VILNIUS GEDIMINAS TECHNICAL
UNIVERSITETY

FACULTY OF CIVIL ENGINEERING

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Student: Francisco Marco López

Supervisor: Jonas Saparauskas

Language – English

Automobilių prekybos salono Turgelių g. 1 Vilniuje statybos projektavimas

Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius

FINAL THESIS WORK

Vilnius, 2013

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VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETAS

APPROVED:
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Supervisor: Dr. Jonas Šaparauskas: _____ data: 2013.06.10

Consultant: Vaidotas Šapalas: _____ data: 2013.06.10

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Study area: CIVIL ENGINEERING
Study program: CONSTRUCTION MANAGEMENT
Specialization: CONSTRUCTION TECHNOLOGY AND MANAGEMENT

APPROVED
Head of Department
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Edmundas K. Zavadskas
(name and surname)

THE TASK OF FINAL BACHELOR'S THESIS
.....No. .....
Vilnius

Student: *Francisco MARCO LOPEZ*

The title of final thesis: *Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius*

Approved: *2013 by Dean's order No* 296st

The term of completion of the Thesis: *10 of June 2013.*

THE TASK OF FINAL THESIS

Initial information: architectural drawings.

Workbook
Architectural and Structural Part: describe characteristics of building under construction and building plot. Make calculation of frame.
Technological and Organizational Part: compile technological cards for curtain wall installation and assembling of frame. Perform calculations of construction masterplan, compile schedule of whole construction process.
Economical Part: perform calculations of costs for both technological cards.

Drawings
Architectural part - 1 item; Structural part - 1 item; Technological cards - 2 items; Construction masterplan - 1 item; Construction schedule - 2 item.

Consultant of bachelor's final thesis: Assoc Prof Dr Vaidotas Šapalas
(position, name and surname)

Supervisor ..... Assoc Prof Dr Jonas Šaparauskas
(signature) (given name and surname, academic degree and name)

I got the Task
.....
(signature)

Francisco MARCO LOPEZ
(name and surname)

2013-01-28
(date)

(the document of Declaration of Authorship in the Final Degree Project)

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

Francisco Marco Lopez, 20130111

(Student's given name, family name, certificate number)

Faculty of Civil Engineering

(Faculty)

Construction Management, STVf-09

(Study programme, academic group no.)

DECLARATION OF AUTHORSHIP IN THE FINAL DEGREE PROJECT

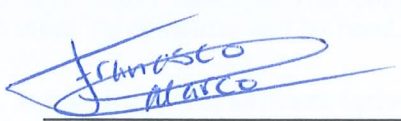
June 7, 2013

I declare that my Final Degree Project entitled „Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius" is entirely my own work. The title was confirmed on June 6, 2013 by Faculty Dean's order No. 296st. I have clearly signalled the presence of quoted or paraphrased material and referenced all sources.

I have acknowledget appropriately any assistance I have received by the following professionals/advisers: Assoc Prof Dr Jonas Šaparauskas.

The academic supervisor of my Final Degree Project is Assoc Prof Dr Jonas Šaparauskas.

No contribution of any other person was obtained, nor did I buy my Final Degree Project.



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(Given name, family name)

Vilnius Gediminas Technical University
Faculty of Civil Engineering
Department of Construction Technology and Management

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Bachelor Degree Studies **Construction Management** study programme Final Work 3

Title	**Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius**
Author	**Francisco Marco Lopez**
Academic supervisor	**Assoc Prof Dr Jonas Šaparauskas**

Thesis language: English

Annotation

The subject of this final work is "Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius (Lithuania)"

This final work consists of four 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 frame of the structure. The calculations are made in two ways, by computer and by hand.

3. Technological part. It consists of two different technological cards:
-Curtain wall installation in two facades.
-Assembling of frame.

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

The final thesis work consists of:
-The explanatory handwriting: 79 pages
-The graphical part: 7 A1 drawings

Keywords: car shopping center, reinforcement concrete, human safety, quality control, scheduling, dangerous zone, workforce, temporary sewerage

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Statybos technologijos ir vadybos katedra

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Pirmosios pakopos studijų **Statybos valdymo** programos baigiamasis darbas 3

Pavadinimas **Automobilių prekybos salono Turgelių g. 1 Vilniuje statybos projektavimas**

Autorius **Francisco Marco Lopez**
Vadovas **doc. dr. Jonas Šaparauskas**

Kalba: anglų

Anotacija

Šio baigiamojo darbo tema "Statybos planavimas automobilių prekybos centras ne Turgeliu g. 1, Vilniuje (Lietuva) "

Baigiamąjį darbą sudaro keturios dalys:

1.Architektūrinė dalis sudaro trumpą pagal projektavimui ir brėžiniams, tai rodo, fasadai, vienas vertikalus pjūvis, du horizontalius pjūvius ir vieną situaciją žemėlapis pastato statybai.

2.Konstrukcijų projektavimo dalis apibūdina konstrukcijos rėmo dizainas. Skaičiavimai atlikti dviem būdais, kompiuteriu ir ranka.

3. Technologinė dalis. Jis susideda iš dviejų skirtingų technologines korteles:
Diafragmos sienų montavimas dviem fasadais.
-Surinkimas rėmo.

4. Organizacinė dalis. Tvarkaraščiai visų darbų, darbininkų ir įrengimų.

Baigiamasis darbas Darbą sudaro:
-Aiškinamasis rašysena: 79 puslapiai
-Grafinė dalis: 7 A1 brėžiniai

Prasminiai žodžiai: automobilių prekybos centras, gelžbetonio, žmogaus saugos, kokybės kontrolė, planavimas, pavojinga zona, darbo jėga, laikinas kanalizacija

ANNOTATION

The subject of this final work is “Construction planning of the car shopping center at Turgeliu str. 1 in Vilnius (Lithuania)”

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Content

1. ARCHITECTURAL PART

1.1 DESCRIPTIVE MEMORY

1.1.1 INTRODUCTION

This final thesis work will consist in the construction of a car shopping center at Turgeliu str. 1 in Vilnius. It will have two floors with a area free of floor to get the light coming through the curtain wall. The building has two different spaces one for the sale of cars, with showroom, waiting room and offices and another to fix cars.

This project building will be done with Spanish standards.
The two different spaces are separated by the staircase, by this way, let avoid noise inappropriate for the sale of cars. In addition, this central core provides stability to the assembly.

Surfaces:
- Building area: 907.06 m^2
- Plot: 2609.06 m^2

1.1.2 LOCATION

The future building is located in Turgeliu str. 1, number 1, in the city of Vilnius (Lithuania). Aerial view (figure 1), and two different pictures are shown (figure 2, figure 3). This situation is 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 907.06 m^2 with increasing slope from west to east**.** The shape is an irregular polygon. There are some constructions near our building; in the north of the field is the Pelesos 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.

1.1.4 DISTRIBUTION FLOORS

First of all, should be said, that the future building will have a really special appearance and it will be very original.

The first floor is smaller than the other one due to the slope but contains the main door for costumers. This floor consists in a big car showroom with a complementary garage through which cars enter, and office to assist customers. Stair case that connects the floors is in the middle of the building, and in the other part of the plant there are lobbies for workers can change clothes.

The second floor has the entrance by the east facade and there is a garage to fixing cars. You can climb to this second level from the car showroom, and at this part of the stairs you can find the direction offices of the car showroom and a meeting room.

Below could be seen the second floor section in the figure 4.

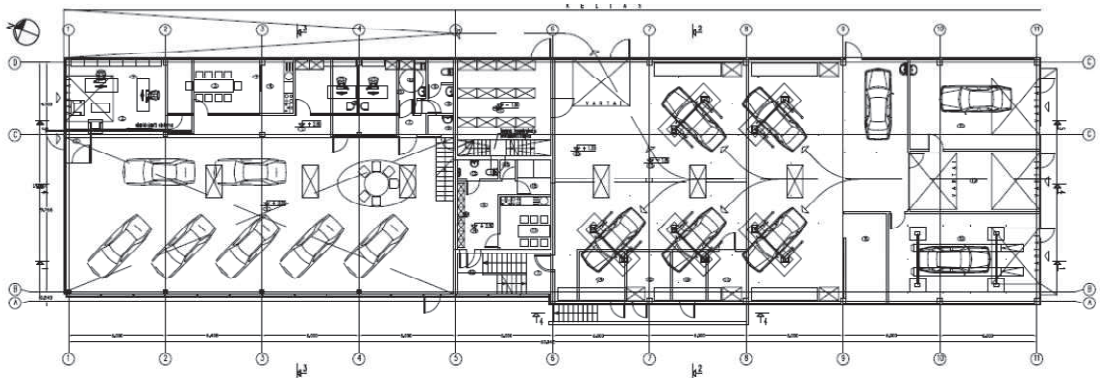


Figure 4. Second floor section

1.2. CONSTRUCTIVE MEMORY

1.2.1 FOUNDATION

After checking the quality of land and consider suitable for the foundation (it is a sandy soil), should be considered to build deep foundation piles (figure 5) joined with bracing beams (figure 6), 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:	γ_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 deep foundation, because we reach a high depth.

The biggest width will be 50 cm.
The bracing beams will be of different sizes. See sizes at the planes.
The highest depth we are going to reach will be 5m.
Iron, of course, will have different diameters. Shall be S275J kind.
All the iron in the foundations will be supported on plastic separators due to not being in contact with the ground.

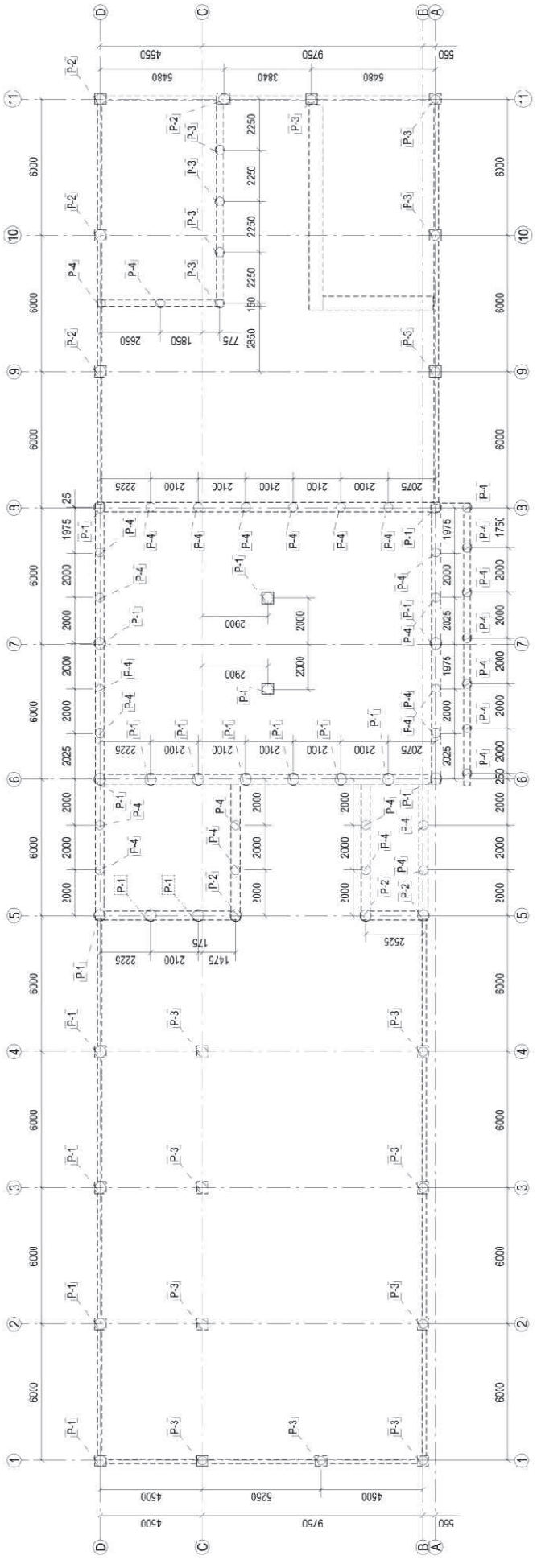


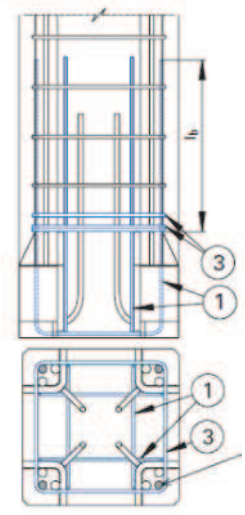
Figure 5. Footing foundation

Figure 6. Brace beam and pile

1.2.2 COLUMNS

a) Reinforced concrete prefabricated columns

Monolithic columns of rectangular and square cross-section (figure 7) are reinforced concrete prefabricated columns.
The concrete we are going to use will be HA – 25.
The iron for our columns will be S275J.
It will be column of 30 x 30 cm of cross-section.



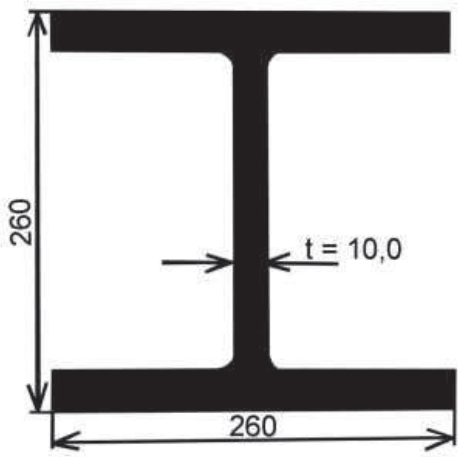
We can find this kind of column in the axes C and D with the meet with the axes 1, 2, 3, and 4 in the first floor.

In the second floor they are in the axe D with the meet with the axes 1, 2, 3, 4, 7, 8, 9, 10 and 11; and in the axe A with the meet with the axes 7, 8, 9, 10 and 11.

Figure 7. Squared section column example

b) Metal columns

It will be steel profiles of the line HEA and HEB with different kind of steel: S235, S275, S355. Below could be seen the shame of one profile used.



We can find this kind of column in the axe B with the meet with the axes 1, 2, 3, and 4.

Figure 8. HEB 260

1.2.3 WALLS

Staircase, and some interior walls are made of monolithic concrete wall. Other ones are brick walls. The concrete we are going to use will be as in the hole building, HA – 25.
The exterior walls are made of sandwich panel and curtain wall.

1.2.4 ROOF

Flat roof of the building. Rainwater drainage is external. Roof flashings constructed of two-layer adhesive roller prilydomosios bituminous pavement. Roof insulation used polystyrene foam as the main layer of rock wool insulation of the upper roof. The roof structure must conform to BROOF (t) class requirements.

1.2.5 SLABS

Our slabs will be build with prestressed prefabricated floor slab and prefabricated beams (Figure 9 and 10), is a kind of one-way slab. Our slab will contain:

- Prestressed prefabricated floor slab
- Prestressed prefabricated beams
- Reinforced concrete beams
- Steel bar

Figure 9. Floor slabs panels and beams

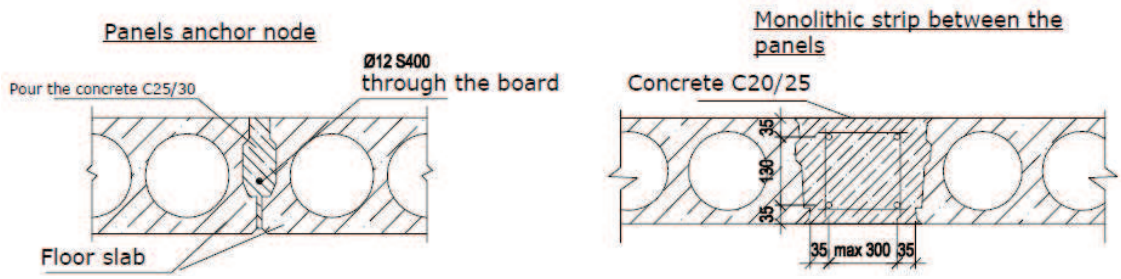
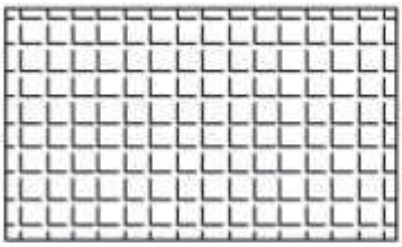


Figure 10. Nodes between floor slab panels

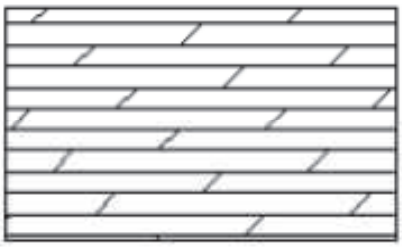
Indoor on roof equipped with multi-base surface 50-60mm or reinforced with polypropylene fiber cement-sand base, steam isolation, of separation of PVC film, 50 mm polystyrene foam and, as needed, 0-30mm baked sand or expanded clay leveling layer. Premises on the ground installed base multi-surface 100-120mm reinforced concrete or fiber base insulation. The design allows for the heating, plumbing, electrical and low voltage cables, carrying cases and the installation of sewer pipelines to perform in the floor.

Floor finish:

- Office space - wood,
- Trade and service center - clinker tiles / stone tiles / epoxy coating. (Figure 11)



Ceramic tile detail - Bathroom



Detailed parquet

Figure 11. Different types of pavement

Below is shown all the areas of the building (Table 1)

PREMISES EXPLICATION			
No.	ROOM	HELP. PL.	BASIS. PL m2
1.	TAMBOUR	3.30	-
2.	CAR IN ROOM	-	35.90
3.	MANAGER'S ZONE	-	45.05
4.	CAR SHOWROOM EXPOSITION	-	226.55
5.	CUSTOMER WAITING ROOM	-	19.00
6.	AUTOSERVICE CUSTOMER SERVICES	-	34.70
7.	CORRIDOR	4.05	-
8.	STAIRCASE DECK	7.90	-
9.	FOR CLEANING	3.05	-
10.	STAIRCASE DECK	4.95	-
11.	PART STORE (FIRST LEVEL)	38.70	-
12.	STAIRCASE DECK	3.80	-
13.	CO-OPERATION IN STOCK	49.75	-
14.	TIRE RECYCLING REPOSITORY	87.40	-
15.	COMPRESSION	6.65	-
16.	WATER SERVICE	13.90	-
17.	THE INLET OF	6.50	-
18.	HEAT POINT	7.35	-

INDICATORS	M2
MAIN AREA	840.85
AUXILIARY AREAS	396.75
USABLE AREA (main + secondary)	1237.60
TOTAL AREA	1237.60
GENERAL BUILDING LOT contruction area	913.70
BUILDINGS HAVE	6052.50

PLOT AREA	0.2610 ha
BUILDING PLOT	0.47
BUILDING PLOT DENSITY	35%
CAR NUMBER OF PARKING SPACES	40vnt

PREMISES EXPLICATION			
No.	ROOM	HELP. PL.	BASIS. PL m2
1.	BALCONY - CORRIDOR	22.90	-
2.	ADMINISTRATIVE CABINET	-	30.10
3.	CONFERENCE HALL	-	20.30
4.	CABINET	-	13.65
5.	CABINET	-	13.65
6.	KITCHENETTE	-	13.80
7.	STAIRCASES INTERIM LOT	4.95	-
8.	STAIRCASES INTERIM LOT	3.70	-
9.	STOCK PART (second level)	38.70	-
10.	CAR SERVICE	-	317.60
11.	CAR WASH	44.80	-
12.	CAR WHEEL ALIGNMENT ROOM	-	52.25
13.	TAMBOUR	28.80	-
14.	CHANGING FACILITIES FOR PERSONNEL	-	10.60
15.	SAN. UNIT	-	2.90
16.	SHOWER	-	4.80
17.	WORKERS 'KITCHEN - DINING ROOM	15.60	-

Table 1. Areas of the building

1.2.6 INTERNAL WALLS AND PARTITIONS

The internal walls will be of reinforced concrete for the staircase and for the basement (25cm thickness).
Inside, the partitions will be of glass or brick partitions (12 cm of thickness).
The interior glass partitions will be modulated with studs, and the interior brick partitions will be two kinds, depending of the rooms that this one separates.

Humid zone-dry zone:

-Single-fired stoneware pieces 20x20cm e = 10mm
-Tail-Mortar
-Mortar trowelled screed (15mm)
-Hollow-Brick 24x11, 5x7 cm
-Plastering and plastered (15mm)
-Painting

Dry zone-dry zone:

-Painting
-Plastering and plastered (15mm)
-Hollow-Brick 24x11, 5x7 cm
-Plastering and plastered (15mm)
-Painting

1.2.7 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.

1.2.8 FACADE

Facades will be of curtain wall and sandwich panel wall.
The surface of the facade corresponding to the curtain wall is 322,60m2. This is the west facade and south facade. We can find tinted glazed and transparent glazed among which are the windows. This system is according all requirements of safety, noise and thermal. In addition we have modern solutions that exist. The curtain wall makes the building sophisticated and modern. And it is a perfect combination with the frame. See technological card about curtain wall.

1.2.9 HOME DECORATION

Sanitary units and other wet room wall are covered with glazed tiles. The walls of the other areas are covered with painting, and the inner face of the facade are covered by a monolith, gypsum board. Surfaces are plastered, painted and / or coated with leaf decoration materials. Below could be seen a interior view of the car showroom. (Figure 12)

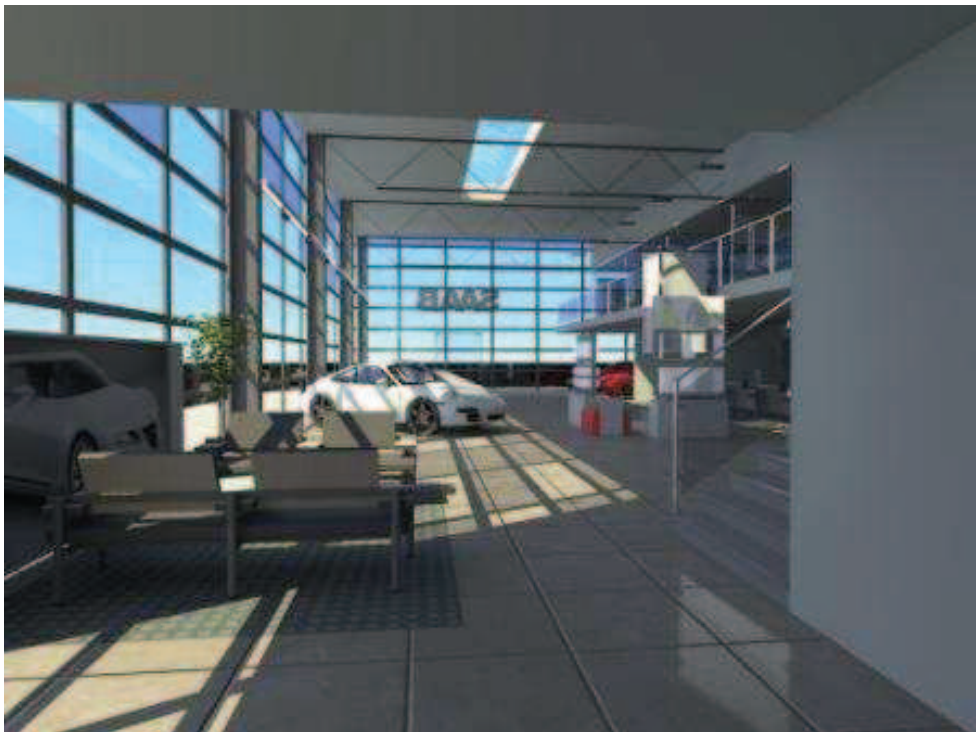


Figure 12. Interior view of the car showroom

1.2.10 INSTALLATIONS

Water supply and sewerage

Design Water and wastewater network 2.07.01:2003 prescribed based on STR. Connecting sewer codes and branch joints elbows should not be steeper than 45 ° angle and is installed with the minimum number of bends.

Domestic wastewater find hot and cold water intended for the design of the mounting locations of the device.

Node to provide water for irrigation of lawn care products and wellness.
Water meter on the top and bottom frame counters must be removed and inspected. Systems for hot and cold water measurement should be able to read the data remotely. Water supply pipes are designed from plastic pipes are insulated.

Heating and ventilation

Heat networks. Connection to the district heating network in Vilnius Vilniaus energy 2010 05 24 No specifications issued. 10063rd Designed un-ducted heat trail DN 48.3 / 110 to the Factory insulation.

The substation. Designed by 3 independent heating circuits node.

Heating, cooling. Designed for air heaters, the total power of 77.2 kW radiator heating power of 20.21 kW, under floor heating power of 30.98 kW.

Designed to cool the Freon "split-type air conditioning system. AHU-1 ventilation unit provides air cooled chillier-heat pump. The heat pump operates down to -10 ° C and at a lower temperature heat activated node. Server contains two conditioners ventilation. Designed for one air supply, exhaust system with separate flow recuperator AHU-1 and heating, cooling section, 9 air-stripping system.

Electricity

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

Electricity networks and electricity accounts designed on "Electrical installation of general rules for 2007, STR 2.01.04:2004 Fire Safety. Basic requirements and energy facilities fire safety regulations.

1.2.11 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.

1.2.12 HEALTH CONDITIONS

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

1.2.13 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 issues.

1.2.14 DISABILITY NEEDS

The first floor of the building is accessible for the disabled people, complying with all necessary regulations.

2. CONSTRUCTIONAL PART

In this part, will be defined the frame of the structure. It will consist in a special structure composed by a prefabricated reinforced concrete column, HEB 260 and a truss with slope, like in figure 13, figure 14, figure 15 and figure 16.

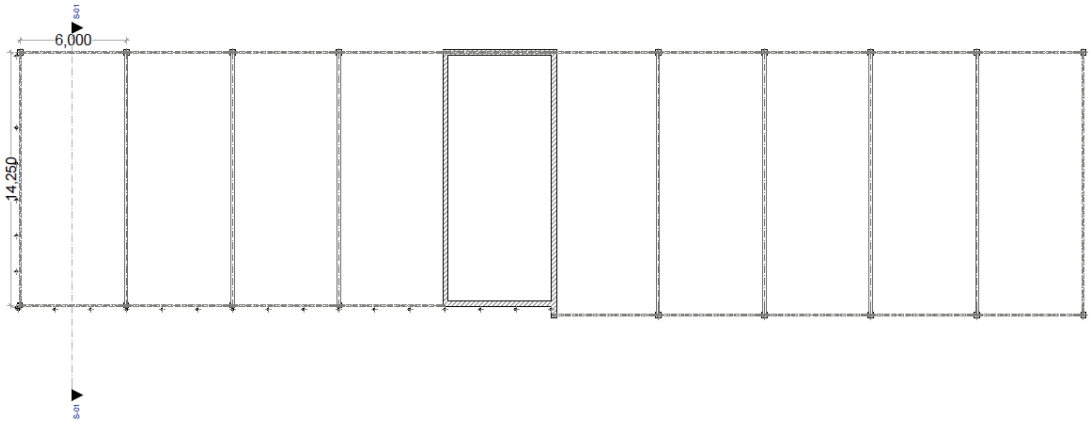


Figure 13. Aerial view of the structure

Figure 14. 3D view of the structure

Figure 15. 3D view of frame

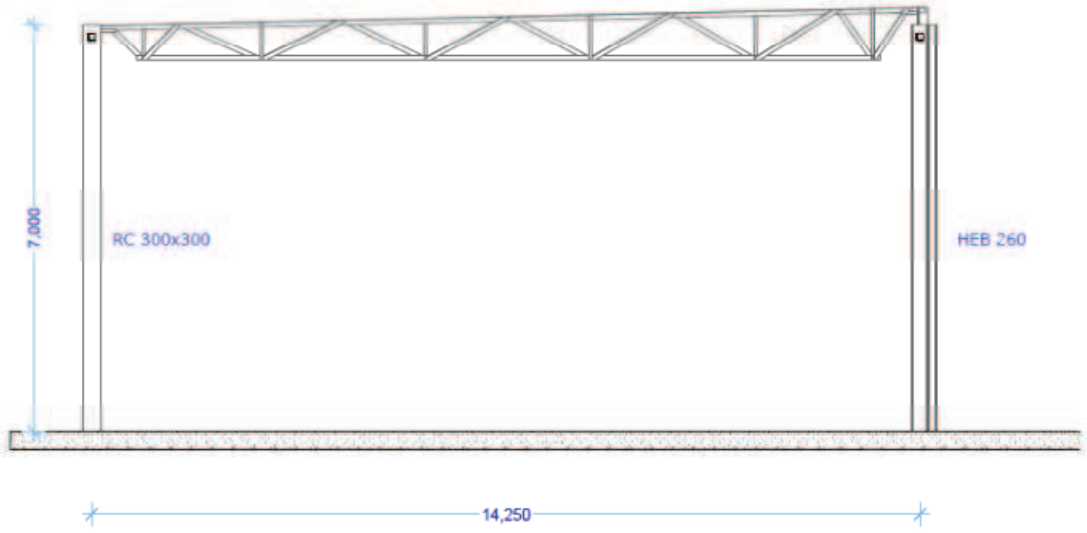


Figure 16. Front view of frame

2.1 DESIGN OF FRAME

2.1.1 INTRODUCTION

We are going to check another possibility of frame; we are going to check if it is possible with a HEB 500 instead of truss.

Justification loads:

Permanents = G $\gamma_G = 1.35$

Variables = Q $\gamma_Q = 1.50$

Dead loads

Self weight + Roof weight

Below could be seen the description of the weight of the deck roof (Table 2):

DECK		
COMPOSITION	KG/m^2	
Two layers roll roofing	2x1.9	
Heat insulation of solid rock wool compressive strength of 80 kPa, thickness 30mm	4.5	
Heat insulation of solid rock wool compressive strength of 30 kPa, thickness 130mm	19,5	
Vapor barrier stabilized PE film (thickness 200MKM)	0.00023	
Heat insulation of solid rock wool compressive strength of 80 kPa, thickness 30mm	4.5	
Profiled steel sheets	15.3	
TOTAL	47.60	2.80 KN/m

Table 2. Weight of deck roof

47.60 x 6 (distance between frames) = 285.60 Kg/m = 2.80 KN//m

Snow loads

Sk = 1.6 KPa x B

S = 1.6 x 6 x 1.3 = 12.48 KN/m

Wind loads

ω_k = 0.36 KPa

ω_1 = 0.36 x 6 x 0.8 x 1.3 = 2.24 KN/m

ω_2 = 0.36 x 6 x 0.6 x 1.3= 1.68 KN/m

The computer calculations were made with Matrix Frame program. To simplify the development and because it is not really important, we will not take the slope of the beam. Below could be seen load images generated by the program (Figure 17, Figure 18, Figure 19).

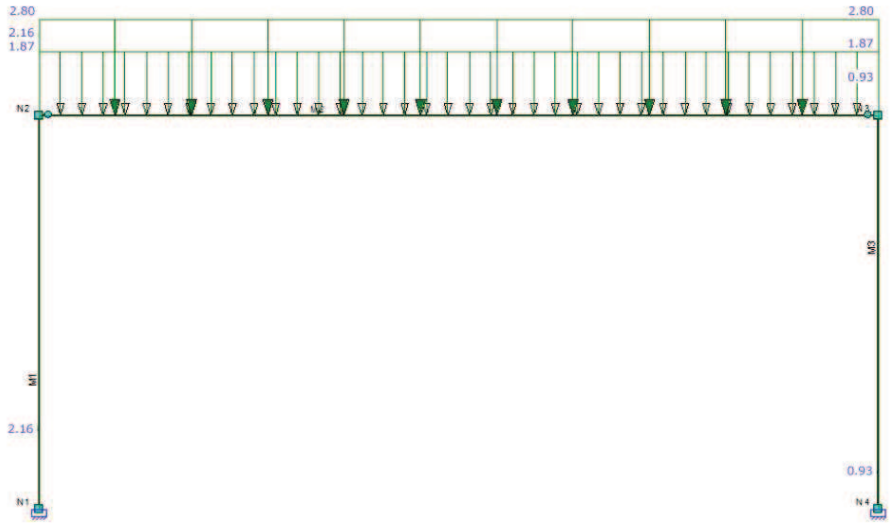


Figure 17. Permanent loads

Figure 18. Snow loads

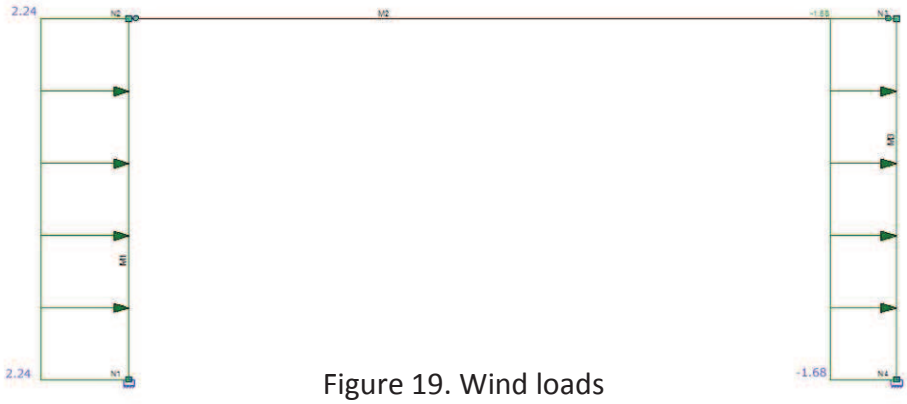


Figure 19. Wind loads

Bending moments obtained with the program (Figure 20, Figure 21, Figure 22).

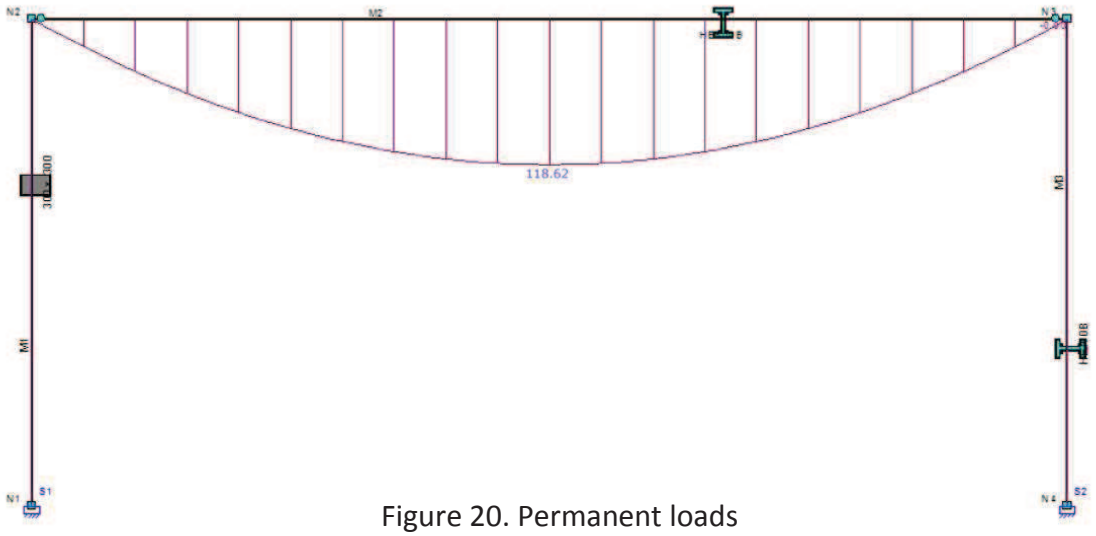


Figure 20. Permanent loads

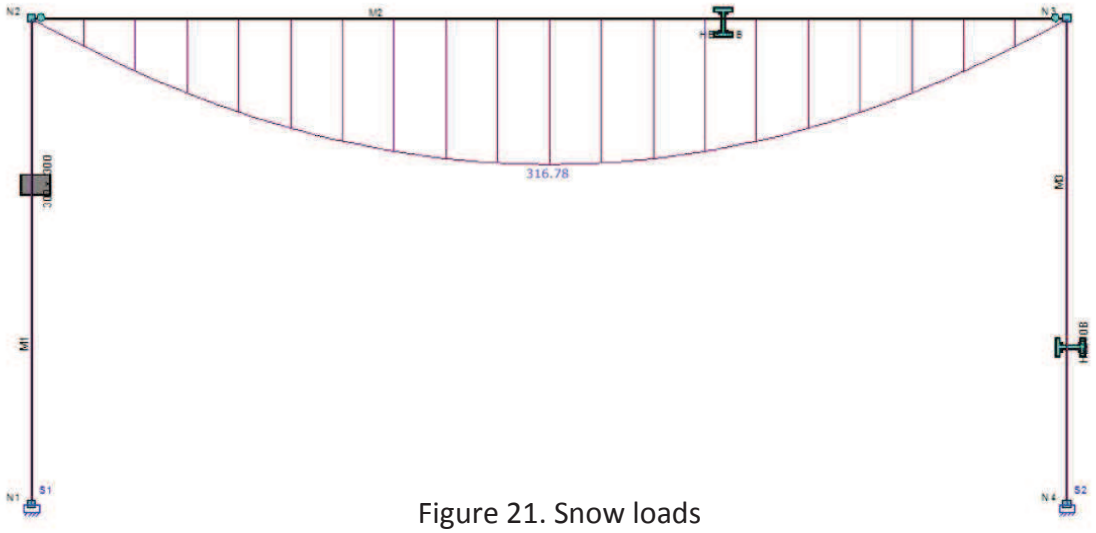


Figure 21. Snow loads

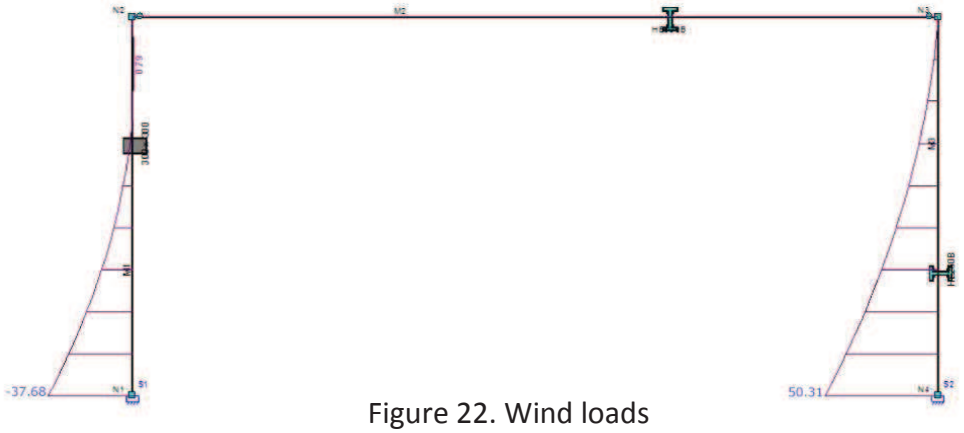


Figure 22. Wind loads

M (Permanent loads) = 118.6 KN
M (Snow) = 316.8 KN

$$\sum M = 118.6 + 316.8 = 435.4\ KN \cdot m$$

2.1.2. CHARACTERISTICS OF THE MATERIALS

CONCRETE:

Concrete type	HA-25
Characteristic resistance	f_{ck}= 25 MPa
Deduction coefficient of concrete:	$\gamma_Q = 1.50$
Specific weight of reinforced concrete	γ_H= 2.5 T/m3=24.5 KN/m3
Coating	d´= 5 cm

IRON:

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

STEEL

Type of steel	S275
Steel Safety Factor	$\gamma_M = 1.05$

2.2. STRUCTURAL CALCULATION OF THE BEAM

The computation is performed by Eurocode 3: Design of Steel Structures (EN 1993).

$$\sigma_{max} = \frac{M_y}{W_y} \leq f_{yd} \quad (1)$$

$$W_y \geq \frac{M_y}{f_{yd}} = \frac{435.4 \cdot 10^2}{25.23} = 1725.72\ cm^3$$

$$f_{yd} = \frac{f_y}{\gamma_M} = \frac{265 \cdot 10^{-1}}{1.05} = 25.23 Kn/cm^2 \quad (2)$$

f_{yd} : see table 3, Minimum mechanical properties of steels UNE EN 10025

Perfil HEB

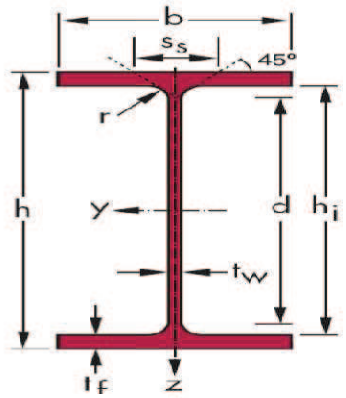


Figure 23. HEB profile data

h	Nominal Overall height
b	Flange width
tw	Web thickness
tf	Flange thickness
r	Radius agreement between the web and flange
d	Length of the straight part of the soul
hi	Internal Height Profile
A	Area of the transverse cross section
M	Mass per meter
P	Weight per meter
Iy	Moment of inertia about the axis yy
Wy	Elastic modulus about yy axis
iy	Turning radius from the axis yy
Wply	Plastic modulus about yy axis
	(for sizing plastic, the cross section must be Class 1 or section 2, in accordance with Eurocode 3)
Iz	Moment of inertia about the axis zz
Wz	Elastic modulus about the axis zz
iz	Turning radius from the axis zz
Wplz	Plastic section modulus about the axis zz
	(for sizing plastic, the cross section must be Class 1 or section 2, in accordance with Eurocode 3)
It	Torsion modulus
Iw	Warping constant
AL	Surface paint per meter
AG	Paint per ton
Avz	Cutting area (load parallel to web)
Sy	Average static moment of area about yy axis
sy	Distance between the centers for compressive and tensile bending about the axis yy

Designacion	M kg/m	P kN/m	h mm	b mm	tw mm	tf mm	r mm	d mm	hi mm	A cm2	Iy cm4	Wy cm3	iy cm	Wply cm3	Iz cm4	Wz cm3	iz cm	Wplz cm3	It cm4	Iw cm6	AL m2/m	AG m2/t	Avz cm2	Sy cm3	sy cm
HEB 100	20,4	0,204	100	100	6,0	10,0	12	56,0	80,0	26,0	450	89,9	4,16	104,2	167	33,5	2,53	51,4	9,3	3387	0,567	27,76	9,04	52,1	8,6
HEB 120	26,7	0,267	120	120	6,5	11,0	12	74,0	98,0	34,0	864	144,1	5,04	165,2	318	52,9	3,06	81,0	13,9	9431	0,686	25,71	10,96	82,6	10,5
HEB 140	33,7	0,337	140	140	7,0	12,0	12	92,0	116,0	43,0	1509	215,6	5,93	245,4	550	78,5	3,58	119,8	20,2	22514	0,805	23,88	13,08	122,7	12,3
HEB 160	42,6	0,426	160	160	8,0	13,0	15	104,0	134,0	54,3	2492	311,5	6,78	354,0	889	111,2	4,05	170,0	31,3	48039	0,918	21,56	17,60	177,0	14,1
HEB 180	51,2	0,512	180	180	8,5	14,0	15	122,0	152,0	65,3	3831	425,7	7,66	481,5	1363	151,4	4,57	231,0	42,2	93807	1,037	20,25	20,24	240,7	15,9
HEB 200	61,3	0,613	200	200	9,0	15,0	18	134,0	170,0	78,1	5697	569,7	8,54	642,6	2003	200,3	5,07	305,8	59,7	171413	1,151	18,78	24,84	321,3	17,7
HEB 220	71,5	0,715	220	220	9,5	16,0	18	152,0	188,0	91,0	8091	735,6	9,43	827,1	2843	258,5	5,59	393,9	77,0	295814	1,270	17,77	27,93	413,5	19,6
HEB 240	83,2	0,832	240	240	10,0	17,0	21	164,0	206,0	106,0	11260	938,3	10,31	1053,2	3923	326,9	6,08	498,4	103,9	487675	1,384	16,63	33,23	526,6	21,4
HEB 260	93,0	0,930	260	260	10,0	17,5	24	177,0	225,0	118,5	14921	1147,7	11,22	1283,0	5135	395,0	6,58	602,3	126,7	754854	1,499	16,12	37,60	641,5	23,3
* HEB 280	103,1	1,031	280	280	10,5	18,0	24	196,0	244,0	131,4	19272	1376,5	12,11	1534,5	6595	471,0	7,08	717,6	146,1	1131686	1,618	15,69	41,10	757,3	25,1
* HEB 300	117,0	1,170	300	300	11,0	19,0	27	208,0	262,0	149,1	25168	1677,8	12,99	1868,8	8563	570,9	7,58	870,1	189,2	1690325	1,732	14,80	47,44	934,4	26,9
* HEB 320	126,7	1,267	320	300	11,5	20,5	27	225,0	279,0	161,4	30826	1926,6	13,82	2149,4	9239	615,9	7,57	939,1	230,5	2071813	1,771	13,98	51,78	1074,7	28,7
* HEB 340	134,2	1,342	340	300	12,0	21,5	27	243,0	297,0	170,9	36659	2156,4	14,65	2408,3	9690	646,0	7,53	985,7	262,8	2457424	1,810	13,49	56,10	1234,1	30,4
* HEB 360	141,8	1,418	360	300	12,5	22,5	27	261,0	315,0	180,6	43196	2399,8	15,46	2683,2	10141	676,1	7,49	1032,5	298,3	2887857	1,849	13,04	60,61	1341,6	32,2
* HEB 400	155,3	1,553	400	300	13,5	24,0	27	298,0	352,0	197,8	57684	2884,2	17,08	3231,9	10819	721,3	7,40	1104,0	361,0	3823884	1,927	12,41	69,99	1616,0	35,7
* HEB 450	171,1	1,711	450	300	14,0	26,0	27	344,0	398,0	218,0	79892	3550,8	19,14	3982,6	11721	781,4	7,33	1197,7	448,0	5268037	2,026	11,84	79,67	1931,3	40,1
* HEB 500	187,3	1,873	500	300	14,5	28,0	27	390,0	444,0	238,6	107181	4287,3	21,19	4814,8	12624	841,6	7,27	1291,7	548,1	7031022	2,125	11,34	89,83	2407,4	44,5
* HEB 550	199,4	1,994	550	300	15,0	29,0	27	438,0	492,0	254,1	136698	4970,8	23,20	5590,9	13077	871,8	7,17	1341,2	610,2	8874020	2,224	11,15	100,08	2795,4	48,9
* HEB 600	211,9	2,119	600	300	15,5	30,0	27	486,0	540,0	270,0	171050	5701,7	25,17	6425,4	13530	902,0	7,08	1391,1	677,1	10969947	2,323	10,96	110,82	3212,7	53,2

NAME	Nominal thickness t (mm)				Charpy test temperature °C
	yield stress f_y (N/mm^2)			breaking stress f_u (N/mm^2)	
	t ≤ 16	16 < t ≤ 40	40 < t ≤ 63	3 ≤ t ≤ 100	
S235JR	235	225	215	360	20
S235J0					0
S235J2					-20
S275JR	275	265	255	410	20
S275J0					0
S275J2					-20
S355JR	355	345	335	470	20
S355J0					0
S355J2					-20
S355K2					-20 (1)
S450J0	450	430	410	550	0

(1) Se le exige una energía mínima de 40J.

Table 3. Minimum mechanical properties of steels UNE EN 10025

HEB 500

See previous figure 23 to get the W_y

$$W_y \text{ (HEB 500)} = 4287.3 \text{ cm}^3 \geq 1725.72 \text{ cm}^3 \quad \rightarrow \text{OK}$$

(Resist the bending moment)

3. TECHNOLOGICAL CARDS

3.1 TECHNOLOGICAL CARD OF ASSEMBLING OF FRAME

3.1.1GENERAL DESCRIPTION

This technological card consists in the construction of steel frame and roof. The length of the building is 60 m and width 14.80 m. We are going to use metal sections type HEB 260 and prefabricated reinforced concrete columns 30x30 cm for the columns and warren type inverted struts truss for roof in the transverse direction and metal sections type RHS 100x100x5 in the longitudinal direction.

The truss is to only a direction and upon it rests the roof.

The roof drains water to only one side with a slope of 2.5%.

I choose this type of material for the realization of frame for it is quick and easy installation.

3.1.2 DESCRIPTION OF TECHNOLOGY AND SEQUENCE OF WORKS

The basics components of our frame are metal sections:

-HEB 260
-HEA 260
-HEA 180
-RHS 100x100x5
-RHS 120x120x5
and prefabricated reinforced concrete columns 30x30 cm

The truss measured 14.80 m and height is variable. Truss come already assembled and is composed of:

-RHS 60x5
-RHS 60x4
-RHS 80x80x5
-RHS 100x100x5

Roof will be mounted on works and is composed of:

-Two layers roll roofing
-Heat insulation of solid rock wool compressive strength of 80 kPa, thickness 30 mm
-Heat insulation of solid rock wool compressive strength of 30 kPa, thickness 30 mm
-Vapour barrier stabilized PE film (thickness 200 MKM)
-Heat insulation of solid rock wool compressive strength of 80 kPa, thickness 30 mm
- Profiled steel sheets

CONSTRUCTION SEQUENCE:

1. Pillars staking
2. Connect columns with foundations
3. Connect columns with beam and trusses
3.1. Raise trusses and beams that need assembling with the crane
3.2. Do assembly work uploaded to a stable structure (scaffold)
4. Connect the trusses with diagonal stabilizing
5. Leave holes in the roof for skylights
6. Put the different layers of the roof

Works order:

1. Pillars staking

Each column has to be correctly positioned in plan or 'line', but also correct in level and in orientation. It must also be plumb. We will work from centre lines: the lines will be marked on the ground. We will have a main line of columns, and then any line parallel to it at a known distance can be used. The first column to be erected will need guying if the holding-down bolt group is not sufficiently strong.

2. Connect columns with foundations (Details A and B)

The top surface of the concrete foundation is set slightly low to permit steel nuts to be packed beneath the steel column's base plate. (The steel base packs are placed and levelled before erection of the columns).

Prefabricated reinforced concrete column

Put the column in the vertical of the bolts with the help of a crane and place washers and nuts higher. Rest the column between 10% and 20% of the weight of the column to be able to level it. Plumb the column and all connections tight butt proceed to rest the weight of the column. Fill the joint with mortar Grout.

Steel column

Level nuts and washers lower. Take one benchmark. Put the motherboard and screw the upper nuts. Concrete the joint through the hole of the motherboard. Weld the metal profile to the metallic based.

3. Connect columns with beam and trusses (Details C and D)

Connect the beams and truss threading screws and nuts. Raise trusses and beams that need assembling with the crane. Do assembly work uploaded to a stable structure (scaffold).

4. Connect the trusses with diagonal stabilizing

Connect the diagonal stabilizing and truss threading screws and nuts. Raise diagonal stabilizing that need assembling with the crane. Do assembly work uploaded to a stable structure (scaffold).

5. Leave holes in the roof for skylights

Connect the small beams that form the hole for skylights

6. Put the different layers of the roof

3.1.3 INSTALLATION SEQUENCE. FROM 1 TO 45

The works sequence will be as shown bellow (figure 24), beginning from one to forty-five.

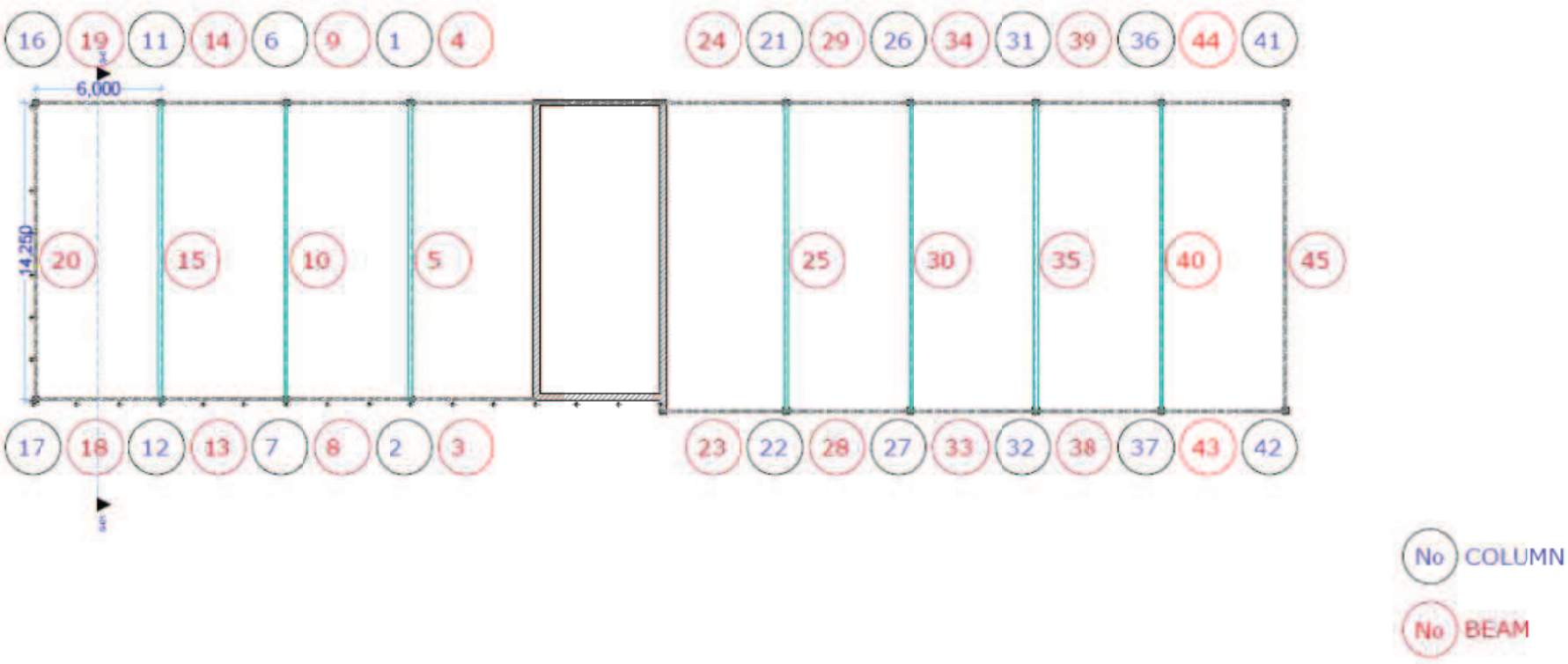


Figure 24. Installation sequence of frame

ORGANIZATION OF WORKS

Below could be seen a gantt chart with the duration of works (Figure 25).

Id	Name of work	Duration
1	PILLARS STAKING	1 day
2	CONNECT THE PORCH COLUMNS WITH SHOE	10 days
3	DO THE CHANGE OF COLUMN FOR CONNECTION TO THE TRUSS	14 days
4	CONNECT BEAMS WITH COLUMNS	12 days
5	CONNECT TRUSS WITH COLUMNS	8 days
6	CONNECT TRUSSES WITH DIAGONAL STABILIZING	21 days
7		
8		
9	total works of this kind of structure	35 days

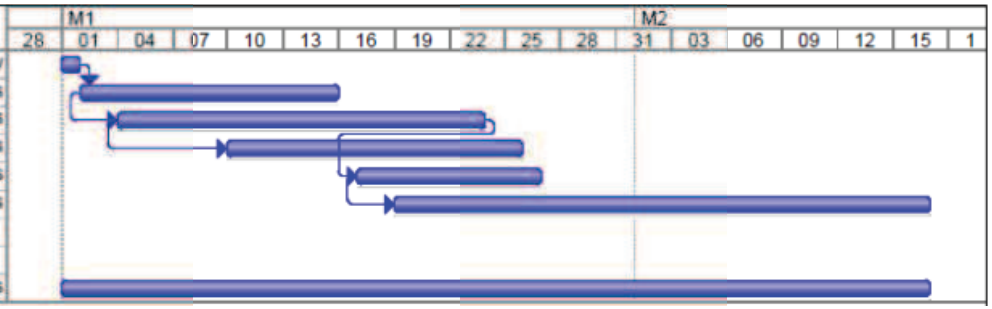


Figure 25. Duration of works of assembling of frame

3.1.4 HUMAN SAFETY

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 welds, workers should 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 be in perfect condition.

3.1.5 MATERIAL – TECHNICAL RESOURCES

Below could be seen a table with the tools, mechanisms and materials needed (Table 4)

num.	name	quantity
1	TOOLS:	
1.1	Metal Roulette 2PK	2
1.2	Ladder platform with 10m	2
1.3	Hammer ST-1	3
1.4	The electrodes 42A	2
1.5	Levels H-10KL	1
1.6	Crowbar LM-24	2
1.7	Building level 700mm	2
1.8	Theodolite 2T30	1
1.9	Guying weight 13.3 kg	2
1.10	The visor welding	2
1.11	Helmet	12
1.12	Security belts	2
1.13	Metal brushes	2
1.14	Chemical cleaning detail and found	2
1.15	Chalk axes marked	2
1.16	Wrench	2
2	MECHANISMS	
2.1	Electric welding machine for Tc-500 Q = 1.2 kW	1
2.2	Crane KS-5363 lst = 25m	1
2.3	Traverse TS-12, 5 weight 242kg	1
2.4	Hook and versatile sling	4
3	Structures and Materials bored piles installed NAME	
3.1	Construction	
3.2	Trusses	7
3.3	Materials	
3.4	Anchor bolts	128

Table 4. Tools, mechanisms and materials needed

3.1.6 QUALITY CONTROL

Below could be seen a table with the tolerances fitting trusses

Tolerances FITTING Trusses (mm)

1.	Trusses up to 18m: length	+10
	section width of	+5
	section thickness or height	+5
2.	Truss deviations from marking axes	+5
3.	Trusses supporting nodes altitudes	+5

Table 5. Tolerances fitting trusses

1. Control of material. Should be checked before and during installation each piece of the steel frame 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. Construction manager to monitor erection progress to confirm work follows the schedule submitted by the steel contractor

3. Construction manager to hold regular meetings with the contractor, erector, surveyor and testing lab to review ongoing submittals and progress of the work.

4. Surveyor to measure each critical point as structure following plumbing and fixing, but prior to welding. Confirm each critical point is positioned correctly, with acceptable tolerances, according to the 3D model. Construction manager to record in reporting system whether work is within allowable tolerances.

5. Inspection labs to monitor each bolted and field welded connection and confirm it is performed in accordance with approved procedures and submit reports. Construction manager to record in reporting system whether work is per approved procedures.

6. Re-survey each critical point after welding to confirm that it remains within acceptable tolerances relative to its preloaded geometric position. Construction manager to record in reporting system whether work is within allowable tolerances.

7. Welding engineer to monitor welding procedures at particular conditions where recommended by peer review engineer and submit reports. Construction manager to record in reporting system whether work is per approved procedures. Should unacceptable conditions occur, welding engineer to provide forensic engineering to recommend remedial action.

8. Construction manager to confirm all inspections for each member. Identify members, connections and critical points that exceed allowable tolerances to owner. EOR and architect to determine whether corrective measures are required for reasons of structural integrity, aesthetics or to accommodate other trades.

9. Architect to perform periodic inspections and provide field observation reports addressing the following issues:

    • Confirm weld finishing satisfies contract terms.
    • Identify work that is aesthetically unacceptable as a result of being outside tolerances.
    • Issue field observation reports.

10. EOR to perform Special Inspections of work as it progresses and submit field observation reports.

11. Owner to review weld finishes to determine whether weld finishing beyond the contract terms is required.

12. Construction manager and EOR to monitor removal of falsework to confirm the approved procedure is followed.

13. Surveyor to perform a final survey of all members to determine final de-propped position of members. Survey to be submitted for review by EOR and for use by other trades. Construction manager to record in reporting system whether final position of members is within allowable tolerances.

3.1.7 SOME DETAILS

Bellow will be shown some details, for a better understanding.
It is shown how the prefabricated reinforced concrete column is (Figure 26).

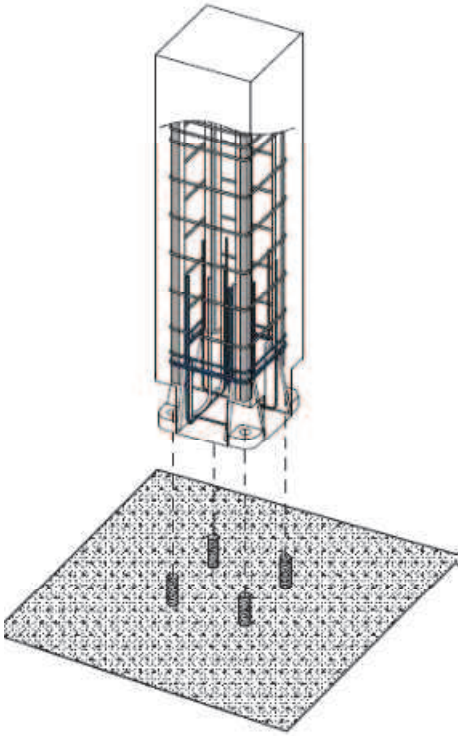


Figure 26. Prefabricated reinforced concrete column

Figure shows how steel column (HEB 260) is connected with foundation (Figure 27).

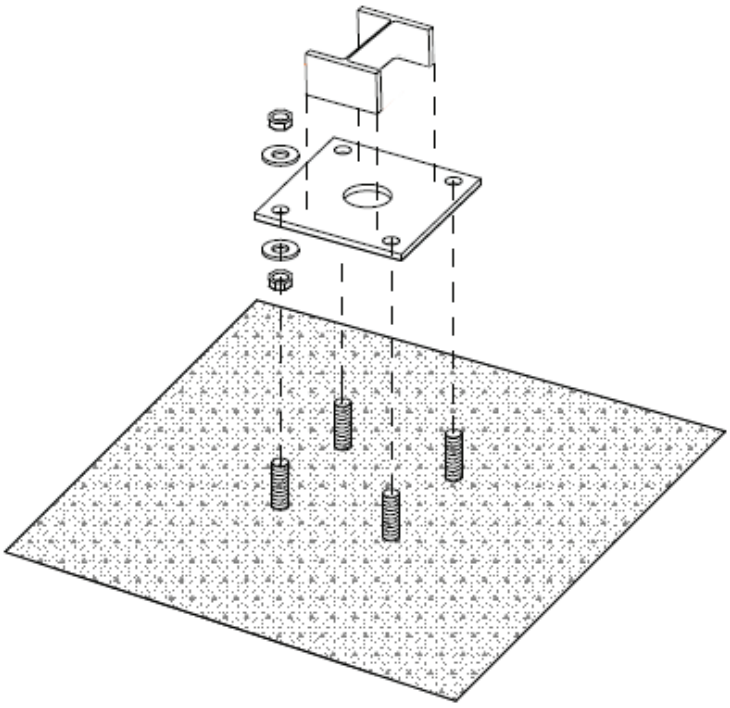


Figure 27. Column HEB 260

Figures show how beams are connected with the column (Figure 28 and 29).

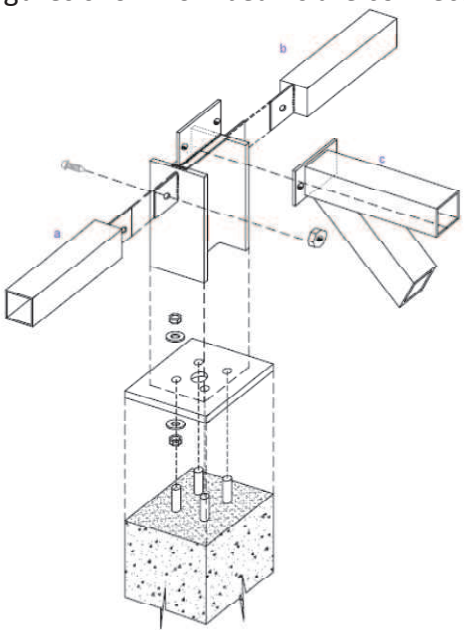


Figure 28. Change of reinforced concrete column to steel column.

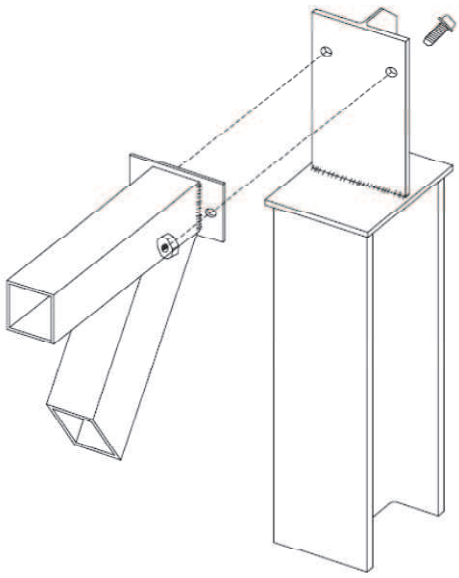


Figure 29. Connection of column with beam.

3.1.8 REPRESENTATION OF ASSEMBLING OF FRAME DETAILS.

1. 

2. 

3. 

4. 

Shows how is assembling of prefabricated reinforced concrete column with foundation

Figure 30. Assembling prefabricated reinforced concrete column with foundation.

5. 

6. 

Figure 30. Assembling of prefabricated column

3.1.9 CALCULATION OF QUANTITY OF WORKS AND PRICE

Below could be seen a table with the description of works (Table 6)

EEAM.1bba	m2	Structure height 5-7 industrialized mixed with light 15m	74,98

Mixed structure industrialized S275JR steel, coated in industrial building with skylight, with a height of 7m and up to 15m of light, with supports, trusses, belts, even two coats of primer.

Codec	Nat CHAPTER	Ud	Summary FRAME	Quantity	Price €	Amount
MOOM.8A	workers	h	2 Official 1st steel	0.312	19.41	12.11
MOOMM11a	workers	h	2 Specialist steel	0.156	18.55	5.79
MOOMM11a	workers	h	1 Assembler helper	0.156	17.68	2.75
PEAP10a	material	Kg	Average value S275JR Structural profile	32.000	0.81	25.92
	material	Kg	Prefabricated reinforced concrete column	4.500	2.30	10.38
PEAW.2b	material	U	Metal Repercusión/m2	1.000	3.74	3.74
Prcp.8CBC	material	l	Matte color metal primer	1.300	11.43	14.86
%			Supplemental Direct Costs	0.035	62.42	2.18
			Total (€)	-	-	74,98

Source: http://www.five.es/basedatos/Visualizador/Base12/index.htm

Table 6. Performance table

3.1.10 TECHNICAL - ECONOMIC INDICATORS

1. Quantity of works: 888 m^2
2. Installation costs: 74.98 €/m^2 x 888 = 66582.24 € or 229708.72 Litas
3. Duration of works: 35 days

The amount of work is 888 m^2 and worker performance longer needed is 0.312 h/m^2, so that:

888 x 0.312 = 277.056 /8 = 34.6 ≈ 35 days

4. Wage: Official: 888m2 x 12.11€/m^2 = 10753.68 € or 37100.19 Litas

Specialist Steel: 888m2 x 5.79€/m^2 = 5141.52 € or 17738.24 Litas

3.2 CURTAIN WALL – TECHNOLOGICAL CARD

3.2.1 GENERAL

In this technological card we will focus on analyzing installation of curtain wall. The surface of the facade corresponding to the curtain wall is 322,60m^2. This is the west facade and south facade. We can find tinted glazed and transparent glazed among which are the windows. This system is according all requirements of safety, noise and thermal. In addition we have modern solutions that exist. The curtain wall makes the building sophisticated and modern. And it is a perfect combination with the frame.

3.2.2 DESCRIPTION AND CONSTRUCTION SEQUENCE

Curtain wall is a highly developed type of facade over the last years in Lithuania, due to many reasons. The main reason for the reform cases is because it protects the facade.

There are many types of curtain wall. I have chosen this kind of curtain wall because it has not pronounced joints where water can enter and it damages the joints with the periods of frozen and unfrozen.

The brand of our curtain wall supplier will be "METRA".

This curtain wall consist of a auxiliary frame where put modules of glass

The dimensions of our curtain wall modules are 1995 mm, with a thickness of 14 mm and with a width of 850 mm.

Below, are described the works:

Construction sequence:

1. Transportation, storage and handling
2. Anchorage and connection provision
3. Connections stakeout
4. Installation arrangement
5. Placement of the uprights with the help of the crane
6. Glazing of the auxiliary structure with the help of the lifting platform
7. Final fixing and inspection

1. Transportation, storage and handling

We have to make a checking of the materials: auxiliary frame and modules, and leave them where we have planned.

2. Anchorage and connection provision

Before concreting the first floor we have to do a study of connection of the auxiliary frame with the main frame and slabs.

3. Connections stakeout

Before concreting the first floor we have to mark where will go the connectors and the correct place of auxiliary frame.

4. Installation arrangement

We have to check before starts to put the uprights if everything is Ok to get the curtain wall how we had planned.

5. Placement of the uprights with the help of the crane

Use the crane to lift the uprights and place them in their correct position.

6. Glazing of the auxiliary structure with the help of the lifting platform

Two workers will have to get on the lifting platform and fix the glass modules in the correct place.

7. Final fixing and inspection

A supervisor has to check the connections done.

3.2.3 INSTALLATION SEQUENCE.

Bellow (figure 31) is shown the sequence installation of curtain wall. After build auxiliary frame, put modules in the direction of the red arrow. Beginning with the bottom row and following with the row above.

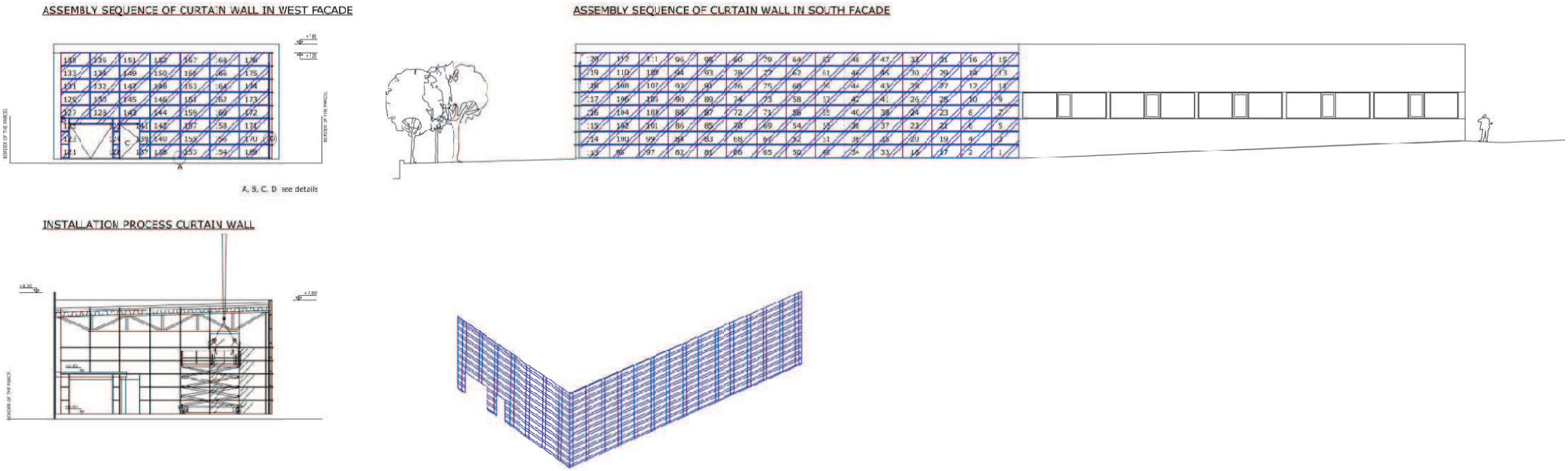


Figure 31. Installation sequence of the curtain wall

ORGANIZATION OF WORKS

Below could be seen a Gantt chart with the duration of works (Figure 32).

Id	Name of work	Duration
1	Transportation, storage and handling	1 day
2	Anchorage and connection provision	1 day
3	Connections stakeout	1 day
4	Instalation arrangement	1 day
5	Placement of the uprights with the help of the crane	11 days
6	Glazing of the auxiliary structure with the help of the lifting platform	29 days
7	Final fixing and inspection	1 day
8		
9	Total number of days	45 days

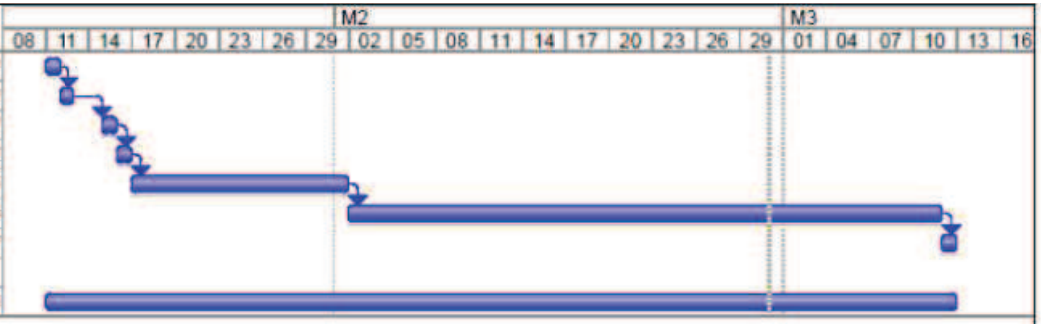


Figure 32. Gantt curtain wall

3.2.4 HUMAN SAFETY

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 welds, workers should 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 be in perfect condition.

3.2.5 MATERIAL – TECHNICAL RESOURCES

Below could be seen a table with the tools, mechanisms and materials needed (Table 7)

num.	name	quantity
1	TOOLS:	
1.1	Levels H-10KL	2
1.2	Helmet	4
1.3	Security belts	2
1.4	Chemical cleaning detail and found	2
1.5	Chalk axes marked	1
1.6	Wrench	2
2	MECHANISMS	
2.1	Crane KS-5363 lst = 25m	1
2.2	Traverse TS-12, 5 weight 242kg	2
2.3	Hook and versatile sling	2
3	Structures and Materials	
	NAME	
3.1	Construction	2
3.2	Auxiliar frame	2
3.3	Materials	2
3.4	Metal connectors	2

Table 7. Table of tool, mechanism and materials

3.2.6 QUALITY CONTROL

1. Design Data:

a. Submit structural and thermal calculations for complete wall assembly. Structural calculations and design shop drawings shall be signed and sealed by a structural engineer registered in state in which project is to be located.

2. Factory Test Reports:

a. Test Reports: Provide certified test reports, for each of following listed tests, from a qualified independent testing laboratory showing that curtain wall system assembly has been tested in accordance with specified test procedures and complies with performance characteristics as indicated by manufacturer's testing procedures. Manufacturer shall submit appropriate testing numbers for specific tests indicated below.

1) Deflection and structural tests.
2) Water penetration tests.
3) Air infiltration tests.
4) Delamination tests.
5) Thermal conductance tests.
6) Sound transmission loss test.
7) Submit factory tests required except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested within last year, under conditions specified herein, resulting test reports may be submitted in lieu of listed testing.

3. Manufacturer's Certificates:

a. Submit Certificates of Compliance, with specification requirements, for the following:

1. Metal extrusions.
2. Metal accessories.
3. Stating that aluminum has been given specified thickness of anodizing or organic coating finish.
4. Indicating manufacturer's and installer's meet qualifications as specified.
5. Submit list of equivalent size installations, for both manufacturer and installer, which have had satisfactory and efficient operation.

4. Manufacturer's Field Reports:

a. Submit field reports of manufacturer's field representative observations of curtain wall installation indicating observations made during inspection at beginning of project, during middle of installation and at conclusion of project. Indicate results of field testing, and any directions given Contractor for corrective action.

INSTALLATION

A. Installation and erection of glazed curtain wall system and all components shall be in accordance with written directions of curtain wall manufacturer. Match profiles, sizes, and spacing indicated on approved shop drawings.

B. Bench Marks and Reference Points: Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of marks, stop erection work in that area until discrepancies have been corrected.

C. Ensure that drainage system operates properly.

D. Do not proceed with structural silicone work when metal temperature is below 0 degrees C (32 degrees F).

E. Isolate between aluminum and dissimilar metals with protective coating or plastic strip to prevent electrolytic corrosion.

F. Install curtain wall system so as to maintain a virtually flat face cap, with no visible bowing.

G. Install entire system so that fasteners are not visible.

H. Tolerances:

1. Maximum variation from plane or location shown on approved shop drawings: 3 mm per 3600 mm of length up to not more than 13 in any total length.
2. Maximum offset from true alignment between two identical members abutting end to end in line: 0.8 mm.
3. Sealant space between curtain wall mullion and adjacent construction: Maximum of 19 mm and minimum of 6 mm.

I. Door:

1. Install door in accordance with details indicated and approved shop drawing detail drawings.
2. Seal exterior metal to metal joints between members of door, frames, mullions, and mullion covers in accordance. Remove excess sealant.
3. After installing and glazing doors, adjust ventilators and hardware to operate smoothly and to be weathertight when ventilators are closed and locked. Lubricate hardware and moving parts.
4. Install to make weathertight contact with frames when ventilators are closed and locked. Do not cause binding of sash or prevent closing and locking of ventilator.
5. Provide for ventilating sections of all windows to insure a weather-tight seal meeting infiltration tests specified. Use easily replaceable factory-applied weather-stripping of manufacturer's stock type.

J. Joint Sealants:

1. Surfaces to be primed and sealed shall be clean, dry to touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 3 mm. Do not apply compound unless ambient temperature is between 5 and 35 degrees ^{o}C. Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.
2. Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, shall be tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 19 liters.
3. Apply primer to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after caulking is completed.
4. Tightly pack backing in bottom of joints which are over 13 mm in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.
5. Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.
6. Remove compound smears from surfaces of materials adjacent to sealed joints as work progresses. Use masking tape on each side of joint where

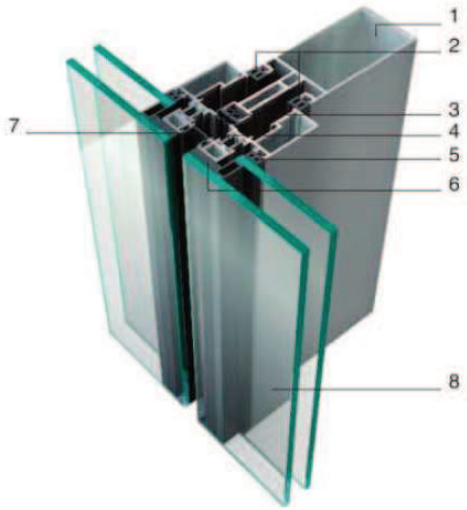
texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of caulking and sealing, remove remaining smears, stains, and other soiling, and leave work in clean neat condition.

K. Glass:

1. Install in accordance with manufacturer's recommendations as modified herein.
2. Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.
3. Clean sealing surfaces at perimeter of glass and sealing surfaces of rebates and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer. All sashes shall be designed for outside glazing. Provide continuous snap in glazing beads to suit glass as specified.
4. Insulate and tempered glass, and glass of other types that exceed 100 united inches in size: Provide void space at head and jamb to allow glass to expand or move without exuding sealant. Perimeter frames and ventilator sections shall have glazing rebates providing an unobstructed glazing surface 19 mm in height. Glazing rebate surfaces must be sloped to shed water.
5. Provide adequate means to weep incidental water and condensation away from sealed edges of insulated glass units and out of wall system. Weeping of lock-strip gaskets should be in accordance with recommendation of glass manufacturer.

3.2.7 SOME DETAILS

Bellow (figure 33) is shown a 3D detail.



LEGEND

1.- Upright
2.- Internal joint
3.- Internal seal EPDM
4.- Thermal rod
5.- EPDM gasket for glass
6.- Structural sealant
7.- Round seals EPDM outer
8.- Insulated glazing

Figure 33. 3D DETAIL

Some other details are shown bellow. A boot detail vertical section (figure 34), a forging step detail vertical section (figure 35), door detail (figure 36) and a corner (figure 37).

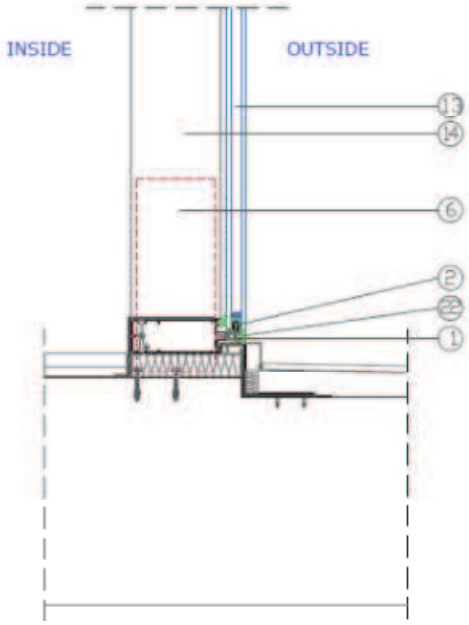


Figure 34: Boot detail

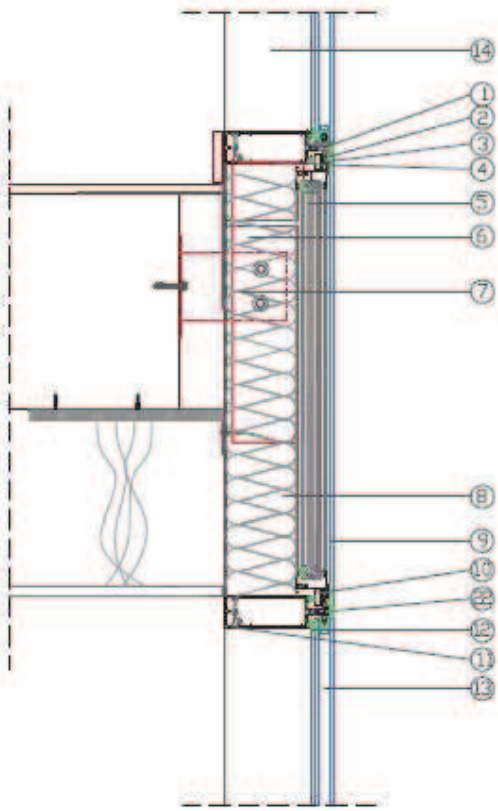


Figure 35: Forging step detail

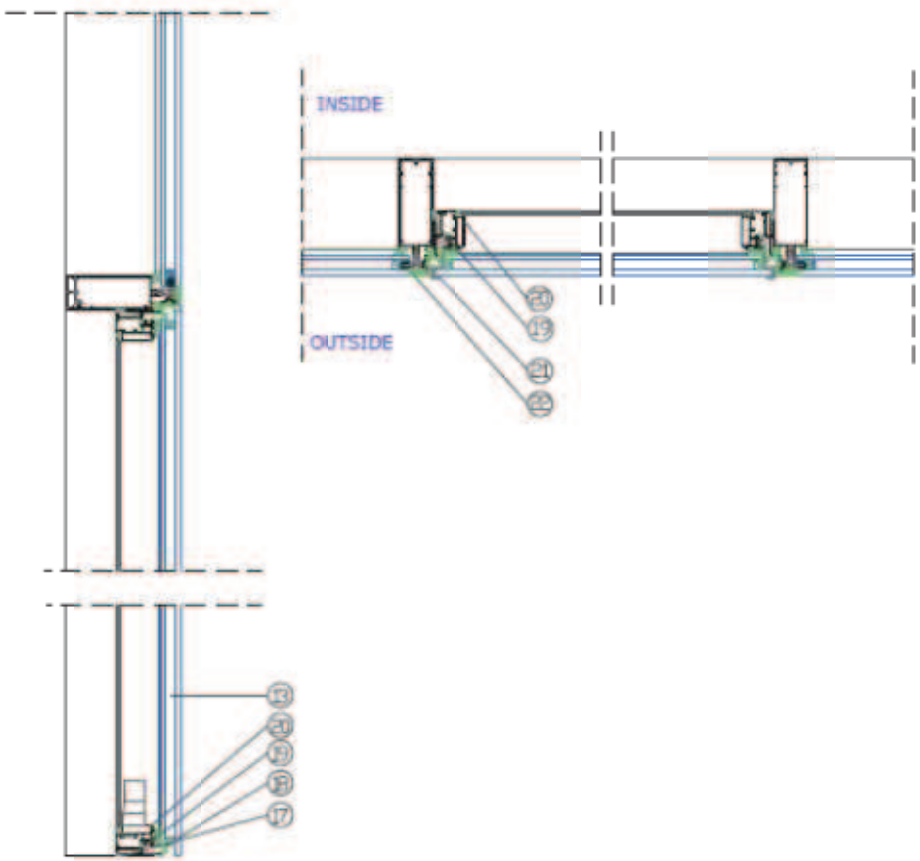


Figure 36. Door detail

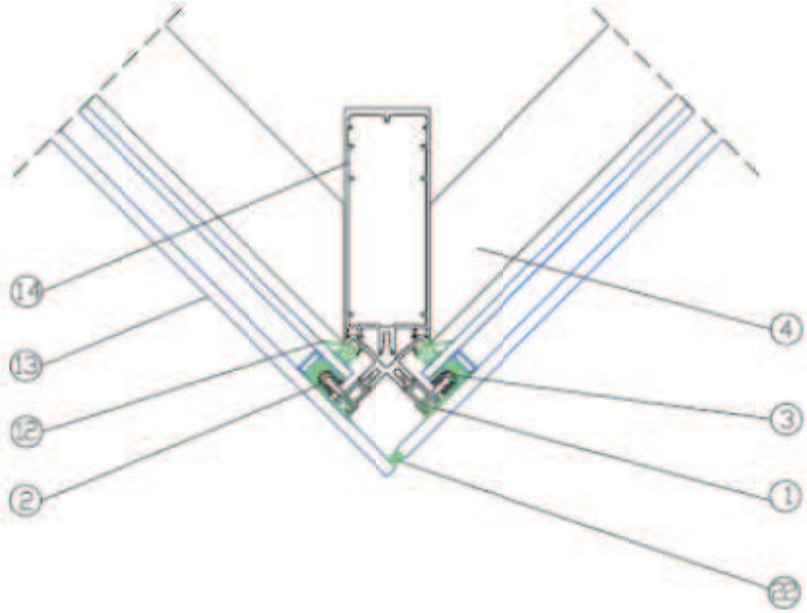


Figure 37. Corner detail

LEGEND

1.- EPDM gasket intercalaria J0815
2.- Staple 56KM807
3.- Interlayer KM806
4.- Beam profile
5.- Wick
6.- Forged anchor
7.- Insulation: rock wool
8.-Thermal Break
9.- Spandrel glass
10.- Profile FM830
11.- Beam profile
12.- Inner joint JO810
13.- Glass viewing area
14.- Stud profile
15.- 90472
16.- Italian window outer seal J0818
17.- JO117
18.- Italian sheet board J0818
19.- Italian window frame FM835
20.- Italian FM 323 sheet
21.- Window safety part Italian KM 813
22.- Watertight seal between Dow Corning silicone crystals type 791 or 756

3.2.8 REPRESENTATION OF THE GLASS MODULES INSTALATION DETAILS.

For the realization of the works, we are just going to need two workers (Figure 38).

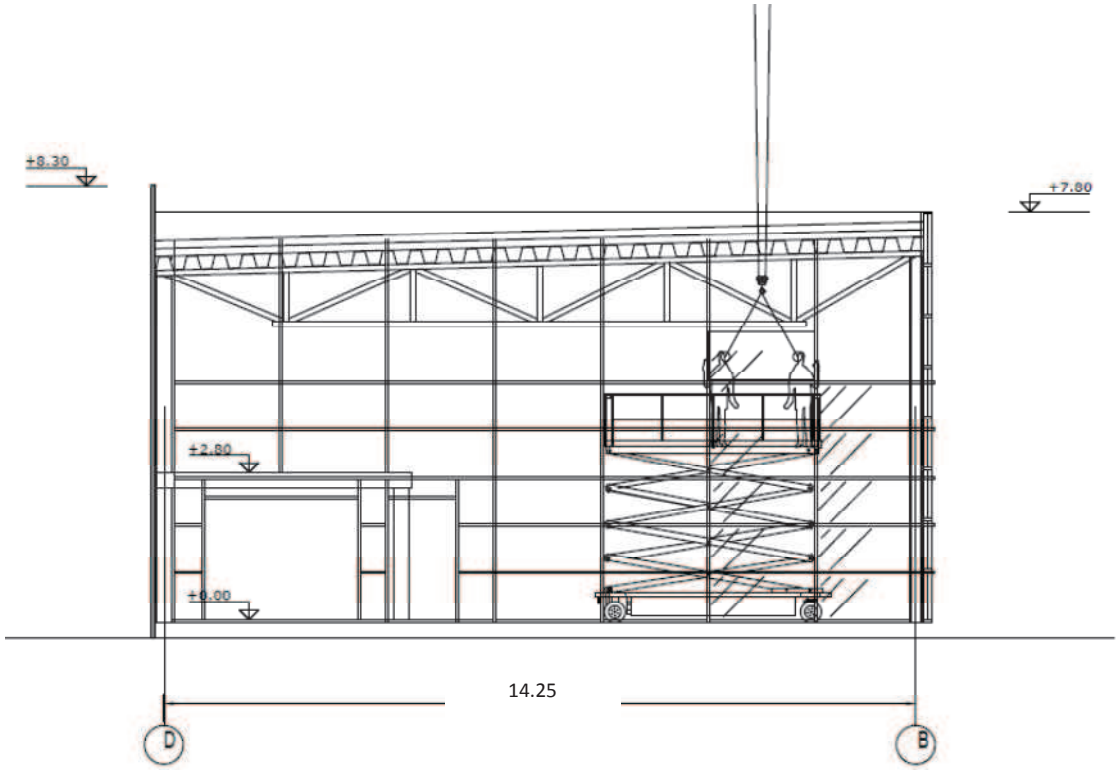


Figure 38. Shows a step of construction the curtain wall.

3.2.9 CALCULATION OF QUANTITY OF WORKS AND PRICE

Below could be seen a table with the description of works (Table 8)

EFIC.2nbb	m2	Grill 70%-tempered glass 30%- Opaque areas + glass	192,41

Curtain wall system made with grill, made of lacquered aluminium profiles undefined colour, stud section 120 x 52mm and thickness of 4 mm, cross section 60 x 52mm and a thickness of 2 mm, wheelbase stud between 2.00m and 3.00m forged axes, grid-like two divisions per plant. Enclosure made of 70% transparent area with double glazing made with reflective outer glass 6mm tempered air chamber of 12 mm and interior in silver glass 6 mm, sealed in cold neutral silicone drawstring on the outside, including share of galvanized sheet tray for separating insulating core between plants, especially for glazing would outline the wall anchors fixing the amounts to building, profile link between stiles and rails with thermal break and top of wall to work done with lacquered aluminium sheet, fully finished.

Codec	Nat CHAPTER	Ud	Summary FRAME	Quantity	Price €	Amount
MOOC.8a	workers	h	Official locksmith	0.707	2169	30.37
MOOC10a	workers	h	Locksmith helper	1.100	18.51	40.72
MOOC.8a	workers	h	Official 1st carpentry	0.707	21.69	30.37
MOOC10a	workers	h	Assistant carpentry	1.100	18.51	40.72
PFPP41b	material	m	Curtain wall aluminium Profile 120x52mm	0.600	15.96	9.58
PFPP41a	material	m	Curtain wall aluminium profile 60x52mm	0.600	10.64	6.38
PFPP43a	material	m	Tapeta 20x52mm straight curtain wall	1.200	3.54	4.25
PFPP42a	material	u	Anchor curtain wall	0.160	28.62	4.58
PFAW.1ª	material	m2	Repercussion silicone seal	1.000	4.00	4.00
PFAD.5ff	material	m2	Glazing 6-12-6 ctrol db pl 18%	0.700	75.77	53.04
PFAM.6ccf	material	m2	Tempered glass seg refl 6mm Ag	0.300	48.22	14.47
PNTU10b	material	m2	PUR foam roll e25mm	0.300	25.61	7.68
PBTL.6ag	material	m2	Sheet al 2000x1000x0.8 lac 1 cr	0.300	39.14	11.74
%			Supplemental Direct Costs	0.030	188.81	5.60
			Total (€)	-	-	192.41

Source: http://www.five.es/basedatos/Visualizador/Base12/index.htm

Table 8. Performance table

3.2.10 TECHNICAL - ECONOMIC INDICATORS

1. Quantity of works: 322.60 m^2
2. Installation costs: 322.60 x 192.41 = 62071.46 € or 214146.55 Litas
3. Duration of works: 45 days

The amount of work is 322.60 m^2 and worker performance longer needed is 1.100 h/m^2, so that:

322.60 m^2 x 1.1 = 354.86 /8 = 44.35 = 45 days

4. Wage: Official 1st carpentry = 30.37€/m2 x 322.60 = 9797.36 €

Assistant carpentry = 40.72€/m2 x 322.60= 1313.27€

4. ORGANIZATION PART

4.1 DESCRIPTION OF TERRITORY

The function of building will house a car showroom (will be car shopping center too) which is in Vilnius city, Turgeliu street 1. The work plan includes the following works:

- Access and space for the working machines (trucks, concrete pump) fixed and mobile machines.

- Space for storage of building materials.

- Electricity supply, water supply, sewerage and fire hydrant.

Perimeter areas of work:

- Danger areas in passing.
- Dangerous spaces for residence of workers.
- Access roads safe separation of workers and machinery access.
- Temporary buildings areas for workers and staff.

Before to start with the constructional works we must have prepare the construction master plan.

- The first job we have to plan is the removal of plants and trees that might disturb the execution of works.
- Must be removed 10 cm of soil and prepare the ground to begin the work of staking.
- This works will be done according to the organization project and we must meet the estimated execution times.
- We must put one fence in the perimeter of the construction work site with one signal panel of mandatory protective measures.
- We must pay attention to areas of crane installation and safety distances.
- Before to starting we must prepare a big entrance for the supplied trucks and machinery.
- We must prepare the storage sites for the materials.

The storage zones are designed for this purpose. It has a previous study on the project. Be marked and identified. This zone will be as near as possible of the tower crane for easy access and moving. It should have easy access to the material supply trucks.

The temporary buildings must be equipped with water and electricity. The crane also needs electricity. There will be a transformer connected to the current from the general supply. This provision requires a specific license, which we must seek and obtain before starting work.

4.1.1 SELECTION OF TOWER CRANE

Will be explained in the next part why will be chose our tower crane LIEBBHER 110 ECB6.
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:

$$HR = h1 + h2 + h3 + h4 = 8.30 + 0.50 + 1.00 + 1.45 = 11.25 \text{ m.} \quad (3)$$

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. (4)
Here:
P - the weight of heaviest lifting construction, *T*
Pstr - 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 calculated according to our needs. I decide to put the crane in the floor of the building because we haven't enough place to put the crane outside the building area and having a reasonable distance of arm or enough place to that workers can walk between the tower and the fence. So the reach that I need is the enough distance that arrives to the unload zone and storage place.

LR= 50.00 m.

When the values of LR, HR and QR are known, the crane could be selected using the diagrams of the tower crane.

The diagrams show, that the selected crane 110 EC-B6 LIEBHERR, match all requirements.

Qk = 3.4 > QR.= 2.65 t
Hk = 22.50 > HR.= 11.25 m
Lk = 50.00 > LR = 50.00 m

As we can see, our tower crane 110 EC-B6 LIEBHERR selected (figure 39) is capable of performing the required works.
It is shown also, the tower crane supported basement (figure 40)
Below, will be shown, the 110 EC-B6 LIEBHERR main characteristics, tower crane reach (figure 41) and lifting (figure 42).

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

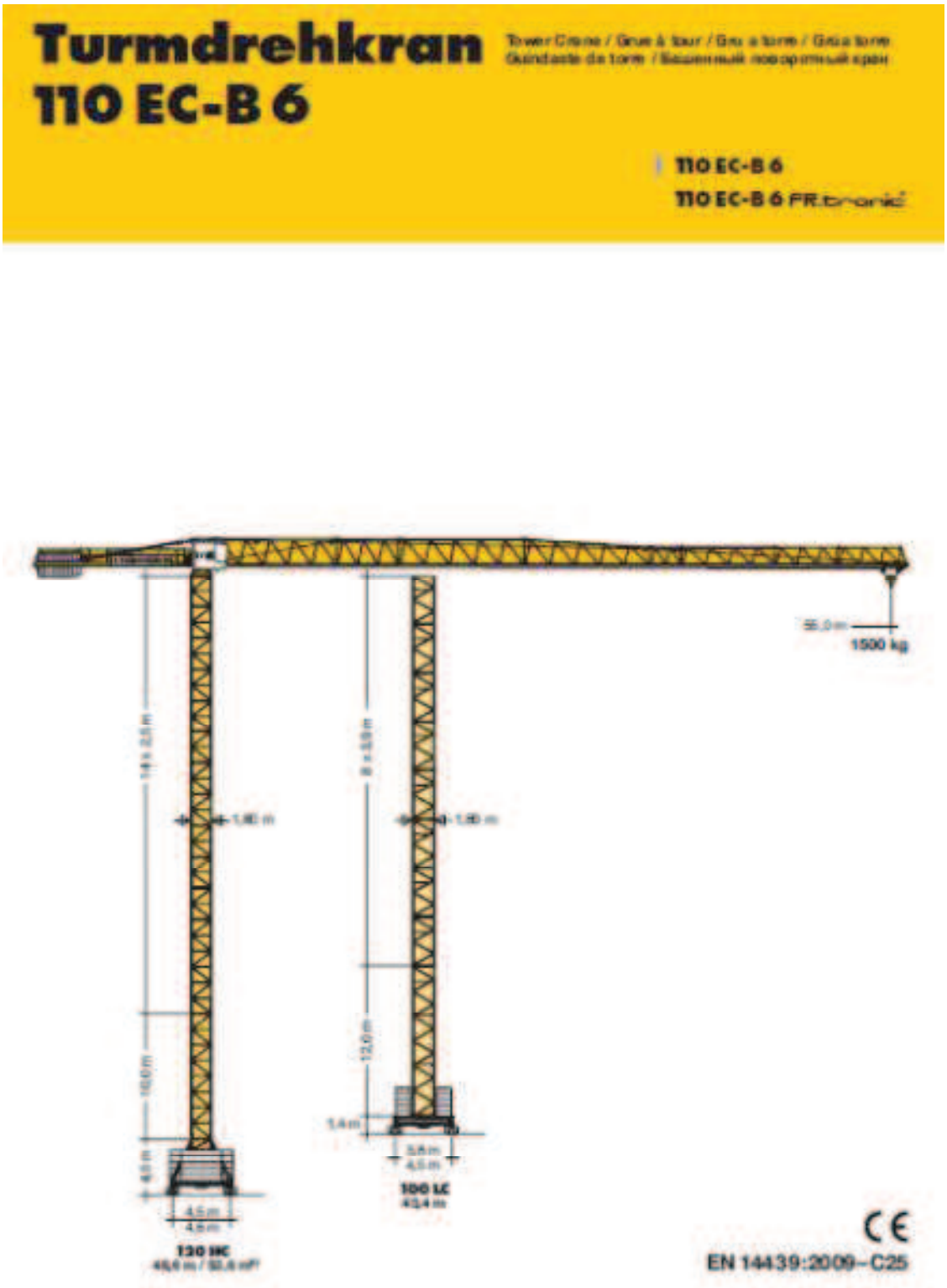


Figure 39. Selected Liebherr tower crane

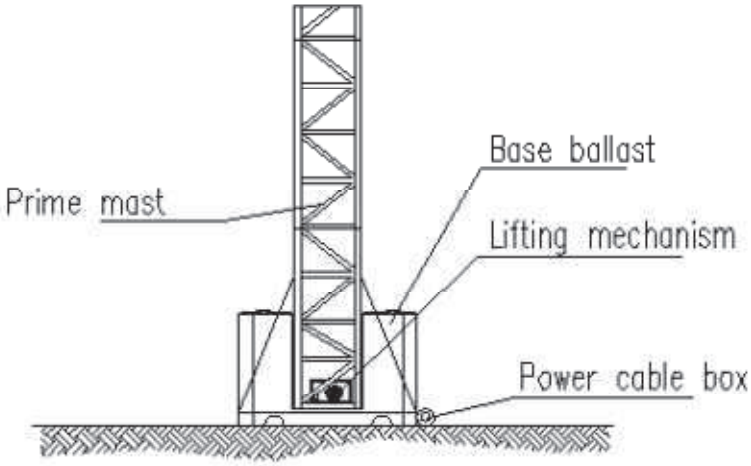


Figure 40. Tower crane supported basement

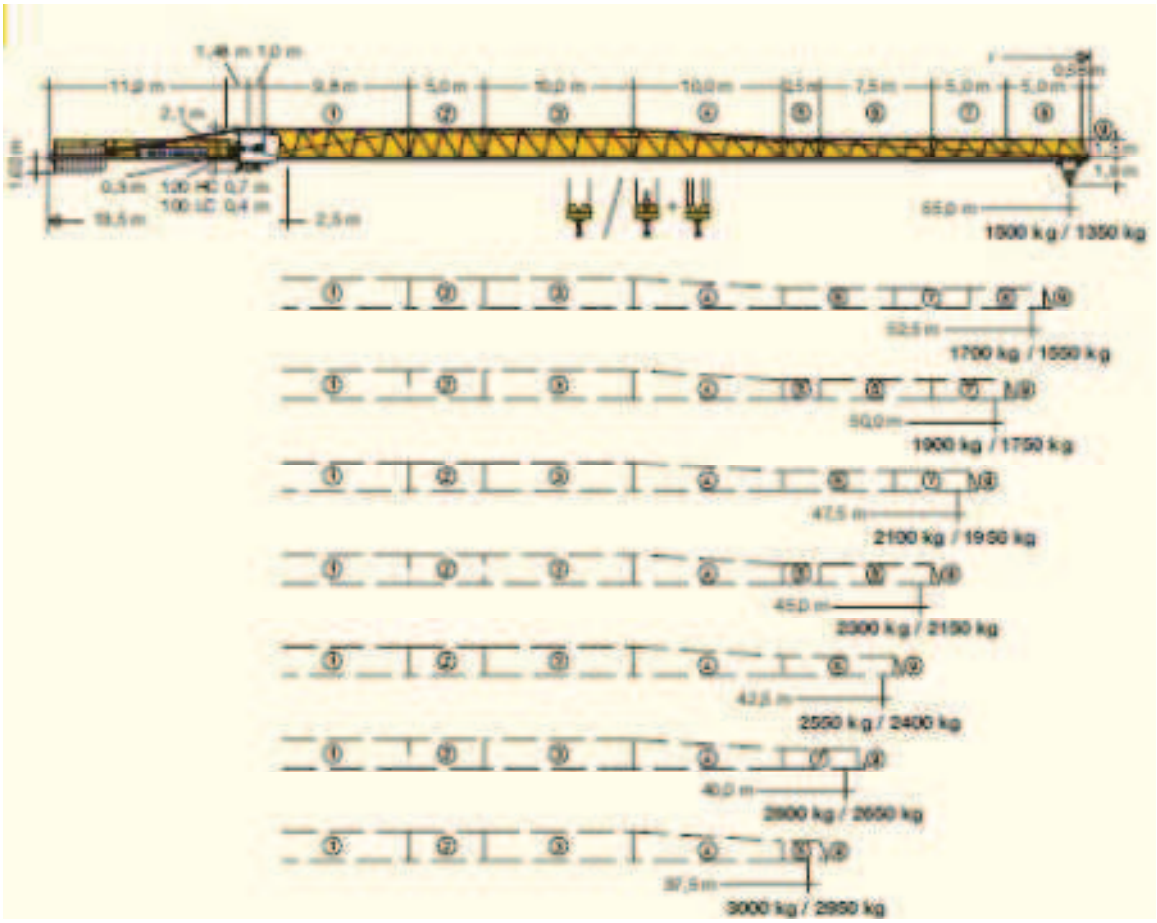


Figure 41. Tower crane reach

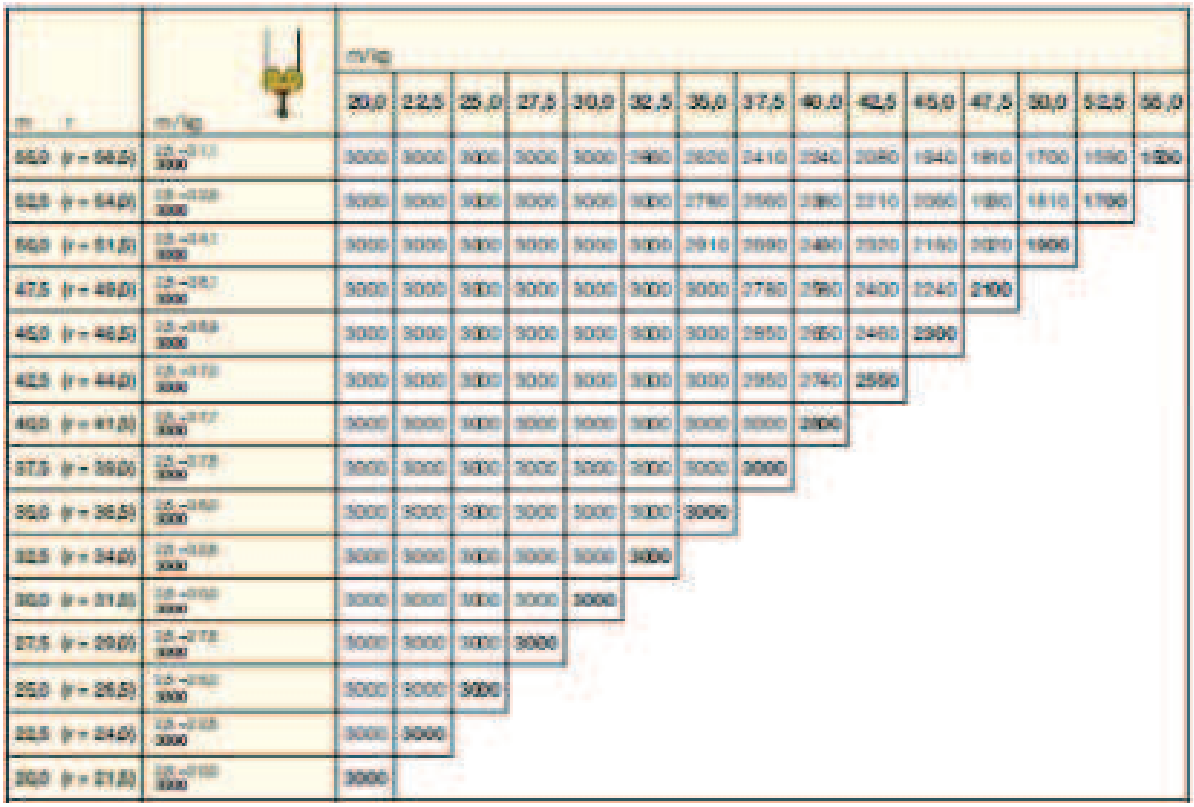


Figure 42. Tower crane lifting

4.1.2 SETTING OF DANGEROUS ZONE

During the instalment 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 9);
- Fenceless zones at a height when height difference is 1.3 m or 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 9. 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 zone where there is transfer of elements performed by crane are determined by calculation the sum of horizontal projection of lifted element, the maximum dimension (length) of biggest element and its possible fall distance.

Due to the conditions surrounding our lot we must consider our danger zone should not override existing buildings. Then, let's put some limitations on the movement of loads with the crane:

- Raise the load vertically to a reasonable height, and then carry the load to the centre turning radius so as to reduce the area of the danger zone.

- The projection of the arm of the crane will not go on existing buildings.

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 "MIEAEM2" 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 of crane works. Conditions of installation and use.

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 43. And to the work area, which inevitably we must consider the burden, will be indicated in figure 44.

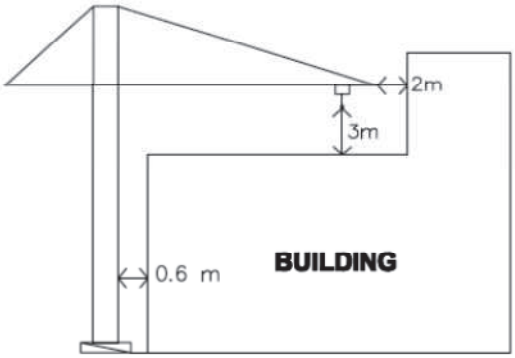


Figure 43.Horizontal and vertical obstacles

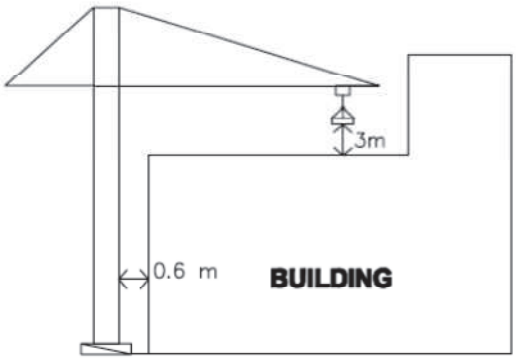


Figure 44. Vertical obstacles with load

As you can see, we are not inclined to use signalling 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 45.

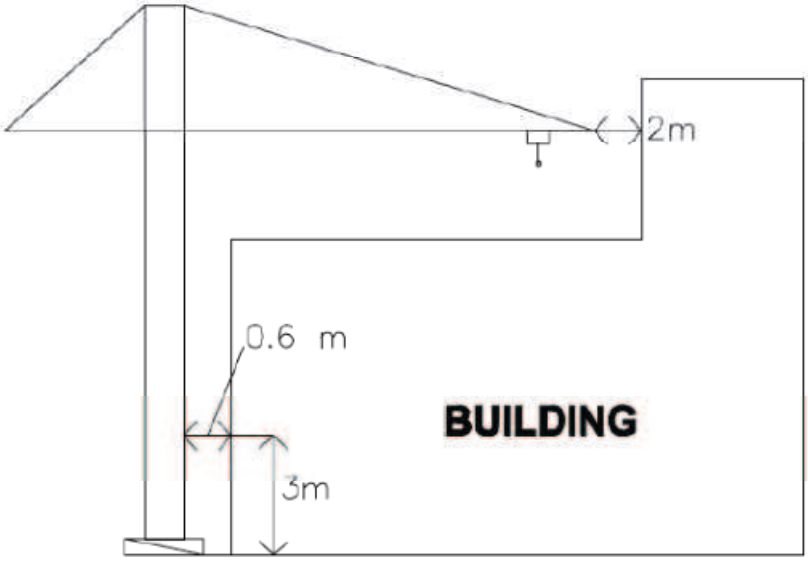


Figure 45. Safety distances

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 46.

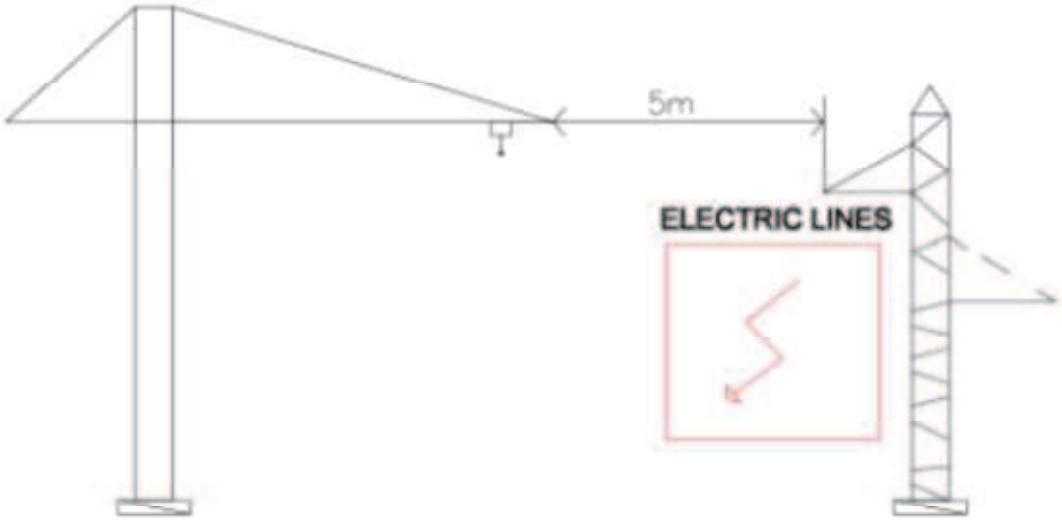


Figure 46. Special distance with electrical installations

As we can see below, it is shown one front view of the future building with the crane situation (figure 47), and an aerial view for understanding the reach of the crane (figure 48).

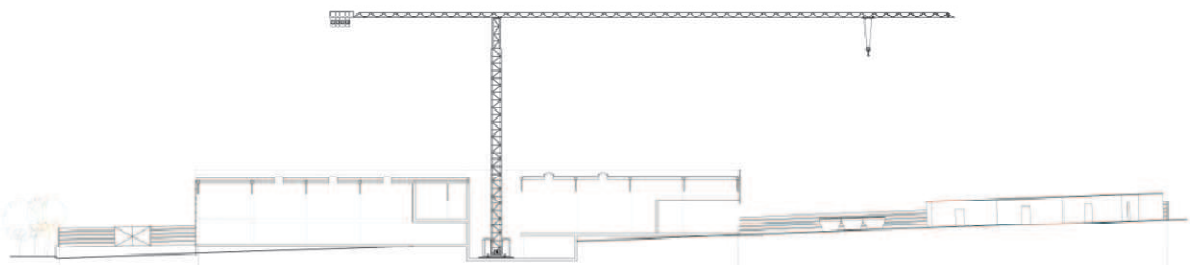


Figure 47. Building and tower crane front view

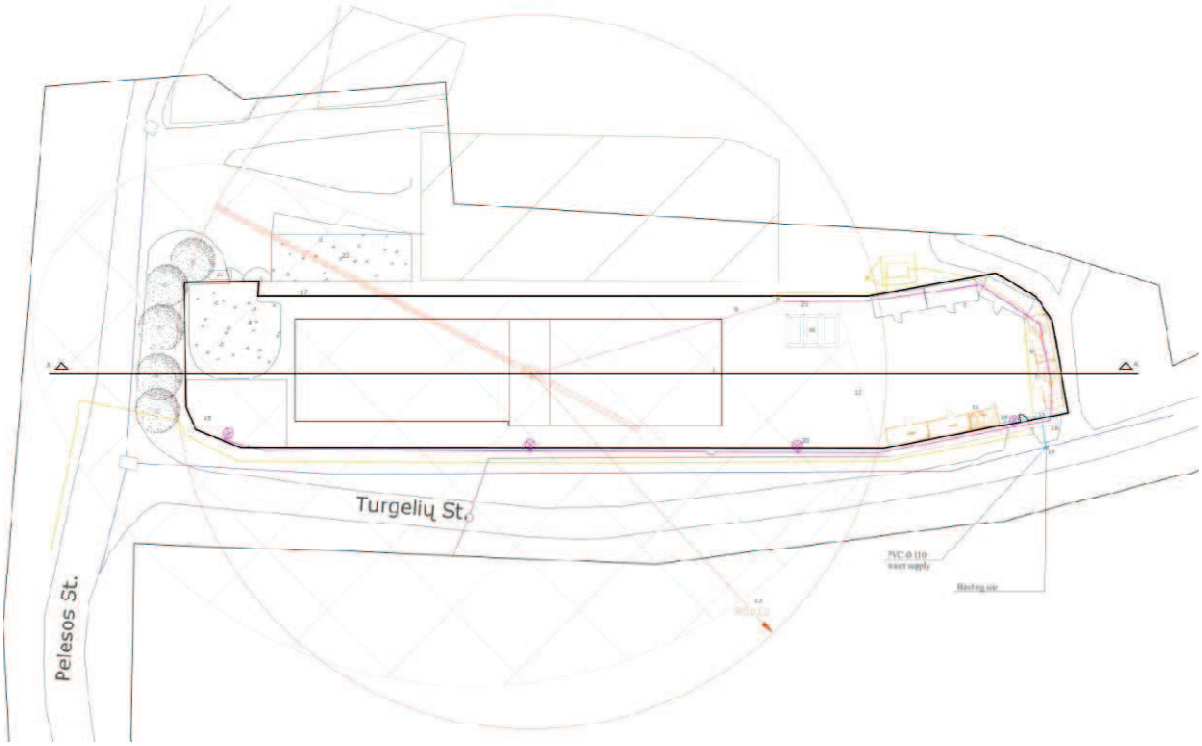


Figure 48. Plot, tower crane and dangerous zone on aerial view

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 an insignificant slope... The smallest distance from the road to the storage place is 1 meter. This kind of roads is built to ensure easy driving to the building place and fast work.

Due to the small size of our plot we can not have the space needed for the trucks to turn around, so that the solution adopted is as follows:

Taking advantage of the space prior to entry have trucks can manoeuvre to face either the door, enter, download and then back out. But it is expected to use a truck dimensions (2.80 x17 m) can not manoeuvre, so it will prepare a further area for loading and unloading outside the fenced the work of dimensions (6.5 x 20m) large enough to special truck. This may be used as a waiting area for those times when you have more than one truck to unload.

4.1.4 TEMPORARY STORAGE BUILDINGS AND SITES

The construction site will contain two storage buildings (9x4x2.3 m) for satisfying all the storage needs, will be needed one no covered site (size according to the maximum length of the biggest element (truss)) 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 to satisfy all the needs. Knowing the workers volume was possible to calculate all the necessary temporary buildings.

Basing on "REAL DECRETO 486/1997, de 14 de abril, por el que se establecen las disposiciones mínimas de seguridad y salud en los lugares de trabajo. BOE nº 97 23-04-1997" approaching the changing surface of 2 m2 per worker.

The maximum number of workers that we have working at the same time is 19. So we calculate 38m^2 of surface for temporary changing building.

1 sink / 10 workers
1 shower / 10 workers
1 toilet / 10 workers
1 mirror / 10 workers

S = 19 x 2m^2= 38 m^2

Chosen buildings:

- 2 x Modelo MH6 (6x2,44) = 29.28 m^2
- Toilet Modelo M4S (4x2,44) = 9.76 m^2
- SUM = 39.04 m^2

The workers will be able to use a temporary buildings (Modelo MH6 6 x 2.44), as place for resting, eating, etc

The managing staff will have one temporary building (Modelo MH6 6 x 2.44) where will be situated the office.

Information: http://www.remsa.net/

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 49).

Justification of individual 4x16 mm² derivation

$$P=/3.u.i.\cos f \quad (5)$$

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)

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

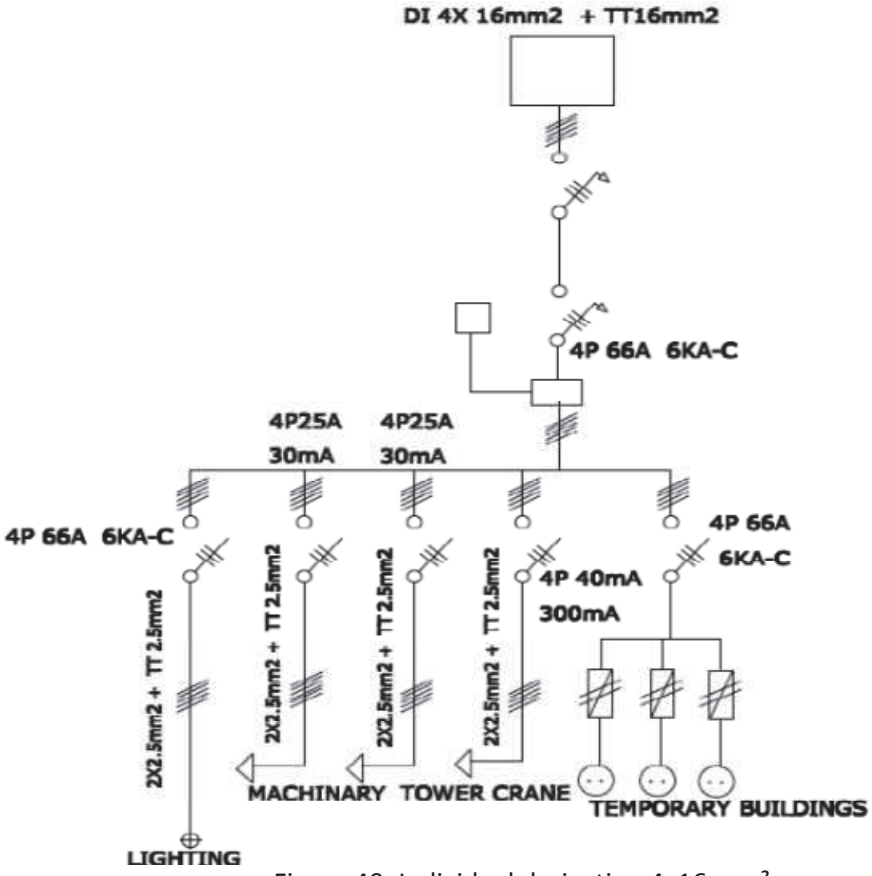


Figure 49. Individual derivation 4x16 mm²

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:

$$N = \frac{E \times A}{\phi_n \times F_U \times F_{MI}} \quad (6)$$

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 2609.06 **,** to be illuminated with an average illumination of 15 lux, with 1x150 W metal halide lamps, which produce a luminous flux of 13000 lumens per lamp. Will be used a normal maintenance factor 0.95.

Data from the lighting area are:

Length: 122.54 m.
Width: 21.29 m.
Height: 4.50 m

$$\text{Index: } K = \frac{l \times b}{h\,(l+b)} = \frac{2609.06}{4.5\,(122.54+21.29)} = 4.03 \quad (7)$$

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:

$$N = \frac{15 \times 2609.06}{13000 \times 1 \times 0.95} \approx 4$$

By calculation we have obtained, the need to place a minimum of 4 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 32 mm in diameter (is the standard diameter in Spain), wash step and tap. All the things mentioned before, are shown in the figure 50.

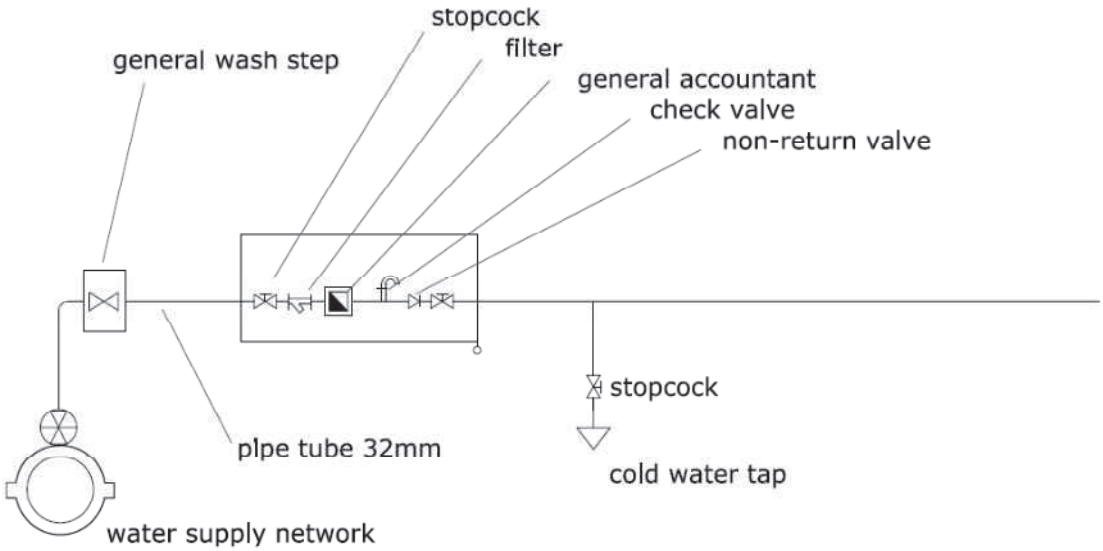


Figure 50. Temporary water supply scheme

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 200 mm.

4.1.10 FENCE OF CONSTRUCTION SITE

The construction fence will protect the entire front of parcel. The maximum width of the strip of public or private space to be occupied by work of fenced will be of 2.00 meters. In any case, fence will let a minimum clearway of 0.70 meters measured from the inner line of sidewalk until most salient point of the fence and, if there were no curb, the minimum step width shall cover the separation or boundary between pedestrian and traffic.

Formal conditions:

It will force that the fence will have a minimum height of 2.00 meters measured at any point on the outer face.

The crown height is uniform and horizontal projections admitting only to suit the terrain slopes, subject to compliance with the minimum height indicated in the previous section.

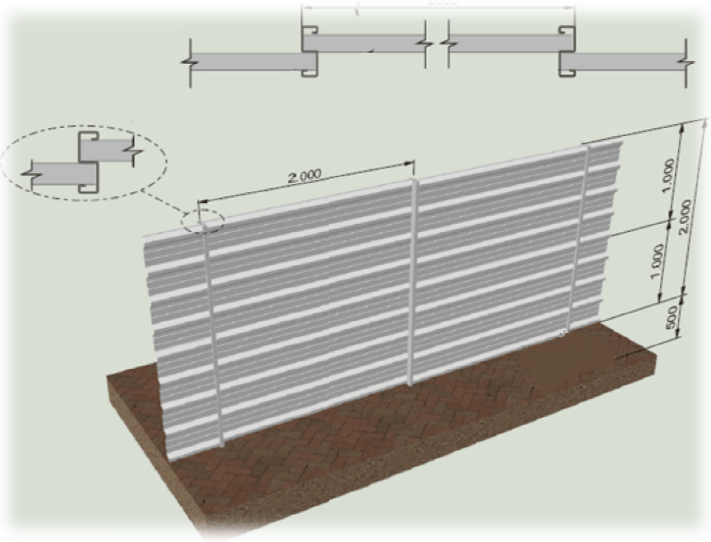
It is expressly prohibited ridges and sharp objects, sharp and aggressive that can be incorporated into the fence, both temporarily and permanently.

The outer face of the fence shall not allow the visualization hollow interior or protrusions or holes that allow the stencil. The projections requiring good performance of the fencing construction will be made, wherever possible, by the inner face thereof.

Not be allowed to cover the space of public or private road bounded by the fencing work. It will be mandatory placement of lights signalling pathway hedges occupying public or private.

Will be needed 285.22m for all the perimeter.

The building fence will be an opaque fence ideal for construction by the rapid assembly and disassembly solving the problem of delimitation of works. It 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. (Figure 51)

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

Figure 51. Fence

4.1.11 TEMPORARY COMUNICATION

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

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

4.1.12 GENERAL REQUIREMENTS OF LABOR SAFETY

This section will evaluate the prevention of hazards and individual protective measures which must be available for the protection of workers.

List of hazardous jobs in our construction place:

-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

The individual protective elements are:

- Safety helmet: a helmet is expected per worker every six months.
- Safety helmet with screen viewfinder: Expected a helmet every ten workers, since their use is more specific than that of normal helmets.
- Helmet with ear protectors: S provides a helmet with hearing protectors every five workers.
- Safety glasses: glasses are expected every 3 workers.
- Safety glasses oxyacetylene cutting: glasses are planned every 5 workers.
- Hearing protection in the form of foam earplugs: Some blocks per worker every two months for those works around loud noises.
- Hearing protection earplug as: Every five workers and nine months.
- Fine dust filter mask: One per employer every two months.
- Utility Gloves: Some gloves per worker every six months.
- Gloves High resistance to cutting and abrasion: One for every five employers and every six months.
- Welder gloves: A pair of gloves for welder for every ten workers and nine months.
- Dielectric gloves: Two pairs of gloves, since their use is limited to electrical work.
- PVC water boots: A pair of shoes per worker per nine-month duration of the work.

- PVC boots: A pair of boots for every five workers and nine-month duration of the work.
- Safety boots: boots per worker every six months during the work.
- Pair of boots dielectric: Two pair of boots for all the work, as the electrical work are often limited.
- Seatbelt lifeline: One for every ten workers and twelve months of the work, to work at height associated with safety lines.
- Safety belt: One in three workers and six months
- Device fall arrest safety belt: Same as belts for fall arrest.
- Fall arrest system: Same as fall arrest safety belts.
- Strip back injury protection: A worker for nine months of the work.
- Coverall: One per worker every six months.

The most important collective protective elements are:

- Safety net in the first structural floor (in the place that there are more than 1 floor)
- Safety harness for all the workers.
- Perimeter railings on each floor of the work.
- Holes in the floor must be covered with nets.
- Walkways and ramps at the same or different level.
- Working platforms: for working at height.

4.1.13 REQUIREMENTS OF ENVIRONMENTAL PROTECTION

We must have planned the management of waste may be generated during the execution of the work.

There must be a previous study that generates waste, classified according to their nature and dangerousness. And check which can be recycled and which not.

This will prepare a plan of construction waste that we meet. When construction works will be finished, waste must not stay on the site.

During the execution of the work we will have different containers for separate waste, and the appointment of a person who controlled the management.

4.1.14 REQUIREMENTS OF FIRE PROTECTION

Before the construction, we must consider the risk of fire and damage this may cause. We will make a study of the risks and establish fire safety measures and means of protection and fire suppression.

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

In the future construction site will have a visible and accessible place should be a panel with inventory:

- two buckets
- two axes
- two crowbars
- ladders
- hook
- 0.5m^3 of sand box
- two fire extinguishers
- two spades

4.2. WORKFORCE

4.2.1 DISTRIBUTION OF WORKFORCE

For all the works we are going to need many workers. The eleventh month will be when more of them are working at the same time as we can see in figure 52.

4.2.2 MACHINERY

For all the works we will need many different kinds of machinery as we can see in figure 53, being the month with more of them in the construction on third month.

Figure 52. Workforce

	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	MONTH 7	MONTH 8	MONTH 9	MONTH 10	MONTH 11	MONTH 12	MONTH 13
Transport truck		x x	x										
Loader		x x	x										
Dumper		x x	x										
Backoe		x	x										
Tower crane			x x x x	x x x x	x x x x	x x x x	x x x x	x x x x	x x x x				
Concrete truck transport			x x x	x x x x		x				x			
Concrete pump			x x x	x x x x						x			
Vibrator			x x x x	x x x x						x			
Scaffolding equipment					x x x x	x x x x	x x x x	x x x x	x x x x	x x x x	x x x x	x x	
Weilding equipment							x x x x	x x					
Mobile crane		x								x x			

Figure 53. Machinery

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