

2014

Housing construction project in Halmstad

Study of the project management.

Planning of a housing project at the proposed plot in Halmstad (Sweden). Determine the project scope, costs and durations. Analysis of the costs and risks by the earned value method and a supposed case. Internal organization of the work space.



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HÖGSKOLAN
I HALMSTAD



ESCUELA TÉCNICA SUPERIOR
INGENIERÍA DE
EDIFICACIÓN

SCHOOL OF BUSINESS
AND ENGINEERING

Jordi Belda Soriano
Universitat Politècnica de València – Halmstad University
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PERSONAL AND INSTITUTIONAL INFORMATION

AUTHOR: **Jordi Belda Soriano**

Student of the Escuela Técnica Superior de Ingeniería de la Edificación in the Universidad Politécnica de Valencia, Valencia (Spain). Coursing and Erasmus exchange stay in the School of Business and Engineering of Högskolan i Halmstad, Halmstad (Sweden) during the 2013/2014 course.



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PROJECT SUPERVISORS:

Sending institution: **Carola Sabina Aparicio Fernández**, teacher in the Escuela Técnica Superior de Ingeniería de Edificación.

Receiving institution: **Åke Spångberg**, teacher in the School of Business and Engineering.

PROJECT INTRODUCTION

The following project is going to be the bachelor final project for my degree in Building Engineering (Arquitectura Técnica in Spain). According to the supervisors of both institutions it will consist in the development of a construction project for a proposed plot in the Swedish city of Halmstad. Starting from this project, the objective is to focus in the construction planning and management part. As one of the disciplines a building engineer can develop.

On the other hand some parts of the project have been simplified, removed or just estimated due to the limited time available for do all the work or because according to Spanish legislation the building engineers can't do them. For example, the quality or safety projects and the structure calculations.

In this particular case the plot was quite big so the project will consist in a promotion of fifty detached houses grouped five by five in ten blocks. These blocks are separated in six and four by a central park which contains: gardens, a leisure zone and a swimming pool for the summer time. At the same time, in both sides of the park the blocks are separated in two sides by an access road. The plot final distribution is attached in the drawings section.

The houses blocks consist in five attached houses. Each of these houses is made of two floors and a space under the roof only available for installations and storage. Outside the houses there is a little garden accessible by the backwards door.

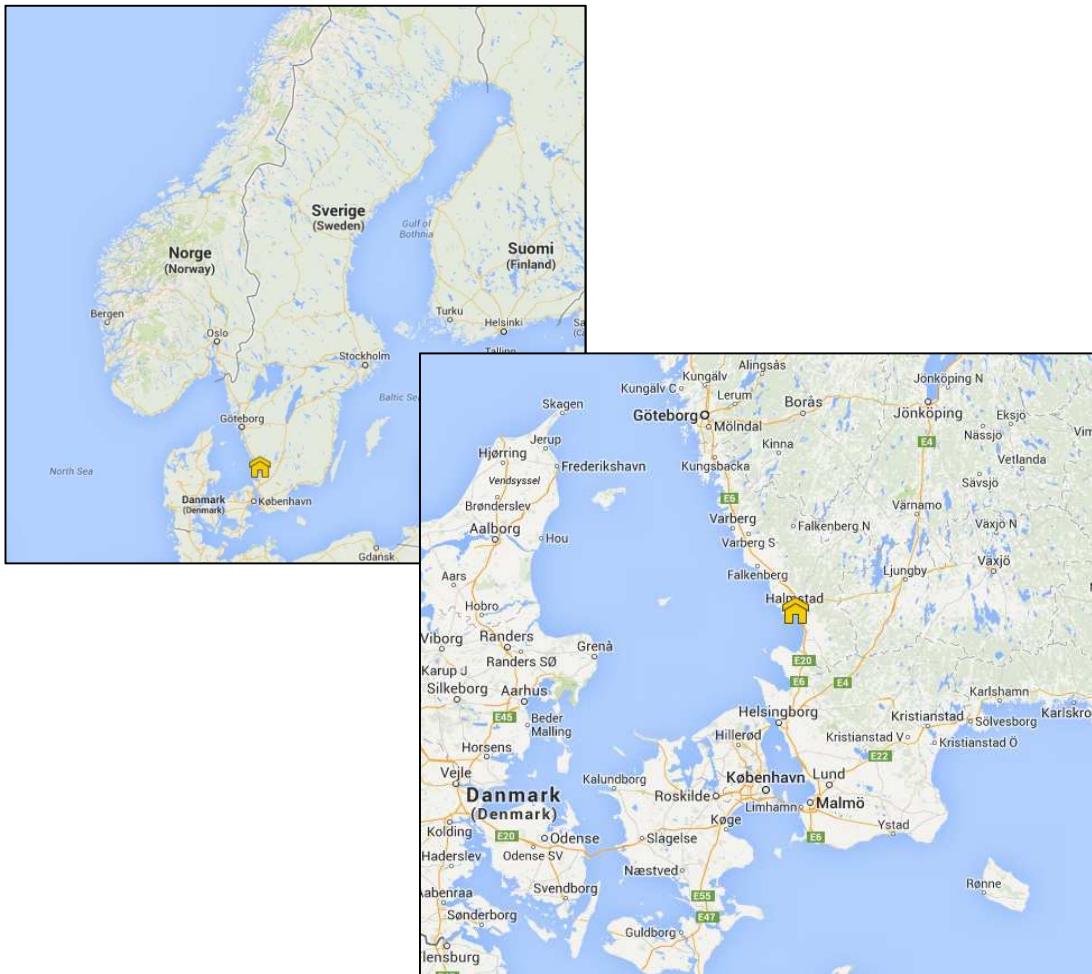
All the houses contain inside in the first floor a living room-kitchen combo, a small toilet and a laundry room. On the second floor we can find the main room with a linked complete bathroom, other room, a complete toilet, and a little space over the stairway for an office or study room.

The objective in this project, is to calculate and estimate the cost and duration of the tasks involved in a housing block, and then in the whole promotion. Once the first estimation is done, we will continue trying to make a better time planning so the work can be finished earlier and in a cheaper way.

For this we are going to calculate the probable real duration of the tasks using the PERT method. And then work with a supposed case for analyse the evolution with the earned value method. The final part is going to be a work site plan. With this we can observe the movement of the materials stocks and working teams during all the promotion.

PLOT SITUATION AND DESCRIPTION

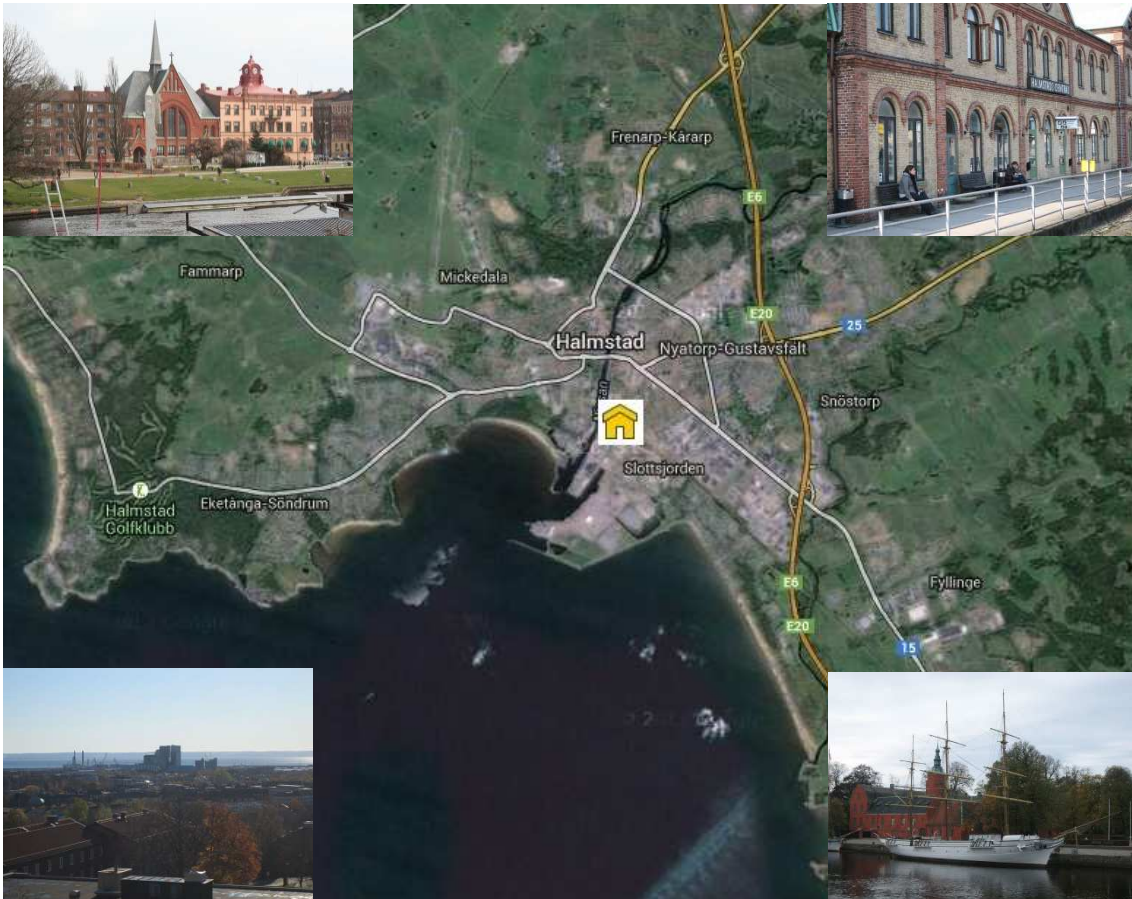
The plot proposed by Åke Spangberg is situated in the Swedish city of Halmstad in the west coast of this country. Halmstad is a medium size city of a little more than 62.000 citizens. Is the capital of the Halland Region, and it is situated between Malmö and Gothenburg. The economy is based in the port, education, industry and recreational activities. The history of the town goes back to 1307 with the first city charter.



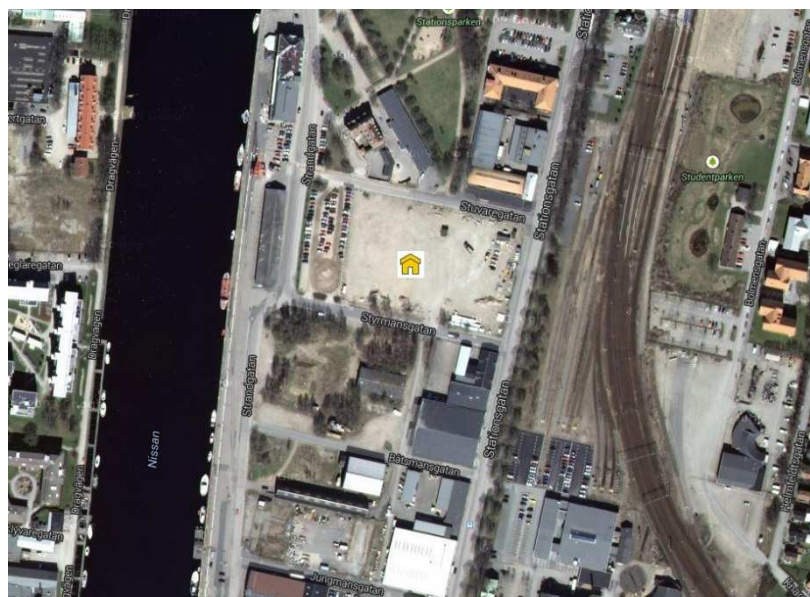
During the various centuries Halmstad was an important city due to his castle and his frontier position between Denmark and Sweden when the first country ruled over an important part of the Scandinavian Peninsula.

The city evolved from the fishing and coal port into the mixed economy that can be found nowadays.

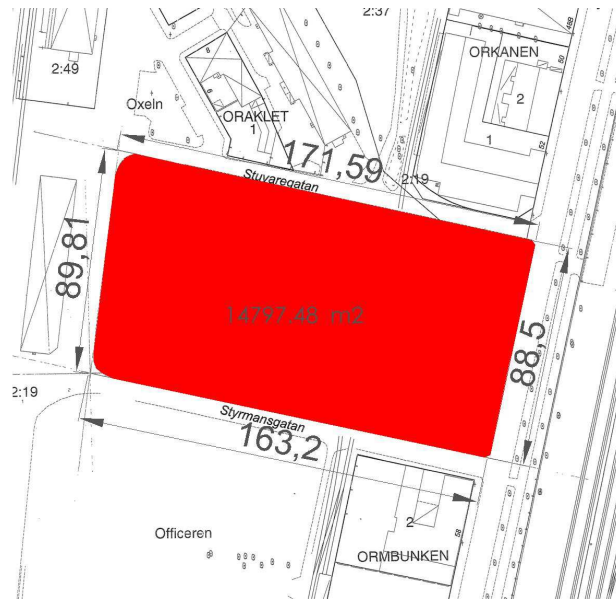
Halmstad municipality is composed of the city and twenty more urban areas extended over the Nissan River Estuary and the surrounding coast.



The project plot is located between Nissan River and the train track, in the East part of Halmstad. Rounded and limited by the following streets (Starting from the North and clockwise direction): Stuvaregatan, Stationsgatan, Styrmansegatan and Strandgatan.



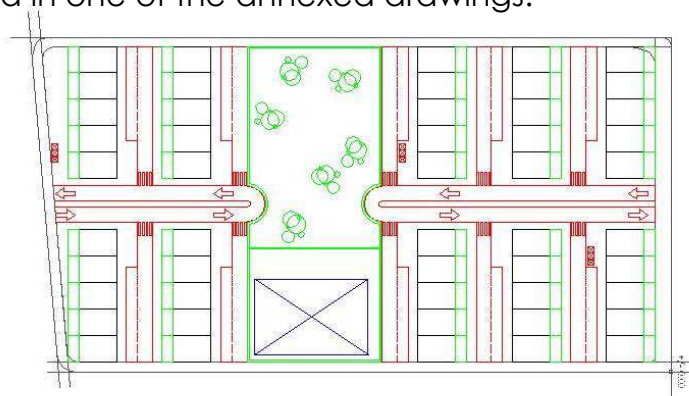
The average dimensions of the land are a rectangle of 167.39 x 89.15 m, which provides an area close to 15.000 m².



As mentioned before, in order to fill up the full size of the area the project will contain 50 houses distributed in blocks of five. Every house is a rectangle of 7x10m, so the blocks shape is a 35x10m rectangle. There are a total of 10 blocks divided in 4 and 6 by a central park, and in the other way the access roadway divides again the blocks by the half and in several branches.

The park lengths are 35 m and 83.6m including the swimming pool zone, which measures 29.5x35m. The proposed pool is 19x30m, but as the rest of the park is not going to be developed in this project. So we are not going to pay a lot of attention to this central zone except for the storage programme. This is because the flat extension is going to be used as the promotion warehouse. And the pool and trees are going to be done at the end of the houses works. The promotion also includes wastes keeping zones in three points, trying not to be so far of any house.

This is an approximated view of the promotion that will be more detailed and dimensioned in one of the annexed drawings.



HOUSES DESCRIPTION

1. CONDITIONING OF THE AREA

The actual state of the plot is a flat extension used as car park with some gardened areas around it. There are also several big stones delimiting the parking zone and a small square one floor edification with an approximated measures of 4x4m.

So the conditionings works will consist in demolish the mentioned building, remove all the stones spread around the zone and the same for the trees and the bushes. For these last we can plant them in another place temporarily before place them again in the future park.

After that all the vegetal terrain has to be removed by mechanical ways until obtain a complete flat surface at the high desired to start to work (-0.30m). The land stones and debris retired will be transported with trucks to the closest dump which can keep it.

Once the entire plot is at the right high to start the machines have to start dig the foundations of a single houses block. In order to keep the rest of the land in the right humidity and stability conditions.

In this moment the space for the foundations has to be took down to the (-0.60m) mark, where the insulation and founding works can start.

2. FOUNDATION

These buildings foundation consists in a continuous footing of reinforced concrete with central spaces for the insulation under the floor. As mentioned before this foundation is no mathematically calculated, it is only an estimation done by the student.

The overall dimensions of each foundation are 11.14 x 36.152m having a surrounding footing of 0.8m outside the pillars axis and 0.6m inside. The middle footings measure 0.6m at the side of the loads axis. In all the foundation the thickness is going to be 500mm high. An there is a central foundation beam of 0.40 x 0.50m in the middle of each space created by the footings, in order to improve the seismic resistance.

The concrete used for the footings and beams has to be

HA-30/B/20/IIIb+h due to the wet conditions close to the river, sea and cold temperatures during the winter, and the chemical corrosion produced by the marine salts and chlorides. The steel used in the footings it's going to be B-400S.

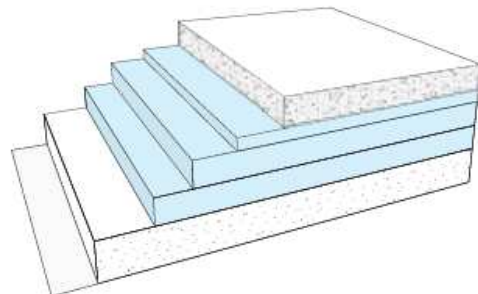
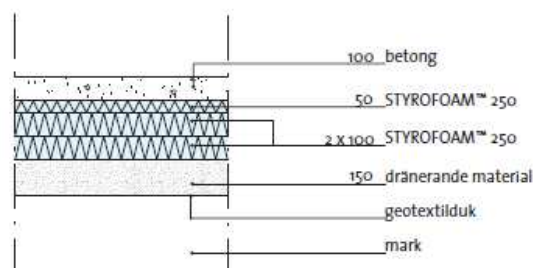
Previous to the structural concrete, a layer of 100mm of cleaning concrete needs to be putted over the land to prevent the mixture of the structural concrete with sand or mud.

Then the forms are going to be putted on his right position, form and size to finally add the steel and the concrete. The concrete dump will stop 10 cm before the final mark in order to dump it together with the final layer of the isolated floor. An adhesive product will be used in the joint.

The founding measured schemes and drawings can be found in the drawings section of this project.

The proposed floor was obtained from the IsoverBoken and is numerated as G:201 and satisfy the regulation of a maximum transmittance of 0.15 with 0.13 KW/m²k.

Once the concrete is dry and the forms can be retired, the floor insulation is going to be placed in the procured space. Keeping in mind the necessary holes for the sanitary pipes, placed at the same time than the insulation under the 50mm insulation. First we place a geotextile sheet before a 150mm layer of drain material like gravel. After this, two insulation panels of 100mm and another one of 50mm will be placed over the gravel. And finally a 100mm concrete layer will finish the basement.

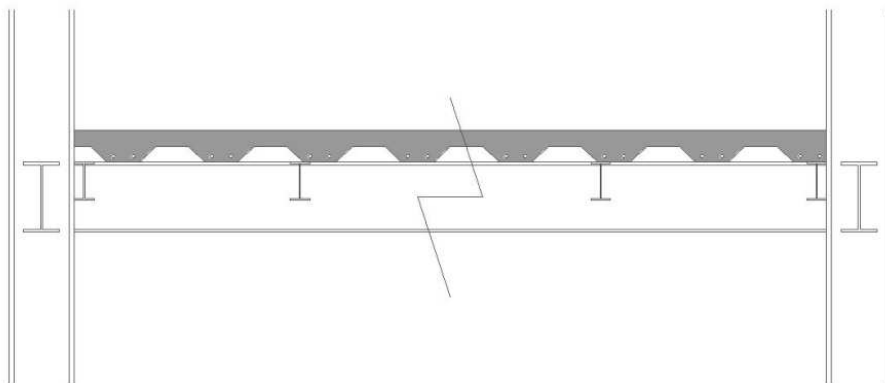


3. STRUCTURE

The planned structure for the building is a mixed of laminated structural steel with concrete, in order to obtain a fast and cheap work procedure. As the foundations it has not been calculated mathematically, it is only an estimation. All the steel in the structure is S275J type.

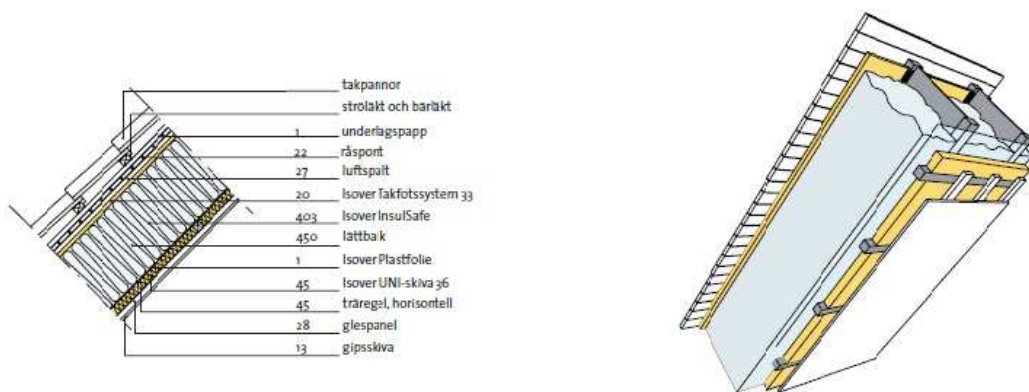
The structure consists in HEB 200 laminated steel pillars located at both sides of each house, doubling the pillars if the wall is not a façade. In the first floor (2.83m) and roof (6.08m) marks, there are steel IPE 220 beams in the two directions. The IPE 120 joists follow the shortest gap direction between beams with and interval of 600mm, and support a composite slab of 5+5cm reinforced with 12.5mm steel bars.

The detailed and measured drawings of the structure can be found in the drawings section. As made of steel this structure requires additional fire protection so it is covered with intumescent paint for a 90 minutes resistance.



4. COVER ROOF

The selected roof was took from the IsoverBoken and is coded as S:203 it satisfy the transmittance requisite with 0.08 over 0.13. The only modification is the finishing with galvanized aluminium instead of ceramic tiles. The 60% pitch of the roof is formed by wood beams (450mm). The space between beams is filled with wool insulation. Going outside we can found two wood boards and an impermeable layer under the battening that sustain the aluminium plate. In the other way we place plastic sheet to support the exterior plate. Then horizontal wood studs alternated with insulation, and finally a gypsum board fixed to the furring.

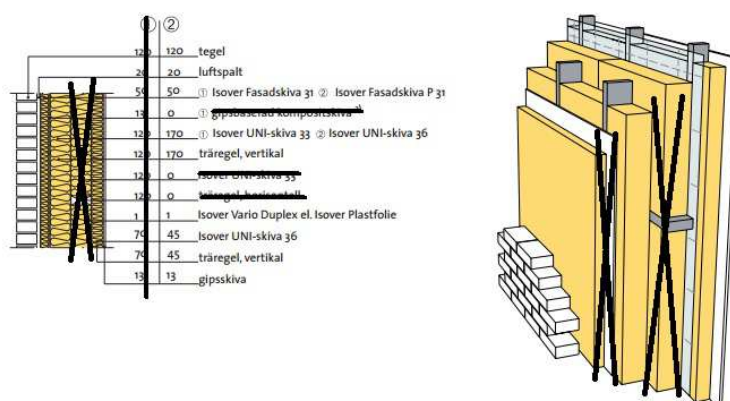


5. FAÇADE

The maximum transmittance allowed in exterior walls is 0.18 W/m²K, the chosen solution from IsoverBoken is the Y:209(2) which transmittance is 0.15 W/m²K.

This solution from outside to inside is composed by: viewed bricks (24x11.5x5cm) colour smocked brown, 2 cm air gap, 50mm of insulation and then 170mm studs with 170mm insulation in the spaces between studs. After that, a plastic sheet as vapour barrier, 45mm vertical studs alternated with 45mm insulation and finally a gypsum board. Total 414 mm.

For the partition between two houses we are going to use only part of this wall. These are: the 170mm insulation between studs, the plastic sheet, the 45mm insulation between studs and the gypsum board. SO the total tough is 229 mm on each house.

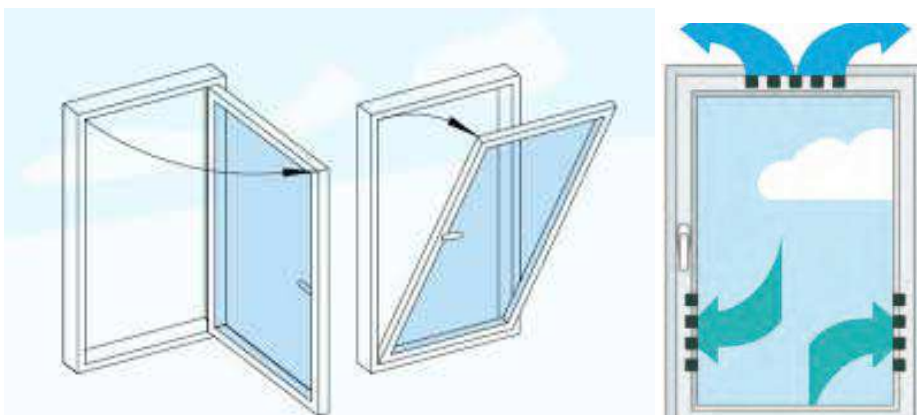


All the carpentry located in the facades is half-way located, in the same plane than the 170mm studs, In order to prevent the thermic communications and the entrance of water. The 45mm internal insulation and the gypsum panels won't be placed until the water and electrical installation has finished.

6. CARPENTRY

The external carpentry of the building, including windows and doors, can have a maximum transmittance of $1.3 \text{ W/m}^2\text{K}$. According to this, the materials used for them are going to be treated beech wood lacquered in white and double glassing with silicone sealing. The size of doors and windows is showed in the drawings part. As said before, they will be placed at the middle of the façade.

All the windows are tilt and turn windows, and include ventilation in the mark according to Boverket building regulations. This ventilation is insulated and can be regulated even never completely closed.



External doors follow the same rules as the windows. White lacquered wood with insulated ventilation and a maximum transmittance of $1.3 \text{ W/m}^2\text{K}$. Are also described and dimensioned in the drawings section.

The external carpentry will be placed as soon as possible in order to close the thermic surrounding of the building to allow the works inside.

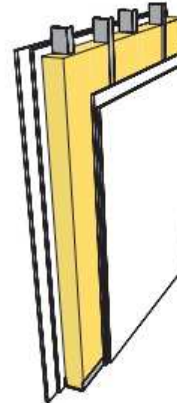
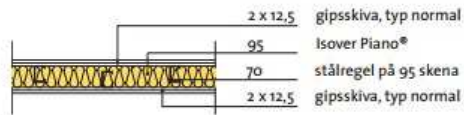
Inside doors, wardrobes, handrails will be placed when the works are finishing to not damaging them.

Internal carpentry is going to be beech varnished wood.

7. INTERNAL WALLS

The internal walls of the houses are limited by the acoustic conditions. This determines that for houses like these we are in the C grade and a minimum noise resistance of 53dB. For that, the chosen solution from IsoverBoken is the coded I:205 with 55dB.

This wall is formed by steel studs and 95mm acoustic insulation. All the walls are up until the slab height. Finally two gypsum panels (12.5+12.5mm) on each side finish the wall.



The gypsum boards are not going to be placed until the electrical and water installation is finished, in order to pass the pipes in the insulation space. In the toilets the last gypsum board is going to be water-resistant and in the kitchen zone water and fire resistant.

8. CEILINGS

The ceilings in these houses were thought as a space for installations conductions so it generates a space between it and the joists/beams able to keep pipes or ventilation. It is placed at a height of 2.71m in the first floor and 2.76 in the second, allowing enough space under it for a comfortable stance.

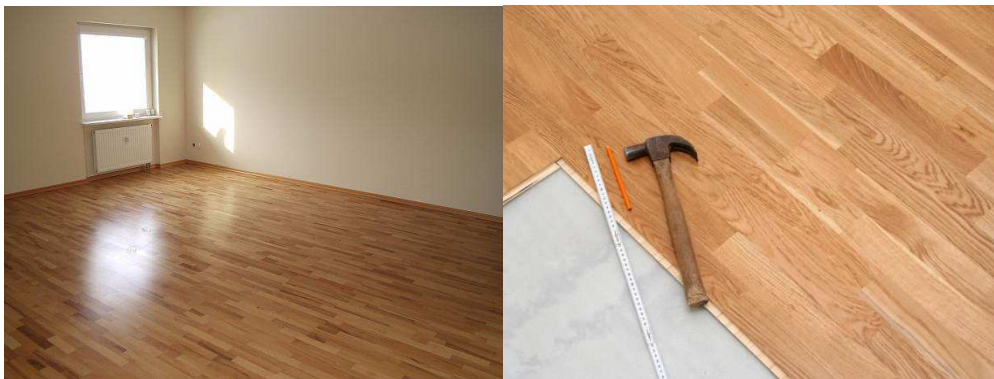
The space between the joists is covered by insulation panels of 45mm in order to reduce the noise between floors. The ceiling is composed by panels 60x60cm of insulating gypsum of 10mm. In the wet zones the gypsum is water-resistant and in the kitchen also fire-resistant. These panels are fixed to aluminium viewed tracks.



9. FLOORS

We can find three types of floors in the house. The main difference is in the final layer, which changes depending on the room. The final layer of the floors will be placed at the end of the works, just before the internal doors and the sanitary terminals in order to prevent great damages.

For the kitchen-living room combo, the bedrooms, the stairs and the second floor corridor we are going to place a varnished oak wood floor 15mm thick over 35mm styrofoam insulation between a battening and over an acoustic sheet.



For the toilets and bathrooms, we are going to use ceramic tiles (400x400mm) on brown tones. They are placed after a concrete grip layer of 30mm and 12.5mm styrofoam.



Finally for the laundry room we place a linoleum floor over 46 mm concrete because this room can be used as work or storage zone for the garden. So we place something cheap, durable but easy to change in the case it is needed.

10. ELECTRICAL INSTALLATION

The electrical installation is composed by all the illumination points, the outlets and the wires necessary for connect everything. Also it includes the communication network in the same contract so it will be measured together. The electrical circuits are made of insulated copper wire.

The components are:

- Land connection with steel pikes and copper wire with insulation. Placed in a ditch with mechanical protection and PVC tape marking. There will be a single wire rounding the founding and each house has its own connection to it.
- Connection branch from the general supply to each house insulated and marked with security tape.
- Electricity meter for each house.
- General protection box.
- Power control switch. Lighting circuit (10A).
- Circuit for general purpose shots (16A).
- Circuit for washing machine, dryer, (20A).
- Kitchen circuit, oven, fridge/freezer, dishwasher (25A).
- Points of light. 16
- Points of light with multiple switch. 13/16
- Base for plugs. 11 First floor. 8 Second Floor.
- Emergency luminaries. 3
- Phone/Internet plugs. 3
- TV aerial and plugs (2).

11. PLUMBING INSTALLATION

The plumbing works include the cold water supply, the warm water production, the heating system and the waste pipes. Water supply and distribution are made of galvanized steel, the same for the warm water net. The heating net is made of copper in order to resist the high temperatures needed for the heaters. Finally, the waste system is made of PVC pipes according to the flow required; it is hanged for the second floor and buried in the first one.

It is composed of:

- Connection to municipal water supply.
- Water meter for each house.
- Sinks. 4
- Bidets. 2
- Toilets. 3
- Shower tub. 1
- Bath tub. 1
- Washing machine connection. 1
- Dish washer connection. 1
- Dish washer, washing machine, dryer waste pipes. 3
- Water heater connection. 1
- Thermostat 1
- Accumulation system 350 L. 1
- Radiator heaters 12 units 0.5x0.75m.

12. FIRE PROTECTION

The houses are designed following the Boverket Building Regulations for fire protection. It means that the materials used are fire-stable or fire-resistant in order to allow the evacuation of the building in a reasonable time. These are particular houses with regular use, which involve a good knowledge of the building. So lots of signals or fire-fighting items are not compulsory.

As said before, the structure needs a minimum stability of 90 minutes against fire. This is provided by an intumescent paint over the steel. The roofs and walls only need to be heat-keepers to prevent the expansion of the fire to other parts of the same building or other buildings and a reasonable evacuation time.

Every house has emergency signals and lights over the stairs and in both external doors, to allow the visibility when the lights are off.

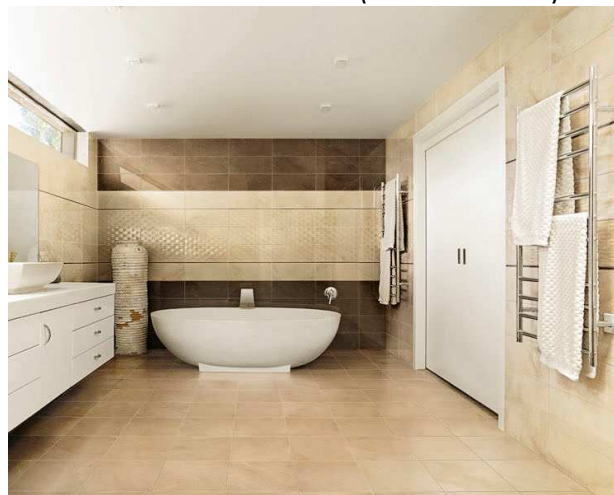
As fire-fighting equipment, every house holds two universal (ABC) extinguishers. The first one is in the kitchen (15kg) and other one in the second floor (10kg), in the corridor.

13. WALLS FINISHINGS

Each house contains three different wall finishings.

For the rooms and living we are going to use acrylic paint with cream matte colours. Applied in two layers with almost 8 hours of difference.

Toilets are covered with ceramic tiles (200x600mm) like the floor.



Finally, there are also ceramic tiles in the kitchen front covering the space over the kitchen countertop.



Wooden parts will be varnished on his place after collocation with colourless acrylic oil after cleaning them.

14. OTHER EQUIPMENTS

The houses are equipped with some appliances necessary for their daily use. There is a small list of them.

- Water heater unit, gas or gas-oil fuelled.
- Fridge/freezer combo.
- Oven/Stove combo.
- Dishes washing machine.
- Washing machine.
- Dryer machine.
- Kitchen closets.

DRAWINGS

This page acts as an index of the following drawings section. They are named and numbered according to this list.

GENERAL DRAWINGS

001 - Plot situation and promotion distribution.

002 - Promotion distribution measured.

003 - Houses blocks. Views and global measurement.

004 - House plants, full block.

005 - House façades. Measurements.

006 - House plants, distribution and measurement.

007 – House vertical sections. Measurements.

FOUNDATIONS

001 - Foundations

STRUCTURE

001 - Block structure, general view and dimensions.

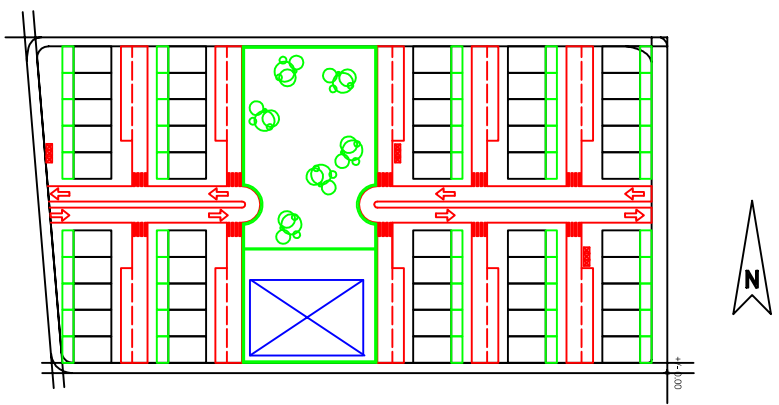
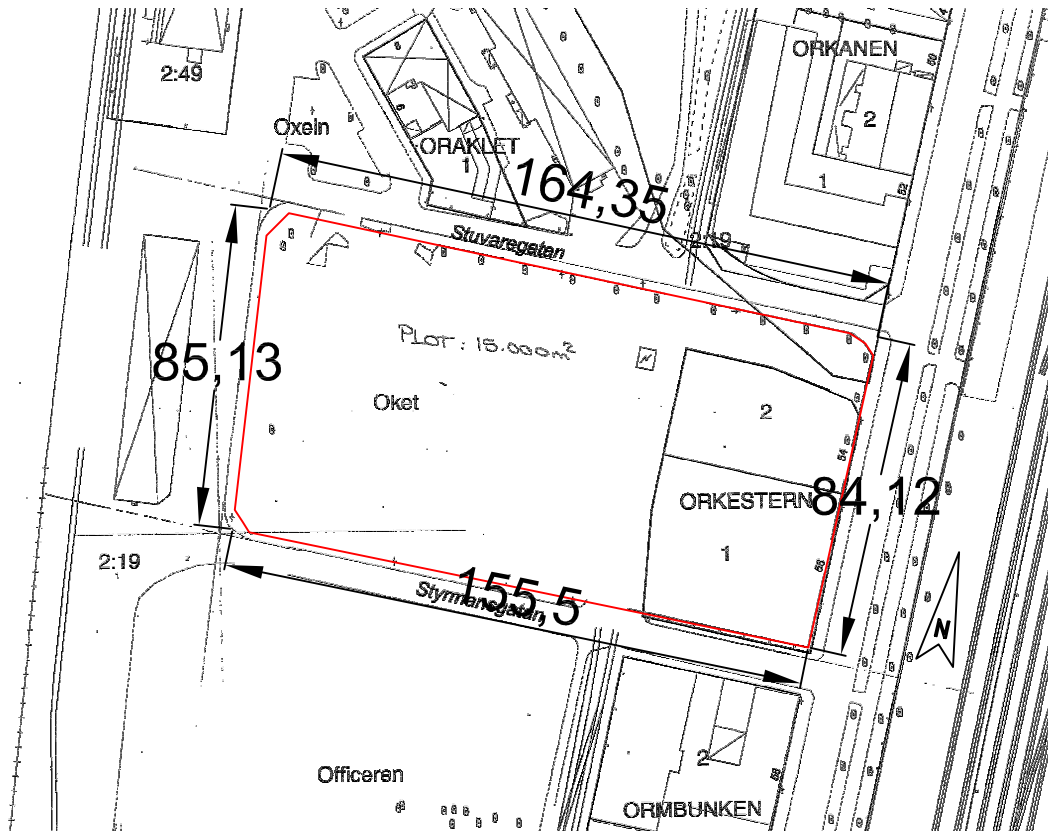
002 - House structure, views and dimensions.



003 - Structure, details.

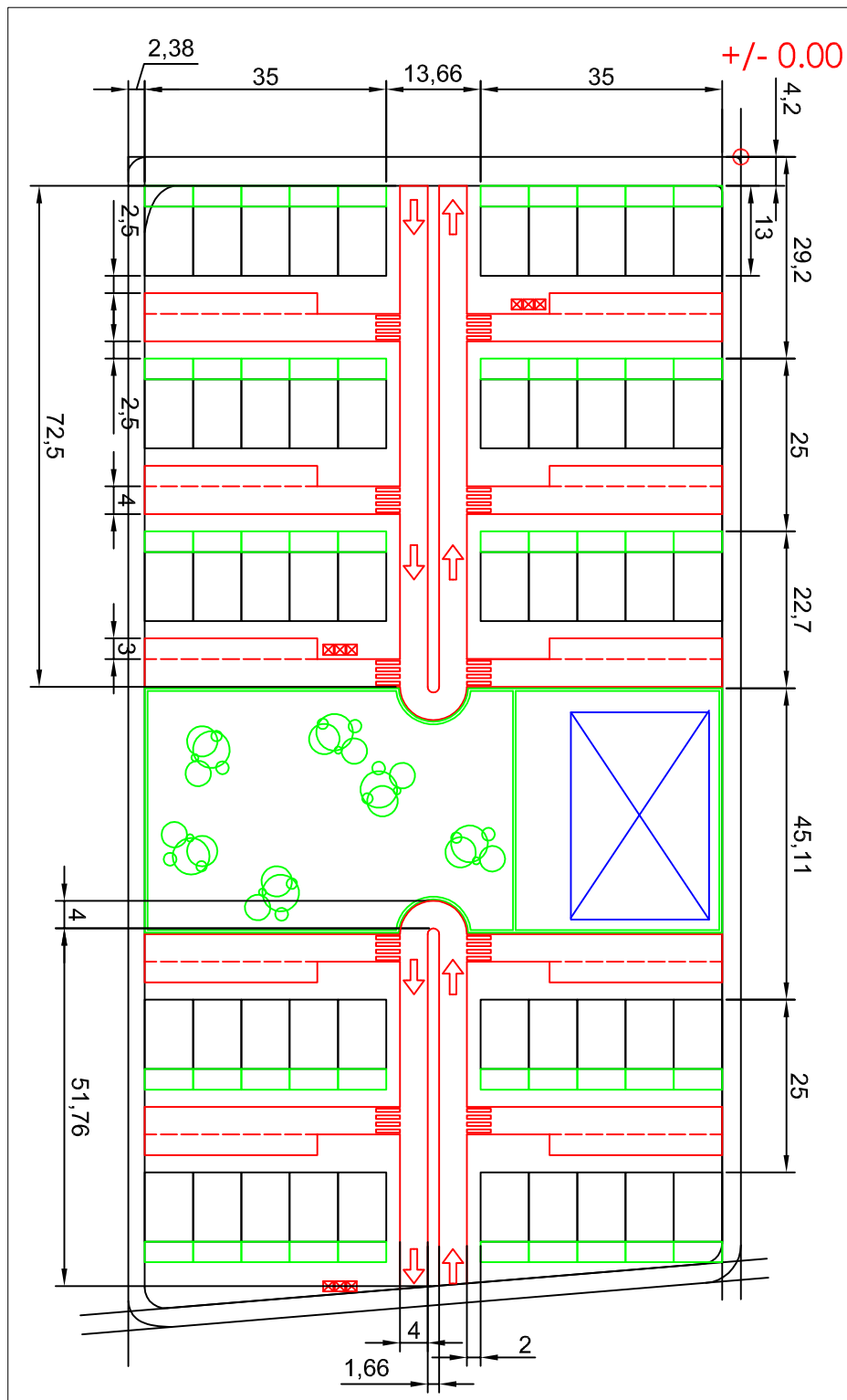
SYSTEMS



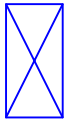



001 - Water, hot water and heating system.



002 - Electricity and illumination system.

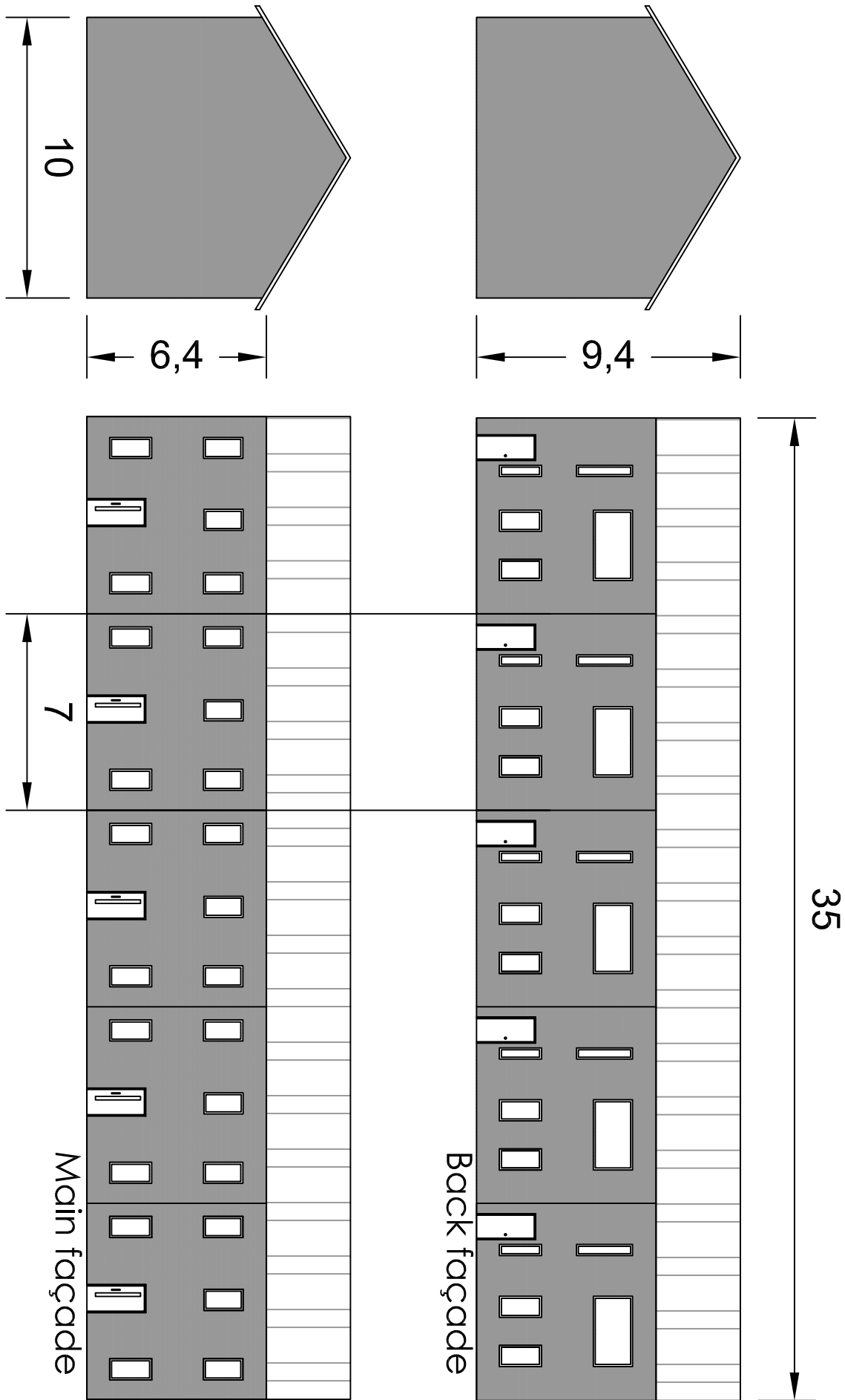


Drawing: Plot situation and promotion distribution.	Drawing Number: Gen-001 Scale: 1:2000	 HALMSTAD UNIVERSITY
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LEGEND			
	House & Garden		Garden Zone
	Swimming Pool		Car Park Zone
	Rubbish container		Zebra Crossing

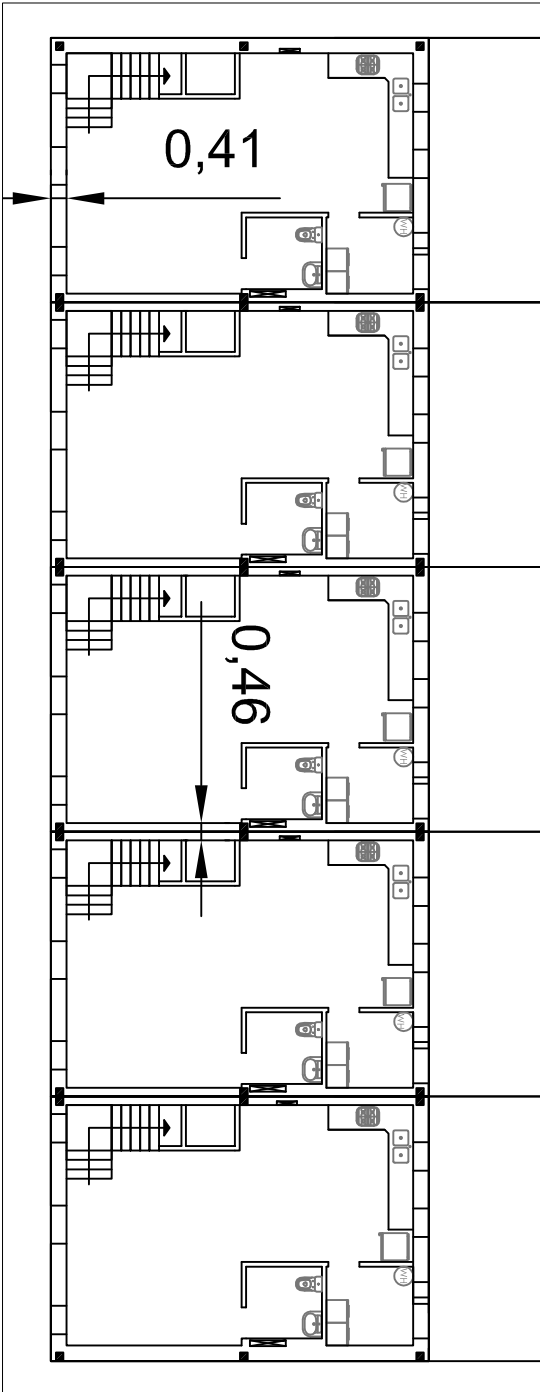
Drawing: Promotion distribution measured.	Drawing Number: Gen-002	 HALMSTAD UNIVERSITY
	Scale: 1:1000	
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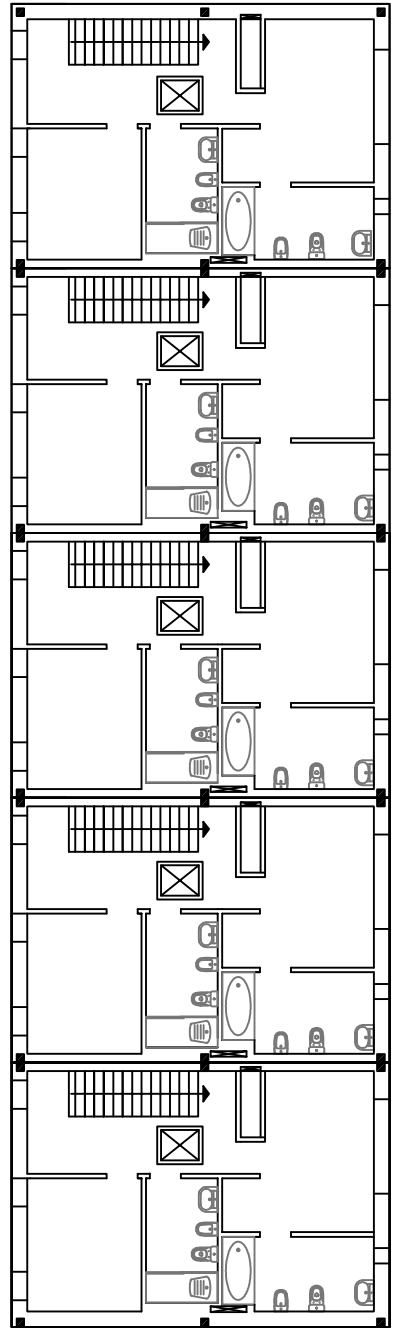
Drawing:
 Houses blocks.
 Views and global measurements.
 Housing construction project in Halmstad
 Study of the project management

Drawing Number:
Gen-003
 Scale:
1:200
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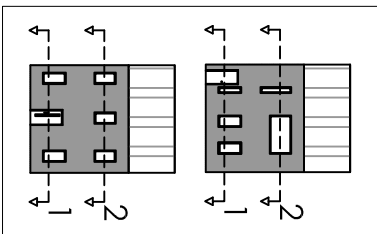




FIRST FLOOR (1)



SECOND FLOOR (2)



Drawing:
House plants, full block. Measurements.

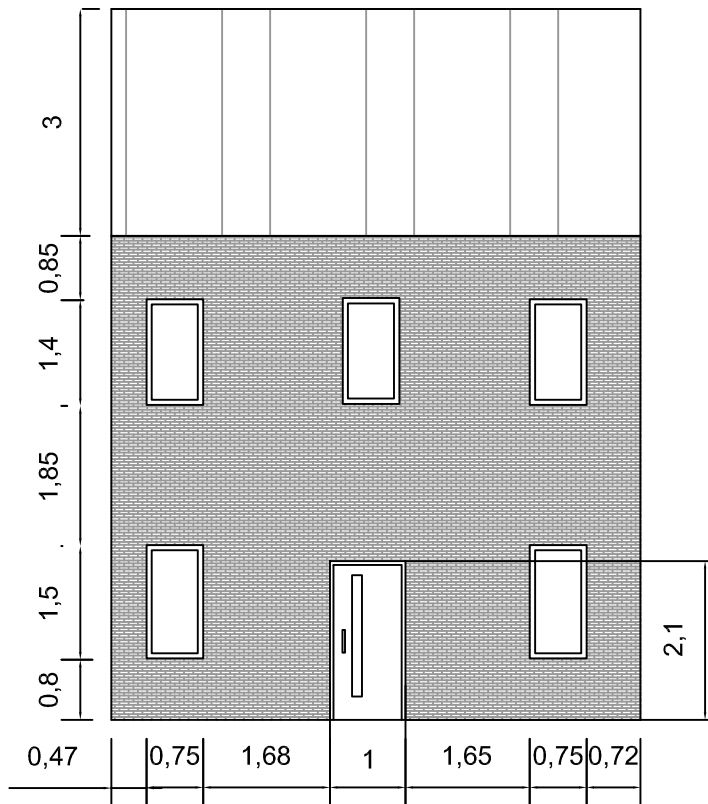
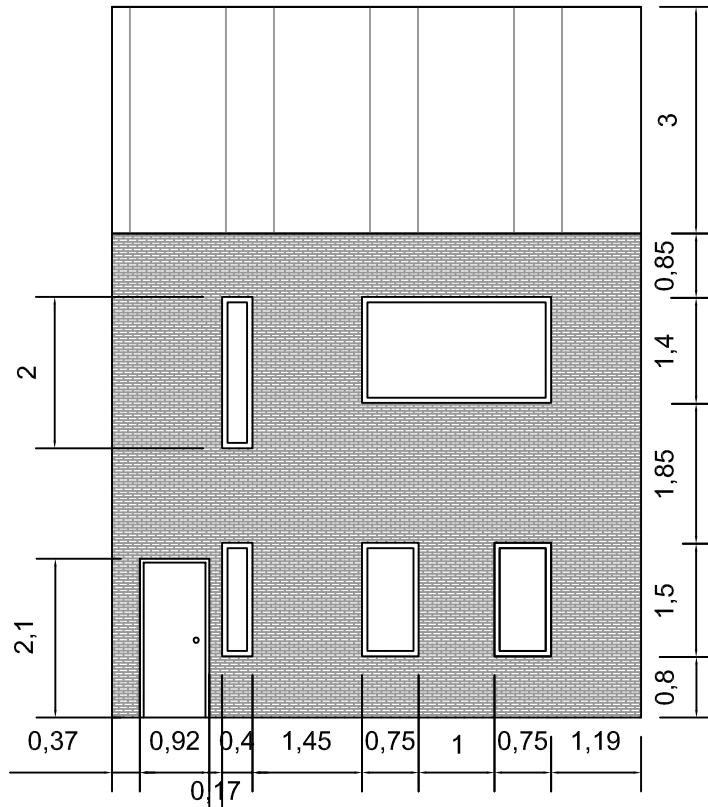
Housing construction project in Halmstad
Study of the project management

Drawing Number:
Gen-004

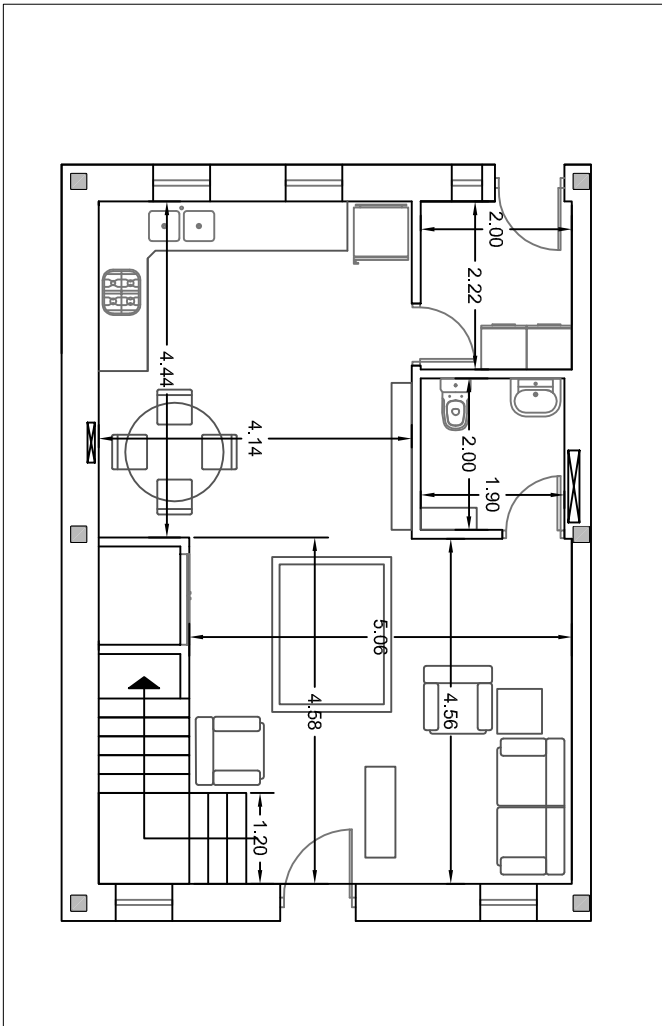
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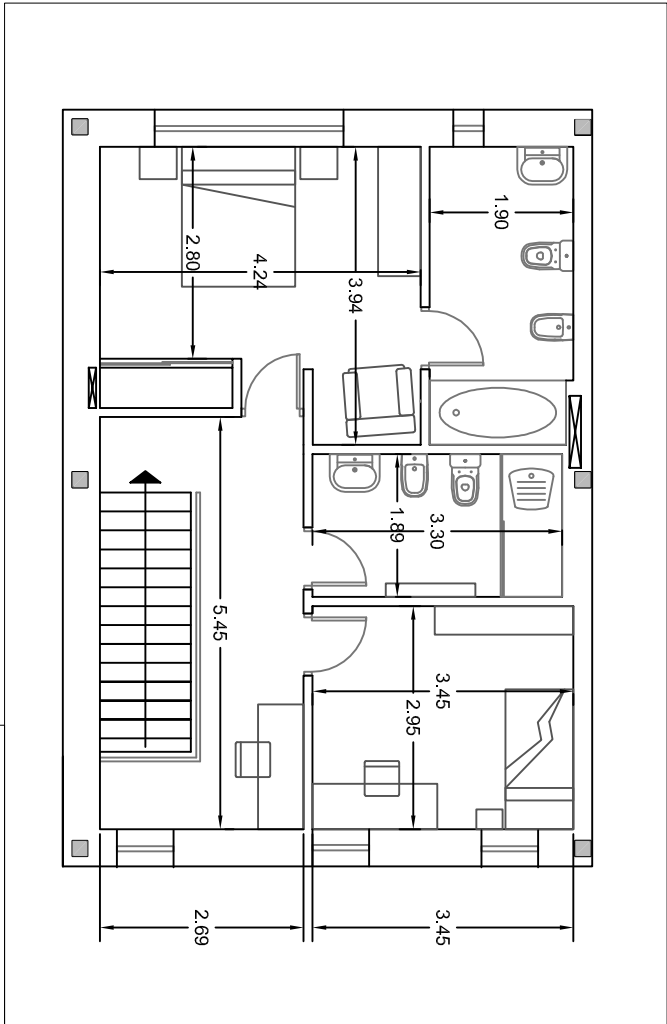




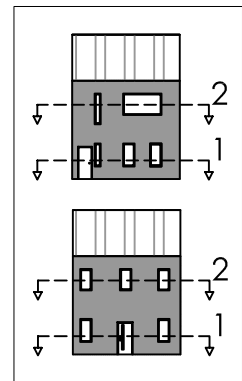
Drawing: House façades. Views and global measurements.	Drawing Number: Gen-005	 HALMSTAD UNIVERSITY
	Scale: 1:100	
Housing construction project in Halmstad Study of the project management	JORDI BELDA SORIANO	 UNIVERSITAT POLITÈCNICA DE VALÈNCIA



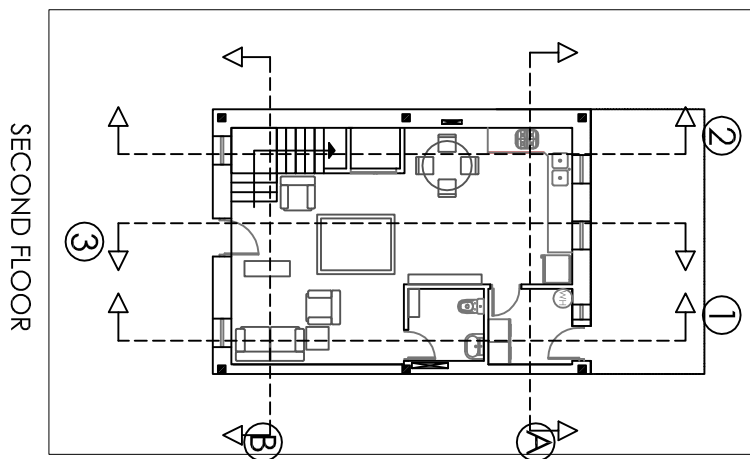
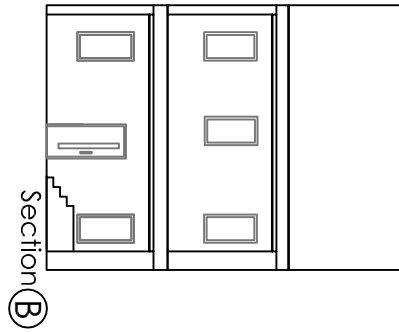
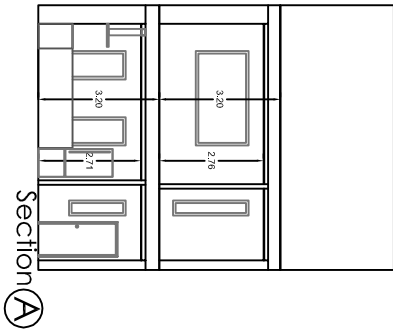
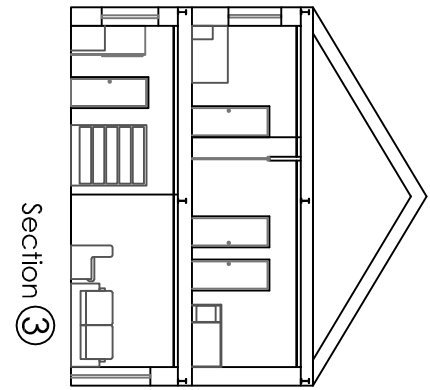
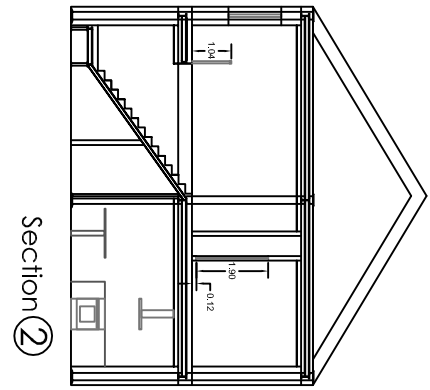
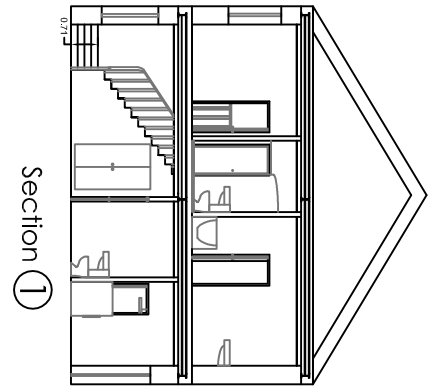
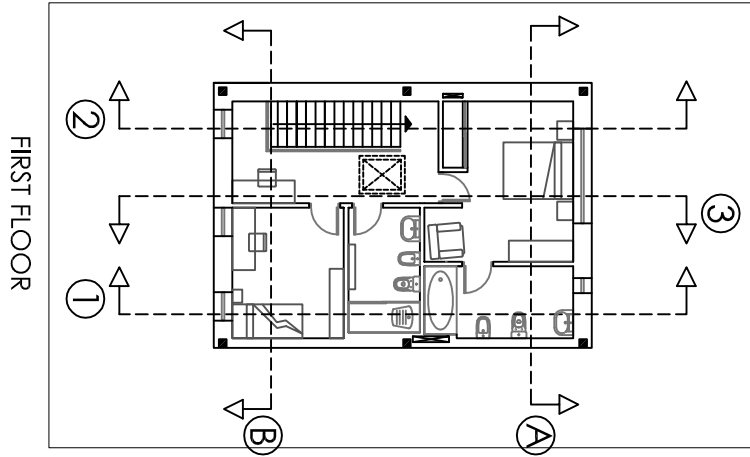
FIRST FLOOR (1)



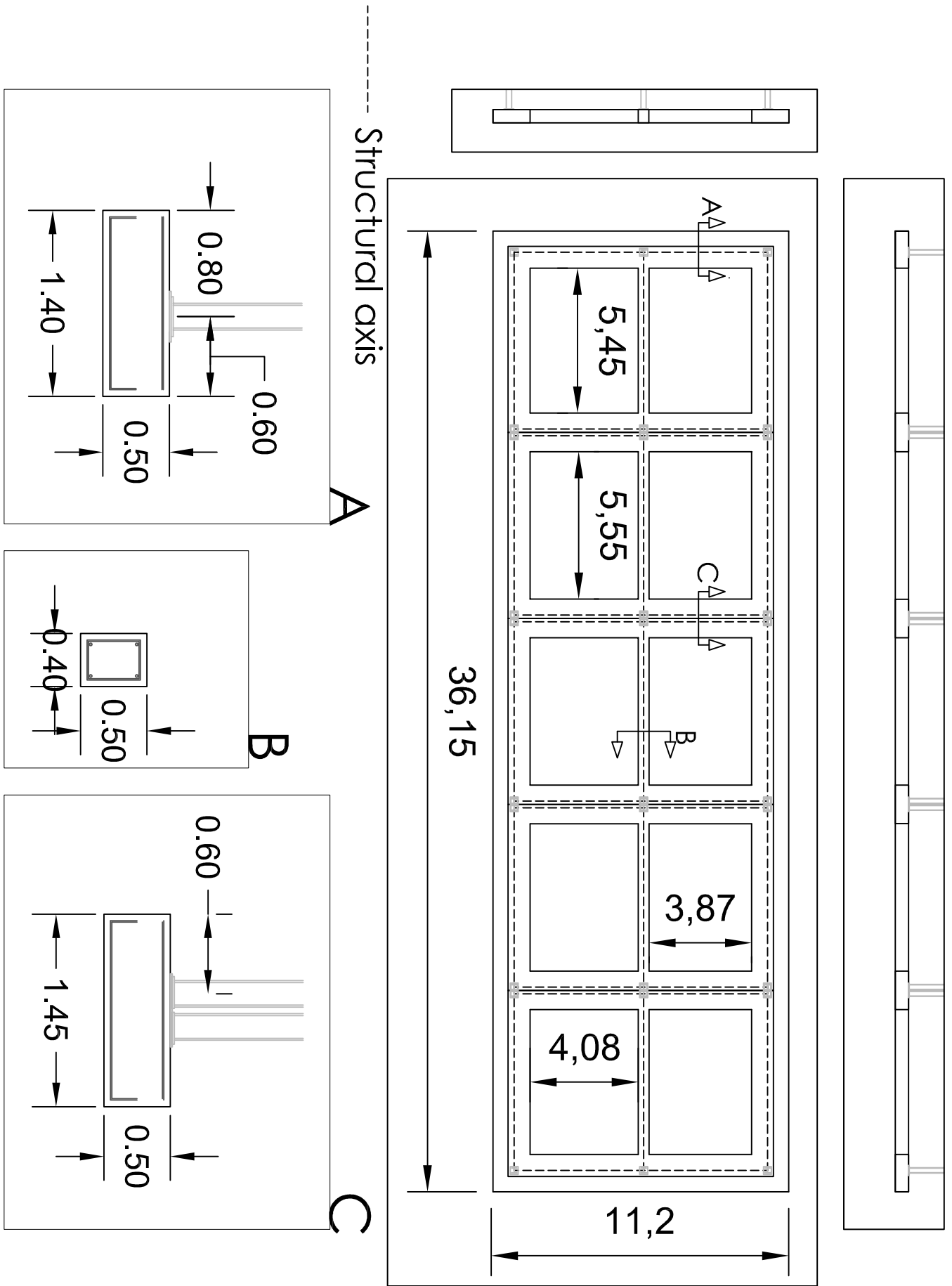
SECOND FLOOR (2)



Drawing: House plants, measurements.	Drawing Number: Gen-006 Scale: 1:100	 HALMSTAD UNIVERSITY
Housing construction project in Halmstad Study of the project management	JORDI BELDA SORIANO	 UNIVERSITAT POLITÈCNICA DE VALÈNCIA



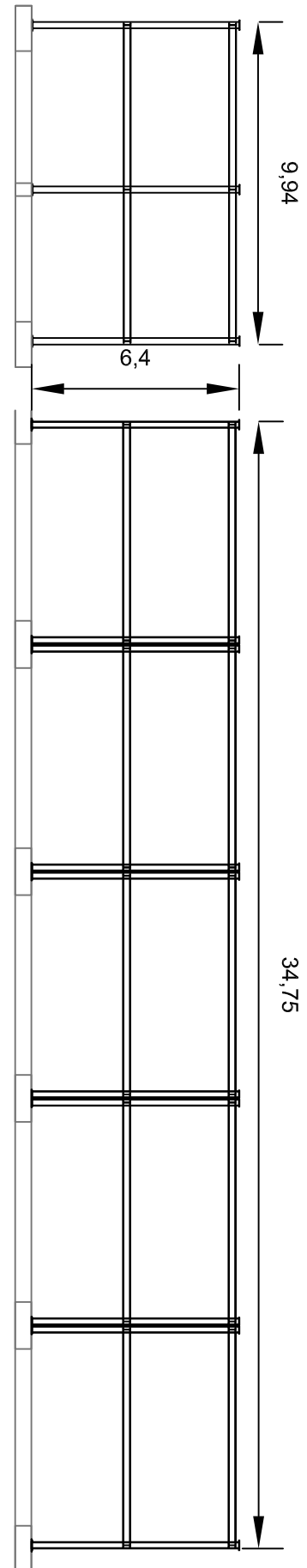
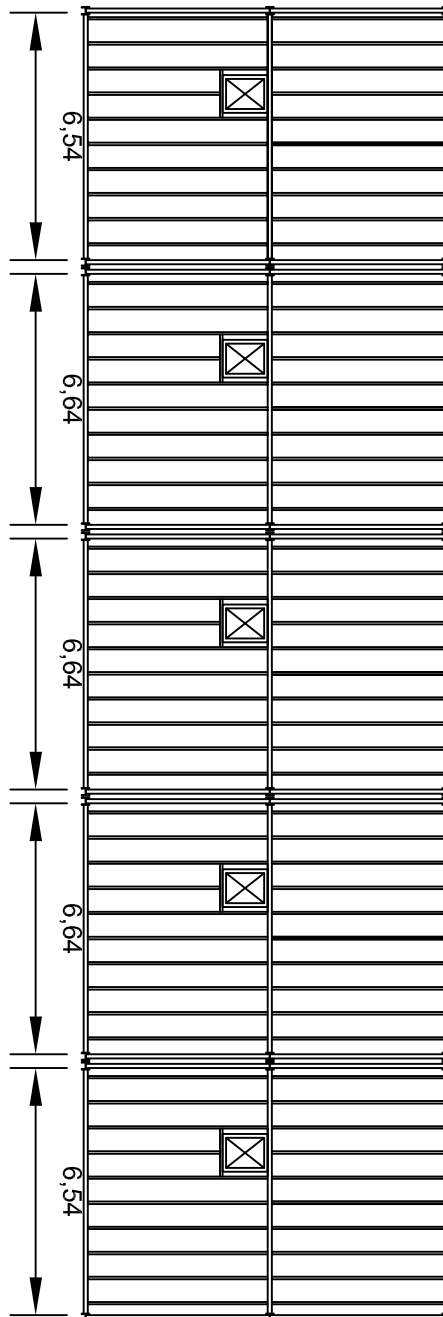
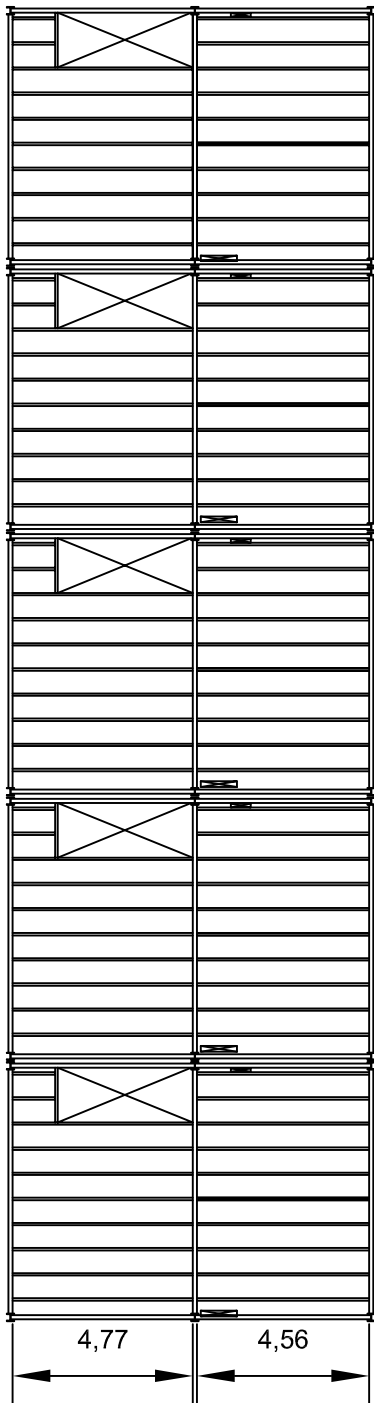
Drawing: House vertical sections. Measurements.	Drawing Number: Gen-007	 HALMSTAD UNIVERSITY
	Scale: 1: 200	
Housing construction project in Halmstad Study of the project management		JORDI BELDA SORIANO



Drawing:
 Foundations.
 Plant, shape and measurement.
 Housing construction project in Halmstad
 Study of the project management

Drawing Number:
Fnd-001
 Scale:
1:200
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Drawing:

Structure.
Block structure, general view and dimensions.

Housing construction project in Halmstad
Study of the project management

Drawing Number:

Str-001

Scale:

1:200

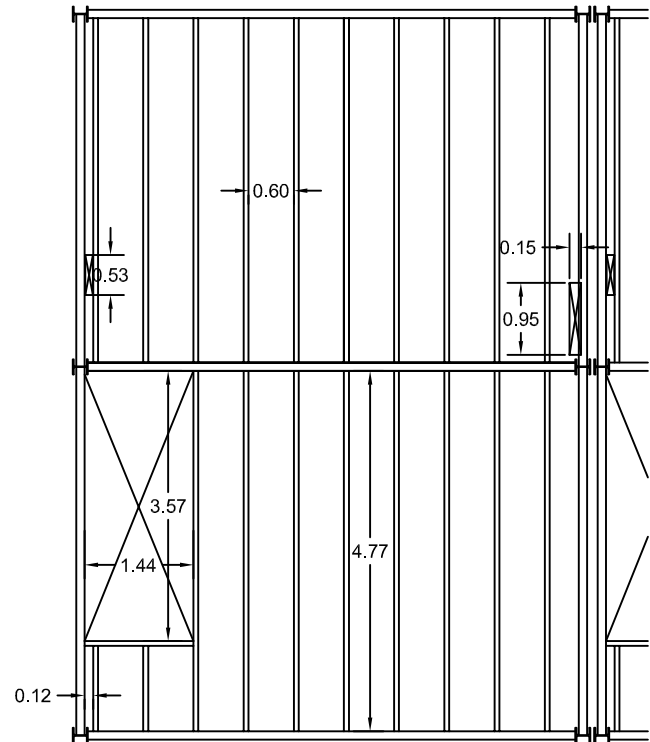
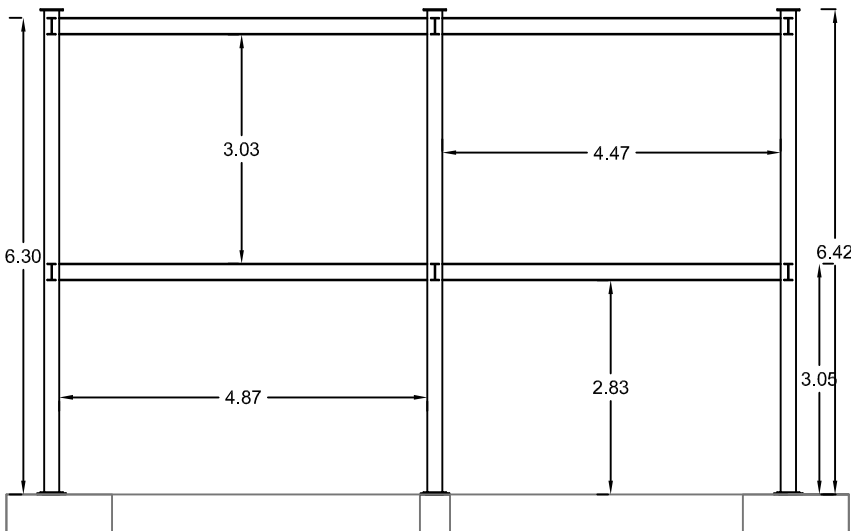
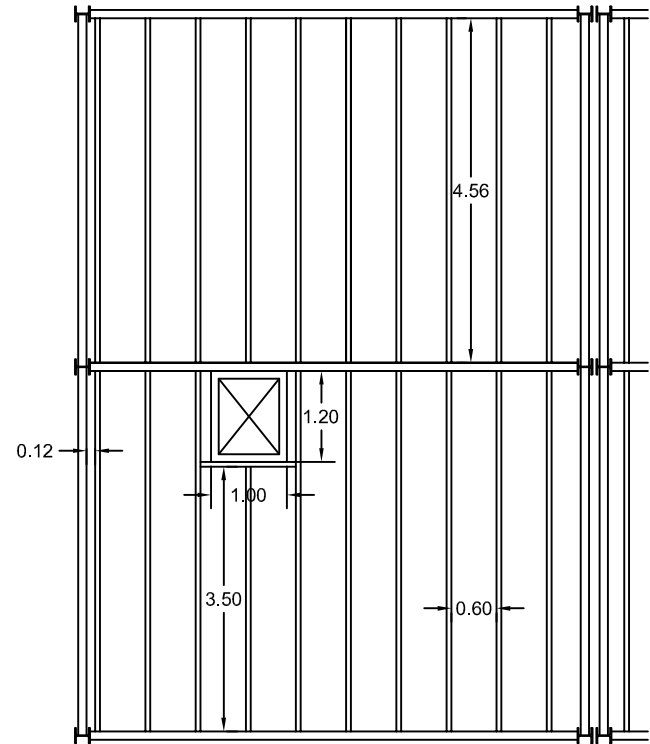
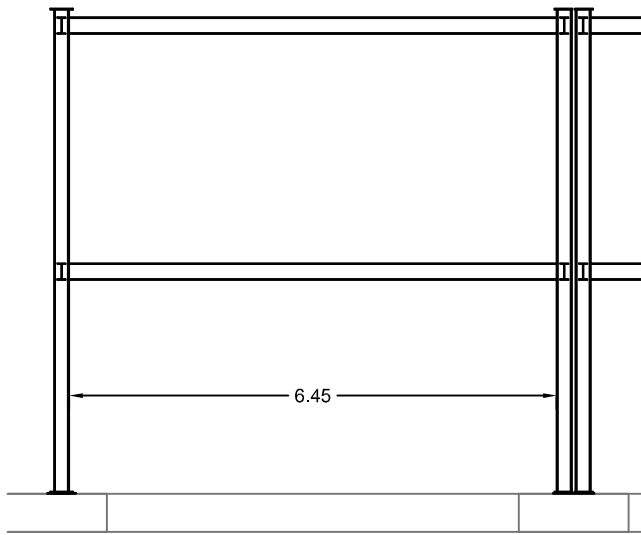
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UNIVERSITY



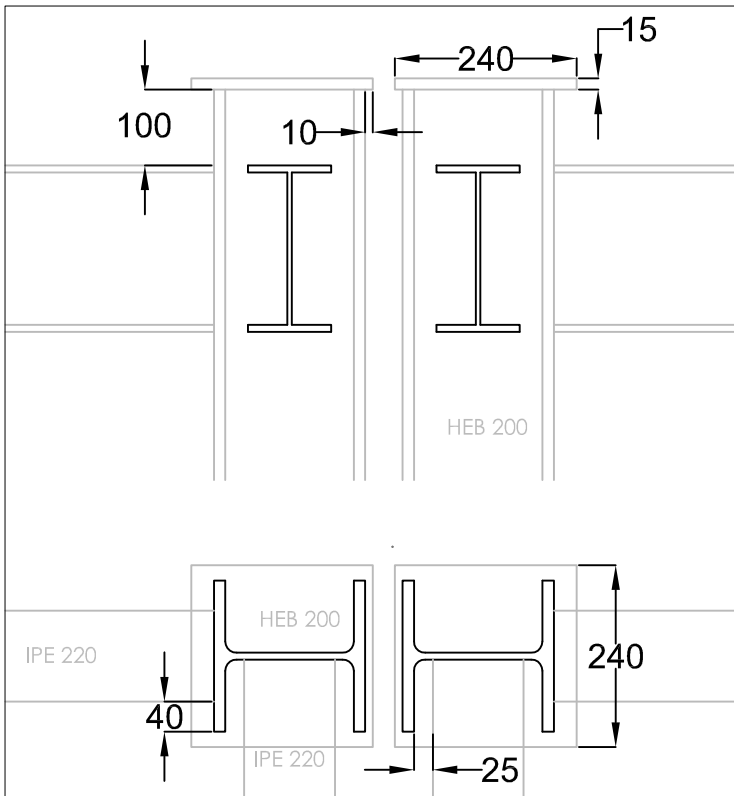
UNIVERSITAT
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DE VALÈNCIA



Drawing:
Structure.
 House structure, views and dimensions.
 Housing construction project in Halmstad
 Study of the project management

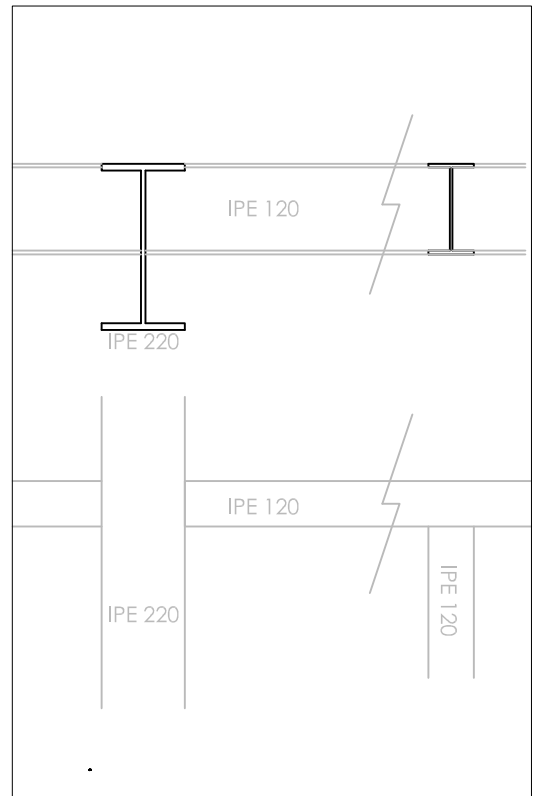
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 Scale:
1:100
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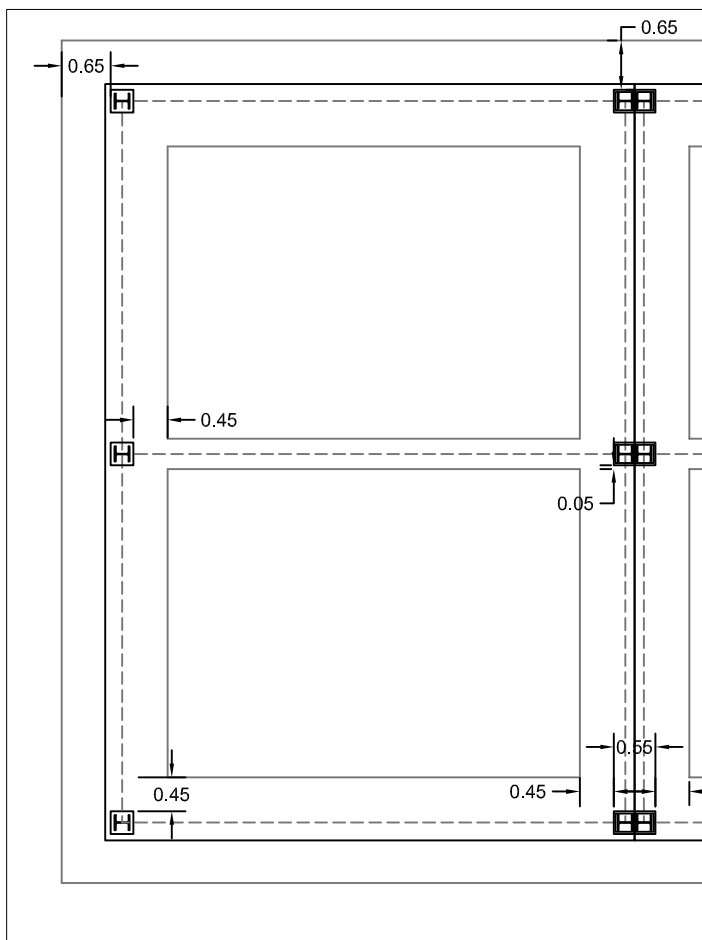
Beams and pillars union.

Scale 1:10

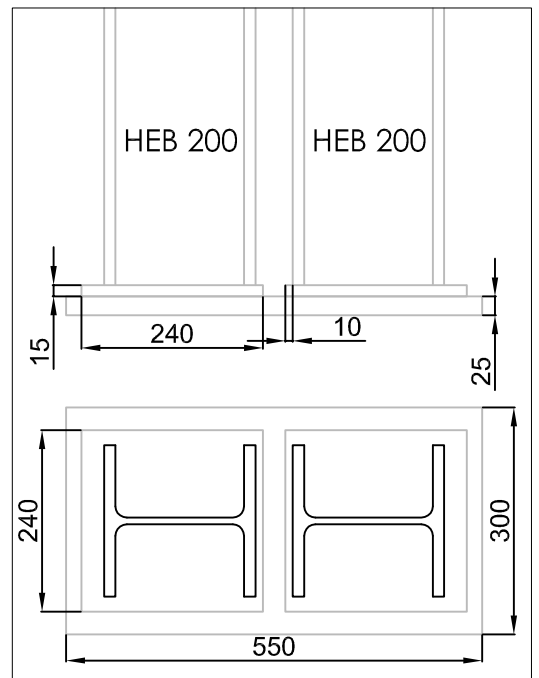


Beam and joists unions.

Scale 1:10



Foundings, structure connections.



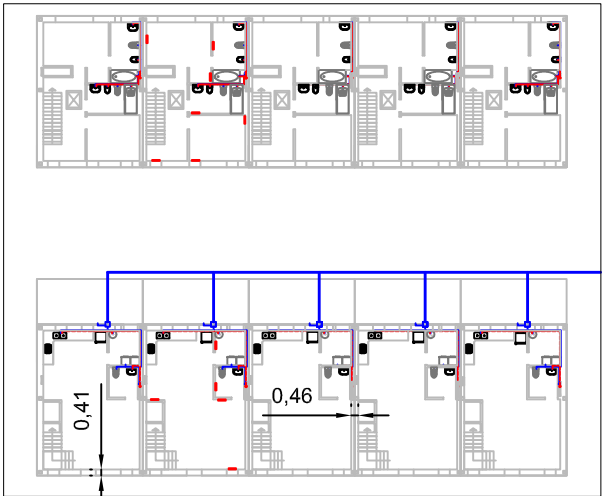
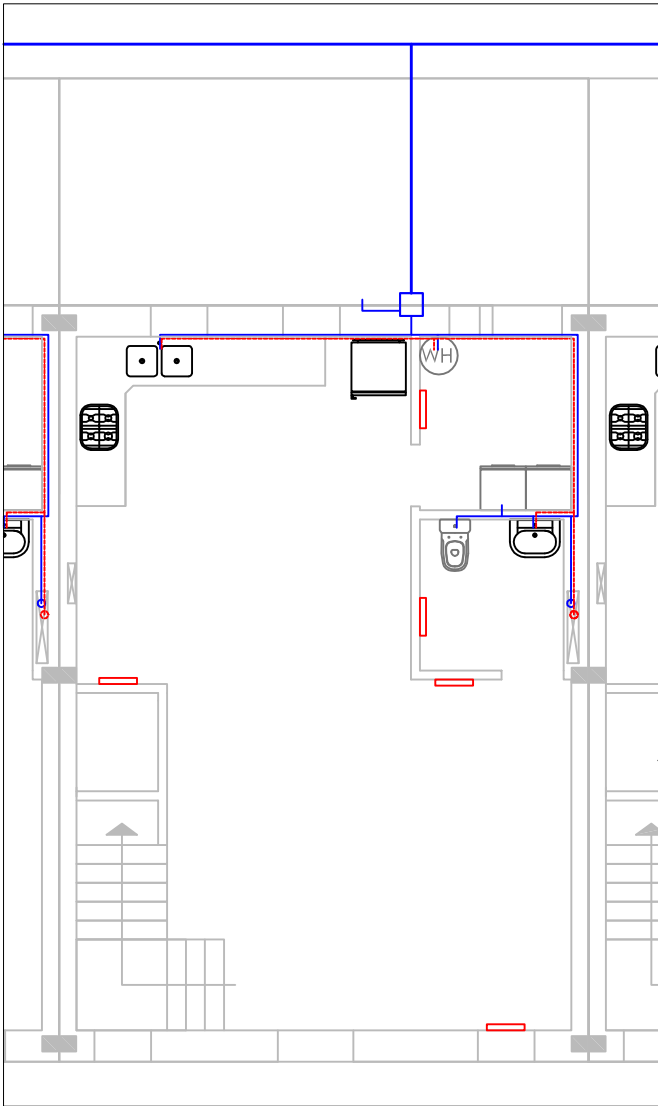
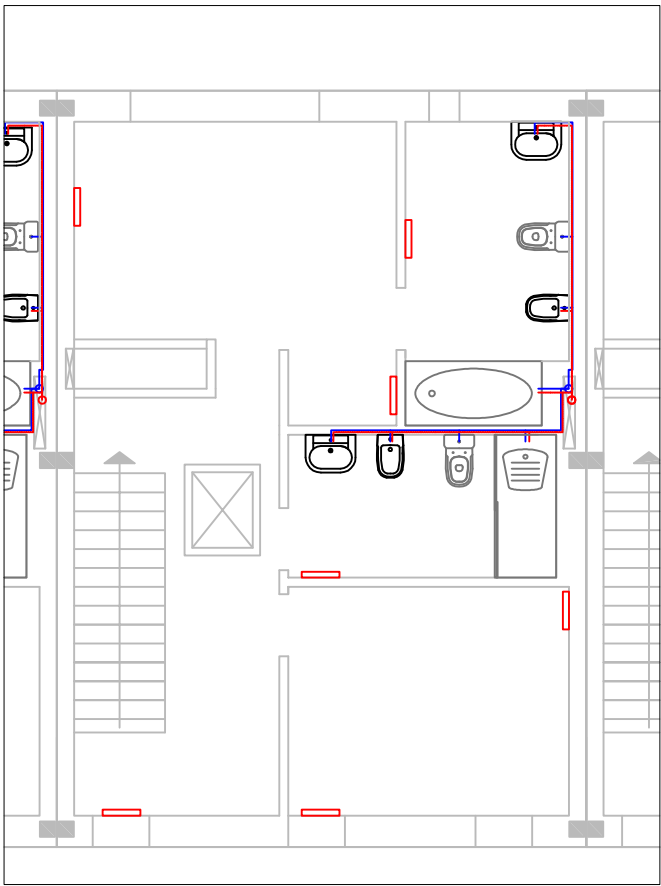
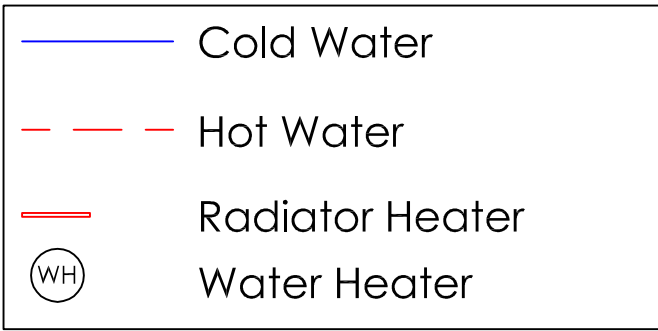
Pillar Base

Scale 1:10

Drawing:
Structure.
Details. Connections to foundations.
 Housing construction project in Halmstad
 Study of the project management

Drawing Number:
Str-003
 Scale:
1:10
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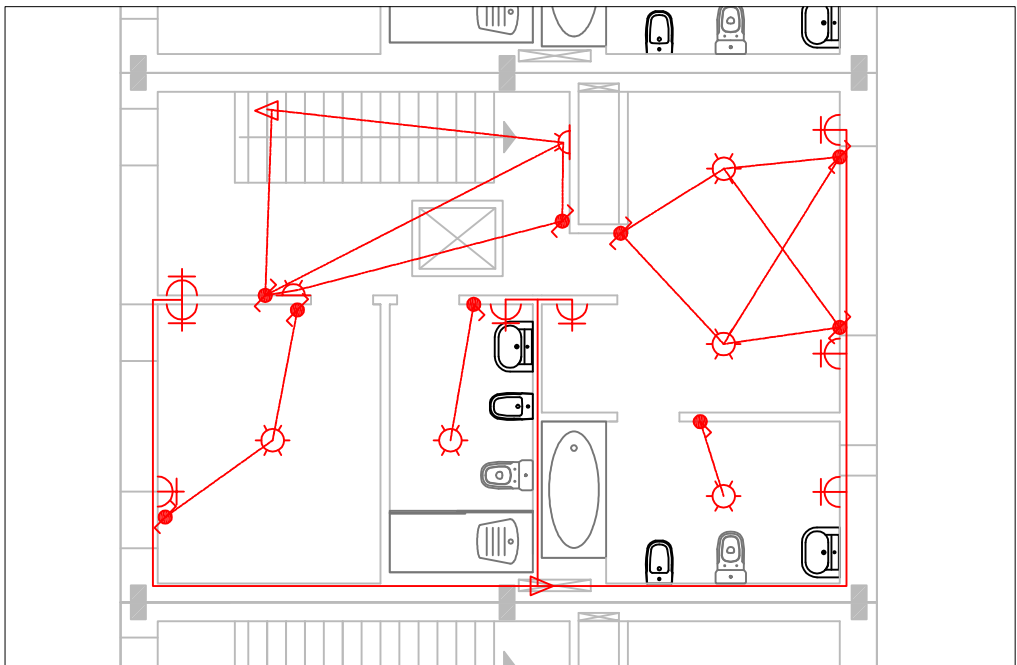
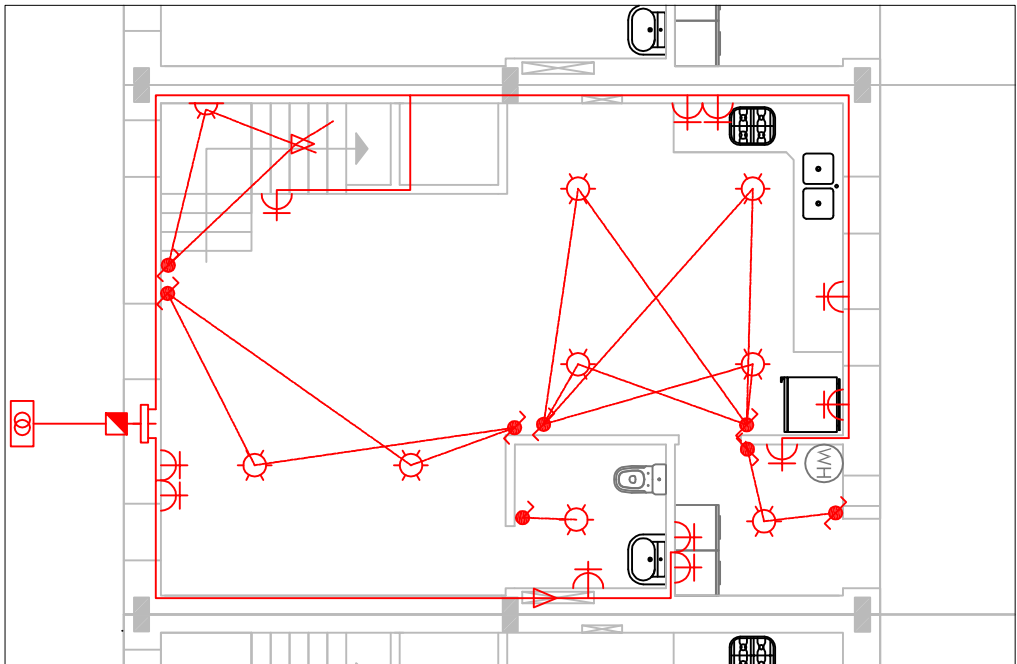




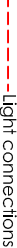
Drawing:
 House systems.
 Water, hot water and heating.
 Housing construction project in Halmstad
 Study of the project management

Drawing Number:
Sys-001
 Scale:
1:100
 JORDI
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LEGEND

-  General electricity supply
-  Power circuit
-  Light connections
-  Electricity meter
-  General protection box
-  Plug base
-  Light point
-  Light switch or double switch
-  Connection to the other floor

Drawing:
House systems.
Electricity and Illumination

Housing construction project in Halmstad
 Study of the project management

Drawing Number:
Sys-002

Scale:
1:100

JORDI
 BELDA SORIANO



Presupuesto : Costes Directos

Capítulo 1 : Land works

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
1.1 u Existing building demolition.							
					Total:	0,100	107,75
							10,78 €
1.2 u Rocks and rubble transport.							
					Total:	0,100	134,93
							13,49 €
1.3 u Trees and plants transport and transplant.							
					Total:	0,100	2.888,35
							288,84 €
1.4 u Vegetal terrain removal.							
					Total:	0,100	14.381,15
							1.438,12 €
1.5 m3 Foundations excavation.							
					Total:	98,822	13,80
							1.363,74 €
1.6 m3 Soil transport.							
					Total:	567,444	8,73
							4.953,79 €
Total Capítulo 1 :							8.068,76 €

Presupuesto : Costes Directos

Capítulo 2 : Foundations

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
2.1 m3 Cleaning concrete.							
					Total:	18,270	37,44 684,03 €
2.2 m Surrounding footings 140x50.							
					Total:	88,984	125,25 11.145,25 €
2.3 m Central footings 145x50.							
					Total:	33,360	130,75 4.361,82 €
2.4 m Foundation beam 40x50.							
					Total:	27,554	41,47 1.142,66 €
2.5 m2 Isolated floor.							
					Total:	218,887	85,05 18.616,34 €
2.6 m Sanitary pipes.							
					Total:	5,000	361,78 1.808,90 €
					Total Capítulo 2 :		37.759,00 €

Presupuesto : Costes Directos

Capítulo 3 : Structure

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE	
3.1 u	Pillar bases							
					Total:	30,000	101,00	3.030,00 €
3.2 u	Pillar ending							
					Total:	30,000	58,89	1.766,70 €
3.3 m	HEB 200 pillar.							
					Total:	192,600	31,00	5.970,60 €
3.4 m	IPE 220 beam.							
					Total:	315,800	59,69	18.850,10 €
3.5 m	IPE 120 joist.							
					Total:	905,350	18,07	16.359,67 €
3.6 m2	Composite slab 5+5 +12mm bars.							
					Total:	660,360	63,27	41.780,98 €
Total Capítulo 3 :							87.758,05 €	

Presupuesto : Costes Directos

Capítulo 5 : Roofs

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE	
5.1 m2 Cover roof								
					Total:	441,000	237,03	104.530,23 €
					Total Capítulo 5 :			104.530,23 €

Presupuesto : Costes Directos

Capítulo 6 : Interior Walls

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
6.1 m2 Internal wall							
					Total:	541,900	50,54 27.387,63 €
					Total Capítulo 6 :		27.387,63 €

Presupuesto : Costes Directos

Capítulo 7 : Carpentry

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE	
7.1 u Window 75x150								
					Total:	20,000	329,13	6.582,60 €
7.2 u Window 75x140								
					Total:	15,000	312,57	4.688,55 €
7.3 u Window 40x200								
					Total:	5,000	293,11	1.465,55 €
7.4 u Window 40x150								
					Total:	5,000	262,78	1.313,90 €
7.5 u Window 250x140								
					Total:	5,000	791,62	3.958,10 €
7.6 u Main door 100x210								
					Total:	5,000	134,19	670,95 €
7.7 u Back door 92x210								
					Total:	5,000	116,23	581,15 €
7.8 u Internal door 82x205								
					Total:	30,000	105,34	3.160,20 €
7.9 u 5 Kitchen closets set								
					Total:	5,000	535,61	2.678,05 €
7.10 u Wardrobes								
					Total:	10,000	221,08	2.210,80 €
7.11 m Handrail								
					Total:	62,600	33,59	2.102,73 €
Total Capítulo 7 :								29.412,58 €

Presupuesto : Costes Directos

Capítulo 8 : Ceilings

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
8.1 m2 Ceiling							
					Total:	551,510	32,95 18.172,25 €
8.2 m2 Insulation							
					Total:	474,300	3,98 1.887,71 €
					Total Capítulo 8 :		20.059,96 €

Presupuesto : Costes Directos

Capítulo 9 : Floors

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
9.1 m2 Wood floor							
					Total:	430,720	112,68 48.533,53 €
9.2 m2 Ceramic floor							
					Total:	79,520	52,95 4.210,58 €
9.3 m2 Linoleum floor							
					Total:	24,960	55,79 1.392,52 €
					Total Capítulo 9 :		54.136,63 €

Presupuesto : Costes Directos

Capítulo 10 : Electric and Communications Installation

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE	
10.1 u Land connections.								
					Total:	24,000	9,89	237,36 €
10.2 m Copper wire for land connection.								
					Total:	100,000	96,69	9.669,00 €
10.3 m Connection branch from general supply.								
					Total:	15,000	61,43	921,45 €
10.4 u Electricity meter.								
					Total:	5,000	85,12	425,60 €
10.5 u General protection box.								
					Total:	5,000	237,48	1.187,40 €
10.6 m General purpose circuit. (10A)								
					Total:	592,000	6,63	3.924,96 €
10.7 m Washing machine, dryer circuit. (16A)								
					Total:	86,200	8,02	691,32 €
10.8 m Kitchen circuit (25A)								
					Total:	67,000	8,02	537,34 €
10.9 u Light points simple switch.								
					Total:	15,000	100,49	1.507,35 €
10.10 u Light points multiple switch.								
					Total:	65,000	129,49	8.416,85 €
10.11 u Plugs bases.								
					Total:	95,000	35,03	3.327,85 €
10.12 u Emergency luminaries.								
					Total:	15,000	33,24	498,60 €
10.13 u Phone & Internet plugs.								
					Total:	15,000	80,97	1.214,55 €
10.14 u TV aerial and plugs.								
					Total:	5,000	450,23	2.251,15 €
Total Capítulo 10 :							34.810,78 €	

Presupuesto : Costes Directos

Capítulo 11 : Plumbing and heating Installation

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE	
11.1 u Connection branch form general supply.								
					Total:	5,000	880,57	4.402,85 €
11.2 u Water meter.								
					Total:	5,000	74,59	372,95 €
11.3 u Water supply pipes.								
					Total:	450,700	25,59	11.533,41 €
11.4 u Waste water pipes								
					Total:	147,150	26,44	3.890,65 €
11.5 u Toilet sinks								
					Total:	15,000	159,79	2.396,85 €
11.6 u Kitchen sink								
					Total:	5,000	232,04	1.160,20 €
11.7 u Bidets								
					Total:	10,000	183,50	1.835,00 €
11.8 u Toilets								
					Total:	15,000	251,67	3.775,05 €
11.9 u Shower tub								
					Total:	5,000	287,79	1.438,95 €
11.10 u Bath tub								
					Total:	5,000	259,75	1.298,75 €
11.11 u Water supply terminals								
					Total:	70,000	94,70	6.629,00 €
11.12 u White goods waste connections								
					Total:	20,000	23,31	466,20 €
11.13 u Thermostat								
					Total:	5,000	37,92	189,60 €
11.14 u Accumulation system 350 L								
					Total:	5,000	199,91	999,55 €
11.15 u Radiator heater								
					Total:	70,000	124,97	8.747,90 €

Presupuesto : Costes Directos

Capítulo 11 : Plumbing and heating Installation

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
11.16 u Radiators system							
					Total:	401,000	22,04 8.838,04 €
					Total Capítulo 11 :		57.974,95 €

Presupuesto : Costes Directos

Capítulo 12 : Walls Finishings

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
12.1 m2 Acrylic paint							
					Total:	1.158,500	4,92 5.699,82 €
12.2 m2 Ceramic tiles							
					Total:	308,200	38,74 11.939,67 €
					Total Capítulo 12 :		17.639,49 €

Presupuesto : Costes Directos

Capítulo 13 : Equipements

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
13.1 u Water heater unit gas/gas-oil fuelled.							
					Total:	5,000	3.092,58
							15.462,90 €
13.2 u Fridge/freezer combo							
					Total:	5,000	652,05
							3.260,25 €
13.3 u Oven/stove combo							
					Total:	5,000	447,12
							2.235,60 €
13.4 u Dish washing machine.							
					Total:	5,000	376,84
							1.884,20 €
13.5 u Washing machine							
					Total:	5,000	378,09
							1.890,45 €
13.6 u Dryer machine.							
					Total:	5,000	274,17
							1.370,85 €
13.7 u Fire extinguishers							
					Total:	5,000	152,22
							761,10 €
Total Capítulo 13 :							26.865,35 €

Presupuesto : Costes Directos

Capítulo : Costes Directos

Presupuesto

COMENTARIO	NUM.	DIM 1	DIM 2	DIM 3	ACUM.	PRECIO	IMPORTE
1 Land works							
					Total:	1,000 8.068,76	8.068,76 €
2 Foundations							
					Total:	1,000 37.759,00	37.759,00 €
3 Structure							
					Total:	1,000 87.758,05	87.758,05 €
4 Façades							
					Total:	1,000 130.697,17	130.697,17 €
5 Roofs							
					Total:	1,000 104.530,23	104.530,23 €
6 Interior Walls							
					Total:	1,000 27.387,63	27.387,63 €
7 Carpentry							
					Total:	1,000 29.412,58	29.412,58 €
8 Ceilings							
					Total:	1,000 20.059,96	20.059,96 €
9 Floors							
					Total:	1,000 54.136,63	54.136,63 €
10 Electric and Communications Installation							
					Total:	1,000 34.810,78	34.810,78 €
11 Plumbing and heating Installation							
					Total:	1,000 57.974,95	57.974,95 €
12 Walls Finishings							
					Total:	1,000 17.639,49	17.639,49 €
13 Equipements							
					Total:	1,000 26.865,35	26.865,35 €
Total Capítulo :							637.100,58 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
1.1	u	Existing building demolition.				01.01
R00001		Mechanic work		1,024 h	75,59	77,40
R00002		Worker helper labour		1,344 h	19,87	26,71
Coste Directo						104,11
3,500 % Coste Indirecto						3,64
Total Redondeado =						107,75 €
1.2	u	Rocks and rubble transport.				01.02
R00003		Mechanic work		0,640 h	75,59	48,38
R00006		Worker helper labour		1,280 h	19,87	25,43
R00004		Truck rent. Includes load and transport.		2,200 h	25,71	56,56
Coste Directo						130,37
3,500 % Coste Indirecto						4,56
Total Redondeado =						134,93 €
1.3	u	Trees and plants transport and transplant.				01.03
R00007		Tree removal		22,000 u	80,00	1.760,00
R00008		Plant/Bush removal		33,000 u	25,00	825,00
R00009		Truck rent. Includes load and transport.		8,000 h	25,71	205,68
Coste Directo						2.790,68
3,500 % Coste Indirecto						97,67
Total Redondeado =						2.888,35 €
1.4	u	Vegetal terrain removal.				01.04
R00010		Vegetal terrain removal deep 0.3m		4.439,244 m3	3,13	13.894,83
Coste Directo						13.894,83
3,500 % Coste Indirecto						486,32
Total Redondeado =						14.381,15 €
1.5	m3	Foundations excavation.				01.05
R00010		Vegetal terrain removal deep 0.3m		1,000 m3	3,13	3,13
R00006		Worker helper labour		0,001 h	19,87	0,02
R00011		Mechanical work		0,120 h	84,81	10,18
Coste Directo						13,33
3,500 % Coste Indirecto						0,47
Total Redondeado =						13,80 €
1.6	m3	Soil transport.				01.06
(Sin descomposición)						
Coste Directo						8,43
3,500 % Coste Indirecto						0,30
Total Redondeado =						8,73 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
2.1	m3	Cleaning concrete.				02.01
R00014		Worker labour		0,450 h	20,63	9,28
R00015		Worker helper labour		0,900 h	18,87	16,98
R00013		cleaning concrete 150/B/40		1,000 m3	9,91	9,91
Coste Directo						36,17
3,500 % Coste Indirecto						1,27
Total Redondeado =						37,44 €
2.2	m	Surrounding footings 140x50.				02.02
R00014		Worker labour		0,270 h	20,63	5,57
R00015		Worker helper labour		0,400 h	18,87	7,55
R00016		Concrete v vibrator		0,070 h	1,42	0,10
R00017		Concrete 30/B/20/IIIb+h		0,700 m3	93,81	65,67
R00018		Steel B 400S		36,000 kg	1,17	42,12
Coste Directo						121,01
3,500 % Coste Indirecto						4,24
Total Redondeado =						125,25 €
2.3	m	Central footings 145x50.				02.03
R00014		Worker labour		0,290 h	20,63	5,98
R00015		Worker helper labour		0,400 h	18,87	7,55
R00016		Concrete v vibrator		0,070 h	1,42	0,10
R00017		Concrete 30/B/20/IIIb+h		0,725 m3	93,81	68,01
R00018		Steel B 400S		38,200 kg	1,17	44,69
Coste Directo						126,33
3,500 % Coste Indirecto						4,42
Total Redondeado =						130,75 €
2.4	m	Foundation beam 40x50.				02.04
R00014		Worker labour		0,085 h	20,63	1,75
R00015		Worker helper labour		0,320 h	18,87	6,04
R00016		Concrete v vibrator		0,040 h	1,42	0,06
R00017		Concrete 30/B/20/IIIb+h		0,200 m3	93,81	18,76
R00018		Steel B 400S		11,500 kg	1,17	13,46
Coste Directo						40,07
3,500 % Coste Indirecto						1,40
Total Redondeado =						41,47 €
2.5	m2	Isolated floor.				02.06
R00014		Worker labour		0,287 h	20,63	5,92
R00015		Worker helper labour		0,320 h	18,87	6,04
R00019		Geotex tile sheet		1,000 m2	1,21	1,21
R00020		Drain material (gravel 10mm)		0,150 m3	19,20	2,88
R00021		Extruded poly sty rene 100mm 30Kg/m3		2,000 m2	21,20	42,40
R00022		Extruded poly sty rene 50mm 30Kg/m3		1,000 m2	12,65	12,65
R00035		Steel mail for the concrete layer		1,350 m2	1,25	1,69
R00017		Concrete 30/B/20/IIIb+h		0,100 m3	93,81	9,38
Coste Directo						82,17
3,500 % Coste Indirecto						2,88
Total Redondeado =						85,05 €

Presupuesto : BID

Capítulo 2 : Foundations

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
2.6	m	Sanitary pipes.				02.07
R00014		Worker labour		1,360 h	20,63	28,06
R00015		Worker helper labour		1,360 h	18,87	25,66
R00024		Waste pipes slab connection		2,000 u	40,21	80,42
R00025		PVC sanitary pipes 125mm		8,000 m	14,72	117,76
R00026		Connection local waste system		1,000 u	97,65	97,65
						<hr/>
						Coste Directo 349,55
						3,500 % Coste Indirecto 12,23
						<hr/>
						Total Redondeado = 361,78 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
3.1	u	Pillar bases				03.01
R00014		Worker labour		0,724 h	20,63	14,94
R00015		Worker helper labour		0,724 h	18,87	13,66
R00029		15mm steel plate S275J		0,165 m2	294,60	48,61
R00030		25mm steel plate S275J		0,115 m2	177,09	20,37
Coste Directo						97,58
3,500 % Coste Indirecto						3,42
Total Redondeado =						101,00 €
3.2	u	Pillar ending				03.06
R00014		Worker labour		0,210 h	20,63	4,33
R00015		Worker helper labour		0,210 h	18,87	3,96
R00029		15mm steel plate S275J		0,165 m2	294,60	48,61
Coste Directo						56,90
3,500 % Coste Indirecto						1,99
Total Redondeado =						58,89 €
3.3	m	HEB 200 pillar.				03.02
R00014		Worker labour		0,524 h	20,63	10,81
R00015		Worker helper labour		0,524 h	18,87	9,89
R00031		IPE 120 Joist		1,000 m	9,25	9,25
Coste Directo						29,95
3,500 % Coste Indirecto						1,05
Total Redondeado =						31,00 €
3.4	m	IPE 220 beam.				03.03
R00014		Worker labour		1,226 h	20,63	25,29
R00015		Worker helper labour		1,226 h	18,87	23,13
R00031		IPE 120 Joist		1,000 m	9,25	9,25
Coste Directo						57,67
3,500 % Coste Indirecto						2,02
Total Redondeado =						59,69 €
3.5	m	IPE 120 joist.				03.04
R00014		Worker labour		0,208 h	20,63	4,29
R00015		Worker helper labour		0,208 h	18,87	3,92
R00031		IPE 120 Joist		1,000 m	9,25	9,25
Coste Directo						17,46
3,500 % Coste Indirecto						0,61
Total Redondeado =						18,07 €

Presupuesto : BID

Capítulo 4 : Façades

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
4.1	m2	Exterior wall				04.01
R00036		View ed brick wall (24x11.5x5)		1,000 m2	16,78	16,78
R00037		Insulation. Glass wool 50/60 kg/m3 50mm		1,000 m2	19,96	19,96
R00038		170x40mm w ood studs		2,520 m	7,54	19,00
R00039		Insulation. Glass wool fire resistant 17-19kg/m3 170mm.		0,890 m2	7,72	6,87
R00040		Plastic sheet 0.05mm. Wind and v apour barrier.		1,000 m2	0,72	0,72
R00041		45x40mm w ood studs		2,520 m	3,02	7,61
R00014		Worker labour		2,250 h	20,63	46,42
R00015		Worker helper labour		2,250 h	18,87	42,46
R00042		Insulation Glass wool fire resistant 17-19kg/m3 45mm.		0,890 m2	2,09	1,86
R00043		Gypsum board 13mm.		1,000 m2	4,57	4,57
Coste Directo						166,25
3,500 % Coste Indirecto						5,82
Total Redondeado =						172,07 €
4.2	m2	Diving wall				04.02
R00038		170x40mm w ood studs		2,520 m	7,54	19,00
R00039		Insulation. Glass wool fire resistant 17-19kg/m3 170mm.		0,890 m2	7,72	6,87
R00040		Plastic sheet 0.05mm. Wind and v apour barrier.		1,000 m2	0,72	0,72
R00041		45x40mm w ood studs		2,520 m	3,02	7,61
R00014		Worker labour		0,900 h	20,63	18,57
R00015		Worker helper labour		0,900 h	18,87	16,98
R00042		Insulation Glass wool fire resistant 17-19kg/m3 45mm.		0,890 m2	2,09	1,86
R00043		Gypsum board 13mm.		1,000 m2	4,57	4,57
Coste Directo						76,18
3,500 % Coste Indirecto						2,67
Total Redondeado =						78,85 €

Presupuesto : BID

Capítulo 6 : Interior Walls

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
6.1	m2	Internal wall				07.01
R00014		Worker labour		0,310 h	20,63	6,40
R00015		Worker helper labour		0,310 h	18,87	5,85
R00055		Steel trucks and studs 70mm s900		2,900 m	1,70	4,93
R00043		Gypsum board 13mm.		4,200 m2	4,57	19,19
R00056		Acoustic/thermical insulation 45mm		2,000 m2	6,23	12,46
					Coste Directo	48,83
					3,500 % Coste Indirecto	1,71
					Total Redondeado =	50,54 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
7.1	u	Window 75x150				08.01
				(Sin descomposición)		
				Coste Directo		318,00
			3,500	% Coste Indirecto		11,13
				Total Redondeado =		329,13 €
7.2	u	Window 75x140				08.02
				(Sin descomposición)		
				Coste Directo		302,00
			3,500	% Coste Indirecto		10,57
				Total Redondeado =		312,57 €
7.3	u	Window 40x200				08.03
				(Sin descomposición)		
				Coste Directo		283,20
			3,500	% Coste Indirecto		9,91
				Total Redondeado =		293,11 €
7.4	u	Window 40x150				08.05
				(Sin descomposición)		
				Coste Directo		253,89
			3,500	% Coste Indirecto		8,89
				Total Redondeado =		262,78 €
7.5	u	Window 250x140				08.06
				(Sin descomposición)		
				Coste Directo		764,85
			3,500	% Coste Indirecto		26,77
				Total Redondeado =		791,62 €
7.6	u	Main door 100x210				08.07
				(Sin descomposición)		
				Coste Directo		129,65
			3,500	% Coste Indirecto		4,54
				Total Redondeado =		134,19 €
7.7	u	Back door 92x210				08.08
				(Sin descomposición)		
				Coste Directo		112,30
			3,500	% Coste Indirecto		3,93
				Total Redondeado =		116,23 €
7.8	u	Internal door 82x205				08.09
				(Sin descomposición)		
				Coste Directo		101,78
			3,500	% Coste Indirecto		3,56
				Total Redondeado =		105,34 €

Presupuesto : BID

Capítulo 7 : Carpentry

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
7.9	u	5 Kitchen closets set				08.10
				(Sin descomposición)		
				Coste Directo		517,50
			3,500	% Coste Indirecto		18,11
				Total Redondeado =		535,61 €
7.10	u	Wardrobes				08.11
				(Sin descomposición)		
				Coste Directo		213,60
			3,500	% Coste Indirecto		7,48
				Total Redondeado =		221,08 €
7.11	m	Handrail				08.12
				(Sin descomposición)		
				Coste Directo		32,45
			3,500	% Coste Indirecto		1,14
				Total Redondeado =		33,59 €

Presupuesto : BID

Capítulo 8 : Ceilings

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
8.1	m2	Ceiling				09.01
R00057		Aluminium guides		3,330 m	1,50	5,00
R00014		Worker labour		0,270 h	20,63	5,57
R00015		Worker helper labour		0,270 h	18,87	5,09
R00058		Gypsum panel 10mm		2,780 u	5,82	16,18
						<hr/>
						Coste Directo 31,84
						3,500 % Coste Indirecto 1,11
						<hr/>
						Total Redondeado = 32,95 €
8.2	m2	Insulation				09.02
R00015		Worker helper labour		0,120 h	18,87	2,26
R00042		Insulation Glass wool fire resistant 17-19kg/m3 45mm.		0,760 m2	2,09	1,59
						<hr/>
						Coste Directo 3,85
						3,500 % Coste Indirecto 0,13
						<hr/>
						Total Redondeado = 3,98 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
9.1	m2	Wood floor				10.01
R00059		Acoustic sheet		1,000 m2	8,95	8,95
R00060		Wood batenings		7,550 m	1,85	13,97
R00061		Styrofoam 12.5mm		0,773 m2	2,24	1,73
R00063		Oak wood floor 15mm		1,000 m2	54,60	54,60
R00014		Worker labour		0,750 h	20,63	15,47
R00015		Worker helper labour		0,750 h	18,87	14,15
					Coste Directo	108,87
					3,500 % Coste Indirecto	3,81
					Total Redondeado =	112,68 €
9.2	m2	Ceramic floor				10.02
R00059		Acoustic sheet		1,000 m2	8,95	8,95
R00061		Styrofoam 12.5mm		1,000 m2	2,24	2,24
R00064		Concrete grip 46mm		1,000 m2	8,13	8,13
R00065		Ceramic tile 400x400mm		1,050 m2	17,35	18,22
R00014		Worker labour		0,450 h	20,63	9,28
R00015		Worker helper labour		0,230 h	18,87	4,34
					Coste Directo	51,16
					3,500 % Coste Indirecto	1,79
					Total Redondeado =	52,95 €
9.3	m2	Linoleum floor				10.03
R00064		Concrete grip 46mm		1,000 m2	8,13	8,13
R00066		Linoleum floor 4mm		1,050 m2	28,16	29,57
R00014		Worker labour		0,410 h	20,63	8,46
R00015		Worker helper labour		0,410 h	18,87	7,74
					Coste Directo	53,90
					3,500 % Coste Indirecto	1,89
					Total Redondeado =	55,79 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
10.1	u	Land connections.				11.01
R00014		Worker labour		0,210 h	20,63	4,33
R00015		Worker helper labour		0,210 h	18,87	3,96
R00067		1.5mm pike diametr 16mm		1,050 u	1,21	1,27
Coste Directo						9,56
3,500 % Coste Indirecto						0,33
Total Redondeado =						9,89 €
10.2	m	Copper wire for land connection.				11.02
R00014		Worker labour		0,400 h	20,63	8,25
R00068		Electricity meter		1,050 u	77,52	81,40
R00015		Worker helper labour		0,200 h	18,87	3,77
Coste Directo						93,42
3,500 % Coste Indirecto						3,27
Total Redondeado =						96,69 €
10.3	m	Connection branch from general supply.				11.03
R00068		Electricity meter		0,610 u	77,52	47,29
R00015		Worker helper labour		0,400 h	18,87	7,55
R00069		Protection tube		1,050 m	1,81	1,90
R00105		Copper wire 6mm		3,000 m	0,87	2,61
Coste Directo						59,35
3,500 % Coste Indirecto						2,08
Total Redondeado =						61,43 €
10.4	u	Electricity meter.				11.04
R00068		Electricity meter		1,000 u	77,52	77,52
R00015		Worker helper labour		0,250 h	18,87	4,72
Coste Directo						82,24
3,500 % Coste Indirecto						2,88
Total Redondeado =						85,12 €
10.5	u	General protection box.				11.05
R00014		Worker labour		1,500 h	20,63	30,95
R00015		Worker helper labour		1,000 h	18,87	18,87
R00070		Protection box		1,000 u	167,75	167,75
R00071		Connection copper wire		3,000 m	3,96	11,88
Coste Directo						229,45
3,500 % Coste Indirecto						8,03
Total Redondeado =						237,48 €
10.6	m	General purpose circuit. (10A)				11.07
11.17		PVC protection 15mm		1,000 m	0,95	0,95
R00014		Worker labour		0,100 h	20,63	2,06
R00015		Worker helper labour		0,080 h	18,87	1,51
R00104		Copper wire 4mm		3,000 m	0,63	1,89
Coste Directo						6,41
3,500 % Coste Indirecto						0,22
Total Redondeado =						6,63 €

Presupuesto : BID

Capítulo 10 : Electric and Communications Installation

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
10.7	m	Washing machine, dryer circuit. (16A)				11.08
11.17		PVC protection 15mm		1,000 m	0,95	0,95
R00014		Worker labour		0,100 h	20,63	2,06
R00015		Worker helper labour		0,080 h	18,87	1,51
R00072		Copper wire 6mm		3,000 m	0,76	2,28
11.17		PVC protection 15mm		1,000 m	0,95	0,95
Coste Directo						7,75
3,500 % Coste Indirecto						0,27
Total Redondeado =						8,02 €
10.8	m	Kitchen circuit (25A)				11.09
R00014		Worker labour		0,100 h	20,63	2,06
R00015		Worker helper labour		0,080 h	18,87	1,51
11.17		PVC protection 15mm		1,000 m	0,95	0,95
R00072		Copper wire 6mm		3,000 m	0,76	2,28
11.17		PVC protection 15mm		1,000 m	0,95	0,95
Coste Directo						7,75
3,500 % Coste Indirecto						0,27
Total Redondeado =						8,02 €
10.9	u	Light points simple switch.				11.10
R00106		Worker labour		0,080 h	18,84	1,51
R00107		Copper wire 2.5mm including pvc protection		13,000 m	5,05	65,65
R00109		Light point		1,000 u	29,93	29,93
R00111		Button		0,000 u	11,83	0,00
Coste Directo						97,09
3,500 % Coste Indirecto						3,40
Total Redondeado =						100,49 €
10.10	u	Light points multiple switch.				11.12
R00110		Worker labour		0,120 h	18,84	2,26
R00108		Commuter button		1,000 u	12,12	12,12
R00109		Light point		1,000 u	29,93	29,93
R00107		Copper wire 2.5mm including pvc protection		16,000 m	5,05	80,80
Coste Directo						125,11
3,500 % Coste Indirecto						4,38
Total Redondeado =						129,49 €
10.11	u	Plugs bases.				11.13
R00112		Worker labour		0,530 h	20,63	10,93
R00113		Worker helper labour		0,450 h	17,57	7,91
R00072		Copper wire 6mm		9,000 m	0,76	6,84
11.17		PVC protection 15mm		3,000 m	0,95	2,85
R00114		Plug base		1,000 u	5,32	5,32
Coste Directo						33,85
3,500 % Coste Indirecto						1,18
Total Redondeado =						35,03 €

Presupuesto : BID

Capítulo 10 : Electric and Communications Installation

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
10.12	u	Emergency luminaries.				11.14
				(Sin descomposición)		
				Coste Directo		32,12
			3,500	% Coste Indirecto		1,12
				Total Redondeado =		33,24 €
10.13	u	Phone & Internet plugs.				11.15
				(Sin descomposición)		
				Coste Directo		78,23
			3,500	% Coste Indirecto		2,74
				Total Redondeado =		80,97 €
10.14	u	TV aerial and plugs.				11.16
				(Sin descomposición)		
				Coste Directo		435,00
			3,500	% Coste Indirecto		15,23
				Total Redondeado =		450,23 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
11.1	u	Connection branch form general supply.				12.01
R00080		Worker labour		3,500 h	20,80	72,80
R00081		Worker helper labour		3,500 h	19,87	69,55
R00082		Supply connection		1,000 u	99,02	99,02
R00083		Supply manhole 40x40		1,000 u	122,97	122,97
R00084		Non structural concrete 15/B/20		0,008 m3	82,63	0,66
R00085		Connection right tax		1,000 u	330,48	330,48
R00086		Brick wall		0,800 m2	27,19	21,75
R00087		Ex cavation		3,600 m3	37,10	133,56
Coste Directo						850,79
3,500 % Coste Indirecto						29,78
Total Redondeado =						880,57 €
11.2	u	Water meter.				12.02
R00088		Worker labour		1,000 h	18,84	18,84
R00089		Water meter		1,000 u	53,23	53,23
Coste Directo						72,07
3,500 % Coste Indirecto						2,52
Total Redondeado =						74,59 €
11.3	u	Water supply pipes.				12.03
R00090		Galvanized steel conduction diam. 16-12-10mm including 10% for special pieces.		1,100 m	7,15	7,87
R00091		Worker labour		0,550 h	20,80	11,44
R00092		Worker helper labour		0,300 h	18,02	5,41
Coste Directo						24,72
3,500 % Coste Indirecto						0,87
Total Redondeado =						25,59 €
11.4	u	Waste water pipes				12.04
R00080		Worker labour		0,770 h	20,80	16,02
R00081		Worker helper labour		0,100 h	19,87	1,99
R00093		PVC conduction diam. 125-110-35mm including 10% for special pieces.		1,100 m	6,85	7,54
Coste Directo						25,55
3,500 % Coste Indirecto						0,89
Total Redondeado =						26,44 €
11.5	u	Toilet sinks				12.05
R00080		Worker labour		1,500 h	20,80	31,20
R00081		Worker helper labour		1,500 h	19,87	29,81
R00095		Drain v alve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		0,500 m	2,14	1,07
R00120		Ceramic Sink		1,000 u	86,23	86,23
Coste Directo						154,39
3,500 % Coste Indirecto						5,40
Total Redondeado =						159,79 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
11.6	u	Kitchen sink				12.12
R00080		Worker labour		1,500 h	20,80	31,20
R00121		Steel double sink		1,500 u	113,21	169,82
R00081		Worker helper labour		0,500 h	19,87	9,94
R00095		Drain v alve		2,000 u	6,08	12,16
R00096		PVC drain pipe 40mm		0,500 m	2,14	1,07
Coste Directo						224,19
3,500 % Coste Indirecto						7,85
Total Redondeado =						232,04 €
11.7	u	Bidets				12.06
R00080		Worker labour		1,200 h	20,80	24,96
R00081		Worker helper labour		1,200 h	19,87	23,84
R00095		Drain v alve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		0,500 m	2,14	1,07
R00118		Bidet		1,000 u	121,34	121,34
Coste Directo						177,29
3,500 % Coste Indirecto						6,21
Total Redondeado =						183,50 €
11.8	u	Toilets				12.07
R00080		Worker labour		1,200 h	20,80	24,96
R00081		Worker helper labour		1,200 h	19,87	23,84
R00095		Drain v alve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		1,000 m	2,14	2,14
R00117		Toilet		1,000 u	186,14	186,14
Coste Directo						243,16
3,500 % Coste Indirecto						8,51
Total Redondeado =						251,67 €
11.9	u	Shower tub				12.08
R00080		Worker labour		1,500 h	20,80	31,20
R00081		Worker helper labour		1,500 h	19,87	29,81
R00097		Show er tub		1,000 u	207,76	207,76
R00095		Drain v alve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		1,500 m	2,14	3,21
Coste Directo						278,06
3,500 % Coste Indirecto						9,73
Total Redondeado =						287,79 €
11.10	u	Bath tub				12.09
R00080		Worker labour		1,500 h	20,80	31,20
R00081		Worker helper labour		1,000 h	19,87	19,87
R00095		Drain v alve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		2,000 m	2,14	4,28
R00116		Bath tube		1,000 u	189,54	189,54
Coste Directo						250,97
3,500 % Coste Indirecto						8,78
Total Redondeado =						259,75 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
11.11	u	Water supply terminals				12.10
R00080		Worker labour		0,500 h	20,80	10,40
R00081		Worker helper labour		0,250 h	19,87	4,97
R00099		Water terminal		1,000 u	76,13	76,13
Coste Directo						91,50
3,500 % Coste Indirecto						3,20
Total Redondeado =						94,70 €
11.12	u	White goods waste connections				12.11
R00080		Worker labour		0,500 h	20,80	10,40
R00081		Worker helper labour		0,250 h	19,87	4,97
R00095		Drain valve		1,000 u	6,08	6,08
R00096		PVC drain pipe 40mm		0,500 m	2,14	1,07
Coste Directo						22,52
3,500 % Coste Indirecto						0,79
Total Redondeado =						23,31 €
11.13	u	Thermostat				12.14
(Sin descomposición)						
Coste Directo						36,64
3,500 % Coste Indirecto						1,28
Total Redondeado =						37,92 €
11.14	u	Accumulation system 350 L				12.15
(Sin descomposición)						
Coste Directo						193,15
3,500 % Coste Indirecto						6,76
Total Redondeado =						199,91 €
11.15	u	Radiator heater				12.16
R00080		Worker labour		0,280 h	20,80	5,82
R00100		Radiator 0.5x0.75 (8modules)		1,000 u	114,92	114,92
Coste Directo						120,74
3,500 % Coste Indirecto						4,23
Total Redondeado =						124,97 €
11.16	u	Radiators system				12.17
R00080		Worker labour		0,400 h	20,80	8,32
R00081		Worker helper labour		0,100 h	19,87	1,99
R00094		Copper conduction 10mm		2,000 m	5,49	10,98
Coste Directo						21,29
3,500 % Coste Indirecto						0,75
Total Redondeado =						22,04 €

Presupuesto : BID

Capítulo 12 : Walls Finishings

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
12.1	m2	Acrylic paint				13.01
R00075		Worker Labour		0,200 h	20,80	4,16
R00076		Acrylic paint		0,060 l	3,15	0,19
R00077		Repairing fluid		6,710 l	0,06	0,40
					Coste Directo	4,75
					3,500 % Coste Indirecto	0,17
					Total Redondeado =	4,92 €
12.2	m2	Ceramic tiles				13.02
R00014		Worker labour		0,400 h	20,63	8,25
R00015		Worker helper labour		0,200 h	18,87	3,77
R00073		Adhesive layer		1,000 m2	3,27	3,27
R00102		Ceramic tile 200x600		1,050 m2	21,09	22,14
					Coste Directo	37,43
					3,500 % Coste Indirecto	1,31
					Total Redondeado =	38,74 €

Cuadro de Precios Descompuestos

NUM	UD	RESUMEN	COEF.	CANTIDAD	PRECIO	IMPORTE
13.1	u	Water heater unit gas/gas-oil fuelled.				14.01
					(Sin descomposición)	
					Coste Directo	2.988,00
			3,500	% Coste Indirecto		104,58
					Total Redondeado =	3.092,58 €
13.2	u	Fridge/freezer combo				14.02
					(Sin descomposición)	
					Coste Directo	630,00
			3,500	% Coste Indirecto		22,05
					Total Redondeado =	652,05 €
13.3	u	Oven/stove combo				14.03
					(Sin descomposición)	
					Coste Directo	432,00
			3,500	% Coste Indirecto		15,12
					Total Redondeado =	447,12 €
13.4	u	Dish washing machine.				14.04
					(Sin descomposición)	
					Coste Directo	364,10
			3,500	% Coste Indirecto		12,74
					Total Redondeado =	376,84 €
13.5	u	Washing machine				14.05
					(Sin descomposición)	
					Coste Directo	365,30
			3,500	% Coste Indirecto		12,79
					Total Redondeado =	378,09 €
13.6	u	Dryer machine.				14.06
					(Sin descomposición)	
					Coste Directo	264,90
			3,500	% Coste Indirecto		9,27
					Total Redondeado =	274,17 €
13.7	u	Fire extinguishers				14.08
R00078		Universal ABC fire extinguisher 10L		1,000 u	66,43	66,43
R00079		Universal ABC fire extinguisher 15L		1,000 u	80,64	80,64
					Coste Directo	147,07
			3,500	% Coste Indirecto		5,15
					Total Redondeado =	152,22 €

TIME ESTIMATION AND GANTT PLANNING

In this part we are going to calculate duration of each activity or task in order to obtain the total duration of a houses block. When we knew all the durations we are going to plan the work with a Gantt chart.

ACTIVITY:		Land works			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
u.	Existing building demolition	0,1	1,24	0,1	0,02
u.	Rocks and rubble transport	0,1	0,64	0,1	0,01
u.	Trees and plants transplant	0,1	16	1,6	0,20
m2	Vegetal terrain removal	1438,115	0,006	8,6	1,08
m3	Foundations excavation	98,822	0,12	11,9	1,48
u.	Soil transport	-	-	-	-
Total				22,3	3,00

ACTIVITY:		Foundations			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m3	Cleaning concrete	18,27	0,45	8,2	1,03
m	Surrounding footings 140x50	88,984	0,27	24	3,00
m	Central footing 145x50	33,36	0,29	9,7	1,21
m	Foundation beam 40x50	27,554	0,085	2,3	0,29
m2	Isolated floor	218,887	0,287	62,8	7,85
m	Sanitary pipes	5	1,36	6,8	0,85
Total				86,3	15,00

ACTIVITY:		Structure			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
u.	Pillar base	30	0,724	21,7	2,72
u.	Pillar ending	30	0,21	6,3	0,79
m	HEB 200 pillar	192,6	0,524	100,9	12,62
m	IPE 220 beam	315,8	0,524	165,5	20,68
m	IPE 120 joist	905,35	0,208	188,3	23,54
m2	Composite slab 5+5	660,36	0,35	231,1	28,89
Total				482,7	90,00

ACTIVITY:		Façades			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m2	Exterior wall	507,35	2,25	1141,5	142,69

m2	Diving wall	550,38	0,9	495,3	61,92
				Total	1636,9 205,00

ACTIVITY:		Roofs			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m2	Cover roof	441	1,31	577,7	72,21
				Total	577,7 73,00

ACTIVITY:		Interior walls			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m2	Internal wall	541,9	0,31	168,0	21,00
				Total	168,0 21,00

ACTIVITY:		Carpentry			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
u.	Windows	50	7,25	362,5	45,31
u.	External doors	10	1,2	12,0	1,50
u.	Internal doors	30	1,2	36,0	4,50
u	Handrails	5	20	100,0	12,50
u.	Kitchen closets sets	5	24	120,0	15,00
u.	Wardrobes	10	12	120,0	15,00
				Total	750,5 94,00

ACTIVITY:		Ceilings			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m2	Ceiling	551,51	0,27	148,9	18,61
m2	Insulation	474,3	0,12	56,9	7,11
				Total	56,8 26

ACTIVITY:		Floors			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
m2	Wood floor	430,72	0,75	323,0	40,38
m2	Ceramic floor	79,52	0,45	35,8	4,47
m2	Linoleum floor	24,96	0,41	10,2	1,28
				Total	369,1 47,00

ACTIVITY: Electric and communications installations						
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days	
u.	Land connections	24	0,21	5,0	0,63	
m	Copper wire land connection	100	0,4	40,0	5,00	
m	Connection branch	15	0,4	6,0	0,75	
u.	Electricity meter	5	0,25	1,3	0,16	
u.	General protection box	5	1,5	7,5	0,94	
m	General purpose circuit (10A)	592	0,1	59,2	7,40	
m	White goods circuit (16A)	86,2	0,1	8,6	1,08	
m	Kitchen circuit (25A)	67	0,1	6,7	0,84	
u	Light points simple switch	15	0,08	1,2	0,15	
u	Light points multiple switch	65	0,12	7,8	0,98	
u	Plugs bases	95	0,53	50,4	6,29	
u	Emergency luminaries	15	0,1	1,5	0,19	
u	Phone and internet plugs	15	0,62	9,3	1,16	
u	TV aerials and plugs	10	1,2	12,0	1,50	
				Total	216,5	28,00

ACTIVITY: Plumbing and heating installations						
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days	
u.	Connection branch	5	3,5	17,5	2,19	
u.	Water meter	5	1	5,0	0,63	
u.	Water supply pipes	450,7	0,55	247,9	30,99	
u.	Waste water pipes	147,15	0,77	113,3	14,16	
u.	Toilet sinks	15	1,5	22,5	2,81	
u.	Kitchen sinks	5	1,5	7,5	0,94	
u.	Bidets	10	1,2	12,0	1,50	
u.	Toilets	15	1,2	18,0	2,25	
u.	Shower tubs	5	1,5	7,5	0,94	
u.	Bath tubs	5	1,5	7,5	0,94	
u.	Water supply terminals	70	0,5	35,0	4,38	
u.	White goods connections	20	0,5	10,0	1,25	
u.	Thermostat	5	0,33	1,7	0,21	
u.	Accumulation system 350L	5	3,5	17,5	2,19	
u.	Radiator heater	70	0,28	19,6	2,45	
u.	Radiators system	401	0,4	160,4	20,05	
				Total	702,8	88,00

ACTIVITY: Walls finishings					
Unit.	Tasks	Quantity	Unitary time	Total	Total

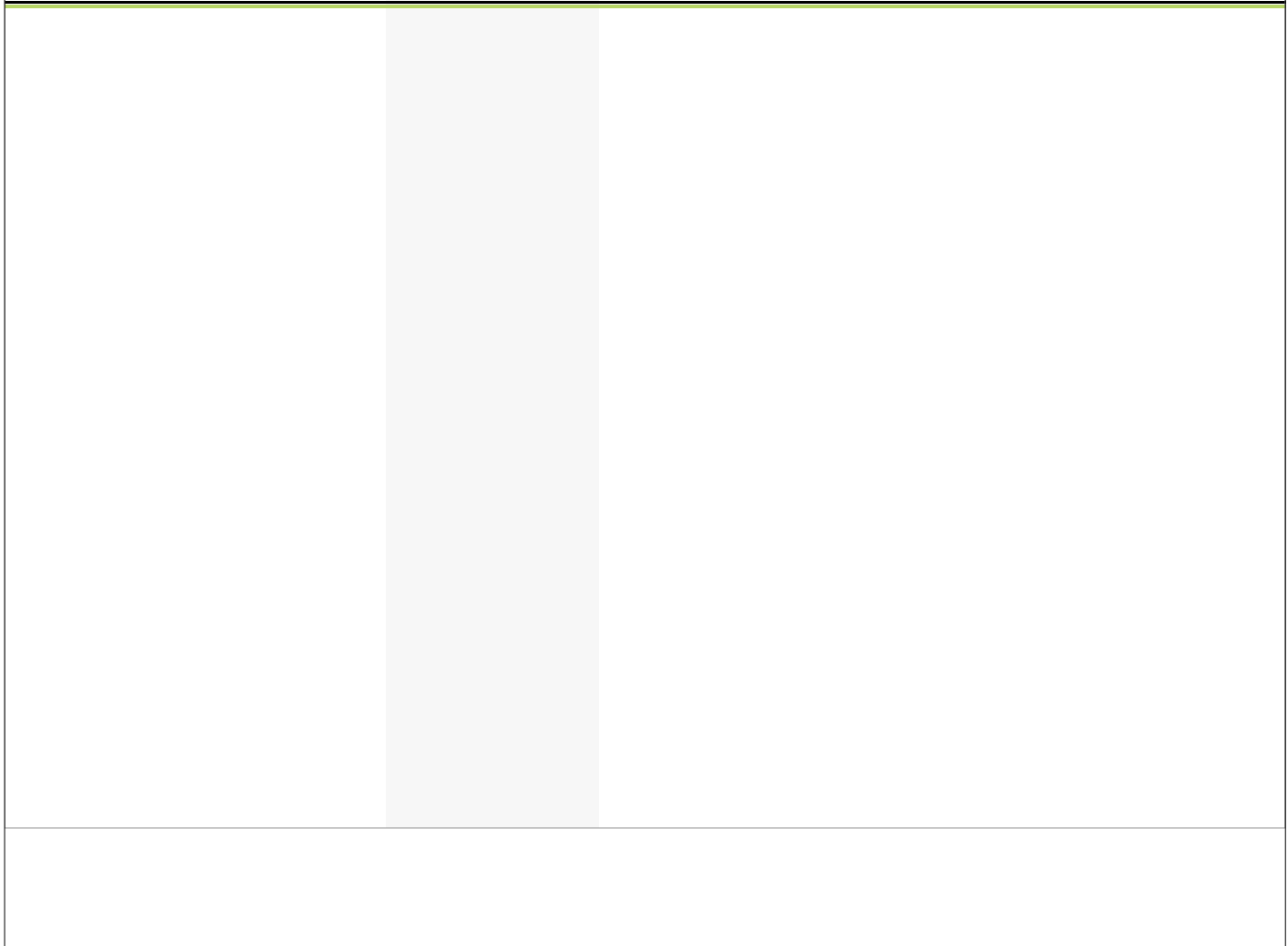
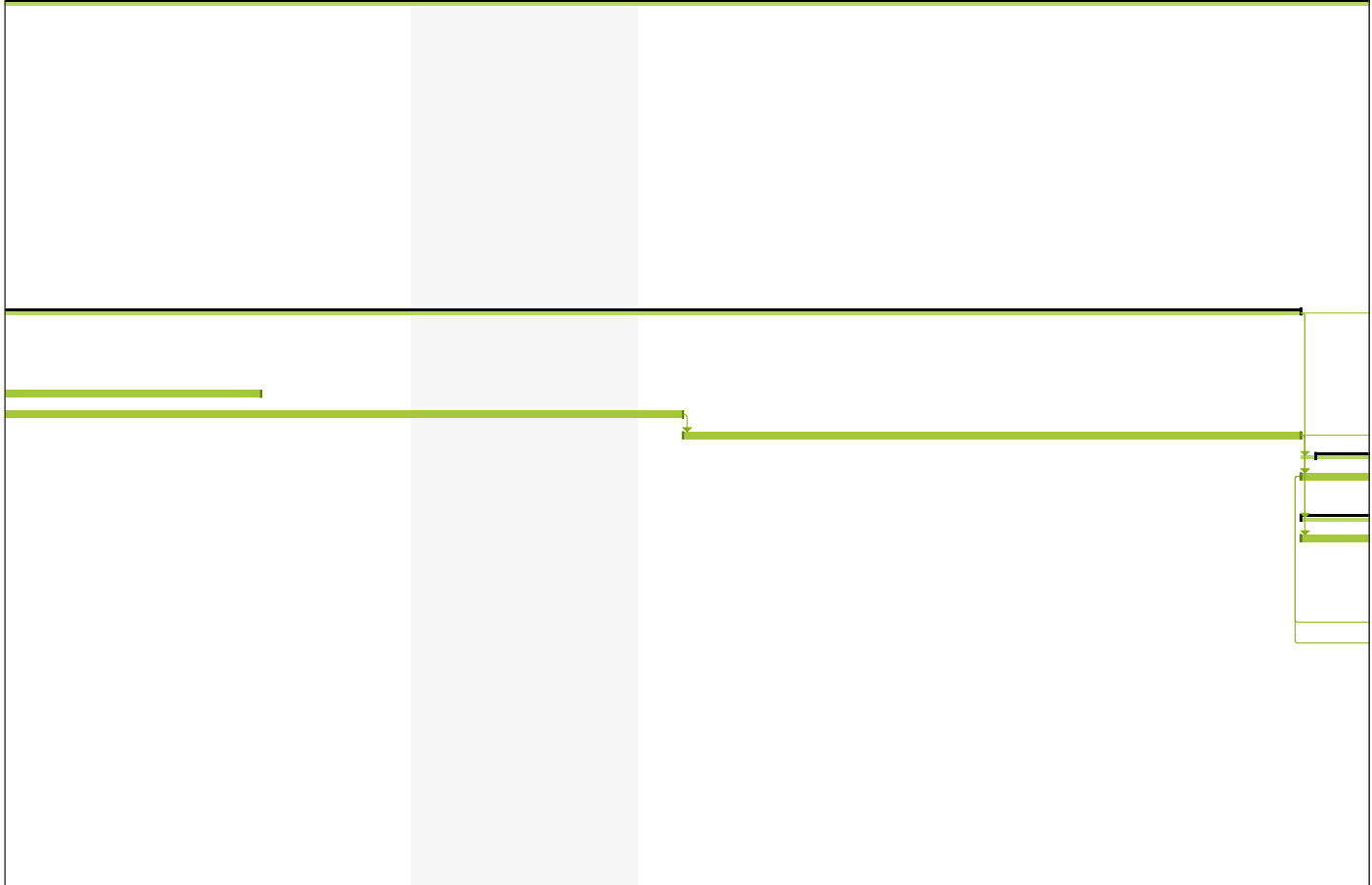
			consumed (h)	hours	days
m2	Acrylic paint	1158,5	0,2	231,7	28,96
m2	Ceramic tiles	308,2	0,4	123,3	15,41
Total				355,0	45,00

ACTIVITY:		Equipements			
Unit.	Tasks	Quantity	Unitary time consumed (h)	Total hours	Total days
u.	Water heater unit	5	6,5	32,5	4,06
u.	Fridge/freezer combo	5	0,3	1,5	0,19
u.	Oven/stove combo	5	3.2	16	2,00
u.	Dish washing machine	5	0,85	4,3	0,53
u.	Washing machine	5	0,55	2,8	0,34
u.	Dryer machine	5	0,4	2,0	0,25
u.	Fire extinguishers	10	0,02	0,2	0,00
Total				64,2	8,00

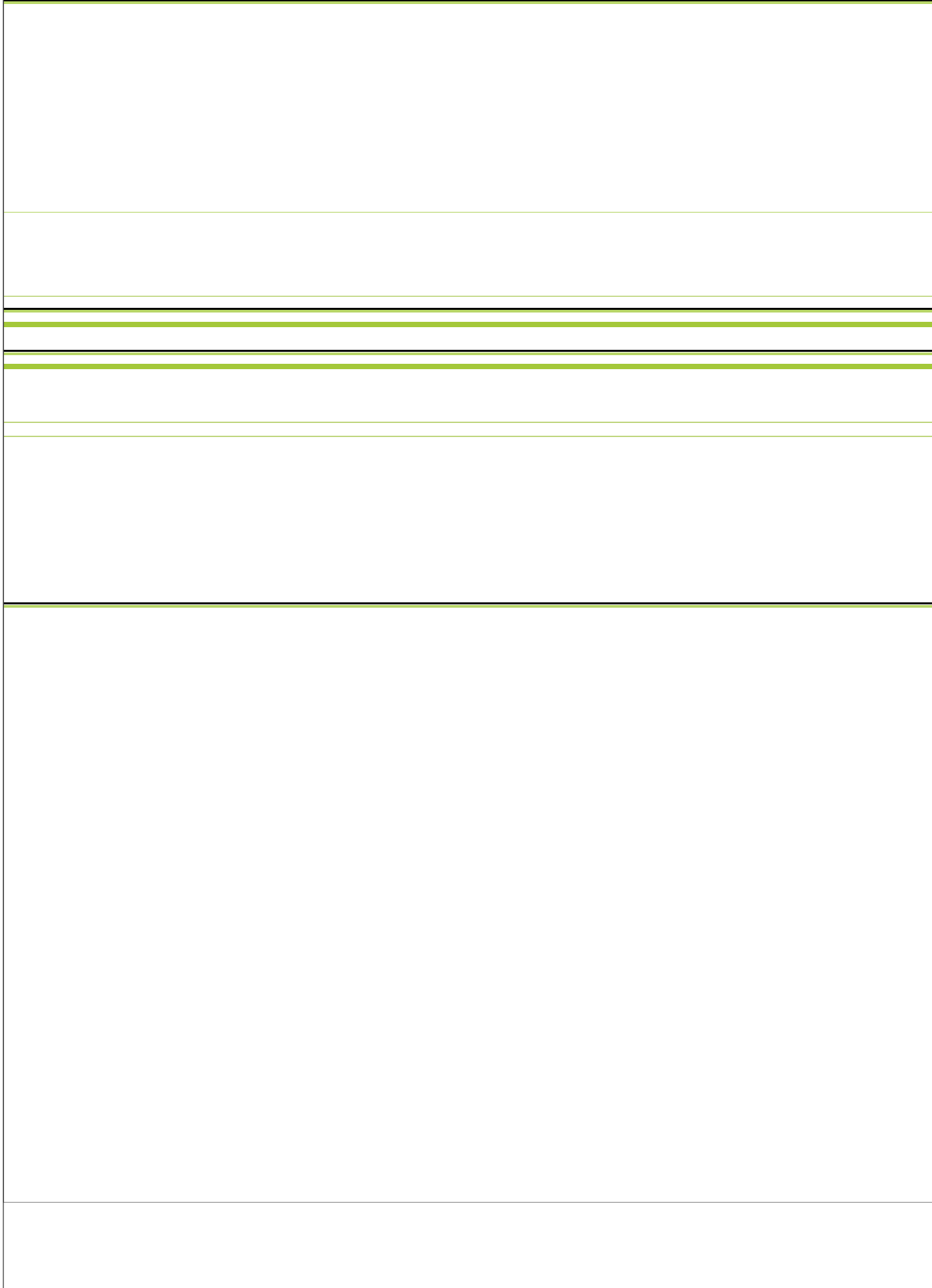
These are the durations determined by allocating only one resource (worker or group of workers) on each task. On the next pages we are going to programme the activities in a Gantt chart in order to overlap the activities we can and obtain the total time for a houses block. But as we said, with only one worker or team in each activity. Then we will allocate more resources to all the tasks in order to do it in a faster way, and we would compare the global time obtained with both programs.

Id	Modo de tarea	Nombre de tarea	Duración	Comienzo	Fin	junio 2014												julio 2014							
						27	30	02	05	08	11	14	17	20	23	26	29	02	05	08	11	14	17	20	
1	✚	Houses block	317 días	lun 02/06/14	mié 16/09/15																				
2	✚	Land Works	5 días	lun 02/06/14	vie 06/06/14																				
3	✚	Existing building demolition	1 día	lun 02/06/14	lun 02/06/14																				
4	✚	Rocks and rubble transport	1 día	lun 02/06/14	lun 02/06/14																				
5	✚	Trees and plants transplant	1 día	lun 02/06/14	lun 02/06/14																				
6	✚	Vegetal terrain removal	2 días	mar 03/06/14	mié 04/06/14																				
7	✚	Foundations excavation	2 días	jue 05/06/14	vie 06/06/14																				
8	✚	Soil transport	3 días	mar 03/06/14	jue 05/06/14																				
9	✚	Foundations	12 días	lun 09/06/14	mar 24/06/14																				
10	✚	Cleaning concrete	1 día	lun 09/06/14	lun 09/06/14																				
11	✚	Surrounding footings 140x50	3 días	mar 10/06/14	jue 12/06/14																				
12	✚	Central footing 145x50	1 día	mar 10/06/14	mar 10/06/14																				
13	✚	Foundation beam 40x50	1 día	mar 10/06/14	mar 10/06/14																				
14	✚	Isolated floor	8 días	vie 13/06/14	mar 24/06/14																				
15	✚	Sanitary pipes	1 día	mar 10/06/14	mar 10/06/14																				
16	✚	Structure	69 días	mié 25/06/14	lun 13/10/14																				
17	✚	Pillar base	3 días	mié 25/06/14	vie 27/06/14																				
18	✚	Pillar ending	1 día	jue 17/07/14	jue 17/07/14																				
19	✚	HEB 200 pillar	13 días	lun 30/06/14	mié 16/07/14																				
20	✚	IPE 220 beam	21 días	mar 08/07/14	mar 05/08/14																				
21	✚	IPE 120 joist	24 días	jue 17/07/14	mar 02/09/14																				
22	✚	Composite slab 5+5	29 días	mié 03/09/14	lun 13/10/14																				
23	✚	Façades	204 días	mar 14/10/14	lun 27/07/15																				
24	✚	Exterior wall	143 días	mar 14/10/14	jue 30/04/15																				
25	✚	Diving Wall	62 días	mié 04/02/15	jue 30/04/15																				
26	✚	Roofs	73 días	mar 14/10/14	jue 22/01/15																				
27	✚	Cover Roof	73 días	mar 14/10/14	jue 22/01/15																				
28	✚	Interior Walls	21 días	jue 02/04/15	jue 30/04/15																				
29	✚	Internal wall	21 días	jue 02/04/15	jue 30/04/15																				
30	✚	Carpentry	128 días	mar 03/03/15	vie 11/09/15																				
31	✚	Windows	46 días	vie 06/03/15	vie 08/05/15																				
32	✚	External doors	2 días	mar 03/03/15	mié 04/03/15																				
33	✚	Internal doors	5 días	vie 01/05/15	jue 07/05/15																				
34	✚	Handrails	13 días	jue 11/06/15	lun 29/06/15																				
35	✚	Kitchen closets sets	15 días	vie 07/08/15	vie 11/09/15																				
36	✚	Wardrobes	15 días	jue 02/04/15	mié 22/04/15																				
37	✚	Ceilings	25 días	mar 07/04/15	lun 11/05/15																				
38	✚	Ceiling	19 días	mar 07/04/15	vie 01/05/15																				
39	✚	Insulation	7 días	vie 01/05/15	lun 11/05/15																				
40	✚	Floors	44 días	lun 08/06/15	jue 06/08/15																				
41	✚	Wood floor	41 días	jue 11/06/15	jue 06/08/15																				
42	✚	Ceramic floor	5 días	lun 08/06/15	vie 12/06/15																				
43	✚	Linoleum floor	1 día	jue 11/06/15	jue 11/06/15																				
44	✚	Electric and communication	217 días	mar 10/06/14	mié 22/04/15																				
45	✚	Land connections	1 día	mar 10/06/14	mar 10/06/14																				
46	✚	Copper wire land connection	5 días	mié 11/06/14	mar 17/06/14																				
47	✚	Connection branch	1 día	lun 30/03/15	lun 30/03/15																				
48	✚	Electricity meter	1 día	lun 30/03/15	lun 30/03/15																				
49	✚	General protection box	1 día	mar 31/03/15	mar 31/03/15																				
50	✚	General purpose circuit (10A)	8 días	mié 01/04/15	vie 10/04/15																				
51	✚	White goods circuit (16A)	1 día	mié 01/04/15	mié 01/04/15																				
52	✚	Kitchen circuit (25A)	1 día	mié 01/04/15	mié 01/04/15																				
53	✚	Light points simple switch	1 día	lun 13/04/15	lun 13/04/15																				
54	✚	Light points multiple switch	1 día	lun 13/04/15	lun 13/04/15																				
55	✚	Plugs bases	6 días	lun 13/04/15	lun 20/04/15																				
56	✚	Emergency luminaries	1 día	mar 21/04/15	mar 21/04/15																				
57	✚	Phone and internet plugs	1 día	mar 21/04/15	mar 21/04/15																				
58	✚	TV aerials and plugs	2 días	mar 21/04/15	mié 22/04/15																				
59	✚	Plumbing and heating installation	107 días	lun 16/03/15	mar 11/08/15																				
60	✚	Connection branch	2 días	lun 16/03/15	mar 17/03/15																				
61	✚	Water meter	1 día	mié 18/03/15	mié 18/03/15																				
62	✚	Water supply pipes	31 días	jue 19/03/15	jue 30/04/15																				
63	✚	Waste water pipes	14 días	mié 18/03/15	lun 06/04/15																				
64	✚	Toilet sinks	3 días	vie 01/05/15	mar 05/05/15																				
65	✚	Kitchen sinks	1 día	mar 11/08/15	mar 11/08/15																				
66	✚	Bidets	2 días	mié 06/05/15	jue 07/05/15																				
67	✚	Toilets	3 días	vie 08/05/15	mar 12/05/15																				
68	✚	Shower tubs	1 día	mié 13/05/15	mié 13/05/15																				
69	✚	Bath tubs	1 día	jue 14/05/15	jue 14/05/15																				
70	✚	Water supply terminals	5 días	mar 28/04/15	lun 04/05/15																				
71	✚	White goods connections	2 días	vie 01/05/15	lun 04/05/15																				
72	✚	Thermostat	1 día	vie 08/05/15	vie 08/05/15																				
73	✚	Accumulation system 350L	3 días	mar 05/05/15	jue 07/05/15																				
74	✚	Radiator heater	3 días	vie 01/05/15	mar 05/05/15																				
75	✚	Radiators system	20 días	mar 31/03/15	lun 27/04/15																				
76	✚	Walls finishings	29 días	vie 01/05/15	mié 10/06/15																				
77	✚	Acrylic paint	29 días	vie 01/05/15	mié 10/06/15																				
78	✚	Ceramic tiles	16 días	vie 15/05/15	vie 05/06/15																				
79	✚	Equipements	58 días	vie 12/06/15	mié 16/09/15																				
80	✚	Water heater unit	5 días	vie 12/06/15	jue 18/06/15																				
81	✚	Fridge/freezer combo	1 día	lun 14/09/15	lun 14/09/15																				
82	✚	Oven/stove combo	3 días	lun 14/09/15	mié 16/09/15																				
83	✚	Dish washing machine	1 día	vie 12/06/15	vie 12/06/15																				
84	✚	Washing machine	1 día	vie 12/06/15	vie 12/06/15																				
85	✚	Dryer machine	1 día	vie 12/06/15	vie 12/06/15																				
86	✚	Fire extinguishers	1 día	lun 14/09/15	lun 14/09/15																				

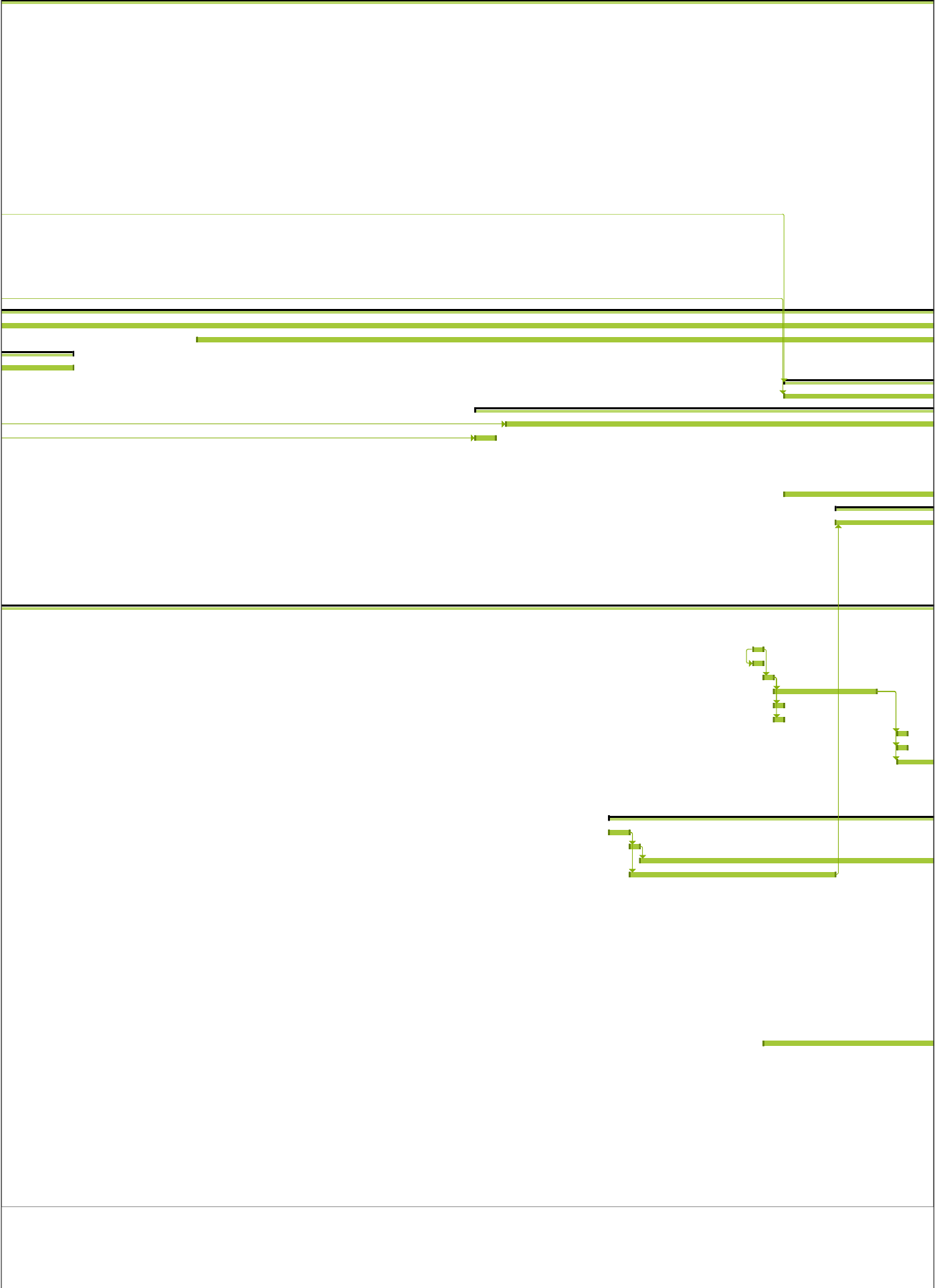
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 División: Tarea inactiva
 Hito: Hito inactivo
 Resumen: Resumen inactivo
 Tarea manual: solo duración
 Informe de resumen manual: Resumen manual
 solo el comienzo: solo el comienzo
 solo fin: solo fin
 Tareas externas: Tareas externas
 Hito externo: Hito externo
 Fecha limite: Fecha limite
 Progreso: Progreso
 Progreso manual: Progreso manual



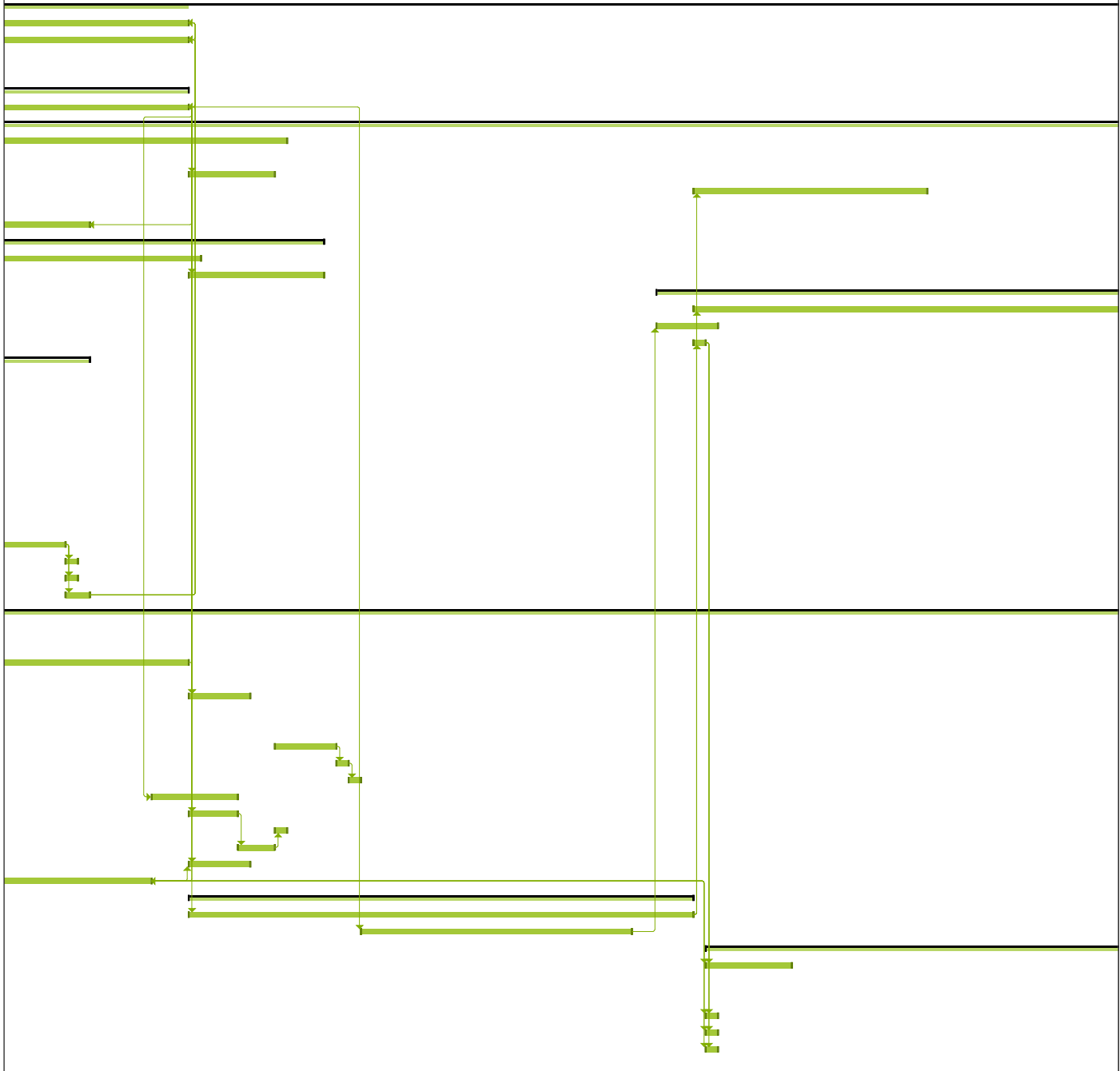
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	División	Tarea inactiva	solo duración	solo fin	Progreso
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	Resumen	Resumen inactivo	Resumen manual	Hito externo	



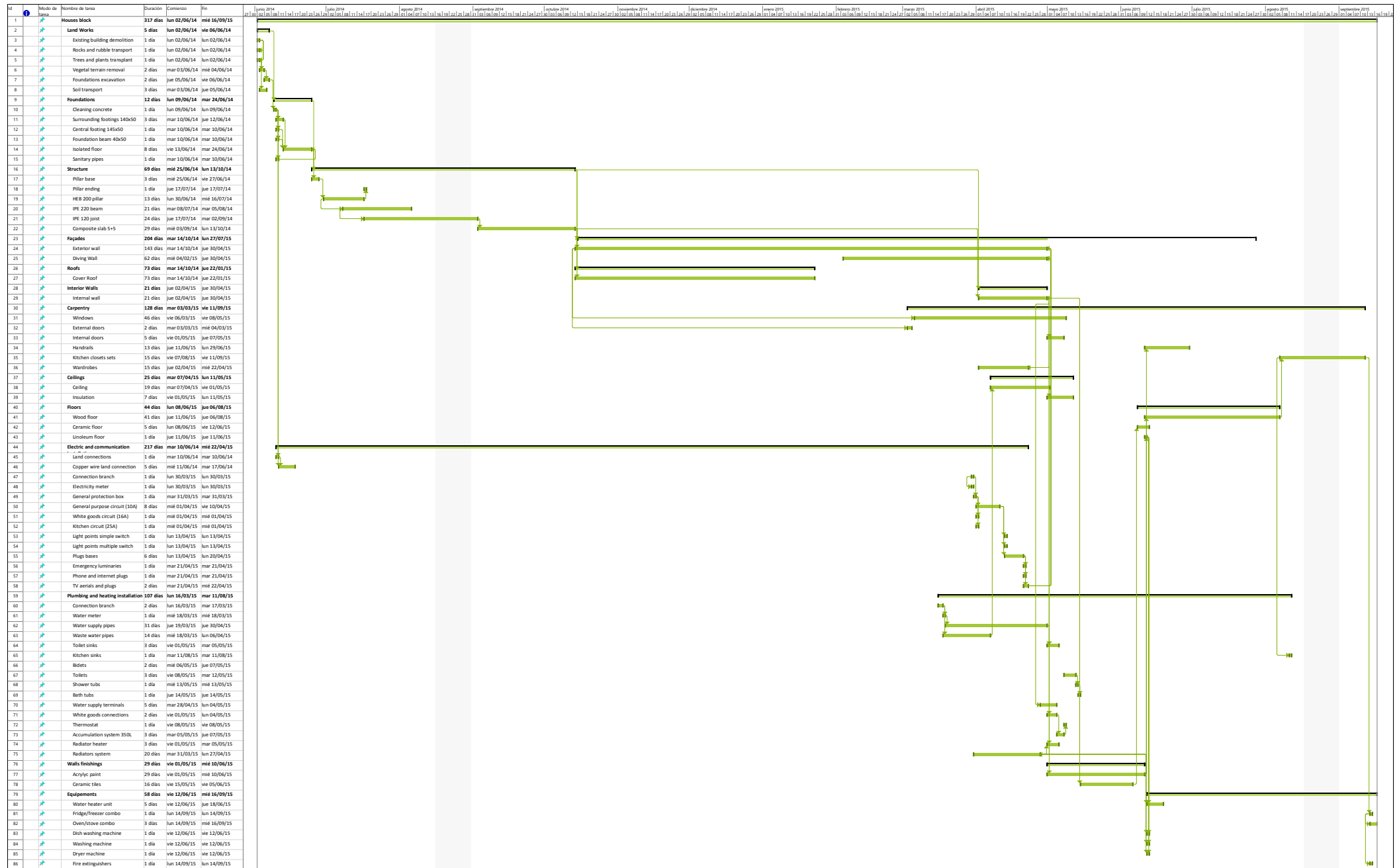
Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	↓
	División	Tarea inactiva	solo duración	solo fin	Progreso	Progreso manual
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual	Progreso manual
	Resumen	Resumen inactivo	Resumen manual	Hito externo	Hito externo	Hito externo



Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	↓
	División	Tarea inactiva	solo duracion	solo fin	Progreso	—
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual	—
	Resumen	Resumen inactivo	Resumen manual	Hito externo	◇	—



Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	↓
	División	Tarea inactiva	solo duración	solo fin	Progreso	Progreso
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual	Progreso manual
	Resumen	Resumen inactivo	Resumen manual	Hito externo	Progreso manual	Progreso manual



For one resource per task the total duration of the housing block is 317 productive days, which could be approximately 15 real months. This is produced by the large amount of production required in the façades, the roof and some other items. For reduce it we are going to allocate more resources into the longer activities in order to reduce their duration. Once we reduce the durations we can plan again our project to obtain a shorter duration.

	Initial duration	Original resources number	New resources number	New duration
Existing building demolition	1	1	1	1
Rocks and rubble transport	1	1	1	1
Trees and plants transplant	1	1	1	1
Vegetal terrain removal	1	1	1	1
Foundations excavation	2	1	1	2
Soil transport	-		-	-
Cleaning concrete	1	1	1	1
Surrounding footings 140x50	3	1	1	3
Central footing 145x50	1	1	1	1
Foundation beam 40x50	1	1	1	1
Isolated floor	8	1	2	4
Sanitary pipes	1	1	1	1
Pillar base	3	1	2	2
Pillar ending	1	1	1	1
HEB 200 pillar	13	1	3	5
IPE 220 beam	21	1	3	7
IPE 120 joist	24	1	3	8
Composite slab 5+5	29	1	3	10
Exterior wall	143	1	4	36
Diving wall	62	1	2	31
Cover roof	73	1	3	25
Internal wall	21	1	2	11
Windows	46	1	3	16
External doors	2	1	1	2
Internal doors	5	1	1	5
Handrails	13	1	2	7
Kitchen closets sets	15	1	2	8
Wardrobes	15	1	2	8

	Initial duration	Original resources number	New resources number	New duration
Ceiling	19	1	2	10
Insulation	8	1	2	4
Wood floor	41	1	3	14
Ceramic floor	5	1	1	5
Linoleum floor	2	1	1	2
Land connections	1	1	1	1
Copper wire land connection	5	1	2	3
Connection branch	1	1	1	1
Electricity meter	1	1	1	1
General protection box	1	1	1	1
General purpose circuit (10A)	8	1	2	4
White goods circuit (16A)	1	1	1	1
Kitchen circuit (25A)	1	1	1	1
Light points simple switch	1	1	1	1
Light points multiple switch	1	1	1	1
Plugs bases	7	1	2	4
Emergency luminaries	1	1	1	1
Phone and internet plugs	1	1	1	1
TV aerials and plugs	2	1	1	2
Connection branch	2	1	2	1
Water meter	1	1	1	1
Water supply pipes	31	1	3	11
Waste water pipes	14	1	2	7
Toilet sinks	3	1	1	3
Kitchen sinks	1	1	1	1
Bidets	2	1	1	2
Toilets	3	1	1	3
Shower tubs	1	1	1	1
Bath tubs	1	1	1	1
Water supply terminals	5	1	2	3
White goods connections	2	1	1	2
Thermostat	1	1	1	1
Accumulation system 350L	3	1	1	3
Radiator heater	3	1	1	3
Radiators system	20	1	3	7

Acrylic paint	29	1	2	15
Ceramic tiles	16	1	2	8

	Initial duration	Original resources number	New resources number	New duration
Water heater unit	5	1	1	5
Fridge/freezer combo	1	1	1	1
Oven/stove combo	3	1	1	3
Dish washing machine	1	1	1	1
Washing machine	1	1	1	1
Dryer machine	1	1	1	1
Fire extinguishers	1	1	1	1

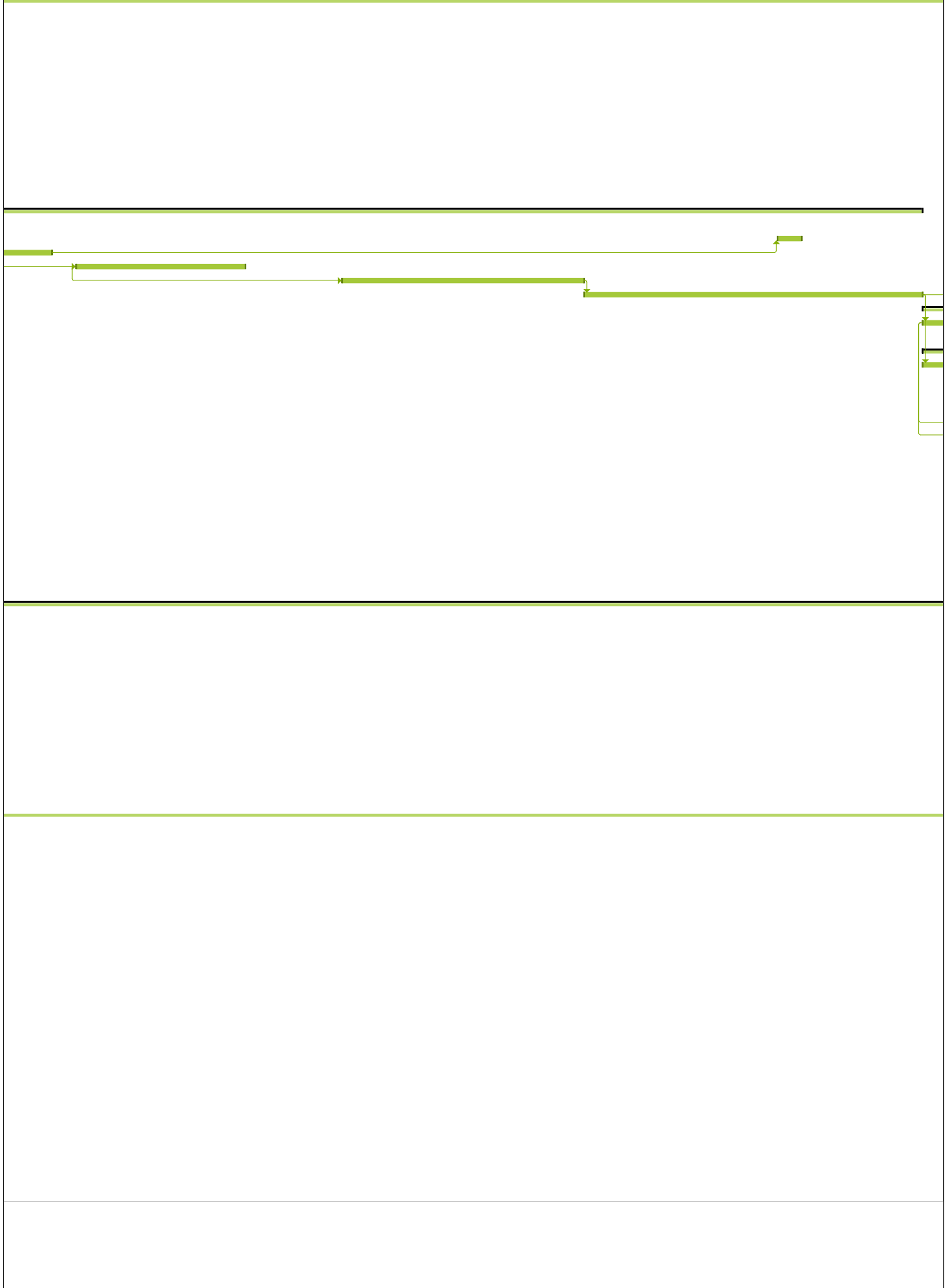
As we can see we increased some activities resources in one or two, only the exterior wall is raised to 4 resources because his long duration. On this way, we try to finish before the work without crowding the construction place.

We can achieve this because we are not placing too many work teams simultaneously, and because on our five houses block there will be enough space between the work sites of every task.

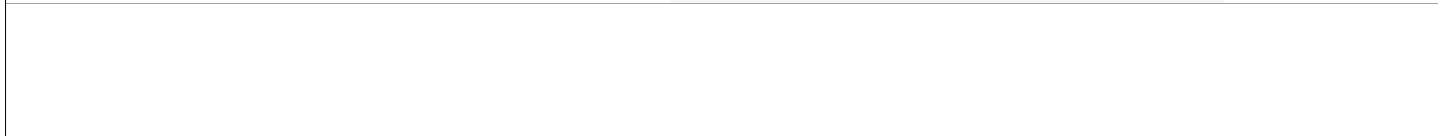
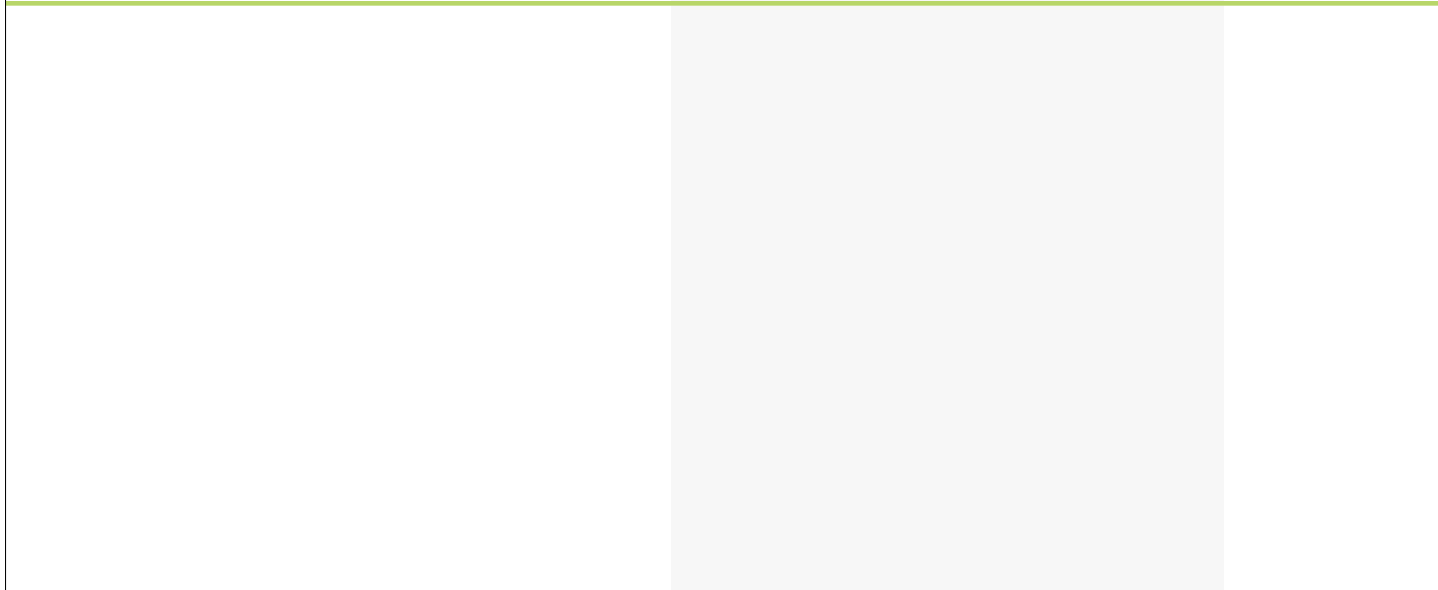
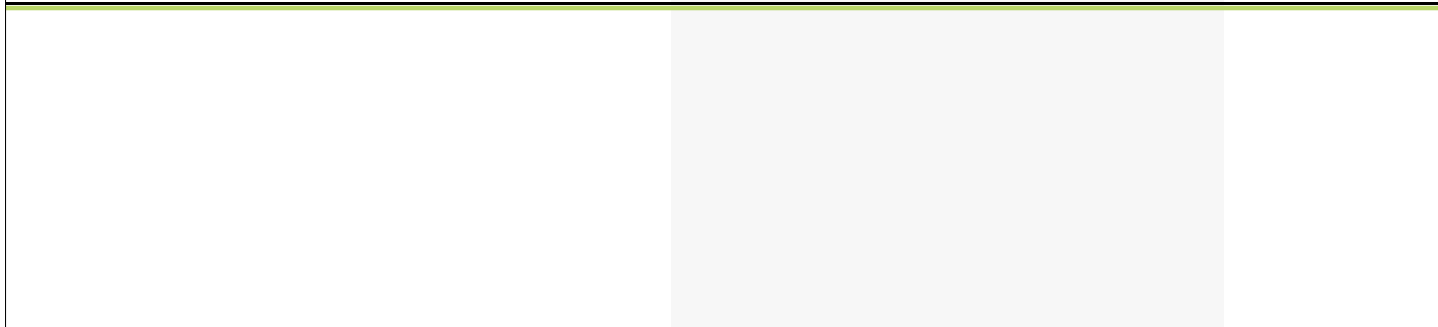
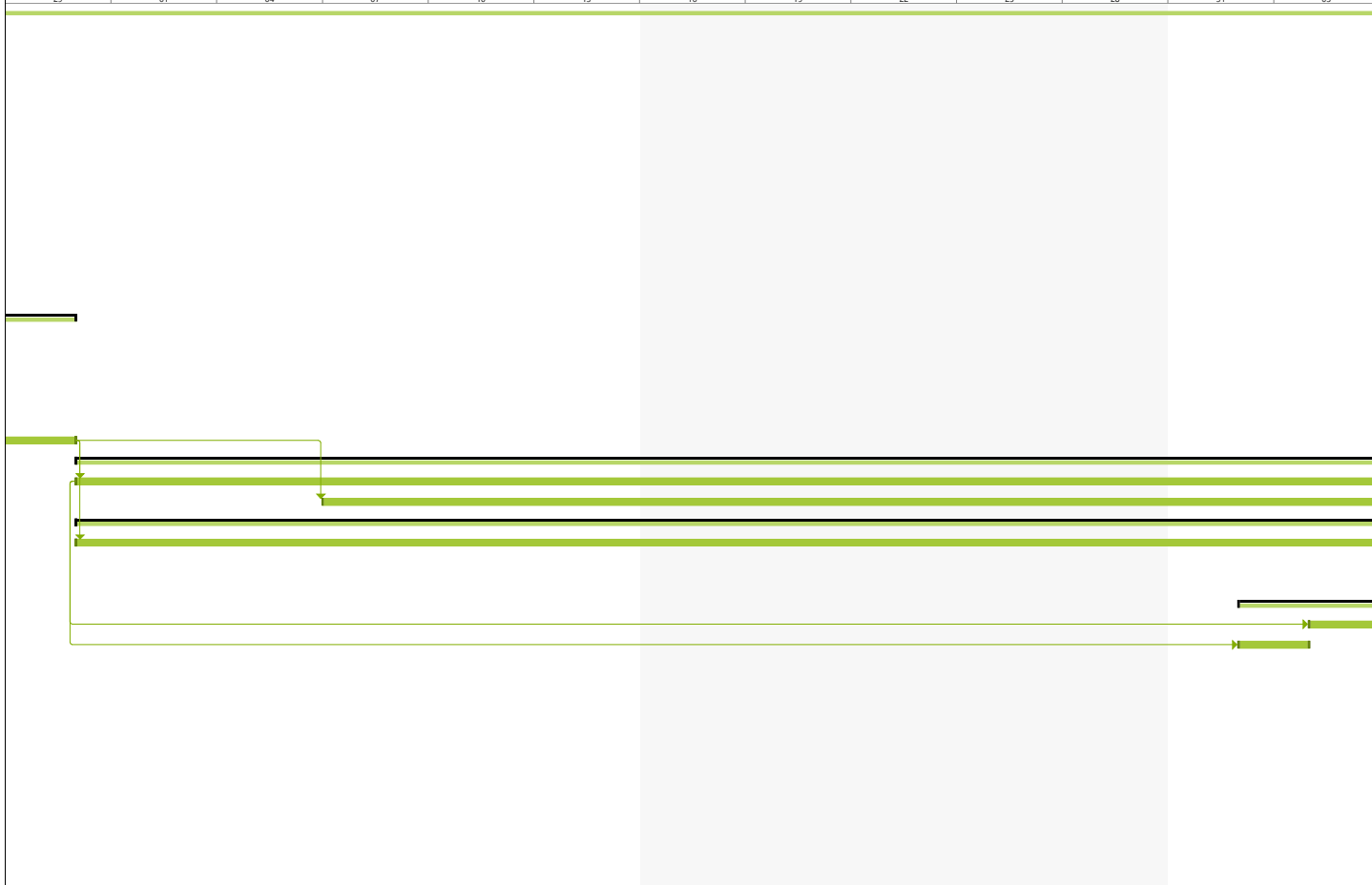
Now, we are going to check the Gantt chart obtained with the new activities duration, so we can compare the total time required.

Id	Modo de tarea	Nombre de tarea	Duración	Comienzo	Fin	junio 2014											
						30	02	05	08	11	14	17	20	23	26	29	01
1	🚀	Houses block				[Barra horizontal de inicio a fin]											
2	🚀	Land Works	5 días	lun 02/06/14	vie 06/06/14	[Barra horizontal de inicio a fin]											
3	🚀	Existing building demolition	1 día	lun 02/06/14	lun 02/06/14	[Barra horizontal de inicio a fin]											
4	🚀	Rocks and rubble transport	1 día	lun 02/06/14	lun 02/06/14	[Barra horizontal de inicio a fin]											
5	🚀	Trees and plants transplant	1 día	lun 02/06/14	lun 02/06/14	[Barra horizontal de inicio a fin]											
6	🚀	Vegetal terrain removal	1 día	mar 03/06/14	mar 03/06/14	[Barra horizontal de inicio a fin]											
7	🚀	Foundations excavation	2 días	jue 05/06/14	vie 06/06/14	[Barra horizontal de inicio a fin]											
8	🚀	Soil transport	3 días	mar 03/06/14	jue 05/06/14	[Barra horizontal de inicio a fin]											
9	🚀	Foundations	5 días	lun 09/06/14	vie 13/06/14	[Barra horizontal de inicio a fin]											
10	🚀	Cleaning concrete	1 día	lun 09/06/14	lun 09/06/14	[Barra horizontal de inicio a fin]											
11	🚀	Surrounding footings 140x50	3 días	mar 10/06/14	jue 12/06/14	[Barra horizontal de inicio a fin]											
12	🚀	Central footing 145x50	1 día	jue 12/06/14	jue 12/06/14	[Barra horizontal de inicio a fin]											
13	🚀	Foundation beam 40x50	1 día	jue 12/06/14	jue 12/06/14	[Barra horizontal de inicio a fin]											
14	🚀	Isolated floor	4 días	mar 10/06/14	vie 13/06/14	[Barra horizontal de inicio a fin]											
15	🚀	Sanitary pipes	1 día	vie 13/06/14	vie 13/06/14	[Barra horizontal de inicio a fin]											
16	🚀	Structure	33 días	lun 16/06/14	mié 30/07/14	[Barra horizontal de inicio a fin]											
17	🚀	Pillar base	2 días	lun 16/06/14	mar 17/06/14	[Barra horizontal de inicio a fin]											
18	🚀	Pillar ending	1 día	vie 25/07/14	vie 25/07/14	[Barra horizontal de inicio a fin]											
19	🚀	HEB 200 pillar	5 días	mié 18/06/14	mar 24/06/14	[Barra horizontal de inicio a fin]											
20	🚀	IPE 220 beam	5 días	jue 26/06/14	mié 02/07/14	[Barra horizontal de inicio a fin]											
21	🚀	IPE 120 joist	8 días	lun 07/07/14	mié 16/07/14	[Barra horizontal de inicio a fin]											
22	🚀	Composite slab 5+5	10 días	jue 17/07/14	mié 30/07/14	[Barra horizontal de inicio a fin]											
23	🚀	Façades	36 días	jue 31/07/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
24	🚀	Exterior wall	36 días	jue 31/07/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
25	🚀	Diving Wall	31 días	jue 07/08/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
26	🚀	Roofs	25 días	jue 31/07/14	mié 17/09/14	[Barra horizontal de inicio a fin]											
27	🚀	Cover Roof	25 días	jue 31/07/14	mié 17/09/14	[Barra horizontal de inicio a fin]											
28	🚀	Interior Walls	11 días	jue 18/09/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
29	🚀	Internal wall	11 días	jue 18/09/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
30	🚀	Carpentry	59 días	mar 02/09/14	vie 21/11/14	[Barra horizontal de inicio a fin]											
31	🚀	Windows	16 días	jue 04/09/14	jue 25/09/14	[Barra horizontal de inicio a fin]											
32	🚀	External doors	2 días	mar 02/09/14	mié 03/09/14	[Barra horizontal de inicio a fin]											
33	🚀	Internal doors	5 días	vie 03/10/14	jue 09/10/14	[Barra horizontal de inicio a fin]											
34	🚀	Handrails	7 días	jue 13/11/14	vie 21/11/14	[Barra horizontal de inicio a fin]											
35	🚀	Kitchen closets sets	8 días	lun 27/10/14	mié 05/11/14	[Barra horizontal de inicio a fin]											
36	🚀	Wardrobes	8 días	jue 18/09/14	lun 29/09/14	[Barra horizontal de inicio a fin]											
37	🚀	Ceilings	10 días	vie 03/10/14	jue 16/10/14	[Barra horizontal de inicio a fin]											
38	🚀	Ceiling	10 días	vie 03/10/14	jue 16/10/14	[Barra horizontal de inicio a fin]											
39	🚀	Insulation	4 días	vie 03/10/14	mié 08/10/14	[Barra horizontal de inicio a fin]											
40	🚀	Floors	19 días	vie 17/10/14	mié 12/11/14	[Barra horizontal de inicio a fin]											
41	🚀	Wood floor	14 días	vie 24/10/14	mié 12/11/14	[Barra horizontal de inicio a fin]											
42	🚀	Ceramic floor	5 días	vie 17/10/14	jue 23/10/14	[Barra horizontal de inicio a fin]											
43	🚀	Linoleum floor	2 días	vie 24/10/14	lun 27/10/14	[Barra horizontal de inicio a fin]											
44	🚀	Electric and communication install	76 días	mar 10/06/14	mar 07/10/14	[Barra horizontal de inicio a fin]											
45	🚀	Land connections	1 día	mar 10/06/14	mar 10/06/14	[Barra horizontal de inicio a fin]											
46	🚀	Copper wire land connection	3 días	mar 10/06/14	jue 12/06/14	[Barra horizontal de inicio a fin]											
47	🚀	Connection branch	1 día	mar 16/09/14	mar 16/09/14	[Barra horizontal de inicio a fin]											
48	🚀	Electricity meter	1 día	mar 16/09/14	mar 16/09/14	[Barra horizontal de inicio a fin]											
49	🚀	General protection box	1 día	mié 17/09/14	mié 17/09/14	[Barra horizontal de inicio a fin]											
50	🚀	General purpose circuit (10A)	4 días	jue 18/09/14	mar 23/09/14	[Barra horizontal de inicio a fin]											
51	🚀	White goods circuit (16A)	1 día	jue 18/09/14	jue 18/09/14	[Barra horizontal de inicio a fin]											
52	🚀	Kitchen circuit (25A)	1 día	jue 18/09/14	jue 18/09/14	[Barra horizontal de inicio a fin]											
53	🚀	Light points simple switch	1 día	mié 24/09/14	mié 24/09/14	[Barra horizontal de inicio a fin]											
54	🚀	Light points multiple switch	1 día	mié 24/09/14	mié 24/09/14	[Barra horizontal de inicio a fin]											
55	🚀	Plugs bases	4 días	jue 25/09/14	mar 30/09/14	[Barra horizontal de inicio a fin]											
56	🚀	Emergency luminaries	1 día	lun 06/10/14	lun 06/10/14	[Barra horizontal de inicio a fin]											
57	🚀	Phone and internet plugs	1 día	lun 06/10/14	lun 06/10/14	[Barra horizontal de inicio a fin]											
58	🚀	TV aerials and plugs	2 días	lun 06/10/14	mar 07/10/14	[Barra horizontal de inicio a fin]											
59	🚀	Plumbing and heating installation	24 días	lun 15/09/14	jue 16/10/14	[Barra horizontal de inicio a fin]											
60	🚀	Connection branch	1 día	lun 15/09/14	lun 15/09/14	[Barra horizontal de inicio a fin]											
61	🚀	Water meter	1 día	mar 16/09/14	mar 16/09/14	[Barra horizontal de inicio a fin]											
62	🚀	Water supply pipes	11 días	mié 17/09/14	mié 01/10/14	[Barra horizontal de inicio a fin]											
63	🚀	Waste water pipes	7 días	mié 17/09/14	jue 25/09/14	[Barra horizontal de inicio a fin]											
64	🚀	Toilet sinks	3 días	vie 03/10/14	mar 07/10/14	[Barra horizontal de inicio a fin]											
65	🚀	Kitchen sinks	1 día			[Barra horizontal de inicio a fin]											
66	🚀	Bidets	2 días	mié 08/10/14	jue 09/10/14	[Barra horizontal de inicio a fin]											
67	🚀	Toilets	3 días	vie 10/10/14	mar 14/10/14	[Barra horizontal de inicio a fin]											
68	🚀	Shower tubs	1 día	mié 15/10/14	mié 15/10/14	[Barra horizontal de inicio a fin]											
69	🚀	Bath tubs	1 día	jue 16/10/14	jue 16/10/14	[Barra horizontal de inicio a fin]											
70	🚀	Water supply terminals	3 días	mar 30/09/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
71	🚀	White goods connections	2 días	vie 03/10/14	lun 06/10/14	[Barra horizontal de inicio a fin]											
72	🚀	Thermostat	1 día	vie 10/10/14	vie 10/10/14	[Barra horizontal de inicio a fin]											
73	🚀	Accumulation system 350L	3 días	mar 07/10/14	jue 09/10/14	[Barra horizontal de inicio a fin]											
74	🚀	Radiator heater	3 días	vie 03/10/14	mar 07/10/14	[Barra horizontal de inicio a fin]											
75	🚀	Radiators system	7 días	mié 24/09/14	jue 02/10/14	[Barra horizontal de inicio a fin]											
76	🚀	Walls finishings	15 días	vie 03/10/14	jue 23/10/14	[Barra horizontal de inicio a fin]											
77	🚀	Acrylic paint	15 días	vie 03/10/14	jue 23/10/14	[Barra horizontal de inicio a fin]											
78	🚀	Ceramic tiles	8 días	mar 07/10/14	jue 16/10/14	[Barra horizontal de inicio a fin]											
79	🚀	Equipements	10 días	mar 28/10/14	lun 10/11/14	[Barra horizontal de inicio a fin]											
80	🚀	Water heater unit	5 días	mar 28/10/14	lun 03/11/14	[Barra horizontal de inicio a fin]											
81	🚀	Fridge/freezer combo	1 día	jue 06/11/14	jue 06/11/14	[Barra horizontal de inicio a fin]											
82	🚀	Oven/stove combo	3 días	jue 06/11/14	lun 10/11/14	[Barra horizontal de inicio a fin]											
83	🚀	Dish washing machine	2 días	jue 06/11/14	vie 07/11/14	[Barra horizontal de inicio a fin]											
84	🚀	Washing machine	2 días	mar 28/10/14	mié 29/10/14	[Barra horizontal de inicio a fin]											
85	🚀	Dryer machine	2 días	mar 28/10/14	mié 29/10/14	[Barra horizontal de inicio a fin]											
86	🚀	Fire extinguishers	1 día	jue 06/11/14	jue 06/11/14	[Barra horizontal de inicio a fin]											

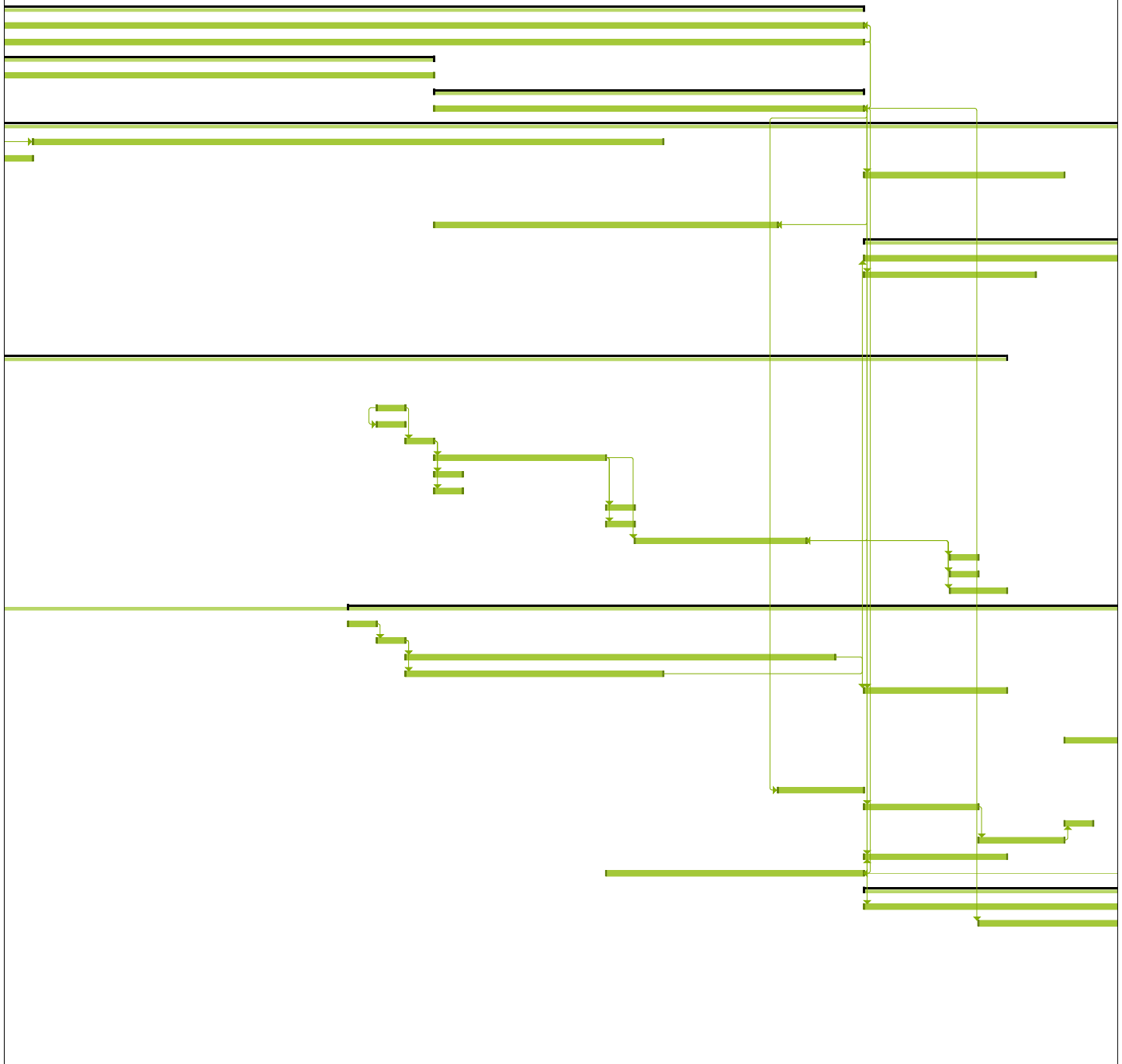
Proyecto: Gantt 1 recurs
 Tarea: [Barra azul] Resumen del proyecto | [Barra roja] Tarea manual
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 Hitos: [Barra negra] Hitos inactivos | [Barra naranja] solo fin
 Resumen: [Barra gris] Resumen inactivo | [Barra morada] Tareas externas
 [Barra blanca] Resumen manual | [Barra roja] Hitos externos
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 Progreso manual: [Barra roja]



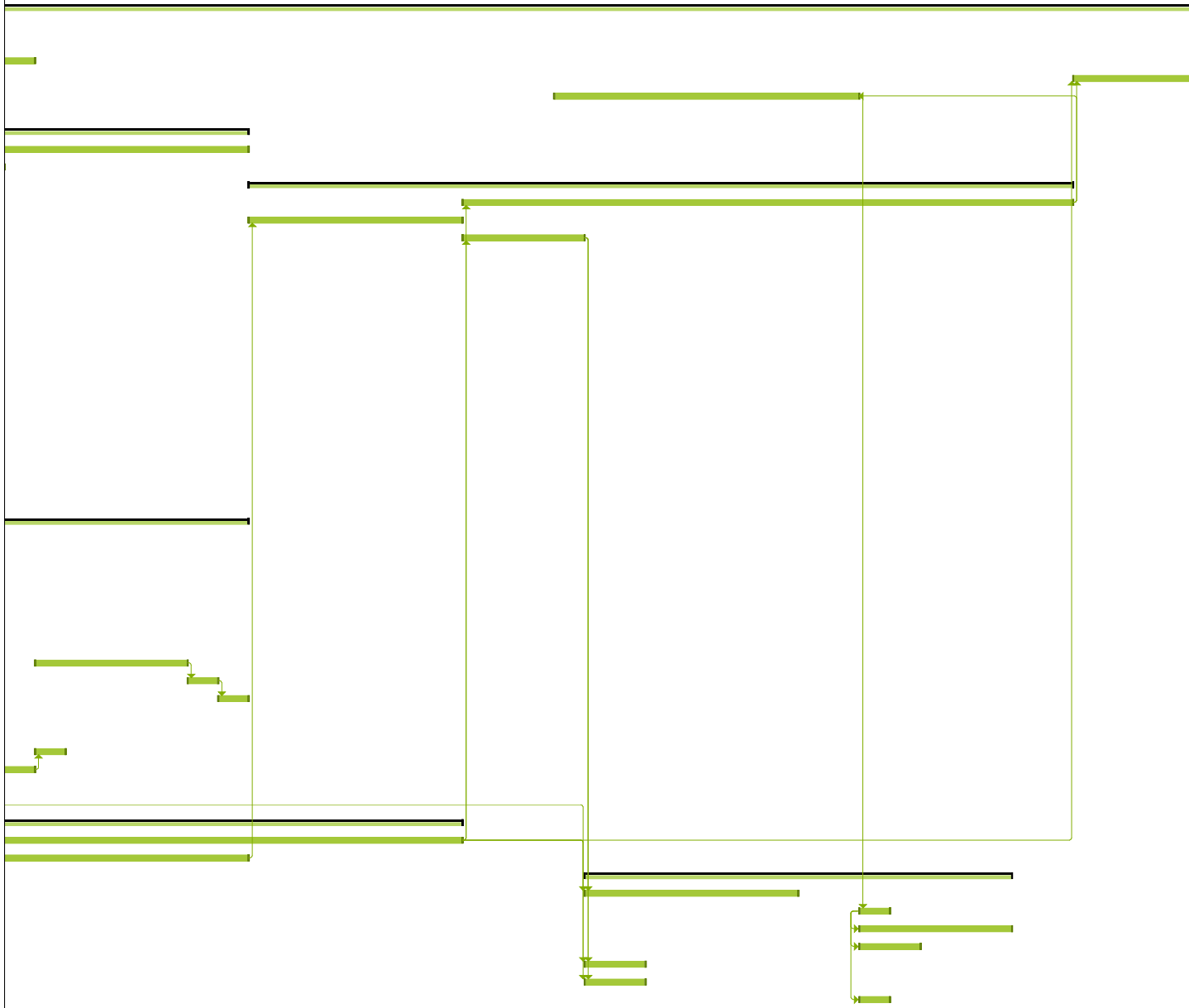
Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	Progreso
División	Tarea inactiva	solo duración	solo fin	Progreso manual		
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Hito externo		
Resumen	Resumen inactivo	Resumen manual				



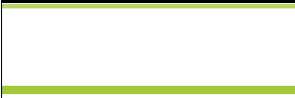
Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	Progreso
	División	Tarea inactiva	solo duración	solo fin	Progreso manual	
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas		
	Resumen	Resumen inactivo	Resumen manual	Hito externo		



Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha limite	+
	División	Tarea inactiva	solo duración	solo fin	Progreso	—
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual	—
	Resumen	Resumen inactivo	Resumen manual	Hito externo	◇	—



Proyecto: Gantt 1 recurs	Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite	Progreso
	División	Tarea inactiva	solo duración	solo fin	Progreso manual	
	Hito	Hito inactivo	Informe de resumen manual	Tareas externas		
	Resumen	Resumen inactivo	Resumen manual	Hito externo		



Proyecto: Gantt 1 recurs

Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite	Progreso
División	Tarea inactiva	solo duración	solo fin	Progreso manual	Progreso
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual	Progreso
Resumen	Resumen inactivo	Resumen manual	Hito externo	Progreso manual	Progreso

On this second work planning, the total duration is reduced from 317 to 115 working days, which is quite less than a half of the initial duration. On real duration this equals approximately to six months, even including 15 days of summer vacations.

As we mentioned before, and you can see in the previous table the resources have been increased just in order to make shorter the longest activities. The exterior walls received a major increase because this is a work which do not interferes so much with the other ones as is done in the surroundings of each building, and it requires a lot of time due to his multiple layers configuration.

Something similar happens with the roofs. They require many hours of work performed over the second slab, where do not disturb the workers involved in other tasks except for example the electricians working with the TV aerials and the communications connections.

Other affected activities are the ones involved in the steel structure or the service installations, because form them depend most of the other works like the interior walls and the finishings. The structure is a priority because once one house is done we can start with the other works in that one, like the roofing or closing the façades, that will require lot of time.

The reduction of the tasks duration is not only important in the planning and production side. Also for the quality control is required that all the items performed from the same batch are done in a certain amount of time. So they can be considered the same thing done with the same materials in the same conditions. Because the supplied materials change with the time in aspects that can be notorious as the façade bricks colour. It's the same for the security in the structures, every steel piece shall pass their quality tests and use pieces from different batches involve realize the double of tests which are not cheap.

COSTS AND DURATIONS ANALYSIS (PERT)

On this part we are going to apply the Program Evaluation and Review Technique, known as PERT method, to the durations and costs of our project trying to obtain more reliable amounts for our planning.

This method consists in procure optimistic, pessimistic and mean values for anything you want to recalculate taking in consideration the possible variations it might suffer.

The expected value obtained with this method is calculated with the following formula. $Te = \frac{P+4M+O}{6}$ This system makes that the more dispersed values, without considering they are optimistic or pessimistic, can modify the estimated value in their way but considering that most of the times the result will keep close to the mean. The only exception is if both optimistic and pessimistic values are worthy of consideration the final value will stay constant but the deviation and variance of the operation will say us that this is a really uncertain activity.

These uncertain activities are dangerous for our project because they can both increase or decrease the time and cost of our planned work. Sometimes we can just assume the amount of uncertainty if it is not too big, but there is a point where we should reconsider carrying on that activity.

On the next pages we are going to calculate both estimated time and cost for our project. Also we will obtain the uncertainty ratio of each activity for the two sides. With this we will analyse the most variable activities in terms of time and cost, why they are like this and what can we do with that kind of activities.

We are going to use as mean cost the cost procured in the bid for each item and the times from the reallocation of resources that are considerably better than using only one resource per task. The rest of optimistic and pessimistic values will be defined by the student judgement considering their own knowledge trying to produce some notorious results for the analysis.

	Optimistic duration (days)	Mean duration (days)	Pessimistic duration (days)	Estimated duration (days)	Estándar Deviation	Variance	Percentual value
Existing building demolition	1	1	4	2	0,50	0,25	200%
Rocks and rubble transport	1	1	2	2	0,17	0,03	200%
Trees and plants transplant	1	1	2	2	0,17	0,03	200%
Vegetal terrain removal	1	1	3	2	0,33	0,11	200%
Foundations excavation	2	2	6	3	0,67	0,44	150%
Soil transport	-	-	-	-	-	-	
Cleaning concrete	1	1	2	2	0,17	0,03	200%
Surrounding footings 140x50	2	3	8	4	1,00	1,00	133%
Central footing 145x50	1	1	4	2	0,50	0,25	200%
Foundation beam 40x50	1	1	2	2	0,17	0,03	200%
Isolated floor	2	4	12	5	1,67	2,78	125%
Sanitary pipes	1	1	2	2	0,17	0,03	200%
Pillar base	2	2	5	3	0,50	0,25	150%
Pillar ending	1	1	3	2	0,33	0,11	200%
HEB 200 pillar	3	5	12	6	1,50	2,25	120%
IPE 220 beam	5	7	12	8	1,17	1,36	114%
IPE 120 joist	6	8	11	9	0,83	0,69	113%
Composite slab 5+5	7	10	16	11	1,50	2,25	110%
Exterior wall	31	36	52	38	3,50	12,25	106%
Diving wall	22	31	34	30	2,00	4,00	97%
Cover roof	20	25	33	26	2,17	4,69	104%
Internal wall	9	11	16	12	1,17	1,36	109%
Windows	13	16	21	17	1,33	1,78	106%
External doors	2	2	4	3	0,33	0,11	150%
Internal doors	4	5	6	5	0,33	0,11	100%
Handrails	5	7	10	8	0,83	0,69	114%
Kitchen closets sets	5	8	15	9	1,67	2,78	113%
Wardrobes	6	8	13	9	1,17	1,36	113%
Ceiling	7	10	12	10	0,83	0,69	100%
Insulation	2	4	5	4	0,50	0,25	100%
Wood floor	12	14	29	17	2,83	8,03	121%
Ceramic floor	4	5	8	6	0,67	0,44	120%
Linoleum floor	1	2	3	2	0,33	0,11	100%
Land connections	1	1	2	2	0,17	0,03	200%
Copper wire land connection	2	3	5	4	0,50	0,25	133%
Connection branch	1	1	3	2	0,33	0,11	200%
Electricity meter	1	1	1	1	0,00	0,00	100%
General protection box	1	1	3	2	0,33	0,11	200%
General purpose circuit (10A)	3	4	9	5	1,00	1,00	125%
White goods circuit (16A)	1	1	3	2	0,33	0,11	200%
Kitchen circuit (25A)	1	1	2	2	0,17	0,03	200%
Light points simple switch	1	1	3	2	0,33	0,11	200%
Light points multiple switch	1	1	5	2	0,67	0,44	200%
Plugs bases	3	4	9	5	1,00	1,00	125%
Emergency luminaries	1	1	2	2	0,17	0,03	200%
Phone and internet plugs	1	1	1	1	0,33	0,11	200%
TV aerials and plugs	1	2	3	2	0,33	0,11	100%

Connection branch	1	1	3	2	0,33	0,11	200%
Water meter	1	1	1	1	0,00	0,00	100%
Water supply pipes	9	11	35	15	4,33	18,78	136%
Waste water pipes	4	7	16	8	2,00	4,00	114%
Toilet sinks	1	3	4	3	0,50	0,25	100%
Kitchen sinks	1	1	2	2	0,17	0,03	200%
Bidets	1	2	4	3	0,50	0,25	150%
Toilets	2	3	5	4	0,50	0,25	133%
Shower tubs	1	1	3	2	0,33	0,11	200%
Bath tubs	1	1	3	2	0,33	0,11	200%
Water supply terminals	2	3	6	4	0,67	0,44	133%
White goods connections	2	2	3	3	0,17	0,03	150%
Thermostat	1	1	1	1	0,00	0,00	100%
Accumulation system 350L	2	3	5	4	0,50	0,25	133%
Radiator heater	2	3	5	4	0,50	0,25	133%
Radiators system	6	7	18	9	2,00	4,00	129%
Acrylic paint	10	15	19	15	1,50	2,25	100%
Ceramic tiles	7	8	13	9	1,00	1,00	113%
Water heater unit	2	5	6	5	0,67	0,44	100%
Fridge/freezer combo	1	1	2	2	0,17	0,03	200%
Oven/stove combo	1	3	5	3	0,67	0,44	100%
Dish washing machine	1	1	3	2	0,33	0,11	200%
Washing machine	1	1	3	2	0,33	0,11	200%
Dryer machine	1	1	2	2	0,17	0,03	200%
Fire extinguishers	1	1	2	2	0,17	0,03	200%

As you can see, it is strange that any task can be done in less time than the initial planning. This is because the mean time is quite regular but the task can become really delayed.

If you check the standard deviation column you can see the amount of days that task is usually delayed. On the last column you can see the tasks that increase their duration in more than a 50% marked in red, because this ones can cause serious problems if they become delayed. The other ones had a delay rate to less notorious and we can manage with them without having great problems.

As seen on the table only the diving walls are usually done in less time than the initially planned. There are some more tasks that can be done faster than the planned, but as the duration is rounded up for make full days their total duration has been equalled to the mean so you cannot see any difference in the time and the percentage is also showed as 100%.

Now we are going to estimate the possible variations of the activities costs.

	Optimistic cost	Mean cost	Pessimistic cost	Estimated cost	Estándar Deviation	Variance /100	Percentual value
Existing building demolition	8,31 €	10,78 €	45,80 €	16,21 €	6,25 €	0,39	150%
Rocks and rubble transport	11,27 €	13,49 €	15,63 €	13,48 €	0,73 €	0,01	100%
Trees and plants transplant	275,62 €	288,84 €	313,44 €	290,74 €	6,30 €	0,40	101%
Vegetal terrain removal	1.100,00 €	1.438,12 €	2.512,95 €	1.560,91 €	235,49 €	554,56	109%
Foundations excavation	974,87 €	1.363,74 €	2.502,31 €	1.488,69 €	254,57 €	648,08	109%
Soil transport	3.855,30 €	4.953,79 €	5.220,16 €	4.815,10 €	227,48 €	517,46	97%
Cleaning concrete	577,57 €	684,03 €	732,81 €	674,42 €	25,87 €	6,69	99%
Surrounding footings 140x50	8.543,23 €	11.145,25 €	20.604,12 €	12.288,06 €	2.010,15 €	40.406,96	110%
Central footing 145x50	3.874,92 €	4.361,82 €	7.239,72 €	4.760,32 €	560,80 €	3.144,97	109%
Foundation beam 40x50	856,30 €	1.142,66 €	3.261,76 €	1.448,12 €	400,91 €	1.607,29	127%
Isolated floor	15.489,69 €	18.616,34 €	31.015,48 €	20.161,76 €	2.587,63 €	66.958,38	108%
Sanitary pipes	1.305,86 €	1.808,90 €	2.350,00 €	1.815,24 €	174,02 €	302,84	100%
Pillar base	2.211,55 €	3.030,00 €	4.210,29 €	3.090,31 €	333,12 €	1.109,71	102%
Pillar ending	1.065,31 €	1.766,70 €	2.325,63 €	1.742,96 €	210,05 €	441,22	99%
HEB 200 pillar	4.328,97 €	5.970,60 €	7.160,11 €	5.895,25 €	471,86 €	2.226,49	99%
IPE 220 beam	13.658,97 €	18.850,10 €	24.446,83 €	18.917,70 €	1.797,98 €	32.327,20	100%
IPE 120 joist	14.887,38 €	16.359,67 €	19.500,00 €	16.637,68 €	768,77 €	5.910,07	102%
Composite slab 5+5	38.822,15 €	41.780,98 €	55.488,91 €	43.572,50 €	2.777,79 €	77.161,36	104%
Exterior wall	81.365,61 €	87.299,71 €	101.612,31 €	88.696,13 €	3.374,45 €	113.869,13	102%
Diving wall	38.656,17 €	43.397,46 €	47.317,20 €	43.260,54 €	1.443,51 €	20.837,07	100%
Cover roof	85.652,78 €	104.530,23 €	113.264,13 €	102.839,64 €	4.601,89 €	211.774,07	98%
Internal wall	24.656,43 €	27.387,63 €	28.654,55 €	27.143,58 €	666,35 €	4.440,27	99%
Windows	16.521,08 €	18.008,70 €	19.300,00 €	17.975,98 €	463,15 €	2.145,11	100%
External doors	1.114,35 €	1.252,10 €	1.620,33 €	1.290,51 €	84,33 €	71,12	103%
Internal doors	2.800,00 €	3.160,20 €	3.857,79 €	3.216,43 €	176,30 €	310,81	102%
Handrails	1.860,82 €	2.102,73 €	2.607,29 €	2.146,51 €	124,41 €	154,78	102%
Kitchen closets sets	2.166,56 €	2.678,05 €	3.866,14 €	2.790,82 €	283,26 €	802,38	104%
Wardrobes	2.000,00 €	2.210,80 €	3.360,87 €	2.367,35 €	226,81 €	514,44	107%
Ceiling	17.564,21 €	18.172,25 €	19.200,00 €	18.242,20 €	272,63 €	743,28	100%
Insulation	1.530,24 €	1.887,71 €	2.460,73 €	1.923,64 €	155,08 €	240,50	102%
Wood floor	42.600,90 €	48.533,53 €	61.230,74 €	49.660,96 €	3.104,97 €	96.408,59	102%
Ceramic floor	3.844,71 €	4.210,58 €	4.603,88 €	4.215,15 €	126,53 €	160,09	100%
Linoleum floor	1.000,00 €	1.392,52 €	1.600,00 €	1.361,68 €	100,00 €	100,00	98%
Land connections	206,59 €	237,36 €	289,22 €	240,88 €	13,77 €	1,90	101%
Copper wire land connection	8.420,73 €	9.669,00 €	10.307,00 €	9.567,29 €	314,38 €	988,34	99%
Connection branch	859,24 €	921,45 €	1.230,50 €	962,59 €	61,88 €	38,29	104%
Electricity meter	380,89 €	425,60 €	430,65 €	418,99 €	8,29 €	0,69	98%
General protection box	985,68 €	1.187,40 €	1.800,99 €	1.256,05 €	135,89 €	184,65	106%
General purpose circuit (10A)	3.287,11 €	3.924,96 €	5.210,90 €	4.032,98 €	320,63 €	1.028,05	103%
White goods circuit (16A)	620,14 €	691,32 €	752,33 €	689,63 €	22,03 €	4,85	100%
Kitchen circuit (25A)	496,80 €	537,34 €	607,66 €	542,30 €	18,48 €	3,41	101%
Light points simple switch	1.211,41 €	1.507,35 €	1.611,24 €	1.475,34 €	66,64 €	44,41	98%
Light points multiple switch	7.900,00 €	8.416,85 €	10.325,11 €	8.648,75 €	404,19 €	1.633,66	103%
Plugs bases	2.560,74 €	3.327,85 €	3.917,14 €	3.298,21 €	226,07 €	511,06	99%
Emergency luminaries	410,00 €	498,60 €	520,79 €	487,53 €	18,47 €	3,41	98%
Phone and internet plugs	1.003,50 €	1.214,55 €	1.630,00 €	1.248,62 €	104,42 €	109,03	103%
TV aerials and plugs	1.969,62 €	2.251,15 €	2.438,65 €	2.235,48 €	78,17 €	61,11	99%

Connection branch	3.860,31 €	4.402,85 €	4.854,36 €	4.387,68 €	165,68 €	274,48	100%
Water meter	322,60 €	372,95 €	460,90 €	379,22 €	23,05 €	5,31	102%
Water supply pipes	9.656,22 €	11.533,41 €	18.230,65 €	12.336,75 €	1.429,07 €	20.422,46	107%
Waste water pipes	3.052,06 €	3.890,65 €	5.407,19 €	4.003,64 €	392,52 €	1.540,73	103%
Toilet sinks	2.128,90 €	2.396,85 €	2.948,83 €	2.444,19 €	136,66 €	186,75	102%
Kitchen sinks	995,30 €	1.160,20 €	1.234,13 €	1.145,04 €	39,81 €	15,84	99%
Bidets	1.750,68 €	1.835,00 €	1.980,50 €	1.845,20 €	38,30 €	14,67	101%
Toilets	3.260,41 €	3.775,05 €	4.210,11 €	3.761,79 €	158,28 €	250,54	100%
Shower tubs	1.300,00 €	1.438,95 €	1.726,69 €	1.463,75 €	71,12 €	50,57	102%
Bath tubs	1.150,00 €	1.298,75 €	1.600,55 €	1.324,26 €	75,09 €	56,39	102%
Water supply terminals	6.130,52 €	6.629,00 €	7.305,42 €	6.658,66 €	195,82 €	383,44	100%
White goods connections	350,90 €	466,20 €	640,31 €	476,00 €	48,24 €	23,27	102%
Thermostat	170,00 €	189,60 €	211,89 €	190,05 €	6,98 €	0,49	100%
Accumulation system 350L	870,12 €	999,55 €	1.204,77 €	1.012,18 €	55,78 €	31,11	101%
Radiator heater	7.860,33 €	8.747,90 €	9.350,62 €	8.700,43 €	248,38 €	616,93	99%
Radiators system	8.451,62 €	8.838,04 €	16.240,00 €	10.007,30 €	1.298,06 €	16.849,68	113%
Acrylic paint	5.100,00 €	5.699,82 €	7.180,76 €	5.846,67 €	346,79 €	1.202,66	103%
Ceramic tiles	11.351,46 €	11.939,67 €	13.602,41 €	12.118,76 €	375,16 €	1.407,44	101%
Water heater unit	13.653,45 €	15.462,90 €	21.912,85 €	16.236,32 €	1.376,57 €	18.949,36	105%
Fridge/freezer combo	2.999,60 €	3.260,25 €	3.500,00 €	3.256,77 €	83,40 €	69,56	100%
Oven/stove combo	1.820,85 €	2.235,60 €	2.611,67 €	2.229,15 €	131,80 €	173,72	100%
Dish washing machine	1.750,99 €	1.884,20 €	2.100,63 €	1.898,07 €	58,27 €	33,96	101%
Washing machine	1.620,07 €	1.890,45 €	2.204,00 €	1.897,65 €	97,32 €	94,72	100%
Dryer machine	1.020,85 €	1.370,85 €	1.560,40 €	1.344,11 €	89,93 €	80,87	98%
Fire extinguishers	635,64 €	761,10 €	802,30 €	747,06 €	27,78 €	7,72	98%

Checking now the costs table you can see that lot of prices can be lightly reduced. This is produced because sometimes for big promotions like this or just by the good relations between the suppliers and the company the products price include a discount or are just made rounding down. These are the ones marked in green, where you can see that the percentage reduced isn't so big but can help a lot both parts. The contractor obtains cheaper goods and the supplier gains a contract for a big amount of units or a long time contract.

But we have to be careful with the red ones, which mark prices increased. And if you check the amount usually the prices grow quite more than the discounts made by the other parts. This can be produced by lot of reasons starting just by time delays where we have to pay the rent of the equipment to wrong materials deliveries or even rebuild some parts due to a bad execution.

The rest of the items showed in yellow, usually get a price increasing but not a considerable amount. The limit has been fixed in a 5%.

COSTS AND DURATIONS ANALYSIS FOR A SUPPOSED CASE **(EARNED VALUE METHOD)**

In this chapter we are going to analyse the progress of the project by the earned value method. This method, consist in compare the data of the real performed work with the planned work. It is valid for the time and the cost of the project, what is more, they should be checked both together. This is because most of the times both values are linked not only in the rents but also in the basic costs. Sometimes we can allow a task to be delayed if it becomes cheaper and in the other way too. We can afford to pay more for a task if almost we can complete it in less time than the initially planned.

We are going to use a supposed case for check the developing of the works in our project. Then we will calculate some coefficients that will inform us about how right or wrong is the developed work according to our planification.

The circumstances for the analysis are:

- Date 1st September 2014
- First day after the summer vacations, so the company wants a complete analysis of the situation to check if the work is running in a satisficing way.
- The land works, foundations and structure were completed properly before leaving for the vacations.
- As the plan says, the façades, diving walls and roofs started in august but stopped due to the vacations. Now before restarting we observe that as we analysed in the PERT:
 - The façades works are delayed around 3 days so they need days more to finish. And the cost is 2% higher than the planned.
 - The diving walls are in a better situation where they are running faster than the programmed amount for 5 days and the cost is still the one we plan.
 - The roofs are 2 days delayed but we are saving a 3% in the cost.
 - The carpentry works with the external doors and in a few more days the windows are ready to start on the planned date.

These are the numbers for the complete activities.

Task	Duration	Total Cost	Unitary cost
External Wall	36 days	87.299,71 €	2.424,99 €/day
Diving Wall	31 days	43.397,46 €	1.399,91 €/day
Cover Roof	25 days	104.530,23 €	4181.20 €/day

And these ones represent the actual situation.

Task	Planned work (days)	Performed work (days)	Planned cost (€/day)	Performed cost (€/day)
External Wall	12	9	2424,99	2473,4898
Diving Wall	7	12	1399,91	1399,91
Cover Roof	12	10	4181,2	4055,764

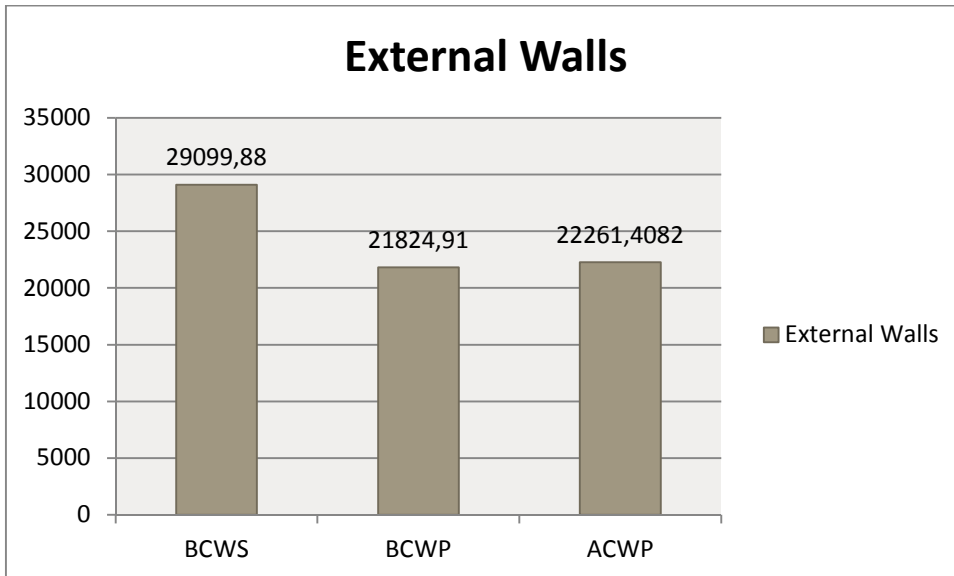
For continue with the analysis we need to calculate the following values of each task in order to compare them and obtain the data of the progress of the work we wanted.

BCWS - Budgeted Cost of Work Scheduled: The planned budget for the work scheduled, also known as Planned Value (PV).

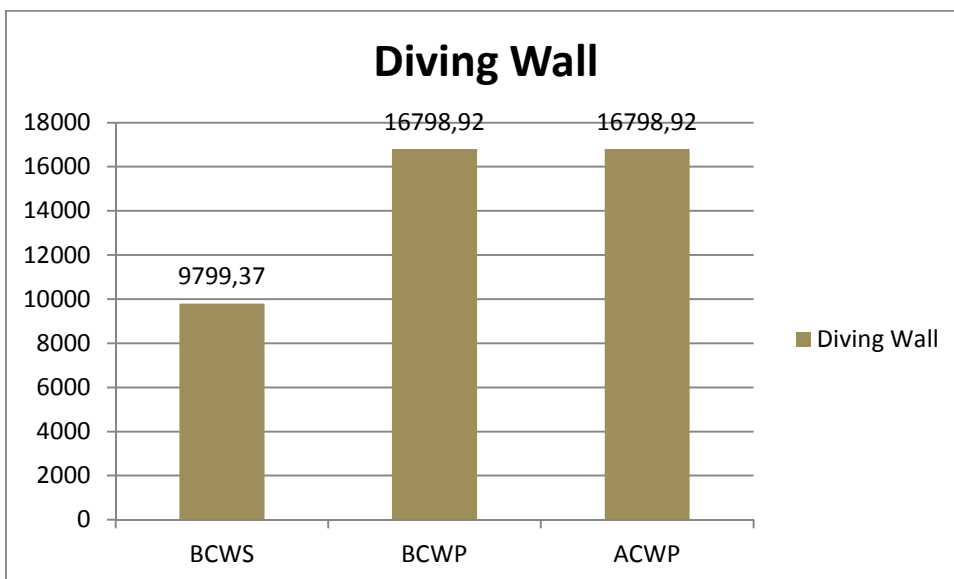
BCWP - Budgeted Cost of Work Performed: The budget for the real completed work in one date. It can be also named Earned Value (EV).

ACWP - Actual Cost of Work Performed: The costs incurred for the work completed by the specified date, or Actual Cost (AC).

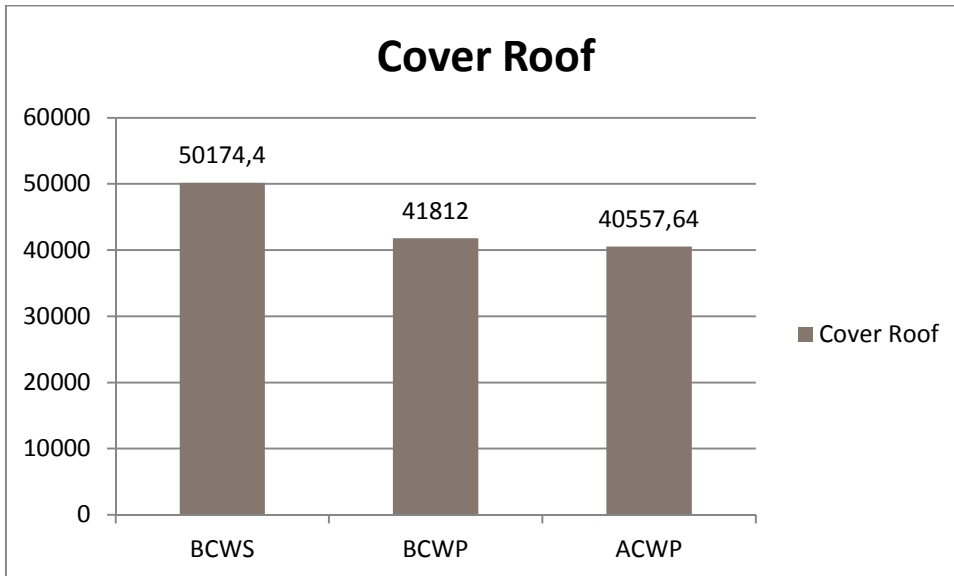
Task	BCWS	BCWP	ACWP
External Wall	29099,88	21824,91	22261,4082
Diving Wall	9799,37	16798,92	16798,92
Cover Roof	50174,4	41812	40557,64



Here we can see that the main problem in the external walls is the delayed days, because the price has suffered "only" a minimum growth comparing to the planned one. This delay could develop later in more delays that cannot be "cheap" as this one. So we should fix this as soon as possible



On the diving walls we can see that the main difference is produced again by the performed work. But in the other hand as we keep the same unitary price is really good to know that this activity is keeping the planned price, even when it is running quite faster than the planned. We can use the overwork produced here to move some resources to work in the external walls in order to readjust the delay that activity has the soon we can.



Finally in the cover roof we realise that even when we are getting delayed the actual cost of this task is a bit lower than the planned. This delay can be accepted because no more tasks depend from the roofs except the aerials installation and probably it won't increase our costs linked to the time. This is slow rhythm is making us save some money so it's not totally harmful for us.

Now we have these information we can calculate other index that are going to tell us more about the evolution of each task.

The ACP, or actual cost productivity shows up the efficiency of the performed work over the planned. Comparing the actual incurred costs with the planned ones. (ACWP/BCWP)

Task	ACP
External Wall	1,02
Diving Wall	1
Cover Roof	0,97

As a result we know that the planned costs are quite close to the real ones. This is valid for both cases, when we over-estimated (cover roof) and under-estimated (external wall) the costs.

The efficacy over planning rate (EPR) compares the really performed work with the planned. Calculated by BCWP/BCWS, the EPR shows if the work is being delayed or advanced to the planning.

Task	EPR
External Wall	0,75
Diving Wall	1,714285714
Cover Roof	0,833333333

Here we see that the roofs and the external wall are getting delayed when the diving wall has produced close to the double we have expected for this date.

Finally the PFP or Productivity at Finished Project shows how close is the work performed to the planification initially done.

Task	PFP
External Wall	0,765
Diving Wall	1,714285714
Cover Roof	0,808333333

This index, even when is more dispersed than the other ones, shows us that our global planning involving times and costs it's not being accomplished by some reason. We can check here if globally "under or over" estimated the time and money needed. The closest it's this index to one the closest was our planification to the reality.

WORK SITE PLAN

On this part we are going to describe the organization of the work site during the construction phase. The security and service installations can be found in a drawing in the next pages.

The first objective of these measures is to protect the people and the material goods outside the work site. For that reason the first thing to do will be place a surrounding wall in the entire plot. This wall will prevent strange people to get inside the working site and also the dust or other objects that can be propelled outside the plot.

This wall is going to be made of 1.5mm steel plate and with a height of 2.00 m. Every 5m and in all the corners light points will be placed for the security during the nights or low visibility days. On this wall only four overtures are planned, two for the entrance/exit of the vehicles and two more for the workers access.

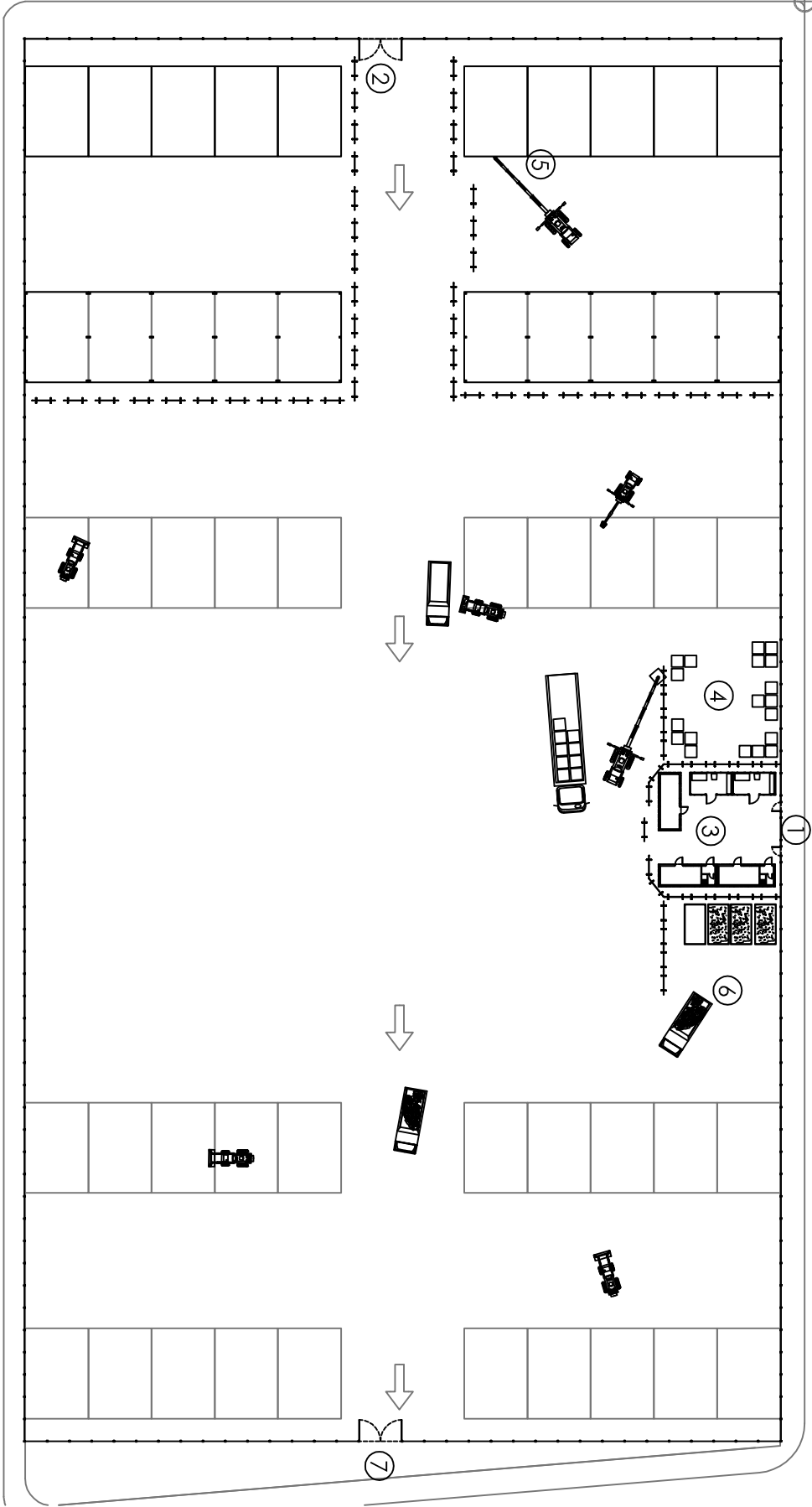
The workers entrance lead to a service zone where they can change their clothes and wear the protection equipment before getting into the working zone. In the service zone is also placed the work site office, to keep a copy of the project documents and also the documentation about the machines, the supplied materials or the quality tests done.

Then we also have a nursery with a pallet and a complete first-aid kit and a dining room with something useful for warm up workers meals.



This zone and the one where the workers will be working without vehicles will be delimited by traffic walls, in order to advertise both workers and vehicles about the presence of the other and the need of move with caution on this zone.

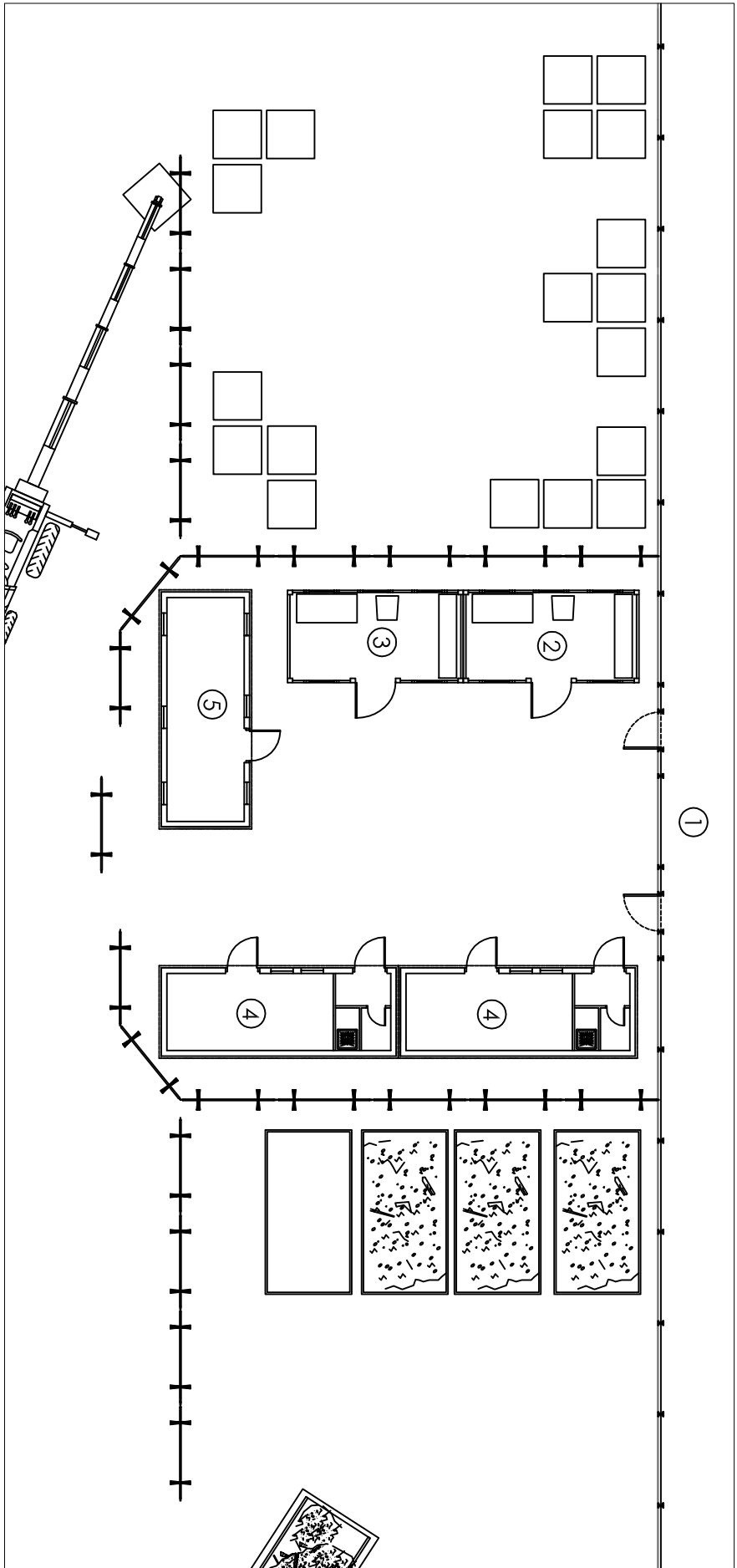
The central zone of the plot which will become the park in the future is used for storage of supplies and waste parts. Also we placed the service huts here because they need water and energy supply, and once we finished, we can use these ones for the pool installation.

As the space of the promotion is quite big, some of the buildings can be almost finished while in the other part of the plot we still have land works.

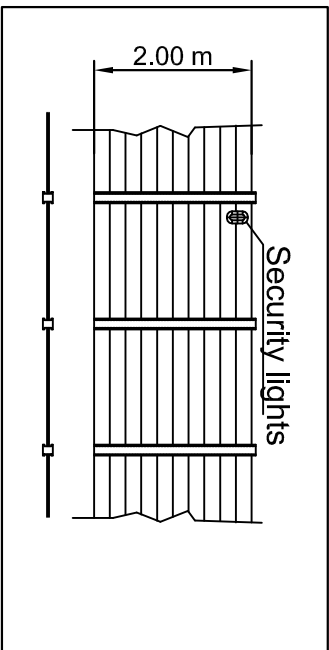


- ① Pedestrian entrance/exit
- ② Vehicles acces
- ③ Pedestrian services zone including:
 - Work site office
 - Locker room
 - Nursery
 - Dining room
- ④ Storage zone
- ⑤ Working zone
- ⑥ Wastes storage
- ⑦ Vehicles exit

Drawing: Work site plan.	Drawing Number: Wsp-001	 
	Scale: N/A	
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- ① Pedestrian entrance/exit
- ② Work site office
- ③ Nursery
- ④ Locker room
- ⑤ Dining room



Drawing:
Work site plan.

Drawing Number:
Wsp-002



Scale:
N/A



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ANALYSIS AND CONCLUSIONS

This project and globally all the Erasmus experience were quite a good way of starting to know the other working systems and construction typologies.

On the subjects I learnt about the management techniques that are being used around the world and I tried to apply here in this project. This helps me to understand the amount of work needed to carry on a construction project. Because even when I avoided some parts due the time they require or some knowledge I do not have, I needed more than three months only for create this short, simple and probably with several mistakes or missing details project.

The project management is a powerful tool witch procures you lot of information and helps you to make closer predictions for the developing of the project. But it needs more than the knowledge and experience I have on this moment and also to keep updating and a continuous learning during the whole life.

Also it requires involving the experience of the other members of the project and the construction world in general. Who can say you more about the possible durations of a pipe installation than an expert plumber? And this is the same for everything.

The directive and projecting ranks of the construction world should listen and learn what they can from the ones who perform one work day after day until they become experts. We should take in consideration all the ideas for the final objective, produce better, cheaper and faster and in better conditions for the workers involved.

In my opinion this is not only necessary for the young ones who start now, because yes, we still have to learn a lot. But also the experienced ones should take in consideration the new ideas the young people provide, because maybe someday those ideas will become the procedure rule.

Everyone should be involved in the management tasks; directives, workers, suppliers, the users, because everyone forms part of an idea, a project, a family... our building.

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2. General rules for buildings (BFS 2011:26)
3. Accessibility, dwelling design, room height, and utility rooms (BFS 2011:26)
4. Mechanical resistance and stability (BFS 2011:26)
5. Safety in case of fire (BFS 2011:26)
6. Hygiene, health and environment (BFS 2011:26)
7. Protection against noise. (BFS 2011:26)
8. Safety in use (BFS 2011:26)
9. Energy management. (BFS 2011:26)

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