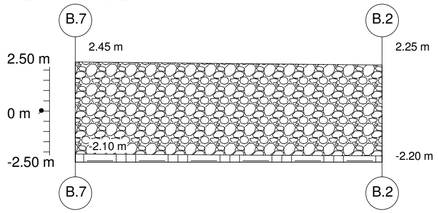
SECTION C-C'



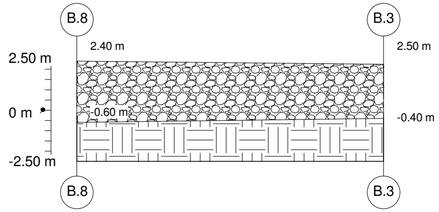
SECTION A-A'



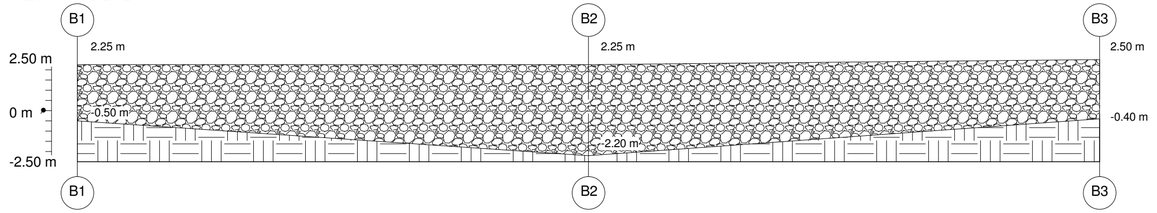
SECTION B-B'

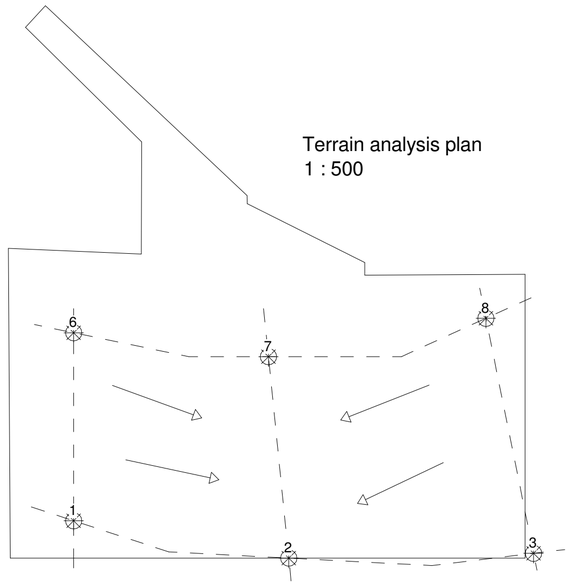


SECTION E-E'



SECTION D-D'





- We want to align the existing terrain to 2.30 m because this way the evacuation of the water to public drain will be easily.
Also, the level of the main street is 2.25 m, so it provides easy access to the plot.

- The average of the topsoil si calculated summing the raw soil level and dividdin this amount by 6 (because we have 6 bores):
Topsoil: (0.50 + 2.20 + 0.40 + 0.70 + 2.10 + 0.60) / 6 = 1.083 m=Average

- Now we will calculate (estimately) the volume to take of from the plot (plot area are 2572 m2 and the swelling coefficient is 1.20):
2572 m2 x 1.083 m x 1.20 = 3343.6 m3

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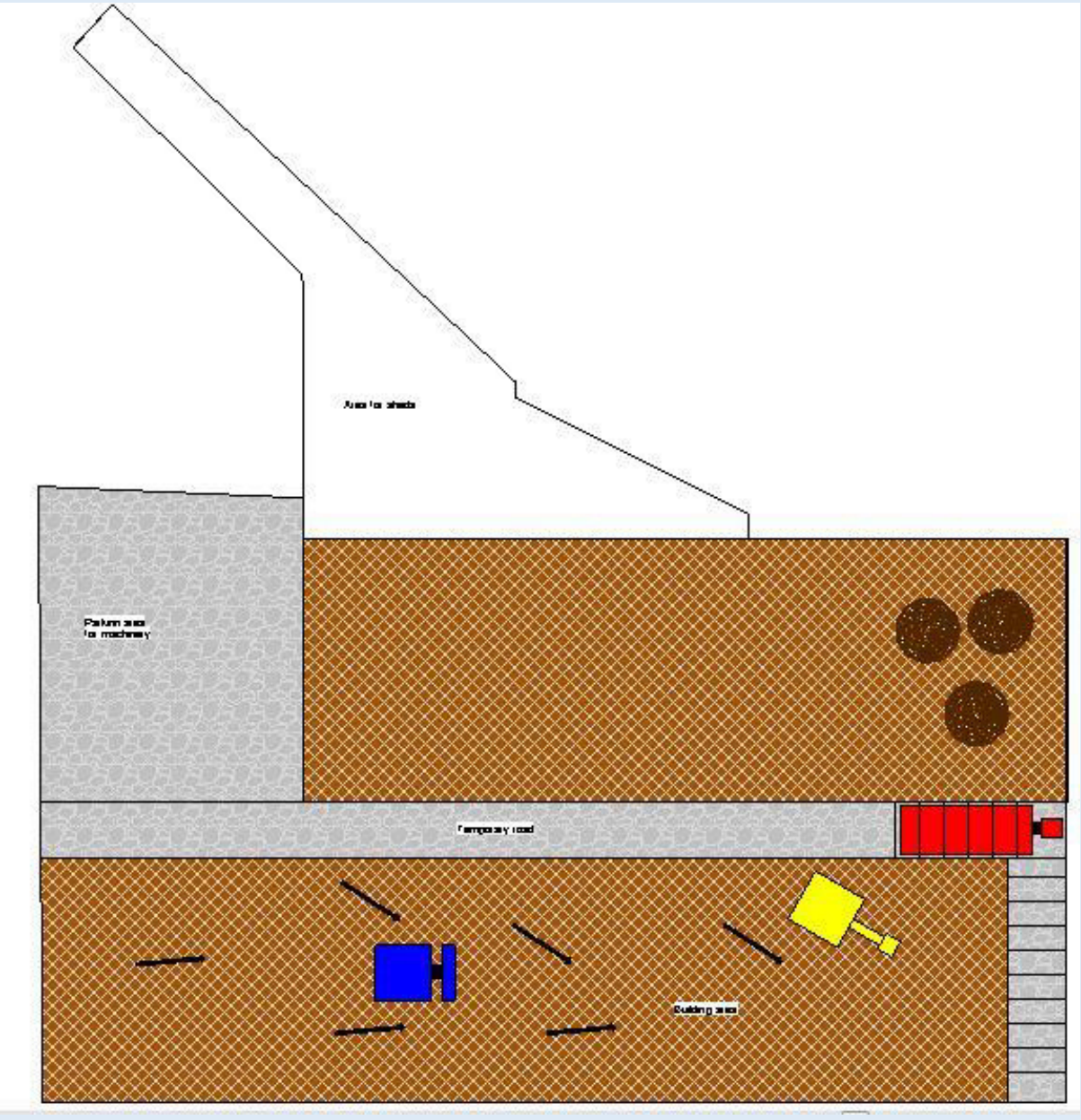
PROJECT: TYPE PROJECT NAME	DATE: 06/20/15	**K01_TXX_H7_EX_N03**
SUBJECT: Terrain analysis	SCALE: As indicated	
DRAWN BY: Maria Julian Martin	CLASS:	

4.2.2. Method analysis

Method analysis

The method I have chosen is based in the next points:

- We will need two excavators:
  - One bigger which will take the soil from the level of the road.
  - The small excavator will go to building area and pass soil as close to the big excavator as it is possible.
- We will need a truck which transports the soil.
- A crane truck to put steel plates at the beginning when the top soil is not excavated.
- The temporary road will be made from gravel (200 mm).



4.2.3. Working stages and steps

WORKING STAGES AND STEPS

STAGE I:TOP SOIL

- Step 1: Removal of top soil for temporary roads
- Step 2: Removal of topsoil for sheds
- Step 3: Removal of topsoil for building

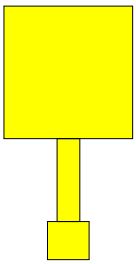
STAGE II: RAW SOIL

- Step 1: Removal of raw soil to level 1 (groundfloor foundation)
- Step 2: Removal of raw soil to level 2 (basement foundationn)
- Step 3: Removal of raw soil to level 3 (elevator foundation)

STAGE III: SAND FILL

- Step 1: Fill elevator foundation
- Step 2: Fill basement foundation
- Step 3: Fill groundfloor foundation

STAGE IV: MAKE ONE LEVEK ON ALL BUILDING SITE (2.30 m)



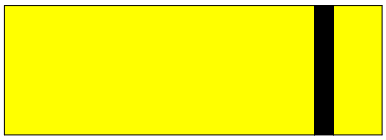
Excavator

Sand

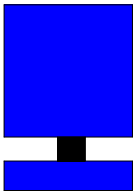
Topsoil

Raw soil

Gravel

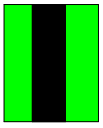


Dumper

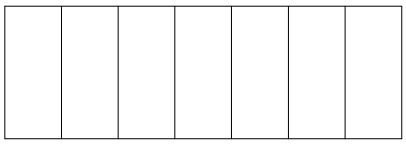


Dozer

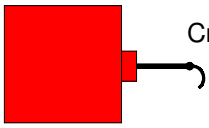
Truck



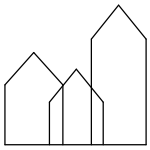
Compactor



Steel plates



Crane



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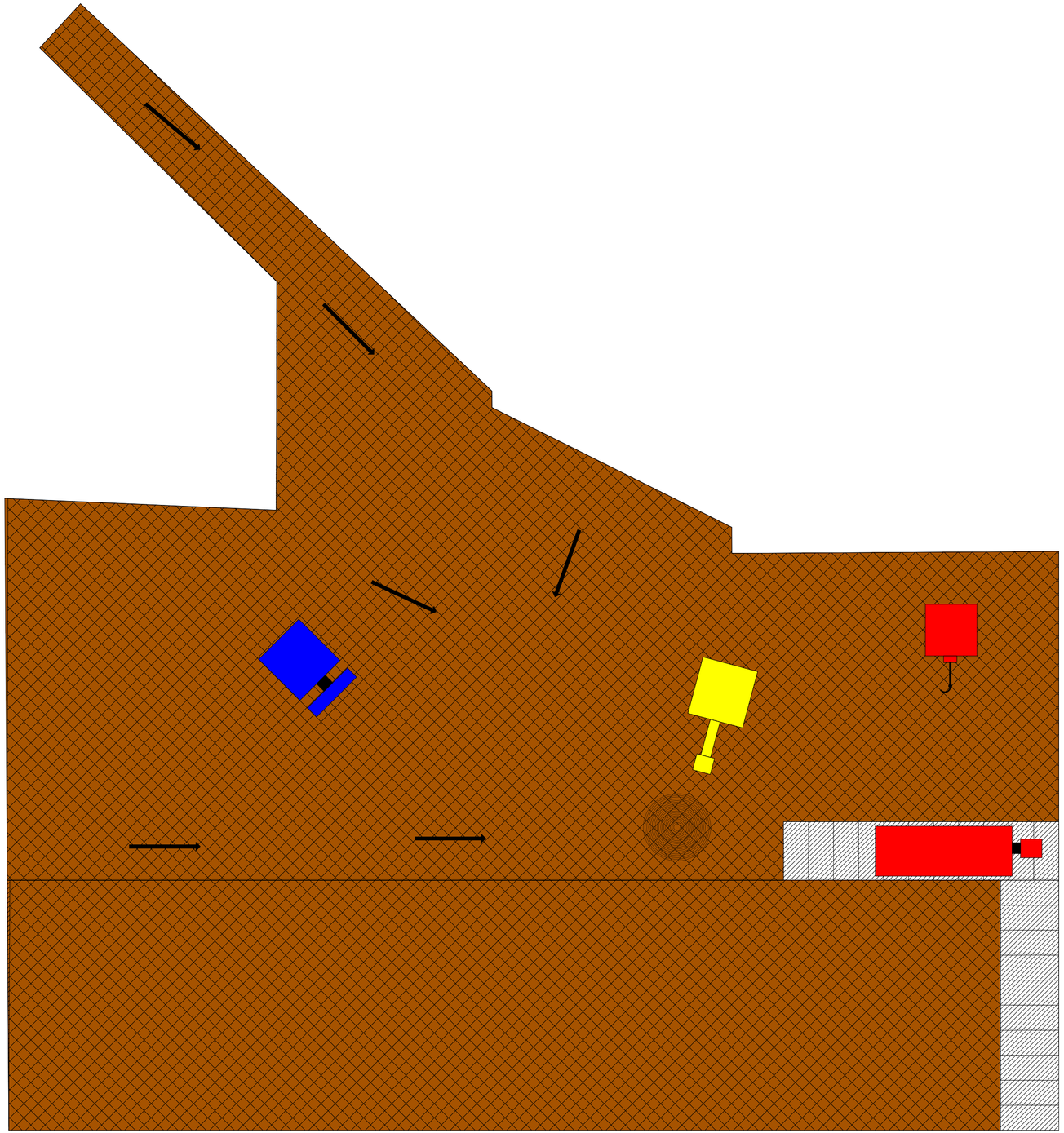
PROJECT: TYPE PROJECT NAME	DATE: 06/21/15	**K01_TXX_H7_EX_N05**
SUBJECT: Legend	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 1
Step 1: Removal o topsoil for temporary roads

K01_TXX_H7_EX_N06



Working stages and steps 1
1 : 200

The dozer lifts the topsoil and the excavator amount it .
On the other hand, the crane place the steel plates whit will be the temporary road for the truch.

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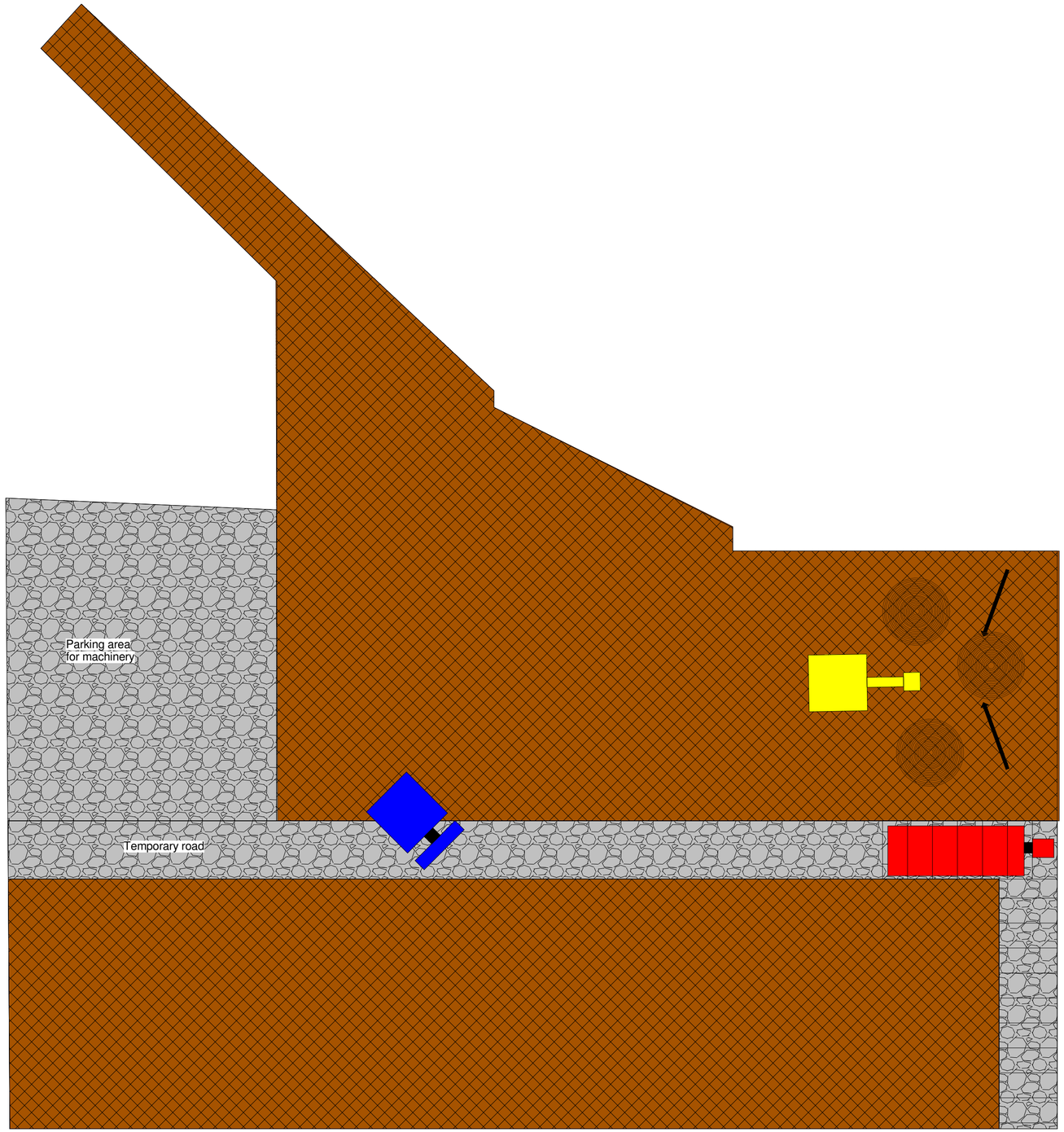
PROJECT: SOIL WORKS	DATE: 06/21/15	K01_TXX_H7_EX_N06
SUBJECT: Stage 1 - Step 1 - Removal of topsoil for temporary roads	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 1
Step 2: Removal o topsoil for sheds

K01_TXX_H7_EX_N07



When truck will go with the soil out of the plot, it can in it way back tacke gravel for temoprary road, which will be spread by dozer

Working stages and steps 2
1 : 200

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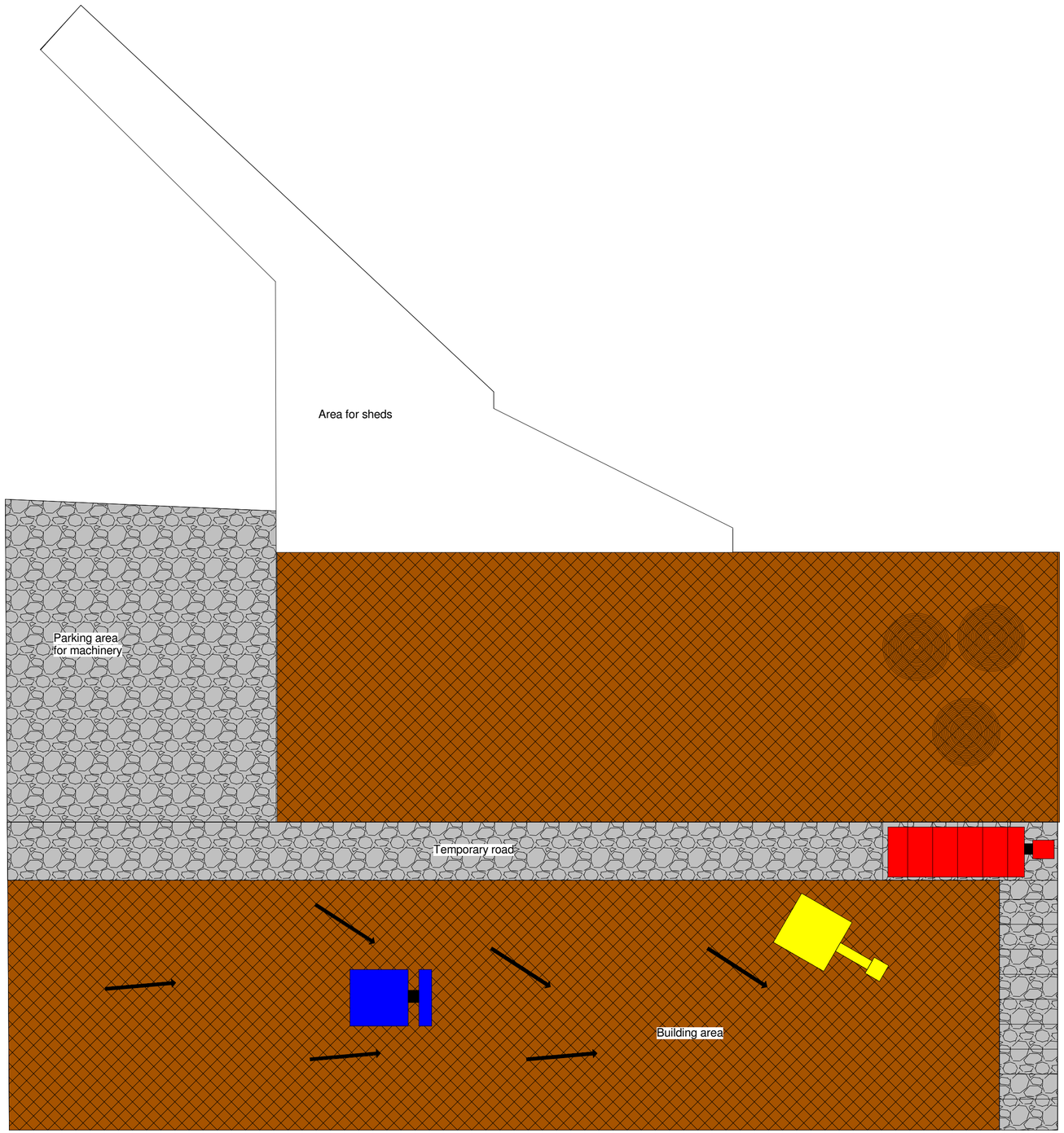
PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N07**
SUBJECT: Stage 1 - Step 2 - Removal of topsoil for sheds	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 1
Step 3: Removal of topsoil for building

K01_TXX_H7_EX_N08



Working stages and steps 3
1 : 200

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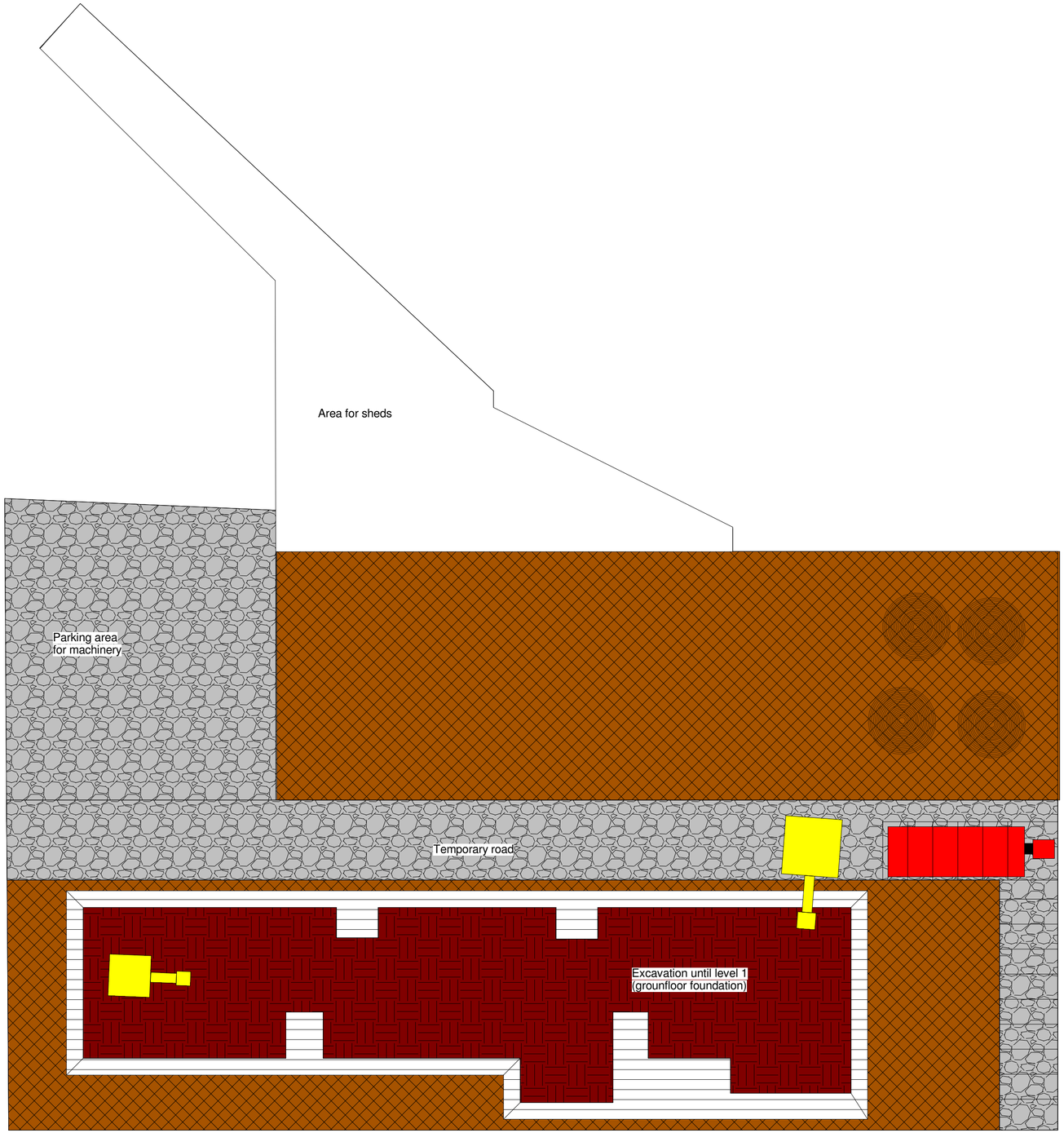
PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N08**
SUBJECT: Stage 1 - Step 3 - Removal of topsoil for building	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 2
Step 1: Removal of raw soil to level 1 (groundfloor foundation)

K01_TXX_H7_EX_N09



Working stages and steps 4
1 : 200

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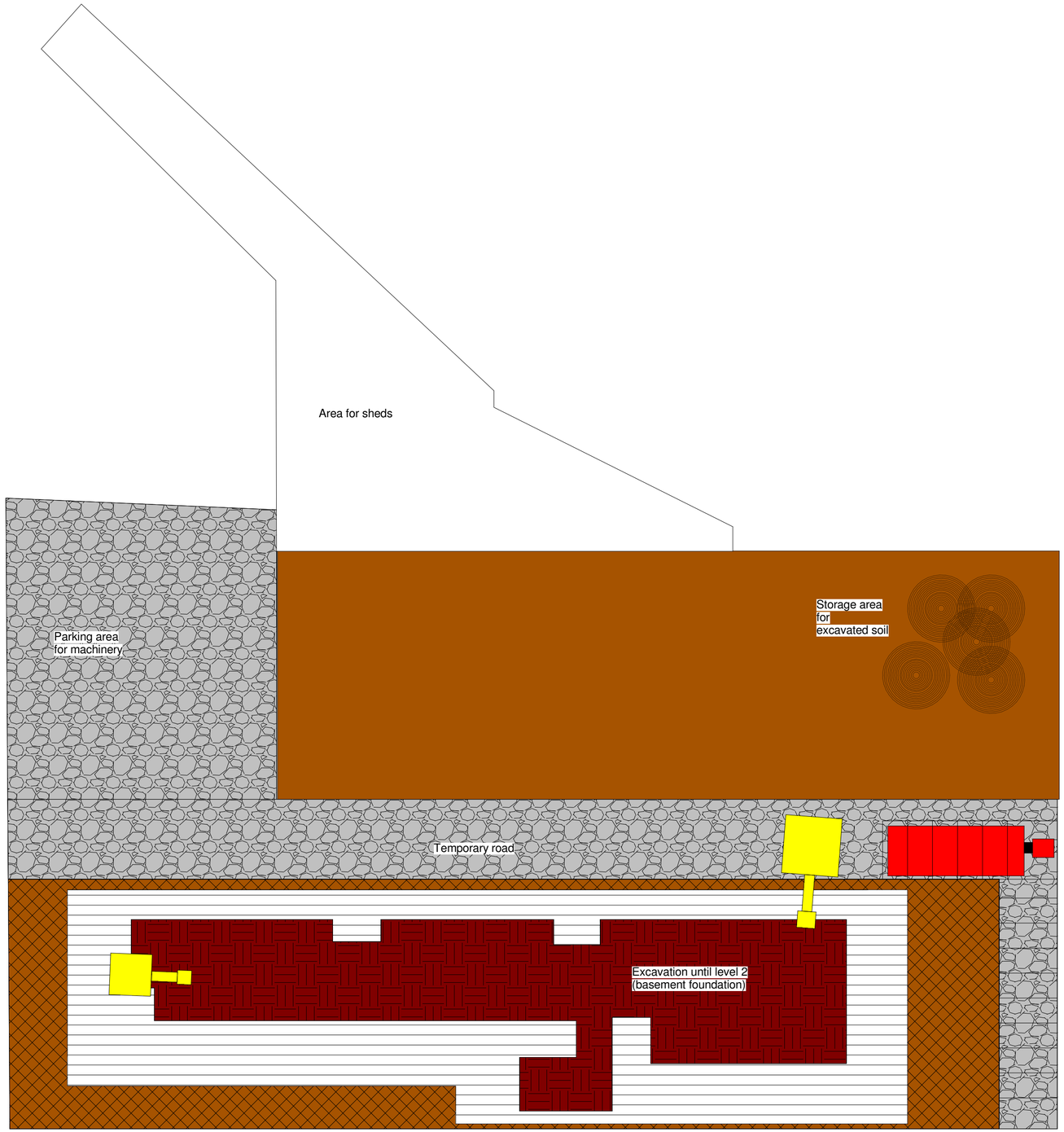
PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N09**
SUBJECT: Stage 2 - Step 1 - Removal of raw soil to level 1 - Groundfloor foundation	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 2
Step 2: Removal of raw soil to level 2 (basement foundation)

K01_TXX_H7_EX_N10



Working stages and steps 5
1 : 200

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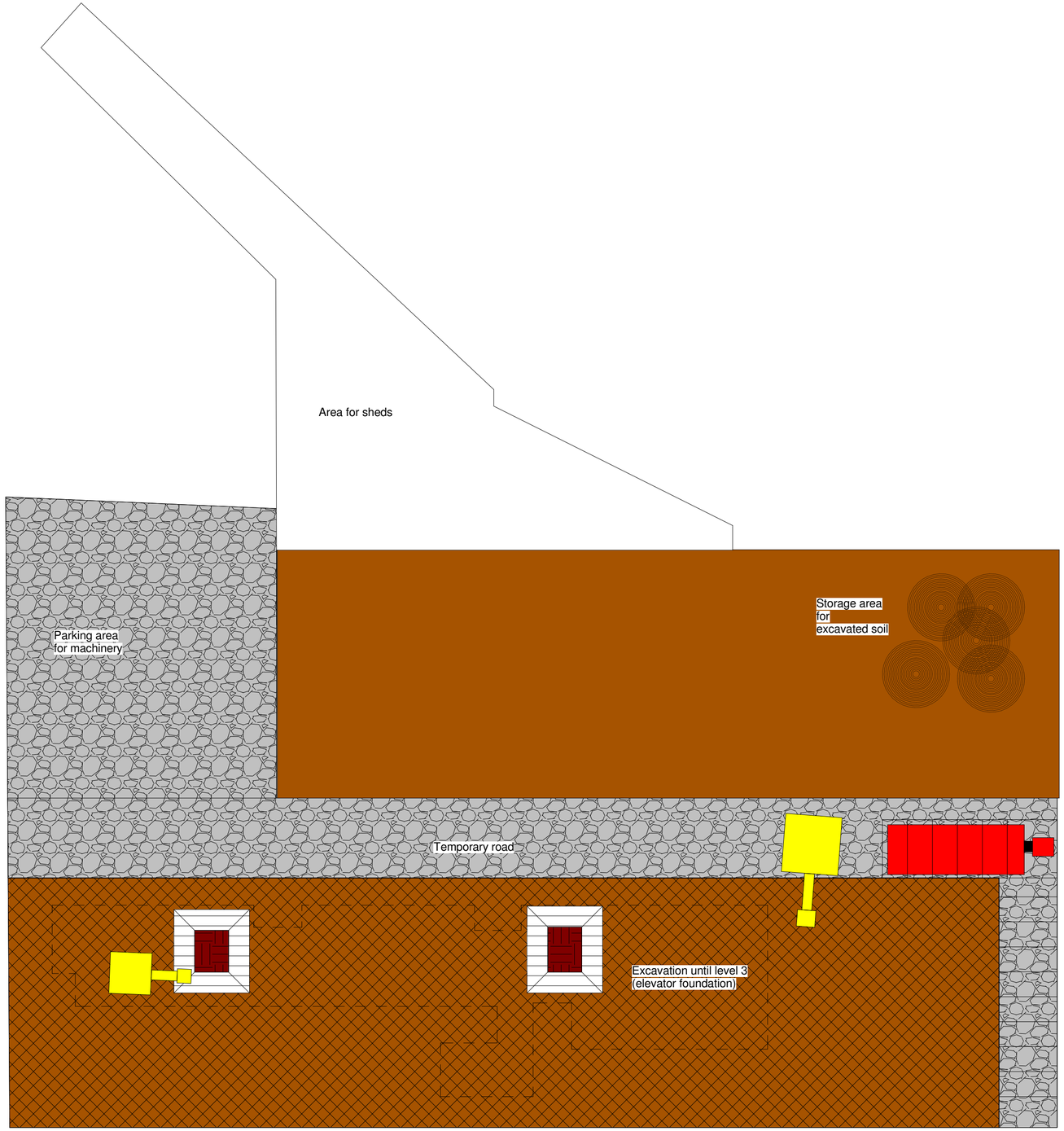
PROJECT: SOIL WORKS	DATE: 06/21/15	K01_TXX_H7_EX_N10
SUBJECT: Stage 2 - Step 2 - Removal of raw soil to level 2 - Basement foundation	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 2
Step 3: Removal of raw soil to level 3 (elevator foundation)

K01_TXX_H7_EX_N11



Working stages and steps 6
1 : 200

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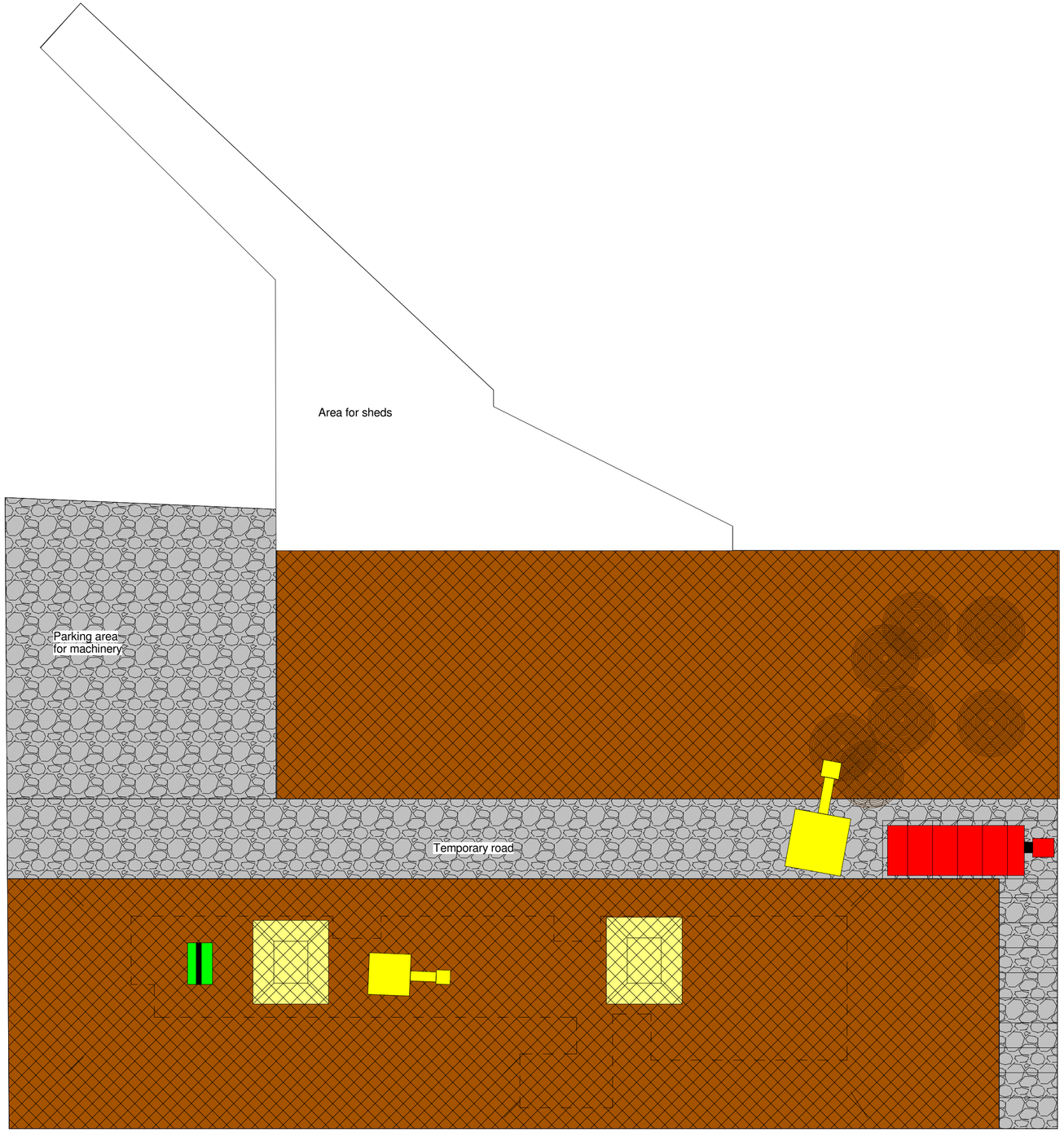
HORSENS

PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N11**
SUBJECT: Stage 2 - Step 2 - Removal of raw soil to level 2 - Elevator foundation	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 3
Step 1: Fill elevator foundation with sand

K01_TXX_H7_EX_N12



Working stages and steps 7
1 : 200

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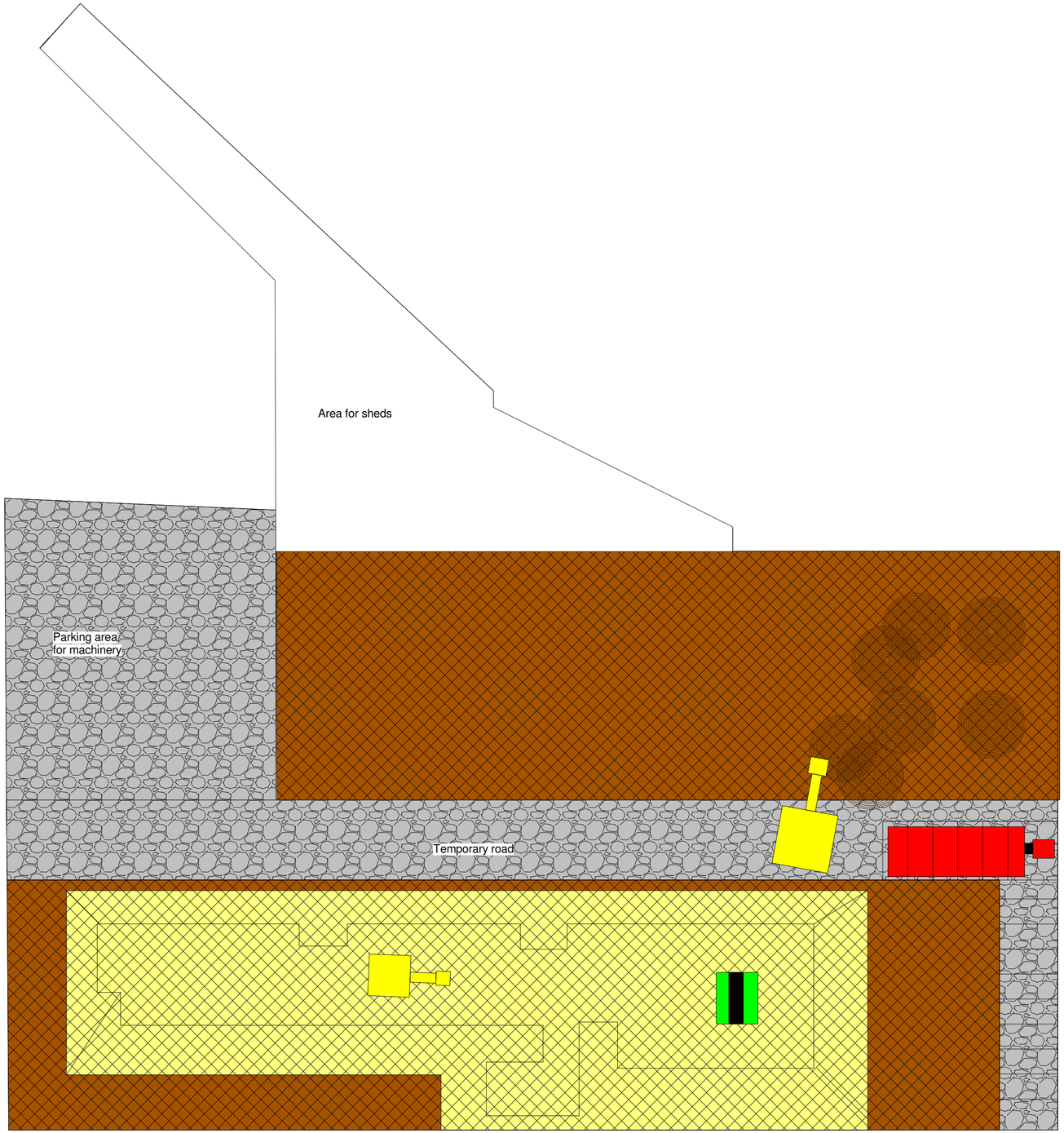
PROJECT: SOIL WORKS	DATE: 06/21/15	K01_TXX_H7_EX_N12
SUBJECT: Stage 3 - Step 1 - Fill elevator foundation with sand	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 3
Step 2: Fill basement foundation with sand

K01_TXX_H7_EX_N13



Working stages and steps 8
1 : 200

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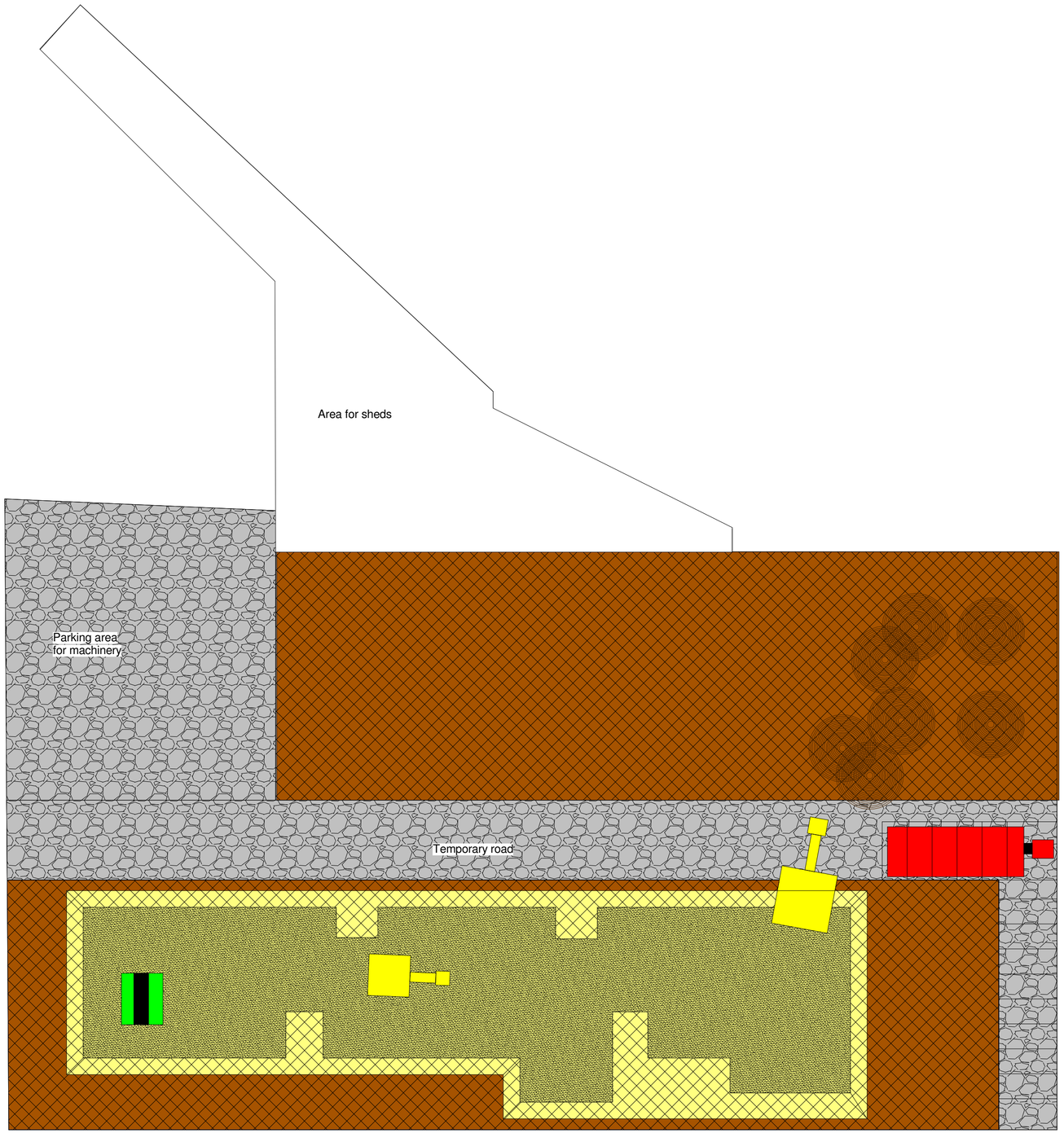
PROJECT: SOIL WORKS	DATE: 06/21/15	K01_TXX_H7_EX_N13
SUBJECT: Stage 3 - Step 2 - Fill basement foundation with sand	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 3
Step 3: Fill groundfloor foundation with sand

K01_TXX_H7_EX_N14



Working stages and steps 9
1 : 200

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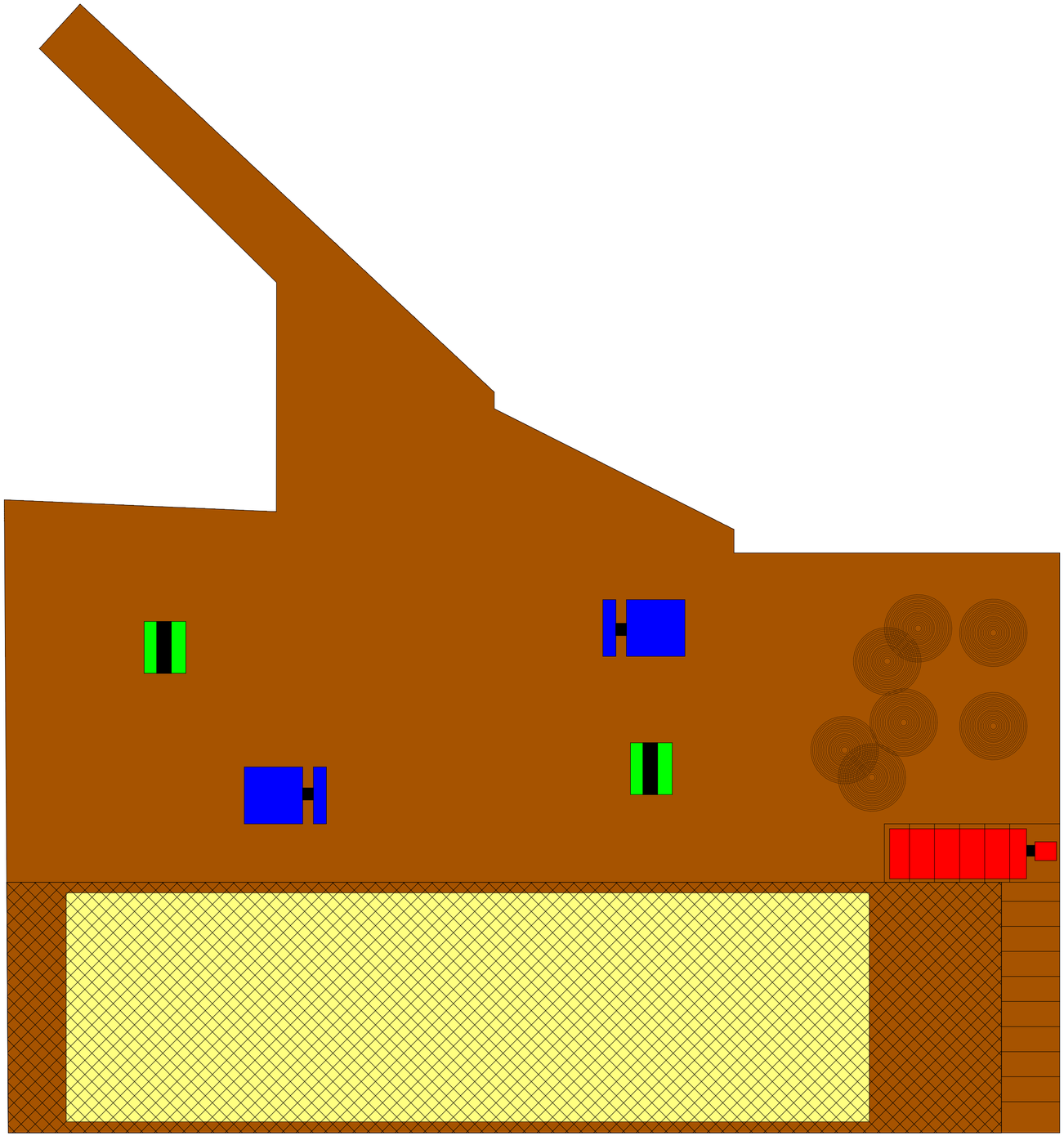
PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N14**
SUBJECT: Stage 3 - Step 3 - Fill groundfloor foundation with sand	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

STAGE 4: Make one level on all building site (2.30 m)

K01_TXX_H7_EX_N15



Filling with topsoil

Working stages and steps 10
1 : 200

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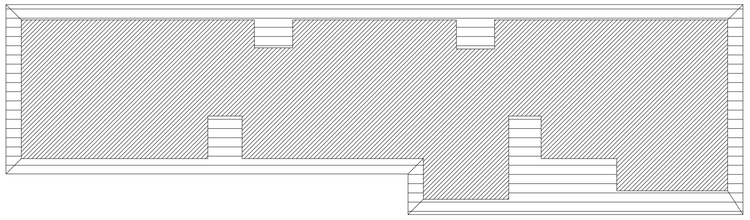
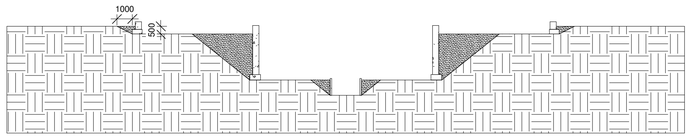
HORSENS

PROJECT: SOIL WORKS	DATE: 06/21/15	K01_TXX_H7_EX_N15
SUBJECT: Stage 4 - Make one level on all building site	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

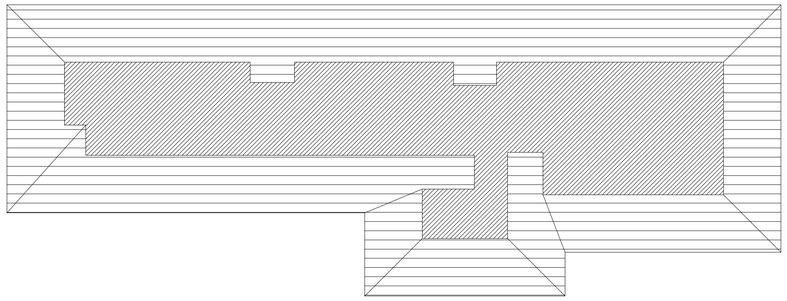
Groundfloor excavation and filling plan



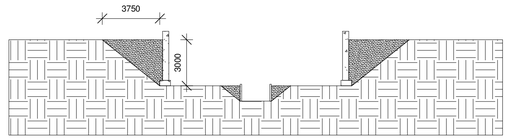
Grundfloor excavation and filling section



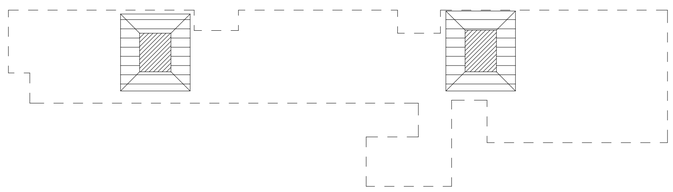
Basement excavation and filling plan



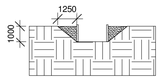
Basement excavation and filling section



Elevator excavation and filling plan



Elevator excavation and filling section



Plans and sections
1 : 200

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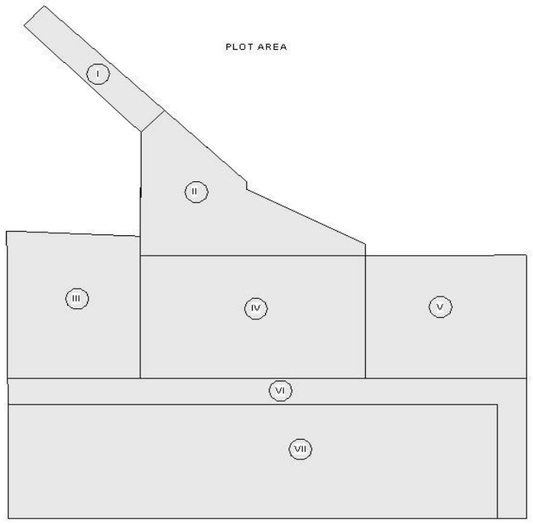
PROJECT: SOIL WORKS	DATE: 06/21/15	**K01_TXX_H7_EX_N16**
SUBJECT: Plans and sections of excavation and filling	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

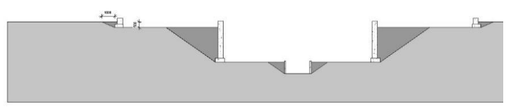
4.2.4. Quantities

Calculation of quantities schedule

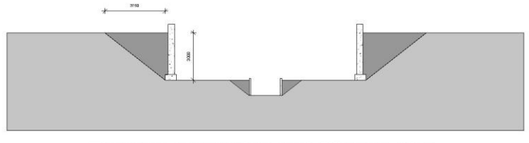
												Page	1	
												Name	Maria Julian	
												Date	19.06.2015	
	Waste	Topsoil will be stored on site				Area	Excavation (1m3)	depot (1,2m3)	Volume per step	Total volume per Stage				
	Pos. Nr	**Area/ location**	L	W	H	m2	m3	m3	m3	m3				
	01.	TOP SOIL								3342,571				
	01. 01	Removal topsoil from temporary roads							756,071					
		Area III				308,613	334,22788	401,07345						
		Area VI				273,159	295,8312	354,99744						
	01. 02	Removal topsoil from sheds							451,372					
		Area I				76,924	83,308692	99,97043						
		Area II				270,392	292,83454	351,40144						
	01. 03	Removal topsoil from building area							2135,128					
		Area IV				433,964	469,98301	563,97961						
		Area V				316,582	342,85831	411,42997						
		Area VII				892,366	966,43238	1159,7189						
	02.	RAW SOIL								3827,781				
	02. 01	Removal of raw soil to ground floor foundation				425,428	28,503676	34,204411	58,744					
	02. 02	Removal of raw soil to basement foundation				302,859	908,577	1090,2924	3734,278					
	02. 03	Removal of raw soil to elevatorfoundation				11,080	11,08	13,296	34,759					
	03.	SAND FILL								2689,988				
	03. 01	Fill elevator foundation with sand				17,886	17,886	21,4626	21,463					
	03. 02	Fill basement foundation with sand				734,441	2203,3215	2643,9858	2643,986					
	03. 03	Fill groundfloor foundation with sand				40,899	20,4495	24,5394	24,539					
Proces quantities/ methods														
	Quantities netto													
	Waste													
	Quantities total													



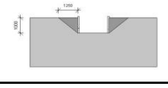
Groundfloor excavation and filling section



Basement excavation and filling section



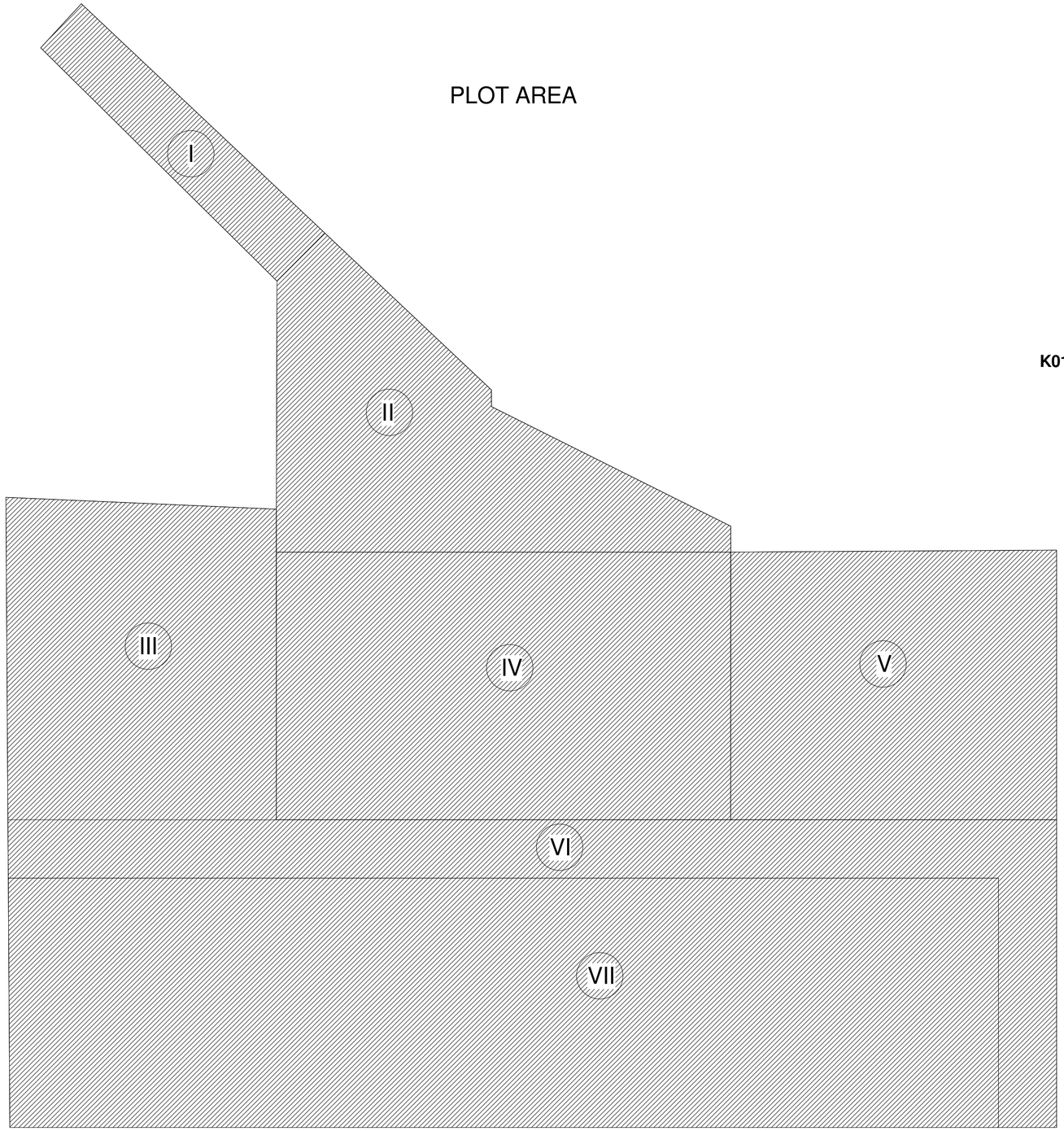
Elevator excavation and filling section



PLOT AREA

I	76.924 m2
II	270.392 m2
III	308.613 m2
IV	433.964 m2
V	316.582 m2
VI	273.159 m2
VII	892.366 m2

2572m2



K01_TXX_H7_EX_N02

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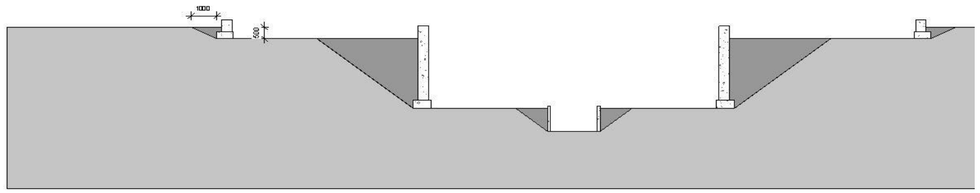
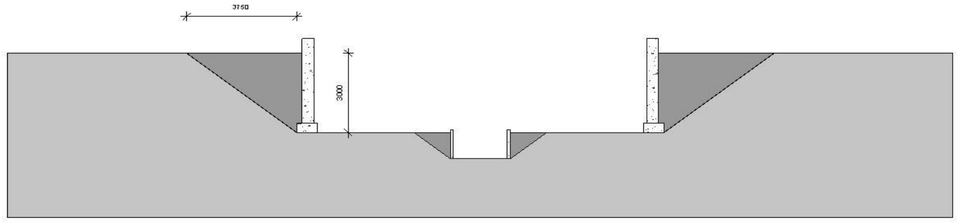
PROJECT: TYPE PROJECT NAME	DATE: 06/20/15	K01_TXX_H7_EX_N02
SUBJECT: Plot area	SCALE: 1 : 200	
DRAWN BY: Maria Julian Martin	CLASS: 4SemAH42	

FLOOR PLAN	Area	Height	Volume (floorplan)	Area '	Height'	Volume (all)	Volume (earthwork square)	Volume earthwork (triangle)
Groundfloor	425,428	0,5	212,714	589,024	0,5	294,512	81,798	40,899
Basement	302,859	3	908,577	792,486	3	2377,458	1468,881	734,4405
Elevator	10,666	1	10,666	46,437	1	46,437	35,771	17,8855

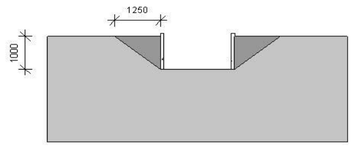
Groundfloor excavation and filling section



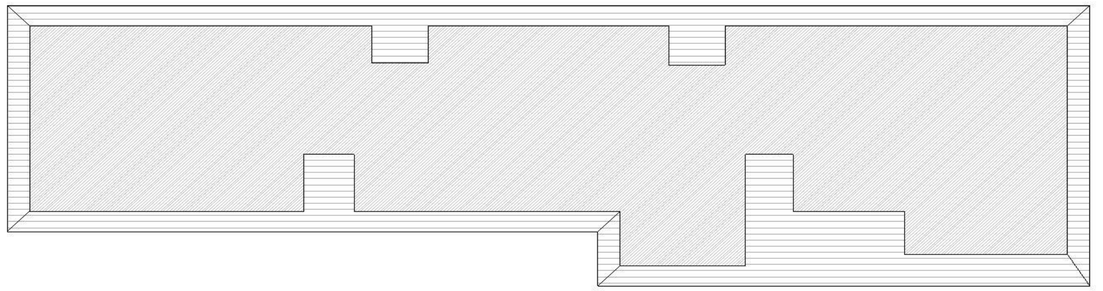
Basement excavation and filling section



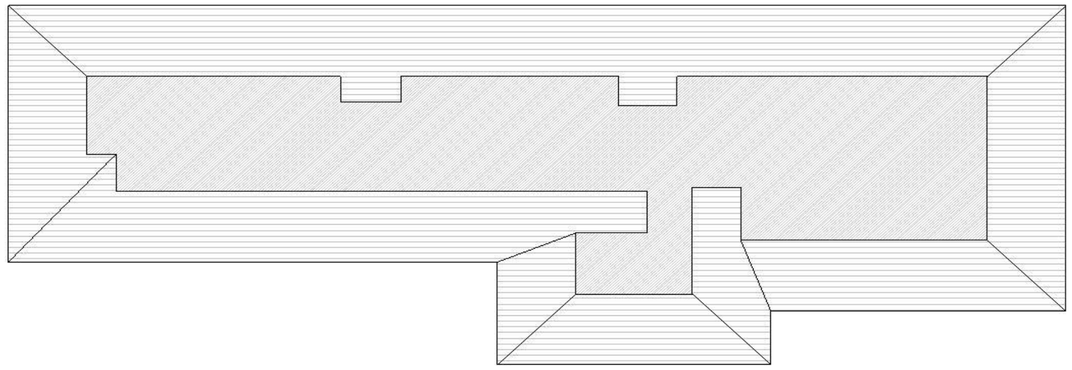
Elevator excavation and filling section



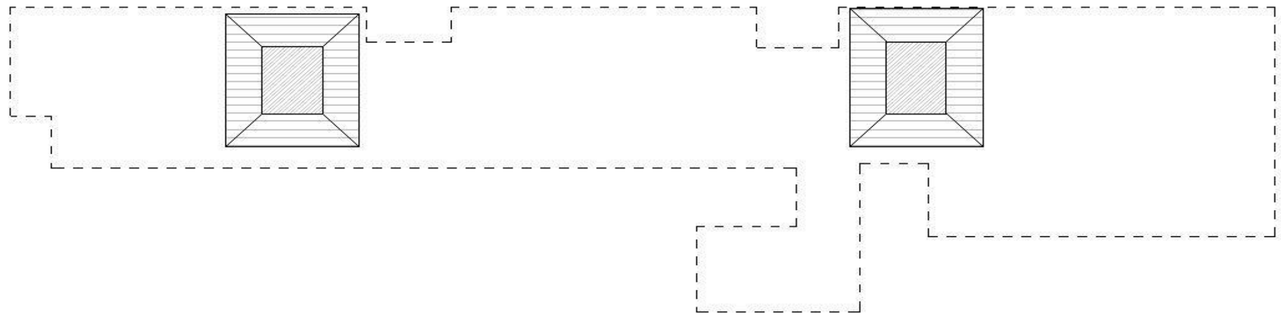
Groundfloor excavation and filling plan



Basement excavation and filling plan



Elevator excavation and filling plan



4.2.5. Machine Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	3342,5712	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		3342,5712	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		26,378	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		108,085	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	756,071	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		756,071	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		5,966	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		24,448	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	451,372	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		451,372	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		3,562	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		14,596	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	2135,128	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		2135,128	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		16,849	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		69,041	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	58,744	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		58,744	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		0,464	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		1,900	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	3734,278	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		3734,278	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		29,469	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		120,751	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	14,09	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3
		14,09	m^3
Density		1850	kg/m^3
Efficiency		0,6	Faktor
Cyclus time		30	Sek
Loadind factor	0,8	0,8	Faktor
Bucket factor		1,1	Faktor
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time
Hours total		0,111	Hours

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg
Distance to tip		5	km
Speed		40	km/t
Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Unloading time		1,00	min
Maneuvretime		1,60	min
Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
Number off truks		4,1	
Hours total		0,456	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	34,759	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

Pos.nr:

Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3

Text	Formel.	Quantity	Unit
Max. Weigth		22.200	kg

			34,759	m^3	Distance to tip		5 km
Density			1850	kg/m^3	Speed		40 km/t
Efficiency			0,6	Faktor	Max volume.	(max weigth/soildensity)/loadingfactor	12,00 m^3
Cyclus time			30	Sek	Drivingtime total	2*(distance*60min/h)/avarage speed	15,00 min
					Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68 min
Loadind factor		0,8	0,8	Faktor	Unloading time		1,00 min
					Maneuvretime		1,60 min
Bucket factor			1,1	Faktor			
					Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28 min
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket		126,72	m^3/time	Lorrys production	(60min/h/ circulationtime)*max.volume	30,93 m^3/time
					Number off truks		4,1
Hours total			0,274	Hours	Hours total		1,124 Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur 21,463 m^3

Bucket size 2,00 m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle: 21000 kg

Max number of m3 12,00 m^3

Do not exceed the maximum payload 22.200

Pos.nr:

Text	Formel.		Quantity	Unit	Text	Formel.	Quantity	Unit
Bucket size			2,00	m^3	Max. Weigth		22.200	kg
			21,463	m^3	Distance to tip		5	km
Density			1850	kg/m^3	Speed		40	km/t
Efficiency			0,6	Faktor	Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Cyclus time			30	Sek	Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
					Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Loadind factor		0,8	0,8	Faktor	Unloading time		1,00	min
					Maneuvretime		1,60	min
Bucket factor			1,1	Faktor				
					Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket		126,72	m^3/time	Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
					Number off truks		4,1	
Hours total			0,169	Hours	Hours total		0,694	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur 2643,986 m^3

Bucket size 2,00 m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

Choice of vehicle: Scania R114CB

Max load pr vehicle: 21000 kg

Max number of m3 12,00 m^3

Do not exceed the maximum payload 22.200

Pos.nr:

Text	Formel.		Quantity	Unit	Text	Formel.	Quantity	Unit
Bucket size			2,00	m^3	Max. Weigth		22.200	kg
			2643,986	m^3	Distance to tip		5	km
Density			1850	kg/m^3	Speed		40	km/t
Efficiency			0,6	Faktor	Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Cyclus time			30	Sek	Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
					Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Loadind factor		0,8	0,8	Faktor	Unloading time		1,00	min
					Maneuvretime		1,60	min

Bucket factor			1,1 Faktor				
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket		126,72 m^3/time	Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
				Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
				Number off truks		4,1	
Hours total		20,865	Hours	Hours total		85,496	Hours

Machine hour calculation: Excavatioake away

Number of m3 to be moved in solid measur	24,539	m^3
Bucket size	2,00	m^3

Choice of Machine: Excavator Volvo EC210C

Calculation of transport

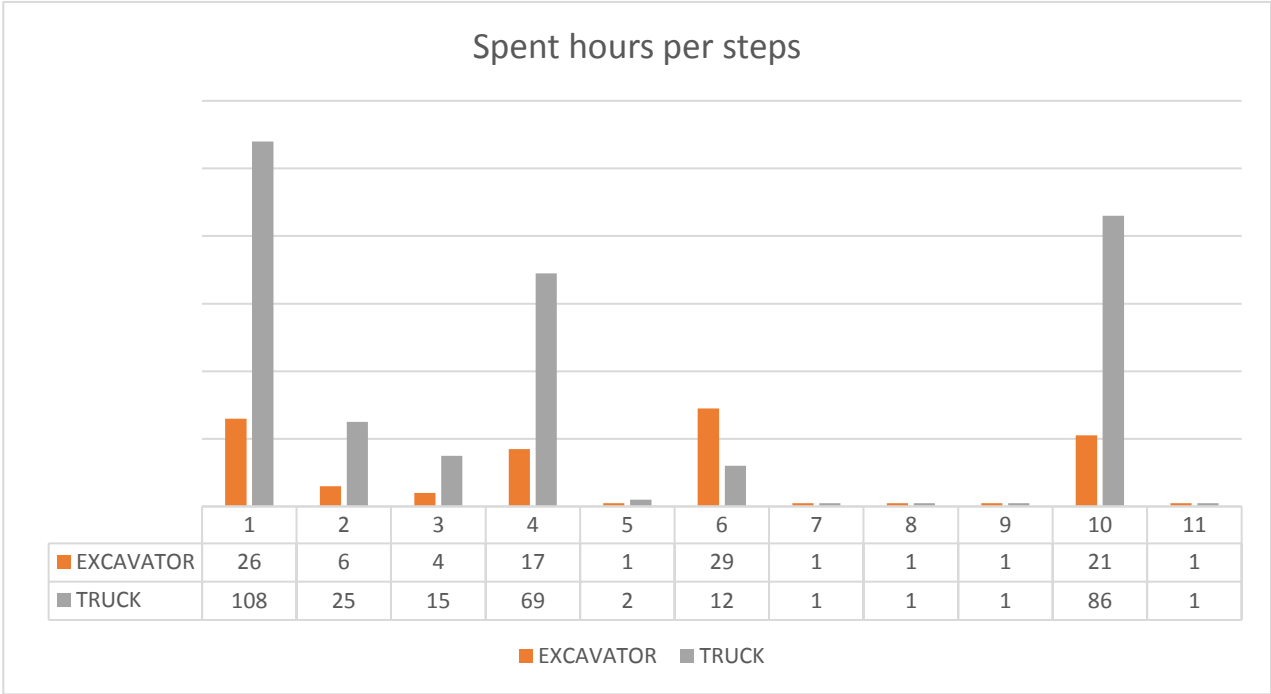
Choice of vehicle: Scania R114CB

Max load pr vehicle:	21000	kg
Max number of m3	12,00	m^3
Do not exceed the maximum payload	22.200	

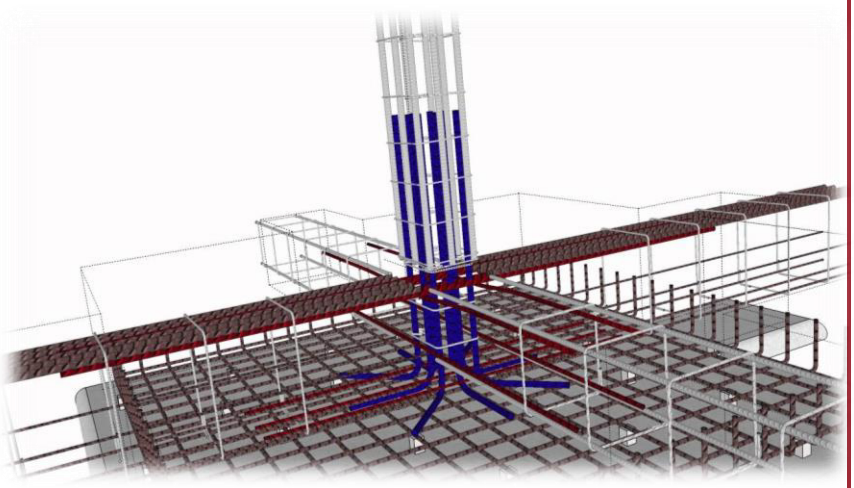
Pos.nr:

Text	Formel.	Quantity	Unit	Text	Formel.	Quantity	Unit
Bucket size		2,00	m^3	Max. Weigth		22.200	kg
		24,539	m^3	Distance to tip		5	km
Density		1850	kg/m^3	Speed		40	km/t
Efficiency		0,6	Faktor	Max volume.	(max weigth/soildensity)/loadingfactor	12,00	m^3
Cyclus time		30	Sek	Drivingtime total	2*(distance*60min/h)/avarage speed	15,00	min
				Loadingtime	Max volum/bucketsize*(cyklustime/60)	5,68	min
Loadind factor	0,8	0,8	Faktor	Unloading time		1,00	min
				Maneuvretime		1,60	min
Bucket factor		1,1	Faktor				
Production.	Bucketsize*(3600/cyclus time) *Efficience.*bucket	126,72	m^3/time	Circulationtime	Loadingtime+drivingtime+maneuvre+ unload	23,28	min
				Lorrys production	(60min/h/ circulationtime)*max.volume	30,93	m^3/time
				Number off truks		4,1	
Hours total		0,194	Hours	Hours total		0,793	Hours

STEP	EXCAVATOR	TRUCK
1	26	108
2	6	25
3	4	15
4	17	69
5	1	2
6	29	12
7	1	1
8	1	1
9	1	1
10	21	86
11	1	1



5. ANEXO 5 (ELECTIVE SELF STUDY REPORT – DIFFERENCES BETWEEN DANISH AND SPANISH METHODS OF FOUNDATION)



DIFFERENCES BETWEEN DANISH AND SPANISH METHODS OF FOUNDATION

4th semester Elective Subject

BATCoM Bachelor of Architectural Technology and Construction Management

Author: Maria Julian Martin

Consultant's name: Steen Fynbo Larsen

Name of institution: VIA University College, Horsens, Denmark

Date Handed in : 26th May 2015

the author.

TITLE PAGE

Architectural Technology and Construction Management

BATCoM

TITLE of DISSERTATION: Differences between Danish and Spanish methods of foundation

CONSULTANT: Steen Fynbo Larsen

AUTHOR: María Julián Martín

Student number: 219844

Date / Signature: 26th of May 2015

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NOTE: This dissertation was completed as part of a Bachelor of Architectural Technology and Construction Management degree course – **no responsibility is taken for any advice, instruction or conclusion given within!**

1 PREFACE

This report has been written as a compulsory research assignment in the 4th semester of Danish Bachelor of Architectural Technology and Construction Management.

This report is about foundation, such as Denmark as Spain, my home country. I would like to show the differences between both countries as well as the different information received as student by the teachers.

Lot of information given in this report is written, but also I want to show with pictures, drawings or details of the information. This way I think will be easily to understand almost technical words, constructive elements as well as constructive process.

Acknowledgements

I have to say thank you to my consultant teacher that have shown his dedication and interest by giving tips, advices and assistance that helped in creating this report, because without his support this report wouldn't be as good as it is.

As well, I would like to say thank you to one of my Spanish teacher who helped me with Spanish Technical part of this report.

2 ABSTRACT

My problem statement is "DIFFERENCES BETWEEN DANISH AND SPANISH FOUNDATION". Like I write in next steps of this report, I want to write about foundation because I think is one of the most important points in buildings. This semester I do details about foundation and basement walls and it is very important to take care of insulation, good drainage, dimensions that can support the load from the building to the soil, have knowledge of soil characteristics, groundwater level and all kind of conditions outside and inside the building that can produce damages to the foundation.

The report contains next Research Questions: 1) Kinds of foundation's methods in Denmark. 2) Kinds of foundation's methods in Spain. 3) Pathologies in foundations

In two first questions, I explain, like title says, different methodologies of foundation in each country, factors that we have to consider when we have to choose one type or other one. I want to write about pathologies in foundations because I think is very important consider all the problems we can find when we are going to build the foundation, like groundwater level, soil properties, loads to consider…

KEY WORDS: foundation, footing, terrain, soil, concrete, loads, stress.

3 LIST OF CONTENTS

4 INTRODUCTION

4.1 BACKGROUND INFORMATION AND PRESENTATION OF SUBJECT

This report has been written as a compulsory research assignment in the 4th semester of Danish Bachelor of Architectural Technology and Construction Management education for an educational, technical and potential career perspective.

The purpose of this report is, on the one hand, make a study of the different methods of foundation used in both Denmark and Spain, and make a study of pathologies we can find, how we can solve it and problems we can avoid in foundations.

The research method that have been used to find needed information is internet, books, building regulations and lectures from my Spanish subjects.

Foundation is one of the most important point in buildings. It is composed of a set of structural elements whose mission is to transmit the loads of the building to the soil, distributing so as not to exceed the allowable stress or not creating zonal loads. I am very interested in this subject because, as an Architectural Technology student, I love different ways to build construction elements, their functionality such as kind of materials used to build it.

I choose foundation because in Scheme Design Phase in 4th semester, I had to draw the details, prices and study of materials of this part of the building, and I realized that there are some differences between the ways we are used to build in Spain.

4.2 RESEARCH QUESTIONS

The next step in the report will be analysing foundation. We will focus on:

- Kinds of foundation's methods in Denmark
- Kinds of foundation's methods in Spain.
- Pathologies in foundations.

4.3 DELIMITATION

Because the delimitation can be sometimes hard to approve, I will try to find the best way to combine all the knowledge that I have gained after searching for information on different sources, in order to highlight the most important things that involves studying different methodologies of foundation, as well as pathologies or damages we can find in this part of the building.

4.4 CHOICE OF THEORETICAL BASIS

My research is based on information found in Building regulations (Spanish and Danish), lectures of different Spanish subjects I studied there, pictures I took in some visit works with university, drawings of construction books and some pictures of web pages.

5 MAIN QUEST

5.1 KINDS OF FOUNDATION'S METHODS IN DENMARK

This main quest is about, like the title said, foundation in Denmark. I am going to write about information I founded in "SBI Direction 189", dimensioning of footings, kinds of concrete used to build this constructive elements and foundation control classes.

Foundation includes dimensioning and construction elements that transmit load from the building to soil bearing stratum.

Next I show some details of three possible solutions of foundation:

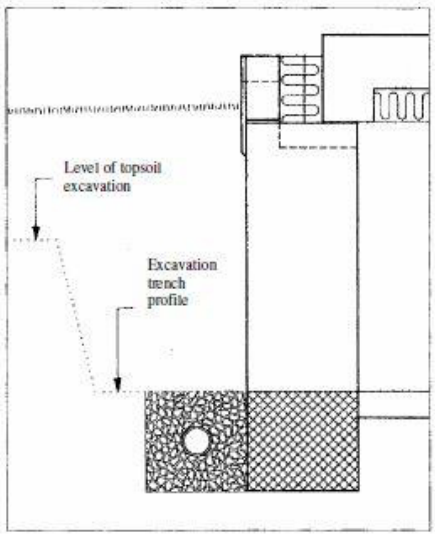


Figure 1. Foundation at ground supported floor

- Foundation at ground supported floor. Normally in situ cast concrete as a deep strip foundation is used. The upper part is often built using clinker concrete blocks. Hollow concrete blocks may also be used especially where the topsoil excavation level is below the topside of the deep strip foundation, thus avoiding the use of formwork for casting the upper part of the foundation. The foundation shall have at least the same width as the wall above and should be symmetrically placed below this. The figure also shows the placement of a perimeter drain and a branch drain, which connect the capillary breaking layer beneath the floor with the perimeter drain.

- Foundation at crawl space. Often a concrete pad is cast in situ and the crawl space wall is then constructed using clinker concrete blocks or hollow concrete blocks cast with concrete. The wall can also be cast fully or partly fully in situ. The foundation shall have at least the same width as the wall above, and it should be symmetrically placed below this.

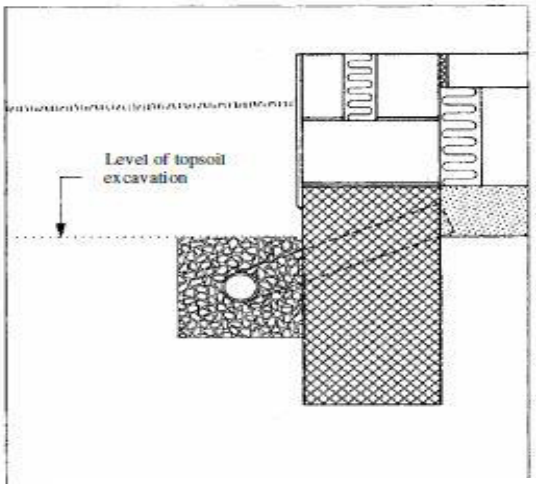


Figure 2. Foundation at crawl space

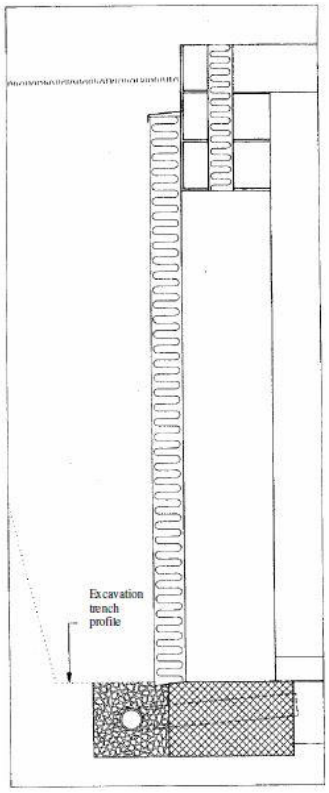


Figure 3. Foundation at basement

- Foundation at basement. Usually a concrete pad is cast in situ and the basement wall is then built using clinker concrete blocks or using hollow concrete blocks cast with concrete. Alternatively, the entire wall can be cast in situ. The foundation pad shall have at least the same width as the basement wall and it should be symmetrically placed bellow it. The figure also shows the placement of a perimeter drain and a branch drain which connect the capillary breaking layer under the floor with the perimeter drain.

FOUNDATION CONTROL CLASSES

In this section, I am going to write about low control class. This class only comprises small and simple foundations on virgin and stable stratum above the water table. Such foundations can under certain conditions be constructed based on empiric knowledge and

without prior geo-technical surveys. In such cases geo-technical surveys of the sub soil shall be undertaken.

LOW FOUNDATION CONTROL CLASS

Foundations shall be constructed to a dept where they will rest directly on firm bearing stratum. That is usually a packed mixture of clay, sand and stone. However, a bearing stratum can also consist of packed sand, gravel or coarse silt (called non-cohesive soil).

If the bearing stratum is deeper than 2m, it will usually be expedient to let an expert carry out the actual design work.

When inspecting finished excavations, it must always be verified that foundation is carried out on firm and stable sediments.

The local building authorities will demand to inspect the excavation before casting the first foundation.

Usually the following soil layers are not considerable stable: fill, soil which has been excavated before or frozen soil, sediments with content of organic material. The latter is characterised by not containing sand or stones and by having a high water content (25-40%).

Apart from resting on a bearing stratum, foundations shall be constructed at least to frost-free depth. Regarding external wall foundations, frost-free depth is usually 0.9m below the surface. However, with special soil conditions such as silty soil the depth may have to be high. Silt is a soil type with grains rougher than clay but finer than sand.

In low foundation control class there must be no digging below the level of the water table. It is therefore important to ensure that the water table is deeper than the planned level of foundation before starting the excavation.

The excavation must not constitute any risk of damages to neighbouring buildings, sewer and supply lines, public traffic areas or similar. Thus, conditions in the neighbouring areas can in some cases exclude foundation work according to conditions in low foundation control class.

DIMENSIONS

Based on presumptions deep strip foundation can be carried out without further investigations (using values of table nr. 2).

Type of house	Width of deep strip foundation in m	
	Under load-bearing and non-load-bearing external walls	Under load-bearing internal walls
1 storey with ground supported floor	0.30	0.20
1½ storeys with ground supported floor	0.30	0.20
2 storeys with ground supported floor	0.30	0.25
1 storey with crawl space	0.30	0.25
1½ storeys with crawl space	0.30	0.35
2 storeys with crawl space	0.35	0.35
1 storey with basement	0.35	0.25
1½ storeys with basement	0.35	0.35
2 storeys with basement	0.40	0.40

The foundation height should be chosen to at least 0.30 m under load-bearing internal walls. However, in houses with ground supported floor, at least 0.20 m. Brickwork chimneys and fireplaces require a foundation of the same height as stated for the deep strip foundations.

Figure 4. Dimensions of deep strip foundation under walls in small single length houses.

The dimensions are valid for traditional single length houses that is, houses with load-bearing facades and possible load-bearing longitudinal walls placed close to the centre line of the house.

Deep strip foundations shall have at least the same width as the wall above and should be placed symmetrically beneath this. In houses with basement where the foundation is used as abutment for the concrete slab in the basement floor, the foundation shall be at least 0.10m wider than the basement wall. This will usually be fulfilled if the width is chosen 0.50m.

Non-load bearing internal walls can usually be founded directly at the floor deck concrete slab. The maximum linear and point loads, which can be transmitted, depend on the concrete slab and the insulating material.

If bracing walls are not founded as load-bearing walls one must ensure that the vertical reaction can be absorbed by the bed on which the wall is resting.

WORKMANSHIP

Foundation work starts by excavating an area similar to the geometry of the building. However, topsoil must be removed to a depth where the stratum is no longer weak and compressible (removal of layers containing organic material). Hereafter commences the excavation of trenches for the foundation according to dimensions (widths and depths). Dug out material must under no circumstances be filled back into the trenches. Noticed that the foundation level (depth) shall at least correspond to the underside of the floor to be constructed later.

Internal walls foundations in houses with ground supported floor shall only be taken down to load bearing subsoil, as they will not exposed to frost.

If the over site excavation level is lower than the topside of the deep strip foundation the upper part of the foundation can be cast using formwork. Alternatively hollow blocks of concrete or clinker concrete as well as massive clinker concrete blocks may be used. The hollow blocks are stacked on the strip foundation with tight joints and bonding.

When casting no more than two courses must be cast at one time using 5 or better. The concrete is carefully compressed with immersion vibration. Horizontal construction joints shall be placed along the centreline of the blocks.

When over site excavation reaches deep down it might be expedient to build the entire foundation of hollow blocks on top of a concrete blinding.

The under site of the foundation shall be horizontal. It is showed in figure nr 4. Where service lines are taken across the foundation, the foundation must be carried out according to figure 5.

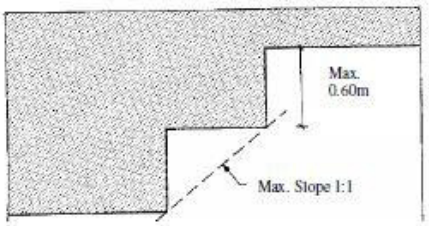


Figure 5.

The under site of deep strip foundations shall be horizontal and even. Stepping must have a maximum height of 0.60m. The gradient depends on the soil conditions, but cannot slope more than 1:1.

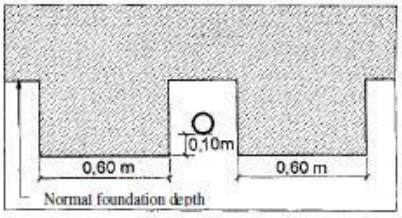


Figure 6

Where service lines cross the deep strip foundation, the underside of the foundations shall be at least 0.10m deeper than the crossing line at a distance of minimum 0.60m on either side of the line.

Trenches for sewer and drain pipes which are dug parallel to the foundation must not be dug deeper than the bottom of the foundation.

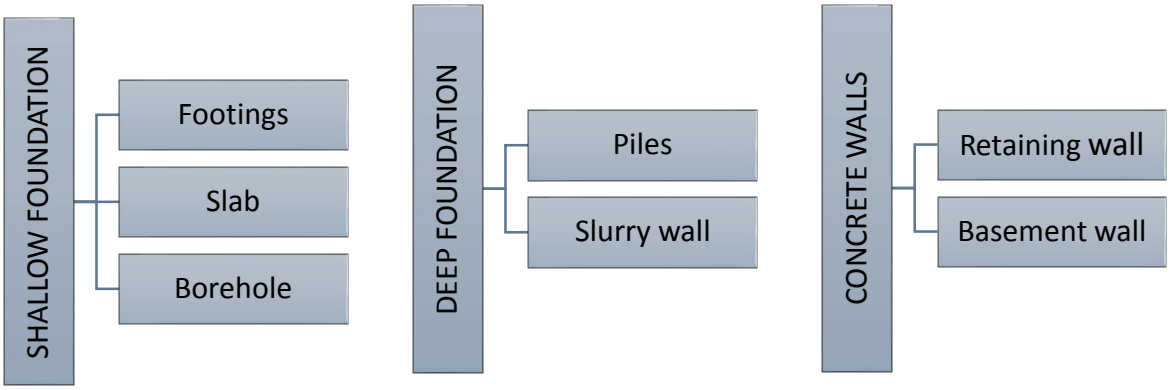
INSERTS OR RECESSES

To ensure the stability of the house it is often necessary to anchor the roof construction and/or the walls to the foundation. The placement of anchors must be determined prior to casting the foundation because the fixing of anchors can be done either simultaneously to casting or recesses can be made in the concrete for later fixing. The same applies to the placement of branch drains.

5.2 KINDS OF FOUNDATION'S METHODS IN SPAIN

This part of the report contains information about how are differenced kinds of foundation depend of their function. All kinds of foundation have the same function, which is transmit the load from the whole building to the soil.

Following, I am going to show a scheme about kind of foundations depending on the depth to which they are built:



5.2.1 Shallow foundation

They are hose transmit the load to the soil above a horizontal plan. They are used when the terrain has enough resistance to load bearing in an accessible depth and it is sufficiently homogeneous to have differential seats.

FOOTINGS

In this kind of foundation, each column rests above one footing, transmitting the load to the soil. The way of work of the footings is different depending of they are flexible or rigid. The first one works as flexion work, having compressed zones (absorbed by concrete) and traction zones (where we put reinforcement). When the footing has more high than the half of its width, it does not work as a flexion work, unless it does rigid way. In this case, it is applied connecting rods and braces. The pressing distribution above the soil is bigger in the edges than in the middle of the footing.

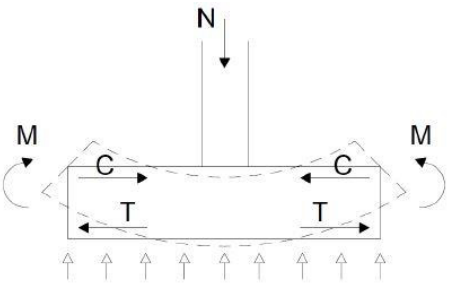
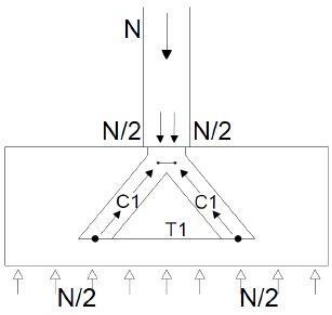


Figure 7. Flexible and rigid footing



- Single footing. They are those receive load from only one support. Its plant is used to be square or rectangular. The first step in the constructive process is throw around 10 cm of poor concrete and when it is hardened, it is placed the reinforcement with receptive spacer.

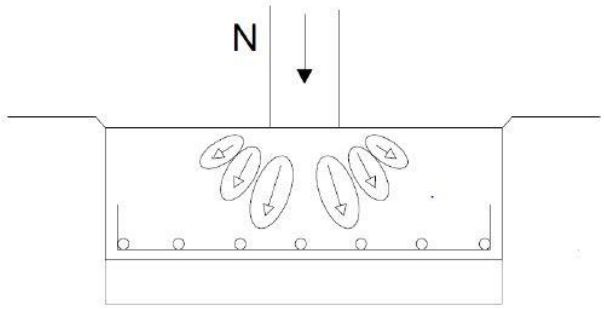


Figure 8. Section of single footing

Figure 9. Construction of single footing

- Strip footing. They are used as foundation of brickwork or concrete work load bearing walls. The longitudinal reinforcement serves to tie the footing and to avoid the footing does not crack transversally. If the wall is made of concrete, the footing will also carry vertical reinforcement to join it to the reinforcement of the wall.

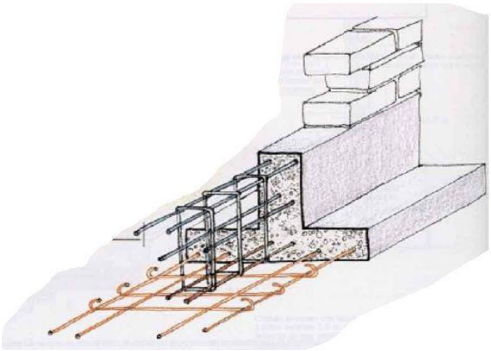


Figure 11. Drawing of strip footing

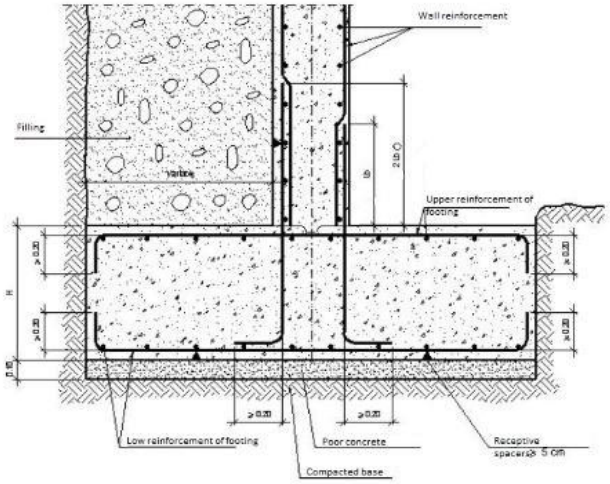


Figure 10. Section of strip footing

- Eccentric footing. Depeending where the column is placed, we have different kind of eccentric solutions:

Centred column.	Column with a little eccentricity	Column with eccentricity	Column in the edge of the footing	Centred column, but with one load and as well as flexor moment

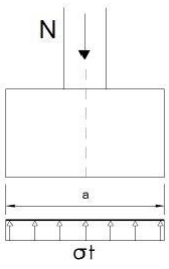
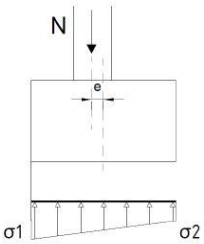
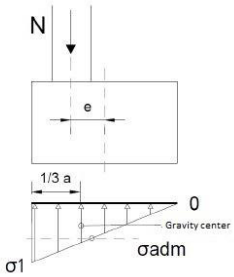
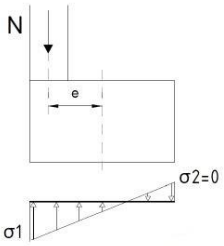
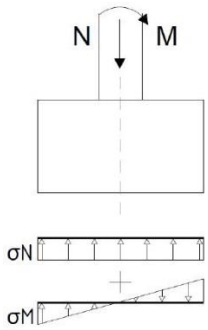

				

Figure 12	*Figure 13*	*Figure 14*	*Figure 15*	*Figure 16*

- Bracing beam. They are elements which tie single footings horizontally, avoiding that they are scrolled. Usually it is placed one bracing beam tieing all the footings of the perimeter of the building, and another ones tieing interior footings.
- Strap footing. They tie one eccentric footing with another footing (might be eccentric or not). They counterbalanced the turnaround of the eccentric footing, witn tractions placed in the upper side.

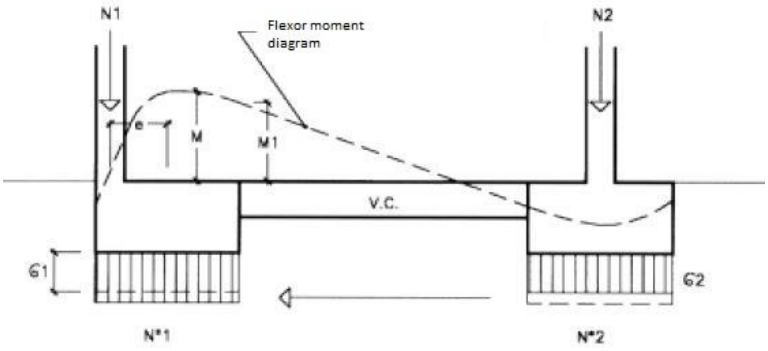


Figure 17. Section with strap footing

- Pooled footing. They are used when single footings are placed closed one each other and gather more than one column. It consists in that the gravity center of the footing plant concurs with the result of loads of the supports. One example of this kind of foundation is in the case when two columns and they have in the middle one dilatation joint of the building.

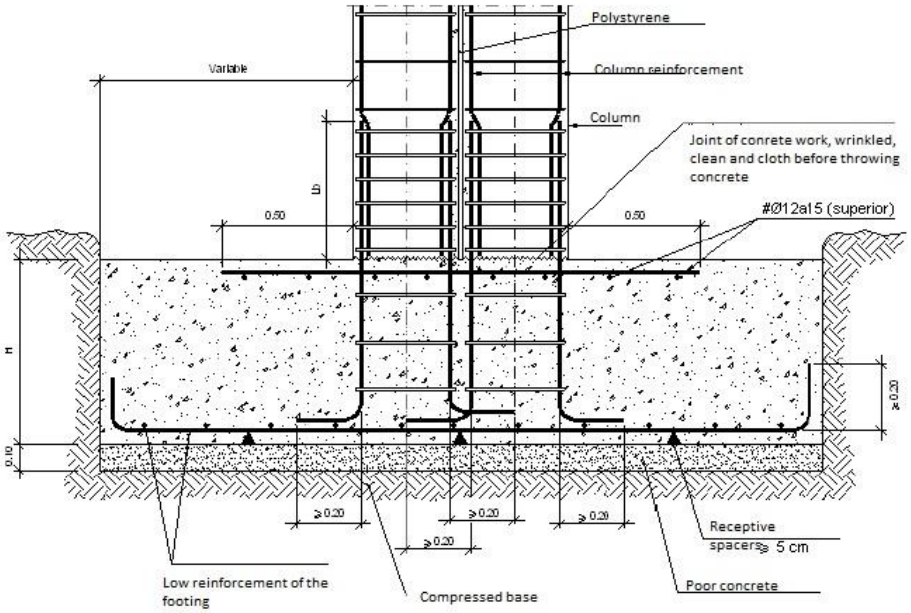


Figure 18. Section of pooled footing

SLABS and FOUNDATION BOARD

The theoretical difference between slabs and boardas is that the first one works in one direction and the other one in two directions.

- Lineal slab. They are footings which support more than two columns.They are used when the building has columns close one each other, or when it is wanted to avoid eccesive differential seats.
- Reticular slabs. They are those that used when lineal slabs are placed in two orthogonal directions. This way, there is stress distribution in a buf surface without eccesive shift. The bracing is perfect in this case and there is capacity with local fails of the terrain.
- Foundation boards. They are used in heterogeneous terrain, with low strenth and when the structure does not permit differential seats.

Figure 20. Foundation board

Figure 19. Foundation board

BOREHOLE

When the firm of the terrain is next to the surface	When the firm is more depth, we

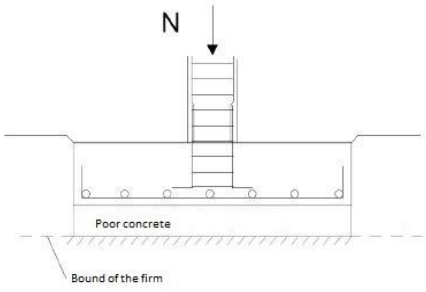
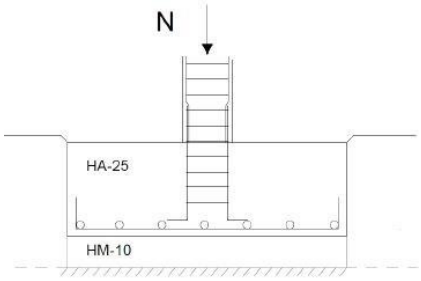

	

Figure 21	*Figure 22*
With higher depth of the firm, we might throw one layer of poor concrete more than 10 cm, or using one concrete footing in mass with more high	**When the firm is placed in a depth of 2-5m, it isfrequently used boreholes, which consists in fill the digging with poor concrete to optim height**

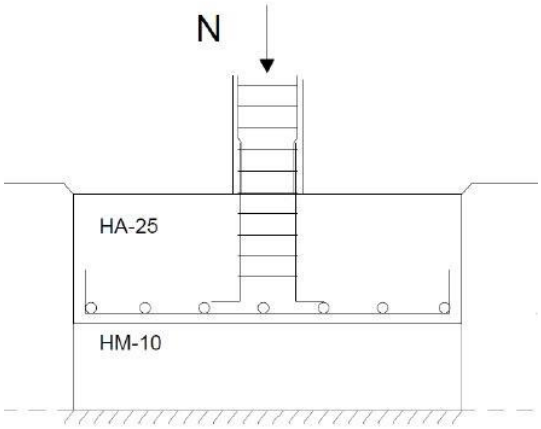
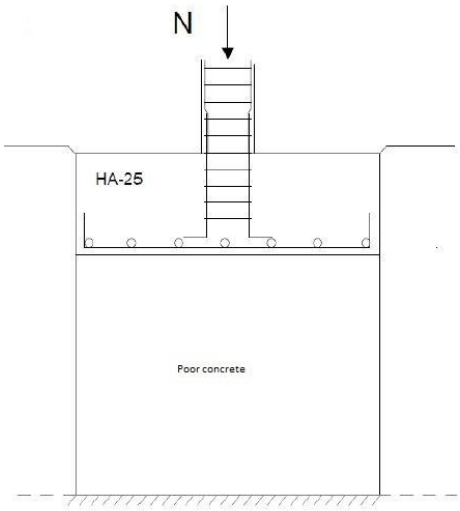
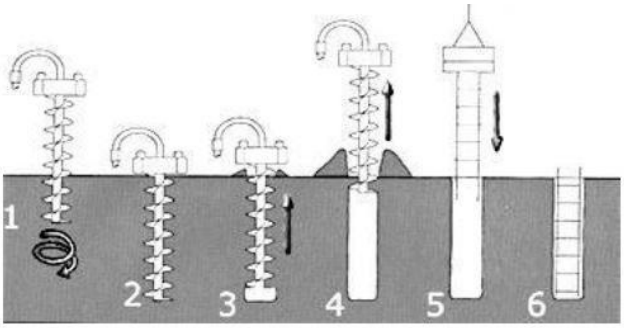
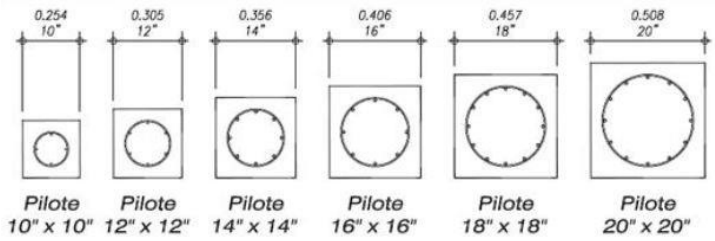
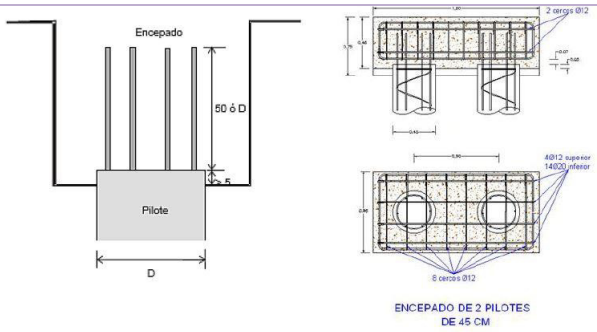

	

Figure 23	*Figure 24*

5.2.2 Deep foundation

When the foundation can't be made as a shallow foundation, because the firm is founded in more than 6-8 m of depth, where the back hole does not reach there.

- Piles. They are columns nailed in the terrain, which they found the firm. We can difference depending their way of execution:

In situ: it is made a perforation in the soil where it is placed reinforcement inside and then it is filled with concrete	 *Figure 25*
Prefabricated: they are nailed in the terrain by hitting or by a metallic blade equipped for this work. They are made for two reinforcement: one longitudinal and another one transversal	 *Figure 26*
Pile cap: constructive element used to connect pile groups with other columns or load bearing walls of the building	 *Figure 27*
Micro piles: foundation element combined for a steel tube placed inside a drilled hole in the terrain and received by injected cement	 *Figure 28*

- Slurry wall. They are land retaining elements, which are executed before cleaning the terrain, from the surface of the column. This kind of foundation is used in case when the soil would not be stable before cleaning the terrain.

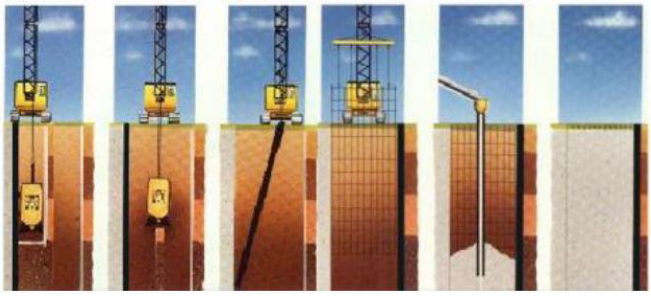


Figure 29. Slurry wall construction scheme

5.2.3 Concrete walls

Loads to considering in walls: self-weight, earth pressure, loads over the wall and loads over fill of stem.

The walls must be have vertical dilatation joints to absorbing deformations caused by temperature. They will placed each 30m maximum.

- Retaining walls/ basement walls. In this walls, the stress produced by building loads are bigger than those produced by the terrain. The walls are braced horizontally by the edges. The constructive process is explained in the following lines:

Digging the basement alternatively in steps of 2-3m of width, but keeping a perimeter slope. Once the footing and the correspondent wall are concreting (form worked walls one side), it is excavated other non-consecutive stretch. Finally, when the perimeter is closed, one top of the wall beam is executed in the upper side of the wall.

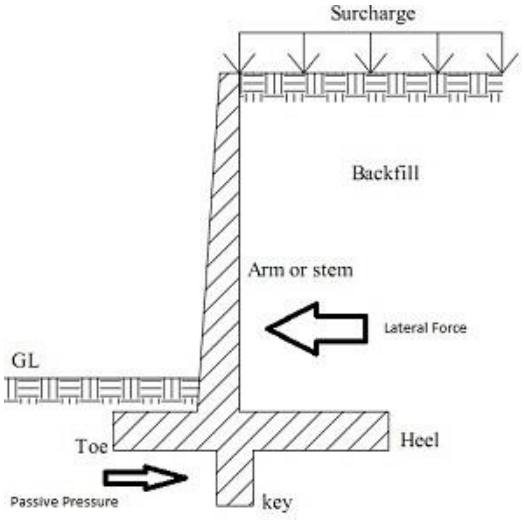


Figure 31. Parts of retaining wall

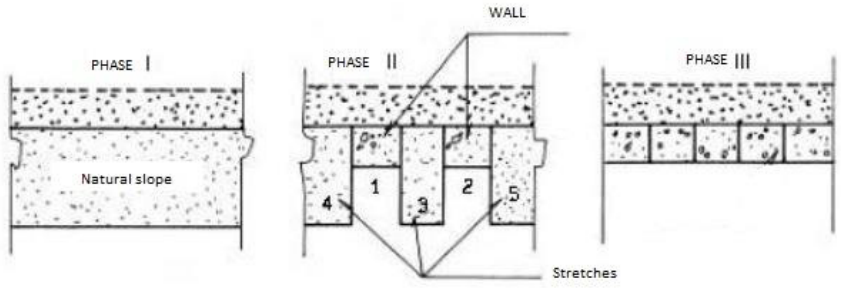


Figure 30. Retaining wall construction

Figure 32. Retaining wall image

5.3 PATHOLOGIES IN FOUNDATIONS

One of the first steps before we start with the project of one building is ordering the geotechnical study.

It should be ordered giving information about kind foundation to make, high of the building, loads to foundation, characteristics… with the objective of the report determines suitable alternative foundations, resistant stratum's depth, seats, precautions to take into account to foundation' execution, terrain's aggressive, groundwater level…

We can group the pathologies in this points:

5.3.1 Damages caused by ignorance of the terrain

The pressures bulb of one square footing affects the soil to depth around 1.5-2 times B (B=foundation width). This way, pressures distribution depends of the footing form.

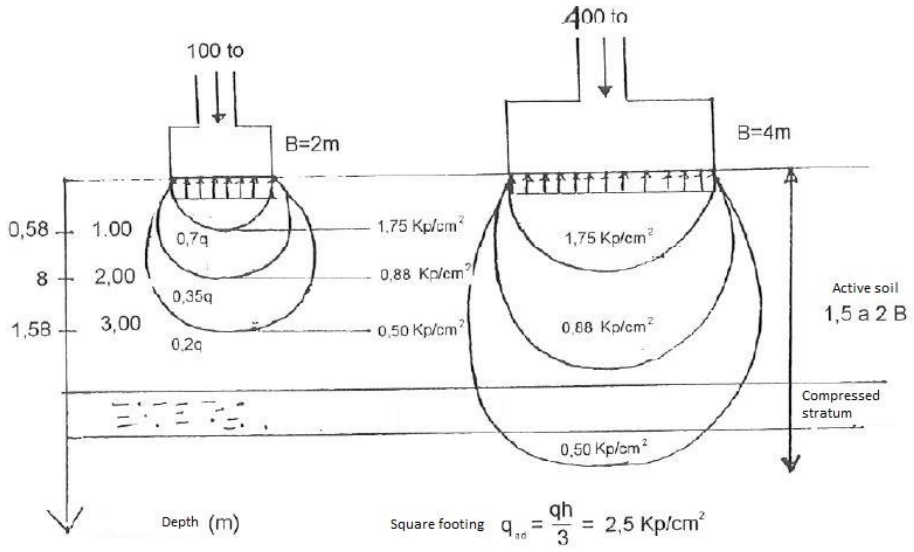


Figure 33. Possible different seats

5.3.2 Damages caused by the water

The moisture variations in soils can be produced by some points:

- Green area openings
- Water supply cracked
- New watercourse creation
- Diversion of currents for slurry wall construction, basements…

5.3.3 Foundations in expansive terrains

Expansive soils can swell when water is present and shrink back when they get drained. They are very fine grain soils, and as much smaller are the grains of their mineral structure, bigger is the phenomenon, because meniscus smaller are made and inter-granular strengths more potent appear which can produce cracking the soil.

The expansibility depends of:

- Particles size
- Mineralogical composition of them
- Moisture variation
- Weather
- Terrain (permeability)

This damages will worsen depending of next factors:

- Construction time
- Foundation's depth
- Number of floors and total weight of the building

- Rigidity or flexibility of the structure and work's resistance
- Situation and deformation capacity of water supply and sewer, to avoid leaks.
- Rainwater network design
- Perimeter pavement
- Gardens, trees existing close to the construction
- Heating system existing that may produce terrain dried

Expansively and retraction of expansive clay are manifested in every direction, giving rise to horizontal movements, that they produce horizontal thrust above foundation. Consequently, it produces vertical cracking in buildings and producing the walls to tip over.

Foundation must be treated to adequate to the phenomenon, what increase the process constructive price adopting solutions like:

- Solutions that delete or treat to mitigate moisture variations (making wider pavements…)
- Treating to insulate the foundation of the active terrain (piles, boreholes…)
- Solutions that adopt the structure rigidity to expected deformations, or in the other hand, making very rigid structures.

5.3.4 Foundations in stroking terrains

This soils have low density, big pores 'rate, with rigid appearance and they correspond to flabby silts bit cohesive non-saturated. When they are saturated, the water dissolves natural cement that gives rigidity to its mineral structure and produces collapse.

Appropriate foundations should be those one that transmit their loads to deeper stratums non-stroking (piles). In the case it couldn't be possible, it could be cemented directly over a compressed soil (of 2-4m power) in function of stroking way of the soil and pressure bulb, with a density equal or higher than 1.60T/m3.

5.3.5 Damages caused by frostings

In wet soils, when some frozen is produced, the water get frozen and increases its volume. If the terrain has fine grain, when it gets frozen and interstitial water increases its volume, it is sponged and when the defrosting is produced, the opposite phenomenon is taken placed, this way one light foundation that is inside the frozen influence zone will have movements that it have to raise during the frosting and go down with the defrosting.

5.3.6 Foundations in unstable terrains

Instability in terrains may be due to superficial effects that may cover big zones, like movements of hillsides, and problems with subsidence and cavities.

Unstable hillsides used to be produced by plastic terrains, that above rock bases, impermeable, with a little angle, have tendency to get expanded because of the water.

The subsidence phenomenon is a generalized seat of the terrain for consolidation, dissolution or extraction of it in below layers.

5.3.7 Foundations in terrains with organic field

The soils with organic field, vegetal rests… are not able to make foundation, because of decomposition of organic field produces important seats. This way, it has to be necessary replace or cross them with deep foundations.

5.3.8 Foundations in aggressive fields for the concrete

The aggression of the terrain can be evaluated by:

- Water analysis: PH value, silicic acid content, calcic ion content, magnesium ion content, sulphate ion content, chlorine ion content, carbonic acid content, water hardness.
- Soil analysis: organic field content, soluble salts content, determination of PH of soil.

Once the aggression of the soil around the foundation is determined, it is used appropriate special cements.

5.3.9 Pathologies caused by basement's excavations and execution

When an excavation is made, one stress alteration in the next terrain, producing horizontal and vertical deformations.

Horizontal deformations are made by earth pressure, aggravating in the case of loads produced to close foundation exist.

Vertical deformations are made by different isostatic loads that the excavation soil is subdued.

There are some factors that take action in this movements:

- Soil conditions and characteristics of it
- Groundwater level existence
- Dimensions and excavation depth
- Systems and excavation times
- Retaining support rigidity and execution sequence
- Surrounding loads. Kind of buildings (New or old)
- Vibrations existence
- Weather conditions

5.3.10 Pathologies caused by fillers

When a filled soil is placed above one terrain, this load increase will produce some terrain seats, which will depend of the filed weight and soil compressibility. This seat will affect to adjacent plots, and next foundations will be affected, inducing differential seats in footings.

6 CONCLUSION

After completing this report, I have better idea how is used to work in foundations in Denmark. I had an idea of Spain, but this way, my knowledge about foundation is bigger.

As well, like I said in the beginning of this report, foundation is one of the most important points in the buildings, so we have to study carefully different pathologies, possible damages, soil where we are going to build and every characteristics that can produce any kind of problem in foundation build.

7 LIST OF ILLUSTRATIONS

8 LIST OF REFERENCES

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Relación de documentos

(_) Memoria ..... 31 páginas

(X) Anexos .....199 páginas

La Almunia, a 8 de septiembre de 2015

Firmado: María Julián Martín