VILNIUS GEDIMINAS TECHNICAL
UNIVERSITETY

FACULTY OF CIVIL ENGINEERING

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Alumn: Vicente, Carrion Medrano

Supervisor: Jonas Saparauskas

Language - English

Construction design of the multistorey dwelling-house at Rygos str. 11 in Vilnius

Daugiabučio gyvenamojo namo Rygos g. 11 Vilniuje statybos projektavimas

FINAL THESIS WORK

Vilnius, 2011

ANNOTATION

The subject of this final work is “Construction design of the multistorey dwelling-house at Rygos str. 11 in Vilnius“

This final work consists of three parts:

1. The architectural part consists of a short description of the building under design and drawings, which shows facades, one vertical section, two horizontal sections, and one situation map of the building.

2. The part of structural design describes the design of the key footing foundation supporting the squared columns. The calculations are made in two ways, by computer and by hand.

3. Technological part. It consists about two different technological cards:
-Laminate flooring installation in the third floor.
-Gypsum plasterboards partitions in the third floor

4. Organization part. Schedules of all works, workers and machinery.

The final thesis work consists of:

-The explanatory handwritting: 70 A4pages
-The graphical part: 7 A1 drawings

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APPROVED

Head of Department:

Edmundas K. Zavadskas

Vicente Carrión Medrano

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Final thesis work

Supervisor: Dr. Jonas Saparauskas

Consultant: Dr. Remigijus Salna

Vilnius, 2011

1. ARCHITECTURAL PART

1.1 DESCRIPTIVE MEMORY

1.1.1 INTRODUCTION

This final thesis work will consist in the construction of a multi-storey dwelling building in Vilnius (Lithuania), in Rygos street 11a. It will be an unusual building, due to it will be three different blocks with five, seven and nine floors respectively, which are going to be connected at the same time in the second and third floor.
The users will be able to choose between dwelling with two, three, four and five rooms.
This project building will be done with Spanish standards.
First and second floor will contain commercial premises, for different kind of business
From second, to ninth floor, three nucleus of stairs and three elevators give service to two, three, four and five apartments.

Surfaces: - Building area: 2004, 32 m^2

- Plot: 7490 m^2

1.1.2 LOCATION

The future building is located in Rygos Street, number 11a , in the city of Vilnius (Lithuania). Aerial view (figure 1), and two different pictures are shown (figure 2, figure 3). This situation, in far from the city centre.

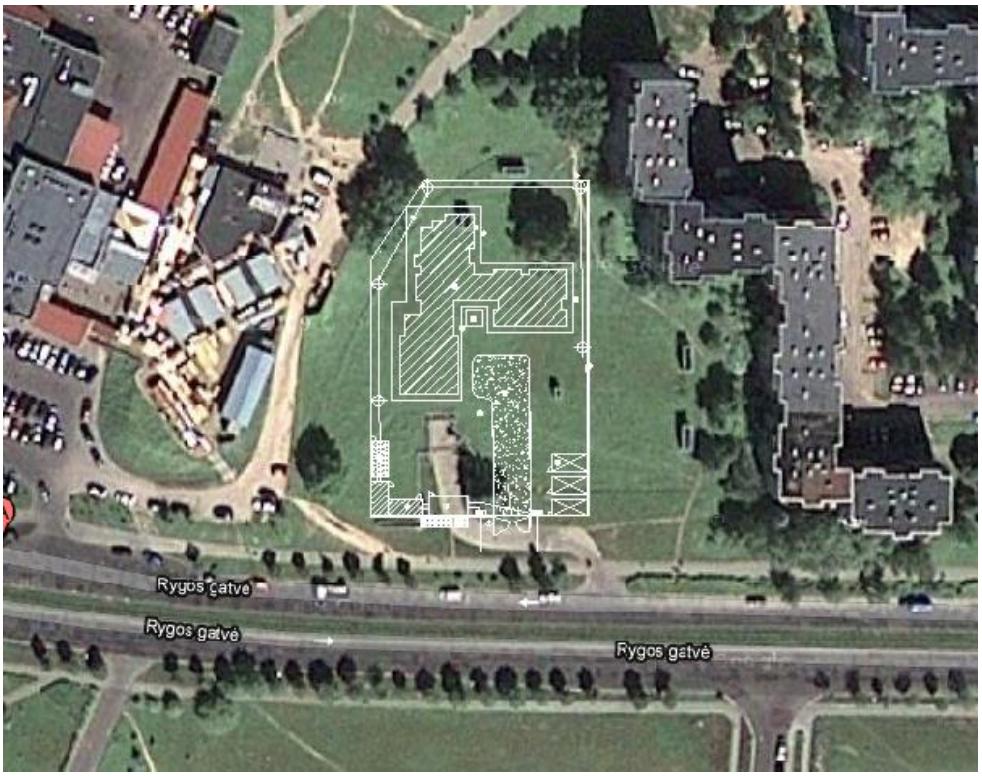

Figure 1. Aerial view of construction site

Figure 2 and figure 3. Current status of the site

1.1.3 FIELD

Our building area is 2004,32 m^2**,** forming an irregular polygon, there are some constructions near our building, in the south facade is the Rygos Street, as we can see in our location plan.
This street will be the main access for all the machinery, and when the construction finishes, will be the access for private cars. We will be able to reach also the future building from a small street behind of the construction, without any name yet.

1.1.4 DISTRIBUTION FLOORS

First of all, should be said, that the future building will have a really special shape and it will be very original.
The first floor consists in seven salons and four flats, three stairs and three elevators, one for each different block.
Each block will have of course its own access.
The shape of this floor will not be repeated once more.
At second level there are two salons and nine flats, as in the ground floor, is the only one floor with this shape. In this floor we can also see how first and third block are joined, letting these two blocks to increase their surfaces.
From third to fifth floor, we are not going to find differences, will be inside twelve different flats.
Sixth and seventh floor will be identical, like eighth and ninth. Will be inside eight different flats. This is due to the different blocks height that was said before. Will be inside four different flats. Below could be seen the third floor section in the figure 4.

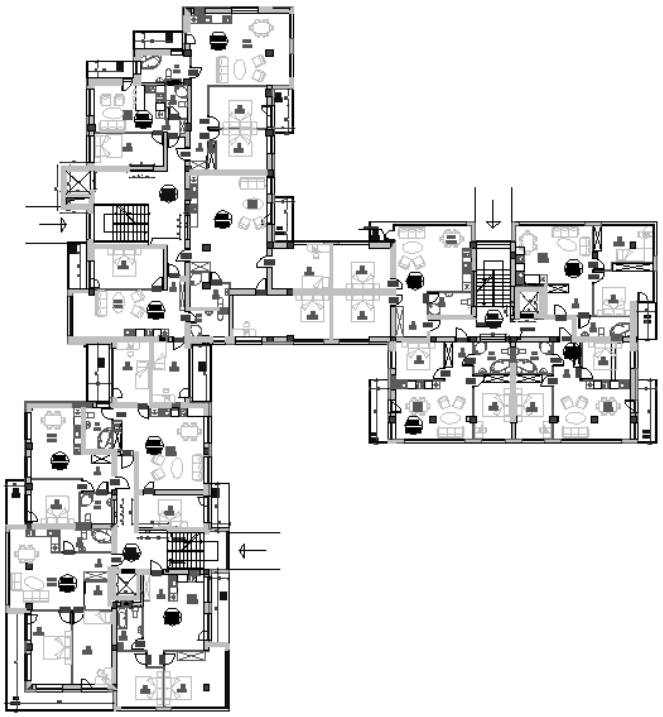

Figure 4. Third floor section

1.2. CONSTRUCTIVE MEMORY

1.2.1 FOUNDATION

After checking the quality of land and consider suitable for the foundation (it is asandy soil), should be considered to build superficial foundation footing (figure 5) joined with bracing beams (figure 6), because is the cheapest way for construct the foundation, must be used reinforced concrete HA-25 according to the EHE-08 normative.
Below are shown the concrete and iron main characteristics:

Concrete type	HA-25
Characteristic resistance	f_{ck}= 25 MPa
Deduction coefficient of concrete:	$\gamma_c = 1{,}5$
Specific weight of reinforced concrete	γ_H= 2.5 T/m^3=24.5 KN/m^3
Coating	d´= 5 cm
Type of iron in the armors	B500S
Characteristic resistance of iron	f_{yk}= 500 MPa

This kind of foundation is called superficial or direct foundation, because we don´t reach a high depth.
Each footing will have different measures. The biggest width will be 95 cm.
The bracing beams will be of 40 x 40 cm.
The highest depth we are going to reach will be 95 cm and the lowest, just 70 cm.
Iron, of course, will have different diameters. Shall be a S275J kind.
All the iron in the foundations will be supported on plastic separators due to not being in contact with the ground.

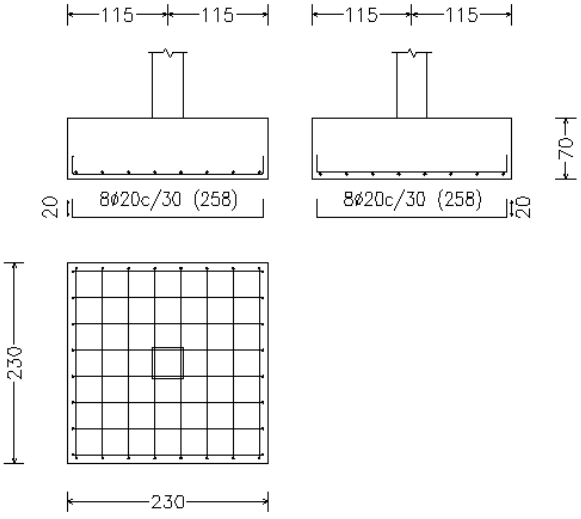

Figure 5. Footing foundation

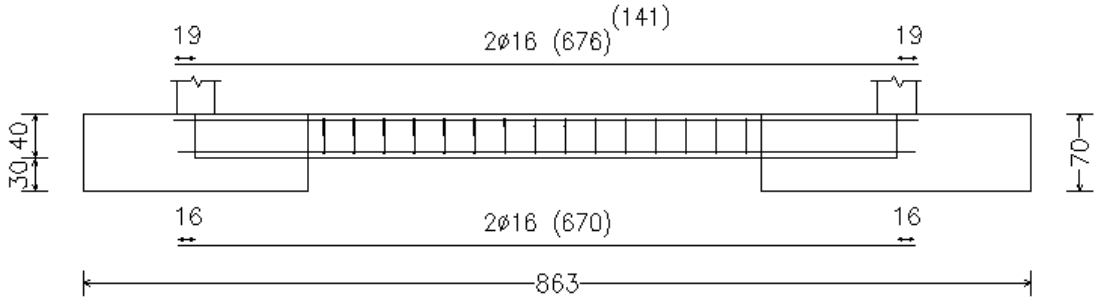

Figure 6. Braced beams in each footing

1.2.2 COLUMNS

Monolithic columns of rectangular and square cross-section (figure 7) made of reinforced concrete according to the EHE-08 normative.
The concrete we are going to use will be HA – 25.
The iron for our columns will be S275J.
There will be two different column measures: 30 x 30 cm and 35 x 35 cm, and depending on the column, will be more or less iron.

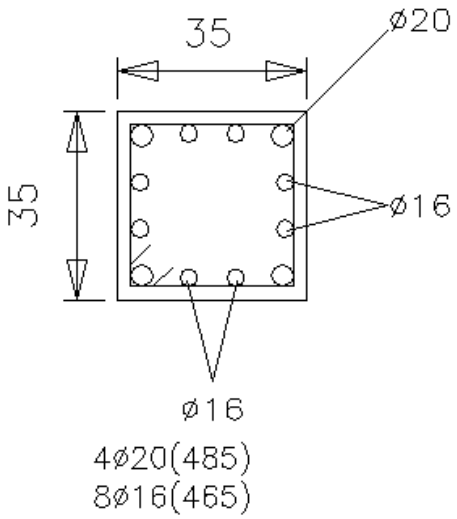

Figure 7. Squared section column example

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1.2.3 WALLS

Stairs, elevator hollows made of monolithic concrete wall.
The concrete we are going to use will be as in the hole building, HA – 25.
The exterior walls are made of expanded clay bricks with a thickness of 250 mm.

1.2.4 SLABS

Our slabs will be build with prestressed slab beams (Figure 8), is a kind of one-way slab. Our slab will contain:

- Prestressed reinforced concrete beams.
- Vaults, between prestressed beams. Its function will be to light the slab.
- Iron. Is the last step before the concrete.
- Concrete poured on site, for refilling all the hollows. Formation of the upper layer of the slab.

The floor surface is made of laminate flooring except the bathrooms, which are made of ceramic tile glued with cement. (Figure 9)

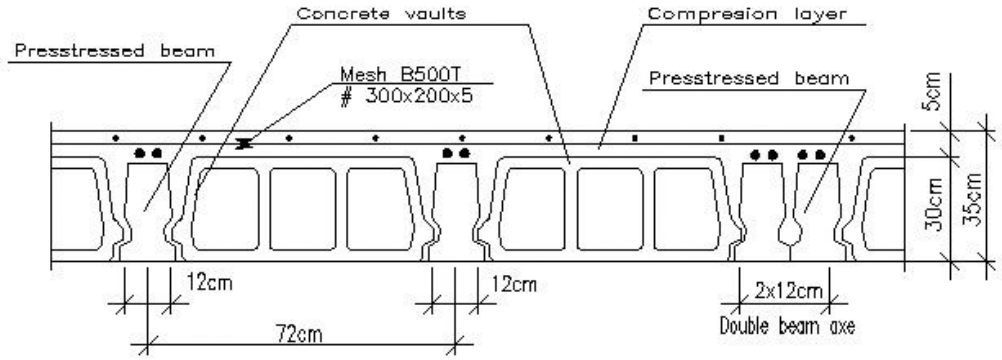


Figure 8. Prestressed beams slab example

In each floor, we are going to use three different kind of pavements, two ceramic kinds and our laminate flooring. The wardrobe will not have laminate flooring inside. One of our technological cards will be about laminate flooring pavement in each flat.

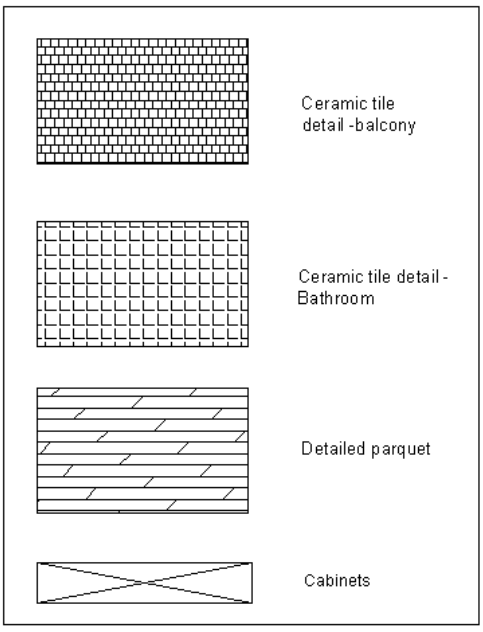


Figure 9. Different types of pavement in each flat

Below is shown all the areas of the third floor (Table 1)

3rd FLOOR			m^2	3rd FLOOR			m^2
1	**FLAT**			**7**	**FLAT**		
	a	Living room / kitchen	18.59		a	Living room / kitchen	23.16
	b	Main room	12.84		b	Main room	19.27
	d	Bathroom	3.93		c	Second room	12.59
	f	Entrance	1.74		d	Bathroom	6.16
	TOTAL		37.10		f	Entrance	3.62
	g	Balcony	4.14		**TOTAL**		64.80
2	**FLAT**				g	Balcony	7.02
	a	Living room / kitchen	40.70	**8**	**FLAT**		
	b	Main room	13.44		a	Living room / kitchen	34.48
	c	Second room	12.34		b	Main room	12.25
	d	Bathroom	6.98		c	Second room	11.33
	f	Entrance	7.99		d	Bathroom	6.14
	TOTAL		82.66		**TOTAL**		65.46
	g	Balcony	4.36		g	Balcony	4.46
3	**FLAT**			**9**	**FLAT**		
	a	Living room / kitchen	29.66		a	Living room / kitchen	31.92
	b	Main room	15.39		b	Main room	14.10
	c	Second room	11.33		c	Second room	13.88
	d	Bathroom	5.90		d	Bathroom	5.63
	f	Entrance	1.15		f	Entrance	3.77
	TOTAL		63.43		**TOTAL**		69.30
	g	Balcony	4.53		g	Balcony	2.34
4	**FLAT**			**10**	**FLAT**		
	a	Living room / kitchen	46.68		a	Living room / kitchen	24.63
	b	Main room	13.81		b	Main room	14.52
	c	Second room	23.71		c	Second room	12.56
	d	Bathroom	5.88		d	Bathroom	6.16
	TOTAL		90.08		f	Entrance	7.94
	g	Balcony	4.36		**TOTAL**		65.81
5	**FLAT**				g	Balcony	3.66
	a	Living room / kitchen	19.92	**11**	**FLAT**		
	b	Main room	11.66		a	Living room / kitchen	25.12
	d	Bathroom	5.29		b	Main room	13.03
	f	Entrance	6.51		c	Second room	10.27
	TOTAL		43.38		d	Bathroom	6.37
	g	Balcony	4.46		f	Entrance	5.91
6	**FLAT**				**TOTAL**		60.70
	a	Living room / kitchen	29.96		g	Balcony	6.28
	b	Main room	16.33	**12**	**FLAT**		
	c	Second room	16.33		a	Living room / kitchen	25.10
	d	Bathroom	6.58		b	Main room	13.25
	f	Entrance	3.82		c	Second room	10.27
	TOTAL		76.81		d	Bathroom	6.40
	g	Balcony	18.73		f	Entrance	5.91
					TOTAL		60.93
					g	Balcony	6.28

Table 1. Third floor areas

1.2.5 INTERNAL WALLS AND PARTITIONS

Inside each flat, plaster boards partitions walls have 10 cm of thickness; we will use this kind of partition except when we want to separate the bathrooms. In this case we will use porous expanded clay tiles walls with the same thickness.

One of the technological cards is about plaster boards partitions. Will be in this technological card, where will be explained everything.

Porous expanded clay tiles Partitions between apartments 250 mm with two 10mm coating, one for each side. The last step is to use paint.

1.2.6 STAIRS

Stair structure consists of a monolithic elements stairways and landings. Will be used reinforced concrete HA – 25 and some different kinds of iron B 500 S.

1.2.7 FACADE

Designed brick facades (ventilated facade decoration, construction, granite facade panels). Thermal insulation used in a non-combustible mineral wool. Balconies designed metal railing fence. Windows designed plastic frame with two glass tubes coated selective surface package.

1.2.8 HOME DECORATION

Sanitary units, wall and other wet room wall, along the entire height, is covered with glazed tiles. The walls of the other areas are covered with gypsum plasterboards, and then painted.

1.2.9 INSTALLATIONS

Water supply and sewerage

Projection of the building water supply facilities in the existing urban water supply networks. Domestic sewage water collected in plastic tubes and sewage discharged into urban sewage networks.

Heating and ventilation

Heating devices are radiators. Space for a natural ventilation system.

Electricity

Projected building is connected to an existing nearby transformer. Power consumption remains within the specifications issued.

1.2.10 FIRE SAFETY

The building will comply with all requirements of CTE (technical construction code) - SI Fire Safety.
The facades, partitions and ceilings shall be fire resistant. Stairs design allows quick evacuation in case of fire.
The building is designed for easy access by fire trucks.

1.2.11 HEALTH CONDITIONS

The building has been designed to meet all hygiene standards according to the CTE (Technical building code) - HS Health security.

1.2.12 ENVIRONMENT

The building will be conditioned by the environment. Domestic wastewater is led to the current urban sewerage networks and treatment plants in the city.
During all the works, the needs of the environment will be satisfied, being one of the most important issue.

1.2.13 DISABILITY NEEDS

The building is accessible for the disabled people, complying with all necessary regulations, being an excellent building for all of them.

1.2.14 LIFT AND MACHINERY

The building has three different elevators, one in each different block with a power load of 1000 kg.

2. CONSTRUCTIONAL PART

In this part, will be defined the foundation system, it will consist in footing foundation with tie beams and it will be like in figure 10, figure 11, figure 12 and figure 13. The computer calculations where made with CYPECAD program.

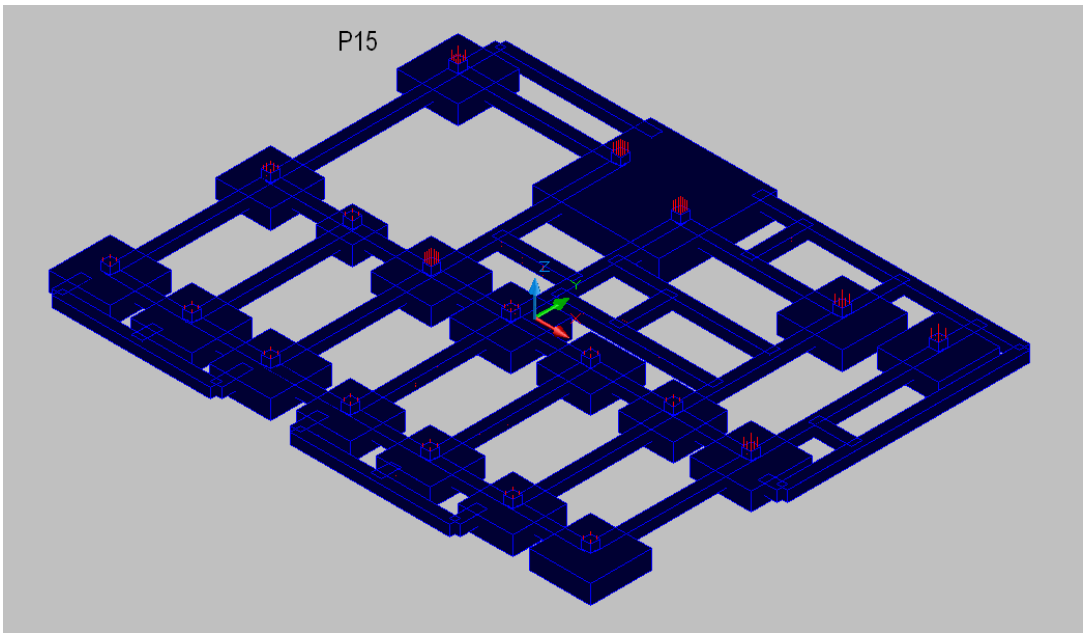


Figure 10. Isometric view of footing foundation design in the fifth floor block

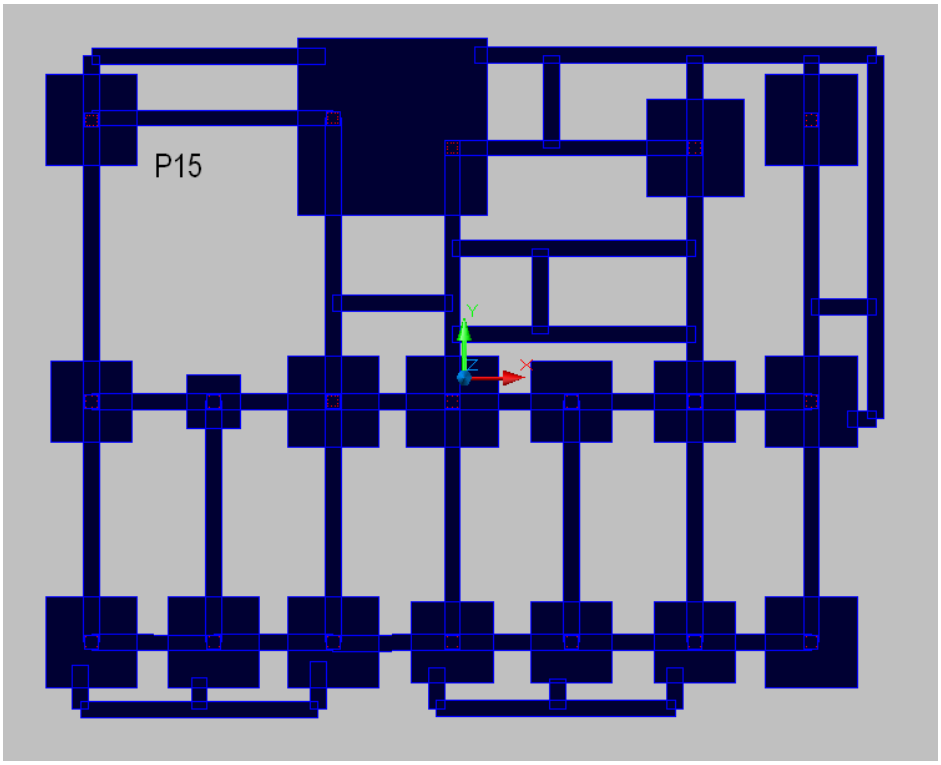


Figure 11. Aerial view of footing foundation in the fifth floor block

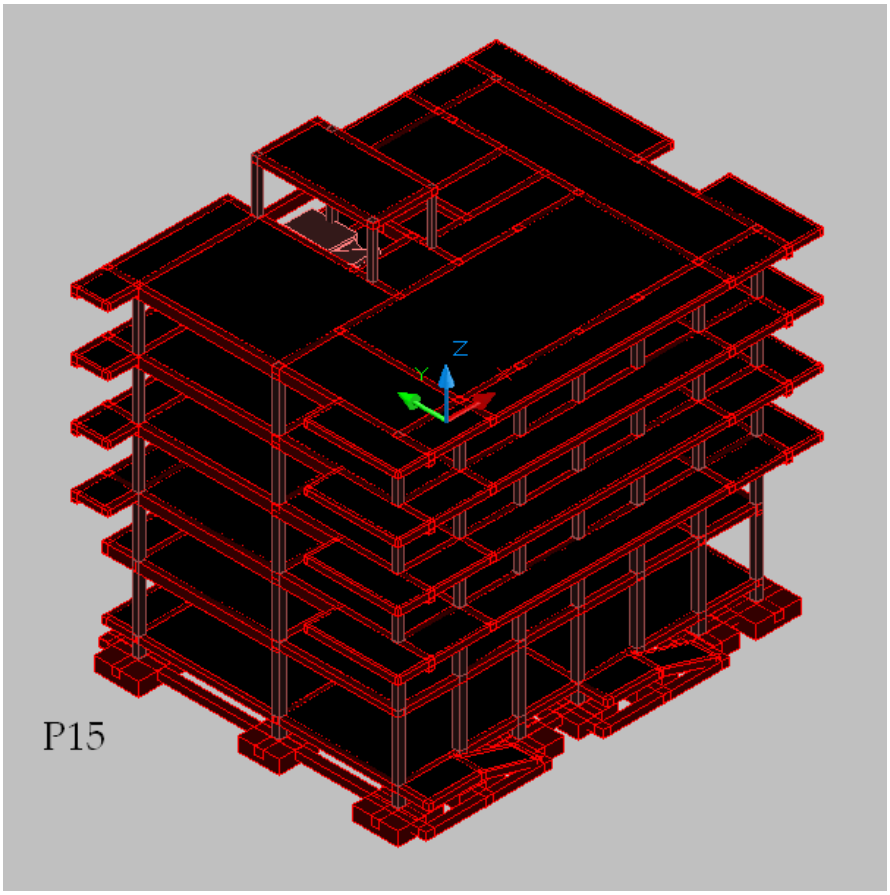


Figure 12. Isometric view of fifth floor block

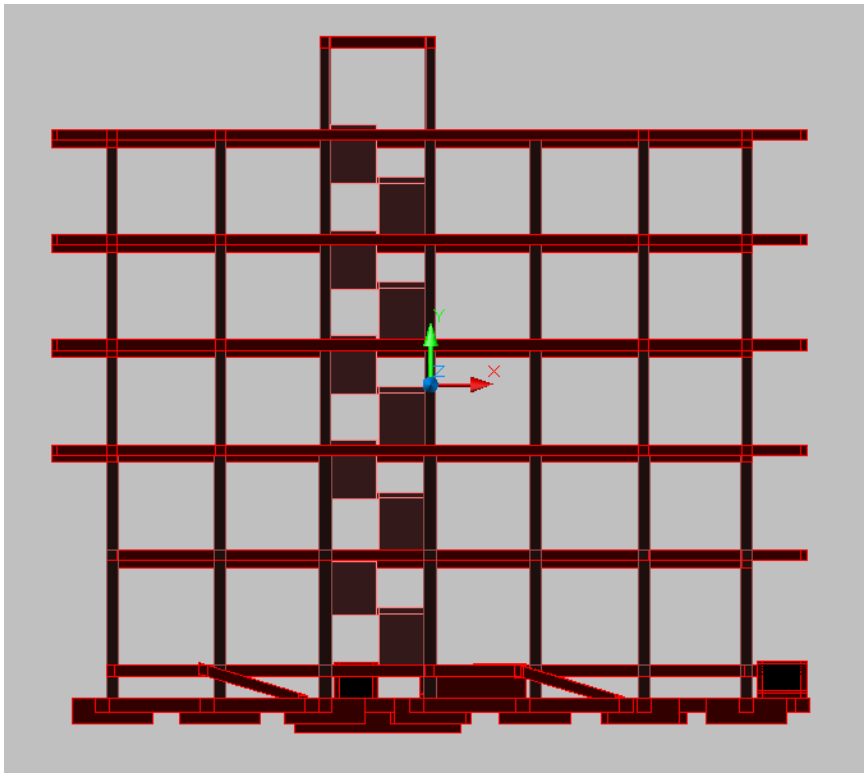


Figure 13. Front view of fifth floor block

2.1 DESIGN OF FOOTING FOUNDATION

2.1.1 INTRODUCTION

Will be studied the footing foundation of column P15 (35x35 cm), with dimensions of 230x230x70 cm.(figure 15)
The tests that are going to be performed are:
-Slip. Will be verified that the footing doesn´t slip due to the action of horizontal loads.
-Spill.
-Sinking. Will be verified that the land are not exhausted by the stresses transmitted by the foundation.

These three tests allow us to ensure that the size of the shoe is right for the acting loads.
Below will be done the footings structural calculations, setting the iron, and verifying that all the requirements established by the concrete standards EHE-08.
The loads acting on the footing are obtained from the corresponding plane (figure 14).

P15: Hypothesys	Axil	Mx	My	Qx	Qy
Permanent load	1066.49	0.08	1.47	0.23	4.26
Use overload	156.84	−0.04	0.25	−0.15	0.70
Wind +X exc.+	−2.96	4.39	2.04	12.83	6.17
Wind +X exc.−	−5.00	3.66	1.20	10.70	3.63
Wind −X exc.+	4.83	−7.16	−3.32	−20.94	−10.06
Wind −X exc.−	8.16	−5.98	−1.95	−17.46	−5.93
Wind +Y exc.+	56.52	−0.32	15.55	−0.95	46.98
Wind +Y exc.−	65.73	3.00	19.39	8.78	58.56
Wind −Y exc.+	−56.52	0.32	−15.55	0.95	−46.98
Wind I−Y exc.−	−65.73	−3.00	−19.39	−8.78	−58.56

Figure 14. Loads acting in P15 footing

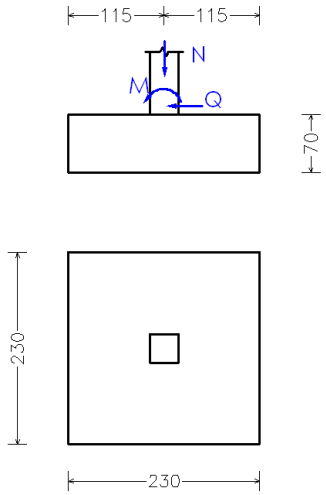


Figure 15. Dimensions of P15 footing
These loads are expressed en KN and meters.

As the most unfavorable combination should be adopted:

Permanent load + use overload + wind + Y exv.-.

Axil	1289.06
Mx	3.04
My	21.11
Qx	8.86
Qy	63.52

To simplify the development and because it is not really important, we will not take into account all the efforts along the X axis, and we will just use the next:

N	1289.06
My=M	21.11
Qy=Q	63.52

This fact makes that tests which are going to be made, will not match exactly with the computer results, which have been obtained by considering the bending along the axis x, being the differences very small.

2.1.2 CHARACTERISTICS OF THE MATERIALS

CONCRETE:

Concrete type	HA-25
Characteristic resistance	f_{ck}= 25 MPa
Deduction coefficient of concrete:	$\gamma_c = 1{,}5$
Specific weight of reinforced concrete	γ_H= 2.5 T/m^3=24.5 KN/m^3
Coating	d´= 5 cm

The weight of the footing W, is:

$$W = \mathrm{b} \cdot \mathrm{a} \cdot \mathrm{h} \cdot \gamma_{\mathrm{H}}$$

Being:

b: footing base lengh
a: footing base width
h: footing height
$\gamma_{H:}$ specific weight of reinforced concrete

$$\mathrm{W} = 2{,}3 \text{ x } 2{,}3 \text{ x } 0.7 \text{ x } 2{,}5 = 9{,}26 \text{ T} = 90{,}72 \text{ KN}$$

IRON

Type of iron in the armors	B500S
Characteristic resistance of iron	f_{yk}= 500 MPa
Deduction coefficient of the iron:	$\gamma_s = 1.15$

LAND

Allowable stress in the field:	σ_t= 3 kg/cm^2= 0,294MPa
Angle of internal friction:	ø=25º

2.2 TESTS

2.2.1 SLIP CHECKOUT

Must be complied:

$$(W+N)\cdot\mu > Q$$

μ , friction coefficient ground-concrete

Adopting:

μ = tg (2/3 ø)=tg (2/3 25)=0.3

Being ø the angle of internal friction of the land (25º)

$(W+N) = 90.72 + 1289.06 = 1379.78\,\text{KN}$

$(W+N)\cdot\mu = 413.08 > Q(63.52)$ SATISFIES

This test could have been overlooked because the footings are joined with tie beams.

2.2.2 SPILLING CHECKOUT

Let us now compare the stabilizing moments with spilling moments.(figure 16)
The spill will be in relation to A point.
Me= Stabilizer Moment
Mv= Spilling Moment
γ_v= Tipping safety coefficient

According to the CTE (Technical building code) , the safety factor should be equal or higher than 2.

Me= (W+N)·a/2= 1379.78 · 1.15=1586.74 KN·m
Mv= M+Q·h=21.11+63.52·0.70=65.574 KN·m

$$\gamma_v = \frac{M_e}{M_v} = \frac{1586.74}{65.574} = 24.2 > 2$$ SATISFIES

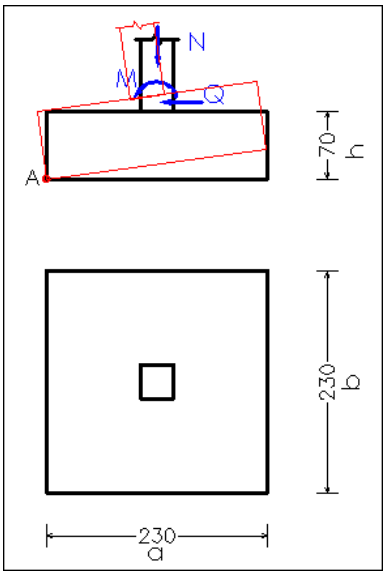


Figure 16. Spilling checkout

2.2.3 SINKING CHECKOUT

In this section we will see that the stresses transmitted by the foundation to the field are less than acceptable.
In case of non-uniform distribution, it is recognized that at the point of maximum tension exceeds in 25%, if the midpoint is less than the permissible (in our case 30 T/m2 o 0.294 MPa).

We estimate the eccentricity **e** in the base of the footing.

e= M´/N´
If e≥a/6, the stress distribution below the footing will be triangles.
If e<a/6, the stress distribution below the footing trapezoidal
M´, resultant moment at the base of the footing
N´, axially resulting in the base of the footing

M´= M+Q·h= 21,.1 + 63.52·0,7= 65.574 KN·m
N´= (W+N) = 1379.78 KN

$$e = \frac{M'}{N'} = \frac{65.574}{1379.78} = 0.0475\ m. < \frac{a}{6}(0.383\ m) \rightarrow$$
TRAPEZOIDAL DISTRIBUTION (figure 17)

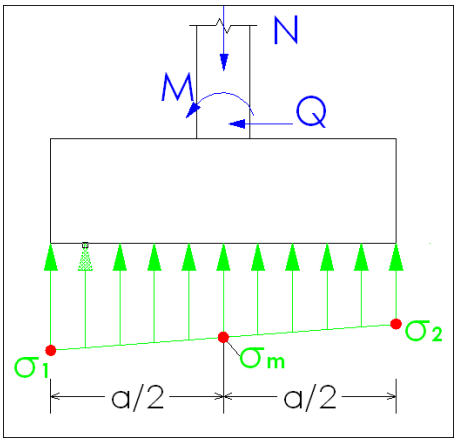


Figure 17. Trapezoidal distribution

Tensions those obtained by Navier's law:

$$\sigma = \frac{N'}{A} \pm \frac{M'}{w}$$

Where:

N´, the total axial base
A, core area of the footing
M´, resulting in the base moment
w, modulus of the base of the zapata

N´=1379.78 KN
M´= 65.574 KN·m
A= a x b = 2.3·2.3=5.29 m^2

$$w = \frac{b \cdot a^2}{6} = \frac{2.3 \cdot 2.3^2}{6} = 2.03\ m^3$$

$$\sigma = \frac{1379.78}{5.29} \pm \frac{65.574}{2.03}$$

$$\sigma_1 = 293.13 \frac{KN}{m^2} = 0.293\ MPa < 1.25\sigma_t\ (0.3675\ MPa) \rightarrow \text{SATISFIES}$$

$$\sigma_2 = 228.52 \frac{KN}{m^2} = 0.228\ MPa$$

$$\sigma_m = \frac{\sigma_1 + \sigma_2}{2} = 228.52 \frac{KN}{m^2} = 0.260\ MPa < \sigma_t\ (0.294\ MPa) \rightarrow \text{SATISFIES}$$

Therefore the dimensions of the footing are valid.

2.3 STRUCTURAL CALCULATION OF THE FOOTING

The computation is performed by the Spanish standard EHE-08 (Structural Concrete).

CLASSIFICATION OF THE FOOTING (ART 58.2):

$v_{max} = \frac{a+a1}{2} = \frac{230-35}{2} = 97.5\ cm < 2h\ (140\ cm) \rightarrow$ *RIGID FOOTING* (figure 18)

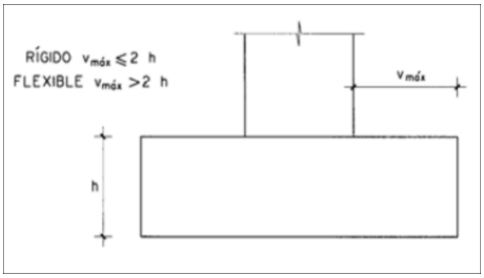


Figure 18. Footing calculation

2.3.1 FLEX CALCULATION

The reference sections according to EHE-08 are located inside face of the column, at a distance of 0.15 . a1, being a1 the width of the column as shown in the figure 19:

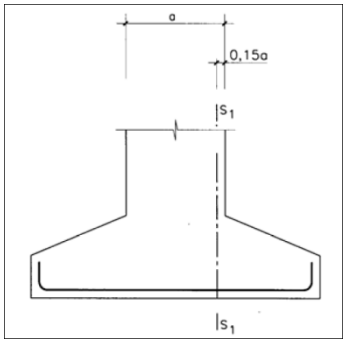


Figure 19. Flex calculation

The reference sections in our case are shown in Figure
Although we have 4 sections of reference, in this case due to the squared footing and for having a trapezoidal pressure distribution is enough to study the S1 section, featuring the identical iron in the perpendicular direction.
Moreover, as we will see later, the armed is not made because of the moment, is made

for geometric level, so in the section S3 and S4, because is a lower moment than the S1, it would be armed also because of the condition of minimum geometric size.
We will calculate M1 bending moment distribution originating trapezoidal in section S1(figure 20), and subtract the bending moment due to the weight of the footing M2. (figure 21)

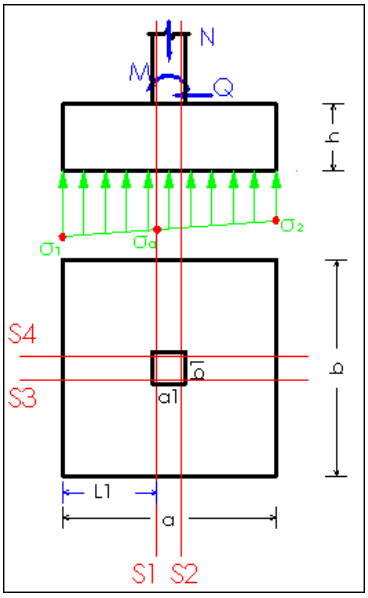


Figure 20. Reference sections

$$\boldsymbol{L1 = v_{max} + 0.15 \cdot a1} = 97.5 + 0.15 \cdot 35 = 102.75\ cm$$

On the geometric relationships of pressure on the trapeze, you can get the value of σ_a.

$$\boldsymbol{\sigma_a = \sigma_2 + \frac{\sigma_1 - \sigma_2}{a} L1 = 0.228 + \frac{0.293 - 0.228}{2.30} 1.0275 = 0.257\ MPa}$$

To determine the M1 moment that incurred in the trapezoidal distribution in the reference section, is decomposed in a rectangular and triangular, which give rise respectively M1R and M1T.

$$M1 = M1_R + M1_T$$

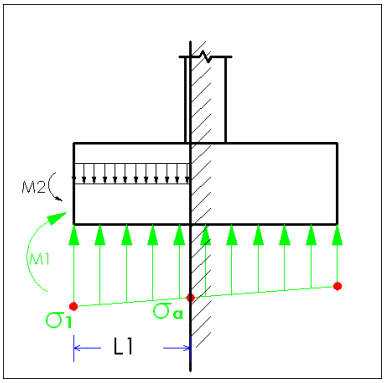


Figure 21.M1 and M2

$$M1_R = \frac{\sigma_a \cdot L1^2}{2} \cdot b$$

Figure 22. $M1_R = \frac{257 \cdot 1.03^2}{2} \cdot 2.3 = 312.03\ KN \cdot m$

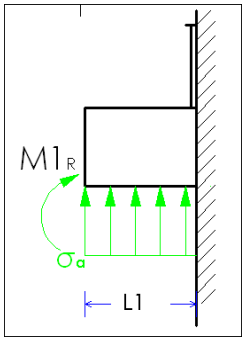


Figure 22.M1R

$$M1_T = \frac{\sigma_1 - \sigma_a}{2} \cdot L1 \cdot b \cdot \left(\frac{2}{3} \cdot L1\right)$$

$$M1_T = \frac{293 - 257}{2} \cdot 1.03 \cdot 2.3 \cdot \left(\frac{2}{3} \cdot 1.03\right) = 29.14\ KN \cdot m$$

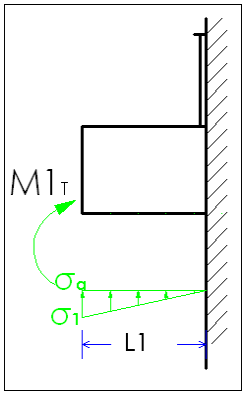


Figure 23. M1T

Figure 23. $M1 = M1_R + M1_T = 312.03 + 29.14 = 341.17\ KN \cdot m$

At this point M1 (positive), which causes traction on the underside of the footing, should be subtracted the bending moment M2 which causes the weight of the footing respect to the reference section S1.

The distributed load due to self weight q_p (figure 24):

$$q_p = \gamma_H \cdot h \cdot b$$

$$q_p = 24.5 \cdot 0.7 \cdot 2.3 = 39.445\ KN/m$$

$$M2 = -\frac{q_p \cdot L1^2}{2}$$

$$M2 = \frac{39.445 \cdot 1.03^2}{2} = -20.92\ KN \cdot m$$

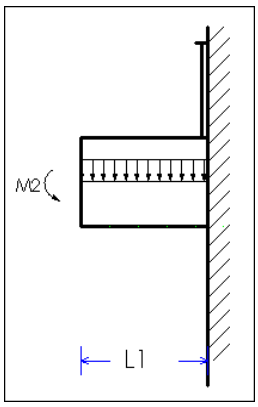


Figure 24. M2 calculate

This moment is negative, That is to say that produce traction on the upper surface of the footing.

The total time in the reference section would be:

$$M_{S1} = M1 + M2$$

$$M_{S1} = 341.17 - 20.92 = 320.25\ KN \cdot m$$

For calculating the armor, we put this value M_{S1} With a 1,5 coefficient, so the section S1 moment is:

$$M^*_{s1} = \gamma_a \cdot M_{S1}$$

$$M^*_{s1} = 1.5 \cdot 320.25 = 480.375\ KN \cdot m$$

FOR THE CALCULATION OF THE LONGITUDINAL REINFORCEMENT IN THE FOOTING TO PROVIDE WILL BE USED THE STANDARDS OF EHE-08, ATTACHMENT 7 º. Simplified calculation of sections Depletion Limit State against any normal action.
REPRESENT NEUTRAL FIBER PLACED A LIMIT DEPTH XL = 0.625 D .(Figure 25)

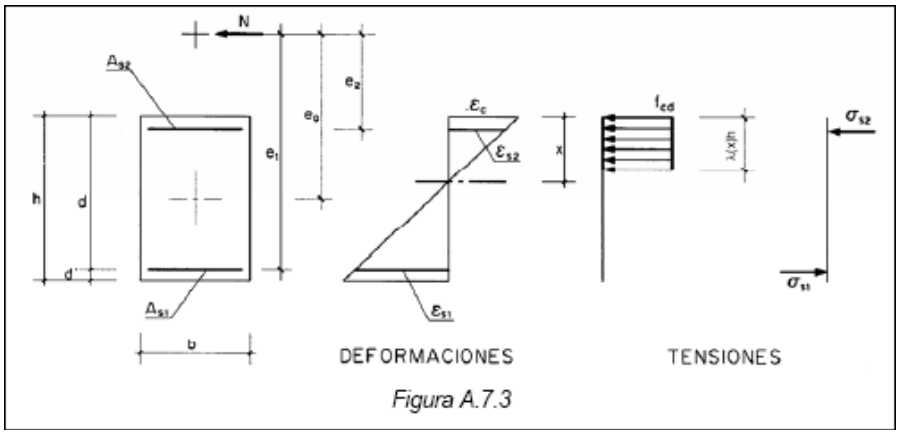
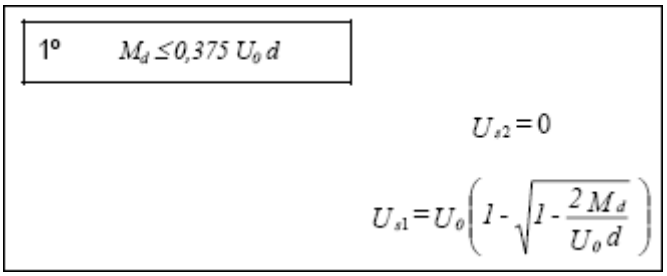


Figure 25. Neutral fiber



Where:

$$\mathbf{M_d = M^*_{s1} = \ 480.375\ KN \cdot m}$$

$$\mathbf{f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 434.78\ MPa}$$

$$\mathbf{U_{s1}\ = f_{yd} \cdot A_{s1}}$$

$$f_{cd} = \frac{f_{cd}}{\gamma_c} = \frac{25}{1.5} = 16.66\ MPa$$

$$\mathbf{d = h - d' = 0.70 - 0.05 = 0.65\ m}$$

$$\boldsymbol{U_0 = f_{cd} \cdot b \cdot d = 16.66 \cdot 2.3 \cdot 0.65 = 24.9 \cdot 10^6\ N = 24.9 \cdot 10^3\ KN}$$

$$\mathbf{0.375 \cdot U_0 \cdot d = 0.375 \cdot 24.9 \cdot 10^3 \cdot 0.65 = 6071\ KN \cdot m}$$

So, the condition will be satisfied $\mathbf{M_d \leq 0.375 \cdot U_0 \cdot d}$

Will not be needed to have the armor in the compressed area (top side) being Us2 = 0.
It is determined the mechanical ability of the tensile reinforcement:

$$\boldsymbol{U_{S1} = U_0 \left(1 - \sqrt{1 - \frac{2M_d}{U_0\, d}}\right);}$$

$$\mathbf{U_{S1} = 24.9 \cdot 10^3 \cdot \left(1 - \sqrt{1 - \frac{2 \cdot 480.375}{24.9 \cdot 10^3 \cdot 0.65}}\right) = 750.34\ KN;}$$

$$\mathbf{A_{s1} = \frac{U_{s1}}{f_{yd}} = \frac{750.34 \cdot 10^3}{434.78} = 1725.8\ mm^2;}$$

The armor cannot be less than the amount of minimum mechanical or geometric minimum amount.

2.3.2 MINIMUM MECHANICAL CLAIMS (ARTICLE 42.3.2 EHE-08)

To avoid breakage without notice achieved in the concrete tensile strength than is required (for rectangular and concrete strength less than 500 N/mm2):

$$\mathbf{A_s \geq 0.04 \cdot A_c \cdot \frac{f_{cd}}{f_{yd}}}$$

$$\mathbf{A_s \geq 0.04 \cdot 650 \cdot 2300 \cdot \frac{16.66}{434.78} = 2291.43\ mm^2}$$

2.3.3 GEOMETRIC MINIMUM AMOUNT (RULE 42.3.5 EHE-08)

Tabla 42.3.5. Cuantías geométricas mínimas, en tanto por 1000, referidas a la sección total de hormigón

Tipo de elemento estructural	Tipo de acero	
	Aceros con $f_y = 400 N/mm^2$	Aceros con $f_y = 500 N/mm^2$
Pilares	4,0	4,0
Losas (*)	2,0	1,8

Table 2: Minimum geometric amounts, referred to the total concrete section.
In our case, the only armor available at the bottom of the footing, the geometric size ρ must be higher than 0.9 ‰:

$$\boldsymbol{\rho = \frac{A_S}{A_C} \geq 0.0009}$$

$$\boldsymbol{A_S \geq 0.0009 \cdot A_C = 0.0009 \cdot h \cdot b = 0.0009 \cdot 650 \cdot 2300 = 1345.5\ mm^2}$$

2.3.4 SUMMARY

Of the values of area, we will take the biggest:

STRICT ARMED (FOR CALCULATION)

$$\mathbf{A_{s1} = 1725.8\ mm^2}$$

CLAIMS BY MECHANICAL:

$$\mathbf{A_s \geq 2291.43\ mm^2}$$

AMOUNT OF GEOMETRIC:

$$\mathbf{A_S \geq 1345.5\ mm^2}$$

We adopt the value of claims mechanical assembly

$$\mathbf{A_s \geq 2291.43\ mm^2}$$

$$\boldsymbol{n \cdot \frac{\pi \cdot \emptyset^2}{4} > 2291.43}$$

The number of bars will be, adopting 20mm:

$$\boldsymbol{n \cdot \frac{\pi \cdot \emptyset^2}{4} > 2291.43}$$

$$n > \frac{2291,43 \cdot 4}{\pi \cdot 20^2} = 7,3$$

We chose for the Armed 8 bars of 20 mm in each direction.

Bars distributed evenly, and leaving a coating side of 8 cm, the separation between bars is 28.3 cm, the maximum permissible recorded by the standard (30 cm).

Shear Testing

Although testing is done on computer, it is not necessary rigid footings as the EHE-08, art. 58.4.1.1

Anchorage (Art. 69.5.1.2 EHE08)

Anchorage length of the bars would be:

- Para barras en posición I:

$$l_{bI} = m\,\varnothing^2 \geq \frac{f_{yk}}{20}\varnothing$$

- Para barras en posición II:

$$l_{bII} = 1,4\,m\,\varnothing^2 \geq \frac{f_{yk}}{14}\varnothing$$

For bars in I and II position.

Bars are in I position
The value of m (art 69.5.1.2.a), for iron B500S yHA 25, is 1,5

So, the ancorage lenght is:

$$\boldsymbol{L_{bI} = m\varnothing^2 = 1,5 \cdot 20^2 = 600\ mm}$$

This lenght will count from the reference section S1
With constructive basis, will be to the end and pin double in 20 cm. Figure 26.

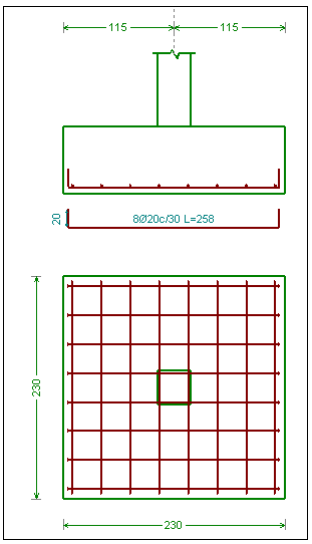


Figure 26. Iron distribution.

3. TECHNOLOGICAL CARDS

3.1 TECHNOLOGICAL CARD OF LAMINATE FLOORING INSTALATION FOR THIRD FLOOR

3.1.1GENERAL DESCRIPTION

This technological card consists in the parquet flooring installation of the third floor, of our building.

Will be used this kind of surface in all the 72 flats. Total surface of all the apartments is 4585.05 m^2, we are going to use parquet in all the surface except in bathrooms and balconies.

The floors of bathrooms and balconies should be implemented before others.
Before starting the installation of parquet flooring, must be complete all the masonry, installations and coatings.

The ability to put this without removing the existing pavement, as well as the speed of installation, makes it the most common soil type in reforms, But it is always advisable to remove the existing pavement if we talk about a reform.

This type of soil, relatively new, gets finished with the same visual quality than solid wood parquet, surpassing even in some aspects, such as dimensional stability, as it prepared the successive layers perpendicular to the grain, the deformation of parts due to humidity or temperature decrease. The multilayer parquet usually incorporates, as well as synthetic parquet floors, a click-type anchorage system.

3.1.2 DESCRIPTION OF TECHNOLOGY AND SEQUENCE OF WORKS

Laminate flooring is is a highly developed type of pavement over the last years in Spain, due to many reasons.

There are basically two types of synthetic material (mutants to wood) and natural wood. I have chosen the natural wood because it is of superior quality.
The mark of our laminate flooring supplier will be "KÄHRS".

This laminate flooring consist of two sheets rather differences among them, the bottom 10 mm of cheap wood and hardwood top 4 mm.
The dimensions of our Laminate flooring are 1830 mm, with a thickness of 14 mm and with a width of 129 mm.

Below, are described the works, bearing in mind that should begin when the support surface is completely clean

Works order:

1. Polyethylene Film placement
2. Placement of natural hardwood tables
3. Placement of skirting
4. Varnish

1. Polyethylene Film placement

The first step is to place a polyethylene film of 2 mm thick.
This material is supplied in large rolls of a meter wide.
Should be deployed the roll to suit the geometry of space requirements, making 20 cm overlap different layers.
Finally we will fix with adhesive tape because we don´t want any kinds of movements.

2. Placement of natural hardwood tables

Natural wood tables are supplied in boxes of 30 kg, so it can be transported comfortably.
The fixation system is called clicking; each piece has two parts, male and female.
Must be put the male against the wall always, and at the same time, we will also need wedges of separation to allow the expansion of this kind of materials.
Now could start joining all the different pieces with the clicking system.
When is needed to adjust a piece to a particular form, will be used a wood sawing machines.

3. Placement of skirting

When all the wooden parts are assembled, we proceed to the placement of the skirting board. To do this, we use a wood adhesive rather than nails, because we do not want to see them. Finally we push all the skirting boards against the wall and that is all.

4. Varnish

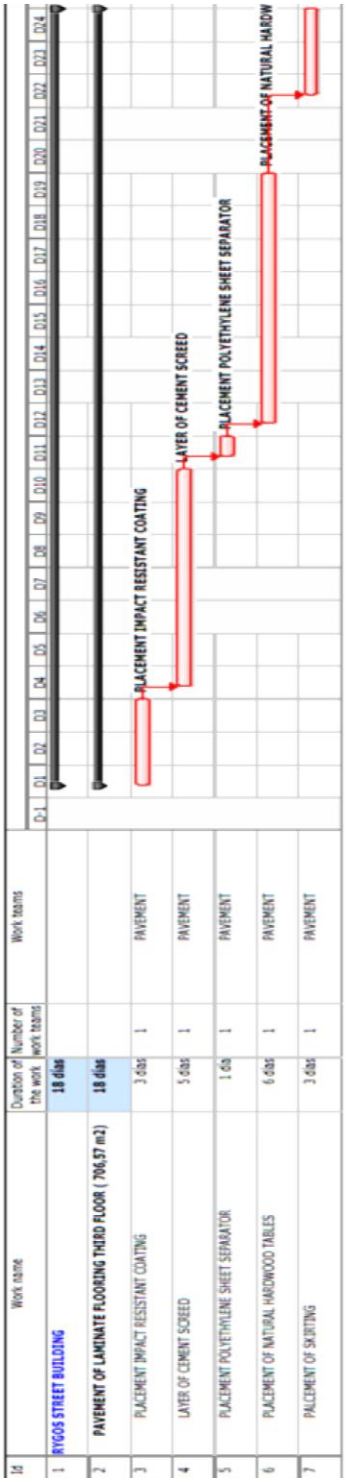
This may take 7 layer of varnish to keep the pieces for the desired time. It can be varnished at the factory or on site. Our choice will be to receive the varnished pieces.

3.1.3 INSTALLATION SEQUENCE. FROM 1 TO 12

The works sequence will be as sown bellow (figure 27), beginning from one to twelve. The accesses will be in each block stairs obviously.

Figure 27. Installation sequence of the laminate flooring

ORGANIZATION OF WORKS



3.1.4 HUMAN SAFETY

Although the works cannot be considered dangerous, the work will be carried out in accordance with health and safety rules in construction request.

1. Workers are allowed to work only with the knowledge of safety equipment.
2. Each worker must use protective equipment (special clothing, footwear, gloves and respirators).
3. For mixtures, workers should wear gloves and goggles.
4. Collection of unnecessary materials and debris from the workplace.
5. Electrical equipment should be grounded.
6. All electrical devices must be absolutely clean.
7. All cables must be in perfect condition.

3.1.5 MATERIAL – TECHNICAL RESOURCES

Num	NAME	UNITS	QUANTITY
1	**Machines**		
1.1	Chainsaw wood	Unit	1
2	**Materials**		
2.1	Polyethylene Film	m2	706,57
2.2	Natural hardwood tables varnished	m2	706,57
2.3	Skirting	m	623,11
2.4	Adhesive	L	1
2.5	Adhesive tape	m	350
3	**Tools**		
3.1	Hammer	Unit	1
3.2	Level	Unit	1

3.1.6 QUALITY CONTROL

1. Control of material

Should be checked before and during installation each piece of the laminate flooring if they would have any damage. You cannot use pieces that look at flaws or damaged. The installation should be done only in daylight or with adequate lighting, because they may not be able to recognize damaged or defective pieces.

2. To acclimate the Laminate flooring before installation

The laminated parquet pieces must stay a minimum of 48 hours at a temperature above 17 ° C and a humidity of 50-65% in the room where will be installed. The unopened packages must be adapted to the climatic conditions of the room. In the case of very large differences between the point of storage and room to install you have to prolong this period of acclimation.

3. The ground state

All subfloors must be leveled (maximum difference 3 mm by 1 m long), dry and solid enough. The large slopes must be equaled with a special product called “leveler paste”. Basement areas should not have or cracks or breaks. Particles or basements that are not completely glued (PVC flooring or carpet) must be removed.

4. Steam barrier for minerals subsurface

In dry and minerals soils is very important to install a polyethylene sheet with a thickness of 0.2 mm to prevent remaining moisture from reaching the back of the planks of laminate.
The polyethylene sheet acts as a brake.

---

5. Expansion joints

The laminate flooring substrate is made of a material based on wood particles, such as natural wood also expands according to weather conditions. It is therefore important to maintain a corresponding distance (called "expansion joint") to all walls and all fixed objects in the room. You have to keep expansion joints when you have a facility that exceeds the previously defined measures. An expansion joint is too small is the most common mistake on the premises. Often is not noticed until the summer because during those months laminate flooring expands automatically because of the high humidity and temperature.

Keep an expansion gap of at least 8mm *. In larger areas, this board has to be higher. Generally one can say that: per meter of pavement is needed at least 1.5mm of expansion joint on both sides of the room. (An example: A room with 5m wide = at least 8mm expansion joint on each side of the room).
Note: min. 15mm with a relative humidity> 65%.

Although the material installed only is in contact with a wall or fixed object can occur if the floating floor to bulge. Weaknesses are the doorways, the connection points to the stairs, the heating pipes and profiles of closure.

Heavy objects such as kitchen units or cupboards (the pavement at these points can move only sideways) require that on the opposite side of the room has an expansion

joint twice as wide. We recommend mounting heavy objects prior to installation. Then install laminate flooring, just to get to the furniture.
This allows you to recover the ground at any time and easily. Expansion joints are plugged into wall sockets / baseboards and other locations with special profiles.

6. Position of expansion joints

Since laminate flooring expands depending on weather conditions, it will need in the following cases expansion joints min. 8mm:

-large areas (greater than 8 x 12m).

-areas with many angles.

-continued from one installation to the next room.

These expansion joints are covered with appropriate transition profiles.
Note: Damages arising from failure to stop expansion joints will always by the installer.

7. The optical setup

You can do an installation of laminate planks set both regular and irregular one.
Make sure the gap bevel heads fit the minimum is 30 cm.

8. The direction of the facility / level of stay

For optical reasons, we recommend installing the longitudinal part of the blade transverse to the length of the room.

Stay this way optically appear more square, larger and not close in a "tube". This is not a general rule, since we must also take into account the natural light sources (windows, etc..), it is advisable to steer the direction of the blades at right angles (to the line of the window) because to the positioning of the front and a few feet away unless unions see pieces and obtain a greater sense of space, just as in the rectangular environment, install the pavement parallel to the longest side of the room, gives us a sense in length. That said, it is up to the customer and their interests as the disposition of these parameters. Note that the sense of pieces (in the laminate flooring) should not affect the durability of them.

3.1.7 SOME DETAILS

Bellow will be shown some details, for a better understanding.
In figure 28 is shown how is the click system for joining the pieces.

Figure 28. Click system

Figure shows when the laminate flooring finds the wall. We should leave a small space (more or less 1cm) because the laminate flooring usually expands some millimeter.

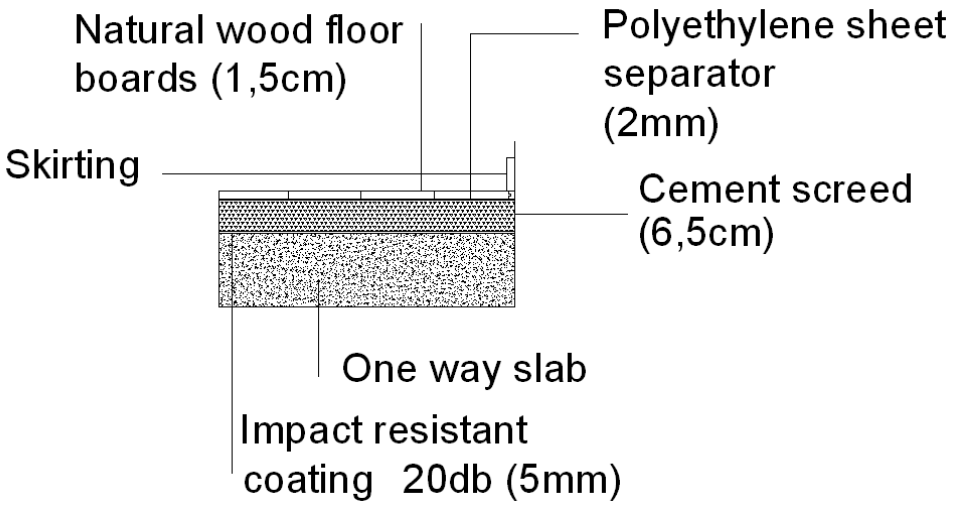


Figure 29. Pavement finding the wall

The most important thing is that, all the pavements are going to meet should be in the same level (figure 30), a good way to do is give more or less thick to the layer of semi-dry cement.

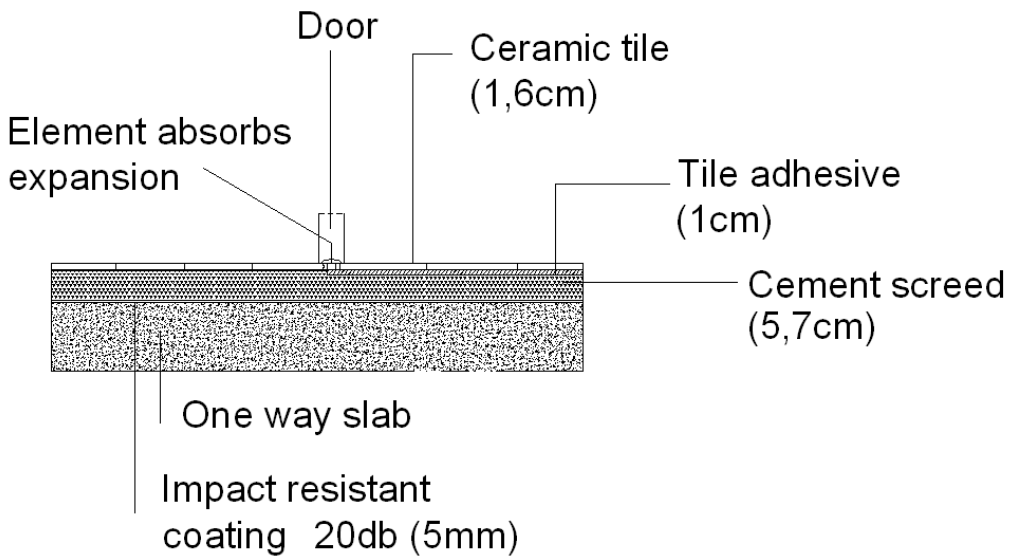


Figure 30. Meeting of two different pavements

3.1.8 REPRESENTATION OF THE LAMINATE FLOORING INSTALATION 3D SKETCHUP 8.0 DETAILS.

For the realization of the works, we are just going to need two workers, one officer and one regular worker (Figure 31). Figure 32 shows once more the click system.

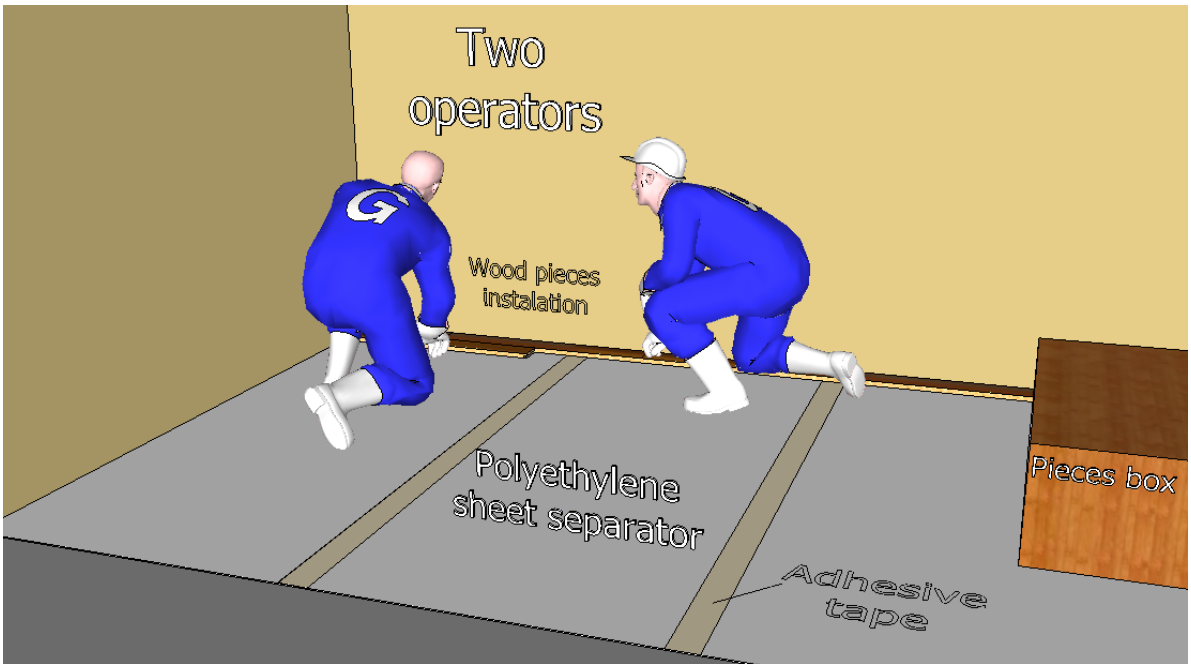


Figure 31. Laminate flooring installation

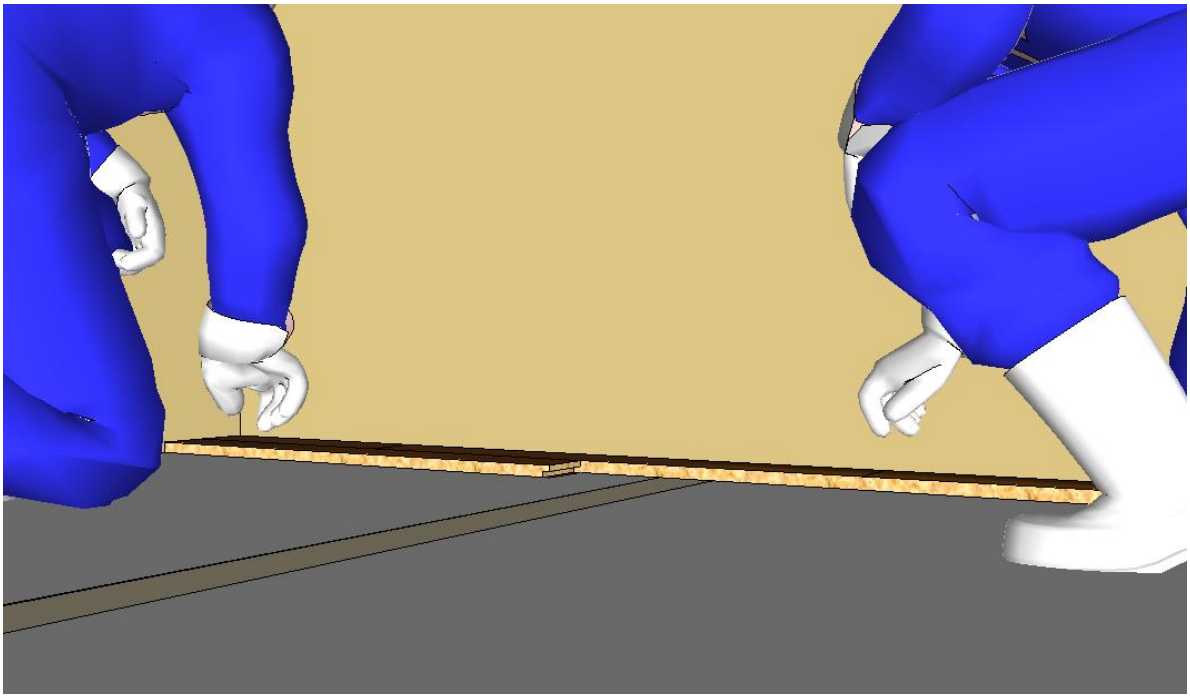


Figure 32. Detailed click system

3.1.9 CALCULATION OF QUANTITY OF WORKS AND PRICE

Codec	Nat	Ud	Summary	CanPres	PrPres	ImpPres
02	**CHAPTER**		**PAVIMENTS**	**1**	**77.164,51**	**77.164,51**
E11RMF020	Partida	m2	OAK FLOATING STAGE 14mm. Floating Floor 1830x129x14 mm pallet., oak, extra class (s / UNE 56809-1:1974), dovetailed on all four sides with two coats of UV drying and two coats of polyurethane varnish finish, set with clips every 70 cm., polyethylene sheet placed over 2 mm cell. with film thickness of 0.2 mm polyethylene. incorporated anti-vapor barrier, placed on screed floor, not including this one, i / pp scrapbooks and skirting of the same material.	706,57	109,21	77.164,51
O01OB150	Workers	h.	Official 1st carpenter	0,300	18,12	5,44
O01OA070	Workers	h.	Regular worker	0,300	15,35	4,61
P08MT143	Material	m2	Solid oak flooring 1830x129x14 mm.	1,050	84,98	89,23
P08MR180	Material	m.	Solid oak skirting	1,150	3,76	4,32
P08MA100	Material	m2	Clips system	1,000	2,37	2,37
P08SW065	Material	m2	Polyethylene 2mm. sheet Defogger	1,050	3,09	3,24
				706,57	**109,21**	**77.164,51**
				1	**77.164,51**	**77.164,51**
			TOTAL (€)			

Total costs for one floor: 77.164,51 Euros or 266.430 Litas.

CHECKING ALL THE SURFACES:

1º 18.59 + 12.84 + 1.74 = 33.17
2º 40.70 + 13.44 + 12.34 + 7.99 = 74.47
3º 29.66 + 15.39 + 11.33 + 1.15 = 58.53
4º 46.68 +13.81 + 23.71 = 83.2
5º 19.92 + 11.66 + 6.51 = 38.09
6º 29.96 + 16.33 + 16.33 + 3.82 = 66.44
7º 23.16 + 19.27 + 12.59 + 3.62 = 59.64
8º 34.48 + 12.25 + 11.33 = 58.06
9º 31.92 + 14.10 + 13.88 + 3.77 = 63.67
10º 24.63 + 14.52 + 12.56 + 7.94 = 60.65
11º 25.12 + 13.03 + 10.27 + 5.91 = 54.33
12º 25.10 + 13.25 + 10.27 + 5.91 = 54.53
TOTAL: 33.17 + 74.47 + 58.53 + 84.2 + 38.09 + 66.44 + 59.64 + 58.06 + 63.67 + 60.65 + 54.33 + 54.53 = 706.57

3.1.10 TECHNICAL - ECONOMIC INDICATORS

1. Quantity of works: 706.57m^2
2. Installation costs: 77.164,51 € or 266.430 Litas
3. Duration of works: 50 days / 9 floors = 5.55 days
4. Wage: Official: 22.2h x 18.12€ = 402.264 € or 1387.8 Litas
   Regular worker: 22.2h x 15.35€ = 340.77 € or 1278 Litas

3.2 PLASTER BOARDS PARTITIONS – TECHNOLOGICAL CARD

3.2.1 GENERAL

This card technological consist of the construction of interior partitions between houses with gypsum boards on the third floor of our building.
Will be used this kind of surface in all the 72 flats.
It was chosen this type of material for the realization of partitions for its quick and easy installation, in addition to its ease of hosting facilities.
Will be used this material in our building for separating rooms, except wet areas , because this material could have some problems with humid.
Gypsum boards partitions will be made before the laminate flooring pavement.
To separate wet areas of other rooms, should be used other materials, hollow bricks (7cm).
Could be used plaster boards moisture resistant, but will not be reasonable to spend a lot of money because the prize of this material is very expensive.

3.2.2 DESCRIPTION AND CONSTRUCTION SEQUENCE

The basic components of our walls are metal studs and gypsum boards.
These boards will have the following dimensions:

-Width: 600 to 1200 mm
-Height: from 2400 to 3000 mm
-Thickness: 6.5 to 23 mm

The ones we choose are: 1200mm wide, 2400mm high (will be conditioned by the height of the housing) and 15mm thickness.

There is the option of introducing soundproofing in the partition, in order to provide more soundproofing.

Will be used the trademark "KNAUF" for their reliability and warranty.
Below, are described the works, bearing in mind that should begin when the support surface is completely clean.

Construction sequence:

1. Stake in the ground with Tracer.
2. Placement of beams and uprights.
3. Placement of the door frame.
4. Installation of gypsum boards.

5. Mudding and taping joints.
6. Coating.

1. Stake in the ground with Tracer.

First of all, we need to rethink on the floor with Tracer.

2.Placement of beams and uprights.

The floor and roof rails have to locate with great precision, this step is very important.
Under the rail, place a tight band.
Then, we will set screw studs to floor and ceiling, to ensure stability.
Once done, we can start by installing the uprights, to be ready every 40 or 60 cm.

3.Placement of the door frame.

For doors, we will set the frame to the metal frame with screws.
The threshold should be properly enforced.

4.Installation of gypsum boards.

Once this is done, proceed to the plate installation on one side, with screws.
Then we put all the facilities which have to cross the partition.
Then proceed with the placement of the insulation between both sides of the partition.
Once completed, we install the plaques on the other side.

5. Mudding and taping joints.

At this time we start the meetings coating substances, that are not joints.
In the joints between panels apply a first coat of filler and then placed a ribbon across the height of the plate, properly ironed.
To extend the second layer, we expect the drying of the previous. The last layer will be the third, which we call the finish coating.
The corner boards, they are running in the same way as the previous.
Not be overcome tapes on other boards.

6. Coating.

Finally the plasterboards partitions will be painted as a coating, giving the partitions a more attractive appearance. We will use paint for gypsum plasterboards partitions.

3.2.3 INSTALLATION SEQUENCE. FROM 1 TO 12

Bellow (figure 33) is shown the sequence installation of plasterboard partitions from 1 to 12 should be taken into account that we will have three different access.

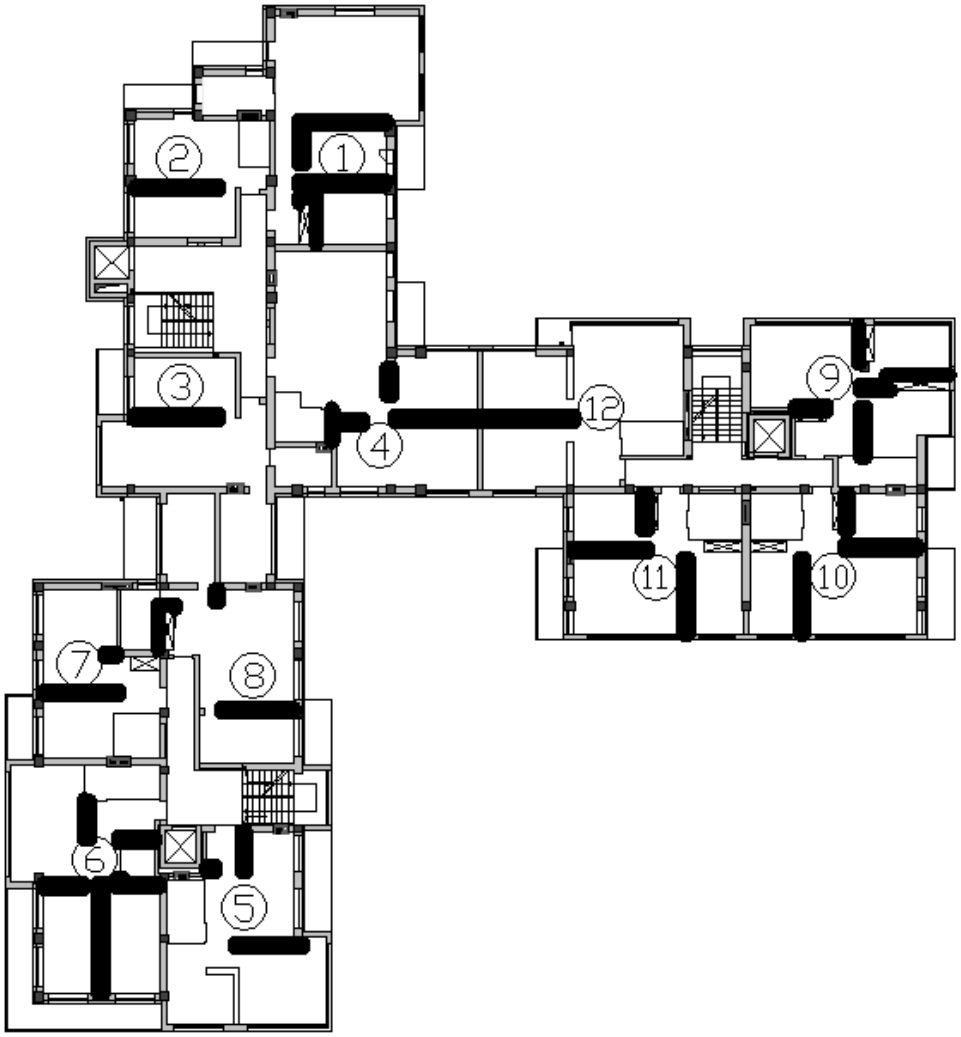
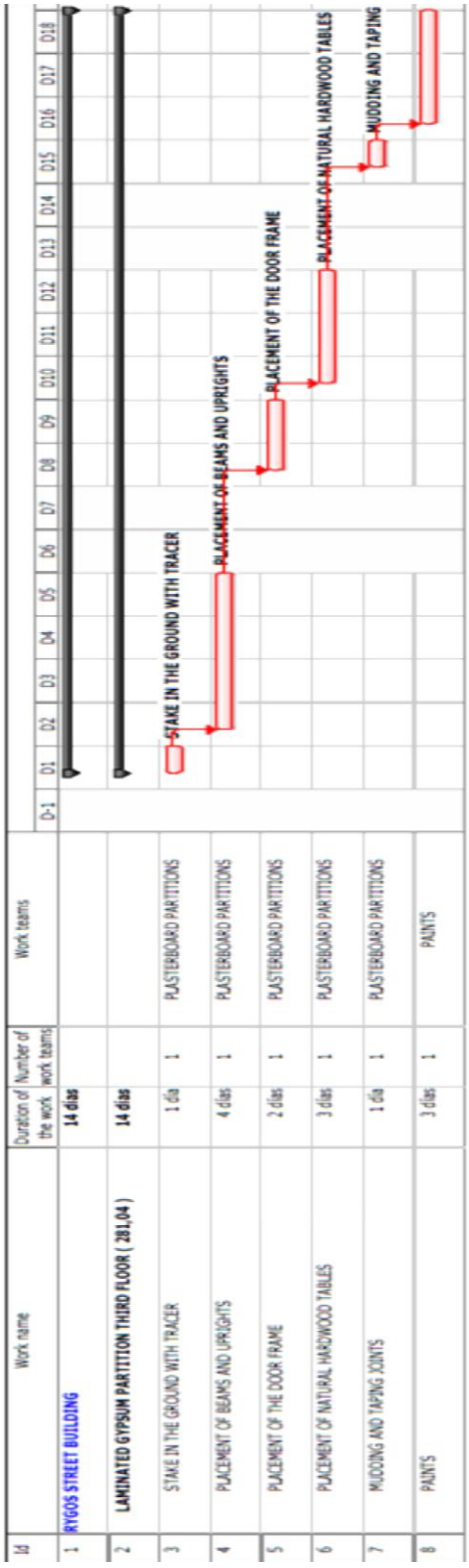


Figure 33. Installation sequence of the plasterboard partitions

ORGANIZATION OF WORKS



3.2.4 HUMAN SAFETY

Although the works cannot be considered dangerous, the work will be carried out in accordance "with health and safety rules in construction request".

1. Workers are allowed to work only with the knowledge of safety equipment.
2. Each worker must-use protective equipment (special clothing, footwear, gloves and respirators).
3. For mixtures, should workers wear gloves and goggles.
4. Unnecessary collection of materials and debris from the workplace.
5. Should be grounded electrical equipment.
6. Must Be all electrical devices absolutely clean.
7. All cables must me in perfect condition.

3.2.5 MATERIAL – TECHNICAL RESOURCES

Num	NAME	UNITS	QUANTITY
1	**Machines**		
1.1	Drill screw	Unit	1
2	**Materials**		
2.1	Elastic band	m	150
2.2	Screws	unit	600
2.3	Crossbars and uprights	m	120
2.4	Plaster boards	m	208
2.5	Adhesive tape	m	221
2.6	Jointfiller	L	5
2.7	Paint	L	10
3	**Tools**		
3.1	Hammer	Unit	1
3.2	Level	Unit	1
3.3	Paint roller	Unit	1

3.2.6 QUALITY CONTROL

SYSTEMS. RECOMMENDED MINIMUM SPECIFICATIONS

It will be exposed the plasterboards systems recommended for compliance of different Regulations, in a satisfactory way and at the same time for being accepted by the user, appreciating it, the advantages respect to its comfort, isolation or other technical advantages.
Above them, there are many other systems that can be used to increase their different characteristics and therefore adaptable to other more stringent requirements than those reflected in the standards.
Below them, there may be other systems which although they may comply strictly with the Rules, no are appropriate to the quality accepted by the user.

"Systems with Single or Double walls each formed by a Laminated Gypsum Board 15mm. thick."

In renovation, decoration works, eventually partitioning, etc., where is not applicable Building Basic Standards referred to, the walls may be made of a plasterboards of 12.5mm

as the minimum thickness and the structure separate maximum 400mm axes, whatever maximum height to cover and in any case not exceeding the specific check each manufacturer's.

FINISHING RECOMMENDATIONS

Termination

a) Staking:
No errors can occur more than + 2 cm. non-cumulative

b) Appearance:
The surface finish should allow the application of decorative coatings without other jobs that normally required for each other, depending on type. The type of rear facing must be communicated with priority

c) Local planarity:
A rule of 0,20 m., applied to the finished surface facing in all directions
especially along the boards, cannot detect between the more outgoing zone and incoming an upper bound to 5 mm., or sudden changes of plan.

d) General planarity:
A rule of 2.0 m, applied to the surface of the facing in any direction, cannot detect between the more outgoing zone and incoming an upper bound to 5 mm.

e) Collapse:
The maximum allowable collapse in a partition with a height of 3.0 m. will not exceed 5 mm. In walls other height, you should be consulted the manufacturer's technical services.

HANG ON WALLS OF PLASTERBOARDS IN BACKFILL SYSTEMS

Before performing operations hang on these walls, is recommended to test the type of load will be received, in order to choose the most suitable anchor in each case.
The charges are of two types: ground and eccentric.
The first is moved usually to the wall, shear stresses and the second produce a lever arm to absorb in a more difficult way by the anchor.
In the first recommendations to follow are those indicated below, taking into account that if they are evenly distributed along the wall, it will become your crash, in both acute and necessary based on weight and following the recommendations described for including:

FLUSH STATIC POINT LOADS.

- Loads less than 15 kg per item, may be affixed directly to the board by hanging pictures 'X' shape, ordinary plastic pins or similar. As shown in figure 34.

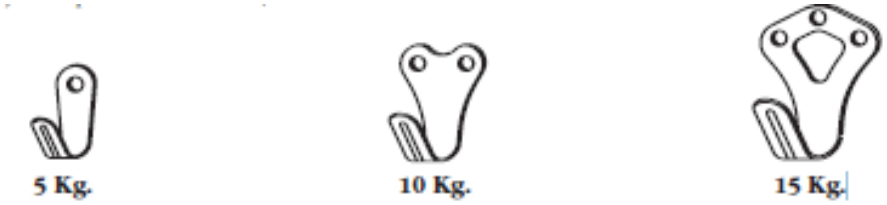


Figure 34. Flush static point loads. Low weight

- The loads between 15 and 30 kg per item can also be set directly on the plate but always by means of anchors such as' umbrella 'folding', 'clip', 'scale', 'tip', or similar and with a minimum gap between each anchor point of 400 mm. As shown in figure 35.

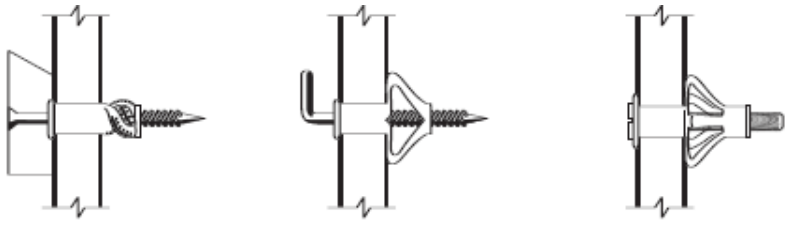


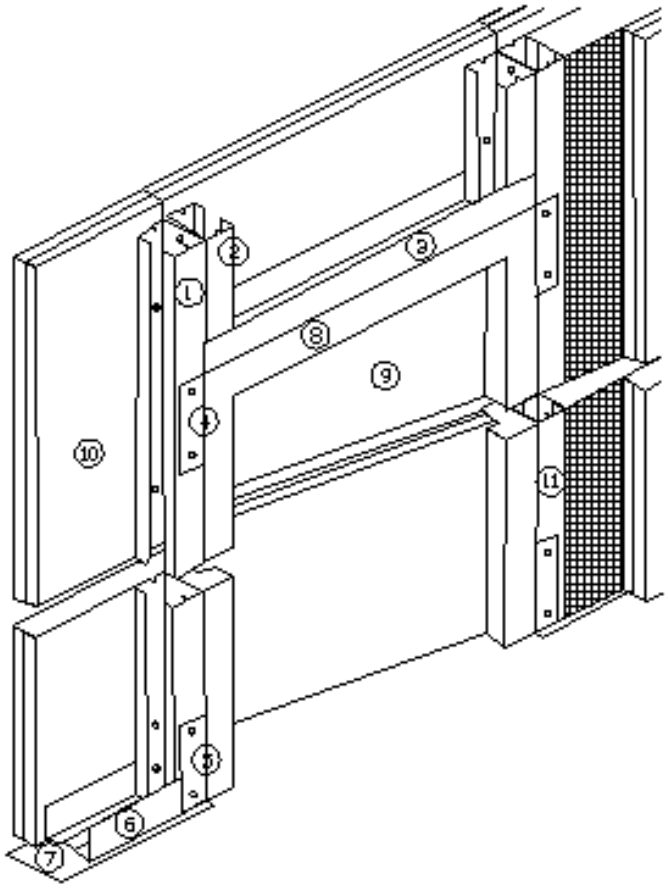
Figure 35. Flush static point loads. High weight

BASIC RULES FOR CONSTRUCTION OF ACOUSTIC CONDITIONS IN BUILDINGS NBE – CA88 (Basic Construction Standards – CA88)

<table>
<tr><th colspan="2">VERTICAL CONSTRUCTIVE ELEMENTS</th><th>MINIMUM AIR NOISE ISOLATION R IN dB (A)</th></tr>
<tr><td rowspan="2">INTERNAL PARTITIONS
(vertical building elements, excluding doors)
-Local-separator elements belonging to the same property, or user in residential buildings.
-Elements separators local residential buildings or public health.</td><td>BETWEEN SAME- AREA OF USES</td><td>≤ 30</td></tr>
<tr><td>BETWEEN DIFFERENT - AREA OF USES</td><td>≤ 35</td></tr>
<tr><td colspan="2">SEPARATING WALL OF PROPERTY OR OTHER USERS
-Dividing walls between properties and different users, in-use buildings private residential and office or administrative.
-Room-dividers for different users in buildings residential use and public health.
-walls separating buildings from classroom teaching purposes.</td><td>≤ 45</td></tr>
<tr><td colspan="2">SPACER WALL OF INTERNAL AREAS
-walls that separate the home or office space and office of building's common areas such as stairwells, hallways or corridors access, and local community service.
-walls separating the rooms of the building's common areas, similar to those
mentioned above, in residential buildings and public health
-walls separating the classrooms of the building's common areas, similar to those mentioned above, teachers use buildings.</td><td>≤ 45</td></tr>
<tr><td colspan="2">COMPARTIMENTALIZACION OF HOUSING ROOM COMMUNITY TEAMS
(For the NBE-CA/88, community teams are defined as those susceptible to noise or vibration in normal use scheme, which part of the hydraulic systems, ventilation, air conditioning, transportation and electricity.</td><td>≤ 55</td></tr>
</table>

3.2.7 SOME DETAILS

Bellow (figure 36) is shown a 3D door detail, when are used plasterboard partitions.



1 Upright. Galvanized steel profile C. (46mm)
2 Hollow reinforcement. Profile C Galvanized steel. (46mm)
3 Lintel reinforcement. Profile U Galvanized steel. (46mm)
4 Reinforcement bent pins of profile 3.
5 Reinforcement bent pins of profile 6.
6 Profile U Galvanized steel. (46mm)
7 Watertight neoprene band.
8 Door pine´s frame.
9 Door leaf of two boards. (30mm)
10 Two plasterboard. (15mm)
11 Glass wool insulation. (40mm)

Figure 36. Door assembly

Some other details are shown bellow. A horizontal section (figure 37), a union with door (figure 38), union with walls and other plasterboards partitions (figure 39) and a corner (figure 40).

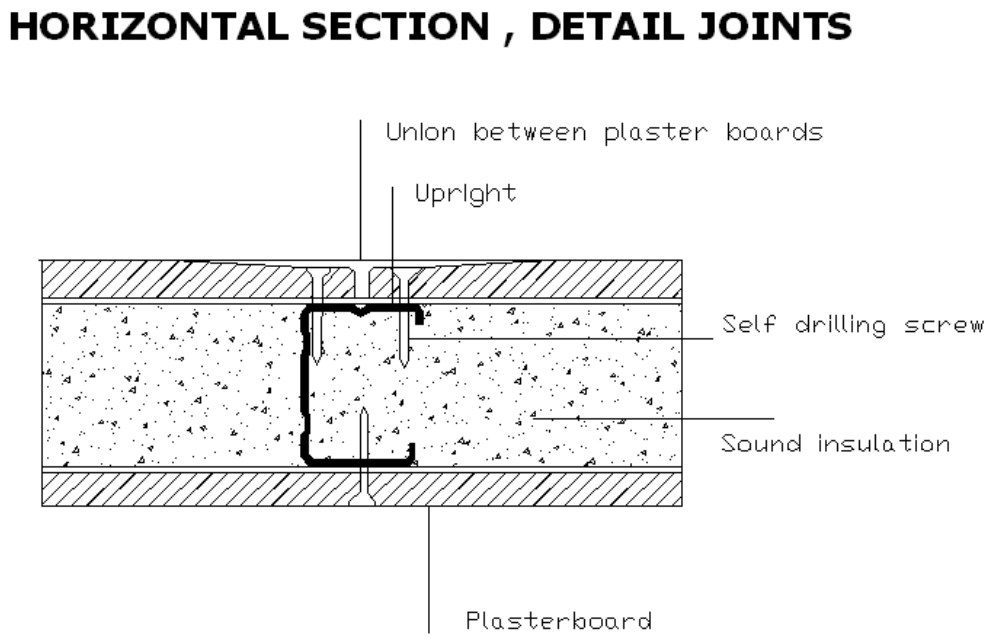


Figure 37. Horizontal section

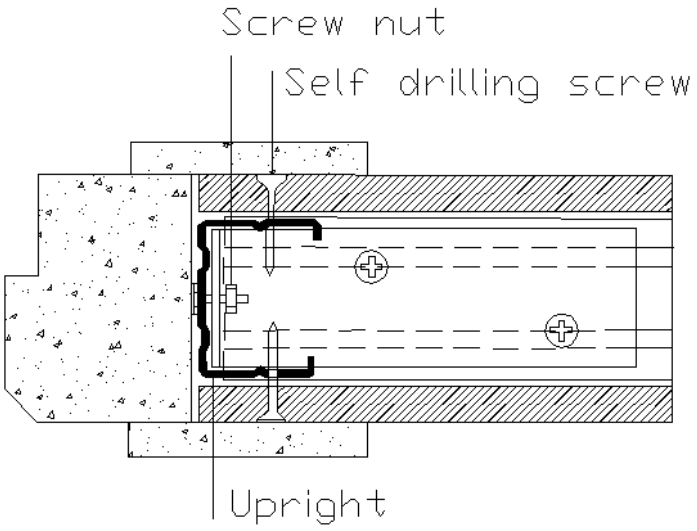


Figure 38. Union with door

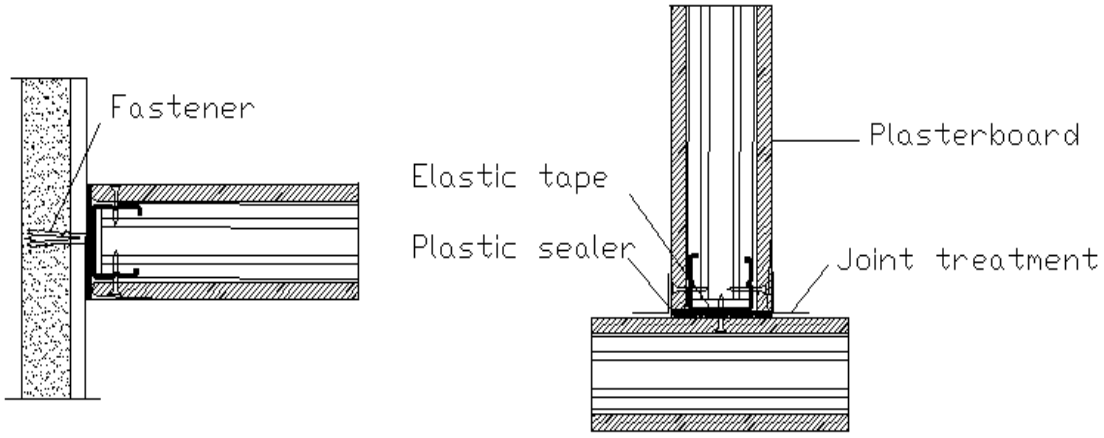


Figure 39. Union with walls and other plasterboards partitions

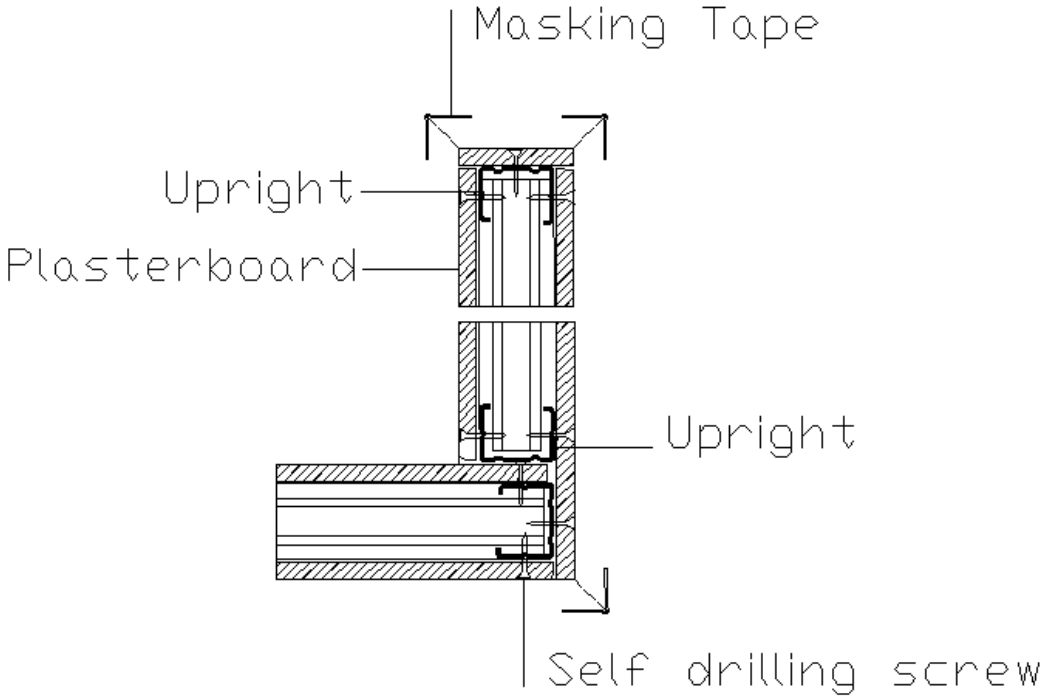


Figure 40. Corner

3.2.8 REPRESENTATION OF THE PLASTERBOARDS INSTALATION 3D SKETCHUP 8.0 DETAILS.

For the realization of the works, we are just going to need one worker, one regular worker (figure 41). Figure 42 shows a different view.

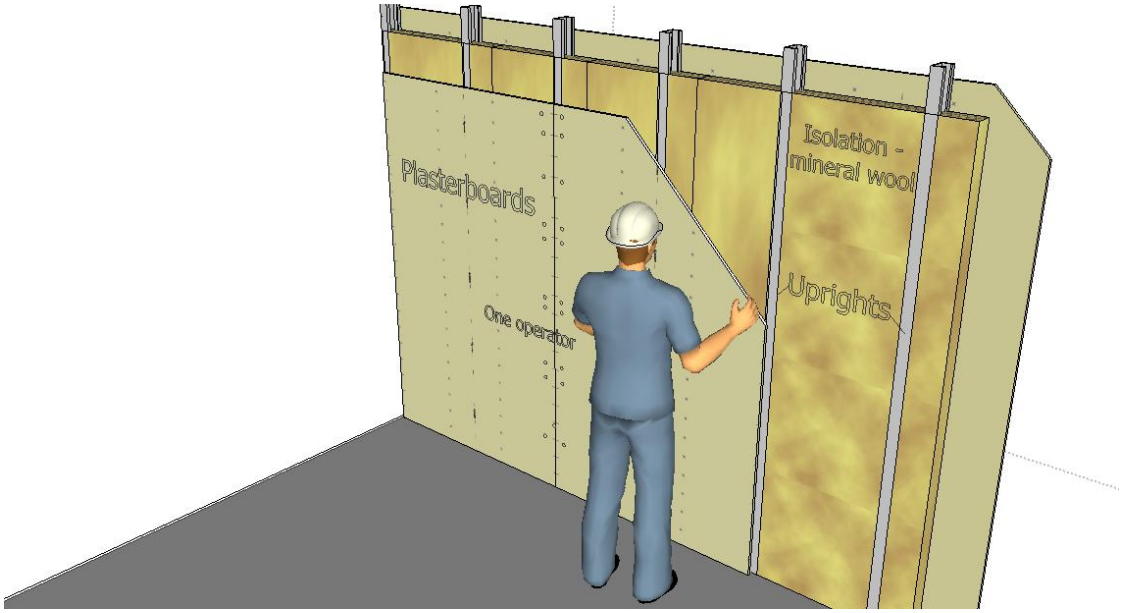


Figure 41. Plasterboards installation. One worker

Figure 42. Detailed aerial view

3.2.9 CALCULATION OF QUANTITY OF WORKS AND PRICE

Codec	*Nat*	*Ud*	*Summary*	*CanPres*	*PrPres*	*ImpPres*
01	**Chapter**		**WALLS AND PARTITIONS**	**1**	**9.017,80**	**9.017,80**
D10DA206	Partida	m2	PARTITION KNAUF 78/400 (15+48+15) M2. 111 W Knauf partition formed by a plate of 15 mm Knauf Standard. thick, bolted to a each side of a galvanized metal frame of horizontal and vertical channels of 48x30 and 0.6 mm. thick, with a modulation of 400 mm. e / e, even p.p. paste and tape to joints, screws, fasteners, acoustic band under the perimeter profiles ... completely finished and ready for priming and decorating.	281,02	32,09	9.017,80
U01FL100	Workers	m2	M.O. Partition W 111	1,000	8,80	8,80
U10JA106	Material	m2	Plasterboard KNAUF Standard 15 mm.	2,100	6,40	13,44
U10JA210	Material	Ml	Channel 48x30 mm. KNAUF	0,735	1,50	1,10
U10JA220	Material	Ml	Upright 48x36 mm. KNAUF	2,888	1,80	5,20
U10JA284	Material	Ml	Acustic band 50 mm.	1,260	0,47	0,59
U10JA250	Material	Ud	Screws TN 3,5-25 mm. KNAUF	38,850	0,02	0,78
U10JA233	Material	Ud	Fixations	1,680	0,01	0,02
U10JA280	Material	kg	Grip pasta Knauf Perlfix	0,105	0,63	0,07
U10JA282	Material	kg	Joints pasta Knauf Jointfiller	0,630	1,50	0,95
U10JA260	Material	Ml	Joints tape KNAUF	3,360	0,06	0,20
%CI	Others	%	Indirect costs..(s/total)	0,312	3,00	0,94
				281,02	**32,09**	**9.017,80**
			Total costs for one floor: 9.017,80 Euros or 31.130 Litas.	1	**9.017,80**	**9.017,80**

3.2.10 TECHNICAL - ECONOMIC INDICATORS

1. Quantity of works: 281m
2. Installation costs: 9.017,80 € or 31.130 Litas
3. Duration of works: 35 days / 9 floors = 3.89 days
4. Wage: 31.12 h x 8.80€ = 273.859 € or 944.8 Litas

4. ORGANIZATION PART

4.1 DESCRIPTION OF TERRITORY

The plan of building lot is composing for a constructing of housing building (will be commercial salons too) which is in Vilnius city, Rygos street 11 street. In the plan of building lot is intended:

-The main machines working places and moving tracks;
-Storages and storing sites positions;
-Temporary electricity, water-supplying, sewerage and fireplug, positions;
-Safety and dangerous zones;
-Territory and dangerous zones enclosure, roofs and so on;
-Temporary access roads and passages;
-Temporary buildings and domestic rooms positions.

The plan of building lot is preparing before starting constructional works. The lot is on planning, trees, which are impeding, are cutting of, the soil is pushed aside and stored. Earth is dozen of. All the site preparation has to be made according to construction organizing project. The building lot is surrounding by fence. There is built roads and base of it are multiplexed. The working zone of crane and dangerous zones are marked. The plan of building lot is made in case not to be broken roles of technology process requirements. On the preparation stage, which will be started on June, it is necessary to do these works:

-To prepare domestic rooms;
-To cut trees which are in the building zone;
-To make a entrance to building lot;
-To prepare storage sites.

The storages in the building plan are closed to designed areas of them. Open storages and roof s are in the crane working zone, near to road.. All the administration and domestic rooms will be supplied by electricity. Electricity will be getting from transformer substation roof, when the license will be gained. The building site will be supplied by electricity from the transformer substation, where is the main electricity distributional and accounting lock and cable.

4.1.1 SELECTION OF TOWER CRANE

Will be explained in the next part why will be chose our tower crane LIEBBHER 110 EC-B6.

Tower cranes are selecting by two ways:

1. According to technical parameters.
2. According to economical parameters.

In this task we will scrutinize the first way, when tower crane are selecting according to technical parameters. This way is dividing into two steps:

A. Tower crane selection when the underground and over-ground works are fulfilling.
B. Tower crane selection when only the over-ground works are fulfilling.

Calculation of technological parameters of tower crane.

First of all the following parameters of installing building have to be known:

1. The dimensions of building and location (underground and over-ground parts).
2. The weights, dimensions and location of installing constructions.
3. The work conditions (the peculiarities of building site, soil characteristics, the peculiarities of underground structures).

First of all, you must check if crane technical characteristics match the inequalities:

$$Qk > QR.$$
$$Hk > HR.$$
$$Lk > LR$$

Here:

Qk – the ascension power of selected crane, t
QR – the required ascension power, t
Lk - the reach of selected crane boom, m
LR - the required reach of crane boom, m
Hk - the lifting height of selected crane hook, m
HR – the required lifting height of hook, m

The technological parameters of crane are calculating according to the building characteristics. The required crane is selecting according to the tables of technical characteristics of cranes.

Tower crane selection when the underground and over-ground works are fulfilling like in the future building.

First of all, using the next, formula the required height of hook lifting is determining:

$HR = h1 + h2 + h3 + h4 = 30.65 + 0.45 + 3.8 + 1.45 = 36.35$ m.

Here:

h_1 – the height of abutment (support), on which the installing element is bracing, which is calculating from the under-crane track or the bottom of support, m

h_2 – the height of installing element, m
h_3 - free interval between abutment (support) and installing element (0.5 – l m)
h_4 – the height of hitching (trailing) equipment *(strops)* above the installing element, m.

Then the ascension power of crane is calculating using the next formula:

QR = P + Pstr = 2,5 + 0,15 = 2,65 t.

Here:

P - the weight of heaviest lifting construction, *T*
$P_{str.}$ - the weight of hitching (trailing) equipment *(strops)*, *t*

When the values of L_R, H_R and Q_R are calculated, the crane could be selected.

Whereas for determining the reach of crane boom LR , will needed to know the under-crane width or width of supports and dimensions of platform turn. These values are finding in crane diagrams.
The reach of crane boom LR is calculating using the next formula:

LR= 1,25 + 1 + 1,5 + 3,8:2 + 20,95 = 26,6 m.

When the values of LR, HR and QR are calculated, the crane could be selected using the diagrams of the tower crane.
The diagrams show, that the selected crane 110 EC-B5 LIEBHERR, match all requirements.

Qk = 3,4 > QR.= 2,65 t
Hk = 42,1 > HR.= 36,35 m
Lk = 37,5 > LR = 26,6 m

As we can see, our tower crane 110 EC-B6 LIEBHERR selected (figure 43), is is capable of performing the required works.

It is shown also, the tower crane supported basement (figure 44)

Below, will be shown, the 110 EC-B6 LIEBHERR main characteristics, tower crane reach (figure 45) and lifting (figure 46).

Information: http://www.liebherr.com/es-ES/default_lh.wfw

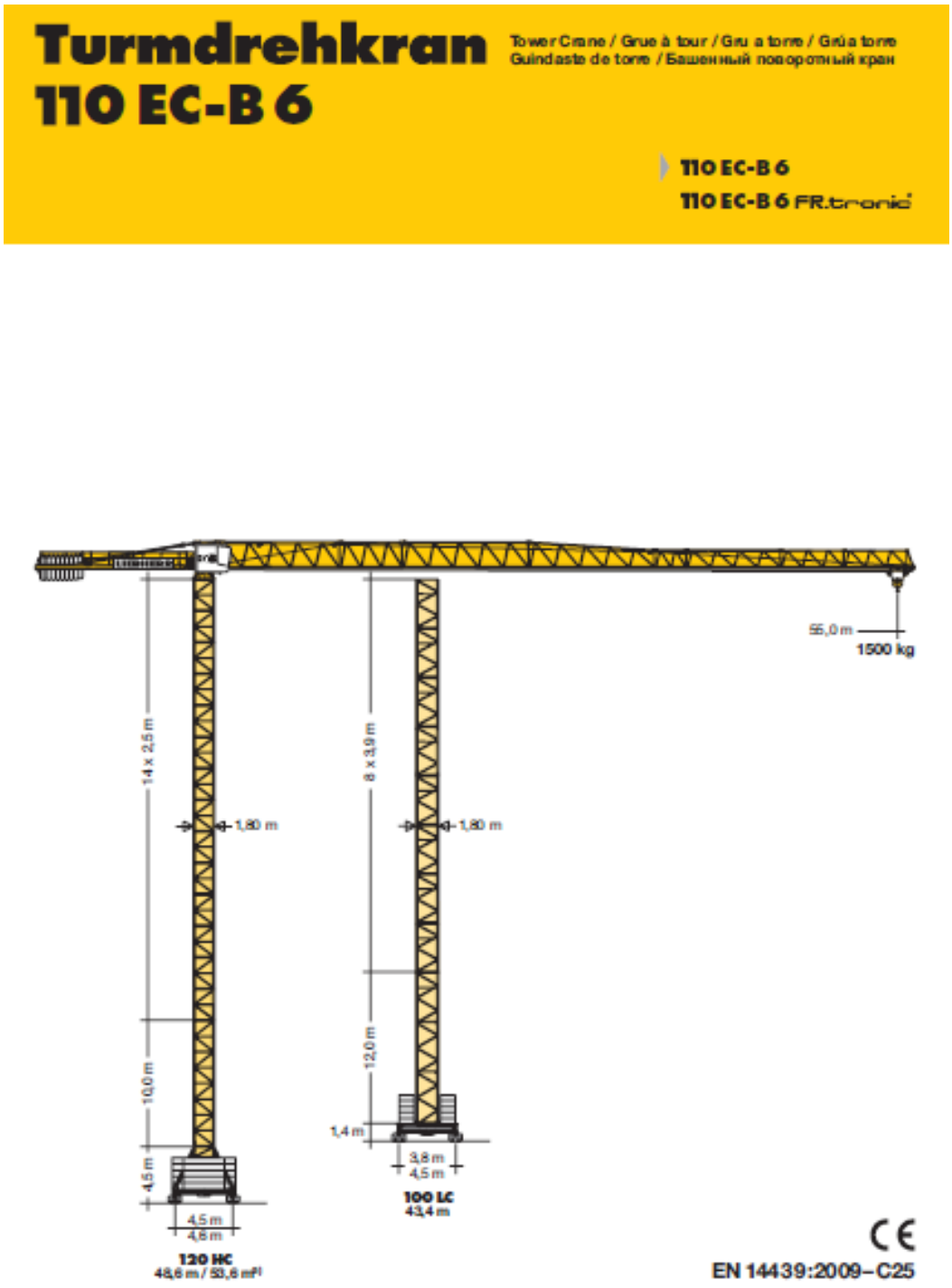


Figure 43. Selected Liebherr tower crane

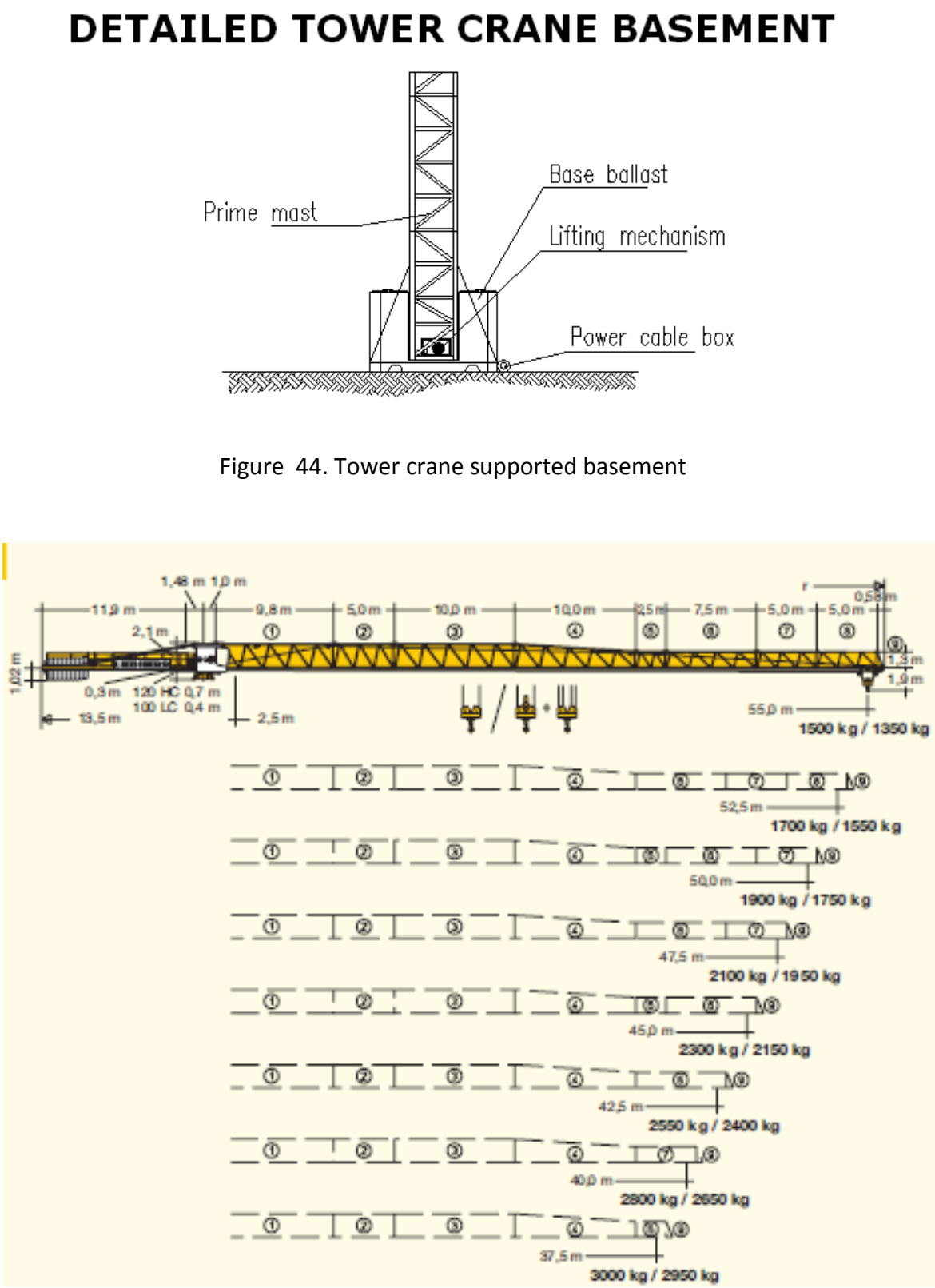
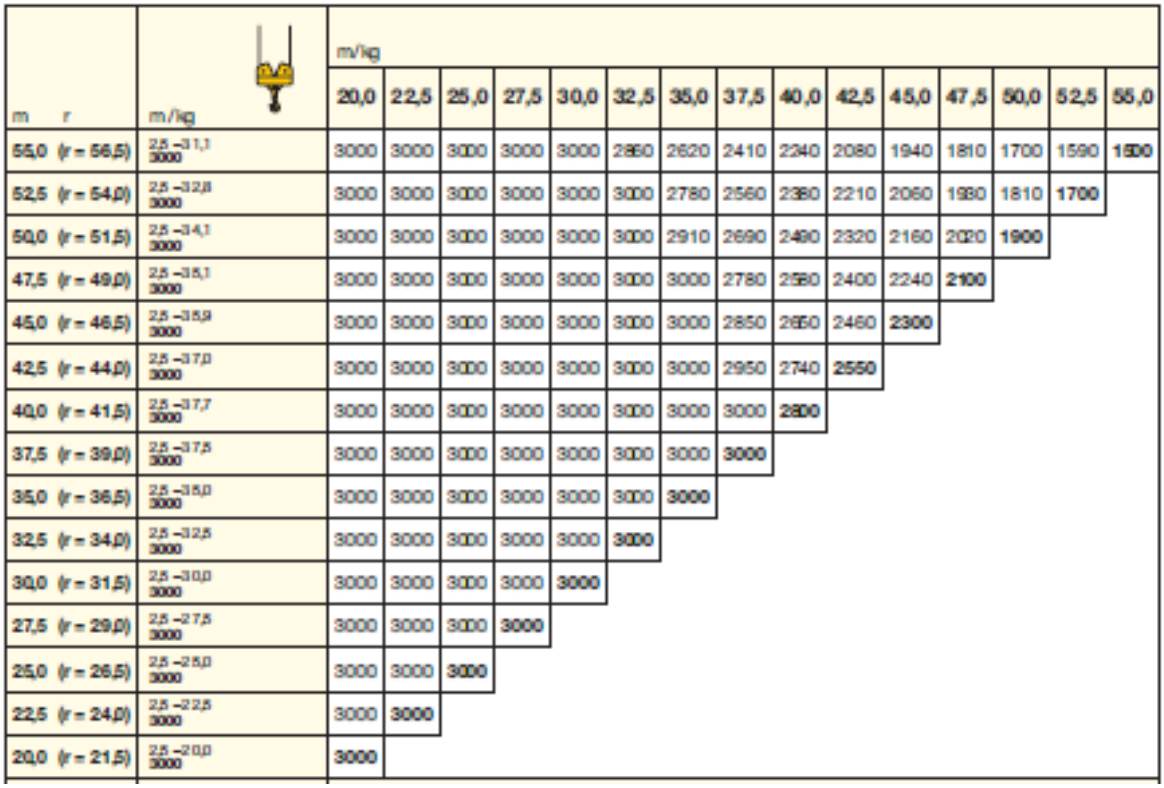


Figure 44. Tower crane supported basement

Figure 45. Tower crane reach



m r	m/kg	m/kg														
		20,0	22,5	25,0	27,5	30,0	32,5	35,0	37,5	40,0	42,5	45,0	47,5	50,0	52,5	55,0
55,0 (r = 56,5)	2,5 – 31,1 3000	3000	3000	3000	3000	3000	2860	2620	2410	2240	2080	1940	1810	1700	1590	1500
52,5 (r = 54,0)	2,5 – 32,8 3000	3000	3000	3000	3000	3000	3000	2780	2560	2380	2210	2060	1930	1810	1700	
50,0 (r = 51,5)	2,5 – 34,1 3000	3000	3000	3000	3000	3000	3000	2910	2690	2490	2320	2160	2020	1900		
47,5 (r = 49,0)	2,5 – 35,1 3000	3000	3000	3000	3000	3000	3000	3000	2780	2580	2400	2240	2100			
45,0 (r = 46,5)	2,5 – 35,9 3000	3000	3000	3000	3000	3000	3000	3000	2850	2650	2460	2300				
42,5 (r = 44,0)	2,5 – 37,0 3000	3000	3000	3000	3000	3000	3000	3000	2950	2740	2550					
40,0 (r = 41,5)	2,5 – 37,7 3000	3000	3000	3000	3000	3000	3000	3000	3000	2800						
37,5 (r = 39,0)	2,5 – 37,5 3000	3000	3000	3000	3000	3000	3000	3000	3000							
35,0 (r = 36,5)	2,5 – 35,0 3000	3000	3000	3000	3000	3000	3000	3000								
32,5 (r = 34,0)	2,5 – 32,5 3000	3000	3000	3000	3000	3000	3000									
30,0 (r = 31,5)	2,5 – 30,0 3000	3000	3000	3000	3000	3000										
27,5 (r = 29,0)	2,5 – 27,5 3000	3000	3000	3000	3000											
25,0 (r = 26,5)	2,5 – 25,0 3000	3000	3000	3000												
22,5 (r = 24,0)	2,5 – 22,5 3000	3000	3000													
20,0 (r = 21,5)	2,5 – 20,0 3000	3000														

Figure 46. Tower crane lifting

4.1.2 SETTING OF DANGEROUS ZONE

During the installment works in some parts of the construction site, in bars, workplaces, and crossings the dangerous areas are appearing. In construction such areas are known as dangerous zones. In the beginning of construction works and during construction dangerous zones, in which constantly arise or may arise risk factors should be determined. The dangerous zones are dividing into two groups:

1. Dangerous zones, in which dangerous and (or) hazardous factors constantly affect the processes.
2. Dangerous zones, in which dangerous factors could appear.

1. Dangerous zones, in which dangerous and (or) hazardous factors constantly affect the processes, are:

- Near the electrical equipment with non-insulated parts electric current (flow) (Table 1);
- Fenceless zones at a height when height difference is 1.3 m and the higher;
- Places where hazardous wastes and (or) the concentration of harmful substances in workplace air may exceed the limit values.

Voltage, kW	Distances, limiting the dangerous zone from the fenceless uninsulated parts of the electrical equipment or from the vertical plane, which is the nearest power line wire, with a projection on the land, m
< 1	1,5
1 ÷ 20	2,0
35 ÷ 110	4,0
150 ÷ 220	5,0
330	6,0
500 ÷ 750	9,0
800 (current)	9,0

Table 1. The boundaries of dangerous zones were the influence of electric current (flow) could appear.

The boundaries (limits) of dangerous zones, were appear the risk factors of harmful substances exceeding should be determined by measurements.

2. Dangerous zones, in which dangerous factors could appear, are:

- Near buildings under construction and assembling (or dismantling) building structures or equipment;
- Places over which the structures or equipment installation (or dismantling) works are executing;
-Places over which loads are lifting and transporting by cranes;
-Places where the machinery, their parts or work equipment are moving.

The determination of crane dangerous zones

The limits of dangerous zones areas, where there is transfer of elements is performing by cranes, are determining by calculation the sum (the total distance) of horizontal projection of lifted element, the maximum dimension (length) of biggest element and its possible fall distance.

The limits of dangerous zones near structures are determining by summarizing the maximum dimension (length) of biggest installed element and its possible fall distance.

$Rpav = l + 1/2\ l_1 + r$

Rpav: danger tower crane area
L: boom length
l_1: the biggest dimensional structure length
r: distance of the danger zone Stocks

$Rpav = 37.5 + 1/2\ 7.64 + 8.5 = 50m$

Will be considered the next risks:

-Presence of obstacles.
-Areas of way.
-Jobs in proximity to high voltage power lines.

The prevention measures, for the first four are specifications established on the basis of the following legal texts:

-Royal Decree 836/2003 of 27 June, approving a new Technical Instruction "MIE-AEM2" Regulations Lifting and handling equipment, referring to tower cranes for construction or other applications.

-Royal Decree 1215/1997 of 18 July laying down minimum safety and health for use by workers in teams.

It should be borne in mind also that through Article 5 of the ITC-MIEAEM2, binding is established in the UNE 58-101 - 92, Part 2: Lifting heavy equipment. Terms of strength and safety removable crane works. Conditions of installation and use with what we have for each of the assumptions made as follows:

Presence of obstacles

In paragraph 7.3 of the UNE 58-101-92, states: "The vertical clearance between the pen and the last area of movement of personnel shall be 3 m minimum. If the load or empty hook passes within 3 m of the area, will be necessarily placed on it enough to prevent the indicators of his approach.
This means that when the crane weathervane turn must respect the distances shown in figure 47. And to the work area, which inevitably we must consider the burden, will be indicated in figure 48.

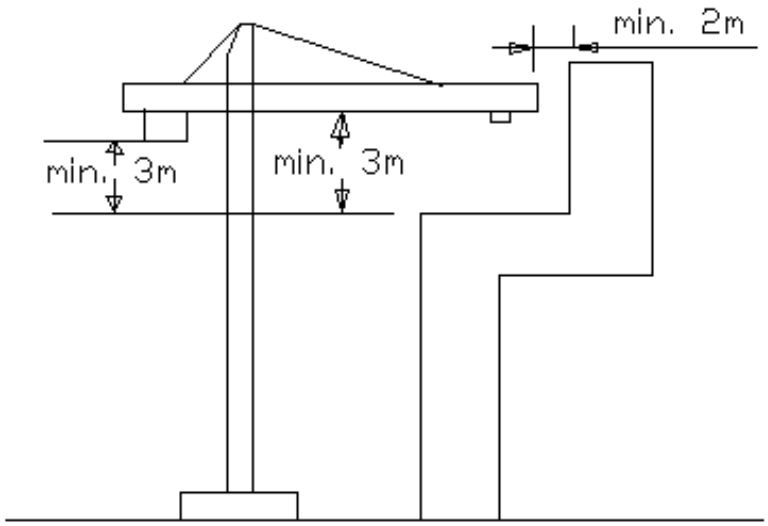


Figure 47.Horizontal and vertical obstacles

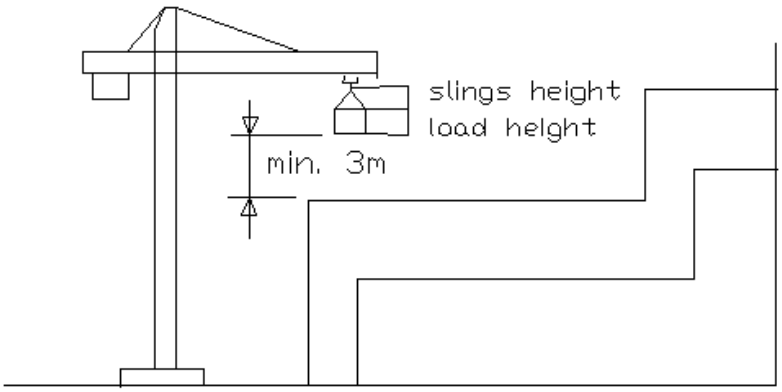


Figure 48. Vertical obstacles

As you can see, we are not inclined to use signaling and also taking into account the flexibility of these structures, we have considered a minimum distance between the tip of the arrow and the nearest obstacle of 2 m Walkways in paragraph 4.1 of the UNE 58-101 92 states: "The minimum clearance for the passage of personnel, among the most prominent parts of the crane and any obstacle is 0.60 m wide and 2.50 m high. In case of failure application of this condition will prohibit the access of staff to this area dangerous".
It is shown a detail in figure 49.

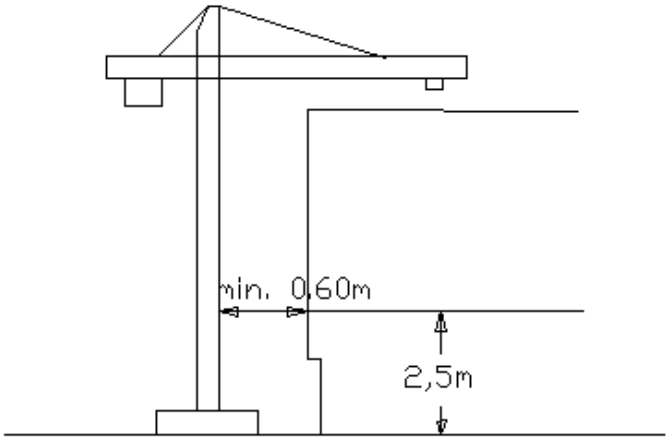


Figure 49. Safety distances

Obstacles in proximity of high voltage power are lines referenced in paragraph 4.1 of the UNE 58-101-92, states: "At no time any part of the crane and its suspended loads, can enter contact with power lines. If these lines are high voltage power should exist between these lines and these items a safe space of 5 m, as minimum, measured in horizontal projection", as shown in figure 50.

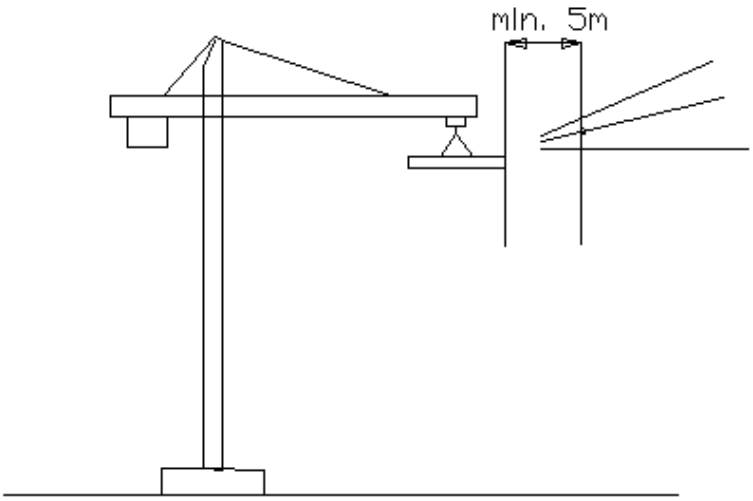


Figure 50. Special distance with electrical installations

As we can see below, it is shown one front view of the future building with the crane situation (figure 51), and an aerial view for understanding the reach of the crane (figure 52).

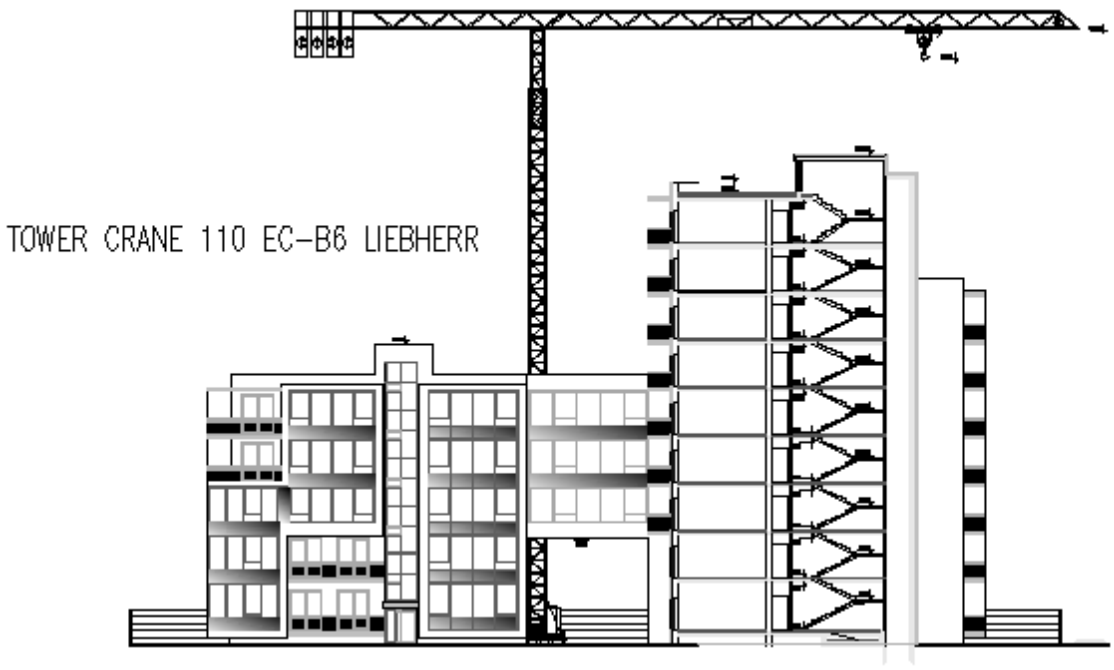


Figure 51. Building and tower crane front view

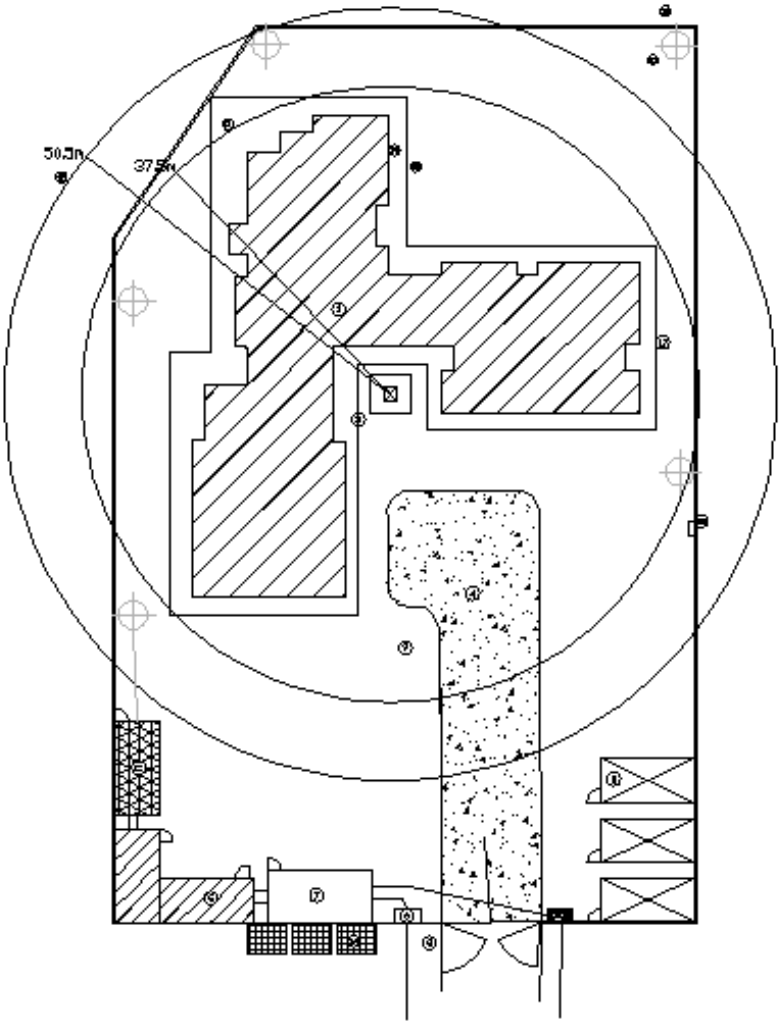


Figure 52. Building and tower crane aerial view

4.1.3 TEMPORARY ROADS TO THE BUILDING PLACE

Temporary roads in the building places are used to bring construction materials , etc. Temporary roads are built combining with existing roads to reach warehouses, work places, machines and etc. outside the building place.
Temporary roads in the building place have to be two ways. The wide of the road has to be at least 6 meters. The road is straight and has a insignificant slope.. The smallest distance from the road to the warehouse is 1 meter. This kind of roads is built to ensure easy driving to the building place and fast work.

4.1.4 TEMPORARY STORAGE BUILDINGS AND SITES

The construction site will contain two storage buildings (9x4x2.3m) for satisfying all the storage needs, will be needed exactly three storage buildings and one no covered site (8x8m) inside the construction plot.

4.1.5 TEMPORARY BUILDINGS FOR WORKERS AND MANAGING

All the working and managing staff will have their own temporary buildings for satisfying all the needs.
The managing staff will have one temporary building (10x4.5x2.3m) where will be situated the office.
The workers will be able to use four temporary buildings (9x4x2.3m), three of them as place for resting, eating, etc, and one of them (9x4x2.3m) for using the showers and the toilets.
Knowing the workers volume was possible to calculate all the necessary temporary buildings.

Information: http://www.casetaspredes.com/casetas-obras.htm

4.1.6 TEMPORARY ELECTRICITY SUPPLY

Will be needed a temporary electricity supply for making mostly all the works. Will be needed a general electricity counter in the building fence connected to the electrical rush supply connected to the general electrical system of the city placed close the road, will be made an individual 4x16 mm² derivation (figure 53).

Justification of individual 4x16 mm² derivation
P=/3.u.i.cos f

Where:
-P= Power in W
-u=Voltage in volts for three-phase system as is in the case 400V
-I= intensity in A.
-cos f = power factor (in Spain is considered 0,9)
-I max adm = maximum admissible intensity in A.

I= 40 A
I= 63 A (intensity of the protection element) (the switch of the box)
I max adm= 80 A according to rebt itc-bt 19 tabla 1 (Spanish rules REBT 02)

So:
I ab < I n < I max adm (justification that satisfies the individual derivation overload).

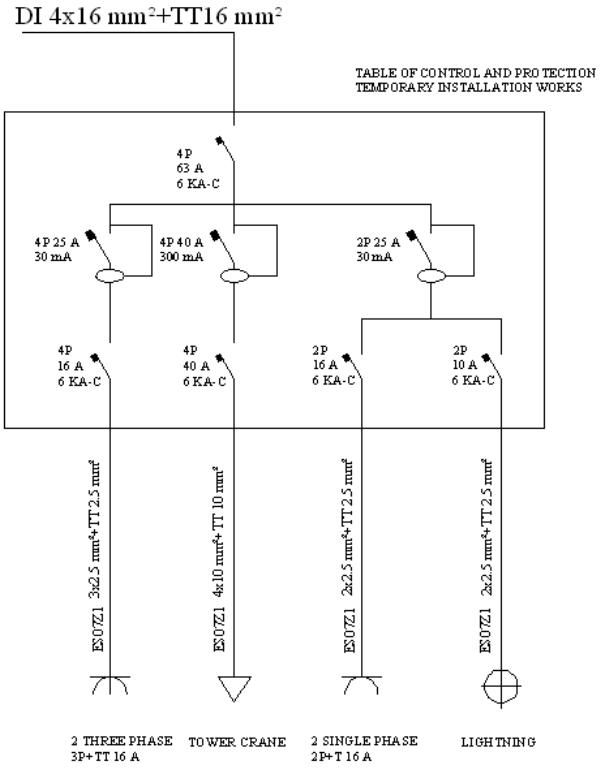


Figure 53. Individual derivation 4x16 mm²

4.1.7 CONSTRUCTION SITE LIGHTNING

To calculate the number of luminaries necessary for the correct illumination of the work, is used the following formula:

$$N = \frac{E \times A}{\phi_n \times F_U \times F_M}$$

Where:

N: Number of luminaries required.
E: Average luminance in lux.
fn: Flow Rate of the lamp in lumens.
FU: Factor of use.
FM: maintenance factor.
A: Local Area m^2

The surface of the work area is 7490 m^2**,** to be illuminated with an average illumination of 15 lux, with 1x150 W metal halide lamps, which produce a luminous flux of 13,000 lumens per lamp. Will be used a normal maintenance factor 0.95.

Data from the lighting area are:

Length: 107.00 m.
Width: 70.00 m.
Height: 4.50 m

$$\text{Index:}\quad K = \frac{l \times b}{h(l+b)} = \frac{7490}{4.5(107+70)} = 9.40$$

With this index, and media with colors for floors and ceiling, and clear to the walls, is a factor in initial use in direct lighting luminarie 1.

Thus the number of lamps required for proper lighting of the premises is:

$$N = \frac{15 \times 7490}{13000 \times 1 \times 0{,}95} = \approx 10$$

By calculation we have obtained, the need to place a minimum of 10 lamps.

4.1.8 TEMPORARY WATER SUPPLY

Of course will be needed a temporary water supply for our works. Will be installed a general accountant in the building fence connected to the water supply rush of the city placed close to the road.
The future temporary water supply line will require an accountant, stopcock general, pipe tube 32mm in diameter (is the standard diameter in Spain), wash step and tap.
All the things mentioned before, are shown in the figure 54.

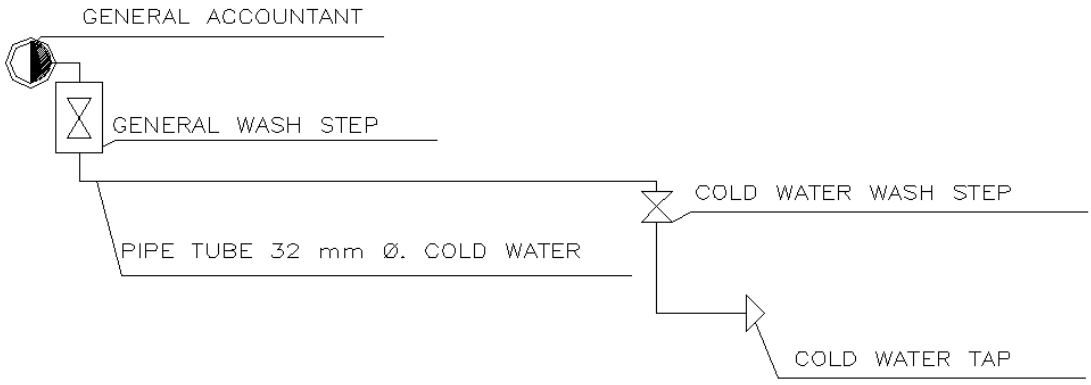


Figure 54. Temporary wáter supply scheme

4.1.9 TEMPORARY SEWERAGE

The sewer construction will consist in removing water from rain and the elimination of waste water as a showers, basins and toilets.
Drainage is connected to the network of urban wastewater.
The drainage plan consists in connecting our network to existing networks of the city.
The sewerage system will have a diameter of 200mm.

4.1.10 TEMPORARY ROADS

Temporary roads in the building places are used to bring construction materials and etc. Temporary roads are built combining with existing roads to reach warehouses, work places, machines and etc. outside the building place.

Temporary roads in the building place have to be two way. The wide of the road has to be at least 6 meters.

The road is rolled and has a 3 ° slope. The smallest distance from the road to the warehouse is 2 meter, from the road to the fence – 3 meters. Turnings of those roads will be made at the end of the road. This kind of roads is built to ensure easy driving to the building place and fast work.

Will be at the same time, one temporary road to access the temporary buildings.

4.1.11 FENCE OF CONSTRUCTION SITE

The building fence will be a opaque fence ideal for construction by the rapid assembly and disassembly solving the problem of delimitation of solar work or works. Opaque fence height will be 2 meters.

Will be needed 309.14m for all the perimeter.

Is a very practical fence for temporary and permanent closures.

Composition: built in modules 2X1 meters folded sheet evenly with nerves at their ends for rigidity, covered with Aluzinc which is 6 times more resistant to corrosion.

Information: http://www.adosa.es/

4.1.12 TEMPORARY COMUNICATION

Temporary communication will consist in cellular phones (five of them) and USB modem internet devices (three of them) for laptops.

Will all this staff all the works needs are going to be satisfied.

4.1.13 GENERAL REQUERIMENTS OF LABOR SAFETY

List of hazardous jobs in our construction:

-Working crane
-Work with hand tools and power machinery
-Welding
-Work excavators
-Working at heights
-Roof and façade installation
-Formwork installation
-Reinforcement and concrete works
-Installation works

- Building area is surrounded of 2m high wire mesh fence.
- Fence encloses crane dangerous and work area.
- In construction site is being installed fire fighting shield with fire extinguishers, crowbars, shovels, buckets, box with sand.
- All persons in the construction site must wear protective helmets.
- For doing a work is being used only scaffolding and ladders of inventory.
- In a construction site is being installs fire hydrant.
- The fence of the construction is being posted with signs about imminent danger and is informing that unauthorized persons entering to the construction site is prohibited strictly.
- All work is being made as is required in technological requirements.
- Construction contractor before work informs employees with safe working conditions.
-Also is determined the danger zones, they are marked with highly visible warnings.
- Give the permits for work in dangerous zone limits.
- Develop a list of hazardous work in a construction site.
- If weather conditions are bad - cancel all work.
- Workers locations should be installed out of dangerous zones.
- Check whether the tools and appliances which are being used for work, complies all standards.

- For each employee for service should be given a helmet, gloves, shoes with metal ends, working clothes, safety glasses.
- Construction rubbish should be disposed of in appropriate locations.
- Transport and traffic routes must be maintained in good order, not loaded with constructions, the road surface must be cleaned.
- Ladders, scaffolding must comply with all safety requirements - if the scaffolds are unsteady, it should be attached with the rope to the still surface. After installation check the connections on the fasteners. If there are traffic routes near, should be installed roofs, facades and scaffolding covered with net.
- Scaffolding and ladders are being viewed every 10 days.
- Work at a height where protection is rope, should work qualified worker.
-Dig trenches in sandy soils without reinforcement is possible only up to 1.25 m.
- Raising Material or construction crane, used pallets, straps, measures preventing the lifting objects to fall.
- It is prohibited to walk under raised structures or materials.
- Constructions which are raised should be well fortified.
- Should be installed fences witch to prevent falls, it may be marked.
- When it is break time, construction or materials shall be prohibited to leave.
- Before the roof, the supervisor must check supporting structures and enclosures; the workers must be equipped with safety equipment.
- The materials can be packed on the roof only in the places where allows technical project and ensure that they are falling.

GENERAL PROTECTION. SAFETY LABOUR

NAME	NUMBER
Helmet	Each worker
Security gloves	Each worker
Protective clothing against mechanisms	Each worker
Protective footwear	Each worker
Protective glasses with direct ventilation	Each worker
First Aid Kit	One kit
Vessel with drinking water and disposable cups	One kit

4.1.14 REQUIREMENTS OF ENVIRONMENTAL PROTECTION

Will not be able in construction site bury waste the rubbish. When construction work is completed, is required to remove construction waste, unnecessary soil, clean up area and plant the plantations.

If any of these works on time of year can´t be competed, they should be finished in the next season of planting.

4.1.15 REQUIREMENTS OF FIRE PROTECTION

During construction, will be followed rules about fire protection - construction works and installation of fire protection rules.

In the future construction site in a visible and accessible place should be a panel with inventory: two buckets, two axes, two crowbars, ladders, hook, 0.5 m^3 of sand box, two fire extinguishers and two spades.

4.2.2 WORKFORCE

For all the works we are going to need many workers, the ninth month will be when more of them are at the same time as we can see in figure 55.

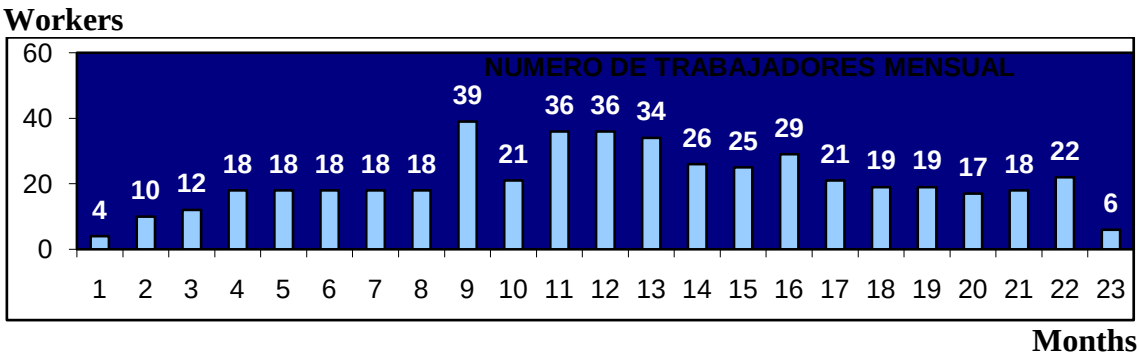


Figure 55. Workforce

4.2.3 MACHINERY

For all the works we will need many different kinds of machinery as we can see in figure 56, being the month with more of them in the construction on tenth month.

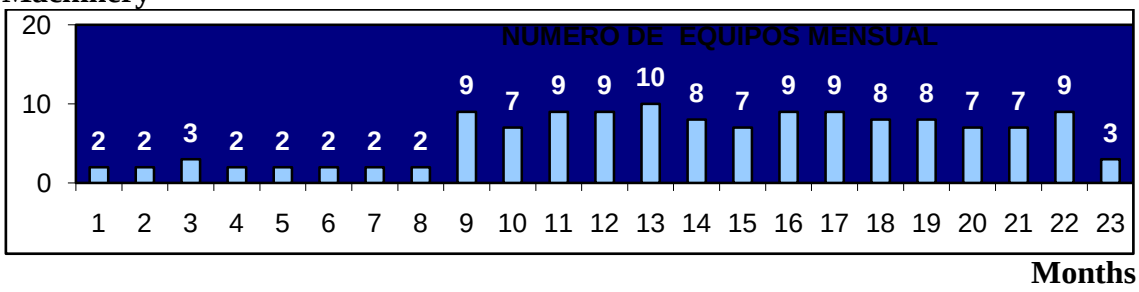


Figure 56. Machinery

BIBLIOGRAPHY

I have used many bibliography for the thesis, mostly, this bibliography are books, and internet websites.

Websites:

Forum soloarquitectura
www.soloarquitectura.com
Liebherr webpage
www.liebherr.com
Construction fences
www.adosa.es
Storage buildings
www.casetaspredes.com/casetas-obras
Pavements website
www.kahrs.com/es/Consumer/Pages/Start.aspx
Plasterboards website
www.knauf.es/knauf/controller/controller.jsp
General architecture
www.arq.com.mx/index481.html
General architecture
www.plusarquitectura.info
Spanish construction standards
www.codigotecnico.org/web
Standards
www.grupoprevenir.es/normativas/c/itc_2.htm
General architecture
www.arquitectura.com/tecnica/legal/legalespana/viviend.asp
General architecture
www.arquitectura-3d.com/soporte/tutorial-video
Polotechnique university of Valencia
https://poliformat.upv.es/portal

Books:

1. Aceros para hormigón
   Madrid: AENOR, D.L. 1989
2. Apuntes de construcción de estructuras de hormigón armado / Pascual Urbán Brotóns.
   San Vicente (Alicante): (Imp. Gamma), D.L. 1999
3. Construcción de estructuras : hormigón armado : detalles constructivos y perspectivas
   Pascual Urbán Brotóns
   Alicante: Club Universitario, 2001
4. Construcción de estructuras de hormigón armado
   Urbán Brotóns, Pascual
   Alicante: Club Universitario , 1999

5. Construcción de estructuras. Hormigón armado : adaptado a las instrucciones EHE, EFHE, NCSE-02 y CTE. Urbán Brotóns, Pascual
   San Vicente, Alicante: Club Universitario , 2009
6. Atlas de detalles constructivos : con más de 400 ejemplos
   Beinhauer, Peter
   Barcelona: Gustavo Gili , 2006
7. Construcción de estructuras : hormigón armado : detalles constructivos y perspectivas
   Urbán Brotóns, Pascual
   San Vicente, Alicante: Club Universitario , 200