Year 2013-14

CONSTRUCTION OF AN ADMINISTRATIVE BUILDING IN KLUIZEN, BELGIUM

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Abstract

The following Bachelor Final Project is a technical assignment of an administrative building located in Nieuweweg 30 - 9940 Evergem - Kluizem (Belguim). Include a site installation plan, principal section, additional detailed drawings, a technical study, a comparative study and schedule, using MS Project. In order to monitor the progress of the works, several visits were made to the building site.

After studying the way buildings are made in Belgium, a comparative with the Spanish method is done. This is the main reason why I chose to do my final project abroad, so I could learn different ways of construction and maybe some new techniques.

Key words: comparative study, detailed drawing, principal section, schedule, site installation.

Acknowledgements

Thank you to everyone who helped me in carrying out my work: my academic tutor in Belgium Bart Craeye, David Peters and Frank Verplanken from KaHo Sint-Lieven; Jean-Marie Goemaere and Frederick Clarysse, from De Coene Construct NV and my academic tutor in Spain Mª José Vidal Lucas, from Polytechnic University of Valencia.

Content

Chapter 1.

Introduction

The following project is about the construction of an administrative building in Kluizen, Belgium.

The building site has no adjacent buildings, so there is as much room as needed for the equipment. Also the tower crane can be placed outside the building and they only need to consider the height of the own building when transferring materials. Vehicles can enter the building site and place the materials on the stockage area, near the entry and the tower crane.

The water table had to be lowed and stay at -5.55 m. The construction itself consists on a basement, ground floor and first floor with impassable roofs (see plan 2). Foundations are made by piles in the whole building. Wall foundations with beams, both made of in situ concrete, are used in the basement. The rest of the building is supported by in situ concrete beams. Stairs consist of 6 parts of prefabricated steps, going around the elevator, which is covered by concrete blocks walls. Floors are made by prefabricated slabs 15x120cm with a layer of in situ concrete and electrowelded mesh 150x150mm on top. All concrete used is C30/37 GB EE3 S3, both in situ and prefabricated. The steel used for the reinforcement is BE500S, while the electrowelded mesh type is BE500SD.

The slopes of the top roofs are made with prefabricated beams with different heights, which support the slabs and the rest of the layers. On the roofs of the first floor the slope is created by aerated concrete. All ledges are made by cellular concrete YTONG coated of insulation.

The façade is composed of brickwork of thermoblock 29cm, insulation, an air cavity and another brickwork on the outside. This building is meant to demand as no energy as possible so thick insulation (15-25 cm of cellular glass UTHERMWALL R 5.2) is used all over, as well as insulating materials, such as cellular concrete or thermoblock.

That is why well insulated joinery is also used. However, there is heating in the floors, in case it is needed. Ceilings are composed by suspended ceiling with 5cm of acoustic insulation. Walls are finished with plasterwork.

Chapter 2.

Site instalation plan

Location of the construction crane on site, radius, lifting capacity and lift capacity at max. radius. The construction has no adjacent buildings, so the only restriction for the tower crane is the building itself.

Location for temporary storage of material and consumer goods.

Location of site offices and building supervisor's offices.

Location of temporary site access roads and their construction.

Location of available utilities.

HSE measures.

See plan 1

Chapter 3.

Principal section

Broken longitudinal section of the building of study, to scale 1:50.

Plans of ground floor and first floor indicate where the section comes from.

On the section are also indicated the additional detailed drawings.

These are the main elements shown on the section:

- Pile foundations.
- Basement of in situ concrete beams and walls.
- Prefabricated stairs.
- Floors of prefabricated slabs with electrowelded mesh and a layer of concrete on top.
- Walls of concrete blocks, prefabricated concrete or thermoblock bricks. View leyend.
- Façade covered by 2 x 10 cm of insulation, 4 c of air cavity and ceramic bricks on the outside.

See plan 2

Chapter 4.

Detailed drawings

Ten detailed drawings to scale 1:10 of relevant constructive building joints from the principal section.

See plans 3.1 to 3.10

Chapter 5.

Technical study

The subject of the technical study is the elevator pit. It is made of in situ concrete C30/37 GB EE3 SE with reinforcement BE 500 S. It has pile foundations, like the whole building.

The lowest level the concrete will be is -4.4 m, so according to what the laboratory calculated, water table must stay at least 1 m under the slab.

See plan 4

Chapter 6.

Comparative study

The comparative study is focused on the columns. It aims to prove which material -bricks, in situ concrete or prefabricated concrete- is the best option for these elements.

After studying the pros and cons of each material, the prefabricated concrete is the one that bests suits, since its high price is offset by the short execution and good resistance of the material.

See plan 5

Chapter 7.

Schedule

Works were started on August 8th, 2014 and it is planned to finish the building by January 21st, 2015.

Main activities and their durations are included on the schedule.

See Gantt of the works.

Chapter 8.

Conclusion

The main difference I noticed between the way buildings are made in Spain and in Belgium is the structure.

Prefabricated elements are commonly used in Belgium, like in the construction assigned. As the drawings show, prefabricated slabs are the main element of the floors, which rest on the lower floor walls and columns. This means both floors and walls are part of the building structure.

In Spain the main kind of building has an in situ concrete structure, including columns, beams and stairs. First all the structure is done, followed by the roof. After this, brickworks can start, so they will not be a part of the structure.

Chapter 9.

Appendix

Class notes from Polytechnic University of Valencia

Class notes from Project Management 3, at KaHo Sint-Lieven

http://www.construmatica.com/construpedia/Ejecuci%C3%B3n_de_Pilares

http://www.construmatica.com/construpedia/Ventajas_y_Desventajas_de_la_Construcci%C3%B3n_Prefabricada

http://www.construmatica.com/construpedia/Tecnolog%C3%ADa_de_la_Construcci%C3%B3n_-_Estructuras,_Cerramientos_y_Materiales_de_Impermeabilizaci%C3%B3n:_Prefabricados_Utilizados_en_Sistemas_Estructurales

http://www.construmatica.com/construpedia/Ejecuci%C3%B3n_de_F%C3%A1brica_de_Ladrillo

http://www.construmatica.com/construpedia/Reglas_Generales_de_Ejecuci%C3%B3n_de_Muros_con_Bloque_Termoarcilla

https://www.youtube.com/watch?v=ha0_KGNu8gw

Annex

Plan 1. Site installation plan

Plan 2. Principal section

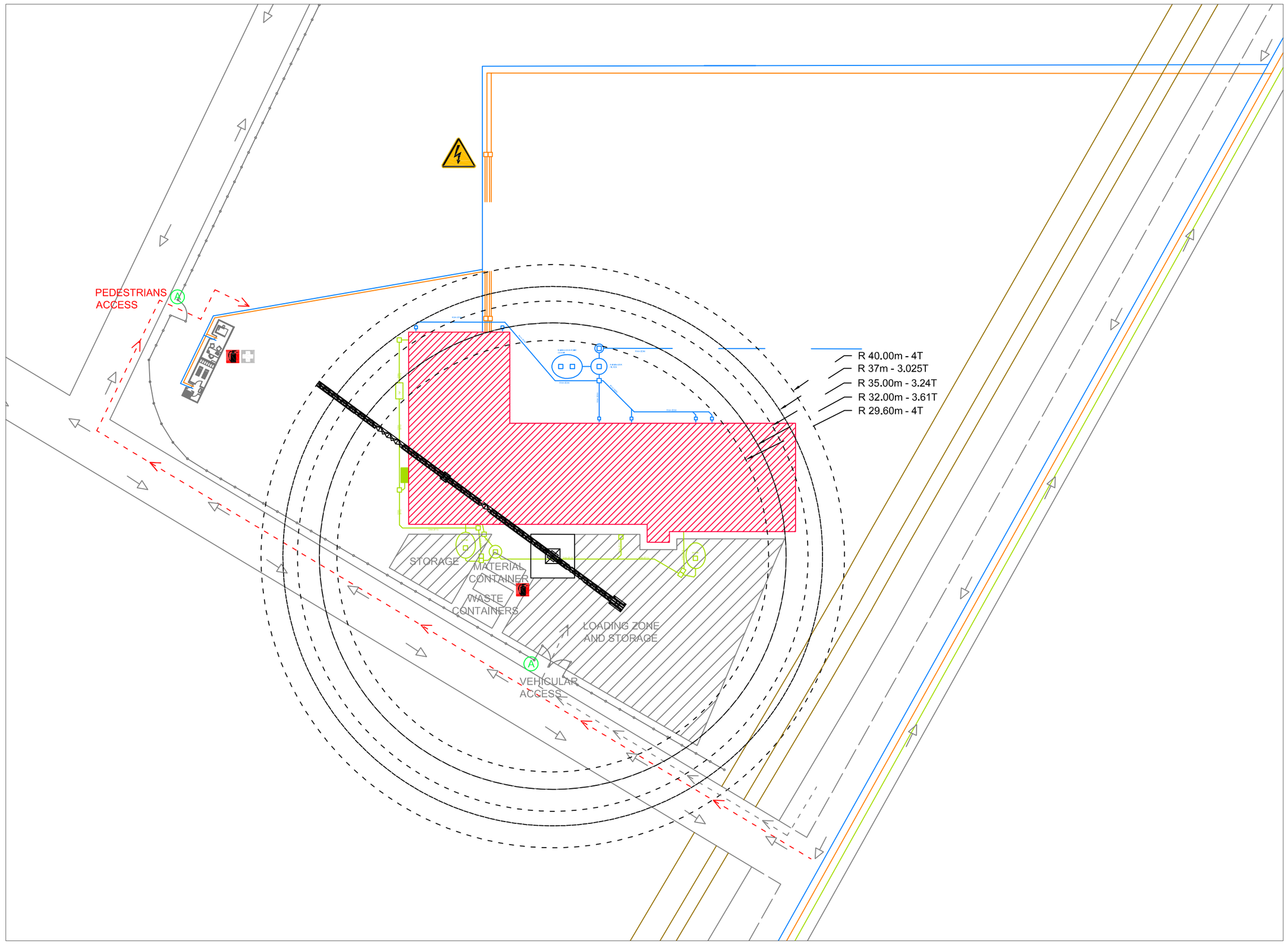
Plans 3.1-3.10. Additional detailed drawings

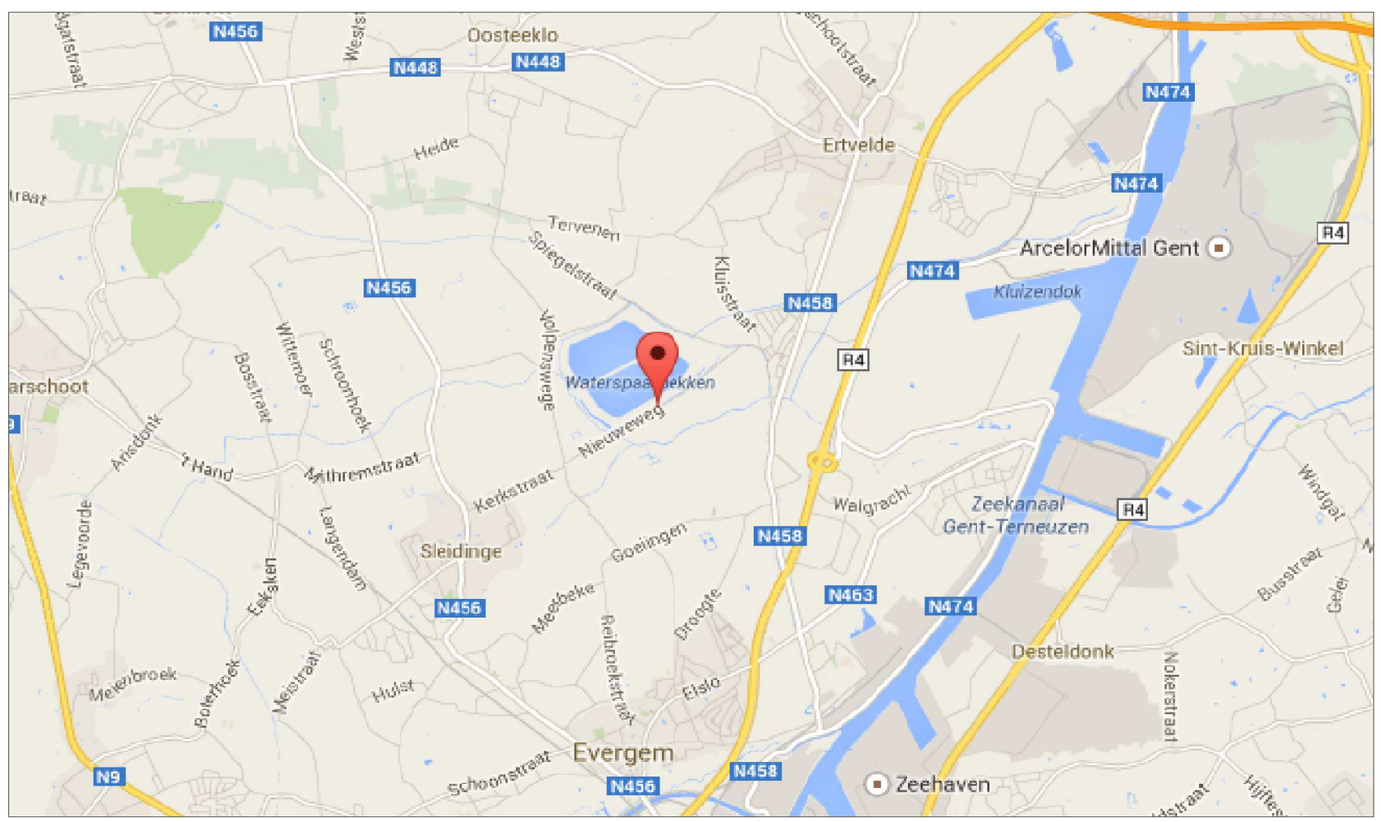
Plan 4. Technical study

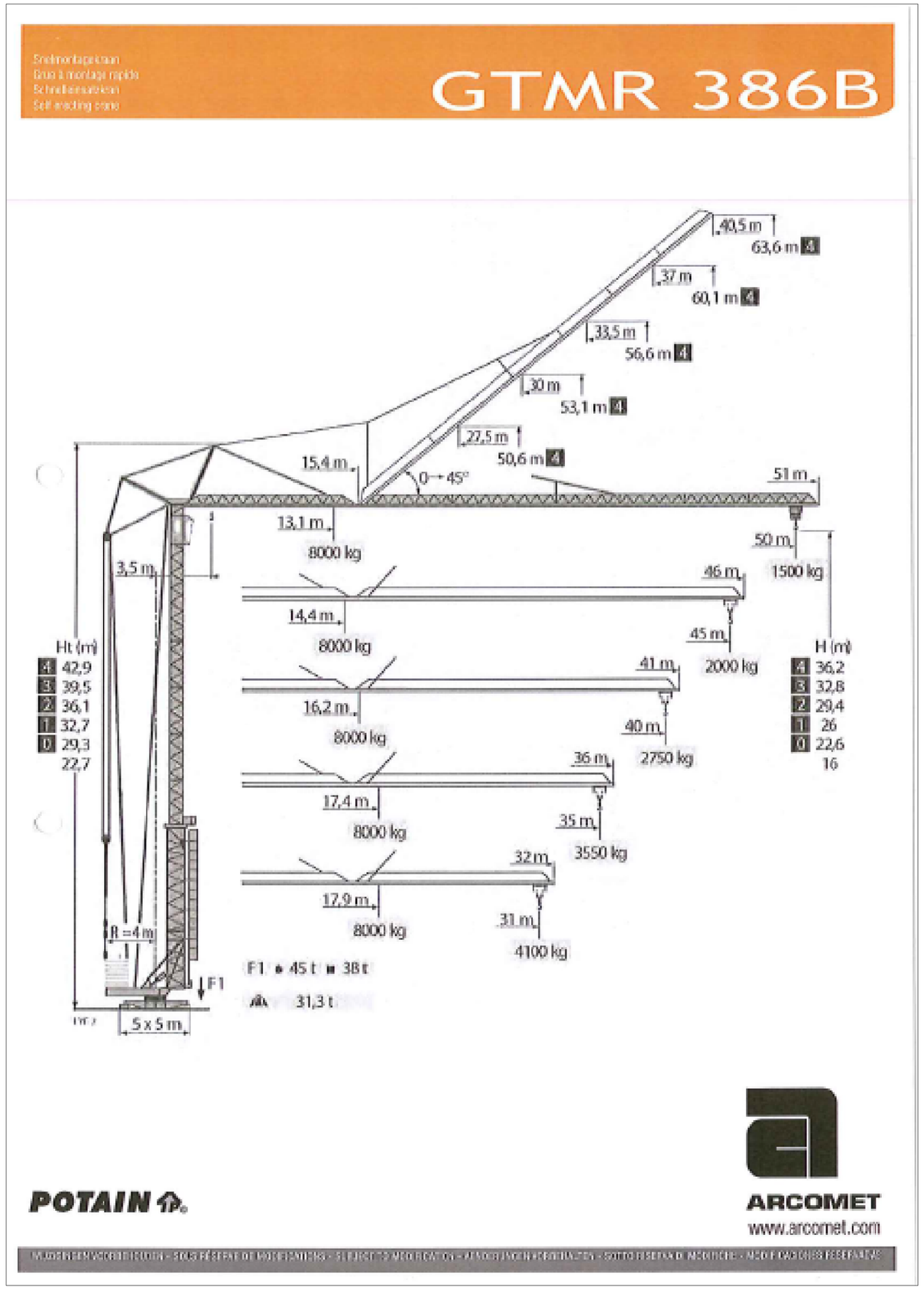
Plan 5. Comparative study

Gantt of the works

Pictures of the construction







LEGEND

- Ⓐ SIGNALING PANEL
- FIRST AID
- FIRE EXTINGUISHER
- FENCE AND LIGHTING
- HIGH VOLTAGE

Ⓐ SIGNALING

- HELMET
- SAFETY BOOTS
- PARKING
- WORK IN PROGRESS
- DANGER

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PART 1. SITE INSTALLATION PLAN

PLAN 1

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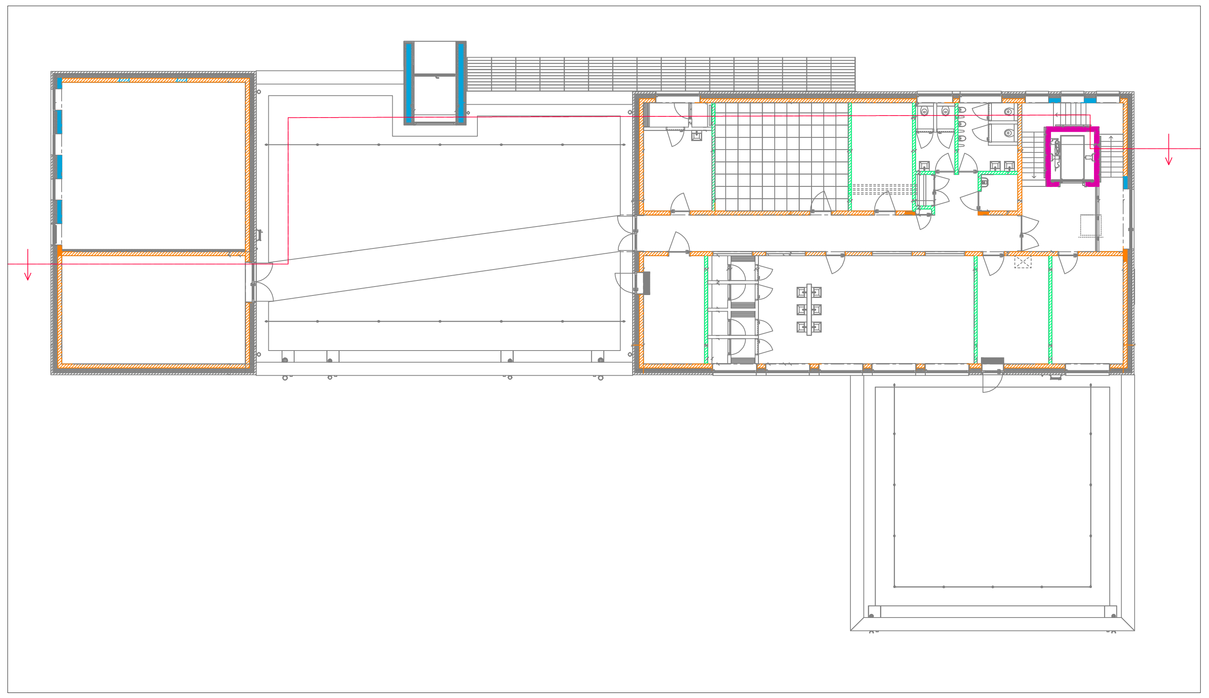
PART 2. PRINCIPAL SECTION E 1:50

PLAN 2

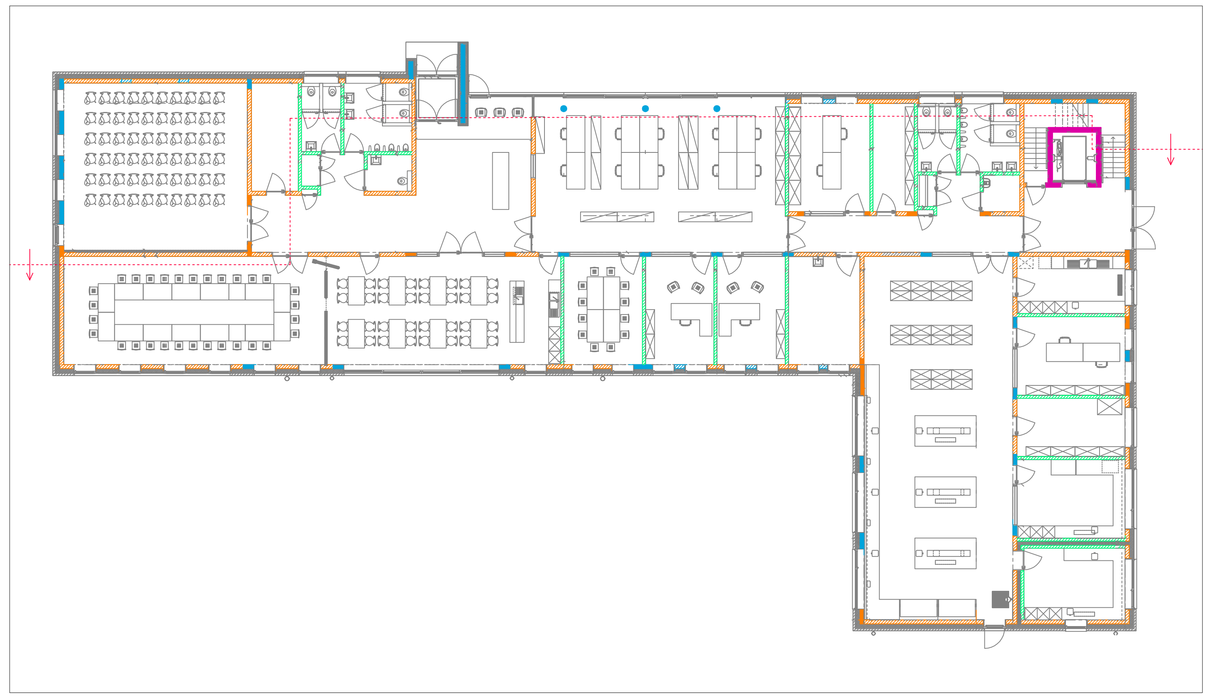
WALLS LEGEND

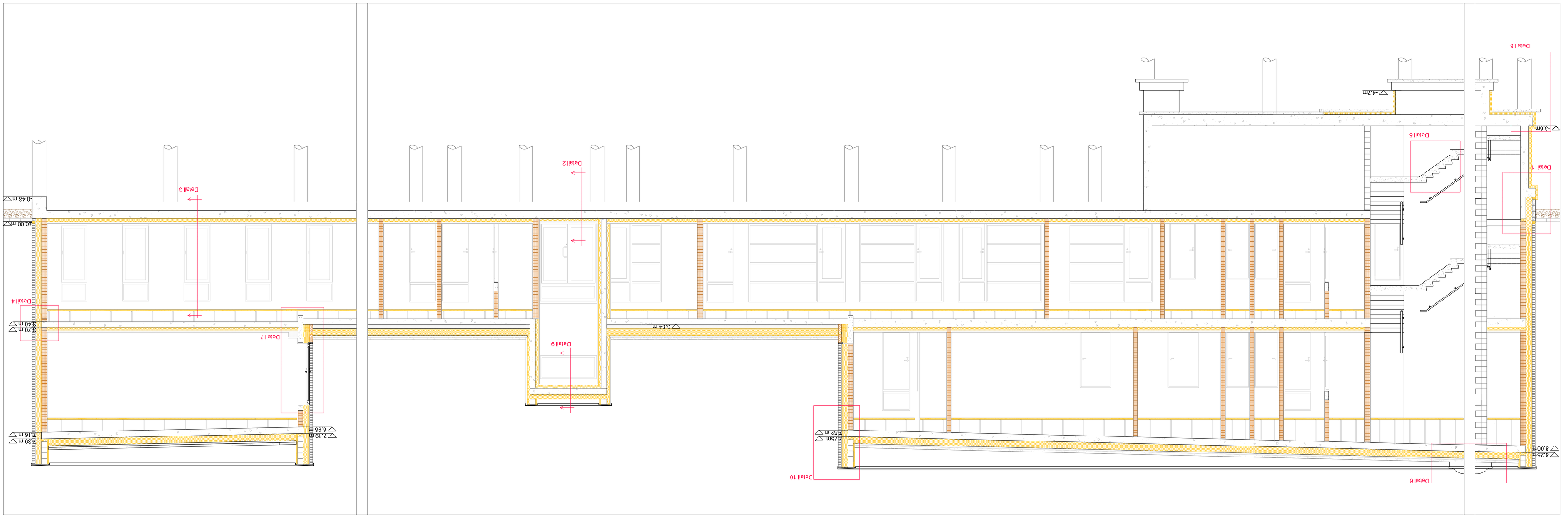
- CONCRETE BLOCKS
- PREFABRICATED CONCRETE
- THERMOBLOCK BRICKS 14CM
- THERMOBLOCK BRICKS 19CM

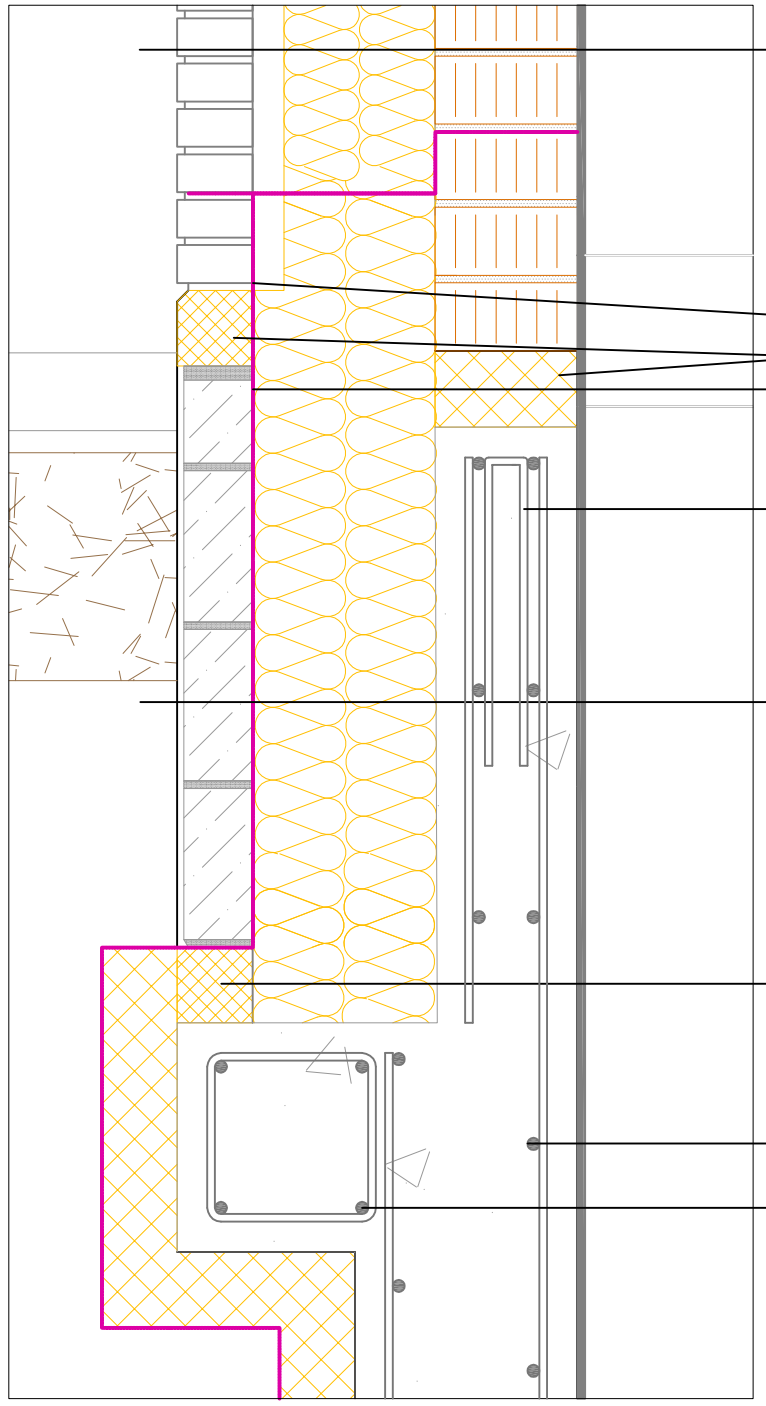
FIRST FLOOR
E 1:150

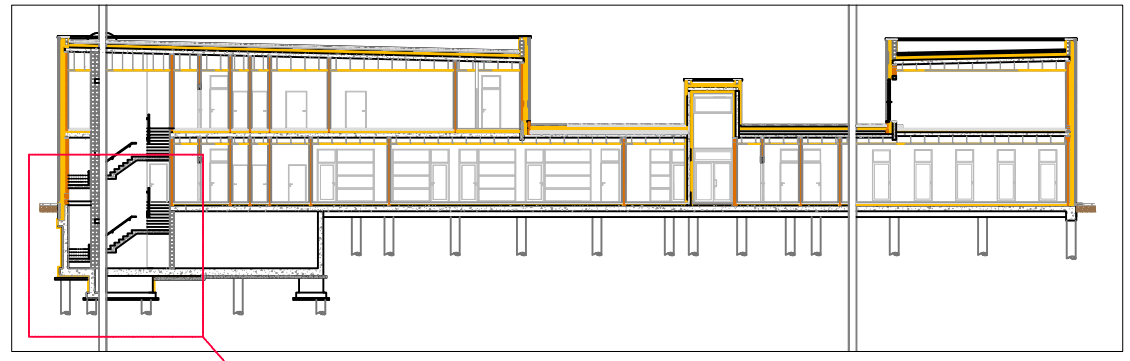


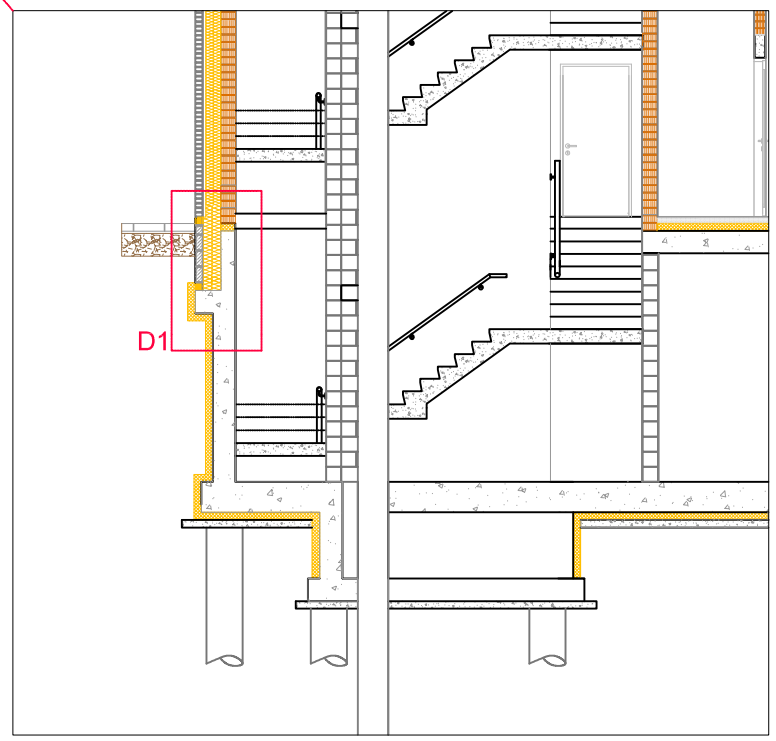
GROUND FLOOR
E 1:150











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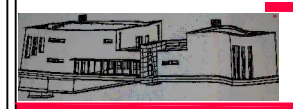

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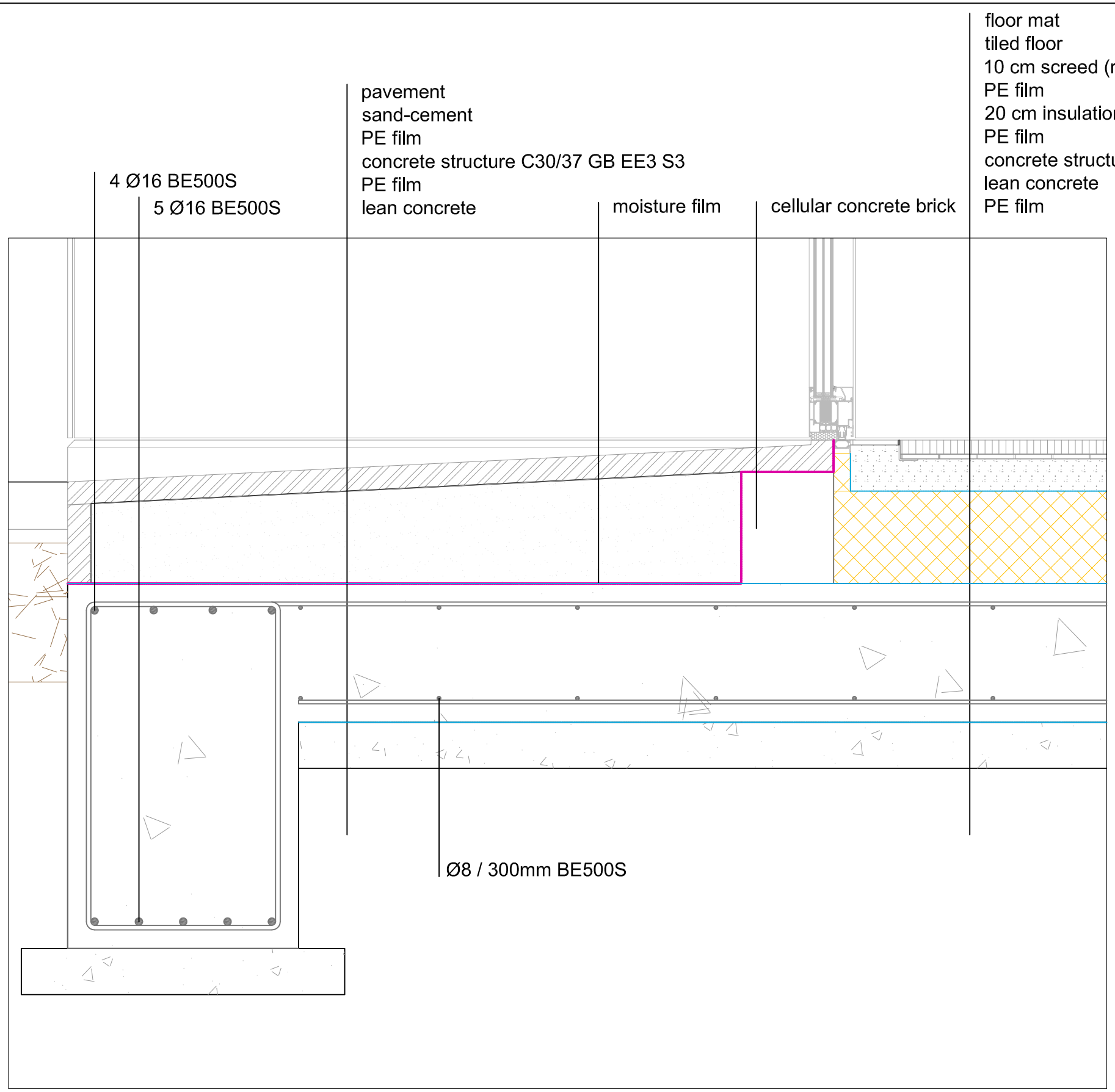
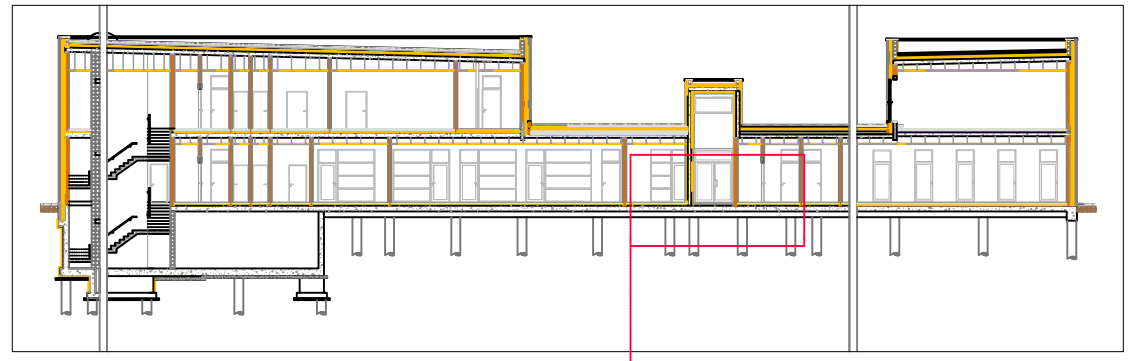
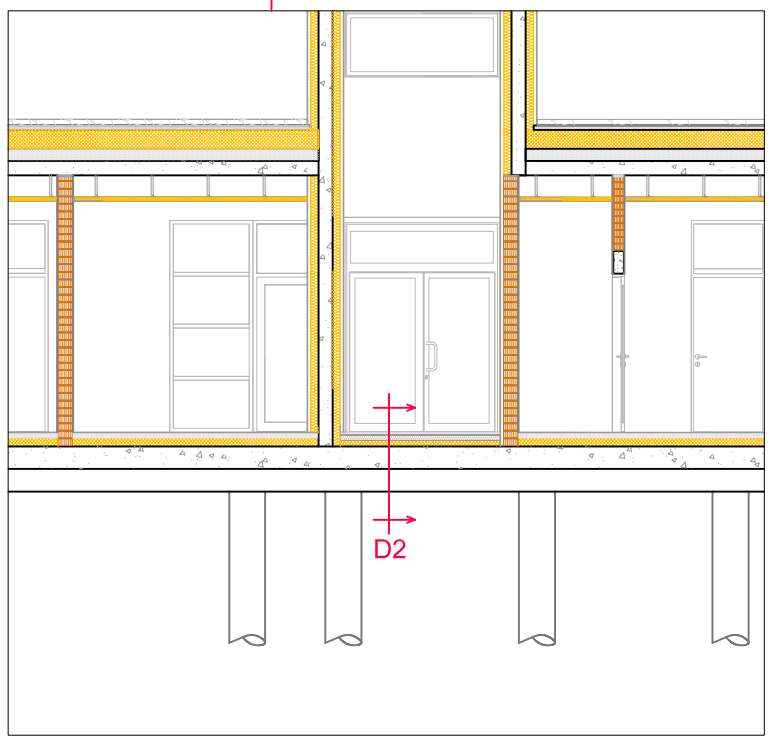
PART 3. DETAIL 1 E 1:10

PLAN 3.1







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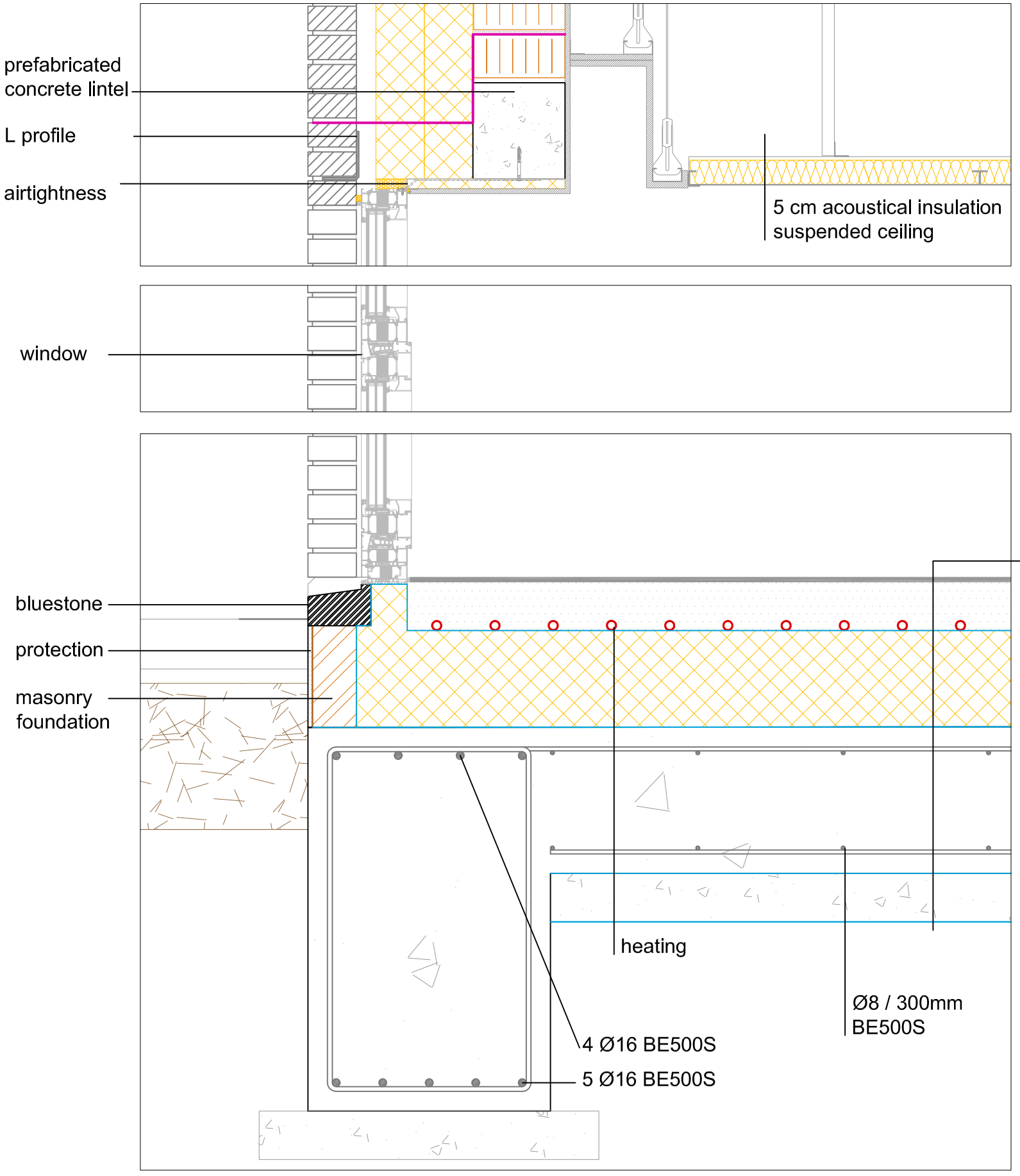
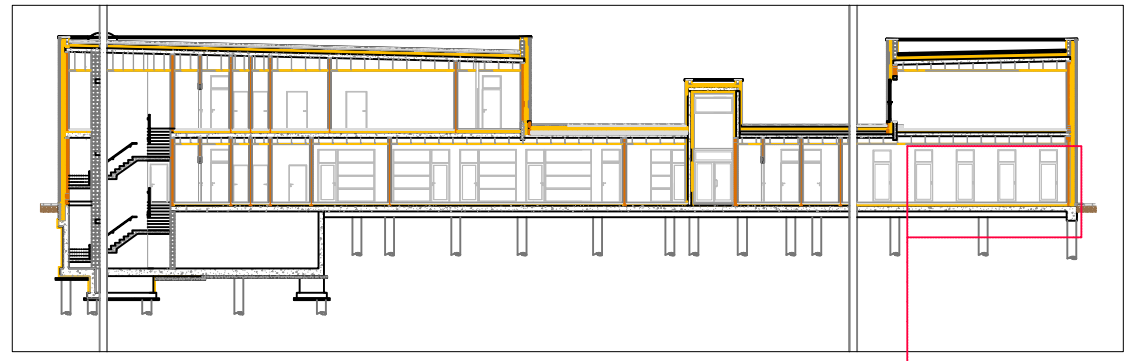
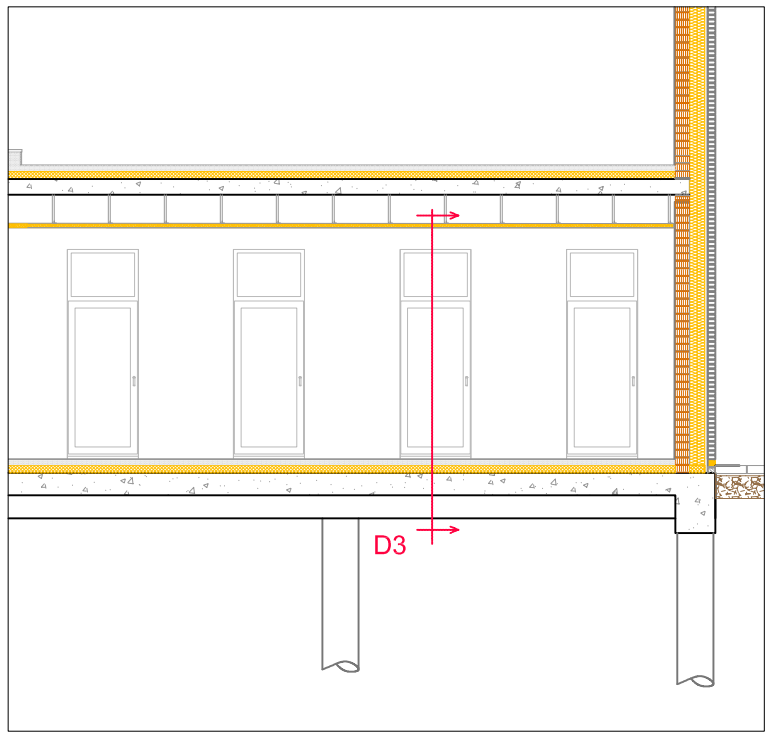
PART 3. DETAIL 2 E 1:10

PLAN 3.2



tiled floor
10 cm screed (reinforced)
PE film
20 cm insulation cellular glas
concrete structure C30/37 GB EE3 S3
PE film
lean concrete
PE film





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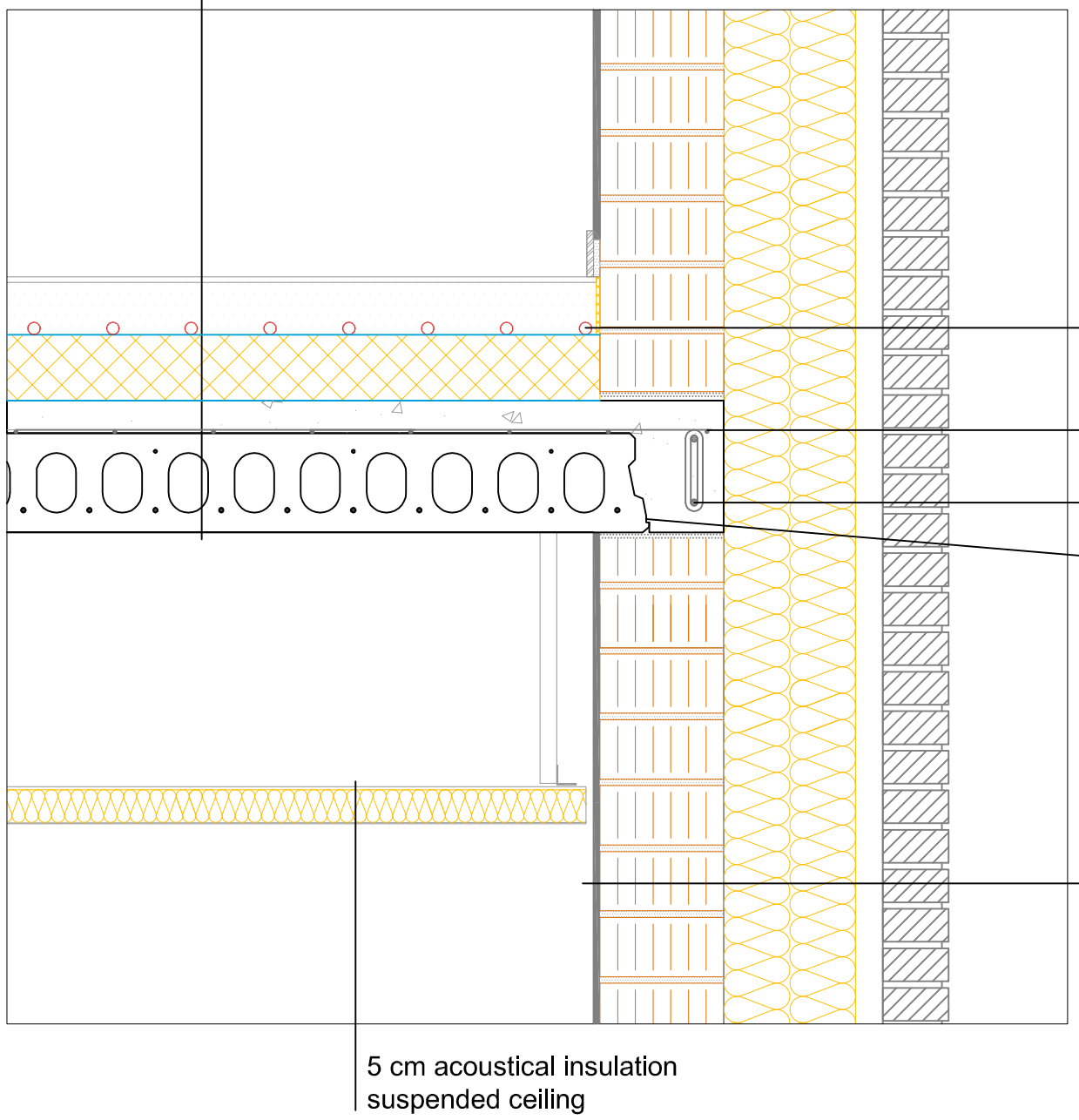
PART 3. DETAIL 3 E 1:10

PLAN 3.3

bluestone
legbed
PE-foil
10 cm insulation cellular glas
PE-foil
concrete structure C30/37 GB EE3 S3



heating

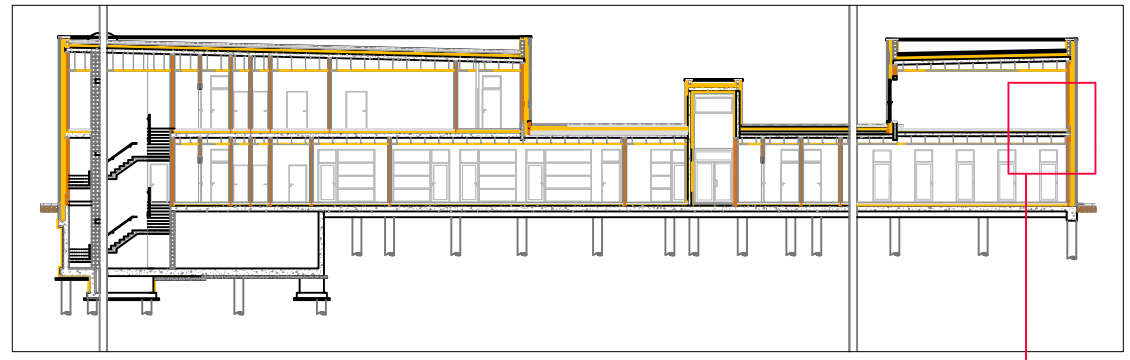
electrowelded mesh 150x150mm B500BS

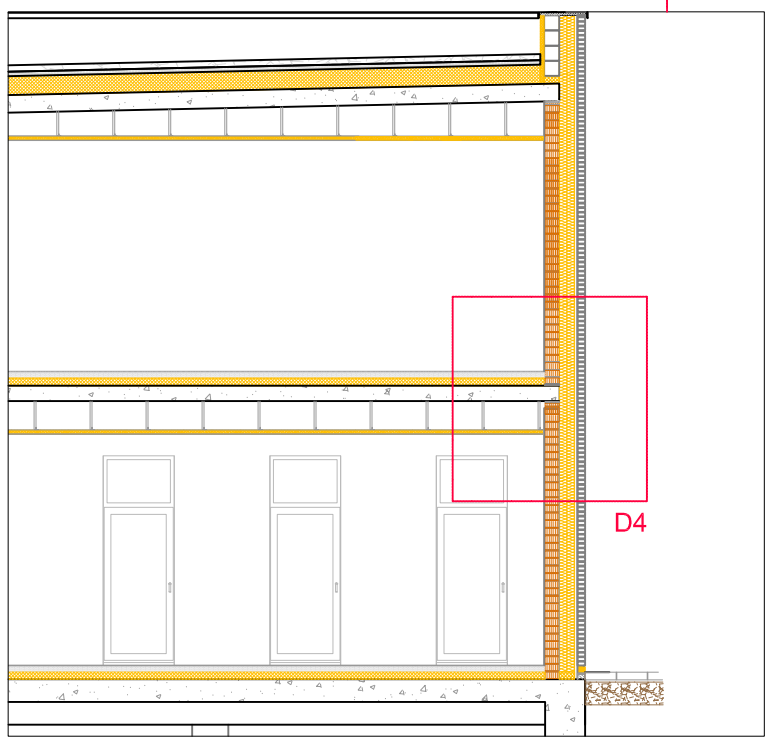
2 Ø10 BE500S

prefabricated slab 15x120cm
C30/37 GB EE3 S3

plastering
19 cm masonry
2x10 cm insulation UTHERMWALL R5.20 120 TG
4 cm air cavity
brickwork

5 cm acoustical insulation
suspended ceiling





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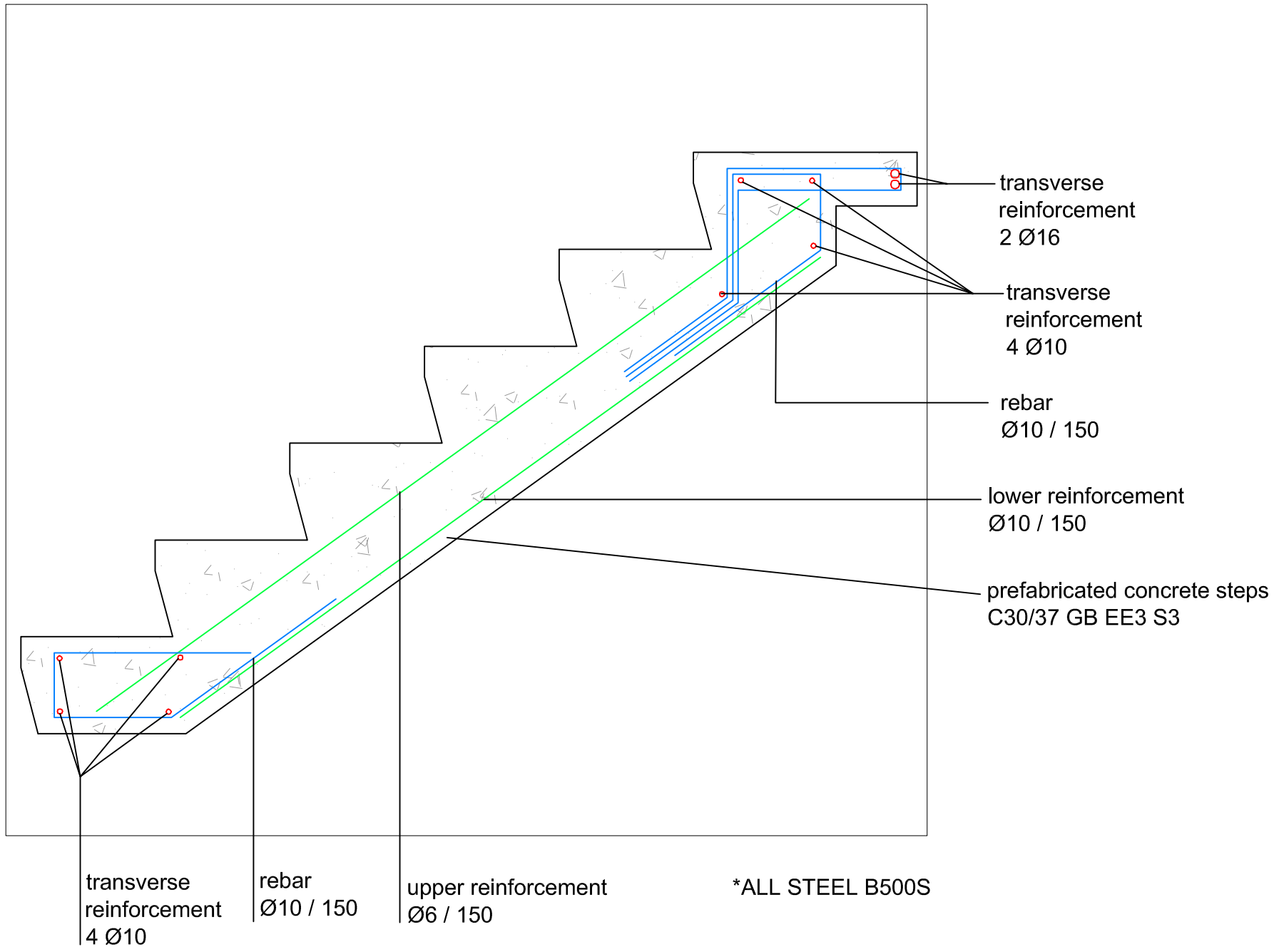
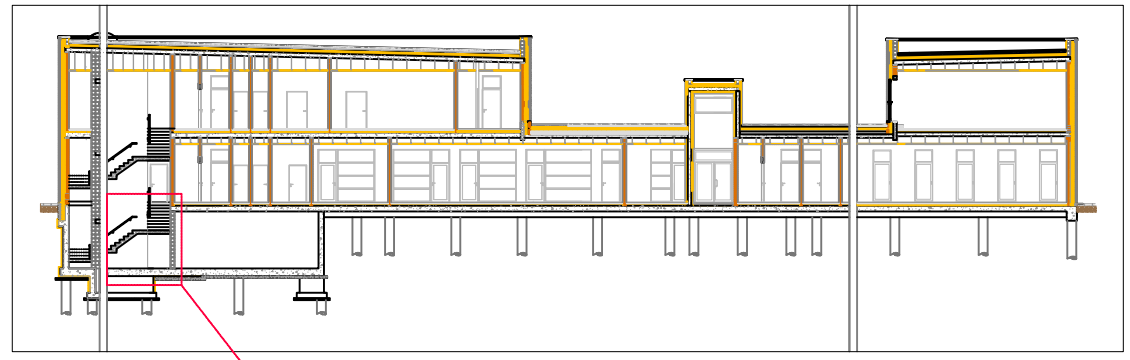
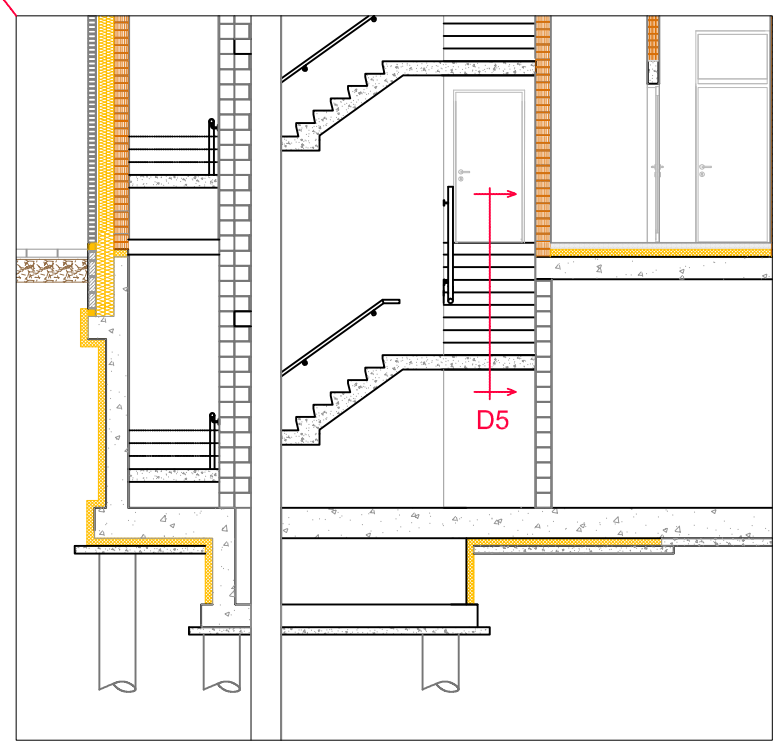
PART 3. DETAIL 4 E 1:10

PLAN
3.4







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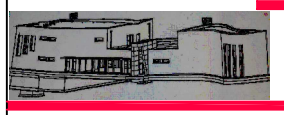

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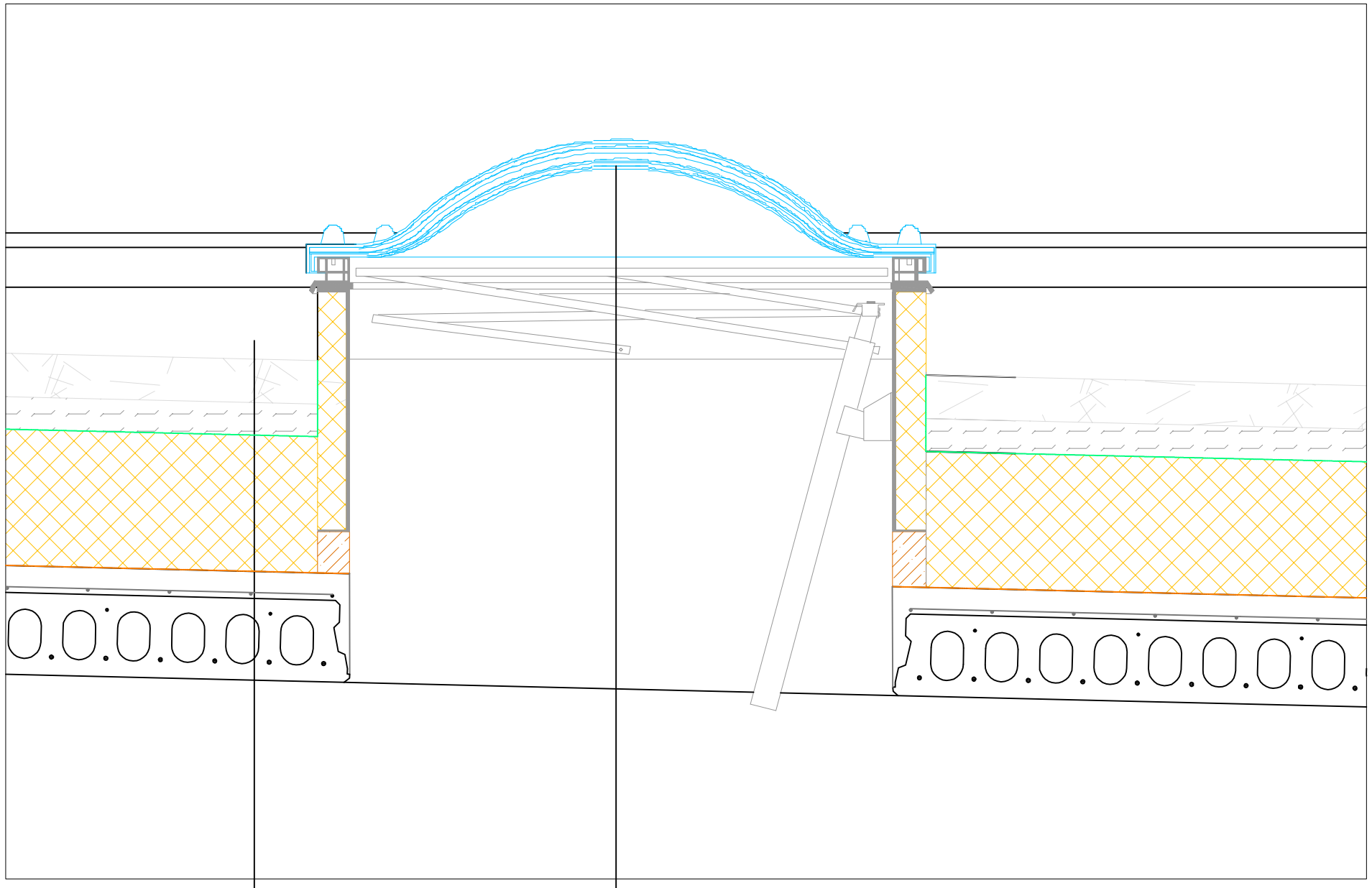
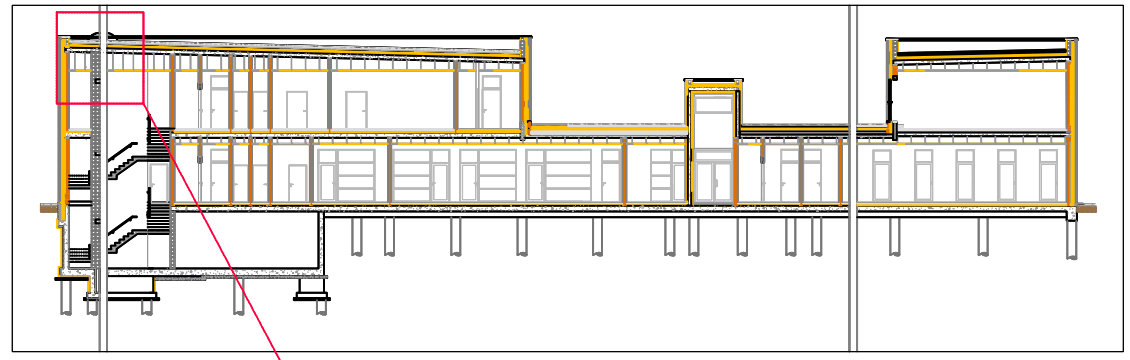
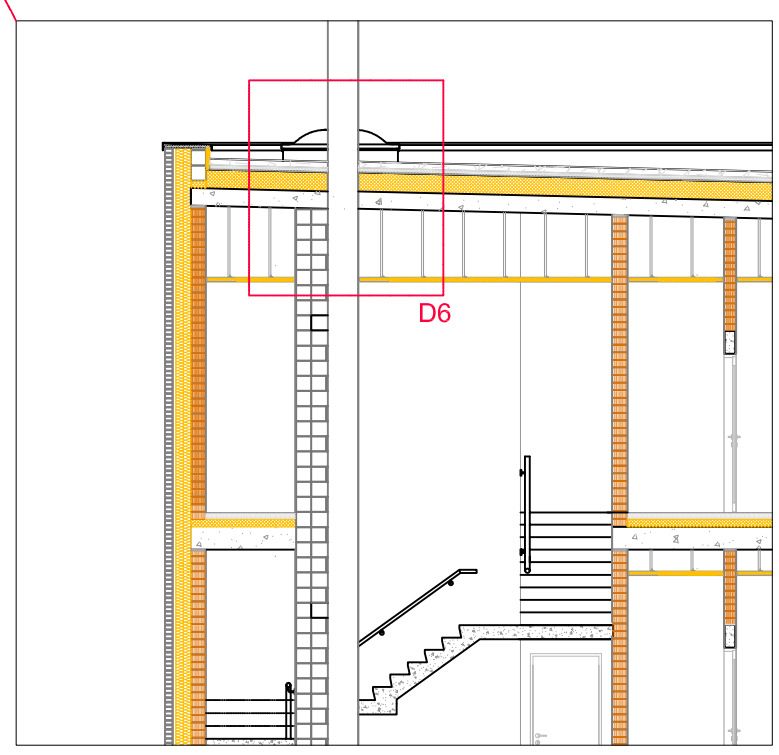
PART 3. DETAIL 5 E 1:10

PLAN 3.5







8 cm grounded gravel Ø40
drainage + filterfleece
root resistant foil
25 cm insulation cellular glas
vapor chem
concrete in situ C30/37 GB EE3 S3
electrowelded mesh BE 500 BS
prefabricated slab C30/37 GB EE3 S3

prefabricated skylight

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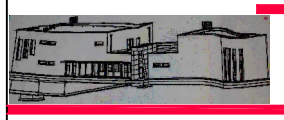

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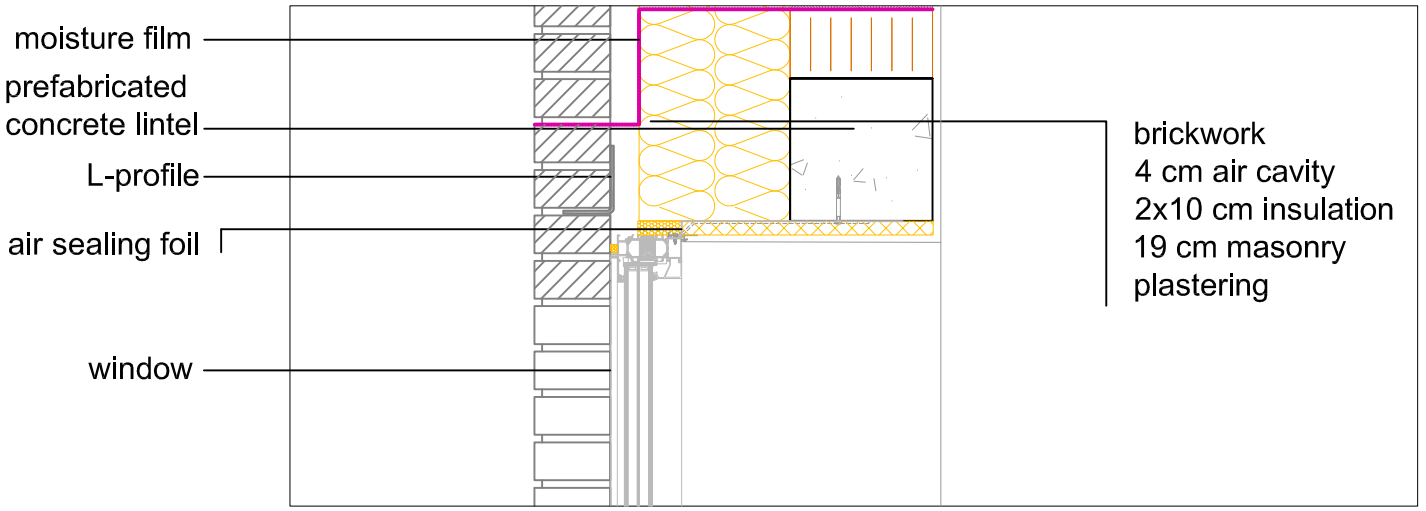
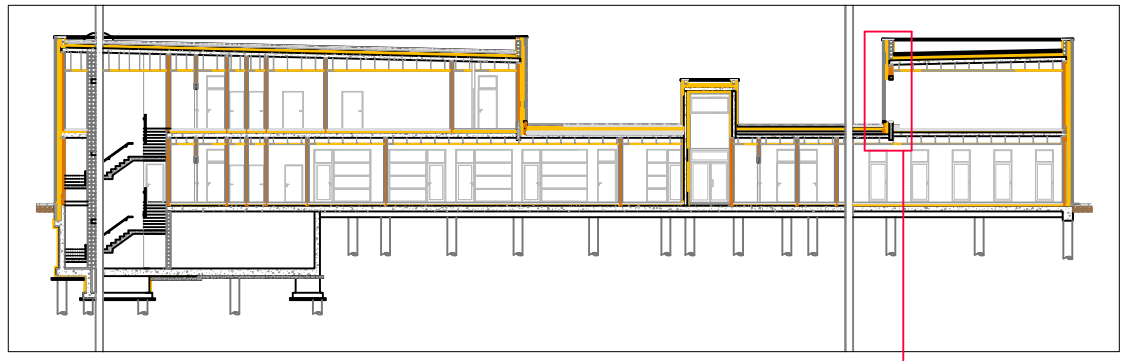
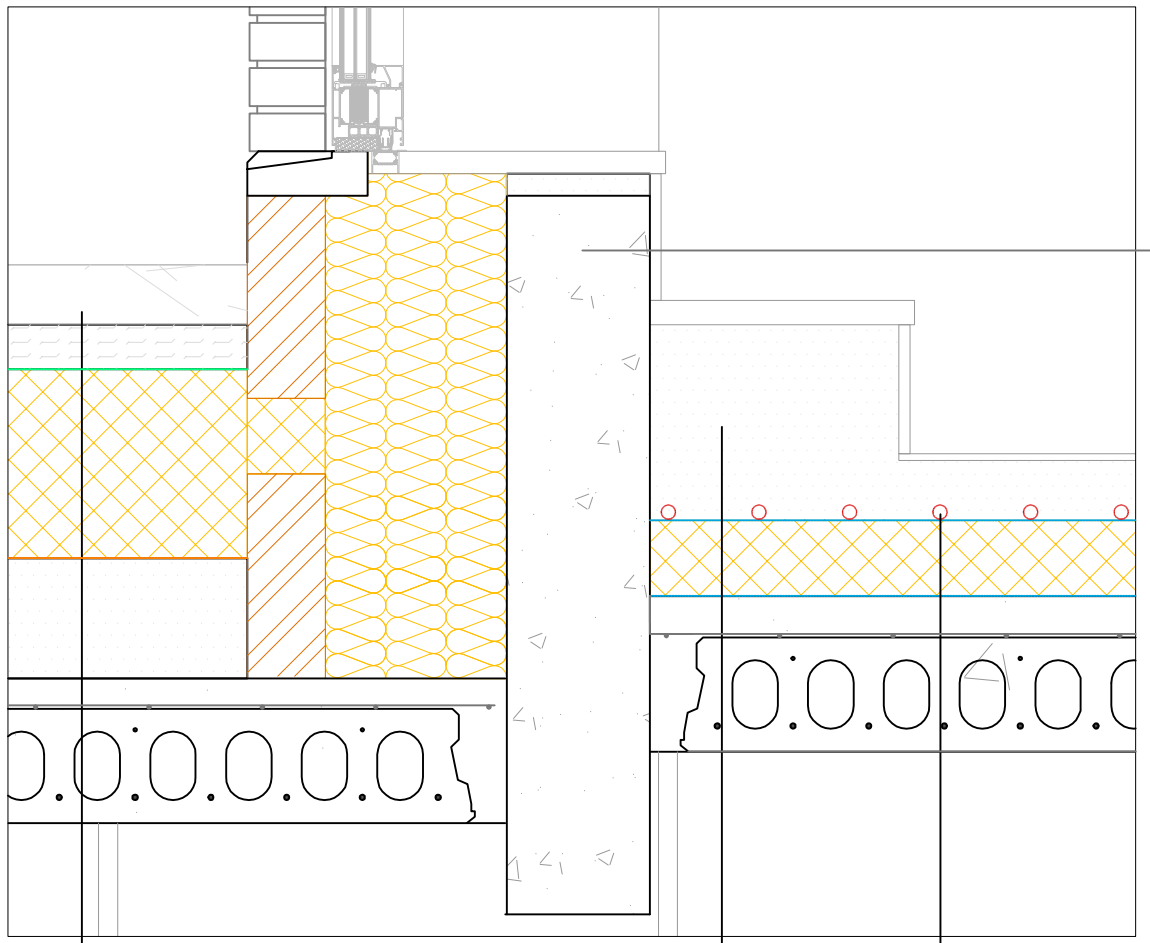
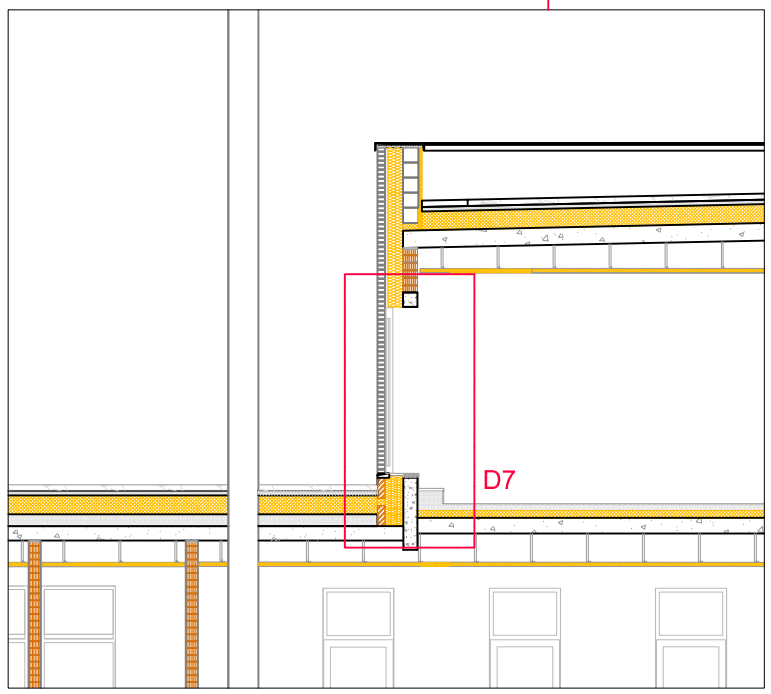
PART 3. DETAIL 6 E 1:10

PLAN 3.6









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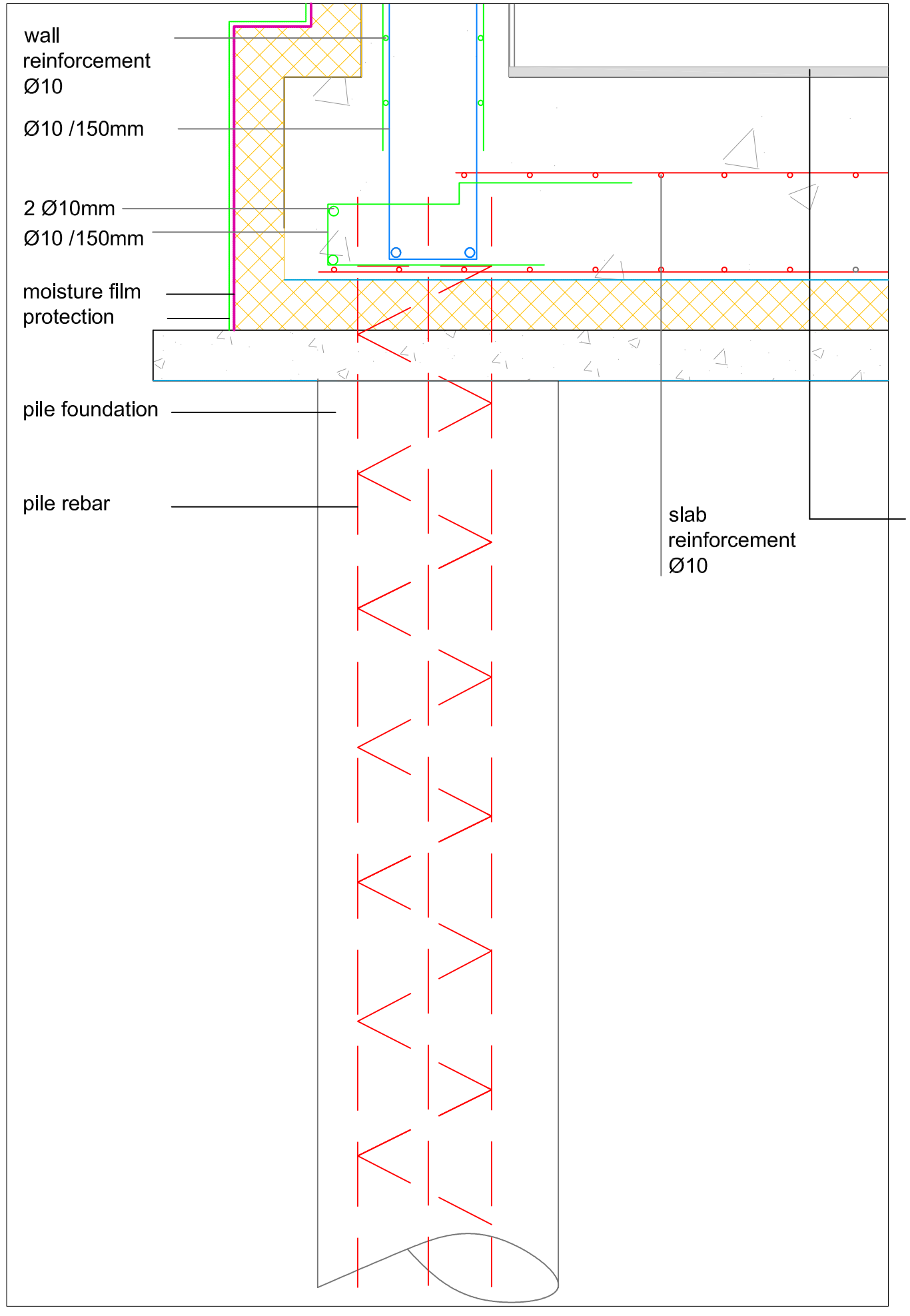
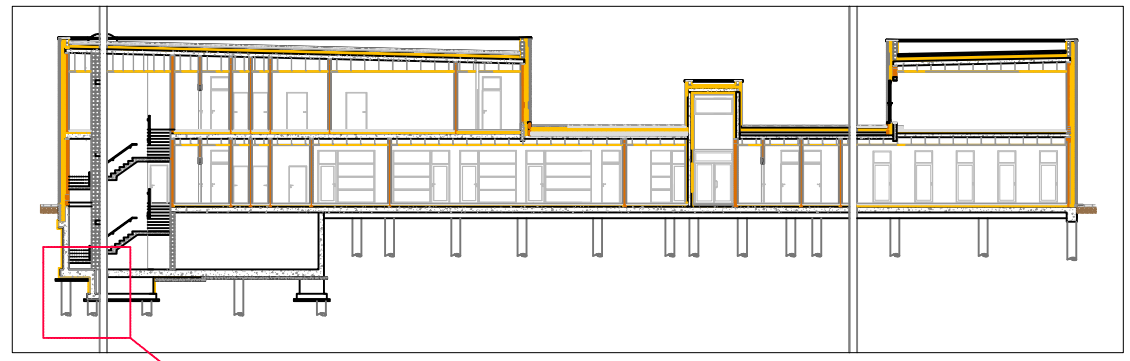
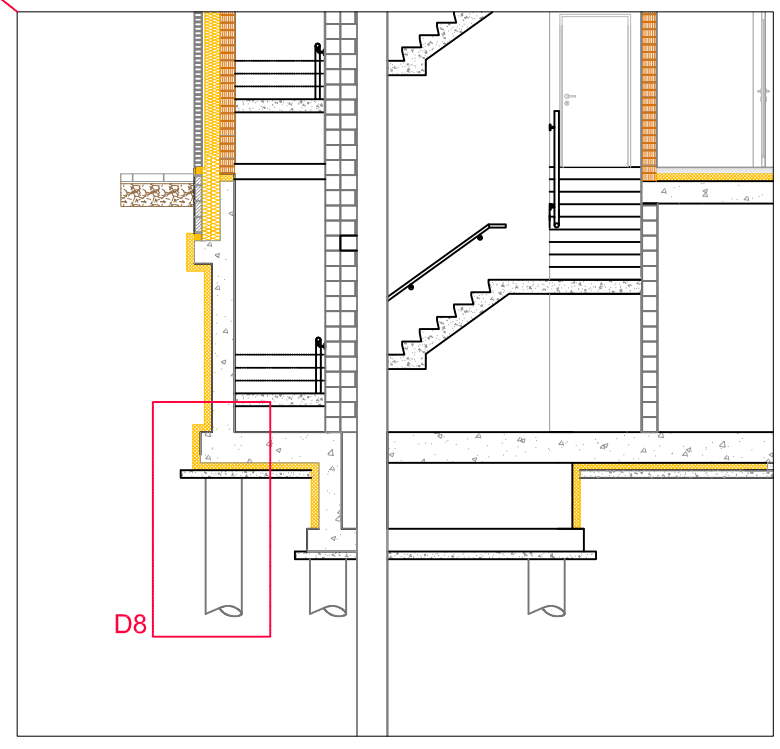
PART 3. DETAIL 7 E 1:10

PLAN 3.7



screed
concrete structure C30/37 GB EE3 S3
2 x PE-film
10 cm cellular glass
10 cm lean concrete
PE-foil





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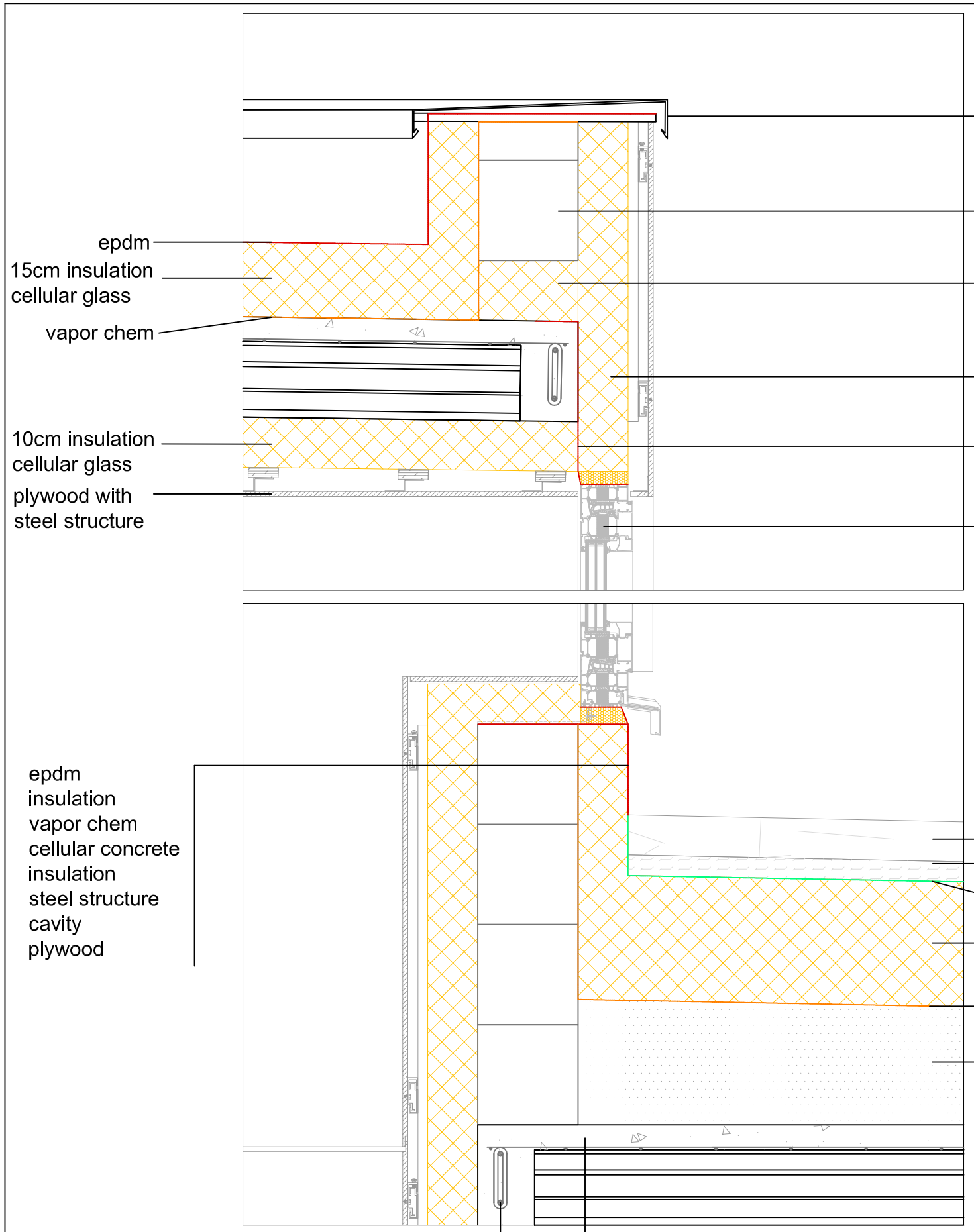
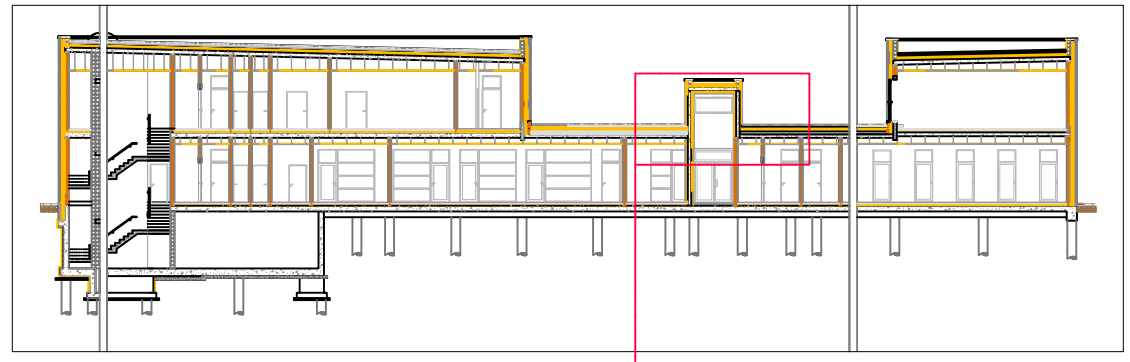
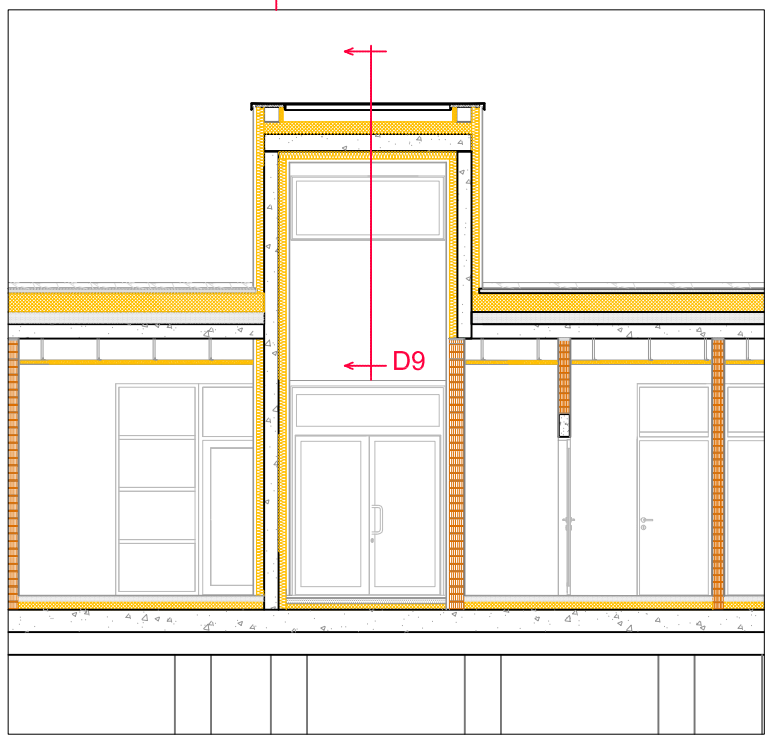
BARBARA COTANDA BRELL
UNIVERSIDAD POLITÉCNICA DE VALENCIA
KAHO SINT-LIEVEN

PART 3. DETAIL 8 E 1:10

PLAN
3.8







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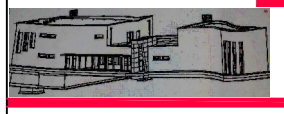

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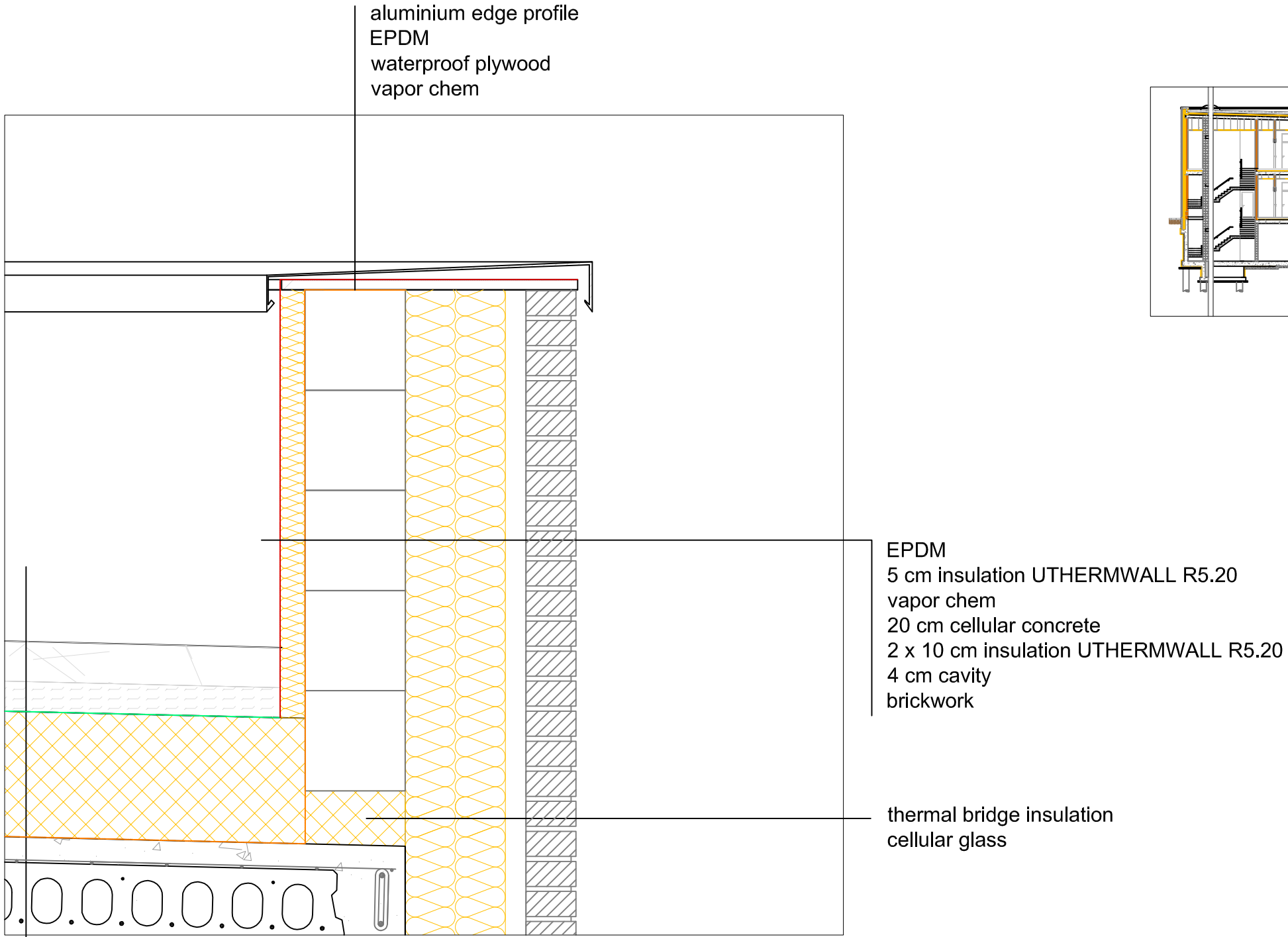
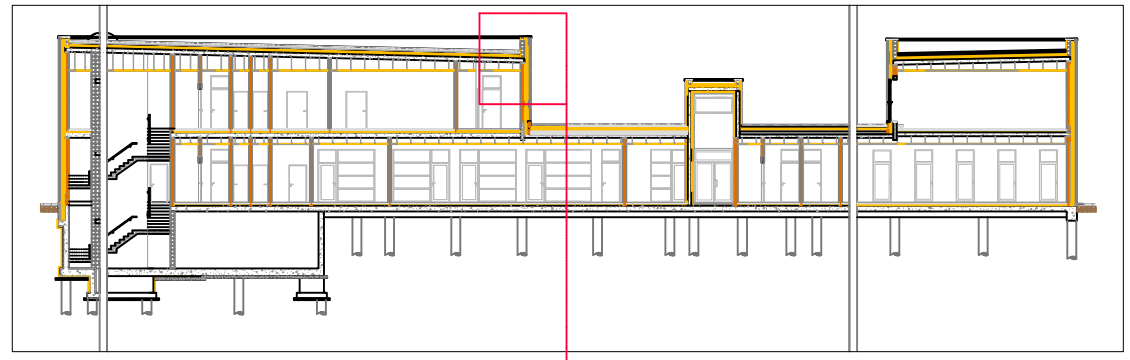
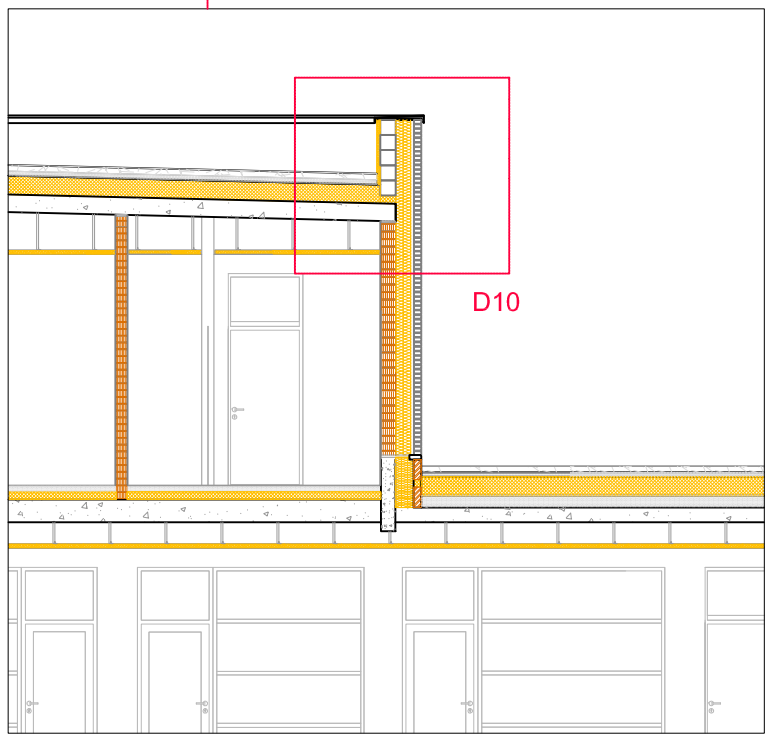
PART 3. DETAIL 9 E 1:10

PLAN 3.9







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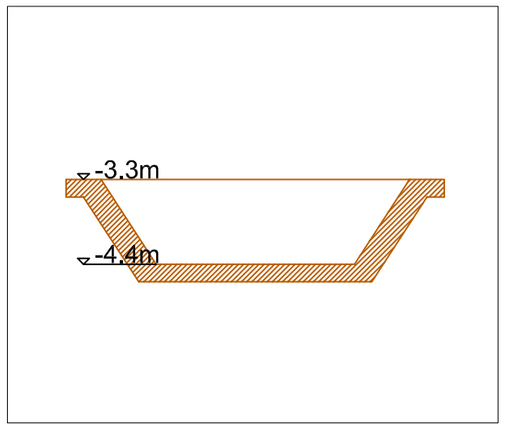
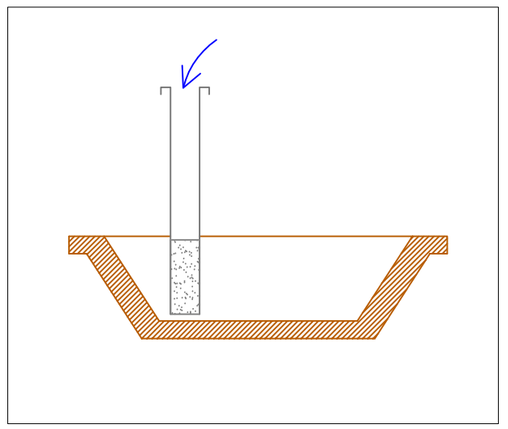
PART 3. DETAIL 10 E 1:10

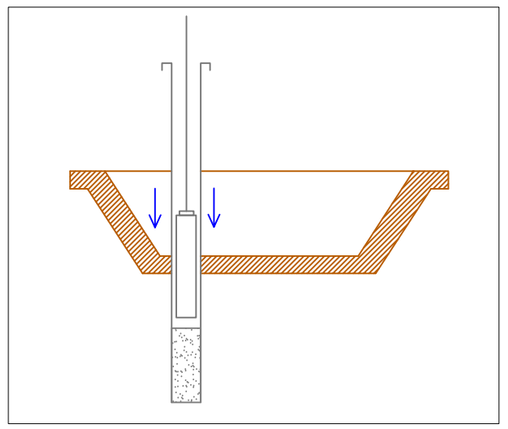
PLAN 3.10



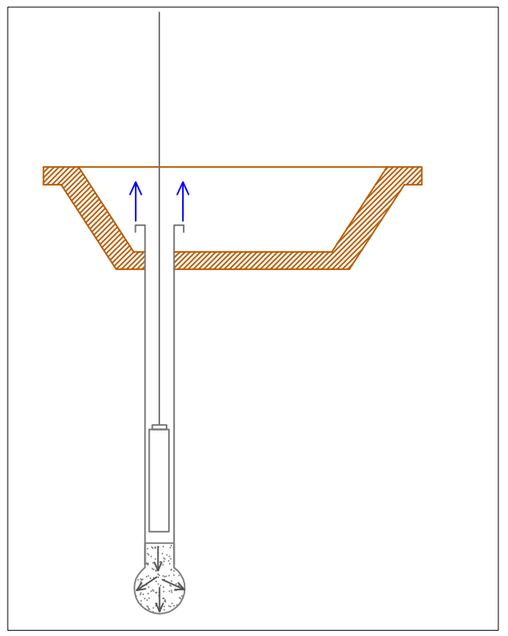
STEP 1. Lift pit excavation



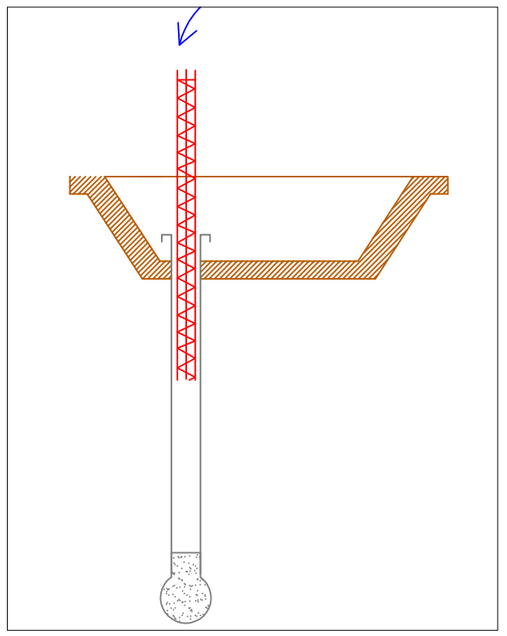
STEP 2. Pile plug formation



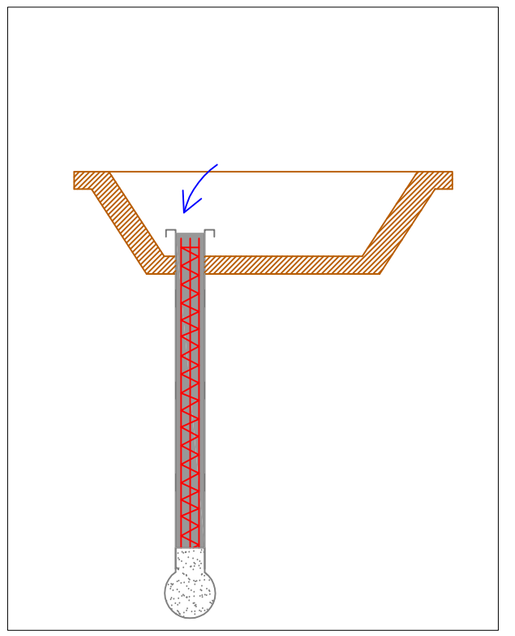
STEP 3. Pipe sinking



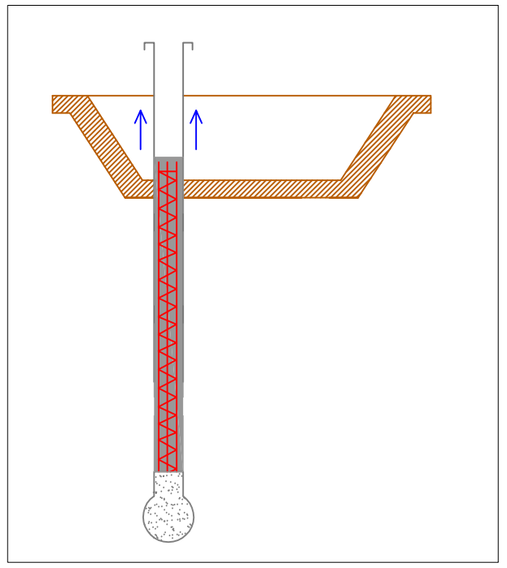
STEP 4. Bulb formation



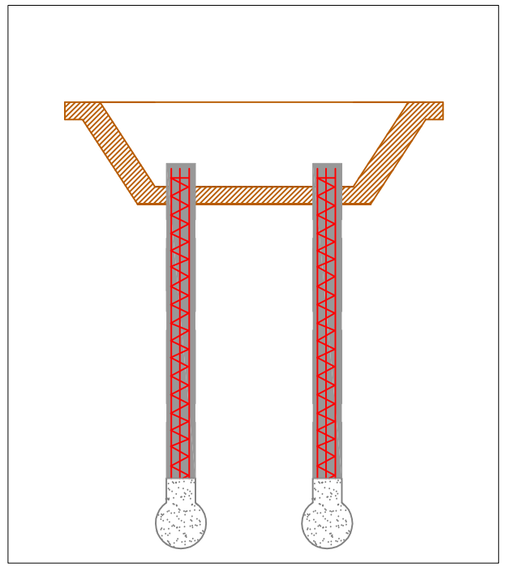
STEP 5. Pile reinforced



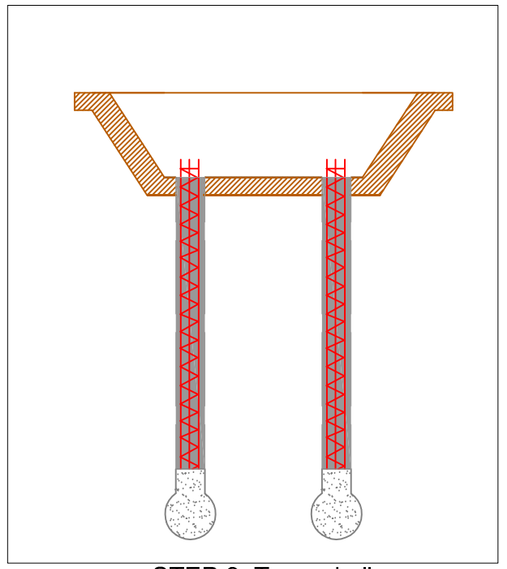
STEP 6. Concrete pouring



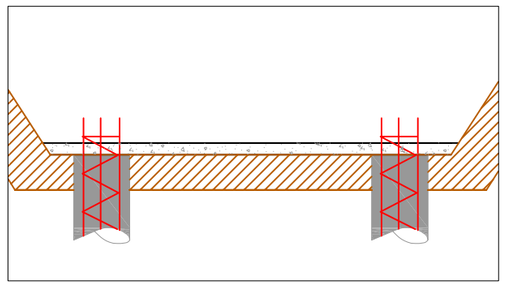
STEP 7. Pipe removing



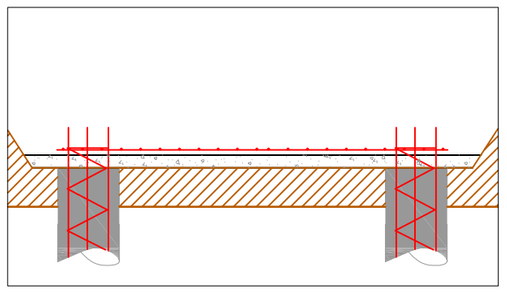
STEP 8. Finished piles



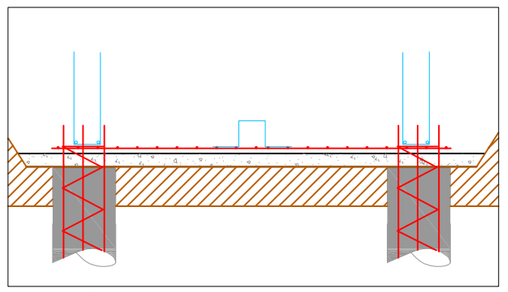
STEP 9. Topped piles



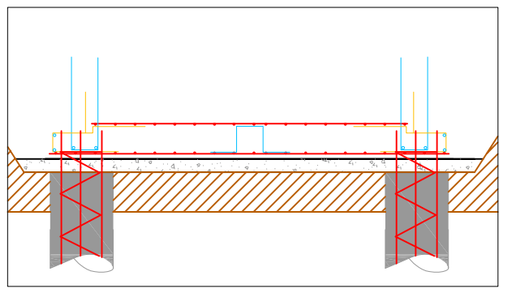
STEP 10. Blinding



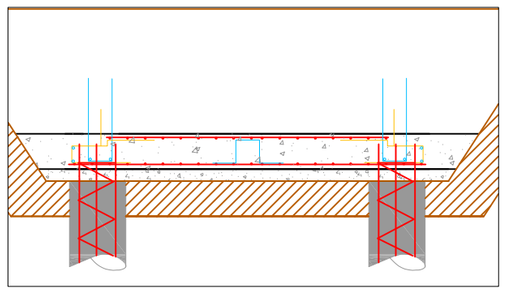
STEP 11. Bottom reinforcement of the slab



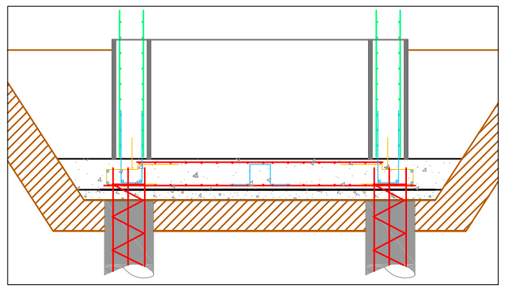
STEP 12. Rebar placement



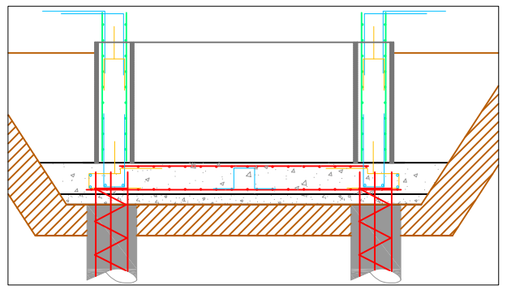
STEP 13. Top reinforcement of the lab and waterproofing placement



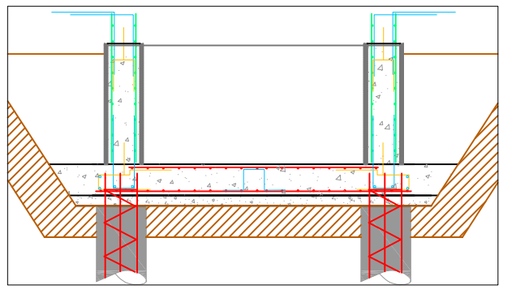
STEP 14. Concrete slab



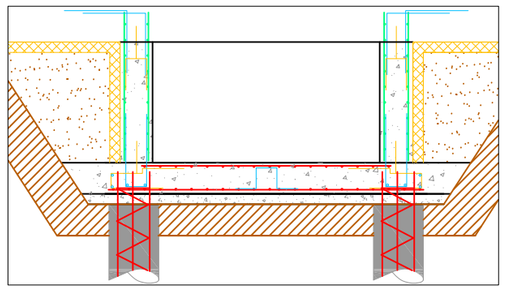
STEP 15. Formwork and walls reinforcement



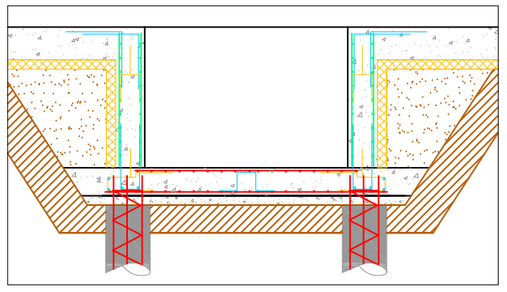
STEP 16. Waterproofing and rebar placement



STEP 17. Walls concrete



STEP 18. Walls stripping.
Insulation placement and backfilling



STEP 19. Formwork and beams concrete

	MATERIAL	EQUIPMENT
STEP 1	-	Excavator
STEP 2	Gravel	Tower crane, pipe
STEP 3	Gravel	Tower crane, pipe
STEP 4	Gravel	Tower crane, pipe
STEP 5	Reinforcement	Tower crane
STEP 6	Concrete	Tower crane, concretre skip
STEP 7	-	Tower crane, pipe
STEP 8	-	-
STEP 9	-	Pile cutter
STEP 10	Lean concrete	Tower crane, concrete skip
STEP 11	Rebar	Tower crane
STEP 12	Rebar	-
STEP 13	Rebar, waterproofing	-
STEP 14	Concrete	Tower crane, concrete skip
STEP 15	Rebar	Tower crane, formwork
STEP 16	Rebar, waterproofing	Tower crane
STEP 17	Concrete	Tower crane, concrete skip
STEP 18	Insulation, ground	Shovel
STEP 19	Concrete	Tower crane, concrete skip, formwork

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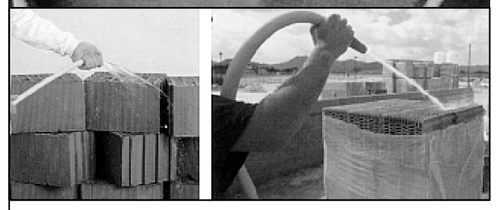
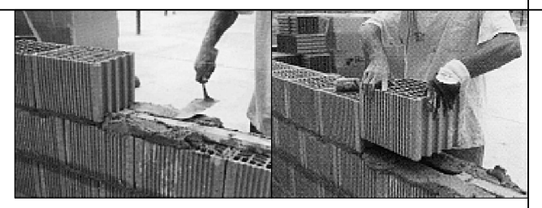
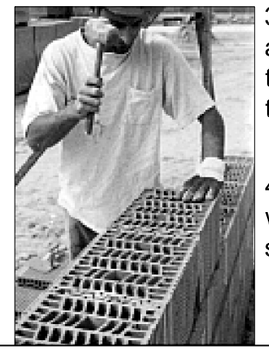
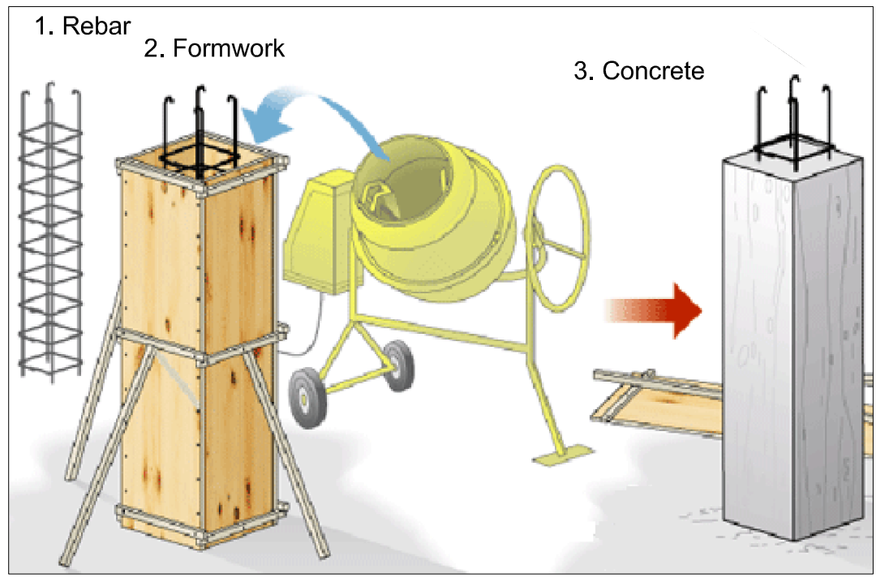
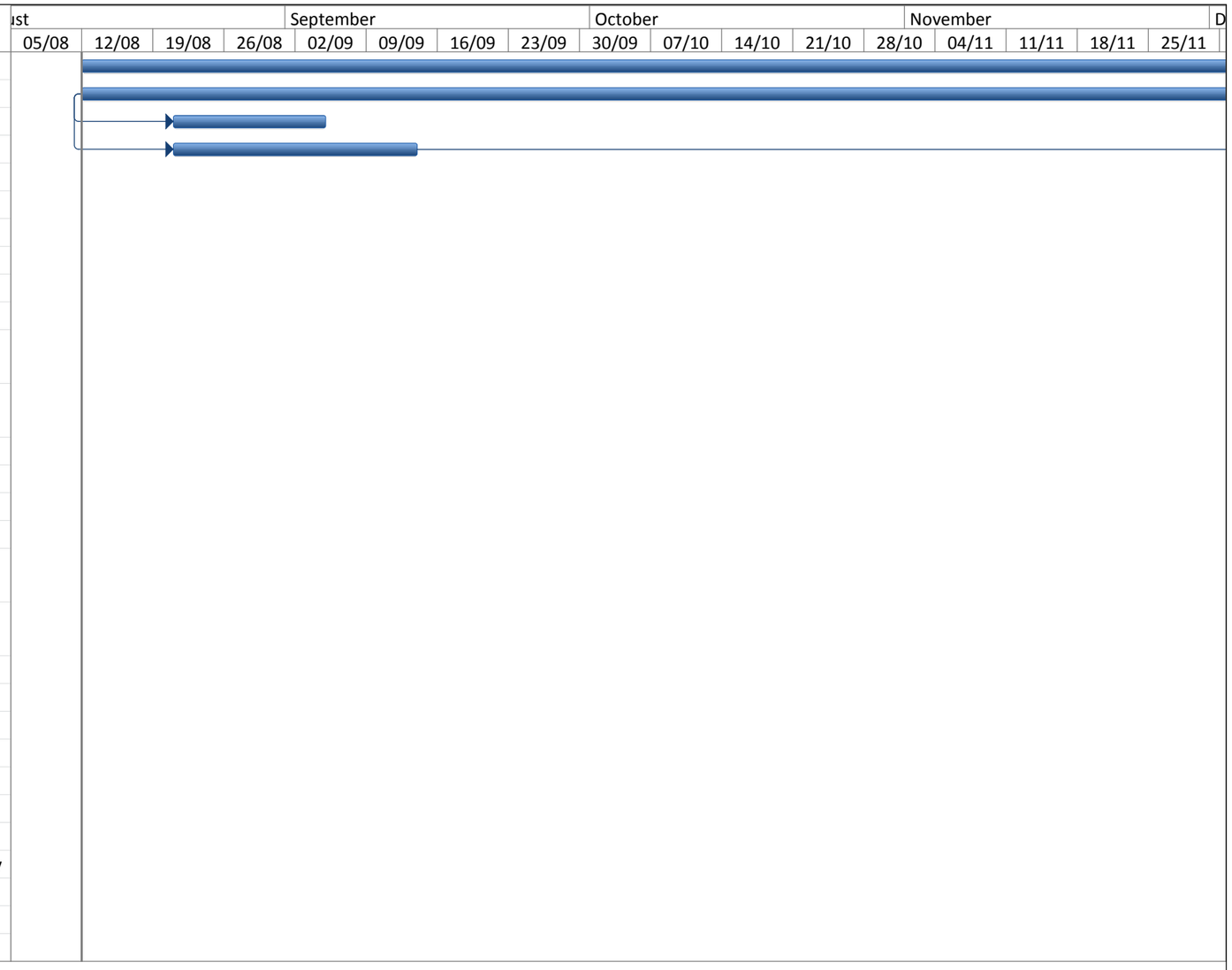
PART 4. TECHNICAL STUDY

PLAN
4

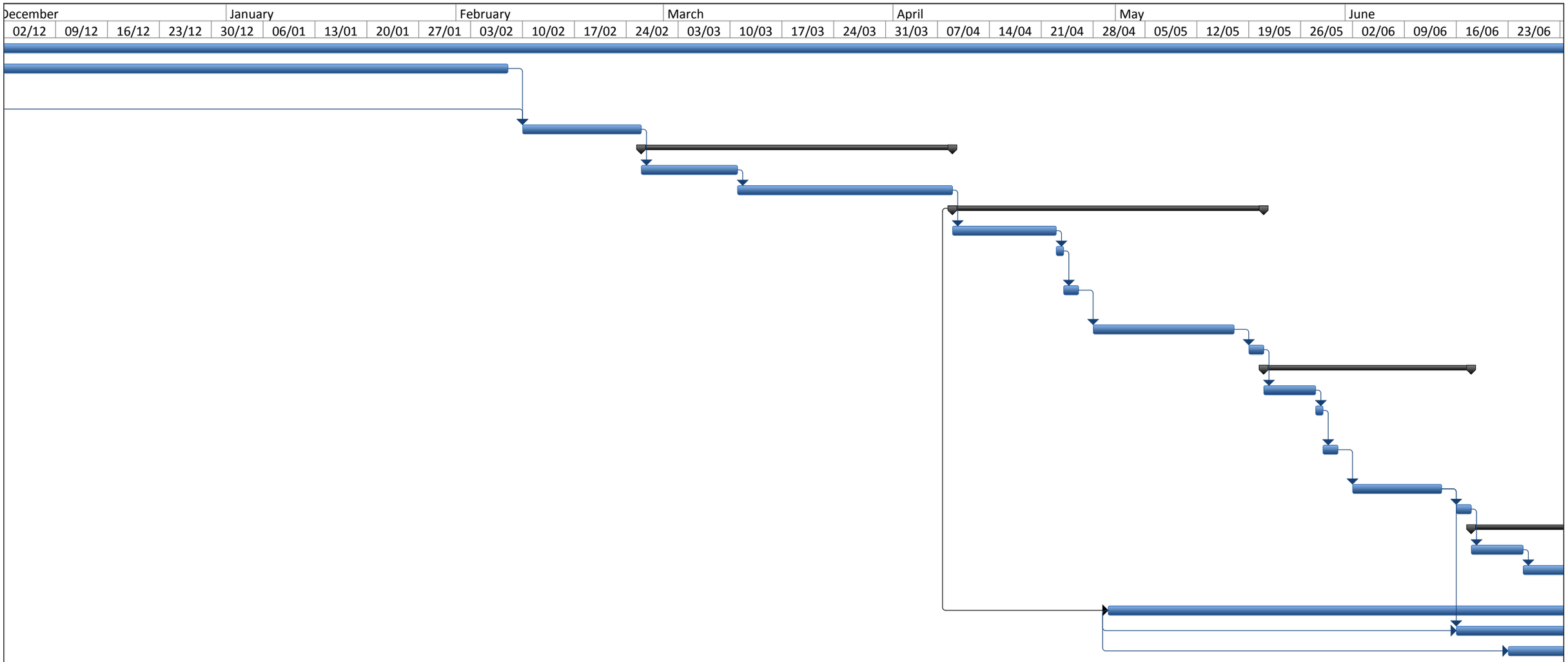
COLUMNS 2.80 x 1.00 m	BRICKS	IN SITU CONCRETE	PREFABRICATED CONCRETE
IMPLEMENTATION	  1. Wet the pieces before placing them  Note that some pieces need to be cut  2. Spread a layer mortar and place the piece on it. Use a string as a guide  3. Hit the pieces with a rubber mallet so that the mortar gets into the gaps 4. Check levels with a spirit level 	 Labourers place the reinforcement cage before assembling the formwork. Then the concrete can be poured; when it is cured they remove the formwork.	 Stored columns The crane moves the column and places it  Labourers place the column in the exact position and fix it with bolts and nuts
MATERIALS	Bricks Mortar	Reinforcement cage Concrete	Prefabricated columns Bolts and nuts
EQUIPMENT	String or line Line pins Spirit level and plumb rule Brick trowel Scaffold	Spacers Formwork Truck mixer Plumb Scaffold Crane with cupola Concrete pump Vibrator	Tower crane
EFFICIENCY	Labourer_0.4h/m²	Labourer_0.285h/m³	Labourer_0.25h/unit
TOTAL DURATION PER FLOOR (18 CLUMNS)	Labourer_0.4h/m² · 2.8m² = 1.12h · 18 = 20.16h	Labourer_0.285h/m³ · 0.532m³ = 0.15162h + waiting days untill the concrete gets cured	0.25h
COST	Bricks_0.95€/u · 56 = 53.2€ Mortar_133.3€/m³ · 0.5225m³ = 69.65 € Labourer_17.24€/h · 0.4h = 6.9€ TOTAL/COLUMN = 129.75€ TOTAL = 2 335.5€	Spacer_0.06€/u · 12 = 0.72€ Reinforcement cage_120kg · 1€/kg = 120€ Formwork (10 times)_10.60€/m² · 16m² = 169.6€ / 10 = 16.9€ Concrete_76.88€/m³ · 2.8m³ = 215.264 € Labourer_18.10€/h · 0.1516h = 2.74€ TOTAL/COLUMN = 355.624€ TOTAL = 6 401.232€	Prefabricated columns_471€/unit Labourer_18.10€/h · 0.252€ = 4.58€ Labourer help_16.94€/h · 0.252€ = 4.26€ Crane driver_66.84€/h · 0.25h =16.71€ TOTAL/COLUMN = 496.55€ TOTAL = 8 937.9€
PROS / CONS	PROS Manufacturing Cheap materials Easy construction method CONS Less resistence Need to check levels	PROS Manufacturing Proper resistance Good quality materials CONS Time Concrete comes from manufacture Waiting days until concrete gets cured	PROS High quality materials Reduction in execution time Sections with greater resistance CONS Handling and transport Manufacturing
CONCLUSION	According to the data above, the brick column is the cheapest one, but it could cause some resistence problems, so it should be discarded.	The materials needen for the in situ concrete column can be reached easilly, althoughit has waiting times, it is a good option since it is properly resistant.	The main problem of the prefabricated elements is the existance of a manufacturer on the nearby to the building site. If it is, then this is the best option, because its high price is offset by the short execution time and its resistance

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		START	646 days	Mon 12/08/13	Mon 01/02/16	
2		1. Dewatering	130 days	Mon 12/08/13	Fri 07/02/14	
3		2. Dig	11 days	Wed 21/08/13	Wed 04/09/13	2SS+7 days
4		3. Pile foundations	18 days	Wed 21/08/13	Fri 13/09/13	2SS+7 days
5		4. Lift pit	12 days	Mon 10/02/14	Tue 25/02/14	2;4
6		**5. Basememt**	**30 days**	**Wed 26/02/14**	**Tue 08/04/14**	
7		5.1. Slab	9 days	Wed 26/02/14	Mon 10/03/14	5
8		5.2. Walls	21 days	Tue 11/03/14	Tue 08/04/14	7
9		**6. Ground floor**	**30 days**	**Wed 09/04/14**	**Tue 20/05/14**	
10		6.1. Floor	10 days	Wed 09/04/14	Tue 22/04/14	8
11		6.2. Prefab staircase	1 day	Wed 23/04/14	Wed 23/04/14	10
12		6.3. Prefab elements	2 days	Thu 24/04/14	Fri 25/04/14	11
13		6.4. Brickworks	15 days	Mon 28/04/14	Fri 16/05/14	12
14		6.5. Prefab lintels	2 days	Mon 19/05/14	Tue 20/05/14	13
15		**7. First floor**	**20 days**	**Wed 21/05/14**	**Tue 17/06/14**	
16		7.1. Floor	5 days	Wed 21/05/14	Tue 27/05/14	14
17		7.2. Prefab staircase	1 day	Wed 28/05/14	Wed 28/05/14	16
18		7.3. Prefab elements	2 days	Thu 29/05/14	Fri 30/05/14	17
19		7.4. Brickworks	10 days	Mon 02/06/14	Fri 13/06/14	18
20		7.5. Prefab lintels	2 days	Mon 16/06/14	Tue 17/06/14	19
21		**8. Roof**	**20 days**	**Wed 18/06/14**	**Tue 15/07/14**	
22		8.1. Floor	5 days	Wed 18/06/14	Tue 24/06/14	20
23		8.2. Ledge	10 days	Wed 25/06/14	Tue 08/07/14	22
24		8.3. Finishings	5 days	Wed 09/07/14	Tue 15/07/14	23
25		9. Parament	74 days	Wed 30/04/14	Mon 11/08/14	9SS+15 days
26		10. Installations	27 days	Mon 16/06/14	Tue 22/07/14	19;25SS+1 day
27		11. Exteral joinery	41 days	Mon 23/06/14	Mon 18/08/14	25SS+38 days
28		12. Finishings	104 days	Tue 19/08/14	Fri 09/01/15	26;27
29		END	1 day	Mon 12/01/15	Mon 12/01/15	28;24



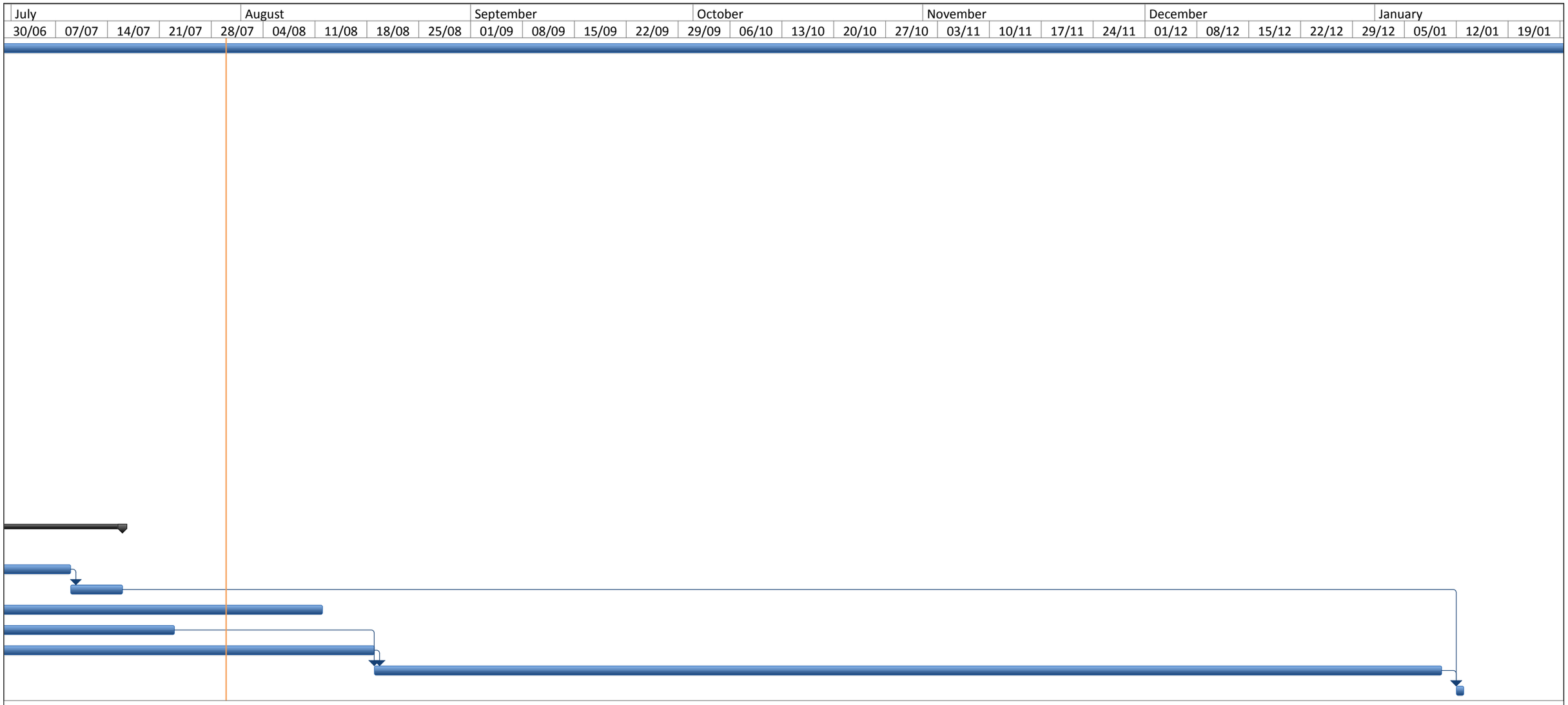
Project: Project1
Date: Wed 30/07/14

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline			
Split	External Tasks	Inactive Summary	Manual Summary	Progress			
Milestone	External Milestone	Manual Task	Start-only				
Summary	Inactive Task	Duration-only	Finish-only				



Project: Project1
Date: Wed 30/07/14

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		



Project: Project1
Date: Wed 30/07/14

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

March 4th 2014

April 3rd 2014

April 29th 2014

May 22nd 2014